

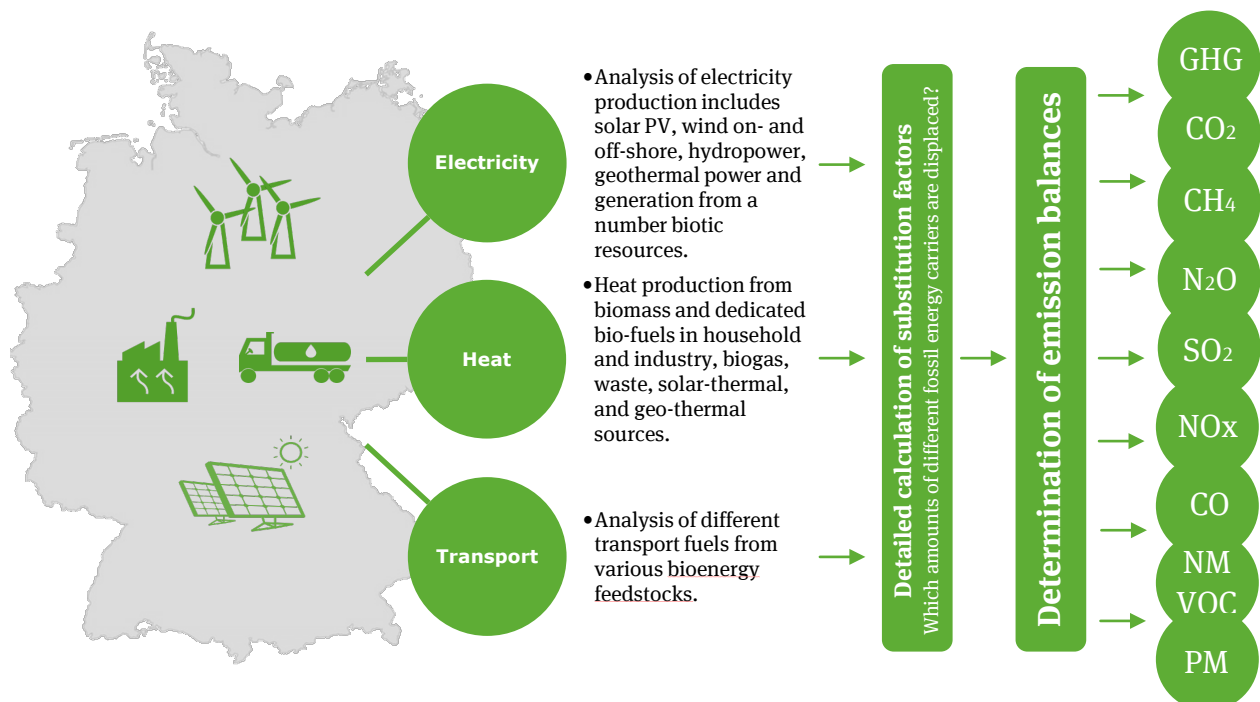
# Emission Balance of Renewable Energy Sources in Germany

An analysis of the Federal Environment Agency (UBA)

## Summary

Since 2007, the German Federal Environment Agency (UBA) has been continuously compiling data to provide a comprehensive balance of emissions from renewable energy sources used in Germany. The work is undertaken on behalf of the German Federal Ministry for the Environment, Nature conservation, Building and Nuclear Safety (BMUB) with the aim to ensure a continuous monitoring of main ecological impacts of renewable energy deployment in Germany.

The work is based on the framework provided by Directive 2009/28/EC of the European Parliament and of the European Council of 23 April 2009 “on the promotion of the use of energy from renewable sources” (RED) and is implemented through the collection and evaluation of a large number of different data sets.



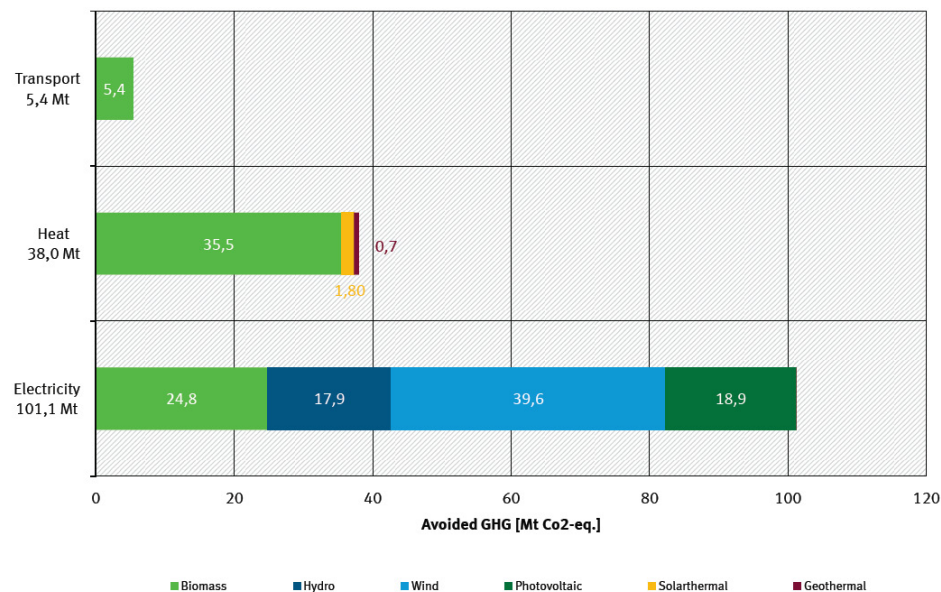
## Innovative Approach

Within this analysis a number of integrated aspects are investigated:

- The evaluation is not limited to GHG emissions alone but also takes into account some of the most important air pollutants (according to Directive 2001/81/EC).
- Specific substitution factors for renewable power production are derived and calibrated on the basis of available ex-post generation data of the German power sector.
- A detailed analysis of substitution inter-linkages and feedback effects within the heat sector is applied, taking into account different consumption pattern (household, industry and agriculture) and the influence of electricity and district heating as secondary energy carriers.
- Consideration of life-cycle assessments of biofuels consistent with the RED. This includes differentiated assessments of various biomass feedstocks.

### Avoided Greenhouse Gas Emissions 2012

Total avoided GHG emissions 2012 (Electricity/Heat/Transport): app. 145 Mt CO<sub>2</sub>-equivalents



Avoided GHG-emissions through electricity under the renewable energy law (EEG) 81,6 Mt CO<sub>2</sub>-eq.

Quelle: Umweltbundesamt

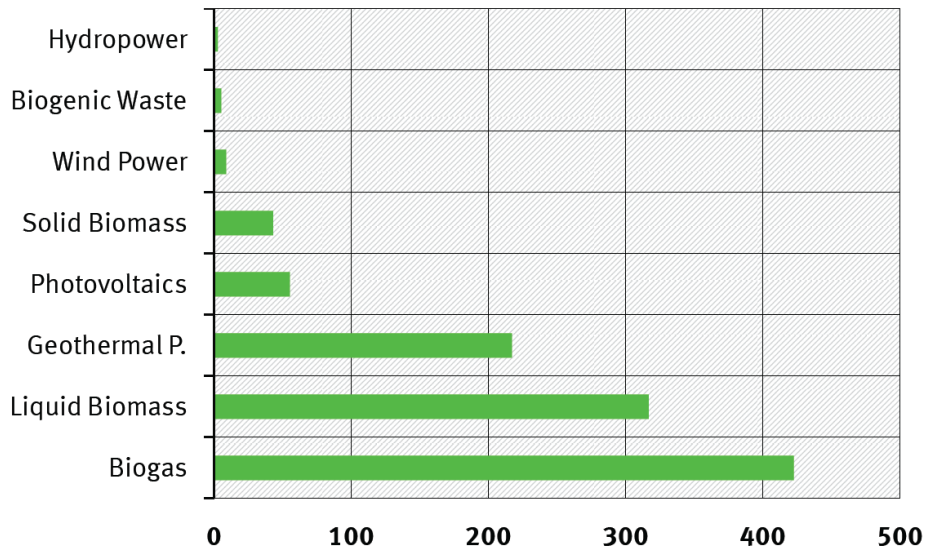
## Methodology

The work on the emission balance of renewable energy sources takes into account all emissions produced during the generation and transport of renewable energy, this includes all steps in the production chain such as manufacturing, construction or maintenance of technical hardware (e.g. PV panels). In a consecutive step these life cycle emissions are compared to the avoided emissions of substituted fossil fuels and technology specific emission balances are derived.

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## Selected emission factors for RE electricity generation

Greenhousegas emissions (GHG) in g CO<sub>2</sub>-eq/kWh



Quelle: Umweltbundesamt

### What is accounted for?

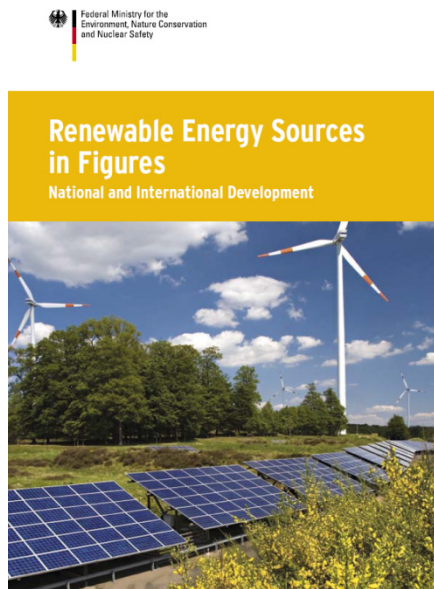
The work on the emission balance includes all three relevant renewable energy sectors: electricity production (including solar PV, wind on- and off-shore, hydropower, geothermal power and electricity production from a number of biotic resources), heat production (from biomass and dedicated biofuels in household and industry, biogas, waste, solarthermal, and geothermal), as well as transport (and associated emissions from biofuels). The examined emissions included GHG emissions (CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O), acid former (SO<sub>2</sub>, NO<sub>x</sub>) and ground-level ozone substances (CO, NMVOC), as well as particulate matter (PM).

### Latest Results

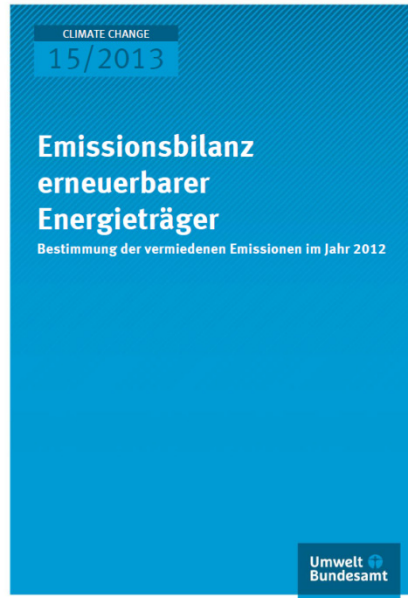
The last years have shown a steady increase in renewable energy use in Germany. Current figures show a renewable share of 12.7% in total final energy consumption and of 23.5% in electricity consumption. This development contributes significantly to the aim of reducing GHG emissions. Calculations show that in 2012 GHG emissions amounting to 145 million tons of CO<sub>2</sub>eq have been avoided through the use of renewables. The main share of these GHG savings are coming from the electricity sector (101.6Mt) with a significant part (81.6 Mt) being directly related to renewables under the renewable energy law (EEG).

## Publication

The result of the work as well as the applied methodology is made available through openly available and regularly updated publications including: “Renewable Energy Sources in Figures: National and international developments” (published by BMUB) and “Emission Balance of Renewable Energy Sources” (published by UBA in German language only).



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