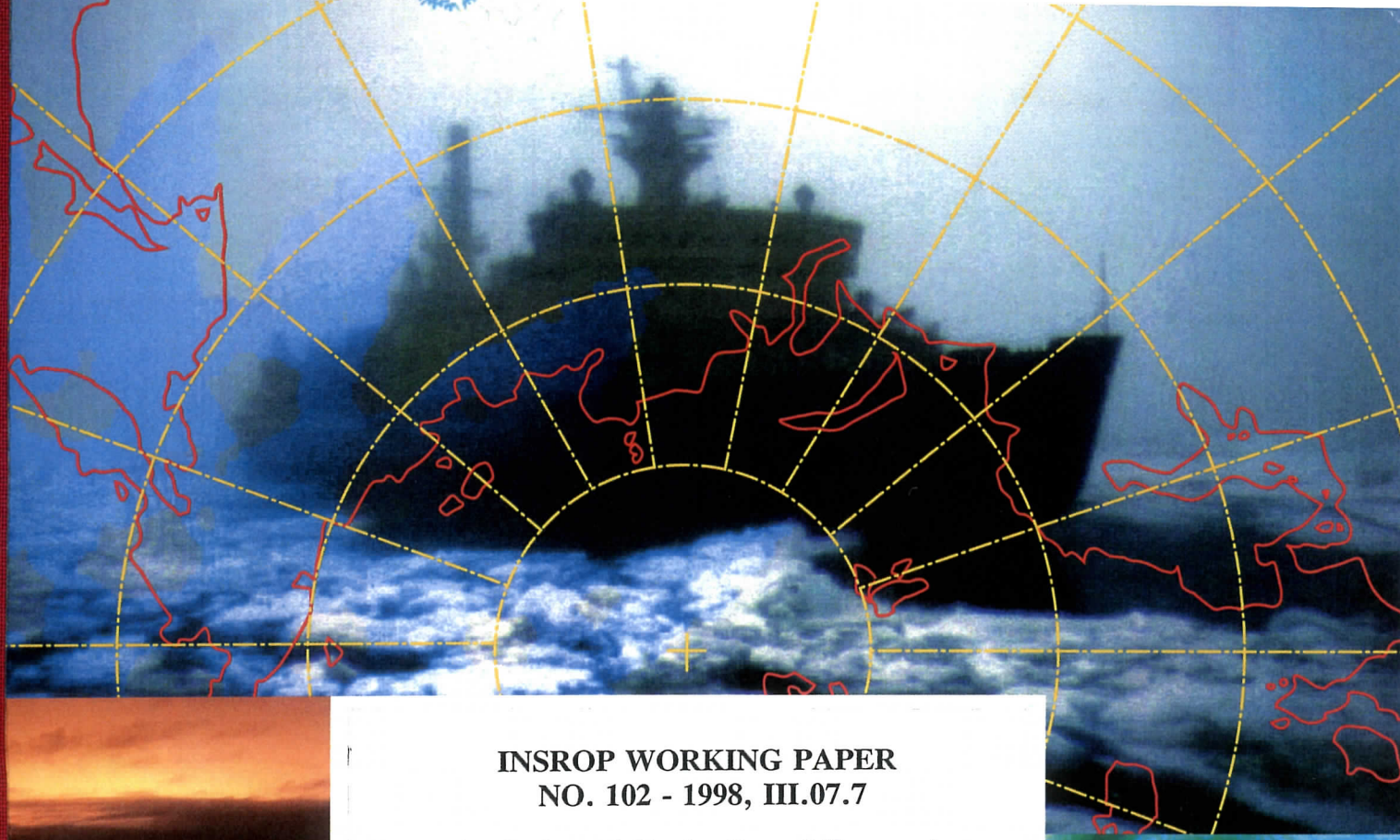

INSROP WORKING PAPER
NO. 102 - 1998, III.07.7

Analysis and Evaluation of Economic Conditions of Energy Prospects Implementation of the Yamalo-Nenets Autonomous Okrug

By Valery Kryukov, Anatoli Tokarev
and Vladimir Schmat

INSROP International Northern Sea Route Programme

Central Marine Research & Design Institute, Russia

The Fridtjof Nansen Institute, Norway

Ship and Ocean Foundation, Japan

International Northern Sea Route Programme (INSROP)

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Title:	**Analysis and Evaluation of Economic Conditions of Energy Prospects Implementation of the Yamalo-Nenets Autonomous Okrug**
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FOREWORD - INSROP WORKING PAPER

INSROP is a five-year multidisciplinary and multilateral research programme, the main phase of which commenced in June 1993. The three principal cooperating partners are **Central Marine Research & Design Institute (CNIIMF)**, St. Petersburg, Russia; **Ship and Ocean Foundation (SOF)**, Tokyo, Japan; and **Fridtjof Nansen Institute (FNI)**, Lysaker, Norway. The INSROP Secretariat is shared between CNIIMF and FNI and is located at FNI.

INSROP is split into four main projects: 1) Natural Conditions and Ice Navigation; 2) Environmental Factors; 3) Trade and Commercial Shipping Aspects of the NSR; and 4) Political, Legal and Strategic Factors. The aim of INSROP is to build up a knowledge base adequate to provide a foundation for long-term planning and decision-making by state agencies as well as private companies etc., for purposes of promoting rational decisionmaking concerning the use of the Northern Sea Route for transit and regional development.

INSROP is a direct result of the normalization of the international situation and the Murmansk initiatives of the former Soviet Union in 1987, when the readiness of the USSR to open the NSR for international shipping was officially declared. The Murmansk Initiatives enabled the continuation, expansion and intensification of traditional collaboration between the states in the Arctic, including safety and efficiency of shipping. Russia, being the successor state to the USSR, supports the Murmansk Initiatives. The initiatives stimulated contact and cooperation between CNIIMF and FNI in 1988 and resulted in a pilot study of the NSR in 1991. In 1992 SOF entered INSROP as a third partner on an equal basis with CNIIMF and FNI.

The complete series of publications may be obtained from the Fridtjof Nansen Institute.

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INSROP

SUB - PROGRAMME III

Project III.07.7

Energy Prospects in Yamalo-Nenets Autonomous Okrug.

Hydrocarbon Cargo Potential for the NSR

Analysis and Evaluation of Economic Conditions of Energy Prospects Implementation of the Yamalo-Nenets Autonomous Okrug

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Introduction

The present report is the logical and substantial continuation of a cycle of research which is carried out within the framework of the International Project on the study of problems of using the Northern Sea Route (International Northern Sea Route Program - INSROP) as international economic transportation way.

Within the framework of the first stage there was conducted a significant (both in volume and in scope of the problem) range of research, that covered mainly actual shipping and technological aspects. Thus, estimations of potential cargo - both on separate directions, and in types of cargo (both separately and within the projects - such, for example, as development of offshore hydrocarbon fields of Barents and Kara Seas) were also carried out.

The group of researchers who conducted research within the present report, earlier in the framework of the first phase of the INSROP project (together with Mr. A.Moe - The Fridtjof Nansen Institute) has carried out a preliminary evaluation of a potential opportunity of hydrocarbons transportation, which might be produced in the Northern part of West Siberia - in the area close to the Northern Sea Route (See: INSROP Working Paper No. 56 - 1996, III.07.3 - V.Kryukov, A.Moe, V.Schmat "West Siberian Oil and the Northern Sea Route: Current Situation and Future Potential" // see also "Polar Geography", 1995, 19, pp. 219-235). The basic conclusion of that research was that in the Northern part of West Siberia there are significant resources of hydrocarbons directly in the zone contiguous to the area of NSR influence. Thus, the development of resource potential is restrained both by backwardness of transportation infrastructure and extremely high capital costs for the development of the projects considered. In this respect, it was offered that all the projects related to development of hydrocarbon resources in the above area are to be subdivided into two categories – the so-called "local" (individual schemes of hydrocarbons shipping without integration into existing and future transportation infrastructure - first of all, with the system of trunklines), and the so-called "integrated" (connected with development of trunklines and formation of regional transportation infrastructure).

The work during the first stage did not give an answer to basically economic

questions of implementation of the hydrocarbon fields development projects.

Therefore, within the framework of the second stage it was planned to give the answers to specific economic questions. First of all, to such questions, as:

- hydrocarbons prices in areas of production, under which it makes sense to speak about the expediency of energy potential implementation of the Northern part of West Siberia;
- distribution of hydrocarbons - from the point of view of expediency of transportation either via NSR ("Northern" scenario) or via the system of trunklines ("Southern" scenario in the present work);
- forms of economic regulation (first of all, of tax character), directed at the increase in economic efficiency of implementation of energy potential of the Northern part of West Siberia.

The overall objective of the present research (as it also is determined by the terms of reference and program of INSROP - phase two) consists in identification of economic conditions and preconditions necessary for realization of potential profitability of energy potential of the area. That is why the analysis of expenses of hydrocarbons transportation via NSR in comparison with similar parameters of transportation via trunklines is carried out in the present study.

In the authors' point of view, this report could give an answer to a major question (together with comparative analysis of variants of development.of oil and gas fields of Nadym-Pur-Taz or Gydan-Yenisey oil and gas areas) - what are the marginal hydrocarbon **production** prices in different areas (the so-called DAF prices - Delivery At Frontier – at the starting oil gathering units and gas pipelines that have to be built within the framework of the project) which would allow their profitable extraction. From this viewpoint, the determined value of hydrocarbons prices could be viewed as an estimate of marginal level of expenditures (in case of zero profitability) for the fields development and future hydrocarbons production. Also, it is important that the determined value of the prices allows to distinguish all fields by the efficiency of future production:

- fields development of which is effective in case of given DAF price;

- fields, development of which is inefficient

Also all hydrocarbon fields of examined area could be (due to DAF price level) divided into subgroups depending on a direction of delivery of production - NSR or system of on-shore trunklines. Distribution of particular (specific) groups of hydrocarbon fields by directions of transportation is another task which was not carried out within this study.

The structure of the report is designed in accordance with the main research objective. The report consists of 5 chapters, introduction and conclusion (principal conclusions), including 10 tables with results of evaluation of economic parameters, and one diagram.

1. Role of the Northern Sea Route in solving the problem of oil and gas transportation from Siberia

Role of NSR, as one of the major factors of the development of oil and gas resources of Siberia, is most obvious in case of Ob-Yenisey North zone, where nowadays several oil and gas projects are at the initial stage of implementation. Just a month ago competitive bids on the rights to explore and to develop several fields in the area close to Yenisey valley were completed. For the purposes of analysis (and future development), it is logical within the borders of this vast territory to divide different territories by geographical situation, concentration of resources, stage of geological exploration. Such subdivision could be useful for the purposes of analyzing the use of NSR for the development of these territories:

- Arctic areas of Tyumen oblast (Yamal and Gydan peninsulas);
- Far North of Tyumen Oblast (Nadym, Pur, Taz and Krasnoselkup districts);
- Far North of Krasnoyarsky Krai (left bank of Yenisey, near the border with Tyumen oblast).

Basic interrelations between the use of NSR and development of oil and gas industry in the Ob-Yenisey North areas are rather obvious. NSR allows:

- shipment of cargoes (equipment, materials and other) needed for the development of hydrocarbon fields;

- transportation of hydrocarbons produced to potential consumers - both in Russia and abroad.

The first task for NSR is traditional. As to the second task, neither now, nor in the previous years, was NSR practically used for export of bulk-oil loads from areas of production (except small-size regular seasonal export of condensate from Yamal peninsula). This opportunity was considered only as purely hypothetical.

To transfer these suggestions into the sphere of more quantitative analysis, first of all it is necessary to understand what role, in general, NSR could play in solving transportation problems in the development of oil and gas industry of North Siberia.

It is accepted to consider that the development of new oil and gas fields in Siberian North is connected with the problem of transporting the hydrocarbons produced. At the same time, this problem is not common in all cases. Previously, quite a big system of oil trunklines, covering all currently functioning production areas and allowing to transport out of the region 400 million tons of liquid hydrocarbons annually (6 main oil pipelines having external exits, total length within the boundaries of Western Siberia - more than 10,000 km) was constructed in the North of West Siberia.

Actually the transport problem consists, in the author's opinion, of four most important issues:

- Absence of specialized transportation infrastructure in the case of new developing areas (which have large resources of hydrocarbons - as shown during the first INSROP stage);
- Dependence of production enterprises on transportation monopolies - JSC"Transneft" and RJSC "Gasprom", and, related to the access to efficient export facilities - from Ministry of Fuel and Energy of the Russian Federation;
- Lack of capacity of export oil transportation systems belonging to Russia (such as sea terminals in Baltic and Black seas), and still disputable relations with Ukraine concerning the use of capacity of main on-shore export oil trunkline "Friendship"/"Druzhba");
- Actual absence of reliable "exit" for Siberian oil to the Russian Far East and, consequently, to the countries of the Asia-Pacific region.

As for the first part of the problem, it is clear that many promising oil and gas areas of Yamal, the Lower Ob, Pur-Taz, Yenisey-Hatanga regions currently have no connections with the system of trunk lines of West Siberia. Oil and oil-condensate fields (often with rather small reserves) are dispersed on broad territory; this reduces efficiency of the traditional schemes of their development (with construction of stationary transportation pipeline systems).

The necessity of reasonable diversification of oil and gas transportation routes as a whole also is caused by the transition of Russian oil and gas sector to the market-oriented conditions. In the more particular aspect, in the case of oil export - quite clear aspiration of the producers to weaken or even to eliminate the dependence on physical and administrative restrictions. For areas of Siberian Extreme North it is a particularly urgent step. Development of oil and gas resources here objectively requires involvement of new investors - both foreign and Russian investors (not only oil and gas companies but also from financial institutions - like banks and various foundations).

Therefore, in the areas of Ob-Yenisey North that have direct access to the Arctic seas a natural alternative is quite obvious. This alternative is a traditional (for Russia) approach to the development of oil and gas transportation infrastructure; the essence of this approach is in the use of combined transportation schemes binding them to NSR. The importance of NSR from the point of view of implementation of particular (specific) oil and gas projects could be much bigger: it could open quite a new route for Siberian hydrocarbons both in the west and in the east. It is necessary to note and to underline that more general strategic and economic factors are connected with the use of transportation opportunities of the NSR.

NSR development in the direction of transition to all-year-round navigation and changing of its status - from internal to international - is the main driving force of the process of formation of the new global transportation network (new transit route from Europe to the countries of American continent and Asia-Pacific region).

Formation of such transportation route could promote economic development of the northern territories in a much broader international context. It could promote, along with others, economic development of the areas of the Ob-Yenisey North. For

these areas (many of which are undeveloped) the transportation factor is the key condition that determines the options for industrial operations based on local natural resources - and further export of them (like oil and gas) to potential markets.

2. Analysis of possible approaches to solving the problem of hydrocarbons transportation from the Northern part of West Siberia

2.1. General characteristics of basic scenarios

In case of the predominant export (not only abroad but also out of the region of production) orientation of the hydrocarbon resources development in the Northern part of West Siberia, two alternative scenarios of transportation of hydrocarbons from this area are possible.

Scenario No1 ("Southern") provides connection of the developing fields with existing oil and gas trunklines, which start in northern districts of Tyumen Oblast (namely, Yamal-Nenets Okrug).

Scenario No 2 ("Northern") is focused on creation of the new transportation route, using the opportunities provided by the NSR. This scenario is based on construction of new oil and gas trunklines from the fields to the future sea terminals, construction of terminals themselves (and other objects necessary for the maintenance of sea transportation of hydrocarbons), and, finally, organization of the transportation process on the NSR.

Within the framework of each of the named scenarios various "internal" variants of construction of the transportation scheme are possible.

Construction part of the "Southern" scenario of hydrocarbons transportation includes the following **variants**:

- construction of oil and gas trunklines to a Zapolyarnoe gas-condensate field which is now under initial development phase (and quite important element of development strategy for the entire RJSC "Gasprom"). This trunkline could also give an opportunity to transport oil and gas produced at the closely

located fields;

- construction of oil and gas pipelines in separate "corridors" in the direction of Urengoy gas-condensate field (gas and condensate pipelines) and to Purpe area (where existing oil trunkline starts, owned by JSC "Transneft").

The further transportation of oil is possible via existing oil trunk lines (which are under JSC "Transneft" supervision) in the direction of the site of any existing or perspective sea export terminals (Black Sea - Novorossiisk, Baltic Sea - Ventspils, Batareinaya Bay, Baltiysk etc.), or towards the starting point of "Friendship"/"Druzhba" export oil pipeline.

Similarly, existing gas trunklines (which are under RJSC "Gasprom" supervision) could be used for the delivery of gas to the consumers.

In the case of the "Northern" scenario, basic distinctions between variants are connected with the choice of :

- site of construction of sea terminals (to load tankers);
- technologies of gas conversion into transportable product (liquefaction, hydratation or processing into methanol);
- organizational (charter of vessels or construction, or just purchase of own tankers) and technical (class of vessels and their weight capacity) schemes of the product transportation via the NSR;
- structure of exported output (crude oil, oil products or their combination);
- markets for the products - Western Europe, North America, countries of Asia-Pacific region (APR), Russian ports en route of the NSR.

No doubt, variants of the "Northern" scenario implementation (in comparison with "Southern") - especially in investment aspects – are connected with the acceptance of solutions concerning the construction of onshore objects and organization of sea transportation. That is why this scenario requires deeper and more careful analysis.

2.2. Comparative analysis of scenarios and variants

Both the above scenarios and each of the individual variants of their implementation have advantages and disadvantages caused by the impact of many

different factors: natural, technical, economic, political, and many others. It is necessary to note that a detailed quantitative evaluation of the given factors, which would allow to reach unequivocal conclusions about the predilection of either scenario and variant is practically impossible (at least, at the present moment). The reason is the absence of necessary information, or limited applicability of the available information, concerning realization of the "Northern" scenario. Information problem is quite objective by virtue of relative novelty of the analyzed approaches to organization of oil and gas transportation in the conditions of Siberian North and absence of precedents (which could be considered complete analogues of the examined project).

Therefore, in this situation comparison of scenarios and variants is expedient to conduct from the viewpoint of their basic qualitative features, of potential opportunities and probable disadvantages inherent in them. As to evaluation of quantitative parameters, - in the conditions of an inevitable high error of calculation - it is important that they are comparable in the levels of values, i.e., do not have multiple distinctions. First of all, it pertains to parameters of hydrocarbons transportation expenditures.

2.2.1. Basic advantages and disadvantages of the "Southern" scenario

Implementation of the "Southern" scenario is based on the construction of new pipelines in the direction of starting points of the already existing oil and gas trunklines. The elements of transportation infrastructure within the framework of this scenario are quite traditional (ground pipelines, pump and compressor stations), though to build them could be much more difficult than before (because of much more extreme ground and climatic conditions).

The main and quite obvious advantage of the "Southern" scenario is much lower level of technical risk (which is determined by the lack of non-traditional and not yet proved in practice solutions), and also much lower financial risk caused by the impact of technical factors.

Many difficulties which are usually expected by potential investors of the project

in case of this scenario, are also easy to predict and to understand them it is sufficient to look at the experience of work in similar conditions of the companies chosen as contractors and then as operators. On the one hand, it is possible to consider as a "plus" to work in familiar conditions and to deal with well known problems (if they basically have a solution) is usually much easier than with new ones. On the other hand, in this there is hidden the obvious and most essential disadvantage of the "Southern" scenario - in case of its implementation, probably, the highest level of dependence of investors and operators of the project on the internal Russian factors will take place - like trunkline carriers monopoly and dependence on unpredictable position of government bodies (both at a regional and a federal level).

The specified dependence could have dual character:

- firstly, in the issues of "physical" access to the units of oil and gas transportation system (pipelines and terminals), particularly, in the case of connecting the proposed pipelines within existing field infrastructure (which is owned by the producing companies) and then in the case of trunklines (deals with such monopolies as JSC "Transneft" and RJSC "Gasprom");
- secondly, expected threat of quantitative restrictions on export abroad of hydrocarbons produced; main actors here - government bodies which are under pressure from different political factors and policy oriented regulations (for example, oil companies are simultaneously under pressure of changes taking place in export regulations - like procedures of "distribution" of the most attractive geographical directions).

It is important to emphasize, that the marked disadvantages of the "Southern" scenario have no precise quantitative characteristics - like possible changes of oil volumes sold or variation of transportation costs. These disadvantages are more of qualitative character - their existence as more or less probable threat capable to some extent to prevent implementation of the project. It is possible also to expect, that the probability of such threat (in case of formation of more competitive environment in Russian oil and gas sector) might be decreased in the future.

A rather crucial disadvantage of the "Southern" scenario (about which it is

possible to speak with complete certainty) is the absence of guarantees of the delivery to the buyer of the oil which was actually produced within the project. Pumping of oil into the trunkline system (owned by JSC "Transneft") will result in the fact that in reality the buyers will be shipped the regular Russian export mixture ("Urals") and, consequently, the probable price gain from the higher quality oil (almost all oil of the North Siberia fields has very low sulfur content in it and has characteristics not worse than oil of the "Brent" grade) will be completely lost. The specified losses are not difficult to estimate quantitatively - on the basis of a difference in the prices of oil of a similar type and "Urals" mixture they might reach 10 or even more US dollars per 1 ton.

At present, with oil transportation via JSC "Transneft" pipelines there are no mechanisms yet of compensation to the producer of losses from deterioration of quality of oil delivered to the ultimate users, as a result of its mixing. It is rather difficult to say exactly when such mechanism of discounts and extra charges to the transport tariff in case of transportation of different quality hydrocarbons are put into practice.

The last from a number of the most crucial disadvantages of the "Southern" scenario is connected with the limit of capacity of the existing oil and gas transportation systems (particularly, sea terminals in Russian ports of the Baltic and Black seas). At the same time, substantial portions of oil and gas trunklines have spare capacity (especially in Tyumen Oblast and in European Russia). Having been constructed 20 or more years ago, most trunklines are completely depreciated or close to this. For their maintenance and preservation in a workable condition (and, furthermore, for realization of fundamental reconstruction) huge investments are needed. In the present situation the only one possible source is the transportation fee – i.e., payment for the transportation of oil and gas. Usually, significant escalation of volumes of transportation work means reductions in tariffs of oil and gas transportation via existing trunklines. In our case it is clear enough that such combination is impossible - mainly due to bad conditions of existing trunklines. More probable future - increase in both transportation work and in tariffs. Besides the threat of higher transportation tariffs it is necessary to keep in mind the risks of

default of the export contracts due to failures of pipelines; the higher the degree of pipelines wear and tear, the higher is such probability.

As for the problem of oil loading in Russian ports, the prospects of its solving also are by no means cloudless. The implementation of the projects of reconstruction of operating terminals and construction of new terminals is going rather slowly. It is also necessary to take into account such aspect of onshore transportation as a steadily growing number of intermediaries between the producer and the buyer of oil: this leads to increase in associated expenditures.

2.2.2. Basic advantages and disadvantages of the "Northern" scenario

"Northern" scenario has a number of advantages that reflect a wide spectrum of economic targets (state, territories, oil and gas companies) and arise mainly from disadvantages of the "Southern" scenario.

First of all, this scenario is characterized by much lower extent of **monopolization of access to oil and gas transportation systems.**

With organization of transportation of oil and gas via northern route the threat of monopoly behavior could arise from Administration of the NSR and shipping companies positions (especially subordinated to Federal Service of Sea Transportation (FSST). The share of former state shipping companies today consists of approximately 85% of arctic transportation (share of the foreign shipping companies - 9-10%, other Russian departments and companies - 5-6%) [See: A.Granberg. Use of Northern Sea Route: the tendencies and prospects // Russian economic magazine, No 5-7, 1997].

At the same time, the situation of FSST shipping companies essentially differs from the situation with JSC "Transneft" and with RJSC "Gasprom". The latter are absolute monopolies, owning the scarce specialized infrastructure. For the overwhelming majority of oil and gas producers in Russia at the present moment it is not possible to deliver produced hydrocarbons to the final consumers by-passing both JSC "Transneft" and RJSC "Gasprom". The shipping companies (which are under the FSST umbrella), first of all, have no absolute monopoly for transportation

services; and, second, they do not represent uniform corporate structures but are acting as competitors. Economic crisis (since end of 80-th till present) has had, among other consequences, a sharp reduction of general (including foreign trade transportation and transit) cargo volumes of the arctic sea transportation - from 4,8 million tons to 2,4 million tons (more than two times reduction). Transportation of bulk-oil cargo have decreased from 1 to 0,2 million tons, or almost 4,6 times. The reduction of transportation via NSR occurs due to general fall of demand and also due to rationalization of transportation activity (like replacement of sea transportation by river transportation, - for example, the ever growing amounts of oil products are delivered to the Northern territories by river) [A.Granberg, 1997].

The increase in volumes of transportation (export of hydrocarbons) with evidence corresponds to the interests of Russian shipping companies and Administration of NSR, and consequently, reduces probability of negative consequences of their "half-monopoly" position in their contacts with of oil and gas producers. Moreover, hydrocarbon producers have an opportunity to resort to services of the foreign shipping companies or to use their own vessels. The threat of restrictions on the activity of independent operators in the NSR zone is rather remote - mainly because such restrictions immediately come into contradiction with numerous international obligations and initiatives of Russia concerning the use of NSR. Formation of the new oil and gas transportation "corridors", diversification of directions of transportation and markets of selling the products, directly corresponds both to the nation-wide targets of Russia and to the local targets of Northern Siberian territories. In particular, it would be favorable for YaNAO, to develop new transportation infrastructure for the new oil and gas projects within its own territory. Such a development is possible only in the case that hydrocarbons transportation is linked with the northern route. The aforementioned circumstances could give to the potential investors and operators quite objective and powerful arguments for asking for tax and other fiscal exemptions at the regional level (in case of implementation of the new oil and gas projects in the areas of North of West Siberia).

The **third** serious advantage of "Northern" scenario is actual novelty of created transportation system and opportunities deriving from it. For the oil and gas

producers, the specified factor plays an extremely important role - first of all, from the point of view of stabilization of transportation tariffs (this tendency might play a counterbalance role towards potential tendency to growth of transportation costs in the case of using old oil and gas trunklines). The competitiveness of the "Northern" scenario will depend on the volumes of transportation work (with other things being equal): specific costs might be reduced in case of growth of volumes of transportation. In transportation of natural gas (which is connected with construction of technological complex of ground facilities and specialized sea vessels) the level of costs is especially sensitive to the scale factor.

If we estimated construction of new technological systems for the transportation of oil and gas from the point of view of national economic targets, we could see that this process, under the conditions of reasonable government protection, might have essential stimulating influence on the development of domestic machine building (especially for the producers who are in a process of conversion of their capacities from military oriented production to civilian).

A certain advantage of the "Northern" scenario is connected with the opportunities of development of the arctic market of oil products which includes two main segments:

- internal - delivery of oil products to the Russian consumers in a zone of the Arctic Region through ports which are en route of the NSR;
- external - supply by fuel of Russian and foreign vessels - in case of organization of large-scale transit transportation from Europe to Asia and America en route of NSR.

With a reasonable level of oil-condensate processing costs near sea terminals the competitiveness of oil products produced at the Arctic coast and intended to be sold near by could be rather high.

At the same time "Northern" scenario has four basic disadvantages.

The **first** of them is the high level of technical risk related to a large number of factors.

In spite of the fact that in the world practice sea transportation of oil and gas has

extremely wide application, for Russia (by virtue of a number of objective reasons) it is a rather new kind of activity. This is quite new approach (despite of pioneering experience during Tsarist Russia time) to the solution of transportation problem in case of the development of the new oil and gas producing areas. Both in the USSR and in Russia for the last few decades there were no precedents of realization of the large-scale projects of hydrocarbons sea transportation.

It is obvious, that one of the main factors of risk is **the hard conditions of navigation on the NSR**. Not too much from previous experience could be used. Large-scale transportation of oil and gas needs the use of vessels of super-large carrying capacity with dead-weight (DWT) varying from 70 up to 300 thousand tons that have never been used before in the Russian Arctic Region. E.g., in 1995 FSST shipping companies working in the Russian Arctic Region had the average dead-weight of one vessel of an ice class about 6.7 thousand tons [A.Granberg, 1997]. Especially acute also might be a problem of navigation in coastal zones (in water areas of shallow gulfs of the arctic seas).

At the present time, the problem of all-year-round navigation on the whole line of NSR is far from a solution and this also complicates the organization of transportation of hydrocarbons from north of Siberia to the East - to the markets of the APR countries.

Another risk factor is connected with the conditions of construction and operation of technological facilities (for example, pipelines, liquefaction gas plants, methanol plants, terminals and other) on the Arctic coast in absolutely undeveloped areas with extremely fragile natural environment. Russia does not have the appropriate experience, only at the beginning stage offshore projects on the development of oil and gas resources in Barents sea.

The **second disadvantage** of "Northern" scenario consists in high capital-intensity of implementing any of its variants.

This problem, as well as many others, first of all, concerns the organization of gaseous hydrocarbons transportation. Analysis of the cost normative base (based on other similar projects both in Russia and in the world) shows, that even small projects with volumes of transportation of 1-2 billion m^3 of natural gas require investments of

several hundred million dollars. Up to a half (or even more) of all capital expenditures is necessary for installations which convert gas into liquid phase suitable for transportation by specialized sea vessels. In this case, ideal situation is considered to be the one when such plant is located on flat coast of good natural harbor far from any inhabited place and close to sources of supply of natural gas. Deviation from ideal conditions results in the corresponding growth of expenditures [See: Issues in Midterm Analysis and Forecasting. 1997. / Energy Information Administration - U.S. Department of Energy. Washington, July 1997].

Combination of the factors of technological risk and capital-intensity underlies the **third** main disadvantage of the "Northern" scenario - high financial risk.

It is natural, that the factor of financial risk, in the first place, has an impact on investors' and operating companies' (which might be differ from investors) decision making on participation in oil and gas development projects in the Northern part of West Siberia.

Technological and economic features of sea transportation of hydrocarbons might lead to the risk of non-return of the monies invested in the project. In case of implementation of local projects intended to develop individual groups of fields with rather small absolute capital expenditures the probability of non-return of the investments due to low profitability of each individual projects is much higher. The increase in expected profitability of the projects could take place (with other things being equal) only with expansion of their scale - with increase both in production capacities and in transportation capacities due to amalgamation of the local projects into bigger groups. But, in this case the absolute sizes of CAPEX (and possible sizes of losses) and the problems of co-ordination (in terms of implementation and managerial procedures) of many local projects might grow up considerably.

The last (but not least), **fourth** basic disadvantage of the "Northern" scenario is that with its implementation certain isolation of the process of development of hydrocarbon resources in the areas of Northern part of West Siberia from the development of oil and gas resources in other ("southern") regions of Siberia might take place. It means that northern oil and gas companies will not have direct connections with the domestic consumers of oil and gas (except consumers located

near the Arctic coast). It could lead to squeezing of the potential markets for the hydrocarbons produced. One possible solution to avoid such squeeze of the internal market is to introduce a rather complex system of cross delivery of hydrocarbons (when a company operating in the Far North could implement export contract signed by a southern company and vice versa). Such procedure could lead to increase in operational space for small northern companies.

The majority of the above factors and conditions could be analyzed only in qualitative terms. Therefore, today it is rather difficult to predict, whether or not in the future there will be a balance of advantages and disadvantages of each of the scenarios. And which combination is more preferable from the viewpoint of the hydrocarbon resources development in the Northern part of West Siberia as a whole. Much will depend on circumstances and parameters of each particular project: field location, reserves and structure of pool, connection with other projects and so on.

3. Analysis of variants of implementation of "Southern" and "Northern" scenarios of the external transportation scheme

3.1. Variants of "Southern" and "Northern" scenarios of the external transportation scheme

In the framework of the "Southern" scenario one variant of transportation of liquid and gaseous hydrocarbons is considered. Such scheme provides:

- delivery of oil and condensate via pipeline to the Purpe area, where existing oil trunklines in the direction of Novorossiisk (sea terminal on Black Sea coast) starts;
- delivery of gas via pipeline to the Urengoy field area where gas route Urengoy - Western Europe starts.

The above variant of gas transportation within the framework of the "Southern" scenario is the only one way possible. Alternative variants of oil transportation (direction of transportation is to the Baltic Sea terminals - Ventspils, Batareinaya and others) were not examined in detail (such as cost level). Alternative variants are quite

close in terms of costs with the "Novorossiisk" variant which is the best among the schemes of transportation in the southern (in terms of current report) direction.

Within "Northern" scenario several variants with different oil, condensate and gas transportation tariffs/parameters of products delivered for transportation and different technologies of conversion (transformations) of gas from gaseous stage into liquid and the subsequent transportation of hydrocarbons, were calculated.

3.2. Characteristics of technological and organizational schemes of sea transportation of hydrocarbons

3.2.1. The technological scheme of oil and gas condensate transportation

Basic variants of oil transportation consist of oil pumping in icebreaking tankers with DWT of 80 thousand tons (variants N1o and N2o) and 40 thousand tons (variants N3o and N4o). Variants N2o and N4o also include additional construction of oil refining installations (with capacity up to 3 million t/year) close to the terminal and further loading of both crude oil and oil products).

Basic assumption is that terminals are to be installed in the water area. The terminals of similar designs are widely used in Arctic areas of North America. For example, "Amoco" offers for the development of Bovanenkov field (Yamal), as the optimal solution, the design of the terminal anchored to the bottom monolithic structure. Such terminal might be connected with onshore tanks by the special sea pipeline. [See: The review of a current condition of joint works on Yamal / "Amoco" - "Gasprom" - "Nadymgasprom", 1995].

Technological scheme of liquid hydrocarbons transportation includes oil storage tanks of capacity enough to accumulate hydrocarbons during the period of departure and arrival of tankers in the most adverse navigating period and the maximum daily production of oil for the whole period of operation.

Application of the simplified technology of oil processing (refining) aimed to reach maximum output of bunker fuel (up to 60 % in terms of depth of refining) and includes processes of direct processing of oil ("AVT"), secondary refining of petrol

fractions and unleaded high-octane gasoline production unit.

3.2.2. Technological scheme of natural gas transportation

In the analysis of variants of gaseous hydrocarbons transportation 3 different technological schemes of transformation/conversion of gas into transportable product and its subsequent transportation are taken into account:

- on the basis of the liquefied natural gas (LNG);
- on the basis of frozen gas-hydrate (NGH - natural gas-hydrate);
- on the basis of methanol (Me).

LNG Technology.

LNG production and transportation technology includes the following basic elements:

- Natural gas liquefaction plant.
- Terminal - loading sites plus storage tanks.
- Special cryogenic tankers of the strengthened ice class.
- Installations (factory) of re-gasification in the port of destination.

Within the framework of the considered project of development of resources of the Northern part of West Siberia a particular (specific) technological scheme of LNG transportation is considered as the basic one and it should include:

- Natural gas liquefaction plant of a regular (onshore) design.
- The loading terminal with storage facilities.
- Cryogenic tankers for LNG transportation (strengthened ice class, capacity close to 135 th.m^3 or 70 thousand t DWT).
- Re-gasification plant (or sale of the liquefied gas) in the port of destination.

NGH Technology

NGH transportation technology ("Gas-in-Ice") is completely new and has not been practically tested yet. The specified technology is patented in 1990 by Professor Ion Goodmudson (University of Trondheim, Norroute) [T.R.Ramsland Msc, E.F.Loy, S.D (see: Northern Gas Fields and NGH Technology - A Feasibility Study to

Develop Natural Gas Hydrate Technology to Supply International Gas Markets from Year 2005 / INSROP Sub-Program III. Preliminary Report. Bergen, 1996].

Within the framework of this study variants based on application of NGH technology, were also considered. The following elements of transportation scheme were taken into account:

- natural gas hydrate plant located on the coast;
- sea terminal with storage tanks;
- bulk ships (bulkers) for transportation of natural gas hydrate (with carrying capacity of 300 and 150 thousand tons DWT);
- re-gasification plant in the port of destination.

Methanol technology.

Implementation of methanol production technology requires the following elements:

- methanol plant on the coast;
- loading terminal with storage tanks ;
- tankers (ULA class) 40 thousand tons DWT.

3.3. Evaluation of quantitative parameters of scenarios and variants of external hydrocarbons transportation

3.3.1. Methodical and informational aspects of the evaluation

Selection of target parameters.

From the standpoint of economic analysis of different schemes of external oil and gas transportation the basic parameters are as follows:

- The average rate of transportation tariff;
- The price designed by the principle of "Net Back Price" (price ex-field or ex-gathering point of oil and gas).

Evaluation of the above parameters is executed with the use of a standard financial model, which allows to calculate the net present value (NPV) and internal rate of return (IRR) of a transportation subsystem of the development project for the

fields of the Northern part of West Siberia.

The values of the tariff and price in the variants of "Northern" scenario are estimated under conditions of various levels of required profitability.

The basic values of the tariff and price in the variants of "Northern" scenario are estimated under the condition of zero "net" profitability: R = IRR - E, where E is the value of discount rate (E = 5%). Thus, the payback period of CAPEX needed to construct the transportation system is 25 years, and NPV = 0.

Such approach allows to estimate just the costs of hydrocarbons transportation and to receive the estimate of real efficiency of the project as a whole (production + transportation) without distortions comes from various sorts of transactions. From the practical point of view unprofitable functioning of a transportation infrastructure corresponds to the principle of maximum of general efficiency of the project in a counterbalance to maximum of local efficiency of separate subsystems (production or transportation).

In addition, the values corresponding to the conditions of achieving "net" profitability (5-20%) are estimated. These variants of evaluation correspond to the hypothesis of formation and operation of a transportation system as an independent commercial entity.

Informational aspect.

Complexity of informational aspect of the evaluations are connected with selection of parameters rather than data itself. Key data are as follows:

- hydrocarbons future prices;
- tariffs for oil and gas transportation via existing "corridors" ("Southern" scenario);
- capital (CAPEX) and operating (OPEX) expenditures of newly constructed objects ("Northern" scenario).

It is quite important not to overestimate the probable efficiency of the "Northern" scenario of external transportation scheme (which is characterized by the highest level of uncertainty of technical and economic parameters).

Forecasting future prices. Basic oil, natural gas and methanol prices are fixed at the average level (between maximum - scenario of restraint of production - and minimum - energy saving scenario) for the forecast for the years 2000-2005 and based on the CIF-Rotterdam principle [See: World Energy Outlook. International Energy Agency. Paris, France, 1996 Edition, pp. 231-233].

Thus, the basic price of exported oil is based on the price of the "Brent" grade oil.

Future prices of natural gas in the schemes of conversion into transportable product are estimated with account for decreasing/discount factor which reflects technological consumption and losses of gas within all stages of processing and transportation.

Existing tariffs. For the purpose of estimating expenditures in case of the "Southern" scenario as a basis, the following data were proposed.

1. The cumulative tariff for oil transportation (via trunk line) from the North of Tyumen area to Novorossiisk as estimated by the Ministry of Fuel and Energy of the Russian Federation [1].
2. The existing maximum officially accepted tariff for the independent producers for gas transportation (by trunkline) (7,700 rubles for transportation by pipeline of 1,000m^3 to the distance of 100 km) [2].
3. Estimate of transfer costs in Novorossiisk and subsequent transportation to port of Genoa [3].

Capital and operating expenses. Construction costs to build new objects in the framework of the "Northern" scenario are determined on the basis of the data on the analogous objects.

1. In the scheme of **transportation of oil and oil products**:

- Average capital costs needed to build the linear part of trunklines are determined on the basis of data describing similar projects in the Timan-Pechora region and Arctic territories of North America, i.e., in the areas similar in climatic conditions to the Northern part of West Siberia;
- Average capital costs needed to build terminals are determined on the basis of the numerous data describing similar projects in Russia;
- Capital costs needed to build storage facilities are determined on the basis

of the data describing the Ventspils oil port reconstruction;

- Capital costs needed to build tankers are estimated on the basis of published data on the prices of new vessels [4].
- Capital and operating costs for oil refining installations are determined based on the data on the process of primary refining of the "Technip" type / Source:
- Capital and operating costs of transfer are determined on the basis of the existing tariff at the port of Novorossiisk (with deduction of profit and tax component);

2. Under the scheme of **LNG transportation** the following projects are taken as the basic analogues of the projects of implementation of the schemes of external transportation: development of Harasavey and Shtokmanov fields. Materials describing these projects contain almost all the necessary normative data on the cost of a LNG plant (with infrastructure, terminal and storage facilities), tankers and installations for re-gasification, and also operating costs of the listed objects [6, 7].
3. In the case of **NGH transportation** scheme, development of Shtokman field was taken as the analogue of the appropriate variant of the external transportation project. Materials describing this project contain all the necessary normative economic data -both CAPEX and OPEX - concerning NGH plant (and also the data concerning infrastructure, terminal and storage facilities), bulk ships and re-gasification installations [7].
4. CAPEX and OPEX for the **methanol transportation** scheme are also designed on the basis of data describing analogous objects. Methanol plants and tankers [8].

The terminal - by analogy to the oil terminal.

Storage facilities - on the data of construction of methanol reservoirs in the port of Ventspils.

1. The published data on probable factors of price escalation were used for re-calculation of the price of regular ships into the price of the ice-breaker class vessels [9].
2. Depreciation rate of fixed capital is equal to 4%.
3. The level of associated expenses (like insurance) is determined in the

following way:

- Usual insurance payments - according to the standard technique [10].
- Specific ice conditions insurance payments during the presence of vessels in the ice area (per unit of register capacity - GRT - per day) are based on similar payment pattern established for the Arctic areas of Canada [9].
- The payment for the service delivered by icebreakers during navigation in ice conditions in the NSR area is based on real expenses paid by Murmansk Shipping Company;
- The port fee in Rotterdam (per unit of GRT) is accepted on the basis of the published data [7].

4. Duration of voyage on the chosen routes of transportation is taken on the basis of the navigation diagram on a line "Rotterdam - Yamal (Harasavey) - Rotterdam" adjusted to the changes in distances and in speed of different classes of ships (LNG tankers, oil and methanol tankers, bulk ships) [6].

- To adjust CAPEX of analogous objects (onshore structures) to the capacity of the objects included in the schemes of external transportation of the project considered, the standard formula was used:

I1 = I0 x (C1 / C0)^n, where:

I1 - required (unknown) CAPEX for object;

I0 - CAPEX of object-analogue;

C1 - known capacity of chosen construction site;

C0 - capacity of object-analogue;

n - factor (parameter of a degree), describing sensitivity of the investments in the objects of certain type due to changes in their capacity. It is accepted to consider, for example, that for the majority of chemicals manufacturers the meaning of "n" factor is the range from 0.6 up to 0.8 (0.75).

5. To take into consideration the differences arising from characteristics of location zones of the selected technological objects and characteristics of location zones of analogous objects, the cost increasing coefficients were used depending on the level of industrial development of an area:

I - high-developed zone with an existing infrastructure (1,000);

II - advanced zones with an existing infrastructure (1,155);

III - developing zones with certain elements of infrastructure (1,562)

IV - undeveloped zones without infrastructure (2,250) - like Arctic areas of North America [8].

3.3.2. Estimated values of key parameters

The aforementioned evaluation process has allowed to determine the values of key parameters of the external transportation scheme variants.

Level of generalized transportation tariff (which includes: processing in the loading point, loading, transportation, processing in the port of destination) and additional charges (like insurance and commission fee), are determined for each variant. This figures are determined as average weighted values for the whole period of implementation of the project.

Oil and gas prices obtained as a result of evaluation are determined as DAF prices: price at the starting points for the onshore gathering pipelines (which are among the objects to be constructed within the project).

Much higher DAF price level means that it might be possible to put less efficient fields into operation. Thus, DAF price might be used as a criterion to classify all fields by two groups:

- efficient fields - in terms of their profitability (e.g. real production price lower than DAF price);
- non-efficient fields - development of which is profitable (e.g. production price higher than DAF price level).

The results of the above evaluation are presented in tables 1 - 5.

Table 1.

Oil, natural gas and methanol prices used for evaluation of the transportation scheme variants

Products	Unit	Minimum prices	Average prices	Maximum prices
Oil "Brent" / CIF Western Europe	$/bbl	19,1	23,6	28,1
Oil "Brent" / CIF Western Europe	$/t	144,5	178,5	212,5
Price discount for "Urals" Oil	$/t	11,3	14,0	16,7
Oil "Urals" / CIF Western Europe	$/t	133,2	164,5	195,8
Natural gas / CIF:				
- USA	$/Th.m^3	91,4	95,4	99,4
- Western Europe	$/Th.m^3	107,0	131,4	155,8
- Japan	$/t LNG	218,1	267,7	317,3
Methanol / CIF Western Europe	$/t	140,0	160,0	190,0

Table 2.

Results of evaluation of transportation tariffs and oil prices in the case of the "Southern" scenario

Parameters	Unit	Minimum prices	Average prices	Maximum prices
Oil / Variant S1o:				
Urals / CIF Western Europe	$/t	133,20	164,50	195,80
Freight + insurance: Novorossiisk – Western Europe	$/t	7,78	7,78	7,78
Transfer in Novorossisk	$/t	3,50	3,50	3,50
Transportation tariff Purpe – Novorossiisk	$/t	23,47	23,47	23,47
Transportation tariff North of West Siberia - Purpe (profitability = 15 %)	$/t	16,10	16,10	16,10
Total costs	$/t	50,85	50,85	50,85
DAF price North of West Siberia	$/t	82,35	113,65	145,0

Table 3.

Results of evaluation of transportation tariffs and natural gas prices in the case of the "Southern" scenario

Parameters	Unit	Minimum prices	Average prices	Maximum prices
Natural gas - variant S1g:				
The price CIF Western Europe	$/th.m^3	107,04	131,40	155,77
Transportation tariff Urengoi-West. Europe	$/th.m^3	56,91	56,91	56,91
Transportation tariff North of WS – Urengoi, profitability = 15 %	$/th.m^3	14,00	14,00	14,00
DAF price North of WS, profitability=15 %	$/th.m^3	36,13	60,49	84,86

Table 4.

Results of evaluation of the transportation tariffs and oil prices in the case of the "Northern" scenario, $/t

Variants	Tariff	Price DAF		
		Minimum	Average	Maximum
Brent / CIF Western Europe		144,5	178,5	212,5
Variant N1o - profitability 0%	**30,3**	114,2	148,2	182,2
- profitability 20%	**73,6**	70,9	104,9	138,9
Variant N2o - profitability 0%	**27,2**	117,3	151,3	185,3
- profitability 20%	**65,7**	78,8	112,8	146,8
Variant N3o - profitability 0%	**32,8**	111,7	145,7	179,7
- profitability 20%	**76,9**	67,6	101,6	135,6
Variant N4o - profitability 0%	**28,9**	115,6	149,6	183,6
- profitability 20%	**67,6**	76,9	110,9	144,9

For variants N2o and N4o the average weighted transportation tariff might be taken as an estimate of generalized tariff ($/t) - in the case of oil transportation (including gas condensate) via the NSR and in the case of possible preliminary processing of liquid hydrocarbons.

Evaluation results tell us that oil transportation variants using tankers having DWT 80 thousand tons are more preferable than variants with tankers having DWT 40 thousand tons. Construction of oil refinery plant could also reduce the level of generalized tariff. As a result, the most preferable variant of transportation in the northern direction is represented by variant (N2o) (tankers having DWT 80 thousand tons and construction of oil refinery plant with the capacity of 3 million tons/year).

Table 5.

Results of evaluation of transportation tariffs and gas prices in the case of the "Northern" scenario, $/th.m^3

Variants	Tariff	Price DAF		
		Minimum	Average	Maximum
Gas / CIF Western Europe		107,0	131,4	155,8
LNG - profitability 0%	56,9	36,2	57,4	78,6
- profitability 5%	72,5	20,6	41,8	63,0
NGH - profitability 0%	77,8	20,6	43,1	65,5
- profitability 5%	91,1	7,3	29,8	52,2
Methanol - profitability 0%	60,2	48,3	73,4	97,9
- profitability 5%	76,4	32,1	56,9	81,7

Note:
CIF gas prices take into account technological losses and processing.
DAF gas prices are based on evaluation of 1 th.m^3 of the utilized gas.
DAF gas prices include excise tax.

As seen from the above results, the highest level of gas price (DAF) might be achieved in the variant that involves gas processing into methanol. Competitive technology in this case could be the LNG. Price differences in the above evaluated variants are connected with technological issues, like the level of possible losses and output of products.

It is necessary to note that these results have been obtained for the scenario having the most intensive development of oil and gas fields. In this scenario, oil, gas, and gas condensate production volumes are considered both for the existing fields and for the areas which are yet subject to exploration.

Quite important issue: it is supposed that the development and future production of oil and gas in the Northern part of West Siberia will be based on the "integrated" approach. Such approach assumes joint operation both of regional infrastructure (roads, storage facilities, ports and terminals) and technological facilities (pipelines, in the first place). Satisfactory economic results of the northern fields development might be achieved with to such approach only.

"Integrated" approach should provide:

- construction and joint operation of uniform (for all the fields) gathering

systems, storage and transportation facilities (including the NSR);

- co-operation of all license holders in developing the prospect areas; co-ordination of development of all fields (based on agreed schedule) located in a territory (the latter could provide stable and smooth level of production during a long period of time which is important for paying back the capital invested in the infrastructure).

4. Analysis of the conditions of effective oil and gas transportation in the case of the "Northern" scenario

The entire set of conditions which are important for the organization of efficient hydrocarbons transportation schemes via the northern "corridor" might be divided into two groups: internal and external.

4.1. Internal conditions

Major internal conditions (which have substantial influence on the formation of an efficient transportation scheme) are arising from the factors that determine the level of expenditures within the project. Level of expenditures depends first of all from:

- characteristics of the technology used and the extent of its novelty;
- scale of the project: volume of hydrocarbons to be processed and to be transported.

Gas transportation projects are most sensitive to the factor of scale (regardless of the phase - liquid, solid or processed into methanol). Dynamics of expenditures on implementation of the projects due to changes in volumes of gas processed and transported is shown on Diagram 1. In this diagram, it is seen that expenditures both in case of the project and in case of separate units variation, have non-linear character (particularly, in the case of capacity changes). Also, it is clear that the biggest changes in expenditures are taking place when capacity level is lower than 5 billion m^3/year. When capacity of the project reaches the level of 25-30 billion m^3, sensitivity of expenditures is at its lowest level. The above functional interdependence relates not only to the

whole project of gas transportation, but also to all its individual components (e.g., liquefaction installation, installation of re-gasification, sea tankers).

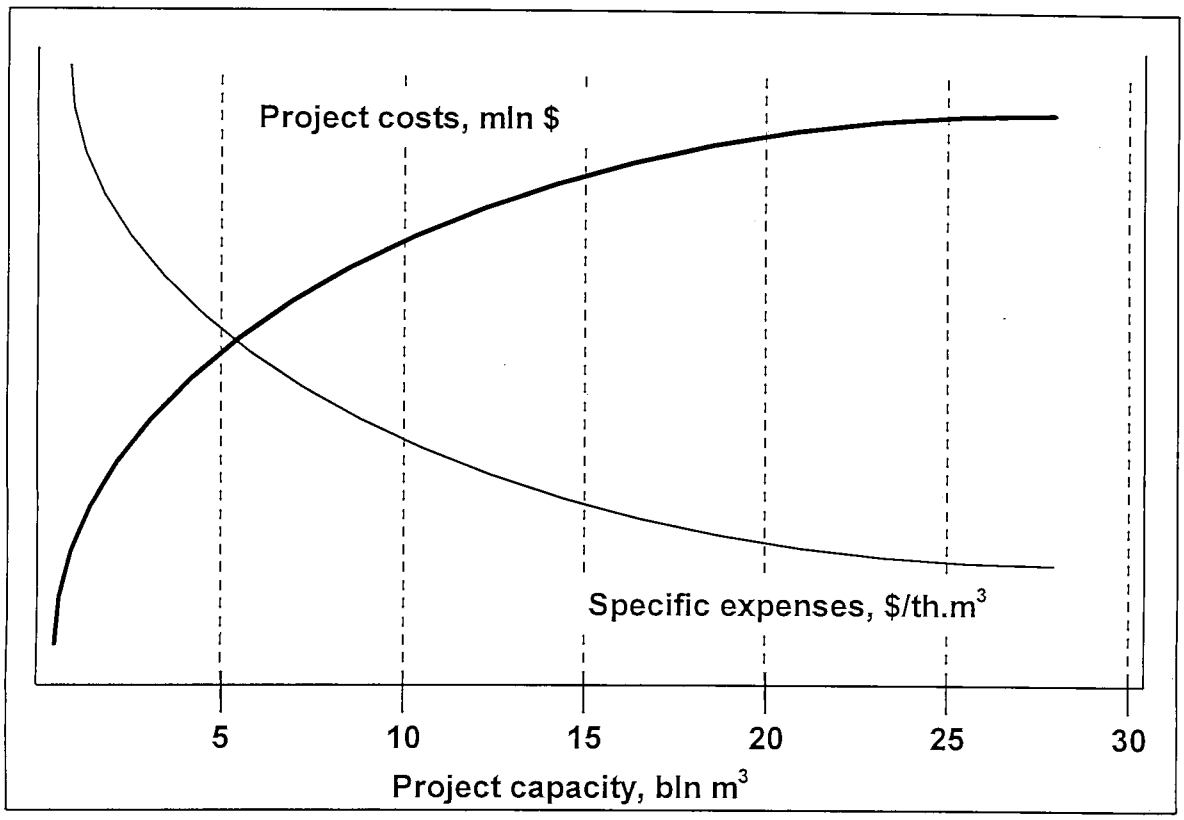

Diagram 1. Dynamics of expenditures on implementation of the projects due to changes in the volumes of gas processed and transported.

The presence of potential opportunities for significant increase in volumes of gas production in the Northern part of West Siberia requires evaluation of probable changes in the level of transportation costs.

4.2. External conditions

Among external conditions that determine the efficiency of construction and operation of the of external hydrocarbons transportation schemes in the Northern part of West Siberia in the "Northern" scenario, it is necessary to distinguish the factors that have direct influence on the level of expenditures.

Among such factors are:

- additional payments and charges/taxes (above the tariff for the freight of vessels), connected with transportation en route of the NSR (among them the most substantial are icebreaking fees and ice insurance (presumably, by analogy to the rules of navigation in the Arctic areas of North America);
- general (common) taxes and charges, which have predominant influence on commercial effectiveness.

In the preliminary evaluation, the share of additional payments in the costs of sea transportation of oil by the "Northern part of West Siberia - Rotterdam – Northern part of West Siberia" itinerary using tankers with DWT of 80,000 tons amounts to almost 65% of total costs; in the case of tankers with DWT of 20,000 tons it is about 43%. Thus, estimated level of total costs (freight + insurance + icebreaking fee) in the first case is 1.8 times higher than in the second.

Hence, with the increase in internal efficiency of oil transportation the burden of additional charges is sharply amplified (apparently, similar situation takes place with taxes); this, however, is in contradiction with the common sense.

In our opinion, it is possible to make a conclusion that hypotheses under evaluation correspond to the combination of factors that is far from being the most favorable.

Organization of practical hydrocarbons transportation via the NSR objectively requires changes in the existing mechanism of charging the icebreaking fee ($/t, regardless of the season and vessel's carrying capacity), which, in fact, acts as another tax. More reasonable system of charging of icebreaking (or navigation) fee might be based not on the tonnage of cargo transported, but on the whole on vessel which use icebreaker. Thus, the rate of charge should grow with the increase in register DWT, and not in direct proportion (with decreasing progression). Such approach could stimulate the increase in transportation activity via the NSR (which is particularly important at the initial stage).

As for the ice insurance, the Canadian system applies (this hypothesis was put into the core of the present evaluation that was based on the fixed rate of payment - per unit of register capacity for each day of stay of a vessel in ice); it also has no

stimulating influence on the increase in the volume of hydrocarbons transported from northern areas of Siberia. This system does not take into account two essential factors:

- regularity of navigation of the vessels chartered for a long period of time;
- increased reliability of the ice Arctic class vessels.

It is in the interests of the companies engaged with the development of oil and gas resources in the Northern part of Siberia (including shipping), and also in the interests of the Russian Government, to construct an incentive-based model of ice insurance. Such model has to consider the character of transport operations, both by types of vessels and by the level of commercial activity along the NSR.

5. Comparative analysis of oil and gas transportation tariffs in the "Northern" and "Southern" scenarios

From the point of view of increasing the competitiveness of the "Northern" scenario of oil and gas transportation via the NSR, two directions of the transportation tariffs reduction (consequently, higher oil and gas DAF prices) in the hydrocarbon resources development projects of Northern part of West Siberia were considered:

- reduction of a required profitability level in the hydrocarbons transportation project;
- use of preferential schemes of taxation in the project of hydrocarbons transportation.

Evaluation results are given in Tables 6 - 8.

Table 6.

Variation of DAF oil prices in the "Northern" and in the "Southern" scenarios (%)

Variants of oil transportation	Required profitability level for the Northern scenario			
	20%	15%	10%	5%
N1o	-7,7	6,4	17,3	25,4
N2o	-0,7	11,8	21,6	28,7
N3o	-10,6	3,6	14,7	23,0
N4o	-2,5	10,1	19,8	27,1

Note. Parameters presented here and below (Tables 7-10), are calculated according to the following formula: $(P_n - P_s) / P_s$, where P_n is DAF price in the variants of the "Northern" scenario, P_s is DAF price in the "Southern" scenario.

Opportunity of using preferential taxation schemes

From the point of view of the national strategic purposes, social and economic benefits (including not only government revenue from taxes, but also solution of a large number of related social-oriented problems, such as a certain stable level of employment, multiple effect on the development of economic activity, etc.), are among the main objectives of any economic project. If a certain project is not implemented or is cancelled, the authorities immediately have to find resources to eliminate social pressure and to support existing population nodes and infrastructure (especially in case of northern conditions). So, in most cases it would be better (instead of maximizing federal taxes) to grant certain exemptions and tax privileges (especially during the starting phase of the project) to resource-users and other commercial entities (like shipping companies, in this particular case). Application of the preferential tax rates could lead to lower transportation tariffs, and, hence, could promote higher competitiveness of the appropriate directions of hydrocarbons transportation.

Granting of tax privileges could also promote the decrease in the total risk of hydrocarbon resources development in the Northern part of West Siberia. Tax

privileges are expedient from the point of view of increasing the federal tax revenue in the future. Thus, the potential size of the expected budget revenue could decline at the beginning, but at the same time could grow in the future (owing to more intensive economic activity in the area).

The authorities (particularly, regional ones) have both tax instruments and other quite important tools intended to promote economic activity within area.

The project considered could help to solve a number of problems, which are now the responsibility of the federal government (like various policies and programs intended to support economic activity in the Extreme North).

E.g., the Federal Law of the Russian Federation of February 26, 1997 No 29 "On the Federal Budget for 1997" granted the government financial support of the delivery of oil, oil products and fuel for the Extreme North in the amount of 3.5 trillion rubles (which is equivalent to 650-700 million USD).

Implementation of the above project could promote reliable delivery of cheaper oil products both for the areas of Extreme North and for the shipping companies operating on the NSR. In such case, there is no need to support these areas in the aforementioned amounts through the federal budget. Experience of subsidizing the economy of the Extreme North for the last few years shows inefficient and, quite often, corrupted character of such transactions. Project-binged character of such activity (e.g., financial support of the Northern economy development) could help to make such transactions more transparent and visible.

Implementation of this project could help to solve such problems as:

- reliable delivery of oil products (in case of the appropriate variant of the "Northern" scenario), and, hence, decrease (not total elimination) in federal budget expenses for those purposes;
- development of regional infrastructure, first of all, communications and transportation facilities, including the Northern Sea Route, which is in direct correspondence with the basic principles of Government regulation of social and economic development of the North mentioned in the Federal Law No78 dated June 19, 1996 "On the Principles of Government Regulation of Social and Economic Development of the North of the Russian Federation".

To evaluate the options of tariffs reduction (and, consequently, DAF price increase), three schemes of preferential taxation of oil and gas transportation (including pipelines, terminal, tankers, refinery plant) were considered (at the same time, gasoline excise tax level and oil products sales tax were not changed):

- Scheme 1: all tax rates (both federal and regional) were decreased by 2 times;
- Scheme 2: all regional tax rates were decreased by 2 times, and federal taxes fixed at current level (income tax is equal to 24%: regional part - 11% and federal - 13%), property tax - 1%, "taxes in the cost" - 2% (1% + 1%);
- Scheme 3: regional income tax is not levied and other taxes are as in the regular case.

Scheme 1 is based on the joint policy of federal and regional authorities during implementation of the given project. Schemes 2 and 3 allow to evaluate possible tariff reduction only within the limits of tax competence of the regional authorities.

Table 7.

Variation of gas (DAF) prices in the "Northern" and "Southern" scenarios under various schemes of the preferential taxation (%)

Variants of gas transportation	Profitability = 5 %	Scheme of privileges 1	Scheme of privileges 2	Scheme of privileges 3
LNG	-30,9	-18,3	-20,8	-22,0
NGH	-50,8	-39,7	-42,7	-44,0
Methanol	-6,0	6,9	4,5	3,3

Earlier, we have made a conclusion that southern direction of gas transportation is more preferable. This means that we could choose the variant with minimal profitability (5%) as a base variant for further reduction of taxes.

Table 8.

Variation of oil DAF prices in the "Northern" and "Southern" scenarios under various schemes of the preferential taxation (%%)

Variants of transportation	Scheme of privileges 1	Scheme of privileges 2	Scheme of privileges 3
N1o	1,6	-0,8	1,0
N2o	7,8	5,5	7,2
N3o	-1,1	-3,7	-2,0
N4o.	6,0	3,7	5,3

Note. Preferential terms are intended to provide the required level of profitability of the project (20%). Variants marked by gray color are more preferable (much higher level of DAF price) in comparison with the "Southern" scenario.

Application of the preferential schemes of taxation with higher level of required profitability allows to reach higher DAF prices of oil.

Thus, transportation of oil in the northern direction using the NSR is more preferable, than in the southern direction. Transportation of gas in the northern direction could be more effective only in case of lower level of required profitability (at 5%) and granting of tax privileges.

Estimation of the marginal oil and gas DAF prices (in cases of various combinations of external and internal factors)

Evaluation of the DAF prices should also include certain elements of sensitive analysis: joint influence of different combinations of external and internal factors, including hydrocarbons prices, various schemes of taxation, different profitability levels of the oil and gas transportation project, different oil and gas production levels, etc. Such evaluation requires large volumes of information, exact identification of all factors having influence on the project implementation. Within the framework of the present paper we have made evaluation of the DAF prices for different cases: the scenarios of the world (subdivided into areas) oil prices, different profitability levels of the oil and gas transportation projects, and also different schemes of tax exemptions.

Results for the variant (N2o) are presented in Table 9: oil transportation by tankers with DWT of 80,000 tons and construction of a refinery plant.

Table 9.

Oil DAF prices under various combinations of oil prices and profitability of transportation

Profitability of transportation	Scenario of oil prices		
	low prices	average prices	high prices
20%	78,8	112,8	146,8
15%	93,1	127,1	161,1
10%	104,2	138,2	172,2
5%	112,3	146,3	180,3

From Table 9 it is clear that if oil prices correspond to the average prices scenario and the required profitability of transportation is 15%, only hydrocarbon fields which have DAF price at the level of $127/t could be developed (see Table 9).

Table 10.

Oil DAF prices under various combinations of oil price scenarios and preferential taxation schemes

Schemes of privileges	Scenario of oil prices		
	low prices	average prices	high prices
Scheme 1	88,5	122,5	156,5
Scheme 2	85,9	119,9	153,9
Scheme 3	87,8	121,8	155,8

Results given below (Table 11), present the variant of natural gas transportation in combination with the methanol scheme. This variant is most effective in terms of the DAF price level.

Table 11.

Gas DAF prices under various combinations of natural gas prices and preferential taxation schemes

Schemes of privileges	Scenario of natural gas prices		
	low prices	average prices	high prices
Scheme 1	**39,9**	**64,7**	**89,5**
Scheme 2	**38,4**	**63,2**	**88,0**
Scheme 3	**37,7**	**62,5**	**87,3**

Table 11 shows that methanol price level and approaches to the preferential taxation are among the key factors for determination of the DAF prices.

The principal conclusions

The analysis of conditions and opportunities of formation of the schemes of external transportation in the case of oil and gas resources development in the Northern part of West Siberia, has shown that major factors promoting the establishment of a new transportation "corridor" according to the "Northern" scenario are:

- dependence on the monopoly position of existing oil and gas transportation systems (represented by JSC "Transneft" and RJSC "Gasprom");
- high degree of deterioration of existing oil and gas trunklines (first of them were constructed more than 25 years ago) requires enormous additional investments;
- limitation of capacities of efficient export-oriented trunklines and facilities which could not be solved in the near future (despite of the construction of new terminals on the Black and Baltic Seas - since new factors are arising – e.g., restrictions on passage of tankers through Bosporus and transit transportation of up to 15-20 million tons of Kazakh oil through Russia).

At the same time, implementation of the "Northern" scenario of hydrocarbons

transportation is connected with many difficulties caused by the factors of high technological and financial risk. The latter, in particular, is connected with the necessity of significant investment into transportation infrastructure (regardless of any selected technology) and expected instability of the world market of hydrocarbons.

General result of evaluation of the variants of transportation) is that:

- development of the local oil and gas projects with rather low levels of production in the "Northern" scenario of oil transportation is quite close to the "Southern" scenario in terms of costs;
- transportation of gaseous hydrocarbons in the "Southern" scenario from the point of view of direct costs minimization is, no doubt, more favorable than in the "Northern" scenario.

The efficiency of the "Northern" scenario of natural gas transportation could be increased only with the increase in oil delivered for transportation. Economic result comparable with the "Southern" scenario, can be reached only in the case of gas production level close to 5 billin m^3 (and the respective level of transportation work).

Sufficient economic parameters of the oil and gas fields development project in the Northern part of West Siberia could be achieved only by implementation of the general "integrated' approach to the project. Basic characteristics of such approach are as follows:

- joint development of regional infrastructure (both general and specialized);
- co-ordination of time and schedule of the development of each field within the area;
- tax and fiscal motivation of the activity at the initial stage of development.

To increase the competitiveness of the "Northern" scenario of oil and gas transportation, it is quite important to introduce a flexible system of taxation, insurance and ice-breaking fees.

Application of flexible schemes of taxation and granting tax exemptions is caused by the high social and economic importance of the project. Here, the losses of

budgets of all levels resulted from reduction in direct tax revenue could be compensated by the bigger multiplier effect on the entire economy.

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8 June, 1998

Mr. Claes Lykke Ragner
Deputy Head of INSROP Secretariat
The Fridtjof Nansen Institute
P.O.BOX 326 Lysaker, NORWAY

Dear Mr. Ragner,

As promised, I have now (belatedly) completed the review of the paper by Kryukov, Tokarev and Schmat *Analysis and evaluation of economic conditions of energy prospects implementation of the Yamalo-Nenets autonomous Okrug.*

Overall, I find this a very interesting paper, particularly because it tackles the economic value (rather than just the technical merit) of an important energy development project. The report is quite clear, well-structured, but could benefit from the clearing up of occasional expression errors and the truncation of some very long sentences. More specifically:

- The methodology used is quite widely accepted (NPV and IRR investment criteria), although I would caution the authors as to the use of IRR, which has some well documented problems in its application. I would suggest the use of NPV throughout. Even better, the APV (adjusted present value) method could be used. This method explicitly calculates the present value of all the sources that add value to the project, i.e. operating cashflow, taxation, finance, etc.

- One aspect which was not quite clear from the analysis was the basis on which NPV/IRR calculations were made. I hope that there was a common assumption that the northern /southern projects and their variants were 100% equity-financed.

- In the analysis it was assumed, for cost purposes, that the "northern route" ends up in Rotterdam, while the "southern route" ends in Genoa. This assumption also implies that both routes can generate economically significant trade flows. Is that so? Otherwise, the basis of comparison becomes invalid.

- It seems that taxation is quite crucial in the case of gas transportation, so it would be advisable to explicitly calculate the value added by any preferential tax treatment (using APV as mentioned before).

- It would also be advisable to give some more information on the most important assumptions made for the calculation of NPV/IRR, cut-off implementation prices, etc. It is important for any reader to be able to scrutinise all pertinent assumptions with relative ease. To maintain brevity of the main text, such figures could be provided in an appendix.

- It would be desirable to have an appropriate cost of capital, although the practical difficulties of such a task are understood.

Detailed suggestions and corrections have been made on the paper itself, which I also enclose. I hope the authors will find the suggestions useful and I am at their disposal for any further comments and clarifications.

Yours sincerely,

Michael N. Tamvakis

Novosibirsk, 11 June 1998

Dear Claes Lykke Ragner,

In general we agree with the reviewer's comments, but we would like to add a few comments.

We agree that there are limits to the use of the IRR approach, but at the project stage we are now it is not an acute issue.

The basis of NPV/IRR calculations was a common assumption that the northern/southern scenarios and their variants were 100% equity-financed. The main reason is that we have no information concerning loan finance of similar projects in Russia now.

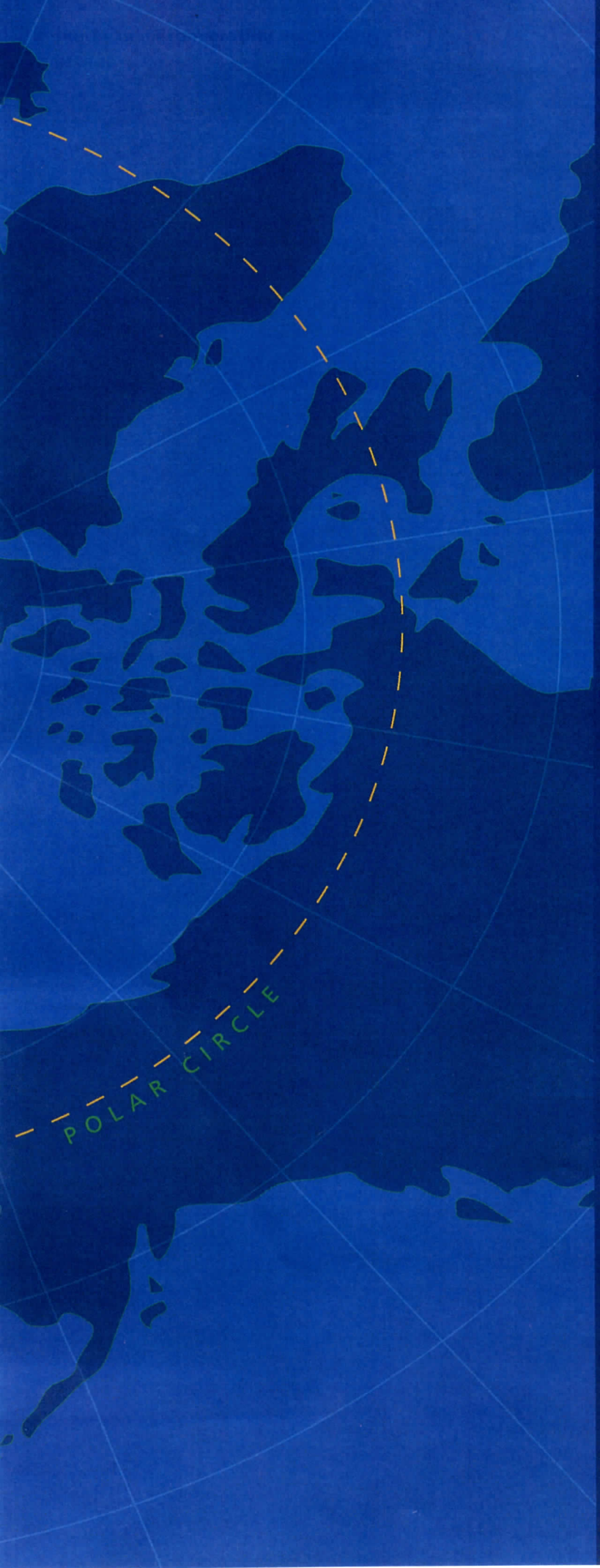
As to information on assumptions made for the calculation of NPV/IRR - we used widely accepted assumptions for such calculations (see, for example, references to INSROP reports).

Our calculations show that taxation is quite crucial in the case of hydrocarbon transportation. Our analysis is based on comparative estimates of gas and oil DAF prices (using NPV/IRR methodology) for northern and southern scenarios, because we believe that now one of the main problems for/under development of YaNAO hydrocarbons is to choose the scenario for main cargo routes. Estimation of value added by different preferential tax treatment is quite important for the next stage of our research project. At this stage we intend to estimate meanings of different tax treatment.

We are sending to you our updated version of the report (taking into account the reviewer's comments).

Yours sincerely,

V.Kryukov



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Ship & Ocean Foundation (SOF), Tokyo, Japan.
SOF was established in 1975 as a non-profit organization to advance modernization and rationalization of Japan's shipbuilding and related industries, and to give assistance to non-profit organizations associated with these industries. SOF is provided with operation funds by the Sasakawa Foundation, the world's largest foundation operated with revenue from motorboat racing. An integral part of SOF, the Tsukuba Institute, carries out experimental research into ocean environment protection and ocean development.

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