

ABB Automation & Power World: April 18-21, 2011

# From the sun to the grid An introduction to solar power applications

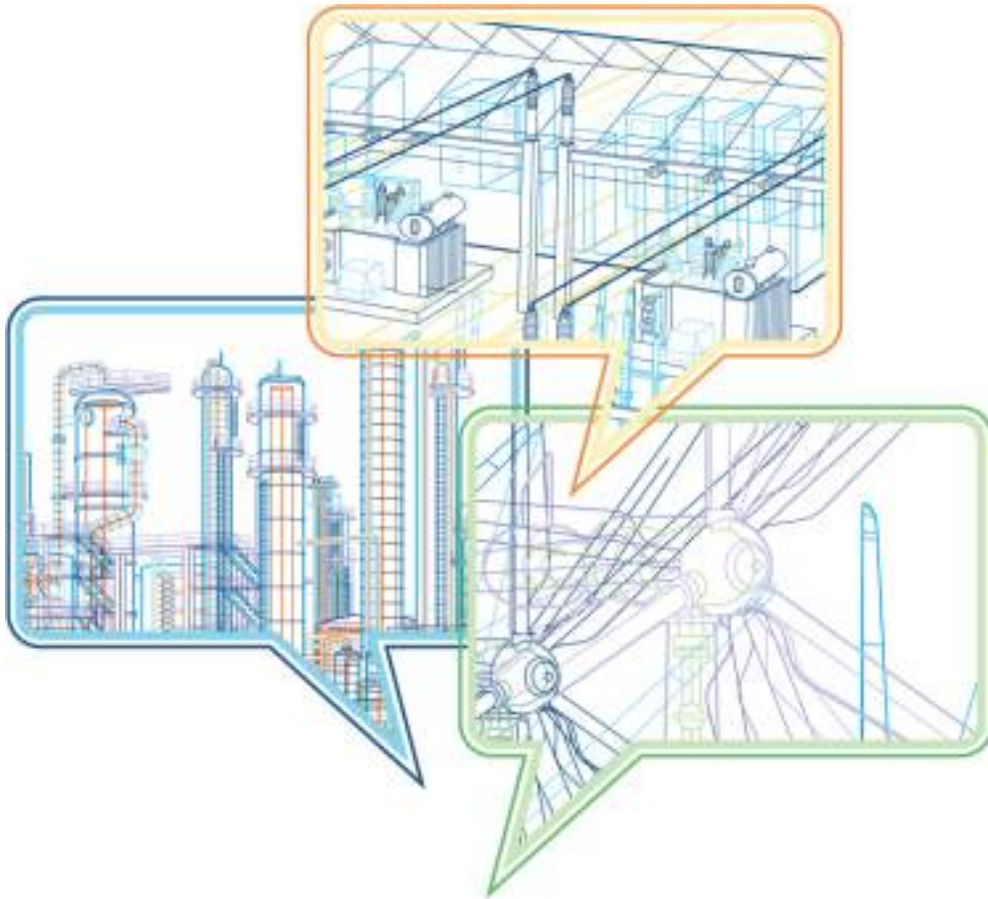
# Automation & Power World 2011

April 18-21, 2011 in Orlando, Florida



# Automation & Power World 2011

## April 18-21, 2011 in Orlando, Florida



- ▣ Save the date for this “must attend” event!
- ▣ April 18-21, 2011
- ▣ Orlando World Center Marriott, Florida
- ▣ Over 400 hours of educational training
  - ▣ Business forum
  - ▣ Customer case studies
  - ▣ Hands-on training
  - ▣ Panel discussions
  - ▣ Technical workshops
- ▣ Earn PDHs and CEUs
- ▣ Technology & Solution Center
  - ▣ Over 70,000 sq. ft. of exhibits
- ▣ Network with your peers
- ▣ [www.abb.com/a&pworld](http://www.abb.com/a&pworld)

# ABB Automation & Power World

## At-a-glance

400+

### Educational workshops

Automation & Power World offers over 400 hours of educational workshops specifically designed to make engineers, maintenance and management more valuable to their companies.

70K

### Technology & Solution Center

Over 1 ½ acres (70,000 ft<sup>2</sup>) of with nearly 100 tons of electrical gear and 100's of experts ready to answer any of your questions and share the future of Automation & Power Solutions.

4,000

### Connect with peers

With over 4,000 of your peers in attendance, this is a powerful opportunity to network and learn from the industry. In addition, over 45 customers will be sharing their own case studies.



# Educational workshops developed for all audiences

## Just a few examples

### Roles

Engineering

Management

Maintenance

### Company types

Industrials

EPCs

Utilities

OEMs

- ▣ The coming wave of process safety system migration
- ▣ Implementing an alarm management strategy for a 100,000 I/O system - Case study
- ▣ Replacement and retrofit of large motors: Challenges and solutions
- ▣ Dynamic studies for large scale renewable energy integration at a Texas CREZ - Case study
- ▣ Secure commissioning of your process plant - Case study
- ▣ New arc flash mitigation technologies and techniques for a safer working environment
- ▣ Robotics 101
- ▣ A better approach to non-revenue water loss
- ▣ Electric vehicles: Are they real this time?
- ▣ Why is SIL more important than architecture?

# Past attendees input



“I am impressed with the different parts of the program, the workshops and also the exhibit set-up... there is a lot of information to pick up.”

**Duane Souers, Georgia Pacific**

“It’s a great opportunity to get a lot of exposure to people and products in one week.”

**Pardeep Gill, Alcoa**



“It is well worth the time given the opportunities to: learn from industry experts, network with peers in the same industry, learn about emerging technologies, and build excellent supplier relationships.”

**Sanjin Osancevic, National Grid**

# From the sun to the grid

## An introduction to solar power applications

- Speaker name: Ted Wodoslawsky
- Speaker title: Director of Marketing, Low Voltage Products
- Company name: ABB, Inc

# Learning objectives

## **Solar power defined**

**Understanding the basics of solar thermal power & utilized equipment**

**Understanding the basics of solar photovoltaic power & utilized equipment**

**Define ABB's offering for solar power applications**

**Summary review – Q&A**



# From the sun to the grid

## An introduction to solar power applications

### **Solar power defined**

Understanding the basics of solar thermal power & utilized equipment

Understanding the basics of solar photovoltaic power & utilized equipment

Define ABB's offering for solar power applications

Summary review – Q&A

# From the sun to the grid

## An introduction to solar power applications

- **Solar power defined**

- **Solar thermal power(STP) –**

Type 1. Converts sun energy into heat via reflective materials used to make steam to drive steam or heat engines that produces electricity. Mostly utility scale applications.

Type 2. Solar thermal panels use sun rays to heat a special fluid that releases the heat to a water tank through a forced circulation heat exchanger. Mostly residential and commercial applications.

# From the sun to the grid

## An introduction to solar power applications

- **Common acronyms**
  - **STP** – Solar Thermal Power
  - **STPP** – Solar Thermal Power/Plant
  - **PV** – Photovoltaic
  - **CSP** – Concentrating Solar Power
  - **CSPP** – Concentrating Solar Power Plant

# From the sun to the grid

## An introduction to solar power applications

### Solar Power defined

Understanding the basics of Solar Thermal Power & utilized equipment

Understanding the basics of Solar Photovoltaic Power & utilized equipment

Define ABB's offering for Solar Power applications

Summary review – Q&A

# Solar thermal power

## The basics of thermal solar power plants

Solar thermal power plants (scaleable from 10 to 500MW)



- Solar thermal electric energy generation concentrates the light from the sun to create heat in a stored fluid. The heat from the fluid is used to run a heat engine, which turns a generator to make electricity.
- The working fluid that is heated by the concentrated sunlight can be a liquid or a gas
  - Different working fluids include water, oil, salts, air, nitrogen, helium, etc.
- Different engine types include: steam engines, gas turbines, Stirling engines, etc.
- All of these engines can be quite efficient, often between 25% and 50%, and are capable of producing 10's to 100's of megawatts of power.

# Solar thermal power plant technologies

- **Parabolic trough technology**: Formed by collectors consisting of a mirror that reflects the radiation onto a tube positioned on the focal line, which contains an absorbent area and a heat carrying fluid. Stage: forthcoming commercial development.
- **Central receiver technology**: Formed by a field of heliostats that reflect the radiation onto a heat exchanger situated at the top of a central tower. Stage: proven technical feasibility.
- **Parabolic dish technology**: Formed by a set of individual parabolic dishes concentrating sunlight on a Stirling engine. New technology.



**PARABOLIC TROUGH**



**CENTRAL RECEIVER**



**PARABOLIC DISH**



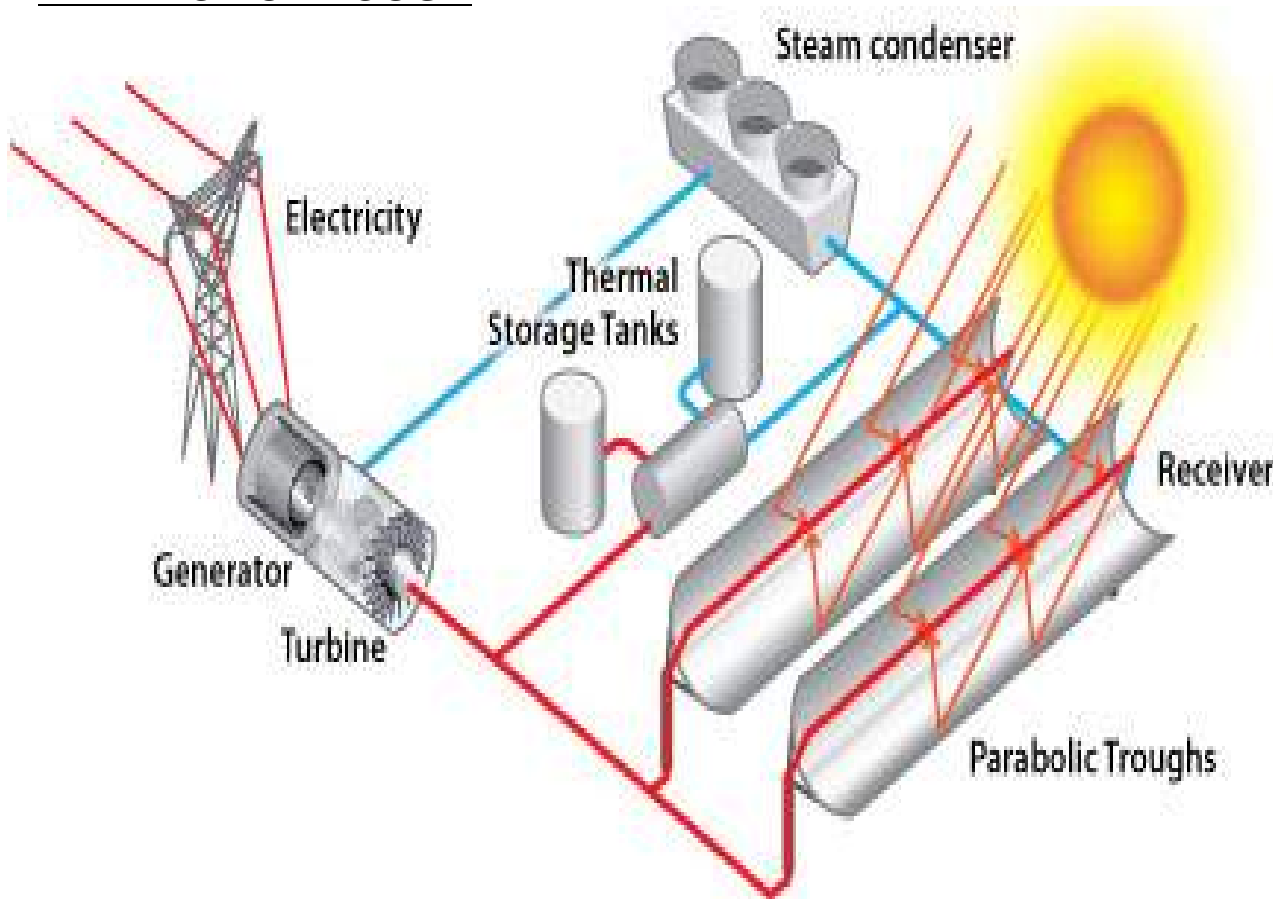
# Solar thermal power – Trough technology



- In most cases the actual method of power generation in a Solar Thermal Power plant is traditional steam turbines.
- The main difference is the fuel (sunlight) and how it is used to generate enough thermal mass to create meaningful electric power.
- There are currently two popular methods for solar thermal collection.
- The first is line focus collection. (**Solar Trough Technology**)
  - Line focus is less expensive, technically less difficult, but not as efficient as point focus. The basis for this technology is a parabola-shaped mirror, which rotates on a single axis throughout the day tracking the sun.
- Line focus solar thermal plants are reporting 80-100x concentration, with some claiming 112x
- At these concentrations a steam turbine can be run at roughly 25% efficiency.

# Trough/concentrated solar power plants (CSPP): Basics

## PARABOLIC TROUGH



- Standard CSPP divided into: solar field, thermal energy storage and steam cycle.
- Trough-shaped parabolic mirrors concentrate solar radiation onto tubes along the focal line of each concentrator.
- Fluid flowing through the tubes is heated up by the concentrated sunlight.
- The hot fluid is used to generate steam, which drives a standard steam turbine generator.

# Solar thermal power – Central receiver point of focus

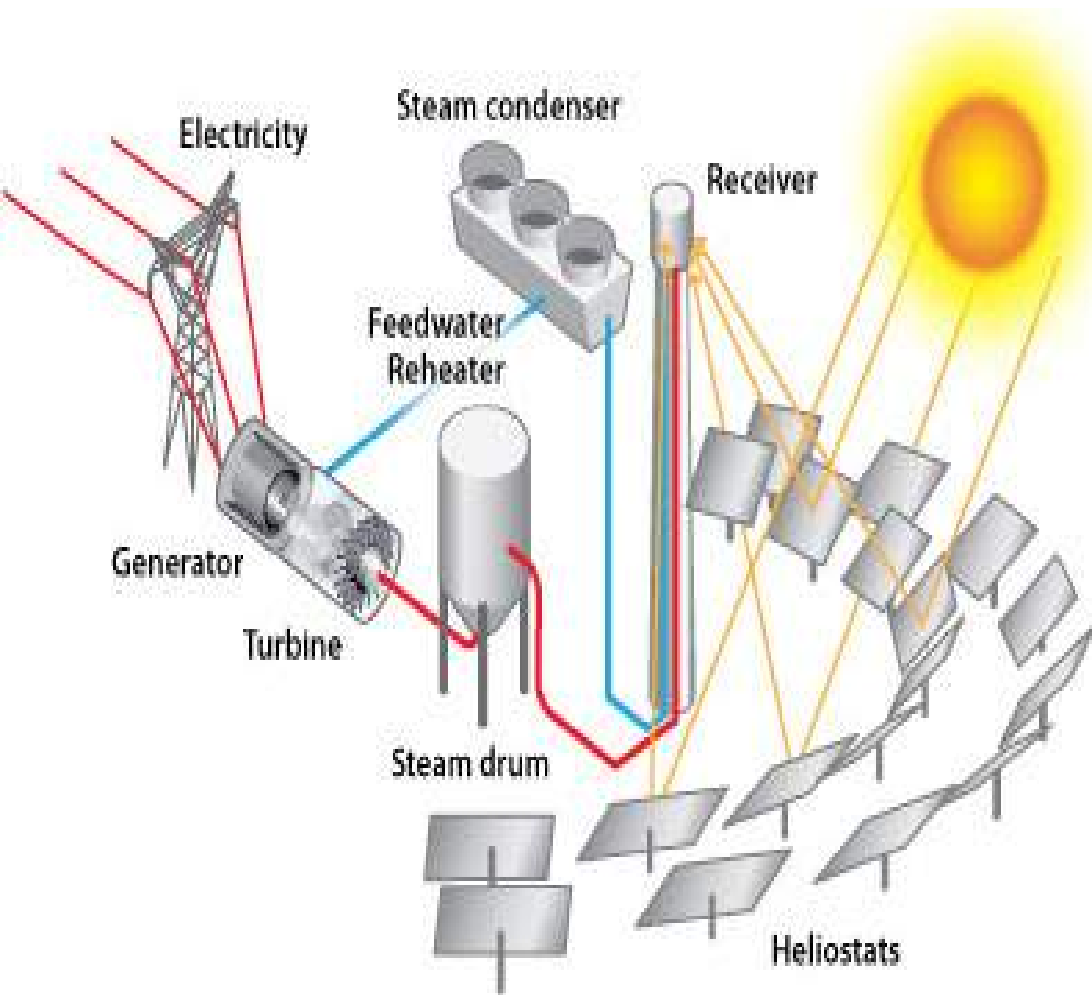


- The second is point focus collection (Concentrated Solar Power)
  - Point focus, though initially costlier and technically more difficult to implement.
  - The point of focus in a line focus mirror array can only reach temperatures around 250° C-300° C.
  - That is a sufficient temperature to run a steam turbine, but when compared to the 500° C and higher temperatures that point focus can reach, the extra effort and cost is balanced out by its greater efficiency capability.
  - High efficiency matters because it drives down both the land usage, and the effective cost per kWhr of the plant
  - Point focus, however, has a much higher maximum concentration ratio at 44,000:1. Current technology is reaching 1,000x concentration.
  - Point focus' concentration can run a steam turbine at anywhere from 35-50% efficiency.



# Concentrating solar power plants (CSPP): Basics

## power tower – Central receiver



**CENTRAL RECEIVER**

- Standard CSPP divided into: solar field, thermal energy storage and steam cycle.
- Central Receiver Technology mirrors: collectors concentrate solar energy on the central receiver.
- The fluid flowing along the receiver is heated to about 300°- 500° C.
- The heated fluid is led to a thermal storage system, after which it moves to the steam condenser.
- The steam feeds the turbine-generator, which generates electricity. After its passage through the processor, the energy is ready to be distributed to the network.



# Learning objectives

## Solar power defined

Understanding the basics of solar thermal power & utilized equipment

**Understanding the basics of solar photovoltaic power & utilized equipment**

Define ABB's offering for solar power applications

Summary review – Q&A

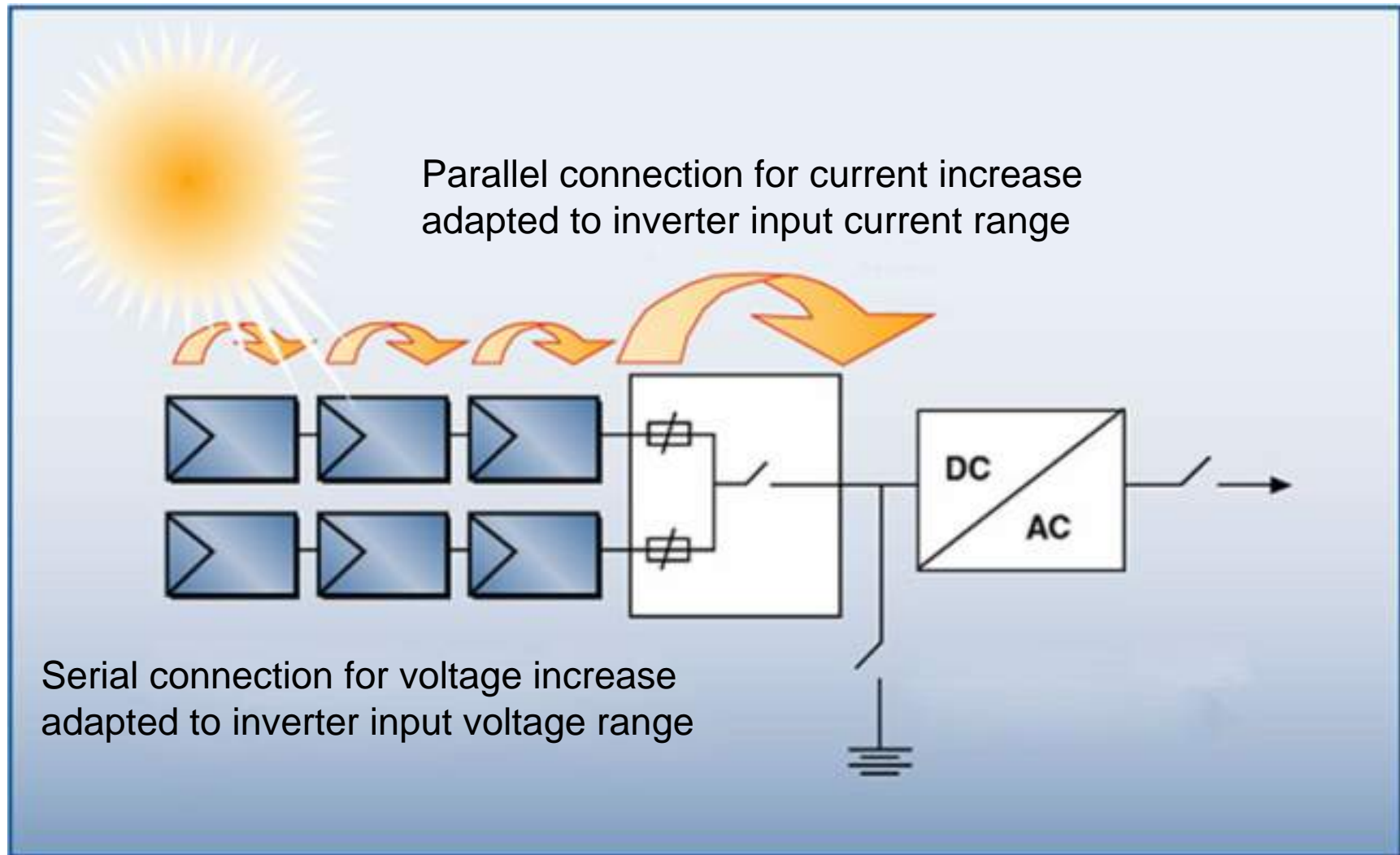
# Photovoltaic Systems (Scaleable from 0.1 to 50MW)

- **Photovoltaic** energy is the most popular form of solar energy. In solar photovoltaics, sunlight is actually converted into electricity. This is very different from a conventional understanding of solar power as only a way of heating water. Photovoltaic is now the most common usage of solar energy around the world.
- **How does a solar electric (photovoltaic) system work?** Photovoltaic modules (a.k.a. solar panels) convert sunlight into direct current (DC) electricity. This electricity is either used immediately, exported to the grid or stored in batteries. It may be used either directly (as direct current) or converted to alternating current (AC) by a device called an inverter.
- **Residential/commercial vs utility scale** – Residential systems are typically tied into the grid via the onsite utility meter and disconnect 1- 20KW– Net Metering. Utility Scale systems are larger systems ranging from 20KW to 50MW, and have a dedicated substation, switchgear and SCADA system.





# Standard PV power generation



## Solar modules connection

# PV solar power types



## PV roof installation

- Residential and Commercial applications
- Low / medium power photovoltaic installation in a fix structure
- Fixed structures, solar panels, inverters, switchgear, low voltage controls & protection cabinets, automation and transformer.
- Typical power ( **10 Kw to 500 Kw** ).



## PV ground plant installation ( Fixed structure )

- Medium / high power standard photovoltaic installation in a fixed structure.
- Fixed structures, solar panels, inverters, switchgear, low voltage & protection cabinets, pre-built transformation center, security, automation, transformer, cabling and small civil work
- Typical power ( **100 Kw to 50 Mw** ).

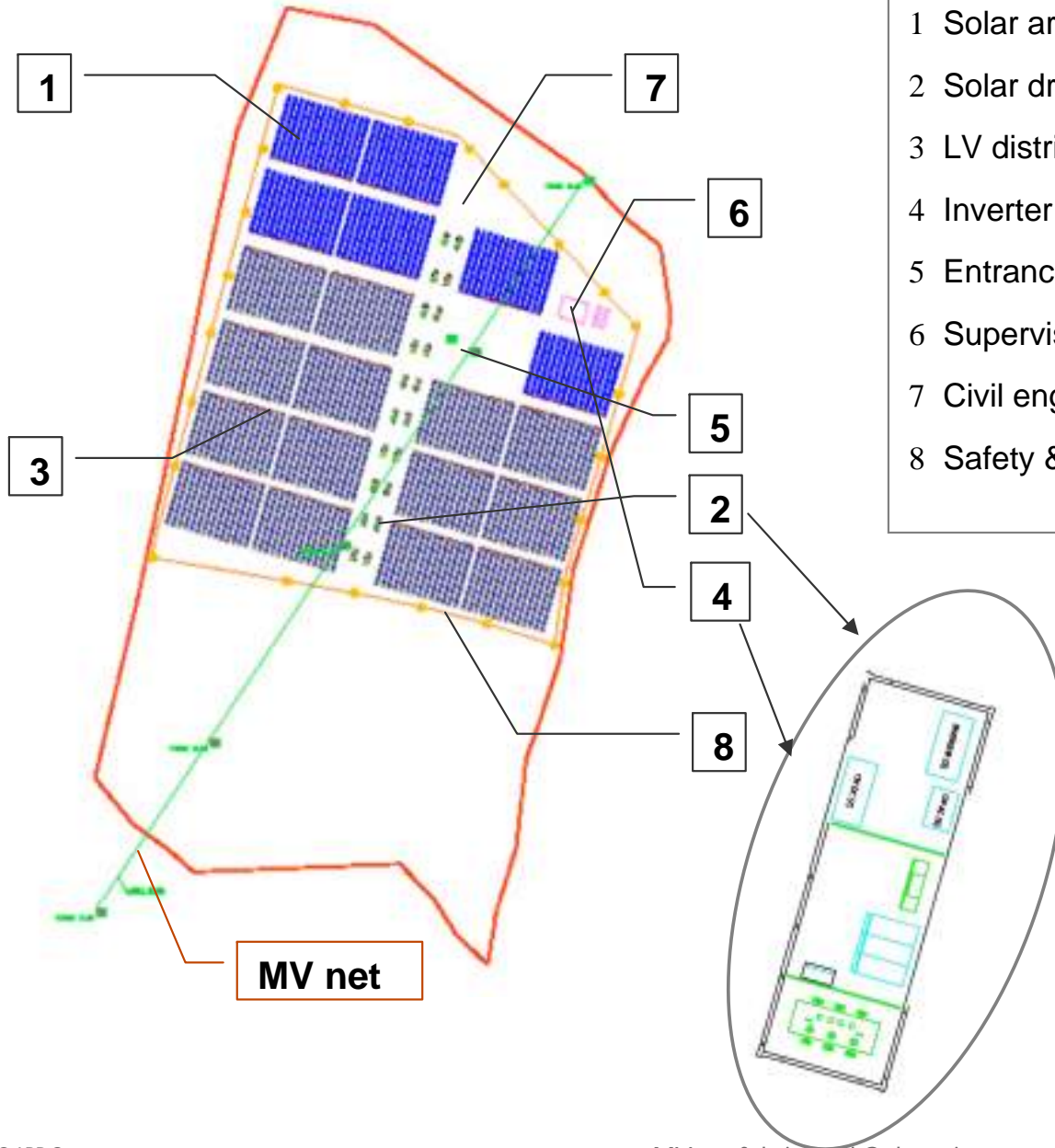


## PV ground plant installation ( 1 or 2 axis trackers ) ( EPC option )

- Medium / high power photovoltaic installation in a 1 or 2 axis structure.
- 1 or 2 axis structures ( multiple or single pole ), robots, motors, drives, solar panels, inverters, switchgear, low voltage & protection cabinets, pre-built transformation center, security, automation, transformer, cabling, substations and small civil work )
- Typical power ( **100 Kw to 50 Mw** ).

# Standard solar power plant and ABB portfolio.

Map of a 2MW solar power plant



Main elements of a solar power plant:

- 1 Solar arrays (fixed or solar trackers)
- 2 Solar drives
- 3 LV distribution and protection cabinets
- 4 Inverter + transformation center
- 5 Entrance point
- 6 Supervision and control station
- 7 Civil engineering (ground preparation, streets, buildings...)
- 8 Safety & Security system (CCTV, etc)



MV prefabricated Substation

# Learning objectives

## Solar power defined

Understanding the basics of solar thermal power & utilized equipment

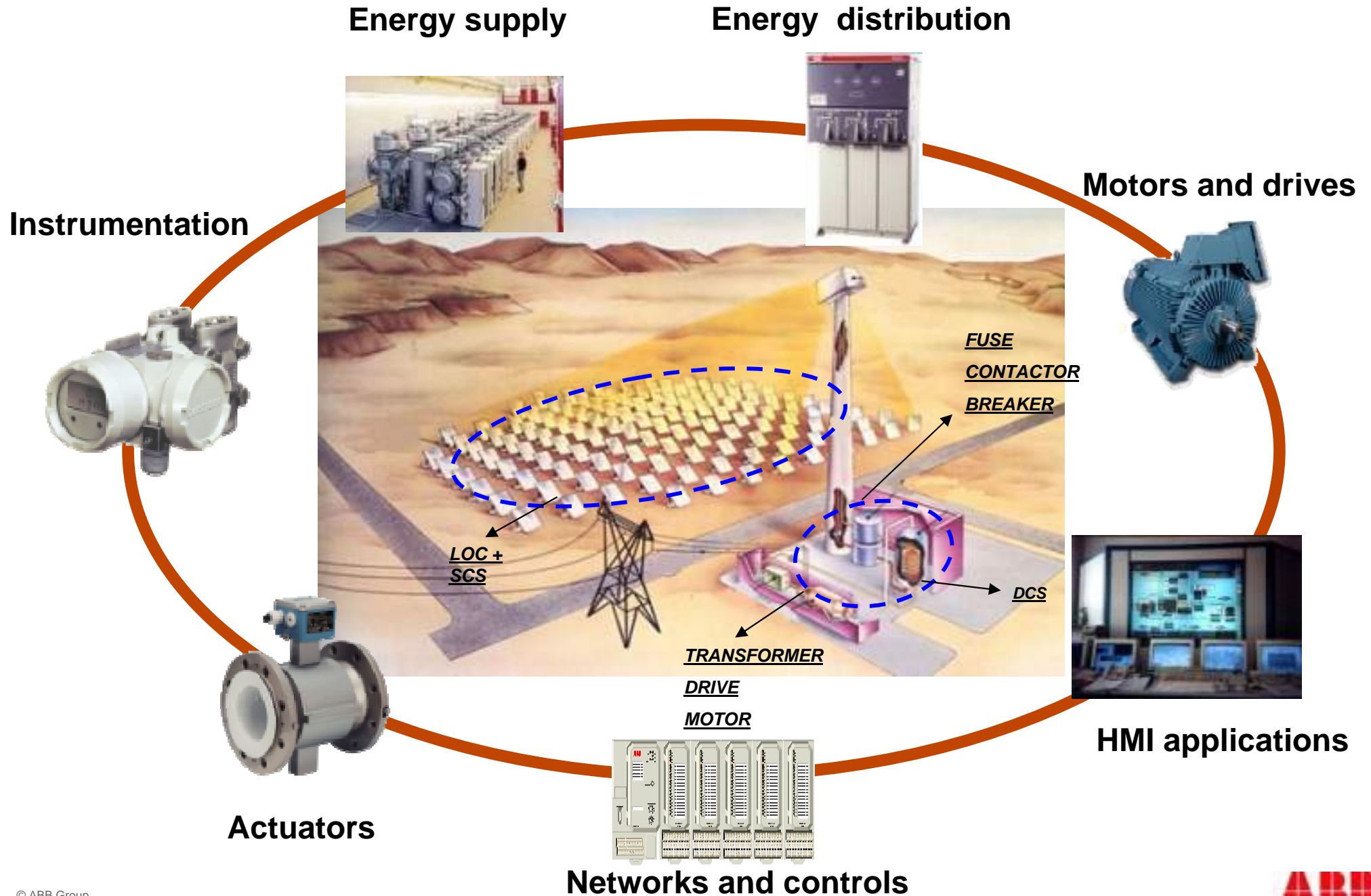
Understanding the basics of solar photovoltaic power & utilized equipment

**Define ABB's offering for solar power applications**

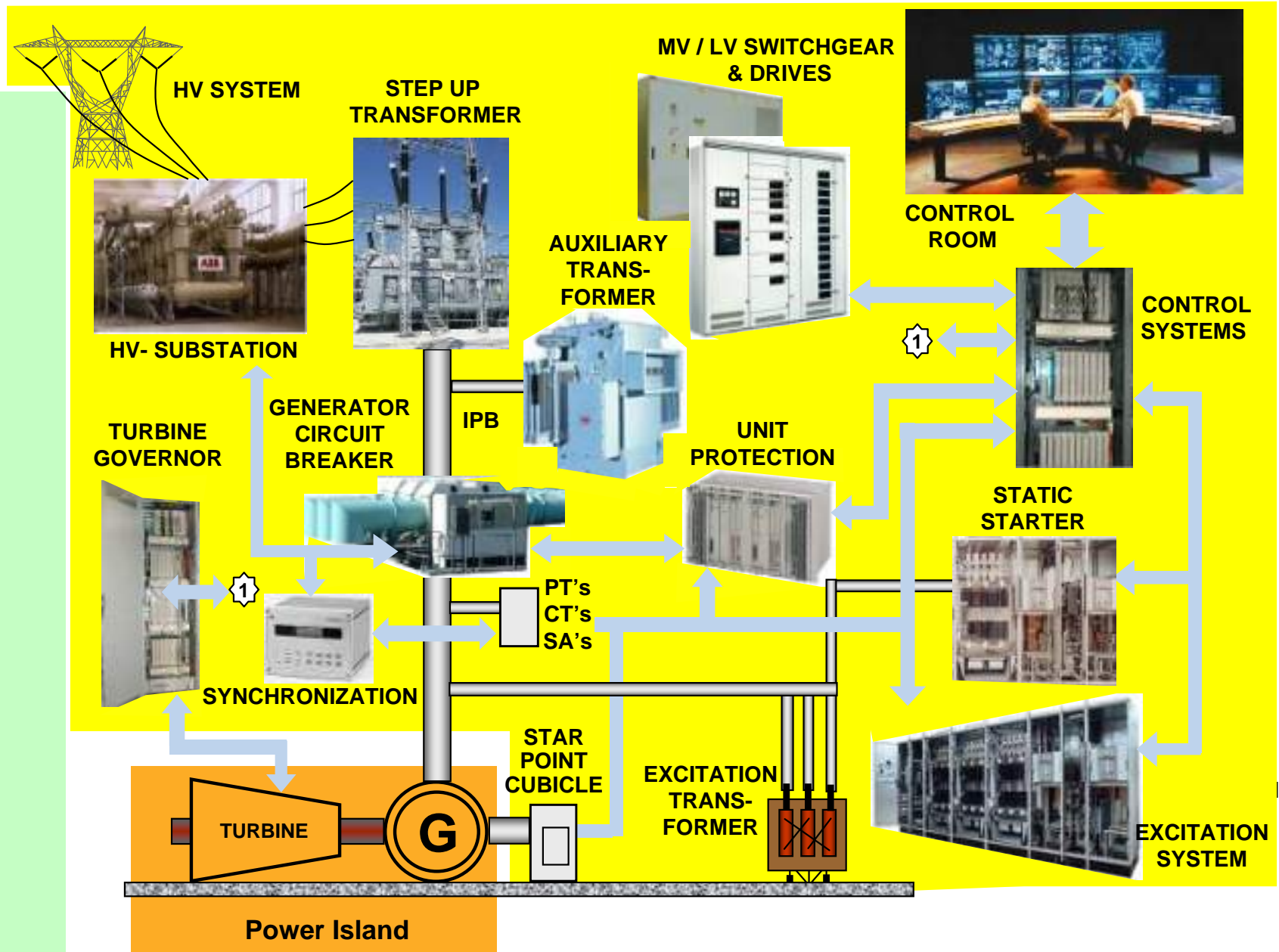
Summary review – Q&A



# Solar thermal plant experience make a turnkey project:



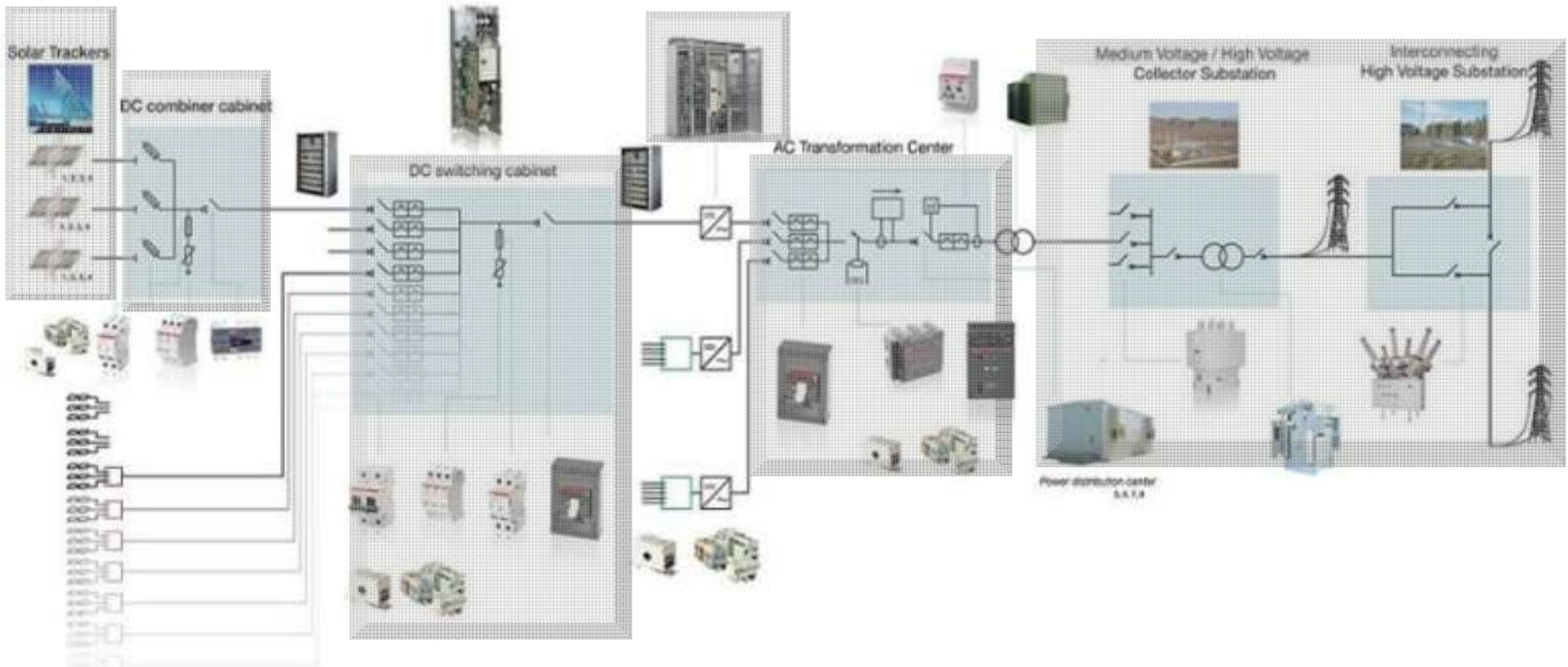
# Integration of electrical systems and I&C





# Solar PV applications and how ABB fits

Overall system control



# From the sun to the grid

## An introduction to solar power applications

### Solar power defined

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# From the sun to the grid: Summary review

- **Key points to remember**
  - **STP** – Solar Thermal Power
    - Uses solar radiation to heat liquid that is then converted to steam to drive steam turbine to produce electricity
    - Uses solar radiation to heat liquid in panels. Heated liquid then is pumped through a heat exchanger to heat water
  - **STPP** – Solar Thermal Power/Plant
    - .1 to 500MW power generation
    - Trough technology – traditional installation and less costly with 25% steam turbine efficiency
    - Central receiver or focus point technology – more costly installation with 35-50% steam turbine efficiency
  - **PV** – Photovoltaic
    - Converts sun energy into electricity with no moving parts. Properly treated silica based semi-conductive materials known as solar panels convert solar radiation into direct current(DC) electricity.
      - Roof top installations- Residential and commercial systems 10KW to 500KW of power
      - Ground plant installations- Small commercial to large utility installations 100KW to 50MW power
  - **CSP** – Concentrating Solar Power
  - **CSPP** – Concentrating Solar Power Plant
- **ABB Solar Power solutions**
  - Power control products
  - Switch gear and distribution equipment
  - Motors and transformers
  - HMI/PLC solutions
  - System consulting services
  - For more information visit [www.ABB.com/solar](http://www.ABB.com/solar)

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# Workshop statistics

## Over 400 hours of training

- ~45 customer presented case studies
- 87 sessions in the Technology and Solution Center
- 11 hours of panel discussions consisting of customers, industry experts and ABB executives
- Nearly 50 hours of hands on technical training

# ABB Automation & Power World

## Registration options

	Full Conference	Courtesy Registration
Access to ABB product developers and application experts in the 70,000 ft <sup>2</sup> (over 1.5 acre) Technology & Solution Center		
Access to a series of complimentary and educational workshops.		
Free Lunch and Tuesday Evening Reception		
Access to over 300 additional educational workshops – Including ARC Analysts presentations		
Up to \$1,500 off a future ABB purchase*		
Complimentary ARC report valued at \$2,500!*		
Evening Events (Monday and Wednesday)		
* See <a href="http://www.abb.com/a&amp;pworld">www.abb.com/a&amp;pworld</a> for more details	<b>Cost</b>	<b>Free!</b>
	\$300 per day or \$800 for all three days.	



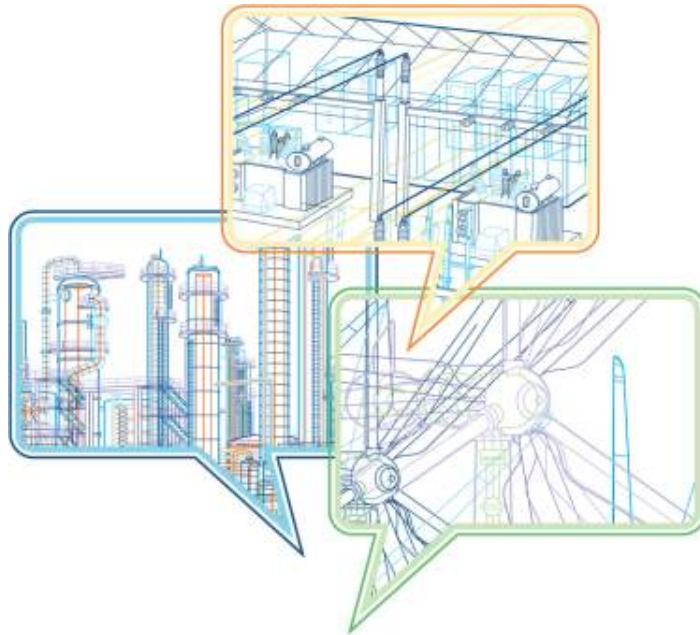
# Top ten reasons to attend



- Become more valuable, choose from over 400 educational workshops and hands-on training sessions
- Connect with thousands of peers and industry experts from 40 countries
- Ask questions of, and give feedback to, ABB product developers and executive management
- Get up to date with new and emerging technologies and industry trends
- Learn how to maximize the value from your existing assets
- Discover how to improve grid reliability, energy efficiency and industrial productivity
- Apply lessons learned from over 45 customer-presented case studies
- Focus on critical non-technical issues facing your company in the business forums
- Succeed professionally by earning CEUs on select workshops and PDHs for every workshop you attend
- See the widest range of technologies from one company at one conference!

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Register today!

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**Stay in the loop:**



**Power and productivity  
for a better world™**

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