CHATHAM HOUSE

GLOBAL ENERGY & ENVIRONMENT STRATEGIC ECOSYSTEM
GlobalEESE

briefing paper

A joint publication of Chatham House and Global EESE

The Vulnerability of Energy Infrastructure to Environmental Change

Cleo Paskal

Energy, Environment and Resource Governance | April 2009 (reissued with additions July 2009) | EERG BP 2009/01

Summary points

- Much energy infrastructure lies in areas that are predicted to become increasingly physically unstable owing to changes in the environment.
- Already there have been environment-related disruptions to hydroelectric installations, offshore oil and gas production, pipelines, electrical transmission and nuclear power generation.
- As a result of scheduled decommissioning, revised environmental standards, stimulus spending and new development, there is likely to be substantial investment in new energy infrastructure.
- It is critical that new and existing infrastructure be designed or retrofitted for changing environmental conditions.
- It is no longer sufficient only to assess our impact on the environment; now we must also assess the impact of a changing environment on us.

Introduction

Energy generation, extraction, refining, processing and distribution require a complex, interlinked, expensive and sometimes global infrastructure. However, much of that infrastructure lies in areas that may become increasingly physically unstable owing to changes in the environment. Of particular concern are disruptions caused or exacerbated by climate change. A compromised global energy supply could result in a range of undesirable ancillary affects.

There are two separate but often interlinked challenges. One is inherited, one is new. Both stem from the fact that energy infrastructure tends to have a long lifespan. The Hoover Dam in the western United States was completed in 1935 and is still an important hydroelectric generator. China's Three Gorges Dam, which is still not fully operational, has an expected lifespan of at least fifty years. Nuclear power stations, from design through to decommissioning, may be on the same site for a hundred years. Additionally, constructions such as refineries, coal power plants and high-voltage transmission lines can be perceived as undesirable for a community. As a result, when the time comes to build new installations, they are often erected in the same locations as the previous ones, as the local population is already accustomed to the infrastructure. This means that sites chosen in the 1980s may still be in operation in 2080 and beyond.

The lifespan of existing energy infrastructure is well within the timeframe predicted for potentially disruptive environmental change. When much of it was designed and installed, the degree of change was not understood and so was not factored in. This is an inherited challenge.

The new challenge involves upcoming investments. A substantial segment of energy infrastructure in North America and Western Europe is scheduled to be decommissioned in the coming decades either because it has reached the end of its natural lifespan or owing to the introduction of revised environmental standards. Combined with stimulus packages in some countries and development in others, this is likely to be the beginning of an era of large-scale investments in new infrastructure. In some cases it is now possible to predict with scientific accuracy at least the minimum level of environmental change over the next century (well within the lifespan of most new investments). However, in too many cases proposed new builds still do not incorporate the likely effects of environmental change.

> ‘It is not enough just to assess an installation's impact on the environment; one must also assess the impact of a changing environment on the installation. Then, as much as possible, the impact of that change must be integrated into planning and countered’

When planners talk about performing ‘environmental impact assessments’, almost invariably what is being assessed is how the construction would change the existing environment, not how a changing environment might affect the construction. While engineers and planners may perform a site inspection before designing an installation, they normally consider the parameters of that site a constant, not a variable. The general assumption is that the coast will not move, river levels will remain constant, the ground will not subside and precipitation will stay predictable. Most planners are not accustomed, and often not trained, to incorporate environmental change-induced site changes into designs. An added problem is that while some change may be broadly predictable, there is likely to be wide variability in some areas, making precise projections impossible. The science is improving, but there are still many unknowns and a lack of fine graining. This in itself is sometimes used as a justification to avoid incorporating any change at all. The result is that a multi-billion-pound, high-tech, environmentally friendly installation could be erected in what will soon become a flood zone. Not only will the original investment be lost, the destruction of the property itself can cause new vulnerabilities.

It is not enough just to assess an installation's impact on the environment; one must also assess the impact of a changing environment on the installation. Then, as much as possible, the impact of that change must be integrated into planning and countered. In pursuit of this goal, this Briefing Paper aims to identify some of the most susceptible nodes in the global energy infrastructure and show how they might be affected by moderate environmental change.

Hydropower

The successful management of hydroelectric installations is contingent on the ability to predict the volume of water entering the system. Before construction, care is taken to assess river level, hydrological cycles and precipitation patterns. Until recently those findings were considered to be constants. For example, precipitation patterns might run on decadal cycles but the cycles themselves were considered largely predictable, and dams, turbines and reservoirs were designed accordingly. As the climate changes, what were constants are now becoming variables. This causes problems for both primarily glacier-dependent and primarily precipitation-dependent power plants.

Glacier-dependent hydro plants

Hydroelectric installations, such as some in the Himalayas, Alps and Andes that depend primarily on glacial melt, are likely to face difficulties in managing widely varying flows both seasonally and over the years. In Europe, mountain areas are likely to see more flooding in the winter and spring, and drier summers. These fluctuations can disrupt hydroelectric power generation, erode infrastructure and damage valuable regional industries.

Currently, many glaciers are retreating, producing more run-off than dams were designed for.[1] In China, for example, virtually all glaciers are in retreat and as of 2005 the start of spring flow has advanced by nearly a month since records began.[2] The Chinese Academy of Science estimates that by 2050 possibly 64 per cent of China's glaciers could be gone.[3]

One immediate impact of that melt is flooding. An estimated fifty new lakes have formed in Nepal, Bhutan and China as a result of melting glaciers. Glacial lakes can be unstable and liable to burst their banks, as happened in Nepal in 1985, when one outburst washed away communities and a hydroelectric installation.[4] It is also possible that in areas that are already susceptible, the added geological stresses caused by the new lakes could be the 'last straw' that triggers an earthquake.

Eventually, once the glaciers reach a minimal extent, the flow may markedly decline, creating a new set of challenges, including a potential decline in hydroelectric production and increased competition with other sectors, including agriculture, for the water itself.

Precipitation-dependent hydro plants

Hydro plants that depend primarily on predictable seasonal precipitation, such as many of those in India, will find it increasingly difficult to anticipate flow. This could potentially cause a decline in power generation, floods and irrigation problems.

Unexpected rainfall has already complicated the management of some of India's many dams (the country is one of the world's major builders of dams). In India, as in many other places in the world, dams often serve three purposes: flood control, irrigation and power generation. Most rain-dependent plants are designed to store water from the rainy season in order

1. South Asian Disaster Report 2007, SAARC Disaster Management Centre, New Delhi, 2008, pp. 61–66.
2. *Stern Review: The Economics of Climate Change*, HM Treasury, London, 2005, p. 78.
3. *The Fall of Water*, UNEP, 2005, available at unep.org/PDF/himalreport.pdf.
4. Ibid.

to be able to irrigate and generate power in the dry season. Those plans rely on predictable rain patterns. Some Indian dam managers are working on monsoon schedules that assume regular 35-year rainfall cycles. However, in 2008–09, hydroelectricity generation in India declined by 8.42% relative to the previous year. The loss was blamed on inadequate rainfall.[5]

> 'In 2008–09, hydroelectricity generation in India declined by 8.42% relative to the previous year. The loss was blamed on inadequate rainfall'

The situation can be equally problematic when there is too much water for the design of the installation. If the reservoir fills in the rainy season and then, owing to changing precipitation patterns, the rain keeps falling well into what should be the dry season, the reservoir can back up and risk inundating the villages upstream. If in order to prevent that the dam's floodgates are opened, the released water can add to the already swollen river and flood the cities downstream.

It was just such a downstream flooding that happened in August 2006 to Surat, an Indian city with a population of over 3 million people with a thriving economy as one of the world's largest diamond-cutting centres. Unseasonably heavy rains overwhelmed dam management and led to the sudden release of water from an upstream dam. The resulting floodwaters covered around 90 per cent of the city and destroyed nearby villages. Over a hundred people are known to have died, hundreds more went missing, and disease spread as thousands of animals drowned and rotted in the waters. The financial cost was at least in the tens of millions of dollars, and the cost of the loss of rare manuscripts from the city's academic institutions was incalculable.[6]

Other factors

These flow extremes, especially when combined with other environmental change factors such as deforestation, can cause erosion, subsidence, landslides and siltation, each of which can affect the efficacy and stability of hydroelectric power plants.

There are added political complications. Disputes between states, already concerned over electric power- and water-sharing, will only get worse as water supplies become even more erratic and hydroelectricity becomes less reliable. Additionally, Clean Development Mechanism financing and the push for low-carbon power generation generally is resulting in a new era of dam building. Over a quarter of all CDM projects are for hydroelectricity, with 784 slated for China alone.[7] Some projects are well conceived; others less so. It is critical that all new and existing plants be assessed to determine how environmental change over the lifespan on the dams will affect both their power generation viability as well as their structural integrity.

Nuclear power

Nuclear power generation may also face challenges in ensuring output and site security. Reactors usually require a large amount of water for cooling. As a result, they are generally situated in areas that are susceptible to environmental change. They are normally either on the coast, making them increasingly vulnerable to sea level rise, extreme weather and storm surges, or they are on rivers, lakes or reservoirs and are dependent on increasingly valuable, and variable, freshwater supplies.

Some installations have already been tested. There has been a degree of flooding at nuclear power plants in the

5. 'Power generation growth plummets to 2.71% in FY'09', *Times of India*, 9 April 2009.
6. Dinesh Kumar Mishra, 'The unbearable lightness of big dams', *Hard News*, October 2006. Himanshu Upadhyaya, 'Cry me a river', *Hard News*, October 2006. Himnshu Thakkar, 'Damn it, this was designed!', *Hard News*, October 2006. Monika Nautiyal, 'Desert into sea', *Hard News*, October 2006. Ashok Patel, 'Modidom's watery grave', *Hard News*, October 2006.
7. http://cdmpipeline.org/cdm-projects-type.htm#6.

US, France and India, and in 1992 Hurricane Andrew caused extensive damage to the Turkey Point site in Florida.

> 'In the summer of 2006, France, Spain and Germany all had to power down nuclear plants because of heat and water problems'

In the UK, many of the existing coastal power stations are just a few metres above sea level. The Dungeness plant, in coastal Kent, is also built on an unstable geological formation. Already the site needs regular management to stay protected. Many of these installations are ageing, and there is momentum for new plants to be commissioned. However, as noted above, it is difficult to get communities to accept a nuclear power station in their region, so in many cases the proposal is for the new plants to be located on the same sites as the old ones. The government has given assurances that builders would have to 'confirm that they can protect the site against flood-risk throughout the lifetime of the site, including the potential effects of climate change'.[8] It is, however, difficult to estimate both the lifetime of the site (those who built the existing installations did not factor in that new ones would be going in beside them, markedly extending the lifespan of the site) and the potential effects of climate change. For example, while sea level rise and storm surges may be increasingly well understood, other disruptive factors, such as the possibility that changes in wave action could liquefy coastal sands, are not.[9]

Riverside plants have different problems. In Europe, cooling for electrical power generation (including both nuclear and fossil fuel plants) accounts for around one-third of all water used. However, in some areas drought is reducing river, lake and reservoir levels at the same time as air and water temperatures are increasing.

During Europe's record-breaking heat wave of 2003, temperatures across the continent reached more than 40° Celsius. As a result, in France, 17 nuclear reactors had to be powered down or shut off. The reduction in generation capacity forced state-owned Électricité de France to buy power on the open market at close to ten times the cost it was charging clients. The inability to generate its own power in a heat wave cost the utility an estimated €300 million.[10]

The Hadley Centre predicts that, by 2040, heat waves such as the 2003 one will be 'commonplace'. The effect on any form of power generation requiring large amount of water (including coal-powered plants) is likely to be substantial.[11]

The same heat conditions that make it difficult to deliver power also create a peak in demand owing to the desire for air conditioning. As a result, as average temperatures increase, it may take less of a temperature spike to affect system stability. In the summer of 2006, which was not as hot as 2003, France, Spain and Germany all had to power down nuclear plants because of heat and water problems. Exemptions were also given, allowing the plants to discharge water hotter than normally permitted into ecosystems, potentially disrupting other industries, such as fisheries. Installations in the US have experienced similar problems.

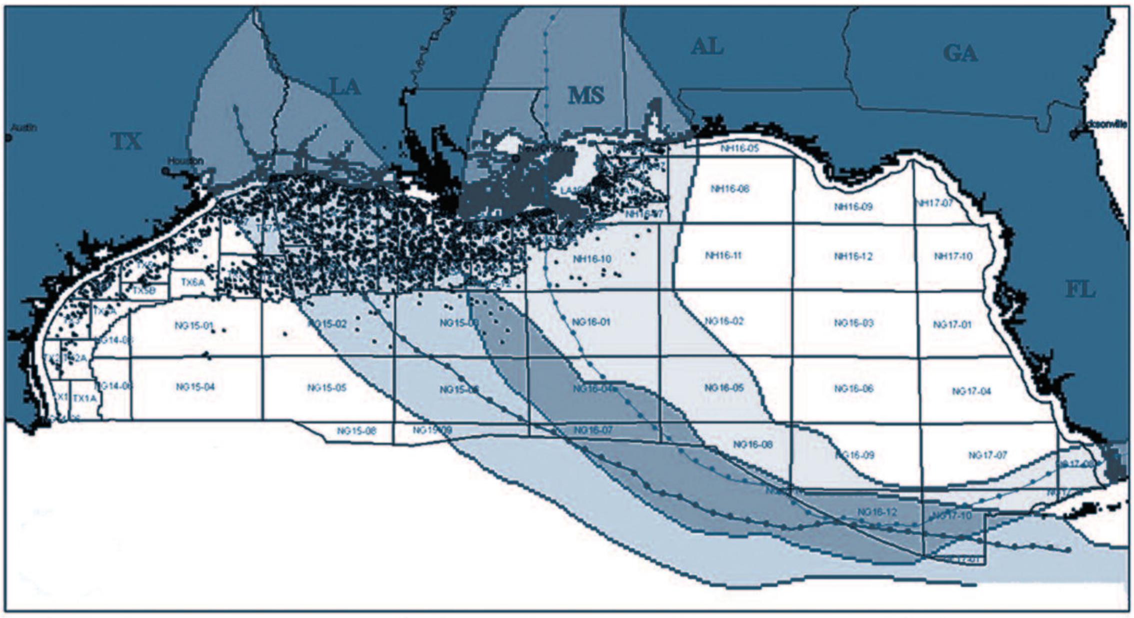
Given the high cost, long lifespan and potential for damage of nuclear power plants, it is essential that substantially more research be done on how they will interact with an increasingly volatile global environmental system.

Offshore/coastal production and facilities

As more accessible oil and gas sites are depleted, more difficult offshore and coastal production may gain in

8. 'Flood risk "won't stop nuclear"', BBC News, 22 July 2008.
9. Michael J. Savonis et al., *Impacts of climate change and variability on transportation systems and infrastructure: Gulf Coast Study, phase 1*, US Climate Change Science Program Synthesis and Assessment Product 4.7, US Department of Transport, March 2008, p. 4-38.
10. James Kanter, 'Climate change puts nuclear energy into hot water', *New York Times*, 20 May 2007.
11. http://www.metoffice.gov.uk/climatechange/science/explained/explained1.html.

Figure 1: Paths of Hurricanes Katrina and Rita through energy infrastructure in the US Gulf



Source: US Department of the Interior, http://www.mms.gov/ooc/Assets/KatrinaAndRita/Rita1.jpg. Hurricane data from www.nhc.noaa.gov.

importance. Offshore and coastal oil and gas extraction is accomplished under a wide range of conditions, from the tropics to the tundra. The challenges vary depending on the location. In order to assess the variety of risks, case studies of the uncertainties in the Gulf Coast of the United States and the Arctic are instructive.

> 'Hurricane Katrina shut off what amounted to around 19 per cent of the US's refining capacity and, combined with Hurricane Rita, damaged 457 pipelines and destroyed 113 platforms'

US Gulf Coast

Over a quarter of US oil production and close to 15 per cent of US natural gas production come from the Gulf of Mexico. As of August 2008, there were over 3,800 production platforms of various size operating in the Gulf. Additionally, this region refines around 30 per cent of the US oil supply and contains 42,520 km of onshore pipelines.

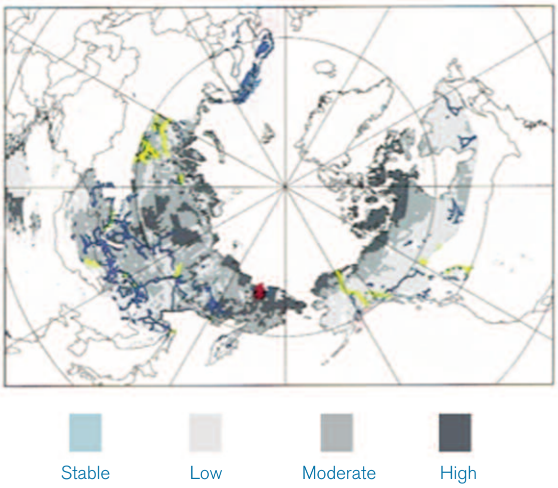
Climate change projections anticipate that the US Gulf Coast will see increased flooding and extreme weather events. Storm activity has already affected supply. In the summer of 2005, Hurricane Katrina shut off what amounted to around 19 per cent of the US's refining capacity and, combined with Hurricane Rita, damaged 457 pipelines and destroyed 113 platforms (see Figure 1).[12] Oil and gas production dropped by more than half, causing a global spike in oil prices. Much of the infrastructure destroyed in 2005 was rebuilt in the same location, leaving it vulnerable to similar weather events.

In the summer of 2008, Hurricanes Gustav and Ike passed through the Gulf and destroyed 60 platforms. Interestingly, even before the hurricanes arrived, the economic effect was felt. What amounted to almost 10 per cent of US refining capacity, as well as much of

12. http://www.mms.gov/ooc/press/2006/press0501.htm.

Figure 2: The hazards of melting permafrost

Map of the Arctic showing areas that either will remain stable or have a low, moderate or high susceptibility to permafrost melt-induced instability (using the Hadley Centre's UKTR climate change scenario for the middle of the 21st century), potentially resulting in the disruption of energy infrastructure. Electrical transmission lines are in blue and pipelines are in yellow. The location of the Bilibino nuclear station is in red.



Source: F. E. Nelson, O. A. Anisimov and N. I. Shiklomanov, 'Climate Change and Hazard Zonation in the Circum-Arctic Permafrost Regions', *Natural Hazards* 26 (2002): 203-25, Kluwer Academic Publishers, The Netherlands.

Map courtesy of F. E. Nelson and N. I. Shiklomanov (Department of Geography and Center for Climatic Research, University of Delaware) and O. A. Anisimov (State Hydrological Institute, St Petersburg).

offshore Gulf production, was shut down in preparation for the hurricanes. This shows that even just the threat of extreme weather can affect supply and price. Climate change predictions suggest that this sort of disruption is likely to become more common.

There are also other potential impacts. While most pipelines are buried, and thus seemingly insulated from the effects of severe weather, there are exposed nodes, such as pumping stations and valves, that are vulnerable. Also, it is uncertain how changes in water tables, soil structure, stability, erosion and subsidence might affect the pipelines.[13] Understanding how, or if, those factors may affect supply will require more research.

Other low-lying coastal facilities

Many of the world's largest oil and gas facilities (including Ras Tanura, Saudi Arabia; Jamnagar, India; Jurong Island Refinery, Singapore; Rotterdam Refinery; and major installations in the Niger Delta) are only slightly above sea level. This leaves them vulnerable to rising sea levels, storm surges, increasing storm activity, subsidence and changes in ground composition. If even one of these regions is affected, it could affect local security and global supply and markets.

Arctic

The US Geological Survey estimates that the Arctic might contain over a fifth of all undiscovered oil and gas reserves.[14] One study postulated that Siberia could contain as much oil as the Middle East.[15] However, dreams of a resource bonanza in the north are premature. The environment is difficult and becoming increasingly unpredictable. Norway's northern Snohvit gas field cost 50 per cent more than the original budget and, in the autumn of 2006, North Sea storms sank a 155-metre Swedish cargo ship and caused an oil rig to break away from its tow and be set adrift off the coast of Norway.[16] As one North Sea oil industry executive said: 'We've had our third "once-in-a-hundred-year" storm so far this year.'[17]

In the short to medium term, there are likely to be higher waves, increasing storm activity and more icebergs threatening offshore rigs and complicating shipping.[18] Additionally, with warmer and wetter air freezing and thawing more often, icing of ships, aircraft and infrastructure will become more common.[19] Also, many key elements of production, such as how to contain an oil spill

13. *Impacts of climate change and variability on transportation systems and infrastructure*, pp. 4-37 to 4-43.
14. http://www.usgs.gov/newsroom/article.asp?ID=1980&from=rss_home.
15. Beth Chalecki, 'Climate change in the Arctic and its implications for US national security', Oceanic Studies, Fletcher School of Law and Diplomacy, fletcher.tufts.edu/oceanic/documents/ArcticSecurity.pdf, accessed 15 August 2006.
16. 'Nordic storm sink Swedish ship', BBC News, 1 November 2006. 'Arctic riches coming out of the cold', *International Herald Tribune*, 10 October 2005.
17. Private conversation.
18. 'Nordic storm sink Swedish ship'. 'Arctic riches coming out of the cold'.
19. 'Naval operations in an iceless Arctic', Oceanographer of the Navy, Office of Naval Research, Naval Ice Center, United States Arctic Research Commission, briefing paper for a symposium on 17–18 April 2001, www.natice.noaa.gov/icefree/Arcticscenario.pdf.

in Arctic waters, are poorly researched. All of this could result in high insurance costs, hampering exploration.

Energy production and distribution in cold climates

An additional problem for offshore Arctic energy extraction is that onshore Arctic energy infrastructure is like to suffer substantial damage. Coastal areas are already seeing more erosion and are weathering stronger storm activity. However the biggest problem may be the melt of the permafrost.

Permafrost, essentially permanently frozen land, acts as a concrete foundation for infrastructure in cold climates. It covers around 20 per cent of the planet's landmass, including large areas of Russia, parts of the Alps, Andes and Himalayas, and almost half of Canada. Many of these are energy production regions. They are also regions of energy transmission and distribution. The Trans-Alaska pipeline alone carries as much as 20 per cent of the US domestic oil supply.[20] As temperatures rise, the permafrost melts. The ice trapped inside the frozen ground liquefies. If there is poor drainage, the water sits on the earth's surface and floods. If there is good drainage, the water runs off, potentially causing erosion and landslides.

Melting permafrost has the potential to severely affect infrastructure in cold climates (see Figure 2). Linear installations such as pipelines, electrical transmission lines and railways are only as strong as their weakest point. If one section is destabilized, the entire supply can be disputed. Already in some cold climates pipelines, roads, ports and airports are at risk of imminent structural damage and possible permanent loss. In Alaska, complete Arctic communities are being relocated. One of China's top permafrost experts who was involved in the multi-billion-dollar, state-of-the-art Tibet railway, built in part on hundreds of kilometres of Himalayan permafrost, was quoted as saying, 'Every day I think about whether the railway will have problems in the next ten to twenty years.'[21] Although the railway is still in operation, not long after its opening sections of the foundation started sinking.[22] Often engineering solutions to these problems can be found, but they can add substantial costs and affect performance.

> 'One UK government report, commissioned after the costly summer floods of 2007, has found that potentially hundreds of UK substations are at risk of flooding'

Construction and repair are also being affected. In cold climates, heavy equipment is often moved in the winter when the ground is most solid. With warming, that window is shortening. In some areas of Alaska, for example, the number of days per year on which heavy equipment can be driven on the tundra has halved.

Not only does environmental change create challenges for new cold climate resource extraction, but existing installations that that rely on ice roads, waste containment and pipelines built on melting permafrost may need to be reassessed. In August 2006 a BP pipeline in Alaska corroded and broke. While this was not a direct result of environmental change, it gave an indication of the sort of vulnerabilities that may become more likely if melting permafrost undermines pipelines. The line carried close to 2.6 per cent of the US daily supply and the closure created an immediate spike in oil prices and gas futures. The US government considered releasing emergency stockpiles and the Alaska government faced a financial crunch.[23]

The stability of cold climate infrastructure is often overestimated. For example, with the retreat of Arctic sea

20. 'Climate change in the Arctic and its implications for U.S. national security'.
21. David Wolman, 'Train to the Roof of the World', *Wired*, July 2006.
22. Pankaj Mishra, 'The train to Tibet', *The New Yorker*, 16 April 2007.
23. Mary Pemberton, 'BP: Oil production may be closed months", Associated Press, 7 August 2006.

ice a shipping route from Russia to Canada, through the Northwest Passage, has been mooted. Russia has offered to keep the Canadian section of the route open past the summer season with icebreaker convoys. The proposed Russian terminal is Murmansk. The proposed Canadian one is Churchill, Manitoba, on Hudson Bay. Shipping via Churchill can cut transit routes between Russian and the US Midwest by hundreds of kilometres. Under the plan, grain is the main proposed cargo; however, fossil fuels could also be transported. Some in Ottawa support the plan. However, Churchill is only linked to the rest of Canada by rail, not road, and the railway, built in many places on permafrost, is already suffering from deteriorating tracks. There have already been derailments and at times in the summer the train cannot travel faster than 10 km an hour. This is an example of realities on the ground literally undermining economic and strategic analyses made in distant locations.

With environmental change, infrastructure problems in cold climates are likely to become more common. It is going to take a major investment in permafrost and cold climate engineering research to find ways to rebuild Arctic and other cold climate infrastructure in a manner that will be viable over the long term.

Other causes of disruption

Any extreme weather event, such as high winds, heavy rains/snows and ice storms, can impair power delivery, and there are global predictions of an increase in these kinds of disasters. One UK government report, commissioned after the costly summer floods of 2007, has found that potentially hundreds of UK substations are at risk of flooding.[24] The wake-up call came that summer when a switching station near Gloucester, servicing around 500,000 homes and businesses, came within inches of being flooded. Stronger storms can also bring down power lines and some areas, such as parts of the northern United States and southeastern Canada, may face more ice storms like the one that cut off the power for millions in the winter of 1998. Extreme events of all sorts are likely to become more common, straining power delivery systems.

Renewable energy generation

EEvery form of energy generation, including renewables, and every installation site chosen should be evaluated for its stability in times of environmental change. For example, while solar plants may seem immune from disruption as long as the sun transits the sky, if they are built on flood plains they risk being rendered useless. Wind farms should assess if longstanding air currents may shift or if the hills they are often built on are likely to erode or suffer from landslides. Geothermal power plants should ensure that they do not trigger earthquakes. Tidal generation should incorporate the effects of sea level rise, erosion, storm activity and so on. Just because an energy source is 'green', this does not mean it is sustainable under environmental change conditions.

Economic recalculations caused by environmental change

The clearest example of how energy supplies may be affected by a re-evaluation of cost is the way in which all of the above-mentioned disruptions (or even the likelihood of disruption) may affect insurance costs, potentially endangering the economic viability of certain investments.

Other factors may change calculations as well. For example, if predictions of increasing water scarcity hold true, fresh, clean water may substantially increase in value. This would force a re-evaluation of the real cost not only of hydro and freshwater-cooled nuclear installations, but of fossil fuel extraction and refining techniques that pollute water which could otherwise be used for drinking and irrigation.

Already China has abandoned or suspended the vast majority of its coal-to-liquid projects, in part as a result of concerns about water availability. Another potential area of concern is Canada's oil sands. The method of extraction used in the oil sands requires and contaminates large amounts of water. Currently Canada is perceived to have abundant freshwater; however that is predicted to change in some regions as the climate shifts. Already there are

24. David Shukman, 'Flood risk fear over key UK sites', BBC News, 7 May 2008.

concerns about water quality in some of the communities that share river systems with the oil sands. Apart from the domestic value of freshwater availability, ensuring a stable supply of freshwater for agriculture in Canada has wider implications. It is increasingly likely that, as other areas of the planet, such as Australia, become less fertile, Canadian agriculture's contribution to global supply will gain in relative importance.

Geopolitical factors

Many of the potential disruptions mentioned could engender a political response. For example, in the case of Russian pipelines being undermined by melting permafrost, if the engineering required for stabilization proves too costly, Russia might switch increasingly from pipelines to tankers. This would allow Russia much greater flexibility in delivery and could lead to greater politicization of supply.

It is also possible, though quite controversial, that an increasingly parched US will look to Canada to supplement its water deficiencies. In some areas of the US, such as the agricultural belts and water-scarce cities such as Las Vegas, water security might become more important than oil security. Other forms of energy may be found, but it is more difficult to find other forms of water. In such a case, US energy security policy (which has been supporting the water-polluting Canadian oil sands) might come into conflict with US water and food security policy (which would benefit by ensuring that a vast water supply to the north is not contaminated).

Another problem related to the politics of water that might affect energy supply could arise when dam building deprives one group, region or country of its expected supply of freshwater. Attacks on the installations themselves are even conceivable, should some become desperate enough as a result of increasing water scarcity – their goal being to destroy the dam in order to attain water supply.

Conclusion

There are concerns about both older installations not being designed for new conditions and new installations not integrating change into their planning. Either situation could result in marked decreases in energy output and risks to the installations themselves. That, in turn, could affect energy prices, economic growth and regional and global security. Volatile energy prices have the potential to destabilize major economies.

> ‘Energy infrastructure is often among the best funded, planned and maintained constructions available. The challenges that even this well-supported sector will face are an indication of the vulnerability of other large sections of the critical infrastructure that support our economies, security and lives’

Many of the challenges outlined above can be overcome with sufficient research, planning, engineering and financing. In some cases, it may even be possible to integrate change into planning in such a way that energy output increases with changes rather than decreases. For example, hydro installations in regions that are expecting higher rainfall could be designed to eventually take advantage of that excess flow, rather than be overwhelmed by it.

However, the reinforcement of global energy infrastructure is unlikely to happen overnight. A number of steps are required:

(1) an acknowledgment that the problems are real and wide-ranging;
(2) a will to counter them;

(3) appropriate investment in, and research on, potential impacts as well as engineering and design solutions;
(4) implementation;
(5) continual re-evaluation in the light of changing environmental conditions and predictions.

It is in the best interest of those concerned with energy security, such as national governments and the business community, especially the energy and insurance industries, to ensure this happens as quickly as possible. Until it does, it is to be expected that there will be increasingly frequent disruptions to energy supply, potentially in multiple locations and sectors at the same time. The economic, social and political costs are likely to be substantial.

At the same time, it may make sense to focus on building a more decentralized energy structure, preferably based on locally available renewables situated in secure locations. A degree of regional energy self-sufficiency could provide a better defence against the sort of large-scale outages that result when centralized power systems are compromised. This sort of regional, network-based system might also prove more flexible and adaptive, and therefore more able to cope with the increasing variability and unpredictability caused by environmental change.

Finally, it is worth remembering that energy infrastructure is often among the best funded, planned and maintained constructions available. The challenges that even this well-supported sector will face are an indication of the vulnerability of other large sections of the critical infrastructure that support our economies, security and lives.

Cleo Paskal is an Associate Fellow in the Energy, Environment and Development Programme at Chatham House and a consultant for the US Department of Energy on the Global Energy and Environment Strategic Ecosystem (Global EESE). She is also Adjunct Faculty in the Department of Geopolitics, Manipal University and Adjunct Professor of Global Change at the School of Communications and Management Studies, Kochi, India.

Chatham House has been the home of the Royal Institute of International Affairs for over eight decades. Our mission is to be a world-leading source of independent analysis, informed debate and influential ideas on how to build a prosperous and secure world for all.

Global EESE is a collaborative, international, multi-disciplinary network created to develop actionable foresight on energy and environmental security issues for the benefit of policymakers and the public. EESE convenes people worldwide to discuss, analyze and research critical issues and questions related to energy and the environment that potentially have security impacts. The insights and understanding that come out of these collaborative efforts can be used to make appropriate strategic decisions to mitigate risks, build resiliency, and seize opportunities to make a safer world.

Chatham House
10 St James's Square
London SW1Y 4LE
www.chathamhouse.org.uk

Registered charity no: 208223

Designed and typeset by SoapBox, www.soapboxcommunications.co.uk