

An initiative by

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UNTERNEHMER
POSITIONEN **NORD**

UP^o FOCUS ISSUE

The changing energy landscape

Opportunities and threats for entrepreneurs

UP° FOCUS ISSUE

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Foreword

The world of energy is undergoing a sea change. And it is changing the global economy. While the extraction of unconventional gas resources is giving industry a boost in the U.S., Germany is going through an energy transition which offers significant opportunities for many entrepreneurs, but is also associated with risk. And this is the case whether we are talking about energy efficiency in the building or industrial sectors, the transportation of energy, the development and expansion of renewable energies or alternative drive technologies.

Unternehmer Positionen Nord has commissioned The Foresight Company Z_punkt to put together a collection of facts and figures on energy, giving you an overview of many aspects of the changing energy landscape. In each case they also address the opportunities and threats for entrepreneurs.

We trust you will find this booklet interesting and useful.

Unternehmer Positionen Nord – the HSH Nordbank initiative for private business owners

Changes in the global energy environment

We are living in times of far-reaching transformation processes, which are impacting on the global energy landscape to an extent hitherto unknown. The climate debate, growth in the emerging economies and the huge fluctuations in the price of, and demand for, natural resources are driving energy policies around the world. In Germany, the subject of how/whether to pay for an energy transition in economically strained conditions arouses heated debates, in which the externalised costs of current energy supply in our economy are all too often left to one side.

Green technologies deliver security in the future

Germany has never imported so much energy as it does today. If our country wishes to continue to live from the value created by its exports, the change to a sustainable energy supply system is imperative. This transition does not just offer the prospect of economic security in the future through the financially attractive vision of leadership in green technologies, however. It also results in less damaging treatment of the environment coupled with, by and large, an end to the dependence on imports of fossil fuels.

The upheavals in the global energy landscape carry risks, because access to affordable energy is fundamentally threatened. The associated demand for alternatives and resulting emerging markets present opportunities. The developments taking place at global level must be carefully monitored and taken into account in the discussions about energy transition, if a future-proof strategy for these most dynamic times is to come out of the debate.

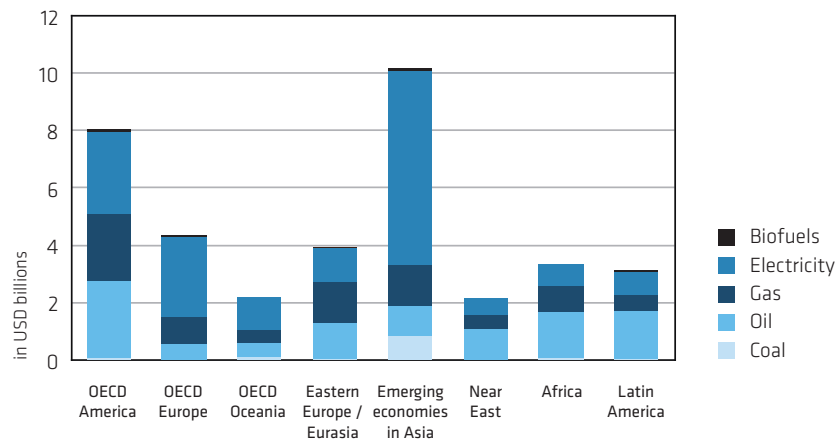
Opportunities and threats in a new energy landscape

This brochure gives an overview of the topics relevant to the subject of our energy landscape. In it, we outline current developments and highlight the opportunities and threats to be faced in this changing market environment. The reader will find some controversial issues here looked at from a business owner's perspective, which do not claim to be exhaustive in their coverage, but are given deliberately neutral treatment. All statements are backed up with their sources and further references to studies addressing the issues in more depth are supplied.

Sven Hirsch, Z_punkt The Foresight Company

Background note: There is frequent mention of, and quotes from, the World Energy Outlook (WEO) of the International Energy Agency (IEA) in the pages that follow. Their sophisticated energy model has become a benchmark. We have taken the "New Policies Scenario", described in the WEO, as our standard. It describes the pathway, in terms of energy policy, for implementing and developing measures announced today. Despite the approaches described, the emissions targets for maximum concentrations of carbon dioxide in the atmosphere (450 parts per million) would be missed by a large margin.

The world of energy



Investment in the energy infrastructure in the „New Policy Scenario“, 2012–2035 (SOURCE:IEA 2012a)

- According to all relevant studies, global energy consumption, standing currently at 13,000 million tonnes of oil equivalent (mtoe), will increase significantly in the next 20 years. The scenarios for the year 2035 range from 14,800 mtoe to just under 18,700 mtoe. (BP 2013, IEA 2012a, Shell 2008)
- Oil, providing just over 4,000 mtoe of energy (status: 2010), is globally the largest source of energy, followed by coal, with about 3,500 mtoe, and gas, with some 2,700 mtoe. (IEA 2012a)
- The IEA estimates that the amount of coal and oil produced for energy will increase in absolute terms, but that their relative share of the energy mix will decline significantly in favour of gas and renewable energies.
- The conversion of primary energy sources into heat and power is accompanied by high conversion losses; electricity's share of end energy consumption is and remains comparatively low. Nevertheless, 45 per cent of total investment into the energy infrastructure to 2035 will go into electricity production. (IEA 2012a)
- Renewable energies are deployed primarily in the area of building and in electricity production. Direct usage of renewable energies in industry and transport is marginal.

OPPORTUNITIES

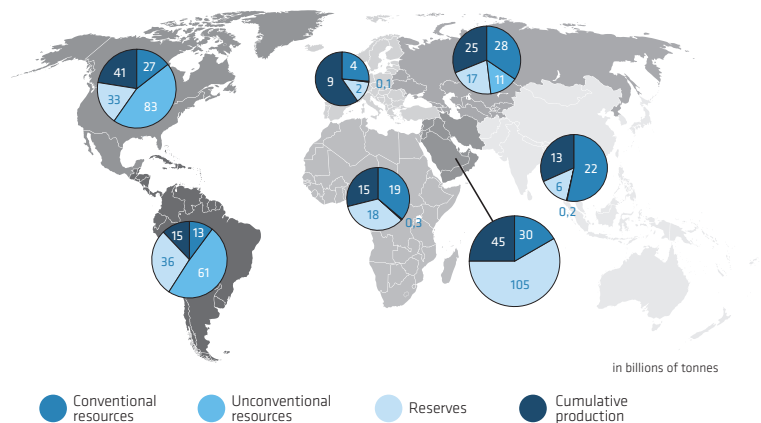
- » good opportunities for newcomers in a dynamic market environment
- » increase in absolute terms in the use of all sources of energy in nearly every scenario
- » in the long term there will be a progression towards sustainability as a result of the increased use of renewable energies
- » gas and renewable energies viewed as „a bank“ – with a comparatively steep rise in usage
- » developing and emerging economies „leapfrogging“ in terms of the structuring of their energy infrastructures
- » coal-to-liquid and coal-to-gas as options for using cheap coal

THREATS

- » coal and gas are the first losers – both as a result of converting to renewable energies and of the concerted global efforts to reduce carbon emissions
- » energy companies in OECD countries with multinational operations dependent on their inventiveness, as their home markets are no longer expanding



The natural resource oil



Total mineral oil potential in 2010; regional distribution (SOURCE: DERA 2011)

- Mineral oil will remain the most important source of energy in the next few years. A decline in demand can only be assumed in the long term, although this will develop in different ways from region to region.
- The Federal Institute for Geosciences and Natural Resources (BGR) in Germany assumes that mineral oil is the only non-renewable energy resource for which demand will increasingly outstrip supply in the coming decades.
- In part also due to rising oil prices, the extraction of oil sands (in particular in Alberta, Canada) and production of gas condensates or liquid gas will become increasingly important. According to BGR projections, these two energy sources could account for up to 27 per cent of total production in 2036. (DERA 2012)
- All scenarios show the share of production coming from the OPEC countries increasing above the current level of 40 per cent. Other than the OPEC countries, Brazil, in particular, can develop and expand its production significantly.
- The industrial sector's demand for oil will only have increased by eight per cent in 2035 over 2011. (IEA 2012a)

OPPORTUNITIES

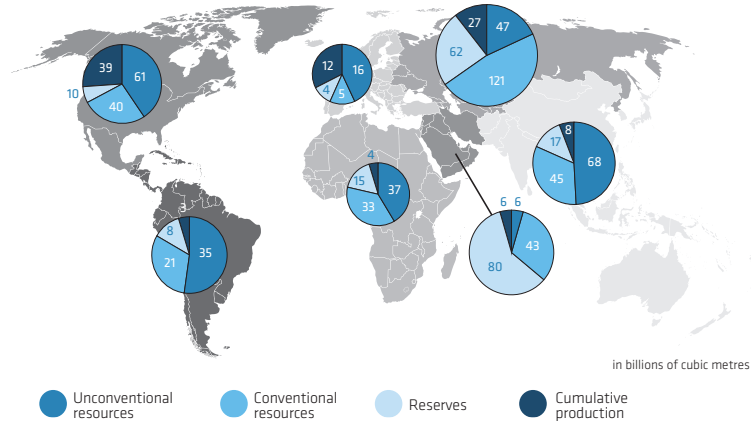
- » substitution possibilities through cheaper alternative energy sources / primary products
- » international efficiency standards for road, air and shipping transport
- » potential for end users through investments in companies within the value-added chain

THREATS

- » huge uncertainty about how crude oil prices will develop
- » higher production and delivery costs in sectors with no opportunities to substitute, as a result of higher oil prices
- » a greater burden on consumers and industry as a result of rising oil prices
- » high costs and environmental risks involved in establishing both conventional and unconventional energy sources
- » doubts about the quality of oil coming from unconventional sources
- » rising costs of processing in Germany as a result of the underutilisation of the refineries



The natural resource gas



Total natural gas potential in 2011; regional distribution (SOURCE: BGR 2012)

- Demand for natural gas is likely to rise by 1.6 per cent per annum to 2035. (IEA 2012a)
- Globally there are sufficient conventional reserves of gas for the foreseeable future; but the dependency of the EU countries on imports will rise.
- Exploiting unconventional natural gas reserves (shale gas, tight gas, coalbed gas) improves the global supply situation. These reserves will already account for half of all additional gas production in 2035. (IEA 2012a)
- By exploiting unconventional oil and – in particular – natural gas reserves, the US will move from being an energy importer to an energy exporter in the long term. This has far-reaching geopolitical and economic consequences for energy markets and the global economy.
- According to conservative estimates, total gas reserves will rise by 40 per cent as a result of the unconventional gas reserves. (EIA 2011b)
- Trade in liquefied natural gas (LNG) is growing thanks to the relevant infrastructure (liquefying plant and pipelines) becoming operational and is leading to global market and pricing convergence.
- The production of synthetic fuels from natural gas (gas-to-liquid, GTL) is increasing.

OPPORTUNITIES

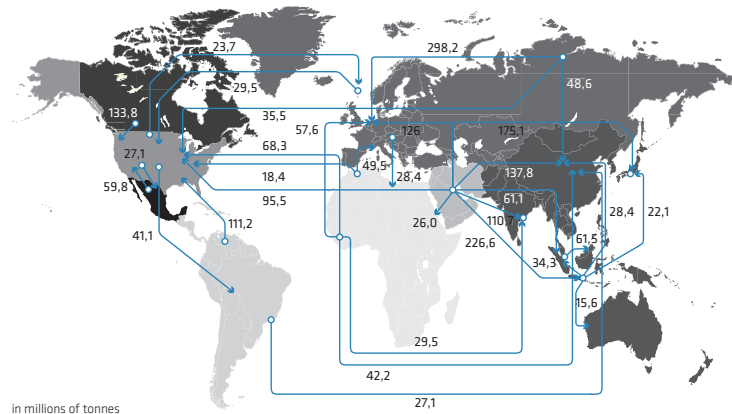
- » gas as a substitute in the production process
- » potential from new unconventional shale gas reserves in Northern Germany (BGR 2012)
- » more flexible supply contracts
- » strain taken off the fuel market through further development and expansion of GTL production

THREATS

- » European gas processing industries at a competitive disadvantage
- » Germany's high dependence on gas imports, particularly from Russia
- » society's acceptance of the methods of extracting unconventional gas reserves - fracking - remains at a low level
- » higher gas prices in the medium term following market consolidation through unconventional gas
- » new supply-side situation with resulting geopolitical shift as a result of the U.S. no longer being dependent on imports
- » climate protection effect overestimated as gases damaging to the climate are released during the extraction process



Transporting energy resources



The most important oil trade channels 2011 (SOURCE: BP 2012)

- With global consumption rising, the transportation of energy resources will continue to grow steeply. (BP 2012)
- Demand for coal and oil is increasingly shifting to the emerging economies and is declining in the OECD countries.
- As a result of unconventional production technologies (e.g. fracking, oil sand), mainly in North America, transportation will shift towards Asia. (IEA 2012a)
- The global rise in gas consumption is leading to the development and expansion of the corresponding infrastructure in terms of pipelines and LNG terminals for liquefying natural gas.

OPPORTUNITIES

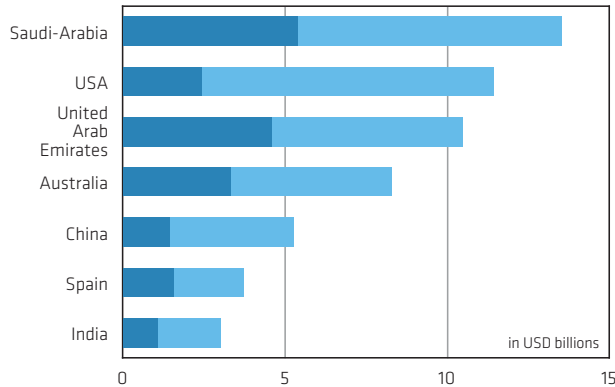
- » greater security of supply with gas as a location factor
- » additional transportation requirement through global trading in gas (ships, pipelines and LNG terminals)
- » end of the dominance of the global market by just a few market players

THREATS

- » short-term interruptions to supply as a result of many potential suppliers in different regions
- » development of the LNG market unsure; danger of an investment bubble
- » extent of transportation required difficult to calculate
- » continuing vulnerability of the transport infrastructure to terrorist attacks



Water usage by the energy sector



Market volume for desalination plants in selected countries

(SOURCE: GWI 2010)

■ 2007-2011
■ 2012-2016

in USD billions

- Water will be the subject of massive conflicts over usage in the future. Many regions suffer from scarcity of supply seasonally or per se. As a result, the balance between use as drinking water, for agricultural purposes and in hydro-electric power production or power station cooling must be renegotiated and redefined. (WRG 2009)
- The regions expected to generate the greatest population growth in the future and in which the majority of the world's population lives suffer from a tendentially worsening water situation compared to the rest of the world. (UNESCO 2012)
- According to IEA estimates, in 2010 some 15 per cent or 583 billion cubic metres of global water intake was used for energy production. Of this intake, eleven per cent was not returned directly to the water cycle and therefore counts as water consumption. (IEA 2012a)
- Water consumption in both the extraction of combustibles and their conversion into electricity varies greatly depending on the technology used.
- With just a few exceptions, the level of water consumption when producing electricity from coal, gas or nuclear power is very high; wind power lies at the other end of the scale.

OPPORTUNITIES

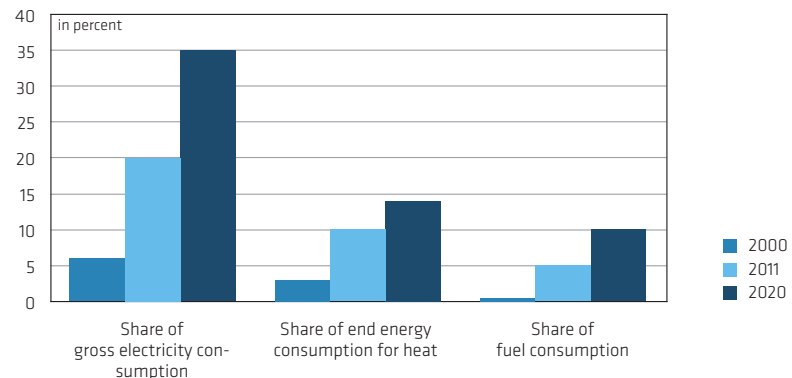
- » opening up of markets because of water scarcity
- » particular advantages for renewable energies because of their low water consumption
- » increasing importance of water desalination and water treatment

THREATS

- » frequently uncertain predetermination of climate-induced water scarcity
- » constant threat of regulatory intervention with regard to water consumption
- » curtailment of energy production because of water shortages



Renewable energies in Germany



Renewable energies' share of energy provision in Germany (SOURCE: BMU 2012a)

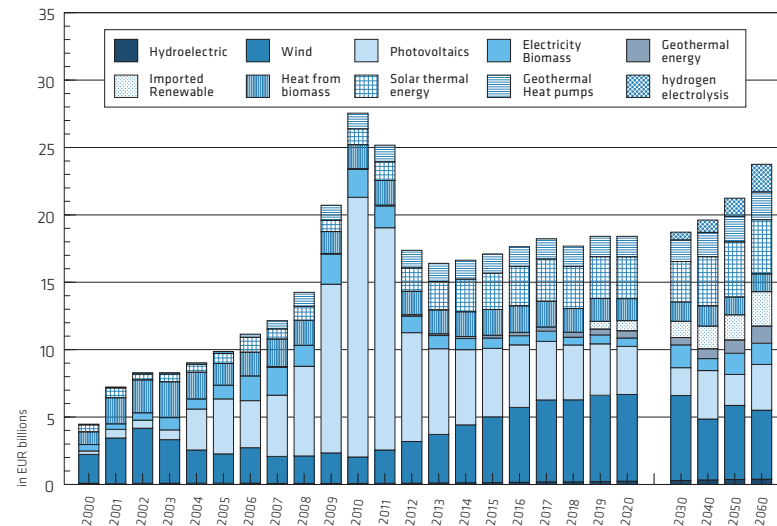
- Germany plans to increase the share of renewable energies used in electricity supply to at least 35 per cent by 2020.
- In 2011 renewable energies contributed 123 and 135 terawatt hours (TWh) towards the provision of heat and electricity respectively, and thus ten per cent and 21 per cent respectively to each form of end energy consumption. Biomass plays a leading role in heating; electricity comes above all from wind energy. (BMU 2012b)
- Wind energy and photovoltaics (PV) account for the greatest increase in power production capacity. PV currently accounts for the most investment; but the enormous volumes of investment in PV will in future decline in favour of wind power. (DII 2012)
- Production costs of (onshore) wind energy could be lower than those for the conventional mix – i.e. electricity production based on fossil fuels and nuclear power – in as little as five years. (FISE 2012)

OPPORTUNITIES

- » new markets arising from big investment in new technologies
- » opportunities for auxiliary industries and for installation, maintenance and related services
- » growing potential for buffer technologies, as well as energy-related services and load management
- » new markets for specialist companies from the development and expansion of offshore wind energy
- » new investment perspectives through the electrification of flexible applications
- » rapidly sinking PV prices as a result of products offered by Chinese competitors

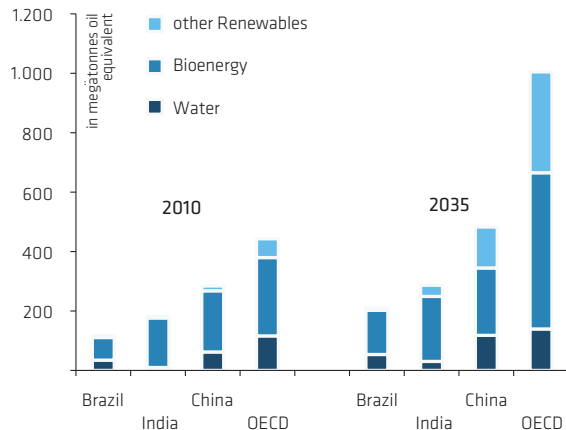
THREATS

- » uncertainty about future funding
- » slow development and expansion of the necessary networks, threat of emergency cut-off
- » extreme price squeeze on manufacturers of PV and wind power equipment
- » rising costs for integration due to insufficient flexibility in the electricity system
- » public resistance to new installations



Annual volume of investment in renewable technologies for power and heat production in Germany (middle scenario) (SOURCE: DII 2012)

Renewable energies worldwide



Development of energy requirement from renewables (water, bioenergy, other); in selected regions

(SOURCE: Z_PUNKT, from IEA 2012a)

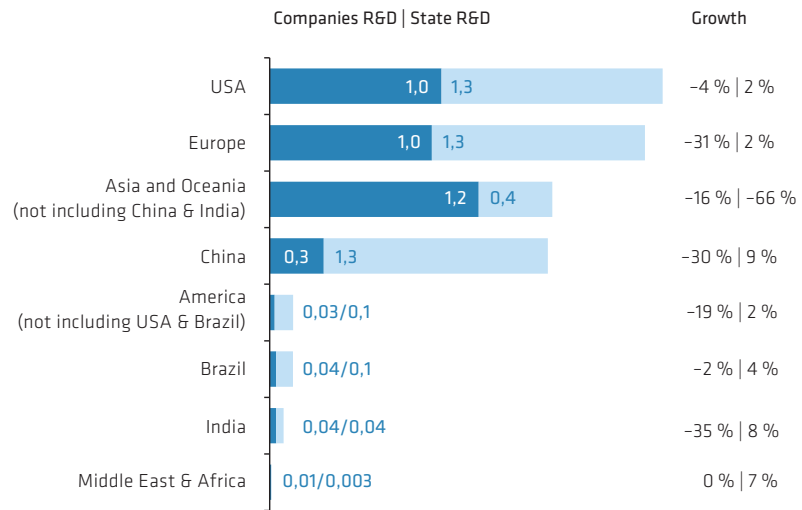
- The share of renewable energies in primary energy provision will rise from its current 13 per cent (i.e. a total of 12,700 mtoe) to roughly 17 per cent (then 17,200 mtoe) by 2030. (BP 2013, IEA 2012a)
- Experts are forecasting that renewable energies' share of the total global electricity mix will rise in the coming years, from 20 per cent currently to between 24 and 48 per cent depending on the scenario taken. (BP 2013, IEA 2012a)
- Hydroelectric energy, the most proven form of renewable power production, should be consistently accounting for some 16 per cent of global power production by 2035. (IEA 2012a)
- In its „New Policies Scenario“, the IEA assumes an increase from 3.3 per cent to 14 per cent of global power production for wind, photovoltaics and bioenergy. (IEA 2012a)
- In terms of investment volume, the use of renewable energies for power production far outstrips its use in heating or as a fuel. (BP 2012, IEA 2012a)
- renewable energies are becoming more competitive as a result of the rising cost of carbon certificates.

OPPORTUNITIES

- » pressure on electricity prices in the long term because of decreasing electricity production costs with renewable energies
- » new sources of revenue for the service and manufacturing industries through the provision of system-related services
- » optimal integration of the electricity from renewable energies through the creation and expansion of the corresponding infrastructures
- » new development perspectives for rural populations in developing countries and emerging economies through the use of renewable energies

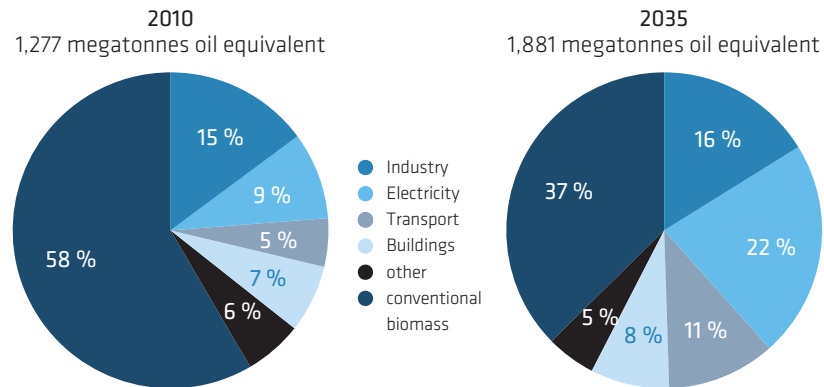
THREATS

- » uncertainty with regard to future subsidy mechanisms
- » cost explosion and rare earth supply bottlenecks
- » development of emissions trading unclear



Corporate and state investment (Research and development, R&D) by region (2011) and growth (2010) in USD billions (SOURCE: BNEF 2012)

Bioenergy



(Global) bioenergy use by sector; IEA „New Policy Scenario“ (SOURCE: IEA 2012a)

- Global demand for bioenergy will increase by an average of 3.3 per cent per annum between 2010 and 2035; the steepest increases will come from Europe. (IEA 2012a)
- Biomass consumption for the manufacture of biofuels will grow by 250 per cent by 2035. (IEA 2012a)
- Estimates of the potential for covering primary energy requirement through biomass vary greatly.
- The Federal government is planning to cover 15 per cent of primary energy needs through biomass by 2020 (five per cent today).
- The countries with the largest cultivation areas are Brazil, the US and China.
- Biofuels which are not intended to compete directly with the growth of foodstuffs are scheduled to become available from 2020.

OPPORTUNITIES

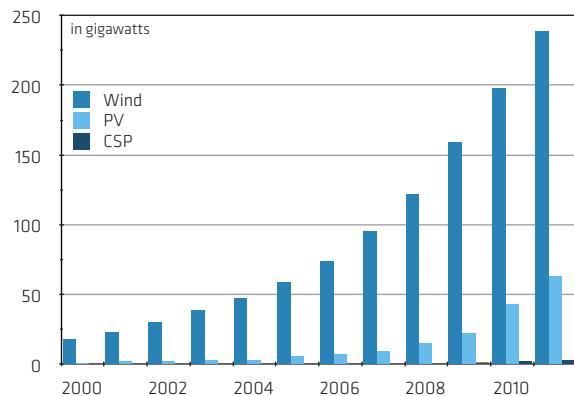
- » flexible use of biomass in chemicals and fuel production and electricity generation
- » compensating for fluctuations in food prices
- » transport market opportunities as a result of the huge areas to be covered

THREATS

- » competition between cultivation areas
- » climate protection risks from clearing areas with a high carbon level
- » little research on the effect of energy crops on soil and water



Decentralised power and heat supply



**Installed capacity worldwide:
PV – photovoltaics, CSP –
concentrated solar power
plants, Wind – wind energy
installations**

(SOURCE: FISI 2009)

- Cost reductions in renewable energies production and the need for greater efficiency are leading to a steep increase in the proportion of decentralised energy supply. (IEA 2012a)
- Solar energy can become a credible alternative to centralised power and heat or refrigeration supply in developing countries and emerging economies close to the equator which do not yet have a comprehensive energy supply system.
- By pre-integrating communications interfaces, decentralised production plant can be use to make the energy system more flexible and to store energy.
- Power-heat coupling is particularly suited to decentralised deployment and leads to greater flexibility of the system. The same applies to fuel cells, which could benefit in the mid-term from hydrogen production through surplus-to-requirements electricity. (EuPar 2010)
- With increasingly decentralised supply, the need for transmission networks will decline; in contrast, the demand for distribution grids will grow.

OPPORTUNITIES

- » greater flexibility in the overall systems thanks to the decentralised thermal production plants which are, in the main, very flexible
- » dynamic growth of the still relatively small market for decentralised power and heat supply plant likely
- » increase in energy efficiency through the use of power-heat coupling
- » new business opportunities as a result of the high on-site installation costs

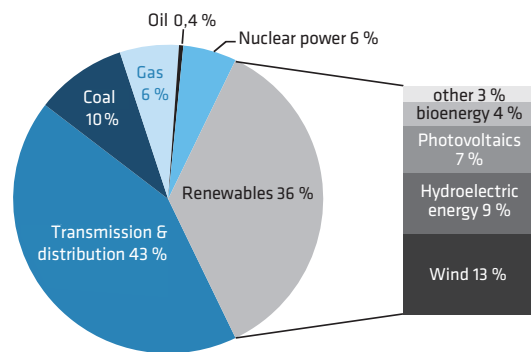
THREATS

- » large power plants increasingly uneconomic
- » the success of decentralised energy supply systems is dependent on customer acceptance



The structure of global power production

Total investment: USD 16.9 billion



Investment in energy (cumulative 2012–2035) by type of production

(SOURCE: IEA 2012a)

- Globally the share of renewable energies of total power production is growing significantly. The IEA is assuming growth in capacity of 180 per cent by 2035. (IEA 2012a)
- By 2035 some 36 per cent of capital investment in the electricity sector will be in renewable energies - higher, therefore, than investment in power production from conventional combustibles (approx. 22 per cent). The rest will go into network infrastructure. (IEA 2012a)
- In the regions of the world with strong economic and population growth in particular, almost every source of energy will be needed for power production.
- Outside the OECD countries, conversion of coal into electricity is growing. Extra coal-fired power plants giving capacity for over 1,000 gigawatts will be built by 2035. Strong growth is expected in the overall market for gas for power production. (IEA 2012a)
- The development of nuclear power is uncertain. The assumption is of an unchanging share of power production worldwide.

OPPORTUNITIES

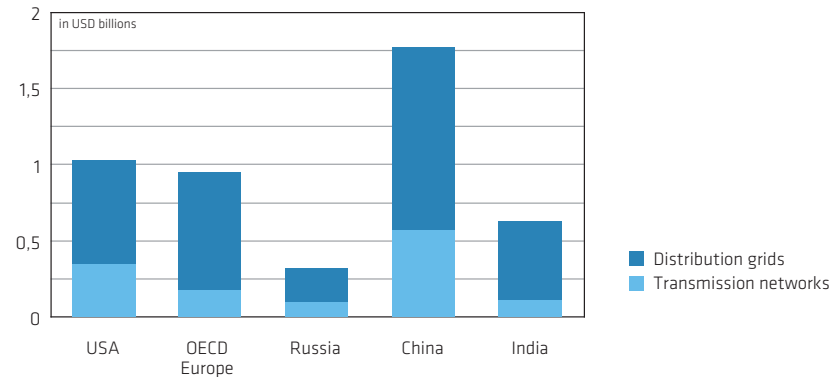
- » growing requirement for system-related services and energy storage
- » strong growth in comparatively new technologies
- » growing potential for demand side management in the industrial and service sectors

THREATS

- » problems with public supply due to investment lagging behind in the area of networks
- » obstacles to the development and expansion of compensatory capacity and threat to the stability of power supply through deficiencies in the market set-up.
- » high costs for integrating renewable energies into the system if load management and other flexibility technologies are not developed and expanded.
- » carbon costs, flexibility demands and an unclear outlook on the price of coal act as a stumbling block to coal-based power generation
- » technological and economic outlook for carbon sequestration unclear



Power transmission and distribution



Investment in the network infrastructure in selected regions 2012–2035 (SOURCE: IEA 2012a)

- Power transmission and distribution are nearly as capital intensive as power production itself - the IEA estimates that its share of investment in the electricity sector stands at some 43 per cent. (IEA 2012a)
- As a natural monopoly, power grids are normally heavily regulated or have strong state intervention.
- According to dena, 950 million euros will have to be invested in Germany up until 2020 for 3,600 kilometres of power transmission lines in order to meet requirements for the energy transition. (dena 2010)
- New technologies such as the one for transmitting direct current via the high-voltage grid or smart grid components will play a major role when it comes to adapting the networks to the requirements of increasingly volatile power production.
- The global market for smart grid equipment is estimated to have annual growth in volume of around USD 14 billion per annum. (BNEF 2013)

OPPORTUNITIES

- » hardware and software requirement for digitalising the power networks
- » growing market for security infrastructure and software
- » opportunity for collaboration between energy providers and other businesses in the area of smart grid and demand response
- » markets for specialists in cable laying (deep sea, underground, new cable technologies)

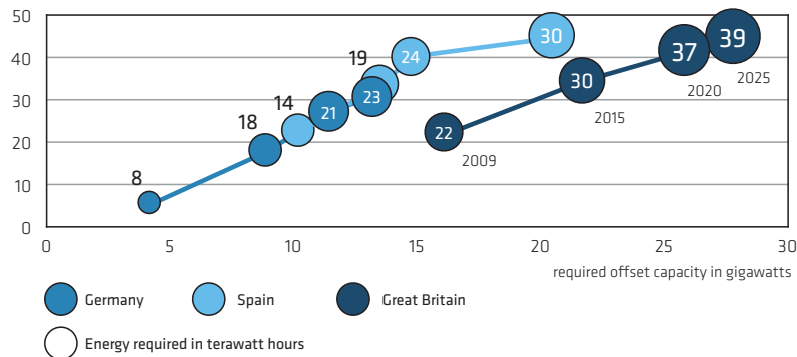
THREATS

- » cyber terrorism, security problems with smart grid
- » difficulties in raising finance given the uncertain profitability of investments in the network infrastructure
- » investment uncertainty due to changing political conditions
- » insufficient standardisation of communications interfaces



Energy storage and flexibility

Share of installed variable quantities of renewables as a per cent of total deployed output



Offset capacity required to link up with renewable energies (SOURCE: BCG 2010)

- Flexible production plant or power consumers coupled with storage possibilities help to iron out strongly fluctuating residual load.
- Pumped storage hydro power stations are currently used in the main to store electricity. Other processes, such as conversion to hydrogen or synthetic natural gas, battery storage or thermal energy storage have not yet proved to be economical.
- The increasing share of renewable energies in power production is reducing the requirement for inflexible baseload electricity power plants (coal and nuclear-powered)
- Around 300 gigawatts of flexible capacity will need to be added worldwide by 2035, to supplement the growing power production from renewables. (IEA 2012a)
- In Germany at the start of 2013 tenders were put out for three gigawatts of load which can be disconnected or reduced at short notice if required.

OPPORTUNITIES

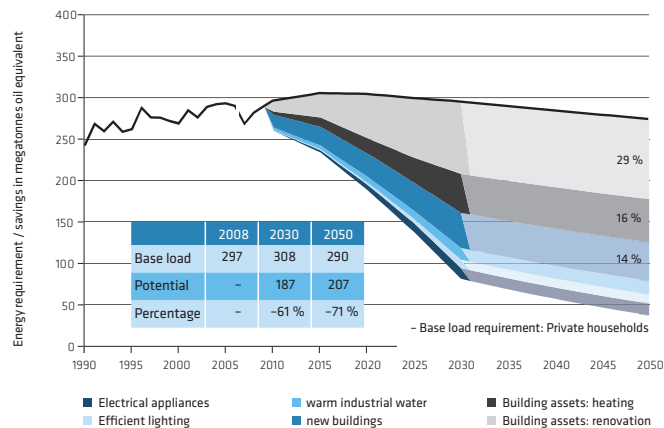
- » Uses for new battery technologies outside e-mobility and energy storage
- » Demand side management for large-scale consumers: potential for load transfer
- » Investment to enable the necessary flexibilisation of the conventional power plant inventory

THREATS

- » continuingly hesitant implementation of intelligent power grids as a prerequisite for intelligent power management
- » uncertain political conditions: payment for storage capacity not settled



Energy efficiency in the building sector



Distribution of savings potential in the building sector

(SOURCE: BMU 2012c)

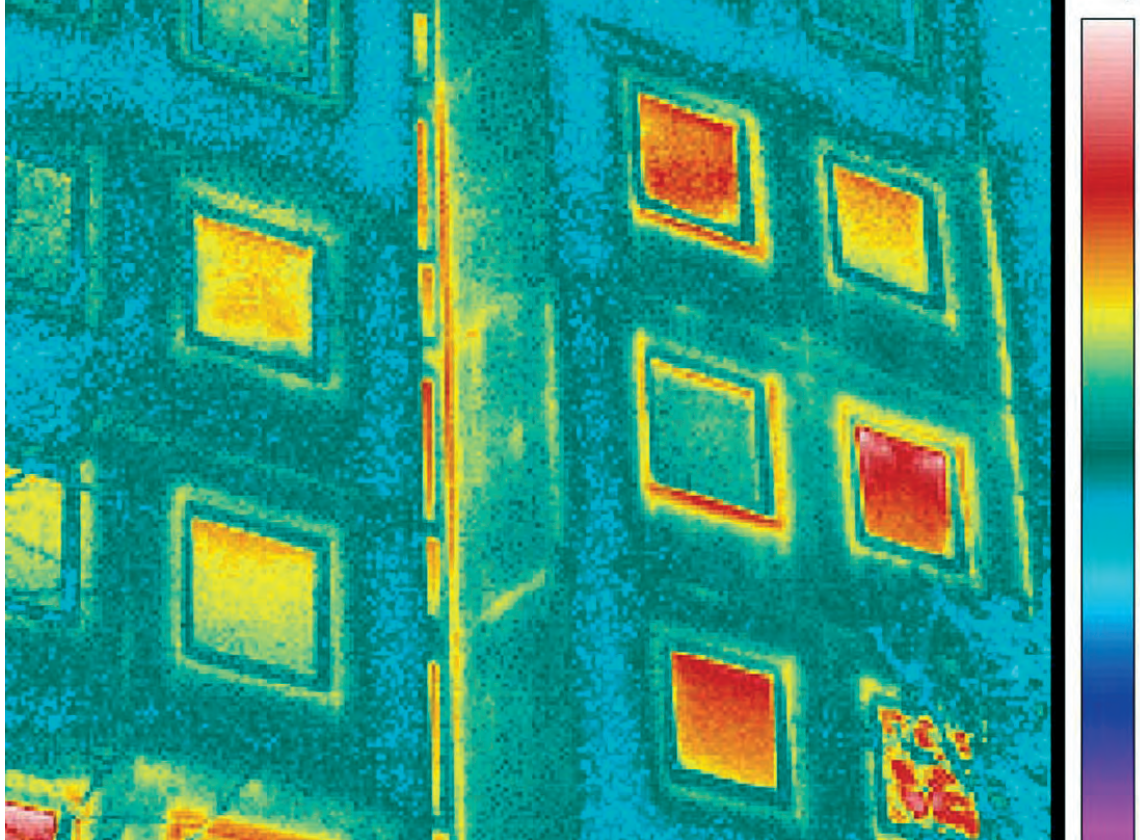
- The building sector offers up the greatest potential for energy saving and can thereby make a major contribution to the attainment of Germany and the EU's climate protection goals.
- In comparison to the base year 2005, end consumption can be reduced by 71 per cent by 2050. (BMU 2012a)
- There is particular potential for efficiency in renovating old buildings (insulation and heating), in new buildings specifications and in provision of heated water.
- In 90 per cent of cases savings exceed investment costs. (McKinsey 2007)

OPPORTUNITIES

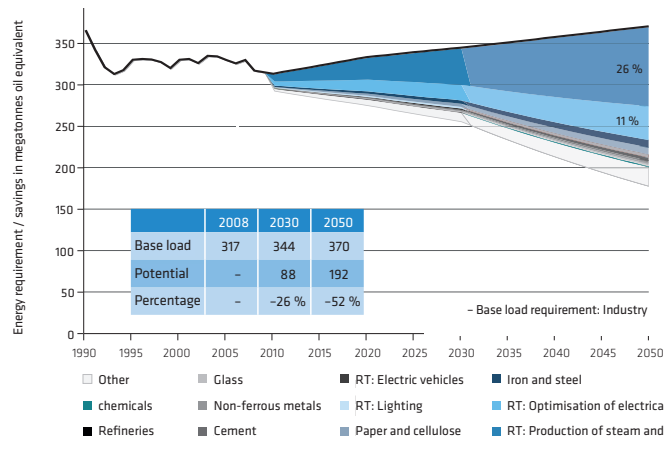
- » faster amortisation through rising energy costs
- » economic growth through the global implementation of energy efficiency
- » the opportunity to establish oneself as the market leader

THREATS

- » cost and benefit of the measures fall to different partners (split incentives)
- » marked underestimation of savings measures (according to surveys)
- » increased complexity of measures and transaction costs because of multiple market players



Energy efficiency in the industrial sector



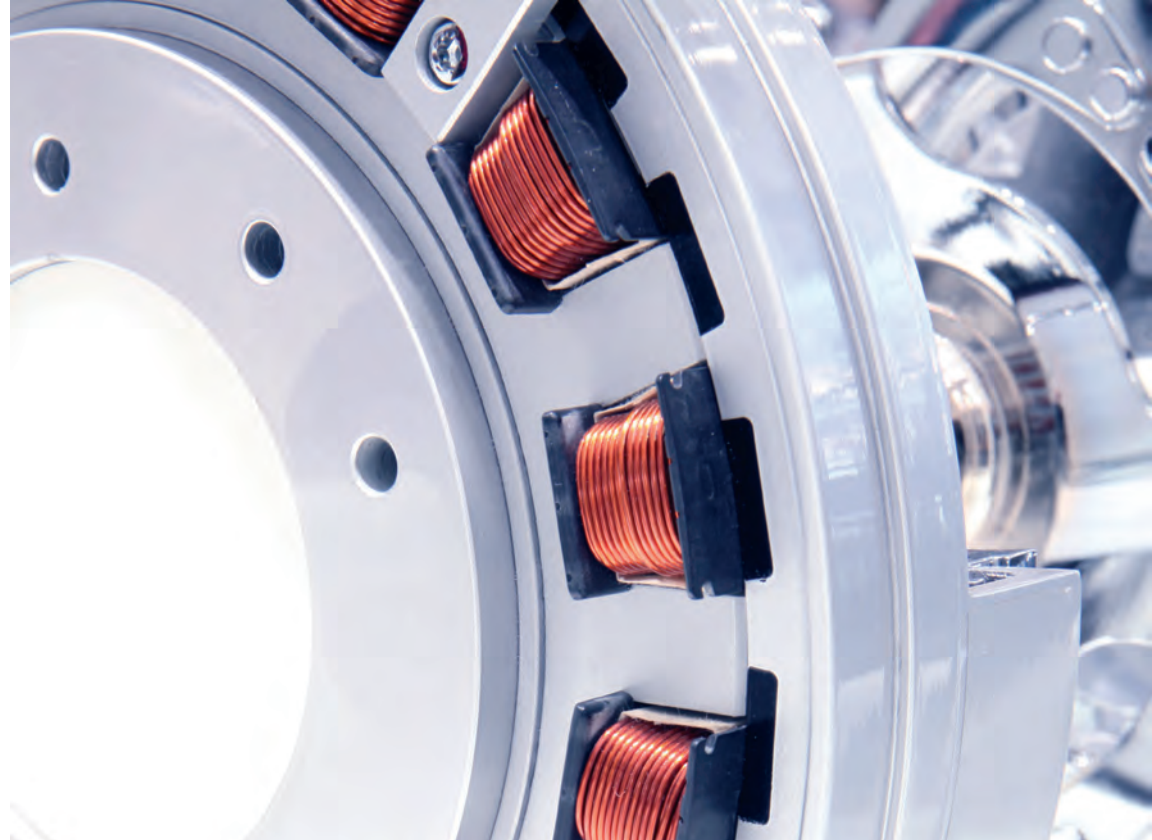
- In suitable economic conditions, the industrial sector could save 20 to 40 per cent of its end energy consumption by 2020. (BMU 2012c)
- The demand for primary energy will continue to rise in the industrial sector. The manufacturing sector, at 46 per cent, is the largest consumer of power. (FISI 2012)
- The greatest savings potential is in manufacturing processes, electric power systems and room heating.
- In favourable conditions, annual savings of 102 billion euros could be achieved in 2050 as a result of energy saving measures. (BMU 2012c)

OPPORTUNITIES

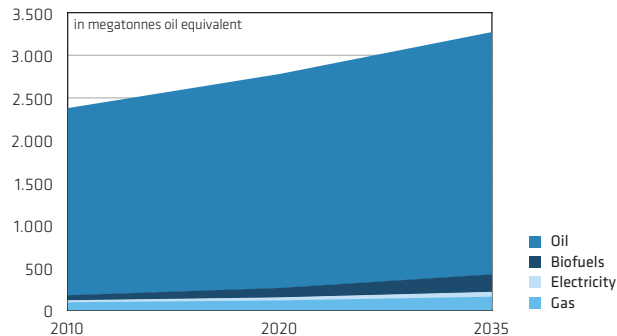
- » funding for the market through the reindustrialisation strategy
- » short-term cost savings through simple investments in more efficient motor and lighting systems
- » market opportunities for technologies and services
- » identifying already existent efficiency potential

THREATS

- » worthwhile investments fail to materialise despite their economic viability
- » investment measures are slowed or stopped because of concessions on energy and power prices as well as exceptions made for certain sectors in other parts of the world - despite going to great lengths with high carbon avoidance costs in Europe



Energy efficiency in the transport sector



Global transport sector energy requirement, by type of fuel (SOURCE: IEA 2012a)

- Globally, an increasing level of motorisation for private individuals can be assumed, with particularly high growth rates in the emerging economies.
- The transport sector consumes roughly one-fifth of the total primary energy requirement and, together with the chemical sector, is responsible for the increasing demand for oil. (IEA 2012a)
- In Germany, road transport accounts for the lion's share of fuel consumption, at 83 per cent. (prograns 2006)
- After the building sector, the transport sector has the greatest potential for saving energy.
- Opportunities to save energy using different technologies and alternative fuels already exist to a great extent and are able to be deployed.

OPPORTUNITIES

- » individual cost reduction and CO₂ avoidance through cost-effective measures within a short time
- » reduction in dependence on oil imports thanks to efficiency gains
- » positive effects on growth and employment through exploiting savings potential

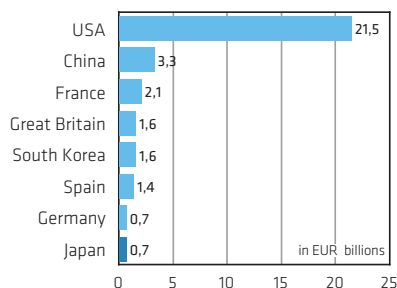
THREATS

- » lack of transparency and high individual transaction costs, for private households and small business in particular
- » growing dependence on biofuels imports
- » disincentives because of subsidies

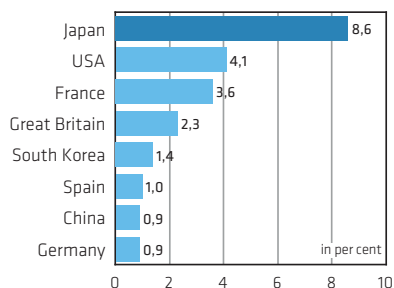


Alternative drive technologies

Japan's subsidies for e-mobility are comparatively low (Forecasts for state funding 2010-2015)



Nevertheless Japan is far in advance of other industrial nations (E-car share of national vehicle production to 2016)



E-mobility subsidies in relation to e-car manufacturing costs (SOURCE: McKinsey 2009a)

- Sales of e-cars are growing worldwide, but are still lagging behind targets and expectations. (IEAHEV 2011)
- The development and introduction of e-cars is being increasingly pushed around the world. The federal government's goal is to have one million e-cars on the roads by 2020, and six million by 2030.
- The additional consumption of electricity relative to total electricity consumption which is attributable to e-cars will remain at two per cent until 2035. (IEA 2012a)
- Without sufficient incentives and in the current framework conditions, conventional vehicles continue to be a more attractive financial proposition than e-vehicles. (FZ) 2012)
- Any CO2 savings from alternative drive technologies are subject to the carbon footprints of the mix making up their source of power.
- Vehicles using fuel cell technology are market-ready; but the necessary infrastructure is not yet available.

OPPORTUNITIES

- » further development of load management
- » reduction in air pollution in towns and cities
- » fuel cells made more attractive through cheap gas and hydrogen
- » changing behaviour patterns with regard to mobility

THREATS

- » e-mobility slowed down by the high costs of the infrastructure
- » insufficient progress made on battery technology
- » great demands put on the system by peak charging times – intelligent power supply is the solution



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Imprint

Publisher

Unternehmer Positionen Nord
A HSH Nordbank AG initiative

Author

Z_punkt GmbH The Foresight Company

Editing

SCRIPT Corporate+Public Communication GmbH

Layout

BEST FRIEND Agentur für Kommunikation GmbH

Print

HSH Nordbank AG

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