

Northern Climate ExChange

Independent Information - Shared Understanding - Action on Climate Change

NCE Update December 2, 2009

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Announcements

- 1. TRUE NORTH: Adapting Infrastructure to Climate Change in Northern Canada** - released November 26

The **National Round Table on the Environment and the Economy's** report **True North: Adapting Infrastructure to Climate Change in Northern Canada** finds that "infrastructure and communities in Canada's North are unprepared to cope effectively with the looming threat that climate change poses to roads, buildings, industrial waste sites, energy and other critical infrastructure."

[Download Report](#) pdf (6.2 mb)

[Read the Flash version on-line](#)

www.nrtee-trnee.ca

- 2. GLOBAL DAY OF ACTION - International Demonstrations on Climate Change, December 12th 2009.**

The **Global Day of Action** on climate has occurred every year since 2005 at the time of the annual United Nations Talks on climate change (the COP or "Conference of Parties" to the United Nations Framework Convention on Climate Change or UNFCCC). People from all around the world have come together on the same day to demand urgent action on climate, and climate justice, from the governments of the world meeting at the annual climate



talks. The Global Day of Action 2009 will take place **December 12**, during the United Nations Talks on climate change (COP15/MOP5) in Copenhagen, Denmark.

www.globalclimatecampaign.org

3. State of the Arctic Conference: 16-19 March 2010

The **State of the Arctic Conference** will be held 16-19 March 2010 at the Hyatt Regency Miami in Miami, Florida, USA. The main goal of the conference is to review our understanding of the arctic system in a time of rapid environmental change.

The conference will provide an open international forum for discussion of future research directions aimed toward a better understanding of the arctic system and its trajectory. Topics will range from basic understanding of the Arctic and system-wide change to developing response strategies to adapt and mitigate change.

Abstract submission deadline: **Monday, 14 December 2009**

www.soa.arcus.org

4. Antarctic Climate Change and the Environment A contribution to the International Polar Year 2007-2008

The first comprehensive review of the state of Antarctica's climate and its relationship to the global climate system is published this week (Tuesday 1 December) by the **Scientific Committee on Antarctic Research (SCAR)**.

The review - **Antarctic Climate Change and the Environment** - presents the latest research from the icy continent, identifies areas for future scientific research, and addresses the urgent questions that policy makers have about Antarctic melting, sea-level rise and biodiversity.

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Articles

1. Arctic ice meltdown remains severe: report

By Randy Boswell
National Post
November 27, 2009

Studies suggesting the Arctic sea ice has made a modest recovery following its record-setting retreat in 2007 are misleading and underestimate the severity of the polar meltdown, says one of Canada's top ice scientists.

David Barber, Canada Research Chair in Arctic System Science at the University of Manitoba, says satellite images used to track the overall extent of Arctic ice don't adequately perceive how weak and "rotten" the region's older, thicker, multi-year ice cover has become.

His findings, to be published in the journal *Geophysical Research Letters*, suggest a transformative change in Arctic ecosystems is accelerating and that safe shipping in polar waters during the summer and fall will begin much sooner than many experts predict.

"These are very significant findings since the scientists and public all thought that sea ice was recovering since the minimum extent in 2007," says Mr. Barber, an environment and geography professor with the university's Centre for Earth Observation Science.

"In 2008 and 2009 satellite data showed a growth in Arctic sea ice extension leaving some to reckon global warming was reversing," states a summary of the research. "Contrary to what satellites recently suggested, we are actually speeding up the loss of the remaining, healthy, multi-year sea ice."

The replacement of older, thicker ice with weak first-year ice has been noted by the U.S. National Snow and Ice Data Center, one of the leading trackers of the annual ebb and flow of Arctic ice cover.

The Colorado-based centre was instrumental in alerting the world in 2007 to the unprecedented meltdown in Arctic sea ice, from 14 million square kilometres that winter to about 4.3 million square kilometres by September 2007.

The past two summers have shown the late-summer minimum at about 4.7 million square kilometres (2008) and 5.4 million square kilometres (2009), still the second- and third-lowest extents since satellite measurements began in 1979.

The NSIDC did note in its October summary of sea ice conditions that "the ice cover remained thin, leaving the ice cover vulnerable to melt in coming summers."

But Mr. Barber's study appears to drive home that point and raise new questions about the health of even the thickest Arctic ice. The research highlights the limitations of satellites in assessing the rapid and widespread degradation of the region's older ice cover.

Using data gathered in September, during a voyage in the Beaufort Sea aboard the Canadian Coast Guard research vessel Amundsen, Mr. Barber observed that even relatively thick multi-year ice was so "heavily decayed" by warming temperatures that the ship "easily broke through floes six to eight metres thick."

He said: "Ship navigation across the pole is imminent as the type of ice which resides there is no longer a barrier to ships in the late summer and fall."

Satellite readings of ice age and thickness are limited, he notes, because they can't fully distinguish between rock-hard, super-thick floes and degraded ones vulnerable to rapid breakdown after decades or even centuries of remaining intact.

He said that healthy multi-year ice and "the 'rotten' ice have similar near-surface temperatures, similar near-surface salinities" and that "when satellites try to identify who's who, the microwaves behave similar enough that cases of mistaken identity abound."

Mr. Barber's findings emerge at a time when federal MPs are debating a bill to rename Canada's northern sea route the "Canadian Northwest Passage" to symbolically bolster the country's claims to the disputed waterway.

The study also coincides with rising concern about Canada's long-term environmental strategy - including mitigation of climate change impacts in the North - ahead of the international Copenhagen conference aimed at curbing global carbon emissions.

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2. Northern Infrastructure Not Ready for Climate Change, Concludes NRTEE

Report recommends updating construction codes, better Climate and Weather Data and Northern Inclusion in Adaptation Solutions

November 26, 2009

Infrastructure and communities in Canada's North are unprepared to cope effectively with the looming threat that climate change poses to roads, buildings, industrial waste sites, energy and other critical infrastructure, according to a new report from the National Round Table on the Environment and the Economy.

"Canada's North is on the frontline of climate change", stated the NRTEE, requiring a comprehensive effort to ensure infrastructure and communities become more ready to adapt to expected climate changes leading to degrading permafrost, melting ice roads, storm surges and coastal erosion.

Among its 16 recommendations, True North: Adapting Infrastructure to Climate Change in Northern Canada, suggests updating construction and engineering codes and standards, providing better weather and permafrost data and information, examining changes to the insurance system, and leveraging federal infrastructure funding to ensure that new infrastructure will be built with the changing climate in mind.

The report comes just as the world's nations meet in Copenhagen to discuss how best to work together to reduce emissions of greenhouse gases, which are blamed for Arctic phenomena like degrading permafrost, melting sea ice and changes in precipitation patterns. But, while reducing carbon emissions is critical over the long term, the NRTEE emphasizes that adaptation at the local level is critical now in dealing with effects of climate change that appear unavoidable.

The report is available on the NRTEE website at www.nrtee-trnee.ca/true-north.

"Climate change is moving fastest in Arctic areas, requiring Canada to be a world leader in adaptation practices, more than we had even contemplated," said Round Table Chair Bob Page. "We believe our report fills an important niche for the federal government in implementing its Northern Strategy."

The report notes that winter roads melting earlier in the spring can force communities to airlift supplies, while melting permafrost can destabilize foundations for buildings. Moreover, increased snowfall and changing ice conditions will add stress to buildings, and energy and communications infrastructure that were built for different snow and ice conditions. Permafrost degradation can also undermine airport runways and roads. Storm surges put coastal communities at risk and may require relocation of infrastructure.

The Round Table found that national codes and standards pay inadequate attention to northern interests and conditions, and that significant gaps exist in the availability and accessibility of data that forms the basis for infrastructure risk management and loss prevention. The NRTEE also found that capacity across northern jurisdictions to assess climate risks to infrastructure is uneven and lacking. An absence of coordinated strategies can result in piecemeal responses from various governments that can be ineffective and costly.

"From buildings to roads, from airports to pipelines, infrastructure is essential to modern, secure communities," said NRTEE President and CEO David McLaughlin. "This new study of northern infrastructure by the NRTEE offers practical advice to make infrastructure more resilient and less vulnerable to climate change."

The NRTEE examined the role of three key mechanisms that can be utilized to manage risk to infrastructure:

- Codes, standards and related instruments that set down requirements for construction, maintenance and other infrastructure requirements;
- Insurance policies that can provide incentives to adjust premiums to reduce risk and;
- Disaster management policies that can increase preparedness and capacity for communities to prevent and cope with disasters.

Some of the highlights from the NRTEE's 16 recommendations include;

- National codes and standards for engineering and construction should be reviewed and modified to accommodate risks of climate change.
- The Government of Canada should adjust funding vehicles for infrastructure development and

rehabilitation so that they become incentives to integrate the risk of damage from climate change in infrastructure decisions.

- Governments and the insurance industry need to work together so that insurance products encourage modifications to infrastructure in light of climate risks and are affordable.
- Governments at all levels should collaborate with northern experts to develop the best possible design and engineering guidelines for the North.
- The Government of Canada should invest in updating and providing more comprehensive climate data, climate change projections, and information for infrastructure design.
- The Government of Canada needs to share the expertise and experience of Canada's North in addressing climate risks to infrastructure with other polar nations as part of Canada's Northern Strategy.

True North forms part of Canada's contribution to the International Polar Year, 2007-2008, a large international scientific program focused on the Arctic and the Antarctic.

The NRTEE consulted with more than 100 stakeholders including infrastructure experts, federal, provincial and territorial government officials, Northern residents, and Aboriginal representatives during its research.

The NRTEE is an independent federal government agency with a mandate to research and advise on sustainable development issues of importance to Canada and Canadians.

www.nrtee-trnee.ca

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3. Government of Canada Creates Jobs by Investing in Green Projects in the North

Natural Resources Canada
Press Release: 2009/118
November 27, 2009

The Government of Canada will invest \$1.66 million this year to develop climate change adaptation plans that will increase the ability of communities in Nunavut to better understand and plan for the impacts of climate change. This investment will incorporate geoscience knowledge on changing permafrost and sea level conditions and will also generate new employment in the community. "Our Government is investing in these projects because they allow us to combine new scientific studies of the Arctic with traditional knowledge, which in turn employs local residents," said the Honourable Lisa Raitt, Minister of Natural Resources. "This project will help ensure Northern communities have the information they need to adapt to potential climate change."

"Building partnerships in the North has been an effective way of delivering programs that assist with adaptation to climate change," said the Honourable Chuck Strahl, Minister of Indian Affairs and Northern Development and Federal Interlocutor for Métis and Non-Status Indians. "This partnership has been valuable in implementing adaptation planning in Nunavut."

Climate change adaptation plans will be developed this year for Arviat and Whale Cove in the Kivalliq Region and for Kugluktuk and Cambridge Bay in the Kitikmeot Region. The new plans are part of the Nunavut Climate Change Partnership, a multi-year collaborative effort launched by the Government of Canada, the Government of Nunavut and the Canadian Institute of Planners. To date, the Government of Canada has invested a total of \$3.19 million in this program, which is one of a number of federal initiatives that are delivering \$85.9 million to help Canadians better understand, plan for and adapt to the impacts of a changing climate.

www.nrcan-rncan.gc.ca

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4. Climate science still sound

By Bob McDonald
CBC Quirks & Quarks
November 27, 2009

Conspiracy theorists and climate change deniers were in full force this week over the [illegal release](#) of thousands of private emails from the [Climate Research Unit](#) at the University of East Anglia in England. Comments made by some of the scientists in the personal messages have been interpreted to suggest that global warming is a grand hoax. What it really shows is how politicized and polarized climate science has become and how the real science is being covered over by a denial industry that uses selective information to distort the issue and confuse the public.

Fortunately, despite the furor over these private comments that were never intended to be public, they have no impact on the integrity of climate science. For the most part, these emails reveal that the scientists were doing what scientists do, debating with each other and deciding how to handle the mountains of data that form the foundation of an unimaginably complex system called the Earth's climate.

Among the most damaging remarks were those from Dr. Phil Jones, head of the Climate Research Unit, who wrote, "I can't see either of these papers being in the next IPCC report. Kevin and I will keep them out somehow..." Another comment from another scientist that got a lot of attention was, "hide the decline."

Now, obviously climate scientists should not be attempting to suppress research. But no such thing happened. One of the two papers to which Dr. Jones was referring was hugely publicized, though it was widely criticized by many scientists. The "hide the decline" comment referred to a technical point about mixing two different kinds of data sets - a point that was "hidden" in plain sight by being [published in the journal Nature](#) 10 years ago.

Taking selective bits of information out of context and using them to attack the credibility of climate scientists has been a common theme employed by conspiracy theorists. A recent example of this is the tidbit of information that the average global temperature of the Earth has not increased since 2000. This is true. Look closely at the right hand side of [these graphs](#) and you will see the lines go down at the end.

Taken by itself, that makes it look like global warming has stopped. But look at the very long-term data and you will see many ups and downs over time, with each downturn followed by a general upward trend.

[The Intergovernmental Panel on Climate Change \(IPCC\)](#) involves thousands of scientists from around the globe who gather all the peer-reviewed scientific publications they can find and assemble them into a report.

That report itself is peer-reviewed before publication. For the last 21 years, these reports have supported the idea that the climate is indeed warming and human activity is responsible for part of it. They also won the Nobel Prize for their work. The evidence to support this is abundant, clear and continues to pour in. Satellites continue to track increasing ocean temperatures, disappearing ice and rising sea levels. Scientists in the field have been following changes in vegetation, wildlife, fish stocks, glaciers and countless other environmental markers right before their eyes. Among those who are actually doing the science, the "debate" about climate change is over.

Science, by definition, is a debate, a growing body of evidence that seeks the truth in understanding nature. Part of the process is updating old information and incorporating new ideas. Challenges to current theories are welcomed but any challenge has to be rigorous enough to stand up to the peer review process, which is where real, informed, healthy scientific skepticism rules. Popular skepticism is more like denialism. It's manufactured doubt, driven by opinion, ideology and politics. Yet casting seeds of doubt is the very tactic being used in an attempt to derail the upcoming climate talks in Copenhagen.

Fortunately, climate science stands on a firm footing of rigorous research and appropriately skeptical peer review, not on what people say privately through emails or chatting over the water cooler. Let's get on with the real issue of adapting to a changing planet and ignore the stalling tactics of a very vocal minority.

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5. Climate change turns conservationists into triage doctors

CBC News
December 1, 2009

Deep in the wilds of northern British Columbia, people are trying to imagine what the region's forests, salmon streams and alpine meadows will look like by 2050, when climate change is expected to have drastically altered the ecosystem.

The Taku River Tlingit First Nation and the province are in the midst of deciding how to manage three million hectares bordering Alaska and the Yukon. When it is completed in the spring of 2010, their agreement will be one of the last large land-use plans in B.C.

It may also be the first to explicitly address climate change by relying on research released earlier this year that helps predict which zones are best conserved as wilderness and which could be developed. But it is a devilishly difficult task, scientists familiar with the area say.

How do you make conservation decisions when the land to be conserved is in the midst of dramatic change? In addition to warmer temperatures and increased precipitation, rapid changes in snow pack, water flow, permafrost, wildfire and insect infestations are all anticipated for the region.

B.C. is not alone in this challenge. In fact, conservationists around the world, who are struggling to protect plants and animals in the face of rapid climate change, are beginning to compare themselves with harried triage doctors. While, technically, conservation is about keeping things as they are, scientists now say that may no longer be possible.

"The point is not to think outside the box, but to recognize that the box itself has moved and, in the 21st century, will continue to move more and more rapidly," University of Colorado ecologist Timothy Seastedt and his colleagues write in the journal *Frontiers in Ecology and the Environment*.

Seastedt and others argue land managers must focus on ecosystem diversity to give plants and animals the best chance to adapt to the change scientists say is coming: The more diversified a system, the more resilient.

Trying to return ecosystems to some historic or natural state is no longer possible, they say.

"To be honest, the combination of climate and atmospheric chemistries we're experiencing now -- you can't find any historical match," Seastedt says.

Giving grizzlies and wolves a place to flee

B. C. ecologist Jim Pojar is grappling with this in his climate change study on behalf of the Taku River Tlingit First Nation and the province.

His report divides the area into cells of 90 square metres, identifying the landscape's enduring physical features such as bedrock geology, mountains, valleys, lakes and streams. He then overlays on that grid the 3C to 5C rise in mean annual temperature predicted for the region and the 10 to 30 per cent increase in predicted precipitation.

The report recommends protecting large intact watersheds with as many different landforms as possible as the best way to retain biodiversity. Pojar also recommends wildlife sanctuaries and migration corridors for grizzlies, wolves and other species as they flee rising temperatures and precipitation.

But the harsh reality is that some animals may eventually disappear from the region, regardless of how much land is protected. For instance, predictions of more frequent thawing and freezing will coat ground lichen with a layer of ice, cutting off caribou from their main source of winter food, Pojar warns.

"The name of the game is going to be triage. Many species are not going to make it through this climate change bottleneck," says Pojar, a former provincial forester and retired executive director of the Canadian

Parks and Wilderness Society.

While he is the first to overlay predicted climate changes on physical landscapes over such a vast area, scientists at the Virginia-based Nature Conservancy are using the technique on a smaller scale. They are assessing lands the conservation group plans to buy to see whether they will remain important targets for conservation in the future.

The group is now considering buying land based on its potential, not on its current conservation value. For instance, nondescript habitat slightly in from the coast in the southeastern United States could morph into valuable wetlands as sea levels rise, says the conservancy's chief scientist, Peter Kareiva.

A controversial proposal: assisted migration

While habitats will undoubtedly change, the species that live in them may have trouble relocating. In years past animals could move on their own as their native range became inhospitable, but cities and farms now stand in their way.

That's why some biologists are beginning to talk about assisted migration, despite worries that it could have unforeseen consequences.

University of Notre Dame conservation biologist Jessica Hellmann and her colleagues recently proposed a system for assessing when to help wildlife relocate to places they aren't currently found. Writing in the journal *Proceedings of the National Academy of Sciences*, they suggest a scoring system for weighing scientific and social implications.

They don't expect their scorecard to eliminate controversy -- Hellmann says she and her colleagues often disagree when applying it, even in theoretical situations. But she argues that because climate change is so radically and rapidly altering habitat, we need to consider equally radical answers.

"We're responsible for climate change, and therefore maybe we're responsible for helping animals deal with climate change," Hellman says.

The case of the Western Swamp Tortoise

That is the thinking behind an Australian project designed to find suitable habitat for the world's most endangered tortoise, the Western Swamp Tortoise.

University of Western Australia biologist Nicola Mitchell and her colleagues aim to predict where best to introduce captive-bred individuals, given her country's extended drought.

The tortoises are highly adapted to their particular habitat -- they need swamps with roughly 30 cm of standing water in winter and spring for feeding, mating and growth. But with a predicted overall warming of up to 3C and a decrease in rainfall of up to 20 per cent by 2100, those swamps are drying up.

Mitchell will use computer programs to figure out an area's continuing suitability by looking at the interaction between predicted precipitation and temperature, and topography, vegetation and soil. She'll match that up with the very specific conditions the tortoise needs to successfully reproduce and, armed with this information, her team hopes to make recommendations for future habitat.

Still, conservationists are only too aware that such attempts to mitigate the effects of climate change could encourage a laissez-faire attitude to halting it.

"It's clear that our policy makers are not making the tough decisions needed to prevent significant climate change," Seastedt says.

"A number of conservationists and a few scientists classify our viewpoint as defeatism, but they're missing the point. We still can keep the parts, the biota; we just have to find creative ways to do that."

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6. Climate research centre opens

The new climate research centre will help the Self-Rule administration to make better decisions, research minister says

By Inge S. Rasmussen

Sermitsiaq

November 23, 2009

Greenland's Climate Research Centre opened its doors today in an official ceremony that saw Research Minister Mimi Karlsen doing the ribbon cutting formalities.

"The centre fills an important function in a knowledge base that can serve as basis for decision on how future we will live," Karlsen said.

Centre head Søren Rysgaard was optimistic about its future role. Already, around 100 researchers are affiliated with the centre, and 10 PhD students will be accepted next year.

"Interest is so great that we actually have a space problem," Rysgaard said. "But that's one of the problems you like to have. I think everyone can now see that it is a sensible idea to base the centre in Greenland."

The Climate Research Centre has a three-year budget of 75 million kroner. The funds come from the Danish globalisation pool, and was crucial in getting the centre off the ground. The Self-Rule administration has contributed office space, housing and administrative assistance.

Rysgaard underscored that the centre intends to seek more funding from international research projects. He said one of the main goals of the centre was to develop cooperation between fishermen, hunters and researchers.

'The centre wishes to continue and expand the fruitful and important work with hunters and fishermen who frequently come over with new 'strange animals', Rysgaard said, adding that unknown 'genetic material below the surface of the sea' may prove to be commercial valuable.

www.sermitsiaq.gl

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7. First comprehensive review of the state of Antarctica's climate

Antarctic Climate Change and the Environment

Alfred Wegener Institute

November 30, 2009

The first comprehensive review of the state of Antarctica's climate and its relationship to the global climate system is published this week (Tuesday 1 December) by the Scientific Committee on Antarctic Research (SCAR). The review - Antarctic Climate Change and the Environment - presents the latest research from the icy continent, identifies areas for future scientific research, and addresses the urgent questions that policy makers have about Antarctic melting, sea-level rise and biodiversity.

Based on the latest evidence* from 100 world-leading scientists from 13 countries, the review focuses on the impact and consequences of rapid warming of the Antarctic Peninsula and the Southern Ocean; rapid ice loss in parts of Antarctica and the increase in sea ice around the continent; the impact of climate change on Antarctica's plants and animals; the unprecedented increase in carbon dioxide levels; the connections between human-induced global change and natural variability; and the extraordinary finding that the ozone hole has shielded most of Antarctica from global warming.

Dr. Colin Summerhayes, Executive Director of the Scientific Committee on Antarctic Research said,

"Antarctica is an unrivaled source of information about our planet. This review describes what we know now and illustrates how human activity is driving rapid climate change. By integrating this multidisciplinary evidence into a single source we will help scientists and policy makers understand the distinction between environmental changes linked to the Earth's natural cycles, and those that are human induced. The work is particularly important because it puts Antarctic climate change into context and reveals the impact on the rest of the planet."

Professor John Turner of British Antarctic Survey is the lead editor of the review. He said, "For me the most astonishing evidence is the way that one man-made environmental impact - the ozone hole - has shielded most of Antarctica from another - global warming. Understanding the complexities surrounding these issues is a challenge for scientists - and communicating these in a meaningful way to society and to policymakers is essential. There is no doubt that our world is changing and human activity is accelerating global change. This review is a major step forward in making sure that the latest and best evidence is available in one place. It sets the scene for future Antarctic Research and provides the knowledge that we all need to help us live with environmental change."

Key findings from the review are highlighted in 85 key points, which you can see in full at:

<http://www.scar.org/publications/occasionals/acce.html>.

www.awi.de

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8. In Greenland, warming fuels dream of hidden wealth

By Karl Ritter
Associated Press
Nov 27, 2009

Gert Ignatiussen returns to this fjord-front Inuit town with the spoils of his hunting trip. Six seals, all killed with a single shot to the head.

With nimble handwork, his wife Bartholine cuts them up on the porch of their wood-frame home, saving the best meat for dinner. Ignatiussen throws leftover chunks of flesh and intestines to the yelping sled dogs fettered on a dusty slope below the house.

The blood-drenched scene offers a glimpse into Greenland's past - a time not long ago when seal hunting meant survival to nomadic Inuit tribes in one of the most hostile climates on Earth.

Inside, Ingatiussen, 54, shows what he believes is Greenland's future: A collection of mineral-rich rocks that he has stashed away in a drawer if he ever needs money.

Global warming is melting the fringes of the frozen world where Greenland's Inuits have hunted seal, whale and polar bear for generations. It's thawing the permafrost on which their homes are built. It's disrupting Arctic wildlife and fish stocks, and making hunting trips more dangerous by thinning the ice that supports their dog sleds.

But all is not doom and gloom. The retreating ice could uncover potential oil and mineral resources which, if successfully tapped, could dramatically change the fortunes of this semiautonomous Danish territory of 57,000 people.

The U.S. Geological Survey estimates there are more than 18 billion barrels of oil and gas beneath the Arctic waters between Greenland and Canada, and 31 billion barrels off Greenland's east coast.

North Sea resources of the same magnitude have made Norway one of Europe's richest countries. Even if only a small part becomes recoverable as the Arctic sea ice retreats, it would be enough for a major boost in living standards for Greenland's tiny population.

"If we find those kind of quantities of oil and gas and the prices remain at current levels, then Greenland

would be a very wealthy country, no doubt," said Joern Skov Nielsen, the director of Greenland's Bureau of Minerals and Petroleum.

Finding hydrocarbons would be crucial to help Greenlanders realize their long-held dream of cutting the annual 3.4 billion kroner (\$680 million) lifeline from former colonial power Denmark that currently rules out full independence.

It's still a big "if."

To date no oil has been found in Greenlandic waters. Even if discoveries are made in new areas under exploration, the most optimistic estimates say commercial production is at least 10-15 years away because of the long time-scale involved when developing offshore oil and gas fields.

Even so, local decision-makers are getting prepared. Last year the Greenland parliament approved the creation of a sovereign wealth fund similar to that which Norway uses for its surplus oil income.

Any payoff from minerals would be smaller, but more immediate. The giant island is believed to be rich in base metals such as zinc, and iron; precious stones like diamonds and rubies; and precious metals like gold and platinum. It's also a potential hotspot for rare earth minerals used in electronic gadgets including mobile phones and flat-screen TVs.

The problem is 80 percent of the island is covered by an ice sheet that is up to 2 miles (3 kilometers) thick, which means exploration is only possible in coastal regions. Even there conditions are far from ideal due to the long winter with frozen ports, 24-hour darkness and temperatures regularly dropping below -20 F (-30 C) in the northern parts.

However, as the climate slowly warms, more of Greenland is opening up for exploration.

Nielsen said the retreat of Greenland's massive inland ice sheet has uncovered new deposits of iron on the west coast near the capital, Nuuk.

In northern Greenland, Britain's Angel Mining PLC said a new deposit of zinc has been laid bare by a retreating glacier. The company plans to reopen an abandoned zinc mine in the area, and eventually link it to the new deposit, chief executive Nick Hall said.

Climate change has been "helpful rather than unhelpful" to miners in Greenland, he said, but added that the main stimulus for the mining activity "is that the world is hungry for resources."

Angel Mining already operates a gold mine in the south. An olivine mine just north of Nuuk also has started production.

Many more are expected soon. The number of mineral exploration licenses issued by Greenland's local government surged from 17 in 2002 to 72 this year.

In Tasiilaq, a cluster of brightly colored homes on Greenland's southeast coast, residents believe more in minerals than oil. They don't know what's hidden under the ocean, but they can sense during the summer months that there are glistening riches embedded in the barren mountains.

Hunters from the area are frequent winners of Greenland's annual amateur mineral hunt, a popular competition designed to encourage Greenlanders to learn more about geology and mining.

Ignatiussen won the inaugural competition in 1989 when he found a rock with traces of gold.

"It had many colors. I could feel there were minerals inside," he explained to visitors invited to his home in August for a home-cooked seal stew.

About 1,000 fist-sized rocks are sent in every year to the Bureau of Minerals and Petroleum, which gives out 120,000 kroner (\$24,000) in tax-free prize money, including 55,000 kroner (\$11,000) for the top entry. Postage-free packaging is available at every post office on the island.

Officials also offers basic courses in geology to amateur mineral hunters, and started a more advanced mining education in Sisimiut in western Greenland last year. The goal is to prepare Greenland's labor force for jobs in the mining industry.

Skeptics question whether Greenland is ready for a transformation into an industrial society. The only large-scale industry on the island is fishing, which accounts for about 90 percent of exports.

"Greenlanders are hunters and fishermen," said Finn Lyngé, a retired Greenlandic diplomat who lives in Narsaq, on the southern tip. He said the mining and oil industries require job skills "for which Greenlanders are not apt at all."

He noted plans by Alcoa to build an aluminum smelter and two hydroelectric plants to power it in Maniitsoq, southwestern Greenland. Project leaders say the 600 workers needed for the construction phase would have to be recruited from Europe or China because Greenland doesn't have that kind of labor.

Even when the plant is up and running, the engineers would likely have to come from outside. "What we can put on the table is menial labor," Lyngé said.

Under a self-rule agreement that took effect last year, Greenland will use any revenue from oil and minerals to slash its annual grant from Denmark, which currently accounts for one-third of its economy.

If the windfall were to exceed the grant, new negotiations would take place, which many hope would result in Greenland becoming a sovereign nation modeled after the welfare states of Scandinavia.

Skeptics say Greenland's population is too small to govern a territory that is three times the size of Texas - even if it discovers untapped wealth. Also, the population is plagued by social problems including alcoholism, domestic violence, sexual abuse and suicides.

Local authorities say the suicide rate corresponds to about 100 per 100,000 residents. That's higher than any country in the World Health Organization's suicide statistics. Greenland is not part of those numbers because it's not an independent country.

Greenlanders older than 15 drink an average of about 12 quarts (12 liters) of pure alcohol per year, according to official health statistics.

The social ills are evident on the sparsely populated east coast, where the change from a hunting lifestyle to a modern society happened in a matter of decades in the last century.

The town bar in Tasiilaq, a smoke-filled gallery of drunk faces and glazed eyes, only sells beer. Police say there's been less trouble since hard liquor was banned last year.

"People who were used to living from fishing and hunting ... there's nothing for them to do. They have no education," said Taatsi Fleischer, a 30-year-old policeman from Nuuk who has been stationed in Tasiilaq for a year. "People get welfare benefits. They buy food, but the rest is for drinks."

Despite the promise of wealth and independence, many Greenlanders regard the hypothetical treasure trove buried beneath their feet with ambivalence. Lyngé worried about what kind of Greenland it would produce - a once-pristine landscape flecked with oil derricks and hulking smelting facilities?

"Out of my window I see fjords and mountains and icebergs," he said. "Caribou, musk ox and an occasional polar bear. Wonderful country. Then a generation from now, two generations from now, what will meet the eye?"

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*The next Update from the Northern Climate ExChange will be sent out **Thursday, December 9, 2009***