



# Alberta's Role in Connecting the Hydrogen Economy

## Utilizing Natural Gas Pipelines to Transport Hydrogen



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### INTRODUCTION

- Canadian heavy diesel trucks are forecasted to produce 76Mtonne CO<sub>2</sub>e in 2060 [1].
- Hydrogen fuel cell (HFC) trucks can be used as an alternative to diesel [2].
- Steam methane reforming (SMR) is a proven way to produce hydrogen [3] and would keep Alberta relevant in the energy and transportation industries in a world rapidly moving to de-carbonize its energy supplies.
- 90% of the CO<sub>2</sub> produced from the SMR reaction can be sequestered [4].
- The produced hydrogen can be blended up to 15% by volume with natural gas and transported through existing pipelines [5].
- Wholesale cost of other hydrogen production technologies (thermal cracking or electrolysis) are typically more expensive because of high electricity costs.



Fig. 1. Nikola One Hydrogen Truck [2]

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### METHODS

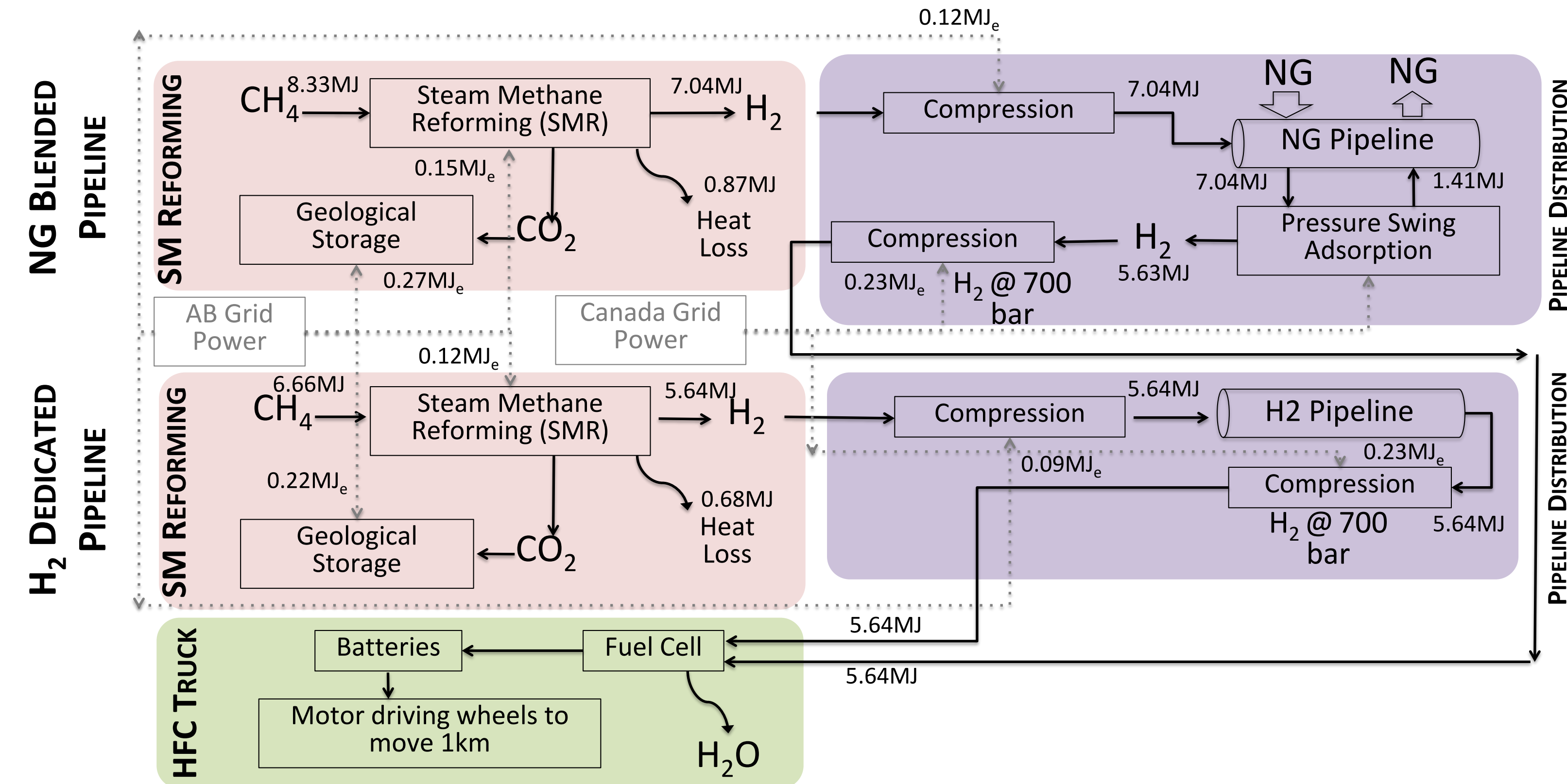


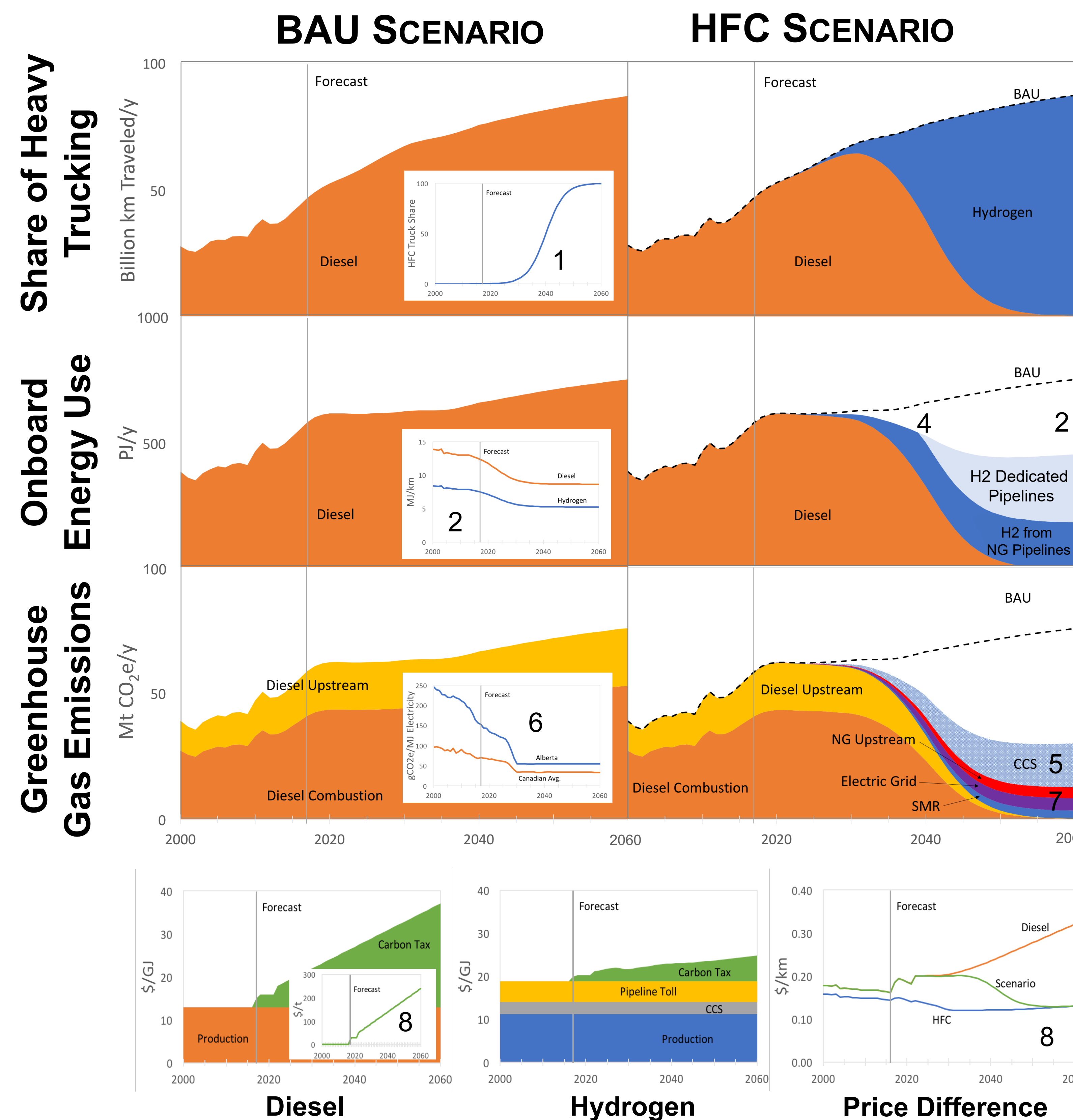
Fig. 2. Per Kilometer Energy Flow of Hydrogen Production and Distribution[1]

- Use of adoption curve to model conversion to 100% market share.
- Implementation of hydrogen dedicated pipelines to supplement blended natural gas pipelines.
- Single stage pressure swing absorption (PSA) process for cost effective extraction of hydrogen from pipelines.

### CONCLUSIONS

- Alberta has sufficient natural gas reserves and forecasted production to meet hydrogen demand.
- Market conversion from diesel to HFC freight trucks is limited to 30% due to the volume of NG in pipelines.
- Dedicated hydrogen pipelines would be required in 2040 to meet demand.
  - Pipelines could be retrofitted to prevent hydrogen embrittlement and handle higher concentrations.
  - New interprovincial hydrogen pipeline networks would need to be built.
- Regulatory approval required, but possible, before hydrogen can be blended into existing pipelines.
- With 100% market share CO<sub>2</sub>e emissions are reduced by over 80% from 76Mt/y to 13 Mt/y in 2060.
- 450 midsized (21,600 kgH<sub>2</sub>/day) SMR plants would be required in 2060 to meet demand [6].
- Hydrogen wholesale cost is highly dependent on natural gas prices (as is diesel) and estimated to be 18.50\$/GJ at 3.50/GJ for natural gas [7].

### RESULTS



### DISCUSSION

- Adoption curve shaped to avoid early retirement of existing diesel trucks.
- Higher HFC efficiency reduces total energy demand by 300PJ/y.
- 590PJ/y of Alberta's 4200PJ/y natural gas required to produce H<sub>2</sub>.
- Dedicated hydrogen pipelines required in 2040 to meet demand.
- 17Mt/y CO<sub>2</sub> from SMR sequestered in 2060.
- Grid CO<sub>2</sub> intensity reduction keeps electrical emissions relatively constant.
- GHG emissions reduced from 76Mt/y to 13Mt/y.
- HFC efficiency and increasing carbon tax make HFC vehicles competitive.

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