7 Governance:
Changing the Rules to Enable Climate-Safe Infrastructure

Introduction

How infrastructure is built is in large part determined not just by the available science, tools, assessment methodologies and design paradigms prevailing, but also by the rules that govern how infrastructure should be built. In this chapter we turn to these rules and how they need to change in order to accommodate a changing climate and create the conducive environment that supports the movement toward climate-safe infrastructure.

We use the term "governance" to capture these societal rules because governance consists of all the processes of interaction and decision-making that create, reinforce, change or maintain the affairs of society. Besides governments, governance is carried out through markets, networks and social systems (such as formal and informal organizations) using laws, regulations, standards, guidelines and less formal, but often powerful societal or professional norms, incentives, market signals and so on.

How infrastructure is built is in large part determined not just by the available science, tools, assessment methodologies and design paradigms prevailing, but also by the rules that govern how infrastructure should be built.

Following the mandate of AB 2800, we focus first on the existing standards and non-standard-based approaches that govern how infrastructure to date is being built. We describe how standards are developed and changed and to what extent existing standards and guidelines help or hinder the ability to use forward-looking climate science. We close with exploring how current advances in engineering methodologies (professional paradigms, norms and principles) can be incorporated into infrastructure governance to support the transition to climate-safe infrastructure.

Existing Approaches to Infrastructure Design

Traditional Approaches of Governing Engineering Design

Assuming a stationary world in which historic weather and climate patterns were good predictors of the future, the traditional approach for infrastructure design has generally yielded reliable infrastructure that provided the necessary functions, while also protecting life and safety. Engineers, architects, designers and contractors have an extensive suite of engineering standards upon which to design all different types of infrastructure (Box 7.1). Conforming to these baseline standards decreased the risk of catastrophic failure of a specific type of infrastructure and reduced the liability to the engineer, architect, designer or contractor.

Below, we discuss the traditional approach to standard-setting and then discuss how the field is already beginning to shift its practices to accommodate a non-stationary climate future. In Appendix 9, we present a specific case example of the information needs required to update California's Building Energy Standards.

The Standard-Setting Process

Generally, standards are developed at the international or national levels through various standard-setting organizations. The most commonly recognized are the National Institute of Standards and Technology (NIST), the International Organization for Standardization (ISO), the International Code Council (ICC), and the American National Standards Institute (ANSI). Professional organizations for individual sectors, such as the American Society of Civil Engineers (ASCE), the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), or the American Association of State Highway and Transportation Officials (AASHTO) can also set new standards within their own organizations or initiate the updating of existing national and/or international standards. State or local agencies typically adopt these international, national or sector-specific professional standards as minimum standards and codify them in design guidelines, manuals and codes. Both states and local jurisdictions can – and often do – adopt more stringent codes and standards above and beyond those prescribed by the minimum standards developed at the national and international levels (Figure 7.1).

Figure 7.1 Generally, standards are developed at the international and national levels through standard-setting organizations and states and local jurisdictions adopt them. Sometimes, states and local governments develop more stringent codes and standards that go above and beyond minimum standards. (Photo: Pipe installation at Jones Tract levee break in 2004; DWR, used with permission)

Box 7.1: Definitions of Key Terms and Examples of How Infrastructure Design is Governed

- **Design Standards:** Office of Management and Budget (OMB) Circular A-119 establishes policies on the federal government's role in development and use of standards. It defines "standards" to include the common and repeated use of rules, conditions, guidelines or characteristics for products or related processes and production methods. For example, the American Society of Civil Engineers (ASCE) issued a design standard that specifies minimum structural load requirements under various types of conditions, taking into account factors such as soil type and potential for floods, snow, rain, ice and wind.
- **Building Codes:** Building codes are laws or regulations that specify minimum safeguards to ensure public health, safety and general welfare of the occupants of new and existing buildings and structures, according to the International Code Council (ICC), a standards-developing organization. For example, building codes may ensure that exterior walls and roofs are resistant to the weather, such as by including flashing and drainage. Building codes may reference one or more design standards.
- **Specification:** A set of conditions and requirements of precise and limited application that provide a detailed description of a procedure, process, material, product or service for use primarily in procurement and manufacturing. Standards may be referenced or included in specifications. For example, a particular government agency may have specifications as to what type of material is to be used (and not used) for culverts.
- **Technical Regulation:** A mandatory government requirement that defines the characteristics and/or the performance requirements of a product, service or process.
- **Voluntary Certifications:** Voluntary certifications assess infrastructure across a spectrum of key criteria, including environmental performance, and recognize those that go beyond minimum code compliance. For example, the U.S. Green Building Council (USGBC) developed the Leadership in Energy and Environmental Design (LEED) certification, which offers four ratings levels - certified, silver, gold and platinum - depending on how many points a project earns in various categories.

(Source: Based on GAO (2016)[226])

Updating existing standards, or creating a new one, generally follows a deliberately slow, empirically-tested and consensus-based process. To provide more detail beyond what is shown in Figure 7.2, the process can be described as following these general steps:

1. An entity suggests the need to update or create a new standard;
2. A standard-setting policy body initiates a committee and selects a chair;
3. The chair selects the committee membership from volunteering association members and obtains approval from the standard-setting policy body;
4. The Committee meets periodically – this could be either a public or private meeting process depending on the standard-setting body's rules;
5. Committee deliberations include seeking out necessary research or data or advice, which can take considerable time to conduct and be reported back to the committee;
6. The Committee drafts the standard;
7. When the draft is ready, the committee holds a consensus vote to release for public review;
8. The standard-setting policy body approves release, which can be followed by public review process (again depending on the standard-setting body's rules);
9. The Committee holds a consensus vote to publish the finalized standard;
10. The standard-setting policy body approves the publication/adoption of the finalized standard;
11. The standard is published;
12. The standard is disseminated or sold;
13. In some cases, a standard written in code-intended language is adopted into code by various jurisdictions; and, finally,
14. The standard is either put on continuous maintenance or a committee is periodically reconstituted to revise the standard, at which point the process repeats.

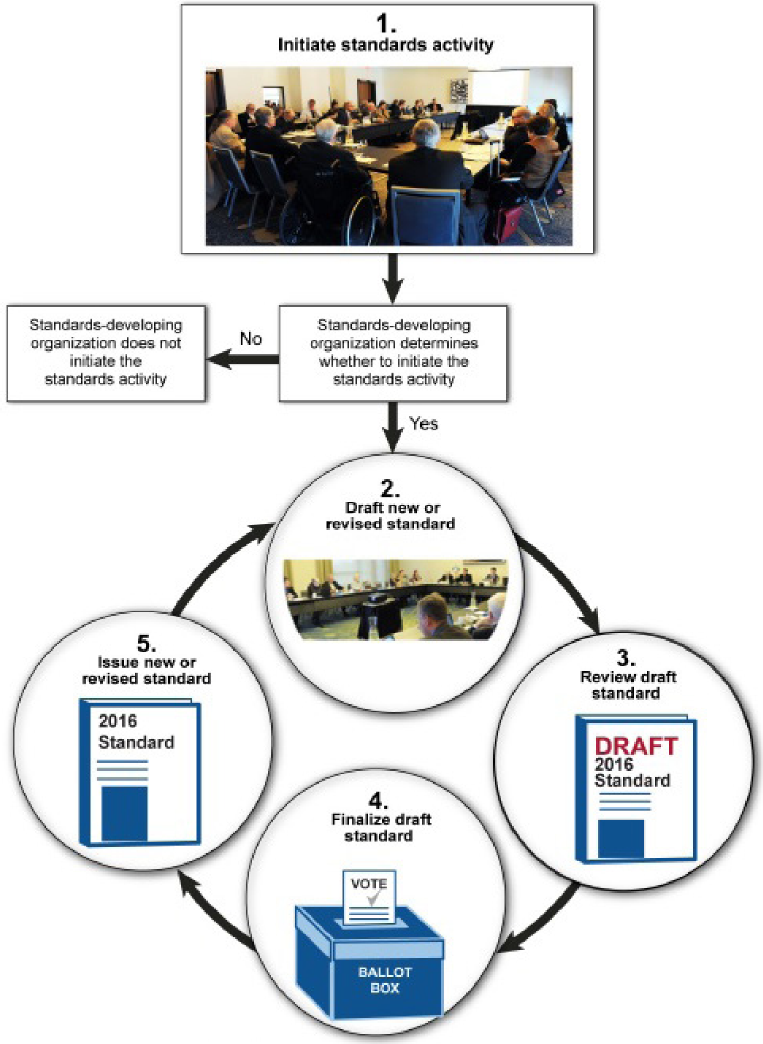

Figure 7.2 Generalized standards-developing process (Source: GAO 2016 [226])

Some standards take 20 years to develop or change; others have been changed in much less time (1-2 years) but given the significant implications of changing the way things are built all over the world or in a particular nation, the approach is methodical and often time-consuming. Often, in addition to research, years of testing and in-the-field observations are required before a standard can be advanced to a vote with voting rules depending on the rules of the standard-setting organization. Engineering standards setting is recognized as being a very conservative process that is resistant to change, since the potential for failure resulting from a poorly developed standard can have costly and – sometimes – tragic consequences.

Information utilized in developing climate-sensitive standards traditionally has relied on historic weather and climate information. Over time, the historical period used has changed, even if the basic standard did not. But as a general rule, structural standards have relied on backwards-looking data, not forward-looking climate projections. To address the gaps in the observational record and deal with the natural variability (i.e., uncertainty in historic information), engineers and architects have been trained to use and thus have methods for factoring in these uncertainties, through "safety factors" (see Box 3.3).

Non-Standard Based Approaches

If standards – turned into prevailing code, rules and regulations – are the most stringent ways to ensure infrastructure is built a certain way, State and local jurisdictions can establish more ambitious guidelines if they see a necessity or if they wish to take leadership and action before a higher standard is adopted nationwide or internationally. California has a long history of doing just that. The State's energy efficiency standards have and still lead the nation and have demonstrated that such higher standards do not restrict the economy or well-being of its people and the environment. Some local jurisdictions, too, have chosen to go beyond minimum standards, by either adopting higher voluntary standards or by establishing other local guidance that those building infrastructure locally must adhere to.

The success, and eventual wider adoption, of these beyond-minimum approaches typically depend on being able to illustrate that the more stringent approach works, exceeds performance and is cost-effective. This requires establishing frameworks, indicators and metrics of "success" that can be tracked over time to make that convincing case. LA Metro offers a good example.

In 2015, LA Metro published its *Resiliency Indicators Framework*[195], a guidance document that explains how the transportation agency understands resilience, what principles guide its work, what factors it sees as contributing to transportation resilience and how indicators of organizational and technical readiness can be tracked and combined to produce a quantitative and qualitative sense of progress toward greater resilience (Figure 7.2).

California's Infrastructure Design Standards

As part of the work of the Climate-Safe Infrastructure Working Group (CSIWG), members compiled lists of standards, guidelines and other frameworks that guide how infrastructure in the state must be built (Appendix 10).[1] This compilation illustrates that there are dozens of standards, design manuals, bulletins, plans and specifications, design guidance, design criteria and references to rely on in any one infrastructure sector.

Simply identifying which standards need to be updated – and doing so – will not get the job done on its own, however. There is much more to building climate-safe infrastructure than simply updating standards, though that is an important process. The real change will come from using different types of standards and deploying them in practice throughout the infrastructure planning, design and operation and maintenance (O&M) process.

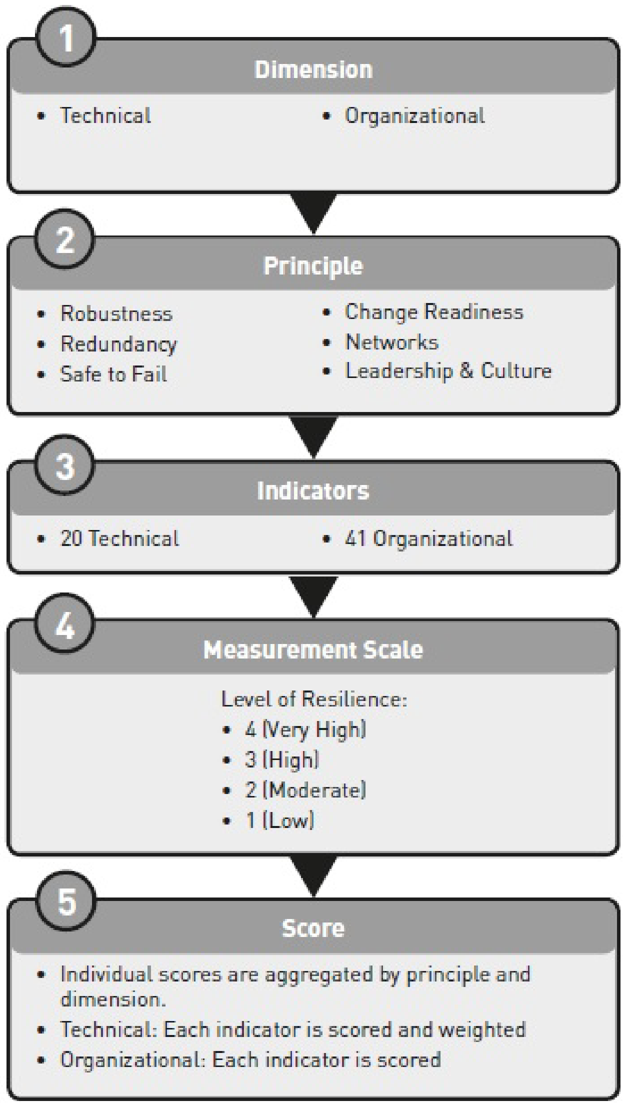

Figure 7.3 The process by which key dimensions and principles of resilience identified by LA Metro in its *Resiliency Indicators Framework* result in specific indicators and scores (Source: LA Metro, 2015[195], used with permission)

Standards and other guidance and governance mechanisms used by State agencies are updated at different intervals (some annually, some once per decade, others irregularly) to reflect changes in codes and standards set elsewhere and experience with existing codes. In some instances, these standards and guidelines are adopted from national and international standard-setting organizations; in others, the State sets its own standards and guidelines. As described above, updating these standards can take considerable time, but the State has opportunities to take steps immediately (Box 7.2).

Box 7.2: Small Steps Toward Climate-Safe Infrastructure: The California Building Code

The California Building Code does not yet require that building envelope designs be capable of maintaining healthy indoor environments over a wider range of expected future climate conditions even when there is a power outage (see Chapter 3). To address this type of shortcoming, one step could be to direct the California Building Standards Commission to clarify its criteria that guide code development and updates. One of these criteria currently states that proposed standards must serve the public interest, including environmental considerations. To operationalize the overarching mandate to update State codes and guidance, this criterion could be clarified to state that proposed standards must also address climate resiliency, to the extent possible. The first and most important first step then is to direct State agencies to prioritize these types of efforts in all infrastructure-related planning with the goal of achieving Recommendation 6.

Clarifying the criteria that trigger standard and code updates can be an effective small step toward initiating updates to existing codes and advancing on the path toward climate-safe infrastructure for all. (Photo: Lawrence Scarpa, LEED-certified building in Hollywood, Wikimedia Commons, licensed under Creative Commons license 2.0)

The exercise of compiling the codes, standards and guidelines used in state infrastructure construction and O&M (Appendix 10) revealed many institutional barriers to integrating forward-looking climate science (even if it were available). We compiled those barriers in Appendix 11. The exercise also offered a number of overarching lessons for the State, if it wishes to update its State-based standards above and beyond national and international minimum standards in order to enable the transition to climate-safe infrastructure:

1. **A plethora of standards of varying stringency.** While potentially confusing, having more stringent standards in California than elsewhere, and/or more stringent standards at the state than at the local level in order to account for climate change, has precedent: already, there is a plethora of standards and codes in play. Side-by-side infrastructure built at varying times was built to the prevailing codes at the time of construction. There is nothing fundamentally new or more difficult about that if California wishes to update its standards now to account for climate change. However, structures built to standards and codes no longer sufficient for a changing climate constitute potential weak spots in infrastructure systems.
2. **More stringent State codes can pave the way for more stringent local and national codes.** Often infrastructure systems under State ownership or regulation is placed in local contexts or involves local and/or federal partner agencies that have different prevailing codes than the State. State policy changes, translated into design standards and guidance can have a strong influence on what others do. It sets precedent, provides a model, and – through appropriate mechanisms – can incentivize others to follow suit.
3. **Varying degrees of ease to change standards.** In some instances, standards and codes can – with appropriate policy guidance from above – be updated relatively easily. Updating base years on a rolling basis, moving the range of years forward over which averages and patterns of extremes should be assessed, extending the design-life length from 20 to 30 or 50 years, are examples that fall into this category. In other instances, the shift to using forward-looking climate science faces greater obstacles. Some code and standard changes require regulatory action, others can be implemented through administrative processes within agencies.
4. **Standards and guidelines that are there vs. that aren't there.** Sometimes, existing standards present a barrier to the use of forward-looking science; other times they are agnostic, and ideally, they should allow, support or mandate the use of forward-looking science. But sometimes the barrier lies in the fact that relevant standards or guidelines are absent (see Chapter 10 for a summary and Appendix 11 for a detailed overview of these types of barriers).
5. **Resources and technical capacity to change standards vary across State agencies.** While CSIWG members agreed that standards, codes and guidelines should be updated to help create the enabling environment for climate-safe infrastructure, State agencies differ in their technical capacity to make these changes themselves vs. awaiting standard-setting organizations to provide those updated standards, which the State would then adopt. Thus, while policy guidance should be unambiguous, the way to implement it at the level of standards and codes would need to be flexible to reflect this range of in-house capacities.

Recommendation 6

Consistent with Executive Order B-30-15 and AB 1482, State agencies should update all relevant (i.e., climate-sensitive) infrastructure standards and guidelines that they can directly affect. Alternatively, or in addition, they should develop new state-specific guidelines where there are gaps to address climate resiliency by incorporating forward-looking climate information in those standards and codes. Where State agencies rely on standards developed by standard-setting organizations, state engineers and architects should work through the relevant professional organizations to advance development of climate-cognizant standards. Until new standards and codes are in place, State agencies should develop guidelines that go above and beyond minimum standards and codes to meet the goals of the Climate-Safe Path for All. Where agencies don't have resources to fulfill this workload, they should be fully funded in the State budget.

Moving from Structural Design Standards to Different Kinds of Standards

Internationally and nationally, standard-setting organizations are exploring different approaches to standards that can accommodate the adaptive infrastructure and safe-to-fail approaches described above and build in flexibility in a heretofore very prescribed and inflexible process. The essence of what a standard is, and what guidance it should contain, is an equally important and active area of discussion and testing. Examples include performance-based standards and standards for professional practice.

Prescriptive vs. Performance-Based Standards

In common prescriptive standards, the goal is to specify required elements in a system design, assuming that if something is built with these elements, it will perform adequately in order to achieve policy goals for the standard. This often leads to a "least common denominator" approach to the design, using what is well known, tried and tested, including historical data. Less certain scenarios are not addressed, controversial or innovative measures are not included and changing climate conditions are not accounted for. Prescriptive standards are valuable in that they provide a simple approach to achieving desired policy outcomes. However, prescriptive standards are limited in that they discourage innovation. As integration of climate resiliency in design standards is an emerging issue, both prescriptive standards and performance standards will be useful. Prescriptive standards will allow the integration of basic climate resiliency measures broadly in standard practice (the "no-regrets" opportunities), while performance standards will give designers the flexibility to devise the best way to achieve the desired outcome for a particular application without the State prescribing how to get there. California's Title 24 Building Energy Code is an example of this. Title 24 includes a "prescriptive path", in which mandatory measures are specified, along with a finite list of optional measures that can be traded off for one another, to accommodate different applications. This approach is simple but not frequently used, since it does not give the designer much latitude.

Performance standards, in contrast, identify a performance objective, and leave it to the designer to identify a particular design that will deliver that performance. Some of the advantages to performance standards are that they allow designers to innovate in their designs and be rewarded for clever designs. They also can be more successfully applied to non-typical situations. For a future that will not mimic the past, the flexibility inherent in performance-based standards is particularly promising.

The challenges to this approach are in defining performance metrics and mechanisms for demonstrating performance. Ideally, performance can be demonstrated through observation or measurement of actual system operation (i.e., not just performance of the asset, but reflecting the goals of the larger, integrated system of interest; see Chapter 6). This can have limited usefulness because system compliance cannot be evaluated until after the system has been operating in the field for some period of time, at which point it may be too late to make modifications or deny approval. So, in practice some performance standards evaluate designs for their "potential" to perform adequately. The availability of modeling tools that capture a range of operating scenarios and accurately predict how a system with a given design will perform in the real world enables setting these kinds of standards. In those cases, ongoing monitoring and evaluation over time are critical, so that such performance standards can be updated on the basis of actual performance data.

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Future standards are now being contemplated that will provide an even deeper level of performance assessment. For example, air conditioner efficiency is reaching a theoretical maximum, so many of the remaining measures to implement in standards (such as unique operating modes or system configurations) must be carefully targeted toward specific applications. To support improvement to these existing standards, sophisticated modeling algorithms are being developed and validated so that a range of quite different system approaches can be used to meet a performance standard.

The CSIWG recognizes that performance standards are more complex to establish and to enforce, however, the sophisticated measures that will be needed to ensure system resiliency in the future may demand these types of approaches. As the State moves to implement Recommendation 6 above, the CSIWG urges that it consider performance-based standards, as opposed to narrowly targeted prescriptive design standards.

Standards for Professional Practice

Another category of standard that should be considered are Standards for Professional Practice. Examples of this kind of standard are ASHRAE's Standard 180 (standard for quality maintenance of HVAC systems) and ASHRAE's Guideline 0 (standard for the building commissioning process).

As described above, simple prescriptive technical standards will likely not be sufficient to achieve the State's goals for climate-safe infrastructure, and more sophisticated approaches may be needed in the future. ASHRAE Standard 180, for example, provides a lengthy checklist of items that a technician should check on a mechanical system (Figure 7.4). Because it is impossible to know ahead of time which of these items will be necessary in a particular building, however, the teeth of the Standard are in the provisions that establish the process for selecting the tasks and the accountability for carrying out the process. In this case, the process requires establishing performance objectives and identifying indicators of failures to perform. Once this has been completed, it is relatively straightforward to define the necessary observations, measurements and tests. Similarly, ASHRAE Guideline 0 identifies the process for commissioning a building or building system, including stating the Owner's Project Requirements, developing a Commissioning Plan, developing Functional Performance Tests and Construction Observations and documenting the requirements for ongoing operation and maintenance of the commissioned system.

Figure 7.4: ASHRAE's Standard 180 for quality maintenance of HVAC systems is a good example of a professional standard of care. It provides a lengthy checklist of items a mechanic must check and ensures accountability for carrying out the process. (Photo: Aaron Plewke, flickr, licensed under Creative Commons license 2.0)

Box 7.3: Example of a Performance Standard

The ASCE is currently in the process of developing a Sustainable Infrastructure Standard, which will be a performance standard (Proposal to the ASCE Codes and Standards Committee by the ASCE Committee on Sustainability 2018; pers. communication by Cris Liban).

Achieving sustainability in an infrastructure project requires the balance of environmental, economic and social conditions – conditions that are unique in every project; as a result, the way sustainability is achieved will be unique to every project. Rather than develop a standard with prescriptive provisions, the standard currently in development will provide performance objectives which, when met, will result in sustainable infrastructure projects. The performance objectives will be written such that they are applicable across all infrastructure sectors.

Existing performance requirements (through various federal Executive Orders or voluntary standards such as the LEED Rating System) do not address infrastructure systems for communications, energy, transportation, and water, sewage and storm water and civil infrastructure projects that benefit the economy, environment and society. Thus, the ASCE standard that is currently being developed is anticipated to provide coherent and consistent performance objectives that can be included in procurement documents by owners, regulators, stakeholders, and policy makers committed to enhancing the sustainability of infrastructure projects.

Approaching sustainability from a performance-oriented perspective facilitates implementation of sustainability measures that are unique to projects; involve owners in establishing the “triple bottom line;” encourage the use of rating systems or tools to monitor and measure sustainability; foster creativity and innovation by the design and construction community to meet the performance objectives and provide for flexibility in how – sometimes conflicting – objectives can be met.

Furthermore, some of the common elements of these standards for professional practice involve the owner or end-user in defining the ultimate objectives, establishing a plan, and identifying how the plan will be adapted over time. These steps ensure that the process has buy-in and will go beyond simply running through a checklist. Providing accountability for developing and applying the process is essential: codes or programs that apply these standards must recognize that the standards provide a measuring stick and they will only have an impact if accountability is enforced through the code or the program. Buy-in and accountability ensure that the standard generates ongoing and permanent savings.

Building to More than One Number: The ASCE’s Manual of Practice

Building on its *2015 Roadmap*, ASCE is currently developing a Manual of Practice (MOP) for infrastructure that provides guidelines for how engineers – and architects – can incorporate forward-looking climate information in their infrastructure plans and designs[253]. The MOP is not a standard *per se* but helps those needing to account for future climate change in infrastructure design absent any standards doing so.

While still under review at the time of this report, the MOP provides guidance on how engineers can bolster the use of historic information with climate model-based future projections to get a more robust assessment of future risks. Rather than selecting one number as the definitive value to which to build and thus to measure the success of a particular piece of infrastructure, the MOP recommends adopting a range of numbers that capture the full complexity of risk. Using risk management and adaptive design principles, the suggestion is to build infrastructure for a particular design load (based on observations or future projection) but such that it can be adapted in the future upon observing changes in statistics of extremes. The ASCE MOP provides an important suite of implementable stepping stones for how engineers can begin to incorporate climate science into their practice.

California can build on this pioneering work by adopting the principles within the ASCE’s MOP and modifying or extending them to be California-centric. This would entail tailoring the suite of climate information included to address the state’s specific climate regimes and changing patterns of extreme events common across the state (with emphasis on the high-emissions scenario, particularly for vulnerable assets) and addressing all of the infrastructure categories outlined in this report.

Thus, another concrete step the State can take in moving toward climate-safe infrastructure is to:

1. Appoint a working group of relevant technical experts that develops a California-specific Manual of Practice. This Cal-MOP should build on the ASCE's MOP and
   - address all relevant infrastructure sectors in the state;
   - reference the climate science information that is most relevant to California, produced by and for the state; and
   - include experts on the various approaches described in this chapter, such as adaptive design and pathways, as well robust decision making under uncertainty, social scientists, economists, as appropriate.

2. Adequately support the work of this working group with in-house staff, external experts and commensurate funding.

Advancing Standards in Support of Climate-Safe Infrastructure

Leadership Through Voluntary Standards

The discussion above presumes that creating new or updating old standards are the only – or maybe the most important – methods by which the State can ensure climate-safe infrastructure gets built. Through Working Group discussions and the webinar series, the CSIWG also explored non-standard-focused approaches for building resilient and climate-safe infrastructure. Because climate adaptation measures will frequently involve incorporation of incremental measures or strategies that may add cost to a project design or retrofit (see Chapter 8), and because changing standards and codes will take some time, incentivizing voluntary approaches that go above and beyond existing minimum standards would be a way to rapidly start moving in the direction of climate-safe infrastructure.

Examples of voluntary programs in the building sector that might be appropriate candidates are LEED certification, Cal Green Tiers 1 and 2, Title 24 and various certifications from ASHRAE, Uniform Building Code (UBC), Unified Mechanical Code (UMC), Building Research Establishment Environmental Assessment Method (BREEAM), the Living Building Challenge, and others (Box 7.4). Meister Consultants Group (2017)[254] compiled an overview of the different voluntary "resilience" standards currently available in the building sector and rated them on a four-point matrix from facility-specific to community-level and from technical (usually focusing on just one hazard and one type of infrastructure) to holistic (generally focusing on multiple hazards and applicable across a system) (Figure 7.5).

The combined use of mandatory standards and voluntary standards can help advance the development of climate-safe infrastructure. Indeed, in our webinar series, the US Green Building Council (USGBC) provided an example of how the push-and-pull interplay of voluntary measures and building codes have served to increase the resilience in both (Figure 7.6). In this instance, as the LEED voluntary certification raised its standards, one observes the raising of the minimum building codes over time. The voluntary standards essentially provide field testing of nontraditional approaches; after demonstrated success, this allows time for the more conservative mandatory minimum standard-setting process to gain comfort and acceptance with these new approaches, which eventually become the new standard operating practice. Incorporating climate resiliency measures in voluntary standards such as LEED or Cal Green Tiers, will serve as a motivation for design engineers to incorporate climate resiliency in their building design because there are other benefits to them in achieving these levels of voluntary compliance.

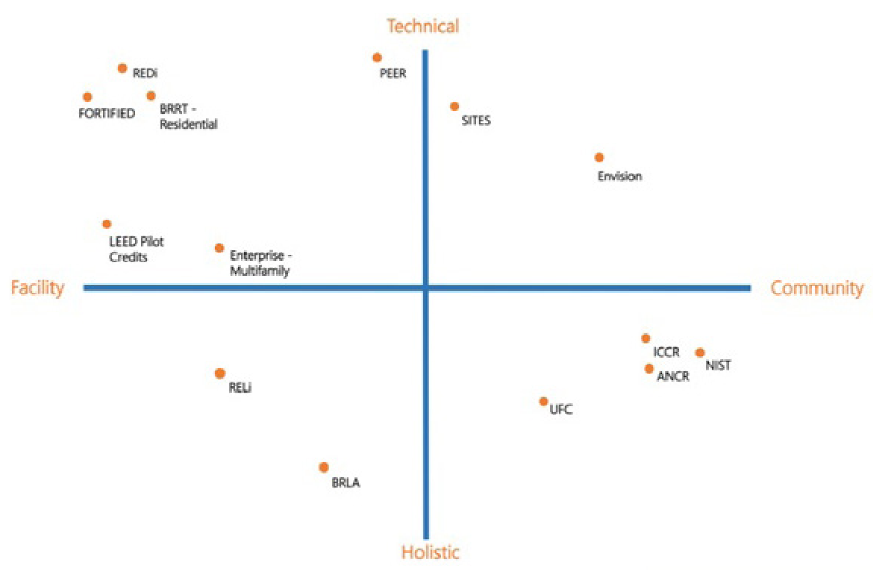

Figure 7.5: Voluntary standards in the building sector fall into a number of categories, here classified by whether they are technical or more holistic in focus, and whether they focus on a single facility or a community (Source: Meister Consultants Group 2017[254], used with permission)

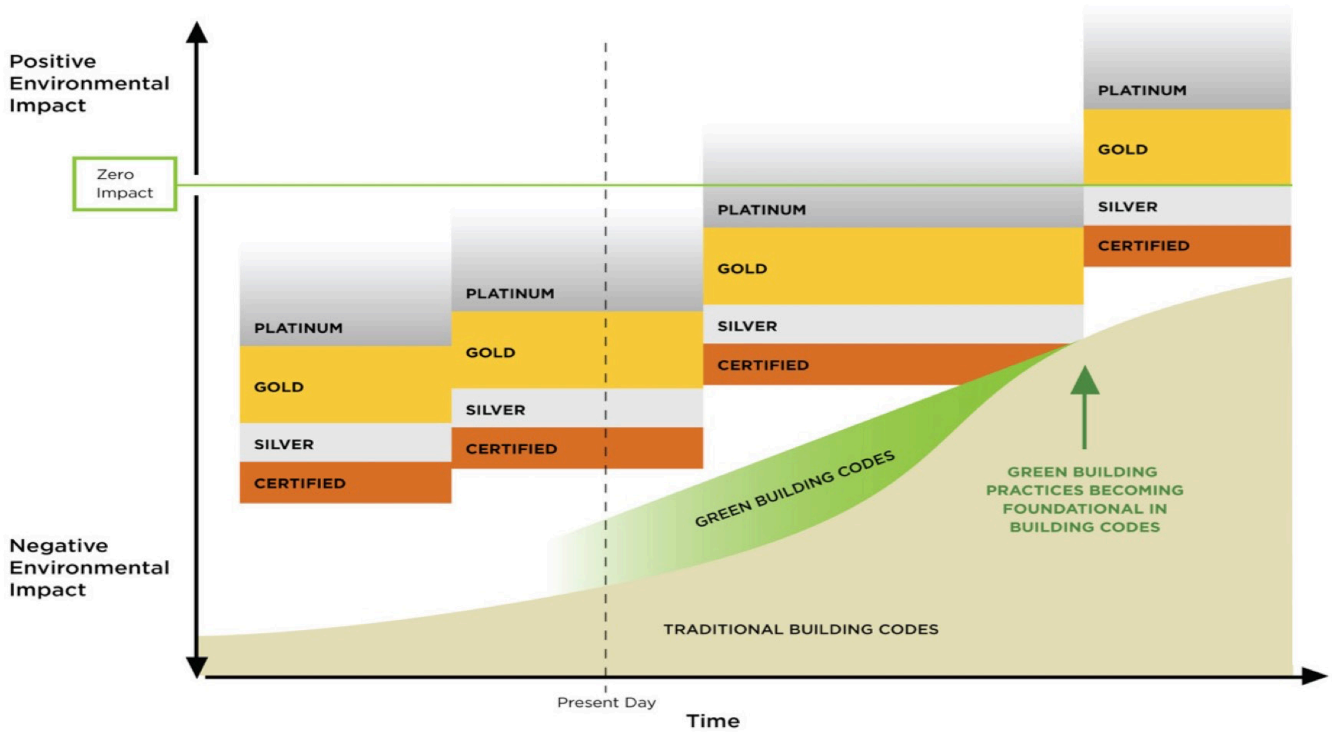

Figure 7.6 States can lead through adopting aspirational voluntary standards that over time raise the floor of mandatory/minimum standards (Source: adapted from US Green Building Council, used with permission)

Box 7.4: Examples of Voluntary Resilience Standards

- The US Green Building Council's Building Resilience—Los Angeles Project (BRLA)
- The Insurance Council of Australia's Building Resilience Rating Tool (BRRT)
- The Institute for Sustainable Infrastructure's Envision Rating System
- The Insurance Institute for Business and Home Safety's FORTIFIED Standards
- The US Green Building Council's LEED program
- The US Green Building Council's Performance Excellence in Electricity Renewal (PEER) program
- The RELi Resilience Collaborative's RELi Resiliency Action List & Credit Catalog
- Arup's The Resilience Based Earthquake Design Initiative (REDi)
- Sustainable Sites Initiative (SITES)
- Enterprise Community Partners' Enterprise Green Communities Certification
- Alliance for National and Community Resilience (ANCR) (and its resilience benchmarking system, currently under development
- The Department of Homeland Security's Interagency Concept for Community Resilience (ICCR)
- The National Institute of Building Sciences' Unified Facilities Criteria (UFC)
- The National Institute of Standards and Technology (NIST) Community Resilience Assessment Methodology (CRAM)
- Cal Green Tiers 1 and 2

The Need to Address Liability

One important governance issue – requiring further study – is liability and the protection against liability for building structures in certain ways, namely design immunity. Climate change will affect liability issues. There is a more general and a more specific issue at hand. The first and broader issue has to do with liability for climate change impacts in the first instances, in an attempt to link specific local impacts and the financial damages and costs incurred to local communities to those bearing significant responsibilities for greenhouse gas emissions. This has been the subject of a number of court cases, including one involving several California cities against several international oil companies. That particular case was recently dismissed on the grounds that such liability issues should not be decided in the court but in legislative bodies at the state and national levels (and through international law).

The second, and more specific issue, of considerable concern to the matter at hand in this report, is the liability of individual engineers, architects, developers, project sponsors, contractors, realtors and insurance agents for designing structures with or without accounting for climate change, and to what level of climate change. These liability concerns are the subject of a recent publication by the Environmental Law Foundation and should be taken very seriously[255].

Licensed engineers and architects in private practice must carry professional liability insurance, which is tied to the requirement to adhere to prevailing professional standards and codes, which – after all – reflect consensually determined, best professional practice and widely-accepted professional ethics.

Deliberation with subject matter experts over the course of the CSIWG meetings pointed to the ways in which liability concerns among practitioners can stymie innovations that would go beyond well-established practice. It can also lead infrastructure designers to pass liability on to project owners, in that the engineering consultant might inform the project owner of the state of science and the range of design options, but then leave the decision as to which design to choose to the project owner, thus disavowing responsibility (i.e., liability) for that decision. This practice raises critical questions, including what the impacts of such transfer of responsibility has on coordinated planning and coherent levels of protection if infrastructure owners vary in their level of risk aversion. It is, at the very least, challenging to imagine how this approach would lead to coherent implementation of the Climate-Safe Path for All.

There is relevant case law[256] in California that could not be assessed at the level required in the course of this project, but liability and design immunity have critical implications for whether and in what ways infrastructure will be designed and how climate change can be accounted for from a legal standpoint (see also[255]). The CSIWG recommends that to further operationalize its recommendation on updating standards, State agencies work with legal experts and insurance experts to address these concerns.

Ultimately, establishing professional standards of care that affect liability and convey a responsibility to safeguard infrastructure and the people that depend on it in the face of climate change may be the most powerful influence on how practicing engineers and architects carry out their work. To enable professionals to carry out their work to appropriate levels of care, enhanced training, professional development and certification programs can support the effective implementation of this recommendation (see Chapter 9 for additional detail).

Liability issues constitute a large and complicated enough challenge that a separate panel may need to be convened to address all the nuances and complexities; this group could then provide guidance and recommendations to infrastructure agencies.

Figure 7.7: Establishing professional standards of care that affect liability and responsibility in the face of climate change may be the most powerful way to influence how practicing engineers and architects carry out their work. (Photo: Dave Rauenbuehler, Chase Center, flickr, licensed under Creative Commons license 2.0)

Institutions for Integrated Infrastructure Systems

The governance of climate-safe infrastructure discussed so far was mostly concerned with the rules that govern how infrastructure is built. But the governance challenge is in fact bigger than that. The current approach to infrastructure planning, design, financing, construction, O&M, and eventually decommissioning is siloed by sectors and frequently isolated, narrowly focused agencies within sectors.

As we discussed in the Chapter 6 on pre-development and as we will discuss in Chapter 8 on financing climate-safe infrastructure, developing infrastructure in the future should be more systems- and outcome-oriented to both reveal and take account of the multi-faceted challenges and multi-sectoral benefits that can be generated (Figure 7.8). This is not just a nice idea, but a critical necessity given the high degree of infrastructure interconnectedness and interdependence[165]. The current institutional set-up and common ways of working, however, are not conducive to this approach.

In deliberating these institutional barriers, the CSIWG recognizes that there is little taste and few resources for major government reorganizations. A "softer" approach to improving cross-sector coordination and integration that help operationalize the transition to climate-safe infrastructure might involve:

- Minimizing obstacles to collaboration;
- Experimenting with new forms of coordination (e.g., coordinated integrative budgeting for projects);
- Fostering standing cross-agency working groups for infrastructure;
- Ensuring wider and more effective stakeholder participation; and
- Fostering regular communication across silos.

A long and more specific list of suggestions for improving cross-sector coordination and collaboration was provided in Moser and Finzi Hart[165].

In some instances, where infrastructure projects cross-jurisdictional lines, more formal institutional entities might need to be created. There is precedent for this, too, in the form of special districts. As we will discuss in Chapter 8, such special districts (made up of local jurisdictions, but involving State funding) are often essential for complex infrastructure projects to go forward.

Figure 7.8: Integrated infrastructure development can create many synergies and co-benefits. This multi-family housing unit, known as Colorado Court, in Santa Monica was the first LEED "Gold" certified multi-family building in the U.S. It combines many sustainability features and provides affordable housing to lower-income residents. (Photo: Calder Oliver, Wikimedia Commons, licensed under Creative Commons license 2.0)