AREVA Solar Overview

Tom DePonty –Director, Government Affairs
United States Energy Association
May 16, 2012

AREVA

Table of Contents

AREVA offers one-stop-shop solutions for carbon-free power generation

World leader in nuclear power and major player in renewable energy

Bioenergy Power Generation

More than 100 bioenergy plants built by AREVA worldwide

2800 MWe

Offshore Wind Power Generation

250 AREVA wind turbines chosen for use in offshore wind parks in Europe

1200 MWe

Concentrated Solar Thermal

Most cost-effective, utility-scale turnkey concentrated solar power (CSP) solution

Over 500 MWe in operation, construction and advanced development

Hydrogen & Storage

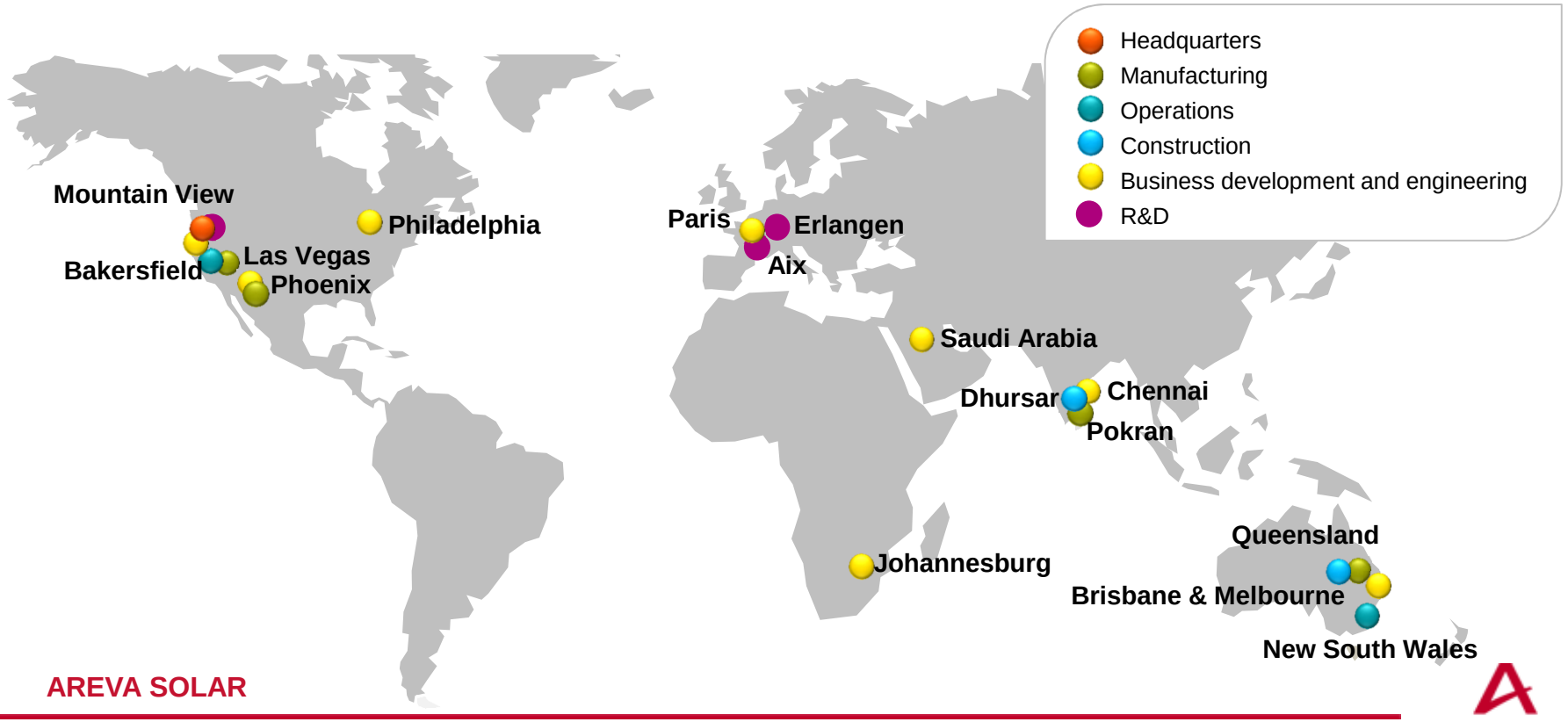
Energy Storage solutions with GreenergyBoxTM and Myrte fuel cell system

100 kWe

Source: AREVA

AREVA Solar

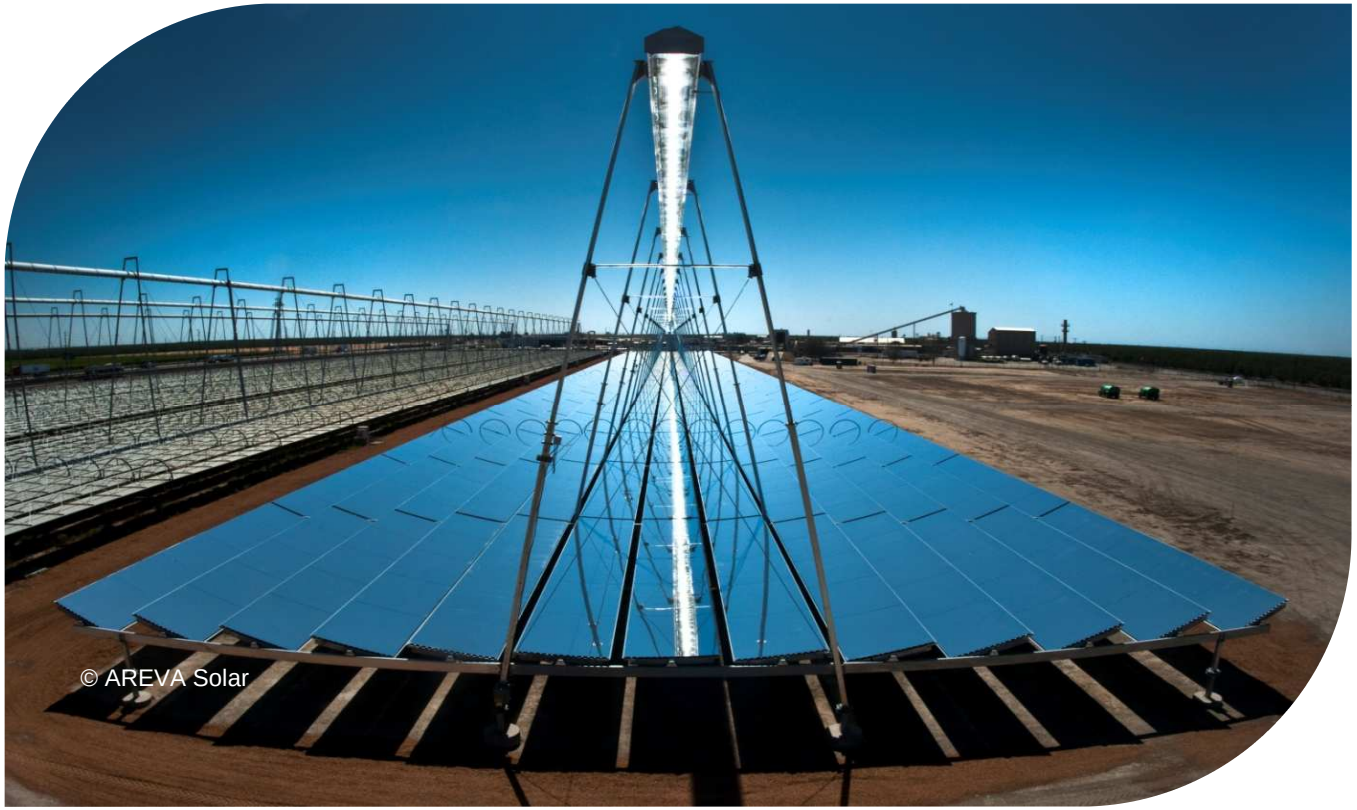
- **AREVA Solar, a global Business Unit of AREVA Renewables, is headquartered in California with R&D centers in Europe.**
- **Specializes in the design, manufacture and installation of CLFR solar steam-generating solar systems for power generation and industry**



Compact Linear Fresnel Reflector (CLFR)

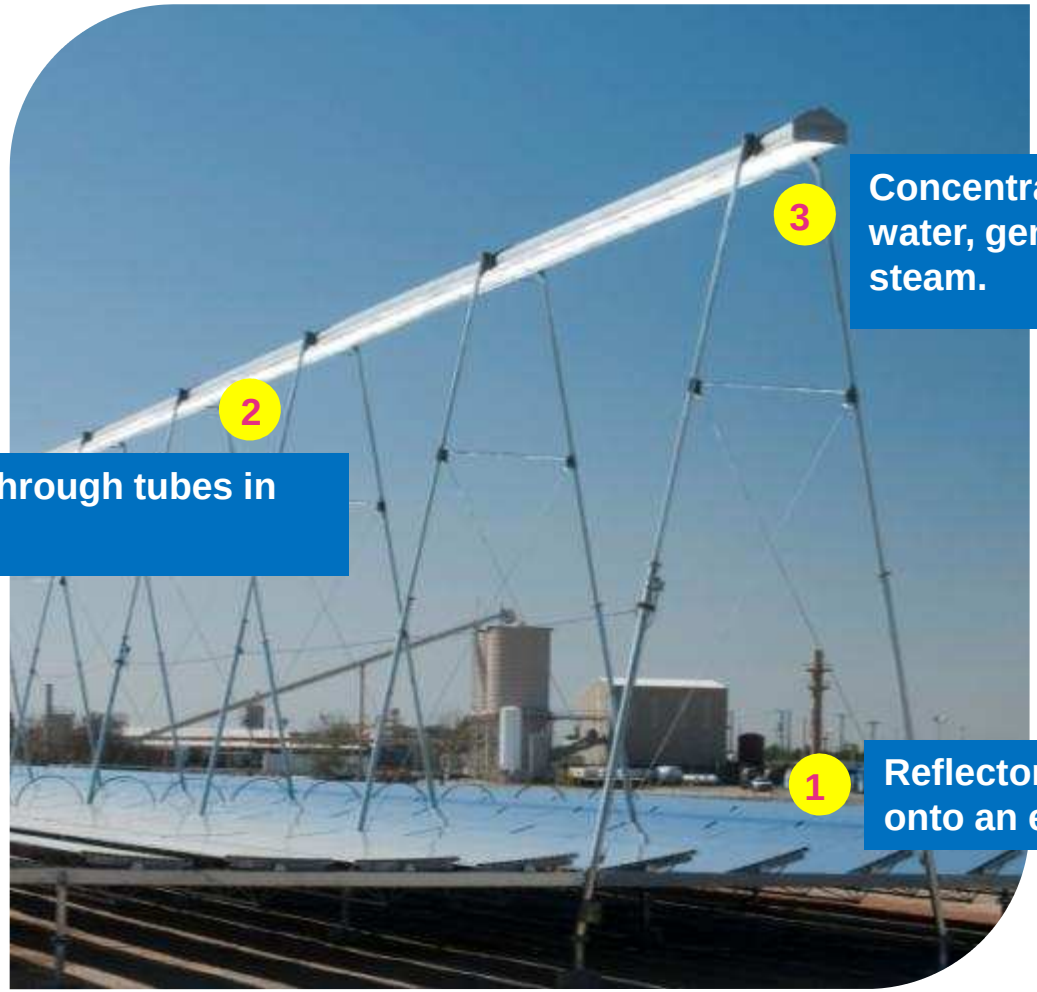
TECHNOLOGY

Compact Linear Fresnel Reflector
AREVA's Solar Technology of Choice



- **Conceived in the early 1990s in Australia.**
- **One CLFR Solar Steam Generator = 18 MWt / 7 MWe**

CLFR's Direct, Superheated Steam Generation



3 Concentrated sunlight boils the water, generating superheated steam.

2 Water runs through tubes in the receiver.

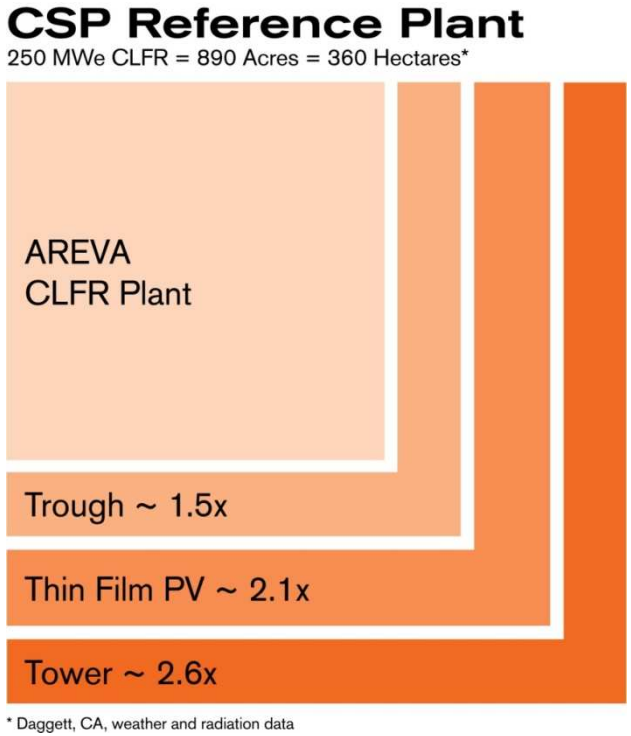
1 Reflectors focus the sun's heat onto an elevated receiver (fig. 2)

AREVA's CLFR technology at-a-glance

ASME "S" Stamp Certified CLFR Performance	
Temperature	Designed for up to 900°F (482°C)
Pressure	Up to 2,400 psia (165 bara)

- CSP industry's lowest cost of energy
- Most land-efficient solar technology
- Direct, superheated steam generation
- Water is working fluid, no toxic or hazardous materials
- On-site manufacturing approach
- Simple design; uses readily available commodity materials
- Water-conservative closed loop system and dry cooling capability
- Modular and scalable
- Automated tracking
- Engineered for toughest weather conditions
- Backed by AREVA performance guarantees

CLFR is most land-efficient solar technology



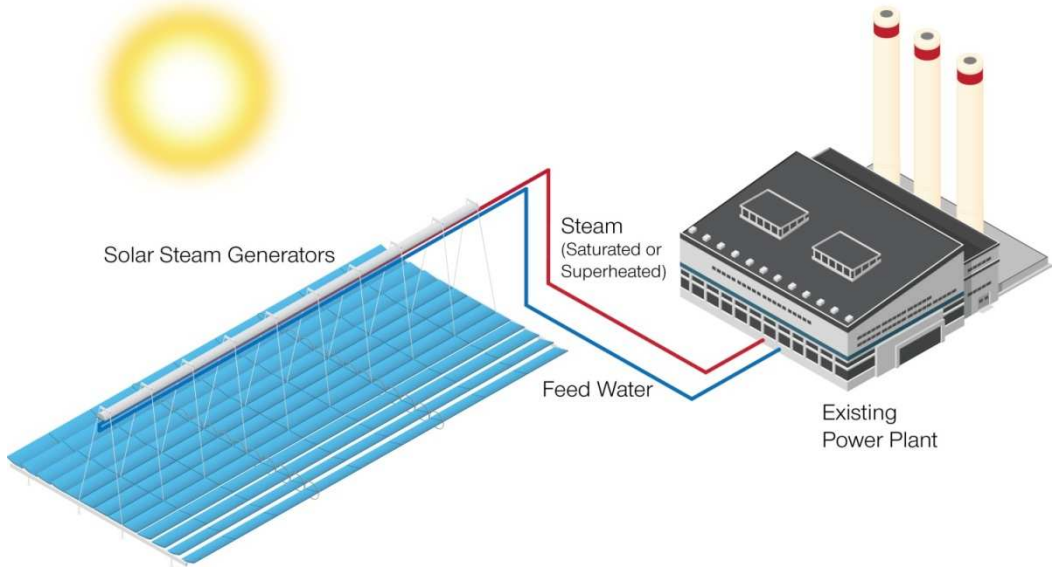
Primary market applications for solar steam

Standalone Solar Thermal and Solar-Fossil Fuel Hybrid Power Plants

Steam Augmentation for Fossil-Fired, Geothermal and Biomass Power Plants

Solar Steam for Industrial Processing, and Enhanced Oil Recovery

Solar steam augmentation of existing power plants



Opportunity

- Co-locate solar steam generators with existing or new-build fossil-fueled power plants and for industrial processes
- Repower/extend life for geothermal and biomass power plants

Advantages

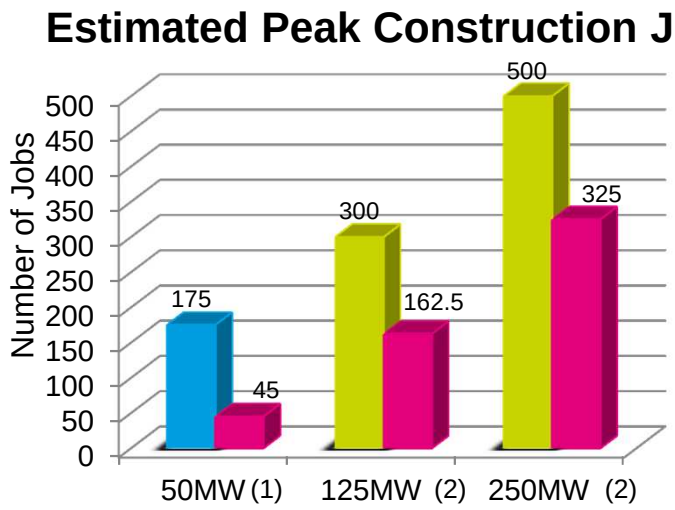
- Increase output of existing capital equipment without added emissions
- Match peak electricity demand
- Reduce fuel consumption
- Reduce carbon and other emissions
- Rapid deployment (< 1yr to COD)
- “Greens” existing assets

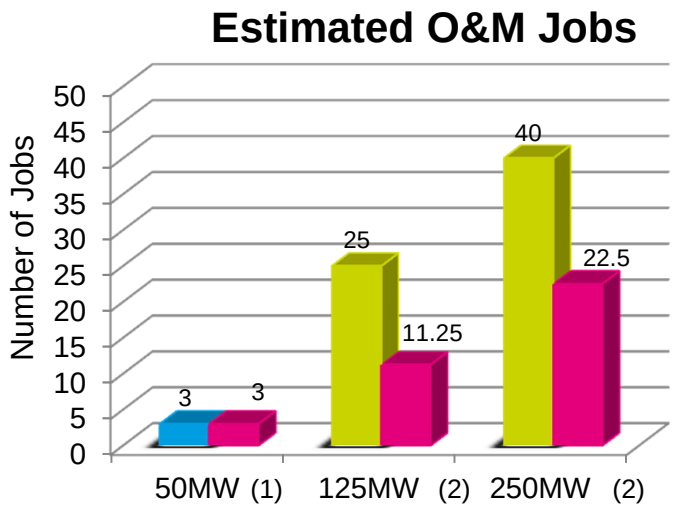
Steam Augmentation or "Solar Booster" for existing fossil plants

- **Unlike PV, CSP applications produce steam:**
  - **This steam can be injected into the steam cycle in a conventional coal or gas-fired combined-cycle plant to "boost" production or reduce fuel consumption**
  - **5-20% of the plant's output can be supplemented with solar steam**
- **Benefits of a Solar Booster project:**
  - **Lowest cost solar generation available**
  - **Adds capacity during peak demand**
  - **Can use existing electrical interconnect and transmission**
  - **Creates Renewable Energy Credits to help meet RPS standards or for sale**
  - **Reduces or offsets emissions of SO2, NOx, CO_2, CO, and Mercury**
  - **Reduces maintenance and extends life of existing coal plants by reducing coal consumption**
  - **Provides hedge against future fuel price increases**

AREVA's CLFR technology for booster applications represents the lowest cost solar power available

US job creation estimates: CLFR vs. PV





CLFR Booster Jobs CLFR Power Plant Jobs PV Jobs

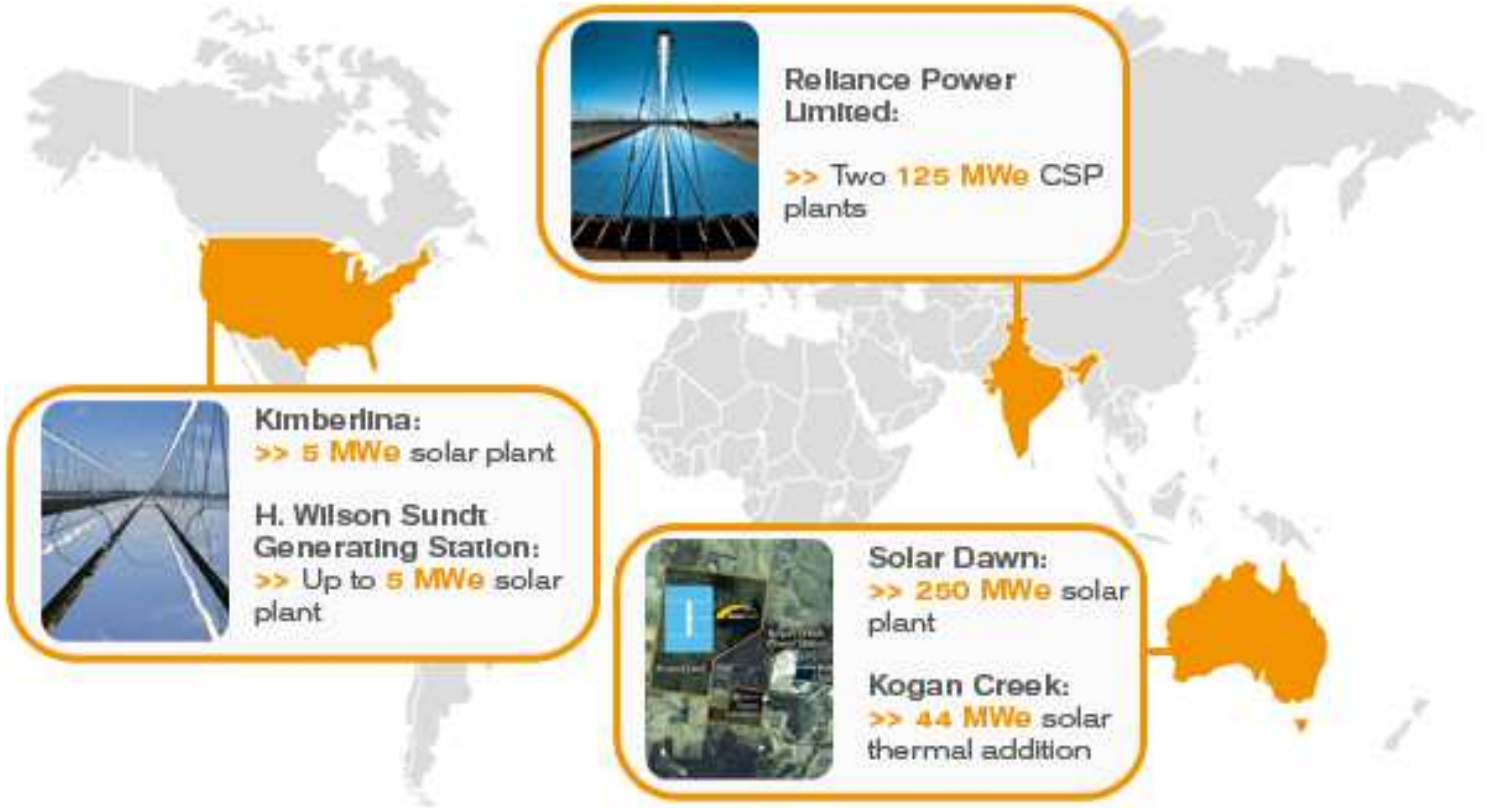
(1) CLFR data represents a booster project. Data from AREVA Solar.
(2) CLFR data represents a stand alone power plant. Data from AREVA Solar.

Source of PV data: Bureau of Land Management www.blm.gov/ca/st/en/prog/energyfasttrack/chevron.html and the Renewable Energy in the California Desert : Mechanisms for Evaluating Solar Development on Public Lands" research study by the University of Michigan graduate students http://webservices.itcs.umich.edu/drupal/recd/?q=node/64. Chevron Lucerne Valley Solar Project. This analysis is based on the Chevron Lucerne Valley Solar Project, a 45MW solar power project.

Market for Solar Steam

PROJECT EXAMPLES

AREVA Solar's Ongoing Projects Worldwide



World’s largest coal-solar booster

An aerial impression of where the solar boost project will be constructed at Kogan Creek Power Station.

Kogan Creek Highlights

A clean power boost; no added emissions

- **Existing power plant: 750 MW Kogan Creek Power Station**
- **Additional electricity: ~44 MW peak production**
- **Avoided CO_2: ~35,600t/annum**
- **Connection: cold reheat steam**
- **Location: Queensland, Australia**
- **Online: Early 2013**

Tucson Electric Power: Sundt Solar Boost Project

High-pressure superheated steam for feedwater heating

- **CLFR solar steam augmentation project for TEP's Sundt Generating Station in Tucson**
- **5 MWe solar power "boost" for 156 MWe dual-fueled Unit 4**
- **U.S.-designed and manufactured technology**
- **Construction : Summer 2012**
- **Online: Early 2013**
- **Job creation and other economic benefits**
  - 50 peak construction jobs
  - US high-volume manufacturing

Sundt Solar Boost Project: avoiding emissions

Reliance Power: 2 X 125 MWe Solar Power Plant

Asia's largest CSP Project with India's leading private sector power generation company

Part of India's National Solar Mission, aiming to establish India as a global leader in solar energy

- **Size: 2 X 125 MW solar thermal power plant**
- **Technology: AREVA Solar CLFR**
- **Location: Rajasthan, India**
- **Commercial Operation: Unit 1 May 2013**
- **Avoiding 557,000 tons of CO_2**
- **500 construction jobs at peak construction as well as 40 permanent O&M positions**

Solar Dawn:
Australia's first large-scale (250 MW) CSP Plant

- **Solar Dawn will use AREVA Solar's CLFR technology and be designed with the ability to operate as a gas-solar hybrid for 24/7 dispatchability**

QUESTIONS?

Tom DePonty

Director, Government Affairs

301.841.2468

tom.deponty@areva.com