

Case Studies on Lowering the Net Carbon Content in our Gas Supply

Northeast Gas Association

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May 6, 2020

nationalgrid



Agenda

➤ **Context**

- Our Decarbonization Pathway
- Toolkit of options to decarbonize heat

➤ **RNG**

- Staten Island Landfill & Newtown Creek Wastewater Treatment Facility

➤ **Hydrogen**

- Hydrogen Blending Study & P2G Demonstration Proposals

➤ **Geothermal Heat Pumps**

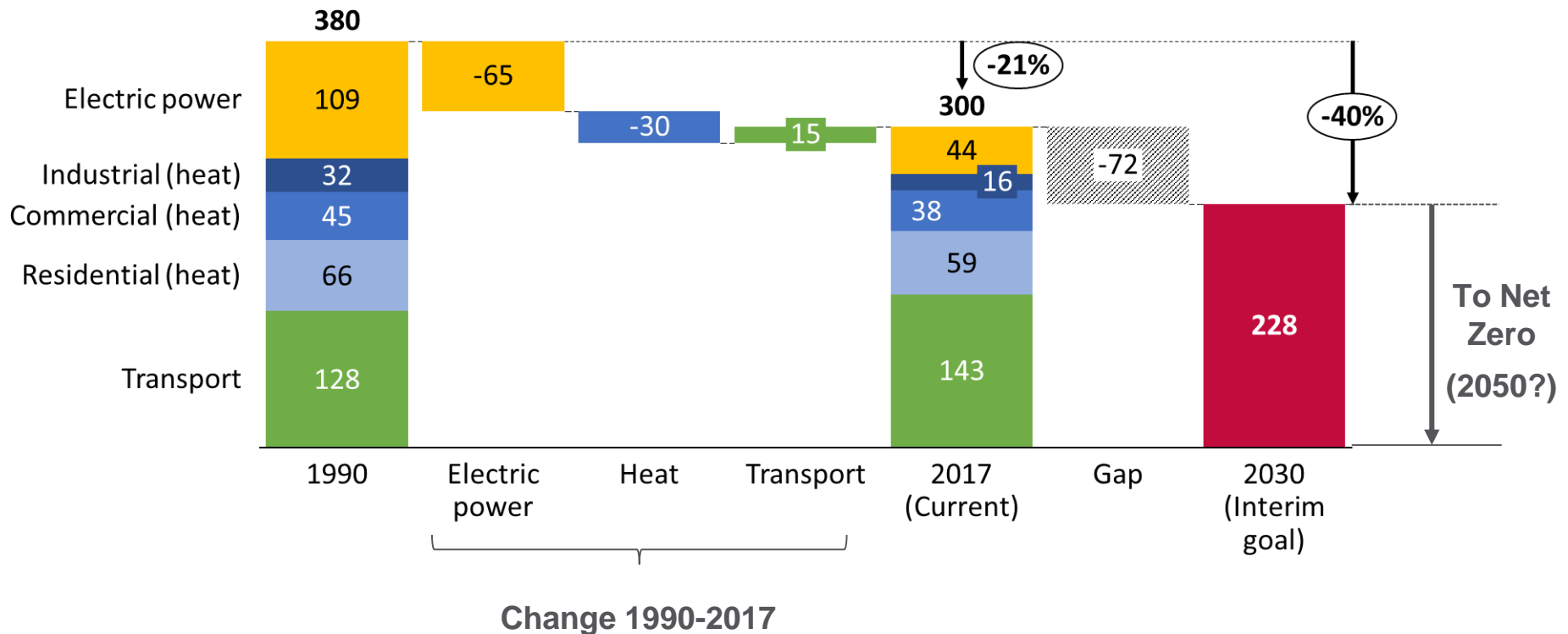
- Riverhead Long Island Pilot Project

➤ **Our Vision & Next Steps**

Context

Northeast U.S. has reduced energy-related emissions by 21%; further reductions from heat & transport required to reach net zero

US Northeast energy-related CO₂ emissions¹ and change by sector (million metric tons CO₂)



National Grid

¹ Includes only emissions from fossil fuel combustion in the energy sector, which account for ~85% of economy-wide emissions, i.e. excludes agriculture, land use. Sources: US DOE Energy Information Administration.

National Grid's Northeast Decarbonization Pathway

Elements of the National Grid Northeast Decarbonization Pathway

	40% x 2030	80% x 2050
Power	<ul style="list-style-type: none"> 67% zero-carbon electricity supply, supported by a large increase in renewables (vs. 45% in 2017) 	<ul style="list-style-type: none"> 100% zero-carbon electricity supply, utilizing: <ul style="list-style-type: none"> Large-scale renewables Zero-carbon “firm” capacity, e.g. hydro, nuclear, gas with carbon capture and storage and interconnections (Quebec) Inter-seasonal energy storage
Transport	<ul style="list-style-type: none"> >10 million light-duty (passenger) electric vehicles on roads (vs. <75k in 2017) 	<ul style="list-style-type: none"> >20 million light-duty (passenger) vehicles (100% of the fleet) Low-carbon technology use in medium and heavy duty vehicles (electric or natural gas) Efficiency improvement in aviation, shipping
Heat	<ul style="list-style-type: none"> 2x rate of energy efficiency retrofits 3x rate of oil-to-gas heating conversions 10x scale up of oil-to-electric heating conversions Lay the foundation to scale RNG and hydrogen 	<ul style="list-style-type: none"> Deepen energy efficiency investment, especially in home insulation Decarbonize natural gas supply for heating, e.g. RNG, hydrogen blending Use hybrid natural gas / electric heating

A toolkit to address heat sector emissions is developing



Energy Efficiency

Gas Decarbonization



Biomass

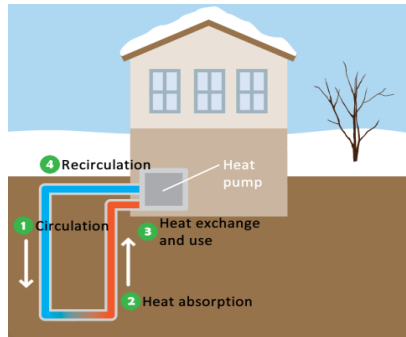


Hydrogen

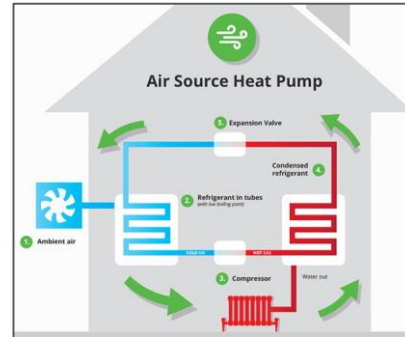


Power-to-Gas Methane

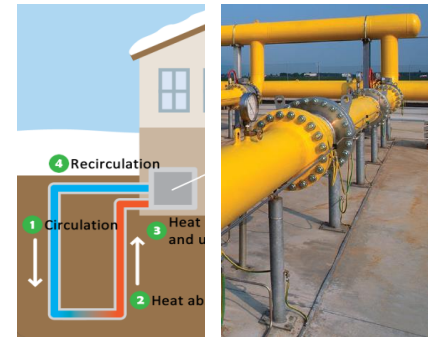
Heat Pumps (with renewable power)



Geothermal Heat Pumps



Air Source Heat Pumps



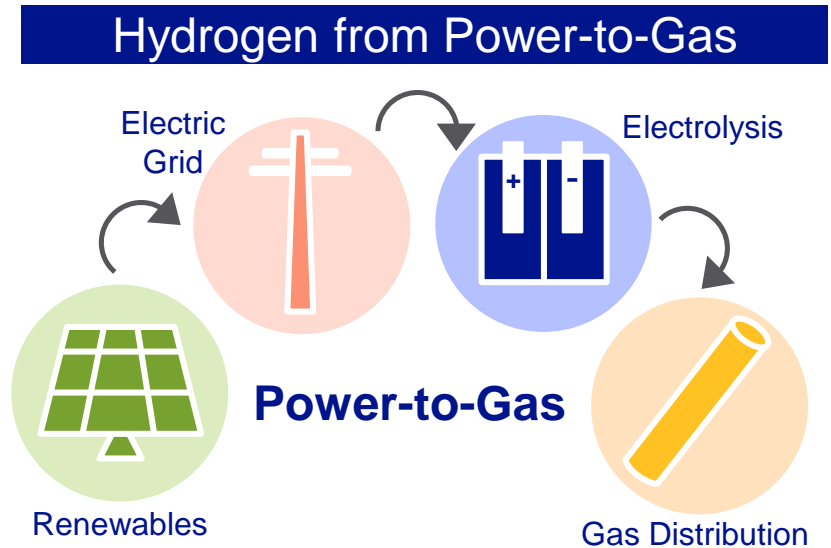
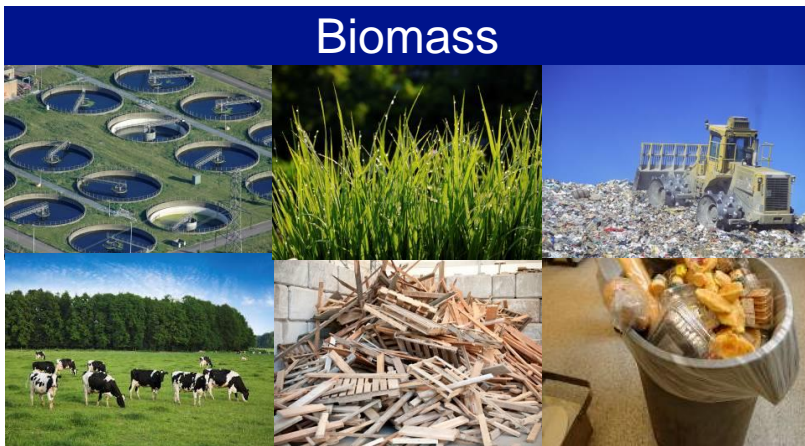
Hybrid Heat Pumps

What is Renewable Natural Gas (RNG)?

RNG is...

- Pipeline-compatible gas derived from biomass or other renewable sources that has lower lifecycle CO₂e emissions than geologic natural gas

RNG includes...



RNG deployment for heat faces three significant hurdles

1. POLICY & REGULATORY SUPPORT

Regulators can work on valuing RNG used for heating

2. INTERCONNECTION

Utilities and regulators can collaborate on guidelines

3. EDUCATION

Utilities, regulators & developers can work together to raise awareness

Overview of National Grid's RNG Journey

2010 RNG WHITEPAPER

Outlined the value of RNG as an alternative energy source. Analyzed the potential for RNG in NY, MA, RI & NH. Paper also provides a vision for a sustainable gas network and a roadmap on how to get there



2010

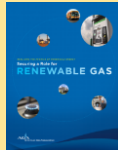
NEWTOWN CREEK DEMONSTRATION PROJECT (2010-2020)

Partnership with NYC-DEP to convert New York City's wastewater into a source of clean energy



2011 AGA/AGF NATIONWIDE RNG REPORT

Partnership with AGA & AGF to analyze the national potential for RNG



2019 AGF NATIONAL RNG STUDY

Participated in a national study led by AGF, Conducted by ICF



2020

2019 RNG INTERCONNECTION GUIDELINE

Collaborative effort with NGA to develop a revolutionary interconnection guideline. The purpose of this effort is to develop a guideline addressing gas quality standards and streamline the process of connecting RNG projects to the gas distribution network

2019 NY: KEDNY/LI RATE CASE (In-flight)

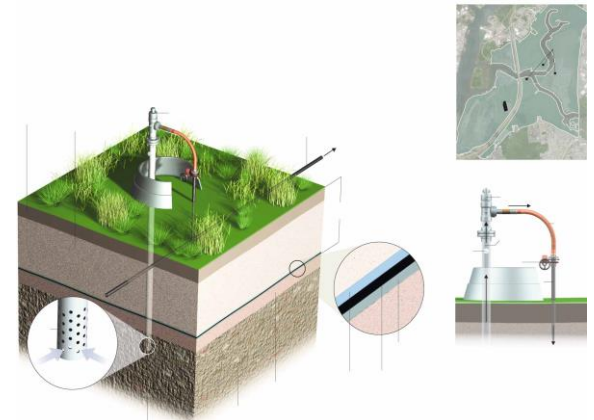
Focus on several "future of heat" items, including a green gas tariff for voluntary RNG procurement, FTEs for RNG interconnection, final approval for Newtown Creek operations, and local H2 assessment:

NY: NMPC RATE CASE (Upcoming)

MA: BOSTON & COLONIAL GAS RATE CASE (Upcoming)

Fresh Kills Staten Island Landfill

- Organic waste comprises 31 percent of New York City's residential waste stream, and New York is the birthplace of the RNG industry.
- The first landfill facility to capture and use biogas was built at New York's Fresh Kills landfill in 1980 and that facility still operates today, though the landfill has been closed and capped.
- It has now been operating for almost 40 years, providing 1.8 billion cubic feet (Bcf) of pipeline quality gas annually.
 - Heat approximately 4,000 homes.



Source: *New York Times*



Newtown Creek Demonstration Project

Partnership with NYC DEP to convert city's largest wastewater treatment plant into a source of clean energy

- Processes 250 million gallons/day of wastewater
- Operational 2020
- Inject enough RNG to heat 2,500 homes, reduce CO₂ emissions by ~16,000 metric tons
- Significant potential to increase RNG production if NYC food waste pilot project becomes permanent
 - Heat 5,200 homes; reduce emissions by 90,000 metric tons



Source: New York City Department of Environmental Protection

Suite of ‘Future of Heat’ proposals included in our 2019 Downstate New York (KEDNY/LI) rate case filing*

Goals	Proposed Programs/Products/Demonstrations
Offer customers clean heating solutions	Green Gas Tariff
	Geothermal Utility Ownership Demonstration
Encourage RNG development to decarbonize the gas network	RNG Interconnection Proposal
	Future of Heat Engineering Group
Drive gas decarbonization innovation	Power-to-Gas Demonstration Evaluation
	Hydrogen Blending Study
Develop incentives (EAMs) that align state decarbonization goals	System Efficiency, Carbon Reduction, Energy Efficiency

***Rate case still in process.**

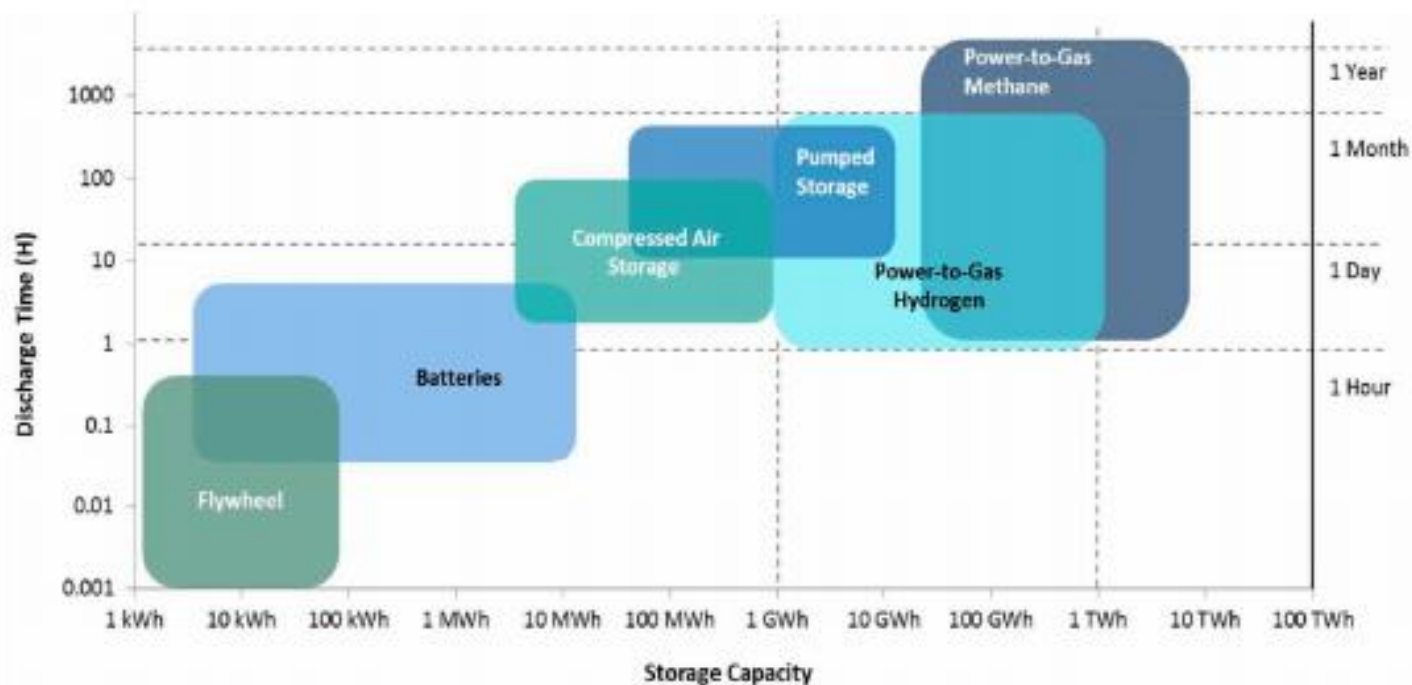
Hydrogen has the potential to transform the industry – Green hydrogen via power-to-gas can provide long-term seasonal energy storage

Benefits of Green H₂ / P2G

- Enables higher penetration of renewables like offshore wind by providing long-term, seasonal storage

Additional Benefits of Methanation

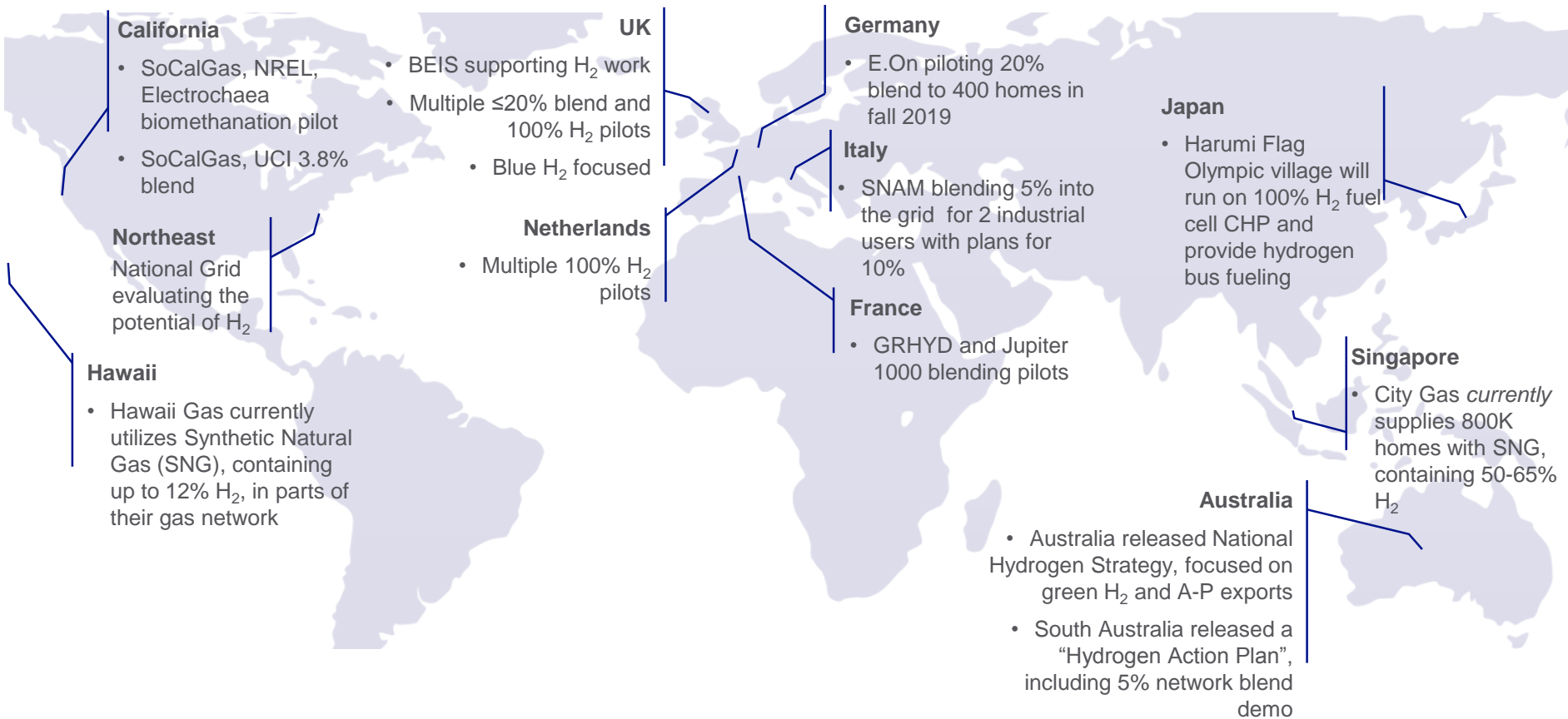
- Recycles CO₂
- Requires no modifications to standards, procedures, or equipment



Source: Moore and Shabani, *energies* 2016

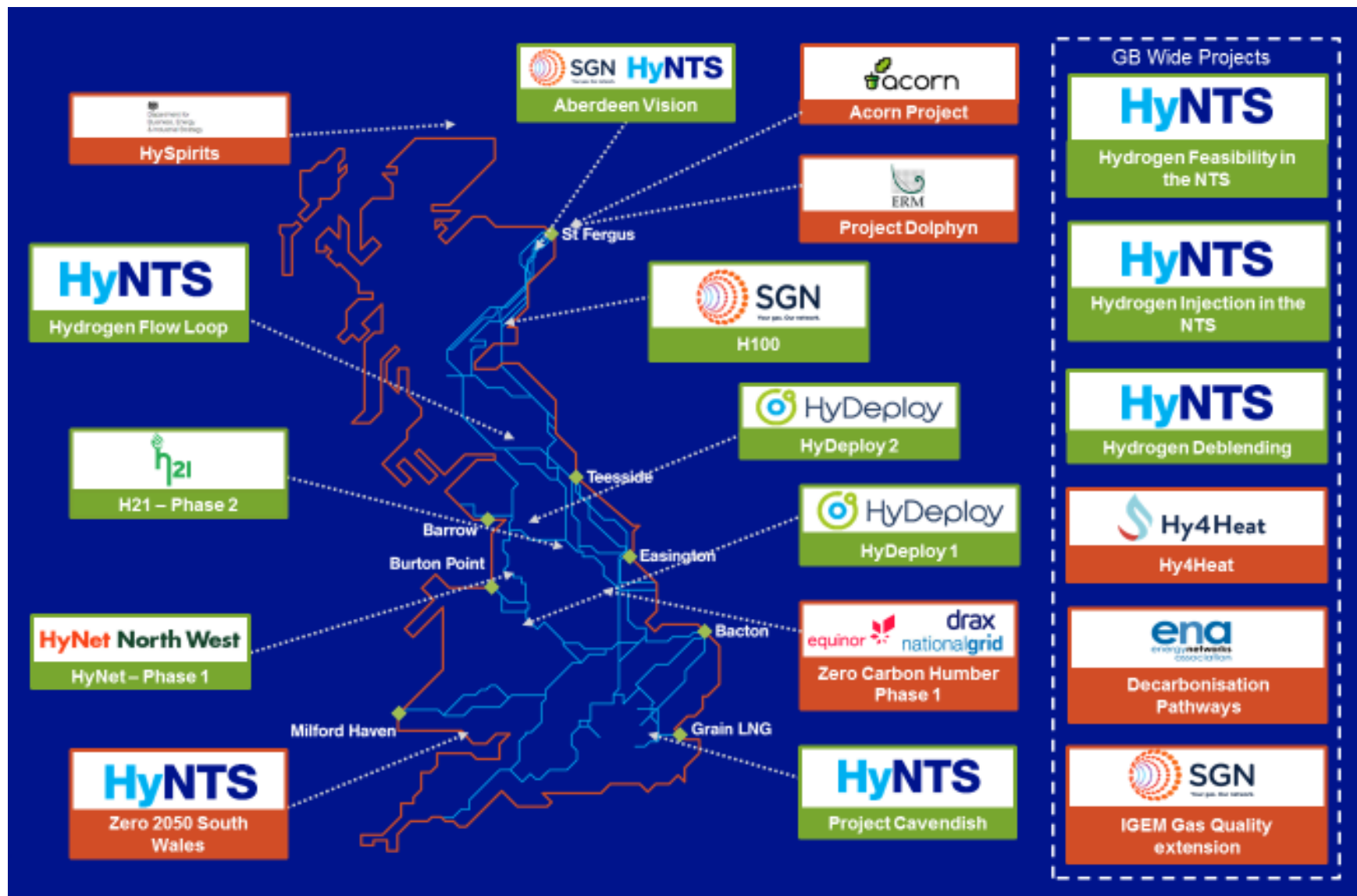
Hydrogen for heat investments are increasing; these case studies will provide insight into the characteristics of successful deployment

Hydrogen for Heat Snapshot, Across the Globe



Map image from Icon Library: <https://icon-library.net/icon/global-map-icon-11.html>

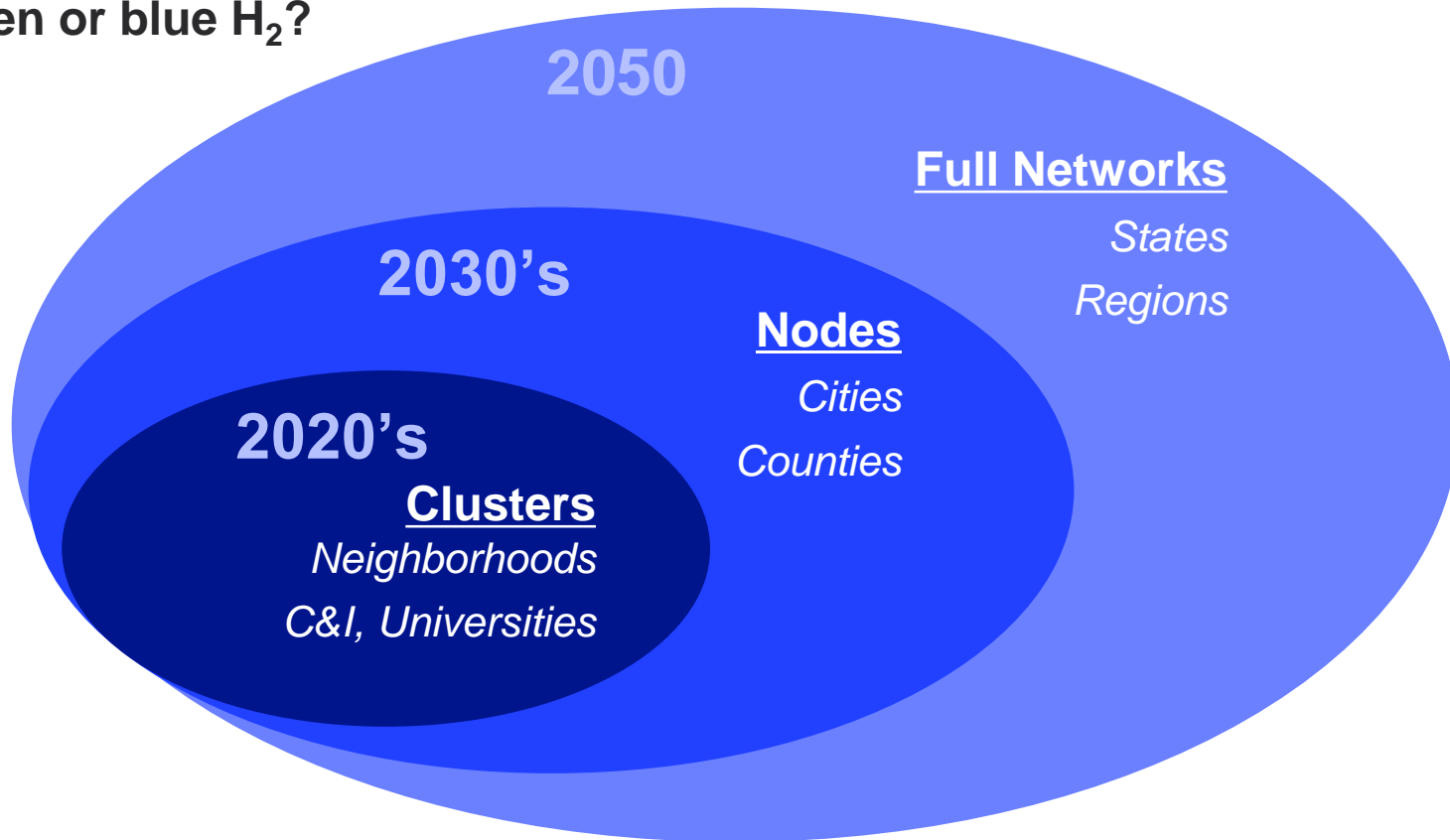
There's growing support in the UK for hydrogen to play a role in the decarbonization of heat



Our current thinking of integrating hydrogen in the future of heat

Staged Roll-out of Hydrogen into the Network, *Illustrative Example*

Green or blue H₂?



Blended H₂ & biomethane/RNG or 100% H₂?

Two hydrogen proposals were included in our recent Downstate NY rate case filing

1

Study: Partner with Stony Brook's Institute of Gas Innovation and Technology (IGIT), with potential NYSERDA support, to assess how much hydrogen can blend into the existing natural gas system

Goal

- Assess the impacts of hydrogen on **NY's natural gas infrastructure**
- Determine acceptable blend amounts
- Identify required alterations to accomplish safe and cost-effective inclusion of hydrogen in gas systems

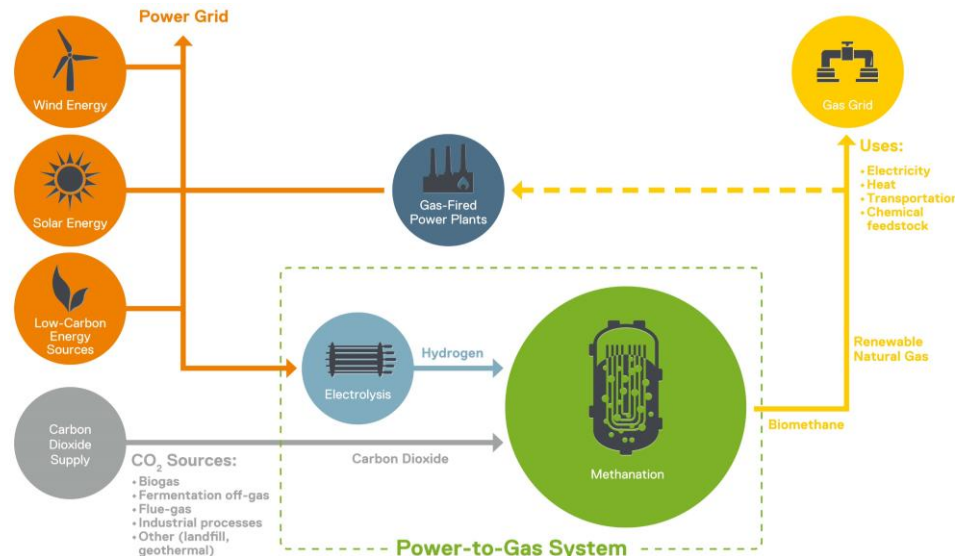
Scope of Study

- Task 1.** Technology & risk assessment
- Task 2.** Simulated gas pipeline test unit & safety protocols
- Task 3.** Test natural gas - H₂ mix
- Task 4.** Gas quality measurements
- Task 5.** Modeling dynamic mixed gas flow through pipelines

2

P2G: Develop a 2-step project to produce pipeline-quality RNG from excess electricity

1. Use electricity to split water into hydrogen oxygen
2. Convert to methane using a carbon dioxide waste stream and a biocatalyst



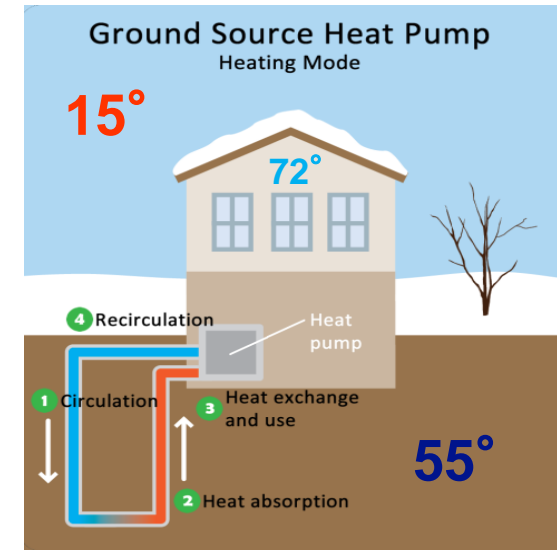
Geothermal heat pumps

Renewable, electric heating & cooling solution that uses the Earth as a thermal battery

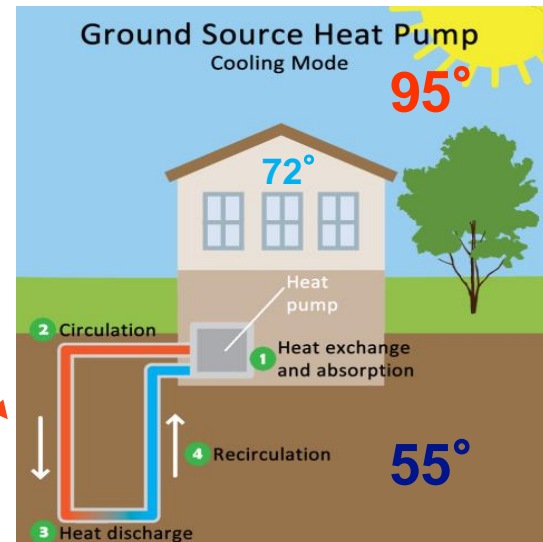
- Coefficient of Performance (COP) >3.0
- >\$3 of heating for each \$1 of electricity
- Not affected by outdoor air temp

Underground pipes are akin to utility gas assets

Winter

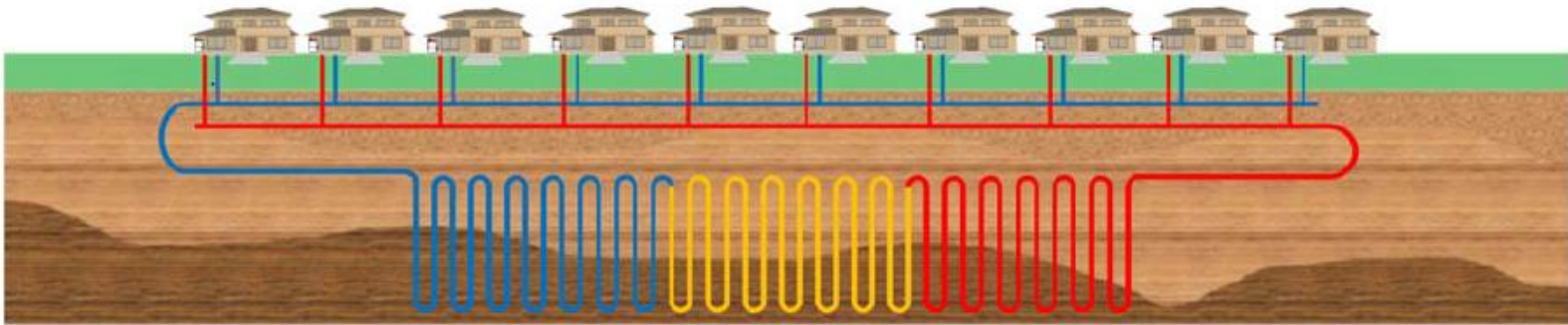


Summer



Geothermal efforts to-date

NY Riverhead Pilot Project (approved in 2016 KEDNY/KEDLI Rate Case)



- Purpose was to test the technologies performance and customer experience
- Connected 10 homes in a senior living community to a shared geothermal loop (community has no access to gas network)
- Provides both heating and cooling & has received positive feedback from participants
- Budget \$450,000 (OpEx)
- Operational since Dec 2017

2019 NY KEDNY/KEDLI Rate Case Proposal

- Requested \$12.1M for an expanded demonstration (900 homes worth)
- Purpose to develop a utility business model. Test whether utility ownership of ground loops can accelerate market adoption

Moving toward a robust Northeast heat decarbonization strategy

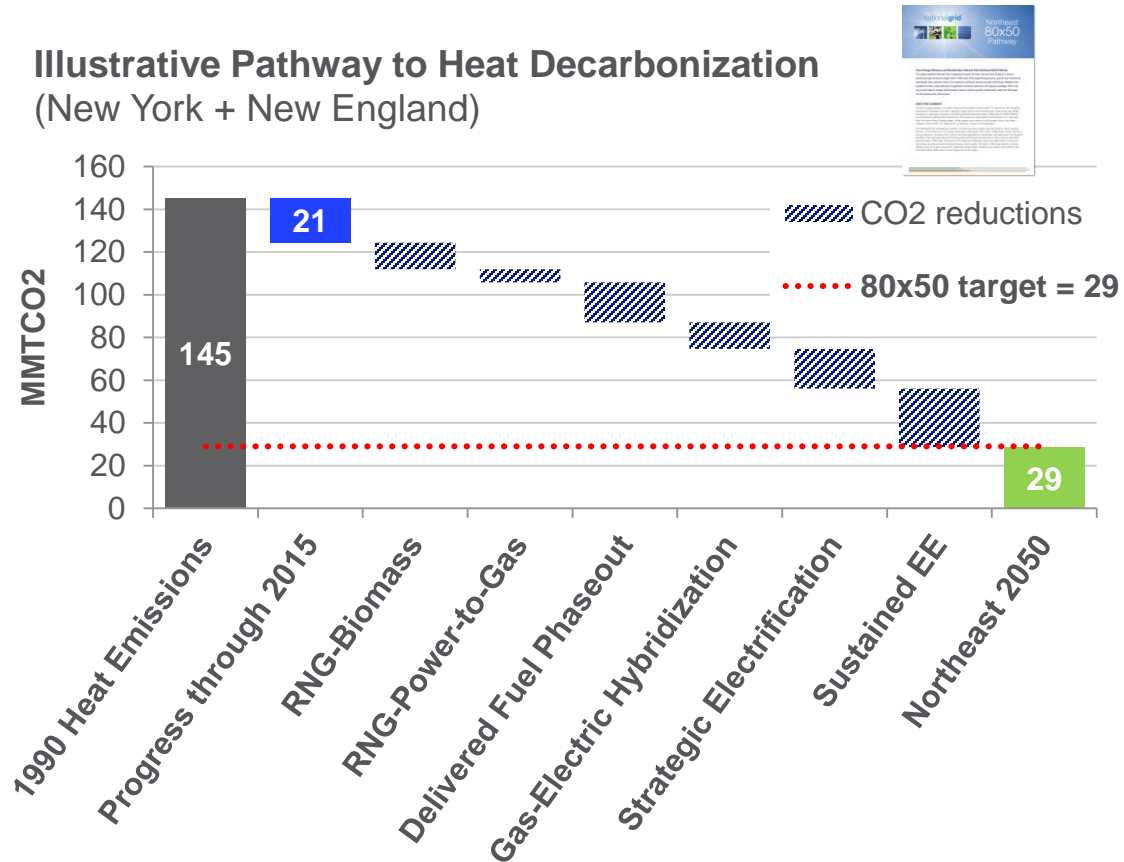
Heat pumps, hybrid homes, biomass, and hydrogen will all play a part.

Sustained building energy efficiency investment is foundational.



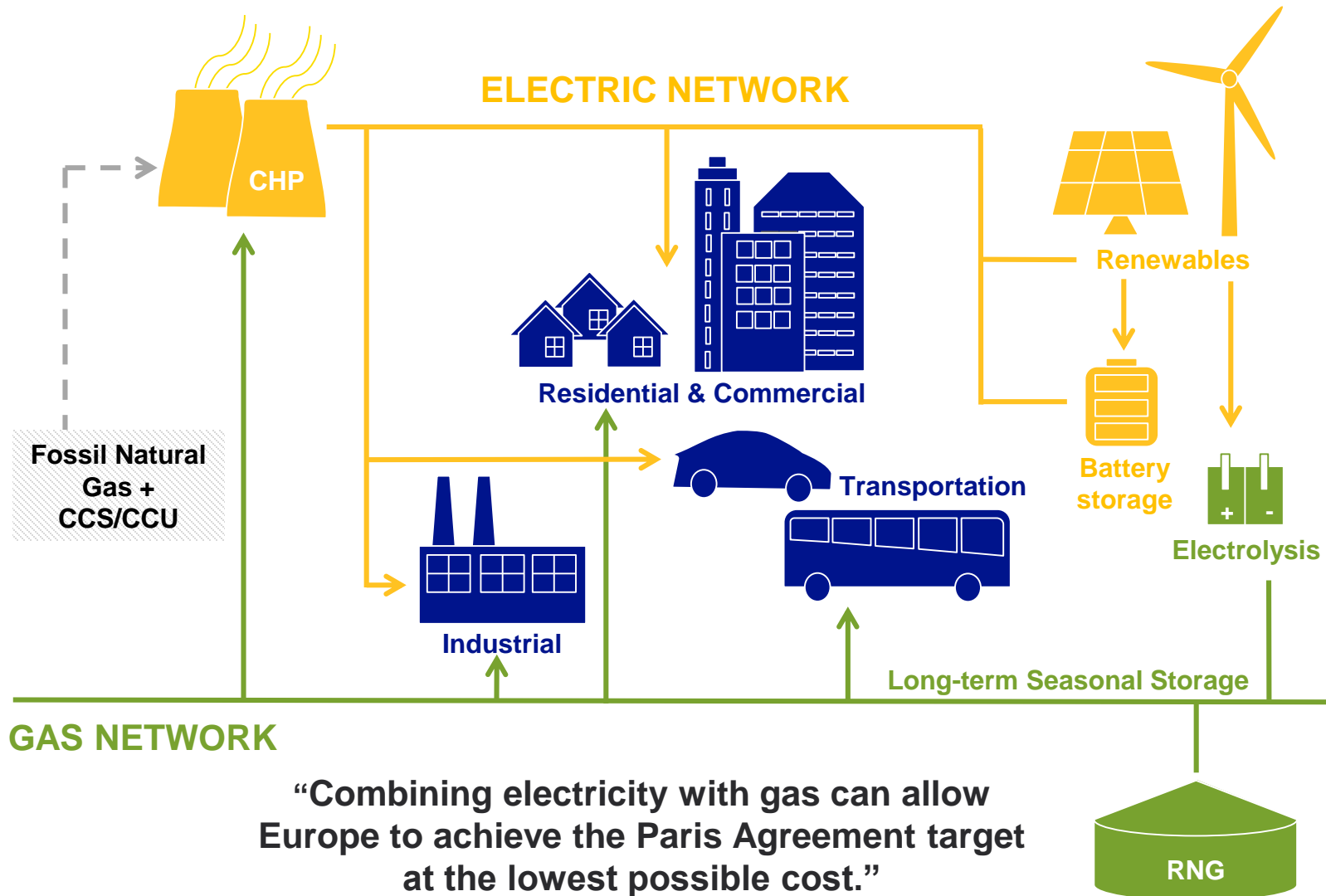
To minimize consumer impact, the Northeast decarbonization strategy seeks a balanced mix of strategic electrification, decarbonized gas, and energy efficiency

Illustrative Pathway to Heat Decarbonization
(New York + New England)



Our vision – a holistic energy system

A deeply decarbonized gas & electric system is integrated & complementary



“Combining electricity with gas can allow Europe to achieve the Paris Agreement target at the lowest possible cost.”
Ecofys 2018, “Gas for Climate”

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