Practicing Democracy: Improving Participatory Technology Assessment for Sustainability Challenges

by

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ABSTRACT

Participatory approaches to policy-making and research are thought to “open up” technical decision-making to broader considerations, empower diverse public audiences, and inform policies that address pluralistic public goods. Many studies of participatory efforts focus on specific features or outcomes of those efforts, such as the format of a participatory event or the opinions of participants. While valuable, such research has not resolved conceptual problems and critiques of participatory efforts regarding, for example, their reinforcement of expert perspectives or their inability to impact policy-and decision-making. I studied two participatory efforts using survey data collected from participants, interviews with policy makers and experts associated with each project, and an analysis of project notes, meeting minutes, and my own personal reflections about each project. Both projects were based one type of participatory effort called Participatory Technology Assessment (pTA). I examined how project goals, materials, and the values, past experiences, and judgments of practitioners influenced decisions that shaped two participatory efforts to better understand how practitioners approached the challenges associated with participatory efforts.

I found four major themes that influenced decisions about these projects: Promoting learning; building capacity to host pTA events; fostering good deliberation; and policy relevance. Project organizers engaged in iterative discussions to negotiate how learning goals related to dominant ideas from policy and expert communities and frequently reflected on the impact of participatory efforts on participants and on broader socio-political systems. Practitioners chose to emphasize criteria for deliberation that were flexible and encompassing. They relied heavily on internal discussions about materials and format, and on feedback collected from participants, policy makers, and other stakeholders, to shape both projects, though some decisions resulted in unexpected and
undesirable outcomes for participant discussions and policy relevance. Past experience played a heavy role in many decisions about participatory format and concerns about deliberative or participatory theory were only nominally present. My emphasis on understanding the practice of participatory efforts offers a way to reframe research on participatory efforts away from studying ‘moments’ of participation to studying the larger role participatory efforts play in socio-political systems.
DEDICATION

To my family and Danielle, who put up with many late nights writing and subsequent grumpy mornings.

To those who seek a freer, happier world.
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This dissertation focusses on two projects meant to democratize decision making about sustainability-related issues. The projects aimed to create forums where citizens could bring their own values and preferences to the policy making process, either through contact with policy-/decision-making officials about resilience to climate-related hazards (Community Resilience Forums or CRF project) or through their own ballots (Prop 127 Forums). When I set out my plan for my dissertation in 2017, I decided I wanted to ‘unpack’ or ‘un-blackbox’ participatory efforts such as these as a way to improve their function. I wanted to open up the very social nature of these projects and bring to light the very human ways they come to be: People (including myself) make decisions under all sorts of institutional and social constraints with many implicit assumptions about what a ‘good’ participatory project looks like. And these decisions are worth daylighting to ensure participatory efforts accomplish what practitioners hope they accomplish: “Opening up” technical or scientific decision-making to broader ideas, empowering diverse public audiences to contribute to policy-making, and informing policies that better address the elusive public good.

I arrived at this approach after months of mulling over my own ideas about outcomes that usually emerge from participatory projects. In particular, I long had a nagging concern that participatory efforts rarely impacted actual decision-making. Through the Community Resilience Forums project, one of the foci of my dissertation, I saw an opportunity to involve local decision makers in a participatory effort and evaluate what exactly they saw as the benefit of participatory efforts and how, if at all, they used the outcomes of the forums in decision making. Through this analysis, I could then assess if the efforts impacted decision making and how. If they did not impact decision making, I could ask why? I wanted these efforts to matter for decision making as I firmly believe,
as a matter of principle, that people *should* be involved in matters of policy that impact them. If, as I believed, participatory efforts weren’t affecting decision making, I wanted to know why and identify ways to make them impactful.

After some time and tweaking, my focus expanded. Of course, it’s not just what the decision makers think of participatory efforts that impacts how participatory efforts might impact policy and decision making. The features and characteristics that the project planning team chooses to include or exclude matter as well. As does the language used to talk about these efforts: Are they talked about as an educational tool or as a decision support tool? How do project planners think about empowerment? All of these factors are part of the social ‘process’ by which a participatory effort takes shape and influences the people and institutions around it. Critically, those social processes are where important disagreements about what participatory efforts should or should not accomplish and how these disagreements get resolved or addressed. The implicit and explicit judgments, decisions, and priorities of the practitioners for participatory efforts reveal important characteristics of participatory efforts and their multitude of goals. After all, forums are inherently political undertakings and those who plan them do so with their own ideas and priorities in mind; these priorities may never come to light in interviews with decision makers or data collected from forum participants. My dissertation plan grew to encompass more than just what decision makers said and did in their interactions with participatory projects to include what the project team (including myself) said and did as they developed materials, partnerships, and the participatory events themselves. After collecting lots of data and source materials, I sat down to analyze and write in Fall 2018 but found few points of entry into my topic. To be blunt, the materials I had felt disjointed and disparate.
While writing in winter 2018-2019, I began to look beyond the two participatory projects on which I was focused. I dug through reports about a particular type of participatory engagement, participatory technology assessment, that guided the development of the projects I was studying. Those reports could serve as a ‘baseline’ measure of how project planners talk about participation and what priorities and values were embedded in that talk, I thought. After all, the social practice (a la Shove et al. 2012) of these participatory efforts took shape and meaning from projects, ideas, and people that came before. Yet the outline still felt a little disorganized and meandering.

Sometime after this, a colleague passed on paper by Charles Lindblom. I was somewhat familiar with his work; this piece, however, was new to me. Written in 1986, Lindblom laid out four ‘conventional rules of good policy research’, followed by a critique of those rules. Those ‘conventional rules’ are:

1) Policy research should be “concerned in a nonpartisan way with the values or interests of the whole society rather than on some segments of society” or the researchers’ own values.

2) Policy research should “avoid the irrelevance of investigating policy alternatives that are simply infeasible.”

3) Policy research should “speak to the people who have to make the policy decisions”, that is, to policy makers and those in power. And

4) Policy research should recommend what a policy maker ought to do given the subject. (Lindblom, 1986, p 346-347)

Without venturing into too much detail, Lindblom threw out rule 1 on the grounds that there is no such thing as a singular public interest because the interests of some clearly conflict with the interests of others. Thus, “there is only a choice to be made,” (p.
about what interests matter to a policy problem and that choice is decidedly not something research can answer. To finish the argument, he added that everyone is partisan anyway, even people trying to be non-partisan, because everyone comes at policy problem with some inkling of partisanship, even if that inkling is masked or embedded in an approach to research. He threw out rules 2 and 3, stating that people at large, not those in power, are most in need of the benefits of research. The existence of broad agreement on “complex issues on which free minds would be expected to disagree,” (p. 359) makes it clear that citizens and leaders alike aren’t thinking critically about the issues at hand. The role of research, then, is to enlighten and open up societal discussion rather than focus on those in power through research on feasible (i.e., existing) policy alternatives. He threw out rule 4 on similar grounds to rule 1. Policy issues are matters of resolving interests through choices to act and not matters of knowledge. Therefore, policy researchers shouldn’t be giving recommendations but should be responding to critical needs of policy makers who are making choices.

At first, I saw Lindblom’s analysis as a way to understand the values and ideas in the social practice of participation: Why do scholars and practitioners of participatory efforts seek to be non-partisan? But my mind’s eye slowly shifted from using Lindblom’s insightful commentary to critique and understand the social practice of participatory efforts. Instead, I started using that commentary to critique how I was approaching my dissertation. Through the twists and turns of doing interviews, analyzing transcripts, and reading (and re-reading) documents and notes, my dissertation notes and chapter drafts took on a sort of detached view of the participatory efforts I was studying. I was trying to be neutral, in a sense, in my writing. I lost sight of why I started out interested in participatory efforts in the first place: I firmly believe that people should be involved in
matters of policy and research that impact them. With that, I re-wrote the central ideal of my work:

Citizens of all walks of life should contribute informed, thoughtful input to research and assessment on sustainability issues. And that input should be an integral part of decision and policy making.

I feel it is important to state this ideal up front. While it provides little analytic insight into my dissertation, it surely has motivated my work. In the chapters that follow, I examine how two participatory efforts unfolded. I tried to scrutinize the decisions—or at least some of them—that shaped these projects and their outcomes. Academics are good at scrutinizing for the sake of scrutinizing. I tried to tie my analysis to ways that participatory projects can better open up sustainability and technical decision-making to broader views in the interest of a pluralistic public good. My experience planning and studying participatory efforts leads me naturally to think about how to make them better, as does the ideal cited above. It is easy and satisfying to tear something down. But critique, however justified, fails to address the challenges facing democracy and human flourishing and the uncertainty inherent in the future. Through my dissertation, I hope to offer my own take on how people can be better involved in the policies and decisions that impact them.
Chapter 1 - Participation, pTA, and practice

1.0 Sustainability, post normal science, and participation

At the heart of many sustainability problems lies uncertainty, socio-political contestation, and the need to integrate diverse values and knowledge in the service of creating more desirable futures. Many sustainability problems can be understood as post-normal science. Post-normal science (Funtowicz and Ravetz, 1993) problems are characterized by high uncertainty, large normative implications or decision stakes, and disagreement about whether the problem is a problem at all. Accordingly, sustainability issues, such as addressing climate change impacts, require more than scientific expertise and down-scaled climate models. Funtowicz and Ravetz (1993) pointed to broader participation in scientific assessment and related decision-making to account for uncertainty and normative disagreements (1993). Additionally, aspirations for inclusive, just, and socially responsive approaches to sustainability undergird reasons to pursue participatory approaches in sustainability.

Practitioners and researchers have utilized various methods for public engagement around sustainability issues such as climate change, but not without substantial disagreement over the type of engagement (Bellamy et al., 2017), the roles of engagement in broader systems (Whitmarsh et al., 2013), or even the normative and epistemological groundings of engagement itself (Wynne, 2006; Lövbrand et al., 2011). These discussions cover practical debates about formats (Bellamy et al., 2017) and connections to formal decision-making bodies (Tomblin et al., 2017) alongside more theoretical debates about representation (Irwin, 2001), power and justice (Mosse, 2001), and political legitimacy (Lövbrand et al., 2011). Further, a variety of ‘best practices’ and models for participation extend from these literatures, including participatory technology assessment (pTA, the focus of my work), participatory budgeting (Patsias et
al., 2013), and citizen review panels (Gastil & Knobloch, 2010). Below, I outline three considerations for participatory approaches for dealing with sustainability problems: Participation as a mechanism for learning, expert knowledge and participation, and the role consensus and agreement in participatory efforts.

1.1 Participation as a mechanism for learning

Participation in policy making, science, and design has been linked to learning about a given topic or about a process. Barabas (2004) documented that participants in a public forum regarding social security reform in the U.S. demonstrated increased knowledge about social security-related issues compared to a random sample of local residents who did not participate in the forum. In a review of empirical literature, Delli Carpini et al (2004) highlighted that participant learning was one of the few broadly supported findings of assessments of participation and deliberation. Walker and Seymour (2008) and Staub and Iulo (2011) argued for the utility of participatory design as a learning mechanism for design students and the broader community involved in design. Some have argued that participation in decision-making, science, or design should be educative. Godschalk et al (2003), for example, found that communities at risk of certain natural hazards often did not discuss or plan for those hazards during public participation events for broader planning processes. The authors took this as evidence that participatory processes should focus on learning to raise public concern about potential hazards. Finally, participatory processes could promote learning by people other than participants, particularly organizers and decision makers. Burgess (2014)

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1 Instead they found that most participants were concerned with more immediate planning concerns, such as the status of new development projects.
highlighted how decision makers can learn about and identify policy and practical challenges regarding a particular issue from participatory processes.

Promoting learning through participatory efforts can create outcomes at odds with other desirable outcomes of participatory efforts, such as countering power imbalances or opening up an issue to broader perspectives. For example, a participatory process that accomplishes substantial participant learning about an issue may result in many participants sharing the same background knowledge on a problem. In one sense, then, the post-normal science problem has been tamed a bit because there is some consensus about the state of the world related to the problem, a consensus achieved through the success of a participatory event; the ‘contested knowledge’ component of a post-normal science problem is no longer present. Yet such agreement brings up other questions: Was this consensus knowledge the perspective of experts? What has been lost in coming to agreement on the knowledge relevant to the problem? Learning could mean (or could be construed as) a problem of co-optation (i.e., getting participants to agree with positions of organizers or experts). This example brings up questions about who is learning and who is defining what is to be learned. This tension has been highlighted in science and technology studies assessments of participation and the normative perspectives of deliberative democracy advocates (for example, Lövbrand et al, 2011; Petersen, 2007).

Beyond questions about who is learning and who is to determine what is learned, the idea that participatory efforts should lead to some learning outcomes is also at odds with ideas about the benefits of pluralistic participation. Some authors have argued that the benefits of participatory efforts stem from bringing multiple perspectives and knowledge, beyond expert knowledge, to bear on a problem (see for example, Funtowicz and Ravetz, 1993; Barabas, 2004). Case studies show that consensus about the knowledge relevant to a complex problem led to undesirable outcomes for a whole host
of psychological, organizational, and sociological reasons (See for example, Jervis, 2010; Tuft, 1997)². Indeed, the roots of participation in urban planning and design stem from the failures of ‘blueprint planning’ or ‘systems planning’ of the 1950s, 60s, and 70s in which planners’ expert knowledge on how cities operated was unquestioned (Hall, 1983)³.

1.2 Expert knowledge and participation

The limits of expert knowledge also contributes to arguments for participation in sustainability-related issues. Expert knowledge struggles to provide accurate assessments or predictions regarding complex systems or those outside of the usual domain of scientific assessment (i.e., contexts that cannot be controlled, made highly conditional, or take place at time scales beyond scientific assessment; see Toulmin, 1961; Cartwright, 1999), which are often at the heart of post-normal science and sustainability problems. Several case studies have shown that despite best assessments and science, some expert-based assessments and predictions turn out to be inaccurate both for reasons related to the complex context about which they are made and due to institutional or organizational pressures (see, for example, Metlay, 2000; Gautier, 2000; and Pilkey, 2000). Thompson et al (2007) showed how perspective or worldview shaped assessments of the state of a social-ecological system and, importantly, decisions about how to manage that system. Evidence from psychology (Kahan et al, 2008; Kahan 2012) supports this, demonstrating that people who were provided with the same information about climate change and the benefits and risks of nanotechnology did not then agree

² To be clear, these case studies are not about participatory processes, but they are about complex and value-laden decision-making processes not unlike those that participatory processes are utilized to address.

³ Of course, other factors were at play here too, such as issues of power, race, and poverty.
with dominant values of scientists about those issues. Rather, worldview is a stronger predictor of their opinions about the issue. Worldview and values are inexorably tied up in expertise about sustainability-related issues.

Problems with expert knowledge can also be understood as power imbalances or justice issues. Expert knowledge can justify the use of professional judgment, which leaves non-experts left out of judgment-based decisions (Rayner and Malone, 1998) and leads to opaque decision-making (Rayner, 2003). In a case of a citizen air quality monitoring effort detailed by Ottinger (2016), expert knowledge, which served to disregard citizen concerns, contributed to exposure to air contaminants. On a more conceptual level, Fischer (2000), citing Foucault and others, argued that power has been ‘devolved’ through expertise as to extend it through all parts of society. Rayner and Cantor (1986) argued that decisions of risk, generally the domain of expert assessments, are less about costs, benefits, and probabilities and more about fairness, consent, and institutions. Thus, again, we are faced with normative questions, not scientific ones, regarding how to deal with complex challenges.

Such cases demonstrate the need for humility around expert knowledge. Building on that humility is a need for diverse perspectives on a given assessment, prediction, or decision. As mentioned above, Funtowicz and Ravetz (2003) called for extended peer review—the critique, creation, and review of scientific assessment and decision-making by broader groups holding different worldviews and with different ways of knowing in hand—for complex, indeterminate, and contested problems. Schwarz and Thompson (1990) highlighted how new perspectives on problems can bring about new solutions that accommodate more perspective. Given problems with expert assessments and knowledge in complex situations, we are forced to make a decision about how to deal with conflicting worldviews and values as they relate to knowledge. We can insist that
those with worldviews that do not align with expert knowledge are wrong. Or we can take such conflicts to the institutional process we have constructed for dealing with them: Politics.

This discussion of expert knowledge undergirds why participation is useful and important in sustainability topics. But it also takes us back to a key concern about what learning means for participatory efforts. Are practitioners and academics missing out on a key benefit of participatory approaches—their ability to draw on diverse perspectives—by focusing on what people learn at participatory events? Additionally, learning through participatory efforts requires some agreement about the state of the world as an outcome (i.e., what is learned). Yet the need for agreement as an outcome of participatory efforts is also contested. In the next section, I describe how ideas about agreement and consensus further challenge and shape ideas about what participatory efforts ought to accomplish, particularly in light of calls for participatory efforts to shape policy making and foster learning.

1.3 Consensus and agreement in participatory efforts

Consensus and agreement are sometimes seen as important for participatory efforts to provide legitimacy to the outcomes of those efforts. For example, consensus conferences, pioneered by the Danish Board of Technology\(^4\), seek to create consensus statements from a panel of citizens in order to bring citizen values to politicians and experts. However, consensus and agreement can lead to outcomes counter to the ideals of participatory efforts. In practice, consensus-oriented participatory efforts can create opportunities for coercion and manipulation. Participatory events involving decision

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\(^4\) For details on the Danish Board of Technology’s consensus conference model, see an archived website from 2011: https://web.archive.org/web/20110816173526/http://www.tekno.dk/subpage.php3?article=468&toppic=kategor12&language=uk
makers as the organizers can be problematic if decision makers seek consensus that favors their own ends. Studies from participatory development show that consensus may be reached regarding a certain topic but it is only reached 1) because on-the-ground power structures greatly influence it or 2) because community members recognize that organizers have certain resources and say what they think organizers want to hear (see Cooke and Kothari, 2001; Mosse, 2001). This is not to say that participatory processes that do not seek consensus would not also fall prey to these problems, but that consensus itself might be a legitimizing force for decisions made by those in power in contexts where a large power imbalance exists. Seeking consensus in community development programs has been tied to participant unhappiness with the process when, for example, one person can hold up an otherwise widely agreed upon decision (Chaskin, 2005). This seems to pit the legitimizing abilities of consensus against even having a decision in need of legitimation. Other case studies showed that the absence of consensus led to a demand for expert input on the issue. In a study of joint agency-public water management councils in the Pacific Northwest, Lach et al (2005) noted that technical panels were set up to find out more about issues that councils could not agree on5. To summarize, seeking consensus gets wound up with other considerations such as good deliberation or legitimizing decision support.

Deliberation, participation, and consensus in general have been associated with perverse processes befalling like-minded groups. Cooke (2001), for example, cited four particular processes from social psychology that could potentially be at play in deliberation, including group willingness to take riskier decisions (compared to individuals in the group), groups who take action contradicting what individual

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5 Plenty of decision-making bodies delegate contentious issues to objective expert assessments (see for example, Pilkey, 2000) so it’s little surprise that citizen-led bodies do as well.
members want to do due to perceived consensus, ‘Groupthink’ in which groups fail to recognize evidence contrary to the groups dominant opinion due to a ‘domestication of dissent,’ and coercive persuasion in which groups can be manipulated by organizers to achieve some preconceived end point. While Cooke’s critique is useful, it is also broadly descriptive of problems that could befall any group, not just groups involved in participatory engagement efforts.

Few studies have documented participant experiences with consensus and non-consensus approaches to participatory engagement. Barabas (2004) provided some insights into this but only regarding changes in participant opinions. Barabas (2004) found that in policy questions where consensus in deliberation emerged, the aggregate opinion of participants shifted towards that consensus. But in issues where consensus was not achieved, those with weak prior opinions on the subject moved towards the direction of the majority while those with strong prior opinions tended to move in the opposite direction or not change at all. This, perhaps, is tied to evidence from psychology showing that people fall back on opposing cultural predispositions when presented with information regarding the benefits and costs of something (Kahan et al, 2008).

The need for consensus in at least part of a participatory process around sustainability issues mirrors concepts from studies of interdisciplinary or transdisciplinary research (Petrie, 1976), namely that some shared understanding of the problem at hand or how other viewpoints understand that problem is the basis for more in depth conversation (or research) about that problem. Yet, as discussed above, a lack of consensus about whether a problem even exists is a hallmark of wicked (Rittel and Webber, 1973) or post-normal science (Funtowicz and Ravetz, 2003) problems. Klenk and Meehan (2015), drawing on experience studying transdisciplinary problems, argued that the integration of diverse disciplinary perspectives (i.e., reaching a consensus
viewpoint of a problem) masked important conflicts among those perspectives and limits understanding and problem solving.

Lövbrand, Pielke, & Beck (2011) pointed to the tensions between deliberative democratic theory, theory that many participatory efforts directly or tacitly draw on, and concepts from science and technology studies regarding agreement and consensus in participatory efforts:

“Whereas [the] appeal to universal validity serves as a cognitive standard for evaluating the quality of deliberated outcomes, it marks a fundamental [dividing] line between deliberative democratic theory and studies of science and technology. At the core of the constructivist theory of democratic expertise is a general mistrust in universal solutions. By studying how claims to epistemic validity come into being and are sustained across cultural and political contexts, many scholars of science and technology have questioned the notion that all publics reason in the same fashion or from the same epistemological foundations (cf. Jasanoff 2005). From this vantage point, consensus on the common good is neither attainable, nor desirable. Lacking a shared understanding of the meanings of principles and concepts, diverse publics cannot be expected to reach agreement on what is good and true.” (Lövbrand et al., 2011; p. 485; emphasis added).

They acknowledged that many calls for deliberative efforts from science and technology studies (STS) recognize this tension and instead call for pluralistic assessments of expert opinions and judgments. But to what end? Deliberative engagements must contribute to
some “commitment to action” if they are to have policy impact and fulfill the normative implications of deliberative theory.

Stirling (2008) asserted that participation might be more useful in ‘opening up’ decision-making options and assessments rather than ‘closing down’ on particular decisions or conclusions. Stirling did so to address a frequent critique of participatory approaches in practice: Decisions reached via participatory processes will not affect decisions given existing power and political structures. Rather than focusing on securing ‘consent’ for decisions through participatory engagement designed to achieve a commitment to action, which Stirling equates to replacing existing democratic means for policy making, participatory efforts that happen upstream of policy decisions, “[reveal] to policy discourses the inherent indeterminacies, contingencies, or capacities for agency.” (Stirling, 2008; p. 279). Doing so allows participatory efforts to augment and complement existing democratic institutions. His argument was, at least in part, a commentary on consensus. ‘Opening up’ decisions or assessments precludes any need for consensus on individual options for decision making or even the boundary of the problem being addressed. Yet an ‘opened up’ approach to participatory efforts could still support considerable deliberation about the issue at hand and variety of considerations and options for decision making. ‘Closing down’ on the other hand put different opinions, perspectives, sources of knowledge, etc. at odds as each tries to bear on the final decision, a considerable barrier to consensus and potentially a barrier to other benefits of participatory processes. Ironically (and something that Lövbrand et al., 2011 point out), using participatory efforts to close down on policy decisions simply supplants existing democratic institutions of representation with ones created by practitioners of participatory efforts.


1.4 Participatory technology assessment

Given the discussion above, practitioners, decision makers, and academics interested in participatory approaches to sustainability problems face difficult yet coupled decisions: How do projects balance expert and lay perspectives in participatory approaches? How do projects balance the need to inform with the problems associated with seeking consensus and agreement? How do projects balance the benefits of pluralistic approaches to participation with the need to inform? And how do practitioners situate participatory efforts in relation to existing policy-making channels?

The projects under study in my dissertation were grounded in a participatory approach called participatory technology assessment (pTA). This approach attempts to compliment lay and expert perspectives to support decision making around science and technology issues. It also pushes lay participants to explore areas of agreement while documenting broader values and rationales that may or may not be part of that consensus. Further, it builds on the practice of policy-oriented technology assessment. In short, this model attempts to address some of the tensions I’ve highlighted above by: 1) seeking to create a pluralistic input into policy about scientific or technical topics; 2) seeking to improve decision making through a search for shared agreement; and 3) informing participants of relevant technical considerations while soliciting their opinions and values about a given topic. In the next section, I discuss two reports that contributed to the use of pTA in the United States and relate those reports to the discussion of participatory approaches above.

1.4.1 A brief overview of pTA

Participatory Technology Assessment, as its name implies, involves bringing public input to technology assessments (TA). In a major 2010 report on pTA, which I detail
throughout this chapter, Richard Selove (2010) outlined the basics of TA as a practice “intended to enhance societal understanding of the broad implications of science and technology” to prepare or “constructively [influence] developments to ensure better outcomes.” Without rehashing his argument in too much detail, TA is critical to policy making because it brings technically-informed and policy-relevant information to entities such as the United States Congress so that they can make decisions that better achieve desirable societal outcomes. Given rapid and uncertain developments in science and technology, TA is a prudent input to governance. The United States had an *Office of Technology Assessment* (OTA) before its budget was axed in the mid 1990’s. Talk of restoring the office has reemerged off and on since, most recently with backing from Democrats after the 2018 elections and Congress’s poor showing in hearings with technology giants like Facebook and Twitter⁶. OTA largely led the field of TA. After its closing, European counterparts continued developing TA practices as a way to advise parliamentary bodies.

Those European counterparts, and in particular the Danish Board of Technology (DBT), pioneered methods of involving publics in TA to further tie policy making to societally-held priorities for science and technology. Back in the U.S., a handful of scholars and practitioners conducted pTA-like engagements in 2008 on Nanotechnology and Human Enhancement (see Hamlet, Cobb, and Guston, 2008). Following these forums, Richard Sclove published his 2010 report on pTA with the Wilson Center, entitled “Reinventing Technology Assessment: A 21st Century Model.” In this report, Sclove highlighted a new network, called the Expert and Citizen Assessment of Science and Technology Network (ECAST), as a viable and desirable home for pTA capacity.

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⁶ Some functions of OTA have also been captured within the Government Accountability Office’s newly formed Science, Technology, Assessment, and Analytics program (STAA).
Scholars and practitioners from ECAST led U.S. involvement in an international pTA-style engagement called World Wide Views (WWViews) on Biodiversity in 2012. ECAST followed shortly after with another white-paper highlighting the reasons the U.S. needs pTA and the successes of the network’s participation in WWViews (Worthington et al., 2012). The network has since conducted pTA for the National Aeronautics and Space Agency (NASA) and on topics such as climate resilience—one of the projects I studied—and climate engineering.

The two projects I focused on were conducted by ECAST and its partners, including myself, using pTA as the basic model for engaging lay audiences. The Climate Resilience Forums project (from now on referred to as the CRF project) and the Proposition 127 Forums project (Prop 127 project) both aimed to create social spaces (forums) where participants could bring their own values and preferences to the policy making process, either through contact with policy/decision making officials about resilience to climate-related hazards (CRF Project) or through their own ballots (Prop 127 project). The purpose of my work was to better understand how these projects took shape by examining the participatory events that were part of both projects and the social processes that led to those events, including past experiences and ideas of the practitioners, the formation of priorities for both projects, and the unstated judgements that helped shape them. As I argue throughout the rest of this dissertation, this broader view of participatory efforts creates a richer assessment of participatory efforts that speaks to their ability to accomplish the goals laid out for them and to conceptual challenges laid out by the literature. I focus on these two projects to achieve this purpose for three reasons. First, I was intimately involved in both, providing me favorable access

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7 Proposition 127 was a citizen referendum on the Arizona general election ballot in 2018. The measure required (if passed) some electric utilizes to source 50% of their electricity from renewable sources by 2030.
to the processes by which both projects took shape and changed. Second, both projects shared common roots in pTA, which offered an opportunity to examine how pTA and its associated ideals and practices were implemented across two projects. Third, these projects were somewhat sequential. The CRF project ran from October 2015-September 2018 and the Prop 127 project ran from June 2018-November 2018. Their sequential nature allowed me to examine how lessons, practices, and ideas from one participatory effort transferred to another effort.

Because both projects shared common roots with pTA, I viewed the Sclove and Worthington et al. reports as a useful baseline for understanding the ideals, practices, and goals of pTA that potentially influenced the CRF and Prop 127 projects. In the next section, I analyze the reasons that the Sclove and Worthington et al. reports used to justify the need for pTA and the criteria they laid out for what makes for ‘good’ pTA and a successful pTA network (i.e., ECAST). I discuss some of the other pTA projects ECAST has conducted and contrast them with the CRF and Prop 127 projects. I also briefly overview broader literature about participatory efforts in general with the goal of providing additional context to each report.

1.4.2 Examining reports on pTA

I chose to detail the reports from Sclove and Worthington et al. because both are relevant to the projects under study for my dissertation and both are broadly relevant to the literature and practice of pTA in the U.S. The Sclove report, for example, has been cited 87 times, and an synopsis of the report published in Issues in Science and Technology in 2010 has been cited a further 18 times. The report by Worthington et al. has been cited 11 times. ECAST, the network of academic institutions, think tanks, and

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8 These citation estimates are from Google Scholar as of July 18, 2019.
informal science education institutions, developed from ideas Sclove presented in his 2010 report. The Worthington et al. paper described in some detail the initial operations and aspirations of ECAST as it conducted World-Wide Views projects, which were based on pTA-exercises developed by European groups. ECAST molded future pTA projects in the US, including the two I focus on in my dissertation, and ECAST itself emerged from the academic and practitioner community that contributed to the Sclove and Worthington et al. reports. Examining the roots of the pTA model through its recent history and the development of ideas from ECAST helps provide context to a larger discussion of pTA and participatory efforts in general.

In a broader context, ECAST represents a unique institutional model for involving publics in science and technology affairs across the U.S. and in collaboration with international partners. Its position as a distributed network for convening public deliberations makes it a suitable and interesting focus to study how individual pTA projects fit within a larger social context of evolving practice. After all, the pTA projects I discuss here have roots within ECAST due to both the people involved and the ideas and values we strived to meet. Accordingly, the Sclove and Worthington et al. reports also provide a useful ‘baseline’ for understanding how pTA evolves and can contribute to a larger role for citizens in decision making. The two papers, though not peer-reviewed, provide useful ideas for the academic community interested in public involvement in science and technology policy and affairs. Examining them here provides an opportunity to share them in a constructive way with the academy.

Understanding why scholars and practitioners call for pTA-style engagements amongst citizens and experts, as well as how they justify those calls, helps clarify the priorities and values that pTA and its practice embodies. Additionally, working on a pTA project demonstrated to me the diversity and sometimes competing nature of
justifications for public involvement in science and technology issues. As such, I wanted
to examine the rationales laid out in Sclove and Worthington et al. as a baseline from
which further pTA projects stemmed.

1.4.3 Rationales and criteria for pTA

I identified rationales of why pTA is useful and needed as well as criteria for what
pTA should look like from the Sclove and Worthington et al. reports. Some of the
rationales and criteria I report below were quite explicitly stated in each report (Sclove,
for example, laid out “Criteria for pTA Capacity”) while others were discussed more
generally. I also noted other important themes and considerations frequently highlighted
in these two papers to help form my analysis and discussion. This process was akin to
qualitative coding: I treated each report as a body of text to be analyzed for dominant
codes and categories. Through successive iterations and lots of note cards, I refined the
codes and categories that I report below. The rationales or arguments that Sclove and
Worthington et al. advanced broadly fit into four categories: Rationales related to
people’s democratic rights, rationales about empowering people, rationales about the
ability of pTA to improve decision making, and rationales about other outcomes that the
use of pTA promotes.

Sclove highlighted that people have a democratic right to participate in decisions
about science and technology issues. He discussed the pace of technological change and
the need to avoid socially undesirable paths as part of this right to participation in
matters that impact people. In other words, because science and technology issues 1)
move and change rapidly and 2) impact people’s lives, people should have the right to
weigh in on these decisions. Worthington et al. furthered this argument, noting that pTA
“emphasizes that everyone lives with positive and negative consequences of science and
technology,” though the authors stopped short of explicitly stating that this undergirds the right of people to make decisions about science and technology issues. Regarding the global nature of the World Wide Views on Biodiversity project, a pTA-based engagement conducted across the world in 2012, Worthington et al. noted that engagement with citizens does not happen on the international level (i.e., United Nations) and implied that it should. Grounded on the rationale of democratic right, pTA ought to support input from lay people in assessment and policy making around S&T issues. The corollary of this argument is that pTA must be effective at conveying input from lay people to the social and institutional spaces where it can be used to impact assessment and policy making. Were it not effective, then it would be counterproductive to reinforcing the rights of people to participate in S&T policy issues.

Sclove highlighted empowerment of citizens as a reason to pursue pTA. How pTA empowers people took several forms in his report. Sclove highlighted that pTA could level the political playing field and limit capture of decision making by entrenched interests. By involving the public in decision making about science and technology issues, pTA helps to take power and agency over those issues away from groups who might otherwise dominate decision making. Participatory TA helps ‘raise the issue’ and inform people about science and technology issues, which Sclove and Worthington et al. linked to empowerment. The link between informing (or increasing understanding) and empowering extends into both papers’ conceptualization of how pTA should operate: A group of citizens should receive information about an issue before being asked to weigh in on it. The idea of ‘informed public opinion’ was used by both Sclove and Worthington et al. to note the advantages of pTA as compared to traditional political polling, in which citizens may or may not be even aware of the issue about which they are being asked.
Empowerment through informing, however, hints at a tension between calls for discussion (and thus participants in that discussion) that is informed about an issue and the need for democratic inputs into decisions on those issues. Experts largely frame science and technology issues in public debate, meaning the salient considerations, information, and options for decision making come from experts. If informing pTA participants involves replicating that expert framing, participants might be limited in bringing their own perspectives to the table. Several prominent scholars, notably Rayner (2003), have noted that expert framing inherently limits what Sclove noted lay citizens are good at doing: Bringing in broader social and cultural perspectives about an issue or decision. Informing participants risks prescribing a frame to the issue that hinders participants from bringing in new perspectives, much as Lindblom (1959) noted about policy research in general. Given these critiques, does empowerment through informing further the impact that lay people might have on assessment and policy making?

Rationales about empowerment also extend from the notion that, “means and ends are inextricably interwoven” (Sclove, p. 28) in matters of S&T policy, meaning that the tools we use to address certain problems carry with them specific expected outcomes and vice versa. Because ends and means are interwoven, choosing amongst them is not something that can be entirely left to objective assessment about what policy tool is best. From this argument, Sclove noted that deliberation is the only “plausible, convincing and legitimate way to examine ends and values.” In short, pTA-style deliberation helps uncover the relation of ends and means in science and technology policy issues, which helps empower citizens to critique, shape, and inform decision making.

Much of the Sclove and Worthington et al. reports focused on the ability and merits of pTA to improve decision making as a rationale for why it should be used. However, improvement was itself multifaceted. Both reports referenced pTA as a mechanism to
inform decision makers about what the public thinks. For example, Sclove cited pTA as a way to better evaluate “opinion of common good” by broadening how science and technology issues are framed and by clarifying values inherent in science and technology. In turn, pTA helps decision makers “craft decisions that take into account the informed will of the American people” (Sclove). Worthington et al. noted a similar capacity, stating that pTA helps decision makers “learn what ordinary citizens think about an issue in circumstances where they have become informed.” Worthington et al. contrasted pTA’s ability to help decision makers learn about the preferences of citizens with more ‘utilitarian’ political polling methods that aim to identify how to convince voters to support or reject a candidate or policy. Sclove also noted that pTA helps uncover areas of agreement that can help shape decision making through 1) its ability to broaden issue framing and 2) the building of new relationships among actors. In both reports, rationales about improving decision making largely rest on the ability of pTA as a mechanism to incorporate more values and other types of knowledge (what Sclove calls “social knowledge”) that experts might overlook. In other words, the ability of citizens to make value judgements regarding science and technology issues helps broaden the knowledge base for decision making and improve assessments of options for decision making. The Worthington et al. report highlighted the importance of communicating pTA results to policy makers in order to influence policy, a more mechanistic consideration alongside arguments about why pTA could improve decision making,

In practice, using pTA as an input to policy making requires securing buy-in from policy makers and experts doing the construction of policy. In turn, that buy-in requires that policy makers must see pTA efforts as credible in order to consider them appropriate inputs to decision making processes. Few policy and decision makers would see a need to thoroughly consult the public if they perceived this consultation to be
disconnected from the issue at hand or lacking relevance to the minutiae they might be considering. The impact of pTA on decision making thus hinges on its relevance to the considerations of policy making communities. This turns the conversation back to the information (i.e., salient considerations for policy making) presented to participants as a matter of making pTA legitimate and credible for decision makers and experts. In turn, we face questions about the role of expert opinion in framing pTA efforts.

Sclove referenced value pluralism to address this difficulty. In short, pTA should allow for a large plurality of perspectives from the experts, decision makers, and participants. Thus, empowering through informing becomes informing enough to empower, a fine line to walk⁹. Successful pTA, then, must convey relevant information about an issue and its context to participants without replicating or endorsing expert framing and allow room for participants to critique expert framing, both as part of empowering participants and to ensure that pTA efforts are relevant and salient to policy making. Worthington et al. noted a participant-level outcome of the WWViews pTA project relating to value pluralism: The forums encouraged people to “hear and heed” others.

Sclove and Worthington et al. further offered several outcomes tied to decision and policy making. The first was reducing controversy, cost, and delay. Sclove argued that getting values disputes into the public sphere sooner helps mitigate controversy and delay down the line. If we better understand concerns, preferences, and values around a science and technology issue sooner, we can make decisions that help incorporate those considerations and avoid larger conflicts. Worthington et al. noted two other outcomes of pTA. They cited pTA’s ability to build social trust and legitimacy as a reason to pursue

⁹ Not discussed here is the possibility that lay participants might, indeed, be capable of critiquing expert framing of an issue when presented with it.
it. In discussing trust, Worthington et al. referenced a *Science* article written by nuclear scientists (and, notably, Sclove) about nuclear waste siting that demonstrated the need for social trust in scientific decision making: “public engagement and transparent deliberations are ‘communication acts’ that build social trust and legitimacy (Rosa et al, 2010).” Worthington et al. linked that statement to the need for pTA as a mechanism to maintain trust and legitimacy in institutions that deal with science and technology issues. However, other scholars, notably Wynne (2006), critiqued the use of public engagement efforts to build trust, noting, “...it is a contradiction in terms to instrumentalize a relationship with is supposed to be based on trust. It is simply not possible to expect the other in a relationship to trust oneself, if one’s assumed objective is to manage and control the other’s responses.” (Wynne, 2006, p. 219-220).

Beyond the rationales for pTA, both Sclove and Worthington et al. highlighted more specific criteria for evaluating the success of pTA projects and partnerships. In short, they described a vision for what an ECAST network ought to look like and how it should operate. Inherent in these criteria are additional values and ideas about what constitutes ‘good’ pTA and how it’s useful. These criteria provide a map for evaluating how ECAST and the practice of pTA has progressed in recent years. Additionally, they provide a baseline for critically evaluating what pTA aims to do and how.

First, Sclove discussed these criteria in the context of capacity for technology assessment in the U.S., with a specific emphasis on creating a distributed institution like ECAST to support pTA efforts. To Sclove, pTA should incorporate “effective citizen and expert participation,”. Yet as demonstrated in the discussion of rationales above, effective citizen or expert participation could mean many things. In discussing the need for pTA practice to ‘improve and innovate’, Sclove highlighted that pTA results should be integrated “into government policy making, into wider societal deliberation and decision
making, and into technology research,” hinting that effectiveness involves the use of pTA results, and thus citizen perspectives, in a diversity of processes that influence S&T policy issues. Sclove also pointed to the need for a decentralized, collaborative, and agile structures for pTA capacity, citing those criteria as important to effectiveness and keeping costs down. Sclove stated that pTA results should be transparent and publicly available, drawing on his discussions of the history, shortcomings, and politics of technical assessment capacity in the US.

Sclove also argued that pTA should be conducted in a non-partisan and value-pluralistic way. In the case of strongly divergent societally-held views on an issue, he called on pTA to outline “a wide range of alternative normatively informed perspectives.” Building off of Sclove’s emphasis on value pluralism, Worthington et al noted that WWViews attempted to “incorporate diversity of views into the conversation,” and referenced that diversity as part of the success of WWViews on Biodiversity.

Worthington et al. noted two other criteria, though they didn’t necessarily call them out as criteria: Creating credible, informative, and useful results for the public and for policy makers; and creating clear, comparable outputs. The first warrants discussion as it touches on questions about the impact of pTA for decision and policy making. First, what might be useful for policy or decision makers might not be useful for the public. One can easily imagine policy makers using the results of pTA to justify a decision they already made rather than using those results as part of the policy making process. Second, if something is informative for public audiences (or for policy makers), what is it informing them of? Inherent in this criterion is a tension that returns throughout my experience on pTA projects and the analysis presented throughout my dissertation: How do we navigate expertise, power, and democratic principles in issues of science and technology and sustainability? The second criteria from Worthington et al., the need to create clear
and comparable pTA outputs, is also in tension with what Worthington et al. noted as a key capability of pTA. Worthington et al. highlighted that qualitative results about what citizens discussed were one of the most enlightening outcomes of the WWViews project. However, devising schemes for clear and comparable results, in the context of WWViews, meant a focus on quantitative results from voting exercises.

The discussion above highlights the numerous goals, rationales, and ideas for what pTA should accomplish. Importantly, some of the tensions highlighted earlier, including questions about what it means to inform participants through participatory engagement exercises, are present in the both Sclove and Worthington et al.’s conceptualizations of pTA. Of course, pTA doesn’t just exist in reports. It’s an approach to public engagement that has been utilized for several projects in the US by ECAST and its affiliates. As mentioned above and in the report by Worthington et al., the World Wide Views (WWViews) forums used a pTA-style engagement to hold public deliberations about several topics as part of an international effort to support decision making and negotiation at the United Nations, efforts that ECAST facilitated within the U.S.10. In 2014, ECAST held forums about asteroid and Mars missions for NASA that were based on pTA, putting the goals and ideals referenced above into practice (Bertrand et al., 2017; Tomblin et al., 2015; Tomblin et al., 2017). The forums for NASA directly connected citizens at forums to decision making at NASA, helped NASA administrators understand concerns and values from the public, and showed that democratic input for highly technical processes is both useful and achievable. The NASA forums demonstrated pTA as a viable practice for informing decision-making through public

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10 For more on the various WWViews deliberations, see http://wwviews.org/
engagement. Further, lessons learned in the NASA forums impacted the pTA projects I studied for this dissertation.

1.5 Research questions

The two projects I studied were very different from the NASA pTA effort. The CRF project lacked a built-in client for policy support and was funded by NOAA's Office of Education. Further, the CRF project was about a topic (climate resilience) that is very local, unlike the NASA forums. The Prop 127 project was also different as it focused on helping voters deliberate on Proposition 127, a measure on Arizona's 2018 statewide ballot that would change the state's laws related to renewable energy generation.

Someone (like me) interested in participatory efforts must contend with questions about how participatory efforts change, react, or embody the ideals and concerns mentioned above across different projects, host institutions, topics, and project partners. How does a group of pTA practitioners apply a tool used to discuss asteroid impact mitigation for NASA to discussions of drought or sea level rise? Further, how do pTA practitioners respond to the conceptual challenges about learning, deliberation format, or expert knowledge outlined above?

To reiterate, my interest in studying these two projects, and to thinking about these questions, was twofold. First, I hoped to better understand how pTA projects function to improve their ability to “open up” technical decision-making, empower diverse public audiences, and inform policies that address a pluralistic public good. Second, I wanted to consider how participatory efforts take shape. Many studies of participatory efforts focus on specific features or outcomes of those efforts, such as the format of the participatory event or the opinions expressed by participants. While valuable, such research has not resolved conceptual problems and critiques of participatory efforts highlighted above.
Considering *how* participatory efforts take shape—the decisions, judgments, inherent values, and priorities that influence their structure and ties to communities and policy-making—better captures how these conceptual problems do or do not manifest in participatory efforts.

These goals and motivations in mind, the overarching research questions driving my research were:

1. *How does a group of practitioners conducting pTA projects make decisions about those projects? Or, more simply, how do pTA projects take the shape they take?*
2. *How do those decisions and project outcomes relate to conceptual disagreements about what participatory efforts ought to do?*

Notably, these questions place *what actually happens in a participatory effort* ahead of conceptual disagreements about how pTA ought to be done, not to sideline those disagreements but to better understand how those disagreements relate to the practice of pTA. I take this approach because 1) considerable conceptual work has already been done, 2) I’ve been intimately involved in two pTA projects and have noticed the very messy process by which they go from idea to event to reporting to potential policy impact, and 3) evaluation of participatory efforts often focuses on participant-generated outputs, but these evaluations only tell part of the story of pTA efforts and don’t capture the practicalities of the conceptual disagreements. My underlying premise is that there is theoretical and practical value in examining the practices themselves, that is the actual ‘doing’ of pTA, rather than only the underlying concepts of pTA. For example, examining expert framing in a participatory effort requires looking beyond what participants at a
public forum reported in survey data about their knowledge of a given topic, or even what was written in the materials, prompts, or questions given to participants. Examining the stated and unstated decisions, priorities, and other factors that create materials used for a participatory effort helps better capture how expert understandings of a given problem are used to structure participatory efforts, thus providing a richer understanding of the role of expert framings in participatory efforts. On the practical side, examining the practice of participation shows the strategies, priorities, or considerations important to practitioners as they navigate the suggestions and feedback of subject matter experts or policy makers.

A focus on practice means digging into the dynamics of actual pTA efforts because those dynamics can be informative for understanding conceptual disagreements and the impacts of pTA. However, examining inter- and intra-project dynamics means looking beyond individual evaluation products. Rather than examining individual pTA events, the usual ‘site’ from which evaluation products typically stem (gold band in figure 1.1), examining the changes and dynamics in the practice of pTA involves analyzing the activities leading up to and after that event where many decisions relating to the ideals of pTA and conceptual challenges are made. What decisions went into that event? What parts of the pTA project were simply ‘assumed’ to be part of the project? Further this approach frames learning and innovation among pTA projects as important factors in understanding how pTA projects function (figure 1.2).
Figure 1.1 Assessment of pTA events, which focuses analysis on discrete events where participants are present

Assessments of participant learning, opinions, deliberation quality, etc.

Figure 1.2 Learning across practice of pTA, which emphasizes a variety of sites that influence the shape and outcomes of successive participatory efforts.
1.6 Conceptual and methodological approach

Addressing my research questions, and capturing the practice of participation, required a framework and methodology that could capture how people come together to run a pTA project. Doing pTA (i.e., practicing pTA) involves a team of people, all of whom draw on their personal experiences and knowledge along with the knowledge and resources of others. Those actors come together to secure funding, create pTA materials, plan and convene pTA events, and examine outcomes. Doing pTA is thus a very social activity. Importantly, it’s a social activity that doesn’t just happen when a pTA event happens or when a report is released. Doing pTA entails much more than an actual pTA forum. Practitioners (the people who do pTA) interact with funders, experts, public audiences, and others before the forum events happen, and continue to do so afterwards. Additionally, they learn from past experiences and the experiences of others.

Several factors are important in considering an appropriate framework for understanding how pTA functions in practice, given conceptual disagreements about what participatory efforts should accomplish. These are 1) pTA draws on a wide body of academic literature and practice (from science and technology studies [STS] to public affairs to participatory democracy), 2) practitioners have tweaked and modified pTA to apply it to a variety of decision making contexts and topics, and 3) pTA’s relative youth as a practice in the U.S. means that each new project presents an opportunity to learn and improve the practice of pTA. These considerations point to the need for a framework that recognizes the variety of ways that pTA changes, the influence of pTA practitioners on pTA practice and the context in which those practitioners exist, and the need for examining pTA projects as continuous social activities rather than focusing on discrete pTA events. The next few paragraphs describe the utility of a practice theory approach thinking about pTA with the aim of addressing my research questions.
1.6.1 Practice theory

Practice theory is about understanding the “novelty and persistence” of social phenomena; it’s about understanding why practices change or stay the same. Social practices are “…recognizable blocks or patterns of activity that are filled out and enacted by practitioners… who, in the enactment and performance of these doings reproduce, transform and perpetuate the practices they carry.” (Shove and Walker, 2014; paraphrasing Shove et al., 2012 and Schatzki, 2010). In other words, practices are things people do that other people might recognize as a particular activity with identifiable traits. If I’m talking to someone about woodworking, they likely have an idea in their mind about what it means to woodwork or what the practice of woodworking is. Importantly, when people do some practice, they reinforce what that practice is by carrying that practice on in time, and they are (in some cases) making it something new. When I pick up my saw or a chisel and mallet when I’m woodworking, I’m carrying on the practice of woodworking. Perhaps I’ll try something new or talk about what I’m doing in a new way while sharing my woodworking with others (I’m not a very good woodworker so this is usually not the case). In this way, I’m also changing what the practice looks like, or transforming it in some way. Practices, then, change and morph but carry on independent of whether they are being practiced at any one moment.

Practice theory extends from Schatzki’s (2002) work on social sites, which is helpful to show why focusing on an entire pTA project is a useful analytic approach. Schatzki’s Site of the Social took on a rather big agenda. For Schatzki, the best way to approach “the nature of social existence, what it consists in, and the character of its transformation…is to tie social life to…place[s] where, and as part of which, social life inherently occurs” (Schatzki, 2002, p. XI). To state this in simpler terms, Schatzki argued that we should
look where social things actually happen, where people come together to do some social thing, if we want to better understand social change. Schatzki called the places where social things happen social sites. In these sites, people and things come together with organized activities (Schatzki, 2002). To take a mundane example, a meeting is a ‘social site’ because people come together with certain materials, such as a boring slide show presentation or uncomfortable office chairs, and engage in the social activity many of us who attend meetings would call a meeting.

Schatzki contrasted his focus on social sites with more structural approaches of understanding social events (e.g., societal change is dominated by social hierarchies) or more individualist notions of change (e.g., that social change is the sum of many individual rational choices). Schatzki argued that an approach centered on social sites is better for understanding social change than structural or individualist-based theories not because it throws those theories to the side, but because it integrates them. Likewise, practice theory scholars such Shove et al. (2012) have noted that practice theory combines claims of individualist notions of social change (i.e., rational choice theory) with more structural or social ideas about social theory (e.g., theories about social hierarchies). In understanding social change by examining specific places where social things happen, practice theory leaves conceptual room for both individual actors and the social ‘forces’ that set the context in which those actors reside.

Discussing the ‘elements’ of practices that Shove et al. (2012) posited, along with an example, helps to show how practice theory creates this conceptual space and why that’s conceptually advantageous. Shove et al. (2012) argued that practices are composed of materials, meanings, and competences. People bring those three elements together when ‘doing’ something, thus engaging in the practice. Materials are the ‘things’ involved in a practice. To take my woodworking example, workbenches, wood, tools, and the physical
places where woodworking happens make up the materials of the practice. Meanings are the larger social values associated with and stemming from a practice. Ideas about self-sufficiency or the value of craft are some contemporary meanings associated with woodworking practice. Competences are the sets of know-how and knowledges that practitioners use when engaging a practice. Competences can be generalizable knowledge or more practical types of know-how (e.g., metis, see Scott, 1998). Knowing how to use a saw to cut a particular woodworking joint, for example, is one example of a competence associated with woodworking. People bring these elements together when they do a practice.

How can this configuration leave room for individualist notions of agency and change? How does thinking about practices in terms of meaning, materials, and competences leave room for theories of social change extending from the individualist to the structural? For one, Shove et al. (and Schatzki) recognized that people are the ones doing practices. As such, they are carriers of meanings and competences associated with a practice, even if those meanings and competences might be traced back to more structural origins. While I learned woodworking technique from others (i.e., the technique was socially transmitted), I still employ agency in my woodworking. What woods I choose to use, what projects I chose to build, the tools I chose not to use—I’m quite afraid of using a table saw and so I don’t use one in the interest of keeping my fingers—are choices informed by what I’ve learned from others, but also from my own experiences. This is not exactly a pure ‘rational choice theory’ interpretation of individual agency (which has been shown to be empirically problematic in many contexts), but it is a recognition that people do react and make decisions about what they encounter, even if those decisions are imbued by social considerations.
On the other hand, my discussion of woodworking above frequently refers to areas where more ‘social’ forces are at work. I learned somethings about woodworking from people around me, such as family members, who in turn learned them from other people and their own experience. I read blogs and other websites to learn new techniques or get ideas for my next project. And I’m responsive to ideas about the value of craft work as a form of self-improvement, a values-based stance that I’ve absorbed from others and reinforce when I talk about woodworking with others or share a photo on social media. I also contribute to social understandings of what it means to be a hobbyist woodworker, a hobby resurgent--in my experience--in part due to the attractiveness of the meanings associated with woodworking to younger, white males with desk jobs.

Shove et al.’s elements of practice also nod to social forces and agency in non-human systems. In line with work from science and technology studies, the recognition of materials as a component of practice that both changes other elements of a practice and responds to those elements leaves conceptual room for non-human systems (e.g., technical systems, the environment) to shape practices. Large technical systems associated with the mass production of cheap furniture continue to impact woodworking. For example, veneer-makers largely dominate the hardwood market and thus the products available in most lumber stores. On a smaller scale, woodworking tools themselves shape practices associated with joinery or fine furniture making.

The conversation above highlights practice theory’s recognition of socio-historical and technical context and agency of human and non-human actors. Practices exist outside of the actors that perform them, and they persist across different places and times. A focus on social practices as entities separate from the people that do them shifts the ‘model’ of change away from the foci of other theories of social change: Social structures, external forces (e.g., technology), or individual agency.
Why does a practice theory approach help me answer my questions about pTA? Rather than focusing on discrete participatory events (see gold box in figure 1.1), a practice theory approach sees that event as just one place where elements (materials, meaning, competences) come together. Those elements change and evolve in the lead up to and after a given participatory effort. Practitioners carry with them ways of doing pTA from past projects, but also integrate new ideas from other practices. By using a practice theory approach, I hope to provide a richer overview of how pTA projects come together. Taking a practice theory approach has a variety of methodological implications.

1.6.2 Methodological considerations of practice theory

Given a practice theory approach, my methods and data collection tools had to incorporate a diversity of approaches for capturing the elements of pTA practice in the lead up to and after discrete pTA events. In short, they needed to capture the multitude of changes, decisions, and factors that make up the ‘doing’ of pTA. Additionally, my methods needed to account for the fact that I was part of the projects being studied. Methodological considerations associated with practice theory are summarized in table 1.1.
Table 1.1 Methodological considerations of practice theory

<table>
<thead>
<tr>
<th>Methodological considerations of practice theory &amp; case study projects</th>
<th>Methodological needs</th>
<th>My approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Account for the elements of practice: Meanings, materials, competences</td>
<td>In depth view of process, decisions where elements came together</td>
<td>Process analysis through diagramming, iterative coding, reflexive writing</td>
</tr>
<tr>
<td>Project-oriented (i.e., not event-focused)</td>
<td>Case study approach</td>
<td>Examined two pTA projects to observe both inter, intra-project change</td>
</tr>
<tr>
<td>Focus on change, dynamics</td>
<td>Multiple lines of inquiry, sources of data</td>
<td>Relied on interviews, project notes and observations, communications with project team, and survey data from forum participants</td>
</tr>
<tr>
<td>Account for individual agency, structural forces</td>
<td>Autoethnographic approach</td>
<td>Reflexive writing, checks through written communications with project team</td>
</tr>
<tr>
<td>Account for agency of practice, materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>My embedded role in case study projects*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Examining two case study pTA projects using practice theory helps show implicit and explicit decisions, the changes in practice of pTA across two projects, and the sources/impetus for those changes. A broader, historical view of the evolution of pTA, while valuable to the field and practitioners, is beyond the scope of my work. As both a practitioner and researcher, I am more interested in examining the practice of pTA as it's implemented, discussed, and negotiation in and across two specific projects.

1.6.2.1 Autoethnographic approach

I was part of a larger team leading the development and implementation of the CRF project. For the Prop 127 project, I led development and implementation. In other words, I was embedded in both projects that I studied. Capturing the practice of pTA from within a project team presented unique challenges. In part, I relied on an autoethnographic approach to data collection and analysis for this dissertation. Autoethnography allows for the critical engagement of a researcher with larger social
actions or problems by considering personal experiences as part of social inquiry (Ellis, 2002). Further, it accommodates the subjectivity inherent in research and helps better present the challenges and political nature of research activities (Ellis, Adams, & Bochner, 2011). In the context of my work, autoethnography allowed me to critically engage with issues related to the CRF and Prop 127 projects as both project teams—and myself—made decisions about those projects. Additionally, autoethnography allowed me to document the reflexive behaviors of the CRF project team and myself, making those behaviors more regular and systematic in the two efforts I studied. This approach provided an assessment of how conceptual or theoretical challenges associated with participatory efforts are addressed within the projects themselves. I treated my personal experience with both pTA projects as a complimentary view to project notes, interviews with involved officials, and other sources of data to capture how individual decisions and experiences interacted with broader factors that shape pTA decisions. Most basically, reflecting on and examining my own experiences from pTA projects helped better examine the dynamics of pTA projects.

As part of both of the project planning teams for each project case study, I wrote notes and observations throughout the planning, execution, and analysis of each project. I also wrote notes and reflections on my experience, both motivated by what I observed in both projects and by the connections between what I observed and conceptual disagreements about participatory approaches. I attempted to write these reflections regularly in both projects while coordinating or working on different pieces of each project (i.e., content improvements, analysis of participant responses, etc.). Importantly, I didn't treat my notes and reflections as 'data' for my dissertation until Fall 2017, when I began to think of my work as a study of the practice of pTA (per the recommendation of one of my committee members, Sonja Klinsky). Before this point, however, I still
An autoethnographic approach, however, came with substantial challenges. As highlighted by Wall (2008), issues of representation and the overt subjectivity of autoethnographic work complicate the use of autoethnographic inquiry. Indeed, I found myself in situations similar to those reported by Wall in, “attempt[ing] to avoid emotion and defensiveness and thus to attain objectivity,” (Wall, 2008, p 44) despite the strength of autoethnographic works in addressing subjectivity. I fully recognized that I was part of these projects and thus don’t have an entirely objective perspective. However, my intent in using an autoethnographic approach was not to establish an objective perspective on the project through project reflections and notes. Rather, it was to highlight considerations important to me during various parts of the project. For example, I express my frustrations about the content creation process for the Prop 127 project (Chapter 3) not to show that I was justified in being frustrated but to show the challenges of navigating expert disagreement in pTA projects. Relatedly, when recounting the decisions made by the CRF project team in later chapters, I try to note when my perspective differed from others on the team.

1.6.2.2 Synthesizing across diverse data sources

Beyond my autoethnographic approach, I’ve tried to synthesize a diversity of data sources to better understand how pTA projects take shape, change, and respond to various conceptual challenges. These data include project documents (e.g., proposals),

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11 The Prop 127 effort didn’t take shape until summer of 2018.
pTA forum materials (e.g., participant worksheets), interviews with relevant public officials, surveys given to forum participants, and participant voting responses recorded at forums. To identify major themes in both pTA projects, I relied on an iterative process of mapping both projects, coding those maps, and writing about processes important to both projects. In Winter 2018 following the wind-down of the CRF project and the Prop 127 effort, I created diagrams of the major pieces and decisions within each project using the notes I had collected about each. I loosely coded these diagrams to highlight important considerations that cropped up throughout the life of the projects. Additionally, I turned back to various data sources throughout this process to note if the general themes I was coding for were represented within multiple sources. Transitioning from these diagrams to 1) a handful of themes that guide the rest of this dissertation and 2) writing about each of these themes across multiple pieces of both projects was a much messier project. I used diagrams and writing to break down how decisions in both projects came about, on what grounds those decisions were justified (if they were justified explicitly), and other factors that influenced those decisions (e.g., prior practice, certain ideals, etc.). Throughout this process, I continued to write reflections about each project. I also asked others associated with each project for their take on the development of different project components as appropriate. Using this analysis of the processes by which these pTA projects took shape and of the factors (e.g., ideals, past practice, specific materials, etc.) contributing to those processes, I arrived at four major themes that captured a variety of decisions and considerations about the practice of pTA in both projects: Promoting learning and educational goals, building capacity for pTA, promoting deliberation, and making pTA relevant to policy.

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12 I discuss my approach to data collection for each of these data sources as they are discussed throughout the rest of this dissertation.
1.7 A roadmap for this dissertation

The next chapter outlines the basic structure and features of the CRF and Prop 127 projects. Chapter 2 describes the topics, participatory activities, content development processes, and participant recruitment processes used for each project. This descriptive chapter is meant to provide context to the decisions, processes, and priorities discussed throughout the rest of the dissertation.

Chapters 3 through 6 focus on one of the major themes that emerged from my analysis. As stated above, each theme captured considerations, decisions, and priorities that were important to how participatory technology assessment took shape in the CRF and Prop 127 projects. These chapters first introduce the theme and its importance to pTA or participatory efforts. Each chapter then describes how that theme impacted each project and where it was important to each project. I also detail data collected from participants or involved policy makers, project notes, and personal reflections in each chapter. Each chapter concludes with a summary of what can be learned from the discussions of each theme.

I try to highlight salient findings important to the practice of pTA in Chapters 3 through 6. I note where the practice of pTA changed from one project to another, or where practice maintained its inertia. I also attempt to discuss what practitioners and others interested in pTA can learn from this practice approach to better meet the goals of pTA, a discussion I return to in earnest in the conclusion (Chapter 7). Finally, I note where interactions amongst different practices, practitioners, and components of practice (e.g., materials) occurred in each project and what those interactions tell us about the practice of pTA and the conceptual disagreements highlighted earlier in this chapter.
The first theme is educational goals. In Chapter 3, I describe how the desire to inform participants through each project unfolded and relate these dynamics to concerns about expert framing in participatory efforts. Chapter 4 describes how goals to build the capacity of different institutions to host pTA events influenced decisions within the CRF and Prop 127 projects and some lessons learned about capacity building. Chapter 5 covers how each pTA project sought to promote good deliberation and the ways that materials and other project goals influence deliberation in unintended ways. The last theme chapter, chapter 6, shows how a desire to make pTA relevant to policy making so that it might be used to support policy making factored into the CRF project in particular. Chapter 6 also details how the CRF project could be used to support policy making and how other project goals and factors external to the project factored into my own decision making about how to disseminate the results of the CRF forum in Phoenix.

Chapter 7 focuses on synthesizing findings from Chapters 3 through 6. It is broken into two sections. The first relates findings about the practice of pTA to conceptual disagreements in the literature. It also discusses the utility of my practice-based approach to examining how the CRF and Prop 127 projects took shape. The second section of my conclusions attempts to turn my findings about the practice of pTA into lessons for interested policy makers, practitioners, and funders.
Chapter 2 – Overview of pTA Case Studies

2.0 Introduction

In this chapter, I discuss the basic structure of the Climate Resilience Forums (CRF) project and the Prop 127 project, the two case studies I examine throughout the rest of my dissertation. This chapter is meant to provide an overview of the focus of each project, the processes by which these projects took shape, and the types of data that were collected. Subsequent chapters cover important themes, ideas, and findings that emerged from my analysis. Both projects are based on participatory technology assessment (pTA). Both take on a topic that can be informed by science and assessment but that are imbued with value-laden considerations. These two projects represent two different scales of pTA efforts. The CRF project reached several hundred participants through forums in eight US cities. The Prop 127 project reached about 100 through online surveys and another two dozen through in-person forums in Arizona. The Prop 127 project further stands out due to its focus on a hot button political issue during the 2018 statewide election in Arizona.

2.1 The Community Resilience Forum project

I begin this chapter by discussing the CRF project in three parts. First, I describe why climate resilience is an appropriate topic for pTA. Then, I describe the timeline for the project followed by a brief description of the forum recruitment process and the forum activities.

2.1.1 Why pTA for climate resilience?

Communities must confront difficult and complex decisions to prepare for climate change impacts. The question of ‘how should communities respond to threats posed by
climate change?’ is a multifaceted one, involving community value judgments at a variety of levels. First, a community might consider who might be affected by climate-related hazards, potential responses, and how to implement those responses. This in itself involves a great deal of analysis related to the hazard itself (e.g., how hot will it be?), the social and geographic extent of impact (e.g., who will be affected by heat and in what neighborhoods?), and the ability of those impacted to respond or cope with impacts (e.g., do these neighborhoods have cooling centers?), amongst many other considerations differentiated for various hazards. Entire sub disciplines on risk assessments and social vulnerability strive to answer such questions. Beyond technical details of these concerns a community might consider what types of impacts are acceptable or how impacts should be prioritized, inherently normative considerations.

Second, a community might consider what is politically feasible in the court of public opinion. Are there options that are simply off the table due to underlying cultural or political characteristics of certain neighborhoods or the entire community? Anyone who has attended a contentious meeting at city hall knows the power of local considerations, or at least the power of well-organized perspectives with the sufficient time and people power to participate. Past political experiences (e.g., mismanaged or well managed public programs), broader community issues (e.g., high unemployment), and broader cultural-political identities (e.g., pro-environmental tendencies) shape community perceptions of various resilience strategies. However, inequities and power dynamics underly local politics and often mute some voices.

Third, communities must consider the tradeoffs inherent in resilience strategies. Some strategies to cope with heat (e.g., increasing tree shade), for example, might directly or indirectly hurt efforts to deal with drought (e.g., water conservation efforts). Likewise, resources dedicated to green infrastructure to cope with extreme rainfall
events cannot be used to fund emergency shelters. This is not to say that win-win situations do not exist, but that even those come at a public expense. In other words, the resources a community might expend on a ‘win-win’ resilience strategy may still leave other problems, vulnerabilities, or potential hazards unaddressed.

Finally, communities must prioritize what resilience to a given threat means over different temporal and spatial scales. Are any heat-related deaths acceptable over the course of the year? What about in 2040? Is a new sea wall that will keep storms surges at bay until 2060 a ‘long-term’ strategy or a short term one?

Thus, communities planning for the impacts of climate change must assimilate a wide variety of community priorities with technical information and uncertainty about future hazards. Accordingly, climate change impacts, and uncertainty and socio-political contestation surrounding those impacts, pose a unique challenge to communities across the world and decision-makers tasked with preparing for climate change. At its heart, climate adaptation and resilience is a post-normal science problem (Funtowicz and Ravetz, 1993) characterized by high uncertainty, large normative implications, and disagreement about whether the problem is a problem at all. Accordingly, addressing climate change impacts requires more than scientific expertise, down-scaled climate models, and estimates of community vulnerability. As the discussion above shows, community priorities and values come to fore in any decision a city might make about climate adaptation and resilience.

Despite the profound impact that climate change, and measures to deal with climate impacts, might have on communities, relatively little research on public values and preferences regarding climate change adaptation efforts exists in the literature (Whitmarsh et al., 2013). Numerous studies outline acceptance and awareness regarding climate change but these studies gloss over the tough choices communities might face in
planning for climate change adaptation and resilience. In other words, they focus on public understanding of the science itself (i.e., are humans influencing the climate?) and not on the gritty details of what climate change adaptation and resilience mean for communities.

2.1.2 CRF project goals

The CRF project used participatory technology assessment (pTA) model to engage public audiences in informed discussions about the uncertainties, tradeoffs, and normative conflicts that emerge in climate adaptation and resilience efforts. The project, run by Arizona State University and the Museum of Science, Boston (MOS), was funded in 2015 by the National Oceanic and Atmospheric Administration's Environmental Literacy Program (NOAA ELP), housed within NOAA's Department of Education. The project proposal highlighted the following goals:

"...this project will create a next-generation, replicable institutional model for strengthening community resilience to a variety of hazards. We will engage lay citizens to discuss the hazards they face and improve public awareness of these hazards; increase the capacity of museums as convening institutions for public engagement; incorporate the coastal, weather, and climate science needed to inform decisions; and involve the public directly in decisions about measures that contribute to resilient communities, ecosystems, and economies."
In many presentations about the project, the project team (including myself) also cited the following project goals:

1. Engage laypeople in learning and making decisions about resilience;
2. Communicate hazard vulnerabilities, resilience strategies, and tradeoffs;
3. Promote informed and respectful civic dialogue among diverse groups in a replicable way; and
4. Collect and analyze informed public opinion.

The original proposal sought to achieve other goals as well, including recruiting citizen participants "to include citizens from traditionally underrepresented groups--those, not coincidentally, who are often most vulnerable to natural hazards." The project also took on considerable capacity building components, including building a network of science museums capable of hosting such forums and incorporating the input of various experts, including a variety from NOAA and other federal agencies. I return to these goals in more details in the following chapters.

2.1.3 CRF project partners

The project itself involved four major institutions who led the project and six other science museums who hosted forums in 2018. Partners from the Museum of Science (MOS) and Arizona State University’s Consortium for Science, Policy & Outcomes (CSPO) managed the bulk of content creation, relationships with the funding agency, and outreach to policy making communities. The Museum of Science was also responsible for project evaluation, which focused on educational outcomes for forum participants. Importantly, both MOS and CSPO had experience running forums and pTA efforts, including forums conducted for NASA in 2014. Both are also part of ECAST, a
consortium of institutions dedicated to peer-to-peer deliberation about scientific and technical topics. Partners at Northeastern University (NEU) developed visualizations used in forums. Finally, the Arizona Science Center supported efforts to involve educators in the project with other educator programming provided by MOS. The eight forum host institutions are presented in table 2.1.

2.1.4 Project timeline

The project proceeded in three major phases, roughly corresponding to each year (see project workflow in figure 2.1). In the first year, project partners at ASU, MOS, and NEU focused on content creation. This included engagement with policy makers and subject matter experts to inform the substance and structure of the pTA activity, the creation of evaluation tools by MOS’s evaluation and research team, and the creation of a planetarium show to complement the forum activities. Forum activities were created for four hazards: extreme precipitation, extreme heat, sea level rise, and drought. The second phase (year two) focused on testing those activities through two pilot forums, one in Boston focused on extreme precipitation and sea level rise and one in Phoenix focused on drought and extreme heat. Organizers from the six other forum hosts, all informal science education centers (i.e., science centers), participated in the pilot forum in Boston to learn about the activities and the logistics associated with the forum. In the final (3rd) year of the project, these six sites (see table 2.1) hosted forums on two of the four hazards for which we created content. Sites were responsible for choosing the two hazards to focus on, recruit public participants, implement the forum programming, create a “local resilience question” to augment the two hazard activities, and recruit an expert or policy maker presentation for lunch. Additionally, third-year sites were responsible for
collecting evaluation data from participants, reporting voting data from the activities back to ASU and MOS, and dispersing participant stipends.

**Figure 2.1 CRF project workflow showing project inputs, various phases associated with content creation and testing, and desired outcomes.**

Diagram from the CRF project proposal.

The next two sections lay out the 1) the process of content development for the hazard activities, 2) the materials associated with each hazard activity and standard format for each of the forums, and 3) an overview of recruitment efforts for participants.
Table 2.1 Climate Resilience Forum locations, hosts, and chosen hazards

<table>
<thead>
<tr>
<th>Location</th>
<th>Host Institution</th>
<th>Date</th>
<th>Hazards*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston, MA</td>
<td>Museum of Science</td>
<td>Jun 2017</td>
<td>SLR, EP</td>
</tr>
<tr>
<td>Phoenix, AZ</td>
<td>Arizona Science Center</td>
<td>Sep 2017</td>
<td>EH, DR</td>
</tr>
<tr>
<td>Honolulu, HI</td>
<td>Bernice Pauahi Bishop Museum</td>
<td>Mar 2018</td>
<td>SLR, EP</td>
</tr>
<tr>
<td>Mobile, AL</td>
<td>Gulf Coast Exploreum Science Center</td>
<td>Apr 2018</td>
<td>SLR, EP</td>
</tr>
<tr>
<td>Oakland, CA</td>
<td>Chabot Space &amp; Science Center</td>
<td>May 2018</td>
<td>SLR, DR</td>
</tr>
<tr>
<td>Durham, NC</td>
<td>Museum of Life and Science</td>
<td>May 2018</td>
<td>SLR, DR</td>
</tr>
<tr>
<td>Portland, OR</td>
<td>Oregon Museum of Science &amp; Industry</td>
<td>May 2018</td>
<td>EH, EP</td>
</tr>
</tbody>
</table>

* EP refers to extreme precipitation, SLR to sea level rise, EH to extreme heat, and DR to drought

2.1.5 Content Development

The project team developed materials used by participants in the CRF project over an 18-month process. This process integrated the project team's experience with past pTA efforts, academic literature on climate-related hazards and resilience, city and regional resilience plans, and input from researchers and resilience practitioners. I describe this process in detail below but return to salient points in the process throughout this dissertation.

2.1.5.1 Literature and resilience plans

Before beginning substantial development of materials and formal engagement with experts and practitioners, we examined academic and professional literature on four climate related hazards: Extreme precipitation, drought, extreme heat, and sea level rise. We sought to identify key uncertainties about each hazard and key findings about their impacts, including literature about how hazards affect different economic sectors and communities in different ways (e.g., drought impact on urban versus rural residents,
pronounced impact of extreme heat on low-income communities). We relied on both academic literature and government reports, including the US Climate Assessment, reports from climate.gov, and numerous state, county, and municipal reports and plans on climate-related hazards, emergency preparedness, and general plans.

Using this review, we compiled 1-page briefings on each hazard and a list of potential resilience strategies that we shared with experts and resilience practitioners who attended content development workshops (see below). We asked workshop attendees to review the documents so that everyone had 1) an expectation of what would be discussed and 2) a baseline understanding of each hazard. Importantly, workshop invitees had expertise in one hazard, both, or were in more general roles related to resilience.

2.1.5.2 Expert and policy maker workshops

We conducted workshops with researchers, resilience practitioners, and various government officials to help define and scope the shape and function of pTA activities for each hazard. We identified potential project partners and workshop invitees via our own professional networks and recommendations from our funders. These included elected officials, university and government researchers, and officials from a variety of municipal, regional, and state agencies. Agencies represented were related to resilience planning, including emergency management, public health, water resources, public works, and sustainability planning. We invited these partners to attend one of two workshops, one in Phoenix, Arizona on heat waves and drought, and one in Boston, Massachusetts on extreme precipitation and sea level rise.

At each workshop, attendees worked through an example deliberative activity to get a sense of the types of engagement activities we sought to develop. These deliberative
activities were based on existing activities developed by the Museum of Science. In Phoenix, partners worked through an activity about how to deal with sea level rise in various neighborhoods in Boston. We deliberately chose to have Phoenix partners work through an activity very different (in terms of content) from heat and drought. We did so as to not overly prescribe what an activity might look like. In Boston, project partners worked through an activity about genetically modified mosquitoes, again, to provide partners an idea about what types of activities we sought to create. Additionally, A team member from MOS gave a brief presentation on what makes for a good deliberative activity. He discussed 5 criteria for a solid deliberative activity:

1. It discusses a socio-scientific question that science and data cannot answer on their own
2. It reflects authentic decision-making priorities for resilience planners and stakeholders
3. It is broadly accessible (easily understood) and robust (not decided in 5 minutes) for public learning and discourse
4. Rich data are available as an input
5. Background materials (e.g., multimedia) are readily available

Several attendees delivered brief ‘lightning’ talks on issues related to their expertise and to the various hazards. The purpose of each talk was to help attendees, not all of whom had expertise relevant to every hazard, conceptualize the hazard and provide a shared baseline to promote discussion. Following the lightning talks, partners split into small groups to identify salient and relevant issues related to a variety of resilience strategies. Each group was given several resilience strategies to discuss. These list of strategies included a brief description, relevant considerations based on academic and
professional literature, and suggestions from pre-workshop conversations with policy makers and other stakeholders. Groups were asked to reflect on the following three questions for each hazard:

1. What are the one or two most important or central decisions to be made about this case study? Who will be most involved in making these decisions and in what time frame?

2. What perspectives are most important to include in the case study? These can include individuals, groups, or private or public institutions. In one or two sentences at most, briefly summarize why you think each perspective is relevant.

3. What kinds of data (NOAA and otherwise) can you suggest that would be most relevant to help communicate and inform decisions about this case study? Who oversees, manages, or creates these datasets?

A notetaker at each table recorded responses. As is expected with groups of experts and practitioners, some attendees chose to diverge from the activity and discuss broader issues related to each hazard and strategy, an outcome that nonetheless provided our project team with valuable insight about the topic. The information collected at these workshops served as inputs into the activity and content development processes.

2.1.5.4 Content creation and review

The Museum of Science built initial format in fall 2016 and spring 2017 based on feedback from expert and policy maker workshops, formats from past forum projects, and MOS’s expertise and experience in creating public engagement activities. The format for each hazard activity was initially developed for the extreme precipitation and then
sea level rise activities. Once the format was largely developed and tested, the MOS and ASU created the extreme heat and drought activities. After several internal rounds of activity and content development, we turned back to partners for review. We used in person conversations or phone calls with each partner to review these descriptions and identify improvements. For example, after reviewing draft materials for the drought activity, we clarified pieces of the activity that referred to the feasibility of grey water systems. This process served to hone content and make it more reflective of resilience priorities currently in consideration by policy makers. It also served as an opportunity for us to reassess our content’s coverage of a very complex subject.

Finally, the materials developed for forums were tested with small groups of public volunteers as well as with staff from MOS (extreme precipitation and sea level rise) and ASU (extreme heat and drought). These focus groups included a formal evaluation protocol developed by the MOS evaluation team. Findings from this evaluation, as well as observations by the project team and feedback directly from test groups resulted in mostly minor changes and tweaks to the materials.

### 2.1.6 Forum activity overview

Through the iterative process outlined above, the NOAA project team created four deliberative modules, one each on extreme precipitation, sea level rise, extreme heat, and drought. I describe the format of these activities below.

#### 2.1.6.1 General forum format

The activities relied on group discussions of 6-8 participants led by facilitator. A large poster on each table served as the focal point of the activity with various cards providing additional details and consideration (Figure 2.2). Participants received individual
workbooks that summarized materials from the larger group activity (see Appendix A for an example workbook). Facilitators helped keep the group on time, ensured that every participant was given a chance to speak, and distributed cards and other materials during the appropriate sections of the activity. Each host site recruited and trained their facilitators using an approximately 2-hour training session developed by the project team. Graduate students, professional mediators, museum staff, and other educators served as facilitators at the forums.

**Figure 2.2** Example table-top poster for drought activity showing the 4 steps to each hazard activity
Forums were held on Saturdays and generally lasted 8 hours (See sample agenda in Figure 2.3). A general welcome, usually given by museum staff alongside any NOAA officials present, began the day. Participants then saw a general planetarium show or slide show. This presentation provided basic information about climate change and the impacts of extreme precipitation, sea level rise, extreme heat, and drought. It included up-to-date data showing active wildfires and recent flooding events. After participants returned from the planetarium show, they began one of two climate related hazard deliberation activities. Each museum host chose the two hazards (out of four) based on their own assessment of what was most relevant to local conditions. Table 2.1 shows the chosen hazards by site. Each hazard deliberation activity took approximately 2 hours. After the first activity, participants were given lunch and museum staff or a local resilience official or expert presented on the state of climate resilience measures in the local community. For example, the Chief Resilience Officer for the City of St. Paul, MN presented during lunch at the Science Museum of Minnesota’s forum. After lunch, participants completed the second hazard deliberation. Following a short break, the forums ended with a shorter (~1 hour) activity focused on specific local resilience priorities, which is described below.
Before participants attended the forum (see section 2.1.7 for a description of the participant recruitment process), they received a background information packet. The packet was approximately 25 pages long, including figures and photos. We provided this packet to help participants learn about the issues and feel more comfortable conversing with others. In general, the packet included information that mirrored the content of the hazard-specific activities described below, along with case studies of how communities across the world are impacted by climate related hazards.
2.1.6.2 Hazard activities

All of the activities were designed to mirror the steps in the U.S. Climate Resilience Toolkit created by the United States Global Change Research Program:\(^3\):

1. Explore Hazards
2. Assess Vulnerability and Risks
3. Investigate Options
4. Prioritize and Plan
5. Take Action

Each hazard activity was designed around a U.S. city dealing with a particular climate related hazard. We relied heavily on data, case studies, and government documents about each city but anonymized them (e.g., removed names from maps)\(^4\). For example, we choose the city of Louisville, Kentucky, which we referred to as *Heattown*, as the city of focus for the extreme heat activity. We requested data about the urban heat island and heat-related mortality that the City of Louisville had collected, with help from the Georgia Institute of Technology\(^5\). These data showed where in the city the urban heat island was worst and where heat related deaths were reported for the summer of 2012. We represented these data as maps (see Figure 2.4, for example) at various points throughout the activity alongside data from other sources (e.g., social vulnerability data from the US Census) and fictional accounts of the impacts of extreme heat (e.g., materials about aging electricity infrastructure in *Heattown*). Those fictional accounts were based on academic literature, government documents, and case studies from

\(^3\) [https://toolkit.climate.gov/#steps](https://toolkit.climate.gov/#steps)

\(^4\) I discuss our decision to anonymize the cities used in the activities in detail in chapter 5

climate.gov to highlight important considerations cities must deal with in planning or a hazard. Participants were informed that the cities in the activity were based on real U.S. cities. In summary, the city case studies were grounded in the scale and scope of problems that US cities face.

### 2.1.6.3 Introduction to activity

Each hazard deliberation activity started with an introduction to the case study city. A series of visuals showed an overview of the city and particular vulnerabilities to the hazard at hand. For extreme precipitation, for example, the introduction showed an aerial image of Grand Rapids, MI, though the activity referred to it as Rivertown. Other visuals showed areas of the city that might be flooded during an extreme rain event, a Rivertown hospital that might be impacted, and historical sites on the outskirts of town that might experience flooding. Host museum staff gave introductions to the entire forum group. Participants also had a map of the city on the back of their individual workbook.
2.1.6.4 Consider stakeholder perspectives

After the introduction to the city, the museum host turned over the activity to facilitators at each table. Facilitators asked participants to read one of six stakeholder cards aloud while other participants could follow along and take notes in their workbook. The content of the stakeholder cards was written to convey important considerations for resilience planning. The stakeholders for Kingstown (Charleston, SC) for the sea level rise activity, for example, included transportation workers concerned about flooding in tunnels, an oysterman concerned about water quality and infrastructure that might impact his livelihood, and a resident in a poorer, flood prone area of the city who is concerned with rising rents and new development. After participants read all six cards,
facilitators asked questions about what priorities stakeholders might be most concerned with: the environment, the economy, and social well-being. These questions were intended to start initial discussions about how each stakeholder might approach resilience planning.

2.1.6.5 Prioritize stakeholder values

After becoming comfortable with their table and learning about the people who might be impacted by the hazard, participants read about various resilience strategies. They then rated how each stakeholder might view each resilience strategy by discussing if each stakeholder would support some public resources ($), a lot of public resources ($$), or no public resources (O) to address each given strategy. This step helped familiarize participants with different proposals for how a community might address the impacts of climate-related hazards. It also allowed participants to further explore the perspectives captured in the stakeholder cards. For each hazard, participants learned about three resilience strategies designed to capture major ideas about how to approach resilience planning (see appendix X for a list of all of the strategies). Participants also had access to a table summarizing the economic, social, and environmental implications of each strategy along with a Consumer Reports-like star rating for each.
2.1.6.6 Make a resilience plan

After reading about each resilience strategy and discussing how stakeholders might view each strategy, participants were asked to consider what strategies they as participants prioritized. Participants read two resilience plans (see Figure 2.6) for each resilience strategy. These plans represented investing either *some* resources (labeled plan B's) in a strategy and investing *a lot* of resources (labeled plan A's) in a strategy. The plans were more specific than the strategies and included particular proposals. For example, Plan A for 'Cool the City' (extreme heat) included a tree planting program and incentives to promote the use of high albedo surfaces. Thus, these plans reflected both a desired end (e.g., reducing outdoor temperatures and the urban heat island phenomenon) and means to achieve that end (e.g., a tree planting program). After
reading each plan aloud, participants were asked to create their own resilience plan using the options in the activity. Each participant could only spend three 'coins'. Plan A's cost two coins, plan B's cost one coin. Participants could not invest all three coins in one strategy. After individuals recorded their own plan in their workbook (Figure 2.7), facilitators asked each participant to share what they choose and why. Facilitators then asked each table to decide on a resilience plan as a table and record that plan on their game board. The table's resilience plan was also limited to the three-coin constraint.

**Figure 2.6 Resilience plan card from extreme precipitation activity**
2.1.6.7 Implement and explore your resilience plan

After a group decided on a plan for their table, they read about their plan’s impact and examined visuals showing those potential impacts. First, the facilitator asked one participant to read an overview of the plan they chose. This overview highlighted major features of their plan as well as tradeoffs (e.g., comments about programs they did not
While the participant read this overview to the group, the facilitator loaded a map tour of the case study city (e.g., Heattown). These map tours were recordings made through Google Earth and were shown either through Google Earth or through screen recordings (videos) of Google Earth. These visuals contained:

1. data showing the extent of the hazard before any resilience plans were implemented;
2. specific features of the chosen resilience plan (Figure 2.8);
3. fictional news stories about the impacts of the plan (Figure 2.9);
4. some visualization of the impact of the plan on the hazard itself.

   - For sea level rise and extreme precipitation, we showed predicted flooding given certain parts of the chosen plans (e.g., sea walls, levies)
   - For drought, we showed a unitless chart demonstrating change in water availability and use from the initial.
   - We did not show any predictions regarding changes in extreme heat given the difficulty of undertaking such predictions.

Visualizations were meant to convey potential outcomes of each resilience plan, tradeoffs amongst the plans, potential unintended consequences (e.g., pest problems associated with green infrastructure), and uncertainties associated with making complex decisions about the future. Additionally, the fictional news stories allowed us to return to some of the stakeholders from earlier in the activity to show how resilience plans impacted parts of the community in different ways.
Figure 2.8 Screenshot of a resilience plan for the extreme heat activity

Figure 2.9 Fictional news story from drought activity

OTTAWATTA TIMES

IMPACTS OF DESALINATION ON OCEAN LIFE UNCERTAIN

Researchers at Ottawatta University say the long-term impacts of Coasttown’s desalination plant are uncertain but that the filters and salty waste produced by the plant could harm marine plants and animals.

COASTTOWN: A desalination plant that turns saltwater to freshwater for users in Ottawatta is being blamed for water quality problems and environmental degradation in Coasttown. The facility uses technologies to dilute waste water by mixing it with ocean water but, a recent water quality assessment showed high salt concentration near the facility.

“Of course the ocean is already salty but increasing the concentration of salt in the water can adversely affect marine plants and animals,” said Dave Choi, a researcher at Ottawatta University.

Researchers are also concerned about the intake pipes for the desalination plant. Desalination plants suck up microscopic plants and plankton, and fish larvae that are in the ocean and strain them out on fine filters.

“We don’t really know yet what the long-term impact of the desalination plant will be in Coasttown,” said Choi.
Participants were then asked to reevaluate their chosen plan using the information from the visuals and from their group discussion. If they wished, they could choose a new one as a group, learn about its impacts and associated tradeoffs, and choose amongst the two plans before reporting out to the rest of the tables at the forum. In addition to their final group plan, participants could record a final plan in their individual workbook, providing them the opportunity to support or challenge their group’s chosen plan.

2.1.6.8 Local resilience forum activity

After completing the two hazard-specific deliberations, facilitators led participants through an activity focused on local resilience concerns. The format and details of the local resilience activity were left up to each host site. While the CRF project team provided a generic set of questions for this local activity, most sites sought to develop their own activity alongside local resilience planners, experts, and other stakeholders. The local resilience activity was meant to start conversations about what resilience might mean in participants’ communities. After spending a day learning, discussing, and debating resilience strategies in the hazard activities, participants could take these discussions and focus them on their own backyards.

2.1.7 Participant selection

Key to both the proposal for the CRF project and broader literature about pTA is the selection process for forum participants. As with other pTA project, recruitment efforts for the forums focused on reaching ‘unusual suspects’ in resilience and climate issues. The intent here, was to focus on groups that are not historically involved in discussions about climate or the environment, including historically underrepresented groups who,
not coincidentally, bear disproportionate impacts from climate hazards. We also sought to limit the participation of people involved in advocacy related to climate and environmental issues. Both of these decisions reflect a push to bring diverse perspectives to bear on climate resilience challenges but also to recognize the reality of how policy is often made. First, some groups have historically been or currently are excluded from policy making. Second, issue advocacy groups already have channels to convey their values. The push for a diversity of perspectives stems directly from the pluralistic ideals for what pTA should do as discussed in chapter 1.

Each host site received a similar briefing, suggestions for recruitment and selection, and was responsible for advertising and selecting participants with assistance from ASU and MOS. Advertising took a variety of forms, including social media advertisements, email lists, printed flyers, and advertisements on craigslist gigs, an online board for posting temporary work needs. The latter two options, flyers and advertisements on craigslist, helped to reach groups that museum hosts might otherwise have struggled to reach in the past, including low-income residents and those with a high school education or less. In some cases, forum hosts targeted flyers to homeless shelters or community shelters to help reach these groups. Additionally, host sites received funds as part of the project to incentivize participation through $50 incentives (in the form of gift cards) to be distributed to all participants at the end of the forums. The $50 incentive helped encourage participation from groups who otherwise might not contribute to these types of community forums. We did not, however, provide child care services or other services to lower the barrier of participation. Advertisements described the subject of the forum and included language stating that all perspectives were welcome, though host sites could customize their advertisements as they saw fit.
Potential participants filled out an online application survey that collected basic demographic questions regarding age, household income, race/ethnicity, and educational attainment (see Appendix D). The project team or someone from the host institution then examined the applications and created pools of applicants who would receive invitations. As a general goal, we used regional census data to guide decisions about recruitment. Our intent was to invite a diverse audience but one that mirrored the diversity of the larger community (e.g., that the portion of those with a graduate education at the forums matches the portion of the regional population that holds a graduate education). However, we also overrepresented some groups, knowing that people may be uncomfortable if they felt that they were the lone representative of a given demographic group. Invited participants were asked to confirm their attendance several days before the forum. Once confirmed, participants received a background material packet with general information about the issues they would discuss at the forum and a pre-survey designed by the MOS evaluation team about their knowledge and interest in climate related issues. See Appendix E for a summary of participant demographics across all CRF project forums.

2.2 Proposition 127 and pTA

The Prop 127 forums project originated from my own interest in holding forums about Proposition 127. The proposition--if passed--would have required 50% of electricity generated by certain electric utilities to come from renewable sources, such as solar and wind, by the year 2030. It also included provisions for a certain amount of electricity to come from sources located on utility customer property (e.g., roof top solar) and for a renewable energy credit trading system. The proposition would have changed Arizona’s constitution had it received a majority of votes in Arizona’s 2018 statewide
election. After receiving enough signatures from Arizona voters, it was placed on the ballot for a statewide referendum in 2018.

I was disappointed and frustrated with public discourse about the proposition\textsuperscript{16}. Supporters and opponents advanced incompatible claims about the impact of Prop 127, leaving Arizona voters with little access to assessments of Prop 127, acknowledging that the impacts of Prop 127 really are challenging to predict. I was concerned that this discourse would erode (or was eroding) prospects for addressing important problems facing Arizona, including climate change and the state's economy. I discussed the idea for an 'issue guide' and forums about Prop 127 with friends and colleagues and pitched it to others at CSPO, who encouraged me to pursue the project and provided a small budget to support the effort. A handful of other graduate students and colleagues helped with various pieces of the project as it progressed. The goal for the project was to "[p]romote informed discussion about energy systems in Arizona in advance of November's general election and the Clean Energy for a Healthy Arizona Initiative (Prop 127)."

\textbf{2.2.1 Content development}

I followed a content creation process similar to that of the CRF project, though abbreviated over about 3 months (July–September 2018). First, I used academic and professional literature on renewable energy policy to identify important considerations about the proposition, including case studies of other states and countries who have implemented renewable portfolio standards such as Prop 127. I then used my own professional networks to identify about a dozen experts familiar with renewable energy

\textsuperscript{16}I detail my motivations for this project more in chapter 3.
policy and related topics to help inform the content for the project. These experts included researchers at universities and policy think tanks, elected officials with oversight of utilities, and former utility administrators. I interviewed six experts before completing a draft of the issue guide to be used in forums. Interviews were semi-structured and focused on 1) current policy towards renewable, 2) challenges facing Arizona’s electricity grid, 3) potential impacts of Prop 127, and 4) uncertainties and nuances surrounding the proposition that voters may want to consider. As I created the issue guide for forums, I asked three interviewees to review drafts and provide feedback.

2.2.2 Prop 127 forum guide

The issue guide itself was based on deliberative guides created by the Kettering Foundation and CSPO on autonomous vehicles. It included six sections, each with short questions that participants could use to reflect on their own values, opinions, and concerns about the proposition (see Appendix B for a copy of the guide). The first section introduced Prop 127 and described the purpose of the guide. The second described Arizona’s electricity system and its governance. Then three sections each described a single important consideration related to Prop 127 and important uncertainties associated with it. The three considerations were: Technical challenges; economy, jobs, and costs; and environment and human health. The last section offered questions for discussion. Importantly, the guide was made to be used outside of forums as well, and a colleague and I submitted opinion pieces for local newspapers to share the guide, though none were published.

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17 I discuss the Kettering Foundation’s model in chapter 5.

18 The final guide is available in the appendix.
2.2.3 Prop 127 forums

Two forums were held as part of this project, one in Sierra Vista, AZ and one in Glendale, AZ. Both forums took place the week before the general election in 2018. Participant recruitment and selection took a similar form as the CRF project. Participants were offered a $15 Amazon gift card for their participation in the forum and this was noted on advertisements. I used emails to community groups, flyers, and advertisements on craigslist gigs to recruit participants. Interested people filled out a brief application with basic demographic information (See Appendix F). I planned for between 20 and 30 participants at each forum and would use demographic information provided by applicants to invite a diverse group of participants. However, because of low turnout I ended up inviting all applicants to both forums. Nine participants attended the forum in Sierra Vista and 17 attended the forum in Phoenix.

Forums lasted about two hours and were hosted on weekday evenings. Participants sat at tables with 4-9 other participants and a facilitator. The forums began with a brief introduction to Prop 127 and 'ground rules' for discussion. Then facilitators led participants through the issue guide described above. Facilitators asked participants to read aloud sections of the guide before pausing for group discussion using the questions from the guide. At the forum in Glendale, each table had a group response sheet with the same questions as those in the issue guide. Facilitators asked participants at the Glendale forum to complete this sheet as a group. Participants received a survey about their knowledge of Prop 127 and related issues, their confidence in assessing arguments about Prop 127, and their opinion about Prop 127 before and after the forum (See Appendix G)

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In later chapters I present survey data from forum participants which fewer total participants. Some participants choose not to complete some or all questions in pre and post surveys.
for the pre-forum survey and Appendix H for the post-forum survey). The post-forum survey also included questions about participants' experiences at the forum.

### 2.2.4 Evaluation and comparison survey groups

To evaluate the impact of forums on participants opinions and reported knowledge about and confidence in assessing Prop 127, I collected surveys from Arizona residents about Prop 127. I used Amazon's Mechanical Turk Service to recruit participants to an online survey with the same questions as the pre- and post-forum surveys given to in-person participants with the exception of questions about participants' experiences at forums (See Appendix I). I grouped participants into two treatments. One group took the pre survey, received a summary of for and against statements about Prop 127 submitted to the Arizona Secretary of State (see Appendix C), and then took the post survey. The second group received the same pre and post survey but received the issue guide developed for the forums. Participants received $3.75 for their participation in this project. Fifty-six online respondents completed the surveys and saw the forum guide and 51 respondents completed the surveys and saw the summary of pro and con statements submitted to the Arizona Secretary of State. More about this experimental set up is described in chapter 5. See Appendix J for participant demographics.
Chapter 3 - Educational goals in pTA

3.0 Introduction

Participatory Technology Assessment, as outlined in the introduction, is designed to capture informed public opinion. Accordingly, pTA is at least in part about bringing information, data, and perspectives to pTA participants during deliberation; it’s about informing participants through materials and deliberation. The educational nature of pTA, however, can quickly conflict with the goals of public participation. Constraining discussion to expert views through materials, can limit the value of discussion by narrowing how participants can bring in diverse values and concerns. Maps, figures, and data can provide helpful information to a discussion, but it can also shift the discussion away from important disagreements about values or can solidify the authority of those representations over the experiences of participants. Further challenging educational goals in pTA is the focus on post-normal problems characterized by high uncertainty and high decision stakes. How do pTA planners navigate high uncertainty and political stakes in crafting materials to meet educational/informative goals? Conveying uncertainty, and the factors that contribute to it, is no easy task, particularly because pTA conveners strive to be neutral in their framing of issues (see Chapter 1). The need and desire to inform participants comes with many questions about expertise and the communication of factors important to uncertainty around contested issues.

This chapter is about the educational goals of the two pTA projects I studied and how those goals changed in response to various factors in each project. Educational goals included the information, data, perspectives, or concepts that implicitly or explicitly were to inform participants in the CRF project and the Prop 127 forums. My focus on educational goals, and on the rest of the major themes in this dissertation, emerged from my analysis of project documents, meeting minutes, notes, literature on pTA, collected
survey and interview data, and my own reflections. When appropriate, I used direct language from these materials in the pages that follow.

This chapter has three major sections. In the first, I present some background on the educational goals laid out in the CRF project proposal, the emergence of related educational goals early in that project, findings from an evaluation of forum participant learning conducted by the Museum of Science, and findings from interviews with policymakers who attended the climate resilience forums. In particular, I discuss how the practice of pTA responded to ideas from another related practice: Co-producing projects with policymakers (in this case, co-production of educational goals). The second focuses on educational goals in the Prop 127 forums, which emphasized understanding and communication of uncertainty. Finally, I synthesize these observations and findings and reflect on the role of learning in the practice of pTA.

3.1 Learning about resilience: Educational focus of the CRF project

The CRF project was funded by NOAA’s Office of Education under their Environmental Literacy Program (ELP). According to the ELP website, the program supports efforts that “educate and inspire people to use Earth systems science to improve ecosystem stewardship and increase resilience to environmental hazards.”21 Education is a cornerstone of the projects that the ELP supports, so it’s little wonder it was a major theme in the NOAA project22. Given the prominence of education in the funding organization’s mission, the original proposal narrative for the CRF project highlighted the following educational outcomes on the first page:

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22 Notably, the ELP website makes rather explicit connections between education and other outcomes, such as stewardship and resilience.
"[This project will increase awareness about] the ways human and natural systems interact; the nature of scientific processes and uncertainty; the ways that people and places are connected to each other across time and space; and the potential intended and unintended impacts of actions aimed at improving resiliency."

Per the project proposal, these educational goals were to be met via pTA programs and materials designed with input from policy makers and experts around mitigation and adaptation strategies for each hazard and associated costs, benefits, and salient issues. Additionally, planetarium shows and other visualizations were proposed to illustrate “the ways human and natural systems interact; scientific processes and uncertainty; and the potential impacts of actions aimed at improving resiliency.”

In line with the ELP’s emphasis on education to improve resilience and stewardship, the proposal noted that “increased literacy in scientific processes and uncertainty, and improved knowledge about measures that can reduce vulnerabilities to local hazards, produce a public more involved in and supportive of robust resiliency measures (White et al., 2001),” an acknowledgement that learning in this project was linked to policy or planning actions. Finally, the proposal noted that programs and materials would seek to “improve participants’ awareness and understanding of key aspects of oceans, climate, and atmospheric science.):

“We will particularly focus on the importance of citizen understanding of fundamental concepts—understanding how natural systems function and interact with human systems, how scientists study and evaluate
These goals, laid out rather clearly in the proposal, responded to other project goals and elements of practice. In doing so, they changed and morphed to address the ideas and materials from the project team and project partners. In the next section, I present one prominent educational goal, a focus on tradeoffs and complexity, that emerged early in project planning and I discuss some of the ways this goal interacted with other parts of the project.

3.1.1 Tradeoffs as a learning goal in the CRF project

Beyond the specific educational goals laid out in the proposal, other more specific goals emerged as the project progressed. The workshops with NOAA representatives, policy makers, and the project team held in Boston and Phoenix in 2016 were focused on identifying topics that forum activities should cover. In short, what should the project team put in front of public participants? In the lead up to these workshops, the CRF project team laid out goals for the workshop around this theme: What resilience strategies should we discuss in the forums? What about those strategies warrants public discussion? On which topics related to resilience should we solicit public opinion and feedback? We compiled lists of resilience strategies based on academic literature and government documents to serve as a baseline for these workshop discussions. We included a section on costs, benefits, salient issues, and relevant stakeholders for each of these strategies with the intent of asking workshop attendees to fill in gaps in these sections (e.g., are there any considerations we’ve missed?). Notably, the project team discussed these considerations (that is, the costs, benefits, salient issues, and relevant
stakeholders associated with each strategy) as an opportunity to elicit important tradeoffs from workshop attendees. Collecting this feedback from workshop attendees would help create “rich” case studies for public audiences. We strove to create activities that asked forum participants to address difficult decisions that could be informed by science but not decided by science. Officials and experts at the workshop responded to this exercise by lauding the importance of tradeoffs. One CRF team member noted the following during wrap up discussion from the Phoenix workshop: “There is no silver bullet. What are the trade-offs in your neighborhood, what scale are you worried about?”

The focus on tradeoffs by policy makers and experts took two forms. Officials and experts wanted forum participants to understand the tradeoffs inherent to specific issues (e.g., tradeoffs present in decisions about water management) and in general (e.g., tradeoffs as part of the resilience planning process). Some officials were interested in learning about what tradeoffs participants felt comfortable making (e.g., accepting some amount of flooding due to rains even if that slowed or stopped traffic or public transit). For example, an official from the Boston area asked, “What kinds of tradeoffs are people willing to take? Seems like a good goal for these [forums]. How well do we want the T [subway] to run?”

Other workshop attendees emphasized that forum participants should learn about tradeoffs in general. An official from the Phoenix area highlighted the need to discuss local water policy to help characterize tradeoffs and complexity in the forum activities. In a summary of follow-up calls with attendees from the Phoenix workshop, I wrote, “[I]t might be necessary to convey what policies exist [to] help people understand tradeoffs and complexity around heat and drought.” While the project team discussed tradeoffs as more of a characteristic for what makes good deliberative activities, workshop attendees understood tradeoffs as something that the forums should communicate to participants
so that members of the public understood that resilience planning involved making difficult decisions about tradeoffs.

Discussions of tradeoffs as a suggested educational goal were linked to the need for forum participants to understand concepts related to complex systems and ecosystems, such as cascading impacts or unpredictability. A representative from NOAA linked tradeoffs to ecosystem services, noting that visualizations could help forum participants understand the ecosystem services provided (or not) by different resilience strategies and the related tradeoffs amongst strategies. Another workshop attendee highlighted that many municipalities already conduct planning and public engagement efforts for individual hazards and encouraged us to think about cascading effects: How do multiple hazards compound each other? For example, how might a community prepare for a drought that makes wildfire conditions worse, wildfires that in turn threaten powerlines during a heat wave?

Tradeoffs, ecosystem services, cascading impacts, and other concepts related to complex systems, of course, are closely related to the educational goals laid out in the proposal for this project. Ecosystem services are rooted in the interactions of human and natural systems. Complexity and tradeoffs closely relate to unintended consequences, and even human and natural system interactions. The jump from wanting to raise awareness about “the ways human and natural systems interact” to wanting to raise

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23 This wasn’t a universal focus. One Phoenix workshop attendee noted that while participants should understand and address the systems level issues via forum activities, participants should also consider what they can do on a personal level. This attendee wanted us to both educate participants about the systems-level dynamics relevant to resilience planning and empower participants to make change.

24 An emphasis on ecosystem services also wasn’t universal. A heat expert noted that ecosystem services can be a limiting frame: A simple way to protect homeless people from heat is to give them an air-conditioned place to stay, something not particularly related to ecosystem services. In other words, there were tradeoffs built into resilience strategies that prioritize ecosystem-provisioned services.

25 Emergency planners in central Arizona were convening meetings and workshops about similar topics around the same time as our 2016 workshops.
awareness about tradeoffs amongst various strategies to respond to a given natural hazard is a short one. The word ‘tradeoff’ is missing from the proposal but is abundantly present in planning documents and notes from content development workshops with policy makers and subject matter experts. Through workshops in particular, a focus on tradeoffs emerged as a learning goal that shaped other materials and decisions in the project. Tradeoffs and cascading impacts provided substance to more general educational goals laid out in the proposal. In the next two sections, I describe how tradeoffs and concepts related to complex systems influenced other pieces of the CRF development process.

3.1.2 Cascading impacts and forum format

Later in the project, the focus on cascading impacts across different hazards proved important to decisions about the format of forums themselves. Conducting forums on multiple hazards (e.g., extreme precipitation and extreme heat) highlighted the cascading impacts amongst hazards and resilience strategies. After the completion of the two pilot forums, our team discussed changes to the forum structure for the final six forums. Two options were on the table. We could limit the forum to just one of the hazard activities, leaving more time in the forum for a robust local activity. With a one-hazard format, we could help each host institution build a local activity in collaboration with local policy makers. The second option was to maintain the structure from the pilot forums: Two hazard activities plus a smaller local resilience question. The team decided on the two-hazard format we used in the pilot forums, in part by noting that cascading impacts between resilience strategies and hazards emerged as an important educational

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26 Some of the ‘local’ deliberation activities even built on those cascading impacts by asking participants to consider strategies for their community from multiple hazard activities.
goal from the workshops. In short, a desire to inform forum participants about cascading impacts, tradeoffs, and complexity proved to be an important consideration in our decision to continue using the 2-hazard forum format. This decision carried other implications, most notably making the forums less focused on specific challenges faced by each host community, something I discuss in more detail in chapter 6.

### 3.1.3 Learning about tradeoffs: Putting participants in the shoes of resilience planners

An educational focus on tradeoffs and complexity reinforced the structure of the forum activities in another way: The hazard activities placed forum participants in the role of a decision maker. Participants had to consider the perspectives of prominent stakeholders, weigh different options for resilience plans and their costs, and use visualization tools that showed the potential impact of the hazard and their chosen strategy. As noted above, local officials and experts who contributed to material development through the 2016 workshops placed a heavy emphasis on getting participants to grapple with the tradeoffs and complexity that they, as officials, address in their day-to-day decision making, from considering the needs of different stakeholders to working within the limits of current institutional structures.

After the 2016 workshops, the project team led by MOS began developing a general format for each of the four hazard exercises. A Boston-specific sea level rise activity developed by the Museum of Science for a different project served as the basic skeleton

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27 That a NOAA representative placed a lot of emphasis on cascading impacts likely swayed our decisions.

28 This wasn’t the only consideration, but it was referenced in our meetings and phone calls. The difficulty of supporting all six other host institutions in their collaborations with local resilience officials influenced our decision as well.
for the pTA activities developed for the CRF project. The final CRF materials differed in a very important way: Participants were allotted three ‘coins’ they could dedicate to various resilience plan options, each of which cost 1 or 2 coins. The idea of adding a resource constraint to the CRF activities first arose in the workshops with policy makers and subject matter experts in 2016 in direct reference to wanting participants to confront tradeoffs. The addition of the resource constraint to the activity reinforced 1) a focus on tradeoffs in the activities and 2) a format that places participants in the shoes of policy makers.

Officials who attended the forums in 2018 noted that the activity put participants in the shoes of policy makers and forced them to make tradeoffs. Of the nine officials I interviewed, five were decision makers, on city commissions about climate change, or other officials from local, regional, or state governments. Four out of those five (I didn’t record one interviewee’s responses at their request) commented positively after they observed forum participants engaging in difficult decisions that they as officials had to address, repeating sentiments from an entirely different group of officials who attended workshops in 2016 to help guide content creation. For example, one interviewee who served on a city climate commission observed,

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29 Adding the resource constraint also served to impact participant deliberations in important ways, which I describe in chapter 5.

30 While the resource constraint reinforced a focus on tradeoffs and the idea that participants would be acting as resilience planners in the activity, the general premise of pTA already reinforces the latter. Participatory Technology Assessment exercise rest on opening up what are usually expert decisions to broader input, in essence placing supplanting expert decision makers with pTA participants. The idea then of placing participants in the shoes of policy makers comes somewhat easily from the premise of pTA.

31 The others were outreach, federal or state extension officers, or university researchers.
“[the forum activity] was something that would be helpful for me in my work, having that kind of exercise where people can really think about why policies are the way they are because you have different groups advocating for different needs.”

A chief resilience officer who attended a forum in 2018 appreciated that the forum activities were designed to be “real world” in nature because they got into the tradeoffs of resilience planning. Another interviewee who managed municipal climate programs noted,

“...it was really fascinating to watch [participants] struggle with a lot of the things that I and my colleagues struggle with on a regular basis in terms of no clear solutions that are gonna fix everything, winners and losers, not enough money to do everything, things that you think are gonna work sometimes don’t work how you think they’re gonna work. Just to watch them struggle through that, and try to balance the perspectives of stake holders, and make sure that people’s voices weren’t discounted or form your own biases. Anyhow, it was really interesting to watch that, and I’ve never had the opportunity to see that. I think there was just a lot of education in that, in and of itself, in terms of just understanding the complexities at play more so than just if you were to do a presentation and tell people that things were complex.”

One of the most notable and positive features of the forums to these interviewees was that the public learned about the difficult, thorny, contested, and sometimes uncertain
decisions and situations that they as decisions makers faced. This outcome closely matched the desired learning outcomes about tradeoffs and cascading impacts that emerged from workshops with officials in 2016.

3.1.4 Did participants learn about tradeoffs? Lessons from evaluation data

Given the educational nature of the project, the CRF project team sought to capture participant learning, interest, and attitudes related to resilience. The Museum of Science’s Research and Evaluation Department was responsible for both formative and summative evaluation of the project. Formative evaluation refers to evaluation of forum materials as they were being developed, which consisted of testing materials with focus groups. Summative evaluation consisted of surveys distributed to forum participants before and after the forum. Here I report on portions of the summative evaluation as they relate to the discussion above about tradeoffs and complexity as educational goals. This section heavily relied on a draft summative evaluation report from MOS’s Research and Evaluation Department (personal correspondence with authors, May 3, 2019; Todd et al., in preparation).

The pre-forum participant survey asked participants to list what they knew about climate-related hazards, climate resilience plans, and factors that impacted both. The post survey included the same open-ended questions as the pre-survey, followed by a series of questions asking participants to rate their knowledge about certain topics or agreement with provided statements before and after the forum32. Notably, only one of these questions addressed tradeoffs: “How much did you know about the following topic before the forum, and how much do you know after participating in the forum? The

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32 For more detail about the survey instruments, statistical tests, or the summative evaluation report, please see the appendix.
impacts of resilience strategies on different community members.” While not directly about tradeoffs, understanding the implications of resilience strategies on different people or groups of people is a critical part of thinking about tradeoffs. Participant responses were statistically significant and showed a large effect size (figure 2.1)\(^{33}\).

Todd et al., also examined the open-ended questions (“What I know about climate resiliency plans:” and “Factors I think impact/affect climate resiliency plans:”) from pre and post surveys. Written responses were coded based on participants’ demonstrated knowledge about resilience efforts (goal 1) and the impacts of resilience efforts on different stakeholders (goal 2)\(^{34}\). Results are presented in table 2.1\(^{35}\). While limited in scope, both qualitative and quantitative data demonstrated that participants overall did learn about factors related to tradeoffs. Reflections from policy makers and subject matter experts who observed the forums further illustrated that participants grappled with tradeoffs and complexity in the forum activities.

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\(^{33}\) Wilcoxon Signed Ranks Test: n = 355, Z = -15.139, p < .001, r = 0.804. The effect size of 0.804 (r) was the largest of any effect sizes for the six knowledge questions asked.

\(^{34}\) The Research and Evaluation Department used the following scheme to determine if a response qualified as a superior response or achievement response:
- **Superior response:** The respondent described the interactions between resilience strategies and more than one human/social, environmental, or economic factor, including human stakeholders, individuals, cultures, corporations, communities, infrastructure, costs, etc.
- **Achievement response:** The respondent described resilience strategies and their interactions with one human/social, environmental, or economic factor.

\(^{35}\) The draft summative evaluation report noted that, “the data about resilience efforts [goals 1 and 2] show that respondents reported high levels of learning and demonstrated knowledge of resilience efforts and their impacts both prior to and after the forum.” However, the report also noted that, “the high levels of prior knowledge make measuring increases in the qualitative responses difficult...However, there is clear evidence that participants had strong understandings of the project goals, and the quantitative self-report of increased knowledge with large effect sizes are encouraging data suggesting that there was change over time.”
Figure 3.1. Participant responses to the survey question, “How much did you know about the following topics BEFORE the forum, and how much do you know AFTER participating in the forum?” Figure from Todd et al. in preparation.
Table 3.1. Qualitative evidence of knowledge about resilience efforts (n=258). Table from Todd et al. in preparation. See footnote 34 for details about Superior and Achievement responses.

<table>
<thead>
<tr>
<th>Code</th>
<th>Frequency</th>
<th>Example quotations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Met Goals 1 and 2</td>
<td>Pre-survey: 87.6% Post-survey: 88.8%</td>
<td>“[Factors I think affect climate resiliency plans are] people refusing to believe climate change is taking place. Economics, people don’t want to loose profits by acknowledging and doing something positive to curtail it.”</td>
</tr>
<tr>
<td>Superior response</td>
<td>Pre-survey: 66.7% Post-survey: 70.2%</td>
<td>“Communities’ inability to communicate and prepare [affect climate resiliency plans].”</td>
</tr>
<tr>
<td>Achievement response</td>
<td>Pre-survey: 20.9% Post-survey: 18.6%</td>
<td>“[Climate resiliency plans are] having a plan to deal with the effects of climate change.”</td>
</tr>
<tr>
<td>Met Goal 1 but not 2</td>
<td>3.1%</td>
<td>“Since I know very little about them, I cannot point to appropriate factors [that affect climate resiliency plans].”</td>
</tr>
<tr>
<td>Did not meet Goal 1 or 2</td>
<td>9.3%</td>
<td></td>
</tr>
</tbody>
</table>

3.1.4 Educational goals, the CRF project, and the practice of pTA

To summarize, the CRF project proposal included a variety of educational goals, including goals related to tradeoffs, complexity, and cascading impacts. As the project developed, policy makers, experts, and representatives from NOAA involved in the project highlighted the importance of participants learning about tradeoffs and ideas related to complexity. This emphasis impacted the forum activities and forum structure in a way that shored up the forum format to include two hazard activities. An entirely different group of policy makers and experts enthusiastically noted the ability of forums to communicate tradeoffs and complexity in the pTA activities. Further, evaluation of
participant learning noted that participants reported knowing more about “the impacts of resilience strategies on different community members,” a concept related to thinking about tradeoffs and complexity.

The evolution of these learning goals highlights lessons for the practice of pTA. First, the use of approaches from usable science, in this case the direct involvement of policy makers in decisions about content, is an example of intersecting practices. Principles of usable or actionable science informed a general approach for engaging policy makers, which in turn led to a specific focus on tradeoffs as an educational goal. And participants did learn about and grapple with tradeoffs through the activities. Second, an educational focus on tradeoffs paired well with stated rationales for pTA. Tradeoffs are inherently about considering (un)desirable traits or outcomes of various decisions; they’re a matter of prioritizing values. Participatory Technology Assessment, in part, focuses on making the values embedded in given socio-technical pathways clear. In the CRF project, an emphasis on tradeoffs by policy makers and funders overlapped with a stated rationale for pTA that emphasizes discussions about values.

3.2 Prop 127 Forums: Educational Goals

In discussing the educational goals of the Prop 127 forums, I should first note that this project was close to me. I planned and ran it with the help of a few colleagues inspired by what I saw as troublesome or disappointing discourse on the subject and by my own desire to give back to my community in a difficult election season. I hoped that a pTA-like forum, and materials developed to support a forum, would improve that discourse in some small way. As in the CRF project (see 3.1), informing and educating

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36 In this example, ‘usability’ for policy makers only included educational goals. Nonetheless it mirrors the practice of making usable products for policy makers.
through forums served as vehicle to further another goal. Educational goals in the CRF effort linked informing participants to fostering resilient communities. For the Prop 127 project, I wanted to inform participants to promote a more pluralistic discourse, one that acknowledged the uncertainty of the future and embraced the disputes about values at the heart of the issue more fully. To get started, I’ll briefly discuss public discourse about Prop 127 in spring and summer of 2018 and how this influenced my decision to take on this project. I then discuss the challenges of navigating uncertainty and politics around one particular part of the pTA forum guide created from the effort and present results from surveys to Arizona voters who read the materials or participated in forums.

3.2.1 Motivation for the Prop 127 pTA effort

Proposition 127 would have modified Arizona’s Constitution to require certain utilities to source 50% of their electricity from certain renewable sources by 2030. By June 2018, several months ahead of the election in November but shortly after the group who proposed Proposition 127 submitted paperwork to the Arizona Secretary of State to get the proposition on the ballot, supporters and opponents of the measure had forcefully advanced two blatantly contradictory messages. Opponents claimed it would raise utility bills and lead to job losses. Supporters stated the opposite: Prop 127 would reduce costs, create more jobs, and improve environmental quality. Other competing claims emerged about the impact of Prop 127 on Arizona’s nuclear power plant, Palo

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37 See the Prop 127 forum guide available in the appendix for further information about the proposition itself.

38 While the website VoteNoOnProp127.com is now defunct, many of the claims from the page are available on a similar social media page: https://twitter.com/noazenergytax. Additionally, an archived version of the website from November 8, 2018 is available here: https://web.archive.org/web/20181108084247/https://votenoprop127.com/ from the Internet Archive.

Verde Generating Station (PVGS). Opponents claimed the measure would lead to the plant’s early closure, risking a substantial portion of Arizona’s low-carbon emission electricity capacity. Proponents claimed the analysis used by opponents was exaggerated, citing a different analysis commissioned by the Natural Resource Defense Council showing that PVGS could remain open with substantially higher rates of renewables on the grid40.

As I read these competing claims and as family members asked me, the resident sustainability person in my family, about the policy, I was vexed about how to make sense of the claims: “What were voters supposed to think of these widely contradictory claims?” While claims about the impact of Prop 127 were rooted in predictions about the future, those claims made little note of the challenges of forecasting the future of complex socio-technical systems41. In my eyes, the uncertainty inherent in claims about costs, jobs, and environmental outcomes created a gaping hole in political conversations about the topic. Political tribalism and narratives about the funders of the for and against campaigns took hold in this gap42. Proponents pointed to monopolistic utilities’, in particular Arizona Public Service or APS, desires to protect their bottom lines regardless of the potential environmental benefits of the proposition. The funder of the proposition’s ‘for’ campaign, a wealthy political donor, drew the ire of Prop 127’s


41 Of course, this is not limited this issue, but it’s one that I was able to contribute to because of my own expertise and perspective.

42 These discussions of political funding were important ones as more money was spent on this proposition than any other state-wide election in Arizona’s history: https://www.azcentral.com/story/news/politics/elections/2018/10/16/arizona-clean-energy-ballot-measure-proposition-127-most-expensive-state-history/1660198002/

Nonetheless, finger pointing about whose money was behind each campaign did nothing to address what I was concerned about: A political discussion failing to acknowledge that claims about the future impact of something like Prop 127 are fraught with uncertainty and that we should accordingly acknowledge uncertainty and value differences.
opponents, who framed him as a California billionaire trying to prop up a market for his investments in the solar industry.

Distinctive lines amongst liberal and conservative partisans emerged following these talking points. How did supporters justify their correct view about utility bill costs? The utilities were simply lying about the potential impact of the proposition. How were opponents justifying their claims? Tom Steyer is just trying to spread California-style environmental policy. While discussions of political funding are worthy of robust political discussions (and maybe pTA), I saw these talking points as distractions, side conversations that limited broader discussion about important environmental and economic challenges facing the state in climate change and the energy sector. That a thoughtful accounting of the impacts of Prop 127 might show that costs to consumers could rise or could fall seemed an impossibility but something that, to me, might improve political discourse.

I came to a personal conclusion: Arizona voters had little access to assessments of Prop 127 acknowledging that the impacts of Prop 127 really are challenging to predict (i.e., that they were uncertain). Technological change, global markets, and even population growth in Arizona made any assertions about the impact of Prop 127 on costs or existing generation inherently uncertain and imbued with value considerations. Pluralistic mechanisms for politics, such as pTA, help capture uncertainty and foster discussions of competing and shared values. I thought that pTA might help find shared priorities that could inform voters’ decisions about Prop 127 and other policies on energy, the economy, and the environment. Further, I was concerned that political discourse in general was losing appreciation for the difficulty of predicting technological futures and thus pTA was worthwhile to pursue.43

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43 I was also concerned about the long-term politics of energy and climate in Arizona. The combination of us-versus-them’ accusations about who was funding the ‘for’ and ‘against’ campaigns with the sincere
This perspective in mind, I set out to conduct pTA-style forums, and create appropriate materials to support forums, about the proposition. In doing so, I hoped that the materials and forums would build awareness and appreciation for uncertainty and unpredictability associated with complex socio-technical systems, as well as bring to light important considerations about Prop 127 (i.e., what it does and does not do). I thought of this acknowledgement-of-uncertainty-through-forums as a mechanism to improve political and policy discourse, which might in turn create space for shared policy priorities on issues related to energy and climate.

In a July 2018 summary of the idea I shared with colleagues, I pointed to the educational focus of the materials under the heading Helping voters consider complexity: “Energy systems impact everyone in the state of Arizona either directly or indirectly. A non-partisan issue guide informs citizens about complex issues facing them.” I then pointed out that pTA-style deliberations go beyond such a guide: “Deliberative engagement goes one step farther, allowing participants to combine relevant facts and expert positions with their own values. Broad input from diverse groups helps ensure that a wide variety of viewpoints are considered on uncertain topics.”

By early August, I refined the direct educational goals of the guide: “Energy systems impact everyone in Arizona either directly or indirectly. A non-partisan issue guide relies on expert assessment to outline key issues, considerations, and arguments about energy systems and the Clean Energy Initiative.” Elsewhere in that document, I stated, “We plan

challenges of decarbonizing our electricity grid (or economy in general) makes the political stakes for energy and climate policies incredibly high. Even minor setbacks in integrating renewables into the grid could corrode support for more ambitious efforts. I personally was concerned that Prop 127’s very permanence (it was a constitutional amendment) could prevent experimentation with other policies to address climate and energy, a worry made worse by discourse about the policy. I say this to qualify my own perspective on the issue at the time I set forth in creating forum materials.
to produce an accessible and non-partisan issue guide on the challenges facing Arizona’s energy systems to help voters better understand the initiative before voting in November.” These changes aside, I still noted that the guide was about helping voters understand the proposition and the complexity of its impacts, while deliberations amongst voters would be about exploring values with the aid of the information provided by the guide. In short, I began to separate the functions of the materials from the forum. The materials would help inform voters about the proposition and complexity, while forums would provide a space for voters to explore the materials, values disagreements, and their own questions about the policy.

3.2.2 Building the guide: Navigating uncertainty and contestation

I created the Prop 127 guide using existing academic and professional literature augmented with interviews with energy policy experts and thoughtful editing from close colleagues. The guide was meant to capture key issues, considerations, and arguments to help voters understand the proposition and its potential (and uncertain) impacts. Capturing those arguments and considerations, however, came with distinct challenges during the interview and review process, challenges that proved tricky to navigate under the banner of informing voters. Below, I describe one challenge I faced navigating expert opinion and the creation of the guide with these educational goals in mind.

After I conducted interviews in August and September 2018, I drafted several versions of the guide. Decisions about how to present information, what figures to produce, and what details to include and exclude taxed my own understanding of the

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44 I describe the format briefly in Chapter 2 and examine the roots of the format in Chapter 5.

45 I eventually created nine major iterations of the guide, and many more minor tweaks within each iteration, over a period of about one month.
issues (e.g., how important is it to include information about where the coal used in Arizona power plants comes from?), much like the decisions about content in the CRF project required constant discussion among the CRF team. After several iterations and feedback from colleagues assisting with the creation of the guide, I sent drafts to four of the interviewees to gather their feedback and thoughts. Three responded with direct comments. Most of their suggestions were clarifying suggestions or links to resources I had not yet seen. Two pieces of the guide, about the affordability of grid-level battery storage and the experience of Germany’s efforts to reduce emissions throughout the 2000’s, garnered more complex attention from reviewers. I describe the back-and-forth editing process regarding the costs of grid-level battery storage technology below.

Almost all of the expert interviewees referenced battery costs and the practicalities of deploying battery storage as a critical part of understanding or predicting the impacts of Prop 127. Some stated that falling prices of batteries and solar were trends likely to continue, making grid-scale renewable storage a viable option in the mid-term future. Others outlined factors such as international trade (e.g., trade disputes with China) and the lack of experience possessed by utilities operating such systems as uncertainties in prices for battery storage systems. Based on these interviews, as well as research from groups such as the Energy Information Administration and private consultants, I wrote the following in one iteration of the guide: “Currently, battery storage is very expensive but is getting cheaper. Some experts think battery storage will be affordable in the next 10 years but not all agree.”

After reviewing this draft, one interviewee thought this statement misleading, noting that some utilities, including those in Arizona, have deployed battery storage at costs

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46 I noted no specific timeframes in my notes.
similar to new natural gas power plants that serve similar grid functions as battery storage systems\textsuperscript{47}. I reviewed the case studies this interviewee provided and changed the guide to read, “Utilities can also use large batteries to store electricity. Utilities are beginning to deploy batteries at costs comparable to other energy sources, like small natural gas plants.” However, I left language about uncertainty in future battery costs in a different section:

\begin{quote}
Some experts point to new battery projects and falling battery costs as evidence that battery storage will be more widely deployed and affordable over the coming decade. Others highlight that utilities could face challenges deploying batteries across the grid due to existing regulations, market rules, and technical concerns.
\end{quote}

In my own reflections about this exchange, I described my frustration with this review process and the challenges of dealing with conflicting sources:

\begin{quote}
[Interviewee] claimed, and he did so in his interview as well, that batteries are already affordable for grid storage. He cited an example [from two utilities] that demonstrates as much. I got a little frustrated. [He and another interviewee] made claims about affordability that I just don’t see elsewhere, save websites w/ names like “green-power news”. [Other interviewees] pointed to uncertainties in battery prices, and [another interviewee] really didn’t comment on them as much, short of
\end{quote}

\begin{footnote}
\textsuperscript{47} Natural gas power plants and battery storage facilities can quickly increase or decrease generation to cope with steep net demand changes, like those associated with solar.
\end{footnote}
saying they’re getting cheaper, and that some experts think they will be [affordable] soon. McKinsey, the global consulting group, point out that they are affordable now but only for certain applications.

So what to do? I can change the ‘degree’ of language I use. But this underscores a broader difficulty… This IS expert disagreement, so what do we change?

-Personal Reflection, October 14, 2018

A nagging sense that there was a right answer about battery prices (or any other number of disagreements that came up in my interviews), and that I was misleading readers by pointing to uncertainties, accompanied the frustrations highlighted above. I worried I was obscuring evidence that parts of the proposition were not so complex after all using the goal of communicating uncertainty. If battery storage pricing was a settled topic, perhaps I really was, in the words of one reviewer, “undermin[ing] one of the best arguments for saying that the 50% renewable energy standard is feasible.” In the same reflection, I wrote:

Did I go too far in on the “highlight uncertainty” framing? I don’t want this to turn into a citation matching [contest] where everyone tries to put their credentials and research out there to ‘settle’ a factual dispute about prices.”

-Personal Reflection, October 14, 2018
I felt as if my own commitment to critiquing predictions and acknowledging the monumental task of transitioning an energy system from fossil fuels to renewables left me (and this project) in a morass, unable to say much definitive about the impacts of Prop 127. Importantly, my struggles with uncertainty emerged from my own effort to promote pluralistic assessment and discourse around an uncertain, contested, and high-stakes topic. I dedicated a good 20-30 hours every week for two months trying to sort through the claims made about costs and Prop 127 only to be frustrated. In my reflections, I did not acknowledge that these frustrating characteristics were exactly why this problem was well beyond the realm of ‘normal science’ (i.e., low uncertainty, low stakes, fairly predictable relationships). Creating a definitive assessment of battery costs would have involved ratcheting down uncertainty and stakes associated with grid-scale battery storage costs (and renewable energy efforts more generally), two bolts likely quite tight already.

In the moment, I largely fell back on my academic training, reminding myself that this was highly contested and uncertain, even if my gut felt otherwise. I knew from other work (e.g., case studies about uncertainty and prediction [Gautier, 2000; Metlay, 2000; Pilkey, 2000]) that expert disagreements arise around complex, contested issues due to a variety of institutional, political, and scientific pressures and the complexity of the world we inhabit. In my mind, predicting the ease and affordability of socio-technical system transitions came with significant challenges: We could not ‘test’ the impacts of policies like Prop 127 in advance without in some way committing to them. Complexity and indeterminacy complicated predictions based on models: What does future population growth look like? What about household energy use? The cost of solar panels and battery storage technologies? Changes to US climate or environmental policy? Changes to international climate agreements? Even simplifying predictions to one portion of the
potential inputs and outputs of Prop 127, such as battery costs, left a difficult task. While I worried about a right answer, the notion of a correct assessment of costs associated with batteries seemed far-fetched given that prices themselves emerge from a complex system of legal contracts, technologies, and expert/utility judgment. Most basically, however, the handful of experts I interviewed didn’t agree on what the future of battery technology might look like, short of that most agreed prices would likely fall sometime in the future but that other factors might come into play. Reports and example battery projects from industry showed that batteries were affordable, but sometimes this was qualified with in limited applications.

All of this in mind, engaging with these topics was difficult. I largely relied on heuristics (and related knowledge) about post-normal science and uncertainty. Even with that training, I fell into a 'normal science' way of thinking about community uncertainty: More research would provide a more certain answer. This isn't to say it was a bad thing that I spent so much time fretting over language about battery costs in the guide, which was very important to honing the content and language in the guide. My fretting provides an important window into the practice of pTA and the practice of assessing post-normal science issues. In pursuing the goal of communicating uncertainty and complexity around Prop 127, I (surprise surprise!) encountered uncertainty, complexity, and expert disagreement and struggled to navigate those in service of my goals for the guide. An analytical-normative commitment to post-normal science and attendant perspectives on complexity, uncertainty, and pluralism might be critical to the practice of pTA. Training and familiarity with these concepts thus might be critical to future practitioners of pTA.

3.2.4 Participant learning: Prop 127 guide
My struggles managing uncertainty for the guide aside, I still placed uncertainty as an educational goal in this project. To that end, I collected surveys from members of the public who saw either the guide I created for forums (the Forum Guide) or a summary of for and against statements submitted to the Arizona Secretary of State’s office and included in the state’s election notice mailed to all registered voters (the AZ Secretary of State Guide) as well as the in person forum participants48. The AZ Secretary of State Guide served as a proxy for ‘existing discourse’ around Prop 127. The for and against statements in the AZ Secretary of State Guide roughly restated what supporters and opponents argued on television ads, yard signs, and radio spots. If the forum guide was helping voters understand uncertainty and complexity, then I expected to see higher ‘agree’ responses to questions about unintended consequences and the helpfulness of the guide for assessing arguments for and against Prop 127. Based on results presented in figure 2.2, the forum guide did not help voters consider uncertainty, though participation in forums might have had an impact.50.

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48 Respondent demographics, survey instruments, and the materials respondents received, is available in the appendix. Online participants were recruited through Amazon’s Mechanical Turk service. They received a small stipend ($3.75) for their participation. Forums were held in Sierra Vista and Glendale, Arizona the week before Arizona’s general election. Forum participants were recruited via Facebook posts, emails to community organizations, emails to participants from past projects, and through advertisements on Craigslist. Forum participants received a $15 Amazon gift card at the conclusion of the 2-hour forum. The survey instruments themselves were developed from prior project surveys with input from another graduate student, Sarah Hall, who agreed to review the instrument.

49 For and against statements could be submitted to the Secretary of State by members of the public but most came from people associated with the for and against campaigns.

50 There are lots of ways one could explain away this negative result. For example, respondents might simply report that any information about the topic as helpful. Further, unintended consequences and assessing arguments about Prop 127 are only proxies for thinking about uncertainty. Likewise, there are ways to explain away the result that in-person forum participants reported much higher satisfaction with the guide, most notably that they were interested enough in the topic to show up to a forum on a weekday evening for a paltry $15 gift card.
Survey results showed few differences between participants who saw the guide based on the Arizona Secretary of State’s collection of for and against statements and participants who saw the Prop 127 Forum guide but who did not participate in a forum. In other words, participants reported that both guides were equally helpful to both understanding unintended consequences and assessing arguments made for and against Prop 127\textsuperscript{51}. In-person forum participants responded more positively to these two guides.

\textsuperscript{51} I did not have the aid of the Museum of Science’s Research and Evaluation Department like I did in the CRF project. Nor did I have much time to put together these surveys given the relatively short duration of the project. I’d make several changes. First, I’d follow a retrospective pre/post question format to address the tendency of participants to overestimate their knowledge before participation (Rennie and Johnson, 2007) Second, I’d adjust the language used in the survey questions about unintended consequences. Unintended
questions, perhaps because they engaged in 2-hour long conversations about the guide with peers, rather than just reading it. The act of engaging in conversation perhaps helped uncover competing values and ideas about the future more than simply reading the guide (either of them). In other words, face-to-face conversations might matter more than materials in appreciating unintended consequences. Alternatively, materials that convey uncertainty might be a precursor to rich discussion of the values disputes and uncertainty central to the issue. Alternatively, people who willingly participated in a forum might simply be more open to consider the forum materials helpful than those who did not.

Part of my motivation for creating the materials at all was the hope that a guide would help people understand uncertainty, and that this in turn would lead to more pluralistic dialogue and improved public discourse about the issue. Through several opinion pieces submitted to Arizona newspapers, a colleague who helped most with the effort, Michelle Govani, and I laid this goal out quite clearly:

“The guide is not meant to settle whether or not utility bills will increase or decrease, but to show what we know and don’t know about the complex and sometimes unpredictable relationships between policy and technical systems like our power grid. We did our best to strip away partisanship to provide information and balanced perspectives that help voters explore uncertainties and identify their values and preferences as they prepare to vote on Prop 127.”

consequences are only part of communicating uncertainty and complexity.
The survey results reported above challenged this narrative. At the time, I did not really have a mechanism in mind to explain why communicating uncertainty through an issue guide or pTA forums would help discourse or help voters. In hindsight, the first thing that comes to mind is the information deficit model or what Kahan et al. (2012) called the scientific comprehension thesis (SCT), which predicts that people will agree with scientists if they know more about an issue or about science in general (Kahan, 2008; Kahan et al., 2012). But Kahan et al. found the SCT was essentially bogus. People who know more about science aren’t any more likely to agree with scientists about what to do about that issue, or whether the issue was an issue at all. Worldview and group identity are a better predictor of their opinions than knowledge about scientific topics in general or their knowledge about particular issues. Substitute ‘uncertainty’ for ‘science’ in these conclusions and you wind up right where I was in fall 2018. I assumed that communicating uncertainty about Prop 127 through a well-researched guide would lead to 1) people learning about uncertainty and 2) more respect for uncertainty and pluralistic discourse. Survey data did not show that people learned about uncertainty.

Just as I caught myself applying 'normal science' thinking to predictions of grid-level battery storage technologies, here I caught myself relying on deficit model thinking about uncertainty. I knew well (at the time and now) that evidence like that from Kahan et al. showed that the deficit model was bunk. Indeed, I and other pTA practitioners associated with the CRF project talked about pTA as a response to the failure of the deficit model. Frankly, I don’t know why I thought building uncertainty into an issue guide might help people learn about uncertainty or appreciate the role of uncertainty in claims about Prop 127. Perhaps old habits die hard. That aside, the survey data above

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52 Notably, however, several participants from the in-person forums noted that they wished similar forums could have happened across the state for this very reason.
highlighted an important finding: In-person deliberation appears to matter more than materials themselves. While the sample sizes here were small, making statistical tests inappropriate, these results suggested that face-to-face conversations might be critical to appreciating and navigating uncertainty in politically contested contexts. I return to this topic in a later chapter about promoting deliberation.

3.3 Uncertainty, tradeoffs, and complexity: pTA and participant learning

In both the CRF project and the Prop 127 project, learning goals related to uncertainty, tradeoffs, and complexity factored heavily into the pTA materials given to forum participants. Based on the surveys from the CRF project, pTA can be an effective model for participant learning about concepts related to resilience, including tradeoffs and complexity. Survey results from the Prop 127 project showed a more muddled picture, suggesting that communicating concepts such as uncertainty requires more than materials focused on those topics. For the Prop 127 project, face-to-face discussions, not the materials, promoted self-reported learning about unintended consequences and uncertainty.

The ability of CRF project organizers to engage with policy and expert communities proved critical to shaping learning goals. In the Prop 127 project, however, engagement with experts and policy makers proved difficult to navigate. Expert interviewees contested the uncertainty around particular considerations related to Prop 127, particularly around grid-level battery storage. This difficult process of engagement helped better map important considerations but also showed the importance of viewing problems characterized by high uncertainty, high stakes, and related expert disagreement as post-normal problems rather than falling into a 'normal science' approach.
That these pTA forums focused on educational outcomes at all presents a different challenge. As the section above discusses, lots of learning was designed to happen and did happen through these pTA projects. And pTA requires some of amount of learning to meet the goal of creating informed public opinion. However, that learning was designed to happen and did happen still leaves questions about the role of learning in pTA as discussed chapter 1. Participatory engagements have been criticized for uncritically accepting the framings and perspectives of experts as given inputs, thus reproducing those perspectives (Wynne, 2006). In both the CRF project and the Prop 127 project, substantial reflection on behalf of pTA practitioners helped shape decisions about learning outcomes and how those outcomes related to dominant ideas from the existing policy and expert community. In the CRF project, reflection was guided by a commitment to creating activities that accommodated a diversity of perspectives and worldviews, an agnostic approach to different strategies included in activities, and a focus on high level concepts related to resilience but that were not particularly controversial. In the Prop 127 project, decisions about pTA forum content focused on assessing considerations from experts from the view of post normal science and maintaining a neutral stance on the proposition.

In the context of the learning goals outlined above, does an emphasis on tradeoffs, complexity, cascading impacts, and/or uncertainty constitute reinforcing expert perspectives? Certainly, we reproduced some priorities from experts. We did, after all, ask experts and policy makers to help guide content creation for the four hazard activities in the CRF project and provide input for the Prop 127 project. However, the CRF project team limited that input to providing assessments of different resilience strategies and to providing high level concepts that complicate planning for climate-related hazards. The CRF project team further sought to ensure that a diversity of
strategies and considerations were built into each hazard activity. Tradeoffs and complexity were overarching themes across activities, yet neither constrained the activity or learning goals in a way that might limit a diversity of world views from contributing to discussions (short of a view that held that tradeoffs or complexity were not relevant in planning for impacts of climate change). The materials and activities were not designed to have participants learn about the benefits or costs of any particular resilience strategy; we were strategy ambivalent. Further, we sought to create opportunities for participants to critique the strategies embedded in the activity. Finally, we attempted to open up the process by which resilience planners and policy makers might make decisions about resilience plans. Faced with decisions about what to include and exclude from learning goals, the CRF project team erred towards 1) high level concepts that might encourage participants to share a wide swath of values, 2) a diversity of perspectives and resilience strategies in materials, and 3) presenting the tools, considerations, and priorities important to current resilience planning efforts.

In the Prop 127 project, my experience trying to capture my learning goal (i.e., uncertainty) into a pTA discussion guide relates to other challenges of navigating expert perspectives in pTA projects. The act of creating a very small piece of the Prop 127 effort (three sentences out of the whole document were about battery prices) forced me to draw on my own expert judgment, built through my own experience with pTA and other work to answer the following questions: What types of information were and were not useful to building materials for a pTA exercise? Are prices of battery storage critical to discussions of Prop 127? And was I presenting them in a way that promotes discussion without misinforming people? While working through those questions in 2018, I thought

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53 Of course, we didn’t include every strategy that could conceivably apply to the hazards we chose.
back to the CRF project and the occasions where observers and participants noted that certain parts of the CRF activity were also not neutral. For example, some forum participants got hung up on a rating chart for different resilience strategies in the materials, noting that one strategy had 1 or 2 more points than another. But the ratings were a matter of judgment with scores based on the project teams’ reading of academic and professional literature and reviews by project partners. In a similar vein, the costs of a critical technological system like battery storage attracted scrutiny from experts and participants alike in the Prop 127 forums. The creation of resilience strategy assessments in the CRF project, and my own decisions about how to present costs of battery storage systems in the Prop 127 project, were exercises in expert judgement related to conveying uncertainty, values, complexity, and tradeoffs to diverse audiences. In short, I made political choices about what to include, and how to include it, in the Prop 127 project, just as we made judgments about what to include in the CRF project. These decisions stemmed from past practice creating pTA exercises, but also from a certain ideological and analytical commitment to the complexity of responding to climate-hazards or energy transitions, to understanding these challenges as post-normal science ones, and fostering pluralistic discussions. In hindsight, these commitments are critical to navigating questions about framing. From a practical perspective, they provide a helpful tool to make decisions about pTA projects. From an analytical perspective, they help to justify the pluralistic approach of pTA and force pTA practitioners to be reflective and critical about what is being communicated to participants, how, and to what end.
Chapter 4 - Capacity Building for pTA

4.0 Introduction

Participatory efforts have been linked to their ability to build capacity important for achieving other outcomes, including political capabilities (Fung and Wright, 2003), capacity to challenge existing power structures (Björginsson et al, 2012), and the ability to cope with uncertainty (Hage et al, 2010) or unforeseen events (Barben et al, 2008). However, these capacities largely focus on the capacities of participants or groups of participants. The ability of communities to host participatory efforts (i.e., to make participatory efforts sustainable, ongoing practices) likely enables the participant-oriented capacities mentioned above. Both the CRF and Prop 127 projects included capacity building goals focused on expanding pTA-style forums to more institutions. In short, project organizers wanted to build capacity to host pTA forums in more communities so that pTA can become a more useful and widespread mechanism for peer-to-peer deliberation.

Experience from the case study projects showed that not all practices associated with pTA readily transferred to new institutions. Some practices were stunted by a lack of experience, a lack of adequate support systems, or simply a lack of resources. Further, capacity building goals, like the need to increase the number of institutions capable of hosting pTA, can conflict with other project goals. In the next section, I describe how the CRF project sought to build capacity for future pTA engagements and how struggles with participant recruitment and the creation of robust local resilience activities challenged these goals. I then turn to the Prop 127 project to describe (mostly unwritten) goals to host pTA forums in smaller communities through local host institutions very different from the large science museums in the CRF project.
4.1 Building capacity in science museums to support pTA through the CRF project

A critical goal, and one stated in the original proposal to NOAA, of the CRF project was to build a broader infrastructure to support pTA forums in the future. The logic here was pretty straightforward: Helping science museums host forums for the CRF project builds capacity in the museums, and in ECAST, to support more forums in the future. Both the Sclove (2010) and Worthington et al. (2012) reports highlighted the need for a broad network of institutions capable of hosting forums as part of a national group, ECAST, supporting pTA engagements. Science museums (or informal science education institutions) were singled out as ideal partners given their trusted status in communities and the need for these institutions to reinvent themselves in a new informational age. The CRF proposal reiterated these capacity building goals and the characteristics of science museums that make them good partners for pTA projects.

The capacity of science museums to host forums in the CRF project included many more specific abilities. Science museum hosts needed to handle the logistics of planning the event, conduct recruitment and participant selection, be comfortable with the pluralistic nature of the forums, and work with local officials and stakeholders to customize content through the local portions of each forum. The project partners at MOS and ASU supported partner institutions through a variety of in-person trainings, regular online project meetings focused on various pieces of the forums and associated logistics, and repeatable protocols and templates. Additionally, the project team lent more specific support when appropriate, some of which is described below. Unsurprisingly, science museums were very comfortable with the event-related logistics of hosting forums. Science museum partners had substantial experience hosting one-off events involving
large public audiences. Coordinating planetarium shows, distributing materials and surveys, and handling other logistical tasks were not reported as issues at any site.

**4.1.1 Challenges with participant recruitment**

Recruitment and participant selection proved more of a challenge for some sites. In pilot forums, which were run or heavily supported by project partners at MOS and ASU, recruitment included the use of Facebook advertisements, Craigslist ‘gig’ advertisements, emails sent to science museum patrons, and outreach to community centers. Through these efforts, we sought to reach groups we historically have had trouble reaching (e.g., people without a high school education) through community partners. The Museum of Science and ASU used regional or state census demographic data as a 'baseline' for which to recruit for both pilot forums, though we consciously overrecruited and accepted people from historically marginalized groups based on experience at past forums\(^{54}\). We subsequently recommended that the other host institutions use a similar demographic baseline and approach, though we did not prescribe if sites should use state, city, or regional census data.

Translating this recruitment strategy, a strategy specifically highlighted in our proposal to NOAA, to other forum sites proved challenging. Some sites struggled to recruit robust applicant pools, let alone worry about diversity of the applicants. During the Phoenix forum, ASU and the Arizona Science Center (ASC) strove for around 180-200 applicants so that we could invite about 100 participants\(^{55}\). Yet some of the third-year forum sites struggled to get more than 100 applicants at all. Other sites had large

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\(^{54}\) We’ve observed that people feel more comfortable when they see other people like them at forums so we try to make sure that’s the case.

\(^{55}\) Inviting 100 would get us close to our goal of 70 people at the forum. From past forum experience, we estimate that 30% of confirmed invitees would not show up.
applicant pools but a crowd of predominately wealthy and white participants showed up on the day of their forums. Lackluster turnout and diversity plagued even the Boston pilot forum, which served as a training and example for all seven other hosts\textsuperscript{56}.

The recruitment and involvement of diverse group of participants is a cornerstone of pTA. The pluralistic function of pTA, a function that seeks to uncover areas of agreement and disagreement and provide an epistemologically diverse assessment of the issues at hand, crumbles without a diverse group of participants. Of course, the capacity of science museums to conduct robust recruitment cannot be gauged by just one forum. Conducting a forum once helps identify pathways to improve future efforts. Indeed, a diverse population might look very different in Mobile, Alabama compared with Portland, Oregon, where the types of social organizations that bring people together differ greatly, meaning the resources and support project organizers provided were adapted to each site’s broader social context. Further, lessons from recruitment efforts by each forum host provided valuable feedback to the project team. For one, the $50 stipend for participants may have been too small given the length of the forum. Previous and subsequent ECAST-led forums used stipends of $100 for similar all-day forums on other topics, resulting in greater turnout and comparable if not improved diversity.

Recruitment, then, proved to be a practice associated with pTA that was difficult to transfer and implement at other sites. Recruitment is not formulaic and is not a matter of plugging in an existing protocol and getting results. Recruiting a diverse applicant pool requires familiarity with local outlets and organizations for reaching groups

\textsuperscript{56} Beautiful weather in Boston might have contributed to low turnout. The Boston forum was held on a late spring weekend when sunny skies and warm temperatures (~90 F) returned to New England. Weather may have also been a factor in low turnout at the Mobile, AL forum. Severe thunderstorm warnings and tornado watches were issued for the day of the forum, leaving both forum organizers and participants continually checking local radar during the forum. Some participants left the Mobile forum early out of precaution. While the weather is not part of the practice of pTA, it certainly impacted the outcomes of one-off events associated with the CRF project.
historically excluded from technical decision making, such as communities of color or those with less than a high school education. Partners from MOS and ASU, including myself, tried to help with recruitment efforts in Mobile, AL for example. But without a good sense of the social networks of the local community, all we could do was call organizations identified through NOAA or university partners in Alabama--connections dominated by environmental stewardship groups. The practice of recruitment for pTA-based forums highlights aspects of pTA that are not readily transferable from one context and practitioner group to another. Even with regular webinars, on-site trainings, and other support, recruitment of a diverse participant group proved challenging for some sites.

4.1.2 Building connections to resilience planners to support local resilience activities

Some host sites struggled in building robust connections to local planning and policy making efforts, another nonformulaic practice. Each site was given the option of using a 'generic' local question (e.g., “Who from your community should be at the table to discuss resilience to [insert hazard]?”) or of creating their own local question. While the project team did not require sites to work with local policy makers to create such a question, we did highlight (via webinars) that working with local officials could create a more robust and locally-relevant activity for participants. Some sites successfully collaborated with local resilience planners to create local portions of their forums. In St. Paul, MN, the Science Museum of Minnesota had close contacts with the Chief Resilience Officer for St. Paul, who helped support recruitment and the planning of the local forum activity. The project team also provided support to help sites build connections to local resilience planners. In Portland, OR, we helped connect the Oregon Museum of Science
and Industry (OMSI) with sustainability planners in the City of Portland. Those officials presented during the forum and provided feedback on the ‘local’ question at the Portland Forum through a series of meetings and phone calls before the forum.

All of the sites invited local experts or resilience planners to speak at the forums, generally during lunch. This more passive involvement did not always translate to robust local resilience activities or the connection of the forums to resilience planning efforts. Some officials I interviewed who observed the forums noted that the local activities could benefit from improvements. For example, one outreach specialist for a federal agency stated, "I also think that maybe a little bit more guidance on thinking about, and possibly getting them to hook up with experts as they’re thinking about, the local scenario that they developed would have been better." Beyond difficulty engaging with policy makers, more straightforward personnel or resource limitations may have hindered the creation of local resilience questions alongside policy makers. The logistics of hosting a forum take considerable amounts of time. The CRF project provided funding to each host museum to support the forums but staff time allotted to the project can quickly be swept up in just putting on the forum.

4.1.3 Capacity building through the CRF project

The ‘capacity building’ portion of the CRF project demonstrates the difficulty of distributing pTA practice. A team consisting of two institutions well versed in pTA, participant recruitment, and working with local policy makers strove to empower other sites to do the same, with varying degrees of success. While some sites had considerable experience working with MOS or ASU (e.g., the Science Museum of Minnesota), others

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57 See chapter 6 for further discussion of the connection between local resilience activities at the forums and policy outcomes.
were new to such collaborations (e.g., the Exploreum in Mobile, AL). The struggles by several sites to create robust partnerships with local officials and to reach recruitment goals underlie a rather simple premise: Conducting pTA is about more than making materials and putting them in front of participants. Relationships with local community groups, policy makers and officials, and knowledge of broader recruitment strategies extends beyond things captured in power points and webinars. However, it should be noted that this experience, for some host sites, might have nonetheless increased the ability of host sites to support future forums, despite shortfalls in this particular project.

4.2 Prop 127 and diversifying pTA hosts

Capacity related goals for the Prop127 project centered around exploring how pTA could be used in smaller communities across the state\(^{58}\). What other community partners could support pTA-style engagements that would allow for broader geographic reach? I was particularly interested in how community centers or libraries could host pTA forums. My motivation for this goal extended from reflections about pTA between myself and other practitioners. All of the supported pTA projects in Arizona have been held in Phoenix, usually at ASU or the Arizona Science Center. One recent pTA project not covered in this dissertation held a large pTA forum at ASU’s West Campus in Glendale, AZ, which aided in recruiting a diverse participant pool for that project. Nonetheless, the reach of pTA forums in Arizona has so far been limited to the Phoenix area, revealing a hole in pTA’s ability to reach diverse audiences in more rural communities. Further, even communities within the central Arizona region with limited access to transportation may not be reached by forums.

\(^{58}\) This was a relatively minor goal of the project but did influence my thinking about where to host the Prop 127 forums.
As such, I saw the Prop 127 project as an opportunity to reach other potential forums hosts in other communities across Arizona. I worked through my professional networks to identify potential host locations in the Phoenix Region and in Sierra Vista, AZ, a smaller community in the southeast corner of the state. I chose Sierra Vista for very personal reasons: I grew up and had good knowledge of potential hosts as well as community groups and members who could help with recruitment. Libraries and community centers were good options given their presence in a diversity of communities in Phoenix and in Sierra Vista. My thinking here was that conducting a pTA forum at one of these hosts would 1) expose willing partners at these host sites to pTA forums; 2) garner interest in forums; and 3) lay the groundwork for relationships between ASU and smaller local hosts for future projects.

4.2.1 Challenges in reaching other communities

My goal to work with local libraries or community centers in the Phoenix region or in Sierra Vista soon fell apart. The timeline for the project was very short and I didn't begin reaching out to potential hosts until September 2018, largely because I felt unsure about planning a forum on such short notice. By this time, a few libraries and community centers I reached out to were already booked. Responding to an emerging need for forums required more preparation than I could provide as a pilot project. Some more administrative hurdles complicated efforts as well. For example, one community center asked me for paperwork certifying that I was part of a non-profit entity in order for me to use the community center. I possessed no such paperwork as a student at a public university. After a follow up phone call, I decided to look elsewhere given my short timeline and their apparent lack of interest. Finally, some potential hosts expressed reservations about the topic, citing the contested public discourse about Prop 127. While
no potential host turned down the forum for this reason, the political nature of potential future pTA events could hamper those efforts if adequate trust and experience in forum organizers is not yet present. In Sierra Vista, I worked with a local church to host the forum because I knew several members of the church through my family. In the Phoenix area, I ultimately chose to host the forum at ASU’s West Campus in Glendale based on my familiarity with the venue. Accordingly, building capacity within new forum hosts did not happen in this project because neither host was really a host, just a location for the forums themselves.

Even if I had partnered with another community host for the Prop 127 project, other challenges may have still limited efforts to build capacities to host forums. As in the CRF project, participant recruitment proved challenging in the Prop 127 project. In Sierra Vista, AZ, usual strategies for recruitment, such as advertisements on Craigslist, turned up no responses. In this smaller community, word-of-mouth proved to be a better recruitment tool. Relying on word-of-mouth, however, meant a limited diversity in the applicant pool. Further, the $15 Amazon gift cards provided little motivation for participants, as evidenced by the fact that three of the nine participants at the forum turned them down; participants attended because they were interested in the topic. Frankly, I thought recruiting participants in Sierra Vista would progress well given my own personal connections to the community. Difficulties recruiting in Sierra Vista revealed a need to test other recruitment strategies in smaller communities. In Phoenix, advertisements on Craigslist, emails to past forum applicants, and advertisements sent

59 A university campus, however, presents distinct challenges for hosting these type of public events. Parking is often limited or not free. University campuses are also not known for being easy to navigate.

60 I’m indebted to my grandmother for this effective word-of-mouth advertising. She handed a few flyers out to her friends, who in turn told their friends to submit applications. Five of the nine participants at the Sierra Vista Forum heard about the forum through her.
through email lists to community members returned a reasonably diverse pool of 45 applicants. I invited all applicants, knowing about 1/3 would not show up (per experience from past forums). Only 17 attended the forum, representing a much higher drop-off than usual. While I cannot know for sure, the timing of the forum likely limited turnout. The forum was held on a weekday evening, which may have dissuaded some who confirmed from attending. Planning forums for weekends, even shorter forums such as the Prop 127 forums, may have resulted in better turnout.

4.3 Capacity building and the practice of pTA

Participatory Technology Assessment efforts are large and complex undertakings that require a diversity of experiences and capacities. The CRF and Prop 127 projects sought, to various degrees, to build the capacity of other institutions to host pTA-style forums. Yet scaling pTA efforts proved challenging. In both projects, the difficulties of recruiting a diverse participant group challenged forum hosts. In the CRF project, a combination of limited resources and time, demanding logistics for the forums in general, and potentially a lack of experience working with local policy makers limited some of the local resilience activities and recruitment success. Efforts to connect pTA forums to smaller institutions, such as libraries and community centers, through the Prop 127 effort fell flat due to a tight project schedule and a lack of working partnerships with such institutions.

These observations point to the need for pTA practitioners to consider capacity-building goals more systematically. Learning through doing, the approach taken by the CRF project, led to successful forums at all host sites. But if pTA practitioners are serious about expanding capacity to host forums, we need to consider the diversity of constraints, strengths, and strategies that enable hosts to be successful. Additionally,
resources and support for a diversity of capacities (e.g., outreach to policy makers) should be built into future projects. Fortunately, CRF project partners at the Museum of Science are already seeking to build a larger network of science museums to host future climate resilience forums and citizen science efforts as part of a NOAA-funded follow up to the CRF project. That effort provides another opportunity to test strategies for building forum capacity across more institutions.

Not discussed in this chapter—but discussed in chapters 3, 5, and 6—is the variety of ways that capacity building goals influenced various decisions about other goals. The need to scale forum activities across eight different sites proved important to decisions about the structure of those activities. Those decisions had important implications for policy relevance, participant deliberation, and educational goals. The impact of capacity building goals on other parts of the project, as well as the struggles in transferring practices related to pTA to new institutions, highlighted the difficulty that comes with scaling a practice in flux (i.e., a practice that changes to adapt to new topics and goals) and scaling a practice with diverse goals.

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61 As other chapters have noted, however, various pTA goals can force pTA practitioners to make tradeoffs about what goals to pursue and how.
Chapter 5 - Promoting Deliberation

5.1 Introduction

This chapter describes how the pursuit of deliberation influenced various decisions about the Community Resilience Forums (CRF) and Prop 127 projects. Participatory Technology Assessment (pTA) forums rely on face-to-face conversations among public audiences. Materials, including written materials, table top exercises, videos, and other graphics, are generally oriented towards promoting discussion at forums while communicating key considerations about the topic at hand. Deliberative democracy theorists posit many features of ‘good’ deliberation and link deliberation to a host of beneficial outcomes for social decision making and normative goods (see for example, Benhabib, 1996; Fishkin and Laslett, 2003; and Fung and Wright, 2003). But as Lövbrand et al. (2011) point out, deliberative ideals can be problematic in their emphasis on rational discourse and gaps exists between empirical work and theory on deliberation (Thompson, 2008). I start this chapter by describing the features of pTA that relate to deliberation. I do so to set the stage for examining how these features, and changes to these features, were used, debated, and implemented in both projects. I also discuss what those dynamics can tell us about how participatory projects take shape.

5.2 Deliberative features of pTA

Several features of pTA directly relate to deliberation or are themselves mechanisms to promote deliberation, making deliberation an important ideal in the practice of pTA. Participatory technology assessment forums consist of small group discussions about

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62 The features discussed in this section are based on my experience with pTA forums in general, including the CRF project, Prop 127 project, pTA Forums conducted for NASA, and forums on Solar Geoengineering Research. See https://ecastnetwork.org/ for more on these projects.
technical topics. This discussion-focused (or conversation-focused) structure undergirds a key characteristic of pTA as outlined by Sclove (2010) and Worthington et al. (2012): Participatory Technology Assessment brings different opinions to bear on a topic to 1) inform participants, 2) bring diverse worldviews to assessments of science and technology, and 3) promote a search for shared areas of agreement.

Given this importance, many more specific features of pTA forums provide infrastructure to support participant discussions. Many pTA forums included trained facilitators who help guide participants through activities, ensuring that everyone had a chance to voice their opinion in a respectful manner, and called for help when participants had technical or content-related questions. Subject matter experts helped answer questions that prevented discussions from moving forward. Those experts were made available through forum hosts (rather than directly) to prevent experts from steering table conversations. Features of participant recruitment also contributed to the deliberative quality of pTA forums. Generally, pTA organizers used small stipends to attract demographic groups whose voices are often excluded from decision and policy making, including people from lower socio-economic categories, those with little education, or of historically marginalized ethnic or racial groups. Participants were selected by pTA organizers to create a diverse participant group, with attention given to over-representing some groups so that people feel welcome to share their opinions. Forum organizers also attempted to assign participants into diverse groups once they arrived at forums to ensure that participants shared a diversity of worldviews and opinions at each table.

The structure of pTA forum activities also contributes to deliberation at tables. Generally, pTA activities include materials that promote shared exploration of a topic to get participants up-to-speed on that topic. For example, participants might read aloud
cards with helpful information for the topic at hand or watch a brief video. Then facilitators ask participants to share their opinions on the topic, often through open-ended questions relating to a normative aspect of the topic. After each participant has shared their opinions, the group discusses the various opinions brought up, asking follow-up questions of each other or further sharing their perspective on the question. The gathering of responses from participants generally supports deliberation as well. Participants record their responses to specific questions or tasks (e.g., creating a plan for investing in research) both as a small group and individually. While not explicitly oriented-towards consensus, participants are encouraged to respond in a way that their table or group feels acceptable, though time constraints associated with any given activity mean that groups can turn to a majority vote or other mechanisms to choose a group response. Individual responses allow participants to dissent, support, or otherwise nuance their opinion in relation to group responses. For both group and individual responses, participants are encouraged to explain why they chose their response.

The topics of pTA forums must be somewhat amenable to discussion and deliberation. Participatory technology assessment addresses questions that science can inform but cannot answer due to normative considerations embedded in those questions. For example: *Should scientists release genetically modified mosquitoes that prevent the spread of malaria?* While science can elaborate on the technical feasibility of doing so, provide estimates of consequences, and describe how such a technology might work, this is fundamentally a policy question encompassing concerns about public health and the environment: Who should release them or who should be responsible for releasing them? When will they be released and where? And who will be affected, positively or negatively, by these decisions? By focusing on questions that science or technical assessment can inform but not answer, pTA encourages normative
disagreements. An in-person format, however, pulls those agreements and disagreements out of the pages of surveys and into discussion where participants can consider evidence from scientific or technical assessment and the opinions and perspectives of others.

Put simply, pTA and its basic features are tied up in promoting deliberation amongst groups of diverse participants. Thus, the experiences of organizers practicing pTA are tied up in considerations about deliberation. Notably, however, very little of Sclove’s 2010 report on pTA discusses what ideal deliberation looks like in pTA. Sclove leaves this question somewhat open, with deliberation playing a mechanistic role in reaching pTA goals (e.g., capturing informed public opinion from a diverse group of participants to support policy and decision making)\textsuperscript{63}. In both the CRF and Prop 127 projects, practitioners (including myself) likewise had no explicit goals for what deliberation ought to look like short of asking participants to engage in respectful dialogue. Yet concerns about deliberation factored into many decisions made about both projects. The rest of this chapter focuses on specific ways that the pursuit of good deliberation worked through the CRF and Prop 127 projects. First, I describe two components of the CRF project that shaped, and were shaped by, the project team’s concern for deliberation at forums. I then note how unexpected events shaped what participants experienced in the CRF forums and some assessments of deliberation quality with the CRF forums. I then turn to the Prop 127 project to describe how lessons from the CRF project and from other

\textsuperscript{63} ECAST began to explain important qualities of deliberation for pTA in a final report on the pTA forums conducted for NASA:

"The quality of table discussions was high in many fundamental regards: most participants contributed their thoughts to the discussions; participants considered the issues raised in the background information and videos; there were few uncorrected errors or misconceptions in the deliberations; and the justifications participants provided for their votes on various issues were consistent with those addressed in discussions." - (ECAST, 2015, p. 8)
practitioners of deliberative engagement influenced that project. I also describe various data about participants' opinions as measures of deliberation. Finally, I discuss the definition of deliberation that emerged in these two pTA projects and important considerations for future pTA practice.

5.3 Decisions about deliberation in the CRF project

The CRF project relied on many of the features of pTA described above. Forum hosts sought to recruit diverse groups of participants. At some forums, experts from NOAA, other agencies, or universities were available online or in-person to answer participant questions. The materials for each hazard activity included a group response and individual responses. Trained facilitators helped guide participants through the activity and ensured that all participants could voice their participants.

Beyond this features, however, the CRF activities incorporated two specific features important to deliberation: The voting activity included an explicit resource constraint that structured how participants could respond (both as a group and individually) and participants viewed visualizations of both the impacts of a given hazard and the potential outcomes of different resilience strategies before writing their final group and individual responses. These two features were not implemented and designed solely as mechanisms to foster good deliberation; other considerations factored into decisions about both. But concerns about deliberation, including how participants would interact with each feature and how those interactions might influence discussions amongst participants, played an important role in how these features were designed and implemented. Further, both features created certain kinds of discussions that the CRF project team viewed as desirable or undesirable. The next two sections describe these features, their emergence in the project, and their impact on discussions amongst participants.
5.3.1 Resource constraint

In each hazard activity, participants could choose from three broad strategies for responding to the hazard at hand (see appendix for full list of materials). For the sea level rise activity, for example, the activity included *Keep Water Out, Live with Water*, and *Managed Retreat*. After reading about the general characteristics of these strategies, participants then read two specific plans for each strategy: *Plan A* and *Plan B*. However, Plan A cost two coins and Plan B cost one coin. Participants, both in their individual and group responses, could only use three coins in total, and couldn’t allot all three coins towards one strategy (e.g., they couldn’t choose both Plan A and Plan B for *Keep Water Out*). Participants did not have to spend all three coins. This created 17 unique combinations of plans (including saving all the coins). Notably, a resource constraint is *not* a defining characteristic of past pTA exercises. While prior pTA exercises may have used cost as a topic of discussion (or participants may have brought it up in discussion), none of the pTA projects associated with ECAST utilized a resource constraint in a forum activity. Below, I describe how this resource constraint took shape within the CRF project.

The format for the CRF hazard activities stemmed from a similar activity that the Museum of Science had created on sea level rise (SLR) in Boston in late 2015. This activity included a case study about the impact of SLR in Boston (e.g., impacts on an historic church), perspective cards showing impacted stakeholders, various strategies for dealing with those impacts, and a table top board encompassing these various pieces. These features largely persisted in the activities developed for the CRF project, though in

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64 The Museum of Science conducted a small forum using this sea level rise activity in February 2016 to inform the CRF project.
project notes from April 2016, the project team noted that the CRF activities need not be wedded to the format of this activity and that we should use the workshops with policy makers and experts to explore alternative ideas.

In updating that format, we made many decisions, some explicitly, some implicitly, about how to achieve the various goals set forth for the project. The CRF project team added the resource constraint to each of the hazard activities before the pilot forums and testing in Boston and Phoenix. The project team tied the addition of a resource constraint to tradeoffs, a desire to promote discussion about the different priorities within each suite of resilience strategies, and to make the activity more realistic as if participants were truly handed the reins of a city while planning for a specific hazard. These emphases largely emerged from discussions amongst our project team and from feedback from policy and decision makers.

For example, attendees at the workshop in Phoenix noted that many of strategies for building resilience to extreme heat overlapped with each other (e.g., planting trees and building shade structures), and that participants might struggle to make a plan from the numerous strategies available (note: The strategies provided to attendees at the expert and policy maker workshops were not all included in the forum activities, and those that were included were lumped into broad categories). From this discussion, one notetaker at the workshop noted that providing a budget or asking participants to make a timeline of strategies might be advantageous (as compared to making a resilience plan from numerous strategies). Concerns about tradeoffs and the desire to create activities that emulate the challenges that policy makers face in planning for resilience also emerged from the workshops with policy makers and experts in both Boston and Phoenix (see chapter 3 on educational goals and chapter 6 on policy relevance for further discussion of how this focus emerged). A resource constraint quite plainly forces participants to make
tradeoffs amongst the different priorities in each strategy. And cities, of course, do not have unlimited budgets for resilience planning; adding a resource constraint thus ties the activities to the real limitations that resilience planners face.

As mentioned above, pTA forums revolve around participant discussions. Yet from experience, the CRF team knew well that some participants or groups of participants might find discussion challenging to start (anyone who has taught middle, high school, or college classes might be sympathetic to this view). In part, the resource constraint encouraged discussion by providing a rather discrete choice to participants. Rather than a more nebulous task creating a resilience plan from a large set of options, the resource constraint immediately provided a point where disagreement and agreements could arise in ways that were easy to talk about ("I think we should spend two coins on "Plan A, Keep the Water Out"). Importantly, tying the resource constraint (and related factors like an emphasis on tradeoffs) to good deliberation was very much an exercise in judgement by the CRF project team. The sea level rise forum that preceded the CRF forums provided a prototype of the engagement without the resource constraint, but we collected no systematic data about how participants reacted to a similar activity with and without a resource constraint. Quite simply, the project team could not test these various formats given time and constraints and the sheer number of other decisions that had to go into making the pTA engagement activity. Rather than relying on testing for each individual feature of the forums, the CRF team relied on the Museum of Science's experience creating engaging materials to make decisions about what features to include in the activity. The resource constraint emerged from that experience, and from input of policy makers and experts and the CRF project team's experience working at the interface of research and policy.
Unexpectedly, some participants reacted to the bean-counting resource constraint by engaging in bean-counting elsewhere in the activity to determine the strategy with the most benefits for three coins. For each hazard, the table top boards and participant workbooks included a table summarizing the environmental, economic, and social implications of each major strategy. To simplify these tables, we added what we referred to as Consumer Reports-style ratings to each category and strategy. For example, the *Soak it Up* strategy in the extreme precipitation activity received a social rating of three and a half stars (see figure 5.1)

**Figure 5.1 Social ‘rating’ for the Soak it Up strategy in the extreme precipitation activity**

![Soak it Up Strategy Description](image)

Parks, green roofs, and rain gardens create opportunities for recreational space. This strategy also avoids the disruptive construction that comes with installing larger storm pipes. Some of the potential hazards from increased vegetation include infectious pathogens carried via rodents, ticks and mosquitoes, as well as increased pollen allergens.

Some tables of participants noted that the number of stars differed across strategies if one totaled them up across the social, environmental, and economic considerations. Picking the strategy with the most stars as the investment worthy of two coins in the activity thus turned into the economically rational outcome for some participants. This was not a widespread phenomenon but did occur in forums for the CRF project, particularly in the pilot forums, and in subsequent use of these activities with other
audiences. Both the consumer reports-style tables and the resource constraints were meant to serve as mechanisms to promote dialogue, at least in part. But the roles of these features in structuring discussion paradoxically limited discussion for a few participants who, in their minds, simply did the math to find the best strategy.

Both the resource constraint and the consumer reports-style tables embodied a great deal of simplification-by-judgement on the part of the CRF project team. The star ratings were rough estimations of impacts based on scholarly and professional literature and case studies about various resilience strategies. Oddly, one core ideal of pTA is breaking down the assumptions embedded in commitments to one scientific or technological pathway or another. Yet by providing tools to inform, participants learned about the implications of different resilience strategies (i.e., the consumer reports-style table) and by seeking to promote dialogue and tradeoffs through the resource constraint, the forum activities unintentionally recreated the very dynamics pTA ostensibly helps combat in technical decision making: An overemphasis on quantitative analysis that obscures where expert judgement is present and the embedded values associated with that judgment.

An additional implication of the resource constraint on participant discussions extends from the very structured response options that the resource constraint (in combination with other factors) necessitated. To provide a workable forum activity and to ensure we could provide unique visuals for responses (see below), participants could only use their three coins to choose from the 17 different combinations of Plan A and Plan B. In short, we implemented rules about how participants could use the resources. However, in the pilot forums in Boston and Phoenix, we never made it clear to

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65 Some of the detailed Plan A and Plan B options for each strategy included specifics about costs for various pieces of the plans, which participants in some cases also tallied up to find the plan with the most bang-for-the-buck.
participants that people could reject those rules. Facilitators were trained to tell the participants the spending rules. We did so because changing those rules would mean participants could not see a visualization of their chosen plan and its impacts: If participants choose to spend four coins or come up with new resilience strategies beyond those in the activity, participants could not fully complete the rest of the activity. One table at the Phoenix pilot forum did reject the strategies we gave them and choose to write their own strategy that only included some portions of what was included in Plan A Cool the City for the extreme heat exercise. Upon hearing this during a group share out, participants at other tables laughed but also commented that they didn’t know they could do that, and that they might have chosen to bend the rules as well if they had known it was an option.

This example highlights another feature of many public engagement activities: Many activities carry with them expectations for how the activity must proceed, much like in a classroom setting. The structure of the activity itself, in this case, set up expectations and bounded participant responses to those in the activity. Trained facilitators reinforced those expectations by serving as a referee of sorts (some more rule-oriented than others) who relied on a structured facilitator guide. After the Phoenix forum, several members of the project team remarked positively about the group of participants who challenged the rules. We never changed the materials to make dissenting from the rules an explicit option. In subsequent forums that I attended, I reminded both forum organizers and participants that they could change the rules if they felt strongly enough about it.

Prior experience, assumptions about how participants might react to various formats, and a push for visualization-based feedback to each table’s resilience plan created an activity structure that was designed to get participants to confront tradeoffs (and embedded values) but that also potentially limited conversation at some tables. The
CRF project team sought to foster dialogue amongst groups of participants with diverse world views, yet the in-forum dynamics of complex activities led to unintended dynamics. Some of these dynamics were positive (i.e., participants breaking the rules at the Phoenix forum) while others embodied problematic (and, frankly, not very robust) quantifications of costs and benefits associated with resilience strategies. An explicit resource constraint might have been a new feature in pTA activities, but in being new, it brought challenges for fostering robust discussion.

5.3.2 Anonymized case study cities

The visualizations of each hazard and different resilience strategies contributed to project goals about deliberation in intended and unintended ways. Visualizations of climate-related hazards and their impacts were a key component of this pTA project, both in the activities themselves and in the time dedicated by the project team. The original proposal outlined the use of visualizations as part of the forum programming. This included a planetarium show or Science on a Sphere show (NOAA’s climate data visualization system) as part of forum agendas. But the proposal did not explicitly spell out the use of visualizations within the hazard activities themselves.

In workshops with policy makers, subject matter experts, and representatives from NOAA in 2016, visualizations took on a more prominent theme. For one, the CRF project team explicitly asked workshop attendees to brainstorm existing visualization resources (e.g., publicly available data sets, existing visualizations in online platforms, etc.) for the four climate-related hazards, the impacts of those hazards, and the impacts of various resilience strategies discussed at the workshops. Beyond this explicit call for visualization resources, attendees referenced the need for visualizations in tandem with other priorities. Attendees at the Phoenix workshop noted the importance of visuals in
the sea level rise activity that MOS developed as a precursor to the CRF activities, stating, "visuals are [a] game changer in seeing how North Church would or would not be affected." Others discussed the challenges of visualizing specific features related to the activities, such as tradeoffs or ecosystem services. In the Boston workshop, attendees discussed the merits of computer renderings showing depths of inundation associated with extreme precipitation or storm surge made worse by sea level rise. The group also discussed how to visualize the resilience strategies we might provide to forum participants.

In a debrief amongst the CRF project team and representatives from NOAA after the Boston workshop, we discussed the broader role of visualizations at the forums, noting two distinct roles: Visualizations that showed the impacts of climate change and the interconnectedness of human and natural systems and visualizations that focused on the specific hazards and resilience strategies associated with each hazard-specific forum activity. This conversation also included discussions of local versus general forum activities. Specifically, we discussed the merits and drawbacks of presenting generic case studies versus activities grounded in the specific challenges facing the community in which a forum was being hosted.

Ultimately, the forums relied on planetarium shows (or similar power points) about climate change and resilience and more specific visualizations developed for each hazard activity. The planetarium show, created by the Museum of Science, introduced climate change, resilience, and the four climate-related hazards at the beginning of a forum. The

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66 This sea level rise activity focused on Old North Church in Boston, a historic building in a neighborhood at risk of inundation during major storms. We led attendees at the Phoenix workshop through this activity to familiarize them with the types of activities we sought to create for the CRF project.

67 See chapter 6 for further discussion of local versus general qualities of the forum activities as these qualities related to the policy relevance of the CRF project.
hazard activity-specific visualizations went through several iterations. The general format for these visualizations was developed by project partners at the Museum of Science and Northeastern University. These visualizations were developed in Google Earth and included a case study city showing the impact of a given hazard through overlays and clickable icons. When possible, we used data specific to the case study city to create the visualizations (e.g., actual heat-related death data for the city of Louisville, KY or Heatown in the extreme heat activity). After participants chose a particular resilience strategy as part of the activity, they returned to these visualizations to see their implemented plan and its impacts. For the sea level rise, extreme precipitation, and drought activities, the visualizations of each plan included an updated overlay showing the direct impact of the hazard, pieces of the resilience plan as overlays or clickable icons, and hypothetical news stories that showed the impacts of the resilience plan on different stakeholders in the city across different time spans (as shown by the date on the newspaper article; see figure 2.9 for an example news article).

The decision to use generalized case study cities (that is, to use a city different from the city in which the forum was being held as the case study subject) and to anonymize those cities was born out of a concern for generalizability across sites and considerations regarding how participants might react to talking about their own city. Given the national scope of the CRF project—eight cities across the country—and the resources required to create content specific to each host location, the CRF project team opted to use one case study city for each of the hazards to allow us to build a more complex case study embodying priorities sourced from workshops with policy makers and experts. Further, the project team decided that the case study cities should not be any of the communities who were going to host a forum. This decision was based on experiences from others in the climate education and engagement community about participant
reactions to exercises about their own city versus fictional scenarios: When participants worked through activities about their own city, participants tended to focus on their homes or neighborhoods. We thought a focus on specific neighborhoods would limit conversations about city- or region-wide resilience considerations and the tradeoffs, uncertainties, and complexities related to those considerations. Additionally, we worried that conversations about the actual cities hosting forums would be markedly different than those about a hypothetical city in a way that would prevent some strategies from even being considered by participants. Put simply, we were concerned no one at a forum in Boston, for example, would want to talk about managed retreat if the case study city was Boston. We thought using cities different from the forum host cities would allow conversations about strategies that participants may be unwilling to discuss in their own city (e.g., managed retreat from the coast). After deciding to use cities other than those hosting forums as the case study cities, we had to decide if we would anonymize the case study cities or refer to them by their actual names. The project team felt that participants might be less engaged in discussions of a US city other than their own relative to discussions about a fictionalized city (albeit one grounded in the challenges a real community might be facing). We anonymized the case study cities because we did not want participants to reproduce (positive or negative) opinions about a given city that

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68 Specifically, two members of our team heard about these experiences from other practitioners at a 2014 Climate Change Education Symposium held at the Museum of Science and a 2016 Local Solutions Conference on climate preparedness held by the Antioch University Center for Climate Preparedness and Community Resilience.

69 We anecdotally noted this dynamic at our forums. At the Mobile, AL forum, many participants suggested or even preferred plans that emphasized moving away from coastal areas as a strategy to adapt to rising sea levels in the sea level rise activity about Kingstown. Groups of participants rarely brought up managed retreat when asked what Mobile or other Gulf Coast communities—their communities—should do in response to sea level rise.
might impact their participation. Additionally, we thought participants would find a hypothetical city more engaging than a U.S. city that may or may not be familiar to them.

These decisions, though partially related to the scope of the project, defined the types of discussions we wanted to promote through the forum activities. Specifically, we wanted participants to discuss the more general considerations of resilience strategies, as opposed to specifics about where in their city specific strategies might be implemented. While not entirely clear from project notes, this emphasis on general considerations of resilience strategies stemmed from two ideas. First, we wanted participants to learn about those general considerations. Second, we thought a city-wide emphasis would be more interesting to policy makers. As discussed further in Chapter 6, we wanted to share the values and concerns of public audiences at the forums with local policy makers so that those values and concerns might influence resilience planning and policy making. These ideas in mind, we sought to blend participant values with considerations (e.g., tradeoffs, equity issues, etc.) embedded in the visualizations and case studies themselves.

Through all of these decisions, we implicitly defined a type of discussion we wanted to promote through materials and the visualizations—one in which participants could share broad values about the hazards and resilience strategies but in which those values were somewhat separate from how participants might consider those hazards and resilience strategies in their own backyard. This type of discussion did not extend from ideals for deliberation laid in deliberative theory. Instead, it arose from a combination of experience from others in the climate and public engagement community, past

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70 In practice, many participants recognized maps of the cities and correctly guessed which cities we used. Others, interestingly, made incorrect assumptions about what city they were considering and used that information as part of their deliberation. In St. Paul, MN, for example, one group assumed that the extreme heat case study city was Phoenix, AZ. That assumption in mind, they focused particular attention on potential water availability problems the city might face in responding to extreme heat.
experience and judgment of the CRF project team, the project goals, and ideals related to pTA, including pTA’s emphasis on capturing informed public opinion.

Despite careful planning to link visuals to robust dialogue at forums, some aspects of the visualizations had an unintended impact on discussions. In testing the sea level rise and extreme precipitation activities in 2017, partners at the Museum of Science noted that both museum staff and members of the general public who participated in focus group testing commented positively on the visualizations. In the pilot forum in Boston, however, I noted that some participants used the visualizations not as an object of discussion but as a puzzle to solve:

"[Visualizations] turned into very iterative process

People turned to visuals way more than the cards

My group quickly wanted to look at many options and visuals

Drawn most to areas flooded, became a bit of an optimization problem.

Is that really what we want?"

After the forum, I further reflected on this observation:

"Flood expanse visuals became a little deterministic: participants sought out visual to show them which [plan] did the ‘most’ [in terms of flooding impacts]. Quickly made other positions difficult to defend, not as much support for discussions of tradeoffs."

While we sought to provide participants with feedback on their chosen plan to foster discussion, some feedback looked different than other feedback. Blue swaths on the map
showing potential flooding looked very different than icons describing the impact of a sea wall on a low-income neighborhood or on marine habitat important to oyster farmers. Searching through multiple visualizations of different resilience plans to find the one that minimized flooding is a totally valid approach for thinking about resilience if the group's goal was to minimize flooding at all costs. What I found problematic at the time was that this quickly sidelined any discussion of other impacts of each resilience plan. That the visualizations of flooding extent were themselves problematic due to assumptions inherent in them (e.g., regarding where certain infrastructures would be placed, etc.) only compounded their negative impacts on deliberation.

While visualizations replicated the look and feel of potential decision-support tools that resilience planners might use, the dynamics at the table I observed may have detracted from learning and our ability to collect informed public opinion by way of robust dialogue. One rationale for the use of pTA is unpacking technical assessments that mask assumptions and values associated with expertise. But the visualizations, to some degree, provided just that: Maps that showed deterministic impacts of given hazards that were laden with assumptions, judgments, and uncertainty. As this chapter has laid out, the CRF project team made many decisions to promote good dialogue that integrated participant values with considerations from experts. Yet the case above showed that the visualizations led to deterministic searches for plans that minimized flooding, a process that discounted other concerns not presented in such a spatially visible manner. This impact on participant discussion additionally threatened other project goals, including learning about tradeoffs and the opinions of others and the use of the CRF project to collect informed public opinion.

Discussions following the Boston pilot forum and the development of materials for the extreme heat and drought activities led to changes in format to address some of these
concerns. The visualizations for drought and extreme heat placed less emphasis on showing how a given resilience plan changed the impact of each hazard. This involved a move towards more qualitative feedback (e.g., gauges that used color gradients to show water availability and water use in the drought activity). The extreme heat visualizations started by showing participants a distribution of heat related deaths for one summer in *Heattown* (Louisville, KY). After participants chose a resilience plan, we presented the same data but did not show how their strategy impacted heat-related deaths, in part because quantitatively relating strategies like increased shade cover or the availability of cooling centers to heat-related deaths is likely a fool’s errand in modeling very complex systems (e.g., urban micro-climates, transportation networks, epidemiology of heat exposure). For all four hazards, we chose to use videos of the visualizations rather than having participants or facilitators directly interact with Google Earth layers containing the visualizations. In the videos, icons automatically opened to show tradeoffs and impacts so that a facilitator or participant did not need to click through each icon. Participants at subsequent forums still wanted to thumb through every visualization to get a sense of which option was ‘the best’. However, no forum hosts reported problems such as those at the Boston pilot forum, nor did I observe this dynamic at forums in Phoenix, Portland, St. Paul, or Mobile.

As with the resource constraint feature of the forum activities, this example shows the importance of the materials provided to participants and the unintended ways they can impact discussion. Practitioners can provide feedback to participants through visualizations showing tradeoffs, uncertainties, and impacts of their chosen strategy. But we can also skew perceptions of effectiveness of various strategies through the data and stakeholder stories we chose to show (or not show). This example is also a case of practitioner learning through the project. The changes made after the pilot forum
showed the importance of testing and continual changes by the CRF project team. Critical to that learning was the variety of perspectives within the project team. Various parts of the team provided feedback or emphasis on different aspects of the visualizations, including: 1) the need for engaging visualizations; 2) emphasis on showing a variety of tradeoffs and considerations for each hazard and plan; 3) emphasis on how visualizations impacted participant discussion; and 4) the need for relevant data. These various emphases and regular time for reflection on what came out of the pilot forums and other tests of the materials allowed the CRF project to create and refine visualizations to support plurality of project goals, including discussion.

5.4 Conceptualizing deliberation in the CRF project

Both the resource constraint and visualizations were designed to promote deliberation, though both also facilitated unexpected dynamics in forums that limited participant discussions. More generally, both features of the pTA activities in this project defined a type of deliberation that the CRF team sought to promote: One that integrated participant values with considerations solicited from experts. Visualizations, for example, took the form of predictions or scenarios to show the impact of various resilience strategies on the hazard itself (e.g., flooding associated with extreme precipitation events) and people in the community. These visualizations contained information and considerations from experts, case studies from the peer-reviewed and professional literature, and, in some cases, rudimentary models of impact (e.g., bathtub models of SLR impact). They were part of the 'informed' in informed public opinion in that they communicated intended and unintended consequences of various measures to address climate-related hazards, as well as uncertainties about their impacts. Additionally, participants had the opportunity to choose one resilience plan, implement
it through the visualizations, and then continue discussion before settling on a final plan. The visualizations allowed participants to further explore their group opinions, assessments, and values as they evaluated the impact of their plan and debated how to move forward. The underlying scope of deliberation in this pTA exercise integrated participant values as shared with one another and as considered by one another with relevant considerations from experts and scientific literature.

5.5 Facilitators and role-playing

Further complicating deliberation was the implementation of the materials as designed. For all the hazard activities, participants were read aloud stakeholder cards that summarized the ways different people (or organizations) in a community would be impacted by a given hazard and their (very loose) preferences for different resilience strategies. The team created six stakeholder cards, each containing a few sentences and a photo, for each hazard. After participants read all six cards aloud, the facilitator guided them through a discussion of 1) what priorities those stakeholders might have for creating a resilience plan and 2) how each stakeholder might rate the different resilience strategies in the activity. Participants considered those stakeholders and their preferences and priorities as they worked through each step. The CRF project team included stakeholders so that participants would have to consider different priorities and think through how different groups in a community might be impacted by a hazard or by different resilience strategies. The cards were meant to inform discussion and provide different perspectives than those that participants may have brought to the forum.

Importantly, participants were not supposed to take on the stakeholder roles through the rest of the activity. In some cases, however, many participants did, with implications for our goal of promoting deliberation. In the Phoenix workshop with policy makers and
experts, a few attendees expressed confusion about the stakeholder cards in the sea level rise activity that was a precursor to the CRF activities. In the Boston pilot forum, at least on table treated the stakeholder cards as a role-playing activity without being corrected by the table facilitator. The project team attempted to clarify that the activity was not meant to be a role-playing activity in subsequent meetings and conference calls with the final six forum host sites. Yet several tables at least two other forum sites treated the exercise as a role-playing exercise, with either implicit acceptance or explicit instructions to do so from facilitators.

Role play as an unintended use of forum materials carried many implications and opportunities for learning. Having participants take on a role other than their own quickly pushes discussion away from the model we laid out, a model that integrated participant views and relevant considerations from experts and scientific literature through participant discussions. Role playing obscured participants own views in favor of their idea of what their character prioritized. Discussion thus changed from one that included participant perspectives alongside content imbued with expert considerations, to one in which expert-imbued stakeholder cards defined the perspectives shared across the table. This shift impacted other project goals as well. For example, role playing weakened a key claim to the policy relevance of pTA: that it can provide a summary of informed public opinion about a complex issue. How could pTA activities do so when the opinions solicited through the activities were not those of the participants, but of their ideas of what others might think? Another CRF project goal, learning about resilience and the perspective of others, might have been unimpeded by the use of role playing. Indeed, participants might be even more receptive to ideas from others after acting as a low-income resident dealing with extreme heat or an oyster farmer battling with the impacts of sea level rise.
This unintended use of pTA materials also created opportunities for learning and improvement to the practice of pTA. Most obviously, pTA practitioners should be aware that facilitators don’t always implement materials as designed. The complexity of a given pTA activity likely increases the odds that facilitators implement an activity in an unintended way. Further, the language used to describe activities might have had unintended impacts on how forums hosts, participants, and facilitators viewed the activities. Some forum hosts, as well as policy maker and expert observers at some of the forums, referred to the activity as a game, perhaps shifting how facilitators (and participants) viewed the activity and encouraging them to take on the activity as a game. Further, the CRF project team occasionally referred to role playing but with a different emphasis: The activity was meant to place participants in the shoes of resilience planners; that is, they were to role play being resilience planners for a community.

This example also speaks to the power of unstated expectations in forum materials. Presented with cards showing different people in a community, many groups simply treated those cards as roles to play for the duration of the exercise, with either explicit instructions from facilitators or implicit acceptance of role playing by facilitators. The CRF team viewed stakeholders as a mechanism to broaden the considerations that participants had to address, yet their very format as game-like cards perhaps made role playing an obvious next step to participants and facilitators facing a complicated task and set of materials. Materiality can shape discussions in predictable and unpredictable ways.

5.6 Assessing deliberation in the CRF project

Deliberation in the CRF project was further defined by efforts to measure and evaluate it. Some of this was observational (as noted above in my discussions of the
impacts of the resource constraints, visualizations, and role playing). We also built in two rough assessments of deliberation into the project. These were factors we could evaluate through individual and group responses and post-forum survey questions about table discussions.

In post-forum surveys, we asked participants to reflect on their experience at the forums with prompts about hearing the viewpoints of others, sharing their own viewpoints, and whether their group’s resilience plan reflected their own personal views. The first two prompts, on sharing their views and hearing the views of others, most closely mapped to the priorities for deliberation laid out above. Across all eight forum sites, 71% strongly agreed that they heard other viewpoints and 58% strongly agreed they shared their views (see figure 5.2). By these measures, then, participants overall felt comfortable sharing their perspectives and hearing those of others.

Figure 5.2 Participant responses to questions about their experience at the CRF project forums. From Todd et al., in preparation.

<table>
<thead>
<tr>
<th>Prompt</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I heard others' viewpoints about what actions should be taken to reduce the impacts of climate-related hazards. (n=355)</td>
<td>71%</td>
<td></td>
<td>28%</td>
<td></td>
</tr>
<tr>
<td>I shared my views about what actions should be taken to reduce the impacts of climate-related hazards. (n=357)</td>
<td>58%</td>
<td></td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>My group's resilience plan reflected my personal views. (n=353)</td>
<td>32%</td>
<td></td>
<td>59%</td>
<td></td>
</tr>
</tbody>
</table>
Participants recorded their chosen resilience plans before and after they viewed the visualizations and discussed their plans with other participants. These response sheets allowed us to document if participants changed their plans after seeing the visualizations and discussing them as a group. We took this as proxy for two bigger questions: Did participants consider the visualizations before making their final plan? And did participants consider the viewpoints of others in the group before making their final plan? Across six sites, an average of 46% of participants changed their resilience plan choice after discussing with their group and after seeing the visualizations while an average of 27% stuck with their original plan. An average of 28% of participants did not complete both voting sheets, meaning we do not know if these participants changed their plans. Of course, this metric has one major limitation: Participants who stuck with their original plan did not necessarily neglect the visualizations or the opinions and discussion of others. Nonetheless, these data suggest that people on the whole were willing to hear other ideas and take evidence from the visualizations to reconsider what they initially thought was the best plan.

Both of these measures suggest that participants considered the perspectives of others, felt comfortable voicing their views, and integrated feedback built into forum materials. Despite the observed challenges associated with the activity noted above, participants largely engaged in discussions in line with the model embedded in the structure of forum activities.

5.7 Assessing deliberation in the Prop 127 project

In addition to my decisions about how to structure the Prop 127 forum, I decided to use the project as a way to explore the impact of deliberation on participant opinions about Prop 127 and about the forum materials. Partly, this was due to my experience
with the CRF project, where I noted how some materials influenced participant discussions in ways that I found problematic (see early sections in this chapter). More broadly, I wanted to better understand the role of deliberation for participant outcomes. One piece of literature, a journal article by Barabas (2004), seemingly continued to crop up as I thought about how deliberation interacted with goals for pTA. Barabas found that people who engaged in deliberation and who already had strong opinions tended to strengthen their opinions through deliberation if a consensus with their deliberating peers failed to emerge. Those who did not do so shifted towards the majority opinion of the people in their discussion group. This example has long stuck with me as contrary to what people often attribute to deliberation: Deliberation helps people consider other people's perspectives. Opinion about an issue doesn't necessarily reveal if someone considered other opinions. In a decisive issue, however, change in opinion may help understand the role deliberation plays in facilitating a search for areas of agreement where progress on policy can be made. Participatory technology assessment (and the in-practice definition of deliberation used by the CRF team, my immediate circle of fellow pTA practitioners) emphasizes having participants hear other views and using pTA to promote searches for areas of shared agreement.

To better understand the impact of deliberation on participant opinions, I distributed surveys to Prop 127 forum participants and a related online survey group. As described in chapter 3, in-person forum participants received a printed copy of the forum guide and engaged in a 2-hour discussion at two small forums in 2018. Online survey groups received one of two guides: A digital copy of the forum guide or a series of for and against

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71 I mention Barabas's findings to highlight the influence of this paper on my thinking at the time, not as the sole published context about the role of deliberation in various participant outcomes. For a good discussion on the tensions between deliberative democratic theory and empirical studies of deliberation, see (Thompson, 2008).
statements about Prop 127 sourced from the Arizona Secretary of State website. For all three groups, I asked participants to rate their support for or opposition to Prop 127 on a 7-point Likert scale before and after they read the guide or attended the in-person forum. For each participant, I calculated the difference in their support for or opposition to Prop 127 before and after they read the guide or participated in the forums. Based on this difference, I assigned each participant to a category showing if their opinion did not change, if their opinion strengthened, if their opinion moderated (i.e., their support or opposition diminished), or if they flipped their opinion (i.e., moved from opposed to support or vice versa). Results from this analysis are presented in figure 5.3.

**Figure 5.3 Changes in participant opinion about Prop 127**

![Diagram showing the distribution of participants' opinion changes.]

In-person forums had a higher proportion of participants strengthen, moderate, or flip their opinions than either of the online response groups, indicating that in-person deliberation about Prop 127 influenced participant opinions in a diversity of ways. In particular, the proportion of participants who flipped (10%) or moderated (20%) their
opinion at in person forums was substantially higher than for either of the online groups (5-6% flipped, 6-14% moderated). A much higher proportion of online participants who received the forum guide moderated their opinion (14%) compared to those who received the Arizona Secretary of State’s guide (6%), suggesting the content in the forum guide perhaps allowed participants to consider other perspectives on the topic that made them less certain about their stance. These results may also suggest that participants could easily find reasons to reinforce their prior opinion in the Arizona Secretary of State’s guide.

I did not track specific participant conversations—for example, by tracking who was at each table at the forum—and so cannot say that those with stronger opinions swayed those with less strongly held opinions. Of the 11 in-person participants whose opinion changed in any direction, 7 changed only slightly (1-point on the Likert scale), while the remaining 4 moved 3 points. Ten of those 11 participants shifted towards opposing Prop 127, though 4 still supported the measure.

Participants on average expressed support for Prop 127 across all groups (see Figure 5.4 and 5.5). The largest change in average support/opposition for Prop 127 was from the in-person forum group, whose average support as measured as an average of all Likert scale responses dropped from 0.67 to 0.05. Support for the proposition by both online groups increased (0.06 for the group who saw the Arizona Secretary of State's Guide; 0.20 for those who saw the forum guide). The measure ultimately failed with around 69% of voters rejecting the Proposition, suggesting participants in this study were more supportive of the measure than Arizona voters overall.
Did the Prop 127 forums foster deliberation that allowed participants to consider their own opinions alongside considerations from experts, the goal for deliberation that I laid out in my project proposal? Though changes in opinion are an imperfect indicator of deliberation, the results presented in Figures 5.5 and 5.6 show in-person forum participants took in the perspectives of others and information from the guide to reconsider their position on the Prop 127. The decrease in support for Prop 127 amongst
in-person forum participants could be explained in a similar manner to what Barabas (2004) found: A few participants with strong negative opinions were convincing to other participants who came to the forum with less strongly held opinions. Notably, we had facilitators at each table who (based on my observations) provided all participants with opportunities to share their opinions, suggesting that participants with strong negative opinions of Prop 127 were persuasive and not simply dominating the conversation. The online group who received the same guide as in-person forum participants on average increased their support for Prop 127 while those at the in-person forum decreased their support, suggesting that the materials themselves likely did not sway participant opinions in a strong manner.

The post surveys provided to in-person forum participants also included questions about experiences at the forums, which provide more detail about how participants perceived deliberation at the events. These responses are presented in Figure 5.6
Figure 5.6 Participant responses about their experiences at in-person Prop 127 forums

- Participants discussed the topics constructively (active listening, respectful treatment, etc.).
- Participants were treated respectfully by the organizers and forum staff.
- All participants had the same opportunities to voice their opinion.
- I was able to contribute my ideas and views during the general discussions.
- Facilitator(s) effectively moderated discussions.
- I am fully satisfied with the forum.**
- The event used my time productively
- The guide was unbiased.*
- Important societal groups (ethnic minorities, age and income groups, etc.) were appropriately represented at the event.
- There was enough time for participants to discuss and reflect on information and arguments.
- Some relevant technical information and positions were missing from the guide

* n=20
** n=19
n= 21 for all other questions

- Strongly Agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree
- Strongly disagree
Overall, these responses suggested that participants felt able to share their opinions, heard the opinions of others constructively, and saw the format as appropriately moderated and worthwhile. Taken by themselves (i.e., regardless of the dynamics of opinion at the forums), these results suggested that the Prop 127 forums were successful in engaging participants in deliberation where they considered their own values and those of others, a key component of the type of deliberation laid out in my project goals. Responses about the forum guide showed that some participants perceived the guide as slightly biased and that some considerations were missing from the guide, perhaps undercutting the goal of deliberation that integrates relevant considerations from experts. Further, one participant felt that the participant pool lacked representation of certain groups. Frankly, I would assess the diversity of the participants at both forums as lacking as well.

5.8 Deliberation and the practice of pTA

Deliberation in the CRF and Prop 127 projects was defined in an emergent manner. While the CRF project team laid out criteria for good topics for pTA and provided participants with rules for dialogue that emphasized respectful discussion, no specific criteria were used to guide decisions about forum materials in relation to deliberation. As described above, the goals for deliberation that did emerge were general and emphasized the sharing of participants perspectives and the inclusion of considerations deemed important by subject matter experts and policy makers. These goals were impacted by other project goals, past experiences, and the general ideal of pTA to capture informed public opinion. Project notes and meetings, overall, included very little discussion of deliberative ideals from academic literature. Instead, practitioners relied on past experiences, internal conversation, and know-how shared from other practitioners to
guide decisions that related to project goals and deliberation, suggesting that much of deliberative theory and other literature plays only a nominal role in the day-to-day practice of participatory engagement.

Deliberation in both projects was also somewhat unpredictable. We sometimes adversely impacted discussions in providing materials we thought would help promote discussion. Despite these struggles, in-person discussion was clearly important to participants and to the goals of pTA practitioners. Participants overall rated their experience of the forums as positive in response to questions related to deliberation. In-person discussion also had a different impact on participant opinions than forum materials alone, suggesting that deliberation, and decisions about deliberation, are functionally important to outcomes for participants.

Do these findings lend themselves to a definition of deliberation in pTA projects? In a very basic way, yes: Deliberation in these two pTA projects led to forums that encouraged participants to share their opinions, hear the opinions of others, and consider information and priorities gleaned from experts and policy makers. Beyond this very general definition, however, are substantial questions. More detailed criteria for deliberation did not emerge from my analysis but might be critical to capacity building efforts aimed at widening the use and impact of pTA. However, defining such criteria could be difficult and could lead to an overemphasis on getting deliberation ‘right’.

The general definition of deliberation in these two projects somewhat side-stepped questions and concerns from deliberative theory. But what about questions posed by STS scholars about the epistemological inconsistencies associated with deliberative rationality (e.g., Lövbrand et al., 2011)? The general understanding of deliberation in both projects might reflect more constructivist ideals for participation. In short, the ideal for participation in the CRF and Prop 127 projects shifted away from specific qualities of
deliberation towards broader concerns about how the participatory effort took shape and who was involved, such as concerns about how forums were connected to policy-making, questions of who attended the forums, and efforts to understand expert disagreements and expert framings in the creation of forum materials. Deliberation in these pTA projects emerged from the interaction of a variety of goals, people, and materials. This approach to deliberation might better open up policy conversations to broader concerns and might help avoid participatory approaches from becoming sites where decisions are ‘closed down’ (i.e., participatory efforts replacing other political processes for making decisions; Stirling, 2008) based on specific criteria for deliberative legitimacy.
Chapter 6 - Making pTA policy relevant

6.0 Introduction

This final theme describes the intended or idealized use of participatory efforts to provide input to or otherwise impact formal decision and policy making. Policy relevance was a very expected emphasis of both of these projects. Technology assessment, a practice from which pTA emerged, is at heart a policy- or decision-support tool. In describing the need for pTA in the US, both Sclove (2010) and Worthington et al. (2012) laid out policy relevance as a critical aspirational feature of pTA (see chapter 1). In this chapter, I focus on the diversity of ways policy relevance was manifest in the Climate Resilience Forums (CRF) project as a way to better understand how an emphasis on policy relevance shapes the practice of pTA. As further described below, a focus on policy relevance in the CRF project meant making the effort relevant to the resilience-related decisions, plans, and policies being considered by policy makers. For the Prop 127 project, policy relevance took on a different meaning given that the policy makers were Arizona voters (including pTA participants) who would decide whether or not to enact Prop 127. Put simply, the policy relevance of Prop 127 was baked into the topic, which motivated my decision to conduct forums on Prop 127 in the first place. Because policy relevance took on a more complex shape in the CRF project, most of this chapter focuses on the CRF project and the project team’s efforts to connect the Climate Resilience Forums to resilience planning.

First, I briefly describe the importance of discussing this theme at all. I then describe where a focus on policy-relevance emerged as an important factor in the planning and undertaking of the CRF project. For example, I discuss the focus on policy relevance in the project proposal and later efforts to connect policy makers to the forums. Two outcomes emerge from this discussion: Engagement with policy makers early in the CRF
project shaped an emphasis on 1) tradeoffs and 2) locally-focused forum activities\textsuperscript{72}. Importantly, these outcomes interacted with other project goals in ways that impacted that policy relevance of the project. I then present reflections from policy makers and subject matter experts who attended the forums about how the forums could be used to inform resilience planning efforts. Then I describe how we presented the results of forums to policy makers based on past pTA efforts. Finally, I briefly discuss the Prop 127 project as a unique application of pTA to a highly contested political issue.

6.1 Policy relevance across pTA

Policy relevance emerged from the project notes and documents as an important theme for the CRF project. Put simply, the CRF project team continually discussed making the forum effort a usable policy support tool for resilience planners. Beyond this emergent emphasis on policy relevance, this theme reflects a critical, aspirational part of pTA as presented in the Sclove and Worthington reports. As discussed in chapter 1, those reports were published before the CRF or Prop 127 projects (or predecessor projects such as the ones conducted for NASA) started, but were written by partners and practitioners from across ECAST. In other words, policy relevance is part of the fabric of meaning and practice that supports pTA. It is a normative goal for what good pTA should embody. Considering how this theme arises in an actual pTA project helps inform this broader analysis of the practice of pTA and more narrowly focused evaluations of pTA impact.

The decision- and policy-making impact of pTA is incredibly difficult to measure. In the case of pTA projects conducted by ECAST and partners for NASA (see chapter 1), Tomblin et al. (2017) highlighted the difficulty of assessing whether or not the pTA

\textsuperscript{72} I discuss tradeoffs and locally-focused forum activities in the chapter 3 as well.
activities on options for NASA’s planned asteroid redirect mission (ARM) influenced agency decisions regarding ARM. The nature of decision making at the agency about ARM, which took place in meetings with senior project officials within NASA and incorporated a wide variety of considerations and inputs, limited an accounting of the impact of the pTA activities\textsuperscript{73}. In the NASA project, lines of causality between participatory engagement exercises and actual decision making were blurry and complex. This should be expected in contexts where participatory efforts are situated as decision support tools (i.e., where they stand next to and are complimentary to existing policy and decision-making processes) rather than replacements to existing policy or decision-making processes. Identifying and reflecting on the ways that this ideal played out in the CRF project, an effort in which policy-making connections were even more nebulous and complex than in the NASA project, presents an opportunity to better understand how policy relevance is created and navigated in pTA efforts. In short, a thorough accounting of efforts to make the CRF project relevant to resilience policy making is likely the least-worst (and perhaps only) way to address how practitioners think about the decision-making impact of participatory efforts and about ways to bolster that impact.

6.2 Policy relevance: Past pTA projects and the CRF project proposal

The original proposal for the CRF project noted the potential of the project to “strengthen community decision-making” and create “usable outputs for decision makers.” Even the title of the project referenced improved decision-making:

“Community Engagement for Environmental Literacy, Improved Resilience, and

\textsuperscript{73} Nonetheless, this accounting is notably the most direct snapshot of the impact of pTA on major decisions in the public sector in the United States.
Decision-Making.” As discussed above, the idea that pTA can support policy making comes from past pTA literature and prior pTA practice (see chapter 1 for a larger overview). Further, the CRF project team included researchers and practitioners with experience using participatory efforts to help inform decisions by policy makers, particularly decisions traditionally considered the domain of technical experts. Making pTA policy relevant was an assumed standard or default for many on the project team, and this idea was embodied in various team member experiences with past projects and in the CRF project proposal\textsuperscript{74}.

Members of the CRF project team have also contributed to the literature relating scientific products to policy. For example, members of the Consortium for Science, Policy and Outcomes (CSPO) at Arizona State University who were involved with the CRF project have previously worked with federal agencies and other researchers on projects related to use-inspired science, usable science, and actionable science. In a report about actionable science and climate change prepared for the U.S. Department of Interior, the authors stated that actionable science

> “provides data, analyses, projections, or tools that can support decisions regarding the management of the risks and impacts of climate change. It is ideally co-produced by scientists and decision makers and creates rigorous and accessible products to meet the needs of stakeholders” (Beir et al., 2015, p5\textsuperscript{75}).

\textsuperscript{74} I’ll refer to decision making and policy making interchangeably throughout this chapter. Though distinct, I’m considering them as highly intertwined processes for the purposes of this chapter. Roughly, I conceptualize them to be two sides of the same coin where policy making is the process of making commitments to certain courses of action and decision making is the process of managing actions towards those commitments.

\textsuperscript{75} One of the authors, Mahmud Farooque, manages pTA projects at Arizona State University.
The relevance, salience, and legitimacy of scientific evaluations also contributes to the concepts of usable or actionable science (Pielke, Sarewitz, and Dilling, 2010; Lemos and Dilling, 2011). These concepts were described in the original CRF project proposal under the heading “From Decision-Making Under Uncertainty to a New Typology for Science,” which covered the above-referenced report on actionable science in addition to CSPO’s work on related concepts for various federal agencies.

From the start, the CRF project team linked lessons from actionable science with participatory engagement, and with the desired output of creating a public engagement effort relevant and salient to policy making processes. Importantly, the emphasis on linking the ideas and opinions solicited from forum participants to policy making rises and falls during various parts of the project in response to other materials, meanings, competences, and dynamics discussed throughout this chapter.

6.2.1 Policy makers and content creation: Navigating framing and policy relevance

To the end of making pTA relevant to policy and decision-making, and drawing on the practice of actionable science (see chapter 3 for more discussion of this overlapping practice), we planned stakeholder meetings with subject matter experts and policy makers in Phoenix and Boston in 2016. These workshops set the tone for how we managed the content creation process and how we linked our project to concerns and interests from the resilience planning community.

76 Another project partner, Daniel Sarewitz from the Consortium for Science, Policy and Outcomes at ASU was an author on this report.
We invited local policy makers, resilience and hazard experts, and representatives from our funding organization (i.e., NOAA) to these workshops to identify strategies and questions salient to decision- and policy-making priorities. We did so under the assumption that making the activities relevant to priorities of workshop attendees would make the forums, and outputs of the forums, more transferable to policy making considerations. This was based both on literature about usable science (e.g., establishing credibility, salience) and on team experience working with policy makers on past projects (notably, the NASA pTA project). Additionally, the CRF project team was comprised of experts and practitioners in public engagement and policy support, not experts in resilience. The involvement of subject matter experts and policy makers helped ground the CRF effort to the current state of knowledge around resilience-related issues.

Before these workshops, invitees received a list of resilience strategies relevant to different climate-related hazards sourced from the academic and professional literature (e.g., municipal resilience planning documents) to assess. We did so to communicate the state of our knowledge as a project team and to provide an opportunity for attendees to provide suggestions on strategies or considerations absent from our list. Additionally, we arranged to have selected workshop invitees present on the state of research and planning for each hazard to 1) foster conversation and 2) provide a baseline knowledge on issues that might be unfamiliar to some (i.e., the experts and policy makers familiar with one hazard could learn about the perspectives of those familiar with another hazard). After these initial presentations, we asked workshop attendees to reflect on the following questions in group exercises: What was good about these strategies? What are potential tradeoffs (social, economic, and environmental) associated with each? Who are important stakeholders we need to consider for each of these strategies? We
designed this exercise to better appreciate the existing resilience planning landscape and ensure that the CRF forums would represent a diversity of potential policy options being considered by resilience planners and policy makers. Throughout the content creation process following these workshops, we continued to involve policy makers and experts in reviews of forum materials to ensure that the pTA forums would, in fact, be relevant to current resilience planning efforts. Both the workshops and follow up engagement with experts and policy makers represent a ‘site’ where the project team and external partners negotiated priorities for the forum activities. These negotiations also encompassed decisions about policy relevance.

Throughout this process, officials and experts focused in part on details about what to avoid and include in the forum activities, in addition to the very high-level concepts of tradeoffs and cascading impacts discussed in chapter 3. These details often were specific considerations related to different strategies (e.g., role of ridesharing platforms to get people to heat shelters). In soliciting these details, the project team had to navigate competing priorities for what to include in the forum materials. In a follow up phone call after the Phoenix workshop, for example, one local policy maker in Phoenix told us *not* to get into details about water rights because they were too complicated and might distract from broader discussion about resilience. As we began designing forum materials for drought several months later, I conducted phone calls with a different official (a municipal water specialist) to gauge the feasibility of the strategies included in the drought activity. This official urged us *to discuss water rights* after noticing they weren’t mentioned in initial drafts of participant activities, contradicting feedback from the workshop attendee. We ended up not including water rights in the drought activity, though the rationale for why was not explicit in any notes. In hindsight, we may have
regarded water rights as too complicated or too location-specific and thus difficult to discuss in different communities.

Decisions about which priorities and considerations from policy makers to include in or exclude from forum materials represented a key area where the CRF project team made decisions about expert framing. As in the decisions the team made about what participants should learn about through forums, we made decisions about many specific policy details that did or did not end up in the forum materials. Put simply, a desire to make the project policy relevant involved figuratively handing over the materials to policy makers and experts and then trying to make sense of competing ideas. To some degree, we recreated expert frames by including or excluding some priorities through our efforts to make the forum activities relevant to policy making.

We made editorial decisions about the materials, including avoiding some subjects (e.g., water rights). There were many specifics that we could have included in discussions about each hazard, but the format of forums limited how much material we could provide participants. While some individual decisions about what to include or exclude were unclear, in hindsight, the project team relied on high-level goals and concepts important to the project team (e.g., uncertainty, diversity of strategies), solicited from policy makers and experts (e.g., tradeoffs, cascading impacts), or built into the project itself (e.g., materials relevant to variety of communities) to inform those decisions.

Additionally, we were critical of suggestions about what to include or exclude. Expert and policy maker reviewers provided constructive criticism in response to our ideas or those proposed by others at workshops. For example, one expert who attended the Phoenix workshop criticized a focus on ecosystem services in the extreme heat exercise (an idea itself brought up by another workshop attendee), noting that an effective means to prevent heat-related deaths in homeless populations is to simply improve homeless
services in general and that discussing ecosystem services might distract from such social programs. Workshops, the review process, and continued dialogue with experts and policy makers helped to challenge the ideas and framings that arose on the subject at a variety of points in the project. These efforts were complimented by internal project dialogue and goals, which helped to reassert values important to pTA (e.g., making forums relevant to broad set of values). Based on these experiences, concerns about framing were important but not insurmountable.

6.2.2 Tradeoffs, local emphasis of forums, and policy relevance

The goals, priorities, and strategies that emerged through the workshop process described above included a focus on tradeoffs and the need to make parts of the forums specific to local considerations (i.e., considerations specific to the communities where we held the forums). I discussed tradeoffs and related concepts as educational goals in chapter 3. Here, I want to describe how the focus on local considerations and tradeoffs influenced the CRF project in ways that impacted the policy relevance of the project.

As discussed in chapter 3, tradeoffs emerged as an important learning outcome in workshops with policy makers and experts. Beyond the educational focus on tradeoffs (i.e., wanting participants to learn about tradeoffs in general), policy makers and experts at those workshops emphasized tradeoffs as part of making the forums truer to current policy considerations. Attendees emphasized that forum participants should be led

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78 This discussion skips another consideration about expert framing: How inflexible are those framings when presented to the public? Forum participants in St. Paul, MN quickly noted that our activities took “problems with capitalist systems” as a given instead of challenging those systems, suggesting that they were comfortable calling out this very overarching framing of the activities. The heat forum activity included references to new electricity generation infrastructure but stopped short of prescribing what type of electricity generation. Participants in Portland filled in these missing details, specifying that any new electricity generation should come from renewables. And one table in Phoenix partially rejected the plans we provided them on the grounds that they privileged a government-first approach to resilience. They proceeded to write their own plan instead. While these are just a few examples, they clearly show that at least some participants are quite comfortable challenging the ideas embedded in forum materials.
through realistic policy-making scenarios imbued with tradeoffs and difficult decisions. A representative from our funding agency (NOAA) asked the group at one workshop how tradeoffs inherent in resilience strategies could be visualized and made more explicit. Building on this idea, the workshop attendees explored ideas for the forum activities, such as building in hypothetical situations, that would ensure that public participants were thinking about tradeoffs as they might arise in planning decisions. In my summary of follow-up phone calls with workshop participants, I noted that, “it might be necessary to convey what policies exist [to help participants] understand tradeoffs and complexity around heat and drought”.

The CRF team noted the connection between policy relevance and tradeoffs in a meeting after the first workshop, as I documented in my notes about the meeting (note that these are summaries of the conversation):

CRF team member 1: Need to ‘frame and package problems to interact with policy makers and decisions, might have to experiment.’

Funding agency representative: ‘How do we balance rich local context while still developing materials to be useful elsewhere?’

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79 In chapter 3, I note that some policy makers made positive remarks about the forums after seeing participants struggle with tradeoffs:

“...it was really fascinating to watch [participants] struggle with a lot of the things that I and my colleagues struggle with on a regular basis in terms of no clear solutions that are gonna fix everything, winners and losers, not enough money to do everything, things that you think are gonna work sometimes don’t work how you think they’re gonna work.”
CRF team member 2: ‘make some [pieces of the activity] general and others that can be customized - helps expand capacity through science museums, universities, and city connections.’

...

CRF team member 3: [today] ‘did not find strategies that should be used, we learned about tradeoffs to be made between them.’

CRF team member 4: ‘use different scenarios/hypotheticals —> values and tradeoffs. Helps separate decisions from local context. But this makes it harder to make ‘usable”

Here, concerns for making the project relevant to policy making came together with other goals, including embodying tradeoffs in the forum activities, scaling the project across multiple sites, and building the capacity of science museums to engage resilience officials. The CRF project team noted that a focus on tradeoffs might challenge any translation of the forums into useful policy support tools for decision makers. As noted in the summary above, tools to foster discussion and learning around tradeoffs challenged a separate push to make activities specific to the location where they were being held.

6.2.3 The local focus of CRF project forums

Attendees at workshops in Phoenix and Boston discussed the importance of making the forum activities more locally-focused. One attendee quite simply stated that the

Some participants expressed other ideas. For example, an attendee at the Phoenix workshop noted that concrete or realistic case studies for the forums would be critical to making the forums policy relevant. Below is selection of my notes from a post-workshop interview with this attendee:
project team “need[ed] [the] exercise[s] to matter locally.” During group discussion at the Boston workshop, I wrote that “we want our strategies to be novel and relevant to decision makers,” after noting that one workshop attendee stated that “coastal armoring is not going to happen [in Boston].” I wrote this as an example of a local consideration (in this case, Boston’s urban form near the waterfront) that might shape the types of strategies we wanted to put in front of forum participants if we wanted the forum results to be relevant to decision makers. Coastal armoring might be off the political table for planners in Boston; bringing it up in a forum designed to be policy relevant might degrade the ability of forums to feed into policy making.\footnote{I use this example not to show that this was the stance of our project team but to show how the discussion at workshops with policy makers and experts unfolded. Forums might actually be a \textit{very good} place to bring up options that aren’t currently on the metaphorical political table. Forums offer an opportunity for policy makers to learn about options outside the normal discussion without necessarily showing interest in them in a public way. This can hedge risk for policy makers while still exploring public values.}

A concern for locally-specific materials arose earlier in the project as well. In meetings before workshops with policy makers and experts, team members discussed balancing the local and general qualities of the forum activities. For example, the team described creating a “boiler plate” activity that could be modified at each forum site. Implicit in many of these conversations was that activities customized by each site would be more directly relevant to policy making in the communities hosting forums. On a participant experience level, we thought participants would find locally-oriented activities more interesting and engaging than activities not specific to their community. But the team also had concerns about making activities \textit{too locally focused}. We discussed the potential for locally-focused materials to derail broader discussion about resilience, particularly if visual aids such as maps were used. Specifically, we worried that forum

\textit{We really want concrete case studies, too general of studies won’t be useful to other cities and decision makers who often use specific case studies from other cities as decision making tools (e.g., how did city X enact this ordinance and how has it worked?).}
participants would respond with not-in-my-backyard (NIMBY) type concerns: If we gave people a map of their community showing areas most likely to flood in certain situations, they might focus their discussion on areas of most concern to them (e.g., their neighborhoods, places of work, places of worship). This idea was reinforced by experiences shared by other practitioners working on public engagement for climate change issues. As discussed in Chapter 5, we wanted participants to discuss more general considerations about each hazard and resilience strategy so that participants might learn about those general considerations. Further, we thought NIMBY-type concerns could prevent participants from discussing some resilience strategies at all, an outcome we found undesirable given our goals to foster informed yet open conversation about a wide-variety of considerations related to resilience.

Our desire to avoid NIMBY-type concerns also related to the potential use of CRF project forums to inform policy making. Concerns about the impact of a given hazard or resilience strategy on one’s backyard are valid and important considerations for resilience planning. Policy relevance in this project, however, necessitated a focus broader than the neighborhood scale. We wanted to focus on broader decision making about resilience. We did not see these forums as ways to assess resilience strategies in a particular neighborhood within each host city. The scale of pTA forums (i.e., several dozen participants from across a wide geographic area and a diversity of demographic groups) in this project precluded a focus on neighborhood scale plans. Instead, we saw the forums as a way to take the opinions of a diverse group of residents to policy makers. Rather than talk about where individual resilience measures might be implemented, we wanted participants to discuss what measures were even on the table across an entire city. By focusing on broader resilience planning priorities, rather than neighborhood-
level considerations, we chose to structure the CRF project to speak to particular policy communities: City- or region-wide resilience planning concerns. Part of this thinking extended from current models of engagement within municipal governments. The urban planning community is flush with other engagement mechanisms focused on involving community members in neighborhood-scale programs. By focusing on a wider policy scale, we could show the relevance of pTA engagement for policy making beyond those existing tools. Further, we reinforced this broader focus through our use of anonymized city case studies that encouraged participants to focus on "big picture" resilience planning concerns (a lesson we drew from other climate engagement practitioners, see chapter 5 for further discussion of the anonymized case study cities).

Regardless of this city-regional focus, the CRF project team grappled with decisions about how local to make the forums. We relied on feedback from policy makers, the experiences of others in the climate engagement community, and the team's own intuitions about what participants might find engaging. These decisions, along with an emphasis on tradeoffs and other project goals, impacted the structure of forums and project outcomes.

6.2.4 Local focus, tradeoffs, and forum structure

Educational goals, the need to make materials broadly relevant across different sites, and concerns about how specific local considerations would impact deliberation presented competing priorities to creating locally-relevant materials. The CRF project team, using input from workshops and balancing other goals of the project, pursued a forum format that included ‘general’ sessions about a given hazard (including tradeoffs, impacted stakeholders, etc.) and a session focused on specific local considerations. Two outcomes emerged from this decision. First, the non-local pieces of the forums (i.e., the
generic hazard modules) took on a particular structure that potentially limited how the forums could be used to explore public values for policy makers. Second, the local pieces of the forums became the major space where each site could ask questions relevant to the specific situations each location might encounter. This shifted where policy relevance could be generated in the project to each individual host institution\textsuperscript{83}.

In an effort to communicate tradeoffs, particularly through visualizations, and to make each hazard activity applicable across sites, the CRF project ultimately relied on an activity structure in which participants could choose among 17 different resilience outcomes for each hazard activity\textsuperscript{84}. These highly structured responses were successful at showing tradeoffs, particularly through the future-oriented news articles built into each outcome. But these structured outcomes also combined many individual resilience strategies into one discrete option that potentially clouded participant concerns, a consideration that proved important in my calculus about presenting the results of the Phoenix forum to broader policy making audiences (discussed later in this chapter). For example, one plan for the extreme heat activity combined wildfire mitigation with various measures related to electricity infrastructure (e.g., replacement of aging transformers and power lines). A participant who selected this plan might have seen great value in wildfire mitigation, in the measures related to electricity infrastructure, or both, making it difficult to parse what participants found more desirable and why.

Further, the emphasis on visualizing feedback for each of the 17 outcomes within the activity came to dominate project time in the lead up to the pilot forums and before the other six forums when we made adjustments. Overall, the visualizations garnered

\textsuperscript{83} Perhaps this shift was inevitable given the geographic scope of the project and limited resources. Regardless, this shift had important implications for policy relevance

\textsuperscript{84} Activity outcomes were presented as combinations of different features in each resilience plan; see discussion in chapter 5 for more details about decisions about the forum structure.
positive feedback from focus groups, funders, facilitators, and the team itself. However, time dedicated to them could have been used in efforts to reach other project goals, including policy relevance. This is not to say that we as a project team took a wrong approach, just that the diversity of project goals led to decisions focused more on some goals that others.

After pilot forums in Boston and Phoenix, the CRF project team noted that the hazard modules took a considerable amount of forum time and that the visualizations as shown through Google Earth were not intuitive to use for some facilitators. We subsequently took measures to shorten hazard modules by simplifying visuals and moving to video-based visualizations. Further, we noted that participants wanted to talk about local considerations in the forums and that would be worthwhile to change the forum format to better connect to policy considerations. The team considered changes to the forum agendas (see 3.1.2 for more discussion of this) to address this concern, specifically discussing a forum format consisting of one hazard activity and a more robust local activity. Given more forum time to discuss local considerations, some CRF team members (including myself) thought we could better connect questions posed to forum participants to local resilience planning considerations. However, other project goals led us to keep the two-hazard forum format. First, NOAA representatives and policy makers at early workshops focused on cascading impacts across hazards as an important feature for participants to consider. Second, we had few resources to support the remaining six forum host sites in efforts to develop their own activities.

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85 That the visualizations did not contribute to policy relevance was contested amongst the CRF project team. After one of the pilot forums, for example, one project team member noted that participants were encountering decision support tools through the visualizations while others, including myself, expressed concerns about how they were used by some participant groups (see chapter 5).
As a result of the decisions about forum format and the impact of those decisions on policy relevance, the local activities for each forum became the major space for locally-specific policy relevance. This series of decisions and outcomes shifted the site where policy relevance would be negotiated to each individual host institution, and away from the CRF project team. This shift took a particularly winding path, starting with an emphasis on policy relevance in the proposal, through extensive engagement with policy makers and experts early in the project, to a forum format that shifted policy-relevance to questions of local concern. Further, the local resilience activities for both pilot forums took a limited role in the forums and were mostly developed by our team, rather than in collaboration with interested officials in either city. The confluence of educational goals, the scope of the project, decisions about the structure of the hazard activities, and a focus on visualizations limited the policy relevance of the forums, at least as we conceived it (i.e., locally-specific activities that could inform policy makers about public values). Put simply, the complexity of the CRF project and a variety of interacting goals led to tough decisions about what to accomplish and how. In the end, policy relevance took on a smaller role, or one that might extend from relationships made during this project.

6.3 What did policy makers think after observing a forum?

As described above, concerns about policy relevance factored heavily into the CRF project planning process and the structure of forum activities. To complement this emphasis, and based on my own interest in the policy impact of forums, I conducted interviews with nine policy makers, extension agents, municipal officials, and other resilience experts who observed the forums in Phoenix, Durham, St. Paul, Mobile, Portland, or Honolulu. In most cases, I interviewed officials before and after the

86 Importantly, none of these interviewees were officials or experts who helped with content creation at
forums to evaluate if observing forums impacted their views on public engagement. All interviews were semi-structured and focused on their past engagement with the public, their ideals for what public engagement should do or what it should look like, and their reflections and assessments about what they observed at forums. The most obvious question here was: Did policy makers see the forums as useful to their decision and policy making processes? Below, I discuss a variety of important policy relevance considerations that emerged from these interviews.

Interviewees were satisfied with the complexity of the pTA exercises. As discussed in chapter 3, the interviewees readily acknowledged that CRF participants had to grapple with the tradeoffs and complexities that impact decisions about resilience. Complementing the complexity and applicability of the exercise to the task of resilience planning, interviewees remarked positively on the ability of participants to navigate the exercise and the complexity embedded in the activity:

"I was surprised by the level of apparent understanding they had about—a lot of the materials were pretty technical. It used a lot of jargon, and sometimes I wasn’t sure they really understood what, especially the solutions, plan A, plan B, whatever. A lot of them were full of a lot of things that I think assumed that they had knowledge in things that they maybe didn’t...I was surprised at their ability to navigate that”

Interviewees also remarked positively on the way participants approached the forums, particularly in relation to interviewees perceived ‘usual’ interactions with public audiences or their perception of the 'usual' role of public input in their roles. For

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the beginning of the CRF project.
example, one official who serves on a city climate change commission noted that the forums were, "a great opportunity to connect with a section of people that are very interested and want to be there and aren’t there to complain about something in their neighborhood, which is fine too." Another resilience expert referenced an interaction with their state's Department of Transportation, noting that a continual challenge that users of infrastructure are not always the ones impacted by construction and operation of that infrastructure and vice versa. He noted those groups (potential users and those impacted) are rarely at the same public engagement activities. Relatedly, interviewees cast their past experiences with public engagement in a problematic light, mostly defined by hearing complaints or receiving criticism about a planned project:

"...I think [the forum] created a situation where the focus was on the issues and the problems, and not on me or my work, or my—it shifted the focus of that engagement in a way that made it much more accessible for me, where I could listen, and ponder things without having to be in a reactionary mode."

Relatedly, interviewees noted that the format of the activity shifted the emphasis of public engagement to a mode where participants were thinking about solutions. The same interviewee stated,

"...it seemed to me then it's a room full of people that were primed to help me find solutions. Where often when we go out, and we do engagement, we have something we're proposing, or it's almost like we've figured out the solution and then we just wanna hear what people think of it. Often that can be less fruitful, because people have their own agendas, or their own priorities, or whatever, and they're not necessarily in that problem-
solving mode. They’re in the I’m-gonna-tell-you-what-I-think-mode. I see promise in [this engagement], to have better alignment between the public, and the practitioners who are trying to consider these trade-offs. I think the mindset that the community is in then going into those, then conversations about what are the right solutions for [our city] would be potentially more fruitful, and the complexities of that would be better understood, I think."

The last portion of the above quote, about finding the right solutions for our city, hints at the role that this particular official saw in these pTA efforts: Forums would be a good lead up to conversations about their neighborhoods. A common critique of the CRF forums was the case study cities. Interviewees consistently expressed a desire to have the forums be more locally-oriented or remarked that they were disappointed that more of the forum wasn’t about their community. Despite these critiques, some interviewees acknowledged that the non-local focus helped participants better understand resilience challenges:

"It’s really hard to think about [these resilience challenges] when you are thinking about your house, your neighbor’s house, your water, what comes out of your pipes, what goes into your pipes. To back that out and make that fun a little bit, in a way, I think made it easier for people to wrap their heads around the process, without them personally being the ones to have the gravity of these decisions immediately weighing on them."

In some cases, interviewees noted that the local sessions for each forum could have been better developed. Other interviewees noted that forum participants emphasized
different resilience strategies in the hazard activities than in questions about their own communities:

"It was really interesting to see how distrustful people are of levies--the primary ways with which we would traditionally keep water out...I think that’s part of why [participants] gravitated towards the solutions around retreat[ing from the coast], and living with water [strategy. Conversely to that, when it came time to talk about [this community], that was never discussed."

The CRF project team faced difficult decisions about the local versus general focus of forums and forum activities. Interestingly, interviewees noted some of the concerns that factored into conversations amongst the CRF project team, including not-in-my-backyard reactions to local resilience questions and that policy makers desired to see more locally-oriented exercises. That interviewees picked up on both of these considerations suggested that the tradeoffs the CRF project team faced may have been better dealt with through further engagement with policy makers. Perhaps we could have presented alternative formats to policy makers to determine which one may have been more applicable in different contexts. Of course, other project considerations constrained decision making and, as discussed in chapter 4, the CRF project team had limited ability to support forum hosts in their interactions with local policy makers.

For some interviewees, who was at the forums was just as important as the activity. In an interview before a forum, one official expressed concerns about who would show up to forum events at science museums:

"...if a place like the Science Museum puts out information that they want people to come to this one-day event, on a Saturday, and talk
about climate scenarios, my concern is that they’re going to get the people who already think about these issues attending."

By expressing their concerns about who shows up to forums, interviewees highlighted a key facet of the practice of pTA: Reaching and consulting with audiences that are otherwise left out of policy planning processes. The interviewee quoted above later expressed some skepticism about the willingness of unengaged audiences to work through a complex activity like those in the forums. This tension between engaging the unengaged and creating forums that dug into the challenges and complexities of policy making complicated the potential policy relevance of pTA efforts.

Interviewees sometimes expressed more direct skepticism about how much forum exercises could inform policy making within their agencies or departments. For example, one official noted

"Then you have all of the complexities of the potential solutions, or—so it’s just really hard and technical, and there are people who spend their entire careers just focusing on little pieces of it. I think there’s probably just some limitation in terms of what you could practically expect to lead the public through"

Other officials saw opportunity for participants to further engage policy makers, shifting

“I think it could be very valuable if you can connect it to the people who do need it and can use it in a way that they need it but without the specific audience defined. Is it the mayor, or is it the community engineer or whatever the roles are?... if you were able to make connections with those sorts of people in [our community] and could bring some of the participants of the workshop back to present to them in some way, or to
help author a presentation of some sort, I think that could be very meaningful.”

Another official echoed this sentiment, noting that the forum format could be very useful for having conversations with different communities within their city:

“If events with this [pTA] format took place in each of those five areas [of the city], and they were based around neighborhoods, where the tables were neighborhoods where people could get together and get to know each other, and learn that information, I think it could be really helpful.”

Finally, a few interviewees saw the exercise as something to be used internal to their agency or organization to help officials better think about different perspectives that they or community members might hold. Relatedly, one official noted that a few meteorology experts who participated in one of the forums struggled to pin down how to approach value in non-quantitative or non-monetary ways.

Anecdotally, other pTA practitioners have shared that having officials and decision makers present for the forums helps build interest in pTA and helps those officials see how pTA activities can be used as a decision support tool. Indeed, these anecdotes were part of the reason I wanted to conduct interviews with officials who observed the forums. Based on findings from these interviews, it is difficult to draw general conclusions about how the CRF activities might be useful to policy makers in the eyes of officials who only observed the forums. The complexity of the activity was seen as both a positive feature embodying the realities of policy making and as a factor that might limit who might be able to participate. Relatedly, who showed up to forums and how they participated was important to some interviewees but not in a uniform way: Some referenced a desire to engage broader audiences or historically neglected communities while others saw an
audience of the already-engaged as a good target to further climate resilience projects. Interviewees remarked positively on the non-local format as a way for participants to learn and enter a 'solutions-finding' mode of thinking but also regretted that the majority of the forum activities weren't specific to their community.

These mixed results might be due to the very limited number of interviews I conducted. The nine officials interviewed occupied diverse roles, from Chief Resilience Officer of a city of 300,000 to an outreach and education coordinator at a federal extension office, across six different cities facing different hazards and with different levels of resources for thinking about climate resilience and public engagement. Given this diversity, I received a wide range of responses which made both coding and synthesizing the results difficult and limited to very broad level issues. All interviewees noted both positive and negative features and outcomes of the forums, as well as potential outcomes of hypothetical pTA-like activities in their communities. While more interviews would have been valuable, the potential pool of interviewees was limited to officials who observed the forums, which took place for several hours on a Saturday. Some officials who observed the forums declined to be interviewed.

Nonetheless, it is clear that even those officials who simply observed the forums showed interest in the pTA format and potentially different outcomes of forums. Several remarked that they would like to see the activities used internally to their agencies, while others noted that activities specific to their community could be of great value for their planning processes. Most basically, these interviews highlighted the difficulty of creating pTA forum content to be used across a variety of locations while also setting project goals related to policy impact at the local scale. As noted in chapter 4, better preparing or enabling each forum host to work with policy makers in their community could have substantially enhanced how policy officials viewed the forums, with implications for
better connecting public input to policy outcomes. More engagement between policy makers and forum organizers could have better shifted the emphasis of each forum to be more applicable to resilience planning processes in each city. For example, the CRF project team could have helped facilitate brief interviews among forum hosts and local officials to help make decisions about the format of each forum (e.g., one hazard activity and a longer local activity versus two hazard activities), though forum hosts might still not have been prepared to create content to support a more robust local activity. While hindsight might be 20/20, I still struggle to see a clear path to building policy relevant materials across eight sites given the size of this project (e.g., available staff and budget) and the diversity of project goals.

Further, calling for more engagement between policy makers and the CRF project team did not simplify the challenges of incorporating public input into the policy making process. In the next section I describe the data the CRF project collected about public preferences, values, and concerns regarding climate-related hazards and resilience. I also describe the difficulties of engaging policy makers about the results of the CRF forum in Phoenix, AZ.

6.4 Supporting resilience-related policy making through the results of pTA forums

The analysis and communication of preferences and opinions from pTA forums to policy makers and policy making processes is critical to serving the policy support and “informed public opinion” aspirations of pTA. Understanding the policy support function of pTA, in part, means understanding how pTA organizers compile and analyze the preferences, concerns, and aspirations of the public to policy makers. This section outlines this analysis in the CRF project, as well as how I came to decide to not bring this
analysis to policy makers in Phoenix. This section is organized in two parts. The first
overviews the data we collected from participants that could be used to inform policy
making. I then provide a summary of those data from the Phoenix forum. The second
section describes the process by which I considered bringing these findings to officials in
central Arizona, and the many factors that ultimately influenced my conclusion to not
bring it to policy makers. I then discuss how decisions about policy relevance in pTA
weave together forum materials and much broader considerations about local political
and policy communities.

6.4.1 Data collection for policy support

The basic premise of analysis for past pTA projects combines quantitative results
from participant voting exercises with qualitative assessments related to the reasonings
and thought processes of groups of participants (for an illustrative example see Bertrand
et al., 2017 and Tomblin et al., 2017). The quantitative results for the CRF project came
rather directly form the format of the activity. The forum activities asked participants to
work through a specific exercise in which they could vote on a variety of options of
resilience. Those voting sheets make up the quantitative results. Qualitative analysis of
recorded conversations of groups of participants in past pTA projects has primarily taken
the form of public value mapping (PVM). Public value mapping aims to make clear the
values and priorities inherent in science and technological policies (Bozeman and
Sarewitz, 2011). In past pTA projects, PVM has been used to report dominant values
discussed by participants to help contextualize results from group and individual voting
exercises to address questions such as what about a given set of social, economic,
environmental, and technical commitments do participants find valuable or
problematic? Public value mapping helps create a richer technology assessment (as
called for by Sclove, see chapter 1) that unpacks policy and technical commitments so that those considerations can be considered by policy and decision makers.

In the CRF project, considerable time went into the development of the voting exercises for each hazard module (see discussion elsewhere on material development process). From the resource constraint (e.g., coins participants could spend that limited what participants could chose) to the available resilience strategies, the team made rather deliberate choices when creating the voting exercises. But less attention was paid to qualitative data collection. Short of small “explain your choice” prompts in group and individual materials, no systematic qualitative data collection efforts about participants preferences were built into the project. As part of my own research, I collected recordings of table conversations at forums in Hawaii, Alabama, Minnesota, Arizona, and Oregon87. Yet these were limited in myriad ways, as discussed below.

Before I discuss the limitations of the data collected, I want to show how they could provide policy-relevant (or potentially policy-relevant) information about public opinion. Below, I present an analysis of table and individual voting and a PVM-based analysis of participant conversations for the extreme heat exercises conducted in Phoenix, AZ (2017), Portland, OR (2018), and St. Paul, MN (2018)88.

6.5 Voting results: Extreme heat

Participants at each site were recruited through a variety of methods, including advertisements on craigslist, emails to museum patrons, flyers in community centers, and social media. Participants applied to participate. Applications collected basic

87 I selected these sites to because I felt confident I recruit notetakers at each and to collect data at every site using the extreme heat activity

88 I focus on heat here because of the time required to conduct such an analysis and my assessment of what might be most policy-relevant, which is further described below.
demographic data. Each host site used applications to select participants to roughly capture the diversity of the city, region, or state. More participants from the application pool were invited as participants confirmed or declined their attendance. Those who confirmed their attendance received a pre-survey (see chapter 2) including questions about knowledge and interest in climate resilience. Final demographics from participants who attended the forum are presented in the table 6.1. At all three sites, organizers struggled to recruit participants with a high school education or less, Hispanic or Latino participants, and Black participants. In Portland, a substantial portion of participants identified as active members of environmental groups. The Portland forum also included a large proportion of students. The participants at the St. Paul forum were overwhelming white and well-educated.

Participants could use three ‘coins’ to build a resilience plan. For each of three strategies, there was a ‘Plan A’ option that cost two coins and a ‘Plan B’ option that cost one. Participants could not choose both plan A and plan B for the same strategy. They could mix and match a Plan A and Plan B for different strategies or choose the three Plan B’s across all three strategies. Additionally, participants did not have to use all of the coins. In total, participants could choose from 17 different combinations of resilience plans, including not spending any coins at all. The three strategies were Cool the City (CC), Protect Infrastructure (PI), and Ensure Safety (ES). Cool the City plans focused on measures to lower outdoor temperatures, such as shade trees or shade structures. Protect Infrastructure included measures to make electricity grids and transportation

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89 General recruitment practice for past pTA projects emphasized limiting the number of active members of interest groups under the assumption that the perspectives and ideas from these groups are well documented (though maybe not directly addressed) in the policy process (i.e., those ideas are already captured through other inputs into policy and decision making).

90 The resilience plan cards given to participants are available in the appendix.
networks more resilient to extreme temperatures, such as replacing aging power lines. Ensure Safety emphasized measures to minimize the human impact of extreme heat events, including cooling centers and wellness check programs.

Final resilience plans chosen by each table at the three sites are presented in figure 6.1. Across all three sites, participant groups showed a preference for plans that prioritized infrastructure and safety programs, or that spread resources equally across all three strategies. In Phoenix, AZ, all groups chose to allocate at least one coin to PI plans, while all groups in Portland and St. Paul allocated at least one coin to ES plans. Further, tables in Portland and St. Paul chose the same four strategies, only two of which were chosen by tables at the Phoenix forum. Participants in St. Paul overwhelmingly chose the plan that spread resources equally across all three strategies, a result that some participants attributed to their status as Minnesotans.

Individual voting preferences largely matched these patterns. Participants in Phoenix favored measures to strengthen infrastructure, while those in Portland and St. Paul preferred plans with a bigger emphasis on safety measures. Most participants chose to use all of the coins (resources) available to them, an unsurprising finding given the game-like quality of the activity. Results from St. Paul showed a lower diversity of plans chosen by all participants. This could be due to facilitators encouraging participants to use the plan as their preferred plan on their individual worksheet.

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91 The number of participants listed as in figure 6.1 differs from the numbers presented in table 6.1. Some participants did not complete their pre and post surveys or did not check in but still participated. This underscores another challenge of conducting these large events.

92 As one participant noted when asked to reflect on their group’s decision, “Mostly, we didn't wanna disagree with one another. We're Minnesotans.” Besides being a somewhat charming comment on social expectations in the Midwest, this comment relates to the consensus-based nature of the table voting exercises and the different ways people interact with this focus. Notably, individual participants in St. Paul agreed with their tables’ decisions and in their individual voting to a much higher degree than those in Phoenix or Portland.

93 Another explanation could be that some participants did not turn in their voting sheets. Between 11-
Table 6.1 Participant demographics at forums using the extreme heat activity

<table>
<thead>
<tr>
<th></th>
<th>Phoenix, Arizona</th>
<th>St. Paul, MN</th>
<th>Portland, Oregon</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>Percentage</td>
<td>Count</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>53</td>
<td>41</td>
<td>45</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>30</td>
<td>56.6%</td>
<td>27</td>
</tr>
<tr>
<td>Male</td>
<td>23</td>
<td>43.4%</td>
<td>13</td>
</tr>
<tr>
<td>I don’t identify as either</td>
<td>0</td>
<td>0.0%</td>
<td>1</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-24</td>
<td>7</td>
<td>13.2%</td>
<td>5</td>
</tr>
<tr>
<td>25-44</td>
<td>21</td>
<td>39.6%</td>
<td>13</td>
</tr>
<tr>
<td>45-64</td>
<td>18</td>
<td>34.0%</td>
<td>12</td>
</tr>
<tr>
<td>65+</td>
<td>7</td>
<td>13.2%</td>
<td>11</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than $25,000</td>
<td>9</td>
<td>17.0%</td>
<td>4</td>
</tr>
<tr>
<td>$25,000 to 49,999</td>
<td>11</td>
<td>20.8%</td>
<td>10</td>
</tr>
<tr>
<td>$50,000 to 99,999</td>
<td>20</td>
<td>37.7%</td>
<td>16</td>
</tr>
<tr>
<td>$100,000 or more</td>
<td>13</td>
<td>24.5%</td>
<td>11</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No high school degree</td>
<td>1</td>
<td>1.9%</td>
<td>2</td>
</tr>
<tr>
<td>High school degree or equivalent</td>
<td>4</td>
<td>7.5%</td>
<td>0</td>
</tr>
<tr>
<td>Some college</td>
<td>18</td>
<td>34.0%</td>
<td>8</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>21</td>
<td>39.6%</td>
<td>16</td>
</tr>
<tr>
<td>Graduate or professional degree</td>
<td>9</td>
<td>17.0%</td>
<td>15</td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>30</td>
<td>56.6%</td>
<td>22</td>
</tr>
<tr>
<td>Unemployed</td>
<td>5</td>
<td>9.4%</td>
<td>0</td>
</tr>
<tr>
<td>Retired</td>
<td>9</td>
<td>17.0%</td>
<td>9</td>
</tr>
<tr>
<td>Student</td>
<td>4</td>
<td>7.5%</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>9.4%</td>
<td>5</td>
</tr>
<tr>
<td>Educator?</td>
<td>11</td>
<td>20.8%</td>
<td>5</td>
</tr>
<tr>
<td>Environmental group member?</td>
<td>4</td>
<td>7.5%</td>
<td>22</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>3</td>
<td>5.7%</td>
<td>0</td>
</tr>
<tr>
<td>White, not Hispanic</td>
<td>31</td>
<td>58.5%</td>
<td>36</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>8</td>
<td>15.1%</td>
<td>0</td>
</tr>
<tr>
<td>Black, not Hispanic</td>
<td>4</td>
<td>7.5%</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>3.8%</td>
<td>2</td>
</tr>
<tr>
<td>Mixed race</td>
<td>5</td>
<td>9.4%</td>
<td>1</td>
</tr>
</tbody>
</table>

32% of participants left their voting sheets partially incomplete.
Individual preferences differed from group preferences about as much as they agreed in both Phoenix and Portland (Table 6.2). Participants in St. Paul agreed with their table
preferences twice as much as they disagreed. As mentioned above, however, this could be due to facilitator instructions. Importantly, providing an opportunity to vote as a table and via individual voting sheets provided participants the opportunity to both seek consensus while maintaining a mechanism to dissent from group decisions, or to challenge the egalitarian-consensus model on which group decisions depended\(^\text{94}\).

Overall, almost a third of participants at every site disagreed with their group and participant plans emphasized a diversity of strategies to address extreme heat. Further, participants had two chances to vote on their personal plan, meaning they could change their preferred plan after discussion amongst their table and after seeing visualizations showing the potential impacts of their group plan. At all three sites, 35-52\% of all participants changed their plan.

Even with these differences in both individual and group voting results, participants did not show a dominant preference for one strategy or another. For comparison, table voting for other hazards showed a dominant preference for one set of strategies over others: Fifty eight percent of tables invested two coins in green infrastructure programs to cope with extreme precipitation and half of tables invested two coins in managed retreat strategies to address sea level rise. That no dominant preference emerged from the extreme heat exercise compared to the results for the other hazards shows that participants hold a diversity of perspectives on how to address extreme heat.

Based on these results, policy makers concerned about resilience to extreme heat events should note that public audiences expressed interest in a variety of measures, including measures to mitigate extreme heat (e.g., combat the urban heat island effect), adapt to hotter conditions (e.g., protecting critical infrastructure), and safeguarding

\(^\text{94}\) For an interesting discussion and case study of different participatory mechanisms structured around consensus, majoritarian, and individualist models, see Bellamy et al., 2017.
human well-being during extreme heat events. Quantitative results are inherently limited in their ability to show values, ambivalences, and concerns of residents in relation to these strategies. Next, I present a summary of qualitative data followed by analysis relating voting exercises to qualitative results to provide a more nuanced account of participant preferences, concerns, and values.

Table 6.2 Participant agreement with table plans.

<table>
<thead>
<tr>
<th></th>
<th>Phoenix, AZ</th>
<th>Portland, OR</th>
<th>St. Paul, MN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agree with table plan</td>
<td>34%</td>
<td>41%</td>
<td>60%</td>
</tr>
<tr>
<td>Disagree with table plan</td>
<td>37%</td>
<td>37%</td>
<td>29%</td>
</tr>
<tr>
<td>Unknown*</td>
<td>29%</td>
<td>22%</td>
<td>11%</td>
</tr>
</tbody>
</table>

* Unknown represents participants who did not turn in a final voting sheet

6.6 Qualitative results: Extreme heat

I recorded group discussions at three tables in Phoenix, Portland, and St. Paul. Transcribed conversations were coded following an open coding approach to highlight dominant themes emerging in participant discussions (Saldaña, 2016). Due to resource constraints, I conducted all coding and did not enlist the aid of a secondary coder to check intercoder reliability.

Across all three sites, seven dominant categories of codes emerged from my analysis. Table 6.3 presents these major categories and more specific codes for each. Participant conversations emphasized three categories in particular, Effectiveness and Timing, Electricity and Infrastructure, and Health and Safety, in particular. I discuss these three categories in more detail below and present pieces of participants’ discussions to show how participants were referencing these categories.
### Table 6.3 Major categories from participant discussions

<table>
<thead>
<tr>
<th>Category</th>
<th>Related concepts</th>
<th>Illustrative example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness &amp; Timing</td>
<td>Reactive Long/Short term solution Efficacy</td>
<td>“We can end up putting in all those trees and all that plant life but...we’re just assuming that all these trees are going to survive... Which is why I’m still reallocating the extra money to [infrastructure upgrades]” – Phoenix</td>
</tr>
<tr>
<td>Cost</td>
<td>Affordability Expensive Affordable</td>
<td>“...you're still reliant on maintaining that [cooling center] system, so it's gonna always be a money siphon of having to rely on the air conditioning...what happens if funding goes away?” – St. Paul</td>
</tr>
<tr>
<td>Equity</td>
<td>Hazard effects on certain groups, Strategy effects on certain groups</td>
<td>“If we’re looking at the people that wouldn’t necessarily have the resources to be able to put up [shade] structures on their own or put up shade on their own, we’re protecting them; we’re protecting the community.” – Phoenix</td>
</tr>
<tr>
<td>Electricity &amp; Transport</td>
<td>Power grid Electricity generation Transportation</td>
<td>“If this is going to be sustainable, you need your power grid to keep working... There’s already concerns at the current loads of its sustainability and longevity.” – Portland</td>
</tr>
<tr>
<td>Reduce Outdoor Temps</td>
<td>Outdoor temperature Trees or built shade Evaporative cooling Urban heat island</td>
<td>“I think just based off of personal experiences. I have been to communities where there’s heat zones... I do believe that having more green spaces and trees does make a difference outside. If people can’t be in com-munity centers, at least they can be outside.” – Portland</td>
</tr>
<tr>
<td>Environment</td>
<td>Impacts on wildlife, ecosystems Changes to environment Increased water temperatures</td>
<td>“Well, just changes in temperature means that habitat that used to support X types of animals, no longer does.” – St. Paul</td>
</tr>
<tr>
<td>Health &amp; Safety</td>
<td>Exposure Safety Coping mechanism</td>
<td>“...limit outdoor work hours too, because so many people get heat-stroke. My fiancé is in construction, and people pass out all day long... He’s been out there for three summers, and this was really bad. People got really sick this summer.” – Phoenix</td>
</tr>
</tbody>
</table>
6.6.1 Effectiveness and Timing

Participants questioned, commented on, or otherwise discussed the potential effectiveness and timing of a given resilience strategy. Discussions of band-aid solutions and long-term strategies highlighted participant concerns with the feasibility and appropriateness of strategies to address both the impacts of extreme heat and factors that make extreme heat worse, such as the urban heat island (UHI) effect. Participants noted that tree planting programs associated with Cool the City strategies, for example, could only be successful if the city, neighborhood, or residents properly maintained the trees. Some comments about effectiveness stemmed from debate about dealing with causes rather than symptoms of extreme heat, short-term measures to protect health, for example, versus longer-term strategies to create cooler environments. In St. Paul, one participant noted the urgency of dealing with the impacts of extreme heat:

“I’d like this [strategy] if there was more time and it wasn’t already impacting [residents], but because it already is, I just think you have to do a little bit of each [strategy]. You don’t want to completely ignore the long-term infrastructure that might eliminate the problem”

Shortly after, this group continued to debate the impacts of air conditioning versus the need for long-term planning to cool the city:

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95 Participants in St. Paul noted the region’s struggles with the Emerald Ash Borer, an insect causing substantial damage to street trees in the Minneapolis and St. Paul, Minnesota, a problem even my hosts during my trip to the St. Paul forum noted.
Participant A: “I might disagree with it, being reliant on air conditioning. This [strategy] will help maintain that [reliance]. It might push the problem along, but it gets results...”

Participant B: “We just can’t keep pushing it down the road though without doing anything that’s long term.”

Participants also questioned whether or not some strategies would work at all. In Phoenix, one participant expressed concern about the impact of an extreme heat hotline program:

“...[ensure safety] plan B, it kind of sounds like it’s very passive, like “Hey, we’re gonna help you but we’re really not gonna help you in the long run. We’re just providing a phone number for you”. You know, it’s really—there’s no real action on that plan.”

Finally, participants referenced the complementarity of some strategies, noting that plans that included a variety of solutions would help bolster better outcomes. These comments demonstrated the value of diverse strategies for addressing extreme heat. One participant in Phoenix, for example, stated the following to justify their decision to allocate some resources (one coin) to all three strategies:

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96 This table, like a majority of groups at the St. Paul forum, ultimately chose to invest some resources in all three strategies.

97 While this chapter is about policy relevance, this particular example shows how participants pushed back on the materials generated through expert consultation. This counters the idea that we were over-framing discussion through materials.
“[The strategies] kind of all go hand in hand. Infrastructure is almost essential, so there were some infrastructure that would [need to be] solidified and built around, but also there’s a point to having more shade in the city, kind of getting rid of the heat island effect. Then ensuring safety, just making sure that we can address some local issues, with ensuring safety.” - Phoenix participant

Another participant at the same table related the complementarity of different strategies to testing out different strategies to see what works:

“[All plan B’s] would end up being a little bit easier to execute and end up selling to the general public as well, and I think what it would come down to is you would—I don’t want to say “buy time”, it might end up saying which side would end up working out better.” – Phoenix participant

Codes related to effectiveness and timing were by far the most dominant codes by frequency, showing that participants felt comfortable criticizing the plans provided, but also argued for strategies they thought to be most appropriate based on those critiques.

6.6.2 Electricity and transportation

Codes related to the category electricity and transport were dominated by discussion of the electricity grid (e.g., What would make the grid more reliable? How is the grid impacted by other strategies?) and the primacy of electricity for keeping people cool
during extreme heat events. A participant in Phoenix, for example, felt that the far-reaching impact of the electricity grid meant that it had to be a focus on any resilience plan:

“I felt like doing at least a minimum for the infrastructure was necessary. If we have blackouts in the future, that’s—and it affects everybody in the city. Doing something to prevent that I think was required.” – Participant in Phoenix

Many participants also saw electricity and transport infrastructure as a basis for other responses. Measures to subsidize AC bills for low income residents don’t matter much if the power goes out during a heat wave. Likewise, cooling centers might be inaccessible if public transit systems are slowed or stop during heat waves. As one participant in Portland noted,

“A lot of these [other resilience strategies] increase the demand for electricity without providing any great support for the grid, so if more people are using the grid because they have access to subsidies and things like that, there’s gonna be a higher demand and a higher likelihood that the system would fail.” – Participant in Portland

In some cases, concerns about grid reliability arose from specific references in the forum materials, which highlighted that the grid (as with infrastructure across the U.S.) is in need of repair:
“...you need your power grid to keep working. When we were introduced to our [case study] city, one of the concerns was stated and it comes up in a number of these, as well, is that we’re on an aging power system. There’s already concerns at the current loads of its sustainability and longevity.” – Participant in Portland

Some participants also connected concerns about the electricity grid to the need for renewables, micro grids, or other energy technologies of interest to them:

“I admittedly maybe giving extra weight to the line ‘new power sources will help the electricity grid keep up with demand’ cuz I’m reading that and going, ‘Okay, so that’s things like solar, and wind, whatever,’ but possibly.” – Participant in Portland

Both renewables and microgrids were part of the extreme precipitation forum materials but were not specifically addressed in the heat materials. Participants might have referenced these because of their presence in other activities, or simply because they were interested in these systems anyway.

Despite the prominence of this category of codes in participant conversations, it did not correspond to overall high support for the Protect Infrastructure strategy (see table and individual voting results above)\(^8\). This underscores the difficulty of sorting out these strategies from one another. As the sample quotes above demonstrate, discussions of

\(^8\) One table in Phoenix that chose a plan emphasizing Protect Infrastructure spent more time discussing equity, as opposed to specifically discussing electricity and transportation.
electricity infrastructure included other resilience measures, concerns for vulnerable
groups, and broader concerns about energy systems.

6.6.3 Health and Safety

Participants emphasized human health and safety throughout their discussions.
Participants discussed health and safety in general terms, highlighting that the safety of residents needs to be a priority in planning:

“...when you’re talking about heat-related events in a warming climate,
like the one we live in, it makes more sense that we should – in my mind
– that we should prioritize the safety of citizens who are at risk of
climate change, which is something we can’t reverse at this point.” –
Participant in St. Paul

But conversations also revolved on the impacts of extreme heat on specific groups who may be more vulnerable or more exposed, overlapping with codes related to equity. For example, a participant in Phoenix discussed the safety of homeless people in relation to efforts to cool the city through shade structures and tress:

“I don’t understand how the homeless are going to be okay with nowhere
to go and no safety...Even if they have some trees during the day.” –
Participant in Phoenix

Another Phoenix participant expressed concerns about outdoor worker safety in arguing for Ensure Safety measures, drawing on the experience of her fiancé:
“I think [Ensure Safety] Plan B too, because they limit outdoor work hours too, because so many people get heatstroke. My fiancé is in construction, and people pass out all day long. Over the summer, it was terrible. It is just the hardest. He’s been out there for three summers, and this was really bad. People got really sick this summer.” – Participant in Phoenix

In Portland, participants discussed the impact of heat on housebound elderly residents, referencing the heatwaves in Chicago in the mid 1990’s:

“...[one] thing that got me for ensure safety is the check-in program, the wellness checks. Then they cited the background materials, the ‘95 Chicago heatwave.”

“Right, 700 people.”

“Yeah, and one of the things they were saying is that, disproportionately, the number of people who were killed as a result of that were housebound elderly people who needed those kind of wellness check programs that just weren’t in place, or weren’t funded nearly well enough.” – Participants in Portland

A participant in St. Paul more generally referenced the impact of heat on those who can’t afford air conditioning, or who can’t afford to run it:
“... the injustice of people with less money suffering in that way just because they can't afford air conditioning, I could not stomach, so I put—I did the two dollars to the plan A [Ensure Safety].” – Participant in St. Paul

Another participant in Portland similarly referenced the impact of heat on communities of color and low-income residents, noting that heat presents similar challenges as other public health concerns:

“One of the things I heard from city planners, too, is not just about housing centers, but about investing in public health, like asthma issues, things that are happening, disproportionately affecting communities of color and low-income communities, and doing it now.” – Participant in Portland

The overlap of codes related to equity and health and safety demonstrate the variety of outcomes related to planning for heat embodied in participant conversations. In short, participants wove together concerns about safety and health, impacts on specific groups, and specifics about the Ensure Safety plans from the activity.

6.6 Discussion and recommendations for policy and research

This analysis serves as valuable input for policy makers considering actions related to extreme heat. Participants shared considerable concern for the effectiveness and longevity of heat-related resilience strategies and prioritized a range of actions to deal
with the distributed nature of heat impacts. Further, participants cited a need to test
different strategies in response to the impacts of extreme heat, suggesting that policy
makers could consider a variety of pilot-projects alongside communities with different
needs to inform decision makers. Presented with a challenging planning scenario and
uncertainty about the future (conveyed through unintended consequences built into the
exercise) participants emphasized effectiveness and demonstrated their willingness to
see through a variety of strategies to ‘see what works.’

No dominant preference emerged across sites, though participants in Phoenix
showed a higher preference for strategies emphasizing protecting infrastructure while
those in Portland and St. Paul emphasized public safety measures. At all sites,
participants expressed concerns about addressing the short-term impacts of heat while
combating factors (such as UHI) that compound extreme heat over longer time scales.
Thus, policy makers should be cognizant of the need for both short-term and long-term
measures.

Policy makers should also consider more specific engagement with communities
before deciding on any given heat resilience strategy. Conversations about effectiveness,
in particular, highlighted the challenges of defining what ‘effectiveness’ might mean in
different contexts. Some participants emphasized human outcomes (e.g., heat-related
deaths and illness) while others focused on factors that contribute to those outcomes,
such as electricity grid stability or outdoor temperatures. Accounting for various ideas of
effectiveness, and transparently documenting that accounting process, should be a
priority for policy makers. Perhaps this statement from a participant in Portland best
summed the discussions about effectiveness and timing:
**To me, the nature of a heat problem being wherever you are, you are gonna be under hot temperatures, I feel that you need to attack this problem is as many ways as possible.** – Participant in Portland, OR

Additionally, policy makers could use this assessment to augment existing plans. For example, the City of Phoenix (and other municipalities in central Arizona) have committed to greatly increasing tree canopy cover\(^99\). Yet participants in Phoenix expressed skepticism about the effectiveness of shade tree programs in the long-term, citing concerns about maintenance and the limited impact trees may have on keeping vulnerable people safe. Despite this skepticism, a good portion of participants in Phoenix still chose to allocate resources to shade measures. Put more simply, participants like the idea of trees as at least part of a resilience strategy for heat, particularly when it’s coupled with other strategies. But participants want to make sure the impact of tree planting programs is sustainable. Can those trees be maintained? Where will they be located and who will make those decisions? Engaging communities and partners in conversations about these considerations before engaging in a large-scale effort to increase tree canopy could better link the city’s goal of increasing canopy to outcomes that drive community concerns.

For researchers or others who wish to support policy making around heat resilience, participant conversations about effectiveness reveal a strong concern for ‘what works’ around a variety of outcomes important to heat resilience. What reduces mortality and heat-related illness? What reduces outdoor temperatures? And what measures best ensure that infrastructure failures don’t compound the impacts of extreme heat?

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\(^99\) See the City of Phoenix Tree and Shade Master Plan (2010) available here: [https://www.phoenix.gov/parksite/Documents/PKS_Forestry/PKS_Forestry_Tree_and_Shade_Master_Plan.pdf](https://www.phoenix.gov/parksite/Documents/PKS_Forestry/PKS_Forestry_Tree_and_Shade_Master_Plan.pdf)
Participant (or even policy maker) desires to know what works leaves substantial challenges for thinking about what effectiveness means. Given the complexity of extreme heat and its impacts, models linking an increase in shade to a reduction in heat-related mortality should be viewed as suspect. As researchers think about their role addressing the impacts of extreme heat, they should consider directly engaging with community members who can then help shape research to address priorities important to them. Yet this still leaves open questions of how to bridge research to larger scale (e.g., regional) planning for extreme heat.

6.7 Bringing results to policy makers

The above sections outline the types of data collected at forums that can inform policy making. But collecting and analyzing those data is only part of the process of using it to inform policy. In this section, I briefly describe how the CRF project team disseminated voting results from each forum. I then discuss how results from past pTA projects have been communicated to policy makers and my experience trying to replicate these efforts for the climate resilience forum in Phoenix.

To disseminate results from the forums to policy makers and public audiences at each site, the project team created a slide deck containing 1) graphics of individual and group (i.e. table) voting for each hazard, 2) participant demographics, and 3) some figures related to participant agreement with their group's chosen plan and how many participants changed their votes throughout the activity. Reports were shared with participants and local officials who attended the forums at the discretion of the forum host institution. These slide decks included links to specific resilience-related efforts or

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100 Changes in participants' selected plans shows that participants were considering evidence and other people's opinions to revise their selections. In other words, it's a useful metric of the quality of deliberation.
resources in each community, which we sometimes sourced from participating policy makers. Generally, our engagement with local officials about forum results ended there. If local officials (or participants) had more specific questions, we were open to further explore the data. This rather limited dissemination of results contradicts the emphasis on policy making outcomes earlier in the project.

For the forum in Phoenix, I planned to conduct further analysis of the results alongside policy makers in Phoenix, AZ through a workshop or meeting. This effort never happened, though; a decision I return to below. At this analysis workshop, project team members, local resilience officials, and other stakeholders would co-create research questions about the results we collected. Feedback and ideas from stakeholders would drive further examination of the voting and qualitative data collected at the Phoenix forum. This workshop would answer questions such as: What is interesting to policy makers? What stands out or what’s missing? And what else would policy makers like to know about these results? Engagement around these questions could help guide further analysis, uncovering ideas, themes, or trends that might help policy makers work through policy decisions.

6.7.1 Building on success of NASA forums

The desire to do this type of engagement with policy makers and other stakeholders stemmed from prior pTA efforts. In particular, meetings and phone calls between ECAST and NASA for the Asteroid Redirect Mission (ARM) forums proved incredibly fruitful for refining the analyses and data generated in those forums. As outlined in (Tomblin et al. 2017) and as reiterated by ECAST affiliates with whom I consulted, engagement between NASA and ECAST on forums results allowed ECAST to focus analyses on concerns from
NASA. Discussions with NASA highlighted several concerns not addressed in initial write-ups and presentations of forum results. Those discussions led ECAST to create:

“...a further analysis to answer questions concerning the effects of overall forum framing on participant choices (did the framing bias participants towards Option B), participant ability to overcome misconceptions, inconsistencies in forum implementation (why did the Arizona forum have groups voting for Option A, but not Massachusetts), and the processes by which participants reasoned out their choices,” Tomblin et al., 2017, p 159.

Further, Tomblin et al. (2017) noted:

“In the end, the iterative dialog between ECAST and NASA did generate a rough public value map that highlighted the socio-technical complexity that lay citizens introduce into an assessment of emerging technology, which NASA managers could reflect on in relation to their decision about Option A versus B...the combination of quantitative and qualitative results helped managers consider statements written by a broader group, better positioning themselves to consider what would benefit the public at large.” p 159-160

The back-and-forth between NASA and ECAST helped to focus analysis on mission-relevant considerations. In doing so, it also furthered the legitimacy and salience of pTA results in the eyes of NASA decision makers.
Given this success, conducting a similar effort for the CRF forum in Phoenix was a priority for me. In the lead up to the forum, I tried to connect the Phoenix CRF forum to ongoing resilience planning by city, county, and state officials in a variety of ways. Officials helped shape content for the heat and drought activities used at the Phoenix forum. They provided feedback on draft materials and participated in numerous one-on-one interactions about the activities and forum content. To create the ‘local question’ for the Phoenix forum, I worked with ASU and community partners on a separate effort to engage local representatives from the urban planning community in central Arizona, with the premise that urban planners could submit their ideas for how to deal with heat and drought that we could subsequently put in front of public audiences at the forum. I also participated in numerous other workshops held by other ASU researchers to build connections between on-going resilience efforts and our forums. Finally, I invited local officials and resilience planners to speak at the forum and observe participant conversations.

At the conclusion of the Phoenix forum in September 2017, however, none of these interactions resulted in concrete avenues to connect the forums or results to specific planning efforts. Nor did local officials request more details about the results. Perhaps I needed to be more patient, but I was frankly disappointed by how little traction the forums received in the local policy and resilience planning community. Yet I was still interested in connecting the forums and forum results to local policy makers. I viewed the NASA project as an aspirational example that could be replicated for the CRF forum in Phoenix. In the lead up to and time immediately after the Phoenix CRF forum, I

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101 This effort ultimately didn’t work out as well as I had hoped, which I discuss in detail later.

102 Notably, the NASA project was a very different project than the CRF project. The funder for NASA was also the client; NASA was interested in the forum results as a form of decision support from the start. The CRF forums had a funder (NOAA) different from the potential clients (local resilience planners). And indeed, we had little buy-in from local resilience planners and policy makers at the beginning of the project.
turned my attention to conducting similar engagement with policy makers in central Arizona.

I talked to three ECAST affiliates familiar with the public values mapping approach and with the back-and-forth analysis ECAST conducted with NASA but who were not involved with the CRF project. Based on their feedback, which largely reiterated what was already captured in published reports and literature on the NASA project, I sought to create a similar effort to co-create an analysis of the Phoenix CRF forum results. I also continued engaging with other ASU resilience-related projects in an effort to build interest in the forum results. I presented a brief overview of the forum and results at a briefing with City of Phoenix officials just 2 weeks after the forum. To support the analysis of forum results, I sought resources to transcribe group conversations from the forum and continued researching how NASA and ECAST partners coded materials and participant transcripts to conduct a public values mapping analysis. I developed several draft agendas for a workshop with resilience planners, agendas that includes potential activities and invitees. From here on, however, the need to conduct a workshop and my thinking around this subject became muddled.

I began to doubt how useful or relevant the results might be to local officials. My initial skepticism stemmed from the structure of the forum activities. The exercises were dense with policy and strategy considerations. One of the voting options for the extreme heat activity included new power plants, road and bridge upgrades, and preparations to protect infrastructure from wildfires in one option. Participants voting for this option might be concerned about one of these considerations, or all three. Recordings of participant conversations could be used to explore why participants might have chosen

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Buy-in largely remained flat when the forums actually happened, as described above. I was certainly aware of these differences at the time but didn’t note or acknowledge them in my own project notes or reflections.
that option, but this was only true for groups whose conversations we recorded (4 of 9 at the Phoenix forum).

As I thought through these considerations, I struggled to contextualize written comments on the voting sheets or the aggregate voting data from participants in a way that decision makers might see as valuable or useful. What can we learn about participant values from aggregate voting exercises with such complex structure? As someone intimately familiar with the materials we put in front of participants (or perhaps because of this intimacy), I was distressed that I couldn’t see how to package voting results in a way that might start discussion with policy makers or encourage policy makers to reflect on the choices they faced. Furthering my own skepticism about the exercises, one policy maker who attended the forum commented that he wished the forum was more specific to strategies being considered by local governments103.

Other concerns emerged when I began coding transcripts of participant conversations. A good 60% of any transcript consisted of participants just reading materials or engaging in conversations that were quick or focused on the logistics of the activity. These initial transcripts left me a little disillusioned: How was I to take these conversations to local officials and say, “this is important.”? Even when conversation was robust and on-topic, it was difficult to sort through and make the content understandable as a decision support tool. For example, there are many ways one might interpret the statement, “we’re just assuming that all these trees are going to survive,” as an assessment of policy options. Is this participant arguing that the city couldn’t maintain the trees? Or that the community at-large couldn’t maintain trees? Or is this a larger comment about the longevity of one solution over another? At root, my concerns

103 Other policy makers who observed forums in other locations expressed a similar concern.
centered on *what the data we collected could actually tell us about participant values.*

What can we learn about the values, concerns, and ambivalences of participants from the voting data? What about the analysis of participant conversations?

Two things are missing from my reflections from this period. First, there is little mention of my experience at the actual forum. Other team members and I were very happy with the quality of participant conversations. In looking at the written transcripts, I became much more skeptical of those conversations despite our rosy on-the-ground assessment during and immediately following the forum. Second, I never mention what, exactly, I thought decision makers *would* find useful, just that what I was seeing from the results didn’t seem useful. How could I be comfortable putting these results in front of policy makers? While ideas about actionable science permeated the project in its early stages, I did not once write in my notes or coding memos about my criteria for policy relevance as I was conducting the analysis.

Further, most of my reflections about the potential utility of collected data for decision makers came *before* I actually finished an initial qualitative analysis and largely *before* I showed results to other ASU researchers working on resilience-related projects. In other words, I had rushed to judge the potential salience of our data before I was familiar with those data and before I solicited feedback from either the project team or others who might be in a position to judge the salience of the data. My skepticism and rush to judgement stemmed partially from my familiarity with the topic. I’d spent months researching resilience to extreme heat and drought. I was immersed in the subject and perhaps placed too much trust in my own judgement about what local officials would or would not find interesting or salient.

Considerations about social capital also entered my thinking. Asking policy makers and officials for feedback, particularly through in-person conversations, requires their
time, which is a scarce resource. Would it be worth more of their time to review results that I viewed with skepticism? Beyond time concerns, other project needs competed for my time to complete the analysis. Through winter 2017 to spring 2018, I helped the project team update the forum materials, create a simplified format for visualizations, and support the six sites hosting forums in 2018. Coordinating data collection at four of those six sites, and interviews with policy makers at them, also required my project time. Competing interests and goals in a project with many moving parts forced me to make decisions about where to dedicate my time. Only by late spring 2018, I completed an initial analysis of voting and participant conversations from the extreme heat portion of the Phoenix forum.

Personal concerns and time commitments aside, a third factor beyond my control complicated any efforts to co-produce an analysis of results from the Phoenix forum. The broader political context of drought and heat planning in central Arizona proved challenging to navigate. Drought in Arizona is a very crowded and highly political issue. During 2017-2019, the water community in Arizona was particularly focused on the creation, negotiation, and approval of the Drought Contingency Plan (DCP) governing Colorado River water use by several states. While some municipal offices, who may not be involved in conversations about the DCP, might find value in discussing policies (and participant reflections) about household water use, the forum activity included broader considerations about emergency planning and securing additional water resources, topics distinctly beyond the scope of thinking about household water use. I thought involving policy makers in a discussion about the drought results would be difficult due to the household-level focus of existing drought-related partners and the existing political and policy landscape around drought.
Meanwhile, several groups of public officials and researchers were working on efforts to address the impacts of extreme heat. The Central Arizona-Phoenix Long-Term Ecological Research Program was conducting scenario workshops on hotter futures. Researchers associated with ASU’s Urban Resilience to Extreme Events project were partnering with local officials to conduct visioning workshops with residents and stakeholders on extreme heat. Other researchers from ASU were assisting with the City of Phoenix’s application to a major philanthropic organization with an explicit focus on building resilience to extreme heat. Many of these projects were tied to additional efforts headed by non-governmental organizations such as the Nature Conservancy and other government units, such as the Maricopa County Department of Public Health. While the drought space was too well developed and institutionalized to squeeze into, the heat space was simply crammed with projects, most less than a few years old. Given the crowded space and given my role as a graduate student working with a science museum and a distant federal agency, I struggled to create my own connections to local officials. I relied on other ASU researchers working with local officials to create connections between forums and other efforts. But social capital with important gatekeepers is scarce, and I frankly didn’t want to waste it when I was not confident in our ability to deliver a valuable results analysis workshop.

The combination of my own skepticism about the relevance of the data, the time required to complete the public values mapping of transcripts, and challenges working with policy makers fed my decision to abandon the idea of conducting iterative analysis of the results alongside stakeholders. Importantly, the timeline of writing this dissertation and building connections with resilience planning efforts don’t entirely mesh. In 2018, a fellow student working on heat issues provided a short report about the forum results to the City of Phoenix, which she described as “well-received.” Further, she noted city
interest in results in other personal communications to me and we’ve recently discussed the best way to bring results to the city. Continued conversation, plus a vocal and well-connected advocate and gate keeper, might lead to the use of results in policy making for resilience in Phoenix.

6.8 The Prop 127 project and policy relevance

I’ve dedicated most of this chapter to the CRF project and how the ideal of policy relevance influenced various pieces of that project. But the Prop 127 project warrants very brief discussion with regards to policy relevance, though not in the same manner as the CRF project. Proposition 127 was a very explicit policy choice sent to the voters of Arizona in 2018. Voters could choose among three very discrete choices: Vote yes on the policy, vote no, or not vote at all. For this reason, the Prop 127 pTA effort was by default policy relevant, and indeed many who chose to attend the forums about Prop 127 did so to help them reach a conclusion about how to vote.

Beyond this very direct policy relevance, the Prop 127 project showed that pTA-style efforts can be implemented in a relatively short amount of time on a pressing and contested issue. Development of the materials took about 3 months of work by one individual (me) working about 10-20 hours per week. This condensed timeline demonstrated that the pTA model can be adapted rapidly for an issue of emerging importance. Further, it showed the applicability of pTA-style forums to highly contested and politicized issues where public engagement is often limited to interactions with media (or social media), a handful of question and answer-style townhalls hosted by the Arizona Secretary of State, or advocacy-oriented events.

Engaging in hypotheticals (particularly in my dissertation) is of course a risky game. Based on the success of the Prop 127 project, however, even a modest project budget of
$20,000 and the dedicated time of two project planners/researchers for three months could have facilitated a half dozen forums that could reach upwards of 150–200 people. Better executed outreach to share forum results could have more widely distributed both the forum issue guide and forum results to help others in Arizona reach their own conclusions about the proposition. In short, this pilot-scale project demonstrated the policy relevance of the Prop 127 forum project but also the potential policy relevance of pTA-style engagements for other issues facing the state. The biggest unknowns in this equation relating policy relevance to pTA might be scale and topic. Perhaps the next general election may include a proposition suitable for a larger scale pTA effort. While past pTA projects have focused on specific decision-making clients (e.g., NASA) or funder-relevant topics (e.g., climate resilience), the Prop 127 project served as a pilot project for empowering citizens who vote on questions that science can inform but cannot answer.

6.9 The practice of pTA and policy relevance

This chapter discussed how the ideal of policy relevance impacted the CRF project. First, I discussed how policy relevance interacted with various pieces of the CRF project, ultimately shaping the forum activities in ways that were less relevant to policy making at the local scale. Then, I presented how policy makers and officials viewed the forums, noting that their opinions were diverse, that they largely saw opportunity in the model, but that few direct lessons for policy making came from the forums. I then described the results from the three forums focused on heat, highlighting some major takeaways for policy makers and researchers. I described my skepticism about the results of the forums that factored into my decision not to pursue further engagement with policy makers about our results. This skepticism centered on three considerations. First, the structure
of the voting exercise incorporated lots of factors into one voting option, making it
difficult to interpret participants' preferences. Second, I encountered challenges
interpreting transcripts of forum conversations in a way that would help policy makers
understand the values and concerns of participants. The first two considerations
contributed to a third: How would the data collected from forum participants be a
substantive input to policy and decision making? Past pTA project's suggested the
answer to that question was give policy makers the results and see what questions they
ask but the decision to do so was not easy given my concerns and variety of social and
organizational realities about policy making for resilience in central Arizona.

The findings from this chapter highlight two lessons for the practice of pTA. First,
successes in format from one pTA project cannot always be readily transferred to
another. A back-and-forth analysis between NASA and ECAST undoubtedly helped
further the policy support goals of the NASA project. But the NASA and CRF projects
were fundamentally different projects from the start, meaning the know-how and
approach from NASA was not readily transferable to the CRF project. The Asteroid
Redirect Mission activity for the NASA forums, for example, included a discrete choice
between two missions plans NASA officials were already considering. The CRF forum
activities, on the other hand, included a variety of options that participants could chose
from, all containing several specific resilience measures, which may or may not have
been under consideration by policy makers in cities that hosted forums. For the NASA
forums, NASA was the funder and the agency interested in the policy support function of
pTA. In the CRF project, the funder was entirely separate of the policy makers who might
use the results as policy support. Further, those policy makers were distributed amongst
many agencies in many cities and brought diverse professional concerns and
backgrounds to the forums. Further, most of the officials involved in the project
expressed only limited interest in the forums as a policy support tool. Involving officials in the creation of CRF project content did not necessarily translate to sustained interest in the forums or a desire to use the results (or at least not yet).

Second, the policy relevance goals of pTA depend on the ability of practitioners to utilize very different sets of competences and meanings to create working relationships with policy makers. In the absence of established relationships with potential policy making clients, the ability to put on a good event and write a report was very separate from policy impacts. We built a great cart but had no horse to pull it. In some cases we did have relationships with resilience planners and policy makers or even an advocate within those groups but other project goals or external factors limited our ability to use the forums as an input to policy making.

Of course, all of this discussion about the policy relevance of the project skips one major consideration: The CRF project or activities developed as part of the project could still lead to policy impacts through relationships built through the project or the use of the activities in future planning processes. Several of the host science museums have reused the forum activities. Project partners from the Northeastern University took the CRF forum activities to policy makers in one community in Massachusetts as a way to start community conversations about resilience104. That community ultimately did make a resilience plan for dealing with the impacts of sea level rise, though the connections between that process and the use of the CRF forum activities are unclear.

To continue to pursue policy relevance and policy impact through pTA projects that lack defined users would require practitioners to both learn from the lesson of the CRF project (i.e., lacking a client proved challenging to get forum results to policy makers)

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104 Personal communication, Brian Helmuth.
and build relationships (or empower host institutions to build relationships) with differing policy-making communities. Compounding these challenges is the difficulty of measuring policy relevant outcomes in any pTA project. The use of CRF activities by partners at Northeastern University to support resilience planning is undoubtedly a productive outcome for the policy relevant goals of the project. But establishing causality in diffuse policy and decision-making processes is likely impossible (indeed Tomblin et al. noted this in their write up of the asteroid redirect mission forums for NASA). The diffuse nature of policy relevance goals means that pTA practitioners might need to adopt goals for success similar to the deliberation-related goals established in the CRF and Prop 127 projects. Those goals largely emerged through decisions about both the projects and past practice without any direct regard for deliberative theory. Having frank conversations about how to connect pTA efforts to policy making throughout all components of a pTA project might promote a practical approach to building and evaluating policy relevance.
Chapter 7 Conclusions for the Practice of pTA

7.0 Introduction

My conclusions are broken into two sections: 1) Conclusions for scholarship on participatory efforts and 2) conclusions for practitioners, interested policy makers, and funders. The first highlights lessons from my analysis relevant to concerns in the literature about framing, the instrumental use of participatory efforts, and larger conceptual questions about how participatory efforts are conceptualized and deployed. The second focuses on steps practitioners can take to improve the practice of pTA. I chose this structure for two reasons. First, my practice approach to thinking about participatory efforts led quite naturally to thinking about where interesting dynamics in practice connected to tensions in the literature, to lessons for practitioners affiliated with ECAST, and to funders and policy makers. Second, my own normative commitment to improving democratic processes around sustainability-related issues inspired this work: How do we make pTA better so that we can better include public input in policy and decision making about challenging sustainability problems?

7.1 Lessons for scholarship

As described in Chapter 1, scholars from science and technology studies, international development, and participatory engagement have expressed concerns about how participatory efforts reinforce power structures (Mosse, 2001) and legitimize expert or technical decision making that obfuscates wider policy discourses (Stirling, 2008) — in short, how participatory efforts can work against the normative goals linked to them (e.g., empowerment). The discussion in Chapters 3 and 6 highlights the complex decisions that influence how pTA practitioners, including myself, approached creating content, addressed concerns about expert frames, and thought about the role of pTA
engagements in broader contexts. Two factors helped guide practitioners through decisions about how to interpret expert perspectives and include/exclude those perspectives in pTA materials: 1) Choosing high-level concepts from expert framings, such as tradeoffs, that allowed for a diversity of world views to come to bear on a problem and 2) avoiding a myopic focus on any one consideration related to the topic of pTA forums. But practitioners recreated their own framing focused on post-normal science. Thinking of climate resilience and renewable energy policy as post-normal science (PNS) problems served as a sort of precursor to pTA engagement, as expressed in a continual refrain by pTA practitioners that pTA forums work great for “questions that science can inform but cannot answer.” Commitment to PNS as an analytical-normative frame also guided difficult decisions through project framing.

These frames served to open up social and technological choices and commitments (as opposed to closing down those choices by providing a means to a justification; see Stirling, 2008). The CRF and Prop 127 project teams were reflective, critical of input from experts and policy makers, and thoughtful about how we approached the role of participation. The Prop 127 project opened up both Prop 127 and the largely technical claims being levied around it to further scrutiny by members of the public, albeit only a handful. The CRF project attempted to open up choices about climate-related resilience but the scale of this ‘opening up’ was limited by the project’s ties to policy makers. Participants themselves discussed, critiqued, and modified various ideas for responding to the impacts of climate change, but without more concrete ties to policy making, that critique of socio-environmental and technical options never reached policy makers themselves, or only reached them in limited ways. The forums could open up framings about responses to climate-related hazards, as demonstrated by the public values
mapping presented in Chapter 6, but without actually taking that to decision making, no ‘opening up’ happened outside of participants learning on their own.

The challenges of connecting pTA to policy making and addressing concerns about expert framing point to a larger factor complicating participatory engagements: Democratic politics are messy. Participatory engagements seeking to challenge current structures of policy making inevitably encounter the messiness of the problem at hand. The CRF and Prop 127 project team members were critical about their own decisions and engaged in reflexive planning (to some degree). But even so, the complexity of the topics at hand and our desire to bring concerns and values from broader audiences to policy makers meant we inevitably would encounter difficult decisions about what to include/exclude and how to open up policy making to wider discourses.

Scholars in science and technology studies have critiqued participatory efforts on a more basic epistemological level. Lövbrand, Pielke, and Beck (2011) noted that many conceptualizations of deliberation in participatory efforts ignore constructivist understandings of socio-technological systems, even though constructivist understandings of socio-technological systems undergird many calls for participation. Building on those critiques, Chilvers and Kearnes (2019) laid out a framework for participation based on a constructivist understanding of participatory efforts (i.e., participatory efforts are embedded in the socio-technical systems and thus shaped by them, not just ‘bolted on’ to them, to use their words). Their framework included four paths:

“forge reflexive participatory practices that attend to their framings, emergence, uncertainties, and effects; ecologize participation through attending to the interrelations between diverse public engagements in wider systems; catalyze practices of anticipatory reflection to bring about
responsible democratic innovations; and reconstitute participation as constitutive of (not separate from) systems of technoscience and democracy.” Emphasis original (Chilvers and Kearnes, 2019, p. 1).

Chilvers and Kearnes—and my introduction—perhaps overstate the novelty of thinking about participatory events as socially constructed. The CRF project team engaged in reflections about the project and its constituent components; was aware of the ways the project did and did not relate to broader discussions about resilience in different cities and to policy makers; was motivated to better integrate (though not successfully) reflexivity about public values into expert-driven technical decisions (i.e., acknowledged and leveraged the constitutive nature of the project into “systems of techno-science and democracy”); and learned from and changed the format of engagements based on experience in forums, feedback from testing and learning across projects as part of ECAST. The CRF project team was working within Chilvers and Kearnes framework and perhaps other participatory efforts have as well; the project team seemed keenly aware that participatory engagement did not exist on some reified plane above socio-political institutions relevant to climate-related hazards. Nonetheless, critiques put forward by Stirling (2008), Lövbrand, Pielke, and Beck (2011), Wynne (2006), and Chilvers and Kearnes (2019) offer important perspectives on the potential instrumentality of participatory efforts and their ability to reach the goals they are designed to accomplish. And at times, I felt concerned about the instrumentality about these pTA projects (see my discussion of uncertainty as an educational goal in chapter 3).

Concerns about instrumentality revolve around using participation to build trust in scientific or technical decision making (Wynne, 2006), to legitimize decisions made by current power structures (Stirling, 2008), or even around normative goals for deliberation (e.g., inclusiveness) that create participatory efforts for the sake of
participatory efforts. Each of the four themes I’ve presented in this dissertation could be linked to instrumental notions of participatory efforts. Indeed, I talked a lot about the ‘goals’ designed into each project and perhaps employ what Chilver sand Kearnes call “residual realist” understandings of participation (i.e., rendering science, the public and democracy as “highly specific, pregiven, and external categories imported into the design and evaluation of participatory practices,” Chilvers and Kearnes, 2019, p. 3). It’s not a stretch to think that some of the data I presented, for example on participant learning or changes in opinion, reinforce this residual realist view that emphasizes creating and evaluating participatory efforts around ‘natural’ categories about what good participation looks like. However, the larger picture in which I embedded these data provides some separation from this view.

Results from the Prop 127 project showed that face-to-face discussions had a bigger impact on participant opinions (measured through changes in those opinions) and reported understanding of unintended consequences than written content, something I reference in Chapter 5 as evidence that deliberation met the goals put forth by pTA. Did a focus on change in participant opinion represent an instrumental or preconceived notion of what participatory engagement should accomplish? Perhaps. In the context of the Prop 127 project, however, what could be an alternative measure of ‘opening up’ discourse about Prop 127, particularly given the highly publicized and political nature of Prop 127? Evaluating change in opinion was a useful measure for better understanding the role of framing and materials in participatory efforts. Figure 5.4 shows that change of opinion varied across groups that received different materials and those who attended in-person deliberations. This suggests that participants might interpret materials (no matter how nuanced a view it takes on expert framings) in different ways when used during in-person discussions, a finding worthy of further testing and that could be
important to future participatory practices. Further, this evaluation suggests that the in-person discussion and the materials that were provided perhaps shook up participants’ previous understandings of Prop 127, understandings likely rooted in dominant political narratives advanced by opponents and supporters. Forums on Prop 127 helped ‘open up’ arguments (some very technical) that had been advanced about the initiative, and evaluating changes in participants opinion represents one indicator of this. In summary, scholarship on participatory efforts should be careful not to throw the baby out with the bathwater: Evaluation tools associated with ‘residual realist’ understandings of democracy, science, the public, and deliberation may still provide valuable feedback about participatory efforts.\(^{105}\)

The format and materials used for the CRF and Prop 127 projects relate to important discussions in the literature about the need for ‘innovating’ formats (Chilvers and Kearnes, 2019; see Bellamy et al, 2017 for an example of such innovation involving various ideas of social choice). It’s not clear to me that the pTA projects studied here sought to realize an idealized participatory format, such as an egalitarian consensus or majoritarian voting model.\(^{106}\) Instead, practitioners baked in various modes of social choice into activities, allowing participants to cast their own votes, create consensus plans, and seek to persuade others within their group. This left open opportunities for a variety of people with differing views on social choice to participate, so long as they were willing to engage respectfully. Likewise, discussions and decisions about pTA activities in both projects defined what constituted ‘good’ deliberation, rather than an \textit{a priori} focus on specific definitions from deliberative theory. Two loose criteria for deliberation

\(^{105}\) Though the risk of seeking just to change opinion, for example, is still present if projects placed too much emphasis on using changes in opinion as an evaluation tool.

\(^{106}\) See Bellamy et al. (2017) for a discussion of the relationship between world views and participatory structure, which builds on Douglas and Wildavsky’s (1982) work on culture and risk.
emerged: 1) Participants should be able to share their views and should consider those of others and 2) participants should consider views solicited from experts that were built into the materials themselves. Neither of these criteria seems controversial or overly constrained, particularly in light of the discussion of expert framing presented above. Further, participants challenged formats, challenged the materials, and offered their views about fairly complex and sometimes technical problems associated with renewable energy policy and climate resilience.

Materials used in participatory efforts impacted participant discussions and views, the policy makers’ perceived relevance of pTA efforts, and embodied and important considerations from the pTA project planning team. In both the CRF and Prop 127 projects, we strove to create materials that would accomplish a variety of goals, including fostering deliberation about expert considerations and participant values and fostering reflection among participants about tradeoffs, and other high-level concepts related to post-normal science challenges. However, these goals only partially extended from pre-conceived ideals for participatory efforts. Further, the impact of materials was diverse and connected to other factors: Visualizations in the CRF project impacted discussion dynamics in unexpected ways, the forum guide for Prop 127 impacted learning and changes in opinion only when used in in-person discussions, and the inclusion of stakeholder cards in the CRF project activities caused participants in some forums to role play. Further, the non-local focus of the CRF hazard activities impacted (in various ways) how policy makers and resilience experts viewed the project. Decisions about materials, the diverse impacts of materials, and the discussion above about forum format present substantial opportunities to reflect on changes to participatory efforts as part of innovating practice.
The results presented here also suggest the utility of evaluating and analyzing participatory efforts as social practices. The emphasis on materials, meanings, and competences provided a useful frame for understanding change within and across the two pTA projects presented here, and helped identify important but not obvious factors shaping participatory efforts, such as the ways project team structure played a role in content creation in the CRF project. Further, a practice approach can help reframe research on participatory efforts away from studying ‘moments’ of participation to studying the larger role participation plays in socio-political systems (in line with suggestions from Chilvers and Kearnes, 2019). Most basically, the practice-based analysis presented in my dissertation shows how pTA includes other practices, such as set of practices associated with actionable science, including the co-creation of materials alongside policy makers. Notably, pTA itself took various forms as a practice. The Prop 127 project activities looked very different from the CRF project activities. The meanings and competences relevant to the practice of pTA in both projects provided a better-defined link between the two projects.

While inherently partial, this practice approach shifts the emphasis of analysis away from individual events to better address questions about the instrumentality and impact of participatory efforts and their connections to broader social and political systems. One cannot say that a participatory effort was or was not functioning in an instrumental way by simply looking at results from a participatory event itself because instrumentality (or lack thereof) hinges on decisions, implicit judgment, normative commitments, and materials that feed into a participatory effort before participants ever show up. Examining those characteristics of participatory efforts—the decisions, judgment calls, materials, and embedded values—better oriented my analysis to examine instrumentality, connections to policy making, and the attainment of ideals important to
participatory efforts. As described above, this practice approach helped show that the practitioners involved in these pTA projects sidelined many conceptual or theoretical notions of participation or deliberation. Practitioners instead built efforts centered on explicitly post-normal science challenges to foster learning, policy relevance, and broadening capacity for hosting forums. Practitioners chose to emphasize criteria for deliberation that were flexible and encompassing. They relied heavily on internal discussions about materials and format, and on feedback collected from participants, policy makers, and other stakeholders, to hone efforts toward those goals. These findings in part came from data collected at participatory events (i.e., forums) but, to a larger extent, stem from an analysis of the practice of pTA in these two projects, learning across those projects, and reflections.

A practice-based approach to studying pTA came with methodological challenges. Many things happen in large-scale pTA projects, making it difficult to collect data across projects with multiple team members spread out over several institutions. Some of my conclusions and observations are inherently partial because I couldn’t be at every meeting or interview everyone involved due to time constraints. Regular moments of reflection in pTA projects (see next section) helped address these challenges. Indeed, the autoethnographic elements of my dissertation proved incredibly valuable for examining the decisions, framings, and embedded values built into both projects. Autoethnography and other methods for iterative reflection, analysis, and writing provided perhaps the only for examining the inherent political features of participatory efforts and research about them. Further, reflective approaches make decisions and research about participatory efforts more transparent.

Beyond these conclusions, academics interested in participatory efforts should keep in mind the unpredictability of participatory practices, and should retain some humility
about what we can say about them. As stated above, democratic politics are messy and unpredictable, even in the small doses held within participatory efforts. Participants themselves stand out to me when I think about my experience with these forums over the last three years. Participants critiqued and challenged pretty much every forum in which I have been involved. They pushed back on formats, asked how forums might be used to influence policy or research, and sought ways to get themselves and others involved in the problem at hand. Providing opportunities for people to critique and solve problems through dialogue is, in my opinion, critically important.

7.2 Lessons for interested practitioners, policy makers, and funders

The practice approach I used refined my own understanding of what makes pTA projects work and what factors influence their design, implementation, and use. The analysis presented in this dissertation suggests several paths for interested practitioners, funders, and policy makers to consider to better democratize assessment and policy making through pTA-like engagements. These include lessons related to the goals of participatory efforts, of host institutions, and of practitioners themselves.

The CRF project included several goals, including participant learning, policy-making impact, and expanding the practice of pTA. However, these goals at times muddled each other and created tensions within the project. Tensions were not inherently a negative feature. Indeed, the process of balancing different goals can create positive outcomes. But numerous goals present a challenge for practitioners and force tradeoffs within a project. Given competing goals, practitioners, policy makers, and funders should maintain an analytical/normative commitment to a post-normal science approach. Participatory technology assessment projects can promote learning, can provide valuable support to policy, and can be used to build broader networks of
institutions to support deliberative engagement. As demonstrated by the CRF project, however, accomplishing all of these goals simultaneously is challenging. Continuing to rely on a post-normal science framework helps better situate pTA where its strengths lie: Creating pluralistic dialogue about the problem at hand, potential solutions, and the impact of those solutions.

Practitioners should also seek out engagements with policy making communities, community organizations, and other important stakeholders early in a project (as was done in the CRF project), with an emphasis on communicating the potential policy-relevant outcomes of a pTA effort. Participatory technology assessment (and related engagements) can provide new perspectives, views, and opinions on complex issues facing policy makers. The assessment of public values on resilience to extreme heat presented in Chapter 6 demonstrates that pTA can be applied to climate resilience issues and that participants can provide thoughtful critique and opinions on resilience measures. This ability needs to be more clearly communicated up front to potential policy-making partners and stakeholders.

The practitioner community also needs to think more systematically about what it means to build capacity for pTA. The CRF project showed the importance of working and partnering with policy makers, a very different set of capacities than those associated with putting on a pTA event. First, pTA projects need to build in more resources and support if capacity of science museums (‘usual’ pTA hosts) is expected to move beyond just hosting forums. Second, practitioners should outline tiered capacities for partner institutions. For example, some institutions might be capable of working with local policy officials to customize forum content while others might be more suited for hosting a forum but need assistance in planning recruitment. Tiered capacities could help identify which institutions are well suited for various scales of projects, from hosting a
forum to building or customizing content to training others in specific pieces of a project (e.g., recruitment). Such a system could also be used to think about how to build capacity in different types of host institutions, such as libraries, community centers, or other more geographically diverse hosts. Third, pTA practitioners should learn from and connect with other networks that build capacity across multiple institutions, such as the National Informal Science Education Network (NISENet), to identify best practices for building capacity. Funders and interested policy makers can contribute ideas for more policy or topic-oriented networks that may also provide valuable insight for 1) building capacity across institutions and 2) linking those institutions to topic-relevant stakeholders.

Important to both the CRF and Prop 127 projects was practitioner deployment of a post-normal science frame. As discussed in my reflections on the Prop 127 project in Chapter 3, however, practitioners face challenges implementing pTA-style engagement even with graduate school training in thinking about post-normal science problems. Additionally, much of the practice of pTA involves various skills, knowledge, and experience with numerous moving parts. Training on recruitment techniques, expert disagreement, how to frame questions for pTA activities, and how to develop activities that public audiences enjoy could better prepare practitioners and forum hosts to plan, develop, and run pTA forums. Training on these skills, knowledge sets, and practices could be integral to building capacity for pTA engagements.

For current practitioners, the work presented above highlights how regular reflection within pTA projects helped to build pTA activities that better accomplished the goals of the project team. Practitioners should build in opportunities for reflection within projects. Simple meetings or short interviews that allow teams to share concerns, experiences, and priorities can be easily folded into pTA projects. Indeed, in the CRF
project these opportunities regularly occurred thanks to planning by CRF team members at the Museum of Science. Reflections help leverage a team’s diverse experiences and sets of expertise to identify ways practice can change (or has changed) and what change means for project goals and broader considerations about pTA. Further, practitioners should seek to reflect on the larger goals of pTA early and often in the proposal-formulating stage to better set the context for the project.

Further, reflexive activities can be a helpful part of qualitative and quantitative analysis of data collected at forums, particularly if policy-making relevance is of concern. As outlined in Chapter 6, my own concerns about the policy relevance of qualitative and quantitative data collected in the CRF project stemmed—at least in part—from not discussing interim results with the CRF project team and people external to the project team who were familiar with local resilience policy-making priorities. Practitioners should solicit feedback from policy makers or gatekeepers regarding data collection before forums and regarding analysis after forums. In the CRF project, such feedback could have led to more robust incorporation of public values into resilience policy-making processes. However, involving policy makers and gatekeepers in decisions about data collection also requires pTA practitioners to scrutinize their input and feedback to avoid policy makers using data collection efforts to close down on policy commitments or reinforce existing commitments.

Practitioners, funders, and policy makers should be cognizant of the difficulties of evaluating participatory efforts while looking to improve the practice of pTA. The complexity of pTA complicates evaluation given that the undertaking itself is fairly daunting (i.e., recreate in an accessible and open manner a contested socio-political debate). As discussed in Section 7.1, evaluation measures, such as measures of deliberation, are partial and imperfect. In view of these limitations, practitioners should
consider learning and successes across practice to highlight improvements to pTA. Demonstrating learning (for practitioners) and innovation in pTA can tell a richer story of pTA outcomes than can measures of participant learning, deliberation, or states values from any individual project. Documenting important differences between pTA projects could show changes across practice, create an object for reflection, and build a record that better demonstrates what pTA can and cannot accomplish.

Finally, a bit of motivation is critical to the practice of pTA and to practitioners. While not presented anywhere in this dissertation, many of my reflections about pTA were about why I thought it was important in the first place. My work with both of these projects, as well as my own experiences with politics and science\textsuperscript{107}, have created a strong respect for the wisdom of democratic governance. I care deeply about the foundations of democracy and basic rights that enable and empower democracy to work. As democratic institutions falter in countries around the world, or as they are slowly chipped away at by leaders and partisans seeking their own ends, I am ever more certain of the importance of new ways of to embody democratic ideals in policy making, science, and larger discourse. Gut wrenching stories of disenfranchisement or the disregard for (albeit imperfect) democratic institutions provide motivation for my work. I hope practitioners, interested policy makers, participants, and anyone else affiliated with a pTA project comes away with renewed hope and confidence in the wisdom of democracy.

\textsuperscript{107} I know, I can’t say they are entirely unconnected, per good constructivist understandings of the two.
REFERENCES


Ottinger, G. (2016). Citizen Engineers at the Fenceline,. In *Issues in Science and
Technology (Winter) (pp. 72–78).


Science and Technology, (27).


APPENDIX A

PARTICIPANT WORKBOOK FOR THE DROUGHT CLIMATE RESILIENCE FORUM ACTIVITY
Drought

Participant Workbook

Name:  
Table #:  

228
## Stakeholders

<table>
<thead>
<tr>
<th>Farmer</th>
<th>Construction Company Owner</th>
<th>Suburban Resident</th>
</tr>
</thead>
</table>
| • Concerned that drought could leave her without water for her crops  
  • Water-saving irrigation systems would stress her budget  
  • Wants the community to have access to local food  
| • Worried that a drought could impact the real estate market  
  • Wants to invest in water-efficient homes, but is concerned that they won’t be as competitive  
| • Concerned about higher utility bills  
  • Worried that a severe drought could mean removing grass from his yard  
  • Worried about the future of water for his kids  |
Stakeholders

Outdoor Enthusiast
- Fishes, hunts, and hikes on the lands that feed water to the city
- Concerned that drought could affect plant and animal populations

Manufacturing Plant Manager
- Plant is one of the largest water users in the city
- Worried about the costs of more efficient manufacturing equipment
- Wants to see a reclaimed water system for industrial users

Environmental Group Director
- Concerned that drought and groundwater pumping would lower flows in the river
- Worried that dams upstream will affect plant and animal populations
### Resilience

<table>
<thead>
<tr>
<th>CONSERVE &amp; PROTECT</th>
</tr>
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<tbody>
<tr>
<td>Conserve &amp; Protect involves saving water and cleaning up existing ground and surface water sources. Efforts to save water include new water efficiency standards for old and new buildings, changing water prices, drought tolerant landscaping, and water-saving irrigation technology for farms.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECONOMIC ★★★</th>
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<tbody>
<tr>
<td>Ground and surface water clean-up can be very expensive depending on the level of contamination. Changing fixtures in old buildings can require costly construction but water-saving fixtures are very inexpensive to install in new buildings. Increases in water pricing affect businesses that use a lot of water, such as farms and factories.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NEW SUPPLIES &amp; STORAGE</th>
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<tbody>
<tr>
<td>New Supplies &amp; Storage involves solutions to increase the amount of water available to a community. New supplies include desalination, drilling new groundwater wells, treated and reclaimed wastewater, or captured stormwater. Strategies for storage include expanding reservoirs and storage in underground aquifers.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECONOMIC ★★★★</th>
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</thead>
<tbody>
<tr>
<td>Expanding the city's water supply ensures that businesses and people can continue to function into the future. However most of these strategies are expensive and require a lot of new infrastructure. Desalination, for example requires a lot of energy and pipes or canals to move water to where it is needed.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>PREPARE THE PUBLIC</th>
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<tbody>
<tr>
<td>Prepare the Public involves safeguarding people from the impacts of severe droughts, including water shortages and wildfires. Solutions include grass and forest management to control wildfires, increasing access to municipal water supply systems, and drought insurance to protect people financially impacted by drought.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECONOMIC ★★★</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass and forest management for wildfires, expanding municipal water systems, and drought insurance and relocation efforts are expensive, however, these strategies also reduce potential harm to businesses and commerce.</td>
</tr>
</tbody>
</table>
## Strategies

### ENVIRONMENTAL ★★★★

In general, saving water has environmental benefits only if that saved water is used for environmental purposes, like maintaining flows in a river. Cleaning surface waters can improve the environment by reducing contamination that harms plants, animals, and ecosystems.

### ENVIRONMENTAL ★★

Desalination creates very salty water that can harm marine ecosystems. Desalination is also very energy intensive. Pumping groundwater can lower water levels in streams and wetlands, which can damage those ecosystems and affect water quality. Conversely, recharging aquifers helps to maintain water levels. Stormwater capture using plants and basins improves water quality.

### ENVIRONMENTAL ★★★

Forest management for wildfires improves environmental quality by reducing the risk of catastrophic wildfires. Other Prepare the Public strategies have little to no environmental impact.

### SOCIAL ★★★

Increasing the price of water can impact the price of some goods and can impact residents’ utility bills. Construction for new landscaping or replacing fixtures can be disruptive to residents and businesses. If saved water can be stored, conservation can increase the amount of water available to the community for the future.

### SOCIAL ★★★★

In general, increasing water supply reduces the risk of water shortages, which can quickly threaten the health and well-being of a community. Pumping groundwater, however, can lower water levels and endanger the water supply of people who depend on individual private wells.

### SOCIAL ★★★

Preparation for wildfires reduces losses of life and property. Expanding municipal water systems ensures that those dependent on groundwater have access to a more diverse water supply. Insurance and relocation funds provide a safety net for those whose livelihoods are threatened by drought.
# Resilience Plans

## CONSERVE & PROTECT

### Plan A

- A new plant that cleans polluted groundwater will increase the amount of water available for municipal use.
- The city will provide $1,000-$5,000 for new fixtures and leak repair in older residential and commercial buildings.
- New efficiency requirements for indoor fixtures will reduce water use in new buildings.
- The city will provide grants for drought-tolerant landscaping and for farmers to use water-efficient irrigation technologies.
- Incentive program will provide farmers up to $10,000 to install irrigation systems that reduce water use.

### Plan B

- A large education campaign will encourage conservation across the city.
- A small grant program will encourage homeowners to replace old fixtures and use drought tolerant landscaping.
- A new water pricing system will raise water rates for large water users to encourage conservation.
- The city will use public buildings and parks to demonstrate water conservation practices. This includes replacing landscaping at city parks with drought tolerant plants and replacing faucets and toilets in city buildings.
## Resilience Plans

### NEW SUPPLIES & STORAGE

#### Plan A
- The city will build a desalination plant on the coast. With pipes, pumps, and canals moving the water into the city, the plant will require a lot of energy to operate.
- Water from this new system will not be available until 10-15 years from the start of construction.
- Extra water from the desalination plant will be stored underground and in existing reservoirs using newly built pumps and pipes.

#### Plan B
- The city will focus on using reclaimed wastewater, expanding storage, and building new wells to provide groundwater in the event of a drought.
- To protect against falling groundwater levels, the city will invest in new codes that require retention basins on commercial lots, a grant program for residential stormwater capture, and passive recharge basins.
- The city will build a distribution network for reclaimed water and use excess reclaimed water for groundwater recharge.
## Resilience Plans

### PREPARE THE PUBLIC

#### Plan A

- To protect against wildfires, the city will manage grass and forests near the edge of town and restore already burned areas to limit erosion and increase water retention.
- An expanded municipal water system will connect residents who depend on individual private wells. This system will protect them from falling groundwater levels.
- Funding for drought insurance and relocation will help residents, farmers, and ranchers most impacted by drought.

#### Plan B

- The city will invest in emergency water supplies and water delivery trucks for use during water shortages.
- An outreach and grant program will encourage residents to prepare for wildfires and clear grass and trees away from structures.
- The city will increase investment in emergency preparedness to provide food, shelter, and water in the event of a severe drought, and encourage residents to prepare by stocking up on bottled water and limiting use in water shortage.
### My Resilience Plan 1

<table>
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<tr>
<th>CONSERVE &amp; PROTECT</th>
<th>NEW SUPPLIES &amp; STORAGE</th>
<th>PREPARE THE PUBLIC</th>
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<tbody>
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<td>Plan A</td>
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<td>Plan B</td>
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What resilience plan would you make for Ottawatta? Why did you choose this plan?

*Mark the empty coin spaces to choose a plan. Remember you only have three coins and can’t use all three on one strategy!*
## My Resilience Plan 2

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<tr>
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<th>CONSERVE &amp; PROTECT</th>
<th>NEW SUPPLIES &amp; STORAGE</th>
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<td>Plan A</td>
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<td>Plan B</td>
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</tbody>
</table>

What resilience plan would you make for Ottawatta? Why did you choose this plan?

Mark the empty coin spaces to choose a plan. Remember you only have three coins and can’t use all three on one strategy!

______________________________________________________________________________________________________________________________________________________

What would you change about this plan? Are there specific resilience actions you would like to add or remove?

______________________________________________________________________________________________________________________________________________________
Over the last decade, Ottawatta has faced droughts of various lengths and intensities. The image above shows when droughts occurred since 2000 across the area. When the bar reaches the top of the graph, then all of the area was in a drought. The dark red areas are the most severe droughts.
PROP 127
Mapping Arizona’s Energy Future

Proposition 127, or the Clean Energy for a Healthy Arizona Initiative, would amend Arizona’s Constitution to mandate that electric utilities get 50% of electricity from renewable sources like solar and wind by 2030.

This guide describes Arizona’s energy systems, challenges those systems face in the future, and the uncertainties that make large changes to energy systems difficult. This guide is not meant to convince voters to support or reject the proposition. It focuses on important considerations, tradeoffs, and factors that complicate our energy future.

The Basics

Prop 127 would require 50% of electricity to come from renewable sources, like solar and wind. Ten percent must come from sources located on customer property, such as roof top solar. Prop 127 would create a renewable energy credit system. Utilities and electricity generators could buy and sell credits to meet the 50% requirement.

Existing Arizona regulations require 15% of electricity to come from renewable sources by 2025.

Using this Guide

This guide outlines three considerations about the impacts of Prop 127. Unexpected developments could change these considerations from positive to negative, or negative to positive. Twenty years ago, for example, few experts predicted that natural gas prices would be as low as they are today. The “Key Uncertainties” sections highlight some big question marks about the future.

This guide includes questions, like the one below, to help you sort your own values and opinions about the issues presented. Answer them by yourself or use them as discussion questions with neighbors, coworkers, or friends and family. The last page has suggestions for discussing the issue with others.

Question: What do you find appealing about renewable energy? What concerns you?
Arizona’s Electricity System: The Grid, Utilities, & Markets

Electricity generated at power plants is fed into a large grid of transformers, substations, and power lines. Making the grid work is more than just turning on a power plant and plugging in a TV. The amount of electricity used by homes and businesses must be matched by output from power plants. Too much demand can cause outages. Too little demand can damage equipment and lead to grid failures. Grid managers use forecasts to predict demand and manage power plants accordingly. Forecasts use information about the weather and times people turn on major appliances like stoves and A/C to predict demand. Despite this complex task, U.S. electricity grids are incredibly reliable.

In the U.S., electric utilities evolved in the late 1800’s to provide reliable and affordable access to electricity. In Arizona, we have investor-owned utilities and non-profit cooperatives that are owned by their customers.

Electricity in Arizona

Most coal burned for electricity in Arizona came from mines in Arizona (38%), New Mexico (29%), and Wyoming (27%) in 2016. Almost all natural gas used in Arizona comes from wells in other states. Oil for transportation fuels comes from California and Texas. About 90% of uranium for nuclear power generation in the U.S. comes from sources outside the country, mostly in Canada, Australia, Russia, and Kazakhstan.

Source: US Energy Information Administration

In 2016, 4% of Arizona’s electricity came from solar and wind. If electricity demand does not change, a 50% goal would require about 12 times as much solar and wind by 2030. Experts expect demand to rise.

Investor-owned means that for-profit companies own those utilities. Utilities are different from other companies because the state government guarantees utilities access to customers. In exchange, utilities must meet regulations requiring them to provide reliable and affordable access to electricity.

The Arizona Corporation Commission, or ACC, regulates most utilities in Arizona. The ACC, for example, must approve changes to rates that utilities charge customers and the construction of new power plants. The five members of the ACC are elected in statewide elections. Other agencies, like the Federal Energy Regulatory Commission and federal and state environmental agencies, also regulate utilities.

Some parts of electricity systems are managed like markets. For example, utilities will pay for electricity from other generators to help meet demand. The price of electricity on the market can in turn impact the price consumers pay on their utility bills.

Arizona Electricity Generation

In 2016, 4% of Arizona’s electricity came from solar and wind. If electricity demand does not change, a 50% goal would require about 12 times as much solar and wind by 2030. Experts expect demand to rise.
Prop 127 presents technical challenges for utilities.

Renewable Generation and Electricity Demand

Electricity demand is usually highest in the mornings and evenings when people turn on stoves, A/C, and TVs. Output from solar panels is highest near noon and decreases as the sun gets lower in the sky. During hot Arizona summers, a lot of solar generation could help meet demand for electricity as homes and businesses run A/C. As temperatures fall, demand for electricity midday is much lower. A large amount of solar generation during spring and fall can lead to too much electricity on the grid, which forces utilities to ramp down production from other sources. But ramping down production from large coal, natural gas, and nuclear plants can be costly and is not always feasible.

Storage

Pumped water storage and batteries are two proposed methods of storing energy to help match solar generation to demand. Pumped water storage involves pumping water uphill when lots of electricity is available and running it through a hydroelectric power plant to generate electricity when it’s needed. Utilities can also use large batteries to store electricity. Utilities are beginning to deploy batteries at costs comparable to other energy sources, like small natural gas plants.

Key Uncertainties

Changes in Demand: Many factors impact electricity demand. Electric vehicles could greatly increase electricity demand, straining the grid. But the batteries in electric vehicles could provide electricity storage on the grid. Population growth and economic changes also impact demand.

Technology & Markets: Some experts point to new battery projects and falling battery costs as evidence that battery storage will be more widely deployed and affordable over the coming decade. Others highlight that utilities could face challenges deploying batteries across the grid due to existing regulations, market rules, and technical concerns.

Questions: What hopes and concerns do you have about these technical challenges?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

What developments would change your hopes and concerns?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Consideration 2: Economy, Jobs, & Costs

Prop 127 could impact the economy, jobs, and costs for utilities and consumers.

Retiring Old Power Plants, Building New Ones
Utilities plan to build power plants years in advance and operate those plants for decades. Closing a fossil-fuel power plant early can translate to a loss of investment. Building new renewable power plants requires investment even though costs of renewable technologies continue to fall. These investments would impact rates for consumers.

Jobs
According to the US Energy Information Administration, the number of solar and wind jobs are far greater than those associated with fossil fuel power plants. But fossil-fuel burning power plants employ many people, meaning a switch from fossil fuels to renewables could mean a shift of some jobs. In Arizona, the proposed closure of the Navajo Generating Station (left), a closure planned independent of Prop 127, concerns local residents and leaders. Jobs at the plant and the coal mines that supply its fuel might leave the community.

Creating New Industries
Much of the fuel that powers Arizona’s coal and natural-gas plants comes from outside the state. An industry for renewable energy and power storage in Arizona could drive economic and job growth through selling renewable energy to other states. Within Arizona, Prop 127’s renewable energy credit system could incentivize businesses to provide renewable energy.

Key Uncertainties

Questions: What hopes and concerns do you have about Prop 127 and the economy?
________________________________________________________________________
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What developments would change your hopes and concerns?
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Policy: Renewable standards in other states could drive up demand for renewable energy produced in Arizona. Climate change or carbon policy could push fossil fuel plants to shut down or drive up operation costs. Federal and state tax credits make some renewable energy technologies more affordable. The price of renewable energy technologies could increase if those credits expire.

International Markets: Electricity systems depend on complex global trade for things like fuels and batteries. Changes to the economy in China or Europe, for example, could impact costs here.
Prop 127 electricity could affect the environment in numerous ways.

**Air quality:** The burning of coal and natural gas contributes materials to the atmosphere that harm air quality. Those materials can reduce visibility, impact the health of plants and animals, and worsen some health conditions, like asthma and heart disease. Switching from coal power plants to renewables can improve regional air quality and human health.

**Water use:** Conventional power plants use a lot of water. Both wind and solar require very little water to operate, meaning switching from conventional power plants to renewables could save a lot of water.

**Climate change:** Burning coal and natural gas creates carbon dioxide that contributes to climate change. Climate change could make heat waves, droughts, and severe storms worse for future Arizonans. Coal emits more carbon dioxide than natural gas to create the same amount of power. Both solar and wind produce very few emissions even when emissions from manufacturing and construction are considered.

### Key Uncertainties

**Impact on existing capacity:** Some experts worry that a large deployment of renewables could make nuclear power plants too expensive to operate. Nuclear power plants generate few carbon emissions, like renewables, and provide consistent generation. If a nuclear plant’s capacity was replaced by something like a natural gas plant, emissions would increase.

**Effectiveness for climate:** Policies like Prop 127 have helped reduce emissions in some states. But unforeseen factors have challenged efforts elsewhere. Germany invested heavily in renewables over the last two decades. But output from solar and wind, as discussed on page 3, varied without a way to store energy. Steep daily changes in output, along with an emissions trading market that priced emissions too low and the retirement of nuclear plants, caused German utilities to burn more low-quality coal. This prevented Germany from achieving its emission reduction goals.

### Questions

What hopes and concerns do you have about Prop 127 and the environment?

What developments would change your hopes and concerns?

From the National Climate Assessment, 2014
nca2014.globalchange.gov
Discussing the Issue with Others

Here are some ground rules to help lead a discussion:
1. Read each section of the guide and allow equal time to discuss each section.
2. Be respectful of others’ opinions, and allow everyone to share their ideas.
3. Review the conversation. What common ground emerged? Which tradeoffs were most difficult?

Plotting a course for the future is not easy. It involves weighing uncertainty and tradeoffs to navigate from where we are now to the goals, values, and aspirations we hope to achieve. Prop 127 and the environmental and economic issues surrounding it will affect all Arizonans. We think it’s best if all Arizonans deliberate about the issue with neighbors, coworkers, and friends and family.

Questions:
What concerns you about Prop 127 over the next 5 years? What about over the next 15 years?
_________________________________________________________________________________________
_________________________________________________________________________________________

What makes you optimistic about Prop 127 over the next 5 years? What about over the next 15 years?
_________________________________________________________________________________________
_________________________________________________________________________________________

How might Prop 127 affect you or people you know?
_________________________________________________________________________________________
_________________________________________________________________________________________

What else can Arizona do to address energy issues, the environment, and the economy?
_________________________________________________________________________________________
_________________________________________________________________________________________

About this Guide
This guide was developed by Arizona State University’s Consortium for Science, Policy & Outcomes. ASU researchers conducted interviews with several energy and policy experts to create this guide.

The Consortium of Science, Policy & Outcomes, a research center at Arizona State University’s Institute for the Future of Innovation in Society, is an intellectual network aimed at enhancing the contribution of science and technology to society’s pursuit of equality, justice, freedom, and quality of life. For more information about the consortium, please visit www.cspo.org.
APPENDIX C

GUIDE FOR PROP 127 SURVEY PARTICIPANTS FROM THE ARIZONA SECRETARY OF STATE'S ELECTION PUBLICITY PAMPHLET (EDITED FOR THE SURVEY)
Proposition 127 would amend the Arizona Constitution to require utility companies that produce electricity and that are regulated by the Arizona Corporation Commission (which do not include Salt River Project or other governmental utilities) to sell increasing amounts of renewable energy from specific types of renewable energy resources beginning in 2020, as follows:

1. A renewable energy resource would be defined as an energy resource that is replaced rapidly by a natural, ongoing process and would not include nuclear power, natural gas, coal, oil, municipal solid waste combustion or trees that are larger than 12 inches in diameter. Eligible renewable energy resources would be limited to resources such as solar, wind, geothermal and biomass/organic matter resources.

2. Each utility company would be required to meet an annual renewable energy requirement by sourcing a portion of the company’s annual retail electricity sales from eligible renewable energy resources. The Arizona Corporation Commission currently requires at least 8% of the amount of retail electricity sold by a utility company to come from eligible renewable energy resources, increasing to 15% in 2025. Proposition 127 would instead require at least 12% to come from eligible renewable energy resources in 2020, increasing to at least 50% in 2030.

3. Each utility company would be also required to meet an annual distributed renewable energy requirement by sourcing a portion of the company’s annual retail electricity sales from renewable energy that is located on a utility customer’s premises. Beginning in 2020, at least 3% of the amount of retail electricity sold by a utility company would be required to come from distributed renewable energy resources, increasing to at least 10% in 2030. Distributed renewable energy produced to meet this requirement would count toward the annual renewable energy requirement.

4. A utility company would meet the renewable energy requirements by using renewable energy credits as a way to track the amount of electric power derived from a specific renewable energy resource or a conventional energy resource displaced by an energy resource that is produced on a customer’s premises. A utility company would be able to use:
   a. A renewable energy credit acquired in any year to meet its annual renewable energy requirement.
   b. A distributed renewable energy credit acquired in any year to meet its annual distributed renewable energy requirement.

5. A utility company would only be allowed to use a renewable energy credit or distributed renewable energy credit once and would not be allowed to use the credit for a different regulatory requirement.

6. Not later than December 31, 2019, the Arizona Corporation Commission would be required to adopt any rules that may be necessary to fully implement the measure.

7. Each utility company would be required to annually provide to the Arizona Corporation Commission a detailed compliance and implementation plan.
A.R.S. § 19-123E requires the Joint Legislative Budget Committee Staff to prepare a summary of 300 words or less on the fiscal impact of voter-initiated ballot measures. The proposition would amend the Arizona Constitution to establish a renewable energy requirement for electric utilities regulated by the Arizona Corporation Commission. Currently, the Commission requires their regulated utilities to get 8% of their electricity for retail sales from renewable sources and raises that standard to 15% by 2025. Proposition 127 would instead require these utilities to increase their electricity for retail sales from renewable sources to 12% in 2020 and to 50% in 2030. The proposition would require 10% of retail electricity sales to be from renewable energy resources produced on the customer’s premises by 2030.

Proposition 127’s fiscal impact is difficult to quantify in advance, especially since it would not be fully implemented until 2030. In the intervening years, technology changes may significantly affect the cost of producing both renewable and non-renewable energy. In addition, current studies have produced varying estimates of the economic impact of higher renewable energy requirements.

By revising the mix of energy sources used to generate electric power, Proposition 127 may directly affect the following:

- Retail electricity prices: Retail electricity sales are subject to the state’s sales tax, and price changes may affect revenue collections. To the extent that government agencies are consumers of electricity, price changes may also affect their expenditures.
- Employment in energy production industries: Employment changes may affect state income tax collections.
- Assessed property value for energy production facilities: Electricity infrastructure is subject to property taxes, so any changes in such infrastructure may affect property tax collections.

The revised mix of energy sources may have other impacts on business profits and consumer disposable income that would potentially affect state revenue collections.
ARGUMENTS FOR PROP 127

VOTE YES FOR PROP 127 to make sure Arizona gets 50% of its energy from clean, affordable, renewable sources by 2030!

Arizona is America’s sunniest state, but only 6 percent of our energy comes from solar power. Prop 127 takes advantage of our state’s unique potential to generate nearly unlimited, cheap, clean energy.

Proposition 127 cuts dangerous pollution, creates thousands of jobs, and lowers electric bills – saving Arizonans more than $4 billion by 2040.

According to doctors, nurses, and scientists, Proposition 127 dramatically reduces the rates of asthma attacks, heart disease, lung disease, and even cancer – especially for children, seniors, and low-income families.

We have a right to clean air and water and an obligation to leave a healthy future for our kids and grandkids. We each take responsibility in our daily lives for protecting our environment. But for too long, utility companies like APS refuse to take the same responsibility. Instead, they raise rates, rack up profits, and buy political influence to protect the status quo. Last year, APS made $488 million in profits. Now they’re spending millions of your dollars fighting this measure to protect those profits.

We all pay the price – and not just on electric bills. Over the last five years, solar jobs grew nine times faster than the overall economy, but sunny Arizona actually lost solar jobs. One in twelve Arizona children suffer from asthma, and the American Lung Association found that Arizona cities and counties have some of the nation’s dirtiest air.


Vote YES for clean energy for a healthy Arizona!

Alejandra Gomez, Chair, Clean Energy For A Healthy Arizona, Phoenix

Sponsored by Clean Energy For A Healthy Arizona

THE ORGANIZATIONS ARIZONANS TRUST URGE A “YES” VOTE ON PROP 127

We support Prop 127 because we know that:

- Clean energy is good for our health because it reduces dirty air and water pollution
- Clean energy is good for our economy and creates jobs
- Clean energy is good for consumers because it’s cheaper and it reduces our rates

Arizona has more sunshine than any other state, and yet only about 6% of our energy comes from clean, solar power. Together, we can fix this by voting YES on PROP 127! Prop 127 will make sure that 50% of our energy comes from renewable sources like solar and wind power!

PLEASE JOIN US IN VOTING YES!

Arizona Public Health Association
Conservative Alliance for Solar Energy
Elders Climate Action
Mi Familia Vota
Dear Arizona Voter,

I hope you will take a minute to read my statement about my support for Prop 127.

I am a mother of two, including a child with asthma, and I am a nurse practitioner, so I think about the air we breathe every day. I see the impact of dirty air as Phoenix has some of the most polluted air of any of the major cities in the United States. For those with asthma and other breathing challenges, this is a daily concern. Even those without asthma can have major health concerns from breathing polluted air.

This is why I am voting yes on Prop 127 to support Clean Energy for a Healthy Arizona.

Renewable energy, like solar and wind, are clean and affordable alternatives to dirty fossil fuels, and they don’t pollute our air! The harmful side effects to our health are a hidden tax of dirty fossil fuels that everyone pays—everyone except our major utilities, who make hundreds of millions of dollars of profit off of dirty fossil fuels. Renewable energy is clean and affordable, and every child with asthma is more important than protecting the profits of big utility companies that already raise our rates at every opportunity.

Join me in voting YES on Prop 127 and supporting Clean Energy for a Healthy Arizona.

Thank you for your time,

Damaris Hazell
Arizona Voter
Maricopa County

Sponsored by Clean Energy For A Healthy Arizona

Alejandra Gomez, Chair, Clean Energy For A Healthy Arizona, Phoenix

Sponsored by Clean Energy For A Healthy Arizona
ARGUMENTS AGAINST PROP 127

Vote NO! Keep electricity prices low
Arizona voters: Beware!

California billionaire Tom Steyer thinks you don’t pay enough for electricity. Under the guise of “green energy,” he’s spending millions to trick you into amending the Arizona Constitution with heavy-handed regulations that match those in California ... where electricity is 50% more expensive than here in Arizona. If his proposal passes, experts say it will double electricity rates for the typical Arizona family. The added cost would average $1,200 per year – and much more for many families. This is a burden families cannot afford. It amounts to a new energy tax on consumers and businesses. An economic-impact study by ASU found the initiative will kill thousands of jobs, reduce the earnings of Arizona workers and weaken our economy just as many people are recovering from the Great Recession. Arizona public schools will also be hurt. The increased price of electricity will mean hundreds of millions of dollars each year in added costs to heat and cool classrooms. This is money better spent improving teacher pay, reducing classroom sizes and making sure students have the textbooks, equipment and technology they need. Don’t be fooled – this initiative will do nothing to reduce pollution or improve public health. An independent analysis found the proposal will have “no effect at all” on air pollution for most Arizona families and “no measurable impact on asthma rates” and other illnesses. Ironically, the proposal will force the closure of Palo Verde Nuclear Generating Station, the nation’s largest source of clean, sustainable electricity. Arizona is making progress on clean energy, but let’s be smart. Keep California-style regulations OUT of our Arizona Constitution.

VOTE NO on the energy initiative.

Matthew Benson, Arizonans for Affordable Electricity, Phoenix
Sponsored by Arizonans for Affordable Electricity

A liberal San Francisco billionaire and his group – NextGen America – are funding this ballot initiative. Of course, this mandate won’t affect the backers of the measure, since NextGen is a California-based organization funded by liberal billionaire Tom Steyer. It doesn’t matter to him or NextGen that draconian renewable energy mandates will harm hardworking families and small businesses in Arizona. They like the idea that rural communities will pay a steep price as a result of sky high energy prices and hefty job losses due to the shuttering of Arizona’s coal power plants. The intellectual dishonesty surrounding this measure is offensive. Making the initiative even more destructive is that it does NOT include nuclear power. This means that one of our most reliable, sustainable and clean sources of power (Palo Verde Nuclear Generating station) would not count toward the mandate. Additionally, Compliance with the 50 percent mandate is anticipated to result in an average utility rate increase of $1,250 per year for Arizona families. Just as absurd, the language exempts SRP (Arizona’s largest carbon-emitting utility) from the energy mandate. This is grossly unfair, and likely was done to reduce their political opposition at the ballot box. The reality is this measure isn’t about improving our environment or making Arizona healthier. This is a power play by wealthy California interests that see our state as an easy target for their liberal ideas. To them, spending a couple million dollars sneaking their renewable mandate into Arizona’s constitution is a drop in the bucket compared to the hundreds of millions Steyer has spent the last two election. NextGen doesn’t have any real grassroots support, so they have brought in an out of state consultants to help pass the measure. We urge Arizona residents to tell NextGen to take their liberal ideas back.

Scot Mussi, President, Arizona Free Enterprise Club, Phoenix
Sponsored by Arizonans for Affordable Electricity
This amendment to Arizona’s Constitution would place unreasonable mandates on Arizona communities, and is not aligned with Arizona’s previously established renewable energy goals, which Arizona is on track to meet. If passed, the measure would dramatically harm Arizona’s competitiveness, put our utilities’ reliable delivery of power at risk, and would send the wrong message about Arizona’s economic development environment. If this mandate were to be enshrined in the state constitution, it would mean dramatically higher energy prices – estimates are that corporate and industrial rates would rise over 100 percent, and residential ratepayers would see an average annual increase of $1,250 – which would create a significant drag on the overall economy and reduce the state’s competitive standing. The proposed standards undermine the current energy structure, which is built upon facilities such as the Palo Verde nuclear plant. Palo Verde is the country’s largest supplier of carbon-free energy and employs over 3,000 Arizona workers, but its contributions to Arizona’s energy portfolio would not count toward the initiative’s proposed mandates. The mandates would also force Arizona residents to pay hundreds of millions of dollars for the construction of new, carbon-emitting natural gas plants that would be necessary to generate electricity when the sun is not shining not blowing. The initiative would require that 20 percent of utilities’ renewable generation come from rooftop solar, which is the most expensive and least efficient form of solar. VOTE NO ON PROP127.

Glenn Hamer, President & CEO, Arizona Chamber of Commerce and Industry, Phoenix

_Sponsored by Arizonans for Affordable Electricity_

Spelling, grammar and punctuation were reproduced as submitted in the “for” and “against” arguments.

The above materials, including the Legislative Council Analysis, Fiscal Impact Statement, and the selected “for” and “against” statements, are from the Arizona 2018 General Election Publicity Pamphlet mailed to registered voters by the Arizona Secretary of State.

The Pamphlet is available here: [https://azsos.gov/sites/default/files/2018_Publicity_Pamphlet_Final.pdf](https://azsos.gov/sites/default/files/2018_Publicity_Pamphlet_Final.pdf)
APPENDIX D

PARTICIPANT RECRUITMENT QUESTIONNAIRE FOR THE PHOENIX CLIMATE RESILIENCE FORUM. SIMILAR QUESTIONNAIRES WERE USED AT OTHER CLIMATE RESILIENCE FORUMS
Thank you for applying to be part of the daylong deliberation, "Building Resilience For Heat Waves and Drought: Preparing for Phoenix's Uncertain Future."

The program will take place at the Arizona Science Center on September 16, 2017. Applicants must be at least 18 years of age.

* 1. The event will be presented in English, but we welcome participants whose preferred language is Spanish and we can provide interpreters on request. Would you be comfortable participating in the event at a bilingual table?

El evento se presentará en inglés, pero damos la bienvenida los participantes que prefirieren el español y tenemos intérpretes disponibles si lo piden. ¿Sería cómodo participando en el evento de una mesa bilingüe?

- Yes / Sí
- No / No
Thank you for applying to be part of the deliberation "Building Resilience For Heat Waves and Drought: Preparing for Phoenix's Uncertain Future". This project is supported by a national Environmental Literacy Grant from the National Oceanographic and Atmospheric Administration. To learn more about the project, please go to http://cspo.org/research/science-center-public-forums-community-engagement-for-environmental-literacy-improved-resilience-and-decision-making.

We will choose 100 participants from several hundred applicants based on a number of factors in order to ensure a diversity of experiences and views among our participant group.

These factors include: (a) Age, (b) Gender, (c) Race/Ethnicity, (d) Income, (e) Educational Level, (f) Occupation, and (g) Geographical Zone.

Criteria and categories are adapted from the 2010 U.S. Census. http://factfinder.census.gov/

Since we will be selecting participants on the basis of these criteria, answering questions about them is a necessary requirement for applying to be part of the deliberation. The program will take place at the Arizona Science Center on September 16, 2017. Applicants must be at least 18 years of age.

We will let you know whether or not you have been accepted to participate by mid-August. If you are not selected, there may still be opportunities to participate in public events at the Arizona Science Center. We will let you know. Please answer as fully and accurately as possible so that we can assure that a range of viewpoints are represented at the deliberation.

Thank you for your interest in our programs!

Questions? Need assistance? Please email Kamlynn Thomas at thomask@azscience.org or call (602) 716-2000, Ext. 245.

* 1. What is your first name?
   Please note that we need your real full name and phone number in order to provide the stipend payment for participation.

* 2. What is your last name?
* 3. What is your email address?
   We will only use your contact information to correspond with you about your application for this deliberation. We will never give your email address to another party.
   Email Address: 

* 4. What is your phone number?
   Phone Number: 

* 5. What is the street name and number for your mailing address?
   Street 

* 6. What city do you live in?
   City/Town: 

* 7. What is your zip code? (enter 5-digit ZIP code; for example, 00544 or 94305)
   ZIP: 

* 8. What state do you live in?
   State: -- select state -- 

* 9. Which of the following would you say describes the area where you live?
   - Urban
   - Suburban
   - Rural

* 10. Are you male or female?
   - Male
   - Female
   - I don't identify as either
* 11. What is your age?
   - 18-24
   - 25-44
   - 45-64
   - 65+

* 12. What is your household income per year?
   - Less than $25,000
   - $25,000 to 49,999
   - $50,000 to 99,999
   - $100,000 or more

* 13. What race/ethnicity best describes you?
   - White, not Hispanic
   - Black, not Hispanic
   - Asian
   - Hispanic or Latino
   - Mixed race
   - Other (please specify)

* 14. What is the highest level of education you have completed?
   - No high school diploma or GED earned
   - High school degree or equivalency
   - Some college
   - Bachelor's degree
   - Graduate or professional degree
15. Which of the following best describes your occupational situation?
- Employed
- Unemployed
- Retired
- Student
- Other

16. If you are employed, what is your:
   - Occupation?
   - Industry?

17. Would you consider yourself to be a professional teacher or educator?
- Yes
- No

18. If you are an educator or teacher, please briefly describe your work.

19. Are you professionally involved in climate, energy, or urban planning issues through your work or business?
- Yes
- No

20. If you are professionally involved with the issues of climate, energy, or urban planning, please describe how you are involved.

21. Are you member of an environmental organization? (a non-governmental organization that works actively and politically to promote sustainable development and to promote environmental protection)
- Yes, an active member
- Yes, a passive member
- No
22. Do you have any accessibility needs or accommodation requests that we should be aware of?

23. How did you hear about this program?
APPENDIX E

PARTICIPANT DEMOGRAPHICS AT ALL CLIMATE RESILIENCE FORUM SITES
<table>
<thead>
<tr>
<th>Participant Demographics - All Climate Resilience Forum sites</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>365</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>219</td>
<td>60%</td>
</tr>
<tr>
<td>Male</td>
<td>140</td>
<td>38%</td>
</tr>
<tr>
<td>I don’t identify as either</td>
<td>6</td>
<td>2%</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-24</td>
<td>53</td>
<td>15%</td>
</tr>
<tr>
<td>25-44</td>
<td>137</td>
<td>38%</td>
</tr>
<tr>
<td>45-64</td>
<td>117</td>
<td>32%</td>
</tr>
<tr>
<td>65+</td>
<td>58</td>
<td>16%</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than $25,000</td>
<td>73</td>
<td>20%</td>
</tr>
<tr>
<td>$25,000 to 49,999</td>
<td>71</td>
<td>19%</td>
</tr>
<tr>
<td>$50,000 to 99,999</td>
<td>110</td>
<td>30%</td>
</tr>
<tr>
<td>$100,000 or more</td>
<td>63</td>
<td>17%</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No high school degree</td>
<td>4</td>
<td>1%</td>
</tr>
<tr>
<td>High school degree or equivalency</td>
<td>22</td>
<td>6%</td>
</tr>
<tr>
<td>Some college</td>
<td>95</td>
<td>26%</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>111</td>
<td>30%</td>
</tr>
<tr>
<td>Graduate or professional degree</td>
<td>133</td>
<td>36%</td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>169</td>
<td>46%</td>
</tr>
<tr>
<td>Unemployed</td>
<td>19</td>
<td>5%</td>
</tr>
<tr>
<td>Retired</td>
<td>49</td>
<td>13%</td>
</tr>
<tr>
<td>Student</td>
<td>46</td>
<td>13%</td>
</tr>
<tr>
<td>Other</td>
<td>34</td>
<td>9%</td>
</tr>
<tr>
<td><strong>Educator</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>91</td>
<td>25%</td>
</tr>
<tr>
<td><strong>Environmental group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active member</td>
<td>101</td>
<td>28%</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>30</td>
<td>8%</td>
</tr>
<tr>
<td>White, not Hispanic</td>
<td>219</td>
<td>60%</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>31</td>
<td>8%</td>
</tr>
<tr>
<td>Black, not Hispanic</td>
<td>41</td>
<td>11%</td>
</tr>
<tr>
<td>Other</td>
<td>21</td>
<td>6%</td>
</tr>
<tr>
<td>Mixed race</td>
<td>23</td>
<td>6%</td>
</tr>
</tbody>
</table>
APPENDIX F

PARTICIPANT RECRUITMENT QUESTIONNAIRE FOR THE GLENDALE, AZ PROP 127 FORUM. A SIMILAR QUESTIONNAIRE WAS USED FOR THE PROP 127 FORUM IN SIERRA VISTA, AZ.
Applicant Information

Thank you for your interest in this study

We are researchers at Arizona State University. We are conducting a study to collect public views about renewable energy policy. If selected, you will be asked to participate in a forum on Monday, October 29th, at the Sierra Vista Community United Church of Christ from 5:30-7:30pm. Below are details about the study.

We invite your participation and request that you complete the prescreening survey (application) below to provide demographic information. We will choose approximately 35 participants from the applicant pool based on a number of factors in order to ensure a diversity of background, experiences and perspectives among our participant group. These factors include: Age, Race/Ethnicity, Income, Educational Level, Gender, Occupation, and Geographical Zone. Criteria and categories are adapted from the 2010 U.S. Census. http://Factfinder.census.gov

If selected, you will be invited to spend an evening participating in a group discussion. We will be collecting anonymous worksheets and surveys at this discussion.

Your participation in this study is voluntary. Selected participants will receive a $10 Amazon gift card after completion of the forum. You must be 18 or older to participate in this research study.

Participants will review information about Proposition 127, a ballot initiative in Arizona concerning renewable energy. Participants will learn about potential impacts of Proposition 127 and policies like it, both positive and negative. You’ll also learn about the opinions and perspectives of others. There are no foreseeable risks or discomforts involved with your participation.

Your responses, including the demographic data collected in the application and opinions collected in surveys before and after the event, will be anonymous. The results of this study may be used in reports, presentations, or publications but your name will not be known. Most results will only be shared in the aggregate form and any individual comments will remain anonymous.

All survey responses will be kept in a secure location and be used only by the researchers to further our understanding of the deliberations.

If you have any questions concerning the research study, please contact the research team at: mahmud.farooque@asu.edu or nicholas.weller@asu.edu

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance at (480) 965-6788.

Please let us know if you wish to be part of the forum by completing the application below.
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>* 1. What is your first name?</td>
<td></td>
</tr>
<tr>
<td>* 2. What is your last name?</td>
<td></td>
</tr>
<tr>
<td>* 3. What is your email address?</td>
<td></td>
</tr>
<tr>
<td>We will only use your contact information to correspond with you about your application for this forum. We will never give your email address, phone number, or other contact information to another party.</td>
<td></td>
</tr>
<tr>
<td>Email Address:</td>
<td></td>
</tr>
<tr>
<td>* 4. What is your phone number?</td>
<td></td>
</tr>
<tr>
<td>Phone Number:</td>
<td></td>
</tr>
<tr>
<td>* 5. What is the street name and number for your mailing address?</td>
<td></td>
</tr>
<tr>
<td>Street</td>
<td></td>
</tr>
<tr>
<td>* 6. What city do you live in?</td>
<td></td>
</tr>
<tr>
<td>City/Town:</td>
<td></td>
</tr>
<tr>
<td>* 7. What state do you live in?</td>
<td></td>
</tr>
<tr>
<td>State: -- select state --</td>
<td></td>
</tr>
<tr>
<td>* 8. What is your zip code? (enter 5-digit ZIP code; for example, 00544 or 94305)</td>
<td></td>
</tr>
<tr>
<td>ZIP:</td>
<td></td>
</tr>
<tr>
<td>* 9. Which of the following would you say describes the area where you live?</td>
<td></td>
</tr>
<tr>
<td>- Urban</td>
<td></td>
</tr>
<tr>
<td>- Suburban</td>
<td></td>
</tr>
<tr>
<td>- Rural</td>
<td></td>
</tr>
</tbody>
</table>
* 10. What is your gender?
   - Male
   - Female
   - I don’t identify as either

* 11. What is your age?
   - 18-24
   - 25-44
   - 45-64
   - 65+

* 12. What is your household income per year?
   - Less than $25,000
   - $25,000 to 49,999
   - $50,000 to 99,999
   - $100,000 or more

* 13. What race/ethnicity best describes you?
   - White, not Hispanic
   - Black, not Hispanic
   - Asian
   - Hispanic or Latino
   - Native American
   - Mixed race
   - Other (please specify)
* 14. What is the highest level of education you have completed?
   - No high school diploma or GED earned
   - High school degree or equivalency
   - Some college
   - Bachelor's degree
   - Graduate or professional degree

* 15. Which of the following best describes your occupational situation?
   - Employed
   - Unemployed
   - Retired
   - Student
   - Other

16. If you are employed, what is your:
   - Occupation?
   - Industry?

* 17. How familiar are you with renewable energy?
   - Very Familiar
   - Somewhat Familiar
   - Not Familiar

* 18. Are you involved in climate change or renewable energy issues through work, business, or advocacy?
   - Yes
   - No

If yes, please explain your involvement
19. Are you an active member of an advocacy organization that works for or against policies regarding renewable energy?
- Yes
- No

If yes, please explain your involvement

<table>
<thead>
<tr>
<th>20. Many people feel that their political views are too complex to describe with a single label. But if you had to choose one of the following categories, how would you describe your political orientation?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Far left</td>
</tr>
<tr>
<td>Liberal</td>
</tr>
<tr>
<td>Middle of the Road</td>
</tr>
<tr>
<td>Conservative</td>
</tr>
<tr>
<td>Far right</td>
</tr>
<tr>
<td>Don't know</td>
</tr>
<tr>
<td>Other (please specify)</td>
</tr>
</tbody>
</table>

21. How did you hear about this program?


APPENDIX G

PRE-FORUM PARTICIPANT SURVEY FOR THE PROP 127 FORUMS
Thank you for your interest in this research. Please read the following before beginning the survey.

You have been selected to participate in a forum on renewable energy policy on November 1st at ASU West campus from 6-8pm. Below are details about the study and your rights as a study participant.

STUDY TITLE: Assessing the impact of public deliberations on public opinion regarding renewable energy policy

RESEARCH TEAM
My name is Nicholas Weller. I am a graduate student under the direction of Professor Mahmud Farooque in the School for the Future of Innovation in Society at Arizona State University. I am conducting this research study to examine the impact of public deliberations on public opinion regarding renewable energy policy in Arizona.

STUDY ACTIVITIES
Your participation in this study will involve a survey, reading materials about renewable energy policy, and participating in a group discussion at an event held in the evening on Thursday, November 1st. Completing an initial survey (below) will take 10-15 minutes. You have the right not to answer any question and to stop participation at any time.

The event itself will take approximately 2 hours, 90 minutes of which is discussion. At the event, you’ll read through a discussion guide along with several other participants. A facilitator will help guide the group conversation. At the end of the discussion, you’ll be asked to fill out another survey that will take 10-15 minutes to complete. We’ll also collect the answers you provide on a question sheet during the forum.

Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty and you can still participate in the event and discussion. You will receive a $15 Amazon gift card as compensation for your participation at the end of the event. You must be 18 or older to participate in the study.

Through your participation, you will review information about Proposition 127, a ballot initiative in Arizona concerning renewable energy. You’ll learn about potential impacts of Proposition 127 and similar policies, both positive and negative. You’ll also learn about the opinions and perspectives of others. There are no foreseeable risks or discomforts to your participation. This research will help inform future efforts to engage broad audiences in conversations about technical and contested topics.

CONFIDENTIALITY
Your responses will be confidential. Survey responses will be kept password protected and separate of information, like your name, linked to your identity. We collect information like your name and email for recruitment and logistical purposes only. The results of this study may be used
in reports, presentations, or publications but your name will not be used. Results from this study will be shared in the aggregate form.

If you have any questions concerning the research study, please contact the research team at Mahmud.Farooque@asu.edu or nicholas.weller@asu.edu. If you have any questions about your rights as a participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788. Please select “I agree to participate in this research” below if you wish to continue as a participant in this study.

* 1. Do you agree to participate in this study?
   - I agree to participate in this study
   - I do not wish to participate in this study

### Match Code

To allow us to match pre-event and post-event surveys, please enter the following information. This information will ONLY be used to match pre- and post-event surveys.

* 2. What is the first letter of your first name?  

* 3. In what month is your birthday? Please enter a 2 digit number. For example, if you're birthday is in February, you would enter '02'.  

* 4. What are the last four digits of your primary phone number?

### Proposition 127

* 5. Have you heard of Proposition 127, also known as the Clean Energy for a Healthy Arizona Ballot initiative?
   - Yes
   - No
Proposition 127, or the Clean Energy for a Healthy Arizona Initiative, would amend Arizona’s Constitution to mandate that electric utilities get 50% of their electricity from certain renewables sources like solar and wind by 2030. Arizona citizens will vote to approve or reject Prop 127 in the upcoming general election held on November 6, 2018.

Motivation to Participate

What are your reasons for participating in this renewable energy forum? Please rate the importance of the motives listed below.

* 6. To learn about Proposition 127 or renewable energy in general.
   - [ ] Strongly agree
   - [ ] Agree
   - [ ] Somewhat agree
   - [ ] Neither agree nor disagree
   - [ ] Somewhat disagree
   - [ ] Disagree
   - [ ] Strongly Disagree

* 7. To influence decision making by others on Prop 127.
   - [ ] Strongly agree
   - [ ] Agree
   - [ ] Somewhat agree
   - [ ] Neither agree nor disagree
   - [ ] Somewhat disagree
   - [ ] Disagree
   - [ ] Strongly Disagree

* 8. To discuss with other people, regardless of topic.
   - [ ] Strongly agree
   - [ ] Agree
   - [ ] Somewhat agree
   - [ ] Neither agree nor disagree
   - [ ] Somewhat disagree
   - [ ] Disagree
   - [ ] Strongly Disagree

* 9. To hear alternative perspectives to my personal opinion on Prop 127 or renewable energy in general.
   - [ ] Strongly agree
   - [ ] Agree
   - [ ] Somewhat agree
   - [ ] Neither agree nor disagree
   - [ ] Somewhat disagree
   - [ ] Disagree
   - [ ] Strongly Disagree
* 10. There is no specific reason why I chose to participate.
   - Strongly agree
   - Agree
   - Somewhat agree
   - Neither agree nor disagree

* 11. I understand the way electricity and energy systems work.
   - Strongly disagree
   - Disagree
   - Somewhat disagree
   - Neither agree nor disagree

* 12. I feel knowledgeable about issues related to renewable energy.
   - Strongly Disagree
   - Disagree
   - Somewhat disagree
   - Neither agree nor disagree

* 13. I understand what Prop 127 is and what it proposes to do.
   - Strongly Disagree
   - Disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - [ ] Strongly Disagree
   - [ ] Disagree
   - [ ] Somewhat disagree
   - [ ] Neither agree nor disagree
   - [ ] Somewhat agree
   - [ ] Agree
   - [ ] Strongly agree

* 15. I understand how unintended consequences can come from changes to complex systems like energy systems
   - [ ] Strongly Disagree
   - [ ] Disagree
   - [ ] Somewhat disagree
   - [ ] Neither agree nor disagree
   - [ ] Somewhat agree
   - [ ] Agree
   - [ ] Strongly agree

* 16. I have tried to find information about Prop 127 to help me decide how to vote.
   - [ ] Strongly Disagree
   - [ ] Disagree
   - [ ] Somewhat disagree
   - [ ] Neither agree nor disagree
   - [ ] Somewhat agree
   - [ ] Agree
   - [ ] Strongly agree

17. Please describe where you have seen or heard information about Prop 127. If you haven't heard of Prop 127, please say so:

   

* 18. Based on what you know about Prop 127, how would you rate your support or opposition to the initiative?
   - [ ] Strongly oppose
   - [ ] Oppose
   - [ ] Somewhat oppose
   - [ ] Neither oppose nor support
   - [ ] Somewhat support
   - [ ] Support
   - [ ] Strongly support

19. Please briefly describe why you feel this way:

   

275
* 20. Please answer the following question by selecting one response that best captures your plans to vote in the upcoming election.

On a scale of 1 to 10, where 1 is definitely will not vote and 10 is definitely will vote, how likely are you to vote in the upcoming election on November 6th?

- 1
- 2
- 3
- 4
- 5
- 6

- 7
- 8
- 9
- 10

- Don't know
- Cannot vote/not registered

About you - Demographics

Please answer the following demographic questions in a way that best describes how you identify.

* 21. What is your gender?

- Male
- Female

- Other (please specify)

* 22. In what year were you born? Please enter a 4 digit year

* 23. What is your level of formal education?

- Did not graduate from high school
- College degree
- Graduated from high school or equivalent
- Graduate professional degree
- Attended, but did not graduate from college
* 24. What race/ethnicity best describes you

- White, not Hispanic
- Black, not Hispanic
- Asian
- Other (please specify)

* 25. What is your household's income level?

- Less than $25,000
- $25,000-49,000
- $50,000-99,000
- More than $100,000

* 26. Please indicate your basic political orientation

- Far left
- Liberal
- Middle
- Conservative
- Far right
- Other
- Don't know

* 27. When it comes to politics, do you identify as a Republican, a Democrat, or something else? Please pick a point on the following scale that best represents you.

- Strong Republican
- No-so-strong Republican
- Independent (lean towards Republicans)
- Independent (lean towards Democrats)
- Independent
- Independent
- No-so-strong Democrat
- Strong Democrat
APPENDIX H

POST-FORUM PARTICIPANT SURVEY FOR THE PROP 127 FORUMS
Prop 127 In-Person Forum
POST Survey

To allow us to match pre-event and post-event surveys, please enter the following information. This information will ONLY be used to match pre- and post-event surveys.

First Letter of First Name: ___  Month of Birth: ______  Last 4 Digits of Primary Phone #: __ __ __ __

Location of event (Sierra Vista or Glendale): ________________

INTEREST & KNOWLEDGE
Please answer the following questions by selecting one response. How do you rate your personal interest and knowledge about energy systems?

1. I understand the way electricity and energy systems work.
   □  □  □  □  □  □  □

2. I feel knowledgeable about issues related to renewable energy.
   □  □  □  □  □  □  □

3. I understand what Prop 127 is and what it proposes to do.
   □  □  □  □  □  □  □

4. I feel confident assessing arguments made for and against Prop 127.
   □  □  □  □  □  □  □

5. I understand how unintended consequences can come from changes to complex systems like energy systems
   □  □  □  □  □  □  □

SUPPORT FOR PROP 127
Please answer the following questions by selecting one response that best captures your opinions about Prop 127.

6. Based on what you know about Prop 127, how would you rate your support or opposition to the initiative?
   □  □  □  □  □  □  □

Please briefly describe why you feel this way:
UPCOMING ELECTION
Please answer the following questions by selecting one response that best captures your plans to vote in the upcoming election.

On a scale of 1 to 10, where 1 is definitely will not vote and 10 is definitely will vote, how likely are you to vote in the upcoming election on November 6th?

1 2 3 4 5 6 7 8 9 10 Don’t know Cannot vote/not registered

ORGANIZATION OF THE FORUM
Please assess the following statements about the Prop 127 Forum.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Neither Agree or Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The objectives of the whole event were clear to me.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. All participants had the same opportunities to voice their opinion.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I was able to contribute my ideas and views during general discussions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I was able to contribute my ideas and views while developing our group plan.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Participants were treated respectfully by the organizers and forum staff.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Participants discussed the topics constructively (active listening, respectful treatment...).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Important societal groups (ethnic minorities, age and income groups, etc.) were appropriately represented at the event.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Facilitator(s) effectively moderated discussions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. I understood the information in the guide.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. The guide was unbiased.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Some relevant technical information and positions were missing from the guide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. There was enough time for participants to discuss and reflect on information and arguments.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. The event used my time productively.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
14. I am fully satisfied with the forum.

15. The guide helped me understand the way electricity and energy systems work.

16. The guide helped me understand issues related to renewable energy.

17. The guide helped me understand what Prop 127 is and what it proposes to do.

18. The guide helped me assess arguments made for and against Prop 127.

19. The guide helped me arrive at a more informed opinion about Prop 127.

20. The guide helped understand how unintended consequences can come from changes to complex systems like energy systems

If you have any recommendations for improving the forum or the quality and validity of the results, please report them here.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
APPENDIX I

PRE AND POST SURVEYS FOR ONLINE RESPONDENTS IN THE PROP 127 FORUMS
Online Guide – Prop 127
PRE Survey

DEMOGRAPHICS

1. Are you registered to vote in Arizona? (y/n/not sure)
2. What is your gender? (m/f/other text box)
3. In what year were you born? (numerical)
4. What’s the highest level of education you’ve completed? (No HS, HS, Some College, B deg, G/P deg)
5. What is your race? (White, Black, Asian, Hispanic, Mixed, Native American, Other)
6. What is your zip code? (numerical)
7. What is your employment status? (Employed, Unemployed, Retired, Student, Other)
8. What is your household’s income level? (<$25K, $25K-49K, $50K-99K, >$100k)
9. How do you identify politically? (far left, liberal, middle, conservative, far right, other, don’t know)
10. Are you an active member of an advocacy organization that works for or against policies regarding climate change? (y/n, if yes then text box about their role)
11. Are you an active member of an advocacy organization that works for or against policies regarding renewable energy? (y/n, if yes then text box about their role)
12. Have you heard of Proposition 127, also known as the Clean Energy for a Healthy Arizona Ballot initiative? (y/n)

Prop 127
Prop 127 would amend Arizona’s Constitution to mandate that electric utilities get 50% of their electricity from certain renewables sources like solar and wind by 2030. Arizona citizens will vote to approve or reject Prop 127 in the upcoming general election held on November 6, 2018.

Have you heard of proposition 127? Yes No Unsure
**INTEREST & KNOWLEDGE**
Please answer the following questions by selecting one response. How do you rate your personal interest and knowledge about energy systems and Prop 127?

1. I understand the way electricity and energy systems work. 
   - Strongly Disagree
   - Neither Agree or Disagree
   - Strongly Agree

2. I feel knowledgeable about issues related to renewable energy. 
   - Strongly Disagree
   - Neither Agree or Disagree
   - Strongly Agree

3. I understand what Prop 127 is and what it proposes to do. 
   - Strongly Disagree
   - Neither Agree or Disagree
   - Strongly Agree

4. I feel confident assessing arguments made for and against Prop 127. 
   - Strongly Disagree
   - Neither Agree or Disagree
   - Strongly Agree

5. I understand how unintended consequences can come from changes to complex systems like energy systems 
   - Strongly Disagree
   - Neither Agree or Disagree
   - Strongly Agree

6. I have tried to find information about Prop 127 to help me decide how to vote. 
   - Strongly Disagree
   - Neither Agree or Disagree
   - Strongly Agree

7. Please describe where you have seen or heard information about Prop 127:

---

**SUPPORT FOR PROP 127**
Please answer the following questions by selecting one response that best captures your opinions about Prop 127.

8. Based on what you know about Prop 127, how would you rate your support or opposition to the initiative? 
   - Strongly oppose
   - Neither oppose or support
   - Strongly support

   Please briefly describe why you feel this way:

---

**UPCOMING ELECTION**
Please answer the following question by selecting one response that best captures your plans to vote in the upcoming election.

On a scale of 1 to 10, where 1 is definitely will not vote and 10 is definitely will vote, how likely are you to vote in the upcoming election on November 6th?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>Don’t know</th>
<th>Cannot vote/not registered</th>
</tr>
</thead>
</table>

**Prompt about issue guide**

A) Please review the issue guide for Proposition 127 available at the link below. You don’t need to know every detail covered in this guide but you should be aware of the main points. This guide is meant to help voters learn about the proposition before they go to the polls. The guide is in pdf format.


OR

B) Please review the issue guide for Proposition 127 available at the link below. You don’t need to know every detail covered in this guide but you should be aware of the main points. This guide is meant to help voters learn about the proposition before they go to the polls. The guide is in pdf format.

https://www.dropbox.com/s/7wu9658j2sfml9q/Guide%20w%20basic%20graphic%20draft%208.pdf?dl=0

**INTEREST & KNOWLEDGE**

Please answer the following questions by selecting one response. How do you rate your personal interest and knowledge about energy systems?

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Neither Agree or Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I understand the way electricity and energy systems work.</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>2.</td>
<td>I feel knowledgeable about issues related to renewable energy.</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>3.</td>
<td>I understand what Prop 127 is and what it proposes to do.</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>4.</td>
<td>I feel confident assessing arguments made for and against Prop 127.</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>5.</td>
<td>I understand how unintended consequences can come from changes to complex systems like energy systems</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>6.</td>
<td>I plan to seek out more information about Prop 127 to help me decide how to vote.</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐</td>
</tr>
</tbody>
</table>

**ORGANIZATION OF THE GUIDE**

Please assess the following statements about the issue guide.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Neither Agree or Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I understood the information in the guide.</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐</td>
</tr>
</tbody>
</table>
2. The guide was unbiased.

3. Some relevant technical information and positions were missing from the guide

4. The guide helped me understand the way electricity and energy systems work.

5. The guide helped me understand issues related to renewable energy.

6. The guide helped me understand what Prop 127 is and what it proposes to do.

7. The guide helped me assess arguments made for and against Prop 127.

8. The guide helped me arrive at a more informed opinion about Prop 127.

9. The guide helped understand how unintended consequences can come from changes to complex systems like energy systems

**UPCOMING ELECTION**
Please answer the following questions by selecting one response that best captures your plans to vote in the upcoming election.

On a scale of 1 to 10, where 1 is definitely will not vote and 10 is definitely will vote, how likely are you are you to vote in the upcoming election on November 6th?

1 2 3 4 5 6 7 8 9 10  Don’t know  Cannot vote/not registered

**SUPPORT FOR PROP 127**
Please answer the following questions by selecting one response that best captures your opinions about Prop 127.

1. Based on what you know about Prop 127, how would you rate your support or opposition to the initiative?

Please briefly describe why you feel this way:
If you have any recommendations for improving the information provided, please report them here:

______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

Match code
To allow us to match survey responses with HITs on Mechanical Turk, please enter the following information. This information will ONLY be used to ensure completion of surveys and facilitate payment. Be sure to enter the same code in the HIT.

First Letter of First Name: ___  Month of Birth (#): _______  Favorite color: _______________
APPENDIX J

PARTICIPANT DEMOGRAPHICS AT ALL PROP 127 FORUMS AND ONLINE RESPONDENTS
### PARTICIPANT DEMOGRAPHICS AT ALL PROP 127 FORUMS AND ONLINE RESPONDENTS

<table>
<thead>
<tr>
<th></th>
<th>All Online Participants</th>
<th>Forum Guide</th>
<th>AZ Sec. of State Guide</th>
<th>Forum Participants</th>
<th>Arizona 2015/16*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>108</td>
<td>56</td>
<td>51</td>
<td>21</td>
</tr>
<tr>
<td>Registered Voter</td>
<td>Registered voter - Yes</td>
<td>102</td>
<td>53</td>
<td>49</td>
<td>67.7%</td>
</tr>
<tr>
<td></td>
<td>Registered voter - No</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>32.3%</td>
</tr>
<tr>
<td></td>
<td>Registered voter - Not Sure</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>67.7%</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>41</td>
<td>27</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>38.0%</td>
<td>48.2%</td>
<td>27.5%</td>
<td>49.7%</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>65</td>
<td>28</td>
<td>36</td>
<td>52.4%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60.2%</td>
<td>50.0%</td>
<td>70.6%</td>
<td>50.3%</td>
</tr>
<tr>
<td></td>
<td>Other/Did not specify</td>
<td>2</td>
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<td>1</td>
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<tr>
<td>Age</td>
<td>18-24</td>
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<td>3</td>
<td>2</td>
<td>4.6%</td>
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<td></td>
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<td>5.4%</td>
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<tr>
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<td>25-44</td>
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<td>25</td>
<td>5</td>
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<tr>
<td></td>
<td></td>
<td>48.1%</td>
<td>48.2%</td>
<td>49.0%</td>
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<td>41.7%</td>
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<td>41.2%</td>
<td>23.8%</td>
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<tr>
<td></td>
<td>65+</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>4.6%</td>
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<tr>
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<td></td>
<td>4.6%</td>
<td>3.6%</td>
<td>5.9%</td>
<td>15.4%</td>
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<tr>
<td></td>
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<td>1</td>
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<td>Income</td>
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<td></td>
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<td>20.4%</td>
<td>25.0%</td>
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<tr>
<td></td>
<td>$25,000-$49,000</td>
<td>30</td>
<td>18</td>
<td>11</td>
<td>5</td>
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<tr>
<td></td>
<td></td>
<td>27.8%</td>
<td>32.1%</td>
<td>21.6%</td>
<td>9.5%</td>
</tr>
<tr>
<td></td>
<td>$50,000-$99,000</td>
<td>39</td>
<td>15</td>
<td>24</td>
<td>6</td>
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<td></td>
<td></td>
<td>36.1%</td>
<td>26.8%</td>
<td>47.1%</td>
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</tr>
<tr>
<td></td>
<td>More than $100,000</td>
<td>17</td>
<td>9</td>
<td>8</td>
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<tr>
<td></td>
<td></td>
<td>15.7%</td>
<td>16.1%</td>
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<tr>
<td></td>
<td>Did not specify</td>
<td>4</td>
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<tr>
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<td></td>
<td></td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td></td>
<td>Graduated from high school or equivalent</td>
<td>17</td>
<td>9</td>
<td>16.1%</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Attended, but did not graduate from college</td>
<td>39</td>
<td>24</td>
<td>42.0%</td>
<td>14</td>
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<tr>
<td></td>
<td>College degree</td>
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<td>17</td>
<td>22</td>
<td>4</td>
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<td></td>
<td></td>
<td>36.1%</td>
<td>30.4%</td>
<td>43.1%</td>
<td>19.0%</td>
</tr>
<tr>
<td></td>
<td>Graduate professional degree</td>
<td>12</td>
<td>6</td>
<td>10.7%</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Did not specify</td>
<td>3</td>
<td>3</td>
<td>12</td>
<td>1.9%</td>
</tr>
<tr>
<td>Employment</td>
<td>Student</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>4.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.6%</td>
<td>5.4%</td>
<td>3.9%</td>
<td>11.0%</td>
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<tr>
<td></td>
<td>Employed</td>
<td>78</td>
<td>37</td>
<td>40</td>
<td>78.4%</td>
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<tr>
<td></td>
<td></td>
<td>72.2%</td>
<td>66.1%</td>
<td>78.4%</td>
<td>54.0%</td>
</tr>
<tr>
<td></td>
<td>Unemployed</td>
<td>9</td>
<td>7</td>
<td>2</td>
<td>8.3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.3%</td>
<td>12.5%</td>
<td>3.9%</td>
<td>5.3%</td>
</tr>
<tr>
<td></td>
<td>Retired</td>
<td>9</td>
<td>5</td>
<td>4</td>
<td>8.3%</td>
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<td></td>
<td></td>
<td>8.3%</td>
<td>8.0%</td>
<td>7.8%</td>
<td>45.3%</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>3.7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.7%</td>
<td>5.4%</td>
<td>2.0%</td>
<td>2.0%</td>
</tr>
</tbody>
</table>
## Participant Demographics at All Prop 127 Forums and Online Respondents

<table>
<thead>
<tr>
<th>Political Orientation</th>
<th>All Online Participants</th>
<th>AZ Sec. of State Guide</th>
<th>Forum Participants</th>
<th>Arizona 2015/16*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>108</td>
<td>56</td>
<td>51</td>
</tr>
<tr>
<td>Far right</td>
<td></td>
<td>5 4.6%</td>
<td>4 7.1%</td>
<td>1 2.0%</td>
</tr>
<tr>
<td>Conservative</td>
<td></td>
<td>28 25.9%</td>
<td>14 25.0%</td>
<td>14 27.5%</td>
</tr>
<tr>
<td>Middle</td>
<td></td>
<td>34 31.5%</td>
<td>16 28.6%</td>
<td>18 35.3%</td>
</tr>
<tr>
<td>Liberal</td>
<td></td>
<td>35 32.4%</td>
<td>17 30.4%</td>
<td>17 33.3%</td>
</tr>
<tr>
<td>Far left</td>
<td></td>
<td>4 3.7%</td>
<td>3 5.4%</td>
<td>1 2.0%</td>
</tr>
<tr>
<td>Don’t know</td>
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<td>0 0.0%</td>
<td>0 0.0%</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td></td>
<td>0 0.0%</td>
<td>0 0.0%</td>
<td>0 0.0%</td>
</tr>
<tr>
<td>Did not specify</td>
<td></td>
<td>1 4.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 19.0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Party Identification</th>
<th>All Online Participants</th>
<th>AZ Sec. of State Guide</th>
<th>Forum Participants</th>
<th>Arizona 2015/16*</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Total</td>
<td>108</td>
<td>56</td>
<td>51</td>
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<tr>
<td>Strong Republican</td>
<td></td>
<td>12 11.1%</td>
<td>8 14.3%</td>
<td>4 7.8%</td>
</tr>
<tr>
<td>No-so-strong Republican</td>
<td></td>
<td>12 11.1%</td>
<td>6 10.7%</td>
<td>6 11.8%</td>
</tr>
<tr>
<td>Independent (lean towards Republicans)</td>
<td></td>
<td>14 13.0%</td>
<td>7 12.5%</td>
<td>7 13.7%</td>
</tr>
<tr>
<td>Independent</td>
<td></td>
<td>19 17.6%</td>
<td>11 19.6%</td>
<td>8 15.7%</td>
</tr>
<tr>
<td>Independent (lean towards Democrats)</td>
<td></td>
<td>21 19.4%</td>
<td>10 17.9%</td>
<td>11 21.6%</td>
</tr>
<tr>
<td>No-so-strong Democrat</td>
<td></td>
<td>14 13.0%</td>
<td>4 7.1%</td>
<td>9 17.6%</td>
</tr>
<tr>
<td>Strong Democrat</td>
<td></td>
<td>16 14.8%</td>
<td>10 17.9%</td>
<td>6 11.8%</td>
</tr>
<tr>
<td>Did not specify</td>
<td></td>
<td>4 19.0%</td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Issue Advocacy</th>
<th>All Online Participants</th>
<th>AZ Sec. of State Guide</th>
<th>Forum Participants</th>
<th>Arizona 2015/16*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>108</td>
<td>56</td>
<td>51</td>
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<tr>
<td>Climate issue advocate - Yes</td>
<td></td>
<td>2 1.9%</td>
<td>1 1.8%</td>
<td>1 2.0%</td>
</tr>
<tr>
<td>Climate issue advocate - No</td>
<td></td>
<td>105 97.2%</td>
<td>54 96.4%</td>
<td>50 98.0%</td>
</tr>
<tr>
<td>Renewable energy issue advocate - Yes</td>
<td></td>
<td>1 0.9%</td>
<td>0 0.0%</td>
<td>1 2.0%</td>
</tr>
<tr>
<td>Renewable energy issue advocate - No</td>
<td></td>
<td>105 97.2%</td>
<td>55 98.2%</td>
<td>49 96.1%</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>All Online Participants</th>
<th>AZ Sec. of State Guide</th>
<th>Forum Participants</th>
<th>Arizona 2015/16*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>108</td>
<td>56</td>
<td>51</td>
</tr>
<tr>
<td>Asian</td>
<td></td>
<td>4 3.7%</td>
<td>3 5.4%</td>
<td>1 2.0%</td>
</tr>
<tr>
<td>Black, not Hispanic</td>
<td></td>
<td>4 3.7%</td>
<td>2 3.6%</td>
<td>2 3.9%</td>
</tr>
<tr>
<td>White, not Hispanic</td>
<td></td>
<td>81 75.0%</td>
<td>41 73.2%</td>
<td>40 78.4%</td>
</tr>
<tr>
<td>Hispanic</td>
<td></td>
<td>11 10.2%</td>
<td>5 8.9%</td>
<td>6 11.8%</td>
</tr>
<tr>
<td>Mixed</td>
<td></td>
<td>7 6.5%</td>
<td>4 7.1%</td>
<td>2 3.9%</td>
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<tr>
<td>Native American</td>
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<td>0 0.0%</td>
<td>0 0.0%</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>1 0.9%</td>
<td>1 1.8%</td>
<td>0 0.0%</td>
</tr>
<tr>
<td>Did not specify</td>
<td></td>
<td>3 14.3%</td>
<td></td>
<td></td>
</tr>
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</table>

* Retirement data sourced from the American Association of Retired People. Voter registration data sourced from the Arizona Secretary of State. Other data from U.S. Census.

Census data: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF
Retirement data: http://dataexplorer.aarp.org/profile/4/arizona/?ind=236
APPENDIX K

INSTITUTIONAL REVIEW BOARD CORRESPONDANCE LETTER FOR INTERVIEWS CONDUCTED WITH POLICY MAKERS AND EXPERTS WHO OBSERVED A CLIMATE RESILIENCE FORUM
EXEMPTION GRANTED

Mahmud Farooque
Future of Innovation in Society, School for the
202/446-0397
Mahmud.Farooque@asu.edu

Dear Mahmud Farooque:

On 8/4/2017 the ASU IRB reviewed the following protocol:

<table>
<thead>
<tr>
<th>Type of Review:</th>
<th>Initial Study</th>
</tr>
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<tbody>
<tr>
<td>Title:</td>
<td>Decision maker perceptions of a participatory Technology Assessment (pTA) of climate resilience strategies</td>
</tr>
<tr>
<td>Investigator:</td>
<td>Mahmud Farooque</td>
</tr>
<tr>
<td>IRB ID:</td>
<td>STUDY00006622</td>
</tr>
<tr>
<td>Funding:</td>
<td>None</td>
</tr>
<tr>
<td>Grant Title:</td>
<td>None</td>
</tr>
<tr>
<td>Grant ID:</td>
<td>None</td>
</tr>
<tr>
<td>Documents Reviewed:</td>
<td>• pTA decision maker interview guide, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • pTA decision maker recruitment, Category: Recruitment Materials; • pTA decision maker consent, Category: Consent Form; • pTA decision maker protocol, Category: IRB Protocol;</td>
</tr>
</tbody>
</table>

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 8/4/2017.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator
cc:  Nicholas Weller
     Nicholas Weller
APPENDIX L

INSTITUTIONAL REVIEW BOARD CORRESPONDANCE LETTER FOR
OBSERVATIONS CONDUCTED AT WORKSHOPS WITH POLICY MAKERS AND
EXPERTS. WORKSHOPS INFORMED CONTENT FOR THE CLIMATE RESILIENCE
FORUM ACTIVITIES
EXEMPTION GRANTED

Ira Bennett
Future of Innovation in Society, School for the
480/727-8830
Ira.Bennett@asu.edu

Dear Ira Bennett:

On 3/29/2016 the ASU IRB reviewed the following protocol:

<table>
<thead>
<tr>
<th>Type of Review:</th>
<th>Initial Study</th>
</tr>
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<tbody>
<tr>
<td>Title:</td>
<td>Connecting participatory Technology Assessments (pTA) of resilience strategies to decision makers and outcomes</td>
</tr>
<tr>
<td>Investigator:</td>
<td>Ira Bennett</td>
</tr>
<tr>
<td>IRB ID:</td>
<td>STUDY00004108</td>
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<tr>
<td>Funding:</td>
<td>None</td>
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<td>Grant Title:</td>
<td>None</td>
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<tr>
<td>Grant ID:</td>
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<tr>
<td>Documents Reviewed:</td>
<td>• Connecting pTA to decisions IRB protocol.docx, Category: IRB Protocol; • Connecting decision making pTA - Consent form, Category: Consent Form; • Connecting decision making pTA - Recruitment, Category: Recruitment Materials;</td>
</tr>
</tbody>
</table>

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 3/29/2016.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc: Nicholas Weller
    Jennifer Fuller
    Ira Bennett
    Nicholas Weller
APPENDIX M

INSTITUTIONAL REVIEW BOARD CORRESPONDANCE LETTER FOR
OBSERVATIONS AND RECORDINGS OF PARTICIPANT CONVERSATIONS AT
CLIMATE RESILIENCE FORUMS
EXEMPTION GRANTED

Mahmud Farooque
Future of Innovation in Society, School for the
202/446-0397
Mahmud.Farooque@asu.edu

Dear Mahmud Farooque:

On 9/11/2017 the ASU IRB reviewed the following protocol:

<table>
<thead>
<tr>
<th>Type of Review:</th>
<th>Initial Study</th>
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<tbody>
<tr>
<td>Title:</td>
<td>Deliberation dynamics in participatory technology assessment (pTA): A case study of climate resilience public forums</td>
</tr>
<tr>
<td>Investigator:</td>
<td>Mahmud Farooque</td>
</tr>
<tr>
<td>IRB ID:</td>
<td>STUDY00006832</td>
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<tr>
<td>Funding:</td>
<td>Name: DOC-NOAA: Office of Education, Grant Office ID: FP00003592, Funding Source ID: NA15SEC0080005</td>
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| Grant Title: | FP00003592; |
| Grant ID:    | FP00003592; |

<table>
<thead>
<tr>
<th>Documents Reviewed:</th>
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<tbody>
<tr>
<td>• NOAA Narrative Draft v5 (Clean) (1).docx, Category: Sponsor Attachment;</td>
</tr>
<tr>
<td>• Delib Dynamics pTA - protocol v1.docx, Category: IRB Protocol;</td>
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<tr>
<td>• Table observation protocol_v1.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);</td>
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<tr>
<td>• 2015 12 NOAA 2015 Initial.pdf, Category: Off-site authorizations (school permission, other IRB approvals, Tribal permission etc);</td>
</tr>
<tr>
<td>• Consent &amp; Recruitment v1.1.pdf, Category: Consent Form;</td>
</tr>
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</table>

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 9/11/2017.
In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc: Nicholas Weller
    Christopher Sanchez
    Elizabeth Garbee
    Nicholas Weller
    Patrick McGurrin
    Katja Brundiers
APPENDIX N

INSTITUTIONAL REVIEW BOARD CORRESPONDANCE LETTER FOR PARTICIPANT

SURVEYS USED IN THE PROP 127 PROJECT
EXEMPTION GRANTED

Mahmud Farooque
Future of Innovation in Society, School for the
202/446-0397
Mahmud.Farooque@asu.edu

Dear Mahmud Farooque:

On 10/12/2018 the ASU IRB reviewed the following protocol:

<table>
<thead>
<tr>
<th>Type of Review:</th>
<th>Initial Study</th>
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<tr>
<td>Title:</td>
<td>Assessing the impact of public deliberations on public opinion regarding renewable energy policy in Arizona</td>
</tr>
<tr>
<td>Investigator:</td>
<td>Mahmud Farooque</td>
</tr>
<tr>
<td>IRB ID:</td>
<td>STUDY00009044</td>
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<tr>
<td>Funding: Name:</td>
<td>Future of Innovation in Society, School for the (SFIS)</td>
</tr>
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<td>Grant Title:</td>
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<tr>
<td>Grant ID:</td>
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Documents Reviewed:
- Consent - Online participants v1.pdf, Category: Consent Form;
- Prop 127 pTA Protocol v1.1.docx, Category: IRB Protocol;
- Consent - In person participants v1.1.pdf, Category: Consent Form;
- Prop 127 Public Forum Flyer v1.pdf, Category: Recruitment Materials;
- In person Pre Survey v1.pdf, Category: Measures (Survey questions/Interview questions/interview guides/focus group questions);
- Online Survey v1.pdf, Category: Measures (Survey questions/Interview questions/interview guides/focus group questions);
- In person Post Survey v1.pdf, Category: Measures (Survey questions/Interview questions/interview guides/focus group questions);
- MTurk Recruitment Language.pdf, Category:
Recruitment Materials:
• Question sheet for forums.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 10/12/2018.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc: Nicholas Weller
    Nicholas Weller
    Sarah Hall
    Michelle Sullivan