

# **ASRA Retreat**

## **Alberta Climate Change and Technology Challenges**

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# *Climate Change Central (C3)*

## **- what is it?**

- **Incorporated as a not-for-profit company in early 2000**
- **Designed as a private-public partnership**
- **The multi-stakeholder board includes representatives from major industry sectors, environmental associations, municipalities, and the provincial government**
- **Core staff of 8 individuals with experience across all stakeholder groups**
- **Consultants assisting with specific projects or analyses**
- **Head office in Calgary, smaller office in Edmonton**



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## **- what's the role?**

- **Providing Leadership**
  - to take action in Alberta on climate change
  - to develop climate change partnerships and alliances
- **Providing Strategic Intelligence**
  - to identify climate change priorities and appropriate policy frameworks
  - to pursue technology and market opportunities
- **Providing Outreach**
  - to increase public awareness of the issue
  - to communicate Alberta's accomplishments and solutions available



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# *How many ways of framing Climate Change have been developed by one interest group or another?*

- **Ethics/morality**
- **Science**
- **Technology solutions**
- **Economics**
- **Sustainable Development**
- **Domestic Policy**
- **Risk Management**
- **International Policy**
- **Health**

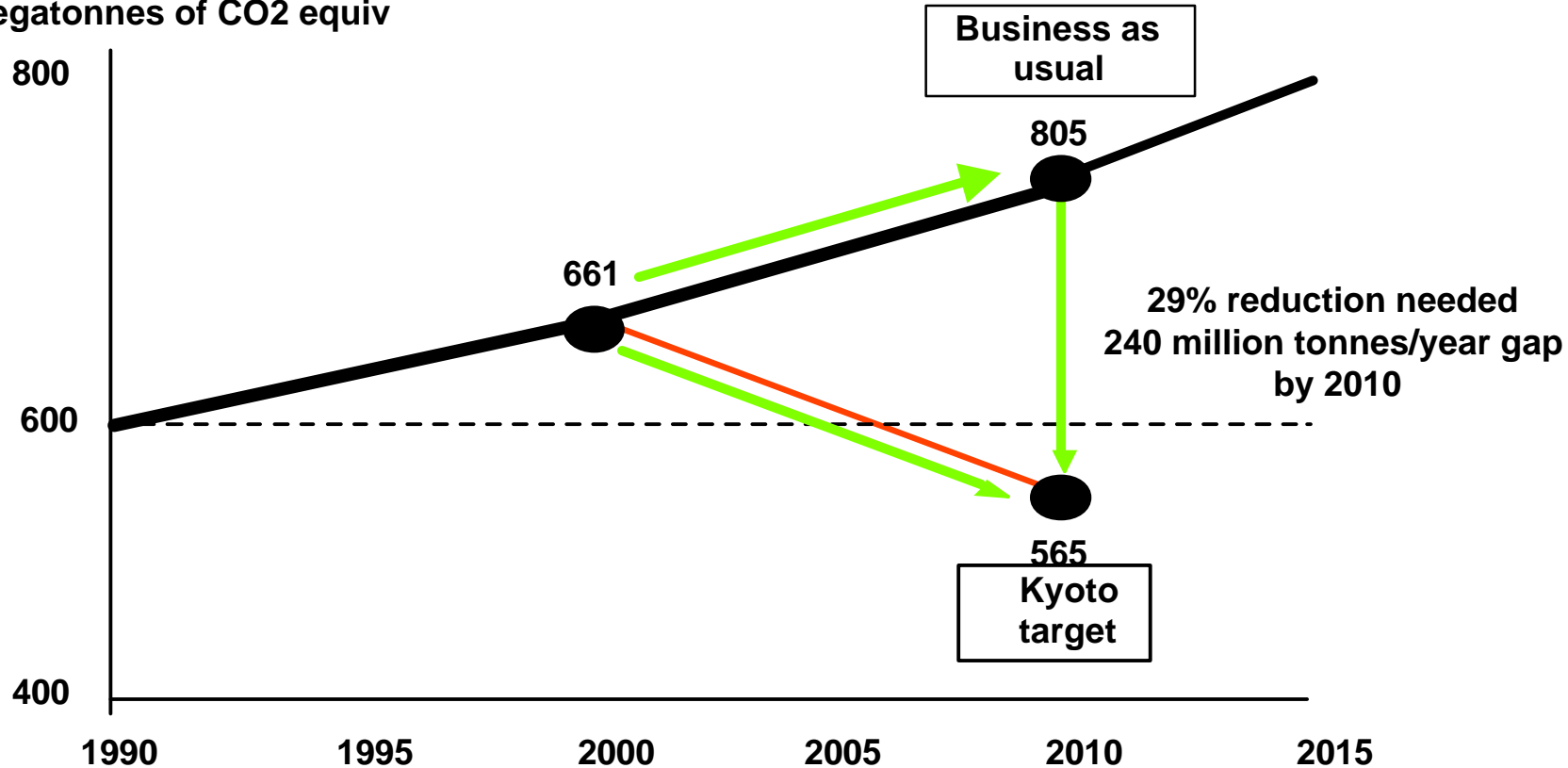
**Climate Change is a complex, all encompassing issue of massive proportions with very diverse perspectives. Everyone has an opinion and an apparent solution**



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# Canada's Current and Projected Greenhouse Gas Emissions – a significant challenge

**GHG Emissions**  
Megatonnes of CO2 equiv



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# *A Significant Challenge not just for Canada*

## *Emissions Change 1990-1999(CO<sub>2</sub>e)*

*Source: UNFCCC*

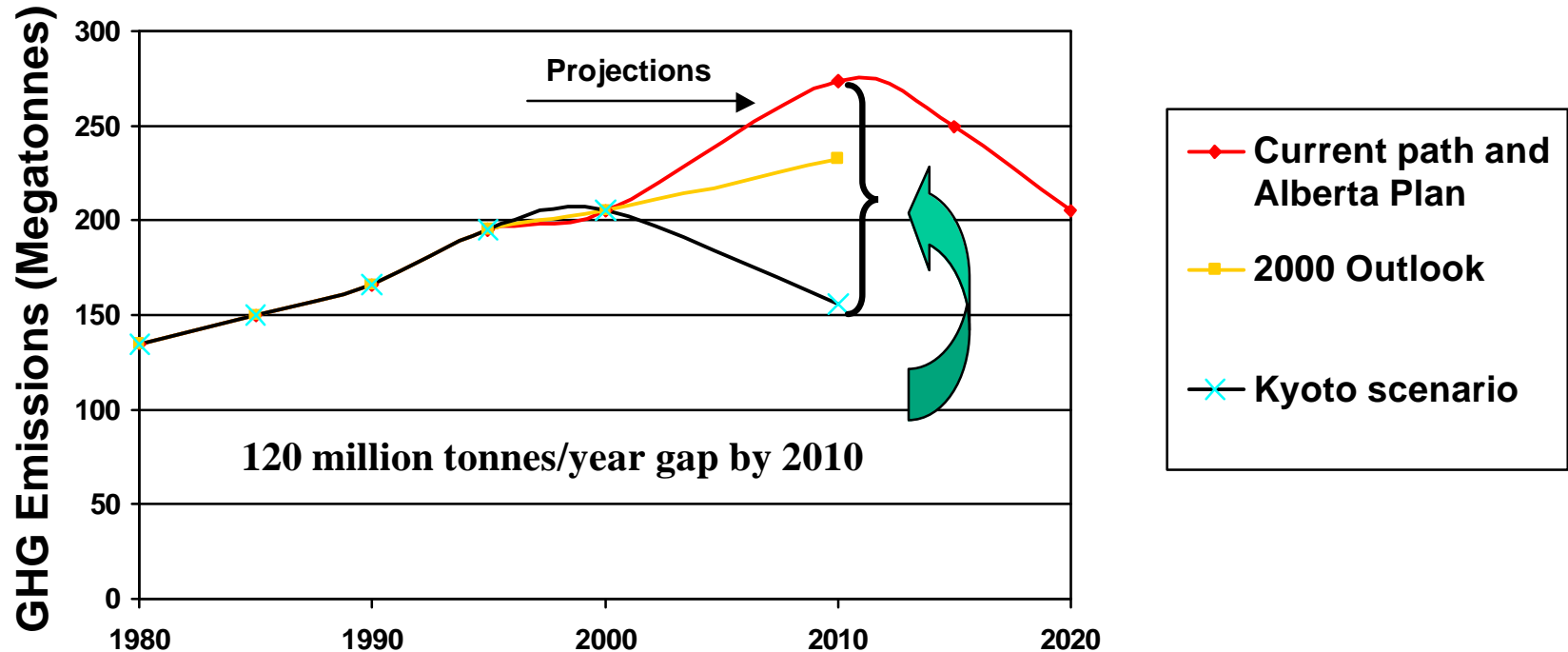
- |               |       |                |           |
|---------------|-------|----------------|-----------|
| • Portugal    | + 23% | • Denmark      | + 5%      |
| • Ireland     | + 22% | • Italy        | + 4%      |
| • Spain       | + 18% | • Austria      | + 3%      |
| • Greece      | + 17% | • Sweden       | + 2%      |
| • Australia   | + 15% | • Switzerland  | + 1%      |
| • Canada      | + 15% | • France       | No Change |
| • USA         | + 12% | • Finland      | - 1%      |
| • Belgium     | + 11% | • Eur. Commun. | - 4%      |
| • Norway      | + 8%  | • UK           | - 14%     |
| • Netherlands | + 7%  | • Hungary      | - 15%     |
| • Japan       | + 6%  | • Germany      | - 17%     |
| • New Zealand | + 5%  | • Russian Fed. | - 35%     |



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# Alberta's Current and Projected Greenhouse Gas Emissions

## Alberta GHG Emissions



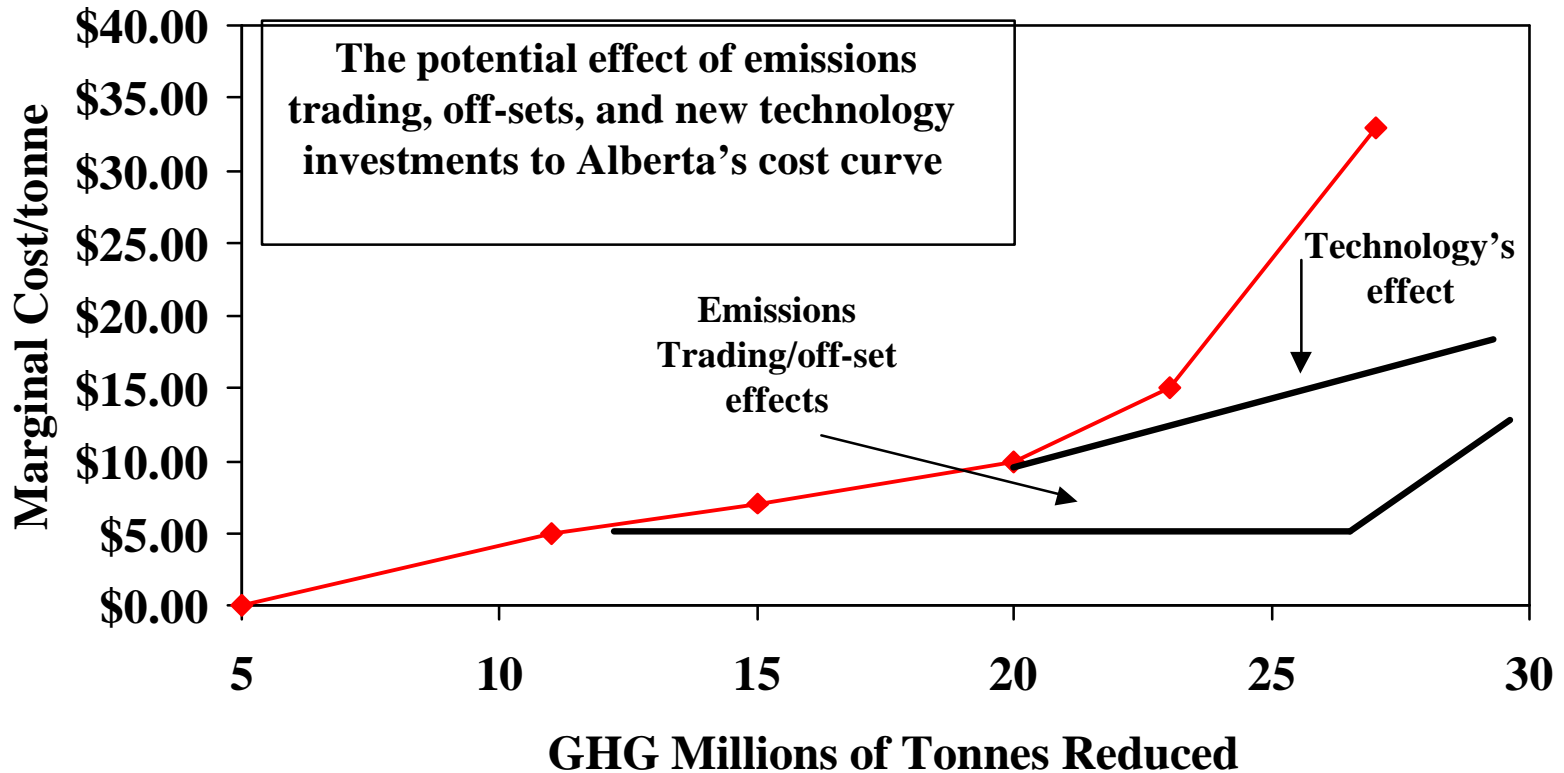
In a Kyoto world and at a regulated or market price of \$10 Cdn/CO<sub>2</sub>E tonne, CO<sub>2</sub> emissions potentially represent a cost of \$1.2 billion annually to Alberta's economy in 2010.



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# Alberta's Emissions Reduction Challenge

## Alberta's Energy Sector GHG Emissions Reduction Cost Curve



Source: Climate Change Central



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# *How are Carbon Emissions, Energy, and Economic Growth Related?*

- **Carbon emissions ( C ), energy (E), and economic growth (GDP) are directly related:**

<b>Net Carbon Emissions</b>	<b>Gross Domestic Product</b>	<b>Energy Intensity</b>	<b>Carbon Intensity</b>	<b>Carbon Sequestered</b>
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$$\text{Net C} = (\text{GDP} \times \underbrace{\text{E/GDP} \times \text{C/E}}_{\text{C/GDP}}) - \text{S} \quad (1)$$

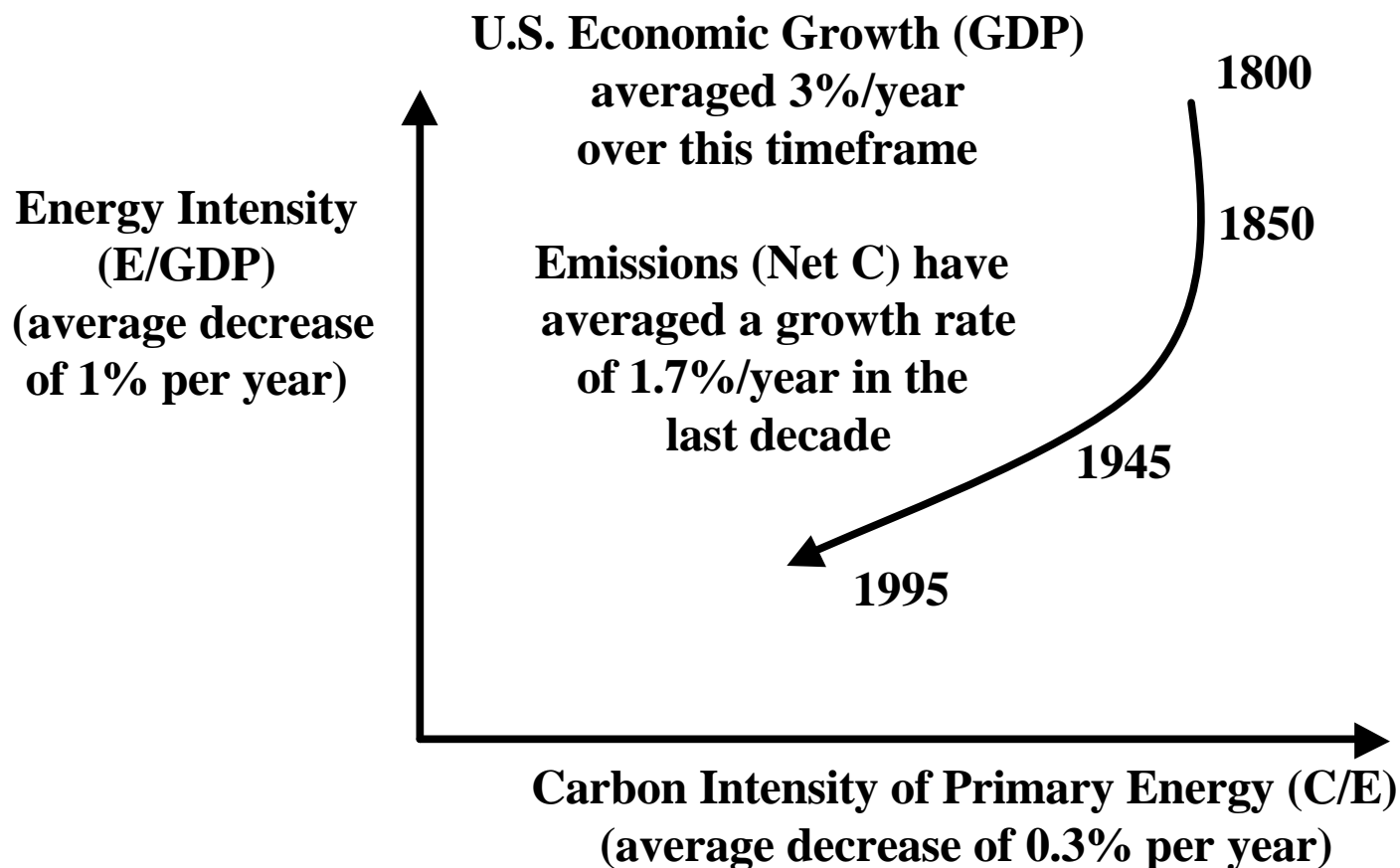
**C/GDP**  
Emissions Intensity

**What has been the historical relationship amongst these parameters and what role can technology play?**

(1) Reichle, Oak Ridge National Laboratory, Bull, National Renewable Energy Laboratory



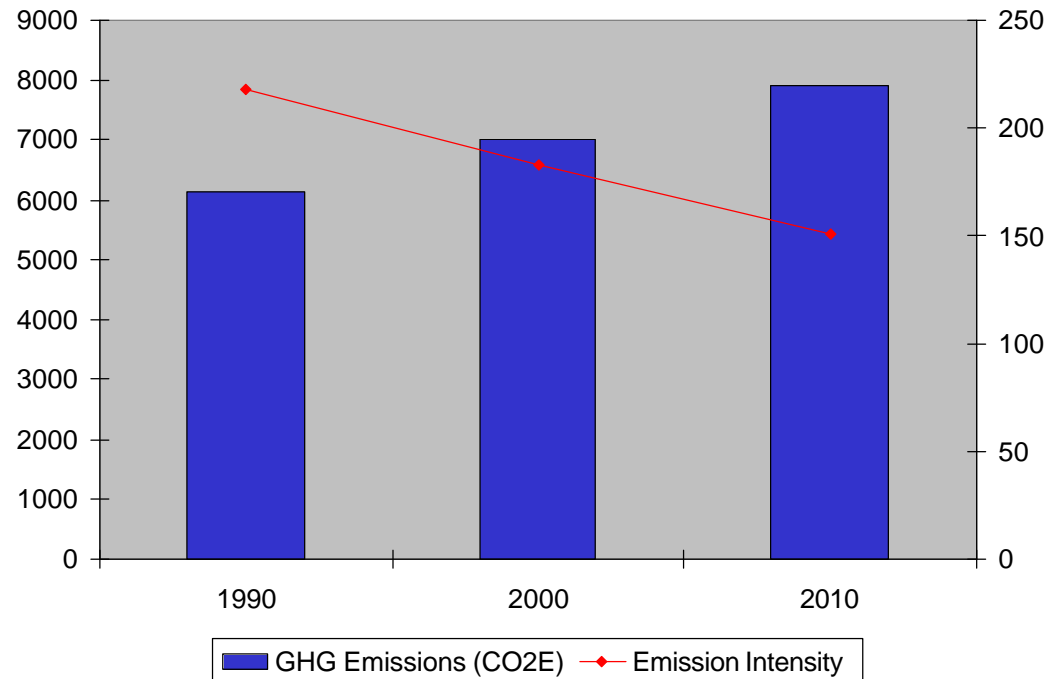
*Historically, with long-term U.S. economic growth, carbon emissions have continued to grow even as energy intensities & carbon intensities have decreased*



# *What does the recently announced U.S. Clean Skies Plan look like in terms of future GHG emissions and emission intensities?*

Emissions MMTCO<sub>2</sub>E

Metric Tons/M\$GDP



**Over the next 10 year period,  
emissions are forecast  
to grow 15%  
emissions intensities  
are forecast to  
decrease by 18%**

Source: Pew Center Analysis of President Bursh's February 14<sup>th</sup> Climate Change Plan



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# *How do these U.S. trends compare to Alberta's targets and how big might the technology challenge be for Alberta?*

$$\text{Net C} = \text{GDP} \times \text{E/GDP} \times \text{C/E} - \text{S}$$

emissions intensity  
C/GDP

Average Annual  
Change

+1.7%      +3%      -1.3%      ?      U.S. (195 yr historical)

+1.5%      +3%?      -1.8%      ?      U.S. (10 yr forecast)

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+0.8%      +3%?      -1.7%      ?      Alberta 2020 targets  
(30 year forecast  
1990 - 2020)



This involves a significant, sustained investment in carbon mitigation technologies



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# *Can Technology break the link between Economic Growth and Carbon Emissions Growth in a fundamentally carbon-based fuel source world?*

- **Technology can play a key role in three ways:**
  - **By reducing the energy intensity ( $E/GDP \downarrow$ ) of our economy**
  - **By reducing the carbon intensity ( $C/E \downarrow$ ) of energy use**
  - **By increasing the absorption of  $CO_2$  ( $S \uparrow$ ) from our atmosphere (subtracting carbon from the equation)**
  - **By integrating all of the above strategies to produce more value-added hydrocarbon end-products and increase GDP ( $\uparrow$ )**



# *What are Alberta's Potential Opportunities?*

- **New energy infrastructure technologies are needed**
  - CO2 separation, transportation, and storage technologies
  - Clean coal power generation technologies
  - Integrating hydrocarbon sources to refine higher value-added end products
  - Electric transmission line optimization technologies
- **Leading market mechanisms are needed**
  - Market-based emissions trading approaches
  - Energy conservation and climate change educational programs
  - Energy efficiency initiatives
- **Leading alternative energy initiatives are needed**
  - Distributed generation, combined heat & power projects
  - Continued wind power development
  - Alternative transportation fuels projects (fuel cells, hydrogen, bio-fuels)
  - Sustainable building projects

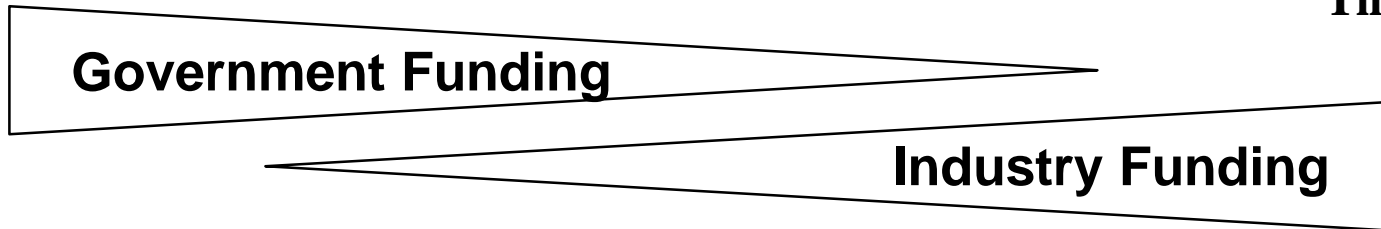
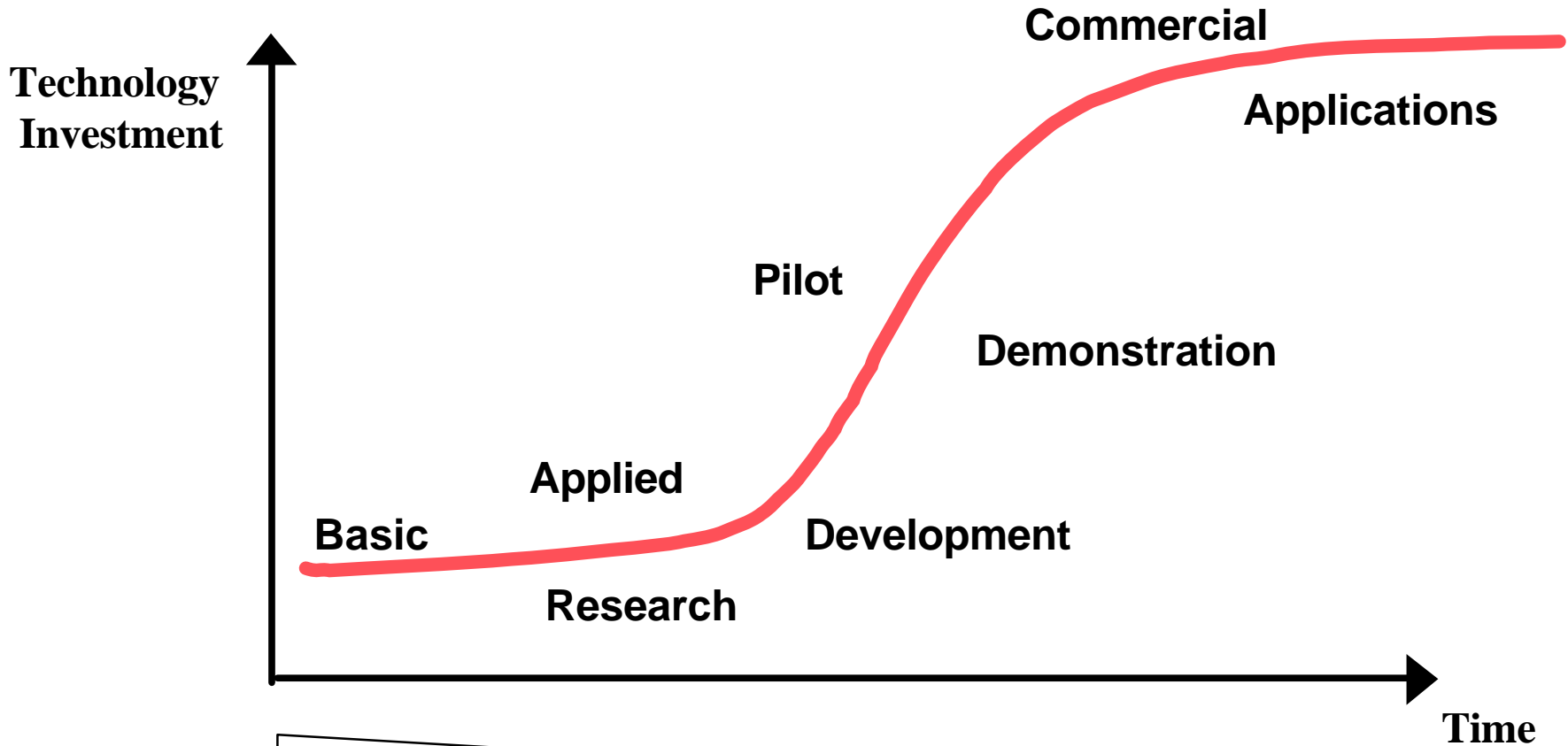


# *What are the Climate Change Technology Challenges?*

- **Strong leadership is needed to drive the technology advancements**
- **A market signal (a price for carbon) is needed to drive significant climate change technological innovation**
- **Successful technology commercialization and implementation requires the technology be of increased (not equal) shareholder value**
- **Technology breakthroughs (disruptive technologies) are needed to substantially reduce emissions – these take time and require sustained investment**
- **Clusters of basic science expertise and experimentation will be needed as the solutions may come from a combination of less-than-obvious innovations**
- **Partnerships between industry and government, between Canada and other countries will be important to making significant progress**



# *R&D and technology application takes time*



# *Additional Background Slides*



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# *C3 Priorities - in support of economically closing the Alberta Emissions “gap” now and in the future*

	<b>Analysis, Engagement, and Policy Advice</b>	<b>Communications and Outreach</b>	<b>Promoting Innovation</b>
<b>Economics of Climate Change</b>	<b>Development of cost curves across all Alberta sectors</b>	<b>Leadership forums and public presentations</b>	<b>Recommendation of action steps needed</b>
<b>Emissions Off-set Development</b>	<b>Economic and research analysis of options and pre-cursors to implementation</b>	<b>Emissions trading simulation and mock negotiation</b>	<b>Agricultural sinks protocols project, telecommuting credit opportunities, CDM/JI opportunities</b>
<b>Efficiency Gain Opportunities</b>	<b>Energy efficiency office options for Alberta and options in different sectors</b>	<b>Sustainable buildings symposium</b>	<b>Exploring a number of CHP projects and efficiency projects in different sectors</b>
<b>Potential Technology Contributions</b>	<b>Participation in CO2 sequestration economics study and Alberta energy technology strategy</b>	<b>Distributed generation and climate change technology forums</b>	<b>Exploring a number of innovative technology approaches to reducing emissions</b>
<b>Adaptation Requirements</b>	<b>Coordination of an adaptation research strategy for Alberta</b>	<b>Sponsor an adaptation Research chair at The University of Lethbridge</b>	<b>Support the selection and development of adaptation projects through PARC</b>



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# *How do C3's Priorities Support Alberta Emission Reductions?*

$$\begin{array}{ccccc} \text{Net Carbon} & \text{Gross} & \text{Energy} & \text{Carbon} & \text{Carbon} \\ \text{Emissions} & \text{Domestic} & \text{Intensity} & \text{Intensity} & \text{Sequestered} \\ & \text{Product} & & & \\ \text{Net C} = & (\text{GDP} \times \underbrace{\text{E/GDP} \times \text{C/E}}_{\text{C/GDP}}) - \text{S} \\ & & & & \\ & & & & \text{Emissions Intensity} \end{array}$$

**Energy Efficiency / Conservation** - Reduce Energy Intensity (E/GDP)

**Technology Contributions** - Reduce Carbon Intensity (C/E)

**Emission Offset Development** - Minimize Emissions Reduction costs (C/GDP) and Sequestration (S) costs

**Economic Implications** - Balance environmental concerns with economic growth to maximize GDP

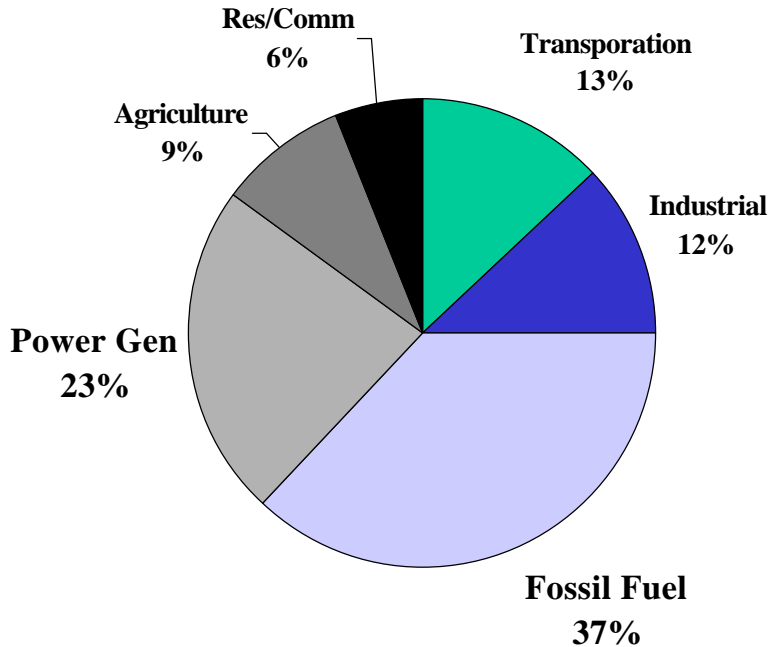
**Adaptation** - Prepare for possible future climates/develop the ability to adapt successfully



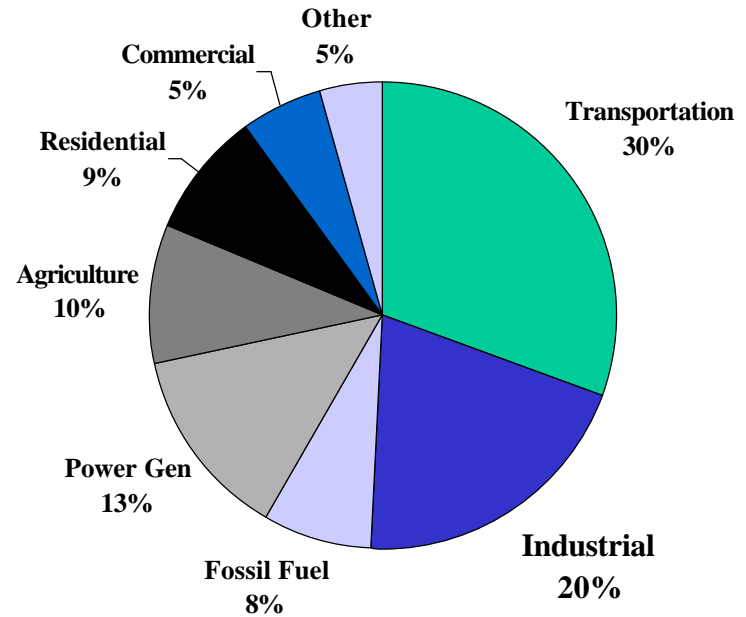
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# *Alberta's (and Canada's) Energy Resource Advantage produces a unique sectoral emissions profile*

**Alberta**  
214MT (1999)



**Rest of Canada**  
490MT (1999)

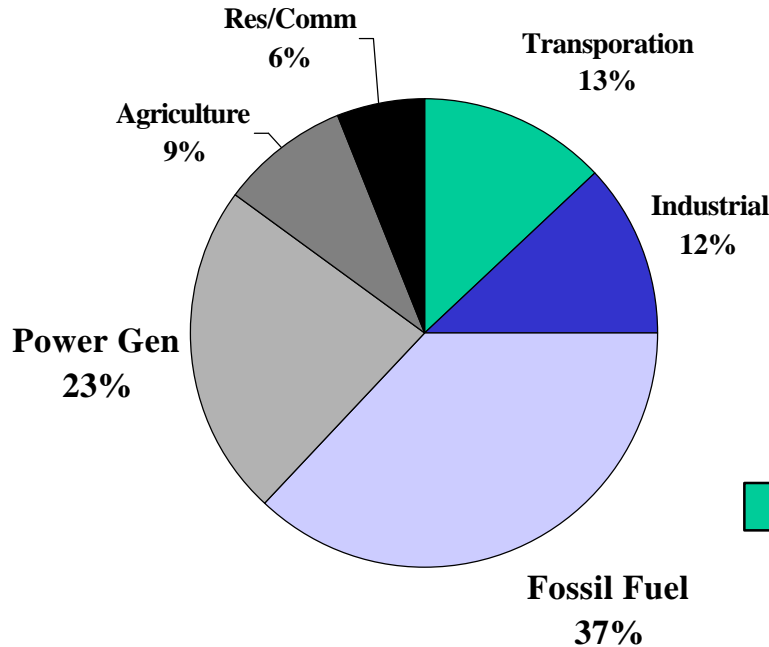


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# Alberta Energy Supplier/Consumer GHG Emissions

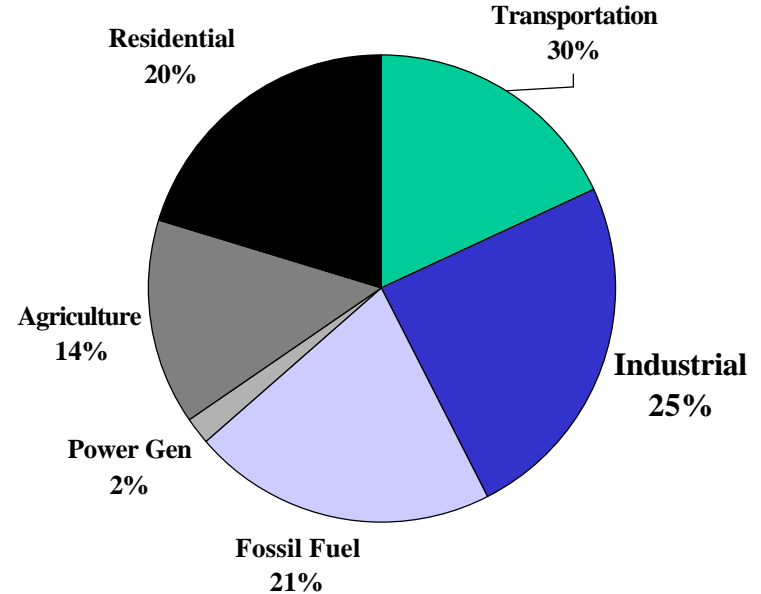
## Alberta as a *Supplier* of Energy

214MT (1999)



## Alberta as a *Consumer* of Energy

150MT (1999)



**40% of Alberta's GHG emissions associated with oil and gas exports**



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