The Development of the Oil-Gas Cluster in Primorsky Krai: Perspectives, problems, restrictions

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Summary

Oil and gas transportation and petrochemical processing is a new branch of economic specialization for Primorsky Krai, Russia. The authors describe its main infrastructural elements including: oil and gas pipelines to deliver crude oil from the deposits in Eastern Siberia and gas from Sakhalin; sea oil-reloading terminals on the coast of the Sea of Japan; and projects for the construction of oil and gas chemical enterprises and gas liquefaction. In addition, among the priority issues arising from the oil and gas cluster development in the region they highlight: 1) exclusive orientation toward the export of crude oil and gas, and the output of the planned processing enterprises; and 2) the potential environmental consequences. Two examples of the changing of the location of planned facilities of the oil and gas chemical cluster are due to their possible environmental impacts and the public concern voiced.

Keywords: oil and gas pipelines, sea terminals, petrochemical processing, deployment, environmental restrictions

In Primorsky Krai the elements of the oil and gas cluster, a new branch of the krai's specialization, have started to form in recent years (since 2008). The perspectives of development of the oil and gas cluster in the eastern areas of Russia are stated in the Governmental Program of Development of the Far East and the Baikal Region.[1] The basic direction for development of the oil and gas sector in the eastern areas of Russia will be coordinated with the general trends for power sector development in the Asia-Pacific region (Korzhubaev et al, 2011). In the Strategy for the Social and Economic Development of Primorsky Krai up to 2025,[2] the creation of the cluster for transportation and the deep processing of raw hydrocarbon materials is considered as one of the major directions of the krai's development, aimed at the formation of a new quality to its economy.

The composition of the oil and gas cluster of Primorsky Krai is comprised of the following components:

Existing facilities:

- the eastern portion of the main oil pipeline: Eastern Siberia-Pacific Ocean (ESPO-2) within Primorsky Krai;
- the sea oil-reloading terminal in Kozmino Bay;
- the Sakhalin-Khabarovsk-Vladivostok (SKV) gas pipeline.

Planned facilities (according to the Strategy and regional programs):

- the eastern oil-chemical complex (EOCC) in the settlement of Pervostroiteley, near the city of Nakhodka;
- the liquefied natural gas (LNG) plant in Perevoznaya Bay, Khasansky District;
- the gas pipeline toward the border with the Democratic People's Republic of Korea.

The development of the petrochemical industry in Primorsky Krai (Figure 1) is based upon oil and gas resources from Eastern Siberia, Southwest Yakutia and the Sakhalin continental shelves.

It should be noted that in the period 1990-2000, the re-valuation began of Primorsky Krai's perspectives on its own oil and gas, both onshore and on the continental shelf of the Sea of Japan. In some authors' estimation the preliminary

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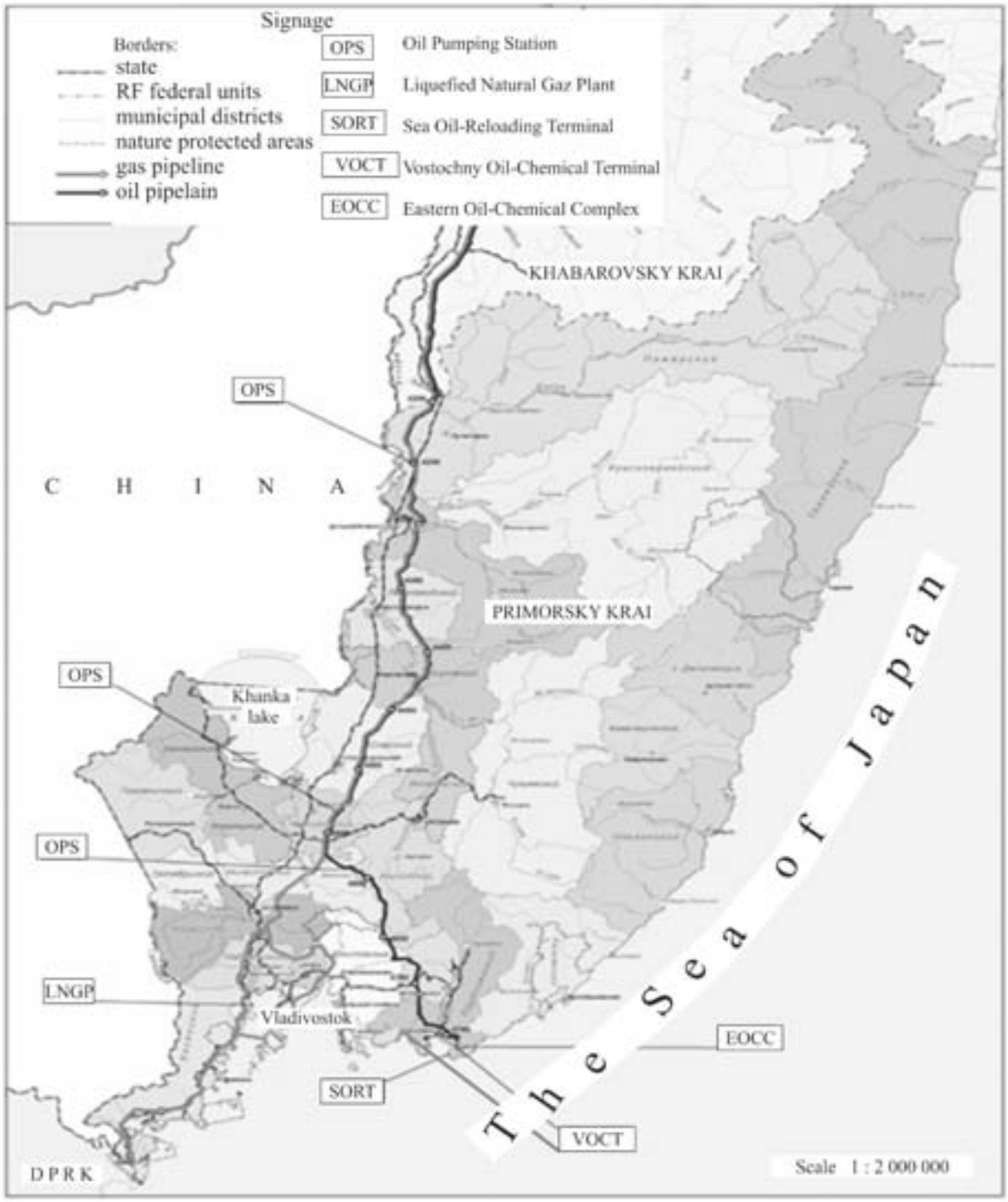
The article was prepared under the grant of the Russian Scientific Fund No. 14-18-03185
[1] Adopted by the government of the Russian Federation on 29 March 2013, Order No. 466.
[2] Adopted by Primorsky Krai's legislative body on 20 September 2008, No. 324-K3.

Figure 1: The Oil and Gas Chemical Cluster in Primorsky Krai



forecast for oil reserves there varies in the range 10-150 million tonnes (Sorokin et al, 2001). The developed infrastructure and currently created capacity for oil-gas processing in Primorsky Krai allow us to assume that in the more remote perspective more detailed prospecting work can be conducted there. If the results are positive, drilling for even small oil deposits and gas in the region will probably be economically expedient.

At present the following units of the oil and gas cluster are being built in Primorsky Krai.

Oil Pipeline

The eastern part of the ESPO-2 oil pipeline running through Primorsky Krai's territory to Kozmino Bay near Nakhodka had been finished in September 2011. There, at the endpoint of the ESPO-2 oil pipeline, in Kozmino Bay, a large sea oil-reloading terminal (LLC *SpecMorNeftePort Kozmino*) has been constructed.

The oil pipeline from Skovorodino to Kozmino stretches for 2,100 kilometers. The extent of the oil pipeline within Primorsky Krai totals 544 kilometers. Three oil-

pumping stations (OPSs) in the town of Lesozavodsk, the village of Gorny Khutor in Chernigovsky District and the village of Ivanovka in Anuchinsky District ensure the functioning of the oil pipeline in Primorsky Krai.

On 25 December 2012, the OJSC Transneft finally put into operation the ESPO-2. The capacity of ESPO-2 totals 30 million tonnes of oil per year, with a subsequent increase of up to 45-50 million tonnes.

In the future, the capacity of the ESPO-2 can be increased to 80 million tonnes of oil per year.

The Kozmino sea oil-reloading terminal (SORT) is located in Kozmino Bay in Nakhodka Gulf, on the territory of the Nakhodka municipal district, 30 kilometers from the city. It was opened on 28 December 2009. Until the pipeline was constructed, crude oil was delivered by railway to the oil-reloading railway station Gruzovaya, and then transported through 23 kilometers of underground pipeline to the terminal in Kozmino Bay.

The terminal allows the loading of tankers at the bulk-oil pier with a load displacement from 80 to 150 thousand tonnes. It represents a complicated oil-reloading complex consisting of two oil piers with a length of 300 meters. It has a technological overpass suitable for loading tankers with oil; oil tanks, railway drain overpasses and a system of connecting pipelines, coastal units for servicing the oil terminal (tens of civil and industrial constructions providing oil loading) and various conveniences, such as power, communications, water supply, sewers and other things.

In 2010 the terminal processed 150 foreign tankers with a load displacement of up to 100 thousand tonnes. Thus, that year 30% of the oil exports was shipped to Japan; 29% to the Republic of Korea; 16% to the United States; 11% to Thailand; 8% to China, 3% to the Philippines, and 2% to Singapore. By the end of 2012 oil exports were mainly to Japan at 31%, China 24%, and the United States 22%. In total, from December 2009 to March 2013, about 50 million tonnes of ESPO oil were shipped to the Asia-Pacific region.

In preparation for the launching of ESPO-2 a second oil pier with a loading capacity of up to 120 thousand tonnes has been commissioned.

Out of the 21 million tonnes of oil planned to be exported from Kozmino SORT in 2013, 18 million tonnes should arrive by the main ESPO-2 oil pipeline and 3 million tonnes by railway from Skovorodino. According to the Transneft company, oil deliveries to Kozmino by railway, about 3-4 million tonnes per year, will continue in the near future.

Kozmino SORT is referred to as a facility of the second degree in terms of danger. The environmental audit according to the ISO 14001:2004 standards has been implemented within the terminal. There is engineering equipment for the recuperation of oil-product vapors emitted by tankers. The sea booms are set at a radius of 30 meters during the processing of oil tankers so as to prevent possible oil spills spreading in the bay waters. Industrial drains enter treatment facilities located on the oil depot's site. Permanent control over the level of contamination of the ballast waters dumped by tankers is carried out by experts from the ecological analytical laboratory.

To monitor the environmental condition of the waters of the bay, in October 2010, not far from the bulk-oil pier of Kozmino SORT, ecologists from the Transneft Company created a specific bed of sea scallops and other hydrobionts as bio-indicators for the clarity of the water. They are able to accumulate polluting substances within their bodies and by that testify to the ecological conditions of the surrounding aquatory. Periodic samples of water, soil and the tissues of aquatic organisms in the course of the monitoring showed that the presence of hydrocarbons within them does not exceed background values (Environmental Safety, 2013).

Oil Refining and Petrochemistry

Construction of the "Eastern Siberia-Pacific Ocean" pipeline system gives an opportunity to create oil-refining and petrochemical industries in Primorsky Krai, mainly of export significance.

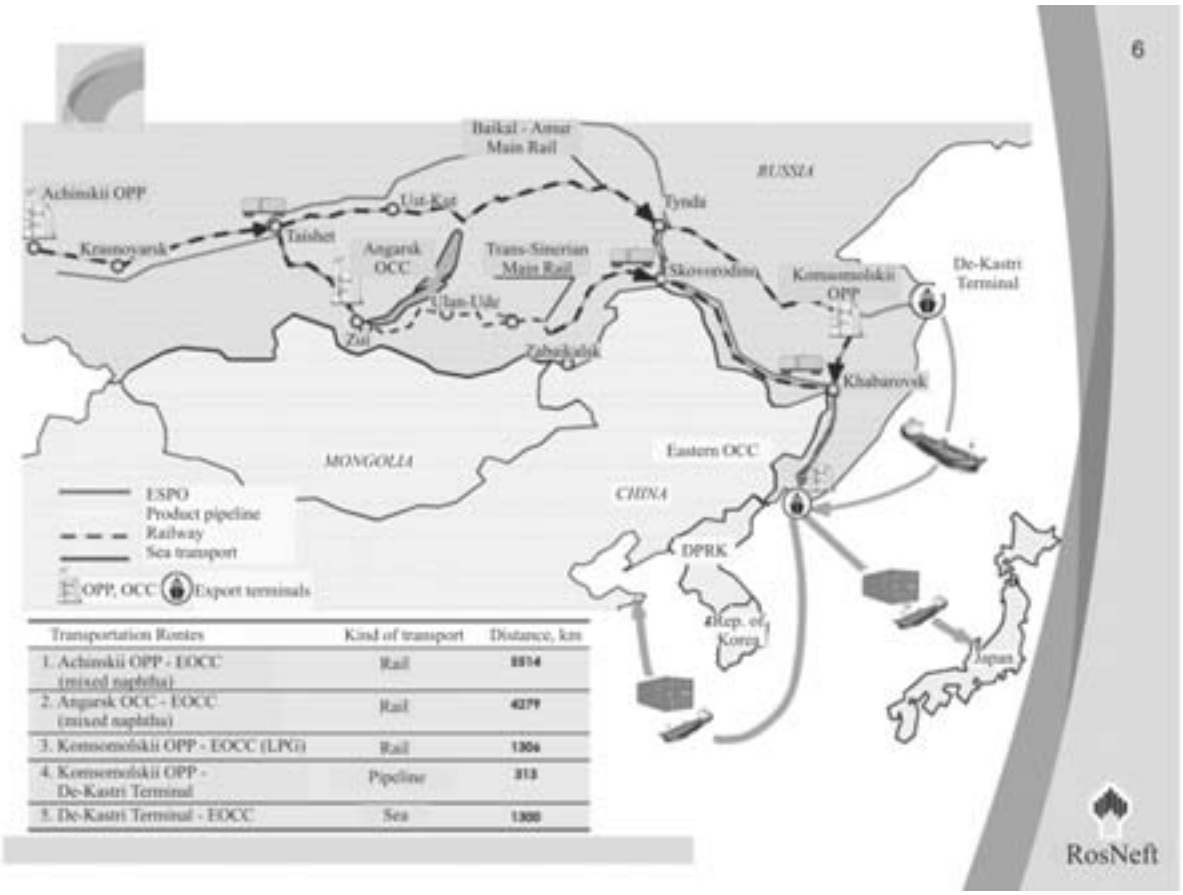
It was originally planned to construct an oil-refining plant with a capacity of 20 million tonnes near Vostok Bay, to the west of the city of Nakhodka, but ecologists greatly objected to it. Economists were also concerned with this problem (Minakir et al, 2010). In 2010 these plans were corrected. At present it is proposed to build the Eastern Oil-Chemical Complex (EOCC) which will process up to 10 million tonnes of hydrocarbon raw materials. The complex is intended to be located a little to the east of the city of Nakhodka, near the settlement of Pervostroiteley on the coast of Vrangel Bay and near Vostochny Seaport within Nakhodka municipal district. This is the endpoint of the ESPO oil pipeline, and it draws few objections in terms of environmental impact.

Designing of the EOCC was finished by the *OmskNefteKhimProekt* Institute in 2012. The CJSC Vostochnaya Oil-Chemical Company (VOCC), a daughter company of Rosneft, is engaged in the project's realization.

It is planned to realize the project for the construction of the EOCC, with a total processing capacity of hydrocarbon raw materials of up to 10 million tonnes per year, in three stages. The preliminary capital expenditure totals 173.2 billion rubles. The total area, on which the enterprise itself, the sea terminal, a water reservoir and other units will be located, covers 1,680 hectares. In the first stage the complex will process mixed naphtha and liquefied hydrocarbon gases from the enterprises of Rosneft situated in the cities of Achinsk, Angarsk and Komsomolsk-on-Amur (about 3.5 million tonnes of raw materials per year). In the second stage (with completion in 2018) processing of 5 million tonnes of oil will be added from the ESPO pipeline to produce gasoline, diesel oil and kerosene. In the third stage the complex will also start to process 1.5 million tonnes of gas condensate from the Sakhalin-III Project. In total it will process up to 10 million tonnes per year (Figure 2 and Table 1). Recently a new EOCC project with a total processing capacity of up to 30 million tonnes per year to be located near Vostok Bay is being developed.

The main profile of EOCC is to output polymers (polyethylene and polypropylene) in granules, and also benzene, olefins, alpha-olefins, mono-ethylene-glycol, and pyrolysis pitches. Its production is planned to be exported to both the foreign and domestic markets. Being considered

Figure 2: The Scheme for Oil Deliveries and Shipment of EOCC Products (from *OmskNefteKhimProekt* materials)



Transportation Routes	Kind of transport	Distance, km
1. Achinskii OPP - EOCC (mixed naphtha)	Rail	8574
2. Angarsk OCC - EOCC (mixed naphtha)	Rail	4279
3. Komsomolskii OPP - EOCC (LPG)	Rail	1306
4. Komsomolskii OPP - De-Kastri Terminal	Pipeline	313
5. De-Kastri Terminal - EOCC	Sea	1300

Table 1: Planned Output Items at the Eastern Oil-Chemical Complex

Raw Materials	Term	Output in Tonnes per Year	
The First Stage			
Processing of 3.4 million tonnes/year of mixed naphtha and liquefied hydrocarbon gas from the eastern oil refining factories of Rosneft	To 30 December 2016	Polyethylene	750,000
		Polypropylene	813,000
		Mono-ethylene-glycol	700,000
		Alpha-olefin	13,000
		Butadiene	198,000
		Pyrolysis pitch	58,000
		Benzol	43,000
		Pyrolysis gasoline	581,000
The Second Stage			
Crude oil: 7 million tonnes/year naphtha and liquefied hydrocarbon gas The oil refining factories of Rosneft: 2.2 million tonnes/year	To 30 December 2017	Polyethylene	850,000
		Gasoline	590,000
		Diesel fuel	1,850,000
		Kerosene	720,000
		Bunker/Boiler black oil	1,000
		Sulfur, granulated	10,000
		Para-xylene	590,000
		Styrene	390,000
		Mono-ethlene-glycol	700,000
		Butadiene	200,000

Source: *OmskNefteKhimProekt*

are perspectives on the creation of supplementary production on the basis of the EOCC to process polymers into consumer and industrial goods of a wide variety: i.e. from handles and chairs to the details of spacecraft.

The realization of the large investment project for the construction of the oil chemical complex will have a positive impact on the social-economic development of the territory of Primorsky Krai, including:

- the attraction of investment to Primorsky Krai;
- the creation of new engineering and municipal infrastructure facilities in the south of Primorsky Krai (water supply, electric power transmission lines, a fresh water reservoir and waterworks, and roads);
- the attraction of new contractors and the creation of new workplaces, including those of a high caliber, in Primorsky Krai;
- the development of social infrastructure (the construction of residential dwellings, kindergartens, schools, hospitals, and roads);
- the increase of budget inflows at all levels due to tax revenues. For example, the expected cash inflow to the budget of Primorsky Krai and the local municipal budget over the period of construction from property tax, individual incomes tax, lands tax and land rent will total over 0.6 billion rubles. The expected tax revenues in the period of subsequent operation of the oil-chemical complex will total 11.4 billion rubles.

Within the EOCC project, the OJSC Rosneft plans to construct a marine terminal at Vostochny Seaport to transship petrochemicals and oil products, with a capacity of up to 11.1 million tonnes of bulk cargo per year on its final completion.

Of the above-mentioned volume of bulk liquid cargoes, 6.6 million tonnes of petrochemicals and petroleum products will be exported. At the same time, 2 million tonnes of naphtha will be delivered to the terminal.

It is planned to provide the terminal with piers to transfer petrochemical cargoes (polyethylene, polypropylene, and others) in containers, with a capacity of 1.5 million tonnes (150 thousand TEU) per year.

It is assumed that this terminal will be located on the base of the existing oil-chemical terminal of the LLC Vostochny Oil-Chemical Terminal (VOCT). This is the first stevedore company in Russia providing services in the complex reloading of liquid chemical and oil-chemical cargoes. This dock complex is located in the central part of Vostochny Port, on the 39th pier, in Primorsky Krai's Vrangel Bay, near the city of Nakhodka. Vrangel Bay refers to the nonfreezing area of waters of the Sea of Japan, and is favorably located in relation to the countries of the Asia-Pacific region. The reloading complex occupies eight hectares, including its own railways. In addition, there are a further 20 hectares available for an increase in the reloading capacities of the complex.

Currently the reloading complex of VOCT is capable of transshipping 1.3 million tonnes of chemical and oil-chemical cargoes a year and to send it by either sea or rail.

The complex is characterized by unique measures providing environmental and handling safety. Technological facilities exclude the possibility of penetration of liquid chemical and oil chemical goods into water or soil.

The completed modern equipment and qualified staff of the reloading complex, a high degree of readiness and the convenient geographical position of the VOCT in the ice-free Vrangel Bay open new opportunities for manufacturers' dispatch of chemical and oil-chemical products to the developing markets of the Asia-Pacific countries.

Gas Pipeline

The first startup complex of the SKV main gas pipeline, with a capacity of 6 billion cubic meters a year, was put into operation in September 2011. LLC Gazprom Transgas Tomsk has been appointed as the major contractor to exploit the main gas pipeline. The length of the gas pipeline route is 1,350 kilometers. Taking into account the branches to Khasan, Vladivostok and Russky Island, its extent within Primorsky Krai totals 782 km. The system can provide transportation of up to 30 billion cubic meters of gas a year.

Within Primorsky Krai the routes of the oil and gas pipelines lie in parallel 230 km apart in the same corridor. The diameter of both pipes is 1,220 mm. The minimum distance of the oil and gas pipelines from the railway is approximately 500 meters, whereas the maximum one is some tens of kilometers.

The pipelines run through rugged terrain (in some places the hills are 300 meters high, and there are numerous river barriers, vast wetlands, and difficult seismic-tectonic conditions). The width of the open space for certain routes is 32 meters. The merged routes of the oil and gas pipelines run in a corridor from 80 meters to one kilometer, with differences in the height of terrain from 300 m to below 0 m (under the rivers).

According to the "The Program of Gas Supply Development of Primorsky Krai in 2011-2015", the following projects are planned: construction of a gas pipeline tapping the gas distribution station (GDS) Vrangel with an extent of 168 kilometers; construction of inter-settlement gas pipelines with an extent of 556 kilometers; gasification of 20 municipalities of Primorsky Krai along the main gas pipeline and a gas pipeline tapping GDS Vrangel (toward the city of Nakhodka); gasification of the Primorye Gambling Zone (the city of Artem); and gas supply pipelines to the Artem thermal power station, a gas-chemical and oil-chemical factory (the city of Nakhodka), the Nakhodka thermal power station, and a gas-processing factory (Khasansky District).

There are plans to build a gas pipeline from Russia through the Democratic People's Republic of Korea to the Republic of Korea. In September 2011 Gazprom and the ROK company Kogas signed up to a road map on the realization of the project for gas deliveries to the Republic of Korea via a gas pipeline (Figure 3).

It is supposed to commence gas deliveries in 2017. The total extent of the gas pipeline will total 1,100 kilometers. Realization of this project will allow gasification of the power facilities in the Khasansky District of Primorsky Krai.

Almost half of the gas pipeline route, about 240 kilometers (at the construction sites of LLC

Figure 3: Schema for the Planned Realization of the Eastern Gas Program (according to Mr. Kayuk Yu, Rosneft)

StroiGazMontazh), passes through seismically dangerous areas. For the first time in Russia, a geotechnical monitoring system to watch the ground and pipe movements in real time has been established there.

In Primorsky Krai, 128 kilometers of the gas pipeline has been laid in mountainous areas characterized by big differences of elevation. In Primorsky and Khabarovsky Krais the gas pipeline route crosses zones of active tectonic faults, which was also taken into consideration in determining the construction technologies.

Gas in the inter-settlement gas pipeline from GDS Vladivostok to Russky Island comes from the SKV main gas pipeline and is used as the basic fuel for the Vladivostok Thermal Power Station No. 2 (TPS-2) and for the heating and the power supply of the facilities for the APEC Summit 2012 (now The Far Eastern Federal University: FEFU).

Transfer of the Vladivostok TPS-2 from coal over to gas has already provided a more stable and reliable power supply for consumers in Vladivostok, and also it will significantly improve the environmental situation in the city.

In Primorsky Krai, a group of companies from LLC *StroiGazMontazh* carried out a unique (there is not any analog in the world) three-kilometer passage under the Bosporus Vostochny Strait using horizontal directional drilling in the process of the gas pipeline construction to Russky Island.

First gas from Sakhalin was supplied to Russky Island simultaneously with the start-up of the SKV main gas pipeline in September 2011. In May 2012, construction of the second (reserve) thread providing more stable supplies was completed.

Liquefied Natural Gas (LNG) Plant

Based on natural gas transmission to Primorsky Krai, construction of large gas-processing industries in the south of Primorsky Krai has been planned. In particular, the OJSC Gazprom plans to build a plant for production of liquefied natural gas (LNG) with a processing capacity of 26 billion cubic meters of gas a year in Perevoznaya Bay.

However, environmentalists were concerned once again on the siting of the LNG plant. In this area there are several protected nature areas (PNAs), and coastal water areas used for mariculture and recreation. Besides that, there are harder ice conditions here. In this regard some experts suggest considering alternative choices of location for this plant, including in Strelka Bay.

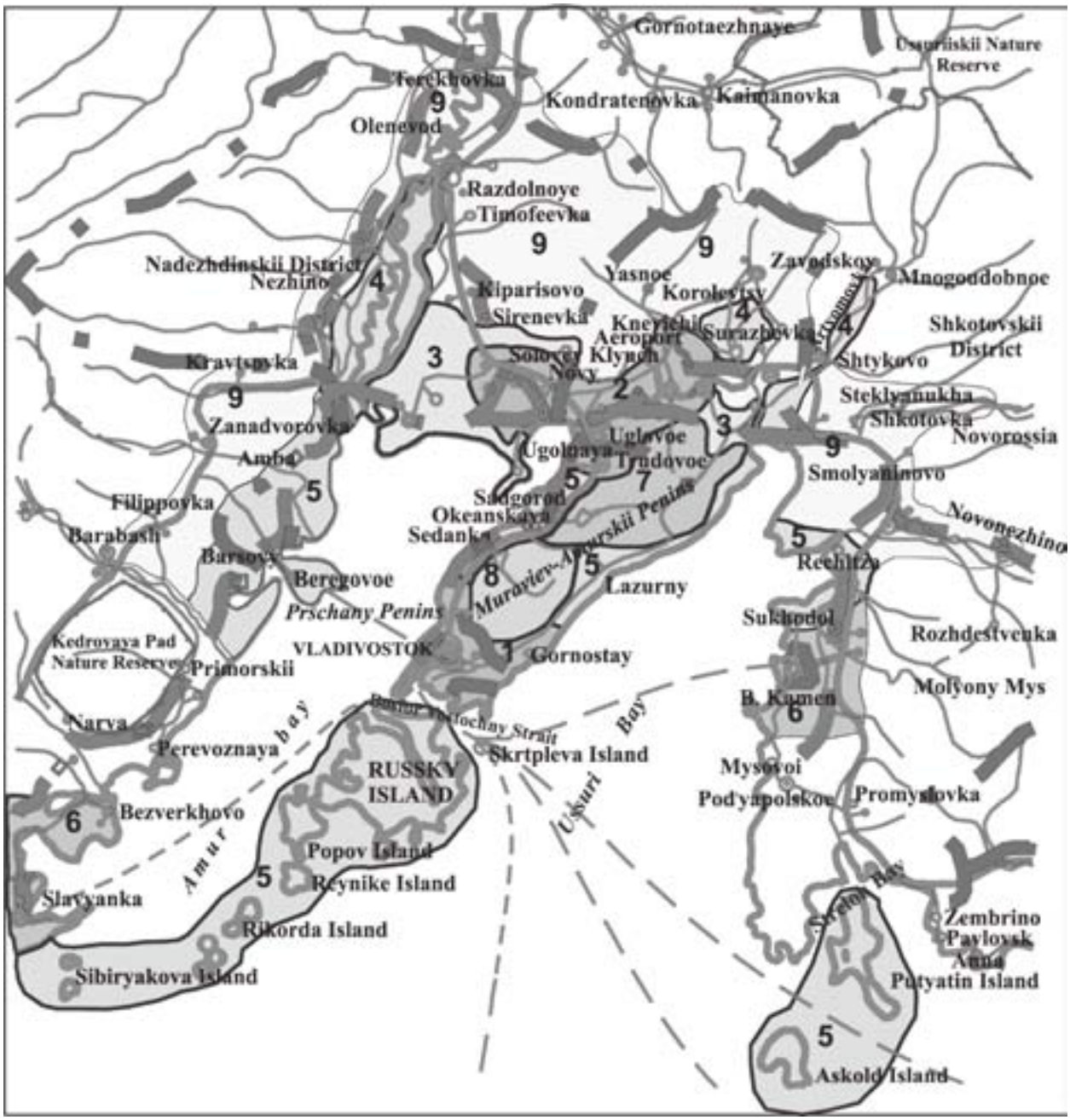
It should be noted that in a number of development programs for Primorsky Krai, development was suggested in Southwest Primorye of mainly recreational industries, nature conservation activities, and mariculture, as shown by the functional zoning of the southern portions of Primorsky Krai made by the Pacific Geographical Institute of the Far Eastern Branch of the Russian Academy of Sciences (FEB RAS) (Figure 4).

For example, discussion of these questions at the Presidium of FEB RAS (in March 2013) revealed that it makes sense: 1) to estimate more thoroughly the possible environmental consequences resulting from the LNG plant construction in Perevoznaya Bay, and; 2) to implement comparative evaluations of other alternative sites, for instance, near the settlements of Dunai-Fokino.

Priority Issues

The economic expediency of all these projects for the development of the oil and gas complex in Primorsky Krai is wholly based on the presence of a sufficient raw-material

Figure 4: Functional Zoning of the Territories and Water Areas of the Vladivostok Agglomeration



Map Key:

1. A business center (an Old City)
2. An industrial-settlement zone of "a New City" of the first degree of development
3. An industrial-settlement zone of " a New City" of the second degree of development
4. Water protection zones
5. Recreational zones
6. Zones of impact of agglomeration centers of the second order
7. Territory of a natural park (projected)
8. A "Green" mountain-forest zone with water protection functions
9. The periphery of Vladivostok agglomeration (*dachas*, agricultural sites, etc.)
10. The boundaries of functional zones.

base (East Siberia, Southwest Yakutia, and Sakhalin, etc), on access to new markets in the Asia-Pacific region, and also on the stimulation of the social and economic development of the Far East from these large investment projects. Moreover, Primorsky Krai has its own great demand for petroleum products too.

Nevertheless, it is necessary to emphasize that the development of the oil and gas cluster in the region is mainly focused on the export of crude oil and gas. For example, the satisfying of the extensive needs of Primorsky Krai in petroleum products and in gasification of the areas has been postponed until the second and third stages of the projects. The interests of various agencies (to build their own sea terminals, etc.) prevail in some cases.

Overall, realization of these projects will provide a certain amount of economic growth in the transportation and logistics sector, and in other related activities. It will promote the attraction to Primorsky Krai of some of the service centers and enterprises specializing in engineering and technological support for the oil and gas projects in Sakhalin and on the continental shelves of the Far Eastern seas, and various small businesses.

At the same time all these projects are bound up with considerable negative impacts on the environment and possible serious environmental consequences, especially in the case of accidents (Table 2). Both academic specialists and the general public are concerned about this issue.

It is necessary to emphasize that in designing all the facilities for the oil and gas chemical complex in Primorsky Krai (along the routes of pipelines and at industrial sites), large-scale engineering and environmental studies were carried out. They included:

- ●assessment of the hydro-chemical state of bodies of water;
- ●assessment of the existing state of soils and land resources;
- ●assessment of the existing state of the flora;
- ●assessment of the existing state of the fauna;
- ●collecting and estimation of data on PNAs, the hydro-biological condition of water currents, the sanitary status of the area, and the environmental situation (by Hydromet monitoring data), etc.;
- ●calculation of losses from and damage to the environmental components in the construction and operation of facilities.

These investigations were mainly carried out by institutes of FEB RAS (the Pacific Geographical Institute, the Institute of Pedology and Soil, the Institute of Water and Environmental Problems, the Institute of Biology of the Sea, and the Pacific Oceanological Institute). Such engineering and environmental studies included a large amount of field work (all of the pipeline routes and the industrial site areas), geochemical analyses of samples of soils, water, bottom sediments, assessment of environmental losses and possible damage.

A list of the studies and the main results is given below (Table 3).

Using the information from the engineering and environmental studies, detailed maps of scale 1:25,000, and in some places up to 1:5,000, have been compiled. Subsequently, based on these materials a state environmental impact assessment was conducted. In some cases the project's solutions have been changed. Two examples of the change in location of the planned facilities for the oil and gas chemical cluster, due to possible very serious environmental consequences, can be illustrated.

The first example. The initial site for the location of the marine reloading terminal (the endpoint of the ESPO) was planned for Perevoznaya Bay. However, the studies and assessments conducted primarily by specialists from FEB RAS revealed that the construction and functioning of this terminal in situ, and especially in the case of possible accidents with tankers, could lead to oil contamination of the coasts of the city of Vladivostok and Russky Island. It could also affect a number of PNAs, including Kedrovaya Pad Nature Reserve, a habitat for the Amur Leopard and Amur Tiger. In addition, highly dangerous invasions of alien species from ballast water could occur there. Modeling of the possible contamination of the coasts has been carried out in the case of an accident caused by oil spill occurring in Perevoznaya Bay (Amidin et al, 2007).

Taking into account the above-mentioned issues, the sea terminal project has been moved to Kozmino Bay, where it has been constructed and is in successful operation.

Table 2: The Main Possible Negative Impacts of the Oil and Gas Facilities on the Environment

Stages of Realization of Projects	Impacts on the Environmental Components				
	Ground, Soil	Surface Water	Vegetation	Fauna	Marine Ecosystems
1. Construction including:					
oil and gas pipelines,	+ +	+	+ +	+	+
oil and gas plants	+	+	+	+	+
2. Operation including:					
oil and gas pipelines,	--	--	--	+	+
oil and gas plants	+	+	+	+	+
3. Accidents including at:					
Oil and gas pipelines,	+ +	+ +	+ +	+	+ +
Oil and gas plants	+	+ +	+ +	+	+

Note: + = presence of impact; ++ = considerable impact; -- = absence of impact.
Sources: Amidin et al, 2007; Arzamastsev, et al, 2010; Solodovnikov, et al, 2011

Table 3: The Results of Engineering and Environmental Studies near the EOCC Facilities Carried Out by the Pacific Geographical Institute, FEB RAS

Facility	Facility's Area in Hectares	Assessed Components	Compiled Maps
An industrial site and a sanitary-protective zone	2,129.5	Water surface; Soil cover; Vegetation; Fauna; Radiation conditions; Current environmental state; Economic and geographical state; Sanitary and epidemiological conditions	Soil cover Vegetation Fauna Radiation situation: on a 1: 25,000 scale
A land portion of the sea terminal and a sanitary-protective zone	425.4		
Hydro-knots: the corridors under water pipes	3,661.8		
An area for industrial waste	196.9		
Total	7,613.6	28 kinds of estimations	24 maps

The second example. It was originally planned to locate a large oil refinery in the vicinity of the city of Nakhodka, near Vostok Bay. In this case the entire coast of the Bay, with its recreational value and unique biodiverse ecosystem, could suffer a dangerous technogenic impact. Based on the arguments of environmentalists and public opinion, it was decided to transfer the location of the oil-chemical factory closer to Kozmino Bay, to the east of the city of Nakhodka.

In conclusion, it is worth mentioning that practically all the facilities of the oil-gas-chemical cluster are environmentally dangerous, no matter where they may be located. By the sanitary classification accepted in Russia, almost all such facilities are referred to as of the first or second degree in terms of harm. All of them should have sanitary-protective zones, of 500 to 1,000 meters distance. Harmful technogenic impacts on the environment also occur in the process of the normal functioning of a facility (pipeline, terminal, EOCC, or LNG plant). These also should be minimized. However, the most dangerous technogenic impacts are the result of accidents, such as explosions, leakages, and spills, etc. They are not always evaluated fully at the design stage, and this is extremely important. Similar assessments of the hazards should be considered in the siting of infrastructural facilities, pipelines, and oil-reloading terminals, etc.

To obtain such estimations, specific calculations and modeling of a number of variants for location and function are advisable. Working groups of experts, including those from the institutes of FEB RAS, can and should be involved in these activities. Unfortunately, investors in Russia do not always apply to highly professional experts of the appropriate order. Sometimes such environmental assessments are carried out by organizations with a dubious capability in terms of experts and local knowledge. It complicates the passage of the pre-feasibility and design stages of the prospective schemes for local development and the realization of the specific oil and gas facilities planned, whereas they should be maximally adapted to the ecological and geographical features of the area of their location and operation. This last can minimize negative consequences for natural ecosystems and the degree of conflict in public relations, resulting from the construction and operation of the complex's facilities. Probably in this case it makes sense to elaborate additional regulations and decisions.

Thus, the development of the oil and gas cluster in Primorsky Krai will serve to give a significant momentum to its social and economic development as a whole. However, it is necessary to solve the important region-wide-level tasks related to large investment projects, such as:

- the overarching orientation toward the export of crude oil and gas;
- an exclusive focus on the export of petrochemical products;
- the dominance of departmental interests in the development of certain links of the oil and gas complex;
- insufficient attention to environmental factors and restrictions, especially at the pre-design stage;
- lack of highly-skilled engineers and workers for the enterprises of the oil and gas complex.

And, of course, all these projects should be based on the newest technologies and innovative solutions.

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