

## A FULLY RENEWABLE ENERGY SYSTEM GLOBALLY BY 2050

The Energy Report shows that a global energy system based on renewable energy is possible by 2050



A fully sustainable and renewable global energy system is possible by 2050. For the first time, the feasibility of such a system is demonstrated by The Energy Report, published by Ecofys and WWF. With emphasis on detailed developments and practical application, the report illustrates how almost 100% of all energy carriers, all regions and all sectors of the global energy system can be renewable, by 2050.



For several reasons, the world needs an adapted energy system to accommodate its growing population: Climate change, depletion of natural resources and a growing dependence on only a few energy suppliers are a threat to our current system. Renewable energy sources are therefore necessary for a sustainable balance.



The Energy Report is unique. Never before has a renewable energy scenario been so ambitious and so broad in scope, incorporating all aspects of sustainability. By utilising today's technologies alone, 95% of all energy can be renewable by 2050, comfortable lifestyles can be developed and sustained and long-term benefits can outweigh short-term costs. To make this transition, we must abandon the convention of meeting energy demand with fossil fuels. Systems and energy markets must change and hard choices must be made. The Energy Report charts the elements needed for this transition.



### Approach

The Energy Report asks the fundamental question: "Is a fully sustainable global energy system possible by 2050?" Ecofys, with over 25 years of experience in the field of renewable energy and energy efficiency, investigated the technical, social and economical developments of the future world, by:

- > forecasting the future level of energy-consuming activities (e.g. tonnes of steel produced)
- > deriving the minimum level of energy necessary for these activities
- > defining the most sustainable sources of that energy.



## Activity and energy demand

First, The Energy Report makes an estimate of future energy demand. This demand is based on a detailed assessment of activities in ten global regions and in all energy-using sectors: industry, buildings and services, and transport.

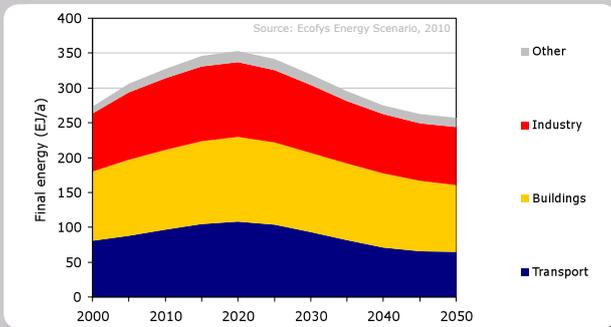
An important condition in assessing demand is the rate of development towards a sustainable standard of living, based on increasing equity between different regions in the world. This part of the Report leads to a development of demand differentiated into the three main energy carriers: electricity, heat and fuels.

## Step one: maximise conservation of energy and material

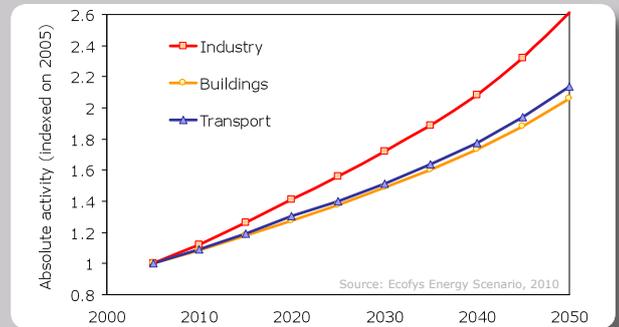


### A very different energy system

The energy system in 2050 will look quite different from the system of today. All sectors and sub-sectors will use energy and materials as efficiently as possible; the recycling and recovering of base materials will be elemental to



The stabilisation and contraction of overall energy demand (left) is mostly due to ambitious energy efficiency improvement since activity levels continue to increase (right) in all sectors.



## Energy supply

This energy demand profile is then matched with different energy supply options that rely entirely on existing technologies. These options are arranged in order of sustainability. The utilisation of energy from the sun, from wind, water and heat from the earth's crust are prioritised. Only once these options are exhausted is bio-energy deployed. Within the bio-energy category, The Energy Report also applies a ranking of sources by sustainability and excludes non-sustainable use. Through this method, demand and supply are matched using renewable resources and proven technologies.

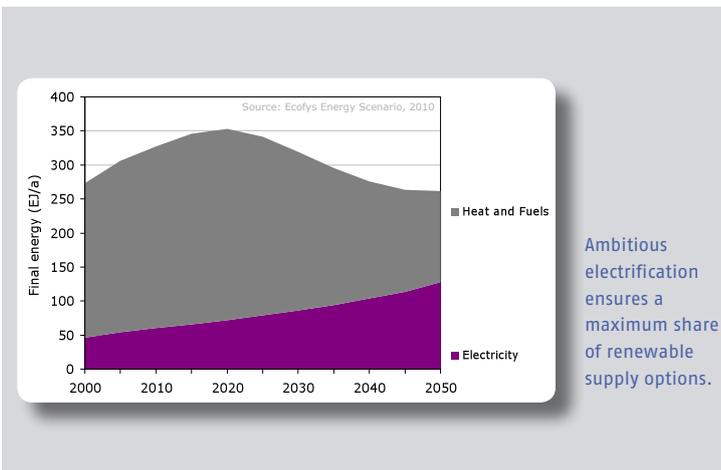
all industrial processes. By substantially increasing efficiency globally, the final energy consumption in 2050 will fall below the annual consumption of 2000, while global activity, and the associated increase in living standards, will more than double. Only with this significant reduction in energy demand is it possible to supply this energy from renewable sources.

## Step two: scale up currently available renewable energy options



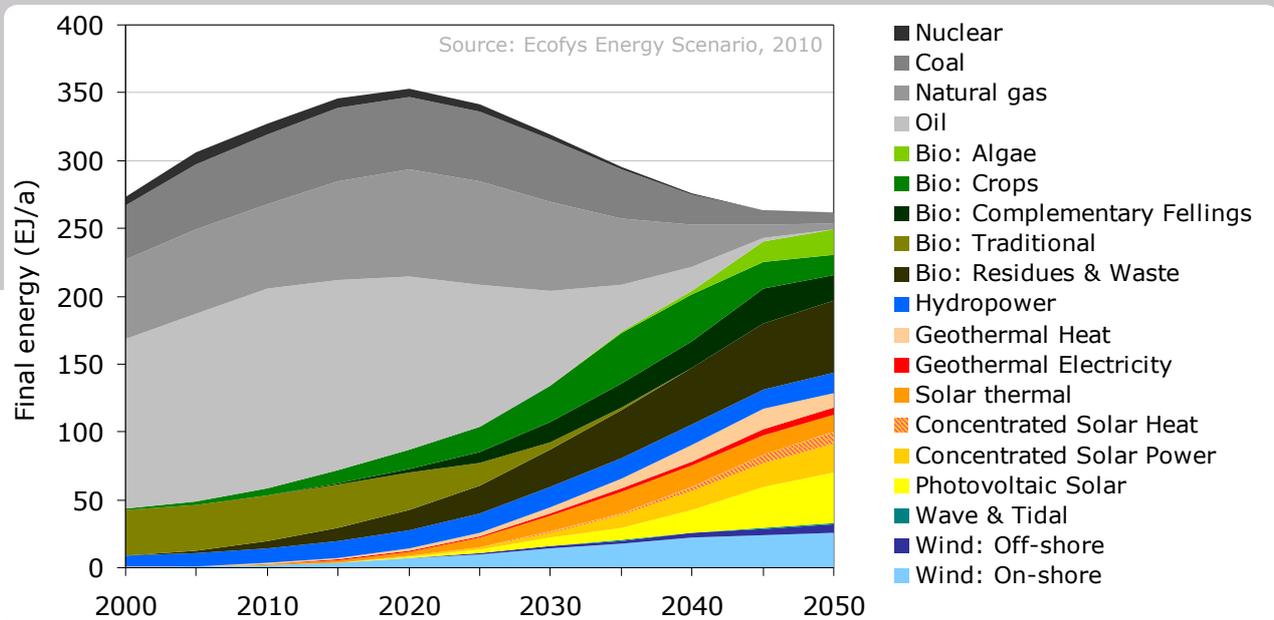
Approximately 60% of the low energy demand will be sourced from the sun, wind, hydropower and geothermal

energy. An accelerating and sustained utilisation of these energy sources is essential to the realisation of The Energy Report's energy system. Most of these sources will contribute to a further electrification of our society. The renewable sources mentioned here are particularly suitable for producing electricity, more so than they are for offering heat or fuel solutions. This is reflected by an increasing share of electric power in the overall energy supply to end-users, from around 20% to almost 50%, in 2050.



Ambitious electrification ensures a maximum share of renewable supply options.

Overall energy supply in The Energy Report.



## Sustainable bio-energy

Not all transport fuels and industrial heat and fuel supply can be substituted with electricity however and by 2050 a substantial contribution from bio-fuels will also be needed. Air and freight transport, for example, will require large quantities of bio-fuels to maintain current and future high levels of activity.



More so than other sources, bio-energy requires a careful consideration of sustainability conditions. The Energy Report ascertains that sufficient source options and conversion technologies for bio-energy are available; source options that meet stringent sustainability criteria for biodiversity, non-degradation of land systems and effects on food production. Following this approach, energy from organic residues and waste will contribute the largest proportion of bio-energy to the 2050 energy supply, followed by the sustainable use of fellings from forestry and, to a lesser extent, energy from crops and algae.



## Limitations

Certain manufacturing processes (e.g. steel, cement) need specific properties of their fuels that cannot yet be substituted by renewable fuels. This leads to a residual fossil energy use of 5% in 2050 for which substantially new technologies or alternative products would need to be developed. Renewable energy, as a source,

is not the limiting factor; the technical potential of renewable sources is much higher than that used in the scenario.



Grid constraints are another reason why the renewable energy sources are not used to their full potential. New and renovated grids are necessary to accommodate the evolving balance between 'supply-driven' power (solar and wind) and 'demand-driven' sources (biomass or hydropower). With an increase in transmission range and capacity, a share of 20–30% 'supply-driven' power can be achieved. To accommodate higher shares of up to 60%, The Energy Report postulates a re-design of our grids, making full use of demand side management and storage.

## Initial investments will yield returns by 2050



### Investments, savings and benefits

Large additional upfront investments are required in the early decades but a considerable share of these will be recouped before 2050 through additional savings. The investments will be approximately 1–2% of the global Gross Domestic Product (GDP); comparable to the value that the world currently invests in clean air and water. There are significant economic gains stemming from a large decrease in material and energy use and by 2035 these annual gains can be higher than the annual investments. The net profit will reach approximately 2% of the global GDP by 2050 from the energy system alone. The Energy Report does not account for additional economic benefits from reduced pollution.

## Acting now will secure benefits later



The Energy Report creates questions such as:

- > Who will invest?
- > Which policies are needed?

- > How will tasks be divided between public and private actors?
- > How will benefits be distributed?
- > What are implications at regional or sectoral level?
- > What are the consequences for businesses, organisations, individuals?



The Energy Report concludes that a substantial concerted effort is required in every sector and region of the world's economy over the next four decades and a particularly dynamic effort over the next 10 years. The current level of action is not substantial enough to realise the scenario in The Energy Report. It requires resolute and rapid action. Familiar excuses for inaction no longer apply; conserving energy is compatible with increasing living standards, sufficient renewable energy options are available today and the transition is affordable, even profitable, in the long-term.



The Energy Report provides a concrete direction to a new horizon; a horizon that is technically possible and economically viable for the entire global society. By providing a clear route to achieving this possible scenario, The Energy Report is intended as a source of inspiration for governments, companies and citizens.



**WWF** is one of the world's largest and most experienced independent conservation organizations, with over 5 million supporters and a global network active in more than 100 countries. WWF's mission is to stop the degradation of the earth's natural environment and to build a future in which humans live in harmony with nature.

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## Ecofys – Experts in Energy

Established in 1984 with the vision of achieving “sustainable energy for everyone”, Ecofys has become the leading expert in renewable energy, energy & carbon efficiency, energy systems & markets as well as energy & climate policies. The unique synergy between those areas of expertise is the key to its success. Ecofys creates smart, effective, practical and sustainable solutions for and with public and corporate clients all over the world. With offices in the Netherlands, Germany, the United Kingdom, China and the US, Ecofys employs over 250 experts dedicated to solving energy and climate challenges.

Please visit our website: [www.ecofys.com](http://www.ecofys.com) for the download of the full report.

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