ENERGYWATCHGROUP LUT University

New Study

First Ever Hourly Simulation of Global Energy System Across All Sectors

100% Renewables are cheaper than current energy system

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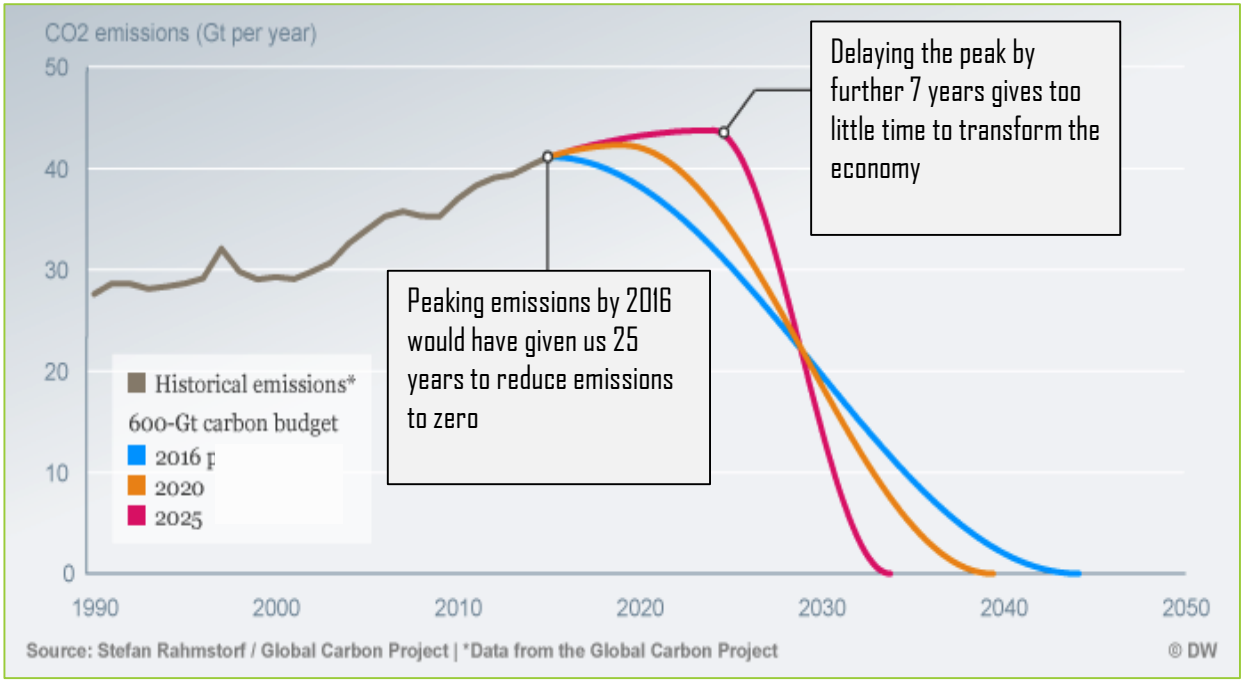
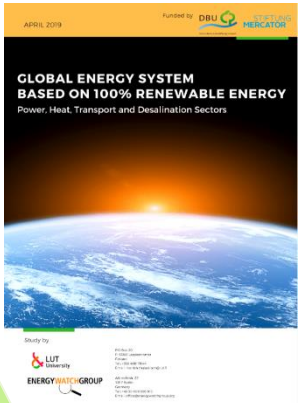
STIFTUNG MERCATOR DBU Deutsche Bundesstiftung Umwelt

Global GHG Emissions Must Come to Zero around 2030 to Reach the 1.5°C Paris Target



New Study by EWG & LUT Shows:

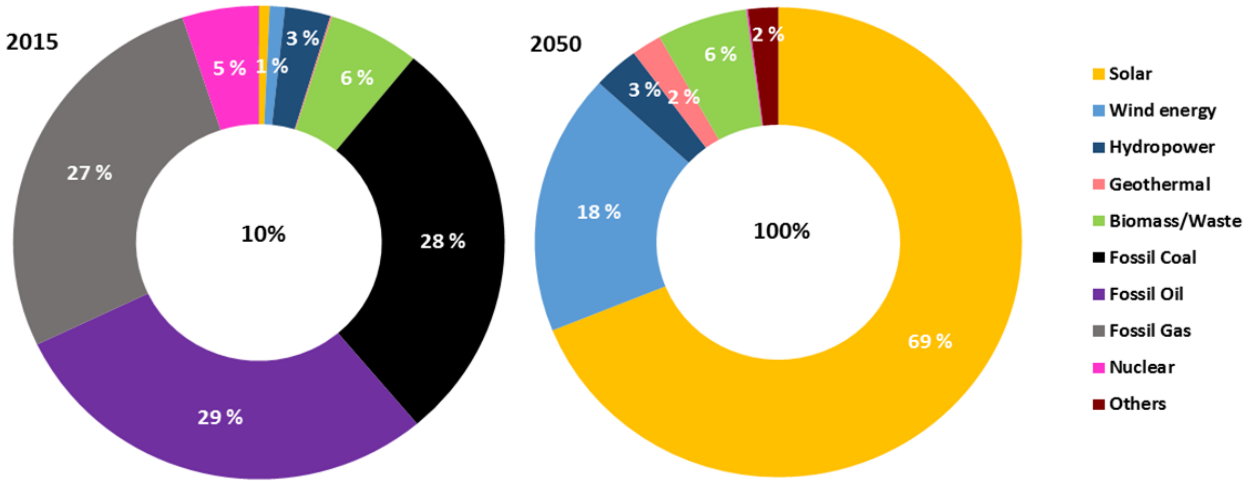
The energy transition is not a question of technical feasibility or economic viability, but one of political will.



100% renewable energy worldwide is more cost effective than the current energy system and leads to zero emissions before 2050.

Largely domestic energy systems based on 100% renewables will create energy independence and support millions of local jobs in the energy sector.

Solar and Wind Will Dominate the 100% Renewable World



Primary energy source	Solar	Wind	Biomass/ Waste	Hydro	Geo-thermal
Share in 2050	69%	18%	6%	3%	2%

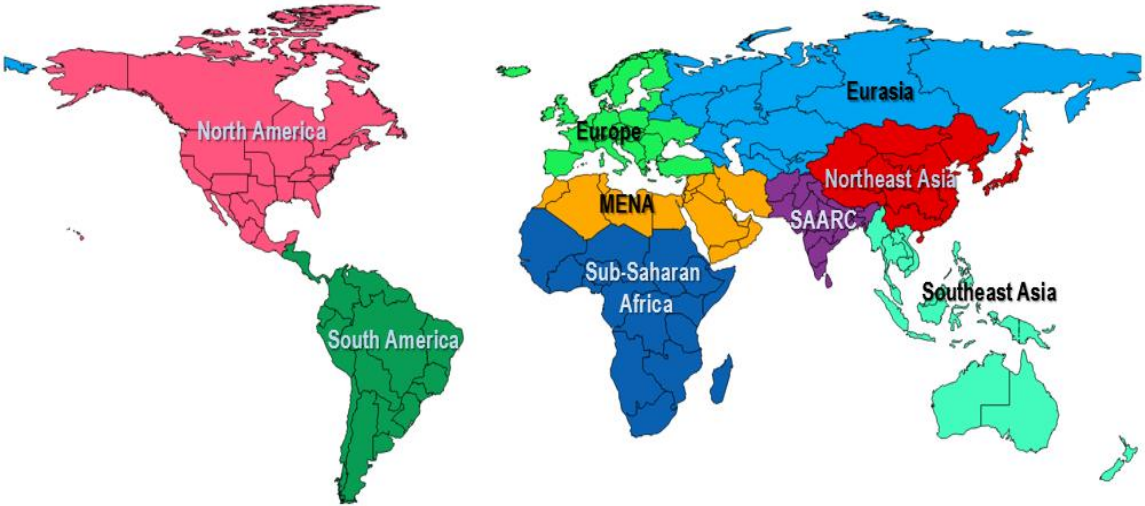
Policy Recommendations

- Feed-in-tariffs crucial until 40 MW (GET-FiT)
- Auctions for utility-scale projects
- Abolish fossil and nuclear subsidies
- Carbon, methane, radioactivity tax
- Research, education & campaigning
- Reducing licensing obstacles

Not successful:

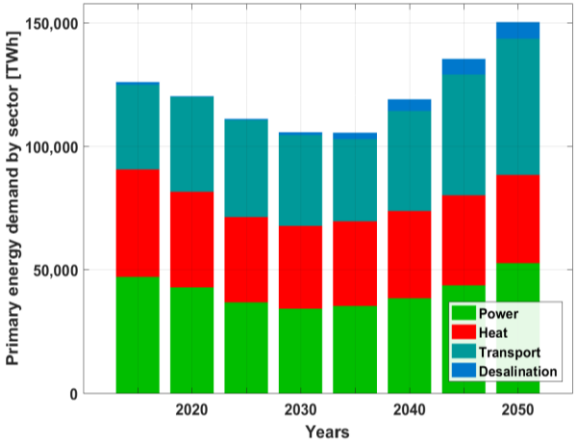
- Certificate systems
- Emission trading

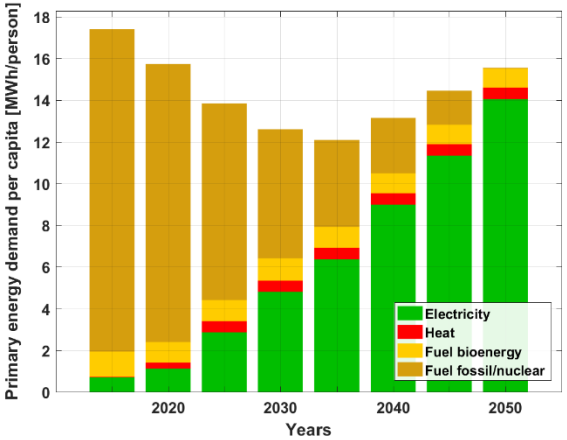
Global Overview



- The world is structured into 9 major regions, which are further divided to 145 sub-regions
- Some sub-regions represent more than one country, others parts of a larger country
- The sub-regions are interconnected by power lines within the same country
- The results shown are for the Power, Heat, Transport, Desalination sectors
- The energy transition scenario is carried out in full hourly resolution for all energy sectors
- In total 106 different technologies are applied

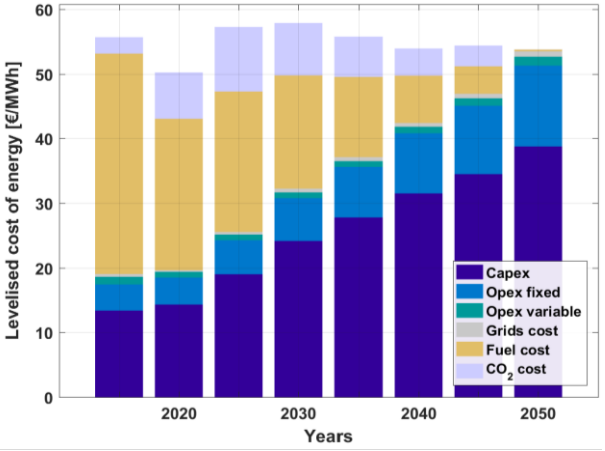
Long-term Energy Demand

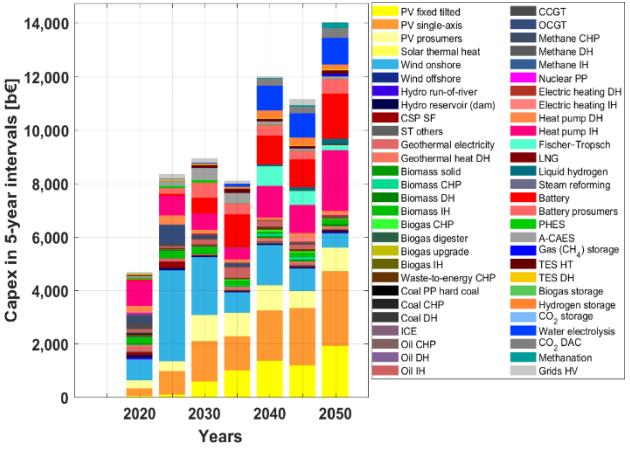




- Final energy demand grows by 1.0% per year, while energy services grow faster
- Broad electrification leads to only 0.5% per year in primary energy demand growth
- World population grows from 7.2 billion (2015) to 9.7 billion (2050)
- Substitution of inefficient combustion processes by electric solutions where possible
- Processes of 2015 for energy services in 2050 would double primary energy demand
- Fossil fuels are practically substituted by renewable electricity (mainly solar PV, wind)

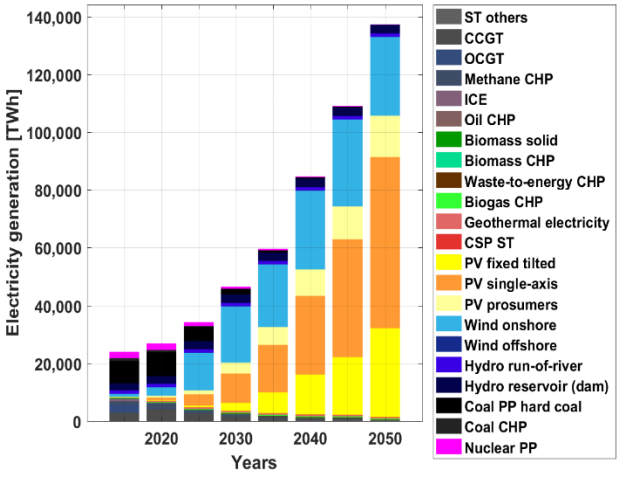
Energy System Costs

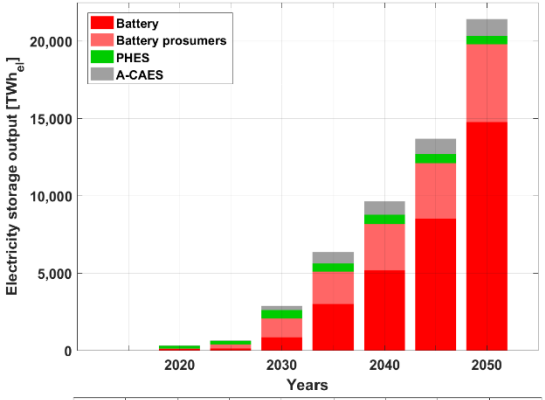


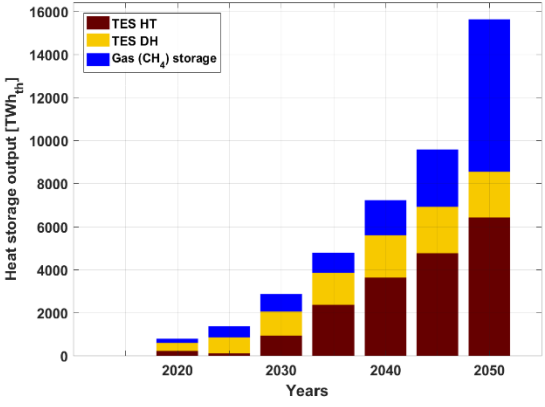


- Levelised cost of energy decline from 54 €/MWh (2015) to 53 €/MWh (2050)
- Fuel costs diminish through the transition period, while capital expenditures dominate
- Costs are well spread across a range of technologies with major investments for solar PV, wind energy, batteries, heat pumps and synthetic fuel conversion up to 2050
- The cumulative investment costs are about 67,200 b€

Electricity Supply and Storage

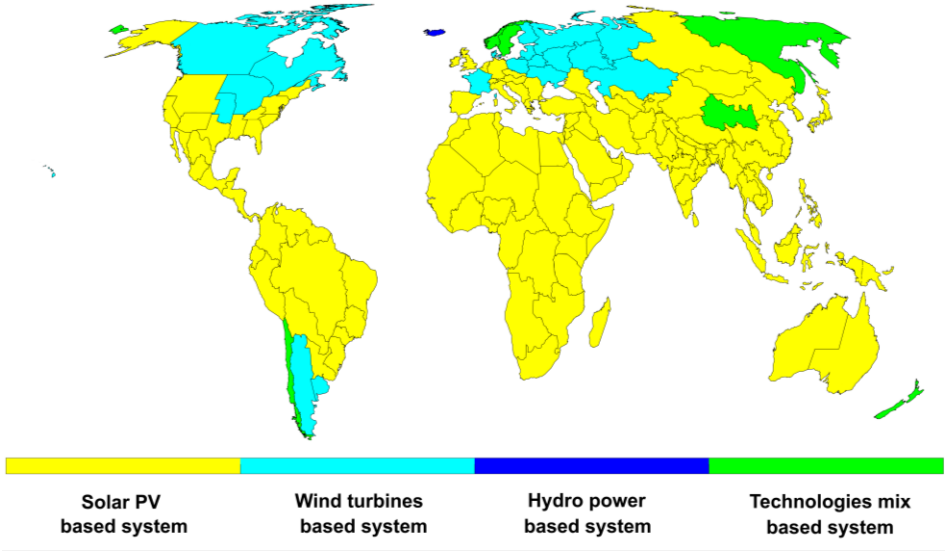






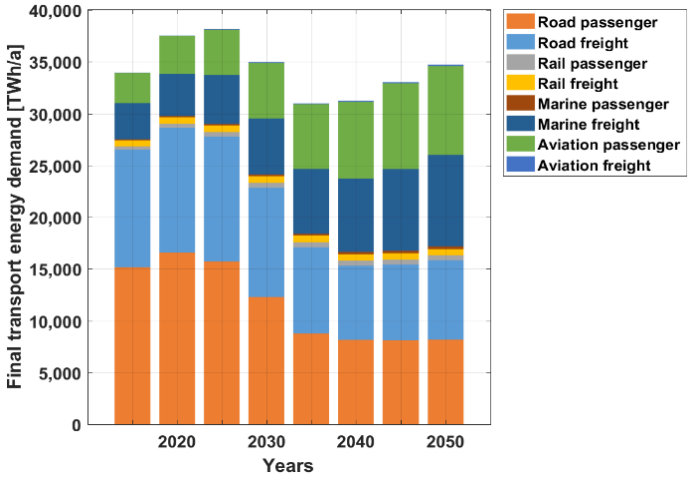
- Electricity generation covers demand of all sectors
- Solar PV supply increases from 32% in 2030 to about 73% in 2050 becoming main energy source
- Wind energy very important in Northern hemisphere
- Batteries store 92% of all to be stored electricity
- Heat is mainly stored in thermal energy storage
- Gas storage contributes around 39% of the heat storage output in 2050, mainly for seasonal demand

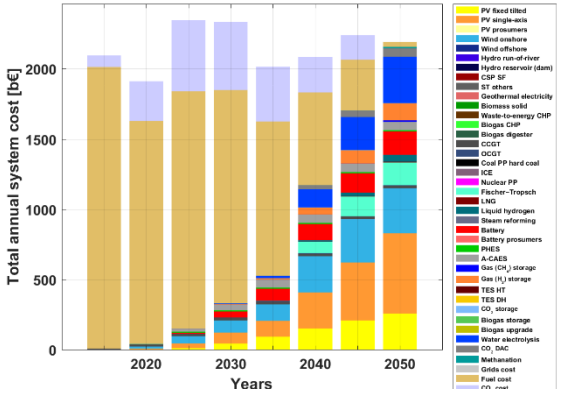
Regional Variations

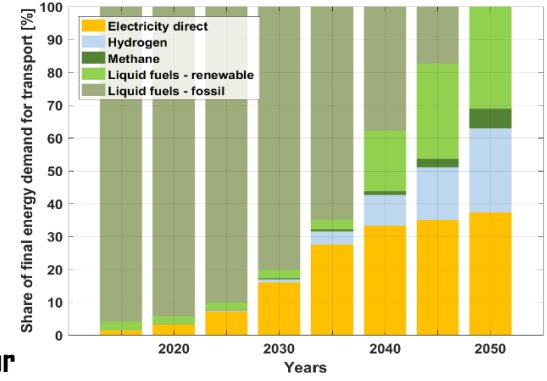


- Solar PV dominates most of regions around the world and particularly in the Sun Belt
- Wind energy drives systems in the Northern and Southern hemispheres with excellent wind conditions and lacking seasonal solar energy
- Some regions are further complemented with hydropower to form a mixed system

Transport Sector

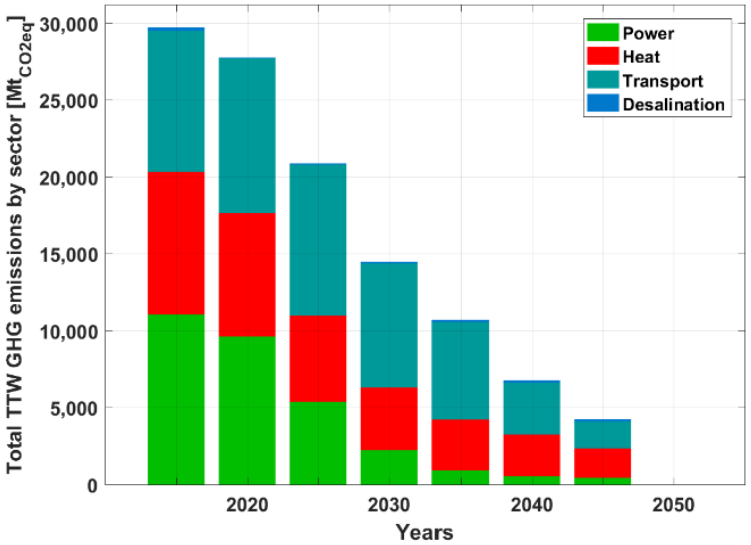






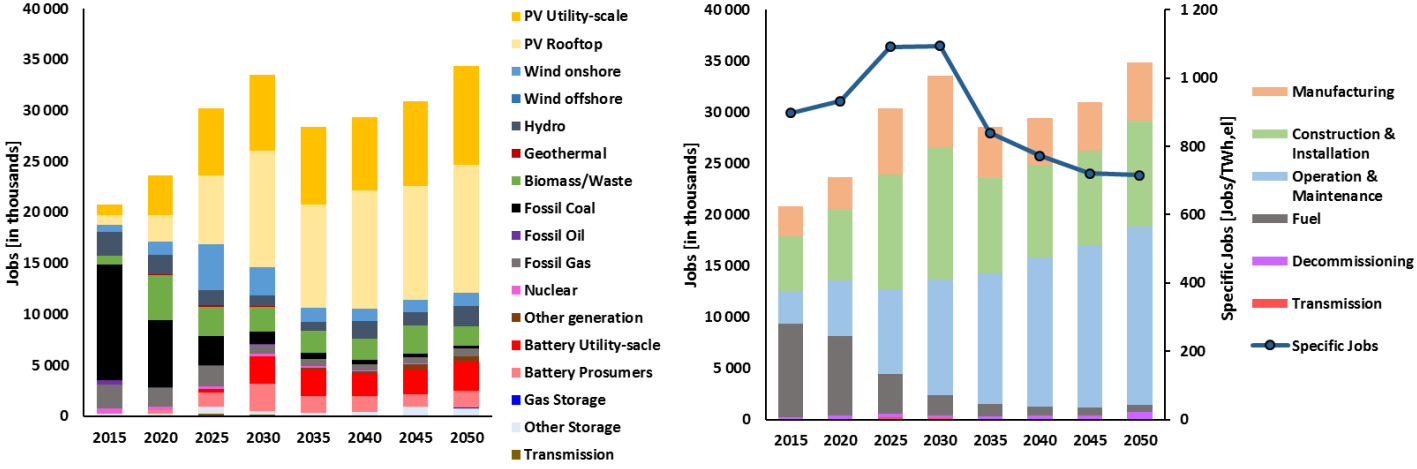
- Transportation demand is assumed to triple till 2050
- Final energy demand and energy cost remain stable, thanks to broad electrification and low electricity cost
- Fossil fuel costs are substituted by capital expenditures and some sustainable biofuels
- Liquid fuels (31%) and hydrogen (26%) produced by electricity contribute substantially to the final energy demand in 2050, mainly for marine and aviation

Greenhouse Gases Emissions



- Greenhouse gases (GHG) emissions can be reduced from around 30,000 $MtCO_{2eq}$ in 2015 to zero by 2050 across all energy sectors
- Remaining cumulative GHG emissions comprise ca. 422 $GtCO_{2eq}$ from 2018 to 2050
- The presented 100% RE scenario is compatible with the Paris Agreement for 1.5°C

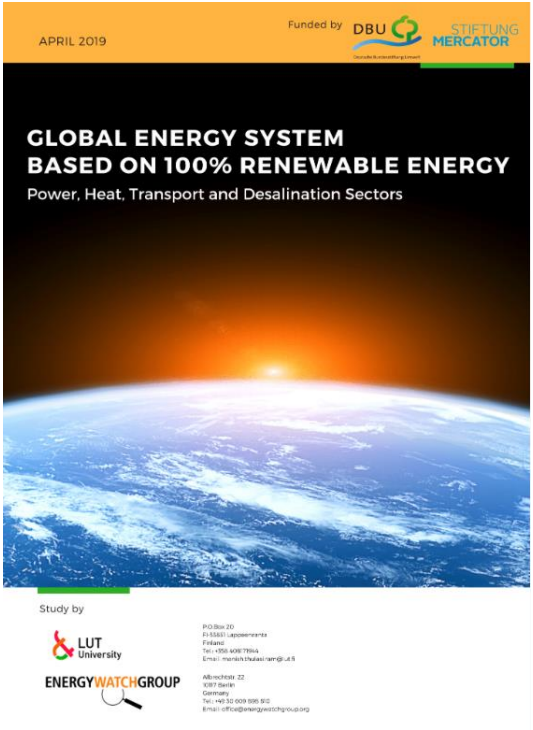
Jobs Prospects – Power Sector



- Total direct energy jobs are set to increase with the initial ramp up of installations from about 20 million in 2015 to around 35 million by 2050
- Loss of coal and other fossil fuel related jobs are more than compensated by new jobs
- Solar PV emerges as the prime job creator with over 22 million jobs by 2050
- Operation and maintenance jobs continue to grow through the transition period and become the major job segment by 2050 with 50% of total jobs

Key Aspects

- 1.5° C scenario with zero GHG emissions in 2050
- Specific energy cost shrink slightly
- Broad electrification of the entire energy system
- Energy services expand, while primary energy grow slowly
- More renewable energy leads to more jobs
- Solar photovoltaic, wind energy, batteries, heat pumps and synthetic fuel conversion technologies are central
- Methods used: full hourly and high geo-spatial resolution and cost optimisation for applied constraints
- No risk technologies required
- Political will and ambitious execution drive transition



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DBU Deutsche Bundesstiftung Umwelt

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