Avangrid A member of the Iberdrola Group

Natural Gas Long-Term Plan Technical Session

Electrification and Heat Pump Adoption Assumptions

Case 23-G-0437

December 13, 2023

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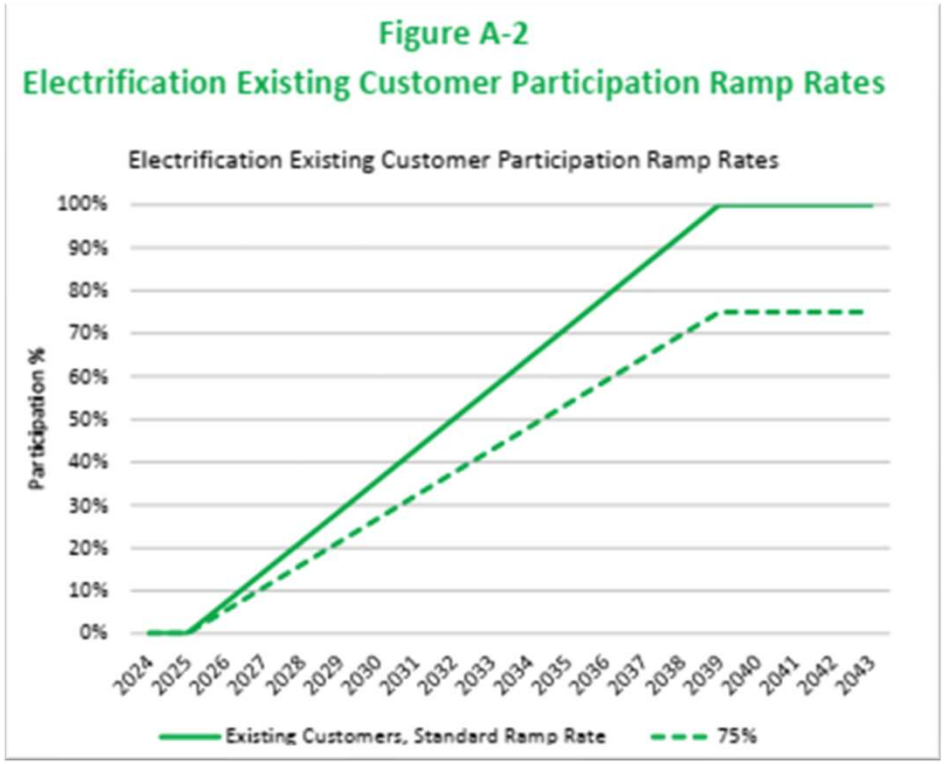
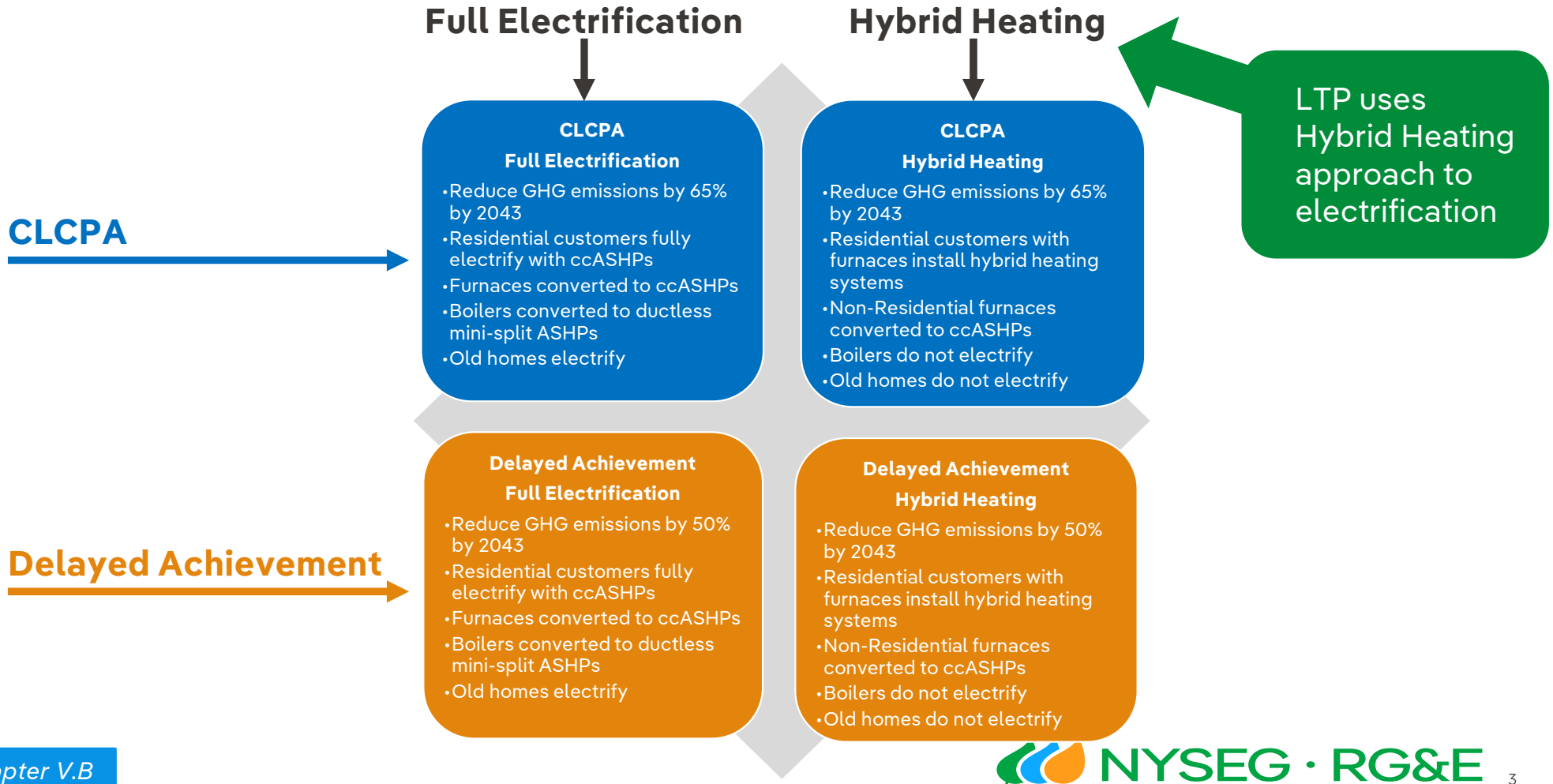
Electrification Adoption Assumes Ramp-up Over Time



- **Electrification of gas end uses (space heating, water heating, clothes drying, cooking) in existing buildings assumed to occur at end of life of equipment**
  - **Conversions of heating systems assumed to occur at end of life of central AC or end of life of heating system**
- **All new residential and commercial customers assumed to be fully electrified starting in 2026 in all scenarios and the LTP**

Appendix A, IV.B

Scenarios Illustrate Different Adoption Rates and Types of Electrification



Electrification Maximum Participation Rates Vary Across Scenarios

Electrification Scenario	CLCPA Scenario		Delayed Achievement		LTP
	Full Electrification	Hybrid Heating	Full Electrification	Hybrid Heating	
Residential					
NYSEG	60%	95%	40%	80%	75%
RG&E	90%	100%	65%	90%	75%
Commercial					
NYSEG	30%	90%	20%	30%	30%
RG&E	45%	100%	30%	35%	30%
Municipal					
NYSEG	60%	95%	40%	80%	50%
RG&E	90%	100%	65%	90%	50%
Industrial					
NYSEG	30%	90%	20%	30%	30%
RG&E	45%	100%	30%	35%	30%

Appendix A, V.C,VI.C,VII.C

Percentage of Residential Appliances Converted to Electric by 2043

Table A-20

NYSEG Percentage of Residential Appliances Converted to Electric by 2043

Electrification Scenario	CLCPA Scenario		Delayed Achievement		LTP
	Full	Hybrid	Full	Hybrid	
Gas Forced Air Furnace	50%	63%	40%	58%	56%
Gas Boiler	28%	0%	18%	0%	0%
Gas Water Heating w/ Tank	46%	71%	31%	60%	57%
Gas Tankless Water Heater	46%	71%	31%	60%	57%
Gas Clothes Dryer	46%	71%	31%	60%	57%
Gas Range	49%	73%	33%	63%	60%

RG&E Percentage of Residential Appliances Converted to Electric by 2043

Electrification Scenario	CLCPA Scenario		Delayed Achievement		LTP
	Full	Hybrid	Full	Hybrid	
Gas Forced Air Furnace	62%	82%	52%	78%	56%
Gas Boiler	41%	0%	30%	0%	0%
Gas Water Heating w/ Tank	67%	92%	50%	85%	57%
Gas Tankless Water Heater	67%	92%	50%	85%	57%
Gas Clothes Dryer	67%	92%	50%	85%	57%
Gas Range	70%	92%	52%	85%	60%

Note: NYSEG and RG&E Initial Gas LTP Appendix A, Table A-20 and Response to Data Request LTGP-23-129 (23-G-0437)

Appendix A, V.C

Percentage of Non-Residential Appliances Converted to Electric by 2043

Table A-26
NYSEG Percentage of Commercial Appliances Converted to Electric by 2043

Scenario	CLCPA Scenario		Delayed Achievement		LTP
	Full	Hybrid	Full	Hybrid	
Gas Forced Air Furnace	22%	54%	15%	22%	22%
Gas Boiler	21%	0%	14%	0%	0%

RG&E Percentage of Commercial Appliances Converted to Electric by 2043

Scenario	CLCPA Scenario		Delayed Achievement		LTP
	Full	Hybrid	Full	Hybrid	
Gas Forced Air Furnace	31%	85%	22%	38%	22%
Gas Boiler	32%	0%	21%	0%	0%

Note: Full electric conversions are assumed for all commercial gas equipment.

Table A-29
NYSEG Percentage of Municipal Heating Appliances Converted to Electric by 2043

Scenario	CLCPA Scenario		Delayed Achievement		LTP
	Full	Hybrid	Full	Hybrid	
Gas Forced Air Furnace	43%	67%	29%	57%	36%
Gas Boiler	43%	0%	29%	0%	0%

RG&E Percentage of Municipal Heating Appliances Converted to Electric by 2043

Scenario	CLCPA Scenario		Delayed Achievement		LTP
	Full	Hybrid	Full	Hybrid	
Gas Forced Air Furnace	64%	96%	46%	87%	36%
Gas Boiler	64%	0%	46%	0%	0%

NYSEG Percentage of Industrial Heating Appliances Converted to Electric by 2043

Scenario	CLCPA Scenario		Delayed Achievement		LTP
	Full	Hybrid	Full	Hybrid	
Gas Forced Air Furnace	7%	21%	5%	7%	7%
Gas Boiler	7%	0%	5%	0%	0%

RG&E Percentage of Industrial Heating Appliances Converted to Electric by 2043

Scenario	CLCPA Scenario		Delayed Achievement		LTP
	Full	Hybrid	Full	Hybrid	
Gas Forced Air Furnace	9%	26%	6%	9%	6%
Gas Boiler	9%	0%	6%	0%	0%

Appendix A, VI.C,VII.C

Economic Assessment: Full Electrification Scenarios are More Expensive than Hybrid Heating Scenarios for Same Emissions Reductions

The CLCPA-Full Electrification scenario is projected to cost $6.8 billion for NYSEG and $7.8 billion for RG&E, whereas the CLCPA-Hybrid Heating scenario is projected to cost $6.0 billion for NYSEG and $7.3 billion for RG&E.

- The Hybrid Heating scenarios also have a lower projected cost per unit of GHG emission reduction and a lower projected impact on electric peak winter demand.

NYSEG

	Cost per GHG Emission Reduction ($/MT CO2e)	2043 GHG Reduction (% vs. 1990)	Total Cost 2024-2043 (NPV $M)	2043 Electric Winter Peak Demand Impact (MW)
NYSEG				
CLCPA–Full Electrification	$ 704	-65%	$ 6,759	879
CLCPA–Hybrid Heating	$ 618	-65%	$ 6,032	434
Delayed–Full Electrification	$ 714	-50%	$ 4,781	662
Delayed–Hybrid Heating	$ 580	-50%	$ 3,919	313
Long-Term Plan	$ 475	-58%	$ 4,095	291

RG&E

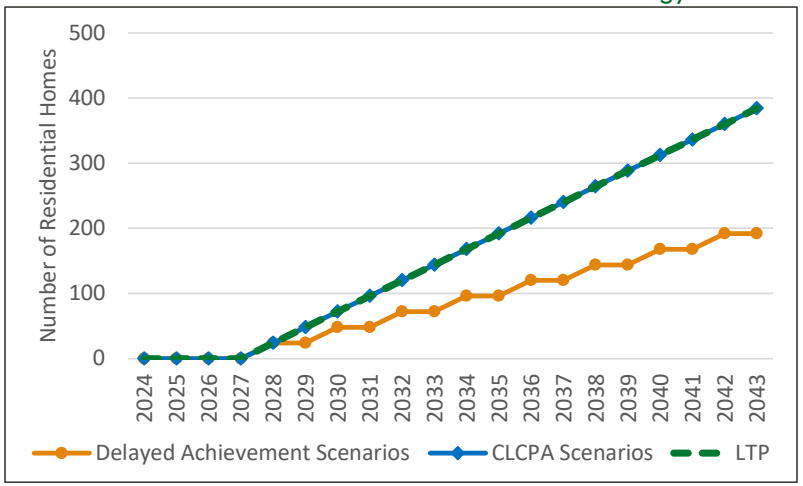
	Cost per GHG Emission Reduction ($/MT CO2e)	2043 GHG Reduction (% vs. 1990)	Total Cost 2024-2043 (NPV $M)	2043 Electric Winter Peak Demand Impact (MW)
RG&E				
CLCPA–Full Electrification	$ 775	-65%	$ 7,813	1,302
CLCPA–Hybrid Heating	$ 622	-65%	$ 7,288	568
Delayed–Full Electrification	$ 809	-50%	$ 5,781	1,041
Delayed–Hybrid Heating	$ 579	-50%	$ 4,828	406
Long-Term Plan	$ 475	-51%	$ 3,811	316

Chapter VI.B,C,D

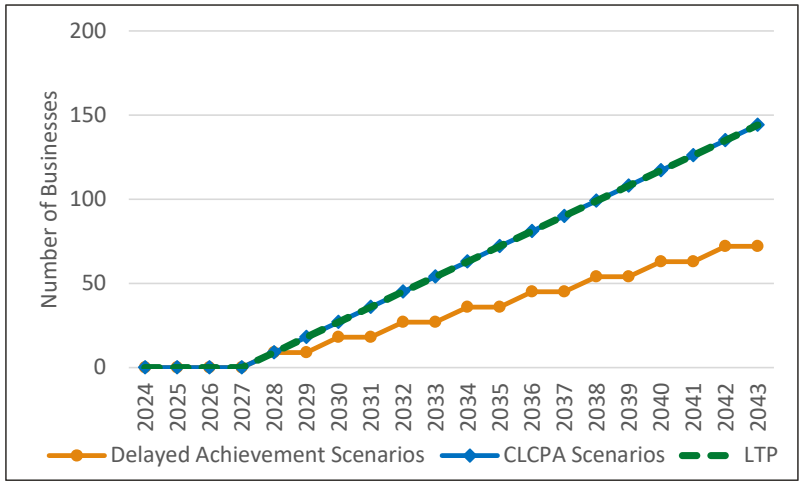
Geothermal Heat Pumps included in Thermal Energy Networks (TENS)

- Modeling of TENS based on hypothetical networked geothermal projects built in existing neighborhoods
- Each hypothetical project assumed to be comprised of 24 homes plus 9 businesses converted to geothermal heat pumps operating on a shared network
- The CLCPA Scenarios and the LTP assume that one hypothetical TENS project will be put into service per year starting in 2028
- The Delayed Achievement Scenarios assume that one hypothetical TENS project will be put in service every other year starting in 2028

Number of Residential Homes included in Thermal Energy Networks



Number of Businesses included in Thermal Energy Networks



Appendix A, X.B, X.C

Questions

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