Reducing climate risk: Climate change mitigation and bioenergy

Avoiding dangerous climate change requires ambitious actions to sharply reduce greenhouse gas emissions. SEI works to inform, support and advise decision-makers and civil society on ways to achieve these reductions and build a low-carbon future – including the role of bioenergy. We have also built tools and analytical frameworks to explore the options, from the global to the local level.

Key insights

SEI's research on climate mitigation is broad and diverse, with significant contributions to both the scientific community and policy discourses around the world, as well as capacity development. The insights discussed here provide a sampling of the range of our work.

- ***Sub-national climate policy should focus on sectors where local actors can exert the most influence and the potential for abatement is greatest; in cities, that is likely to be transport and buildings.***

Sub-national governments can provide an important laboratory for climate policy innovation, and with rapid urbanization around the world, city-scale mitigation efforts are ever more crucial. Building on SEI's history of analysing GHG abatement opportunities for U.S. states (e.g. Massachusetts), SEI has worked with local governments to better gauge their emissions and find effective mitigation options.

For example, SEI's work with King County stands as one of the most comprehensive analyses of local-scale emissions to date (Erickson et al. 2012). From that research, SEI built a detailed framework for local governments to track emissions (Erickson and Lazarus 2012) and informed the local government network ICLEI's primary reporting framework in its U.S. Community Protocol. SEI then worked with officials in Seattle to develop an in-depth, detailed scenario for how the city might achieve its goal of carbon-neutrality, identifying ways to cut emissions by up to 90% by 2050 (Lazarus et al. 2011).

Most recently, SEI has worked with the C40 Cities Climate Leadership Group to develop estimates of the GHG abatement potential of C40 cities in the years 2020 and 2030, as well as to identify criteria for a robust framework for assessing GHG reductions at the city scale, which is now under development.

- ***Climate change mitigation policy urgently needs to confront fossil-fuel development, as global warming can only be kept below 2°C if the vast majority of the world's coal and unconventional oil and gas resources stay in the ground.***

The International Energy Agency has warned that if we are to meet the 2°C target, about two-thirds of the world's proven oil, gas and coal reserves must be left undeveloped, and many financial institutions have begun to explore the implications for markets of having "unburnable carbon". Still, massive new investments continue to be made; according to the IEA, enough new fossil-fuel infrastructure is slated to come online by 2017 to lock in what remains of our carbon budget.

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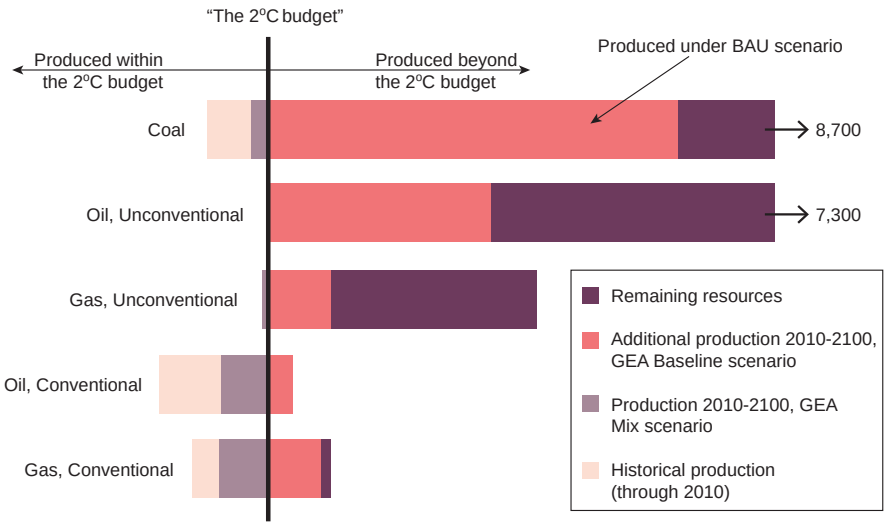
Seattle and Washington State have worked to reduce transport-related emissions by improving public transit options and encouraging cycling.

An SEI project launched in 2013 explores the implications of this disconnect between climate policy debates, and energy development – especially in countries that are focusing on green growth. Our work is based on three premises: that climate change mitigation can and must happen; that technologies such as carbon capture and storage (CCS) are unlikely to make a major near-term impact; and that policies to slow or limit fossil fuel extraction, not just fossil fuel use, are needed.

In this context, we have examined different ways to assess the GHG impact of new fossil-fuel infrastructure (Erickson and Lazarus 2013b), aiming to develop a more robust analytical framework that could be applied to fossil-fuel investments around the world. We also produced a case study of the proposed Keystone XL pipeline that was cited in the U.S. Department of State's Environmental Impact Statement of the project.

A related analysis focused on different ways to account for fossil fuels in GHG emissions inventories (Erickson and Lazarus 2013a). Typically, emissions are measured and regulated at the point of fossil fuel combustion (e.g. power plants) or distribution (oil and gas supply); however, this demand-side focus means countries could increase fossil-fuel supply and infra-



Fossil fuels exploited vs. left in the ground, through 2100, relative to a 2°C emissions budget, in terms of CO_2 emissions resulting from fuel use.

Drawing from data on historical fossil fuel use (IEA 2013a), fossil fuel reserves and resources (GEA 2012), and projected fossil fuel use under GEA's Mix and Baseline scenarios, this figure shows the amounts of five categories of fossil fuel – conventional natural gas, conventional oil, unconventional gas, unconventional oil, and coal – that have been burned (pale pink bars) and could still be exploited and combusted through 2100 (pale purple bars) under a scenario (GEA Mix) that represents at least a 50% chance of staying within 2°C. The dark pink bars illustrate the additional amounts of fossil fuels exploited and combusted through 2100 under a business-as-usual scenario (GEA Baseline). The dark purple bars represent the amount of additional recoverable resources. As shown, the vast majority of the resources left in the ground as the result of achieving a 2°C target would be coal and unconventional oil.

structure, potentially locking-in substantial future emissions, with relatively little effect on their own emissions accounts. Complementary, extraction-based accounting frameworks are needed to fill this gap.

SEI's work on this topic has also emphasized the need to consider fossil-fuel development in green growth planning efforts and LEDS studies. To date, neither guidance documents, nor country-specific studies have paid much attention to these issues, yet failure to consider them creates substantial lock-in risks. Supply-side accounting frameworks and policy interventions can lead to more effective and comprehensive strategies to reducing global GHG emissions (Lazarus and Tempest 2014).

- ***Modern bioenergy, including liquid biofuels, is not a panacea, but done well, it can greatly contribute to both mitigation and energy access in developing countries.***

Perceptions of bioenergy have changed dramatically in the last decade. Once dismissed as dirty and undesirable in most developing countries, and little-used elsewhere, it thrived as liquid biofuels were embraced as low-carbon alternatives to petroleum products. Then came the "food vs. fuel" backlash as well as an extended EU policy debate on the sustainability of biofuels (Johnson 2011).

SEI's research has focused on three aspects of this issue. The first, the subject of the book *Food versus Fuel* (Rosillo-Calle and Johnson 2010), is the complex linkages, synergies and conflicts in the use of land resources, which involves a series of connected choices across multiple products and multiple landscapes. The second is the potential for developing countries – SEI's focus has been on Africa – to exploit biomass resources that can give them a comparative advantage, as Brazil did with sugarcane; this was the subject of a second book (Johnson and Seebaluck 2012). SEI has also compared transitions to alternative transport fuels and vehicles in countries at different levels of development, focusing on Brazil, Malawi and Sweden (Johnson and Silveira 2013).

Third, SEI research has shown that developing modern bioenergy can not only expand energy access, but also help reduce traditional biomass use in poor countries that is associated with deforestation and black-carbon emissions. Thus, the net result is not necessarily more biomass use for energy, but rather more effective and efficient biomass use. As part of this work, SEI co-hosted a national seminar on bioenergy in Malawi (for a summary, see Johnson and Jumbe 2013).

SEI's approach has emphasized looking at energy security and climate mitigation through a "development lens", to highlight the complexity and multi-scale, multi-sector nature of bioenergy policy-making. It has also stressed the need to link biofuels policies to the creation of a "bio-based economy", which was also the subject of an in-depth report (Kemp-Benedict et al. 2012) produced as part of the business-focused 3C (Combat Climate Change) partnership. Pathways of investment in bioenergy have been explored in a dynamic setting in the National Bioenergy Investment Model developed through an SEI collaboration with the Centre for International Forestry Research (CIFOR).

Other major activities

• LEAP (the Long-range Energy Alternatives Planning system), which is used by thousands of planners and researchers worldwide, is a major contribution by SEI to mitigation and low-carbon development planning at all levels. LEAP has been applied by many developing countries in creating their National Communications to the UNFCCC, at the U.S. state scale, and for city-level planning in Seattle, Copenhagen and several cities in China and South Africa. In addition, it has been applied in several SEI-led projects, including *Energy for a Shared Development Agenda* (Nilsson, Heaps, et al. 2012), a global energy study prepared for the Rio+20 conference. The project, a major international collaboration, included building a global energy and emissions model, scenario analysis and transitions analysis, and synthesized lessons from 20 transformation cases around the world.

• LEAP has also become a key tool for countries creating Low Emissions Development Strategies (LEDS). SEI is supporting several countries developing these strategies, including Mexico, the Philippines, Kazakhstan and Mongolia, and has also been a key provider of technical support to international programmes such as the United Nations Development Programme (UNDP) Low Emissions Capacity Building programme and the U.S. government's LEAD programme (Low Emission Asian Development). SEI has also been working to develop improved methodologies, fill data gaps and enhance national capabilities. As part of SEI's work with the Climate and Clean Air Coalition, LEAP has also been upgraded to support short-lived climate pollutants (SLCPs) analysis.

• SEI is building considerable expertise in consumption-based emissions accounting, not only through the Seattle team's subnational work, described above, but also through several projects in York, most notably the Resources and Energy Analysis Programme (REAP, discussed in detail in a separate brief). SEI has

also adapted REAP (as REAP Petite) to help community groups reduce their carbon footprint. This is part of a broader effort to foster behavioural change, engage citizens in climate responses, and build resilience by developing new skills and fostering a sense of community.

• SEI has explored ways to reduce emissions in specific economic sectors; this includes a project on mitigation (and adaptation) in the UK food system; a report on a "zero carbon" vision for UK transport; a study for the U.S. Environmental Protection Agency of the emissions implications of different ways of disposing of woody biomass residues in the U.S. Northwest, and a study of issues and options for benchmarking industrial GHG emissions.

• As part of the BalticClimate project, SEI-Tallinn led the development of a web-based resource for policy-makers, planners and businesses, with scientific data and practical support for mitigation and adaptation. Launched in 2008, with 23 partners from across the region, BalticClimate aims to provide decision-makers and other stakeholders with the climate knowledge they need. The online toolkit that SEI developed (toolkit.balticclimate.org) includes modules for policy-makers, spatial planners, and small and mid-sized businesses, provided in the 11 Baltic Sea Region languages as well as English.

• SEI has also done important work on sustainable transport. A study in Estonia, for example, found that electric cars there emit more GHGs than gasoline-fuelled vehicles, because Estonia's power comes from shale oil (Jüssi and Sarv 2011). Another set of studies focused on how effective policies and institutions could stimulate the development, diffusion and use of low-carbon transport technologies such as fuels cells, biofuels and hybrid-electric vehicles (Nilsson, Hillman, et al. 2012).

New research and future pathways

SEI continues to develop and improve LEAP, and to build capacity and support a community of users around the world. In 2012, SEI completed a project to link LEAP and WEAP (SEI's Water Evaluation and Planning system), and we continue to promote the use of both tools for integrated mitigation and adaptation planning. SEI also continues to develop data sets and methods that can be used by national policy-makers, and to engage in studies that apply LEAP to pressing policy questions.

SEI plans to be increasingly active in global conversations on the role of cities in climate change mitigation. We have been working with a number of cities around the world (including Cape Town and a number of C40 cities) to pilot GHG abatement accounting and analysis frameworks and facilitate conversations among cities in developing countries on low-carbon development. SEI is now developing tools, approaches, and new research to steer cities towards high-impact, scalable emission reduction measures, as well as research to document and advocate for the role of cities in global climate change mitigation and a low-carbon economy.

SEI is a major partner in the Global Commission for the Economy and Climate and its flagship research project, the New Climate Economy (www.newclimateeconomy.net), in which SEI leads the energy transition work package. The project aims to provide independent and authoritative evidence on the relationship between actions to strengthen economic performance and to reduce climate risks. The premise, consistent with the findings of

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Sugarcane stalks are crushed at a mill in Brazil to extract sucrose, which is then refined to make sugar, ethanol or other products.

the former SEI Climate Economics Group, is that conventional economic analysis often understates the social and economic benefits of a low-carbon transition.

SEI is also going deeper in its work on the risks of, and responses to, new fossil-fuel development. Along with global-level analysis, we are focusing on "hot spots" or "convergence zones" where countries pursuing green growth initiatives may also face decisions on whether or how to develop sizeable new fossil-fuel resources. We are exploring potential policy and other responses that various stakeholders, including policy-makers, NGOs, and multilateral and bilateral institutions can take to minimize risks, and will provide resources for stakeholders to respond to these risks.

SEI is evaluating the sustainability of a major sugarcane agro-energy project in Sierra Leone, focusing on three key elements: energy access and energy/GHG balances, water resources, and livelihoods. More broadly, the work examines the linkages, conflicts and synergies that arise when economic development and renewable resource development processes unfold in tandem. Our goal is to use this on-site work to lay the foundation for a long-term sustainability monitoring and evaluation programme that could be applied to agriculture and agro-energy projects in other countries.

SEI has also expanded its bioenergy research capacity through the Nordic Centre of Excellence for Strategic Adaptation Research (NORD-STAR), delving into new questions such as the implications of increased bioenergy trade and the linkages between bioenergy, energy efficiency, and adaptation.

In addition, through collaboration with transitions analysts and integrated assessment modellers, SEI will explore in more depth how analysis of social and policy issues such as power distribution, equality, trust, institutional norms and cognition can be combined with technical and economic analysis of climate mitigation. Questions for our further research include: What do we know about which social variables matter most in climate mitigation strategies at different scales? How do they influence mitigation pathways? How can we treat them as research variables in different types of mitigation studies?

This synthesis brief was written by Marion Davis with input from Charles Heaps, Michael Lazarus, Peter Erickson, Francis X. Johnson, and Måns Nilsson.

The Mulan Wind Farm, in Heilongiang, China's northernmost province, was one of the first wind farms in China. © Flickr / Land Rover Our Planet

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