LEDS GLOBAL PARTNERSHIP

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LEDS in Practice

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Ensure energy security
To achieve the benefits of low emission development

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Key messages

- Energy security is a prerequisite for development and economic growth, and is arguably the most important driver for energy policy.
- Low emission energy systems have the potential to greatly improve energy security; at the same time policies for reducing emissions often align or overlap with energy security policies.
- Introduction of large shares of renewable energy into a country's energy mix requires careful planning. Low emission development strategies (LEDS) can set pace and timing to ensure and improve energy security.
- Energy efficiency and conservation present a double win situation in most (if not all) situations—lower demand both makes it easier to offer secure energy supply and reduces emissions from (fossil) power generation or fuel consumption.

How can low emission development improve energy security?

Energy for power, heat, cooling, and mobility is the key ingredient for development and growth. In recent years, energy security has regained interest because of ever increasing demand for energy, aspirations on providing energy access for all, worries about global scarcity of fossil fuels, and environmental concerns related to fossil fuel use.

Scaling up **renewable energy** as part of a low emission development strategy typically diversifies countries' energy mixes and reduces dependence on imports. It lowers geopolitical risks and exposure to fuel price volatility, and improves the balance of trade for importing countries (noting that only a handful of countries export oil and gas). Renewable energy offers lower financial and economic risk for businesses through a more stable and predictable cost base for energy supply.[1] In recent years, the costs of renewable energy technologies have dropped dramatically,[2] making them competitive alternatives to fossil based generation in many contexts and thereby contributing to affordability of energy supply.[3] An increased share of renewables will encourage new market and infrastructure configurations that offer greater robustness

Energy security is the uninterrupted availability of energy sources at an affordable price.

Energy insecurity is the loss of economic welfare that may occur as a result of physical unavailability or energy prices that are not competitive or overly volatile.

Also in the LEDS GP series on realizing the benefits of low emission development:

- *Create green jobs*
- *Promote gender equality*
- *Gain the competitive edge*
- *Boost ecosystem resilience*
- *Use trade policy*

This series of short papers gives an overview of selected benefits and development goals linked to LEDS and Nationally Determined Contributions (NDCs).

Series editor: Natalie Harms, Energy research Centre of the Netherlands (ECN) and resilience to shocks and stresses—thereby offering improved energy security. Scalability, small unit sizes, and independence from imported fuels often make renewable energy solutions the preferred choice to provide access to modern energy services in impoverished rural and remote areas.

A second feature of low emission development is increased **energy efficiency**, which in turn lowers overall demand and makes it easier to offer a secure energy supply. This is not just a matter of efficient conversion and consumption of energy, but also includes intelligent infrastructure, which typically offers a greater degree of resilience.

How can energy security goals contribute to low emission development?

Low emission energy systems can offer an environmentally acceptable alternative to fossil fuels, addressing concerns about local pollution and global warming. At the same time, climate change can introduce specific risks to energy security: changing rainfall patterns can affect hydropower performance, as witnessed in several countries (e.g. Kenya, Colombia) and infrastructure may be vulnerable to extreme weather events. Hurricane Sandy, for instance, caused US$30–50 billion in losses from power outages, liquid fuel shortages, and the shutdown of regional transportation systems in the US.[4] Undeniably, renewable energy systems are also affected by climate change. There are several options to increase resilience of energy infrastructure that may favor renewable energy technologies (see below). Although decentralized and (spatially) distributed generation can be applied to fossil fuel systems, it is more easily achieved with renewable energy options, which may be more flexible overall by offering smaller unit sizes and lower dependence on economies of scale (greater scalability).

Workers at Olkaria Geothermal Plant, Kenya (Photo credit: Lydur Skulason)

Moreover, the scalability and independence of imported fuels make renewable energy solutions particularly suitable to provide access to modern energy services in impoverished rural and remote areas.

Resilience and energy security—a win–win?

Sadie Cox, National Renewable Energy Laboratory (NREL)

Climate related temperature changes, droughts, and increases in extreme weather events have various implications for the energy sector. Rising temperatures are expected to increase energy demand, while decreased water availability and natural disasters may impact energy production and reliability of the electricity grid. Solutions for climate resilient, low emission energy systems include:

- **Deploying renewable energy sources adapted to climate change:** Solar photovoltaic and wind power generation consume significantly less water than traditional thermal technologies and offer a valuable solution to address both climate change mitigation and resilience challenges.
- **Spatially diverse electricity systems:** Whereas conventional power systems in one central geographic location could be severely impacted by a single weather event, spatially diverse electricity systems reduce the risk of large scale power outage where electricity is drawn from spatially distributed resources, including renewable energy. "Extreme weather events such as storms, forest fires, landslides, floods and extreme temperatures affect energy production and delivery facilities, cause supply disruptions and affect infrastructure that depends on the energy supply. The risk to energy infrastructure will grow as the frequency and intensity of certain types of extreme weather events increase."[5] Rising sea levels caused by climate change will affect coastal and offshore energy infrastructure, and need to be taken into account when choosing energy supply options.
- **Distributed generation such as micro grids or islanded systems:** Systems that can operate independently from the central grid can be crucial during natural disasters or electricity outages to provide power to health care and other sensitive facilities.

Integrating energy security goals into low emission policies and planning

Energy security is a prerequisite for development and economic growth, and is arguably the most important driver for energy policy. Traditional policy responses to address energy security vulnerabilities are often the same as those designed to promote low emission development: switching to more abundant and (domestically) accessible energy sources, investing in robust and resilient infrastructure to withstand and recover from disruptions, and decreasing energy intensity per unit of GDP.

A low carbon energy system can greatly improve energy security, but it does require careful context specific planning: certain renewable energy technologies may not (yet) be cost effective compared with import or fossil alternatives, and some technologies introduce new vulnerabilities that need to be addressed when planning and balancing energy systems, such as the variability of wind and solar radiation. Existing infrastructure may also need to be extended or replaced. In general, it can be assumed that energy efficiency measures are "low hanging fruit" that simultaneously lead to both increased energy security and reduced emissions. Combining such measures with renewable energy options can further contribute to both energy security and mitigation, albeit a certain level of vulnerability will remain. It is therefore important that LEDS set the right pace and timing for expanding and reforming the energy sector (towards greater efficiency and use of renewable sources) in a way that ensures greatest energy security benefits.

Energy security benefits of low emission energy systems may be an important driver to increase ambition of domestic climate change targets such as NDCs. This being said, boosting energy security requires a system wide approach to transform a country's energy infrastructure and mix in alignment with wider national goals for economic development and climate change action. Simultaneously pursuing energy security and lower emissions will require strengthened and institutionalized cooperation between respective ministries responsible for energy, climate, and economic development planning as well as the inclusion of relevant stakeholders from the energy sector. In any case, this increased cross-sector collaboration will be necessary to detail and achieve NDCs in the coming decades and may provide positive momentum to reap both energy security benefits and emission reductions through low emission energy systems.

Methodology and tools

There are a large variety of measures and indicators available for quantifying energy security, but linking these directly to government priorities and policies has often proven problematic in practice. A pragmatic approach to identifying the benefits of energy security looks at different vulnerabilities and threats, and unpacks the security aspect by assessing (i) the target group; (ii) the threats; and (iii) the means to increase security.

Over the years, many different typologies of energy security vulnerabilities and threats have been suggested. Some focus on the distinction between predictable and unpredictable factors, and early work focused on energy sovereignty from oil and gas (by diversification of energy sources and establishment of strategic oil reserves). Assessment of vulnerabilities and threats can include indicators such as resource scarcity; inadequate match of demand and supply; failing and aging infrastructure; exposure to international commodity price fluctuations; extreme weather events; extreme natural events; political instability causing domestic or geopolitical tensions; and interference by actors with private interests or malicious intent. The International Energy Agency (IEA), for instance, is developing a Model of Short term Energy Security (MOSES)[6] to evaluate energy security risks and resilience capacities. The tool covers short term security of supply for primary energy sources and secondary fuels, and lays the foundation for analysis of vulnerabilities of electricity and end use energy sectors.

While energy security benefits are most easily expressed and communicated in terms of cost reduction and price supply stability, such financial assessments should consider long term risk factors that could result in stranded assets. The reduced dependence on fossil fuels can easily be quantified in terms of trade volume, while the positive (geo)political effect of increased independence may be harder to value in numeric terms. As boosting energy security is a not a stand alone measure, but rather a meaningful feature of a low emission energy system, analyzing respective system impacts will require more complex modeling and simulation to reveal vulnerabilities and effective responses to environmental and financial threats.

Case study

Energy security in Thailand's INDC

Lopburi solar power plant, central Thailand. (Photo credit: Asian Development Bank)

Thailand's Intended Nationally Determined Contribution (INDC)[7] explicitly links mitigation actions (20–25% reduction relative to business as usual) to energy security and the country's development goals. Thai energy policy comprises a number of sectoral development plans (soon to be integrated in the Energy Master Plan) and is driven by energy security, affordability, and environmental sustainability. More than two thirds of the power sector relies heavily on natural gas, which has gradually replaced oil based thermal plants. Domestic natural gas reserves are rapidly declining and Thailand is largely dependent on imports from Myanmar. With demand for power expected to double in the coming two decades, Thailand pursues an active policy of resource diversification. As a consequence, it has issued one of the region's most ambitious renewable power supply targets, aiming to triple its respective capacity. However, the same diversification policy also foresees additional coal capacity coming on line, leading to tensions between energy security and climate ambitions.

Resources

- For a recent review of energy security literature on concepts, definitions, indicators, and challenges with quantification of energy security, see: Ang, B.W., Choong, W.L., and Ng, T.S. (2015) 'Energy security: Definitions, dimensions and indexes.' *Renewable and Sustainable Energy Reviews* 42: 1077–1093; and Mansson, A., Johansson, B., and Nilsson, L.J. (2014) 'Assessing energy security – an overview of commonly used methodologies.' *Energy* 73: 1–14.
- For an overview of energy security considerations, with examples per technology and country/region, see: Cherp, A. et al. (2012) 'Chapter 5 - Energy and security,' in *Global energy assessment -– Toward a sustainable future*. Cambridge, UK, New York, USA, and Laxenburg, Austria: Cambridge University Press and the International Institute for Applied Systems Analysis. See also: Cherp, A. and Jewell, J. (2011) 'The three perspectives on energy security: Intellectual history, disciplinary roots and the potential for integration.' *Current Opinion in Environmental Sustainability* 3(4): 202–212.
- For an overview of policy interactions and the link between energy security and climate change, see: IEA (2007) *Energy security and climate policy—Assessing interactions*. Paris: International Energy Agency.
- See the LEDS GP website for tools to assess energy security benefits.
- For more information on resilience in the energy sector, see: NREL (forthcoming) 'Bridging climate change resilience and mitigation in the electricity sector through renewable energy deployment' Enhancing Capacity for LEDS paper; IEA (2012) *Water for energy—Is energy becoming a thirstier resource?* Excerpt from the World Energy Outlook 2012. Paris: International Energy Agency; NREL (2011) *A review of operational water consumption and withdrawal factors for electricity generating technologies*. Golden, CO: National Renewable Energy Laboratory; Urban, F. and Mitchell, T. (2011) *Climate change, disasters and electricity generation*. Strengthening Climate Resilience Discussion Paper 8. Brighton, UK: Institute of Development Studies.

Notes

1 IRENA (2014) *REThinking energy: Towards a new power system*. Abu Dhabi: International Renewable Energy Agency.

2 The most remarkable cost reduction in the past years can be observed in crystalline-silicon PV: the average global levelized costs dropped from US$315 per MWh in 2009 to US$122 in 2015 (ibid.).

3 UNEP (2016) *Global trends in renewable energy investment 2016*. Frankfurt School/UN Environmental Programme Collaborating Centre and Bloomberg New Energy Finance.

4 IEA (2015) *Making the energy sector more resilient to climate change*. Paris: Organisation for Economic Co-operation and Development and International Energy Agency, p. 2.

5 Ibid.

6 IEA (2011) *The IEA Model of Short-term Energy Security (MOSES) – Primary energy sources and secondary fuels*. Paris: International Energy Agency.

7 ONEP Thailand (2015) 'Submission by Thailand – Intended Nationally Determined Contribution and relevant information' submitted to the UNFCCC. Bangkok: Office of Natural Resources and Environmental Policy and Planning Thailand; IEA (2016) *Thailand Electricity Security Assessment 2016*. Paris: International Energy Agency.

The **Energy research Centre of the Netherlands (ECN)** is the largest energy research institute in the Netherlands. ECN develops new technology and conducts pioneering research in various ways into innovative solutions to facilitate the transition to sustainable energy management. With around 500 members of staff, ECN is active in projects both domestically in Europe and internationally in joint efforts with industry, government authorities, and research institutes. Part of the Policy Studies unit, the International Sustainable Energy Group provides research and policy advice to develop sustainable energy and climate strategies in cooperation with developing country governments and civil society actors around the globe. www.ecn.nl

The **LEDS GP Benefits Assessment and Communication Working Group** focuses on identifying, communicating, and integrating social, economic, and environmental benefits associated with low emission pathways. The group works to advise on development impact assessment to provide tools and exchange knowledge and guidance on how to align development priorities with climate change policies and measures. Contact: benefits@ledsgp.org

The **Low Emission Development Strategies Global Partnership (LEDS GP)** was founded in 2011 to enhance coordination, information exchange, and cooperation among countries and international programs working to advance low emission, climate resilient growth. LEDS GP currently brings together LEDS leaders and practitioners from more than 160 countries and international institutions through innovative peer to peer learning and collaboration via forums and networks. www.ledsgp.org

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