The Building Electrification Initiative:

City-Industry Cooperation for Renewable Heating and Cooling

June 26, 2018

Agenda

- **What is the challenge we face?**
- What are leading cities doing to transform the heating and cooling sector?
- Where are cities going to do next?

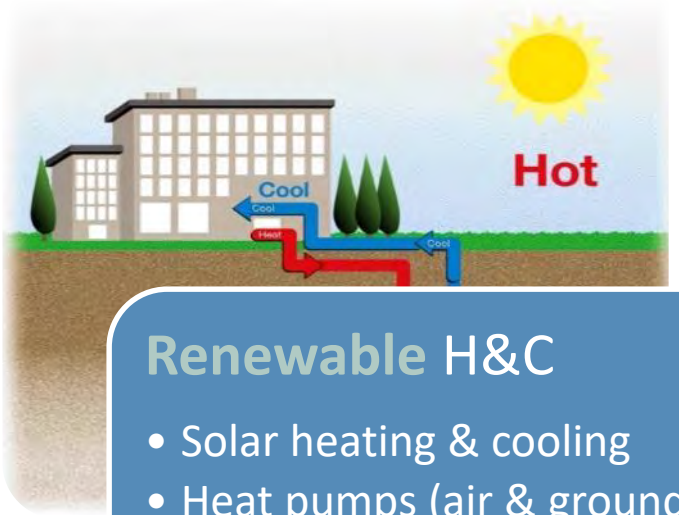
Major shifts in energy, climate, policy and economics are influencing the heating and cooling market

- Deep decarbonization requires new strategies
- Heating and cooling is a primary contributor to GHG emissions
- Strategic electrification is emerging as a leading decarbonization strategy
- Cities (and states) continue to lead on climate action and policy
- Cities are leading on new RH&C strategies

Major shifts in energy, climate, policy and economics are influencing the heating and cooling market

Deep decarbonization requires new strategies

- Many GHG emissions reductions to date have been achieved by fuel switching from coal or fuel oil to gas
- Energy efficiency programs have also achieved success, though low-hanging fruit has already been picked in many regions (e.g. lighting)
- Achieving 80x50 targets and Paris goals will require new tactics



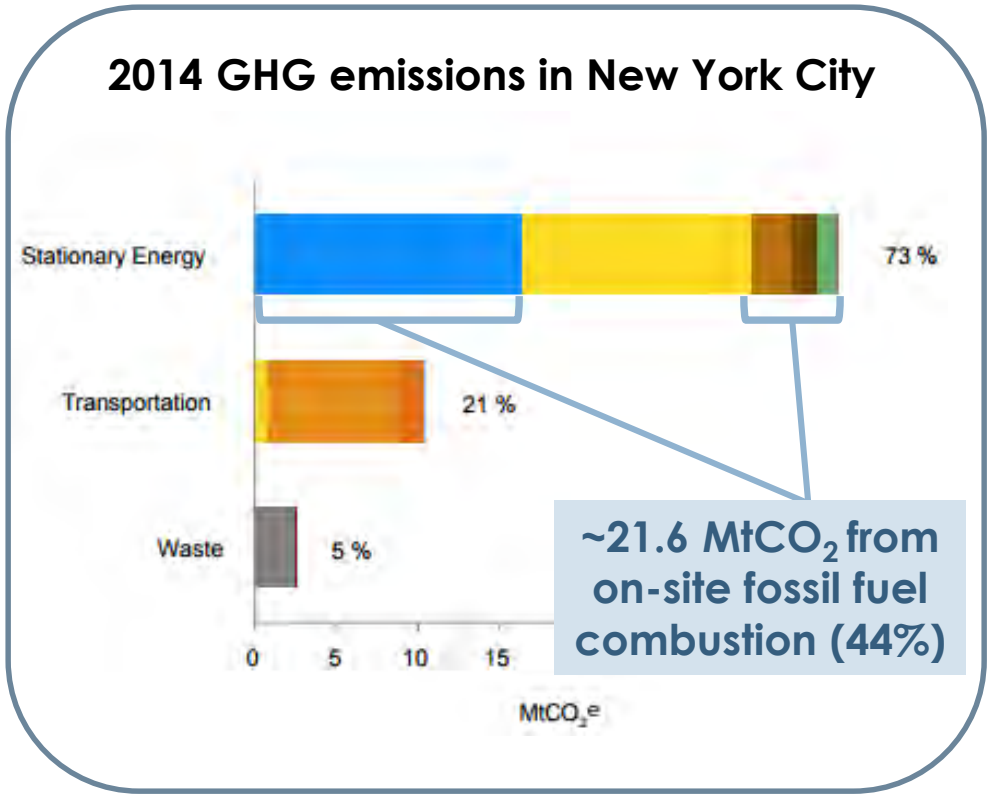
Renewable H&C

- Solar heating & cooling
- Heat pumps (air & ground source)
- Heat pump water heaters
- Sustainable bioenergy
- Anaerobic digestion
- Combined heat + power

Major shifts in energy, climate, policy and economics are influencing the heating and cooling market

Heating and cooling sector is a primary contributor to GHG emissions

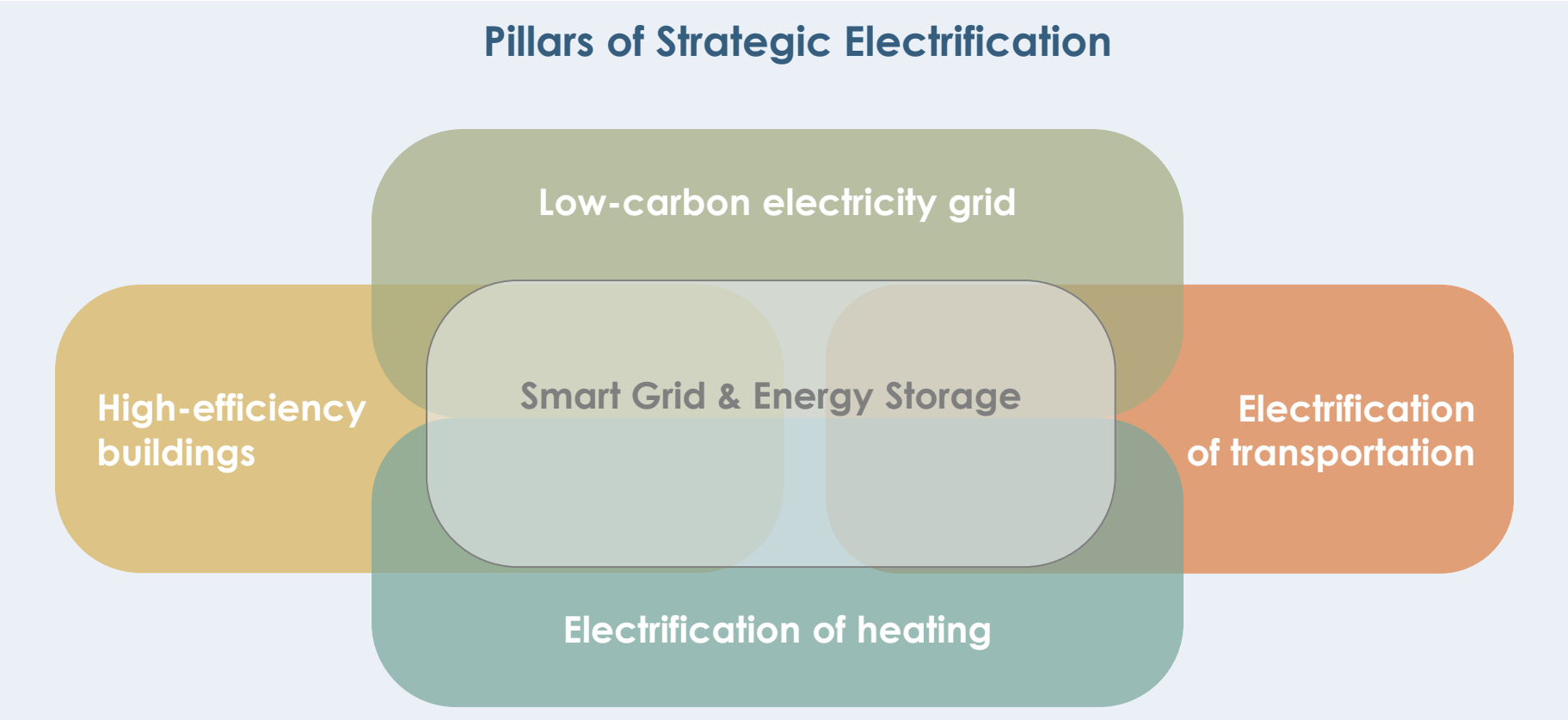
- On-site fossil fuel combustion in buildings accounts for 15-40% of citywide emissions
- Thermal energy use is the single largest source of city GHG emissions in many heating dominated climates.
- Energy planners note that grid decarbonization and building efficiency will be insufficient to achieve 80x50 goals (e.g. NYC 80x50 Roadmap, Clean Energy DC)



Source: NYC (2016). Inventory of New York City Greenhouse Gas Emissions in 2014.

Major shifts in energy, climate, policy and economics are influencing the heating and cooling market

Strategic electrification is emerging as a leading decarbonization strategy



Adapted from Fig. 2 of NEEP Northeastern Regional Assessment of Strategic Electrification

Major shifts in energy, climate, policy and economics are influencing the heating and cooling market

- **Cities (and states) continue to lead on climate action and policy**
  - 382 US Mayors (representing 68 million Americans) have adopted the goals enshrined in the Paris Agreement (and more ambitious ones
- **Cities are leading on new RH&C strategies**
  - Cities across North America are exploring strategies to scale up deployment of renewable heating and cooling (RH&C) technologies, including:
    - Air-source heat pumps (ASHPs)
    - Ground-source heat pumps (GSHPs)
    - Heat pump water heaters (HPWHs).

What does scenario modeling show us?

Source: NEEP (2017). Northeast Regional Assessment of Strategic Electrification. Prepared by Synapse Energy Economics and Meister Consultants Group. Retrieved from www.neep.org.

Table 10: Comparing the Max Electric and Plausibly Optimistic scenarios with the Reference case based on the 2017 Annual Energy Outlook.

	Max Electric	Plausibly Optimistic	Reference (AEO 2017)
2050 GHG reduction from 2001 levels	77%	69%	24%
2050 electric consumption	402 TWh	339 TWh	259 TWh
Electric energy efficiency	~2% annual savings via long-lived measures	~2% annual savings via long-lived measures	~1.1% annual savings via long-lived measures
Clean electricity	95% in 2050	95% in 2050	61% in 2050
Residential heat pumps	Delivered fuels: 96% sales share in 2035 Natural gas: 95% sales share in 2035	Delivered fuels: 89% sales share in 2035 Natural gas: 68% sales share in 2035	6% total installed share in 2050
Commercial heat pumps	Delivered fuels: 89% sales share in 2035 Natural gas: 78% sales share in 2035	Delivered fuels: 80% sales share in 2035 Natural gas: 66% sales share in 2035	4% total installed share in 2050
Cars and light trucks	81% sales share in 2035	70% sales share in 2035	3% sales share in 2035
Medium- and heavy-duty road vehicles	50% of miles electric in 2035	25% of miles electric in 2035	0.3% of miles electric in 2035
Process heat and steam	16% fossil energy displaced in 2035	13% fossil energy displaced in 2035	None

What does scenario modeling show us?

Table 10: Comparing the Max Electric and Plausibly Optimistic scenarios with the Reference case based on the 2017 Annual Energy Outlook.

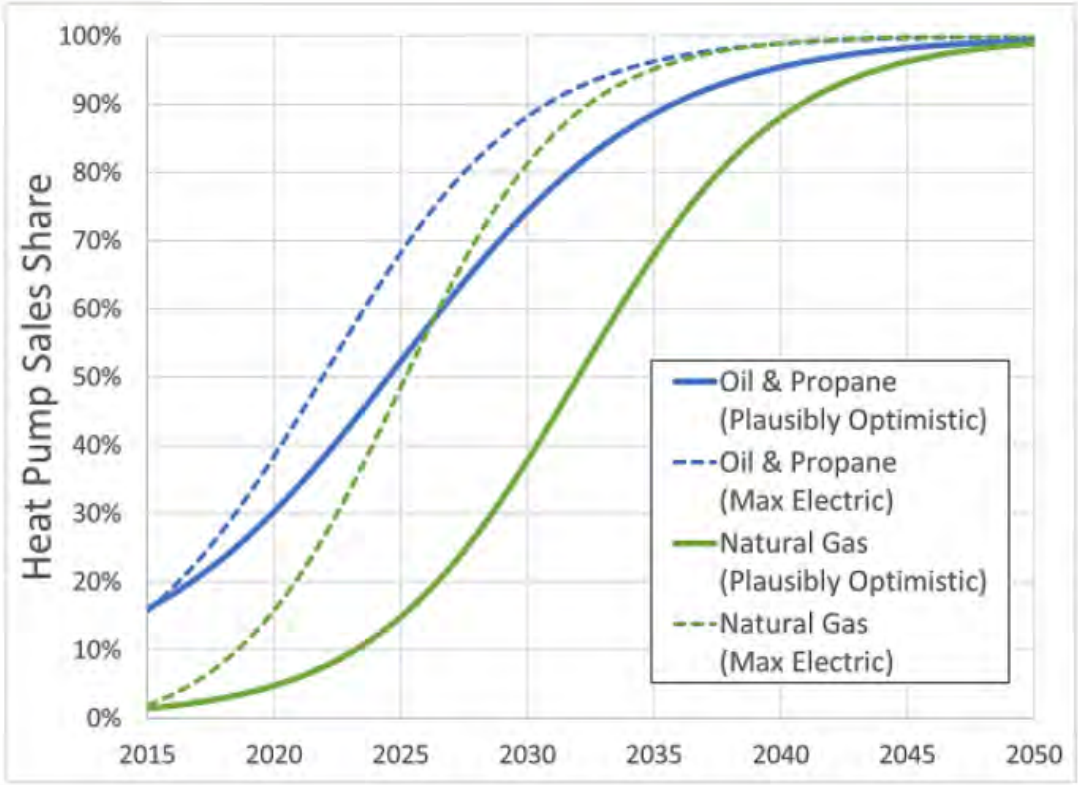
	Max Electric	Plausibly Opti	
2050 GHG reduction from 2001 levels	77%	69%	
2050 electric consumption	402 TWh	339 TWh	
Electric energy efficiency	~2% annual savings via long-lived measures	~2% annual sa long-lived mea	
Clean electricity	95% in 2050	95% in 2050	
Residential heat pumps	Delivered fuels: 96% sales share in 2035 Natural gas: 95% sales share in 2035	Delivered fuels sales share in 203 Natural % sales share in 2035	2050
Commercial heat pumps	Delivered fuels: 89% sales share in 2035 Natural gas: 78% sales share in 2035	Delivered fuels: 80% sales share in 2035 Natural gas: 66% sales share in 2035	4% total installed share in 2050
Cars and light trucks	81% sales share in 2035	70% sales share in 2035	3% sales share in 2035
Medium- and heavy-duty road vehicles	50% of miles electric in 2035	25% of miles electric in 2035	0.3% of miles electric in 2035
Process heat and steam	16% fossil energy displaced in 2035	13% fossil energy displaced in 2035	None

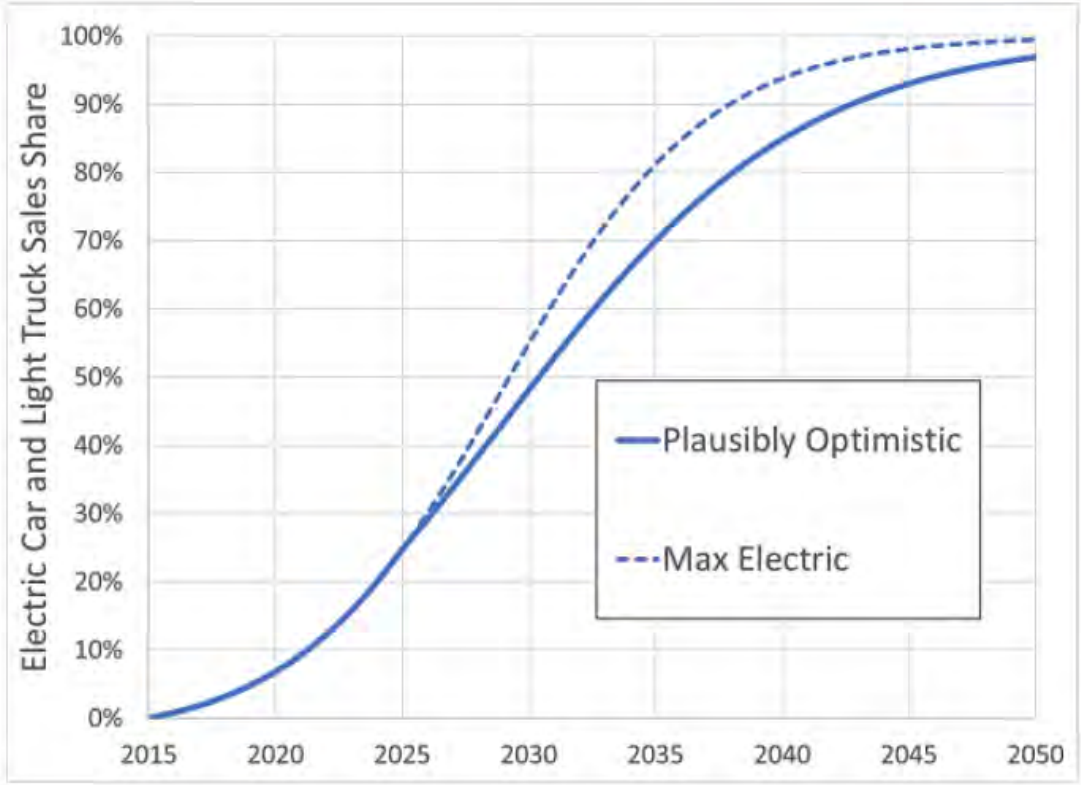
Over 95% of residential sales and **over 78% of commercial sales** by 2035

Source: NEEP (2017). Northeast Regional Assessment of Strategic Electrification. Prepared by Synapse Energy Economics and Meister Consultants Group. Retrieved from www.neep.org.

What does scenario modeling show us?

Figure 12: Sales shares for residential heat pumps and electric cars and trucks under the Max Electric and Plausibly Optimistic scenarios.





Source: NEEP (2017). Northeast Regional Assessment of Strategic Electrification. Prepared by Synapse Energy Economics and Meister Consultants Group. Retrieved from www.neep.org.

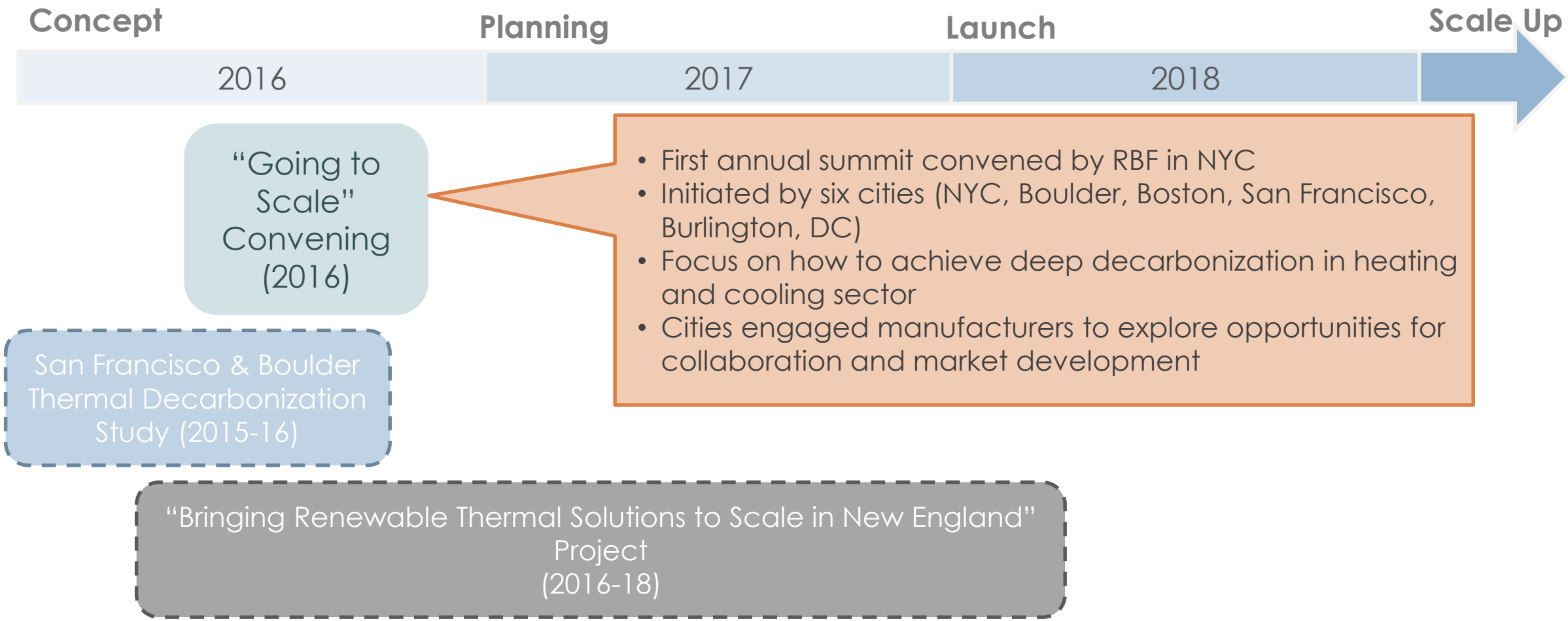
Public private collaboration will be essential to achieve energy and climate goals

How can **cities and the private sector take joint action to accelerate heat pump deployment** and thermally decarbonize the building sector?

Agenda

- What is the challenge we face?
- **What are leading cities doing to transform the heating and cooling sector?**
- Where are cities going to do next?

The Building Electrification Initiative



Major market barriers slow down adoption of heat pumps

Policy & Regulatory Barriers

- Fuel switching regulations
- Fossil fuel subsidies
- Lack of economy-wide carbon pricing

Tech. & Building Barriers

- Low refurbishment rates
- Lack of performance data

Economic Barriers

- High installed costs
- Lack of financing and poor ROI
- Capital constraints

Awareness Barriers

- Lack of consumer awareness
- Policy & consumer awareness of thermal energy impacts

Decision-Making Barriers

- Ownership priorities
- Split incentives
- Lack of confidence in tech

Supply Chain Barriers

- Insufficient contractor base
- Staff training for O&M
- Supply chain gaps

Why direct collaborations between city and industry leaders?

Cities and industry actors have a variety of **complementary strengths** that can be leveraged to drive a market transformation

	Cities	Manufacturers
Strengths	• Access to local datasets • Access to and credibility with constituents • Control/influence over building codes and local regulations	• Strong relationship with distributors and contractors • Resources for marketing • Customer insights and technical expertise • Drivers of technology innovation
Challenges	• Limited financial resources • Limited ability to affect policies/programs outside sphere of influence	• Limited financial resources • Limited ability to affect policies/programs • Strengthening supply chain / contractor sales force

The Building Electrification Initiative

Phase 1: City Roadmaps

Lead Funder: Summit Foundation and USDN

- NYC, Wash DC, Boulder, and Burlington (VT):
  - **Market characterization analysis** to explore the state of the market and assess the suitability of each city's building stock for heat pump technologies
  - **Local supply chain analysis** to identify status of local distribution and contractor network for heat pumps
  - **Barrier analysis** to identify pathways for cities and partners to address key market challenges
  - **Internal roadmaps** exploring next steps for city policies and programs

Phase 1 NYC Example | Key market opportunities

176,000 1-4 family buildings citywide identified as good candidates for ASHPs

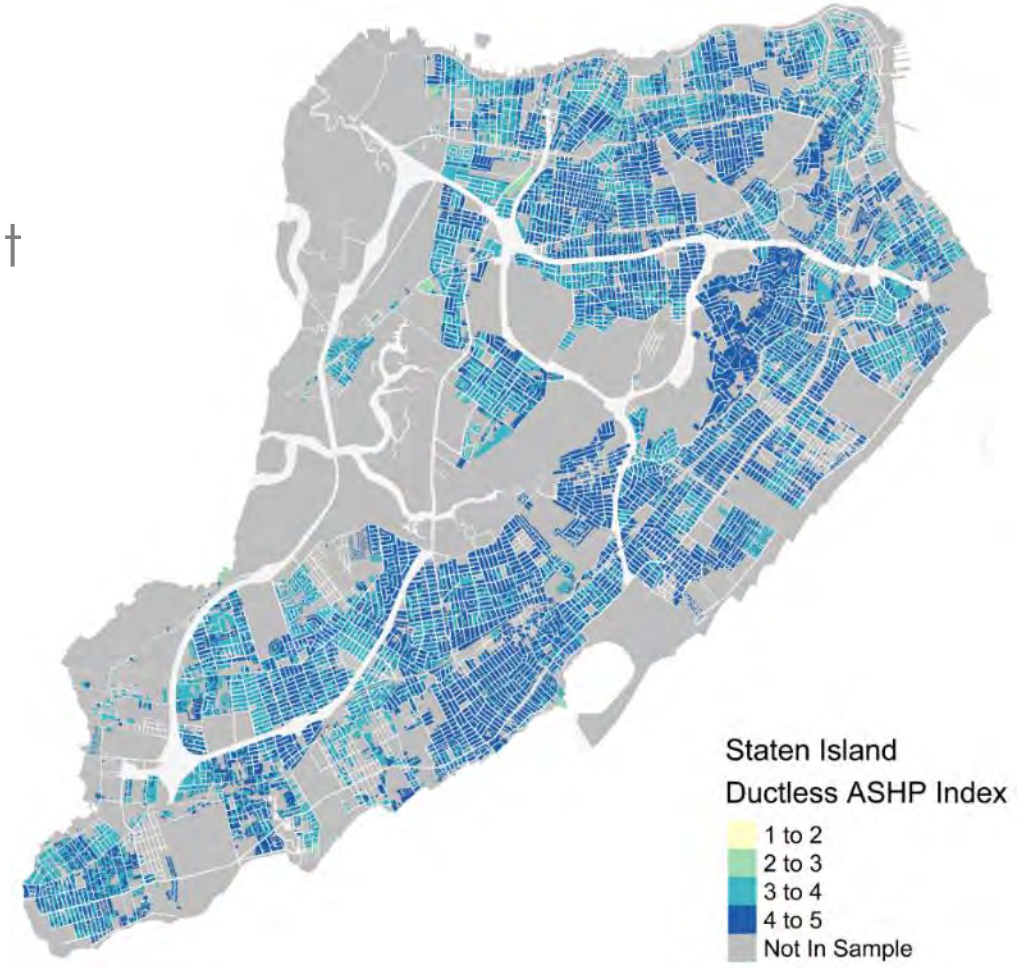
» Most homes are heated by natural gas, but lack central air conditioning

Staten Island: **70,742** high potential homes for ASHPs

» 71% single family homes

» 86% owner-occupied

» Nearly 100% gas heated



Phase 1 NYC Example | Large and fragmented local supply chain

Local Cold Climate ASHP Supply Chain

NYC and Surrounding Counties (~25 mile radius)

- 17 NEEP-certified manufacturers supply products locally
- At least 67 distributors with over 200 locations in operation
- The top 8 distributors account for roughly half of locations
- Nearly 14,500 local HVAC contractors
- Over 90% of firms employ 10 or fewer employees

Three primary areas of focus for The Building Electrification Initiative

City-driven market transformation

1) Customer Demand Generation

- **Approach:** Outreach, education, and/or group purchasing programs
- **Barriers addressed:** Lack of customer awareness; high upfront costs; lack of quality assurance and confidence in technology

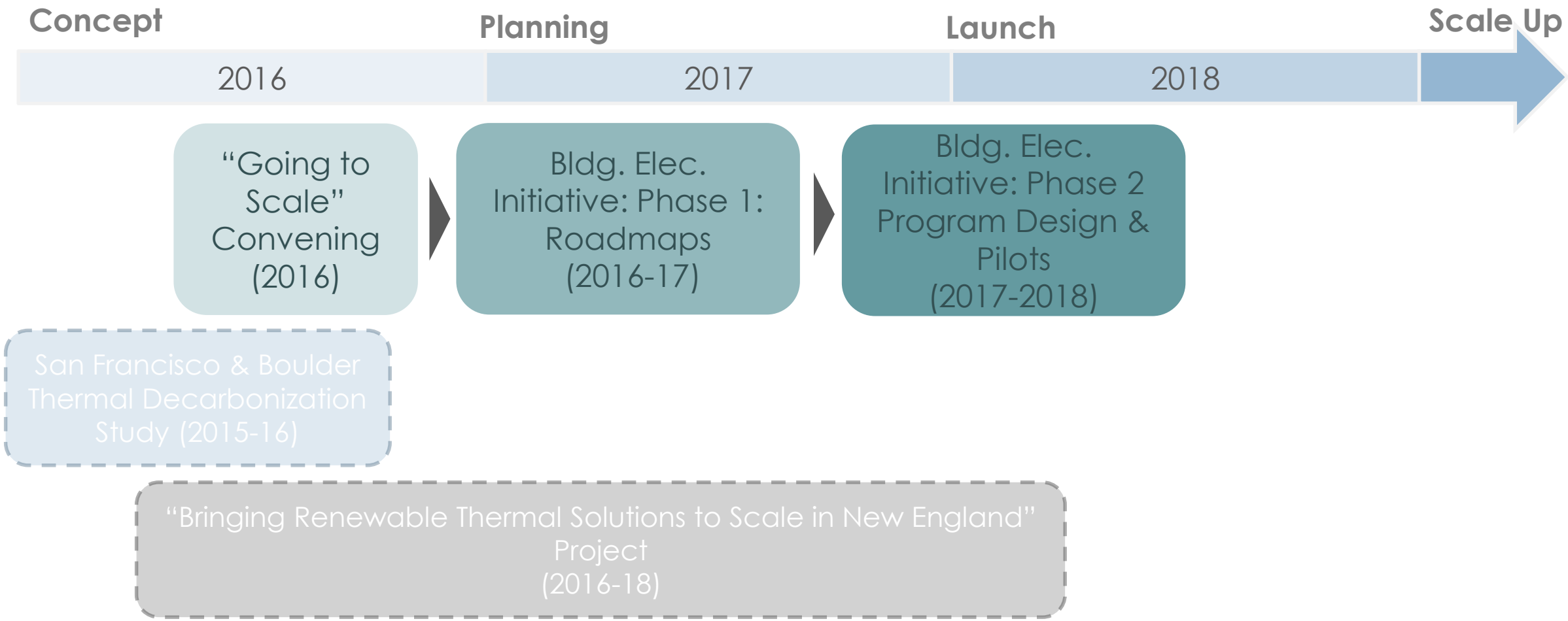
2) Local Supply Chain Development

- **Approach:** Increase the number and quality of HVAC contractors via contractor outreach, training, and certification programs
- **Barriers addressed:** insufficient local contractor base; supply chain inefficiencies; lack of confidence/quality

3) Market Partnerships & Regional Policy

- **Approach:** partner with state agencies, utilities, financiers, and industry to develop policies outside of direct city control (e.g. incentives, utility regulations, etc.).
- **Barriers addressed:** Regulatory constraints; high upfront costs; lack of low-cost financing programs

The Building Electrification Initiative



Phase 2: Program design and pilot projects

Lead Funder: Carbon Neutral Cities Alliance with in-kind & financial support from manufacturers and cities

- NYC, Wash DC, Boulder, and Burlington (VT) collaborating with MCG and Mitsubishi to:
  - **Pilot program design and/or implementation** to grow customer demand and engage supply chain
  - **Foster development of new partnerships** with local contractors/distributors, state policymakers, and other stakeholders to support market development
  - **Assess models for collaboration with manufacturers** that can support industry-wide scale up over medium-long term

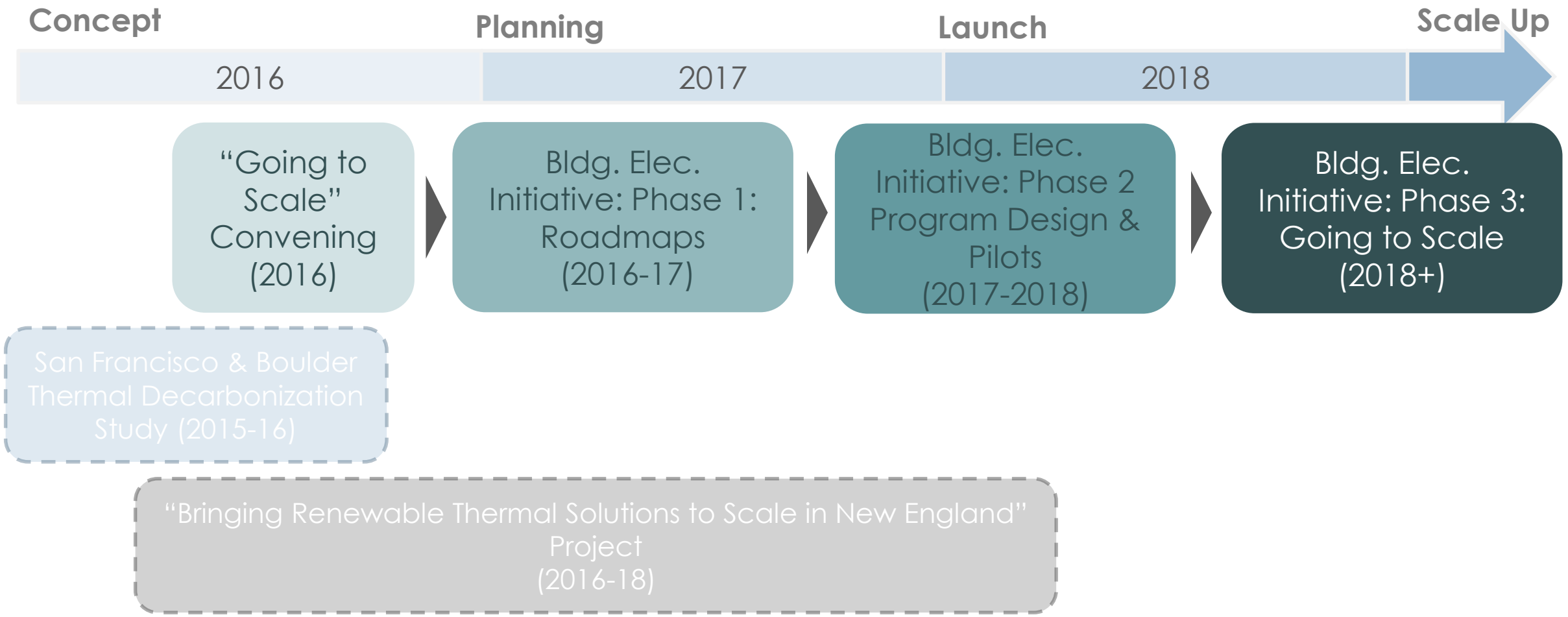
Boulder Example | Marketing, Outreach & Education Campaigns

- Spring and Fall campaigns with collaboration between
  - City of Boulder
  - County EE implementer and approved installers
  - Manufacturers (Mitsubishi)
  - Utility (Xcel)
  - and community groups
- $1000+ incentives from County, Xcel, Mitsubishi and City
- Regional advertising campaigns, social media, and community outreach
  - 600 min viewing time on Facebook Live
  - 10-15% conversion from contacts to installs

Agenda

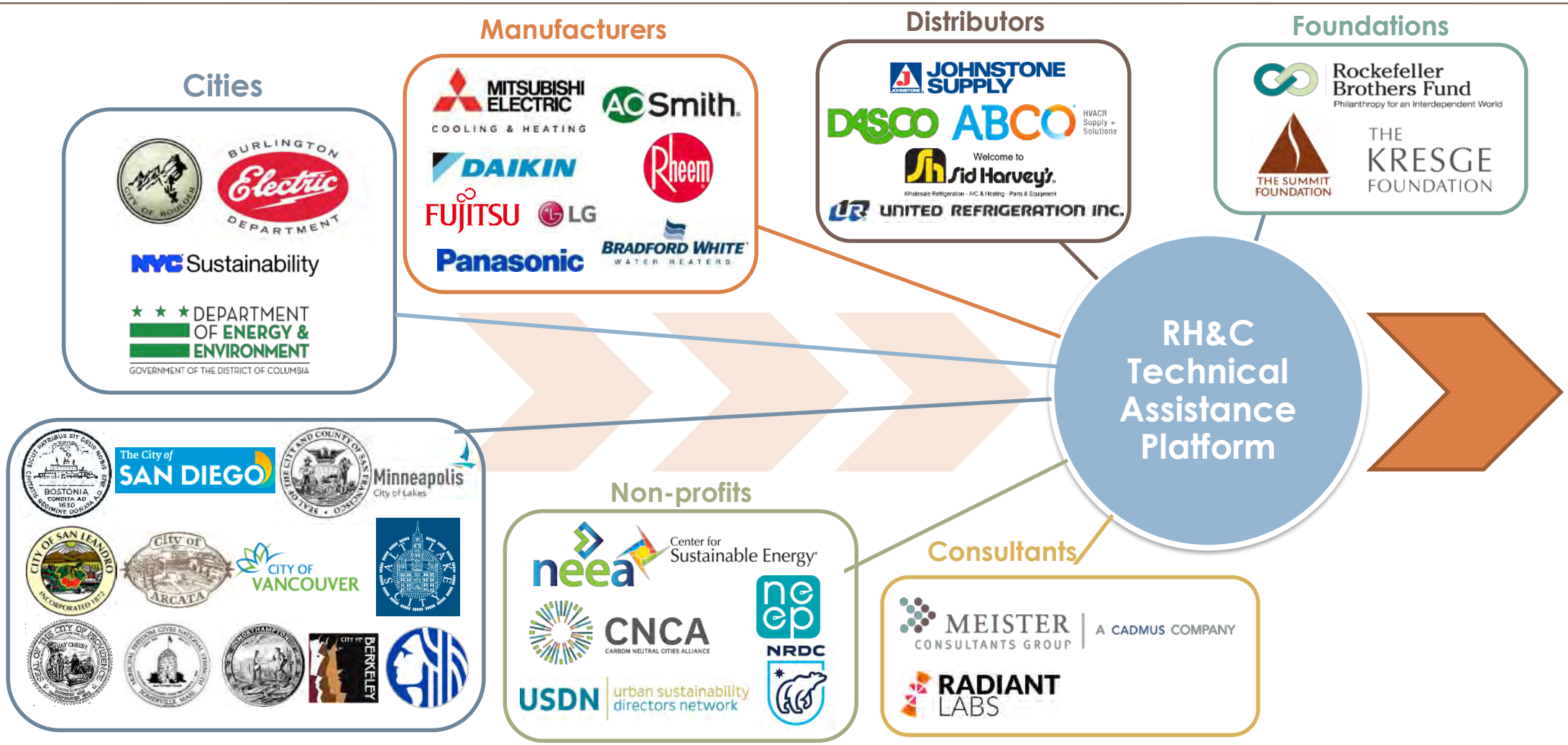
- What is the challenge we face?
- What are leading cities doing to transform the heating and cooling sector?
- **Where are cities going to do next?**

The Building Electrification Initiative



The Building Electrification Initiative

Collaboration across public, private and non-profit sectors will be critical for success



Lessons learned from the solar PV playbook

SunShot U.S. Department of Energy

- **US Dept. of Energy SunShot Initiative** to drive down costs and support adoption
  - **High-level public-private collaborations** between federal/state governments and private sector to drive technology and business model innovations
  - **Community technical assistance programs** (e.g. SolSmart, Solar Outreach Partnership, Rooftop Solar Challenge, Solar in Your Community Challenge)
  - **Training programs** to support solar workforce development (e.g. STEP, Solar Ready Vets, GEARED)

Case Study:

SOLAR in Your Community CHALLENGE

- Focus on community and low- and moderate-income households
- Collaborative local/regional teams compete for $1 million in final prize
- All teams eligible to receive seed funding and technical assistance from a roster of experts

Immediate Next Steps

- **Hire Full-time Project Coordinator.** Engage professional PM to engage new cities and raise funds for expansion.
- **Prove Concept in New Regions:** Select the next cohort to join The Building Electrification Initiative
- **Address Energy Equity :** Develop approach to address LMI and energy access issues as it relates to RH&C
- **Engage Utilities:** Identify collaborative pathways to engage utilities by developing the "City-Utility Regulatory Primer"
- **Scale Up Initiative Across North America:** Develop and launch The Building Electrification Platform to scale the Initiative

Thank you!

Neil Veilleux | Principal

neil.veilleux@mc-group.com
Office: +1.617.849.9947
Cell: +1.404.863.6524

Questions?

Meister Consultants Group |
A Cadmus Company

One Center Plaza, Suite 320
Boston, MA 02108
www.mc-group.com