

Learning Sequence

Space 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.

Air Source Heat Pumps (ASHPs) and Variable Refrigerant Flow (VRF) systems offer households and businesses a super-efficient clean energy solution to dramatically reduce the use of less efficient, carbon-intensive space heating systems while also offering efficient air conditioning. In the northeast, according to a study by NEEP, residential and commercial space heating account for 30% of direct fossil fuel use. In regular homes and buildings, current ASHPs are not well suited to heat the entire building on their own. This is due to the predominance of ductless mini-split units and reduced heating outputs at the coldest temperatures. Installations are not necessarily coupled with heating system replacements but are instead serving as additional heat (and cooling) sources. Multi-head and whole-building systems are becoming more available. At the large commercial scale, variable refrigerant flow systems are a growing option. Heat pump customer

economics are stronger for buildings heated with delivered fuels such as oil than for those heated with natural gas. However, economics of heat pumps for new construction can be favorable even against natural gas. Resident behavior regarding the interaction between heat pump and combustion heating systems is not well characterized and likely highly variable across installations. The heat pump market share as of 2017 among households purchasing heating systems is about 5 percent across the region.

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 heating.





SPACE HEATING

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 & reduces negative environmental impacts.	Both programs and regulations are moving to promote/require electric technologies. Outline pros/cons and specific changing codes and policies.	Enables better grid management.	Examine electric technologies and building types (New vs. existing, residential vs. commercial vs. institutions, etc.).	<ul style="list-style-type: none">• Briefs on available technologies (one pagers)• Recorded webinars on electrification basics• FAQ documents

2 Electrification Requirements

Understand the various means of complying with electrification regulations.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Understanding of code and permitting regulations for showing compliance.	Examine existing codes/regulations related to buildings related compliance pathways.	Understanding of future regulations and codes.	Impact and costs of non-compliance.	<ul style="list-style-type: none">• Links to existing resources• Code trainings—in person and online• Central repository/landing page• Working through electrification

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 & 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">• FAQ documents• Case studies—focus on successful projects• Manufacturer presentations and integrated workshops/trainings• Short videos

4 Design Impacts

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

Topic A	Topic B	Topic C	Topic D	Educational Tools
Understand interaction with code at both federal and state level.	Understand the impact on building systems and limitations (space, size, panel adequacy, climate, and etc.).	Communicating and coordinating with jurisdictions and code officials.	Understand proper installation for different system types.	<ul style="list-style-type: none"> • Links to existing resources • Short, very hands-on videos • Educational trainings and sessions • Better information directly from manufacturers

5 Cost Implications

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

Topic A	Topic B	Topic C	Topic D	Educational Tools
Understanding of different systems and sequencing for optimal cost savings.	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"> • Cost studies • How to use energy service contracting • Links to direct handouts for rebates to use on site

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"> • Code compliance • Documentation • Flow chart • Short video

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 (space water heating). Common best practice education.	Relationships with owners, contractors, code officials, manufactures, and vendors.	Successful projects highlighted. Proper documentation.	<ul style="list-style-type: none"> • Continuing education sessions • Project data availability • Guidance docs provided by jurisdictions



SPACE HEATING

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 building 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 and have the confidence in heat pumps working well (ASHP in particular) in all climates.

GOAL

2

Promote heat pumps to all customers.

GOAL

3

Design and install heat pumps well and 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
Understand critical pathway to reducing GHG emissions and associated climate benefits.	Programs, code, and regulations are changing to promote electric technologies.	Understand the market growth opportunities associated with electrification.	Understanding electric technologies and building types (new, existing, residential, commercial, institutions, and etc.).	<ul style="list-style-type: none"> • Links to existing resources • FAQ documents • Short videos • Workshops

2

Electrification Requirements

Understand the various means of complying with electrification regulations.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Understand existing codes and regulations related to buildings and compliance pathways.	Examine existing codes/regulations related to buildings related compliance pathways.	Understand code, permitting guidance, and inspection guidance.	Impacts and costs of non-compliance.	<ul style="list-style-type: none"> • Links to existing resources • Central repository/landing page • Compliance guidance documents • Short videos • workshops

3

Available Technologies

Examine what technologies and building system components are available.

Topic A	Topic B	Topic C	Topic D	Educational Tools
<p>Air-to-Air (ATA) heat pumps (introduce all “flavors” of ATA heat pumps including various ducting configurations).</p> <p>Emerging: Packaged Terminal Heat Pumps (PTHP)/Single Package Vertical Heat Pumps (SPVHP), Window heat pumps?</p>	Air-to-Water (ATW) heat pumps.	Water-to-Air (WTA) heat pumps (i.e. GSHP).	Water-to-Water (WTW) heat pumps (i.e. GSHP).	<ul style="list-style-type: none"> • FAQ documents • Case studies—focus on successful projects • Manufacturer presentations, integrated trainings • workshops/trainings • Short videos

4 Design Impacts

Understand which building systems and types of heat pumps exist in the market.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Importance on design & install and operations & maintenance. Understand how to train customers on different systems.	Knowledge on residential best practices.	Knowledge on commercial best practices.	Understand impact on building systems (space, size, panel adequacy, separating space and water heating, and climate challenges).	<ul style="list-style-type: none"> • Links to existing resources • Short, very hands-on videos that can be referenced in the field • Educational trainings and sessions • Better information directly from manufacturers

5 Cost Implications

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

Topic A	Topic B	Topic C	Topic D	Educational Tools
Understand different systems and sequencing for optimal cost savings.	Understand costs: product availability, and upfront installation costs, and operational costs.	Understand rebates and incentives available.	Understand how to properly bid on electrification driven projects.	<ul style="list-style-type: none"> • Cost studies • How to use energy service contracting • Links to direct handouts for rebates to use on site • Direct guides and trainings from manufacturers and distributors

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 designers.	Understand role of inspectors, code officials, and permit technicians.	Understand role of utilities.	Understand role of owners.	<ul style="list-style-type: none"> • Code compliance documentation • Flow chart • Short video

7 Preparing for Success in the Future

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

Topic A	Topic B	Topic C	Topic D	Educational Tools
Validation Studies on performance (ATA); cost data, rebate programs, etc.	Validation studies on performance (ATW), (WTA), (WTW).	Relationships with owners, designers, manufacturers, and vendors.	Successful projects highlighted and documented.	<ul style="list-style-type: none"> • Continuing education sessions • Project data availability • Guidance docs provided by jurisdictions



SPACE HEATING

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

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
Understand electrification model policies.	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 jurisdictions, overview of enforcement, educating contractors, etc.).	<ul style="list-style-type: none"> • Links to existing resources • FAQ documents • Workshops/ educational sessions

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, regulations, regulating departments and options for transitioning fuels.	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"> • Presentations • Webinars • Case studies/review of cities leading the way • Workshops • Toolkits

3

Available Technologies

Examine what technologies and building system components are available.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Basics on electric space heating technologies.	Characterization & understanding of market: Cost savings and climate benefits of technologies.	Understand how designers and contractors are making decisions based on building type. Communicate and coordinate with other market players.	Code compliance and inspection understanding based on technology and proposed systems.	<ul style="list-style-type: none"> • FAQ documents • Case studies—focus on successful projects • Manufacturer presentations, integrated trainings • Workshops/trainings • Quick reference guide by technology • Short videos • Toolkits

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 (changes to current process, impact on building systems, proper installation and planning, support needed from code official).	Overview of the role of contractors, manufacturers, vendors (equipment procurement, compliance guidance, education needs, support needed from code official).	Role of utilities (energy efficiency programs, rebates, support needed from code official).	Role of owners, consumers (messaging, support needed from code official).	<ul style="list-style-type: none"> • Links to existing resources • FAQ documents • Training modules developed for other audiences

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 (electrification-specific processes or changes to existing processes, 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"> • Links to existing resources • Central repository/ landing page • Working through electrification • Checklists • Training course (for CEUs) • Short videos • Electronic permitting tools • Sequencing guides for compliance



SPACE HEATING

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 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 and why policymakers should want to learn more.

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 & Inclusion.	How to draft electrification policies without re-inventing the wheel. Utilize existing resources.	<ul style="list-style-type: none">• Presentations• Webinars• Peer to peer exchanges• Toolkits• FAQs• Workshops

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, regulations, regulating departments and options for transitioning fuels.	When is the right time to switch? Understanding existing infrastructure, policies, building stock, and how that impacts electrification.	Understand how to properly phase regulations based on financial impacts and building types.	Understand new processes that will be required at the city level and how to prepare the workforce.	<ul style="list-style-type: none">• Presentation• Webinars• Peer to peer exchanges• Toolkits• FAQs• Workshops

3 Available Technologies

Examine what technologies and building system components are available.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Basics on electric space heating technologies.	Understanding electric technologies to building types.	Characterization & understanding of market: Cost savings and climate benefits of technologies.	Understand role of jurisdiction in providing financial support.	<ul style="list-style-type: none">• Presentations• Webinars• Peer to peer exchanges• Toolkits• FAQs• Workshops

4 Preparing Jurisdiction for Electrification

Examine the various roles in electrification.

Topic A	Topic B	Topic C	Topic D	Educational Tools
Overview of the role of designers (changes to current process, impact on building systems, proper installation and planning, support needed from policymaker).	Overview of the role of contractors, manufacturers, vendors, and utilities.	Role of jurisdictions, code enforcement, and city staff.	Role of building owners and tenants.	<ul style="list-style-type: none">• Links to existing resources• FAQ documents• Training modules developed for other audiences

5 Preparing for Success in the Future

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

Topic A	Topic B	Topic C	Topic D	Educational Tools
Support building departments and have processes in place.	Ensure workforce trainings are in place for contractors and designers.	Ensure underrepresented communities and community based organizations are a part of the process.	Identify and examine future potential gaps with phasing out fossil fuel jobs.	<ul style="list-style-type: none">• Presentations• Webinars• Peer to peer exchanges• Toolkits• FAQs• Workshops



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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.

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