



# Initial Modeling Results: Policy Options for Canada's Commercial Buildings

National Roundtable on Environment and the Economy  
July 29, 2008

# Commercial Building Sub-Sectors

- Transportation Services
- Communication
- Electric Utilities
- Gas Utilities
- Water & Other Utilities
- Wholesale
- Retail
- FIRE (Finance, Insurance & Real Estate)
- Offices – Business Service
- Education
- Health & Social
- Food, Lodging, Recreation
- Government

# Commercial Building End-Uses

- Space Heating
- Air Conditioning
- Water Heating
- Lighting
- Refrigeration
- Other Substitutable loads<sup>2</sup>
- Other Non-Substitutable loads<sup>3</sup>

<sup>2</sup> Other Subs or other substitutable loads includes devices that can use another energy form other than electricity (i.e. gas stoves & dryers)

<sup>3</sup> Other Non-Subs or other non-substitutable loads include devices that consume electricity and can't readily use any other energy form

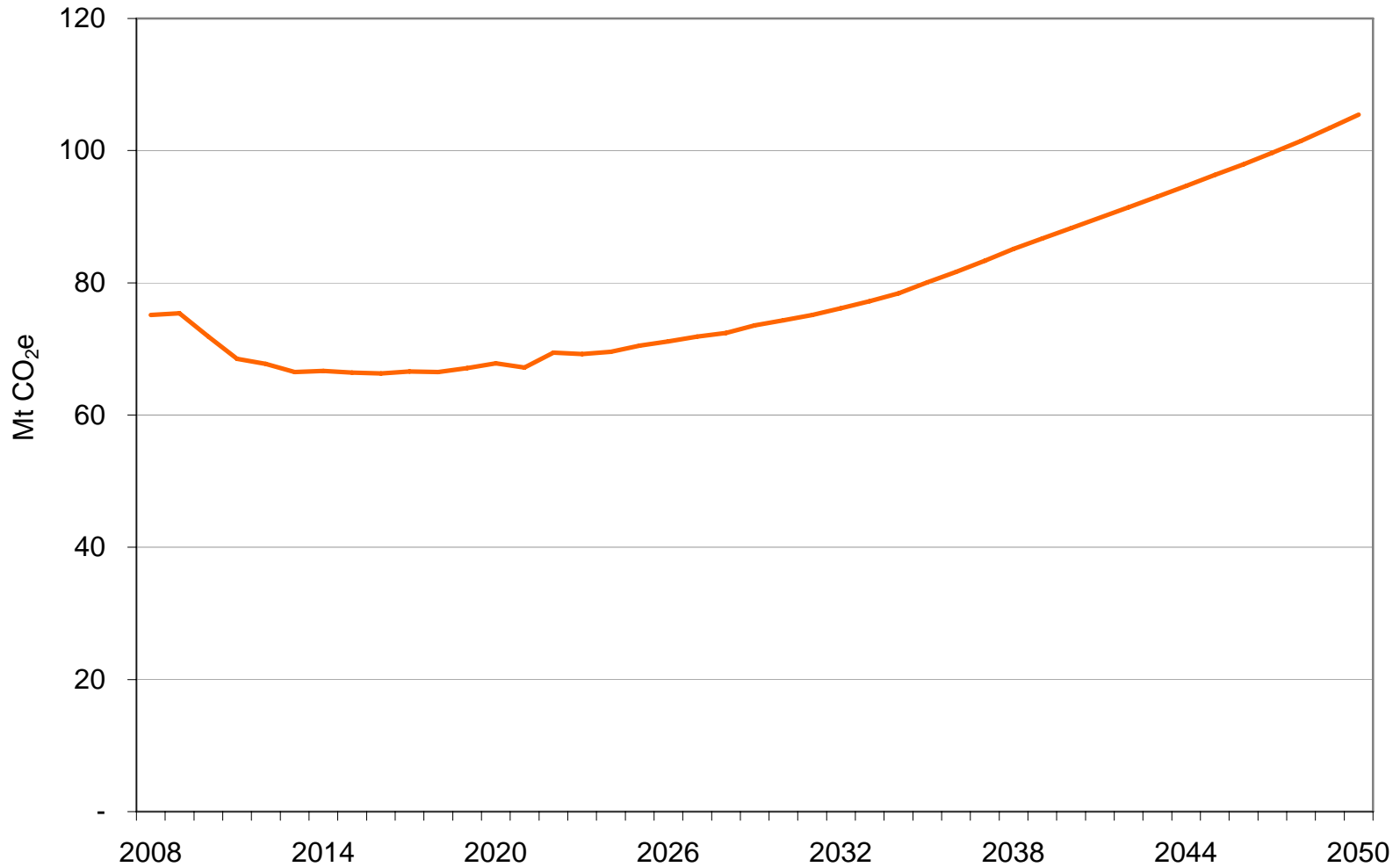
# Allocated Emissions

- ENERGY 2020 normally treats the power sector and upstream oil and gas as separate, stand-alone sectors with their own emissions.
  - For example, emissions from the production of electrical power, are allocated to that sector rather than to the end uses which demand the power produced.
- For this project, emissions associated with the production and delivery of energy have been allocated to the end-use sector which requires the energy.
- This approach was followed in the “Low GHG Futures” scenario developed for the NRTEE (using Socolow wedge analysis).

# Reference Case

- The economy is projected to grow at 2.1% per year over the forecast period.
- Without the Turning the Corner plan, national greenhouse gas (GHG) emissions are projected to reach close to:
  - 950 Mt by 2020; and
  - 1,300 Mt by 2050.
- Under Turning the Corner, the “regulated” sectors include:
  - oil and gas industry, power generation (by combustion), pulp & paper, smelting and refining, iron and steel, iron ore pelletizing, cement, lime, potash, chemicals and fertilizers.
- Requires an 18% improvement by 2010 followed by 2% per year reductions thereafter, from a 2006 baseline year.

# Reference Case – Commercial Buildings



# Carbon Tax Scenario

- Carbon costs assumed (specified by NRTEE):

	Emissions Charges (2003\$/tonne)							
	2011: 2015	2016: 2020	2021 - 2025	2026: 2030	2031: 2035	2036 - 2040	2041: 2045	2046: 2050
GDP maximizing	\$48	\$212	\$272	\$286	\$286	\$286	\$286	\$286
Fast and Deep	\$18	\$88	\$176	\$264	\$317	\$317	\$317	\$317
Slow and Deep	\$18	\$29	\$59	\$117	\$235	\$352	\$411	\$411

- 10% reduction in GHG emissions compared to Reference Case.
  - Approximately 2 Mt of reductions associated with reduced emissions from allocated electricity emissions and 9 Mt from direct fuel use.
- Due to the carbon tax, fuel expenditures reach a peak of 25% more than the Reference Case in 2035.
- Overall, commercial energy demands decrease by close to 7% by 2050.
  - Electricity sales increase by 4% as more end users select electricity rather than natural gas or other fuels.

# Carbon Tax Scenario

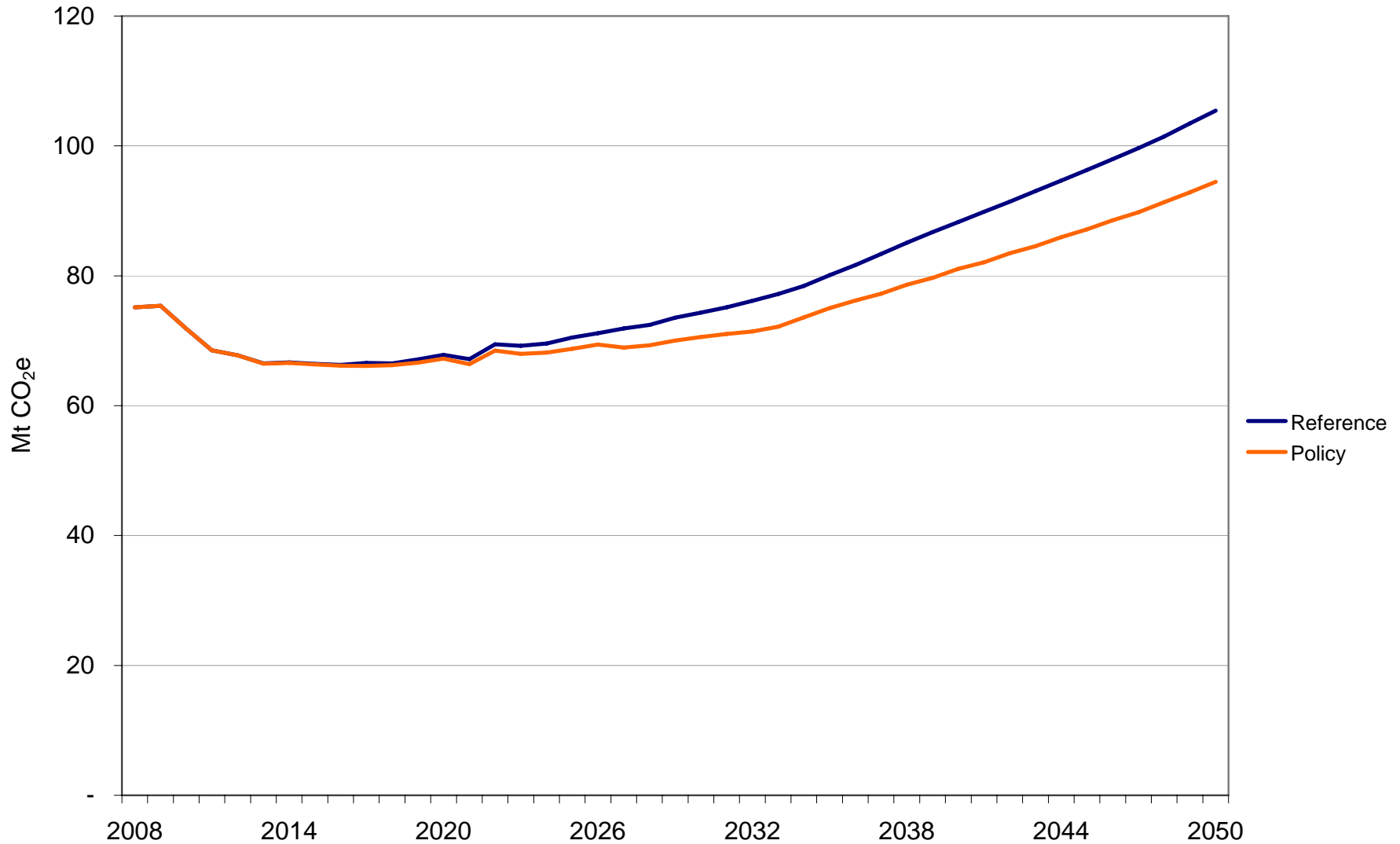
Commercial Energy Demands (PJ/year)	2008	2020		2050		Change from Reference in 2050
		Reference	Policy	Reference	Policy	
Space Heating	756	787	778	1,101	977	-11.3%
Water Heating	209	237	235	336	322	-3.9%
Other Subs	70	85	85	123	117	-5.3%
Refrigeration	136	167	167	258	258	-0.2%
Lighting	117	123	123	186	186	0.0%
Air Condition	99	110	110	167	152	-8.6%
Other Non-Subs	98	120	120	180	179	-0.4%
<b>Total</b>	<b>1,486</b>	<b>1,630</b>	<b>1,617</b>	<b>2,351</b>	<b>2,192</b>	<b>-6.8%</b>

Average Energy Prices (2002 CAD / mmBtu)	2008	2020		2050		Change from Reference in 2050
		Reference	Policy	Reference	Policy	
Electric	22.4	22.3	23.0	21.7	23.2	6.8%
Gas	8.4	7.5	9.1	7.2	13.0	79.4%

- Greatest changes occur in space conditioning
- Investments in buildings and equipment increase by 11% by 2050
- Electricity prices are less affected to the extent that non-fossil fuel generation sources are used



# Carbon Tax Scenario



# Carbon Tax Scenario

GHG Emissions (Mt)	2008	2020		2050		Change from Reference in 2050
		Reference	Policy	Reference	Policy	
Transportation Services	3.5	3.4	3.4	5.7	5.1	-9.7%
Communication	1.8	2.1	2.0	4.5	4.0	-10.0%
Electric Utilities	2.2	2.1	2.1	3.8	3.4	-9.6%
Gas Utilities	0.2	0.2	0.2	0.2	0.2	-6.3%
Water & Other Utilities	0.0	0.0	0.0	0.0	0.0	-8.0%
Wholesale	4.1	3.9	3.9	7.0	6.2	-11.4%
Retail	12.5	11.6	11.5	17.6	15.9	-9.9%
FIRE	15.8	13.9	13.8	19.6	17.5	-10.8%
Offices - Business Services	5.5	5.1	5.1	9.1	8.1	-11.3%
Education	9.7	7.3	7.2	9.5	8.6	-10.3%
Health & Social	6.7	6.4	6.4	11.0	10.0	-9.2%
Food, Lodging, Recreation	9.3	8.2	8.1	10.2	8.8	-13.2%
Government	4.0	3.6	3.6	7.2	6.6	-8.0%
<b>Total</b>	<b>75.1</b>	<b>67.8</b>	<b>67.3</b>	<b>105.4</b>	<b>94.5</b>	<b>-10.4%</b>

- Largest absolute reductions occur in the FIRE, Retail and Food, Lodging and Recreation (the largest sectors, by emissions)
- In relative terms Food, Lodging and Recreation is reduced by the greatest amount; sectors with the greatest heat loads see the greatest change
- Education and Food, Lodging and Recreation reduce their absolute emissions from 2008 by 2050
- Electricity generation using CCS technology increases relative to the reference case, as the carbon tax changes the relative costs of that technology relative to natural gas

# Policy Scenario – Policy Summary

- Updated Model National Energy Code for Buildings required in the National Building Code:
  - 20% increase in efficiency over current practice; 4.2% cost increase; 15% non-compliance assumed
- Increase building equipment efficiency:
  - Including control systems for lighting; heating efficiency increased between 5 and 12.5%; cooling systems by 9%; plug load efficiency increases by 25%
- Accelerated Capital Cost Allowance for energy efficient technologies:
  - Class 1 equipment rate set at 20%; Class 8 equipment at 35%
- Mandatory commissioning/re-commissioning:
  - 15% increase in building efficiency; cost equal to 2% of capital cost of building; 70% compliance rate; cost re-incurred every 5 years to sustain savings

# Policy Scenario – Policy Summary

- Increased standards for government buildings and equipment:
  - 60% of existing government buildings increase efficiency by 11%; plug load efficiency increases by 25%; 75% of new government buildings increase efficiency by 34% over current practice
- Streamlining green building permitting:
  - Increased incremental building efficiency (30-50%) reduces permitting costs by (10-30%)
- Increase training and communications for building operators and owners:
  - Reduction of 1.2 mmBtu/ft<sup>2</sup> per building; 70% compliance rate; cost of \$1,400 per building
- Provide corporate tax incentive for increased building efficiency:
  - Retrofit of existing buildings to achieve a 20% efficiency improvement above current new building practice; \$40 million cap on fund; tax credit equal to 7% of the capital cost of the building credited over 5 years.

# Policy Scenario

- Reduction of 15% from Reference Case by 2050.
  - Education and Food, Lodging and Recreation reduce absolute emissions over this time period (savings exceed growth in sector).
- Fuel expenditures drop by 13% overall, driven by a 13% reduction in commercial energy demands.
- No significant change in energy prices.
- Investments in buildings and equipment increase by 5% by 2050.

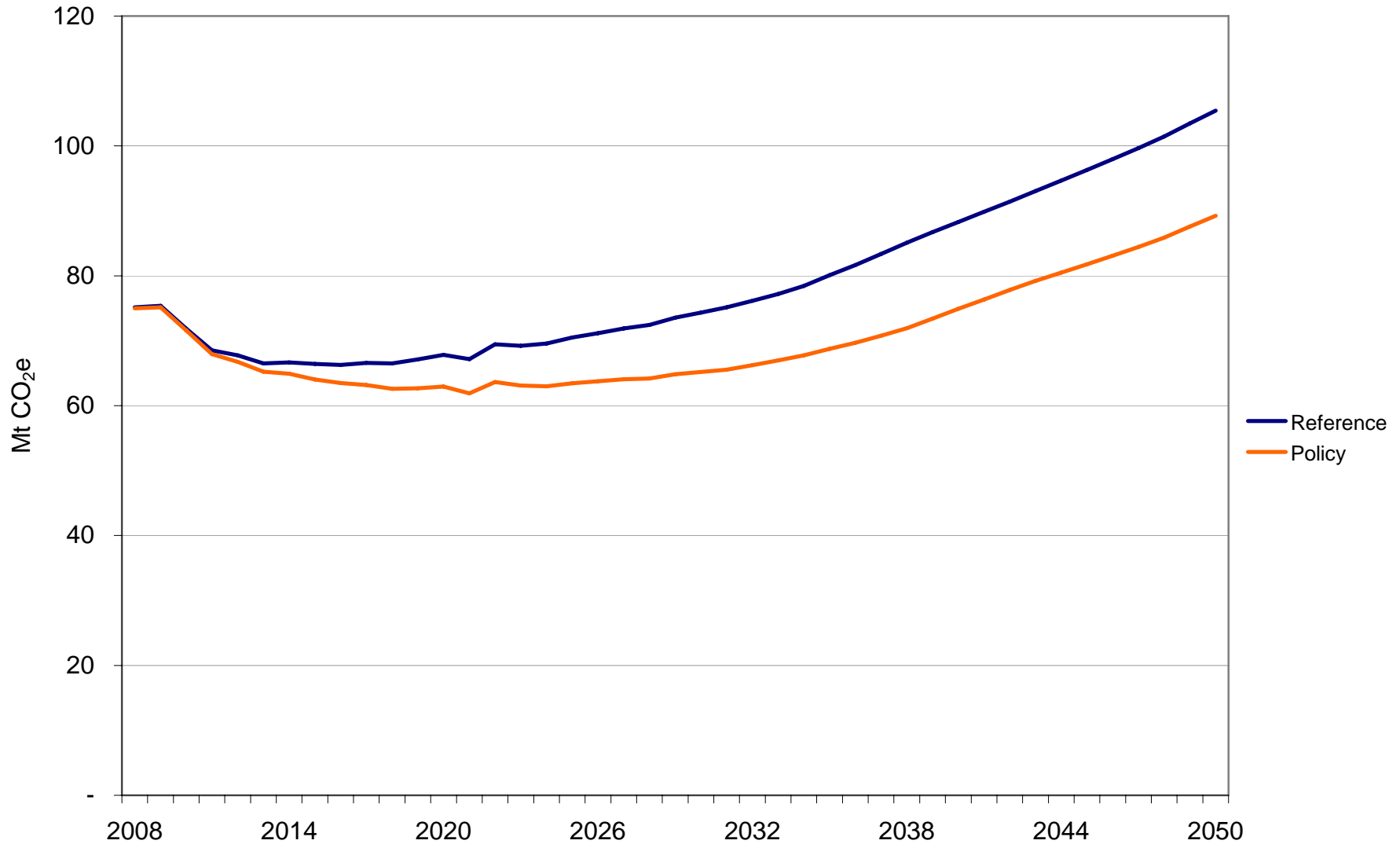
Commercial Energy Demands (PJ/year)	2008	2020		2050		Change from Reference in 2050
		Reference	Policy	Reference	Policy	
Space Heating	756	787	726	1,101	926	-15.9%
Water Heating	209	237	228	336	302	-9.9%
Other Subs	70	85	83	123	117	-4.9%
Refrigeration	136	167	163	258	245	-5.3%
Lighting	117	123	111	186	156	-16.1%
Air Condition	99	110	96	167	125	-25.3%
Other Non-Subs	98	120	115	180	167	-7.1%
<b>Total</b>	<b>1,486</b>	<b>1,630</b>	<b>1,522</b>	<b>2,351</b>	<b>2,039</b>	<b>-13.3%</b>

# Policy Scenario

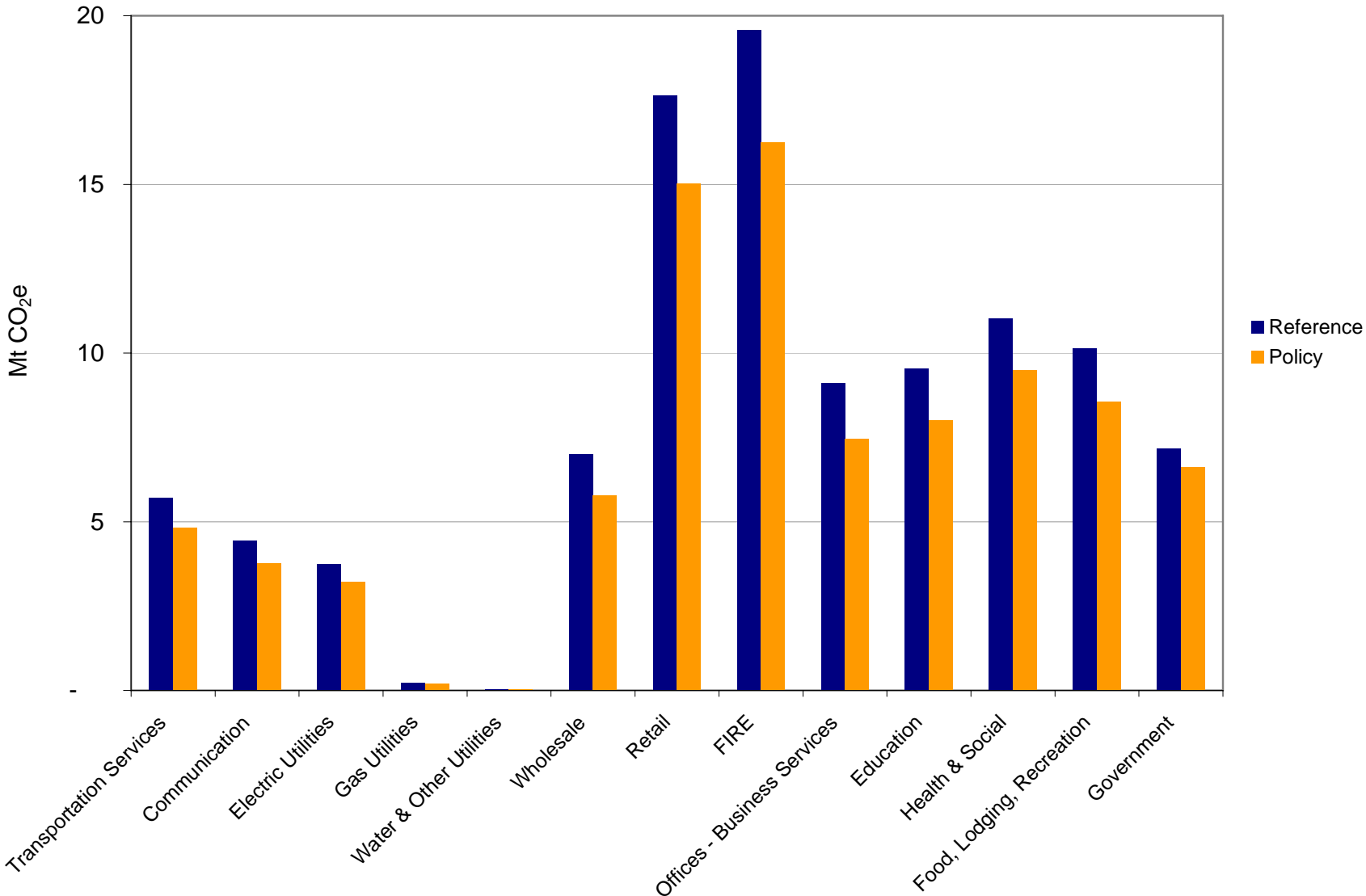
GHG Emissions (Mt)	2008	2020		2050		Change from Reference in 2050
		Reference	Policy	Reference	Policy	
Transportation Services	3.5	3.4	3.2	5.7	4.8	-15.2%
Communication	1.8	2.1	1.9	4.5	3.8	-15.6%
Electric Utilities	2.2	2.1	1.9	3.8	3.2	-14.3%
Gas Utilities	0.2	0.2	0.2	0.2	0.2	-9.8%
Water & Other Utilities	0.0	0.0	0.0	0.0	0.0	-7.2%
Wholesale	4.1	3.9	3.6	7.0	5.8	-17.3%
Retail	12.5	11.6	10.8	17.6	15.0	-14.8%
FIRE	15.8	13.9	12.7	19.6	16.2	-17.1%
Offices - Business Services	5.5	5.1	4.7	9.1	7.5	-18.2%
Education	9.7	7.3	6.8	9.5	8.0	-15.9%
Health & Social	6.7	6.4	6.0	11.0	9.5	-14.1%
Food, Lodging, Recreation	9.3	8.2	7.6	10.2	8.6	-15.7%
Government	4.0	3.6	3.5	7.2	6.6	-8.1%
<b>Total</b>	<b>75.1</b>	<b>67.8</b>	<b>62.9</b>	<b>105.4</b>	<b>89.3</b>	<b>-15.4%</b>

- Because the Government sector is further ahead in terms of efficiency, changes are less significant
- The impact of some of the policies grow over time, becoming more significant; it is useful to view these over the longer-term

# Policy Scenario - Commercial Emissions



# Policy Scenario – Commercial Emissions, 2050





# Policy and Carbon Tax Scenario

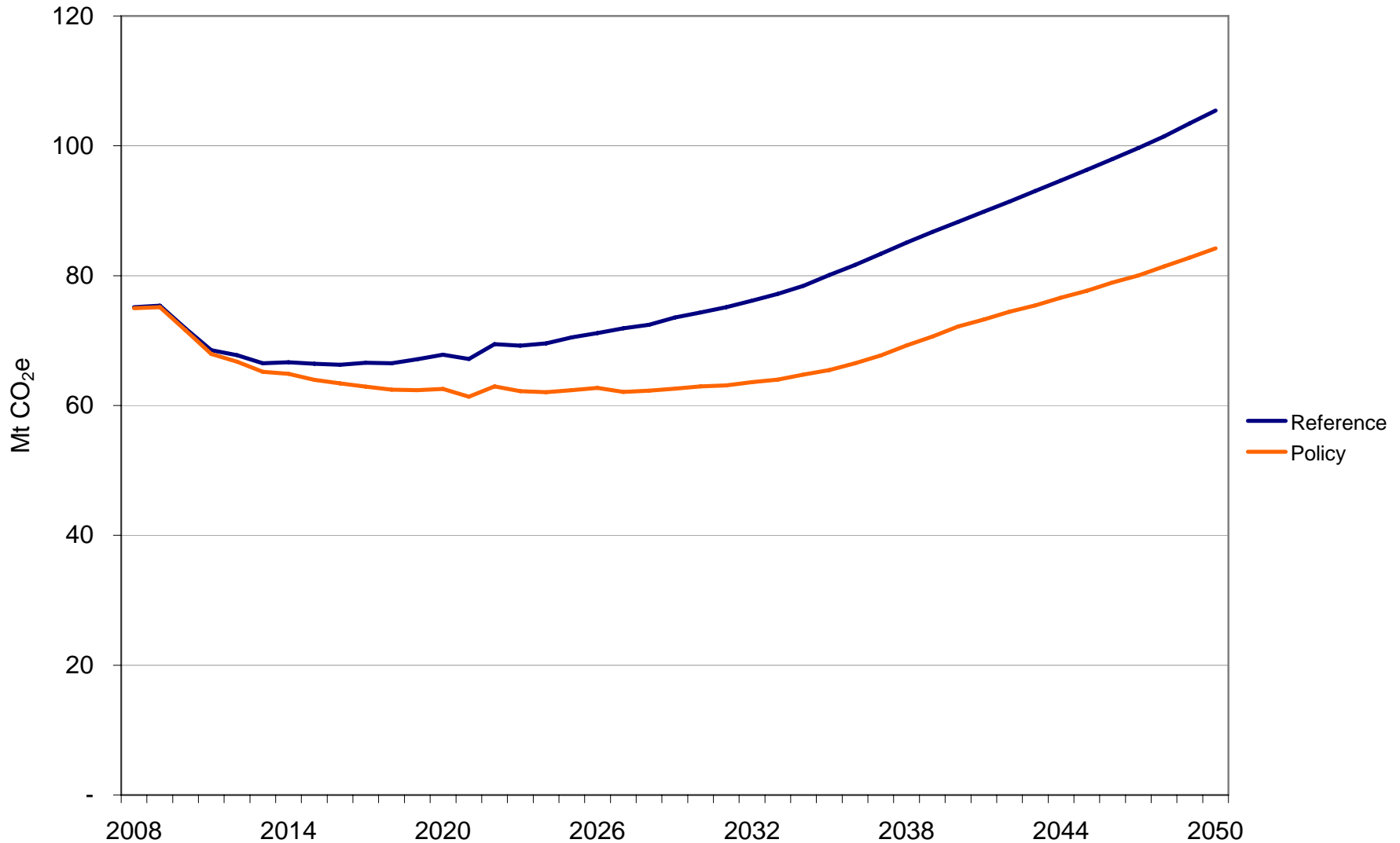
- Combined 20% reduction in emissions from Reference Case by 2050 (7.8% by 2020)
  - The largest absolute decreases occur in the FIRE and Retail sectors
- Commercial sector energy demands decrease by almost 17%, increase in electricity and gas prices of 7% and 80%, respectively
  - Reductions in air conditioning and space heating demand.
- Small increase in overall fuel expenditures of 5% as efficiency gains offset fuel price changes
  - Increases in energy prices do not translate into much higher costs, as they are offset by reduced consumption.
- The use of CCS increases, but not as much as under the Carbon Tax scenario
- Investments in buildings and equipment increase by 17% over Reference Case by 2050

# Policy and Carbon Tax Scenario

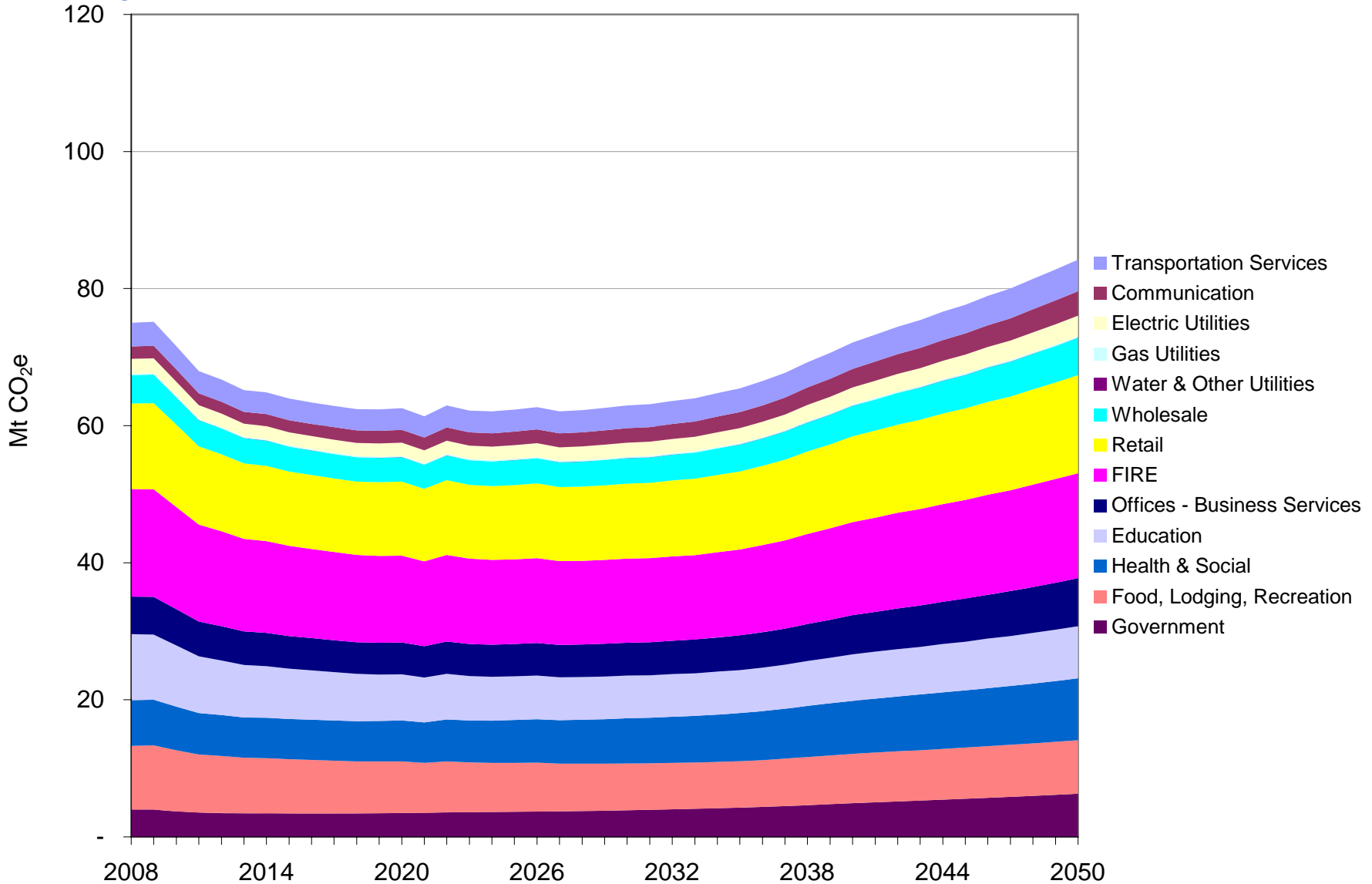
GHG Emissions (Mt)	2008	2020		2050		Change from Reference in 2050
		Reference	Policy	Reference	Policy	
Transportation Services	3.5	3.4	3.1	5.7	4.6	-19.3%
Communication	1.8	2.1	1.9	4.5	3.6	-20.2%
Electric Utilities	2.2	2.1	1.9	3.8	3.0	-19.2%
Gas Utilities	0.2	0.2	0.2	0.2	0.2	-12.9%
Water & Other Utilities	0.0	0.0	0.0	0.0	0.0	-12.6%
Wholesale	4.1	3.9	3.6	7.0	5.4	-22.3%
Retail	12.5	11.6	10.8	17.6	14.3	-19.0%
FIRE	15.8	13.9	12.7	19.6	15.3	-21.7%
Offices - Business Services	5.5	5.1	4.7	9.1	7.0	-23.1%
Education	9.7	7.3	6.7	9.5	7.6	-20.4%
Health & Social	6.7	6.4	6.0	11.0	9.0	-18.2%
Food, Lodging, Recreation	9.3	8.2	7.5	10.2	7.8	-23.1%
Government	4.0	3.6	3.5	7.2	6.3	-12.3%
<b>Total</b>	<b>75.1</b>	<b>67.8</b>	<b>62.5</b>	<b>105.4</b>	<b>84.2</b>	<b>-20.1%</b>

Commercial Energy Demands (PJ/year)	2008	2020		2050		Change from Reference in 2050
		Reference	Policy	Reference	Policy	
Space Heating	756	787	718	1,101	862	-21.7%
Water Heating	209	237	226	336	293	-12.7%
Other Subs	70	85	83	123	111	-9.7%
Refrigeration	136	167	163	258	244	-5.5%
Lighting	117	123	111	186	156	-16.1%
Air Condition	99	110	96	167	123	-26.5%
Other Non-Subs	98	120	115	180	167	-7.1%
<b>Total</b>	<b>1,486</b>	<b>1,630</b>	<b>1,512</b>	<b>2,351</b>	<b>1,956</b>	<b>-16.8%</b>

# Policy and Carbon Tax Scenario - Emissions



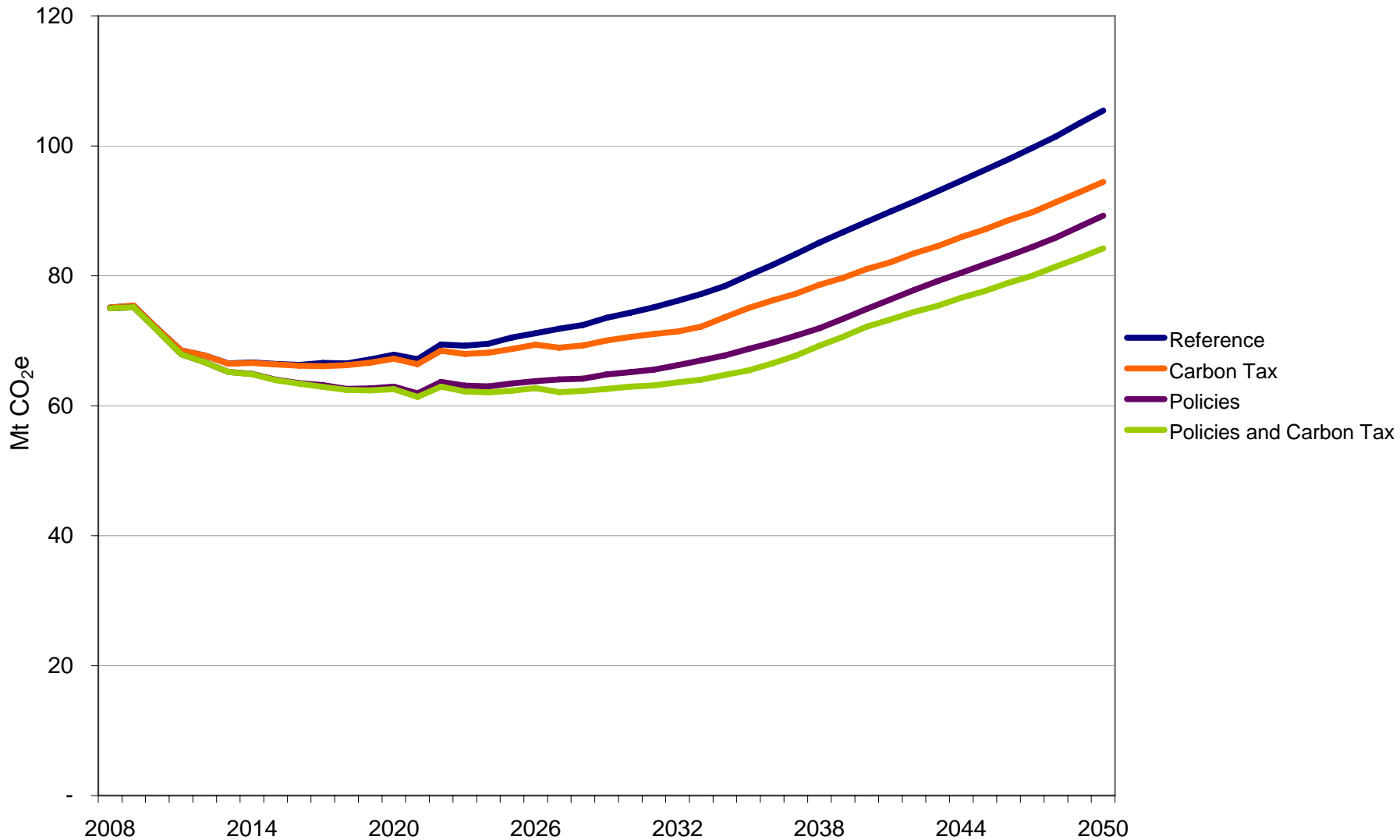
# Policy and Carbon Tax Scenario - Emissions



# Summary

- Under the combined carbon tax and policy scenario, aggressive actions result in absolute emissions declining in all sectors until 2030.
- After that time, continued economic growth begins to drive increasing emissions until the end of the period.
- Further actions would need to be introduced in the latter part of the period to avoid increased absolute emissions from 2008 levels by 2050.
- Carbon tax or policies on their own limit growth to below 2008 levels until about 2030, while combining a carbon tax and policies limits growth past 2040.

# Scenario Comparison



## Contact Information:

Glen Wood  
Senior Manager  
[gwood@icfi.com](mailto:gwood@icfi.com)  
Phone (416) 341-8952

Chris Caners  
Associate  
[ccaners@icfi.com](mailto:ccaners@icfi.com)  
Phone (416) 341-0638

