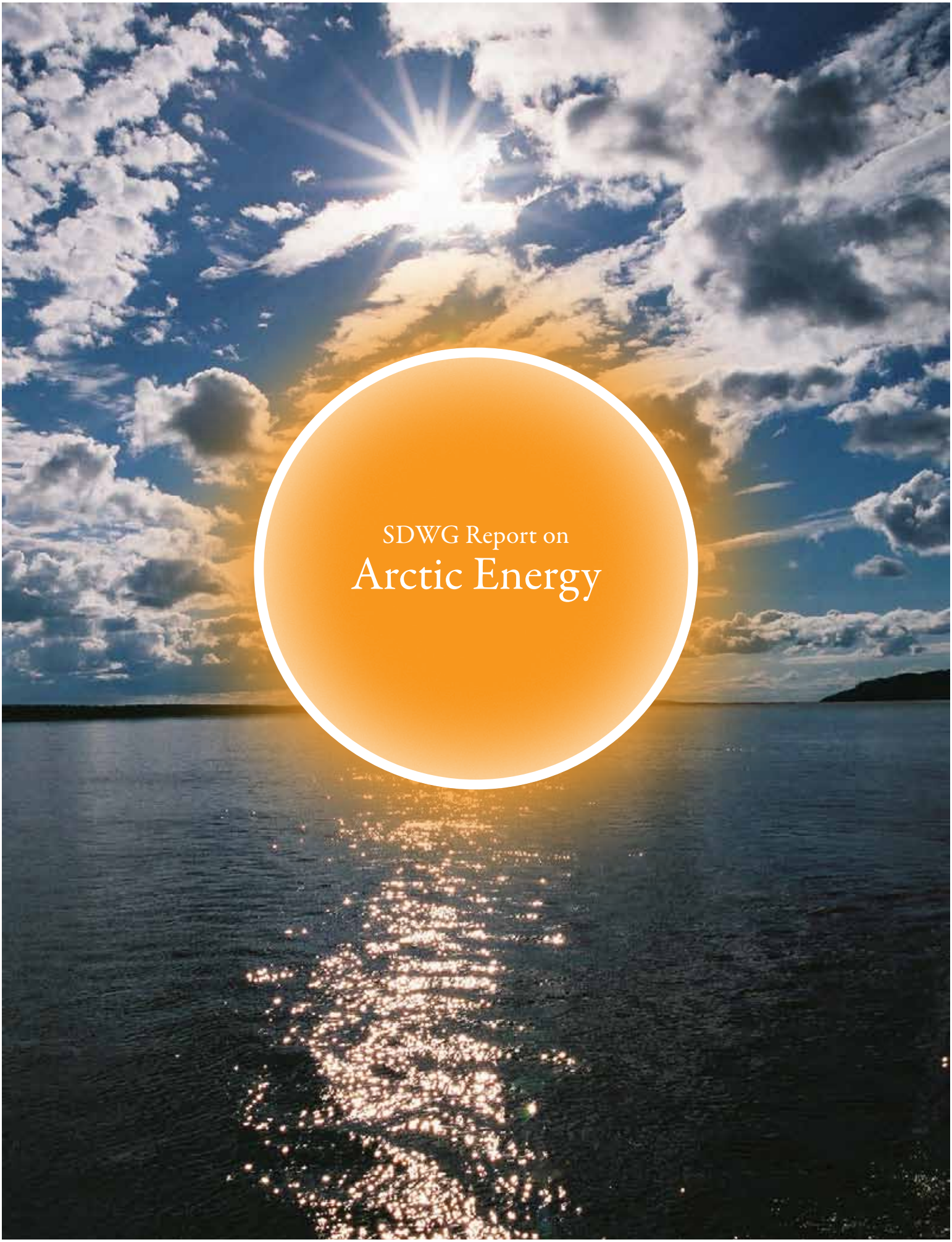
SDWG REPORT ON

Arctic Energy

Arctic Council

Sustainable Development

Working Group



SDWG Report on

Arctic Energy

Table of Contents

Executive Summary




The Arctic Council Ministers requested in their Salekhard Declaration (2006) the following:

Welcome the increased co-operation in the field of energy, reflected in various AC projects, and endorse energy, including renewable energy and environmentally friendly technologies, as an important component of the AC cooperation, addressing energy issues and their impact on human life and the environment, and request the SDWG to report on this activity to the AC Ministerial session in 2008, and to identify activities that the Arctic Council could consider for future implementation.

Based on the mandate given by Ministers, the SDWG has prepared this report to:

- Identify some emerging Arctic energy issues;
- Reference completed Arctic Council projects and activities relating to energy;
- Provide some background information on energy sectors in an Arctic context; and
- Identify some possible areas for cooperation in the field of Arctic energy.

The Report examines some emerging trends and issues under the main headings:

- Energy and the Arctic
- Arctic Energy and Global Issues
- The Arctic as Emerging Energy Province
- Arctic Energy, Arctic States and the Arctic Council
- Arctic Energy and Arctic Communities
- Conclusions & Potential Activities for Future Implementation

This report is not intended as a comprehensive assessment of Arctic energy resources, nor of the impacts of Arctic energy development on the natural and human environments in the circumpolar region. Rather, it is intended as an overview report on the Council's cooperation in the field of Arctic energy so as to allow Arctic Council Ministers to take stock of past activities and to make some strategic decisions about future cooperative activities. In this sense, the report is an overview of the broad subject of cooperation on Arctic energy issues.

By its nature, the subject of energy in the context of the Arctic has many facets and embraces a wide range of complex technical and political issues. It must be said at the outset that these issues have already been the subject of considerable research and cooperative activity within the Council. The Arctic Council has more than a decade of experience bringing together a broad network of scientists, policy makers, indigenous peoples' organizations, and other Arctic residents and stakeholders to expand the knowledge base in respect of the Arctic and to cooperate on issues of common interest. (It is noteworthy that, to date, the involvement of the energy industry in these deliberations has been somewhat limited and could be enhanced in future Council activities in the field of energy.)

Throughout, reference is made to numerous other reports and assessments prepared by other working groups of the Arctic Council. The reader is encouraged to refer to these documents for detailed examination of issues that can only be dealt with in cursory fashion in this report.

The Report notes in particular that greater attention needs to be given to the Arctic as an energy consumer in order to foster sustainable development and to meet the challenges facing communities in many parts of the Arctic.

I. Introduction: Energy and the Arctic

Energy is critical to civilization. The search for energy resources and the development and delivery of energy resources to communities across the planet has been a perrenial preoccupation since the earliest days of organized societies.

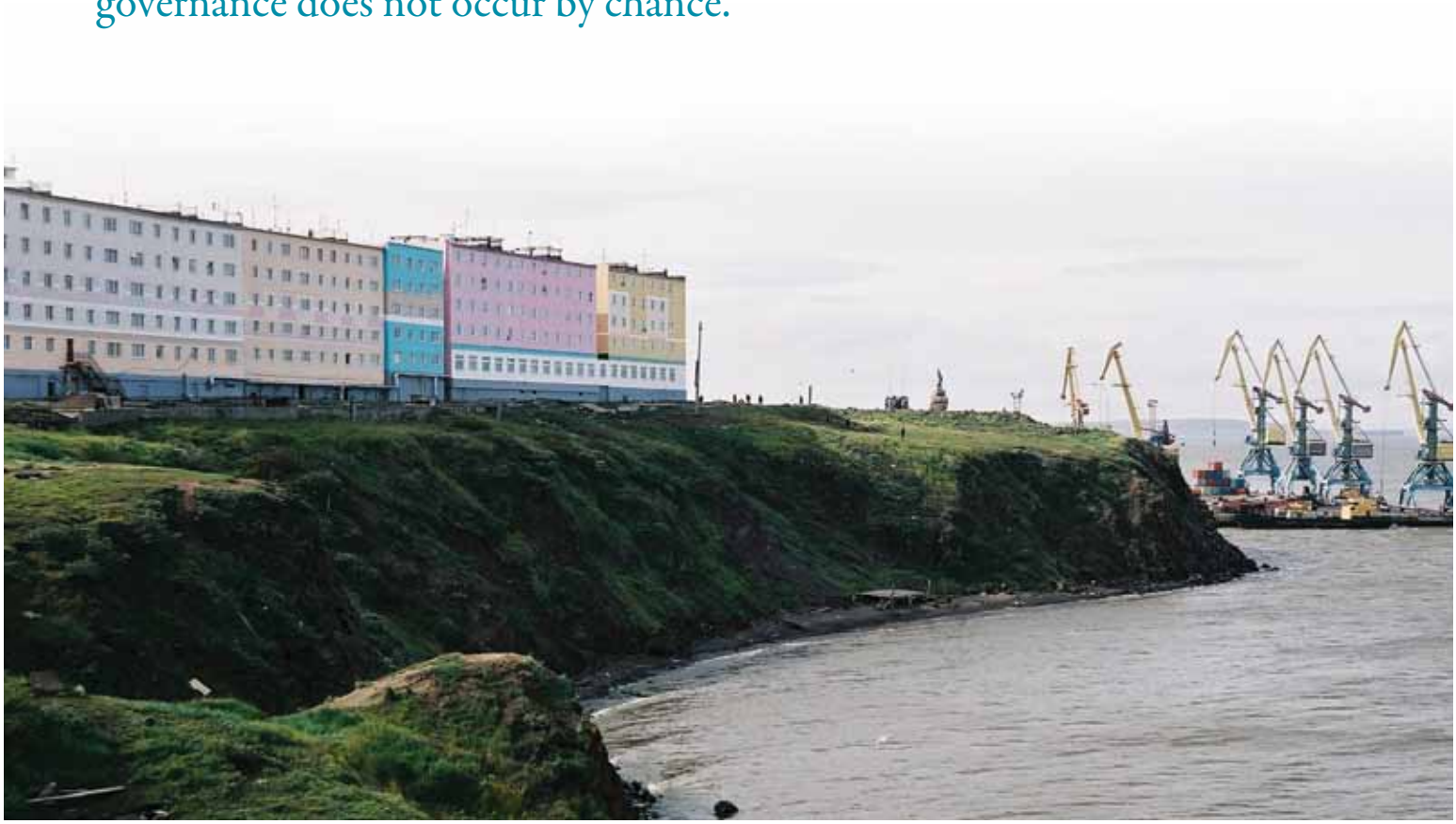
Arctic populations in particular face energy challenges given the climatic extremes created by long periods of cold and darkness in their often remote communities. Access to energy is a prerequisite for the existence and development of Arctic communities and societies. To sustain people and their livelihoods in Arctic regions, energy resources are essential for basic heat, power, light and transportation, as well as for a myriad of other purposes.

In coming years the pressures to develop Arctic energy resources are expected to increase in the Arctic states. Unfortunately, the phrase "Arctic energy resources" is often equated only with Arctic oil and gas. While Arctic petroleum hydrocarbons are currently the overwhelming focus for development, a broader spectrum of renewable energy resources requires examination in the context of the Arctic. In this report the phrase "Arctic energy resources" is intended to include renewable energy options.

Arctic energy provides a compelling theme around which to focus many issues that have already received some attention by the Arctic Council. Since 1996, the Council has operated as a high-level forum for Arctic cooperation. This forum is intended to provide a means for promoting cooperation, coordination and interaction among the Arctic States, with the involvement of the Arctic's indigenous communities and other Arctic inhabitants on common Arctic issues, in particular issues of environmental protection and sustainable development in the Arctic.

Many important political, economic, social, environmental and technological questions underlie development of Arctic energy resources. This paper does not attempt to answer all these questions. Instead it provides an overview of emerging issues and trends, references some past Arctic Council cooperative activities relating to Arctic energy, and explores opportunities to reinvigorate efforts to cooperate and colloborate on common interests in the field of Arctic energy, including sharing information and coordinating development of alternative energy technologies. This focus on the need for cooperation and good governace in the Arctic is important. As the recent Arctic Council oil and gas assessment points out "effective governance does not occur by chance". [1]

As the recent Arctic Council oil and gas assessment points out "effective governance does not occur by chance."



II. Arctic Energy and Global Issues

"The world's energy system is at a crossroads. Current global trends in energy supply and consumption are patently unsustainable — environmentally, economically, socially. But that can — and must — be altered; there's still time to change the road we're on. It is not an exaggeration to claim that the future of human prosperity depends on how successfully we tackle the two central energy challenges facing us today: securing the supply of reliable and affordable energy; and effecting a rapid transformation to a low-carbon, efficient and environmentally benign system of energy supply. What is needed is nothing short of an energy revolution." [2]

The Accessible Arctic

In modern times energy has been a critical feature of the geopolitical dynamics between and among states. As states become increasingly reliant on energy supplies to fuel their economies and maintain or improve the quality of life of their citizens, a broad range of foreign policy decisions, while not primarily based on energy considerations, must take energy issues into account. Arctic states are no different and will continue to vigorously assert their sovereignty against real or perceived incursions as accessibility to the Arctic and its resources increases.

The Arctic, for so long perceived to be on the periphery of main stream events nationally and internationally, is no longer in this position. The blurring of the line between the far north and the rest of the planet is a critical development that carries with it a range of important new considerations that mark this transition to a main stream issue. The perception of an accessible Arctic has certainly put the region firmly on the global geopolitical agenda. The potential for rapid economic development in the Arctic as a result of high world prices for energy and minerals, and easier access to resources as a result of climate change, raises numerous questions relating to environmental, social, and cultural impacts of development in an ecologically fragile and culturally vulnerable region.

The Search for Conventional Oil and Gas Resources

Since the Middle East Oil Embargo of the 1970s, nations around the world have been taking steps to ensure that they can better manage or absorb the impacts of a dramatic and prolonged reduction in supply or an unexpected increase in the price of energy,

particularly oil. It is likely that oil will continue to be the dominant factor in the global energy picture for the foreseeable future:

> *Oil is the world's vital source of energy and will remain so for many years to come, even under the most optimistic of assumptions about the pace of development and deployment of alternative technology. But the sources of oil to meet rising demand, the cost of producing it and the prices that consumers will need to pay for it are extremely uncertain, perhaps more than ever. The surge in prices in recent years culminating in the price spike of 2008, coupled with much greater short-term price volatility, have highlighted just how sensitive prices are to short-term market imbalances. They have also alerted people to the ultimately finite nature of oil (and natural gas) resources. In fact, the immediate risk to supply is not one of a lack of global resources, but rather a lack of investment where it is needed. Upstream investment has been rising rapidly in nominal terms, but much of the increase is due to surging costs and the need to combat rising decline rates — especially in higher-cost provinces outside of OPEC. Today, most capital goes to exploring for and developing high-cost reserves, partly because of limitations on international oil company access to the cheapest resources. Expanding production in the lowest-cost countries will be central to meeting the world's needs at reasonable cost in the face of dwindling resources in most parts of the world and accelerating decline rates everywhere.*
>
> *Just over half of projected global energy investment in 2007-2030 goes simply to maintain the current level of supply capacity: much of the world's current infrastructure for supplying oil, gas, coal and electricity will need to be replaced by 2030.* [3]

Some nations are more dependent on imported oil and gas because of their geographic size, economic structure, location or climate. Some Arctic states have been reasonably successful in implementing conservation programs, introducing new energy-efficient technologies and locating alternate sources of supply. However, increases in the price of conventional oil and gas, driven in part by reduced inventories and escalation in demand in rapidly-developing economies in Asia, have begun to fuel interest in Arctic oil and gas resources as a means to manage or absorb such demand pressures.

According to the International Energy Agency (IEA), world primary energy demand will increase by 45% in the period 2006-2030.[4] In their 2008 reference scenario, fossil fuels will account for 80% of the world's primary energy mix in 2030, with oil being the dominant fuel. The demand for coal is anticipated to rise more than the demand for any other fuel in absolute terms. The share of the world's energy consumed in cities is anticipated to grow from two-thirds to almost three-quarters in 2030.[5]

To date, petroleum production in the Arctic has mainly taken place in Alaska and Northern Russia, although Canada and Norway have some production from the far north and potential is being explored in Iceland and Greenland (see Figure 2). Around 97% of current total Arctic oil and gas production is from onshore developments in Russia and Alaska.[6] However, exploration and production in Arctic offshore regions is expected to increase. For example, in the Norwegian sector of the Barents Sea, the Snøhvit gas field is now in production having been developed by Norway drawing upon its extensive record of achievement in offshore energy development in non-Arctic areas of the Norwegian continental shelf. On the Russian continental shelf in the Barents Sea, the Schtokmanovskoye discovery has estimated gas reserves of around 3200 billion cubic metres.[7] Other significant offshore gas discoveries have also been made in the Petchora Sea.

The Arctic shares of undiscovered oil and gas are estimated to be as high as 20.5% and 27.6% of the total global resources, respectively.[8] When total proven reserves and undiscovered oil resources are considered, the Arctic represents appproximately 13% of the world reserves. About 10% of the global oil production takes place in the Arctic today. Around 25% of total proven reserves and undiscovered gas resources are located in the Arctic. The current Arctic share of global gas production[9] is also around 25%. The words "undiscovered" and "unproven" are important in the

context of the Arctic: there can be little doubt that the search for new reserves of oil and gas will be a significant driver in Arctic affairs in coming years. Promising hydrocarbon areas have been described in several Arctic Council publications, most recently In the phase I and phase II ECONOR reports (SDWG) and in Arctic Oil and Gas 2007 (AMAP).[10]

Arctic Energy and the Search for Sustainable Alternatives

As of 2006, renewable energy sources accounted for only about 13% of the world's total primary energy supply, with the largest percentage coming from biomass.[11] While coal will continue globally as a major source of energy for generating electricity, the IEA forecasts that renewable technologies will grow rapidly in coming years, eventually overtaking gas as the second-largest source of electricity.[12] Wind, solar, geothermal, tide and wave energy are expected to grow fastest as renewable energy sources, primarily in the power sector. Nonetheless, the share of non-hydro renewables in total power generation is still only anticipated to be about 4% in 2030.[13]

Many alternative and renewable energy options are the subjects of development programs and research projects sponsored by the Arctic states and industry. The possibilities include large and small scale hydroelectric power, geothermal energy, nuclear power, clean coal, solar power and photovoltaics, offshore and onshore wind energy, tidal and wave power, biomass and biogas, gas hydrates, hydrogen fuels and so on. Efforts to improve technologies, for example in relation to battery storage systems, are ongoing. However, some of these energy options have yet to be thoroughly explored in an Arctic context; nor have they been subjects of extensive Arctic Council cooperation.

In addition to new sources of conventional resources, or development of alternative resources, Arctic energy strategies must also consider reduced consumption, efficiency measures, new technologies, heat recovery, carbon capture and storage, and emissions trading systems.

In order to increase energy security while reducing energy demand, air pollution and anthropogenic greenhouse gas emissions, financial incentives, new regulatory frameworks and policy support will be required to increase the use of renewable energy sources and the development of related environmental technologies. In the context of Arctic communities in some parts of the circumpolar region, transportation and electrical power generation are highly dependent on fossil fuel consumption. Unfortunately, high conventional oil prices can encourage use of some alternatives energy sources which are even more carbon-intensive. Efficiency measures and increased used of alternative biofuels in transportation are under consideration in some Arctic States, as is "decarbonisation" of electricity generation for industrial, commercial, government and domestic buildings.

The Demand for Other Arctic Resources

While it is likely that the northern circumpolar region will play an increasingly important role in the global energy picture, potentially as a producer of energy resources such as oil and gas, the region is also attracting attention in respect of other renewable and non-renewable resources, including fresh water.

Forests cover 30% of the world's land area and the boreal forests of the Arctic cover about 17% of the global land area.[14] These Arctic forests represent the largest natural forests in the world. Most of the boreal forests are uncultivated due to remoteness and lack of

infrastructure.[15] Data on fishing and aquaculture for the four large Arctic marine ecosystems[16] reveal that in 2002 the total catch of wild fish in the Arctic amounted to 7.26 million tonnes, or 10% of the world catch of fish.

Approximately 3.2% of the world's gold production comes from the Arctic, primarily from Arctic Russia and to some extent from Alaska and Northern Canada. A small amount of production also takes place in Northern Finland and Sweden.[17] Arctic Russia produces 21 and 23 per cent of global gem-quality diamonds and industrial diamonds, respectively,[18] while almost 15% of world production of gem-quality diamonds is now being extracted from northern Canada.

Large, population-rich developing countries have experienced rapid economic growth in recent years,[19] adding to the existing demands in industrialized nations. The rising demand for raw materials is creating interest even in remote areas, such as the Arctic. The Arctic is endowed with petroleum, minerals, fish and forests that increasingly attract the interest and mobilize the purchasing power of these emerging economies. The Arctic is also of interest to many industrialized countries trying to find secure supplies of natural resources.[20] Development of Arctic resources will be energy-intensive, not only because of the Arctic conditions under which mines, fisheries and other activities must operate, but also because of the remoteness of such sites from markets. Transportation infrastructure is underdeveloped in the Arctic region. On another level, however, new marine shipping routes through Arctic seas could become more attractive for a global transportation network that has come under pressure from increasing costs of fuels. Some of these routes are considerably shorter than existing routes for transporting manufactured goods.[21]

Ten Perspectives on Nordic Energy

(2006, offprint, ISBN 91-631-9275-6, p. 44)
(see: www.nordicenergyperspectives.org)

The present introduction of new policy instruments has led to a number of unexpected and negative consequences. The electricity prices have increased substantially due to the unexpected high CO2 price in the EU ETS, existing taxes acquire a new role when new, market-based policy instruments are implemented in parallel and the electricity certificate system (in Sweden) still show uncertainties, e.g. concerning the price formation. When the decisions to introduce these new policy instruments were made, there was little debate regarding the negative consequences and the uncertainties of their effects.

Another example is the combined effect of a number of policy instruments which have made biofuels very competitive for energy production in Sweden. The result is a high price for biomass. This use of biomass in energy production is therefore to an increasing degree competing with the use of biomass for pulp production, which could lead to a general increase in timber prices. This is a problem for the pulp and paper industry, since they operate on an international market.

The increasing number of parallel policy instruments is also a problem in itself, since their combined consequences are difficult to foresee for policy makers and market participants alike. A recommendation may therefore be to analyze the effect of new policy instruments and the combination of policy instruments more carefully before drastic changes are implemented. – Policy or market, national versus international: constant balancing?

It is a truism to state that the energy policy is dynamic. It is constantly changing, both when it comes to the political agenda and challenges, and when it comes to the implementation of different policy instruments. It is important to realise that these changes to a large extent are consequences of the dynamic development of the society as a whole, i.e. the framework conditions of the energy system and not in the policies as such. Our simple picture of the dynamics of energy policy illustrates this.

Due to the dynamic nature of society and politics, and the complexity of energy systems and their importance for society and the environment, the energy branch must be prepared to live in a less than perfectly stable political framework even in the future. Somewhat more stability and a more long-term perspective on energy policies is however desirable.

Climate Change and Other Environmental Issues

While the global profile of the Arctic as an emerging energy province has been raised considerably in recent years, it does not compare to the overwhelming attention the Arctic receives from an environmental perspective .[22] In less than a decade, all dimensions of the Arctic environment, including its flora and fauna, oceans, rivers, snow, ice, glaciers and permafrost have become the focus of intense scrutiny to determine the impacts of climate change. Not to be overlooked in this context is the human dimension of the Arctic which is discussed more fully in Part V of this report.

Climate change is defining many issues in the Arctic. Indeed, the designation of the Arctic as an energy province is based upon a number of assumptions about the pace of climate change in the northern circumpolar region and about the availability of technology required to develop and deliver Arctic energy resources, in particular oil and gas, to markets under these emerging climatic conditions (see Part III of this report).

This creates a real challenge for policy-makers and decision-makers who are called upon to balance the various socio-economic and environmental risks and benefits. Development of Arctic resources is now, more than ever, being scrutinized through the climate change lens, frequently being portrayed as activity which will further contribute to, or initiate, climate-change-related impacts on the Arctic environment.

Notwithstanding work conducted to date, actual and projected changes in the Arctic, particularly in the marine environment, are raising important questions about the adequacy of circumpolar and international arrangements to regulate and manage the development of natural resources and to protect and conserve the natural environment. High profile issues, like the impact of climate change on Arctic access, delineating Arctic offshore boundaries and global pressures for access to energy resources, are receiving extensive and ongoing coverage in deliberations about the development of Arctic energy.

Concerns about the potential for marine traffic accidents in the Arctic often relate to the limited infrastructure available for high Arctic navigation and the lack of capacity to respond in a timely fashion in the event of an accident. To successfully explore for and develop Arctic energy resources, governments and industry will need to make significant expenditures to deploy the best engineering and technologies available to operate in the region. Much of the special technology required to develop the region's energy resources continues to be tested and refined as sea ice and permafrost conditions change. In addition, there is increasing activity by state-owned and private sector corporations seeking out energy-related opportunities in the Arctic. International political and market dynamics are likely to play a significant role in the development of Arctic energy resources, particularly "mobile" resources such as oil and gas.

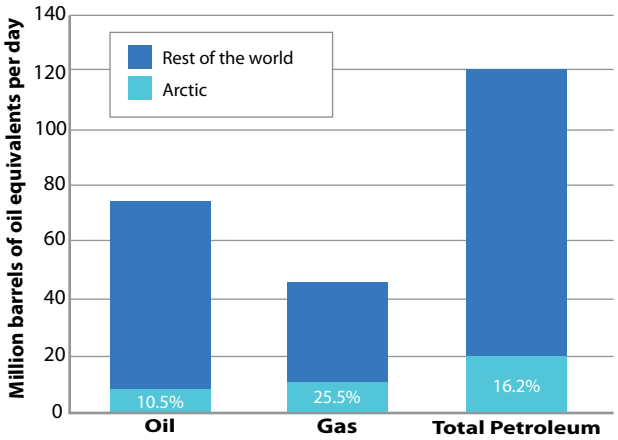


Figure 1: Arctic share of global petroleum production, 2002.
[source: AHDR 2004, p.27]

Summary

Cooperation among the Arctic states is now the norm through numerous bilateral initiatives and multilateral initiatives such as the Arctic Council. The foreign policy dimensions of energy are a complex field and there is no reason to think that energy developments in the Arctic will be immune from these issues. Relationships between state-owned and operated energy firms and private sector firms in the Arctic will be an important dimension of investment in Arctic energy developments. Events in the Arctic and elsewhere can have a bearing on cooperative relationships that have developed in the context of the Arctic Council and therefore every effort will be required to maintain and enhance the levels of cooperation which have already produced such an impressive legacy within the Council.

Cooperation among the Arctic states is now the norm through numerous bilateral initiatives and multilateral initiatives such as the Arctic Council.

III. The Arctic as Emerging Energy Province

Emerging Energy Province

The designation of the Arctic as an "emerging energy province" represents a significant departure from the past when relatively little attention was paid to potential Arctic energy resources generally; the costs of developing and transporting Arctic oil and gas to markets were prohibitively high; and much more affordable and accessible oil and gas were available from other sources.

However, as the Council's Arctic oil and gas assessment shows, interest in Arctic energy is not really "new". There is a long history of energy exploration and production in Arctic and sub-Arctic regions over the past 100 years and in some cases, even longer.[23] The potential of other Arctic energy resources, whether uranium, geothermal energy, coal, gas hydrates, wind power, solar energy, tidal power or others, have been studied significantly less by the Arctic Council, although interest in these alternative sources of energy is increasing.

The entire Arctic region will not be an energy province,[24] but those Arctic areas that have such potential will play a critical role in the strategies which Arctic and non-Arctic states must develop to address issues relating to energy security and climate change in the 21st century and beyond [see Fig. 2].

Arctic Council reports have used a range of definitions to delimit the Arctic region.[25] The land territories encircling the Arctic basin belong to the eight Arctic states.[26] Sweden and Finland do not have coastlines on the Arctic Ocean. The Arctic Ocean dominates the centre of the region but is the smallest of the world's five oceans. It covers an area of approximately 14 million square kilometres, or about 1.5 times the size of the USA, with a maximum depth of 5,500 metres (18,040 feet). The Arctic Ocean has the widest continental shelf of all the oceans. The shelf is wide and shallow off Europe and Asia, all the way from the Barents Sea in the west to the Bering Strait. In some areas of the Arctic the continental shelf extends a significant distance towards the North Pole. Extensive mapping activities are ongoing in Arctic offshore areas. Currently, there is only a sparse network of air, ocean, river, and land routes circumscribing the Arctic Ocean. To expand this network will require considerable infrastructure investment.

Geographers have ongoing debates about where to draw the dividing line between the Arctic and non-Arctic; however, the Arctic is not a closed system. What happens in the Arctic does not stay in the Arctic, and vice versa. The Arctic is oftern referred to as a barometer that is highly responsive to other global processes. Quite simply, the solutions to some Arctic problems cannot be implemented by actions in the Arctic. On the other hand, non-Arctic regions may be unable to address some of their pressing problems without giving due attention to the Arctic. A variety of interests are already looking northward to determine the Arctic's potential in relation to fisheries, energy resources, minerals and fresh water.

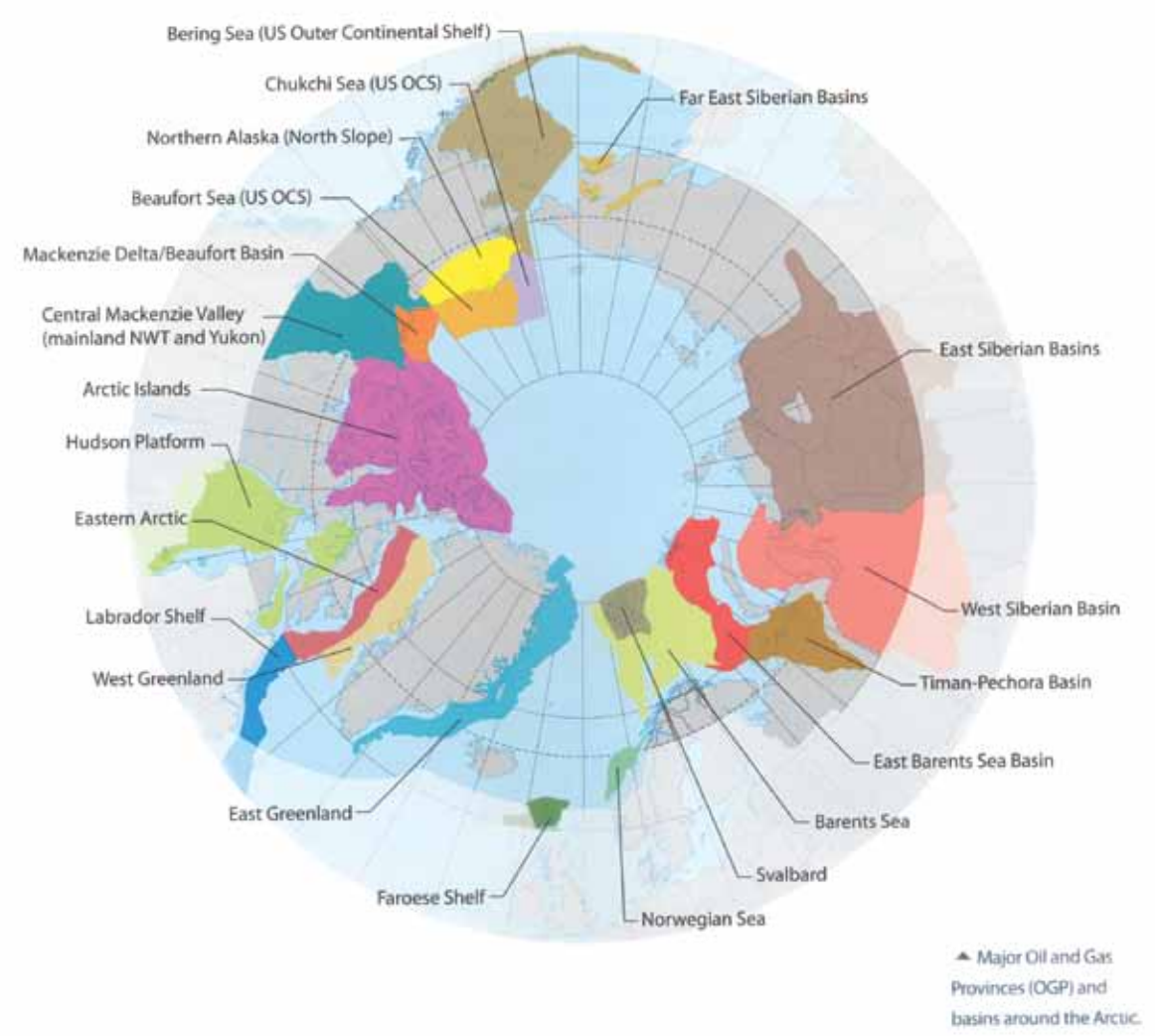


Figure 2: Major Oil and Gas Provinces and Basins around the Arctic *[Source: AMAP. Arctic Oil and Gas 2007, p.5]*

Arctic Energy Resources

As noted above, there is a tendency to equate the phrase "Arctic energy resources" with the phrase "Arctic oil and gas". This report refers to energy resources in their broadest sense. Some energy needs are site specific or relatively stationary (e.g. lighting and power for Arctic households) while other energy needs require resources that are highly mobile (e.g. vehicles for land, water and air transporation). In all cases infrastructure for exploiting, storing, delivering or transmission of renewable and non-renewable Arctic energy resources is a central issue, whether the energy is used in local communities or exported outside the circumpolar region to national or international markets.

Although economic, political, social, environmental and technical issues relating to Arctic energy are complex, the fault lines along which many issues fall appear to be relatively simple. At a basic level, energy issues can be divided geographically in terms of onshore and offshore/marine areas. While these designations are by no means exclusive, they may be helpful when considering future Arctic Council cooperative activities. There are no serious questions about jurisdiction over onshore energy resources, notwithstanding any stakeholder concerns regarding any specific energy policies in respect of these areas. Some Arctic onshore energy issues will therefore be confined primarily to domestic national or local agendas, while others have broader significance for regional or global economies and environments.

However, where offshore resources are concerned, there are some notable issues relating to territorial and sovereign rights which have been the subject of recent discussions and publications. The United Nations Convention on the Law of Sea (UNCLOS) has been ratified by most Arctic states with coastal regions, the exception being the United States of America. This Convention provides a rules-based framework for exercising sovereign rights in respect of natural resources out to the edges of the continental margins, potentially leaving only a relatively small "donut hole" of international waters in the Arctic Ocean.

The Ilulissat Declaration adopted by the Ministers of Foreign Affairs of five Arctic states[27] on May 28th, 2008 acknowledges pressing issues to address in the Arctic offshore region. Existing national and international legal frameworks already cover large parts of the Arctic region and address a range of issues. Thus, the declaration states that:

> *The Arctic Ocean stands at the threshold of significant changes. Climate change and the melting of ice have a potential impact on vulnerable ecosystems, the livelihoods of local inhabitants and indigenous communities, and the potential exploitation of natural resources.*
>
> *By virtue of their sovereignty, sovereign rights and jurisdiction in large areas of the Arctic Ocean the five coastal states are in a unique position to address these possibilities and challenges. In this regard, we recall that an extensive international legal framework applies to the Arctic Ocean as discussed between our representatives at the meeting in Oslo on 15 and 16 October 2007 at the level of senior officials. Notably, the law of the sea provides for important rights and obligations concerning the delineation of the outer limits of the continental shelf, the protection of the marine environment, including ice-covered areas, freedom of navigation, marine scientific research, and other uses of the sea. We remain committed to this legal framework and to the orderly settlement of any possible overlapping claims.*

During the past decade in particular, there has been a dramatic change in how Arctic and non-Arctic nations perceive the circumpolar North, its importance to global systems and the development of its resource base. There is a strong perception that important new trends and developments are creating new opportunities and challenges for Arctic states and other stakeholders in relation to Arctic energy.[28]

Arctic states have recognized the dramatic shift in interest in the Arctic and have begun to consider ways to improve regulatory and management frameworks to contribute to the sustainable development of the region.[29] Arctic states are now faced with a broad range of issues, many of which require more meaningful cooperation and collaboration between and among neighbours, as well as full engagement of Arctic residents.

As noted above, some Arctic energy resources have actually been commercially exploited in some Arctic areas for at least the past century and have been used by Arctic local populations for millenia. So while the search for energy in the circumpolar North is not new, the intensity and urgency of discussions on this issue seem to have increased markedly in the past few years. To date, the intensity of these discussions has not necessarily been matched by on-the-ground activities related to exploration for, and development of, high Arctic energy resources, particulary in Arctic offshore areas.[30] The actual ongoing and planned development in the Arctic offshore is quite limited in extent at present. The Arctic's designation as a new energy province is currently based more on projected potentials than on significant proven reserves of oil and natural gas and other energy resources. The willingness of the private sector or state-owned ventures to commit to significant exploration expenditures and other investments is dependent on a range of technical, economic, political and environmental factors.

A significant first step in relation to Arctic energy is the need to confirm the existence of commerically-feasible resources, for example oil and gas reserves, but at the same time to consider the energy options for local communities which are dependent on access to sustainable, affordable energy. Taking this step will require difficult political and investment decisions. Even with a relatively ice-free and accessible Arctic during summer months, there would not likely be much interest in exporting Arctic oil and gas resources if stable, conventional sources of oil and gas were in plentiful supply elsewhere at low costs. On the other hand, the energy needs of

local communities are immediate and ongoing. Without affordable energy, the sustainablility of some Arctic communities could be threatened.

Interest in Arctic energy ventures is also dependent on national and international political and economic circumstances, so some improvements in the price and security of supply may produce a partial reassessment of development plans for Arctic energy resources. For example, dramatic changes in the international economic environment in 2008 drove the price of oil to $147 USD per barrel and appeared to increase the interest in Arctic resources. By contrast, the subsequent "credit crunch" in the autumn of 2008 resulted in an equally dramatic drop of oil prices below $40 USD per barrel and may bring a cooling of interest in large-scale, high-risk investments in the Arctic.

Some large-scale efforts to exploit newly-accessible energy resources in the Arctic are underway. At the time of this report Norway has developed the Snøvit gas fields and Russia is proceeding with plans to develop the Shtokman gas fields in the Barents Sea, while Canada and the USA are considering major pipeline projects to tap onshore Arctic gas reserves. In other areas developments are still relatively speculative. Iceland and Greenland, for example, are exploring oil and gas potentials in their offshore areas. Similarly, while there are promising hydro-electric, nuclear, geothermal and coal resources in some locations in the Arctic, it appears that the timescales for development of most of these Arctic energy resources tend to be in the medium and longer term. These timescales give Arctic states opportunities for reflection and analysis to further develop policies and legislation so that decisions can be made within a rationale framework.

Summary

There are a number of questions the Arctic Council may wish to consider as it contemplates additional new cooperative activities in the field of Arctic energy. For example, what is "the Arctic" region for the purpose of discussing energy issues? Given the importance of energy security to all states within the global community, how should the Arctic region be integrated into national energy concerns and into the larger global energy picture? What differentiations should be made between cooperation on onshore and offshore resources in the Arctic region? The Council's Arctic oil and gas assessment describes almost a century of experience with exploration and development of petroleum hydrocarbons in the Arctic, so what is "new" or "emerging" about the Arctic energy file? What are the prospects for development of renewable energy sources in the Arctic? How should the Council balance consideration of the Arctic region as an energy supplier and the Arctic region as an energy consumer? Consideration of these and other questions may assist the Council in structuring future cooperative activities in relation to Arctic energy.

Given the importance of energy security to all states within the global community, how should the Arctic region be integrated into national energy concerns and into the larger global energy picture?

IV. Arctic Energy, Arctic States and the Arctic Council



Arctic communities and settlements are largely based on the use of natural resources. Traditionally, these activities included hunting, gathering, fishing and reindeer herding. However, the importance of the non-renewable resources in the Arctic is growing. Together with the fisheries, the exploitation of minerals and fossil fuels is now the main basis for some regional economies. This growing economic activity offers significant opportunities for Arctic states and Arctic communities, but also involves challenges, particularly in the field of environmental protection. New economic activities, for example in relation to Arctic oil and gas, may provide an important basis for welfare and economic growth, but it is equally important that resource utilization is planned and carried out in a sustainable manner in order to facilitate coexistence of activities in different sectors. Such activities must be carried out in accordance with environmental and safety standards and should be to the benefit of Arctic societies. [31]

Arctic energy is likely to be a critical component for improving and maintaining the quality of life in Arctic states and for reducing reliance on expensive energy imports from politically unstable suppliers. The primary energy resources exploited in the Arctic have been hydroelectric power, oil and gas, and coal. To a lesser extent uranium and other fissile materials have also been mined. Biomass, solar and wind power have been used on a small scale in some areas mainly to supplement local users, while geothermal energy has been successfully utilized in Iceland, Russia and Alaska at various scales. For Arctic states and energy industries operating in the Arctic, the unsettling economic and political effects of high-cost energy world wide will have a bearing on how they will respond with initiatives to develop the Arctic's energy resources.

Regulation and Management of Arctic Energy Developments

Energy is an important factor in economic and social stability because in the modern world most activities consume energy. Consideration of this relationship is critically important to economic and environmental regulatory systems and policy development. Greenhouse gas emissions can be reduced by energy efficiency measures, a transition to less carbon-intensive fuels, and elimination of polluting industrial processes. Regulatory caps on emissions, emission trading systems and carbon taxes are included in the range of policy measures aimed at meeting environmental objectives. However, alternative energy sources and new carbon capture and storage technologies are in the early stages of development in many cases. Investments in these technologies will need to be accelerated. Policies can encourage investment and create demand for new technologies that are more "environmentally-friendly" or carbon-efficient. However, it will be necessary to monitor the effects of such initiatives because new policy instruments can lead to unexpected and negative consequences [see sidebar p.9].[32]

Some of the trends and issues among consumers and other stakeholders identified below are factors in decision-making relating to development of Arctic energy resources and accordingly will have to be taken into account by Arctic states and industry. It is highly unlikely that any Arctic state could adopt a complete "hands off" approach to the Arctic.[33] Therefore there needs to be a reasoned response to the increasing support for a development-free Arctic, as well as every effort to take into account suggestions for

Policies can encourage investment and create demand for new technologies that are more "environmentally-friendly" or carbon-efficient.

alternative approaches to energy issues.[34] Many of the solutions to Arctic environmental issues actually will lie outside the Arctic and this will need to be taken into account in formulating any energy-related strategies for the Arctic. This reality also emphasizes the need for cooperative measures outside the Arctic which have as their objective the reduction of Arctic impacts caused by non-Arctic activities.

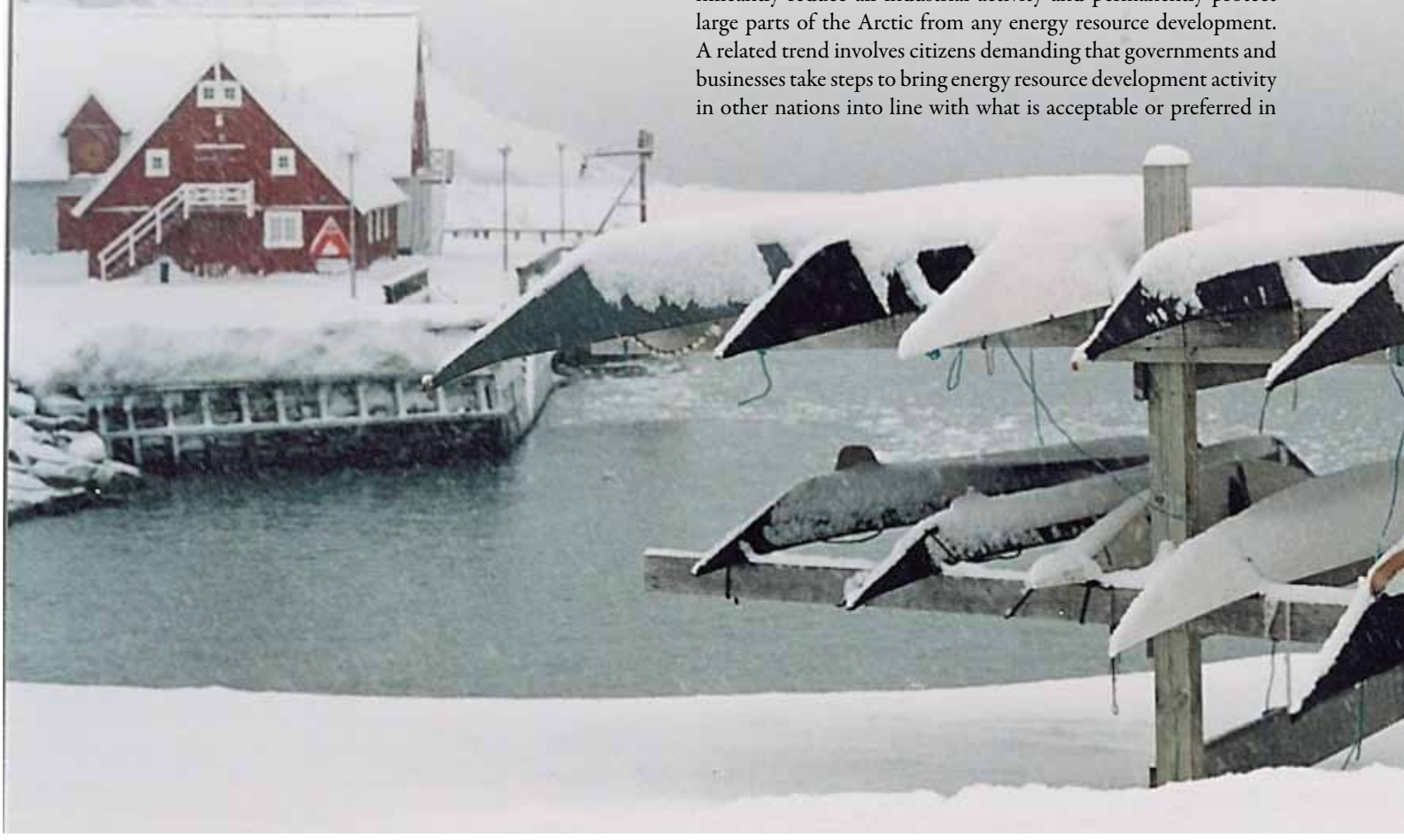
An unfortunate and inaccurate trend in some media reports has been to portray Arctic resource developments as poorly regulated or not regulated at all from socio-economic or environment impact perspectives. Recently there has also been an outpouring of ideas and proposals aimed at reforming existing governance systems to address Arctic governance issues, including in relation to energy resources. These include suggestions from various official and stakeholder interests within Arctic states, as well as from non-Arctic states, scientists, political commentators, and representatives of nongovernmental organizations, some of whom warn of competition and conflict for access to the Arctic's natural resources.

The tone of some of this commentary on Arctic governance leaves the impression that Arctic states and industry are not paying sufficient attention to the Arctic environment when making resource development decisions. However, in most Arctic states there is an extensive history in the Arctic of regulating energy resource development. In most cases developments are subject to strict regulatory conditions. Therefore, efforts are required to demonstrate that Arctic energy developments are being effectively regulated and that Arctic states are taking steps to respond through regulation to changing environmental circumstances. Cooperation between Arctic states and industry to meet environmental protection and socio-economic objectives in the Arctic could also be better communicated.

Stakeholders

Some Arctic and non-Arctic consumers and stakeholders have become increasingly vocal about the real or perceived consequences of Arctic energy resource development activities, both renewable and non–renewable. For example, there is often opposition to oil and gas development activity which disrupts the traditional land-based livelihoods and culture of indigenous peoples. Coal attracts considerable opposition as a fuel. Opposition is also increasing to certain biofuels which convert agricultural production into energy. Activities associated with uranium mining and waste disposal for nuclear power face public relations challenges, as do large scale hydro-electric developments involving damming or diversion of existing river systems that might disrupt local or regional ecosystems. With the exception of agricultural production for biofuels, the Arctic contains many of these energy resources and activities to develop them will take place in the Arctic or "near north" areas bordering on the Arctic.

Some stakeholders have suggested that the only response to the increasing concerns about Arctic climate change, Arctic ecosystems and the potential impacts of energy development is to significantly reduce all industrial activity and permanently protect large parts of the Arctic from any energy resource development. A related trend involves citizens demanding that governments and businesses take steps to bring energy resource development activity in other nations into line with what is acceptable or preferred in



their home countries. For example, opposition to imports of "dirty oil" has become more common. Some utility companies have been encouraged not to purchase power from hydroelectric developments which will flood traditional lands of indigenous peoples.
A relevant factor affecting cooperation on energy issues is the political structures within each of the Arctic states. Political decision-making, legislative jurisdiction and regulatory processes in the three large federations, Canada, Russia and the Unitied States, can be quite different from the arrangements in unitary Arctic states.

In some Arctic states, there are legal requirements that will require participation of local, regional or indigenous peoples' authorities in matters relating to energy developments. Some decisions on energy resource developments can only be made with the active involvement of, and in some cases the consent of, local or regional governments or indigenous peoples' institutions. There are some sub–national governments which have jurisdiction over resource development decisions, which in the case of energy can have significant national and international implications. It is not uncommon for local and regional institutions with such jurisdiction over resource development to bargain for commitments from national governments and industry for infrastructure or other spending to support both resource development and their local and regional interests. They may also seek a share in taxation or royalty revenue flowing from energy resource developments.

In many cases, Arctic states and their industry partners institute measures which demonstrate a commitment to cooperation and involvement of local interests, to protecting the local Arctic environment, and to responding to larger global issues such as climate change. It will be necessary to articulate and demonstrate to stakeholders that Arctic energy resources, whether petroleum hydrocarbons, hydro-electric, nuclear, geothermal, coal or other large scale developments, have a necessary role to play in strategies to make a transition to sustainable development, not just in the Arctic but on a national and global scale.

Investment and Partnerships

The history of Arctic resource development demonstrates that partnerships between government and other stakeholders, in particular industry, have been common, while in other cases state-owned, controlled and financed corporations have received a monopoly, or near monopoly, over access to Arctic resources. In these partnerships each party performs a role which has been necessary to the development of resources. Equally important have been measures where governments provide infrastructure or financial considerations to reduce the risk for industry and to make investment more attractive.

These partnerships may create challenges for Arctic state governments which have to find a balance between acting as the managers of resources and the regulators of development, while potentially also having a role as active participants in exploration for, and production of, Arctic energy resources. Moreover, in reaching agreements on infrastructure and financial concessions, Arctic state governments must be aware of potential political perceptions created by such corporate support and concessions. Notwithstanding this type of political risk, the reality has been that operations in the Arctic have generally required cooperation and partnerships between Arctic governments and industry because of the high–cost, high–risk circumstances.

Investing in the Arctic is costly. Governments, industries, small businesses and private individuals want to make sure that they get their investments right the first time, using the best information and technologies to avoid costly mistakes. Where oil and gas are

concerned, the history of Arctic development reveals numerous ventures which sought, but failed, to demonstrate resource potential, even with significant government support. In cases where potential was determined, there was often a need for large-scale direct or indirect government involvement to bring production to market.

Investments will need to comply with an ever-increasing network of regulations, many of which are designed to protect the Arctic environment. Depending upon the nature and scale of the investment, most Arctic states have established elaborate processes which attempt to determine environmental impacts and how industry investors can best eliminate, mitigate, manage or remediate these impacts before licenses or permits to proceed with a development project are issued. The changing Arctic environmental conditions will require that Arctic states reformulate, and industries adapt to, new regulations.

Arctic nations, state-controlled corporations and private industry will have to take into account environmental, socio-economic and geopolitical factors in determining whether to invest in energy-related activities in offshore or onshore regions of the Arctic. If Arctic governments and major industry stakeholders with access to significant financial resources withdraw, or significantly reduce their investments in the Arctic, there may be few sub-national governments and small energy corporations with the capacity to take their place.

While operations in the Arctic will always carry some risks, understanding and effectively managing these risks is critical for Arctic states, Arctic residents and industry. There is considerable global competition for investment. It will be important, therefore, to demonstrate to all stakeholders that investments needed to develop Arctic energy are reasonably secure over the long term.

Infrastructure and Technology

Industry experience has shown that traditional technologies and expertise are not particularly well-suited to Arctic conditions. Considerable advances in technology have been made. However, some engineering, technological and information gaps will need to be addressed in relation to both renewable and non-renewable energy options. Arctic states and industry stakeholders will need to expand existing programs to begin closing these gaps and to demonstrate preparedness for the challenges which lie ahead. In some cases where appropriate technologies already exist, governments and industry still face a "communication gap" in convincing some stakeholders that the costs and risks of development are manageable. For example, while there are some successes and failures in relation to Arctic oil and gas technologies in onshore areas, offshore practices continue to face challenges in ice-covered marine areas, in particular in relation to cleanup operations in the event of an oil spill.

Arctic Cooperation

The popular image of a mysterious and unstudied Arctic is often reinforced by media reports. In fact, the Arctic has been studied systematically and comprehensively. This is not to suggest that all questions have been answered. However, while the image of the Arctic as a cold, dark, inhospitable enigma might have had some validity at the beginning of the 20th century, by the beginning of the 21st century the situation has changed, and is changing, dramatically.

It is important to stress that multi-lateral cooperative organizations such as the Arctic Council have generated a wealth of information about the Arctic. The International Polar Year will contribute an unprecedented amount of new data. Not only has the region been an object of study, over the past 50 years the Arctic has also been subjected to scientific, political and socio-economic experimentation and innovation. New forms of governance, locally, nationally and internationally, are being pioneered. New institutions for scientific cooperation and distance learning are in place. Novel approaches have been taken to understanding the human dimensions of the Arctic.

The Arctic Council is not new to the subject of Arctic energy. Energy issues fit into a larger matrix of issues relating to Arctic human development and the Arctic natural environment. While there are still important gaps in the Arctic knowledge base, extensive research has occurred in all dimensions of Arctic studies. A large body of information is found in Arctic Council publications[35] ranging from climate change and other environmental issues, to emerging socio-economic and governance issues. To date, the Council's working groups have focussed primarily on issues related to petroeum hydrocarbons, including comprehensive assessments of Arctic oil and gas, Arctic marine shipping issues, regulatory guidelines and intergovernmental agreements, emergency preparedness and response measures, contaminants and other impacts on ecosystems, socio-economic issues and other human dimensions of Arctic large-scale developments and a range of other subjects which all have relevance for emerging Arctic energy issues. This essential work provides a solid foundation for efforts to integrate environmental and socio-economic policies in the context of development of Arctic energy resources.

Summary

In coming years the pressures to develop Arctic energy resources are likely to increase in the Arctic states. While Arctic petroleum hydrocarbons are perhaps the overwhelming early favorite for development, a broader spectrum of energy issues requires examination in the context of the Arctic, including:

- What is the nature and extent of renewable and non-renewable energy resources in the Arctic?
- Are these resources commercially viable or locally affordable and what are the economics of developing them?
- What are the associated political, social, environmental, and technological implications of development? Can development be managed with acceptable levels of socio-eoconomic and environmental impact?
- What are the costs and benefits for Arctic residents resulting from development of Arctic energy resources?
- Where does development of Arctic energy resources fit in the national economic/energy strategies of Arctic states?
- Where does development of Arctic energy resources fit in the broader context of a global transition to lower carbon emissions?

As noted above, there has been significantly less work done by the Arctic Council on energy consumption, energy efficiency and alternative and renewable energy options in the Arctic, although interest in these subjects is increasing.

When considering future cooperative activities, the Arctic Council will need to take into account the time frames associated with emerging Arctic energy issues. In the short term of one to five years, there is a range of pressing issues facing Arctic communities in some parts of the Arctic relating to access to affordable energy resources (see Part V of this Report). On the other hand, major new resource developments, by their nature, require investments and infrastructure developments that are likely to have timeframes of five to ten years, at a minimum. Similarly, the role of Arctic energy resources in global issues such as climate change and energy security is likely to be relevant well into the medium and longer terms.

Some cooperative activities that the Arctic Council could consider for future implementation are identified in Part VI of this report.

V. Arctic Energy and Arctic Communities

The Arctic Human Dimension

The Arctic is a region in which people have lived for thousands of years, accumulating local and traditional knowledge that is highly relevant in decision-making relating to the field of energy. Indeed, energy issues may be central to the continued existence of some communities in the Arctic. The population of the entire Arctic region is estimated at approximately 4 to 9.9 million people (see Figs. 3 & 4), depending on the area defined to fall within the Arctic.[36] The figure of 4 million, which is more widely used in Arctic Council publications, represents about 0.07% of the world population and about 0.9% of the total population of the eight Arctic states.

In some parts of the Arctic there is a significant indigenous population. As the Arctic Council's Arctic Human Development Report (AHDR) describes in some detail, these populations often differ noticeably in their demographic characteristics and lifestyles.[37] Some Arctic states do not maintain official statistics that identify indigenous peoples specifically. Nonetheless, the AHDR provides some general data on indigneous peoples of the Arctic (see Fig. 5).

The major findings[38] in the AHDR provide a concise and helpful profile of the human dimension of the Arctic (see Appendix II).

Sustaining Arctic Local Communities

Within the global economy, competition for secure energy supplies is highly charged. Therefore, the politics of cooperation surrounding Arctic energy issues is very complex. For some, the Arctic is perceived as a warehouse of resources for export to world markets. The emphasis of media reports relating to Arctic energy tends to be about environmental and geopolitical issues associated with large scale export of oil and gas from the region to feed growing demand in populous regions outside the Arctic. However, the Arctic Council will also need to consider the importance of energy for the sustainablility and prosperity of communities within the Arctic.

In some parts of the circumpolar north[39] communities are struggling with the growing costs of imported energy products. Therefore, an immediate concern for these communities is access to affordable energy, either from conventional sources or through development of alternative energy projects to alleviate the disportionate costs which they are now facing for light, heat, power and transportation.[40] While these local issues are first and foremost domestic issues for each Arctic state, there is a significant opportunity for cooperative activities given the commonality of circumstances faced by many local communities across the Arctic. As the Interim Report of the Arctic Energy Summit notes:

> *"...all Arctic nations are not created equal. The differences in geography, landmass and population density result in differing viewpoints on the application of energy technology. The Scandinavian nations have high population densities and relatively short distances between communities that generally allow more economy of scale to be developed. Iceland, while low in population, has a significant population center that is located within a short distance of the main renewable energy source. Russia and Canada both have long distances between communities; but Russia has large communities, allowing economies of scale. Alaska has large distances, relatively harsh terrain and very small population sources making any opportunity for load sharing difficult. These differences make it more difficult (not impossible) to find areas of commonality among Arctic nations that could allow a more leveraged opportunity for shared technology development."*

Efforts to collect information and practical solutions to energy challenges faced by Arctic communities include the USA-led Arctic Energy Summit, which will report in the fall of 2009. This Arctic Council project is exploring ways to meet the energy needs of Arctic rural communities. The Nordic Network for Sustainable Energy Systems in Isolated Locations (NordSESIL) was established in 2007, with funding from Nordic Energy Research, to help communities in isolated areas access information and resources about sustainable energy options and to initiate appropriate projects.[41]

Arctic Communities as Energy Consumers

The quality of life for Arctic residents is directly dependant on the availability and the cost of energy. Energy is a critical issue for Arctic residents given the sparse populations, long distances between many settlements, lack of transportation infrastructure in some parts of the Arctic and energy requirements for sustaining their communities in the climatic extremes created by long periods of cold and darkness.

As energy consumers, Arctic residents require relatively high per capita consumption of energy to maintain their economies, cultures and lifestyles. Transportation costs and fossil fuel taxes make this energy a significant component of the high cost of living in the Arctic. Many energy consumers in the Arctic are dependent

Population of Arctic Regions and Countries circa 2003

Arctic Country/Region	Square (1,000 sq. km)	Date	Population Size (1,000)	Population Density (per 100 sq. km)
Total	12575		4058	32
USA: Alaska	1516	1.7.2003	648.2	43
Canada: Arctic regions	4191	15.5.2007	130.3	3
Denmark: Greenland	2176	1.1.2003	56.7	3
Iceland	103	31.12.2002	288.5	280
Denmark: Faroe Islands	1	31.12.2002	47.7	3410
Norway: Arctic regions	107	1.1.2003	462.7	431
Sweden: Arctic regions	99	31.12.2002	253.6	257
Finland: Arctic regions	93	31.12.2002	187.8	202
Russia: Arctic regions	4289	9.10.2002	1982.5	46

Figure 3: Arctic Populations *[source: AHDR 2004, p.27]*

Table 2.3. Arctic Countries and Arctic Regions population. 2003. N

N	Countries *N*	Regions *N*	Per cent of total *N*
Canada	31,600,000	111,546	0.4
Faroe Islands	47,000	47,000	100.0
Finland	5,200,000	645,272	12.4
Greenland	56,000	56,000	100.0
Iceland	289,000	289,000	100.0
Norway	4,600,000	465,200	10.1
Russian Federation	143,400,000	7,144,000	5.0
Sweden	9,000,000	508,973	5.7
United States	290,800,000	648,280	0.2
Total	484,992,000	9,915,271	2.0

Figure 4: Arctic Populations *[ECONOR I, 2006, p.18]*

Indigenous Population of the Arctic Region

Arctic Region or Country	Date	Population (1,000) Total	Indigenous	Share of indigenous (%)
USA (Alaska)	Census 2000	627	98(119)*	15.6 (19.0)
Canada: Arctic region	Census 2001	130	66.0	50.8
Denmark: Greenland	2003	57	50.0	88.1
Iceland	2003	288	NA	
Denmark: Faroe Islands	2003	48	NA	
Norway: Arctic region	2003	463	50***	~5
Sweden: Arctic region	2003	254	50***	~5
Finland: Arctic region	2003	188	50***	~5
Russia: Arctic region	Census 2002	1982	~90***	>4

Notes:
*Just American Indians and Alaska Natives (American Indians and Alaska Natives and some other race.)
**Estimate for Nordic Saami (AMAP, 1998)
*** Estimate author (D. Bogojaviensky, Census 1989=77)

Figure 5: Arctic Indigenous Populations

upon refined high-cost energy products imported from more southerly regions of their home nation or from nearby producing nations, even in situations where raw energy resources might have originated nearby. These energy resources can include hydro-electric power, and gasoline and diesel fuels for air, water and ground transportation, as well as for heating homes, businesses and government offices. It is not uncommon for national and sub-national governments to provide direct or indirect subsidies to reduce the impact of high costs of energy in Arctic communities.

The media have provided extensive coverage of the impact which higher energy costs are having on non-Arctic urban and rural areas. However, it is the residents, businesses, industries and government institutions in many Arctic communities which are experiencing some of the most significant and immediate impacts of high energy costs. In rural areas of Alaska, for example, the kilowatt-hour charge for electricity can be three to five times higher than the charge in more urban areas of the state. Fully a third of energy usage in some Arctic rural communities is in transportation fuels (aircraft, ATVs, snow machines, boats, personal vehicles).[42] High costs of these fuels significantly impact rural subsistence lifestyles and the viability of these communities. Ironically, energy costs for some Arctic consumers are highest in some regions where oil has been developed for export to non-Arctic consumers.

The identification of alternative approaches to supply the energy needs of Arctic communities has been a true challenge. Gasoline and diesel products are easily transported, easily stored and run in a wide variety of engines. Any alternative transportation fuels will have to have similar properties. In some parts of the Arctic, diesel fuel is the primary source of home heat. In general, the energy options available in some Arctic communities tend to be significantly limited, whether in relation to local needs or for export to larger commerical markets outside the Arctic.

For example, economies of scale, costs associated with remoteness or environmental factors may prevent the development of hydro-electric resources even where they are located near to a small, remote community. Some alternative energy options, such as wind power, have faced technical difficulties in some regions of the Arctic.[43] Other options such as solar or tidal power are severely limited by seasonal natural conditions.

In some areas of the Arctic, centralized power generation and transmission to communities is not an option because the distances between communities prevent cost-effective generation and distribution of power to users. In some areas, fuel for power generation must be flown in or shipped by barge during the open ice season. Accordingly, where possible, rural residents have adapted by utilizing non-hydrocarbon fuel sources. When such renewable and alternative energy sources are utilized to supplement diesel-fired power generation, this usually results in lower costs for power.

While it unlikely that energy from petroleum hydrocarbons will be completely replaced in the near future in most Arctic communities, there is a growing trend in Arctic communities toward developing alternative local sources of energy. For some

communities, accessing nearby, locally-produced energy resources might be an alternative if cost-effective development can be achieved. However, for many others, this is not an option. Limited transportation infrastructure means that energy resources must be relatively close to communities if they are to be effectively utilized. Among the available options for some communities are coal, wood-pellets, wind, solar and small-scale hydro power, and a range of more experimental energy resources. Even nuclear power, on the scale used for submarines, has been proposed.

Finding affordable, efficient and reliable sources of alternative energy is a priority for Arctic residents and businesses, given the dual pressures of escalating costs and concerns about environmental impacts of energy developments and climate change. For most Arctic residents, climate change is a phenomenon which originated in other parts of the world and which they cannot stop. The circumpolar North is currently experiencing the consequences of climate change which have been attributed, in part, to energy consumption and other activities outside the Arctic. The International Agency Agency states in its 2008 World Energy Outlook that:

> *"The bulk of the increase in global energy-related CO2 emissions is expected to come from cities, their share rising from 71% in 2006 to 76% in 2030 as a result of urbanisation. City residents tend to consume more energy than rural residents, so they therefore emit more CO2 per capita."*[44]

Arctic residents and their institutions have been vocal about how climate change is affecting their immediate environment, including seasonal weather patterns, traveling on winter ice, harvesting local wildlife and threats to livelihoods and infrastructure resulting from thawing permafrost or loss of snow cover. They are also becoming very active in various initiatives which are intended to manage and adapt to the impacts of climate change on their environment .[45]

Environmental and socio-economic issues associated with potential large-scale energy developments are juxtaposed with issues relating to access to affordable energy for Arctic residents. Many permanent Arctic residents rely on resource development economies and also have a direct interest in the protection of their environment. Their voices in the energy future of the Arctic are important.

While there may be time for planning large-scale energy developments in the Arctic, some Arctic local communities might not have the luxury of time with respect to energy challenges which are threatening their sustainability. Some Arctic communities face immediate and critical questions in relation to access to energy. Affordable, alternative fuel technologies will need to be quickly developed to provide economical and environmentally appropriate fuels if these communities are to be sustainable.

The Arctic as Energy Producer

For many remote Arctic communities, the experience to date with large scale resource development construction projects can be characterized as "boom and bust".

On the one hand, revenues generated from exporting energy products hold the promise of bringing prosperity to some Arctic communities. For example, statistics indicate that 85-90% of Alaska's revenues come from taxes and royalties on oil production. Energy resources can clearly play a significant role in some local and regional economies.

On the other hand, typically there is a period when more money than usual is injected into the local labour force and business community, followed by a range of social disruptions, including crime, substance abuse or inflation in the housing markets.[46] When

construction is completed a few operational jobs may be all that is left behind. Given these circumstances, the challenge is to work with Arctic communities to put energy resource development into its proper context in terms of the both the expectations and realities of development impacts.

Transient workforces and isolated project facilities are still a dominant feature of many Arctic resource developments. However, there appears to be a growing trend toward establishing social conditions which will attract and support a more locally-based workforce residing in permanent communities at or close to an energy project. In order to attract or retain skilled professionals and their families, Arctic communities require the necessary social infrastructure and amenities. Measures are required to minimize the social disruption, particularly among indigenous peoples, which can take place prior to and following project construction.

Governments, national and sub-national, continue to have a major role in providing a stable social environment in Arctic communities close to resource developments. Considerable expenditures are being made by some governments to provide modern municipal, educational, medical, recreational and cultural facilities and services in order to make life in Arctic communities more attractive. In recent years, industry has also been making major contributions in support of government initiatives, as well as in terms of providing support directly to local organizations.[47] There may also be social measures imposed by regulatory agencies which set the terms and conditions for a resource development.

The Arctic's resident business community and labour force are generally active in lobbying decision-makers to ensure that resource development projects will provide employment, training and business opportunities during construction and operation of energy projects. Depending on the project, there may also be demands to establish secondary industries which will do some processing for local consumption or before production is sent to southern markets. The challenge for all parties is to produce and retain a skilled labour force to work on, or provide services to, resource development projects. For the resident business community, there needs to be access to necessary financing in order to compete successfully on projects which are larger than typical local projects.

In some parts of the Arctic, the rights and interests of indigenous peoples are important factors to be taken into account in development of resources on lands which they traditionally use and occupy. For example, over the past four decades in both the USA and Canada, governments have reached agreements with indigenous people concerning land ownership and the management and development of resources on or near land owned by indigenous people. Both industry and governments have implemented programs to encourage involvement of indigenous people in training, employment, business and equity opportunities arising from resource development. These measures have been important for providing certainty and stability necessary to attract investment by both industry and state-owned corporations. Equally important, it is necessary to take into account traditional pursuits, for example reindeer herding in northern Europe and Russia, to ensure that commercial development of energy resources does not disrupt these economically and culturally significant traditional livelihoods.

In some cases, interpreting and implementing these agreements is just beginning, which tends to create uncertainty for all parties. For Arctic communities, there will always be risks and trade-offs associated with resource development which governments, industry and regulatory agencies can help to manage. In addition, the experience to date has been that where agreements are in place, indigenous peoples and their institutions are active participants in the decision-making processes relating to resource development, participating in and receiving benefits from development, and in finding appropriate balances between positive and negative impacts of development.

Southern-based unions may also be a factor in some Arctic energy developments. Where unions are involved, this can complicate local access to economic opportunities associated with resource development. In some Arctic regions, states and industry have been successful in producing a relatively stable business community and northern labour force which can match the quality of expertise and service being provided from outside of the Arctic. In some part of the Arctic programs are in place to support development of the indigenous peoples' work force and business community. In some cases regulatory agencies may require local employment as a condition of receiving development permits. A major challenge for all parties is maintaining the skill levels necessary to operate, to service or to provide the new technologies continually being introduced in Arctic energy resource development initiatives.

Another set of issues can arise in Arctic communities from the anticipation surrounding major energy developments. In the Canadian Arctic in the 1970s and 1980s, for example, government and industry made significant expenditures to prepare for energy development in the oil and gas sector. However, in response to market forces, industry withdrew from the Canadian Arctic in the mid-1980s, except where government incentives made it worthwhile to continue to explore for oil and natural gas reserves. It would be over a decade before market conditions improved enough to attract industry back to the Canadian Arctic. In this interim, local and regional businesses and governments, which had made considerable investments to increase their capacity to meet the demands of development, had to manage the consequences of a sudden down-turn in interest.

Further into the future, as the global demand for Arctic energy resources increases, a range of participatory issues will arise in relation to Arctic residents and Arctic communities. These issues relate primarily to participation in decisions and activities that will have local socio-economic and environmental implications. From the perspective of many Arctic communities the important conditions that need to be addressed to permit development of energy resources, both onshore and offshore, include: preservation of environmental integrity; development of a skilled local labour force; developedment of local infrastructure; opportunities for an experienced and competitive local business community; where applicable, involvement of local indigenous communities; and the amenities which are required to create and attract these dynamics

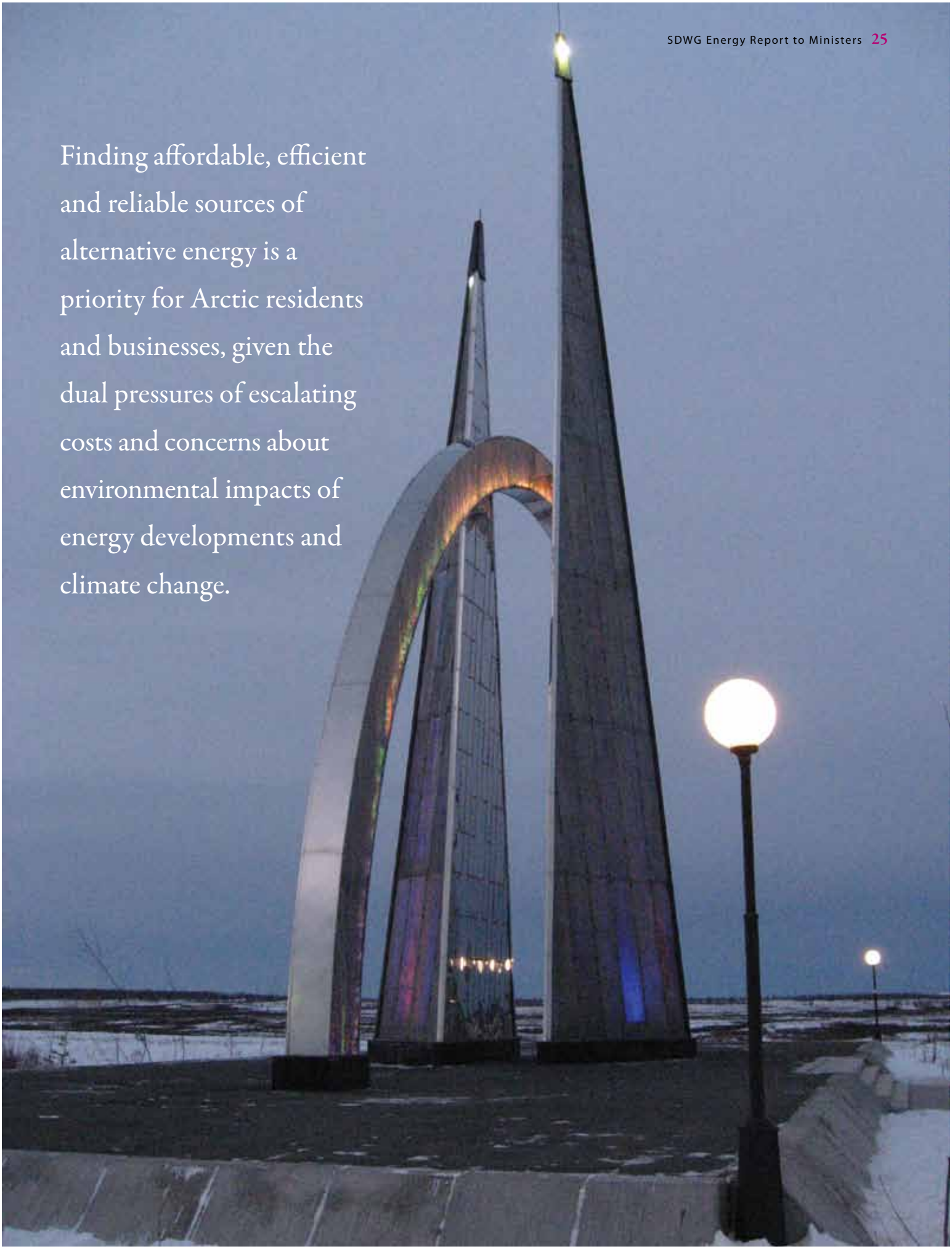
Summary

In coming years the pressures to develop Arctic energy resou The impacts on Arctic residents, businesses and institutions of high-cost energy will require some Arctic states to increasingly focus on the role of energy in relation to the sustainablility and prosperity of their Arctic communities. Two trends which warrant further consideration are:

1) From an energy and resource development perspective, Arctic states need to be concerned about how high-cost energy will impact on the sustainability of their northern communities. During the rapid increases in oil prices in early 2008, some Arctic residents were forced to leave because of unaffordable increases in the cost of living; traditional livelihoods and commercial businesses were struggling to operate; and government institutions were forced to reduce some programs and services. Some of the infrastructure required to service renewable and non-renewable resource development and the people required to operate and maintain this infrastructure are located in the northern regions of Arctic states. If this local and regional capacity is significantly diminished, there will be implications for all concerned – Arctic residents, governments and industry. Re-establishing Arctic infrastructure for energy or other resource development, or managing such operations from more southerly locations, will present considerable challenges.

2) Higher subsidies to help offset the high-priced energy in the Arctic may not be an adequate answer to Arctic energy costs. Arctic states can expect that there will be more local and regional demands to access alternative Arctic sources of energy, especially when these resources are located nearby. There will also be an increase in demand for development of renewable sources of energy, particularly hydro-electric, wind, solar or nuclear energy on a scale which can supply sufficient and reasonably-priced power to small Arctic communities. Arctic residents and businesses will likely face difficult trade-offs resulting from the high cost of living in the Arctic.

There is a range of cooperative activities which could be considered by the Arctic Council in this regard. Some activities that the Arctic Council could consider for future implementation are identified in Part VI of this report.



Finding affordable, efficient and reliable sources of alternative energy is a priority for Arctic residents and businesses, given the dual pressures of escalating costs and concerns about environmental impacts of energy developments and climate change.

VI. Conclusions & Potential Activities for Future Implementation

Conclusions

The Arctic Council provides a unique forum for further cooperation and collaboration on energy issues. The Council is well-placed to consider the broad spectrum of energy issues and to engage the full range of stakeholders through its Arctic and non-Arctic networks.

In this context, potential activities for consideration by the Arctic Council are organized below under three broad categories:

I. Arctic Energy and Arctic Communities
II. Arctic Energy and the Arctic Council
III. The Arctic Energy in a Global Context

These categories were chosen based on the following conclusions:

- There is an immediate need to examine energy issues that affect Arctic local communities, including access to afforabable, sustainable energy and socio-economic and environmental issues associated with large-scale energy developments.
- Arctic states need to look "inward" at the Council's ongoing capacity to better deal with energy issues and related national concerns in the Arctic.
- Arctic energy issues are part of the larger international energy issues. The Arctic Council may find situations where it is beneficial to engage with non-Arctic stakeholders on matters of global economic, environmental, and security issues as they relate to energy.

Decisions by Arctic states in relation to energy resources must take into account the complex dynamics created by a mix of local, national and global political, socio-economic and environmental issues. Development of renewable and non-renewable Arctic energy resources involves management of socio-economic impacts of large scale development; preserving the environmental intergity of fragile Arctic ecosystems; adapting to climate-change-related environmental impacts to land, water and wildlife; taking into account the interests and rights of indigenous peoples and other Arctic

residents; ensuring effective and predictable regulatory regimes to regulate resource developments; and providing attractive fiscal regimes to attract investments in energy developments.

The Arctic knowledge base upon which to make sound political decisions is already considerable and is rapidly growing. Numerous projects and activities relevant to Arctic energy issues have been, or are being, carried out by the Arctic Council's working groups.[48] Collectively they cover a broad scope of issues. Many of these reports and assessments are comprehensive and cross-cutting.

In order to achieve an appropriate balance of interests, management of impacts and realization of benefits from renewable and non-renewable Arctic energy development, decisions about development will need to be considered at all levels (ie. local, national, circumpolar and global).

Such a balancing act presents a considerable challenge for stakeholders and governance institutions. The search for appropriate balances between socio-economic policies and environmental policies will need to take into account:

- the Arctic as an energy consumer, as well as the Arctic as an energy producer and exporter;
- environmental protection within the context of sustainable development in the Arctic, as well as the environmental impacts on the Arctic region resulting from non-Arctic sources;
- technical capabilties in relation to development of Arctic energy resources, as well as political decision-making and institutional capacity of various stakeholders to effectively initiate and manage such developments.

There are considerable pressures to achieve proper balances among all Arctic stakeholders. Scientific studies have documented the role of the Arctic as a complex and dynamic system that is connected in a number of major ways to the overarching Earth System. At the same time, emerging geopolitical concerns highlight the need for effective governance systems to address growing interest in developing the region's natural resources and in using the region's potential for commercial shipping.

All eight Arctic states and most non-Arctic states share common issues and concerns regarding access to energy resources, security of supply, environmental integrity, reducing climate change impacts, economic transitions to new energy sources and management of economic, social and cultural impacts which accompany such transitions. Arctic residents and local communities have similar concerns and issues.

Through this report the SDWG wishes to draw special attention to the Arctic as an energy consumer. There is considerable confidence in many quarters that oil and gas development in the Arctic can proceed in an environmentally-responsible way so as to improve the quality of life and prosperity of Arctic residents and the Arctic states. At the same time there is increasing attention being given to practical technologies for enhancing access to Arctic renewable energy. Such developments are closely linked to the important environmental, socio-economic and political dimensions of larger-scale developments aimed at exporting energy out of the Arctic. However, efforts to export energy resources (primarily oil and gas) from the Arctic are on a somewhat longer time scale. Some of the most pressing and immediate issues relate to access to affordable and sustainable energy for Arctic residents, businesses and governments in order to meet their needs for power, light, heating and transportation under the demanding conditions in this region. Therefore, Arctic states may wish to give special attention to activities that into account the theme of "the Arctic as an energy consumer".

The SDWG has included in its work plan for 2009-2011 the new theme of "Energy and Arctic Communities". The SDWG will explore the possibility of new projects and activities under this thematic area and bring any project proposals to Senior Arctic Officials for intersessional consideration and approval, as appropriate.

Activities that the Arctic Council could consider for Future Implementation

Based on the foregoing identification of issues in this report, the Arctic Council[49] may wish to consider a broad range of opportunities for future cooperation on Arctic energy issues. Many detailed recommendations relevant to Arctic energy issues have already been put forward in documents prepared by Arctic Council and some new activities may already be included in work plans of the working groups.

Therefore, the recommendations set out below are not intended to be a substitute for, nor to supercede, the more detailed recommendations contained in other working group documents. Instead, this report proposes a framework to assist the Council in considering concrete proposals for project and activities in the future and for realizing increased cooperation and coordination within the Arctic Council, among its working groups, as well as with other stakeholders who have an interest in Arctic energy issues.

This is not intended to be an exhaustive list of potential activities but it is hoped that the categories chosen will provide a helpful framework for the Arctic Council at this stage of its deliberations on Arctic energy issues. While these three (3) categories might assist in considerations of future work and activites in the Council, the SDWG notes that this not necessarily mean the Council will undertake projects and activities in each category at this time. The determination as to priority areas and appropriate projects will be a matter for ongoing deliberations within the Council and its working groups. The fluidity of the energy picture during 2008, coupled with current global economic challenges, places the issue of the Arctic as an emerging energy province into a very complex context. Sufficient time will be required to develop concrete proposals for projects and activities.

I. Arctic Energy and Arctic Communities

Under this category the Council might wish to consider projects and activities that are designed to enhance the understanding of the Arctic as an energy consumer. The sustainability of many Arctic communities is dependent on access to affordable energy. In parts of the Arctic dependent on imported oil and gas, escalations in price can have profound impacts, as was the case in 2008. Given the time scales and costs associated with developing alternative energy supplies, whether renewable or non-renewable, small communities may have few options. Some possible activities could include:

- **International Conferences/Workshops on Arctic Energy Innovation:** Building upon the work of the Arctic Energy Summit Technology Conference in October 2007, focussed international conferences/workshops could be held to bring together stakeholders from Arctic communities, industry, research institutions and governments to showcase specific innovations that have been or are being developed to improve energy efficiency or to utilize alternative sustainable energy sources in the Arctic. A communications plan to bring such conferences or workshops to the attention of communities across the Arctic would be a helpful component of this sort of initiative.

- **Arctic Renewable Energy Assessment:** In order to accelerate a move away from non-renewable energy sources in the Arctic, where it is practical to do so, it will be necessary to better understand viable options for renewable energy sources in the Arctic. An Arctic Renewable Energy Assessment could provide a comprehensive report on the status renewable energy developments in the northern circumpolar region. In addition such an assessment could assist in identifying a research agenda in relation to Arctic renewable energy issues.

II. Arctic Energy and the Arctic Council

Under this category the Council might wish to consider some "inward-looking" projects and activities that are designed to enhance the cooperative traditions that have developed on multiple levels within the Council through major assessments, including in relation to Arctic oil and gas. Activities and projects in this category could focus more on the interests of Arctic states, Permanent Participants and Observers. Some examples include:

- **Follow-up on past recommendations:** Based on past activites and reports, the working groups could be requested to cooperate to 1) consolidate priority recommendations; 2) identify priority opportunities for cooperation on renewable and non-renewable Arctic energy issues; and 3) identify Arctic energy research possibilities and priorities.

- **Coordination Among Working Groups:** Given the range of energy-related activities already undertaken by the Arctic Council, the working groups could be encouraged to coordinate an integrated work plan for activities for future implementation.

- **Standing Item on Ministerial Agenda:** Given the importance of Arctic energy issues for Arctic states, Arctic residents and other stakeholders, Ministers could request a regular report from SAOs on Arctic energy issues at Arctic Council Ministerial meetings under a standing agenda item.

- **SDWG Follow-on to projects such the Arctic Energy Summit, ECONOR II, etc.:** During the Norwegian chairmanship, the SDWG has conducted a number of projects that are relevant to Arctic energy issues. Reports on these projects will be finalized by the time of the Arctic Council Ministerial in April 2009. The SDWG could be requested to consider follow-on activities to these projects and to carry out such projects and activities, as may be approved by SAOs.

- **Building the Arctic Energy Knowledge Base:** Consideration could be given to establishing appropriate circumpolar networks/mechanisms/fora for ongoing exchange of information and ideas on Arctic energy issues. This matter could be on the agenda for discussion at a conference on Arctic Energy Innovation and could be a followup activity to the conference.

- **Clearing House for information & ideas on Alternative Energy Technologies for Remote Communities in the Arctic:** Consideration could be given to enhancing the use of the Arctic portal (http://www.arcticportal.org) for disseminating information on the outcomes from the numerous programs, conferences and other workshops that are being conducted in the field of Arctic energy. Research and development activities and programs relating to Arctic energy in the Arctic states could be reported. A database of Arctic energy technology suppliers could be considered.

III. The Arctic Energy in a Global Context

Under this category the Council might wish to consider projects and activities that take account of Arctic energy issues as part of the larger international energy picture. Such projects and activities could be designed to enhance cooperative networks and take into account the growing interest in the Arctic among non-Arctic states, international organizations and the global community generally. In particular, the Council might wish to consider possibilities for increased dilaogue with the energy sector on Arctic issues.

Appendix I

Arctic Council and Energy-Related Projects and Activities

Note: These reports are loosely categorized below in accordance with their primary focus. Some reports are listed under more than one category.

Socio-Economic

1. Arctic Energy Summit (SDWG) (report anticipated fall 2009)
2. Vulnerabilty and Adaptation to Arctic Climate Change, 2009 (SDWG)
3. Arctic Social Indicators, 2009 (SDWG)
4. Arctic Oil and Gas Assessment, 2007 (AMAP)
5. Economy of the North I and II, 2006 and 2009 (SDWG)
6. Survey of Living Conditions in the Arctic, 2006 (SDWG)
7. Arctic Human Development Report, 2004 (SDWG)

Environmental Monitoring and Assessment

8. Arctic Oil and Gas Assessment, 2007 (AMAP)
9. Arctic Climate Impact Assessment, 2004 (AMAP/CAFF)
10. Circumpolar Map of Resources at Risk from Oil Spills in the Arctic, 2002 (EPPR)
11. Environmental Risk Analysis of Arctic Activities, 1998 (EPPR)
12. AMAP Assessment Report: Arctic Pollution Issues (1998)
13. There are also numerous other AMAP and CAFF reports and fact sheets that are relevant to Arctic energy issues

Governance & Regulatory

14. Arctic Marine Shipping Assessment, 2009 (PAME)
15. Best Practices in Ecosystems based Oceans Management, 2009 (SDWG/PAME)
16. Regional Programme of Action for the Protection of the Arctic Marine Environment from Land-based Activities, 2008 revision (PAME)
17. Arctic Marine Strategic Plan, 2004 (PAME)
18. Analysis of adequacy and effectiveness of existing arrangments and agreements, 2000 (EPPR)
19. There are also numerous other PAME documents that are relevant to Arctic energy issues

Renewables & Energy Innovation

20. Arctic Energy Summit, 2009 (SDWG)

Technical/Operational

21. Arctic Offshore Oil and Gas Guidelines, 1997, updated 2002 and 2009 (PAME)
22. Guidelines for transfer of refined oil and oil products in Arctic waters, 2004 (PAME)
23. Field Guide for Oil Spill response in Arctic waters, 1998 (EPPR)
24. Arctic Shoreline Cleanup Assessment Technique, 2004 (EPPR)
25. There are also numerous other ACAP, EPPR and PAME reports and fact sheets that are relevant to Arctic energy issues

Appendix II

Profile of the Arctic Human Dimension

Note: Excerpt from the ***Arctic Human Development Report***. 2004, pp. 229-240:

Demography
The human population of the Arctic is sparse, unevenly distributed, and skewed in terms of both age structure and gender balance.

Societies and cultures
Human societies in the circumpolar North are highly resilient; they have faced severe challenges before and adapted successfully to changing conditions.

Economic systems
Arctic economies are narrowly based and highly sensitive to outside forces, including market fluctuations and political interventions.

Political systems
The devolution of political authority to regional and local governments in the Arctic has not been accompanied by significant reallocations of material resources.

Legal systems
There is a growing dualism between the legal rights of indigenous peoples and the authority of public governments in the Arctic.

Resource governance
Many new and promising systems of resource governance have arisen in the Arctic, but little has been done so far to assess their performance using common criteria of evaluation.

Human health
Telemedicine has been highly successful in the Arctic, but effective responses to problems involving mental health, violence, and accidental death require the development or strengthening of community-based health services. Also, dietary concerns arising from changing lifestyles and responses to contamination have to be addressed.

Education
Although education in the hands of missionaries, economic entrepreneurs, and colonial administrators has been a vehicle for assimilation, there are opportunities today to develop education systems well-suited to the needs of Arctic residents.

Community viability
Maintaining the viability of Arctic communities requires an enhanced ability to take advantage of interactions among governmental, corporate, organizational, and personal networks from the local level to the global level.

Gender issues
Recent developments in the Arctic have generated new concerns about gender roles, without alleviating pre-existing problems.

International relations
The impacts of both global environmental change and global social change threaten to overwhelm efforts to carry out regional initiatives and to forge a strong sense of regional identity in the Arctic.

Cultural integrity
The experience of the Arctic demonstrates that cultures can remain viable even in the face of rapid and multi-dimensional changes.

Political and legal innovations
The Arctic has become a leader in the development of innovative political and legal arrangements that meet the needs of the residents of the circumpolar North without rupturing the larger political systems in which the region is embedded.

Technological advances
Evidence from the Arctic demonstrates both the feasibility and the desirability of applying advanced technologies to address social problems.

Cultures and Societies
There is a need for a better understanding of the effects of cumulative changes on cultural and social well-being in the Arctic.

Demography
There is a need to collect more and better information on the Arctic's residents using common data protocols.

Settlers
There is a need to learn more about the experiences of recent settlers in the Arctic and their interactions with the region's indigenous peoples.

Industry
There is a need to improve our understanding of the roles that modern industrial activities play in the pursuit of sustainable development at the regional level.

Governance
There is a need to do more to compare and contrast new institutions in the Arctic and to distil lessons relevant not only to the Arctic itself but also to other area s of the world characterized by an abundance of natural resources and sparse and culturally diverse populations.

Endnotes

[1] Arctic Monitoring and Assessment Programme (AMAP), *Arctic Oil and Gas 2007*, p. 37

[2] International Energy Agency. *World Energy Outlook 2008 Executive Summary*, p. 37 (available at: http://www.iea.org/Textbase/npsum/WEO2008SUM.pdf)

[3] International Energy Agency. *World Energy Outlook 2008 Executive Summary*. p. 37 and 39 (available at: http://www.iea.org/Textbase/npsum/WEO2008SUM.pdf)

[4] International Energy Agency. *World Energy Outlook 2008 Executive Summary*, p. 38 (available at: http://www.iea.org/Textbase/npsum/WEO2008SUM.pdf)

[5] International Energy Agency. *Op cit*., p. 38

[6] ECONOR, 2006, p. 27. See also AMAP *Arctic Oil and Gas Assessment* (2007) for more detailed information.

[7] The current world financial situation could have wide-reaching consequences for a number of large regional industrial projects. One of them is the Shtokman field in the Barents Sea: see Barents Observer. *Shtokman in jeopardy*? (October 10, 2008) .

[8] *Economy of the North I (ECONOR I)*, 2006, p.28-29 (at: http://portal.sdwg.org/media.php?mid=454&xwm=true). However, the U.S. Geologicial Service released new estimates in 2008 which indicate these resources account for about 22 percent of the undiscovered, technically recoverable resources in the world. The Arctic accounts for about 13 percent of the undiscovered oil, 30 percent of the undiscovered natural gas, and 20 percent of the undiscovered natural gas liquids in the world. About 84 percent of the estimated resources are expected to occur offshore. See: Bird, Kenneth J., Charpentier, Ronald R., Gautier, Donald L., Houseknecht, David W., Klett, Timothy R., Pitman, Janet K., Moore, Thomas E., Schenk, Christopher J., Tennyson, Marilyn E. and Wandrey, Craig J., 2008, *Circum-Arctic resource appraisal; estimates of undiscovered oil and gas north of the Arctic Circle: U.S. Geological Survey Fact Sheet 2008-3049*, Ver.1.0, July 23, 2008; initially released online at http://pubs.usgs.gov/fs/2008/3049

[9] *ECONOR I*, 2006, p.28-29

[10] Chapters of the scientific report of the Arctic oil and gas assessment are available at: http://www.amap.no/oga/

[11] Chandler, Hugo. *Renewable Energy*: *Status and Outlook*. Renewable Energy Unit, International Energy Agency (presentation to Fifth Energy Summiit in Africe, 17 Oct 2006)

[12] *Ibid*. p.39

[13] *Ibid*. p.39

[14] ECONOR, 2006, p.34

[15] ECONOR, 2006, p.34

[16] The North-east Atlantic (the Barents and Norwegian Seas); the Central North Atlantic (the waters around Iceland, Faroe Islands and Greenland); the waters of North-eastern Canada (Newfoundland/Labrador area); and the Bering Sea: ECONOR, 2006, p.33.

[17] ECONOR, 2006, p.32

[18] ECONOR, 2006, p.32

[19] ECONOR I, 2006, p. 27

[20] Ibid. ECONOR I, 2006, p. 27

[21] See *Arctic Marine Shipping Assessment*, 2009 (due for release in April, 2009).

[22] AMAP's *Arctic Oil and Gas 2007*and its companion scientific assessment document chronicle in considerable detail many issues relating to the environmental dimensions of petroleum hydrocarbon developments in the Arctic.

[23] See *Arctic Oil and Gas 2007* and the scientific assessment document for the history of petroleum hydrocarbon development in the Arctic (available at: http://www.amap.no/).

[24] The Arctic as an emerging energy province is the theme of the *Arctic Energy Summit*, an Arctic Council project led by the United States in conjunction with the Institute of the North and the University of the Arctic. The *Arctic Energy Summit* is also an official International Polar Year project. AES will report in the fall of 2009. See: www.arcticenergysummit.org.

[25] See for example AMAP report on *Arctic Oil and Gas 2007* (www.amap.no/) ; *Arctic Human Development Report, 2004* (www.svs.is/AHDR/); and *ECONOR Report, 2006* (http://portal.sdwg.org)

[26] Canada, Denmark, Finland, Iceland, Norway, Russian Federation, Sweden and United States of America

[27] Canada, Denmark, Norway, Russia, and the United States

[28] See, for example: AMAP. *Arctic Oil and Gas 2007*.

[29] See for example: PAME/SDWG Report on *Best practices in Eco-systems Based Marine Management* (available April 2009) and PAME's updated *Arctic Offshore Oil and Gas Guidelines*, 2009 (available April 2009).

[30] See U.S.Geological Service: Bird, Kenneth J., Charpentier, Ronald R., Gautier, Donald L., Houseknecht, David W., Klett, Timothy R., Pitman, Janet K., Moore, Thomas E., Schenk, Christopher J., Tennyson, Marilyn E. and Wandrey, Craig J. *2008, Circum-Arctic resource appraisal; estimates of undiscovered oil and gas north of the Arctic Circle: U.S. Geological Survey Fact Sheet 2008-3049*, Ver.1.0, July 23, 2008; initially released online at http://pubs.usgs.gov/fs/2008/3049 .

[31] See *Programme for the Norwegina Chairmanship of the Arctic Council 2006-2008*. (Available at http://www.arctic-council.org)

[32] *Ten Perspectives on Nordic Energy, results from the first phase of the Nordic Energy Perspectives project.* (see offprint summarizing ten main findings, September 2006, p. 44, ISBN 91-631-9275-6; also see: www.nordicenergyperspectives.org)

[33] For example in September, 2008 that Russia has declared the Arctic as a key region for its economic future.

[34] See for example *Climate Solutions*, *WWF's Vision* for 2050. ISBN 2-88085-277-3

[35] See Appendix I for a listing of some Arctic Council project reports relating to energy.

[36] See for example the *Arctic Human Development Report*, 2004, p. 27 and *ECONOR I, 2006*, p.17. The *ECONOR I* report defines the circumpolar area as comprising the following 29 regions: Alaska, Northern Canada (Yukon, Northwest and Nunavut Territories and Nunavik), Greenland, Iceland, Faroe Islands, and the northern portions of Norway (Finnmark, Nordland, Troms, Svalbard), Sweden (Norrbotten, Vasterbotten), Finland (Lapland, Oulu) and the northern part of the Russian Federation (Karelia, Komi, Arkhanglesk, Murmansk, Khanty-Mansi, Yamalo- Nenets, Nenets, Taymir, Evenkia, Sakha, Chukotka, Magadan, Koryakia).

[37] *Arctic Human Development Report, 2004*, p. 29

[38] *Arctic Human Development Report, 2004*, p. 229-240.

[39] In the North American Arctic, for example, many communities rely on costly diesel-generated power, while in the Nordic countries electrical power is more affordable due to a comprehensive grid that relies on hydro-electric power generation.

[40] It is often the case that while decreases in the price of oil and gas are reflected relatively quickly in pricing in southern urban areas, prices tend to stay higher in Arctic communities once they have risen.

[41] See: www.nordsesil.net

[42] Cited in the *Arctic Energy Summit Proposal* to the SDWG, 2006.

[43] See for example: *Wind Power Development In Sub-Arctic Conditions With Severe Rime Icing* by John F. Maissan, P.Eng., Director, Technical Services, Yukon Energy Corporation, *Circumpolar Climate Change Summit and Exposition*, March 19-21, 2001, Whitehorse, Yukon, Canada.

[44] International Energy Agency. *World Energy Outlook 2009 Executive Summary*, p. 46

[45] See for example, the SDWG Report of the project on *Vulnerability and Adaptation to Climate Change in the Arctic*. (available April, 2009 at http://portal.sdwg.org)

[46] See the *Arctic Human Development Report,* 2004 and scientific report of the *Arctic Oil and Gas Assessment,* 2007, ch. 7.

[47] In the Canadian north, for example, industry has entered into "impact benefit agreements" with private organizations representing indigenous people residing on or near the local of development projects.

[48] See Appendix 1

[49] Note: In the recommendations below the phrase "Arctic Council" is intended to mean the representatives of Arctic states, Permanent Participants and Observers. It is recommended that due consideration be given to broad participation in any Arctic energy activities by all Arctic Council states, Permanent Participants and Observers, as well as by experts and other stakeholders as appropriate.

Sustainable Development Working Group

Stein Rosenberg (Chair, Norway); Marianne Lykke Thomsen (Co-Vice-Chair, Denmark, Greenland, Faroe Islands); Gunn-Britt Retter (Co-Vice-Chair, Saami Council); Harald Finkler (Canada); Anna-Maria Liukko (Finland); Ragnar Baldursson (Iceland); Asbjørn Braanaas (Norway); Sergey Khvan (Russian Federation); Marten Ehnberg (Sweden); Karen Perdue (United States of America)

Permanent Participants: Aleut International Association (AIA); Arctic Athabaskan Council (AAC); Gwich'in Council International (GCI); Inuit Circumpolar Council (ICC); Russian Association of Indigenous Peoples of the North (RAIPON).

Observers: China, France, Germany, Italy, Netherlands, Poland, Spain, United Kingdom

Conference of the Parliamentarians of the Arctic Region (SCPAR); International Federation of Red Cross & Red Crescent Societies (IFRC); International Union for the Conservation of Nature (IUCN); Nordic Council of Ministers (NCM); Nordic Environment Finance Corporation (NEFCO); North Atlantic Marine Mammal Commission (NAMMCO); United Nations Economic Commission for Europe (UN-ECE); United Nations Environment Programme (UNEP); United Nations Development Programme (UNDP); Advisory Committee on Protection of the Seas (ACOPS); Arctic Circumpolar Route (ACR); Association of World Reindeer Herders; Circumpolar Conservation Union (CCU); International Arctic Science Committee (IASC); International Arctic Social Sciences Association (IASSA); International Union for Circumpolar Health (IUCH); International Work Group for Indigenous Affairs (IWGIA); Northern Forum; University of the Arctic (UArctic); World Wide Fund for Nature (WWF)

Author
Bernard W. Funston
Executive Secretary
Arctic Council Sustainable Development Working Group
bfunston.ncc@rogers.com

Research
George Braden, Braden & Associates, Ottawa, Canada, gbraden@rogers.com
Bernard W. Funston, Executive Secretary, SDWG

Photos
All photos courtesy of Harald Finkler, Ottawa, Canada

Design and Production
TerraGraphica, Anchorage, AK, USA,
Eric Cline, Creative Director, ecline@alaska.net
Lonna Laiti, Production Designer

This report is available electronically at:

http://portal.sdwg.org

To order hard copies please contact:

Bernard W. Funston
Executive Secretary
SDWG Secretariat
Ottawa,Canada
Bfunston.ncc@rogers.com

Arctic Council Homepage: http://www.arctic-council.org
Arctic Portal Homepage: http://new.arcticportal.org

Arctic Council Working Group Homepages:
ACAP: http://arctic-council.org/working_group/acap
AMAP: http://www.amap.no
CAFF: http://caff.arcticportal.org
EPPR: http://eppr.arctic-council.org
PAME: http://arcticportal.org/en/pame
SDWG: http://portal.sdwg.org

Indigenous Peoples' Secretariat: http://www.arcticpeoples.org