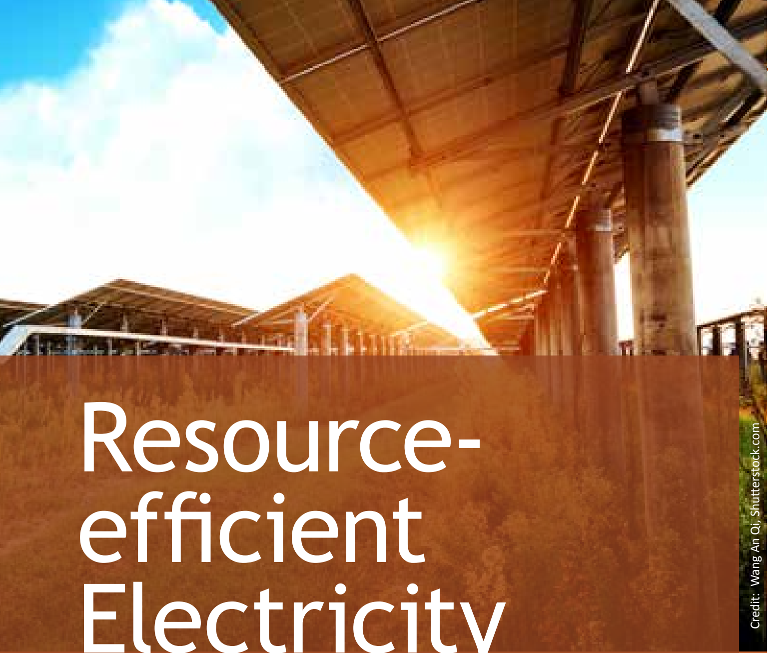

Resource-efficient Electricity Systems

Challenges

- Electricity generation is a major consumer of resources and producer of environmental impacts. The generation of electricity accounts for around 32% of total global fossil fuel use, and is responsible for around 41% of total energy-related CO_2 emissions.
- Demand for electricity is on a rapidly increasing trajectory, owing to increased demand in existing sectors, and the potential for increased electrification in newer applications such as electric vehicles.
- The electricity sector has a huge potential to reduce its environmental impact through the wide range of fossil-free electricity generation technologies available and in development. For example, under the International Energy Agency's Blue Map Scenario (assuming aggressive efforts to halve global energy-related CO_2 emissions by 2050 compared to 2005 levels), the carbon intensity of electricity falls by around 90% by 2050 compared to 2007 levels. The graphs on the right show a comparison of pollution and resource pressures resulting from the Agency's Baseline and Blue Map electricity scenarios.
- Yet, low-carbon and renewable energy technologies face technical and market barriers. Moreover, while renewable electricity technologies in most cases reduce carbon emissions, and deliver substantial reductions in other environmental and resource impacts, there are some cases where increased resource impacts, or higher life-cycle carbon emissions may be incurred.

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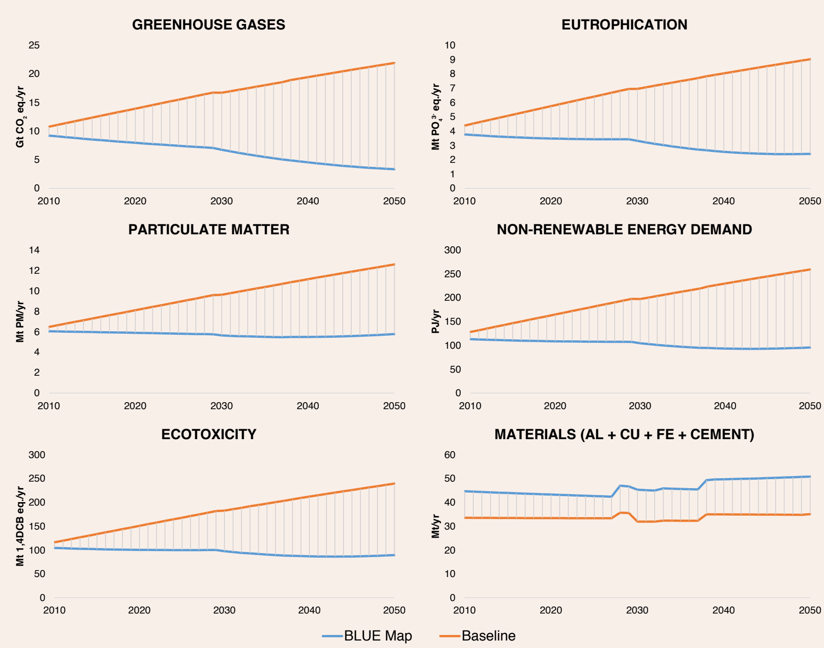
Responses

- Life Cycle Analysis (LCA) is a crucial tool to ensure that undesired side-effects of low carbon policies are not incurred.

Example

LCA studies of biomass to electricity supply chains reveal that in some circumstances biomass electricity generation can produce substantial greenhouse gas reductions compared to coal and gas generation. However, they show that there is substantial potential for variation in the final carbon intensity of the electricity produced, including to the extent of counter-productive results. Important sources of variation include the means by which the biomass is produced, length of the transportation stage of the biomass, length of time for which it is stored, and type of fuel used for drying the biomass. This underlines the importance of LCAs in informing the selection of biomass to electricity chains, and in informing policy.

Impact indicators, resource demand and deployment characteristics of the investigative power generation technologies under the IEA BLUE Map scenario, consistent with goal of limiting global warming to 2°C above pre-industrial level



Source: UNEP. (2015). Green Energy Choices: The benefits, risks, and trade-offs of low-carbon technologies for electricity production. E.G.Hertwich, T. Gibon, S. Suh, J. Aloisi de Larderel, A. Arvesen, P. Bayer, J. Bergesen, E. Bouman, G. Heath, C. Peña, P. Purohit, A. Ramirez. Paris: International Resource Panel

- In order to help overcome market barriers and encourage the adoption of renewable technologies, a long-term policy framework will need to be in place. A "smart" mix of well-targeted, proportionate and transparent policy support measures with good future visibility, is likely to be needed to ensure the transition of power systems from fossil fuel to renewable energy generating sources. Resource-efficient Electricity Systems should also encourage demand-side measures, such as energy efficiency and flexible demand side response.

Examples

German Energy Policy

What?

- Technology differentiated feed-in tariff, guaranteeing price to renewable generators for 20 years.
- Renewable generators given priority access to the grid.
- The "Energy Concept" provides long-term policy basis, requiring renewables' share of German electricity supply to be at least 35% in 2020, 50% in 2030, 65% in 2040 and 80% in 2050.

Success factors

- Strong price support to renewables through long-term feed-in tariff contracts.
- Clear and legally enshrined long-term policy goals, providing confidence to investors.

Results

- Renewable sources rose from 7% of electricity generation in 2000 to around 30% in 2014.

Demand side response aggregation

What?

- Demand side aggregator – bringing together electricity consumers who agree to reduce consumption at peak periods, then selling this unused electricity to the system generator.

Success factors

- Clients are asked to delay consumption of non-time dependent power loads, such as air conditioners or chillers, but without having an impact on their service requirements (e.g. staying within the acceptable temperature range).
- This flexibility enables the electricity system operator to meet peak demands through demand-side response, which can replace an expensive and resource-intensive back-up plant.
- The benefit to the system is rewarded through payments, accruing to the participating clients.

Results

- In the US in 2013, customers enrolled on (retail and wholesale) demand side response schemes were collectively capable of providing around 56,000 MW of potential peak load reductions.

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