energy [r]evolution

A SUSTAINABLE USA ENERGY OUTLOOK

Executive Summary

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May 2014

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A Sustainable USA Energy Outlook

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Partners and Contributors: Greenpeace International; Greenpeace USA; European Renewable Energy Council; Global Wind Energy Council; DLR, Institute of Technical Thermodynamics, Department of Systems Analysis and Technology Assessment (Stuttgart, Germany); Utrecht University, the Netherlands; Institute for Sustainable Futures, University of Technology (Sydney, Australia); energynatutics, GmbH (Langen/Germany); Onehemisphere (Sweden)

contacts:
sven.teske@greenpeace.org
kyle.ash@greenpeace.org

Avoiding the worst impacts of climate change requires a fundamental shift in the way we consume and generate energy. This shift should begin immediately and be well underway within the next ten years. The scale of the challenge requires a complete transformation of the way we produce, consume and distribute energy. Fortunately, we can meet this challenge while giving a boost to the economy, energy sector employment and energy security. The Energy (R)evolution provides a pathway for the US energy sector to reduce climate pollution and phase out dirty fuels, a pathway which comprises a very large piece of a global Energy (R)evolution analysis. The US pathway reduces territorial CO_2 emissions 39% by 2025 (-27% under 1990), and 60% in 2030 (-48% under 1990).

The five key principles behind this Energy [R]evolution will be to:

- Implement renewable solutions, especially through decentralized energy systems and grid expansions
- Respect the natural limits of the environment
- Phase out dirty, unsustainable energy sources
- Create greater equity in the use of resources
- Decouple economic growth from the consumption of fossil fuels

The reference scenario for this report is the 2013 Annual Energy Outlook, published by the US Energy Information Agency (EIA), which uses a 2011 base year. Renewable energy sources accounted for 6.6% of primary energy demand in 2011. The main sources were biomass, mostly used for heating, and hydro and wind which are used for power generation. For electricity generation, renewables contributed about 13%. For heat supply renewables contributed around 10%, the majority from biomass but increasingly also from solar thermal collectors and to some degree from geothermal heat pumps. About 93% of primary energy supply was from fossil fuels.

Decentralized energy systems, where power and heat are produced close to the point of final use will avoid the current energy waste in distribution. The Energy [R]evolution requires investments in ‘climate infrastructure’ such as smart interactive grids and super grids to transport large quantities of offshore wind and concentrating solar power.

Key Results

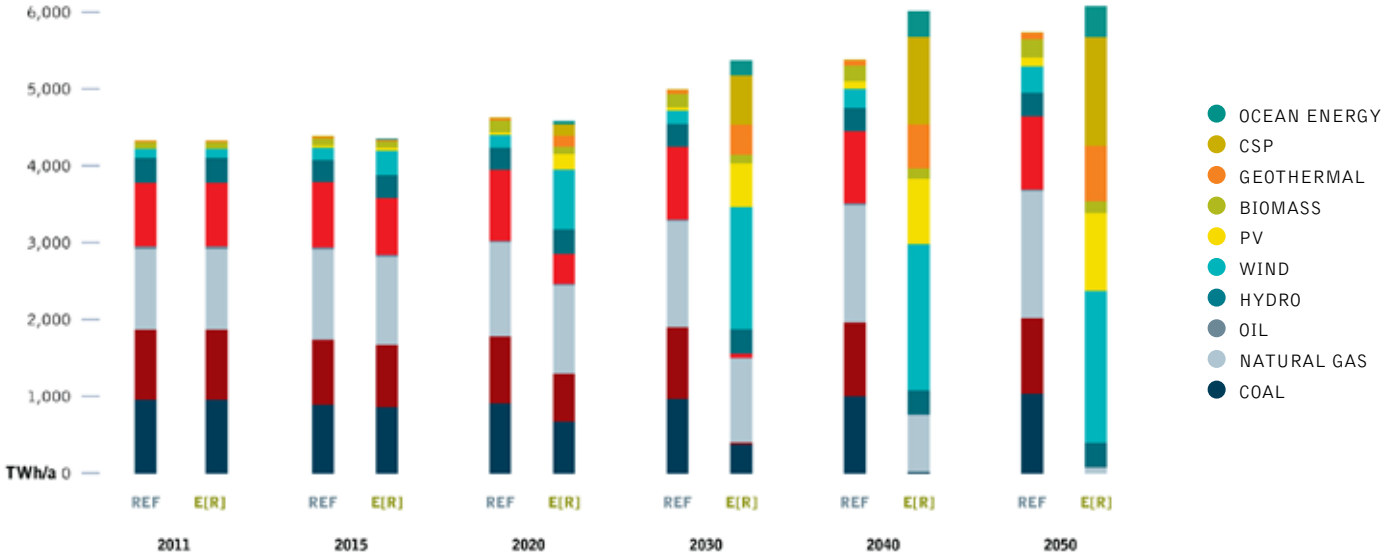
The Energy [R]evolution scenario describes development pathways to a sustainable energy supply, achieving the urgently needed CO_2 reduction targets and a fossil fuel phase-out.

This is achieved through the following measures:

- **Controlling power demand:** Under the Energy [R]evolution scenario, electricity demand is expected to decrease in both the industry sector as well as in the residential and service sector. Demand will grow in the transport sector because of the use of electric vehicles. Compared to the EIA forecast, efficiency measures in the industry, residential and service sectors avoid the generation of about 1,930 TWh/a. This reduction can be achieved in particular by introducing highly efficient electronic devices using the best available technology in all demand sectors.

- **Reducing heating demand:** Compared to the EIA forecast, consumption equivalent to around 5,380 Trillion BTU/a is avoided through efficiency gains by 2050. As a result of energy-related renovation of the existing residential buildings, as well as the introduction of low energy standards and 'passive houses' for new buildings, enjoyment of the same comfort and energy services will lead to much lower energy demand.

- **Electricity generation (see figure below comparing EIA reference):** An increasing share of renewable electricity will compensate for the phasing out of nuclear energy and reduce the number of fossil fuel-fired power plants required for grid stabilization. 'New' renewables – mainly wind, solar thermal energy and PV – will contribute 88% of electricity generation. By 2020 the share of renewable electricity production will be 37%, and 71% by 2030. By 2050, 97% of electricity produced will come from renewable energy sources.

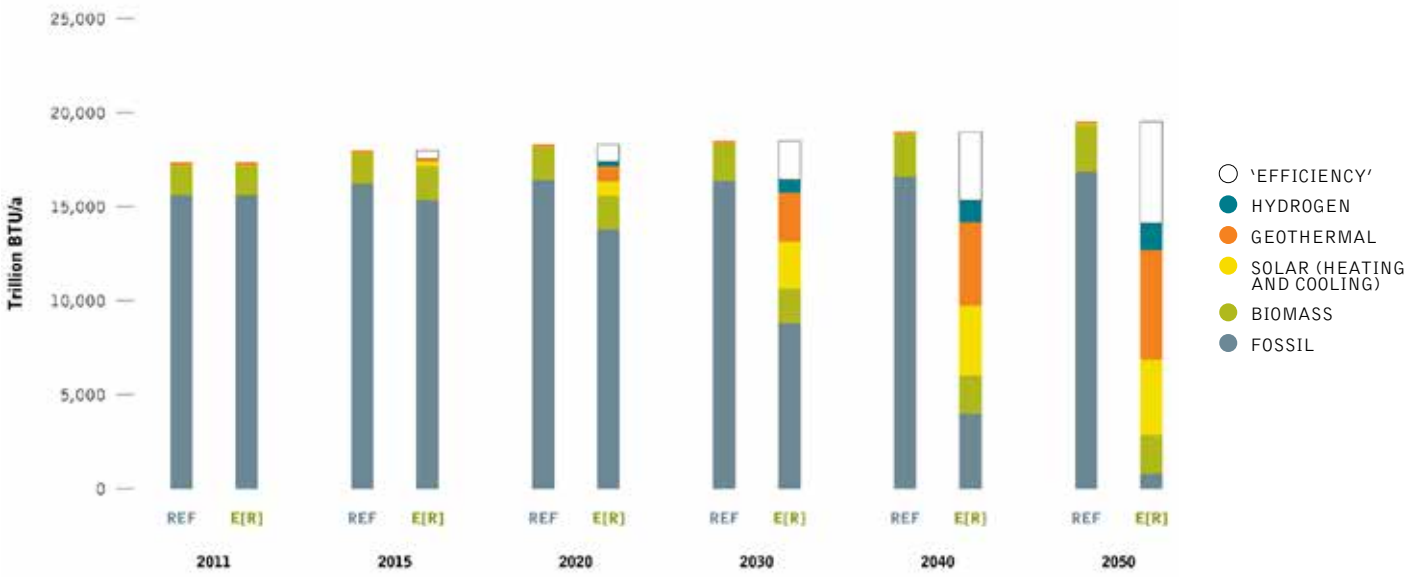


- **Future costs of electricity generation:** The introduction of renewable technologies under the Energy [R]evolution scenario slightly increases future costs of electricity generation compared to EIA predictions. This difference will be only around 0.3 cent/kWh up to 2025 when increasing fossil fuel prices are considered. Because of high costs for conventional fuels and the lower CO_2 intensity of electricity generation, electricity generation costs will become economically favorable under the Energy [R]evolution scenario. By 2050, costs will be 10.5 cents/kWh below the EIA price outlook.

- **The future electricity bill:** Under the EIA scenario, an unchecked growth in demand, an increase in fossil fuel prices and the cost of CO_2 emissions all result in total electricity supply costs rising from today's $469 billion per year to more than $1,088 billion in 2050. The Energy [R]evolution scenario helps to stabilize energy costs and relieve the economic pressure on society caused by CO_2 emissions. Increasing energy efficiency and shifting energy supply to renewables leads to long term costs for electricity supply that are 47% lower than in the EIA forecast.

- **Fuel costs savings cover power investments:** Because non-biomass renewable energy has no fuel costs, the fossil fuel cost savings (excluding nuclear) in the Energy [R]evolution scenario reach a total of $6,100 billion up to 2050, or $153 billion per year. The total fuel cost savings would cover 150% of the total additional investments compared to the EIA scenario. The costs for coal and gas inputs would continue to be an economic burden, saying nothing to costs associate with unwanted 'outputs' like coal ash, as well as local air and water pollution from combustion and extraction. New renewable energy sources also would produce electricity without any further fuel costs beyond 2050.

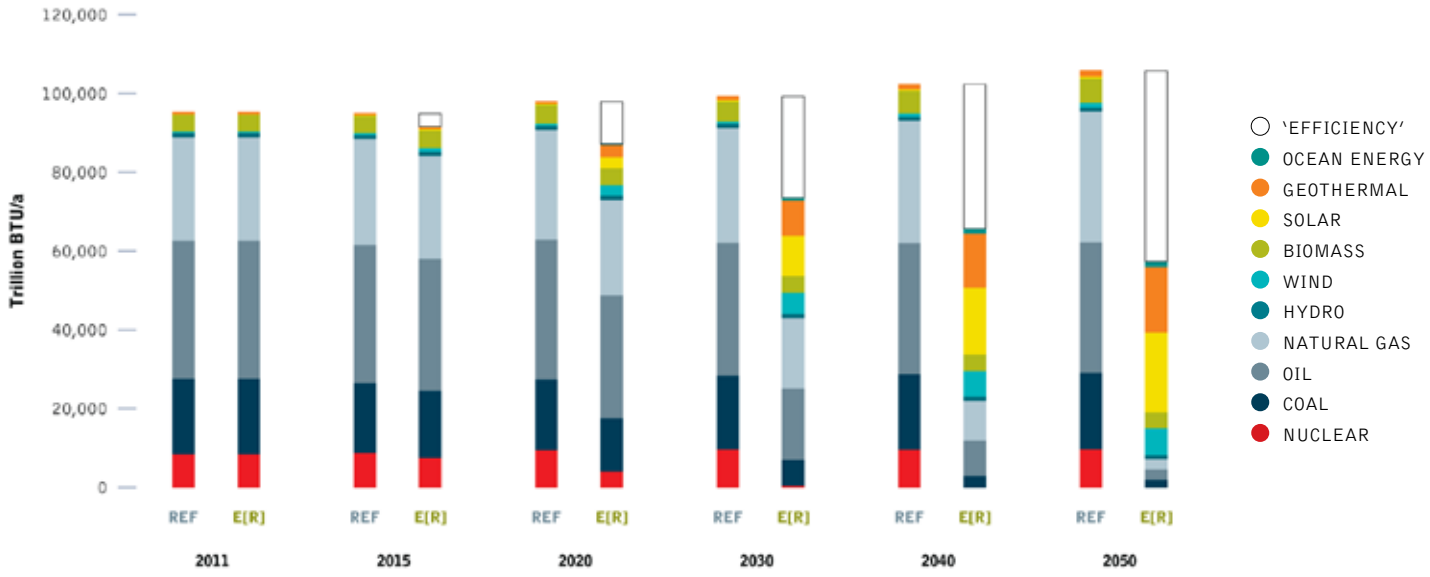
- **Heating supply (see figure below comparing EIA reference):** In the Energy [R]evolution scenario renewables provide 45% of total heat demand in 2030, and 94% in 2050. Energy efficiency measures help to reduce the currently growing energy demand for heating by 28% in 2050 (relative to the EIA forecast), in spite of improving living standards. In the industry sector, heating sources like solar collectors, geothermal energy (including heat pumps), and electricity from renewables are increasingly substituting for fossil fuel-fired systems.



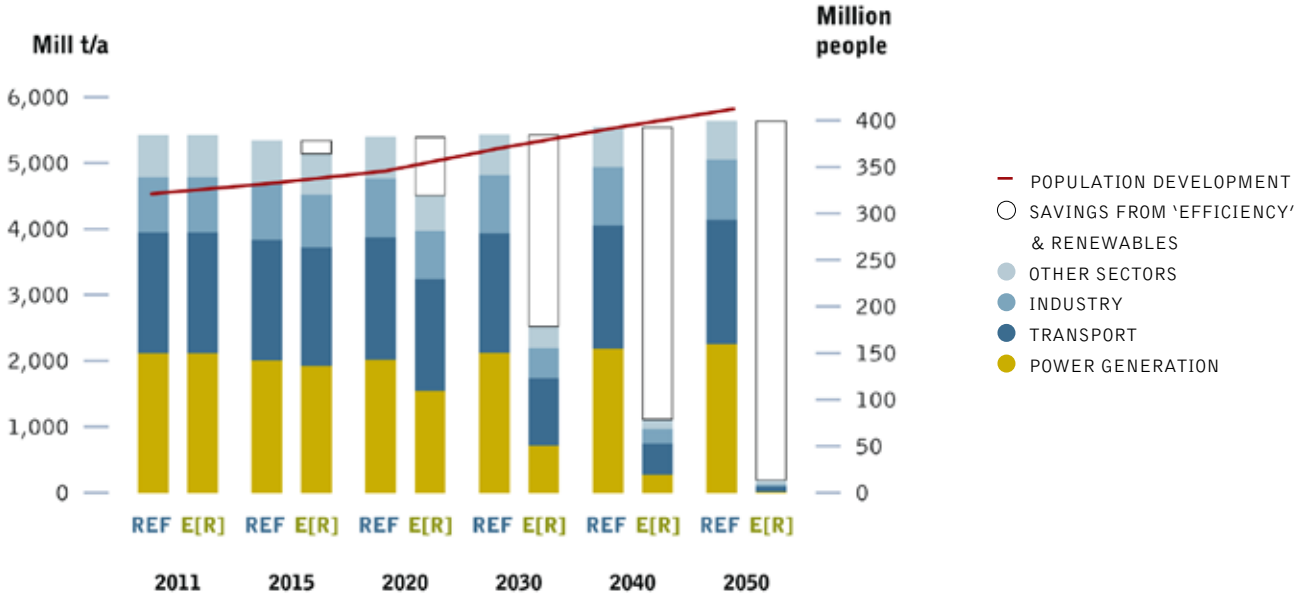
- **Future employment in the energy sector:** Energy sector jobs are higher in the Energy [R] evolution scenario at every stage in the projection. Energy sector jobs double by 2015, with 0.7 million additional jobs. Jobs drop between 2015 and 2030, but despite this are 38% above 2010 levels. Renewable energy accounts for 61% of energy jobs by 2030, with solar heat having the greatest share (18%), followed by geothermal, heat pump heat and wind.

- **Transport:** A key component will be incentives for people to drive smaller cars. In addition, it is vital to shift transport use to efficient modes like rail, light rail and buses, especially in the expanding large metropolitan areas. Together with rising prices for fossil fuels, these changes reduce the huge car sales projected under the Reference scenario. Energy demand from the transport sector is reduced by around 18,700 Trillion BTU/a in 2050 (saving 71%) compared to the EIA forecast. Energy demand in the transport sector will therefore decrease between 2011 and 2050 by 71% to 7,480 Trillion BTU/a. Highly efficient propulsion technology with hybrid, plug-in hybrid and battery-electric power trains will bring large efficiency gains. By 2030, electricity will provide 12% of the transport sector's total energy demand in the Energy [R]evolution, while in 2050 the share will be 39%.

- **Primary energy consumption (see figure below comparing EIA reference):** Compared to the Reference scenario, overall primary energy demand will be reduced by 46% in 2050. Around 87% of the remaining demand will be covered by renewable energy sources. Of note, ***due to efficiency measures reliance on primary energy from biomass falls slightly*** by 2050 despite its contribution to heat and power rising significantly. This scenario acknowledges serious, cross-cutting environmental concerns with over-reliance on biomass, and the fact that carbon neutrality of sourcing continues to be ignored by federal policymakers. The Energy [R]evolution aims to phase out coal and oil as fast as technically and economically possible. This is made possible mainly by replacement of coal power plants with renewables and a fast introduction of efficient electric vehicles in the transport sector to replace oil combustion engines. This leads to an overall renewable primary energy share of 42% in 2030 and 87% in 2050. Nuclear energy is phased out just after 2035.



- **Development of CO_2 emissions (see figure below):** Emissions of CO_2 will increase by 4% between 2011 and 2050 under the EIA scenario. Under the Energy [R]evolution scenario CO_2 decreases from 5,420 million tons in 2011 to 188 million tons in 2050, a 96% reduction from 1990 (97% from 2005). By 2025, CO_2 emissions are 27% below 1990 (39% under 2005), by 2030 the reduction is 48% (60% under 2005).



Policy Developments Needed

To make the Energy [R]evolution real we need local, state, or federal policies in the following areas:

1. Abolish all subsidies, including any policies which confer a financial benefit, to fossil fuels and nuclear energy. The End Polluter Welfare Act, introduced by Senator Bernie Sanders (I-VT) and Representative Keith Ellison (D-MN) is an example of federal action that must move forward.
2. Internalize the currently socialized cost of industrial climate pollution, such as with a federal carbon fee.
3. Mandate strict efficiency standards for all energy consuming appliances, buildings and vehicles.
4. Establish legally binding targets for renewable energy and combined heat and power generation.
5. Reform electricity markets by guaranteeing priority access to the grid for renewable power generators.
6. Provide defined and stable returns for investors, for example by feed-in tariff schemes.
7. Implement better labeling and disclosure mechanisms to provide more environmental product information.
8. Increase research and development budgets for renewable energy and energy efficiency.