



Picture credit: left and lower right: Snetterton biomass power plant, UK, by courtesy of Burmeister & Wain Scandinavian Contractor A/S, upper right: biomass storage area at the biomass power plant Nesle- Douard, by courtesy of CNIM Waste & Energy Management Solutions (WEMS).

Biomass to Power

The World Market for Biomass Power Plants 2018/2019

Extract

9th edition, 2018

ecoprolog GmbH

Biomass to Power 2018/2019

This study is the world's largest of its kind. It is the standard work of the industry for electricity generation from solid biomass. The updated 9th edition includes:

- Specific data on more than 3,700 units in nearly 3,400 biomass power plants with a capacity of over 55 GW_{el}.
- Description and evaluation of more than 1,080 projects worldwide, including essential data such as on project developer as well as project status, commissioning date and fuel type (if information has been announced so far).
- Worldwide market development forecast 2018-2027 by country, including assessment of new constructions, shutdowns and investment volumes based on over 600 cost examples.
- Analysis of the existing plants by country, e.g. age, feedstock, capacities and competition.
- Analysis of biomass electricity generation subsidisation (feed-in tariffs, quota systems and auctions) by country (for the world's most important markets).
- Overview of market factors, fuels, treatment technologies as well as investment and operational costs and revenues (with exemplary calculations).
- Description and market shares of all important operators and technology providers.

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- **ecoprolog BtE Project Tracker:** complete list of all known projects worldwide, including information on status, electrical capacity and expected commissioning (emailed every three months)
- **ecoprolog BtE Archive:** online access to all BtE Monitor news since the first edition in July 2010

Price: **from 3,400.- EUR plus VAT**. Please see the last page of this extract for further details.

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Background

In early 2018, there were nearly 3,800 active biomass power plants worldwide, reaching an installed electrical capacity of 60.0 GW_{el}. We expect the plant portfolio to increase to 5,600 BMPPs with a capacity of around 83.3 GW_{el} by 2027. The subsidisation of renewable energies and the development of domestic energy sources from existing waste material, e.g. wood waste or bagasse, are the most important reasons for this growth.

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India	176	Czech Republic	453
Indonesia	248	Denmark	462
Malaysia	256	Estonia	475
Philippines	267	Finland	483
South Korea	289	France	515
Taiwan	296	Germany	544
Thailand	300	Hungary	606
Vietnam	323	Ireland	613
Rest of Asia	335	Italy	621
6.3 Australia and Pacific	348	Latvia	658
Australia	348	Lithuania	668
Japan	362	Netherlands	675
Rest of Australia and Pacific	388	Norway	699

Poland	704	Rest of Europe	878
Portugal	724	6.5 North America	884
Romania	734	Canada	884
Russia	740	USA	906
Serbia	751	Rest of North America	959
Slovakia	756	6.6 South and Central America	960
Slovenia	763	Argentina	960
Spain	770	Brazil	971
Sweden	787	Chile	1049
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United Kingdom

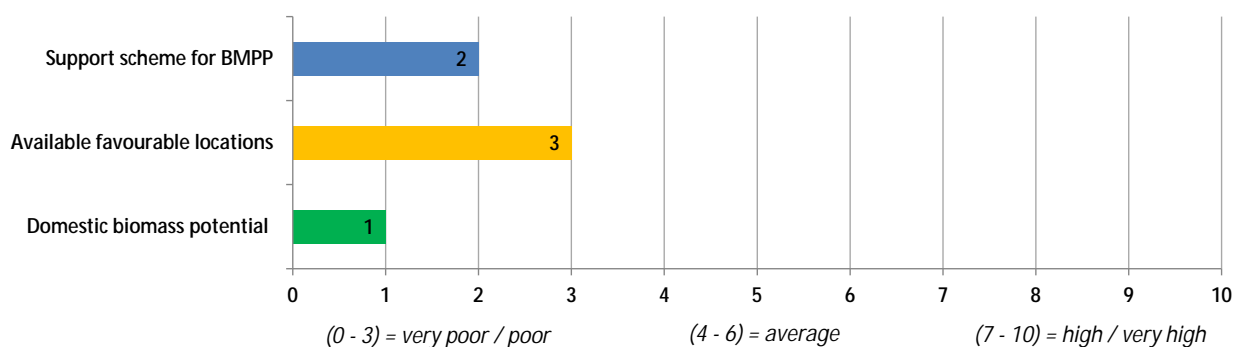
Update: 11-2018

Number of BMPPs	91	Installed electrical capacity [MW _{el}]	3,990
Inhabitants [million]	63.0	Area [thousand hectare]	24,361
Goal: biomass capacity by 2015 [MW _{el}]	1,290	Goal: biomass capacity by 2020 [MW _{el}]	3,140
<i>Forecast 2018-2027</i>		<i>Forecast 2018-2027</i>	
Total invest market [mn EUR]	13,200	Capacity of new commissionings [MW _{el}]	1,750

Management summary

The currently large project pipeline in the UK, backed by expired attractive incentive conditions, will shrink in the years to come. This is mainly due to the current incentive scheme (CfD) offering incentives only to individual biomass projects. We expect the market volume in the UK to decrease in the years to come.

Figure 10: Ratings for the biomass market in the UK



Source: ecoprogram

Electricity generation

For many years, the country’s electricity generation had completely relied on fossil energy sources. Coal and gas still account for a large share of electricity generation. In January 2018, the British Department for Business, Energy and Industrial Strategy (BEIS) decided to phase out coal by 2025.

The development of renewable energies had been neglected for a long time. The United Kingdom only obliged to a significant development of renewable energies after it had signed the Kyoto Protocol and EU goals had been introduced.

The share of renewable energies of the overall electricity generation amounted to 8% in 2009 and increased to 26% in 2015. Among the renewables, electricity generation is quite diversified. Wind is the most important energy source, followed by solid biomass and biogas.

[...]

Background / market factors / legal framework

[...]

The Brazilian regulatory authority ANEEL annually awards guaranteed electricity purchase contracts with a duration of 20 years via auctions (Leilão). The awarded total amount is based on an annually redetermined electricity capacity. This capacity is shared between existing plants and new construction projects.

Suppliers may participate in the auctions with their project and a favoured electricity price. Electricity generation from biomass thus faces strong competition, especially from natural gas and a rapidly increasing number of wind power projects.

There are two different auctions for biomass: firstly, the A-4 auction, in which renewable energies, including biomass, hydro wind and photovoltaic, may participate. The contract period for biomass is 20 years.

Secondly, the A-6 auction also includes biomass, but here it is not only competing with wind and water, but also with conventional power sources such as natural gas and coal. The contract period for biomass is 25 years. A minimum capacity of 5 MW is required for the participation in both tenders.

Figure 279: Overview of ANEEL auctions 2013-2018

Auctions (cumulated)	Number of biomass projects awarded	Capacity of the awarded biomass projects	Average level of PPA in BRL/MWh
2013	16	820	135.38
2014	8	611	205.76
2015	26	308	211.90
2016	6	178	235.95
2017	7	202	225.87
2018	4	90	187.26

Source: ANEEL 2013-2018, PPA = power purchase agreement

The auctions in 2017 were delayed and both of them took place in December 2017. The price of the power purchase agreement reached 5.37 EURct/kWh in the A4 tendering round for biomass. This level is below the maximum level reached in 2015, with a PPA price of 278 BRL/MWh (6.3 EURct/kWh) during the auctions in 2015, coming from a low point of 133 BRL/MWh in 2013.

The increasing level of the awarded incentives for biomass and other renewables from 2013 to 2016 originated in the fact that the high dependency on hydropower should be reduced, because it is vulnerable for droughts. Due to the high competition with wind, solar and natural gas, the level of incentives has been reduced again since 2017. Furthermore, the competition with solar, wind and natural gas resulted in significantly lower biomass awardings in recent years.

In general, biomass only play a small role in both auction categories. The dominant technologies are wind (A-6) and solar (A-4).

On 7 December 2018, an auction will be held for already existing biomass and natural gas plants. It will be organised in two pots called A1 and A2, providing incentives of up to 170 BRL/MWh.

[...]

Plants

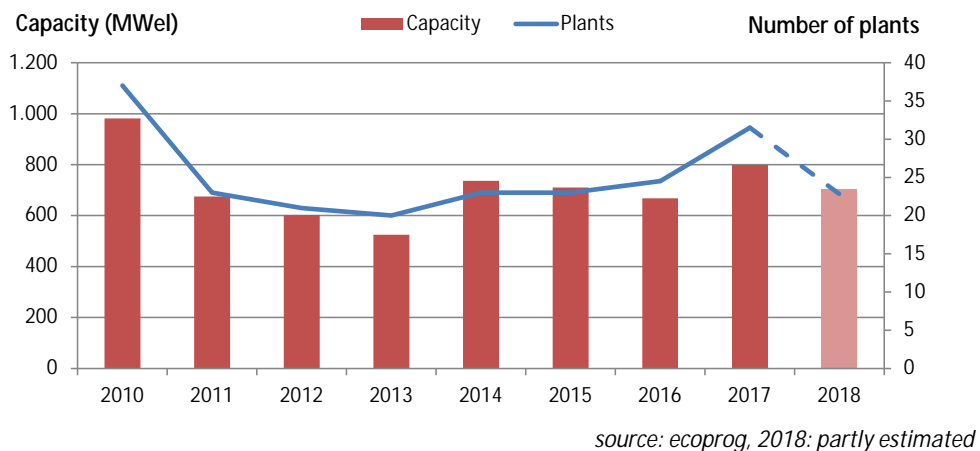
As ecoprolog has been analysing the Chinese market since mid-2010, we are able to reliably document the plant development of the past 8 years. From 2010 to October 2018, at least 214 plants with an installed capacity of around 6,100 MW_{el} were commissioned. This represents an average annual commissioning rate of 27 plants with a capacity of 760 MW_{el} – more than in any other country of the world.

Altogether, in October 2018, we knew of 296 active biomass power plants in China. They had a capacity of around 8,100 MW_{el}.

Most plants have an electrical capacity of 20 to 30 MW_{el}. One reason for this is the specification of the Chinese government that a biomass plant is not allowed to be larger than 30 MW_{el}. Due to the still attractive subsidies and the strong growth on the biomass market, the leading Chinese manufacturers have specialised in standardised plant sizes of 15 to 30 MW_{el}. The plants with capacities of around 30 MW_{el} are typically equipped with 2 generators with an installed capacity of 15 MW_{el} each.

Heat use is not very common in China. According to the most recent figures of the International Energy Agency, no electricity was generated with biomass CHP technology in 2016.

Figure 56: Annually commissioned plants in China 2010-2018



Even though the installed capacities in the individual plants and in the overall portfolio in China are very large, less electricity is produced over the course of the year than in European plants, for instance. According to official estimations and exemplary plant data, the plants operate on average for about 6,000 hours per year, which is considerably less than operating at full capacity.

Straw is the by far most common fuel in biomass power plants in China. Approximately 85% of the operating plants are mono-straw firing facilities. The other plants are fuelled with rice husk, forestry waste or bagasse.

[...]

Market development

The biomass market in the USA remains attractive, after 3 years of only few commissioned capacities. The reason for that is that we expect incentives at the federal states level to remain in effect. Furthermore, the biomass power market is more market-oriented than in many European countries due to comparably low incentives and market-oriented power purchase agreements. Even under worsened political conditions, the market influence of limited subsidies would be not comparable to the situation in Europe. Nevertheless, there is not so much upside potential from this forecast, as we also expect some facilities to be shut down. Many plants are old and the financial success of renewal is currently uncertain.

[...]

Figure 267: Project outlook USA

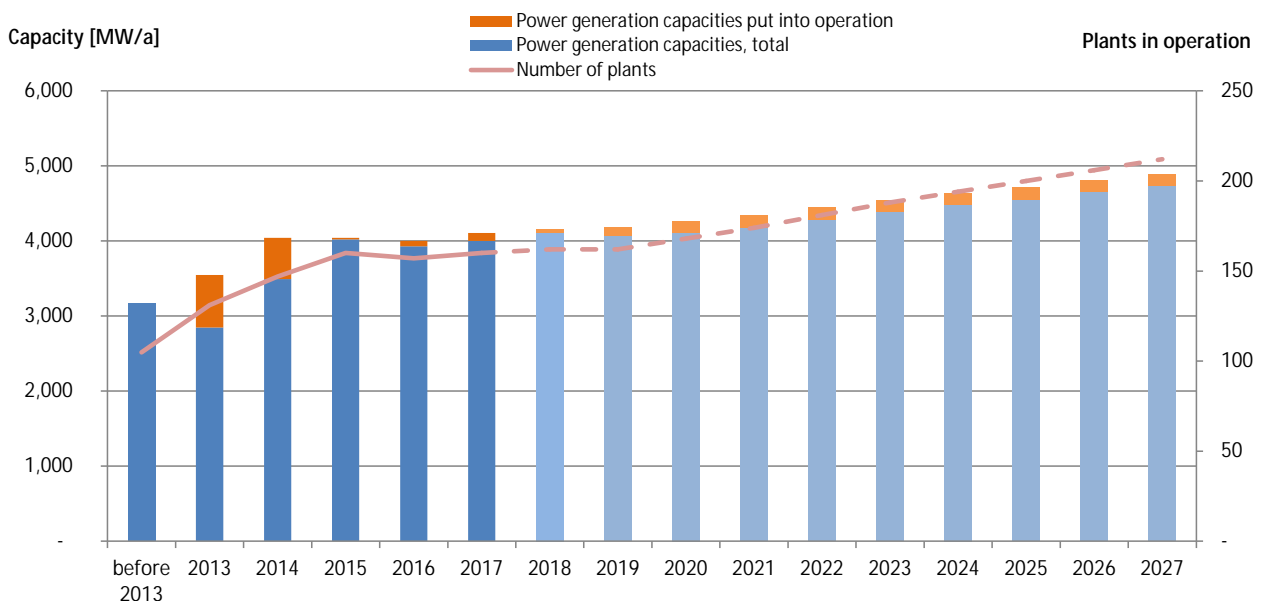
Plant	Country	Type	Plant Unit	Cap. (MW _{el})	Start	Status
Fort Meade	USA	mono-incinerator	1	66	2018	under construction
Council Bluffs	USA	mono-incinerator	1	n.a.	2019	approved
Mariposa	USA	mono-incinerator	1	2.4	n.a.	approved
Camptonville 2	USA	mono-incinerator	1	3	2022	planned
Grass Valley	USA	mono-incinerator	1	3	2020	discussed
[..]						

See annex of this national chapter for details on the projects.

We assume 80 projects (known and expected) with a total capacity of 1,500 MW_{el} to go online until 2027.

[...]

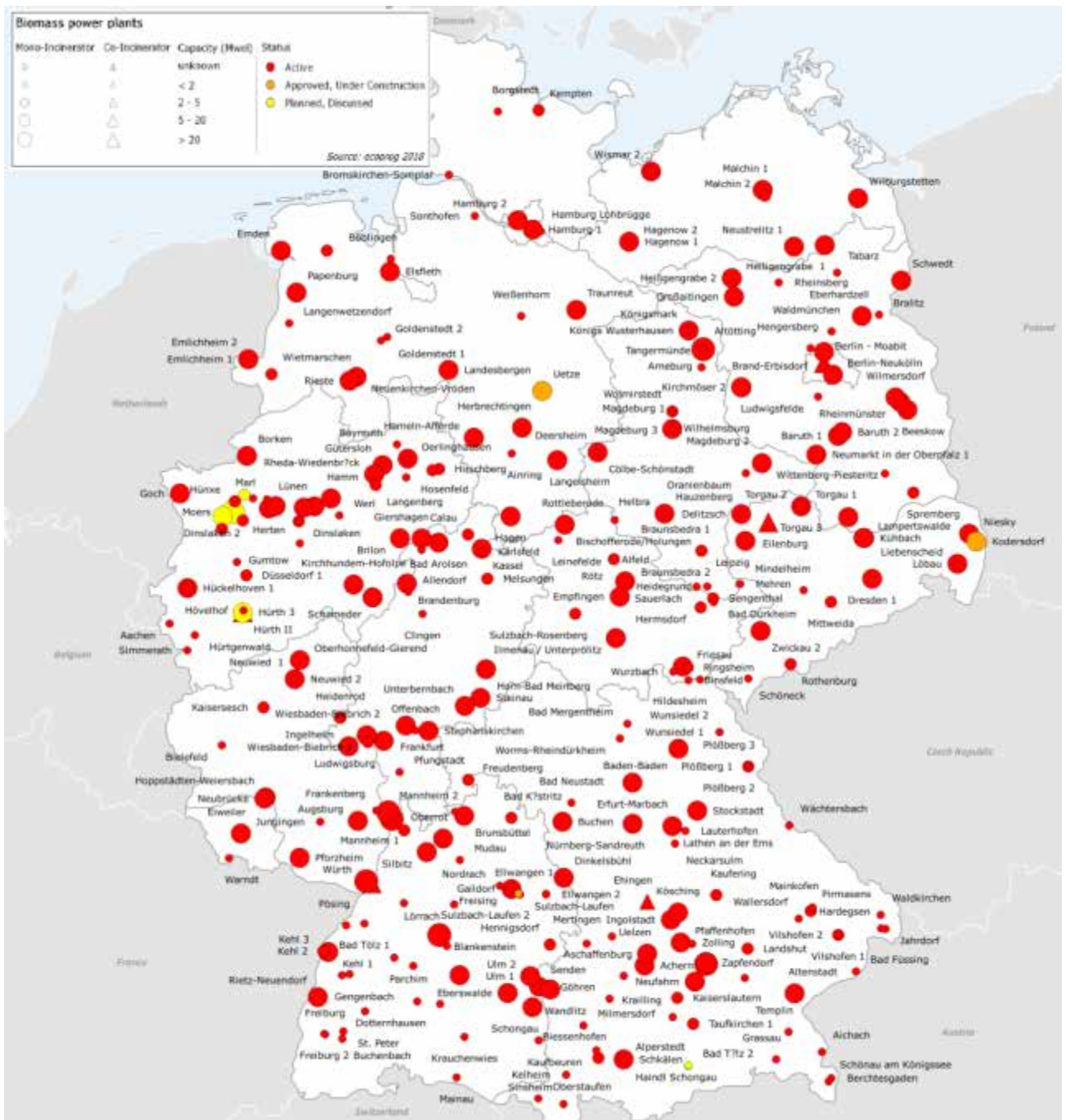
Figure 268: Market forecast USA



Data estimated up to 2017, from 2018 on: forecast, source: ecoprolog

[...]

Figure 163: Locations of plants and projects in Germany



Competition

More than 60% of the German biomass power plants are operated by companies from the sectors of wood processing and woodworking. Energy supply companies are the second most important group of operators; some of them are nationally active, others organised regionally or municipally. Furthermore, different project companies operate some BMPPs as well.

[...]

Projects and plants

[...]

Aristóbulo del Valle, Argentina

Té de Valle

Type: mono-incinerator
Status: active
Electricity generation capacity [MW]: 12
Heat production capacity [MW]: 0,3

Unit: 1 (active) mono-incinerator
Fuel: wood
Electricity generation capacity [MW]: 6,0
Heat production capacity [MW]: 0,3
PGT manufacturer: Spillingwerk GmbH (Hamburg)

Unit: 2 (active) mono-incinerator
Fuel: wood
Electricity generation capacity [MW]: 6,0

Buenos Aires, Argentina

Type: mono-incinerator
Status: planned

Remarks: Argentine wholesale electric market management company CAMMESA has signed 6 contracts with winners of round 2 of Argentine renewable energy auction programme RenovAr with a total capacity of 178.8 MW, including this project owned by Granja Tres Arroyos S.A.C.A.F.I.

Unit: 1 (planned) mono-incinerator
Gross heat production [MW]: 7,2

Capitán Sarmiento, Argentina

Granja Tres Arroyos S.A.C.A.F.I.

Type: mono-incinerator
Status: planned

Remarks: This plant was awarded a power purchase agreement in phase 1, round 2 of the Argentine RenovAr programme. The price per MWh amounts to USD 108.50. It is operated by a chicken farming company.

Unit: 1 (planned) mono-incinerator
Fuel: biomass
Electricity generation capacity [MW]: 7,2

Cerro Azul, Argentina

Molino Matilde S.A.

Type: mono-incinerator
Status: planned

Remarks: This plant was awarded a power purchase agreement in phase 1, round 2 of the Argentine RenovAr programme. The price per MWh amounts to USD 110.00.

Unit: 1 (planned) mono-incinerator

Fuel: byproducts of forest plantations and sawmills
Electricity generation capacity [MW]: 3,0

Chaco 1, Argentina

Unitan S.A.I.C.A.

Type: mono-incinerator
Status: planned

Remarks: Subsidies of 115 USD/MWh

Unit: 1 (planned) mono-incinerator
Electricity generation capacity [MW]: 6,6

Chaco 2, Argentina

Indunor S.A.

Type: mono-incinerator
Status: planned

Remarks: Subsidies of 121 USD/MWh

Unit: 1 (planned) mono-incinerator
Electricity generation capacity [MW]: 10,0

Concordia, Argentina

Type: mono-incinerator
Status: active

Unit: 1 (active) mono-incinerator
Fuel: forest residue
Gross heat production [MW]: 25,0

Cordoba 2, Argentina

Type: mono-incinerator
Status: planned

Remarks: As of May 2018, Argentina's wholesale electric market management company CAMMESA has signed a contract with a biomass plant that won in round 2 of the RenovAr renewable energy auction. The Generacion Ticino project is located in Cordoba. It is developed by Argentinian peanut company Lorenzati, Ruetsch y Cia SA. 88 renewable energy projects with a total capacity of 2,043 MW were awarded in the RenovAr auction round 2. The awarded price per MWh amounts to USD 143.10.

Unit: 1 (planned) mono-incinerator
Fuel: peanut shells and wood chips
Gross heat production [MW]: 3,0

CT Venado Tuerto, Argentina

Type: mono-incinerator
Status: planned

Remarks: The plant is owned by Spain-based conglomerate Global Dominion Access SA.

Unit: 1 (planned) mono-incinerator
Gross heat production [MW]: 8,0
Electricity generation capacity [MW]: 7,0

[...]

Projects and plants

[...]

Aichi 1, Japan

Oji Paper Company, Ltd.
2-1-1 Hirosuehiro Kure-shi
486-0834 Aichi

Type: co-incinerator
Status: active
Electricity generation capacity [MW]: 152

Unit: 1 (active) co-incinerator
Start of operation: 2007
Fuel: bark, tire, RPF, heavy oil, black Liquor, wood chips
Electricity generation capacity [MW]: 76,0
Manufacturer furnace: Mitsubishi Heavy Industries Ltd

Unit: 2 (active) co-incinerator
Start of operation: 1922
Fuel: Black Liquor, heavy oil
Electricity generation capacity [MW]: 76,0
Manufacturer furnace: Mitsubishi Heavy Industries Ltd

Aichi 2, Japan

Chubu Electric Power Co.
447-0824 Aichi

Type: co-incinerator
Status: active
Start of operation: 2002
Capacity [t/a]: 10.000.000

Remarks: There are 2 further units with a capacity of 700 MW and two units each with a capacity of 1000 MW at this plant. Since 2009 a share of 1 to 3% (300,000 tons) of biomass is co-incineration in this plant. Whether all units co-incinerate biomass or only particular ones is not clear.

Unit: 1 (active) co-incinerator
Start of operation: 2002
Fuel: wood chips, coal
Electricity generation capacity [MW]: 700,0
Manufacturer furnace: IHI Co.

Akita 1, Japan

Nippon Paper
1-2-2 Hitotsubashi, Chiyoda-ku
100-0003 Tokyo
Tel.: +81 3 6665 1000
Fax: +81 3 3217 3000

Type: co-incinerator
Status: active
Start of operation: 2008

Unit: 1 (active) co-incinerator
Start of operation: 2008
Fuel: coal, wood residual
Electricity generation capacity [MW]: 45,0
Heat production capacity [MW]: 135,0

Incineration mode: cfb
Manufacturer furnace: Foster Wheeler

Akita Prefecture, Japan

Nippon Paper Group Inc.

Type: co-incinerator
Status: planned
Start of operation: 2018

Remarks: This plant will be located next to one of Nippon Papers production facilities in Akita Prefecture.

Unit: 1 (planned) co-incinerator
Start of operation: 2018
Fuel: timber thinnings, coal
Electricity generation capacity [MW]: 100,0

Anan, Japan

Kurabo Industries Ltd
4-31, 2-chome Kyutaro-machi Chuo-ku
541-8581 Osaka
Tel.: + 81 6 6266 5111
Fax: +81 6 6266 5555

Type: mono-incinerator
Status: under construction
Start of operation: 2018

Remarks: The plant will be located next to Kurabos Tokushima industrial Plant.

Unit: 1 (under construction) mono-incinerator
Start of operation: 2018
Fuel: wood chips
Electricity generation capacity [MW]: 6,4
Incineration mode: fluidized bed

Aomori, Japan

Mitsubishi Paper Mills
2-10-14, Ryogoku, Sumida-ku
130-0026 Tokio
Tel.: +81 3 5600-1488

Type: co-incinerator
Status: planned
Start of operation: 2019

Remarks: Steam data: 65/58 kg/s, 142/28 bar, 557/540 °C. Japanese JFE Engineering Corp. signed an engineering, procurement and construction deal with MPM Oji Eco Energy Corporation (MOE), a Joint Venture between Oji Green Resources Co. and Mitsubishi Paper Mills Ltd. for the 75 MWel biomass plant at Mitsubishi Paper Mill. The plant will generate 5.3 billion kWh of electricity per year. JFE plans to equip the facility with Valmet's circulating fluidized bed (CFB) boilers that will be fueled with woodchips, palm kernel shell and coal.

Unit: 1 (planned) co-incinerator
Start of operation: 2019
Fuel: woodchips, palm kernel shell and coal
Gross heat production [MW]: 86,0
Electricity generation capacity [MW]: 75,0

[...]

Plant register

[...]					
Wels, Austria	415	Wilmersdorf, Germany	602	Xinfeng 1, China	164
Welshpool, United Kingdom	875	Wilseyville, USA	957	Xinfeng Asahi, China	164
Wen County, China	161	Winchester Oregon, USA	957	Xinfeng, China	164
Wen'an County, China	161	Windsor, Canada	905	Xingan, China	164
Wendel, USA	955	Wińsko, Poland	721	Xingang, China	164
Wengshang, China	161	Wismar 1, Germany	602	Xingfeng 2, China	165
Wengyuan County, China	161	Wismar 2, Germany	603	Xingfeng, China	164
Wenshang County, China	161	Wittenbach, Switzerland	827	Xinjiang, China	165
Werchter, Belgium	435	Wittenberg-Piesteritz, Germany	603	Xinmi, China	165
Werl, Germany	601	Wolkersdorf, Austria	415	Xinmin City 2, China	165
West Enfield, USA	955	Wolmirstedt, Germany	603	Xinmin City, China	165
West Point, USA	956	Wolnzach 1, Germany	603	Xinxian Guangchao, China	165
West Thurrock, United Kingdom	875	Wolnzach 2, Germany	603	Xinxiang 1, China	165
Westbrook, USA	956	Wonosobo, Indonesia	255	Xinxiang 2, China	165
Westdorpe, Netherlands	697	Woodland 1, USA	957	Xinxiang 3, China	166
Westfield, United Kingdom	876	Woodland 2, USA	957	Xinyang City, China	166
Westlock, Canada	904	Woodville, USA	957	Xinye County, China	166
Westminster, USA	956	Woongoolba, Australia	361	Xinyu, China	166
Whirinaki, New Zealand	390	Workington, United Kingdom	877	Xixia, China	166
White Springs, USA	956	Worms-Rheindürkheim, Germany	603	Xuancheng, China	166
Whitecourt, Canada	904	Wörth, Germany	604	Xuanzhou 1, China	166
Whitefield, USA	956	Wrexham, United Kingdom	877	Xuanzhou 2, China	166
Whitehorse, Canada	905	Wroclaw, Poland	722	Xunke county, China	167
Whitemoor, United Kingdom	876	Wuchang, China	162	Xunxian, China	167
Wick, United Kingdom	876	Wudalian, China	162	Xuyi 1, China	167
Wickliffe, USA	957	Wudalianchi, China	162	Xuyi 2, China	167
Widnes 1, United Kingdom	876	Wugang, China	162	Xuzhou 2, China	167
Widnes 2, United Kingdom	876	Wuhe, China	162	Xuzhou, China	167
Wielsbeke, Belgium	435	Wulian, China	162	Yala 2, Thailand	322
Wien, Austria	415	Wunsiedel 1, Germany	604	Yala, Thailand	322
Wiener Neustadt, Austria	415	Wunsiedel 2, Germany	604	Yamaguchi 1, Japan	386
Wieringermeer, Netherlands	697	Wuqiao, China	162	Yamaguchi 2, Japan	386
Wiesbaden-Biebrich 1, Germany	601	Wurzbach, Germany	604	Yamaguchi 3, Japan	386
Wiesbaden-Biebrich 2, Germany	602	Wusu, China	162	Yamaguchi 4, Japan	387
Wiesmoor-Hinrichsfehn, Germany	602	Wuzhai, China	163	Yamaguchi 5, Japan	387
Wietmarschen, Germany	602	Xátiva, Spain	786	Yanbian, China	167
Wieze 1, Belgium	435	Xiangfu, China	163	Yancheng 1, China	167
Wieze 2, Belgium	435	Xiangxiang, China	163	Yancheng 2, China	168
Wieze 3, Belgium	435	Xiangyang City 2, China	163	Yancheng 3, China	168
Wilburgstetten, Germany	602	Xiangyang City, China	163	Yancheng 4, China	168
Wilhelmsburg, Germany	602	Xianning, China	163	Yancheng 5, China	168
Williams Lake, Canada	905	Xiaochang, China	163	Yanggu, China	168
Williams, USA	957	Xiaogan City, China	163	Yangshan 1, China	168
		Xiayi, China	163	Yangxin 1, China	168
		Xifeng County, China	164	Yangzhou, China	169
				Yantai, China	169
				Yaroslavl, Russia	750
				[...]	

Price and product information

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