

---

# Report on the Polish power system

---

Version 1.0

---

**COUNTRY PROFILE**

---

**Agora**  
Energiewende



---

# Report on the Polish power system

---

## IMPRINT

---

### COUNTRY PROFILE

Report on the Polish power system  
Version 1.0

### WRITTEN BY

Edith Bayer  
The Regulatory Assistance Project  
50 State Street, Suite 3  
Montpelier, VT 05602  
USA

### ON BEHALF OF

Agora Energiewende  
Rosenstraße 2  
10178 Berlin  
Editing: Christoph Podewils

**029/02-CP-2014/EN**

Typesetting: Peter Pelikan  
Cover: Agora Energiewende  
Published in February 2014

---

---

# Contents

---

---

<b>1. Overview</b>	<b>7</b>
<b>2. Industry structure, ownership and regulation</b>	<b>9</b>
2.1 Industry structure	9
2.2 Ownership structure of Polish energy companies	11
2.3 Policy setting and regulation	11
2.4 Transposition of EU energy policy	12
<b>3. Energy production and consumption</b>	<b>13</b>
3.1 Installed capacity	13
3.2 Electricity production	14
3.3 Electricity consumption	15
3.4 Peak demand	15
3.5 Planned conventional power plants in the pipeline	16
<b>4. Imports and exports</b>	<b>19</b>
<b>5. Electricity market</b>	<b>23</b>
5.1 Wholesale market, prices and liquidity	23
5.1.1 Electricity market design	23
5.1.2 Market liquidity	24
5.2 The retail market	25
5.3 Allocation of grid costs	26
<b>6. Electricity balancing/reserve markets</b>	<b>27</b>
<b>7. Long-term energy policy/decarbonisation</b>	<b>29</b>
<b>8. Renewable energy</b>	<b>31</b>
<b>9. Energy efficiency</b>	<b>33</b>
<b>10. Grid infrastructure and reliability</b>	<b>35</b>
10.1 Generation adequacy standard	35
10.2 Current SAIDI	35
10.3 Smart metering	36
<b>References</b>	<b>37</b>

---



---

# Acronyms

---

CACM	Capacity Allocation and Congestion Management
CCS	Carbon Capture & Sequestration
CEE	Central Eastern Europe
CEER	Council of European Energy Regulators
CFIM	Commodity Forward Instruments Market with Physical Delivery
DSO	Distribution System Operator
EC	European Commission
EDF	Électricité de France
ENTSO-E	European Network of Transmission System Operators for Electricity
ERO	Polish Energy Regulatory Office
ESD	Effort Sharing Decision
ETS	EU Emissions Trading Scheme
EU	European Union
GHG	Greenhouse Gas
GW	Gigawatt
GWh	Gigawatt hour
HHI	Herfindahl-Hirschman Index
KW	Kilowatt
MW	Megawatt
PGE	Polska Grupa Energetyczna SA
POEE	Warsaw Stock Exchange Platform for Trading Electricity
PolPx	Polish Power Exchange
PSE	PSE Operator
SAIDI	System Average Interruption Duration Index
TSO	Transmission System Operator
TW	Terawatt
TWh	Terawatt hour
UOKiK	Urząd Ochrony Konkurencji i Konsumentów (Office of Competition and Consumer Protection)



---

# Preface

---

Dear reader,

A glance at a map reveals a simple truth: Geographically speaking, Germany lies in the heart of Europe. Knowing that annual electricity demand in Germany is the highest in Europe, its generation fleet the largest, and its power system interconnected with ten countries with a total transfer capacity of almost 17 GW, one may wonder how anyone could claim that the Energiewende is purely a national endeavour. The opposite is true: German and European energy systems are heavily intertwined. Whatever happens in Germany has effects on its neighbours and vice versa. It is widely accepted that enhancing cooperation among European partners would create positive welfare effects for all. Sharing resources and developing joint regulatory frameworks could, for instance, help achieving system reliability at lower costs and balance variable power generation across Europe.

Cooperation starts with mutual understanding. So far, the German energy debate has been focused merely on the German power system, with very little awareness of neighbouring countries. In order to enhance the knowledge basis and prepare the ground for thinking about potential cooperation, Agora Energiewende asked the Regulatory Assistance Project (RAP) to develop a set of short, standard and readable reports on the power sectors of Germany's neighbouring countries, focusing on key features, regulatory frameworks and important political developments. Originally, the country profiles were supposed to serve internal purposes only. But, as we believe this information could be valuable for others as well, we decided to publish it and make it accessible to everyone.

This country profile on Poland is the first of a series that will eventually cover twelve countries - including one on Germany. It is certainly not exhaustive. We rather consider it as work in progress that we will be reviewing on a regular basis, checking latest developments, improving the text and adding new aspects. We would thus invite everyone to send us comments and corrections that could be incorporated into the next versions to [countryprofile@agora-energiewende.de](mailto:countryprofile@agora-energiewende.de).

May this country profile be helpful for your work!

Dr. Patrick Graichen  
Executive Director of Agora Energiewende

Markus Steigenberger  
Head of European Energy Cooperation of Agora Energiewende



---

# 1. Overview

---

This report explores the structure of the Polish power sector. It looks at the fuel mix, production and consumption, ownership and market structure, cross-border trade, and energy policy.

Poland's power sector is dominated by hard coal and lignite, which in 2012 accounted for 88.6 percent of total electricity production. Nearly 55 percent of coal-fired power plants are 30 years old or older, and a significant portion of the generation fleet will need to be retired between now and 2030 in order to comply with European environmental regulations. The power market is dominated by four large, vertically integrated power companies, which are legally unbundled. The three largest generating companies in Poland account for some two thirds of production, and wholesale market concentration remains relatively high.

Poland is interconnected with its neighbours, Germany, Slovakia, the Czech Republic, Ukraine, and Sweden. Over the past decade, Poland has been a net exporter of electricity, though exports have been dropping in recent years. There is a marked difference between contracted cross-border power flows and total physical flows, primarily due to unplanned flows through Poland carrying electricity from Germany towards Austria.

Poland expects to see an increase in overall demand for electricity through 2030, combined with a trend of decommissioning old power plants. The Polish Energy Policy to 2030 foresees significant investments in coal and lignite, development of nuclear power, and some added investment in renewable energy and gas-fired capacity to meet demand in 2030. In order to reduce carbon in the electricity sector, the energy policy depends largely on construction of nuclear power and carbon capture and sequestration (CCS) for coal and natural gas. Energy efficiency is expected to play a role in slowing the growth in demand.



## 2. Industry structure, ownership and regulation

Main indicators		Table 1
Total population:	38.51 million (2011)	
GDP:	€489.8 billion	
Average electricity consumption:	2303 kWh/year per household (2009)	
Total consumption:	157 TWh	
Own research		

### 2.1 Industry structure

Poland has unbundled electric transmission from distribution. The Transmission System Operator (TSO), PSE Operator, is the owner and operator of the national transmission grid and it in turn is wholly owned by the State Treasury. There are five distribution companies which, while legally unbundled, are in fact part of large parent companies with significant generation and distribution assets, as well as a significant share of the retail market. Two companies, Energa and RWE, do not own a large amount of generation assets.

Market share of Polish electricity companies				Table 2
Sector	Leading companies	Market share	Remaining companies	
<b>Transmission</b>	PSE Operator	100%	None	
<b>Distribution<sup>1</sup></b>	Tauron Dystrybucja	36.9%	143 small DSOs (under 100,000 customers) <sup>2</sup>	
	PGE Dystrybucja	25.5%		
	Energa-Operator	16.1%		
	Enea Operator	14%		
	RWE Stoen Operator	5.8%		
<b>Generation<sup>3</sup></b>	PGE	38%	GDF SUEZ, PGNiG, Dalkia, CEZ, Fortum, RWE	
	TAURON	13%		
	EDF	10%		
	Enea <sup>4</sup>	8%		
	ZE PAK <sup>5</sup>	7%		
<b>Retail<sup>6</sup></b>	Tauron Polska Energia	36.1%	77 other active retail suppliers, total, 2012	
	PGE	24.4%		
	Energa	14.9%		
	Enea	11.5%		
	RWE	5.1%		
	Other	8%		

1 Market shares for 2011 from Energa (2013)

2 Woszczyk (2013), p. 15

3 Market shares for 2012 for PGE, Tauron, and EDF from Woszczyk (2013)

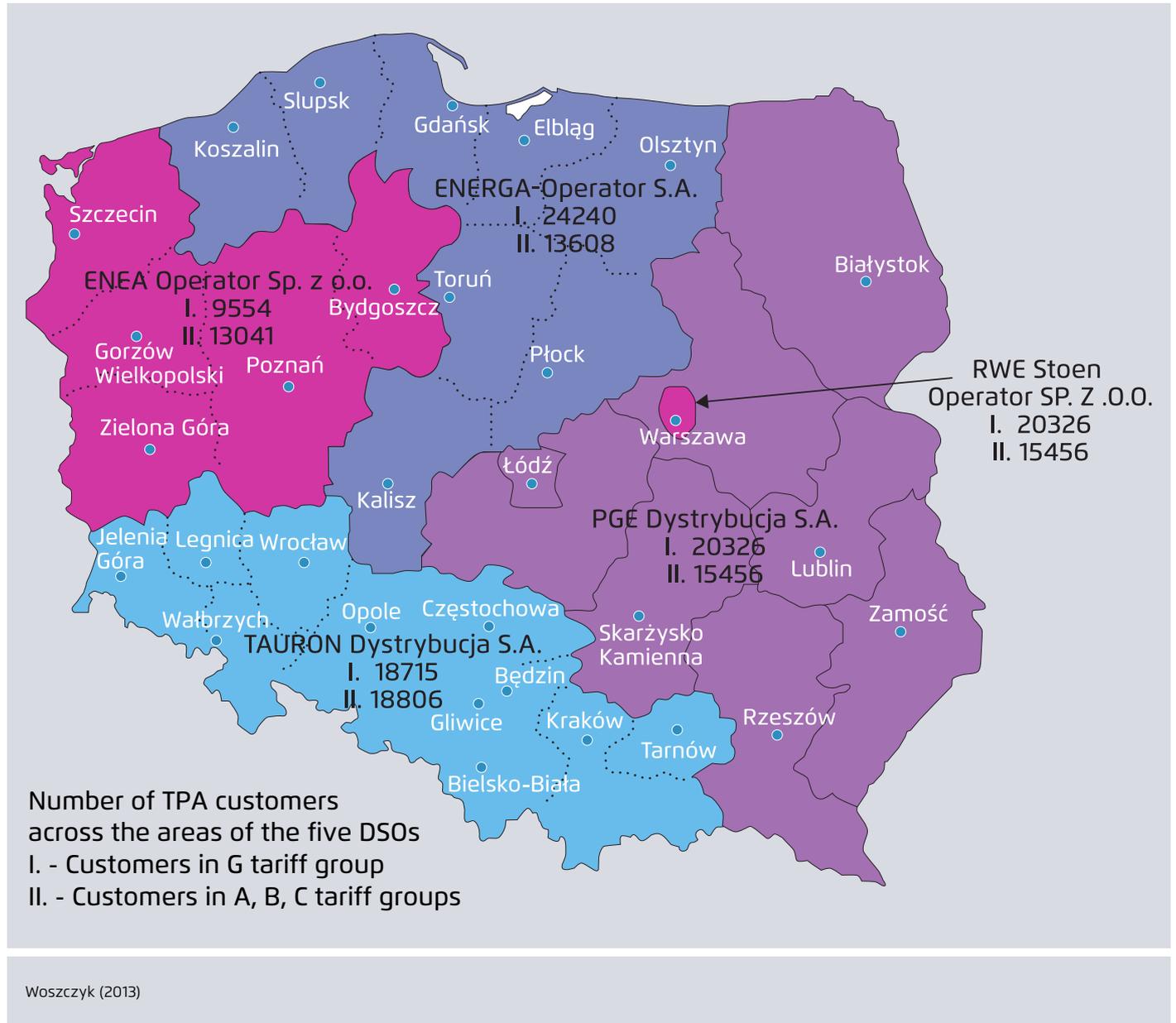
4 Enea (2013a)

5 Market shares for 2012 from PAK (2013)

6 Energa (2013)

DSOs – Geographic Service Areas

Figure 1



The consolidation of Polish power companies into four (PGE, Tauron, Energa, and Enea) vertically integrated, state-owned companies is the result of a policy adopted in 2006, the “Programme for the Electric Power Sector”. This strategic document, adopted by the Council of Ministers, laid down a path for the development of the power market in Poland. The programme called for the consolidation of energy companies

into four, vertically integrated energy groups holding generation and distribution assets, and owned by the National Treasury. Today, three out of four of the largest distribution companies remain majority owned by the State Treasury.

PGE holds the largest share of power production, followed by Tauron Polska and Électricité de France (EDF). Together,

these companies account for 61 percent of total electricity production in Poland.

In 2012, there were 82 active retail suppliers on the electricity market, though the top four suppliers accounted for 86.9 percent of the retail market. 360 entities were licensed to trade in electricity – primarily vertically integrated industrial power companies conducting sales and distribution services.<sup>7</sup>

## 2.2 Ownership structure of Polish energy companies

Most of the Polish power companies continue to be owned by the State Treasury. The Treasury wholly owns PSE Operator, the TSO, and holds a majority share in PGE, Energa, and Enea. Tauron is the only one of the four energy giants not majority owned by the Treasury, though the Treasury continues to hold a 30 percent stake in the company. RWE Polska is wholly owned by RWE.

## 2.3 Policy setting and regulation

The Polish Energy Regulatory Office (ERO) is responsible for the regulation of the electricity, gas, and heating markets. Its responsibilities are set forth in the Polish Energy Act of 1997 (“Energy Act”), which has been amended over time. The ERO is an independent agency. The President of the ERO is appointed by the Prime Minister for a term of five years. The ERO’s responsibilities include: licensing, setting tariffs, approving investment plans by regulated companies, deregulation of electricity and gas markets, and oversight over quality of supply and customer service. The ERO also oversees compliance with energy company obligations under Poland’s “coloured” certificate schemes. The ERO is in charge of issuing certificates (white certificates for energy efficiency, green for renewable energy, etc.), as well as retiring certificates to track compliance with corresponding obligations.<sup>13</sup>

The Ministry of Economy is responsible for preparing a report on the security of electricity supply every two years. The last report was prepared in 2013.<sup>14</sup> The President of

Ownership structure of Polish energy companies

Table 3

Companies	Ownership
PSE Operator	100% owned by the State Treasury.
PGE	61.9% State Treasury; 38.1% other shareholders. <sup>8</sup>
Tauron	30% State Treasury; 10% KGHM Polska Miedz; 5% ING Retirement Fund; 55% other individual and institutional investors. <sup>9</sup>
Energa	50% State Treasury; 50% remaining shareholders. <sup>10</sup>
Enea	51% State Treasury; 19% Vattenfall AB; 30% others. <sup>11</sup>
RWE	RWE Polska is wholly owned by RWE East, which in turn is wholly owned by RWE AG, which is 86% owned by institutional investors, 13% private shareholders, and 1% employees. <sup>12</sup>

7 Woszczyk (2013), p. 19

8 GK PGE (2013)

9 Tauron (2013)

10 The Initial Public Offering of Energa’s shares on the Warsaw Stock Exchange on 11 December 2013 brought the Treasury’s shares in the company down to 50 percent. Martewicz (2013)

11 Enea (2013b)

12 RWE (2012)

13 More on ERO’s responsibilities is available at <http://www.ure.gov.pl/en/about-us/presidents-duties/22,Presidents-duties.html> (English).

14 Ministry of Economy (2013)

the ERO is also obliged to prepare a report on the conditions of conducting electricity business and the monitoring of network investments, which is also required on a bi-annual basis.<sup>13</sup>

Poland's competition authority is Urząd Ochrony Konkurencji i Konsumentów (UOKiK). It is responsible for shaping antitrust and consumer protection policies, including those in the power sector. The ERO also plays a role in antitrust and competition issues. For example, it has directed cases to UOKiK relating to customer complaints of company activities related to customer switching.<sup>14</sup>

The Polish Ministry of Economy is responsible for setting energy policy in the country. The Ministry issues legislative proposals, such as amendments to the Energy Law or the Act on Energy Efficiency. The Ministry consults the ERO on energy-related policies.

## 2.4 Transposition of EU energy policy

Currently, Poland is subject to three infringement proceedings relating to the energy sector:

- In March 2013, the European Commission referred Poland to the Court of Justice for failing to transpose the Renewable Energy Directive (2009/28/EC).<sup>15</sup>
- In June 2013, the Commission issued a Reasoned Opinion for Poland to take action and ensure full compliance with its obligations under the Energy Performance of Buildings Directive (2010/31/EC).
- In September 2013, the European Commission issued a Reasoned Opinion asking Poland to transpose the EU ETS Directive (2009/29/EC) into national law.<sup>16</sup>

In August 2013, the Polish Government adopted a legislative package introducing changes to the Energy Act relating

to regulation of the electricity and natural gas sectors, and renewable energy.<sup>17</sup> The legislation brought Poland into compliance with the Third Energy Package, but not with the Renewable Energy Directive.<sup>18</sup> Poland has not yet complied with its obligations under the Energy Performance of Buildings Directive.

---

13 Article 23.2a of the Polish Energy Act

14 Woszczyk (2013)

15 European Commission (2013a)

16 European Commission (2013b)

---

17 The package is referred to as the "Three-pack" as it amends legislation relating to electricity, natural gas, and renewable energy. The text of the legislation is available in Polish at <http://isap.sejm.gov.pl/DetailsServlet?id=WDU20130000984>.

18 Euroinfrastructure.eu (2013)

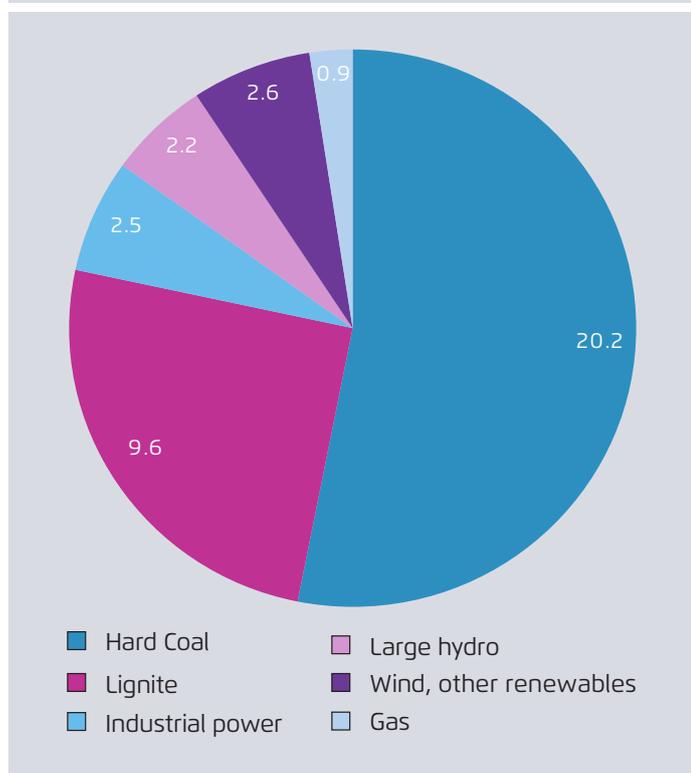
### 3. Energy production and consumption

Main indicators	Table 4
Installed Capacity:	38 GW (2012)
Peak Demand:	29,287 MW (Jan 2012)
Energy Consumption:	157,013 GWh (2012)

#### 3.1 Installed capacity

Poland has a little more than 38 GW of installed capacity. The power mix is dominated by hard coal and lignite, which account for 88.6 percent of total electricity production. Combined heat and power plays a significant role in the Polish power sector. In 2011, 16.6 percent of total electric genera-

Polish power mix, installed capacity in GW (Total of 38.03 GW), 2012 Figure 2

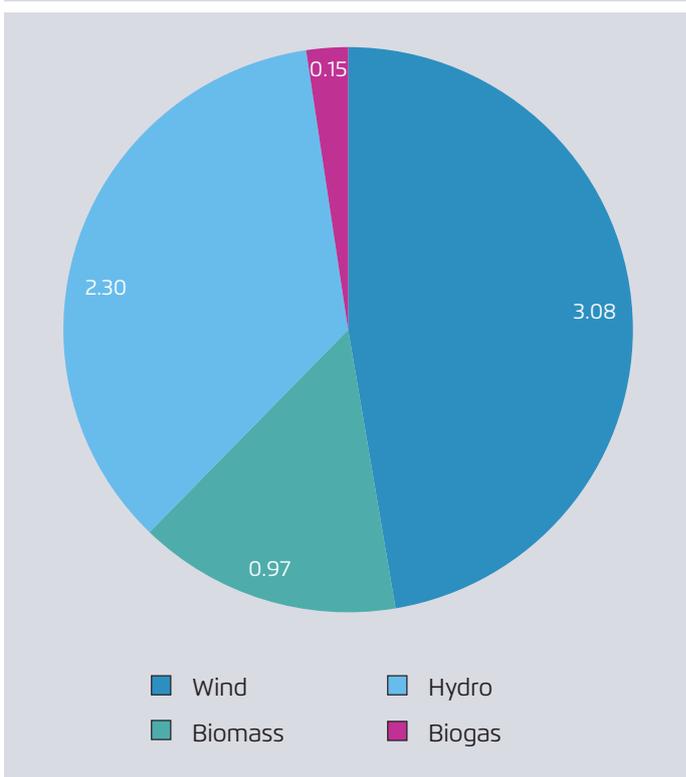


PSE (2013)

tion in Poland was combined heat and power production.<sup>19</sup>

At the end of 2012, renewable energy accounted for about 4.8 GW of the installed capacity, including 1,330 MW of pumped hydro. In 2013, the share of renewable energy increased due to the addition of significant wind resources to the mix. Figure 3 shows the mix of renewable sources in September 2013.<sup>20</sup>

Installed renewable capacity in GW (Total of 6.5 GW), 2013 Figure 3



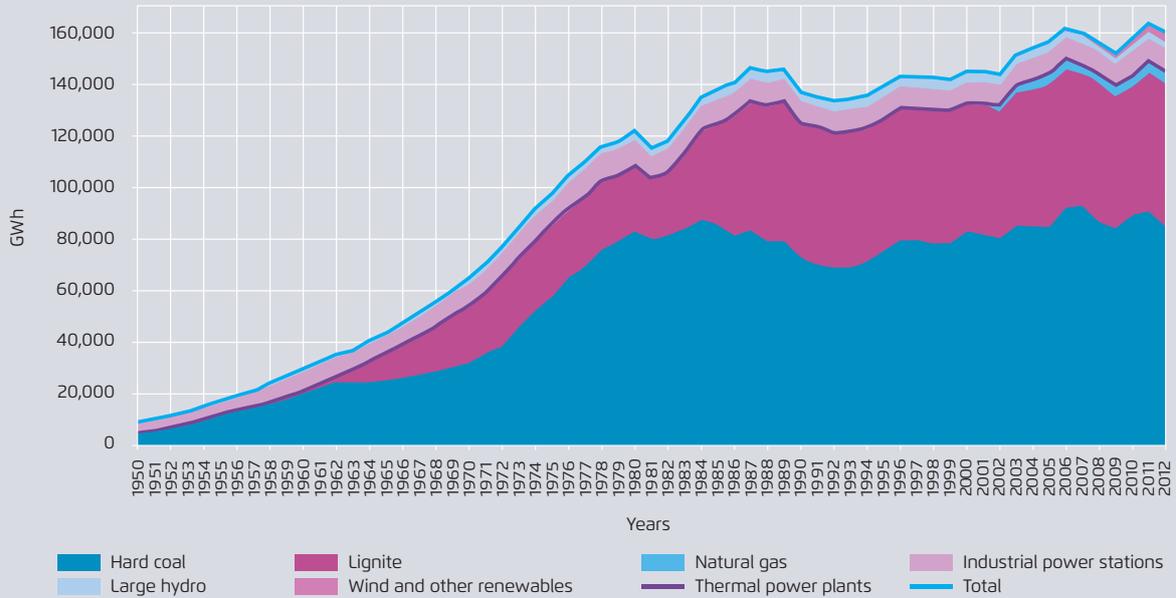
Energy Regulatory Office (2013a) and PSE (2013)

<sup>19</sup> Eurostat (2013a)

<sup>20</sup> Note that biomass in this graph counts only biomass-fired facilities, and does not account for co-firing.

Electricity production by energy source, 1950–2012 (in GWh)

Figure 4



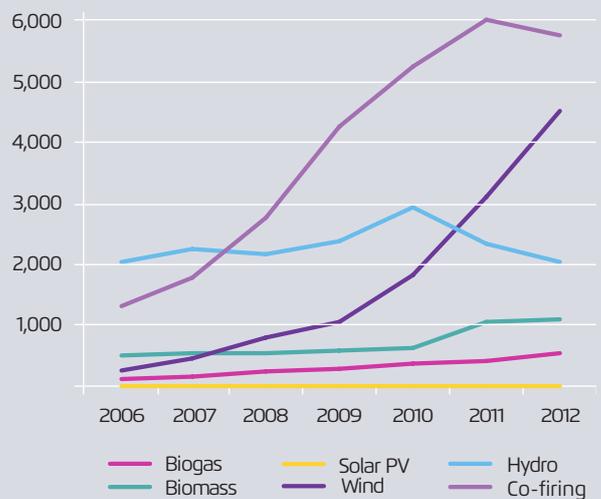
PSE (2013)

### 3.2 Electricity production

In 2012, national gross electricity production was 159,853 GWh. This was 2 percent smaller than in the previous year, due to the economic downturn.<sup>21</sup> Renewable electricity production has increased significantly since 2008, primarily due to increases in wind power and co-firing. While co-firing is difficult to take into account when calculating installed capacity, energy production from co-firing can be tracked by Poland's green certificates scheme. In 2012, renewable energy production, including co-firing, accounted for about 8.7 percent of total energy production. Co-firing accounted for about 41 percent, and wind accounted for about 32 percent.<sup>22</sup>

Renewable energy production, 2006–2012 (in GWh)

Figure 5



Polish Wind Energy Association (2013). Note that the data are based on renewable energy certificates issued as of 23 April 2013.

<sup>21</sup> Woszczyk (2013), p. 12

<sup>22</sup> Polish Wind Energy Association (2013) and PSE (2013)

### 3.3 Electricity consumption

Electricity consumption in 2012 was 157,013 GWh. This was 0.6 percent smaller than 2011. The drop is attributable in part to increased end-use energy efficiency. According to the Polish Ministry of Economy, electricity consumption is expected to rise to just under 167,600 GWh by 2030.<sup>23</sup>

### 3.4 Peak demand

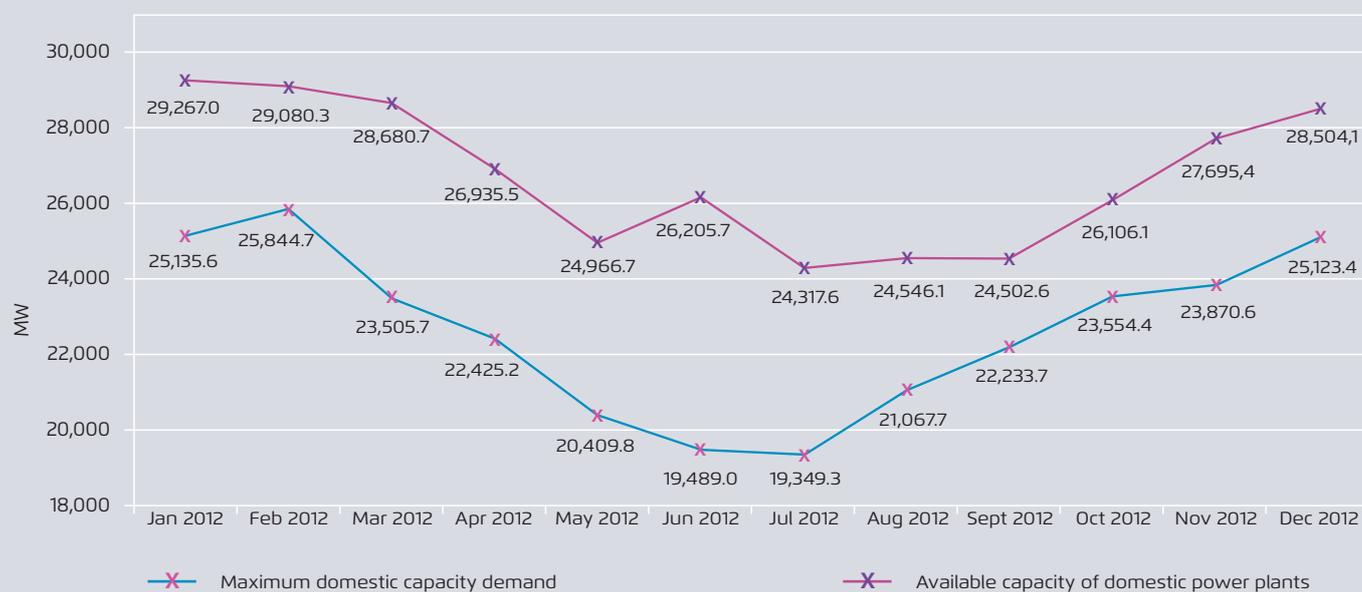
In Poland, peak demand occurs in the winter early evening hours. The annual peak in 2012 occurred on 7 February at approximately 17:30. The lowest level of demand occurred on 17 June at 22:00.<sup>24</sup> It is important to note that while the

peak demand occurs in winter, the lowest level of reserves occurs in summer – 4 percent in 2012. (The Transmission Grid Code requires an operational reserve of 9 percent, which was met or exceeded in 2012 for all but four weeks of the year.)<sup>25</sup> This is due to the fact that less capacity is available in summer as some combined heat and power plants close when the heating season is over.

Figure 6 shows available capacity of domestic power plants during evening peaks, alongside peak demand, in 2012. The low level of reserves experienced in June 2012 is not reflected, as it occurred during the morning hours.

Available capacity of domestic power plants and the peak demand at the evening peak, 2012 average values on working days in a month (in MWs)

Figure 6



Woszczyk (2013)

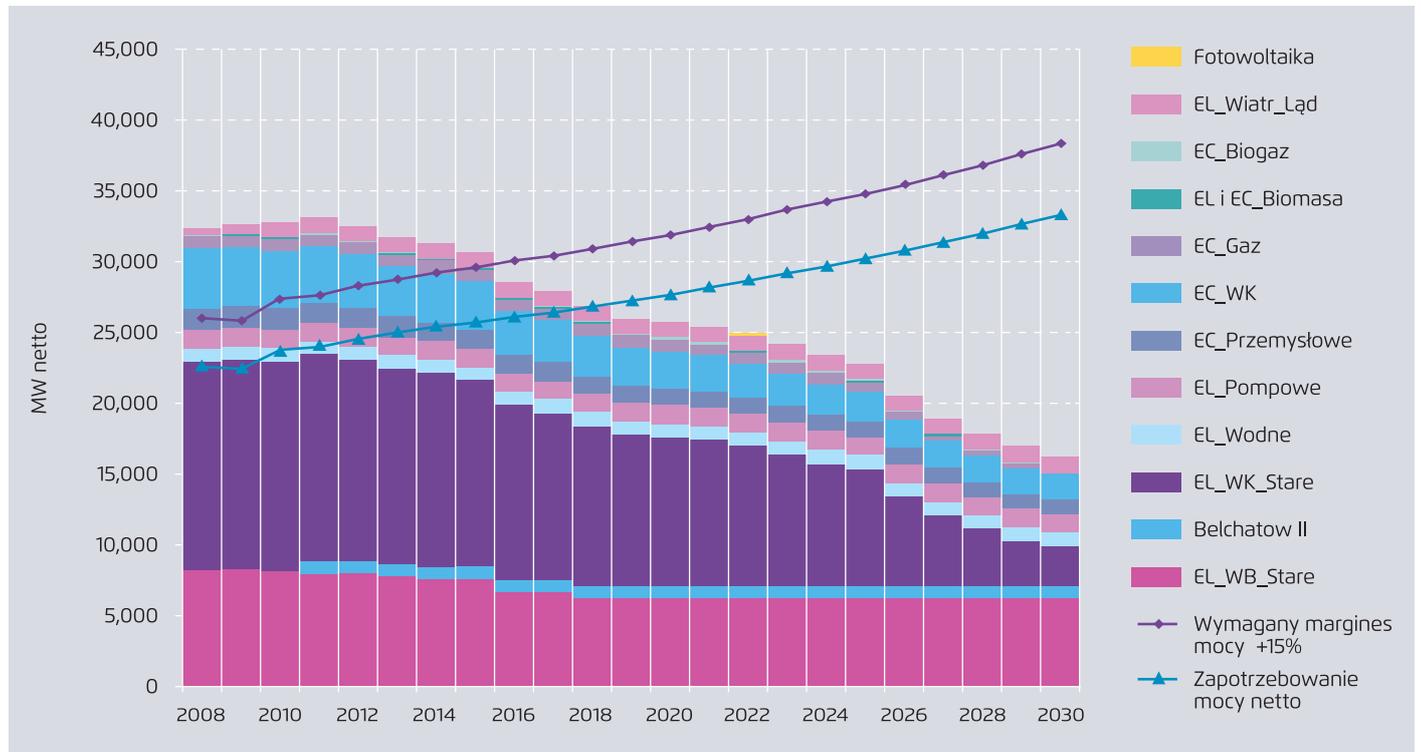
<sup>23</sup> Energy Regulatory Office (2011), p. 30

<sup>24</sup> PSE (2013)

<sup>25</sup> Woszczyk (2013), p. 38

Anticipated increase in demand, 2008–2030

Figure 7



Ministry of Economy (2011), p. 18

### 3.5 Planned conventional power plants in the pipeline

Poland has a number of planned conventional power plants in the pipeline. In order to put these plans in context, it is useful to first consider the broader resource context in Poland. Between now and 2030, Poland is expected to decommission 12.26 GW of generation capacity. 4.4 GW of capacity are expected to decommission between 2014 and 2017.<sup>26</sup>

Figure 7 demonstrates the anticipated increase in demand between 2008 and 2030 and the reduction in available capacity as existing capacity is retired. The top line represents

total power demand, plus a 15 percent capacity margin.<sup>27</sup> The red line below that represents actual projected demand.

According to the Polish Energy Policy for 2030, the gap in available capacity is expected to be met with a combination of lignite, hard coal, and nuclear power, as well as some increase in natural gas and renewable generation. At the same time, there is significant uncertainty as to how the fuel mix will in fact develop, given the timeframe and level of investment needed.

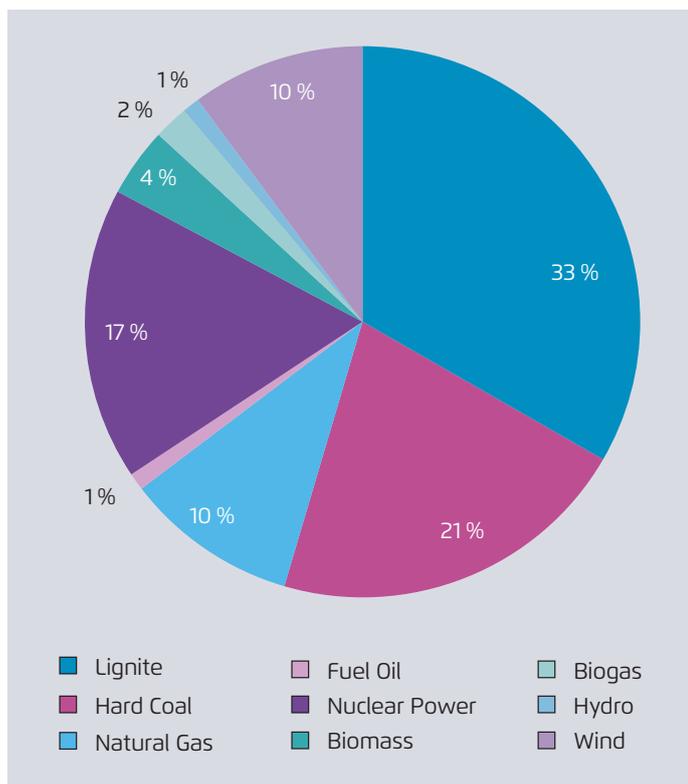
Figure 8 shows the expected share of various fuels in elec-

<sup>26</sup> Easton (2013)

<sup>27</sup> It is worth noting that the 15 percent capacity margin is higher than the current operational reserve of 9 percent mandated by the Transmission Grid Code.

Fuel mix in electricity production – forecast for 2030 (193,2 TWh)

Figure 8



Ministry of Economy (2011) Table 3.7

tricity production in 2030 as set forth in the Polish Energy Strategy to 2030.<sup>28</sup> It is worth noting that in a higher carbon-price scenario, the Strategy foresees a greater share of demand to be met by natural gas (35 percent greater than in the baseline scenario) and biomass, with a 15 percent decrease in the share of hard coal in the fuel mix.

Currently a number of gas- and coal- fired power plants are being planned, though the dates for starting operations remain uncertain. Table 5 lists the conventional power plants that are being planned, their net capacity, fuel and current status.

<sup>28</sup> Ministry of Economy (2011) p 44

Planned conventional power plants

Table 5

Company / name	Net capacity	Fuel	Status
PGE, Turów	430 MW	Lignite	Tendered
PGE, Opole	1,800 MW	Hard coal	After tender
Tauron, Jaworzno	910 MW	Hard coal	Tendered
Enea, Koźienice	900 MW	Hard coal	After tender
Zakłady Azotowe Puławy SA Melamina III	840 MW	Gas CCGT	Announced / planning begun
Polski Koncern Naftowy Orlen SA Włocławek	470 MW	Gas CCGT	Financing secured/under construction
Elektrownia Blachowina Nowa Sp zoo	808 MW	Gas CCGT	Announced / planning begun
Elektrownia Północ SP Zoo	2,000 MW	Coal	Announced / planning begun
Energa Invest SA Progaz Gas Power Plant	1,000 MW	Gas CCGT	Announced/ planning begun
Energa Invest SA Progaz CHP Gas Power Plant	200 MW	Gas CCGT	Announced/ planning begun
Fortum Power and Heat Polska Wrocław CHP Gas Power Plant	400 MW	Gas CCGT	Announced/ planning begun

Bloomberg New Energy Finance and own analysis

## 4. Imports and exports

Poland is interconnected with its neighbours Germany, Slovakia, the Czech Republic, Ukraine, and Sweden. For purposes of this paper, we focus on interconnections only with EU Member States, thereby omitting Ukraine from the analysis. Poland is a net exporter of electricity, though the ratio of exports to imports has been declining, and in fact Poland faces a potential capacity shortage by 2016 as not enough new capacity is expected to come online to make up for capacity reductions.<sup>29</sup> The surplus of exports over imports amounted to 3,606 GWh in 2012, which was lower than in 2011 (5,309 GWh). Most Polish exports flow to Slovakia and the Czech Republic, while most imports come from Germany.

Transmission capacity between Poland, Germany, the Czech Republic, and Slovakia is allocated via coordinated explicit auctions between the transmission system operators in the Central Eastern Europe (CEE) region. Auctions are organized and conducted by the Central Allocation Office in Freising/Germany. Trading along the Polish–Swedish interconnector – SwePol Link – is carried out through a market coupling mechanism. Transactions are carried out through the power exchanges (POLPX and Nord Pool Spot) on a day-

ahead basis.<sup>30</sup> In July 2013, Poland signed a Memorandum of Understanding to join with Romania in the integrated day-ahead electricity markets of the Czech Republic, Slovakia, and Hungary.<sup>31</sup>

Import/export balance, 2002–2012 (in GWh, physical flows)

Figure 9



Import/export balances (exports–imports) (in GWh, physical flows)

Table 6

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CZ	8,094	9,426	9,071	11,090	9,985	9,197	6,840	7,095	5,354	8,197	8,754
SK	2,294	2,728	2,623	2,792	3,373	3,600	2,551	2,337	1,499	3,052	3,498
SE	-929	2,635	2,164	365	1,227	-1,980	-1,920	-1,139	-266	-1,236	-2,618
DE	-1,266	-2,479	-2,754	-1,218	-1,826	-4,841	-5,481	-5,482	-5,164	-4,704	-6,028
<b>Total</b>	<b>8,193</b>	<b>12,310</b>	<b>11,104</b>	<b>13,029</b>	<b>12,759</b>	<b>5,976</b>	<b>1,990</b>	<b>2,811</b>	<b>1,423</b>	<b>5,309</b>	<b>3,606</b>

Eurostat (2013c) and Eurostat (2013d)

<sup>29</sup> 4.4 GW of capacity are planned to be decommissioned between 2014 and 2017, and 12.26 GW of capacity are expected to decommission by 2030. Sections 7. and 10. of this report address the capacity shortage and planned additions to the power system in more detail.

<sup>30</sup> Woszczyk (2012), p. 22

<sup>31</sup> CEPS (2013)

It is important to note that the import/export balances recorded for Poland reflect physical flows. There is a marked difference between the volume of physical flows and contractual imports/exports, particularly between Poland and Germany. In 2011, for example, gross contracts for imports amounted to 1,984 GWh, while physical cross-border flows into Poland were 6,779 GWh. Similarly, 7,234 GWh of energy were contracted for export, while electricity dispatched from Poland amounted to 12,023 GWh.<sup>32</sup>

Poland, in common with other countries in the CEE region, experiences physical energy flows that often differ markedly from those expected from commercial activities.<sup>33</sup> These unplanned or “loop flows” are principally associated with energy transactions within the common German-Austrian bidding zone and tend to flow from Germany through Poland, the Czech Republic, and Slovakia into Austria and Hungary and partly back to Germany. The impact of these loop flows can be to add to or cause network congestion in the transit countries, incurring re-dispatch costs and reducing available interconnection capacity. In extremis, loop flows can cause transit systems to become insecure due to the possibility of post-fault or even pre-fault circuit overloading.

In January 2013, the regulators from Poland, the Czech Republic, Slovakia, and Hungary undertook a study to assess the scope of unplanned power flows in the CEE region, and the effect of these flows on power systems.<sup>34</sup> Scheduled commercial flows between Germany and Austria represent about 28 percent of all exchanges within the CEE region. Poland and the Czech Republic were identified as the countries most affected by the unplanned flows. It was found that, during the three-year period analysed, Poland experienced permanent unplanned flows in the range of 500–1500 MW in the opposite direction to those expected from commercial

transactions and that there was a high correlation between those unplanned flows and realised transactions within the German-Austrian bidding zone. The study concluded that the solution to the loop flow problem was the coordination of all cross border transactions via the introduction of market coupling and flow-based capacity allocation methodology, stressing the need for all significant constraint boundaries to be included in the process.

The market coupling and flow-based capacity allocation methodology to be implemented as part of the market integration process is defined by the Capacity Allocation and Congestion Management (CACM) Code.<sup>35</sup> The Code is currently progressing through the Comitology procedure, following a recommendation by ACER to adopt the Code.<sup>36</sup> The Code recommends that bidding zones be defined so as to support congestion management and market efficiency, and it might therefore be implied that bidding zones should be defined by congestion rather than national boundaries. However, the Code is not explicit on this point and the question of what might constitute the most efficient means of managing congestion, market splitting or coordinated re-dispatch, is left open.

As an interim measure, PSE, and 50 Hertz, signed a “virtual phase shifter” agreement in December 2012 to carry out a trial generation re-dispatch program to investigate the possibility of managing loop flows in a more coordinated and cost effective fashion, prior to the installation of actual phase shifting transformers by 2016.

<sup>32</sup> Woszczyk (2013), p. 33

<sup>33</sup> The CEE region is one of seven regions created for purposes of transmission planning and European electricity market integration. The CEE region is made up of Austria, Czech Republic, Germany, Hungary, Poland, Slovakia and Slovenia, and is led by Austrian regulatory authority E-Control. See CEPS et al. (2013), p. 2.

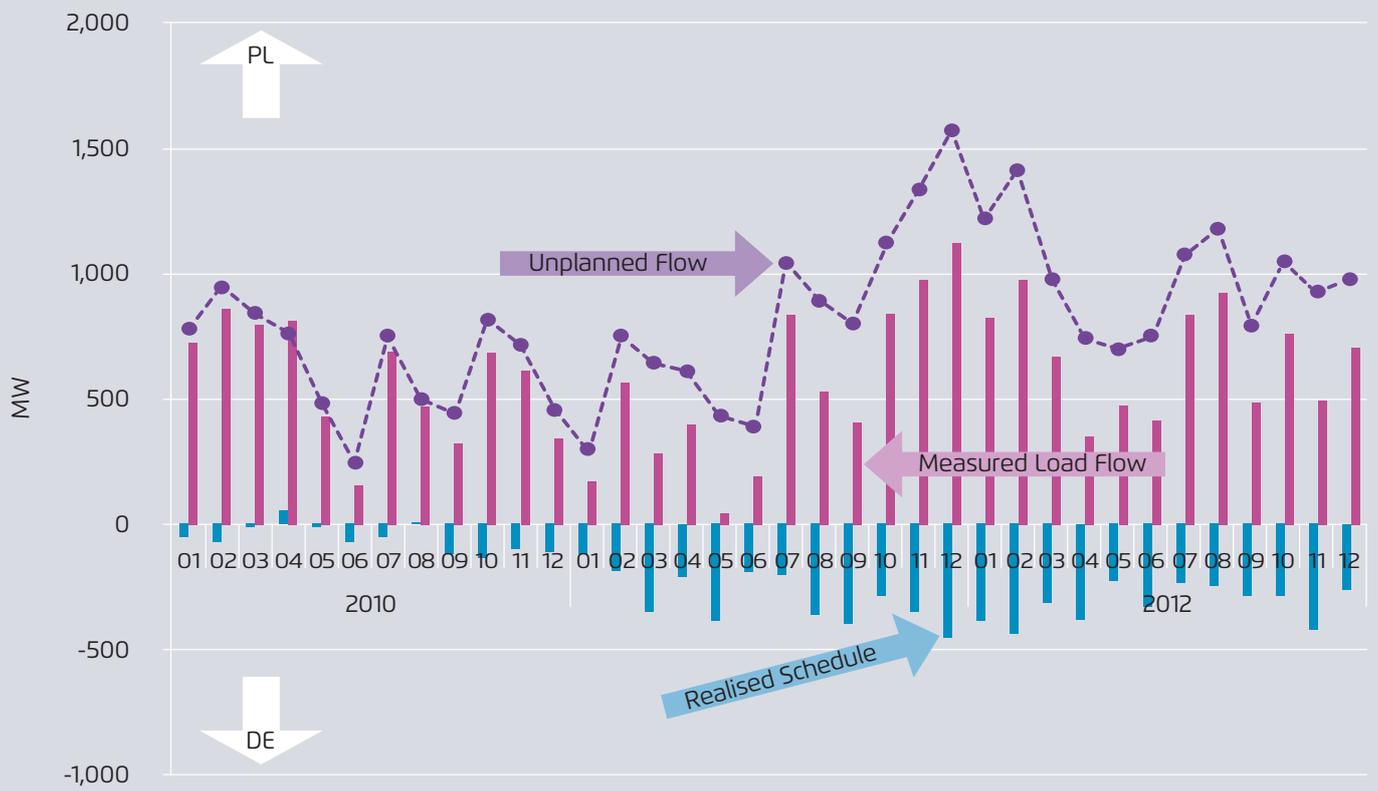
<sup>34</sup> CEPS, MAVIR, PSE, and SEPS (2013)

<sup>35</sup> ENTSO-E (2012)

<sup>36</sup> ENTSO-E (2013b)

Realised schedules, measured load flows and unplanned flows on the DE-PL border

Figure 10



CEPS et al. (2013)



## 5. Electricity market

### 5.1 Wholesale market, prices and liquidity

#### 5.1.1 Electricity market design

The structure of the Polish wholesale electricity market follows the typical West-European model in that energy can be traded on a bilateral basis using "over the counter" standard contracts, via the PolPX power exchange, and also in the balancing market operated by the TSO, PSE Operator. A small portion of electricity is also traded on the Warsaw Stock Exchange Platform for Trading Electricity (POEE). In 2012, trades on the POEE accounted for about 4.7 percent of total electricity consumption.

PolPX operate four markets, which together in 2012 accounted for over 84.1 percent of total electricity consumption in Poland.

Polish electricity markets (2012)		Table 7
Market	Volume traded	
Commodity Forward Instruments Market with physical delivery (CFIM) <sup>37</sup>	112.874 TWh, nearly 72% of all electricity consumption	
Day-ahead market	19.104 TWh, over 12% of all electricity consumption	
Intra-day market	0.019 TWh	
Electricity auctions	1.267 TWh	

Woszczyk (2013)

Energy trading takes place on an unconstrained basis, with network congestion managed by redispatch via the balancing market. However, the Ministry of Economy has been investigating the introduction of a nodal pricing model at

<sup>37</sup> Forwards derivatives market introduced in 2008

some point in the future, which would effectively include the costs of resolving congestion in wholesale energy prices.<sup>38</sup>

Energy trading via the PolPX power exchange has seen significant growth in recent years at the expense of both bilateral and "internal" trading. This growth has been driven primarily by the introduction in 2010 of the "exchange obligation," a requirement that electricity generators sell at least 15 percent of power generated through a power exchange. Companies entitled to receive funds for covering stranded costs in connection with the early termination of long-term power and electricity contracts must offer 100 percent of their electricity production on the power exchange.<sup>39</sup> The share of companies obligated to offer 100 percent of their electricity on the power exchange is significant. In 2005, when the European Commission opened an investigation into the issue of long-term purchase power agreements in Poland, around 40 percent of generation was covered by long-term agreements.<sup>40</sup>

Wholesale energy trading by market (%)					Table 8
	Approximate percentage of total energy trade by volume				
	2009	2010	2011	2012	
Bilateral	90+	90	33	30	
Power Exchange	0.2	4	59	62	

Woszczyk (2013) and Woszczyk (2012)

Figure 11 reflects base and peak prices on the electricity spot market for 2012–2013.

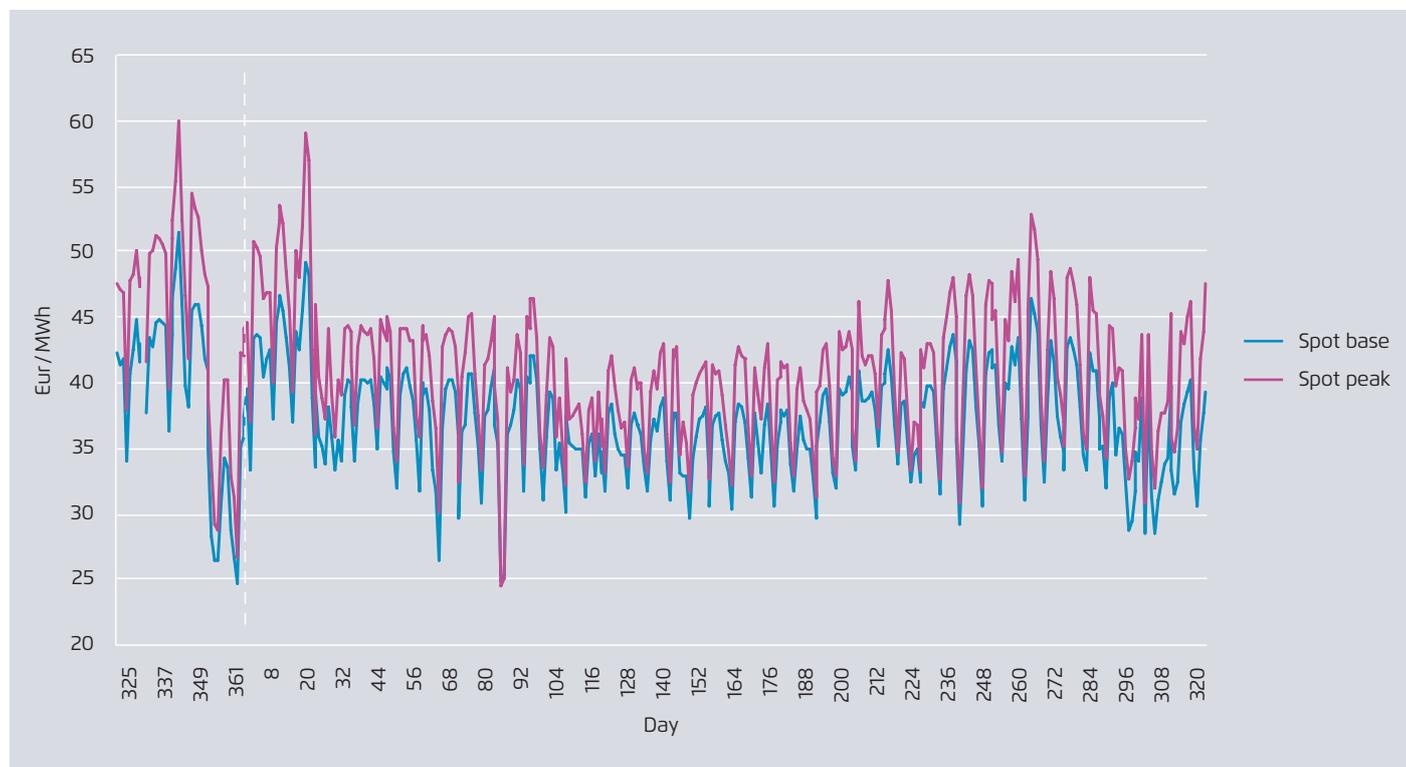
<sup>38</sup> Sikorski (2011)

<sup>39</sup> Woszczyk (2013), p. 12

<sup>40</sup> European Commission (2013c)

PolPX 2013 day-ahead market average daily prices (Eur/MWh)

Figure 11



Polish Power Exchange (2013)

### 5.1.2 Market liquidity

Wholesale market concentration in Poland remains relatively high, with the three largest generating companies accounting for some two thirds of production. In 2011, the wholesale market Herfindahl-Hirschman Index (HHI)<sup>41</sup> was measured at 1,835, on the borderline between a moderately

and highly concentrated market.<sup>42</sup> The Energy Regulatory Office reported that the HHI index (measured on the basis of energy production) fell slightly in 2012.<sup>43</sup> With the (partially mandated) transfer of energy trading from the bilateral and over the counter market, liquidity on the PolPX power exchange has increased significantly in recent years.

41 The Herfindahl-Hirschman Index (HHI) is defined as the sum of the squares of the percentage market share of each market participant. The Index can range in value from 0 to 10,000, the higher the index the more concentrated the market. A market with an HHI of less than 1000 is generally considered competitive, a market with an HHI in the range 1000–1800 would be considered as moderately concentrated, while a market with an index above 1800 would be considered highly concentrated.

42 European Commission (2012)

43 Woszczyk (2013)

Electricity consumption and prices by customer size

Table 9

Consumer groups by consumption volume	Total number of consumers	Consumption volume (MWh)	Value (PLN <sup>44</sup> )	Average price (PLN/MWh)
<50 MWh	16,573,911	46,916,504	13,765,431	293.40
50–2000 MWh	38,475	28,871,075	7,935,722	274.87
>2000 MWh	1,031	30,893,745	7,779,297	251.81
Total	16,613,417	106,681,324	29,480,450	

Woszczyk (2013)

## 5.2 The retail market

In 2012, there were 16.7 million total consumers in Poland, 90 percent of whom were households. 24 percent of total electricity supply went to household consumers.<sup>45</sup> Residential and other small end-users consuming under 50 MWh per year accounted for 44 percent of total consumption. Those consuming between 50–2000 MWh per year accounted for 27 percent of consumption, and large consumers (over 2,000 MWh per year) accounted for 29 percent of consumption.

Retail market concentration in Poland is high, with the three largest companies, Tauron, PGE, and Energa, holding a total market share of around 70 percent. The retail market had a HHI of 2000 in 2010.<sup>46</sup>

Since 2007, all customer classes in Poland have had the right to switch their supplier. While the number of customers switching supplier is increasing, the switching rate remains extremely low (0.86 percent in 2012).<sup>47</sup> The switching rate is lowest for residential customers, despite significant growth over the past year. It is worth noting that tariffs for residen-

tial customers that have not switched from their “incumbent” supplier continue to be subject to approval by the ERO; therefore, the majority of residential customers continue to have regulated rates.<sup>48</sup>

From January 1, 2014, electricity distributors and retailers will be required to offer small customers a bundled rate that includes the generation and distribution charge on one bill. This is expected to facilitate customer switching by simplifying the process for customers.<sup>49</sup>

Electricity prices for household and industrial consumers in Poland fall within the median range of prices in Europe.<sup>50</sup>

44 PLN is the acronym for the Polish złoty, the national currency of Poland.

45 Woszczyk (2013)

46 European Commission (2013d)

47 Woszczyk (2013)

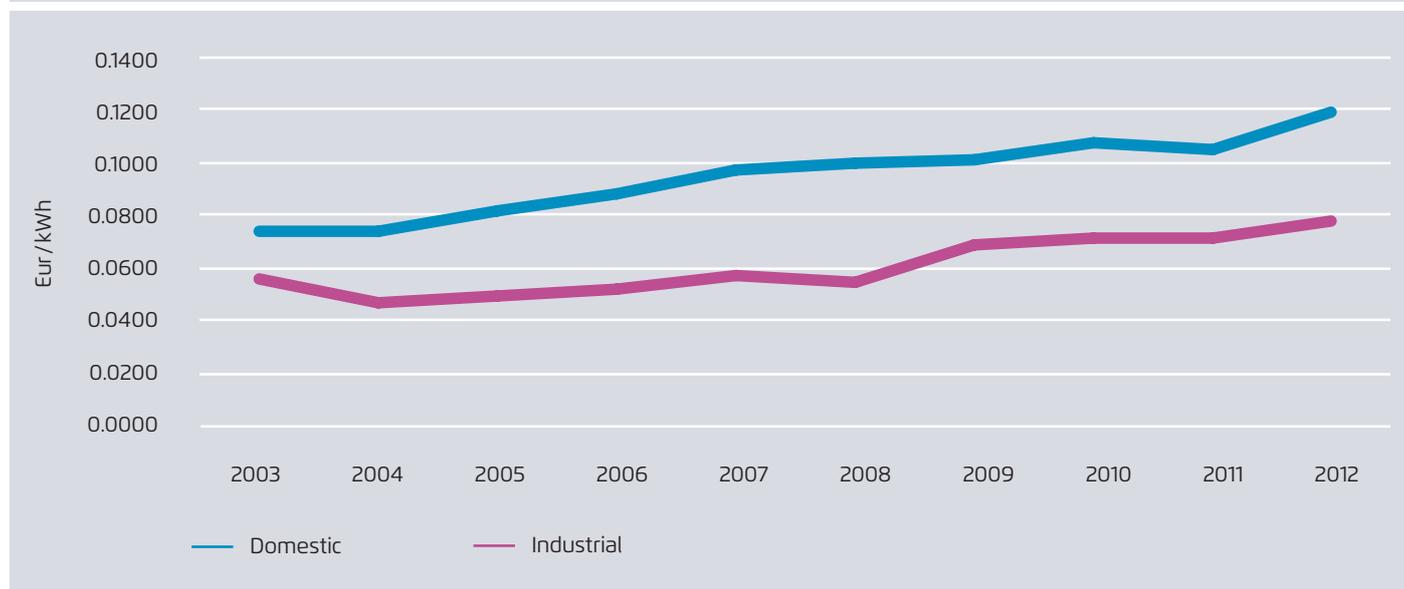
48 Woszczyk (2013), p. 30

49 Energy Regulatory Office (2013b)

50 Eurostat (2013f)

Electricity prices (Euro/kWh, excluding taxes)

Figure 12



Eurostat (2013f)

### 5.3 Allocation of grid costs

Transmission charges are applied on a uniform or “postage stamp”<sup>51</sup> basis within Poland and are paid almost entirely by load (versus some EU member states such as the UK where part of the cost of transmission is paid by generators). In addition to recovering operational costs, depreciation, and return on capital invested, transmission charges cover net balancing costs, the costs of providing ancillary services, internal congestion costs, and the costs of transmission losses.<sup>52</sup> Certain non-TSO costs are also included, for example a transition charge to cover the stranded costs of the early termination of long-term energy sales contracts. Recovery is split 57 percent/43 percent in terms of capacity and energy usage respectively.

Customers connecting to the network are responsible for the costs of the connection but not for grid reinforcement. All wider or shared network costs associated with the connection are socialised through transmission charges. For a typical connection, final customers pay 25 percent of the cost of connecting, renewable and co-generation units with an installed capacity of 5 MW or less pay 50 percent, and generators and distribution companies pay 100 percent.<sup>53</sup>

51 Under “postage stamp” rates, “[e]very transmission customer pays a single rate for any transmission transaction within a defined region, regardless of the contractual origin and contractual destination of the electricity transmitted.” See Hempling (2009).

52 ENTSO-E (2013c)

53 ENTSO-E (2013c)

## 6. Electricity balancing/reserve markets

As is the case in the majority of Member States, the energy balancing arrangements in Poland consist of three main elements: programme responsibility, the single-buyer market for balancing energy operated by the TSO following market closure, and the imbalance settlement process. Balancing market participants can either be active (larger generators equipped with appropriate control and communication systems) or passive (smaller generators and all loads). All participants are required to submit forecast energy volumes at the day ahead stage, with active participants also offering balancing energy bids and offers at this stage. However, with the introduction of intra-day trading, energy volumes can now be adjusted prior to market gate closure, two hours before real time.<sup>54</sup> In the case of renewable technologies, such as wind, forecasts of energy volumes can be modified up to one hour ahead of real time.

Accepted balancing offers and bids are remunerated on a "pay as bid" basis, while imbalances are settled via a marginal

dual-price mechanism: participants who are long with respect to their declared contractual position are paid at the system sell price, and participants who are short are required to buy balancing energy at the system buy price.

There is little opportunity for imbalances to be aggregated, other than for participants connected at the same connection point. This does, however, favour smaller distribution-connected participants.

Primary and secondary reserves (referred to as "second" and "minute" reserves respectively) are procured on an annual basis via bilateral agreements. Tertiary or hourly reserves are predominately purchased via the day ahead balancing market. Remuneration for contracted second and minute reserves is via an enabling payment when the service is activated and a utilisation payment for energy. The technical requirements of second, minute and tertiary or hourly reserve are given in [Table 10](#).

Reserve requirements

Table 10

Primary or second reserve	Secondary or minute reserve	Tertiary or hourly reserve
<p>Delivered automatically via governor response/load frequency control (LFC) in order to contain frequency deviations within prescribed limits.</p> <p>All generators with "rotating masses" and a capacity in excess of 5MW are required to reserve 1 percent of that capacity for use as PCR.</p> <p>The service, which needs to be fully delivered within 30 seconds and maintained for up to 5 minutes, is not remunerated.</p>	<p>An automatically called service which is to be fully deployed over the period 30 sec to 15 minutes. The service is used to replace primary or second reserve and restore frequency to its nominal level.</p>	<p>A manually dispatched reserve product, which needs to be fully deployed over the period 15 minutes to 1 hour in the case of spinning reserves and 4 to 8 hours in the case of plant at standstill.</p>

Polish Power Grid Company, SA (2001)

<sup>54</sup> Obersteiner (2008)



## 7. Long-term energy policy/decarbonisation

The EU has set the goal of reducing GHG emission 20 percent below 1990 levels by 2020. This target is divided between sectors covered under the EU Emissions Trading Scheme (ETS) – covering about 45 percent of total GHG emissions – and the Effort Sharing Decision (ESD), which sets targets for all remaining economic sectors. Under the ETS Directive there are no country-level targets; however, Poland is part of the EU-wide cap requiring covered sectors in the EU to cut greenhouse gas emissions 21 percent below 2005 levels by 2020. The ESD caps Poland's GHG emissions in non-ETS sectors at 14 percent over 2005 levels by 2020.

The main policy document laying out Poland's long-term energy policy, including the strategy for decarbonising the power sector, is the Polish Energy Policy to 2030 and the accompanying Energy and Fuel Demand Forecast to 2030 (updated September, 2011). The Polish Energy Policy to 2030 sets six leading priorities for development of the energy sector to 2030:

- Improving energy efficiency
- Increasing energy security
- Developing nuclear power
- Increasing the share of renewable resources, including biofuels
- Developing competitive energy and fuel markets
- Limiting the effect of the power sector on the environment.<sup>55</sup>

The document does not set specific targets for carbon emissions, energy efficiency, or renewable energy (though Poland is pursuing targets and policies pursuant to related European directives, discussed in more detail below). Rather, it indicates a general pathway to decarbonisation. As mentioned earlier, Poland is expected to face significant capacity retirements between now and 2030. The Polish Energy Policy

anticipates a concurrent increase in demand between 2008 and 2030. In order to meet this shortfall while maintaining a low-carbon trajectory, the Energy Strategy envisions that demand will be met with a combination of fuel diversification (particularly development of nuclear power and renewables) and exploitation of new lignite mines. CCS plays a central role in decarbonising the power sector, which continues to rely on coal and lignite for a significant portion of supply. The updated projections for fuel and energy demand to 2030 forecast a reduction of GHGs in electricity production from 144.2 million tons CO<sub>2</sub> in 2008 to 84.2 million tons of CO<sub>2</sub> in 2030 – a 42 percent reduction.<sup>56</sup>

In addition to the Energy Strategy 2030, the Ministry of Economy has commissioned several analyses of low-carbon pathways for Poland. Moreover, two working groups – the National Program for Developing a Low-Emissions Economy and the Public Council for Development of a Low-Emissions Economy – are helping to develop low-emissions strategies for Poland.<sup>57</sup>

<sup>55</sup> Ministry of Economy (2009), p. 4–5

<sup>56</sup> Ministry of Economy (2011), p. 48

<sup>57</sup> More on these work streams is available on the Ministry of Economy's website <http://www.mg.gov.pl/Bezpieczenstwo+gospodarcze/Gospodarka+niskoemisyjna>.



## 8. Renewable energy

Under the Renewable Energy Directive, Poland is expected to increase the share of energy from renewable energy sources to 15 percent of gross final consumption by 2020. In 2012, renewables accounted for nearly 4 percent of total electricity production and 13 percent of installed electric capacity (including large hydro).<sup>58</sup>

Poland has in place a green certificate scheme, which was first introduced in 2005. The scheme establishes annual renewable energy targets that obligated entities must meet by retiring green certificates. Certificates are tradable. Renewable energy includes renewable electricity or heat generated through hydroelectric power, wind, biomass, biogas, solar photovoltaic and heat, and geothermal energy.<sup>59</sup>

The obligation applies to:

- electricity retailers who are also power producers or traders,
- large industrial end-users who consumed not less than 100 GWh of electricity in the previous calendar year and for whom electricity accounted for no less than 3 percent of production cost, and
- brokerage firms and end-users transacting on the Polish Power Exchange.

Targets are set as a percentage of total annual sales. For 2012–2021, the targets are shown in [Table 11](#).

Obligated parties can also pay an alternative compliance fee to make up for any shortfall in meeting the target.

Prices for green certificates plummeted in late 2012/ early 2013, due to an oversupply of green certificates. The oversupply was caused by a combination of production exceed the annual renewable obligation and certificates from previ-

58 PSE (2013)

59 Ministry of Economy (2012)

Renewable electricity targets

Table 11

Target	Year
10.4%	2012
12.0%	2013
13.0%	2014
14.0%	2015
15.0%	2016
16.0%	2017
17.0%	2018
18.0%	2019
19.0%	2020
20.0%	2021

Ministry of Economy (2012)

ous years that had been banked. In 2012, co-firing produced 5.8 TWh of energy, while wind power produced 4.5 TWh of energy (out of a total of 13.9 TWh).<sup>60</sup> In 2013, the share of wind increased significantly.

Due to the price volatility of green certificates, the desire to diversify sources of renewable energy, and the need to fully transpose the European Renewable Energy Directive, Poland is considering an entirely new incentive scheme for renewables. Under discussion is a departure from the green certificate scheme and transition to a reverse auction for renewable energy.<sup>61</sup>

Recent changes to the Polish Energy Law have introduced some changes to the law governing renewable energy in Poland. The amendments introduce a system for guarantees of origin, a framework for setting a national renewable energy target for 2020, as well as intermediate targets, and a

60 Zaremba (2013)

61 Krasuski (2013)

framework for preparing a national renewable energy action plan. As noted previously, the Polish Energy Law has not brought Poland into full compliance with the European Renewable Energy Directive, and work on transposing the Directive continues.

---

## 9. Energy efficiency

---

Poland has a national, economy-wide target of achieving a 9 percent reduction in final annual energy use by 2016, as compared to Poland's average energy use from 2001 to 2005. The central compliance mechanism to meet this target is an energy supplier obligation, combined with a tradable white certificate scheme.

The energy efficiency obligation covers suppliers of electricity, natural gas, and district heating, as well as brokerage firms and end-users transacting on the Polish Power Exchange. Annual targets are set by the Ministry of Economy. Obligated entities comply with the obligation by retiring white certificates in the amount corresponding with their target. They can also pay an alternative compliance fee to cover any shortfall. Money from the alternative compliance fee is paid into the National Fund For Environmental Protection and Water Management.

The first tender for white certificates was issued in January 2013. Only 3.76 percent of the expected value (in tonnes of oil equivalent) of white certificates expected to be issued in the first tender were issued.<sup>62</sup> The Regulator had to deny half of the applications due to trivial errors, such as accounting errors. Another tender is being organised before the end of the year.

---

<sup>62</sup> Energy Regulatory Office (2013c)



## 10. Grid infrastructure and reliability

### 10.1 Generation adequacy standard

While the ERO considers that sufficient domestic capacity currently exists to meet peak demand, there is a significant concern over potential capacity shortages starting in 2016. The shortages are anticipated as a result of the planned decommissioning of 4.4 GW of capacity between 2014 and 2017, in part due to deferred implementation of the Large Combustion Plant Directive and a delay in commissioning new capacity to meet the shortfall. Poland has an aging power fleet – nearly 55 percent of the country's installed capacity is over 30 years old – and there are plans to decommission 12.26 GW of generation capacity by 2030.<sup>63</sup>

Responsibility for security of supply in Poland lies with the Minister of the Economy. Following the Minister's direction, the ERO has the competence to organise tenders for new capacity should the need arise and to implement initiatives aimed at reducing the demand for electricity. Before announcing such a tender, the President of ERO must agree with the minister in charge of public finance and other relevant public authorities on the types of economic and financial instruments enabling the construction of new generation capacity or the delivery on preferential terms of initiatives leading to the reduction of electricity demand.<sup>64</sup>

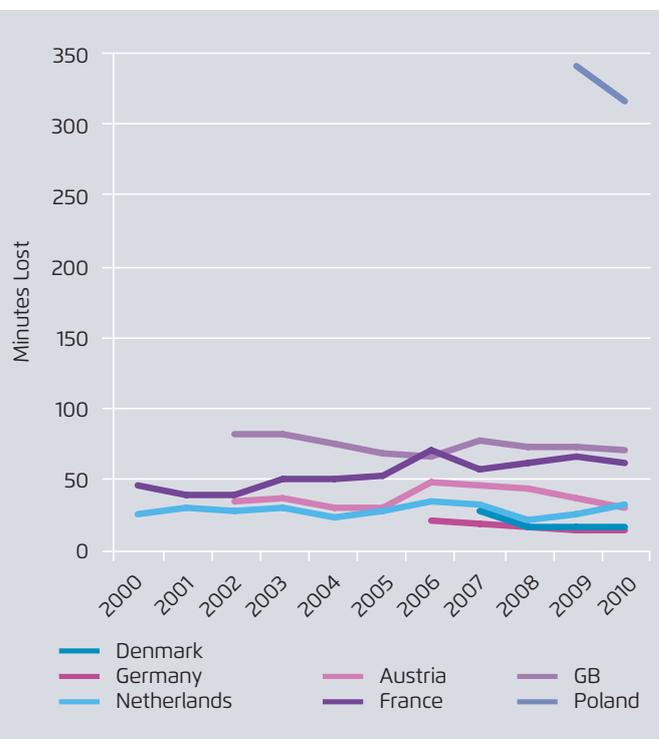
To date, the need to tender for new generation capacity has not arisen. However, recently work has begun to develop a capacity market in Poland. In order to support capacity margins in the period before a capacity market would be in place, an operational reserve mechanism may be introduced to prevent otherwise unprofitable generation capacity from decommissioning.<sup>65</sup>

### 10.2 Current SAIDI

Although there is limited historic data available for Poland, the number of supply minutes lost by consumers due to unplanned transmission and distribution outages is high compared with many other European Member States. A likely contributing factor is the relatively low ratio of underground cable (as opposed to overhead lines) to total circuit km in the Polish low- and medium- voltage distribution networks. There is a clear correlation between the use of overhead lines and increased SAIDI. Comparing Poland and Germany as an example, Polish SAIDI is some eight times higher than the average for Germany. The ratio of underground cable to total circuit km for the Polish low-voltage and medium-voltage

SAIDI – unplanned interruptions, excluding exceptional events

Figure 13



CEER (2012)

<sup>63</sup> Easton (2013)

<sup>64</sup> See Woszczyk (2013) and CEER (2013)

<sup>65</sup> Strzelecki & Martewicz (2013)

distribution systems is 0.32 and 0.22, respectively, compared with figures of 0.87 and 0.75 for Germany.

A comparison of average Polish SAIDI with other European Member States is given in [Figure 13](#).

### 10.3 Smart metering

A number of smart metering pilot projects are underway in Poland; however, currently there is no national roll-out plan. Several of the large power companies, including Energa, Enea, and Tauron are beginning large-scale installation of smart meters. Energa alone plans to install 400,000 smart meters by the end of 2014. The Regulator has prepared a conceptual market model for smart metering in Poland and is working with the government and stakeholders on developing a smart metering plan for the country. The Polish government has not undertaken a cost-benefit analysis of smart metering, though there are industry analyses.<sup>66</sup>

---

<sup>66</sup> See CEER (2013)

## References

- Bloomberg New Energy Finance (2013). <http://www.bnef.com>.
- CEER (2013). Status Review of Regulatory Aspects of Smart Metering (including an assessment of roll-out as of 1 January 2013). Retrieved from [http://www.energy-regulators.eu/portal/page/portal/EER\\_HOME/EER\\_PUBLICATIONS/CEER\\_PAPERS/Customers/2013/7-1\\_C13-RMF-54-05-Status\\_Review\\_of\\_Regulatory\\_Aspects\\_of\\_Smart\\_Metering\\_FOR\\_PUBLICATION.pdf](http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_PAPERS/Customers/2013/7-1_C13-RMF-54-05-Status_Review_of_Regulatory_Aspects_of_Smart_Metering_FOR_PUBLICATION.pdf).
- CEER (2012). 5th CEER Benchmarking Report on the Quality of Electricity Supply. Brussels: Author. Retrieved from [http://www.energy-regulators.eu/portal/page/portal/EER\\_HOME/CEER\\_5thBenchmarking\\_Report.pdf](http://www.energy-regulators.eu/portal/page/portal/EER_HOME/CEER_5thBenchmarking_Report.pdf).
- CEPS (2013). Czech Republic, Slovakia, Hungary, Romania and Poland signed the Memorandum of Understanding aiming to extend the CZ SK HU Market Coupling towards RO and PL markets [press release]. Retrieved from <http://www.ceps.cz/ENG/Media/Tiskove-zpravy/Pages/RozsirMC.aspx>.
- CEPS, MAVIR, PSE, and SEPS (2013). Unplanned Flows in the CEE Region. Warsaw: Authors. Retrieved from [http://www.pse.pl/uploads/pliki/Unplanned\\_flows\\_in\\_the\\_CEE\\_region.pdf](http://www.pse.pl/uploads/pliki/Unplanned_flows_in_the_CEE_region.pdf).
- Easton, A. (2013). Poland faces serious risk of power deficit in 2016-17 – ministry. Retrieved from <http://www.platts.com/latest-news/electric-power/warsaw/poland-faces-serious-risk-of-power-deficit-in-26157950>.
- Enea (2013a). Informacje o Spółce (Information on Enea Capital Group). Retrieved from <http://www.firma.enea.pl/serwis-korporacyjny/o-enea-169.html>.
- Enea (2013b). Shareholder Structure. Retrieved from [http://www.ir.enea.pl/en/information\\_on\\_shares\\_and\\_the\\_shareholding/shareholding\\_structure/](http://www.ir.enea.pl/en/information_on_shares_and_the_shareholding/shareholding_structure/).
- Energa (2013). Strategia i model biznesowy Grupy Energa (Strategy and business model for Energa). Retrieved from <http://grupa.energa.pl/upload/wysiwyg/Grupa%20ENERGA/Strategia%20i%20model%20biznesowy%20Grupy%20Energa.pdf>.
- Energy Regulatory Office (2013a), Interactive Map of Installed Renewable Energy Capacity. Retrieved from <http://www.ure.gov.pl/uremapoze/mapa.html>. (Note that solar PV amounts to only 1.75 MW of installed capacity.)
- Energy Regulatory Office (2013b). URE zapowiada przełom na rynku energii od 1 stycznia 2014 r. (ERO predicts a breakthrough on the energy market 1 Jan 2014). Retrieved from [http://energetyka.wnp.pl/ure-zapowiada-przelom-na-ryнку-energii-od-1-stycznia-2014-r,207295\\_1\\_0\\_0.html](http://energetyka.wnp.pl/ure-zapowiada-przelom-na-ryнку-energii-od-1-stycznia-2014-r,207295_1_0_0.html).
- Energy Regulatory Office (2013c). Pierwszy przetarg na wybór przedsięwzięć służących poprawie efektywności energetycznej rozstrzygnięty (The first tender for selection of energy efficiency projects resolved). Retrieved from <http://www.ure.gov.pl/pl/urząd/informacje-ogolne/aktualnosci/5422,Pierwszy-przetarg-na-wybor-przedswieziec-sluzacych-poprawie-efektywnosci-energet.html>.
- Energy Regulatory Office (2011). Aktualizacja Prognozy zapotrzebowania na paliwa i energię do roku 2030 (Update of Projections for fuel and energy demand to 2030), prepared for the Ministry of Economy. Warsaw: Author. Retrieved from [http://www.mg.gov.pl/files/upload/11099/ARE%20MG\\_2011\\_Raport\\_koncowy\\_01\\_09\\_2011.pdf](http://www.mg.gov.pl/files/upload/11099/ARE%20MG_2011_Raport_koncowy_01_09_2011.pdf).
- ENTSO-E (2013a). Detailed Electricity Exchange (in GWh). Retrieved from <https://www.entsoe.eu/db-query/exchange/detailed-electricity-exchange/>.

ENTSO-E (2013b). Network Code on Capacity Allocation and Congestion Management (CACM). Retrieved from <https://www.entsoe.eu/major-projects/network-code-development/capacity-allocation-and-congestion-management/>.

ENTSO-E (2013c). Overview Of Transmission Tariffs In Europe (Synthesis 2013). Brussels: Author. Retrieved from <http://www.assoelettrica.it/wp-content/uploads/2013/01/Entso-E-Overview-of-transmission-tariffs-in-Europe.pdf>.

ENTSO-E (2012). Capacity Allocation and Congestion Management (CACM) Code. Brussels: Author. Retrieved from [https://www.entsoe.eu/fileadmin/user\\_upload/\\_library/resources/CACM/120927\\_CACM\\_Network\\_Code\\_FINAL.pdf](https://www.entsoe.eu/fileadmin/user_upload/_library/resources/CACM/120927_CACM_Network_Code_FINAL.pdf).

Euroinfrastructure.eu (2013). Poland to avoid financial punishment from the electric energy directive. Retrieved from <http://www.euroinfrastructure.eu/en/infrastructure/polska-uniknie-kary-finansowej-ws-dyrektwy-o-energii-elektrycznej/>.

European Commission (2013a). Renewable Energy: Commission refers Poland and Cyprus to Court for failing to transpose EU Rules [press release]. Retrieved from [http://europa.eu/rapid/press-release\\_IP-13-259\\_en.htm](http://europa.eu/rapid/press-release_IP-13-259_en.htm).

European Commission (2013b). September infringements package: main decisions [memo]. Retrieved from [http://europa.eu/rapid/press-release\\_MEMO-13-820\\_en.htm](http://europa.eu/rapid/press-release_MEMO-13-820_en.htm).

European Commission (2013c). Electricity. Retrieved from [http://ec.europa.eu/competition/sectors/energy/electricity/electricity\\_en.html](http://ec.europa.eu/competition/sectors/energy/electricity/electricity_en.html).

European Commission (2013d). Poland fact sheet. Retrieved from [http://ec.europa.eu/energy/gas\\_electricity/doc/pl\\_energy\\_market\\_2011\\_en.pdf](http://ec.europa.eu/energy/gas_electricity/doc/pl_energy_market_2011_en.pdf).

European Commission (2011). Energy Markets in the Euro-

pean Union in 2011. Brussels: European Union. Retrieved from [http://ec.europa.eu/energy/gas\\_electricity/doc/20121217\\_energy\\_market\\_2011\\_lr\\_en.pdf](http://ec.europa.eu/energy/gas_electricity/doc/20121217_energy_market_2011_lr_en.pdf).

Eurostat (2013a). Combined heat and power generation, percent of gross electricity generation. Retrieved from <http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdcc350>.

Eurostat (2013b). Supply, transformation, consumption - electricity - annual data. Retrieved from [http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg\\_105a&lang=en](http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_105a&lang=en).

Eurostat (2013c). Imports (by country of origin) - electricity - annual data (nrg\_125a). Retrieved from [http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search\\_database?\\_piref458\\_1209540\\_458\\_211810\\_211810.node\\_code=nrg\\_135a#](http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database?_piref458_1209540_458_211810_211810.node_code=nrg_135a#).

Eurostat (2013d). Detailed Electricity Exchange (in GWh). Retrieved from <https://www.entsoe.eu/db-query/exchange/detailed-electricity-exchange/>. Note that import/export data here is limited to transactions with EU countries, and does not reflect imports/exports with Ukraine.

Eurostat (2013e). Exports (by country of destination) - electricity - annual data [nrg\_135a]. Retrieved from [http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search\\_database?\\_piref458\\_1209540\\_458\\_211810\\_211810.node\\_code=nrg\\_135a#](http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database?_piref458_1209540_458_211810_211810.node_code=nrg_135a#).

Eurostat (2013f). Electricity prices for household consumers (ten00115) and medium-sized industrial consumers (ten00114). Retrieved from <http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/database>.

GK PGE (2013) Shareholders. Retrieved from <http://www.gkpge.pl/en/shares/shareholders>.

Hempling, Scott (2009). Postage Stamp Transmission Pricing: The Seventh Circuit Reverses FERC. Washington, D.C.:

NRRI. Retrieved from <http://www.narucmeetings.org/Presentations/nrri%20postage%20stamp%20coursebook%20hempling%20sept%2009.pdf>.

Krasuski, Konrad (2013). Poland Seeks 40 Percent Cut in Renewable Energy Costs Starting in 2014. Bloomberg News. Retrieved from <http://www.businessweek.com/news/2013-11-06/poland-seeks-40-percent-cut-in-renewable-energy-costs-starting-in-2014>.

Martewicz, Maciej (2013). Energa Drops in Debut After Biggest IPO in 2 Years: Warsaw Mover. Bloomberg News. Retrieved from <http://www.bloomberg.com/news/2013-12-11/energa-drops-in-debut-after-biggest-ipo-in-2-years-warsaw-mover.html>.

Ministry of Economy (2013). Sprawozdanie z wyników monitorowania bezpieczeństwa dostaw energii elektrycznej za okres od dnia 1 stycznia 2011 r. do dnia 31 grudnia 2012 r. (Report on Results of Monitoring the Security of Electricity Supply from 1 January 2011 to 31 December 2012). Warsaw: Author. Retrieved from [http://www.cire.pl/pokaz-pdf-%252Fpliki%252F1%252FSprawozd\\_Monit\\_B\\_D\\_E\\_E\\_2011\\_2012\\_31\\_07\\_2013\\_o.pdf](http://www.cire.pl/pokaz-pdf-%252Fpliki%252F1%252FSprawozd_Monit_B_D_E_E_2011_2012_31_07_2013_o.pdf).

Ministry of Economy (2012). Rozporządzenie Ministra Gospodarki z dnia 18 października 2012 r., Poz. 1229 (Regulation, Minister of Economy, 18 October 2012). Warsaw, Author. Retrieved from <http://isap.sejm.gov.pl/DetailsServlet?id=WDU20120001229>.

Ministry of Economy (2011) Aktualizacja Prognozy Zapotrzebowania na Paliwa i Energie do Roku 2030. Warsaw: Author. Retrieved from [http://www.mg.gov.pl/files/upload/11099/ARE%20MG\\_2011\\_Raport\\_koncowy\\_01\\_09\\_2011.pdf](http://www.mg.gov.pl/files/upload/11099/ARE%20MG_2011_Raport_koncowy_01_09_2011.pdf).

Ministry of Economy (2009). Polityka Energetyczna Polski do 2030 roku (Polish Energy Policy to 2030). Warsaw, Author. Retrieved from <http://www.mg.gov.pl/files/upload/8134/Polityka%20energetyczna%20ost.pdf>.

Obersteiner, Carlo (2008). Market Potentials, Trends, and Marketing Options for Distributed Generation in Europe. Freiburg: MASSIG. Retrieved from [http://www.iee-massig.eu/papers\\_public/MASSIG\\_Deliverable2.1\\_Market\\_Potentials\\_and\\_Trends.pdf](http://www.iee-massig.eu/papers_public/MASSIG_Deliverable2.1_Market_Potentials_and_Trends.pdf).

PAK (2013). Informacje ogólne (General Information). Retrieved from <http://ri.zepak.com.pl/pl/o-spolce/informacje-ogolne.html>.

Polish Power Exchange (2013). Electricity Market, Historical Data (2013). Retrieved from [http://wyniki.tge.pl/en/wyniki\\_rdn/ceny-sredniowazone/](http://wyniki.tge.pl/en/wyniki_rdn/ceny-sredniowazone/).

Polish Power Grid Company, SA (2001). Instruction of Transmission System Operation and Maintenance (Rules of Ancillary Services). Warsaw: Author. Retrieved from <http://erranet.org/index.php?name=OE-eLibrary&file=download&id=217&keret=N&showheader=N>.

Polish Wind Energy Association (2013). Energetyka wiatrowa w Polsce (Wind Energy in Poland). Retrieved from <http://www.psew.pl/en/energetyka-wiatrowa/ewi-w-polsce>.

PSE (2013). Zestawienie danych ilościowych dotyczących funkcjonowania KSE w 2012 roku (Presentation of quantitative data on the operation of the national power system in 2012). Retrieved from <http://www.pse.pl/index.php?dzid=180&did=1364>.

RWE (2012). Facts and Figures 2012. Essen: Author. Retrieved from <https://www.rwe.com/web/cms/mediablob/en/108808/data/0/42/Facts-Figures-2012.pdf>.

Sikorski, Tomasz (2011). Nodal Pricing Project in Poland. Paper presented at the 34th IAEE International Conference on Institutions, Efficiency and Evolving Energy Technologies, Stockholm, 21 June 2011. Retrieved from [http://www.hks.harvard.edu/hepg/Papers/2011/IAEE\\_TSIKORSKI\(v1%20\).pdf](http://www.hks.harvard.edu/hepg/Papers/2011/IAEE_TSIKORSKI(v1%20).pdf).

Strzelecki, M. & Martewicz, M. (2013). Poland Watchdog Urges Paying Utilities to Avoid Blackouts. Retrieved from <http://www.bloomberg.com/news/2013-10-06/poland-power-watchdog-urges-paying-utilities-to-avoid-blackouts.html>.

Tauron (2013). Shareholder Structure. Retrieved from <http://www.tauron-pe.com/tauron/investor-relations/Pages/shareholder-structure.aspx>.

Woszczyk, Marek (2013). 2013 National Report of The President of the Energy Regulatory Office in Poland. Warsaw: Energy Regulatory Office. Retrieved from <http://www.ure.gov.pl/download/2/436/NationalReport2013.pdf>.

Woszczyk, Marek (2012). 2012 National Report of The President of the Energy Regulatory Office in Poland. Warsaw: Energy Regulatory Office. Retrieved from <http://www.ure.gov.pl/download/2/377/NationalReport2012.pdf>.

Zaremba, Marcin (2013). URE wydał do końca maja 1943 GWh zielonych certyfikatów za 2013 rok (The ERO issued 1943 GWh of green certificates through the end of May for 2013). Retrieved from <http://www.reo.pl/ure-wydal-do-konca-maja-1943-gwh-zielonych-certyfikatow-za-2013-rok>.

# Publications by Agora Energiewende

---

## IN GERMAN

### **12 Thesen zur Energiewende**

Ein Diskussionsbeitrag zu den wichtigsten Herausforderungen im Strommarkt (Lang- und Kurzfassung)

### **Brauchen wir einen Kapazitätsmarkt?**

Dokumentation der Stellungnahmen der Referenten der Diskussionsveranstaltung am 24. August 2012 in Berlin

### **Die Zukunft des EEG – Evolution oder Systemwechsel?**

Dokumentation der Stellungnahmen der Referenten der Diskussionsveranstaltung am 13. Februar 2013 in Berlin

### **Ein radikal vereinfachtes EEG 2.0 und ein umfassender Marktdesign-Prozess**

Konzept für ein zweistufiges Verfahren 2014–2017

### **Ein robustes Stromnetz für die Zukunft**

Methodenvorschlag zur Planung – Kurzfassung einer Studie von BET Aachen

### **Entwicklung der Windenergie in Deutschland**

Eine Beschreibung von aktuellen und zukünftigen Trends und Charakteristika der Einspeisung von Windenergieanlagen

### **Erneuerbare Energien und Stromnachfrage im Jahr 2022**

Illustration der anstehenden Herausforderungen der Energiewende in Deutschland. Analyse auf Basis von Berechnungen von Fraunhofer IWES

### **Kapazitätsmarkt oder Strategische Reserve: Was ist der nächste Schritt?**

Eine Übersicht über die in der Diskussion befindlichen Modelle zur Gewährleistung der Versorgungssicherheit in Deutschland

### **Kostenoptimaler Ausbau der Erneuerbaren Energien in Deutschland**

Ein Vergleich möglicher Strategien für den Ausbau von Wind- und Solarenergie in Deutschland bis 2033

### **Lastmanagement als Beitrag zur Deckung des Spitzenlastbedarfs in Süddeutschland**

Endbericht einer Studie von Fraunhofer ISI und der Forschungsgesellschaft für Energiewirtschaft

### **Kritische Würdigung des Netzentwicklungsplanes 2012**

Kurzstudie des Büros für Energiewirtschaft und technische Planung (BET)

### **Reform des Konzessionsabgabenrechts**

Gutachten vorgelegt von Raue LLP

---

### **Steigende EEG-Umlage: Unerwünschte Verteilungseffekte können vermindert werden**

Analyse des Deutschen Instituts für Wirtschaftsforschung (DIW)

### **Strommarktdesign im Vergleich: Ausgestaltungsoptionen eines Kapazitätsmarkts**

Dokumentation der Stellungnahmen der Referenten für die Diskussionsveranstaltung am 10. Juni 2013 in Berlin

### **Wie wird sich die Windenergie in Deutschland weiterentwickeln?**

Dokumentation der Diskussion zur Kurzstudie *Entwicklung der Windenergie in Deutschland* am 5. Juli 2013

### **Zusammenhang von Strombörsen und Endkundenpreisen**

Studie von Energy Brainpool

## **IN ENGLISH**

### **12 Insights on Germany's Energiewende**

A Discussion Paper Exploring Key Challenges for the Power Sector

### **Cost Optimal Expansion of Renewables in Germany**

A comparison of strategies for expanding wind and solar power in Germany

### **Load Management as a Way of Covering Peak Demand in Southern Germany**

Summary of intermediate findings from a study conducted by Fraunhofer ISI and Forschungsgesellschaft für Energiewirtschaft

## How do we accomplish the Energiewende?

Which legislation, initiatives, and measures do we need to make it a success? Agora Energiewende helps to prepare the ground to ensure that Germany sets the course towards a fully decarbonised power sector. As a think-&-do-tank, we work with key stakeholders to enhance the knowledge basis and facilitate convergence of views.

---



### **Agora Energiewende**

Rosenstraße 2 | 10178 Berlin | Germany

T +49. (0)30. 284 49 01-00

F +49. (0)30. 284 49 01-29

[www.agora-energiewende.org](http://www.agora-energiewende.org)

[info@agora-energiewende.de](mailto:info@agora-energiewende.de)

