Economic Implications

Of Research Investment in Energy and the Environment

Robert Mansell

ASRA Retreat, June 2002

Objectives

- Highlight the dimensions and impacts of the energy sector
- Outline key challenges with respect to Alberta's future economic performance
- Summarize the general economic implications of different futures shaped by R&D in energy and environment

Key Messages

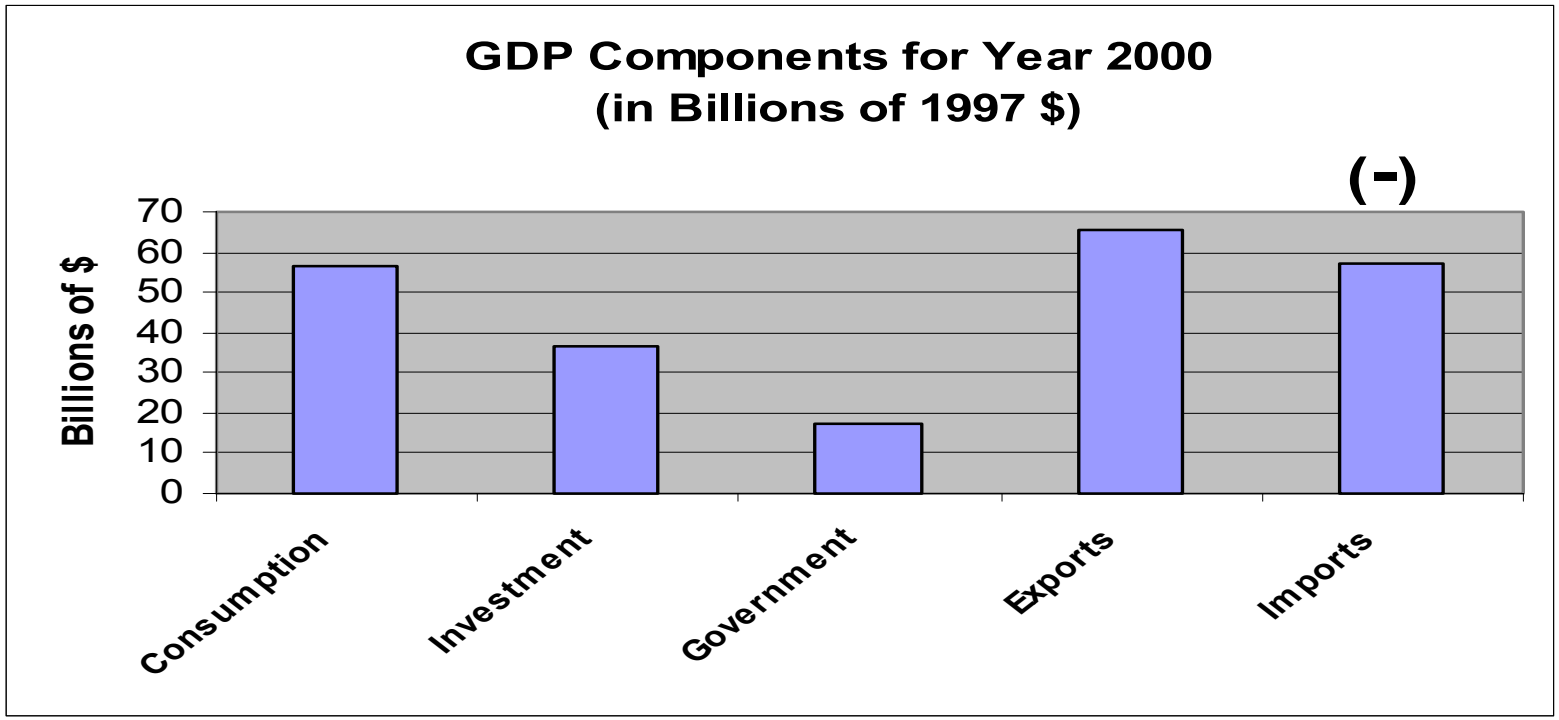
- The energy sector is and will remain fundamental to sustainable prosperity for Alberta
- The technology and policy risks to this sector and sustainable prosperity are large and increasing
- The opportunities to secure and enhance this prosperity are equally large and easily justify substantial increases in R&D effort in energy and the environment

Role of the Energy Sector

- It is the key sector in terms of Alberta's economic growth and prosperity
  - Accounts for about one-half of the economy taking into account direct plus indirect impacts
  - Directly accounts for just under one-half of all investment and, including derivative products, it accounts for about one half of all exports

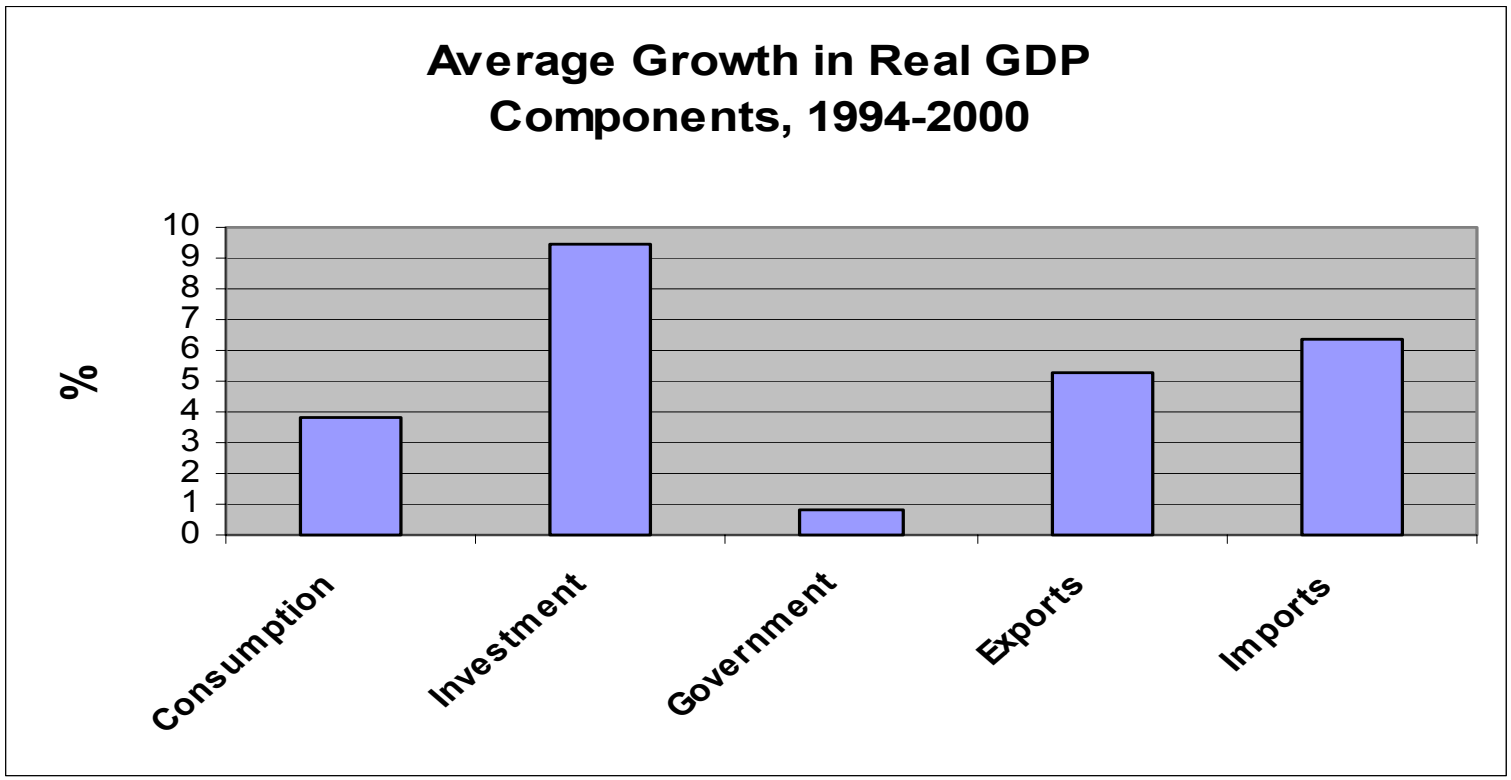
Contributions to GDP

Note: GDP = Cons + Invest + Gov't + Exports – Imports; Investment and Exports are key exogenous drivers



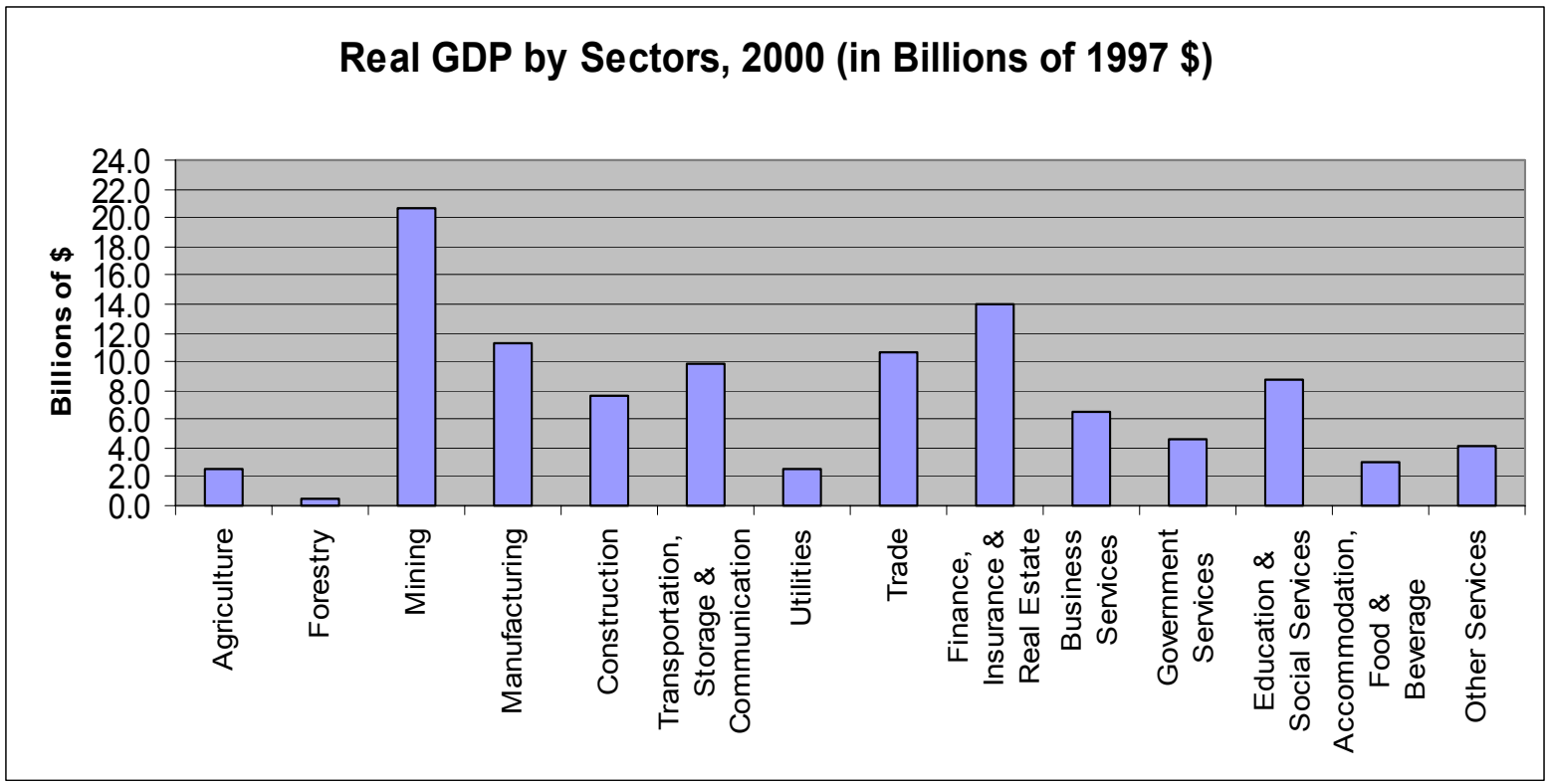
Data from Alberta Economic Accounts

Contributions to Growth



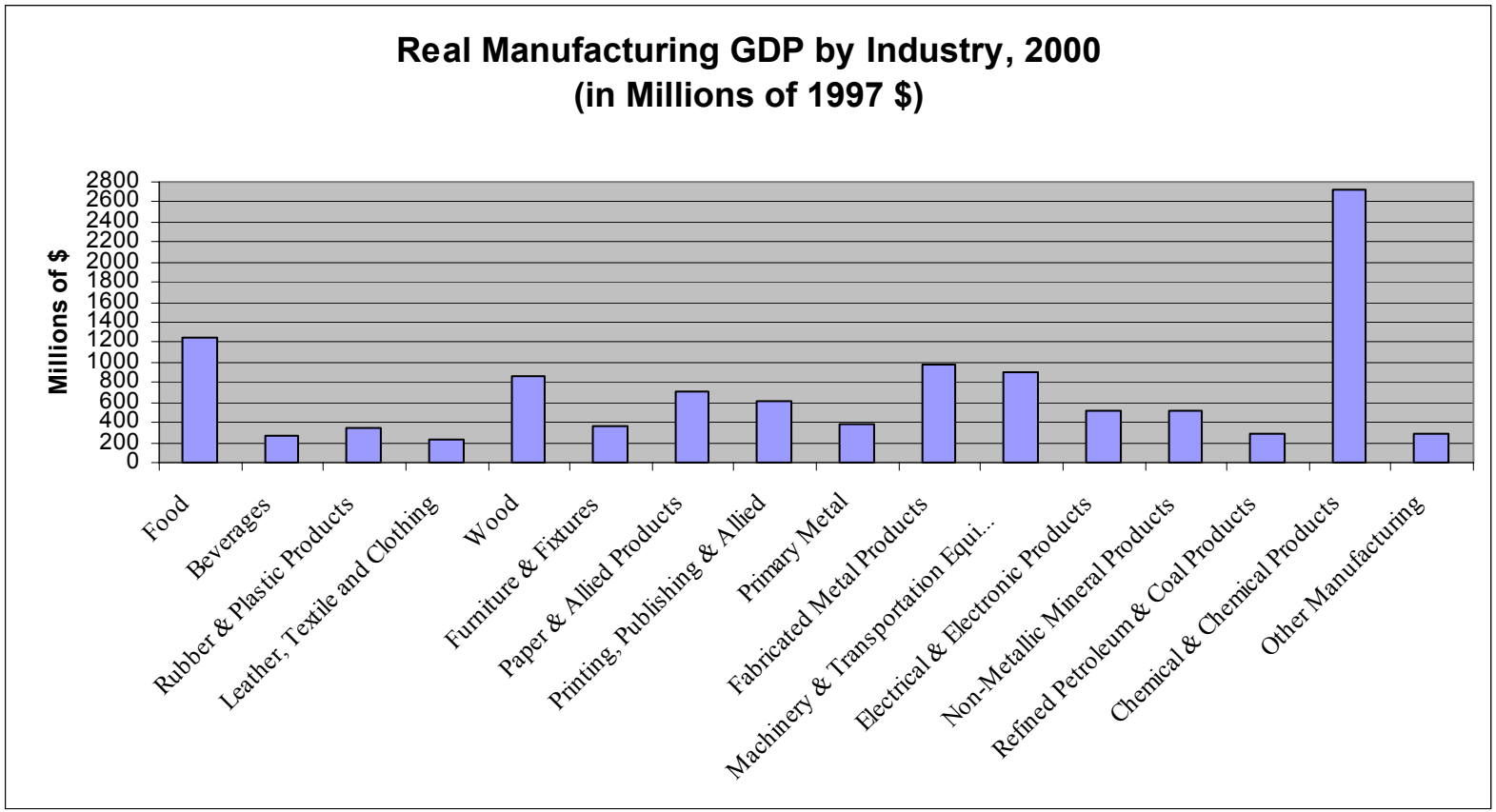
Data from Alberta Economic Accounts

Contributions to GDP



Data from Alberta Economic Accounts. Note that Alberta GDP = sum of sectoral GDP or value added.

Contributions to Mfg. GDP

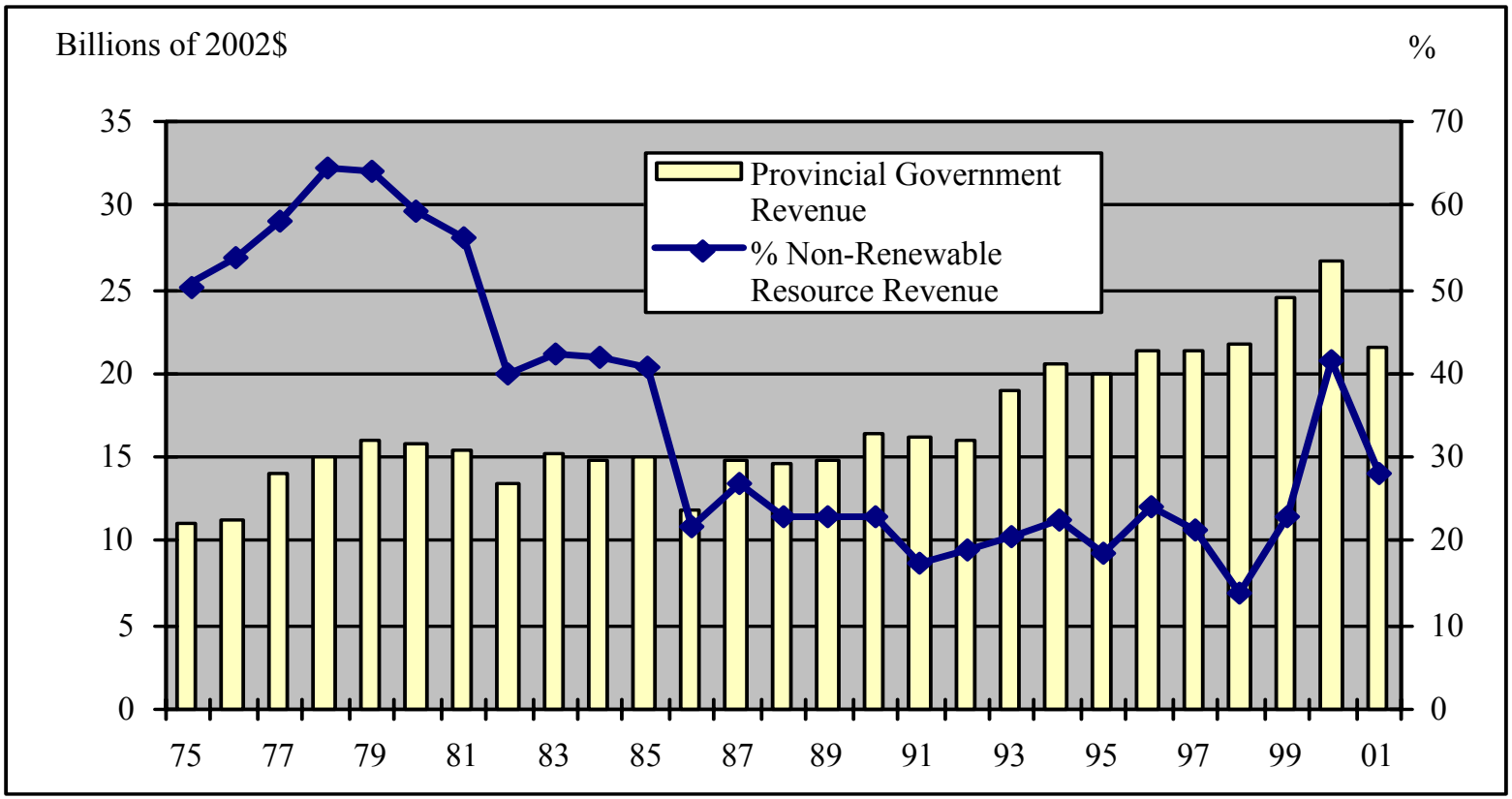


Data from Alberta Economic Accounts

Contributions to Exports

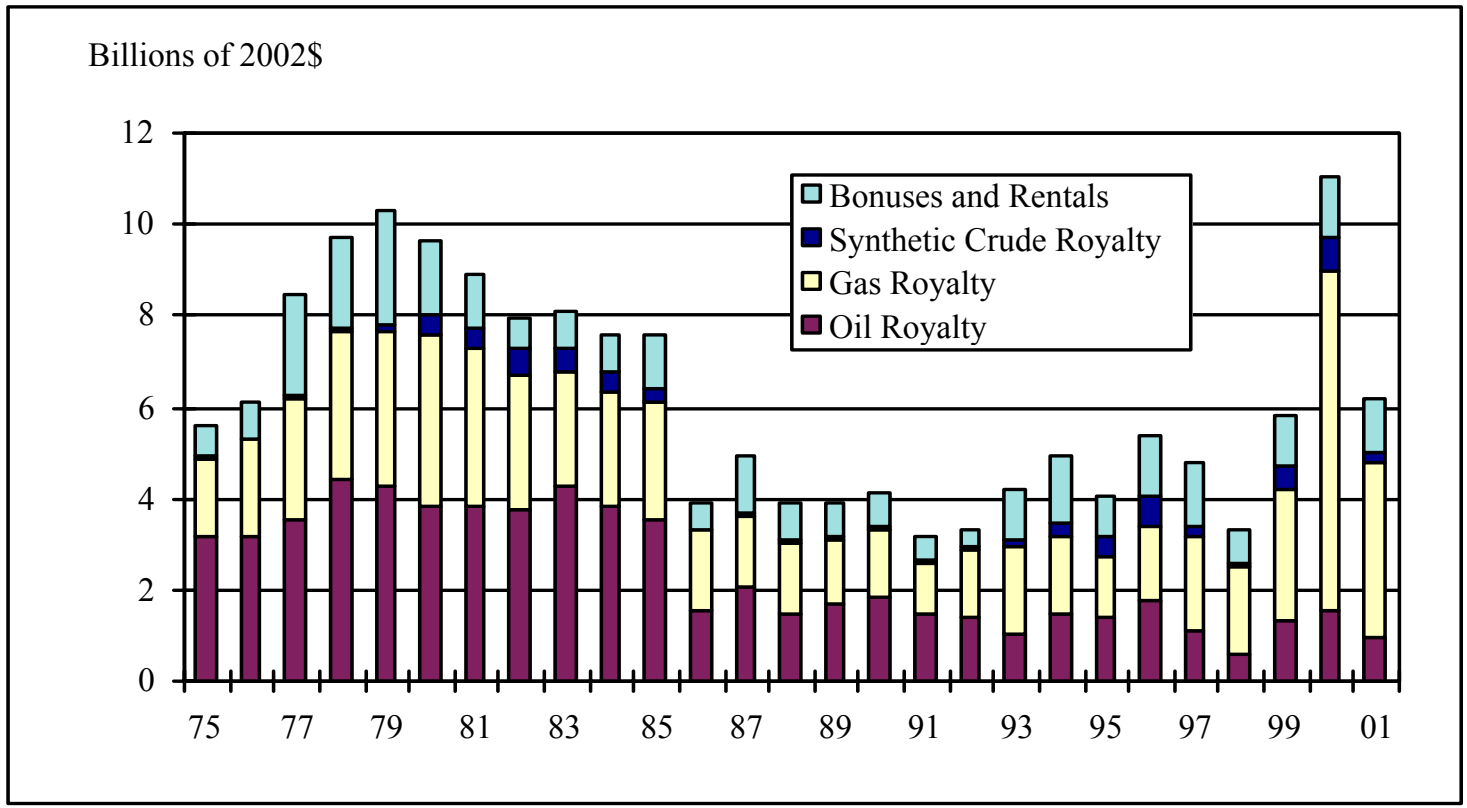
Data from Alberta Economic Accounts

Contributions to Alberta Gov't Revenues



Data from Government of Alberta, Annual Budgets

Contributions to Alberta Gov't Revenues



Data from Government of Alberta, Annual Budgets

Other Contributions

- Major contributions of energy sector to gov't revenues allows high quality infrastructure without high tax levels
- Capital Intensity translates into high productivity and incomes
- Highly developed backward linkages (eg. Construction) and forward linkages (eg. Petrochemicals) means large multiplier effects

Other Contributions

- Major contributions of energy sector to economic growth have meant large inflows of 'human capital'
- Major contributions of the energy sector to our culture of risk taking, entrepreneurship, adjustment, innovation and international competitiveness

Key Challenges

- Avoiding the tendency in resource-based economies to consume rather than invest resource rents
- Meeting increasing environmental constraints
  - GHG and other emissions
  - Water

Key Challenges

- Sustaining prosperity and growth with declining resource revenues, with declining conventional gas production, with current limitations on upgrading (including petrochemicals), with increasing environmental constraints and with longer term technological shifts (eg. transition to a hydrogen economy)

Key Challenges

- Capitalizing on new opportunities arising from the development and implementation of new technologies (for example, with regard to reducing emissions, increasing efficiency, integrating energy systems, developing new resources (such as CBM) and using hydrocarbons to support the long term trend to a hydrogen economy).

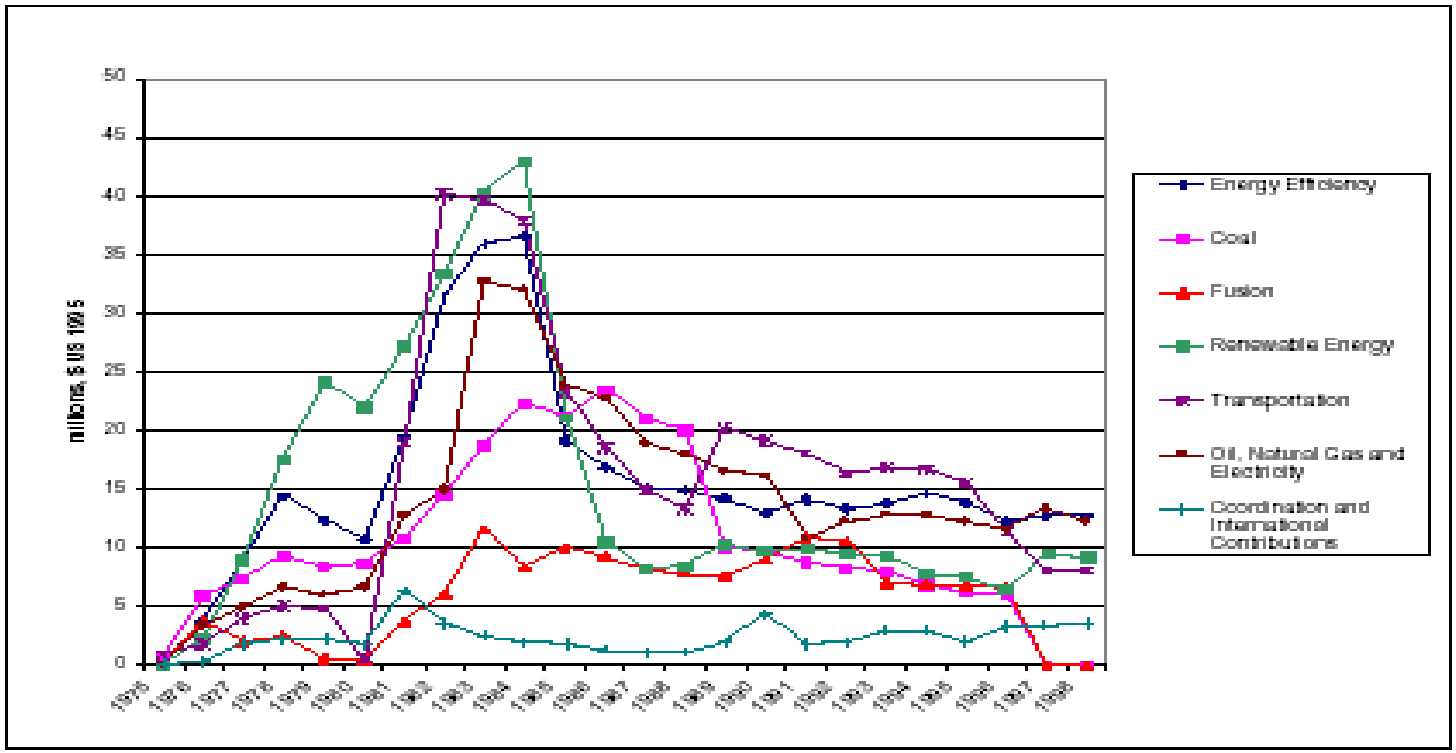
Investment in Research in Energy and the Environment

- ASRA's investment is currently about $12 million per year or around 5% of its total research investment
- Federal investment in energy R&D has declined steadily and was about $175 million in 1999
- Private sector R&D in fossil fuels energy has fallen to just over $100 million annually and total energy R&D of about $200 million annually gives the energy sector the distinction of having one of the lowest rates of investment in R&D

Sources: ASRA Presentation: Sustainable Prosperity and Quality of Life and Energy R&D in Canada, March 2000, by Battelle Memorial Institute.

Trends in Energy Research

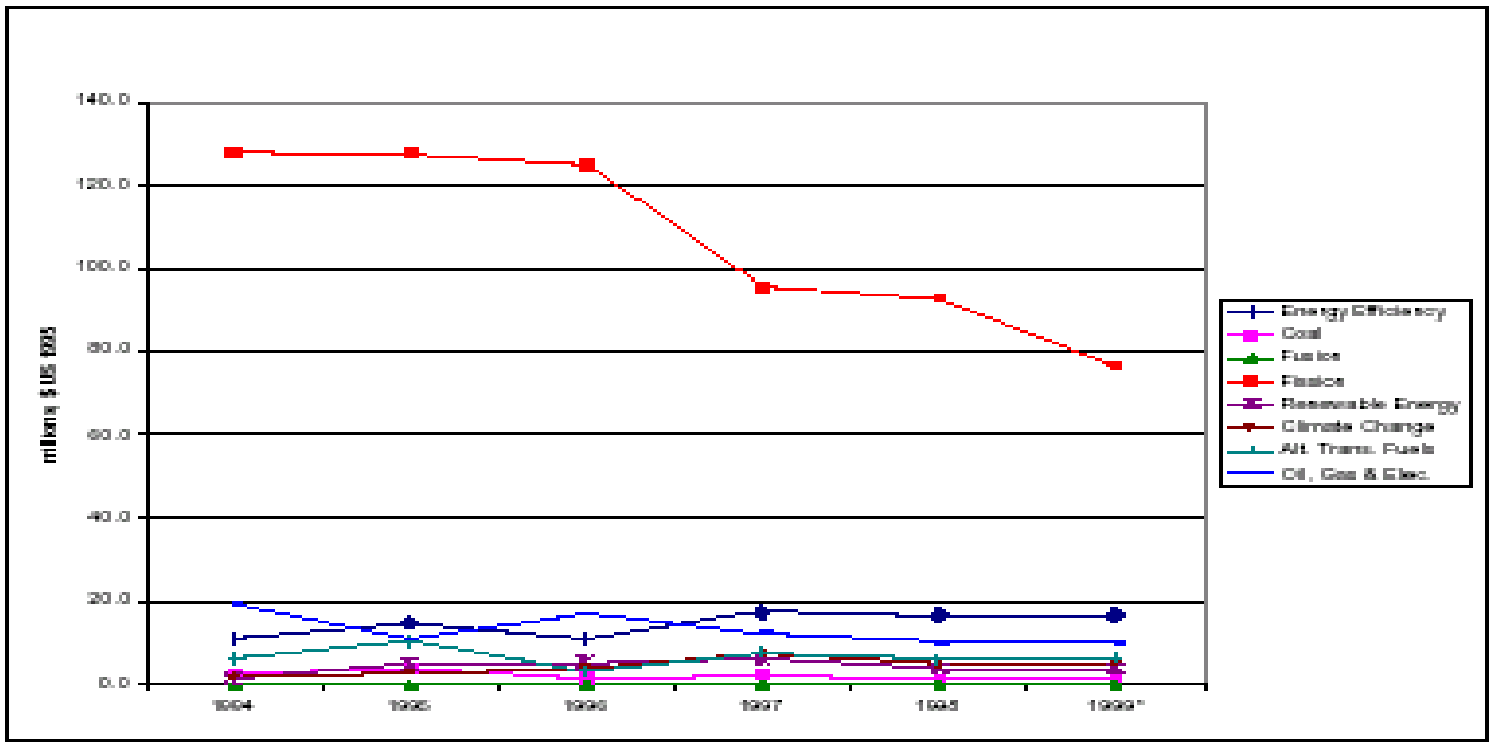
Figure 5. PERD Expenditures by Program Area, 1975-1998



From Energy R & D in Canada, March 2000, prepared by Battelle Memorial Institute

Trends in Energy Research

Figure 4. Non-PERD Federal Energy R&D Expenditures, 1994-1999

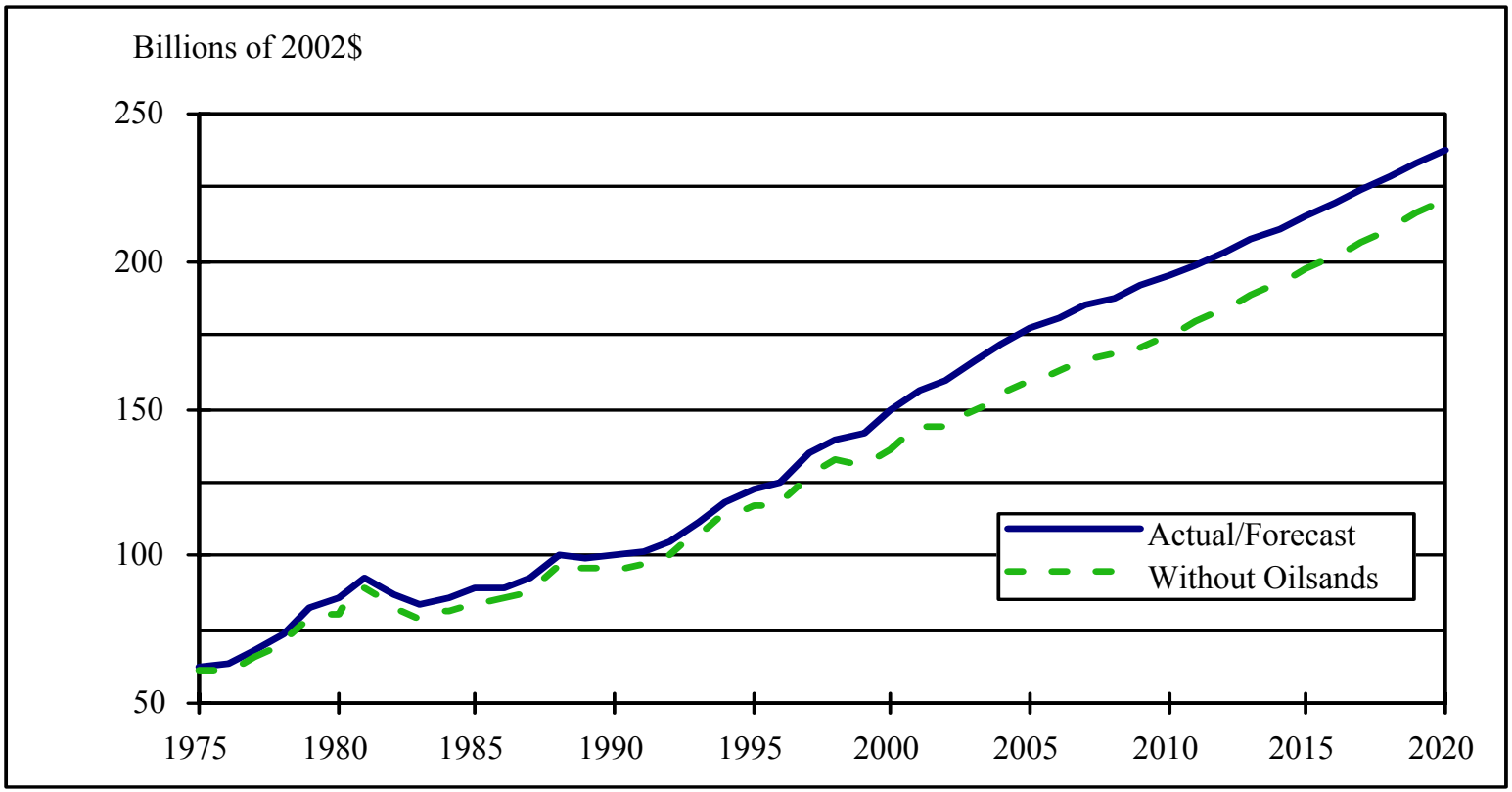


From Energy R & D in Canada, March 2000, prepared by Battelle Memorial Institute

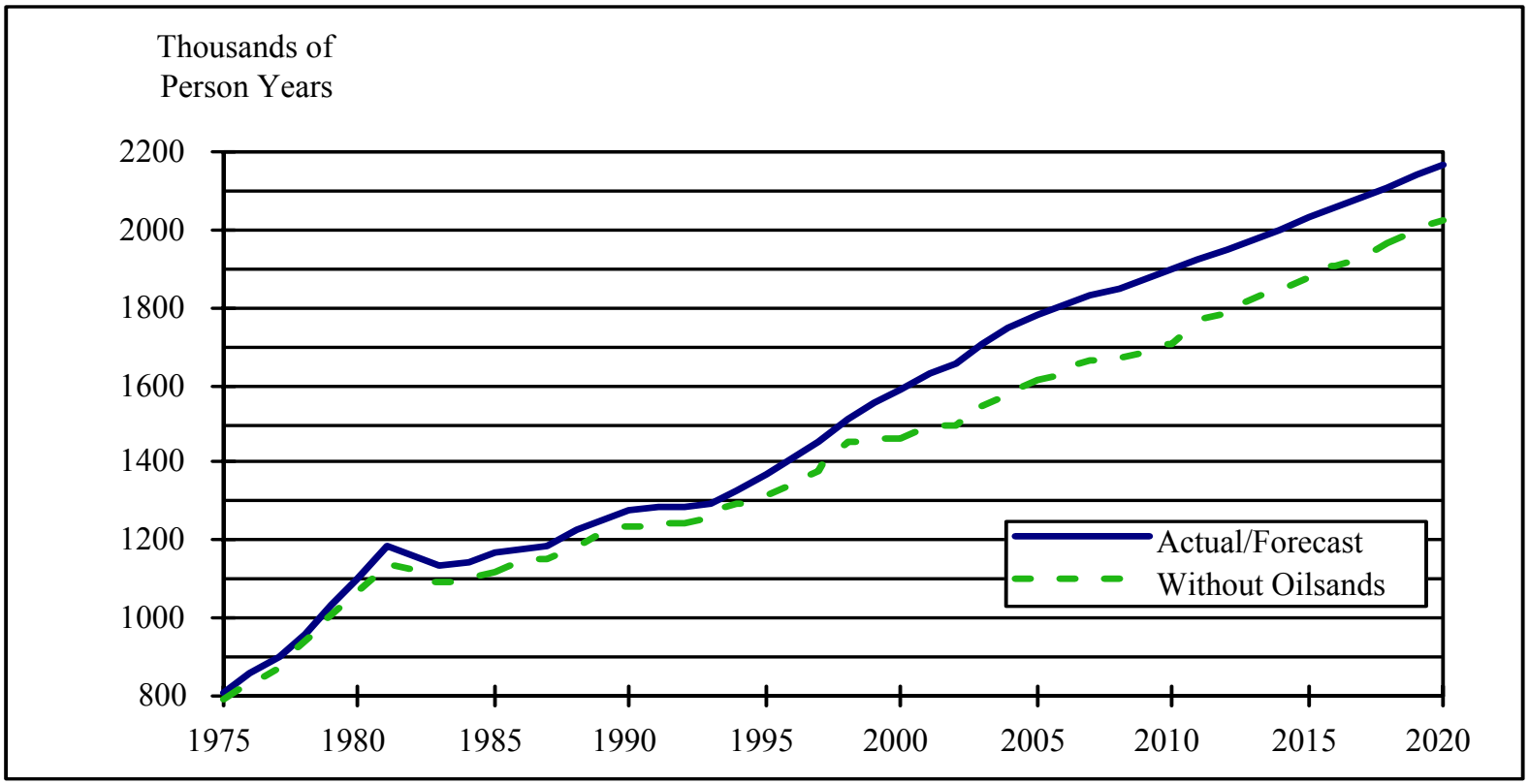
Impacts of Research Investments - Illustrations

- Five 'What If' Scenarios modelled with the Stats Can Input-Output Model
  - **What if actual/projected oil sands developments after the mid-1970s were delayed or did not occur in the absence of AOSTRA**
  - **What if CBM developments were sufficient to offset the decline in conventional gas production**
  - **What if non-upgraded bitumen was upgraded in Alberta**
  - **What if feedstocks were developed to allow another expansion of the petrochemical industry similar to the most recent expansion at Joffre**
  - **What if some significant portion of the expected negative effects associated with Kyoto could be avoided**

Impacts of Oil Sands Development on Alberta GDP



Impacts of Oil Sands Development on Employment



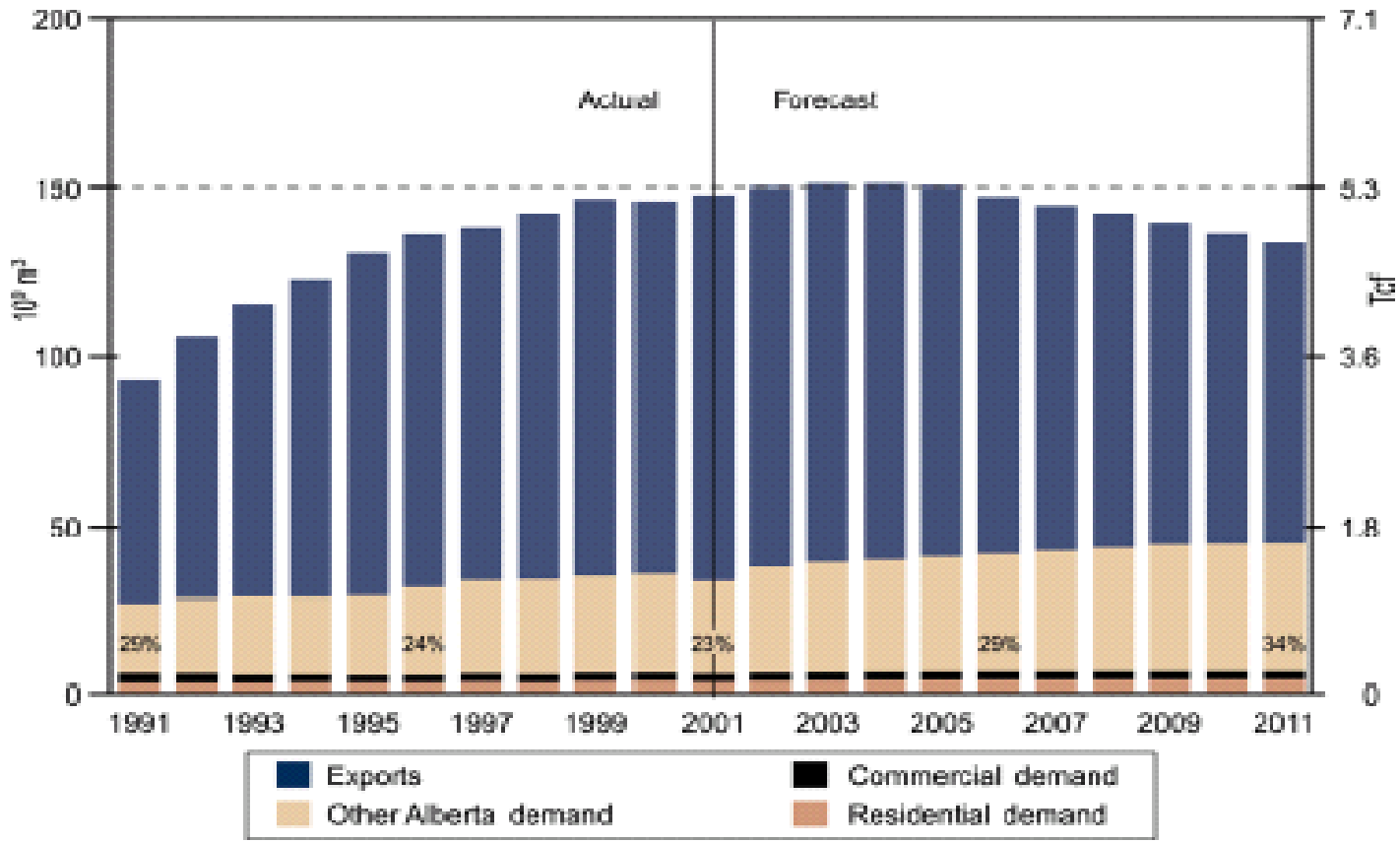
Oil Sands Impacts – Cumulative (in billions1997$)

- 1975-2001
  - GDP = $140.1 (or $5.2/yr or 5.1%)
  - Labour Income = $55.1 (or $2.0/yr)
  - Ab. Gov Revenue = $15.9 (or $0.6/yr)
  - Employment = 1,300,780 per yrs (or 48k/yr)
- 2002-2010
  - GDP = $166.2 (or $18.5/yr or 10.3%)
  - Labour Income = $66.1 (or $7.3/yr)
  - Ab. Gov Revenue = $18.3 (or $2.0/yr)
  - Employment = 1,551,051 person yrs. (or 172k/yr)

Oil Sands Impacts – Cumulative (in billions1997$)

- 2010-2020
  - GDP = $180.9 (or $18.1/yr or 8.3%)
  - Labour Income = $65.1 (or $6.5/yr)
  - Ab. Gov Revenue = $20.3 (or $2.0/yr)
  - Employment = 1,510,003 (or 151k/yr)

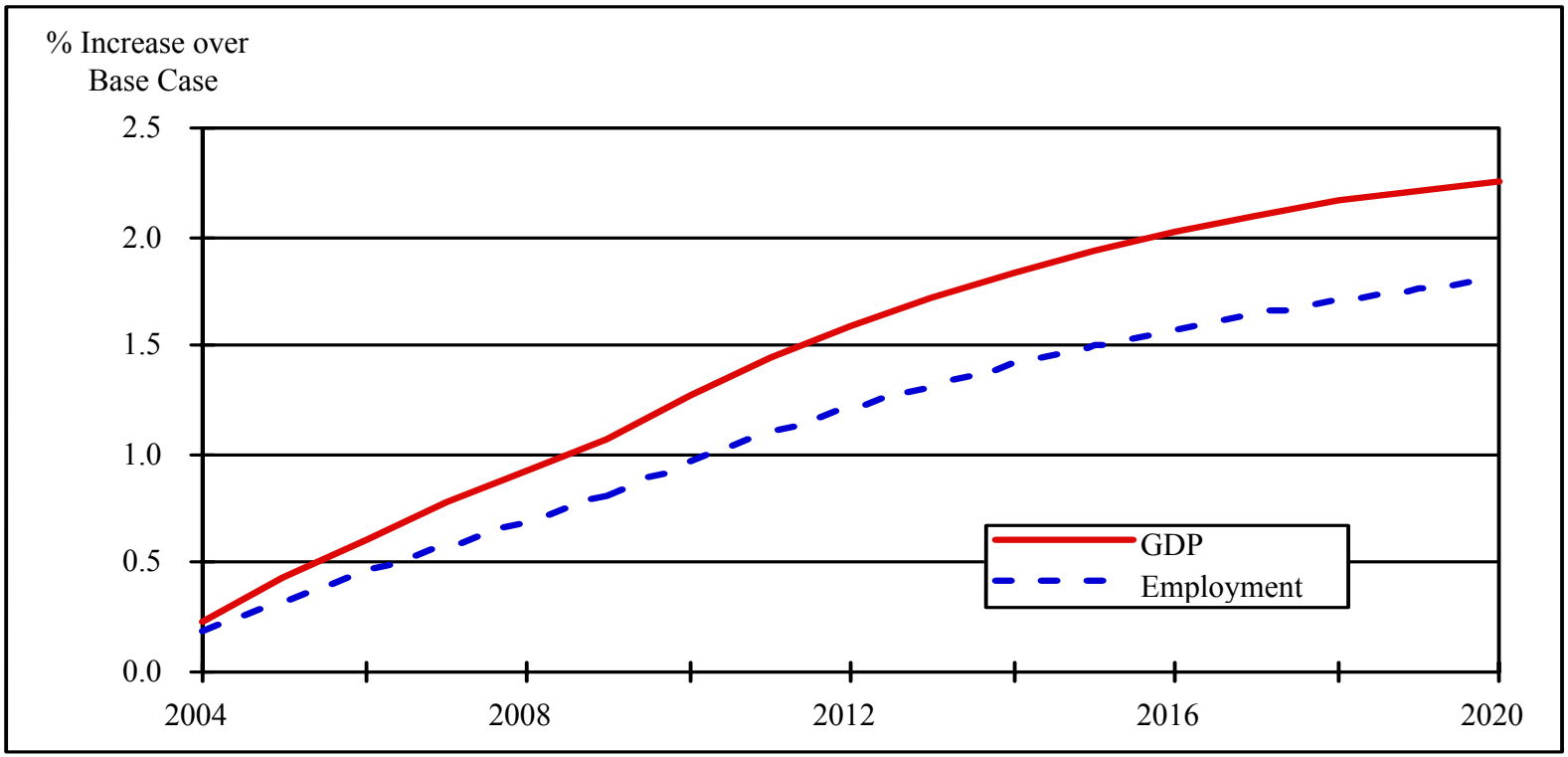
Natural Gas Production



Marketable gas production and demand

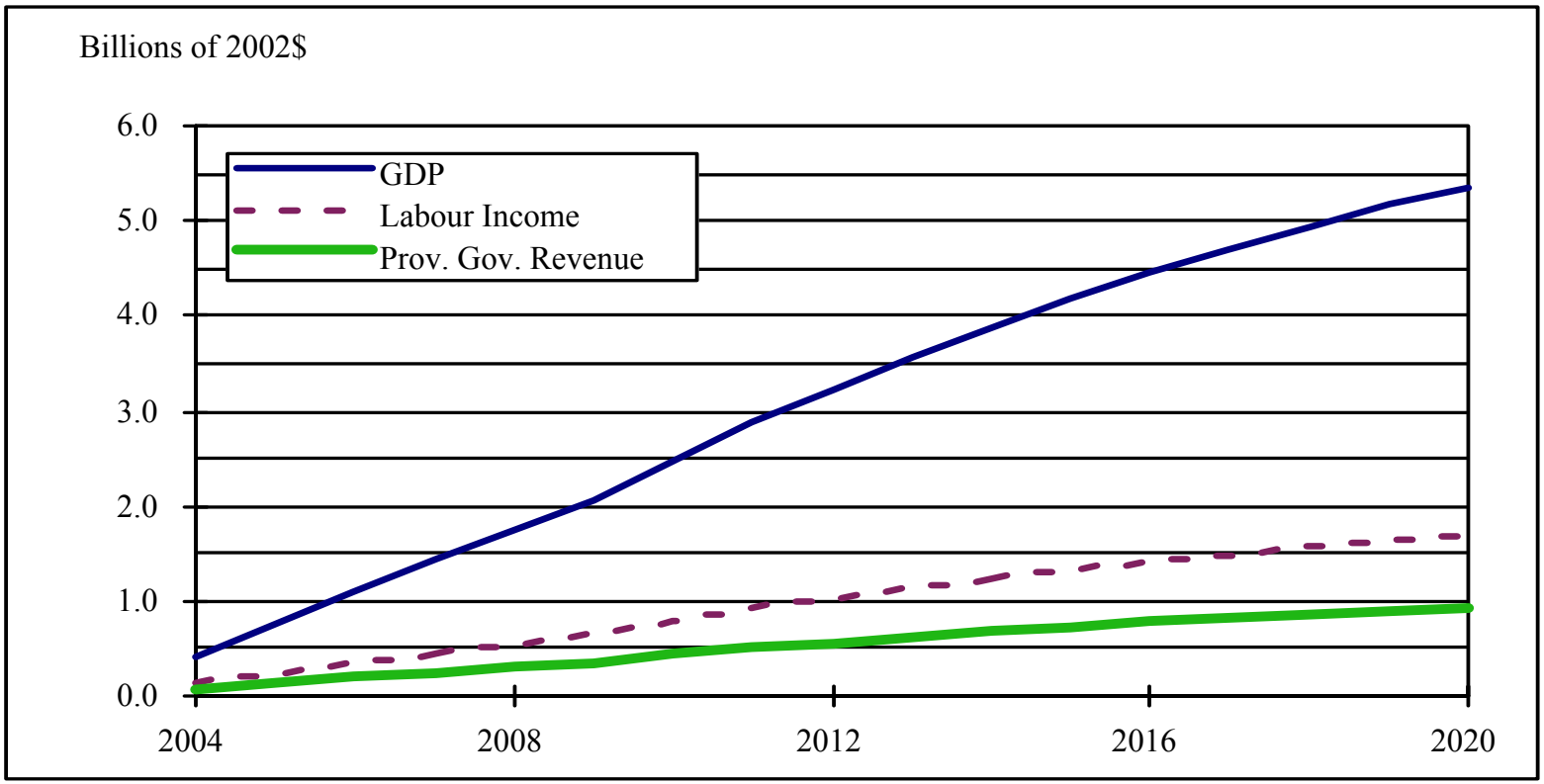
Source: Alberta EUB, Alberta's Reserves and Supply / Demand Outlook, 2002-2011

Potential Impacts of CBM - % impact relative to base case



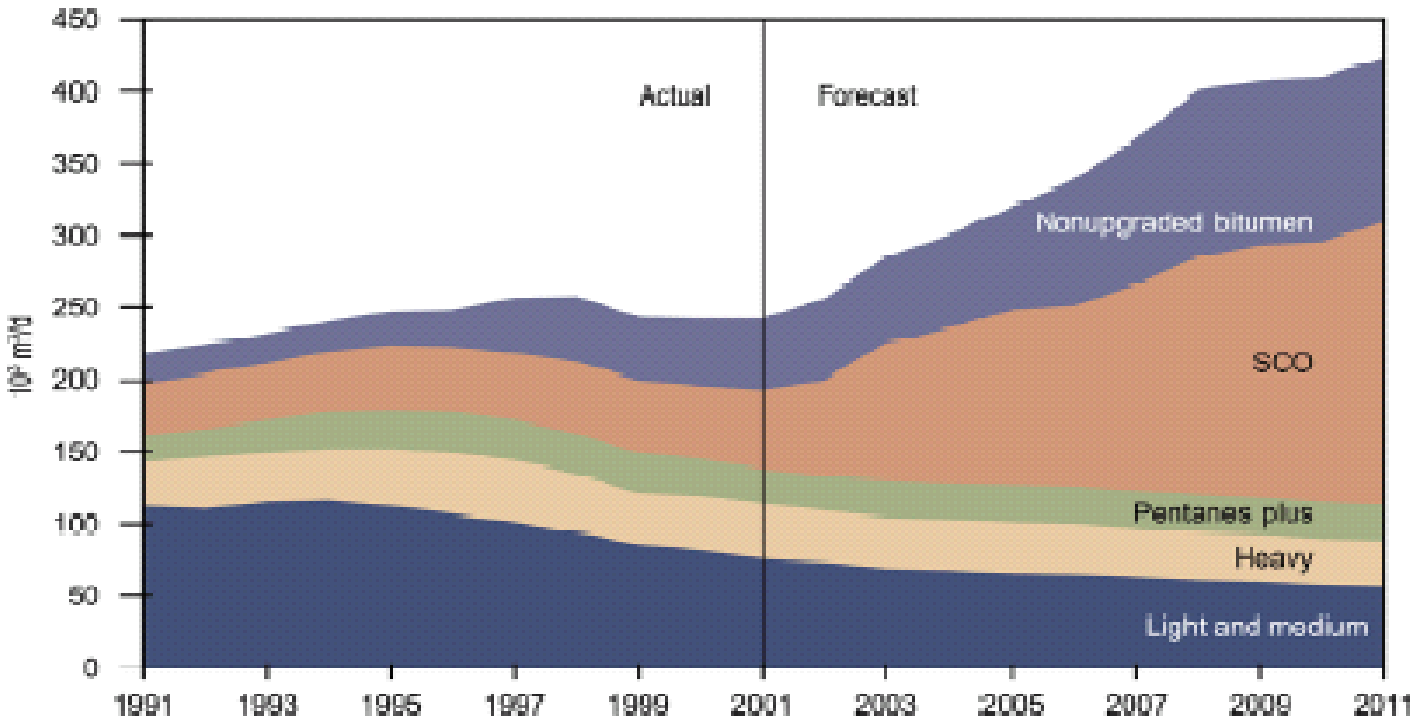
Assumes CBM development sufficient to offset decline in conventional gas production

Potential Impacts of CBM – Annual Impacts in Billions of $



Assumes CBM development sufficient to offset decline in conventional gas production

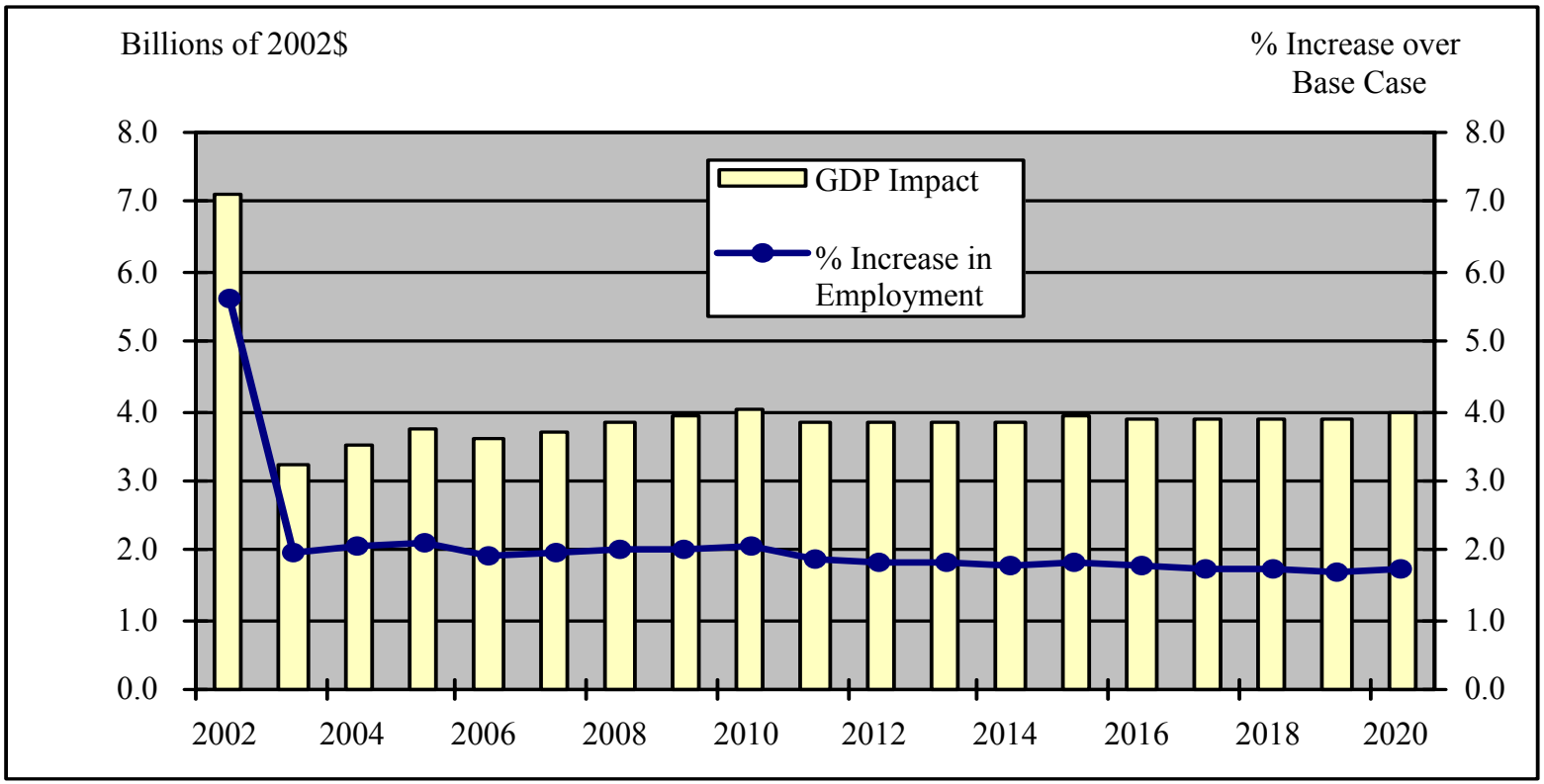
Petroleum Production



Alberta's total oil supply

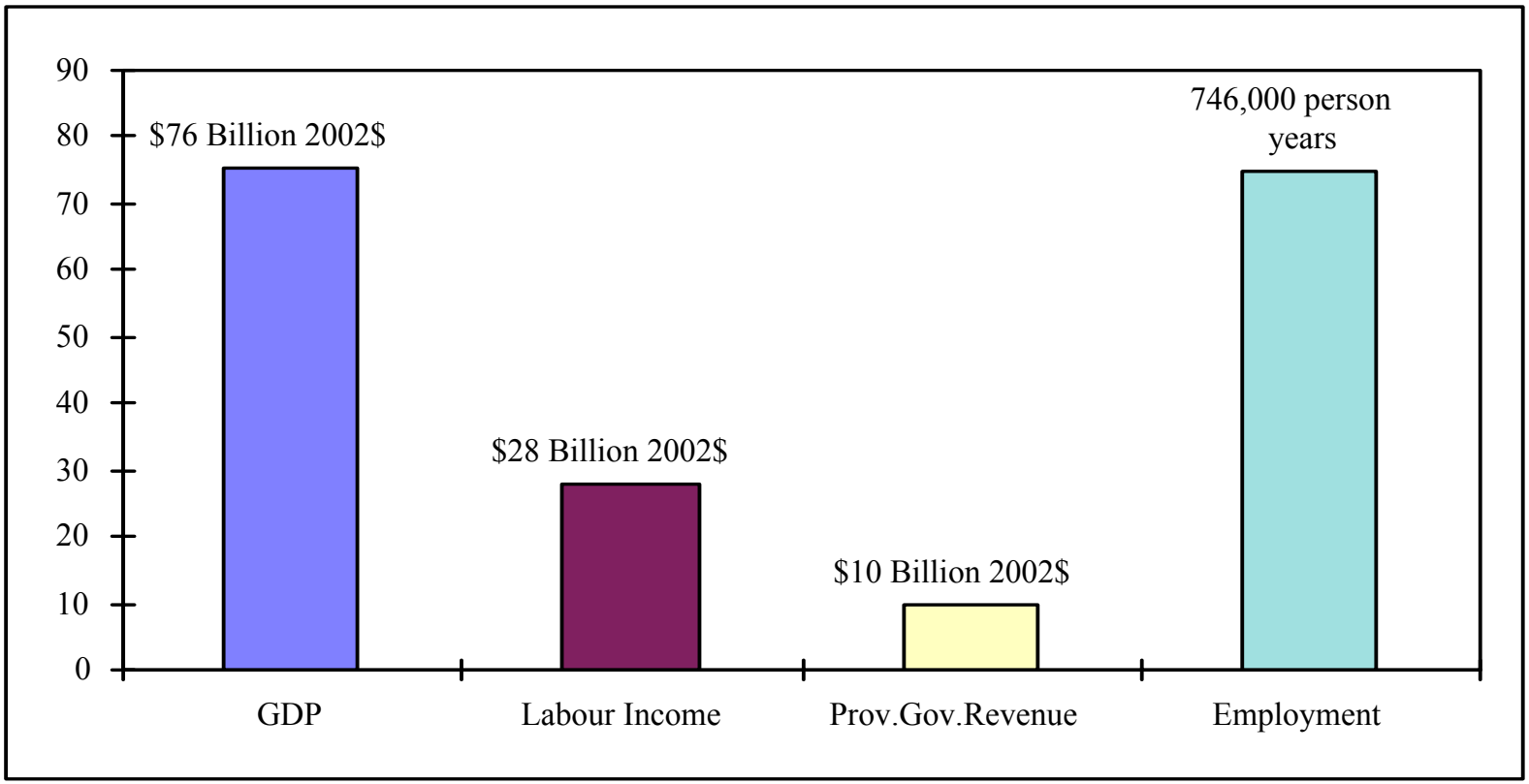
Source: Alberta EUB, Alberta's Reserves and Supply / Demand Outlook, 2002-2011

Potential Impacts of Bitumen Upgrading



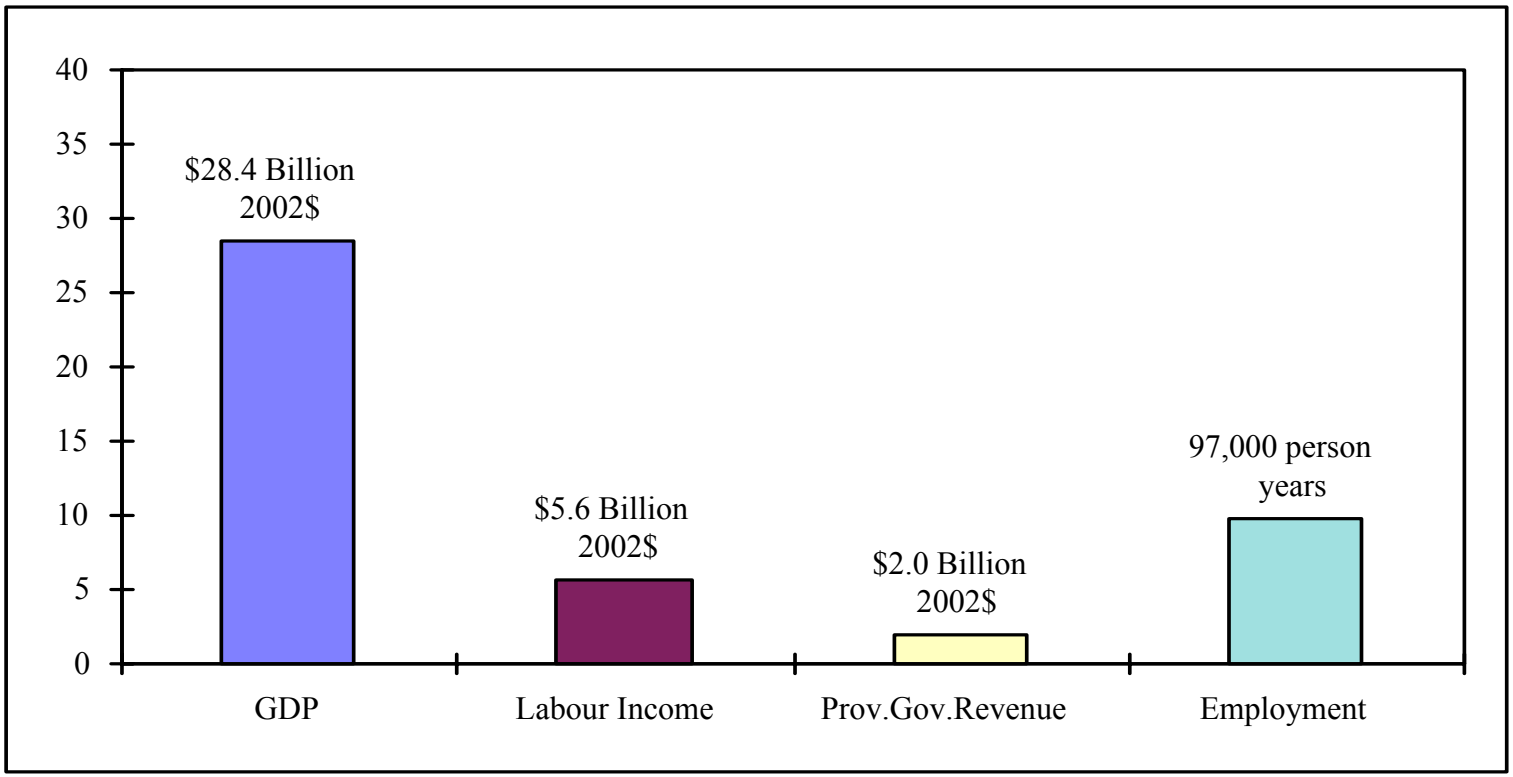
Assumes projected non upgraded bitumen in EUB forecasts is upgraded in Alberta

Potential Added Impacts of Bitumen Upgrading to 2020

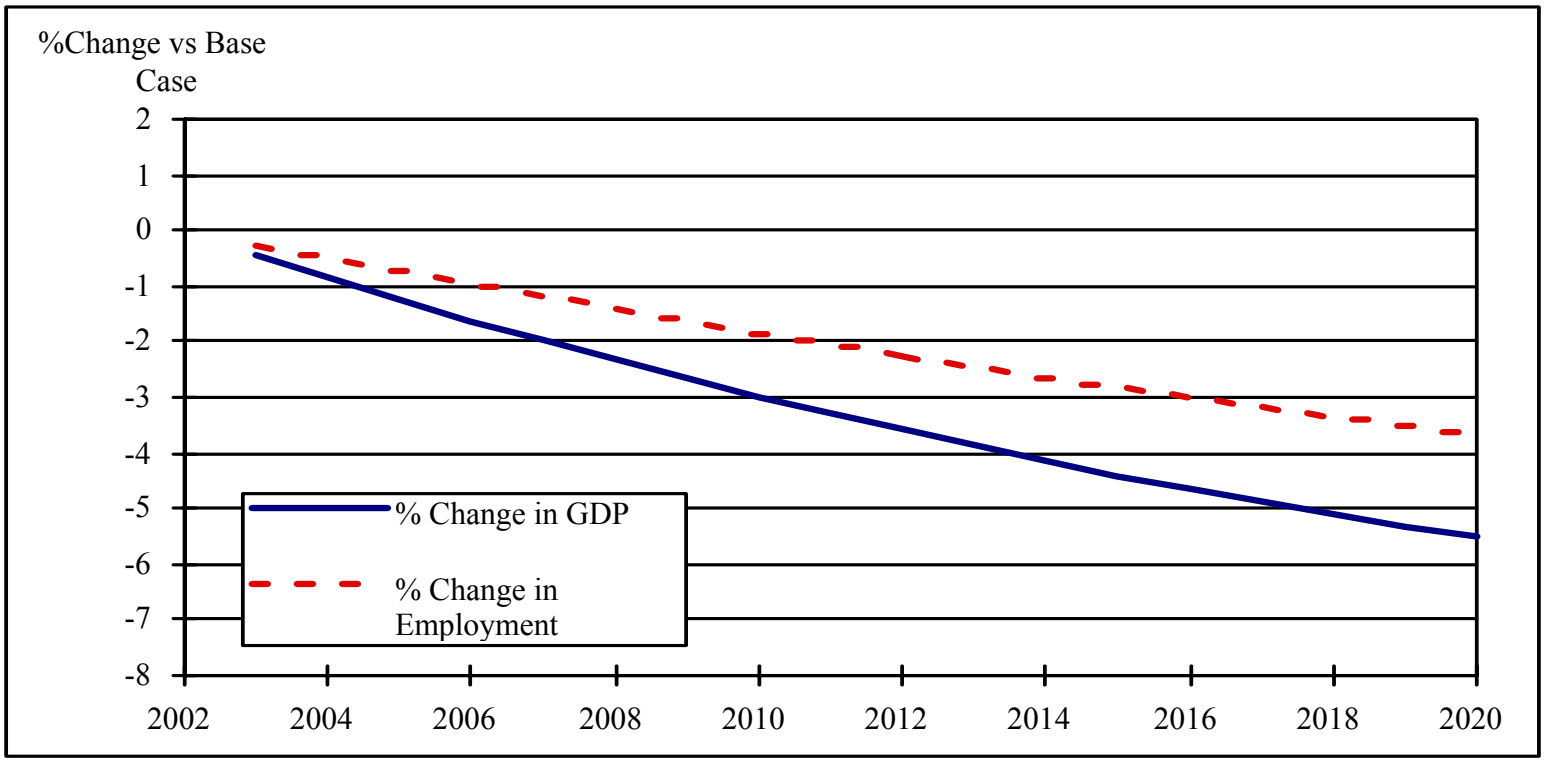


Assumes projected non upgraded bitumen in EUB forecasts is upgraded in Alberta

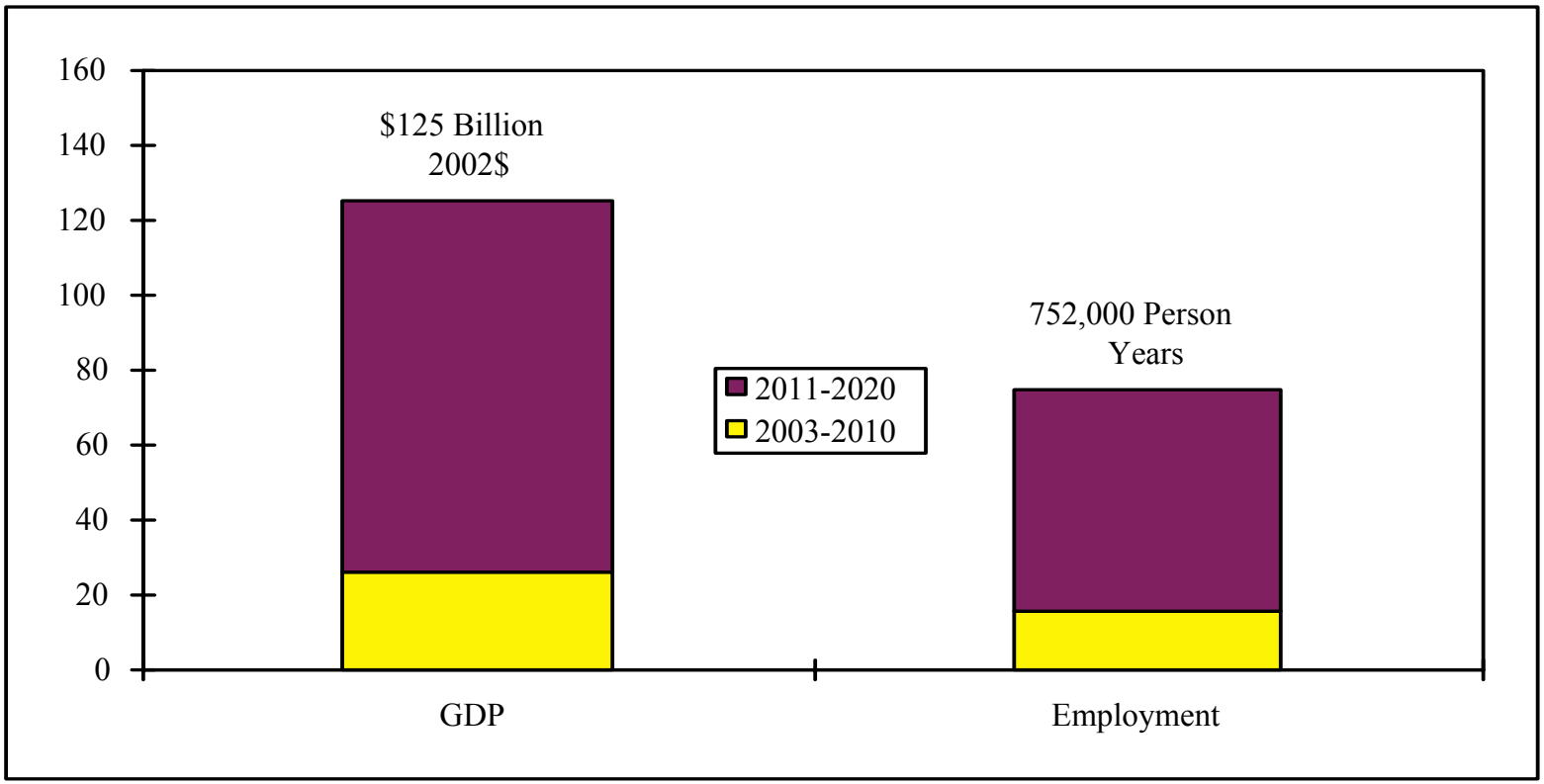
Impacts from another Joffre Petrochemical Expansion



Kyoto Impacts – Medium Case



Kyoto Impacts – Medium Case



A Qualifier Re: Kyoto Impacts

- The impacts of Kyoto on investment are almost certainly underestimated, particularly in the near term
- The adjustment path will not be as smooth as portrayed (ie there would be substantial short/medium term dislocations)