

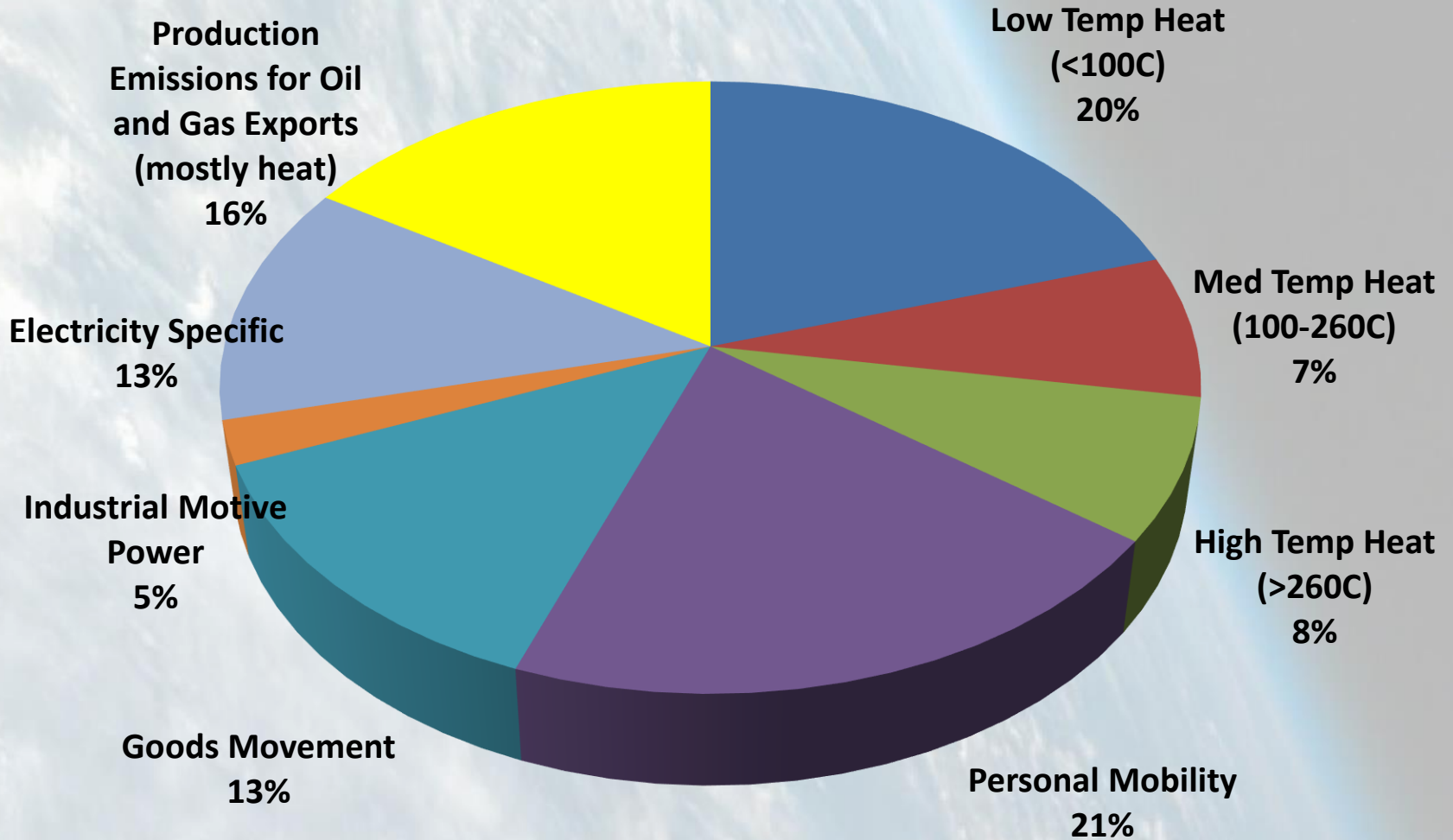
**PRESENTATION SLIDES
RALPH TORRIE**

TRUST IN TRANSITION

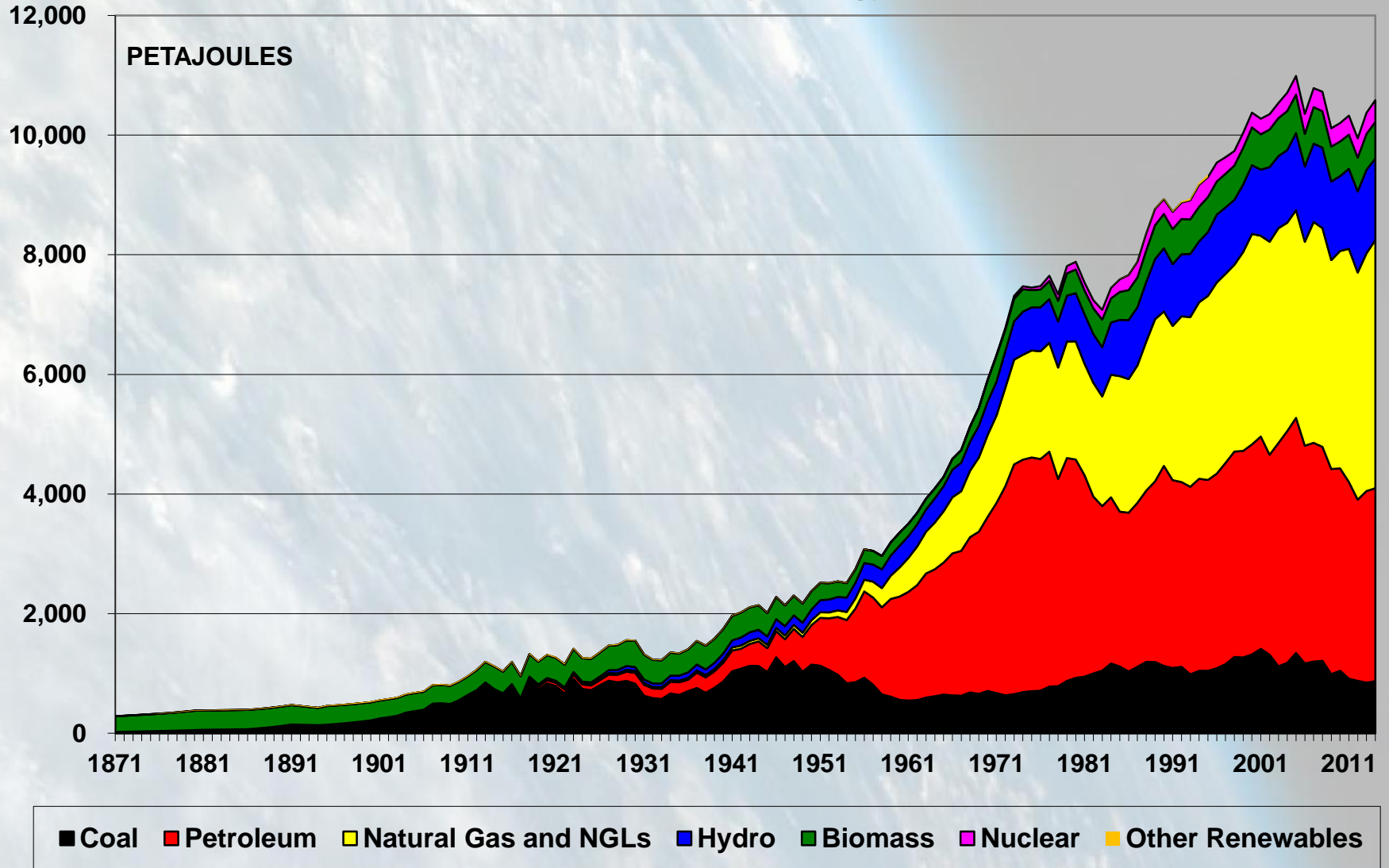
UNIVERSITY OF OTTAWA, JANUARY 23, 2018



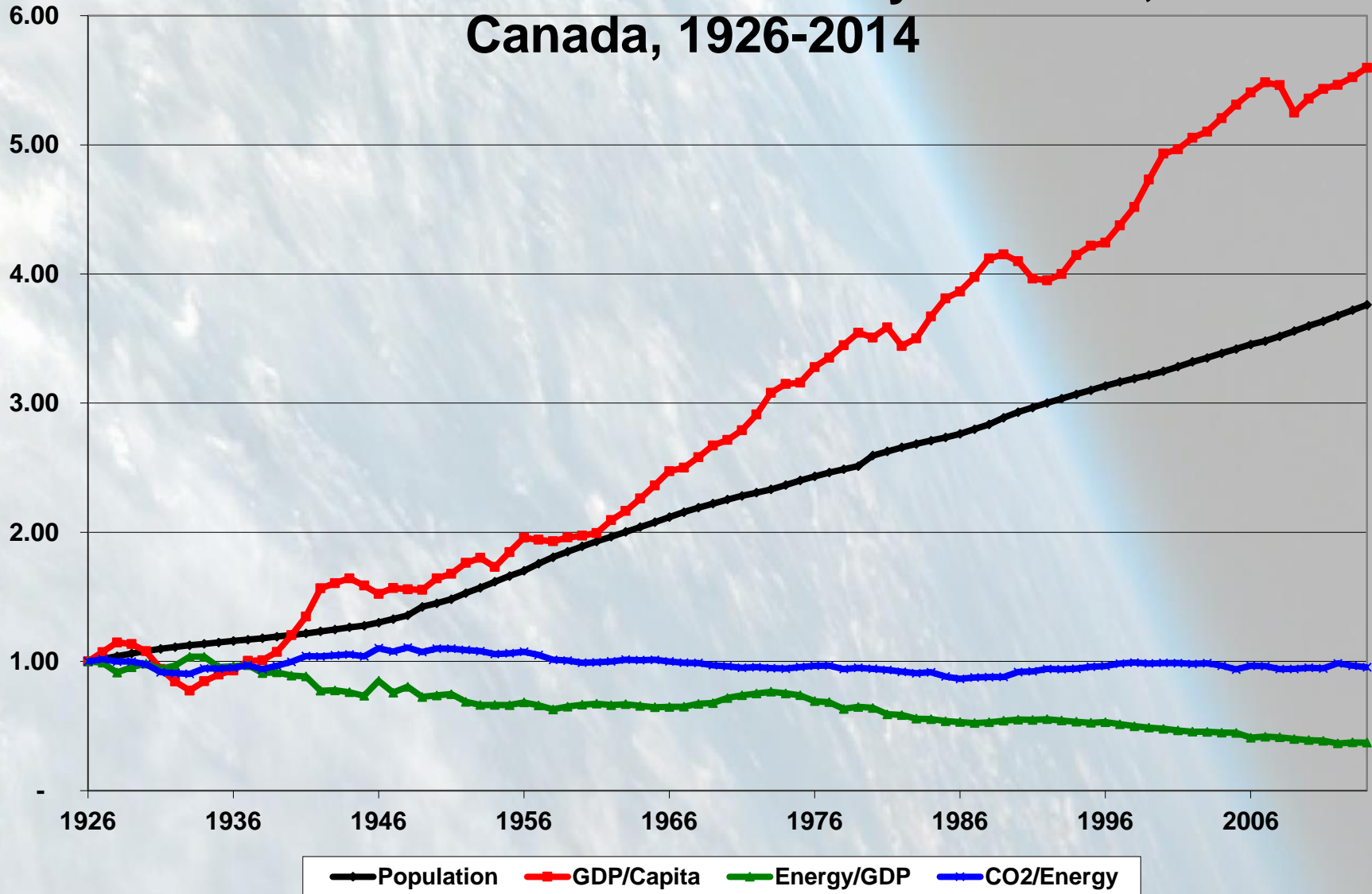
GHG EMISSIONS BY END USE SERVICE



Domestic Consumption of Primary Energy in Canada, 1926-2014



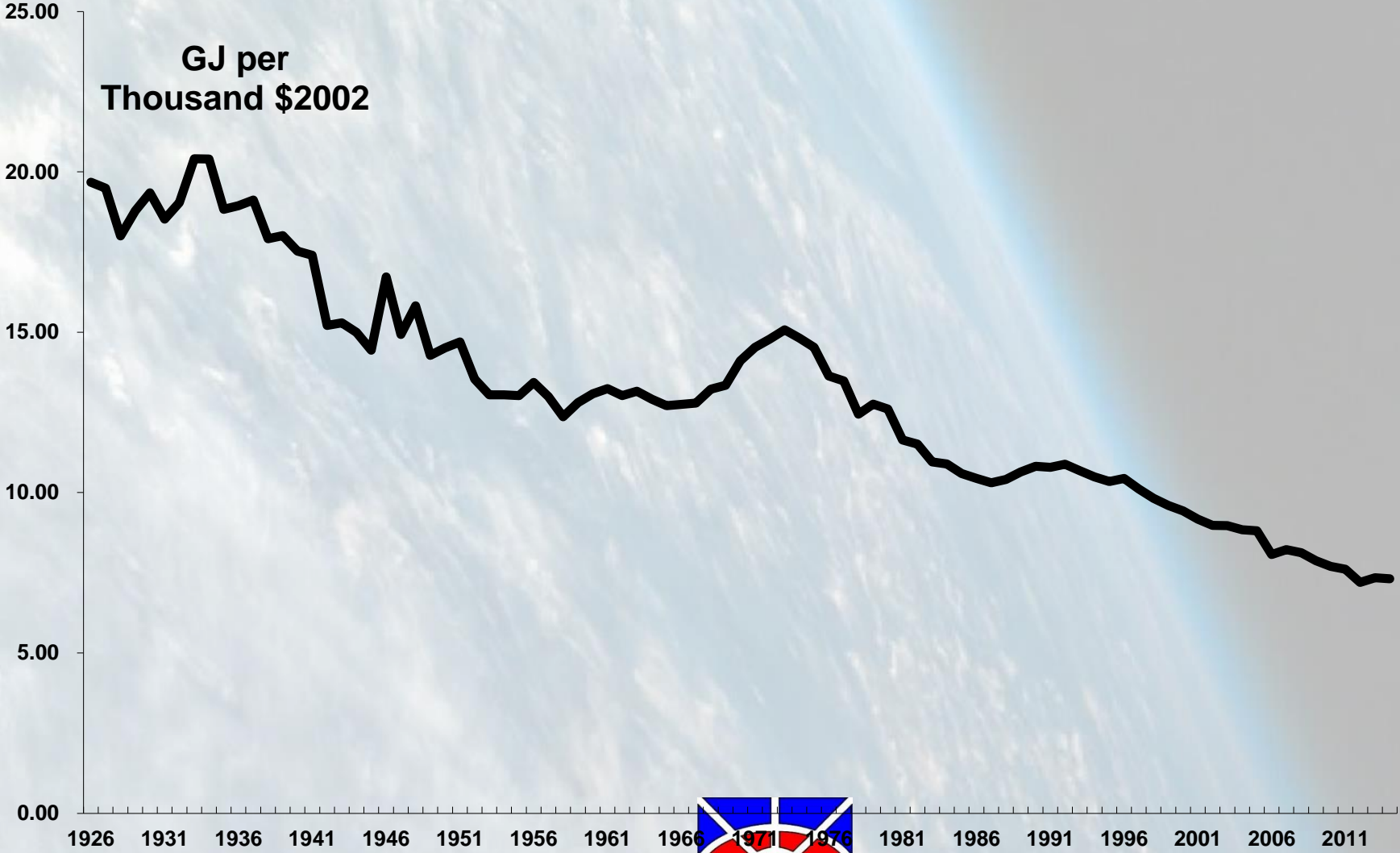
Relative Growth of GHG Kaya Factors, Canada, 1926-2014



1/29/2018



Energy Commodity Consumption/GDP 1926-2014

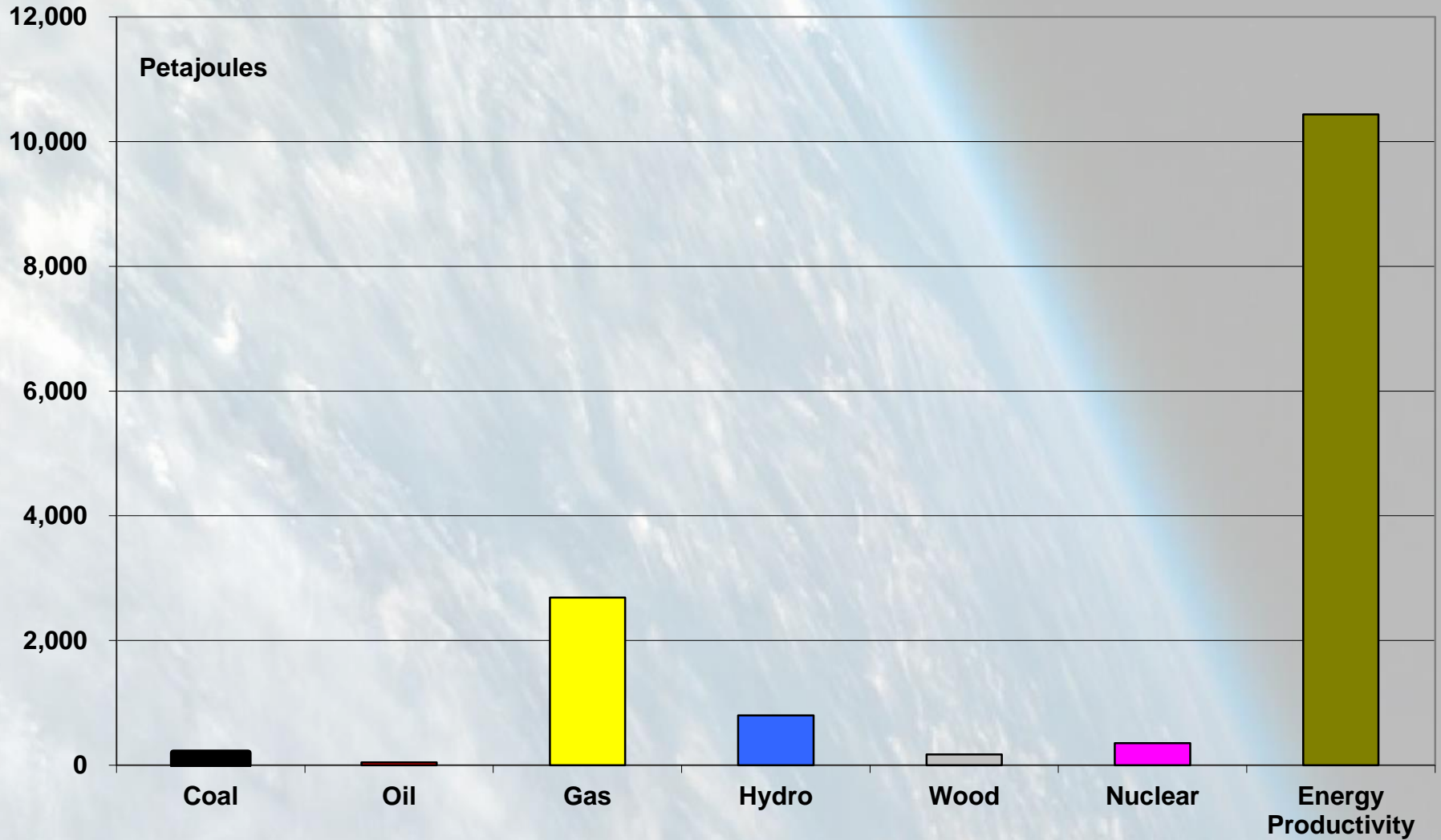


1/29/2018



Torrie Smith
Associates

Contributions to Energy Security in Canada, 1972-2014



1/29/2018





Fuel and electricity production and consumption: \$175 billion

A bracket on the right side of the diagram groups the top two levels (Energy sources & commodities and Efficiency determines fuel & electricity needed) and points to this text box.



THE REST OF THE ECONOMY:
\$1,625 BILLION

A large bracket on the right side of the diagram groups the bottom three levels (Amenities, Technologies for providing amenities, and Energy Services) and points to this text box.



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 Office of the Chief Economist	
 Fuels Division	

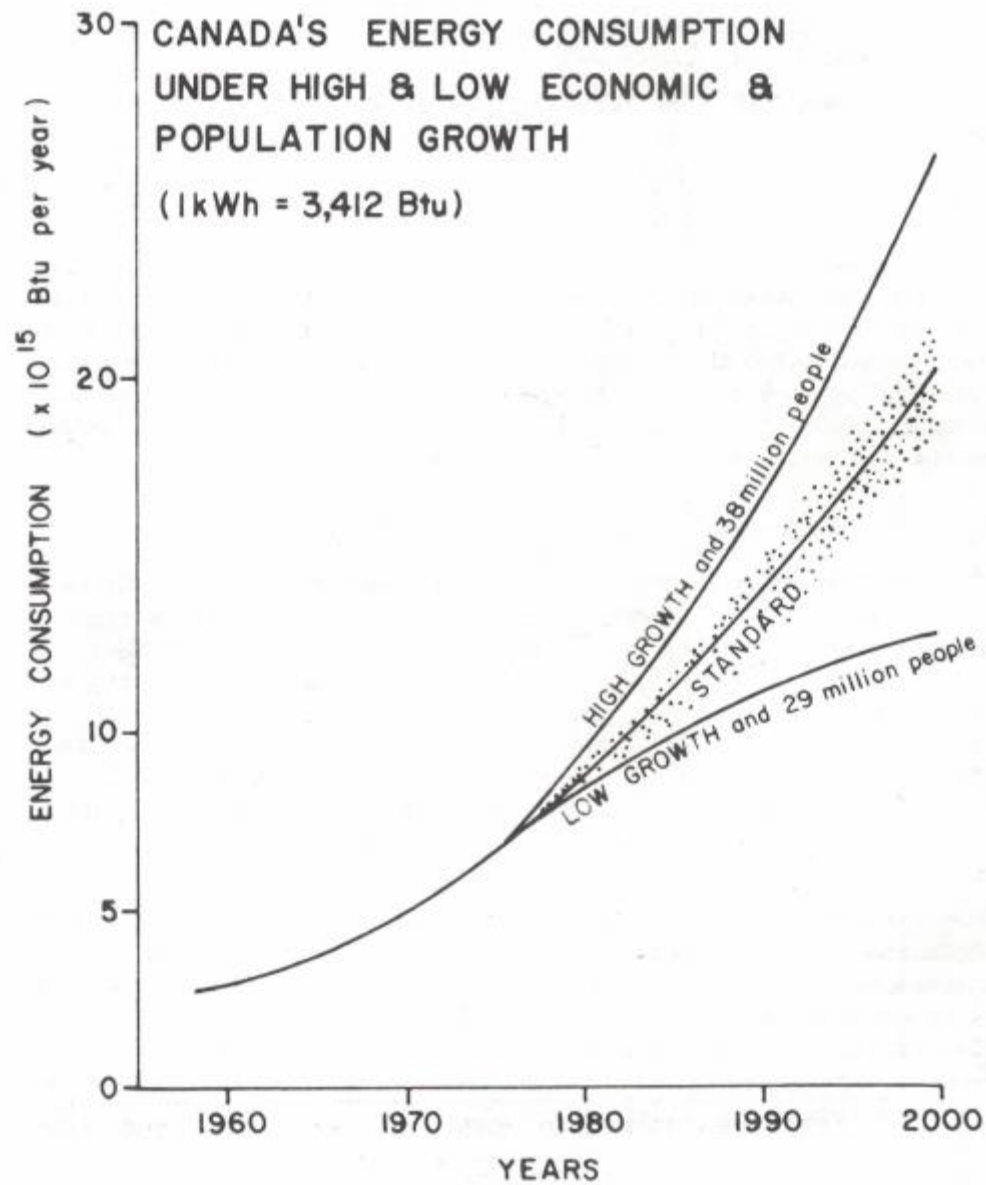


Chart 2

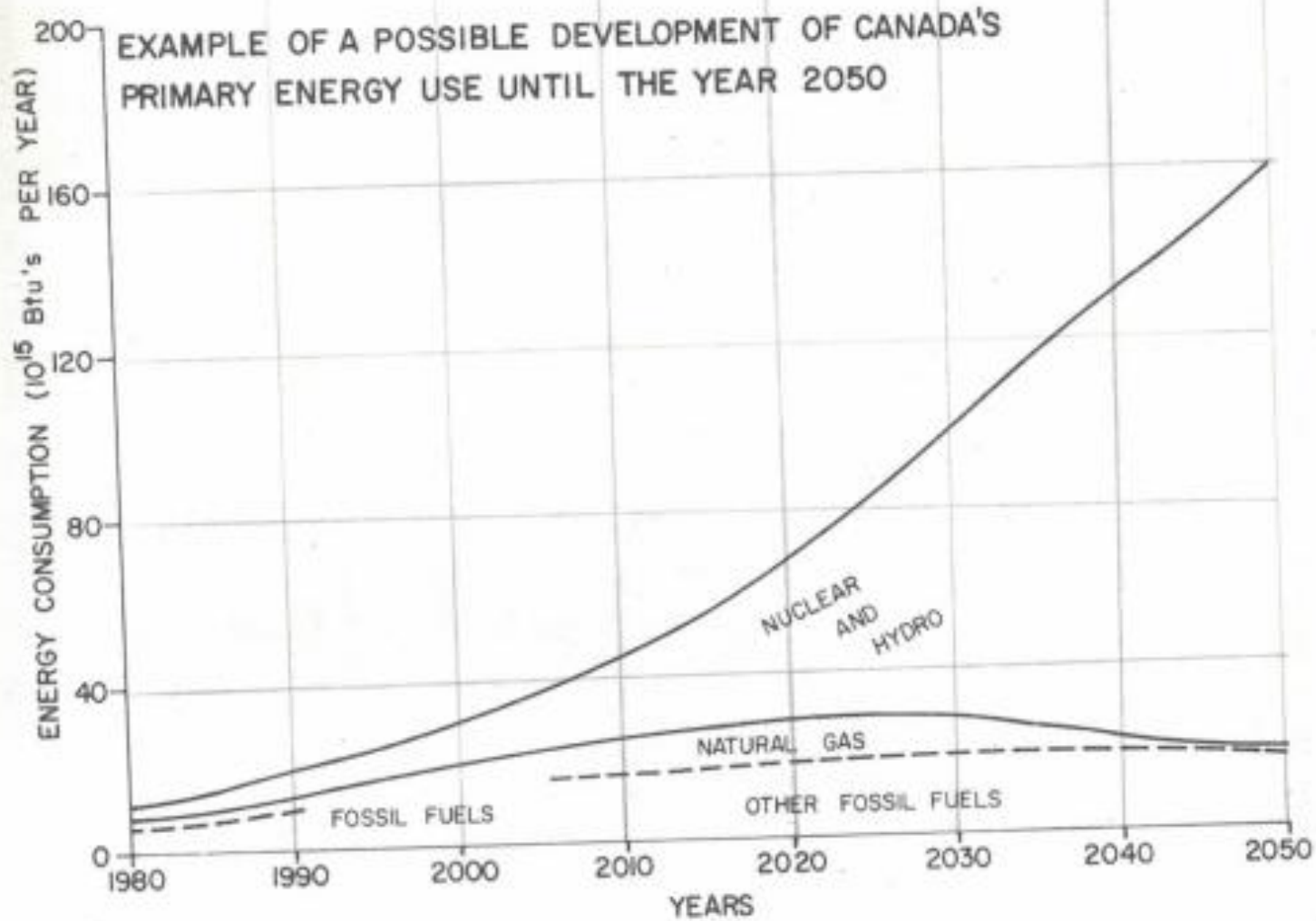
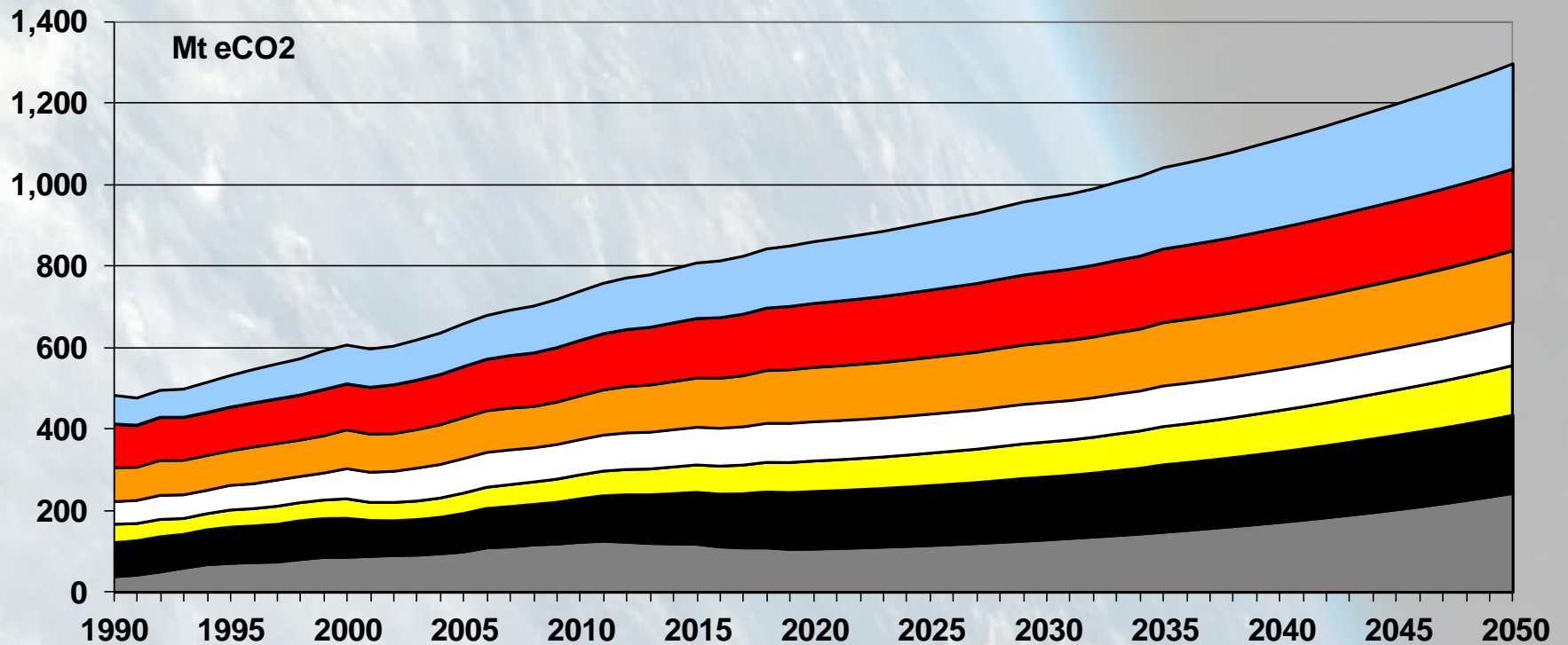


Figure 1

The typical “baseline” or “reference” projection of future GHG emissions, end use allocation:



Oil and Gas Industry -- Export Allocation

General Manufacturing

Residential -- Household Energy Use

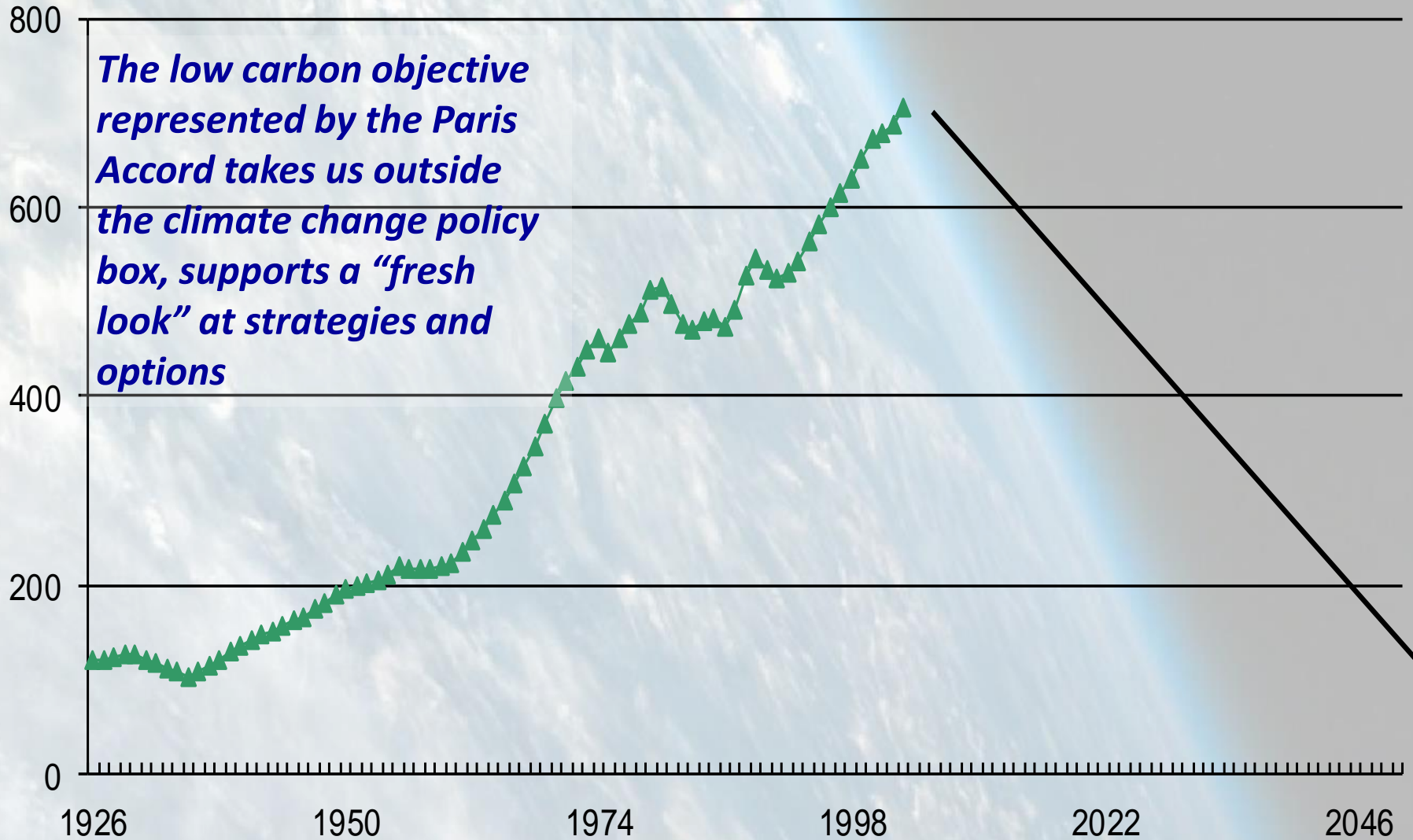
Freight Transportation

Energy Intensive Mfg, Mining and Agriculture

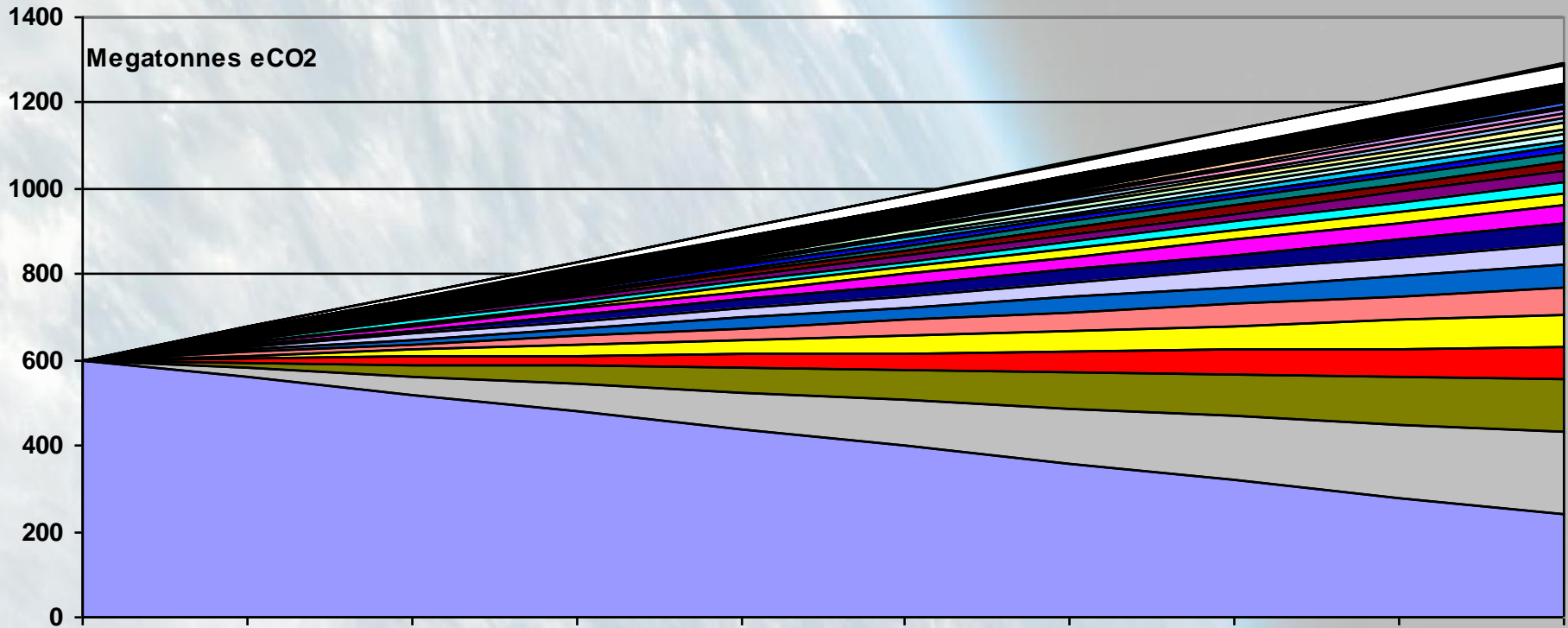
Commercial and Institutional

Personal Transportation



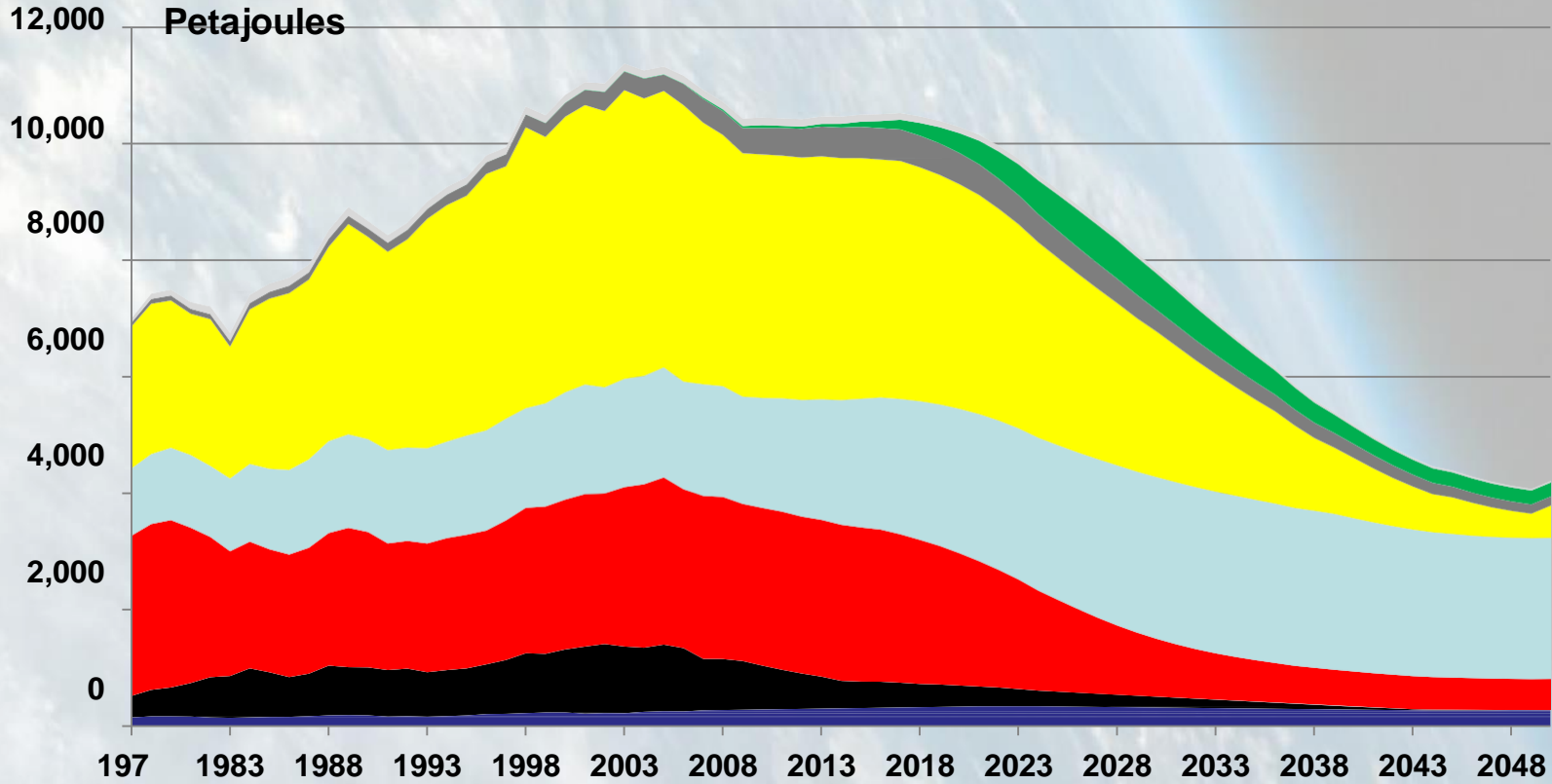


GHG Reduction Wedges for Canada -- All Wedges



- | | | | |
|--|---|--|---|
| <ul style="list-style-type: none"> Target Cogeneration Auto fuel eff Ind Eff - Energy Intensive New res bldg Commerical Lights and equip Res water heat Small hydro Hydrogen | <ul style="list-style-type: none"> Carbon Capture Electricity Intensity Improvements Tran propane & CNG Oil and Gas - Reduce Fugitive Retro comm bldg Industrial Shift TKT Reduction/Mode Shifts Passenger Mode Shift Biodiesel | <ul style="list-style-type: none"> Freight vehicle eff Urban Form Ethanol New nuclear Retro res bldg Wave power Res Appliances Landfill gas electricity RESIDUAL | <ul style="list-style-type: none"> EE in Oil and Gas Sector Wind power EE - Secondary Mfg Biomass New comm bldg Large hydro Geothermal Solar Water Heat El transmission |
|--|---|--|---|

Illustrative Low-Carbon Energy Transition for Canada...



■ Aviation fuel

■ RPP

■ Natural Gas and commodities

■ Biofuels

■ Coal

■ Electricity

■ Oil Sands Fuel

■ Biomass



Low Carbon Energy Futures – These five things must happen:

- **Efficiency, efficiency and then more efficiency**
- **Electricity's role expands into transportation and heat**
- **Decarbonize the electricity supply**
- **Sustainable production of biofuels**
- ***Innovation to reduce fuel and electricity in provision of human needs, amenities***



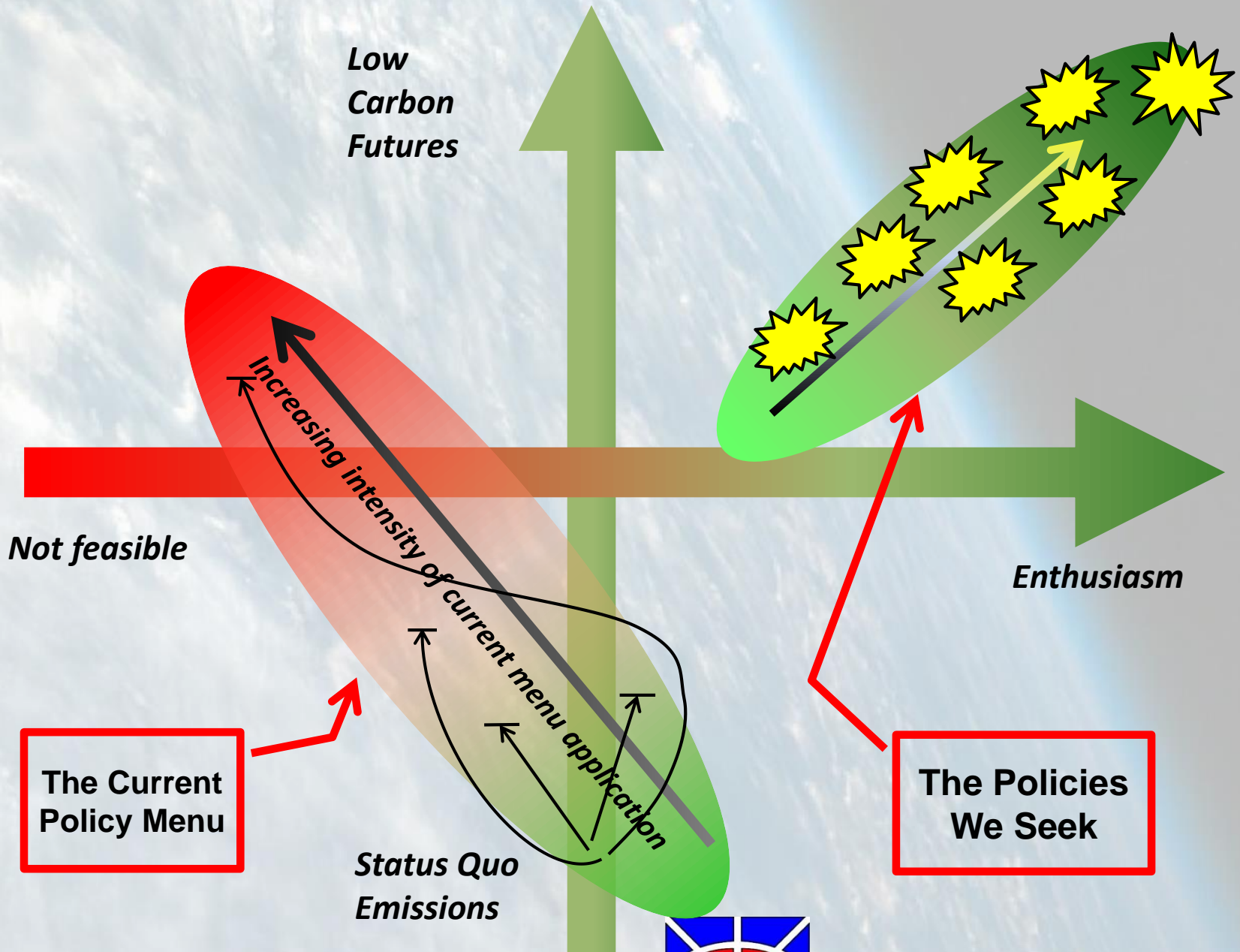
Some wicked complications:

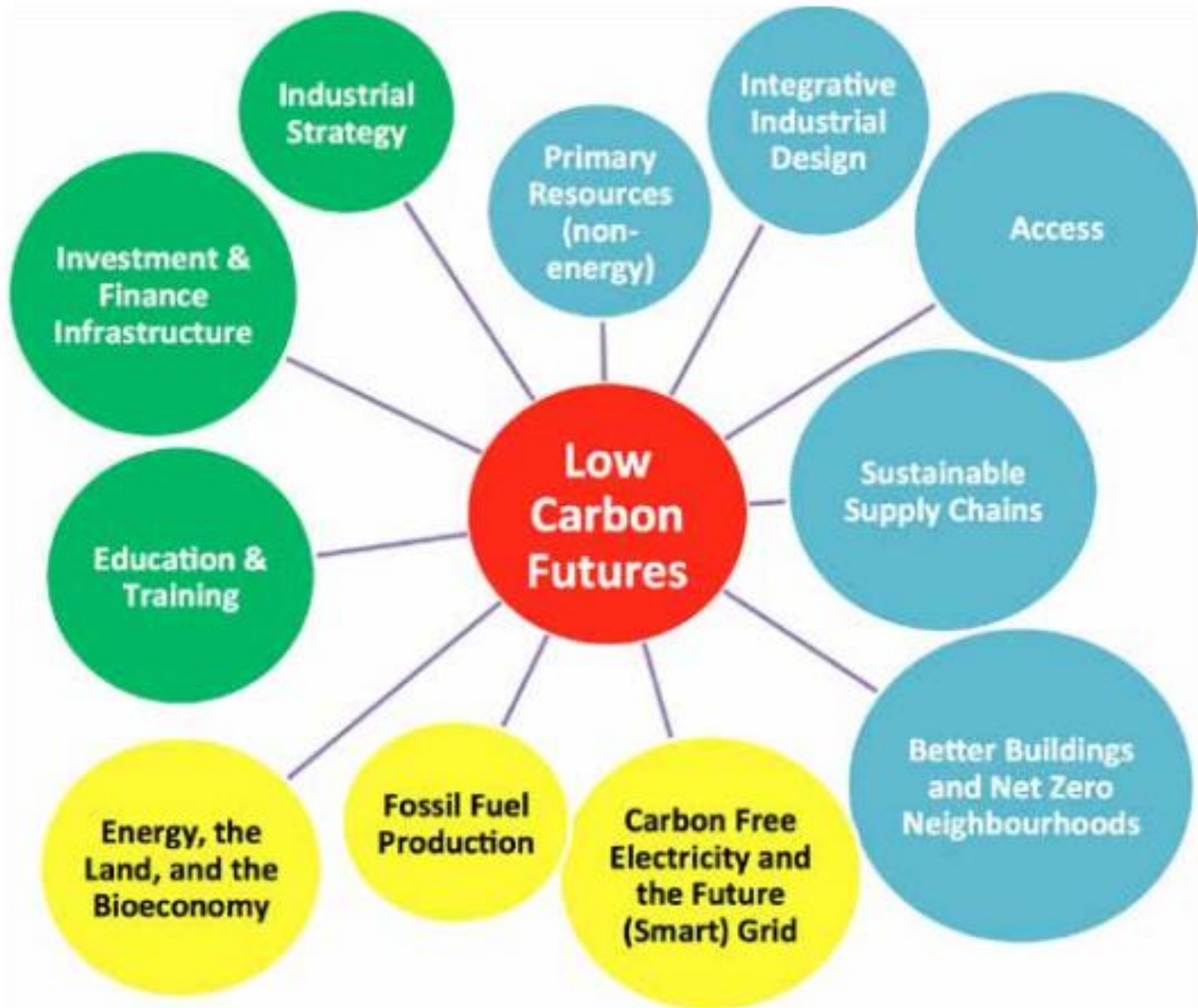
- Climate change and its deleterious impacts will increase throughout this century.
- The time frame for the transition is short compared to the inertia in the current energy system.
- The pre-tax price of fossil fuels will be permanently depressed in a low carbon future.
- The prices Canadian households and businesses currently pay for fuel and electricity, when converted to implied carbon prices, are in the range of \$200-\$500/tonne CO₂eq and higher.

Key considerations:

- Transition to low carbon will take place simultaneously with other disruptive and far-reaching transitions, some helpful, some not.
- Capital intensity presents a challenge to policy and business models, but not the same thing as expensive.
- Innovation in financing and business strategies necessary to remove “first cost” barrier, and to resolve split incentives.
- Education and climate literacy will speed the transition.
- Low carbon solutions vary according to local circumstances; local agency and capacity, including in city halls, are essential.
- Human and institutional capacity development are constraints on the accelerated deployment of otherwise ready solutions.







Thank you!