Climate Lens of Combined Heat and Power

Combustion and Full cycle emissions analysis

TAF

Juan Sotes / January 20th 2021

ABOUT

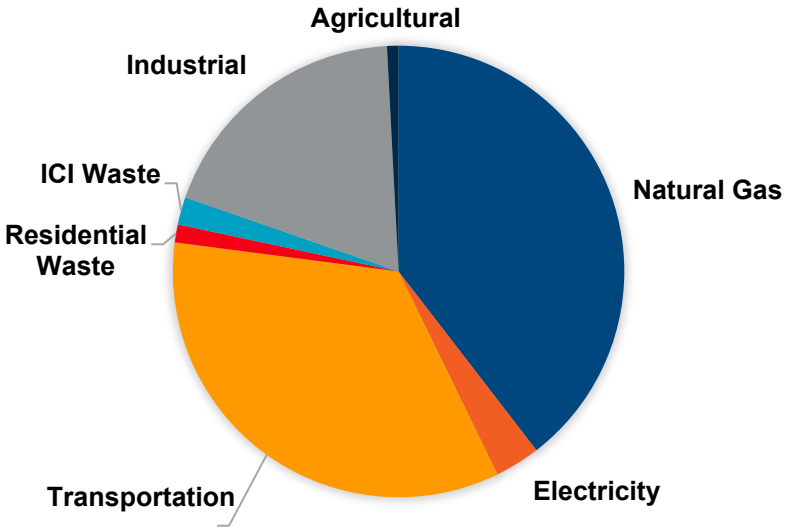
The Atmospheric Fund

As a regional climate agency, TAF invests in low-carbon solutions for the Greater Toronto and Hamilton Area and helps scale them up for broad implementation.

Presentation content

- Heating in buildings and climate change
- Ontario’s electricity grid analysis
- Ontario’s natural gas grid analysis
- Combined heat and power vs other technologies
- What is low carbon?
- Forecast
- Conclusion

GTHA Emissions 2018



More than 2/3 of total **natural gas consumption is used for space and water heating** our buildings, which account for **more than 25% of our total emissions**

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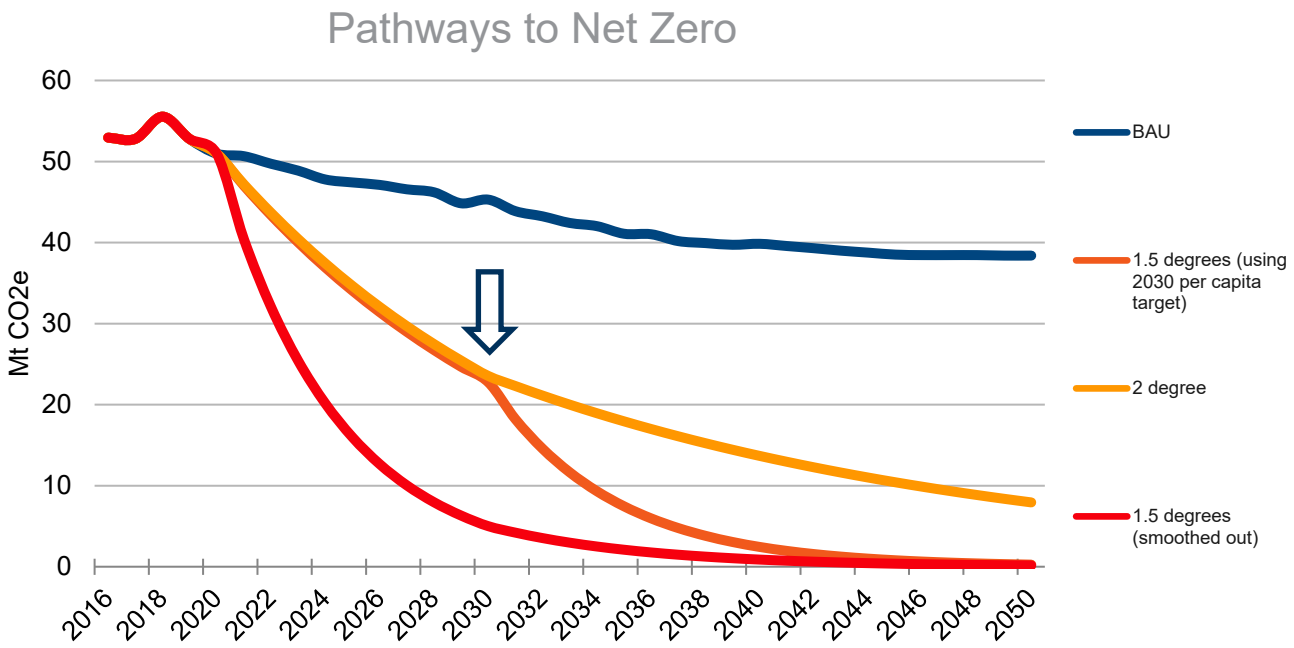
Net Zero 2050 goal



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Alternatives for heating

Two potential replacements have been labelled as low carbon solutions for heating:

- Combined Heat and Power (CHP)
- Heat Pumps

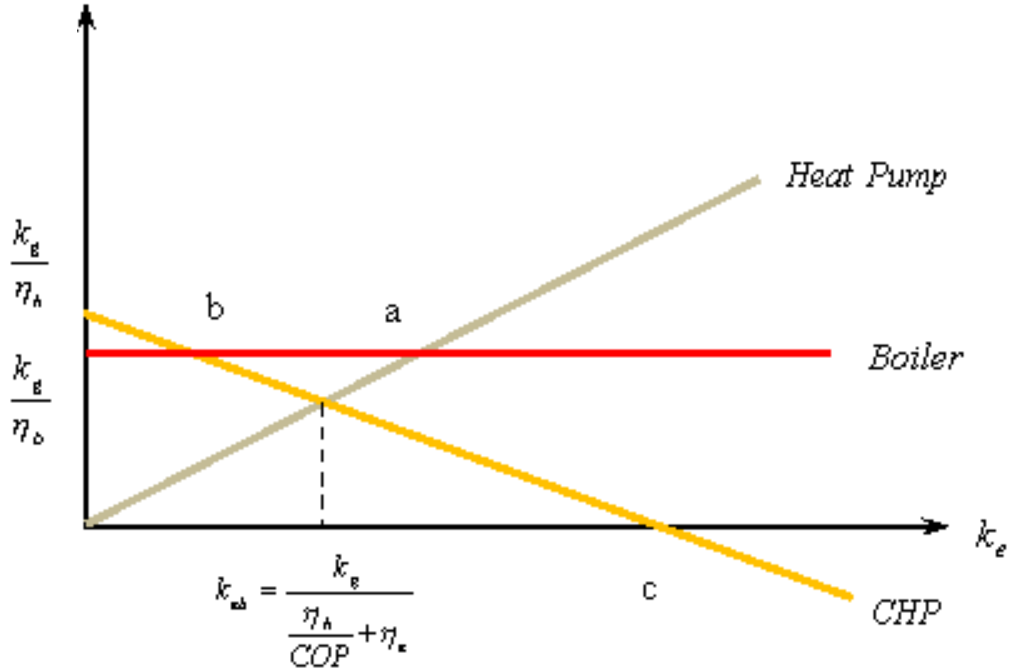
Alternatives for heating

- Combined Heat and Power (CHP): Consumes NG to produce heat and electricity. Emissions are directly related to the NG emissions factors (EF), with avoided emissions related to electricity's EF.

- Heat Pumps: Consumes electricity to provide heat. Emissions are directly related to electricity's EF

Alternatives for heating

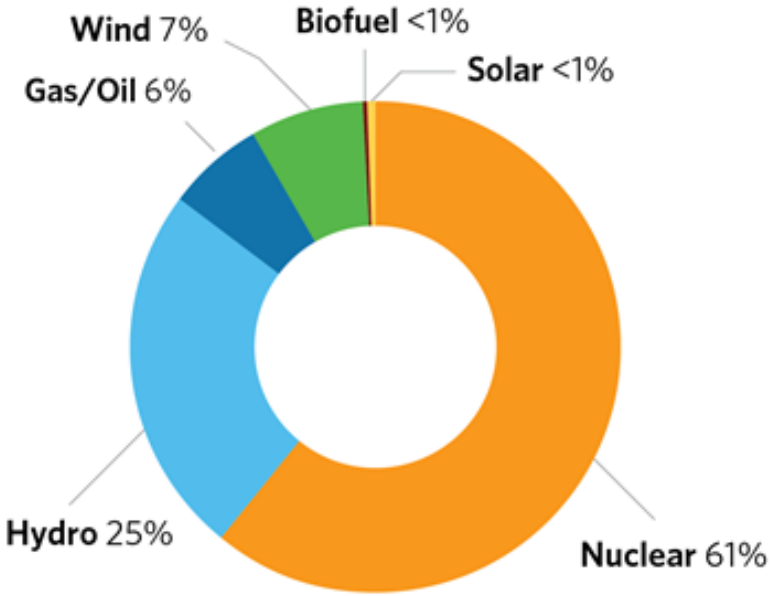
Technology Carbon intensity



Electricity grid EF

Ontario’s electricity grid

2019 Ontario’s electricity generation



Nuclear	90.4 TWh or 61%
Hydro	36.4 TWh or 25%
Gas/Oil	9.5 TWh or 6%
Wind	11.0 TWh or 7%
Biofuel	0.4 TWh or <1%
Solar	0.7 TWh or <1%

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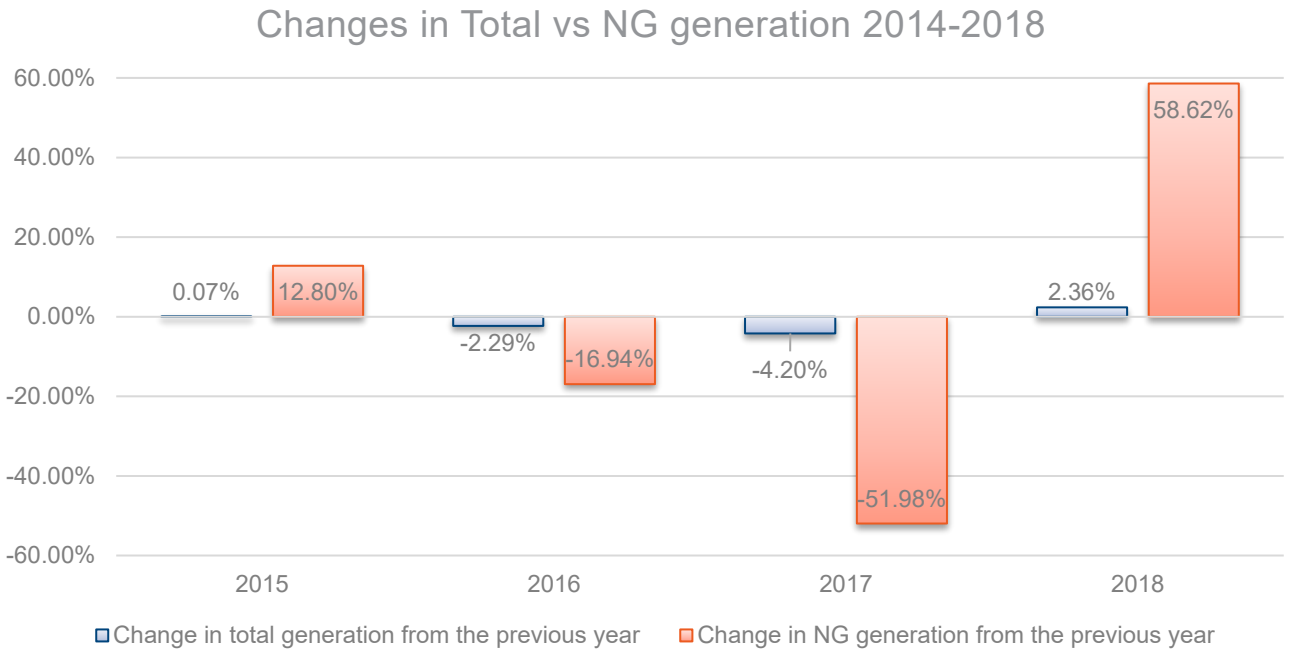
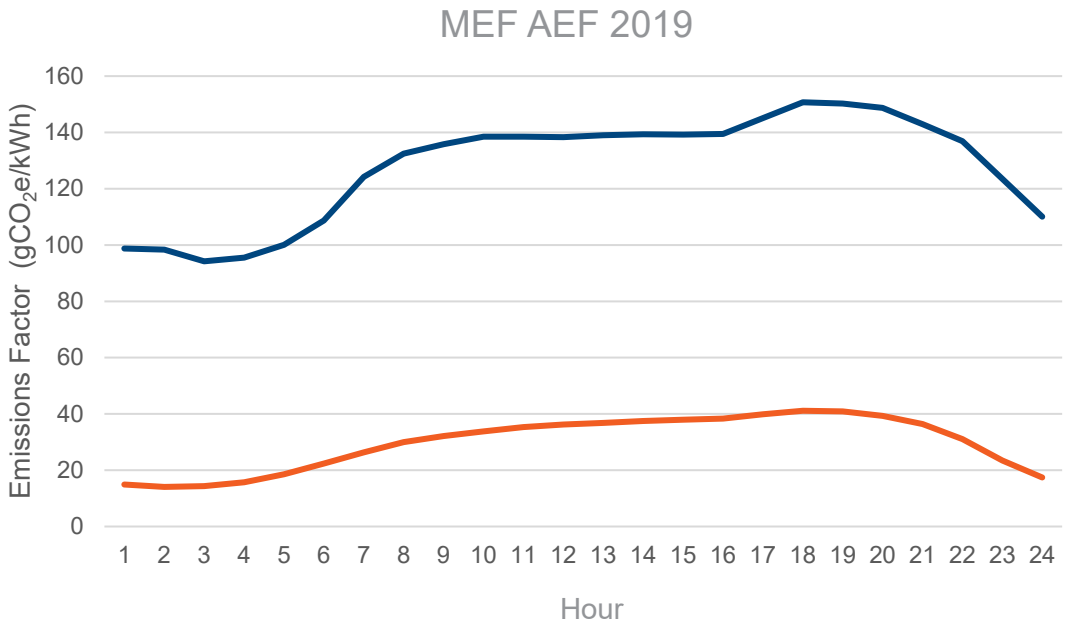
Ontario's electricity grid:

Natural gas generation as marginal resource



Ontario's electricity grid:

Natural gas generation as marginal resource



Marginal Emissions

Average Emissions

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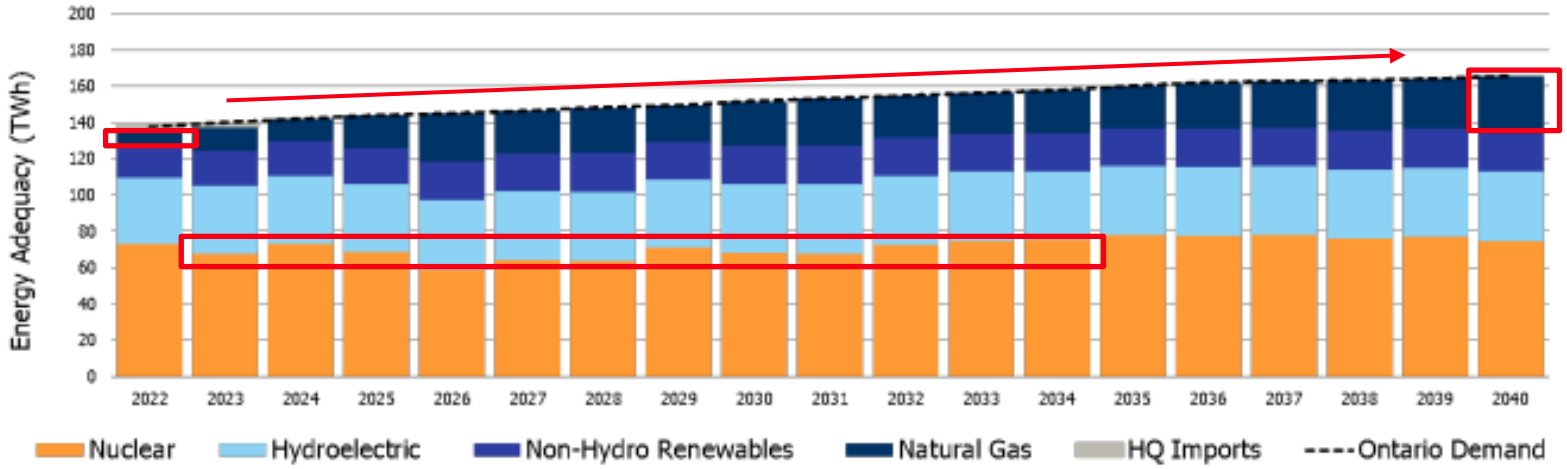
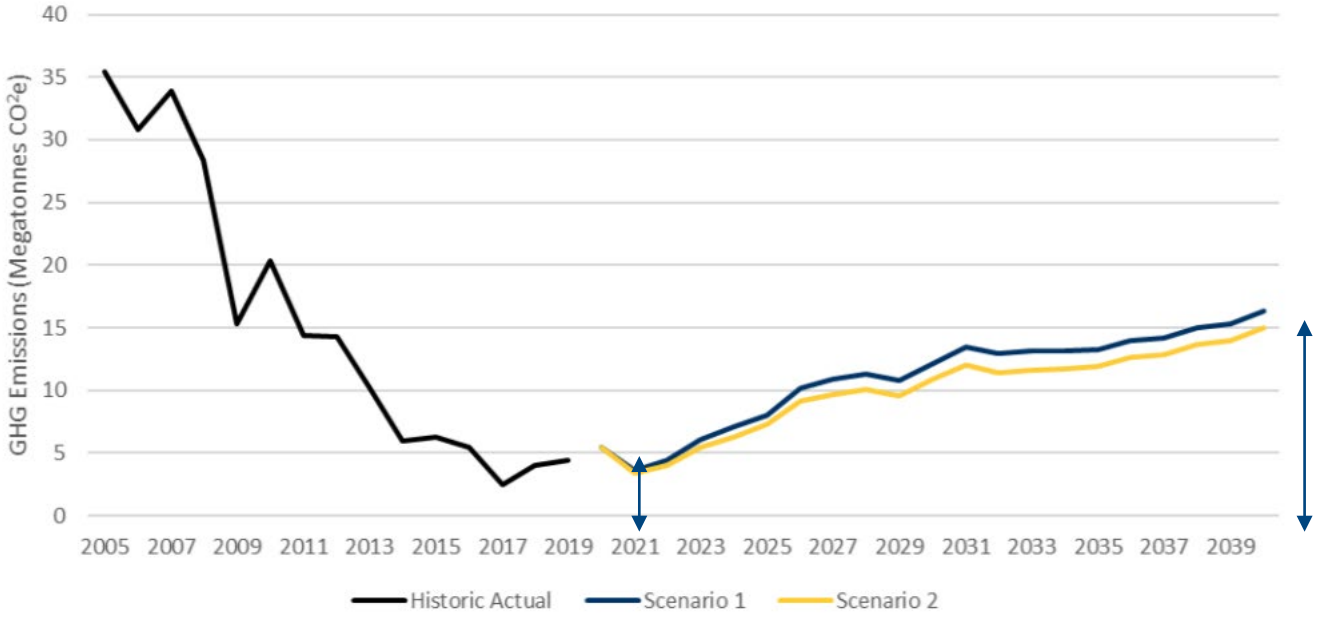
Ontario's electricity grid

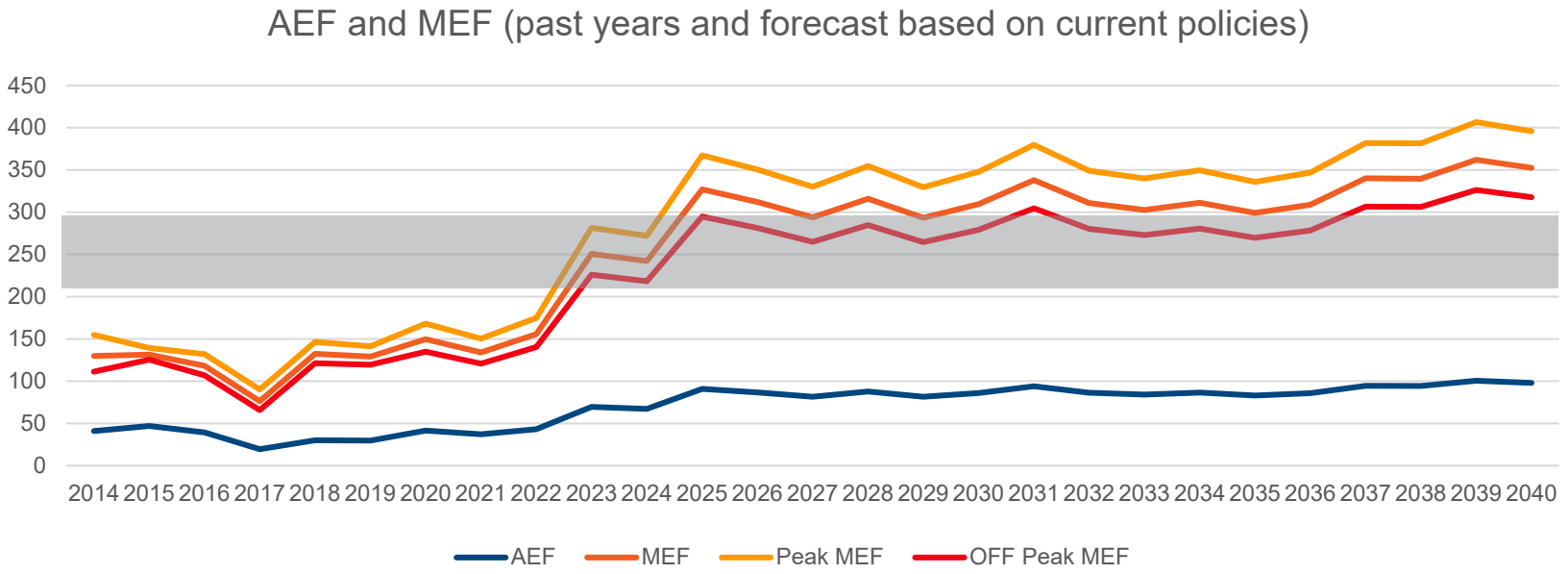
Figure 21 | Scenario 2 – Energy Adequacy Outlook, with Continued Availability of Existing Resources



Ontario's electricity grid:

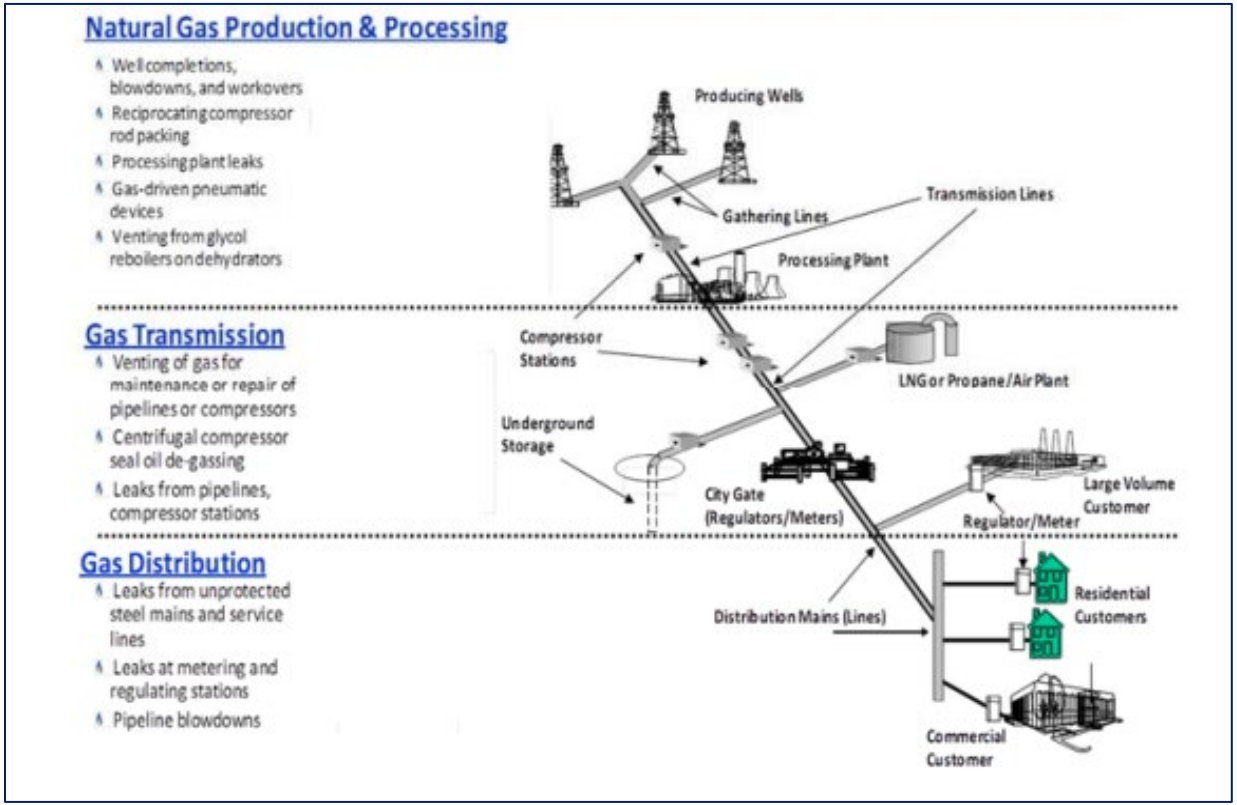
Ontario grid emissions forecast



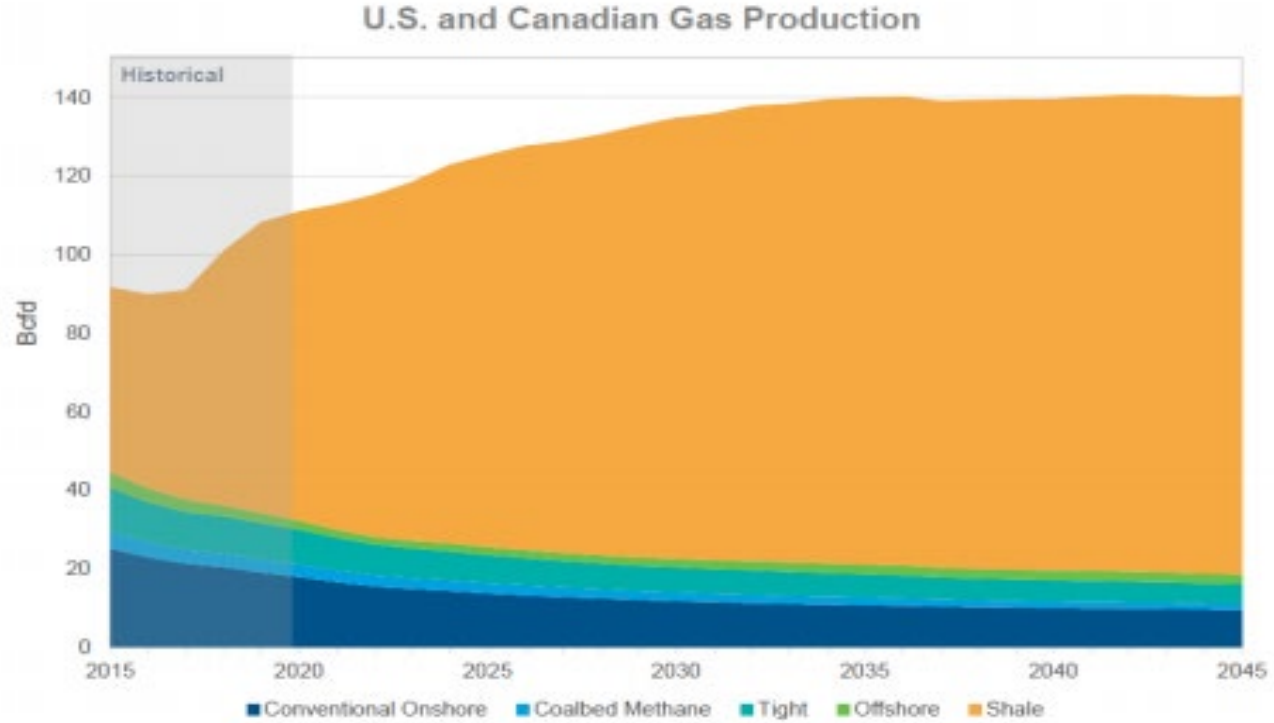


CHP vs Heat pumps equivalence area

Natural Gas Life Cycle Assessment (LCA) emissions



Natural Gas LCA emissions



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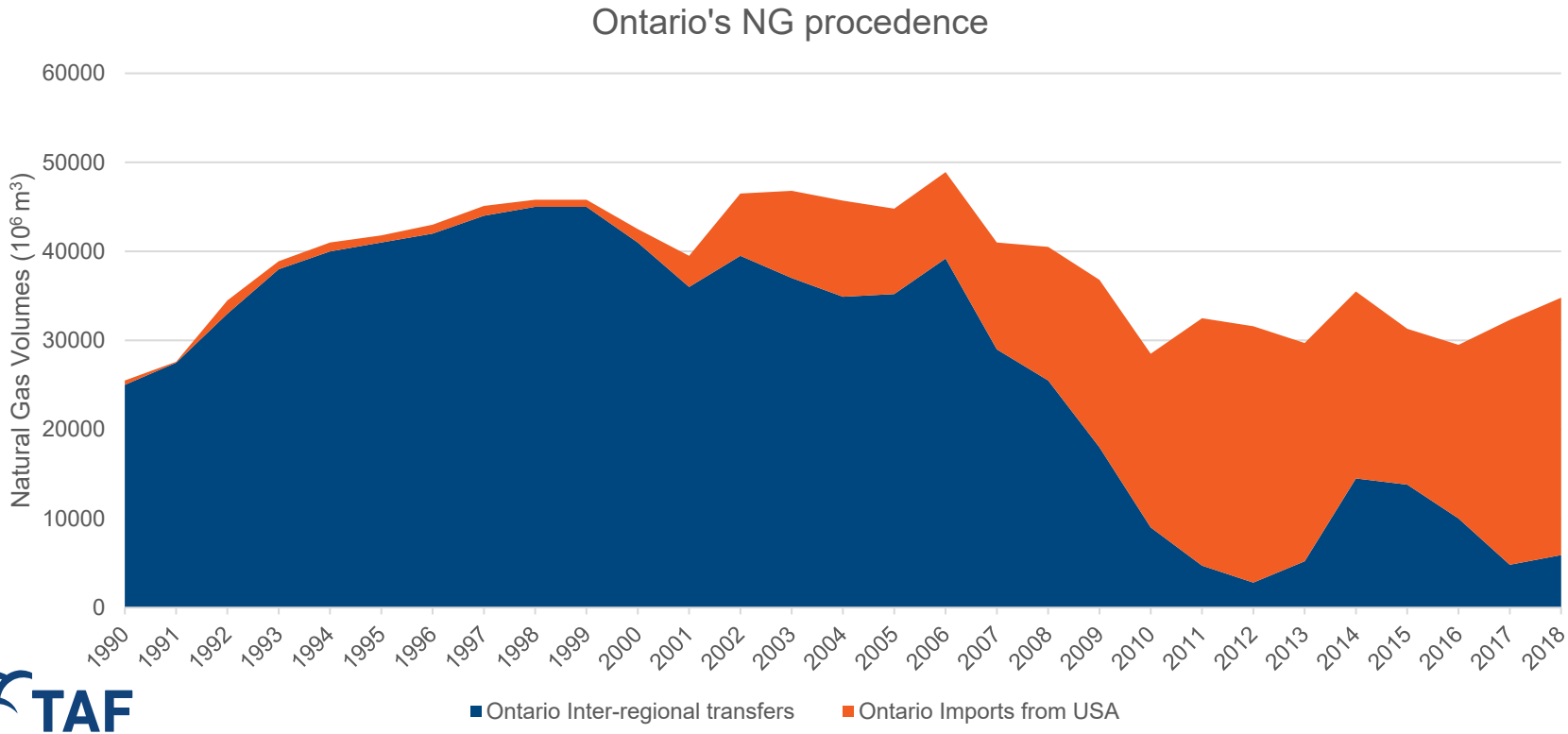
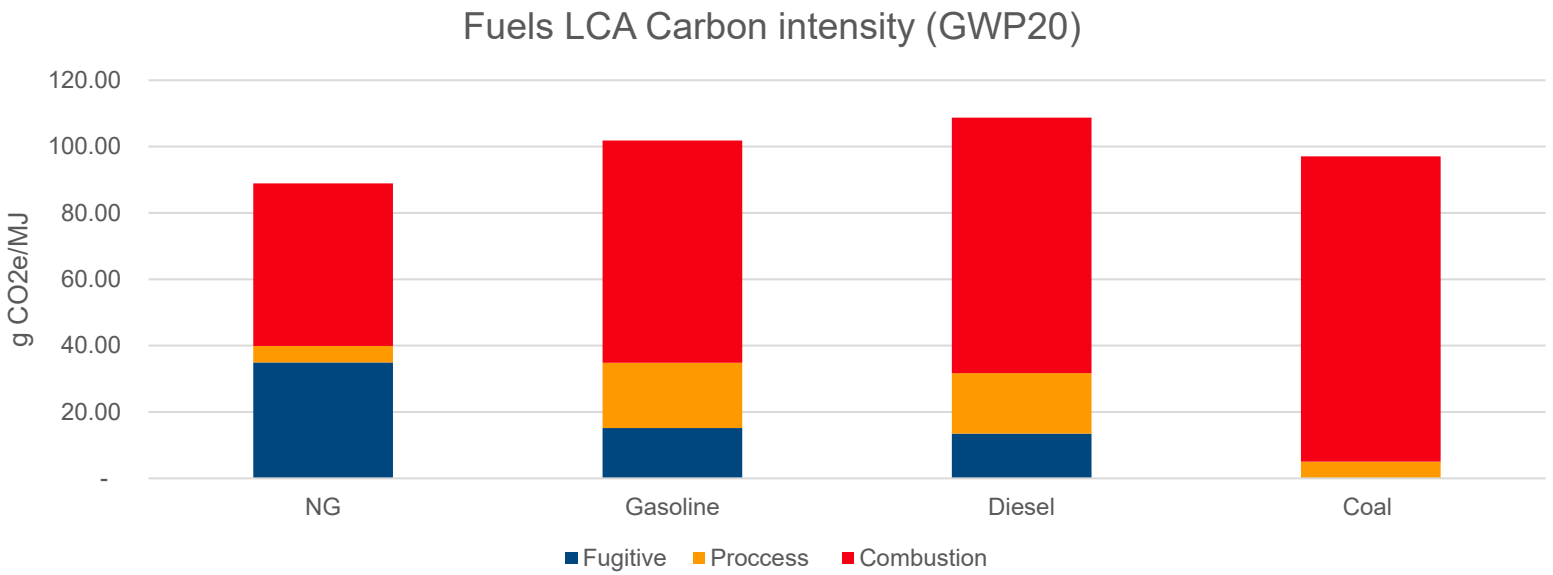
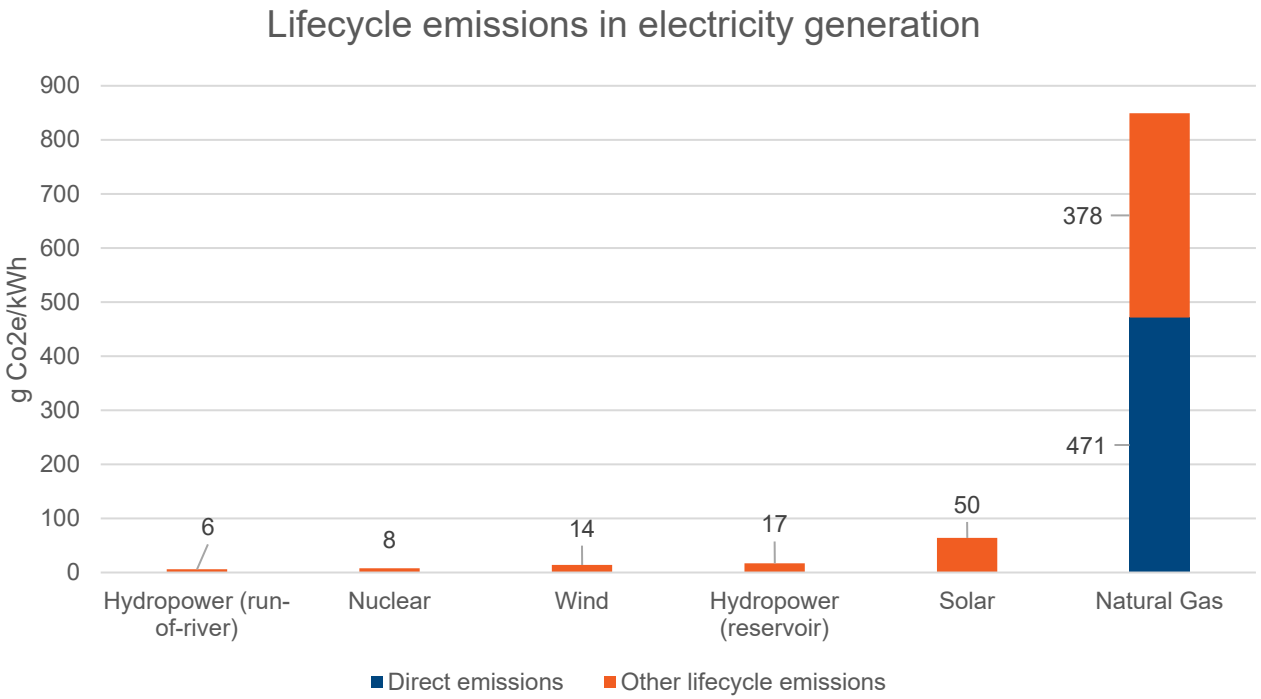
Natural Gas LCA emissions



Natural Gas LCA emissions



Natural Gas LCA emissions



Comparative example

Generation: 100 GJ of energy
Electricity EF: 2019 MEF (129 gr CO2eq/kWh)

CHP generation:
Electricity: 50%
Heat: 30%
Energy wasted: 20%
Emissions: 5.1 TCO2e

Boilers and electricity generation:
Boiler efficiency: 70%
Emissions: 4 TCO2e

Heat pumps generation:
COP: 2
Emissions: 2.6 TCO2e

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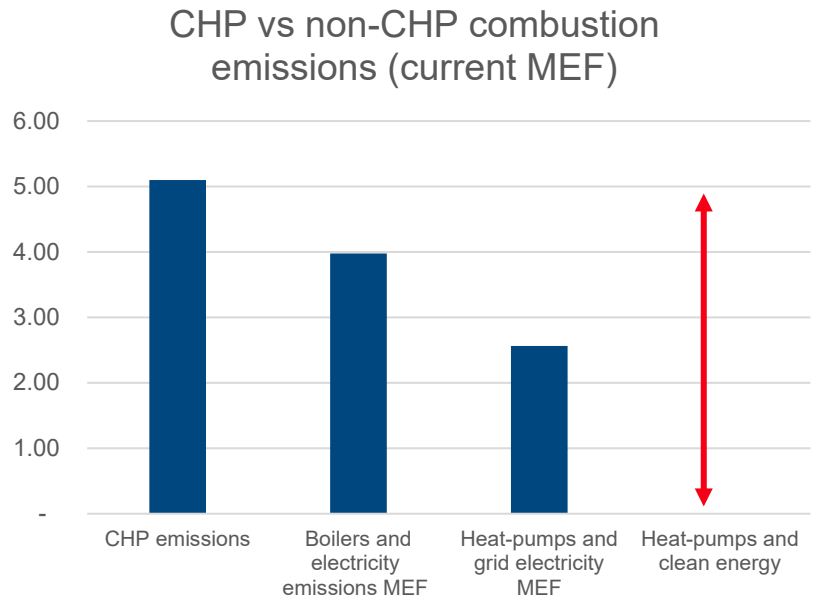
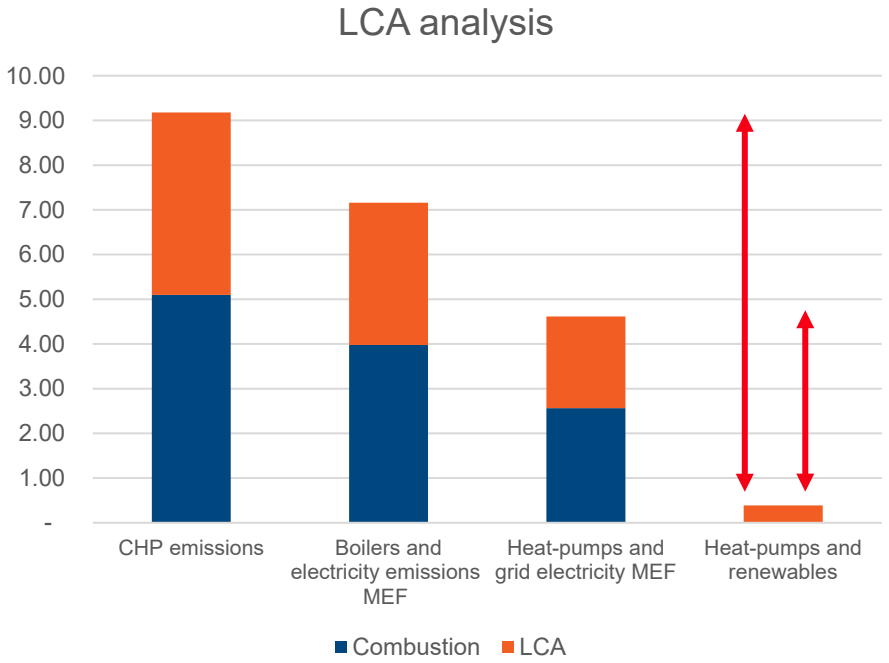
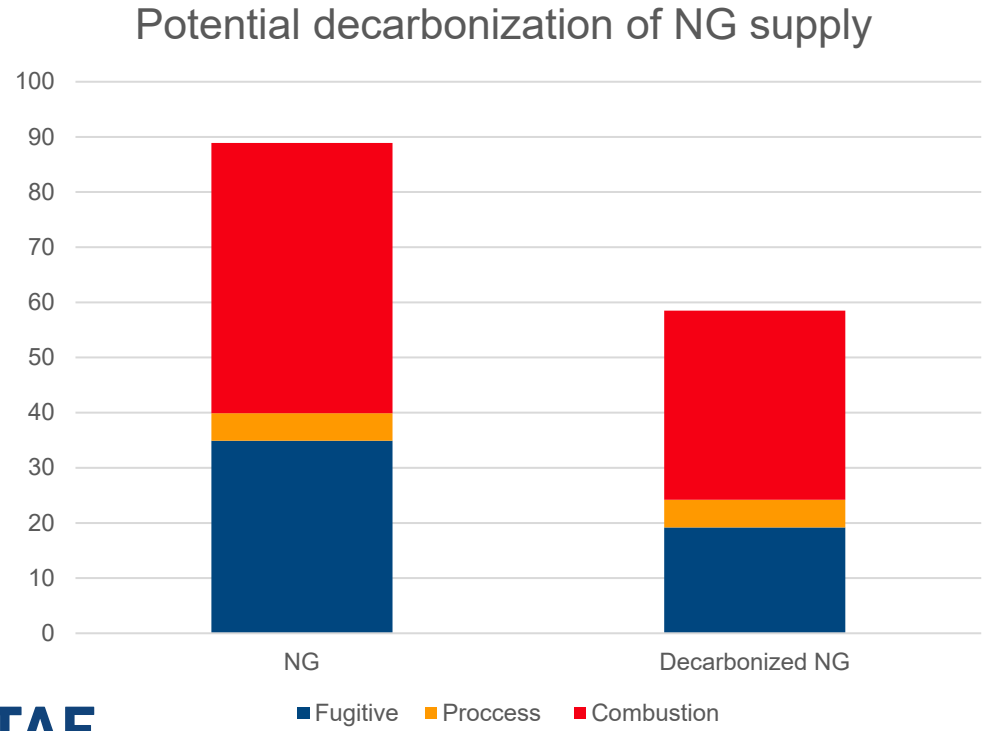
Comparative example



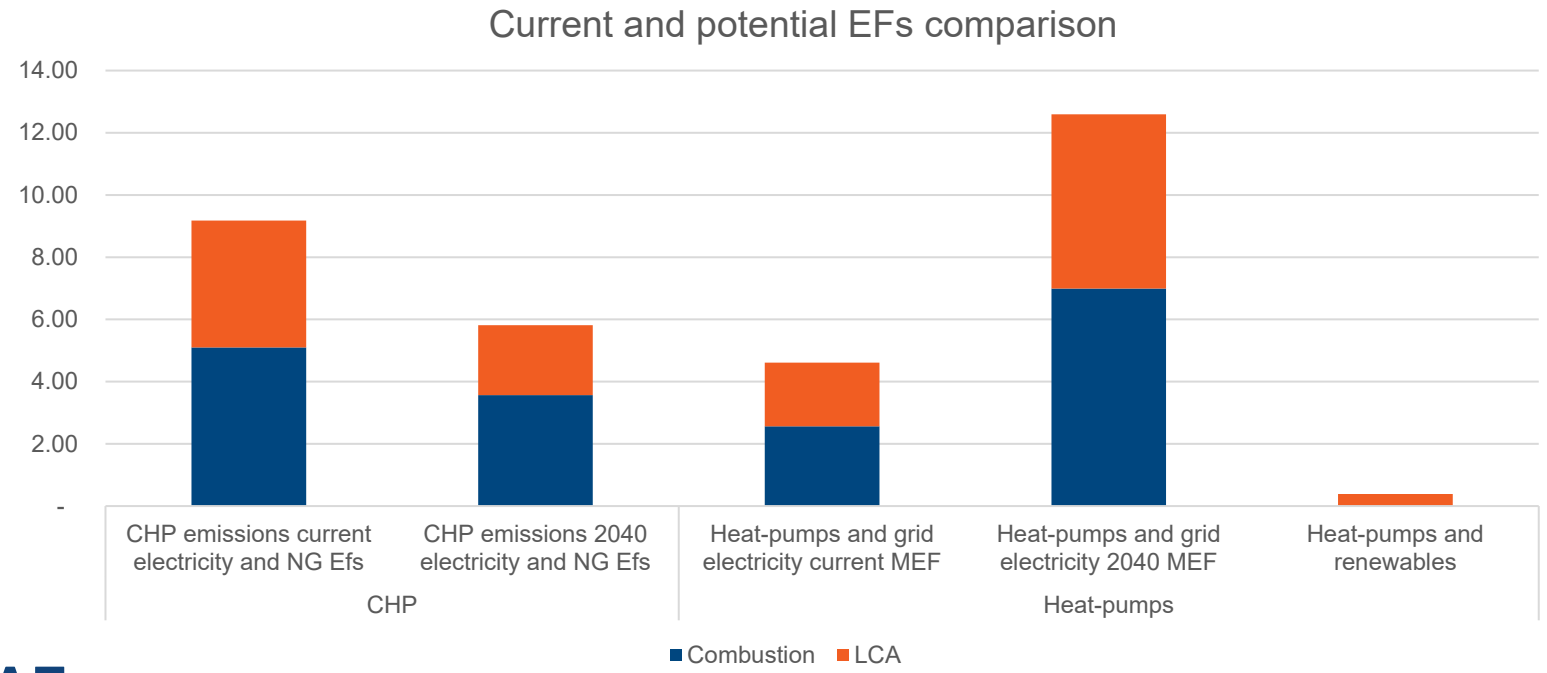


Pipeline potential decarbonization



- LCA: 45% reduction in fugitive emissions
- Combustion: 30% of NG displaced by RNG and hydrogen

Exercise forecast



Conclusion

- While CHP generates emissions reductions compared to current systems, is not consistent with our carbon budgets to Net Zero, even with optimistic hydrogen and renewable natural gas adoption, especially if we look at full LCA emissions.

- With the current electricity generation forecast, heat pumps are similar in carbon intensity as CHP over the next 20 years

- What is needed is a significant combined investment in heat pumps and renewables to meet our climate goals

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Questions?

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