Climate-Safe Infrastructure Working Group
Meeting #2
February 12, 2018, Los Angeles

Meeting Summary

Introduction

This meeting summary provides succinct highlights of the meeting discussions, decisions made and progress on the Working Group's efforts, as opposed to detailed meeting minutes. The meeting agenda and meeting presentation provides additional information on the contents of the meeting.

This meeting was the second gathering of the Climate-Safe Infrastructure Working Group (CSIWG or WG for short). Its primary goals were fourfold, namely to:

1. **Identify and begin to prioritize climate-sensitive infrastructure;**
2. **Agree on definitions** for: *infrastructure*, *resilience* and *climate-safe;*
3. **Identify relevant infrastructure standards** that need to consider forward-looking climate information; and
4. **Identify climate science needs** for updating infrastructure standards, guidelines and guidance and policies.

The key outcomes around each of the meeting goals are summarized. A review of the overall progress of the Working Group along its self-defined goals are summarized first.

Progress on Project Goals

In Meeting 1, the CSIWG determined goals and sub-objectives they wish to achieve over the course of the project. We note them here with progress made since that first meeting.

Project Goal Areas (Developed in Meeting #1)	
	TRACKING PROGRESS
GOALS	**Post-MEETING #2 - February 2018**
Orient toward longer-term outcomes (Vision, indications of success over time)	
Intended Long-term Outcome (therefore work toward recommendations that…)	Brainstormed long-term outcomes of the work of the CSIWG (as indicators of success over time)
State agencies lead by example (…show clearly what the state can do immediately and over the medium- and longer-term).	
Serve as example for the rest of the country (…illustrate what barriers there are and how they could be overcome; provide examples of progress wherever possible).	

Resiliency is embodied in codes (… address the entire infrastructure planning, design, financing, implementation, monitoring and reassessment cycle, and use codes/standards and non-standard strategies to affect resilience).	WG identified relevant codes, standards and guidelines to in the future need to reflect resiliency goals; the WG also advanced toward a common understanding of resiliency, climate-safety, and the infrastructure systems to focus on.
Widely accepted climate change standards (… set up a sustained process for engaging, training engineers; and make uptake of new standards and guidelines more likely).	
Codes and standards are correctly implemented and used (… focus on the development and use of forward-looking science in infrastructure building as well as on implementation).	
Sustainable, resilient and safe buildings in a real-world social context (… reflect an understanding of the systems being designed/redesigned as social-economic-ecological-technical systems).	The WG agreed to focus on infrastructure systems, rather than on isolated physical or technological structures.
Produce a set of outputs by July 1	
Complete a report (core elements and text) that:	Had significant discussion on the level and contents of what the report should include
… includes concrete recommendations for updating design codes.	As work of the WG progresses, initial ideas for items to include in recommendations are being surfaced
… provides useable, tangible tools, techniques, guidance for people to operationalize recommendations.	
… offers technical and policy guidelines.	
... provides a path for how to implement the measures recommended.	
… offers recommendations that are robust, credible and actionable.	
… is written for people who may be skeptical about integrating climate change science into engineering practice.	
Provide clear policy guidance for near-term and longer-term decisions	
Ensure that the Report includes overarching policy recommendations which:	Agreed on the importance of policy recommendations
… emphasize the importance of policy guidance.	

… address the near-term opportunities of $billions of infrastructure-spending in CA.	
… convey that engineers have a responsibility to create safe buildings and communities.	Progress was made on a shared understanding of resilience and climate safety. The importance of liability, which is linked to standards, has also been noted.
… seriously consider environmental justice.	WG members continue to emphasize the importance of recognizing legacies of past infrastructure decisions and the uneven benefits accrued by different communities.
.. model how to inform decisions by science and robust evidence.	A webinar was held and WG focused in Meeting #2 on forward-looking climate science needs.
Address key issues for science & the science-practice interface	
Ensure that the Report:	Brainstormed important aspects that the final report (and the work of the CSIWG must address)
… Identifies vulnerable/critical infrastructure.	Homework to begin doing that will be sent to CSIWG after Meeting #1
… Identifies critical information needs of engineers.	WG focused in Meeting #2 on forward-looking climate science needs.
… looks at variety of time scales over which decisions are made.	WG members recognize that time scales (design life, infrastructure life span, life cycles, planning horizons, frequency with which codes/standards get updated) vary by type of infrastructure and level of governance.
… Defines priorities for future research / understanding and information gaps.	WG members are beginning to identify research needs; work is ongoing
… Identifies ways to integrate changing science into durable designs.	
… Describes a process for selecting engineering designs for a range of climate scenarios.	
… Identifies barriers to integrating science into standards and design.	
… Provides guidance and examples for how to connect cutting-edge, forward-looking science to practice.	
… Addresses the need for ongoing monitoring of projects so as to collect evidence on how new guidelines are working.	WG members have highlighted the importance of ongoing monitoring to validate data and to assess performance.

Focus on engagement during and after the life of the Working Group	
Reach out to public throughout CSIWG's process.	Organizing of webinar series already begun; formal public comment opportunities during each meeting; public was invited to actively participate in discussions with WG members in Mtg #2; project team is building growing listserv of interested stakeholders; CSIWG members invited to send names to add and spread the word about the CSIWG.
Seek input from and reach out to people implementing resiliency/sustainability measures in practice.	Speakers invited to Webinar #1 and #2 offered some illustrative examples. Recruitment of external speakers to future webinars is ongoing. WG and other stakeholders have sent suggestions for future webinar speakers.
Focus on owners/investors of state infrastructure, but assume a much broader audience (non-state-owned infrastructure, engineers and decision-makers everywhere in CA and beyond).	
Ensure that report is not just for the State legislature and Strategic Growth Council, but speaks directly to engineers so they can begin implementing what is being recommended for practice.	
Initiate or recommend the creation of a platform and sustained, adaptive process (beyond the life of this WG) to facilitate ongoing/future science-engineering communication/interaction.	
Embody a set of principles and values throughout the Working Group's work	
Reflect what we want CA government to be.	Meetings are open to the public and widely advertised; provided several opportunities for public input and direct engagement between WG members and attending public. Group process transparent to all. Meeting materials shared publicly well in advance of each meeting. Post-meeting summary notes and other related materials also shared on CNRA website.
Ensure we take social, behavioral, economic dimensions into account in recommendations (not just physical science and engineering approaches).	CSIWG membership and project team membership embodies this range of expertise. Social science information needs are noted in the ongoing work of the WG.

Contribute experience and learn from all others, (e.g., status of climate science, how real-world infrastructure decisions gets made).	Members expressed their appreciation for the diversity of expertise around the table. Diversity of expertise and perspective shared in Wg meetings and webinars. Local example of changing building codes/designs was presented in Meeting #2.
Form new relationships.	Relationship building process begun.
Work toward solutions for social systems.	WG continues to emphasize the importance of defining infrastructure systemically.
Work toward real results with everyone.	
Meet public responsibility to meet design life expectations of expensive infrastructure.	

Definitions

During the first meeting, it was requested by the WG and members of the public, that the WG discuss and come to agreement on definitions for three terms: *resilience*, *infrastructure* and *climate-safe*. The WG was asked to review several definitions for each of these words and then asked to provide feedback.

Infrastructure:
In order to guide the discussion of identifying and then prioritizing which infrastructure should be considered under this legislation, it was important to first ensure that all WG members agreed on what was meant by *infrastructure*. The WG was provided two different definitions and then was asked to review and comment on each.

The first definition comes from the CA Governor's Office of Planning and Research's "Planning and Investing for a Resilient California." This document identifies infrastructure as:

> Assets that support the functioning of society or whose operation and maintenance are necessary for the public's health, safety, and welfare. These assets can be natural or man-made, as well as physical or virtual, and can be held publicly or privately. The benefits from these assets are generally available to a large portion of the population, because they are held in public trust, or because their adoption is so widespread that social processes have become reliant on them.

The second definition comes for the American Society of Civil Engineers, which identifies "critical infrastructure" as:

> Critical infrastructure includes systems, facilities, and assets so vital that their destruction or incapacitation would have a debilitating impact on national security, the economy or public health, safety, and welfare.

> Critical infrastructure may cross political boundaries and may be built (such as structural, energy, water, transportation, and communication systems), natural (such as surface or ground water resources), or virtual (such as cyber, electronic data, and information systems).

Before breaking into small groups to discuss these terms, the WG was asked to provide their initial reactions. Comments included:

- The ASCE definition refers to "critical" infrastructure, not the broader term of "infrastructure." It was noted that ASCE only provides a definition for "critical" infrastructure.
- Multiple comments focused on the notion that infrastructure is not just a stand-alone physical structure, but should be considered a *system* consisting of a physical/technological structure that is embedded in a built and/or natural environment, put to social/economic uses and governed by institutions, rules and social norms and expectations of their functionality/service.
- WG members also argued that infrastructure is more than just levees and dams (i.e., physical structure), but may also include the healthcare system – such as, hospitals, trauma centers etc., and the connectivity among and between these infrastructure components. ASCE does include the healthcare system in their definition.
- It was noted that benefits of infrastructure development and maintenance have accrued unequally across populations. to the recommendations of the WG should consider all of CA society and not only focus on current benefit structures.
- Discussion also reiterated a point made in the first meeting, that the WG should think about both existing infrastructure (and how to retrofit those assets to make them climate-safe) as well as consider new structures (and how those should be built in the future based on forward-looking climate information).
- It was felt that the definitions do overlap, but that incorporation of the term "functioning of society" was critical to include.

WG members continued the conversation on their definition of resilience in their small groups. Notes from these small group discussions were collected by the facilitator with the goal of incorporating these notes into a final definition for review and adoption by the Working Group.

<u>*Resilience*</u>:
The term *resilience* is used by many different disciplines and fields and often times has subtle, but critically important, differences. The Working Group reviewed and discussed the traditional ecological/social-ecological definition of resilience along with several engineering-based definitions.

The ecological resilience definition provided comes from Gunderson (2000); it states:

> The amount of disturbance that an ecosystem can withstand without changing self-organized relationships, processes and structures (i.e. alternative stable states).
>
> - In presenting this definition, the facilitators noted that it was very much centered on the dynamic changes within ecosystems upon disruption.
> - The definition resembled engineering resilience in many ways, but of course it is driven not by human design or ingenuity, but by the self-organizing capacity of the components of natural systems.

The next definition came from the State of California's *Safeguard California* (2018) definition of resilience (which is derived from the Rockefeller 100 Resilient Cities definition). It states:

> Resilience is the capacity of any entity – an individual, a community, an organization, or a natural system – to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience.
>
> - Here, resilience is not a system trait, measured by the return time to a prior state, but a capacity of a social or natural system to do four things: 1) prepare (i.e., on the basis of foresight); 2) recover; 3) adapt and 4) grow.

This was followed by the definition of community resilience from the National Institute of Standards & Technology (NIST), which states:

> Community resilience is the ability to prepare for anticipated hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions.
>
> - This definition includes the integration of human, natural, and infrastructure/lifeline systems. It suggests, communities don't only have to prepare, recover and adapt but also withstand, so it emphasizes a degree of protection against disruption.

Finally, the facilitator presented the definition from the American Association of State Highway and Transportation Officials:

> The ability to prepare and plan for, absorb, recover from, or more successfully adapt to adverse event.
>
> - This definition adds the capacity to plan for; withstand is here phrased as "absorbed"; and it introduces the qualifier "successfully" adapt – which is not defined, and typically is a value-laden and often contested aspect of adaptation.

Climate-Safe:

AB2800 legislation utilizes the term *climate-safe*, but there is no associated definition to fully understand what is meant or how something will be measured to be *climate-safe*. Two passages from associated documents were provided to the WG for their consideration.

The first is from *Safeguarding California* (2018), which describes "infrastructure and built systems withstand changing conditions and shocks, including changes in climate, while continuing to provide essential services.

The Union of Concerned Scientists (sponsors of AB2800) provided this interpretation:

> Infrastructure that is resilient to damage caused by extreme weather and climate change and that reduces heat-trapping emissions to the maximum extent possible. It also seeks to address the inequities in our infrastructure systems and decision processes and to bolster the resilience of California's communities and economy.

Initial feedback from the WG on *resilience* and *climate-safe* included the following comments:

- Resilience needs to imply that something is "still living" or functioning.
- Needs to include the broad notion of looking forward and looking backward.
- In the Safeguarding definition, "grow" implies to "learn." But, just because something is learned, doesn't mean the lesson is being acted upon. E.g., train tracks can be moved out of harm's way. But, if they are built back the same way, they may not be resilient. Need to build back "better."
- Resilience definitions don't include the systems around the infrastructure. E.g., if healthcare communication systems are damaged, what is the ability to pass on information in an emergency? These issues were clearly evident during the recent Santa Barbara mudslides.

In addition to the group discussion, WG members were asked to also take notes on handouts and turn those handouts over the facilitators and/or to email follow-up comments after the meeting. In preparation for Meeting #3, the facilitators will incorporate all comments and provide an integrated definition for *resilience, infrastructure* and *climate-safe* for review and approval by the WG.

Identification and Prioritization of Infrastructure

Identification of Infrastructure:

In advance of Meeting #2, the WG members were asked to fill in a document (see example below) that asked them to identify:

1) The infrastructure types they are concerned with
2) That infrastructure's existing condition/status
3) Exposure to existing climate stresses
4) Perceived/expected changes in climate stressors

<u>Example (Worksheet excerpt):</u>

Infrastructure type	Existing condition / status	Exposure to existing climate stresses	Perceived/expected changes in climate stressors
E.g., Transportation – Culvert Design	205,000 culverts on State Hwys, 65% in Good Condition, 23% in Fair Condition, and 12% in Poor Condition	Exposed to scour from coastal storms; potential for tidal flooding…	E.g., Increased exposure to coastal storms, erosion and rising seas…

WG members organized themselves into three groups based on their expertise: 1) Transportation, 2) Water and 3) Building and Energy/Efficiency. In these small groups, the WG members discussed their initial entries and updated their "homework" to reflect group discussion. Following these small break-out group discussions, the WG reconvened to relate their discussions to the larger group.

Highlights from the small-group work and large group discussion are summarized in the table below. More details are included in the associated excel file compendium of all the infrastructure identified during the meeting and in pre-/post-meeting work by WG members. (Note: This is a living document and will be updated by the WG members and facilitators as part of the ongoing work of the Working Group.)

Sector	Infrastructure Discussed	Current Climate Stresses
WATER	Large-scale: culverts, levees, dikes, dams 3 subcategories: water supply, stormwater and wastewater; also need to consider natural systems that support built systems.	- temperature/precipitation and run/off are most concerning climate stressors - water demand is changing – needs to be considered somehow
TRANSPORTATION	Above and below ground stations; pavement design mix; 13,000 bridges in CA; rail lines;	- flooding and groundwater levels - runoff important consideration - SLR impacts on bridge height and flooding of roads/rail lines/airports - Rain intensity and rainfall event duration

POWER/ENERGY	Grid components (transformers; panels; service boxes etc.); fuels: gas, electricity/NG lines; onsite solar/wind generation	- nighttime cooling temps - daytime high temps - wind
BUILDINGS	HVAC; communication systems	- extreme temperatures

Key takeaways from group discussion:

- In case of a big event (e.g., flood in the Delta; major wildfire), is there the capacity to repair? E.g., are there enough cranes and barges? What if the repair takes many months?
- This raised the question whether standard planning, design and operation is the sole focus of the WH or whether it should also consider needs and standards related to emergency response .
  - General consensus from the Working Group was that both should be discussed. Moreover, What is done for emergency preparedness and response is a good indicator for what needs to be done for long-term climate change preparedness.
- As part of mitigation planning, solar and electric infrastructure is aggressively increased. There needs to be appropriate planning for these. Is it more efficient to charge EV under extreme climate conditions?
- Need to consider redundancy – consider the risk vs. benefits.
- Need to consider a systems approach for thinking about infrastructure.
- Cross-infrastructure identification of social science needs:
  - Projections of land use (where will people be moving too under changing climate?)
  - Better information on social vulnerability
  - Changing energy usage/demand (related to change in EV adoption and use as well as regular usage under changing climate)
  - Changing water usage/demand
- Public comments
  - Important to consider the lifespan and useful life of infrastructure.
  - Important to consider "essential public services."
  - Redundancy does not always mean distributed… e.g. after Hurricane Harvey, reconsidering distributed systems.
  - Need to consider how to get communication out to people during emergencies/events.

Prioritization of Infrastructure

To spark the initial discussion on how to prioritize infrastructure, the WG was provided an initial list of potential prioritization criteria which include:

- Need/state of good repair/status according to "deferred maintenance" list
- Exposure or vulnerability to climate change risks
- Capacity to fund

- Social equity
- Importance to local community/regional/state functioning (i.e., economics)

Discussion on this topic was short, but initial feedback included:

- There is not necessarily one item on this list that makes one type of infrastructure a priority – but rather these can all be combined to determine some sort of evaluation criteria.
- In thinking about prioritization, the focus again should be on infrastructure systems as opposed to just the physical hardware. It is critical to find or develop methods to map these system components all together; given the range of evaluation criteria, some will emerge as more prominent than others.

Identifying Infrastructure Standards & Guidelines

Building on the identification of infrastructure, WG members were then asked to identify relevant sector-specific infrastructure regulations, standards, codes and/or guidelines per the example below:

Example (Worksheet excerpt):

Sector-specific infrastructure regulations, standards/codes and/or guidelines
Caltrans Highway Design Manual (HDM), FHWA Hydraulic Design of Highway Culverts (HDS-5), FHWA Urban Drainage Design Manual (HEC-22)…

In small groups, they addressed the following questions:

- What guidelines, procedures, standards, codes for existing/replaced/new/green infrastructure throughout the infrastructure planning and building process exist?
- To what extent are existing guidelines sufficient to create resilient/climate safe infrastructure / communities?
- Which need to change to support building climate-safe, adaptive, resilient infrastructure systems?

Details of the discussion can be found in the associated compendium excel file. Reporting from each group focused on different aspects; we highlight key points from the discussion include:

Energy / Buildings Key Standards and Codes:

Report out comments focused on the key standards and codes

- Uniform/building codes
- Electric code
- Green building standards
- CA building code
- National and mechanical design guidance
- Chemical design principles
- Heating and cooling debris

Transportation:
Report-out comments from this group focused more on how to incentivize the updating of standards. A list of standards is included in the compendium.

- Different contract types have different implications. E.g.,
  - Design build—design up to 30%, then put to contractor to finish and build.
  - Design bid build—more opportunity. Concrete bid on what you want, rather than design bill.
- There are minimum criteria and standards that go over and above. Need guidance to rise above minimal standards in Highway Design Manual.
- Discussion on liability and incentives: how should resilience be incentivized?
  - Link design immunity with resilience.

Water:
The report-out from this group focused on how the standards/codes are set.

- Design is driven by large organizations (Corps of Engineers, Bureau of Reclamation, Caltrans…) Also, large organizations—professional: ASCE etc.
- All have committees and groups within them that generate manuals of practice to drive design.
- Local agencies have their own standard specifications, e.g., local plumbing codes.
- Design is driven by regulation/permitting requirement. E.g., when building a water treatment plant, there are certain standards that must be met. Not so much a code, but a set of regulation and standards by an agency.

Inter-sectoral discussion/overlap and general points across sectors:

- There was considerable discussion on the use of rating systems (e.g. Envision, LEED etc.) in order to incentivize and/or encourage more “climate-safe” design and practices.
  - Rating systems are limited in that they are typically voluntary.
  - Meeting rating systems requirements requires financial outlay; may lead to further exacerbation of inequities.
  - There is likely not one rating system that addresses all infrastructure; agencies need to have flexibility to best meet their infrastructure needs.

- Incentives can also encourage design above consensus standards. Examples include:
    - Design immunity
    - Expedited plan checking / code review
    - Economic incentive
- Linking resilience to financing:
    - Cost effectiveness calculation
    - Triple bottom line analysis: evaluate cost effectiveness based on social, environmental and financial criteria
- Dynamic updating of codes and standards
    - CA building codes are updated every 3 years; often times city codes are more stringent.
    - There is a mechanism in place to update codes; build in a system that is dynamic. The code doesn't change, just the science underlying the actions you need to take from that moment forward.

Climate Science Information Needs

In this final discussion, WG members were asked to identify what information they currently use and what are their forward-looking climate info needs:

Example (Worksheet excerpt):

Information used in current planning, design, decision-making	Forward-looking information needs
NOAA Atlas 14 precipitation data (based on historical rainfall data), land use (based on stable historical conditions), Material selection, return frequency, Design Life	How fast SLR will impact culvert; rates of coastal erosion; change in return interval of storms, temperature and precipitation increases over regions of State for various lifecycles of culverts…

Working Group members were directed to discuss climate information needs in small groups and then report back to the larger group. Details of this discussion by infrastructure type are presented in the compendium excel file. Key information needs and overarching takeaways from the group discussion include:

- Energy / Buildings:
    - Need to downscale global climate models to CA—from daily (6 hour) to hourly.
    - Sea level rise and groundwater levels.
    - Different spectrums of radiation for material and surface light of building components.
    - Future projections and variability of outdoor air quality.

- Water Infrastructure:
    - Flow rate (hourly) data for urban water systems
    - Increased capacity to model flow in urban areas
    - Runoff
    - Spatial/temporal resolution: varies for different types… depends on size/scale.
- Transportation:
    - Transit dependent demographic
    - Rain intensity
    - SLR downscaled to highest spatial resolution possible
    - Extreme wind prediction
    - Change in storm surges
    - Change in temperature

Discussion on inter-infrastructure connectivity:

- For urban climate modeling, available models are not sophisticated enough to include the complexity of people and infrastructure.
- Need good population information.
- Need good "vulnerable population" information (currently looking to Enviroscreen for these types of data). [Note: Enviroscreen has its own limitations, however.]
- Understand different levels of certainty—need to understand uncertainty around climate projections
- Lack of present data/monitoring data; having such data would help validate models and test assumptions
- Information will change over time. Need to develop flexible recommendations 5-10 years from now.
- Possibly outdated FEMA maps
- Fines could be used to fund monitoring programs and other innovative resilience programs
- Accessing data can be difficult; are there places where people can turn to get the standard set of information.
    - E.g., NYC: they have a set of climate scenarios and projections that are utilized across the city
    - E.g., Los Angeles Region Imagery Acquisition Consortium
    - (LARIAC) for Los Angeles County – suite of data that is available to all (at a cost)

Regional Example: Build Forward LA

Sabrina Bornstein (LA City Mayor's Office) and Matt Barnard (Degenkolb) presented on the City of LA's Building Forward LA. This is a new initiative that the Office of Mayor Eric Garcetti has launched in partnership with local and national organizations. It supports refreshing and "futurizing" policies and processes that influence how we design and build our city's buildings. The aim of Building Forward LA is to encourage buildings of all types to integrate advancements and innovations in design, engineering, and construction, and take full advantage of our buildings' ability to improve.

Ms. Bornstein and Ms. Barnard discussed the results of a series of engagement workshops and a draft action plan for BFLA. The final action plan with detailed recommendations will be made public in March 2018. Interested stakeholders are encouraged to contact Sabrina Bornstein directly for more information (sabrina.bornstein@lacity.org).