APPENDICES

Appendix 1.A Legislation and Russia's Energy Sector Development

Appendix 2.A Maps of Russian Oil Pipelines

Appendix 2.B Gas Turbine Prices Indexed by Heat Rate

Appendix 2.C Discussion on Rybinskye Engine Catalogue

Appendix 2.D Power Plant Costs

Appendix 2.E Corporate Ratings for Russian Oil Companies for Long-Term Investment

Appendix 2.F Costs for Competing Generation Technologies

Appendix 3.A Firms Producing Small Power Sets: Diesels, Gas Turbines, Engines, and Cogeneration Power Sets

Appendix 4.A Russian District Heating Information

Appendix 5.A Foreign Companies Working in Russia

Appendix 6.A Companies Working on Fuel Cells

Appendix 1.A Legislation and Russia's Energy Sector Development

Russia's transition to a market economy after 1985 was different for different sectors of the economy. Two important perestroika-era policies in the energy sector include:

- The Federal Law "On natural monopolies", adopted August 17, 1995, No. 147-FZ, defined principles, methods, and structure of natural monopolies regulation authorities, including those in the fuel-and-energy complex.

- In 1994, Russian Joint-Stock Company Unified Energy System (now well-known as RAO EES) was set up. RAO EES is now among the world's largest monopolies. Regional energy utilities got incorporated and became subsidiaries of RAO EES. The Russian government owns 51 percent of RAO EES.

In 1995-1996, Regulations for power flow between utilities were developed, which set up "Power and capacity wholesale market (FOREM)". FOREM united the largest power plants, including nuclear plants. The market situation required, that relations between market agents be regulated, and the Federal Public Utility Commission (FEC) was established in 1995-1996 to set rate policies and develop guidelines for RAO EES' development. Later on, regional public utility commissions (RECs) were established; most of them became legal entities before 2000. In 2000, this process came to an end. The Federal Committee for Anti-Monopoly Policy and Support for Small Companies was set up, and later on restructured into a Ministry with the same name.

On February 4, 1997, the Russian Federation adopted the law "On federal regulation of electricity and heat tariffs in the Russian Federation", along with Government Decree No. 121 "On the basics of rate design and federal regulation of electricity and heat tariffs". Currently, industrial consumers have a continuously developing "tariff menu" to choose from.

April 3, 1996, Federal Law "On Energy Efficiency" was adopted. Many regional energy efficiency programs were developed based on this Law. Part II of the RF Civil Codes was enacted, which describes basic problems regarding relations between energy utilities and consumers.

After Part II of the RF Civil Code had been enacted, it turned out that many provisions of other documents and energy supply contractual agreements do not comply with the Civil Codes. RF Government Decree No. 80 of January 24, 1998, created a Federal Program on "Energy Efficiency in Russia".

Finally, in 1999, public and large industrial enterprises were required to perform energy audits and start energy efficiency efforts. Over the years, energy consumers' rights have grown, providing a partial counterweight to the still powerful energy utilities.

<u>i. Independence and objectivity in regulations development</u>

- The Federal Public Utility Commission is formally independent from energy utilities, fuel suppliers, and transportation companies. An attempt was made in 1999 to subordinate the Federal Public Utility Commission to the RF Ministry for Anti-Monopoly Policy and

Support for Small Companies (in other words, to make it a structural part of the Ministry and later on to subordinate it to the Ministry of Economy). However, this effort failed. A Presidential decree, specifically signed to achieve this purpose, was cancelled the next day after a mass "attack" by Russian and foreign experts. At that time the Inter-Regional Association of Regional Public Utility Commissions (MAREC) was set up as an independent organization in opposition to the Federal Public Utility Commission. It was MAREC who actively opposed the idea of FEC becoming a part of the Ministry for Anti-Monopoly Policy.

- Energy tariffs in regions are set by regional public utility commissions, which are legally independent from FEC.

- Technical issues regarding energy supply and compliance with standards are regulated by the Federal Energy Inspection, which is part of the RF Ministry of Fuel and Energy and independent from utilities and fuel suppliers. It is also responsible for contractual issues between industrial consumers and utilities and for regulations development.

- The RF Ministry for Anti-Monopoly Policy and Support for Small Companies prevents natural monopolies from infringing upon the interests of energy consumers. The Ministry has representation offices in each region.

- Currently, Ministries responsible for specific economic sectors, as well as large holding companies, are stepping up their efforts to support enterprises they own.

Early 2000 was marked by the fact that the largest monopolies, including Gazprom, RAO-EES, oil, coal and partly railway companies have expressed understanding of a need for coordinated long-term energy conservation efforts.

ii. Energy supply to industrial enterprises

In the Former Soviet Union and in the Russian Federation, industrial power supply was performed in accordance with power supply agreements. The same worked for heat, water, and sewage. Many utilities have been keeping to the same, old contractual terms, although legislation has significantly changed. Moreover, at the dawn of "perestroika" regulations issued by the RF Ministry of Fuel and Energy strengthened the responsibility of consumers for compliance with energy supply contractual agreements.

The following provisions of these agreements created the greatest obstacles:

- In 1989, RF Government decree declared a 10-fold increase of costs of installed capacity and power consumed by industrial consumer beyond the limit set in the energy supply contract (this is a typical feature of the total economy regulation period).

- For late payment for capacity and/or power consumption, fines were imposed on industrial consumers in the amount several times higher than bank re-financing rate.

These “Regulations” were continuously criticized. In 1996, Chief Energy Inspection (Glavgosenergonadzor) of the RF Ministry of Fuel and Energy, which is responsible not only for reliable and safe energy supply to consumers, but also for regulation of contractual relations between enterprises and energy utilities, developed a new version of the “Energy Supply Regulations”, which had 5 editions over 4 years of coordination with federal and public organizations. The first edition of “Energy supply regulations” (1996) suggested that 5-fold, rather than 10-fold, penalties were introduced for exceeding contracted energy consumption amounts. The third or fourth edition supported double penalties.

Consumers have been arguing with this provision, and are currently introducing in energy supply contracts a term “compensation for actual proven damage caused to energy utilities by exceeding contracted energy consumption amount”. Similarly, consumers demand that actual damage caused by energy cut-offs and/or insufficient energy supply be reimbursed to them by utilities.

In early 2000, the old “Regulations” were called off, while the new version was still not put into effect. Therefore, Civil Code is the major document that provides a legal basis for energy supply contracts.

Some large holding companies have developed “Reference Energy Supply Contract” for their own production facilities. This Reference Contract may take into account the specifics of industries, especially in terms of energy supply by major monopolies: Gazprom and RAO-EES.

This Reference Contract aims at providing industries with the “backbone” for any energy supply contract with utilities.

iii. Arbitration

Energy supply contracts identify responsibility for violation of terms of contract. If parties to the contract cannot meet halfway, they apply to the Federal Arbitration Court. However, many disputable questions can be addressed if the Federal Energy Inspection (Glavgosenergonadzor) acts as a referee. There is a Department for Industries and Energy Utilities in the structure of Glavgosenergonadzor, which can provide a sophisticated solution to promote understanding between two parties.

Consumers are still reluctant to apply to the RF Ministry for Anti-Monopoly Policy, and even more so to the Arbitration Court. This unwillingness is to a large extent caused by traditional consumers’ reservations to confront large, powerful utilities and also by the multi-million ruble debts that many consumers owe natural monopolies, debts that emerged during the period of unregulated monopolistic price hikes.

iv. Tariff regulation

Previously, most Regional Public Utility Commissions (RECs) were not legal entities and were totally controlled by local governments. At this point, most RECs are registered as legal entities and are judicially responsible for their acts.

The Federal Public Utility Commission only provides recommendations to RECs in terms of tariff setting. Regional independence in tariff setting, and lack of professionalism at the RECs in

the past, have resulted in different electricity tariffs in Russia's regions for the same consumer groups (sometimes this difference may exceed 10-fold), in spite of the fact that almost all Russian energy utilities are united in Unified Energy System (EES) controlled by RAO EES, and that regional energy utilities (Energos) are subsidiaries of RAO EES. This huge tariff difference leads to a distorted market environment for industries located in regions with high energy tariffs.

Energy sector restructuring, which took place after energy price regulation policy was abolished, started with the abrupt growth of electricity tariffs, which ran ahead of the general inflation rate and price growth in other sectors of economy. Electricity tariffs were totally unbalanced because of a considerable increase in "beneficiary consumers" who received special discounts. In particular, electricity rates for industrial consumers grew excessively, and the industrial sector has been increasingly subsidizing families, agriculture, public buildings, etc. The same imbalance occurred in the tariff structure in the regions: in 1990, the minimum tariffs in Irkutsk (Siberia) and maximum rates in Kamchatka peninsula differed by 8 times; by 1999, this difference had reached 16 times. This is essentially cross-subsidizing of some regions by others.

Paradoxically, residential heat and electricity rates for consumers were lower than production costs. This difference was subsidized by local governments, which were reimbursed through higher industrial energy rates. For this reason, industrial consumers keep paying higher energy tariffs than the population, in spite of the fact that high voltage power is often supplied to industrial enterprises directly from power plants.

Three years ago necessary decisions were made to improve the situation. Residential tariffs and rates for "beneficiary consumers" are currently growing, and must reach actual energy production costs by 2003.

In 1998, the day/night rate differential was launched in the regions. For industrial consumers, the nighttime tariff is often 30 percent less than the daytime rate.

Residential nighttime energy tariffs in some regions of the Russian Federation will drop 7-fold.

Besides, electricity tariffs will be differentiated by power voltage. "Transportation component" will be specifically identified both in electricity and natural gas supply.

In late 1999 and 2000, some Russia's regions introduced electricity (and gas) tariffs for industrial consumers, differentiated by 1) production costs; and 2) power transportation costs.

Besides, natural gas tariffs were also differentiated by production and transportation components. For big consumers, electricity tariffs include transportation costs.

v. Electricity quality standards

In recent years, indexes, which illustrate energy consumption efficiency, have been included in 314 Government Standards (GOSTs). Another 15 major GOSTs were additionally drafted. New Building Codes require that thermal performance of residential, public, and industrial buildings be improved by 1.5-2 times.

GOST 13109-97 “Electricity. Electromagnetic compatibility of equipment. Power quality standards in electricity supply”. The GOST requirements correspond to international practices. They are included in power supply contracts.

vi. Connection charge

Connection charge regulations are just one of many examples of consumers’ rights violation.

Three years ago, energy utilities’ charge for repeated connection of industrial consumers (i.e. for re-connection after a plant was cut off for non-payment) was comparable to the construction costs of a distribution substation (importantly, electricity rates did not include this charge). An intense fight by associations of industrial consumers led to the abolishment of repeated connection charge by Order of RF Minister of Fuel and Energy and by Order of the President of RAO EES. Both these documents are obligatory for energy utilities.

vii. Energy market. FOREM

In 1995, the Government of the Russian Federation issued a decree on setting up the Federal Wholesale capacity and electricity market (FOREM). Russian utilities, a number of the largest power plants, and a single industrial consumer became participants in this market.

Since 1995, very few industrial consumers have joined FOREM. While railroads are very big energy consumers, they have not entered FOREM either. This is a direct consequence of opposition on the part of energy utilities and regional administrations, who worry that if railroads and industries become participants in the energy market, payments registration will be made via the Moscow Central Dispatching Department, and all related taxes would be paid to the Moscow budget. Decisions regarding setting up regional operators of the Wholesale energy market to work in Russia’s regions were discussed. When these regional operators are set up, taxes that they will be paying will stay in the regions, and regional administrations will no longer be in opposition. However, so far these decisions have not been made.

viii. Independent energy sources and energy producers

Like in many other countries, large industrial enterprises in Russia used to build their own co-generation plants. In recent years, pressure from energy utilities (monopolies) forced large enterprises to consider constructing their own power plants. Regional administrations of the Russian Federation are considering possibilities to include in their energy programs a sound share of decentralized energy supply.

ix. Energy Managers

In the Former Soviet Union, Energy Managers of industrial enterprises used to only assess energy consumption and modes to ensure industrial energy supply. Energy supply contract were not amended for many years, and was practically formalistic. Energy tariffs were low, and practically did not change either.

Even now, many energy managers know little of contractual practices, despite the fact that the share of energy tariffs and energy costs in the production costs has increased 2- or 3-fold.

However, in a number of cases some industrial energy managers managed to reduce energy costs as much as by 50 percent through effective negotiation!

Enterprises' lack of working capital and a number of other factors lead to a 20-30 percent average reduction of cash payments by industries of their energy bills. The rest was covered through production/service interchange. Under this system, the federal budget incurred considerable losses. To increase the share of cash payments for energy supply, President Yeltsin issued a Decree in 1998 to allow for 50 percent electricity and natural gas tariff reduction in case of monetary payments. While the Decree insisted that the tariff must not be below production costs, monetary relations of energy utilities and industrial enterprises were still structured according to the scheme: monopoly-to-consumer. However, on the regional level, public utility commissions (RECs) developed and coordinated with regional administrations lists of enterprises to receive benefits in accordance with the above Presidential Decree.

Importantly, when Anatoly Chubais became President of RAO-EES in 1999, the cash component in the structure of electricity payments doubled, and in 2000, RAO-EES set an ultimatum demanding 100 percent cash payments for utility services. In June 2000, payments collection accounted for 110 percent of services supplied.

Previously, RF Ministries used to control energy efficiency activities in Russia. Efforts were taken, and financing was provided to renew the equipment stock at industrial plants, in accordance with a plan. Now it's the task of industrial energy managers.

Therefore, the role of industrial energy managers is no longer purely technical. They have acquired additional functions of decision-makers.

Russian Energy Managers Association (REMA) was the first organization in Russia to provide training to energy managers of industrial plants. REMA was set up in 1996 by industrial energy managers exactly for this purpose, and also to provide assistance to enterprises in their struggle for equal rights with energy utilities. Initial sponsorship for REMA was provided by USAID. Much experience REMA "imported" from the U.S.-based Association for Energy Engineers, and this cooperation is still going on.

At this point, REMA-type associations of industrial energy managers are set up in different Russian regions: in the Urals, Tatarstan, and so on. REMA inspired introduction of a new specialization "Energy Manager" to the curriculum of leading Russian energy universities.

x. Non-government organizations and their role in legislation development

Russian energy legislation has undergone reform, although there is still room for improvement. Like in other countries, area experts and lawyers examine draft regulations in Russia. For this purpose, draft regulations are provided to federal ministries and large enterprises. In the last 5 years (1995-2000), non-government associations of industrial energy consumers have joined these efforts.

Only in 1998-1999, comments to legislative initiatives to amend energy supply contractual practices, and comments to arbitration practices were published in specialized magazines.

However, since 1996, consumers have been struggling for observation of their rights in legislative documents. For example, since 1996, REMA has been holding national seminars on the regulations governing relations between industrial consumers and energy utilities. These seminars are attended by 100-150 energy managers, lawyers, and directors of industrial enterprises from the whole country. At these seminars federal officials and authors of draft federal regulations meet with industrial energy consumers.

Importantly, the Federal Energy Inspection (Glavgosenergonadzor) and Federal Public Utility Commission keep their ears open to the opinion of non-government associations of energy managers. These associations unite various industries, and do not lobby any narrow interests. In 1998, Consulting Council of Consumers was set up within Federal Public Utility Commission. REMA's President represents industrial energy consumers in this Consulting Council.

Following the example of CENEf, and to a great extent due to its initiating activities, around 35 regional energy efficiency agencies have been set up in Russia to develop energy efficiency programs. These energy efficiency agencies are becoming training centers, which also take part in the development of Russia's energy sector regulations.

In other words, both in Moscow and regional centers a lobby has emerged to defend energy consumers' rights.

xii. Restructuring problems

Improving the efficiency of the power sector, abrupt growth of investments, strategically correct decision-making for its development, management structure and mechanisms are currently key factors today not only for the power sector, but also for the whole economy.

In 2000 and 2001, RAO EES has been promoting for adoption and implementation its Program for Russia's energy utilities restructuring. Energy tariffs growth up to the "world level" is identified as the key factor for the Program success. The Program looks into the U.S. and European experience in wholesale energy market development, which was not always a success.

There are no grounds to believe that RAO EES and regional energy utilities (Energos) will be able to provide high quality, inexpensive electricity and heat to the residential and industrial sectors in the near future, because:

> Energy tariffs grow faster, than inflation or price index in the Russian industry (as a ratio to production costs of goods produced in the West).
>
> Very few new power plants have been built in recent years in the "Big" energy sector. These new power plants are do not have enough capacity to replace obsolete blocks which are being decommissioned. 10-15 year old designs are completely out-of-date. It will take 8-10 years to design and build new power blocks.
>
> RAO EES Restructuring Program is very indistinct, and is certainly not consumer-oriented.

There are no grounds to believe, that foreign investors will cooperate with RAO EES, since energy projects have long paybacks, and there are more attractive investment opportunities in Russia than large power projects owned by RAO EES.

Appendix 2.A Maps of Russian Oil Pipelines

Map 1: The Location of Submaps and the Legend

Map 2: Sibnefteprovod JSC

Map 3: JSC Transiberian Oil Trunk Lines and JSC Oil Trunk Links of Central Siberia

Map 4: JSC Northwest Oil Trunk Lines

Map 5: JSC Ural-Siberian Oil Trunk Lines

Map 6: JSC Volga Oil Trunk Lines

Map 7: JSC Caspian and Caucasian Oil Trunk Lines

Map 8: JSC Black Sea Oil Trunk Lines

Map 9: JSC Northern Oil Trunk Lines

Map 10: JSC Upper Volga Trunk Lines

Map 11: Public JSC Druzhba Oil Trunk Lines

Map 12: Northern Division of Public JSC Druzhba Oil Trunk Lines

Map 13: Southern Division of Public JSC Druzhba Oil Trunk Lines and Oil Pipelines of Ukraine

Map 14: Eastern Siberia and the Far East

Расположение листов и условные обозначения
Карта Т-08
Карта Т-03
Карта Т-01
Карта Т-09
Карта Т-02
Карта Т-11
Карта Т-13
Карта Т-04
Карта Т-12
Карта Т-05
Карта Т-10
Карта Т-06
Карта Т-07
Нефтеперерабатывающий завод или комбинат
Газоперерабатывающий завод
Танкерный нефтеналивной терминал
Нефтеналивной терминал на ж/д
Насосная станция
Успенская
Насосная станция, граница тарифного участка
Грушовая
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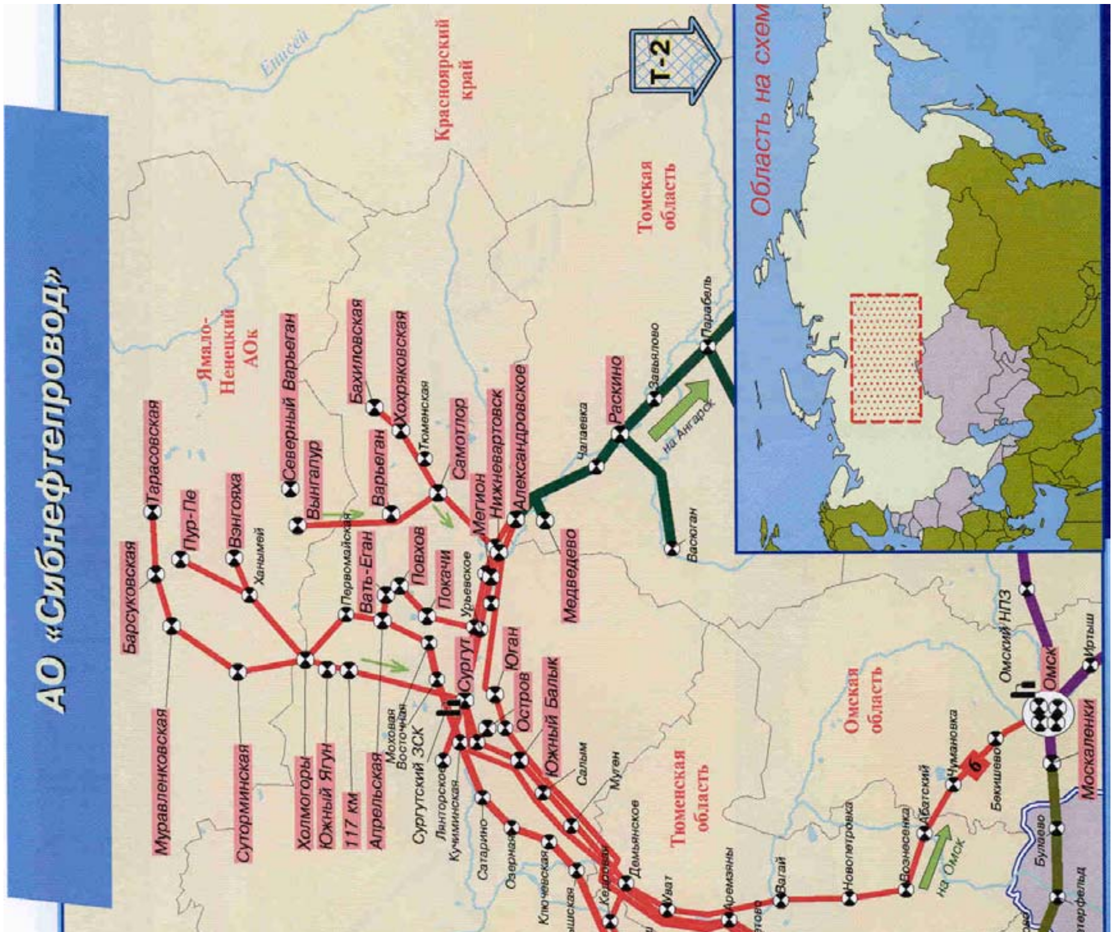
2
21
...
Цветными толстыми линиями выделены потоки транспортировки нефти разными управлениями магистральных нефтепроводов России. Цифрами выделены магистральные нефтепроводы (см. Приложение 1)
Нефтепроводы
Направления потоков траспортировки нефти по трубопроводам и железным дорогам
Железные дороги, показаны только для определенных маршрутов транспортировки нефти
Города и населенные пункты
Территории стран дальнего зарубежья, ближнего зарубежья и Российской Федерации соответственно
Граница Российской Федерации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Ямало-Ненецкий АОк
Ханты-Мансийский АОк
Тюменская область
Омская область
Свердловская область
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Печора
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Тарасовская
Пур-Пе
Вэнгояха
Северный Варьеган
Бахиловская
Хохряковская
Вынгапур
Варьеган
Самотлор
Мегион
Нижневартовск
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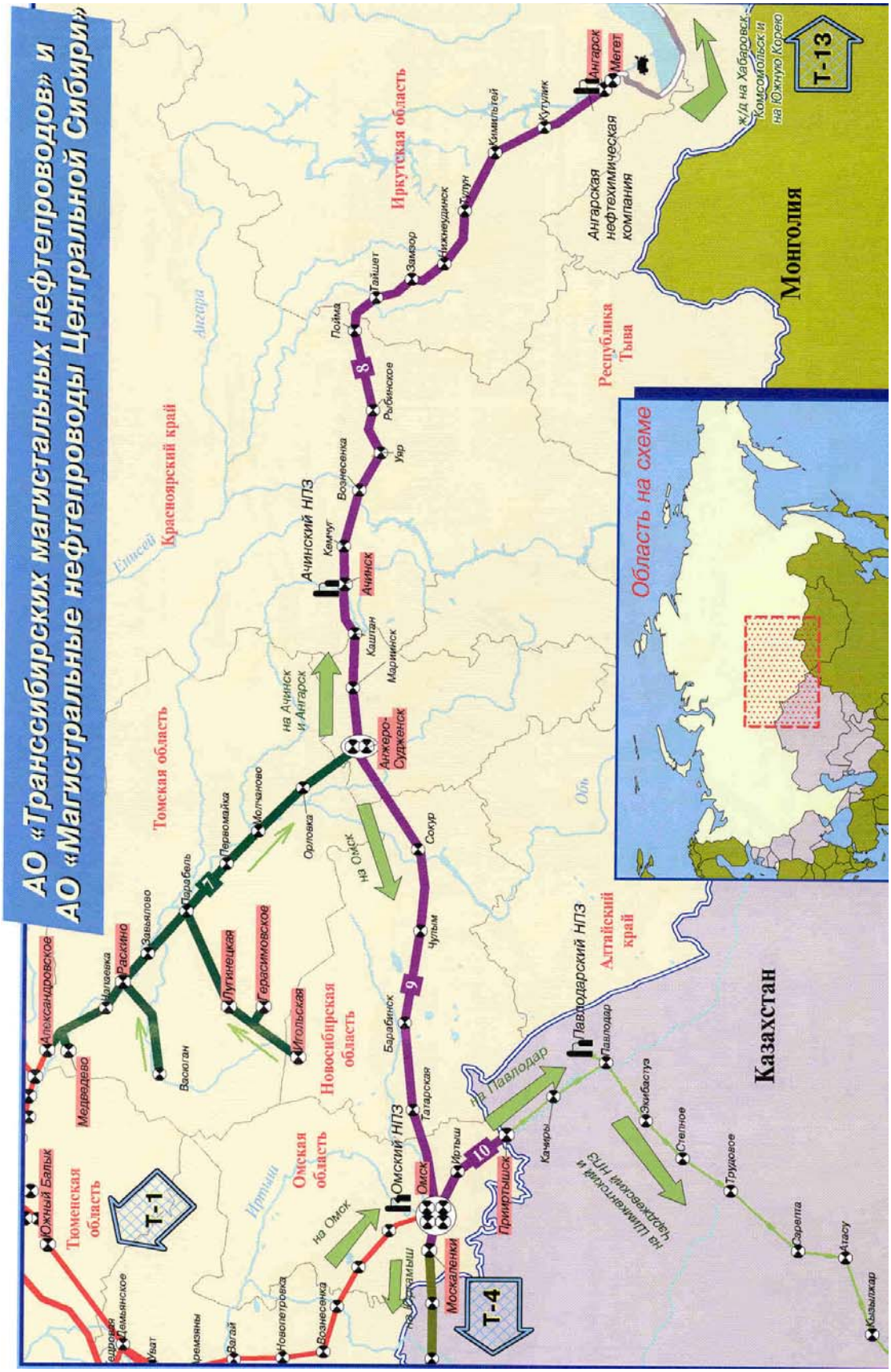
Медведево
Муравленковская
Суторминская
Холмогоры
Южный Ягун
117 км
Апрельская
Сургутский ЗСК
Вать-Еган
Повхов
Покачи
Сургут
Юган
Остров
Южный Балык
Красноленинск
Шаим
Платина
Юргамыш
Омск
Омский НПЗ
Москаленки
Раскино
Парабель
Васюган
на Ангарск
на Омск
на Уфу и Альметьевск
на Альметьевск
на Н. Новгород «Дружба»
Каменный Лог
Пермь
Оса
Нововка
Чернушка
Краснокамск
Кушкуль
Тюмень
Мишкино
Торгили
Уват
Демьянское
Конда
Березовое
Сосьва
Кругое
Ярдное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Красноярский край
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Монголия
Казахстан
Ангарская нефтехимическая компания
Ачинский НПЗ
Омский НПЗ
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Область на схеме
Южный Балык
Александровское
Медведево
Игдаевка
Раскино
Завьялово
Тарабель
Первомайка
Молчаново
Орловка
Васюган
Лугинецкая
Герасимовское
Игольская
Новолетровка
Вознесенка
Барабинск
Татарская
Сокур
Чулым
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Москаленки
Приортышск
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Павлодар
Качиры
Экибастуз
Степное
Трудовое
Сарепта
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Кызылжар
Анжеро-Судженск
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Каштан
Ачинск
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Уяр
Рыбинское
Поима
Тайшет
Заиграй
Нижнеудинск
Тулун
Кимильтей
Кутулик
Ангарск
Мегет
Ж/д на Хабаровск, Комсомольск и на Южную Корею
на Ачинск и Ангарск
на Омск
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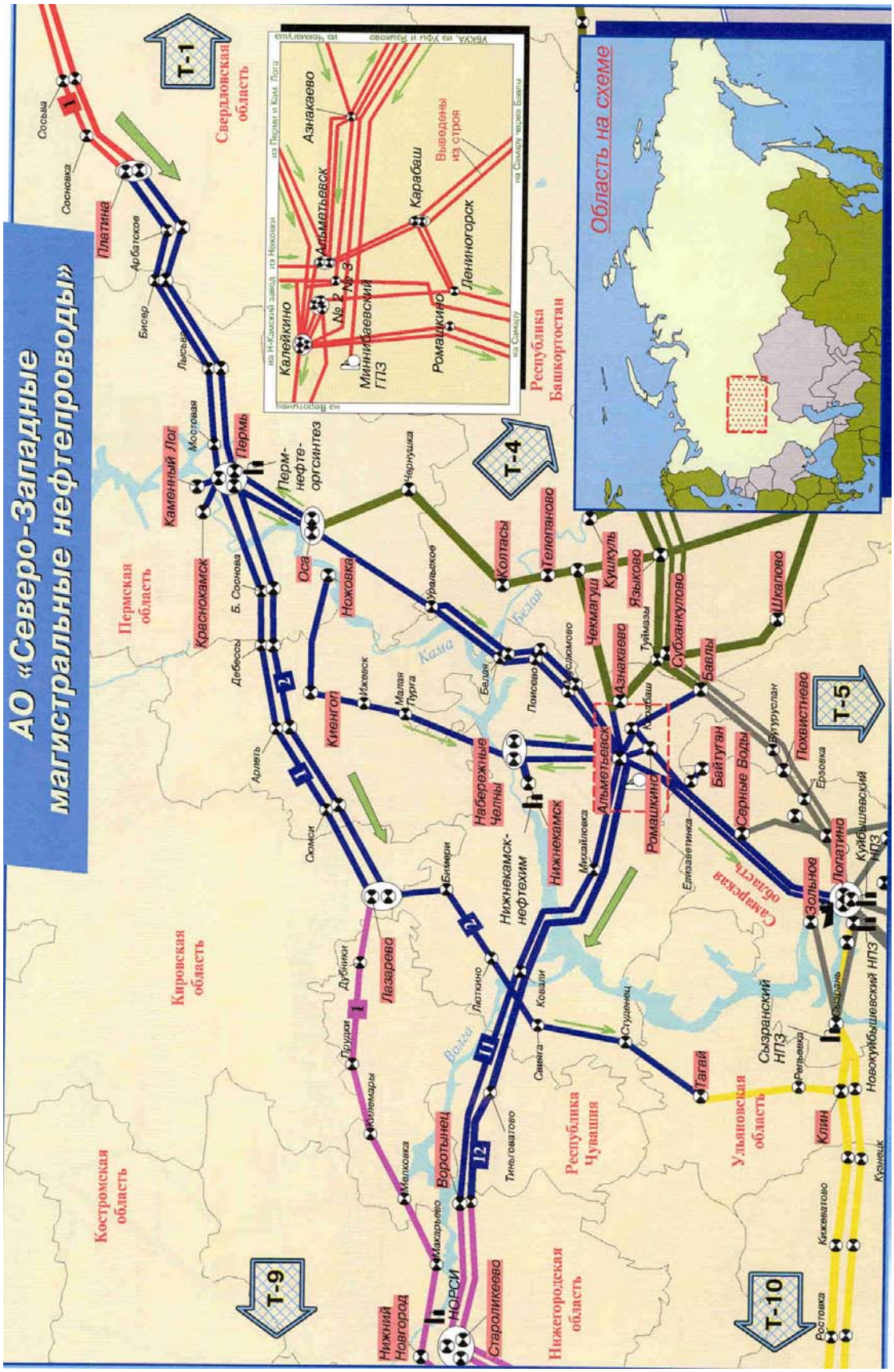
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Платина
Каменный Лог
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Новокуйбышевский НПЗ
Куйбышевский НПЗ
Кинеш
Ростовка
Кулемары
Мелковка
Макарьево
Дубники
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Лютково
Тиньгеватово
Ковали
Самара
Студенец
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Сюмси
Арлеть
Дебесы
Б. Сосновка
Мотовиха
Лысьва
Бисер
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Платина
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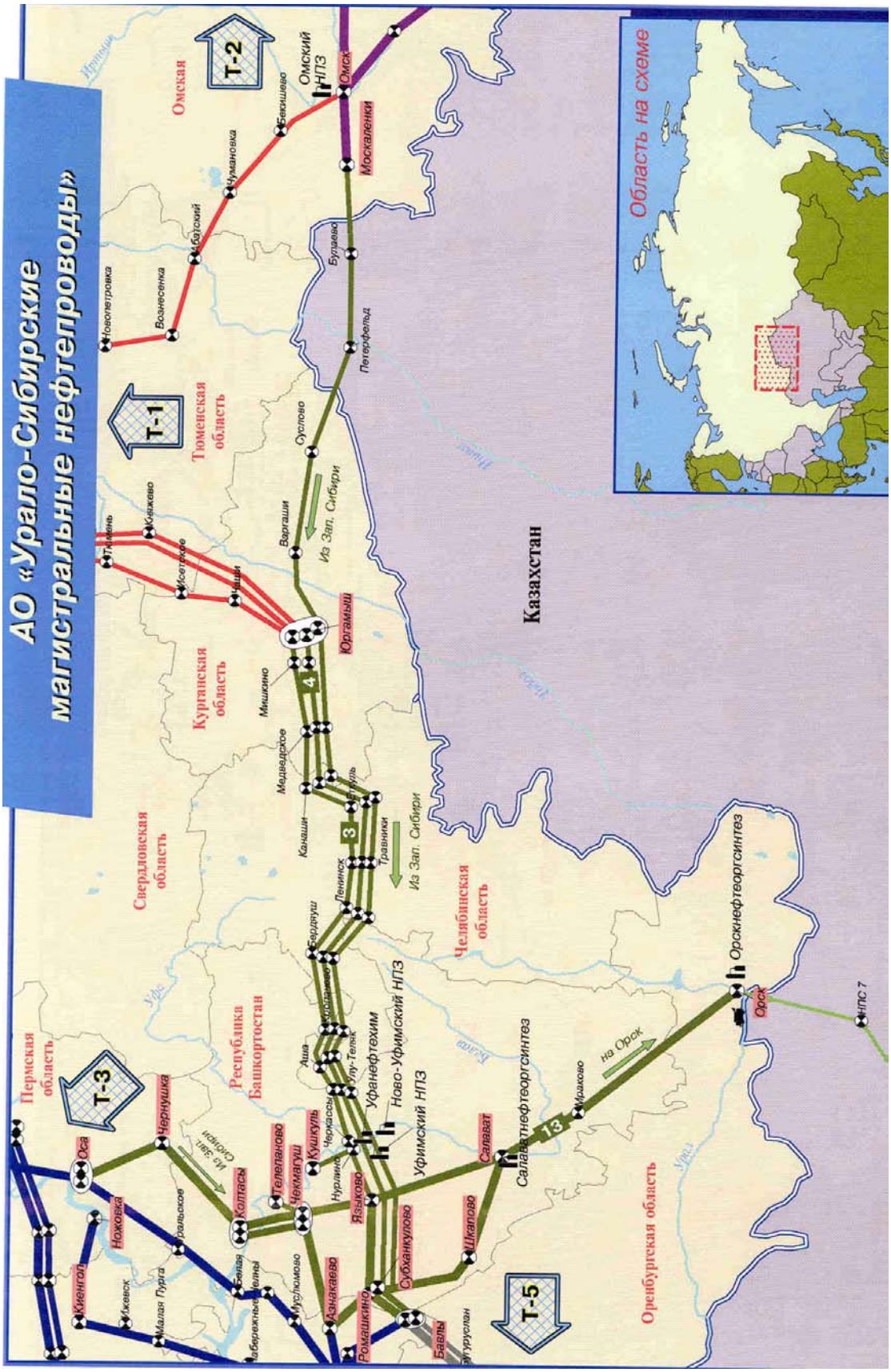
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Ново-Уфимский НПЗ
Уфанефтехим
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Орскнефтеоргсинтез
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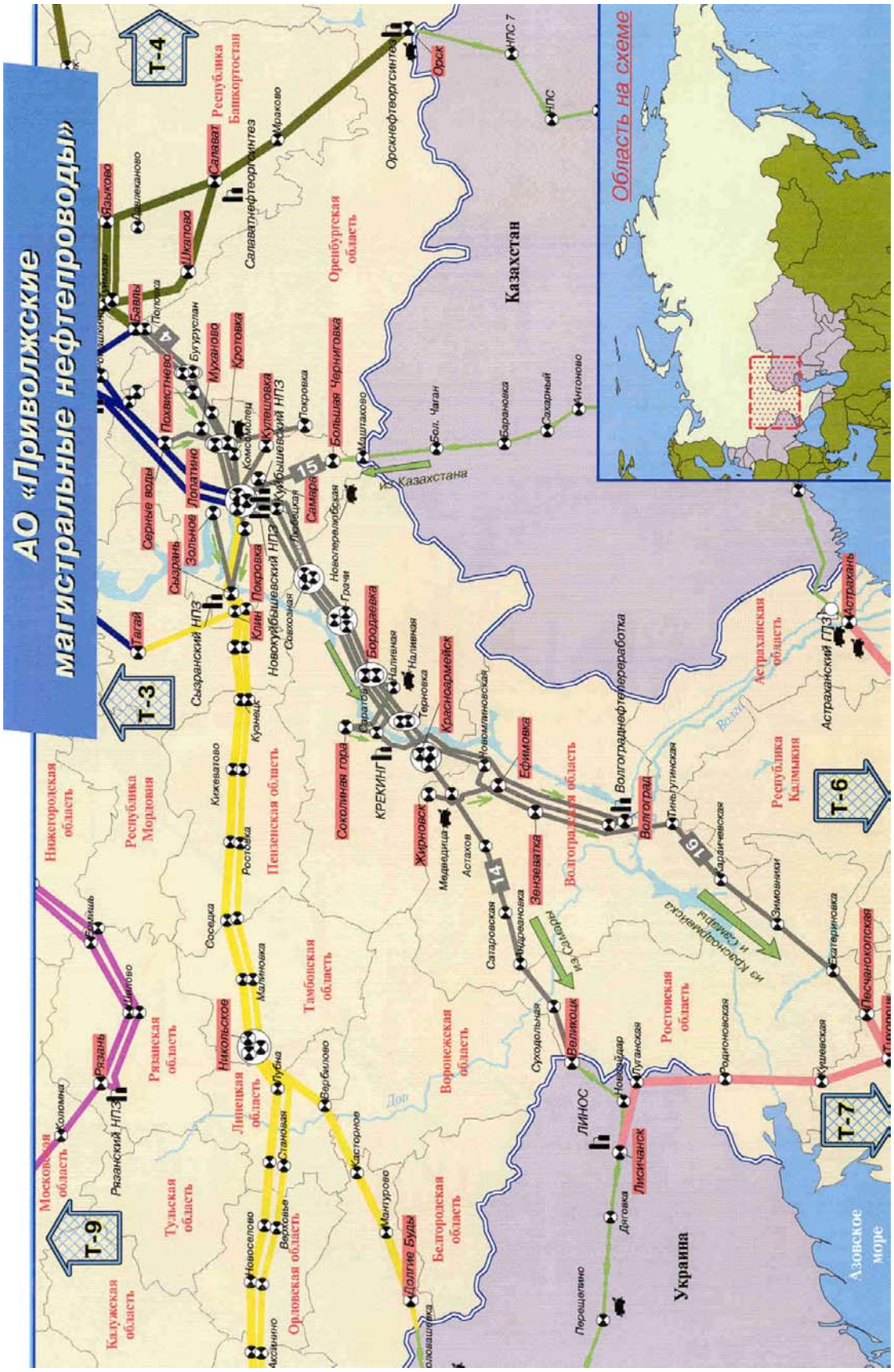
Область на схеме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Т-4
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Т-7
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Азовское море
Калужская область
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Сызранский НПЗ
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КРЕКИНГ
ЛИНОС
Рязань
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Сызрань
Серные воды
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Клин
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Великоцк
Лисичанск
Астрахань
Из Казахстана
Из Красноярского и Самарского
Дон
Волга
Т-9
Т-3
Т-4
Т-6
Т-7
Казахстан
Украина
Азовское море
Калужская область
Московская область
Нижегородская область
Республика Мордовия
Рязанская область
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Астраханский ГПЗ
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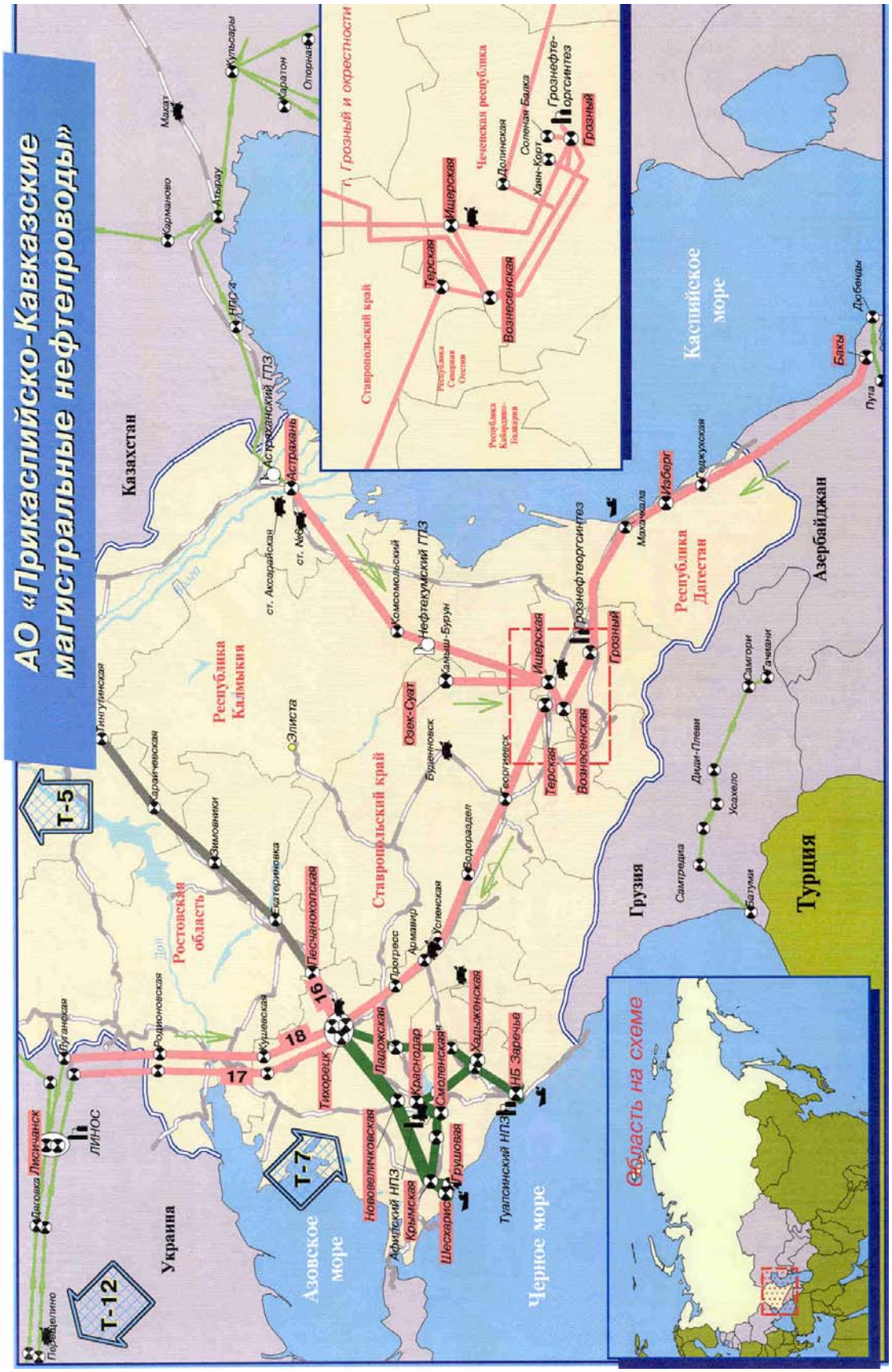
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Т-5
Т-7
Т-12
ЛИНОС
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Нефтекумский ГПЗ
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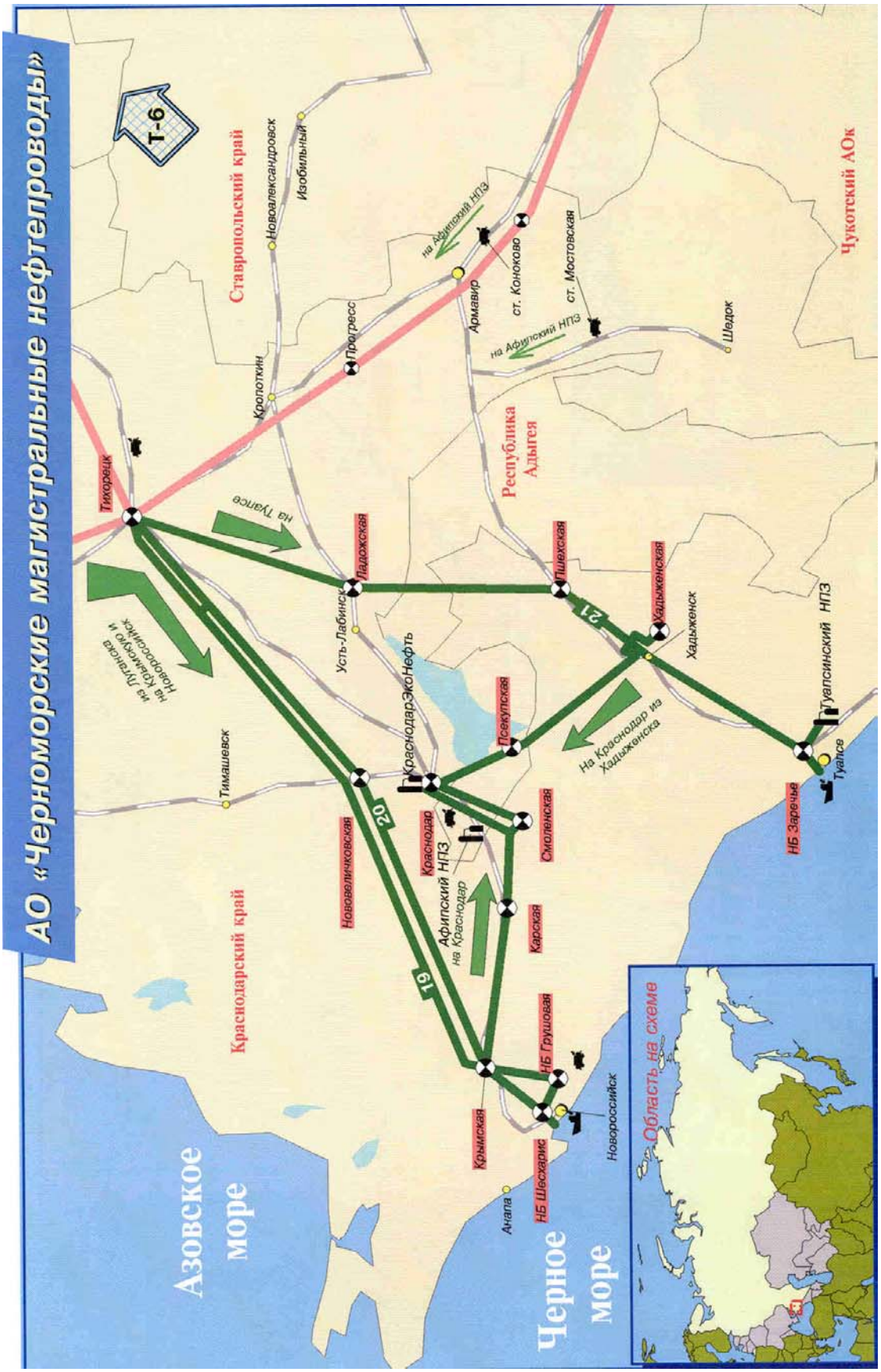
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Анапа
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21
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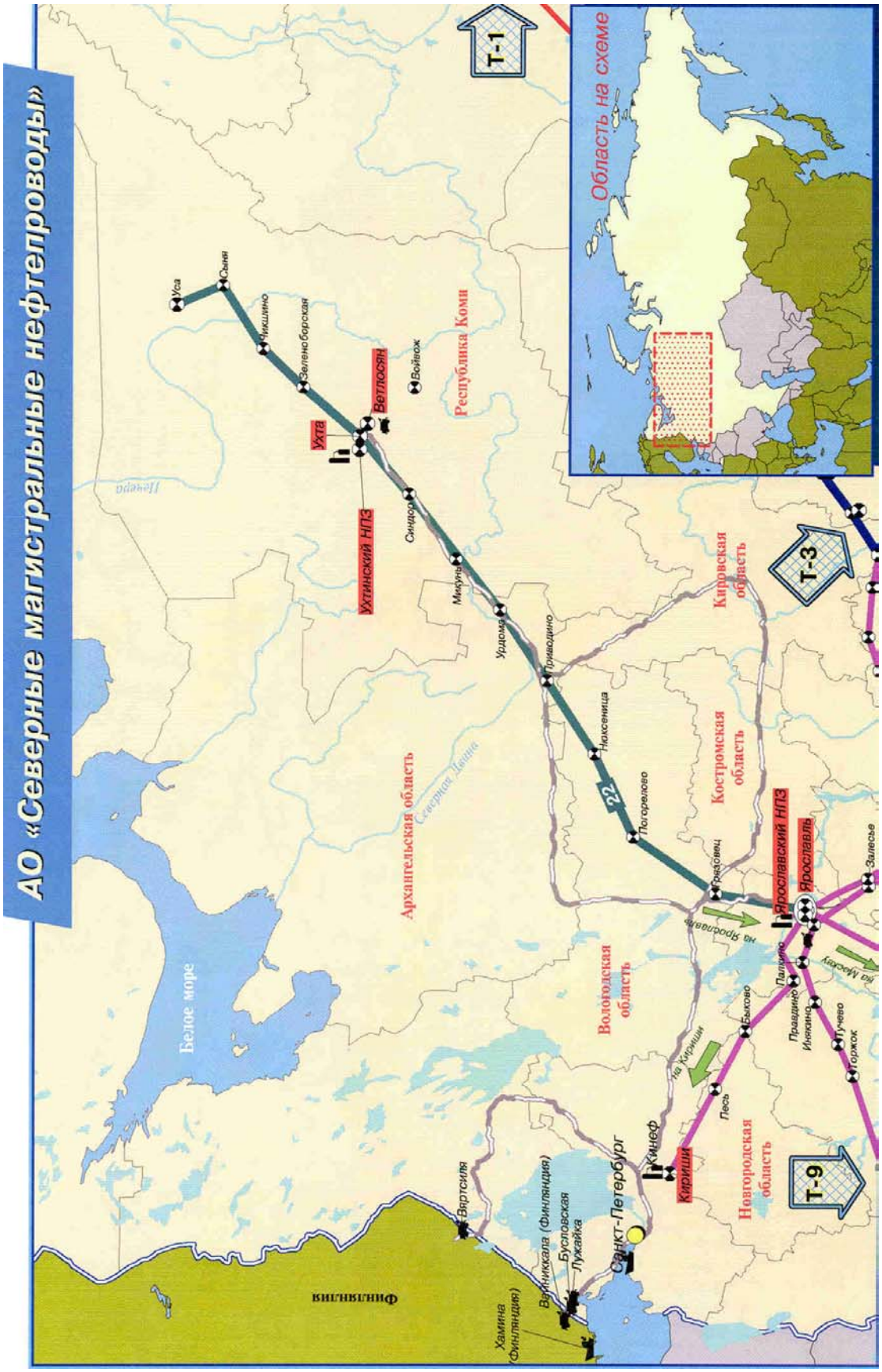
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Т-9
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Залесье
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Санкт-Петербург
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Пужайка
Хамина (Финляндия)
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на Москву
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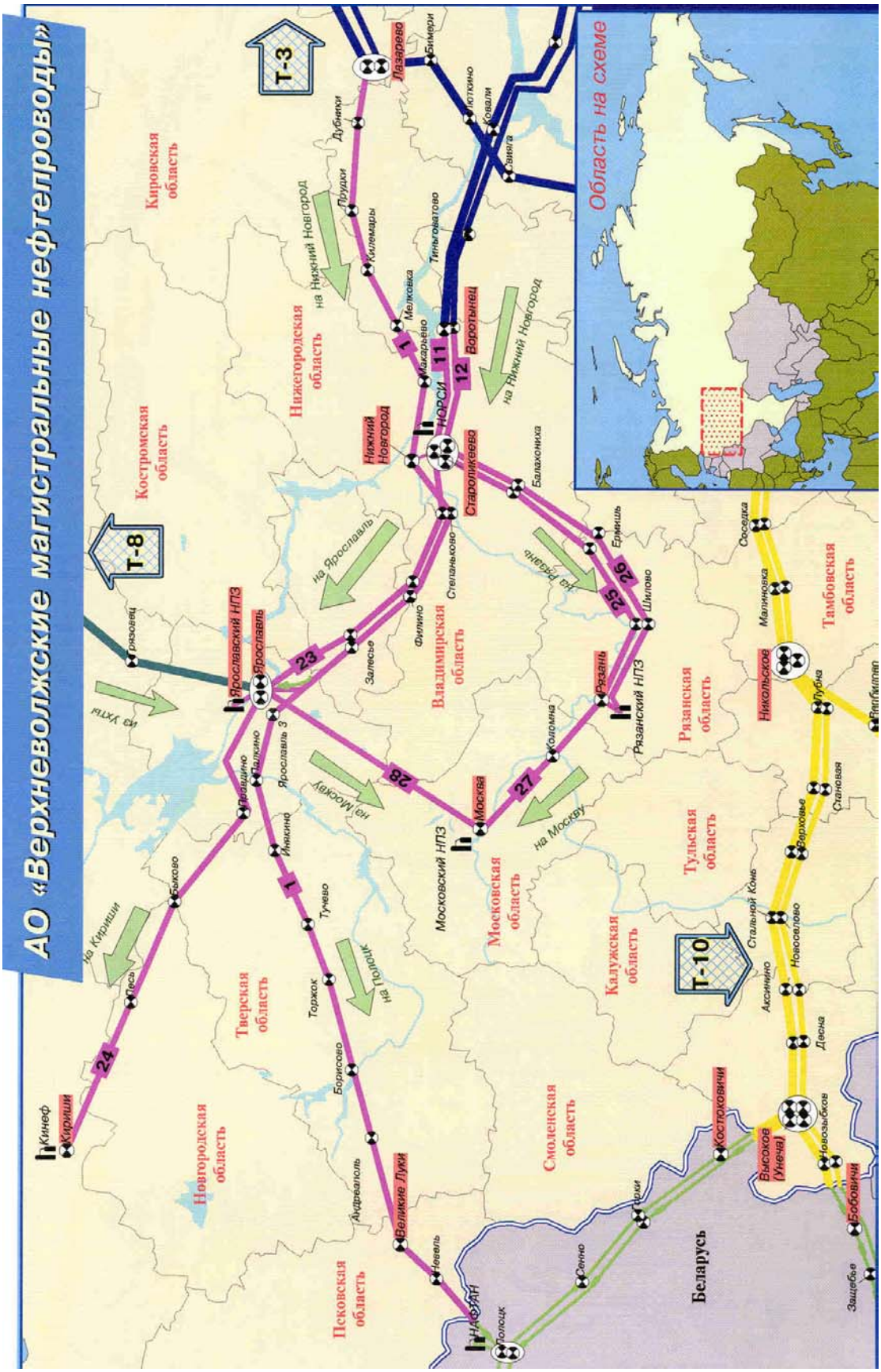
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Т-8
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Лазарево
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Песь
Тужево
Торжок
Борисово
Андреаполь
Невель
Сенно
Орша
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Стальной Конь
Новосеславино
Верховье
Становая
Десна
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Заушье
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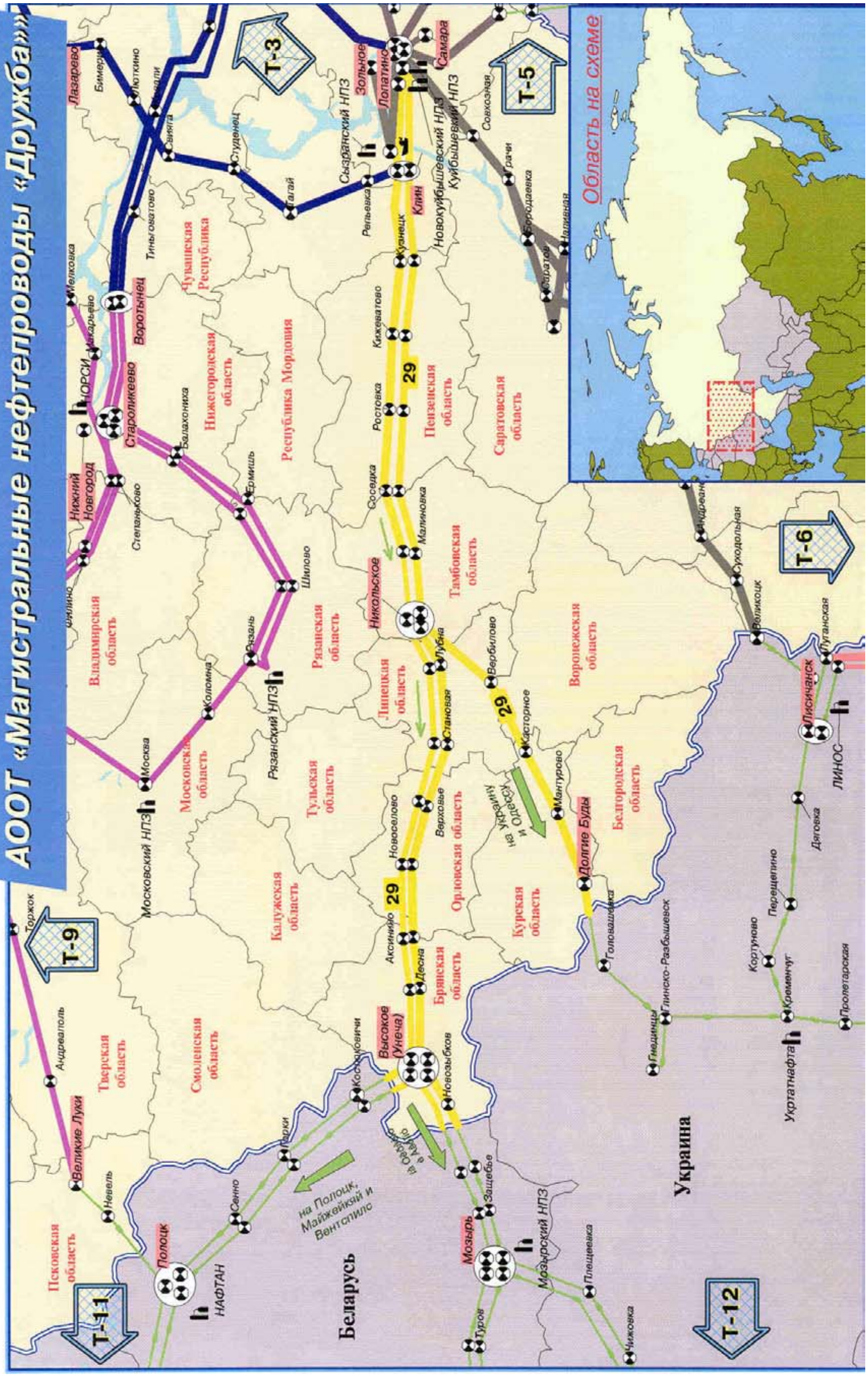
на Полоцк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Т-5
Т-6
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Т-11
Т-12
Беларусь
Украина
Псковская область
Тверская область
Смоленская область
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Высокое (Унеча)
Никольское
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Лопатино
Зольное
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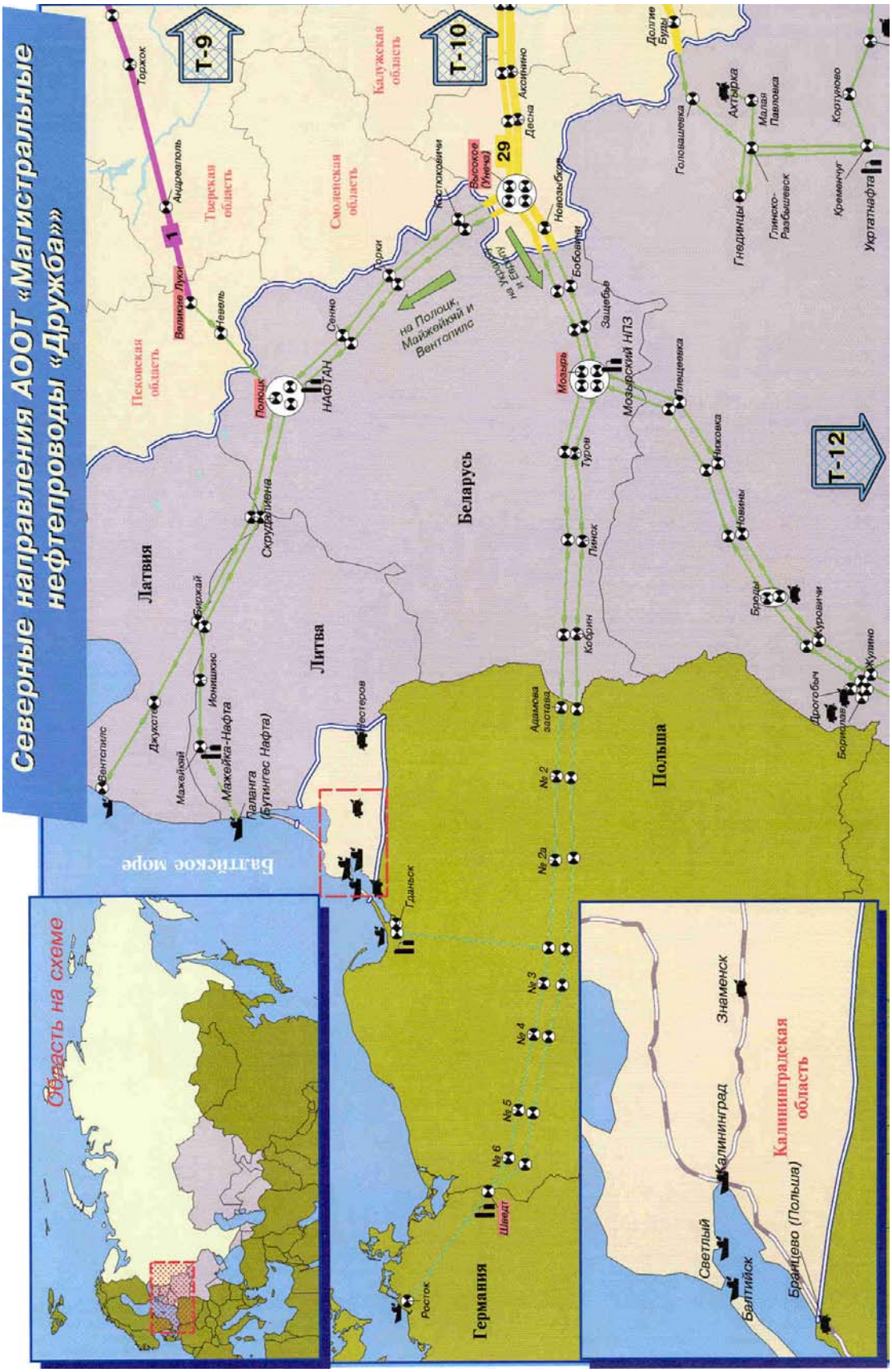
на Украину и Одессу
29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Т-9
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Т-12
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Псковская область
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Высокое (Унеча)
29
Десна
Аксинино
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Туров
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№ 2а
№ 3
№ 4
№ 5
№ 6
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Плещеевка
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Голоскевичи
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Область на схеме
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Долгие Буды
Белгородская область
на Украину и Одессу
29
Польша
Львов
Броды
Куровичи
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Дрогобыч
НПК Галычина
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Жулино
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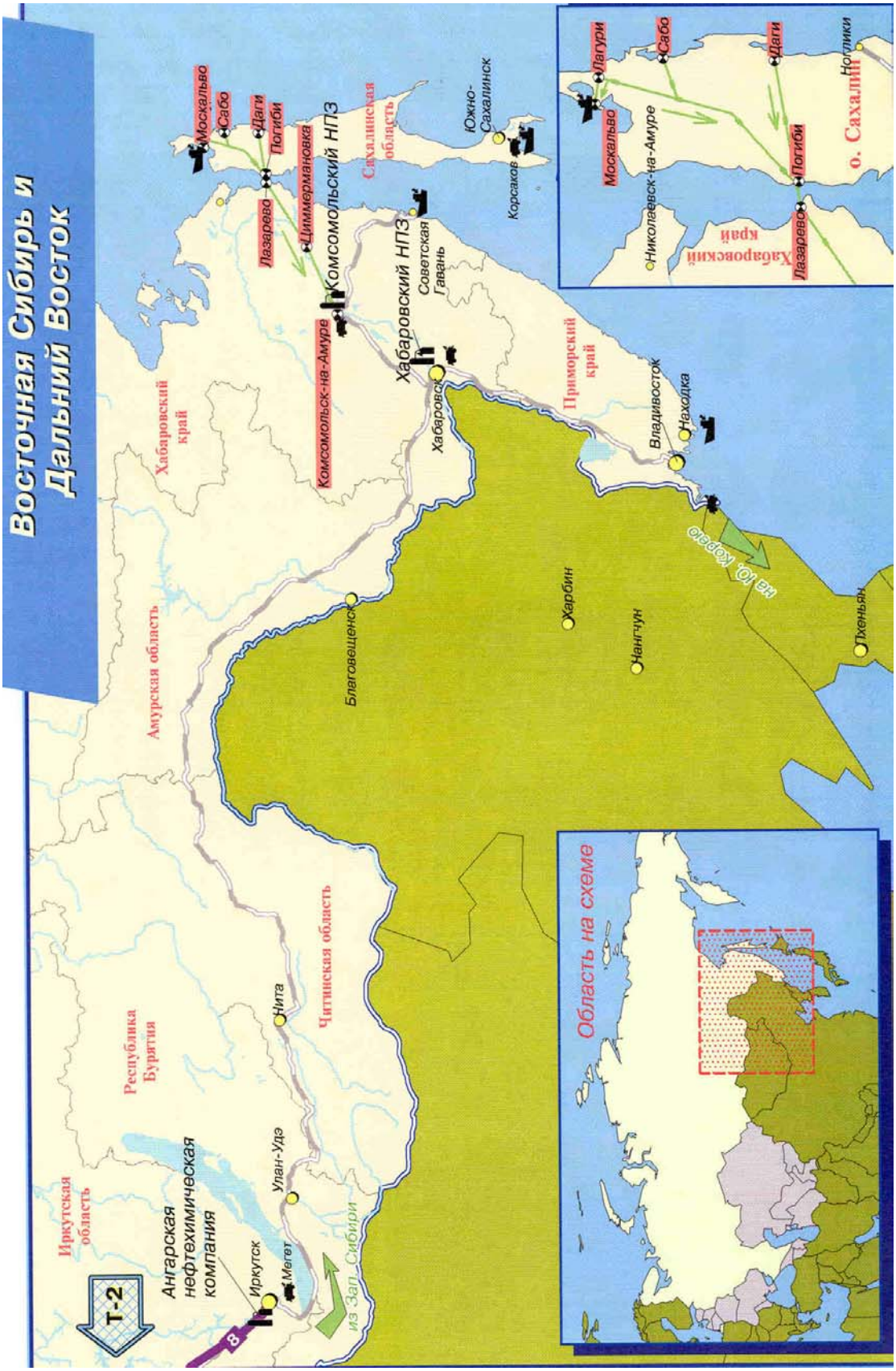
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Пхеньян
Лагури
Николаевск-на-Амуре
о. Сахалин
Ноглики
Область на схеме

Appendix 2.B Gas Turbine Prices Indexed by Heat Rate

Manufacturer	Model	Heat Rate	$ / kW
GE	LM5-ST120	7885	$297.09
GE	LM5-ST80	8170	$317.49
GE	LM6000PA	8720	$294.98
GE	LM6 50HZ	8850	$311.80
TP&M	FT8	8875	$429.69
GE	7221FA	9243	$210.33
WESTINGHOUSE	701F	9280	$199.39
GE	LM5000PC	9350	$409.50
GE	9311FA	9360	$197.20
GE	LM5000PD	9390	$407.80
GE	LM2500	9404	$427.62
GE	9231EC	9435	$185.40
KWU	V84.3	9450	$225.93
KWU	V94.3	9450	$205.48
WESTINGHOUSE	501F	9470	$210.97
KWU	V94.3	9550	$204.63
RR	RB211	9550	$439.60
ABB	GT13E2	9560	$219.11
GE	LM1600	9560	$513.78
KWU	V84.3	9560	$237.41
RR	RB211	9575	$422.17
GE	7191F	9625	$200.93
GE	9281F	9625	$183.14
GE	LM2500PH	9630	$522.84
GE	9301F	9700	$196.26
KWU	V64.3	9705	$305.03
GE	6101FA	9740	$257.84
ABB	GT13E	9855	$209.46
GE	9171E	9890	$194.54
WESTINGHOUSE	501 D5	9890	$206.10
WESTINGHOUSE	701D5	9960	$198.13
ABB	GT10	9965	$410.07
ABB	GT8C	9980	$304.18
GE	7171EF	9990	$228.21
WESTINGHOUSE	501 D5	10010	$210.33
ABB	GT11N2	10030	$224.36
WESTINGHOUSE	701DA	10040	$198.53
KWU	V94.2	10065	$196.10
WESTINGHOUSE	501 D5	10100	$206.93
GE	9161E	10105	$199.41
KWU	V84.2	10124	$219.40

KWU	V94.2	10210	$202.96
GE	7111EA	10212	$227.27
KWU	V84.2	10220	$227.71
ABB	GT11N	10370	$244.40
ABB	GT10	10405	$435.78
WESTINGHOUSE	251 B12	10420	$272.77
WESTINGHOUSE	251 B12A	10440	$284.55
NUOVO PIGNONE	PGT10	10500	$521.04
RR	SPEY SK15	10510	$490.11
SOLAR	MARS	10550	$460.00
GE	6541B	10560	$267.01
ABB	GT35	10600	$489.00
ABB	GT13D2	10600	$223.88
WESTINGHOUSE	251 B10A	10600	$260.05
ALLISON	571KA	10650	$500.89
ABB	GT11N	10700	$251.23
ABB	GT8	10750	$321.65
TP&M	FT4C-3F	10875	$191.21
MITSUBISHI	MF111B	10895	$417.65
SOLAR	MARS	10975	$486.43
MITSUBISHI	MF111A	11175	$451.89
RUSTON	TORNADO	11340	$466.61
RUSTON	TYPHOON	11350	$461.54
RUSTON	TYPHOON	11360	$506.97
GE	LM500	11430	$489.69
MITSUI	SB60	11460	$466.40
GE	M5382C	11667	$271.73
GE	5371PA	11730	$280.01
DRESSER	DC990	11820	$476.19
RR	AVON	11885	$328.54
ALLISON	570KA	12225	$563.99
SOLAR	CENTAUR	12250	$438.14
SOLAR	TAURUS	12250	$434.78
ALLISON	501KB5	12317	$483.22
ALLISON	501KH	12363	$561.50
GE	5271RA	12800	$281.34
TURBOMECA	M	13125	$828.73
RUSTON	TB5000	13450	$443.86
RUSTON	HURRICANE	13820	$698.41
SOLAR	SATURN	14685	$740.74

Appendix 2.C Discussion on Rybinskiye Engine Catalogue

Rybinskiye Motory has issued a catalogue "Gas Turbines – 2001". This is the only Russian annual catalogue providing information on the whole range of industrial gas turbines and turbines-based equipment. The catalogue introduces Russian, Ukrainian, and leading international companies involved in designing and manufacturing gas turbines for stationary and marine applications. All data related to the equipment are given in the universal table form.

The catalogue is available in Russian and English and consists of three chapters:

Chapter 1. Gas turbines and components manufacturers along with addresses and telephone numbers.

Chapter 2 Includes three sections:

Section 1. Gas turbine motors for energy supply (there are over 200 models of gas turbines with capacities of between 75 and 334 MW).

Section 2. Gas turbine motors for mechanical drives (there are 132 models with capacities of between 81 KW and 81 MW).

Section 3. Gas turbine motors for marine applications (there are 45 models).

Chapter 3 Includes four sections:

Section 1. Gas turbine simple cycle power plants (there are 38 models).

Section 2. Gas turbine co-generation power plants (there are 27 models).

Section 3. Combined cycle energy sources (there are 103 models).

Section 4. Gas pumping units (there are 27 models).

Each section provides information on companies manufacturing gas turbine motors; various models of gas turbines and gas turbine units; capacities; efficiency; fuel consumption; shaft rotation frequency; emissions; and other technical parameters.

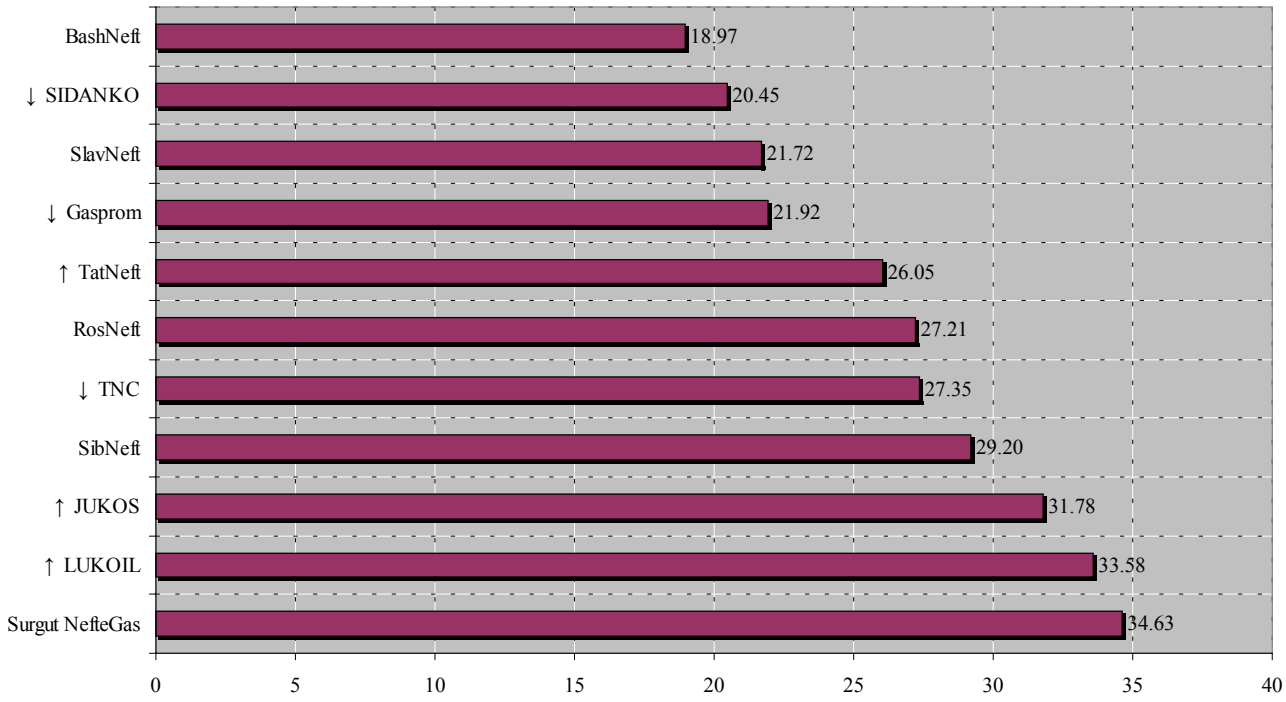
Data on the power capacities and prices of U.S. gas turbines are given in the Attachment.
Low and medium capacity diesel power plants are often used. Examples of such diesel units include AD-100-T/400, AD-60, TMZ-DE-104C4, DG-200, AG-100, AG-200, with capacity range between 60 and 200 KW, manufactured in Kursk or Ekaterinburg, which use casing-head gas, diesel fuel, or natural gas from gas mains. Diesel power plants of foreign manufacturers are only used in rare instances, typically when required by the terms of foreign loans. Table C-1 shows data on the current market of low capacity diesel power plants in Russia.

Appendix 2.D Power Plant Costs

The costs in this table cover capital costs only and do not include shipping, installation, or auxiliary equipment.

Brand	Capacity kW	Price (VAT included) 1000 rubles	Price (VAT included) $1000	$/kW
Domestic Russian diesel power plants				
AD-16-T/400	16	120	4.3	269.8
AD-30-T/400	30	153	5.5	183.5
AD-30-R/400	30	225	8.1	269.8
AD-60-T/400	60	229	8.2	137.3
AD-100-T/400	100	285	10.3	102.5
F.G. Wilson				
P450	360		71.3	197.9
P500	400		79.5	198.8
P500E	400		72.1	180.3
P600	480		113.3	236.0
P725	580		120.6	207.9
P910	728		147.8	203.0
P1000	800		153.7	192.1
Atlas Copco				
QA22	17		10.5	619.4
QA44	35		12.7	363.1
QA60	47		15.1	321.9
QA85	68		18.2	267.8
QA140	112		25.6	228.8
QA165	130		26.8	206.1
QAS38	27		18.4	680.7
QAS78	55		25.9	470.0
QAS138	100		33.0	329.6
QAS228	160		58.0	362.5
QAS278	200		65.8	328.8
AQAS338	240		70.0	291.7

Appendix 2.E Corporate Ratings for Russian Oil Companies for Long-Term Investment



Source: www.rusenergy.com. The numbers in this figure are calculated based on numerous factors and they are not based on a limited scale, but the higher the number, the better the corporate rating.

Appendix 2.F Costs for Competing Generation Technologies

This section shows provides details on large-scale power equipment costs in central Russia. While fuel cells would not compete directly with most of these power plants, these data do provide a point of reference. It is also important to note that transportation, installation, operating and maintenance costs are significantly higher in most of the Far North.

Table 2.F-1 Standard Summer Diesel Fuel

			Diesel Fuel "L"	
Exchange Rate (ruble/$)			27.8	
Electricity Transformation Efficiency		Domestic Equipment	32	
		Foreign Equipment	37	
Specific combustion heat, kCal/kg			10,386	
Price (VAT and transportation included), ruble/ton		Price for October	9,100	
		Price expected from Nov. 2001 (Komsomolskiy oil refinery price estimates)	10,550	
Same Price, VAT excluded, ruble/ton		Price for October	7,583	
		Price expected from Nov. 2001 (Komsomolskiy oil refinery price estimates)	8,792	
Fuel Consumption, g/kWh		Domestic Equipment	259	
		Foreign Equipment	224	
Cost of Fuel component in Electricity (VAT excl.), ruble/kWh	**Domestic**	Price for October	2.0	
		Price expected from Nov. 2001 (Komsomolskiy oil refinery price estimates)	2.3	
	Foreign	Price for October 2001	1.7	
		Price expected from Nov. 2001 (Komsomolskiy oil refinery price estimates)	2.0	
Cost of Heat Power under separate heat and electricity production		Thousand rubles/Gcal	1.0	
		$/Gcal	37.1	
Investment cost including customs duties, construction and assembly, VAT and transport, $/ kWh		Domestic Equipment	145	
		Foreign Equipment	294	
Annual Maintenance Cost, $/kW		Domestic Equipment	43.5	
		Foreign Equipment	14.7	
Annual Operation Cost, $/kW		Domestic Equipment	1.5	
		Foreign Equipment	2.9	
Electricity price all costs included	**$/kWh**	**Domestic Equipment**	**0.11**	**3.0**
	ruble/kWh	**Foreign Equipment**	**0.08**	**2.2**

Table 2.F-2 Fuel Oil

		M-100	M-40	Fuel 3.5 %
Exchange Rate Ruble/$		27.8		
Electricity Transformation Efficiency		37		
Specific combustion heat, kCal/kg		9,500		
Price (VAT and transportation included), ruble/ton		5,000	5,700	4,871
Same Price, VAT excluded, ruble/ton		4,167	4,750	4,059
Fuel Consumption, g/kWh		245		
Cost of Fuel component in Electricity (VAT excl.), ruble/kWh		1.0	1.2	1.0
Cost of Heat Power under separate heat and electricity production	**Thou. Rubles/Gcal**	0.53	0.61	0.52
	$/Gcal	19.2	21.9	18.7
Investment cost including customs duties, construction and assembly, VAT and transport, $/kWh		1,015		
Annual Maintenance Cost, $/kW		20.3		
Annual Operation Cost, $/kW		10.2		
Electricity price with all above costs included	**US cents/kWh**	5.7	6.4	5.6
	Ruble/kWh	1.6	12.8	1.6

Table 2.F-3 Coal

		Coal-dust combustion	Furnace combustion
Exchange Rate Ruble/$		27.8	
Electricity Transformation Efficiency		13.0	
Specific combustion heat, kCal/kg		2,889	1,647
Price (VAT and transportation included), ruble/ton		1.287	
Same Price, VAT excluded, ruble/ton		1,065	
Fuel Consumption, g/kWh.		2,285	4,009
Cost of Fuel component in Electricity (VAT excl.), ruble/kWh.		2.4	4.3
Cost of Heat Power under separate heat and electricity production	**Thou. Rubles /Gcal**	0.45	0.79
	$/Gcal	16.2	28.4
Investment cost including customs duties, construction and assembly, VAT and transport, $/ kWh		761	508
Annual Maintenance Cost, $/kW		38.1	25.4
Annual Operation Cost, $/kW		15.2	10.2
Electricity price with all above costs included	**$/kWh**	0.10	0.16
	ruble/kWh	2.9	4.6

Table 2.F-4 Natural Gas

			Diesel Fuel "L"	
Exchange Rate (ruble/US$)			27.8	
Electricity Transformation Efficiency (%)		Domestic Equip.	30	
		Foreign Equip.	32	
Specific combustion heat, kCal/kg			9,750	
Price (VAT and transportation included), ruble/ton		Price for October	500	
Same Price, VAT excluded, ruble/ton			417	
Fuel Consumption, g/kWh.		Domestic Equip.	294	
		Foreign Equip.	276	
Cost of Fuel component in Electricity (VAT excl.), ruble/kWh.	**Domestic**	Price for October	0.12	
	Foreign		0.11	
Cost of Heat Power under separate heat and electricity production		Thousand rubles/Gcal	0.1	
		$/Gcal	1.9	
Investment cost including customs duties, construction and assembly, VAT and transport, $/kWh		Domestic Equip.	435	
		Foreign Equip.	735	
Annual Maintenance Cost, $/kW		Domestic Equip.	130.5	
		Foreign Equip.	36.75	
Annual Operation Cost, $/kW		Domestic Equip.	4.4	
		Foreign Equip.	7.4	
Electricity price all costs incl.	**$/kWh**	**Domestic Equip.**	**0.03**	**0.9**
	ruble/kWh	**Foreign Equip.**	**0.02**	**0.6**

Table 2.F-5 Summary table: Cost data for energy and heat generation

Fuel Type	Full Cost of Electricity Generation		Heat, $/Gcal	Investment Cost, $/kW
	Ruble/kWh	C/kWh		
Diesel Fuel "L"	2.2	8.0	37.1	294
M-100	1.6	5.7	19.2	1,015
Coal	2.9	10.4	16.2	761
Natural Gas	0.9	3.1	1.9	435

Appendix 3.A Firms Producing Small Power Sets: Gas Turbines, Diesel Engines, and Cogeneration Power Sets

I –Inquiry was sent, R-Response was received, T-Technical info is available, M-mission

Status	Name	Address	Contacts
		Russia and CIS	
	GAS TURBINES		
IRT	**MashProject**	42 a Oktyrabrskiy Ave., Nikolayev, 327018m Ukraine	Tel: (051) 22-13-48 Fax: (051) 22-02-43
IRTM	**Kaluga Engine Factory**	Kaluga, Russia	
IRT	**JSC Aviadvigatel**	93 Komsomolskiy Ave., GSP – 621, Perm 614600, Russia	Tel: (3422) 45-20-19 Fax: (3422) 45-97-77
IRT	**JSC Perm Engines**	93 Komsomolskiy Ave., GSP – 621, Perm 614600, Russia	Tel: (3422) 45-54-97 Fax: (3422) 45-13-20
IRT	**Closed JSC Iskra - Energetika**	28 Vedeneyeva St., Perm 614038, Russia	Tel: (3422) 750-057 Fax: (3422) 51 095 E-mail: happy@geocom.ru
T	**Ufa Engine Construction Factory**	Ufa	
IRT	**ZMKB Progress** **Manufacturer: Motor – Sich**	Zaporozhye, Ukraine.	Tel: (0612) 65-03-27, Fax: (0612) 65-46-97 (0612) 61-44-25 Fax: (0612) 65-60-07
IRT	**Closed JSC Turbomotorniy Zavod (Turbine Engine Factory)**	18 Frontovikh Brigan St., Yekaterinburg 620017, Russia	Tel: (03432) 39-42-22, Fax: (03432) 34-79-65
T	**MODULE** **JSC Kirovenergomash** **JSC Kirovskiy Factory**	47 Stachek Ave., Saint Petersburg 198097, Russia	Tel: (812) 183-88-98, Fax: (812) 184-65-47
IRT	**V. Ya. Klimov Factory.** **1-1.5 MW**	11 Kantemirovskaya St., Saint Petersburg 194100, Russia	Tel: (812) 245-15-86 Fax: (812) 245-43-29

IRT	**JSC Proletarskiy Zavod; 1.5 MW**	Saint Petersburg, Russia	
IRT	**JSC Belenergomash; 2.5 and 6 MW**	Belgorod, Russia	
	Lazurit, 9 MW	Nizhniy Novgorod, Russia	
IRT	**Rybinskie Motory (Engines)**	Rybinsk, Russia	
T	**Kuznetsov Complex; 20-25 MW**	Samara, Russia	
T	**JSC Lyulka- Saturn**	Moscow, Russia	
T	**Granit**	16 Budyonnogo Ave., Moscow 105118, Russia	Tel: (095) 365-15-03 Fax: (095) 366-10-10
	DIESEL ENGINES		
T	**JSC Turbomotorniy Zavod(Turbine Engine Factory) 1000 kW, Diesel fuel**	18 Frontovikh Brigan St., Yekaterinburg 620017, Russia	Technical Characteristics: Tel: (3432) 39-41-22, (3432) 39-46-06 Supply Arrangements: (3432) 39-45-71
IRT	**JSC Maminikh Volzhkiy Dvigatel (Engines); 500 kW, Gas power station**	Balakovo, Russia	
	JSC Zvezda; 500 kW	Saint Petersburg, Russia	
IRTM	**JSC Kolomenskiy Factory; 1500 kW; Gas Station**	Kolomna, Russia	
	OTHER ENGINES		
	JSC TulmashZavod	2 Mosina St, Tula 300002, Russia	Tel: (0872) 330-34-00
	Kurganmashzavod	8 Vavilova St., Moscow, Russia	Tel: (095) 135-2448 Fax: (095) 135-7039

	KAMAZ	2/17–1 Upper Taganskiy blind alley, Moscow, Russia	Tel: (095) 912-64-80 Fax: (095) 911-31-00
	Ulyanovskiy Car Factory	21/5 Kuznetskiy Bridge, Moscow office, Russia	Tel: (095) 924-17-85
	VAZ	3 Gorokhoviy St., Moscow Office, Russia	Tel: (095) 263-11-11 Fax: (095) 263-11-93
	Chernishev Car Factory	7 Vishneva St., Moscow, Russia	Tel: (095) 491-55-44 Fax: (095) 491-55-22
	Marine Equipment	42 Enthusiasts' Highway, Moscow, Russia	Tel: (095) 176 79-39
	Motorostroitel	5 Gospitaniy val. St., Moscow office, Russia	Tel: (095) 263-17-55
T	**Rubin**	5 Naberezhnaya St., Moscow, Russia	Tel: (095) 490-69-06
T	**Salut Mashinostroitelnoe**	16 Budyonnogo Ave., Moscow, Russia	Tel: (095) 366-78-90 Fax: (095) 365-4006
T	**Ufa Engine Factory**	13/1 First Tverskaya-Yamskaya St., Moscow Office, Russia	Tel: (095) 250-07-09
	Saratov Electric Equipment Factory	6 – 2 Vorontsova St., Moscow office, Russia	Tel: (095) 912-96-46
T	**Altay-Diesel- Region**	Khimki, Russia	
	GAZ	5/7 Shukhova St., Moscow office, Russia	Tel: (095) 237-34-13 Fax: (095) 236-70-63

Waste Heat Recovery Boilers

T	**Ukhta, KomiEnergo**	2a Sevastopolskaya St., Ukhta, Komi Republic	Tel:(82147) 923-56
	DINAMO Electric JSC.	4 Masterkova St., Moscow 109280, Russia	Tel: 275- 14-62 Fax: 275- 24-96
	Scientific Research Institute for Technology and Engine Production Organization	17a Electrolitniy Ave., Moscow 115230, Russia	Tel: 111- 23-33 Fax: 316 9909
	Scientific Research Center of Aviation Engine Construction Institute	Lytkarino, Moscow Oblast, 140061, Russia	Tel: 552-52-53 Fax: 552- 59-10

Foreign Institutions

		Moscow Offices	
	Cuvvins Engine Co. Inc.	113/1 Leninskiy Ave., Moscow 117198, Russia Moscow, Suite E708	Tel: 956-51 22 Fax: 956- 53-62
	General Electric International	Kosmodimianskaya 52-1, Moscow 113054, Russia	Tel: 935- 72-11 935-72-10
	Kloekner Gumboldn- Deutz Ag	6/2 Kalanchevskaya St., Moscow 107078, Russia	Tel: 975-19-82
	Pratt and Whitney Corporation	45-5 Leningradskiy Ave., Moscow 125167, Russia	Tel: 157-05-22
T	**Wartsila Corporation**	7 Glazovskiy St., Suite 13, Moscow 121002, Russia	Tel: 203-15-48 Tel: 230-25-84

Appendix 4.A Russian District Heating Information

162 cities with population over 100,000 people each in Russia covered by DH systems.

Russia has 485 CHPs for district heating.

The number of boiler houses (84-419 GJ/h) is 6,500.

The number of boiler houses (below 84 GJ/h) is 180,000.

The total length of pipelines is 320,000 kilometers.

Distribution heat losses (through pipes) are 10-11%.

Total heat losses are 30%.

One breakdown occurs on average per kilometer per year.

Appendix 5.A Foreign Companies Working in Russia

For Russia to be more successful in marketing fuel cells abroad it is important to create partnerships with foreign companies that already have experience in marketing and selling fuel cells to foreign countries. Since fuel cells are a new technology and it seems that Russia does not have extensive experience in marketing new small-scale technologies, cooperation with these companies is crucial. Few companies produce and sell fuel cells and most of them have already established offices in Russia either directly or through subsidiaries. Cooperating with Russia will not be a new experience for these companies and can help produce cheaper fuel cells. For Russia, cooperating with these companies will help it enter new and potentially lucrative markets. Below is a list of foreign companies that have established operations or offices in Russia. While some of them do not currently work on fuel cells, it is possible that they may become interested in this technology in the future. The following section lists only major international companies.

More and more fuel cell manufacturers create partnerships with global energy companies. Large energy companies have better access to financing than fuel cell manufacturers because they have diverse businesses. Such energy companies might want to invest in new technologies. Creating partnerships between Russian and foreign fuel cell developers, Russian power equipment producers, and large global energy companies can decrease the cost of fuel cell technologies, which would ultimately help fully commercialize fuel cells.

Siemens/Westinghouse (http://w4.siemens.com/kwu/fossil/en/organization/index.htm)

Siemens is a global energy company with headquarters in Germany. It is active not only in the energy field but also in information, communications, transportation, and medical technologies development. Siemens has been working in Russia for the last 150 years. It is worth mentioning the Siemens Power Generation Group (KWU), which produces large-scale power generating equipment for thermal power plants. Siemens-KWU is a shareholder at several Russian power equipment producers. It created several joint ventures with Russian manufacturers. One joint venture, Interturbo, assembles gas turbines for sale not only within Russia but also for export. Another joint venture, Interautomatica, produces control equipment for thermal and nuclear power plants.

Siemens has offices in all countries where Russia sells equipment and with the 1998 acquisition of Westinghouse, which was active in Asian markets, has increased its influence as an equipment supplier to China and India.

A Siemens/Westinghouse Science and Technology Center in Pittsburgh develops SOFC for distributed power generation. It has tested a 100 kW unit in the Netherlands and is planning to test a 220 kW microturbine-hybrid unit in Maryland. Siemens/Westinghouse hopes to commercialize solid-oxide fuel cells by the end of 2003 (Perkins 2001).

Siemens has so much experience in cooperating with Russian manufacturers, has already established joint ventures to produce equipment, and is already close to the commercialization of its fuel cell technologies. Therefore, Siemens might potentially be interested in collaborating with Russian fuel cell researchers to ultimately produce fuel cells in Russia.

Siemens has offices in 25 Russian cities. Contact information for Siemens' Moscow office is as follows:

Malaja Kaluschskaja 17,
117071 Moscow, Russia
(Int'l) 7 095 236 2410
(Int'l) 7 095 236 2494

Ballard (http://www.ballard.com/strat_alliance.asp)

Ballard Power Systems, Inc. is a Canadian-based company founded in 1979 under the name Ballard Research Inc. to conduct R&D in high-energy lithium batteries. In 1983, Ballard began developing PEMFC. Proof-of-concept fuel cells followed beginning in 1989 and from 1992 to 1994 sub-scale and full-scale prototype systems were developed to demonstrate the technology.

Fuel cells are Ballard's core competency and Ballard is developing fuel cells for a wide range of applications. To successfully commercialize its fuel cells, Ballard needed partners and customers who would integrate this key component into competitive products to deliver the benefits of clean, efficient, and reliable power in a wide spectrum of potential applications. To leverage its combined efforts, obtain capital, and gain the critical capabilities of market access, product engineering, mass production, and service coverage, Ballard has secured alliances with selected global players in our target markets.

Ballard created an alliance for the stationary power market in 1996 called Ballard Generation Systems. This alliance integrates Ballard fuel cell stacks into fuel cell stationary power plants. Ballard Generation Systems is a partnership between Ballard Power Systems, GPU International Inc., Alstom and EBARA Corporation. GPU International is an international energy company based in New Jersey with a history of leadership in promoting advanced power technologies. Alstom, based in France, is a world leader in the design and manufacture of equipment and systems for the power generation and transmission industries. EBARA Corporation, based in Japan, is globally recognized as a major developer, manufacturer and distributor of fluid machinery and systems, precision machinery and environmental engineering systems and as a leader in zero emission technology.

Alstom (http://www.tde.alstom.com/en/INTL/index.htm)

Alstom is a global company that has offices in 32 countries. It produces control equipment for power transmission and distribution systems and reliable power supply equipment for oil and gas industries. Alstom has offices in all countries where Russia is currently selling its power equipment – China, India, Argentina, Sweden, and Finland and therefore cooperation with Alstom might help Russia to be more successful in marketing fuel cells to these countries.

Alstom's office in Moscow can be contacted at:
91 Vavilova St., Suite 2, 117335 Moscow, RUSSIA
Phone number: +(7 095) 935 04 25 /26/27/28/29
Fax Number: +(7 095) 935 10 47

General Electric (http://www.ge.com/ru/geps/index.htm)

General Electric is a U.S.-based company that has been working in Russia since 1900. General Electric is not only active in power equipment production but also in other fields such as financing, transportation and medical equipment.

General Electric produces equipment for industrial steam and gas turbines and compressor stations at transmission pipelines and directly works with Gazprom and RAO EES. Through its Italian subsidiary, Nuovo Pignone, which General Electric acquired in 1990, it also produces natural gas and steam turbines and gas generators. Nuovo Pignone also has an office in Russia. General Electric is active in all countries where Russia sells power equipment and cooperating with General Electric on new technologies might help Russian companies to diversify their markets and bring in investment. For General Electric, partnering with Russian researchers could potentially help to produce cheaper fuel cells.

General Electric develops PEMFC for distributed power systems and sells them through Plug Power, Inc. For example, Plug Power will be the exclusive supplier and manufacturer of GE HomeGen PEM fuel cell systems up to 35kW (General Electric 2001).

General Electric's office in Moscow can be reached at:

Kosmodamianskaya Nab. 52, Bldg.1, 6th floor
113054 Moscow, Russia
Tel: (7 095) 935 72 11
Fax: (7 095) 935 72 10

Nuovo Pignone's office in Moscow is at:
B.Levshinski per., 10, Bldg. 1
119034 Moscow, Russia
Tel.: (7 095) 916 53 22
Fax: (7 095) 916 53 24

ABB (http://www.abb.ru/global/ruabb/ruabb051.nsf)

The Swiss-Swedish energy company ABB is one of the largest energy companies in the world. It was established in 1988 through the merger of ASEA (Sweden) and BBC Brown Boveri. It produces power generation and transmission equipment, automatic controls, and equipment for oil and gas drilling.

ABB has been working in Russia since 1893 when ASEA opened an office in St. Petersburg. Since 1992, ABB has become one of Russia's major investors. ABB has production facilities in Russia and operates offices in several cities.

ABB is getting involved in the development of equipment for distributed power including microturbines and fuel cells. It collaborates with DuPont on developing direct methanol fuel cells.

ABB's office in Moscow can be contacted at:

23 Profsoyuznaya St.,
117418 Moscow, Russia
Tel.: (7 095)960-2200
Fax: (7 095)960-2201

Fortum Oy (no fuel cells) (http://www.fortum.com/main.asp?path=1)

Fortum Oy is a Finnish-based electric utility created after the merger of the largest Finnish electric utility and the country's major oil and natural gas supplier. While Fortum Oy does not produce fuel cells, it is interested in the technology. For example, in 2001 Fortum Oy installed a residential cogeneration fuel cell unit that was produced by H Power Corp in a test house (Business Yahoo 2001). Cooperation with Fortum Oy on fuel cells could be useful for Russia, since the company is the major energy company in Finland; as mentioned earlier, Russia supplies power equipment to Finland. Fortum Oy also has offices in all countries where Russia sells its power equipment.

Fortum Oy's core businesses in Russia are power generation and distribution, design and construction in power plants, supply of environmental services, sales and purchase of crude oil, petroleum products and feedstocks. Fortum Oy's main activities are described below.

Baltic Oil Pipeline System

An international consortium has conducted a feasibility study on a new routing alternative for exporting crude oil from the Timan Pechora area and Western Siberia under the Baltic Oil Pipeline System (BOPS). The Russian partner Transneft has decided to proceed with the project by building a new pipeline and a new harbor in Primorsk. Fortum Oy in collaboration with Transneft, is investigating the possibility of extending the pipeline to the Porvoo refinery and harbor.

Natural Gas

Fortum Oy and Gazprom both have a 25 percent share of the gas distribution company Gasum Oy, which imports more than four billion cubic meters of natural gas from Russia to Finland annually. Gazprom and Fortum Oy established another joint venture, North Transgas Oy, to study routes for a North European natural gas pipeline linking Russia to Central Europe via Finland.

Oil & Gas Exploration

Fortum Oy takes part in a consortium to study, explore, produce and transport natural gas to Europe from the Shtokmanovskoye gas field in the Barents Sea. In the Barents Sea, Fortum Oy has been involved in several environmental and geological studies in cooperation with Russian and Finnish authorities and geological organizations.

Fortum Oy (50 percent) and a Russian oil company KomiTEK (50 percent) established a joint stock company called SeverTEK, to develop and produce oil in the Shapkino area of Northwest Russia. Fortum Oy is a partner of the Komi Nenets Energy Company in pursuit of oil, condensate and gas opportunities in the Timan-Pechora Basin.

Electricity Imports

Technopromexport and Fortum Oy have agreed on new electricity imports. Beginning in 2001, Fortum Oy will expand its import capacity to 300 MW. At least 1.6 TWh of electricity will be imported each year.

Engineering

Fortum Engineering, a subsidiary of Fortum Oy, manages heat, oil, gas, and chemical businesses in Russia by providing technical know-how and support in business development and in implementing their investments in Russia. The latest project is the Northwest Power Plant in St. Petersburg. Fortum Engineering, Polar International and Siemens Aktiengeselleschaft delivered this natural gas-fired power plant to St. Petersburg. The end user of the power plant is Lenenergo, of which Fortum Oy owns 4 percent.

Fortum Oy has several offices in St. Petersburg and Moscow:

<u>Fortum Engineering Ltd</u>
Leninsky prospekt, 160
196247 St. Petersburg
International telephone:
+7 812 290 9786
Fax: +7 812 118 4567
<u>Fortum Representative Office</u>
14 Stoleshnikov Pereulok, 103031 Moscow
International telephone: +7 095 721 3191
Fax: +7 095 721 3192

Appendix 6.A Companies Working on Fuel Cells

Companies

Acumentrics Corporation (http://www.acumentrics.com)

Air Products and Chemicals (http://www.airproducts.com/hydrogen/)

Aluminum-Power (http://www.aluminum-power.com/)

Ansaldo CLC (http://www.ansaldo.it/CLC/)

Anuvu Incorporated (http://www.anuvu.vom/)

Astris (http://www.astrisduelcell.com)

Avista Laboratories (http://www.avistafuelcell.com)

Ballard Power Systems (http://www.ballard.com)

Catalytica Energy Systems (http://www.catalyticaenergy.com)

Ceramic Fuel Cells Limited (CFCL) (http://www.cfcl.com.au/)

Coval H2 Partners LLC (http://www.covalh2000.com/)

Daimler-Chrysler's Fuel Cell Powered Vehicle
(http://www3.daimlerchrysler.com/specials/concept/concept4_e.htm)

DCH Technology, Inc. (http://www.dcht.com/)

Dias Analytic Corporation (http://www.diasanalytic.com/index.html)

DTI Energy, Inc. (http://www.dtienery.com/)

EcoSoul (http://www.ecosoul.com)

Electric Auto Corporation (http://www.electricauto.com/)

ElectroChem, Inc. (http://www.fuelcell.com/)

Electro-Chem-Technic (http://www.i-way.co.uk/~ectechnic/HOME.HTML)

Element 1 Power Systems Inc. (http://e1ps.tripod.com/E1PSwebsite/)

Energy Partners, Inc. (http://www.energypartners.org/)

Energy Research Corporation (now Fuel Cell Energy Corp) (http://www.fce.com/)

Engelhard Corporation (http://www.engelhard.com/)

Evonyx (http://www.evonyx.com/)

Fuel Cell Technologies Corporation (http://www.fuelcelltechnologies.ca/)

FuelCell Energy, Inc. (http://www.fuelcellenergy.com/)

FuelCellStore.com (http://www.fuelcellenergy.com/)

GE MicroGen (http://www.gepower.com/microgen/)

General Hydrogen (http://www.generalhydrogen.com/)

Giner Inc. (http://www.ginerinc.com/)

Global Thermoelectric (http://www.globalte.com/)

Graftech Inc. (http://www.graftech.com/graftech_top_level-frameset.html)

GreenVolt Power (http://www.greenvolt.com/)

H Power (http://www.hpower.com/)

HbT (http://www.hbti.net/)

Heliocentris Energiesysteme (http://www.heliocentris.com/)

Hydro Environmental Resources Inc. (http://www.hydrogenerate.com/)

Hydrogen Burner Technology (http://www.hydrogenburner.com/)

Hydrogenics (http://www.hydrogenics.com/)

IMPCO Technologies (http://www.impcotechnologies.com/)

International Fuel Cells, LLC (http://www.internationalfuelcells.com/)

Johnson Matthey - UK (http://www.jmcsd.com/)

Manhattan Scientifics (http://www.mhtx.com/)

Metallic Power (http://www.metallicpower.com/)

Methanex (http://www.methanex.com/)

Millennium Cell (http://www.millenniumcell.com/)

Modine Manufacturing Company (http://www.modine.com/markets/m_fuel.html)

Mosaic Energy (http://www.mosaicenergy.com/)

Northwest Power Systems - IdaTech (http://www.northwestpower.com/)

Nuvera Fuel Cells (http://www.nuverafuelcells.com/)

Ocean Power (http://www.pwre.com/)

Plug Power, LLC (http://www.plugpower.com/)

Powerball Technologies (http://www.powerball.net/)

PowerNova Technologies (http://www.powernova.com/)

Porvair Fuel Cell Technology (http://www.porvairfuelcells.com/)

Proton Energy Systems (http://www.protonenergy.com/)

QUANTUM Technologies Inc. (http://www.qtww.com/)

Shell Hydrogen (http://www.shell.com/hydrogen-en/0,6011,,00.html)

Solar Hydrogen Energy Corporation (http://www.solar-h.com/)

StarTech (http://www.startech.net/)

Stuart Energy Systems (http://www.stuartenergy.com/)

Sure Power (http://www.hi-availability.com/)

Technology Transition Corp. (http://www.ttcorp.com/)

THINK Mobility (http://www.thinkmobility.com/)

Toyota Motor Co.'s Fuel Cell section
(http://www.toyota.com/html/about/environment/partner_tech/index.html)

Warsitz Enterprises Inc. (http://www.warsitz.com/)

Xcellis Fuel Cell Engines Inc. (http://www.xcellsis.com/)

Xogen Power Inc. (http://www.xogen.com/)

ZeTek Power (http://www.zetekpower.com/)

Research, Policy, and Other Organizations

American Hydrogen Association (http://www.clean-air.org/)

California Fuel Cell Partnership (http://www.drivingthefuture.org/)

California Hydrogen Business Council (http://www.ch2bc.org/)

Distributed Power Coalition of America (http://www.dpc.org/)

EcoSoul's Fuel Cell page (http://www.ecosoul.org/)

Energy Co-Opportunity (http://www.e-coop.org/)

Fuel Cell Commercialization Group (http://www.ttcorp.com/fccg/)

Fuel Cell Vehicle Modeling Program - University of California, Davis (http://fcv.ucdavis.edu/)

Fuel Cells 2000 (http://www.fuelcells.org/)

German Hydrogen Association (http://www.dwv-info.de/indexe.htm)

H2 Forum - Swedish Hydrogen Forum (in English) (http://www.h2forum.org/home.html)

The Hydrogen and Fuel Cell Investor (http://www.h2fc.com/)

Hydrogen Energy Center (http://www.h2eco.org/)

Hydrogen Now! (http://www.hydrogennow.org/)

Hypercar Center by the Rocky Mountain Institute (http://www.rmi.org/sitepages/pid386.php)

HyWeb (http://www.hydrogen.org/index-e.html)

National Fuel Cells Research Center (http://www.nfcrc.uci.edu/)

National Hydrogen Association (http://www.ttcorp.com/nha/)

Northeast Advanced Vehicle Consortium (NAVC) (http://www.navc.org/)

Partnership for a New Generation of Vehicles (PNGV)
(http://www.ta.doc.gov/pngv/cover/pngvcover.htm)

Rocky Mountain Institute's Hypercar Center (http://www.hypercar.com/)

U.S. Fuel Cell Council (http://www.usfcc.com/)

University of California-Davis' Fuel Cell Vehicle Modeling Program (http://fcv.ucdavis.edu/)

World Fuel Cell Council (http://www.fuelcellworld.org/)

Your Next Car - by Breakthrough Technologies Institute (http://www.yournextcar.org/)

Federal Government Resources

Argonne National Laboratory's Fuel Cell Section
(http://www.ipd.anl.gov/energy_partners/fuelcell.html)

EREN's Fuel Cell Section (http://www.eren.doe.gov/RE/hydrogen_fuel_cells.html)

Federal Energy Technology Center's (FETC) Fuel Cell section
(http://www.fetc.doe.gov/products/power/fuelcells/index.html)

Hydrogen Information Network - Department of Energy Hydrogen Program
(http://www.eren.doe.gov/hydrogen/)

Los Alamos National Laboratory's Fuel Cell page
(http://www.education.lanl.gov/resources/fuelcells/)

U.S. Department of Defense (DoD) Fuel Cell Demonstration Program
(http://www.dodfuelcell.com/)

U.S. Department of Energy Fossil Energy's Fuel Cell section
(http://www.fe.doe.gov/coal_power/fuelcells/index.shtml)

U.S. Department of Energy Office of Transportation Technologies' Fuel Cell section