

## Challenges and Prospects of Renewable Energies in Germany

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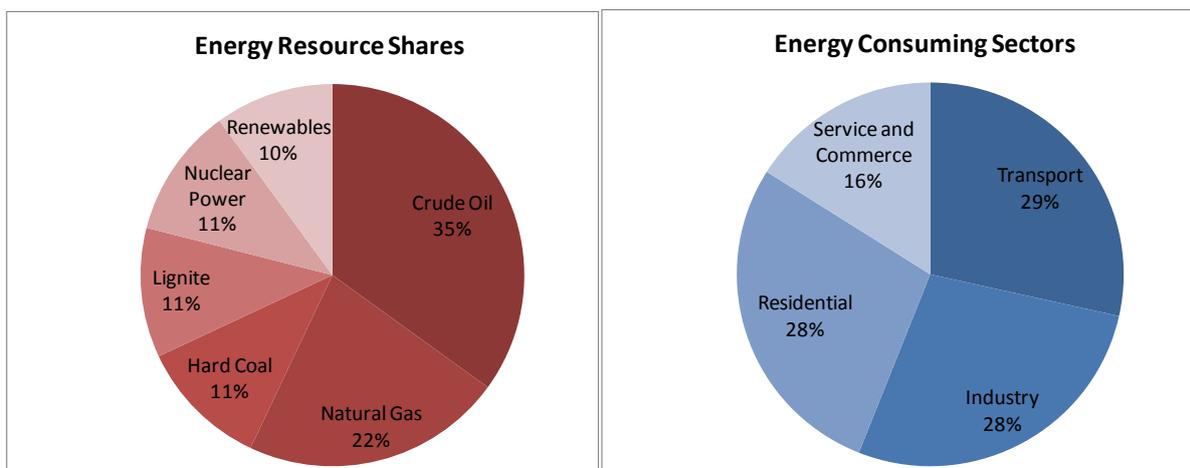
### Introduction

In the last decades, Germany established one of the most ambitious renewable energy programs worldwide. This paper examines Germany's reinforced utilization of renewable resources and identifies challenges in reaching its energy policy goals.

### Current Developments

In 2009, German primary energy consumption was 457 million tons of SKE<sup>1</sup>. Although being considered one of the most advanced and energy efficient economies worldwide, merely 142 million SKE (31% of primary energy consumption) were used as end energy for residential and industrial heating, mechanical applications and lighting, as well as use for information and communication services. Apart from non-energetic utilization, considerable losses in energy conversion and transport are still prevalent in the current energy production and transmission system.

**Figures 1 and 2: Overview of German Energy Production and Consumption**



<sup>1</sup> Hard Coal Units; 1 t SKE = 8.14 MWh

Germany's electric power consumption totals 580 TWh, with peak power demand varying significantly from 45 GW to 78 GW. Germany has extended its renewable energy share to 10% of end energy consumption.

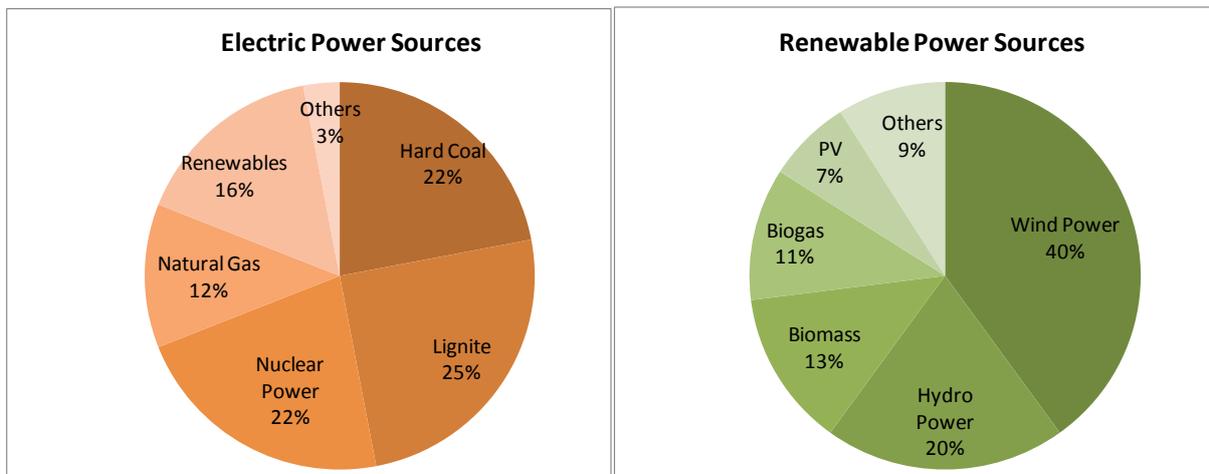
Renewables contribute significantly to electric power production (~16.1%), heating (~ 8.4%, including 350.000 heat pumps) and transport fuels (~5.5%). Renewable energies have created some 310,000 jobs (~ 0.7% of 41 million people employed in Germany)

The corner stones of the German Federal Government's energy concept currently include

- Life time extension of nuclear power production to year 2020+
- Reinforced renewable capacity additions (encouraged by the renewable energy law EEG, combined heat and power production mandates etc.)
- Residential building energy conservation programs
- Energy efficiency programs

The German Federal Government's energy concept calls for 30 - 40% electric power production from renewable energies by 2020, augmenting to an 80% share by 2050 [target of the European Union: 20% renewable energy share of primary energy consumption by 2020].

**Figures 3 and 4: German Electric Power Production**



### Critical Factors

The renewable energy law stimulated a massive extension of renewable power capacities with its long-term fixed reimbursement rates. The further increase of renewable energies, especially fluctuating power sources such as wind power (currently 26 GWp cumulated capacity) and photovoltaics (16 GWp), may culminate in an unstable energy system.

Another 10 GWp wind offshore capacities are being planned and might go online by 2020, with peak power production capacity of >52 GW then potentially exceeding minimum peak capacity demand (45 GW).

Germany faces a fundamental challenge to its electric power infrastructure.

- The current electric power system would not be able to transport considerable electric power streams from off-shore wind parks in the North Sea to South Germany's energy consuming centres (industry and cities). New high voltage transmission lines are necessary (850-900 km new lines involving 20-30 billion Euro investment, according to the DENA Study Wind Power)
- Limited storage capacities (currently ~6.9 GW pumped storage power stations in Germany) require conventional power plants to respond quickly to highly fluctuating renewable power production. Centralised conventional power plants may have to go off line in the case of priority for renewable electric power to be fed into the central grid system. However, reducing production times of large conventional power plants may call for new financing concepts for these.

Currently, a limitation of further photovoltaic capacity additions to maximum 5 GW p.a. is being debated in order to limit electric cost increases to customers due to increasing feed law reimbursements for PV electric power producers.

The European Union is assessing the option of extending its central grid system (e.g. for connecting solar power from Spain with hydroelectric storage power plants in Norway) and estimated infrastructure and energy system costs is estimated to reach up to 1,000 billion Euros (European Commission, 02/2011).

### Outlook

While technological solutions are being promoted and developed to contribute to the transition to a sustainable energy system with a high renewable energy content, various obstacles have to be overcome to ensure public support and warrant mid-term solutions. These obstacles include

- Lead time due to lags in the planning and permission processes
- Public concerns and action groups demonstrating low local support for necessary infrastructure projects

In this context, a rationalization of the renewable energy mix could also contribute to amelioration of the situation. Further augmentation of non-fluctuating renewable energy sources (e.g. biogas) which can at least partially buffer fluctuations in the solar and wind sectors could be viable pathway for future power production.

*Data Sources: Live Energies proprietary calculations; Efe Forschungsstelle für Energiewirtschaft, Munich: Informations on Energy Consumption; AGEB AG Energiebilanzen e.V.; Deutsche Energie-Agentur DENA Study on Wind Power; European Commission Announcements.*

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