



Reliable Solar **Steam** for a Clean Power Boost

AREVA Solar


AREVA

Solar Steam Augmentation

Clean Energy for Coal- and Combined-Cycle Gas Power Plants



In today's evolving carbon market, power producers seek energy solutions that decrease emissions while enhancing their competitive advantage. AREVA's innovative solar steam generator design does just that.

Our experienced management team, leading engineers, superior technology, and volume production capacity lead to direct saturated and superheated steam generation tailored to meet your unique energy needs. Existing coal- and gas-fired power stations can deploy our solar steam generators to deliver reliable, emissions-free steam that increases plant output, lowers carbon emissions, and provides a hedge against volatile fuel prices.

Market-Ready

For coal stations, AREVA's solar system can replace the extraction steam used for feedwater heating with solar steam from our reliable, land-efficient solar steam generators. The steam that is not extracted can continue expanding through the steam turbine and produce more electricity without increasing plant emissions.

Existing gas-fired, combined-cycle facilities can readily mix AREVA's solar-generated steam with the power plant's intermediate pressure (IP) evaporator or cold reheat steam. The solar steam enables the turbine to produce additional electricity without additional fuel.

Powerful Performance

The AREVA solar steam generator delivers more peak energy per acre than any other solar technology. When used for augmentation, solar steam can lead to significant improvements in overall plant performance.

For mid- to large-scale coal-fired power stations and combined-cycle gas-fired power stations, the installation of an AREVA solar field can increase electrical output by approximately 5 percent during peak demand. For combined-cycle gas-fired power stations, it can provide a 200 to 250 Btu/kilowatt-hour heat rate improvement at peak boost.

The improved performance is also extremely reliable. AREVA is the first and only solar steam power boiler manufacturer to receive the American Society of Mechanical Engineers' "S" Stamp Certificate of Authorization – the industry hallmark for acceptance and certification. The company also has received the National Board Certificate of Authorization "NB" to register its solar boilers.

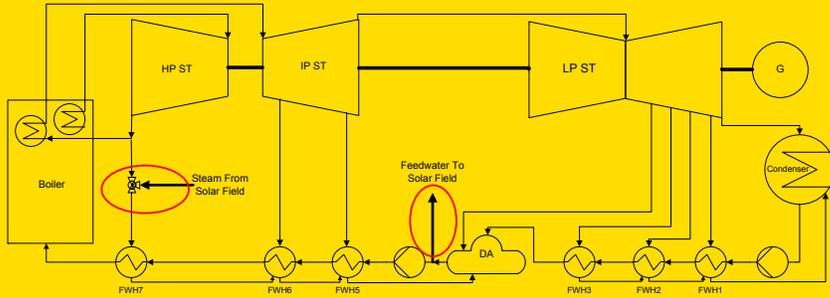
Reduced Emissions

As governments create more incentives for reduced emissions, the AREVA system increases in value by helping power producers reduce carbon costs and generate emission reduction credits. Adding steam from the sun provides carbon-free electricity during peak periods, while the daily operational profile of AREVA's solar steam generator reduces air emissions when air quality improvements are needed most – during peak summer demand hours.

Areva Solar Steam

Our Compact Linear Fresnel Reflector (CLFR) technology uses flat mirrors that track the sun, reflecting solar heat onto boiler tubes to raise steam without the costs and emissions of fossil-fired boilers. By providing a hedge against rising fuel and emissions costs, solar steam can play an important role in your integrated sustainability strategy for fuel and carbon market risk reduction.

+ Coal-Fired Augmentation



Example Of Coal-Fired Performance ⁽¹⁾

(#6 HP Feedwater Heater; 55-Acre Footprint)

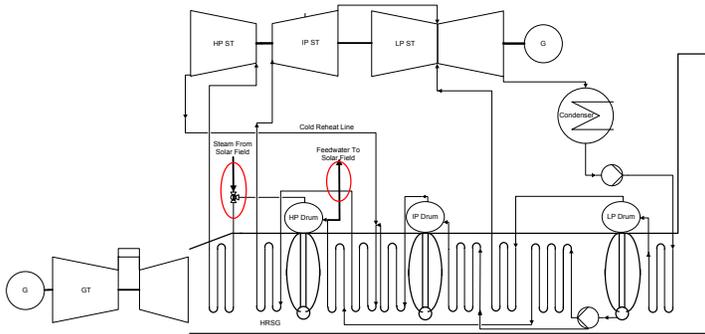
- Name plate Rating:** 450 MWe
- Steam Supply Pressure:** 725 psia
- Steam Supply Temperature:** 698 F
- Steam Supply Enthalpy:** 1,342 Btu/lb
- Annual Thermal Energy:** 326,750 MMBtu
- Gross Annual Electrical Energy:** 31,600 MWhe
- Peak Gross Electricity Boost:** 23.5 MWe
- Annual Avoided CO₂ Emissions:** 29,500 - 1,725,000 Tons ⁽²⁾

(1) 250F feedwater, Phoenix TMY2 weather and radiation data, 33% gross conversion efficiency; no clipping to solar field output due to plant limitations.

(2) Assumes original plant output maintained by reducing fuel input.

+ Combined-Cycle Gas-Fired Power Augmentation

→ INTEGRATION CONCEPT: OPTION 1 HP BOOSTER SCHEMATIC



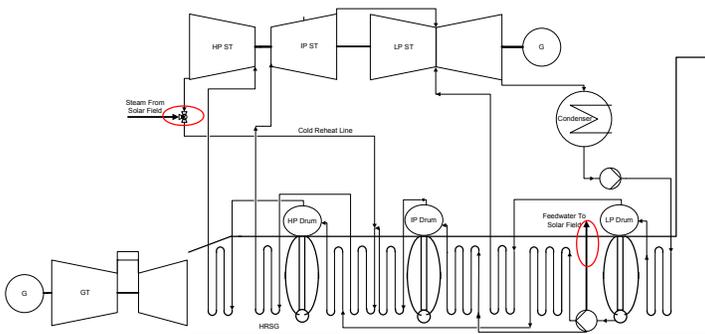
Combined-Cycle Performance ⁽¹⁾

(F-Class 2 on 1 configuration; 55-acre footprint; superheated steam to HP Drum Outlet)

- Name Plate Rating:** 500 MWe
- Steam Supply Pressure:** 1,813 psia
- Steam Supply Temperature:** 622 F
- Steam Supply Enthalpy:** 1,149.8 Btu/lb
- Annual Thermal Energy:** 360,977 MMBtu
- Gross Annual Electrical Energy:** 42,317 MWhe
- Peak Gross Electricity Boost:** 30.4 MWe
- Annual Avoided CO₂ Emissions:** 21,500 Tons

(1) 554F feedwater, Phoenix TMY2 weather and radiation data, 40% gross conversion efficiency; no clipping to solar field output due to plant limitations.

→ INTEGRATION CONCEPT: OPTION 2 CRH BOOSTER SCHEMATIC



Combined-Cycle Performance ⁽¹⁾

(F-Class 2 on 1 configuration; 55-acre footprint; superheated steam to cold reheat (CRH) line)

- Name Plate Rating:** 500 MWe
- Steam Supply Pressure:** 725 psia
- Steam Supply Temperature:** 698 F
- Steam Supply Enthalpy:** 1,342 Btu/lb
- Annual Thermal Energy:** 372,744 MMBtu
- Gross Annual Electrical Energy:** 40,419 MWhe
- Peak Gross Electricity Boost:** 28.5 MWe
- Annual Avoided CO₂ Emissions:** 20,200 Tons

(1) 320F feedwater, Phoenix TMY2 weather and radiation data, 37% gross conversion efficiency; no clipping to solar field output due to plant limitations.

→ SOLAR STEAM AUGMENTATION

Size	>8 MWe
DNI	>5.5 Kwh / m ² / day preferred
Wind	<90 miles per hour / <145 km per hour
Solar Steam Supply Temperature	Up to 842°F (450°C)
Solar Steam Supply Pressure	Up to 2,400 psia (165 bara)

AREVA supplies solutions for carbon-free power generation. Its expertise and know-how in this field are setting the standard, and its responsible development is anchored in a process of continuous improvement.

As the global nuclear industry leader, AREVA's unique integrated offer to utilities covers every stage of the fuel cycle, nuclear reactor design and construction, and related services. The group is also expanding considerably in renewable energies – wind, solar, bioenergies, hydrogen and storage – to be one of the top three in this sector worldwide in 2012.

Every day, AREVA's 50,000 employees cultivate the synergies between these two major carbon-free offers, helping to supply safer, cleaner and more economical energy to the greatest number of people.

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AREVA SOLAR

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