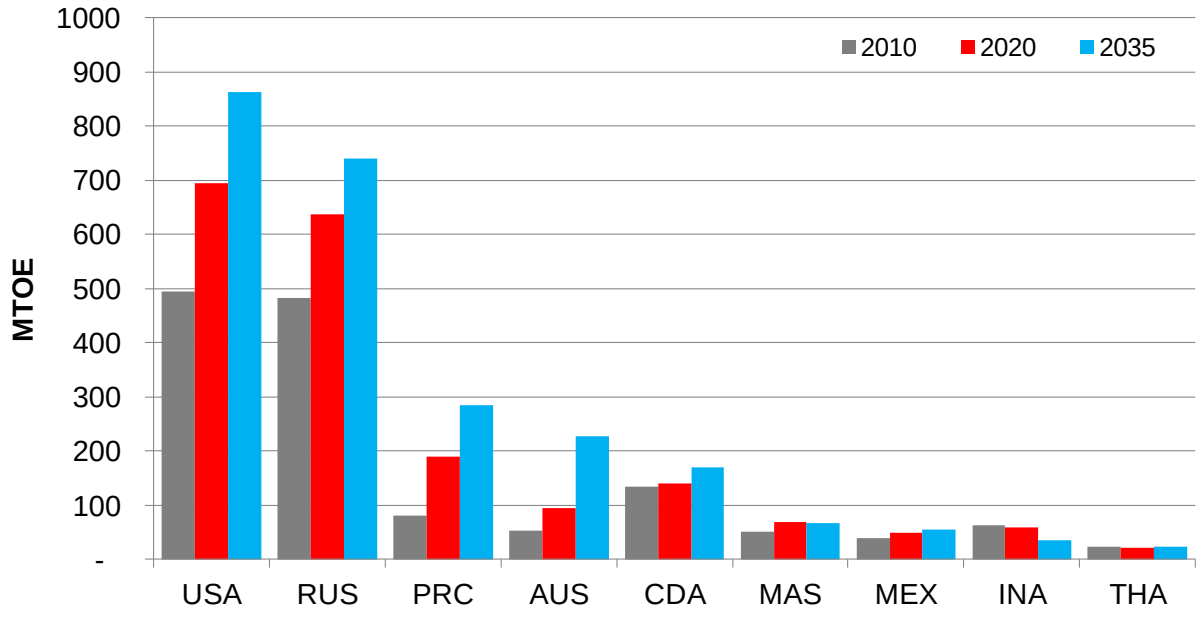
12 NATURAL GAS SUPPLY

GAS PRODUCTION

Production of gas in the APEC region under a business-as-usual (BAU) scenario is projected to grow by 80%, from 1405 Mtoe in 2009 to 2522 Mtoe in 2035. Figures 12.1 and 12.2 show projected gas production by economy. Note the difference in the scales of the vertical axis in the two figures.

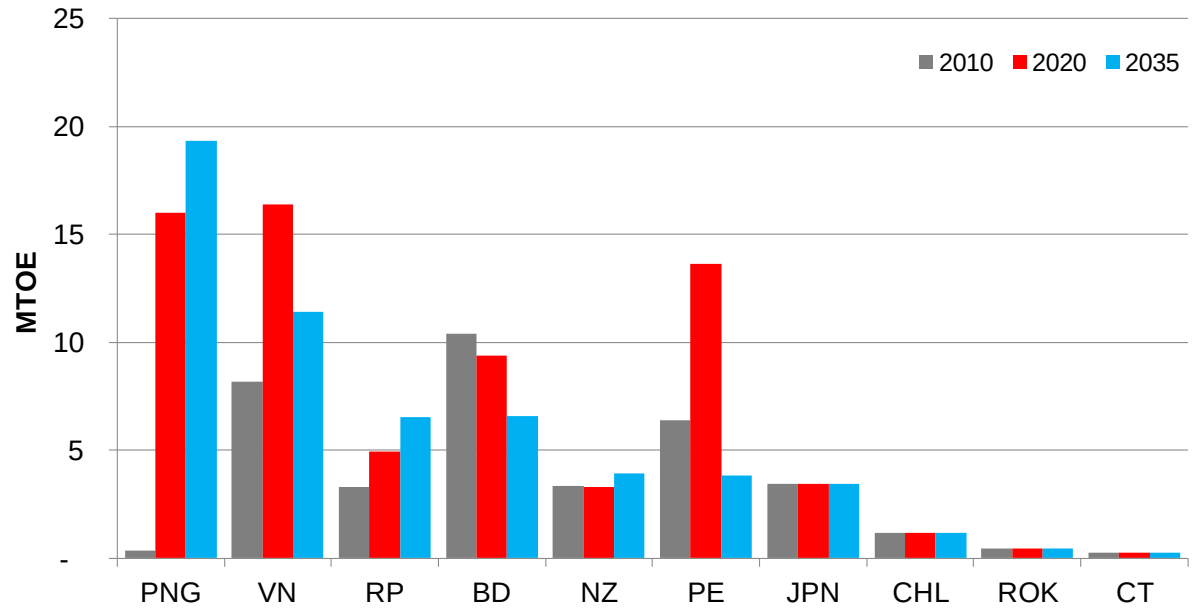
It can be seen that most of the growth in production will occur in four economies: the United States, Russia, China, and Australia. The drivers of growth in each of these economies are somewhat different, but all are contributing to meeting the growing demand for gas worldwide, as gas becomes increasingly recognized as a relatively clean, economical, and easy-to-use fuel.

Figure 12.1: Projected Gas Production, Larger Gas-Producing Economies



Source: APERC Analysis (2012)

Figure 12.2: Projected Gas Production, Smaller Gas-Producing Economies



Source: APERC Analysis (2012)

In Russia, immense resources of conventional gas are available (see Table 12.1) to satisfy both growing domestic demand and export demand. However, much of this gas is in remote locations, so production is expected to move away from mature, existing fields to new and more-difficult-to-develop regions that will require significant investment in infrastructure.

The United States (US) is expected to continue experiencing a boom in the production of unconventional gas, especially shale gas. The growth in unconventional gas in the US is driven by advances in technology, especially horizontal drilling and hydraulic fracturing, which have made it profitable to develop resources that were previously considered to be uneconomic. As discussed in the United States Economy Review in Volume 2, the growth in unconventional gas production in the US is projected to shift the US from a net gas importer to a net gas exporter.

China is seeking to develop its significant conventional and unconventional gas resources, as that economy's rapid economic growth drives rapid growth in domestic demand for energy. Increased gas production will diversify China's energy supply away from coal, while helping to reduce the need for imported energy.

Australia also has significant conventional and unconventional gas resources, some of which are located in areas of that economy that are remote from the domestic pipeline network. Australia is therefore in the process of developing several major LNG projects, which will export gas to growing Asian markets.

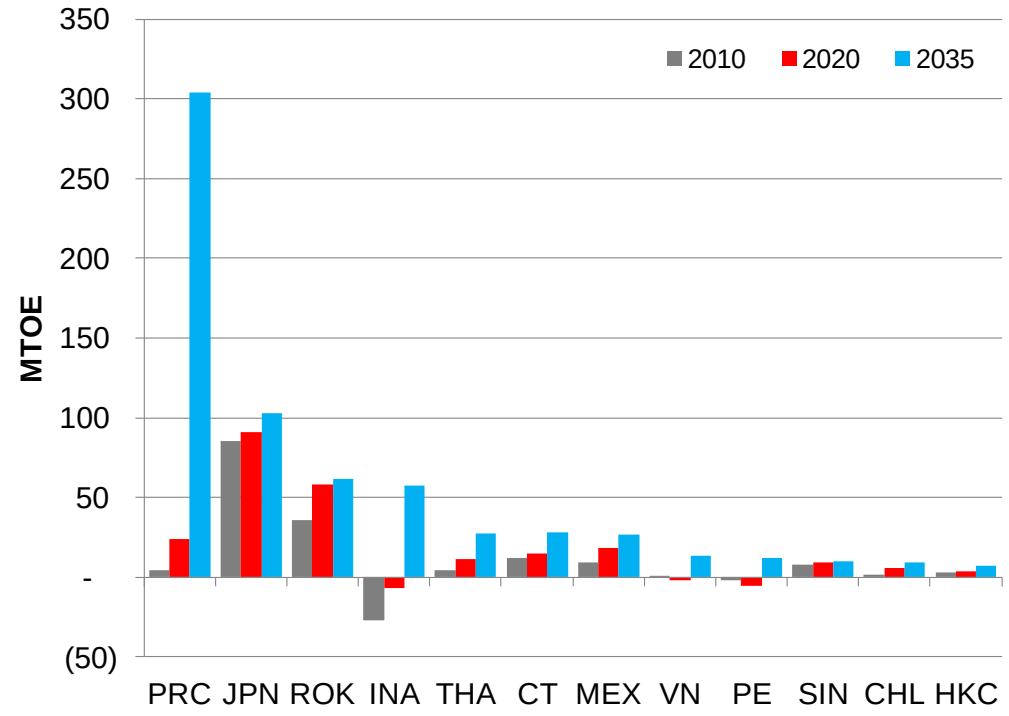
GAS IMPORTS AND EXPORTS

APEC's net gas exports are projected to increase from 48 Mtoe in 2009 to 222 Mtoe in 2020. But after 2020, the trend toward growing exports will reverse and by 2035 APEC could have net imports of 61 Mtoe. These imports and exports are quite small numbers relative to APEC's total gas demand and supply, and are subject to many uncertainties. In general, we can say that APEC will be more-or-less self sufficient in gas during the outlook period.

As shown in Figure 12.3, imports of gas are projected to increase in all importing economies over the outlook period with the exception of the US. The APEC region currently includes some of the largest importers of LNG in the world including Japan, Korea, and Chinese Taipei. China is likely to become an increasingly large importer of gas, utilizing both pipeline transportation from neighbouring economies and LNG. Indonesia is likely to switch from being a net gas exporter to a net gas importer (BP, 2012, p. 28).

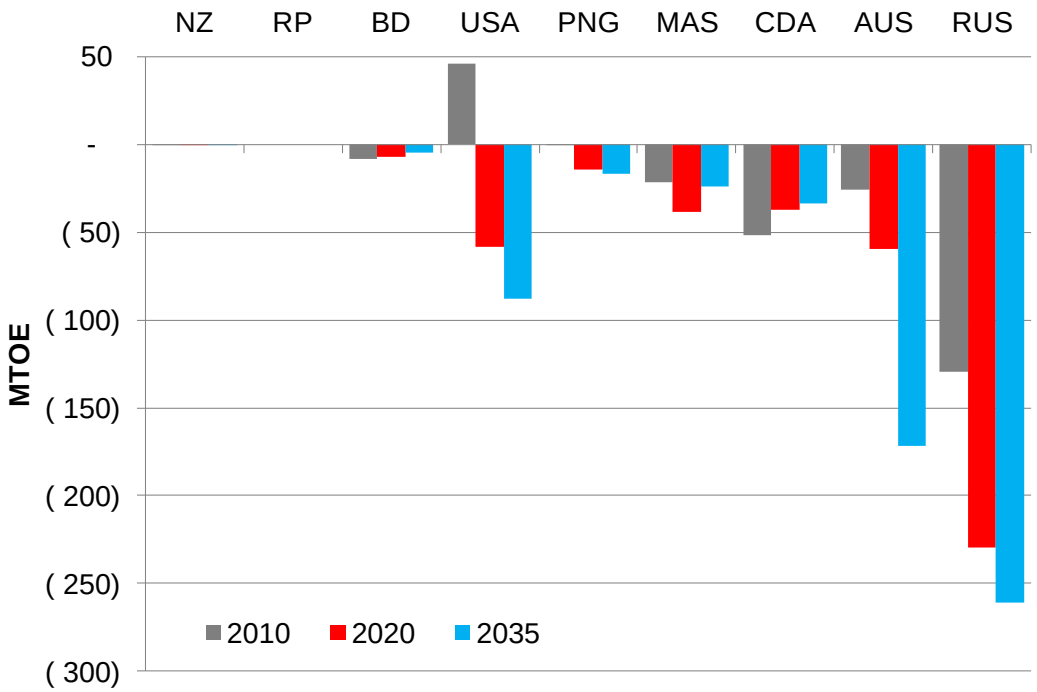
As shown in Figure 12.4, Russia will remain the largest gas exporter in APEC, while Australia will dramatically increase its exports during the outlook period. Canada has historically exported gas by pipeline to the US, but given the booming production in the US, will increasingly turn to overseas exports of LNG. The Philippines and New Zealand are projected not to import or export natural gas.

Figure 12.3: Projected Net Import of Gas in APEC Economies



Source: APERC Analysis (2012)

Figure 12.4: Projected Net Export of Gas in APEC Economies



Source: APERC Analysis (2012)

THE POTENTIAL FOR UNCONVENTIONAL GAS

We have already mentioned the boom in unconventional gas in the US, which includes coal bed methane, tight gas, and especially shale gas. In 2009, 10% of US gas production came from coal bed methane, 31% from tight gas, and 14% from shale gas, implying that more than half of the US gas supply is already coming from unconventional sources. The United States Energy Information Administration projects that in 2035, 6% of US production will come from coal bed methane, 22% from tight gas, and 49% from shale gas (USEIA, 2012, Table A14), implying that more than three-quarters of US gas production will be unconventional by 2035.

A number of other APEC economies are already utilizing unconventional gas resources, especially coal bed methane. In 2011, unconventional gas provided about half of Canada's natural gas supply (70 billion cubic metres (bcm) or about 63 Mtoe). China produced 36 bcm (roughly 32 Mtoe) of tight gas, while Mexico produced about 2 bcm (roughly 2 Mtoe) in 2011. Australia produced 6 bcm (roughly 5 Mtoe) of coal bed methane in 2011 (Moodhe, 2012).

The APEC region is believed to have immense resources of conventional and unconventional gas. Table 12.1 shows estimated technically recoverable resources of conventional gas, shale gas, coal bed methane, and tight gas for those APEC economies whose resources were assessed in the APEC Unconventional Natural Gas Census, as well as Russia. For comparison purposes, 2009 production is also shown and the implied number of years of production at the 2009 production rates. It can be seen that in each case, more than 100 years of production should be available, often considerably more.

Table 12.1: APEC's Technically Recoverable Conventional and Unconventional Gas Resource Base, in Mtoe

Economy	Conventional Gas	Unconventional Gas				Conventional & Unconventional Gas	2009 Production	Years of Production
		Shale Gas	Coal Bed Methane	Tight Gas	Total			
China	5 225	22 150	9 625	na	31 775	37 000	76.7	482
US	30 750	14 475	3 500	13 000	30 975	61 725	532.7	116
Australia	5 700	9 950	10 975	500	21 425	27 125	38.1	712
Canada	8 650	2 250	1 125	4 250	7 625	16 275	147.6	110
Mexico	2 375	7 425	100	na	7 525	9 900	49.1	202
Russia	86 125	1 825	50	na	1 875	88 000	474.9	185

na = not assessed

Sources: Conventional gas: Ejaz (2011, Table 1)—all conventional figures shown are remaining recoverable resources which exclude gas already produced; figure for Australia includes Oceania. Unconventional gas: Moodhe, (2012, slides 9 and 15). 2009 production: BP (2012, p. 24). Original data in trillion cubic feet (Tcf) converted to Mtoe using a conversion factor of 25 Mtoe/Tcf as per BP (2012, p. 44).

Unconventional resource estimates are subject to considerable uncertainty given the limited amount of exploration that has been done in most APEC economies. Table 12.2 shows another set of technically recoverable shale gas resource estimates from a separate analysis by the United States Energy Information Administration. In addition to the economies shown in these tables, Indonesia is known to have significant resources of coal bed methane and shale gas. More modest unconventional gas resources are also known to exist in other South-East Asian economies, Peru, and New Zealand. However, the extent to which these resources are technically recoverable has not been assessed.

Table 12.2: APEC's Technically Recoverable Shale Gas Resource Base, in Mtoe

Economy	Technically Recoverable Shale Gas
China	31 875
US	21 550
Australia	9 900
Canada	9 700
Mexico	17 025
Russia	na
Chile	1 600

Source: USEIA (2011, Table 1). Original data in trillion cubic feet (Tcf) converted to Mtoe using a conversion factor of 25 Mtoe/Tcf as per BP (2012, p. 44).

While the US is experiencing a shale gas boom, and several other APEC economies are developing unconventional gas, the extent to which unconventional gas can be developed throughout the APEC region remains a huge uncertainty. In particular, shale gas has so far been developed on a large scale only in the US.

The shale gas boom in the US has benefitted from unique circumstances that could be difficult to replicate elsewhere. There are questions whether the geology elsewhere is really as attractive as it would appear, and what kind of technology will be required to develop it, which require further investigation.

But perhaps more importantly, the US provides a reasonably stable and transparent system of regulation, taxes, and fiscal terms for gas producers. This includes, on the one hand, an unusual system of privately owned mineral rights, which allows any gas producer to gain land access simply by contracting with the landowner. On the other hand, it also includes another unusual system of privately owned and freely tradable pipeline capacity rights, which allows anyone to access pipeline transportation (or even have it built) simply by contracting for it in the market (see Makholm, 2012). The result is an environment uniquely suited to the entrepreneurial firms who have pioneered shale gas technology. APEC would do well to promote understanding not only of unconventional gas geology and technology, but also of the institutions that could make its development possible.

HIGH GAS SCENARIO

The BAU scenario discussed above does not include significant shale gas development outside North America and includes fairly conservative estimates of production from both conventional and non-shale-gas unconventional resources outside of North America. As discussed above, the conventional and unconventional gas resources of the Asia–Pacific region are immense. And with LNG prices in Asia several times as high as those in North America the economics of gas development outside of North America, as well further gas development in North America for export, should be compelling. For example, in 2011 the average Japanese LNG import price was USD 14.73 per million British thermal units (Btu) compared to an average US Henry Hub price of USD 4.01 per million Btu (BP, 2012, p. 27).

How could development of these resources be better promoted? A first step might be to address some significant barriers to gas development that exist in a number of APEC economies. These include:

- Policies requiring a domestic price of gas below market levels (a form of subsidy), thereby limiting the profitability of gas development and making investment in gas development less attractive.
- Limited technology in some economies for gas development, especially unconventional and deepwater gas development.
- Protective policies restricting the export of gas.
- Policies granting a monopoly on gas development or pipeline access to certain domestic firms, or limiting the participation of foreign-owned firms, or otherwise limiting competition in gas development.
- Slow and cumbersome regulatory approvals and land access processes for gas producers.

APEC could help its member economies to overcome potential constraints on gas production and trade constraints by:

1. Continuing to encourage member economies to rationalize and phase out fossil fuel subsidies in accordance with the APEC Leaders' Declarations; these subsidies can discourage gas development especially when they take the form of price controls on gas producers.
2. Including goods and services for gas industry development in the definition of 'environmental goods and services', and continuing to encourage member economies to reduce existing barriers and refrain from introducing new barriers to trade and investment in environmental goods and services.
3. Encouraging member economies to reform policies that discourage the export of gas or restrict the involvement of foreign firms in gas development.
4. Cooperating to promote best practices in gas industry regulation (safety, environmental protection, economics).

Items 1 and 2 are existing APEC initiatives where the implications for gas development might receive greater emphasis. Items 3 and 4 would be likewise consistent with APEC's mission of championing free and open trade and investment, promoting and accelerating regional economic integration, encouraging economic and technical cooperation, and facilitating a favourable and sustainable business environment (APEC, 2012).

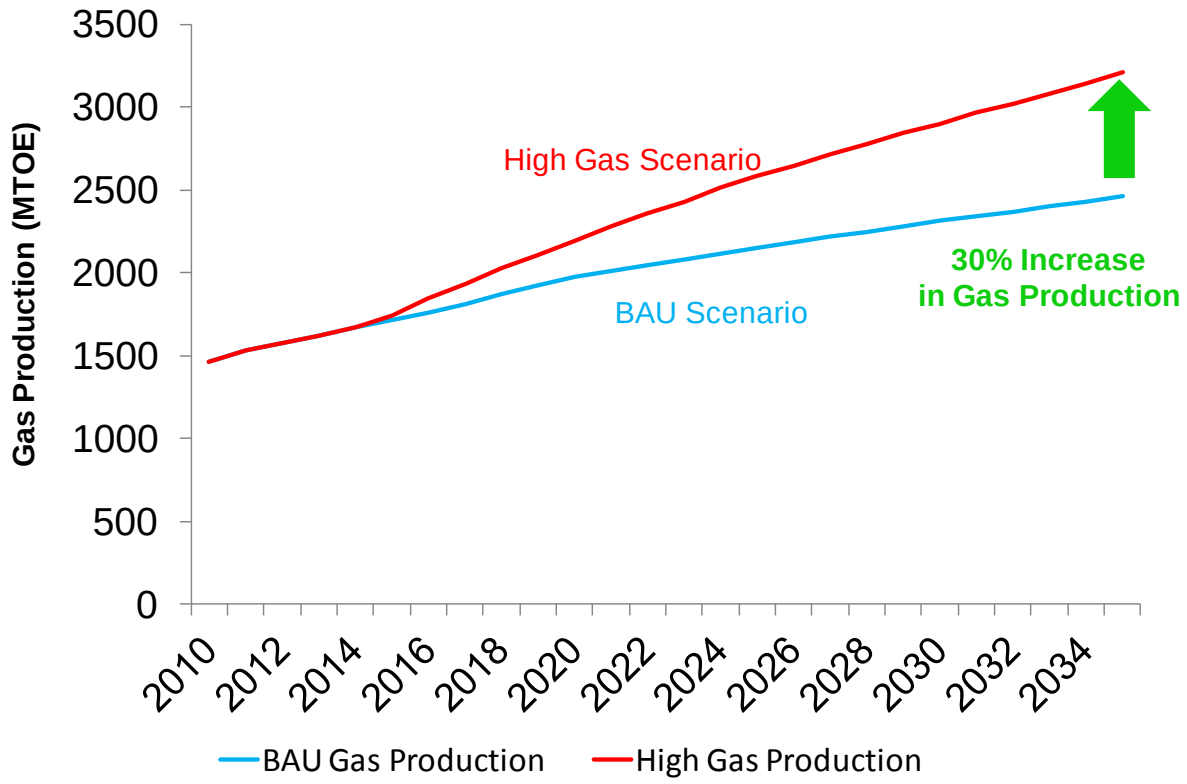
With appropriate policies and regional cooperation, the APEC economies could use their gas resources to move toward a cleaner energy system, while promoting energy security and mutual

prosperity. To illustrate some of the benefits that might accrue from removing the barriers to gas production and trade, APERC has developed an alternative 'High Gas Scenario'.

In the High Gas Scenario, APERC estimated the gas production that might be available without raising prices if existing constraints on gas production and trade were reduced. In most cases, the estimates are based on 'high gas' scenarios developed by economy governments. The results are conservative, since estimated shale gas production in some cases was low or not included. The assumptions and results for each APEC economy are discussed in the Economy Reviews in Volume 2.

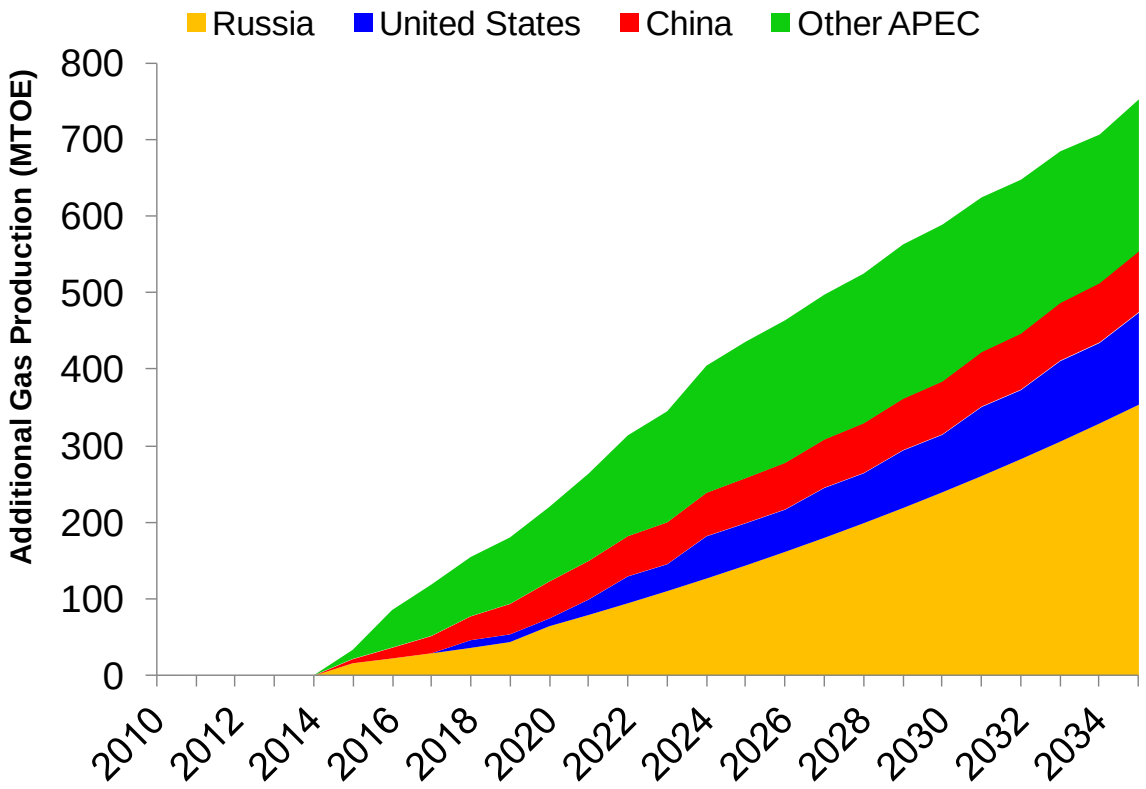
As shown in Figure 12.5, on an APEC-wide basis, gas production by 2035 was about 30% higher in the High Gas Scenario compared to BAU. As shown in Figure 12.6, Russia is the largest source of the additional gas, with the US and China also making large contributions. This should come as no surprise, given the immense estimated gas resources of those three economies.

Figure 12.5: High Gas Scenario – Increase in Gas Production



Source: APERC Analysis (2012)

Figure 12.6: High Gas Scenario – Sources of Additional Gas Production



Source: APERC Analysis (2012)

There are many ways the additional gas could be used in the APEC region, almost all of them positive in terms of economics, energy security, and/or the environment. Using gas to replace coal in electricity generation is an especially good option from a CO_2 emissions perspective due to the combined effect of two factors. First, because of its lower-carbon chemical composition, gas produces considerably less CO_2 emissions per unit of heat than coal—typically around 40% less, depending upon the type of coal (Ecofys, 2010, p. 21). Second, gas-fired generation is generally significantly more efficient than coal-fired generation in converting heat to electricity (see the sidebar 'Improving the Efficiency of Coal-Fired Electricity Generation' in Chapter 13). The combined effect of these two factors means that gas-fired generation typically has less than half the CO_2 emissions of coal-fired generation per unit of electricity produced.

Using gas in electricity generation would have other environmental benefits. When efficiently used:

- gas produces much less local air pollution than coal
- gas production is typically less damaging to land and water resources than coal production
- gas electricity generation can typically be more easily cycled on or off than coal, which allows it to better complement wind and solar generation.

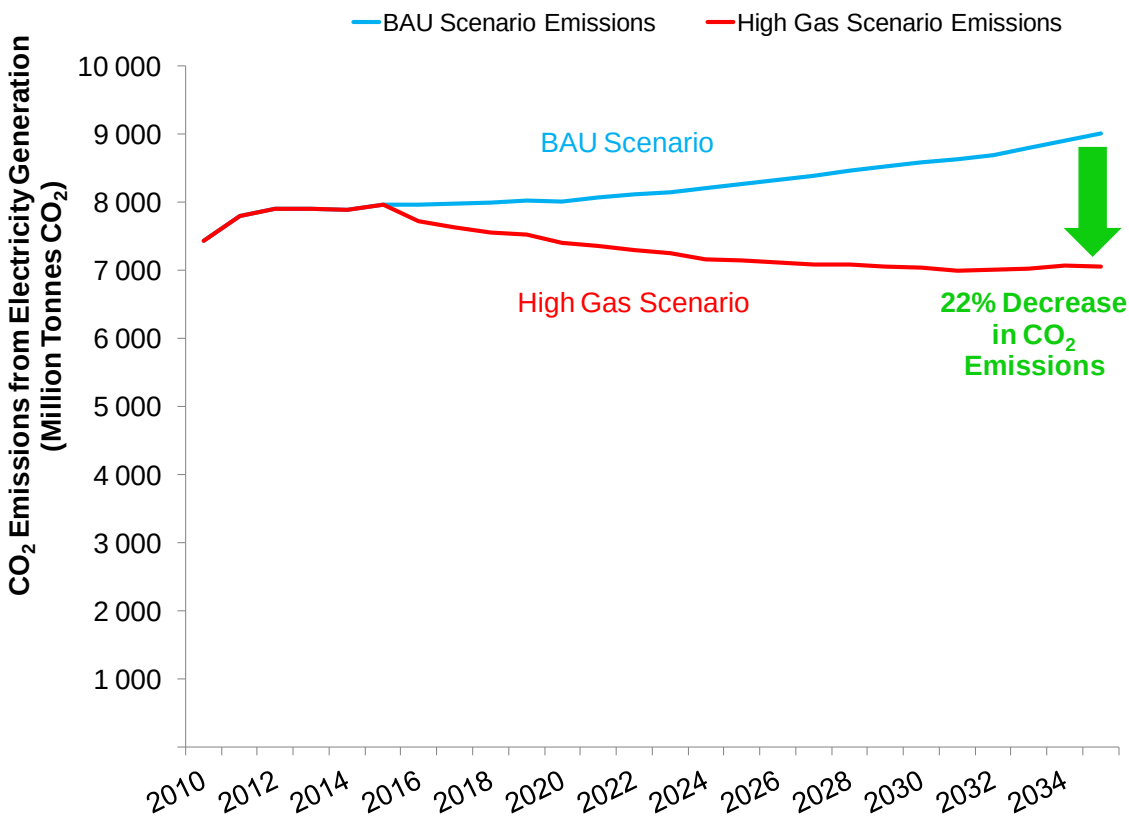
APERC therefore assumed that the additional gas in the High Gas Scenario would be used to replace coal in electricity generation.

As shown in Figure 12.7, the additional gas in the High Gas Scenario could reduce CO_2 emissions from electricity generation in 2035 by about 22% compared to BAU. This implies an overall reduction in energy CO_2 emissions of about 8% compared to BAU.

Alternatively, some of this added gas could be used to replace oil. In this case, there would be additional benefits from reduced oil imports in the form of greater energy security and economic stability. And regardless of how the gas is used, there would be large economic benefits to both producer and consumer economies.

It is worth re-emphasizing that given the immense gas resources of the APEC region, this High Gas Scenario is a conservative example of what could be accomplished if the potential constraints on gas production and trade could be reduced. It is also important to recognize that, in some APEC economies, there is growing public concern over the environmental risks of unconventional gas development. These will need to be addressed through better regulation if gas development is to win the public confidence it will need to deliver benefits like those illustrated in this scenario.

Figure 12.7: High Gas Scenario – Reduction in CO_2 Emissions from Electricity Generation



Source: APERC Analysis (2012)

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