APEC Energy Demand and Supply Outlook to 2030 and Its Implications for Energy Security and Sustainability

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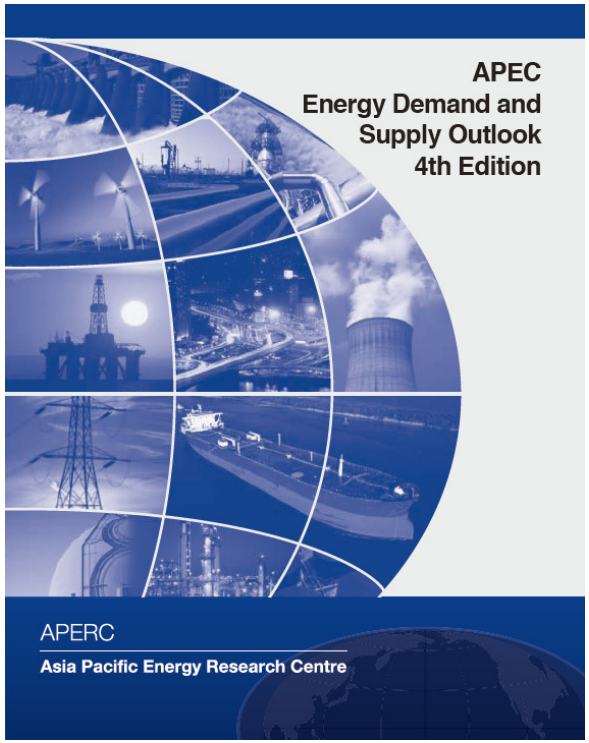
Key Questions

- What are the challenges posed by a business-as-usual energy future?
- What would a more sustainable scenario look like?
- Can APEC's energy intensity improvement goal meet the challenges?

APEC Member Economies

From APEC website, http://hrd.apec.org/index.php/Image:APEC-map.gif

Background on the Outlook



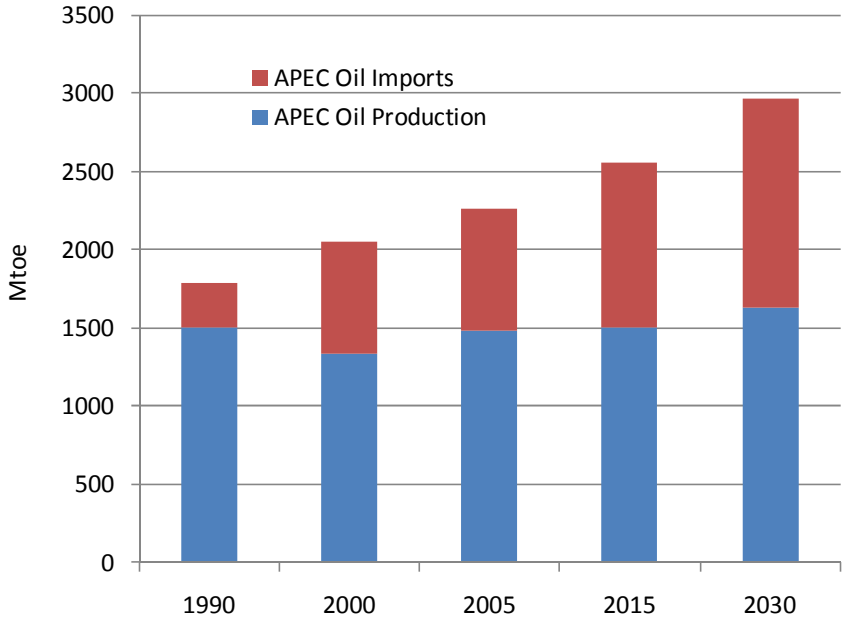
- Long-term (to 2030) perspective on APEC Energy Demand and Supply
- Summarizes wide range of energy issues in all APEC economies
- Relies heavily on advice and feedback from APEC government experts
- Three previous editions, last one in 2006

Business-As-Usual Assumptions

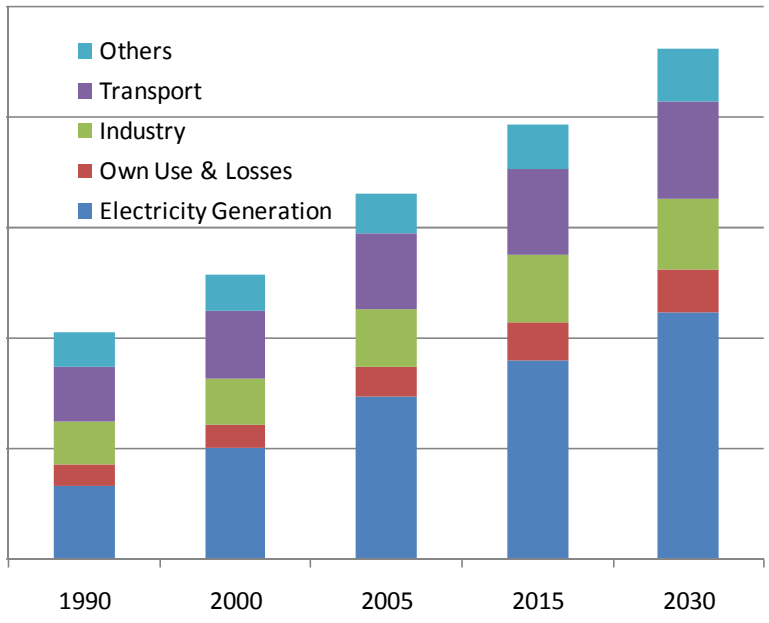
- Despite recent economic crisis, continued economic growth and progress over the long-term, especially in developing economies
  - Shift to commercial fuels and electrification
  - Motorization
  - This is a good thing, especially for millions of people who will be lifted out of poverty
  - But it does pose some significant energy challenges
- Oil prices remain moderate, at least on average ($120/barrel by 2030)

Dual Threats to the APEC Economies

APEC Oil Production and Imports

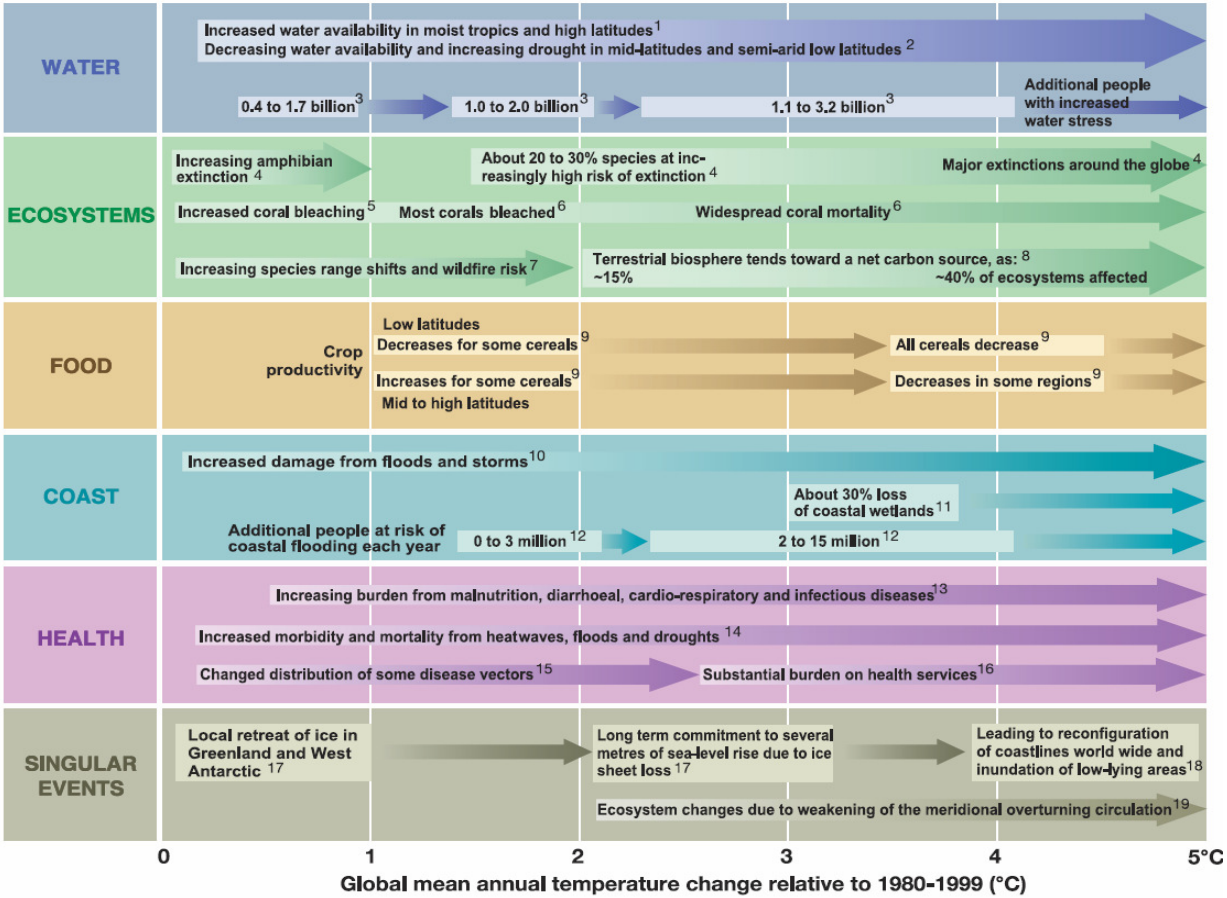


CO_2 Emissions from Fuel Combustion



From APERC, *APEC Energy Demand and Supply Outlook 4th Edition,* Figure 1.4 and Figure 1.7

Impacts of Rising Temperatures

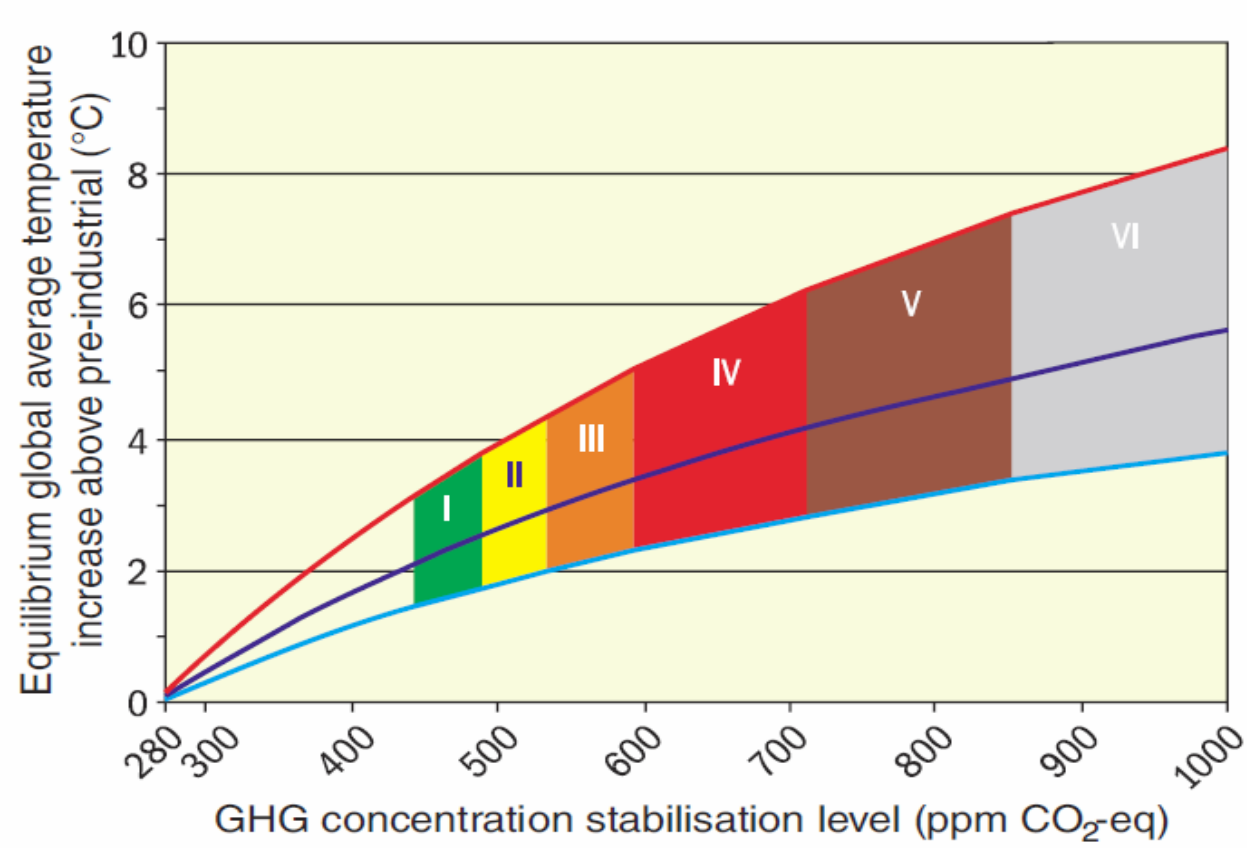


From Intergovernmental Panel on Climate Change, Fourth Assessment Report: *Working Group II Report, Impacts, Adaptation and Vulnerability (2007)*, Technical Summary, Table TS.3

2° C Limit in "Cancun Agreements"
(194 Parties Participating, adopted 11 December 2010)

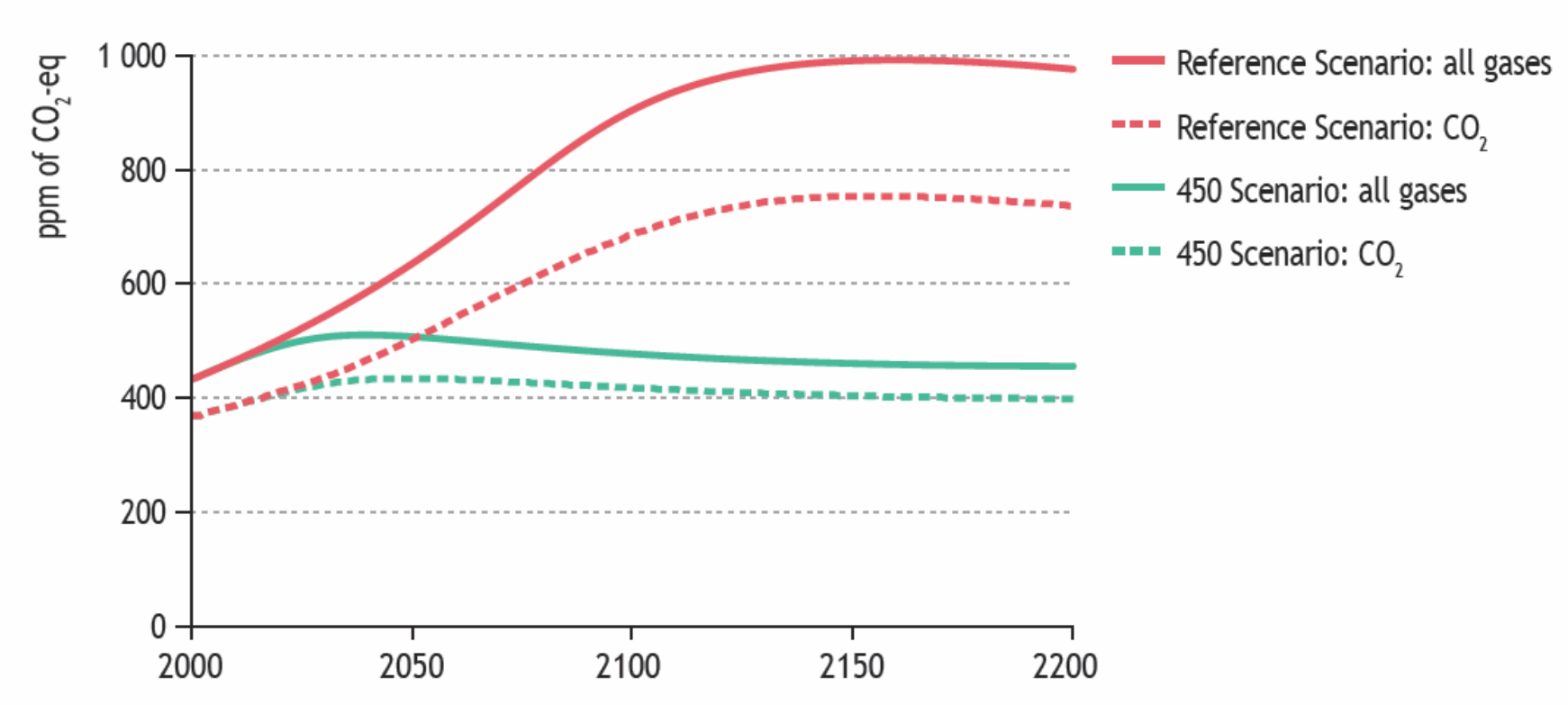
4. *Further recognizes* that deep cuts in global greenhouse gas emissions are required according to science, and as documented in the Fourth Assessment Report of the Inter-governmental Panel on Climate Change, with a view to reducing global greenhouse gas emissions so as to hold the increase in global average temperature below 2°C above pre-industrial levels, and that Parties should take urgent action to meet this long-term goal, consistent with science and on the basis of equity; *Also* recognizes the need to consider, in the context of the first review, as referred to in paragraph 138 below, strengthening the long-term global goal on the basis of the best available scientific knowledge, including in relation to a global average temperature rise of 1.5°C;

Why 450 PPM?



From: Intergovernmental Panel on Climate Change, *Climate Change 2007: Synthesis Report*, Figure 5.1, p 66.

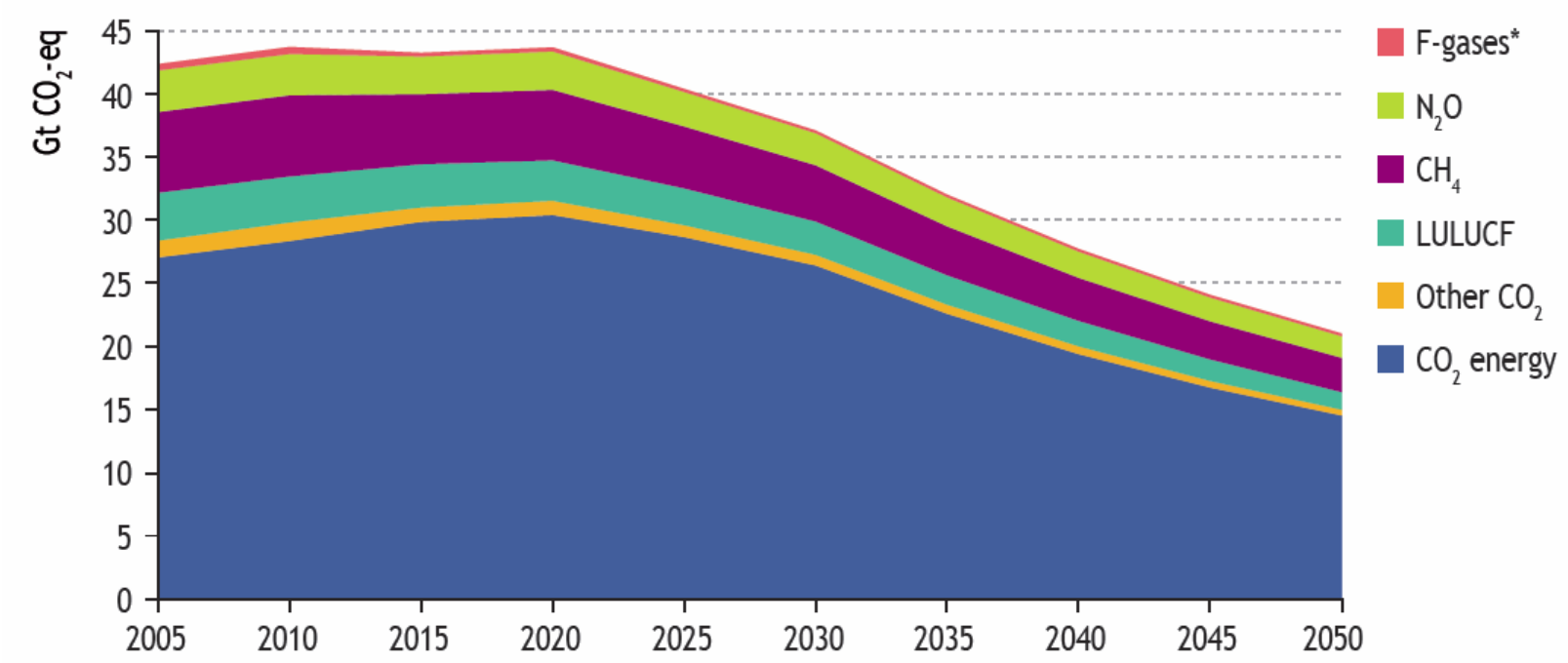
Why Business-as-Usual Is Environmentally Unsustainable



From IEA, *World Energy Outlook 2009,* p. 199, based on analysis using MAGICC and ENV-linkages model.

What Would a More Sustainable Scenario Look Like?

A Worldwide 450 PPM Scenario



F-gases include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) from several sectors, mainly industry.

From IEA, *World Energy Outlook 2009,* p. 200, based on analysis using MAGICC and ENV-linkages model.

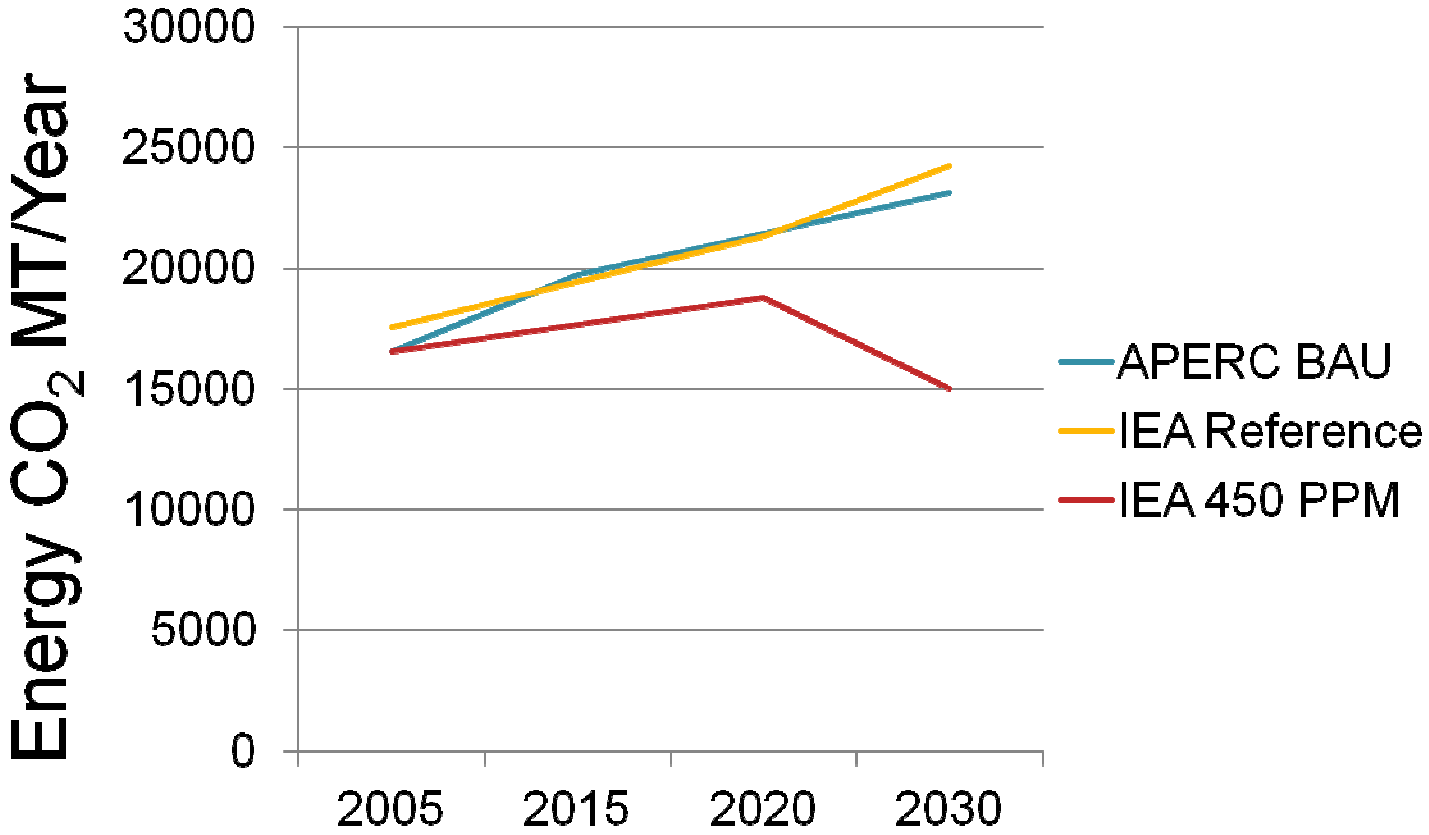
What Emission Reductions Would 450 PPM Require?

- Total CO_2-equivalent greenhouse gas emissions
  - Peak just before 2020 at about 3% above 2005 levels
  - Then decline to 12% below 2005 levels by 2030
  - Then continue to decline reaching about 50% of 2005 levels by 2050
- Energy-related CO_2 emissions
  - Peak just before 2020 at about 14% above 2005 levels
  - Then decline to 2% below 2005 levels by 2030
  - Then continue to decline reaching about 46% below 2005 levels by 2050

The IEA's Model

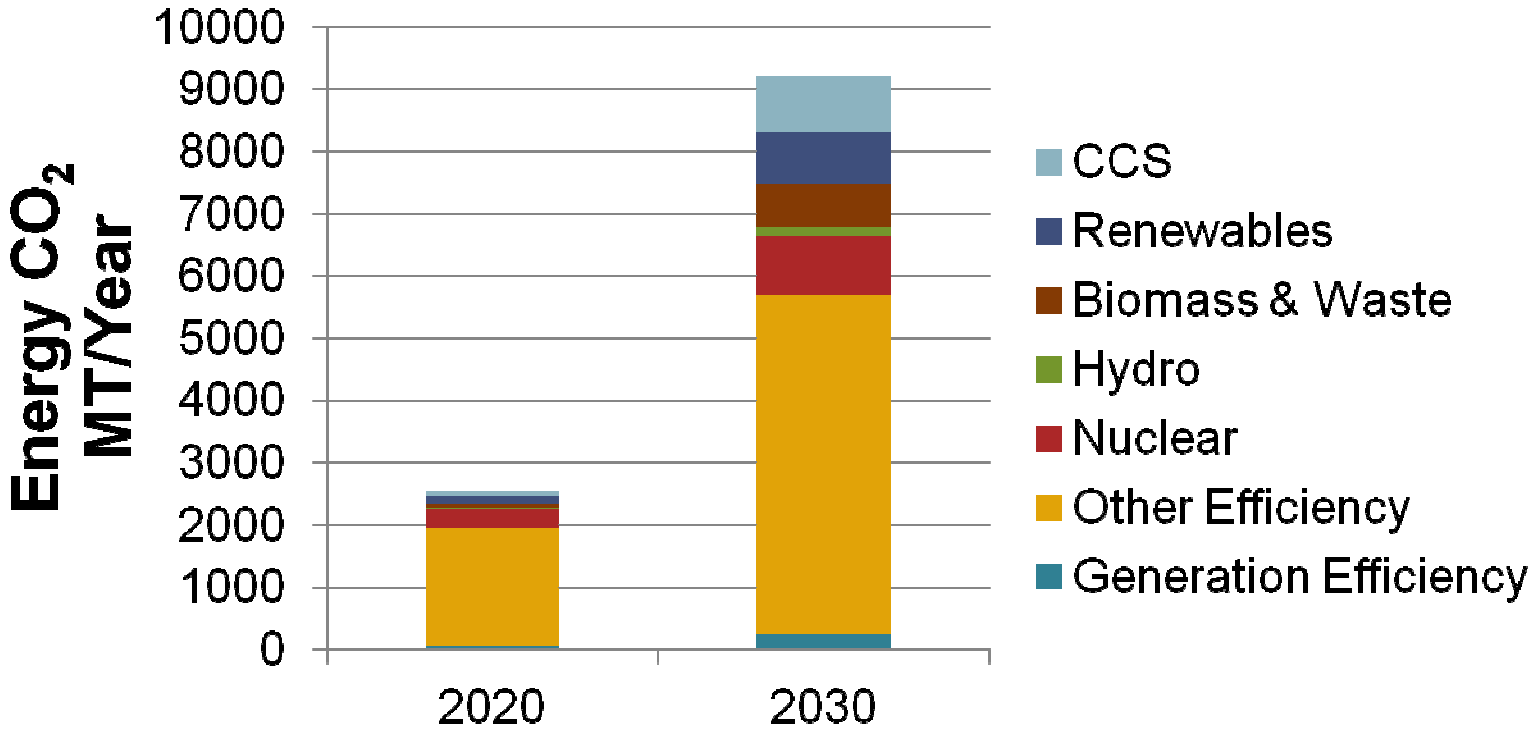
- Very detailed and sophisticated
  - 16,000 equations
  - Developed over a 16 year period
- Comprehensive--modeling takes into account*:*
  - Highly disaggregated demand
  - Specific supply technologies
  - Investment costs
  - Macro-economic impacts
  - Field-by-field oil production
  - Vehicle stock model
  - Refinery model
  - Electricity access

APEC Region Emissions Results



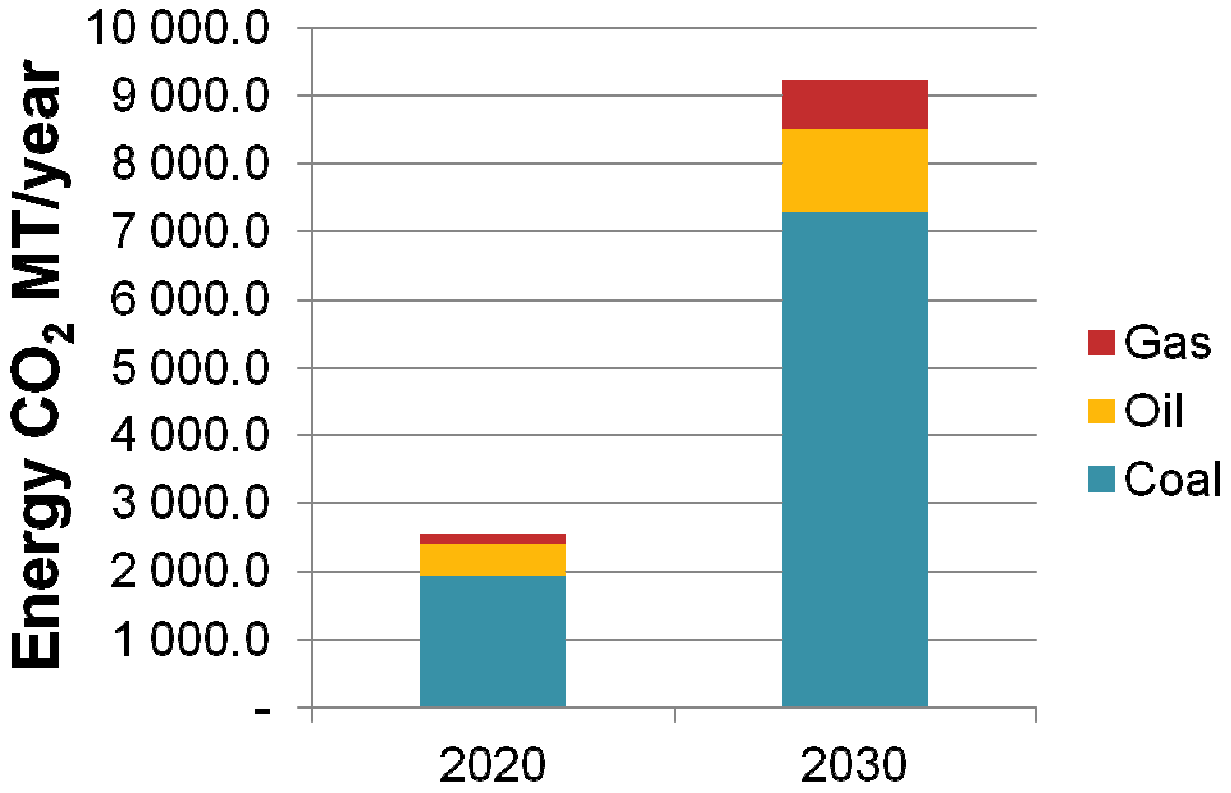
Raw Data for IEA Cases © OECD/IEA 2009; calculations by APERC

APEC Region Mitigation Results by Measure (vs.IEA Reference)



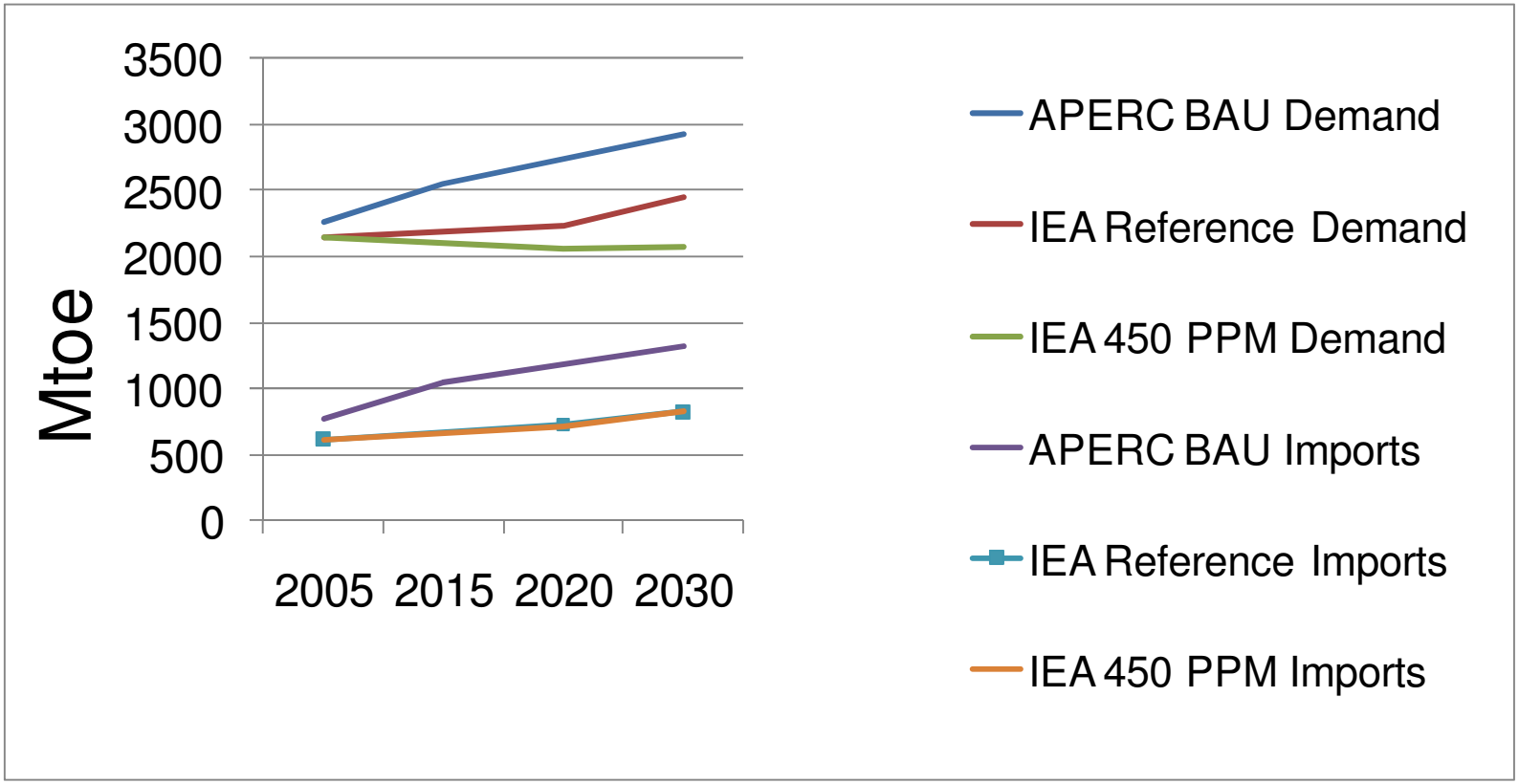
Raw Data © OECD/IEA 2009; calculations by APERC

APEC Region Mitigation Results by Fuel (vs.IEA Reference)



Raw Data © OECD/IEA 2009; calculations by APERC

APEC Region Oil Demand and Oil Import Results



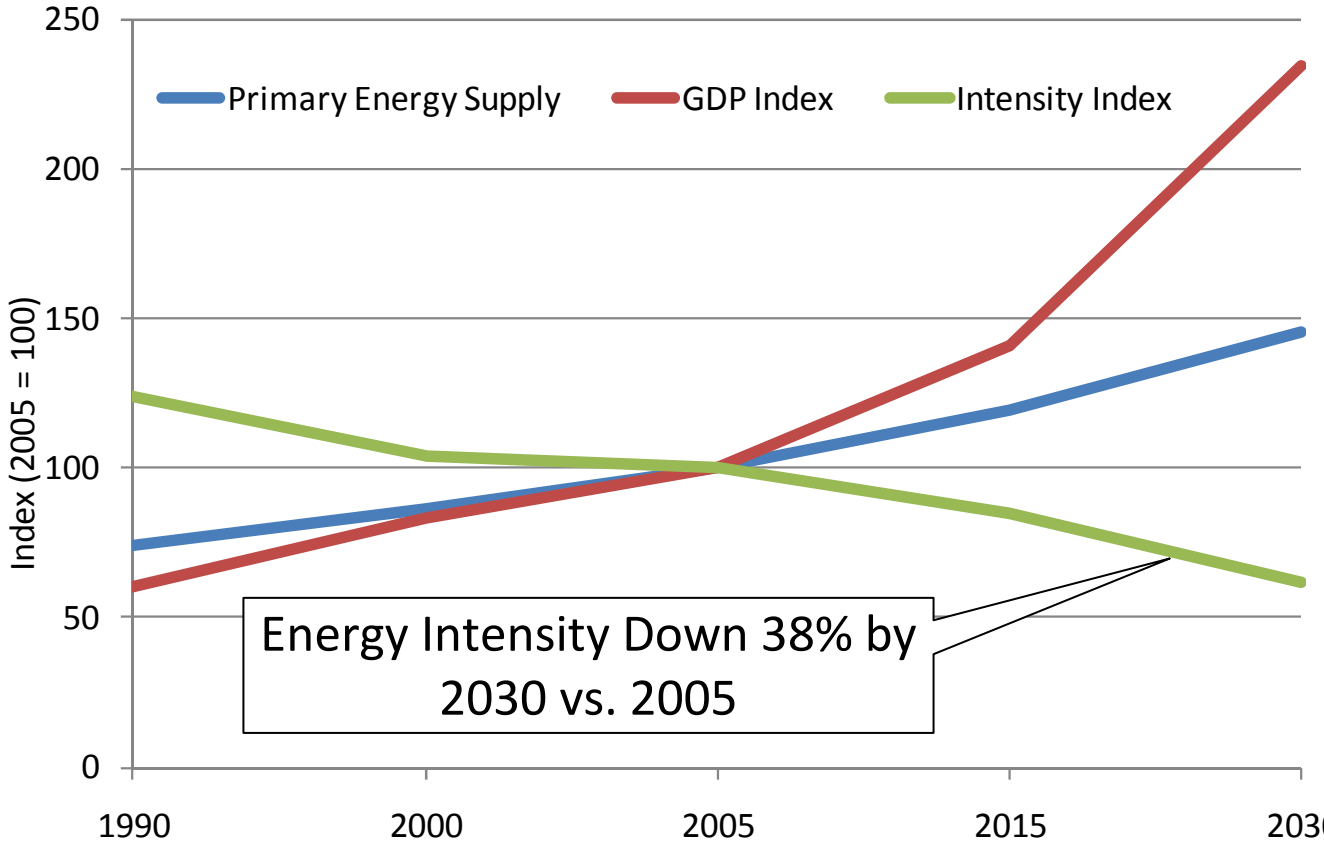
Raw Data for IEA Cases © OECD/IEA 2009; calculations by APERC

Can APEC's Energy Intensity Improvement Goal Meet the Challenges?

Current Status of APEC's Intensity Goal

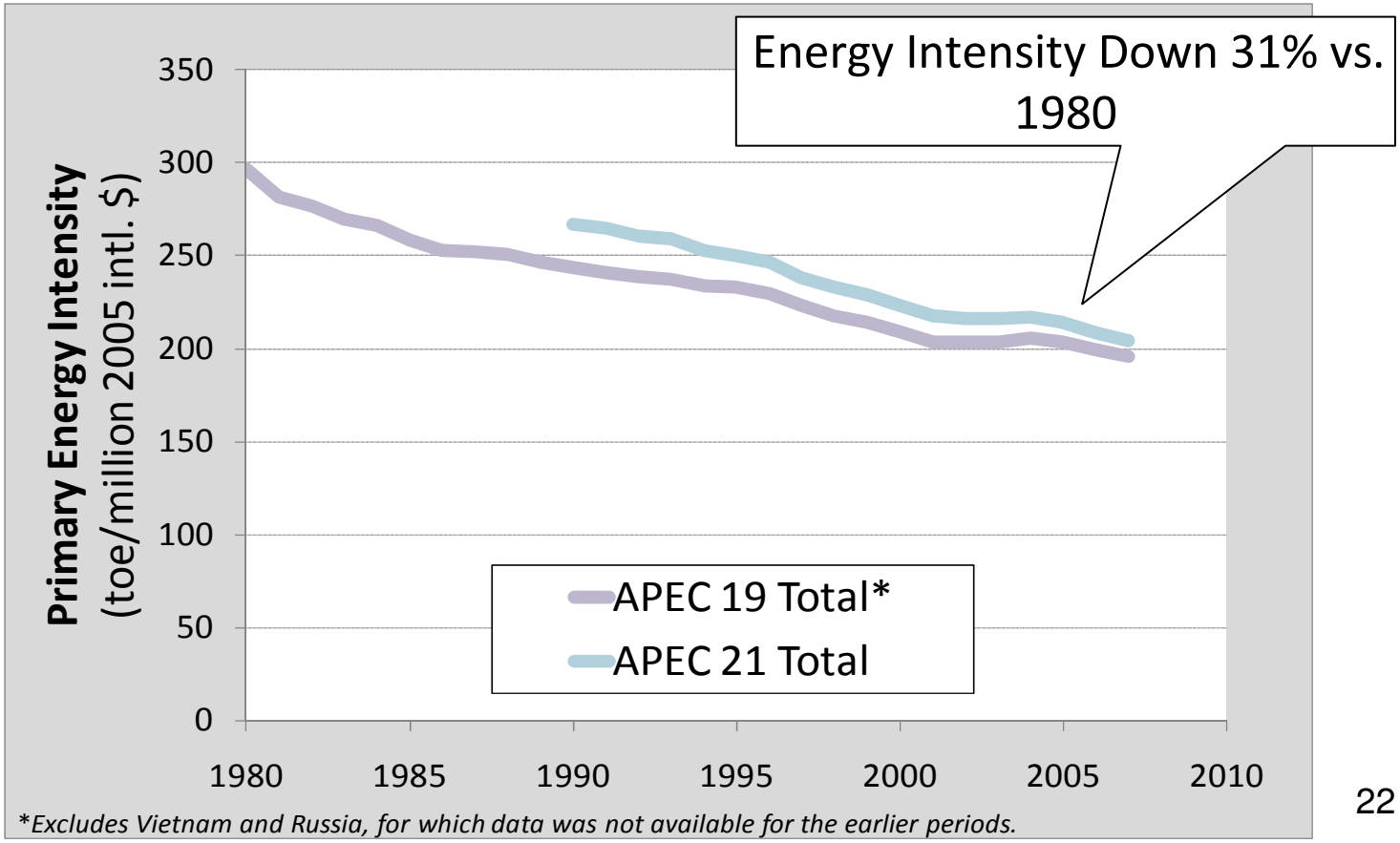
- 2007 Sydney APEC Leaders' Declaration on Climate Change, Energy Security and Clean Development –
  - "Agree to work towards achieving an APEC-wide regional aspirational goal of a reduction in energy intensity of at least 25 per cent by 2030 (with 2005 as the base year)"
- 2010 Yokohama APEC Leaders Growth Strategy –
  - "APEC will assess the potential for reducing the energy intensity of economic output in APEC economies between 2005 and 2030, beyond the 25 percent aspirational goal already agreed to by APEC Leaders in 2007

Minimum Energy Intensity Goal Can Be Exceeded Under Business-as-Usual

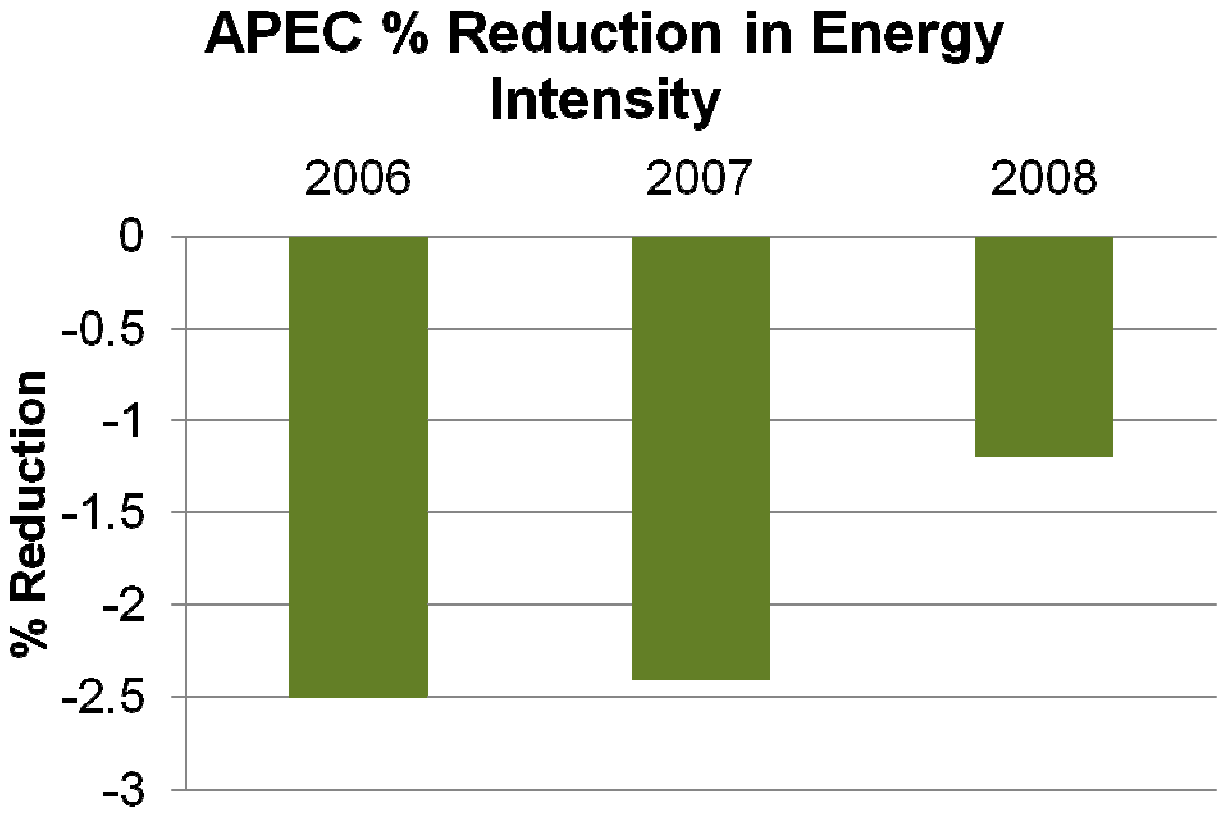


From APERC, *APEC Energy Demand and Supply Outlook 4th Edition,* Figure 1.5

What Happened to Energy Intensity Over the 25 Years from 1990-2005?



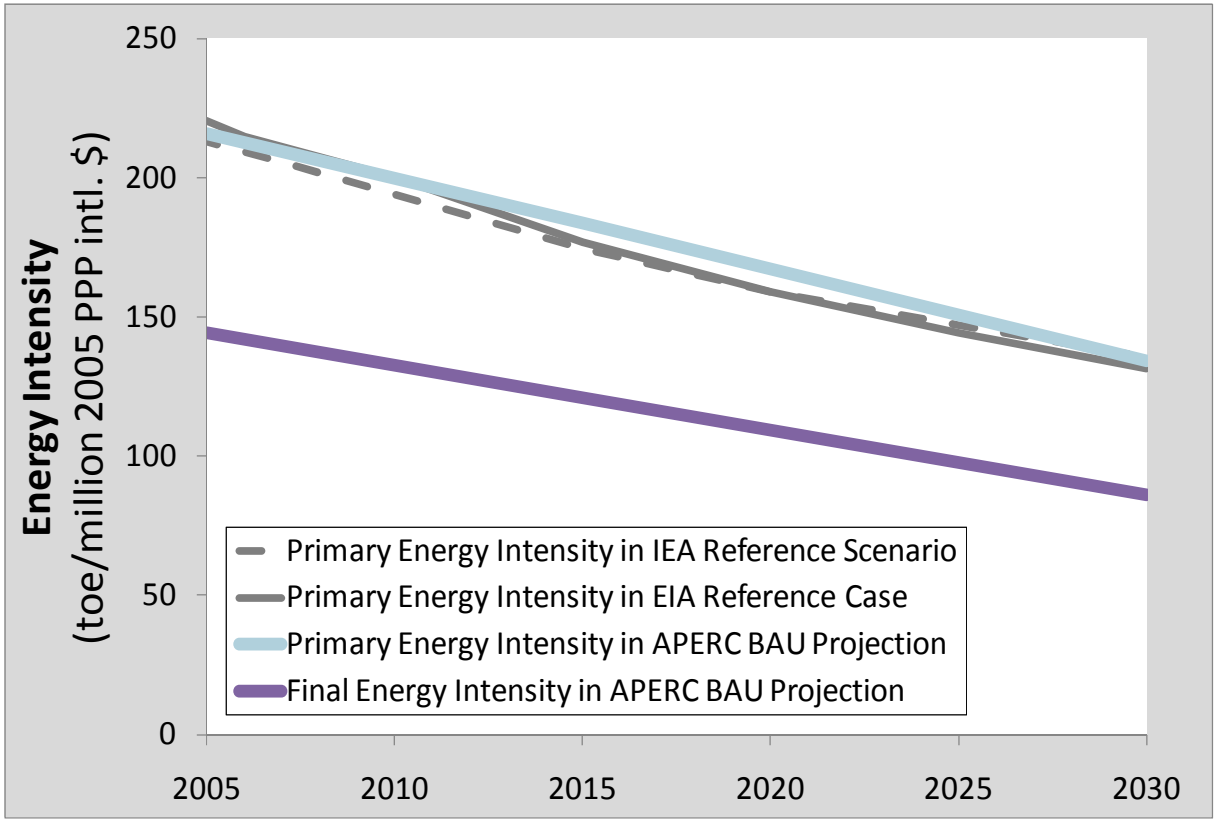
3. What Has Happened to Energy Intensity Since 2005?



Total Reduction Since 2005 = 6.0%

Indicated Reduction 2005-2030 at Average Rate So Far = 40%

How Do APERC's Projections Compare to Other Organizations?



APEC Key Indicators (1)

- Energy Intensity Improvement 2005-2030 (primary energy/constant $ GDP)
  - APERC BAU: 38%
  - IEA 450 PPM: ~50%
- Non-Fossil Primary Energy Share
  - 2005 Actual: 16%
  - 2030 APERC BAU: 18%
  - 2030 IEA 450 PMM: 30%

Raw Data for IEA Cases © OECD/IEA 2009; calculations by APERC

APEC Key Indicators (2)

- 2030 Low-Carbon Electricity Output Share ('Low-Carbon' Means Non-Fossil + CCS)
  - 2005 Actual: 29%
  - APERC BAU: 33% (No CCS Included)
  - IEA 450 PPM: 59% (52% Non-Fossil+7% CCS)

Raw Data for IEA Cases © OECD/IEA 2009; calculations by APERC

Extra Slides

Economics - Worldwide

- GDP Impacts of 450 PPM case compared to IEA Reference Scenario
  - GDP down 0.1% to 0.2% in 2020
  - GDP down 0.9% to 1.6% by 2030
  - However, these impacts would be offset by reduced climate change mitigation costs and health benefits from reduced pollution
  - Net effect on GDP hard to quantify
- Additional investment 2010-2030 of $10,500 billion
  - Offset by lower energy bills of $8,600 billion 2010-2030 ($17,100 billion over life of investments) and other benefits

Global Warming Science vs. 19th Century Germ-Theory of Disease

- Germ theory of disease indicated need for:
  - Clean water
  - Sanitary waste disposal (sewers)
  - Food safety (especially milk)
  - Sterilization and cleanliness in healthcare
  - Control of insects and other disease-transmitting pests
- All of these measures required significant expenditures in both government and private sectors, as well as behavioral changes
- Yet we take the need for these measures for granted today

How to Reduce Emissions in Power Generation

On a life cycle basis, the following emission reductions are typical compared to a coal-fired plant producing 1000 g/CO_2-e per kWh:

1. **Energy efficiency improvements -** roughly 100% (1000 g) reduction; savings may exceed 100% due to savings in transmission and distribution losses.
2. **Substitution of non-fossil fuels -** roughly 90-99% (900-990 g) reduction
   - Biomass – 92-97% (920-975 g) reduction
   - Solar Photovoltaics – 94-96% (940-965 g) reduction
   - 99% (more than 990 g) reduction for hydro, wind, and nuclear.
3. **Substitution of coal with carbon capture and storage -** roughly 90% (900 g) reduction.
4. **Substitution of natural gas generation -** roughly 50% (500 g) reduction.
5. **Improvements to the efficiency of conventional coal generation** - roughly 20% (200 g).

from various sources, see APERC, *Pathways to Energy Sustainability,* Box 5.1

2005 Worldwide Greenhouse Gas Emissions

(million tonnes CO_2-e Using GWP-100)

Gas	From Fuel Combustion	From Energy Sector	From All Sources
Carbon Dioxide (CO_2)	27,147	27,487	34,438
Methane (CH_4)	-	2,548	7,319
Nitrous Oxide (N_2O)	-	234	2,953
Halocarbons	-	-	715
Total	27,147	30,269	45,426

From IEA, *CO_2 emissions from Fossil Fuel Combustion, 2009 Edition, pp. III-44 and III-45.*