30 Russia

30.1 Summary of Coal Industry

30.1.1 Role of Coal in Russia

Russia's coal industry became a principal sector of the country's economy at the end of the 1930s. By 1950, coal accounted for 59 percent of Russia's fuel balance. The discovery of huge oil and natural gas reserves in the 1960s along with the development of nuclear power, however, led to decreasing dependence on coal. As of 2009, 14.7 percent of Russia's total primary energy supply came from coal/peat (IEA, 2009). More than 40 percent of coal consumed in Russia is used for heat and power generation. Natural gas is the principal competitor with coal in these end uses.

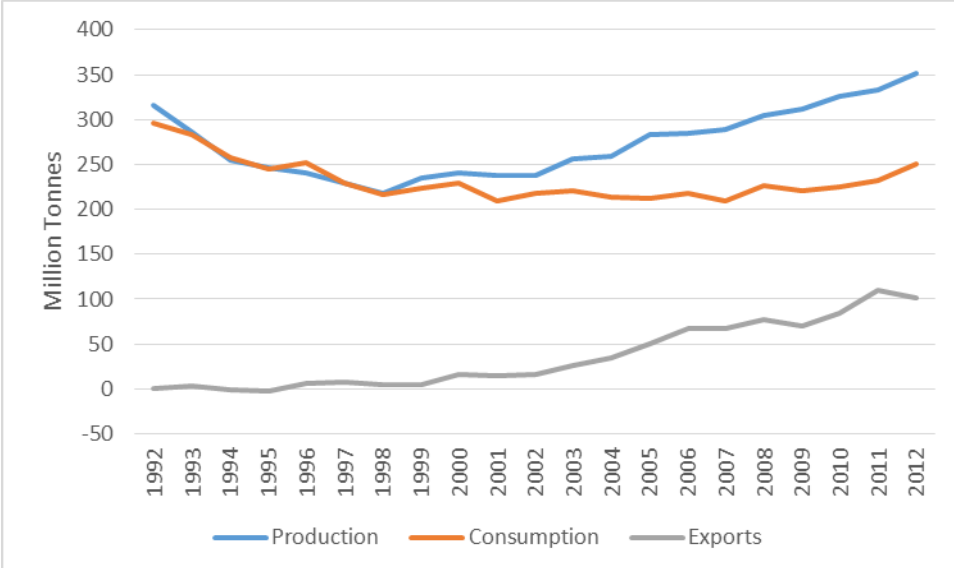
Russia is ranked sixth in global coal production with 2012 production of 354 million tonnes (Mmt) and has coal reserves of approximately 157 billion tonnes as of 2008, which is second worldwide only to the United States (see Table 30-1). Russia exported 136.7 Mmt of coal in 2012 (EIA, 2014a). The Russian Ministry of Energy estimates total coal exports will reach 140 Mmt in 2015, and further anticipated growth in exports will reach 170 Mmt by 2030 (World Coal, 2013). Figure 30-1 illustrates historical Russian coal production, consumption, and exports. Table 30-2 shows Russia's power generation by source.

Table 30-1. Russia's Coal Reserves and Production

Indicator	Anthracite & Bituminous (million tonnes)	Sub-bituminous & Lignite (million tonnes)	Total (million tonnes)	Global Rank
Estimated Proved Coal Reserves (2011)	49,088	107,922	157,010	2 (17.6%)
Annual Coal Production (2012)	276.1	77.9	353.9	6 (4.5%)

Source: EIA (2014a)

Figure 30-1. Historical Russian Coal Production, Consumption, and Exports



Source: EIA (2013)

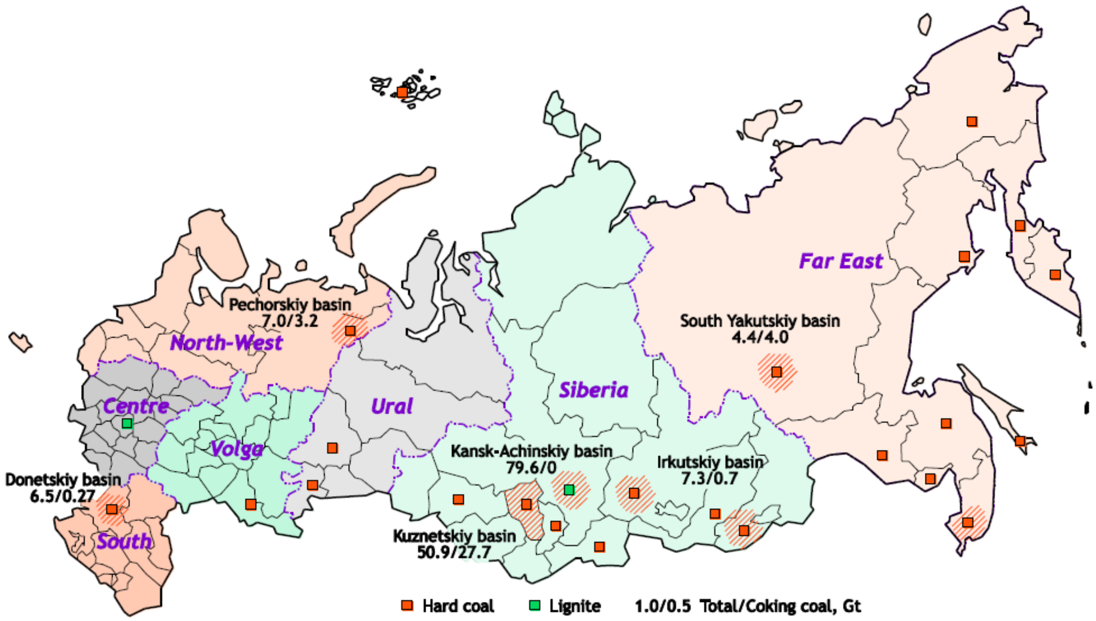
Table 30-2. Russia's Power Generation by Source, 2011

Power Source	Billion kWhr	%
Coal	164,348	15.6
Oil	27,362	2.6
Gas	519,202	49.4
Bio	35	0.0
Nuclear	172,941	16.4
Hydro	167,608	15.9
Geothermal	522	0.0
Solar PV	0	0.0
Solar Thermal	0	0.0
Wind	5	0.0
Total	**1,052,023**	**100**

Source: IEA (2011)

Russia's coal reserves are primarily concentrated in Siberia (80 percent), followed distantly by the Far East region (10 percent), as seen in Figure 30-2. The main coal-producing basins in Siberia are the Kuznetskiy and Kansko-Achinskiy, along with the South Yakutsly basin in the Far East region (IEA, 2009). Table 30-3 shows Russia's coal production by region.

Figure 30-2. Russia's Coal Reserves



Note: The boundaries and names shown and the designations used on maps included in this publication do not imply official endorsement or acceptance by the IEA.

Source: IEA (2009)

Table 30-3. Russia's Coal Production by Region, 2012

Region	Million Tonnes
Kuzbass	198.9
East Siberia	48.2
Kansk Achinsk	40.7
Far East	32.4
Pechora	14.2
Yakutsk	12.2
Donbass (Rostov)	5.6
Moscow	0.3
Urals fields	0.1
Others	0.1
Total	**352.7**

Source: Eastern Bloc Energy (2012)

30.1.2 STAKEHOLDERS

Table 30-4 highlights a partial list of key stakeholders in coal mine methane (CMM) development in Russia.

Table 30-4. Key Stakeholders in Russia's CMM Industry

Stakeholder Category	Stakeholder	Role
Mining Companies	▪ Severstal-Resource ▪ Evraz Holding ▪ MDM ▪ Ural Mining and Metallurgical Company ▪ Sibirsky Delovoy Soyuz ▪ Sibuglemet ▪ Belon ▪ Mechel ▪ Siberian Coal Energy Company	Project hosts
Equipment Manufacturers	▪ Kyshtym Machine Works ▪ Druzhkov Machine Works ▪ Artemovsk Machine Works ▪ VENTPROM ▪ Yurga Machine Works	Power generation equipment supplier
Developers and Engineering/ Consultancy	▪ Uglemetan ▪ Green Gas International ▪ Additional stakeholders: ▪ http://www.epa.gov/coalbed/networkcontacts.html	Project opportunity identification, planning, technical assistance and design work
Universities/Research Establishments	▪ Institute of Coal of SB RAS Mining Institute of the Ural Branch of the Russian Academy of Sciences ▪ National University of Science and Technology "MISIS"/Mining Institute ▪ Promgas ▪ VostNII ▪ Skochinsky Institute of Mining (SIM)	Technical assistance
Natural Gas Transmission & Distribution Companies	▪ Gazprom	Distribution and pipeline sales
Government Groups	▪ Federal Ministry of Natural Resources ▪ Russian Federation Ministry of Energy ▪ Russian Federal Mining and Industrial Inspectorate (RosTechNadzor) ▪ Regional administrations	▪ Licensing ▪ Project approval ▪ Safety standards for mines ▪ Regional environmental and safety rules and requirements

30.1.3 Status of Coal and the Coal Mining Industry

Between 1996 and 2001, Russia worked with the World Bank to restructure the country's coal industry, which is now privatized. As a result of the restructuring, nearly all of domestic coal production comes from independent producers (EIA, 2014b). The Russian Energy Strategy to 2030 released in November 2009 focuses attention on the goal to have the Russian economy become one based more on innovation as opposed to the export of energy resources. However, the energy strategy 2009 projects a 100 percent increase in coal exports from 2008 to 2020 (World Coal, 2013). It also projects an almost three-fold increase in domestic capacity of hard coal processing plants by 2020, reflecting an increase in the domestic use of coal for electricity production (IEA, 2009). Table 30-5 presents production statistics for Russian coal mining.

Table 30-5. Russia's Coal Mining Statistics (2012)

Type of Mine	Production (million tonnes)	Number of Mines
Underground (active) mines	99.6	91
Surface (active) mines	255.1	137
Total mines	**354.7**	**228**

Source: *Coal Age* (2013)

30.2 Overview of CMM Emissions and Development Potential

In 2009, 57 underground coal mines were considered either "Category 3" mines, with methane emissions of 10 to 15 cubic meters per ton (m^3/t) of coal mined, or "Super Hazardous" mines, with methane emissions greater than 15 m^3/t (IEA, 2009). Of these mines, approximately 25 deployed degasification systems in 2009. While underground mining represents 30 percent of Russia's total coal production, forecasts predict an increasing share of coal production from deeper underground mines, leading to increased methane emissions. The restructuring of Russia's coal mining industry over the 1990s resulted in the closure of 188 uneconomic mines. Many of these mines were among the gassiest, and this thereby led to a considerable drop in Russia's methane emissions at operating mines (IEA, 2009).

30.2.1 CMM Emissions from Operating Mines

CMM in Russia is primarily located in three coal basins: Kuzbass, Pechora, and Donetsk (also known as Donbass, the majority of which is situated in Ukraine). According to UNFCC's National Inventory Submissions of greenhouse gases (GHGs), CMM from underground coal mines in Russia totaled 2.02 billion m^3 in 2011 (UNFCC, 2013). The Kuzbass accounts for approximately 65 percent of CMM emissions and the Pechora Basin accounts for 19 percent of CMM emissions (Tailakov, 2012).

Methane emissions from all Russian coal mines are summarized in Table 30-6. The Kuzbass had 47 active mines in 2003 (Tailakov, 2003) and their methane emissions are quantified in Table 30-7 (Tailakov, 2012). The data in these tables may vary from the USEPA data presented in the Executive Summary due to differences in inventory methodology and rounding of digits. Figure 30-3 shows the historical emissions based on reporting to the UNFCCC.

Table 30-6. Russia's CMM Emissions (million cubic meters)

Emissions	2000	2005	2010	2015 (projected)
Total CH_4 Emitted	2,942.8	3,183.8	3,424.9	3,575.5

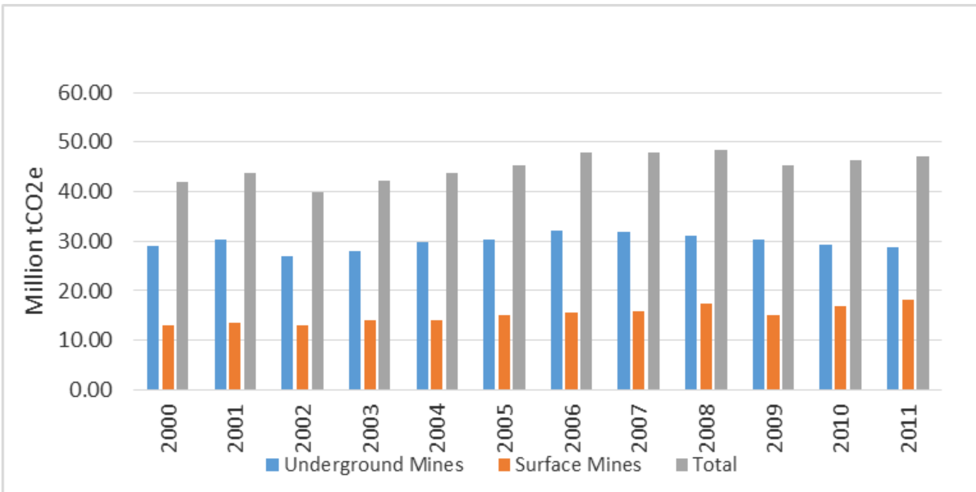
Source: USEPA (2012)

Table 30-7. Kuzbass CMM Emissions (million cubic meters)

Emission Category	2007	2008	2009	2010	2011
Coal Mines Ventilation and Gas Suction Systems	1,520	1,530	1,550	1,550	1,600

Source: Tailakov (2012)

Figure 30-3. Estimated Historical Methane Emissions from Russia's Underground and Surface Coal Mines



Source: UNFCC (2014)

Methane drainage was first initiated in the Kuzbass in 1951 and in the Pechora basin in 1956 (at the Severnaya, Komsomolsksya, Vorkutinskaya, and Zapolyarnaya mines). Degasification, however, reached its peak in 1990 when many of these mines had to shut down due to financial losses. The mines in the Pechora basin vented 289.8 million m^3 of methane in 1998 (RRR, 2001). In 2000, vented methane in the Pechora basin decreased to 42.05 million m^3 (Uglemetan, 2005). The wide disparity between the ventilation emissions was the result of mine closures between 1998 and 2000. In 1998, the seven Pechora basin mines had an average degasification efficiency of about 0.5. By 2000, three of the mines in the basin were closed and only Severnaya, Komsomolsksya, Vorkutinskaya, and Zapolyarnaya mines have continued mining operations. The average degasification efficiency of those mines is significantly higher, accounting for degasification efficiency of 0.7 on average, resulting in more drainage and less ventilation emissions in 2000.

In recent years, the rate of methane recovery from CMM drainage has been roughly 27-30 percent on average, with only 25 percent of active mines utilizing degasification system as of 2009. Drained CMM from mines that have degasification systems in the Pechorskiy and Kuznetskiy basins has methane concentrations of 25-60 percent. CMM at the higher end of this range can be supplied to fuel industrial boilers to generate steam or hot water, if suitable sites are located close to the coal mines. This is the most common application in Russia (IEA, 2009). As of 2008, total methane drained from mines in the Kuzbaas and Pechora basins was estimated to be 320 million m^3. Being drained primarily for the purpose of safety, the recovered methane has typically been of poor concentration (less than 25 percent). Currently, methane drained from the Vorkuta mines in the Pechora basin is being used for boiler fuel (40 million m^3 in 2006) (IEA, 2009).

Siberian Coal Energy Company (SUEK), which, in 2009, developed several CMM recovery and utilization projects at up to five coal mines and submitted the projects for registration under the UNFCCC Joint Implementation. According to the project's Monitoring Report, the CMM reductions equated to 98,887 $MTCO_2e$ from 2009 to 2011 (SUEK, 2011). Another mining group, Yuzhkuzbassugol United Coal Company, a division of the EVRAZ steel and mining group, is the eighth largest underground coal producer in Russia, producing approximately 11 million tons in 2012. Two of Yuzhkuzbassugol's eight coal mines operating in the Kuzbass—Alardinskaya and Uskovskaya coal mines—operate within the Kemerovo Oblast about 200 km apart, and both mine high-grade thermal and coking coal from carboniferous strata and are highly gassy.

The following summarizes select CMM-related activities completed and/or underway in Russia:

- CMM project potential was studied by the not-for-profit organization Uglemetan and by ICF Consulting Ltd. Their joint involvement resulted in a United Nations Development Program/Global Environment Facility project titled "Russian Federation - Removing Barriers for CMM Recovery & Utilization," which started in 2003 and ended in December 2010. The project financing amounted to 8.3 million USD. The project sought to mitigate GHG emissions by removing barriers to implementing and financing CMM recovery and utilization projects in Russia. Its initial focus was on the Kuzbass region, with replication potential expected in other coal-producing areas in Russia and elsewhere (Uglemetan, 2010).
- Plans for a CMM project at active and abandoned underground mines in Prokopyevsk, Kuzbass were initiated in 2010 and continue to date are in development. The recovered methane is intended for use in boilers for heat generation. The potential methane reduction is estimated to be 2.0 million m^3 or 29,346 Mmt CO_2e (GMI, 2010).
- A pre-feasibility study was conducted for two of Yuzhkuzbassugol's eight coal mines operating in the Kuzbass—Alardinskaya and Uskovskaya coal mines in 2012 and 2013. This study is now available from GMI, both in English (http://www.epa.gov/cmop/docs/Yuzhkuzbassugol-Mines-PFS-Jan2014-ENG.pdf) and Russian (http://www.epa.gov/cmop/docs/Yuzhkuzbassugol-Mines-PFS-Jan2014-RUS.pdf).

30.2.2 CMM Emissions from Abandoned Coal Mines

There are 43 abandoned mines in the Kuzbass, 39 of which are monitored for methane concentrations. Methane is registered at 32 mines, 14 of which have dangerous levels of methane gas and 5 with methane concentrations that could be explosive (Uglemetan, 2005).

30.2.3 CBM from Virgin Coal Seams

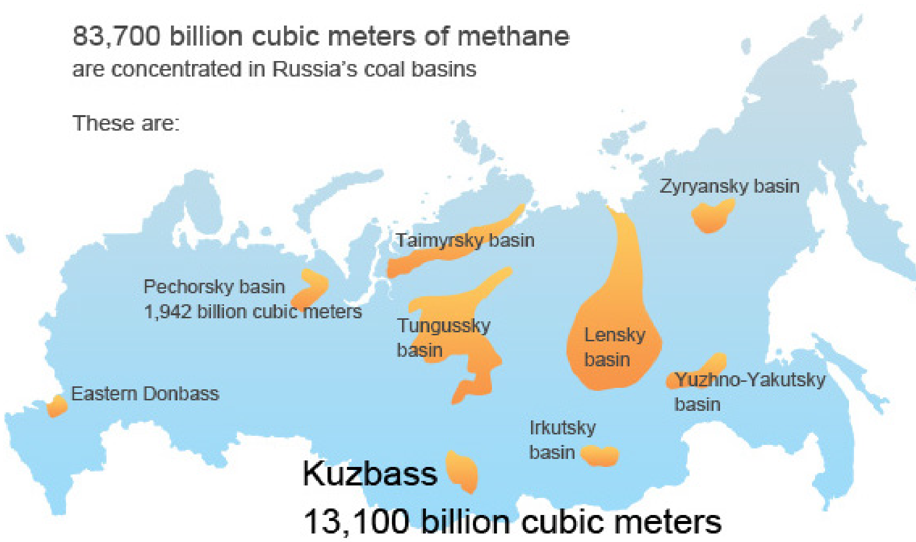
Russia is estimated to have significant CBM resources – more than 80 trillion m^3 in coal seams, with the Kuzbass basin providing possibly one of the largest CBM resource development opportunities in the world. Gazprom estimates more than 13 trillion m^3 of CBM in Kuzbass (see Figure 30-4), accessible at 1,800 – 2,000 m depth (Gazprom, 2014). Another source estimates Kuzbass CBM resources to be 94 billion m^3 in active degasification areas and 120 billion m^3 in areas where degasification is expected to be conducted in the future, for a total of 214 billion m^3 (M2M Workshop – Russia, 2005). The Pechora basin's CBM resource is estimated at 2.26 to 3.40 trillion m^3, but the area's harsh climate may limit exploitation of this resource. Overall, CBM resource is estimated at 48 trillion m^3. The breakdown for individual basins is provided in Table 30-8 (M2M Symposium – USA, 2006). It is estimated that if appropriate technology is deployed and if an economic environment favorable for CBM is created, Russian CBM production could increase to up to 2 billion m^3 per year (M2M Workshop – Russia, 2005).

Table 30-8. Estimate of CBM Resources

Basin	CBM Resources (trillion cubic meters)
Kuzbass	13.085
Pechora	1.942
Eastern Donbass	0.097
South Yakutia	0.92
Ziryank	0.099
Tunguska	20.0
Lensk	6.0
Taymir	5.5
Total Resources	**47.643**

Source: M2M Symposium – USA (2006)

Figure 30-4. CBM Distribution in the Kuzbass Basin in Russia



Source: Gazprom (2014)

The following activities are advancing CBM development in Russia:

- Between 2008 and 2009, Gazprom initiated a pilot operation at eight exploratory wells in Taldinskoye field in the Kuzbaas basin and by 2010, the recovered CBM was being supplied to gas filling stations. In 2011, the daily gas production from the Taldinskaya area totaled 20 thousand cubic meters, and Gazprom aims to reach 4.0 billion m^3 of CBM production from expanded operations by 2021. Two CBM-fired reciprocating-engine power plants have also been commissioned at the Taldinskoye field, which make it possible to supply electricity to the Taldinsky coal strip mine. In February 2012, the Central Commission for Hydrocarbon Fields Development under the Federal Subsurface Use Agency approved the Development Plan by Gazprom Promgaz for the pilot commercial development of the southeastern part of the Taldinskoye CBM field (Gazprom, 2014).

- In early 2005, the Rosnauka (Federal Agency for Science and Innovation or FASI), a federal agency in the Ministry of Science and Higher Education, began an effort to accelerate CBM/CMM development projects to improve mine safety and reduce GHG emissions. This activity involved improving stimulation techniques to enhance methane desorption and drainage, improving methane production and utilization technologies, organizing a scientific and educational center for CBM/CMM development and coordinating same with foreign experts, and developing a CBM/CMM business plan (M2M Workshop – Beijing, 2006). FASI was disbanded as an independent agency in March 2010, but its operations were rolled back into the Ministry (ERAWATCH, 2013). One of FASI's projects, which started in 2007, is a joint operation with private industry (Siberian Coal Energy Company) and implemented by the IPKON RAN research institute. The project will develop operating procedures for CMM recovery for use in gassy mines. The procedures will conform to the Kyoto Protocol, increase productivity of coal seams with high gas content, and use CMM to generate electricity, heat and emission reductions for carbon trading (IEA, 2009). The project is on-going and will be used as a model for future projects.
- Uglemetan works actively to promote the development of CBM recovery in Russia by providing information and assistance to interested companies and government agencies. The non-profit organization was formed in 2002 expressly for this purpose. Under a 2011 GMI grant, Uglemetan has embarked on a project aimed at improving the measurement of ventilation air methane (VAM) emissions in the Kuznetsk Coal Basin (Kuzbass) that will lead to the use of VAM as a potential clean fuel for energy production. A forthcoming pre-feasibility study will include definition of fuel gathering and delivery equipment plus utilization equipment, along with energy delivery systems. The focus of this work will be to perform an economic analysis showing the internal rate of return and net present value of the technology option applied for a real mine situation.

30.3 Opportunities and Challenges to Greater CMM Recovery and Use

The collapse of Soviet-era industry saw Russia's GHG emissions drop nearly 40 percent from 1990 to 1998 (Yale, 2011). Russia ratified the Kyoto Protocol in 2004, and accepted a GHG emission reduction target of 15 – 25 percent by 2020, with 1990 as its baseline emissions (UNFCCC, 2010). Russia is also a participant in Joint Implementation (JI) projects under Kyoto, the first of which— an energy-efficient power plant near Moscow—was approved in 2010.

Table 30-9. Russia's Climate Change Mitigation Commitment

Agreement	Signature	Ratification
UNFCCC	June 13, 1992	December 28, 1994
Kyoto Protocol	March 11, 1999	November 18, 2004

Source: UNFCCC (2014)

Russia saw a major shift in its climate policy in 2009, when the government released its "Climate Doctrine" recognizing the anthropogenic nature of climate change and announcing long-term emission reduction targets at least 50 percent below 1990 levels by 2050 (Yale, 2011). A 2009 government report was also the first to acknowledge the economic benefits from climate change mitigation, (e.g., avoided floods, wildfires, permafrost melt) outweigh potential climate change-induced gains (e.g., Arctic Shelf access, increased agricultural productivity). In 2011, then Prime Minister Putin adopted the "Comprehensive Implementation Plan of the Climate Doctrine by 2020," which included adaptation and mitigation measures, as well as efforts on education and long-term GHG scenarios. Though the Russian government continues to voice support for climate change mitigation, many of these promises have yet to be translated into effective domestic laws and policies.

30.3.1 Market and Infrastructure Factors

Table 30-10 lists total consumption by potential CMM markets in Kuzbass. According to a 2009 report, CMM recovery and utilization is a huge economic opportunity in Russia and estimates 130 million USD in revenue if all of its 1.9 billion m^3 CMM were to be recovered and used (based on 2008 regulated wholesale natural gas prices in Russia) (IEA, 2009). However, safety concerns would remain the principal driver for CMM projects.

Table 30-10. Total Consumption by Potential CMM Markets

Market	Electrical Power (million kilowatt hours)	Thermal Power	Natural Gas
All sectors*	21,343	31,113	3,010
Industry	18,387	23,940	2,971
Fuel industry	4,385	5,570	N/A

Source: *Tailakov (2004)

Russia has many barriers to expanded CMM/CBM development. First, CMM and CBM must compete with large, in-country proven gas resources with low-cost production capacity. Second, state regulations keep the large gas supply at a low sale price, making it difficult for a CMM project to achieve financial viability. Further, power generation projects are not usually financially viable due to historically low power prices. Moreover, technological challenges continue from the extraction of CBM economically from saturated, low-permeability coal seams.

However, there are many positive aspects that favor CMM development in Russia. Mining and geological conditions are similar to those in Australia, Canada, and the United States. Further, expected CBM production rates are promising and natural gas infrastructure and markets exist within 20 to 100 km of high-priority CBM/CMM production areas (M2M Workshop – Russia, 2005). Also, domestic power prices have doubled over the past 10 years and now appear to be in line with global power prices. The power price in 2013 was expected to be $89/MWhr with inflation or $62/MWhr without inflation (i.e., prices are trending upward). Russia is also working toward establishing a favorable legislative climate for CMM development (see below).

30.3.2 Regulatory Information

The institutional oversight of CMM recovery and use in Russia is managed at the federal and regional levels. However, no one institution at either the federal or regional level is directly charged with addressing the issue of CMM utilization. This lack of coordination or management within government is a key challenge to the enhanced recovery and use of CMM in Russia. Regional authorities (part of regional administrations) monitor activities of coal companies and issue licenses for subsoil use (IEA, 2009).

CBM, like any other mineral resource in Russia, is owned by the state. A license is required for methane extraction. There are three types of licenses: exploration license, production license, and combined license. The license is applied for at the Territorial Authority representing the Federal Ministry of Natural Resources, which publishes a tender announcement. The tender is held with a minimum starting price determined by the Federal Agency and it typically takes about a year to obtain a license. As for CMM, licensing for ownership and use currently lacks clarity, which hinders investments from third parties looking to utilize the recovered gas. Licensing processes for CMM activities are also unclear. While an additional license is not required for CMM recovered from and used within the mine, new mineral extraction licenses are needed if the recovered CMM is sold to another party or used for heat and power generation which is sold to another party (IEA, 2009).

Russia offers significant opportunity for foreign investment in CMM projects because of its large CMM resources and a significant market for clean energy. Although rules and regulations on foreign investment in Russia are complex, the investment climate is improving (Tailakov, 2005). CMM projects are expected to be pursued through Production Sharing Agreements (PSAs), which provide exemptions from all federal taxes with the exception of certain payments for subsoil use, a modified profits tax, VAT and excise on domestic purchases, and unified social tax during the period of PSA validity (Uglemetan, 2004). Methane extraction from virgin seams and sale is taxed at 7 percent and is subject to a single license fee. There are no royalties if methane is used for the mine's onsite needs. Uglemetan, as an organization devoted to the promotion of CMM and CBM development projects, provides investors with the latest information on the current investment climate in Russia.

Russian mines are subject to safety regulations but lack the resources to ensure their enforcement. A "Guide for Safe Operation of CMM Energy Units" has been prepared by the local mine safety institute in Kuzbass to provide guidelines to coal mines for the safe installation of CMM recovery and utilization systems. According to the regulations, drained gas must have a minimum methane concentration of 30 percent to ensure that it is not within the explosive range. In addition, the regulations cover various aspects of flame safety (e.g., using flame arresters).

Russia's recent regulatory and energy market developments are poised to stimulate CMM utilization on a larger scale. Initiatives such as a government decision on gradual price increases for natural gas for industrial and residential users, liberalization of the electricity market, and renewable energy targets inclusive of CMM, will facilitate the creation of a market where CMM could become competitive with other energy sources. The Decree on Main State Policy Areas to Increase the Energy Supply from Renewable Power Generation by 2020, passed in January 2009, has specifically incentivized CMM recovery and use by setting targets for increased share of renewable energy—inclusive of CMM—in the electric power supply. More supporting regulations and clarity are needed, though, to further leverage this legislation for CMM development (IEA, 2009).

30.4 Profiles of Individual Mines

Alardinskaya Mine, Kuzbass

Total no. of coal seams: 38, two of which are mined

Thickness of mined seams: Average – 7.6 m; Range 5.3 – 10.0 m

Overburden: Thickness – 700 m ; No. of seams – #6 and #3a

Coal reserves: 160.9 million tonnes

Coal quality and rank:	Ash (%): 16 - 19	Sulfur (%): 0.04 - 0.40
	Heating Value (kcal/kg): 8,600	Volatile Matter (%): NA
	Moisture (%): NA	Rank: high volatile bituminous

Yubileynaya Mine, Kuzbass

Total no. of coal seams: Six, one of which is currently mined

Thickness of mined seams: Average – 2.67 m; Range 1.85 – 3.55 m

Overburden: Thickness – 300 m ; No. of seams – #50

Coal reserves: NA million tonnes

Coal quality and rank:	Ash (%): 6.9	Sulfur (%): 0.54
	Heating Value (kcal/kg): 8,223	Volatile Matter (%): 37.1
	Moisture (%): 5.5	Rank: high volatile bituminous

Source: USEPA (2013)

Although mining and methane emissions and recovery data is outdated, geologic profiles on more coal mines are available in "Reducing Methane Emissions from Coal Mines in Russia: A Handbook for Expanding Coalbed Methane Recovery and Use in the Kuznetsk Coal Basin" at http://www.epa.gov/cmop/docs/int005.pdf (USEPA, 1996).

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