



THE CHALLENGES AHEAD

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The Ecofys analysis shows that the world can technically meet its energy needs from renewable sources by 2050. But it throws up some difficult challenges – and not just technical ones. The social, environmental, economic and political issues this report raises are equally pressing.

On the technical side, two key factors will enable the world to meet its energy needs from renewable sources: (i) We need to reduce demand by improving energy efficiency and reducing wasteful use of energy; and (ii) because electricity and heat are the forms of energy most easily generated by renewables, we need to maximize the use of electricity and direct heat, with improvements to electricity grids to support this.

A sustainable energy future must be an equitable one. Its impact on people and nature will greatly depend on the way we use our land, seas and water resources. Changes in lifestyle also have a critical role to play.

Moving to a renewable future will mean rethinking our current finance systems. It will also require innovation.

Local, national and regional governance will need to be greatly strengthened to secure an equitable energy future. We need international cooperation and collaboration on an unprecedented level to bridge the gap between the energy-rich and energy-poor, both within and between countries.

These challenges are outlined on the following pages.



ENERGY CONSERVATION

How can we do more while using less energy?

Under the Ecofys scenario, global energy demand in 2050 is 15 per cent lower than in 2005. This is in striking contrast to “business-as-usual” projections, which predict energy demand will at least double. This difference is not based on any reduction in activity – industrial output, domestic energy use, passenger travel and freight transport continue to grow, particularly in developing countries. Instead, reductions come from using energy as efficiently as possible.

Energy conservation is one of the prerequisites of a future powered by renewables. We will not be able to meet the needs of our planet’s expected nine billion inhabitants if we continue to use it as wastefully as we do today. It is the single most important element in the Ecofys scenario.

In every sector, solutions already exist that can deliver the massive energy savings we need. The challenge will be in rolling them out on a global scale as soon as possible.

In manufacturing, using recycled materials greatly reduces energy consumption. For example, making new products from recovered aluminium instead of primary aluminium cuts total energy use by more than two-thirds. Stocks of materials that take a lot of energy to produce, such as steel and aluminium, have grown over the past decades, making recycling and reusing materials increasingly viable. Finding alternatives to materials that take the most energy to produce, such as cement and steel, will mean further energy savings.

Product design also has considerable implications for energy use. Making cars with lighter (although not weaker) frames and with new materials, for example, and producing smaller cars reduces both the need for energy-intensive steel in manufacturing and their fuel consumption. Despite some very innovative models on markets already, there is still huge potential to tap into much higher efficiency levels for all energy-hungry appliances.

In the developing world, more than 160 million households now use improved biomass cooking stoves. Simply using a ceramic lining instead of an all-metal design can improve efficiency by up to a half. The stoves cost little, reduce carbon emissions and deforestation from charcoal production, and have immense health benefits. Even more efficient are solar cookers, which simply use and concentrate the heat from the sun. Distributed widely enough, these small-scale solutions add up to a significant reduction in energy demand.

The world already has the architectural and construction expertise to create buildings that require almost no conventional energy for heating or cooling, through airtight construction, heat pumps and sunlight. The Ecofys scenario foresees all new buildings achieving these standards by 2030.

At the same time, we need to radically improve the energy efficiency of our existing buildings. We could reduce heating needs by 60 per cent by insulating walls, roofs and ground floors, replacing old windows and installing ventilation systems that recover heat. Local solar thermal systems and heat pumps would fulfil the remaining heating and hot water needs. For all buildings to meet these energy efficiency standards by 2050, we will need to retrofit 2-3 per cent of floor area every year. This is ambitious, but not impossible – Germany has already achieved annual retrofit rates in this range.

The world will also need to use less energy for transport. That means making more fuel-efficient models of all forms of transport, and operating them more effectively. Improved air traffic management could reduce congestion and allow planes to follow more efficient routes and landing approaches, making a small but significant reduction in aviation fuel demands. Similarly, better port, route and weather planning, along with reduced speeds, can significantly reduce fuel use in cargo ships.

But we will also need to move to more efficient modes of transport; making greater use of buses, bikes, trams and trains, sending more freight by rail and sea, and swapping short-haul flights for high-speed trains. Indeed, WWF would argue that we need to go further than this, by reducing the number and length of journeys we need to take – by improving urban planning, logistics and communication technology, and reassessing our priorities.

The more energy we save, the easier the task of moving to a renewable energy future will become. It is one area where everyone can play a part.

**“THE GLOBAL
COST OF LIGHTING
IS \$230 BILLION
PER YEAR.
MODERNIZING
WASTEFUL
TECHNOLOGY
COULD SAVE 60%”***

* Mills, E. 2002, “The \$230-billion Global Lighting Energy Bill.”, International Association for Energy-Efficient Lighting, Stockholm

**DO MORE
WITH LESS**

**“ENERGY
EFFICIENCY
AND
RENEWABLE
ENERGY CAN
REDUCE OUR
DEPENDENCE
ON FOSSIL
FUELS BY
70% BY
2040”***

** The Ecofys Energy Scenario, December 2010*



WHAT NOW?

- We must introduce legally binding minimum efficiency standards worldwide for all products that consume energy, including buildings, along the lines of the Japanese “Top Runner” scheme and the European EcoDesign requirements. Governments, companies and experts will need to agree standards based on Best-Available-Technology (BAT) benchmarks, which should be monitored and strengthened regularly.
- Energy conservation should be built into every stage of product design. Wherever possible we should use energy-efficient, highly-durable and recyclable materials. Alternatives to materials like cement, steel and plastic that take a lot of energy to produce should be a focus for research and development. We should adopt a “cradle to cradle” design philosophy, where all of a product’s components can be reused or recycled once it reaches the end of its life.
- We need strict energy-efficiency criteria for all new buildings, aiming toward near-zero energy use, equivalent to “Passive House” standards. Retrofitting rates must increase quickly to improve the energy efficiency of existing buildings. Governments must provide legislation and incentives to enable this.
- Energy taxation is a realistic option, particularly in wealthier countries. Taxes on petrol, electricity and fuels are already commonplace. Shifting taxes to products and cars that use more energy will help to steer demand toward more efficient alternatives.
- Developing countries must phase-out the inefficient use of traditional biomass, and pursue alternatives such as improved biomass cooking stoves, solar cookers and small-scale biogas digesters. Industrialized countries should facilitate this by providing financial assistance, as part of international development commitments and global efforts to reduce greenhouse gas emissions.
- Substantial investment is needed into public transport to provide convenient and affordable energy-efficient alternatives to private cars. We particularly need to improve rail infrastructure: high-speed trains, powered by electricity from renewable sources, should replace air travel as much as possible, and a maximum proportion of freight should be delivered by rail. Sustainable and public transport modes for all distances, particularly for rail-based transport, must be made cheaper than road- and air-borne traffic.
- Individuals, businesses, communities and nations all need to be more aware of the energy they use, and try to save energy wherever possible. Driving more slowly and smoothly, buying energy-efficient appliances and switching them off when not in use, turning down heating and air conditioning, and increased reusing and recycling are just some ways to make a contribution.

CASE STUDY





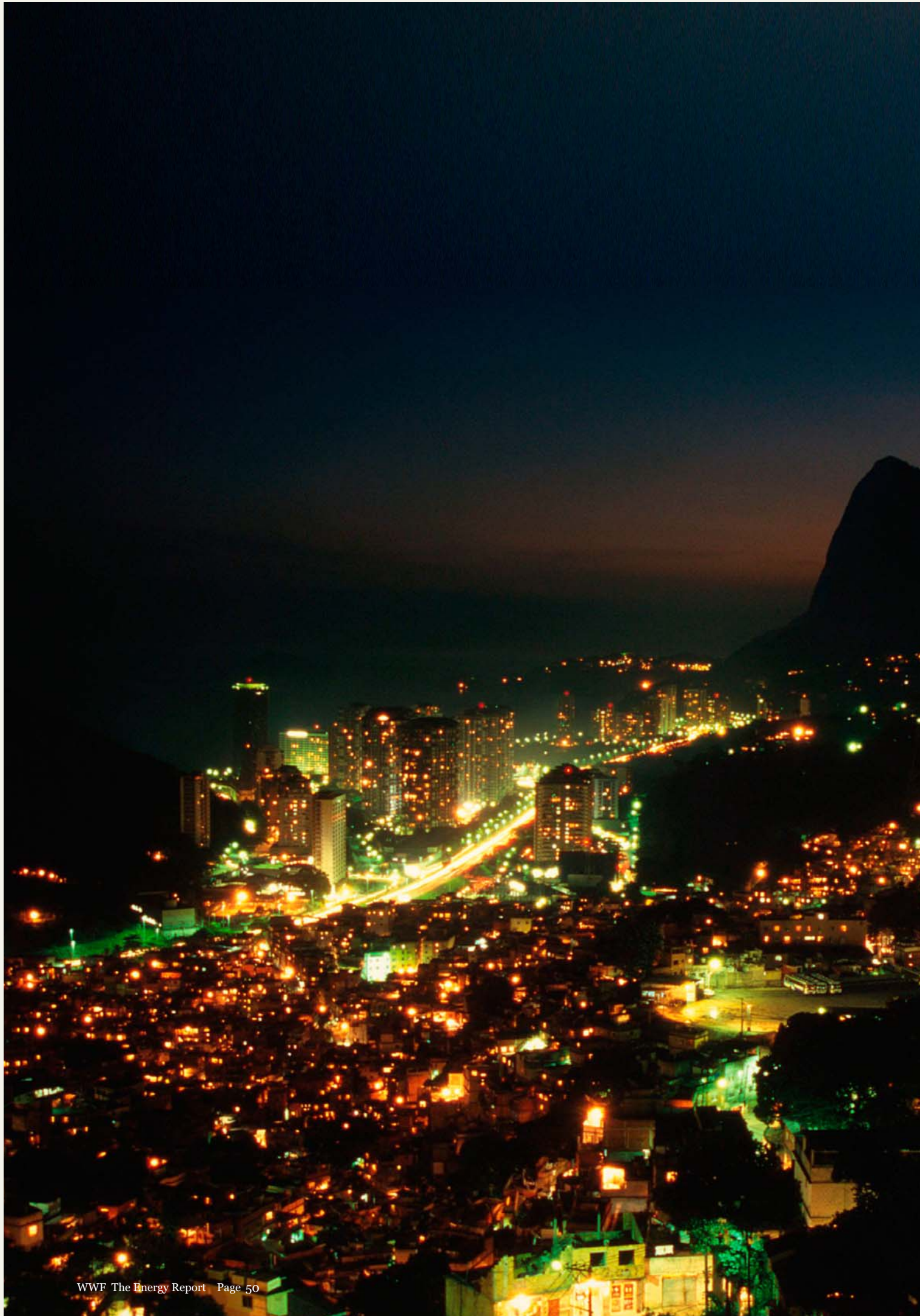
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“WWF HELPED DEVELOP TOPTEN, AN ONLINE SEARCH TOOL THAT IDENTIFIES THE MOST ENERGY-EFFICIENT APPLIANCES ON THE MARKET”

TopTen.info

Consumers and retailers can put pressure on manufacturers to be more energy efficient through their buying choices. WWF helped develop TopTen (www.topten.info), an online search tool that identifies the most energy-efficient appliances on the market. Discerning buyers can compare energy-efficiency ratings for a growing number of items, including cars and vans, household appliances, office equipment, lighting, water heaters and air conditioners. TopTen now operates in 17 countries across Europe and has recently been launched in the USA and China.





ELECTRIFICATION

Renewable sources could provide effectively unlimited power, but how do we switch onto them?

The Ecofys scenario for a renewable energy future depends upon using electrical power from clean, renewable sources in place of fossil fuels and nuclear wherever possible. Currently, electricity makes up less than one-fifth of our total final energy demand; by 2050, under the Ecofys scenario, it accounts for almost half. Cars and trains, for example, will become fully electrified, while other energy uses (such as fuel to heat buildings) will be minimized.

Using more renewable electricity presents several challenges. First, of course, we need to generate it. That will mean massively increasing our capacity to produce power from the renewable resources with the least environmental impact – through wind, solar and geothermal power technologies in particular. While we will need many more large-scale renewable power plants, we will also generate more power at a local level, using solar PV roof tiles, water wheels and individual wind turbines, for example.

We are going to need massive investment to extend and modernize our electricity grids to cope with increased loads and different energy sources. We need to transmit power efficiently from offshore wind turbines, desert solar parks or remote geothermal plants to urban centres – while minimizing the impact of new power lines or subterranean cables. Efficient international networks will also help balance variable renewable sources from different regions. Within Europe, for example, wind and ocean power from the North Sea area could complement Alpine hydropower and solar power from the Mediterranean and even North Africa.

While solar and wind have the potential to supply an effectively unlimited amount of power, this is constrained by the capacity

of electricity grids to deliver it. Our existing grid infrastructure can only manage a limited amount of these variable, supply-driven sources. Grids need to keep electrical voltage and frequency steady to avoid dangerous power surges, and need the capacity to meet peaks in demand. Today, we keep some power stations, notably coal and nuclear, working around the clock to provide a permanent supply of electricity (or “base load”). These power stations cannot simply be switched-off when renewable energy supplies are high, meaning some of this energy goes to waste.

The Ecofys analysis estimates that networks in industrialized countries could take about 20-30 per cent of total electricity from variable sources without further modernization. At a conservative estimate, this will rise to 60 per cent by 2050 through improvements in technology and grid management. The other 40 per cent would come from hydropower, biomass, geothermal electricity and CSP with storage.

The combination of large (“super”) and “smart” grids holds the key. Power companies and consumers will get information on energy supply, and price, to help manage demand. Put simply, it will be cheaper to run your washing machine when the wind is blowing or the sun is shining. Households, offices or factories would programme smart meters to operate certain appliances or processes automatically when power supplies are plentiful. Utility companies would

adjust electricity flow – for example, by tweaking thermostat temperatures – to cope with spikes in demand. We could also take advantage of times when supply outstrips demand to charge car batteries and to generate hydrogen fuel.

At the same time, we need to bring electricity to those who are not connected to the grid – particularly in rural areas in developing countries. We can do this by extending existing grids, or generating power at the household or community level through solar, micro-hydro, wind power or small-scale biomass plants. Providing the 1.4 billion who have no reliable electricity¹⁹ with a basic supply of 50-100 kWh per year would require investments of about €25 billion per year between now and 2030²⁰, or 0.05 per cent of global GDP.

The electricity networks that power our world are one of the great engineering feats of the 20th century. The work we need to do to modernize them over the coming decades will be one of the great feats of the 21st.

19. IEA, World Energy Outlook (WEO), 2010, Paris.
20. IEA, World Energy Outlook (WEO), 2009, Paris.

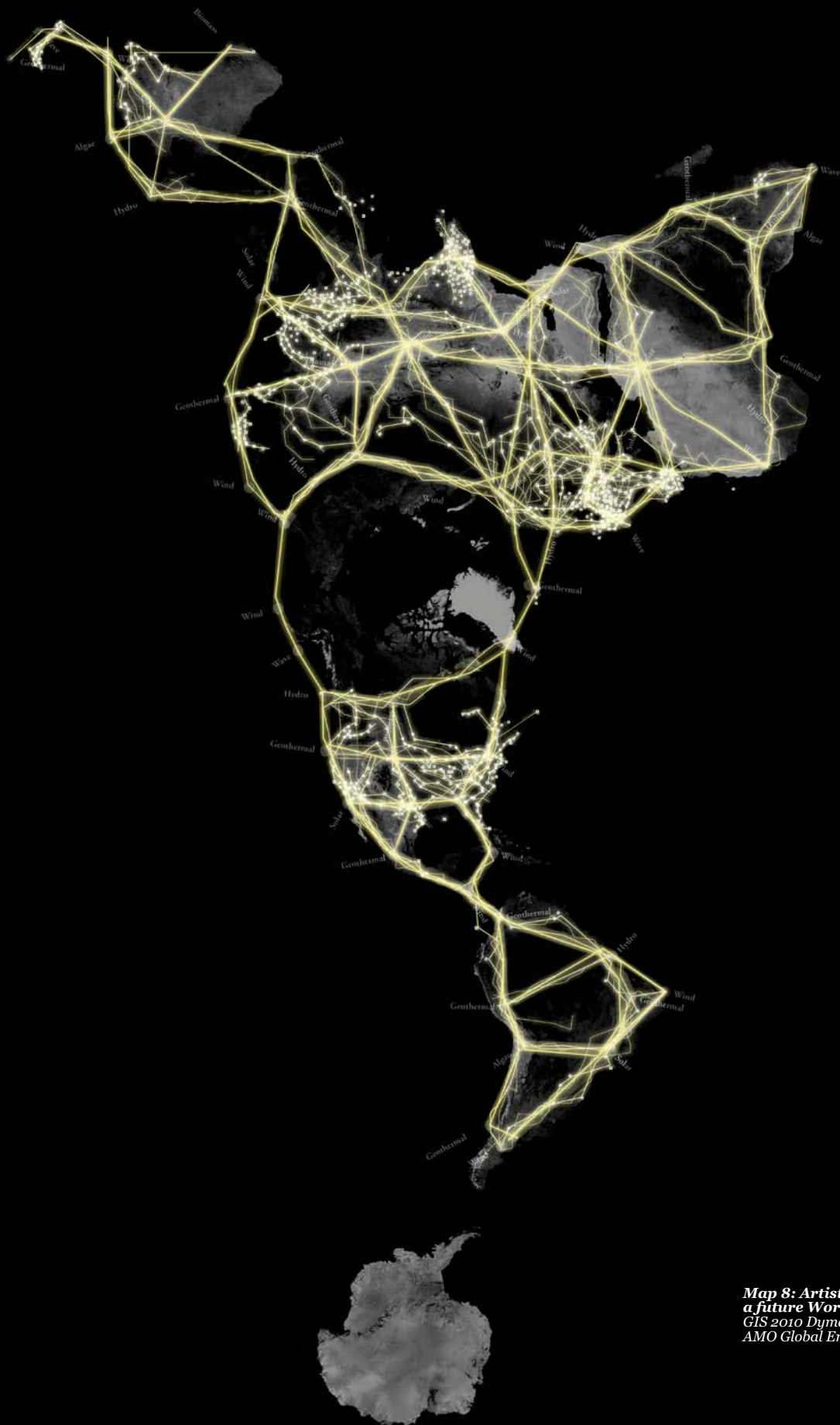


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WHAT NOW?

- We need to massively expand our capacity for generating electricity from renewable resources. Large-scale renewable power plants need to be built, before we divert investment into building a new generation of costly and unsustainable fossil fuel and nuclear power plants that could set us back decades. We also need to support local micro-generation, especially in areas where people have limited or no connection to electricity grids.
- Countries need to work together to extend electricity networks to bring power from centres of production to centres of consumption as efficiently as possible. International networks will help meet demand by balancing variable power sources (such as solar PV and wind), supported by constant sources (geothermal, stored CSP, hydro, biomass).
- We need urgent investment into smart grids to help manage energy demand and allow for a significantly higher proportion of electricity to come from variable and decentralized sources. This will help energy companies balance supply and demand more efficiently, and enable consumers to make more informed choices about their electricity use.
- More research is needed into efficient ways to store energy, including batteries, hydrogen and heat storage for solar power. We also need efficient grid management to release this energy when it is needed, and dispatch it over large distances.
- By 2050, all cars, vans and trains globally should run on electricity. We need legislation, investment and incentives to encourage manufacturers and consumers to switch to electric cars. Improvements in battery technology, and emergence of efficient fuel cells, could allow us to run electric trucks, and possibly even ships, reducing our dependence on biofuels. This is a long-term aim, but research and development is needed now.



Map 8: Artistic impression of a future World Energy Grid
GIS 2010 Dymaxion Projection-
AMO Global Energy Grid Analysis

CASE STUDY





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Micro-hydroelectricity

Near the village of Chaurikharka in Nepal, WWF installed a micro-hydroelectricity system as the demand for wood for cooking and heating was leading to deforestation in the area. Water is diverted from a stream to run a generator, then flows back into the stream, with minimal impact. More than 100 households in six villages now use electricity for cookstoves, microwaves, rice cookers, fridges and room heaters. Four more similar schemes are now operating in the area, saving hundreds of tonnes of fuel wood and improving daily life.

“WWF INSTALLED A MICRO-HYDROELECTRICITY SYSTEM AS THE DEMAND FOR WOOD FOR COOKING AND HEATING WAS LEADING TO DEFORESTATION IN THE AREA”