Reducing GHG Emissions in Canada: A Formidable Challenge

Trottier Energy Futures Project Results
Presented by Dr. John Leggat
5 April 2016

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Background

- IPCC – “There are multiple pathways to… significantly reducing GHG emissions”
- Canadian situation presents unique challenges and opportunities
- TEFP – Study sponsored by CAE and DSF. Funding from Trottier Family Foundation
- Rigorous and comprehensive engineering analysis
- Results suggest pathways and enablers; not solutions
- Stimulate informed discussion

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A Significant Undertaking

- Goal of 80% reduction in GHG emissions by 2050 compared to 1990 levels – 118Mt
- Options and pathways for reducing GHG emissions by more than 100% by 2100
- Combustion and non-combustion emissions
- Alternate Futures analysis
- Medium Term (2030) – promising pathways
- Long Term (2050) – hard problems

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Emissions - Mt

Year	Total	Combustion	Non-Combustion
TARGET	118		
1990 - actual	587	427	164
2010 - actual	692	498	194

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Approach to the Analysis

NATEM Model –

- Linear programming optimization model
- Primary drivers are end-use demands
- Long-term horizon (50-100 years)
- GHG emission targets

CanESS Model –

- Simulation model
- Primary drivers are demographic and macro-economic dynamics
- All scenarios executed in 1-year steps
- Tracks GHG emissions at the sources

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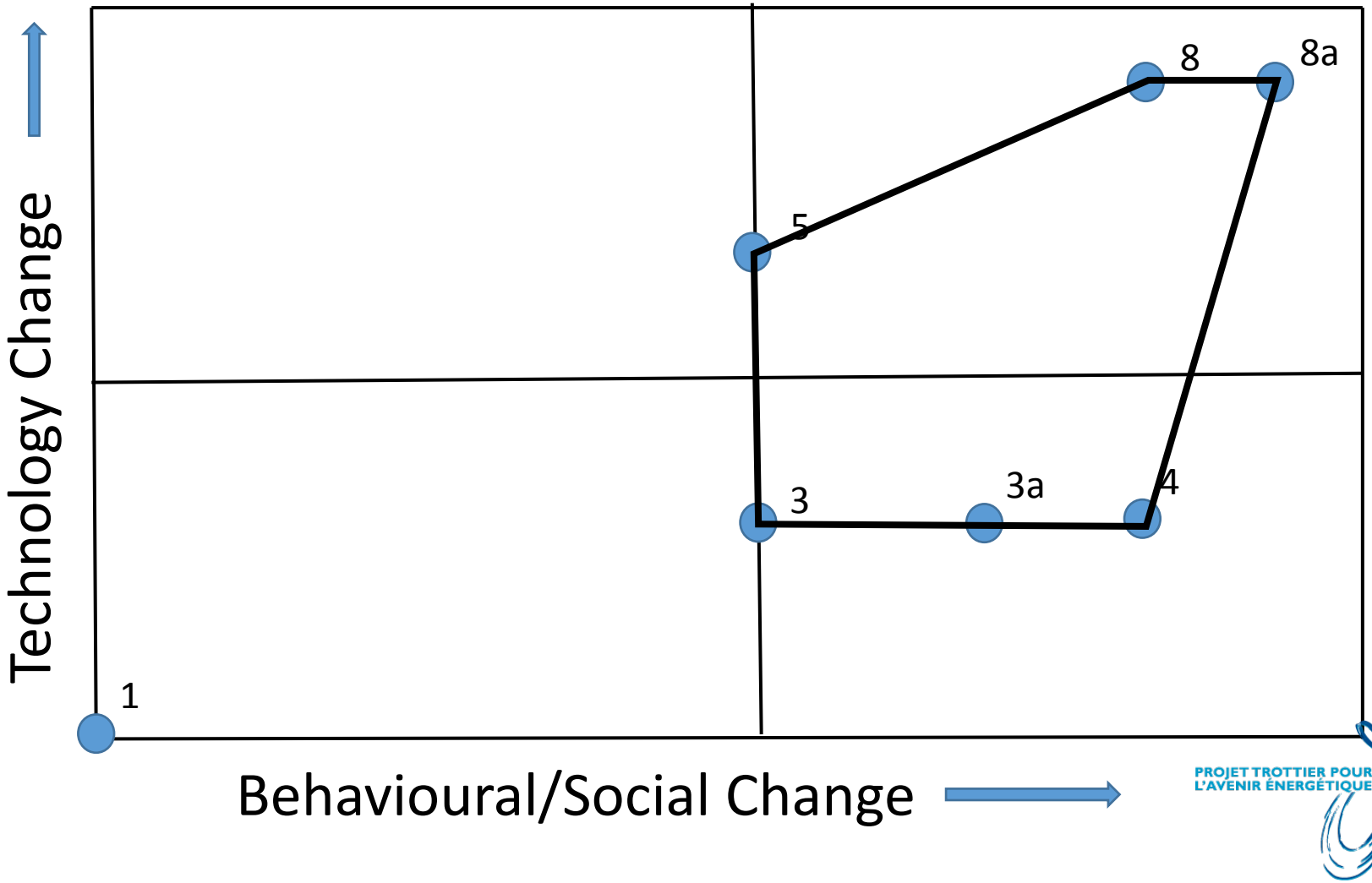
Approach to Analysis
Alternate Futures Scenarios



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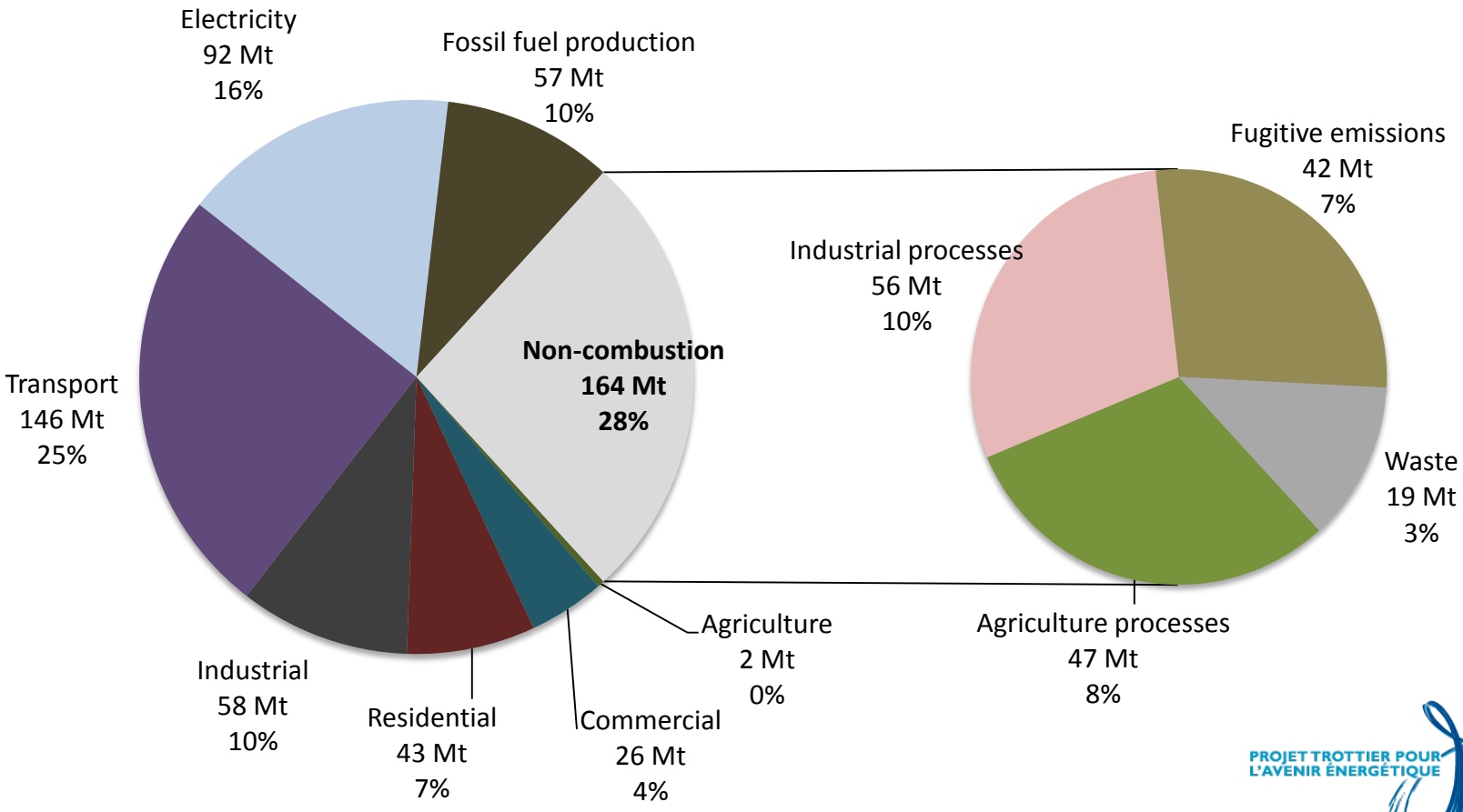
1990 Emissions
591 Mt



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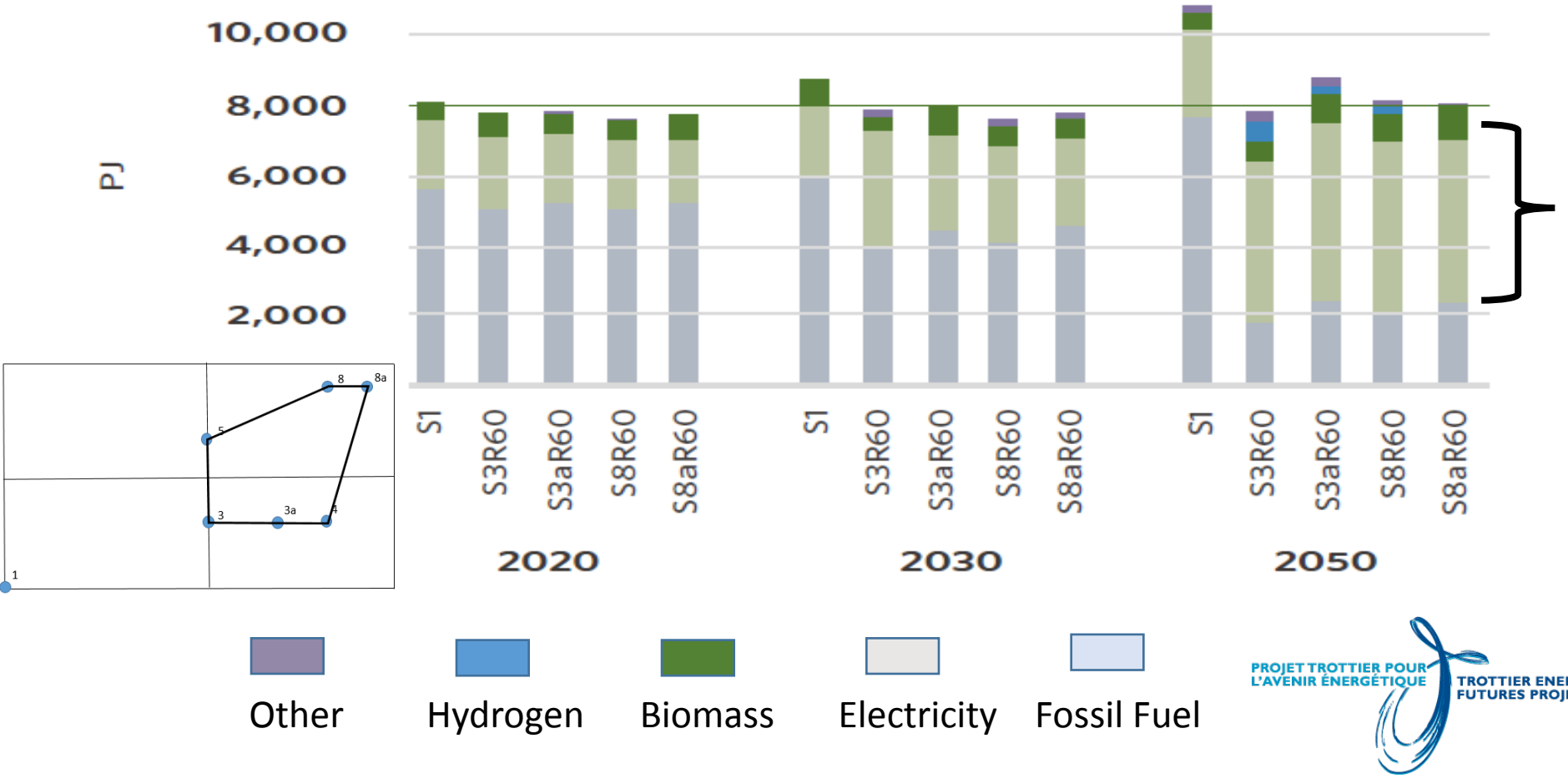
Energy Utilization



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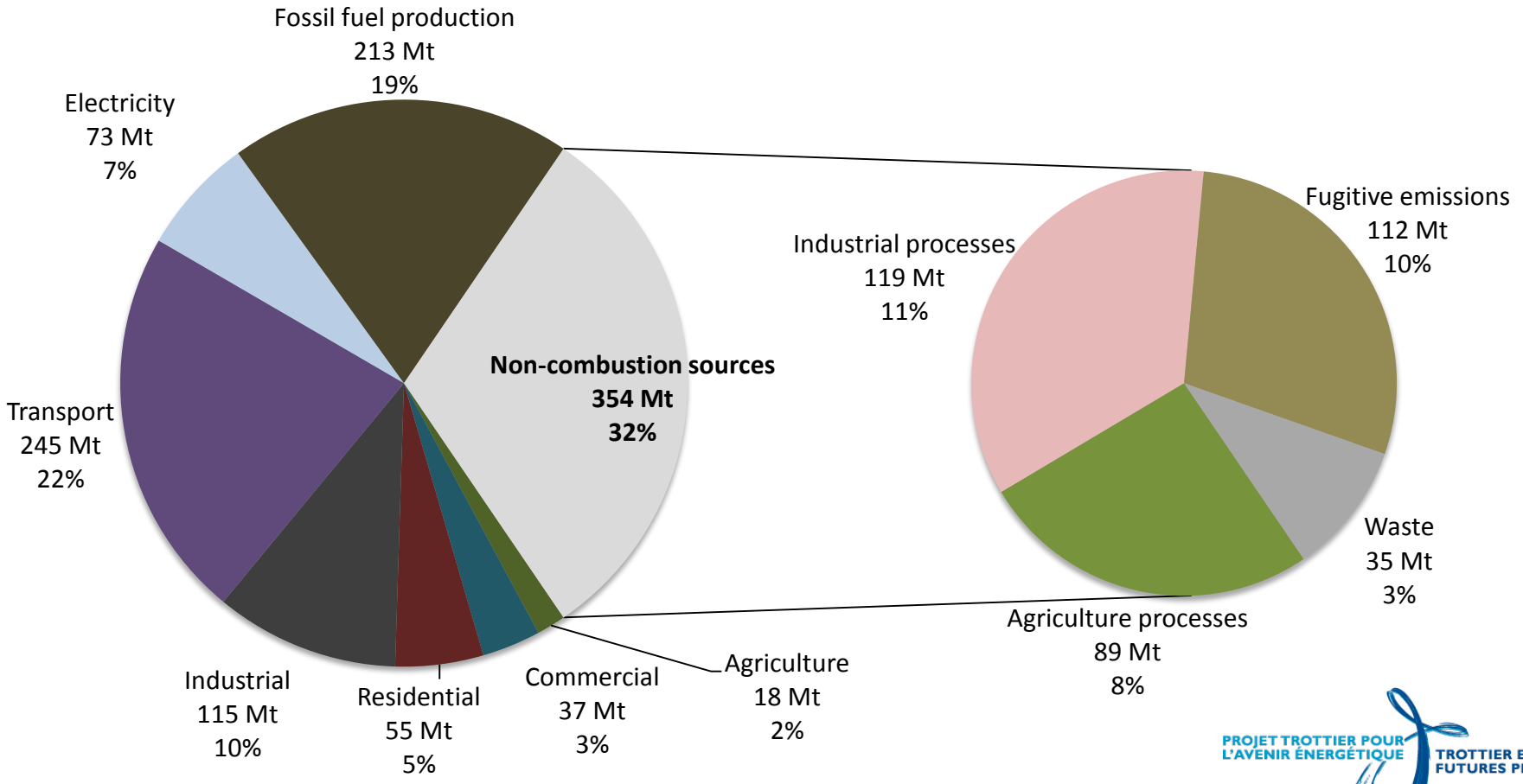
Reference Scenario 1 – Present Policies 1109 Mt in 2050



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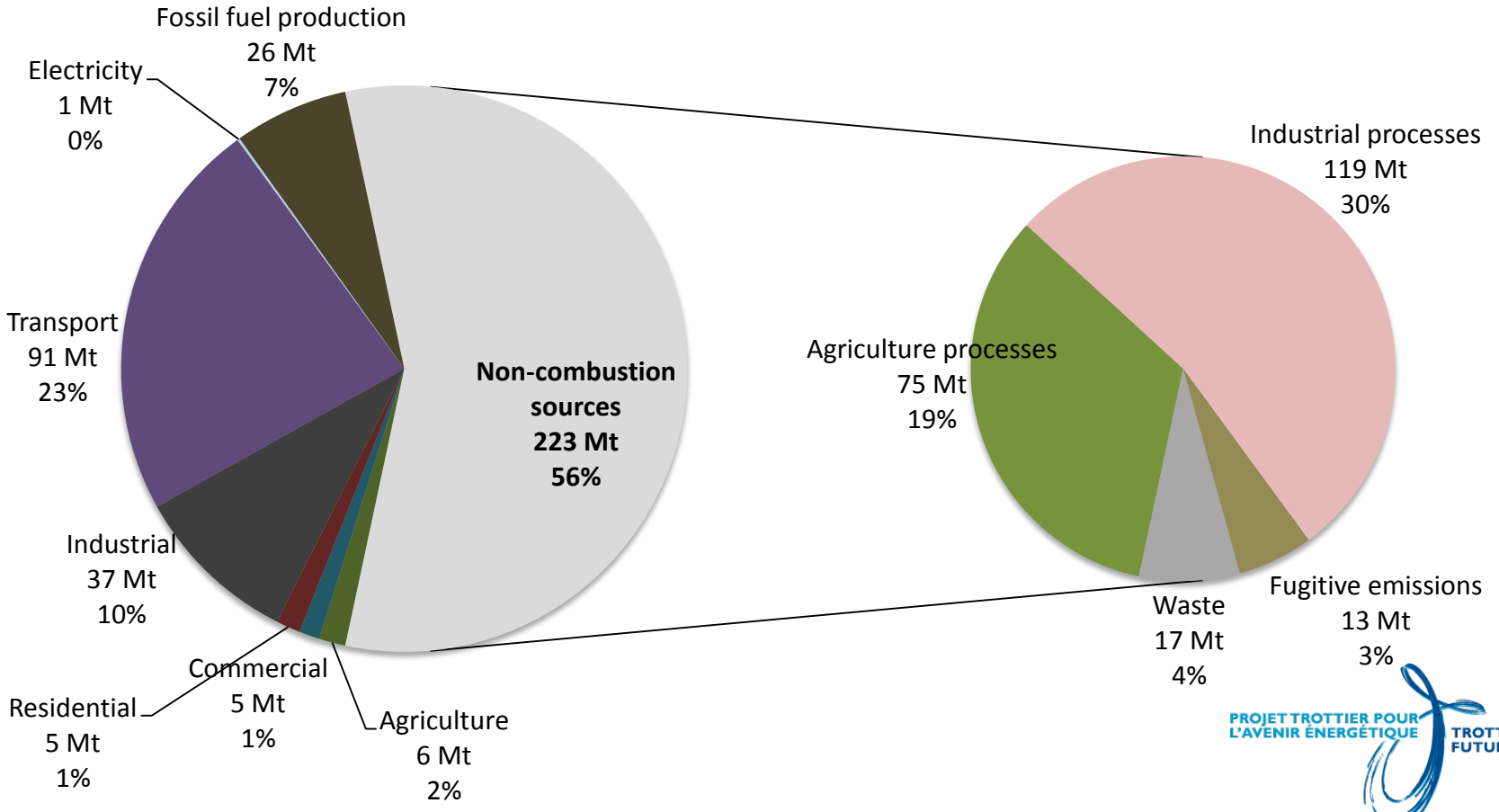
Scenario 8a – 60% Target
394 Mt in 2050



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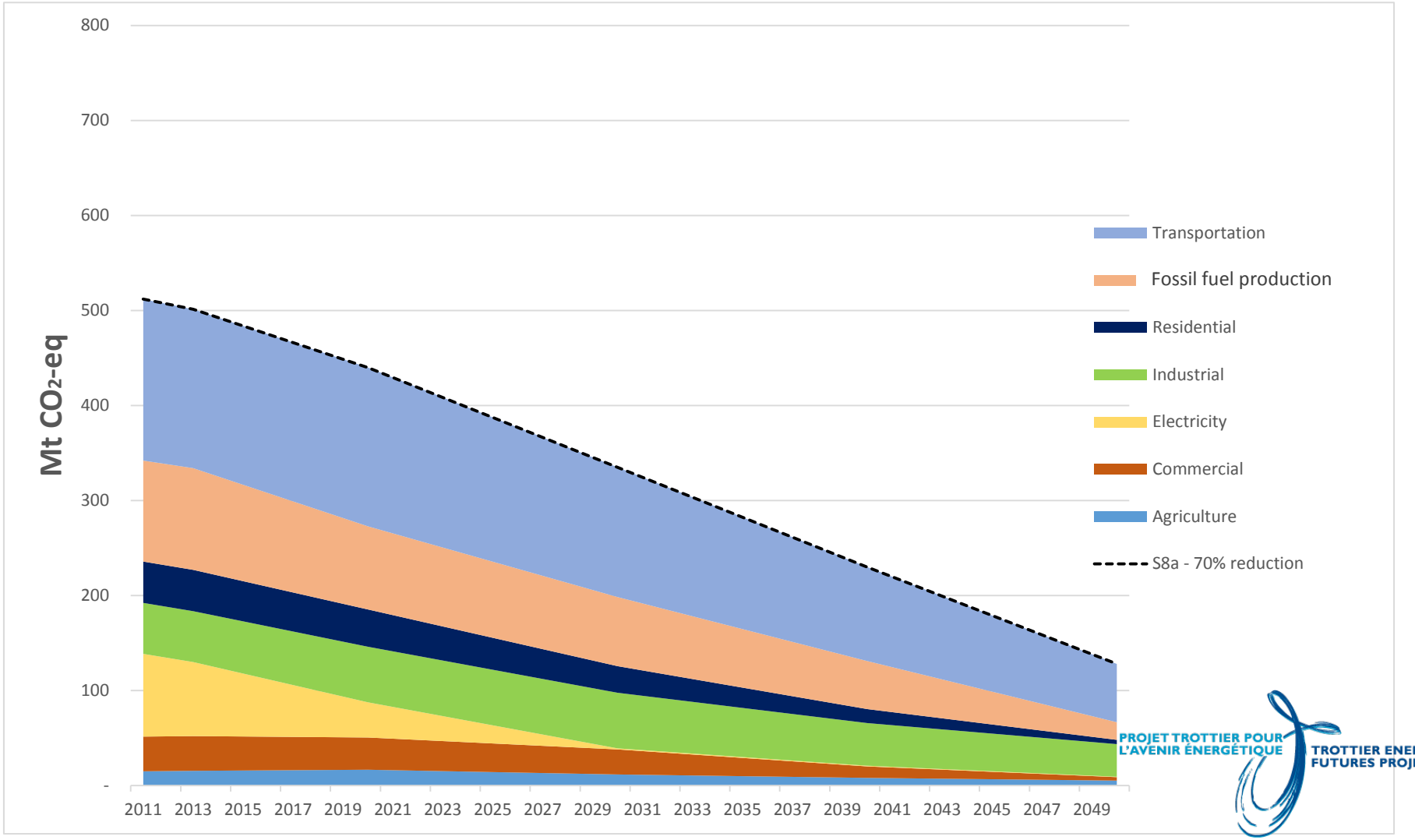
Combustion Emission Reductions Scenario 8a (70% reduction – 128 Mt)



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Emissions - Mt

Year	Total	Combustion	Non-Combustion
TARGET	118		
1990 - actual	587	427	164
2010 - actual	692	498	194
2050 - no change	1109	755	354
2050 – 60%	394	171	223
2050 – 70%	351	128	223

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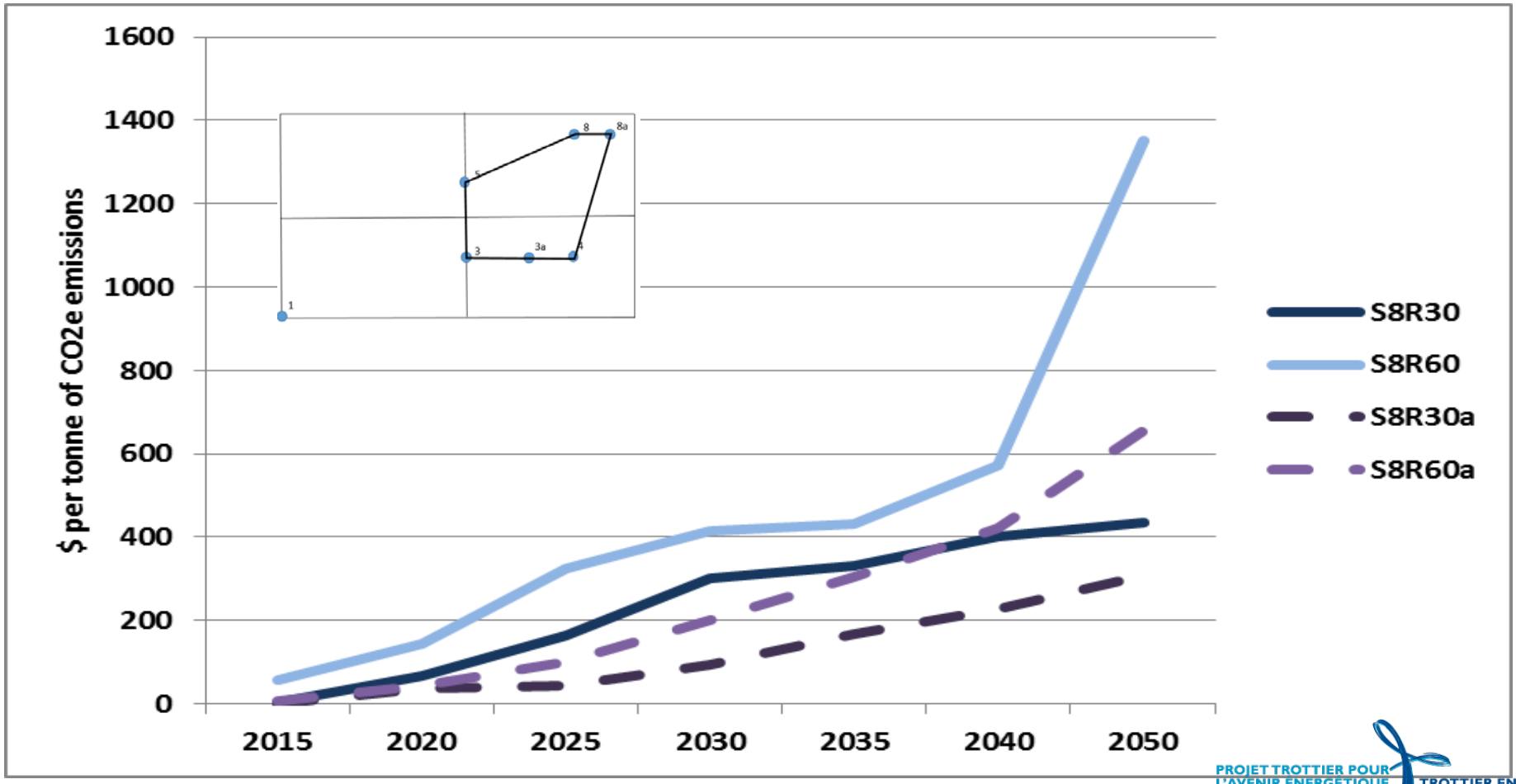
Cost per Tonne of CO_2 Reduction



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Principal Observations

- Reduction pathways result in major end use changes
- Largest reduction is 70% for combustion emissions
- Non-combustion emissions need attention
- Infrastructure availability projections are optimistic
- Challenge to achieve 80% reduction by 2050
- Net negative emissions required before 2050
- Immediate priorities are clear; longer term path requires more investigation and research

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Promising Pathways

- Absolute importance of carbon free electricity
- Best sources of electricity are hydro, nuclear and wind
- Interjurisdictional transfers of electricity and access to storage are important
- Considerable infrastructure investment is needed quickly
- Reduced dependency on fossil fuels means lifestyle changes

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Hard Problems

- Heavy road and rail transportation
- Insufficient feedstock to meet demand for biofuels
- Process changes for oil and natural gas are needed
- Changing urban form and behaviour – how will it be done in a North American context?
- Non-combustion emissions
- Net negative emissions
- Very fast build of large infrastructure required.

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Immediate Priorities

- Energy conservation / energy efficiency
- Electrification of end uses
- Decarbonizing electricity supply
- Major growth and changes to electricity supply system
- Research and development for hard problems

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Opportunities

- Low cost and carbon-free electricity - industrial production and export
- Export of dependable capacity and electricity to U.S. and provision of storage
- Expansion of forestry and agricultural sectors for production of biomass / biofuels
- Carbon retention in wood products
- Changes in petroleum sector for reduced emissions
- Environmental and societal equilibrium

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Contributions from The Trottier Energy Futures Project

- Provides perspectives on different pathways for deep GHG reductions
- Demonstrates scale and complexity of the challenge
- Defines where to start
- Highlights hard problems
- Identifies opportunities for immediate action
- Shows merits of analytical approaches and need for sustaining and growing these capabilities

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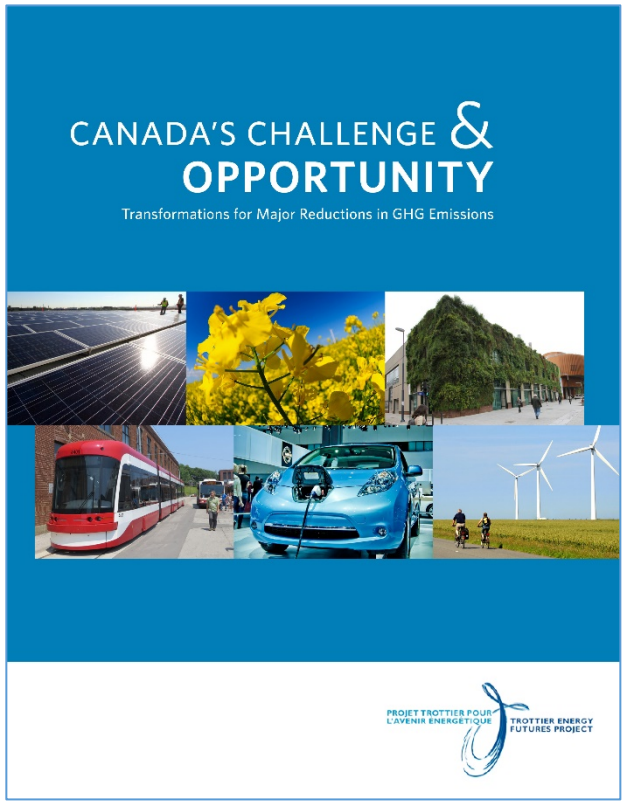

The full report
and executive summary
are available at:
http://iet.polymtl.ca/tefp

We welcome your
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