BIOMASS TO ENERGY CAPABILITY STATEMENT

DECEMBER 2020
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1. AFRY INTRODUCTION

ÅF and Pöyry
In 2019 ÅF and Pöyry became AFRY

— In February 2019 ÅF and Pöyry joined forces in order to become an international engineering, design and advisory company, driving digitalisation and sustainability for the energy, infrastructure and industrial sectors all over the world.

— In November 2019 ÅF Pöyry launched a new common brand, AFRY. The name is a combination of the letters in ÅF and Pöyry: AF+RY [eɪ.fai]

— With a strong focus on sustainable solutions we bring the best from ÅF and Pöyry into the new brand AFRY.
Our first 120 years

1895
ÅF former Ångpanne-föreningen, is founded.

1901
ÅF’s first environmental consultant.

1958
Pöyry is founded.

1976
Inspection operations are nationalized in Sweden.

1981
ÅF from cooperative associations to limited company.

1986
ÅF shares listed on the Stockholm Stock Exchange.

1995
Inspection activities resume. ÅF celebrates 100th anniversary.

1997–99
Pöyry acquires Electrowatt Engineering AG.

2008
Ångpanne-föreningen changes its name to ÅF.

2010
Inspection operations are sold to DEKRA Industrial.

2012
ÅF merges with Epsilon.

2016
Most attractive employer in Sweden among young professionals with M.Sc. Engineer.

2017
ÅF launches new strategy – Making Future.

2019
ÅF and Pöyry join forces and become AFRY.
Total No. of employees: 17,000
Approx. annual revenue: 2 b€
Industry Infrastructure Energy
Offices in countries: 50
European HQ with strong global presence

Our presence
2. AFRY Energy

Wide and Deep Expertise
AFRY ENERGY

One of the world’s leading engineering consulting firms in various segments

Solar Energy  Wind Energy  Hydro  Transmission and Distribution

Combined Cycle Power Plants  Battery Storage  Desalination Plants  Biomass and Waste-to-Energy
AFRY in Biomass-to-Energy

We manage different plant solutions as well as combustion and flue gas cleaning technologies.

— AFRY has had substantial involvement in design and construction of more than 60,000 MW_{e} of thermal power

— AFRY has been involved in industrial scale Biomass-to-Energy projects since the 1970’s.

— Plants and projects in Finland, Sweden, Estonia, Latvia, Lithuania, Germany, U.K., France, Russia, Poland, South Korea, Turkey, Thailand, Indonesia, Vietnam, Philippines, Papua New Guinea, P.R of China and Chile.
Range of Activities

The engineering and consulting services of our Energy Division are rendered around the world. As the company is an internationally operating company, most engineers and experts are well familiar with multicultural work environments. Within the above fields of activity, AFRY is well qualified to offer the following range of services:

- Pre-feasibility and feasibility studies
- EIA procedure / Environmental licensing
- Pre-engineering (incl. Procurement)
- Engineering Procurement Construction Management services (EPCM)
- Detail engineering, delivery supervision, suppliers workshop QA/QC
- Project, site and commissioning management
- Supervision of guarantee and performance test procedures
- Training of technical personnel
- Owner’s engineer services (OE)
- Trouble shooting
- Risk management
- Optimizations of combustion and plant
- Measurement and testing services
- Operation and maintenance advisory services
- Institutional and regulatory development in the energy sector
- Studies of alternative fuel policies and of fuel supply and handling
- Advice regarding project financing and associated Lenders Technical Advisory services
- Technical and Commercial due diligence services for sellers, buyers and lenders of power plants and power projects
Expertise in

- Biomass sourcing
- Fuel handling
- Boiler technologies
- Flue gas treatment and Flue Gas Condensers
- Steam turbines
- Balance of Plant (BOP)
- Heat storage
- Life cycle costs
- Refurbishment of existing facilities
- Performance optimization
- Trouble shooting
- Combined Heat & Power (CHP)
- Due Diligence
- White and torrefied pellets production
- Sludge treatment systems
- Co-incineration of waste and biofuels
- Boiler conversions for Biomass firing
OUR SERVICES

MANAGEMENT CONSULTING
- Strategy
- Market Transactions
- Operational Excellence
- Biomass sourcing

ENGINEERING SERVICES
- Technical Consulting
- Conceptual Engineering
- Pre-Engineering
- Basic Engineering
- Detailed Engineering

PROJECT IMPLEMENTATION
- Site Supervision
- Owner’s Engineer (OE)
- Project & Construction Management
- Engineering & Procurement Services (EPS)
- Engineering, Procurement, Construction (EPC)
- Engineering, Procurement and Construction Management (EPCM)

OPERATIONS SUPPORT
- Operational Improvement
- O&M Management
- Outsourced Operations
- Emission and performance measurements
Why are we different?

Market understanding
— Experience in more than 80 countries gives us deep insight into different international Biomass to Energy challenges.

Whole Life Cycle Experience with Utility Background
— AFRY has strong roots in utility companies (e.g. the engineering arms of Fortum in Finland and ATEL/Alpiq in Switzerland) thus possessing full understanding of whole life cycle of power plants, including operation and maintenance.
— AFRY is one of very few engineering consultants with a proven track record of delivering full Engineering Procurement and Construction Management (EPCM) services on complex projects. Our EPCM approach can unlock significant additional value for our Clients. We continue to receive valuable feedback from our ongoing Owner’s Engineer and EPCM projects.

Best Tools
— AFRY utilizes both in-house and commercially available software to assist the development and implementation of its clients’ projects. Examples our in-house software unique to AFRY include:
  — Safety Stepwise process for management of health & safety related matters through the project phases
  — Co-Pilot for project risk management
  — Smart Site from project engineering to construction and commercial operation
— Tools are only as good as the user behind them. We have standard methods for study creation and systems for employee knowledge sharing.
4. BIOMASS TO ENERGY PROJECT EXAMPLES

OUR RECENT SUCCESS STORIES
Recent Biomass Power Projects in Asia

**Thailand**
- Chana Green Biomass Project (20.6 MWnet) in Chana District, Songkla Province
- 6 MW Biomass Power Plant Project in Nakhonratchasima
- PST 30 MW Biomass Power Plant
- Chang Raek 9.5 MW Biomass Power Plant Project
- 10 MW Biomass Project
- 120 MW Biomass-fired Power Plant at 304 Industrial Park, Prachinburi
- VG Energy 15 MW Biomass Cogeneration Power Plant Project in Chumporn province

**Philippines**
- North Negros Biopower 25 MW
- South Negros Biopower 25 MW
- San Carlos Biopower (SCBP) 20 MW
- La Carlota 40MW Biomass Power Plant
- Global Green Power 15 MW
- San Carlos Bioenergy (SCBI) 8 MW

**Papua New Guinea**
- 15MW Biomass to Energy Plant Development in Papua New Guinea

**Indonesia**
- 5 MW Captive Biomass Fired Power Plant
- Merauke 10 MW Nett Wood Chips Power Plant
- 12 MW Biomass and Coal Fired Cogeneration Power Plant in Kalimantan
Biomass-to-Energy
Golbey, France

Client
Veolia VIGS, France / Norske Skog, Norway

Plant description
Circulating Fluidized Bed (CFB) boiler designed for combustion of waste wood and sludges, wastes from paper mill process. Fuel and ashes handling, CFB boiler, Flue Gas treatment, Bag Filter, steam turbine, BOP, civil works, electrification, automation and DCS system

Capacity
120 MW\textsubscript{thermal}
25 MW\textsubscript{el} (net)
105 t/h \textsubscript{steam production} \quad 390 °C, 105 bara

Schedule
2019 – 2023

Main scope of services
- FIDIC EPC contract elaboration’s support
- Bidding process and negotiations
- Contract negotiations
- Design Review (of technical documents and drawings prepared by the EPC Contractor)
- Site Coordination
- Factory Tests and Inspections
- Site Support Services
Biomass-to-Energy
Teesside, UK

Client MGT Teesside

Plant description Worlds largest biomass fired power plant combusting wood chips and pellets.

Capacity 299 MW_e

Schedule 2008 – 2021

Main scope of services
- Feasibility study / concept refinement
- EPC contract procurement services (preparation of technical specifications, evaluation of proposal and contract negotiation)

Post financial close (2016 – 2021)
- Design Review (of technical documents and drawings prepared by the EPC Contractor)
- Technical project management review
- Shop inspections and factory inspection tests
- Construction and commissioning monitoring
Biomass-to-Energy
Oulu, Finland

Client
Oulun Energia Oy, Finland

Plant description
New Combined Heat and Power (CHP) plant located in Laanila industrial area, Oulu

Capacity
CFB boiler
- Fuel heat: 194MWth
- Fuels: Biomass, peat, SRF
- Live steam: 80kg/s, 120 bar / 540°C,
  Flue Gas Treatment Plant:
  55MWdh heat recovery

Steam Turbine
- 75MWel + 125MWdh; 50MWsteam

Solid Fuel Handling Systems
- Biomass/peat and SRF –lines

Schedule
Pre-engineering 2017,
EPCM 2018-2020

Main scope of services
- Pre-engineering
- EP: Project Management,
  Engineering, Procurement
Chana Green Biomass Project, Songkla, Thailand

**Client**  Sino-Thai Engineering & Construction Plc, Thailand

**Plant description**  Grate fired boiler designed to use rubber wood residue fuels (wood chunk, wood chips, stump, root, etc.). The power plant output is 20.6 MWe.

**Capacity**  20.6 MW<sub>e</sub>

**Schedule**  2018 – 2020

**Main scope of services**
- Contractor’s Engineer Services
- Detailed Engineering including:
  - Plant lay-out and 3D plant design
  - Process and mechanical design
  - Electrical design
  - Control and instrumentation
  - Piping and cabling design
  - Preparation of O&M manuals
Biomass-to-Energy
North Negros, Philippines

**Client**
North Negros Biomass

**Plant description**
- Water cooled vibrating grate boiler designed for combustion of sugar cane residues leaves, stalks and tops.
- Boiler, CEMS, Bag House Filter, Steam turbine, BOP, Civil works, Electrification, Automation and DCS system
- 515 °C, 92 bara

**Capacity**
- 25 MW_{el} (net)
- 105 t/h steam production

**Schedule**
2018 – 2020

**Main scope of services**
- FEED study to establish budget and design
- Limited Notice to Proceed phase to complete site preparation design and bidding of the boiler and steam turbine packages
- Full Engineering, Procurement and Construction services of the entire Power Plant Project with full guarantees for Performance, Time and Cost, participation of the Client during selection of the major equipment (EPC+).
- O&M Management Services
NPS9, 120 MW Biomass Power Plant, Thailand

Client
ADB, Biomass Electricity Co. Ltd

Plant description
The power plant uses wood chips from pulp mills as fuel and burned in a CFB boiler

Capacity
120 MWₑ

Schedule
2009 – 2020

Main scope of services
— Technical due diligence during the pre-financial close
— Construction monitoring and performance test monitoring
— Monitoring of the operation and maintenance during the loan term
Turun Seudun Energiantuotanto Oy, CHP Power Plant, Finland

Client
Turun Seudun Energiantuotanto Oy

Plant description
New CFB power plant integrated to existing power plant. Multifuel CFB boiler with reheating circuit

Capacity
Main steam 550 °C / 160 bar, Reheat steam 550 °C / 40 bar, Fuel power 430 MWₑ, District heating steam turbine 160 MWₑ / 200 MWₜʰ. In addition power plant produces 50 MWₜʰ process steam

Schedule

Main scope of services
— Pre-engineering

EPCM Services including
— Project management, engineering, procurement
— Site management and site supervision for selected disciplines
— EPCM services for flue gas condenser unit
Järvenpää CHP plant, Finland

Client
Fortum Power & Heat, Finland

Plant description
CHP Plant with a biomass and peat-fired BFB boiler,

Capacity
Steam turbine 23 MW<sub>e</sub>
District Heating 44 MW<sub>th</sub>

Schedule
2010-2013

Main scope of services
— Pre-engineering

EPCM contract including
— Project management
— Process engineering,
— Plant engineering
— Piping engineering
— Electrification and automation engineering
— HVAC engineering
— Procurement services
— Design review for main equipment
— Construction and erection supervision services,
— Commissioning services
Biomass CHP plant for Iggesund Paperboard (Workington) Ltd, UK

Client
Iggesund Paperboard Ltd

Plant description
Fuel supply: fresh wood, bark, sawdust. Steam generating capacity of the BFB boiler:
540 °C, 102 bar(a): 54,2 kg/s

Capacity
50 MW_e, 30 MW_th

Schedule
2011 - 2013

Main scope of services; EPCM contract
- Project Management
- Plant design and engineering
- Procurement and Contractor’s supervision
- Site construction, Installation and Commissioning Management
Jelgava CHP plant, Latvia

Client
Fortum Jelgava SIA, Latvia

Plant description
CHP Plant with a biomass and peat-fired BFB boiler,

Capacity
Steam turbine 23 MWₑ
District Heating 44 MWₜₜ

Schedule
2010-2013

Main scope of services; EPCM contract
- Project Management
- Preparation of technical design project (=building permit)
- Process engineering
- Plant engineering
- Piping engineering
- Electrification and automation engineering
- HVAC engineering
- Procurement services
- Design review for main equipment
- Construction and erection supervision services
- Commissioning services
Biomass fired CHP power plant in Gävle

<table>
<thead>
<tr>
<th><strong>Client</strong></th>
<th>Bomhus Energi (Korsnäs AB and Gävle Energi AB) AB, Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plant description</strong></td>
<td>New power unit in Korsnäs industrial estate with a 150 MW, BFB bio boiler, with fuel handling system and a Back pressure turbine of 70 MW&lt;sub&gt;e&lt;/sub&gt;</td>
</tr>
<tr>
<td><strong>Capacity</strong></td>
<td>70 MW&lt;sub&gt;e&lt;/sub&gt;, 100 MW&lt;sub&gt;th&lt;/sub&gt;</td>
</tr>
<tr>
<td><strong>Schedule</strong></td>
<td>2010 - 2013</td>
</tr>
</tbody>
</table>

**Main scope of services; EPCM contract**
- Project management
- Design review for AFRY scope
- Engineering support, Procurement support
- Site management (option) Site inspection and monitoring (option)
- Shop inspection and support for performance testing
- Additional expert services
New CHP Plant
Tolkkinen, Finland

Client
Porvoon Energia Oy

Plant description
Fuels: Biofuels
Output steam flow of the boiler (480 °C, 62 bar(a)): 15,2 kg/s
Boiler type: BFB

Capacity
12 MWₑ
38 MWₜₜ

Schedule
2011 - 2013

Main scope of services; EPCM contract
— Project management
— Plant design and engineering
— Procurement and Contractor’s supervision
— Site construction and commissioning management
Hämeenkyrön Voima Oy, CHP power plant

Client
Hämeenkyrön Voima Oy

Plant description
Brown field project replacing the existing GT+HRSG with bubbling fluidized bed boiler and solid fuel handling system

Capacity
- Thermal power of 88 MWth with steam parameters of 32 kg/s, 85 bar and 510 °C
- The fuel handling consist of fuel receiving stations, one sieving and crushing station, 2 x 1300 m³ storage silos and one fuel conveyor line to the boiler.
  The line capacity is 100-500 m³/h
- Electricity 16 MW
- Process steam to the existing paper mill (12 bar and 4.3 bar) and district heat to the adjacent town

Fuels
Forest residue, bark, stomp, milled peat, slurry

Schedule
2011-2012

Main scope of services
EIA, pre-engineering, full scope EPCM, including: project management, engineering, procurement, construction management
New CHP Plant in Haapaniemi, Finland

Client: Kuopion Energia Oy, Finland

Plant description: New CHP plant with a 46 MW turbine and generator, transformer. BFB boiler. Electrification, automation and DCS system, civil works, BoP and process equipment. Connection to 110kV grid and DH system

Capacity: 46 MW_e, 80 MW_th

Schedule: 2007 – 2011

Main scope of services; EPCM contract including:
- Project management
- Design review for AFRY scope
- Engineering support, Procurement support
- Site management (option) Site inspection and monitoring (option)
- Shop inspection and support for performance testing
- Additional expert services
Langerbrugge Paper Mill, Belgium

Client
Stora Enso Oyj, Germany

Plant description
CHP plant for the Langerbrugge paper mill

Capacity
$\text{MW}_{\text{th}}/40 \text{ MW}_e$
Multifuel CFB boiler, ST, new fuel handling systems and auxiliary systems

Schedule
2008-2010

Main Scope of Services
Implementation engineering for BOP area including:
- Process engineering
- Dynamic simulation study
- Procurement of BOP equipment
- Plant engineering
- Piping engineering
- Automation and instrumentation engineering
New CHP Plant, Fortum Termest, Pärnu, Estonia

Client
Fortum Termest, Estonia

Plant description
BFB Boiler. Fuels: Peat and bio-fuels
Steam flow of the boiler (118 bar(a), 527°C: 26.0 kg/s
Capacity
24 MWₑ, 45 MWₜₜ

Schedule
2008 – 2010

Main scope of services; EPCM contract
— Project management
— Plant design and engineering
— Procurement and contractor's supervision
— Site construction and commissioning management
New CHP Plant in Keljonlahti, Jyväskylän Voima Oy, Finland

**Client**  
Jyväskylän Voima, Finland

**Plant description**  
New CHP plant with peat, biomass and coal fired CFB boiler. The plant comprises total fuel handling system, 209 MW turbine and generator, transformer, switching yard.

**Capacity**  
130 MW_e  (208 MW_e)  
240 MW_th  (0 MW_th)

**Schedule**  
2007 – 2010

**Main scope of services; EPCM contract**  
- Project management  
- Design review for main equipment  
- Engineering, Procurement  
- Site engineering and management  
- Site inspection and monitoring  
- Shop inspection and support for performance testing  
- Additional expert services
New biomass fired CHP power plant
Kaukaan Voima Oy, Finland

Client
Kaukaan Voima, Finland

Plant description
One of the biggest biomass fired power plant worldwide. CFB boiler. Fuels: bark, chips, saw dust, sludge and other mill by-products, external forest biomass and peat. Power and process steam to the UPM-Kymmene Mill, power and district heat to the Lappeenranta Energy

Capacity
125 MW_e, 385 MW_th

Schedule
2007 – 2010

Main scope of services; EPCM contract
— Project management
— Procurement, Expediting, Permit applications
— Time scheduling
— Main detailed engineering
— Erection supervision
— Training, Start-up services and Commissioning
SCBI Bioethanol & CHP Power Plant, Philippines

Client: San Carlos Bioenergy Inc., Philippines

Plant description: The first fully integrated sugar cane ethanol and cogeneration power plant in Philippines. Cane mill capacity of 1,500 t/day, ethanol distillery with an output of 125,000 l/day. Power plant is fuelled by bagasse from the cane mill.

Capacity: 8 MWₑ


Main scope of services:
- Project Management Consultant and EPC Contractor for the Balance-of-Plant (civil works, buildings and foundations, cooling systems, electrical and C&I systems and mechanical interconnections)
VÄO CHP plant, OÜ Digismart, Estonia

Client: OÜ Digismart, Estonia

Plant description: BFB boiler; Fuels: Peat and bio-fuels; Production of electricity and district heat without process steam extraction

Capacity: 25 MW_e
50 MW_th


Main scope of services
EPCM contract:
— Project management
— Plant design and engineering
— Procurement and contractor's supervision
— Site construction and commissioning management
Tartu CHP plant, Fortum Tartu, Estonia

Client
Fortum Tartu, Estonia

Plant description
BFB boiler. Fuels: Peat and bio-fuels. Production of electricity and district heat without process steam extraction

Capacity
25 MW_{e}, 50 MW_{th}

Schedule
2007 – 2009

Main scope of services
EPCM contract:
— Project management
— Plant design and engineering
— Procurement and contractor’s supervision
— Site construction and commissioning management
Implementation of Biofuel Firing to CHP-2 Unit Vilnius Energija, Lithuania

Client Vilniaus Energija UAB, Lithuania

Plant description Conversion of an old gas fired boiler for biofuel. BFB retrofit of a Russian-made BKZ-75-39 FB boiler, including new fuel handling equipment, Automation & Electrification modernisation and new flue gas cleaning equipment. Fuels: forest residue, wood waste and peat

Capacity 24 MW_e, 76 MW_th

Schedule 2004 - 2005

Main scope of services
- Feasibility Study & Basic Design
- Environmental Impact Assessment
- Preparation of Tender and Contract Documents
- Evaluation of Tenders
- Preparation of Purchasing Contract Documents
- Project Management, Construction and Commissioning Supervision
A.T. Biopower
Pichit, Thailand

Client  A.T. Biopower Co., Ltd
Plant description  Rice husk fuelled power plant in Pichit province with an output of 22 MWₑ (gross) and 22 MWₑ (net).
Capacity  20 MWₑ
Schedule  2003 – 2005

Main scope of services
— Turnkey EPC delivery
— Overall project management
— Process engineering and technical integration
— Procurement of all mechanical equipment, electrical systems, I&C and control systems
— Detailed design for the entire plant
— Erection and installation, commissioning and performance testing of the complete power plant
BFB Boiler Plant in Kotka, Finland

Client  
Kotkan Energia, Finland

Plant description  
BFB boiler plant delivering city of Kotka with district heat and electricity. Fuels: Bark, wood chips, peat, RDF

Capacity  
12 MW_e  
45 MW_th

Schedule  
2002 - 2003

Main scope of services  
- EPC Turnkey delivery of boiler plant, incl. Fortum FB500 BFB boiler
Säteri power plant, Fluidized bed retrofit Finland

<table>
<thead>
<tr>
<th>Client</th>
<th>Fortum Power and Heat, Finland</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plant description</strong></td>
<td>Boiler retrofit to BFB technology. Fuels: Wood waste, process waste, sludge, coal. Steam flow 17 kg/s, Steam pressure 61 bar, steam temperature 500 °C</td>
</tr>
<tr>
<td><strong>Capacity</strong></td>
<td>Steam flow 17 kg/s</td>
</tr>
<tr>
<td><strong>Schedule</strong></td>
<td>1998 – 1999; 2004</td>
</tr>
</tbody>
</table>

**Main scope of services**
- Turnkey delivery EPC contractor
- In 2004 ÅF has consulted the Säteri plant with flue gas cleaning issues as well as prepared the documents for environmental licensing. Säteri had plans to incinerate MBM and RDF together with peat
Härnösand Bio CHP Plant, Sweden

Client
Härnösand Energi & Miljö AB, Sweden

Plant description
Fuels: Wood chips, forest residues, bark, saw dust, peat.
Steam flow: 52 t/h,
Pressure/Temp: 90/150 bar/°C.
Turbine by Alstom.
The flue gas condensing system produces additional 7.3 MW district heat

Capacity
17.7 MWₑ
33 MWₜ₉ (total)

Schedule
2000 - 2002

Main scope of services
— EPC Turnkey delivery (excl. civil works), incl. BFB boiler
Salo Power Plant, Finland

<table>
<thead>
<tr>
<th>Client</th>
<th>Voimavasu Oy, Finland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant description</td>
<td>Improvement of efficiency and reduction of emissions at Salo Power Plant. Fuels: Peat, wood chips, wood waste</td>
</tr>
<tr>
<td>Capacity</td>
<td>11 MW&lt;sub&gt;e&lt;/sub&gt;, 22 MW&lt;sub&gt;th&lt;/sub&gt; process steam, 23 MW district heat</td>
</tr>
<tr>
<td>Schedule</td>
<td>1999 - 2000</td>
</tr>
</tbody>
</table>

**Main scope of services**
- Feasibility studies
- EPCM services
  - Project management
  - Time scheduling, budgeting
  - Procurement, design
  - Supervision of deliveries
  - Erection and commissioning
Choices that make a difference
SUSTAINABILITY AT AFRY

Responsible Business

To accomplish our vision, AFRY must be a reliable partner to our stakeholders, conduct business according to high ethical standards and make sure that sustainability is at the heart of everything we do.

AFRY is signatory to the UN Global Compact and has adopted the 10 principles within the fields of human rights, labour, environment and anti-corruption.