Appendix 1. Research methods.

Survey

Survey Questions

We developed a survey to collect background and contextual information for the stakeholder workshops described below, but more broadly to gain insights about adaptation efforts by local government entities in California. The survey contained 19 questions; most of them involved simple nominal or rating questions. Six questions focused on demographics; five were about climate change adaptation more generally, including a broad set of barriers to adaptation; the remaining eight questions were focused on funding and financing adaptation. Detailed results on all survey questions is available in Moser et al. 2018)

> Question 1: Please indicate whether you work with or serve a city or county. This is not for identification purposes, but to collate survey responses by region. (*Multiple choice question*)

> Question 2: Please indicate the city or county you work with or serve. This is not for identification purposes, but to collate survey responses by region. (*Multiple choice question*)

> Question 3: Please indicate the type of entity in which you work. If you work across multiple sectors, please choose the one that best matches your primary work responsibility. (*Multiple choice question*; Please select only one answer.)

> Question 4: Please indicate what type of position you hold in your organization. (*Multiple choice question*)

> Question 5: What is the approximate size of the city or county you serve? (*Multiple choice question*)

> Question 6: Do you currently actively participate in coordinated adaptation efforts in your region (i.e., through the Alliance of Regional Collaboratives for Climate Adaptation or another network)? (*Multiple choice question*)

> Question 7: If you participate in the discussions of a regional adaptation collaborative or network, please indicate which one. (*Write-in question*)

> Question 8: Which category best describes your current phase of climate change adaptation/ preparedness/resilience planning and implementation? (Select only one option that comes closest to your current level of activity.) (*Multiple choice question*)

> Question 9: Whether or not your organization has already taken action to prepare for the possible impacts of climate change, how much of a hurdle has each of the following issues been in your efforts to date or do you anticipate it to be? (*Rating question*)

> Question 10: Can you share how you overcame the barriers you encountered, or provide 1-2 creative ideas for overcoming these barriers? (*Write-in question*)

Question 11: We are interested in how your jurisdiction finances climate adaptation/ preparedness action. Over the past 2 years, has your jurisdiction spent money on any aspect of climate adaptation/preparedness/resilience building? (*Multiple choice question*)

Question 12: If in the last 2 years you have invested in climate adaptation/preparedness/ resilience building, please list the type of actions and processes you have spent money on (check all that apply). (*Multiple choice question*)

Question 13: For the activities you checked in Question 12, what sources of funding did you use (please check all that apply). (*Multiple choice question*)

Question 14: In the next 5 years, for which areas of climate change adaptation/ preparedness/resilience building do you expect to need additional funds? (check all that apply). (*Multiple choice question*)

Question 15: Please indicate the status of your fund-raising efforts for the activities listed in Question 14 (select the option that best describes the current status). (*Multiple choice question*)

Question 16: To date, when attempting to acquire funds to finance adaptation-related activities, which challenges have you encountered (check all that apply). (*Multiple choice question*)

Question 17: If you have successfully obtained funds to finance adaptation-related activities, how have you overcome the above-mentioned challenges (please check all that apply). (*Multiple choice question*)

Question 18: Please share any additional thoughts you might have about financial or institutional barriers that were not covered in the questions above. We welcome your thoughts and insights. (*Write-in question*)

Question 19: Please provide your name and email below if you're willing to be contacted about follow-up questions. Your responses will be kept confidential. (*Write-in question*)

Sampling and Survey Duration

The link to the online survey was distributed through several listservs, email contact lists for the Alliance of Regional Collaboratives for Climate Adaptation (ARCCA)[1], the Local Government Commission (LGC), and to attendees of the Second California Adaptation Forum (CAF, Long Beach, September 7-8, 2016). It was also shared via a project website set up by LGC and at the California Climate Science Symposium (January 25-26, 2017) to reach the widest distribution, rather than specifically representing a bounded population. Reminders were repeatedly sent to contact lists to which the research team had ready access. The survey was open to respondents for a 13-month period from June 28, 2016 and July 27, 2017. Participation in the survey was not tied in an obligatory sense to participation in any other part of the study. Due to the distribution (sampling) method, we cannot construct a response rate. Instead, the responses create a non-parametric dataset, i.e., neither the data, nor its summary statistics, provide a representative sample of all local governments in California. In other words, if we report that x% of

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[1] ARCCA is a network of regional collaboratives from across California. The Local Government Commission (https://www.lgc.org/) serves as its coordinator. Each collaborative, and the statewide network of regional collaboratives, aims to advance adaptation statewide and increase local capacity to build community resilience (see http://arccacalifornia.org).

respondents from local governments expressed that funding climate adaptation is the main hurdle impeding their planning for climate change impacts, it does not necessarily allow us to conclude that that same x% of all local governments in California share that view.

Criteria for Data Inclusion

Survey questions were optional, so that for any given question a participant could skip to the next question without having to answer the previous question. This typically creates a lower response rate per question but can also help prevent early drop-off from potentially frustrated respondents when they want to get through the survey more quickly (Dillman et al. 2009). As with any survey dataset, we reviewed the dataset to identify and eliminate those that did not meet our standards.

The criteria required for inclusion are as follows:

- Respondents must have answered one or more substance question, beyond the question of "do you collaborate…?", thus fulfilling the criteria of being a partial or complete survey.

- Repeat respondents must have not already submitted a survey that met criteria #1.

We collected a total of 333 online survey responses, of which 251 met Criterion #1, i.e. respondents answered at least one substantive question. Criterion #2 implied that those responses associated with the same name and/or email address were removed if there was a prior complete or partial response associated with the same name and/or email address. The earliest dated eligible response was kept as part of the final dataset.

As a result, of the 251 acceptable responses, 18 were omitted from the analysis because they were identified as duplicates submitted by individuals on different occasions. The remaining 233 responses (70% of surveys started) were used in the statistical analysis. When discussing results, the question-specific number of respondents (N) is included, given that not all respondents answered every question.

Potential Biases in the Sample

There are 482 municipalities and 58 counties, for a total of 540 local governments in California. We received 233 valid survey responses, 173 respondents (or 74%) of which work for or with a city or county. Thus, we can assume to have captured a good proportion of local governments across the state. It is likely, however, that these responses are biased toward those more interested in and already working – in one way or another – on climate change adaptation, with fewer respondents who do not yet engage on this topic.

To better characterize our sample of responses and assess the potential for generalizability absent a known response rate, we compared the geo-location of respondents to the geographical distribution of cities and counties across the state. Table A1.1 and

Table A1.2 (see corresponding Figures in Appendix A, A.2 and A.3) compare the representation of cities and counties, respectively according to size. They show that our survey sample under-represents small cities and counties and overrepresents large cities and counties. Only mid-sized cities are comparable in representation. This might indirectly confirm our suspicion that the survey might be biased toward respondents who are interested and engaged in climate change adaptation, possibly due to the more liberal leanings of larger urban settings or due to greater capacity to address adaptation.

Table A1.1: Distribution of California cities by size (based on US Census 2012) and of respondents' locations (based on reported affiliated city size)

Size of cities	Number of cities in CA (N=459)	Percent of total in California	Number of city respondents in survey (N=90)	Percent of city respondents in survey
<25,000	200	44%	17	19%
>25,000 - 50,000	90	20%	11	12%
>50,000 - 100,000	101	22%	22	24%
>100,000 - 500,000	63	14%	32	36%
>500,000	5	1%	8	9%

Source: The Authors

Table A1.2: Distribution of California counties by size (based on US Census 2012) and of respondents' locations (based on reported affiliated county size)

Size of counties	Number of counties in CA (N=58)	Percent of total in California	Number of county respondents in survey (N=45)	Percent of county respondents in survey
<25,000	9	16%	3	7%
>25,000 - 50,000	6	10%	1	2%
>50,000 - 100,000	8	14%	2	4%
>100,000 - 500,000	18	31%	20	44%
>500,000	17	29%	19	42%

Source: The Authors

As for the similarity of our survey sample in terms of the geographic distribution of respondents across the state, we placed CA cities and counties into the climate regions used in the Fourth Climate Change Assessment (CCA4)[2] and compared the representation in the survey to the statewide distribution based on the US Census. Table A1.3 shows that comparison, illustrating that the proportion of city respondents was similar to proportions across regions statewide. For example, according to the 2012 US Census, 36% of CA cities are in the Los Angeles climate region and 34% of our respondents worked with or at cities in the Los Angeles region. Only a few regions are inadequately represented in the survey: for example, the San Joaquin Valley and Inland South are underrepresented, and San Francisco Bay Area is overrepresented in our survey compared to their Census-based prominence.

Table A1.3: Comparison of the Representation of Cities by Climate Region, Statewide and in the Survey

CCA4 Regions	Number of cities in CA (N=459)	Percent of total cities	Number of city survey respondents (N=90)	Percent of city survey respondents
Central Coast	33	7%	9	10%

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[2] To examine responses across regions within California, individual responses were tagged with a regional identifier, based on how respondents answered Question 2 "Please indicate the city or county you work with or serve. This is not for identification purposes, but to collate survey responses by region." The regional identifiers were derived from the climate regions created by the CCA4 team.

Inland South	23	5%	0	0%
Los Angeles	164	36%	31	34%
North Coast	23	5%	3	3%
Sacramento Valley	35	8%	9	10%
San Diego	18	4%	7	8%
San Francisco Bay Area	84	18%	27	30%
San Joaquin Valley	59	13%	2	2%
Sierra Nevada Mountains	20	4%	2	2%

Source: The Authors

In summary, while we cannot assess the statewide representativeness of our survey sample *statistically* by providing an assessment of the response rate, we can describe our sample in qualitative ways: it is likely biased toward more adaptation-interested and -engaged respondents, representing local governments across California, but particularly well from larger cities and counties and less well from smaller inland governments. This may well reflect the observation that larger cities are further advanced in their adaptation efforts, and thus more likely to run into finance challenges and thus more interested in the topic of this study.

Workshops, Archetype Analysis and Coding

Objectives

The project team held nine stakeholder workshops across the state, with the specific objectives of (1) hearing directly from local government staff and from organizations supporting local government efforts on the financing and institutional barriers cities and counties faced; and (2) discussing and exploring potential strategies to overcome these barriers.

To ensure opportunity for engagement from a wide variety of local governments – big and small; coastal and inland; north, central and south – we convened stakeholders in San Diego, Los Angeles, the Central Coast, the San Francisco Bay Area, the Capitol Region, the Central Valley, the North Coast, and the Sierra Nevada, and in an open workshop (without regional specificity) at the 2016 Third California Adaptation Forum in Long Beach.

Recruitment

The primary sources from which workshop participants were recruited included ARCCA email contact lists of local government officials and other individuals engaged in adaptation work across the state as well as LGC email lists of local government officials. While the ARCCA contact list is more specific to adaptation, it is more biased toward regions that already have established or emerging regional adaptation collaboratives, whereas the LGC email list is less specific to adaptation but provides better coverage across the state. The research team also sent personal invitations to any collaborators they knew in different regions across the state.

Workshop participation was open to any local government staff and anyone working with local governments on climate adaptation (e.g., consultants, NGO representatives, State agency personnel). Workshops were not size-restricted, but an online registration process (involving responding to the above described survey) was used to adequately prepare logistics for each event. Participation was uneven across the nine workshops, reflecting the size of interested and engaged individuals in each region. The pattern largely followed regional representation in the survey, with most participants from the major metropolitan regions, those attending the California Adaptation Forum, and fewer participants from other regions. Between the nine workshops, there was a total of 149 participants.

Facilitation

The half-day workshops were organized into two main sessions. The first of these focused on the adaptation funding challenges, while the second focused on institutional barriers to adaptation (the latter is not further discussed in this report as a separate project report was prepared summarizing that effort; see Kay et al. 2018). The project team served as facilitators.

The more specific aim of the funding-focused part of the workshop was to collect information about (a) the size of the funding and financing gap for California local governments, (b) existing economically and politically feasible financing options available to fill this gap, and (c) the nature of the financing challenges and how they can be overcome. The session aimed to answer these questions by (a) generating as much information as possible about the full range of adaptation funding-related challenges that local governments face and (b) engaging participants in sharing and learning about possible ways to minimize or overcome the financing challenges identified.

The workshop began with an introduction and framing of the session. The team highlighted that the session would focus on funding adaptation and climate change preparedness and resilience building efforts, and that any and all related activities and expenditures could be considered part of the conversation. The team also acknowledged that local governments are at various stages in their adaptation efforts, and will therefore vary in experience, knowledge and need. Due to this variance, the team noted that the session would focus on identifying common funding challenges that participants have encountered in other parts of their work; explore to what extent funding adaptation is similar to these common challenges; and examine what if anything is unique about the challenges around funding adaptation. Furthermore, the team noted that mainstreaming adaptation into other efforts (e.g., hazard mitigation planning and general plan updates) was within the workshop scope. Lastly, the team stressed that the session aimed to have a conversation that delved deeper than the oft-heard complaint that there is not enough money. The workshop aimed to explore whether there are challenges in applying for money, accessing or accepting money, limits on what money can be used for, administering money and so on to determine the exact nature of the finance-related problems participants face.

After the framing and introduction, the team engaged in a brainstorming session. Five "stations" (big notepads on tripods) were set up to explore funding challenges from different perspectives:

- Funding issues by **sector** (e.g., coastal, vs. wildfire, vs. health);

- Funding issues by **stage in the adaptation process** (e.g., completing initial assessments, planning, implementing actions or monitoring etc.);

- Funding issues by **size of community** (e.g., work for/with a smaller community vs. a larger city);

- Funding issues by **type of funding source/instrument** (e.g., from a State or federal agency, a foundation grant, or their own general funds; a tax or fee-based source vs. a bond or a grant); and,

- Funding issues that apply to **cross-cutting adaptation needs** (adaptation-related expenditures, e.g., outreach vs. shovel-ready projects)

Participants were given sticky notes to write down up to three issues that fell into any one of these five categories. They then placed these sticky notes on the corresponding notepads. Discussion circles of participants interested in a particular topic formed around each of the five stations to talk about the ideas generated in the brainstorm. Facilitators guided the sharing and discussion of the nature of the challenges written on the sticky notes. Any additional issues identified during the discussion circle were documented on a sticky note and added to the board. Participants then were asked to rotate to another station of interest, and another round of discussion deepened the understanding of the issues raised. Detailed notes were taken by pre-assigned note takers during these rounds of discussion.

Participants then reunited into the big workshop group, and facilitators led a debrief, focusing on the most difficult and complicated issues, the most common issues, and notable insights from the discussion circles. Facilitators also probed further with questions about how funding challenges have been overcome, how foundations, State and federal governments, and others can facilitate overcoming the challenges, what other support would be helpful, and any other ideas. Again, detailed notes were taken by pre-assigned note takers.

Archetype Analysis
The majority of available examples of archetype analysis are either expert elicitations or theory-driven (deductive) quantitative meta-analyses of existing case studies. Such studies typically involve elaborate searches for qualifying case studies, extensive coding of eligible studies or identification of quantifiable indicators, followed by qualitative or quantitative analyses of the information such as cluster analysis, principle component analysis, qualitative comparison analysis or fuzzy logic modelling to derive common patterns of associated factors that constitute the archetypes.

These approaches were deemed not applicable to generating a first understanding of the persistent patterns of adaptation finance challenges experienced by local governments in California. Our goal was to identify/discern the (repeated) causal connections made by workshop participants, not to conduct an objective systems analysis or a theoretically-ideologically driven analysis.[3] We aimed to understand, synthesize and systematize stakeholders' understanding of the finance challenges they face. Thus, after the conclusion of all workshops, detailed workshop notes collected by trained volunteers were inductively labeled (often using key phrases repeatedly used by participants) and sorted, using grounded theory (Glasser and Strauss 2011; Walsh et al. 2015). Grounded theory – while well established in the social sciences – constitutes a methodological innovation in archetype analysis. It begins from stakeholder's own perceptions of a given matter of concern and tries to understand how they explain those matters (rather than impose a theory- or ideologically driven explanation on stakeholders' views). While not focused on establishing consensus views, grounded theory identifies (sets of) issues mentioned

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[33] These methodological approaches differ in the degree to which they seek statistical associations between observed phenomena and to what extent they try to discern causal patterns underlying those observed phenomena. In our analysis we combine these by starting with repeatedly observed phenomena and then try to understand the underlying causal drivers, using stakeholders' own perceptions of these causal relationships.

repeatedly, and then uses those repeated issues to anchor subsequent rounds of analysis that focus on understanding underlying explanations and repercussions of the noted challenges. The analyst's role is to look for patterns among the problems identified across all workshops (in this case, across regions, types of climate risks, types and sizes of local government entities etc.), as well as among the explanatory factors underlying them and for associated consequences of those constellations.

In the first read, the workshop notes were screened independently by two researchers (Moser and Ekstrom) for repetitive themes or funding challenges; subsequent reads involved identifying associated challenges, contributing factors (underlying causes and conditions), and consequences of the challenges identified. Care was taken to retain the associations between factors as they were discussed by workshop participants, rather than separating them on the basis of some pre-conceived logic. In other words, the analysis was not driven by any single theory or underlying framework (as is called for in the typical, deductive approaches to archetype analysis, see, e.g., Eisenack 2012), but rather adhered to the inductive approach of grounded theory. Moreover, initial rounds of identifying finance challenges revealed factors not captured in any single applicable theory. For example, diagnostic approaches to understanding institutional barriers to adaptation (e.g., Oberlack 2017), make "funding resources" one of several explanatory variables of adaptation outcomes, but provide little depth to the many dimensions of these funding resources that are of central interest to this study. Other approaches have a sufficiently broad empirical basis to propose directional interactions among explanatory factors and expected outcomes that we deemed inappropriately early for a first-order identification and understanding of archetypal funding challenges (e.g., Kimmich 2013). However, the observed preponderance of institutional factors caused us subsequently also to examine the workshop notes deductively for additional items typically highlighted in studies of institutional settings and governance systems (e.g., Ostrom 2007, 2009, 2014; Young 2010). Our analysis also retained information about where particular challenges were identified (i.e., the region or sector); however, this turned out to be of small if any relevance, as nearly all core challenges associated with adaptation funding where identified in nearly every region and most cut across sectors.

Iterative and recursive post-workshop processing of workshop notes by the researchers in this fashion helped repeated adaptation funding challenges to rise to the fore. They revealed characteristic associations among:
- observed funding challenges (often, the first-order complaint or problem experienced);
- core anchors or focal points[4] of each challenge (an organizing principle that associated the observed challenge within a stage or logical sequence in the process of obtaining/using adaptation funding);
- a set of underlying contributory factors or attributes (stakeholders' own explanations for why these problems existed); and
- characteristic (and defining) outcomes on their ability to proceed with acquiring/using adaptation funds.

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[4] "Anchor" and "focal point" are used interchangeably in the text. The phrase implies a characteristic temporal dimension of when the archetype occurs in the overall process of obtaining/using funding. In this way, the full suite of archetypes is logically, sequentially organized.

Differently put, each archetype is constituted of these four dimensions: an observed phenomenon occurring (or anchored) at a key stage in the funding process, caused by a characteristic set of underlying and interacting drivers, resulting in defining outcomes.

In this way, the analysis revealed a suite of 15 unique archetypes, several with notable sub-types/variants or specific expressions in different contexts. These subtypes were labeled as such when the anchor/focal point, underlying drivers and characteristic outcomes were still very much like those of the main archetype, but there were slight variations in the way they expressed themselves in different contexts (e.g., differences by region or by climate risk). This variation, however, did not warrant the establishment of an entirely new archetype. In fact, stakeholders themselves on occasion used phrases like "another way this same problem shows up is…", to illustrate this variation on a theme, rather than giving a sense of an entirely different finance challenge.