Energy [R]evolution 2010 at a glance

Key facts and figures

This third edition of the Energy [R]evolution provides a more ambitious and visionary blueprint than the previous two. It demonstrates how the world can get from where we are now, to where we need to be in terms of phasing out fossil fuels, cutting CO_2 emissions while ensuring energy security. This phase-out of fossil fuels offers substantial benefits such as independence from world market fossil fuel prices as well as the creation of millions of new green jobs. It also means providing energy to the two billion people currently without reliable access to energy services.

Energy [R]evolution Concept

In the first global edition of the Energy [R]evolution, published in January 2007, we projected that global installed renewable capacity would be 156 GW by 2010. At the end of 2009, 158 GW had been installed, but more needs to be done.

At the core of the Energy [R}evolution will be a change in the way that energy is produced, distributed and consumed. Decentralised energy systems, where power and heat are produced close to the point of final use, will avoid the current energy wastage during conversion and distribution. Investments in 'climate infrastructure' such as smart interactive grids, as well as super grids to transport large quantities of offshore wind and concentrating solar power, are essential. Building up clusters of renewable micro grids, especially for people living in remote areas, will be a central tool in providing sustainable electricity to the almost two billion people around the world for whom access to electricity is presently denied.

Energy [R]evolution methodology and assumptions

Three scenarios up to the year 2050 are outlined in this report: a Reference scenario, an Energy [R]evolution scenario with a target to reduce energy related CO_2 emissions by 50% from 1990 levels by 2050, and an advanced Energy [R]evolution version which envisages a fall of more than 80% in CO_2 by 2050.

- The Reference Scenario is based on the International Energy Agency's 2009 World Energy Outlook (WEO 2009) analysis, extrapolated forward from 2030. Compared to the previous (2007) IEA projections, WEO 2009 assumes a slightly lower average annual growth rate of world Gross Domestic Product (GDP) of 3.1%, instead of 3.6%, over the period 2007-2030.

- The Energy [R]evolution Scenario has a key target for the reduction of worldwide carbon dioxide emissions down to a level of around 10 gigatonnes per year by 2050. A second objective is the global phasing out of nuclear energy. The general framework parameters for population and GDP growth remain unchanged from the Reference scenario.

- The Advanced Energy [R]evolution Scenario takes a much more radical approach and in order to pull the emergency brake on global CO_2 emissions it assumes much shorter technical lifetimes for coal-fired power plants; 20 years instead of 40 years. This reduces global CO_2 emissions even faster and takes the latest evidence of greater climate sensitivity into account. To fill the resulting energy gap, the annual growth rates of renewable energy sources, especially solar photovoltaics, wind and concentrating solar power plants, have been increased.

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Towards a renewable future

Today, renewable energy sources account for 13% of the world's primary energy demand. The share of renewable energies for electricity generation is 18%, while their contribution to heat supply is around 24%. About 80% of the primary energy supply today still comes from fossil fuels. The following summary shows the results of the new advanced Energy [R]evolution scenario:

- Exploitation of existing large energy efficiency potentials will ensure that final energy demand increases only slightly - from the current 305,095 PJ/a (2007) to 340,933 PJ/a in 2050, compared to 531,485 PJ/a in the Reference scenario. This dramatic reduction is a crucial prerequisite for achieving a significant share of renewable energy sources in the overall energy supply system, compensating for the phasing out of nuclear energy and reducing the consumption of fossil fuels.

- More electric drives are used in the transport sector and hydrogen produced by electrolysis from excess renewable electricity plays a much bigger role in the advanced than in the basic scenario. After 2020, the final energy share of electric vehicles on the road increases to 4% and by 2050 to over 50%. More public transport systems also use electricity, as well as there being a greater shift in transporting freight from road to rail.

- The increased use of combined heat and power generation (CHP) also improves the supply system's energy conversion efficiency, increasingly using natural gas and biomass. In the long term, the decreasing demand for heat and the large potential for producing heat directly from renewable energy sources limits the further expansion of CHP.

- The electricity sector will be the pioneer of renewable energy utilisation. By 2050, around 95% of electricity will be produced from renewable sources. A capacity of 14,045 GW will produce 43,922 TWh/a renewable electricity in 2050. A significant share of the fluctuating power generation from wind and solar photovoltaic will be used to supply electricity to vehicle batteries and produce hydrogen as a secondary fuel in transport and industry. By using load management strategies, excess electricity generation will be reduced and more balancing power made available.

- In the heat supply sector, the contribution of renewables will increase to 91% by 2050. Fossil fuels will be increasingly replaced by more efficient modern technologies, in particular biomass, solar collectors and geothermal. Geothermal heat pumps and, in the world's sunbelt regions, concentrating solar power, will play a growing part in industrial heat production.

- In the transport sector the existing large efficiency potentials will be exploited by a modal shift from road to rail and by using much lighter and smaller vehicles. As biomass is mainly committed to stationary applications, the production of bio fuels is limited by the availability of sustainable raw materials. Electric vehicles, powered by renewable energy sources, will play an increasingly important role from 2020 onwards.

- By 2050 80% of primary energy demand will be covered by renewable energy sources.

Future costs

Renewable energy will initially cost more to implement than existing fuels. The slightly higher electricity generation costs under the advanced Energy [R]evolution scenario will be compensated for, by reduced demand for fuels in other sectors such as heating and transport. Assuming average costs of 3 cents/kWh for implementing energy efficiency measures, the additional cost for electricity supply under the advanced Energy [R]evolution scenario will amount to a maximum of $31 billion US dollars per year in 2020. By 2050 the annual costs of electricity supply will be $2,700 billion per year below those in the Reference scenario.

Future investment

- It would require $18 trillion US dollars in global investment for the advanced Energy [R]evolution scenario to become reality until 2030, approximately 60% higher than in the Reference scenario ($11.3 trillion).

- Under the Reference scenario, the levels of investment in renewable energy and fossil fuels are almost equal - about $5 trillion each - up to 2030. Under the advanced scenario, however, the world shifts about 80% of investment towards renewables; by 2030 the fossil fuel share of power sector investment would be focused mainly on combined heat and power and efficient gas-fired power plants.

- The average annual investment in the power sector under the advanced Energy [R]evolution scenario between 2007 and 2030 would be some $782 billion.

- Because renewable energy has no fuel costs, the savings in the advanced Energy [R]evolution scenario reach a total of $6.5 trillion, or $282 billion per year until 2030 and a total of $41.5 trillion, or an average of $964 billion per year until 2050.

Future global employment

Worldwide, we would see millions of jobs created in the energy sector if we shifted to either of the Energy [R]evolution scenarios.

- By 2015 global power supply sector jobs in the Energy [R]evolution scenario are estimated to reach about 11.1 million, 3.1 million more than in the Reference scenario. The advanced version will lead to 12.5 million jobs by 2015.

- By 2020 over 6.5 million jobs in the renewables sector would be created due to a much faster uptake of renewables, three-times more than today. The advanced version will lead to about one million jobs more than the basic Energy [R]evolution, due a much faster uptake of renewables.

- By 2030 the Energy [R]evolution scenario achieves about 10.6 million jobs, some 2 million more than the Reference scenario.

- The advanced scenario will lead to 12 million jobs, that is 8.5 million in the renewables sector alone. Without this fast growth in the renewable sector global power jobs will be a mere 2.4 million. Thus by implementing the E[R] there will be 3.2 million or over 33% more jobs by 2030 in the global power supply sector.

Development of CO_2 emissions

While CO_2 emissions worldwide will increase by more than 60% under the Reference scenario up to 2050, and are thus far removed from a sustainable development path, under the advanced Energy [R]evolution scenario they will decrease from 28,400 million tonnes in 2007 (including international bunkers) to 3,700 in 2050, 82% below 1990 levels.

Annual per capita emissions will drop from 4.1 tonnes per capita to 0.4 tonnes per capita. In spite of the phasing out of nuclear energy and a growing electricity demand, CO_2 emissions will decrease enormously in the electricity sector.

In the long run efficiency gains and the increased use of renewable electric vehicles, as well as a sharp expansion in public transport, will reduce CO_2 emissions in the transport sector. With a share of 42% of total emissions in 2050, the transport sector will reduce significantly but remain the largest source of CO_2 emissions - followed by industry and power generation.

Greenhouse development rights

Although the Energy [R]evolution envisages a clear technological pathway, it is only likely to be turned into reality unless its corresponding investment costs are shared fairly under a global climate regime. To demonstrate one such possibility, we have utilised the Greenhouse Development Rights framework, designed by EcoEquity and the Stockholm Environment Institute.

The Greenhouse Development Rights (GDR) framework calculates national shares of global greenhouse gas obligations based on a combination of responsibility (contribution to climate change) and capacity (ability to pay). Crucially, GDRs take inequality within countries into account and calculate national obligations on the basis of the estimated capacity and responsibility of individuals. Individuals with incomes below a ‘development threshold’ – specified in the default case as $7,500 per capita annual income, PPP adjusted – are exempted from climate-related obligations. Individuals with incomes above that level are expected to contribute to the costs of global climate policy in proportion to their capacity (amount of income over the threshold) and responsibility (cumulative CO_2 emissions).

The GDR framework represents a good mechanism for helping developing countries to leapfrog into a sustainable energy supply, with the help of industrialised countries, while maintaining economic growth and the need to satisfy their growing energy needs. Greenpeace has taken this concept on board as a means of achieving equity within the climate debate and as a practical solution to kick-starting the renewable energy market in developing countries.

Policy changes

To make the Energy [R]evolution a reality and to avoid dangerous climate change, Greenpeace demands that the following policies and actions are implemented in the energy sector:

1. Phase out all subsidies for fossil fuels and nuclear energy.

2. Internalise the external (social and environmental) costs of energy production through 'cap and trade' emissions trading.

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 the 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 programmes.

7. Implement better labelling and disclosure mechanisms to provide more environmental product information.

8. Increase research and development budgets for renewable energy and energy efficiency

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