DEEP DECARBONIZATION PATHWAYS PROJECT

The APERC “deep decarbonisation” 2DS scenario, the technical & policy implications for heavy industry, and some implications from a Canadian case study for the 8th version

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Questions to address in the next 20 minutes

- Who am I
- The 1.5-2ºC global carbon budget & heavy industry
- Some observations from the global and Canadian DDPP project results
- How currently energy and emission intense industry could respond to the 1.5-2ºC goal; the technical capacity for net-zero GHG emissions heavy industry
- Possible missing dynamics in the 7th edition 2DS scenario
- What are the technology, resource, investment and policy considerations of adopting deep decarbonisation policies in the big 5 APEC economies?
- Deep decarbonisation vs adaptation for the 8th edition?

Who am I

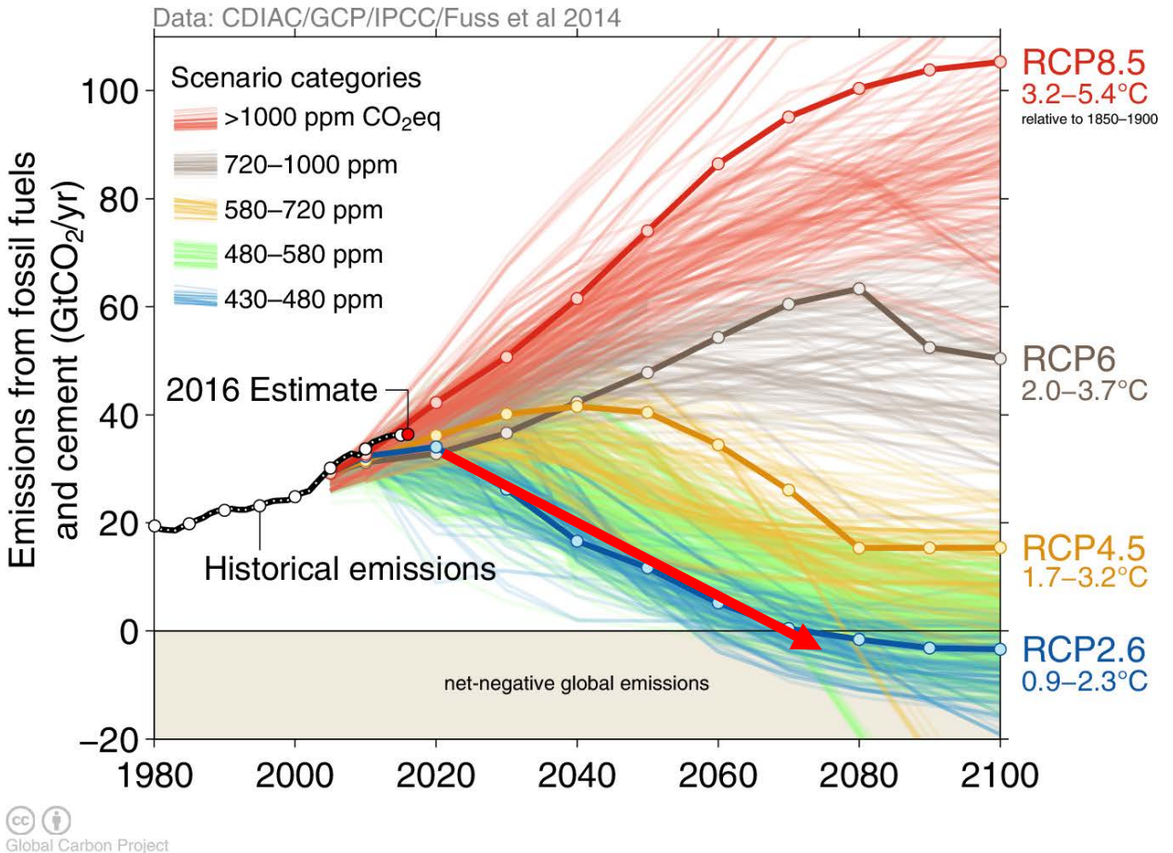
- I have been involved in energy and climate policy analysis for 21 years as a researcher, energy systems and economic modeller, analyst, writer, project manager, and executive. Executive Director of MKJA Inc. (2006-2011), Co-founder & Executive Director of Navius Research Inc. (2011-2014).
- Associate researcher with IDDRI.org in Paris, Lead Author of the Industry Chapter of the next IPCC report (AR6) over 2019-21
- Leader of the DDPP Heavy Industry Deep Decarbonization Project
- Adjunct Professor at Simon Fraser University

The global carbon budgets & what the 2015 Paris Agreement « well below 2°C » means

To 2050:

- ❑ Total GHGs >/2
- ❑ GHGs/capita >/3
- ❑ GHGs/unit GDP -> / 10
- ❑Net-zero ~2070
- ❑Global peaking … now

Updated with data from Fuss (2016)



The Deep Decarbonization Pathways Project (DDPP) 2013-2016

- 16 country teams covering 74% of 2010 energy-related CO_2
  - Country scale to capture dom. circumstances, development goals & politics
  - Goal: long-term vision to 2ºC to inform short term policy
  - Product: Detailed & visual physical & economic maps of the transition via "dashboards" to inform domestic policymaking & international cooperation
- Goal: <2tCO_2e/cap by '50

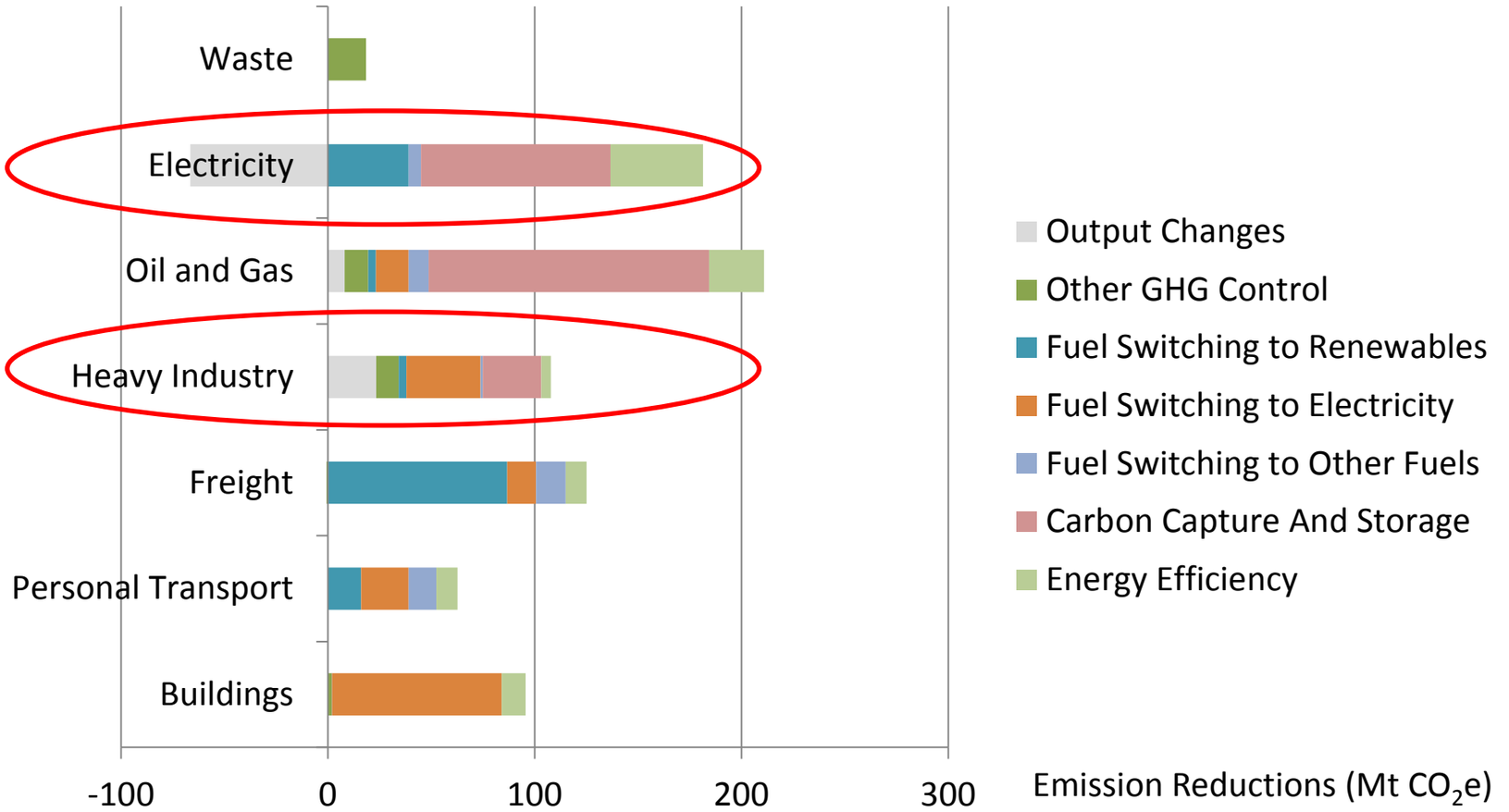
Common findings from the DDPP and other modelling

- 2°C deep decarbonization is technically and economically viable, but requires global technological, financial and trade enabling conditions
- The pillars of decarbonization:
  - Efficiency (+50% min),
  - Decarbonization of fuels (electricity, bioliquids and gases, hydrogen, synthetic hydrocarbons) & switching to them with 200-300%+ elec gen
  - Land use
- Electricity, buildings, personal transport and light manufacturing are relatively easy
- **Heavy industry**, freight and aviation are technological challenges

How to get form 18 to <2 tonnes per capita by 2050
A modelling derived DDPP Canada policy package (2014-15)

- **Best-in-class mandatory energy & GHG intensity regulations requiring the use of zero- emission technologies in the buildings and transport sectors (& potentially electricity)**, applied to all new & retrofits:
  - Net-zero-energy homes starting in 2025, & commercial buildings in '35
  - All new cars zero GHG by early 2030s, and heavy freight by 2040.
- **Hybrid carbon-pricing, for highly traded heavy industry & the rest of the economy**:
  - Carbon price: \$10/tonne CO_2e plus \$10/yr, revenues used to reduce taxes. Cap & trade for heavy industry; an intensity based system falling to -90% with output based allocations to address competitiveness, leakage & linkage
- **Mandatory controls for all landfill and industrial methane sources.**
- **Land-use policy that values the net carbon flows of large parcels.**

DDPP results by sector: Canada

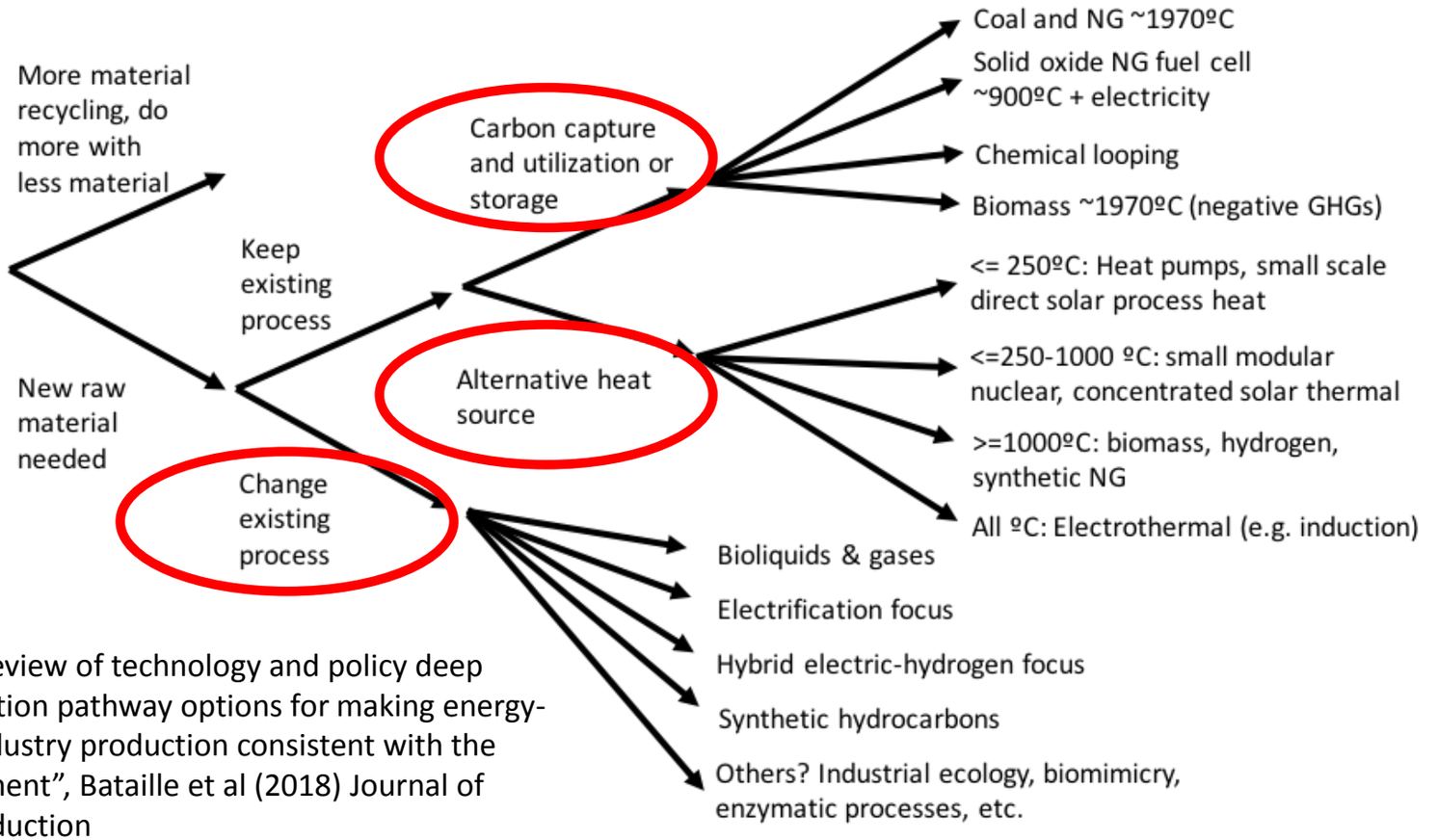


Incremental investment required: Canada & globally

	2000-13 annual inv. CANSIM 31-0002	Capital investment	Energy	Labour	Net
Average annual incremental investment, 2015-50, $2005 billion					
Residential Homes/Buildings		-0.4	1.6	0.0	1.2
Commercial Buildings		0.6	0.6	0.0	1.2
Personal Transport		**-3.6**	-0.7	-0.8	-5.1
Transport & warehousing/(just rail and trucks)	14.2/(3.2)	-0.9	1.1	-2.2	-2.0
Electricity Generation	13.0	**11.2 (+86%)**	0.3	0.8	12.3
Oil, NG & pipelines	41.8	**2.4 (+6%)**	1.1	0.0	3.5
All other heavy industry – (elec, O&G)	35.2	0.5 (+1.4%)	1.2	1.1	2.8
Household expenditure required		-4.0	0.9	-0.8	-3.8
Private sector investment required	172	13.9 (+8%)	4.1	-0.2	17.8

Global reallocation of capital & labour: ~2 trillion USD/yr, ~2.4% global GDP today, ~1.2% of 2050

Generalized choices for industry decarbonization

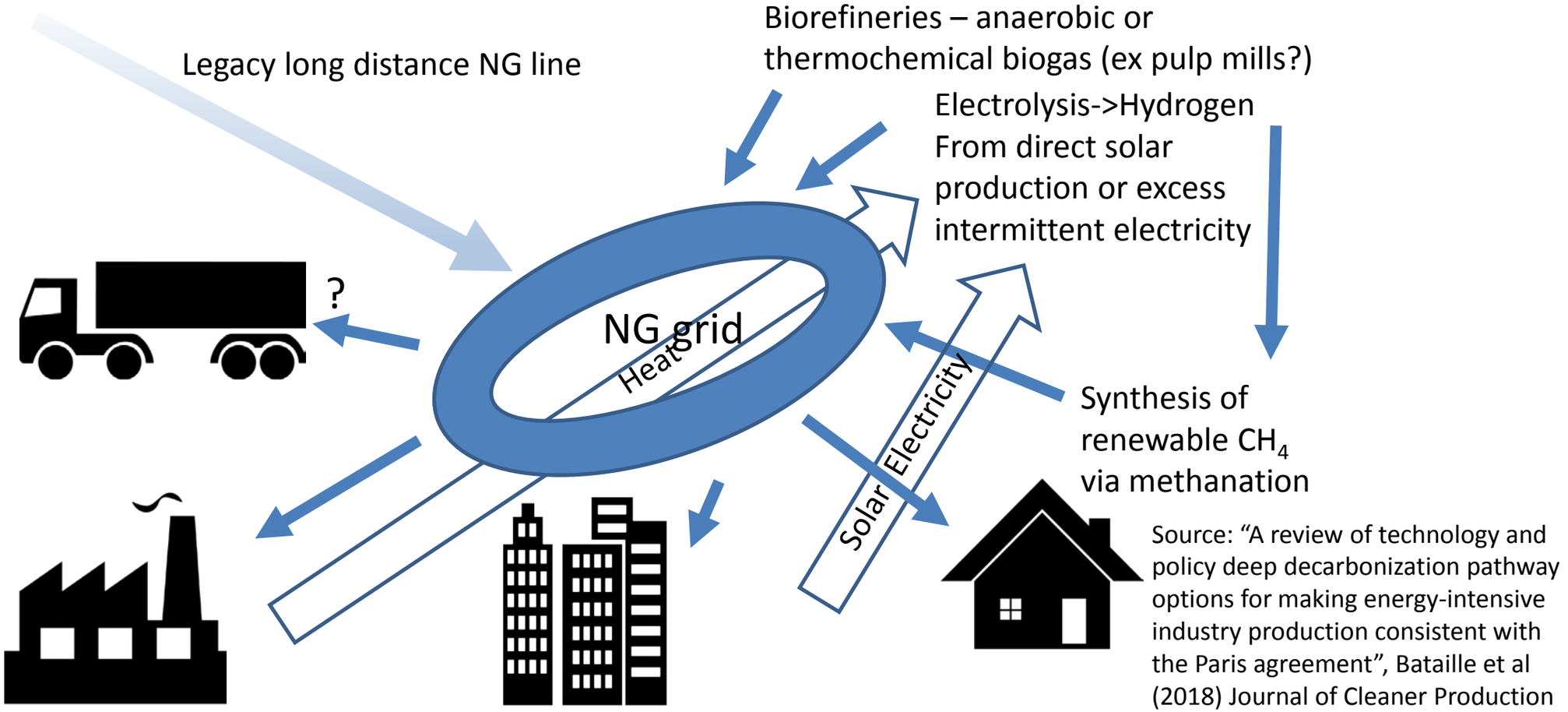


Source: "A review of technology and policy deep decarbonization pathway options for making energy-intensive industry production consistent with the Paris agreement", Bataille et al (2018) Journal of Cleaner Production

Detailed sectoral findings

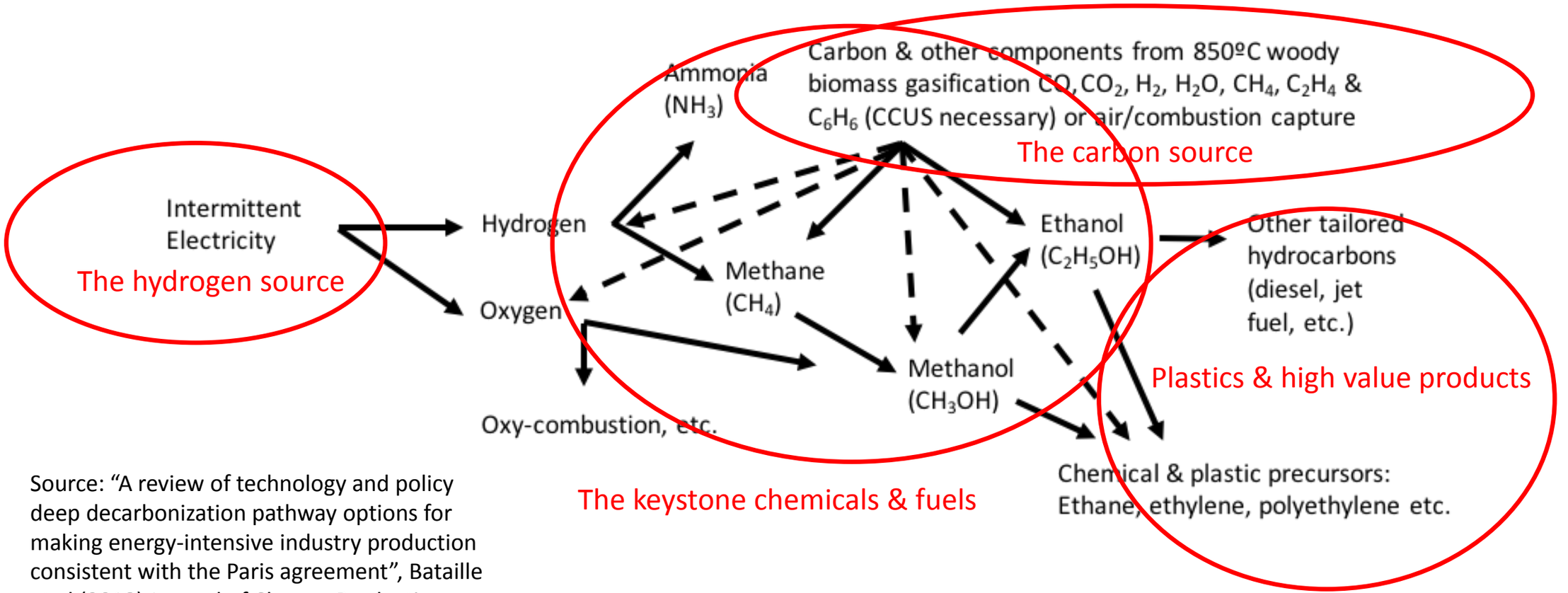
- Pilot techs exist for every sector to completely decarbonize; the project produced a detailed sectoral database of options
- Most technologies are not retrofittable to existing stock, but can use existing siting within context of 1-2 investment cycles
- Most use biofeedstocks, decarbonized electricity or carbon capture and storage, all of which Canada has in abundance
- Large amounts of decarbonized electricity necessary, including institutional reform, policies, and energy and capacity markets to supply it. Grid and storage upgrades to allow more intermittent renewables and to get it to industrial areas
- Some sectors, e.g. iron & steel, may require organizational changes to allow more recycling (e.g. decarb electricity in EAFs)

While new should be electric based where possible by mid 2030s, where there is a methane transmission grid it could be key to transition of legacy buildings and facilities



Source: "A review of technology and policy deep decarbonization pathway options for making energy-intensive industry production consistent with the Paris agreement", Bataille et al (2018) Journal of Cleaner Production

Where is all that net-zero GHG methane (or other high temp burning chemicals) going to come from?



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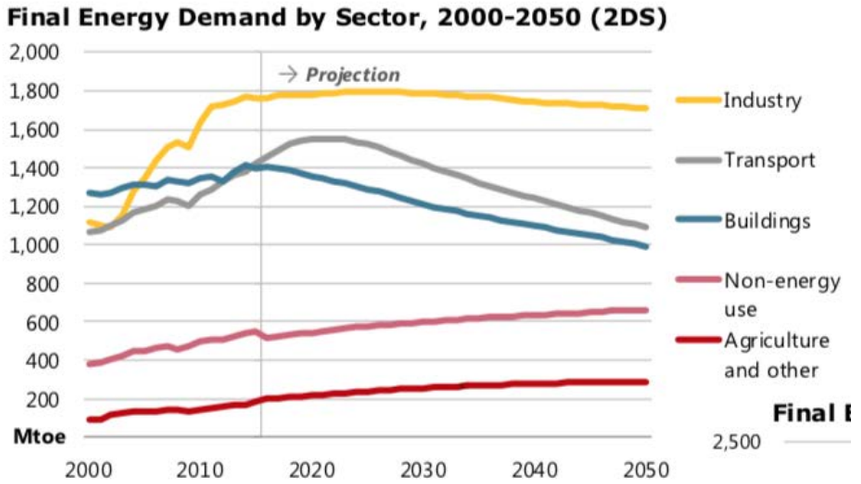
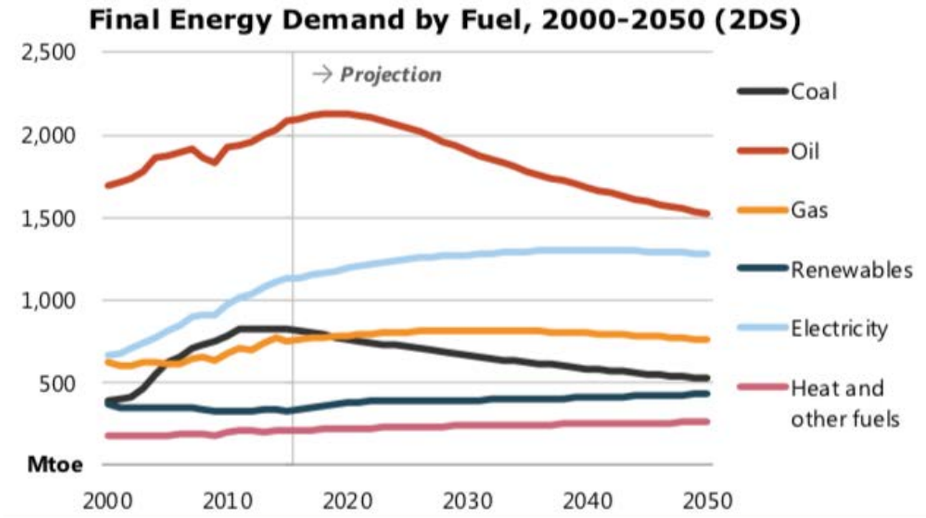
The challenges are more than technological

- Industrial firms will underinvest in low GHG tech because while emerging tech exists, CAPEX is focussed and upfront, they can't capture the benefits, they can’t pass on costs without losing market share, few co-benefits & ***there is no market for more expensive low GHG materials***
- Policy for heavy industry needs to target these challenges directly:
  1. A stakeholder process to assess options and build a working consensus
  2. Business models to share tech risk across firms and willing consumer nations
  3. Output support (e.g. green procurement, GHG content requirements)
  4. GHG pricing in materials, border carbon adjustments in transition
  5. Supporting institutions: lifecycle GHG accounting, insurance, regulatory, etc





The existing 2DS scenario: some missing dynamics

- Summary now to 2050 observations: electricity final energy demand rises and flattens at ~1300 Mtoe, coal falls ~900 to ~500, NG flat at ~800, oil down 2100 to 1500
- Opinion: in a 2DS scenario electricity demand should at least double to ~2000
- Opinion: Gas demand is a wild card, and could double with a global LNG market. And what gas? Fossil, bio, synthetics, some hydrogen, etc.?
- Opinion: Coal, while an energy security fuel, is too high. It's bad for air quality and is harder to use with CCS than gas, and is less useful for industry. It's the "low trust in trade" fuel, and gas is the "high trust in trade" fuel.
- Opinion: Oil could fall another 1000+ Mtoe, depending on transport demand

What are the technology, resource, investment and policy considerations of adopting deep decarbonisation policies in the big 5 APEC economies?

- China just over 10 Gt/yr, US ~6 Gt/yr, Russia ~2 Gt/yr, Japan ~1+ Gt, then …
- I've chosen to reframe the question along these lines:
  - We all have the same technology, but not the same resources. We all need to electrify, but how? Access to nuclear energy; intermittent renewables (land and ocean); carbon capture and storage reservoirs, e.g. depleted oil and gas or deep saline reservoirs?
  - Did a gas network get built already? What capacity is there for renewable methane (biogas, power-to-gas) or other gases (e.g. hydrogen)?
  - Is LULUCF included? Indonesia falls in and out of top emitters …
- Policy: Who owns/governs the energy system?

Deep decarbonisation vs adaptation for the 8th edition?

- I would argue this is the wrong question: 2DS IS an adaptation scenario, +0.9ºC from today. The right question is what level of adaptation are we willing to tolerate as a global society, balanced against mitigation and capability to deliver it.
- A better scenario: one based on prioritization of energy security and air quality without climate change mitigation, as opposed to including climate.
- Great work is being done here, and there lots of possibilities going forward.
- Final note: There is also Latin American DDPP project in progress, with more emphasis on land use, development issues, and necessary domestic technology, finance and trade conditions to embrace stronger conditional NDCs.
- Thank you for your time!

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

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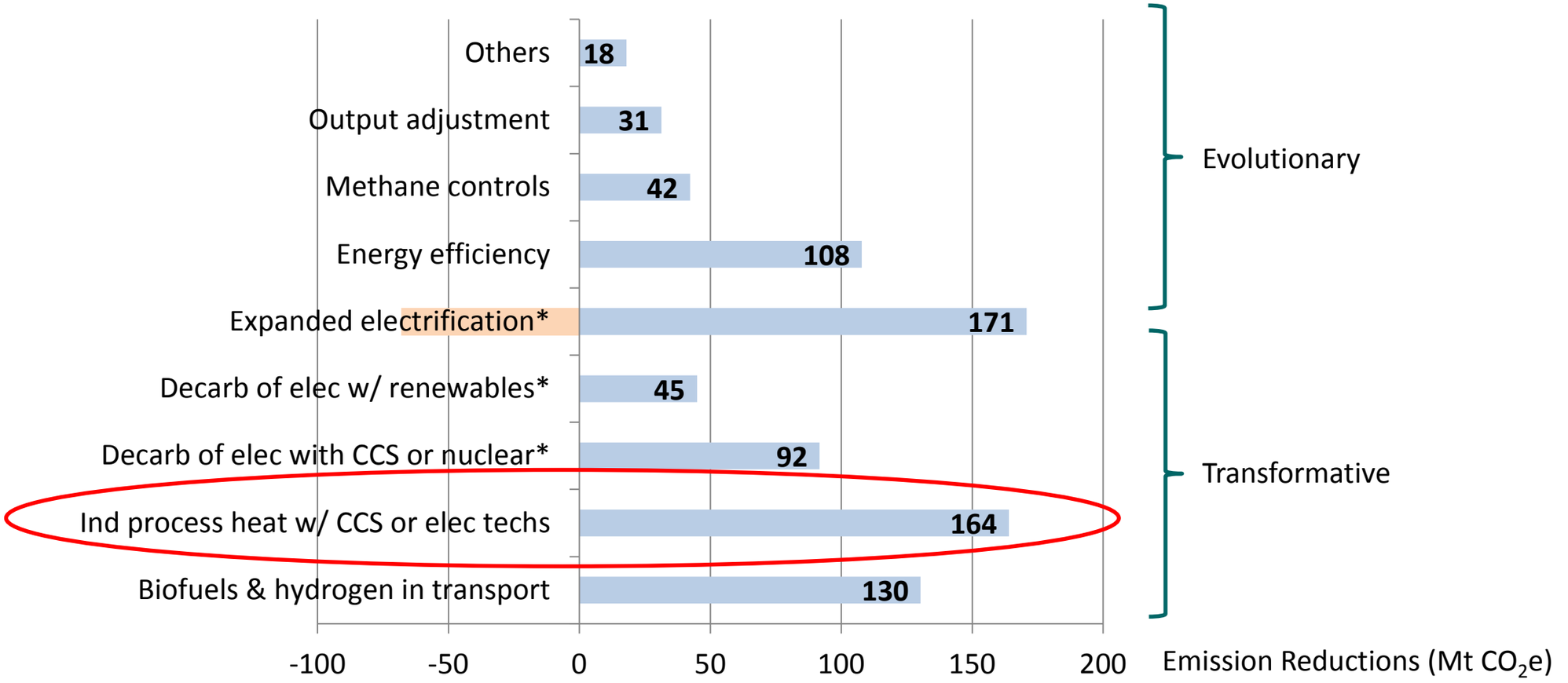
DDPP results by technology pathway: Canada



Pillars of a generalized transition plan
Bataille et al (2018)

- An initial policy commitment to very low carbon industry
- A stakeholder pathways process to assess options and build a working consensus
- De-risked R&D support and direct, pragmatic and declining output subsides to zero carbon production
- Gradual and multistage exposure of all sectors to the full valuation of GHGs via carbon pricing or tradable performance regulations with protections for competitiveness
- Development of supporting institutions for: lifecycle GHG accounting (especially at borders), education, regulatory, insurance and spatial planning.

What do the Paris goals mean for benchmarking performance?

No sector is exempt