CANADIAN INSTITUTE FOR CLIMATE CHOICES

Canada's Net Zero Future: *Finding our way in the global transition*

February 2021

Jason Dion

Mitigation Research Director

REPORT **OBJECTIVES**

- Explore what a net zero 2050 means in practical terms and the pathways Canada can take to get there
- Assess uncertainty on the path to net zero, including the effects of factors Canada does – and does not – control
- Provide an evidence-based touchstone for net zero policy conversations
- Provide clarity for decision-makers on the role different solutions will – or might – play, and what that means for policy

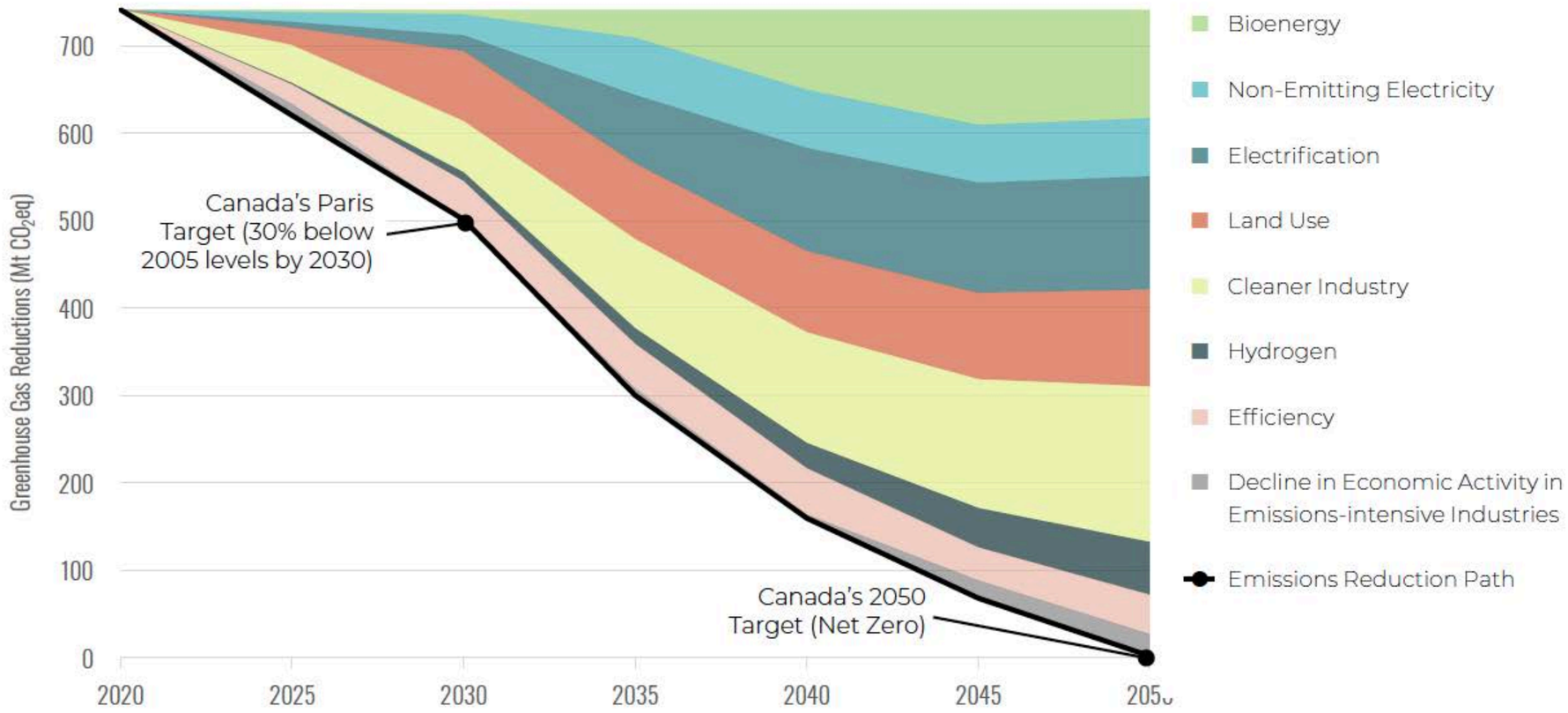
OUR **METHODS**

- Modelling
  - Computable general equilibrium model (Navius Research's gTech)
  - Technology, macroeconomy, behaviour
  - + Air pollution and health impact modelling
- Literature review
- Expert input
- Stakeholder consultation
- **Scenario analysis**

REPORT SUMMARY

Net zero is **achievable**, and there are many potential pathways to getting there

Figure 1: One of the many potential pathways that Canada could take to net zero



CANADIAN INSTITUTE FOR CLIMATE CHOICES

“SAFE BETS”

- Solutions that are **commercially available** and have **no major constraints to scaling**
- Show up **consistently** across *all* our scenarios

Examples of safe bets include:

- Non-emitting **electricity**
- Electric vehicles in **transportation**
- Heat pumps in **buildings**
- Methane management, changes in production processes, and electrification in **industry**

CANADIAN INSTITUTE FOR CLIMATE CHOICES

“WILD CARDS”

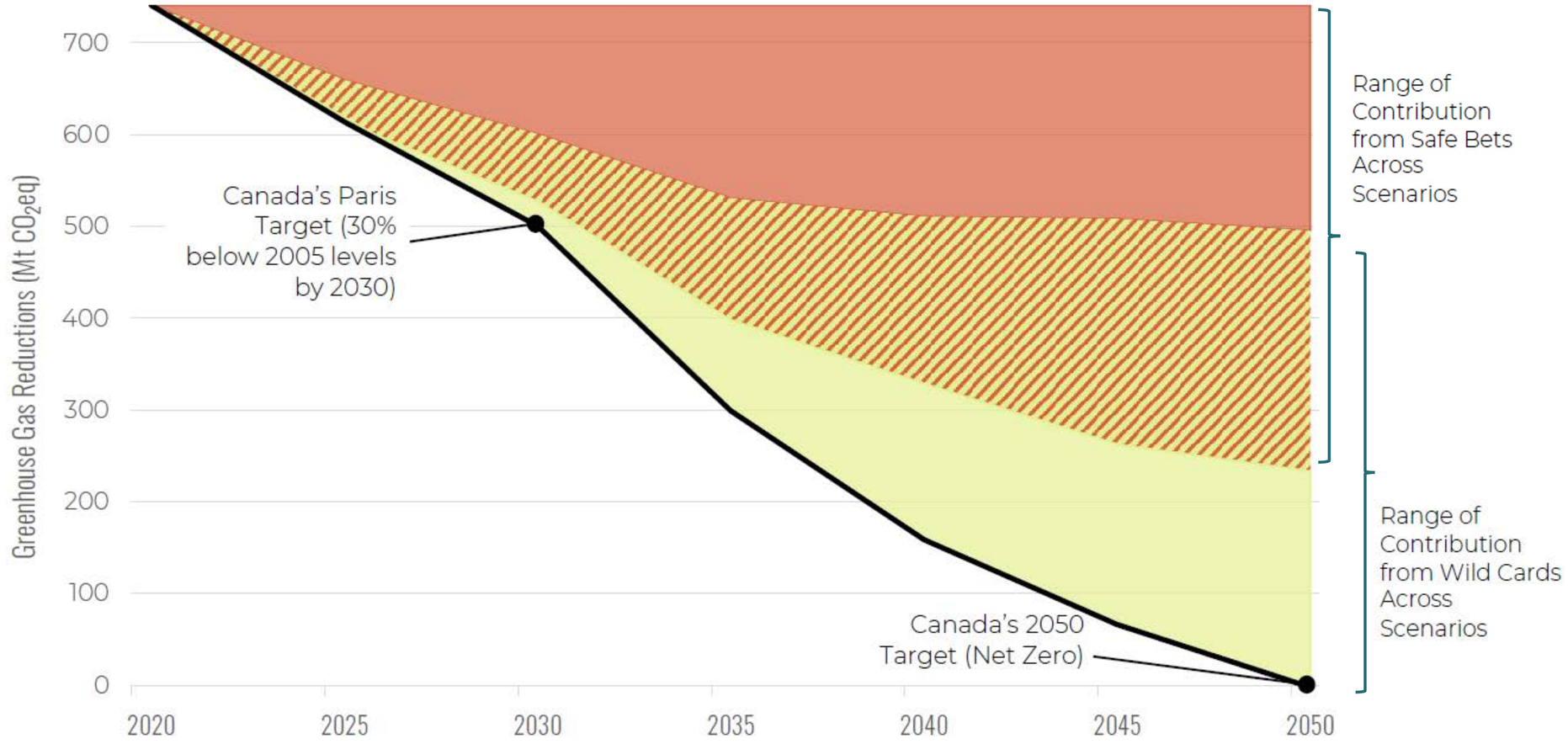
- Solutions that are **demonstration-stage** only and/or face **scalability concerns**
- Only play a role in our analysis under **particular conditions**

Examples of wild cards include:

- 2nd generation liquid biofuels in **transportation**
- RNG and hydrogen in **buildings**
- Negative emissions solutions in **industry**

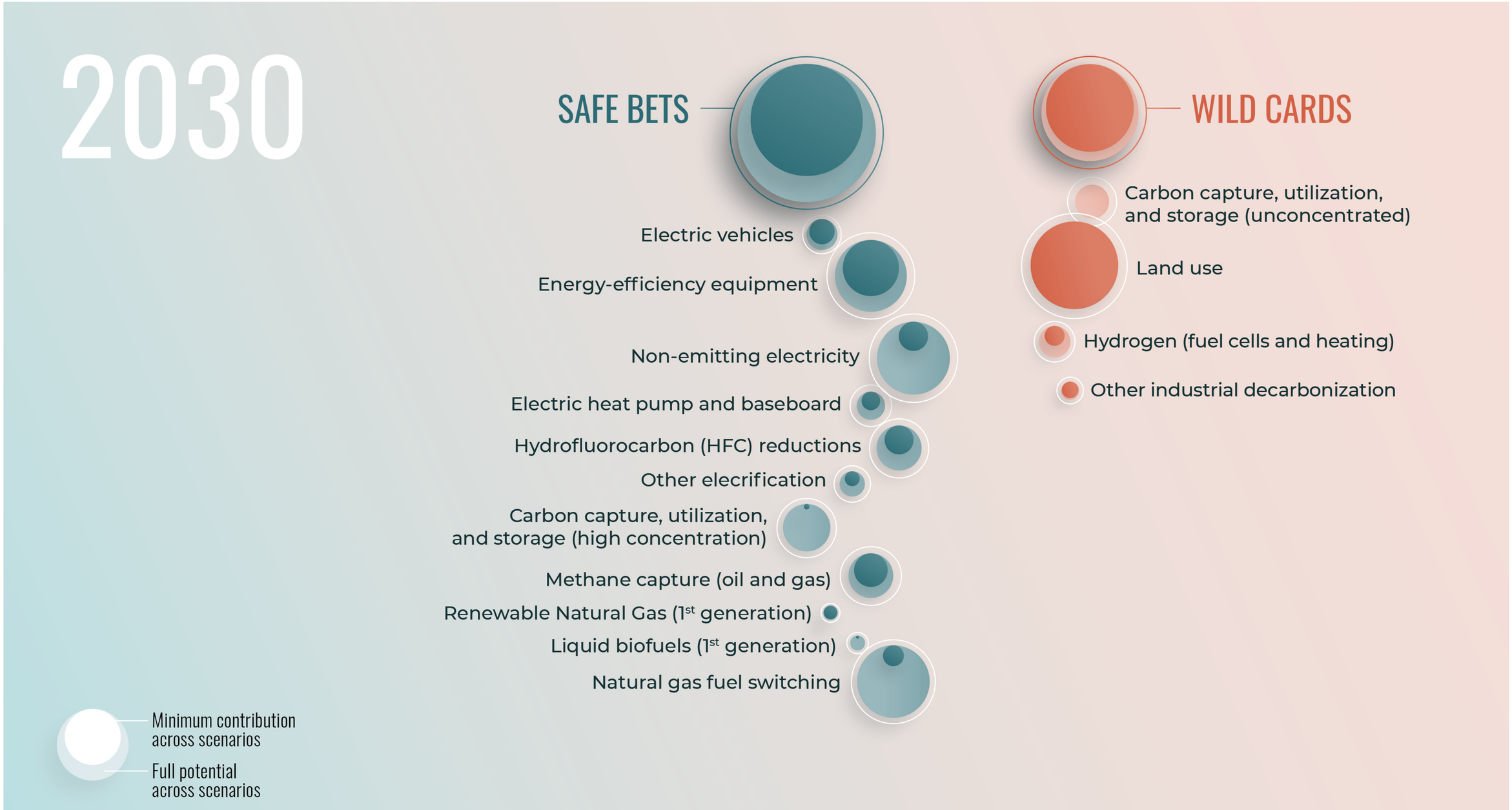
Canada's winning hand will require a combination of **safe bets** and **wild cards**

Figure 18: Contribution of safe bets to emissions reductions across pathways to net zero

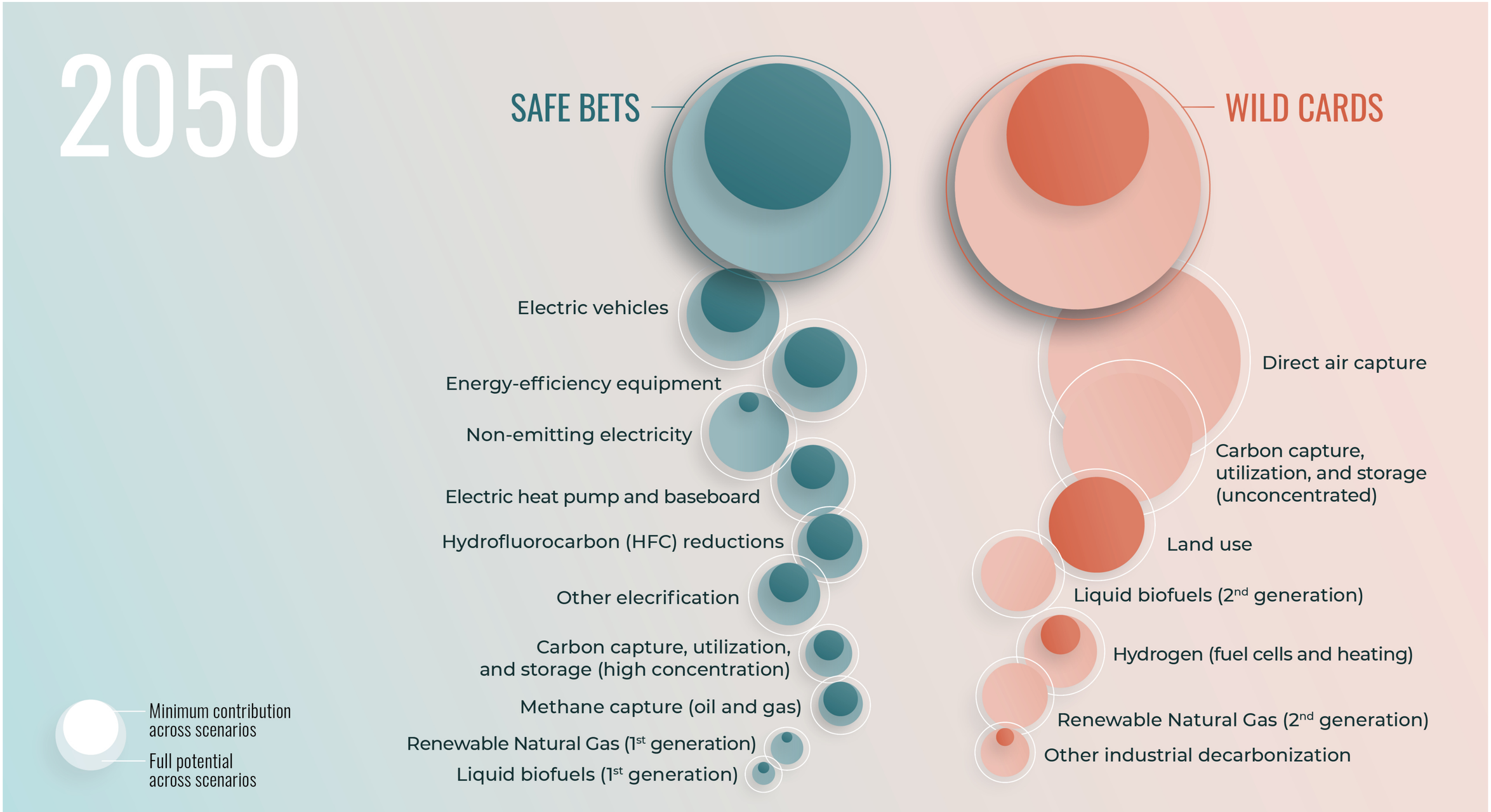


CANADIAN INSTITUTE FOR CLIMATE CHOICES

Meeting 2030 target is about scale, speed and **safe bets**

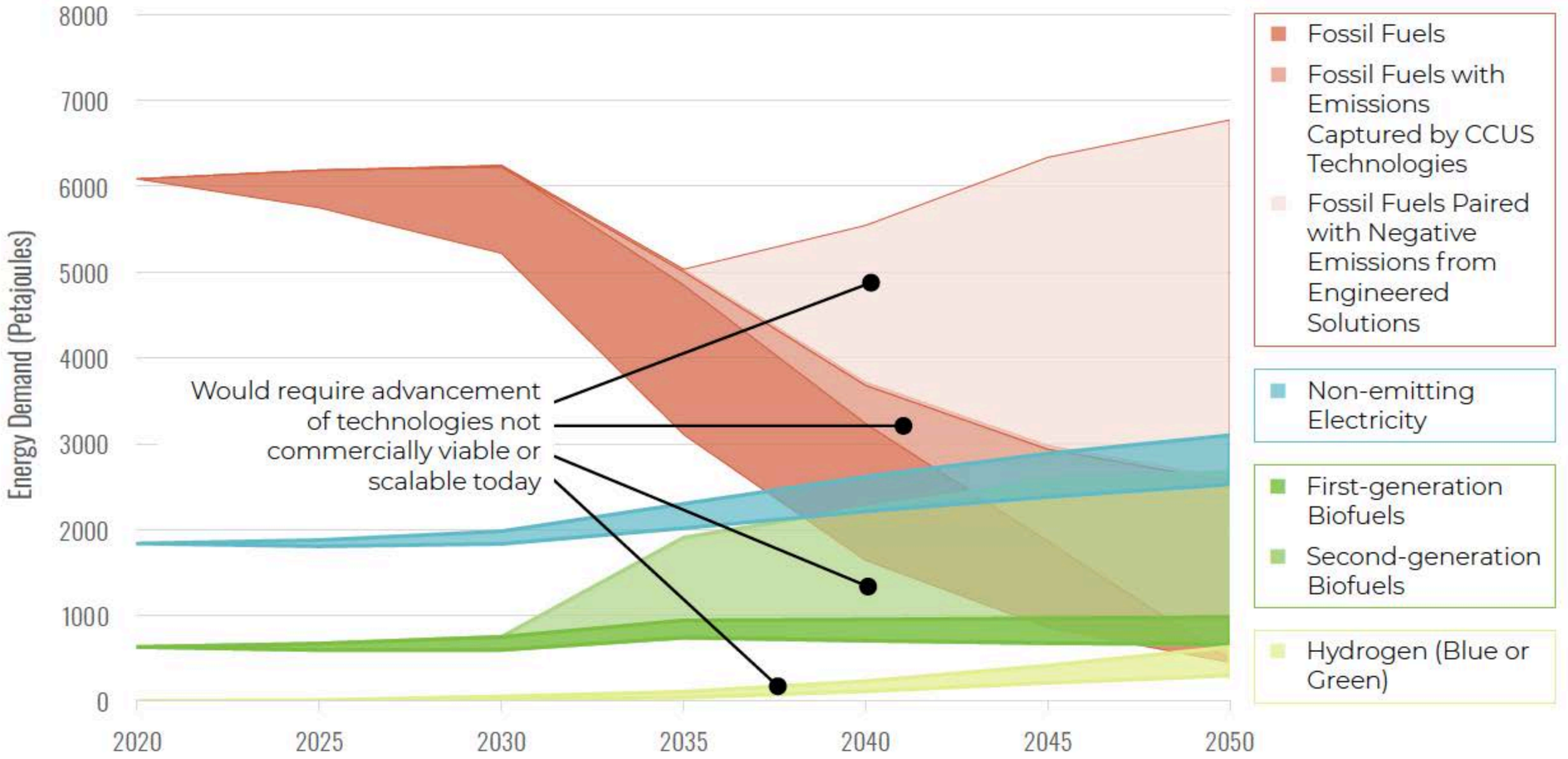


Wild cards are key to long-term success



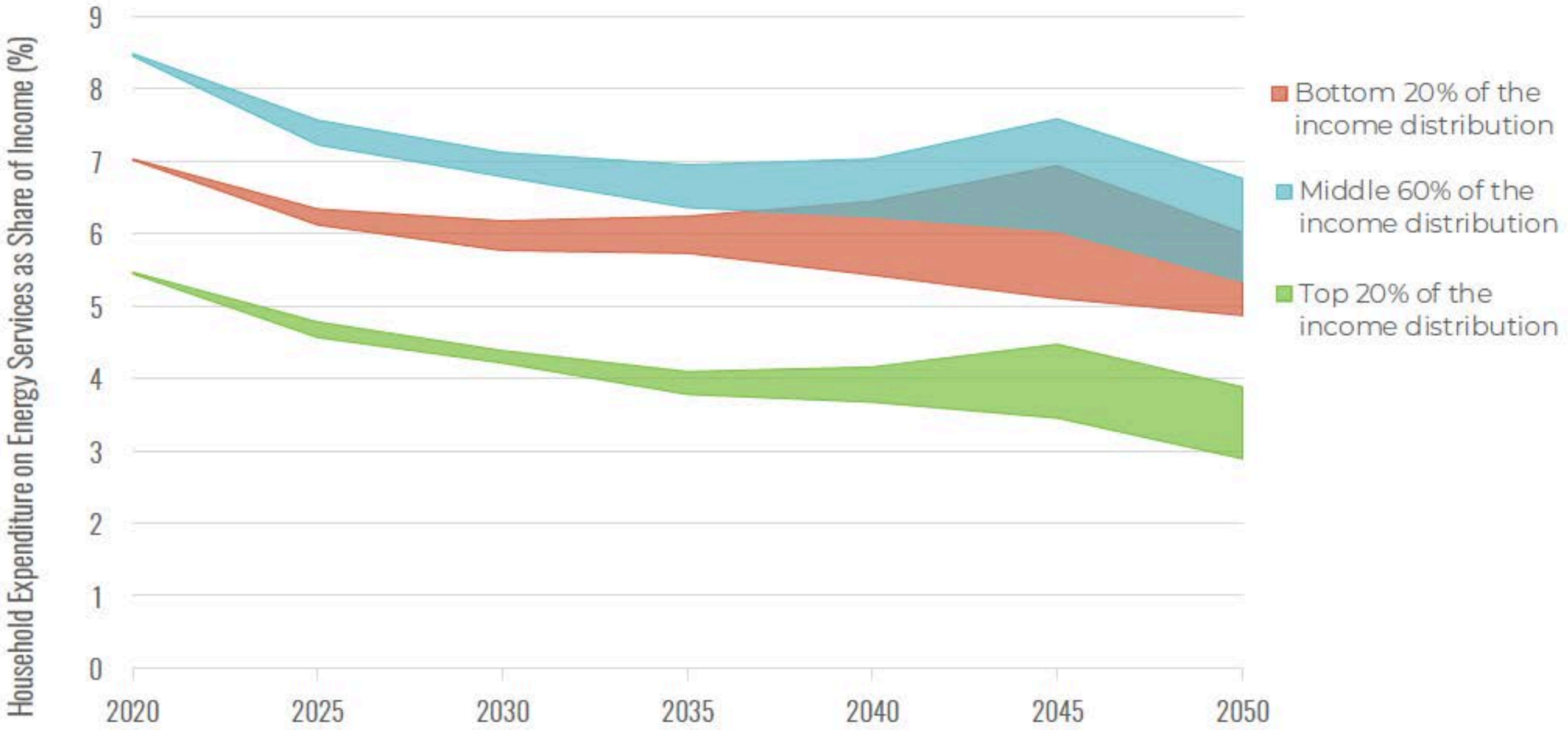
Final energy demand in Canada

Figure 3: The contribution of different types of energy and energy carriers to Canadian final energy demand on pathways to net zero



CANADIAN INSTITUTE FOR CLIMATE CHOICES

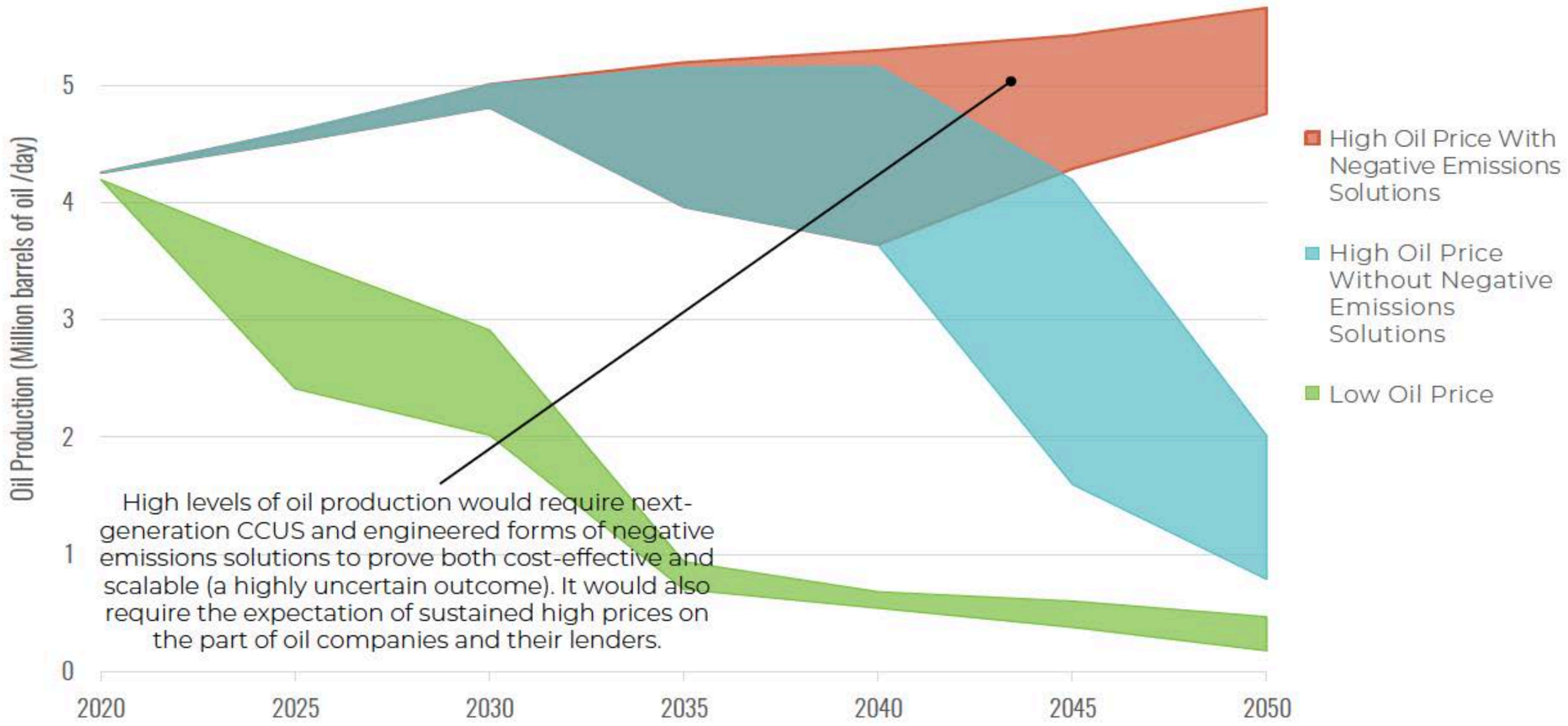
Households **spend less** on energy as a share of income



CANADIAN INSTITUTE FOR CLIMATE CHOICES

Factors beyond **Canada's control** have big implications

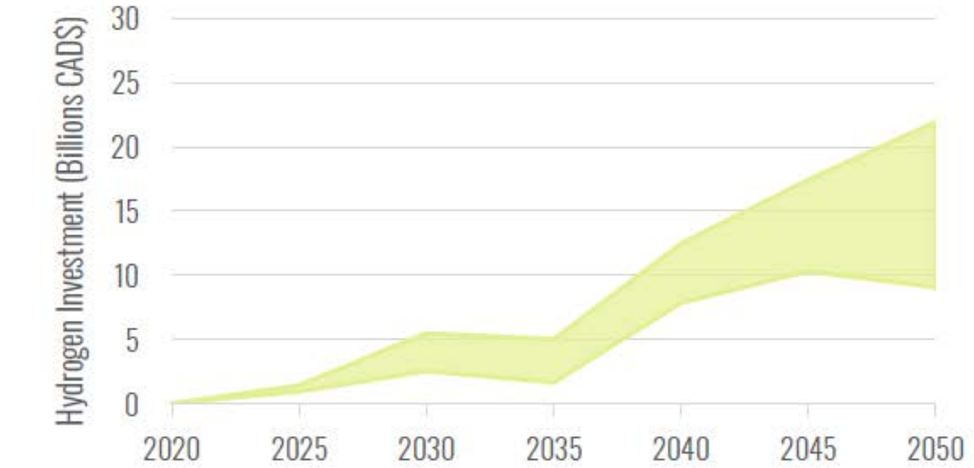
Figure 14: Canadian oil production under low and high global price scenarios for oil across pathways to net zero

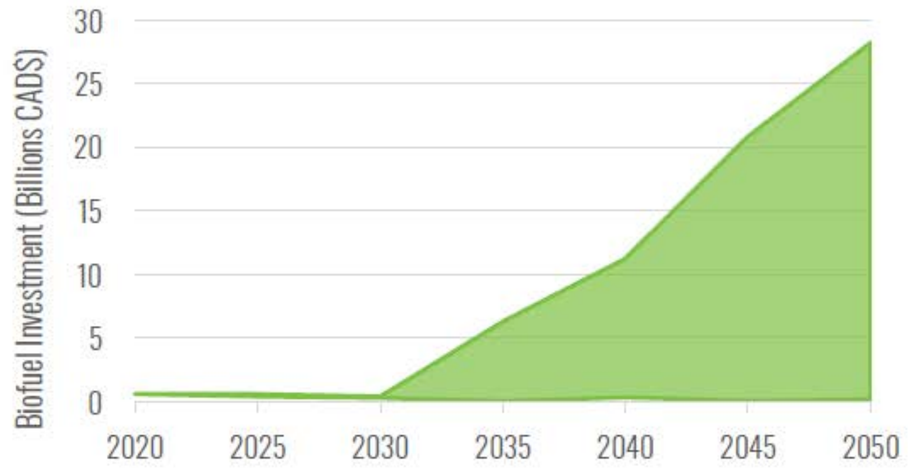


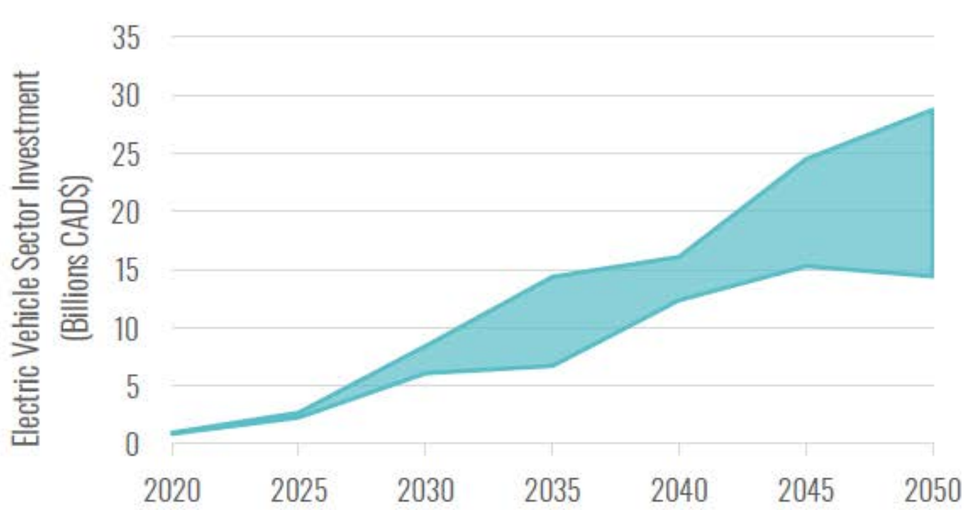
CANADIAN INSTITUTE FOR CLIMATE CHOICES

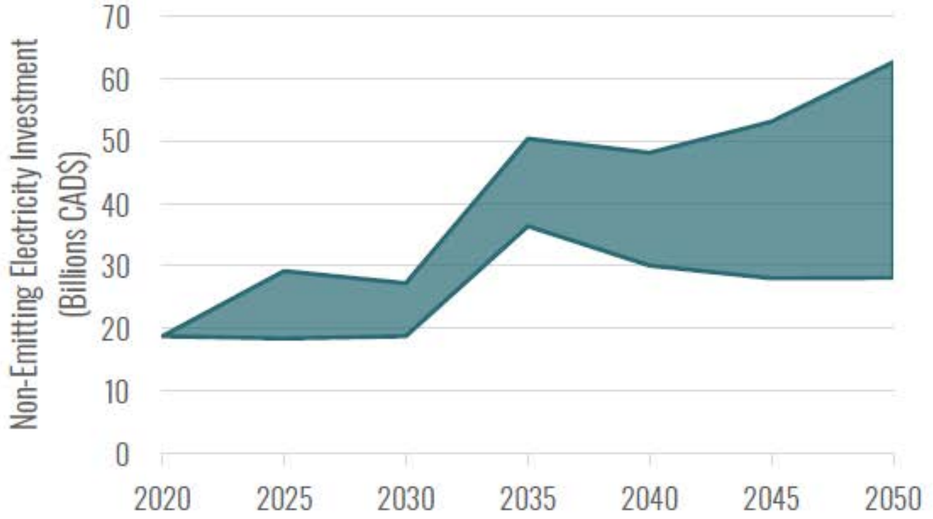
Net zero presents challenges and **opportunities**

Figure 13: National investment in clean technology sectors across pathways to net zero









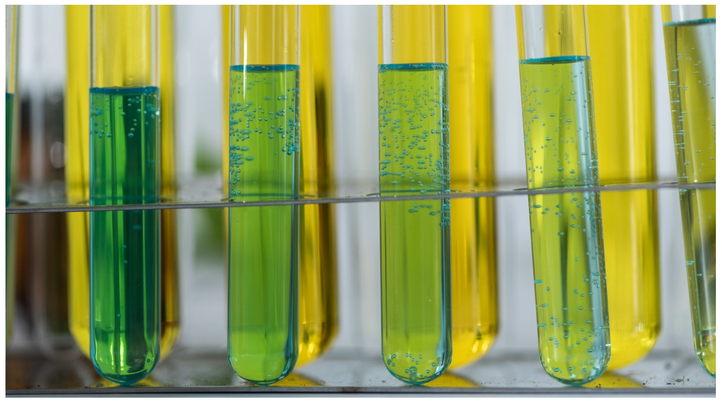
CANADIAN INSTITUTE FOR CLIMATE CHOICES

THREE ILLUSTRATIVE **NET ZERO ENERGY SYSTEMS**

Fossil fuels + negative emissions

Credit: Carbon Engineering

Biofuels



Electrification + hydrogen

CANADIAN INSTITUTE FOR CLIMATE CHOICES

OVERVIEW OF **KEY FINDINGS**

- Net zero is **achievable**, but requires strong policy
- Big **transitions are inevitable** – especially due to global trends
- Canada has significant **competitive advantages**
- We need both *safe bets* and *wild cards*, but they are **different policy conversations**
- Engineered forms of **negative emissions** are best viewed as a complement, not a substitute
- **Pathways to 2050** have far-reaching implications for the well-being of Canadians

RECOMMENDATIONS

1. Governments at all levels should **increase the stringency of existing policies** to create incentives for widespread **deployment of "safe bet" solutions**

2. Governments should **manage the risks and opportunities posed by wild card solutions** through a **portfolio approach**

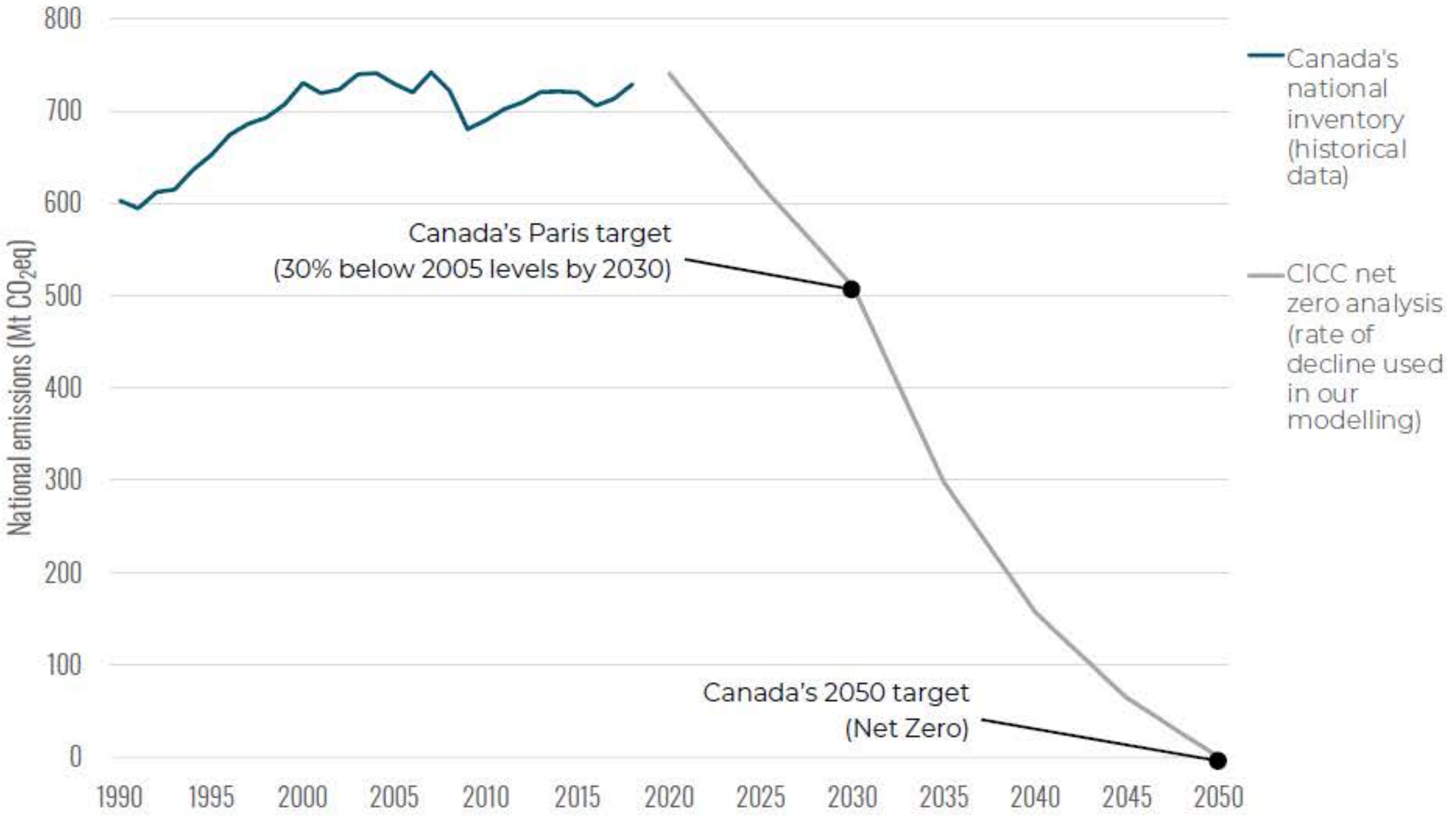
3. Governments should **increase policy certainty** by implementing robust **climate accountability frameworks**

4. Governments should work to ensure that the transition to net zero is **fair and inclusive**

Canadian Institute for Climate Choices

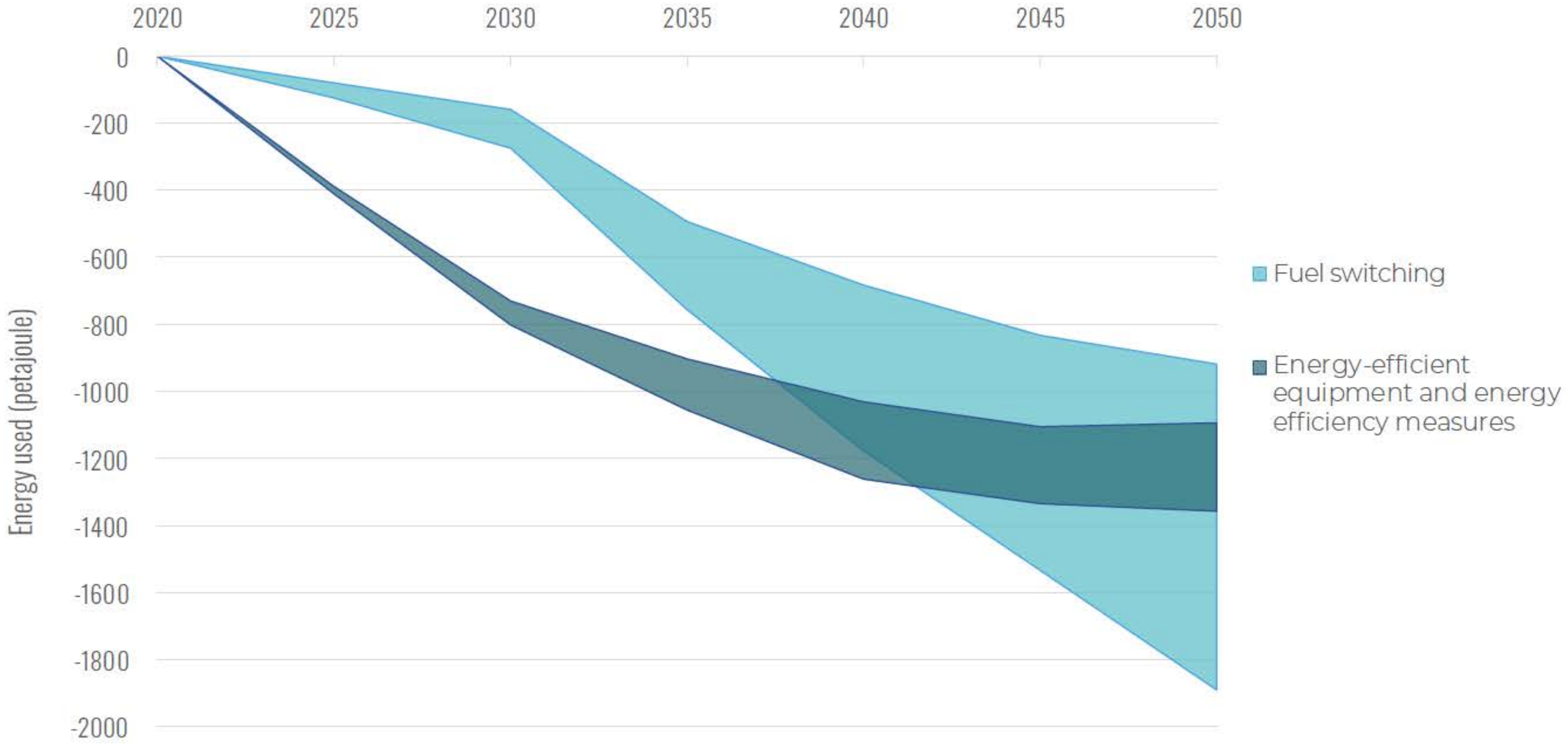
climatechoices.ca
@climatechoices

Figure 2: Comparing Canada's Historical Greenhouse Gas Emissions and the Path to Net Zero



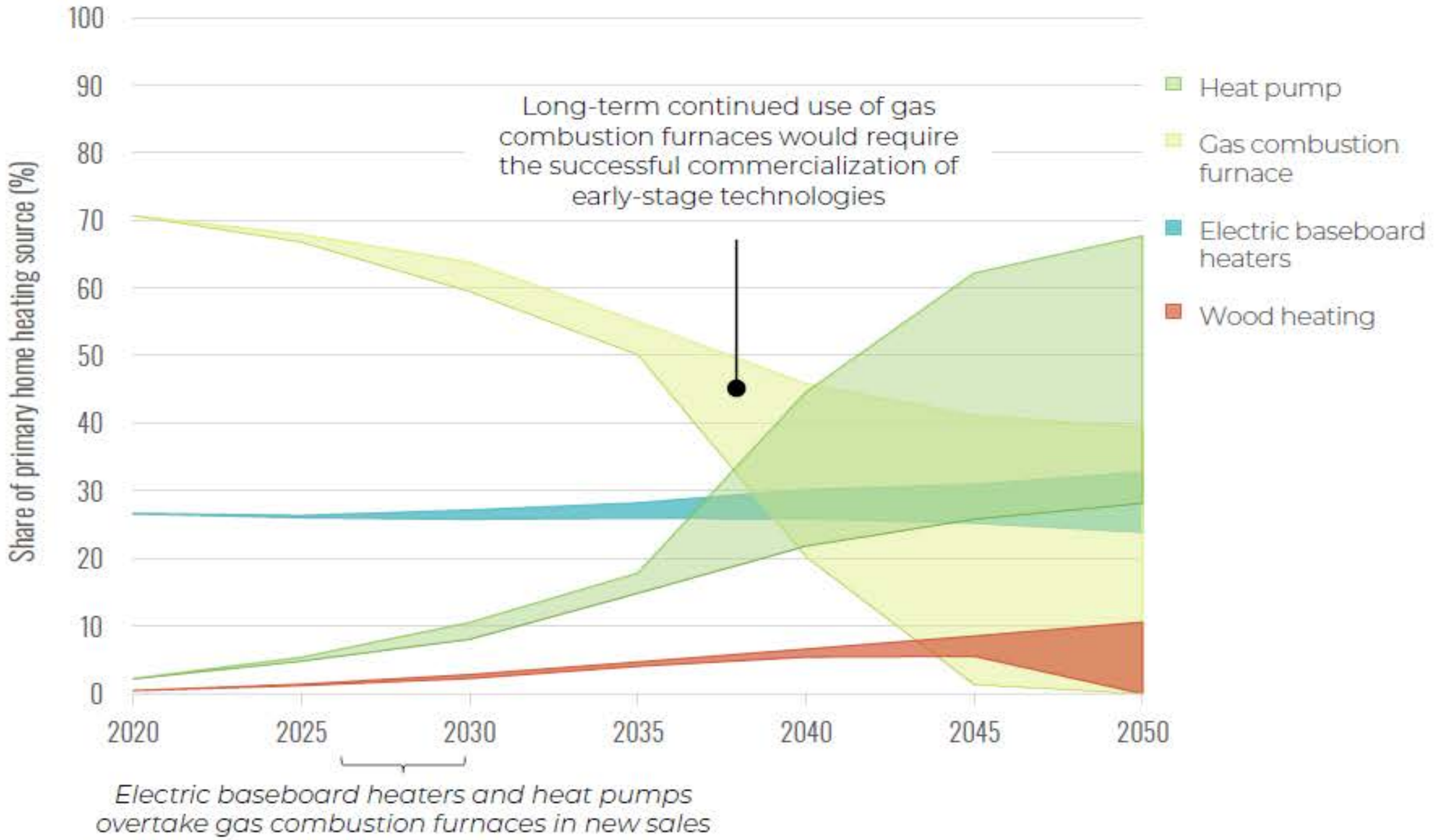
CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 4: The effect of direct energy efficiency improvements and fuel switching on energy use on pathways to net zero



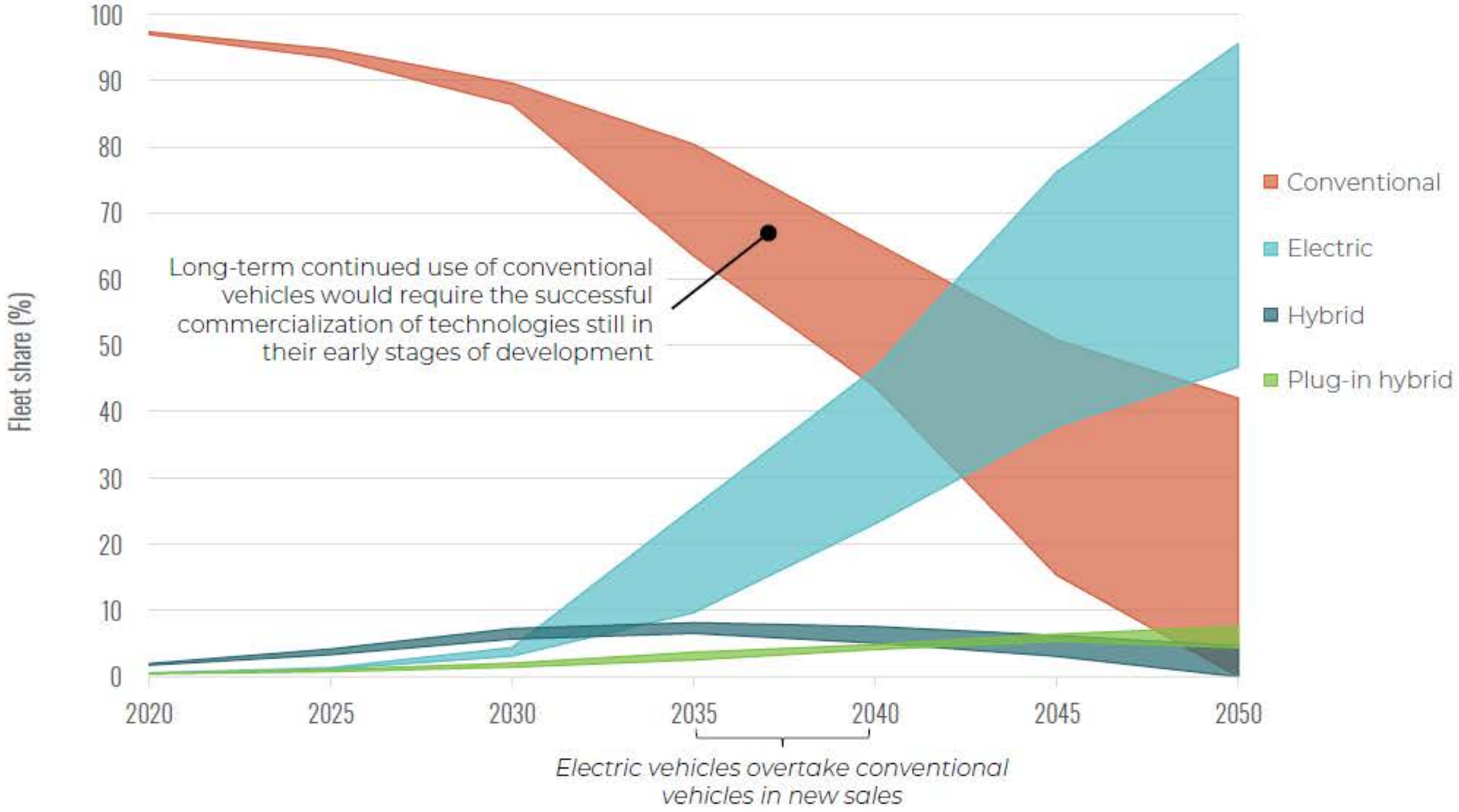
CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 6: Share of heating technologies installed as a primary source of home heating across pathways to net zero



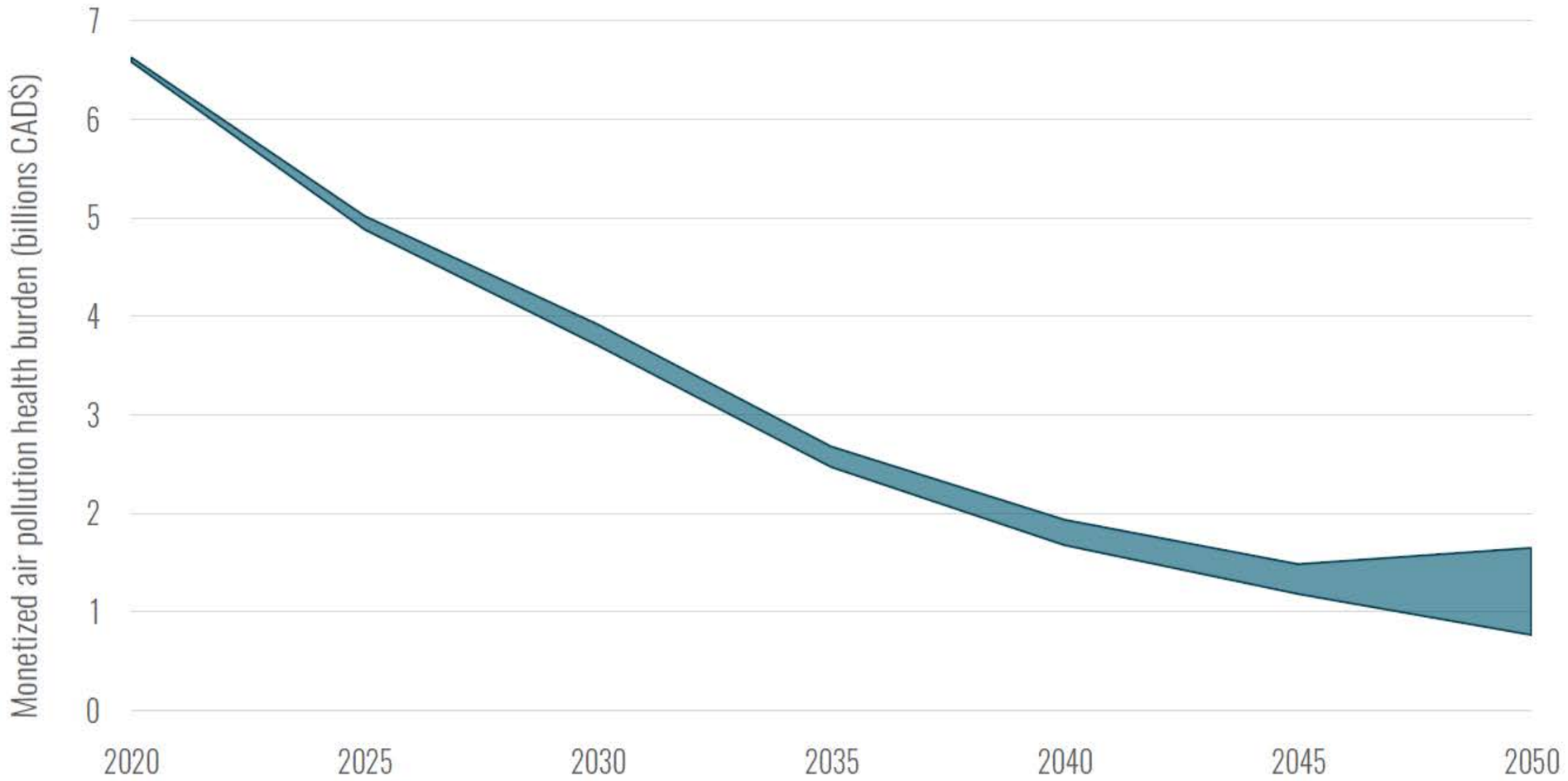
CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 7: The total market share of different vehicle types in Canada's personal transportation fleet across pathways to net zero



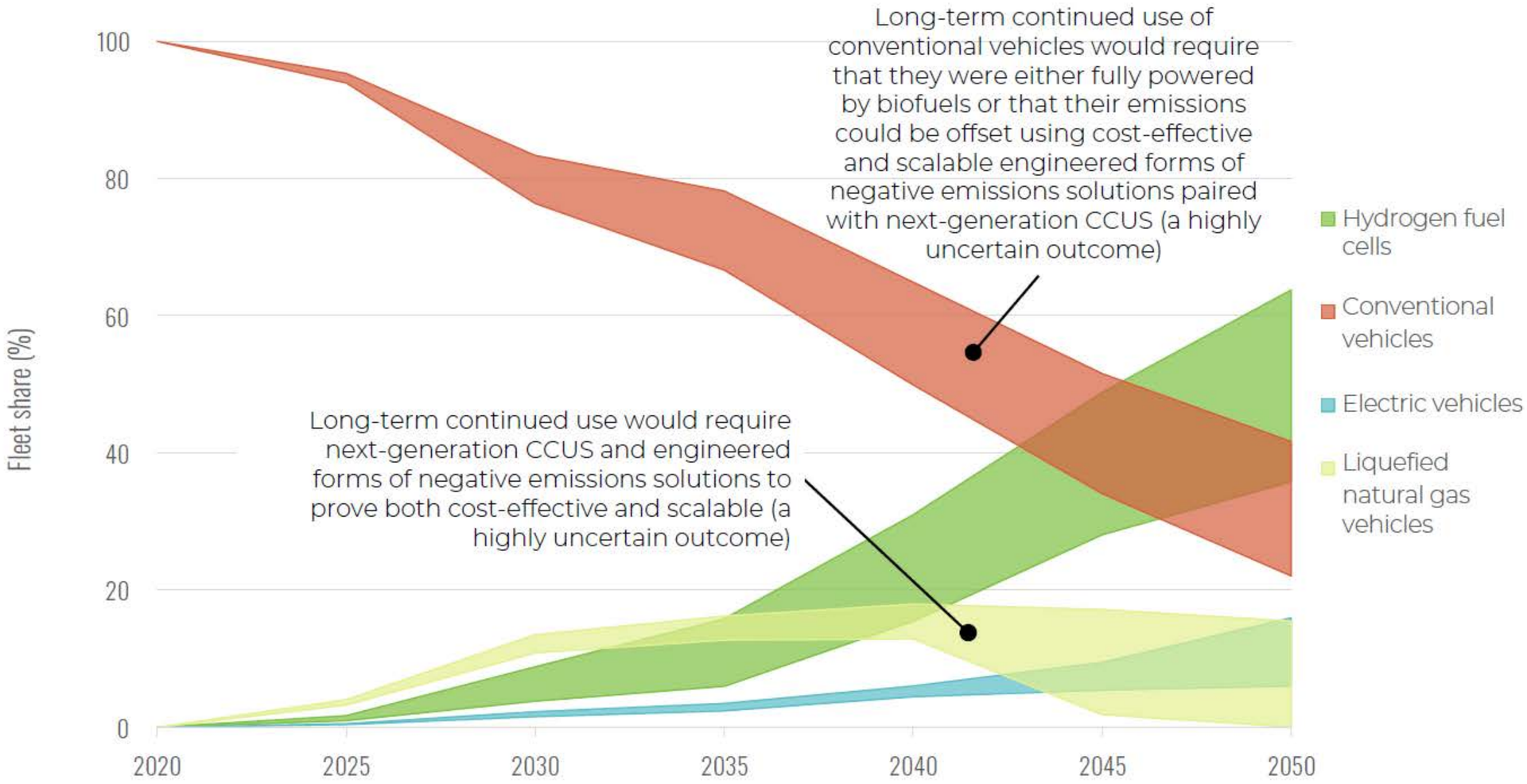
CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 8: National annual estimated economic burden due to mortality associated with air pollution emissions from energy production and use on pathways to net zero



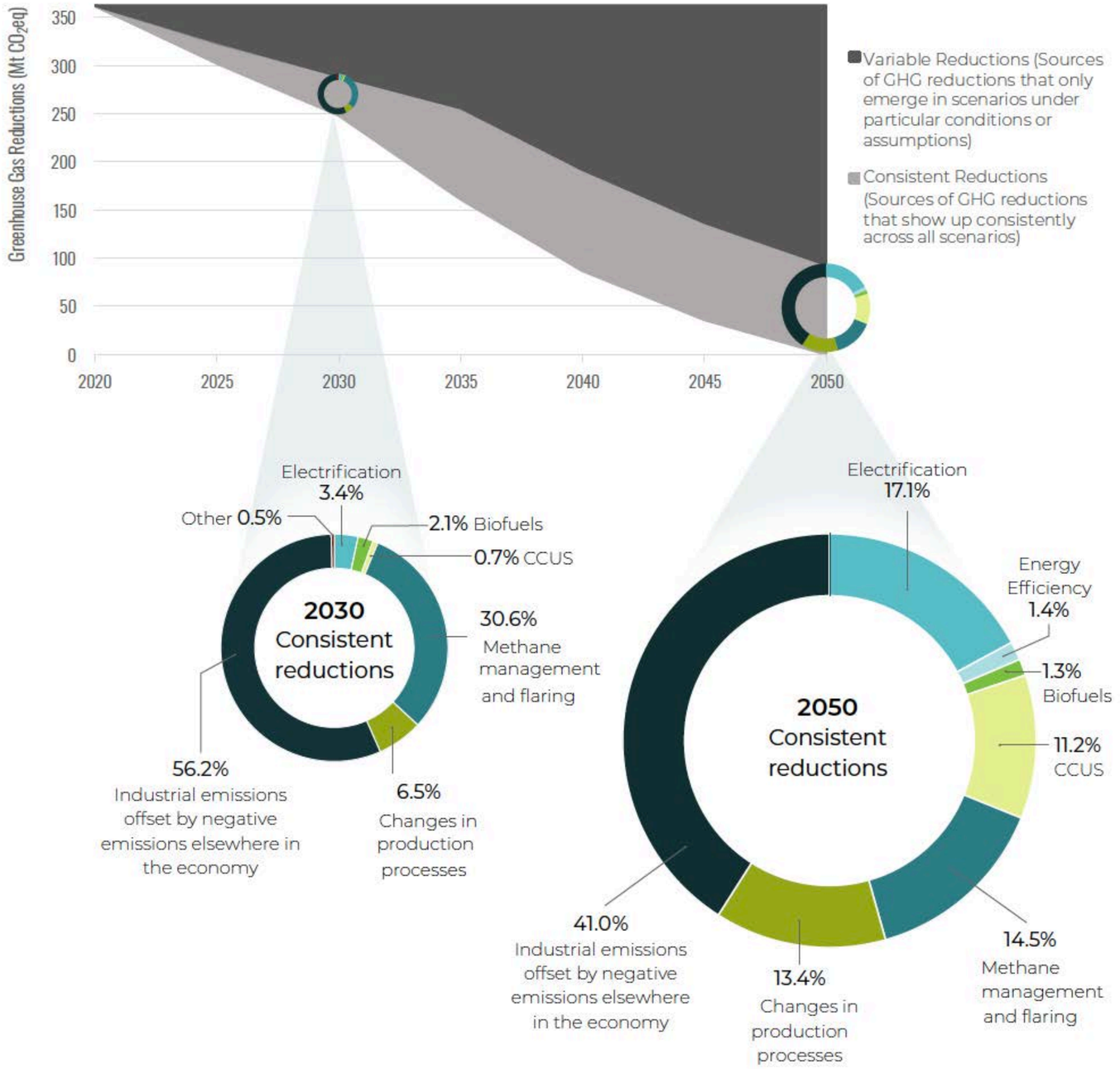
CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 9: The total market share of different vehicle types in Canada's freight transportation fleet across pathways to net zero



CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 10: Consistent versus variable emissions reduction pathways for industry across pathways to net zero



CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 11: Resource output across pathways to net zero

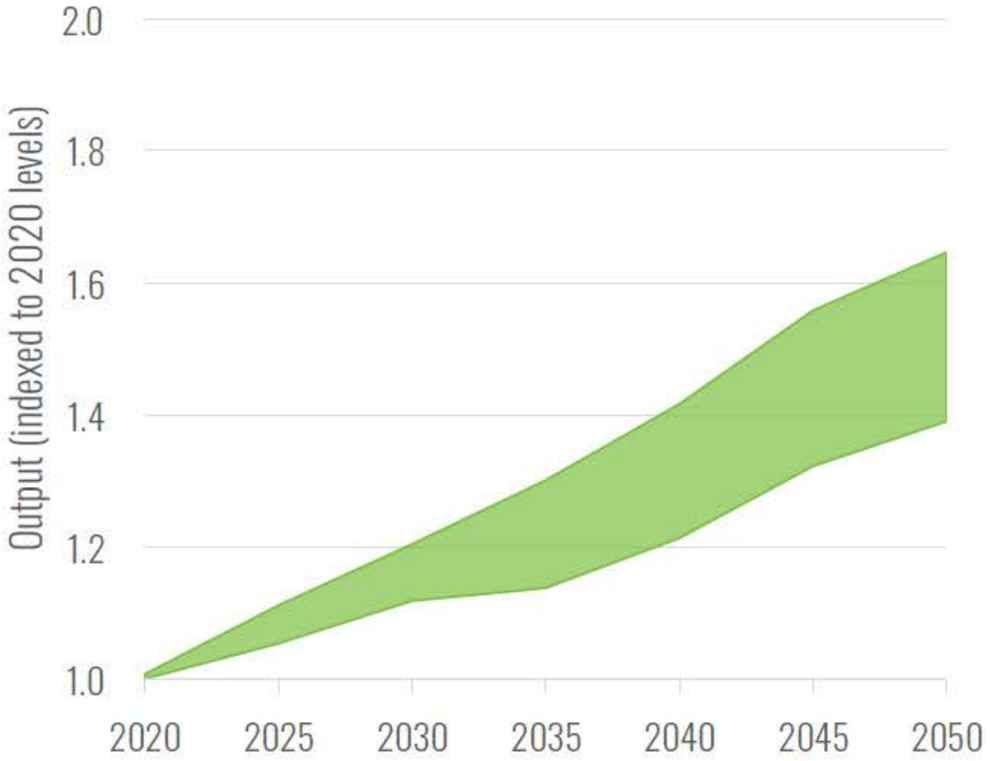
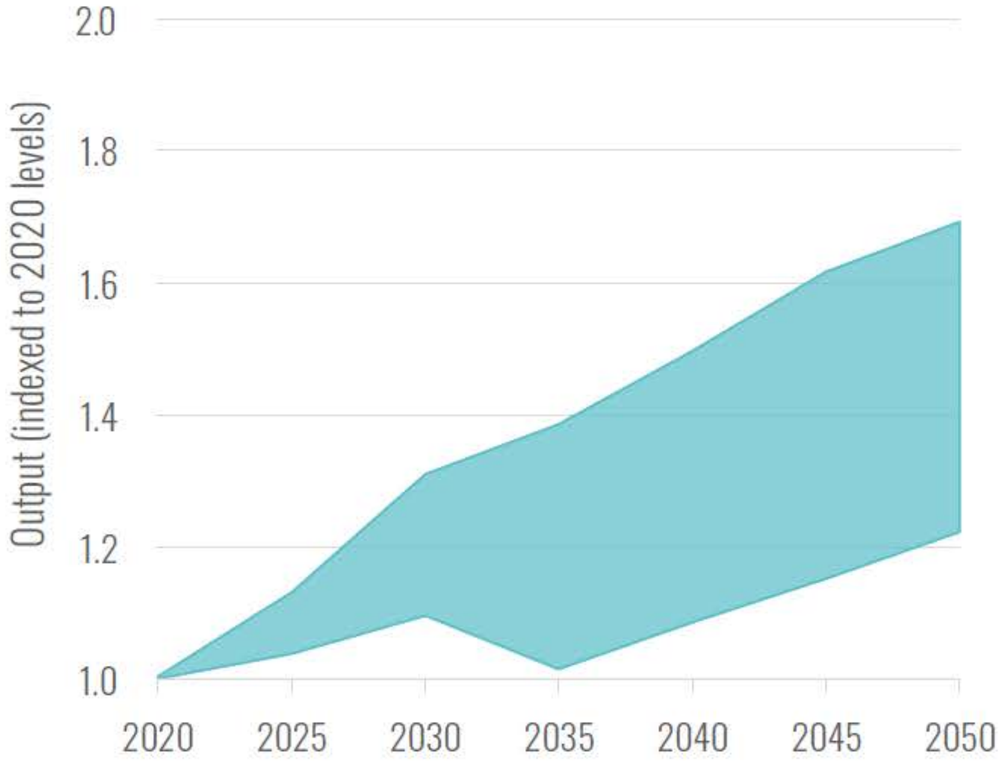
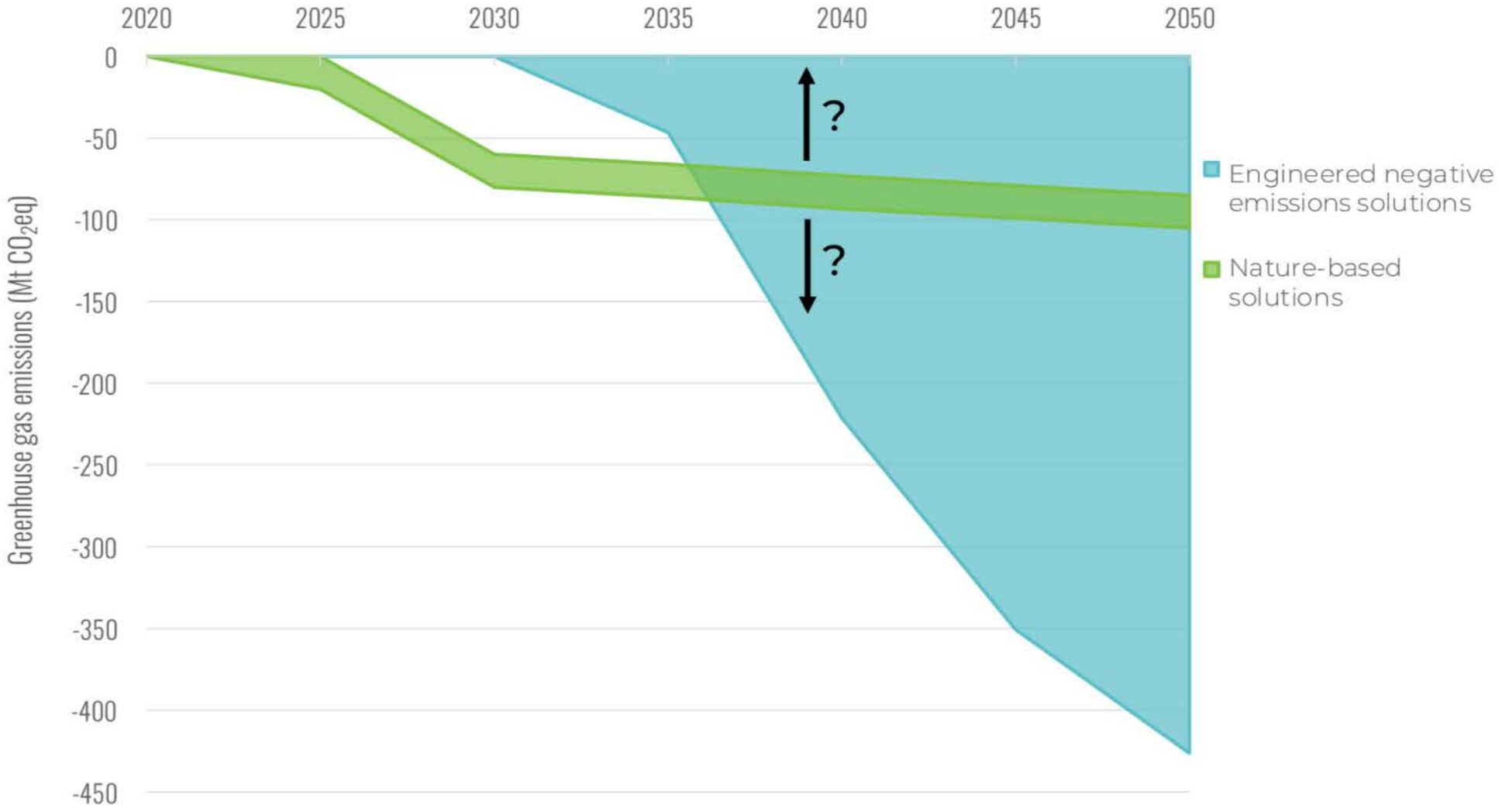


Figure 12: Manufacturing output across pathways to net zero



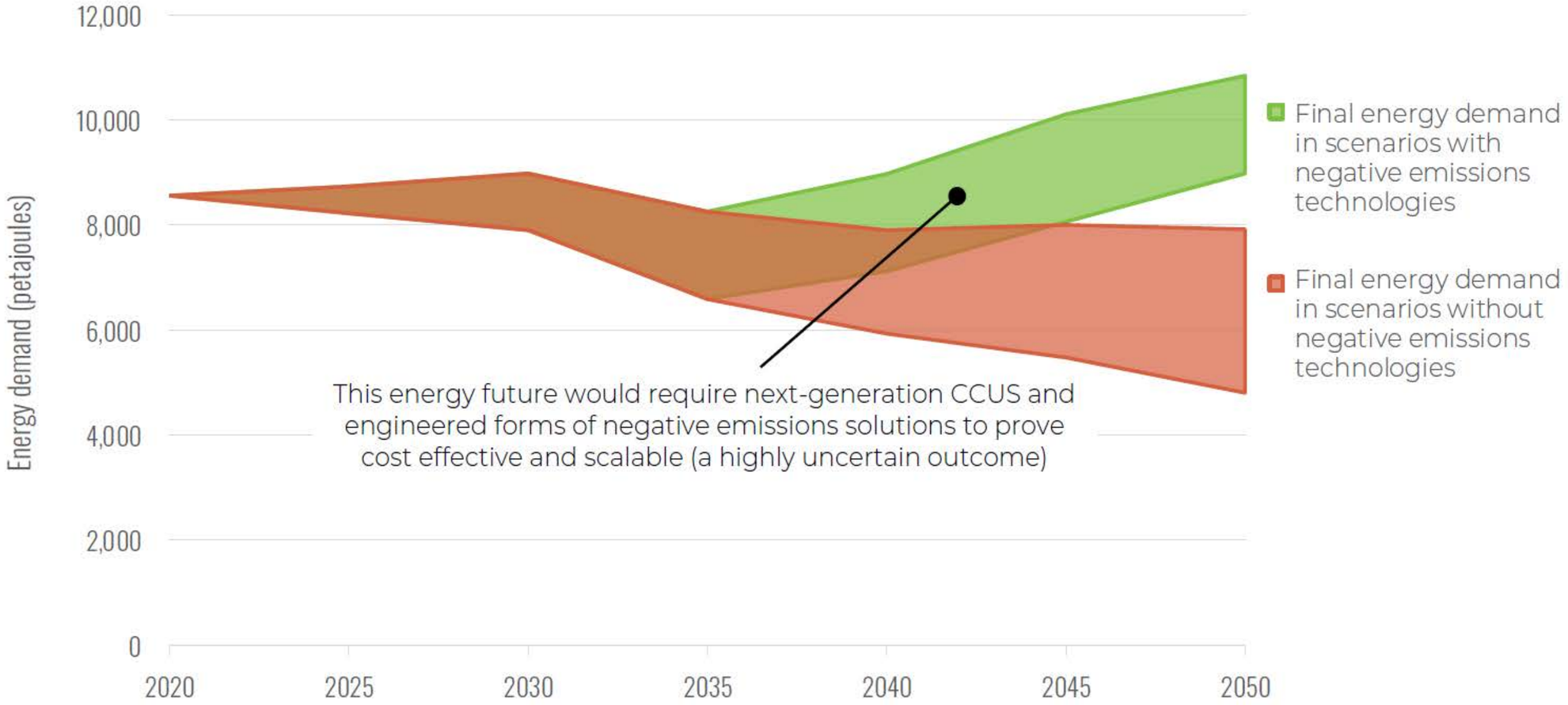
CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 16: The high uncertainty surrounding the potential of negative emissions from nature-based and engineered solutions across pathways to net zero



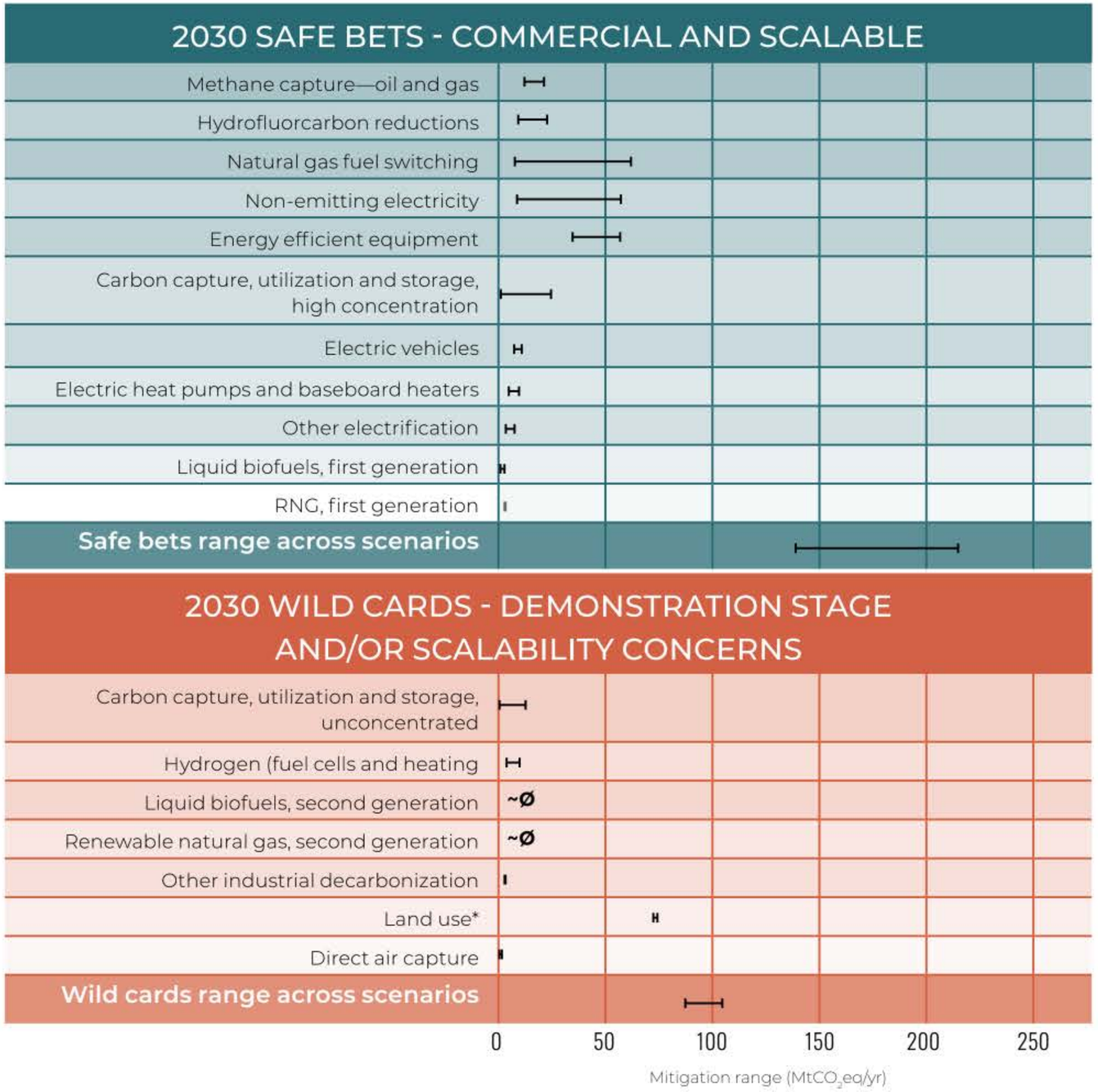
CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 17: Domestic final energy demand (for all energy types) under differing assumptions for the ultimate cost-effectiveness and scalability of engineered forms of negative emissions



CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 19: Projected contributions to 2030 emissions reductions by different solutions across pathways to net zero

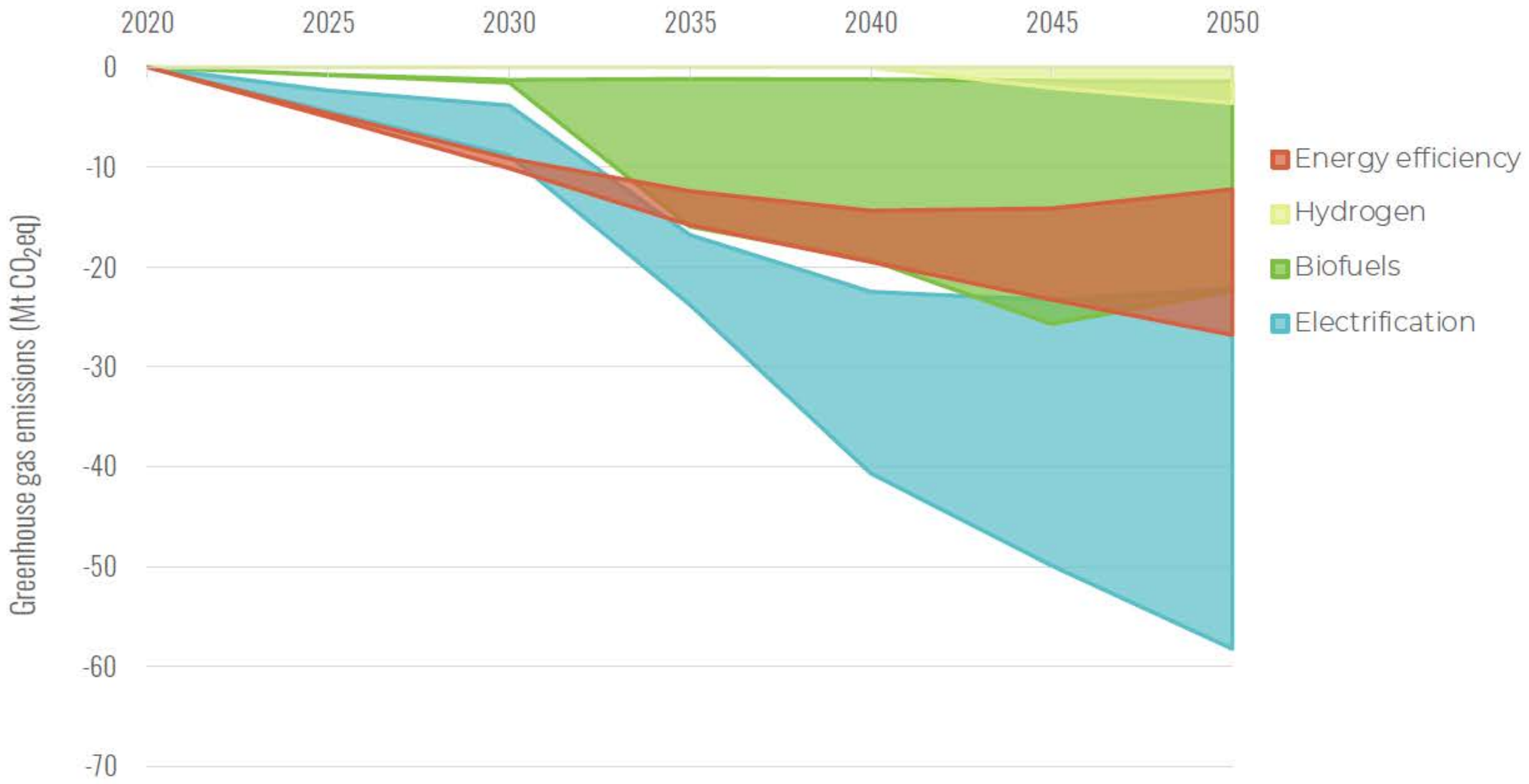


CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 20: Projected contributions to 2050 emissions reductions by different solutions across pathways to net zero

CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 21: Buildings



CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 22: Personal Transportation

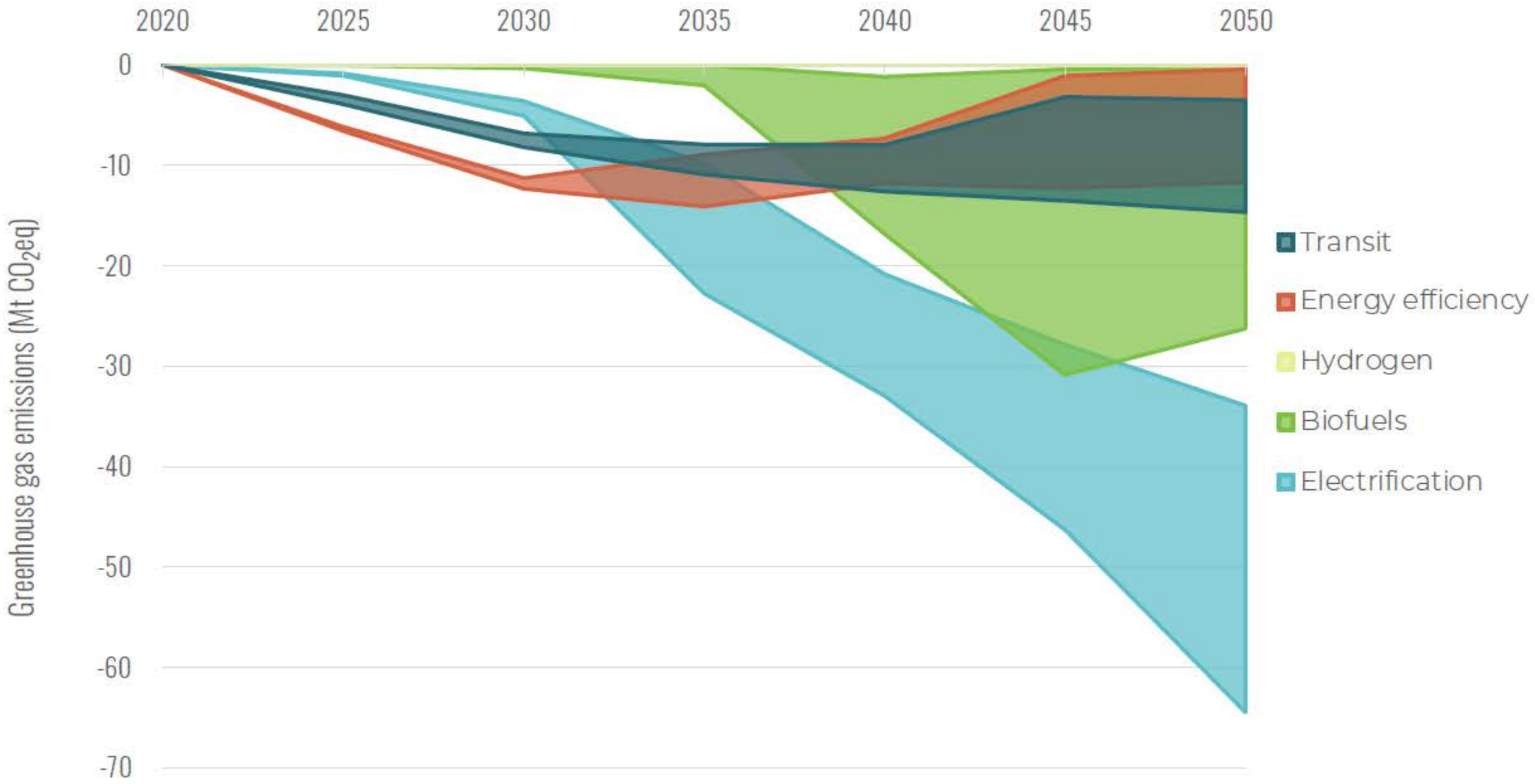
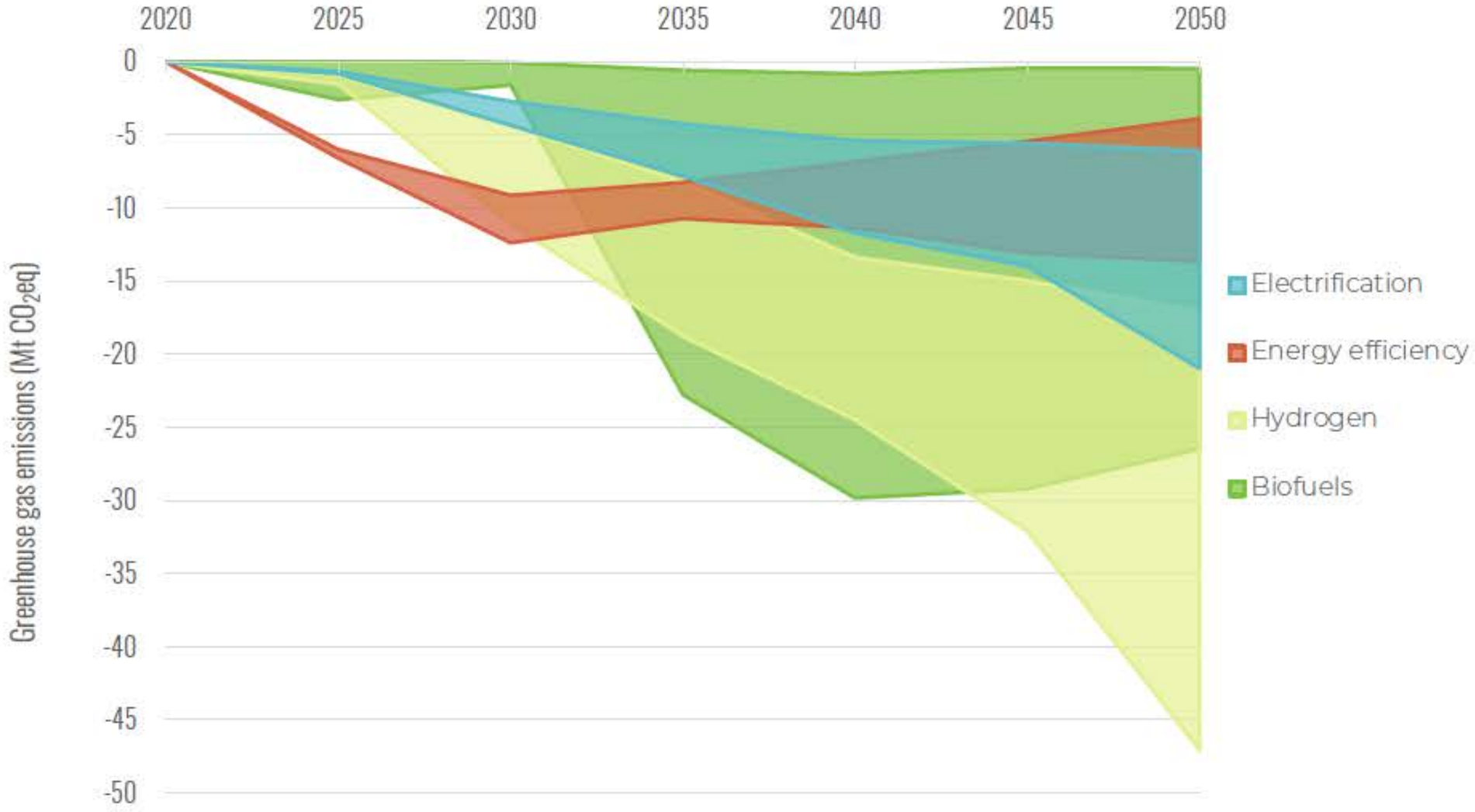
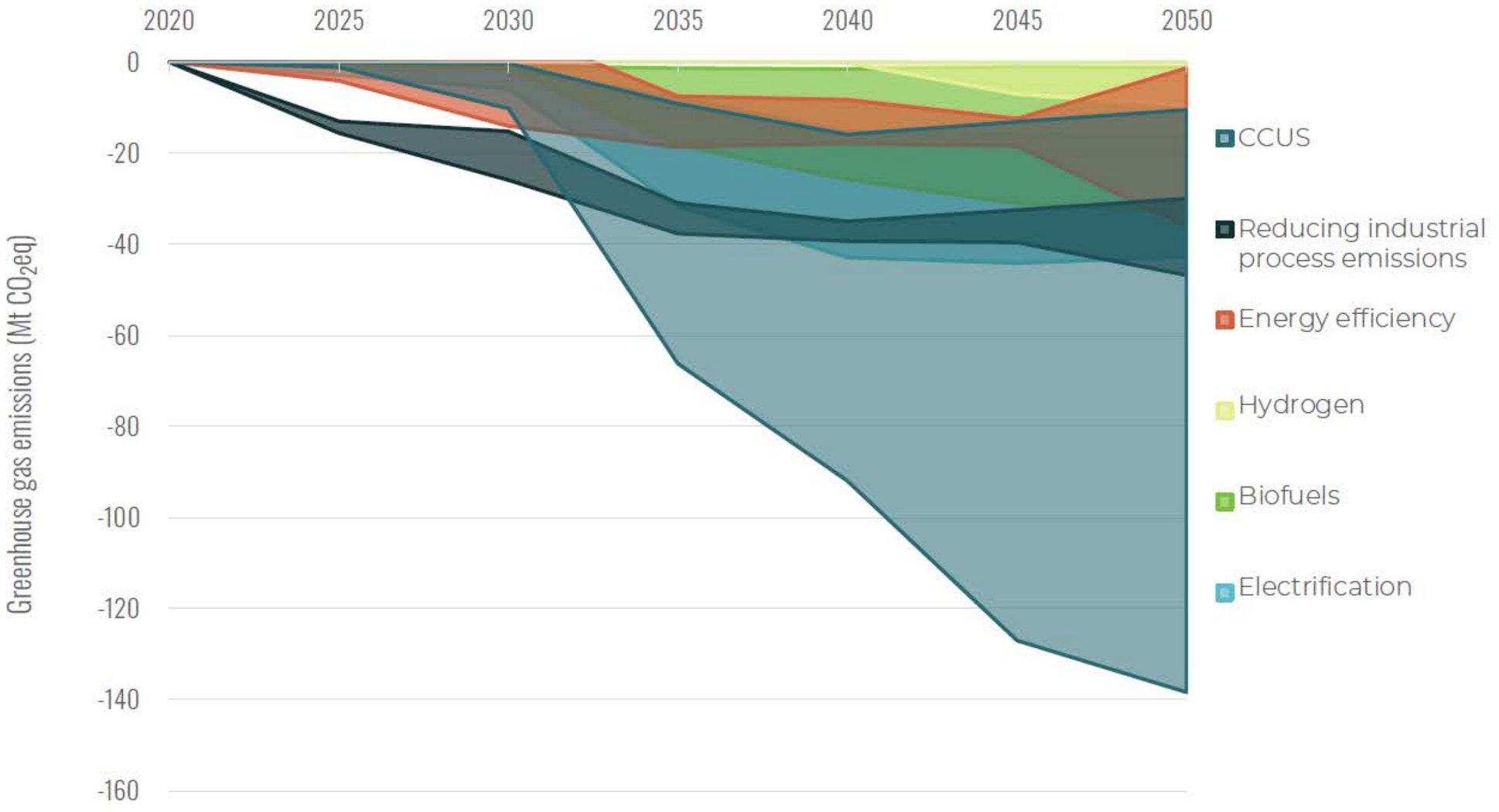


Figure 23: Medium- and Heavy-Duty Transportation



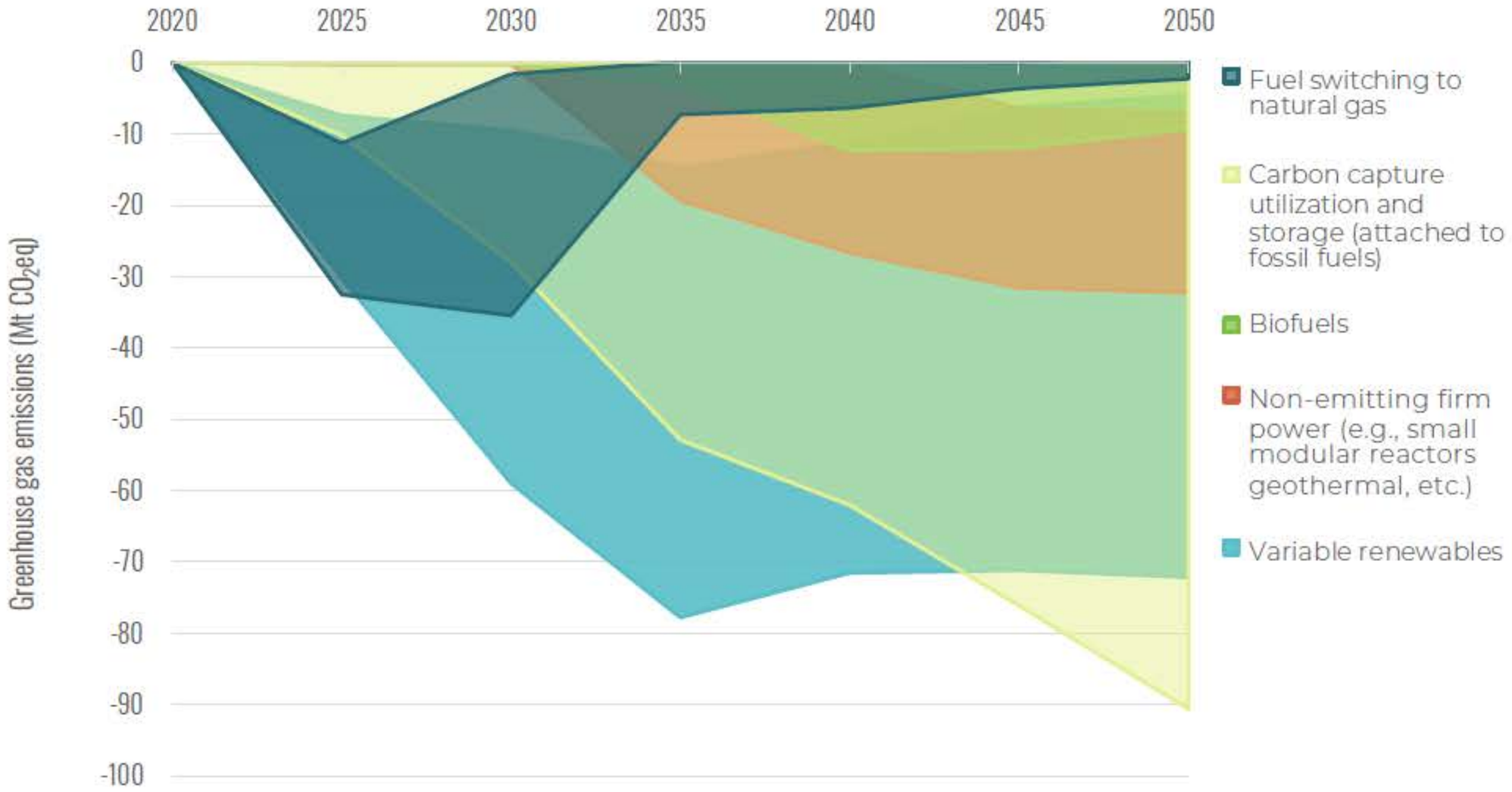
CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 24: Industry



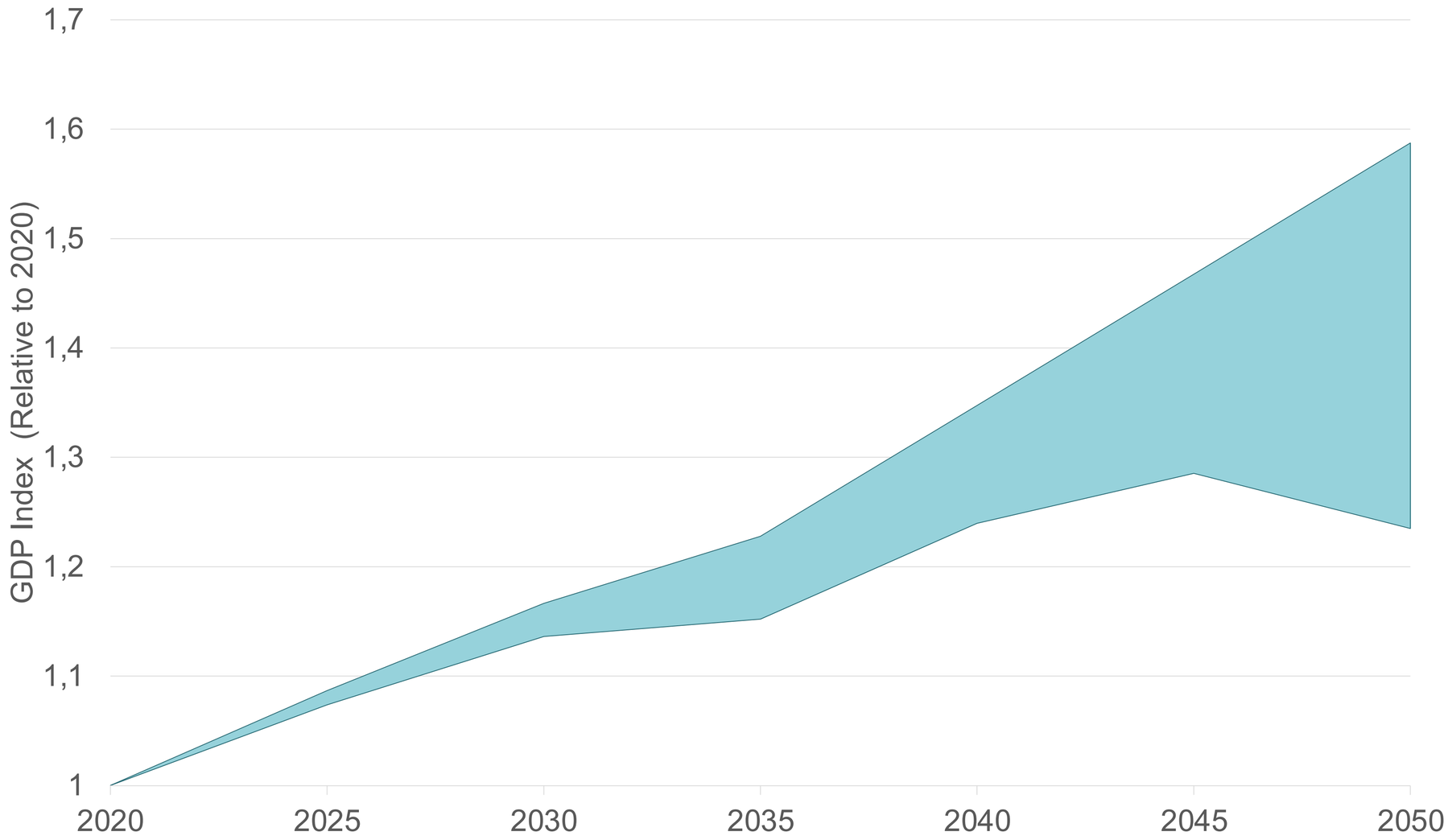
CANADIAN INSTITUTE FOR CLIMATE CHOICES

Figure 25: Electricity Generation



CANADIAN INSTITUTE FOR CLIMATE CHOICES

Additional Figure: National gross domestic product across pathways to net zero

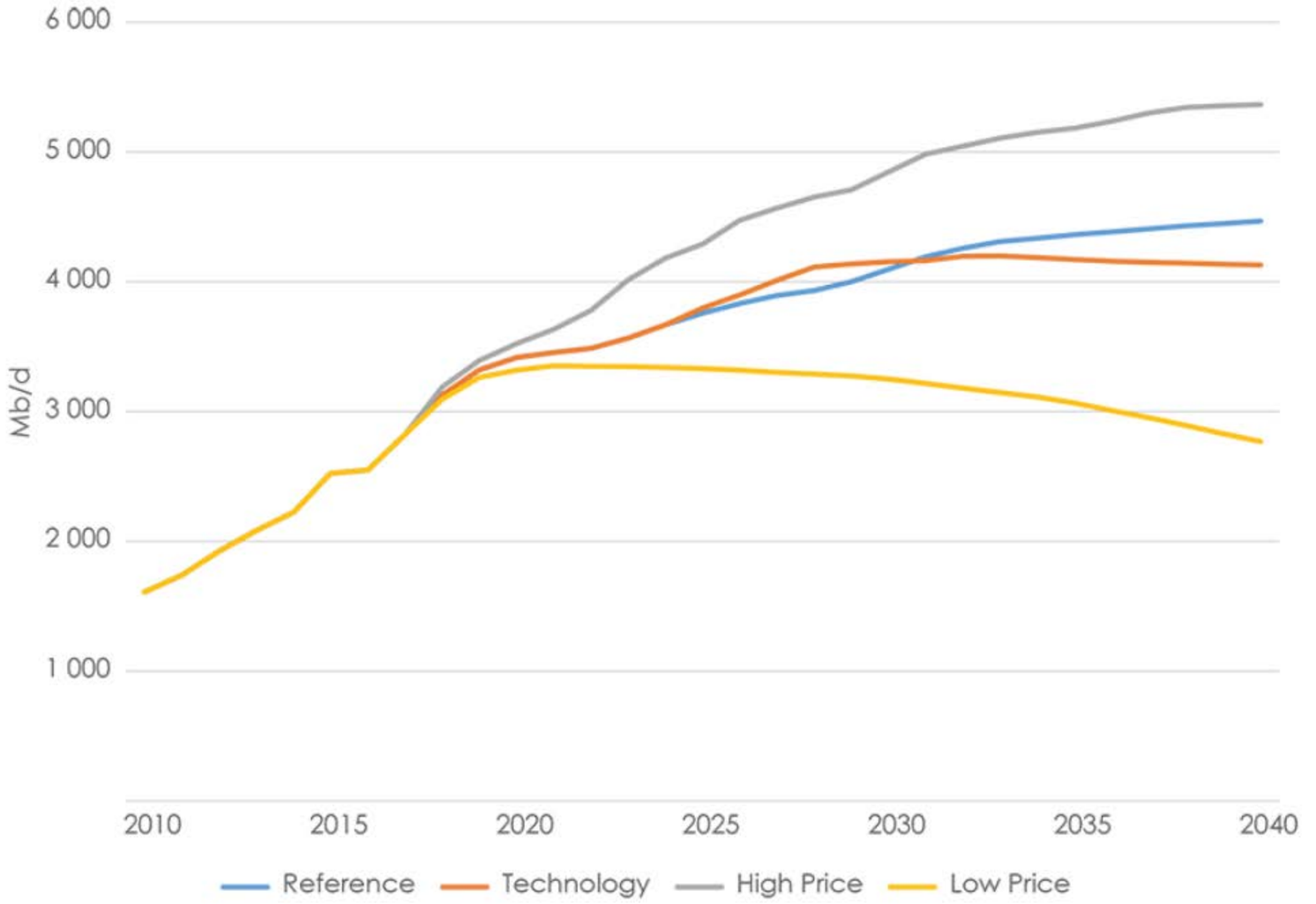


CANADIAN INSTITUTE FOR CLIMATE CHOICES

Additional Figure: Canada's Energy Futures 2018

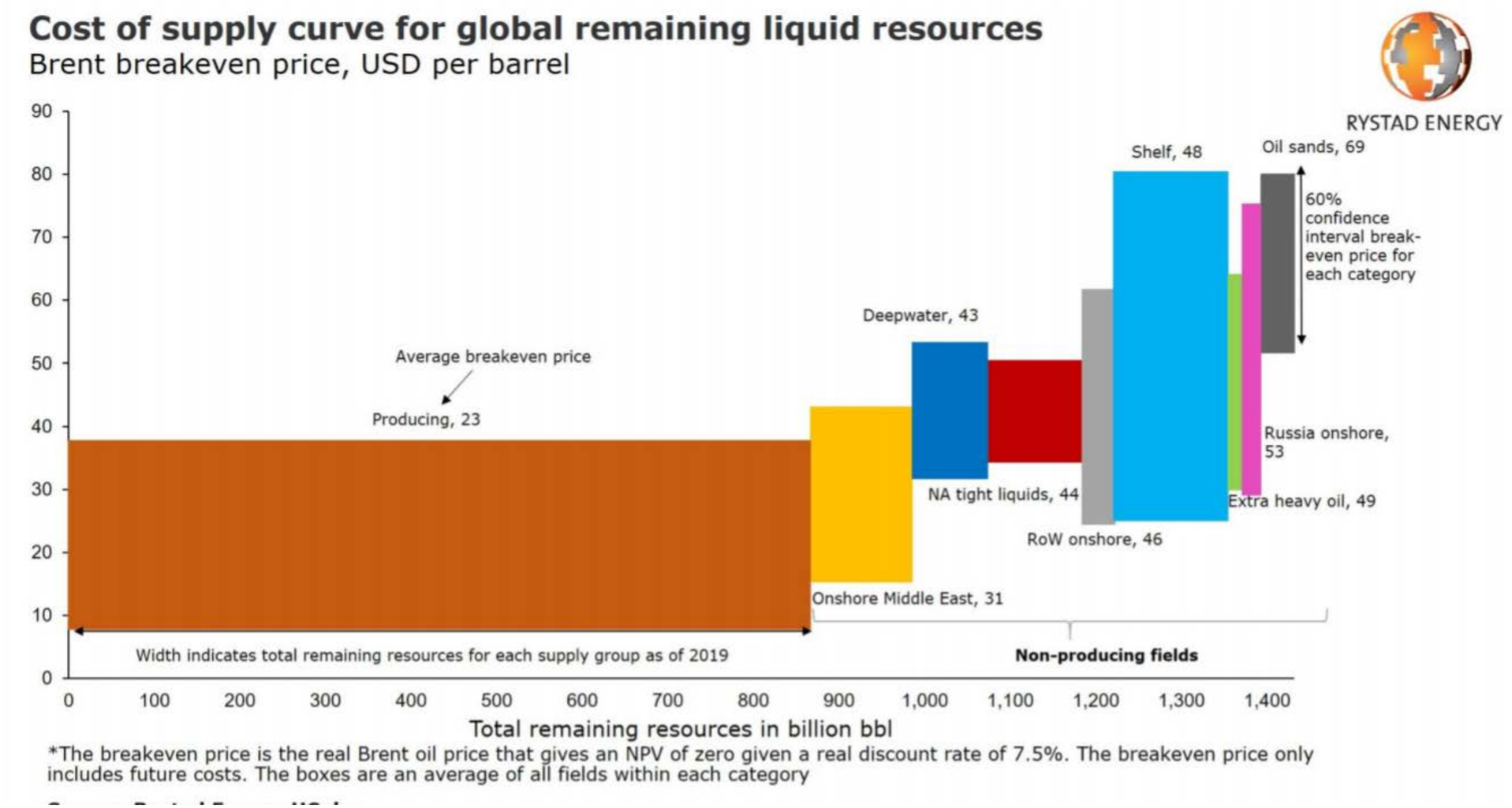
Chapter 3: Results – All Cases

Figure 3.1 Raw Bitumen Production from all four EF 2018 Cases



CANADIAN INSTITUTE FOR CLIMATE CHOICES

Additional Figure: Global oil production cost profile



CANADIAN INSTITUTE FOR CLIMATE CHOICES