Flexicycle™ power plants

Unique operational flexibility with optimum combined cycle efficiency
Combining the advantages of a flexible simple cycle plant with the superb efficiency of a combined cycle plant

The Wärtsilä Flexicycle™ power plant solution provides the flexibility needed to facilitate the integration of renewable energy. As the share of intermittent renewable energy increases in the power market, fast load-following power is needed to maintain system reliability.

The Flexicycle power plant, supported with lifecycle services, is both agile and highly efficient, which enables competitive performance on both the energy and capacity markets. The combination of flexibility and efficiency makes Flexicycle power plants ideally suited for grid system load following. Depending on the power system, Flexicycle power plants can also be the best choice for efficient flexible baseload power generation. It is a perfect solution for both municipal power generation and for the larger utility market.

Traditionally, baseload generation capacity has consisted of large, centralised coal and/or nuclear power plants alongside combined cycle gas turbine (CCGT) plants, with extended ramp-up and ramp-down times. The intermediate load is often handled by combined cycle gas turbines, while the reserve and peaking capacity is often based on smaller, less efficient generating units, which are expensive to operate.

The Flexicycle power plant solution makes the concept of using different dedicated power plant technologies for different load ranges and operation profiles obsolete. It can operate both in highly efficient combined cycle mode as well as in dynamic and fast simple cycle mode.

Flexibility in fuel choice

The Flexicycle solution is based on a gas, multi-fuel, or liquid fuel power plant in combination with a steam turbine combined cycle. The fuel flexibility of our solutions enables the choice and utilisation of the most feasible fuels, including natural gas and many other gases, as well as most fuel oils. The customer can also choose to run their plant on multiple fuels.

![Comparison between CCGT and Wärtsilä Flexicycle plants: impact of two starts per week/100 per year to the plant net efficiency, CCGT 47.2% vs Flexicycle plant 48.7%](image)

![Levelised cost of electricity comparison on 6000 running hours & 100 annual starts. Wärtsilä Flexicycle is outperforming the CCGT plant in the intermediate operation. The higher on-site efficiency is resulting in lower fuel costs. Savings with Wärtsilä gas engine power plant 8 $/MWh, approximately 4.7 MS per year.](image)
Proven engine technology

Wärtsilä has to date supplied customers in 177 countries with 70 GW of installed power plant capacity (of which 250 installations/12 GW are under long-term service agreements) and more than 11,000 engine generating sets. The engine generating sets used in our power plants are driven by medium-speed four-stroke internal combustion engines (ICEs). These heavy-duty generating sets consist of an engine connected directly to a generator via a flexible coupling. The generator and engine are mounted on a common base frame.

Each engine is equipped with a waste heat recovery steam generator. The power plant has a common steam turbine with a condenser. The power plant cooling is typically arranged so that the ICEs are cooled with closed loop radiators, and the steam cycle with radiators, a cooling tower, raw water or an air cooled condenser.

The combination of flexibility and efficiency

The Flexicycle solution combines the advantages of a flexible simple cycle plant with the superb efficiency of a combined cycle plant in a unique way. The combined cycle mode, with an optimum efficiency in excess of 54%, is ideal for baseload operation. In the Flexicycle concept, the dynamic features of simple cycle combustion engines are maintained as the steam production can be turned on and off individually for each generating set.

With quick synchronisation and start-up to full engine power in less than five minutes, without restrictions or impact on maintenance schedules, the Flexicycle plants can be dispatched immediately when an imbalance between supply and demand begins to occur.

The multi-unit design of ICE power plants offers optimised flexibility for dynamic load following with independent units, high efficiency at any plant load (by switching units on and off), as well as optimised plant sizing throughout the lifecycle.
Two-in-one
The Flexicycle power plant solution’s two-in-one characteristic makes it a very competitive solution for handling a grid system’s intermediate load. Thanks to its high combined cycle efficiency, the Flexicycle power plant can also be the best choice for flexible baseload generation, depending on the power system’s capacity mix. Features such as fast synchronisation and ramp times, as well as the flexibility of multiple independent units, make these power plants outstandingly well suited to supporting grid systems that require flexibility because of daily load fluctuations, or that have a significant installed base of wind or other non-dispatchable power.

Flexicycle™ with radiators
The Flexicycle with radiators solution reduces the acquired footprint of the power plant by placing the entire cooling system on the roof. A Flexicycle power plant with radiators is particularly well suited for cold and moderate climate conditions.

Features and benefits
- Smaller plant footprint
- Early power – the plant can be started by running it in open cycle mode, thus generating revenue while the combined cycle system is still under construction
- No or minimal water consumption
- Maximum efficiency over a wide load range
- Decentralised production
- High reliability
- Superb load-following ability
- Reduced environmental footprint
- Easy plant operation
## Selected references

### YAMAMA CEMENT, SAUDI ARABIA
- **Customer**: Yamama Cement Company (Industrial)
- **Type**: Wärtsilä 50DF Flexicycle power plant
- **Operating mode**: Baseload
- **Gensets**: 10 x Wärtsilä 18V50DF
- **Total output**: 161 MW
- **Fuel**: Natural gas & LFO and crude oil (back-up fuels)
- **Scope**: EPC (Engineering, Procurement & Construction) delivery, a 5-year Operation and Maintenance Management and a 10-year Spare Parts Supply solution
- **Delivery**: 2019

### HUINALA, MEXICO
- **Customer**: Energía del Caribe, S.A.(IPP)
- **Type**: Wärtsilä 50SG Flexicycle power plant
- **Operating mode**: Baseload
- **Gensets**: 7 x Wärtsilä 50SG
- **Total output**: 140 MW
- **Fuel**: Natural gas
- **Scope**: EPC (Engineering, Procurement & Construction) and a 10-year O&M (Operations and Maintenance) solution
- **Delivery**: 2016

### QUISQUEYA I & II, DOMINICAN REPUBLIC
- **Customer**: Barrick (mining) + EGE Haina (utility)
- **Type**: Flexicycle 50DF multi-fuel power plant
- **Operating mode**: Flexible baseload
- **Gensets**: 2 x 12 x Wärtsilä 18V50DF
- **Total output**: 430 MW
- **Fuel**: Natural gas, HFO & LFO
- **Scope**: EPC (Engineering, Procurement & Construction)
- **Delivery**: 2012 & 2013

### SEABOARD, DOMINICAN REPUBLIC
- **Customer**: Seaboard Corporation (IPP)
- **Type**: Flexicycle 50DF multi-fuel power plant
- **Operating mode**: Flexible baseload
- **Gensets**: 6 x Wärtsilä 18V50DF
- **Total output**: 110 MW
- **Fuel**: Natural gas, HFO & HFO
- **Scope**: EPC (Engineering, Procurement & Construction)
- **Delivery**: 2012

### LIBERTY POWER TECH, PAKISTAN
- **Customer**: Liberty Power Tech (IPP)
- **Type**: Flexicycle 46 liquid fuel power plant
- **Operating mode**: Baseload
- **Gensets**: 11 x Wärtsilä 18V46
- **Total output**: 200 MW
- **Fuel**: HFO & LFO
- **Scope**: EPC (Engineering, Procurement & Construction)
- **Delivery**: 2011
FEATURES AND BENEFITS

- Two operating modes: dynamic simple cycle and highly efficient combined cycle
- Combined cycle operation extends the plant’s electrical efficiency past 54%, whereas in simple cycle 50% can still be exceeded, thus providing even further operational flexibility.
- Early power – commercial operation in single cycle mode
- Quick start and shut down, fast ramp-up capability without restrictions or influence on maintenance schedules and costs.
- Low water consumption
- Compliance with the strictest international and local emissions legislation.
- Proven EPC track record and plant performance
- Fuel conversion capability
- Capability to operate on different electricity markets (energy, capacity & ancillary services)
- More running hours due to higher rank in merit order
- Lifecycle performance guarantees
- Fuel savings
- Predictable operation and maintenance costs

Project execution

Wärtsilä has the resources and capabilities to fulfill contracts ranging from engineered equipment delivery (EEO) to complete turnkey projects including engineering, procurement and construction (EPC). We have a proven track record having completed 4900 projects in 177 countries.

With experienced and certified project execution personnel and more than 30 years of experience in delivering complex projects around the world, Wärtsilä understands the requirements for power plant projects and is fully capable of handling and managing the complete range of contracting arrangements.

Capabilities:
- Inter-disciplinary team of more than 250 project managers and project engineers with 100+ PMI-certified professionals.
- Certified HSE Management System OHSAS 18001 & ISO 14001
- Quality Management System ISO9001
- Proven engineering solutions and reliable engineering partners
- Modern and efficient project systems and collaboration tools
- Efficient procurement and logistics processes and a well-established global supply chain
- Experienced construction management and commissioning teams of 400+ engineers
- Qualified sub-contractors and sustainable construction methodology.
Our range of services covers everything from rapid spare parts delivery to complete long-term operation and maintenance solutions. By optimising all aspects of the power plant’s operations and minimising the economic and technological risks involved, we ensure the plant’s performance and competitiveness.

Wärtsilä operates and maintains power plants for customers such as independent power producers (IPP), captive power plant operators, and baseload plant owners. These solutions are also suitable for balancing power plants, peaking/intermediate plants and utilities. The aim is always to maximise the productive lifetime of the installation and optimise the return on investment. The solution is always customised to meet the specific needs and operating profile, including for example, performance and lifecycle cost guarantees.

Wärtsilä has more than 1000 marine and land-based installations (more than 30 GW) under long-term service agreements around the world.

For self-operating customers there is also the best possible support available – from long-term service agreements to maintenance and spare parts, or plant modernisation and upgrading.

Our global services network of 11,000 professionals provides services and support for our customers, anywhere at any time. This ensures that the power station will operate at its highest efficiency and performance levels throughout its life.

**Guaranteed asset performance**

Guaranteed asset performance is a lifecycle solution whereby Wärtsilä guarantees the reliability and availability of the power plant at a fixed cost. Customers can manage the operations while outsourcing the maintenance and its management to Wärtsilä.

The onsite support engineer, online data, and remote monitoring enable advanced support and immediate response from Wärtsilä’s experts to ensure the reliable operation of the power plant.

**Lifecycle upgrade solution**

Wärtsilä’s Flexicycle Upgrade solution minimises the ecological footprint and maximises the efficiency of existing simple cycle power plants. This solution improves power plant efficiency by up to 10% by producing additional electricity using waste energy from the exhaust gas. By implementing the Flexicycle Upgrade solution, heavy industries with large amounts of waste heat can achieve very high power efficiency while lowering the emissions per MWe produced.
Wärtsilä Energy Business is leading the transition towards a 100% renewable energy future. As an energy system integrator, we understand, design, build and serve optimal power systems for future generations. Wärtsilä’s solutions provide the needed flexibility to integrate renewables and secure power system reliability. Our offering comprises engine-based flexible power plants – including liquid gas systems – hybrid solar power plants, energy management systems and storage and integration solutions. We support our customers over the lifecycle of their installations with services that enable increased efficiency and guaranteed performance. Wärtsilä has 70 GW of installed power plant capacity in 177 countries around the world.