# Job Potentials of Renewable Energies and Energy Efficiency - A View on Germany and Poland

FACTSHEET


Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit

Umwelt Bundesamt

INSTYTUT JAGIELLOŃSKI

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Part I: **Job Potentials of Renewable Energies and Energy Efficiency – Experiences from Germany**

By: Timon Wehnert, Felix Suerkemper, Tatiana Andreeva (Wuppertal Institut)

Part II: **Renewable Energy Sector – Poland's job potential**

By: Christian Schnell PhD, Antoni Olszewski (Instytut Jagielloński)

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# Key messages

## Part I

**By: Timon Wehnert, Felix Suerkemper, Tatiana Andreeva** (Wuppertal Institut)



Germany has a long history of continuous support for energy efficiency and renewables. Environmental concerns (i.e. reducing $CO_2$ emissions and local air pollution) have been only one reason to do so. Energy efficiency and renewables have become an integral part of Germany's energy policy supporting the country's long-term economic development and security of energy supply (including reducing import dependency). Creating jobs has been a key objective of Germany's energy efficiency and renewable energy strategy:

- In 2015 330,000 people worked in the renewables sector and the amount of jobs is expected to a) grow in a long-term perspective and b) outnumber job losses in fossil fuel energy branches.

- Installation, service and maintenance create a high share of the value added achieved by using renewables. Thus job opportunities are not only linked to manufacturing. In contrast, especially for economically weak, rural areas, using (even importing) renewables offer a great potential to create jobs locally.

- In the area of energy efficiency, it has been possible to trigger massive private investments through governmental regulations and support schemes e.g. in the housing sector. Most of these jobs are in the construction sector and generally create local income.

- Promoting energy efficiency and renewable energy thus offer large employment opportunities. However, to turn these opportunities into jobs, two framework conditions are important:

    - Support schemes should be designed with a long-term perspective in order to avoid boom and bust cycles, but offer reliable framework conditions for investors.

    - Jobs can only be created locally if a skilled workforce exists. Consequently, support schemes for energy efficiency and renewables need to include support for education (e.g. specialised university degrees) and training.

## Part II

**By: Christian Schnell PhD,**
**Antoni Olszewski** (Instytut Jagielloński)



By end of 2016, approx. 31 000 people were employed in RES sector, whereas in hard coal mining – approx. 85 000. Social implications on the job market, mainly in Silesia voivodship, influence policymakers decision towards RES support, as according to their understanding every MWh of "supported RES power", mainly wind power is one MWh less production by coal power plants, which are inevitable to keep jobs in the Polish mining industry. However, it should be understood that RES development is a chance to maintain jobs in coal mining regions, e.g. creating a 'RES Valley' to maintain the industrial character of Silesia in a competitive market environment, as the Polish coal mining sector is internationally not anymore competitive, working conditions for coal miners working in a depth of 1,000 meters are very dangerous, and especially low emissions by burning low quality coal cause severe problems to health and environment – and consequently for Polish economy.

The job potential only for two technologies, offshore wind and solid biomass firing, exceed 100,000 jobs in the next decade, other RES technologies such as solar, biomethane production or energy efficiency measures in public and private building can double this job effect.

Close co-operation of Polish companies with foreign investors could provide to opportunities comparable to the automotive sector, where foreign direct investments provided to hundred thousands of jobs throughout Poland, and often in Silesia region, e.g. current investment of Mercedes-Benz Cars located in Silesia amounting to EUR 500 million and providing to 500 new jobs. Additionally, Polish companies can develop its own highly-innovative technologies for export.

However, to benefit from the worldwide energy transition Polish Government should support RES investments and job creation by direct and indirect incentives for investors, as well as for students to ensure sufficient number of skilled and educated workforce to develop local know-how on RES technologies.

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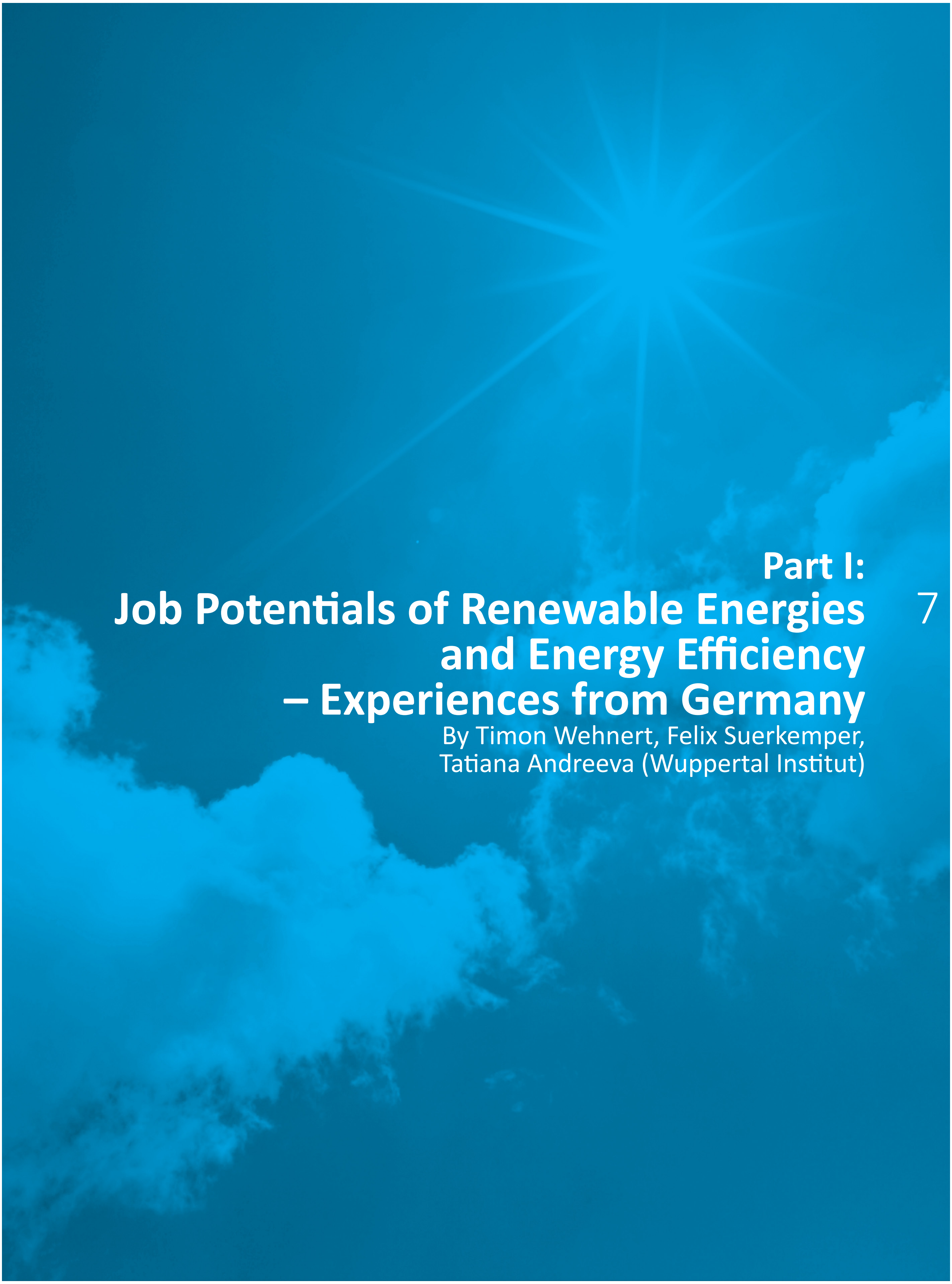


## Part I:

# Job Potentials of Renewable Energies and Energy Efficiency – Experiences from Germany

By Timon Wehnert, Felix Suerkemper, Tatiana Andreeva (Wuppertal Institut)

# 1.1 Macro-Economic Cornerstones of the German Energy Transition

## Germany has decoupled economic growth from energy consumption in the last 20 years.

The German activities to enhance energy efficiency and introduce renewable energy date back to the late 1970s- as an immediate response to the oil crisis. Thus the motivation has always been to increase energy security and economic competiveness in general. Over the decades, environmental concerns gained importance - and today renewables and energy efficiency are perceived as the key elements to reduce both local and global pollution, such as greenhouse gas emissions or air pollutants. But beyond serving environmental objectives, a shift towards low-carbon technologies produces manifold positive effects for the German economy, including an increasing number of jobs- and is expected to do so in the future.



While the economy has grown by an average of 1,3% per year between 1995 and 2015 (Destatis 2016), primary energy demand has declined by more than 7% (OECD 2016). The decrease in energy consumption and a rising GDP lead to increasing energy productivity (of 1,29% per year). Note that this increase is partly due to energy efficiency measures and partly due to structural change in the economy (e.g. increase in services, decrease of energy intensive manufacturing). Over the same period $CO_2$ emission have decreased by 15% (UBA 2016a) due to higher energy efficiency, a switch to cleaner fuels and the use of renewable energy (see Figure 1).

Figure 1 | **EVOLUTION OF GERMANY'S GDP COMPARED TO ITS PRIMARY ENERGY DEMAND AND $CO_2$ EMISSIONS.** SOURCES: BASED ON DESTATIS (2016); IEA (2016); UBA (2016B)

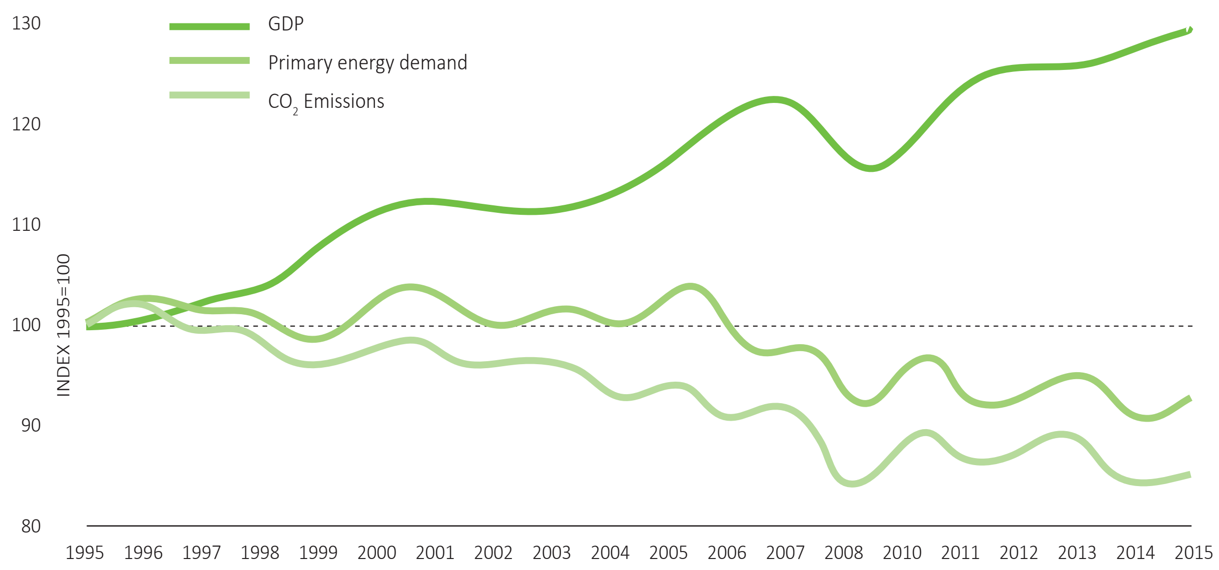
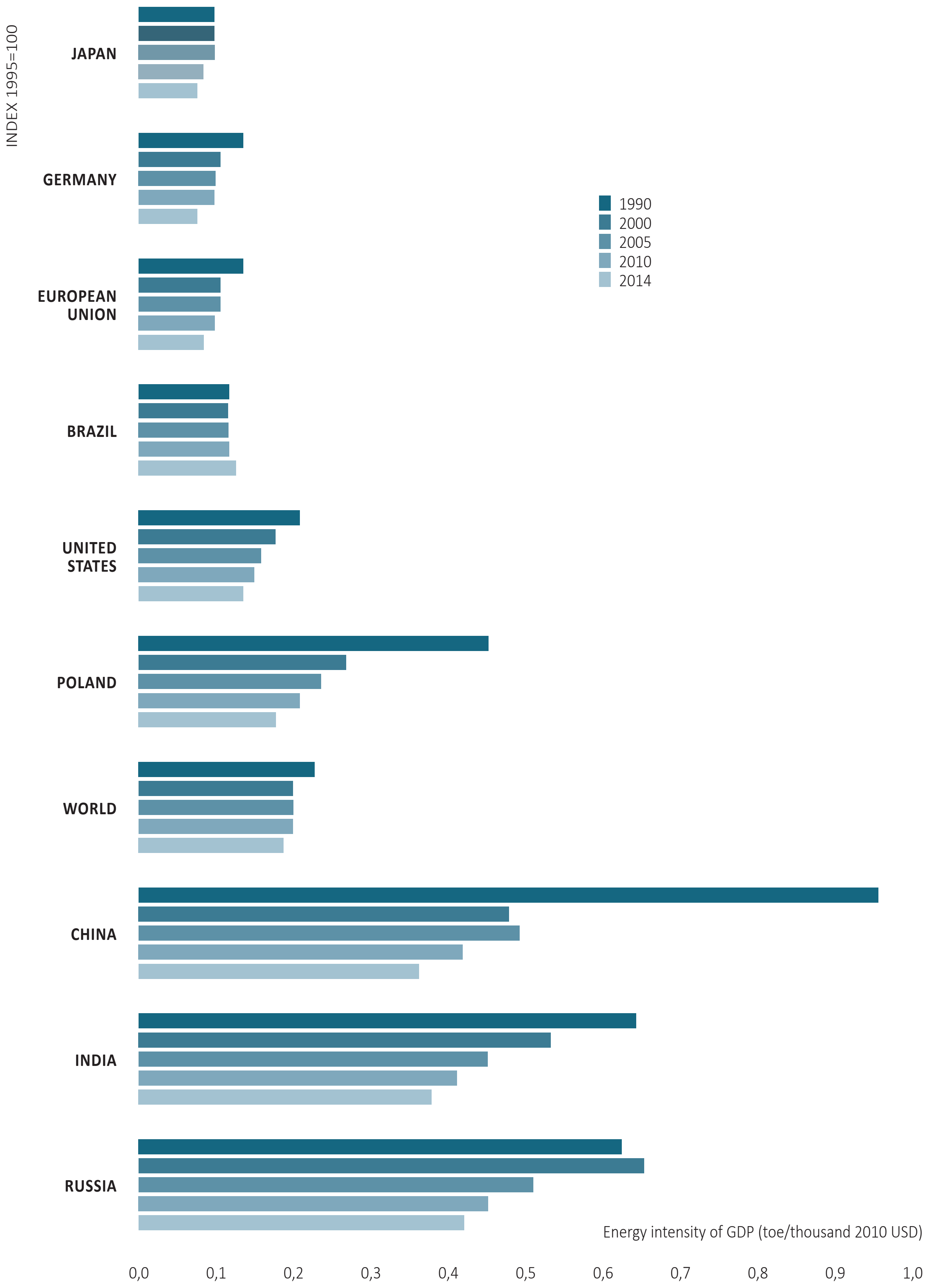


Figure 2 | **EVOLUTION OF ENERGY INTENSITY OF GDP IN SELECTED COUNTRIES.**
SOURCE: BASED ON (IEA 2016)



Energy intensity[1] has been reduced in many countries of the world - in some countries with dramatic reduction rates (Figure 2). Germany's energy intensity lies below the world average and is one of the smallest among large economies. Even against this background, it has been possible to decrease Germany's energy intensity by almost 43% within the last 24 years, from 0,14 toe per 1000 USD in 1990 to 0,08 toe per 1000 USD of GDP in 2015 (IEA 2016).However, even today large energy efficiency potentials exist and are to be tapped in the future - both for environmental and economic reasons.

### Cost of renewables will decrease in the future - and pay off economically in the long term.

While many energy efficiency measures pay off under current market conditions, costs for renewables have been higher than using conventional fuels in the past. However, in the last two decades the costs for energy production from renewables have dropped drastically (Agora Energiewende 2016). Today, levelised costs of electricity (LCOE)[2] of onshore wind are lower or equal compared to fossil fuels. Electricity from (large scale) PV is comparable to electricity from gas (Fraunhofer ISE 2013). For the future further cost reductions are expected (except for biogas), which would make offshore wind cost competitive with the cheapest alternative (lignite) in 2020 and likewise large-scale PV (Fraunhofer ISE 2013). Including system costs and positive benefits like employment solar, wind on- and off-shore are expected to be cost competitive towards nuclear and all fossil fuels in 2025 (EY 2015). One important assumption underlying these cost developments is continuously high installation rates for PV and wind in the future (Fraunhofer ISE 2015). Against this background the German government is considering both energy efficiency and renewables as an investments into a sustainable and economically competitive energy future. Moreover, currently running short-term programs, targeting energy efficiency and renewable energy expansion development, such as the "Climate Action Programme 2020" (BMUB 2014), also show positive impacts on the economy of Germany. According to evaluations of an auditing company PwC, "Climate Action Programme 2020" is expected to add around 1% to the GDP in 2020 and create cost savings of 175 million Euro in hard coal and of 3,3 bn Euro in mineral oil imports by 2020 (PwC 2016).



## 1.2 Renewable Energy

### 1.2.1 Employment and value added

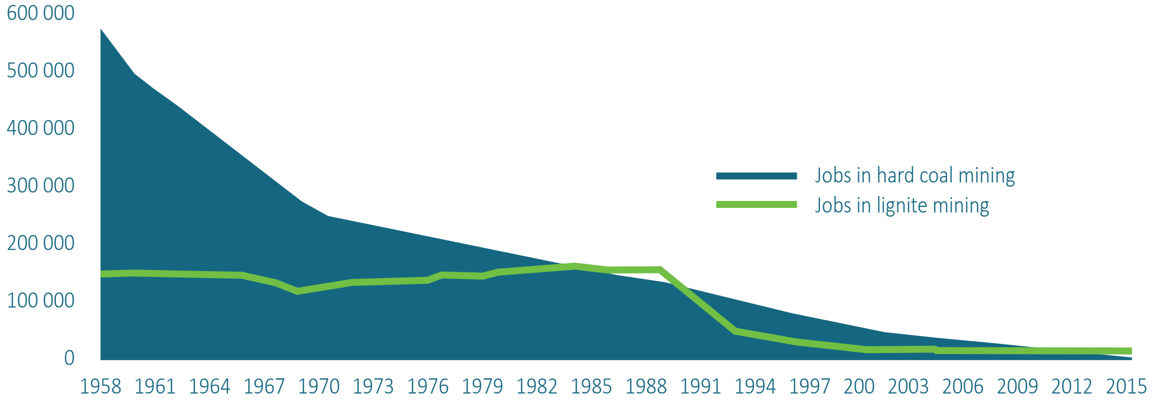
**Germany's transition from a coal country to a leader in renewable energy**

Germany has intensified research on renewables after the oil crisis in the 1970s. Early demonstration projects in the 1980s have been followed by market introduction support schemes from the 1990s on. Beyond environmental concerns this strategy has always been seen as an approach to reduce Germany's energy import dependency and as an innovation program to improve Germany's technology base and as a stimulus to it's economy.

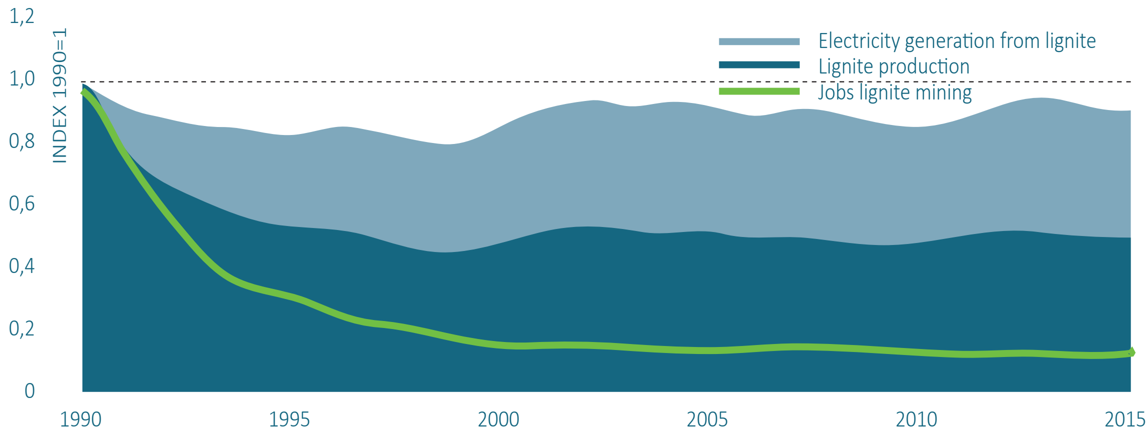
1. Energy intensity is defined as the amount of energy needed for generation of one unit of gross domestic product.
2. LCOE includes all expected full costs during the lifetime of the generating unit, (including construction, fuel, maintenance etc.) divided by unit of electricity

Box 1 | **THE DECLINE OF GERMANY'S COAL MINING INDUSTRY WAS DRIVEN BY PURELY ECONOMIC REASONS.** SOURCE: OWN CALCULATIONS BASED ON STATISTIK DER KOHLENWIRTSCHAFT E.V. (2016A, 2016B); AG ENERGIEBILANZEN E.V. (2016); IEA (2016)

Germany has a history of an economy largely built on coal mining and use. In the late 1950s more than 700,000 people worked in coal mining (East and West Germany combined, both lignite and hard coal). This number has decreased dramatically to less than 30,000 in 2014 (Statistik der Kohlenwirtschaft e.V. 2016a, 2016b). This process was neither driven by environmental concerns nor energy policy objectives- but has been driven mainly by more efficient mining technologies and a switch to other fuels or cheaper globally imported coal. The number of jobs in coal mining in Germany today is small compared to the jobs related to renewable energy.




Zooming in on lignite shows that power production from lignite has been fairly constant (apart from some fluctuations) within the last 25 year. Whereas the jobs in lignite mining have collapsed from almost 130,000 in 1990 to about 17,000 in 2015. There are several reasons for this: In East Germany lignite was of importance not only for power production but also for heating and as a basis for chemical processes. After reunification the later two were increasingly fuelled by gas and oil. Furthermore, new power plants with higher efficiency were built and finally the extraction of lignite became more and more efficient (in terms of jobs per ton of lignite). In summary the loss of jobs in coal mining has not been driven by Germany's shift towards renewables, but by other independent economic reasons.



In total the strategy has paid off: in 2013 more than 330,000 people were directly or indirectly employed in the renewable sector in Germany (see Figure 3). The development has been quite different for the different technologies: Jobs in wind energy have been growing over time with some saturation recently. Jobs in biomass follow the share of biomass use in Germany - which has been more or less constant since 2007. PV shows a dramatic up and down: In 2015 jobs fell to one third of the peak in 2012, due to a massive cut-back in PV installations in Germany and increasing international competition in PV cell manufacturing (especially from Asian countries).

Jobs in renewables are not expected to be a short-term benefit only, but a long-term opportunity for the German economy. Even after subtracting job losses in fossil fuel related jobs, the expected net growth is 50,000 to 175,000 jobs in 2030 and between 175,000 and 275,000 additional jobs in 2050 (DLR et al. 2016). The estimations of renewables expansion in Germany, made by German Institute for Economic Research, are also rather optimistic: an increase of net-employment by 100,000 in 2020, by 190,000 in 2030 and by 230,000 in 2050. In case of successful export development and added value growth, the assumptions are even more positive and expect a growth by more than 300,000 new jobs (DIW 2014).

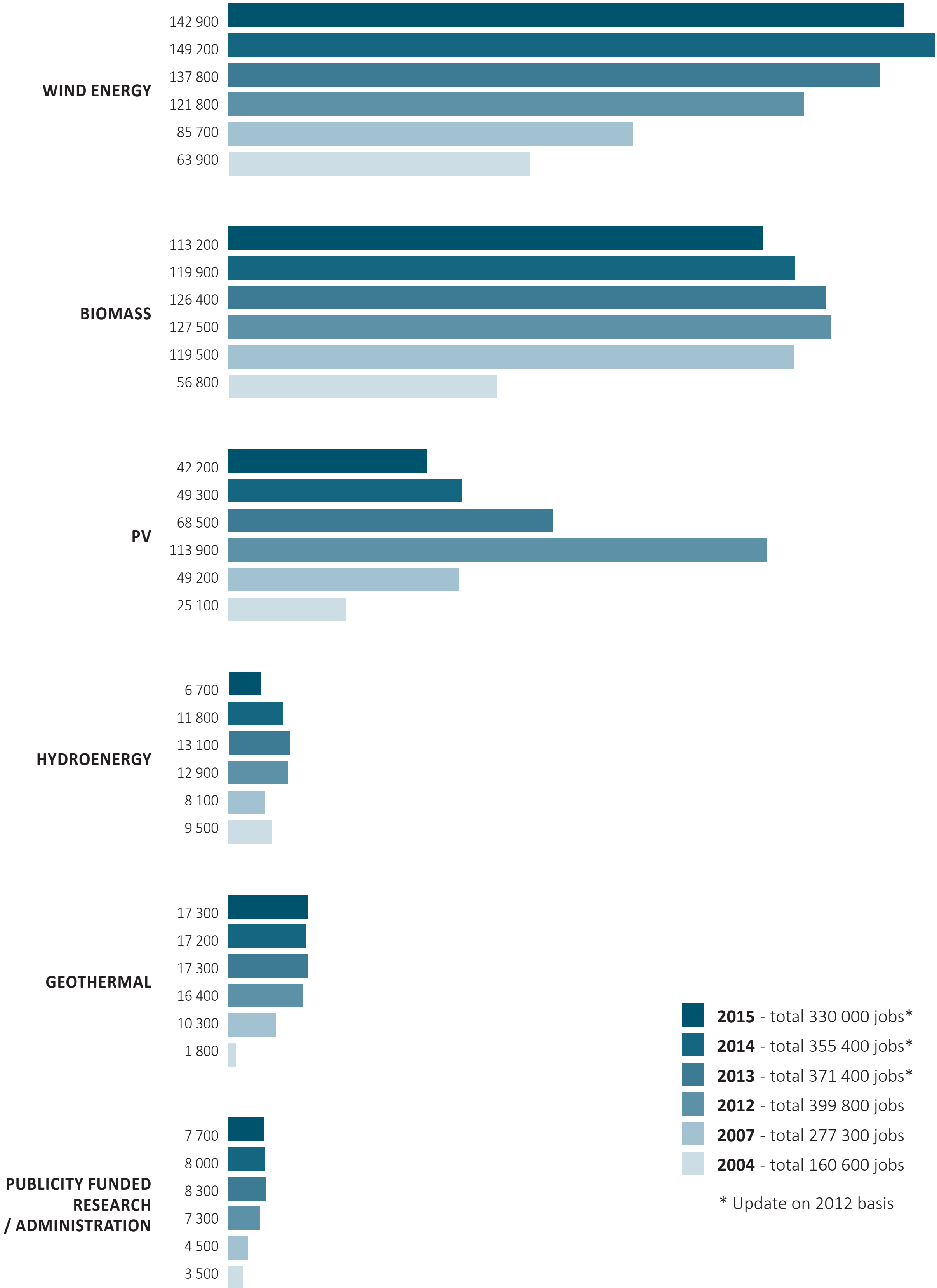


Box 2 | **THE IMPORTANCE OF STABLE FRAMEWORK CONDITIONS**

For most renewables in Germany we see growing numbers of jobs, which saturate at high levels. PV is an exception with a strong up and down. As discussed this is partly due to increasing global competition. But it is also due to a massive cutback in support for PV in Germany. Other countries such as Spain have seen even worse boom and bust cycles with massive ramp-up of jobs as support for renewables increased and a subsequent collapse when cutbacks occurred.

Such boom and bust cycles are very difficult for the industry: instable framework conditions prevent long-term investments. Furthermore, creating jobs also requires training and capacity building (see section 1.4), but students and employees are only willing to acquire skills related to renewable and energy efficiency technologies if they see a long-term perspective for themselves to get jobs in these areas. Against this background we consider long-term continuity as a key success factor of governmental schemes to support energy efficiency and renewables.

Figure 3 **DEVELOPMENT OF GROSS EMPLOYMENT IN RENEWABLE ENERGY'S SECTOR IN GERMANY,COMPARISON OF DIFFERENT YEARS.** SOURCE: BASED ON DLR ET. AL. (2016)



**Who benefits? - Jobs in renewable energies**

A look at the regional distribution of jobs in renewables shows that the federal states with strong industry / manufacturing base benefit the most: in 2013 more than 55% of overall renewables related jobs in Germany were concentrated in four states (Baden-Wuerttemberg, Bavaria, Lower-Saxony and North Rhine-Westphalia) (GWS 2014). Generally one can distinguish very different profiles of German federal states in respect to which part of the value chain are being harvested (IÖW 2013; GWS 2014):

- Lower-Saxony, for example, has many jobs in the wind industry due to a great number of wind turbines installed (due to very good wind conditions) and several strong wind turbine manufacturers within the state. Moreover, the access to the North Sea allows to explore off-shore wind options (see the case study of Cuxhaven below). Thus, the state has high employment rates along all steps of the value chain of wind energy - from manufacturing and installation to maintenance).

- Quite in contrast, the states of Baden-Wuerttemberg and Bavaria focus in their renewable energy use largely on biomass and solar. With respect to jobs, however, they also have significant shares in the wind industry- mainly related to production specific components (upstream products).

- The opposite is true e.g. for Mecklenburg-Vorpommern: the structurally weak region has hardly any production. Thus, more than 75% of jobs are linked to planning, installation and maintenance of renewables (IÖW 2013).

It is noteworthy that the structurally weak states generally have lower total number of jobs in renewables. In relative numbers- percentage of workforce employed in renewables- the structurally weak states benefit even more. While in Baden-Wuerttemberg less than 1% of all jobs are related to renewables, approximately 2% of the workforce in Mecklenburg-Western Pomerania and Saxony-Anhalt is employed in renewables.



**Value added - local benefits**

It is true that Germany benefits from renewables because it has a strong industry base and is exporting technologies. In 2015 the export ratios reached 70% for PV and some 66% for wind. At the same time, biodiesel producers reached a 50% export ratio and 66% of heat pumps produced in Germany were consigned for export (BEE 2016).

But it is even more true that a large share of the jobs related to renewables comes from domestic use and installation. For instance, for PV 50% of the value added is linked to systems manufacture - but the other 50% stay in the region where the plant is actually located (see Figure 5). The shares for local value added are even higher for wind energy (60%) and bioenergy (70 to 80%). It is farmers, land-owners, local installation, maintenance and construction companies and small scale investors who receive the lion's share of the value added generated by Germany's transition towards renewables. Furthermore, municipalities and federal states with high shares of renewables in their territory benefit through higher tax revenues.

Figure 4 **GROSS EMPLOYMENT PER BRANCH & REGION IN 2013.**
SOURCE: BASED ON GWS (2014)

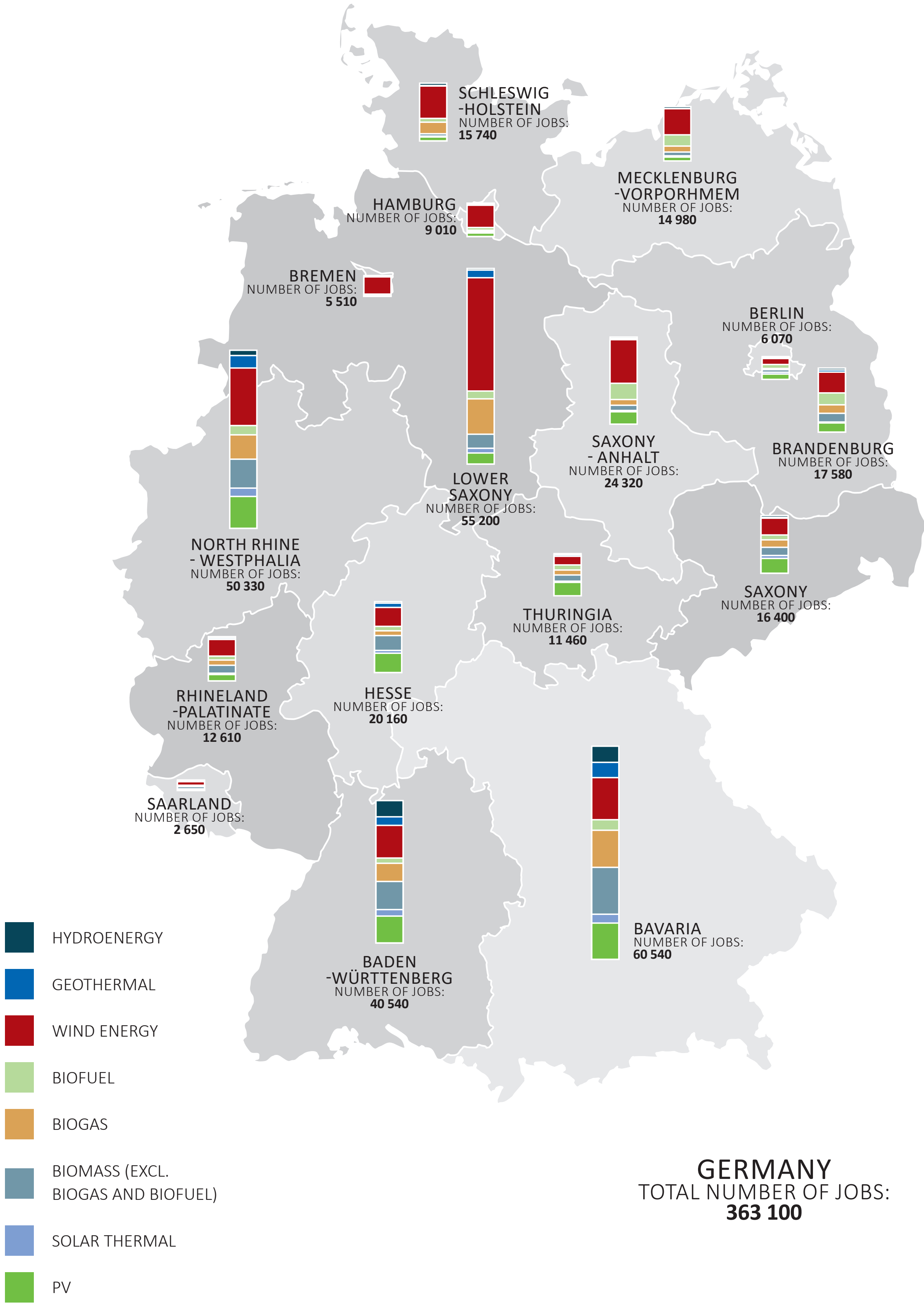
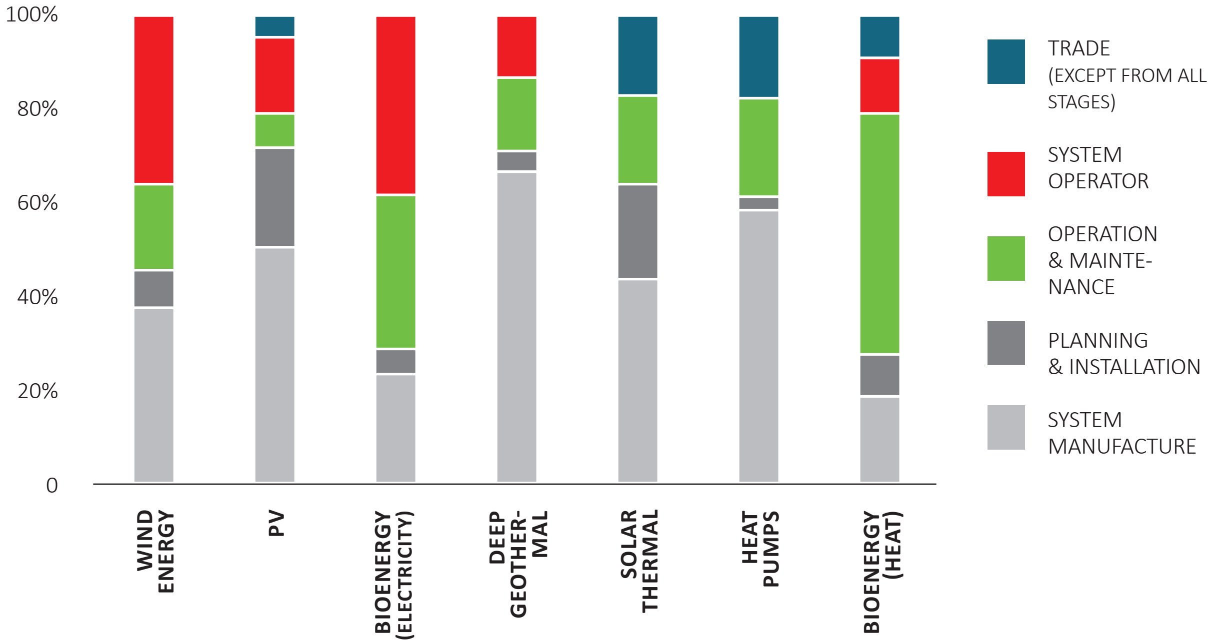


Figure 5 | **VALUE ADDED PER RES TECHNOLOGY ALONG VALUE CHAIN.**
SOURCE: BASED ON GWS (2014)

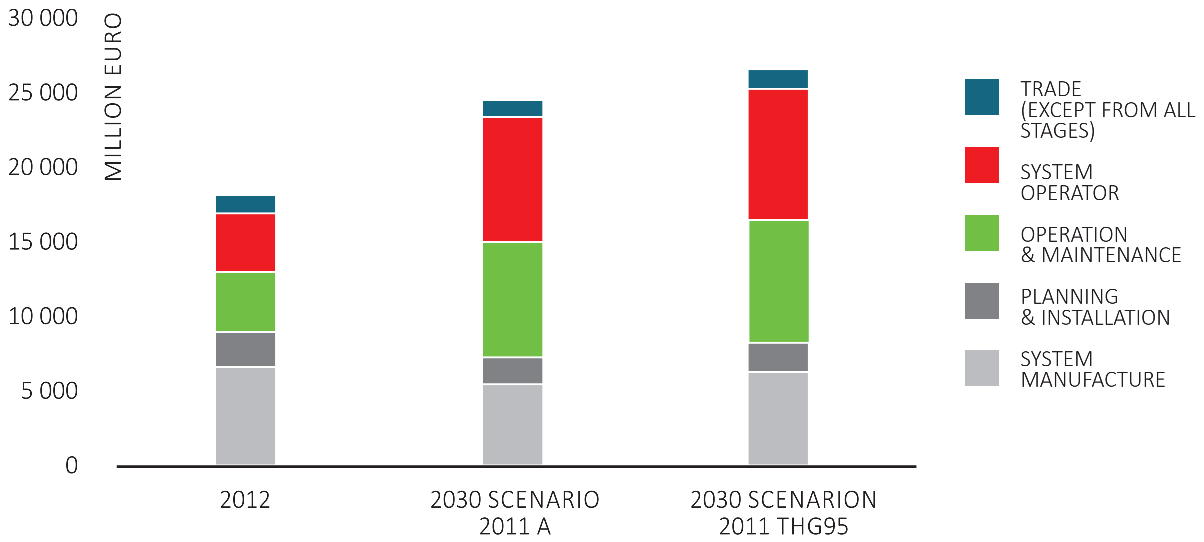





Direct value added from renewables is expected to grow in Germany (see Figure 6). Forecasts on future value added (and subsequent job effects) depend on assumptions on installation rates of renewables. Scenarios by (IÖW 2013) expect value added to rise from 18 billion Euro in 2012 to approximately 25 billion Euro in 2030. As a general trend, the more renewables are installed, the more value creation will be linked to operation and maintenance as well as system operation parts of the value chain.

2. Underlying the scenarios are different assumptions on installed capacity of renewables. For scenario 2011 A a RES share of 68% in overall electricity consumption and 29% in heat are projected for 2030; for scenario 2011 THG95 this share is 66% and 32% respectively.

Figure 6 **CURRENT AND FUTURE DIRECT VALUE ADDED THROUGH RES ALONG VALUE CHAIN FOR DIFFERENT SCENARIOS[2]**
SOURCE: BASED ON IÖW (2013)






## 1.2.2 Case studies - making business with renewable energy

### Cuxhaven - deep water port for off-shore wind

In 2002, two years after the German Renewable Energies Act (EEG) entered into force, the Land of Lower Saxony made a decision to develop Cuxhaven as a main deep-water port for the offshore industry (Economic Development Agency Cuxhaven n.d.). The core of the port are heavy load platforms connected to heavy duty roads, suitable for the huge components of off-shore wind farms. The driveway to the terminal is up to 380 m wide, 120-190 m deep and a special asphalt structure is used to be able to bear 25 t/m2. Subsequently various companies settled in Cuxhaven: manufacturers of steel towers and foundation structures, marine transport companies, including off-shore craning operators. Lately Siemens invested some €200 million in a wind turbine production facility next to the port, expecting to employ 1000 skilled workers (Siemens 2016).

## SMA power inverters
## - there is more to PV then just cell productions

SMA was founded in 1981 in Niestetal, Germany (near Kassel) and has become a global leader in PV system technology. In 2015 the company had 3000 employers in 20 countries. Its turnover was €1 billion. SMA's core product are power inverters („sunny boy") and the company's backbone is the technological expertise of these devices. Based on this knowledge base, SMA extended it's business into various fields of PV system technologies and services, including home and industrial systems. Modern power inverters include a wide range of features for monitoring and management of the performance of a PV power plant.

On this basis SMA has gained knowledge on the performance of PV plants and has transferred this into a portfolio of services like planning of PV plants (SMA 2016). In conclusion, SMA exemplifies the wide variety of products and services which are related to renewable energy technologies- way beyond the mere manufacturing of PV cells or wind turbines.



## Verbio - using fossil refinery know-how for biofuel production

VERBIO is one of the leaders of biofuels production in Germany with annual production capacity of around 470,000 tonnes of biodiesel; 260,000 tonnes of bioethanol and 600 GWh of biomethane (VERBIO 2016a). In 2015/2016, VERBIO had 488 employees, making a turnover of €654 million (VERBIO 2016b). Some milestones of the company's history are:

- Between 2000 and 2005 three productions sites for Biofuels were set up in Schwedt, Zörbig and Bitterfeld, producing bioethanol and biodiesel. In 2006 these individual companies were merged into one company, VERBIO.
- 2010 – expansion of the bioethanol plant Schwedt into bio-refinery with a biomethane production unit
- 2014 – another biomethane production facility using straw as an exceptional raw material.

**Interesting in the company's history is its direct link to infrastructure and know-how from GDR times. The German reunification in 1990 has led to a collapse of many industries in the formerly communist East-Germany.**

Interesting in the company's history is its direct link to infrastructure and know-how from GDR times. The German reunification in 1990 has led to a collapse of many industries in the formerly communist East-Germany. The chemical industry was hit quite hard and many production facilities were closed or downsized - quite similar to processes in many Central and Eastern European countries in the 1990s / early 2000s. In this situation producing biofuels was an option to explore a future market.



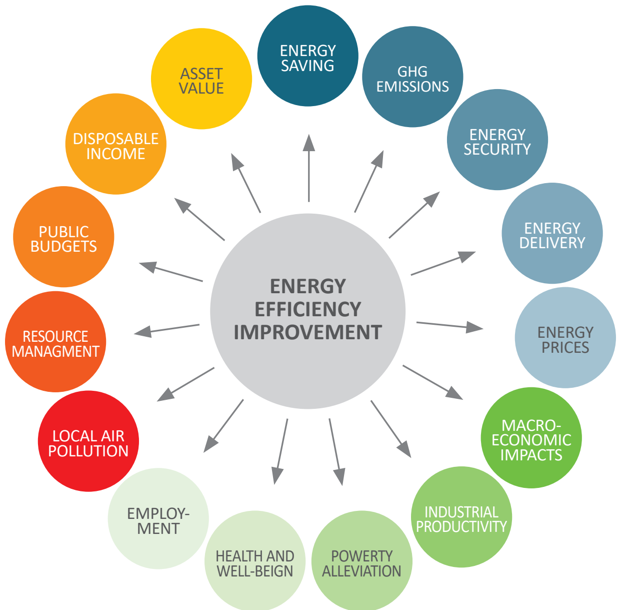
VERBIO has production sites in Eastern Germany, which have easy access to biomass input. Eastern Germany is less densely populated compared to Western Germany, with largely rural areas. Furthermore, VERBIO imports biomass from Poland (the city of Schwedt is right at the border to Poland). All VERBIO production sites are close to existing refineries (Schwedt) or chemical industry sites (Bitterfeld and Zörbig), which in GDR times were also areas of lignite mining and lignite use in the chemical industry. In doing so VERBIO benefits from both shared infrastructure and a pool of skilled workers in the region- both of which were previously linked to fossil fuel industries but then were employed for biofuel production.

# 1.3 Energy Efficiency Improvements

## 1.3.1 Multiple economic impacts

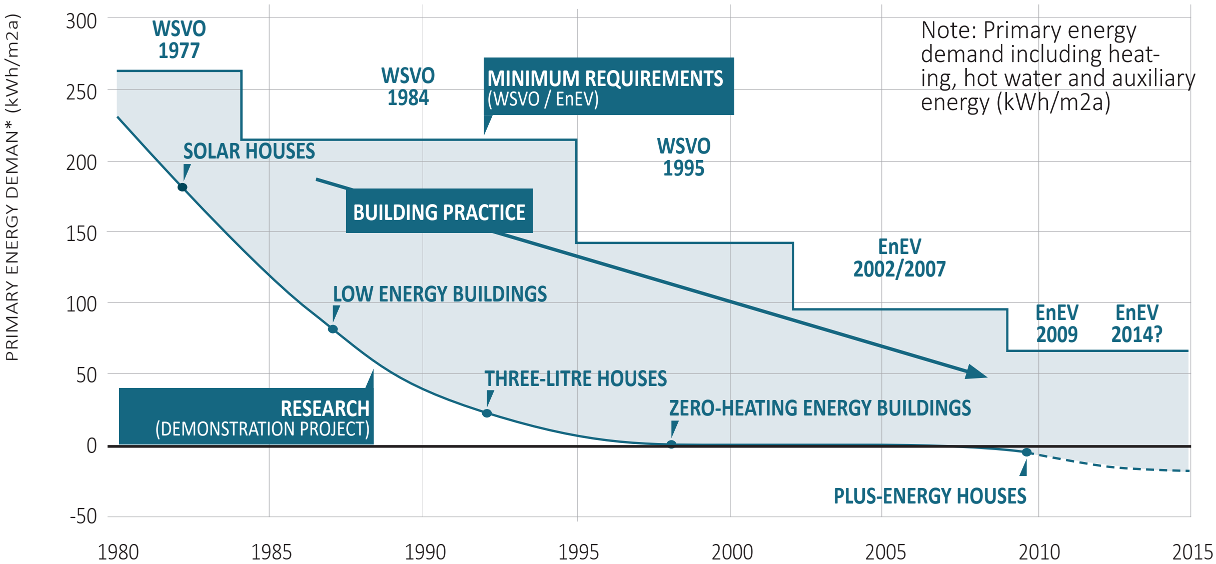
The improvement of energy efficiency plays a prominent role in German energy policy as it does not only reduce energy costs and greenhouse gas emissions, but also leads to further benefits for the economy, society and end-users (see figure 9). Economic impacts include a strengthened competitiveness of industries by reducing energy costs and increasing productivity, improved energy security due to reduced fossil fuel imports and less volatile energy prices, and positive impacts on GDP growth. Moreover, the implementation of energy efficiency measures is labour-intensive, particularly at the local level, and thus creates substantial employment opportunities.

Figure 7 | **THE MULTIPLE BENEFIS OF ENERGY EFFICIENCY**
SOURCE: IEA (2014)




In Germany, as in many European countries, a mix of different types of energy efficiency policy measures has been implemented including regulation, financial incentives and information and advice programs. Taking energy efficiency in buildings as an example: building standards have been introduced in 1977 (as a reaction to the oil crisis) and have been tightened since. This regulatory approach has been supported by research and demonstration projects, information campaigns (including building energy certificates) and a funding scheme for more efficient houses (see KfW case study below).

Figure 8 **REGULATORY FRAMEWORK AND BUILDING PRACTICE FOR MODERNISATION OF EXISTING AND NEWLY-BUILT BUILDINGS.**
SOURCE: BASED ON FRAUNHOFER IBP (2012)




WSVO/EnEV are the abbreviations of the German minimum energy performance standard for buildings (WSVO = Wärmeschutzverordnung; EnEV = Energieeinsparverordnung)

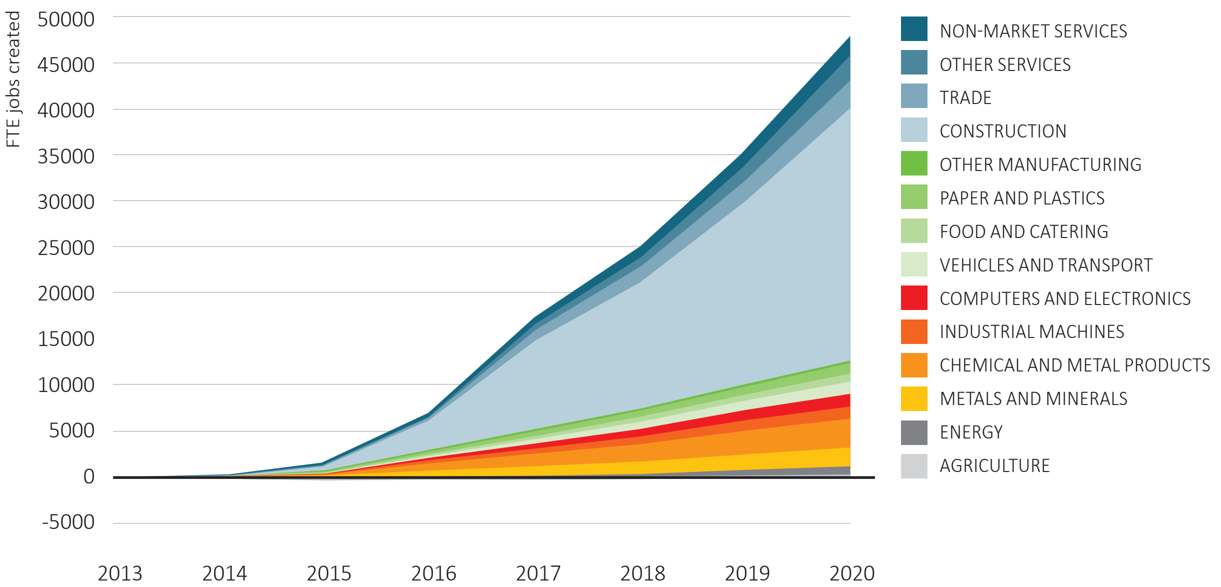


## 1.3.2 Employment effects

In 2014 Germany intensified its ambition for higher energy efficiency and introduced the National Action Plan on Energy Efficiency (NAPE) supporting Germany's aim to reach a 20% reduction in primary energy consumption by 2020 compared with 2008 and halve it by 2050 (BMWi 2016). In 2016 the German government launched the Green Paper on Energy Efficiency which is seen as a public discourse on which elements a "more extensive mid to long-term energy-efficiency strategy" should look like.

Looking at the overall impacts of planned energy efficiency policies, the finding is that Germany's energy policy would trigger more than €100 billion additional investment between 2014 and 2020. This would correspond with increase in GDP of 11 billion €2005 or + 0.4% in relative terms (Ringel et al. 2016). Employment effects would be an additional 48,000 jobs (fulltime equivalents) in 2020 in Germany with the highest number of jobs created in the construction sector (Ringel et al. 2016, see Figure 11). However, it is important to note that this employment potential can only be achieved if education, capacity building and training provide sufficiently qualified employees in the future in Germany. If existing energy efficiency policies are also considered, it is estimated that today more than 100,000 jobs (full-time equivalent) are created through energy efficiency policies and this number will increase to more than 330,000 in 2020 (Fraunhofer ISI 2016).

Figure 9 **INCREASED EMPLOYMENT IN SECTORS DUE TO ADDITIONAL EFFICIENCY MEASURES 2020.**
SOURCE: (RINGEL ET AL. 2016)






## 1.3.3 Case study: The KfW program in Germany

The German state-owned KfW Bank manages two programs to improve the energy efficiency of residential buildings: the Energy-Efficient Construction (EEC) program and the Energy-Efficient Refurbishment (EER) program. Both programs offer financial incentives (upfront grants or soft loans, which may have a grant component) to building owners to overcome economic barriers (e.g. lack of sufficient loan financing or own upfront capital, short payback expectations) to realise energy-efficient investments. Financial incentives are granted only if the energy efficiency performance is better than the minimum legal standard in Germany. The amount of the grants depends on the energy efficiency level achieved: the higher the energy efficiency, the better the financing arrangement (EEW3 2016). The funding requirements of the KfW program were tightened as were the German energy efficiency standard over time (see Figure 10). The KfW makes use of local commercial bank offices to facilitate loans. KfW can raise capital at low costs due to the implicit guarantee of the German government making KfW bonds highly attractive to investors (European Commission 2016).

Figure 10 | **OVERVIEW OF KFW'S FINANCING MECHANISMS FOR NEW AND EXISTING BUILDINGS**
SOURCES: EEW3 (2016) BASED ON KFW (2015A; 2015B; 2015C)

**NEW BUILDING**

**ENERGY-EFFICIENT CONSTRUCTION**

- soft loans
- max. 50 000 EUR per housing unit (EUR 100 000 from April 2016)
- KfW-Efficiency House standard
- three energy efficiency and financial support levels
- partial debt relief possible

**BUILDING STOCK**

**ENERGY-EFFICIENT REFURBISHMENT**

- soft loans
- max. 100 000 EUR per housing unit
- KfW-Efficiency House standard
- five energy efficiency and financial support levels
- partial debt relief possible
- max. 50 000 EUR for single measures as an alternative
- grants as an alternative for owners of single and two family houses

**HIGHER ENERGY EFFICIENCY MEANS BETTER FINANCING CONDITIONS**

According to the monitoring report 2016 (IWU / Fraunhofer IFAM 2016), final cumulated energy savings of the Energy-Efficient Refurbishment and the Energy-Efficient Construction program for the period between 2005 and 2015 amounted to 17,260 GWh and 3,040 GWh respectively. This would correspond to saving the annual demand for heat energy for more than 170,000 households.
The investments triggered by the Energy-Efficient Refurbishment program amounted to €6.4 billion in 2015 and triggered employment effects of 74,500 person-years (PJ) in 2015 and 728,000 accumulated person-years between 2005 and 2015.

The Energy-Efficient Construction program triggered investments of €31.9 billion in 2015 resulting in employment effects of 355,500 person-years (2,124,000 accumulated person-years between 2005 and 2015). Figure 13 differentiates between direct and indirect employment effects. Employment effects that are induced in the companies contracted directly by the investor are defined as direct, all other employment effects in further businesses as indirect (cf. IWU / Fraunhofer IFAM 2016). The key figures of the two KfW programs are summarised in table 1.



Figure 11 | **EMPLOYMENT EFFECTS OF KFW PROGRAMS IN 2015. SOURCE: BASED ON IWU**
SOURCE: FRAUNHOFER IFAM (2016)

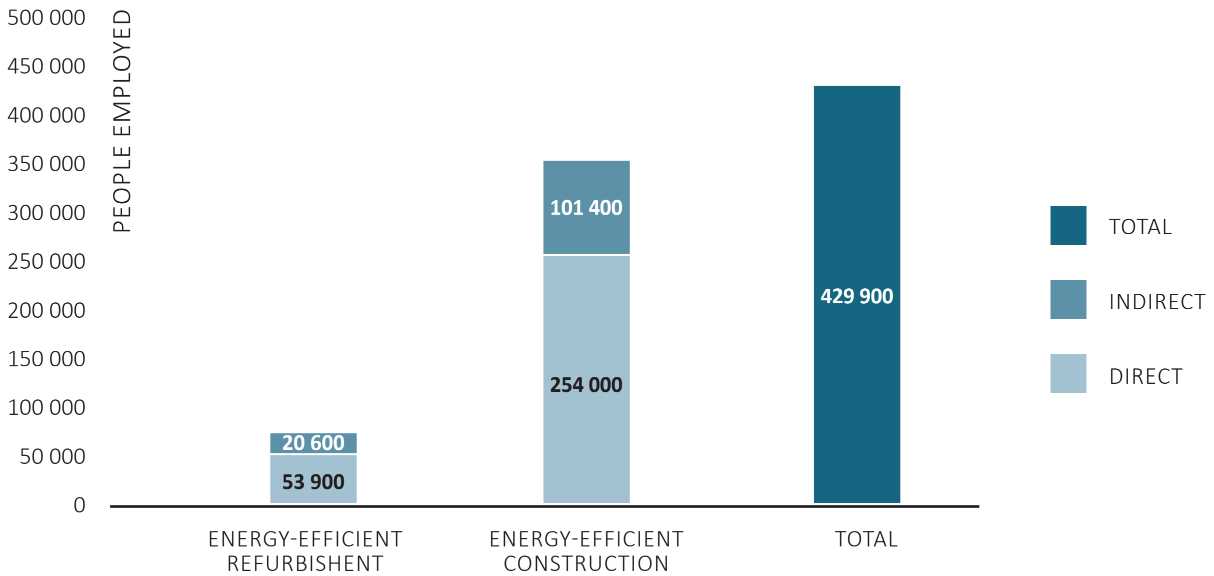


Table 1 | KEY FIGURES OF THE KFW PROGRAMS ENERGY-EFFICIENT REFURBISHMENT (EER) AND ENERGY-EFFICIENT CONSTRUCTION (EEC) BASED ON IWU / FRAUNHOFER IFAM (2016)

| PROGRAM | YEAR | DWELLINGS CONSIDERED | PLANNED INVESTMENT* [MIO. €] | $CO_2$E REDUCTION [TONNES PER YEAR] | FINAL ENERGY SAVINGS** [GWh PER YEAR] | EFFECTS ON EMPLOYMENT [PERSON-YEARS] |
|---|---|---|---|---|---|---|
| EER | 2015 | 237,000 | 6,400 | 523,000 | 1,390 | 75,000 |
| EER | 2005-2015 | 2,320,000 | 52,200 | 6,438,000 | 17,260 | 728,000 |
| EEC | 2015 | 142,000 | 31,900 | 139,000 | 380 | 355,000 |
| EEC | 2005-2015 | 876,000 | 169,200 | 929,000 | 3,040 | 2,124,000 |

* total construction costs
** district heating, electricity, fossil fuels, biomass

## 1.4 Capacity building for energy efficiency and renewable energy



One important learning of promoting renewables and energy efficiency in Germany is that skilled workers are an essential success factor to tap the economic and employment potentials. As important as regulation and support schemes are that it needs people with specialised technical skills to build and install renewable energy technologies and to implement energy efficiency projects. And in fact training and capacity building has been offered over the last decades to engineers, architects, planners, financial experts as well as craftsmen like plumbers or electricians.

It would be impossible to list all training facilities or university classes, which have been established in Germany. But to throw a first glimpse into the wide variety of offers, we list a few selected examples:

- To name a few:
  - DGS- Solarschulen. In 2006 various capcacity building activities in Germany have been brought together under the umbrella of the German Section of the International Solar Energy Society (DGS). The DGS runs 9 “Solar Schools” in Germany and is active in 17 countries globally. Among others they provide guidelines and trainings for craftsmen working in the field of photovoltaics and solar thermal (e.g. for installation, maintainance, security issues etc.) (DGS n.d.).
  - BZEE Bildungszentrum Erneuerbare Energien e.V.- Established in 2000 by wind energy companies. The BZEE Academy GmbH is an important training facility for workers in wind energy. The trainings introduce minimum quality standards based on industry requirements. The certificates participants receive serve as one means for quality control in the sector (BZEE 2016).
  - Cuxhaven Offshore-Safety-Trainingscenter is a specialised training center offering safety and rescue trainings for employees in the offshore sector (Agentur für Wirtschaftsförderung Cuxhaven n.d.)

# Part II:
# Renewable Energy Sector – Poland's jobs potential

By Christian Schnell PhD,
Antoni Olszewski (Instytut Jagiellonski)

## 2.1 Introduction

Poland has a very high potential to develop RES in decentralized power production and highly efficient power and heat plants, but also on a large scale through offshore wind farm investments. In contrast to new solids fired power and heat generation, European funds, private investment and project finance by European and commercial banks is available, so that the Polish taxpayer would not have to subsidize such investments. The costs of power production by wind and solar is lower than of power production by solids fired power plants, therefore the final consumer has to pay less for electricity. RES technologies, supported by an improving energy efficiency, should boost competitiveness of power generation and energy sector and, therefore, of the economy as a whole.



The job potential for RES and energy efficiency is huge, as e.g. investments in offshore wind farms and biomass fired generators can provide more than 100,000 jobs in the next decade. However, currently the number of jobs in the renewable energy sector has been increasing during the last years. In 2012, approx. 35,000 employees were engaged in the sector, currently the amount of employees is slightly lower, amounting to approx. 31,000 employees. The targets of the EU "effort sharing" climate policy till 2030 approved in 2014 show that the development of RES must be continued throughout the next decade. Meanwhile, in Poland the uncertainty regarding the shape of the future support system has affected the job potential already twice, for the first time the biomass sector was hit during the first crash of the green certificate scheme in 2013, and currently by implementing harsh distance rules which generally stopped further wind farm development the wind sector is decreasing. The still unclear future shape of the still not notified auction support system, which replaces the already closed green certificate support system lead to a further instability for all RES technologies. In addition, by virtue of secondary legislation, the minister of energy can decide each year, which renewable technologies are preferred by determining how much electricity is allocated between the various auction baskets. This lack of transparency provides a very high regulatory risk for RES project development.

In Poland, in the discussion about the forth EU energy package debate the most crucial are its social implications on the job market, mainly for hard coal mining in Silesia Voivodship. However, Poland's coal mining industry is not competitive internationally, and the decline of Poland's coal mining sector is inevitable. The net impact of energy transition depends on the success of the adaptation process, which then requires to take cognizance of the two sides of the transformation, i.e. both innovative RES technology enthusiasts and coal miners. Poland is mainly a beneficiary, not a trendsetter, of energy sector technologies. However, recent years have shown that the energy transition also gives a chance for the development of the economy as well as for Polish workers.

## 2.2 Employment and value added in the coal mining sector

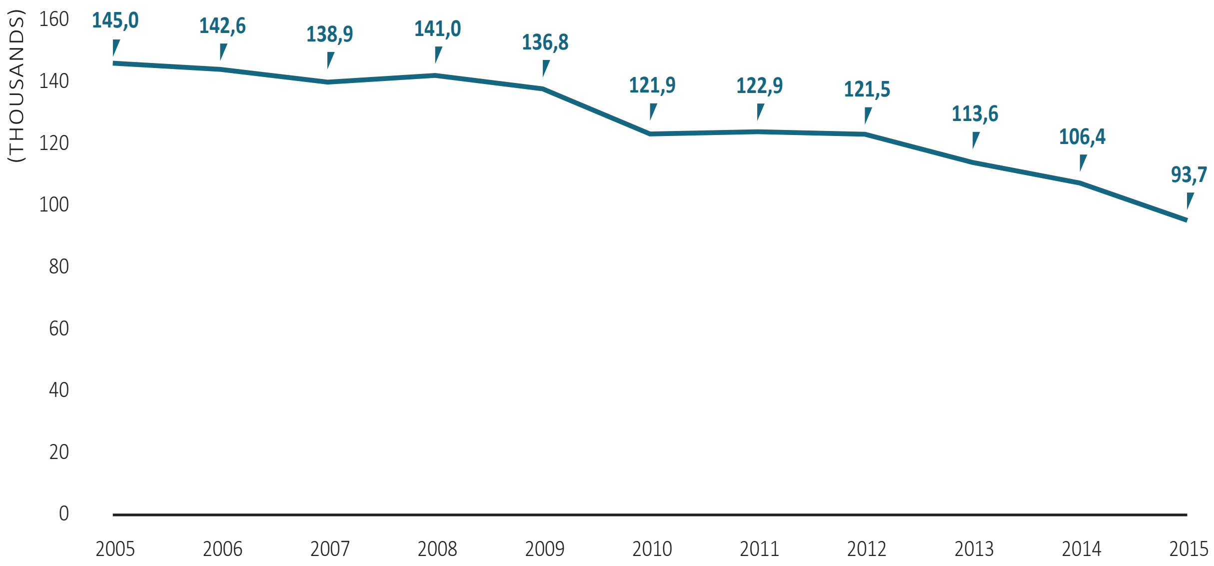
Poland is a European country with the largest coal reserves, however, its lignite reserves are by 25% higher than its hard coal reserves.

Generally, Poland is a European country with the largest coal reserves, however, its lignite reserves are by 25% higher than its hard coal reserves. According to the data from the EU Commission, Poland's share of hard coal reserves in the EU amount to 36% (Germany 17%, UK 39%) and its share of lignite reserves to 64%. More people are employed with the hard coal mining sector, mainly in the Upper Silesia, than with lignite mining. By the end of 2016 approx. 85,000 employees were employed in the mining sector. For the last two years a yearly reduction of 8,000 jobs due to early retirements has been observed, however, at least another 15,000 employees have to quit their job with major state-owned Silesian energy coal mine groups, i.e. PGG (currently 31,000 employees) and KHW (currently 13,500 employees) in order to avoid further losses. Generally, the government counts on a voluntary job reduction scheme, as dismissals due to the unfavourable employment agreements are hardly practicable. Polish coal mines produced 72 million tons of hard coal in 2016, whereas 57 million tons are used in power plants to produce electricity and heat.

The aforementioned major Silesian coal mine groups are highly inefficient, e.g. the Polish formerly private and still profitable coal mine Bogdanka located in the Lublin area produces 8.5 million tons of hard coal with 4,500 employees and another 1,500 temporary workers (1,460 tons per employee), while KHW produces 12 million tons with 13,500 employees (890 tons per employee) and PGG 28 million tons with 31,000 employees (900 tons per employee).

Moreover, in case if new coal power plants replace old coal power plant capacity between 2018 and 2020, the need for energy coal decreases by another 10%. So, the already high level of early retirements has to speed up even more to avoid high operational losses increasing 500 million Euro every year. A conflict with the EU Commission due to the EU state aid policy seemed to become unavoidable at the beginning of 2016, however, the EU Commission seems to be willing to observe the restructuring of coal mines for the time being as the government puts a lot of effort to avoid social conflicts.

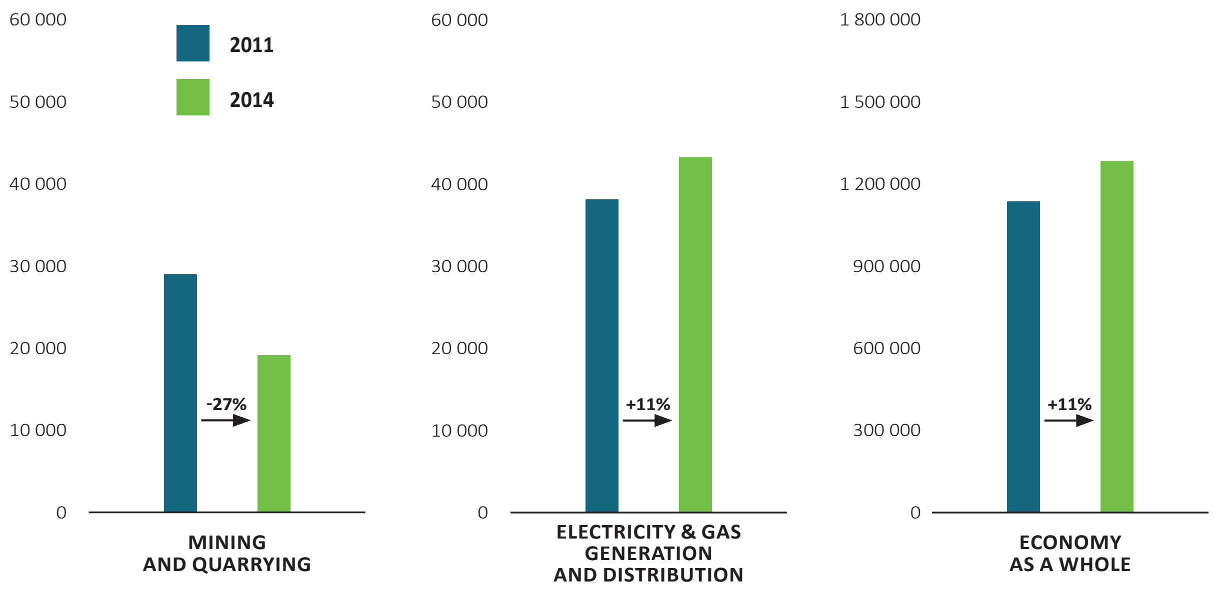
Figure 12 **EMPLOYMENT IN THE MINING SECTOR 2005 – 2016**
SOURCE: GUS CENTRAL STATISTICAL OFFICE






The increase of jobs in the renewable energy sector is, however, associated with their elimination in the sector of non-renewable fuels. This problem is particularly important for Poland. Mining of coal and lignite is in fact one of the main economic sectors.

Figure 13 **VALUE ADDED OF SPECIFIC SECTORS 2011 – 2014**
SOURCE: GUS CENTRAL STATISTICAL OFFICE

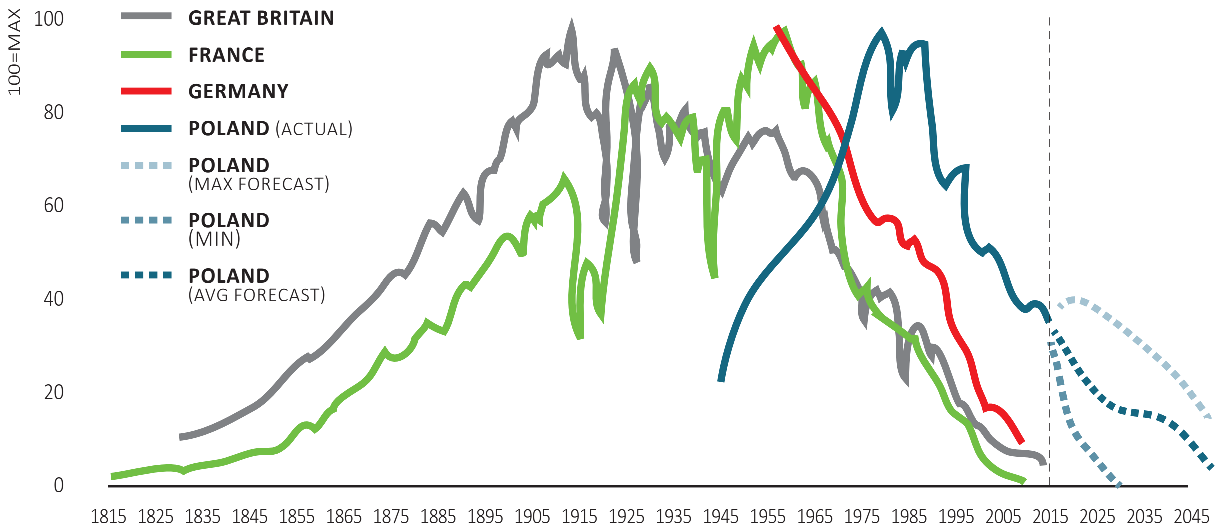


The process of withdrawal from coal use in the energy sector will cause further closures of mines, thus significantly reducing the number of people working in this industry, but also the value added for this specific sector. Moving on towards renewable energy can be perceived as a solution to switch towards more innovative, knowledge-based industry and to save jobs. The development of RES, especially in the regions that will suffer from mine closures (Silesia), should be implemented by the Polish government in order to maintain the regional balance of job supply.

Coal mining industry is in decline worldwide. Poland will likely follow the closure of mines that Western Europe has already experienced, which is illustrated by the "peak coal" concept.



Figure 14 **"PEAK COAL" – THE EXTRACTION OF COAL IN POLAND COMPARED TO WESTERN EUROPEAN COUNTRIES**
SOURCE: M. BUKOWSKI ET. AL., POLSKI WĘGIEL: QUO VADIS? PERSPEKTYWY ROZWOJU GÓRNICTWA WĘGLA KAMIENNEGO W POLSCE"



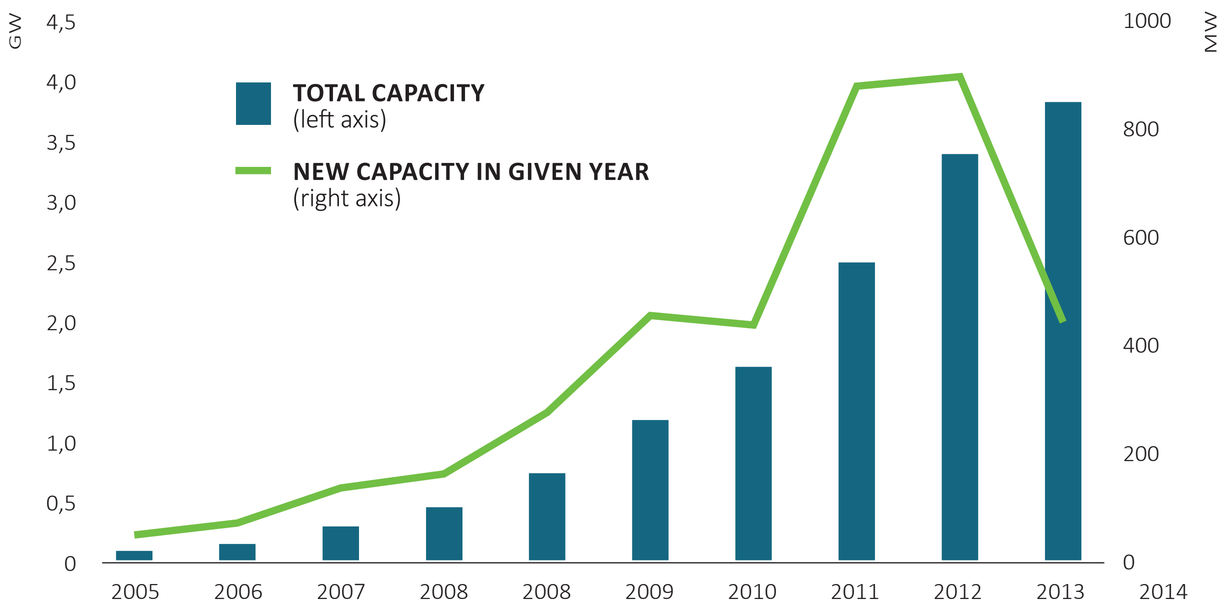
## 2.3 Employment in the onshore wind power sector

In 2015, wind turbines generated 10,041 GWh of electricity, amounting to approx. 6.22% of the domestic electricity consumption and about 6.21% of the total electricity production in Poland. Until the end of June 2016, when the recent support system was closed, further wind farms have been installed amounting currently to a 5.7 GW installed capacity.

Currently, the so-called wind farm investment act enacted by mid-July 2016 has generally stopped further project development. The purpose of the legislation was to determine places where wind power plants can be built. It sets out the minimum distance required between a wind power plant and residential buildings, protected forests or national parks. The distance is set at 10 times the height of a wind power plant (in practice approximately between 1.5 and 2 km). This requirement is very strict. It will be almost impossible to identify find plots of land which meet the statutory distance requirement. In addition, the new definition of a wind power plant will lead to an increase in the real estate tax imposed on the owners of the plants. The legislation has already significantly hampered employment in the wind industry. Although the past pace of the installed capacity in wind farms might suggest future growth, the scale of new investment will stop from 2017 on. Most of employees are needed during the development and installation process, especially when the wind sector in the country is in its primary stage of development and the amount of wind farms that need servicing is low.

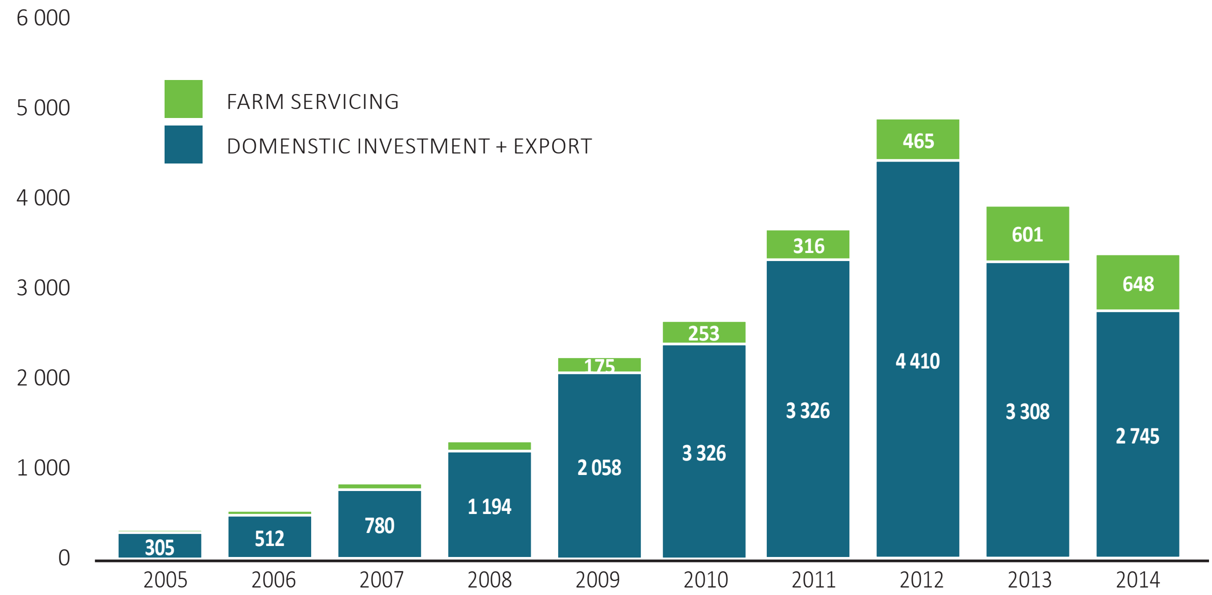


Figure 15 | **INSTALLED CAPACITY IN WIND FARMS 2005-2014**
SOURCE: M. BUKOWSKI ET. AL., "WPŁYW ENERGETYKI WIATROWEJ NA POLSKI RYNEK PRACY"




Historically, the growth of the installed capacity of wind farms and further project development provided to a significant amount of employees in this sector.

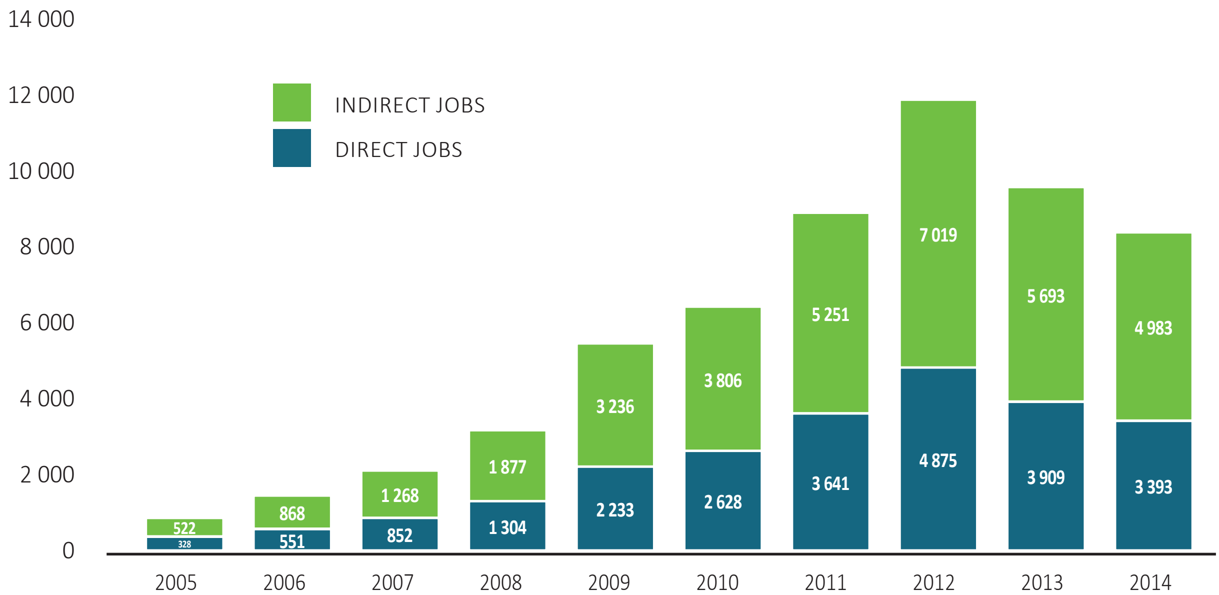
Figure 16 | **DIRECT JOBS IN ONSHORE WIND POWER INDUSTRY 2005-2014**
SOURCE: M. BUKOWSKI ET. AL., "WPŁYW ENERGETYKI WIATROWEJ NA POLSKI RYNEK PRACY"




The wind sector creates a chain of subcontractors, therefore per every job created directly in the wind farm industry, there are estimated on average 1,5 jobs in the production chain.



Figure 17 | **DIRECT AND INDIRECT JOBS IN ONSHORE WIND POWER INDUSTRY**
SOURCE: M. BUKOWSKI ET. AL., "WPŁYW ENERGETYKI WIATROWEJ NA POLSKI RYNEK PRACY"




By the end of 2016, the current jobs in the wind industry are estimated at a level of 4,500 direct and indirect jobs – with a falling tendency.

## 2.4 Employment in the biomass and biogas sector

Currently, the biomass sector is in decline after the 2013 slump of the Green Certificates price and the change of the green certificate support system, which granted so-called simple co-firing of biomass and coal only 0.5 green certificate. The use of pellets from agriculture biomass has almost completely stopped due to fuel specification which made it suitable mainly for co-firing (in proportion of 80% for agriculture and 20% for forest biomass). The dedicated biomass-fired plants still create some demand since the proportions are here invert (20% agriculture and 80%  forest biomass) and the plants are not fitted to other fuel types. The current job potential in biomass mainly exists in the wood biomass sector.

Figure 18 **DIRECT AND INDIRECT JOBS IN POLISH BIOMASS SECTOR 2011-2016**
SOURCE: D. ZYCH, ASSOCIATION POLISH BIOMASS



| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| **FOREST BIOMASS** - DIRECT JOBS | 9500 | 10500 | 10500 | 9000 | 8000 | 6600 |
| **FOREST BIOMASS** - INDIRECT JOBS | 4500 | 4500 | 4500 | 4500 | 4000 | 2500 |
| **AGRICULTURE BIOMASS** - DIRECT JOBS | 10800 | 12000 | 10500 | 10000 | 6000 | 2000 |
| **AGRICULTURE BIOMASS** - INDIRECT JOBS | 5500 | 6000 | 5500 | 5500 | 3000 | 1000 |

Furthermore, a substantial amount of jobs is created by the biofuel sector producing mainly biodiesel, and less bioethanol. However, the amount of biofuels produced has slightly decreased for the last years. The current jobs amount to approx. 3,000 of direct and indirect jobs – similar to the agriculture biomass sector.

According to the Polish Biomass Association, another few hundred people are currently employed by installing small biomass boilers, however, no statistical data is available.

Biogas plants are not very popular in Poland, with currently 100 mostly larger agricultural biogas plants installed, creating 3-4 direct jobs and 10-15 indirect jobs per each larger installation – totalling to approx. 1,500 direct and indirect jobs in this sector – according to the UPEBI Polish Biogas Union. Furthermore, other biogas installations at sewage plants and landfills currently create another 800 jobs.

So, even today biomass, biofuels and biogas are the largest employer within the RES technologies with an estimated amount of direct and indirect jobs of 18,000 employees.

## 2.5 Employment in the solar sector

Currently, the share of photovoltaics in the Polish energy sector is insignificant and the market is undeveloped. IRENA 2030 scenario assumes an annual installa¬tion rate of 1% of the total peak demand for solar PV. Poland's peak demand currently amounts to 25 GW. In 2012, the average installation size of solar PV systems amounted to 156 kW per plant. According to the PSES Polish PV Association, these utility-scale solar PV plants should have an average installed capacity of about 0.5 MW by 2030. With the current shape of the new Renewable Energy Act in Poland there will be a tendency to install mid-scale 1 MWp PV installations, associated with rooftop installations on residential buildings amounting to max. 10 kW each. However, the new support system will most likely change this picture and PV may take over the role of wind farms due to the newly implemented distance rules for wind farms, whereas PV farms do not face any planning restrictions.

According to PSES, the PV sector in Poland currently employs 6,500 people. Furthermore, solar thermal also creates approx. 500 jobs, although due to the cutback of public investment support for solar thermal, and operational support for heat in general, the sector is also underdeveloped.



## 2.6 Employment in other RES sectors

Geothermal is currently not developed, and the run-of-river and pomp-storage hydropower plants are mostly depreciated and, according to a small hydropower plants' association, generate less than 1,000 jobs.

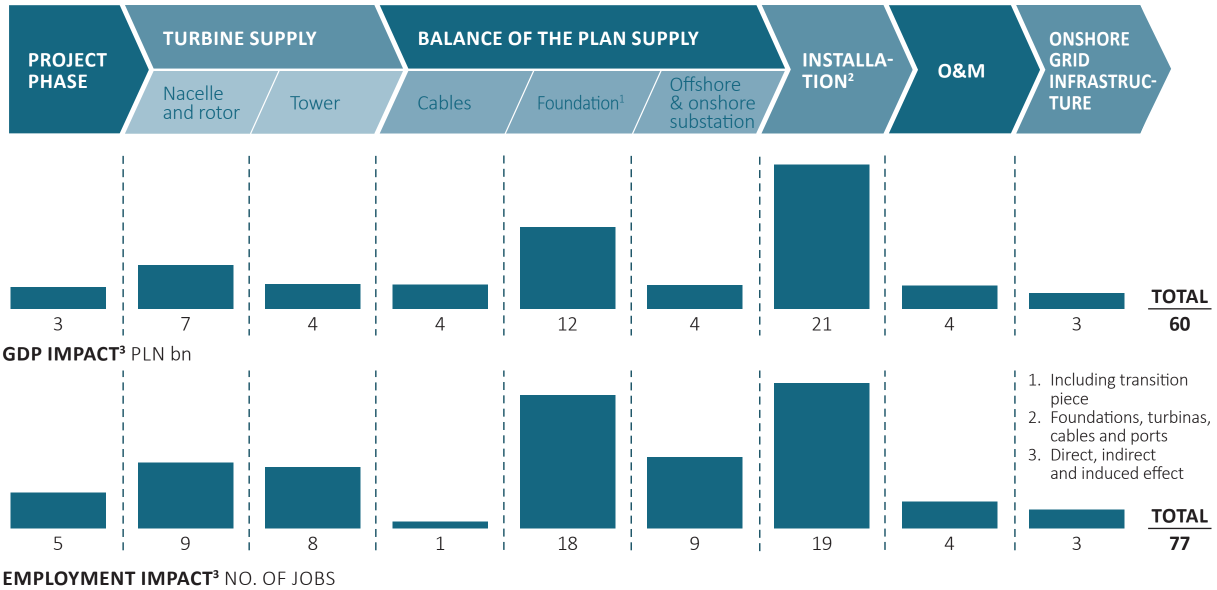
Other employees are engaged by publicly funded institutions, as consultants or in banks. This may generate another 1,000 jobs, however, this is a rough estimation as no reliable data is available.

## 2.7 RES employment outlook

Currently, the number of jobs created by renewable energy investments slightly decreases due to the lack of investments caused by regulatory uncertainty. The peak employment of both onshore wind and biomass, was observed in 2012.

The jobs directly or indirectly created by RES investments amounted in 2016 to approximately 31,000 people – however no statistical data is available-as compared to 86,000 direct jobs only with hard coal mining. However, the job potential of the RES power is huge. According to a McKinsey report published in 2016, the potential of offshore wind in Poland in case of development of 6 GW offshore wind farms totals to 77,000 employees.

Figure 19 | **JOB POTENTIAL IN POLISH OFFSHORE SECTOR 2025-2030**
SOURCE: DEVELOPING OFFSHORE WIND POWER IN POLAND, MCKINSEY & COMPANY 2016

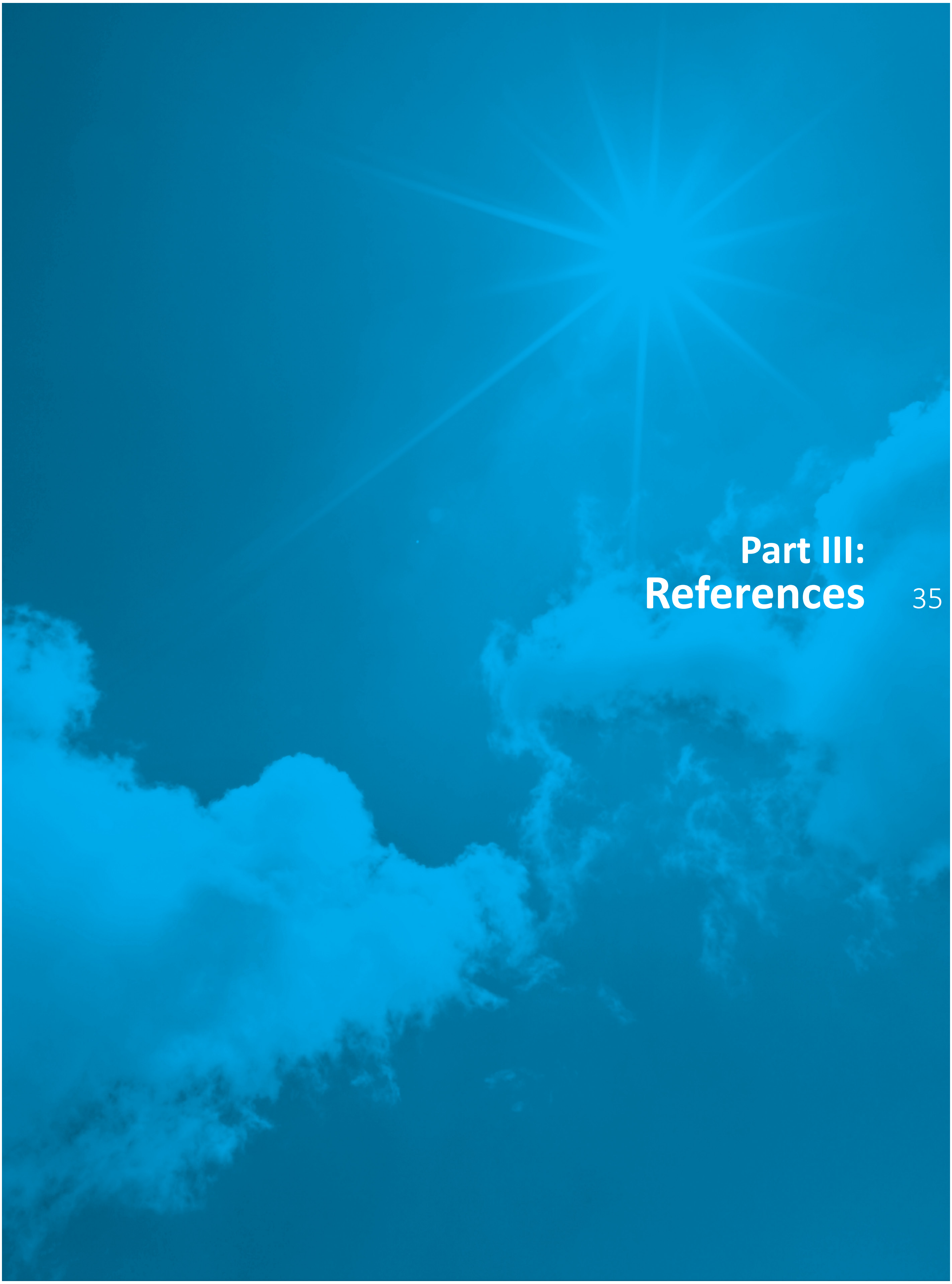



Historically figures proof furthermore, that the current 18,000 employees with the solid biomass sector can be easily doubled or tripled in case if the current heat and CHP plants in 97% fired with hard coal, will be replaced by a fleet of biomass-fired CHP plants.

In case the governments finally decides to push for the development of offshore wind farms, what is still under discussion and an appropriate grid structure is under preparation, we do not expect any further substantial extension of onshore wind farms due to potentially imbalanced RES mix, so the historic role of onshore wind creating up to 12,000 jobs will be soon taken over by the PV industry.

Consequently, offshore wind farms, biomass/biogas CHP plants and the PV prosumer-scale and the mid/large-scale may create more than 100,000 jobs in the next decade in case the government consequently implements the forth energy package after its enactment planned by 2021.

This RES job potential nets an unavoidable job decrease in the coal mining sector due to the lack of competitiveness of coal mining in Poland, and has an even further growth potential in case Polish manufactures develop technical solutions which would be competitive on international markets like a Baltic offshore hub or a European CHP biomass/biogas hub.



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