Chapter 9

Canadian Arctic Offshore Oil and Natural Gas and European Union Energy Diversification: Towards a New Perspective?

Jerome D. Davis, Kamrul Hossain, and Timo Koivurova

9.1. Introduction

Events shape and in turn are shaped by developments in Arctic ocean policy. Nowhere is this truer than of the ever-changing Arctic environment, which is in turn shaping and being shaped by a global demand for secure sources of future oil and natural gas supplies. As the polar ice cap progressively shrinks, and industry interest in the Arctic quickens, Canadians are confronting the challenges of developing their Arctic hydrocarbon resources. In Canada these conflicting objectives have led to innovative regulatory policies accommodating stakeholder desires on the one hand and environmental and economic considerations on the other. The European Union (EU) similarly has multiple objectives intersecting with its Arctic interests. Particularly prominent among these are securing its future sources of natural gas supplies, implementing its natural gas market reforms, and promoting its environmental objectives. A seemingly unrelated event, the development of an Atlantic Basin liquefied natural gas market, both makes the development of Arctic natural gas resources feasible and presents the EU with an additional source of natural gas supply. Examining a project envisaging the development of High Arctic offshore natural gas resources, the giant fields off Melville Island, demonstrates the potential of such resources while tracing the regulatory problems and promises which their development entails for EU policy.

9.1.1. Background: EU Policy in the Arctic

According to the US Geological Survey, the Arctic seabed contains as much as one fourth of the world's undiscovered oil and gas deposits. In recent years, due to high oil prices in the world market, constant market demand, and the combination of the development of ship design technology and availability of modern equipment for drilling and other exploration and exploitation activities, offshore hydrocarbon activities in the Arctic are becoming increasingly attractive.[1] More than 80 percent of current European oil and gas is produced offshore.[2] The EU imports the major share of its energy demands, currently 50 percent of its total consumption. Over the next 20 years this share is predicted to rise to 65–70 percent.[3] Presently, oil imports to the EU are comprised as follows: 38 percent from Russia/CIS (constantly increasing in the past few years), 22 percent from the Middle East, 15 percent from Norway, 14 percent from North America, and 11 percent from other countries.[4] This statistic shows that 53 percent, the largest share of EU consumption, comes from the Arctic states (currently Russia and Norway), and this share is expected to rise in the future. However, from an EU perspective, seabed activities in the Arctic are not of direct relevance as none of the EU countries have direct geo-physical links to Arctic marine waters.[5] Yet, among other EU Arctic interests, the EU is concerned about Arctic energy supplies, especially hydrocarbon resources as these might constitute a strategic reserve for Europe's future energy requirements.[6] Thus regulatory and other cooperative institutions facilitating cross-border and other common interests and energy infrastructure investments are being incorporated into EU energy policy. To date these areas are not extensive (many of these involve sub-sea connections and other competitive offshore issues). However, EU interest in marine-based energy projects is growing.[7]

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[1] A. Airoldi, *The European Union and the Arctic: Policies and Actions* (Copenhagen: Nordic Council of Ministers, 2008), p. 47. The implications of the climate policy for the energy sector, the dramatic increase of energy prices, and intensified concerns for the future security of supply have contributed to push energy issues to the top of the political agenda.

[2] European Parliament, *Energy Policy and Maritime Policy: Ensuring a Better Fit*, Eur. Parl. Doc. SEC (2007) 1283 provisional version (10 October 2007), p. 3 [hereinafter Energy Policy and Maritime Policy].

[3] Airoldi, n. 1 above, p. 47.

[4] Energy Policy and Maritime Policy, n. 2 above, p. 6.

[5] In November 1983, in a hard-fought referendum, Greenland (which is officially an overseas territory of Denmark) voted to withdraw from the European Union. Since January 1985, relations with the EU have been regulated by an agreement reached between Greenlandic and Danish governments and the EU. D. Leonard, *A New Deal for Greenland and the EU* (London: The Foreign Policy Centre, 2004), available: <http://fpc.org.uk/articles/345> (retrieved 16 September 2008).

[6] European Commission, *Strengthening the Northern Dimension of European Energy Policy*, Communication from the Commission (Brussels, November 1999), available: <http://ec.europa.eu/external_relations/north_dim/doc/energy.pdf> (retrieved 3 September 2008).

[7] Energy Policy and Maritime Policy, n. 2 above, p 3.

In early 2008, the European Commission adopted a document entitled "Climate Change and International Security."[8] This document highlights the increasing geopolitical importance of the Arctic in the EU policy. This is mainly due to rapid melting of the sea ice caps, which increases accessibility to Arctic waters. The consequences of this development may include: the possibility of new trade routes, accessibility to potential offshore resources in the Arctic, and potential competitive Arctic territorial claims that threaten international stability and geostrategic regional dynamics. The security concern for the whole of the region is justified. A potential conflict may arise from intensified competition over access to and control over energy resources. An expansion of competitive territorial claims in the region has especial significance as it is expected that Arctic offshore areas contain enormous amounts of hydrocarbon resources. An example of potential conflict may be seen in the laying of a flag on the seabed at the North Pole by Russia during the summer of 2007. Thus, instability in the Arctic is likely to increase for two reasons. Firstly, much of the world's hydrocarbon reserves are expected to be in the region, one that is already vulnerable to the impacts of climate change, and secondly, most of the oil and gas producing countries in the region already face significant social, economic and demographic challenges.[9] Therefore, Europe's ability to secure its trade and resource interests effectively requires close work with its northern partners. Moreover, the European Union is also closely connected to the Arctic through history, geography, economy and science.[10] Therefore, for the EU, the Arctic region, once only of "peripheral" interest,[11] is now vitally important, especially in the context of climate change and Arctic energy considerations. Thus the EU has to take a leading role in responding to the threat posed by rapid climate change and its consequences in the Arctic.[12]

[8] "Climate Change and International Security," Paper from the High Representative and the European Commission to the Council, S113/08 (14 March 2008), available: <http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/reports/99387.pdf> (retrieved 2 September 2008) [hereinafter Climate Change and International Security].

[9] Id., p. 5.

[10] Dr. J. Borg, Member EC (Fisheries and Maritime Affairs), "The Arctic: A matter of concern to us all," Paper presented at Common Concern for the Arctic, European Commission Speech 08/415 (Ilulissat, Greenland, 9 September 2008).

[11] Airoldi, n.1 above, p. 13.

[12] The EU is in a unique position to respond to the impacts of climate change on international security because of its leading role in development and global climate policy and the wide array of tools and instruments at its disposal. Moreover, the security challenge plays to Europe's strengths, with its comprehensive approach to conflict prevention, crisis management and post-conflict reconstruction, and Europe's role as a key proponent of effective multilateralism. Climate Change and International Security, n. 8 above.

Within the framework of the Integrated Maritime Policy, the EU took a step forward to enhancing Europe's leadership role in maritime affairs. In addition to addressing a comprehensive and cross-sectoral approach to all ocean-related issues, the EU policy focuses on the individual needs of the different oceans and seas surrounding the European continent. With regard to the Arctic, an integrated maritime policy has put especial emphasis on the diverse interests within the EU concerning issue areas such as environmental protection, biodiversity, energy, fisheries, and maritime transport. The Action Plan for Integrated Maritime Policy included preparation of a report by 2008 on Arctic Ocean strategic issues that would lay the foundation for decisions regarding European interests in the Arctic Ocean and the EU's response to that end.[13] The work of the Arctic Council in exploring an integrated approach to maritime issues complements the work of the EU.[14] As a result, protecting the Arctic from environmental changes and ensuring sustainable regional development are significant EU policy goals. Any exploration of the Arctic's resources should be conducted in a sustainable manner with the EU applying the principles of a level playing field and reciprocal market access in the Arctic. The scope of the synergy between Europe's energy policy and maritime policy is wide and is likely to increase in the very near future. Europe's energy situation and policy imply more reliance on oceans, seas and ports.[15] There is already an existing framework in this respect, the United Nations Convention on the Law of the Sea and the work done by organisations such as the Arctic Council, the Nordic Council of Ministers, and the EU's Northern Dimension initiative. The EU wants to develop the system further, adapting it to new challenges and circumstances relating to both legal and practical realities. Prominent here is the goal of environmental governance ensuring sustainable development, equitable access to resources and meeting the societal needs of indigenous communities.[16]

Thus the EU policy towards the Arctic has developed as one of cooperation and partnership with its northern neighbours. This cooperation and partnership has been given an institutional framework with the EU's successful

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[13] European Commission, *Accompanying Document to the Integrated Maritime Policy*, European Commission, SEC (2007) 1278, p. 30, available: <http://ec.europa.eu/maritimeaffairs/pdf/ActionPaper/action_plan_en.pdf> (retrieved 20 October 2008). For the final report on Arctic Ocean strategic issues, see n. 40 below.
[14] Borg, n. 10 above.
[15] Energy Policy and Maritime Policy, n. 2 above, p. 2.
[16] Borg, n. 10 above.

adoption and implementation of its Northern Dimension initiative in 1999.[17] The EU Member States, the Russian Federation, Norway, Iceland and the European Commissions are parties to this initiative. Northern regional organisations are also significant actors in the Northern Dimension.[18] This initiative also aims to strengthen transatlantic cooperation by allowing the United States and Canada to have observer status. The purpose of the Dimension is to cooperate actively on the basis of good neighbourliness, equal partnership, common responsibility and transparency.[19] The Northern Dimension promotes partnership between the EU and other northern non-Member States with regard to prosperity, sustainable development and well-being in Northern Europe. It is now being jointly developed on the basis of Northern European consensus.[20] Despite its broad geographical scope, the Northern Dimension is to be used as a political and operational framework for promoting the implementation of the EU-Russia Common Spaces initiative at regional, sub-regional and local levels in the North with the full participation of Norway and Iceland.[21] This initiative focuses on identification of cross-cutting topics for cooperation and implementation. The European Neighbourhood Policy Instrument (ENPI) finances its activities, notably those focusing on cross-border cooperation,[22] along the lines of the relevant EU-Russia financial

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17 Finland played an active role in promoting cooperation in the north after its accession to the EU. This resulted in a proposal for the Northern Dimension (ND) in 1997. The European Council, however, endorsed the concept in 1999. See Airoldi, n. 1 above, pp. 17–18.

18 These regional organisations include: the Council of the Baltic States (CBSS), the Barents Euro-Arctic Council (BEAC), the Nordic Council of Ministers (NCM), and the Arctic Council (AC). These northern regional organisations identify needs for development and cooperation in their respective areas and support project implementation in different ways. See Overview of Northern Dimension policy, European Commission, DG External Relations, available: <http://ec.europa.eu/external_relations/north_dim/index.htm> (retrieved 14 November 2008).

19 "Political Declaration on the Northern Dimension Policy," Northern Dimension Summit (24 November 1996), available: <http://ec.europa.eu/external_relations/north_dim/doc/pol_dec_1106.pdf> (retrieved 2 October 2008).

20 "Guidelines for the Development of a Political Declaration and a Policy Framework Document for the Northern Dimension Policy from 2007," European Council documents, available: <http://ec.europa.eu/external_relations/north_dim/doc/guidelines05.pdf> (retrieved 24 November 2008), p. 1.

21 Id., p. 2.

22 Under the cohesion policy of the EU, cohesion among the regions and Member States was strengthened through economic, social and territorial cooperation. The programmes with particular relevance to the Arctic include: Sápmi Programme (cooperation in priority areas such as development of industry and commerce, research, development and education, regional functionality and identity), Northern Periphery Programme (cooperation in the northern EU regions of Sweden and Finland, a large share of Norway, including Svalbard, the Faroe Islands, Greenland, and Iceland, as well as part of Scotland, Northern Ireland and the Republic of Ireland on sustainable development of natural and community resources, technical assistance to

cooperation arrangements.[23] (A description of the EU Northern Dimension is appended to this paper as Annex One.)

9.2. EU Policy and the Canadian Arctic: A Coincidence of Events and Interests – Towards a Different Perspective?

What is striking about current EU Arctic policy is that it almost totally ignores the hydrocarbon potential of the North American Arctic continental shelf, in particular the Canadian Arctic shelf.[24] While not yet significant, events on the Canadian Arctic/West Greenland continental shelves could prove of interest to EU policy makers.

Following a review of the Atlantic Basin LNG market, this contribution briefly describes EU interest in this developing market. It analyses how the Melville Island project may fit in the patterns of LNG trade, directly or indirectly benefiting EU natural gas markets. (The details of the Melville Island project are further described in Annex Two.) The possible Danish/Greenlandic role within the Atlantic Basin, and possible policy perspectives for the EU, are also reviewed. Outlining the regulatory dilemmas facing the Canadian Arctic offshore suggests the consequences that must be considered for development of the Melville Island project. Overall, it would appear that exploitation of Arctic natural gas will supplement existing and future EU natural gas supplies, with a potentially significant contribution from Canada's Arctic archipelago. However, potential obstacles such as the North American Free Trade Agreement (NAFTA) must be considered in evaluating the future development of these resources.

support administration, and joint projects of community interests), and Kolarctic Programme (cross-border cooperation between EU regions and regions in neighbouring countries, as well as in Russia, on economic and social development, common challenges such as environmental protection and adapting to climate change, and people-to-people cooperation in the northern parts of Finland, Sweden and Norway and northwest Russia). Airoldi, n. 1 above, pp. 29–32.

[23] Guidelines for the Development of a Political Declaration, n. 20 above, p. 4.

[24] This is true as well of the EU External Policy which is devoid of any mention of the resources of the North American Arctic shelf. H. Turvo, *EU's External Relations related to Arctic Offshore Hydrocarbon Activities*, Research Paper (University of Lapland: Arktikum, 2008).

9.2.1. A Different Point of Departure?

Our point of departure juxtaposes disparate events and policies to argue for an increased EU interest in the Canadian Arctic offshore. The following events are indisputable:

The European Union is seeking to diversify its sources of hydrocarbon supply, particularly those of natural gas currently primarily delivered by pipeline from adjacent countries. This concern has manifested itself in the EU Green Paper *A European Strategy for Sustainable, Competitive, and Secure Energy*[25] and by a Council Directive on EU security of supply.[26] In addition, the extensive TENP-E programme not only promotes EU internal natural gas infrastructure, but also a series of trans-Mediterranean pipelines and a host of liquefied natural gas (LNG) reception terminals, and sponsors the now almost defunct Nabucco pipeline, which aims to connect pipelines from Central Asia to the EU pipeline infrastructure. A recent speech by Benita Ferrero-Waldner, the EU Commissioner for External Relations and European Neighbourhood Policy, addressing natural gas supplies highlighted these concerns: "For Europe, the particular concern related to gas imports. As gas is mainly transported in long-distance pipelines, supplies are vulnerable to disruption."[27]

While the exact pace of development is uncertain, the retreat of the polar icecap currently appears irrefutable. This has opened in turn the West Greenland-Canadian Arctic offshore to commercial interests. While the degree to which the western channels to the Northwest Passage will be free of multi-season icepack remains a matter of contention,[28] it is clear that Arctic climate change will open up access to potential oil and natural gas reserves on the Eastern Canadian/ West Greenland continental shelf. This is also true for proven natural gas reserves in the High Canadian Arctic.

Table 9.1 illustrates US Geological Survey estimates of the as yet to be discovered resource base in these areas. Table 9.1 also compares these

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[25] European Commission, *Commission Green Paper. A European Strategy for Sustainable, Competitive and Secure Energy*, COM(2006) 105 final, March 2006.

[26] Council Directive of 26 April 2006, concerning Measures to safeguard security of natural gas supply, 2004/67/EC.

[27] B. Ferrero-Waldener, "Energy Security and Foreign Policy," European Commission Speech/08/458 (New York, 24 September 2008), available: <http://europa.eu/rapid/ press ReleasesAction.do?reference=SPEECH/08/458&format=HTML&aged=0&language=EN&guiLanguage=en> (retrieved 18 October 2008).

[28] J. R. F. Hodgson, J. G. Calvesbert, and M. Winterbottom, *Arctic Shipping Impact Assessment: Scoping Study,* Report Prepared for Transport Canada (Halifax: Dalhouise University, Marine Affairs Program, 31 March 2008). Even broken-up multi-year pack ice poses a threat to marine transport in the Arctic.

estimates with those of Western Siberia. Western Siberia has less than eight percent of the potential oil reserves of the North American offshore Arctic shelf, but almost twice the natural gas reserves (roughly 1.9 times) and more than two and a half times the natural gas liquids. The oil industry has evinced renewed interest in the Canadian Arctic. Between 2000 and 2008, exploration licensees in the Beaufort Basin have work commitments of CAD1.9 billion. In February 2008 the Canadian Minister of Indian Affairs and Northern Development (INAC) invited bids for five parcels in the Beaufort Sea. All five parcels were awarded in June 2008. BP Exploration not only won three of the licenses, but made a work bid of CAD1.18 billion for a single offshore parcel, the highest bid ever for a single offshore Canadian license.[29] Earlier, on the Alaskan shelf, a bidding round for 5,255 blocks (29.4 million acres) in the Chukchi Sea attracted a total of USD2.7 billion in bids. That industry was willing to bid that amount for drilling rights was remarkable. An earlier round in 1991 netted a paltry total of USD7.1 million.[30]

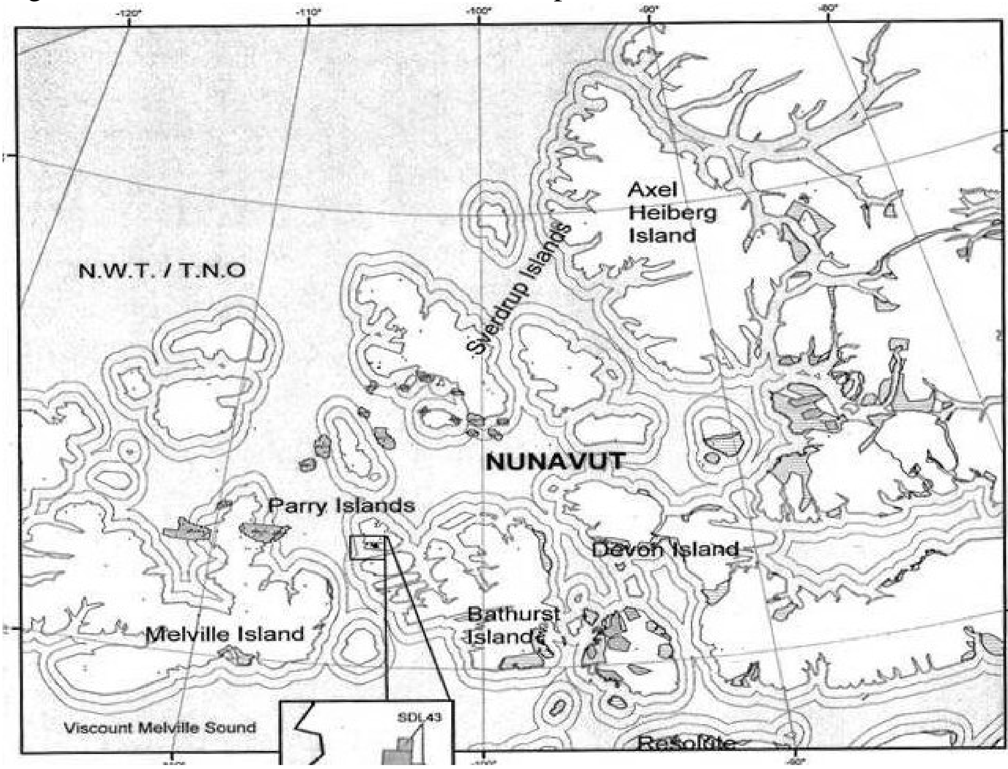
Table 9.1. Offshore estimated undiscovered hydrocarbon reserves: North America/West Greenland

Canada/US/West Greenland Provinces	**Oil** mmbl[a]	**Natural Gas** bcf [b]	**Natural Gas Liquids** mmbl[a]
Arctic Alaska	29,960	221,397	5,905
Amerasia Basin	9,723	56,891	542
NW Canada Interior Basin	23	305	15
Sverdrup Basin	857	8,596	191
W. Greenland/E. Canada	7,274	51,818	1,153
N. Wrangel Chukchi	86	6,066	107
Total (1)	47,923	345,073	7,913
West Siberia (2)	3,660	651,499	20,329
Ratio West Siberia to N. America/ W. Greenland (1)/(2)	0.076	1.888	2.569

[a] mmbl = million barrels of oil/NGL (natural gas liquids)
[b] bcf = billion cubic feet (1 bcf = 28.316 million st m^3)
Source: US Geological Survey, “Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle,” *USGS Fact Sheet* 2008-3049 (2008).

[29] O. R. McHugh, “DFO and LOMAs: Prospects for Successful Development of Offshore Petroleum,” (Thesis submitted in partial fulfilment of the Degree of Master of Marine Management, Dalhousie University, Halifax, N.S., August 2008), p. 57.
[30] See “Chukchi Sea Draws Record Bids,” *Rigzone* (6 February 2008), p. 1.

Figure 9.1. Melville Island and the Sverdrup Basin



Source: Indian and Northern Affairs Canada, Land and Exploration Maps, Sverdrup Basin, available: <http://:www.ainci-incac/oil/act/lan/index_e.html> (retrieved 23 October 2008).

Compared with the resources of the Beaufort Sea Melville Island and the Sverdrup Basin are more attached to the Atlantic Basin LNG market, a market which will increase in significance to the EU Member States. Whereas Table 9.1 estimates the extent of undiscovered reserves in the Arctic, the Sverdrup Basin already possesses 12.2 trillion cubic feet of proven natural gas reserves. It is therefore removed from the realms of U.S. Geological Service estimates of undiscovered reserves. The Sverdrup Basin is also interesting because there have been plans afoot to develop two giant gas fields located off Melville Island in the High Canadian Arctic, the Hecla and Drake Point fields, and ship cargoes of LNG to Atlantic markets. The Arctic Pilot Project was first advanced in 1981. It has since been resurrected, but not as a pilot project. Its proposed successor, what we will term the "Melville Island project," is considerably larger in scale. This project thus serves as a base for the arguments advanced in this contribution. Similarly, one should not discount the West Greenland/ Atlantic Canada shelf. It alone accounts for an estimated 51,818 billion cubic feet of undiscovered natural gas reserves (out of a total 60,414 billion cubic feet for Greenland (Denmark) and Canada. It too has proven natural gas discoveries. Additionally, part of our argument involves using a Greenland port (Godhavn (Disko Island)) as a transhipment point and hub for future North American Arctic LNG trade with the consumer states of the North Atlantic.

Any hydrocarbon development in the High Arctic will encounter problems in terms of the environment and the feasibility study on which it is based. In the Canadian Arctic, the regulatory problems are further complicated by the Canadian federal governmental system and treaty rights granted to the indigenous Inuit. The Melville Island project development in fact straddles two jurisdictions, that of the Beaufort Sea LOMA (and the native rights contained in this regulatory management area) and the offshore/internal sea areas of Nunavut. This provides us with the problem of how multiple overlapping and hierarchical regulatory regimes might be complicating progress in the development of Canadian Arctic hydrocarbon reserves.

9.2.2. The Atlantic Basin LNG Market: Prospects for LNG from the High Canadian Arctic

Almost unnoticed in the analyses of future EU dependence on Mediterranean, Central European and Russian sources of natural gas has been the rise of what is termed the Atlantic Basin LNG market. (See for example, Finon and Locatelli[31] who devote one paragraph to EU's LNG policy in an otherwise praiseworthy analysis of Russian-European gas interdependence.) While LNG trade is flexible, it can also be capital intensive; the fact that pipelines, particularly pipelines to the Yamal peninsula in northwest Siberia, are costly is often easily forgotten. The LNG supply chain involves large carriers each capable of carrying up to 140,000 m^3 or more. Methane, carried in liquefied form (at -160^{0}C), condenses to 1/600 of its gaseous state. (A LNG carrier of 140,000 m^3 capacity is therefore carrying 84 million m^3 natural gas. Larger LNG carriers are on order.[32]) LNG trades are significant. For example, the Melville Island project could deliver 8.76 billion m^3 of natural gas per year to European markets. To put this amount in perspective, the oft-hyped EU's Nabucco pipeline, a line created to diversify European natural gas imports, at its peak will only deliver 16 billion m^3 per year from Erzurum in Turkey to Baumgarten on the Austrian frontier. The Melville Island project can deliver

[31] D. Finon and C. Locatelli, "Russian and European gas interdependence: Could contractual trade channel geopolitics?" *Energy Policy* 36 (2008), pp. 423–442.

[32] These include LNG carriers with a capacity of 200,000 m^3.

a quantity of natural gas equivalent to 56 percent of this capacity, and it is the not largest potential project.

What is of particular interest here is the development of the Atlantic Basin LNG market. The old pattern of integrated LNG trade where project owners would invest in liquefaction facilities, LNG carriers and reception terminals dedicated to a specific trade is being eclipsed by more flexible arrangements. Under the new scenario, assets are not specifically dedicated a specific LNG trade, and LNG carrier loads are often sold on a spot basis, to the highest bidder. LNG cargoes from Trinidad destined for Spain will be swapped with a cargo from Algeria destined for North America. (In this example, the Trinidad cargo will go to North American markets, while the Algerian cargo to Spain is 'swapped' with the cargo destined for North America.) Spot cargoes of LNG, previously non-existent, are becoming increasingly common. In recent years, over half the LNG cargoes for the North American market have been sold on a spot basis. This is the foundation of the Atlantic Basin LNG market. This market is perhaps best defined geographically by Weems and Rogers:

> Under our preferred definition Atlantic Basin LNG markets specifically include current LNG producing countries Abu Dhabi, Algeria, Egypt, Nigeria, Oman, Qatar, Trinidad and Tobago, and LNG consuming countries Belgium, Dominican Republic, France, Greece, Italy, Mexico, Portugal, Spain, Turkey, the UK and the US… as well as future LNG producers Angola, Equatorial Guinea, Norway, Russia, Venezuela, and possible future LNG consumers Brazil, Canadian East Coast, Germany and the Netherlands. [33]

The Atlantic Basin market shares several characteristics with the Pacific Basin market. First, there is a continued short-fall in LNG liquefaction plants vis-à-vis LNG carriers and reception terminals. This shortage will be aggravated by the rumoured postponement of the giant Russian Shtokmanovskoe field in the Barents Sea. Currently, it is thought that this shortfall will be made up by LNG supplies from the Middle East and Nigeria although this promises to be a costly alternative. Second, there is increasing arbitrage in the Atlantic Basin LNG market. LNG parties are increasingly capitalising on seasonal and other price differences among the various pricing regimes on both sides of the Atlantic. This includes the oil product price-linked

[33] P. R. Weems and D. R. Rogers, "Atlantic Basin LNG sees rapid growth: Mideast capacity plays a major role," *LNG Observer* 4, no. 2 (1 April 2007), available: <http://www.ogi.com/articles/print_screen.cfm?ARTICLE_ID=287875> (retrieved 18 October 2008).

natural gas prices characteristic of most European continental trade, commodity futures prices at the US Henry Hub delivery point, and prices obtained at the National Balancing Point in the UK market, among other lesser known spot markets. This in turn has led to some reception terminals basing their primary business on this hub trade. A bright future is seen for this market in that all the Atlantic Basin consumer nations will be experiencing increased demand. This will lead to increased competition for LNG supplies, perhaps including those from the Canadian Arctic/West Greenland Shelf.[34]

Figure 9.2. Current and planned LNG reception terminals

Source: P. R. Weems and D. R. Rogers, "Atlantic Basin LNG sees rapid growth," *LNG Observer* 4, no. 2 (Tulsa, Oklahoma: PennWell Publications, April 2007), available: <http://www.ogi.com/artilcles/print_screen.cfm?ARTICLE_ID+287875> (retrieved 22 October 2008).

Figure 9.2 shows the locations of LNG reception terminals within the EU and Turkey, existing terminals, terminals under construction, and proposed terminals. The map under represents the number of proposed terminals. For example, LNG reception terminals planned for Eemshaven (Netherlands) and Wilhelmshaven (Germany) are not represented on the map.

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[34] Id.

How is the Melville Island project linked to the Atlantic Basin LNG market, more particularly to the EU gas markets? The Hecla and Drake Point fields are estimated to contain 8.7 trillion cubic feet of recoverable reserves. The total capital costs of project development (field development, pipeline to shipping facilities, and liquefaction plant) are estimated to be CAD(2005)2,807 million with an annual operating cost of CAD(2005)121.4 million.[35] The Canadian Energy Research Institute (CERI) has published a plan for five Arctic Class 7 icebreaking tankers which are estimated to cost CAD(2005)1,339 million with annual operating costs of CAD(2005)412 million. In one scenario, these will carry 6.1 million tons of LNG to Godhavn (Disko Island) Greenland. Here the LNG will be transferred to two other less specialised 200,000 m^3 LNG tankers and sold to a (non-existent) Canadian LNG receiving terminal.[36] Curiously, the authors of the report ignore the European LNG market. Yet with the addition of another 200,000 m^3 capacity LNG tanker, European markets become accessible to Melville LNG. (Annex Two contains further details of this project and our modifications.) Given current price scenarios, it is calculated that the project will yield a positive net present value (NPV) at a discount rate of 15 percent, after deductions for royalties, taxes, capital costs, depreciation, and operating costs.

How proximate is the Melville Island project to Atlantic Basin EU and American markets? Table 9.2 places the project in an Atlantic Basin context. The results are somewhat surprising. Distances from Melville Island to the two major American reception terminals, Cove Point, Maryland and Lake Charles, Louisiana, are longer than distances to Milford Haven, Wilhelmshaven and Le Havre in Western Europe. Shtokmanovskoe LNG would have an advantage in penetrating EU markets in terms of distance. (Nonetheless, prior to its cancellation/postponement Gazprom was planning to market some Shtokmanovskoe LNG to the US East Coast.) That Arzew, located in Algeria, has the best access to EU markets is hardly surprising, but the liquefaction plant at Arzew is working at close to capacity. Melville Island LNG can nonetheless compete with Arzew LNG in US markets, Arzew being a major LNG supplier to Cove Point and Lake Charles. As for LNG originating at Doha (Qatar) and Port Harcourt (Nigeria), anticipated to be major suppliers to the Atlantic Basin market, Melville Island LNG has a more proximate location in terms of all destinations in Table 9.2.

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35 L. Chan, G. Eynon, and D. McColl, *The Economics of High Arctic Gas Development: Expanded Sensitivity Analysis* (Calgary: Canadian Energy Research Institute, 2005), p. 16.

36 Id., p. 22. It should be noted that another scenario has seven Class 7 LNG carriers being delivering to the Atlantic Canadian coast.

Table 9.2. Melville Island Project: Proximity to European and North American markets

From\To (nautical miles)	Cove Point	Lake Charles	Milford Haven	Wilhelmshaven	Le Havre
Melville Island	3709	5064	3156	3518	3404
Shtokmanovskoe	4801	6093	2163	1854	2099
Port Harcourt	5293	6131	4162	4611	4209
Arzew	3742	4962	1366	1815	1413
Doha	8465	9685	6089	6538	6136

Source: Asia Maritime, "Distances.com," available: <http://shippingdistance.com/index.php> (retrieved 17 October 2008).

Thus we can preliminarily conclude that Melville Island LNG is marketable within the Atlantic LNG basin, and is reasonably proximate to EU LNG terminals. It promises to deliver 8.76 billion m^3 of natural gas to reception terminals in the EU. If it does not enter into a long-term base load LNG chain relationship to North American or EU markets, it is likely that it will go to where the price differentials are favourable, particularly given the rising share of spot sales in LNG markets in the United States. In both respects, the EU market could well play a plausible role.

9.2.3. Melville Island LNG: The Greenland Connection

There are three reasons for reviewing the Greenland connection for the Melville Island project. Firstly, the Melville Island project proponent's selection of Godhavn is critical to the role that the Melville LNG might play in the Atlantic LNG market. Secondly, Greenland's offshore, together with that of the Canadian Labradorean offshore, constitutes a promising under explored natural gas area. Finally, the status of Greenland's offshore resources is unclear. According to reports, Denmark, a Member State of the EU, exercises sovereign rights over those portions of the Greenland offshore which are beyond thirty nautical miles from Greenland's baselines. The implications of this for the EU are not analysed here.[37]

[37] This is particularly interesting in light of the results of the referendum on Greenland's autonomy on 25 November 2008. The referendum passed and will take effect on 21 June 2009. The proposals were to expand home rule in several areas, including the coast guard and

There are logistical reasons for the Melville Island's proposed location of an LNG transit terminal at Godhavn, Greenland. Locating a transit terminal at Godhavn, an ice-free harbour on the West Greenland coast would enable shorter round trips for the LNG carriers to and from Melville Island, and a considerable savings in capital and operation costs. Such a solution could also give the project owners considerably more flexibility in selecting which markets their LNG would service.[38] A further factor in favour of Godhavn as a transhipment hub to Europe rather than North America lies in the increasing self sufficiency of North American natural gas markets. Technological developments in North America have led to increased extraction of natural gas from shale formations. This could reduce the current anticipated North American demand for LNG making European destinations (and a Godhavn transit terminal) more attractive.

As illustrated in Table 9.1, the US Geological Survey estimates natural gas reserves in the West Greenland-Atlantic Canada Province at 51.8 trillion cubic feet. Exploratory drilling on the both the West Greenland and Canadian Labrador margins is in the initial phases. Six wells have been drilled offshore West Greenland, with only one well discovering natural gas. A particularly promising exploratory effort is focussed around Disko Island where on land oil seeps and gas shows indicate the likely presence of hydrocarbons in a geological basin offshore.

Efforts along the Canadian Labrador margins have been more successful. Twenty-eight offshore wells drilled thirty to forty years ago made five gas discoveries in two Labrador Mesozoic sedimentary basins: the Saglek and Hopedale basins. Two of the discoveries located close to each other, the North Bjarni and Bjarni fields, have estimated recoverable reserves of roughly 3 trillion cubic feet. These and other gas finds in the area (most notably the Gudrid field) currently qualify as "stranded gas," natural gas fields too small for LNG or pipeline transport to North American markets. Further natural gas finds could well be in the offing. Both the Canadian Newfoundland and the Danish Greenlandic authorities are in the process of submitting promising areas for licensing by oil companies.[39] Exploration activities in this area will increase in the near future.

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participation in foreign policy making. How Danish sovereignty beyond 30 nautical miles from the Greenland baseline fits into this picture is unknown to the authors.

[38] The Chan et al. evaluation acknowledges the value of "optionality" but did not undertake to analyse the issues of a Godhavn hub for Atlantic LNG trade. Chan et al., n. 35 above.

[39] The Danish Greenlandic authorities have held three licensing rounds since 2000. The Canadian Newfoundland/Labrador Offshore Petroleum Board has called for interests in the Hopedale and Saglak basins. The deadline for bids in this last instance was August 2008.

9.2.4. The Regulation of Canadian Offshore Arctic Activities – The Problem of Devolution?

On 20 November 2008, in a Communication to the European Parliament and the Council,[40] the European Commission signalled a more activist future role for the EU in the Arctic. The Communication is carefully balanced, emphasizing an increased role in Arctic transport, fisheries, climate change, and political and economic support of indigenous peoples (particularly in Greenland). The Communication is relatively muted in its discussion of EU interest in Arctic hydrocarbon reserves, emphasizing a role engaging indigenous peoples and preserving their way of life.[41] Nonetheless, the EU move was widely interpreted as a manoeuvre for Arctic hydrocarbons. For example, The Canadian Press trumpeted that the EU was "staking [a] claim on Arctic resources," adding that the initiative "is likely to irk other Arctic players, including Canada, Russia, Norway and the United States all of which have issued territorial claims in the polar region."[42]

What are the EU's prospects in the Canadian Arctic Archipelago? The issue is politically sensitive, particularly as regards Ottawa's relationship with the Canadian indigenous peoples. Canadian Arctic offshore oil and natural gas activities present a challenge for Canadian management of Arctic waters. The regime governing offshore activities is currently in the process of transition.

The first set of changes stem from the Canadian federal government concluding land claim treaties with the Northern Canadian Inuit where Inuit were granted various property rights in vast areas in return for giving up their traditional rights throughout Canada.[43]As a result, the Northwest Territories (NWT), originally comprising the entire Canadian Arctic area, was subdivided in 1993 into two territories, the Northwest Territories, the western segment of the original Northwest Territories, and a new entity, Nunavut, comprising the previously eastern segment (including most of the Arctic island archipelago). A wholly new set of innovative consultative institutions was established in both territories. What is remarkable about Nunavut is not only the new Inuit

[40] EU Commission, *Communication for the Commission to the European Parlament and the Coucil: The European Union and the Arctic Region,* Brussels COM(2008) 763.
[41] Id., pp. 5–6.
[42] "European Union joins the lineup, staking claim to Arctic resources," *The Canadian Press* (22 November 2008), available: <http://www.canadaeast.com/rss/article/487158> (retrieved 23 November 2008).
[43] The Canadian government has signed over 20 land claims agreements. These agreements compensate the Aboriginal peoples for lands they inhabited before European settlers arrived in North America.

consultative boards that have been established (this is true of the Inuvialut in the Northwest Territories), but that the new Territory of Nunavut is virtually contiguous with the Settlement Lands granted in the *Nunavut Land Claims Final Agreement Act* and is meant to be an Inuit homeland.[44] ("Nunavut" is translated as "Our Land".) Each of these entities, but particularly Nunavut, is subject to ongoing political change increasing LNG project risk

The offshore regime is also undergoing management change in another respect. In accordance with the *Oceans Act*, the federal Department of Fisheries and Oceans (DFO) has assumed responsibility for the implementation of integrated oceans management. The vehicles for application of this management form are large ocean management areas (LOMAs). To date, there are five LOMAs, with each covering vast areas: the Beaufort Sea, Placentia Bay/Grand Banks, Gulf of St. Lawrence, the Scotian Shelf, and the Pacific North Coast. Both of these developments have complicated the management of Arctic offshore resources. Further, missing among the five LOMAs is a management area covering the Sverdrup Basin and the majority of the Canadian Arctic Islands. This management area falls within Nunavut. This difference may have consequences for the Melville Island project. The Hecate field lies to the east of 110° W longitude which bisects the eastern Melville Island peninsula, and thus falls into the NWT Beaufort Sea LOMA. The Drake Point field lies offshore to the east of Melville Island in Nunavut.

9.2.4.1. The Arctic Offshore and Inuit Land Claims

Prior to the first Inuit land claims agreement with the Inuvialut in 1984, oil and natural gas development in the NWT were exclusively within the purview of the Oil and Gas Directorate of the federal Indian and Northern Affairs Canada (INAC) and the National Energy Board (NEB). INAC and the NEB administer these activities in accordance with the *Canada Petroleum Resources Act* and the *Canada Oil and Gas Operations Act* and their accompanying regulations.[45] The Inuvialut Final Agreement granted the Inuvialut simple fee title to certain lands in the NWT. These included subsurface rights under certain of these lands, including rights to oil and natural gas resources. To date the Inuvialut Final Agreement has not attenuated the role of INAC and the NEB. INAC

[44] The creation of the Territory of Nunavut was directly linked to the Nunavut Land Claims Final Agreement. The *Nunavut Land Claims Agreement Act* of 1993 was passed on the same day as the *Nunavut Act*, which created the new territory of Nunavut.
[45] S. Carpenter, C. A Law, and J. Olynyk, "Oil and Gas Developments in Western Canada in the New Millennium: The Changing Legal Framework in the Northwest Territories, the Yukon, and Offshore British Columbia," *Alberta Law Review* 39 (2001), p. 3.

remains responsible for granting exploration and production licenses. The NEB is responsible for all the stages in between (exploration activities, granting significant discovery and commercial discovery licenses, and approval of development plans).

The Inuvialut Final Agreement created a series of institutions that imposed new conditions on resource development. Nevertheless it did not essentially alter the previous regime. These institutions, essentially management boards with Inuit representation, were grafted onto the existing legislation. The Inuvialut Final Agreement did not grant any comprehensive form for self-government, unlike Nunavut. Nor was the transfer of land ownership as sweeping as that which occurred when Nunavut was created in 1993.

The federal government in Ottawa has nominally delegated significant powers to the territory of Nunavut. However, there are two major interlinked stumbling blocks in the federal-territorial relationship of consequence for the development of the Melville Island Project and other Arctic hydrocarbon resources: disagreement over control of such resources and disagreement as to whether internal Arctic waters and revenues from offshore resources fall within the exclusive purview of territorial government jurisdiction.

The Government of Nunavut (GN) and Nunavut Tunngavik Incorporated (NTI)[46] and Ottawa have been unable to agree on the transfer of control of non-renewable resources located in the territory and on the division of the economic rents involved with resource exploitation. The problem is complicated by the forthcoming devolution of provincial rights to Nunavut, rights which would give the GN and NTI control over land management and natural resources.[47] There is a difference of interpretation over what constitutes devolution. The Nunavut organisations essentially argue that Ottawa is delegating full provincial powers to Nunavut, a claim which would give the GN and the ITC (Inuit Tapirisat of Canada) full authority over all subsurface resources in the territory. These powers were first recognised by the *British North American Act* of 1867 and reaffirmed by the *Canada Act* of 1982. Ottawa maintains that jurisdiction over these resources may pass to Nunavut, but the "programmatic element" remains the prerogative of the federal government.

The Inuit of Nunavut are very dependent on the marine economy, a fact reflected in the Nunavut Final Land Claims Agreement. This cultural

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[46] Nunavut Tunngavik Incorporated is the entity charged with the corporate responsibility of managing the lands granted the Nunavut Inuit in 1993. It is reputed to have a more hawkish position on these issues than does the GN.

[47] See P. Mayer, *Mayer Report on Nunavut Devolution* (Fasken Martineau DuMoulin LLP, June 2007), available: <http://www.fasken.com/publications/Detail.aspx?publication=3322> (retrieved 3 November 2008), p. 21.

dependence, argue the GN and NTI, should give them control over internal waters (including subsurface resources). They also argue that Nunavut control over internal waters and seabed resources would enhance Canada's claim to the internal waters status of the Arctic archipelago. An argument of regulatory efficiency is also made, namely, that a seamless Nunavut land and internal waters administrative structure would contribute to regulatory clarity and consistency. In this respect, the *Mayer Report on Nunavut Devolution* refers specifically to Nunavut frustration with the lack of progress in developing offshore resources. It refers to the dispute over who was to exercise authority over seabed resources in the archipelago, in particular the Drake Point gas field, one of the two fields on which the Melville Island project is based. The *Report* states:

> The GN [Government of Nunavut] expressed its conviction during briefings that devolution of the seabed resources to the GN would immediately unlock the rich potential that exists there. During briefings on what was then Nunavut's draft Mineral Exploitation and Mining Strategy, the GN's Director of Petroleum Resources Division explained that the Drake Point gas field off the Northern tip of Melville Island has a complicated ownership structure [hindering its development].[48]

It was alleged that the current system of regulation allowing for "significant discovery licenses" was delaying the development of the gas field and that a Nunavut administration could prompt a "resumption in oil and gas exploration and development activities in Nunavut."[49]

More recently, on 15 September 2008, a Land and Resources Devolution Protocol[50] was signed by the GN and Ottawa, specifying the manner in which future devolution negotiations will be conducted. Notable in this Protocol are the principles regarding transfer of administration and control of oil and gas resource both on- and offshore. While acknowledging the ultimate objective of transferring these powers to the GN, the Protocol stated that the Government of Canada "is not prepared to negotiate seabed resource management during the initial phase of devolution negotiations" and negotiations over the status of these resources were to occur in a "future phase of devolution negotiations."[51] The degree to which this protocol will defuse the situation remains to be seen.

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48 Id., p. 38.
49 Id.
50 Indian and Northern Affairs Canada, *Lands and Resources Devolution Negotiation Protocol* (15 September 2008), available: <http://www.ainc-inac.gc.ca/al/ldc/cc/fagr/nuna/nti/nti-eng.asp> (retrieved 20 November 2008).
51 McHugh, n. 29 above, p. 6.

More serious, perhaps, was the negative conclusion in the *Mayer Report* as to whether Nunavut was capable of handling the additional demands imposed by its devolution to provincial status. It was expected to be signed by the end of 2008, the ultimate product of negotiation has been a compromise in which both sides have agreed to take up some of the more sensitive issues at a later point in time. It is highly likely that an eventual devolution agreement will retain some federal control over the internal waters and subsurface rights. This is particularly the case for the National Energy Board, the competent technical entity for future offshore petroleum developments. While prediction here is uncertain due to constant policy shifts in the GN, the Devolution Protocol is unlikely to reduce Ottawa-Nunavut conflicts over the long term.

9.2.4.2. The Arctic Offshore and the Creation of LOMAs

While the designation of a LOMA may not be forthcoming for the Arctic archipelago as of yet, it is worthwhile to briefly examine the problems that negotiations leading to LOMAs are encountering with regard to the governance of offshore subsurface resources. Some of these problems are general in nature. DFO, the government agency responsible for establishing and administering LOMAs, is confronted with a high level of variation, both among the various LOMAs (for example, the Scotian Shelf LOMA is very different from the Beaufort Sea LOMA) and among the negotiating stakeholders. No fewer than 38 organisations divided among five committees are engaged in the creation of the Beaufort Sea LOMA. In contrast to elsewhere in Canada, many of these organisations are consultative Inuit organisations. This problem is replicated with regard to coordination of government regulatory bodies. Many of these bodies have negotiated a wide network of memorandums of agreement without fully realising the implication of these agreements or the degree to which they overlap. This overlap could well lead to future conflicts.

With regard to offshore subsea resources, there is a high degree of asymmetric information between the various competent authorities.[52] Different bodies have different expertises. Thus, for example, the National Energy Board, the body concerned with the direct management of offshore hydrocarbon exploitation, has superior sources of information regarding these activities than many other authorities. The degree to which asymmetric information may lead to infighting among LOMA authorities remains unclear. A second problem is the multiple property rights regimes within each LOMA that have to be

[52] Id.

reconciled. Indeed, one need only look at the Nunavut devolution controversy to see the nature of this problem.

At present it is unclear what, if any, effect the lack of a Nunavut LOMA might have on any future approval and regulation of the Melville Island project.[53] Nonetheless, the process of creating the integrated management systems within the individual LOMAs is progressing. Indeed, the Scotian Shelf LOMA and the Beaufort Sea LOMA planning processes are well underway. It remains to be seen how these integrated management systems will actually function in the future.

9.3. Conclusion

On 17 October 2008, an EU-Canada Summit was held in Quebec. EU President Sarkhozy and EU Commissioner Barroso met with Canadian Prime Minister Stephen Harper. The statement issued at the end of the meeting emphasized Canadian-EU cooperation in three areas: economic partnership, energy and the environment, and international peace and security.[54] On further reading, the communiqué deals exclusively with the environment. Energy is shunted aside. The communiqué also mentions future cooperation in the Arctic, reiterating shared interests and objectives, including "protecting the environment and ensuring that Northerners can contribute to economic and social development in the region now and in future generations."[55] Scientific research and sustainable seal hunting were other measures mentioned in the communiqué, as was a report on Arctic cooperation in 2009. Nowhere was there mention of tapping the Canadian Arctic for its natural gas resources.

Just 34 days later, however, the European Commission outlined an activist EU Arctic policy.[56] What are the EU's prospects with regard to Arctic hydrocarbon resources?

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[53] The authors have unsuccessfully investigated the reasons for the lack of a Nunavut LOMA. Telephone enquiries at INAC with officials did not yield any answers. It is rumored that GN and NTI are at odds with DFO, the result of DFO's having given away Nunavut fishing rights to Greenland, and thus may be resisting the establishment of a Nunavut LOMA. Alternatively, a LOMA may be thought to be unnecessary given the presence of an interdisciplinary Nunavut Maritime Board.

[54] Council of the European Union, EU-Canada Summit Quebec, 17 October 2008, 11467/08 (Presse 292), available: <http://ec.europa.eu/external_relations/canada/sum10_08/results_en.htm> (received 20 October 2008).

[55] Id., p. 5.

[56] European Commission, *Communication for the Commission to the European Parliament and the Council: The European Union and the Arctic Region*, Brussels COM(2008) 763.

Our objectives in this contribution are straightforward and perhaps a bit novel. We have argued that while Canadian Arctic natural gas reserves cannot match Siberian volumes, exploitation of Arctic natural gas can serve as a significant supplement to existing and future EU natural gas relationships. This picture can only get better with the revival of exploration, not only in the Arctic Archipelago, but also in the Atlantic Canada-Greenland basin. The latter area, with some 34 wells in total, is far less explored than the Sverdrup Basin (with 124 exploratory wells).

We have used the recently revived Canadian Arctic Pilot project as a *leit motif* in our argument. But it is hardly the only source of Canadian Arctic natural gas. Also available in the Arctic archipelago are the proven gas reserves at the King Christian Island group (some 3.5 trillion cubic feet). On the basis of their finds in the archipelago, the PetroCanada Group estimated an exploitable ultimate potential of 113 trillion cubic feet in 1979.[57] With improved seismic technology, offshore drilling techniques, and receding Arctic ice, renewed exploratory activity will undoubtedly contribute to this figure.

Arctic oil resources have been underplayed in this analysis. This has been largely due to the great EU concern over future natural gas imports into the Community, and the fact that there is an LNG project being considered in the Canadian Arctic archipelago. There are significant crude oil resources in the Sverdrup Basin. Bent Horn, a smallish field with 12 million barrels of recoverable resources, was exploited in the period 1985 through the late 1990s, but this is a minor development. More significant perhaps is Sverdrup's undeveloped Cisco field with 584 million barrels of proven reserves.[58] However, there are no current development plans for the Cisco field.

Expansion of Atlantic Basin LNG trade is widely anticipated. A transit terminal in Greenland would be ideal for proponents of the Melville Island project. While the possibility of a Greenland transit terminal was not considered in the original APP application 29 years ago, this was due to the limited amount of LNG spot trading then. Today, well over half the LNG cargoes delivered to North American markets are arranged on a spot basis. With North American and EU markets roughly equidistant, the Melville Island project proponents can

[57] Arctic Pilot Project (Canada), *Application to the National Energy Board* (Calgary: Petro-Canada, 1981), Vol. 2, p. 49. The APP application comprises seven volumes: v. 1 Application, v. 2 Gas Supply and Markets, v. 3 Facilities, v. 4 Economics, v. 5 Public Interest, v. 6 Canadian economic benefits, and v. 7 Melford Point Alternative (1979).

[58] Even more interesting is the production from the Amauligak field in the Beaufort Sea, with reserves estimated at 2.2 billion barrels. See K. J. Drummond, "Canada's discovered oil and gas resources North of 60^0," (Paper presented at the AAPG Annual Conference, Calgary, Alberta, 19–20 June 2005), available: <http://www.searchanddiscovery.net/document/2006/06022 drummond/index.htm> (retrieved 21 October 21).

now arbitrage European (probably using National Balancing Point prices) with US natural gas prices. The CERI sensitivity study, the details of which are extensively discussed in Annex Two, has found that their Melville Island case study yielded positive NPVs discounted at 15 percent net of all costs, taxes and royalties at natural gas prices as low as USD5.53 per Mcf (Mcf = thousand cubic feet) (Henry Hub) in 2014 rising to USD5.66. per Mcf in 2040.[59] As European prices are generally higher than those in North America, it is likely that much LNG will be delivered to European terminals, even in the absence of a dedicated project. Annex Two shows that the price differentials involved in a European solution to the Melville Island project are within the realm of reason.

Outside the environmental aspects of such a trade, which were evaluated during the initial application,[60] but will likely need to be intensively investigated again, there are three main obstacles to the Melville Island project that appear to be political. First, the conflict between Nunavut and Ottawa over the nature of the coming territorial devolution into something between a territory and a full fledged province will not accelerate the Melville Island project. This is particularly the case given that control of the subsea resources of the Drake Point field is disputed. A second reason, which is linked with the first, is the lack of qualified regulators for offshore activities should these fall under the Nunavut government's competence. This could well make development risk unacceptable for the project's proponents. (In a somewhat unrelated example, given Greenland's vote for 'independence' in a 28 November 2008 referendum, this lack of qualified administrators can stall any development of Greenland resources.[61]) Finally, even where a LOMA planning pprocess has been completed, it is not clear how integrated management will function.

With respect to these three obstacles, it is more than probable that they will not be significant hindrances to the Melville Island project. Disputes over the status of subsea resources have been postponed. Ottawa's insistence on separating juridical devolution over the area's resources from programmatic

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[59] At CAD1 = USD$0.75. Note that a startup delay of five years does affect the NPV significantly.

[60] See Canadian Arctic Resources Committee, *The Arctic Pilot Project: A Submission to the Environmental Assessment and Review Process* (Ottawa: CARC, March 1980), and Arctic Pilot Project Assessment Panel, *Arctic Pilot Project (Northern Component): Report of the Environmental Assessment Panel* (Ottawa: Federal Environmental Review Assessment Office, October 1980).

[61] For example, the Greenland state oil company is participating in all the Greenland offshore blocks. Currently, Nunaoil is owned 50–50 by the Greenland Home Rule Government and the Danish State. On independence, Nunaoil will be 100 percent owned and controlled by the Greenland Home Rule Government. As such, it will have a very limited ability to foot the financing of any future major exploration well, much less the capital needed for an major project offshore West Greenland.

devolution should keep the more complicated aspects of the offshore project within the capable hands of the NEB and INAC.[62] And fears over how LOMAs will function may prove to be unjustified.

A more serious obstacle could lie in the provisions of the North American Free Trade Agreement (NAFTA). Trade in oil and energy is covered by NAFTA Article 605. This article allows governments to restrict energy exports to other countries on the following grounds: (1) exhaustible resource conservation; (2) supply shortages; (3) stabilisation of prices; and (4) national security.[63] Of more particular interest are the terms set out in Article 605 for energy trade "proportionality." In the case of supplies being restricted in either the United States or Canada due to the first three reasons specified above, the "share of the total supply may not fall below the average level in the previous 36 months."[64] The significance of this measure for third parties is obvious. Should a shortage of 25 percent be experienced in Canadian production, exports to the United States must be no lower than 75 percent of the level of the previous 36 months. Thus, in a period of shortage in North America, the exigencies of Canada-US bilateral trade in energy would cause diversion away from a third party, for example, an EU importer, to the US and Canadian markets. This would occur precisely at a time when shortages may also be serious in the importer's home market. However, it may be possible for market participants to swap LNG diverted from Canada-EU trade to bilateral North American trade with cargoes originally destined for North American markets from other suppliers elsewhere in the world.

This proportionality principle is highly contentious. It applies only to US-Canada trade relations (Mexico having opted out). In that it has never been exercised, its status is still somewhat vague. However, actions undertaken within the purview of national security provisions of the accord are more tightly defined than those in the General Agreement on Tariffs and Trade. Watkins and Waverman believe that Canadian acceptance of the proportionality principle and US acquiescence in tightened national security provisions are an example of the give and take between the two countries in the formulation of the treaty.[65] Nonetheless, NAFTA provisions such as these must be taken into account in

[62] From time-to-time, plans are floated with regard to establishing joint Ottawa-territorial regulatory boards modeled on the Canada-Nova Scotia and Canada-Newfoundland Labrador Offshore Petroleum Boards. The advantages and disadvantages of such a solution for the NWT and Nunavut, with separate boards or one joint board, are beyond the scope of this contribution.
[63] See G. C. Watkins and L. Waverman, "How might North American Market Have Performed with a Free Trade Agreement in 1970?" *The Energy Journal* 14, no. 3 (1973), p. 157.
[64] Id., p. 159.
[65] Id.

examining the relevance of the Arctic archipelago for future EU security of supply of oil and natural gas.

Annex One: The Northern Dimension and EU Energy Policy

Energy efficiency and renewable energy were high on the agenda of the new Northern Dimension (ND) initiative in which the Arctic and sub-Arctic areas, including the Barents region, are defined as EU priority areas.[66] EU energy demand is linked to delivery to its regional market. Therefore it is in the EU interest to ensure that traditional energy suppliers in the North (Norway and Russia) will be able to continue to deliver. One of the key sectors in the EU's Northern Dimension,[67] energy, is a function of a growing interdependence between the EU and Russia. In a recent speech, Benita Ferrero-Waldner, the European Commissioner for External Relation and European Neighbourhood Policy, highlighted this interdependence. She stated that Russia remains a very significant partner for the EU. Since the EU markets absorb around two-thirds of Russian gas exports, the EU revenues are vital to Russia's economic growth.[68] Based on this inter-dependence, the EU has interests in the development of energy production in the Arctic. As the EU energy policy requires it to bring its neighbour progressively closer to the EU's internal market, the Northern energy agenda comprises three components: security of supply, competitiveness, and protection of the environment. In relation to EU Arctic interests, energy policy becomes a major driver, as is mitigation of climate change.[69] The focus of EU energy policy includes: harmonisation of regulations governing energy trading (including investment and dispute settlement), setting environmental requirements, developing a stable framework for public and private investments in the energy sector, encouraging more efficient production and use of energy, and the developing gas network supporting a sustainable supply and use of energy.[70] To achieve these goals, the EU has developed variety of instruments such as the Trans-European (Energy) Networks Programme,[71] the Energy Framework Programme,[72] and the TACIS

[66] Airoldi, n. 1 above, p. 22.
[67] Strengthening the Northern Dimension of European Energy Policy, n. 6 above.
[68] Ferrero-Waldner, n. 27 above.
[69] Airoldi, n. 1 above, p. 48.
[70] Strengthening the Northern Dimension of European Energy Policy, n. 6 above.
[71] The Trans-European Networks Programme (TENS), adopted by the Council in 1995, co-finances studies that support and foster energy network development and interconnections necessary for supplying the market and enhancing security of supply, taking account of the need to link island, landlocked, and peripheral regions with the central regions of the Community and to establish or improve interconnections with third countries. Id., Annex II.
[72] The Energy Network Programme has supported Energy Policy activities in Latvia and Poland through its international cooperation programme, Synergy. Id., Annex II.

(Technical Aid to the Commonwealth of Independent States) project in northwest Russia.[73] In addition, EU funds are supplemented by other cooperative instruments contributing to regional economic development such as the European Bank for Reconstruction and Development, regional development banks, the Nordic Investment Bank, and other national and regional programmes.[74]

Due to EU enlargement, international cooperation in the Barents and Baltic regions has opened up the possibility of energy company investment. However, feasible legislation and a favourable economic environment are pre-conditions for such investment. Thus, EU northern energy policy has emphasised strengthening energy cooperation with Russia through the Partnership and Cooperation Agreement. The Common Strategy for Russia specifically mentions the Northern Dimension as a forum in which Russian-EU regional and cross-border cooperation can be strengthened. Current EU policy envisages Russian ratification of the Energy Charter Treaty (ECT), a treaty which Russia signed but has as yet failed to ratify. Russian ratification of the ECT will modernise the current regulatory framework and will build new relationships in competition and standards. It will also attract private sector participation in Arctic investment and encourage development in new infrastructure and technological capacity.[75] The EU Commission has already proposed extending the "motorways of the sea" as part of the development of a common energy import infrastructure.[76]

Given that its future energy supply is secured at the corporate level, a coherent external energy policy regarding the liberalisation of the EU energy markets is needed at the Council of Ministers level. The enhancement of an EU dialogue with Russia is one of the main arguments favouring such a policy. Here, diversification of sources, routes and suppliers is crucial to ensuring EU's energy security. Energy cooperation with major producers, transit countries and consumers must receive support from all Member States. An external European energy policy, based on the principle of solidarity, could provide and effective response to possible future external crisis situations.[77] Whether an overall EU

[73] TACIS (Technical Assistance to the CIS (or Commonwealth of Independent States)) is a programme that has taken both a sector specific and regional approach to the provision of technical assistance to Russia. It has supported several projects in northwestern Russia, concentrating primarily on energy efficiency and environmental issues. Id., Annex II.
[74] See Id.
[75] See, in general, Strengthening the Northern Dimension of European Energy Policy, n. 6 above.
[76] Energy Policy and Maritime Policy, n. 2 above, p. 4.
[77] O. Geden, C. Marcelis, and A. Maurer, "Perspectives for the European Union's External Energy Policy: Discourse, Ideas and Interests in Germany, the UK, Poland and France,"

approach to possibly significant future gas supplies from the Arctic will be able to take priority over the commercial interests of individual companies remains to be seen.[78]

Working Paper FG1, 2006/17 (German Institute for International and Security Affairs, 2006), available: <http://www.swp-berlin.org/common/get_document.php?asset_id=3521> (retrieved 5 October 2008).

[78] Airoldi, n. 1 above, p. 48.

Annex Two: The Melville Island LNG Project

This description of the Melville Island project relies on several earlier studies previously made on a similar project, the Arctic Pilot Project (APP). Chief among these are those submitted with the initial APP application to the Canadian National Energy Board (NEB).[79] There are other publications of interest here, for example, the submission of the Canadian Arctic Resources Committee.[80] Most of the estimates here are based on Chan et al.[81] which in turn is highly dependent on the early APP submission to the NEB. Costs have been adjusted to 2005 levels.

Figure 9.3 illustrates the basic installations of the Melville Island project. As can be seen, the Hecla and Drake Point gas fields straddle the northeastern Melville Island peninsula. Both fields are essentially offshore fields, although both have portions extending under the Melville Island land mass. The two gas fields are to be linked together with a 162 kilometre natural gas pipeline running south following the island's natural features to a liquefaction plant, storage tanks facilities, and LNG carrier berthing facilities on and offshore the Bridport Inlet on the south side of the island.

The following project description focuses on the development of the two fields, the pipeline connections, and the land and offshore liquefaction, storage, and berthing facilities. The proposed LNG carrier routes and environmental impact assessments are then described. The detailed project description will be limited as to its specifics as all available literature deals with the APP as it appeared in 1979–1981. It was a significantly smaller project then, roughly a third the size of the project contemplated here. Chan et al. in their 2005 study rely on the earlier project specifics but have dimensioned the project to accommodate the higher capacity envisaged. Nonetheless, many of the essentials are probably the same (e.g., location and nature of the pipeline, liquefaction and storage facilities).

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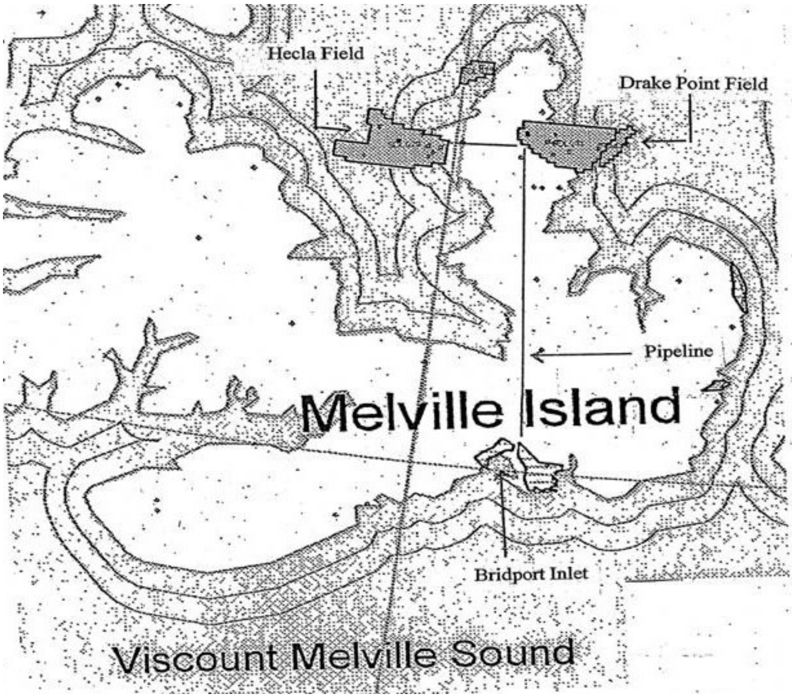
[79] Arctic Pilot Project, n. 57 above.

[80] Canadian Arctic Resources Committee, n. 60 above; The Working Group, *Final Report by the Working Group on the Arctic Pilot Project in Greenland Waters* (Calgary: Working Group on the Arctic Pilot Project, 11 April 1984).

[81] Chan et al., n. 35 above.

Figure 9.3. The Melville Island Project



Source: Indian and Northern Affairs Canada, *Land and Exploration Maps*, *'Sverdrup Basin,'* available: <http://:www.ainci-incac/oil/act/lan/index_e.html> (retrieved 23 October 2008). Map has been adjusted to highlight Melville Island. Arrows and captions are authors' rendition.

Financial Assumptions

Table 9.3 sets out the financial assumptions behind the project.

Table 9.3. Financial assumptions behind Chan et al. analysis

Net present value of project assumes a 15% (after royalty and tax) discount rate Analysis assumes 75% equity financing Corporate income tax is included (also NWT and Nunavut corporate taxes) All costs are in 2005 Canadian dollars Mobilisation and demobilisation costs are included in capital costs of project components Drilling costs are separated from other project capital costs. These can be

depreciated at 30% per annum. All non-drilling facility capital costs qualify for decline balance depreciation at 25% per annum Crown royalties range from 1 to 5% per month until payout. After payout, the royalty is the greater of 30% net revenue or 5% of gross revenue. All prices are determined at the delivery point by netback calculation from nearest city gate (i.e., Strait of Canso, Nova Scotia) Price forecasts are developed from forecasts of Henry Hub prices Throughput prices are made on a volumetric basis using Canadian dollars per Mcf Full Flow Through Analysis is assumed Start up in 2009, 2014, and 2019

Source: Chan et al., n. 35 above, pp. 8–9.

Project Planning Assumptions

The estimated costs of project design and regulatory phases are CAD210 million. The estimated length of time for regulatory filing, regulatory proceedings, design and construction is four years prior to field production.[82]

Assumptions Behind the Development of the Hecla and Drake Point Fields

The Arctic Pilot Project estimated marketable field reserves at 5.1 Tcf for the Drake Point field and 3.6 Tcf for the Hecla fields, for a total of 8.7 Tcf for the two fields (Figure 9.4). Other estimates have been somewhat lower (The Canadian Gas Potential Committee and the Geological Survey of Canada estimate a recoverable amount of 8.4 Tcf at the high end and 6.495 Tcf at the lower end.) The energy content of the natural gas is 1,000,000 Btu per thousand cubic feet. The gas is sweet and "essentially free of heavy ends."[83] Chan et al. assume a target production of 1billion cf/d over a 20-year period.[84]

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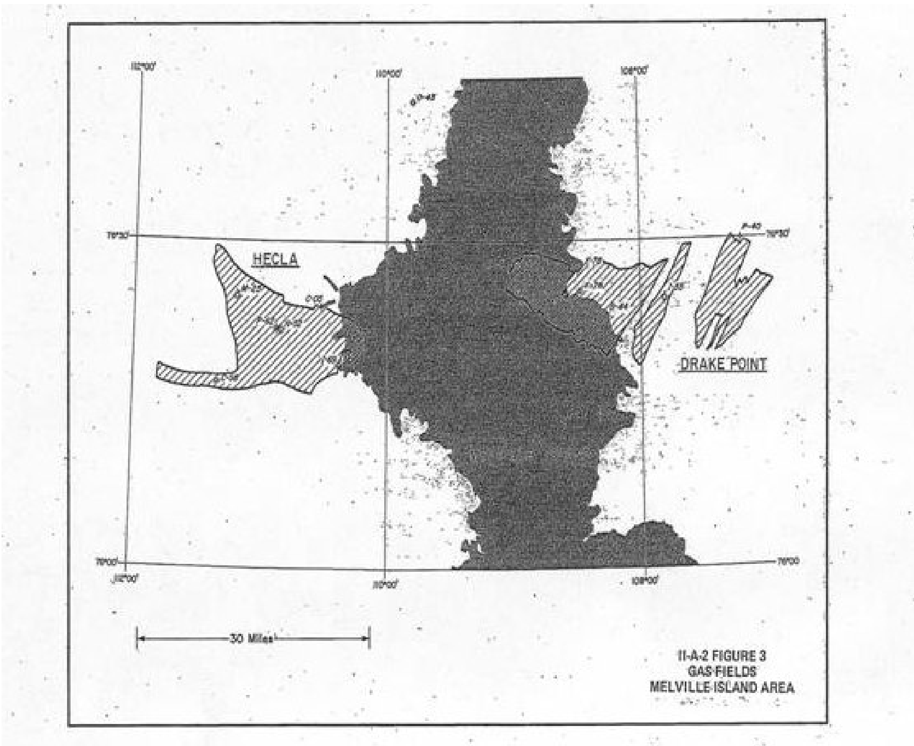
[82] This is a very short period of time for all of these tasks to be successfully performed. It is much more likely to take five or six years to accomplish these ends given the difficulty of the project. However, in this study we assume that the four year figure is accurate.

[83] Chan et al., n. 35 above, p. 7.

[84] Id.

Figure 9.4. The Hecla and Drake Point Fields



Source: Arctic Pilot Project, Vol. II, (1979) p. II-A-2, Figure 3.

The plan is to develop the larger Drake Point field first and to tie the Hecla field into production at a later point in project development. To bring both fields into production, it is assumed that 20 wells will be necessary (Table 9.4). (Chan et al. do not specify in what order the wells are to be drilled or when the Hecla field will come on stream.)

Table 9.4. Estimated field development costs

Estimated drilling capital costs: 20 wells at CAD17.5 million/well or CAD350 million
Flowlines: CAD 18 million
Pipelines: 22 kms @ 20 inch diameter or CAD15.9 million
8 kms @ 8 inch diameter or CAD2.8 million
Dehydration plant (1000 MMcf/d throughput): CAD90 million
Total field capital cost: CAD458 million
Annual field operating costs: CAD33 million

Source: Chan et al., n. 35 above, p. 11.

Assumptions Behind the Cross-island Transmission Line to Bridport Inlet

Gas metering and processing are to take place at Drake Point, where the gas will be fed into a 161 kilometre transmission line to Bridport Inlet. There is to be a winter road paralleling the pipeline, which follows the contours of the island, including those of a riverbed as it approaches the liquefaction facilities at Bridport Inlet. There are also three tentative camp locations along the pipeline route. The original APP pipeline proposal called for a 22 inch diameter line for 32 MM cf/d. To accommodate the 1000 MM cf/d planned for in this project, the pipeline diameter was increased to 36 inches. The 161 km transmission line at a later point in the project would be connected to a 36 inch lateral to the Hecla field. A 22,000 horsepower compression station is anticipated. The date of installation of the compression station or the construction of the Hecla lateral is not specified.

Capital costs of the transmission line are estimated to be CADS million. Annual operating costs are estimated at CAD4.4 million.

Assumptions Behind the Liquefaction, Berthing and Storage facilities at Bridport Inlet

The liquefaction facilities anticipated are considerably larger than those of the APP to take advantage of economies of scale. (Liquefaction technology has improved significantly over the last thirty years, lowering costs and minimising the possibility that the liquefaction facilities will perform significantly below the anticipated load factor.) To account for the increased volume, a two-train barge facility is anticipated. The design and costs of the liquefaction plant, storage tanks, living quarters, berthing facilities, and other site requirements are critical to the success or failure of the project.

Site development represents the largest single capital cost for the facility (Table 9.5). Roughly half of the costs for site development are related to construction of the dock, with the remainder split between onshore site preparation, piping and mechanical equipment, utilities and communications, and accommodation and site buildings.[85] The APP exercised considerable ingenuity in the planning of siting and LNG facilities.[86] Chan et al. arrived at

[85] Chan et al., n. 35 above, p. 18.

[86] Among other things, the natural gas was to be utilised for virtually all required power and heating, and water warmed by the process of liquefaction was to be used to create season-round ice-free berthing facilities for the LNG carriers.

their estimates by adjusting the APP estimates upwards so as to conform to 2005 costs.

Table 9.5. Liquefaction and site estimates

Project development: CAD9 million
Site development: CAD955 million
LNG liquefaction plant: CAD657 million
Barge for LNG plant: CAD77 million
LNG storage barges (2@100,000m^3 LNG apiece): CAD283 million
Barge tow-in costs: CAD29 million
Total capital costs: CAD2,011 million
Annual operating costs CAD84 million

Source: Chan et al., n. 35 above, p. 17.

Shipping Estimates

To date no LNG carrier with an Arctic Class 7 icebreaking capacity has been constructed. The specifics of the proposed LNG carrier fleet are not elaborated in the project proposal. For example, it is not known whether these proposed vessels will be equipped with azimuth propeller pods, which enable a vessel to use its stern configuration for icebreaking and retain its prow designed for optimal speeds in non-ice filled waters. (Another advantage of this configuration is that the propeller placed at the stern of the ship can create a strong current along the underwater hull of the carrier enabling it to break the ice better.) The return journey to and from the Strait of Canso in Nova Scotia is 5,258 nautical miles. It is estimated that seven carriers will make the return voyage every 21.5 days, 345 days per year. The capital cost of the LNG carriers is estimated to be CAD268 million apiece or CAD1,875 million for seven vessels as opposed to CAD1,340 million for five vessels (the Greenland transshipment example). Annual operating costs are CAD44 million per vessel or CAD308 million for seven vessels and CAD220 million for five vessels.

Estimates of the Godhavn Transit Terminal

Chan et al. have developed the Greenland transhipment alternative to reduce the number of Arctic Class 7 icebreaking tankers required from seven to five. These vessels would operate on the first leg of the voyage from Melville Island to Godhavn. The second leg (to the Strait of Canso) would be serviced by two 200,000 m^3 capacity LNG carriers at CAD206 million per vessel, with annual operating costs of CAD33 million apiece. Capital costs of berthing, and storage by the transit terminal are estimated at CAD381 million. Annual operating costs are not mentioned in the Chan study. Differences between the Strait of Canso and a European alternative are briefly mentioned in the study: "Delivery to other ports, such as to Europe, would require additional tankers and may result in the establishment of a hub for Atlantic LNG trade."[87]

Sensitivity of the Godhavn Transit Alternative

The fundamental difference between the two scenarios is that the Melville Island-Godhavn-Strait of Canso scenario has capital costs of CAD257 million more than the Melville Island-Strait of Canso alternative, but annual operating costs of CAD17 million less.

Chan et al. undertook a sensitivity study of the two alternatives along several parameters (Table 9.6). Perhaps most significant was how the two alternatives compared under differing price scenarios (Table 9.7).

Based on Chan et al., Table 9.7 compares the cost of the two alternatives based on start date. It is assumed that production would start earliest in 2014 (not 2009 as assumed in Chan et al.).

Interestingly, as shown in Table 9.7, project economies improve drastically when one takes A', B', and C' into account. Here the initial price to 2015 is CAD7.37 per Mcf (Mcf = thousand cubic feet) rather than is the case with scenarios A, B, and C (CAD5.85 per Mcf).

[87] Chan et al., n. 35 above, p. 29.

Table 9.6. CERI Price Forecasts for Melville Island Natural Gas

Forecast A: Constant at CAD5.85 /Mcf until 2015, then increases to CAD13.89/Mcf in 2040 Forecast A': Constant at CAD7.37/Mcf until 2025, then increases to CAD13.89/Mcf in 2040 Forecast B: Constant at CAD5.85/Mcf until 2015, then increases to CAD10.10/Mcf in 2040 Forecast B': Constant at CAD7.37/Mcf until 2015, then increases to CAD10.10/Mcf in 2040 Forecast C: Constant at CAD5.85/Mcf until 2015, then increases to CAD7.55/Mcf in 2040 Forecast C': Constant at CAD7.37/Mcf until 2015, then increases to CAD7.55/Mcf in 2040
[a]All prices at Henry Hub. A differential of CAD1.37/Mcf is calculated between prices at Henry Hub and prices at the Strait of Canso

Source: Chan et al., n. 35 above, pp. 14–15.

Table 9.7. The two Melville Island alternatives compared at NPV 15%

	LNG (million CAD)	Greenland transfer (million CAD)
NPV@ 15% Price Forecast A		
Production start 2014	29	2
Production start 2019	439	409
NPV@15% Price Forecast B		
Production start 2014	(235)	(261)
Production start 2019	(92)	(119)
NPV@15% Price Forecast C		
Production start 2014	(427)	(451)
Production start 2019	(461)	(483)
NPV@15% Price Forecast A'		
Production start 2014	570	535
Production start 2019	846	817
NPV@15% Price Forecast B'		
Production start 2014	300	266
Production start 2019	300	267
NPV@15% Price Forecast C'		
Production start 2014	105	70
Production start 2019	(98)	(128)

Source: Chen et al., n. 35 above, p. 35.

While the seven LNG carrier option is preferable to the Greenland transshipment option, the differences between the two are not terribly significant. Both are dependent on rising natural gas prices to be profitable. However, natural gas prices have evolved considerably since 2005, the date of publication of CERI report. Mcf prices of USD8.00 to USD10 per Mcf (CAD12.71 to CAD15.25 per Mcf) are not that uncommon today.

The European Option

Chan et al. consider the European option, but dismiss it: "While the optionality provided by alternative delivery points is considered valuable, quantification of this advantage is not examined within the scope of this study."[88] This rejection is prompted by two factors: the 2003 imported prices of pipeline natural into Europe as reported by the International Energy Agency and additional transportation costs. "With additional transportation [required], it is hypothesised the delivery of Arctic gas to European markets would not be competitive with the sources of gas currently serving those markets."[89] The authors of this contribution beg to differ on both counts.

With regards to the price of pipeline gas into the EU, current reported prices are approximately USD370 per thousand m^3. This translates into prices of USD10.53 (CAD13.38) per thousand cubic feet. Furthermore, the prices quoted are border prices. As is well known, transmission costs in the EU are high relative to costs elsewhere, for example, North America. Arctic LNG can be sold directly to coastal urban centres thereby saving on the costs of transmitting pipeline gas from the edges of the EU market.

Regarding the cost of additional transportation, it is curious that Chan et al. consider the major American LNG ports—Everett, Massachusetts; Cover Point, Maryland; Elba Island, Georgia; and Lake Charles, Louisiana—but eschew these for a non-existing terminal in Nova Scotia. Similarly, they downplay the possibilities of European markets, even though European terminals may be more proximate to Melville Island than the US terminals (see Table 9.2).[90] Adding one LNG carrier to the two conventional LNG carriers operating out of Godhavn expands the range of possible markets to be supplied to those within a radius of 3,496 nautical miles (6,992 nautical miles return).

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[88] Chan et al., n. 35 above, p. 16.

[89] Id.

[90] "Regasification facilities in Nova Scotia are assumed to be developed by third parties. The four existing terminals in the US at Everett, MA, Cover Point, MD, Elbas Island, GA, and Lake Charles, LA, are unlikely to accept regular shipments from Canada's North since they are already fully contracted for periods of up to 20 years," Chan et al., n. 35 above, p. 23. The Repsol receiving terminal at Saint John, New Brunswick, to the degree that it has spare capacity, would be a substitute for the Strait of Canso. Utilising this terminal might add two to three days to LNG carrier round trips.

This radius would include the terminals at Milford Haven and Le Havre. The additional LNG carrier increases the capital expenditure of the project by 3.5 percent and operational costs by 6.5 percent. To determine the differences which these costs make in terms of the return on the over-all project, the authors conducted a simplified sensitivity study. Taking capital investment, operational costs, and throughput of the two variations and calculating the price which would return 15 percent on the capital invested (ignoring royalties, taxation, depreciation, and financing costs), we calculated the impact of the transport differential between Le Havre and the Strait of Canso. Deliveries to the Strait of Canso would cost USD119 per ton LNG or USD3.27 per Mcf (USD115.60 per thousand m^3) while deliveries to Le Havre would run USD129.22 per ton LNG or USD3.54 per Mcf (USD139.22 per thousand m^3).[91] The transport differential between existing facilities at Le Havre and non-existent facilities in the Strait of Canso calculated in this manner is USD0.265 per Mcf. While others might disagree, we feel that this is not a terribly significant differential given the price at which LNG is now trading on world markets.

The disappearing polar ice may make further economies possible. For example, one might be able to reduce the number of Arctic Class 7 LNG carriers required to four. With such an adjustment, the price of delivery to EU markets would be even lower than in the arguments presented here. Finally, it may not be necessary to invest in LNG carrier capacity as bare boat charters of LNG carriers are reportedly on the rise.

This analysis does not in any way attempt to minimise the risk of engaging in the Melville Island project or argue that European firms should be lining up to invest in the Melville Island project. Rather it is intended to point out that there could well be a future for the European natural gas industry in the Canadian Arctic, in even as remote a place as Melville Island.

[91] We are assuming an exchange rate of CAD1 = USD 0.75. Delivered amounts are respectively 6,138,000 tons LNG per annum (Strait of Canso) versus 6,006,000 tons LNG per annum (Le Havre) due to LNG boil off during transport. These figures appear to be very low because taxation, financing costs, royalties, and depreciation are not taken into account and the figures are in USD rather than CAD. Changing these assumptions could very easily double our figures, which would approximate those in the Chan et al. sensitivity analysis replicated in Table 9.7.