BWSC

Turnkey power plant solutions

RENEWABLE POWER

BWSC - YOUR GLOBAL ENERGY PARTNER

Burmeister & Wain Scandinavian Contractor A/S (BWSC) provides four main services to the renewables market:

- **turnkey supply of power and CHP plants**
- **project development**
- **operation and maintenance**
- **financing and co-investment**

Turnkey supply of power and CHP plants

BWSC provides renewable power plants in the range of approximately 5-70 MWe. The plants can be configured for combined heat and power (CHP) production with heat or steam output in the required quantity and quality.

The plants are mainly based on wood, straw or waste fuels, but additional types of fuel can be used. The chemical and physical properties of the specific fuel are crucial for the choice of steam boiler, which is always selected from a top-ranking boiler manufacturer.

Based on standard concepts and our flexibility to choose the best available technology in the market, every renewable plant is designed to give you optimal benefit.

Project development

BWSC can provide partnership through cooperation agreements or as co-developer.

We have hands-on experience as developer of and investor in both renewable and diesel power plants and as supplier to independent power producers (IPP) in Europe, Africa and Latin America. This enables us to support our partners in all aspects of project development; from the initial stage, setting up of joint development partnerships over negotiation of agreements for power purchase, fuel supply, leases and finance structures to project implementation.

Cooperation between BWSC and our partners is typically organised through exclusive no-cost support agreements where BWSC provides plant design, data, specifications, etc. or as full co-development agreements where all partners share the development responsibility.

Operation and maintenance

BWSC provides a variety of post-construction services; from sale of spare parts, training, upgrades and rehabilitation of power plants to technical service agreements (TSA) and long-term operation and maintenance (O&M) contracts. The composition of services will be tailored to fit your specific project requirements.

Full O&M agreements are typically signed for periods of 5-20-years with guaranteed production and all-inclusive prices, thereby mitigating the owners' risk and securing stable operation and performance at known cost.

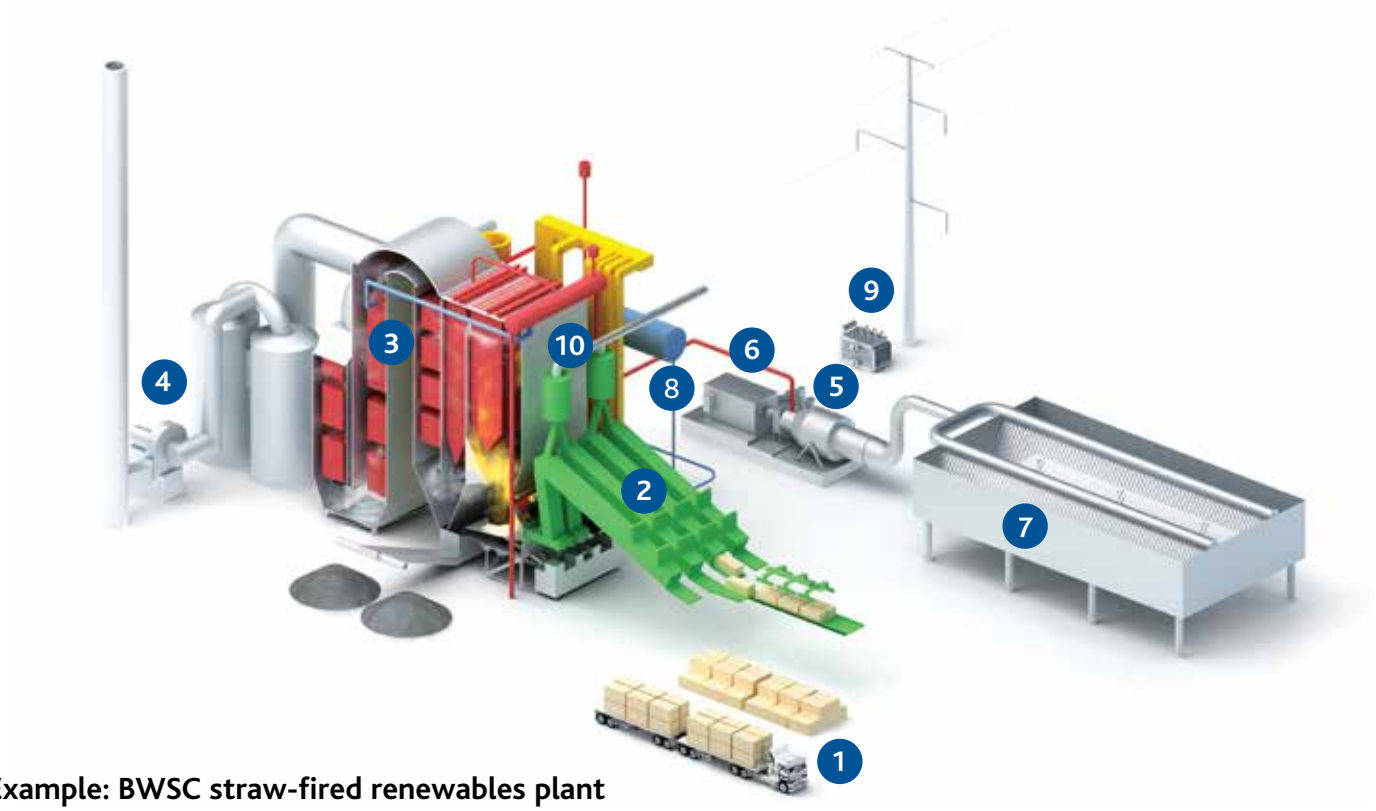
BWSC has, within its organisation, all the engineering, process and construction management resources necessary to ensure a coherently designed and engineered power plant, operable and maintainable throughout the lifespan of the plant at the highest availability and lowest cost.

BWSC has extensive experience in establishing competent, local O&M organisations, providing them with direct access to a strong support organisation and the knowledge gained from managing, operating and maintaining power plants.

Financing and co-investment

During the development phase, BWSC can provide financing assistance based on in-house experience with project-funding and drawing on an extensive network of financial institutions, pension funds and lenders, including export credit agencies. Further, BWSC can invest and provide asset management services as an active owner throughout the lifespan of the plant. At present, BWSC has invested in six renewables projects and four diesel projects.

RENEWABLE ENERGY POWER PRODUCTS



Example: BWSC straw-fired renewables plant

1. fuel reception and storage barn
2. fuel transport and feed system
3. steam boiler
4. flue gas filter and stack
5. turbine
6. generator
7. condensate system
8. feed water system
9. electrical supply and export system
10. optional woodchip fuel system

A complete plant comprises all necessary control and support systems and all required facilities, buildings, structures, roads, etc. The exact electrical output wil vary dependent on site-specific conditions.

BWSC renewable power plants are based on the well-proven steam cycle. To improve overall efficiency, reheat technology can be implemented: Steam will be led through two heating processes and two turbines instead of usually one, hence the term reheat, for increased utilisation of energy.

Thus, more electric power is generated from the same amount of fuel to emphasise the financial and environmental advantages. As an example, the BWSC Cramlington power plant (27.8 MWe) is expected to achieve CO_2 savings of approximately 56,000 tonnes per year compared to a similar size gas-fired power plant. This corresponds to CO_2 emissions from some 20,000 cars.

SELECTED REFERENCES

SLEAFORD
38.5 MWe + 1 MWth STRAW-FIRED POWER PLANT

Project development was completed in the latter part of the 00s, whereas the contract did not become effective until financial close in December 2011. Meanwhile, emission control system requirements had intensified, and the project was adapted accordingly.

Despite a nearby public road, the supply of utilities for the construction site, e.g. telephone lines, power and natural gas, remained a challenge throughout the project. The provision of power for construction was a particular matter of concern, as connection of welding machines to the public grid was not permitted, and power had to be supplied from diesel gensets on site.

The first year of construction suffered from almost daily rain. Combined with a water table only half a meter below ground level, this presented several challenges to maintaining the scheduled progress.

District heating is supplied free of charge to public buildings in Sleaford town centre, including a public swimming pool and council offices. The Sleaford biomass plant was the first of its kind in the UK for many years.

Developer	Eco2
Owner	Glennmont Partners
Lenders	NIBC, Unicredit, RB of Scotland and Siemens
EPC contractor	BWSC and BWE in consortium
Contract start	December 2011
Completion	September 2014
Capacity	38.5 MWe + 1 MWth
Boiler	BWE
O&M contract	BWSC, 12 years

SNETTERTON
44.2 MW STRAW-FIRED POWER PLANT

The Snetterton greenfield plant is designed to produce 44.2 MW electricity, equal to the supply for 80,000 households. The site is situated in Norwich close to the A11 to secure efficient logistics for the fuel supply. The plant burns a combination of biomass fuels; straw, miscanthus and virgin wood.

The BWE steam boiler is tailored to burn the combined renewables. An integrated firing system with spreader stokers and vibrating grate technology guarantees complete burnout of the biomass, minimising emissions while maintaining high combustion efficiency.

Further reduction of emissions is achieved by a bag filter removing dust and particles from the combustion gases before releasing them into the atmosphere. In April 2017, after a construction period of 29 months, the Snetterton Renewable Energy Plant was handed over to the owners, one month ahead of schedule and within the agreed investment budget.

A 15-year O&M contract was signed between Iceni/Eco2 and BWSC following takeover. BWSC holds 37.5% ownership of the plant.

Developer	Iceni/Eco2
Owner	PensionDanmark and BWSC
Lenders	PensionDanmark
Contract start	November 2014
Completion	April 2017
Capacity	44.2 MW
Boiler	BWE
O&M contract	BWSC, 15 years

WIDNES
20.2 MWe + 7.75 MWth CHP WASTE WOOD PLANT

This project has been co-developed by Stobart and BWSC. Stobart and BWSC are, together with Green Investment Bank, equity holders in Mersey Bioenergy Limited (MBL). In November 2014, MBL entered into an EPC contract with BWSC, with 26 months to takeover.

Heat from the Widnes CHP plant will be delivered to an adjacent wood-drying facility. The plant and the dryer share entrance, exit, weighbridges, firewater tank and internal roads, and thus, require a continuous interface dialogue.

Attending to the adverse soil conditions, in part due to galligu contamination (owner's risk), predominated the first six months of construction, on the one hand calling for deep steel piling while on the other hand limiting the piling depth to 32 m to reduce the risk of contaminating the underlying bedrock aquifer. As a consequence, piling under the main buildings was delayed and BWSC was granted a 3-month extension.

BWSC submitted in August 2017 the application for taking-over with expected completion of negotiations in September 2017.

Developer	Stobart and BWSC
Owner	Green Investment Bank, Stobart and BWSC
Lenders	GIB, GCP, Investec with EKF guarantees
Contract start	November 2014
Completion	Expected September 2017
Capacity	20.2 MWe + 7.75 MWth
Boiler	Standardkessel GmbH
O&M contract	BWSC, 20 years

CRAMLINGTON
27.8 MWe + 6.1 MWth CHP POWER PLANT

Expected to be up and running by the end of 2017, the facility will generate 223 GWh of renewable electricity annually – enough to power 52,000 homes. The plant will supply power on direct wires and heating to two pharmaceutical companies and will export the remaining power to the national grid.

The combined heat and power (CHP) plant is based on reheat technology. The steam is led through two heating processes and two turbines instead of usually one for increased utilisation of energy. This improves fuel efficiency and, hereby, provides a higher plant output with the same fuel input. Compared to a power plant without reheat, the Cramlington plant will produce 7% more electricity per kg biomass. This will be the first reheat biomass plant in the UK.

The plant will be powered by a combination of virgin wood and forest residues from sustainable forestry and clean recycled waste wood. BWSC and BWE won this project in consortium. During the execution of the project, BWSC entered into an asset deal for the acquisition of BWE's biomass activities and other activities.

Developer	Estover Energy
Owner	John Laing Group, Green Investment Bank, Estover
Lenders	Barclays Bank Plc with EKF guarantee
EPC contractor	BWSC and BWE in consortium
Contract start	September 2015
Completion	December 2017
Capacity	27.8 MWe + 6.1 MWth
Boiler	BWE
O&M contract	BWSC, 12 years

WESTERN WOOD
14 MW WOODCHIP-FIRED POWER PLANT

The 14 MWe Western Wood Plant in Port Talbot, Wales, consumes some 20 tonnes of wood fuel per hour in full-load operation. An integrated firing system with spreader stokers and travelling grate technology guarantees complete burnout of the wood, minimising emissions while maintaining high combustion efficiency.

In addition to establishing a sustainable energy source, the owner has, with the erection of this plant, demonstrated a close integration into the regional economy, cooperating with local companies supplying wood from the area.

A multinational site crew of 200 people cooperated successfully to deliver the plant within an effective construction period of 24 months. Operation and maintenance (O&M) was guaranteed through the foundation of the local organisation Western Biomass Operating Co. Ltd., securing BWSC and Aalborg Energie Technik (AET) had a 5-year full O&M contract.

Developer	Eco2
Owner	Western Bioenergy Ltd.
EPC contractor	BWSC and AET in consortium
Contract start	April 2006
Completion	October 2008
Capacity	14 MW
Boiler	AET
O&M contract	BWSC and AET, 5 years

TILBURY GREEN POWER
40 MW WASTE WOOD-FIRED POWER PLANT

This project was originally developed by Express Energy, but the drive towards Financial Close was taken over by one of the equity providers, the Irish Utility Electricity Supply Board (ESB).

The plant consumes approximately 35 tonnes of waste wood per hour in full-load operation, and the firing system guarantees complete burnout of the wood, ensuring low emissions while maintaining high net efficiency. The facility comprises a waste wood-processing facility operated by the fuel supplier, Stobart, and a biomass power plant. Waste wood is delivered by truck, and woodchips are produced by the wood-processing facility.

The site is located close to London, along the river Thames. Bearing in mind the risk posed by unexploded bombs from World War II, extensive investigatory work has been carried out to safeguard against such devices.

BWSC is involved as EPC and O&M contractor and also as equity investor; thus, this project truly represents a long-term venture for BWSC.

Developer	Express Energy/EBS
Owner	Green Investment Bank, ESB, AET and BWSC
Lenders	Rabobank, Investec and EKF
EPC contractor	BWSC and AET in consortium
Contract start	March 2015
Completion	Expected October 2017
Capacity	40 MW
Boiler	AET
O&M contract	BWSC and AET, 20 years

BRIGG
42.5 MW STRAW-FIRED POWER PLANT

This 42.5 MW plant facility burn straw and mischanthus in combination with woodchips.

The project was developed by Eco2 with the initial intention of selling it off to another investor. This projection ran into challenges during the spring 2013, and BWSC, together with Copenhagen Infrastructure Partners, agreed to bid for the project. In less than six months, an EPC contract was signed, becoming effective with a contract schedule of 30 months.

The plant was erected on top of a former British sugar works plant demolished to approcimately ground level and left with partly concrete hard surfacing to be excavated and crushed. The area is close to the river Ancholme and is defined as a flooding area. Therefore, all essential areas were elevated, and, due to ground conditions, extensive piling with more than 2600 piles had to be carried out.

The plant was handed over to the owners on 21 January 2016 after a construction period of less than 27 months. This was 3 months ahead of schedule and within the agreed investment budget.

Developer	Eco2
Owner	PensionDanmark and BWSC
Lenders	PensionDanmark
Contract start	November 2013
Completion	January 2016
Capacity	42.5 MW
Boiler	BWE
O&M contract	BWSC, 15 years

SPEYSIDE
OPERATION AND MAINTENANCE OF NON-BWSC BUILT POWER PLANT

The Speyside plant is being built under an EPC contract by German boiler supplier, Standardkessel GmbH, and represents the first BWSC O&M contract for a non-BWSC-built power plant. The project is owned by UK Green Investment Bank and John Laing Investments Ltd., with a minority share for the project developer, Estover Energy Ltd.

The boiler has a net rated thermal input of 46 MW with a combustion system comprising a stepped travelling grate. It will burn virgin wood consisting of small, round woods, chipped brash and woodchips.

The biomass-fired power plant will feed approximately 12.5 MW of electricity into the public grid and export approximately 9 MW of process steam to neighbouring whisky distillery The Macallan.

The O&M contract has a term of 12 years.

Developer	Estover Energy Ltd.
Owner	John Laing Group, Green Investment Bank, Estover
Lenders	Barclays Bank Plc with EKF guarantee
Contract start	August 2014
Capacity	12 MWe + 9 MWth
Boiler	Standardkessel
O&M contract	BWSC, 12 years

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FACTS ABOUT BWSC

- World-leading turnkey EPC contractor and service provider for diesel, natural gas and renewable baseload power plants for electricity generation and thermal energy production
- More than 180 power plants designed and supplied in 53 countries
- Two decades of experience in operation and maintenance of power plants
- A comprehensive range of power plant support services, from spare parts to complete rehabilitation
- Training programmes for all aspects of power plant operation and maintenance
- Extensive experience in financing and development of power plant projects
- Headquarters in Denmark – widespread international sales and support network
- 900 employees in our main office and on power plants around the world
- 100% subsidiary of Mitsui Engineering & Shipbuilding Co. Ltd., Japan
- Certified according to ISO 9001 and OHSAS 18001
- Long-standing AAA rating, 2016 revenues: EURm 395

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