EXTERNAL

ABB INDUSTRIAL AUTOMATION POWER GENERATION & WATER

ABB Ability™ Performance Optimization for power generation

Reduce fuel costs & emissions, manage maintenance risks, expand revenue opportunities

Maintain peak performance in any market

ABB Ability™ Performance Optimization for power generation

Agenda

- Addressing the needs of steam power plant customers
- Scope of the offering
- Success cases
- Key value propositions
- Value calculator
- Delivery model

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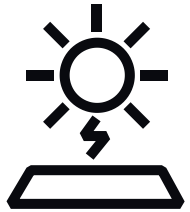
Customer pain points

The key challenges faced by steam power plant customers

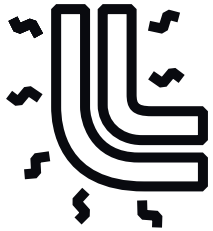
Reduced power prices & dispatch

- Less operating hours due to “must run” renewables, cheap natural gas, emissions concerns
- Resulting in lower earnings, which impacts OpEx and CapEx budgets, effecting the opportunity for performance improvements and successful maintenance



Reliability & Availability due to cycling

- Increased cycling causing additional stress and fatigue in critical components, just as budgetary pressures are cutting into non-critical maintenance and monitoring
- Reduced revenues if units are not capable to reliably operate more dynamic load schedules (faster startup/shutdown, increased ramp rates, etc.)



Transitioning workforce

- Lack of seasoned professionals with “institutional knowledge” for operating specific equipment due to retirements
- Younger, more mobile workforce

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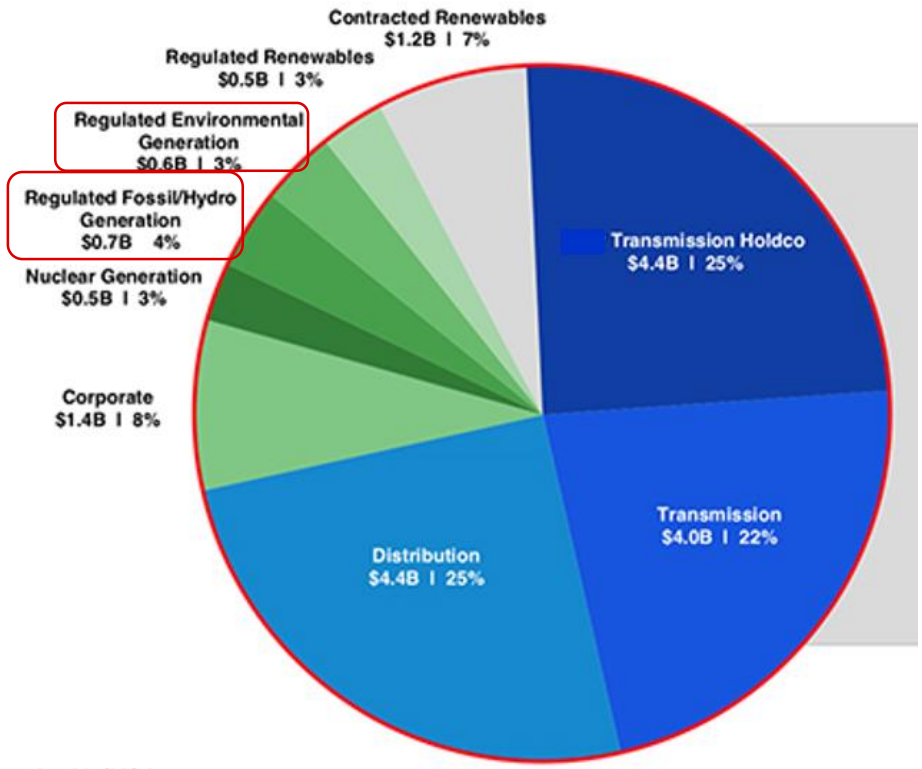
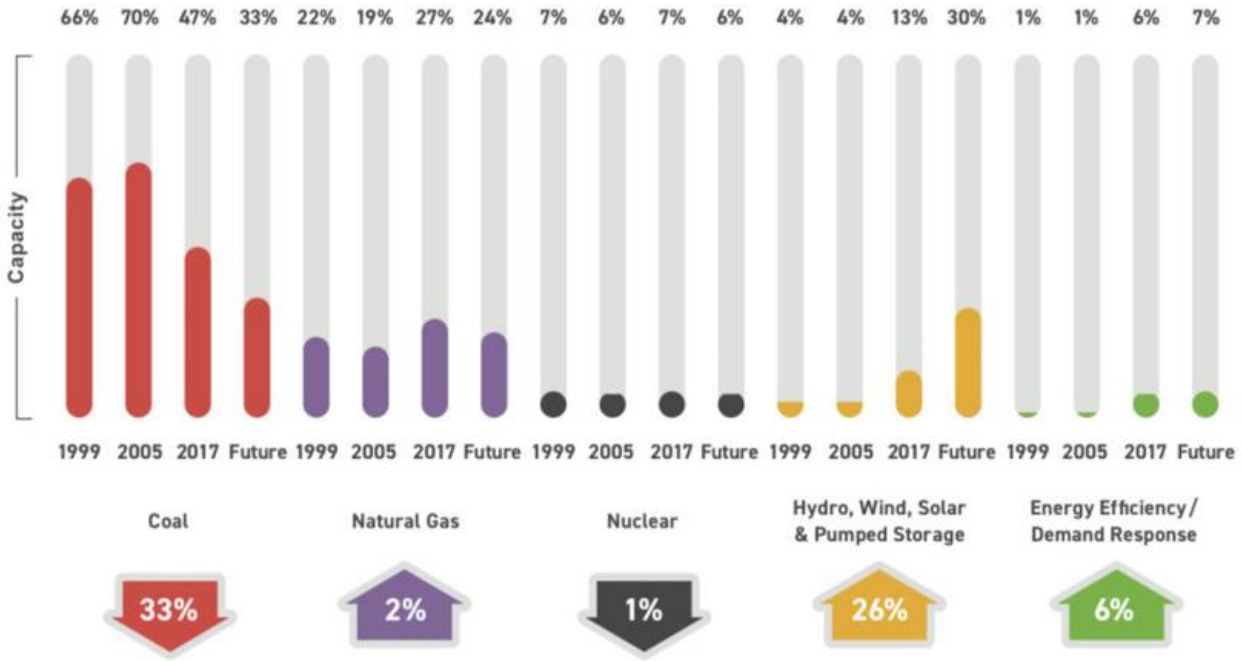
Facing accelerating change & complexity

Example

Consolidated capital forecast ($17.7B)



Changing portfolio



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 Source: AEP

Facing accelerating change & complexity

How to gain a competitive advantage?

Challenge	Response
Reduced prices & dispatch	Increase thermal efficiency, reducing fuel costs while increasing sales to ancillary markets
Reliability & Availability due to cycling	Ramp up faster & more repeatable without increasing thermal stress (and maintenance impact) on equipment
Transitioning workforce	Reduce operator variability and potential maintenance impacts by optimizing operations across the fleet

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ABB Ability™ Performance Optimization for power generation

A suite of advanced applications for steam power plants that leverage closed-loop control and optimization to improve thermal efficiency, reduce emissions and expand ramp rates.

ABB Ability™ Performance Optimization for power generation

Consists of two offerings

Offering	Application	Description
1 **Thermal efficiency improvement and emissions reduction**	**Combustion Optimization**	Model-based advanced process control to minimize combustion air, maintain or reduce emissions levels, and improve thermal efficiency. It balances the need for lower emissions and high boiler efficiency.
	Sootblowing Advisory	Model-based advisory to optimize sootblowing to the actual operating conditions, maximizing overall boiler efficiency. It also determines the cleanliness of individual boiler sections which can be visualized in operator screens and used for monitoring purposes.
2 **Increased ramp rate bands**	**Steam Temperature Optimization**	Model-based advanced process control of live-steam and re-heated steam temperatures to allow higher steam temperature setpoints without increasing stress on critical components. This allows power plants to respond faster to rapid load ramps.

Thermal efficiency improvement and emissions reduction

With Combustion Optimization

What does it do for our customers? *

Increases unit fuel efficiency by as much as 0.3% without increasing emissions

Reduces NOx emissions by as much as 15%

Reduces CO2 emissions by as much as 20’000 tons/year

Reduces operating variability given boiler disturbances, fuel variations, or operation staff experience level

Expands operational envelope by using dynamic models that reflect real and forecasted plant conditions

How is it supplied to our customers?

The application is typically provided as a standalone application installed on an on-site industrial workstation/server

ABB application engineer commissions hardware (ABB or customer provided) and software

The application interfaces to the control system setpoints and the real-time process data (using a standard interface)

What is included?

The application includes the capability to optimize combustion control and to automate combustion control actuators that are normally controlled manually though the control system

The application also includes the capability to improve heat rate while simultaneously lowering emissions

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(*) For a typical 600MW coal-fired boiler.

Thermal efficiency improvement and emissions reduction

With Sootblowing Advisory

What does it do for our customers? *

Increases unit fuel efficiency by as much as 0.2%

Reduces CO2 emissions by as much as 10’000 tons/year

Reduces risk of forced outage due to plugged flue gas passages

Reduces tube erosion due to excessive sootblowing

How is it supplied to our customers?

The application is typically provided as a standalone application installed on an on-site industrial workstation/server

ABB application engineer commissions hardware (ABB or customer provided) and software

The application interfaces to the sootblowing control system or PLC, as well as to real-time process data through the control system (using standard interfaces)

What is included?

The software application monitors cleanliness parameters and fouling and uses a thermodynamic model to optimize heat transfer recovery within the boiler vs. energy consumed by sootblowing equipment

The software application monitors sootblowing sequences and provides recommendations for when to perform the next sootblowing sequence

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(*) For a typical 600MW coal-fired boiler.

Case study: Publicly Owned Utilities

Thermal efficiency improvement and emissions reduction

For the fleet of 10 units, average fuel savings are $7M/year and emissions are reduced by a total of 250'000 tons/year of CO_2 and 10% of NO_x.

CHALLENGE

A fleet owner of 10 x 600 MW steam power plant units faces:

- **Increasing emissions requirements and associated abatement costs.**
- **Increased competition from combined cycle units and less opportunities to run.**
- **Concerns from retirements of more expert operators and less consistent operations**

ABB SOLUTION

- Closed-loop control upgrades that provide consistent operations with improved thermal efficiency and reduced emissions.
- Reduces forced outage risk due to plugged flue gas passages and tube erosion.
- The package supports operators by ensuring optimized combustion and sootblowing operations to reduce variance in operations and risk of increased thermal stresses.

BENEFIT

1. Increases boiler efficiency.
2. Minimizes cost of sootblowing.
3. Reduces maintenance cost.
4. Reduces plant carbon footprint.

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(*) For typical 600MW coal-fired boilers.

Increased ramp rate bands

With Steam Temperature Optimization

What does it do?

Reduces stress and fatigue in boiler/turbine thick-walled components

Contributes to increased plant fuel efficiency

Increases ramp rate by as much as 5MW/min with tighter set point following

Reduces power generation overshoot or undershoot by as much as 2MW

How is it supplied?

The application is typically provided as a standalone application installed on an on-site industrial workstation/server

ABB application engineer commissions hardware (ABB or customer provided) and software

The application interfaces to the control system setpoints and the real-time process data (using a standard interface)

What is included?

The application includes model-based control to increase steam temperatures and move closer to design limits

The application also includes predictive control to reduce excessive spray valve movement and minimize temperature excursions around the set point

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(*) For a typical 600MW coal-fired boiler.

Case study: Investor Owned Utilities

Increased ramp rate bands

By increasing participation in the ancillary services market, the plant has been able to increase revenues by $419'000 per year and sell additional 2MW/minute of ramping totaling 400 hours per year.

CHALLENGE

- In the shoulder periods, an operator of a 600 MW steam power plant runs less, while renewables operate more hours in its market area.
- **While generation markets have been depressed, the operator has the opportunity to increase its participation in the ancillary services market.**

ABB SOLUTION

- Steam Temperature Optimization regulates live-steam and re-heat steam temperatures with higher precision, through model-based control.
- This allows the plant to be run closer to the design limits (at higher steam temperature) and to respond faster to changing load requirements.

BENEFIT

1. Faster startup when requested by load dispatcher.
2. Enhanced ability to follow load demand.
3. Accelerated ramp rates to targeted setpoints.
4. Indirect reduction of emissions and fuel cost.

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(*) For a typical 600MW coal-fired boiler.

Delivery option: ABB Ability™ Collaborative Operations

Provide the necessary competence network and support to customers

Features

- ✓ Connects production facilities fleet-wide with enterprise headquarters & ABB worldwide Collaborative Operations Centers
- ✓ Provides access to ABB experts for troubleshooting and process optimization assistance
- ✓ Remote monitoring of software applications and process KPIs
- ✓ Benchmarking and analytics

Benefits

- ✓ People and organizations are connected.
- ✓ Correct and consistent information is available to all collaborative partners
- ✓ Continuous collaboration with domain and products experts
- ✓ Recommendations are implemented and validated faster
- ✓ Insights are gained through access to fleet data
- ✓ Joint development projects are more efficient

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ABB Ability™ Performance Optimization for power generation - at a glance

Network topology

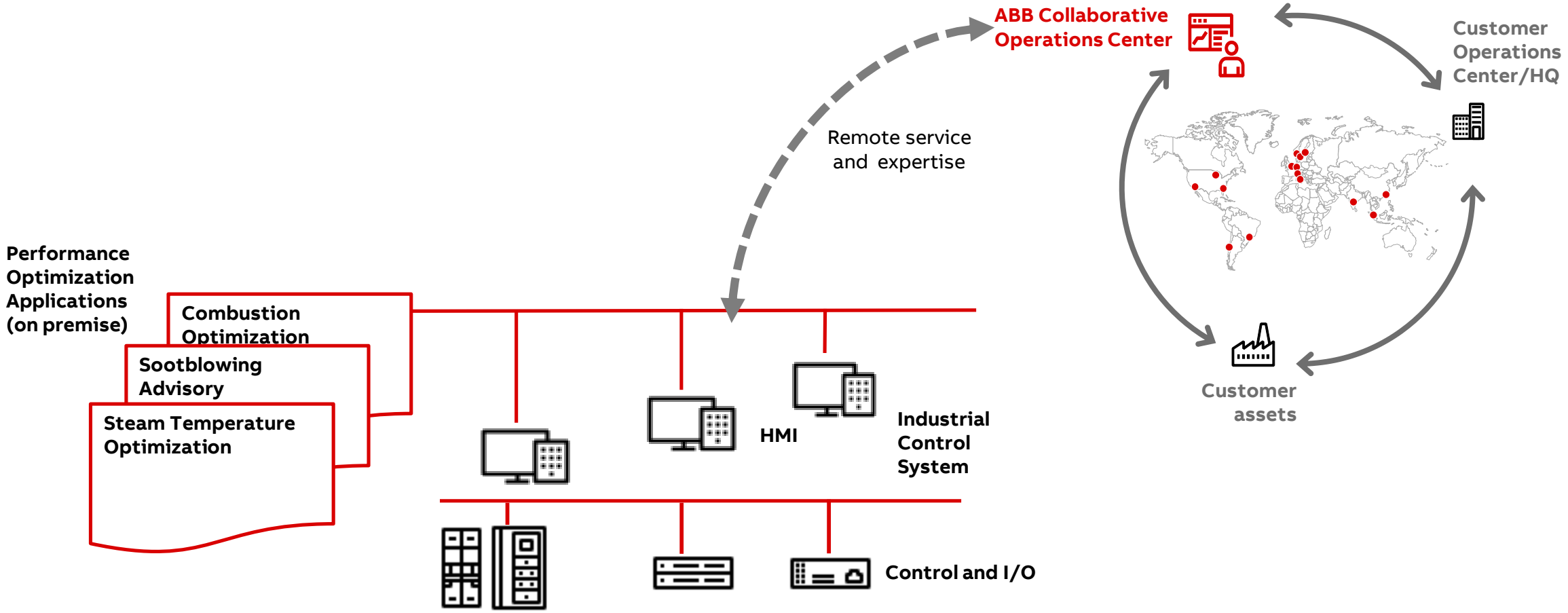

ABB Ability™ Performance Optimization for power generation

Value propositions

Target customers

Key value propositions

Regulated Utilities

- Lower rates for end customers
- Reduced environmental impact
- Improved ramping capability for greater reliability, and renewables can more easily be added to the grid
- Optimized O&M costs
- Minimized operator variability and associated risk of accelerating maintenance costs and intervals

Independent Power Producers (IPP)

- Improved market position and revenues through increased thermal efficiency
- Increased ancillary service revenues through better load ramp rates
- Minimized operator variability and associated risk of accelerating maintenance costs and intervals

Industrial Power Producers (INPP)

- Decreased costs of goods sold by minimizing electricity costs while reducing emissions
- Helps meet corporate goals for energy efficiency & reduced environmental impact
- Reduced operator variability and risks of unexpected maintenance expenditures

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ABB Ability™ Performance Optimization for power generation

Customer value calculator

Customer name	myCustomer		
Industry	Power Generation		
Site name	myUnit		
Country	myCountry		
Customer's email contact info	first.last@company.com		
Unit Nameplate Capacity (MW)	600		
Fuel Type (Oil, Gas, Coal Type: PRB, Lignite, Bituminous, Anthracite, etc.)	Coal		
Fuel Cost: Euro/GJ --> **[Euro/MWh_th] --> [Euro/MWh_el]**	€ 3.14	€/MWh_th **€ 11.30**	€/MWh_el **€ 28.26**
Plant type: Water/Steam, CHP, INPP, WTE,...	Water/Steam Boiler SuperCrit		
Nominal Unit Heat Rate: kJ/kWh = GJ/GWh --> **[Unit Efficiency %]**	9'000	Unit Efficiency **40.0%**	
Unit Capacity Factor (between 0.10 and 0.95)	0.65		
Average Power Sales Price (Euro/MWh)	€ 55		
Operating hours a day	24		
Operating days a year	325		
Unit startups per year	50		
Annual production hours	7'800		
Approximate cost of fuel/energy consumed (% of production revenue)	51%		
Approximate cost of other materials consumed (% of production revenue)	7.0%		
Emissions cost per tons SO2	€ 1'200		
Emissions cost per tons CO2	€ 15		
Emissions cost per tons NOx	€ 500		
Exchange rate (Euro to USD)	$1.20	USD/Euro	
Ancillary services			
Current Ramp Rate	8	MW/min	
Minimum ramp-down load	200	MW	
Number of ramps per day between min & max load	2		
Ramp Rate Price	€ 31	€/MWh	

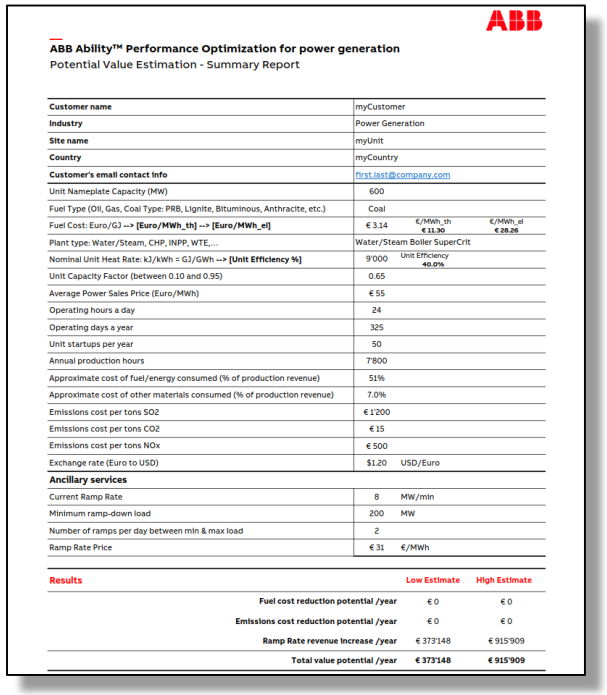

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ABB Ability™ Performance Optimization for power generation
Potential Value Estimation - Summary Report

Customer name	myCustomer		
Industry	Power Generation		
Site name	myUnit		
Country	myCountry		
Customer's email contact info	first.last@company.com		
Unit Nameplate Capacity (MW)	600		
Fuel Type (Oil, Gas, Coal Type: PRB, Lignite, Bituminous, Anthracite, etc.)	Coal		
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Results	Low Estimate	High Estimate
Fuel cost reduction potential /year	€ 0	€ 0
Emissions cost reduction potential /year	€ 0	€ 0
Ramp Rate revenue increase /year	€ 373'148	€ 915'909
Total value potential /year	**€ 373'148**	**€ 915'909**

Results	Low Estimate	High Estimate
Fuel cost reduction potential /year	€ 0	€ 0
Emissions cost reduction potential /year	€ 0	€ 0
Ramp Rate revenue increase /year	€ 373'148	€ 915'909
Total value potential /year	**€ 373'148**	**€ 915'909**

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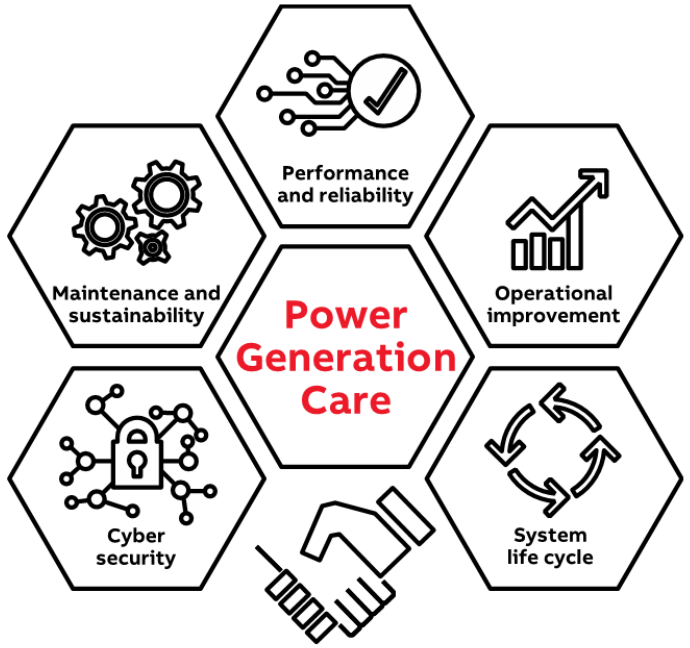
Delivery model



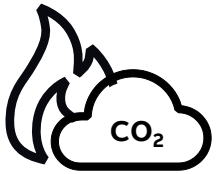
Through a Power Generation Care contract:

- **Perpetual license:** software sold conventionally as a perpetual license with an up-front investment and a yearly maintenance fee, plus support services
- **SaaS:** annual subscription fee plus optional support services

ABB Ability™ Performance Optimization for power generation

Key take-aways

Suite of advanced applications for steam power plants that leverage closed-loop control and optimization to:



Improve thermal efficiency & reduce emissions

Expand ramp rates

… burn less fuel, generate more cleanly, and sell ancillary services.

Why ABB?

- As the global leader in DCS to the power industry, we understand your needs and your markets
- With over 40 years of experience in developing digital solutions, ABB understands the convergence between IT, OT, and operations
- ABB invests heavily upfront to define the challenges and success criteria to build a business case to support your digital investments
- Together, we determine the capabilities that will meet your needs, starting with an assessment

ABB