2 APEC ENERGY DEMAND AND SUPPLY OVERVIEW

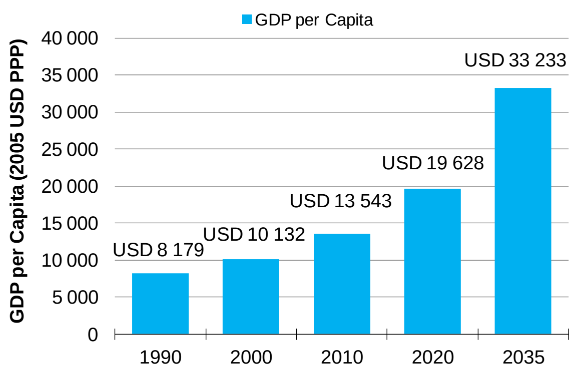
This chapter presents an overview of the business-as-usual (BAU) energy demand and supply results for the APEC region as a whole. We also discuss a key driver behind these results—GDP per capita—and, where appropriate, some policy implications.

GDP PER CAPITA

Chapter 1 discussed our assumptions about APEC-wide economic growth and population growth. Before examining our BAU demand and supply projections, it is worth examining the implications of economic growth and population growth for average GDP per capita in the APEC region and in the individual APEC economies. This is what will shape the kind of energy services consumers are able to afford.

Figure 2.1 shows that average GDP per capita in the APEC region will rise from USD 13 543 (2005 USD PPP) in 2010 to USD 33 233 by 2035. To put these figures in perspective, the average APEC GDP per capita in 2010 is comparable to the 2010 GDP per capita of Chile (USD 13 644), Malaysia (USD 13 244), Mexico (USD 12 427), or Russia (USD 14 348). By 2035, APEC GDP per capita will be comparable to the 2010 GDP per capita of Australia (USD 35 460), Canada (USD 35 383) or Chinese Taipei (USD 32 249).

Figure 2.1: APEC Average GDP per Capita



Source: APERC Analysis (2012)

As a result of the projected large increases in GDP per capita in the APEC region, by 2035 we can expect to see energy used throughout the APEC region in ways typical of the wealthier APEC economies today. This will include a much wider use of energy in motor vehicles, in intercity travel, in more spacious and more climate-controlled housing, in more home appliances, in commercial services (such as restaurants, hotels, healthcare facilities, retail stores, entertainment and recreational facilities, and educational institutions), as well as in industry. Hundreds of millions more people in the APEC region will be rising out of poverty. This is a good economic future if it can be achieved.

FINAL ENERGY

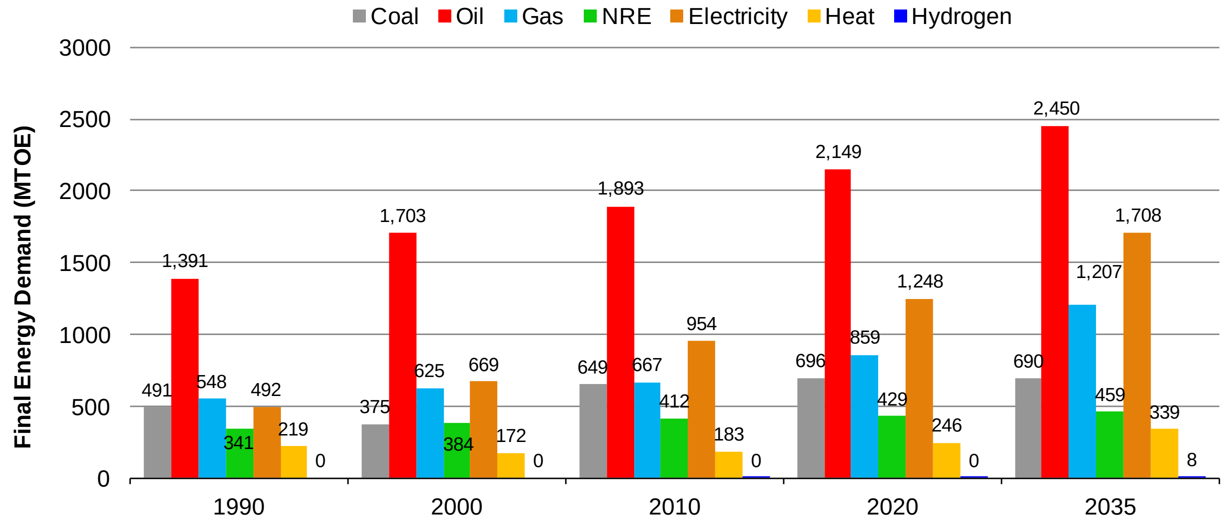
The consequence of this increase in wealth, at least under our BAU assumptions, will be a corresponding increase in the final demand for energy. Final energy is energy in the form it is finally consumed; this means final energy statistics count electricity consumption rather than the primary energy used to make the electricity.

As shown in Figure 2.2, demand for every form of final energy will rise. The largest absolute increase between 2010 and 2035 will be in the demand for electricity (up 754 million tonnes of oil equivalent (Mtoe)), reflecting the growth in demand in the residential and commercial ('other') sectors and in industry.

However, growth in electricity demand will be followed closely by the growth in demand for oil products (up 557 Mtoe), reflecting the increase in motor vehicle use. This will be offset somewhat by increasing vehicle fuel efficiency. Natural gas demand will also rise significantly (up 540 Mtoe).

In percentage terms, the final demand for purchased heat (mainly from district heating systems) will grow the fastest in the 2010–2035 period (up 85%), followed closely by natural gas (up 81%) and electricity (up 79%). Final demand for other fuels will grow more slowly. New renewable energy (NRE) final demand will grow by only about 11% because the demand for this fuel in 2010 was dominated by traditional residential biomass. Residential biomass demand is not expected to grow significantly, since consumers will be increasingly able to afford commercial fuels.

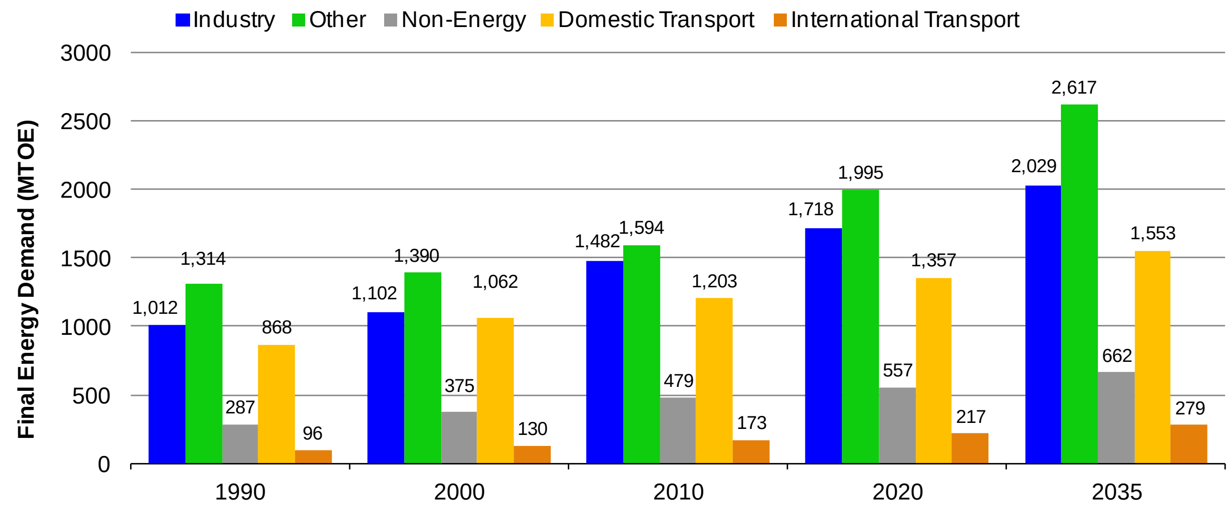
Figure 2.2: APEC Final Energy Demand by Energy Type



Source: APERC Analysis (2012)

Figure 2.3 shows that, between 2010 and 2035, final demand will grow in all the five sectors we model. The 'other' sector (residential and commercial) will grow the fastest in both absolute (up 1023 Mtoe) and percentage (up 64%) terms. However, international transport will grow almost as quickly (up 61%), reflecting an increasingly globalized economy. Domestic transport demand, on the other hand, will be the slowest growing sector, with energy demand growing by 'only' 29%. In this sector, increasing auto ownership will be offset somewhat by increasingly efficient vehicles.

Figure 2.3: APEC Final Energy Demand by Sector



Source: APERC Analysis (2012)

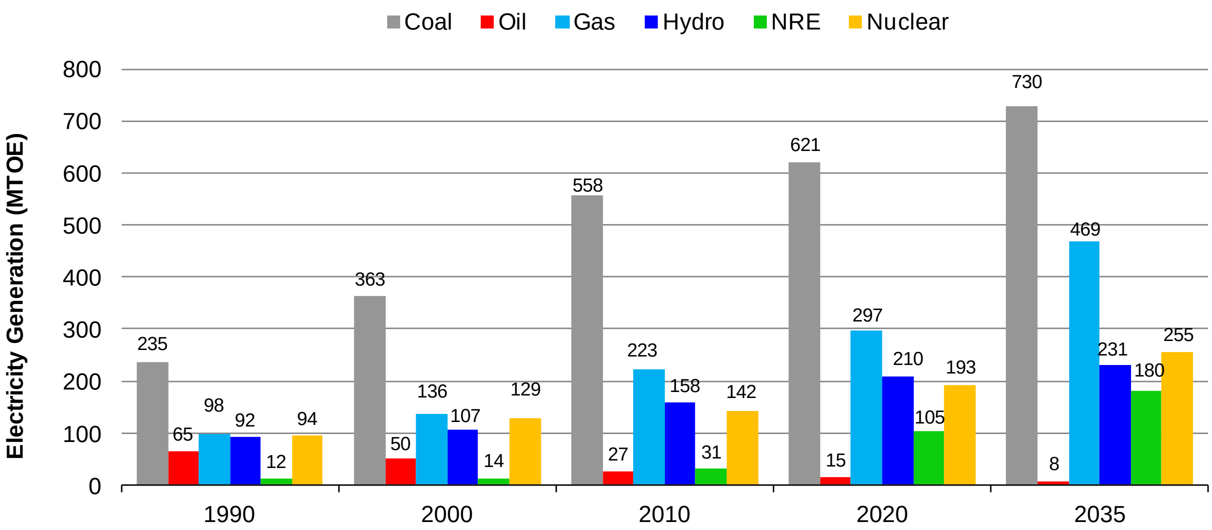
ELECTRICITY SUPPLY

As shown in Figure 2.4, coal was by far the dominant source of primary energy for electricity generation in the APEC region in 2010. Under our BAU assumptions, it will continue to be so in 2035. Coal has the advantages of being widely available and relatively inexpensive in many APEC economies. Therefore, it will experience significant growth: 172 Mtoe or 2002 terawatt-hours (TWh). Growth in China's output of electricity from coal accounts for most of this growth (161 Mtoe or 1872 TWh), while coal generation in the United States is projected to decline by 37 Mtoe or 426 TWh.

The absolute demand for natural gas generation will grow much more rapidly than coal (246 Mtoe or 2867 TWh). Gas has the advantages of also being widely available in many APEC economies and environmentally preferable to coal, since its greenhouse gas emissions are generally lower. New renewable energy (NRE) (which does not include hydro) will show the third-largest absolute growth of 150 Mtoe or 1740 TWh, spurred by declining costs and supportive government policies in many economies. Despite the re-examination of policies on nuclear energy in many APEC economies, nuclear generation is also projected to show a significant growth of 113 Mtoe or 1315 TWh. About two-thirds of this growth will be in China.

In percentage terms, the picture is different. NRE will have by far the largest percentage growth of 490%, followed by gas (111%), and nuclear (89%). As discussed in Chapter 15 (see Figure 15.5), the growth of NRE in electricity generation is dominated by wind energy. Coal generation will grow by about 31%.

Figure 2.4: APEC Electricity Generation by Primary Energy Source



Source: APERC Analysis (2012)

PRIMARY ENERGY SUPPLY

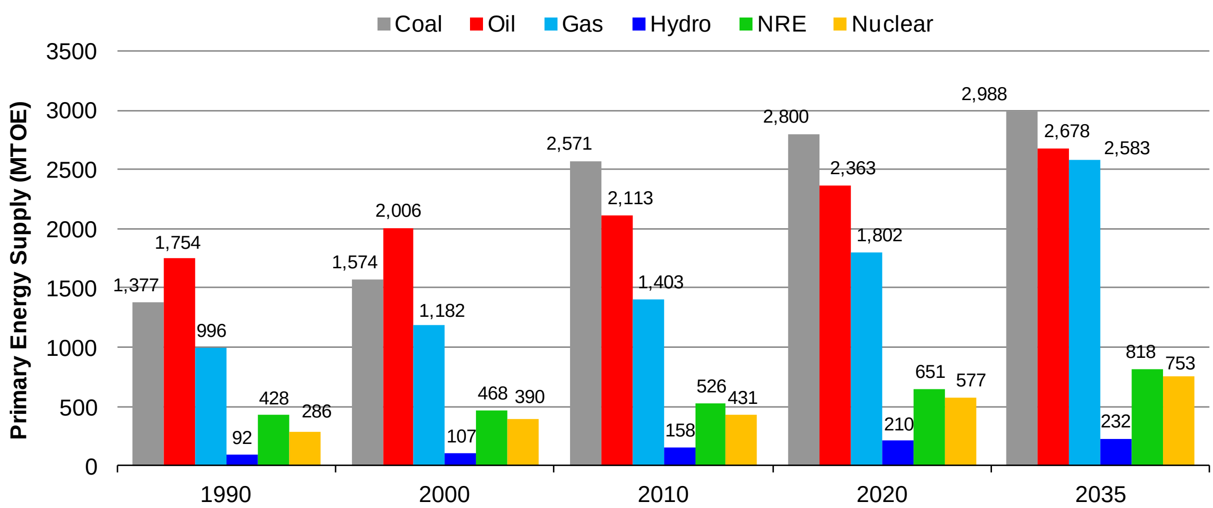
As shown in Figure 2.5, under BAU assumptions coal, oil and natural gas run a close competition to be APEC's leading primary energy source by 2035, with coal still having a slight lead in 2035.

In absolute terms, gas will have the fastest growth in demand between 2010 and 2035 (up 11879 Mtoe). As discussed in Chapter 12, gas supply is benefiting from new technology that allows the economic development of unconventional gas resources. However, our BAU projection may be conservative in that it does not assume large-scale development of shale gas outside of North America. The demand for oil will also grow significantly in absolute terms—565 Mtoe.

Gas also has the largest growth in percentage terms—up 84%. Perhaps surprisingly, nuclear energy is projected to show the second fastest growth in percentage terms, about 75%. As noted above, about two-thirds of this growth will be in China.

NRE will take third place with 55% growth. As discussed above, the use of NRE will grow quickly in electricity generation (up 490%). It will also grow quickly in the domestic transport sector in the form of biofuels (about 130%). In both sectors, this growth will be spurred by favourable existing government policies toward NRE in many APEC economies, as well as technological improvements. However, the use of NRE in the residential and commercial ('other') sector, which accounted for about 60% of the NRE demand in 2010, is not expected to show significant growth. As explained above, many residential and commercial consumers in developing economies are expected to switch their cooking and heating from traditional biomass to commercial fuels as they become able to afford it

Figure 2.5: APEC Primary Energy Supply by Energy Source

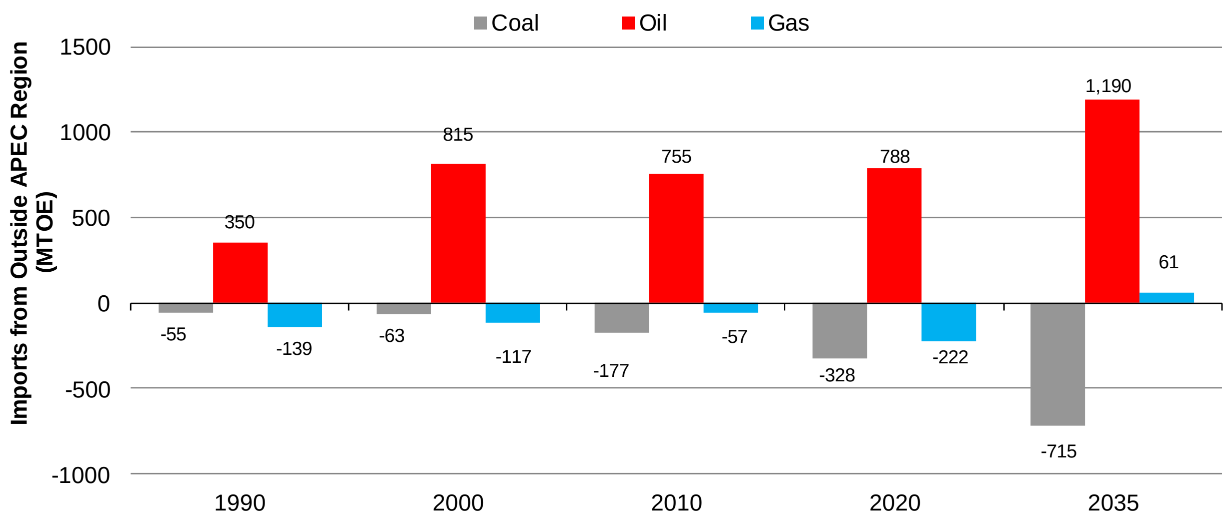


Source: APERC Analysis (2012)

ENERGY IMPORTS FROM OUTSIDE THE APEC REGION

As shown in Figure 2.6, under BAU assumptions, over the 2010–2035 period the APEC region will be a growing exporter of coal to the rest of the world, roughly self-sufficient in gas, and a large and growing importer of oil. In 2010, the APEC region imported about 36% of its primary supply of oil. By 2035, this will rise to about 44% of a significantly larger primary supply of oil. As discussed in Chapter 1, this rising dependence on imported oil poses a serious threat to the economic stability and energy security of the APEC region.

Figure 2.6: APEC Net Imports from Outside the APEC Region



Source: APERC Analysis (2012)

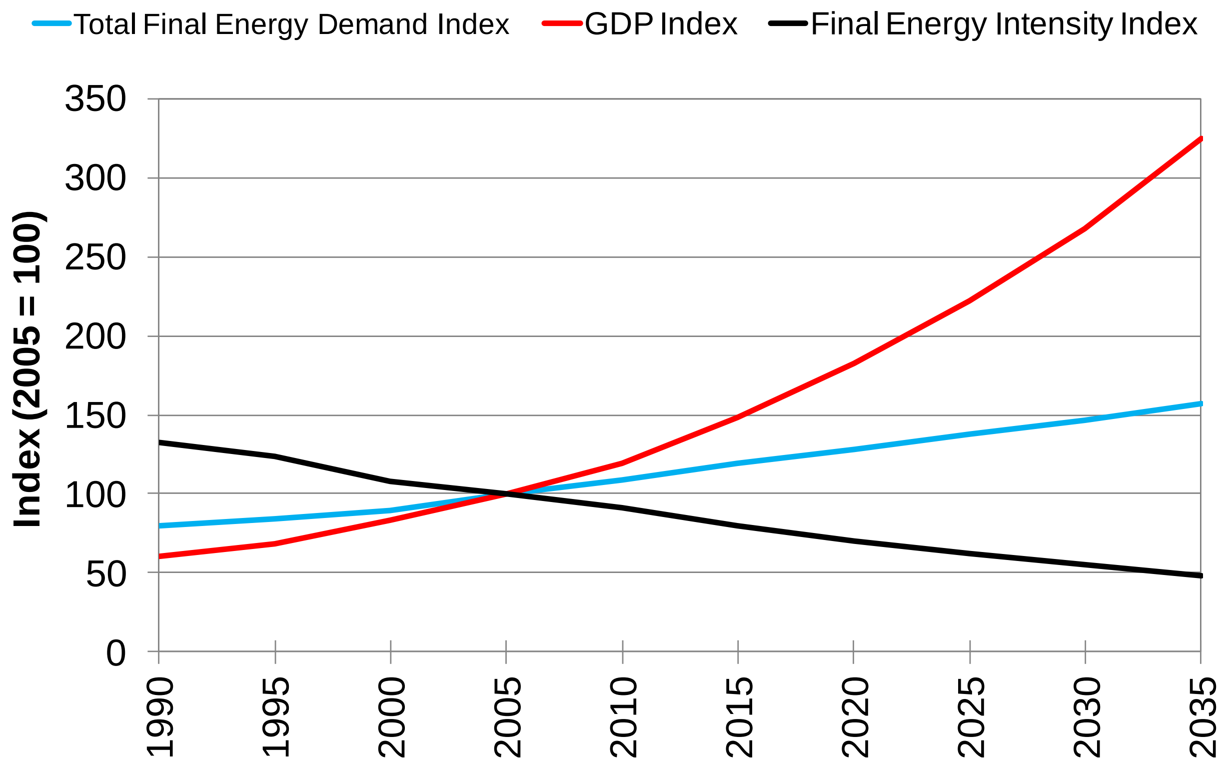
ENERGY INTENSITY

The APEC leaders have agreed to "aspire to reduce APEC's aggregate energy intensity by 45% by 2035" (APEC, 2011), using 2005 as the base year. Energy intensity is defined as energy use divided by gross domestic product (GDP). The APEC energy intensity goal is intended to encourage the APEC economies to work together to improve their energy efficiency to gain economic benefits (cost savings, less exposure to energy price increases), improved energy security, and improved environmental sustainability.

The model results presented here suggest the APEC region will meet the APEC leaders' energy intensity goal under BAU. The APEC leaders did not specify whether energy intensity is to be calculated based on final energy demand or primary energy supply. Figure 2.7 shows the intensity results based on final energy demand, while Figure 2.8 shows the intensity projection based on primary energy supply.

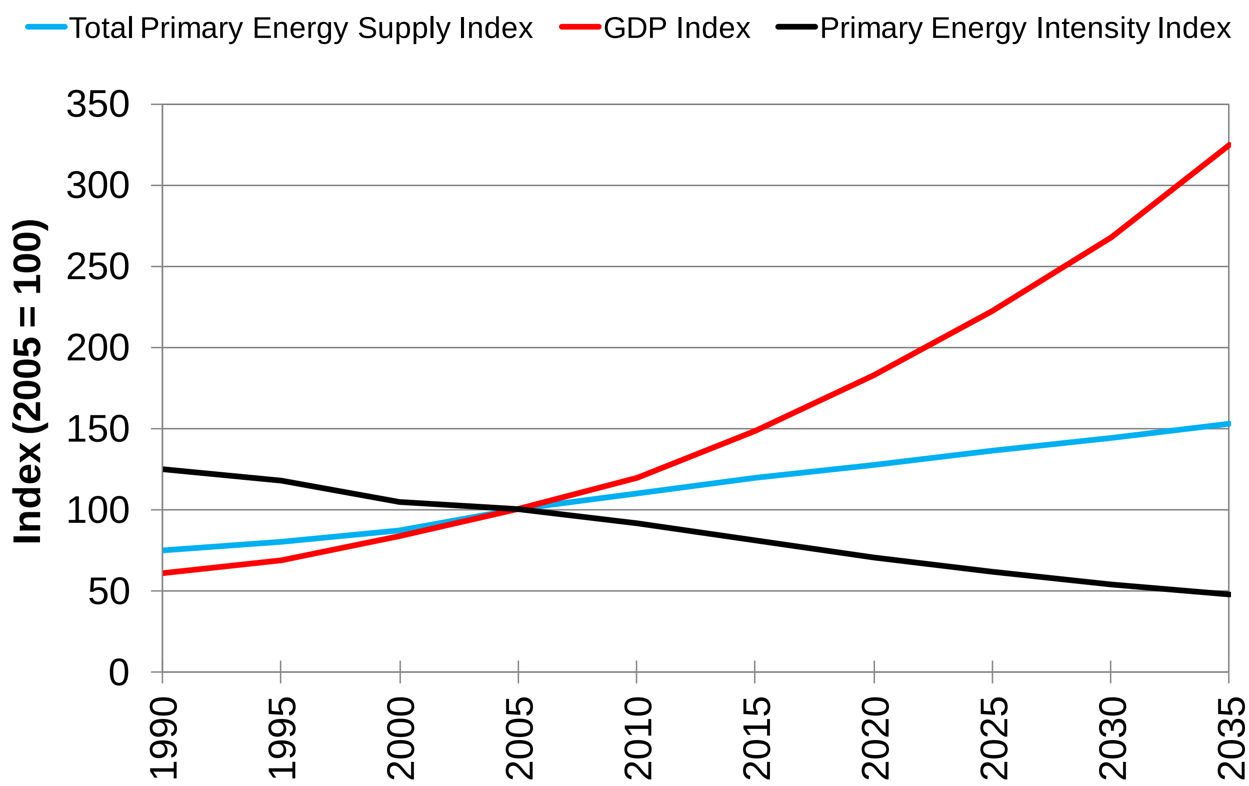
The results in the two cases are virtually identical. Final energy demand increases by about 57% while primary energy supply increases by about 53%. GDP increases by about 225%. The net result in is a decline in final energy intensity of about 48% and a decline in primary energy intensity of about 47%, both exceeding the 45% goal.

Figure 2.7: APEC Final Energy Intensity Improvement



Source: APERC Analysis (2012)

Figure 2.8: APEC Primary Energy Intensity Improvement



Source: APERC Analysis (2012)

Changes in energy intensity can result from changes in energy efficiency as well as from changes in economic structure (where economic sectors with different energy intensities grow or contract at different rates). Changes in economic structure, such as a transition from manufacturing to service industries, can significantly change the energy intensity of an economy.

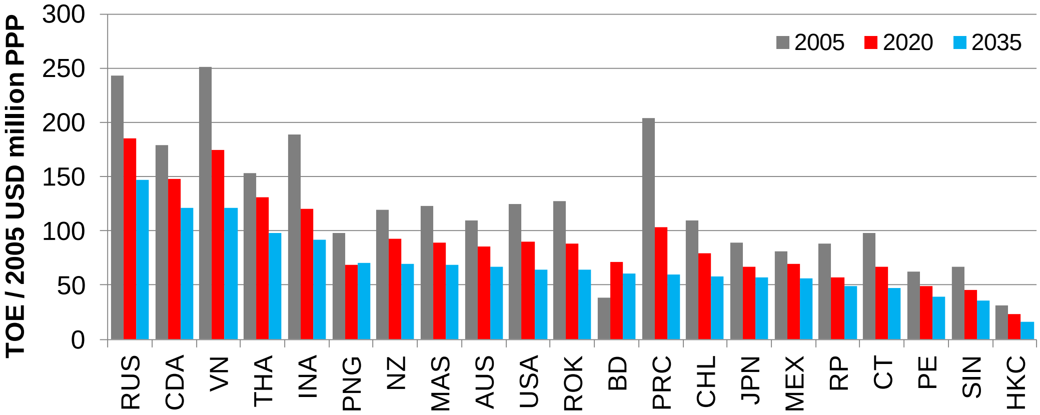
Figure 2.9 shows the expected changes in final energy intensity by economy, while Figure 2.10 shows the expected changes in primary energy intensity by economy.

Every APEC economy, with the exception of Brunei Darussalam for final energy intensity only, is expected to show a significant improvement in energy intensity between 2005 and 2035. (Brunei Darussalam is an outlier only because in 2010 they opened a large export-oriented methanol plant, which significantly increased their industrial energy demand.) There will be a tendency for the economies with the highest energy intensity to show the highest levels of intensity improvement. This will happen as global competitive pressures, government policies, and international cooperation lead all APEC economies to move toward international best practice.

The fact it is likely APEC will meet the APEC leaders' goal for energy intensity improvement under BAU should not be a cause for complacency. As noted in the previous section, despite the improvement in energy intensity, oil imports into the APEC region will grow significantly, posing serious economic and energy security risks. Greenhouse gas emissions from fuel combustion will also rise significantly, the opposite of what the best science says is needed to deal with the challenges of climate change.

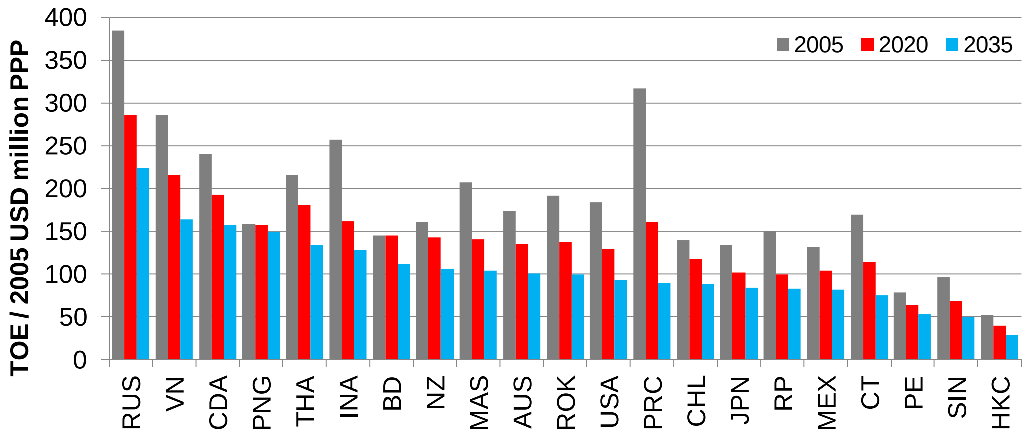
There are a number of factors that can explain the variations in energy intensity among APEC economies. The ratio can be affected by many non-energy-related factors such as climate, geography, travel distances, home sizes and industrial structures (IEA, 2008). As such, it would be misleading to judge an economy's energy-efficiency performance based on its energy intensity alone.

Figure 2.9: APEC Final Energy Intensity by Economy



Source: APERC Analysis (2012)

Figure 2.10: APEC Primary Energy Intensity by Economy



Source: APERC Analysis (2012)

APEC'S ENERGY INTENSITY GOAL: THE LESSONS LEARNED

When the APEC leaders first agreed on an energy intensity improvement goal in 2007, the goal was an improvement of at least 25% by 2030 with 2005 as the base year (APEC, 2007). The goal was revised upward in 2011 to an improvement of 45% by 2035 with 2005 as the base year (APEC, 2011) since it was becoming apparent that APEC economies would easily surpass the original goal. APERC's research work to support the APEC Energy Working Group (EWG) in establishing a revised goal suggests three key lessons that any organization wishing to set an energy intensity improvement goal may wish to keep in mind:

1) *Energy intensity improvement is happening surprisingly quickly, but not quickly enough to meet the world's energy challenges.* Large reductions in energy intensity, in the order of 35–40%, can be expected between 2005 and 2035. However, because of expected rapid economic growth, especially in developing economies, these improvements in energy intensity will not stop the growth of energy demand, with its associated threats to the environment and the stability of the world economy.

2) *It is difficult to find a definition of energy intensity that can make it suitable for use as an indicator of regional energy efficiency.* There are at least three alternative approaches to measuring energy demand, the numerator in the calculation of energy intensity (energy demand/GDP). First, energy intensity can be calculated based on the 'physical energy content' method used by the International Energy Agency (IEA), the OECD, and Eurostat (IEA et al., 2004). However, under this approach, energy intensity will increase (get worse) if an economy uses more nuclear or geothermal electricity generation. The reason is that, under this approach, both nuclear and geothermal have large 'losses' between their primary energy input (nuclear-produced steam and geothermal steam, respectively) and their final energy output (electricity), and are thus counted as inefficient forms of generation. This anomalous outcome runs counter to a presumed objective of the energy intensity improvement goal, which is to encourage low-carbon energy sources, including nuclear and geothermal.

   A second alternative is to calculate energy intensity based on final energy demand (energy after conversion to electricity) rather than primary energy supply. This approach would give a clearer measure of end-user energy efficiency improvement, which is the focus of energy efficiency improvement efforts in many economies. However, it would not reflect the improvements an economy makes in the efficiency of its electricity generation, which in many economies represents a major opportunity to improve energy efficiency.

   A third alternative is to use primary energy calculated using the 'direct equivalent method', as used in the United Nations Statistics Division and various IPCC (Intergovernmental Panel on Climate Change) reports (Moomaw et al., 2011, Appendix II.4). This approach simply counts one unit of electricity generated from nuclear or renewables other than biomass as one unit of primary energy, effectively assuming generation from these low-carbon sources to be 100% efficient. This method would avoid the anomalous outcome of the 'physical energy content method', while still reflecting improvements in fossil fuel generating efficiency. However, it is less well-known among policy-makers and therefore potentially confusing to them.

   The EWG took no position as to whether primary energy or final energy should be used to calculate energy intensity, but it did reject the direct equivalent method for the calculation of primary energy (APEC EWG, 2011). Therefore, primary energy in this publication is calculated using the 'physical energy content' method.

3) *Whether the GDPs of individual economies are converted to a common currency using market exchange rates or purchasing power parity (PPP) can dramatically change the energy intensity improvement calculations.* To calculate energy intensity for a group of economies, one must first calculate their aggregate GDP, the denominator in the calculation of energy intensity (energy demand/GDP). The literature suggests that PPP is the more correct aggregation approach because it is the actual purchasing power of each economy that will drive its energy use (Samuelson, 2012). Energy intensity improvement will typically be downward biased if aggregate GDP is calculated using market exchange rates rather than purchasing power parities. The reason is the economies with the highest market exchange rates relative to purchasing power tend to be the developed economies, which also tend to have lower growth rates than developing economies. Hence, aggregate GDP growth will be slower if calculated using market exchange rates than it would be using PPP, causing energy intensity to decline more slowly. In this publication, all GDP values are consistently expressed in terms of 2005 PPPs.

This sidebar is a summary of Samuelson (2012), a draft paper intended for future publication in a professional journal.

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