THE STATE OF RENEWABLE ENERGIES IN EUROPE

EDITION 2015

15th EurObserv'ER Report

Barometer prepared by Observ'ER (FR) in the frame of the "EurObserv'ER 2013-2016" project with the following consortia members: Renac (DE), Institute for Renewable Energy (IEO/EC BREC, PL), Jožef Stefan Institute (SI), ECN (NL), Frankfurt School of Finance & Management (DE).

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VINCENT BERRUTTO
Head of the Energy Unit in the European Commission's Executive Agency for Small and Medium-sized Enterprises (EASME)

I very much welcome this new EurObserv'ER annual report on the "State of renewables in Europe". It comes at a timely moment.

Since the last edition of this report, the EU energy policy context has changed significantly. The European Commission adopted on 25th February 2015 the so-called Energy Union Package putting forward a framework strategy to make Europe's energy landscape more secure, sustainable, and competitive. One of its objectives is to move away from an economy driven by fossil fuels and further encourage the uptake of renewable energy sources.

To this end, the Commission is now developing a new Renewable Energy Package which will include measures to ensure that the 2030 EU target is met cost-effectively. They will span from empowering consumers, decarbonising the heating and cooling sector, adapting the market design, to enhancing the use of renewables in transport.

In this context, it is important to rely on up-to-date data about the progress made by renewable energies in each sector and in each Member State, which is precisely what the EurObserv'ER report provides. The "State of renewables in Europe" figures and analysis will give you a very clear and comprehensive overview of the current situation identifying the critical issues where policy leaders need to act.

According to the report, the year on year increase in renewable consumption is lower than in previous years, but we still have an encouraging figure for the share of renewable electricity at 28.1% in 2014. The overall share of renewables in the energy mix is estimated by the report at 15.9%, still some steps away from the 2020 and 2030 targets but the EU is on track to meet the former.

The last available data presented in "The state of renewables in Europe" puts forward good and bad news with an in depth analysis. On the one hand, we have seen wind and photovoltaics competing without or with little subsidies with conventional sources while, on the other hand, there is a decrease in momentum experienced by the private investment sector. A thorough explanation of the above and a lot more information on renewable energy, related jobs and investments, can be found in the pages of this publication.

The Executive Agency for Small and Medium-sized Enterprises is proud to support with EU funding this high quality work, already well known in the sector and read by thousands of stakeholders across Europe and beyond.

RÉMI CHABRILLAT,
Director of sustainable production and energies, Ademe

As it stands, the European Union is five years away from the 2020 deadline, yet the EurObserv'ER's 15th annual barometer points to a fragmented picture of renewable energies in Europe at the end of 2014. If we examine the results, we can draw some conclusions and assess the scale of efforts that remain to be made.

As it stands, the European Union is five years away from the 2020 deadline, yet the EurObserv'ER's 15th annual barometer points to a fragmented picture of renewable energies in Europe at the end of 2014. If we examine the results, we can draw some conclusions and assess the scale of efforts that remain to be made.

Renewables managed to increase their share of gross final energy consumption by almost a percentage point rising from 15 to 15.9%, against the global backdrop of plummeting fossil energy prices and despite the drop in wood-energy consumption resulting from an exceptionally mild winter. The same holds true for the renewable share of electricity consumption which increased by 2 percentage points to arrive at 28.1%

However these results are somewhat illusory, as the overall drop in energy needs, which matched the progress made by the sectors themselves, were responsible for delivering the results. The same applies to the respectable socio-economic results – sales of 140 billion euros and more than 1 million jobs across Europe – but which actually declined slightly for the first time. While investments attest to high growth (44%), with an additional 10 billion euros invested over the 2013 level, they were primarily channelled into wind energy which took up 8 billion euros.

Now that the major sectors, namely wind energy, photovoltaic and wood-energy can compete economically against the conventional sectors, the pressure is on to support emerging technologies. It is by harnessing ocean energies or second- or third-generation biofuel that Europe will take the lead and look ahead to 2030 and beyond. This is where the value of the EurObserv'ER barometer comes into its own, by giving insights into understanding European renewable energy development dynamics, regardless of the maturity levels of the individual sectors.

A PARADOXICAL OUTCOME

Vincent Jacques le Seigneur, President of Observ'ER

If we take a narrow field of vision, we cannot help but rejoice at the increase in the renewable energy share of the European energy mix. It now stands at 15.9%, which is twice as much as it was in 2004, and almost a percentage point more than in 2014. The minimal annual growth rate of 0.7 points required to achieve the new European renewable share target – namely, 27% of the energy mix in 2030 – has been exceeded.

However there is no real cause for cheer, as part of the achievement is the result of climate warming. In actual fact, the performance is primarily down to the drop in final energy consumption caused by a particularly mild winter. According to the World Meteorological Organization, 2015 was the warmest year on record for global surface temperatures. From 2011–2015, the WMO observes that mean temperatures exceeded those of the pre-industrial period by about 1°C for the 1st time.

At the same time, the global energy market is giving off disturbing environmental signals. The cost of a barrel of oil is approaching 2004 levels, and should be maintained at low levels for a long time because of the Gulf States' energy strategy, the production of unconventional fossil energies and, last but not least, Iran's return to the global market as a major oil producer.

This is compounded by the fact that renewable energies are losing their political support because of changes to the political leaning of several Member States and zealous application of Community directives on aid. Aid for renewables is no longer the priority in many countries, although there is no standard situation. Nine Member States have already achieved 100% of their national targets, while 12 others have reached the three-quarter way mark.

The European Union must yet again grasp this particular context and set the example by mobilizing funds, primarily to develop innovation, and ensure that renewable energies are increasingly competitive; by taking the international leadership so that country contributions towards the COP 21 targets – the *Intended Nationally Determined Contributions* (INDC), that will be subject to first review in 2020 are as ambitious as the challenges that lie ahead; finally by introducing the carbon tax which has been on the Brussels discussion table for more than twenty-five years: painless in these times of low-cost fossil energy, the groundwork will be prepared for energy transition by rebalancing costs over time and fostering investments in tomorrow's production facilities.

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ENERGY INDICATORS

For sixteen years now, EurObserv'ER has been collecting data on European Union renewable energy sources to describe the state and thrust of the various sectors in its focus studies or barometers. The first part of this assessment is an updated and completed summary of the work published in 2015 in *Systèmes Solaires* (*Journal de l'Éolien* n° 16, *Journal du Photovoltaïque* n° 13 and *Journal des Énergies Renouvelables* nos 227, 228 and 229).

This publication provides a complete overview of the twelve renewable sectors. Their performances are compared against the stated goals set out by each country in its National Renewable Energy Action Plan (NREAP). Additionally, for the sixth year running, the EurObserv'ER consortium members have published their annual renewable energy share estimates of overall final energy consumption for each Member State of the European Union. These figures provide preliminary indication of how the various countries are faring along their renewable energy paths and whether their individual trends point to successful achievement of the targets set by European Directive 2009/28/EC.

Methodological note

The tables present the latest figures available for each sector. Therefore some of the country data on the wind power, photovoltaic, solar thermal, biofuels, biogas and renewable urban waste sectors has been updated, and may differ from the figures published in the bimonthly barometers for those countries that had data available. Data for the small hydro, geothermal, biogas and waste sectors, which were not focus study topics in 2015, has been updated for this edition. Some country data updates have also been made for solid biomass, which was the subject of a barometer at the end of the year for countries that consolidated their data at the very end of the year. The latest version of the annual comparison of the data published by Eurostat against that of EurObserv'ER can be downloaded from: ***www.eurobserv-er.org***

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WIND POWER

The European Union managed to pursue the expansion of its wind energy sector while its electricity sector remained crisis-stricken. However the trend is no longer for steady, constant growth in net installed capacity, as new installations have hovered around the 11 to 12-GW mark since 2012. The EurObserv'ER estimate for net additional wind power capacity installed in 2014 is 11.3 GW, which takes the EU base up to 129 GW.


Siemens AG

THE EUROPEAN UNION WIND ENERGY MARKET STABILIZES

This apparent stability belies opposing individual country trends. The German market's vigorous growth over 2014 actually obscures the slowdown in some other European markets. AGEE-Stat, the Working Group on renewable energies statistics for the Federal Environment Ministry, reports that in 2014, 4 922 MW of capacity went on-grid (including 529 MW of offshore capacity) compared to 3 007 MW in 2013 (including 240 MW of offshore capacity). Momentum in the EU's second biggest market was disappointing. According to DECC (the Department of Energy & Climate Change), the British wind energy market, riding on the back of the offshore segment did not perform as well as in 2013. It fell to 1 773 MW (including 805 MW of offshore compared) compared to 2 316 MW the previous year (including 701 MW of offshore capacity), because of the onshore wind energy market slump (967 MW installed in 2014 compared to 1 615 MW in 2013).


Jens Meier/EnBW

As expected, the Central European markets were generally sluggish. The fortunes of the Polish and Romanian markets that neared the one-GW threshold in 2013, were reversed in 2014, with just 407 MW for Poland and 438 MW for Romania. The Italian market ticked over adding just 141 MW while the Spanish market was practically at a standstill with 17 MW of new capacity.

Sweden and France were more upbeat. Wind energy capacity on mainland France increased by 866 MW in 2014 (685 MW in 2013) for a total of 9 068 MW, according to SOeS, the Sustainable Development Ministerial Statistical Department. This is France's best performance since 2010 (when it connected 1 330 MW). The Swedish market turned in its best performance in 2014 by connecting 903 MW (587 MW in 2013), so taking its installed capacity to 5 097 MW according to Statistics Sweden.

Establishing whether offshore wind energy broke its installation record in 2014 is a matter of indicators, depending on whether the capacity benchmark figure is for wind turbines installed and ready to operate or wind turbines connected to the grid. The difference between these two usually close indicators has become poignant because delays in completing connection infrastructures have left much of Germany's offshore wind turbine fleet awaiting connection. In this publication, EurObserv'ER takes up the official AGEE-Stat estimates of offshore wind energy capacity connected to the grid. Thus we arrive 1 037 MW, namely a little less than half the installed capacity (put at 2 340 MW at the end of 2014). By adopting this indicator, the calculation for the European Union's combined offshore wind energy capacity at the end of 2014 comes to 8 021.3 MW, i.e. 6.2% of its net wind energy capacity.

The increase in the European Union's installed capacity naturally leads to higher wind power output. The consolidated data collected by EurObserv'ER indicates that output increased by 6.4% in 2014 to 251.6 TWh. The top three producer countries are Germany with 57.4 TWh, Spain with 52 TWh and the UK with 32 TWh. These three countries together generate 56.2% of the EU's wind power. If the outputs of France, Italy, Denmark, Portugal and Sweden output are added, 83.5% of total output is accounted for.

1

Installed wind power capacity in the the European Union at the end and 2014 (MW)*

	Cumulative capacity at the end of 2013	Cumulative capacity at the end of 2014
Germany	34 271.0	39 193.0
Spain	22 958.0	22 975.0
United Kingdom	11 214.6	12 987.5
France**	8 202.0	9 068.0
Italy	8 542.0	8 683.0
Sweden	4 194.0	5 097.0
Portugal	4 731.0	4 953.0
Denmark	4 820.0	4 888.0
Poland	3 429.0	3 836.0
Romania	2 783.0	3 221.0
Netherlands	2 713.0	2 865.0
Ireland	1 941.0	2 211.0
Austria	1 684.0	2 095.0
Greece	1 809.0	1 978.0
Belgium	1 680.0	1 818.0
Bulgaria	676.7	686.8
Finland	447.0	627.0
Croatia	254.0	339.0
Estonia	248.0	334.0
Hungary	329.0	329.0
Lithuania	282.0	282.0
Czech Republic	270.0	278.1
Cyprus	146.7	146.7
Latvia	67.0	69.0
Luxembourg	58.3	58.3
Slovakia	5.0	5.0
Slovenia	4.0	4.0
Malta	0.0	0.0
Total EU 28	117 759.3	129 027.4

** Estimate. ** Overseas departments not included.* ***Source: EurObserv'ER 2015***

NEW SCENARIOS FOR 2020

The protracted recession in the European Union and the regulatory instability of several key wind energy producer countries have hit the European market's growth rate. Consequently the manufacturers have been forced to take stock and are contemplating novel growth scenarios.

First assertion: the current electricity consumption trend is much weaker than was forecast some years ago. This lower consumption has benefited the renewable share, which is increasing faster, but this also means that less capacity will be required from the wind sector by the 2020 timeline. The wind power capacity scenarios in the European Union are intimately related to the Member States' commitments, expressed as a percentage. Lower power consumption expected in 2020 will result in a lower requirement for wind energy capacity to fulfil the countries' targets.

Second assertion: market momentum is also related to development-friendly conditions for wind energy, be that at regulatory level, market conditions or even investments in electricity infrastructures and grids to integrate capacity.

Third and final assertion: retroactive changes to legislation weaken the profitability of investments made and undermine investors' confidence.

This new economic reality prompted the EWEA to propose three new scenarios for 2020 in July 2014.

The "low" or least optimistic scenario, anticipates much lower than expected market growth of 165.6 GW of installed capacity by 2020. This assumes offshore growth will be limited to 19.5 GW, which is just over double the current installed capacity.

2

Installed offshore wind power capacities in European Union at the end of 2014 (MW)*

	2013	2014
United Kingdom	3 696.0	4 501.3
Denmark	1 271.1	1 271.1
Germany**	508.0	1 037.0
Belgium	625.2	712.0
Netherlands	228.0	228.0
Sweden	211.7	211.7
Finland	26.0	28.0
Ireland	25.2	25.2
Espagne	5.0	5.0
Portugal	2.0	2.0
Total EU 28	6 598.2	8 021.3

** Estimate. ** Electrical Installed capacity of wind turbines with network connection, the installed offshore wind power connected and not connected was 2340 MW end of 2014.* ***Source: EurObserv'ER 2015***

The "central" scenario puts total installed capacity across the EU at 192.5 GW in 2020, including 23.5 GW of offshore capacity.

The "high" scenario reckons that EU-wide wind energy capacity will be as much as 217 GW, including 28 GW offshore. It forecasts output at 500 TWh (397.8 TWh of onshore and 102.2 TWh of offshore), equating to 17% of European electricity demand.

It has to be said that the decisions taken, be they at European institution level or by specific Member States, give no cause for optimism. Today, the "high" scenario – the closest to the National Renewable Energy Action Plan commitments – hardly applies. The growth drive to close this decade that could have been carried by a new incisive and ambitious climate-energy package was not to be.

According to EurObserv'ER, the "low" scenario now applies. If we take into account current austerity policies in Europe, the sharp drop in incentives and the intent on seeing renewable energies face market mechanisms without having adequately prepared the ground for their entry, the European market could be stifled for years to come. A more optimistic scenario could still be on the cards but will have to be underpinned by much more assertive political will. Some of the uncertainties surrounding the future growth of the wind energy market could be dispelled by the political decisions taken during the Paris Climate Conference from 30 November to 11 December 2015.

3

Electricity production from wind power in European Union in 2013 et 2014 (TWh)*

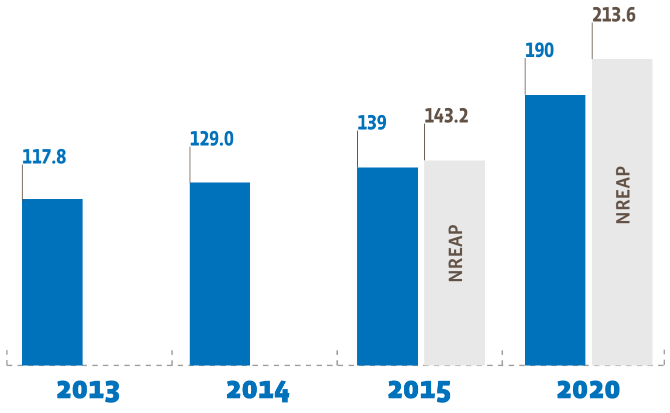
	2013	2014*
Germany	51.708	57.357
Spain	55.646	52.013
United Kingdom	28.421	32.016
France**	16.034	17.249
Italy	14.897	15.178
Denmark	11.123	13.079
Portugal	12.015	12.111
Sweden	9.842	11.234
Poland	6.004	7.676
Netherlands	5.368	5.797
Romania	4.689	4.724
Ireland	4.542	5.140
Belgium	3.687	4.614
Austria	3.152	3.846
Greece	4.139	3.689
Bulgaria	1.240	1.304
Finland	0.774	1.107
Croatia	0.517	0.730
Hungary	0.718	0.657
Lithuania	0.600	0.636
Estonia	0.529	0.604
Czech Republic	0.481	0.477
Cyprus	0.231	0.182
Latvia	0.120	0.141
Luxembourg	0.083	0.080
Slovakia	0.006	0.006
Slovenia	0.004	0.004
Malta	0.000	0.000
Total EU 28	236.6	251.6

** Estimate. ** Overseas departments not included.* ***Source: EurObserv'ER 2015***

This deadline is crucial as it must result in the adoption of a first universal, binding agreement on the climate to limit global warming to below 2°C. If responsible decisions are taken at planet level, European policy could be spurred into being more clear-cut, giving new prospects to the wind energy market and accelerating the introduction of energy transition in Europe. Pending these decisions, EurObserv'ER has scaled down its forecasts for 2020.

4

Comparison of the current trend against the NREAP (National Renewable Energy Action Plans) roadmap (GW)



Source: EurObserv'ER 2015

PHOTOVOLTAIC

The global photovoltaic market's robust health belies the European Union's market situation. While public policies continue to back solar power development in Asia, North America and the emerging markets (South Africa, South America, India, Turkey, etc.), the European market is beset by highly draconian national and European policies that hamper sector development.

For the most part, these policies have been applied in the countries that have already invested heavily in their solar sectors (Germany, Italy, Greece, Belgium, etc.), while policies are more helpful in the UK and France, where the photovoltaic sector lags behind. However their efforts to pick up from where the former left off are too weak to revive the market that has been in free-fall since 2012.

ENECO

THE EU MARKET IS PETERING OUT

Consolidated photovoltaic market data for the European Union are not a patch on the performance of previous years. EurObserv'ER reckons that newly installed capacity for 2014 should approach 7 097 MW, which equates to a 34.3% reduction drop on 2013. The European Union's installed capacity to date stands at 87.2 GW. The market appears to have been on an inexorable downward slide ever since 2011, the year when Europe broke its installation records with almost 22 GW.

The market's sharp decline has naturally resulted in stymied growth in solar PV electricity output. The 2014 figure of 91 TWh represented 12.6% growth on 2013 that compares badly with the two previous years' growth of 19.9% and 48.8% respectively. Most solar PV power is generated in a handful of countries – with the German (35.1 TWh), Italian (22.3 TWh) and Spanish (8.2 TWh) industries accounting for 72.1% of the European Union's output. Spain, whose performance bordered on its 2013 and 2012 levels, and which hardly installed any capacity in 2014, was still the number three producer country.

NEWS FROM AROUND THE MAIN COUNTRIES

For the first time in the country's history, the United Kingdom led the European solar PV market in 2014. Consolidated data released by DECC (the Department of Energy & Climate Change) show that 2 526 MW of capacity was hooked up to the grid over the twelve month period (1 095 MW in 2013), taking the UK's installed PV capacity to date to 5 377 MW. Given that installed capacity was only 96 MW in 2010, the sector has really surged forward rapidly.

For ‹5 MW plants, the Feed-in Tariff, applicable for 20 years, will remain in force. The system is somewhat intricate as it depends on both the plant's capacity (seven capacity segments for roof-mounted systems up to 250 kWp, another for ›250-kWp plants), coupled with an additional level modulation. There are three levels – "higher", "middle" and "lower rate" – depending on building energy efficiency or whether the system is installed on a dwelling. The "higher rate" is set aside for buildings with a Level D or higher Energy Performance Certificate while the "lower rate" applies to buildings that do not make level D and ›250-kW plants. A "middle rate", which is 10% lower than the higher rate, is especially dedicated to multi-occupancy dwellings. The degression is applied quarterly and depends on the previous quarter's installation level. The legislator has defined 5 "installation corridors" (low corridor, default corridor, High 1 corridor, High 2 corridor and High 3 corridor) that correspond to 5 different degression factors (0%, 3.5%, 7%, 14% and 28%), each one defined for three different capacity segments (<=10 kW, >10 kW <=50 kW and >50 kW). The UK governwment plans to slash incentives by 64% in 2016.

Having been outflanked by the UK, Germany lost its leadership of the European PV market in 2014. AGEE-Stat, the Working Group on renewable energies statistics for the Federal Environment Ministry, published its consolidated figures for 2014 that show that only 1 899 MWp of capacity was connected to the grid compared to the previous year's 3 304 MWp. As expected, the effects of the German government's new policy of slowing down the market pace, which had kept above the 7-GW level in 2010 (7 378 MW), 2011 (7 485 MW) and 2012 (7 604 MW), are being felt. Its main aim is to rein in electricity price increases. For the first time since it was introduced in 2000, the surcharge (known as the EEG Umlage) that funds Germany's renewable energies development, dropped. It fell to € 0.617/ kWh in 2015 from € 0.624/kWh in 2014. The new EEG law, applicable since 1 August 2014, has introduced many changes to the German incentive system. Since then, only small installations with <=500 kW of installed capacity are still eligible for the guaranteed Feed-in Tariff system. From 1 January 2016, only <=100 kW installations will be eligible. FiT degression will be applied monthly and adjusted

1

Photovoltaic capacity installed and connected in the European Union in 2013 and 2014 (in MWp)*

	2013			2014*		
	On grid	Off grid	Total	On grid	Off grid	Total
United Kingdom	1 095.0	0.0	1 095.0	2 526.0	0.0	2 526.0
Germany	3 304.0	5.0	3 309.0	1 899.0	0.0	1 899.0
France	672.0	0.0	672.0	1 328.9	0.1	1 329.0
Netherlands	374.0	0.0	374.0	302.0	0.0	302.0
Romania	972.7	0.0	972.7	270.5	0.0	270.5
Italy	2 000.0	1.0	2 001.0	189.0	1.0	190.0
Austria	262.6	0.5	263.1	159.0	0.3	159.3
Portugal	55.0	0.5	55.5	119.0	1.2	120.2
Belgium	341.0	0.0	341.0	102.0	0.0	102.0
Denmark	169.0	0.2	169.2	36.0	0.1	36.1
Cyprus	17.5	0.1	17.6	29.7	0.2	30.0
Malta	9.5	0.0	9.5	26.0	0.0	26.0
Poland	1.0	0.2	1.2	25.0	0.5	25.5
Greece	1 042.5	0.0	1 042.5	16.9	0.0	16.9
Sweden	18.0	1.1	19.1	16.8	0.0	16.8
Luxembourg	21.0	0.0	21.0	15.0	0.0	15.0
Croatia	15.5	0.5	16.0	14.0	0.2	14.2
Slovenia	26.7	0.0	26.7	7.7	0.0	7.7
Hungary	22.5	0.1	22.6	3.2	0.1	3.3
Spain	119.7	0.5	120.3	2.0	0.3	2.3
Slovakia	45.0	0.0	45.0	2.0	0.0	2.0
Finland	0.0	1.0	1.0	0.0	2.0	2.0
Bulgaria	104.4	0.0	104.4	1.3	0.0	1.3
Ireland	0.0	0.1	0.1	0.0	0.0	0.1
Czech Republic	41.5	0.0	41.5	0.0	0.0	0.0
Estonia	0.0	0.0	0.0	0.0	0.0	0.0
Latvia	0.0	0.0	0.0	0.0	0.0	0.0
Lithuania	61.9	0.0	61.9	0.0	0.0	0.0
Total EU	10 792.2	10.8	10 803.0	7 091.1	6.1	7 097.2

** Estimate. ** Overseas departments not included.* ***Source: EurObserv'ER 2015***

2

Connected and cumulated photovoltaic capacity in the European Union at the end of 2013 and 2014 (in MWp)*

	2013			2014*		
	On grid	Off grid	Total	On grid	Off grid	Total
Germany	36 337.0	65.0	36 402.0	38 236.0	65.0	38 301.0
Italy	18 420.0	12.0	18 432.0	18 609.0	13.0	18 622.0
France**	4 614.3	10.7	4 625.0	5 943.2	10.8	5 954.0
United Kingdom	2 851.0	2.3	2 853.3	5 377.0	2.3	5 379.3
Spain	4 759.8	25.2	4 785.0	4 761.8	25.5	4 787.3
Belgium	2 922.0	0.1	2 922.1	3 024.0	0.1	3 024.1
Greece	2 578.8	7.0	2 585.8	2 595.8	7.0	2 602.8
Czech rep	2 063.5	0.4	2 063.9	2 060.6	0.4	2 061.0
Romania	1 022.0	0.0	1 022.0	1 292.6	0.0	1 292.6
Netherlands***	741.0	5.0	746.0	1 043.0	5.0	1 048.0
Bulgaria	1 018.5	0.7	1 019.2	1 019.7	0.7	1 020.4
Austria	620.8	5.2	626.0	779.8	5.5	785.2
Denmark	571.0	1.4	572.4	607.0	1.5	608.5
Slovakia	588.0	0.1	588.1	590.0	0.1	590.1
Portugal	299.0	3.8	302.8	418.0	5.0	423.0
Slovenia	248.1	0.1	248.2	255.9	0.1	256.0
Luxembourg	95.0	0.0	95.0	110.0	0.0	110.0
Lithuania	68.0	0.1	68.1	68.0	0.1	68.1
Cyprus	33.9	0.9	34.8	63.6	1.1	64.8
Sweden	34.8	8.4	43.2	51.6	8.4	60.0
Malta	28.2	0.0	28.2	54.2	0.0	54.2
Hungary	34.3	0.6	34.9	37.5	0.7	38.2
Croatia	19.5	0.5	20.0	33.5	0.7	34.2
Poland	2.0	2.4	4.4	27.0	2.9	29.9
Finland	0.2	9.0	9.2	0.2	11.0	11.2
Latvia	1.5	0.0	1.5	1.5	0.0	1.5
Ireland	0.2	0.9	1.0	0.2	0.9	1.1
Estonia	0.0	0.1	0.2	0.0	0.1	0.2
Total EU	79 972.4	161.9	80 134.3	87 060.6	168.0	87 228.6

** Estimate. ** Overseas departments not included. *** Netherlands: old data for off grid, not updated. Note: According the Ministry of Industry and Trade of Czech Republic, the country disabled 2,9 MW of solar power in 2014.* ***Source: EurObserv'ER 2015***

every three months in line with installation levels. When the installed capacity is in the target corridor set for photovoltaic between 2 400 and 2 600 MW per annum, monthly degression will be 0.5%.

The Italian Economic Development Ministry's consolidated data confirms the relentless slowdown in new PV capacity installation. The market, which peaked in 2011 at 9 303 MW, slid to 3 647 MW in 2012, then to 2 000 MW in 2013, finishing at 189 MW in 2014, which takes the Italian PV panel base to 18 609 MW. The reason for the market's dramatic plunge is that the last Conto Energia programme has run out of funding and that from now on investors can no longer count on any incentive to produce.

A MORE STABLE MARKET THROUGH TO 2020

For the last three years the European Union photovoltaic has been struggling, bridled by public policies bent on regaining control of the sector and healing the "financial" wounds arising from the runaway market boom at the start of the decade. The question we need to answer is exactly how long the national political decision makers will take before they are ready to re-launch their sectors on sounded bases, against the backdrop of a real vision of the future of national and European energy systems.

It is clear that in 2015, the see-saw effect still favours the advocates for taking the heat out of renewable energies' momentum. In the area of solar photovoltaic,

3

Gross electricity production from solar photovoltaic power in the European Union in 2013 and 2014 (in TWh)*

	2013	2014*
Germany	31.010	35.115
Italy	21.589	22.306
Spain	8.327	8.218
France	4.661	5.905
United Kingdom	1.989	4.050
Greece	3.648	3.792
Belgium	2.644	2.883
Czech Republic	2.033	2.123
Romania	0.420	1.295
Bulgaria	1.361	1.244
Austria	0.582	0.785
Netherlands	0.487	0.785
Portugal	0.479	0.627
Slovakia	0.588	0.625
Denmark	0.518	0.596
Slovenia	0.215	0.257
Luxembourg	0.074	0.095
Lithuania	0.045	0.073
Cyprus	0.045	0.061
Malta	0.031	0.058
Sweden	0.035	0.047
Croatia	0.011	0.035
Hungary	0.025	0.027
Finland	0.006	0.008
Poland	0.001	0.007
Ireland	0.001	0.001
Estonia	0.001	0.001
Latvia	0.000	0.000
Total EU	80.825	91.019

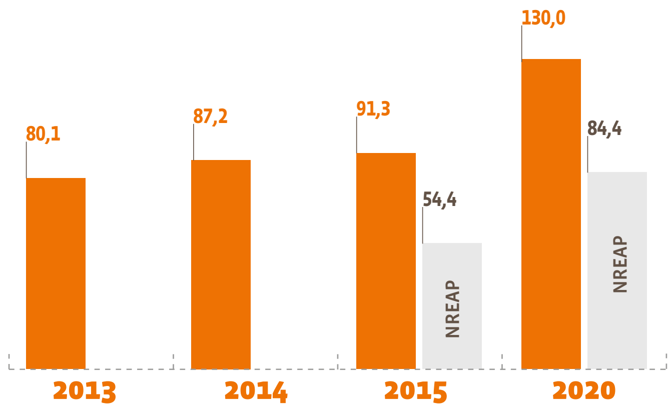
** Estimate. ** Overseas departments not included.* ***Source: EurObserv'ER 2015***

the main legislative aim of a number of Member States is to introduce retroactive measures into their production support systems to reduce their electricity bill. This is already a given in Spain, Italy and some Central European countries such as the Czech Republic. Furthermore, an increasing number of countries are introducing self-consumption taxes or plan to do so. Germany and Italy have already passed such taxes. The generalization and ubiquity of these measures could dash hopes of any revival of the European solar market. It takes considerably longer to establish a legal framework, the vital prerequisite for developing self-consumption and set up a grid.

Accordingly, EurObserv'ER yet again finds itself downsizing its forecasts for installed PV capacity by 2020. The fact that the European Union exceeded its combined national renewable energy plan aims in 2014, six years ahead of schedule, may seem neither here nor there, given that the countries had so grossly underestimated solar power's potential when they drew up their plans in 2009 and 2010.

4

Comparison of the current trend of photovoltaic capacity installed in the European Union against the NREAP (National Renewable Energy Action Plans) roadmap (in GWp)



Source: EurObserv'ER 2015

SOLAR THERMAL

In 2014, the European solar thermal market for producing heat, domestic hot water and heating did not find the recipe for recovery and contracted for the sixth year running. It dropped below the 3 million m² threshold and settled at an installation level comparable to that of 2007. The total installed area in the EU stood at 47 million m² (32 987 MWth).

Many key markets recording drops in excess of 10%, as happened in Germany, Austria, France, Belgium, and the UK. Only a few countries made positive growth; they include Greece, Spain and Denmark. The main reason for the European market decline is the drop in house sales. The solar thermal sector also suffers from competition from alternative technologies: thermodynamic hot water tanks and condensing gas boilers that are also eligible for incentives and offer cheaper installation costs. Furthermore, it has to contend with internecine competition from solar photovoltaic which is now addressing the domestic hot water segment. Finally the plunge in the price of oil and gas in 2014 and 2015 has not encouraged home owners to invest in solar thermal.

DIVERGING COUNTRY FORTUNES

The Spanish market is one of the few in Europe to have grown. The main reason for this growth is the development of prefabricated systems whose sales have increased by 42% and now account for 52% of the market. An improvement in the new build sector shares responsibility for this return to growth, coupled with thermal regulations that impose the use of solar energy. The legislation is particularly helpful to the multi-occupancy segment that accounted for 41% of the Spanish market in 2014.

The Austrian market has the highest equipment rate after Cyprus yet shows no signs of stopping its fall, which equates to a further 14.3% decline on 2013 and has brought the market down to its level of a decade ago. This decline has been brought about by increasingly stiff competition from photovoltaic systems now

frequently coupled to hot water tanks. An AEE Intec analysis suggests that this decline is due to sharp contraction of the individual homeowners' segment, and it also appears that demand from customers receptive to environmental issues has already been met; hence marketing strategies should from now on target other customers who are more cost-sensitive. Very large dimension systems are another major growth segment. The government also seeks to promote technological development of these systems to develop this market segment abroad.

Planenergi, an independent research company has released data demonstrating that >500 m² solar thermal installations accounted for 96% of the total of 179 186 m² collector area installed in Denmark, and they were primarily connected to heating networks. In 2013, this share was 92%. Denmark's market is atypical, because it has opted to develop the use of solar thermal collector fields to supply heating networks,

1

Annual installed surfaces of thermal solar in the European Union in 2013 per type of collectors (in m²) and power equivalent (in MWth)*

	Glazed collectors		Unglazed collectors	Total (m²)	Equivalent power (MWth)
	Flat plate collectors	Vacuum collectors			
Germany	907 800	112 200	20 000	1 040 000	728.0
Italy	261 369	35 640	0	297 009	207.9
Poland	199 100	75 000	0	274 100	191.9
Spain	222 552	6 169	3 794	232 515	162.8
France**	216 185	6 300	6 000	228 485	159.9
Greece	226 700	450	0	227 150	159.0
Austria	175 140	4 040	1 460	180 640	126.4
Denmark	116 770	0	0	116 770	81.7
Czech Republic	32 306	12 225	35 000	79 531	55.7
Netherlands	30 054	2 694	27 396	60 144	42.1
Belgium	48 500	10 500	0	59 000	41.3
Portugal	57 234	0	0	57 234	40.1
United Kingdom	27 721	8 223	0	35 944	25.2
Ireland	17 022	10 679	0	27 701	19.4
Romania	9 000	14 850	180	24 030	16.8
Hungary	10 580	7 170	250	18 000	12.6
Croatia	15 700	1 750	0	17 450	12.2
Cyprus	16 652	472	34	17 158	12.0
Slovenia	7 089	1 949	0	9 038	6.3
Sweden	6 124	2 487	351	8 962	6.3
Slovakia	5 200	1 000	500	6 700	4.7
Luxembourg	6 179	0	0	6 179	4.3
Bulgaria	5 600	0	0	5 600	3.9
Finland	3 000	1 000	0	4 000	2.8
Lithuania	800	1 400	0	2 200	1.5
Latvia	1 500	500	0	2 000	1.4
Estonia	1 000	1 000	0	2 000	1.4
Malta	1 223	493	0	1 715	1.2
Total EU	2 628 100	318 191	94 965	3 041 255	2 128.9

Estimate. ** Overseas departments included.* ***Source: EurObserv'ER 2015*

2

Annual installed surfaces of thermal solar in the European Union in 2014 per type of collectors (in m²) and power equivalent (in MWth)*

	Glazed collectors		Unglazed collectors	Total (m²)	Equivalent power (MWth)
	Flat plate collectors	Vacuum collectors			
Germany	814 600	85 400	20 000	920 000	644.0
Italy	260 000	20 000	0	280 000	196.0
Greece	270 000	600	0	270 600	189.4
Poland	208 000	52 000	0	260 000	182.0
Spain	235 355	15 900	3 839	255 094	178.6
France**	195 739	0	6 000	201 739	141.2
Denmark	179 186	0	0	179 186	125.4
Austria	150 530	2 910	1 340	154 780	108.3
Czech Republic	27 095	11 148	35 000	73 243	51.3
Netherlands	27 000	3 000	27 396	57 396	40.2
Portugal	55 000	0	0	55 000	38.5
Belgium	42 500	9 500	0	52 000	36.4
United Kingdom	24 590	5 870	0	30 460	21.3
Ireland	14 691	10 644	0	25 335	17.7
Croatia	18 400	2 500	0	20 900	14.6
Cyprus	18 834	633	0	19 467	13.6
Romania	6 200	12 300	170	18 670	13.1
Hungary	10 580	6 170	1 250	18 000	12.6
Slovakia	5 500	1 000	500	7 000	4.9
Sweden	5 024	1 649	0	6 673	4.7
Bulgaria	5 600	0	0	5 600	3.9
Finland	3 000	1 000	0	4 000	2.8
Slovenia	2 925	700	0	3 625	2.5
Lithuania	1 000	1 500	0	2 500	1.8
Latvia	1 940	420	0	2 360	1.7
Estonia	1 000	1 000	0	2 000	1.4
Luxembourg	1 985	0	0	1 985	1.4
Malta	1 164	291	0	1 455	1.0
Total EU	2 587 438	246 135	95 495	2 929 068	2 050.3

** Estimate. ** Overseas departments included.* ***Source: EurObserv'ER 2015***

3

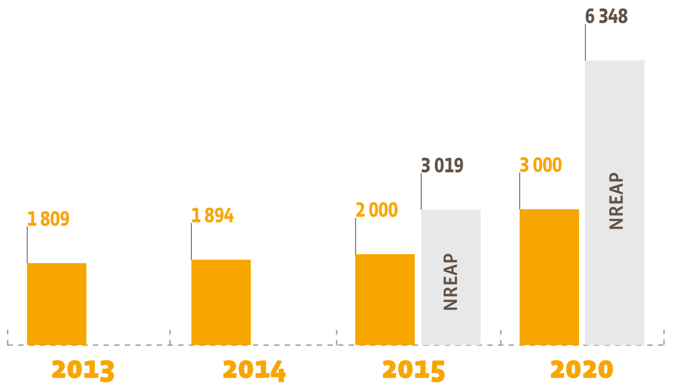
Cumulated capacity of thermal solar collectors installed in the European Union in 2013 and 2014*** *(in m² and in MWth)*

	2013		2014	
	m²	MWth	m²	MWth
Germany	17 222 000	12 055	17 987 000	12 591
Austria	5 054 698	3 538	5 165 107	3 616
Greece	4 180 175	2 926	4 287 775	3 001
Italy	3 515 239	2 461	3 793 239	2 655
Spain	3 197 379	2 238	3 452 473	2 417
France***	2 575 000	1 803	2 759 439	1 932
Poland	1 485 000	1 040	1 744 000	1 221
Portugal	1 024 004	717	1 133 965	794
Czech Republic	972 299	681	1 045 542	732
Danemark	786 000	550	943 761	661
Netherlands	880 450	616	895 846	627
United Kingdom	669 841	469	683 101	478
Cyprus	681 157	477	670 624	469
Belgium	534 628	374	585 128	410
Sweden	478 188	335	470 022	329
Ireland	275 909	193	301 245	211
Slovenia	211 574	148	215 199	151
Hungary	196 109	137	213 723	150
Romania	157 385	110	176 055	123
Slovakia	161 050	113	168 050	118
Croatia	137 050	96	157 950	111
Bulgaria	83 600	59	84 200	59
Finland	46 413	32	50 013	35
Malta	48 456	34	49 991	35
Luxembourg	45 590	32	47 576	33
Latvia	16 650	12	19 010	13
Lithuania	11 350	8	13 850	10
Estonia	8 120	6	10 120	7
Total EU	**44 655 314**	**31 259**	**47 124 004**	**32 987**

** All technologies included unglazed collectors. ** Estimate. *** Overseas departments included.* ***Source: EurObserv'ER 2015***

4

Comparison of the current trend of solar thermal solar capacity in the European Union against the NREAP (National Renewable Energy Action Plans) roadmap (in ktoe)



Source: EurObserv'ER 2015

and already has 43. On 1 May 2015, ARCON Solar inaugurated one of the new projects, the biggest solar thermal collector field with an area of 52 491 m² (37 MWth). The project budget is about 120 million Danish kroner (16 million euros). The solar collector field amounts to 53% of the project's cost, the storage pool 20% and the engineering costs 15%.

LOOKING FOR NEW IMPETUS FOR 2020

Solar thermal promotion policies have been blunted and most of the Member States are drifting away from their NREAP trajectories. Despite lower than expected increase in energy production in 2014, EurObserv'ER maintains its projection for 3 Mtoe by 2020, which is less than half the combined Europe-wide NREAP target figure

The situation hangs in the balance for 2015. Some observers are pessimistic about a market recovery in Central Europe (primarily Poland, the Czech Republic and Austria). There are nonetheless some encouraging signs. The situation in Germany should pick up thanks to the new measures taken in the context of the MAP incentive programme. The build-up of the UK's RHI Domestic programme and the improved tax credit mechanism in France are also likely to put paid to the downward spiral. The Italian market should also benefit from the new version of the Conto Termico incentive system that aims to streamline the system and the tax credit mechanism (alternative system) that is popular with the Italians.

The European solar thermal sector has entered a reorientation phase for its outlets. It should expand its multiple-occupancy, tertiary and industrial segment activities, aided by the implementation of new thermal regulations. Another growth vector is the connection of solar thermal collector fields to existing heating networks equipped with storage pools for the winter season.

Above all the solar thermal market could take up the new impetus that the European Commission is seeking to initiate through the implementation of an Energy Union which primarily aims to boost investments in the renewable heating and cooling production sector. Therefore, announcements are expected during the UN Climate Change Conference to be held in Paris from 30 November to 15 December 2015 that we hope could be the starting point for a revival of European energy policy.

SMALL HYDROPOWER

For about a decade, the development potential of small hydropower, which includes facilities with capacities up to 10 MW, has been under pressure from the European Water Framework Directive and the designation of listed areas with Natura 2000 protection. According to ESHA (the European Small Hydraulic Association), these regulations halved the sector's economic development in some countries.

Yet small hydropower plays an important role in the electricity supply system for not only is it a renewable energy, but it is competitive at that. It contributes to grid stability as its plants are designed to respond immediately to fluctuations in electricity demand.

At the end of every year EurObserv'ER conducts a survey of small hydropower's net capacity by polling the national statistics offices and ministries of the European Union. The survey reveals that in 2014 net capacity stood at 13 652 MW, which is slightly higher than in 2013 (13 594 MW). The top three countries for this installed capacity are Italy (3 086 MW), France (2 029 MW) and Spain (1 948 MW). Following a statistical review in Germany, part of its small hydropower capacity has been transferred to large-scale hydropower, involving a retroactive effect on the statistics for 2013, which reduced Germany's small hydropower capacity by 488 MW.

The two countries that made the most input to the increase in European capacity from 2013–2014 were Italy (which added 52 MW) and Austria (which added 30 MW), while the sharpest reduction in capacity was experienced by Sweden whose net capacity dropped by 59 MW.

Output from both small- and large-scale hydropower increased slightly between 2013 and 2014. Small-scale hydropower output reached 50.1 TWh in 2014, i.e. 0.9 TWh (1.8%) more than in 2013. Large-scale hydropower output, not including pumped-storage output, supplied 323.9 TWh in 2014 (a rise of 3.7 TWh). Thus in 2014, small hydropower output equated to 13.4% of net pumped-storage hydroelectricity output, put at 374 TWh.

A handful of European Union countries are responsible for small-scale hydroelectricity gene-

1

Total small hydraulic net capacity (<10 MW) in running in the European Union countries in 2013 and in 2014 (in MW)*

	2013	2014
Italy	3 034	3 086
France	2 021	2 029
Spain	1 948	1 948
Germany	1 286	1 283
Austria	1 209	1 239
Sweden	992	933
Romania	530	530
Portugal	373	388
Czech Republic	326	328
United Kingdom	299	314
Finland	307	306
Bulgaria	283	283
Poland	277	277
Greece	220	220
Slovenia	161	157
Slovakia	72	75
Belgium	64	64
Ireland	41	41
Luxembourg	34	34
Latvia	29	30
Croatia	28	30
Lithuania	26	27
Hungary	17	16
Denmark	9	9
Estonia	8	5
Total EU	**13 594**	**13 652**

** Estimate. **Source: EurObserv'ER 2015***

rating. The top six (Italy, Germany, France, Austria, Spain and Sweden) between them account for 81.3% of EU output and the top three together for 52.9%. Italy increased its output more than any other country (by 2.1 TWh), which is offset by Germany's 2.3 TWh output shortfall.

THE POTENTIAL IS THERE FOR HARNESSING

Small hydropower is a sector to watch because it can be subject to statistical variations and reclassifications. The current trend is not in keeping with the intermediate capacity targets for 2015 defined in the National Renewable Energy Action Plans. Furthermore its development over the next five years hangs in the balance because it is increasingly running up against Water Quality Framework Directive implementation and lack of political support. The sector players believe that considerable development potential could still be realized. A very comprehensive roadmap has been drawn up that factors in the sector's potential as part of the European Stream Map project coordinated by ESHA. The report reckons that installed small hydropower capacity could rise to 17.3 GW by 2020 yielding 59.7 TWh of energy, which is higher than the NREAP forecasts. The most promising countries are Italy, France, Spain, Austria, Portugal, Romania and Greece. However the report points out that the sector's growth by this timeline will be heavily dependent on the ability of industry, public authorities and the decision makers to take appropriate steps to deal with current and future challenges. The public authorities should set up financial or administrative arrangements for new incentive mechanisms. The industry must also persevere with investing in technologies that preserve the ecological continuity of watercourses and protect fish populations and should also continue its standardisation efforts across the European Union. Thus much progress remains to be made if the sector is to continue to develop smoothly.

2

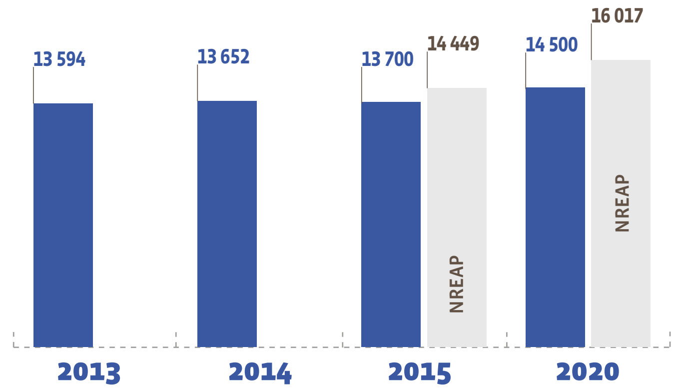
Small hydraulic gross electricity production (<10 MW) in the European Union in 2013 and 2014 (in GWh)

	2013	2014
Italy	11 576	13 649
France	7 196	6 805
Spain	6 314	6 081
Austria	5 290	5 641
Germany	7 157	4 822
Sweden	3 020	3 769
Portugal	1 195	1 421
Bulgaria	716	1 125
United Kingdom	913	1 121
Czech Republic	1 094	1 012
Finland	1 077	996
Poland	994	954
Greece	772	701
Romania	603	600
Slovenia	379	496
Belgium	233	192
Slovakia	137	140
Croatia	122	132
Luxembourg	119	108
Ireland	77	105
Hungary	62	77
Lithuania	92	71
Latvia	60	68
Estonia	26	27
Denmark	13	15
Total EU	**49 236**	**50 125**

Source: EurObserv'ER 2015

3

Comparison of the current small hydropower capacity installation trend (MW) against the NREAP (National Renewable Energy Action Plans) roadmap (in MW)



Source: EurObserv'ER 2015

GEOTHERMAL ENERGY

Geothermal energy can be recovered as heat or electricity using different technologies and for different applications. Geothermal heat can supply heating networks and also be used to heat swimming pools, greenhouses and fish farms.

HEAT PRODUCTION

The capacity of European Union geothermal heat applications linked to heating networks, agriculture, industry, etc., i.e. the direct uses of heat excluding heat pumps, is put at 3 308 MWth in 2014 for 804 ktoe of renewable energy output. This output is somewhat underestimated in a few countries that have yet to monitor the energy output of specific geothermal applications such as their use of hot geothermal water for heating swimming pools.

With regard to the geothermal heating network sector, the EGEC (European Geothermal Energy Council) takes stock of new heating network connections in its annual market report, which states that 8 new geothermal heating networks were commissioned in 2014, for combined capacity of 76.2 MWth. The networks were installed in France (Arcueil, 10 MWth), Germany (Ismaning, 7 MWth; Taufkirchen, 35 MWth; Traunreut, 12 MWth), Hungary (Barcs, 2 MWth; Törökszentmiklos, 3 MWth) and Italy (Montieri, 6.5 MWth; Vicenza, 0.7 MWth). According to EGEC data, the geothermal capacity identified in 17 European Union countries specifically for heating networks was about 1 300 MWth at the end of 2014. France has 45 networks in service, more than half of which are in the Greater Paris basin. It is followed by Germany which has 25 networks, and Hungary is in third place with 21. The EGEC points out that Hungary has a tradition of using geothermal energy and intends to extend this policy as illustrated by the opening of two new networks in 2014.

These new installations are not enough to stop geothermal heat's current trajectory falling behind the projections set out in the ↘

1

Capacity installed and net capacity usable of geothermal electricity plants in the European Union in 2013 and 2014 (in MWe)*

	2013		2014	
	Capacity installed	Net capacity	Capacity installed	Net capacity
Italy	875.5	729.0	875.5	768.0
Portugal	29.0	25.0	29.0	25.0
Germany	30.0	24.0	30.0	24.0
France**	16.2	16.2	16.2	16.2
Austria	1.4	0.7	1.4	0.7
Total EU	952.1	794.9	952.1	833.9

Note: The net capacity is the maximum power assumed to be solely active power that can be supplied, continuously, with all plant running, at the point of outlet to the network.
** Estimate. ** Overseas departments included. Source: EurObserv'ER 2015*

2

Gross electricity generation from geothermal energy in the European Union in 2013 and 2014 (in GWh)*

	2013	2014
Italy	5 659.2	5 916.3
Portugal	197.0	205.0
Germany	80.0	98.0
France**	90.0	83.0
Austria	0.3	0.4
Total EU	6 026.5	6 302.7

** Estimate. ** Overseas departments included. Source: EurObserv'ER 2015*

National Renewable Energy Action plans, which forecast 2 631 ktoe of heat output in 2020 and an intermediate goal of 1 348 ktoe In 2015. With output standing at 804 ktoe, the EU has only achieved 59,6% of this intermediate goal even if EurObserv'ER feels that better monitoring would certainly narrow this gap. The Member States are implementing much stronger incentive policies to remedy the situation, in a legislative environment stabilized to promote geothermal heat. Article 14 of the Energy Efficiency Directive (2012/27/EU) asks each Member State to carry out and notify to the Commission, a comprehensive assessment of the potential for the application of high-efficiency cogeneration and efficient district heating before 31 December 2015. They may eventually be encouraged to reconsider their potential geothermal fields.

3

*Direct uses of geothermal energy (except geothermal heat pumps) in the European Union in 2013 and 2014**

	2013		2014	
	Capacity (MWth)	Energy tapped (ktoe)	Capacity (MWth)	Energy tapped (ktoe)
France	336.9	215.9	346.9	218.8
Italy	757.0	150.2	757.0	147.8
Hungary	863.6	112.7	868.6	118.2
Germany	185.0	74.3	253.0	91.0
Netherlands	100.0	23.7	100.0	35.9
Bulgaria	83.1	33.0	83.1	33.0
Slovenia	66.8	31.7	67.1	31.9
Romania	205.1	26.0	205.1	26.0
Poland	101.9	18.6	101.9	20.2
Spain	21.0	18.1	21.0	19.7
Austria	97.0	22.0	97.0	19.4
Greece	101.0	11.5	88.0	11.7
Croatia	75.5	6.8	75.5	10.7
Slovakia	147.8	6.5	147.8	6.5
Denmark	33.0	5.5	33.0	4.0
Belgium	6.1	3.3	6.1	3.1
Czech Republic	4.5	2.1	4.5	2.1
Lithuania	48.0	1.7	48.0	1.9
Portugal	1.5	1.2	1.5	1.3
United Kingdom	2.8	0.8	2.8	0.8
Total EU	3 237.6	765.7	3 307.9	804.0

* *Estimate.* ***Source: EurObserv'ER 2015***

ELECTRICITY PRODUCTION

European Union-wide geothermal electricity capacity between 2014 and 2013 was stable at 952.1 MWe. Part of the installed capacity is on shutdown or undergoing maintenance, so EurObserv'ER puts the net capacity of geothermal power plants at 833.9 MW in 2014, which equates to an increase, because in 2013, the effective capacity was 794.9 MW.

Gross electricity output is rising... 6 303 GWh was generated in 2014, compared to 6 026 GWh the previous year.

Italy is Europe's geothermal power champion with 875.5 MW installed – the same as in 2013. The country is also driving the increase in net capacity, which rose from 729 to 768 MW over the twelve-month period according to the Italian Economic Development Ministry. Italy's geothermal resource is in two major production areas – Larderello, Travale/Radicondoli and Monte Amiata. According to EurObserv'ER, there were no changes to the net installed capacity in the other countries over the study period, leaving the figures as 25 MW for Portugal, 24 MW for Germany, 16.2 MW for France (including 1.5 MW in mainland France) and 0.7 MW for Austria.

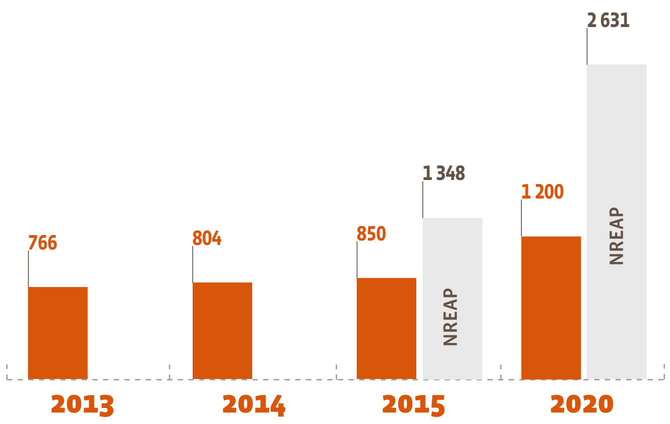
In France, most of the high-temperature geothermal power potential is in the overseas departments. It has two power plants at Bouillante, Guadeloupe, with combined net capacity of 15 MW. The DGEC (Directorate General for Energy and Climate) puts their 2014 output at 83 GWh. France also has a 1.5-MW pilot plant, currently undergoing maintenance, on the Soultz-sous-Forêts (Bas-Rhin) site, that uses geothermal energy from fractured hot rocks. The country is also eager to exploit its geothermal potential by developing deep geothermal energy on the mainland and through its volcanic potential in the overseas departments.

The European Union's geothermal capacity will increase in the coming years. The National Renewable Energy Action Plans foresee 11 TWh of output from electrical applications by 2020 and 1 613 MW of installed capacity. According to the EGEC, Germany has 15 projects in development, which could take the country's capacity to 80–90 MW as early as 2017. Another 28 projects are being looked into, which could amount to more than 100 MW of additional capacity. Italy has four power plants under development that should come on stream in 2017. They include the 40-MW capacity Bagnore 4 project. The EGEC has already identified more than 28 projects in development in 11 countries across the European Union that could yield at least 205 MW of additional capacity.

There are three reasons why geothermal power growth is mediocre. The first is that geothermal energy's potential is underestimated through poor awareness of its advantages. Furthermore, the market lacks financial support and clear support mechanisms. Lastly the projects are subject to geological risk that deserves the introduction of an insurance system to cover it, which could be along the lines of the GEODEEP guarantee fund pioneered by France.

4

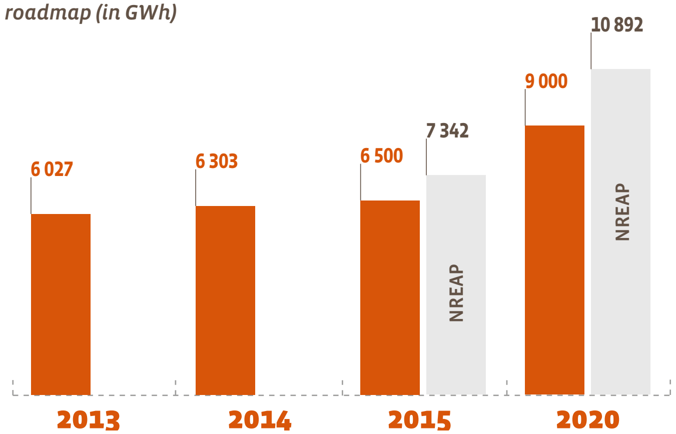
Comparison of the geothermal heat generation trend against the NREAP (National Renewable Energy Action Plan) roadmap (in ktoe)



Source: EurObserv'ER 2015

5

Comparison of the current geothermal electricity generation trend against the NREAP (National Renewable Energy Action Plan) roadmap (in GWh)



Source: EurObserv'ER 2015

HEAT PUMPS

Heat pumps are distinguished by the energy source they harness (ground, water and air), types of heat emitter (fan-convector, underfloor piping, low- or hot-temperature radiators) and the purpose of their use. HPs can heat or cool a home because they are reversible, while some also produce domestic hot water.

There are three types of HPs – air source (ASHP), whose source is air (outdoor air, extracted air or indoor air); ground source HPs (GSHP) that draw their heat from the ground (via horizontal or vertical sensors), hydrothermal HPs whose heat source is water (groundwater, rivers or lakes). In the interest of clarity, we have included hydrothermal HPs with ground source HPs.

A CONTRACTION IN THE EU MARKETS

While this technology is popular in Northern Europe, it still has major growth potential in many European countries. Climate largely dictates how HPs are used. In the north of Europe, they are basically applied to heating, while in warmer areas; the reversible HP market for cooling is bigger.


BWP

The HP market contracted in 2014 with recorded sales of 1.7 million units compared to 2 million in 2013. The slowdown stems from the slump in the Italian and French markets on the reversible air-to-air HP segment. The water source HP market segment (using underfloor heating or low- or high-temperature radiators), enjoyed positive growth with practically 270 000 systems sold in 2014, i.e. an annual increase of 3.6%. Yet the segment was divided between growth in air-to-water ASHP HPs (10.1% up on 2013) and a declining GSHP market with 81 340 units sold (8.8% down on 2013).

In the ASHP segment, momentum is positive for air-to-water HPs, along with exhaust air HPs. The air-to-air market alone is marking time. Nonetheless this technology dominates the air source segment, with about 88% of all units sold.


Stiebel Eltron

THE MAIN HP MARKETS IN A GLANCE

In France, the air-to-water ASHP market data is very positive. Uniclima, the union for the heating, cooling and ventilation industries, claims that the number of units sold in 2014 increased by 29%, which largely made up for the 2014 GSHP market slump of 19% equating to 3 249 units sold. The union explains that air-to-water HPs are performing well because they have found their place in new build. They are taking advantage of the new thermal regulations (RT 2012) that impose the installation of renewable energy technology in the construction of individual housing units. This contrasts with air-to-air heat pump sales, which contracted to 346 037 units sold… a 2% drop. The French thermal regulation sets the principle that thermodynamic hot water heaters use renewable energy-producing technology. The result is that sales of thermodynamic HWHs have soared (by 58%, i.e. 72 530 units sold in 2014 as opposed to 45 950 in 2013). Ground source- and air source-to-water HPs and also thermodynamic HWHs are eligible for tax credit, which only applies to renovation. The new formula raises the credit rate to 30% for all eligible technologies and dis-

1

Air-source heat pump market in the European Union 2013 and 2014 (units sold)*

	2013			2014		
	Aerothermal HP	of which air-water HP	of which exhaust air HP	Aerothermal HP	of which air-water HP	of which exhaust air HP
Italy**	1 042 900	16 900	0	863 000	18 000	0
France**	485 394	53 925	0	415 708	69 671	0
Sweden	71 650	6 635	10 015	61 355	6 355	10 850
Finland	48 870	1 278	1 874	56 069	1 480	1 767
Germany	40 200	40 200	0	41 000	41 000	0
Spain	51 738	2 464	0	54 001	0	0
Netherlands	37 486	4 633	0	44 028	4 499	0
Bulgaria	14 300	716	357	20 727	1 036	518
Denmark	18 537	2 581	198	19 666	2 822	101
United Kingdom	15 656	15 656	0	16 360	16 360	0
Estonia	13 260	800	60	14 340	1 000	40
Austria	8 234	7 994	240	9 141	8 953	188
Portugal	9 197	437	0	7 521	461	0
Czech Republic	5 747	5 747	0	6 247	6 247	0
Slovenia	6 151	2 842	0	5 226	3 108	0
Belgium	4 167	4 167	0	4 552	2 732	0
Poland	2 119	2 119	0	2 308	2 308	0
Ireland	1 190	1 169	21	1 816	1 804	12
Lithuania	230	110	120	340	95	245
Slovakia	576	516	19	319	271	0
Hungary	273	226	47	273	226	47
Total EU	**1 877 875**	**171 115**	**12 951**	**1 643 997**	**188 428**	**13 768**

**Estimate. ** The Italian and French markets data is not strictly comparable with the other European Union markets because they include very low-capacity reversible systems (of the split or multi-split type) that are generally used for cooling.*
Source: EurObserv'ER 2015

penses with the increased rate for multiple energy-saving measures.

In Germany, available HP market statistics only cover systems that convey heat by water. According to ZSW, which takes part in producing renewable energy statistics for the Ministry of Economic Affairs and Energy, the air-to-water ASHP market grew slightly between 2013 and 2014, rising from 40 200 to about 41 000 units sold. Heat-driven HPs (that run on gas, not electricity) are also factored in. Their sales were put at 1 500 units in 2014. As in many countries, the GSHP market is sliding. The ZSW claims the number of units sold dropped from 21 100 in 2013 to 18 500 in 2014.

In Germany, BAFA (Federal Office for Economic Affairs and Export Control) encourages HP market expansion via the Market Incentive Programme, "Marktanreizprogramm" (MAP), which only targets high performance HPs. In the renovation segment (existing buildings), air-to-water HPs are only eligible for installation grants if the systems' seasonal performance factor (SPF) is >3.5. In the case of GSHPs (ground-to-water) or hydraulic (water-to-water) HPs, the required SPF must exceed 3.8 (and >4 for non-residential buildings). The minimum funding amount is € 1 500 for <37.5 kW air-to-water systems, and € 4 500 for <45 kW ground source (ground-to-water) and hydraulic (water-to-water) heat pumps. Very high performance heat pumps (with an SPF in excess of 4.5) are eligible for "Innovationsförderung" – innovation support– is offering of a higher sum.

The Swedish heat pump market is mature, having grown from just over 20 000 units sold in 1999 to 130 000 units p.a. to the end of the 2010s. Now heat pumps are the most popular heating system used in Sweden for family home construction, and also for replacement heating systems. The air-to-air segment of the HP market has not been accurately monitored since 2012. Nonetheless, EHPA estimates that at least 55 000 units have been sold every year since 2011. As for incentives, HPs have been eligible for tax reduction that applies to renovation or home extension work since 2008. The thermal regulations encourage installation of this type of technology in new build.

2

Ground-source heat pump market in the European Union in 2013 and 2014 (units sold)*

	2013	2014*
Sweden	24 897	23 356
Germany	21 100	18 500
Finland	12 341	11 125
Poland	5 142	5 275
Austria	6 073	5 127
France**	4 003	3 249
Netherlands	3 052	2 510
Denmark	2 503	2 242
United Kingdom	1 976	2 190
Czech Republic	1 743	1 578
Estonia	1 400	1 520
Belgium	1 336	988
Italy	1 036	780
Lithuania	470	735
Bulgaria	366	532
Hungary	510	510
Ireland	305	508
Slovenia	441	390
Slovakia	253	225
Spain	246	n.a.
Portugal	24	n.a.
Total EU	**89 217**	**81 340**

*n.a.: non available. * Estimate. **Heat pump ground-ground not included.*
Source: EurObserv'ER 2015

3

Total number of heat pumps in operation in 2013 and 2014 in the European Union*

	2013			2014*		
	Air-source HPs	Ground-source HPs	Total base in service	Air-source HPs	Ground-source HPs	Total base in service
Italy**	16 900 000	12 400	16 912 400	17 718 000	13 200	17 731 200
France	3 879 383	140 820	4 020 203	4 295 091	144 069	4 439 160
Sweden	892 916	453 486	1 346 402	954 271	476 842	1 431 113
Germany	265 181	297 191	562 372	305 137	314 502	619 639
Finland	472 207	74 182	546 389	528 276	85 307	613 583
Spain	246 246	1 144	247 390	300 247	1 144	301 391
Denmark	211 077	49 747	260 824	225 209	51 638	276 847
Austria	150 891	89 161	240 052	160 032	94 288	254 320
Netherlands	155 594	43 882	199 476	199 148	45 986	245 134
Bulgaria	194 244	3 740	197 984	214 971	4 272	219 243
United kingdom	81 491	20 560	102 051	97 851	22 750	120 601
Estonia	72 357	7 355	79 712	86 697	8 875	95 572
Portugal	83 755	3 020	86 775	91 276	3 020	94 296
Czech Republic	30 572	18 330	48 902	36 819	19 908	56 727
Poland	6 699	25 763	32 462	9 007	31 038	40 045
Belgium	22 993	6 008	29 001	27 545	6 996	34 541
Slovenia	17 004	5 110	22 114	22 231	5 500	27 731
Ireland	3 862	2 693	6 555	5 678	3 201	8 879
Slovakia	5 238	2 527	7 765	5 886	2 839	8 725
Hungary	1 955	2 087	4 042	2 228	2 597	4 825
Lituania	920	2 093	3 013	1 260	2 828	4 088
Luxembourg	742	106	848	742	106	848
Total EU	23 695 327	1 261 405	24 956 732	25 287 602	1 340 906	26 628 508

** Estimate. ** The Italian market data is not strictly comparable with the other European Union markets because they include very low-capacity reversible systems (of the split or multi-split type) that are generally used for cooling.*
Source: EurObserv'ER 2015

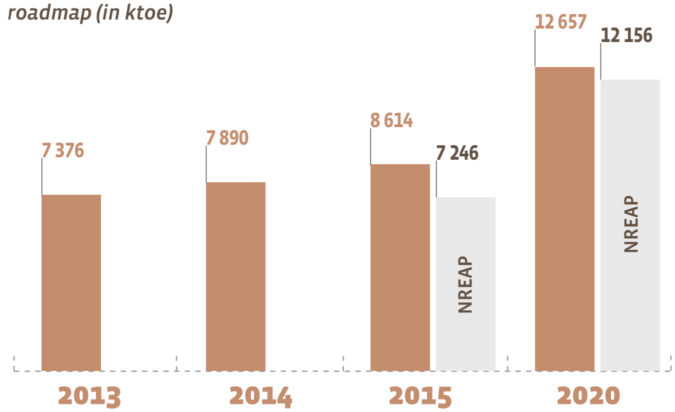
ENCOURAGING GROWTH PROSPECTS

Euroconstruct claims that after seven years of crisis and stagnation, the European construction market has been on an upturn since 2014. Growth should be about 1.8% in 2015, 2% in 2016 and 1.7% in 2017. EU directives are also contributing, by enforcing more stringent energy performance regulations in the building sector. HP heating solutions are patently encouraged. EurObserv'ER puts HP energy output at 7.9 Mtoe in 2014, and reckons it could rise to 12.7 Mtoe by 2020, which is along the lines of the NREAP plans. An EHPA policy note finds the figure of 61 million HPs installed by 2030 realistic. At this capacity level heat pumps would be capable of producing 60 Mtoe or renewable energy and of reducing GHG emissions by 181 million tonnes.

This vision will be reliant on European governments' determination, because HP solutions are costlier than traditional technologies. If the market is to grow, a possible answer could be taxing fossil energies. Additionally, the renewable energy obligation for new build should be enlarged to include the renovation segment, which offers ampler growth prospects.

4

Comparison of the current trend of the renewable energy from heat pumps against the NREAP (National Renewable Energy Action Plan) roadmap (in ktoe)



Source: EurObserv'ER 2015

BIOGAS

Jens Bach/Maabjerg Bioenergy i Holstebro

Anaerobic digesters specially designed to recover energy produce most of the biogas across the European Union. The plants come in different types and sizes ranging from small anaerobic digesters on farms, larger co-digestion (or multi-product) plants and household waste methane production plants. Their feedstock (raw materials) is typically slurry, farming waste, green waste, food-processing waste and domestic refuse but the facilities can also use cultivated farm crops such as intermediate crops (crucifers, grasses, etc.), and other energy crops (maize, etc.), to optimize the methanization reaction by introducing carbon. The umbrella term "other biogas" covers the output of these installations for the sake of convenience, to distinguish it from the biogas produced by wastewater treatment plants that produce methane from sewage sludge only and from landfill biogas whose output is directly captured inside the landfills rather than being produced by an industrial plant.

14.9 MTOE PRODUCED IN THE EUROPEAN UNION

In 2014, EU biogas energy output was estimated at around 14.9 Mtoe, which equates to 6.6% growth on the previous year. It should be pointed out that a number of countries like the UK and Spain have improved the statistical monitoring of their primary biogas energy output, which has led to statistical revisions and upward consolidations of their volume production. However despite these consolidations, the same sector trend of slower growth than in previous years, because of the biogas policy U-turns made by the European Union's two major producer countries, Germany and Italy.

For a number of years, most of the EU's primary biogas energy production spread has generally been taken up by the "other biogas" category, whose share has constantly risen in comparison with the landfill and sewage plant biogas categories. According to EurObserv'ER, the "other biogas" category accounts for about 72.4% of this output in 2014 (69.8% in 2013), which is a long way ahead of landfill biogas at 18.4% (20.2% in 2013) and 9.2% for sewage plant biogas (9.9% in 2013). The spread differs in individual member states and is not always dominated by the "other biogas" category" as it is in those countries that have developed an industrial methane recovery sector for farm biogas and co-digestion. Prime examples are Germany, Italy, Austria, the Netherlands, Belgium and the Czech Republic. Landfill biogas can also be the main sector (as is the case in the UK, Spain, Portugal, Finland and Ireland), while sewage plant biogas is more rarely exploited as heavily as it is in Sweden.

Electricity production, regardless of whether or not it is produced in cogeneration plants, is still the main outlet for biogas energy recovery in 2014. It accounted for

approximately 57 TWh (4.9 Mtoe) of output, which equates to 6.3% growth over 2013. Heat sales to district heating networks amounted to 555.9 ktoe in 2014, i.e. 19.6% growth. Self-consumed heat (used directly on production sites), is put at about 2 429 ktoe in 2014 (6.1% more than in 2013). Biogas can be fully harnessed with maximum energy efficiency to produce heat where there are outlets close to the methanization plant. It can also be refined into biomethane so that it can be put to use in the same way as natural gas, in the form of electricity in cogeneration plants, but also as biofuel for natural gas-powered vehicles (NGVs) or even injected into the natural gas grid.

Germany's new renewable energy law (EEG 2014) that came into force on 1 August 2014 marked a new strategy for biogas, whose future production will be much less reliant on the use of energy crops. One of the new law's aims is to reduce the financial cost of energy transition by slowing down the growth of the more costly electricity generating sectors, singling out solid biomass and biogas. According to the Germany biogas industry association (Fachverband Biogas e.V.), the number of new digester installations installed per annum has dropped sharply, falling from 1 499 in 2011 to 446 in 2012, 350 in 2013 and 163 in 2014. The number should rise slightly 2015 with 202 new installations. It put the number of biogas plants in 2014 at 8 726 (8 563 in 2013) for an equivalent 3 905 MW of electrical capacity (3 673 MW in 2013). In 2015, there should be at least 8 928 plants offering 4 177 MW of electrical capacity. According to AGEE-Stat, the Working Group on Renewable Energy Statistics for the Federal Environment Ministry, 30.9 TWh of biogas electricity was produced in 2014, i.e. 1.7 TWh more than in 2013 (5.8% growth). Most of this output (72% of the total) comes from CHP plants. The biogas heat sold on to district heating networks fared much better, rising to 157.2 ktoe in 2014 or 35% more than in 2013.

1

Primary energy production from biogas in the European Union in 2013 and 2014 (in ktoe)*

	2013				2014*			
	Landfill gas	Sewage sludge gas[1]	Others biogas from anaerobic fermentation[2]	Total	Landfill gas	Sewage sludge gas[1]	Others biogas from anaerobic fermentation[2]	Total
Germany	110.7	438.0	6 326.3	6 875.1	103.7	439.1	6 891.3	7 434.1
United Kingdom	1 535.8	286.2	214.6	2 036.5	1 501.8	310.7	314.0	2 126.4
Italy[3]	403.2	48.6	1 363.8	1 815.5	393.9	51.1	1 516.0	1 961.0
Czech Republic	28.9	39.6	502.5	571.1	30.7	40.6	536.7	608.0
France	180.7	43.4	212.5	436.6	174.1	41.8	204.8	420.7
Spain	193.5	162.1	123.8	479.4	158.5	111.6	83.1	353.3
Netherlands	25.8	57.8	221.6	305.2	22.8	56.3	233.6	312.7
Austria	3.7	14.0	179.0	196.7	3.8	11.2	277.3	292.2
Belgium	28.4	23.7	136.9	189.0	26.8	21.9	157.6	206.3
Poland	51.5	85.3	44.5	181.4	49.0	91.0	67.1	207.1
Sweden	9.8	73.4	61.8	145.0	8.4	74.0	71.0	153.4
Denmark	5.2	22.4	82.4	110.0	4.3	24.3	94.2	122.8
Greece	67.5	16.1	4.8	88.4	67.1	15.6	4.2	86.9
Hungary	14.3	20.1	47.8	82.2	14.3	21.0	48.4	83.7
Latvia	7.0	3.0	55.0	65.0	8.0	2.0	65.0	75.0
Finland	29.7	15.4	12.9	58.0	30.5	14.8	15.8	61.0
Slovakia	3.4	14.8	36.8	54.9	3.4	14.8	40.3	58.4
Ireland	36.8	7.9	3.5	48.2	39.1	7.8	5.4	52.2
Slovenia	7.1	2.8	24.8	34.7	6.5	2.6	21.7	30.8
Romania	1.5	0.1	28.4	30.0	1.5	0.1	28.4	30.0
Bulgaria	0.0	0.0	12.0	12.0	0.0	0.0	27.0	27.0
Lithuania	7.1	3.6	4.8	15.5	7.7	6.9	6.3	20.9
Portugal	61.8	2.7	0.8	65.3	70.3	2.6	0.6	73.5
Croatia	0.4	2.3	13.8	16.6	5.3	2.9	18.1	26.2
Luxembourg	0.1	1.4	14.1	15.6	0.1	1.5	15.2	16.7
Cyprus	0.0	0.0	12.0	12.0	0.0	0.0	12.0	12.0
Estonia	6.3	0.9	0.0	7.2	8.5	1.1	0.0	9.6
Malta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total EU	2 820.1	1 385.7	9 741.3	13 947.1	2 740.0	1 367.3	10 755.1	14 862.4

1) Urban and industrial.
2) Decentralised agricultural plant, municipal solid waste methanisation plant, centralised co-digestion plant.
3) A biomethane production by thermal processes has been included in the "other biogas" catégory in Italy representing 7,6 ktoe in 2013 and 5,5 ktoe in 2014. Estimate.* ***Source: EurObserv'ER 2015***

2

Gross electricity production from biogas in the European Union in 2013 and 2014 (in GWh)*

	2013			2014*		
	Electricity-only plants	CHP plants	Total electricity	Electricity-only plants	CHP plants	Total electricity
Germany	8 800.0	20 435.0	29 235.0	8 728.0	22 189.0	30 917.0
Italy	3 434.9	4 012.8	7 447.7	3 537.8	4 660.7	8 198.5
United Kingdom	6 032.4	611.8	6 644.2	6 232.0	668.6	6 900.6
Czech Republic	55.0	2 239.0	2 294.0	56.0	2 527.0	2 583.0
France	774.8	731.8	1 506.6	632.7	821.7	1 454.4
Netherlands	55.0	925.0	980.0	46.0	959.0	1 005.0
Spain	785.0	189.0	974.0	738.0	169.0	907.0
Belgium	108.5	665.3	773.8	133.7	735.2	869.0
Poland	0.0	690.0	690.0	0.0	816.0	816.0
Austria	572.0	58.0	630.0	563.0	52.0	615.0
Denmark	2.3	382.2	384.5	2.4	447.9	450.3
Latvia	0.0	287.0	287.0	0.0	350.0	350.0
Portugal	238.0	10.0	248.0	263.6	13.0	276.6
Hungary	92.0	175.0	267.0	88.6	168.4	257.0
Slovakia	117.0	96.0	213.0	120.0	100.0	220.0
Greece	38.2	177.2	215.4	36.2	183.5	219.7
Ireland	157.6	28.7	186.4	169.5	36.2	205.7
Finland	82.9	75.3	158.2	79.3	85.7	165.0
Slovenia	4.2	136.8	141.0	4.1	125.6	129.7
Croatia	19.3	58.4	77.7	46.3	68.0	114.4
Bulgaria	49.8	0.0	49.8	104.3	0.0	104.3
Lithuania	0.0	59.0	59.0	0.0	78.0	78.0
Luxembourg	0.0	56.5	56.5	0.0	60.5	60.5
Estonia	0.0	20.0	20.0	0.0	45.0	45.0
Cyprus	0.0	35.8	35.8	0.0	37.5	37.5
Romania	0.0	25.8	25.8	0.0	26.0	26.0
Sweden	0.0	20.0	20.0	0.0	14.0	14.0
Malta	0.0	3.0	3.0	0.0	3.0	3.0
Total EU	21 419.0	32 204.3	53 623.3	21 581.4	35 440.6	57 022.0

** Estimate. **Source: EurObserv'ER 2015***

3

Gross heat production from biogas in the European Union in 2013 and in 2014 (in ktoe) in the transformation sector***

	2013			2014*		
	Heat only plant	CHP plants	Total heat	Heat only plant	CHP plants	Total heat
Italy	0.3	200.8	201.0	0.3	238.5	238.8
Germany	45.9	70.5	116.5	54.4	102.8	157.2
Denmark	1.7	31.0	32.7	5.8	35.3	41.1
France	2.4	14.4	16.8	2.4	18.9	21.4
Latvia	0.0	14.2	14.2	0.0	18.2	18.2
Czech Republic	0.0	11.6	11.6	0.0	13.5	13.5
Finland	7.5	1.8	9.3	7.7	3.0	10.7
Sweden	7.2	6.1	13.3	4.0	4.8	8.8
Slovenia	0.0	8.8	8.8	0.0	8.4	8.4
Poland	0.3	8.7	9.0	0.3	6.8	7.1
Belgium	0.0	5.2	5.2	0.0	7.1	7.1
Austria	1.9	4.4	6.3	1.8	3.0	4.7
Romania	0.9	2.4	3.3	0.9	2.4	3.3
Croatia	0.0	2.7	2.7	0.0	3.2	3.2
Slovakia	0.0	2.8	2.8	0.0	2.9	2.9
Estonia	0.0	1.6	1.6	0.0	2.5	2.5
Lithuania	0.0	2.3	2.3	0.0	2.2	2.2
Hungary	2.1	0.0	2.2	2.1	0.0	2.2
Netherlands	0.0	3.7	3.7	0.0	1.1	1.1
Cyprus	0.0	1.0	1.0	0.0	1.0	1.0
Luxembourg	0.0	0.3	0.3	0.0	0.5	0.5
Total EU	70.3	394.3	464.6	79.7	476.1	555.9

** Estimate. ** Heat sold to the district heating network or to industrial plants. **Source: EurObserv'ER 2015***

The Italian biogas market is also sluggish. The ministerial decree of 6 July 2012 on new incentive systems for renewable electricity that came into force on 1 January 2013 has sent Italian biogas policy down a completely different route. Along the lines of Germany, the Italian government's aim is to rein in its biogas sector's growth by slashing the Feed-in Tariffs (by 10 to 30% depending on the segments) and applying a quota policy. Its new tariff policy also promotes the development of small installations (up to 600 kW) along with the use of farm sub-products and waste rather than energy crops. In the case of biomass plants (not only biogas), the ministerial decree limited the combined capacity of new installations to 170 MW in 2013, which was pared down to 160 MW in 2014 and 2015. However, according to Terna, the Italian electricity transmission network operator, the increase in gross biogas installation capacity was restricted to 17.8 MW, amounting to 1 406.1 MW of biogas capacity to date at the end of 2014 compared to 1 388.3 MW at the end of 2013. The number of biogas plants rose from 1 611 in 2013 to 1 681 in 2014. Farm biogas (agricultural waste and animal waste) alone accounted for 960.8 MW (945.7 MW in 2013) generated by 1 362 installations. The Ministry of Economic Development claims that the growth in biogas electricity output is sharper than installed capacity and is still benefitting from past investment. It rose to 8.2 TWh, which equates to 10.1% more than in 2013. However this level is a far cry from the increases of recent years (62.2% between 2012 and 2013, 35.7% between 2011 and 2012, 65.7% between 2010 and 2011). In 2010, biogas electricity output stood at just 2.05 TWh.

WHERE WILL BIOGAS STAND IN 2020 AND 2030?

Today methanization is fully recognized as an exemplary process for treating waste and recovering energy and that can reduce energy reliance on natural gas. However the development potential of the biogas sector now hangs in the balance as the very fast growth in production of the leading countries for agricultural methanization has been achieved by wholesale recourse to energy crops. The growth pattern has been recently challenged by the European Commission that insists that biogas production should be primarily based on the use of by-products and organic waste. Perforce, current uncertainties about forthcoming European legislation on biomass sustainability and limiting the use of energy crops have and will have an impact on the biogas sector's growth potential.

On the other hand, the countries of the EU are also under obligation to organize recovery circuits for the various types of organic waste and set up sorting systems to collect them, through European waste regulations (Directive 2008/98/EC). The application of this directive, and discussions are currently going on to strengthen its criteria (a draft directive has been filed along these lines), will contribute new fermentable waste to the sector that should make up in part for the decreased use of energy crops.

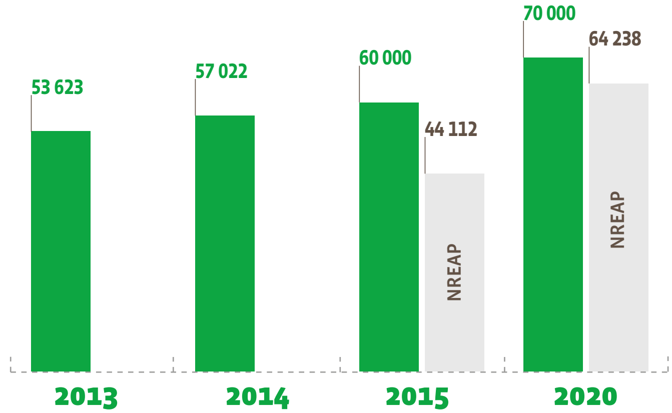
In order to recover, the biogas sector requires fast decisions about the environmental requirement levels for biogas and biomethane production with regard to GHG emissions, so that they can be included in the European renewable energy target calculations. Thus the future development of the biogas sector is essentially a political issue.

For this reason, the best estimates for 2020 are those of the National Renewable Energy Action Plans (NREAPs) defined by the individual Member States, that predict input from the biogas sector of up to 4 456 ktoe in heat output and 64.2 TWh (5 423 ktoe) of electricity (graph 1), giving combined final energy consumption of 9 879 ktoe for the EU of 28.

Its potential is considerable. According to EBA (the European Biogas Association), biogas plays a major role in reducing greenhouse gas emissions. It reckons that the production of 9.6 billion or so standardized m³ of biomethane reduces annual emission of CO_2 by 12.5 million tonnes. It reckons that the potential output of biomethane (including anaerobic digester biogas and biomass gasification) could be up to 48 billion standardized m³ by 2030 (equivalent of 40.6 Mtoe). Harnessing this potential while adopting with suitable policies would enable the industry to produce the equivalent of 10% of the European Union's current natural gas consumption.

4

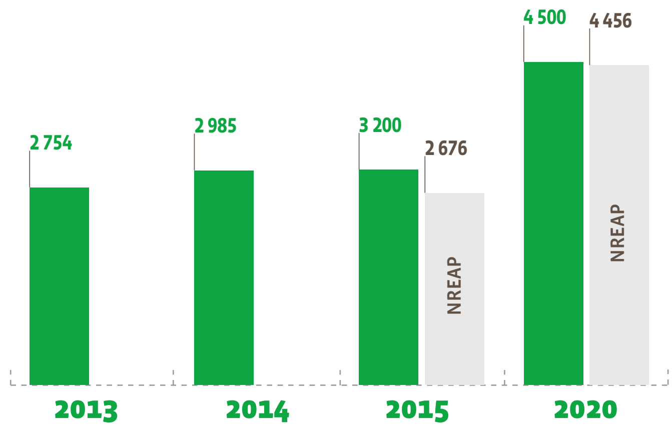
Comparison of the current trend of electricity from biogas generation against the NREAP (National Renewable Energy Action Plans) roadmap (GWh)



Source: EurObserv'ER 2015

5

Comparison of the current trend of biogas heat consumption against the NREAP (National Renewable Energy Action Plans) roadmap (ktoe)



Source: EurObserv'ER 2015

BIOFUELS

Biofuel consumption for transport picked up in Europe after a year of uncertainty and decline, increasing by 7.6% over 2013 (i.e. 1 Mtoe more), to 14.1 Mtoe according to EurObserv'ER. However it is still below its highest level of 14.5 Mtoe, achieved in 2012. This increase is entirely due to increased input from biodiesel (9.6%), as bioethanol consumption was stable (it fell by 0.5%).

According to EurObserv'ER, consumption in 2014 was spread between 11 234 ktoe of biodiesel, 2 669 ktoe of bioethanol, 133 ktoe of biogas fuel and 32 ktoe of other biofuel. Consumption of biofuel officially certified as sustainable, the only consumption that can be considered in European targets, reached its highest level in 2015 with 12.6 Mtoe (11.7 Mtoe in 2013) and thus amounts to 89.4% of European Union biofuel consumption. The reason for the uncertified share is that Spain and Portugal failed to implement the legal framework that would have recognized certification in 2014.

BIOFUEL'S FUTURE IS A LITTLE CLEARER

In April 2015, the European Parliament reached a compromise on the environmental impact of greenhouse gases caused by the growing use of farmland to produce biofuel. It was reached by factoring in the Indirect Land Use Changes (ILUC) effect in the European Union biofuel policy.

The ILUC effect shows that increase in agricultural raw materials consumption by the energy sector, when compensated by the planting of plots not originally dedicated to agriculture, generates additional greenhouse gas (GHG) emissions. The European Commission and Parliament stance was that this ILUC effect should be included in the biofuel production carbon balance. The parliamentarians hold that this inclusion which effectively calls into question the environmental performance levels of first-generation biofuel, justifies a change to the Member States' agrofuel consumption trajectories.

In the three years up to 2015, the European Commission, European Parliament and EU Council of Energy ministers battled and finally arrived at and passed an agreement on a draft directive on land use change on 28 April 2015 in the European Parliament. The text provides for both an agrofuel consumption incorporation ceiling of 7% for final energy transport by transport, with no change to the transport sector's 10% renewable energy consumption target to achieve by the same 2020 timeline. By setting a ceiling, the impact of land use change is effectively acknowledged and factored in.

The directive's other major purpose is to promote 2nd- and 3rd-generation or advanced biofuel consumption, with a non-binding target of 0.5% for the advanced biofuel energy share.

NEWS FROM AROUND THE MAIN CONSUMER COUNTRIES

French biofuel consumption picked up after stagnating in 2013,

1

Biofuel consumption for transport in the European Union in 2013 (toe)

	Bioethanol	Biodiesel	Biogas fuel	Other biofuels*	Total consumption	% certified sustainable
France	394 000	2 294 000	0	0	2 688 000	100%
Germany	777 730	1 823 135	41 798	884	2 643 548	100%
Italy	56 220	1 177 790	0	0	1 234 009	100%
United Kingdom	419 358	602 472	0	0	1 021 829	100%
Spain	170 141	729 100	0	0	899 241	0%
Poland	144 335	594 774	0	0	739 109	100%
Sweden	181 208	453 071	76 469	0	710 748	100%
Austria	57 571	462 310	0	0	519 882	86%
Belgium	48 228	282 620	0	0	330 849	100%
Netherlands	125 108	174 095	0	0	299 202	97%
Portugal	4 725	273 582	0	0	278 307	3%
Czech Republic	51 765	221 007	0	0	272 772	100%
Denmark**	0	223 616	0	0	223 616	100%
Romania	36 885	159 413	0	10 059	206 356	95%
Finland	69 897	134 232	929	0	205 058	88%
Hungary	32 474	87 233	0	16 526	136 233	88%
Slovakia	55 872	79 570	0	0	135 442	76%
Greece	0	122 838	0	0	122 838	19%
Bulgaria	8 380	95 880	0	0	104 260	100%
Ireland*	28 232	44 954	0	51	73 237	100%
Lithuania	6 769	51 907	0	0	58 675	95%
Luxembourg	647	52 721	0	137	53 504	100%
Slovenia	5 290	46 337	0	0	51 627	100%
Croatia	0	29 804	0	0	29 804	100%
Latvia	6 305	12 444	0	0	18 749	100%
Cyprus	0	14 772	0	0	14 772	31%
Malta	0	2 909	0	0	2 909	100%
Estonia	0	0	0	0	0	0%
Total EU 28	**2 681 140**	**10 246 585**	**119 196**	**27 656**	**13 074 576**	**89.1%**

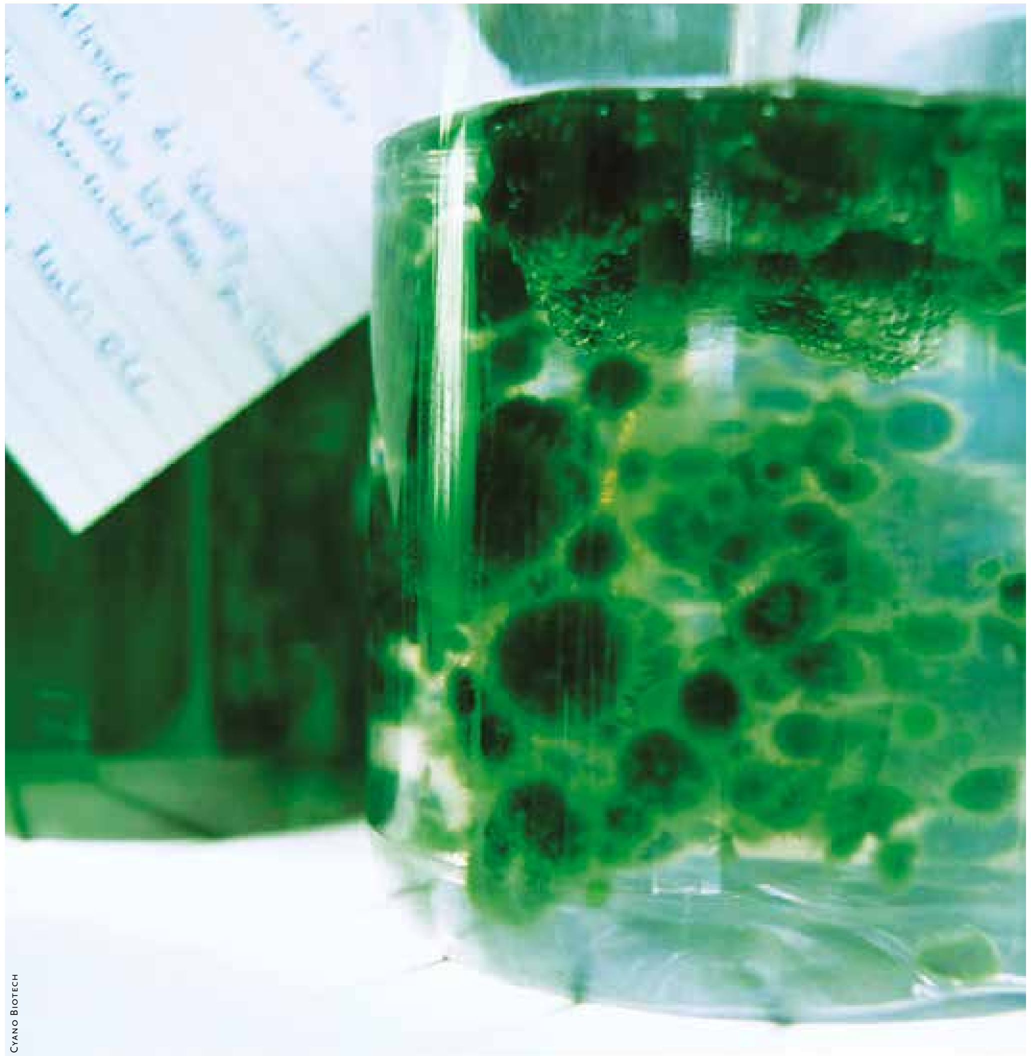
** Vegetable oils used pure and unspecified biofuel. ** For Denmark, biodiesel and bioethanol is mixed due to confidentiality, so the figure contains both bioethanol and biodiesel.* ***Source: EurObserv'ER 2015***

2

Biofuel consumption for transport in the European Union in 2014 (toe)*

	Bioethanol	Biodiesel	Biogas fuel	Other biofuels**	Total consumption	% certified sustainable
France	414 000	2 541 000	0	0	2 955 000	100%
Germany	792 563	1 907 974	42 992	5 302	2 748 831	100%
United Kingdom	415 773	751 123	0	0	1 166 896	100%
Italy	7 764	1 055 134	0	0	1 062 898	100%
Spain	180 891	798 489	0	0	979 380	0%
Sweden	166 557	626 969	88 744	0	882 271	100%
Poland	133 658	557 681	0	0	691 339	100%
Austria	60 163	480 131	0	0	540 293	87%
Finland	69 897	364 636	1 462	0	435 995	100%
Belgium	36 453	350 487	0	0	386 939	100%
Netherlands	128 332	220 933	0	0	349 265	96%
Czech Republic	78 617	265 484	0	0	344 101	100%
Portugal	5 121	290 759	0	0	295 880	5%
Denmark***	0	228 420	0	0	228 420	100%
Romania	36 885	159 413	0	10 059	206 356	95%
Hungary	38 943	95 666	0	16 968	151 577	89%
Slovakia	55 872	79 570	0	0	135 442	100%
Greece	0	133 443	0	0	133 443	23%
Ireland****	25 268	64 689	0	0	89 958	100%
Luxembourg	3 115	65 451	0	65	68 632	100%
Lithuania	6 751	57 556	0	0	64 308	85%
Bulgaria	0	53 429	0	0	53 429	100%
Croatia	0	29 354	0	0	29 354	100%
Slovenia	6 016	23 095	0	0	29 111	100%
Latvia	6 138	15 907	0	0	22 045	100%
Cyprus	0	13 277	0	0	13 277	100%
Malta	0	3 975	0	0	3 975	100%
Estonia	0	0	0	0	0	0%
Total EU 28	**2 668 778**	**11 234 045**	**133 199**	**32 394**	**14 068 415**	**89.4%**

Note: *The consumption data were not available at the time of our survey for Romania and Slovakia. Eurobserv'ER has decided to use the same figures as for 2013. * Estimate. ** Pure used vegetable oil and unspecified ethanol is mixed due to confidentiality, so the figure contains both bioethanol and biodiesel. *** For Denmark, biodiesel and bioethanol is mixed due to confidentiality, so the figure contains both bioethanol and biodiesel. **** For confidentiality reasons, vegetable oil consumption has been added to biodiesel in Ireland.* ***Source: EurObserv'ER 2015***

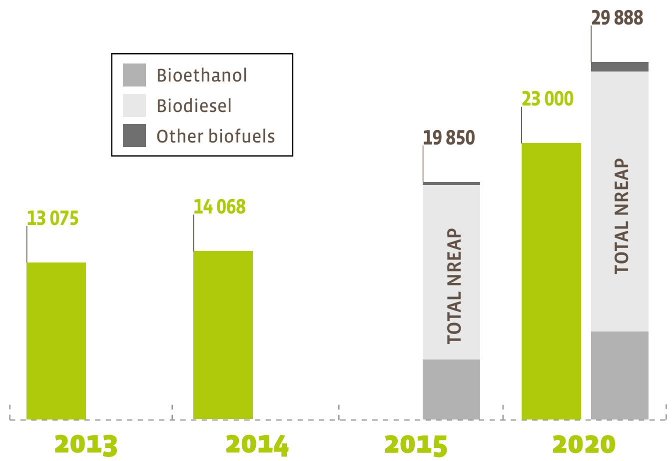


consolidating its European Union top biofuel consumer slot. The Sustainable Development Ministerial Statistical Department (SOeS) statistics for biofuel release for consumption in transport claimed 2 955 ktoe (414 ktoe of bioethanol and 2 541 ktoe of biodiesel). Growth in biodiesel consumption (10.8%) exceeded that of bioethanol (5.2%) and is put down to the rise in the General Tax on Polluting Activities (TGAP), which rose to 7.7% for the diesel sector on 1 January 2014 (kept at 7% for the petrol sector).

German biofuel consumption recovered slightly after posting a sharp drop between 2012 and 2013. Figures from AGEE-Stat, the Working Group on Renewable Energy Statistics for the Federal Environment Ministry, show that in 2014 the German road and rail transport sectors (excluding farming and the army) used 3 430 000 tonnes of biofuel (2 159 000 tonnes of biodiesel, 1 229 000 tonnes of bioethanol, 36 000 tonnes of biogas fuel and 6 000 tonnes of pure vegetable oil), compared to 3 305 000 tonnes in 2013 (2 063 000 tonnes of biodiesel, 1 206 000 tonnes of bioethanol, 35 000 tonnes of biogas and 1 000 tonnes of vegetable

3

Comparison of the current biofuel consumption trend (ktoe) against the NREAP (National Renewable Energy Action Plans) roadmap*



** Consumption of certified sustainable and unsustainable biofuel.*
Source: EurObserv'ER 2015

oil). When EurObserv'ER converts this data to energy equivalent consumption, total German consumption is put at 2 748 831 toe in 2014… a 4% rise on 2013 (2 643 548 toe in 2013). AGEE-Stat's provisional incorporation rate in energy content is put at 5.3% in 2014, as against 5.2% in 2013. Officially the incorporation quota, which factors in double counting, was set at 6.25% from 2010 to 2014 (thus this figure cannot be directly compared with the 5.3% for 2014). A decree dated 10 October published in the Official Journal (Gazzetta Ufficiale) set Italy's new biofuel incorporation targets for 2015–2022. The incorporation rates in biofuel energy content will gradually rise from 5% in 2015 to 10% in 2020 (5.5% in 2016, 6.5% in 2017, 7.5% in 2018 and 9% in 2019), then stay at 10% in 2021 and 2022. Furthermore Italy has set a compulsory incorporation rate target for advanced biofuel, a first in the European Union, while in 2018 and 2019, petrol and diesel must contain at least 1.2% of advanced biofuel. In 2020 and 2021, this incorporation rate will rise to 1.6% and further to 2% in 2022.

In the interim, the Ministry of Economic Development's first estimates suggest lower biofuel consumption. Consumption of biodiesel used in blends dropped from 1 332 748 to 1 193 955 tonnes and bioethanol consumption from 87 178 to 12 039 tonnes. When EurObserv'ER converts this data to energy, it puts Italian biofuel consumption at 1 062 898 toe in 2014, a drop of 13.9%.

THE 2020 TARGETS… STILL ACHIEVABLE

The three years it has taken to settle the issue of factoring in the ILUC effect, have stalled biofuel development. First-generation biofuel was the main target of the reform, but regulatory uncertainties have also retarded the development of second-generation biofuel. The delays in making decisions tended to negate the efforts made to give long-term visibility to investors in advanced biofuel. As a result, reaching the 10% renewable energy target in transport is still achievable, but depends more than ever on the individual countries' political determination.

Member States' capacity to fulfil their targets by using "advanced" biofuel and via "renewable" electrical mobility is not so clear-cut, although their consumption also benefits from special accounting in target calculations. Effectively, the European Commission wishes to concentrate its efforts through these two channels… alternative fuels and e-mobility. In February, it presented a strategic document on the creation of an Energy Union that proposes to set up a "strategic framework for a resilient Energy Union with a forward-looking climate change policy". One of the action points covers decarbonisation in the transport sector.

RENEWABLE URBAN WASTE

In 2014, production of primary renewable energy recovered by household refuse incineration plants across the European Union increased by 281 ktoe (3.2%) to reach the 9 Mtoe mark. Note that this output figure only includes the biodegradable part of household refuse; hence it excludes the energy recovered from non-renewable municipal waste (plastic packaging, etc.).

According to the data gathered by EurObserv'ER, growth in electricity and final heat output outstripped that of primary energy output. The production of electricity qualified as sourced from renewable municipal waste increased by 5.9% over the twelve-month study period to 19.5 TWh. Heat sales to heating networks increased by 6.6% to nearly 2.5 Mtoe. The rising number of heat and electricity outlets results from waste-to-energy incineration plants' improved energy efficiency and is stimulated by European legislation, primarily through the transposition of the framework directive on waste (2008/98/EC) that encourages operators to optimize the energy efficiency of their plants. The Directive stipulates that the incinerators can only be classed as waste-to-energy recovery units if they meet minimum yield criteria, which in the case of plant constructed since 31 December 2008 must be at least equal to 65%. The energy efficiency of those constructed prior to 2008 must be at least 60%.

Within the European Union thermal energy recovery levels from municipal waste vary wildly. The per capita primary energy production indicator illustrates that the Nordic countries (88.9 toe/1000 inhab. for Sweden, 87.1 toe/1000 inhab. for Denmark, and 45.2 toe /1000 inhab. for Finland) and the Netherlands (47.2 toe/1000 inhab.) lead the way in developing this sector. Municipal waste-to-energy recovery levels pale by comparison in countries such as France (17.9 toe/1000 inhab.), where many old-generation design plants were primarily built to process waste rather than recover energy. The countries of Central and Southern Europe in particular have invested very little in recovering energy from their household refuse.

NEWS FROM AROUND THE COUNTRIES

Belgium is one of the countries to have seen its primary renewable energy output from household refuse increase significantly yet has not commissioned any new plants. SPF Economie data shows that Belgium's energy production increased by 18.3% in 2014 to reach 348.6 ktoe and this improved recovery level was fully harnessed by generating 809.6 GWh of electricity, a 23.3% rise and 32.6 ktoe of heat, whose sales to heating networks increased by 39.7%. However, the primary energy output remained below its 2011 record level of 482.4 ktoe.

The Netherlands is one of the leading waste-to-energy producer countries. According to Statistics Netherlands, primary energy output from renewable municipal waste stood at 794.2 ktoe in 2014, which is slightly less (0.6%) than in 2013. Along with Germany, the country is a waste importer. Both countries source from the

1

Primary energy production from renewable municipal waste in the European Union in 2013 and 2014 (in ktoe)*

	2013	2014*
Germany	2 926.6	3 037.0
France	1 158.5	1 179.2
Italy	827.6	858.4
Sweden	820.2	857.7
Netherlands	798.8	794.2
Denmark	492.2	489.0
United Kingdom	485.9	471.9
Belgium	294.8	348.6
Finland	222.0	246.6
Spain	199.7	204.2
Austria	152.0	179.5
Czech Republic	82.9	82.5
Portugal	96.7	81.8
Ireland	48.7	51.6
Hungary	42.5	43.6
Poland	33.2	37.1
Bulgaria	21.0	21.0
Slovakia	15.5	16.7
Luxembourg	17.0	16.1
Lithuania	11.2	11.3
Slovenia	7.4	7.7
Malta	1.0	1.0
Total EU	**8 755.5**	**9 036.8**

* Estimate. **Source: EurObserv'ER 2015**

2

Gross electricity production from renewable municipal waste in the European Union in 2013 and 2014 (in GWh)*

	2013			2014*		
	Electricity-only plants	CHP plants	Total	Electricity-only plants	CHP plants	Total
Germany	3 273.0	2 141.0	5 414.0	3 683.0	2 386.0	6 069.0
Italy	1 229.4	976.5	2 205.9	1 256.5	1 113.8	2 370.3
United Kingdom	1 013.9	635.4	1 649.3	1 224.9	725.4	1 950.3
Netherlands	0.0	2 076.0	2 076.0	0.0	1 909.0	1 909.0
France	1 145.9	681.4	1 827.3	1 113.1	711.5	1 824.6
Sweden	0.0	1 702.0	1 702.0	0.0	1 626.0	1 626.0
Denmark	0.0	874.0	874.0	0.0	885.0	885.0
Belgium	249.6	406.8	656.4	344.7	464.9	809.6
Spain	682.0	0.0	682.0	682.0	0.0	682.0
Finland	58.1	337.4	395.5	56.7	383.0	439.7
Austria	219.0	36.0	255.0	243.0	42.0	285.0
Portugal	286.0	0.0	286.0	240.0	0.0	240.0
Hungary	0.0	136.0	136.0	0.0	137.0	137.0
Czech Republic	0.0	84.0	84.0	0.0	88.0	88.0
Ireland	0.0	68.9	68.9	0.0	68.0	68.0
Luxembourg	0.0	36.0	36.0	0.0	34.0	34.0
Lithuania	0.0	19.0	19.0	0.0	29.0	29.0
Slovakia	0.0	21.0	21.0	0.0	23.0	23.0
Malta	0.0	9.0	9.0	0.0	9.0	9.0
Slovenia	0.0	7.4	7.4	0.0	7.3	7.3
Bulgaria	0.0	0.0	0.0	0.0	0.0	0.0
Total EU	**8 156.9**	**10 247.7**	**18 404.5**	**8 843.9**	**10 641.9**	**19 485.9**

** Estimate.* ***Source: EurObserv'ER 2015***

UK, whose own waste treatment capacities are inadequate. This import policy results from the over-dimensioning of its ultra-modern incineration plants that were purpose-designed for energy recovery. The significant increase in heat output witnessed in 2014 can be explained by the commissioning of new connections to serve industry (in the form of steam) and heating networks (hot water production). Heat sales grew by 8.7% between 2013 and 2014 to 232.8 ktoe. This development hit renewable electricity output, which dropped by 8% to 1.9 TWh.

The UK is making up for part of its waste energy recovery shortfall. According to Ecoprog, a German consulting firm specializing in environmental markets, about 20 waste-to-energy incineration plants should be commissioned by 2017 offering 4.6 million tonnes of annual treatment capacity. The UK has changed its accounting method for the biodegradable content of its solid municipal waste, with the upshot that its production figures are lower. According to the Department of Energy & Climate Change (DECC), primary energy output from municipal waste is now put at 471.9 ktoe in 2014, which is 2.9% less than in 2013. However this output has been used more efficiently for final energy production. DECC also claims that 18.3% more electricity was generated from renewable municipal waste and achieved its highest output to date (1 950 GWh). Heat produced by the sector also increased (by 26.5% year-on-year) to 21 ktoe, which is back to its 2012 level.

3

Gross heat production from renewable municipal waste in the European Union in 2013 and in 2014 (in ktoe) in the transformation sector***

	2013			2014*		
	Heat only	CHP plants	Total	Heat only	CHP plants	Total
Germany	288.2	431.5	719.7	244.4	462.8	707.2
Sweden	46.0	492.6	538.6	42.2	534.1	576.3
Denmark	32.3	281.5	313.8	32.7	299.9	332.7
France	55.6	170.2	225.9	55.6	213.9	269.5
Netherlands	0.0	214.1	214.1	0.0	232.8	232.8
Finland	5.9	92.8	98.7	13.8	105.1	118.9
Italy	0.0	83.3	83.3	0.0	85.2	85.2
Austria	14.4	32.2	46.6	14.5	37.3	51.8
Czech Republic	0.0	35.5	35.5	0.0	37.5	37.5
Belgium	3.3	20.0	23.4	3.3	29.3	32.6
United Kingdom	16.6	0.0	16.6	21.0	0.0	21.0
Hungary	0.0	6.9	6.9	0.0	8.8	8.8
Lithuania	0.0	5.5	5.5	0.0	7.1	7.1
Slovenia	0.0	2.5	2.5	0.0	3.1	3.1
Malta	1.0	0.0	1.0	1.0	0.0	1.0
Slovakia	0.0	0.6	0.6	0.0	0.7	0.7
Total EU	**463.3**	**1 869.4**	**2 332.7**	**428.5**	**2 057.7**	**2 486.3**

** Estimate. ** Heat sold to heating networks.* ***Source: EurObserv'ER 2015***

ACCELERATION PLANNED FROM 2017 ONWARDS

For the time being, primary energy output from waste-to-energy recovery is enjoying restrained growth. Nonetheless, pressure from Europe is gradually trickling through and sparking off investment decisions, primarily in Eastern Europe most of which is facing a blank canvas. It stands to reason that if these countries are to fall in line, they will have to start investing in waste-to-energy recovery in the second half of this decade and appreciably more from 2017 onwards. This should give the sector new impetus over the medium term.

Looking at prospects, CEWEP estimates that the energy contribution of waste to the renewable energy directive targets could realistically reach 67 TWh by 2020 distributed respectively between 25 TWh of electricity and 42 TWh (3.6 Mtoe) of heat. The 2020 potential is assessed at 98 TWh split between 37 TWh of electricity and 61 TWh (5.3 Mtoe) of heat. The Confederation points out that the total contribution of municipal waste, renewable and otherwise, would double those figures, namely 134 TWh by 2020, for a potential of 196 TWh.

EurObserv'ER projects total heat consumption (heat from the processing sector and final heat consumption) at 3.2 Mtoe (including 2.5 Mtoe of heat sold to heating networks) and considers CEWEP's 2020 heat target to be quite feasible. The commissioning of new incineration plants in the UK, combined with the enhanced energy efficiency of existing plants, should enable 25 TWh to be achieved by 2020.

SOLID BIOMASS

Solid biomass includes all the solid organic components to be used like fuels like wood, wood waste (wood chips, sawdust, etc.), wood pellets, black liquors, straw, bagasse, animal waste and other plant matter and residues.

According to EurObserv'ER, solid biomass consumption as primary energy in the EU of 28 amounted to 89.5 Mtoe in 2014, which is 2.5% less than in 2013. The exceptionally mild winter of 2014 which reduced heating requirements over much of Europe (the Northern, Western and Central European countries) is the main culprit for this slowdown. Solid biomass primary energy output, corresponding to solid biomass sourced from the European Union fell even more (by 3.4%, or 84.7 Mtoe in 2014). The difference, made up of net imports, has tended to increase over the past three years, rising from 2.6 Mtoe in 2012, to 4.0 Mtoe in 2013 and to 4.8 Mtoe in 2014.

EurObserv'ER distinguishes the final energy uses, namely electricity and heat. Furthermore solid biomass heat is broken down by distribution method – district heating networks (sold heat) and final consumer direct consumption using heating appliances (boilers, burners, inserts, etc.). EurObserv'ER asserts that at about 9.1 Mtoe, gross solid biomass heat output sales to district heating networks were stable over the twelve months to 2014. This contrasts with heat directly used by end consumers which dropped sharply (by 4.9% compared to 2013) to 61.2 Mtoe in 2014. If these two elements are added together, total biomass heat consumption as final energy dropped by 4.3% to 70.2 Mtoe.

The opposite trend applies to solid biomass electricity output across the EU, which is higher, primarily thanks to a sharp increase in production by the UK and Poland. It rose by 3.6 TWh over the twelve month study period to 84.8 TWh (4.4% more than in 2013). The other countries' outputs are very inconsistent with drops in output registered in Belgium, Sweden, Finland, the Netherlands, Austria and Spain, while Germany put on slight growth in 2014 but has not recovered its 2012 level.

THE UK TOPS THE SOLID BIOMASS ELECTRICITY PRODUCER RANKS

By converting a number of coal-fired power plants to biomass, the UK has become the European Union's top-ranked solid biomass electricity producer in next to no time. According to the DECC, the UK generated 13.9 TWh in 2014, up from 9.9 TWh in 2013 (40.4% more)… a remarkable achievement given that solid biomass electricity output was only 4.6 TWh in 2010. The spurt put on between 2013 and 2014 can essentially be ascribed to the conversion of the second Drax coal-fired power plant unit on the Selby site. A third unit at the same site should start up in co-combustion regime in 2015, heralding its outright conversion subject to obtaining aid with production.

FRENCH FORESTRY HARNESSED

The French Sustainable Development Ministerial Statistical Department (SOeS) confirms that the drop in the country's solid biomass primary energy consumption

was unusually sharp (14.7% down on 2013) falling to 8.9 Mtoe in 2014 and was mainly caused by the plunge in the domestic segment's heating needs. However the fall should not be interpreted as a rejection of solid biomass energy in France. The French government actually ramped up the initiatives to encourage the use of biomass for heating requirements, primarily through the Heat Fund mechanism.

On 20 April 2015, the Élysée announced it was boosting the mechanism by doubling the credits allocated to this fund for three years. They will rise to 520 million euros in 2017. The heat fund results for 2009-2014 are excellent with 640 biomass boiler plants funded in the collective and industrial sectors, equating to 1.1 Mtoe of biomass consumption. ADEME says that biomass took up 48% of a total of 1.2 billion euros of aid granted under the heat fund over the period.

SWEDEN'S CONSUMPTION DROPS FURTHER

Statistics Sweden claims that solid biomass energy consumption fell to 9 Mtoe in 2014 and has declined for the second year running, 2.8% down on its 2013 (9.2 Mtoe) and 6.3% down on its 2012 (9.6 Mtoe) levels respectively. Electricity production has fallen dramatically, by 5.5% between 2013 and 2014 (i.e. 9.1 TWh in 2014), and by 13.6% between 2014 and 2012. Solid biomass energy use as heat (7.5 Mtoe including 2.3 Mtoe in district heating networks) is also declining but to a lesser extent (1.8% between 2013 and 2014, 5.5% between 2012 and 2014). This consumption matches its heating needs. According to the Swedish Energy Agency, energy consumption for heating was exceptionally low in 2014 – the lowest rate observed since the 2000s, because of a remarkably warm year.

LOFTY AMBITIONS FOR 2020

Will climate warning affect the European Union's solid biomass energy growth forecasts to 2020? It may be too early to say, but the string of mild winters seems to have checked the almost continuous growth in solid biomass consumption observed over the last decade. Consumption trends have also been affected, which is a good thing, by the energy efficiency efforts made

1

Primary energy production and gross consumption from solid biomass in the European Union in 2013 and 2014 (Mtoe)*

	2013		2014*	
	Production	Consumption	Production	Consumption
Germany	10.902	10.902	11.425	11.425
Sweden	9.211	9.211	8.958	8.958
France**	10.383	10.383	8.853	8.853
Finland	8.113	8.141	8.105	8.125
Italy	7.448	8.848	6.539	8.066
Poland	6.837	6.837	6.179	6.755
Spain	4.582	5.356	4.562	5.276
Austria	4.700	4.918	4.378	4.542
Romania	3.657	3.591	3.423	3.591
United Kingdom	2.746	3.912	3.048	4.724
Portugal	2.684	2.355	2.685	2.364
Czech Republic	2.293	2.173	2.301	2.222
Latvia	1.749	1.269	2.044	1.334
Hungary	1.454	1.407	1.537	1.474
Croatia	1.465	1.232	1.375	1.093
Denmark	1.431	2.446	1.304	2.350
Netherlands	1.206	1.263	1.290	1.154
Estonia	1.067	0.793	1.122	0.789
Lithuania	1.041	1.026	1.117	1.084
Belgium	1.389	2.016	1.104	1.689
Greece	0.847	0.928	0.869	0.930
Slovakia	0.818	0.813	0.836	0.831
Bulgaria	0.822	1.028	0.824	0.990
Slovenia	0.628	0.628	0.560	0.560
Ireland	0.183	0.218	0.210	0.252
Luxembourg	0.048	0.049	0.066	0.064
Cyprus	0.005	0.009	0.005	0.009
Malta	0.001	0.001	0.001	0.001
Total EU	87.710	91.756	84.721	89.507

** Estimate. ** Overseas departments not included.* ***Source: EurObserv'ER 2015***

2

Gross electricity production from solid biomass in the European Union in 2013 and 2014 (in TWh)*

	2013			2014*		
	Electricity-only plants	CHP plants	Total electricity	Electricity-only plants	CHP plants	Total electricity
United Kingdom	9.866	0.000	9.866	13.852	0.000	13.852
Germany	5.199	6.444	11.643	5.333	6.535	11.868
Finland	1.490	9.968	11.457	1.227	9.927	11.154
Poland	0.000	7.932	7.932	0.000	9.160	9.160
Sweden	0.000	9.609	9.609	0.000	9.077	9.077
Italy	2.142	1.537	3.679	2.031	1.792	3.823
Spain	2.906	1.238	4.144	2.856	0.965	3.821
Austria	1.109	2.590	3.699	1.129	2.308	3.437
Denmark	0.000	3.103	3.103	0.000	3.004	3.004
Belgium	2.218	1.136	3.354	1.244	1.388	2.632
Portugal	0.736	1.780	2.516	0.765	1.765	2.530
Netherlands	1.669	1.230	2.899	1.436	0.662	2.098
Czech Republic	0.015	1.668	1.683	0.054	1.938	1.992
France**	0.069	1.297	1.367	0.095	1.543	1.637
Hungary	1.377	0.093	1.470	1.265	0.165	1.430
Slovakia	0.000	0.722	0.722	0.000	0.758	0.758
Estonia	0.030	0.615	0.645	0.061	0.652	0.713
Romania	0.000	0.411	0.411	0.000	0.637	0.637
Latvia	0.007	0.208	0.215	0.007	0.312	0.319
Lithuania	0.000	0.279	0.279	0.000	0.293	0.293
Ireland	0.210	0.014	0.224	0.248	0.014	0.262
Slovenia	0.000	0.119	0.119	0.000	0.125	0.125
Bulgaria	0.001	0.093	0.094	0.001	0.099	0.100
Croatia	0.000	0.048	0.048	0.000	0.050	0.050
Luxembourg	0.000	0.002	0.002	0.000	0.021	0.021
Total EU 28	29.045	52.137	81.181	31.603	53.189	84.791

** Estimate. ** Overseas departments not included.* ***Source: EurObserv'ER 2015***

3

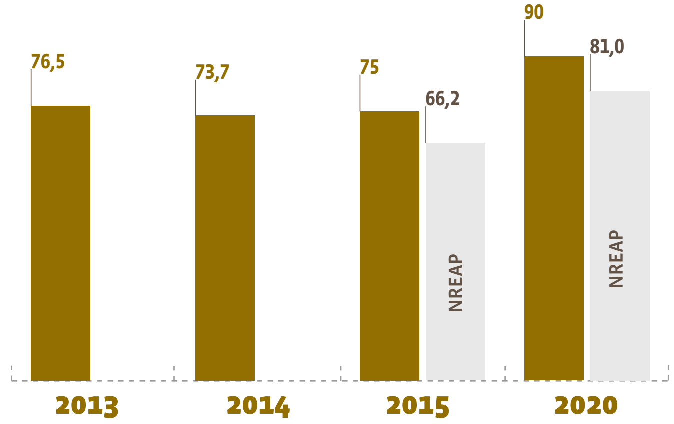
Heat consumption from solid biomass in the countries of the European Union in 2013 and 2014** (Mtoe)*

	2012	of which district heating	2013	of which district heating
Germany	8.022	0.534	8.375	0.537
France***	9.727	0.530	8.150	0.431
Sweden	7.626	2.353	7.487	2.301
Italy	7.383	0.517	6.594	0.593
Finland	6.396	1.728	6.454	1.759
Poland	5.112	0.373	4.772	0.334
Austria	4.096	0.833	3.758	0.793
Spain	3.745	0.000	3.735	0.000
Romania	3.502	0.121	3.417	0.176
United Kingdom	1.966	0.004	2.036	0.004
Denmark	2.022	1.008	1.948	0.989
Czech Republic	1.794	0.119	1.794	0.139
Portugal	1.838	0.000	1.742	0.000
Belgium	1.292	0.024	1.151	0.023
Hungary	1.087	0.072	1.143	0.072
Latvia	1.141	0.154	1.110	0.103
Croatia	1.201	0.006	1.058	0.006
Lithuania	0.938	0.268	0.990	0.355
Bulgaria	1.028	0.025	0.988	0.040
Greece	0.922	0.000	0.927	0.000
Estonia	0.665	0.193	0.653	0.181
Netherlands	0.603	0.032	0.651	0.025
Slovenia	0.604	0.020	0.537	0.019
Slovakia	0.496	0.174	0.512	0.183
Ireland	0.169	0.000	0.196	0.000
Luxembourg	0.048	0.003	0.059	0.011
Cyprus	0.007	0.000	0.007	0.000
Malta	0.001	0.000	0.001	0.000
Total EU	**73.432**	**9.093**	**70.244**	**9.073**

** Consumption of the end user (either as heat sold by the district heating or self-consumed, either as fuels for the production of heat and cold). ** Estimate. *** Overseas departments not included. **Source: EurObserv'ER 2015***

4

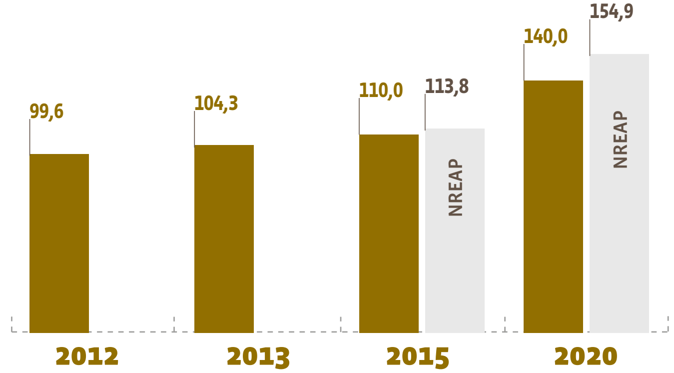
Comparison of the current solid biomass heat consumption trend (Mtoe) against the NREAP (National Renewable Energy Action Plan) roadmaps



*This data includes an estimate of renewable heat from municipal waste incineration plants. **Source: EurObserv'ER 2015***

5

Comparison of the current solid biomass electricity production trend (TWh) against the NREAP (National Renewable Energy Action Plans) roadmaps



*This data includes an estimate of renewable electricity from municipal waste incineration plants. **Source: EurObserv'ER 2015***

by the European Union countries, primarily by renewing the domestic heating system base.
As it stands, most of the countries appear to be on track for achieving their 2020 biomass heat consumption targets set in their National Renewable Energy Action Plans (NREAP). Some countries like Austria, Poland, Italy, Slovenia and Estonia have already fulfilled their commitments. No doubt it will be harder for France and the UK, with their particularly ambitious targets, to make target. Nonetheless, the common aim set out in the NREAPs, which includes renewable heat from household refuse incinerators, should be easily exceeded by 2020. However biomass heat development will soon run out of steam, which has prompted EurObserv'ER to scale back its forecasts for 2020.

Turning to electricity production, achieving the NREAP 2020 targets, namely 155 TWh of output, will depend on the pace of coal-fired power plant conversions and the increase in the amount of biomass used in CHPs. Once again, while a few countries will easily reach their targets, such as Germany, Italy, Austria, Finland, Sweden and Denmark, others, such as France, Poland, the Netherlands, Belgium and Spain have a lot of ground to cover. The current very keenly priced tonne of coal on the global market compounded by the European community system's very low CO_2 emissions trading price are not conducive to accelerating the conversion pace or use of biomass fuel. Solid biomass fuels also suffer from competition from other renewable electricity-generating sectors, which have posted very high competitiveness gains in recent years. Lastly, Europe's electricity production facilities' overcapacity, caused by the drop in European electricity consumption, is no incentive to rush into investing in biomass electricity. In the absence of any additional GHG emission constraints on coal-fired plants, the achievement of the NREAP targets hangs in the balance.

CONCENTRATED SOLAR POWER

Concentrated solar power covers all the technologies that aim to transform the sun's rays into very high-temperature heat. This thermal energy can be used to produce electricity, via thermodynamic cycles or supply industrial processes that run on very high temperature levels (up to 250°C). Concentrated solar systems harness optical concentration devices that convert direct solar radiation.

The four main technologies are tower plants and dish concentrator plants (Dish Stirling), that concentrate the radiation on a given point, those that use parabolic trough collectors and Compact linear Fresnel reflectors (CLFR), that concentrate the radiation on to a linear receiver (a tube containing heat transfer fluid).

One of the particular advantages of concentrated solar power is that it passes through a heat production stage prior to conversion into electricity, which means it can be combined with other renewable energies such as biomass and waste, and also with conventional sources such as natural gas and coal. The other advantage is that the energy can be stored as heat using various processes such as molten salts – hence the plants can operate outside of sunshine periods and during peak consumption periods at the end of the day.

CSP HAS A BLANK YEAR IN THE EUROPEAN UNION

In 2014 the European Union's concentrated solar power capacity did not change from its 2013 level of 2 311.5 MW. EurObserv'ER puts the capacity of development projects at about 608.1 MW in 2015 with the caveat that the granting of requisite authorizations and/or setting up of suitably rewarding incentive schemes were outstanding.

For the time being Spain is the only country in Europe to have developed a commercial concentrated solar power generating sector. However in 2014, No additional CSP capacity was added in Spain over the last twelve months showing little likelihood of any new developments for the rest of this decade. The Spanish Energy Ministry report released in February 2015 forecast only 211 MW of additional CSP capacity by 2020 through a tendering system. The surprise announcement, which has yet to be confirmed, appears to virtually mothball the country's CSP sector by making a U-turn from the Spanish NREAP targets.


Solar Euromed

The 50 Spanish concentrated solar power plants, totalling 2 304 MW of combined capacity have delivered all their promises. As the last power plants were commissioned in 2013, the country's entire CSP capacity has been up and running for a full reference year. According to IDAE (the Institute for Diversification and Energy Saving), the combined output of these plants was 5 455 GWh in 2014 compared to 4 770 GWh in 2013 (consolidated figures), i.e. a 14.4% increase.

Taking a leaf out of Spain's books, Italy did not connect any CSP plants to the grid in 2014. Construction is underway on

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1

Concentrated solar power plant in operation in the European Union at the end of 2014

Projects	Technology	Capacity (MW)	Commisionning date
Spain			
Planta Solar 10	Central receiver	10	2006
Andasol-1	Parabolic trough	50	2008
Planta Solar 20	Central receiver	20	2009
Ibersol Ciudad Real (Puertollano)	Parabolic trough	50	2009
Puerto Errado 1 (prototype)	Linear Fresnel	1,4	2009
Alvarado I La Risca	Parabolic trough	50	2009
Andasol-2	Parabolic trough	50	2009
Extresol-1	Parabolic trough	50	2009
Extresol-2	Parabolic trough	50	2010
Solnova 1	Parabolic trough	50	2010
Solnova 3	Parabolic trough	50	2010
Solnova 4	Parabolic trough	50	2010
La Florida	Parabolic trough	50	2010
Majadas	Parabolic trough	50	2010
La Dehesa	Parabolic trough	50	2010
Palma del Río II	Parabolic trough	50	2010
Manchasol 1	Parabolic trough	50	2010
Manchasol 2	Parabolic trough	50	2011
Gemasolar	Central receiver	20	2011
Palma del Río I	Parabolic trough	50	2011
Lebrija 1	Parabolic trough	50	2011
Andasol-3	Parabolic trough	50	2011
Helioenergy 1	Parabolic trough	50	2011
Astexol II	Parabolic trough	50	2011
Arcosol-50	Parabolic trough	50	2011
Termesol-50	Parabolic trough	50	2011
Aste 1A	Parabolic trough	50	2012
Aste 1B	Parabolic trough	50	2012
Helioenergy 2	Parabolic trough	50	2012
Puerto Errado II	Linear Fresnel	30	2012
Solacor 1	Parabolic trough	50	2012
Solacor 2	Parabolic trough	50	2012

Continues overleaf

Projects	Technology	Capacity (MW)	Commisionning date
Helios 1	Parabolic trough	50	2012
Moron	Parabolic trough	50	2012
Solaben 3	Parabolic trough	50	2012
Guzman	Parabolic trough	50	2012
La Africana	Parabolic trough	50	2012
Olivenza 1	Parabolic trough	50	2012
Helios 2	Parabolic trough	50	2012
Orellana	Parabolic trough	50	2012
Extresol-3	Parabolic trough	50	2012
Solaben 2	Parabolic trough	50	2012
Termosolar Borges	Parabolic trough + HB	22,5	2012
Termosol 1	Parabolic trough	50	2013
Termosol 2	Parabolic trough	50	2013
Solaben 1	Parabolic trough	50	2013
Casablanca	Parabolic trough	50	2013
Enerstar	Parabolic trough	50	2013
Solaben 6	Parabolic trough	50	2013
Arenales	Parabolic trough	50	2013
Total Spain		**2 303.9**	
Italy			
Archimede (prototype)	Parabolic trough	5	2010
Archimede-Chiyoda Molten Salt Test Loop	Parabolic trough	0.35	2013
Total Italy		**5.35**	
Germany			
Jülich	Central receiver	1.5	2010
Total Germany		**1.5**	
France			
La Seyne-sur-Mer (prototype)	Linear Fresnel	0.5	2010
Augustin Fresnel 1 (prototype)	Linear Fresnel	0.25	2011
Total France		**0.75**	
Total EU		**2 311.5**	

Parabolic trough plants, Central receiver plants, Dish Stirling system, Linear Fresnel systemsl, HB (Hybrid Biomass).
Source: EurObserv'ER 2015

a single project – a 1 180 kW Fresnel type plant developed by Archimede SRL at Melilli, Sicily – and it should be up and running at the end of 2015. The grid meter could soon be running faster as many projects have entered the final authorization stage. ANEST (the Italian Solar Thermal Energy Association) has pinpointed about ten projects with 280 MW of combined capacity whose construction could start in 2015.

Two of these projects have already received their permits – Solecaldo led by MF Energy, a 41 MW Fresnel-type plant capable of producing 116 GWh of electricity per annum, due to start commercial operation in December 2016 and Trinacria Solar Power's Bilancia 1 project, which is another Fresnel-type plant with 4 MW of capacity capable of producing 9.5 GWh and due to be commissioned in September 2016.

Three of the biggest projects worth mentioning are the three parabolic trough plants in Sardinia – Flumini Mannu (55 MW), Gonnosfanadiga (55 MW) and CSP San Quirico (10.8 MW). Other major projects are the Mazzara Solar tower plant (50 MW) developed by Abengoa Solar in Sicily and the Banzi parabolic trough plant (50 MW) in the Basilicata region of Southern Italy.

The most recent data published by ANEST shows to a total of 17 plant projects in Italy (1 in the Basilicata region, 3 in Sardinia and 13 in Sicily). Their combined capacity is 361.3 MW and they should produce 1 080 GWh of solar power. The investment value of the projects developed between 2015 and 2017 is put at 1.2 billion euros.

The standstill situation in France appears to be stuck fast. Commissioning of the first two CSP plant projects that won the first call for tenders (CRE 1) in 2012, was scheduled for 2015, but the target date has been missed. The French government made no provision for another concentrated solar power component in November 2014 when it put out its third call for solar tenders dedicated to high-capacity facilities (>250 kW) as a result of the plants' completion problems.

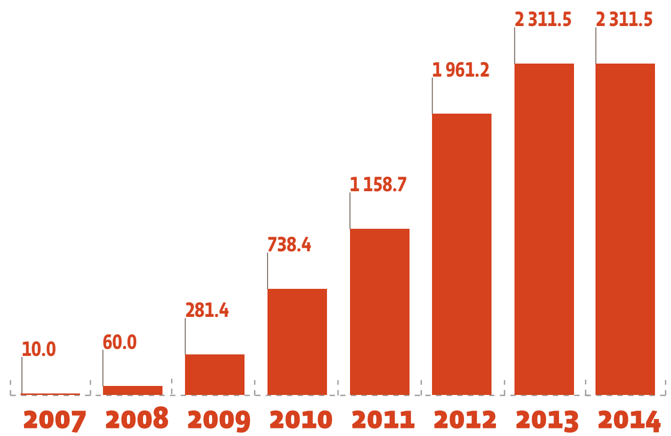
EUROPE'S FUTURE DEPENDS ON COOPERATION MECHANISMS

The National Renewable Energy Action Plans defined under the terms of the European directive, planned for 7 044 MW of capacity in the EU, equivalent to 20 TWh of output by the 2020 timeline. However the Mediterranean countries no longer seem to be in a position to bear the cost of the investments in the CSP sector unaided. Estela, the European Solar Thermal Electricity Association, is still clinging to its hope for a turnaround in European public policies. Its stance is that if the European Union is to retain its technological head start on the world, at least 250 MW of capacity needs to be installed every year. In its view, development of this order would be in line with the IEA's estimates that forecast 15 GW of installed capacity in Europe by 2030.

A potential growth vector for the sector would involve greater development of the grid infrastructures between the countries of Southern Europe (Iberian Peninsula, Southern Italy and Greece) and those of Northern Europe. According to ESTELA, this option would be a step in the direction of securing energy supplies which implies diversifying Europe's energy sources. The energy storing capacity of solar thermodynamic technology would make it a perfect fit for a single integrated, connected and secure market – the European Commission's aspiration under the Energy Union.

2

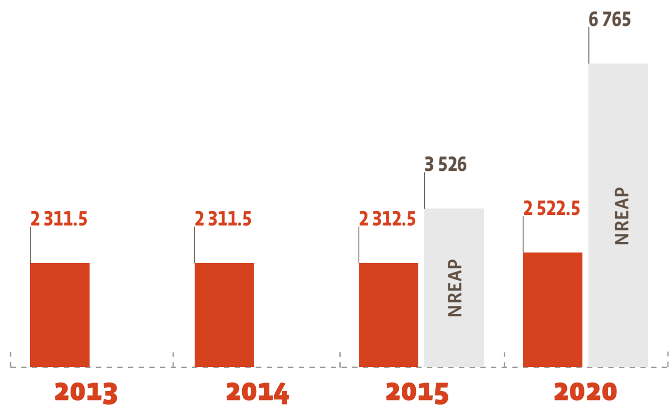
CSP plant capacity trend in the European Union (MW)



Source: EurObserv'ER 2015

3

Comparison of the current trend against the NREAP (National Renewable Energy Action Plans) roadmap (en MW)



Source: EurObserv'ER 2015

OCEAN ENERGY

The Atlantic Ocean, the Mediterranean Sea, the Baltic Sea, the North Sea, the English Channel, the outlying regions... Europe has huge marine resources for reaping all the seas' energies – tidal energy, deep sea current energy with the aid of underwater turbines, wave energy with wave energy converters, the energy from temperature difference or salinity from water at different depths called ocean thermal energy and osmotic energy respectively.

As it stands, installed capacity is low; nonetheless Europe has more capacity than any other region and it could increase rapidly. Ocean energy is now one of Europe's five strategic priority sectors for blue growth. An ocean energy forum has been created to define a roadmap in 2016, to instigate a potential European industrial initiative. Its work will be completed by the Smart Specialisation Platform on Energy launched in May 2015, to help regions coordinate their energy strategies.

Furthermore there are a number of programmes that will provide funding for the sector. The NER 300 initiative was renewed at the end of 2014, and this time includes small-scale projects. At the start of 2015, the European Commission-funded (FP7 programme) MARINET initiative, which offers businesses and research groups free access to test sites, put out a sixth call for proposals. We should highlight the fact that finally in June 2015, 3 450 million euros were granted to a European team of experts led by the Portuguese WavEc institute under the auspices of the European Commission's Horizon 2020 programme to develop the three-year WETFEET project dedicated to the wave energy converter sector.

Tidal energy is the only commercially harnessed form. Its proven technology consists of tidal barrages installed in estuaries. There is only one plant in Europe – the 240-MW tidal barrage at Rance (Ille-et-Vilaine) in France, completed in 1966. However the development opportunities for these systems are limited by social and environmental acceptance issues. Other technologies that exploit tides are being looked into, such as artificial lagoons located away from the estuaries, while other forms of ocean energy are in the research and development phase. They are mainly small-scale pilot projects to test various devices. Nonetheless underwater current and tidal energy systems are attracting increasing commercial interest.

The UK is a prime showcase as it now has 5.5 MW of capacity essentially installed as small tidal and wave energy converter units in the European Marine Energy Centre (EMEC), Scotland. Now the centre, with the backing of political commitment and significant exploitable potential, has been sought after for several years to develop huge projects like the 398-MW tidal stream turbine project by the Atlantis Resources Corporation of Australia, which is starting to take shape. The Scottish Government has granted permission for the first 86-MW phase, at the Inner Sound between the mainland and Stroma Island, and funding was secured for installing 6 MW. Work commenced early in

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2015 for connection scheduled in 2016. Incidentally in June 2015, the British Government gave the green light for the giant 320-MW Tidal Lagoon Power plant in Swansea Bay. Construction could commence by mid-June.

Unfortunately the wave power sector is not in such good health. Scottish company Pelamis Wave Power, a wave energy pioneer, collapsed at the end of 2014. The company Aquamarine Power, which was granted authorization for a 40-MW farm off the North-West coasts of Lewis, was obliged to slash its payroll by two thirds. The Scottish Government has granted a budget of 19.5 million euros over 2015 and 2016 to the new Wave Energy Scotland research body to promote collaborative work and thus revive the sector.

France, which also has significant potential, is starting to reap the fruit of its efforts. Sabella et Engie (formerly GDF-Suez) has submerged and connected to the grid a 1-MW tidal turbine in the Fromveur Strait, towards Ouessant Island. Two projects in the have been selected in the Raz Blanchard passage in the English Channel, under the auspices of the first French call for EoI for pilot tidal turbine farms: the 14-MW DCNS OpenHydro and EDF Energies Nouvelles (EDF EN) project, and the 5.6-MW Alstom et Engie project. The French Government has launched a new call for EoI with three strands: building demonstrators for marine tidal turbine and wave energy technologies; creating critical technology bricks for developing marine tidal turbine, wave energy and floating wind turbine projects; and constructing French-based pilot tidal turbine farms with river or estuary technologies.

With its National Ocean Strategy 2013-2020, Portugal holds considerable promise for wave energy. In April 2015, Europe granted it permission to use state aid for a demonstration tidal energy and project support programme (50 MW of installed ocean wave and tidal current capacity).

Ireland also has considerable wave energy resources and has set up the Offshore Renewable Energy Development Plan (OREDP). According to its guidelines, the Atlantic Marine Energy Test Site (AMETS) was created in 2015, at Annagh Head (County Mayo), to test pre-commercial wave energy converter projects. It is also looking into introducing Feed-in Tariffs for ocean energies that could be implemented as early as 2016.

In addition to Spain and Italy, Finland and the Netherlands included ocean energy in their National Renewable Energy Action Plans. Tocardo Tidal Turbines has installed a three marine turbine farm for a total of 300 kW, in the Afsluitdijk tidal barrage in the Netherlands. The country also supports osmotic technologies. Belgium has defined maritime area for the installation of 20 MW of wave energy converters to harness ocean energy. Sweden has tidal turbine and wave energy converter test sites, Denmark has wave energy converter test sites and Norway has long been working on osmotic energy.

While Europe and certain individual states are highly committed to ocean energy development, we should also emphasize the important role played by industry (Alstom, DCNS, Voith Hydro, Andritz Hydro, Sabella, etc.) and the electricity companies. More than 500 firms are involved in the ocean energy sector, some of whom enjoy internationally recognized expertise.

According to the Committee of Regions (CoR) Commission for the Environment, Climate Change and Energy , ocean energy could cover 10–15% of the EU's energy demand in 2050. Up to 500 000 jobs could be created by the same timeline, including 26 000 direct jobs by 2020. The challenge is to reduce costs to enable a real marine energy market to emerge.

1

List of European Union plants harnessing ocean energy at the end of 2014

Projects	Capacity (MW)	Commissioning date	Current state
United Kingdom			
Limpet	0.5	2000	Connected
Open Center Turbine	0.25	2006	Connected
SeaGen	1.2	2008	Connected
Scottish Power Pelamis P2	0.75	2011	Connected
Scotrenewables Tidal Power	0.25	2011	Connected
Voith Hydro	1	2012	Connected
Wello Oy-Penguin	0.6	2012	Connected
Nova 30	0.03	2014	Connected
Minesto-Deep GreenOcean	0.3	2013	Connected
Evopod	0.035	2014	Being tested
Plat-O	0.1	2015	Connected
Nautricity CoRMat	0.5	2014	Being tested
Total UK	**5.5**		
Portugal			
OWC Pico	0.4	1998	Connected
Total Portugal	**0.4**		
France			
Barrage de La Rance	240	1966	Connected
Hydro Gen 2	0.01	2010	Being tested
HydroQuest River 1.40	0.04	2014	Connected
Hydrotube Énergie H3	0.02	2015	Being tested
Sabella D10	1	2015	Connected
Total France	**241.1**		
Spain			
Mutriku OWC – Voith Wavegen	0.3	2011	Connected
Wello Oy-Penguin II	n. c.	2015	Being tested
Total Spain	**0.3**		
Italie			
R115	0.1	2015	Connected
Total Italy	**0.1**		
Netherlands			
Tocardo	0.3	2015	Connected
Friesland/Afsluitdijk	0.05	2015	Connected
Total Netherlands	**0.35**		
Sweden			
Lysekil	0.018	2005	Being tested
Seabased	1	2015	Connected
Total Sweden	**1**		
Total EU	**248.8**		

Source: EurObserv'ER 2015

THE DROP IN ENERGY DEMAND BOOSTED THE RENEWABLE SHARE IN 2014

The unusual weather conditions in 2014 made a generally good impact on renewable energy share trends. The exceptionally mild winter and the abnormally warm year reduced heating needs over much of Europe (the Nordic countries, Western and Central Europe). Moderate temperatures led to lower fuel consumption overall, starting with natural gas and heating oil, and also solid biomass whose use of firewood fell. Electricity generation is less dependent on the vagaries of climate, with the exception of a few countries like France and Sweden where electric heating technologies are prominent. Nonetheless, the reduction in demand for electricity also had a positive impact on the development of the renewable energy share of total electricity consumption in the European electricity market .

RENEWABLE ELECTRICITY PUT ON ANOTHER TWO POINTS IN 2014

The EurObserv'ER renewable electricity share estimates in the Union European's total electricity consumption (non-normalized for wind energy hydropower) point to a new increase. Despite weaker growth in output than in previous years the renewable electricity share increased by 2 points from 26.1 to 28.1% between 2013 and 2014, according to the data gathered by EurObserv'ER. Gross renewable electricity output increased by 4.6% to 895 TWh between 2013 and 2014, which is half the previous year-on-year's growth rate (11.5%, with 855.5 TWh in 2013). This slower renewable electricity growth may be attributed to the drop in investment in production infrastructures felt over the last three years.

While the renewable electricity share grew quite clearly in 2014, it was caused by dwindling demand for electricity across the European Union. Estimates released by Enerdata, a consultant specializing in energy databases, illustrate that gross electricity consumption continued to drop between 2013 and 2014 (by 2.8%, from 3 274.8 to 3 183.4 TWh), to a steadier pace than between 2012 and 2013 (when it dropped by 1.2%). The effect of the drop in requirements is significant, for while total electricity consumption was stable, the renewable electricity share increased only by 1.2 points. This disparity between the rise in the numerator and fall in the denominator, confirms the European Union electricity production trend placing less reliance on conventional sources (coal, natural gas, nuclear and oil). In the decade from 2004, the EU's renewable electricity share has almost doubled from 14.3 to 28.1% as a result of this phenomenon.

Closer analysis of the production data demonstrates that wind energy and solar power (photovoltaic and CSP) were the main contributors to the increase in the 2014 renewable electricity share with additional inputs of 15.1 and 10.9 TWh respectively. The growth in solar power output was twice as fast as that of wind power between 2013 and 2014, i.e. 12.7% compared to 6.4%. While hydropower's (non normalized) output remained very high, close to its 2010 record, it made a smaller contribution (adding 4.5 TWh, which equates to 1.2% growth. In 2014 it was overtaken by the combined biomass sectors (solid biomass, biogas,

Jens Bach / Maabjerg Bioenergy

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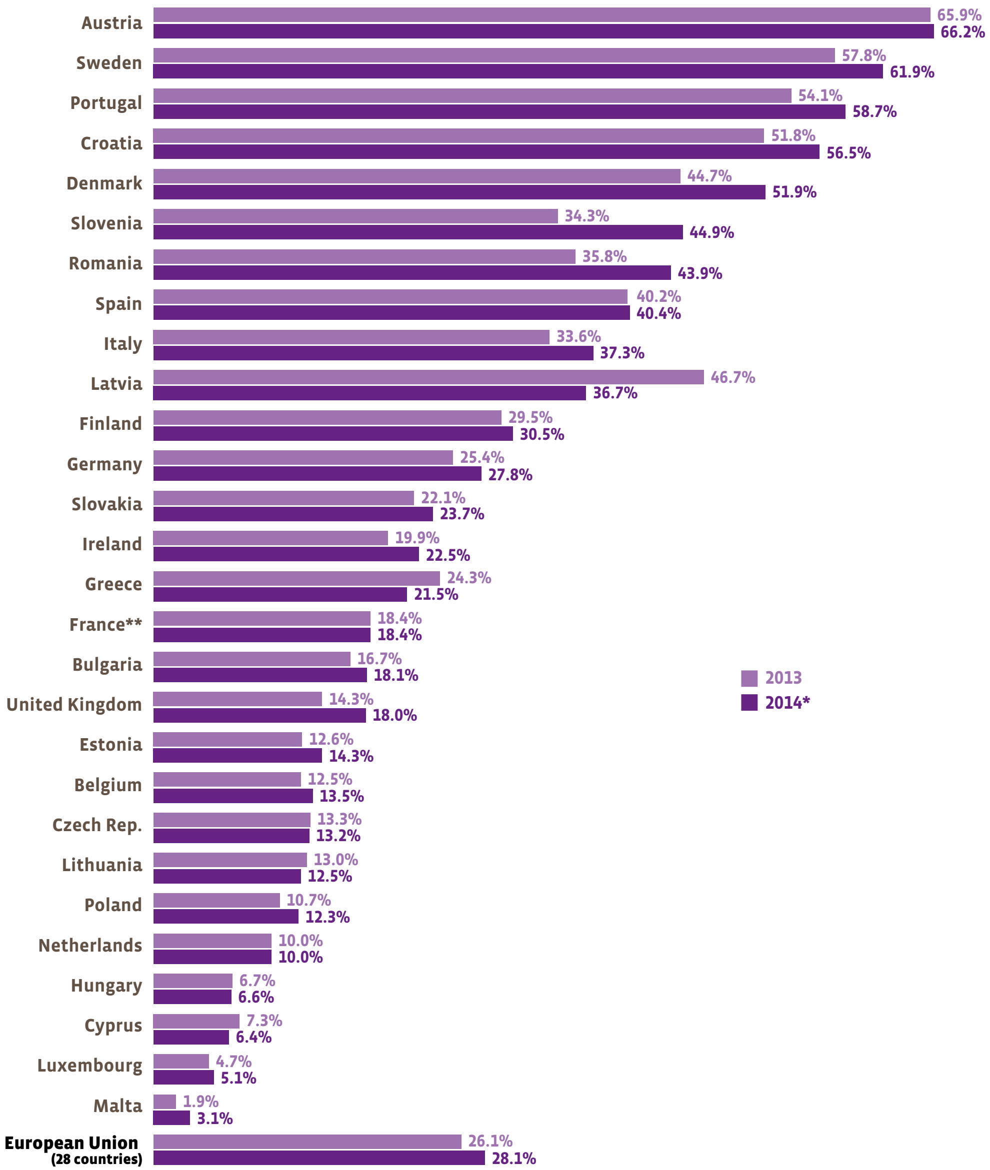
1

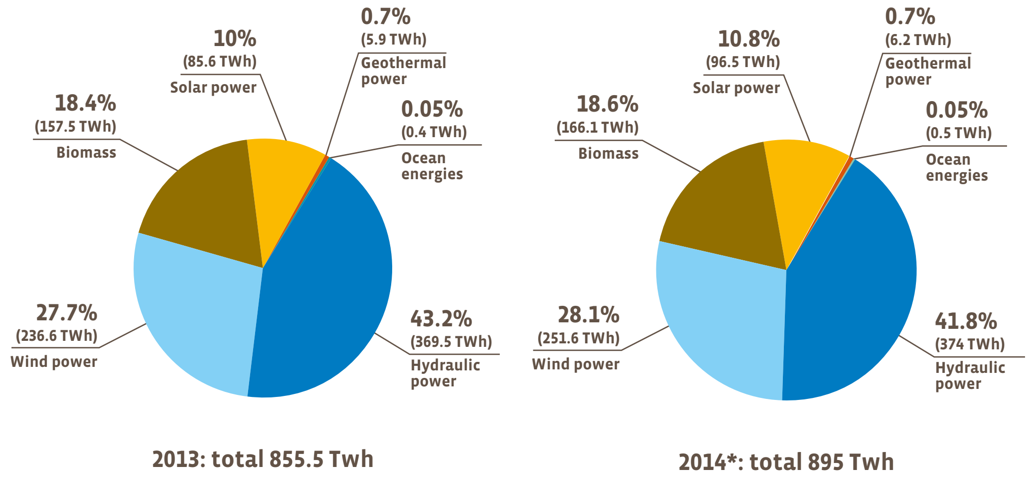
*Share of renewable energy in gross electricity consumption of EU countries in 2013 and 2014**



** Estimate. ** Overseas Departments not included for France.* ***Note:*** *Figures for actual hydraulic and wind generation (no normalisation).*
Source: EurObserv'ER 2015

2

Share of each energy source in renewable electricity generation in the EU 28 (%)



** Estimate.* ***Note:*** *Figures for actual hydraulic and wind generation (no normalisation).* ***Source: EurObserv'ER 2015***

renewable municipal waste, liquid biomass) whose input increased by 8.7 TWh (5.5%). Solid biomass electricity output, championed by the conversion of British coal-fired power stations increased by 3.6 TWh (4.4%), biogas electricity by 3.4 TWh (6.3%), renewable municipal waste by 1.1 TWh (5.9%) and liquid biomass by 0.6 TWh (13.1%). Geothermal energy contributed an additional 283 GWh (4.8%) and marine energies that basically boil down to the output of the Rance tidal power station in France, increased by a few tens of GWh in 2014 (63 GWh).

Thus the two-point increase in the renewable electricity share masks weaker momentum than in the past. Most of the major European Union players that had decided to develop their renewable electricity sectors slashed their investment budgets in 2014. This may initially come as a surprise since certain sectors such as wind energy and solar power have become competitive with the conventional sectors, with much lower production costs than during the large-scale expansion drive in the middle of the last decade.

One of the reasons for this shift is that conventional electricity lost outlets, which raises major economic problems for the energy utilities by reducing the profitability of their production facilities. This is compounded by the inflow of renewable electricity onto the grid during certain periods, primarily winter, which slashes the electricity price on the market thereby adding to conventional electricity production facilities' profitability woes, since they do not benefit from guaranteed Feed-in Tariffs and are being forced to inject less electricity into the grid because of the access priority given to renewables. Some energy utilities are lobbying hard to limit the growth of new renewable energy production capacities and demanding more gradual phasing in of these energies to mirror market requirements.

This is the explanation for the new European Commission stance on renewable electricity sector promotion, which is to «provide a framework for designing more efficient public support measures that reflect market conditions, in a gradual and pragmatic way». In other words, to abandon the guaranteed Feed-in Tariffs in favour of mechanisms that factor in allowance for the price signals sent by the market. Accordingly,

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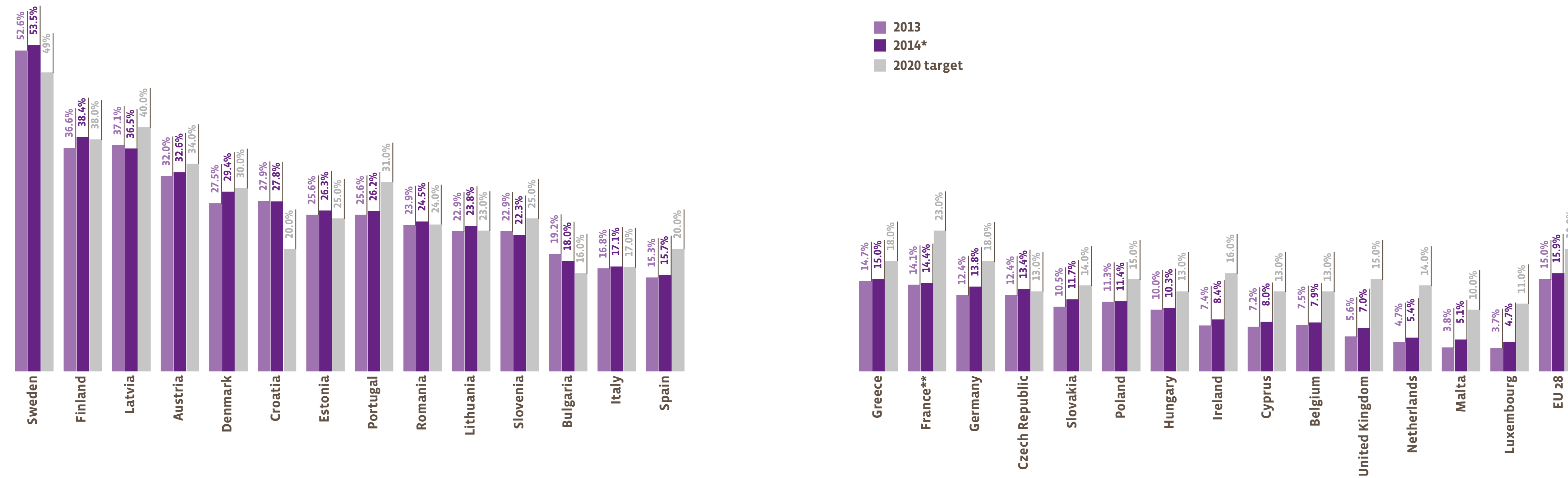
Share of energy from renewable sources in gross final energy consumption in 2013 and 2014 and national overall targets in 2020*



__Note:__ Calculations, defined by the Directive, use a normalized hydro and wind generation.
** EurObserv'ER estimates, calculated on the basis of the project's data collection campaigns. ** Results for France calculated by EurObserv'ER don't include the overseas territories but for the purpose of Directive 2009/28/EC the accounting of energy from renewable sources for France has to include French overseas territories. __Source: EurObserv'ER 2015__*

renewable energies' integration into the electricity system should slow down over the next few years, to allow the energy companies time to adjust their investment strategies to incorporate more renewable energy.

EUROPEAN TARGETS – STILL ON TRACK BUT...

The 2009/28 Directive sets the Member States a 20% target for the renewable energy share of their gross final energy consumption across Europe, by way of binding 2020 targets for the individual countries. EurObserv'ER monitors each Member State's trajectory towards its targets.

Calculating these individual renewable energy shares is difficult exercise. The results presented are EurObserv'ER estimates, based on the data gathered by the project team over the past year. Preliminary estimates suggest that the renewable energy share of the EU's gross final energy consumption was 15.9% in 2014 compared to 15% in 2013, which equates to a 0.9 percentage point increase.

When we look at these calculations in detail, we have to admit that much of the credit for the relatively good result achieved in 2014 is down to special circumstances. Gross final renewable energy consumption increased at a very much slower pace than in 2013, by just 2.6 Mtoe year-on-year (from 172.1 to 174.7 Mtoe) compared to about 9.1 Mtoe between 2012 and 2013 (163 Mtoe in 2012 according to SHARES 2013).

The 2014 rise can be mainly ascribed to the growth in renewable electricity output (this time normalized production for wind energy and hydropower) whose input increased by 3.9 Mtoe – in a 2.1: 0.9 Mtoe split respectively (NB: solar = PV and CSP). It is also explained by an additional 0.9 Mtoe consumption of renewable energy by transport. These two increases were partly offset by the 2.2 Mtoe fall-off in renewable heat consumption across the European Union. It was caused by a particularly warm year on the European continent which reduced households' needs for wood energy heating to 3.2 Mtoe. This reduction can no longer be viewed as a one-off glitch, as solid biomass heat consumption across the European Union had already witnessed contraction in 2011, another exceptionally mild year.

What made the difference and enabled growth of almost one percentage point of the renewable share to be sustained, is the significant fall in gross total final energy consumption (the denominator), which exceeded those of 2012 and 2013. Eurostat put this drop at European Union level at 46.6 Mtoe (from 1 145 Mtoe in 2013 to 1 098.4 Mtoe in 2014). The main culprits being the exceptionally mild weather compounded by sluggish industrial activity in a number of European economies and increased energy efficiency.

These conflicting trends made a positive impact on the renewable energy share of total gross final energy consumption. At individual country level we reckon that 9 Member States had achieved their 2020 targets: Bulgaria, Croatia, the Czech Republic, Estonia, Italy, Lithuania, Romania, Finland and Sweden. Three

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Share of energy from renewable sources in gross final energy consumption in 2013 and 2014 and indicative trajectory*

Country	2013	2014*	Indicative trajectory *2015-2016** (%)*
Sweden	52.6%	53.7%	43.9%
Finland	36.6%	37.9%	32.8%
Latvia	37.1%	36.1%	35.9%
Austria	32.2%	32.8%	28.1%
Denmark	28.0%	28.9%	22.9%
Croatia	27.3%	28.5%	16.1%
Estonia	25.6%	26.5%	21.2%
Portugal	25.6%	26.3%	25.2%
Romania	23.9%	24.5%	20.6%
Lithuania	22.9%	23.5%	18.6%
Slovenia	22.9%	22.1%	20.1%
Bulgaria	19.3%	18.0%	12.4%
Italy	16.7%	17.4%	10.5%
Spain	15.2%	15.8%	13.8%
Greece	14.7%	15.3%	11.9%
France	14.0%	14.5%	16.0%
Germany	12.4%	13.8%	11.3%
Czech Republic	12.3%	13.2%	9.2%
Slovakia	10.2%	12.0%	10.0%
Poland	11.3%	11.4%	10.7%
Hungary	10.2%	10.9%	8.2%
Ireland	7.4%	8.4%	8.9%
Cyprus	7.2%	8.2%	7.4%
Belgium	7.8%	7.9%	7.1%
United Kingdom	5.4%	6.7%	7.5%
Netherlands	4.7%	5.4%	7.6%
Malta	4.0%	5.1%	4.5%
Luxembourg	3.7%	4.7%	5.4%
EU 28	**15.0%**	**15.9%**	**–**

Note: *Calculations, defined by the Directive, use a normalized hydro and wind generation.*
** EurObserv'ER estimates, calculated on the basis of the project's data collection campaigns. ** All percentages originate from Annex I of Directive 2009/28/EC. The indicative trajectory has been calculated from Part B of the Annex. *** Results for France calculated by EurObserv'ER don't include the overseas territories but for the purpose of Directive 2009/28/EC the accounting of energy from renewable sources for France has to include French overseas territories.* ***Source: EurObserv'ER 2015***

Vattenfall/Jorrit Lousberg

countries with less than 10% of their target to meet have them in their sights – Austria, Denmark and Latvia. Europe's major energy consumers, Germany and France are at 76.5 and 62.7% of their respective targets, while the UK is at 46.4% of target.

Across the European Union, the renewable energy share of total gross final energy consumption has practically doubled since 2004, from 8.5 to 15.9%. An annual increase of 0.7 points is required to achieve the European Union's 2020 target. This is still feasible provided that investment levels, which dropped sharply in 2012 and 2013, continue to recover after 2014. The price of a barrel of oil dropped below the $ 40 mark in December 2015 (although it had risen to a record $ 115 in May 2014 before collapsing before the end of 2014). This does not augur well for a clear upturn in renewable energy investments. Particularly as according to the analysts, oil should dip to its lowest price level during the first quarter of 2016 and stay at extremely low levels for at least two years. In this context, the issue of implementing a Community-wide carbon tax could soon be revived, all the more so as its introduction could be made easier by oil prices being maintained at low levels over the long term. The European Union must set the example as never before by giving itself the wherewithal to meet its commitments, a few weeks after the 12 December wake-up call of the 195 countries in Paris that entered an historic agreement to limit global warming to below two degrees. □

SOCIO-ECONOMIC INDICATORS

The first chapter has given an overview on the energy data indicators. The following chapter supplements this data collection by an account that sheds light on the socio economic impact of the renewable sectors across the European Union.

All 28 countries composing the European Union in 2014 are covered individually, detailing ten renewable sectors. The aggregates refer to the employment figures and turnover sales generated in the two previous years 2013 and 2014.

Methodological note

The socio economic indicators published in the subsequent section were derived from a large variety of sources (see compilation below). National statistical offices and national energy agencies provided the bulk of the energy data. Comprehensive national socio economic statistics are provided and were used for France (Ademe), Germany (BMWi and AGEE-Stat), Austria (BMVIT/EEG), the United Kingdom (REA) and Statistics Netherlands (CBS) that conduct annual national surveys resulting in the publication of employment and economic activity figures for some or all RES sectors.

*EurObserv'ER attempts to accurately display and estimate the general market dynamics in each sector. The socio economic indicators given below **cannot be directly compared to the figures from last year's edition** of the 2014 Overview Barometer as some data consolidation took place. Beyond, certain assumptions underlying our calculations were partially retroactively revised. In many cases socioeconomic indicators were estimated. These estimations are either based on energy data (installed capacities or energy output), or on regularly updated and improved employment and investment ratios, as identified in the ongoing literature review.*

Major sources for investment and job coefficients was the Energy [r]evolution report published by Greenpeace / GWEC and SPE (September 2015). For the employment section this report contained an updated methodology part prepared by the Institute for Sustainable Futures (ISF)[1], which was also used as inspiration for the EurObserv'ER analysis.

1. ISF 2015: CALCULATING GLOBAL ENERGY SECTOR JOBS: 2015 METHODOLOGY, Rutovitz, J., DOMINISH, E. AND DOWNES, J. 2015. INSTITUTE FOR SUSTAINABLE FUTURES.

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Further sources are IRENA (2014), or data provided by European industry bodies such as EWEA (wind), Solar Power Europe (PV), ESTIF (solar thermal), ESHA (hydropower), ePURE and EBB (biofuels), EuBIA and AEBIOM (biomass), EHPA (heat pumps), or International industry bodies (IGA for geothermal energy, or WWEA and GWEC for wind). Furthermore, national associations were searched for suitable data. Other sources were European surveys or IEE funded projects such as Stream Map/ESHA, EmployRES, or BiogasIn or dedicated reports from the international sphere such as the REN21 Global status report 2011, the IEA Photovoltaic Power Systems (PVPS) national status reports or the IEA-RETD 2013 employment statistics.

EurObserv'ER endeavoured wherever possible to apply a consistent definition and scope to the presentation of indicators:

- *In order to represent the tentative nature of EurObserv'ER estimations, job figures are rounded to 50 jobs and turnover indicators to €5 million (except for the figures coming from official sources).*
- *Employment data covers both direct and indirect jobs and relate to gross employment, i.e. not taking into account job losses in other industrial sectors or due to expenditure and investment in other sectors.*
- *Direct jobs are those directly derived from RES manufacturing, equipment and component supply, or onsite installation and O&M.*
- *Indirect jobs are those that result from activity in sectors that supply the materials or components used, but not exclusively so, by the renewables sectors (such as jobs in copper smelting plants part of whose production may be used for manufacturing solar thermal equipment, but may also be destined for appliances in totally unconnected fields).*
- *Turnover figures, expressed in current million euros (M€). The focus on the main economic investment activity of the supply chain (manufacturing, distribution and installation of equipment, plant operation and maintenance). Turnover arising from electricity or heat sale, financial and training activities, or publicly funded research, etc. are excluded.*
- *Socio economic indicators for the bioenergy sectors (biofuels, biomass and biogas) include the upstream part, namely fuel supply in the agricultural, farming and forestry sectors. For solid biomass, the activity in terms of self-production / consumption of wood by individual households and the «informal» market is not included in our work.*
- *Socio economic indicators for turnover from biofuels were derived from averaged data from Italy, Germany and France as major producing countries. Jobs and turnover in biofuels are also considering growing import shares that diminish the European part of value creation.*

WIND POWER

The European wind energy sector has seen an impressive comeback in 2014. In 12 countries the market increased. With 12.44 GW of newly installed capacity, it has confirmed its leading role in renewable energy. In most countries wind power is the most important renewable source of energy. According to the European Wind Energy Association (EWEA), wind energy today is fully mainstream and "one of the fastest growing industrial sectors in the world, attracting $100 billion in investment in 2014." Although the major wind hubs have shifted from Europe to Asia, the EU still represents a fair share of this cake. EurObserv'ER estimates a sector ***turnover of over € 48.3 bn. for 2014*** (up from €39 bn. in 2013). Also the employment level should have grown to over ***324 000 jobs*** in the EU-28.

The revival though comes at a price. The trend observed last year of a more concentrated market with the major part of installations in few countries and a less even distribution amongst EU member states has continued. Two countries- namely Germany and the UK - alone account for 60% of new installed capacity.

Germany, with an installation record of nearly 6.2 GW on and offshore*, represents half of the EU market alone. The figures for the first half of 2015 seem to confirm the boom, most notably also in the offshore sector. The German wind industry – home of major manufacturers like Enercon in the domestic onshore market or Siemens the offshore primus - accounts for ***€ 14 bn***. EurObserv'ER assumes a ***work force of 149 000*** based on the market development which is in line with the latest official figure of 138 000 jobs for 2013.

The ***United Kingdom*** came in second with 1 265 MW installed in 2014. The annually updated socio economic analysis by the Renewable Energy Agency (REA) and PwC has lifted the national turnover to ***€ 7.45 bn***. and the number of ***wind employees to over 38 000***. The countries is implementing a new incentive system named Contracts for Differences, with a focus on "less mature" technologies such as offshore wind.

The situation in ***Denmark*** is a bit different. The domestic market further declined to a mere 68 MW. However, with the global leader Vestas and numerous other export oriented companies the countries' wind industry grew to ***€ 11.3 bn. and over 30 000 work places*** according to information from the Danish wind industry Association.

New and encouraging activity can be observed in ***France***. The 1 042 MW is nearly twice as much as in 2013. The turnover of the sector is over ***€ 2.6 bn***. Legal simplifications in the French system are one cause for this uptake. A question mark for future development is the planned expiration of the feed in tariff by a market sales based support system.

Further positive news came from ***Austria*** with another record year of 411 MW. According to the Energy Economics Group (EEG) the Austrian wind industry is estimated at over ***€ 1 bn. and roughly 5 000 persons*** employed in all stages of the value chain.

Former champions Italy and Spain are struggling (the high industry turnover of ***Spain of € 3.8 bn.*** is not based on its domestic installation that virtually came to a standstill (55 MW) but largely attributable to the Spanish global wind energy player Gamesa with an annual turnover of € 2.8 bn. in 2014), whereas Greece also displayed a positive installation trend.

Our cautious predictions of last year concerning investor uncertainty surrounding watered down EU 2020 and 2030 targets did not materialize. In contrary we observed a promising revival. However a growth which seems still a bit shaky and based on only few thriving EU member states though. For the time being the European wind energy sector has confirmed its leading role in terms of socioeconomic impacts in the European Union. □

4,9 GW installed for onshore wind and 1,3 GW installed (connected and not connected) for offshore wind.

SIEMENS AG

1

Employment

	2013		2014	
	Installed capacity to date (MW)	Employment (direct and indirect jobs)	Installed capacity to date (MW)	Employment (direct and indirect jobs)
Germany	34 271.0	137 800	39 193.0	149 200
United Kingdom	11 214.6	35 900	12 987.5	38 300
Denmark	4 820.0	27 500	4 888.0	30 000
France	8 202.0	20 000	9 068.0	20 000
Italy	8 542.0	35 000	8 683.0	30 000
Spain	22 958.0	20 000	22 975.0	18 000
Sweden	4 194.0	7 500	5 097.0	9 900
Austria	1 684.0	4 500	2 095.0	4 850
Poland	3 429.0	3 000	3 836.0	2 500
Romania	2 783.0	5 800	3 221.0	4 500
Belgium	1 680.0	3 500	1 818.0	3 700
Portugal	4 731.0	3 000	4 953.0	3 000
Ireland	1 941.0	2 250	2 211.0	2 500
Greece	1 809.0	1 400	1 978.0	2 000
Netherlands	2 713.0	3 200	2 865.0	2 000
Finland	447.0	1 400	627.0	1 700
Croatia	254.0	1 000	339.0	750
Estonia	248.0	150	334.0	500
Bulgaria	676.7	250	686.8	300
Czech Republic	270.0	200	278.1	200
Hungary	329.0	100	329.0	100
Lithuania	282.0	500	282.0	100
Cyprus	146.7	<50	146.7	<50
Latvia	67.0	<50	69.0	<50
Luxembourg	58.3	<50	58.3	<50
Slovakia	5.0	<50	5.0	<50
Slovenia	4.0	<50	4.0	<50
Malta	0.0	0	0.0	0
Total EU	117 759.3	314 200	129 027.4	324 350

Source: EurObserv'ER 2015

2

Turnover

	2013		2014	
	Annual installed capacity (MW)*	Turnover (M€)	Annual installed capacity (MW)*	Turnover (M€)
Germany	3 466.0	8 100	4 922.0	13 900
Denmark	656.6	10 800	68.0	11 330
United Kingdom	1 888.0	6 200	1 772.9	7 475
Spain	175.0	3 500	17.0	3 800
France	630.0	2 230	866.0	2 620
Sweden	725.4	1 400	903.0	1 700
Austria	307.0	875	411.0	1 035
Belgium	329.3	1 350	138.0	1 025
Italy	444.0	1 030	141.0	1 000
Poland	892.8	1 400	407.0	1 000
Netherlands	303.2	1 300	152.0	800
Romania	637.0	950	438.0	750
Portugal	193.0	450	222.0	430
Ireland	131.7	260	270.0	400
Greece	115.2	230	169.0	310
Finland	162.3	250	180.0	300
Croatia	119.2	180	85.0	130
Estonia	10.5	25	86.0	90
Bulgaria	7.1	40	10.1	45
Czech Republic	12.0	30	8.1	35
Malta	0.0	16	0.0	16
Hungary	0.0	15	0.0	15
Lithuania	54.0	90	0.0	15
Cyprus	0.0	<5	0.0	<5
Latvia	2.0	<5	2.0	<5
Luxembourg	2.3	<5	0.0	<5
Slovakia	0.0	<5	0.0	<5
Slovenia	0.0	<5	0.0	<5
Total EU	11 263.6	40 746	11 268.1	48 246

** Onshore wind only. Source: EurObserv'ER 2015*

PHOTOVOLTAIC

The European Union continues to lose ground in the international PV sector. In 2014 only three countries (UK, Germany, and France) made it into the worldwide top ten ranking in terms of new installations (instead of 5 countries in 2012). Looking at the leading cell and module manufacturers EU actors have disappeared from the global map entirely. Whereas the global PV market is growing at an even increasing speed, the European Union PV industry has lost momentum. EurObserv'ER estimated the 2014 PV market at nearly 6.9 GWp. This is low compared to the 10.6 GWp installed in China alone. If China continues at this pace it will pass Germany

as the largest PV market in terms of total installed capacity in 2015.

Reasons for this downward trend are numerous: sharply reduced incentive systems in member states, declining support rates, lower electricity demand due to the economic crisis, or the paradoxical situation that the rising shares of renewables in the power mix increases pressure on conventional energy utilities which in turn exert their dwindling market and lobbying power to further limit the success of renewables expansion.

Correspondingly for 2014 EurObserv'ER rates the EU PV market **€ 16.4 bn.** (down from € 21.3 bn. in 2013) and a PV sector employing **120 000 persons** (down from 156 000 in 2013).

France has seen an encouraging upward trend with 1329 MWp installed in 2014, although keeping up with previous years. Also in turnover terms **France** should have been the largest sector of all EU-28 member states (**€ 3.9 bn.**) and leaving Germany (**€ 3.7 bn.**) and the UK (**2.8 bn.**) behind. This trend should not be impacted with the implementation of a premium tariff as the country took strong resolution for PV thanks to the Energy Transition Law and the COP 21 organization.

One historic mark is the 2.45 GWp installed in the **United Kingdom**, turning it into the largest EU PV market in 2014 for the first time. The annually updated market statistics by REA and Price Waterhouse Coopers (PwC) assess the sector over **16 000 jobs and a volume of € 2.8 bn.** With the UK Government's intention to further expand the PV sector with a target of 22 GW by 2020 and in the light of other EU countries weak development, the UK might be there to stay at the top.

The PV industry is in free fall in Germany as it went from 56 000 jobs in 2013 to 38 300 according to BMWi. The domestic market, once the EU drive train is only a shadow of its former past. The situation will not be improved by the introduced tendering scheme that replaces the well established feed in system for large PV systems. In terms of turnover BMWi and AGEE-Stat assume **€ 3.9 bn. for 2014** for investment in new plants and operation and maintenance, also down from € 5.5 bn. in 2013.

Prospectively, the planned and announced "Energy Union" – the so far unspecified idea of creating a more harmonized EU energy market that will reduce import dependency on energy imports, and a more sustainable energy supply by an overall transition to a low carbon economy - might stipulate a renewed interest in renewables general and PV. However this will not be enough unless underpinned by concrete measures and predictable support schemes. In absence of it the industry might need to focus on other potentially important fields of action and emerging trends: PV for own consumption, grid integration of larger amounts of PV power, storage systems (batteries or power-to-gas). Despite an apparently lost competition in manufacturing, the energy future is based on renewables. And Photovoltaic energy as one of the main pillars has a golden future also in Europe. □

1

Employment

	2013		2014	
	Installed capacity to date (MWp)	Employment (direct and indirect jobs)	Installed capacity to date (MWp)	Employment (direct and indirect jobs)
Germany	36 402.0	56 000	38 301.0	38 300
France*	4 625.0	26 400	5 600.0	21 400
United Kingdom	2 782.3	15 600	5 230.3	16 100
Italy	18 065.0	10 000	18 450.0	10 000
Spain	4 766.0	7 500	4 787.3	6 500
Netherlands	739.0	5 000	1 100.0	5 000
Austria	630.5	4 850	770.5	5 000
Romania	1 022.0	7 500	1 292.6	4 000
Belgium	3 040.0	5 000	3 105.3	3 000
Greece	2 585.8	10 000	2 602.8	2 000
Portugal	302.8	900	419.0	1 800
Czech Republic	2 063.9	1 500	2 061.0	1 500
Denmark	572.4	650	601.5	850
Bulgaria	1 019.2	1 500	1 020.4	800
Sweden	43.2	800	79.4	750
Slovakia	588.1	350	590.1	450
Cyprus	34.8	250	64.8	400
Malta	28.2	100	54.2	400
Slovenia	248.2	600	256.0	300
Luxembourg	95.0	350	110.0	250
Poland	4.4	<50	29.9	250
Croatia	20.0	250	34.2	200
Lithuania	68.1	500	68.1	150
Finland	10.2	100	10.2	100
Hungary	34.9	<50	38.2	100
Estonia	0.2	<50	0.2	<50
Ireland	1.0	<50	1.1	<50
Latvia	1.5	<50	1.5	<50
Total EU	79 793.7	155 950	86 679.6	119 750

** Overseas departments included for France.* ***Source: EurObserv'ER 2015***

2

Turnover

	2013		2014	
	Annual installed capacity (MWp)	Turnover (M€)	Annual installed capacity (MWp)	Turnover (M€)
France*	672.0	3 780	1 329.0	3 920
Germany	3 309.0	5 500	1 899.0	3 700
United Kingdom	1 095.0	2 670	2 526.0	2 845
Italy	2 001.0	2 800	190.0	2 340
Austria	263.1	890	159.3	905
Netherlands	374.0	500	302.0	600
Romania	972.7	1 500	270.5	500
Spain	120.3	400	2.3	300
Denmark	169.2	600	36.1	250
Greece	1 042.5	1 500	16.9	250
Portugal	55.5	100	120.2	200
Belgium	341.0	380	102.0	150
Sweden	19.1	60	16.8	80
Cyprus	17.6	30	30.0	50
Czech Republic	41.5	100	0.0	50
Malta	9.5	10	26.0	40
Poland	1.2	<5	25.5	30
Bulgaria	104.4	200	1.3	25
Croatia	16.0	30	14.2	25
Luxembourg	21.0	40	15.0	25
Slovenia	26.7	50	7.7	25
Slovakia	45.0	10	2.0	15
Lithuania	61.9	100	0.0	10
Estonia	0.0	<5	0.0	<5
Finland	1.0	<5	2.0	<5
Hungary	22.6	<5	3.3	<5
Ireland	0.1	<5	0.1	<5
Latvia	0.0	<5	0.0	<5
Total EU	10 802.9	21 280	7 097.2	16 360

** Overseas departments included for France.* ***Source: EurObserv'ER 2015***

SOLAR THERMAL

This chapter sums up the joint socio economic impacts of solar thermal energy for heat and hot water and concentrated solar power (CSP). Whereas the European CSP market remained stable and displayed no additional installations in 2014, the EU solar thermal market contracted for the sixth time in a row compared to the previous year. Despite 2 GWth of new installed collector area, this means a decline of another 3.7% putting the planned 2020 targets into jeopardy. Also the European Solar Thermal Industry Federation (ESTIF) complains that the current performance of the sector is not strong enough "to achieve the indicative solar thermal targets proposed by the EU Member States in the National Renewable Energy Action Plans (NREAPs)".

SHK

Reason for the European market decline is the drop in building construction and a very mild winter that has diminished the heating demand in buildings - a trend observed in many countries. Solar thermal also competes with other heating technologies such as heat pumps, or gas and oil fired heating systems, the latter ones benefitting from the drastic drop in oil prices.

EurObserv'ER rates the 2014 turnover volume at around **€ 3.6 billion** and a job market at **40 450 jobs**. The figures in the report refer to the entire solar thermal value chain comprising manufacturing and design (components, system designers and engineers, electrical engineers, laboratory technicians, collector assembly or material scientists), installation and maintenance (roofers, plumbers, electricians, scaffolders, installation engineer and supervisors) or logistics, such as drivers, packers or warehouse staff.

Spain is one of the few examples where a market uptake was observed. ASIT, claims a 9.8% growth year on year from 178 MWth in 2013 to 162 MWth in 2014. An improvement in the new build sector is responsible for this return to growth, coupled with a thermal regulation that imposes the use of solar energy. The legislation is particularly helpful to the multi-family segment. A regained workforce of **5 000** in **Spain** and **€ 250 million** is the reward for the Spanish economy and a result of aggressive marketing strategies in the region of Andalusia that is actively supporting solar thermal. This development highlights the importance of regional promotion strategies.

Despite a further contraction of the solar thermal market in **Italy** to 196 MWth, the outlook is not too bleak. CSP projects with a volume of € 1 billion are expected for the years to come. Currently the sector should employ around **3 500 persons** and an annual turnover of **€ 300 million** (including CSP).

Germany saw another drop in its annual solar thermal installations and for the first time since 2007 ranked below the 650 MWth mark. According to the German Solar Industry Association (BSW), only 112 000 systems were installed in 2014 compared to about 210 000 in 2008. Yet the total number of systems installed in Germany has passed the 12 500 MWth unit mark. Accordingly, the turnover resulting from installation and operation sank to around **€ 1 billion in 2014. 11 000 jobs** in the sector are a job estimations by the Federal Ministry of Economics and Energy (BMWi).

Growth was also more than satisfactory in **Poland**. Driven by the National Fund for Environmental Protection and Water Management (NFOSiGW) Poland installed another 182 MWth, which translates into **2 600 jobs and € 220 million** according to EurObserv'ER estimations.

For **France**, 2014 was a difficult year. New legislative measures and revisions of the sustainable development tax credit systems did not have major effects on investors and homeowners. Another drop in installations to 141 MWth could be observed, although the industry - **€ 410 million and roughly 6 000 workers** – still belongs to the largest in the European Union.

Austria is one of the most developed solar thermal sectors, in terms of both installed capacity and an industrial manufacturing base. The annual BMVIT market statistic revealed a decline but **3 450 jobs and nearly € 365 million** industry turnover are still a valuable resource for the country to build on.

In 2014, the solar thermal sector in the EU may have seen a reversal of the downward trend. The recovery though is only slowly materializing. According to EurObserv'ER, projection the EU will miss its 2020 targets on solar thermal if the current policies continue. There are however potential new pathways in some leading countries that give reason for hope over the next years, such as the market incentive programme in Germany, the Renewable Heat Incentive (RHI) programme in the UK, the revised Conto Termico in Italy. Above all, the recent global climate talks in Paris and the achieved global contract has made clear that many countries are willing to commit to less carbon intensive technologies, and that renewable heat (and transport fuel) will be vital to attain these goals.

1

Employment

	2013		2014	
	Annual installed capacity (MWth)	Employment (direct and indirect jobs)	Annual installed capacity (MWth)	Employment (direct and indirect jobs)
Germany	728.0	12 500	644.0	11 000
France	159.9	6 700	141.2	5 900
Spain	162.8	4 500	178.6	5 000
Italy	207.9	4 000	196.0	3 500
Austria	126.4	3 950	108.3	3 450
Greece	159.0	2 100	189.4	2 700
Poland	191.9	2 750	182.0	2 600
Denmark	81.7	1 200	125.4	1 800
United Kingdom	25.2	800	21.3	800
Czech Republic	55.7	800	51.3	750
Netherlands	42.1	300	40.2	300
Belgium	41.3	600	36.4	500
Portugal	40.1	600	38.5	500
Ireland	19.4	300	17.7	250
Croatia	12.2	150	14.6	200
Cyprus	12.0	150	13.6	200
Hungary	12.6	200	12.6	200
Romania	16.8	250	13.1	200
Slovakia	4.7	100	4.9	100
Sweden	6.3	100	4.7	100
Latvia	1.4	<50	1.7	<50
Lithuania	1.5	<50	1.8	<50
Luxembourg	4.3	<50	1.4	<50
Malta	1.2	<50	1.0	<50
Slovenia	6.3	100	2.5	<50
Bulgaria	3.9	<50	3.9	<50
Estonia	1.4	<50	1.4	<50
Finland	2.8	<50	2.8	<50
Total EU	2 128.8	42 500	2 050.3	40 450

Source: EurObserv'ER 2015

2

Turnover

	2013		2014	
	Cumulated capacity to date (MWth)	Turnover (M€)	Cumulated capacity to date (MWth)	Turnover (M€)
Germany	12 055	1 100	12 591	1 000
France	1 803	430	1 932	410
Austria	3 538	415	3 616	365
Italy	2 461	250	2 655	300
United Kingdom	469	350	478	300
Spain	2 238	200	2 417	250
Greece	2 926	190	3 001	225
Poland	1 040	230	1 221	220
Denmark	550	100	661	150
Czech Republic	681	65	732	60
Netherlands	616	50	627	50
Belgium	374	50	410	45
Portugal	717	50	794	45
Croatia	96	15	111	20
Ireland	193	25	211	20
Hungary	137	15	150	15
Cyprus	477	15	469	15
Romania	110	20	123	15
Slovakia	113	<10	118	<10
Sweden	335	<10	329	<10
Bulgaria	59	<5	59	<5
Estonia	6	<5	7	<5
Finland	32	<5	35	<5
Latvia	12	<5	13	<5
Lithuania	8	<5	10	<5
Luxembourg	32	<5	33	<5
Malta	34	<5	35	<5
Slovenia	148	<10	151	<5
Total EU	31 260.9	3 635	32 989	3 565

Source: EurObserv'ER 2015

SMALL HYDROPOWER

The hydropower sector and more precisely the small hydro section with installed capacities of up to 10 MW that is monitored by EurObserv'ER is the most static one of all renewable technologies. The reason for this being that most suitable sites are already utilized and new constructions being hindered by numerous legislative or environmental obstacles and regulations. EurObserv'ER monitors an increase in installed hydro capacity from 13 594 MW in 2013 to 13 652 MW in 2014. The sector turnover remains around the ***€ 4.9 billion*** mark taking into consideration different country specific investment costs (Streammap). Overall employment of the EU hydropower segment ranges around ***42 250 jobs***. This includes component manufacturing, plant installation, engineering activities and O&M across the European Union member states.

With over 3 086 MW of small hydro capacity and an annual output of 13 649 GWh, Italy is by far the largest small hydro installed capacity in the EU-28. Streammap estimated over 400 companies active in the hydro industry in Italy. EurObserv'ER rates the sector at ***4 500 jobs*** including large hydro and the continent's largest sector turnover of ***€ 880 million***.

France has the second largest small hydro capacity installed (2 029 MW) and features the second largest hydropower generation in the EU-28. The sector is quantified at ***€ 430 million and a labor force of 3 900 persons***.

Figures released by the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW), indicate over ***4 700 jobs in Austria***. The Austrian sector turnover has declined though to ***€ 770 million*** according to the same source.

Little investment activity was monitored in ***Germany*** so overall volume of investments and turnover from operation of hydro facilities declined to ***€ 400 million***. It has to be noted that the official jobs statistics (***11 800 persons*** employed) include large hydro as well.

The growth of small hydro capacity is currently in phase with the intermediate power 2015 objectives defined by National Renewable Energy Action Plans. Its development over the next five is also not assured as it faces increasingly often to the implementation of the Framework Directive on water quality and lack of political support. The sector believes however that a significant development potential can still be realized. As part of the European project coordinated by Stream Map ESHA (European Small Hydropower Association), a road map (roadmap) was conducted taking into account the potential of the sector. The report estimates that small hydro plants could reach an installed capacity of 17.3 GW in 2020 to 59.7 TWh of a producible, more than what is provided under the action Plans. □

1

Employment

	2013		2014	
	Installed net capacity to date (MW)	Employment (direct and indirect jobs)	Installed net capacity to date (MW)	Employment (direct and indirect jobs)
Germany	1 286	13 100*	1 283	11 800*
United Kingdom	299	4 950*	314	5 400*
Austria	1 209	6 150*	1 239	4 700*
Italy	3 034	4 500	3 086	4 500
France	2 021	3 850	2 029	3 900
Greece	220	2 200*	220	2 200*
Poland	277	2 000	277	2 000
Portugal	373	1 700	388	1 700
Spain	1 948	1 500	1 948	1 500
Sweden	992	600	933	550
Romania	530	500	530	500
Latvia	29	500	30	500
Czech Republic	326	400	328	400
Finland	307	400	306	400
Bulgaria	283	400	283	400
Slovenia	161	400	157	400
Hungary	17	400	16	400
Slovakia	72	250	75	250
Croatia	28	250	30	250
Belgium	64	100	64	100
Ireland	41	100	41	100
Estonia	8	100	5	100
Luxembourg	34	<50	34	<50
Lithuania	26	<50	27	<50
Denmark	9	<50	9	<50
Netherlands	0	<50	0	<50
Malta	0	0	0	0
Cyprus	0	0	0	0
Total EU	13 594	44 550	13 652	42 250

** Figures for large and small hydro plants. Source: EurObserv'ER 2015*

2

Turnover

	2013		2014	
	Small hydro gross electricity production (GWh)	Turnover (M€)	Small hydro gross electricity production (GWh)	Turnover (M€)
Italy	11 576	750	13 649	880
United Kingdom	913	820	1 121	850
Austria	5 290	1 000	5 641	770
France	7 196	450	6 805	430
Germany	7 157	600	4 822	400
Spain	6 314	400	6 081	385
Sweden	3 020	250	3 769	310
Portugal	1 195	150	1 421	180
Bulgaria	716	100	1 125	160
Romania	603	110	600	110
Poland	994	100	954	100
Czech Republic	1 094	100	1 012	90
Greece	772	75	701	70
Finland	1 077	40	996	40
Slovenia	379	25	496	25
Slovakia	137	25	140	25
Belgium	233	15	192	10
Croatia	122	<5	122	<5
Luxembourg	119	<5	108	<5
Ireland	77	<5	105	<5
Hungary	62	<5	77	<5
Lithuania	92	<5	71	<5
Latvia	60	<5	68	<5
Estonia	26	<5	27	<5
Denmark	13	<5	15	<5
Cyprus	0	0	0	0
Malta	0	0	0	0
Netherlands	0	0	0	0
Total EU	49 236	5 050	50 116	4 875

Source: EurObserv'ER 2015

GEOTHERMAL ENERGY

Ludovic Le Couster

Geothermal applications generate heat and electricity in larger plants and installations. Not much installation was monitored in the deep geothermal energy segment in the European Union in 2013 and 2014. Indeed, the largest shares of economic activity and employment are based on the operation and maintenance (O&M) part of existing power and/or heat generating facilities, in component manufacturing and geological engineering. The electrical geothermal capacity remained on the same level, whereas – like in recent years - growth was observed in both, the installed heat generating capacity (3 308 MWth against 3 237 in 2013) and in the direct use of geothermal heat (800 ktoe against 765 in 2013). EurObserv'ER assesses the EU geothermal sector at an annual turnover of ***€ 1.3 billion and 10 700 jobs***.

Italy remained the country of major geothermal applications due to a good resource potentials the country use for its energy sector. Virtually all growth in the electricity sector occurs her in the Mediterranean country that also heads the table in terms of positive socioeconomic impacts: ***€ 650 million and 5 500 persons employed***.

With a reasonable good underground potential for exploiting geothermal heat, primarily in the Île de France region and in the east of the country, ***France*** is the next biggest player, which has deep geothermal heat and power generating facilities. The sector turnover is quantified at ***€ 90 million and 1 320 jobs*** according to Ademe figures.

Whereas investment in and ambient heat was slightly growing in 2014 (see separate chapter on heat pumps) deep geothermal energy geothermal sector showed a decline to ***€ 190 million in Germany*** and a reduced workforce of ***1 100*** associated to this segment. The reasons is that a reduced demand in deep geothermal application on the domestic market – unlike the heat pumps segment – could not be compensated by technology exporting activities.

As mentioned in previous years: a lot of the near and mid-term future perspectives of the European geothermal sector will depend on the cost level of fossil fuels, which will affect investment decisions on renewable heat installations. Looking at the massive drop in oil and gas prices witnessed in 2015 and continued in early 2016, this background trend is a very uncomfortable fact for the geothermal industry. Still, if the ambitions of member states expressed in their national action plans will materialize, there is room for sector and industry growth over the coming years. □

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1

Employment

	2013		2014	
	Cumulated capacity to date	Employment (direct and indirect jobs)	Cumulated capacity to date	Employment (direct and indirect jobs)
Italy	729 MWe 757 MWth	5 500	768 MWe 757 MWth	5 500
France	16.2 MWe 336.9 MWth	1 250	16.2 MWe 346.9 MWth	1 320
Germany	24 MWe 185 MWth	1 500	24 MWe 253 MWth	1 100
Hungary	863.6 MWth	1 000	868.6 MWth	1 000
Netherlands	100 MWth	400	100 MWth	300
Poland	101.9 MWth	200	101.9 MWth	200
Romania	205.1 MWth	200	205.1 MWth	200
Slovakia	147.8 MWth	150	147.8 MWth	150
Austria	0.7 MWe 97 MWth	<100	0.7 MWe 97 MWth	<100
Croatia	75.5 MWth	<100	75.5 MWth	<100
Denmark	33 MWth	<100	33 MWth	<100
Greece	101 MWth	<100	88 MWth	<100
Lithuania	48 MWth	<100	48 MWth	<100
Portugal	25 MWe 1.5 MWth	<100	25 MWe 1.5 MWth	<100
Slovenia	66.8 MWth	<100	67.1 MWth	<100
Belgium	6.1 MWth	<50	6.1 MWth	<50
Bulgaria	83.1 MWth	<50	83.1 MWth	50
Czech Republic	4.5 MWth	<50	4.5 MWth	<50
Spain	21 MWth	<50	21 MWth	<50
United Kingdom	2.8 MWth	<50	2.8 MWth	<50
Cyprus	n.a	0	n.a	0
Estonia	n.a	0	n.a	0
Finland	n.a	0	n.a	0
Ireland	n.a	0	n.a	0
Latvia	n.a	0	n.a	0
Luxembourg	n.a	0	n.a	0
Malta	n.a	0	n.a	0
Sweden	n.a	100	n.a	0
Total EU	**794.9 MWe 3 237.6 MWth**	**11 250**	**833.9 MWe 3 307.9 MWth**	**10 770**

n.a.: not available. ***Source: EurObserv'ER 2015***

2

Turnover

	2013		2014	
	Energy tapped (ktoe)	Turnover (M€)	Energy tapped (ktoe)	Turnover (M€)
Italy	150	600	148	650
Germany	74	200	91	190
Netherlands	24	90	36	100
France	216	80	219	90
Hungary	113	75	118	80
Poland	19	30	20	30
Romania	26	25	26	25
Slovakia	7	25	7	25
Austria	22	15	19	15
Slovenia	32	15	32	15
Spain	18	15	20	15
United Kingdom	1	15	1	15
Portugal	1	10	1	10
Croatia	7	<10	11	<10
Belgium	3	<5	3	<5
Bulgaria	33	<5	33	<5
Czech Republic	2	<5	2	<5
Denmark	6	<5	4	<5
Greece	12	<5	12	<5
Lithuania	2	<5	2	<5
Cyprus	0	0	0	0
Estonia	0	0	0	0
Finland	0	0	0	0
Ireland	0	0	0	0
Latvia	0	0	0	0
Luxembourg	0	0	0	0
Malta	0	0	0	0
Sweden	0	0	0	0
Total EU	**766**	**1 235**	**804**	**1 300**

Source: EurObserv'ER 2015

HEAT PUMPS

The socio economic account of the European heat pump sector covers both aerothermal and geothermal heat applications and explicitly excludes the deep geothermal energy sector. Heat pumps are in competition not only with conventional heating technologies (gas, oil) but also with solar thermal applications. Dramatically lower oil and gas prices have disincentivized an even larger market penetration of heat pumps. Currently there are not many signs that the slump in global oil prices – an important driver for house owners to invest in heat pumps- might be reversed. But an uptake in the construction sector in many EU member states is a reason for more positive growth perspectives from which the EU heat pump industry might benefit besides the unquestioned and

Intelligent Heizen/VdZ

crucial importance of renewable heat technologies for decreasing fuel imports, increase energy security, and lowering GHG emissions.

On EU level, a market contraction from 2 million to 1.7 million heat pumps sold in the EU-28 was observed for 2014. The data is though somewhat distorted by the in inclusion of aerothermal heat pumps and the relatively high contributions of aerothermal heat pumps in Italy (860 000) and France (408 000) for cooling. Leaving these out of the equation the EU sector would have grown by 2%.

In total the EurObserv'ER market assessment arrives at ***90 000 jobs and a sector turnover of € 13,8 billion for heat pumps*** as important renewable heating technology.

France is the runner-up heat pump European market with a job force totaling 30 000. This figure is largely due to major French technology manufacturers in the country but also due to the ease to install air heat pumps in new buildings, thanks to the French RT 2012. The ***sector turnover of € 2,5 billion*** is only surpassed by the even larger Italian sector that is dominated by the reversible air/air heat pumps. Nevertheless Italian national market declined because it reached saturation threshold, compounded by the construction market slowdown. Ground source heat pumps play no important role. The industry has an estimated volume of over ***€ 5,3 billion and 8 500 jobs*** in Italy.

60 000 new heat pumps had been installed in ***Germany*** in 2014. A slight growth is reported for aerothermal heat pumps whereas the geothermal heat pump market contracted slightly. Due to a reduced overall heat consumption, the share of renewable heat remained stable. BMWi reported 16 100 job in the geothermal sector for 2014. From experience EurObserv'ER assumes that 90% of these jobs are attributable to the heat pump segment (***14 500 jobs***) with the remaining jobs in the deep geothermal sector. Accordingly, a turnover of ***€ 1.7 billion*** is estimated for Germany.

Despite being a smaller market, a report by the Renewable Energy Agency of the United Kingdom found a heat pump sector turnover of ***€ 1.3 billion and more than 8 300 jobs***.

One of the few countries where job and turnover statistics are found is the mature market of ***Sweden***, where the heat pump is the most popular heating system. The industry association SVEP observed a market decline but assumes an industry turnover of ***€ 630 million***. Considering that Sweden is also the home base of leading heating technology giants such as Nibe or IVT the job estimation of ***7 600 work places*** seems plausible. □

1

Employment

	2013		2014	
	Total heat pumps sales	Employment (direct and indirect jobs)	Total heat pumps sales	Employment (direct and indirect jobs)
France*	489 397	32 000	418 957	30 000
Germany	61 300	15 800	59 500	16 100
Italy*	1 043 936	10 000	863 780	8 500
United Kingdom	17 632	7 300	18 550	8 300
Sweden	96 547	8 700	84 711	7 600
Spain	51 984	4 700	54 001	4 900
Netherlands	40 538	2 800	46 538	2 450
Denmark	21 040	1 900	21 908	2 000
Finland	61 211	2 000	67 194	2 000
Bulgaria	14 666	1 300	21 259	1 900
Estonia	14 660	1 300	15 860	1 400
Austria	14 307	1 300	14 268	1 250
Czech Republic	7 490	650	7 825	700
Poland	7 261	650	7 583	700
Portugal	9 221	850	7 521	700
Belgium	5 503	500	5 540	500
Slovenia	6 592	600	5 616	500
Ireland	1 495	150	2 324	200
Hungary	783	100	783	100
Lithuania	700	<50	1 075	100
Luxembourg	0	<50	0	<50
Slovakia	829	100	544	<50
Croatia	0	0	0	0
Cyprus	0	0	0	0
Greece	0	0	0	0
Latvia	0	0	0	0
Malta	0	0	0	0
Romania	0	0	0	0
Total EU	1 967 092	92 800	1 725 337	90 000

** The high figure of Italian and French heat pumps market is not directly comparable to the other countries because it includes systems mainly used for cooling.* ***Source: EurObserv'ER 2015***

2

Turnover

	2013		2014	
	Heat pump market evolution	Global Heat pumps market Turnover (M€)	Heat pump market evolution	Global Heat pumps market Turnover (M€)
Italy	-3%	6 400	-17%	5 300
France	1%	2 140	-14%	2 500
Germany	1%	1 800	-3%	1 710
United Kingdom	-1%	1 300	5%	1 350
Sweden	2%	655	-12%	630
Finland	-5%	400	10%	400
Austria	-1%	325	0%	370
Netherlands	-15%	400	15%.	350
Spain	4%	320	n.a	330
Denmark	-2%	160	4%	160
Bulgaria	0%	100	45%	150
Estonia	9%	110	8%	120
Poland	2%	105	4%	110
Czech Republic	-13%	75	4%	75
Belgium	-16%	60	1%	70
Portugal	15%	60	n.a.	50
Slovenia	22%	50	-15%	45
Ireland	8%	15	55%	25
Hungary	16%	15	0%	15
Lithuania	9%	10	54%	15
Slovakia	27%	15	-34%	10
Croatia	0%	0	0%	0
Cyprus	0%	0	0%	0
Greece	0%	0	0%	0
Latvia	0%	0	0%	0
Luxembourg	0%	0	0%	0
Malta	0%	0	0%	0
Romania	0%	0	0%	0
Total EU	-2%	14 515	-12%	13 785

n.a.: not available.
Source: EurObserv'ER 2015

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BIOGAS

Total primary production of all types of biogas continually increased over the past years. According to the European biogas association, 17 240 biogas plants and 367 biomethane projects (87 new thereof in 2014 alone) were operational in Europe by the end of 2015. EurObserv'ER quantifies biogas as one of the smaller renewable market segments at ***€ 6.1 billion*** and a stable work force of nearly ***66 000 persons*** in installation of plants, component manufacturing, operation and maintenance and fuel supply.

The EU market is dominated by the two major biogas producing countries Germany and Italy, which have a thriving manufacturing scene. ***Germany***, by far the largest EU biogas employer witnessed a drop in turnover and employment to a sector volume of ***€ 1.64 billion*** and ***48 300 persons*** employed. This downward trend is due to reduced investments in the domestic market. The situation will not improve since the 2014 revisions of the renewable energy sources act

have capped biomass based energy production at an annual 100 MW. Actual new biogas capacity in 2014 was even below that mark. The fall would have been worse without the rather constant exporting activities of many manufacturers. Segments from which to expect growth in Germany might be further biomethane plants or smaller agricultural waste systems.

For ***Italy***, we assume the largest sector turnover, primarily based on numerous small and medium enterprises producing biogas plant components and equipment. ***€ 2.7 billion and 5 000 jobs*** should fairly characterize the scope of the Italian biogas market.

The ***United Kingdom*** comes in second in terms of primary energy production from biogas (2 126 ktoe). The annual market update of the Renewable Energy Agency has counted around ***2 850 jobs and claims a € 485 million*** impact on the British economy by the anaerobic digestion business.

A bit of stagnation is observed in the French market. ***France*** saw its biogas energy generation decline but still an annual ***€ 400 million market*** exists providing employment for at least ***3 500 people***. In Eastern Europe, the natural potential remains largely untapped with the exemption of the ***Czech Republic (€ 150 million and 1 200 jobs)***, that gradually builds up a larger biogas power plant fleet.

The EU biogas industry shows slight upward trends. France is a country to watch as hundreds of biogas plants are still planned to be built. Currently we are witnessing and in the middle of a longer-term transformation – away from energy crops and towards by-products and organic wastes as well as a potentially growing role of biogas in the transport sector and biomethane injection plants. It is hard to foresee whether these innovations will get the sector again off the ground, but the advantages of biogas energy generation – its independence from climatic conditions, its variable uses (power heat, transport fuel, options to store) and the possibility to provide power when it is actually needed will pay off over time, because grid management is a huge emerging topic in an ever mature renewable energy based energy system. □

1

Employment

	2013		2014	
	Primary production (ktoe)	Employment (direct and indirect jobs)	Primary production (ktoe)	Employment (direct and indirect jobs)
Germany	6 875.1	49 200	7 434.1	48 300
Italy	1 815.5	4 200	1 961.0	5 000
France	436.6	3 500	420.7	3 500
United Kingdom	2 036.5	2 650	2 126.4	2 850
Czech Republic	571.1	1 500	608.0	1 200
Spain	479.4	1 000	353.3	800
Austria	196.7	450	292.2	600
Netherlands	305.2	500	312.7	600
Poland	181.4	500	207.1	400
Belgium	189.0	500	206.3	350
Sweden	145.0	300	153.4	350
Latvia	65.0	250	75.0	300
Finland	58.0	200	61.0	250
Denmark	110.0	250	122.8	200
Hungary	82.2	300	83.7	200
Croatia	16.6	150	26.2	150
Greece	88.4	150	86.9	150
Ireland	48.2	100	52.2	150
Lithuania	15.5	100	20.9	150
Romania	30.0	150	30.0	150
Luxembourg	15.6	100	16.7	100
Portugal	65.3	150	73.5	100
Slovakia	54.9	100	58.4	100
Slovenia	34.7	100	30.8	100
Bulgaria	12.0	<50	27.0	<50
Cyprus	12.0	<50	12.0	<50
Estonia	7.2	<50	9.6	<50
Malta	0.0	<50	0.0	0
Total EU	13 947.2	66 600	14 862.4	66 200

Source: EurObserv'ER 2015

2

Turnover

	2013		2014	
	Primary energy production trend	Turnover (M€)	Primary energy production trend	Turnover (M€)
Italy	54%	2 500	7.4%	2 700
Germany	7%	1 750	8%	1 640
United Kingdom	1%	510	4%	485
France	11%	410	-4%	400
Czech Republic	52%	145	6%	150
Netherlands	2%	130	2%	150
Austria	-5%	65	33%	110
Spain	-2%	120	-36%	90
Belgium	20%	50	8%	55
Poland	16%	65	14%	50
Sweden	14%	35	5%	40
Denmark	0%	25	10%	30
Greece	0%	25	-2%	25
Finland	2%	15	5%	20
Hungary	3%	20	2%	20
Latvia	25%	15	13%	20
Slovakia	8%	20	6%	20
Ireland	-14%	10	8%	15
Bulgaria	0%	<5	56%	10
Romania	10%	10	0%	10
Slovenia	-9%	10	-13%	10
Croatia	46%	<5	58%	<5
Cyprus	5%	<5	0%	<5
Estonia	148%	<5	25%	<5
Lithuania	34%	<5	26%	<5
Luxembourg	-4%	<5	7%	<5
Portugal	16%	15	11%	<5
Malta	0%	0	0%	0
Total EU	12%	5 975	6%	6 080

Source: EurObserv'ER 2015

BIOFUELS

Biofuel consumption gained momentum again in 2014, with a 7,4% growth over 2013 and an EU wide incorporation rate of 4,9%. Bioethanol consumption remained stable whereas a rise could be monitored in the biodiesel sector accounting for around 80% of total biofuel consumption. The European Biodiesel Board (EBB) claimed 220 000 biodiesel jobs in Europe in August 2015[1]. ePure, the European bioethanol industry association states "70,000 direct and indirect jobs, even during the recent economic crisis"[2] which would leave us with 290 000 direct and indirect jobs. However, considering overcapacities (substantial parts of production capacity are idle; 15% in the case of bioethanol) and biofuel imports that need to be considered, overall, for 2014, EurObserv'ER arrives at a turnover of ***€ 13.4 billion euro and work force of around 110 000 jobs***. These can be confidently assumed as conservative estimation, taking into account the supply side activities of the agricultural sector.

France is the unrivalled European leader in biofuel use and beyond in the overall incorporation target of 7,5% thanks to recent orders that rose the maximum content of biodiesel and biofuel allowed in diesel and fuel mix. The French Statistical Department (SoES) reported a 10% growth in biofuel consumption due to the spread of service stations selling E10 petrol (that contains 10% of bioethanol). Correspondingly, also in terms of socioeconomic impacts, France is top of the league. EurObserv'ER assume a ***sector turnover of € 3.5 billion*** and an increased ***labor force of 35 000*** reflecting these promising trends.

Germany is the runner-up in European biofuel sector. Renewable energy use in the German transport sector grew. With over 3.4 million tons consumed in 2014 Germany saw a 4% growth in 2014. Sales of biodiesel increased by 4.6% and bioethanol by 1.9 percent. After some remarkable upward trend over the past years, for biomethane only a slight increase could be observed (580 million kWh). The overall share of biofuels in Final energy consumption rose slightly to 5.6% (5,5% in 2013). According to information by AGEE-Stat the sector turnover is quantified at € 2.6 billion for biofuels. Despite growth in domestic biodiesel production (+7%), and in bioethanol production (+8% to 726 881 tons), the annual job statistics provided by GWS/DLR/DIW monitors a decline in biofuel related jobs to 23 100 in 2014. The reason for this is that a particularly high proportion of the employment is created in the agricultural fuel supply. The cultivated area used to provide raw materials for biofuels declined by 16% in 2014 in Germany, ***leading to a 10% drop in employment***.

Spain saw a drop in bioethanol consumption but a clear rise in biodiesel so that in terms of energy content, the country has regained some of its former strength. As the country began to get out of the economic turmoil of the past years, the road fuel consumption increased. Biofuel incorporation rate being legally binding, the rise of biofuel consumption is logical. Spain is also home to some of the world's leading biofuel producers. EurObserv'ER calculates a sector turnover of € 930 million and 10 000 jobs.

A sharp rise in biofuel use is being monitored for the ***United Kingdom***. DECC claims a 14% growth in consumption over 2013 although the incorporation rate is still relatively low compared to other member states. Indeed the country stopped raising its incorporation rates because of contentious proposals of the European Union on including the ILUC effect and the incorporation ceiling for agrofuels. In the annual renewable energy market review of REA and PriceWaterhouseCooper the UK biofuel sector is estimated at a volume of ***€ 645 million and an industry totaling 3 900 jobs***.

EurObserv'ER confirms that the 2020 NREAP targets can still be achieved. For 2017 the European commission has announced to present a legal text on the decarbonization of the transport sector, including an action plan. After the introduction of import duties on biodiesel imports on Argentinean and Indonesian biodiesel has relieved the European biodiesel sector over the past year, this initiative, together with the overall ambition of the Energy Union could give the sector a more predictable legal framework and a more positive outlook on the socioeconomic benefits of biofuel use.

1. *Biodiesel's benefit in Europe, http://www.ebb-eu.org/pressdl/BiodieselsBenifitsInEU_AdjacentGovernment.pdf, August 2015, page 2.*

2. *ePure 2014: Renewable ethanol: driving jobs, growth and innovation throughout Europe - State of the Industry report 2014, http://epure.org/media/1137/state-of-the-industry-report-2014.pdf, page 16.*

1

Employment

	2013		2014	
	Biofuel consumption for transport (toe)	Employment (direct and indirect jobs)	Biofuel consumption for transport (toe)	Employment (direct and indirect jobs)
France	2 688 000	30 000	2 955 000	35 000
Germany	2 643 548	25 600	2 748 831	23 100
Spain	899 241	9 600	979 380	10 000
Belgium	330 849	8 000	386 939	8 300
Poland	739 109	5 800	691 339	5 900
Italy	1 234 009	6 200	1 062 898	5 500
United Kingdom	1 021 829	3 500	1 166 896	3 900
Sweden	710 748	2 400	882 271	3 300
Netherlands	299 202	3 000	349 265	3 000
Finland	205 058	700	435 995	1 900
Portugal	278 307	1 400	295 880	1 500
Czech Republic	272 772	1 200	344 101	1 400
Denmark	223 616	1 200	228 420	1 400
Luxembourg	53 504	1 200	68 632	1 300
Romania	206 356	900	206 356	900
Austria	519 882	850	540 293	800
Greece	122 838	650	133 443	700
Hungary	136 233	550	151 577	600
Slovakia	135 442	400	135 442	400
Bulgaria	104 260	500	53 429	300
Ireland	73 237	200	89 958	300
Lithuania	58 675	250	64 308	300
Croatia	29 804	150	29 354	150
Slovenia	51 627	250	29 111	150
Latvia	18 749	<50	22 045	100
Cyprus	14 772	100	13 277	<50
Malta	2 909	<50	3 975	<50
Estonia	0	<50	0	<50
Total EU	13 074 576	104 750	14 068 415	110 350

Source: EurObserv'ER 2015

2

Turnover

	2013		2014	
	Consumption trend	Turnover (M€)	Consumption trend	Turnover (M€)
France	0%	3 180	9%	3 500
Germany	-13%	3 100	4%	2 700
Italy	-8%	1 150	-16%	1 000
Spain	-57%	850	8%	930
Sweden	15%	750	19%	900
Poland	-7%	690	1%	700
United Kingdom	15%	650	12%	645
Belgium	0%	300	15%	350
Netherlands	-11%	300	14%	330
Czech Republic	-3%	260	21%	320
Austria	14%	345	4%	305
Portugal	-3%	260	6%	280
Denmark	0%	210	2%	250
Finland	-1%	220	53%	200
Romania	2%	200	0%	200
Hungary	11%	130	10%	145
Greece	-1%	120	8%	130
Slovakia	34%	130	0%	130
Ireland	22%	100	19%	110
Luxembourg	14%	50	22%	65
Lithuania	-3%	55	9%	60
Bulgaria	21%	100	-95%	50
Croatia	-11%	25	0%	30
Slovenia	0%	50	-77%	30
Latvia	-2%	20	15%	20
Cyprus	-8%	15	-11%	15
Malta	-34%	<5	27%	<5
Estonia	0%	<5	0%	<5
Total EU	-10%	13 270	7%	13 405

Source: EurObserv'ER 2015

RENEWABLE URBAN WASTE

By definition the incineration of waste (or the renewable biomass share contained in it) is considered by the Renewable Energy directive to contribute to the renewable energy statistics. Total primary energy production in the EU (electricity and heat from incineration plants) increased from 8 756 ktoe in 2013 to 9 037 ktoe in 2014. There is even less information available for the Waste-to-Energy sector (WtE) in terms of employment in the EU-28 than for other RES sectors.


Veolia UK

In addition, the Confederation of European Waste-to-Energy Plants (CEWEP) has not yet released their regular updated national reports update. EurObserv'ER has based its job estimations on previous editions and adjusted job figures according to market development in 2014.

In total Eurobserv'ER arrives at a revised total of around ***8 410 direct jobs*** for the entire European Union. France, Germany, Italy, Sweden, and the Netherlands remain the major energy producing countries using renewable municipal waste.

Belgium is among the countries that registered significant growth in its production of renewable primary energy from household waste, without having commissioned new power plants. According to data of the FPS Economy, it increased 18.3% in 2014 to reach 348.6 ktoe. This increase took full advantage in the production of electricity.

In terms of primary energy production, the growth rate of the wastes sector is currently moderated. Nevertheless, European pressure is growing strong, and investment decisions are starting to be taken, particularly in the countries of Eastern Europe where everything remains to be done. The compliance of these countries should boost investment in the field of energy recovery in the second half of the decade and more sharply from 2017, and give new impetus to the sector in the medium term. □

1

Employment

	2013		2014	
	Primary energy production from renewable municipal waste (ktoe)	Employment (direct jobs only)	Primary energy production from renewable municipal waste (ktoe)	Employment (direct jobs only)
Netherlands	799	1 300	794	1 300
United Kingdom	486	1 150	472	1 050
Italy	828	900	858	1 000
Sweden	820	800	858	900
France	1 159	600	1 179	610
Denmark	492	600	489	600
Belgium	295	500	349	600
Spain	200	500	204	500
Austria	152	450	179	450
Finland	222	350	247	350
Portugal	97	300	82	250
Czech Rep.	83	250	82	250
Hungary	43	150	44	150
Ireland	49	50	52	50
Poland	33	<50	37	<50
Bulgaria	21	<50	21	<50
Slovakia	15	<50	17	<50
Luxembourg	17	<50	16	<50
Lithuania	11	<50	11	<50
Slovenia	7	<50	8	<50
Malta	1	<50	1	<50
Germany	2 927	n.a	3 037	n.a
Romania	n.a	n.a	n.a	n.a
Latvia	n.a	n.a	n.a	n.a
Cyprus	n.a	n.a	n.a	n.a
Estonia	n.a	n.a	n.a	n.a
Croatia	n.a	n.a	n.a	n.a
Greece	n.a	n.a	n.a	n.a
Total EU	**8 756**	**8 250**	**9 037**	**8 410**

n.a.: not available. ***Source: EurObserv'ER 2015***

SOLID BIOMASS

Solid biomass based electricity generation increased by 4.5% to 84.8 TWh in 2014. On the other hand, heat generation using solid biomass decreased following mild winter climate conditions that have reduced overall heating demand. Despite some lower figures for 2014, the European biomass sector remains the socioeconomic elephant in the room, taking second position in terms of generated turnover (around ***€ 36 billion***) ***and employment (306 800)*** only beaten by the ever expanding wind energy sector.

The legislative policy changes in ***Germany*** in 2014 (EEG) were not specifically helpful for the dynamics of the biomass and biogas sectors. Indeed biomass and biogas installations are even below the target of 100 MW per year. The relatively high socioeconomic impacts (***48 500 people employed and close to € 8 billion turnover***) largely stem from the operation and maintenance of the existing power plant fleet and the biomass fuel supply, rather than from installation or component manufacturing as is the case in other renewable energy sectors.

France registered a slight drop in its biomass primary energy production. The French government ramped up the initiatives to encourage the use of biomass and numerous incentives and tax cut are in place. The country belongs to the EU leaders and close to ***48 000 jobs*** can be found in the various market segments. The French sector should be as large as € 5 billion in 2014 according to our estimations.

The ***United Kingdom*** is an important EU player in terms of biomass energy generation. It has converted a number of coal-fired power plants to biomass, and has thus become the European Union's top-ranked solid biomass electricity producer generating 13.9 TWh in 2014, up from 9.9 TWh in 2013. Although large amounts of solid biomass most notably pellets are imported, the socioeconomic impact is clearly visible. REA/PwC has valued the sector at ***21 500 jobs and over € 4.1 billion in turnover***.

One of the few countries with regular and precise job and turnover estimations is ***Austria***. The Annual market review claims that in 2014, 6 266 pellet boilers, 3 820 wood log boilers and 2 658 wood chip boilers were sold, concerning the whole range of power. Furthermore, 2 399 pellet stoves, 6 710 cooking stoves and 11 692 wood log stoves were sold. Fuels from solid biomass contributed to a CO_2 reduction of almost 8.3 million tons in 2014. The whole sector of solid biofuels accounted a total turnover of over ***€ 2.4 billion and roughly 18 000 jobs*** in total.

Further important actors are naturally the Scandinavian countries. Sweden has seen a drop in its biomass use due to an overall decrease of energy consumption for heating, but remains a strong labour force of nearly ***27 000 persons and a sector volume of € 2.6 billion***.

In addition, Finland could keep up its high level of biomass in its energy supply with over 8.1 Mtoe. According to the conservative EurObserv'ER estimations, the Nordic country employs over ***24 000 people in its bioenergy sector which is worth over € 2.4 billion***.

As other RES sectors, solid biomass experienced a flat or stagnating development trend over the past two years. In the absence of binding sustainability criteria – not expected until 2020, biomass could not live up to its full potential. The EurObserv'ER Biomass Barometer (December 2015) concluded that a few countries will easily reach their targets, such as Germany, Italy, Austria, Finland, Sweden and Denmark, others, such as France, Poland, the Netherlands, Belgium and Spain have a lot of ground to cover. However, in turn, political determination might revive the sector also in socioeconomic impact terms. □

1

Employment

	2013		2014	
	Primary energy production (ktoe)	Employment (direct and indirect jobs)	Primary energy production (ktoe)	Employment (direct and indirect jobs)
Germany	10.902	51 600	11.425	48 500
France	10.383	52 500	8.853	48 000
Sweden	9.211	27 600	8.958	26 900
Finland	8.113	24 350	8.105	24 300
United Kingdom	2.746	21 000	3.048	21 500
Italy	7.448	20 000	6.539	19 000
Poland	6.837	20 500	6.179	18 500
Austria	4.700	18 600	4.378	18 100
Spain	4.582	14 000	4.562	13 700
Romania	3.657	11 000	3.423	10 500
Portugal	2.684	8 000	2.685	8 000
Czech Republic	2.293	6 900	2.301	6 900
Latvia	1.749	5 200	2.044	6 000
Hungary	1.454	4 300	1.537	4 600
Croatia	1.465	4 400	1.375	4 100
Denmark	1.431	4 300	1.304	3 900
Netherlands	1.206	3 600	1.290	3 900
Estonia	1.067	3 200	1.122	3 400
Lithuania	1.041	3 100	1.117	3 350
Belgium	1.389	4 200	1.104	3 300
Bulgaria	1.122	3 300	0.902	2 700
Greece	0.847	2 500	0.869	2 600
Slovakia	0.818	2 500	0.836	2 500
Slovenia	0.628	1 800	0.560	1 700
Ireland	0.183	500	0.210	600
Luxembourg	0.048	150	0.066	200
Cyprus	0.005	>50	0.005	<50
Malta	0.001	0	0.001	0
Total EU	88.011	319 150	84.800	306 800

Source: EurObserv'ER 2015

2

Turnover

	2013		2014	
	Primary energy production trend	Turnover (M€)	Primary energy production trend	Turnover (M€)
Germany	0%	8 140	5%	8 060
France	6%	4 930	-15%	5 000
United Kingdom	49%	3 955	11%	4 150
Sweden	-4%	2 650	-3%	2 600
Austria	-2%	2 550	-7%	2 425
Finland	2%	2 350	0%	2 400
Italy	3%	2 200	-12%	1 900
Poland	-2%	2 000	-10%	1 800
Spain	-8%	1 350	0%	1 350
Romania	-4%	1 050	-6%	990
Portugal	15%	750	0%	750
Czech Republic	-6%	670	0%	670
Latvia	-6%	510	17%	600
Hungary	5%	425	6%	450
Denmark	-3%	400	-9%	380
Netherlands	8%	300	7%	350
Estonia	5%	310	5%	330
Lithuania	5%	300	7%	325
Belgium	-2%	400	-20%	320
Bulgaria	1%	325	-20%	260
Greece	-15%	250	3%	250
Slovakia	2%	230	2%	250
Croatia	1%	200	2%	200
Slovenia	12%	180	-11%	160
Ireland	-7%	50	15%	60
Luxembourg	2%	15	37%	20
Cyprus	0%	<5	0%	<5
Malta	0%	0	25%	0
Total EU	1%	36 495	-4%	36 055

Source: EurObserv'ER 2015

2014 has not been one of the best in terms of growth for renewable energy in the EU-28. Sectors such as wind, PV or solar thermal has seen their development going down compared to 2013 but employment and turnover indicators remained at very significant levels: more than 1.1 million jobs and economic activity at more than 143 billion euros.

EMPLOYMENT

The job counts displays once more a drop of the current work force to around ***1.11 million persons in 2014***, - i.e. a loss of over 44 000 work places (down from 1.15 million in 2013). This is a consequence of investors concerns about the slashing of renewable energy policy incentives throughout numerous member states and the indirect impacts of the financial crisis over recent years. The most notable decrease was observed in the European PV sector that could not be offset by clear growth in wind power or minor increases such as in biofuels. The PV sector is now even more clearly distanced from the largest sectors which are biomass (306 000) and wind (314 000) that has regained its leading position and dominant source renewable employment in Europe, most notably through the development in the globally leading offshore sector. Germany (over 347 000 persons) is still the largest job market, but also has lost most jobs of all member states in absolute terms (-16 000 jobs). France (roughly 170 000 persons with slight drops), the UK (98 000 and 6 000 new jobs), Italy (82 500), and Spain (61 000) are the next biggest countries.

Looking from a global perspective on the socioeconomic figures of turnover and employment of renewable energy technologies in the European Union for the past two years, EurObserv'ER monitors stagnation in turnover and once more a clearly visible decline in renewable energy related employment. On the other hand we may conclude that the jobs loss was not as dramatic as in the year before. From today's view one has to honestly state that previous renewable job growth projections (up to 2.3 to 2.7 million jobs by 2020) seem to be out of reach. The Paris COP 21 climate agreements, the EU 2030 targets, and the ongoing creation of an Energy Union might be push factors for the EU renewable energy industry and business over coming years. The low oil and gas prices on the other hand might be a barrier for an even faster market penetration of renewables in heat and power supply. Despite having somewhat lost the momentum as global hub of installing renewable sources of energy and its use, the EU renewable energy industry is still well-positioned to benefit from the rapid changes currently materializing all over the energy world.

A noteworthy trend is also the continually growing divestment movement from fossil fuel exploration: Institutional investors have started to gradually shift their assets away from fossil and nuclear sources of energy. Renewables – despite the moderate current results – might be the winner in the mid and long-term of the energy game.

TURNOVER

The combined turnover of 10 renewable energy sector in all 28 EU member states reached ***€ 143.6 billion in 2014*** and thus remained on a stable level compared to 2013 (142 billion). Comparing to other industry sectors in the aftermath of the economic crisis, these figures may be interpreted as a success story in the long hand. Germany is once more the class primus here with a revived overall country turnover of € 33.3 billion for investment in new installations and turnover from operation of existing renewable energy facilities. Even more than in the years before this is the result of an exceptionally good year in wind power that accounted for over € 12 billion alone. France (€ 18.8 billion), the United Kingdom (€ 18.1 billion), Italy (€ 16 billion and Denmark (€ 12.5 billion) rank next in the EurObserv'ER overview.

The flat development confirms the trend of the past years: stagnation on a high level. Whereas the growth levels witnessed in the first decade of the century cannot be replicated, the European renewable energy industry is mature, internationally competitive, and an irreplaceable part of the EU industry landscape. Wind energy by far attracted the largest share of investments and has created the bulk of turnover (over € 48 billion in 2014), followed by the solid biomass segment (€ 36 billion). The other sectors showed less dynamics. □

EMPLOYMENT

2014 employment distribution by sector

	Country total	Wind	Biomass	Photovoltaic	Biofuels	Heat pumps	Biogas	Hydro	Solarthermal + CSP	Geothermal	Waste**
Germany	347 400	149 200	48 500	38 300	23 100	16 100	48 300	11 800*	11 000	1 100	n.a
France	169 630	20 000	48 000	21 400	35 000	30 000	3 500	3 900	5 900	1 320	610
United Kingdom	98 250	38 300	21 500	16 100	3 900	8 300	2 850	5 400*	800	<50	1 050
Italy	82 500	20 000	19 000	10 000	5 500	8 500	5 000	4 500	3 500	5 500	1 000
Spain	60 950	18 000	13 700	6 500	10 000	4 900	800	1 500	5 000	<50	500
Sweden	50 350	9 900	26 900	750	3 300	7 600	350	550	100	0	900
Denmark	40 900	30 000	3 900	850	1 400	2 000	200	<50	1 800	<100	600
Austria	39 300	4 850	18 100	5 000	800	1 250	600	4 700*	3 450	<100	450
Poland	33 100	2 500	18 500	250	5 900	700	400	2 000	2 600	200	<50
Finland	31 050	1 700	24 300	100	1 900	2 000	250	400	<50	0	350
Netherlands	21 400	2 000	3 900	5 500	3 000	4 200	600	<50	550	300	1 300
Romania	20 950	4 500	10 500	4 000	900	0	150	500	200	200	n.a
Belgium	20 400	3 700	3 300	3 000	8 300	500	350	100	500	<50	600
Portugal	17 650	3 000	8 000	1 800	1 500	700	100	1 700	500	<100	250
Czech Republic	13 350	200	6 900	1 500	1 400	700	1 200	400	750	<50	250
Greece	12 450	2 000	2 600	2 000	700	0	150	2 200*	2 700	<100	n.a
Latvia	7 050	<50	6 000	<50	100	0	300	500	<50	0	n.a
Bulgaria	6 600	300	2 700	800	300	1 900	<50	400	<50	<50	<50
Hungary	7 450	100	4 600	100	600	100	200	400	200	1 000	150
Croatia	5 900	750	4 100	200	150	0	150	250	200	<100	n.a
Estonia	5 600	500	3 400	<50	<50	1 400	<50	100	<50	0	n.a
Lithuania	4 400	100	3 350	150	300	100	150	<50	<50	<100	<50
Ireland	4 200	2 500	600	<50	300	200	150	100	250	0	<50
Slovakia	4 100	<50	2 500	450	400	<50	100	250	100	150	<50
Slovenia	3 400	<50	1 700	300	150	500	100	400	<50	<100	<50
Luxembourg	2 100	<50	200	250	1 300	<50	100	<50	<50	0	<50
Cyprus	800	<50	<50	400	<50	0	<50	0	200	0	n.a
Malta	550	0	0	400	<50	0	0	0	<50	0	<50
Total EU	1 111 780	314 350	306 800	120 250	110 350	91 750	66 200	42 250	40 700	10 720	8 410

** Small and large hydro. ** Direct jobs only. n.a.: non available.* ***Source: EurObserv'ER 2015***

TURNOVER

2014 turnover by sector (€M)

	Country total	Wind	Biomass	Photovoltaic	Heat pumps	Biofuels	Biogas	Hydro	Solarthermal + CSP	Geothermal
Germany	33 300	13 900	8 060	3 700	1 710	2 700	1 640	400*	1 000	190
France	18 870	2 620	5 000	3 920	2 500	3 500	400	430	410	90
United Kingdom	18 115	7 475	4 150	2 845	1 350	645	485	850*	300	15
Italy	16 070	1 000	1 900	2 340	5 300	1 000	2 700	880	300	650
Denmark	12 560	11 330	380	250	160	250	30	<5	150	<5
Spain	7 450	3 800	1 350	300	330	930	90	385	250	15
Austria	6 300	1 035	2 425	905	370	305	110	770*	365	15
Sweden	6 270	1 700	2 600	80	630	900	40	310	<10	0
Poland	4 040	1 000	1 800	30	110	700	50	100	220	30
Finland	3 370	300	2 400	<5	400	200	20	40	<5	0
Netherlands	2 700	800	350	600	320	330	150	0	50	100
Romania	2 600	750	990	500	0	200	10	110	15	25
Belgium	2 030	1 025	320	150	70	350	55	10	45	<5
Portugal	1 950	430	750	200	50	280	<5	180	45	10
Czech Republic	1 455	35	670	50	75	320	150	90	60	<5
Greece	1 265	310	250	250	0	130	25	70*	225	<5
Bulgaria	710	45	260	25	150	50	10	160	<5	<5
Hungary	750	15	450	<5	15	145	20	<5	15	80
Latvia	660	<5	600	<5	0	20	20	<5	<5	0
Ireland	640	400	60	<5	25	110	15	<5	20	0
Estonia	565	90	330	<5	120	<5	<5	<5	<5	0
Slovakia	490	<5	250	15	10	130	20	25	<10	25
Lithuania	445	15	325	10	15	60	<5	<5	<5	<5
Croatia	425	130	200	25	0	30	<5	<5	20	<10
Slovenia	320	<5	160	25	45	30	10	25	<5	15
Luxembourg	130	<5	20	25	0	65	<5	<5	<5	0
Cyprus	95	<5	<5	50	0	15	<5	0	15	0
Malta	50	0	0	40	0	<5	0	0	<5	0
Total EU	143 625	48 230	36 055	16 360	13 755	13 405	6 080	4 875	3 565	1 300

* *Small and large hydro.* ***Source: EurObserv'ER 2015***

INVESTMENT INDICATORS

For the third time, EurObserv'ER presents indicators that shed light on the financing side of RES. In order to show a comprehensive picture, the investment indicators cover two broader aspects:

- the first group of indicators relates to investment in the application of RE technologies (e.g. building power plants) ;
- the second group of indicators shifts the focus towards the development and the production of the technologies themselves (e.g. producing solar modules).

First of all, investments in new built capacity for all RES sectors in all EU member states are covered under asset finance. Asset finance data based on the Bloomberg New Energy Finance (BNEF) data base and covers utility-scale investments in renewable energy, basically investment in power plants.

The second part starts to analyse investment in RE technology by providing venture capital and private equity (VC/PE) investment data as derived from BNEF for all RES for the EU as a whole in order to capture the dynamics of the EU market for new technology and project developing companies.

Then, RES stock indices are presented, that have been constructed by the EurObserv'ER team, which cover the largest European firms for the major RES. This illustrates the situation of publicly traded equity in RE technology producing firms. The data used for the construction of the indices is collected from the respective national stock exchanges as well as public databases (e.g. Yahoo Finance). It should be mentioned that the data on asset finance and VC/PE investment presented in this edition cannot be compared to the data in the previous edition of the State of Renewable Energies in Europe. The reason is that the database evolves continuously. This means that, whenever information on investment deals in previous years is found, it is added to the database to make it as comprehensive as possible. Hence, the investment figures for 2014 presented in last year's edition and this edition naturally differ.

EUROBSERV'ER – THE STATE OF RENEWABLE ENERGIES IN EUROPE – 2015 EDITION

Investment in Renewable Energy Projects

Asset finance covers all investment into renewable energy generation projects at utility scale. It covers the RES-sectors: wind, solar PV, solid biomass, biogas, and waste-to-energy projects with a capacity of more than 1 MW and investments in biofuels with a capacity of more the one million litres per year. In 2013 and 2014 no investments in CSP or geothermal were recorded, so these sectors are not covered in this edition. The underlying data is deal-based and, for the investment indicators presented here, all completed deals in 2012 and 2013 were covered. This means that for all included projects the financial deal was agreed upon and finalised, so the financing is secured. Note that this does not give an indication when the capacity will be added. In some cases the construction starts immediately, while in several cases a financial deal is signed for a project, where construction starts several months (or sometimes years) later. Hence, the data of the associated capacity added shows the estimated capacity added by the asset finance deals closed in the respective year. This capacity might be added either already in the respective year or in the following years. Furthermore, a certain amount of the individual deal values are not disclosed. In these cases, estimations (by BNEF) are assigned to the respective projects.

Methodological note

Asset finance is differentiated by three types: *balance-sheet finance, non-recourse project finance, and bonds and other approaches. In the first case, the respective power plant is financed from the balance-sheet of typically a large energy company or a utility. In this case the utility might borrow money from a bank and is – as company – responsible to pay back the loan. Non-recourse project finance implies that someone provides equity to a single purpose company (a dedicated project company) and this project company asks for additional bank loans. Here, only the project company is responsible to pay back the loan and the project is largely separated from the balance sheet of the equity provider (sponsor). Finally, the third type of asset finance, new / alternative financing mechanisms are captured as bonds (that are issued to finance a project), guarantees, leasing, etc. These instruments play so far a very minor role in the EU, particularly in comparison to the US, where the market for bond finance for RES projects is further developed. Nevertheless, these instruments are captured to monitor their role in the EU.*

EUROBSERV'ER – THE STATE OF RENEWABLE ENERGIES IN EUROPE – 2015 EDITION

WIND POWER

The wind sector experienced the largest development between 2013 and 2014 compared to all other RES sectors. Investments in wind power plants grew by around € 7.8 billion from € 14.2 billion in 2013 to € 22 billion in 2014. This translates into an increase of asset finance for wind by almost 55% between both years. A similar upsurge can be observed, of course, for capacity added. Asset finance for utility-scale wind power was associated with capacity added of 11.73 GW in 2014 compared to 7.67 GW in 2013. The upsurge in capacity added is, with almost 53%, marginally smaller than the growth in investment. This implies an increase of investment cost per MW. In fact, average investment expenditures per MW of wind capacity increased from € 1.85 million in 2013 to € 1.87 million in 2014. However, an increased share of offshore wind in total investments, which is typically more cost intensive, mainly drives this trend. When comparing the number of projects in both years, an even stronger growth can be observed. The number of wind power projects increased by around 72% from 340 in 2013 to 586 in 2014.

With respect to the financing sources of investments for wind, there are no major differences between both years. In both 2013 and 2014, around two thirds of all investments in wind power are financed from balance sheets (64.5% and 65.5%, respectively). The remainder of investments is almost entirely covered by project financing, namely 34.8% in 2013 and 34.4% in 2014. As in the previous years, the role of bonds and other asset financing types is very limited. A striking aspect, which could be observed in previous years as well, is the on average larger project size of wind power plants financed through project financing. This is in indicated by share of the number of investments that are project financed. Although project finance is associated with around a third of financing volume in both years, only 14% (2013) and 9% (2014) of all projects are covered by project financing.

OFFSHORE INVESTMENTS OVERTAKE ONSHORE

A closer look at investments in offshore wind capacity reveals significant differences in onshore and offshore asset finance. Overall, offshore investments increased even more drastically than onshore, namely from € 4.5 billion in 2013 to € 11.3 billion in 2014 which is an increase by 150%. Furthermore, this dramatic increase in investments is associated with fewer projects as the number of offshore projects dropped from nine in 2013 to eight in 2014. Hence, the increase in overall asset finance for offshore is driven by the size of individual projects. The average project size was € 1.4 billion in 2014 compared to only € 0.5 billion in 2013. Because of this rapid growth in offshore investments, the importance of asset financing in offshore relative to onshore wind increased notably between both years. The share of offshore in total wind investment grew from 32% in 2013 to almost 52% in 2014.

The upswing in offshore wind capacity added is even stronger than the growth in asset finance. Capacity added associated with 2013 offshore investments was 995.5 MW compared to 2.70 GW in 2014. This translates into an increase by 172%. This development is also reflected in the investment costs per MW. Average expenditure for one MW of offshore capacity declined from € 4.5 million to € 4.2 million between the two years. In comparison, investment costs for onshore wind are significantly lower, but show a similar trend. Expenditures for one MW of onshore wind were only € 1.18 million in 2014 in comparison to € 1.45 in 2013. Hence, in spite of higher investment volumes for offshore wind in 2014, the capacity added of all onshore wind investments in that year, 9 GW, is significantly higher than the capacity associated with offshore investments, 2.7 GW.

GERMANY EXTENDS ITS LEAD, HIGH INVESTMENTS IN UK AND NETHERLANDS

A look at the national breakdown of asset finance in the leading trio, Germany, the UK, and the Netherlands, shows two similarities. First, all three countries experienced a significant upsurge in investments between 2013 and 2014 and, second, asset finance for offshore is an important driver of wind investments in these Member States. Germany did not only keep its pole position in wind investments, but even increased the distance

1

Overview of asset finance in the wind power sector (onshore + offshore) in the EU member states in 2013 and 2014

	2013			2014		
	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (MW)	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (MW)
Germany	4 719.98	100	2 098.2	8 179.67	364	4 831.3
United Kingdom	3 403.44	69	1 568.3	5 398.11	52	1 910.1
Netherlands	480.80	1	129.0	4 038.43	12	1 149.0
France	1 145.07	43	703.9	1 035.01	58	920.78
Poland	448.16	12	359.2	631.51	10	558.0
Austria	43.57	2	27.0	503.09	12	436.18
Portugal	128.82	13	122.2	439.95	9	364.1
Finland	397.24	11	283.3	439.06	14	372.0
Belgium	48.45	5	45.1	334.05	18	312.6
Sweden	1 248.20	24	806.8	316.09	12	300.0
Ireland	524.30	10	390.1	186.56	6	169.0
Lithuania	0.00	0	0	163.87	3	129.0
Italy	287.93	11	252.5	157.38	5	134.0
Denmark	365.57	27	346.8	141.37	9	134.2
Romania	533.54	6	465.5	10.54	1	10.0
Czech Republic	14.55	1	13.8	2.11	1	2.0
Greece	401.75	4	55.9			0
Spain	18.64	1	5.0			0
Luxembourg	15.04	2	13.8	0.00	0	0
Total EU	14 210.00	340	7 672.4	21 976.80	586	11 732.0

Source: EurObserv'ER 2015

to the other EU members. Asset finance for wind power increased from € 4.7 billion in 2013 to almost € 8.2 billion in 2014. This means that, in 2014, more than 37% of all new investments in wind capacity in the EU were conducted in Germany. The high investments in 2014 are, even stronger than in 2013, caused by large investments in offshore capacity. With almost € 3.6 billion, more than 40% of new investments in Germany were directed to offshore wind. The UK has as well experienced a notable increase in investments from already very high € 3.4 billion in 2013 to € 5.4 billion in 2014. In the UK, the role of offshore wind is even more dominant and increased between both years. While in 2013 around 40% of new wind investments were directed at offshore capacity, the share of new offshore investments increased to more than 80% in 2014. Finally, the Netherlands have experienced impressive new investments of more than € 4 billion in 2014 compared to only € 480 million in the previous year. Around 75% of the investment sum in 2014 was dedicated to two very large offshore wind plants. Overall, Germany, the UK,

and the Netherlands account for more than 80% of all investments into wind capacity in the EU.

INCREASE OF INVESTMENT IN SEVERAL COUNTRIES, FRANCE KEEPS HIGH LEVEL

In France, investments in wind capacity stayed on an approximately constant and high level. Asset finance totalled € 1.14 billion in 2013 and only slightly decreased to € 1.04 billion in 2014. With these investment sums, France experienced the fourth highest new investments in 2014 and is ranked third in 2013. The amount of projects even increased from 43 to 58. In France, the decrease in investment expenditure per MW is particularly visible. Although asset finance dropped slightly, the associated capacity added increased from 703 MW in 2013 to 921 MW in 2014.

Overall, 2014 saw quite a few success stories with respect to wind investments. Six EU Member States experienced, in some cases significant, increases in asset finance. Three of these countries, Austria, Belgium, and Lithuania, experienced particularly high upsurges in asset financing. In Austria, new investments in wind power plants increased from only € 44 million in 2013 to € 503 million in 2014. The case is similar for Belgium where investments of € 334 million 2014 are on a different level compared to the € 48 million in 2013. In both countries, the number of projects

2

Share of different types of asset finance in the wind power sector (onshore + offshore) in the EU in 2013 and 2014

	2013		2014	
	Asset Finance - New Built (%)	Number of Projects	Asset Finance - New Built (%)	Number of Projects
Balance Sheet	64.5%	84.7%	65.3%	90.6%
Project Finance	34.8%	14.1%	34.3%	9.0%
Bond/Other	0.7%	1.2%	0.4%	0.3%
Total EU	100.0%	100.0%	100.0%	100.0%

Source: EurObserv'ER 2015

3

Overview of asset finance in the wind power sector offshore in the EU member states in 2013 and 2014

	2013			2014		
	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (MW)	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (MW)
United Kingdom	1 387.16	5	285.5	4 369.27	3	1 048.8
Germany	2 634.36	2	576.0	3 646.81	3	915.2
Netherlands	480.80	1	129.0	3 326.04	2	744.0
Spain	18.64	1	5.0			
Total EU	4 520.96	9	995.5	11 342.13	8	2 708.0

Source: EurObserv'ER 2015

Vattenfall/Jorrit Lousberg

increased significantly as well from 2013 to 2014. Finally, in Lithuania € 164 million were invested in wind power in 2014. Although this amount is smaller than investments in Austria and Belgium, it is particularly noteworthy as Lithuania did not experience any wind investments in 2013.

Poland, Portugal, and Finland experienced increases in wind investments as well. Particularly in the former two countries, the growth in investment is less dramatic as in the Member States analysed above. In Poland, asset finance for wind increased from € 448 million 2013 to € 632 million in 2014. This makes Poland the member state with the fifth highest wind investments in the EU that will translate into a capacity added of more than 0.55 GW. Although it is only ranked seventh in 2014, the increase in investments is particularly high in Portugal. Investments more than tripled to € 440 million in 2014. Poland and Portugal have one thing in common: they are the only Member States with increasing investments that experienced a drop in the number of projects. Hence, the average project size increased notably in both countries. In Finland, investments grew more moderately from € 397 million in 2013 to € 439 million in 2014.

REDUCTIONS IN INVESTMENTS IN SEVERAL COUNTRIES

The most dramatic decline in asset finance can be observed in Sweden. After being the member state with the third highest new investments in wind in 2013 with € 1.25 billion, investments in 2014 fell to only one quarter of those in the previous year, namely € 316 million in 2014. However, the fall in capacity added is slightly less dramatic dropping by only 63% from 807 MW to 300 MW. Similar dramatic falls in investment can be observed in Greece and Romania. In Romania, asset finance dropped from more than half a billion euros to only one investment amounting to € 10.5 million in 2014. After having experienced investments of more than € 400 million in 2013, Greece has not seen any new asset finance deals for wind power in 2014.

In Ireland, Italy, and Denmark new investments in wind power dropped as well. The decline has the highest magnitude in Ireland, where investments dropped to € 187 million in 2014, which is only 36% of the 2013 investment level. The reductions in investments are less severe in Italy and Denmark, where, in the former, asset finance fell from € 288 million in 2013 to only € 157 million in 2014 and, in the latter, investments decreased from € 366 million (2013) to € 141 million. Particularly in Denmark, the number of new wind projects securing financing dropped notably from 27 wind projects in 2013 to only 9 in 2014. Finally, investments remained on a low level in the Czech Republic, where in both years one wind project was financed amounting to almost € 15 million in 2013 and only € 2 million in 2014. Finally, no new investments in wind power were recorded in Spain in 2014 after one small offshore wind investment in 2013 of almost € 19 million. □

4

Share of different types of asset finance in the wind power sector offshore in the EU in 2013 and 2014

	2013		2014	
	Asset Finance - New Built (%)	Number of Projects	Asset Finance - New Built (%)	Number of Projects
Balance Sheet	39.7%	66.7%	56.4%	62.5%
Project Finance	58.3%	22.2%	43.6%	37.5%
Bond/Other	2.1%	11.1%	0.0%	0.0%
Total EU	100.0%	100.0%	100.0%	100.0%

Source: EurObserv'ER 2015

PHOTOVOLTAIC

When analysing asset financing of solar PV, it is particularly important to keep in mind that asset financing only contains utility-scale investments. Hence, all small-scale investments as rooftop installations that make up the largest share in PV installations in most of the EU countries are not included in the asset finance data. As in the last edition, EurObserv'ER reports EU wide investments in commercial and residential PV installations. This data provides estimates on financing for small-scale PV installations with capacities below 1 MW. Thus, it is complementary to the asset finance data that captures all PV power plants with capacities above 1 MW.

PV INVESTMENTS GROW

Investments in solar PV power plants (>1 MW) increased considerably to a total of € 5.5 billion in 2014. This corresponds to an increase in investments by almost 55% compared to the € 3.57 billion in 2013. The number of projects increased as well between both years, however at a lower rate. In 2013, 277 asset finance deals for utility-scale PV were closed compared to 304 PV projects in 2014. This increase by slightly less than 10% implies that the average project size increased. The average investment expenditure for a PV power plant amounted to € 18.1 million in 2014, whereas the average PV project in 2013 was slightly smaller than € 13 million.

As in the previous years, a significant drop in investment costs of utility-size PV can be observed. The investment expenditure per MW of capacity dropped from € 1.36 million in 2013 to only € 1.22 million in 2014. This is a cost reduction of almost 11% within only one year. Consequently, the capacity added associated with total asset financing increased stronger than investments between both years. Capacity added increased from 2.62 GW in 2013 to 4.53 GW in 2014. This represents an upsurge in capacity by 73% that is significantly higher than the 55% increase in investments.

1

Overview of asset finance in the PV sector in the EU member states in 2013 and 2014 (PV Plants)

	2013			2014		
	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (MWp)	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (MWp)
United Kingdom	1 896.17	138	1 442.3	3 833.17	243	3 165.1
France	387.47	27	252.7	1 403.00	25	1 136.8
Germany	204.89	26	147.6	132.53	19	114.9
Portugal	42.53	2	18.3	71.42	5	59.3
Italy	247.71	18	190.6	53.23	7	44.2
Romania	660.88	41	494.8	7.02	2	5.8
Belgium	3.73	1	3.1	3.61	1	3.0
Cyprus	0.00	0	0	3.61	1	3.0
Poland	6.65	1	4.0	1.93	1	1.6
Austria	3.92	1	1.0			
Bulgaria	6.02	1	5.0			
Czech Republic	3.98	3	3.3			
Greece	44.91	6	21.5			
Netherlands	1.93	1	1.6			
Spain	56.02	11	46.5			
Slovakia	2.33	1	1.0	0	0	0
Total EU	3 566.82	277	2 632.2	5 509.53	304	4 533.7

Source: EurObserv'ER 2015

A comparison of the source of asset finance in 2013 and 2014 does not show any notable differences. In both years, the majority of PV power plants were financed from balance sheets. The share of balance sheet financed investments stayed approximately the same with 67.2% in 2013 and 66.6% in 2014. The remainder of all PV projects in both years, around one third, respectively, was financed using project financing. Since project financing only captures 19.9% (18.8%) of all projects in 2014 (2013), project financed PV investments are on average larger than those financed from balance sheets, a trend that is also very predominant in wind investments. This is not surprising since project financing tends to be applied for large projects. In both years, bonds or other financing mechanisms were not used for PV investments.

2

Overview of asset finance in the PV sector in the EU in 2013 and 2014 (commercial and residential PV)

	2013		2014	
	Investment (mln. €)	Capacity (MWp)	Investment (mln. €)	Capacity (MWp)
Total EU	11 733.86	6 212.9	5 844.75	3 288.5

Source: EurObserv'ER 2015

With a total of € 5.84 billion in 2014, small-scale PV investments still dominate asset financing: utility-scale investments in that year were almost € 300 million less in total. However, the trend within small-scale PV is negative. Investments in 2013 amounted to € 11.73 billion. Hence financing dropped by around 50% between both years. While in 2013 investment in commercial and residential PV was more than three times higher than asset financing, this relation dropped to only 1.06 in 2014. If investments in small-scale and utility-scale PV are to develop in this way in the future, investments in PV power plants could supersede financing in small-scale in future years. The investment costs per MW, however, decreased marginally from € 1.89 million per MW in 2013 to € 1.78 in 2014, which corresponds to a drop by 5.8%.

UK DOMINATES PV INVESTMENTS, MASSIVE UPSURGE IN FRENCH INVESTMENTS

The most striking development in asset financing for utility-scale PV is the strong concentration of investments in the UK. Already in between 2012 and 2013, the most notable development was the rapid increase in PV investments in the UK that overtook Germany and France, where investments dropped significantly between those years. This development is even more predominating between 2013 and 2014. UK investments amounted to more than € 3.83 billion in 2014. This means that asset financing more than doubled in the UK that, with € 1.9 billion, already dominated the PV investments in 2013, when more than 50% of all EU-wide PV investments were recorded. This share even increased to almost 70% in 2014. The number of PV projects increased from 138 in 2013 to 243 in 2014. Hence, the share of UK-projects with closed asset finance deals was even 80% in the EU. Because of this massive increase in investments, the associated capacity added in the UK totalled almost 3.17 GW 2014.

Although smaller with respect to absolute values, France represents the only other notable success story of 2014. Asset financing for PV plants totalled € 1.4 billion in 2014. This magnitude is particularly striking when compared to the 2013 investments of only € 387 million. With the 2014 investments, France has reached again its high investment level of 2012 that was approximately equal in size. In the case of France it is furthermore striking, that the number of projects decreased from 27 in 2013 to 25 in 2014, although the investments more than tripled. Hence, the average projects size increased significantly. An average PV project in 2013 was € 14.4 million and almost quadrupled to € 56.1 million in 2014.

INVESTMENTS FALL IN MOST OTHER EU COUNTRIES

The most significant drop in PV investments can be observed in Romania. After being the EU member country with the second highest investments in utility-size PV in 2013, with € 661 million, investments in Romania crippled to only € 7 million in 2014. Consequently, also the number of projects dropped drastically from 41 in 2013 to only two in 2014. Two other countries with considerable, but less dramatic drops in PV investments are Germany and Italy. In Germany, asset finance dropped by 35% from € 205 million in 2013 to € 133 million in 2014. Italian investments dropped from € 248 million to € 53 million, that is a drop by almost 79%. The drop in investments in these two Member States is particularly noteworthy when compared to their exceptionally high investments in previous years (e.g. € 4.6 billion in 2011 in the case of Italy, and almost € 3 billion in 2012 in the case of Germany).

The only remaining EU member state with a slight increase in PV investments is Portugal. Investments increased from € 42.5 million in 2013 to € 71.4 million in 2014. The remainder of EU countries, where asset finance for PV was recorded in 2014, are characterised by only minor investments. In both Belgium and Poland, one small PV project was financed in 2013 and 2014, respectively A small investment amounting to € 3.9 million was conducted in Cyprus. Finally, it is noteworthy that Greece and Spain, that both saw PV investments around € 50 million in 2013, respectively, did not see any asset finance deals in 2014. □

3

Share of different types of asset finance in the PV sector in the EU in 2013 and 2014

	2013		2014	
	Asset Finance - New Built (%)	Number of Projects	Asset Finance - New Built (%)	Number of Projects
Balance Sheet	67.2%	80.1%	66.6%	81.3%
Project Finance	32.8%	19.9%	33.4%	18.8%
Bond/Other	0.0%	0.0%	0.0%	0.0%
Total EU	100.0%	100.0%	100.0%	100.0%

Source: EurObserv'ER 2015

BIOGAS

When analysing asset financing of biogas, it is essential to characterise the projects that are covered. The following four types of biogas utility-scale investments are tracked: (I) electricity generation (new) – new built biogas plants with 1MWe or more that generate electricity, (II) electricity generation (retrofit) – converted power plants such that they can (at least partly) use biogas (also includes refurbished biogas plants), (III) heat – biogas power plants with a capacity of 30MWth or more generating heat, and (iv) combined heat & power (CHP) – biogas power plants with a capacity of 1MWe or more the generate electricity and heat. In addition to power plants for heating and / or electricity that use biogas, there are also plants that do not produce electricity, but rather produce biogas (bio methane plants) and export it into the natural gas grid. The latter are by far the minority in the data. However, to allow for distinguishing between these two types of biogas investments, two tables are presented, one with asset finance for biogas power plants and one for facilities producing biogas.

BIOGAS INVESTMENTS COLLAPSE

Between 2013 and 2014, overall asset financing for biogas collapsed massively. While investments in biogas – including biogas power plants as well as biogas production plants – amounted to € 331 million in 2013, asset finance totalled only € 33.4 million in 2014. This corresponds to a drop in investments by 90%. The number of biogas project declined as well, however, with less magnitude. In 2013, nine asset finance deals were closed compared to only three in 2014. Consequently, also the average investment size dropped notably from € 36.8 million per project in 2013 to only € 11.1 million in 2014.

Investments in biogas power plants dropped from € 292.2 million to € 33.3 million between 2013 and 2014. The associated capacity added of these investments fell significantly as well, namely from 42 MW in 2013 to only 4.2 in 2014.

1

Overview of asset finance in the biogas sector in the EU member states in 2013 and 2014 (biogas plants)

	2013			2014		
	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (MW)	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (MW)
United Kingdom	198.04	3	20.0	18.92	1	1.2
Germany	0.00	0	0	14.38	1	3.0
France	47.41	1	17.3			
Italy	40.61	1	3.3			
Romania	6.14	1	1.5			
Total EU	292.20	6	42.1	33.31	2	4.20

Source: EurObserv'ER 2015

2

Overview of asset finance in the biogas sector in the EU member states in 2013 and 2014 (biomethane)

	2013			2014		
	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (m³/hr)	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (m³/hr)
United Kingdom	38.68	3	2 750	0.06	1	3
Total EU	38.68	3	2 750	0.06	1	3

Source: EurObserv'ER 2015

GASAG

This 90% decline is even stronger than the decrease in investments. Hence, investment expenditures per MW of biogas capacity have marginally increase between both years, namely from € 6.9 million in 2013 to € 7.9 million in 2014. In case of biogas production plants, the investments and associated capacity decline in the same magnitude. In 2013, three asset finance deals were closed totalling almost € 39 million compared to only a very small project in 2014 amounting to only € 0.06 million. The associated biogas output dropped from 2,750 m³/hr in 2013 to only 3 m³/hr in 2014.

3

Share of different types of asset finance in the biogas sector in the EU in 2013 and 2014 (biogas plants)

	2013		2014	
	Asset Finance - New Built (%)	Number of Projects	Asset Finance - New Built (%)	Number of Projects
Balance Sheet	81.8%	50.0%	43.2%	50.0%
Project Finance	18.2%	50.0%	56.8%	50.0%
Bond/Other	0.0%	0.0%	0.0%	0.0%
Total EU	100.0%	100.0%	100.0%	100.0%

Source: EurObserv'ER 2015

Biogas production facilities were financed entirely from balance sheets in both years. In case of biogas power plants, the relative importance of balance sheet and project finance reversed. In 2013, almost 82% of investment was financed from balance sheets while the remaining 18% used project finance. In contrast, project finance covers 57% of 2014 investments, namely the larger project. The smaller plant was financed from the balance sheet.

SPORADIC INVESTMENTS ACROSS THE EU

Looking at the regional distribution of biogas investments across the EU shows that the UK is the only Member State that experienced investments in both 2013 and 2014. All closed asset finance deals for biogas production facilities in both years were observed in the UK. Furthermore, the larger investment in biogas power plants in 2014 was also conducted in the UK and amounted to almost € 19 million. However, this investment is significantly lower than asset finance for biogas plants in the previous year that amounted to € 198 million in the UK. In both years, asset financing for biogas power plants was the highest in the UK.

The only other Member State with biogas investments in 2014 is Germany, where one asset finance deal was closed amounting to € 14.4 million. In the previous year, no biogas investments were conducted in Germany. In addition to the UK, biogas investments were conducted in three other Member States in 2013. In France, Italy, and Romania one biogas power plant was financed, respectively. The largest asset finance deal was closed in France totalling € 47.4 million followed by Italy with € 40.6 million and Romania with € 6.1 million. □

4

Share of different types of asset finance in the biogas sector in the EU in 2013 and 2014 (biomethane)

	2013		2014	
	Asset Finance - New Built (%)	Number of Projects	Asset Finance - New Built (%)	Number of Projects
Balance Sheet	100.0%	100.0%	100.0%	100.0%
Project Finance	0.0%	0.0%	0.0%	0.0%
Bond/Other	0.0%	0.0%	0.0%	0.0%
Total EU	100.0%	100.0%	100.0%	100.0%

Source: EurObserv'ER 2015

BIOFUELS

Biofuels are liquid transportation fuels that include biodiesel and bioethanol. Asset finance for biofuels largely differs from the other renewable energy technologies, where asset financing is almost entirely defined as investment in power plants that produce electricity (or in a few cases also heat). For biofuels, the asset financing is investments in plants that produce biofuels. Hence, it excludes producers of biomass that is used as an input for biofuels. The following two types of biofuel utility-scale investments are tracked: (i) Diesel substitutes and (ii) gasoline/petrol substitutes. As in the previous edition, these two types of biofuels are reported separately in two tables in order to analyse the relative importance of both biodiesel and bioethanol and to allow for investigating potential averse trends in investments.

BIOFUEL INVESTMENTS STABILISE AT LOW LEVEL

Between 2013 and 2014, overall asset finance for biofuel producing plants in the EU increased. Investments in biofuels totalled € 117 million in 2013 compared to € 141 million in 2014. This corresponds to an increase in investments by 21%. In spite of the rise in investments in 2014, the investment total of € 141 cannot be interpreted only positively as the investment level is still very low compared to the investments of € 934 million in 2012. However, investments seem to have stabilised between 2013 and 2014. In contrast, the number of biofuel projects decreased from four to only three between both years. Hence, the average project size has increased from € 29 million in 2013 to € 47 million in 2014. In contrast to investments, the associated capacity fell by around 5% from 441 mLpa to 419 mLpa.

Both the investments in biodiesel and bioethanol show no differences with respect to the financing structure used for investments. In both years both types of biofuels have been financed entirely from balance sheets.

1

Overview of asset finance in the biodiesel sector in the EU member states in 2013 and 2014

	2013			2014		
	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (mLpa)	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (mLpa)
Netherlands	4.69	1	17.8	66.62	1	178.6
Sweden	0.00	0		34.78	1	167.0
Greece	10.36	1	39.3			
Italy	99.75	1	378.5			
Total EU	**114.80**	**3**	**435.6**	**101.40**	**2**	**345.60**

Source: EurObserv'ER 2015

OPPOSING TRENDS FOR BIODIESEL AND BIOETHANOL

A comparison of investments for biodiesel and bioethanol production plants reveals significant differences. In both years, investments in biodiesel production capacity are notably larger than investments in bioethanol plants. Furthermore, biodiesel investments show a weak negative trend while bioethanol investments rose. Asset finance for biodiesel totalled € 101 mil-

2

Share of different types of asset finance in the biodiesel sector in the EU in 2013 and 2014

	2013		2014	
	Asset Finance - New Built (%)	Number of Projects	Asset Finance - New Built (%)	Number of Projects
Balance Sheet	100.0%	100.0%	100.0%	100.0%
Project Finance	0.0%	0.0%	0.0%	0.0%
Bond/Other	0.0%	0.0%	0.0%	0.0%
Total EU	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: EurObserv'ER 2015

3

Overview of asset finance in the bioethanol sector in the EU member states in 2013 and 2014

	2013			2014		
	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (mLpa)	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (mLpa)
Denmark	0.00	0	0	39.95	1	73
Sweden	1.77	1	5			
Total EU	1.77	1	5	39.95	1	73

Source: EurObserv'ER 2015

lion in 2014 compared to € 115 million in 2013. Total investments in bioethanol plants was only € 1.8 million in 2013, but increased significantly to € 40 million in the following year. Bioethanol investments, however, are still relatively low compared to the investments of € 516 million in 2012.

Interestingly, the investment expenditures per mLpa increased between 2013 and 2014 for both types of biofuel from € 0.26 million to € 0.29 million per mLpa in case of biodiesel and from € 0.35 million to € 0.55 million per mLpa for bioethanol. However, associated capacity added and hence investment expenditures have to be interpreted carefully. The reason is that the data also includes retrofit refineries, e.g., refineries that used to produce petroleum based diesel, but were converted for biodiesel production. For these investments, investment expenditures per mLpa are typically lower.

VERY HETEROGENEOUS SITUATIONS ACROSS THE EU

Taking a closer look at biofuels investments shows a very inconsistent situation across the EU. For biodiesel only in the Netherlands, investments were conducted in both years. For bioethanolthis was not the case for any Member State. Furthermore, no country has seen more than one investment per year. The largest biodiesel project in 2014, totalling € 66.6 million, was financed in the Netherlands and has a capacity of almost 179 mLpa. Although the second largest asset finance deal in Sweden is, with € 34.8 million, significantly lower, the associated capacity is only marginally smaller with 167 mLpa. In 2013, the largest investment was conducted in Italy totalling almost € 100. The large associated capacity added of 379 mLpa of this investment is due the fact that, as indicated above, this investment is an example of a retrofit plant. Further investments in biodiesel in 2013 production were conducted in Greece and the Netherlands, however, with notably smaller investment sizes: € 10.4 million in the case of Greece and € 4.7 million form the Netherlands.

In the case of bioethanol, only one asset finance deal was closed in 2013 and 2014, respectively. In 2014, € 40 million were invested in bioethanol production in Sweden, whereas in 2013 a small investment amounting to € 1.8 million was conducted in Denmark.

4

Share of different types of asset finance in the bioethanol sector in the EU in 2013 and 2014

	2013		2014	
	Asset Finance - New Built (%)	Number of Projects	Asset Finance - New Built (%)	Number of Projects
Balance Sheet	100.0%	100.0%	100.0%	100.0%
Project Finance	0.0%	0.0%	0.0%	0.0%
Bond/Other	0.0%	0.0%	0.0%	0.0%
Total EU	100.0%	100.0%	100.0%	100.0%

Source: EurObserv'ER 2015

RENEWABLE URBAN WASTE

Similar to the solid biomass data, the asset financing data on waste-to-energy data includes four types of utility-scale investments: (I) electricity generation (new) – new built plants with 1 MWe or more that generate electricity, (II) heat – thermal plants with a capacity of 30 MWth or more generating heat, and (III) combined heat & power (CHP) –power plants with a capacity of 1 MWe or more to generate electricity and heat. In practice, most of the investments in waste-to-energy plants in 2013 and 2014 belong to the categories (I) electricity generation (new) and a smaller fraction to and (III) CHP. There are no investments in pure thermal plants. The reason for this similarity in the categories among solid biomass, waste-to-energy, and biogas is due to the fact that the underlying data source does not distinguish between the three industries. This disaggregation was done on a project basis. Another element to note is that waste to energy plants burn municipal waste, which is conventionally deemed to include a 50% share of waste from renewable origin. This part presents investments related to plants, not to the production of renewable waste they burn.

INCREASE IN INVESTMENTS IN THE EU

After investments in waste-to-energy plants increased substantially between 2012 and 2013, the positive trend continues between 2013 and 2014, however, at a lower magnitude. Asset finance for utility-scale waste-to-energy increased from € 1.64 billion in 2013 to € 1.98 billion 2014. This increase translates into growth by more than 20%. In spite of the upsurge in investments, the number of projects declined from 11 projects in 2013 to 10 projects in 2014. Hence, the average project size increased notably between both years. In 2013, an average waste-to-energy investment was € 150 million compared to almost € 200 million in 2014. Another interesting development is related to capacity. Capacity added associated with investments grew from 238 MW in 2013 to 324 MW in 2014. The growth in capacity added, namely 36%, is substantially higher than the 20% increase in investments. Hence, the investment expenditures per MW of capacity declined between both years. In 2013, € 6.9 million were spend on average for one MW of waste-to-energy capacity. In the subsequent year, this amount dropped to € 6.1 million per MW.

1

Overview of asset finance in the waste sector in the EU member states in 2013 and 2014

	2013			2014		
	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (MW)	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (MW)
United Kingdom	1 430.29	9	158.34	1 350.81	8	254.7
Ireland	0.00	0	0	482.89	1	60.0
Poland	0.00	0	0	145.90	1	9.0
Finland	213.78	1	78.0			
France	0.84	1	1.4			
Total EU	1 644.91	11	237.8	1 979.60	10	323.7

Source: EurObserv'ER 2015

An investigation of the sources of financing for waste-to-energy plants reveals considerable changes in the financing structure. In 2014, the relative importance of balance sheet and project finance is fairly balanced: 54% of all investments were balance sheet financed compared to 46% that were project financed. In the previous year, the picture was completely different. With more than 95% of all investments, project finance was the dominant financing mechanisms used for waste-to-energy capacity. Balance sheet financing was only responsible for the remaining less than 5% of all investments. However, there are also similarities between both years. In both years project financing covered a smaller share of projects relative to the investment amounts. In 2013 (2014) only 64% (20%) of all projects were covered by project financing compared to the significantly higher shares in asset finance of 95% (46%). Hence, in both years project was used for the larger projects, what can be typically also observed for other RES. The difference in project sizes is particularly high in 2013, where the average project size of a balance sheet financed project was € 19 millon compared to more than € 224 million for the average project financed investment in that year. In both years, no projects were financed through bond emissions.

2

Share of different types of asset finance in the waste sector in the EU in 2013 and 2014

	2013		2014	
	Asset Finance - New Built (%)	Number of Projects	Asset Finance - New Built (%)	Number of Projects
Balance Sheet	4.5%	36.4%	54.5%	80.0%
Project Finance	95.5%	63.6%	45.5%	20.0%
Bond/Other	0.0%	0.0%	0.0%	0.0%
Total EU	100.0%	100.0%	100.0%	100.0%

Source: EurObserv'ER 2015

THE UK DOMINATES WASTE-TO-ENERGY INVESTMENTS

With respect to the allocation of investments in the EU, the same picture as between 2012 and 2013 can be observed between 2013 and 2014. The UK is the only EU Member that saw investments in waste-to-energy plants in both years. Furthermore, and even more striking, the UK also dominates the investment amounts in both years, although UK investments fell. UK investments in utility-scale waste-to-energy were € 1.35 billion in 2014 compared to € 1.43 billion in 2013. The number of UK projects declined as well from nine in 2013 to eight in 2014. As this drop is stronger than the decline in investments, the average projects size in the UK increased marginally, namely from € 159 million to € 169 million. In spite of a decrease by 5.6%, the investment amount in the UK remains impressive and represents 68% of all EU wide investments for waste-to-energy plants (87% in 2013).

Both in 2013 and 2014, two other countries than UK saw waste-to-energy investments for one plant each. In 2014, the second highest investment was conducted in Ireland amounting to € 483 million followed by a € 146 million investment in Poland. These investments translate into capacity added of 60 MW and 9 MW, respectively. In 2013, Finland saw the second highest investment with asset finance of € 214 million and a capacity of 78 MW. And a small 1.4 MW plant was also financed in France amounting to € 0.84 million. □

SOLID BIOMASS

When analysing asset financing of solid biomass, it is essential to characterise the underlying data before discussing the changes in investments in details. First of all, the asset financing for biomass discussed here solely includes investment into solid biomass power plants. Hence, there are no investments in biomass production capacity in the data. The data contains four types of biomass utility-scale investments: (I) electricity generation (new) – new built biomass plants with 1MWe or more that generate electricity, (II) electricity generation (retrofit) – converted power plants such that they can (at least partly) use biomass (also includes refurbished biomass plants), (III) heat – biomass power plants with a capacity of 30MWth or more generating heat, and (iv) combined heat & power (CHP) – biomass power plants with a capacity of 1MWe or more that generate electricity and heat.

MODERATE DECLINE IN BIOMASS INVESTMENTS

Between 2013 and 2014, a moderate decline in asset finance for utility-scale biomass could be observed. EU-investments shrank from almost € 1.74 billion in 2013 to € 1.53 billion in 2014, which corresponds to a decrease of 12.5%. The number of biomass plants with secured financing dropped slightly stronger by 22.7% from 22 in 2013 to 17 in 2014. Hence, the average project size increased between both years from € 79 million to € 89 million. In comparison to the drop in investments of 12.5% the decline in capacity added seems surprisingly large at first sight. Capacity dropped by more than 34% from 1.06 GW in 2013 to 0.7 GW in 2014. However, this stronger decrease in capacity is mainly driven by the fact that the data also includes investments in converting existing power plants, e.g. coal, into biomass power plants. In these cases, the investment costs per MW are typically significantly smaller. This is the case for two projects in 2013, one in the UK and one in Poland, that add up to 685 MW compared to only € 177 million of investments. But since these also add to the biomass capacity, they are also included in the tables. In the analysis below, however, they will be excluded at certain points whenever advisable.

1

Overview of asset finance in the solid biomass sector in the EU member states in 2013 and 2014

	2013			2014		
	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (MW)	Asset Finance - New Built (mln. €)	Number of Projects	Capacity (MW)
United Kingdom	1 152.83	11	870.7	644.19	8	172.1
Sweden	20.56	1	7.5	611.11	2	165.0
France	529.63	7	139.9	138.16	3	57.3
Denmark	0.00	0	0	60.22	1	280.0
Bulgaria	0.00	0	0	40.27	1	15.0
Spain	0.00	0	0	13.40	1	5.0
Italy	0.00	0	0	10.50	1	5.0
Belgium	1.65	1	2.0			
Germany	8.95	1	2.0			
Poland	21.75	1	40.0			
Total EU	1 735.36	22	1 062.1	1 517.84	17	699.4

Source: EurObserv'ER 2015

Comparing the capacity added without converted plants shows actually an increase of capacity added between both years as, in 2013, capacity added of newly build biomass power plants is only 377 MW. Hence, capacity added associated with investments in new biomass plants almost doubled between 2013 and 2014. Comparing the investment costs per MW of newly build plants between both years reveals a drop of expenditures from € 4.1 million per MW in 2013 to only € 2.2 million in 2014.

With respect to the source of financing for solid biomass plants, there is a notable difference between both years. In 2013, the share of project financed (49%) and balance sheet financed (45%) investments is almost identical. Since balance sheet finance captures 54% of all projects compared to only 41% for project finance, the average project size is larger for project finance deals, which is the typical picture that can also be observed for other RES technologies. Finally, almost 5% of all asset finance deals were financed through emitting bonds. In 2014, the majority of investments, namely 63%, but a significantly smaller share of projects, 35%, were project financed. In the case of balance sheet financing, the situation is reversed. Only 35% of all invest-

ments in 2014 were financed from balance sheets, but almost 65% of all projects. Hence, as in 2013, the size of project financed investments was on average significantly larger than those financed from balance sheet. In contrast to 2013, no biomass investments were financed through bonds in 2014.

THE UK AND SWEDEN DOMINATE BIOMASS INVESTMENTS IN 2014

Investments in biomass capacity are concentrated in two EU Member States in 2014: the UK and Sweden. The UK already dominated biomass investments in 2013, where € 1.15 were invested in biomass capacity. This is more than 66% of all EU investments in that year. From 2013 to 2014, however, UK investments dropped significantly to € 644 million. In spite of this decrease by 44%, the UK is still ranked first in 2014. The more dramatic decline in capacity added in the UK is, as outlined above, driven by a converted plant in 2013. The country with the second highest investment level in 2014 was Sweden. In contrast to the UK, Sweden has experienced a massive upsurge in investments between both years. While in 2013 only one small biomass investment amounting to € 20.6 million was conducted, asset finance totalled € 611 million in 2014. It is furthermore noteworthy that the 2014 project size is very high in Sweden compared to other EU Member States. With the € 611 million only two biomass plants where financed. Hence, Sweden and the UK together dominate biomass investments in 2014. With combined investments of almost € 1.26 billion, 83% of all EU biomass investments were conducted in these two countries.

INVESTMENTS FALL IN FRANCE; DIVERSE PICTURE THROUGHOUT THE EU

A more detailed look at the data reveals a striking point concerning the situation of new investments in

solid biomass plants. New investments are not only heterogeneous across the EU – there are both countries with partly high increases and decreases in investments – but also within countries – there is no country with similar investment amounts in 2013 and 2014.

In contrast to Sweden and the UK, many countries, where finance deals for biomass plants were closed in 2013, saw no investments in 2014. The highest drop in investments could be observed in France. With investments worth € 529 million, France was ranked second in 2013. However, French investments fell drastically to € 138 million in 2014. This is a reduction in investments by 74%. The number of projects fell with a smaller magnitude from seven projects in 2013 to three projects in 2014.

Further investments in 2014 were conducted in Denmark, Bulgaria, Spain, and Italy. In contrast to the three countries described above, none of these Member States saw any investments in 2013. In all four countries, one investment was recorded, respectively. The investments ranged from € 60 million in Denmark to only € 10.5 million in Italy.

However, there were also countries with investments in 2013, but no closed asset finance deals in 2014, namely Belgium, Germany, and Poland. In all these countries, investments in one biomass plant, respectively, were conducted in 2013. □

2

Share of different types of asset finance in the solid biomass sector in the EU in 2013 and 2014

	2013		2014	
	Asset Finance - New Built (mln. €)	Number of Projects	Asset Finance - New Built (mln. €)	Number of Projects
Balance Sheet	45.2%	54.5%	37.3%	64.7%
Project Finance	49.4%	40.9%	62.7%	35.3%
Bond/Other	5.4%	4.5%	0.0%	0.0%
Total EU	100.0%	100.0%	100.0%	100.0%

Source: EurObserv'ER 2015

ONE WORD ON PUBLIC FINANCING

In general, it can be said that public finance institutions play an important role in catalysing and mobilising investment in renewable energy. There are numerous instruments which are used by these institutions which are typically either state-owned or mandated by their national government. The instruments range from providing subsidies/grants, equity to classic concessional lending (loans with favourable conditions) or guarantees. The dominant instrument in terms of financial volume is concessional lending. The loans provided by public finance institutions are typically aimed at projects that have commercial prospects, but would not have happened without the public bank's intervention.

There are a number of public finance institutions providing RES investment support in the EU. These include, but are not limited to, the two European public banks – the European Investment Bank (EIB) and the European Bank of Reconstruction and Development (EBRD) – as well as numerous regional and national public banks such as the Nordic Investment Bank, KfW, Caisse des Dépôts, Cassa Depositi e Prestiti, Instituto de Crédito Oficial.

Investment by public finance institutions for renewable energy projects is generally included in the asset finance data. Although it is more complex to determine details on individual transactions, the lending activities of these banks can shed some light on public finance for renewable energy projects. When looking at the lending of public banks for RES projects, it should be kept in mind that the banks mainly co-finance projects. That means that the projects also receive financing from other sources, e.g. private banks.

In 2013, the EIB, being an EU institution, has signed loans for funding dedicated to renewable energy to € 6.4 billion and in 2014, the funding volume dropped to € 5.9 billion[1]. Both financing amounts, however, are notable increases compared to financing in 2011 amounting to € 3.7 billion and € 2 billion in 2012[2]. In the case of the EBRD, a multilateral bank focussing on Eastern Europe, the investment volume was about € 0.8 billion and € 0.3 billion in 2011 and 2012 respectively; in 2013, investment in renewables and renewable-related activities for EBRD rebounded to € 0.79 billion while in 2014, the new loans under the same initiative declined to € 0.48 billion[3]. The 2013 investments were made under EBRD's Sustainable Energy Initiative, which includes investments in solar, wind, biomass, electricity transmission systems and distribution networks. In 2014, the financing was conducted within the Sustainable energy financing facilities (SEFFs), which are part of EBRD's Sustainable Resource Initiative.

PIXABAY

In the case of the Nordic Investment Bank, lending within its global (not restricted to the EU) "Climate Change, Energy Efficiency and Renewable Energy" (CLEERE) lending facility is reported to amount to about € 1.3 billion and € 1.1 billion in 2011 and 2012, expanding the total loans under the facility to € 4 billion; by the end of 2012 the facility was fully allocated with no additional loans added in 2013 or 2014[4]. KfW's lending for RES projects within its national renewable energy promotional activities add up to total loan commitments for renewable energy projects in Germany of € 4.7 billion in 2013 and decreased to € 4.1 billion in 2014. These figures, however, are below the high financing values of the two previous years, where the KfW financed € 7 billion in 2011 and € 7.9 billion in 2012[5]. It is further worth to mention that, in July 2014, KfW issued its first Green Bond, with a volume of € 1.5 billion and ended with an order book of € 2.65 billion. The second Green Bond was then issued in October 2014 with a placement volume of $ 1.5 billion and an order book of $ 2.48 billion, thus showing the interest from investors[6].

As observed from the above, the investment in renewables in the regional and national public banks as well as the two European public banks is seen with some decrease (in a minor scale) in their share of renewable energy investment. Nevertheless, funding allocated to renewable energy sector still has its share in public finance institutions' loan portfolios and a relative stable trend in renewable energy investment by public finance institutions is likely to continue. For example, in 2014, EIB has dedicated much funding to finance onshore and offshore wind farms, financing 12 wind farm operations in total. This includes one of the largest wind farms in the world, the Gemini offshore wind farm north of the Netherlands, which received € 587 million from EIB. Moreover, EIB also financed 9 solar operations in the same year[7]. We also observe public finance institution making more use of the bond market, as is shown by the KfW's Green Bonds. □

1. EIB (2013), EIB Activity Report 2013, EIB (2014), EIB Activity Report 2014.
2. EIB (2011), EIB Activity Report 2011, pp. 21, European Investment Bank; the figure "€ 3.7 billion" is estimated from "Lending for power generation in the EU reached EUR 4.6bn in 2011, with 80% supporting renewable energies" on page 21 of the annual report; EIB (2012), EIB Activity Report 2012.
3. EBRD (2011), EBRD Annual Report 2011, EBRD (2012), EBRD Annual Report 2012, EBRD (2013), EBRD Annual Report 2013, EBRD (2014), EBRD Annual Report 2014.
4. NIB (2012), Nordic Investment Bank Annual Report 2012, NIB (2014), Environmental Lending BASE & CLEERE.
5. KfW (2011), KfW Annual Report 2011, KfW (2012), KfW Annual Report 2012, KfW (2013), KfW Annual Report 2013, KfW (2014), KfW Annual Report 2014.
6. KfW (2014), KfW Annual Report 2014, pp.77.
7. EIB (2014), EIB Sustainability Report 2014, pp. 28.

Investment in Renewable Energy Technology

The EurObserv'ER investment indicators also focus on describing the financing of the developpment and the production of the RES technologies themselves. To this end, they provide an overview of the investments in venture capital and private equity on the one hand, and on the evolution of RES firms listed on stock markets on the other hand.

Methodological note

VENTURE CAPITAL & PRIVATE EQUITY

EurObserv'ER collects data investments of venture capital and private equity funds into renewable energy technology developing firms. Venture capital (VC) focuses on very young start-up companies typically with high risks and high potential returns. Venture capital can be provided to back an idea of an entrepreneur before the business has started. It may be used to finalize technology development or to develop initial business concepts before the start-up phase. Venture capital can be also used in the subsequent start-up phase to finance e.g. product development and initial marketing or the expansion of a business. Basically, venture capital funds finance risky start-ups with the aim to sell the shares with a profit. Private equity (PE) is a type of equity that is not traded on stock markets. Generally, PE aims at more mature companies than VC and can divided into two types. PE expansion capital is financing companies that plan to expand or restructure their operations or enter new markets. While expansion capital is usually a minority investment, PE buy-outs are investments to buy a company. These investments are often accompanied by large amount of borrowed money due to the usually high acquisition costs.

Summing up, venture capital investments target renewable energy technology firms at the start-up phase, while private equity aims at relatively mature companies. While VC investments are typically small, private equity deals are usually larger that VC deals. PE-buyouts are in general the by far largest deals since in such a deal a mature company is acquired. All these investments together shed a light on the activity of start-up und young renewable energy technology firms, while it is essential to distinguish between the typically large PE buy-outs and the other investments when analysing the VC/PE investments in the RES sectors.

RES INDICES

The sectoral indices are intended to capture the situation and dynamics on the EU market for equipment manufacturers and project developers. The methodological approach is to include RES firms that are listed on stock markets and where at least 90% of the firms' revenues were generated by RES operations. Hence, there might be important large firms that are not included in the indices. The reason is that there are numerous (partly very large) companies that produce renewable energy technologies but are also active in other sectors (e.g. manufacturers producing wind turbines, but as well turbines for conventional power plants). These are not included since their stock prices might be largely influenced by their operations in other areas than RES. Furthermore, there is also a large group of small firms that are not listed on stock markets which hence are also not included here. For the sectoral indices, RES firms are allocated if they are only (or mainly) active in the respective sector. The final choice among the firms in each sector is done by the firm size measured in revenues. Hence, the indices contain the ten largest RES-only firms in the EU in the respective sector.

The indices are constructed as Laspeyres-Indices. The aim of a Laspeyres-Index is to show the aggregated price changes, since the weighting is used based on the base values. Hence, firms are weighted by their revenues in the respective previous period. In 2013, the firms are weighted by their 2012 revenues whereas in 2014, the 2013 revenues are applied. So the weighting is adjusted every year in order to keep the structure appropriate. The reason for this approach – in contrast to weighting the firms according to their market capitalisation – is that this approach reflects less the short term stock market fluctuations but rather focuses on long-term developments as it is in this analysis that concentrates on the development of two years.

VENTURE CAPITAL – PRIVATE EQUITY

Between 2013 and 2014, Venture capital (VC) and private equity (PE) investment in renewable energy grew notably. VC/PE investments totalled € 2.46 billion in 2014 compared to € 1.89 billion in 2013. This corresponds to an increase by more than 30%. It is notable, however, that there was a significant drop in the number of deals in spite of the upsurge in investment sums. The number of deals dropped by more than 45% from 44 in 2013 to only 23 in 2014. Hence, average investment grew even stronger than total investments, namely from an average VC/PE deal size of € 43 million in 2013 to € 107 million per deal in 2014. Comparing these developments with the overall activity in VC/PE investments in the EU (covering all sectors) reveals further insights. According to the data of the European Private Equity and Venture Capital Association (EVCA), overall VC/PE investments in the EU grew as well between 2013 and 2014, however at a lower rate, namely by around 10%. Hence, the renewable energy sector experienced a more successful development between these years compared to the VC/PE market in general.

BREAKDOWN OF VC/PE INVESTMENT STAGES

Before analysing the sectorial trends in VC/PE investments, a disaggregation of data into different investment stages reveals interesting insights. For the first time in this edition, a breakdown of VC/PE investments for all RES in the EU into four stages is provided: (I) VC early stage, (II) VC late stage, (III) PE expansion capital, and (IV) PE buy-outs. In contrast to PE, venture capital investments are used in earlier stages. Early stage venture capital is provided to seed early-stage / emerging young companies for, e.g., research and development in order to develop a product or business plan and make it marketable. Late stage VC is often used to, e.g., finance initial production capacities and marketing activities. In contrast, PE expansion capital is typically aiming at more mature / established companies and hence is less risky. Finally, PE buy-outs are investments to buy (a majority of) a RES company and often imply high investments compared to the other PE and particularly VC deals. This breakdown allows for a more detailed analysis of the dynamics in the VC/PE market. However, the trends have to be interpreted with care as the data coverage might not be perfect and due to the rather low amount of observations for VC/PE, potentially missing data might have a dilutive effect on the results.

The data shows that the higher investments in 2014 compared to 2013 were mainly driven by PE investments. The highest investment amounts can be observed for PE expansion capital. While PE expansion capital remained almost constant, € 1.68 billion in 2013 and € 1.63 billion in 2014, PE buy-outs increased significantly between 2013 and 2014 from only € 27 million to € 786 million. This increase is mainly due to a significant upsurge in deal size as the number of deals only grew from three to five. As it can be argued if PE buy-outs can be accounted for as new investments, the increase in overall VC/PE investments in 2014 should be interpreted with care. When buy-outs are not considered, growth of the remaining VC/PE investments is only 1.2% between 2013 and 2014.

With respect to venture capital investments, a notable decline in investments can be observed. VC investments fell from € 183 million in 2013 to only € 42 million in 2014, which is a decrease by 77%. The number of VC deals dropped slightly less dramatically by 72% from 29 deals in 2013 to 8 deals in 2014. This could indicate that investors became more risk-averse, as VC investments, particularly early stage, dropped whereas typically less risky PE investments increased.

TECHNOLOGY TRENDS

When taking a more detailed look at the respective renewable energy technologies, it is important to keep in mind the types of VC/PE investment discussed above. Hence, when total VC/PE data is dominated by specific large PE buy-out or PE expansion capital deals, this will be addressed in the analysis of the respective sectors. Furthermore, it should be pointed out that, as in previous editions, biomass and waste-to-energy are not disaggregated. The main reason is that the data includes several companies that are either biomass and waste project developers or equipment developers that provide technologies for both biomass and waste-to-energy, which makes a disaggregation nearly impossible.

With respect to technological trends, the most striking observation is the dominance of the wind sector in VC/PE investments in both years. Already in 2013, the wind sector dominated the market


Pixabay

1

Venture capital and private equity investments in renewable energy per technology in the EU in 2012 and 2013

	2012		2013	
	Venture Capital / Private Equity (mln. €)	Number of Projects	Venture Capital / Private Equity (mln. €)	Number of Projects
Wind	978.65	15	222.27	10
Biomass & Waste	833.60	11	15.81	8
Biogas	186.11	9	14.85	4
Solar PV	96.01	16	74.98	16
Small Hydro	25.84	3	0.00	0
CSP	4.41	1	0.00	0
Geothermal	0.00	0	0.00	0
Biofuels	124.38	6	50.82	5
Total EU	2 249.00	61	378.73	43

Source: EurObserv'ER 2015

with investments worth € 1.73 billion. This means that almost 92% of all VC/PE investments were aimed at project developers or technology firms in the wind sector. Wind investments even increased by more than 22% to € 2.11 billion in 2014. Although smaller in magnitude compared to 2013, the share of wind in total VC/PE investments was still an impressive 86% in 2014. However, the upsurge in total VC/PE investments between 2013 and 2014 is solely driven by an increase of large PE buy-outs. In 2014, PE buy-outs in the wind sector amounted to almost € 563 million. In the previous year, this type of deal played only a minor role with only € 11.7 million. Hence, comparing the amounts of VC/PE investment without PE buy-outs shows a reduction of investments in the wind sector. Finally, it should be mentioned that the dominance of the wind sector in terms of investments compared to the other RES sectors is mainly explained by one large PE expansion capital deal in both 2013 and 2014 in the range of € 1.5 billion. Overall, the development of VC/PE investments in the wind sector is similar to investments in wind capacity that offer a good market potential for technology firms and project developers in that sector.

Due to these large single deals in the wind sector in both years, the investments in the PV sector, ranked second in 2014, are notably smaller. However, VC/PE investments in this sector increased considerably between the two years from € 75 million in 2013 to € 299 million in 2014. In contrast to the quadrupled investments, the number of deals declined moderately. Compared to wind, there were notably more deals in the PV sector. Hence, the average deal size in this sector is notably smaller than for wind, but increased notably from € 4.7 million in 2013 to more than € 22 million in 2014. The determinant of this development is quite intuitive, as there were more, typically smaller, venture capital deals in 2013 compared to 2014. The share decreased from 81% to less than 62%.

The sector with the third largest VC/PE investments in both years is biofuels. VC/PE investments for biofuels remained approximately constant with almost € 51 million in 2013 and € 53 million in 2014. However, the number of deals declined from five to only two, where both of the latter are PE deals. In contrast, four of the deals in 2013 are an early or late stage venture capital investment, which explains the smaller deal size in 2013.

For biogas as well as biomass & waste, VC/PE investments dropped notably between 2013 and 2014.In the case of biogas, investments dropped from € 16.35 million to € 3.84 million. With the deal number dropping from five to one, the average deal size did not change considerably. For VC/PE investments for biomass & waste, the drop is even more dramatic. Investments fell from € 14.31 million to only € 0.23 million.

MOST VC/PE DEALS IN FRANCE, GERMANY, AND THE UK

In general, it is difficult to derive country trends in VC/PE investments as typically very few deals can be observed per country and hence the situation varies largely between years. However, a few noticeable country-specific observations should be pointed out to complete the analysis of VC/PE investments. The top four countries with respect to the number of VC/PE deals in 2014 were France, Germany, the Netherlands, and the United Kingdom. Both France and Germany saw six deals respectively compared to three deals in both the Netherlands and the UK. In 2013, the number of deals was particularly high in France and in the UK with 13 and 12 deals, respectively. Hence, these two Member States accounted for 57% of all VC/PE deals in the EU in that year.

With respect to investment amounts, Denmark is ranked first in both years with large distance to other Member States, as both large PE expansion capital deals happened in Denmark. Similar to Denmark, Spain saw two large PE buy-outs in 2014 totalling more than € 563 million. With respect to countries, where investment amounts were not dominated by large PE deals, the highest VC/PE investments in 2014 were observed in France amounting to € 203 million compared to only € 59 million 2013. □

RES INDICES

In order to shed some light on the situation of RES technology firms, EurObserv'ER constructed several RES indices. All these indices are normalized to 100 at the base date. The indices presented here are a wind, a solar PV, and a composite bio-technology index. The latter is composed of biofuel, biogas, and biomass sub-indices. The wind and solar PV indices contain the respective ten largest firms that operate solely/mainly in the wind / solar PV sector in the EU. The bio-technology index consists of 13 companies out of which three are biogas companies next to five biofuels and six biomass companies. Since there are only few companies per bio-technology sector, a composite bio-index was constructed as in the previous issues.

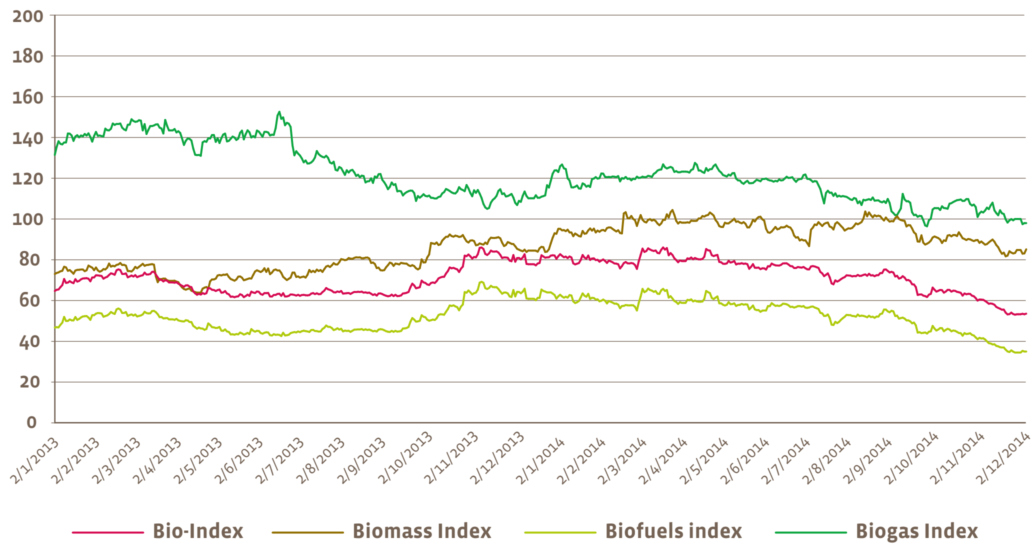
As the stock market indices are focusing on companies that are listed on stock exchanges, entities that are owned by parent companies (e.g. Siemens Wind Power owned by Siemens AG) or limited liability companies (e.g. Enercon) not listed on stock markets are not reflected. Furthermore, there are numerous companies that are not only active in a RES sector. Examples are Abengoa, a Spanish company that is active in CSP and biofuels, but also in other fields as water treatment and conventional generation and hence does not satisfy the criteria of the RES indices as their revenues are not mainly driven by their activities in the area of renewables.

INDEX COMPOSITION

Compared to the last year's edition, some firms in the indices were replaced. One reason for removal was that companies are not listed anymore. Due to this reason, the German biogas company

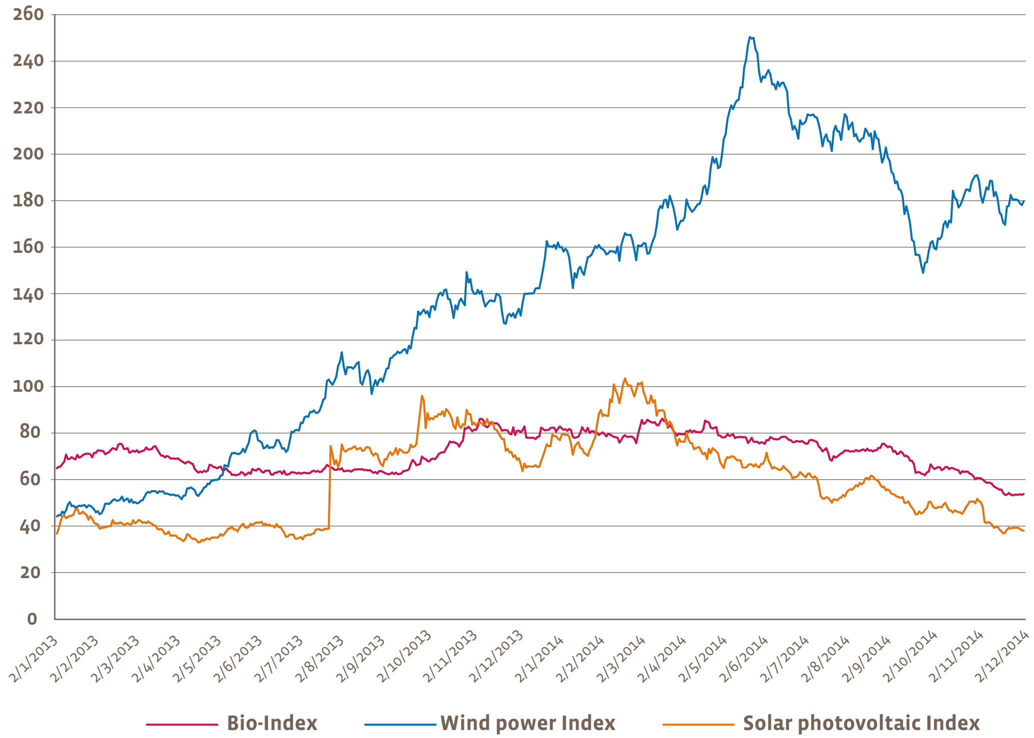
1

Evolution of the biotechnologies indices during 2013 and 2014



2

Evolution of the RES indices during 2013 and 2014



DTB – Deutsche Biogas AG was removed from the biogas index, as the shares of the company are not traded anymore as of October 2014. Furthermore, some firms were replaced by others in the indices based on revenues, since the indices contain the respective largest firms based on revenues. In the wind index, ABO Wind AG (DE) replaced Théolia (FR) and Auhua Clean Energy (UK) replaced Solaria Energia (ESP) in the PV index.

Analysing the composition of the RES indices reveals that German firms dominate the biofuels and the biogas indices. The biofuels index consists of three German companies next to one French and one British company, where the influence of latter two on the index is almost negligible due their very small revenues compared to the three German companies. As in the previous edition, half of the firms in the biomass index are French whereas the other half are British firms, as this is the only index where the composition remained the same. The PV index consists of six German firms, one from Italy and one from Sweden. A UK company, as mentioned above, replaced the only Spanish firm such that now two British firms are included. The largest company is by far SMA Solar Technology AG. Finally, the wind index is significantly more heterogeneous with respect to the regional distribution of the companies with the Danish turbine manufacturer Vestas being by far the largest company in the index. An overview of all included companies can be found in the note (1) page.

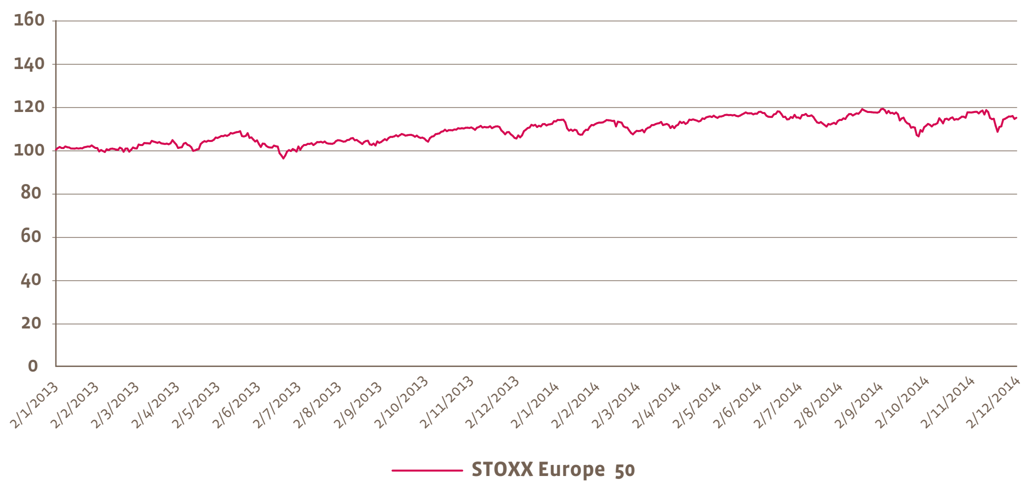
As in the previous editions, the STOXX Europe 50 index is captured in addition to the RES indices in order to assess how RES companies perform in relation to the whole market. The STOXX Europe 50 is an index that contains the 50 largest companies in Europe. Like the RES indices, the STOXX Europe 50 is normalised to 100 at the base date to allow for a better comparability. Since the STOXX is using market capitalization weights, it cannot be compared to the RES indices in every detail. The STOXX Europe 50 index has closed at around 115 points, which translates into a growth rate of almost 14% compared to the initial value in 2013. Compared to this development of the overall EU market, the bio-index and the PV index have underperformed. The PV index has closed at almost the same value as in the beginning of 2013. The biotechnology index has even closed at a lower value. In addition, it is important to keep in mind the absolute value of the points. All indices have been normalised to 100 at the base date and, while the STOXX Europe 50 constantly remained above this value, the PV and the bio indices are at significantly lower values compared to the beginning of 2011. In contrast, the wind index performed notably better and closed at a value that is significantly above its original base value. Overall, the RES indices are more volatile than the STOXX index as they cover fewer companies from a narrow sector and hence are strongly impacted by shocks affecting the sector or one company in the respective sector.

ADVERSE DEVELOPMENTS ACROSS RES SECTORS

In order to analyse the composition of the bio-technology index, figure [enter the name or number of the graph with the bio indices here] displays the bio-technology index and the respective sub-indices. As can been seen in the figure, the composite bio index and the biofuels sub-index differ in the level, but show very similar fluctuations. The reason is that, as in the previous edition, the included biofuel companies have relatively high aggregate revenues compared to biomass and biogas firms. As the sub-indices are weighted by revenues, the biofuels index dominates the composite bio-technology index as the biofuels companies are responsible for around 70% of overall revenues generated by all bio-technology firms included in the indices. The bio index' posi-

3

Evolution of the STOXX Europe 50 reference indice during 2013 and 2014



tive trend in 2013 is followed by a negative trend in 2014 and overall the bio index closes slightly below its initial value of 2013 at almost 54 points, which is a drop by 17%. As indicated above, the biofuels index behaves similarly. The biogas index shows an even more dramatic drop from over 130 points to around 100 points in the end of 2014. In contrast to the other bio indices, however, the biogas index is the only one who has not fallen significantly below its base value as of the beginning of 2011. Finally, the biomass index is the only bio-technology index that shows a modest growth in the period of interest. Between the beginning of 2013 and the end of 2014 the index grew by more than 16%.

A comparison of the three RES indices shows differences both in the trend and the volatility of the indices. As indicated above, the composite bio-technology index shows a moderate negative trend. When only comparing the initial value in 2013 and the end value in 2014, the situation is similar for the PV index. It declines by 2%. The two indices, however, behave differently within those two years. The bio index experiences more moderate fluctuations between 2013 and 2014. In contrast, the PV market seems to be more volatile. Although the PV index starts only at around 40 points in the beginning of 2013, it breaks through the 100 points mark three times at the end of the first quarter of 2014. Afterwards, however, a notable decline follows such that the PV index falls slightly below the 40-point mark at the end of 2014. In contrast to these two indices, the wind index shows overall a positive development. It shows a constant positive trend throughout 2013 that even increases up to the end of the second quarter in 2014 where the index peaks at around 250 points. The second half of 2014, however, is characterised by a negative trend such that the wind index closes at 180 points at the end of 2014. With this development, the wind index is the only RES index that closes significantly above its base value.

SWB

Overall, the RES indices show that the years 2013 and 2014 were not prosperous for listed RES-only companies in the bio-technology and the PV sector. This development observable for technology companies listed at stock markets is overall in line with the observations with respect to investments in capacity. Particularly the PV market has seen a drop in asset financing in the last years, a development that certainly also affects companies that produce the equipment. An exception is the wind market. The wind index shows that an overall very good development for equipment manufacturers in the wind sector. These companies might have profited from the relatively stable investments in wind power in the last years and the notable increase in asset financing for wind in 2014. The more difficult business environment for bio-technology and particularly PV firms can be also seen in the fact that there have been several replacements of companies in the respective indices due to insolvencies over the last years. This trend, however, cannot be observed in the composition of the wind index, where changes in included companies were solely due to changes in relative revenues. However, it is difficult to assess the overall situation for RES-only firms in the EU. Many important high-tech firms are not listed on stock exchanges. □

*1. **Wind Index:** Vestas (DK), Enel Green Power (IT), Suzlon (INDIA), Gamesa (ESP), Nordex (GER), EDP Renovaveis (POR), Falck Renewables (IT), PNE Wind AG (DE), Energiekontor AG (DE), ABO Wind AG (DE)*
***Photovoltaic Index:** SMA Solar Technology AG (DE), Solarworld AG (DE), Centrotherm Photovoltaics AG (DE), Roth & Rau AG (DE), Capital Stage AG (DE), Solar-Fabrik AG (DE), PV Crystalox Solar PLC (UK), Ternienergia (IT), Etrion (SWE) , Auhua Clean Energy (CHINA)*
***Biomass Index:** Albioma (FR), Cogra (FR), Active Energy (UK), Weya (FR), React Energy PLC (UK), Helius Energy (UK)*
***Biofuels Index:** Cropenergies AG (DE), Verbio Bioenergie (DE), Petrotec AG (DE), Global Bioenergies (FR), China New Energy (CHINA)*
***Biogas Index:** Envitec Biogas (DE), 2G Energy AG (DE), KTG Energie AG (DE)*

ON THE WHOLE

Between 2013 and 2014, investments in renewable energy generation projects increased significantly. This increase in investments has been driven by the wind sector. All other RES sectors show a heterogeneous picture with growing investments in some sectors and drops in investments in others. Investments in small scale PV installations, namely residential and commercial PV with capacities below 1MW, dropped notably from 2013 to 2014. However, both these small scale installations as well as PV plant investments indicate, as in previous years, cost reductions in the PV sector as the investment expenditures per MW of capacity declined. Similarly, investments in renewable energy technology, namely VC/PE investments, also increased between 2013 and 2014. The RES indices show that years 2013 and 2014 were not prosperous for listed RES-only companies with the exception of wind companies.

INVESTMENT IN RENEWABLE ENERGY PROJECTS INCREASE CONSIDERABLY

The indicators on investment in renewable energy projects capture asset finance for utility-scale renewable energy generation projects. Combining all RES sectors analysed above shows a significant increase in investments in RES capacity. EU-wide RES investments grow from € 21.6 billion in 2013 to almost € 31.2 billion in 2014, which is an increase by more than 44%. This upsurge in asset financing was mainly driven by the extraordinary investments in the wind sector. In addition to the wind sector, the PV sector saw a notable increase of investments. In the geothermal and the CSP sector, no investments could be observed in 2014, which is why they are not treated this year. While investments in waste-to-energy and biofuels capacity saw a modest increase in investments between 2013 and 2014, asset finance for biomass experienced a moderate drop. The only RES sector with a significant drop in investments between both years was biogas. Another notable trend in investments in RES capacity in 2014 was the dominant role of the UK that saw the highest EU-wide investments in four RES sectors.

WIND INVESTMENTS DOMINATE THE MARKET

Wind investments experienced both the highest growth rate between 2013 and 2014 and the largest investments in both years. Asset finance for wind capacity increased by almost 55% from € 14.2 billion in 2013 to a very impressive € 22 billion in 2014. Hence, the share of wind in total investments in RES capacity in the EU amounted to more than 70% in 2014. A comparable growth could be observed in the PV sector, where investments went up by 54% to € 5.5 billion in 2014 compared to almost € 3.6 billion in 2013. The associated capacity added in the PV sector grew even stronger indicating a reduction of investment costs per MW by more than 10%. In contrast, the investment costs per MW slightly increased for wind. However, this effect is mainly driven by the significantly increased importance of offshore in wind investments, which are notably more expensive. Waste-to-energy investments grew by more than 20% to almost € 2 billion in 2014 and hence overtook biomass investments. The latter experienced a drop from € 1.7 billion in 2013 to € 1.5 billion in 2014. While asset finance for biofuels saw an upsurge by 21%, biogas investments have declined to only € 33 million in 2014.

SIGNIFICANT INCREASE IN VENTURE CAPITAL & PRIVATE EQUITY INVESTMENTS

VC/PE investment in renewable energy grew by more than 30% in the EU between 2013 and 2014. In both years, the largest investments by far could be observed in the wind sector. Hence, the development of VC/PE investments in the wind sector is similar to investments in wind capacity that offer a good market potential for technology firms and project developers in that sector. The second largest investments in both years occurred in the PV sector. The analysis revealed that the higher investments in 2014 compared to 2013 were mainly driven by PE investments. While PE expansion capital remained almost constant, € 1.68 billion in 2013 and € 1.63 billion in 2014, PE buy-outs increased significantly between 2013 and 2014 from only € 27 million to € 786 million. As it can be argued if PE buy-outs can be accounted for as new investments, the increase in overall VC/PE investments in 2014 should be interpreted with care. When buy-outs are not considered, growth of the remaining VC/PE investments is only 1.2% between 2013 and 2014. With respect to venture capital investments, a notable decline in investments can be observed. VC investments fell from € 183 million in 2013 to only € 42 million in 2014. This could indicate that investors became more risk-averse, as VC investments, particularly early stage, dropped whereas typically less risky PE investments increased.

Between 2013 and 2014, the renewable energies have outperformed the overall VC/PE market. The data of the European Private Equity and Venture Capital Association (EVCA) shows that overall VC/PE investment in the EU (including all sectors) grew by around 10% between both years. Hence, the renewable energy project developers and technology firms seem to have been an attractive investment area for venture capital and private equity investors.

RES INDICES

In order to shed some light on the situation of RES technology firms, EurObserv'ER constructed several RES indices. These sectorial indices are intended to capture the situation and dynamics on the EU market for RES equipment manufacturers and project developers.

Relating to the total EU stock market, approximated by the STOXX Europe 50, the bio-index and the PV index have underperformed in 2013 and 2014. In contrast, the wind index performed notably better and closed at a value that is significantly above its original base value. Overall, the RES indices are more volatile than the STOXX index as they cover fewer companies from a narrow sector and hence are stronger affected by shocks affecting the sector or one company in the respective sector. A comparison of the three RES indices shows differences both in the trend and the volatility of the indices. Both the bio-technology index and the PV index experience a similar negative trend. However, the PV market seems to be more volatile. In contrast, the wind index shows overall a positive development and is the only RES index that closes significantly above its base value.

Overall, the RES indices show that the years 2013 and 2014 were not prosperous for listed RES-only companies in the bio-technology and the PV sector. The wind index shows that an overall very good development for equipment manufacturers in the wind sector. These companies might have profited from the strong increase in asset financing for wind in 2014. The more difficult business environment for bio-technology and particularly PV firms can be also seen in the fact that there have been several replacements of companies in the respective indices due to insolvencies over the last years, which is a trend that cannot be observed for listed wind firms.

EXAMPLES OF INNOVATIVE FINANCING SCHEMES

Under the current macro-economic trends in the EU it is difficult for public budgets to secure funds for the further support of renewables. Thus, the so far abundant support system for renewables (mainly in the form of feed-in-tariffs and quota systems) has been drastically modificated. In many EU countries, companies are trying to find alternative ways to secure financing for their renewable energy projects. However, it has to be noted that the withdrawal of public support did not cancel the EU's green ambitions, therefore, new ways of attracting private capital for the realisation of green energy goals have to replace the old schemes. The finance and investment gap needs to be filled by the private sector, by new business and financing models.

It takes effort to convince the market actors to mobilize their accumulated financial resources for the development of renewables. Perception of risk is the most important factor impeding such investments, however, good news is that there is already a significant number of good practice examples, in this chapter we describe some of them. Innovative financing mechanisms presented in the following pages are likely to play an increasingly important role in the allocation of risk among different investor classes and help mobilize investments for new green energy projects in the future.

PIXABAY

FINANCING RES PROJECTS WITH MEZZANINE/SUBORDINATED DEBT

RENEWABLE ENERGY PROJECT FINANCING OPPORTUNITIES USING THE DEBT CAPITAL MARKETS

After the economic crisis, the environment for renewable energy projects got harder and the competition among them sharply increased. The competition was so tight that it not only touched equipment or social impacts of projects but also became harsher on the financial level (such as rates of bank loans). Banks and renewable energy projects developers learned how to work together, in order to build innovative and competitive financing schemes. This also helped to bring to the market bigger projects.

Now that the competition is on the financial aspect of projects and that financial institutions learned about renewable energies, more financing tools appear on this market, such as mezzanine and junior debt.

A mezzanine is a subordinated debt, which means it will only be repaid from project revenues after operating costs and senior debt service, the latter usually coming from banks. The mezzanine is useful to close the gap between equity and standard debt. Although it is a more expensive debt, with rates of return around 15% due to higher risks, it offers many advantages. First, it is easy to access and can be provided more quickly to the project than a senior debt. Second, it does not imply as much loss on the project control for the developer than equity financing. And third, it may convince banks to finance the project more easily, as from their point of view, it strengthens the possibility of being paid back in the case of default. It has to be noted that in case the mezzanine loan is not paid back in time or in full, it gives the lender the right to convert it into equity.

MEZZANINE FINANCING FOR PV PROJECTS – THE UNITED KINGDOM'S CASE

A typical example can be the Lightsource case from the UK. Lightsource is a major solar energy company and an important developer, asset manager and operator of utility scale solar in the UK. It is currently managing a portfolio of more than 1 gigawatt of operational assets. Their portfolio is distributed across central and southern UK and became operational throughout 2011-2015. It was previously financed by a combination of multiple bank loans. Due to the size of its projects and its financial expertise, Lighthouse has to take a sharp look at the way it fulfils its project financial needs.

In October and November 2015, Lightsource refinanced two PV project portfolios thanks to senior debt and mezzanine. The first financing implied £ 12 million of mezzanine as part of a million £ 94 million financing. In November, Lightosource refinanced another portfolio of solar projects, owned or operated. It was a 101-megawatt portfolio that consisted of 33 operational ground-mounted solar projects. It attracted 20-25 year fixed income tariffs under the UK Government's Feed in Tariff subsidy regime. The total financing was £ 284 millions. M&G Investments provided £ 247 million of 22-year inflation linked finance (senior debt) and AMP Capital provided a £ 37 million 8-year mezzanine facility.

As stressed in the introduction, mezzanine is a useful tool for major projects that needs a multi-million financing. Moreover, mezzanine debt is not designed to be the main financing source of a project. It usually represents between 10% and 15% of a project finance.

REPLICABILITY POTENTIAL

Financing of renewable energy projects through mezzanine debt has replicability potential and will spread across Europe, since the mezzanine debt is considered to be a complementary or alternative solution to guarantees. It is the major tool to close the gap between debt and equity.

As the financial market is now aware of renewable energies opportunities, it offers to the latter all the financial mechanisms reserved for mature technologies, such as mezzanine. For example, in 2011 the European Energy Efficiency Fund (EEEF) was launched. It has been initiated by the European Commission and founded by the European Investment Bank and the Cassa Depositi e Prestiti (a state-owned Italian bank). The aim of the fund has been to provide market-based financing for commercially viable public energy efficiency and renewable energy projects within the EU. EEEF has been pursuing investments into financial institutions and direct investment (to project developers, energy service companies (ESCOs), small scale renewable energy and energy efficiency service and supply companies). Investment instruments provided by EEEF include senior debt, mezzanine instruments, leasing structures and forfeiting loans. □

SOURCES:

- *www.ifc.org/wps/wcm/connect/corp_ext_content/ifc_external_corporate_site/home*
- *www.lightsource-re.co.uk/news/2015/11/lightsource-renewable-energy-closes-284m-senior-and-mezzanine-refinancing*
- *www.eeef.lu*

NET METERING FOR LOCAL COMMUNITY RENEWABLE ENERGY PROJECTS IN THE NETHERLANDS

NET METERING IN THE NETHERLAND

With a 5.6% RES share in gross final energy consumption (year 2014), the Netherlands has to intensify its efforts to achieve the national target for year 2020, i.e. 14% as specified in RE Directive CE/28/2009. The main support instrument for RES projects is the SDE+ scheme, which is a combined floating feed-in premium/tendering scheme.

In order to boost both RES implementation as well as to broaden the political support base for dedicated RES stimulation, in 2004 net metering was introduced as an alternative new renewable electricity support instrument. Electricity consumers – households and companies – can install a renewable electricity generating installation on the consumer side of the meter that measures electricity exchanges with the public electricity grid. To date, net metering allows such *prosumers* to settle the annual electricity bill with their electricity supplier based on *net delivery* of electricity by the supplier over the whole past accounting year. This implies, that over all own generation by prosumers up to the level of their total gross electricity consumption they save for each kWh produced the per kWh variable part of the electricity bill. This arrangement is especially favourable for low-volume retail electricity prosumers, as in the Netherlands the variable components of their electricity bill add up to, currently, about 21 €ct/kWh.

In 2013 the so-called *reduced (energy tax) tariff* or *postcoderoos* (PCR) regulation was introduced for local community projects. Following the PCR, households, participating in an eligible community installation generating power from a renewable energy source (such as solar PV, wind power, biomass or other technologies) can instruct their supplier to reduce their payable energy tax by 10 €ct/kWh plus 21% VAT for their part in the annual production of the community power generating installation. The number of kWh to which the tax deduction is applicable is determined through "virtual net metering": virtual in the sense that the public grid is notionally transferring the kWh's generated by the community installation to the community participants. The upper limit is 10 000 kWh per annum per PCR participant. The PCR regulation defines the area where the premises of participating households need to be situated relative to the location of the community installation: i.e. in the same postal ZIP zone of the one where the installation is located or an adjacent postal ZIP zone. The resulting area is dubbed 'rose of postal codes' ('*postcoderoos*' in Dutch).

THE SPECIAL NET METERING VARIANT FOR COMMUNITY PROJECTS

With PCR projects, the Dutch government sets out to stimulate local initiatives to generate renewable energy. In doing so, citizens and - especially SME- business entrepreneurs become directly involved in the production of "their" renewable energy. Moreover - and this is key - citizens who are not so fortunate as to possess a house with a roof, including low-income city dwellers renting a multi-storey apartment building, are eligible and can afford to participate in PCR projects through entering into an operating lease contract with their landlords on their respective share in the local community renewable power system concerned. Hence, PCR projects enable social inclusion of a diversity of population strata, to engage in local renewable energy initiatives and meet their energy needs by "own" renewable energy. And, what is more, at attractive costs.

So far, virtually only PCR projects applying solar PV technology have been applied. Nonetheless, the PCR regulation explicitly allows for eligibility of a wide diversity of RES technology, including wind, solar (notably but not only PV), geothermal, wave and tidal energy, hydropower, biomass, landfill gas, digestion of sewage sludge and biogas.[1] The local public acceptance of , especially, (small-scale) wind projects can be enhanced if being operated as a PCR project. Several PCR projects which include non-PV technologies are in an advanced stage of preparation.

REPLICABILITY POTENTIAL

The Netherlands is the only MS with a dedicated application of (virtual) net metering to local community projects. In replicating the concept in other countries, notably within the European Union, there are several lessons to be learned from the experience gained so far with local community renewable energy (PCR) projects in the Netherlands. The overriding considerations for introduction of the PCR concept are stimulation of grass-root local renewable energy initiatives and social equity. A country-specific, suitable definition is to be designed for local community renewable energy projects, whose members will become eligible to attractive but not exorbitant fiscal incentives. The definition will need to address issues such as the geographical boundaries of membership with respect to the project installation site and the maximum participation size of non-household actors (companies). As for the project installation size, arguably no upper limit seems warranted to enable maximum participation by civil society. All electricity suppliers should be obliged to facilitate eligible local renewable energy community projects. Such projects should be eligible to public concessionary financing programmes for renewable energy projects. □

1. *http://www.hieropgewekt.nl/kennis/verlaagd-tarief/de-regeling-het-kort, section 1.5.*

CROWDFUNDING FOR RENEWABLE ENERGY

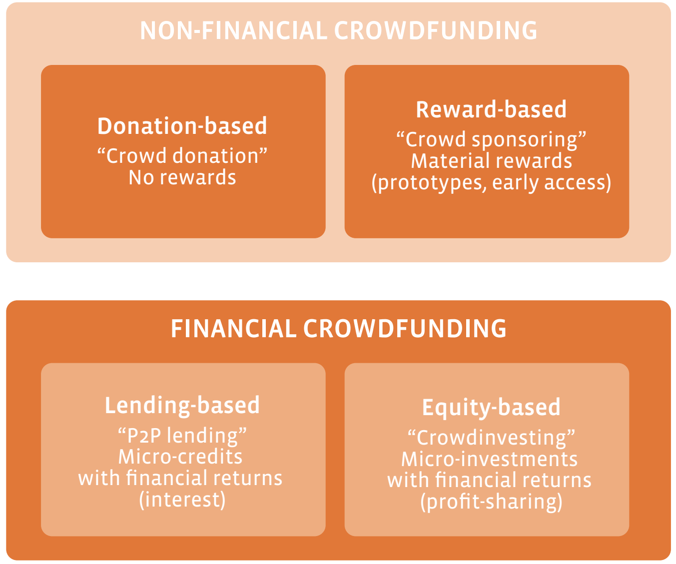
CROWDFUNDING – BASIC CONCEPT AND GROWTH

Crowdfunding (CF) has experienced a rapid and increasing growth in the recent years. Global funding volumes grew by 167% in 2014 compared to 72% in 2011. These growth rates led to total funding volumes of USD 16.2 bn compared to USD 0.85 bn in 2010. The basic concept of CF is as follows: businesses (or households) that require funding pitch their project, business idea, etc. on a crowdfunding platform and other private people or business etc. decide on whether they provide funding to the respective project. Hence, the CF platform takes somewhat the role of a financial intermediary of transforming many small contributions of the "crowd" into projects. The main difference with a bank is that the providers of finance can directly chose the projects or business they want to allocate their funding to. Currently, there are over 1,250 crowdfunding platforms worldwide. CF platforms offer an alternative to classical financing usually intermediated by financial institutions.

In general, CF platforms can be split into non-financial and financial CF. The former includes donation-based CF – there is no material or financial reward – and reward-based crowdfunding – there is no financial return, but a material reward (e.g. the prototype of a product). Financial CF includes equity-based CF (crowdinvesting) and debt-based CF (P2P lending). While non-financial CF is often used for creative start-up ideas or projects in the field of arts (music, film, etc.) financial crowdfunding is increasingly used for financing RE projects.

1

Types of crowdfunding platforms



CROWDFUNDING OF RENEWABLE ENERGY IN THE EU

Crowdfunding of renewable energy grew substantially in the EU in the past few years. The increasing interest in this form of financing becomes apparent in the Renewable Energy Crowdfunding Conference that was first held in 2014 and attracts attendees from crowdfunding platforms as well as project developers and representatives of governments and association. According to a mapping of the Renewable Energy Crowdfunding Conference, 17 major CF platforms in the EU focus solely on RE projects. In addition to these platforms, further platforms are also not exclusively active in renewable energy (RE). In contrast to other forms of financing, as e.g. green bonds, crowdfunding offers a possibility for private investors to invest in a RE project they personally value. In addition, crowdfunding platforms are very flexible with respect to the investment amount. In order to give more insight in crowdfunding of RE, two major crowdfunding platforms in the EU with different business models are presented hereafter.

PRESENTATION OF TWO PLATFORMS: ABUNDANCE (UK) AND WINDCENTRALE (NL)

Abundance is one of the largest and oldest RE-CF platforms having started its operations in 2012 after being set up in 2009. So far, around EUR 16 million from almost 2 000 investors have been used to finance RE projects. Abundance is a financial CF platform according to the definition above. For the money provided for a RE project, investors receive financial returns in form of different types of debentures. Fixed return debentures offer fixed payments and hence are similar to the interest of a loan. Alternatively,

variable return debentures also exist. In this case, the return is determined by the project performance and hence depends on the volume of energy produced and the price as well as the costs of the project.

Windcentrale has a different concept. The CF platform buys windmills and offers consumers to buy shares of this windmill. Currently, a share costs about the EUR 250 plus an additional yearly charge of around EUR 25 per year for maintenance. The benefit for investors is that they receive the electricity produced by their windmill, which is on average around 500 kWh per year. Hence, the concept of Windcentrale is very similar to a cooperative with the main difference that households and business can buy parts of windmills independent of their location. Furthermore, Windcentrale offers the possibility to produce your own renewable electricity for individuals that do not want to or cannot use e.g. solar home systems. Assuming an increase of electricity prices of 2% per year, Windcentrale estimates the financial benefit on a wind share to be approximately 5%. So far, around 15,000 individuals have invested a total of around € 15 million into nine wind power projects through this CF platform.

REPLICABILITY POTENTIAL

Crowdfunding of renewable energy (RE-CF) financing has a high replicability potential, since it can be organized quite flexibly. It provides an opportunity to engage citizens in financing RE. Furthermore, it complements other financing mechanisms with citizen involvement as cooperatives acting as interested investors can invest in renewable energy projects, irrespective of their location. Cooperatives have usually a regional focus. As the two examples above show, there is also a lot of flexibility with respect to the concept of a CF platform, as there are models where investors profit mainly from the green energy generated as well as platforms with pure financial returns.

A potential challenge for CF platforms are the planned and observed reductions in government support for RE. In the UK, the leading market for RE-CF in the EU, platforms started to experience difficulties due to policy changes. The by far largest RE-CF platform, the Trillion Fund, has recently stopped its activities in RE stating on their website that "*In these uncertain times, the company will instead focus on offering technology and crowdfunding services to other businesses across all sectors*". Other challenges may arise due to the different national regulations in the EU. Currently, the EU Project CitizEnergy aims at creating a European CF platform for renewable energy that, among other goals, tries to overcome this challenge. It remains to be seen whether CF will continue its success story in spite of the challenges. □

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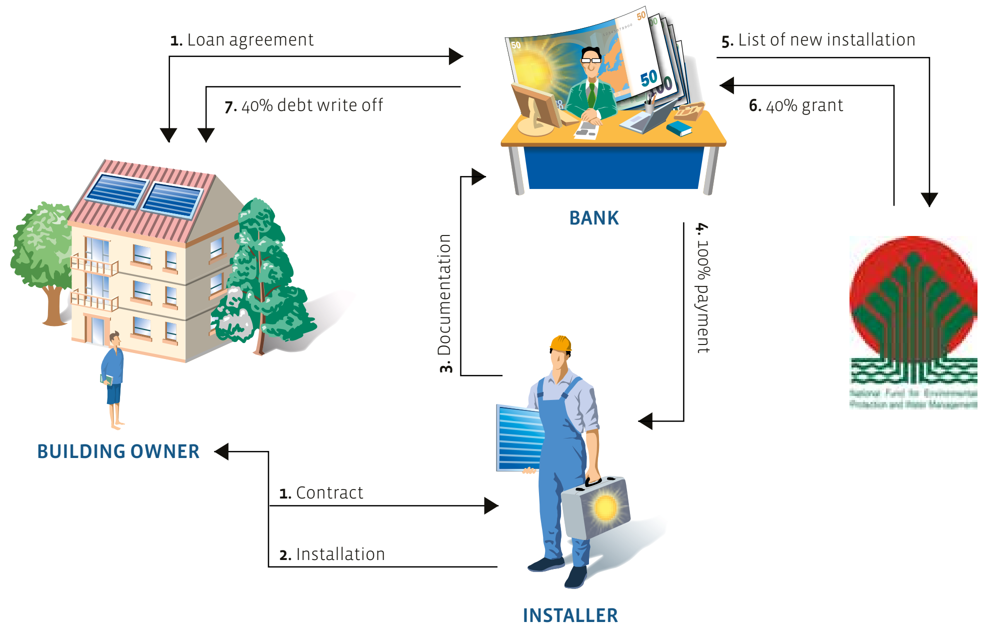
EUROBSERV'ER – THE STATE OF RENEWABLE ENERGIES IN EUROPE – 2015 EDITION



FACILITATION OF DECENTRALIZED RENEWABLE ENERGY USE IN POLAND

INNOVATIVE FINANCING SCHEME INVOLVING LOCAL BANKS

The Prosument program is an innovative financing scheme, which has helped bring sunshine to households and renewable energy (RE) businesses right across Poland. The key to the initiative's success has been to think local. The fund was set up to enable households and residential communities to obtain a loan from one of six partner banks in order to install solar thermal collectors (STC). They would then receive a subsidy, which reimbursed the loan by up to 40% and the 60% remaining of the loan would be based on a 1% rate. This 40% grant is attributed by the National Fund for Environmental Protection and Water Management, through the partner bank. The success that followed has exceeded all expectations. Over 67 000 installations have been installed all over the country, with some 3 500 local bank branches involved. The program has also helped to support Poland's STC manufacturing industry, with an estimated 9 600 new jobs created. The scheme also represents another step forward in the transition from a fossil fuel-based economy to one that embraces clean technology and renewable sources. In 60% of investments which benefited from this kind of financial support, STC contributed to replace installations that used coal as their energy source.

Since 2010, the STC have received support in the amount of 110 MEUR, the majority of which was dedicated to private households (7 m² of the collector area), whereas multifamily buildings (50 m² of the collector area on average) received minor share of the total support (< 1%). Thanks to this innovative financing mechanism the STC market in Poland grew very dynamically in the period 2010-2014, taking the country's total installed capacity from 656 000 m² in 2010 to 1.7 million m² in 2014. Thus Poland became a fast track leading ST market in the EU.

In the 2010 -2014 period two other financing programmes contributed to a rapid STC market development in Poland: the Swiss Contribution Programme as well as the EU supported Regional Operational Programmes. However, in the period 2010-2014 the support from the National Fund for Environmental protection and Water Management was the most significant; it supported 40% of all new installations and in the peak 2013 period even 55%.

VALIDATION BY THE INTERNATIONAL MILIEU

This innovative financing scheme was nominated (nine nominees chosen from a record of 373) to the Sustainable Energy Europe Awards Competition 2015 in the category 1: renewable energy. This category awards actions, which substitute fossil fuels with RE, while substantially reducing CO_2 emissions by innovative integration of RE into the local energy economy.

REPLICABILITY POTENTIAL

In the face of massive investment in the area of prosumer technologies a decision to grant a subsidy or a loan to a large number of potential beneficiaries can be a challenging task. Therefore, aggregated solutions with the involvement of local partners (here banks) is highly recommended. This solution can be applied by any financing institution supporting mass development of small prosumer technologies. □

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- ESTELA – European Solar Thermal Electricity Association *(www.estelasolar.eu)*
- ESTIF – European Solar Thermal Industry Federation *(www.estif.org)*
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- IEA – RETD: Renewable Energy Technology Deployment *(www.iea-retd.org)*
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- Austria Solar – Austrian Solar Thermal Industry Association *(www.solarwaerme.at)*
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- BIOENERGY 2020+ *(www.bioenergy2020.eu)*
- Bundesverband Wärmepumpe Austria – National Heat-Pump Association Austria *(www.bwp.at)*
- BMVIT – Federal Ministry for Transport, Innovation and Technology *(www.bmvit.gv.at)*
- BMLFUW - Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (www.bmlfuw.gv.at)
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BULGARIA

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- CL SENES BAS – Central Laboratory of Solar Energy and New Energy Sources *(www.senes.bas.bg)*
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- Invest Bulgaria Agency *(www.investbg.government.bg)*
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CYPRUS

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- PlanEnergi *(www.planenergi.dk)*
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- WindPower – Danish Wind Industry Association *(www.windpower.org)*

ESTONIA

- EBU – Estonian Biomass Association *(www.eby.ee)*
- Espel (Estonia)– MTÜ Eesti Soojuspumba Liit *(www.soojuspumbaliit.ee)*
- EWPA – Estonian Wind Power Association *(www.tuuleenergia.ee/en)*
- Ministry of Finance *(www.fin.ee)*
- Ministry of Economics *(www.mkm.ee/eng/)*
- MTÜ – Estonian Biogas Association
- STAT EE – Statistics Estonia *(www.stat.ee)*
- TTU – Tallinn University of Technology *(www.ttu.ee)*

FINLAND

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- Finnish Board of Customs *(www.tulli.fi/en)*
- Finnish biogas association *(http://biokaasuyhdistys.net)*
- Metla – Finnish Forest Research Institute *(www.metla.fi)*
- Pienvesivoimayhdistys ry – Small Hydro Association *(www.pienvesivoimayhdistys.fi)*
- Statistics Finland *(www.stat.fi)*
- SULPU – Finnish Heat Pump Association *(www.sulpu.fi)*
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- TEKES – Finnish Funding Agency for Technology and Innovation *(www.tekes.fi/en)*
- Teknologiateollisuus – Federation of Finnish Technology Industries *(www.teknologiateollisuus.fi)*
- VTT – Technical Research Centre of Finland *(www.vtt.fi)*

FRANCE

- ADEME – Environment and Energy Efficiency Agency *(www.ademe.fr)*
- AFPAC – French Heat Pump Association *(www.afpac.org)*
- AFPG – Geothermal French Association *(www.afpg.asso.fr)*
- CDC – Caisse des Dépôts *(www.caissedesdepots.fr)*
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- AGEE-Stat – Working Group on Renewable Energy-Statistics *(www.erneuerbare-energien.de)*
- AGORA Energiewende - Energy Transition Think Tank *(www.agora-energiewende.de)*
- BAFA – Federal Office of Economics and Export Control *(www.bafa.de)*

- BBE – Bundesverband Bioenergie *(www.bioenergie.de)*
- BBK – German Biogenous and Regenerative Fuels Association *(www.biokraftstoffe.org)*
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- GTAI – Germany Trade and Invest *(www.gtai.de)*
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- GWS – Gesellschaft für Wirtschaftliche Strukturforschung *(www.gws-os.com/de)*
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- ZSW – Centre for Solar Energy and Hydrogen Research Baden-Württemberg *(www.zsw-bw.de)*

GREECE

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IRELAND

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- REIO – Renewable Energy Information Office *(www.seai.ie/Renewables/REIO)*
- SEAI – Sustainable Energy Authority of Ireland *(www.seai.ie)*

ITALY

- AIEL – Associazione Italiana Energie Agroforestali *(www.aiel.cia.it)*
- ANEV – Associazione Nazionale Energia del Vento *(www.anev.org)*
- APER – Associazione Produttori Energia da Fonti Rinnovabili *(www.aper.it)*
- Assocostieri – Unione Produttorri Biocarburanti *(www.assocostieribiodiesel.com)*
- Assosolare – Associazione Nazionale dell'Industria Solar Fotovoltaica *(www.assosolare.org)*
- Assolterm – Associazione Italiana Solare Termico *(www.assolterm.it)*

- CDP – Cassa Depositi e Prestiti *(www.cassaddpp.it)*
- COAER ANIMA Associazione Costruttori di Apparecchiature ed Impianti Aeraulici *(www.coaer.it)*
- Consorzio Italiano Biogas – Italian Biogas Association *(www.consorziobiogas.it)*
- Energy & Strategy Group – Dipartimento diIngegneria Gestionale, Politecnico di Milano *(www.energystrategy.it)*
- ENEA – Italian National Agency for New Technologies *(www.enea.it)*
- Fiper – Italian Producer of Renewable Energy Federation *(www.fiper.it)*
- GIFI – Gruppo Imprese Fotovoltaiche Italiane *(www.gifi-fv.it/cms)*
- GSE – Gestore Servizi Energetici *(www.gse.it)*
- ISSI – Instituto Sviluppo Sostenible Italia
- ITABIA – Italian Biomass Association *(www.itabia.it)*
- MSE – Ministry of Economic Development *(www.sviluppoeconomico.gov.it)*
- Ricerca sul Sistema Energetico *(www.rse-web.it)*
- Terna – Electricity Transmission Grid Operator *(www.terna.it)*
- UGI Unione Geotermica Italiana *(www.unionegeotermica.it)*

LATVIA
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- Ministry of Economics *(www.em.gov.lv)*

LITHUANIA
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- LAIEA – Lithuanian Renewable Resources Energy Association *(www.laiea.lt)*
- LBDA – Lietuvos Bioduju Asociacija *(www.lbda.lt/lt/titulinis)*
- LEEA – Lithuanian Electricity Association *(www.leea.lt)*
- LEI – Lithuanian Energy Institute *(www.lei.lt)*
- LHA – Lithuanian Hydropower Association *(www.hidro.lt)*
- Lietssa *(www.lietssa.lt)*
- LITBIOMA – Lithuanian Biomass Energy Association *(www.biokuras.lt)*
- LIGRID AB, Lithuanian electricity transmission system operator *(www.litgrid.eu)*
- LS – Statistics Lithuania *(www.stat.gov.lt)*
- LWEA – Lithuanian Wind Energy Association *(www.lwea.lt/portal)*

LUXEMBOURG
- Biogasvereenegung – Luxembourg Biogas Association *(www.biogasvereenegung.lu)*
- Chambre des Métiers du Grand-Duché de Luxembourg *(www.cdm.lu)*
- Enovos *(www.enovos.eu)*
- NSI Luxembourg – Service Central de la Statistique et des Études Économiques
- Solarinfo *(www.solarinfo.lu)*
- STATEC – Institut National de la Statistique et des Études Économiques *(www.statec.public.lu)*

MALTA
- MEEREA – Malta Energy Efficiency & Renewable Energies Association *(www.meerea.org)*
- MIEMA – Malta Intelligent Energy Management Agency *(www.miema.org)*
- Ministry for Energy and Health *(http://energy.gov.mt)*
- MRA – Malta Resources Authority *(www.mra.org.mt)*
- NSO – National Statistics Office *(www.nso.gov.mt)*
- University of Malta – Institute for Sustainable Energy *(www.um.edu.mt/iet)*

NETHERLANDS
- Netherlands Enterprise Agency *(RVO) (www.rvo.nl)*
- CBS – Statistics Netherlands *(www.cbs.nl)*
- CertiQ – Certification of Electricity *(www.certiq.nl)*
- ECN – Energy research Centre of the Netherlands *(www.ecn.nl)*
- Holland Solar – Solar Energy Association *(www.hollandsolar.nl)*
- NWEA – Nederlandse Wind Energie Associatie *(www.nwea.nl)*
- Platform Bio-Energie – Stichting Platform Bio-Energie *(www.platformbioenergie.nl)*
- Stichting Duurzame Energie Koepel *(www.dekoepel.org)*
- Vereniging Afvalbedrijven – Dutch Waste Management Association *(www.verenigingafvalbedrijven.nl)*
- Bosch & Van Rijn *(www.windstats.nl)*
- Stichting Monitoring Zonnestroom *(www.zonnestroomnl.nl)*

POLAND
- CPV – Centre for Photovoltaicsat Warsaw University of Technology *(www.pv.pl)*
- Energy Regulatory Office *(www.ure.gov.pl)*
- Federation of employers renewable energy forum *(www.zpfeo.org.pl)*
- GUS – Central Statistical Office *(www.stat.gov.pl)*
- IEO EC BREC – Institute for Renewable Energy *(www.ieo.pl)*
- IMP – Instytut Maszyn Przepływowych *(www.imp.gda.pl)*
- PBA – Polish Biogas Association *(www.pba.org.pl)*
- PGA – Polish Geothermal Association *(www.pga.org.pl)*
- PIGEO – Polish Economic Chamber of Renewable Energy *(www.pigeo.org.pl)*
- POLBIOM – Polish Biomass Association *(www.polbiom.pl)*
- Polska Organizacja Rozwoju Technologii Pomp Ciepła PORT PC *(www.portpc.pl)*
- PSG – Polish Geothermal Society *(www.energia-geotermalna.org.pl)*
- PSEW – Polish Wind Energy Association *(www.psew.pl)*
- TRMEW – Society for the Development of Small Hydropower *(www.trmew.pl)*
- THE - Polish Hydropower Association (PHA) *(www.tew.pl)*

PORTUGAL
- ADENE – Agência para a Energia *(www.adene.pt)*
- APESF – Associação Portuguesa de Empresas de Solar Fotovoltaico *(www.apesf.pt)*
- Apisolar – Associação Portuguesa da Indústria Solar *(www.apisolar.pt)*
- Apren – Associação de energies renováveis *(www.apren.pt)*
- CEBio – Association for the Promotion of Bioenergy *(www.cebio.net)*
- DGEG – Direcção Geral de Energia e Geologia *(www.dgeg.pt)*
- EDP – Microprodução *(www.edp.pt)*
- SPES – Sociedade Portuguesa de Energia Solar *(www.spes.pt)*

ROMANIA
- Association Biofuels Romania *(www.asociatia-biocombustibili.ro)*
- CNR-CME – World Energy Council Romanian National Committee *(www.cnr-cme.ro)*
- ECONET Romania *(www.econet-romania.com/)*

- ENERO – Centre for Promotion of Clean and Efficient Energy *(www.enero.ro)*
- ICEMENERG – Energy Research and Modernising Institute *(www.icemenerg.ro)*
- ICPE – Research Institute for Electrical Engineering *(www.icpe.ro)*
- INS – National Institute of Statistics *(www.insse.ro)*
- Romanian Wind Energy Association *(www.rwea.ro)*
- RPIA -Romanian Photovoltaic Industry Association *(rpia.ro)*
- University of Oradea *(www.uoradea.ro)*
- Transelectrica *(www.transelectrica.ro)*

SPAIN

- AEE – Spanish Wind Energy Association *(www.aeeolica.es)*
- ADABE – Asociación para la Difusión delAprovechamiento de la Biomasa en España *(www.adabe.net)*
- AEBIG – Asociación Española de Biogás *(www.aebig.org)*
- AIGUASOL – Energy consultant *(www.aiguasol.coop)*
- APPA – Asociación de Productores de Energías Renovables *(www.appa.es)*
- ASIF – Asociación de la Industria Fotovoltaica *(www.asif.org)*
- ASIT – Asociación Solar de la Industria Térmica *(www.asit-solar.com)*
- ANPIER – Asociación Nacional de Productores-Inversores de Energías Renovables *(www.anpier.org)*
- AVEBIOM – Asociación Española de Valorización Energética de la Biomasa *(www.avebiom.org/es/)*
- CNMC – Comissiòn Nacional de los Mercados y la Competencia *(www.cnmc.es)*
- FB – Fundación Biodiversidad *(www.fundacion-biodiversidad.es)*
- ICO – Instituto de Crédito Oficial *(www.ico.es)*
- IDAE – Institute for Diversification and Saving of Energy *(www.idae.es)*
- INE – Instituto Nacional de Estadística *(www.ine.es)*
- MITYC – Ministry of Industry, Tourism and Trade *(www.mityc.es)*
- OSE – Observatorio de la Sostenibilidad en España *(www.forumambiental.org)*
- Protermosolar – Asociación Española de la Industria Solar Termoeléctrica *(www.protermosolar.com)*
- Red Eléctrica de Espana *(www.ree.es)*

UNITED KINGDOM

- ADBA – Anaerobic Digestion and Biogas Association – Biogas Group (UK) *(www.adbiogas.co.uk)*
- BHA – British Hydropower Association *(www.british-hydro.org)*
- BSRIA – The Building Services Research and Information Association *(www.bsria.co.uk/)*
- DECC – Department of Energy and Climate Change *(www.decc.gov.uk)*
- DUKES – Digest of United Kingdom Energy Statistics *(www.gov.uk/government)*
- GSHPA – UK Ground Source Heat Pump Association *(www.gshp.org.uk)*
- HM Revenue & Customs *(www.hmrc.gov.uk)*
- National Non-Food Crops Centre *(www.nnfcc.co.uk)*
- Renewable UK – Wind and Marine Energy Association *(www.renewableuk.com)*
- Renewable Energy Centre *(www.TheRenewableEnergyCentre.co.uk)*
- REA – Renewable Energy Association *(www.r-e-a.net)*
- RFA – Renewable Fuels Agency *(www.data.gov.uk/publisher/renewable-fuels-agency)*
- Ricardo AEA *(www.ricardo-aea.com)*
- Solar Trade Association *(www.solar-trade.org.uk)*

- UKERC – UK Energy Research Centre *(www.ukerc.ac.uk)*

SLOVAKIA

- ECB – Energy Centre Bratislava Slovakia *(www.ecb2.sk)*
- Ministry of Economy of the Slovak Republic *(www.economy.gov.sk)*
- SAPI – Slovakian PV Association *(www.sapi.sk)*
- Slovak Association for Cooling and Air Conditioning Technology *(www.szchkt.org)*
- SK-BIOM – Slovak Biomass Association *(www.4biomass.eu/en/partners/sk-biom)*
- SKREA – Slovak Renewable Energy Agency, n.o. *(www.skrea.sk)*
- SIEA – Slovak Energy and Innovation Agency *(www.siea.sk)*
- Statistical Office of the Slovak Republic *(http://portal.statistics.sk)*
- The State Material Reserves of Slovak Republic *(www.reserves.gov.sk/en)*
- Thermosolar Ziar ltd *(www.thermosolar.sk)*
- URSO Regulatory Office for Network Industries *(www.urso.gov.sk)*

SLOVENIA

- SURS – Statistical Office of the Republic of Slovenia *(www.stat.si)*
- Eko sklad – Eco-Fund-Slovenian Environmental Public Fund *(www.ekosklad.si)*
- Slovenian Environment Agency - ARSO *(www.arso.gov.si/en/)*
- JSI/EEC The Jozef Stefan Institute – Energy Efficiency Centre *(www.ijs.si/ijsw)*
- Tehnološka platforma za fotovoltaiko – Photovoltaic Technology Platform *(www.pv-platforma.si)*
- ZDMHE – Slovenian Small Hydropower Association *(www.zdmhe.si)*

SWEDEN

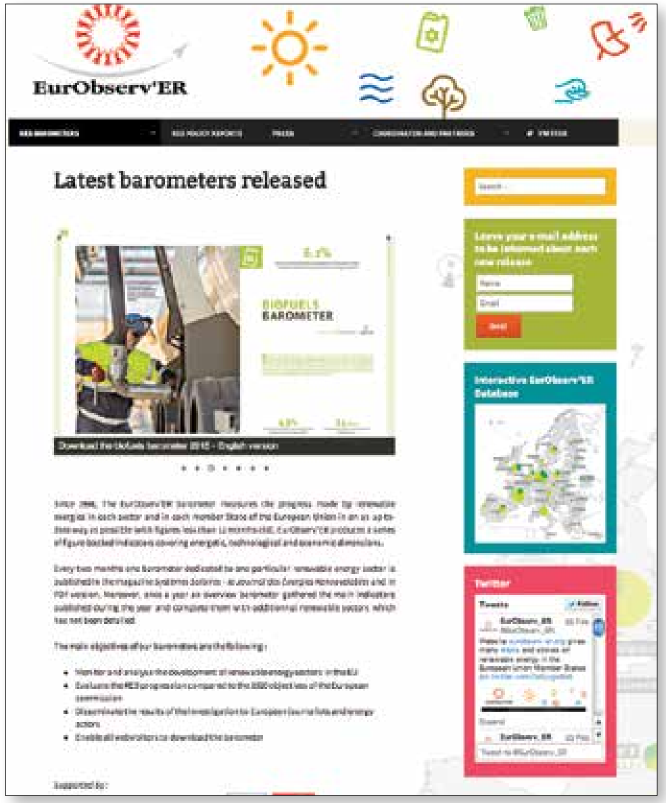
- Avfall Sverige – Swedish Waste Management *(www.avfallsverige.se)*
- ÅSC – Angstrom Solar Center *(www.asc.angstrom.uu.se)*
- Energimyndigheten – Swedish Energy Agency *(www.energimyndigheten.se)*
- SCB – Statistics Sweden *(www.scb.se)*
- SERO – Sveriges Energiföreningars Riks Organisation *(www.sero.se)*
- SPIA – Scandinavian Photovoltaic Industry Association *(www.solcell.nu)*
- Energigas Sverige – *(www.energigas.se)*
- Uppsala University *(www.uu.se/en/)*
- Svensk Solenergi – Swedish Solar Energy Industry Association *(www.svensksolenergi.se)*
- Svensk Vattenkraft – Swedish Hydropower Association – *(www.svenskvattenkraft.se)*
- Svensk Vindenergi – Swedish Wind Energy *(www.svenskvindenergi.org)*
- Swentec – Sveriges Miljöteknikråd *(www.swentec.se)*
- SVEBIO – Svenska Bioenergiföreningen/Swedish Bioenergy Association *(www.svebio.se)*
- SVEP – Svenska Värmepump Föreningen *(www.svepinfo.se)*

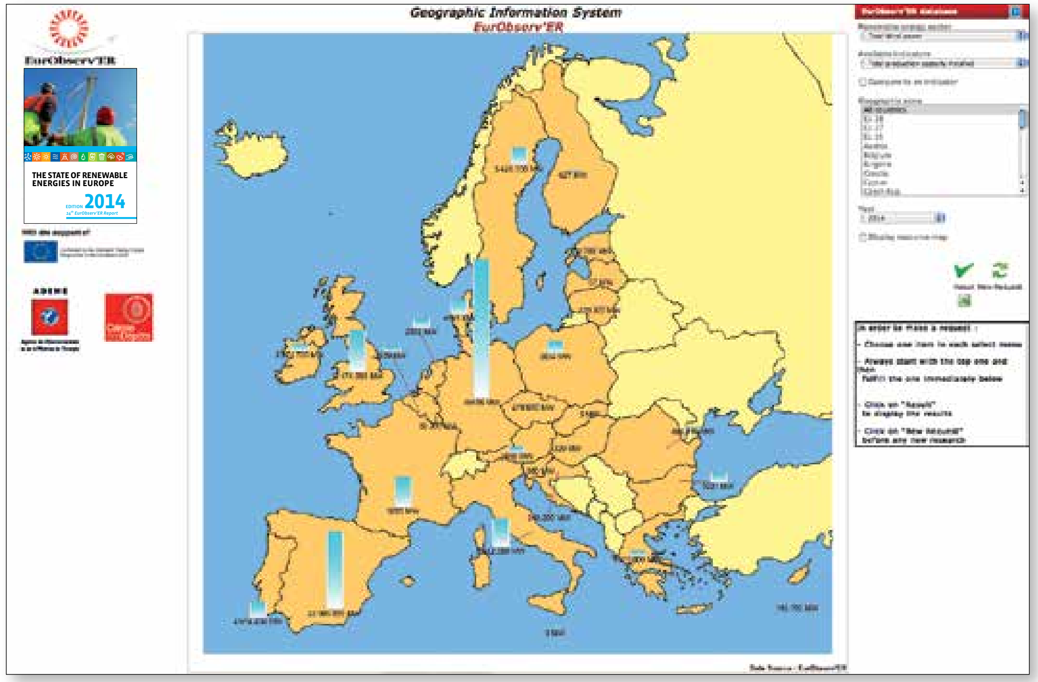
EUROBSERV'ER BAROMETERS ONLINE

EurObserv'ER barometers can be downloaded in PDF format at the following addresses:

www.energies-renouvelables.org
www.rcp.ijs.si/ceu
www.ieo.pl/pl/projekty.html
www.ecn.nl/projects/eurobserver
www.fs-unep-centre.org/projects
www.renac.de/en/current-projects/eurobserver.html

Home page of the website:
www.eurobserv-er.org





THE EUROBSERV'ER INTERNET DATABASE

All EurObserv'ER Barometer data are downloadable through a cartographic module allowing internet users to configure their own query by crossing a renewable energy sector with an indicator (economic, energetic or political), a year and a geographic zone (a country or a group of countries) at the same time. The results appear on a map of Europe that also provides information on the potentials of the different sectors. The system also makes it possible to download desired results in PDF or Excel format files and to compare two indicators at the same time via a crosstab query.

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