Energy Justice

Ensuring Human Dignity in the Post-Carbon Future

By Clark A. Miller

When my flight landed in Ottawa last January, the news had already begun to circulate. The United States government had rejected a proposal to build the Keystone XL pipeline. The pipeline would have carried oil from the tar sands of Alberta to refineries on the Gulf Coast of Texas and Louisiana, creating an immediate burst of construction jobs in the U.S. and helping enhance U.S. energy security. In Canada, it would have ensured the continued expansion of the country's oil boom for decades.

As I saw first-hand, many Canadians were deeply angered by the decision and supported Prime Minister Stephen Harper's reaction to pursue a Chinese offer to buy tar sands oil via an alternative pipeline to British Columbia. Only a few Canadians, however, seemed to acknowledge either the local devastation that oil sands development has already wrought in Alberta, or the serious challenges for climate change that would result from opening new distribution pathways for a pool of oil that, in the end, may rival Saudi Arabia's. Prospects of new oil wealth have a tendency to overshadow a wide range of potential environmental and social risks.

Alberta's tar sands are a key battleground in the global fight over the future of energy. Environmental groups from the U.S. and other countries have funded their Canadian counterparts for years in a pitched battle to halt the development of Alberta's energy resources. Canadian officials cry foul over this foreign interference but for years, multinational oil companies have also lobbied the Canadian government in favor of this development. At stake in this fight is the direction the world will take in responding to an ever increasing energy demand, a decline in conventional sources of oil and natural gas, and the consequences of unconventional fossil fuels for the climate system and the global economy. Oil from Alberta's tar sands

▷ Steam Assisted Gravity Drainage oil processing plant, Fort McMurray, July 21, 2009. *Orjan F. Ellingvag/Dagens Naringsliv/Corbis*

will help perpetuate dependence on carbon-based fossil fuels for another generation of humans, thereby further exacerbating climate change and weakening arguments for investing in renewable energy technologies. Indeed, Alberta's oil will be even worse for the climate system than Saudi Arabia's, putting more carbon in the atmosphere for each unit of energy that is eventually obtained. Yet, it will also make Alberta—and Canada—very, very rich.

The fight over Keystone XL is thus as much about justice as it is about energy. Energy choices are, while obviously technological, also thoroughly social. How societies produce and consume energy is intimately tied to the function and organization of not only ecological but also social, political, and economic systems at scales ranging from one village to the whole planet. Energy is vital to the success of modern societies, the smooth functioning of the global economy, and the day-to-day lives of the world's inhabitants. It is one of the largest sources of wealth on Earth and the driver of some the planet's gravest risks. Over the next fifty years, humanity will face hundreds of choices like Keystone XL: choices about what kinds of energy systems to build for the future, where to build them, and how to distribute their benefits, costs, and risks. These choices will play a key role in shaping the human consequences of our energy future, and will ultimately help determine which communities flourish and which deteriorate over the course of the twenty-first century. No wonder it's a fight.

Humanity cannot rely on its current sources of energy. This is a historical fact that results from four important trends. First, energy demand continues to grow; hence, communities must continue to add new capacities to generate energy over time (or they must find new strategies for reducing the growth of energy demand, through energy efficiency for example). Second, energy infrastructure ages and must be replaced over finite periods of time in order to update technologies, retire old facilities, and meet new regulatory requirements. In the United States, for instance, the electricity grid infrastructure is already over half a century old and most nuclear and coal-fired power plants are forty to sixty years old. The joke goes that the United States has the best grid money could buy–in 1947. Third, current energy resources become depleted and must be replaced with new resources. According to the International Energy Agency's 2011 World Energy Outlook, existing sources of crude oil will supply no more than 20 percent of the world's demand for oil by 2035. Therefore additional oil supplies will need to be found or be replaced with other forms of energy in the intervening years.

Fourth, energy prices are rising in an unsustainable fashion, especially in the oil sector. Blame for this rise is often placed on new demand from China and India, prompting calls for more drilling, especially in the United States. The truth is more complex. Exploration costs and the politics of oil wealth increasingly combine to put a high floor beneath world oil prices. New oil is expensive to find and produce, as

the search for conventional oil moves to more extreme environments and the bulk of new oil finds are unconventional, such as Venezuelan heavy crude and Canadian tar sands. At the same time, the major oil producing countries need high oil prices to balance their budgets.

None of this is a new phenomenon in the energy sector. We often think of the energy system as remarkably durable, while in fact the energy system is in constant flux. New power plants replace old ones. New oil and gas wells are drilled as old ones dry up. Since the 1970s, for example, the Powder River Basin in Wyoming has emerged as a major source of both coal and natural gas, with seven companies now operating coal mines in the region, tens of thousands of natural gas wells dotting the landscape, and new infrastructures connecting the region to major railways. This burst of development occurred in large part as a result of 1970 amendments to the 1963 Clean Air Act, which put a high premium on the region's coal resources; containing little or no sulfur, the region's coal significantly reduced the nation's sulfur dioxide emissions. At current rates of extraction, however, most coal mines in the Powder River Basin have only about twenty years of active life left, and any new mines in the region would require new federal permits. Hence, the basin's economic future remains deeply uncertain.

Fashioning an energy future can seem, therefore, as if it is simply a matter of choosing what kind of energy technologies to deploy in the replacement and expansion of existing infrastructures. And, indeed, widespread deliberations are now occurring both within the energy sector and societies across the globe about energy technology choices for the next fifty years. Yet, to describe these choices as merely about technology does a gross injustice to their import and complexity. Energy choices are ultimately choices not only about what technologies to deploy but also about what societies want to build around those technologies. They are about how people will live and make their livings in the future and how the benefits, costs, and risks of energy systems will be distributed across diverse communities. They are, in other words, choices about energy justice.

Energy and People

To fully appreciate the subtle complexities of concerns about energy justice requires an exploration of the many and varied ways that human lives and livelihoods are bound together with technologies that produce and consume energy. Social scientists refer to such interconnections as socio-technological systems, acknowledging that the social and technical dimensions of such systems can be difficult—at best—to make sense of separately. These ties between the social and the technical range across many facets of all human society. Social identities (and imaginaries) exist around machines—why else would someone pay a large sum of money for a Jaguar, a Ferrari, or a Maserati? So, too, do patterns of human relationships, organization, and work. Human values

and objectives are inevitably designed into technologies and technological systems. Indeed, the defining characteristic of technology—its use as a tool to serve human purposes—invariably shapes the crafting of the technology. Modern human activity and organization and their technical foundations thus come together in tightly coupled socio-technological systems.

The significance of the ties between patterns of energy and patterns of human organization and activity is clearly evident in other energy systems: electricity generation and distribution from coal, natural gas, and nuclear power plants; the production and refining of oil; and the mining and transport of natural gas for household and industrial use as well as for automobile, railway, and ocean transportation. Collectively, energy systems comprise the largest and most important of all human enterprise. Energy infrastructure—electricity grids, oil and gas pipelines, road and rail networks—span continents. Oil production, refining, and distribution is a global system involving oil wells, including massive offshore oil platforms, in dozens of countries, transport ships, pipelines, refineries, gas stations, and hundreds of millions of gasoline and diesel engines in cars, trucks, airplanes, trains, boats, tanks, lawnmowers, generators, industrial facilities, etc. It is no accident that nine of the twelve largest companies on the Fortune 500 are energy companies.

Consider, for a moment, one particular socio-technological energy system: air transportation. In technical terms, the air transportation system comprises a wide range of technological elements designed to convert jet fuel into the ability to move passengers and freight rapidly around the globe. This system is integral to modern social order. Companies, governments, universities, and tourists all depend on its smooth functioning to carry out their business, activities, and operations. In a globally networked society, new technologies of transportation and communication mix to make patterns of human activity and organization never before possible in human history.

Yet, the system also depends fundamentally on patterns of human activity and organization. The smooth functioning of air transportation relies on a large and diverse workforce of highly trained pilots, mechanics, flight attendants, ticket salespeople, baggage handlers, fuelers, de-icing machine operators, meteorologists, air traffic controllers, managers, accountants, software programmers, and many others—not to mention the people and institutions required to train and certify all these individuals. Of course, airlines also need investors, airplane manufacturers, and the companies that drill oil and refine it into jet fuel.

Most important of all, airlines require passengers, as became abundantly clear after the terrorist attacks of September 11, 2011. A renewed fear of flying led to a roughly 25 percent drop in ridership and nearly bankrupted several U.S. airlines in the ensuing six months. To ease travelers' concerns and restore their trust in the system,

the U.S. government established the Transportation Security Administration (TSA) and radically increased security operations at U.S. airports, including the short-term deployment of U.S. military personnel. Airlines also need to be able to trust their passengers not to hijack or otherwise exploit airplane technologies for non-authorized purposes. This trust must either come via a voluntary compact or through robust security procedures to ensure that no passenger carries any other technology onto the plane that could be used as a weapon.

In addition to highlighting the ways in which the social and the technological merge in modern systems, the air transportation system also reveals two other important dimensions of such systems. The first is complexity. Air transportation operates at the intersection of several distinct systems—airplane manufacturing, air travel, fuel production, airport maintenance and operations—as well as a range of social, economic, and political, processes, and phenomena. Routine air travel has increased mobility, for example, for students going to college, grandparents visiting their grandchildren, and middle class families going on vacation to Disney World and Las Vegas. Multinational corporations have become common—as have global supply chains. The floral industry is now global, linking consumers in Europe and the United States with producers in Africa and South America. Some of these processes, such as national air safety policies, are highly top down in organization. Others, such as the flight plans of casual and business travelers, accrete from the daily decisions of millions of individuals, families, and organizations.

The transformation of the air transportation industry after 9/11 also reveals, secondly, the implications of socio-technological systems change. If taken in the context of the global air transportation system, as a whole, the addition of new security procedures at airports constitutes a relatively modest overall change. We might say that passengers must merely now pass through a somewhat more rigorous security evaluation before boarding aircraft. Yet, the depth and implications of this modest change have nonetheless turned out to be quite significant for social and political organization. In the United States, the change ushered into existence an entirely new, if modestly sized government agency, with sixty thousand employees and an annual $8.1 billion budget (roughly comparable to the budget of the U.S. Environmental Protection Agency or the U.S. National Science Foundation).

Security technologies have been upgraded throughout the industry, including onboard planes as well as in airports. The TSA maintains a list of passengers who are not allowed to fly and screens every passenger before allowing them to fly. Airport buildings have, in some cases, been significantly reconfigured. New scanning machines have raised, for some passengers, difficult questions about privacy and propriety. Alternative screening practices involving hand searches have also piqued the ire of

passengers and raised unsettling ethical questions about the suitability of professional security behaviors in a civilian setting. All foreign visitors to the United States must now be fingerprinted and photographed at the border, be registered upon entry and exit, and have their visits to the country tracked. In sum, changes to air travel have altered not only the technological infrastructure of airports and airplanes but people's relationship to one another, their expectations of fellow travelers and foreign visitors, and the organization of government.

Energy systems help define not only what we do and where we go but also who we are and how we live as human beings. When electricity grids began being constructed in the late nineteenth and early twentieth centuries, their predominant customers were industrial factories replacing water wheels or steam engines. Those factories were primarily daytime operations. Early coal-fired power plants didn't like to shut down, however, and so operated twenty-four hours each day. Our 24/7 culture derives from the design of those early power plants. Electricity utilities, looking for ways to improve business, created ways to sell electrons in the evenings, at night, and at weekends. They invested in electric streetcars to move people to and from work in the early mornings and late evenings. They also invested in amusement parks to provide entertainment for evenings and weekends, entertainment that required moving people around the city on streetcars. All of which, incidentally, consumed energy.

Firms like General Electric, one of Thomas Edison's inventions, began manufacturing and marketing electrical devices for the home: lights, stoves, irons, toasters, basically anything to get us to consume more electricity in the mornings and evenings. Today's televisions, microwaves, stereos, video game systems, and the multiplicity of other devices owe much to the original infrastructure of household electric delivery—power lines connected to homes and electric wires and outlets run throughout the walls—built to handle the earliest electrification of the home. In order to push sales of electric lighting, early utility companies sponsored massive lighting displays to illuminate the power of light and its ability to transform night from a time of sleep to a time of play. Early generations were encouraged to use light profligately, and even now sumptuous electric light shows reminiscent of these earlier displays—and still sponsored more often than not by utility companies—remain popular holiday traditions. Perhaps most significantly, lighting extended the business day. Shops remained open longer. Factories moved to double and then triple shifts, benefiting from the sale of cheap electricity at night, when utilities still had excess power to give away. Ultimately, dark cities became symbols of fear, giving rise to widespread street lighting to help ensure the safety of people now out on the town until all hours.

Automobiles, too, have shaped patterns of human settlement and activity in fundamental ways. In postwar cities like Phoenix, Los Angeles, and Atlanta, the car

freed urban developers from the need for density in order to accommodate human transportation by foot. Cities, suburbs, and exurbs continue to sprawl across vast distances, with daily commutes to and from work still extending to an hour or more. The family home, on its own plot of land, has become the de facto American dream—albeit one temporarily set back by the collapse of the housing bubble in the late 2000s. Paved streets and parking lots have become ubiquitous to ensure easy transportation from the home to work, to the shops, and to entertainment. Nor are these trends limited to the United States. Private automobile ownership has exploded around the world as the burgeoning global middle class demands access to this powerful technology of personal transport.

Addiction and its Consequences

The depth of energy's role in constituting modern societies has turned energy into an addiction. That addiction is fueled by a global energy industry primed to provide cheap, reliable energy. Indeed, these two criteria—the cost of energy and its reliable availability, where and when people want it—have defined energy policy and energy business in much of the world over the past several decades. It is hard to gainsay this emphasis. The Arab oil embargo in the 1970s caused major problems for economies highly dependent on cheap oil. More recently, a rapid rise in the price of oil—to well over $100 per barrel in 2008—has contributed to major social and economic dislocations in many parts of the world. In the United States, gasoline prices over $4 per gallon threw poor households, who are often more dependent on automobiles than richer families, into disarray, which helped undercut consumer spending and push the nation further into recession. The continuing high price of oil worldwide has contributed to rising food prices and, with them, a wave of global social and political unrest. Cost and reliability matter in the energy business. In many respects, they *are* the energy business.

Nonetheless, over the past twenty years, energy policies have added a third major criterion to energy analyses: carbon. Rising concentrations of carbon dioxide in the atmosphere, coupled with projections regarding the resultant climate change, have fundamentally altered energy policy debates. Energy's carbon content has become almost as significant as its cost and reliability. Carbon-based energy sources—oil, coal, and natural gas—have seen their long-term prospects challenged by other, non-carbon energy technologies, such as solar, wind, geothermal, and nuclear. Countries now face stark choices between continuing to rely on carbon-based energy, and risking the resultant disruptive shifts in the Earth's climate system, or adopting newer energy technologies that remain, for the most part, more expensive and less reliable. These choices largely pit current stability against long-term climate change for future generations.

Yet, as critical as these three criteria are (cost, reliability, and carbon content), they cannot remain, I argue, the only standards for making energy choices in the twenty-first century. It is critical, I believe, that human societies develop robust frameworks for assessing the human consequences of energy system change. There must be a quest for energy justice.

Meeting this challenge will require two fundamental shifts in energy governance. First, the ends of energy governance must change. If societies are to go to the trouble of transforming the largest human enterprise on the planet, they should set higher ambitions than just reducing carbon emissions. Large-scale energy system change should be an opportunity to significantly improve the flourishing of human communities and to markedly reduce the risks energy production and consumption impose on many of the world's communities. Second, the processes of energy governance must be reinvented. Today, energy planning is largely designed to handle incremental changes and to privilege incumbents. Indeed, in many parts of the world, energy production is a monopoly enterprise. Procedures for siting new energy facilities in the United States, for example, allow only for the proposal and evaluation of specific facilities at specific locations. Instead, new strategies are needed that enable communities and energy industries to partner in reimagining and redesigning broad energy futures.

The need for these changes is particularly urgent given the magnitude and complexity of potential transformations of energy technologies and their associated socio-technological systems. For most of the past century, energy change has been largely incremental. Energy supply and demand grew so energy systems expanded geographically. Major changes occurred slowly, however, and did not fundamentally alter basic patterns of energy production and consumption, giving individuals, communities, and societies time to adapt. Key exceptions to this rule—the rise of nuclear energy in the 1950s and the 1960s and the regulatory push toward low sulfur coal in the United States—are illustrative in their human consequences.

Like it or not, energy systems change will bring fundamental technological and social change in the twenty-first century. Even the established fossil fuel industry faces reformations far removed from those experienced in the past. Drilling for conventional oil has delved into more extreme and difficult environments, including deeper offshore waters. In turn, these operations carry greater risks, as became apparent from the massive economic and environmental damage caused by the Deepwater Horizon spill in the Gulf of Mexico. Similarly, the oil industry will rely more heavily over time on unconventional sources of oil, such as Venezuelan heavy crude and Canadian tar sands, which not only pose greater risks of environmental degradation during drilling and extraction but also result in even greater carbon dioxide emissions per unit of fuel produced and consumed. Likewise, the current boom in

the natural gas industry has resulted, to a large extent, from unconventional sources of methane stored in shale in places like the Marcellus Formation in Pennsylvania, Ohio, West Virginia, Maryland, and New York, and the Powder River Basin in Wyoming. Extracting these resources uses a technology called hydraulic fracturing, or 'fracking,' that injects high pressure water and chemicals deep into the ground. This method is now under attack by activists and communities concerned about the consequences of the extraction process to land, water, and health.

Nor are renewable technologies exempt from concerns about human consequences. Solar panels on rooftops have transformed energy consumers into energy producers, for example. A good thing, yes, but in large numbers, they threaten the stability of the existing electricity grid and the business model of utilities. This in turn threatens the reliability of the income stream for utility investors, the majority of whom are retirees. Utility companies are energy providers of the last resort and their failure would threaten those who rely on such services, especially the poor who cannot afford their own rooftop energy. Yet, solar panels also grant a degree of freedom to homeowners and businesses, changing their relationship with the centralized socio-technological systems that are modern utilities today. Solar panels may also infect behavioral patterns, reversing incentives that utilities have given us to consume energy at night instead of during the day. Over the next century, our energy consumption patterns may change as much as they did during the last.

Large-scale solar farms need land that must be acquired. For a while yet, already disturbed agricultural and public lands will suffice for building solar power plants, but meeting the energy demands of the future will ultimately require building on wild lands. Biologists already worry about the impacts of large-scale solar facilities on biologically diverse deserts. Some solar power plants also consume very high levels of water that can strain water supplies, especially in the arid lands that seem to have so much of the world's available sunlight. Many rural residents complain that solar and wind projects alter rural landscapes largely for the benefit of urban communities. And indigenous communities worry that future renewable energy projects will be carried out with the same disregard for their heritage and history as previous generations of energy projects.

Upstream, Midstream, Downstream

In evaluating the human consequences of energy systems change, it is useful to differentiate the benefits, costs, and risks that occur upstream, in energy production, midstream, in energy consumption, and downstream, as choices about production and consumption ripple through society and the environment. Upstream benefits, costs, and risks occur in the production, distribution, and sale of both energy and the

fuels used to produce it. Owners of energy resources and infrastructure often create enormous wealth for themselves and the communities they invest in. Thanks to the coal mines mentioned earlier, the state of Wyoming, when I grew up there, had no state income tax and one of the nation's lowest sales tax rates, yet it spent more per student on education than any other state but one. Alberta—and Canada—are quickly learning this lesson, too.

Yet, the downsides of energy wealth are also apparent. For decades, the U.S. and Europe helped authoritarian rulers retain power in oil-rich states in order to ensure control over reliable energy supplies. Even after last year's Arab Spring, the relationship between power and oil remains relatively unchanged in the region. Of the major oil producing nations, only Libya ousted its dictator. Leaders in Iran, Kuwait, Saudi Arabia, and elsewhere remain firmly in control, at least for the moment. Oil revenues provide the central resource via which the Tehran government maintains the fealty of both its military and security forces in the face of the very real threat of widespread political unrest. Even in democratic societies, energy producers often use their wealth and position to secure power. It may not be a coincidence that Canada's current prime minister hails from Alberta. The United States has had several presidents and other national leaders with close ties to the oil industry—and widespread concerns persist in the United States about the corrupting influence of the coal and oil industries on American politics.

Changes in energy systems can also have profound consequences for communities and regions. In 2010, for example, U.S. President Barack Obama declared a six-month moratorium on offshore drilling in the aftermath of the Deepwater Horizon oil spill. The outcry from Gulf Coast states was immediate. A region already reeling economically from the spill's impacts on coastal fisheries and tourism now faced at least a short-term halt in revenues from offshore drilling platforms, as well as the longer-term threat that platforms would leave the region in favor of less regulated waters. These events offered a window into the long-term economic consequences that could occur, both regionally and nationally, should the U.S. opt to transition from oil to other energy resources. A quick glance at renewable energy resource maps shows that the geography of renewable energy across the nation overlaps little with the geography of oil, coal, and natural gas. A large-scale shift from coal-fired to solar-fired electricity would bring a financial boom to California, Nevada, and Arizona while undermining the economic futures of states like West Virginia and Wyoming, although the latter also has some potential wind energy resources.

Nor, of course, are the risks of energy production solely financial. American Indian tribes in the desert Southwest have felt the environmental and health impacts of coal and uranium mining for decades, as have miners in many parts of the world. Alberta's tar sands operations have had significant impacts on water and forests in

the province. Louisiana workers whose communities are utterly dependent on the oil industry also face highly polluted environments, as do the predominantly African-American communities who live in the state's 'Chemical Alley'—a concentration of industries that process oil into a wide range of energy and other products. Even solar panels are not free of concern. Life cycle assessments of the industry are only beginning to estimate the potential environmental and social impacts of large-scale solar manufacturing and deployment, and to design strategies for ensuring that 'green' energy is really as green as its image.

Energy is extraordinarily valuable to those who have access to it at low costs. Energy consumption and its midstream benefits are at the heart of modern industrial and post-industrial economies. While Saudi Arabia has grown wealthy from selling oil to the United States and Europe, it is the United States and Europe that have transformed the resulting energy into the world's most powerful economies. China, too, has long recognized how central energy is to economic growth and has gone to great lengths both to secure access to reliable and inexpensive energy and to diversify its energy resources: China today has the largest solar energy manufacturing facilities in the world.

Lack of access to reliable and inexpensive energy can also impose severe limits on poor communities. These poor communities, many of which are just as dependent on energy as anyone else in modern societies, often pay a significantly higher proportion of their income for energy as a result. In the United States, where automobiles are all but essential transportation tools in many cities, families made homeless often face just as difficult challenges from the loss of their vehicle as their home. Without a car, they must rely on minimally available public transportation to get children to and from school and parents to and from work, an exercise that can often require hours at the beginning and end of each day. The resulting time loss makes it even more difficult to seek out new housing arrangements or new jobs that might transform the family's fortunes.

Energy consumption technologies can be just plain dangerous. Anyone living with a toddler in the house knows that children must become thoroughly socialized in order to avoid highly dangerous encounters with electrical cords and plugs, irons, fireplaces, lawnmowers, automobiles, and many other modern technologies. Until they are socialized, children must be carefully protected to avoid injury or death. Even adults are at risk: so dependent are modern societies on technologies that convert energy into transportation that those societies willingly ignore high rates of injuries and deaths from transportation accidents. In the United States, tens of thousands of individuals die in automobile accidents each year, and hundreds of thousands are injured. In Japan, hundreds of thousands of people were displaced from their homes by the threat of radiation exposure after the accident at Fukushima. Yet societies seem perfectly willing to simply ignore these harms in planning

for energy futures. Finding ways to make future energy technologies not only clean but also friendly to all of the world's inhabitants seems an important criteria for future energy justice.

Last but certainly not least, it is critical to remember that the evolution of energy systems can create a range of benefits, costs, and risks well downstream of energy production and consumption. These indirect human consequences stem from the evolution of energy systems as they expand, engage, and transform larger patterns of social, economic, and political organization. Suburbs, for example, are not an energy technology, but they resulted from the choices made by individuals, institutions, and communities as societies reorganized themselves around the rise of the automobile and the availability of inexpensive gasoline. Not surprisingly, therefore, when gasoline prices soared in 2008, it had enormous consequences for the lives of, especially, less wealthy families who had moved to the extreme edges of suburbs to take advantage of new low-cost housing. For the first time, significant numbers were forced to quit secure jobs in search of new ones, closer to home, in order to reduce rapidly rising fuel costs—a choice that turned disastrous for some in the subsequent global economic collapse, when employers tended to shed their newest employees first.

The downstream human consequences of energy systems can flow in other ways, as well. Historically, oil has shaped geopolitics and played a major factor in conflict in the Middle East. The resultant patterns of political oppression, ethnic conflict, and social mobilization helped produce terrorist networks partly financed by oil wealth. The geography of energy geopolitics continues in the rise of Venezuela, Canada, Australia, and Russia as regional energy suppliers. The climatic consequences of oil and coal consumption are also already flowing downstream, challenging communities around the globe. The World Health Organization estimates conservatively that one hundred and fifty thousand people have died as the result of shifts in disease patterns in Africa and Asia due to climate change. Scientists have also begun to link the recent extreme flooding events that have devastated many parts of the globe to climate change. The geography of climatic vulnerability is still being debated in detail, but its patterns will have enormous social, economic, and political consequences for decades to come.

The Search for Energy Justice

Energy system change will arguably remain one of the most important policy domains throughout much of the twenty-first century and energy technologies will make regular headlines throughout this period. Alberta's fight against an international coalition of environmental groups to build an infrastructure to channel its oil to the world is one such story, but hardly the only one.

An Ecuadorian court recently ordered Chevron to pay $18 billion in compensation

for damage inflicted on the Amazon jungle. In Japan, after the Fukushima nuclear accident, public confidence in government efforts to ensure the safety of Japan's food supply has collapsed in the face of new revelations regarding radiation-tainted food. Around the globe, communities are mobilizing against the human consequences of energy systems, giving rise to a wide range of social protest. The government of India has faced extensive social opposition, protest, and even violence over its decision to accelerate the growth of the country's nuclear power industry. Elsewhere, wind and solar farms face strong opposition, too. These events now rival new technologies for energy headlines, introducing world publics to the deep questions of energy justice pervading humanity's choices about energy futures. At stake in these choices is not just how humanity will produce and consume energy but what kind of societies people will live in and how those societies will distribute power, wealth, and risk.

Energy stagnation is not the answer, of course. It cannot be. Energy systems must change. But the world's leaders—in the energy sector and in every other aspect of society—must acknowledge the fundamental questions of justice and injustice that inevitably accompany every energy transformation. Energy assessments must supplement technological and environmental assessments with assessments of the human dimensions of new energy technologies. The energy industry–and society more generally–must learn to ask: "Progress for whom?" and "According to what criteria?" It must find ways to approach communities as honest partners, both in the opening of new energy systems and the closing of old ones. Energy system design and redesign must, from the outset, fully engage the public in thorough deliberations about broad energy futures, alternative energy technology options, and specific energy system design choices. Such strategies will never eliminate the politics of energy change, but they may help mitigate its worst excesses while helping ensure that energy systems of the future are not only more environmentally friendly but also more just.