

Learning Sequence

# Water Heating



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## Summary

With buildings accounting for up to 75% of carbon emissions in U.S. cities, addressing carbon emissions from the built environment is essential to meet the goals of the Paris Agreement and limit the rise in global average temperature to below 1.5 degrees Celsius.

Building decarbonization policies are being discussed by states and cities across the country. These policies address the transition away from onsite fossil fuel combustion in buildings, as the electricity grid (or renewable energy sources) move towards 100% carbon neutral. That is, decarbonization in these policies is the process of moving new and existing buildings towards the highly efficient use of 100% carbon neutral sources of energy.

Many jurisdictions have aggressive climate-related goals, and over 200 cities have made pledges to achieve 100% clean energy or “net zero” emissions. Ensuring that new and existing buildings emit little—or no—carbon is an important component of meeting these goals. Cities in California are leading the way, with around 30 cities that have already adopted electrification reach codes

for new buildings and are working through the adoption process. Outside of California, cities and states are very interested in decarbonization-focused model code language. Local governments and the advocates that work with them are searching for code tools that can help them easily replicate the wave of local action that has swept California in the last year.

Today’s Heat Pump Water Heaters (HPWHs) deliver abundant hot water at two to four times lower energy use and 50-70% lower GHG emissions compared to conventional water heaters. They also provide a highly efficient thermal storage technology that can benefit both customers and utilities by shifting peak time energy use to off-peak periods, reducing methane leakage indoors, and improving indoor air quality by reducing on-site gas combustion. Water heating alone accounts for 20% of the carbon emissions between residential and commercial sectors. According to the U.S. Dept. of Energy, between 7 million and 7.8 million water heaters are replaced annually in the United States, and an additional 1.2 million to 2 million units are installed in new homes.

This resource provides incremental learning opportunities to build knowledge and action over time. Each sequence provides specific stakeholders with the background information they need to support the electrification of water heating.



Credit: Rheem

According to the U.S. Dept. of Energy, between 7 million and 7.8 million water heaters are replaced annually in the United States, and an additional 1.2 million to 2 million units are installed in new homes.



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# Designers

This learning sequence is focused on providing designers with the background information they need to design and support all-electric buildings. For the purposes of this document, Designers are defined as Architects and Mechanical, Electrical, and Plumbing design engineers. Designers are critical to the implementation of building electrification strategies as they make the decisions on design elements including equipment and mechanical systems. They also often serve as the liaison between building owners and code officials, adding to their role as they often serve in an educational capacity for other team members.

## Goals: What do we want designers to know and do in 3-5 years?

GOAL

**1**

Understand the implications of the electrification regulations and how to design solutions in new and existing building projects.

GOAL

**2**

Make decisions and take action to support electrification compliance.

GOAL

**3**

Develop and share best design practices around electrification that lead to compliance.

# Learning Sequence

Incremental learning opportunities to build knowledge and action over time.

## 1 Electrification 101

Understand what it means to electrify building systems, why electrification is important and what technologies are available.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Buildings represent a critical pathway to reducing GHG emissions. Comparison of fossil vs. electric. Reduces negative environmental impacts. Enables better grid management.	Both programs and regulations are moving to promote/require electric technologies. Outline pros/cons and specific changing codes and policies.	Basics on electric technologies (heat pump, electric resistance) and applications in buildings. Take advantage of a growing market.	Matching electric technologies to building realities (new vs. existing, residential vs. commercial v. institutions, etc.).	<ul style="list-style-type: none"><li>• Briefs on available technologies (one pagers)</li><li>• Recorded webinars on electrification basics</li><li>• FAQ documents</li></ul>

## 2 Electrification Requirements

Understand the various means of complying with electrification regulations.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Briefs on code and permitting regulations for showing compliance; permitting guidance.	Existing codes/regulations related to buildings; related compliance pathways.	How electric vs. fossil systems will comply or not overtime. Where you should expect codes/regulations related to buildings to be going.	Impact and costs of non-compliance.	<ul style="list-style-type: none"><li>• Links to existing resources</li><li>• Code trainings—in person and online</li><li>• Central repository/landing page</li><li>• Working through electrification</li></ul>

## 3 Available Technologies

Examine what technologies and building system components are available.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Familiarity with proposed systems: Central, unitized, & applications for 120 volt understanding.	Characterization and understanding of market: cost savings and climate benefits of technologies.	Code compliance and inspection understanding based on technology and proposed systems.	Communicating and coordinating with other market players (contractors, manufacturers, and specifiers).	<ul style="list-style-type: none"><li>• FAQ documents</li><li>• Case studies—focus on successful projects</li><li>• Manufacturer presentations, integrated workshops &amp; trainings</li><li>• Short videos</li></ul>

## 4 Design Impacts

Understand which buildings systems and types of heat pump water heaters exist in the market.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Interaction with code. Federal and state regulations and codes. Understanding of all trades involved and system complexity.	Impact on building systems, limitations with space and size, panel adequacy, separating space/water heating. Cold climate challenges.	Communicating and coordinating with jurisdictions and code officials.	Understanding on proper installation for different system types.	<ul style="list-style-type: none"> <li>• Links to existing resources</li> <li>• Short, very hands-on videos</li> <li>• Educational trainings and sessions</li> <li>• Better information directly from manufacturers</li> </ul>

## 5 Cost Implications

Understand the costs of design decisions, technologies, and the cost of no action.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Electrification + efficiency cost savings. Sequencing for optimal cost savings. Understanding of different systems.	Valuing long term compliance over short term incremental costs.	Product availability and upfront costs.	Discussing costs and benefits with owners and developers.	<ul style="list-style-type: none"> <li>• Cost studies</li> <li>• How to use energy service contracting</li> <li>• Links to direct handouts for rebates to use on site</li> </ul>

## 6 Preparing Jurisdictions for Electrification

Examine the various roles in electrification.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Understand role of code officials, inspectors, and permit technicians.	Understand role of contractor.	Understand role of manufacturers and distributors.	Understand role of owner.	<ul style="list-style-type: none"> <li>• Code Compliance Documentation</li> <li>• Flow chart</li> <li>• Short video</li> </ul>

## 7 Preparing for Success in the Future

What steps to take to ensure best practices and prepare buildings for long term compliance.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Gathering cost and energy data.	Continuing education/training needs around electrification (water heating). Common best practice education.	Relationships with owners, contractors, code officials, manufacturers and related contractors/vendors (equipment specification).	Successful projects highlighted. Proper documentation.	<ul style="list-style-type: none"> <li>• Continuing education sessions</li> <li>• Project data availability</li> <li>• Guidance docs provided by jurisdictions</li> </ul>



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# Contractors

This learning sequence is focused on providing contractors with the background information they need to build and support all-electric buildings. Contractors are critical to the implementation of buildings electrification strategies as they must understand electrification regulation and be able to successfully bid, spec, and install, ensuring client satisfaction and safely installed equipment.

## Goals: What do we want contractors to know and do in 3-5 years?

GOAL

**1**

Understand the implications of the electrification regulations and how to bid, spec, and install for solutions in new and existing building projects.

GOAL

**2**

Understand and have confidence in installing HPWHs in all climates.

GOAL

**3**

Develop and share best design practices around HPWHs that lead to compliance.

GOAL

**4**

Have the knowledge and familiarity with proposed systems to ensure client satisfaction and safely installed equipment.

# Learning Sequence

Incremental learning opportunities to build knowledge and action over time.

## 1 Electrification 101

Understand why electrification is important and why contractors should want to learn more.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Buildings represent a critical pathway to reducing GHG emissions. Comparison of fossil vs. electric.	Both programs and regulations are moving to promote/require electric technologies. Outline pros/cons and specific changing codes and policies.	Contractors who design/install these techs well, can take advantage of growing market. Leverage policies to gain market share. Discuss market growth opportunities.	Matching electric technologies to building realities (new vs. existing, residential vs. commercial v. institutions, etc.).	<ul style="list-style-type: none"> <li>• Links to existing resources</li> <li>• FAQ documents</li> <li>• Short videos</li> <li>• Workshops</li> </ul>

## 2 Electrification Requirements

Understand the various means of complying with electrification regulations.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Briefs on code; permitting guidance/inspection guidance.	Existing codes & regulations related to buildings; related compliance pathways.	How electric vs. fossil systems will comply or not over time. Future trajectory of building codes & regulations.	Impact and costs of non-compliance.	<ul style="list-style-type: none"> <li>• Links to existing resources</li> <li>• Central repository/landing page</li> <li>• Compliance guidance documents</li> <li>• Short videos</li> <li>• Workshops</li> </ul>

## 3 Available Technologies

Examine what technologies and building system components are available. How to make the right decision for repair and replacement based on building type, system type, and savings potential.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Optimal water heating options vary by housing type. Familiarity with proposed systems: Central, unitized, & applications for 120 volt understanding. Evaluating retrofit ready. System upgrades vs. panel adequacy.	Characterization and understanding of market: cost savings and climate benefits of technologies.	Code compliance and inspection understanding based on technology and proposed systems.	How to sell these technologies. Proposed system understanding to ensure client satisfaction and understanding. Ease of maintenance.	<ul style="list-style-type: none"> <li>• FAQ documents</li> <li>• Case studies—focus on successful projects</li> <li>• Manufacturer presentations, integrated trainings</li> <li>• Workshops/trainings</li> <li>• Short videos</li> </ul>



## 4 Design Impacts

Understand which building systems and types of heat pump water heaters exist in the market.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Interaction with code. Federal and state regulations and codes. Understanding of all trades involved and system complexity.	RES current design best practices, install and best practices.	COMM. Current design best practices, install and best practices.	Impact on building systems, limitations with space and size, panel adequacy, separating space/water heating. Cold climate challenges.	<ul style="list-style-type: none"> <li>• Links to existing resources</li> <li>• Short, very hands-on videos that can be referenced in field</li> <li>• Educational trainings and sessions</li> <li>• Better information directly from manufacturers</li> </ul>

## 5 Cost Implications

Understand the costs of design decisions, technologies and the cost of no action.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Electrification + efficiency cost savings. Sequencing for optimal cost savings. Understanding of different systems.	Understand costs: Product availability and upfront costs. Installation and operational costs.	Rebates available and accessible for retrofit projects. Potential incentives.	How to bid on electrification driven projects. Familiarity with pricing and understanding of other market actors including manufacturers and distributors.	<ul style="list-style-type: none"> <li>• Cost studies</li> <li>• How to use energy service contracting</li> <li>• Links to direct handouts for rebates to use on site</li> <li>• Direct guides and trainings from manufacturers and distributors</li> </ul>

## 6 Preparing Jurisdictions for Electrification

Examine the various roles in electrification and where contractors fit.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Understand role of inspectors, code officials, and permit technicians.	Understand role of designers.	Understand role of utilities.	Understand role of owners.	<ul style="list-style-type: none"> <li>• Code compliance documentation</li> <li>• Flow chart</li> <li>• Short video</li> </ul>

## 7 Preparing for Success in the Future

What steps to take to ensure best practices and prepare buildings for long term compliance.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Gathering cost and energy data.	Continuing education/training needs around electrification (water heating). Common best practice education.	Relationships with owners, designers, manufacturers and related contractors/vendors (equipment procurement).	Successful projects highlighted. Proper documentation.	<ul style="list-style-type: none"> <li>• Continuing education sessions</li> <li>• Project data availability</li> <li>• Guidance docs provided by jurisdictions</li> </ul>



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# Code Officials

This learning sequence is focused on providing code officials with the background information they need to deploy electrification strategies. Code officials will need to be comfortable with technologies and processes and work collaboratively with contractors to ensure safety and energy/climate goals are realized and consumers are not unduly inconvenienced. They also play a key role in the implementation of building electrification strategies by ensuring sufficient processes and guidance that leads to fast approvals and deployment.

## Goals: What do we want code officials to know and do in 3-5 years?

GOAL

**1**

Understand what electrification is and how it is being incorporated into local requirements and model energy codes. Be knowledgeable of available water heating and space heating technologies.

GOAL

**2**

Understand the changes to permitting, plan review, and inspection processes associated with electric-ready and electric systems and how to best support other industry audiences in electrification compliance.

GOAL

**3**

Become knowledgeable and comfortable with the safe removal/decommissioning of gas equipment and supporting infrastructure.

# Learning Sequence

Incremental learning opportunities to build knowledge and action over time.

## 1

### Electrification 101

Understand why electrification is important and why building code officials should want to learn more.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Introduction to electrification model policies. Examples of policies gaining momentum in the United States.	Electrification in model codes. Look at what could be included in future iterations of IECC.	Benefits of electrification (e.g., reduces negative environmental impacts, enables better grid management).	Role of code officials in electrification (how to prepare for electrification in jurisdiction, overview of enforcement, educating contractors, etc.).	<ul style="list-style-type: none"> <li>• Links to existing resources</li> <li>• FAQ documents</li> <li>• Workshops/educational sessions</li> </ul>

## 2

### Planning a fuel transition

Understand when and how to switch from existing fuel systems to electric.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Roles and impacts of existing regulations.	When is the right time to switch? Understanding existing infrastructure, policies, building stock, and how that impacts electrification.	How might regulations be phased—What are the financial impacts of switching in an existing building vs building to electric in new construction?	What new processes will be required at the city level? How should we prepare the workforce?	<ul style="list-style-type: none"> <li>• Presentations</li> <li>• Webinars</li> <li>• Case studies/review of cities leading the way</li> <li>• Workshops</li> <li>• Toolkits</li> </ul>

## 3

### Available Technologies

Examine what technologies and building system components are available.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Fundamental understanding and familiarity with the proposed systems of electric water heating technologies.	Characterization and understanding of market: cost savings and climate benefits of technologies.	Understand how designers and contractors are making decisions on system type by housing type and new system vs. retrofits/replacements.	Code compliance and inspection understanding based on technology and proposed systems.	<ul style="list-style-type: none"> <li>• FAQ documents</li> <li>• Case studies—focus on successful projects</li> <li>• Manufacturer presentations, integrated trainings</li> <li>• Workshops/trainings</li> <li>• Quick reference guide by technology</li> <li>• Short videos</li> <li>• Toolkits</li> </ul>

## 4 Preparing Jurisdictions for Electrification

Examine the various roles in electrification and where code officials fit.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Overview of the role of designers.	Overview of the role of contractors, manufactures, and vendors.	Role of utilities.	Role of homeowners.	<ul style="list-style-type: none"> <li>• Links to existing resources</li> <li>• FAQ documents</li> <li>• Training modules developed for other audiences</li> </ul>

## 5 Preparing for Success in the Future

Understand how to properly enforce electrification regulations. What steps to take to ensure a feedback loop for best practices.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Permitting for electrification projects and best practices.	Electrification in construction documents and plan review.	Electrification-specific inspections (timing of inspections, what to look for, electric-readiness).	Support provided by building department to industry (guidelines for compliance).	<ul style="list-style-type: none"> <li>• Links to existing resources</li> <li>• Central repository/ landing page</li> <li>• Working through electrification</li> <li>• Checklists</li> <li>• Training Course (for CEUs)</li> <li>• Short videos</li> <li>• Electronic permitting tools</li> <li>• Sequencing guides for compliance</li> </ul>



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# Policymakers

This learning sequence is focused on providing policymakers with the background information they need to deploy and implement electrification strategies. Policymakers are an essential audience for supporting the development and deployment of these strategies. Policymakers will need to be comfortable with the technologies and processes, and work collaboratively with all other stakeholder groups.

## Goals: What do we want policymakers to know and do in 3-5 years?

GOAL

**1**

Understand the benefits of electrification to communities and its relationship to climate goals.

GOAL

**2**

Develop a plan for how fuel switching can be accomplished in their jurisdiction.

GOAL

**3**

Develop, adopt, and implement successful electrification policies.

# Learning Sequence

Incremental learning opportunities to build knowledge and action over time.

## 1

### Electrification 101

Understand why electrification is important.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Introduction to electrification model policies.	Benefits of electrification (e.g., reduces negative environmental impacts, enables better grid management).	Impacts on DEI—Diversity, Equity, and Inclusion. Ensure all voices are included in the conversation.	How to draft electrification policies without re-inventing the wheel. Utilize existing resources.	<ul style="list-style-type: none"> <li>• Presentations</li> <li>• Webinars</li> <li>• Peer to peer exchanges</li> <li>• Toolkits</li> <li>• FAQs</li> <li>• Workshops</li> </ul>

## 2

### Planning a fuel transition

Understand when and how to switch from existing fuel systems to electric.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Roles and impacts of existing laws, policies and regulations.	When is the right time to switch? Understanding existing infrastructure, policies, building stock, and how that impacts electrification.	How might regulations be phased—what are the financial impacts of switching in an existing building vs building to electric in new construction?	What new processes will be required at the city level? How should we prepare the workforce?	<ul style="list-style-type: none"> <li>• Presentation</li> <li>• Webinars</li> <li>• Peer to peer exchanges</li> <li>• Toolkits</li> <li>• FAQs</li> <li>• Workshops</li> </ul>

## 3

### Available Technologies

Examine what technologies and building system components are available.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Fundamental understanding and familiarity with the proposed systems of electric water heating technologies.	Matching electric technologies to building realities (new vs. existing, residential vs. commercial vs. institutional, etc.).	Characterization & understanding of market: Cost savings and climate benefits of technologies.	Understanding the costs—What incentives are available and what financial support should the jurisdiction provide?	<ul style="list-style-type: none"> <li>• Presentations</li> <li>• Webinars</li> <li>• Peer to peer exchanges</li> <li>• Toolkits</li> <li>• FAQs</li> <li>• Workshops</li> </ul>

## 4 Preparing Jurisdiction for Electrification

Examine the various roles in electrification.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Understand the role of designers.	Understand the role of contractors, manufactures, vendors, and utilities.	Understand the role of jurisdictions, code enforcement, and city staff.	Understand the role of homeowners.	<ul style="list-style-type: none"> <li>• Links to existing resources</li> <li>• FAQ documents</li> <li>• Training modules developed for other audiences</li> </ul>

## 5 Preparing for Success in the Future

Understand how to properly enforce electrification regulations & assist in the transition of existing workforce.

Topic A	Topic B	Topic C	Topic D	Educational Tools
How to support building departments with their processes? What processes will need to be in place?	How to support contractors and designers? What workforce trainings will need to be in place?	Understand ways to support underrepresented communities.	Identify current workforce and gaps. Including future potential gaps with phasing out fossil fuel jobs.	<ul style="list-style-type: none"> <li>• Presentations</li> <li>• Webinars</li> <li>• Peer to peer exchanges</li> <li>• Toolkits</li> <li>• FAQs</li> <li>• Workshops</li> </ul>



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New Buildings Institute (NBI) is a nonprofit organization working to advance energy efficiency and decarbonization in the built environment. Our efforts are imperative to keeping energy costs affordable, cutting emissions that are fueling climate change, and delivering on improved health, safety, and resiliency for everyone. Throughout its 25-year history, NBI has become a trusted and independent resource helping to create buildings that are better for people, communities, and the planet. Learn more at [newbuildings.org](https://newbuildings.org).

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