APEC's Potential for Reducing Energy Intensity: The Research Evidence

APERC Workshop at EWG 41

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Asia-Pacific
Economic Cooperation

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

APEC-Wide Energy Intensity Reduction: Key Research Questions

A. What level of APEC-wide energy intensity reduction would be consistent with business-as-usual?

B. What level of APEC-wide energy intensity reduction would be consistent with what APEC economies currently pledge to achieve?

C. What level of APEC-wide energy intensity reduction would be consistent with a global effort to limit temperature rises to 2^{o} C?

APERC's Modeling Approach

- To help answer these questions, APERC has arranged with the International Energy Agency (IEA) to have access to the detailed model results they developed for their *World Energy Outlook 2010*
  - APERC has broken-out results for the APEC economies, and analyzed their impacts on energy intensity improvement for the APEC region
- APERC is of the view that the IEA's model and model results are more suited *for this analysis* than any others that we could obtain access to.

The IEA's Model

- Very detailed and sophisticated
  - 16,000 equations
  - Developed over a 17 year period
- Comprehensive--modeling takes into account:
  - Impact of changes in demand and supply on energy prices, and the feedback of these prices changes on energy supply and demand
  - Highly disaggregated demand, by sector and end-use
  - Specific supply technologies
  - Investment costs
  - Field-by-field oil production
  - Vehicle stock model
  - Refinery model
  - Electricity access

Regional Definitions

- A limitation of IEA's model is that some of the APEC economies are not separately modeled
- The following regions in the IEA model correspond to directly to the APEC economies:
  - United States
  - Canada
  - Mexico
  - Japan
  - Korea
  - Australia + New Zealand
  - Russia
  - China + Hong Kong, China
  - Indonesia
  - ASEAN 9 (all ASEAN except Indonesia)

Regional Definitions - Continued

- Results for Chinese Taipei, Chile, Peru and Papua New Guinea were combined in the IEA's model with a number of other non-APEC economies, hence we use APERC model results for them

Defining Energy Intensity

- Energy Intensity is generally defined as Energy Demand/Real GDP
  - But what kind of Energy Demand?
  - And what kind of Real GDP?
- The Leaders did not give a precise definition of energy intensity in their declarations; hence EWG will need to consider carefully not only the numerical value of its energy intensity reduction goal, but also its definition
- The choice of what type of energy demand to use is particularly important

What Kind of Energy Demand?

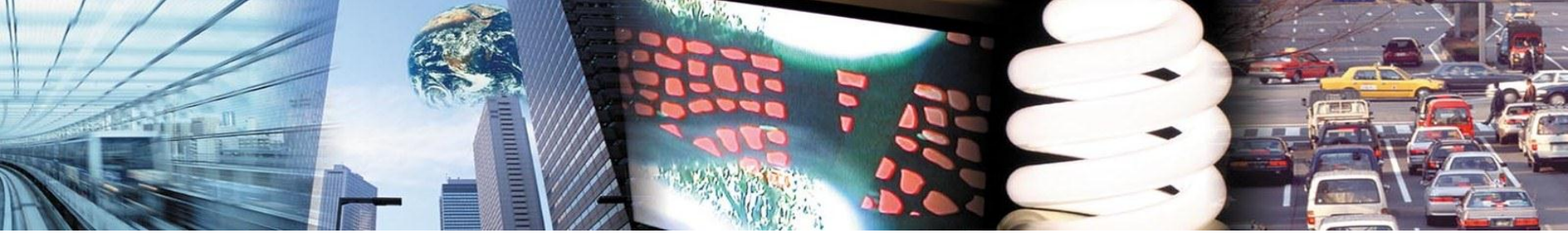
- ‘Final Energy Demand’ = Direct use of fuels and electricity by end-users (including industry, transport, residential, services, agriculture, and non-energy use)
- ‘Primary Energy Demand’ = Final Energy Demand + transformation losses, such as in electricity generation, heat (steam) plants and refineries
- In this presentation, we discuss energy intensity defined using both types of energy demand
- In our presentation for the EWG, we will discuss the pros and cons of each definition

Why Nuclear and Geothermal Generation Usually *Increases* Primary Energy Intensity

- According to the International Energy Agency's *Energy Statistics Manual,* the primary energy of a nuclear or geothermal generating station is the heat content of the fluids (steam) used
- Generally, the conversion efficiency of this steam to electricity is quite low
  - The IEA assumes a default conversion efficiency of 33% for nuclear and only 10% for geothermal
  - This is significantly less efficient than most fossil-fueled generators

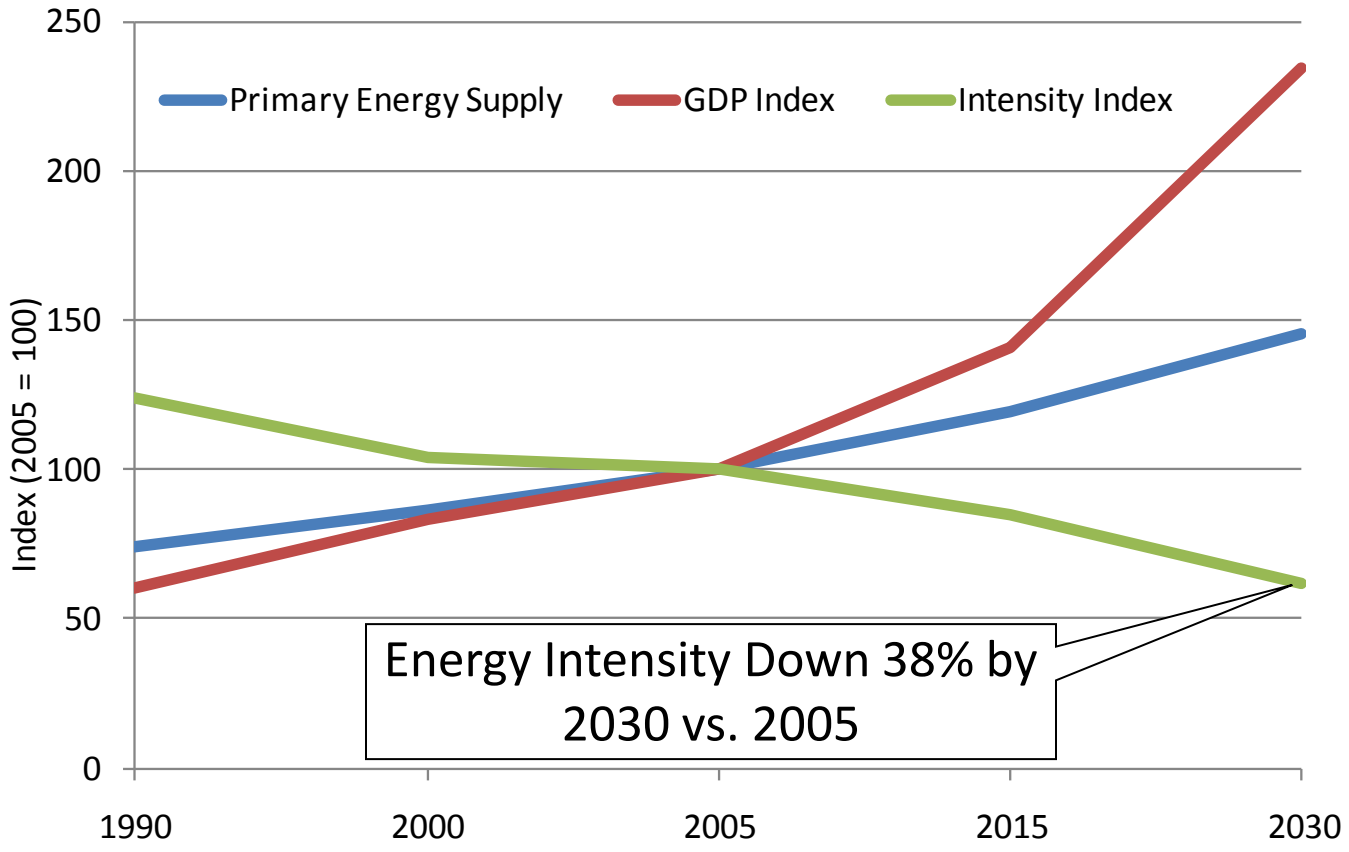
What Kind of Real GDP?

- Real GDP may be defined in terms of
  - Real local currency of each economy, but this would not allow direct comparisons of energy intensity between economies
  - Some standard currency (usually US dollars) based on exchange rates, but these may fluctuate over time, making comparisons over time difficult
  - Some standard currency (usually US dollars) based on purchasing power parity (PPP)—that is, how much the local currency will buy compared to a US dollar
- For this analysis, we define the GDP of each economy in terms of purchasing power parity in US dollars
  - This approach gives the same percentage changes over time that we would get if we used real local currency



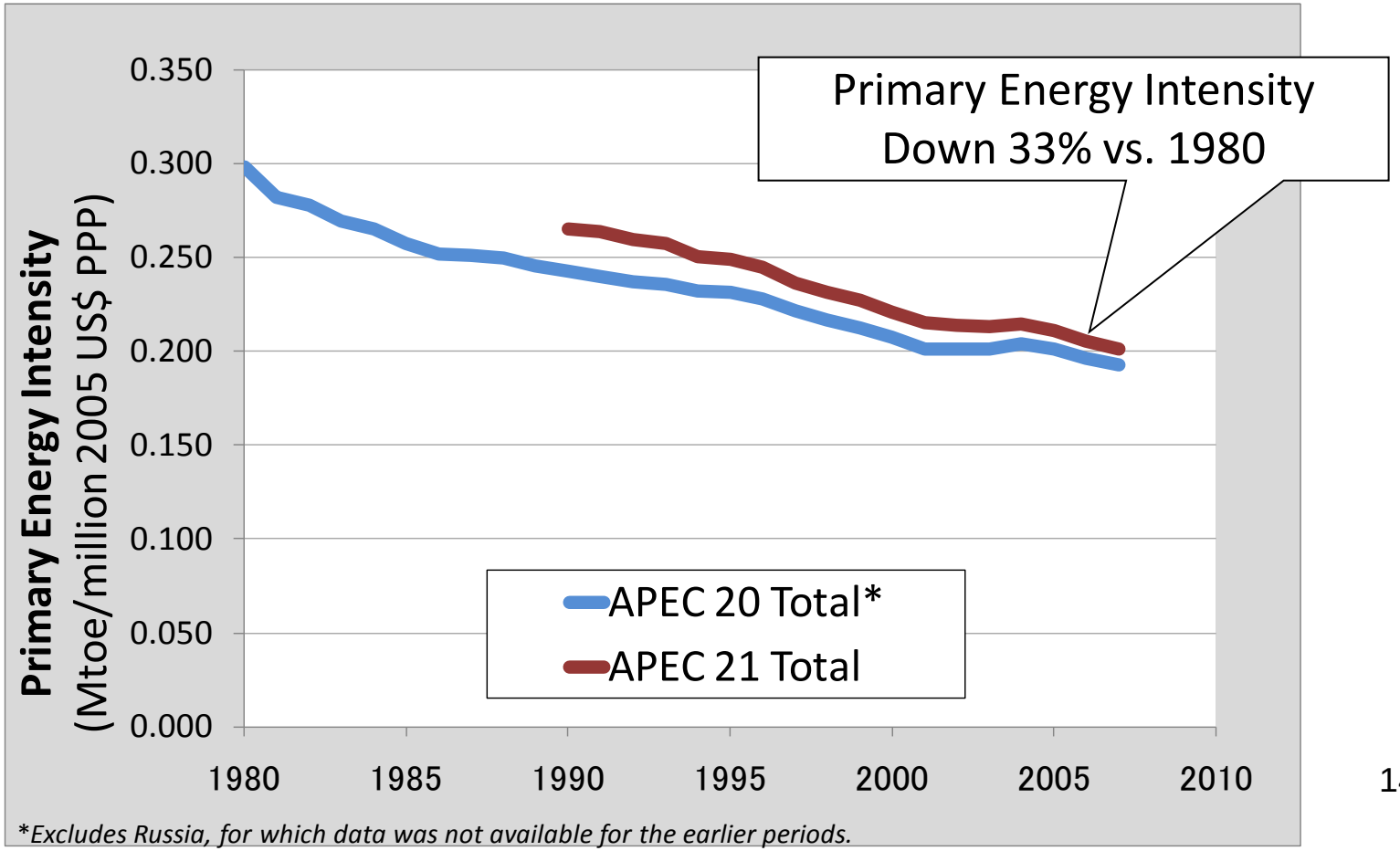
A. What Level of APEC-Wide Energy Intensity Reduction Would Be Consistent with Business As Usual?

APERC's Business-As-Usual Outlook



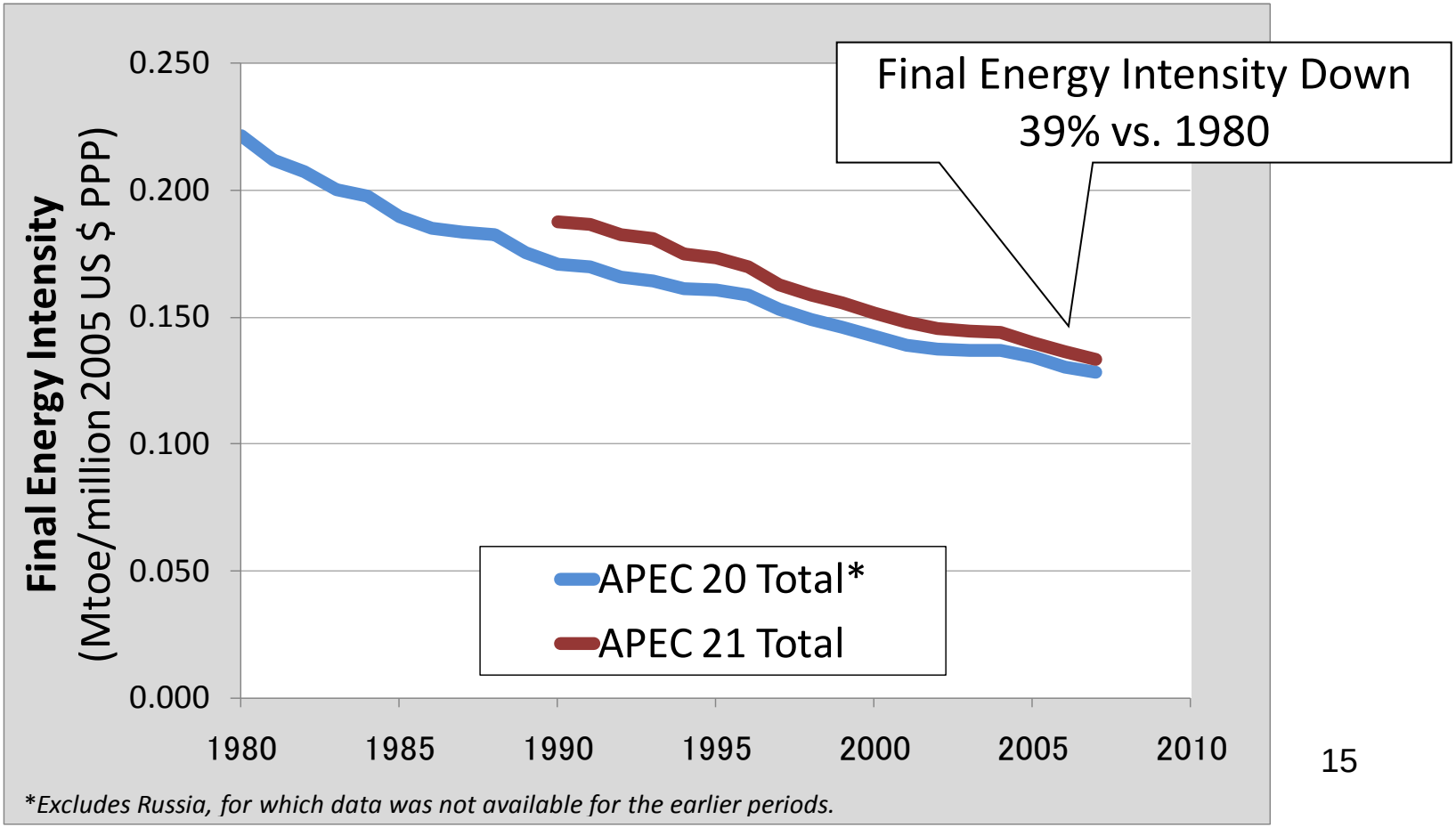
From APERC, *APEC Energy Demand and Supply Outlook 4th Edition,* Figure 1.5

What Happened to Primary Energy Intensity Over the 25 Years from 1980-2005?



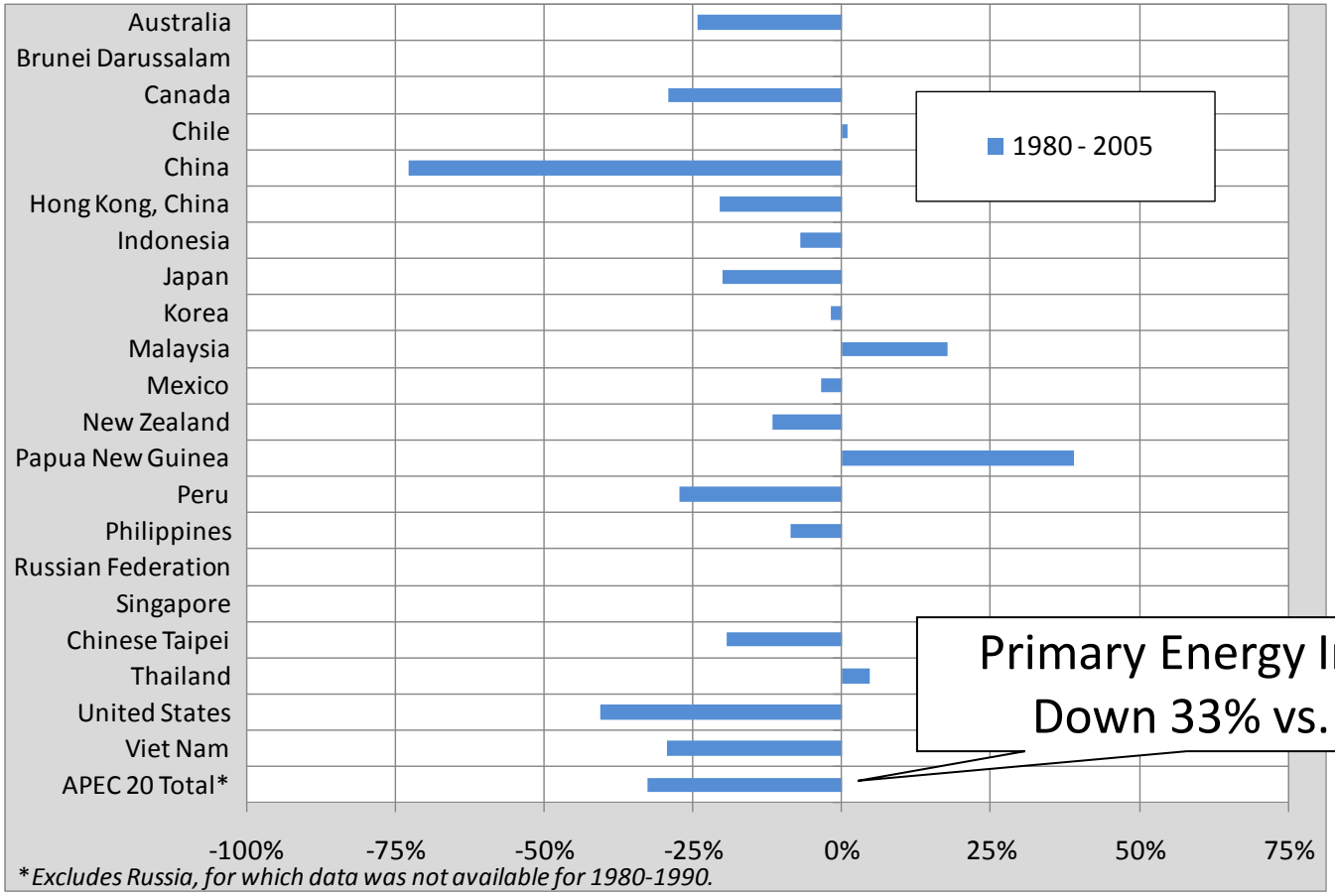
*Excludes Russia, for which data was not available for the earlier periods.

What Happened to Final Energy Intensity Over the 25 Years from 1980-2005?



*Excludes Russia, for which data was not available for the earlier periods.

What Happened to Primary Energy Intensity By Economy Over the 25 Years from 1980-2005?



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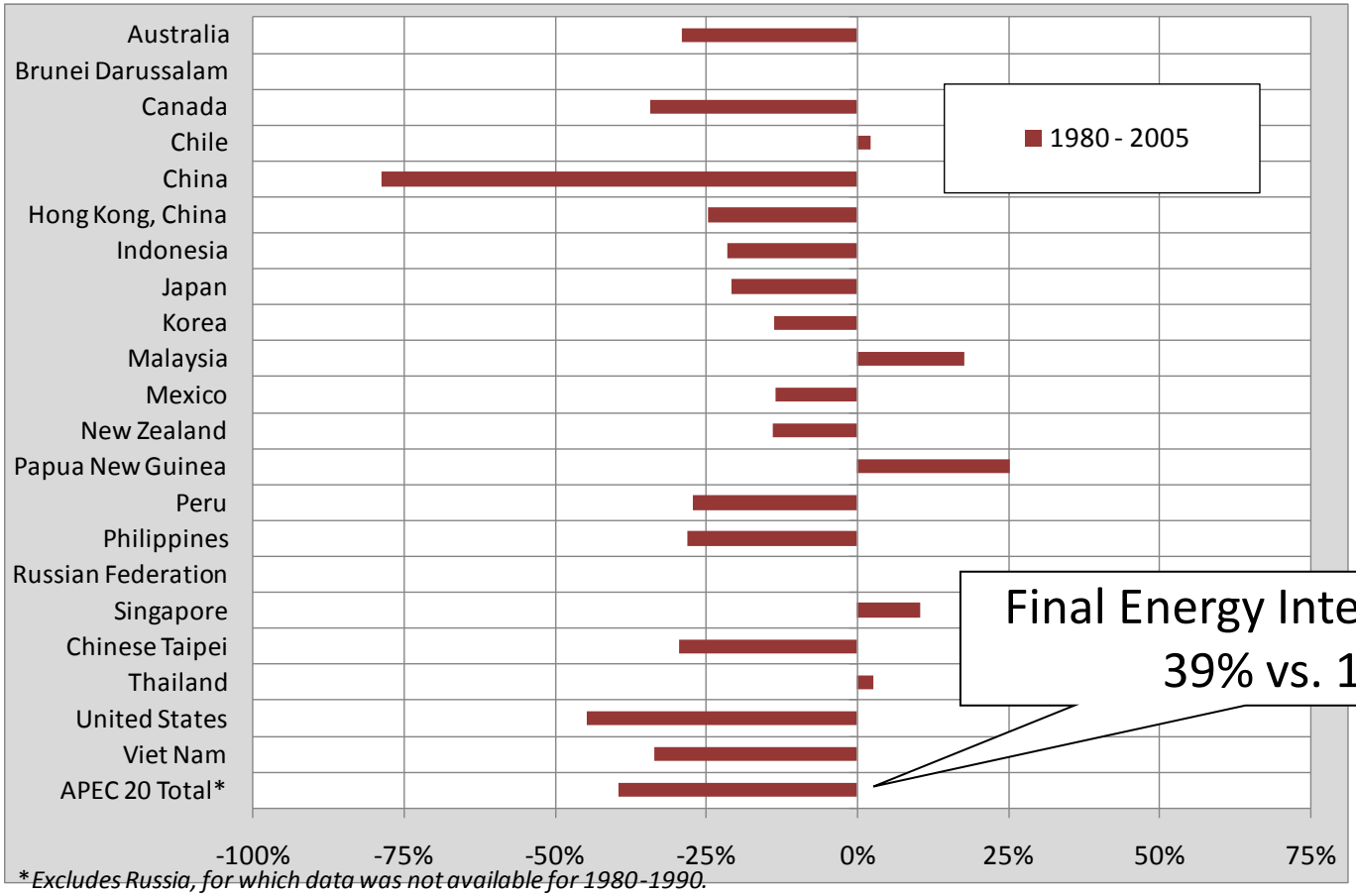
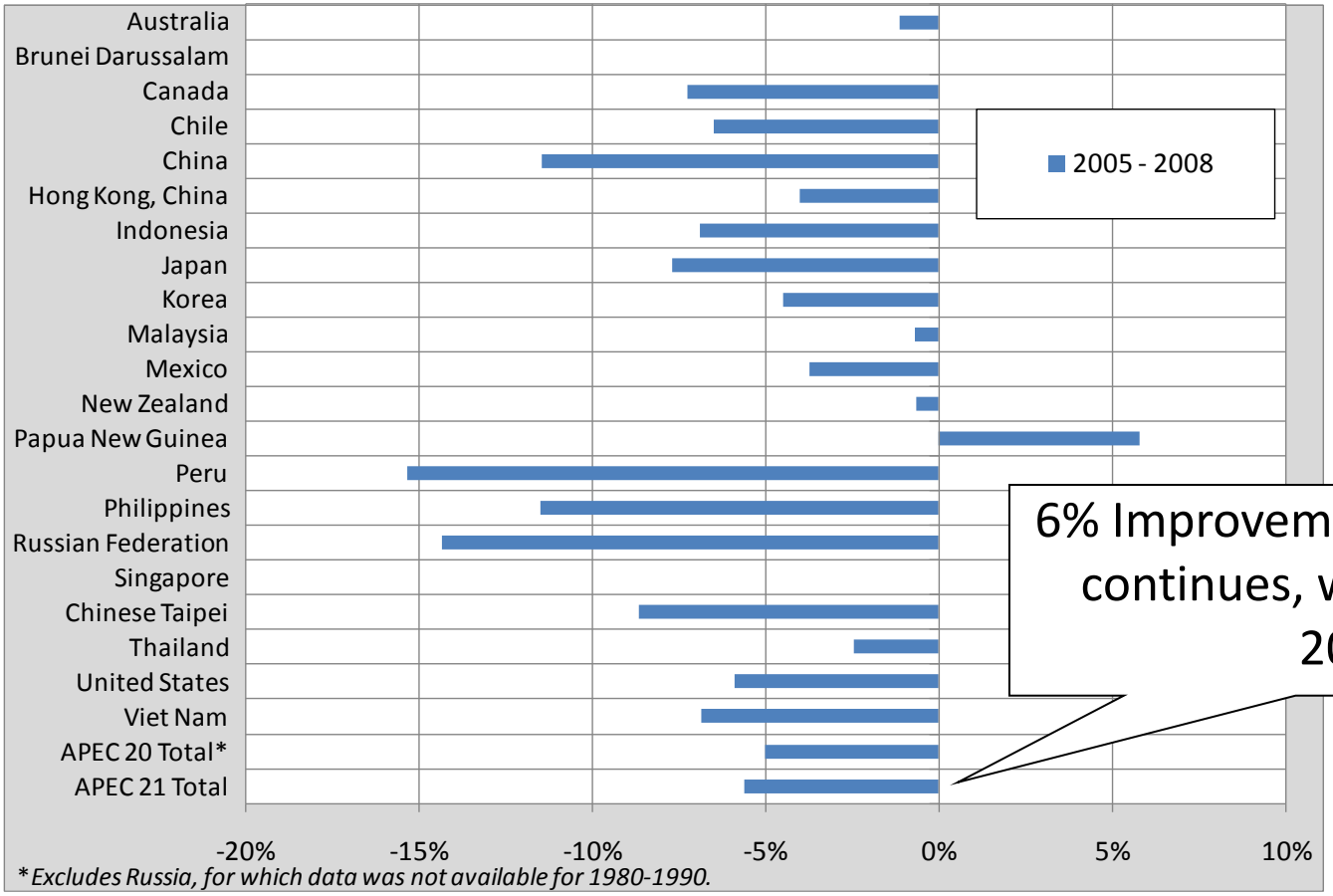


*Excludes Russia, for which data was not available for 1980-1990.

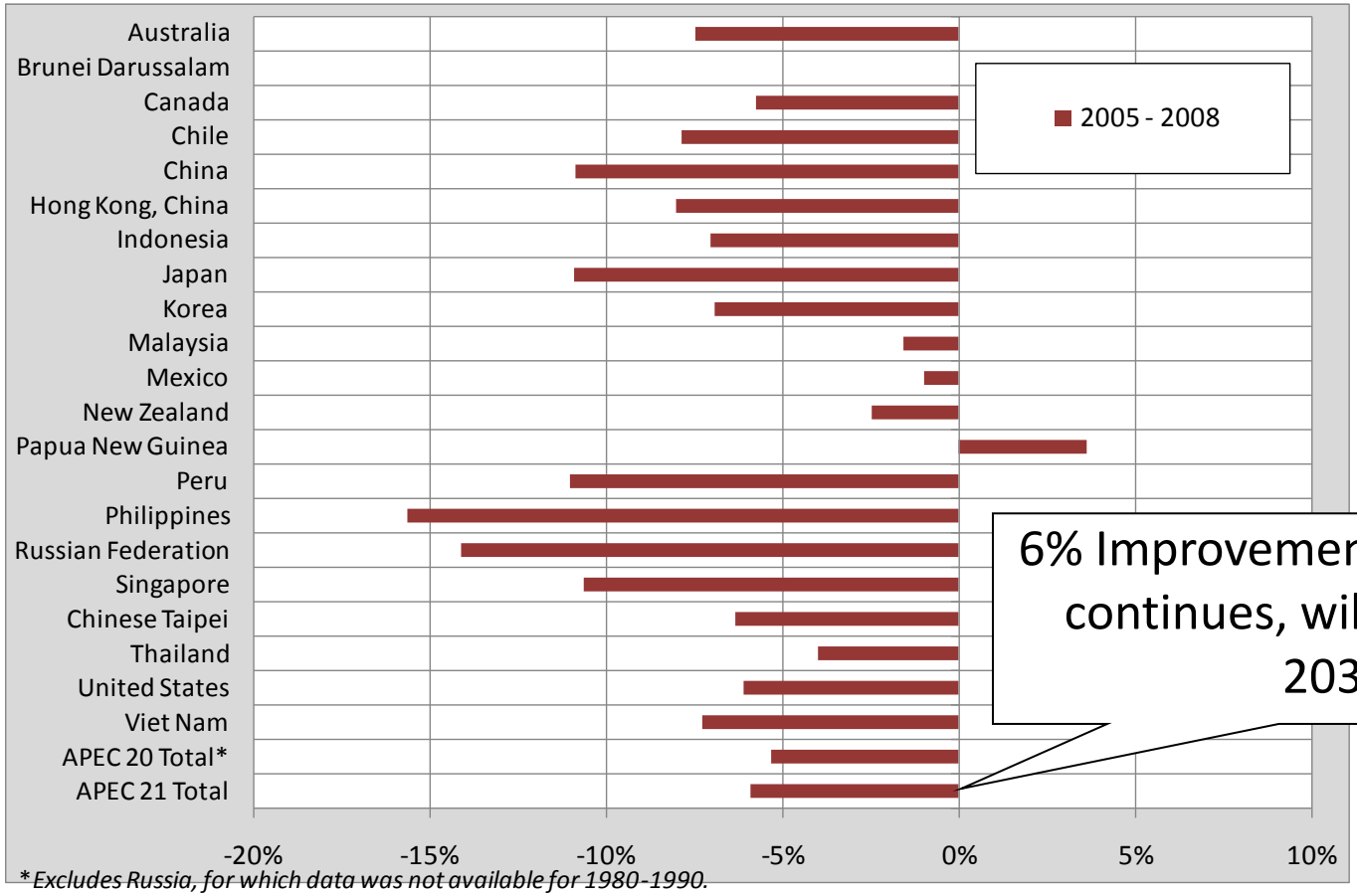
Final Energy Intensity Down 39% vs. 1980

What Has Happened to Primary Energy Intensity Since 2005?



6% Improvement—If this rate continues, will be 38% by 2030

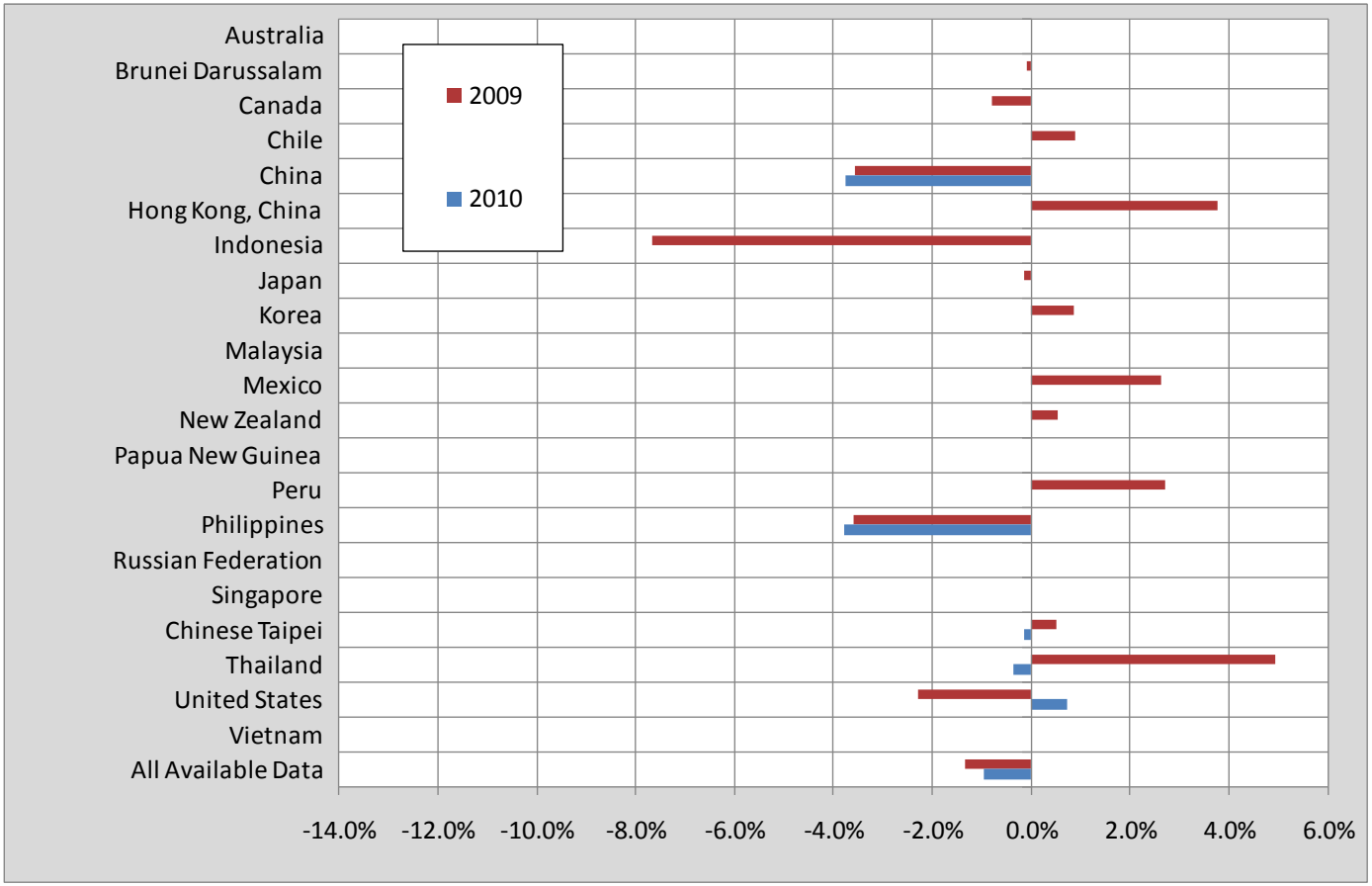
What Has Happened to Final Energy Intensity Since 2005?



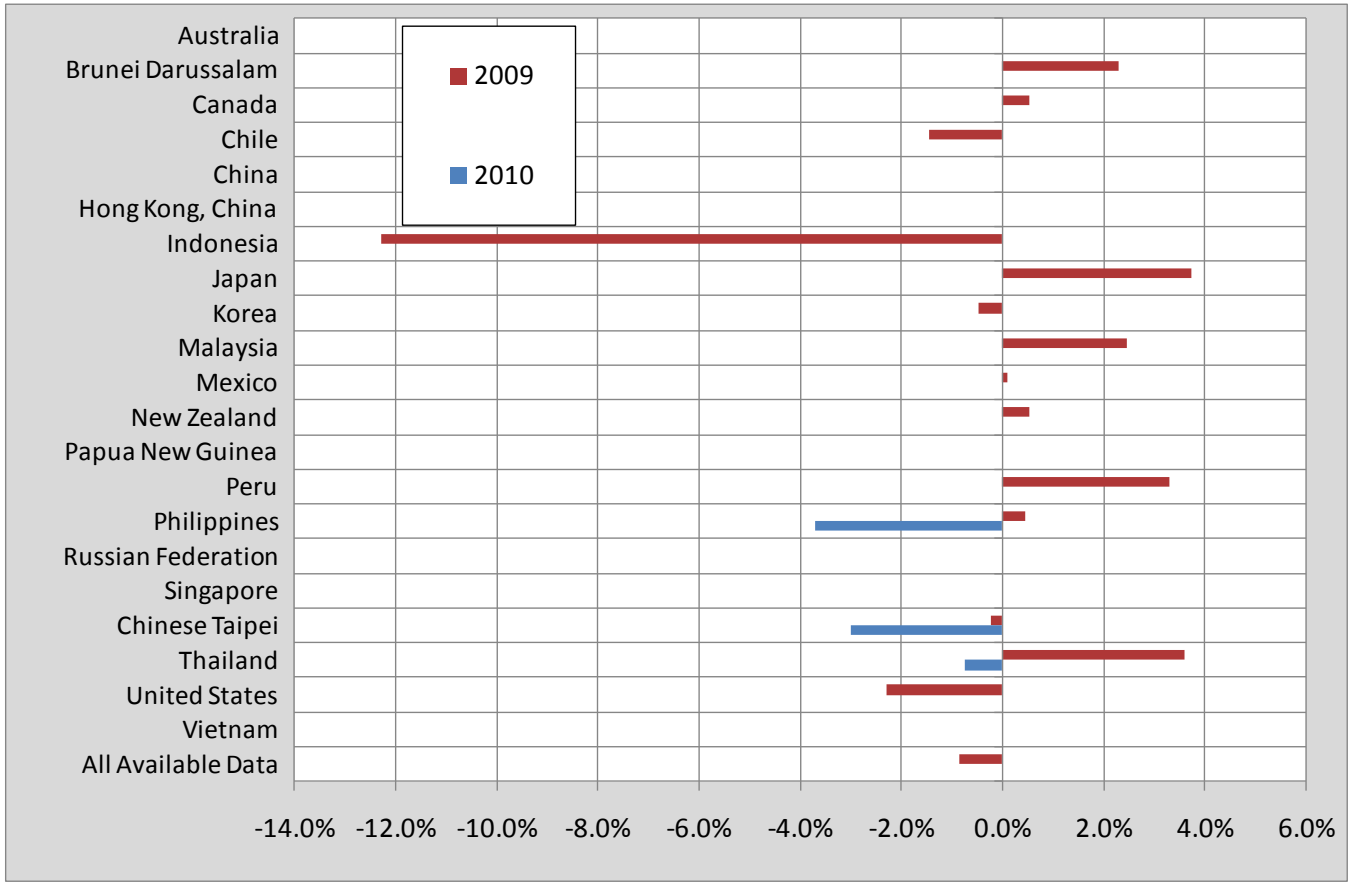
*Excludes Russia, for which data was not available for 1980-1990.

6% Improvement—If this rate continues, will be 40% by 2030

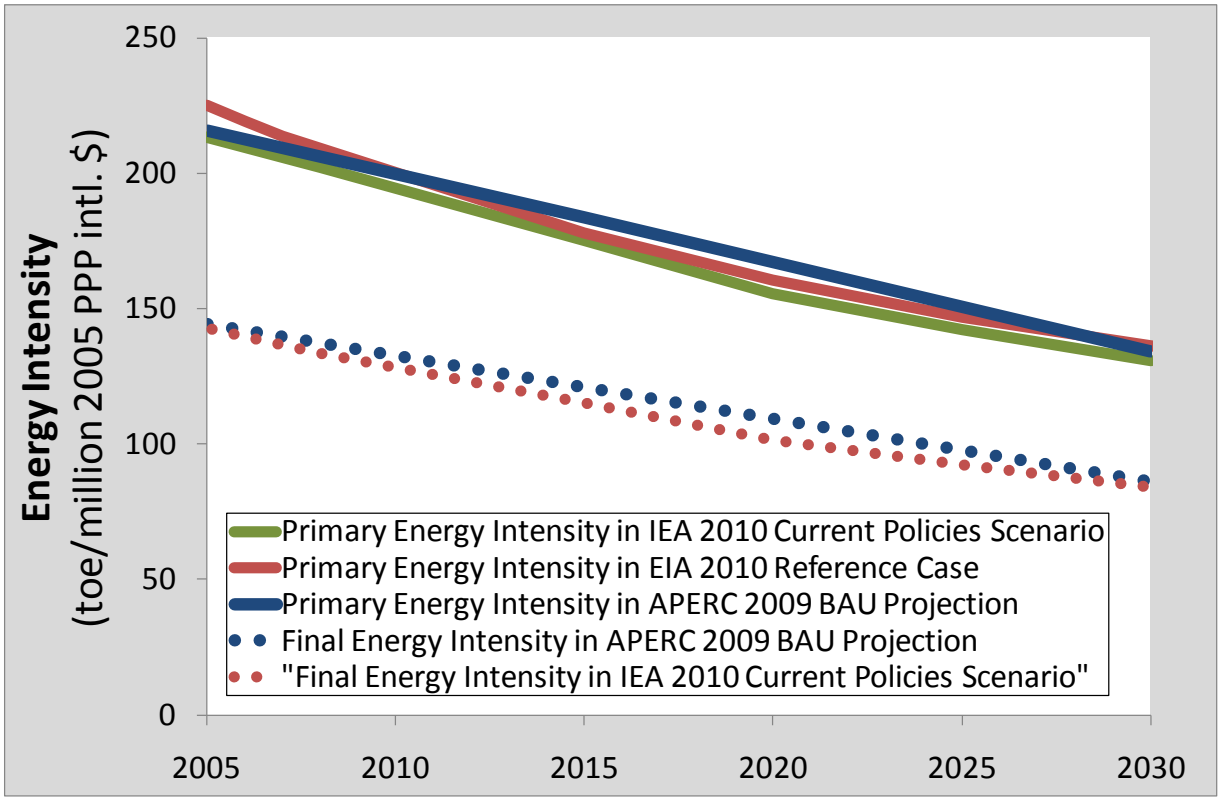
What Has Happened to Primary Energy Intensity In 2009 and 2010?



What Has Happened to Final Energy Intensity In 2009 and 2010?

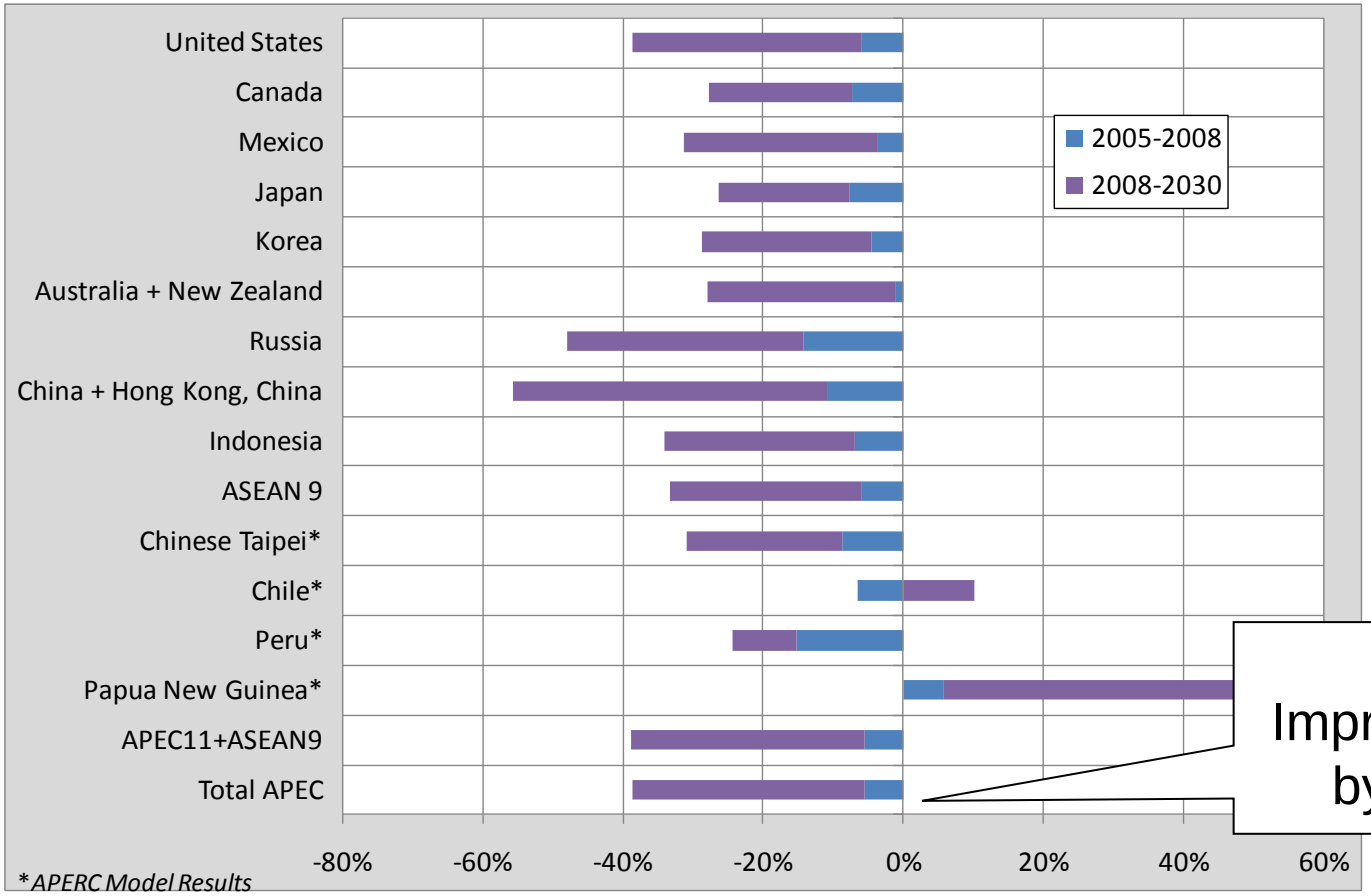


What Do Modelers in Well-Known Research Institutes Say About APEC's Potential for Reducing Energy Intensity in BAU Case?



Raw Data for IEA Case © OECD/IEA 2010; calculations by APERC

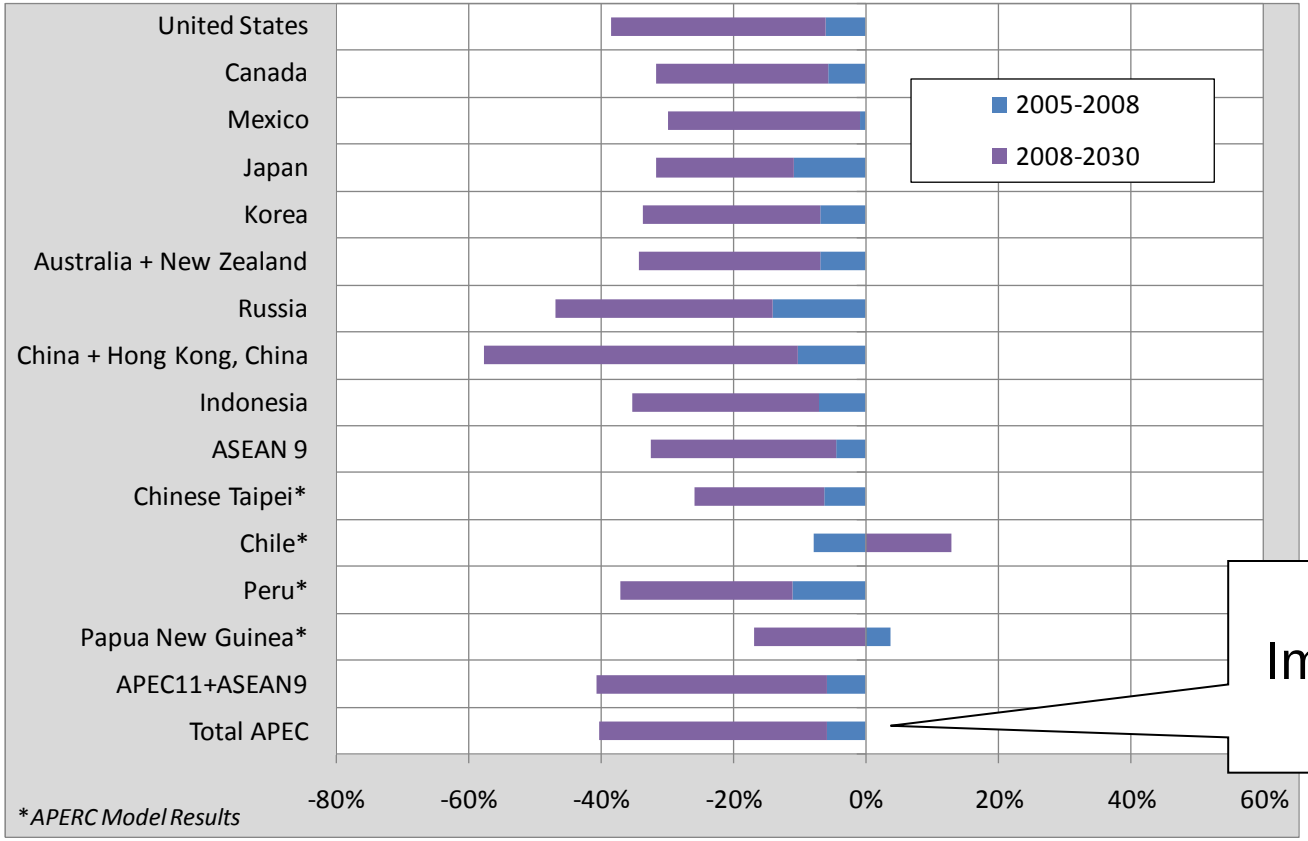
What Is APEC's Potential for Reducing Primary Energy Intensity in the IEA's Current Policies Scenario?



39% Improvement by 2030

Raw Data for IEA Case © OECD/IEA 2010; calculations by APERC

What Is APEC's Potential for Reducing Final Energy Intensity in the IEA's Current Policies Scenario?

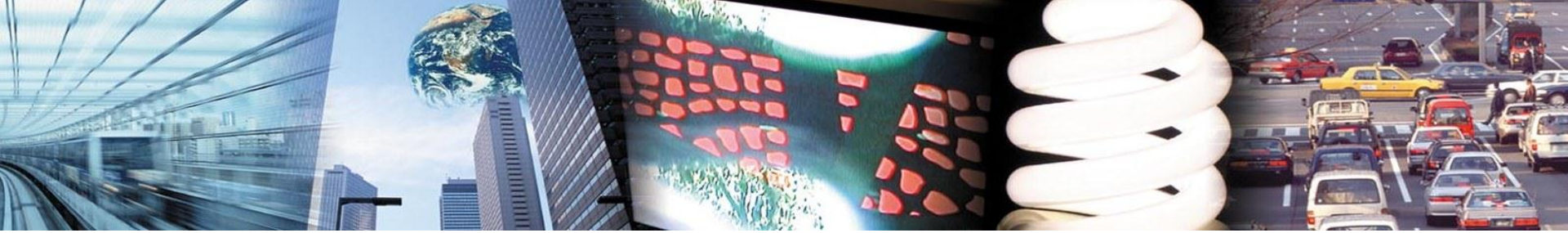


40% Improvement by 2030

Raw Data for IEA Case © OECD/IEA 2010; calculations by APERC

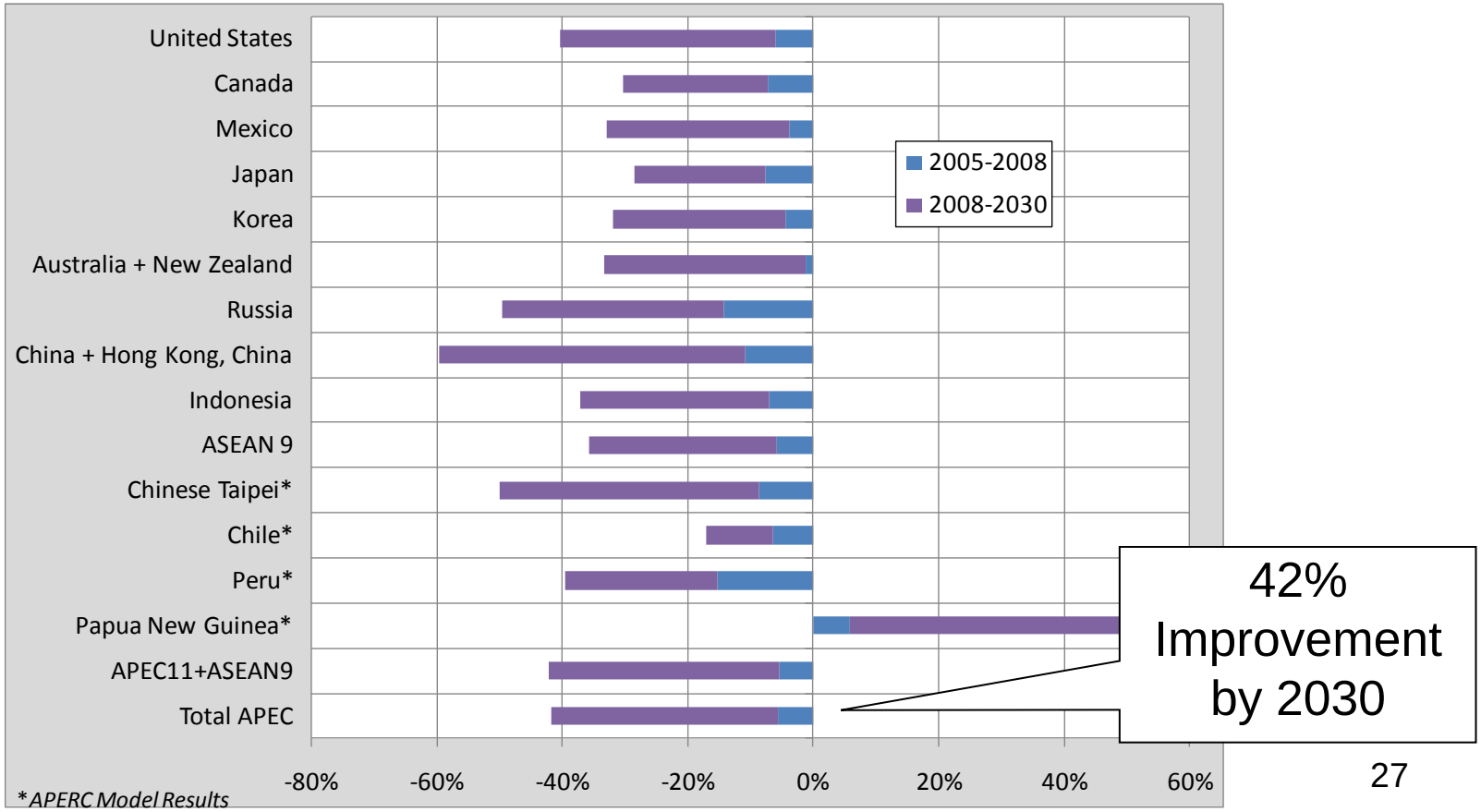
Key Uncertainties

- Any conclusions about what the world is going to be like 25 years from now, even under business as usual, is subject to many uncertainties, including
  - Technological developments
  - Political developments
  - Economic developments
  - Environmental developments
- Hence, all the conclusions here must be regarded as approximate



B. What Level of APEC-Wide Energy Intensity Reduction Would Be Consistent with What APEC Economies Currently Pledge to Achieve?

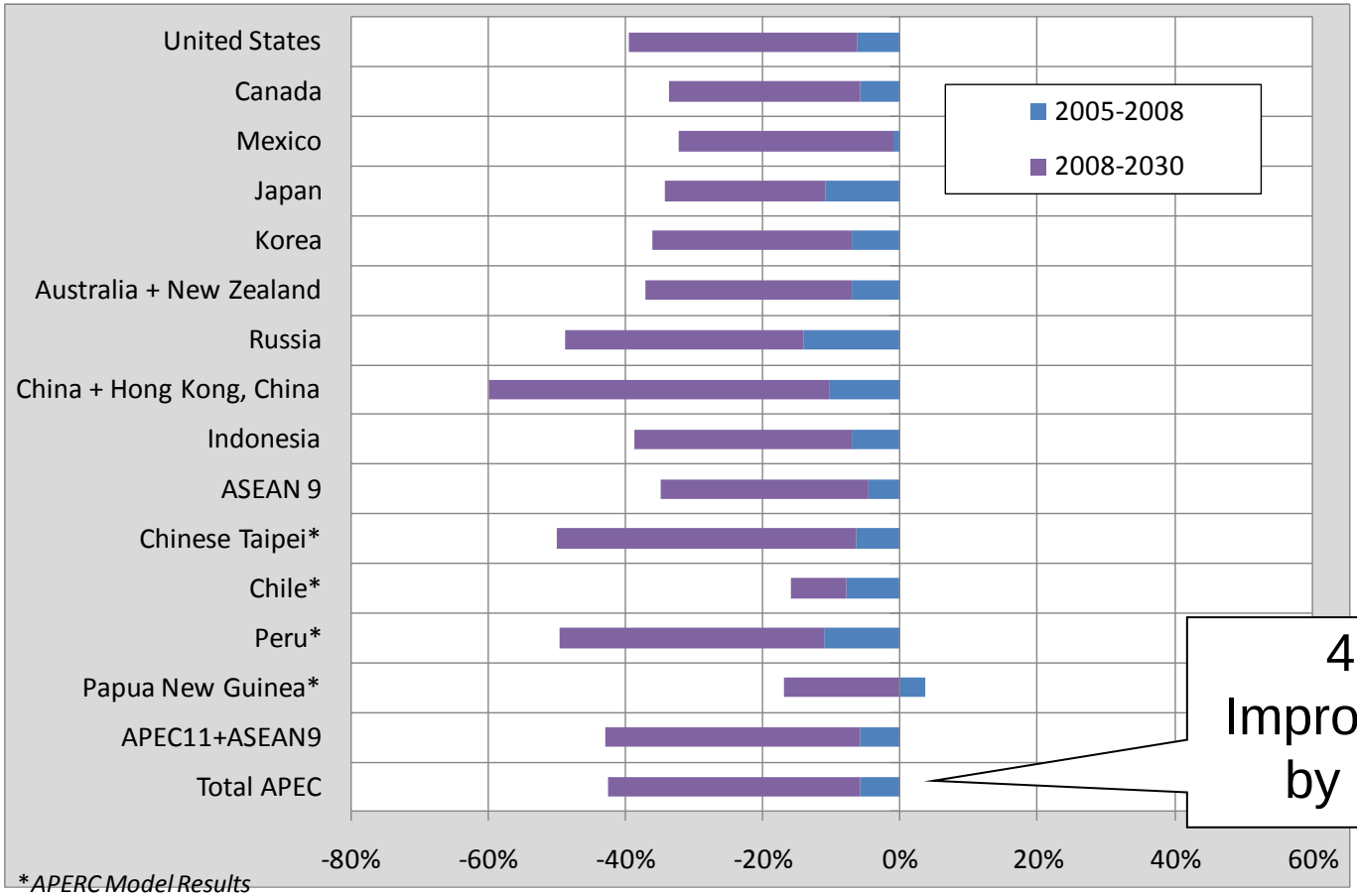
What Is APEC's Potential for Reducing Primary Energy Intensity in the IEA's New Policies Scenario?



42% Improvement by 2030

Raw Data for IEA Case © OECD/IEA 2010; calculations by APERC

What Is APEC's Potential for Reducing Final Energy Intensity in the IEA's New Policies Scenario?



*APERC Model Results

Raw Data for IEA Case © OECD/IEA 2010; calculations by APERC

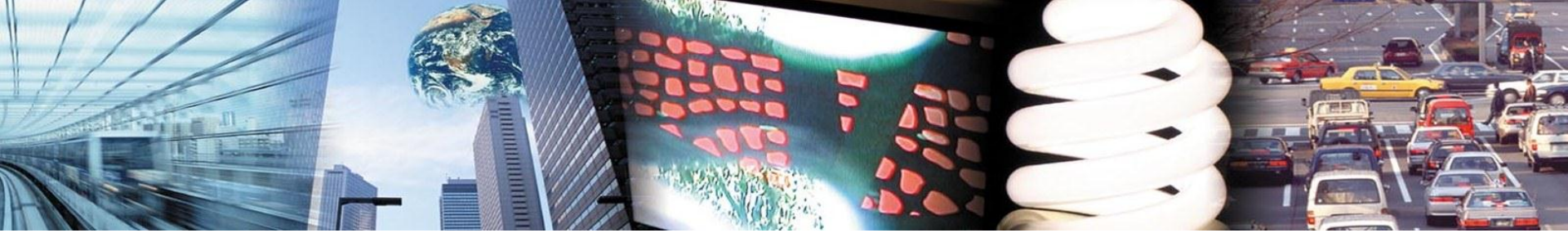
The IEA “New Policies Scenario”

The New Policies Scenario takes into account all policies and measures included in the Current Policies Scenario as well as the following:

- “Cautious” implementation of the Copenhagen Accord commitments by 2020
- Continuation of the European Union Emissions Trading Scheme
- For 2020-2035, additional measures to maintain the pace of the global decline in carbon intensity…established in the period 2008-2020”

Key Uncertainties

- In addition the uncertainties already highlighted in the business-as-usual discussion, there are a number of additional uncertainties regarding how a “New Policies Scenario” would actually unfold, including
  - How each economy’s pledge should be interpreted
  - The extent to which each economy will be able to implement the pledges they have made
  - What will happen in the years after the current pledges expire
- So again, all the conclusions here must be regarded as approximate

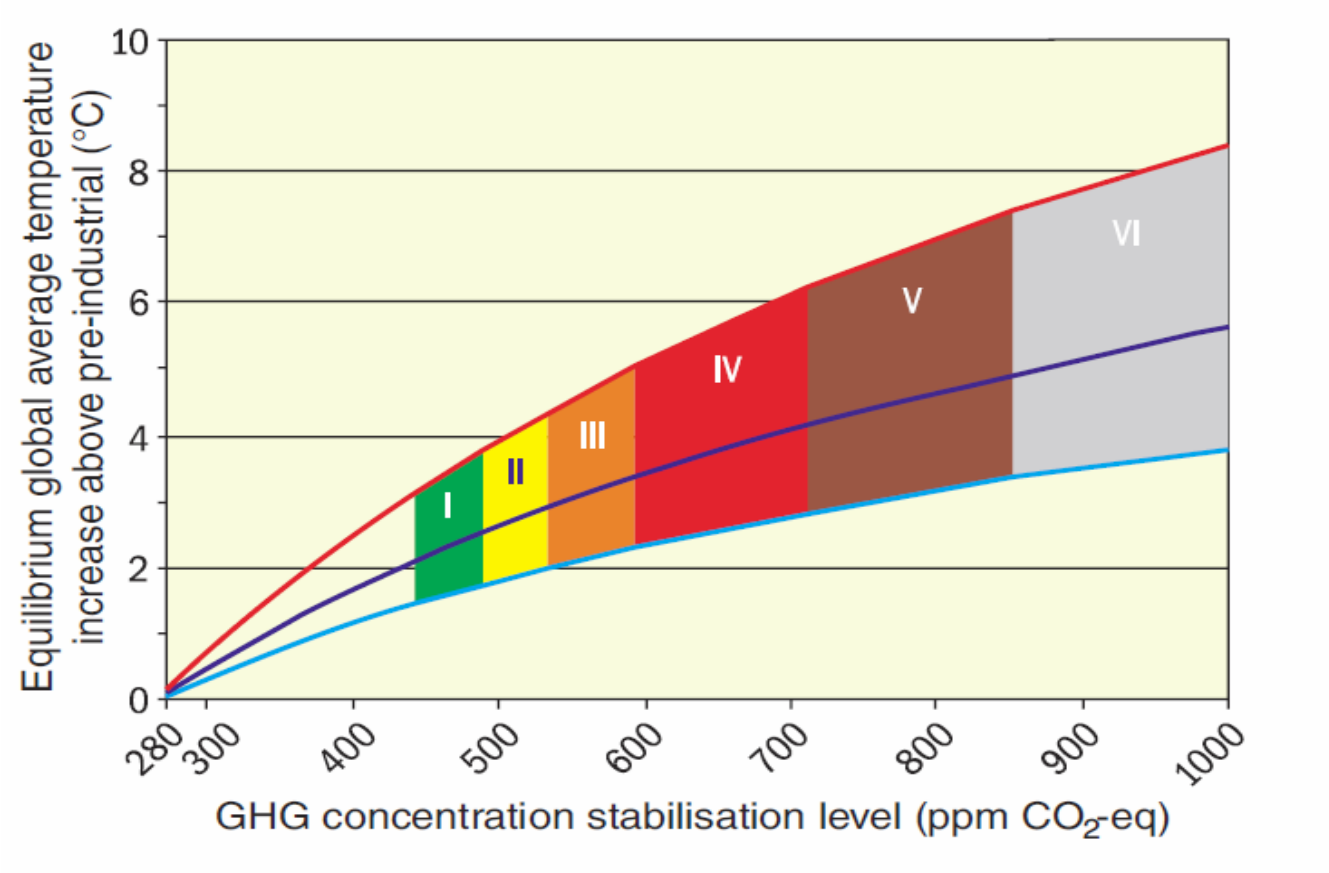


C. What Level of Intensity Reduction Would Be Consistent with Global Efforts to Limit Temperature Rises to 2° C?

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?



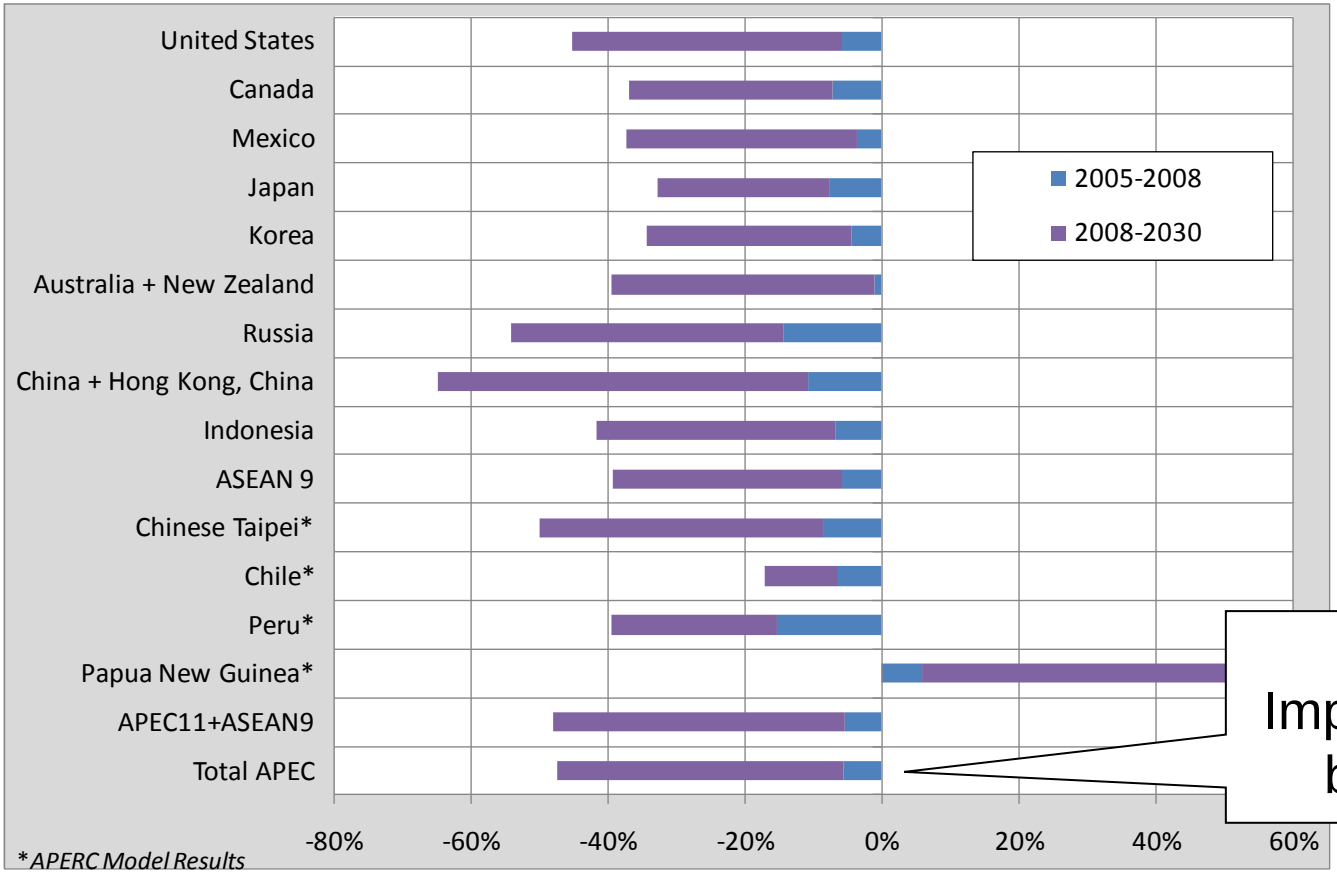
From: Intergovernmental Panel on Climate Change, *Climate Change 2007: Synthesis Report*, Figure 5.1, p 66.

The IEA “450 Scenario”

“The 450 scenario takes into account all policies and measures included in the New Policies Scenario, some of which are assumed to be substantially strengthened and extended, plus the following:

- Implementation by 2020 of the high-end of the range of the Copenhagen Accord commitments, where they are expressed as ranges
- National policies and measures, such as efficiency standards for buildings and labelling of appliances
- Extension of nuclear plant lifetimes by 5 to 10 years with respect to the New Policies Scenaro

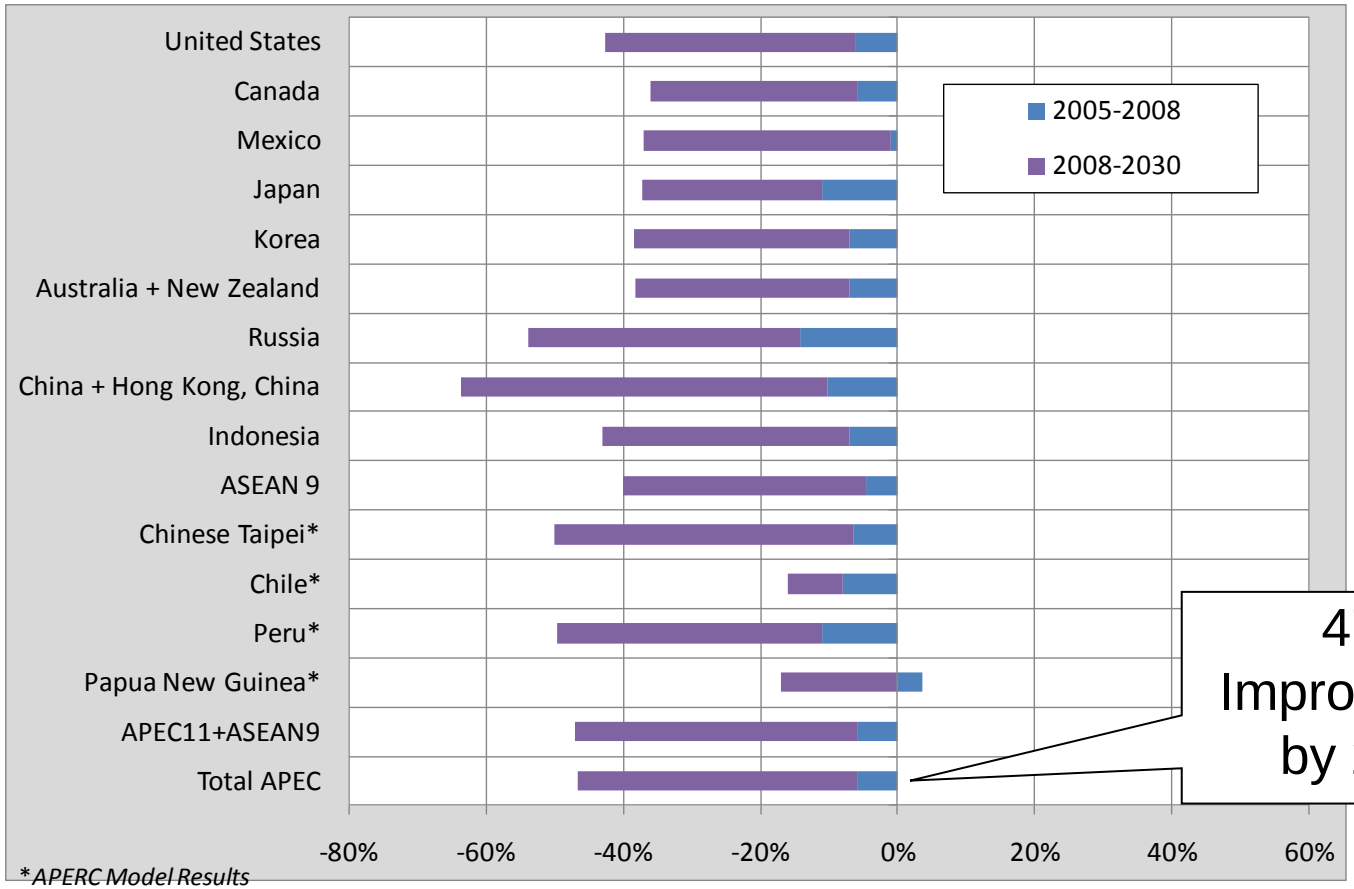
What Is APEC's Potential for Reducing Primary Energy Intensity in the IEA's 450 Scenario?



47% Improvement by 2030

Raw Data for IEA Case © OECD/IEA 2010; calculations by APERC

What Is APEC's Potential for Reducing Final Energy Intensity in the IEA's 450 Scenario ?



*APERC Model Results

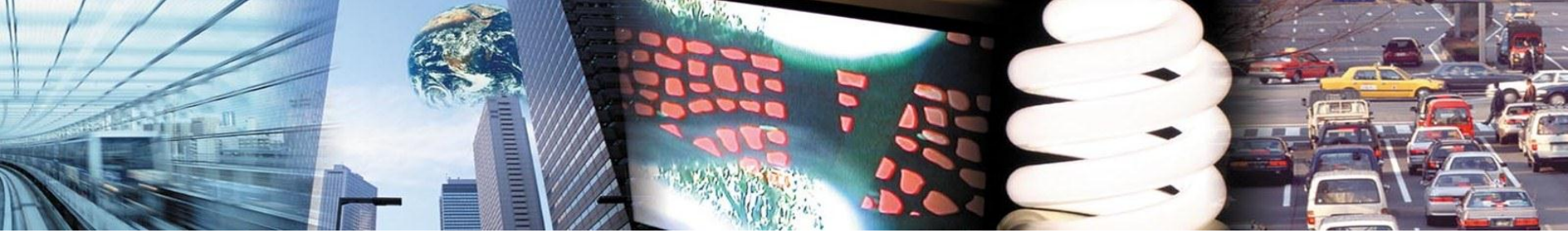
Raw Data for IEA Case © OECD/IEA 2010; calculations by APERC

How Would Higher Oil Prices Affect These Results?

- Oil prices are assumed to reach
  - $130/barrel by 2030 in the Current Policies Scenario
  - $110/barrel by 2030 in the New Policies Scenario
  - $90/barrel by 2030 in the 450 Scenario
- If oil prices turn out to be higher than this, it would reduce oil demand and thus reduce (*improve*) energy intensity
  - A approximate rule-of-thumb is that a 10% reduction in oil demand improves primary energy intensity by 1.5% and final energy intensity by 2.0%

Key Uncertainties

- In addition the uncertainties already highlighted in the business-as-usual discussion, there are a number of additional uncertainties regarding how a “450 Scenario” would actually unfold, including
  - How much emission reduction would be expected of APEC economies vs. the rest of the world
  - How much emission reduction would come from the energy sector vs. other sectors (agriculture, forestry, etc.)
  - How much emission reduction would come from energy intensity reduction vs. lower carbon energy supply
- So again, all the conclusions here must be regarded as approximate



D. Summary

Key Conclusions

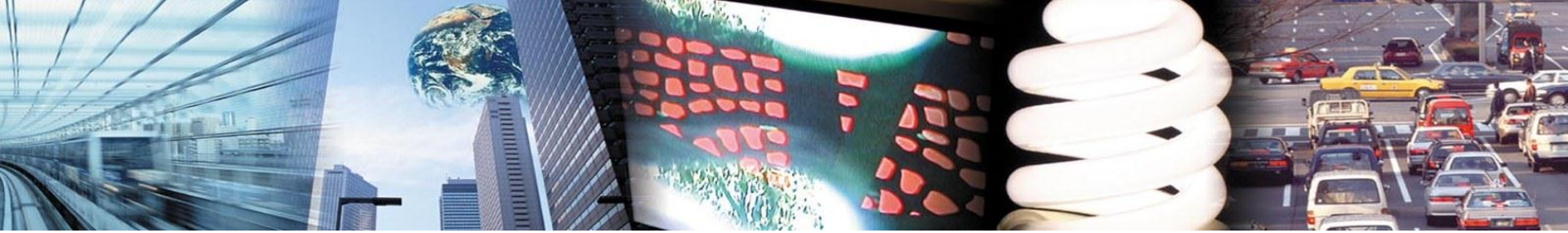
- APEC EWG will need to consider carefully not only the numerical value of its energy intensity reduction target, but also its definition—primary or final energy intensity?
- The choice of definition does not change the target very much, but will change how APEC economies meet the target
- All numerical conclusions are very approximate, as there are a variety of uncertainties that could affect them
- A possible increase in oil prices above those assumed here will make any energy intensity target *easier* to meet

Some Indicative APEC-wide Energy Intensity Reduction Potentials for 2005-2030 Based on the Results Presented Here

A. As a rough approximation, a 38-40% APEC-wide energy intensity reduction would be consistent with business-as-usual

B. As a rough approximation, a 42-43% APEC-wide energy intensity reduction would be consistent with with “cautious” implementation of current pledges

C. As a rough approximation, a 47% APEC-wide energy intensity reduction would be consistent with cooperative efforts to limit temperature rises to 2^{0} C



Appendix – Summary of Key Modeling Assumptions

Population Assumptions

Population growth by region (compound annual growth rates)

	1980-1990	1990-2008	2008-2020	2020-2035	2008-2035
OECD	**0.8%**	**0.7%**	**0.5%**	**0.3%**	**0.4%**
North America	1.2%	1.2%	0.9%	0.6%	0.7%
United States	*0.9%*	*1.1%*	*0.9%*	*0.6%*	*0.7%*
Europe	0.5%	0.5%	0.3%	0.1%	0.2%
Pacific	0.8%	0.4%	0.0%	-0.3%	-0.1%
Japan	*0.5%*	*0.2%*	*-0.2%*	*-0.6%*	*-0.4%*
Non-OECD	**2.0%**	**1.5%**	**1.2%**	**0.8%**	**1.0%**
E. Europe/Eurasia	0.8%	-0.2%	-0.1%	-0.2%	-0.2%
Caspian	*n.a.*	*0.8%*	*1.0%*	*0.6%*	*0.7%*
Russia	*n.a.*	*-0.2%*	*-0.4%*	*-0.5%*	*-0.4%*
Asia	1.8%	1.4%	1.0%	0.6%	0.8%
China	*1.5%*	*0.9%*	*0.6%*	*0.1%*	*0.3%*
India	*2.1%*	*1.6%*	*1.2%*	*0.7%*	*1.0%*
Middle East	3.6%	2.3%	1.8%	1.3%	1.5%
Africa	2.9%	2.5%	2.2%	1.7%	1.9%
Latin America	2.0%	1.5%	1.0%	0.6%	0.8%
Brazil	*2.1%*	*1.4%*	*0.7%*	*0.3%*	*0.5%*
World	**1.7%**	**1.3%**	**1.1%**	**0.7%**	**0.9%**
European Union	*n.a.*	*0.3%*	*0.2%*	*0.0%*	*0.1%*

World Energy Outlook 20010 © OECD/IEA 2010,
http://www.worldenergyoutlook.org/docs/weo2010/World_Energy_Model.pdf

GDP Assumptions

Real GDP growth by region (compound average annual growth rates)

	1980-1990	1990-2008	2008-2020	2020-2035	2008-2035
OECD	**3.0%**	**2.5%**	**1.8%**	**1.9%**	**1.8%**
North America	3.1%	2.8%	2.1%	2.2%	2.2%
United States	*3.2%*	*2.8%*	*2.0%*	*2.1%*	*2.1%*
Europe	2.4%	2.2%	1.5%	1.8%	1.6%
Pacific	4.3%	2.1%	1.7%	1.2%	1.5%
Japan	*3.9%*	*1.2%*	*1.0%*	*1.0%*	*1.0%*
Non-OECD	**3.3%**	**4.7%**	**5.6%**	**3.8%**	**4.6%**
E. Europe/Eurasia	4.0%	0.8%	3.0%	3.1%	3.1%
Russia	*n.a.*	*0.6%*	*2.9%*	*3.1%*	*3.0%*
Asia	6.6%	7.4%	7.0%	4.2%	5.4%
China	*9.0%*	*10.0%*	*7.9%*	*3.9%*	*5.7%*
India	*5.6%*	*6.4%*	*7.4%*	*5.6%*	*6.4%*
Middle East	-1.3%	3.9%	4.0%	3.8%	3.9%
Africa	2.3%	3.8%	4.5%	2.8%	3.5%
Latin America	1.2%	3.5%	3.3%	2.7%	3.0%
Brazil	*1.5%*	*3.0%*	*3.6%*	*3.1%*	*3.3%*
World	**3.1%**	**3.3%**	**3.6%**	**2.9%**	**3.2%**
European Union	*n.a.*	*2.1%*	*1.4%*	*1.7%*	*1.6%*

Note: Calculated based on GDP expressed in year-2009 dollars at PPP terms.

World Energy Outlook 20010 © OECD/IEA 2010,
http://www.worldenergyoutlook.org/docs/weo2010/World_Energy_Model.pdf

Fossil Fuel Price Assumptions

Table 1.4 • Fossil-fuel import price assumptions by scenario (dollars per unit)

			New Policies Scenario					Current Policies Scenario					450 Scenario				
	Unit	2009	2015	2020	2025	2030	2035	2015	2020	2025	2030	2035	2015	2020	2025	2030	2035
Real terms (2009 prices)																	
IEA crude oil imports	barrel	60.4	90.4	99.0	105.0	110.0	113.0	94.0	110.0	120.0	130.0	135.0	87.9	90.0	90.0	90.0	90.0
Natural gas imports																	
United States	MBtu	4.1	7.0	8.1	9.1	9.9	10.4	7.0	8.2	9.3	10.4	11.2	7.0	8.0	8.9	9.4	9.7
Europe	MBtu	7.4	10.6	11.6	12.3	12.9	13.3	10.7	12.1	12.9	13.9	14.4	10.4	10.6	10.7	10.9	11.0
Japan	MBtu	9.4	12.2	13.4	14.2	14.9	15.3	12.4	13.9	14.9	15.9	16.5	11.9	12.2	12.3	12.5	12.6
OECD steam coal imports	tonne	97.3	97.7	101.7	104.1	105.6	106.5	97.8	105.8	109.5	112.5	115.0	92.5	85.8	75.8	66.3	62.1
Nominal terms																	
IEA crude oil imports	barrel	60.4	103.6	127.1	151.1	177.3	204.1	107.7	141.3	172.7	209.6	243.8	100.7	115.6	129.5	145.1	162.6
Natural gas imports																	
United States	MBtu	4.1	8.0	10.4	13.1	15.9	18.9	8.0	10.5	13.3	16.7	20.3	8.0	10.3	12.8	15.1	17.5
Europe	MBtu	7.4	12.2	14.9	17.8	20.9	24.1	12.3	15.5	18.6	22.4	26.0	11.9	13.6	15.4	17.5	19.8
Japan	MBtu	9.4	14.0	17.2	20.4	24.0	27.6	14.2	17.8	21.4	25.7	29.8	13.6	15.6	17.7	20.1	22.7
OECD steam coal imports	tonne	97.3	112.0	130.6	149.8	170.2	192.4	112.1	135.9	157.6	181.4	207.8	106.0	110.2	109.0	106.8	112.1

Note: Natural gas prices are weighted averages, expressed on a gross calorific-value basis. All prices are for bulk supplies exclusive of tax. The US gas import price is used as a proxy for prices prevailing on the domestic market. Nominal prices assume inflation of 2.3% per year from 2009.

Table B.1 • Overall targets, policies and measures as modelled in the New Policies Scenario and the 450 Scenario in key regions

	New Policies Scenario	450 Scenario
OECD		
United States	- Clean Energy Jobs and American Power Act (2010). Policy to increase reliance on domestic energy sources, including gas and biofuels. - American Recovery and Reinvestment Act (2009). Federal funding, loan guarantees and tax credits for renewables, nuclear and energy efficiency.	- 17% reduction in greenhouse-gas emissions by 2020 compared with 2005 (with access to international offset credits).
Japan	- Basic Energy Plan (2010). Implementation of renewable deployment in total primary energy supply and other measures.	- 25% reduction in greenhouse-gas emissions by 2020 compared with 1990 (with access to international offset credits).
European Union	- Climate and Energy Package (2009). 25% reduction in greenhouse-gas emissions by 2020 compared with 1990 (with access to international offset credits). - EU directive on renewables (2009). 20% share of renewables in gross final energy consumption by 2020.	- 30% reduction in greenhouse-gas emissions by 2020 compared with 1990 (with access to international offset credits).
Non-OECD		
Russia	- Energy Strategy of Russia until 2030 (2009). 15% reduction in greenhouse-gas emissions by 2020 compared with 1990.	- 25% reduction in greenhouse-gas emissions by 2020 compared with 1990.
China	- 40% reduction in CO_2 intensity by 2020 compared with 2005 (2009). - Rebalancing of the economy from industry towards services (2009). - Further implementation of the directives of the Renewable Energy Law (2005).	- 45% reduction in CO_2 intensity by 2020 compared with 2005. - 15% share of non-fossil energy in primary energy consumption by 2020.
India	- National Action Plan on Climate Change (2008). 20% reduction in CO_2 intensity by 2020. compared with 2005.	- 25% reduction in CO_2 intensity by 2020 compared with 2005.
Brazil	- National Climate Change Plan (2008) and 2019 Energy Expansion Decennial Plan (2010). 36% reduction in greenhouse-gas emissions by 2020 compared with business-as-usual.	- 39% reduction in greenhouse-gas emissions by 2020 compared with business-as-usual.

Note: Existing policies or measures quoted here are assumed to be extended beyond their current duration, for which they have been considered in the *Current Policies Scenario*. Targets in certain countries are exceeded as already met in the *Current Policies Scenario*.

Table B.2 • Power sector policies and measures as modelled in the New Policies Scenario and the 450 Scenario in key regions

	New Policies Scenario	450 Scenario
OECD		
United States	- 15% share of renewables in electricity generation by 2020. - Extension of nuclear loan guarantee. - OECD+ Emission trading scheme introduced in the power and industry sectors after 2020. - Large-scale demonstration plants fitted with carbon-capture-and-storage (CCS) technology. - Extension of nuclear plants lifetime beyond 60 years.	- OECD+ Emission trading scheme introduced in the power and industry sectors as of 2013. - Extended support to renewables and nuclear.
Japan	Emissions-trading scheme introduced in power sector as of 2013. - Basic Energy Plan. - 9 nuclear additions by 2020; a minimum of 14 additional reactors built by 2030. - Introduction of CCS to coal-fired power generation by 2030.	- OECD+ emissions-trading scheme introduced in the power and industry sectors as of 2013. - Basic Energy Plan. - Share of low-carbon electricity generation raised to 50% by 2020 and to 70% by 2030. - Reinforcement of governmental support in favour of renewables.
European Union	- Extension of EU ETS in accordance with the 25% GHG reduction target. - Expansion of renewable energy sources. - Cancellation of nuclear phase-out plans in Germany (extending average lifetime to 45 years). - EU Directive on the geological storage of carbon dioxide (2009).	- Aligning with the OECD+ emissions-trading scheme as of 2020. - Reinforcement of governmental support in favour of renewables.
Non-OECD		
Russia	- Optimised heat production systems, reduction of losses in heat distribution. - Switch away from coal and gas and increase in nuclear and renewables capacity.	- Other Major Economies emissions-trading scheme introduced after 2020. - Strengthening of the switch away from coal and gas and increase in nuclear and renewables capacity.
China	- Early closure of inefficient coal plants. - Local pollution reduction goals. - Government capacity targets in 2020 including wind 125 GW, nuclear 65 GW and hydro 300 GW. - 20% renewable share in power generation by 2020. - Fossil-fuel subsidies removal by 2020.	- Wind capacity target extended to 150 GW by 2020. - Nuclear capacity target extended to 70 GW by 2020 and continued support to maintain the rate of growth of nuclear additions post 2020. - Solar capacity target of 20 GW by 2020. - Other Major Economies emissions-trading scheme introduced after 2020.
India	- Various renewable energy support policies and targets, including small hydro and solar targets. - Fossil-fuel subsidies removal by 2020.	- Support to renewables, nuclear and efficient coal. - 30 GW of additional renewable (non-large hydro) capacity by 2020.
Brazil	- Increase of biomass and hydro (small and large) capacity.	- Other Major Economies emissions-trading scheme introduced after 2020.

Table B.3 • Transport sector policies and measures as modelled in the New Policies Scenario and the 450 Scenario in key regions

New Policies Scenario			
OECD			
United States	- Renewable Fuel Standard. - Support to natural gas in road freight traffic. - Increase of ethanol blending mandates.		
Japan	- Target shares of new car sales according to Next Generation Vehicle Strategy 2010:		
		2020	2030
	Conventional ICE vehicles	50 - 80 %	30 - 50 %
	Hybrid vehicles	20 - 30 %	30 - 40 %
	Electric vehicles and plug-in hybrids	15 - 20 %	20 - 30 %
	Fuel cell vehicles	0 - 1 %	0 - 3 %
	Clean diesel vehicles	0 - 5 %	5 - 10 %
European Union	- Extended emission target for passenger light-duty vehicles (95 gCO_2/km by 2020). - Emission target for light commercial vehicles (135 gCO_2/km by 2020). - Enhanced support to alternative fuels. - Several national EV targets, subsidy extension. - Aviation and international maritime shipping in EU ETS as of 2013.		
Non-OECD			
China	- Vehicle fuel economy standard 7 l/100 km by 2015. - Extended subsidies on the purchase of alternative vehicles.		
India	- Increased utilisation of natural gas in road transport.		
Brazil	- Increase of ethanol blending mandates.		

450 Scenario			
	OECD+	OME	OC
Emission targets for passenger light-duty vehicles in 2035 (in gCO_2/km)	75	85	105
Light commercial vehicles	Full technology spillover from passenger light-duty vehicles.		
Medium- and heavy-freight traffic	5% more efficient by 2035 than in CPS.		
Aviation	Sectoral target of 45% efficiency improvements by 2035 and support to the use of biofuels.		
Other sectors such as maritime and rail	National policies and measures.		
Fuels	Retail fuel prices kept at a level similar to Current Policies Scenario.		
Alternative clean fuels	Enhanced support to alternative fuels.		

Table B.4 • Industry sector policies and measures as modelled in the New Policies Scenario and the 450 Scenario in key regions

	New Policies Scenario	450 Scenario
OECD		OECD+, Other Major Economies, Other Countries
United States	- Reduced industrial emissions through allowances rebates (Program within Title VII of Clean Air Act). - Tax reduction and funding for efficiency improvement by revolutionary technologies and R&D in low carbon technology.	- OECD+ Emission trading scheme introduced in the power and industry sectors as of 2013. - Other Major Economies emissions-trading scheme introduced after 2020. - Wider hosting international offset projects in Other Countries. - International sectoral agreements with targets for iron, steel and cement industries. - Enhanced efficiency standards or improvements. - Policies to support the introduction of CCS in industry.
Japan	- Maintenance and strengthening of top end/low carbon efficiency standards by: - R&D in revolutionary process and its practical realisation - Higher efficiency CHP technology - Promotion of state-of-the-art technology and faster replacement of aging equipments - Fuel switching to gas with higher efficiency equipments.	
European Union	- EU Directive on energy end-use efficiency and energy efficiency (2009) including the development of: - Inverters for electric motors - High-efficiency co-generation - Mechanical vapour compression - Emergence of significant innovations in industrial processes - Extension of EU ETS.	
Non-OECD		
Russia	- Improvement of the energy and environmental efficiency, including through structural changes and more efficient technologies. - Establishment of a new system for domestic energy prices. - Elaboration of comprehensive federal and regional legislation on energy saving.	
China	- Scrapping of small, energy inefficient plans (less than 10 MW), obsolete iron ore refining plants with a 25 million tonnes capacity, of steel refining plants with a 6 million tonnes capacity, of cement plants with a 50 million tonnes capacity and of electrolytic aluminium plants with a 330 000 tonnes capacity. - Contain the expansion of energy intensive industries.	
India	- Implementation of National Mission for Enhanced Energy Efficiency recommendations including: - Enhancement of cost-effective improvements in energy efficiency in energy-intensive large industries and facilities, through certification of energy savings that could be traded. - Creation of mechanisms that would help financing demand side management programmes in all sectors by capturing future energy savings. - Development of fiscal instruments to promote energy efficiency.	
Brazil	- Copenhagen Accord commitment: More utilisation of charcoal in iron production substituting for coal.	

Table B.5 • Buildings sector policies and measures as modelled in the New Policies Scenario and the 450 Scenario in key regions

	New Policies Scenario	450 Scenario
OECD		
United States	- Clean Energy Jobs and American Power Act (2010). Mandatory standards for lighting systems and appliances, and for manufactured housing. - Extensions to 2025 of tax credit for energy-efficient equipment (including energy-efficient gas, propane, or oil furnaces or boilers, energy-efficient central air conditioners, air and ground source heat pumps, hot water heaters, and windows), extension of access to tax credits for solar PV and solar thermal water heaters.	- More stringent mandatory building codes by 2020. - Extension of energy-efficiency grants to end of projection period. - Zero-energy buildings initiative.
Japan	- Basic Energy Plan: Environmental Efficiency (CASBEE) for all buildings by 2030 - high efficiency lighting 100% of newly sold by 2020; 100% in use by 2030 - deployment of high-efficiency heating, cooling and water heating systems.	- Net zero-energy buildings and net zero-energy houses by 2025 for new construction. - Mandatory standards on high-efficiency heating, cooling and water heating systems.
European Union	- Energy Performance of Buildings Directive (2006) extension to 2020. - Nearly zero-energy buildings standards mandatory for new construction as of 2020.	- Zero-carbon footprint for all new buildings as of 2018.
Non-OECD		
Russia	- Energy Strategy of Russia through 2030 (extension of existing Energy Strategy through 2020): urban development code, customs code, support to renewable energy sources.	- Extension and reinforcement of all measures for energy efficiency, mandatory building codes by 2030 and phase out inefficient lighting equipment and appliances by 2030.
China	- Renewables for rural and 3-selfs scheme ("self construction", "self-management", and "self consumption") aimed at promoting self-reliance in order to be in line with economy-wide 15% renewables target. - Phase out of incandescent light bulbs by 2025.	- 65% energy conservation standard of the "Civil Construction Energy Conservation Design Standard (Heating Housing Construction Part)": Improvement of buildings insulation intended to save up to 65% of heating energy consumption compared with standard buildings designed in the 1980s.
India	- Part of national solar mission: solar water heating systems: (15 million sq. metre solar thermal collector area by 2017 and 20 million by 2022). - Mandatory minimum efficiency requirements and labelling requirements for equipment and appliances by 2035.	- Mandatory energy conservation standards and labelling requirements for equipment and appliances by 2030. - Phase out of incandescent light bulbs by 2025.