Electrification in Minnesota Stakeholder Meeting No. 2b

September 9, 2020

Welcome, The Event Will Be Starting Soon

Electrification in Minnesota Stakeholder Meeting No. 2b

September 9, 2020

Webex Participation

Attendees are in “listen-only” mode. We hope you’ll engage in these ways:

1) Answer the poll questions
2) Chat questions to “all panelists”. Q &A will take place after each presentation.
3) Chat with the “Chat Coordinator” if you have technical difficulties
4) This event is being recorded and will be posted on the project website.
5) Visit www.michaelsenergy.com/electrification-action-plan

Agenda

10:00 – 10:10 – Welcome and orientation to the event

10:10 – 11:40 – Presentations and Q&A for each panelist

11:40 – 12:00 – Additional Q&A, wrap-up, next steps for process

Project Goals

1. Examine benefits and concerns of electrification as a tool for grid optimization, energy efficiency, and emissions reduction in Minnesota.
2. Convene series of stakeholder meetings to provide information, facilitate discussion and solicit recommendations on key electrification topics.

Immediate Next Steps

- August 27, 2020 – Stakeholder Meeting No. 2: Minnesota Perspectives
- September 9, 2020 – Stakeholder Meeting No. 3: Across the U.S. -- Regional, State and Local Electrification Initiatives
- Fall 2020 – Technical Advisory Committee Meetings

Electrification Around the U.S.

- **Ana Sophia Mifsud**, Senior Associate, Building Electrification, Rocky Mountain Institute
- **Samantha Caputo**, Senior Policy and Research Analyst, Northeast Energy Efficiency Partnership (NEEP)
- **Jessica Allison**, Senior Policy Analyst, California Public Utilities Commission

Speaker bios available at
www.michaelsenergy.com/electrification-action-plan/resources/

SEPTEMBER 2020

Building Electrification Around the United States

Ana Sophia Mifsud
Rocky Mountain Institute

Building Electrification is an Emerging Topic Across the United States

Cleaning of the grid and improvements in heat pump technology have enabled the growth of interest in building electrification.

Building electrification is still a **relatively new topic** even in the most advanced jurisdictions and there are are **barriers that are still being addressed**.

Despite the "newness" Minnesota can build on the **major progress across the United States** and decarbonize its heating sector.

Key Approaches

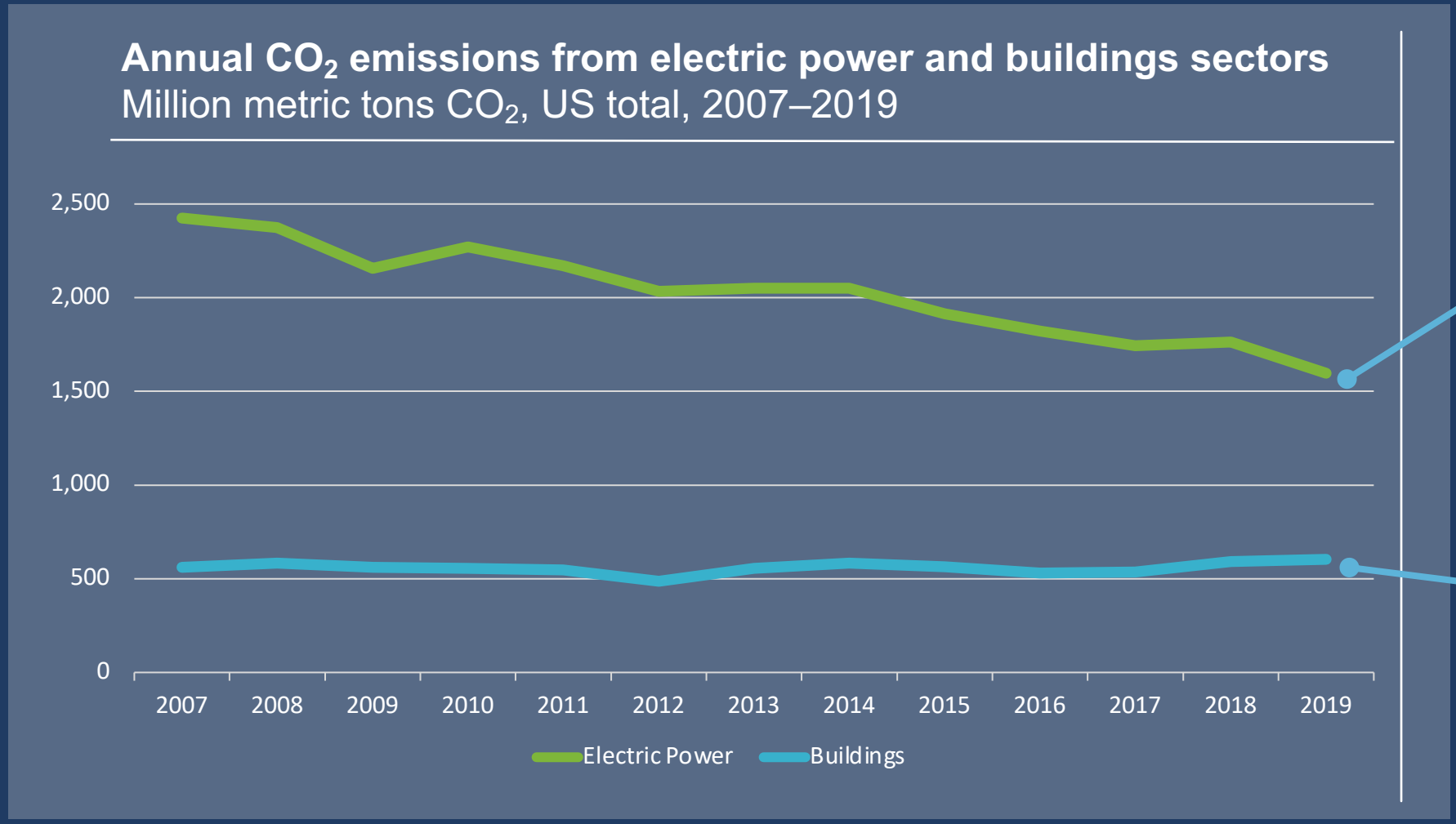
1 **Goals and Commitment**
Building decarbonization is increasingly highlighted in jurisdictions' climate commitments.

2 **Policy and Regulation**
There are both local and state level activity with most ambitious activity happening at the local level.

3 **Heat Pump Programs**
Heat pump programs are increasing nationally and have seen high levels of success in cold climates.

4 **Areas of Increasing Interest**
Considerations around health, cold climates, and equitable transition are becoming increasingly important.

The United States has reduced carbon emissions in the electricity sector, but not in the buildings sector



Electric Power: Down 34% since 2007

Buildings: Up 11% since 2007

Source: EIA 2018; Rhodium Group (2019)

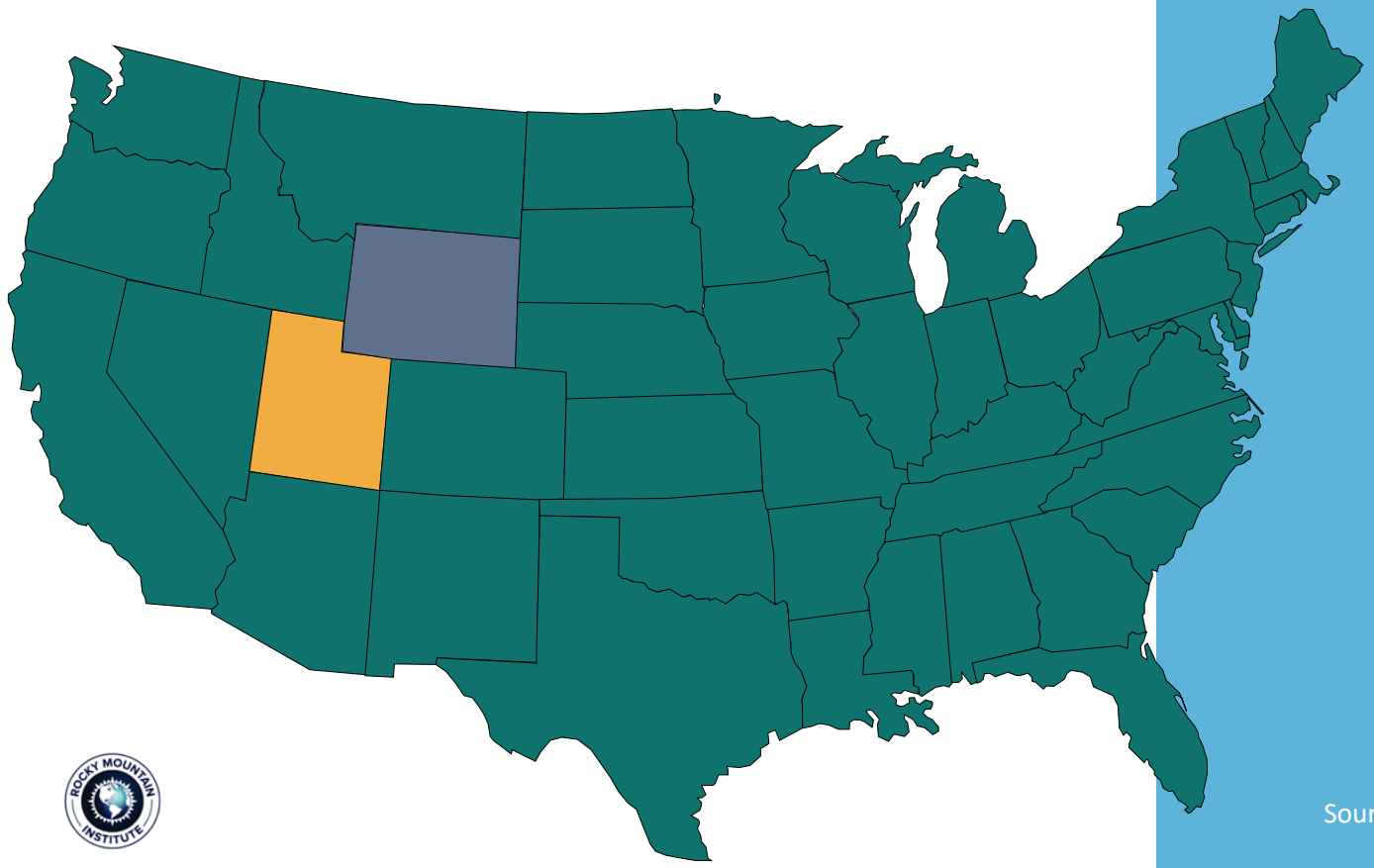
A heat pump uses small amount of electricity to move heat rather than generate heat

- Is different and more efficient than resistance heating
- Heat pumps deliver two to four times more heating energy than the electricity it consumes
- Even burning gas in a power plant to run a heat pump is more efficient than a gas furnace or boiler

For 99% of American households, heat pumps will save emissions compared to gas alternative

- Heat pumps deliver two to four times more heating energy than the electricity it consumes
- When compared to fuel oil there is no question that heat pumps are cleaner source of heat

Emissions Impact by State—Heat Pumps vs. Gas Furnace (Continental United States)

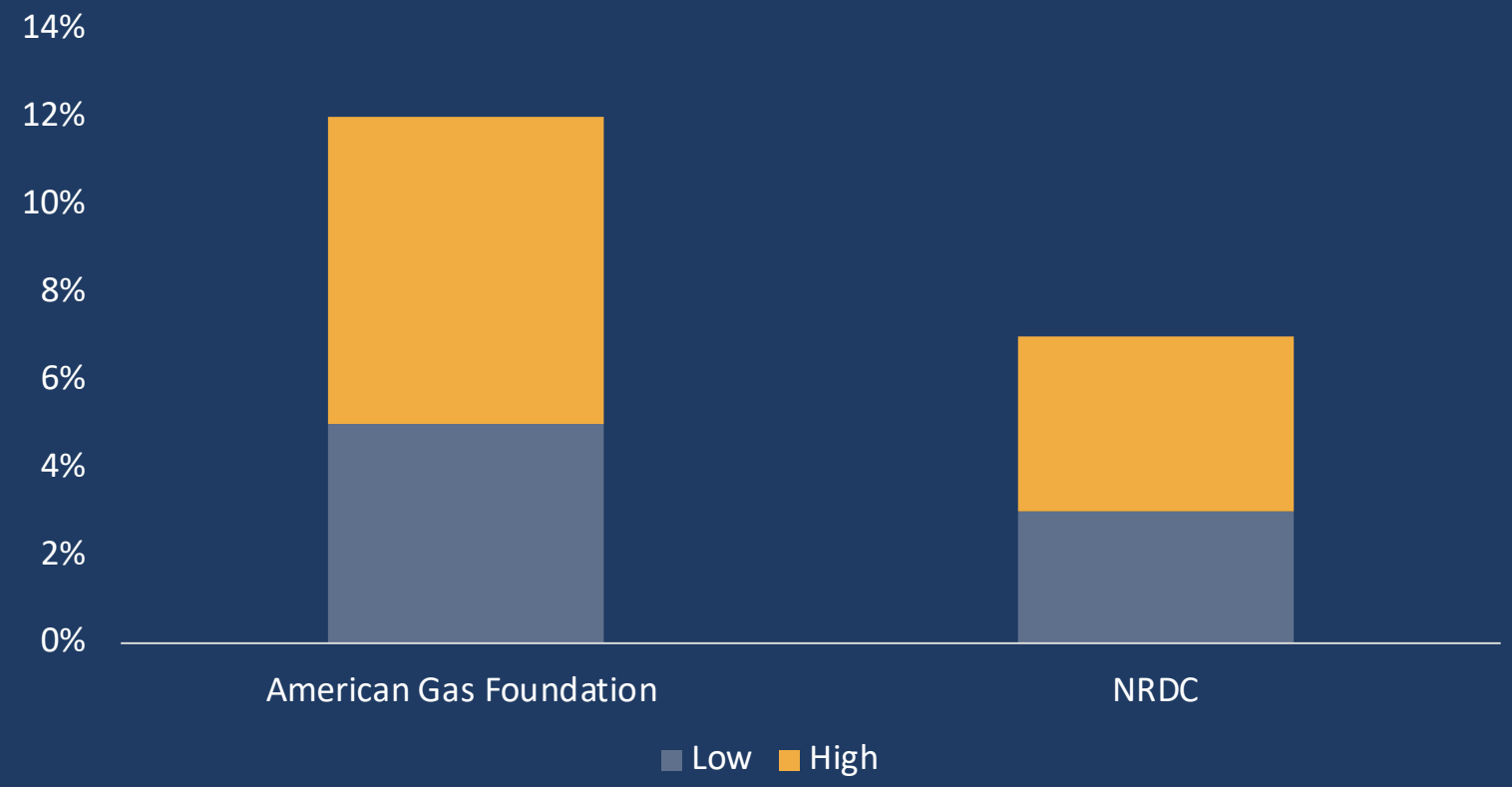


- New Heat Pumps reduce carbon emissions vs. gas furnace
- Pending policy may change outcome
- New heat pump doesn't currently reduce emissions vs. gas

Source: https://rmi.org/its-time-to-incentivize-residential-heat-pumps/

“Renewable Natural Gas” is not a viable alternative to decarbonize the building sector

“Renewable Natural Gas" supply by 2040 compared to 2019 U.S. Demand



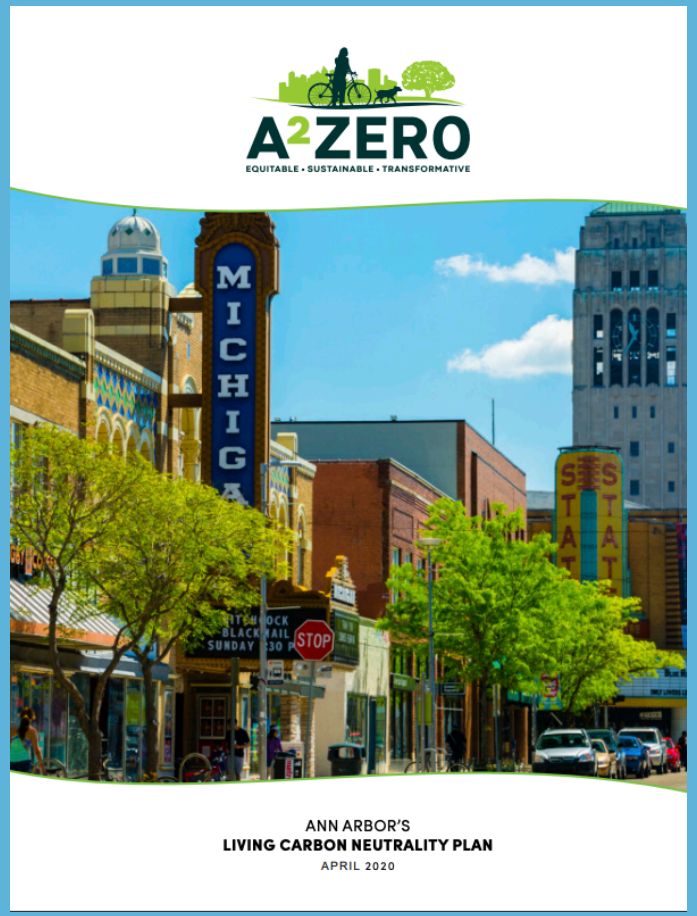
“Renewable natural gas” refers to **biogas** and **synthetic gas**

Even most optimistic analysis show that “renewable natural gas” would meet **at most meet 12% of U.S. demand** by 2040

Biogas gets more expensive over time and synthetic gas is expected to be **8-17 x more expensive** than fossil fuel gas

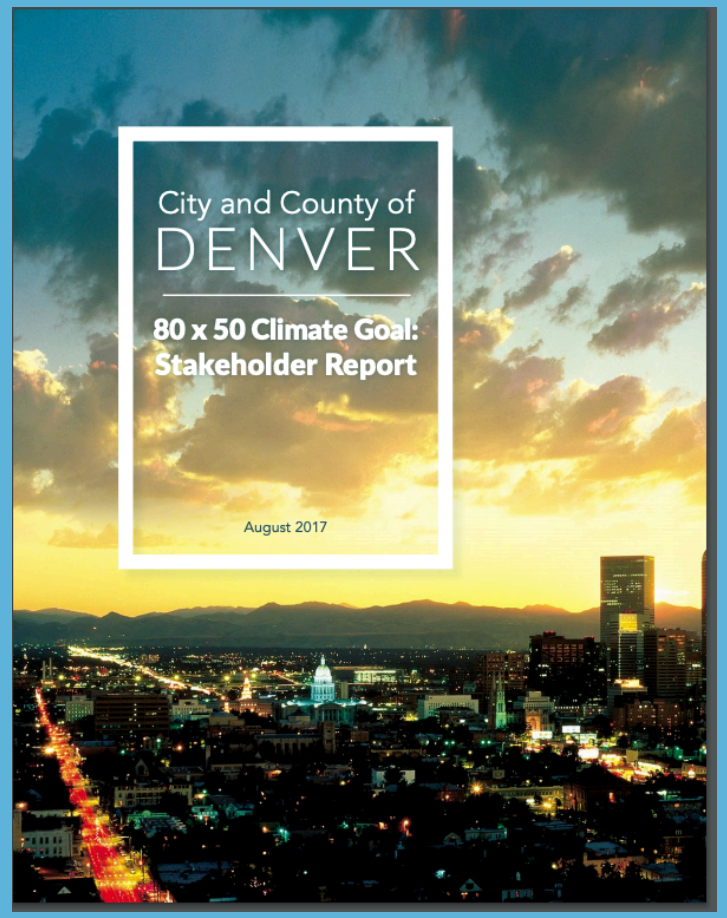
Further Reading: www.nrdc.org/experts/merrian-borgeson/report-renewable-gas-pipe-dream-or-climate-solution

Many goals and commitments focus on one of three metrics



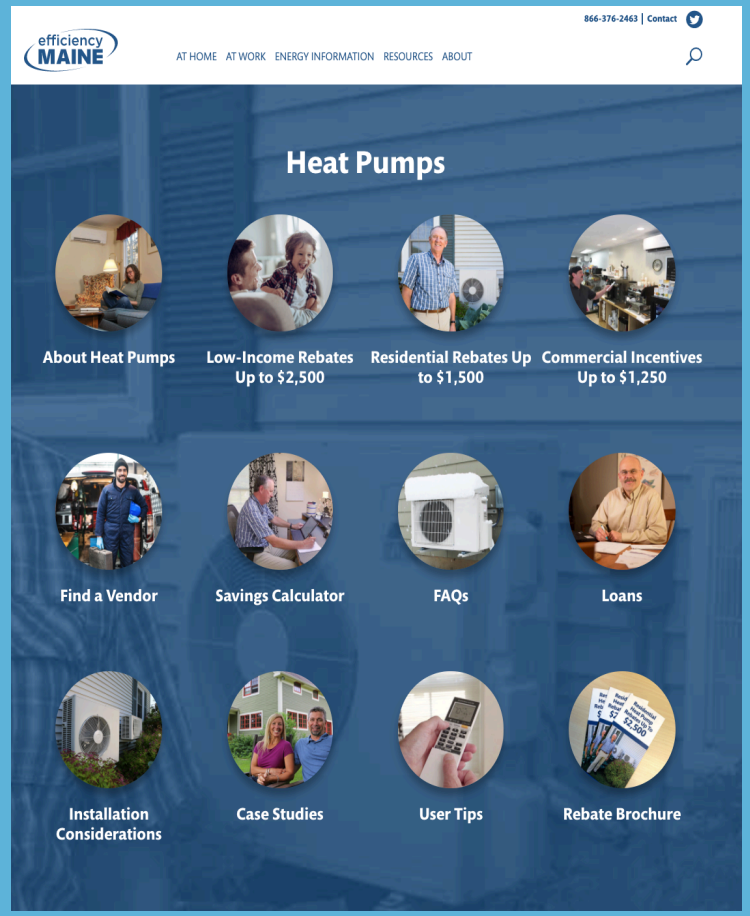
Emissions

City of Ann Arbor, Michigan



Fuel Reductions

Denver, Colorado



Heat Pump Deployment

Maine

Key Approaches

1 **Goals and Commitment**
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There are both local and state level activity with most ambitious activity happening at the local level.

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4 **Areas of Increasing Interest**
Considerations around health, cold climates, and equitable transition are becoming increasingly important.

Policy and regulation are driving building decarbonization in cities and states

All Electric New Construction

Berkley, California

Building Codes and Standards

Saint Louis, Missouri

Regulatory Proceedings

Massachusetts

Regulatory Solutions for Building Decarbonization

Four overarching Recommendation to PUC:

- Set a clear direction for aligning the utility system with the climate imperative
- Build the market for new clean energy solutions in buildings
- Stop expanding the gas delivery system
- Create a path to wind down gas systems affordably

Some key strategies:

- Align efficiency policies with decarbonization
- Expand energy system planning
- Modernize utility business models
- Manage infrastructure and stranded asset risk

Further Reading: https://rmi.org/insight/regulatory-solutions-for-building-decarbonization/

Key Approaches

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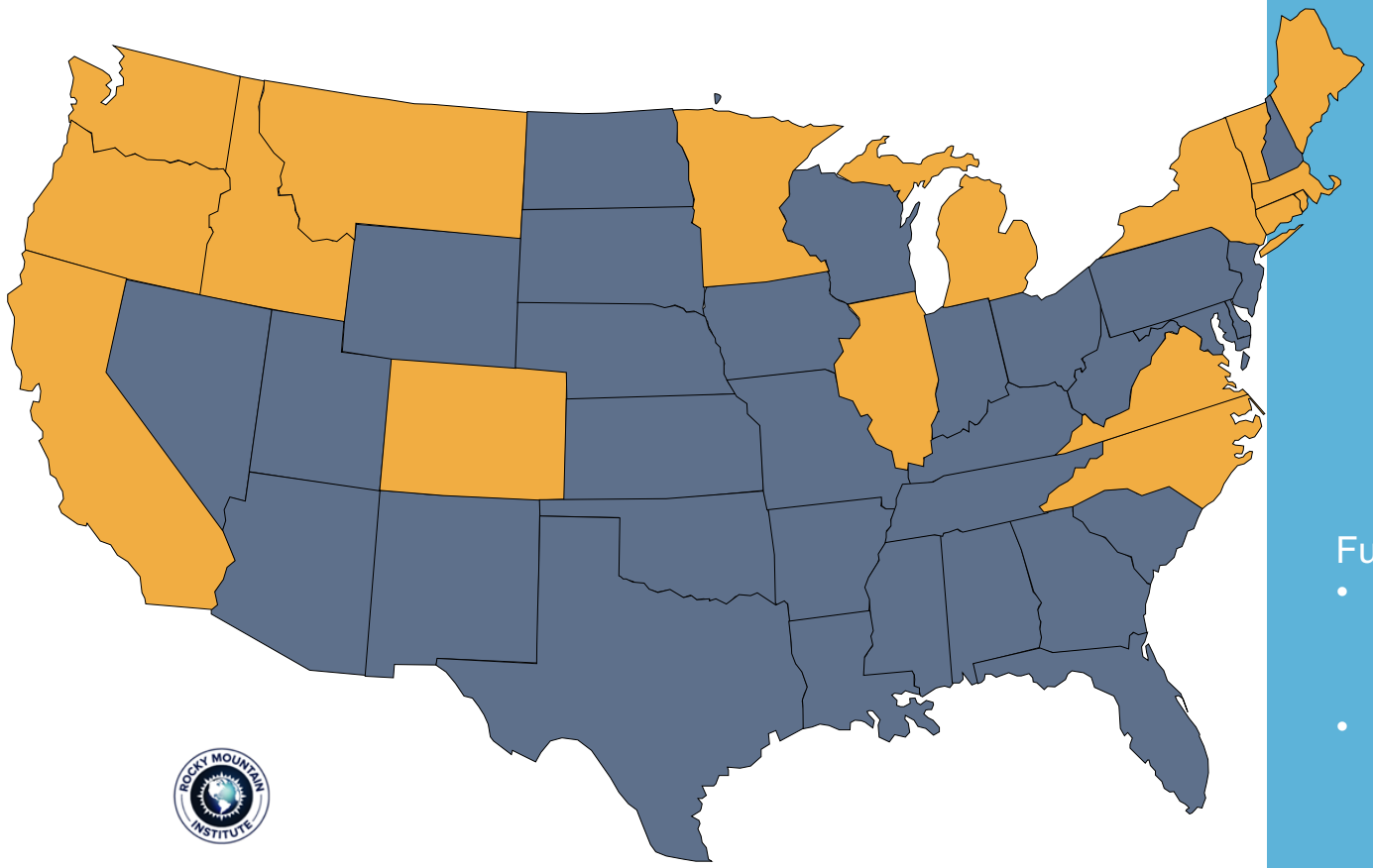
Heat Pump Programs are Growing throughout the United States

States with heat pump programs:



- **New and growing:** Current year budgets are nearly $110 million, up 70% from the prior year.
- **Efficiency Measures:** pair with weatherization, transition electric resistance, growing AC loads.
- **Target delivered fuels**
- **Mostly residential**
- **Midstream Incentives**
- Target **low-income** and vulnerable customers

Active heat pump programs

Further Reading:

- https://www.aceee.org/sites/default/files/pdfs/programs_to_electrify_space_heating_brief_final_6-23-20.pdf
- https://www.nrdc.org/experts/alejandra-mejia/how-design-building-electrification-programs-work

Heat pumps can be cost-effective for new construction and, in some cases, for retrofits

Heat pump programs can drive cost down and stimulate a supporting ecosystem

- **New construction** - heat pumps are usually lower cost
- **Electric resistance** - efficiency leads to significant cost savings
- **Delivered fuels** - high cost of propane and heating oil make investments in heat pumps a good payback for these customers
- **Avoid gas infrastructure** - cost of extending gas delivery or gas expansion projects can be avoided
- **Health and emission costs** – incorporating externalized costs to justify investments

Further reading: https://rmi.org/insight/the-economics-of-electrifying-buildings/ Look for an updated report in the new year.

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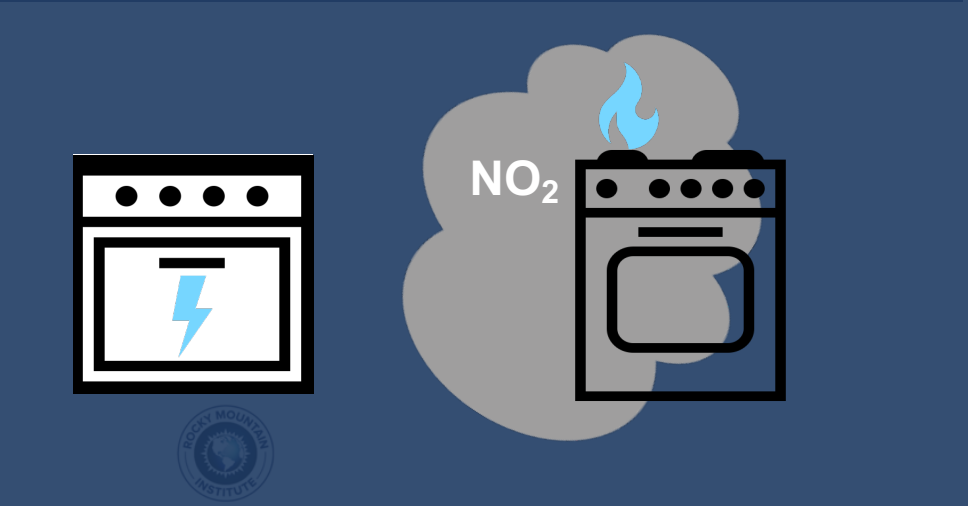
Heat Pumps Work in Cold Climates

Key issues are around back up heating and grid impacts

- **Today modern heat pumps work without back up to -15°F** – in extreme climates some people also install backup heating.
- **Electric resistance or existing fossil fuel infrastructure can be used for backup heating** – some heat pump programs leave existing **fossil fuel infrastructure** as back up source of heating, but **electric resistance** heating is also effective.
- **There is concern over winter peaking** – in a highly electrified future, the electric grid could be strained during the coldest days of the year. Although not an immediate concern, key mitigating strategies include **weatherization and demand response programs.**



Burning fossil fuels in buildings has negative indoor and air quality impacts

Indoor air quality is currently unregulated

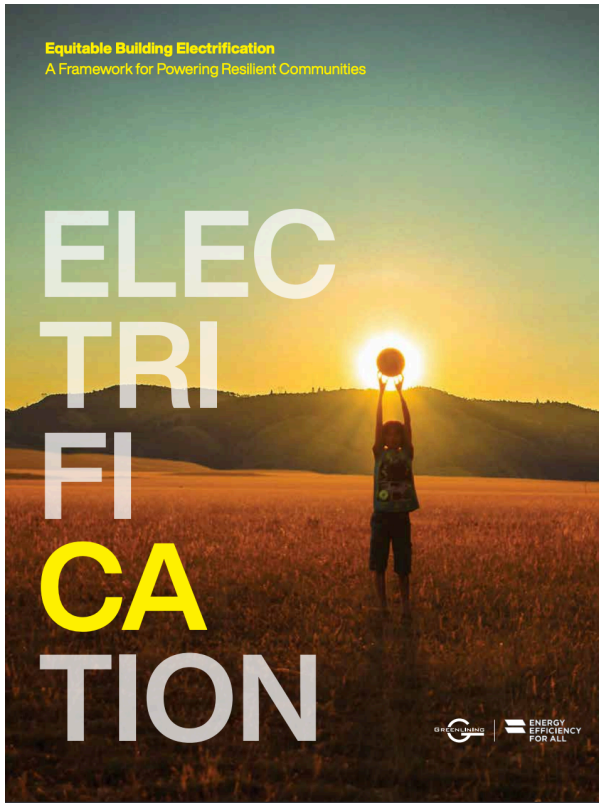
- We spend up to 90% of our time indoors
- EPA states indoor pollutant levels may be 2 to 5 and as much as 100 times higher indoors than outdoors
- Homes with gas stoves have 50 - 400% higher NO2 emissions than homes with electric stoves

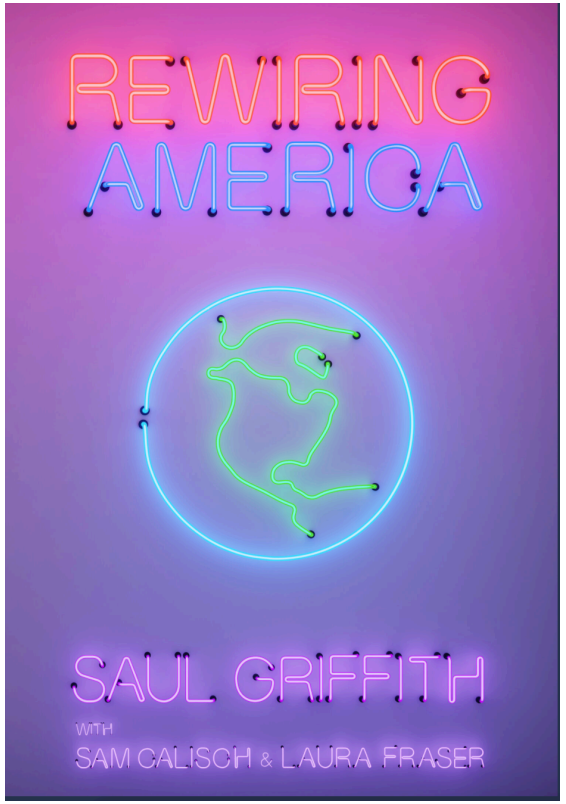
Further Reading:

- https://rmi.org/insight/gas-stoves-pollution-health
- https://coeh.ph.ucla.edu/effects-residential-gas-appliances-indoor-and-outdoor-air-quality-and-public-health-california

Must actively work to ensure an equitable transition

Workforce transition must be address and low-income customers should be protected





- **Important that low-income customers be prioritized –** these customers may be burdened with fixed cost of systems as other customers' defect
- **This transition will produce high-quality jobs** – workforce training programs and incentives will be required to transition existing workforce
- Incentives should **promote equitable building electrification**

Further Reading:
https://www.rewiringamerica.org/jobs-report
https://greenlining.org/wp-content/uploads/2019/10/Greenlining_EquitableElectrification_Report_2019_WEB.pdf

Thank you!

Ana Sophia Mifsud

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Minnesota Electrification Stakeholder Meeting

Electrification in the Northeast

Samantha Caputo
Northeast Energy Efficiency Partnerships
September 9, 2020

Northeast Energy Efficiency Partnerships

"Assist the Northeast and Mid-Atlantic region to reduce building sector energy consumption by at least 3% per year and carbon emissions by at least 40% by 2030 (relative to 2001)"

Mission

We seek to accelerate regional collaboration to promote advanced energy efficiency and related solutions in homes, buildings, industry, and communities.

Vision

We envision the region's homes, buildings, and communities transformed into efficient, affordable, low-carbon, resilient places to live, work, and play.

Approach

Drive market transformation regionally by fostering collaboration and innovation, developing tools, and disseminating knowledge

Building Decarbonization → 3 Key Elements

Advanced Electric Technologies

Space/Water Heating – Heat Pumps

Deep Energy Efficiency

Thermal Improvements

Grid Integration

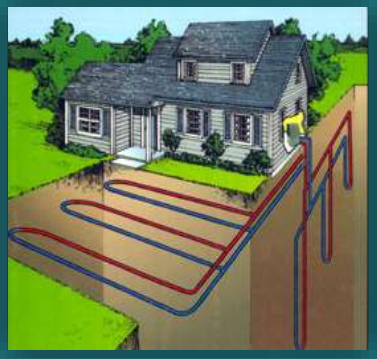
Flexible use of Low-Carbon Electricity

Northeast Strategic Electrification Action Plan – NEEP 2018

Heating Electrification Technologies

Technologies

- Air-Source Heat Pumps
- Ground-Source Heat Pumps
- Solar Thermal



Building Decarb Policy and Programs

- Carbon neutral targets via legislation (currently via policy)
- Heat pump adoption Targets/Goals
- Promotional Programs for EE and heat pumps
  - Expanding EE program metrics making that easier in cases of fuel switching
- Alternative Portfolio Standards
- Benchmarking and Labeling
- Existing Building Standards
- Building Codes & Appliance Standards
- Lead-by-Example
- Workforce Development
- Supporting communities

New York: Climate Leadership for Goal Setting

- Climate Leadership and Community Protection Act (A.8429)
  - Creates a Climate Action Council
    - Develop strategies for decarbonization across the economy
  - Requires 40% GHG reduction by 2030 and 85% by 2050 + 15% carbon capture
    - Commits the state to achieving zero GHG emissions
  - Mandates 70% renewable electricity by 2040
  - At least 35% overall benefits from climate programs be received by disadvantaged communities

Utility Regulation

Utilities need to align with energy efficiency, economic, ***and*** carbon goals.

Pathway one: Creating or shifting obligations and incentives for utilities and their customers.

Where have we seen this?

- Massachusetts
  - The 2018 Act to Advance Clean Energy
    - Broadened Energy Efficiency to focus on reducing **overall energy use**
    - Allows **strategic electrification** and active demand management to be included in EE plans
    - Cost-effectiveness at the **sector level**
  - 2019-2021 Plan includes a fuel-neutral goal, GHG reduction and net benefits goals, and annual and lifetime resource-specific goals.

Utility Regulation

Pathway two: Regulatory proceedings

- Influence utility business reform where rulemakings, rate cases, and utility planning take place
  - convene an investigation into emerging issue areas (such as electrification, resiliency, cost-effectiveness, etc.)

Where have we seen this?

- Rhode Island
  - Power Sector Transformation Initiative
    - Investigation into beneficial electrification, utility business model, distribution system planning, and grid connectivity
    - Phase One Report to Governor Gina M. Raimondo - November 2017

Transition from Gas Proceedings

New York

- Case 20-G-0131-Proceeding on Motion of the Commission in Regard to Gas Planning Procedures
  - Transparency in planning processes
  - Best support customer needs and emissions objectives while minimizing infrastructure investments
  - Ensuring the continuation of reliable, safe, and adequate service to existing customers.

Massachusetts

- Docket 20-80 - Attorney General petition to Dept. of Public Utilities
  - Impact on the continuing business operations of local gas distribution companies as the Commonwealth achieves its target 2050 climate goals.

Highlights of Regional Policy/Program - Buildings

VERMONT
- Incentives for ASHPs and HPWHs through Efficiency VT and utilities
- **GMP leasing ASHPs and HPWHs for RES** compliance

NEW HAMPSHIRE
- Developed first-in-nation **RPS carveout for renewable thermal**

MAINE
- State wide goal of 100k heat pumps by 2025

NEW YORK
- New York REV
- NYSERDA developing rebate program for GSHP; targeting heat pump cost reductions
- NYSERDA Clean Energy Investment Plan

MASSACHUSETTS
- Integrated renewable thermal energy into Alternative Portfolio Standard
- ASHP, GSHP, and HPWH rebates via state and utility programs
- HeatSmart Communities
- Strategic electrification and DR included in efficiency programs with expanded cost-benefit test.

CONNECTICUT
- Heat pump rebates available through Energize CT
- Use RGGI funding to incentivize oil/propane to electric

RHODE ISLAND
- Exploring **workforce development programs** to drive heat pump uptake (e.g. engaging delivered fuel dealers)

Electrification Challenges

- Amortization Rates
  - Gas distribution assets with expected lifetime of pipes at 30, 60, 80 years
    - Far longer than the decarbonization timeline
- Cold Climate
  - Technology available- ground source and cold climate air source heat pumps
  - Need customer buy-in
    - Increased incentives
    - Identify funding resources for oil/propane to electric
    - Marketing and targeted outreach
    - Natural depreciation of current assets

Encouraging Electrification

Sector	Examples
Ratepayer Funded Programs	• Include all fuel services in EE programs (fuel-neutrality) • Incorporate new metrics, such as emissions efficiency • Ensure programs serve low-income households at least as much as other households
Performance-based Rate Design	• Use time-of-use pricing to fairly compensate energy resources and allocate costs, and accelerate energy transition to local DERs • Consider revenue decoupling, multiyear rate plans, performance incentive mechanisms, and shared savings mechanisms to drive higher savings levels
Improved Asset Utilization	• Establish screening criteria for non-wires solutions and non-pipeline solutions • Procure alternative resources with increased targeted incentives, such as energy efficiency, demand response, and behind-the meter battery storage
Grid Modernization	• Invest in modernization of the distribution network to enable two-way communication and two-way flows of energy. • Deploy advanced metering infrastructure
Benefit-Cost Analysis	• Incorporate an enhanced and corrected cost benefit analysis approach using the NSPM that provides a consistent framework for cost-effectiveness

Role of Cost-Effectiveness

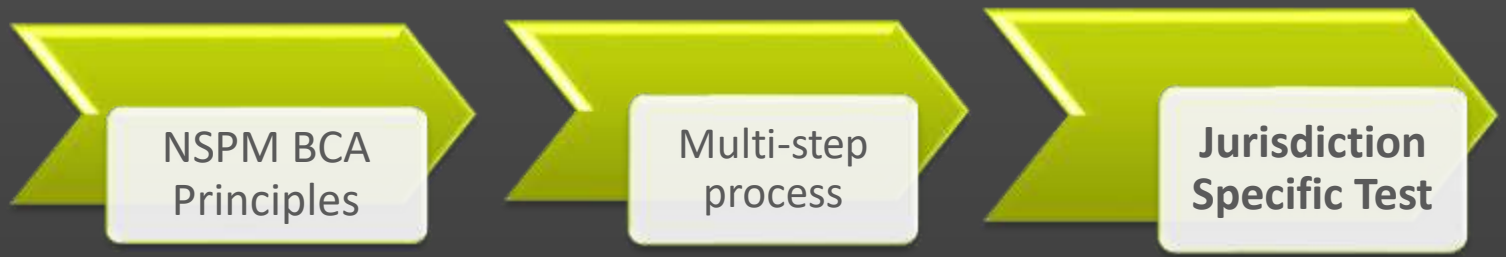
National Standard Practice Manual (NSPM) for DERs

States need to align cost-effectiveness with state policy goals

The NSPM for DERs Purpose:

1. Define policy-neutral principles for cost-effectiveness tests
2. Provides a framework to develop a primary test
3. Insight on key inputs based on state goals

The NSPM for DERs incorporates and expands upon the 2017 NSPM for EE



Source: NSPM for DERS

Building Performance Standard (BPS)

- Builds on benchmarking
- Mandates a level of efficiency/ carbon reduction
- Require buildings to meet certain performance levels with clear compliance pathways
  - Electrification can be a part of the pathway
- The metric should align with policy goals
  - Energy use
  - Carbon emissions
- Phase buildings in by size or use type

Where are we seeing BPS?

NYC: Climate Mobilization Act (LL 97)– emissions limits on 50,000 largest buildings

MA: Boston and Cambridge identify BPS in Climate Action Plan

D.C.: Clean Energy DC Omnibus Act: Building Energy Performance Standards for existing buildings

Thank you!

Samantha Caputo
Senior Policy and Research Associate
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Fuel Substitution in California

Jessica Allison, Energy Division

September 9, 2020

Agenda

1) Fuel Substitution in California
2) Policy Background Driving Decision
3) Fuel Substitution Decision Timeline
4) Review CPUC Fuel Substitution Policies
    1) Elements of Fuel Sub Test
    2) Applicable Measures
    3) Passing the Test
    4) Development of Intensity Factors
    5) Challenges from Decision / Implementation Process
5) Current Fuel Substitution Activities
    1) Measures
    2) Program Design
    3) Cost Effectiveness

Fuel Substitution in California

- Activities which replace an end use utilizing one regulated fuel with a similar end use utilizing a different regulated fuel.
- Incentivized through ratepayer funding alongside traditional energy efficiency measures.
- The CPUC regulates natural gas and electricity.
- Activities substituting wood / propane for electricity / natural gas are not included.

Policy Background

- Approximately 25% of GHG emissions come from buildings.
- AB 3232 required assessment of reducing carbon from buildings to 40% below 1990 levels.
- 90% of water heaters in CA utilize natural gas.
- The energy efficiency budget in 2019 was about $800,000,000

Decision and Background

1992—Three-Prong Test established in D.92-02-075

2017—NRDC, Sierra Club and CEDMC filed for review

2018—Judge issued ruling seeking comments

Aug. 2019—New test established in D.19-08-009

Oct. 2019—CPUC issued technical guidance on test

CPUC Fuel Substitution Policies

Elements of the Fuel Sub Test

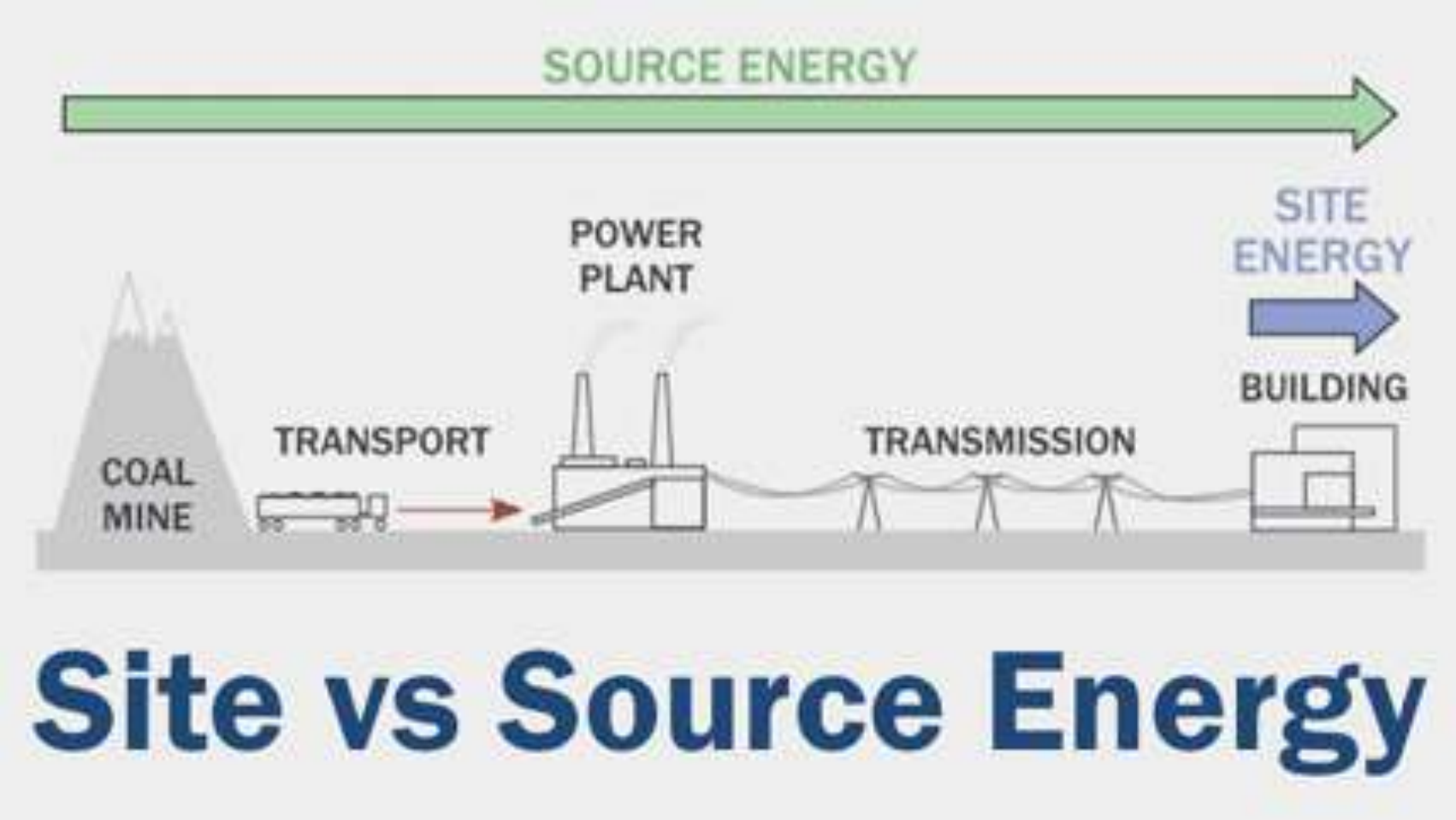
- The Fuel Substitution Test has two parts:
  1) The measure must not increase source BTU
  2) The measure must not increase GHG Emissions

- Applied at a measure level

- No measure level cost effectiveness screen

- Deigned to be fuel neutral

Site vs. Source Energy



Graphic Credit: ArchToolBox.com

Passing the Test

The lifecycle source energy of the measure must be lower than the lifecycle source energy of the baseline technology.

1) Convert site energy savings to source energy savings using intensity factors for year 1.
2) Repeat for all years in the measure EUL and sum.
3) If the source BTU savings values are positive, the measure passes.

Source Energy Calculation

$$Life-cycle\ source\ energy\ savings_{NR}\ [BTU] = \sum_{i=start\ year}^{EUL+start\ year-1} \left(\Delta\ kWh\ \ X\ source\ energy_i\ [\frac{BTU}{kWh}]\right) + \left(\Delta\ Therms\ X\ source\ energy\ \left[\frac{BTU}{Therm}\right]\ X\ EUL\ \right)$$

$\Delta\ kWh$ = Baseline kWh/year – Measure kWh/year in the 1st year. Negative value for increase and positive value for decrease in electricity usage from fuel substitution measure

$source\ energy_i\ \left[\frac{BTU}{kWh}\right]$ = Yearly source energy values for electricity

$\Delta\ Therms$ = Baseline Therm/year – Measure Therm/year in the 1st year. Negative value for increase and positive value for decrease in natural gas usage from fuel substitution measure

$source\ energy\ \left[\frac{BTU}{Therm}\right]$ = Source energy value for natural gas in Table 2

Emissions Intensity Factors for Electricity

Year	Emissions Intensity (metric tonnes CO2/Mwh)	Source Energy Heat Rate (BTU/kWh)
2019	0.195	3,675
2020	0.188	3,543
2021	0.181	3,411
2022	0.174	3,279
2023	0.181	3,406
2024	0.187	3,532

Challenges from Decision / Implementation

- Consensus on applicable measures
- Balancing policy goals with cost effectiveness
- Fitting fuel substitution into existing goal-setting

Current Fuel Substitution Activities

Fuel Substitution Measures

Fuel Substitution measures are approved through technical documents describing specifications.

Approved

- Heat pump clothes dryers
- Ductless Residential HVAC
- Heat pumps for space heating
- Unitary heat pumps for space heating
- Heat pump water heaters
- Residential cooking
- Commercial fryers

Cost Effectiveness of Select Measures

Measure	Climate Zone	Benefit / Cost Ratio
HP Water Heater, 45 – 54 gal	8	1.63
HP Water Heater, 54 – 74 gal	8	0.48
HP Water Heater, >75 gal	8	0.63
HP Water Heater, 45 – 54 gal	10	1.54
HP Water Heater, 54 – 74 gal	10	0.47
HP Water Heater, >75 gal	10	0.60
HP Water Heater, 45 – 54 gal	13	1.47
HP Water Heater, 54 – 74 gal	13	0.37
HP Water Heater, >75 gal	13	0.49

According to estimations, other cost-effective measures include heat pump HVACs replacing both a gas heater and an electric air conditioning unit.

Findings Related to Cost Effectiveness

- Cost effectiveness varies greatly by climate zone
- Equipment specifications (baselines, ratings, water heater sizing) greatly impact cost effectiveness results.
- Focus on upstream / midstream delivery
- Options for combining incentives

Questions?

For more information, please review the following sources:

- Decision 19-08-009
- Fuel Substitution Technical Guidance Document v.1
- Fuel Substitution Calculator v.1

Next Steps

Respond to the poll questions.

Find slides, recordings, and information about the project at:

www.michaelsenergy.com/electrification-action-plan/

Technical Advisory Committee (TAC)

- Approximately 20-25 members, representing a variety of stakeholders
- Focus on understanding technical issues related to electrification of buildings around subject areas of
  - Technologies
  - Grid Impacts
  - Metrics
- Share findings with broader stakeholder group, illuminating decision points and clarifying the impacts of those choices

Technical Advisory Committee

For each topic (Technologies, Grid Impacts, and Metrics), the TAC will answer these four questions:

1. What should stakeholders understand?
2. What needs more research and/or clarity?
3. What are the policy implications?
4. Does the TAC have any recommendations?

Thank You!

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