THE RUSSIAN FEDERATION

- *Russia will maintain its position as a top global energy exporter with a more diversified mix of products exported and a more varied mix of product destinations; frontier and offshore hydrocarbon resources should replace depleting fields in the traditional oil and gas regions.*
- *Russia will need to invest heavily in oil and gas exploration and development in new frontier areas, and in the development of the accompanying energy infrastructure needed to service both existing markets in Europe and new markets in Asia–Pacific. The inflow of investment into the energy sector would be facilitated by improved investor confidence in the stability of Russian institutional arrangements and by domestic energy price liberalization.*
- *Despite the Fukushima Nuclear Accident, Russia's nuclear energy industry remains a focus of Russia's development: nuclear energy will take a larger share in power generation in the domestic market, while the industry will expand abroad. Russia will remain a key player in the practical implementation of improved nuclear fuel technology.*
- *Significant energy conservation and economic restructuring efforts would reduce Russia's high level of energy intensity, allowing it to conserve its energy resources and to reduce greenhouse gas emissions.*

ECONOMY

With a land area of more than 17 million square kilometres, the Russian Federation is geographically the world's largest economy. It is the only APEC economy located in both Europe and Asia, and is bordered by the Arctic and the North Pacific oceans. Its terrain is characterized by broad plains west of the Urals, vast coniferous forests in Siberia, tundra along the Arctic seaboard, and uplands and mountains in the southern regions. The Russian Federation has a vast natural resource base that includes major deposits of coal, natural gas, oil and other minerals. Despite its land area advantage, the economy lacks an optimal climate for agriculture—most of its area has a continental climate, and is either too cold or too dry. Central heating is common for up to 6–8 months of the year, while cooling during the summer is not widely used.

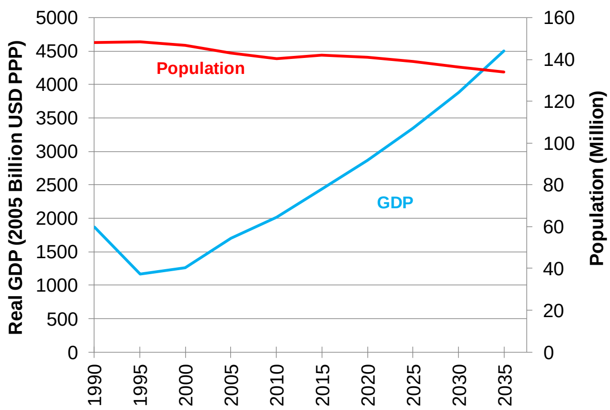
In 1999, after a decade of economic contraction (about 40% compared to the 1990 GDP level), the Russian economy began to grow again. The recovery was triggered by a devaluation of the rouble in the aftermath of the 1998 financial crisis, and its positive impact on the economy's competitiveness. In parallel, soaring world prices of oil and natural gas also drove the recovery.

Russia's major industries include the oil and gas production, petroleum refining, mining, iron and steel, chemicals, machinery and motor vehicles industries.

GDP increased at a rate of 4.8% per year from 2000 to 2009, reaching USD 1931 billion (in 2005 USD PPP) in 2009. Per capita income in 2009 was USD 13 712, 60% more than in 2000. Over the outlook period, Russia's GDP is expected to continue to grow, although at a slower average annual rate of 3.3%, to reach USD 33 600 per person (2005 USD PPP) by 2035.

Russia's population in 2011 was around 142.8 million people. Russia's population is projected to decline at an average annual rate of 0.2% during the outlook period and is expected to be 134 million people by 2035.

Figure RUS1: GDP and Population



Sources: Global Insight (2012) and APERC Analysis (2012)

The urbanization rate in 2011 was 74% and it has not changed much since 1989. Russia's average population density of only 8.4 people per square kilometre is very low, with the majority of the population living in the European part of the economy (GKS, 2012).

Russia's economy faces challenges due to the underdevelopment of its transport infrastructure. In particular, the current condition of Russian airports and air transport facilities provides insufficient capacity for and slows the performance of air transportation services. Further modernization of air and rail transport is planned in connection with Russia's programs for hosting the 2014 Winter Olympic Games, the 2018 Football World Cup, and the 2020 World Expo.

The total length of Russian roads in 2009 was 983 000 kilometres (km), 80% of which was paved. The country had only 29 000 km of high-speed divided highways connecting big cities (GKS, 2012). Further development of highways will be necessary if the big cities are to be connected.

Russia has a state railway system with a total length of 83 000 km, but only some cities have high-speed train services. Almost all towns in Russia regardless of size are served by regional bus services. Subway systems have been introduced in seven of Russia's major cities, and all cities have extensive city bus systems.

Russia's pipeline transport is underdeveloped relative to the potential oil and gas supply. The total length of the pipeline system in the economy was 233 000 km in 2010, 167 000 km of which was gas pipeline, 49 000 km was oil pipeline, and 16 000 km was oil products pipeline.

Russia maintained its place in the top three automobile markets in Europe, following Germany and the UK. Vehicle production in 2011 was 1.7 million units.

ENERGY RESOURCES AND INFRASTRUCTURE

In terms of proven reserves, the Russian Federation holds 21.4% of the world's gas, 5.3% of its oil reserves, 18.2% of its coal reserves, and about 14% of its uranium ore reserves (BP, 2012). Even more resources remain to be discovered, but the formidable obstacles of climate, terrain and distance hinder their exploitation.

The Russian energy sector is very important for the security of the global energy supply. The economy is the world's largest exporter of energy overall, and also the largest exporter of natural gas, and the second-largest exporter of oil. In addition, Russian-labelled nuclear fuel is used at 74 commercial reactors (17% of the global market) and 30 research reactors in 17 economies worldwide, and the economy provides over 40% of the world's uranium enrichment services (ME, 2012).

However, Russia's oil resources in the traditional oil producing regions are believed to be heavily depleted, with more than 50% of the economically-recoverable resources already produced. In the Urals and Volga regions, resource depletion is believed to exceed 70%. The share of remaining resources that is hard-to-recover is constantly growing. Almost 80% of Russia's oil production comes from large fields with remaining lives of 8–10 years. Newly developed resources are often concentrated in middle-size and small-size deposits (ME, 2012). Without the development of new fields in remote areas, oil production is likely to peak at 550 million tonnes of oil equivalent (Mtoe) per year by 2020 and then decline to 400 Mtoe per year by 2035.

The refining industry in Russia includes about 30 major refineries with a total capacity for primary processing of about 254 million tonnes of crude oil per year (ME, 2012). Most of these refineries are older facilities that do not meet modern standards for energy efficiency or environmental protection. During the outlook period, the refinery industry of Russia will need to undergo modernization, with priority given to the cracking processes needed to produce the lighter fuels (such as gasoline, diesel, and jet fuel) most in demand in the market. The Russian Government's export policy favours the export of petroleum products rather than crude oil, which implies that Russia will need a large expansion of refinery capacity by 2035.

The oil sector is heavily controlled by the Russian Government and this control will increase after the state-owned Rosneft takeover of TNK-BP. The merger will create the world's largest listed oil company with a daily output of 4.6 million barrels in oil-equivalent terms (Reuters, 2012).

The gas industry of Russia has a more favourable resource situation than the oil industry. The proved natural gas resources in Russia, estimated at 44.6 trillion cubic meters (BP, 2012), should be adequate to meet both domestic market and export demands in the outlook period. Russia will continue to be a major gas supplier to Europe and planning is in progress for major export projects to serve the Asia–Pacific region.

About 79% of the gas production in 2009 was from Gazprom, a state-controlled corporation. Gazprom is also the owner of Russia's pipeline network. The company is the main gas supplier to domestic and export markets, and is the owner of most of the basic infrastructure of the Russian natural gas business.

The remaining reserves of coal in Russia amount to more than 190 billion tonnes or 18% of the world reserves. At current rates of coal consumption in the economy, these reserves will be sufficient for 800 years. Unlike the oil and gas sector, the coal industry has no large state-controlled company and is almost 100% privatized.

As of 2010, the generation of electricity and heat in Russia from thermal sources was provided by six wholesale generating companies, which operate without regard to territorial boundaries, and 14 territorial generating companies. These companies are mostly privately-owned with some state participation. RusHydro operates most of Russia's hydropower stations. Rosatom operates all Russia's nuclear energy power plants. Both of these companies are state controlled.

Russia has the world's largest and oldest district heating system with centralized heat production and distribution networks in most major cities. The system has a high number of combined heat and power (CHP) installations. Given the obsolescence of the Russian district heating infrastructure, a considerable amount of energy can be saved through relatively accessible technologies and cost-effective energy saving practices (IES, 2010).

During the outlook period, the development of Russia's electricity infrastructure will be determined by the State Program of Long Term Development of Installed Capacity and Forecast of Construction of New Capacities in the Russian Federation for the Period till 2030 (IES, 2010). Our business-as-usual projections are based primarily on this document.

ENERGY POLICIES

The adoption of the Energy Strategy of Russia for the period up to 2020 in August 2003 (IES, 2010) was a milestone in Russia's energy sector development. The strategy identifies the economy's long-term energy policy and the mechanisms for its realization. A revised version of the strategy was adopted by the government in November 2009—the Energy Strategy of Russia for the period up to 2030, (Energy Strategy 2030) (IES, 2010). The new version of the strategy was updated to take into account the new realities and priorities in the energy sector as affected by the global recession. The strategy is a framework within which more detailed industry-oriented medium-term and short-term programs can be developed.

The strategic objective of Russia's external energy policy is to use its energy potential effectively to maximize its integration into the world's energy markets, to strengthen Russia's position in those markets, and to maximize the benefits of energy resources to the economy.

To achieve this, Russia will implement a number of measures to improve the security of domestic energy consumption and energy export obligations, and will make efficiency improvements along the entire energy supply chain. This will include the development of new hydrocarbon provinces in remote areas and offshore. It will also include the rehabilitation, modernization and development of energy infrastructure, including the construction of additional trunk oil and gas pipelines, to enhance the economy's energy export capacity.

To better integrate Russia into world energy markets, export delivery markets will be diversified. At least 27% of Russia's total energy exports in 2030 should be delivered to the Asia–Pacific region (IES, 2010).

Despite the Fukushima Nuclear Accident, Russia's nuclear energy industry remains a focus of Russia's development. Nuclear energy will take a larger share in power generation domestically, while the industry will expand abroad. Russia will remain a key player in the practical implementation of improved nuclear fuel technology.

Despite the existing programs for renewable energy development in the Energy Strategy 2030, the economic potential of renewable energy in Russia is low. Fossil fuels in Russia are so abundant that renewables have difficulty competing.

The Energy Strategy 2030 calls for a reduction in the energy intensity of the economy by 40% by 2030 (IES, 2010). Decreasing Russia's relatively high energy intensity (about 335 tonnes of oil equivalent per million USD PPP in 2009) needs to be a main objective of Russian energy policy. Without significant progress in this area some industries may not be globally competitive, thus impeding Russia's economic development.

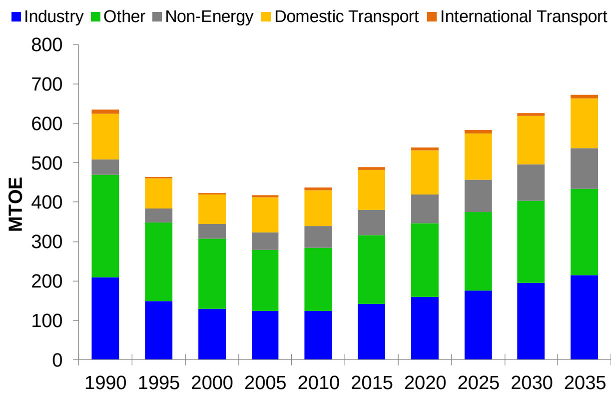
Perhaps the most important measures in the Energy Strategy 2030 are directed toward developing energy market institutions, such as fair pricing mechanisms and transparent trading principles, and making sure there is sufficient energy transportation infrastructure. State participation in the energy sector development will consist mainly of supporting innovative developments in the energy sector, as well as providing a stable institutional environment for the effective functioning of the sector (IES, 2010).

BUSINESS-AS-USUAL OUTLOOK

FINAL ENERGY DEMAND

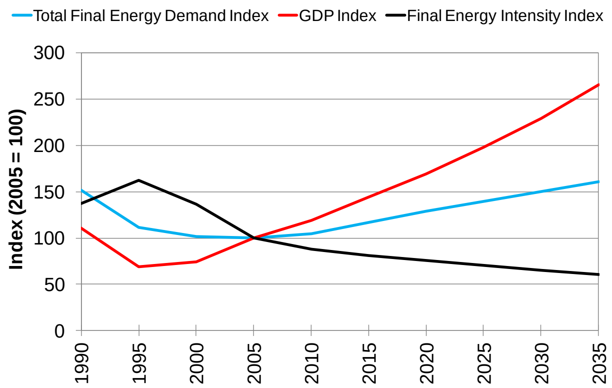
Russia's final energy demand is expected to grow at 1.7% per year over the outlook period, but will not exceed 1990 levels until after 2030. Growth is expected in all sectors. Final energy intensity is expected to decline by about 39% between 2005 and 2035.

Figure RUS2: BAU Final Energy Demand



Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

Figure RUS3: BAU Final Energy Intensity



Source: APERC Analysis (2012)

Industry

Russia's industrial energy demand is projected to grow at an average annual rate of 2.2% until 2035, with industrial growth driven by infrastructure project development in the economy. The anticipated technological retrofitting of industrial facilities is expected to contribute to improvements in energy efficiency. Moreover, a firmly implemented policy to reduce energy subsidies and link domestic energy prices with world benchmarks is expected to provide a major stimulus for energy efficiency improvements in the long term.

Transport

Transport energy demand increases of 1.3% annually are expected over the outlook period. Rising incomes will gradually increase passenger vehicle ownership, from around 230 per 1000 people in 2005 to about 660 per 1000 in 2035.

Road transport will continue to consume the largest share of the energy used in the transport sector over the outlook period. The improvement in living standards and increased vehicle ownership will lead to a shift from public transport to individual passenger vehicles for commuting.

Other

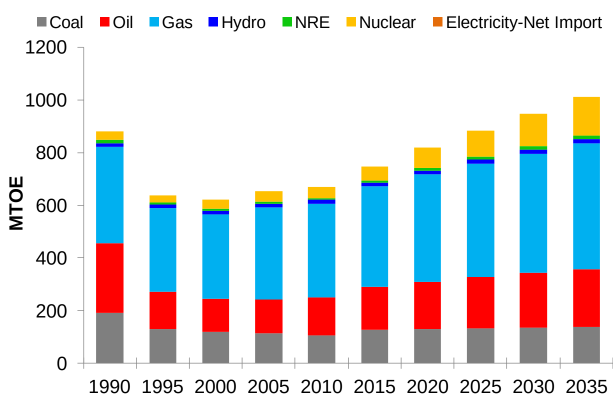
Energy consumption in the 'other' economic sectors (residential, commercial, and agriculture) is expected to grow by 1.2% annually over the outlook period. Due to Russia's frigid climate, space heating accounts for a large share of this demand. Russia's district heating systems will meet 43% of 'other' sector energy demand in 2035, while gas will account for another 22%. However, the current energy efficiency of heat generation and use in the residential and commercial sectors is low. A gradual shift to more energy-efficient apartment and office buildings is expected over the outlook period, encouraged by government programs. Coal and renewable energy (mainly biomass) will maintain shares of 5% and 1% respectively, mainly due to their importance in rural and remote areas.

PRIMARY ENERGY SUPPLY

Russia's total primary energy supply is expected to reach 1009 Mtoe in 2035. Nuclear energy is projected to grow the fastest at an average annual rate of 5% per year, followed by new renewable energy (NRE) at 3.2%. However, NRE's share of the total primary energy supply will still be only about 1.4% in 2035. Of the fossil fuels, oil will grow the fastest at 1.7% per year, driven by a growing transport demand. At the same time natural gas will grow by 1.2% per year, while coal will grow by 1.1% per year. Hydro output will be virtually unchanged over the outlook period.

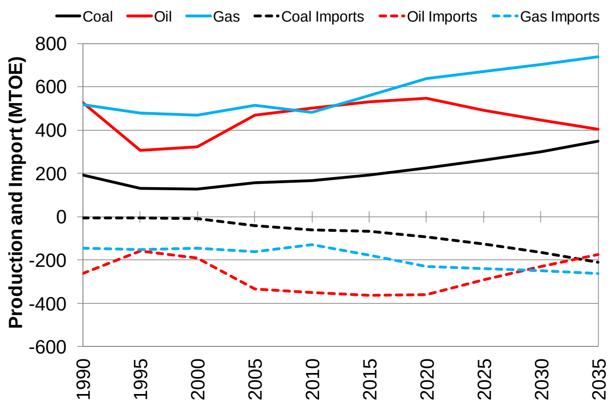
Although there are huge untapped hydro resources in the Russian Far East, their remote location and lack of local markets makes them unlikely to be developed during the outlook period.

Figure RUS4: BAU Primary Energy Supply



Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

Figure RUS5: BAU Energy Production and Net Imports



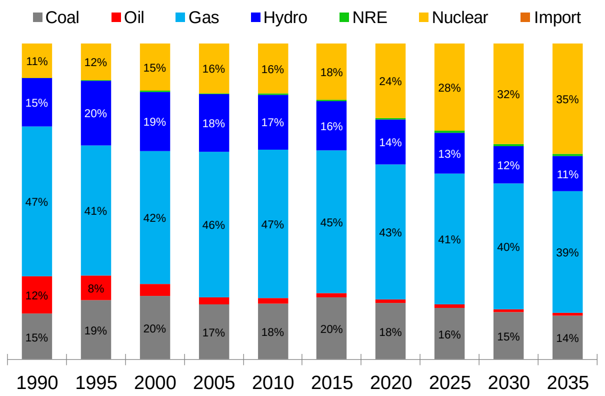
Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

Significant growth is expected in coal and gas production and exports. However, oil exports will experience a contraction over the outlook period, as domestic demand will grow and (after 2020) production may decline.

ELECTRICITY

Electricity demand is projected to grow at an average annual rate of 2.5%. This will require an increase in installed generation capacity from 237 GW in 2010 to 335 GW by 2035 or, in other words, the construction of more than an average 4 GW of new capacity each year within the outlook period.

Figure RUS6: BAU Electricity Generation Mix



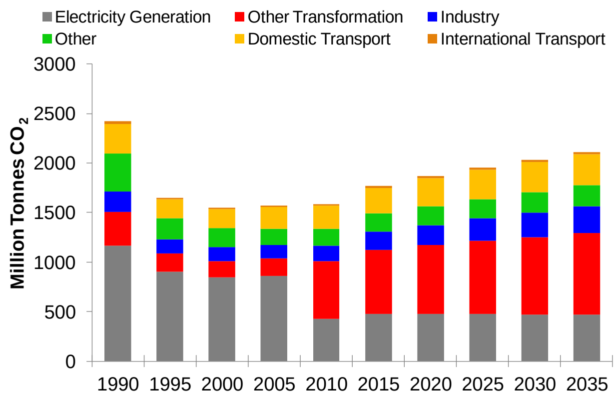
Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

Natural gas will be the main input fuel for electricity generation in 2035 (39% share), followed by nuclear (35%), coal (14%) and hydro (11%). Electricity generation from renewable sources is expected to increase robustly at an average annual rate of 5.9%; however, its share will remain less than 1%. Petroleum products will likewise account for less than 1% of electricity generation, but they will be the major fuel for electricity generation in isolated areas, in particular for the northern regions in the Russian Far East.

CO_2 EMISSIONS

Over the outlook period, Russia's total CO_2 emissions from the energy sector are projected to reach 2113 million tonnes of CO_2, which is still lower than the 1990 level of 2424 million tonnes. The emissions from electricity and district heating production will contribute 50% of the total CO_2 emissions in 2035. (Note, in Figure RUS7, CO_2 emissions from heat production shift from Electricity Generation to Other Transformation after 2010 due to data limitations.)

Figure RUS7: BAU CO_2 Emissions by Sector



Source: APERC Analysis (2012)

The major factor restraining the growth of Russia's CO_2 emissions is the expected decline in energy intensity of GDP at an average annual rate of 1.7% per year (see Table RUS1 below).

Table RUS1: Analysis of Reasons for Change in BAU CO_2 Emissions from Fuel Combustion

(Average Annual Percent Change)

	1990-2005	2005-2010	2005-2030	2005-2035	2010-2035
Change in CO_2 Intensity of Energy	-0.9%	0.4%	-0.2%	-0.3%	-0.4%
Change in Energy Intensity of GDP	-1.3%	-3.5%	-2.0%	-2.0%	-1.7%
Change in GDP	-0.7%	3.5%	3.4%	3.3%	3.3%
Total Change	-2.9%	0.2%	1.0%	1.0%	1.2%

Source: APERC Analysis (2012)

CHALLENGES AND IMPLICATIONS OF BAU

Russia is one of the most energy-intensive economies in the world because of a) its frigid climate; b) the disproportionally large shares of energy-intensive industries in contrast to the much lower shares of less energy-intensive industries and services; and c) the high proportion of technologically obsolete assets within industry and the energy supply infrastructure.

In the energy sector, a refurbishment of the refining industry in Russia is urgently required to meet tightening fuel quality standards and to drastically increase the yield of light products (which is the lowest of all APEC member economies). Russia will need to invest heavily in oil and gas exploration and development in frontier areas and offshore, and in the development of the accompanying energy infrastructure needed to service both existing markets in Europe, and new markets in Asia–Pacific. An inflow of investment into the energy sector would be facilitated by improved investor confidence in the stability of Russian institutional arrangements and by domestic energy price liberalization.

ALTERNATIVE SCENARIOS

To address the energy security, economic development, and environmental sustainability challenges posed by the business-as-usual (BAU) outcomes, three sets of alternative scenarios were developed for most APEC economies.

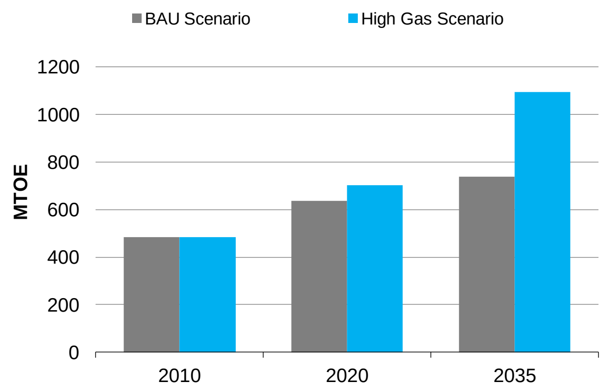
HIGH GAS SCENARIO

To understand the impacts higher gas production might have on the energy sector, an alternative 'High Gas Scenario' was developed. The assumptions behind this scenario are discussed in more detail in Volume 1, Chapter 12. The scenario was built around estimates of gas production that might be available at BAU prices or below if constraints on gas production and trade could be reduced.

The High Gas Scenario production for Russia assumed the production increase shown in Figure RUS8, which equals 48% by 2035 compared with BAU. Russia has vast resources of gas in frontier areas of production like Yamal, Eastern Siberia and the Far East, which require significant investment in both production and pipeline transport infrastructure.

The High Gas Scenario would remove the restrictions on the use of the export pipeline system by private gas producing companies. This would enable greater investment in offshore gas production for liquefied natural gas (LNG) exports from both the Northern Shelf and the Far East, as well as in the onshore development of Eastern Russian gas basins for pipeline transportation to international markets, including pipeline supply to China, Korea and possibly Japan.

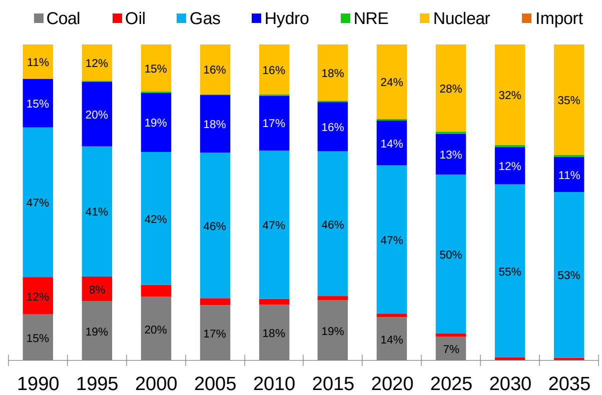
Figure RUS8: High Gas Scenario – Gas Production



Source: APERC Analysis (2012)

The additional gas in the High Gas Scenario was assumed to replace coal in electricity generation. Figure RUS9 shows the High Gas Scenario electricity generation mix. This graph may be compared with the BAU scenario graph in Figure RUS6. It can be seen that the gas share has increased by 14% by 2035, while the coal share has declined by a corresponding amount.

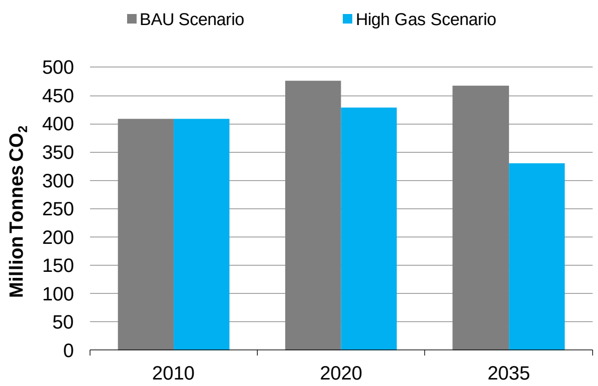
Figure RUS9: High Gas Scenario – Electricity Generation Mix



Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

A higher gas share in the electricity generation mix is projected to reduce the CO_2 emissions in electricity generation by 10% by 2020 and by 29% by 2035, since gas has roughly half the CO_2 emissions of coal per unit of electricity generated. In addition to lowering CO_2 emissions, the High Gas Scenario would boost Russian economic growth, especially in the remote eastern regions of the economy.

Figure RUS10: High Gas Scenario – CO_2 Emissions from Electricity Generation



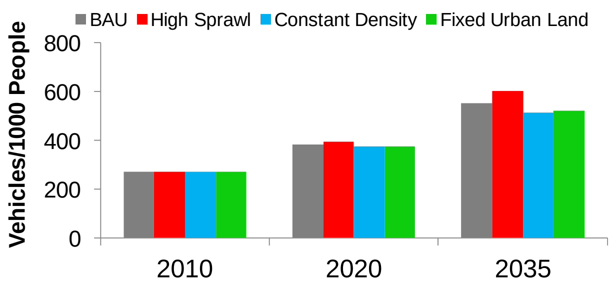
Source: APERC Analysis (2012)

ALTERNATIVE URBAN DEVELOPMENT SCENARIOS

To understand the impacts of future urban development on the energy sector, three alternative urban development scenarios were developed: 'High Sprawl', 'Constant Density', and 'Fixed Urban Land'. The assumptions behind these scenarios are discussed in Volume 1, Chapter 5.

Figure RUS11 shows the change in vehicle ownership under BAU and the three alternative urban development scenarios. Urban planning has a direct effect on the expected level at which the long-term saturation of vehicle ownership is reached. In the High Sprawl scenario, vehicle ownership would be about 9% higher than BAU by 2035, while in the Constant Density scenario, it would be about 7% below BAU. Note, in most economies the Fixed Urban Land scenario has a population density higher than the Constant Density scenario, and therefore a lower vehicle ownership. However, due to Russia's expected population decline, this is not the case for Russia.

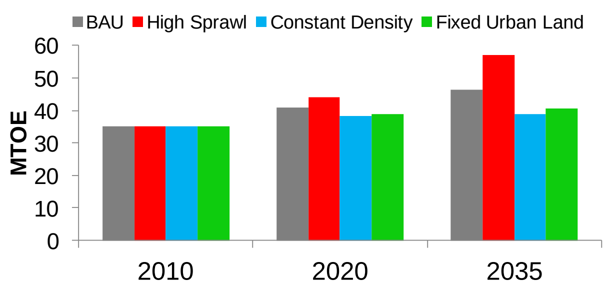
Figure RUS11: Urban Development Scenarios – Vehicle Ownership



Source: APERC Analysis (2012)

Figure RUS12 shows the change in light vehicle oil consumption under BAU and the three alternative urban development scenarios. The impact on oil consumption in the light vehicle fleet is compounded by the change in vehicle travel, since in compact cities the travel distances per vehicle are typically lower than those in sprawling cities. Consequently, in the High Sprawl scenario light vehicle oil consumption would be 23% higher than BAU, while in the Constant Density scenario it would be 16% lower than BAU.

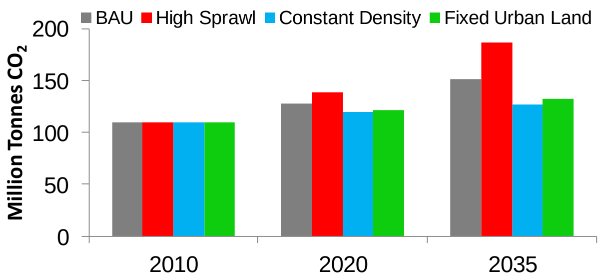
Figure RUS12: Urban Development Scenarios – Light Vehicle Oil Consumption



Source: APERC Analysis (2012)

Figure RUS13 shows the change in light vehicle CO_2 emissions in Russia under BAU and the three alternative urban development scenarios. The impact of urban planning on CO_2 emissions is similar to the impact of urban planning on energy use, since there is no significant change in the mix of fuels used under any of these cases.

Figure RUS13: Urban Development Scenarios – Light Vehicle Tank-to-Wheel CO_2 Emissions



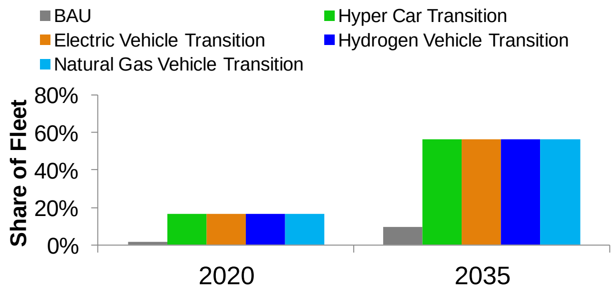
Source: APERC Analysis (2012)

VIRTUAL CLEAN CAR RACE

To understand the impacts of vehicle technology on the energy sector, four alternative vehicle scenarios were developed: 'Hyper Car Transition' (ultra-light conventionally-powered vehicles), 'Electric Vehicle Transition', 'Hydrogen Vehicle Transition', and 'Natural Gas Vehicle Transition'. The assumptions behind these scenarios are discussed in Volume 1, Chapter 5.

Figure RUS14 shows the evolution of the vehicle fleet under BAU and the four 'Virtual Clean Car Race' scenarios. By 2035 the share of the alternative vehicles in the fleet reaches around 56% compared to about 10% in the BAU scenario. The share of conventional vehicles in the fleet is thus only about 44%, compared to about 90% in the BAU scenario.

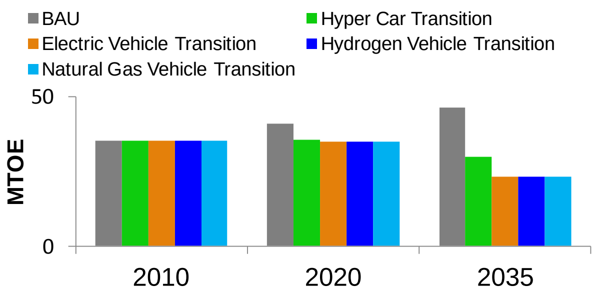
Figure RUS14: Virtual Clean Car Race – Share of Alternative Vehicles in the Light Vehicle Feet



Source: APERC Analysis (2012)

Figure RUS15 shows the change in light vehicle oil consumption under BAU and the four alternative vehicle scenarios. Oil consumption drops by about 50% in the Electric Vehicle Transition, Hydrogen Vehicle Transition, and Natural Gas Vehicle Transition scenarios compared to BAU by 2035. The drop is large as these alternative vehicles use no oil. Oil demand in the Hyper Car Transition scenario is also significantly reduced compared to BAU—down 36% by 2035—even though these highly-efficient vehicles still use oil.

Figure RUS15: Virtual Clean Car Race – Light Vehicle Oil Consumption

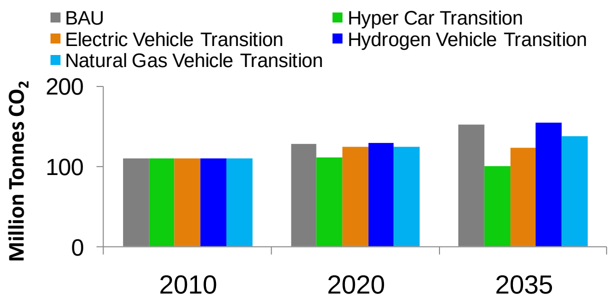


Source: APERC Analysis (2012)

Figure RUS16 shows the change in light vehicle CO_2 emissions in Russia under BAU and the four alternative vehicle scenarios. To allow for consistent comparisons, in the Electric Vehicle Transition and Hydrogen Vehicle Transition scenarios the change in CO_2 emissions is defined as the change in emissions from electricity and hydrogen generation. The emissions impacts of each scenario may differ significantly from their oil consumption impacts, since each alternative vehicle type uses a different fuel with a different level of emissions per unit of energy.

In Russia, the Hyper Car Transition scenario is the clear winner in terms of CO_2 emissions reductions, with an emissions reduction of 34% compared to BAU in 2035. The Electric Vehicle Transition scenario would reduce emissions by about 19%, reflecting our assumption that in Russia the additional electricity required by electric vehicles would be generated primarily from natural gas. The Natural Gas Vehicle Transition scenario would reduce emissions by about 9% compared to BAU. The Hydrogen Vehicle Transition scenario would increase emissions by about 2%. This is mainly due to the way hydrogen is produced—from the steam methane reforming of gas, a process which involves significant CO_2 emissions.

Figure RUS16: Virtual Clean Car Race – Light Vehicle CO_2 Emissions



Source: APERC Analysis (2012)

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