
# Photovoltaic arrays in German municipalities

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# Content

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# How does Photovoltaic (PV) work ?

- ‘photo’ = light, ‘voltaic’ = electric potential

- Photovoltaic systems use cells to convert solar radiation into electricity.
  - One or two layers of a semi-conducting material.
  - Sunshine > Cell creates electric field across the layers, causing electricity to flow.
  - The greater the intensity of the light, the greater the flow of electricity is.
  - It can also generate electricity on cloudy days.
  - The most common semi conductor material used in photovoltaic cells is silicon
- A photovoltaic array is a linked collection of photovoltaic modules.

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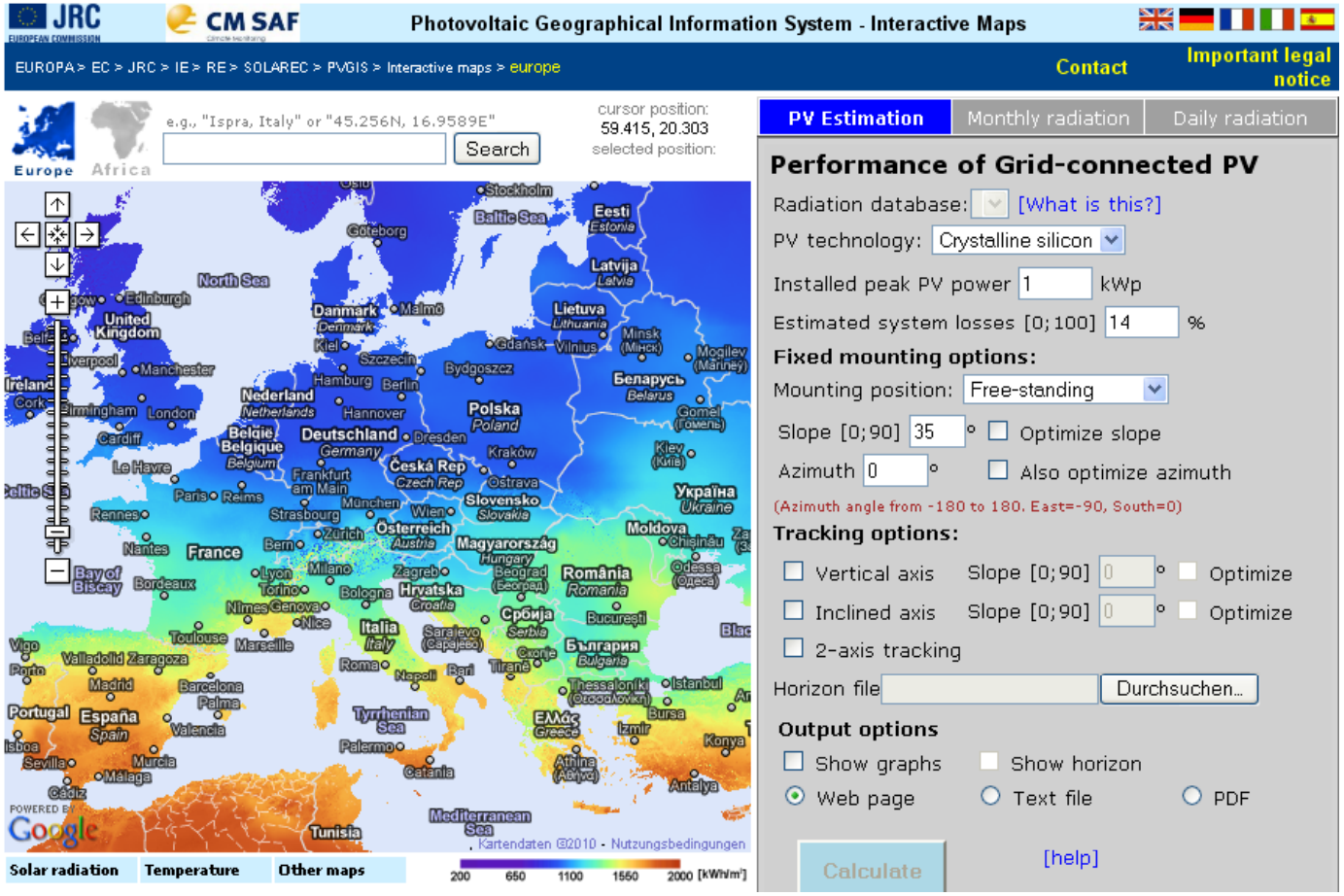
# PV Solar Electricity Potential in Europe




http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php?lang=en&map=europe#

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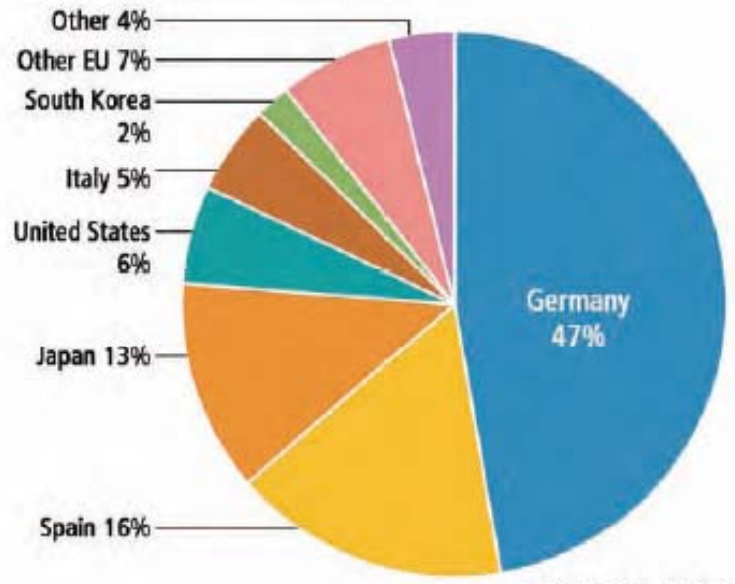
# Current status and Perspectives

- PV in more than 100 countries
- PV is the fastest growing power-generation technology in the world.
- Ground-mounted or built onto the roof or into walls of a building
  (Building Integrated Photovoltaics (BIPV))

Figure 8. Solar PV Existing Capacity, Top Six Countries, 2009




*REN21 Renewable Energy Policy Network for the 21st Century, Renewables 2010, Global Status Report*

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# Current status and Perspectives

Figure 4. Renewable Power Capacities: Developing World, EU, and Top Six Countries, 2009

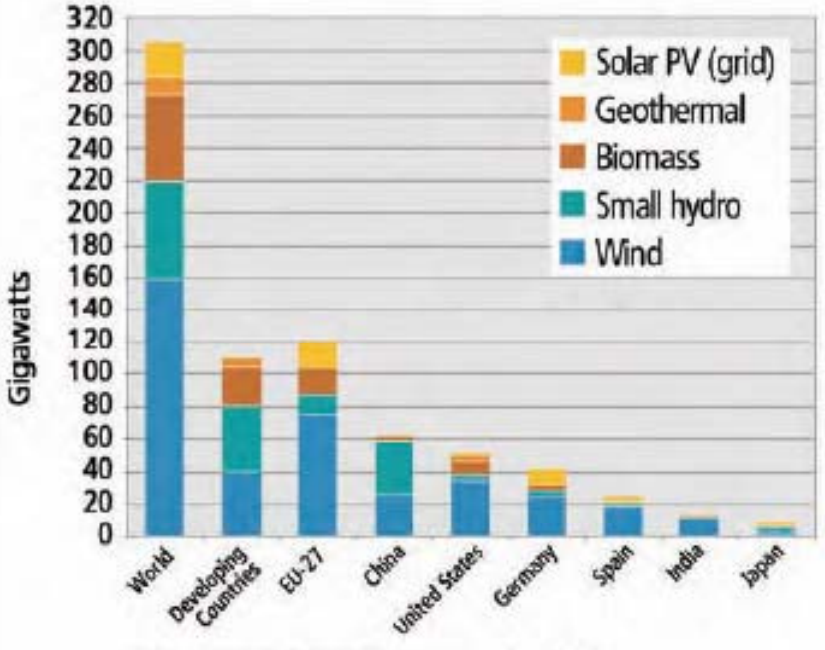
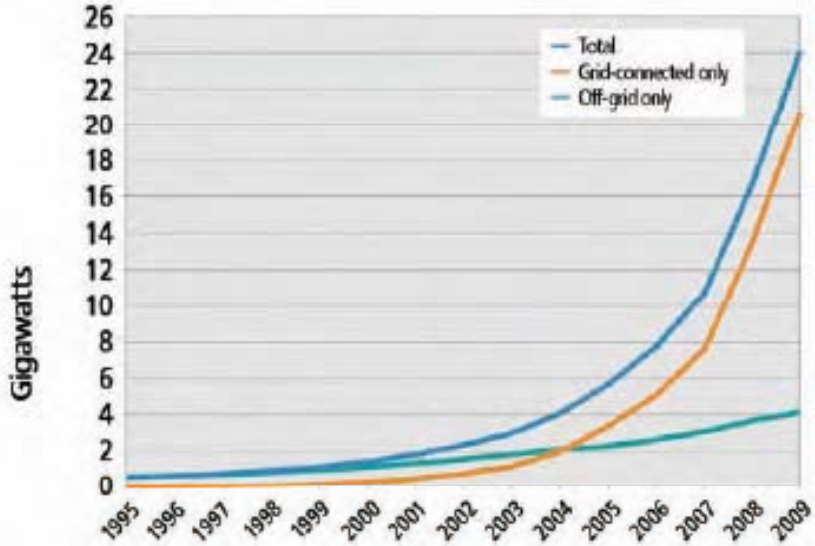



Figure 7. Solar PV, Existing World Capacity, 1995–2009




*REN21 Renewable Energy Policy Network for the 21st Century, Renewables 2010, Global Status Report*

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# 2. EU Policy on energy from Renewable Energy Sources

# 2.1 Renewables Directive 2009/28/EC

- The Renewables Directive is a European Union directive, published 23rd April, 2009.
  - mandates levels of renewable energy use within the European Union
  - official title is 2009/28/EC
  - pre-agreed share of energy consumption from renewable sources for the member countries
  - the EU as a whole shall obtain at least 20% of total energy from Renewables by 2020.
- The directive amends and repeals the 2001 Directive on Electricity Production from Renewable Energy Sources.

# National targets for the proportion of final energy consumption from renewable sources in 2020

**National renewable targets**[22]

| | Share of energy from renewable sources in final consumption of energy, 2005 | Target for share of energy from renewable sources in final consumption of energy, 2020 |
|---|---|---|
| Belgium | 2.2% | 13% |
| Bulgaria | 9.4% | 16% |
| The Czech Republic | 6.1% | 13% |
| Denmark | 17.0% | 30% |
| Germany | 5.8% | 18% |
| Estonia | 18.0% | 25% |
| Ireland | 3.1% | 16% |
| Greece | 6.9% | 18% |
| Spain | 8.7% | 20% |
| France | 10.3% | 23% |

| | | |
|---|---|---|
| Italy | 5.2% | 17% |
| Cyprus | 2.9% | 13% |
| Latvia | 34.9% | 42% |
| Lithuania | 15.0% | 23% |
| Luxembourg | 0.9% | 11% |
| Hungary | 4.3% | 13% |
| Malta | 0.0% | 10% |
| The Netherlands | 2.4% | 14% |
| Austria | 23.3% | 34% |
| Poland | 7.2% | 15% |
| Portugal | 20.5% | 31% |
| Romania | 17.8% | 24% |
| Slovenia | 16.0% | 25% |
| The Slovak Republic | 6.7% | 14% |
| Finland | 28.5% | 38% |
| Sweden | 39.8% | 49% |
| United Kingdom | 1.3% | 15% |

# 3. German context

## 3.1 Feed-In Tariff - Renewable Energy Sources Act / EEG

**An adequate mechanism to develop grid-connected Photovoltaic markets**

- The European photovoltaic market has been pulled by the successful development of the German market.
- The revision of the Renewable Energy Sources Act (Feed-in-tariff law) in 2003 has confirmed the leadership of Germany with 80% of the European market share.
- It offers customers an attractive price for selling their produced electricity to the utility grid.

# Feed-In Tariff

## Key to success :

- The tariff is set at the point of connection to the grid.
- The level of the tariff is guaranteed for 20 years
  > planning security + attractive investment in solar electricity systems.
- The cost of the feed-in tariff is supported by all electricity users
  > it does not rely on State budgets
- The simplicity of the feed-in tariff concept and its low administrative costs
  > it is a highly effective and efficient tool

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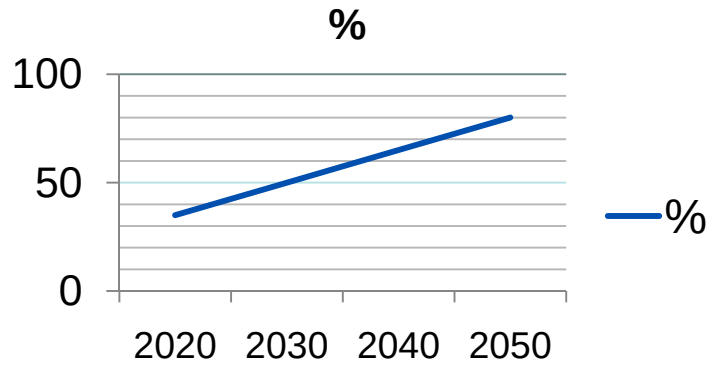
# 3.2 Current development

- Germany is facing **a fundamental transformation of its energy supply**
- By the end of 2022, Germany will **completely waive on electricity generation at nuclear power plants**

- **Federal government bill - Draft Law Amending the legal framework for the promotion of electricity from renewable energies:**
- Share of electricity produced from renewable energy sources:
  - **2020 ⇒ 35 %**
  - **2030 ⇒ 50 %**
  - **2040 ⇒ 65 %**
  - **2050 ⇒ 80 %**



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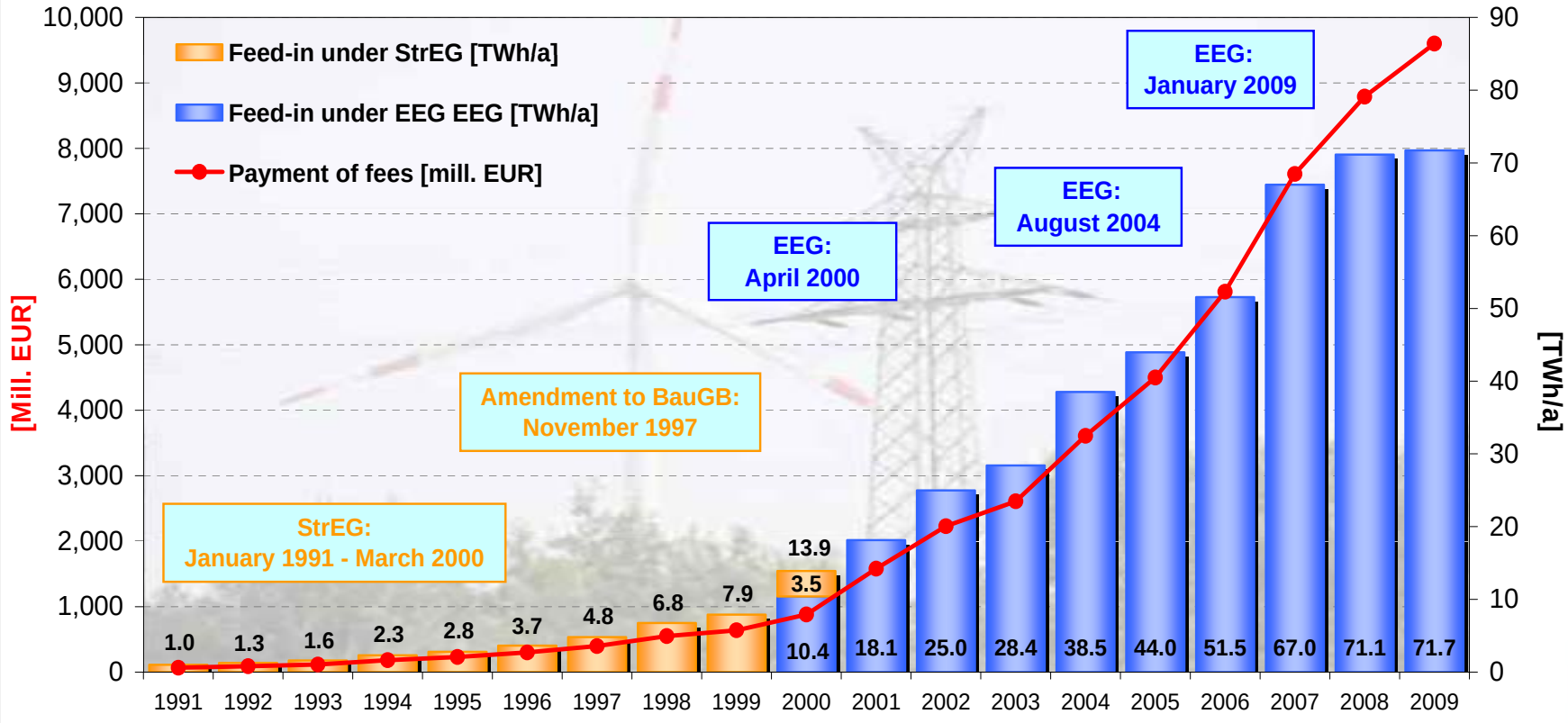
# Feed-in and payment under the Electricity Feed Act (StrEG) and the Renewable Energy Sources Act (EEG) in Germany 1991 - 2009




StrEG: Act on the Sale of Electricity to the Grid; BauGB: Construction Code; EEG: Renewable Energy Sources Act;
Source: BMU-KI III 1 according to Working Group on Renewable Energies-Statistics (AGEE-Stat); Image: BMU / Christoph Edelhoff; all figures provisional

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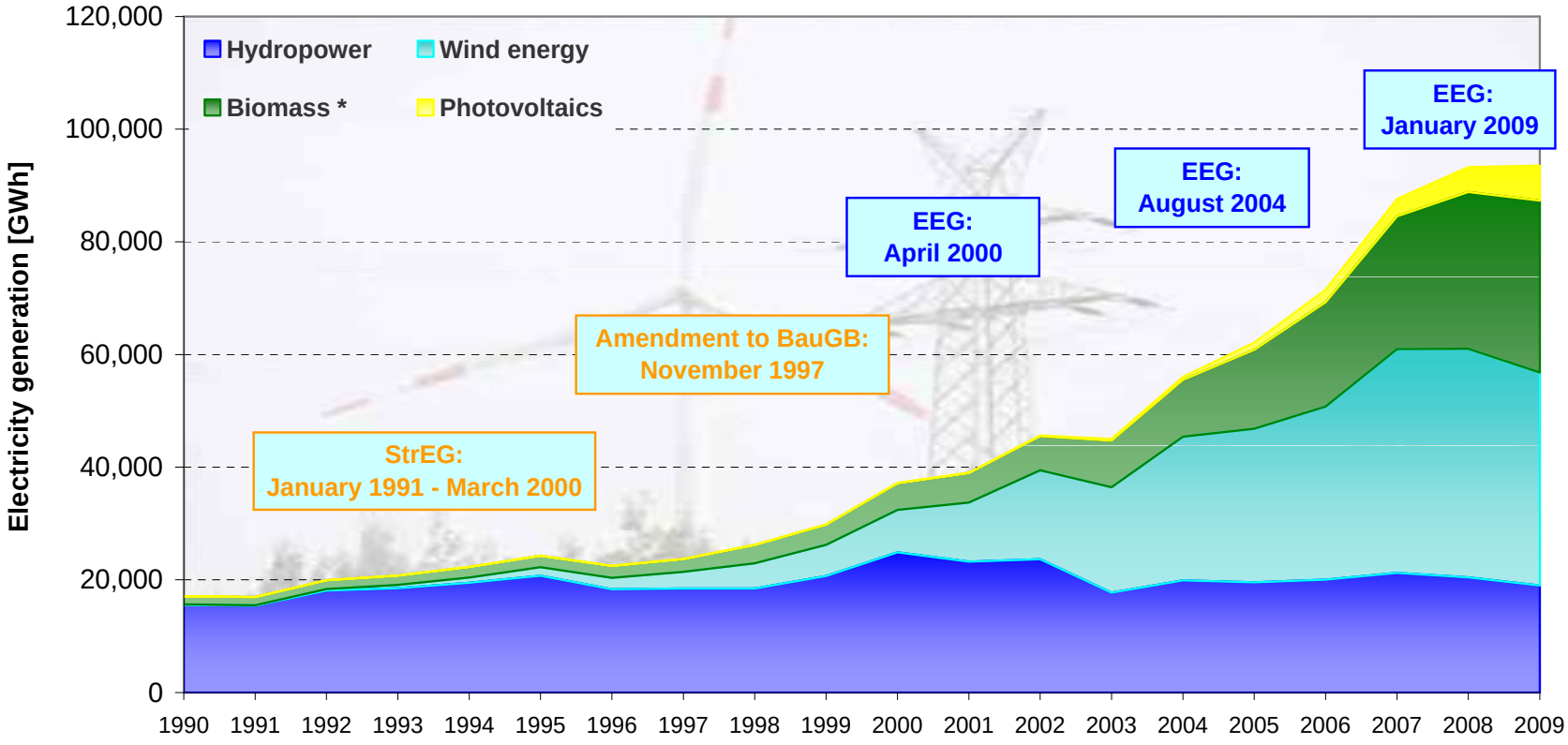
# Development of electricity generation from renewable energy sources in Germany 1990 - 2009




* Solid, liquid, gaseous biomass, biogenic share of waste, landfill and sewage gas;
Electricity from geothermal energy is not presented due to the negligible quantities of electricity produced; StrEG: Act on the Sale of Electricity to the Grid; BauGB: Construction Code; EEG: Renewable Energy Sources Act; Source: BMU-KI III 1 according to Working Group on Renewable Energies-Statistics (AGEE-Stat); Image: BMU / Christoph Edelhoff; all figures provisional

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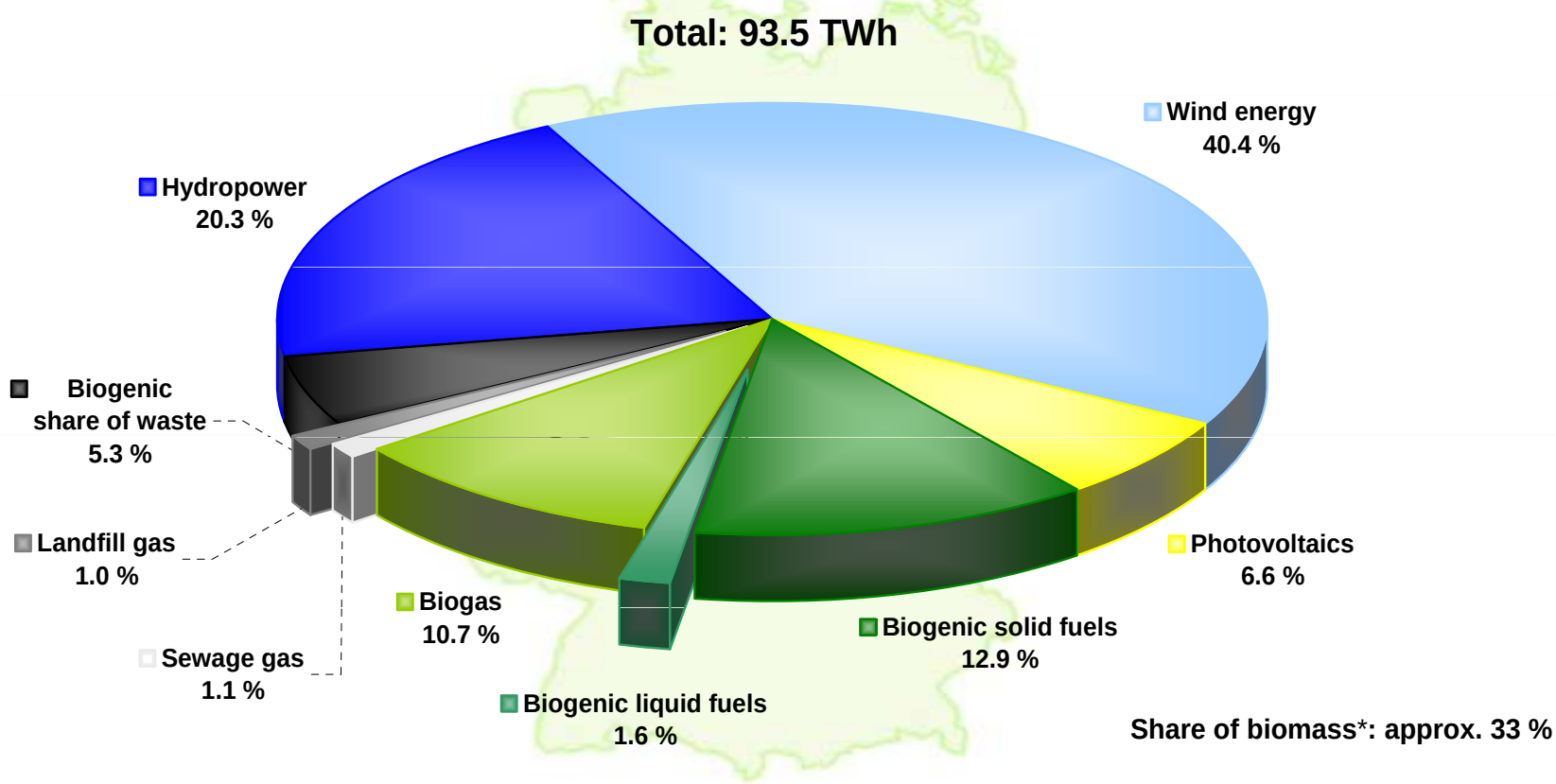
# Structure of electricity supply from renewable energy sources in Germany 2009




* Solid, liquid, gaseous biomass, biogenic share of waste, landfill and sewage gas; Deviations in the totals are due to rounding;
Source: BMU-KI III 1 according to Working Group on Renewable Energies-Statistics (AGEE-Stat); all figures provisional

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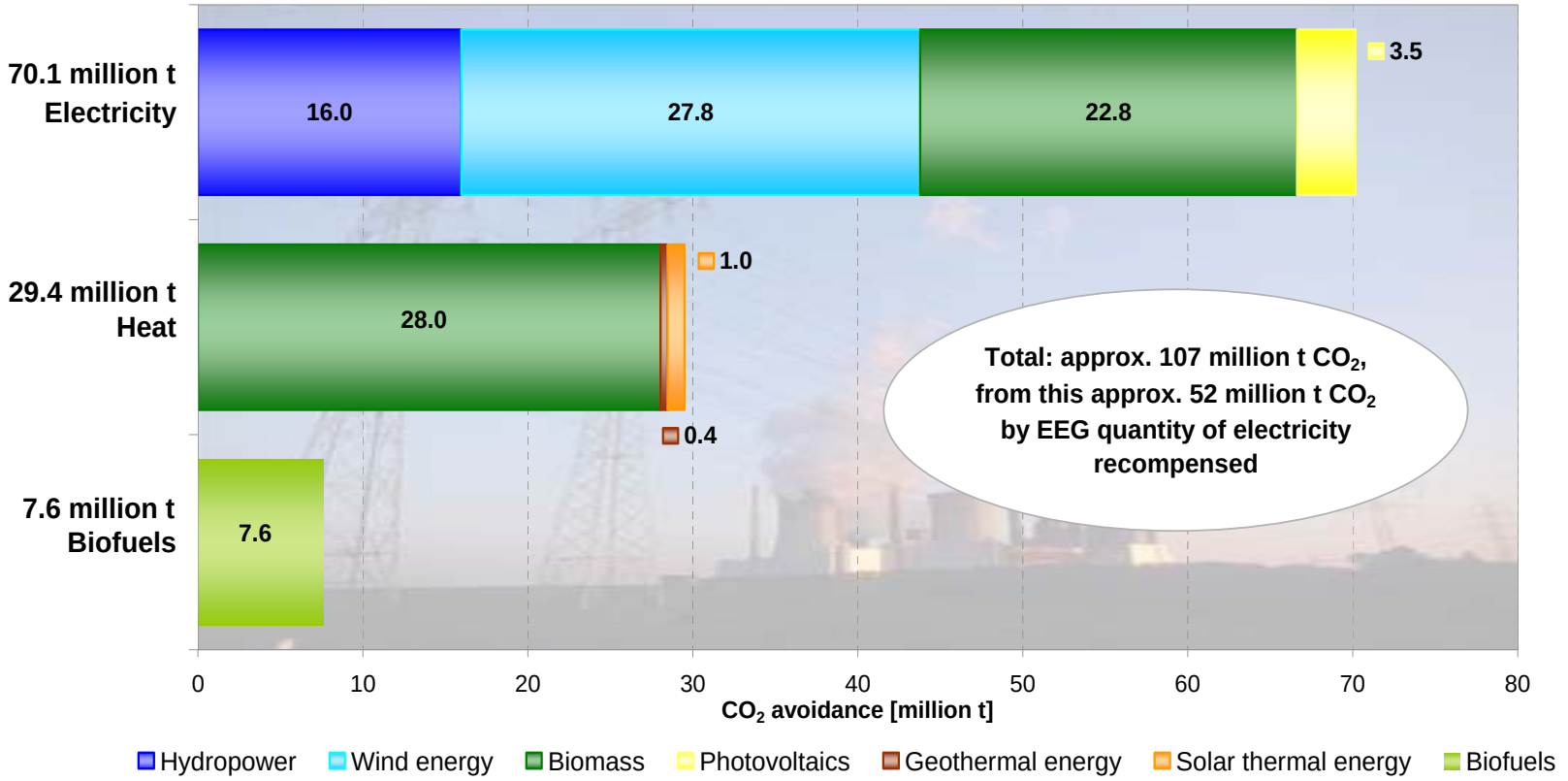
# Total $CO_2$ avoidance via the use of renewable energy sources in Germany 2009




EEG: Renewable Energy Sources Act; Deviations in the totals are due to rounding;
Source: UBA according to Working Group on Renewable Energies-Statistics (AGEE-Stat); Image: H. G. Oed; all figures provisional

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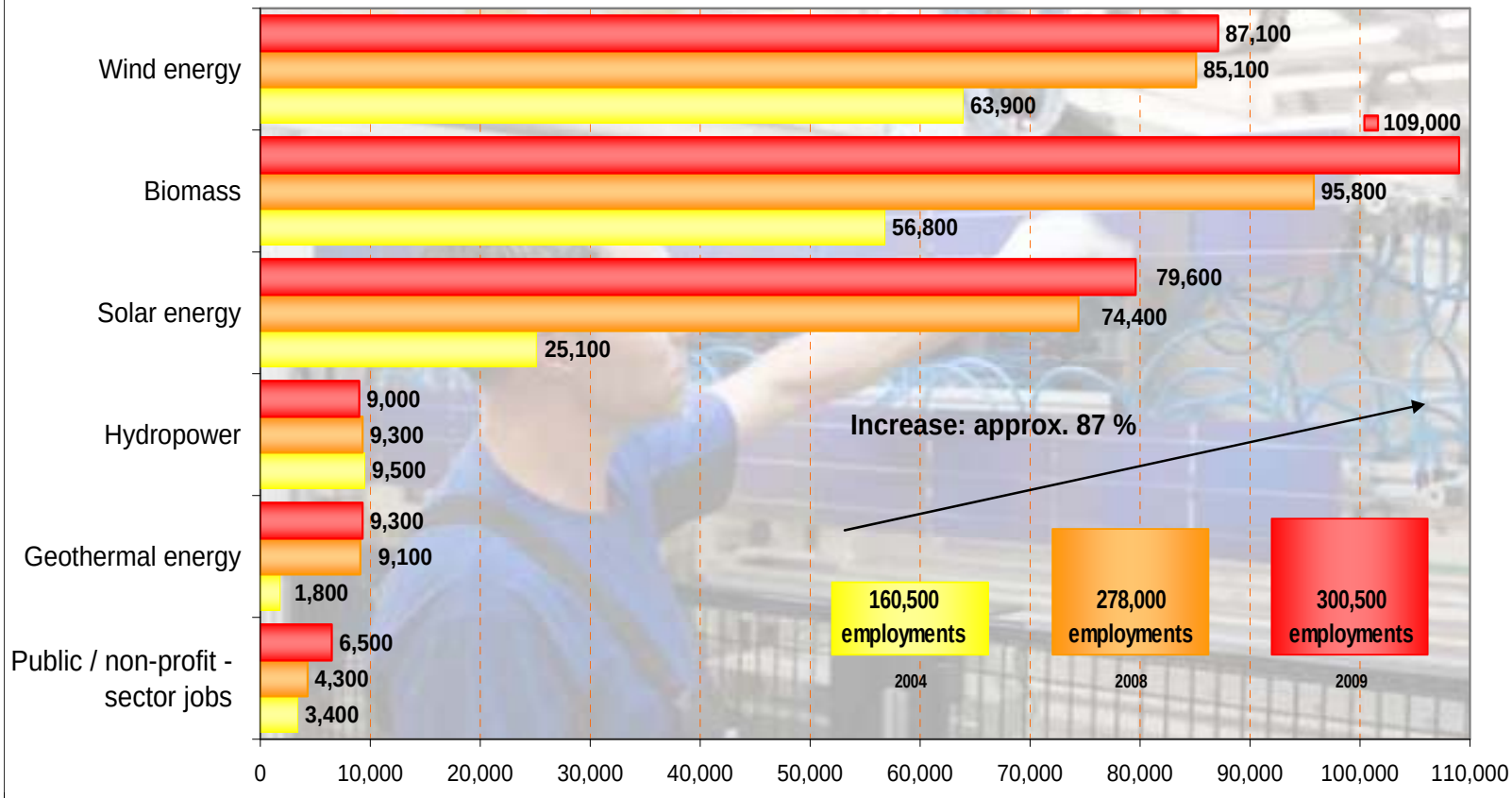
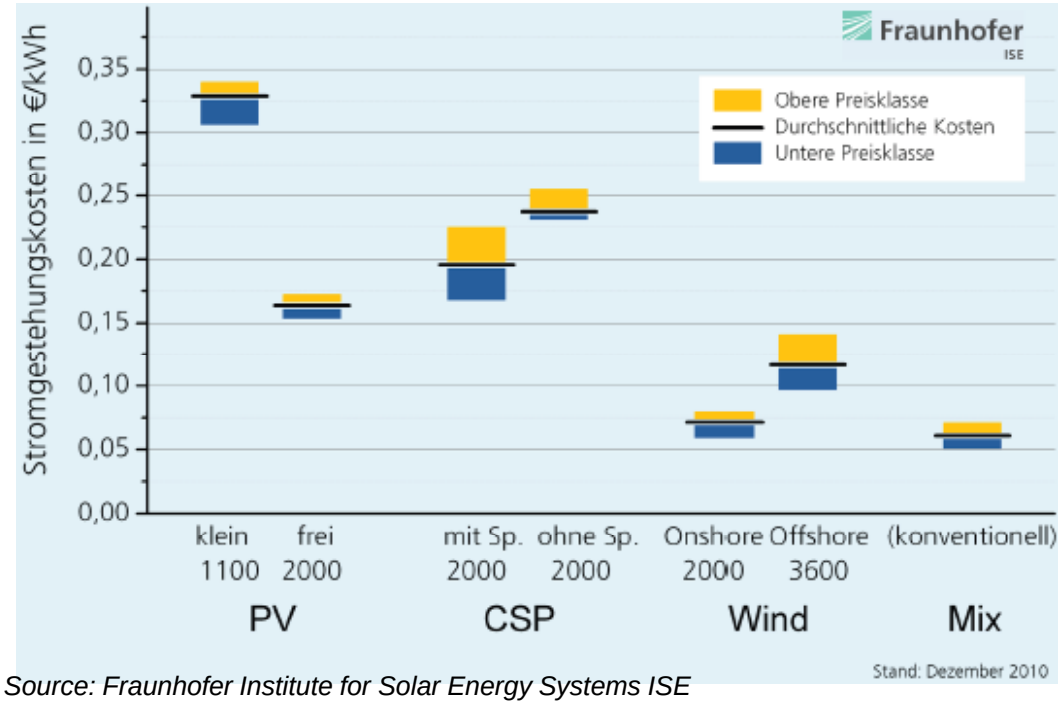
# Jobs in the renewable energy sector in Germany 2004, 2008 und 2009

**2011 > 340,000 jobs**




Figures for 2008 and 2009 are provisional estimate;
Source: BMU-KI III Projekt "Gross employment from renewable energy in Germany in the year 2009, a first estimate"; Image: BMU / Christoph Busse / transit

# 3.4 Electricity production costs in 2010




*Source: Fraunhofer Institute for Solar Energy Systems ISE*

**The electricity production costs of all renewable energies decrease:**

- Technological innovations,
- Reduced material usage,
- More efficient production processes,
- Increase of efficiency factor
- ever-increasing mass production

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# 4. Regional context

## 4.1 Problems of the municipalities

- Political majorities
- Public acceptance
- Municipal budgets
- Higher administrations / authorities > Veto
- Lack of competence
- Unclear ownership structure
- Time frame


# 4.2 Options for action

> direct influence:

- Urban land use planning and land consolidation planning / building law
- Construction and operation of own PV systems
- Solar Roof Exchange Markets/ register

> indirect influence

- Citizens advice on technical issues and support programs
- Local promotion / aid
- Local Public Relations

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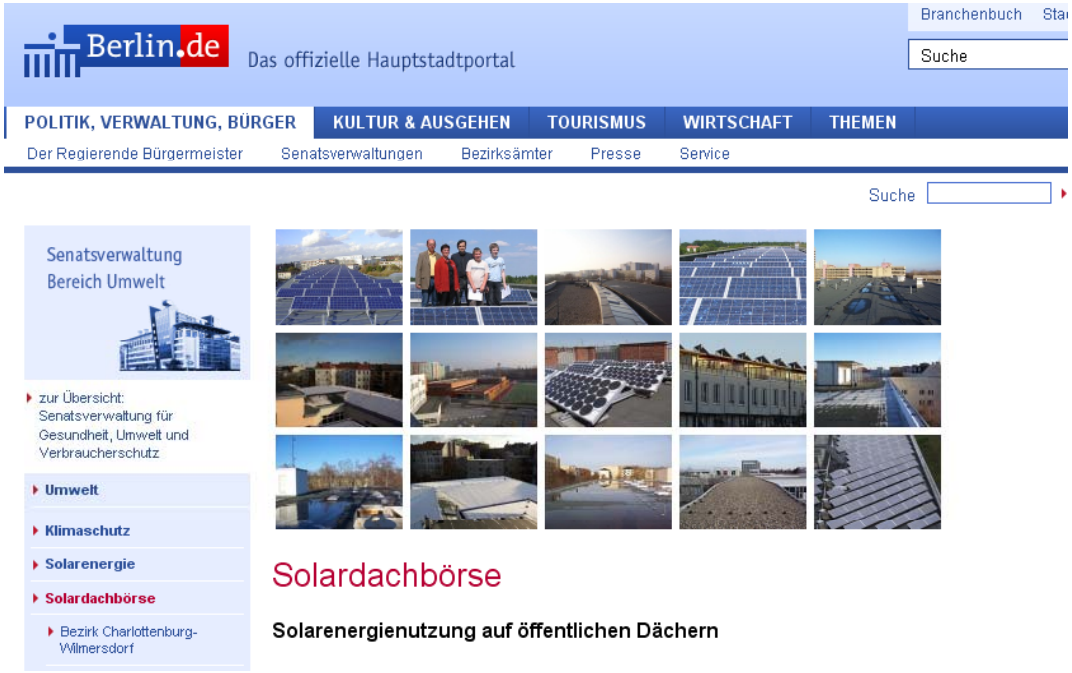
# Solar Roof Exchange Market – e.g. Berlin

- The state of Berlin offers rooftops of public buildings to private investors to build on these photovoltaic systems and to operate them
- The rent = some % of the feed-in tariff
- In the last years were more than 64 solar systems installed




"Currently, the demand for suitable roof areas is so large that set roofs often find an interested party within a day."

Note on the homepage of the solar roof exchange Stuttgart

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STADT KAISERSLAUTERN

1 : 1500

# Solarstadt Kaiserslautern

- Dachflächen zur solaren Nu
  - Luftbilder 2008
  - Stadtgrundkarte
  - Solardachkataster

ok

A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z


## Dachflächen zur solaren Nutzung

- gut geeignet
- geeignet
- nicht geeignet
- nicht auswertbar

**Weiterführende Informationen erhalten sie bei:**


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Direktor des Referates Umweltschutz
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# 4.3 Financing and ownership models

- The municipality invests and operates the facilities under its own responsibility > municipal operating company is founded
  or the municipal utilities provide the work
- A contractor could build and operate the PV-array for the municipality
- Citizens join forces to establish an operating company and finance the project through corresponding shares.
- Planning and operating companies take care for
  > planning, construction, financing and management
- Professional investors (e.g. banks) buy PV projects

>>> The municipality does not have to be financially strong to use photovoltaic arrays.<<<


# 4.4 Advantages for the municipalties

- Solar energy is free
- Produces no noise, high public acceptance
- Minimal maintenance required to keep the system running
- Modular systems can be quickly installed and easily expanded
- Climate protection
- Financial income (Feed-In Tariff, tax), regional value creation
- Image improvement
- Generate local jobs
- New perspectives for the rural areas

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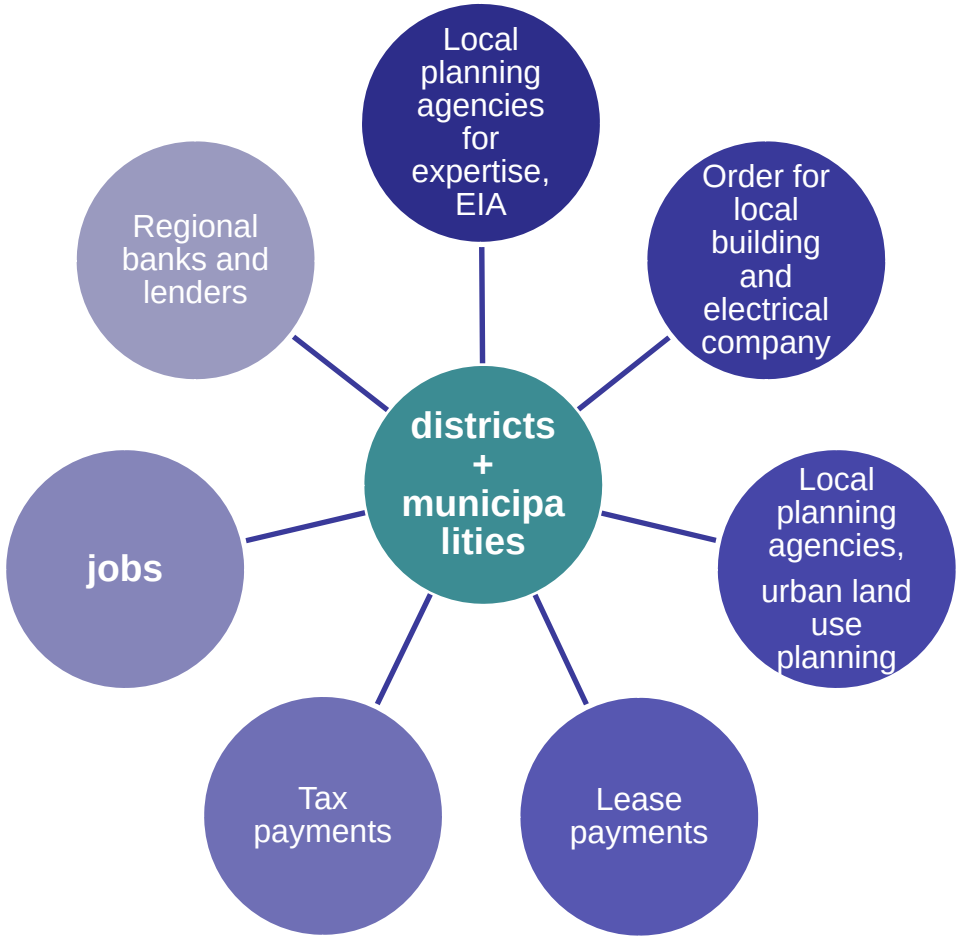
# How can districts and municipalities benefit from renewable energies?



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# 4.5 Best Practice

RHEIN-
HUNSRÜCK-
KREIS

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# Rhein-Hunsrück-District , Germany

- Zero-Emission-District
- Regional value creation from Renewable Energies

| | Anlagen Anzahl | installierte Leistung gesamt in kw | Stromerzeugung in kwh | Stromerzeugung pro Einwohner in kwh/E | Anteil der Stromerzeugung am Gesamtstromverbrauch |
|---|---|---|---|---|---|
| Biomasse | 18 | 4.048 | 15.085.988 | 144,83 | 3,55 % |
| Solarenergie 2009 | 1.362 | 17.255 | 11.080.065 | 106,37 | 2,61 % |
| Wasser | 0 | 0 | 0 | 0 | 0 % |
| Windenergie* (am Netz) | 85 | 135.200 | 216.981.831 | 2.083,00 | 51,18 % |
| Summe Kreis 2009 | 1.465 | 156.539 | 243.127.862 | 2.334,00 | 57,34 % |
| Windenergie* (genehmigt & im Bau) | 16 | 34.000 | 54.405.474 | 522,29 | 12,83 % |
| Windenergie* (beantragt & genehmigungsfähig) | 114 | 223.300 | 357.315.951 | 3.430,19 | 84,29 % |
| Summe Kreis 2013 (inklusive Zuwachs nur Wind) | 1.595 | 413.803 | 654.849.287 | 6.286,48 | 154,46 % |
| Gesamtstromverbrauch 2007 | | | 423.928.821 | 4.069,66 | 100,00 % |

**Electricity generation from renewables 2009**; *Source: Kreisverwaltung Rhein-Hunsrück-Kreis*

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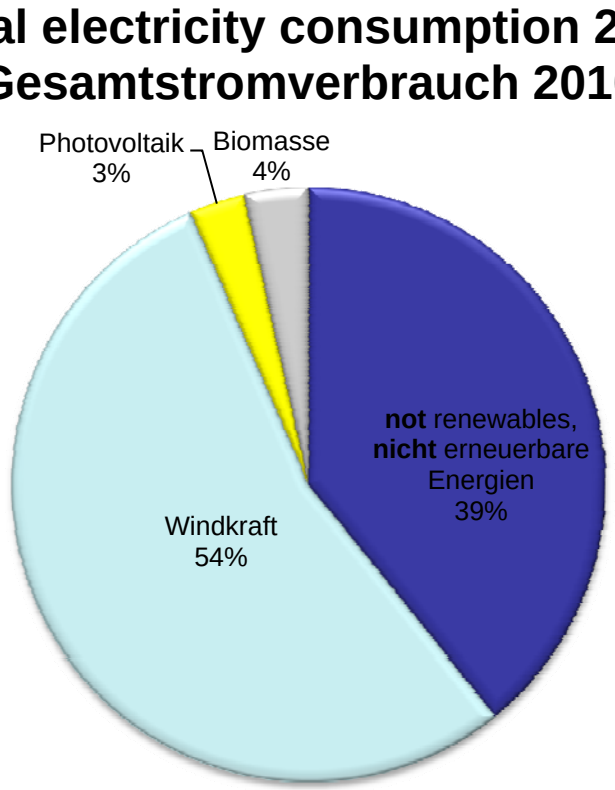
# Total electricity consumption 2010



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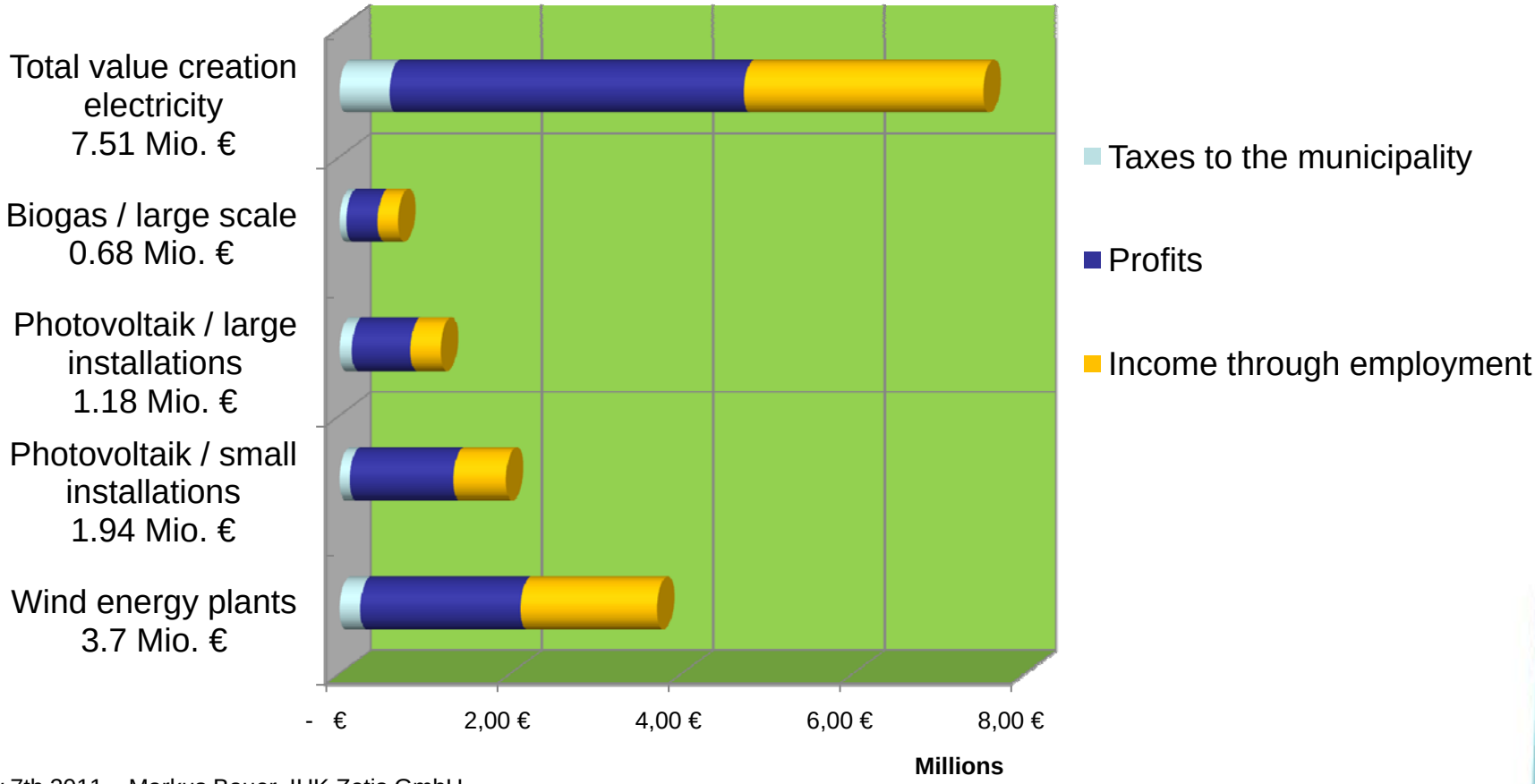
# Regional value creation from Renewable Energy plants 2009



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# Results for the Rhein-Hunsrück-District in 2009:

- **Total local value creation: € 8.3 million**
- **With additional leasing income: € 9.4 million**
- **Electricity: € 7.5 million**
  Wind turbines: € 3.7 million
  Photovoltaic systems: € 3.1 million
- **Heat: € 0.5 million**
- **Biofuels: € 0.3 million**
- **Municipal tax revenues: € 0.6 million**
- **Lease revenue: € 1.2 million**
- **Saving of fossil fuel imports: € 12.3 million**
- **CO2 savings: 269,103 tons**
- **86 full time employees**


**Thank you for your attention.**

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