

November 30, 2016

The Canadian Heavy Industry Decarbonization Technology Project:

*A project of the Canadian Deep Decarbonization
Pathways Project, supported by the Industrial Gas
Users Association*

Dr. Chris Bataille

Associate Researcher / Adjunct Professor
IDDRI-SciencesPo (Paris) / SFU (Vancouver)

chris.bataille@iddri.org

IDDRI

Presentation overview

- Who am I
- **Background** – The global carbon budget, Canada's contribution, the global and Canadian DDPP projects, and why decarbonization of heavy industry is necessary
- **The method** – literature review and gathering of sectoral technologies into a living database for use by modellers and policy people -> ongoing working and peer reviewed publications
- **The results**
- **Discussion & Policy implications**

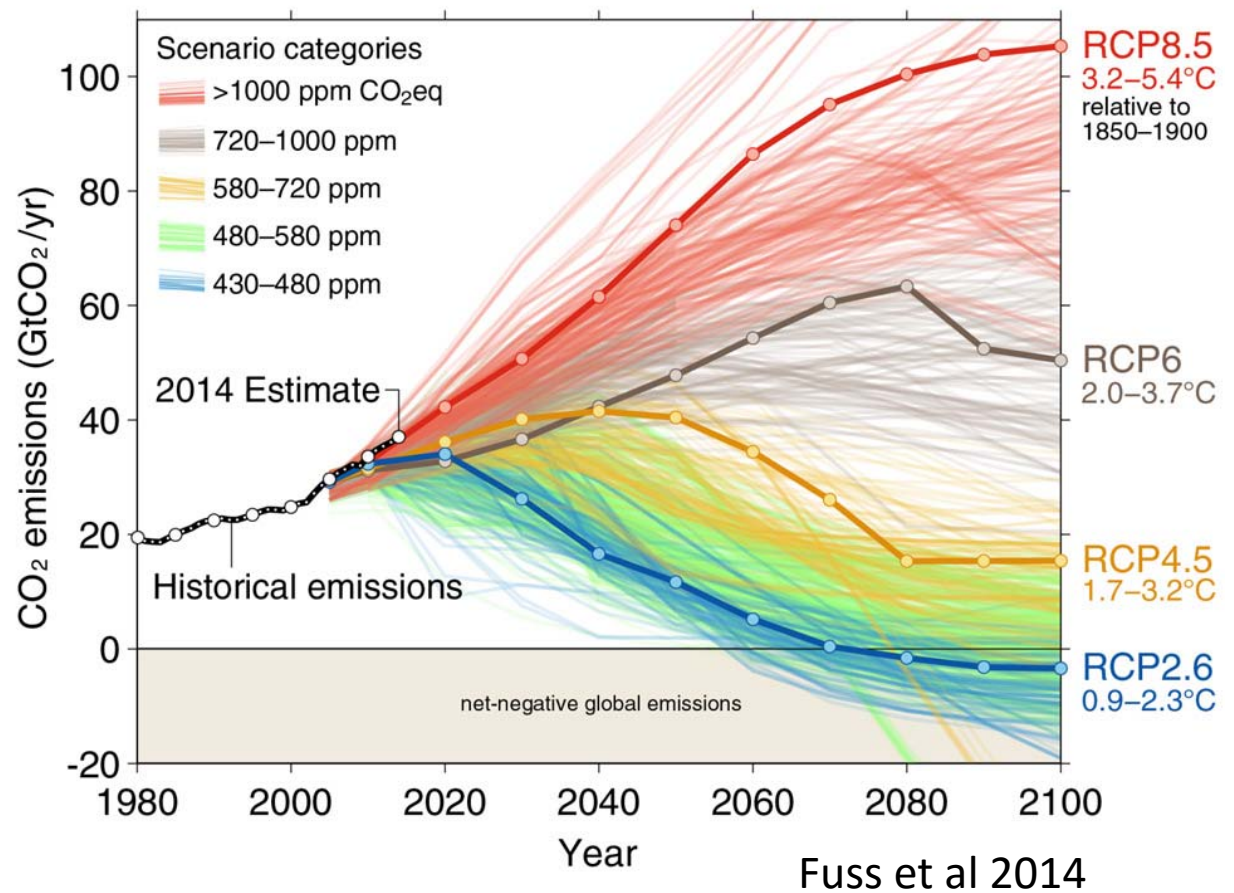
Who am I

- Energy/macro-economist with 20 years of working with engineers on tech sim and CGE models
- Two hats: Co-leader of the Canadian DDPP team & member of the global DDPP secretariat (Assoc. researcher IDDRI in Paris)
- Lead editor of the DDPP Climate Policy Special Issue
- Adjunct Professor at Simon Fraser University
- Consultant: Executive Director of MKJA Inc. (2006-2011). Co-founder & executive director of Navius Research Inc. a Vancouver energy policy consultancy (2011-2014).
 - Clients: NRTEE, Canadian federal ministries of energy & environment; BC, AB, SK, ON, NFL, & NWT governments; provincial regulators; energy utilities; NGOs; OECD

2°C, the global trajectory for energy-related emissions

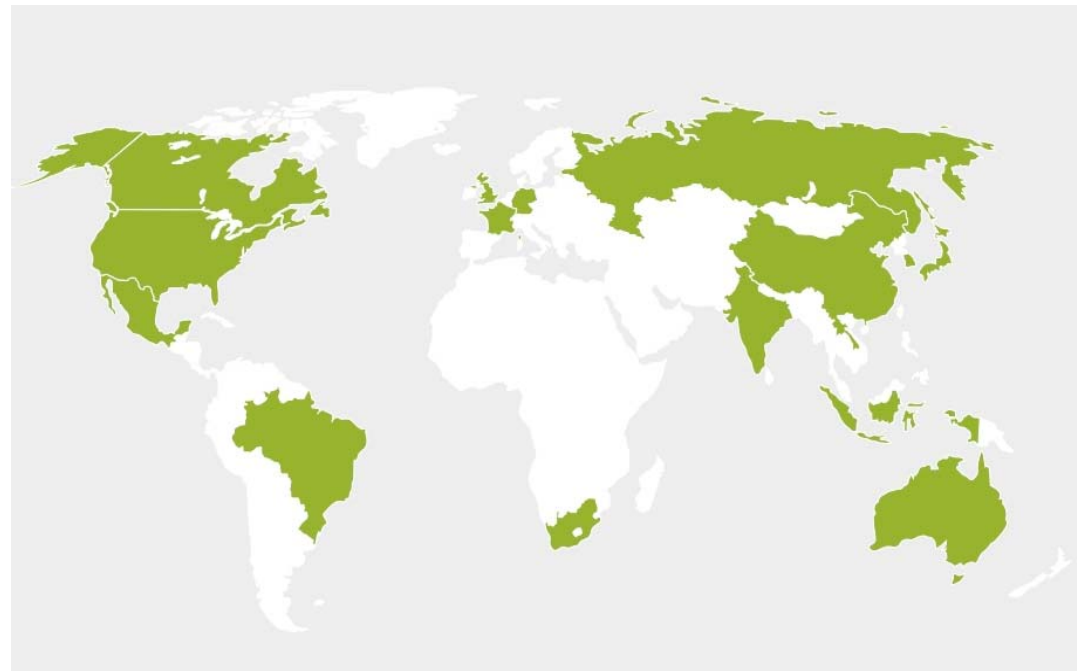
To 2050:

- Absolute GHGs >/2
- GHGs/capita >/3
- GHGs/unit GDP
 - /~ 10
- Carbon neutrality in the 2nd half of XXIe century
- Global peaking around 2020

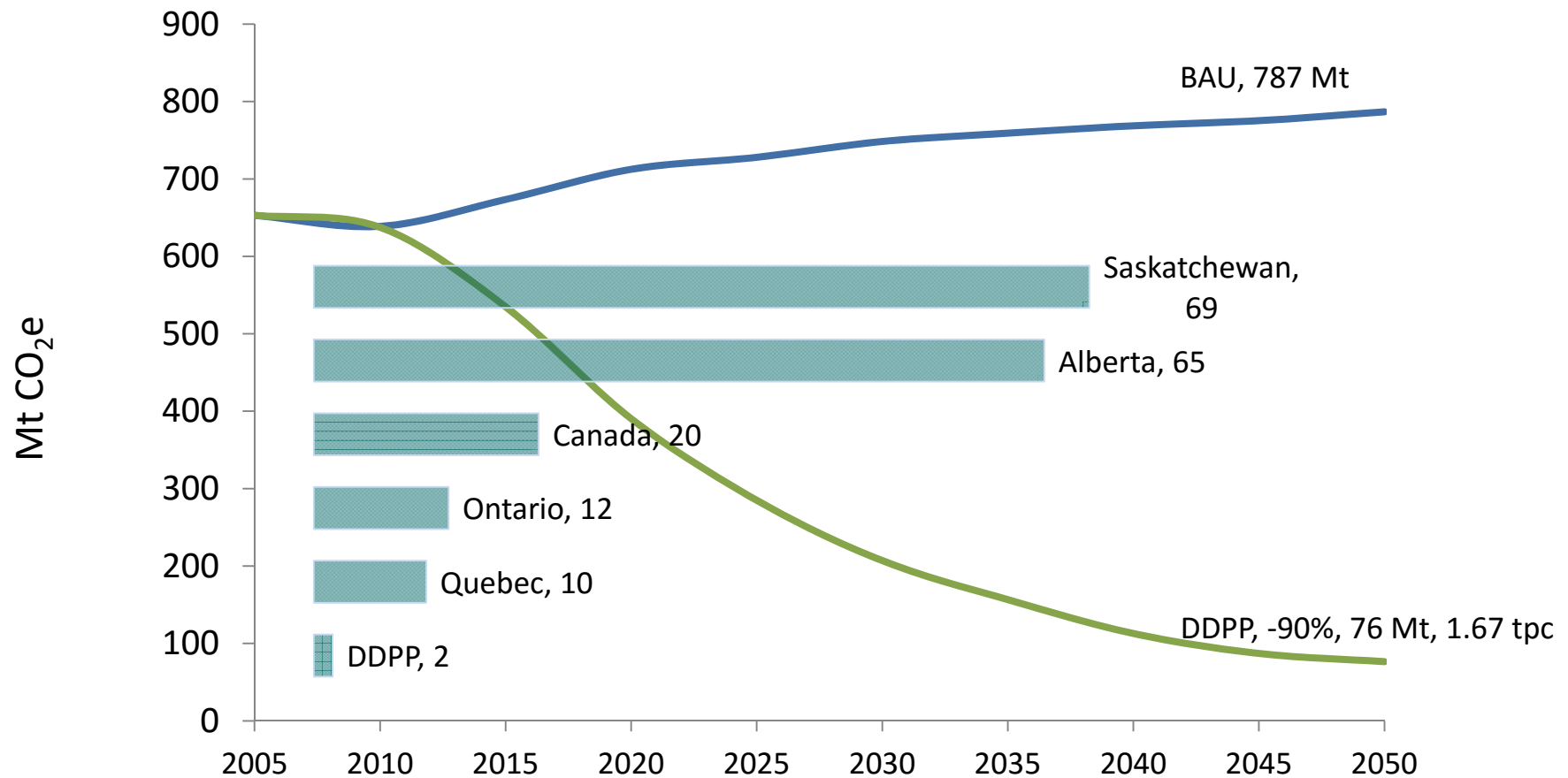


The DDPP

- ❑ 16 country teams covering 74% of 2010 energy-related CO₂
 - National-scale approach to capture domestic circumstances
 - Long-term vision to inform short term policy
 - Product: Detailed & visual physical & economic maps of the transition via “dashboards” to inform domestic policymaking & international cooperation
- ❑ Goal: <2tCO₂e/cap by '50



The DDPP in the Canadian context*



* No agriculture or LULUCF

The pillars of decarbonization

- Efficiency (min 50% improvement)
- Decarbonization of energy carriers (electricity, hydrogen, biofuels, synthetic hydrocarbons (e.g. NG))
- Switching to decarbonized energy carriers
- Direct emissions reduction
 - CCS -> Net negative emissions
 - Land use change
- Domestic and international institutions to carry out policy, allow trading, and conduct shared R&D projects
- **Induced structural change (do we want to import decarbonized industrial commodities, or make them?)**

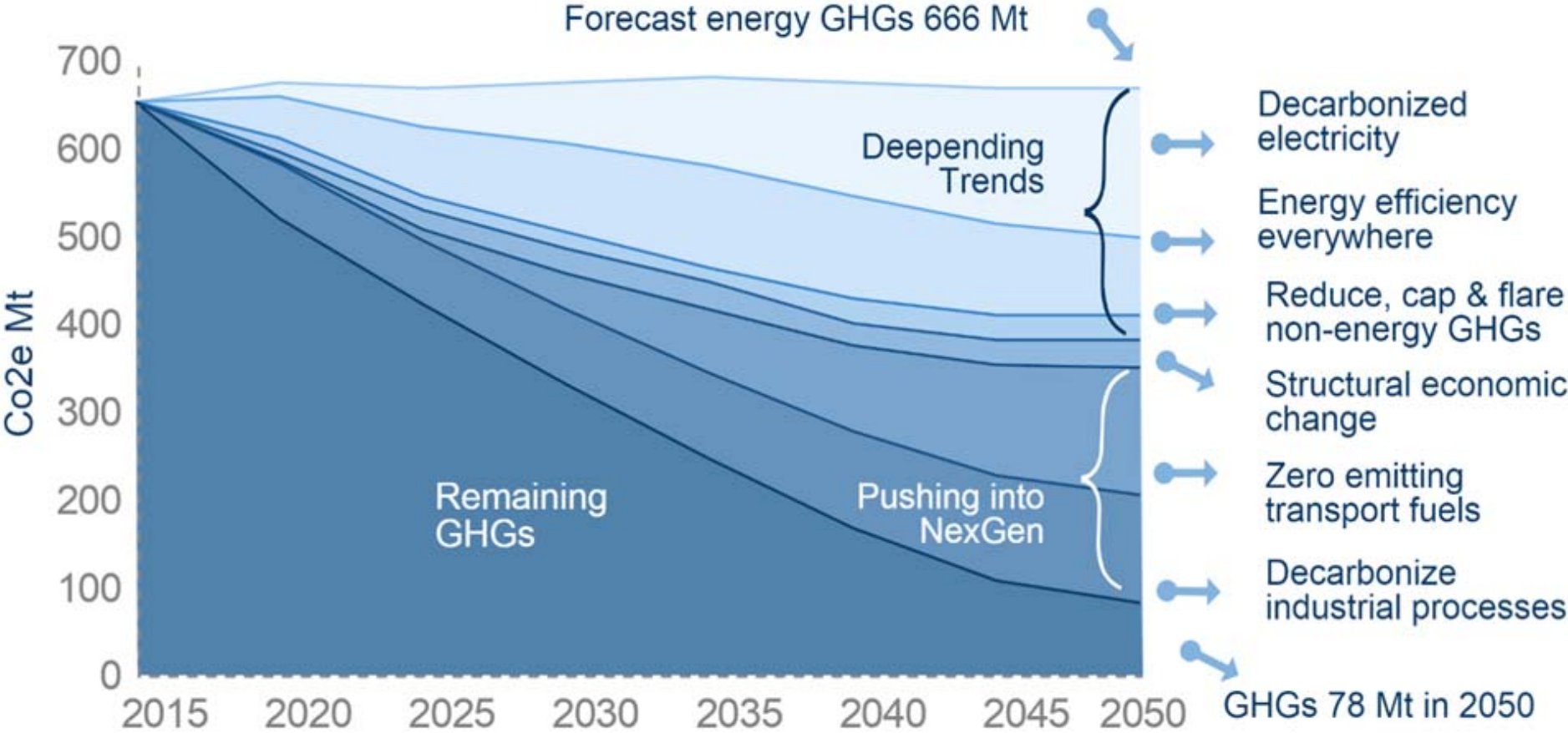
Heavy industry learning from the DDPP and follow-up research

- A repeated finding of the DDPP was the difficulty and cost of decarbonizing heavy industry due to heterogeneity, GHG intensity, sensitivity to costs, and long lived facilities.
- However, global growth in consumption of minerals, steel, cement, chemicals, and glass means even with a ~50% reduction in material intensity in a low carbon economy, more will be needed.
- New bulk commodities will be required: zero GHG electricity, hydrogen, bioliquids and gases, chemicals, & synthetic hydrocarbon liquids and gases.
- **Q: What to do about heavy industry ??**

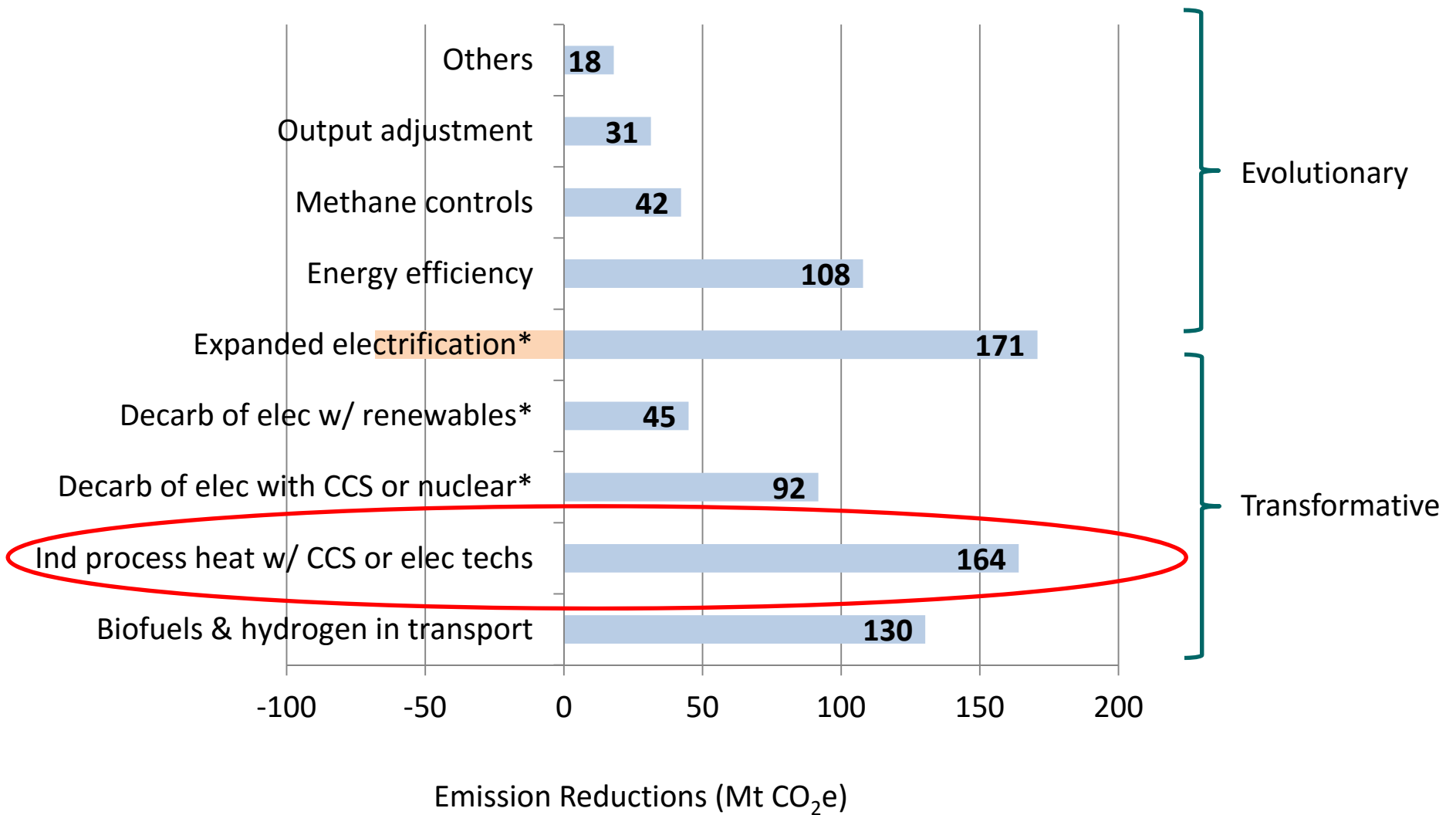
Research Questions

- **Core Q:** What technologies exist to decarbonize heavy industry?
- **Secondary Q:** Relative competitiveness implications?
- **Secondary Q:** What positive approaches have other countries, regions, companies or institutions taken to these challenges?
 - Case studies of Statoil, Saskpower, and the Quest Project
- **Secondary Q:** How can we manage the transition from today's fossil fuel orientated industry to a net-zero carbon future with a minimum of stranded assets, or harming competitiveness?
 - Review of the policy package developed for the CDN DDPP
- This study is an opportunity seeking scoping survey, and is not meant to be exhaustive (that means more money & time).

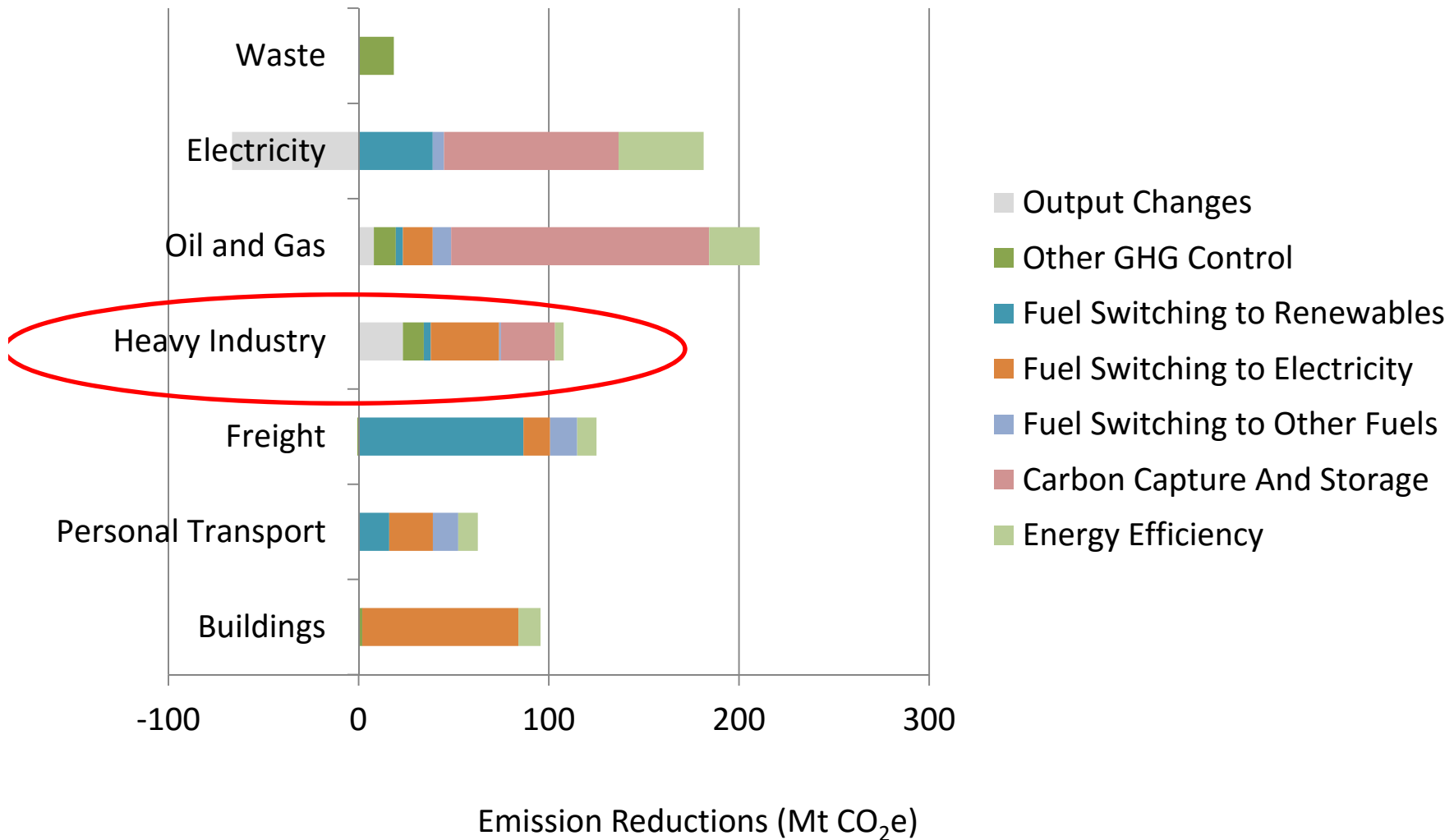
Results: Decarbonization Pathways



Results by technology pathway: Canada



Results by sector: Canada



Results of the academic and trade literature review

- IEA indicates about a 20% improvement in efficiency is possible from BAT, and another 20% from innovation.
- IPCC AR5 (2014) indicates:
 1. 22-38% improvement in efficiency is possible;
 2. that 44-57% of final energy is amenable to electricity or biofuel switching, and
 3. only CCS takes us to 70-90% GHG reductions.
- *Upshot: If we don't want to depend on advanced CCS everywhere we use process heat, then major process developments are necessary.*

Results of the academic and trade literature review (2)

- Pilot techs exist for every sector to completely decarbonize:
 - Database disaggregated by: cement, lime, glass, iron & steel, metal processing, mining, refineries, chemicals (distinguished by type), pulp & paper, and generic services
- Most technologies are not retrofittable to existing stock, but can use existing siting within context of 1-2 investment cycles
- Most dependent on biofeedstocks or decarbonized electricity, used directly or to make hydrogen, methanol (w/+CO₂), ethanol, ethylene, derivative compounds or other synthetic hydrocarbons
- Some sectors, e.g. iron & steel, may require organizational changes to allow more recycling (e.g. decarb electricity in EAFs)

Discussion and recommendations

Tech and infrastructure

- Large amounts of decarbonized electricity necessary, and policy and associated market signals to supply it
- Electricity grid upgrades to allow more intermittent renewables and to get it to industrial areas
- The NG grid: Significant option value as storage and transport for bioNG, H₂ and synthetic CH₄

Discussion and recommendations

Policy (1/2)

- Gather stakeholders (industry, government policy makers, academia, civil society, ENGOs) to develop a detailed vision that :
 - engages research capability,
 - reflects appropriate capital investment cycles,
 - identifies policy options to implement this vision
 - develops feasible decarbonisation pathways for industry based on regionally specific circumstances
- Establish institutions to coordinate public research, technology commercialization, and associated labour force training.
- Make decarbonized heavy industry an explicit priority.

Discussion and recommendations

Policy (2/2)

- Participate in global R&D efforts for key industries, find partners with similar challenges (e.g. Australia, Russia)
- Participate closely and carefully in negotiations related to trade in GHG intense goods. Ensure they preserve a clear signal for decarbonization of new stock while fairly protecting existing stock.
- What policies, beyond R&D, can help us bring these technologies on?

The Canadian DDPP policy principles

- **Performance orientated regulations** and information for less price-sensitive sectors (buildings and transport).
- **Carbon pricing** for price-sensitive sectors, and to incentivize technology innovation.
- **Policies that support:**
 - **innovation**, pushing the technology frontier forward, R&D, prototyping and commercialization support
 - **infrastructure change**, (e.g. elec grid, land use, transit finance,).
- **Institutions to monitor sectoral progress towards decarbonization**, and to adjust policy if necessary.

The Canadian DDPP policy package

- **Energy & GHG intensity regulations requiring the use of zero emission technologies in the buildings, transport & potentially electricity sectors:**
 - Net-zero-energy residential buildings after 2025; commercial buildings 2035.
 - All new personal vehicles to run on decarbonized energy by the early 2030s, and heavy freight vehicles by 2040.
- **Hybrid carbon-pricing, for heavy industry & the rest of the economy:**
 - Some form of cap & trade for heavy industry, designed for competitiveness concerns and linkage. We used an intensity based system w/OBA falling to -90%
 - A carbon price rising to CDN \$50 by 2020 and then reaching CDN \$350 through \$10 annual increments to 2050. We used BC's 50/50 recycling formula. The charge would be flexible to technological progress.
- **Mandatory controls for all landfill and industrial methane sources.**
- **Land-use policy that values the net carbon flows of large parcels.**

Conclusions

- It can and needs to be done:
 - Electrify everything that can be done so today but didn't make sense to before
 - Instigate the necessary R&D, innovation and commercialization to decarbonize everything else via new electric processes, process heat from biofuels or synthetic hydrocarbons, or ...?
- Policy matters:
 - It is economically affordable if done in cooperation with trading partners, and BTAs are engaged against non-players
 - Policy driven R&D, innovation, and trade rules are the key

Going Forward

- Database will be expanded and reviewed with UK, Swedish, Italian and German partners (no US partner yet)
- Review paper based on it at draft stage, will be submitted for publication early in the new year
- Original purpose was to inform modelling, but biggest effect have been in conversations with Canadian policymakers; Ontario (which includes Canada's "rust belt") seems to have absorbed this well at certain levels.
- If the project were to carry on and grow, how, with what resources?
- Questions ?

For the DDPP Global Synthesis and
Canadian DDPP Reports, go to:
www.deepdecarbonization.org

For questions:
chris.bataille@iddri.org, cbataill@gmail.com