Venkateswaran Narayanan, India Corporate Research Centre, ABB, Bangalore. 11 Oct 2012

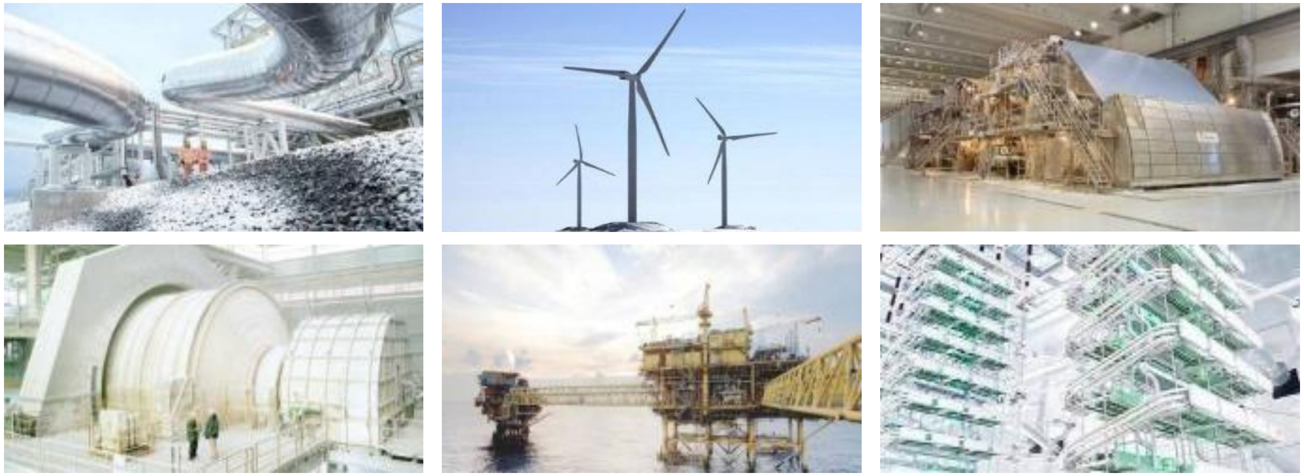
Leveraging Technology for Sustainability

Sustainable Leadership Forum Annual Summit 2012

A global leader in power and automation technologies
Leading market positions in main businesses

- 145,000 employees in about 100 countries
- $38 billion in revenue (2011)
- Formed in 1988 merger of Swiss and Swedish engineering companies
- Predecessors founded in 1883 and 1891
- Publicly owned company with head office in Switzerland

Power and productivity for a better world
ABB’s vision



As one of the world’s leading engineering companies, we help our customers to use electrical power efficiently, to increase industrial productivity and to lower environmental impact in a sustainable way.

How ABB is organized
Five global divisions





Power Products	Power Systems	Discrete Automation and Motion	Low Voltage Products	Process Automation
$10.9 billion	**$8.1 billion**	**$8.8 billion**	**$7.7 billion**	**$8.3 billion**
36,000 employees	**20,000 employees**	**29,000 employees**	**31,000 employees**	**28,000 employees**

(2011 revenues, consolidated; including Thomas & Betts revenue for LP division)

- ABB's portfolio covers:
  - Electricals, automation, controls and instrumentation for power generation and industrial processes
  - Power transmission
  - Distribution solutions
  - Low-voltage products
  - Motors and drives
  - Intelligent building systems
  - Robots and robot systems
  - Services to improve customers productivity and reliability

Developing sustainability of products and operations
Lowering environmental impact and costs

Sustainability in product development

- Focus on resource and energy efficiency of equipment over life cycle
- Independently verified Environmental Product Declarations for main products

Sustainability in ABB's operations

- Cuts targeted in use of energy, raw materials, hazardous substances
  - eg, China: 63% cut in energy use per unit of revenue between 2002 and 2010

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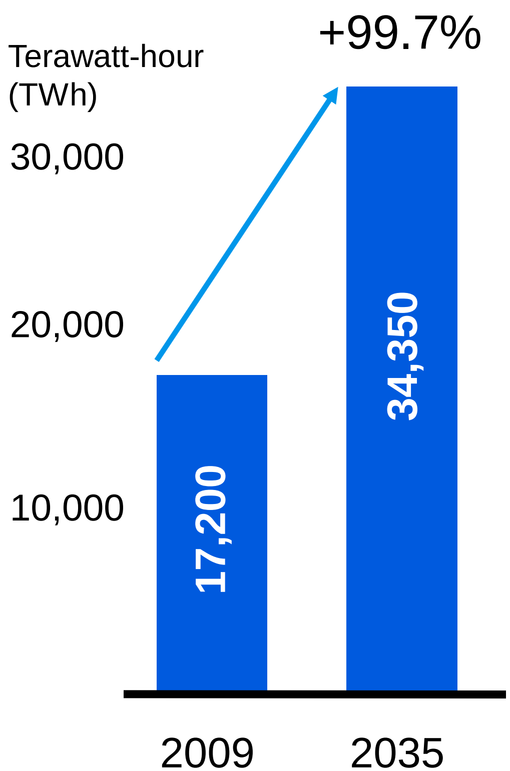
Tackling society's challenges on path to low-carbon era
Helping customers do more using less

Rise in electricity demand by 2035 (under current policies)
Source: IEA, World Energy Outlook 2011

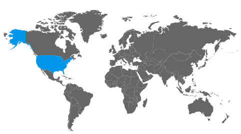
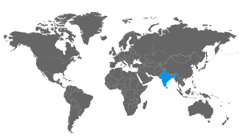


Electricity demand is calculated as the total gross electricity generated less own use in the production of electricity and transmission, and distribution losses.

ABB power and automation solutions are:

- Meeting rising demand for electricity
- Increasing energy efficiency and reducing CO_2 emissions
- Improving productivity to raise competitiveness of businesses and utilities

Improving capacity, reliability and efficiency in the grid
A pioneer in smart technologies

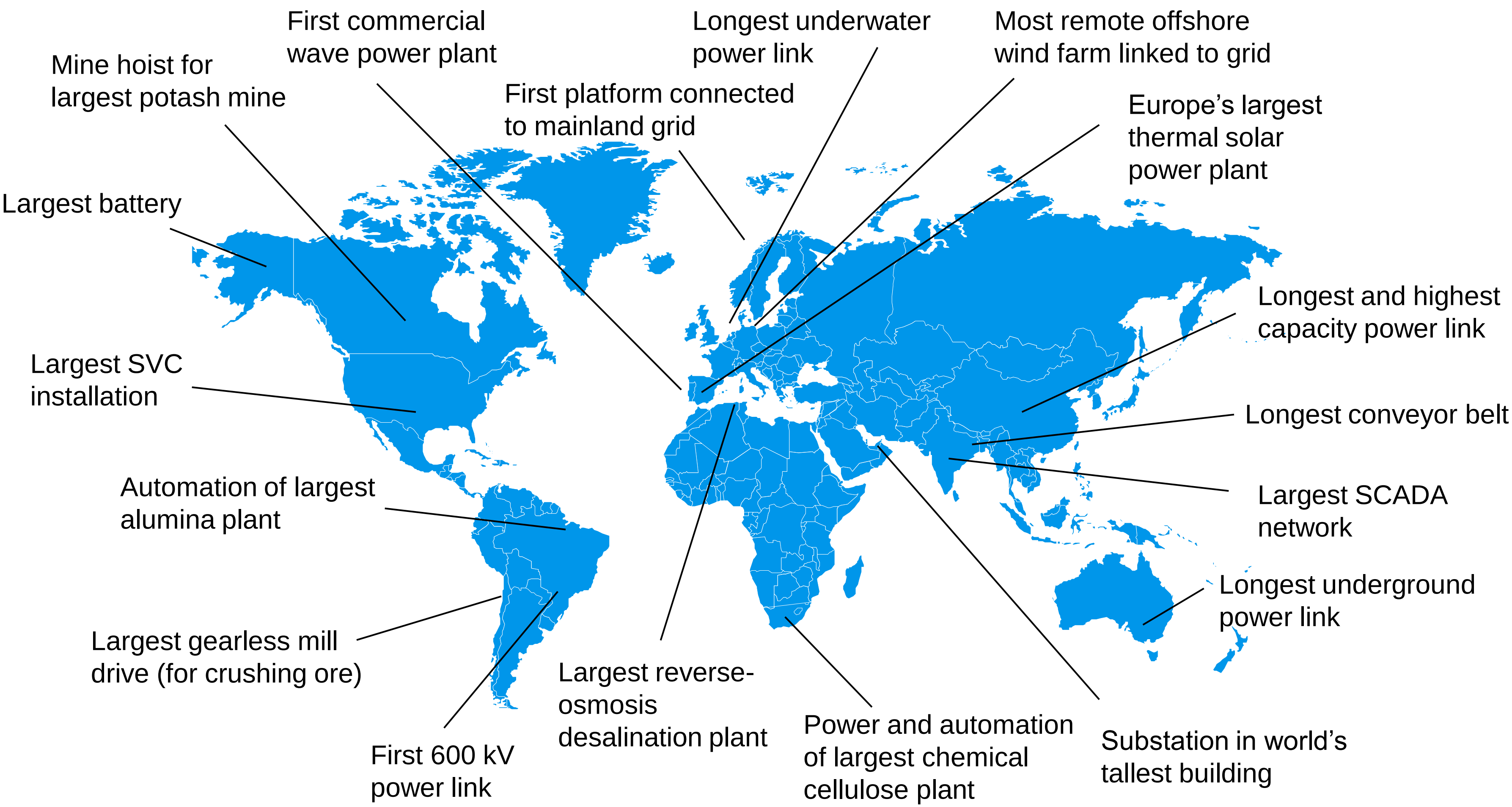
	Challenge	ABB solution
	▪ **China**: deliver 6,400 MW of hydropower over 2,000 km	▪ Transmission at ultrahigh voltage ▪ Minimal losses with direct current solution
	▪ **US**: Increase capacity and reliability for Texas utility	▪ World's largest installation enabling existing lines to carry more power ▪ Also enables integration of renewable energy
	▪ **India**: Improve reliability in grid serving state of Karnataka (pop. 53 million)	▪ Network management with real-time control ▪ Key building block for smart grid

Renewable energy
Key growth driver for both power and automation

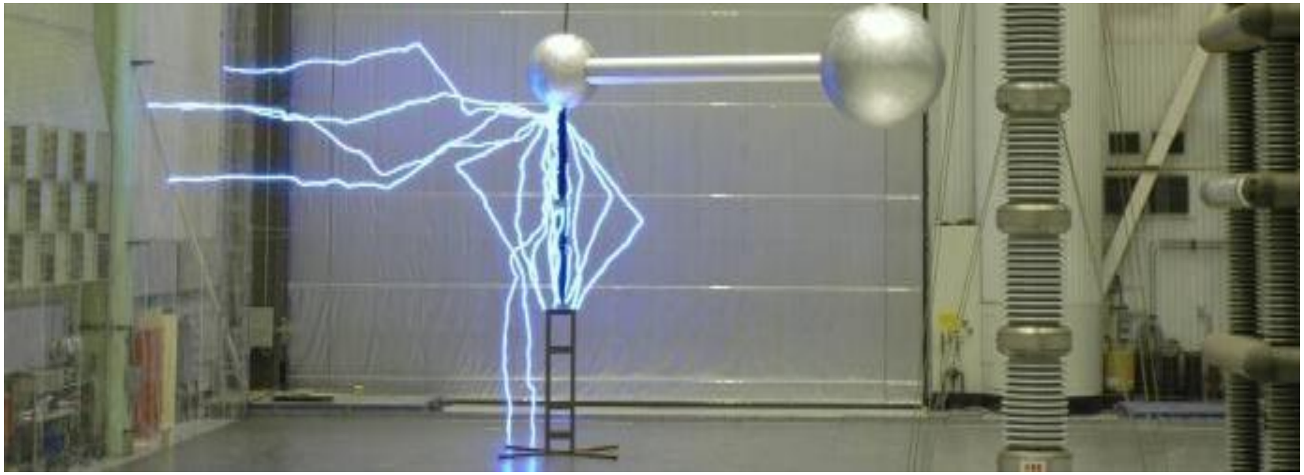
- Generation and transmission solutions for:
  - Hydro
  - Wind
  - Solar
  - Wave

Project examples	ABB scope
Xiangjiaba-Shanghai (China)	Grid connection
Wind Capital (US)	Transformers
La Sugarella (Italy)	Turnkey execution
Pelamis wave energy (Portugal)	Customized generators

Ground-breaking and nation-building projects
Pushing the boundaries of technology

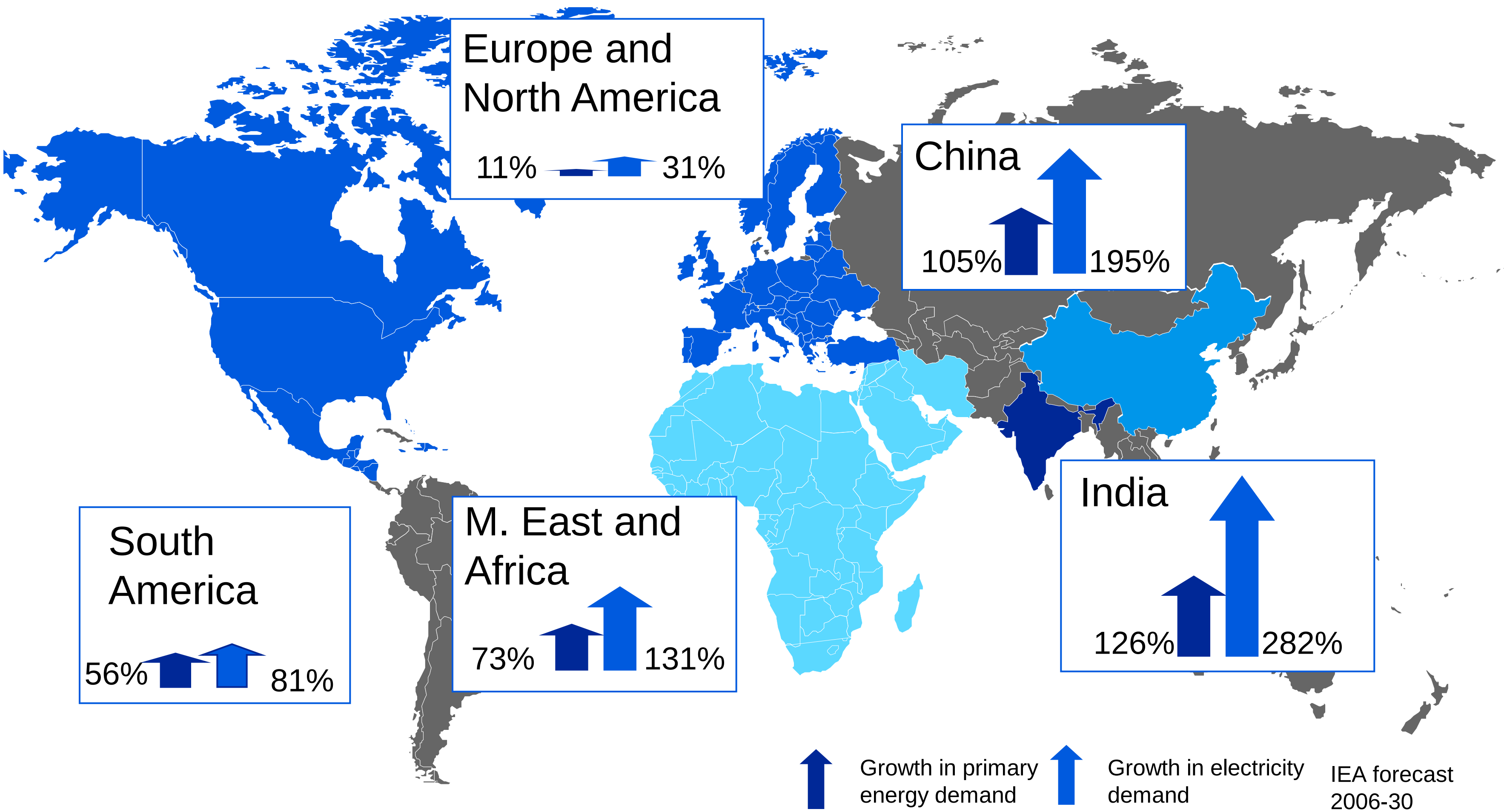


Innovation is key to ABB's competitive advantage
Leadership built on consistent R&D investment

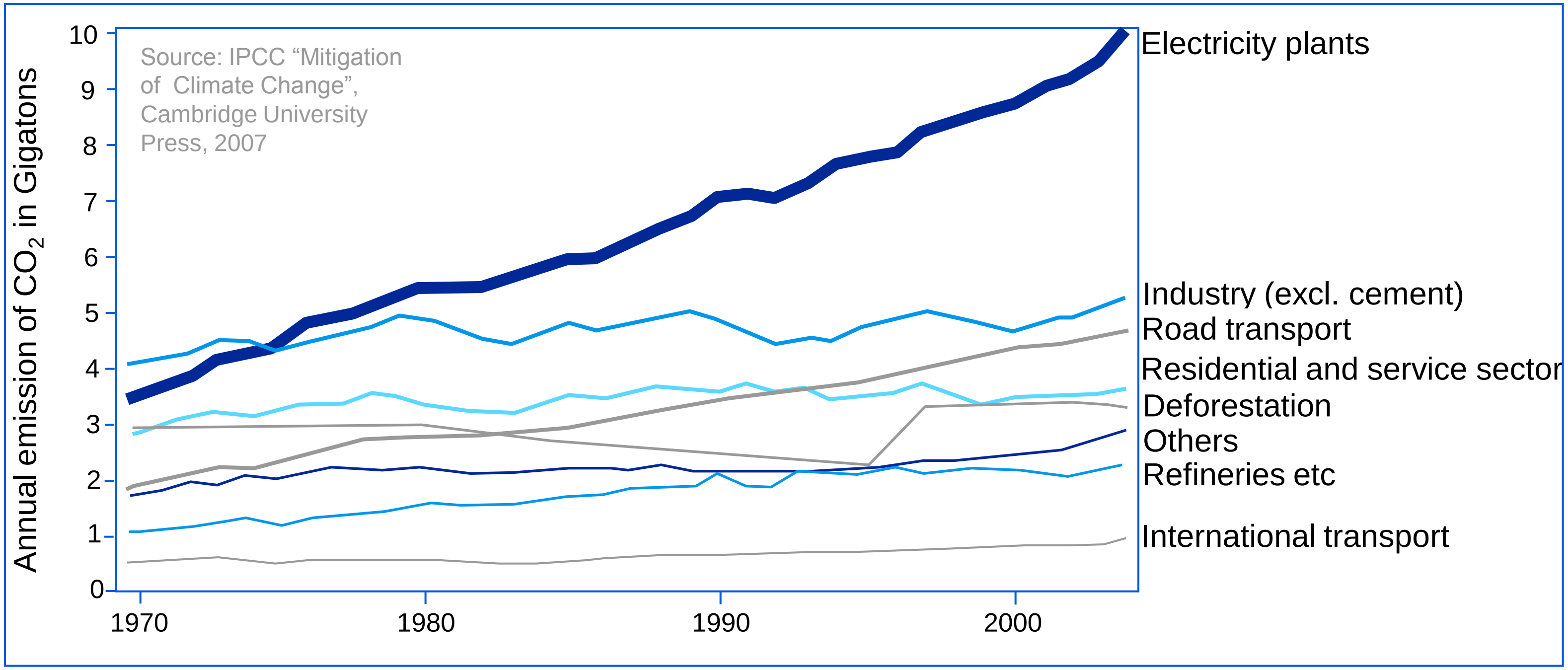


- More than $1.3 billion invested annually in R&D
- 7,500 scientists and engineers
- Collaboration with 70 universities
  - MIT (US), Tsinghua (China), KTH Royal Institute of Technology (Sweden), Indian Institute of Technology (New Delhi), ETH (Switzerland), Karlsruhe (Germany), AGH University of Science and Technology (Poland)

Today’s energy challenge – growing demand
Electricity demand rising twice as fast



Major challenge: environmental concerns



CO_2 is responsible for 80 percent of all greenhouse gas effects

More than 40 percent of CO_2 is generated by traditional power plants

Electric power generation is the largest single source of CO_2 emissions

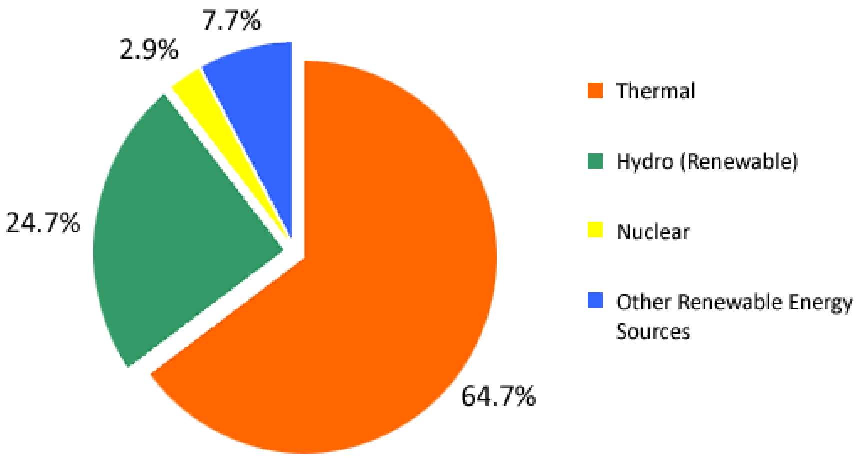
Today's Energy Challenge
Dilute link between growth, energy use and emissions

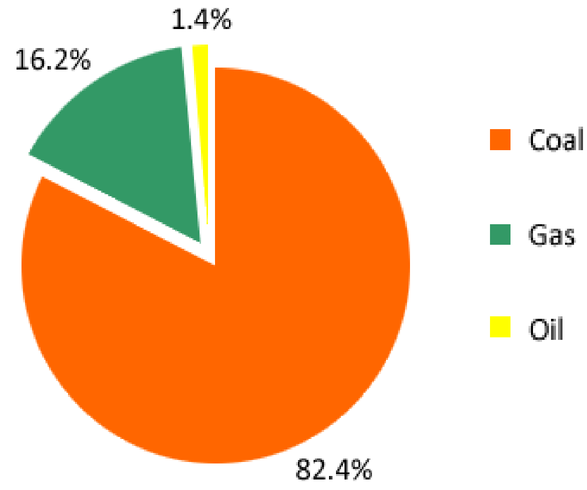
Meeting these challenges requires:

Reduce the correlation between economic growth and energy use	Reduce the correlation between energy use and emissions
Energy Efficiency	Renewable Energy

Energy efficiency and renewable power generation could provide almost 80 percent of the targeted reduction

Power Generation
Indian Scenario





- Total installed capacity: 157.2 Gw_e (2010)
- Growth projections
  - 78,700 MW addition during 11th Plan (2007-11)
  - 83,000 MW addition during 12th Plan (2012-16)
  - 100,000 MW addition during 13th plan (2017-21)
- By 2020, resulting increase in CO2 by ~1500 million tons / year

Ref: http://www.oifc.in/Resources/News/Sector-in-Focus-Indian-Power-Industry

Current Status of Thermal Power Plants in India
Efficiency Assessment

Case study of 60 coal fired plants across India

	Variable Return to Scale Score	Capacity			
		Small < 500 MW	Medium 500-1000 MW	Large > 1000 MW	
Best performer	1	5	7	7	19
Moderate performer	0.8-0.99	4	7	10	21
Laggards	< 0.8	12	7	1	20
		21	21	18	60

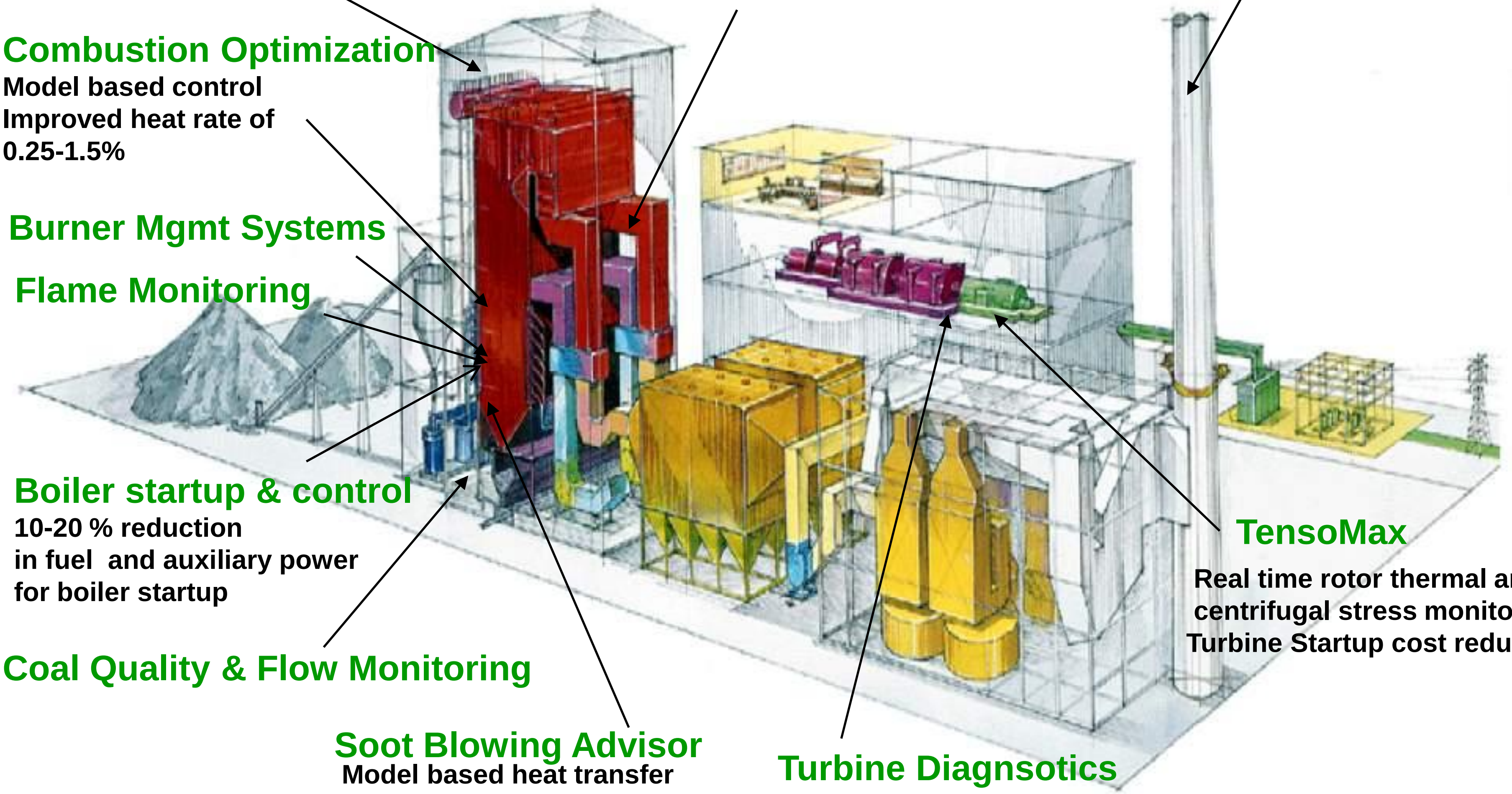
- Overuse of coal, secondary fuel oil and auxiliary power
- 33% (laggards) have potential to reduce inputs as much as 43%
- Primary issues –
  - sub-critical technology, poor combustion, poor condition monitoring, ageing, deteriorated aux equipments, sparse energy audits, lack of organization processes & best practices

** Reference:*
N. Shrivastava, S. Sharma and K. Chauhan, "Efficiency assessment and benchmarking of thermal power plants in India", Energy Policy, Vol.40, pp.159-176, 2012, Elsevier.

Energy Efficiency Improvements for Power Plants

Technology based solutions

Energy Efficiency - Technologies for Power Plants



Boiler Life Monitoring
Helps in maintenance & planning

Carbon in Ash Monitoring
Real-time, non-extractive, highly accurate carbon measuring in fly & bottom ash

Emission Monitoring & Control
Continuous and quantitative measurement CO, Nox, SOx and O2

Combustion Optimization
Model based control
Improved heat rate of 0.25-1.5%

Burner Mgmt Systems

Flame Monitoring

Boiler startup & control
10-20 % reduction in fuel and auxiliary power for boiler startup

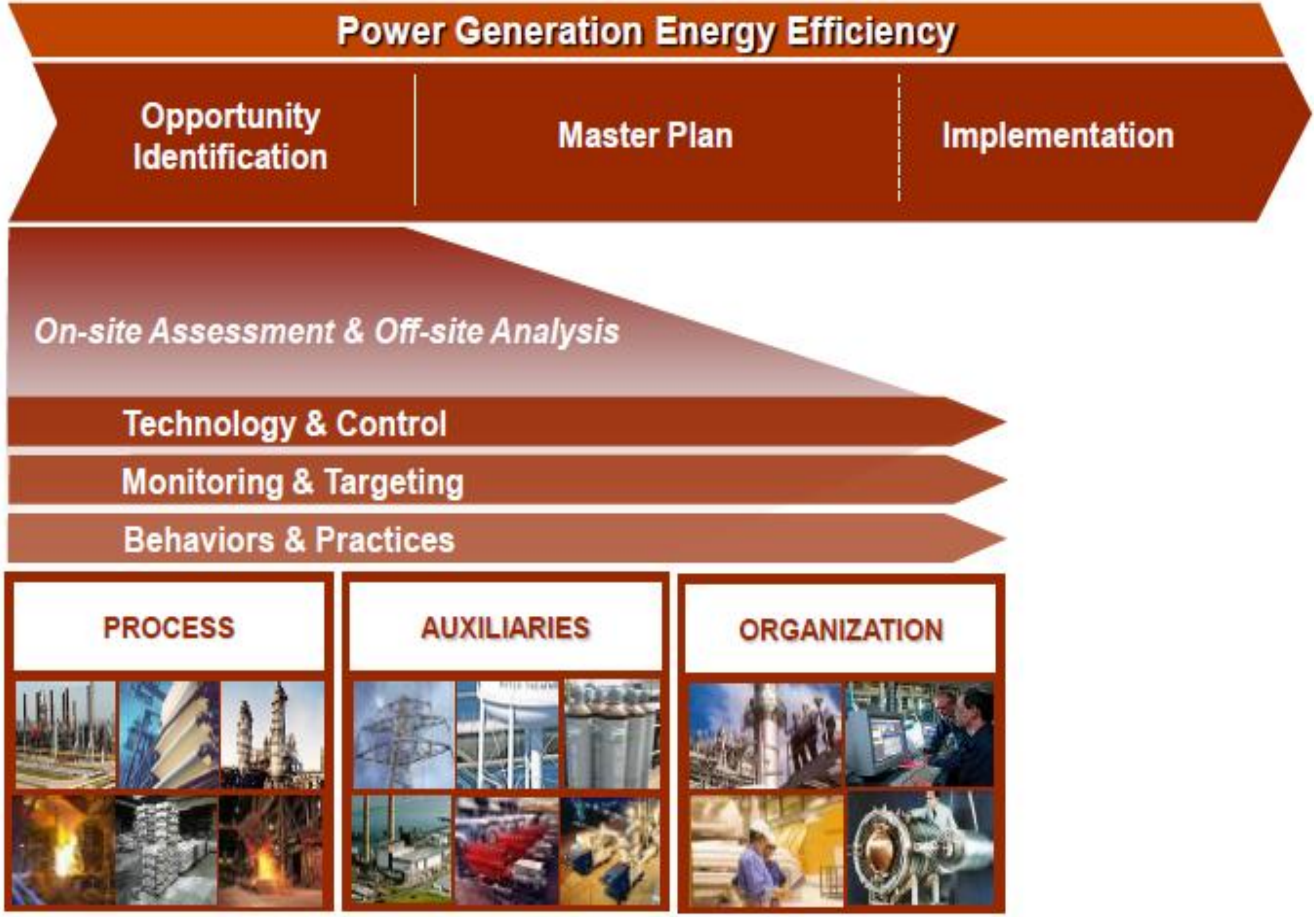
Coal Quality & Flow Monitoring

TensoMax
Real time rotor thermal and centrifugal stress monitoring
Turbine Startup cost reduction

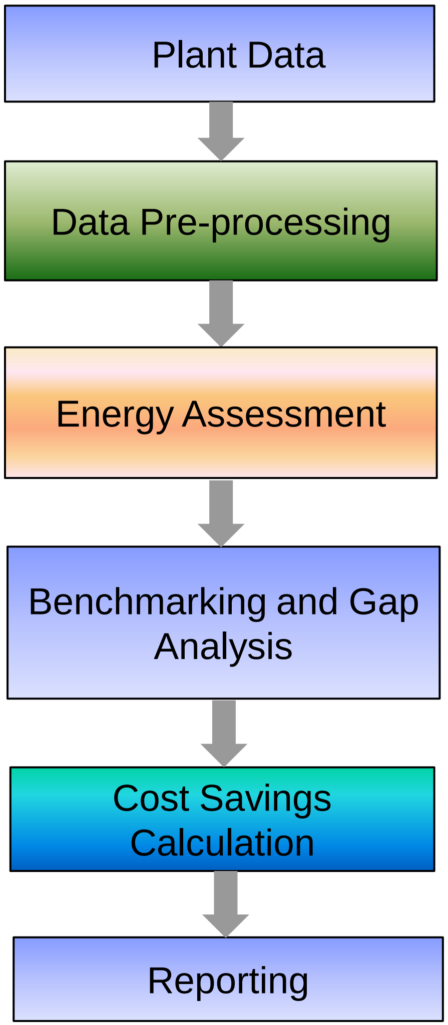
Soot Blowing Advisor
Model based heat transfer calculations
Optimized soot blowing for improved efficiency

Turbine Diagnsotics
Tracks turbine life consumption based on fatigue, creep of turbine components
Improves maintenance planning

Energy Fingerprinting & Analysis
End to end solution



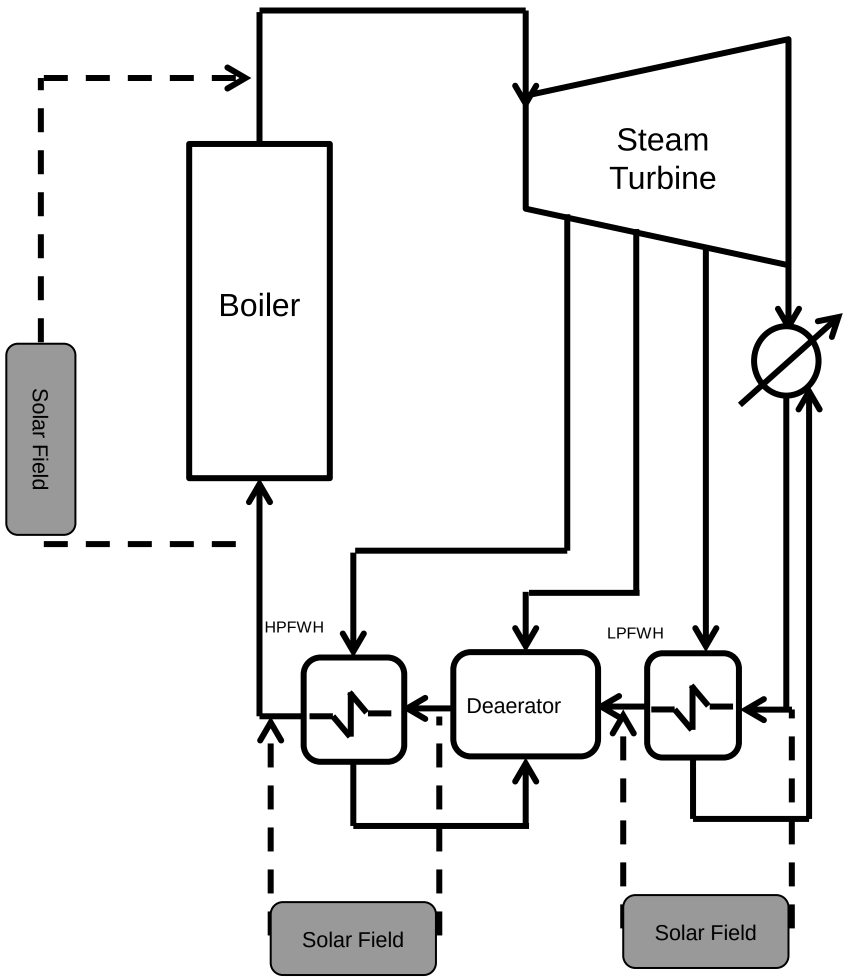
Energy Efficiency Improvement Services
Methodology



- Quick identification of opportunities for energy efficiency improvements by
  - Energy flow distribution analysis
  - Efficiency, KPIs and losses calculation
  - Establishing benchmark
  - Identifying gaps/opportunities by comparing performance against standards/benchmark.
  - Performing cost-benefit analysis and recommend solutions
- Implementation of energy efficiency improvement plan
- Continuous monitoring & interventions for optimal performance

Solar Steam Augmentation
Carbon reduction thro renewables

Fossil Fired Power Plants
Scope for Solar Steam Augmentation



- For feed water pre-heating as well as direct injection into turbines
- Most modern steam cycles are able to handle increased steam mass flows (boosted power output) with up to around 5-10% above the rated turbine capacity
- Solar integration only includes solar field, retrofitting and control system costs (40% less compared to stand-alone solar thermal power plant)
- There are lesser issues related to fluctuation of power generation compared to standalone solar power plants
- Fuel Savings as well as reduced exergy loss by reduced turbine extractions

Significant CO2 reduction potential
150 Million tons / year per 500 MW power plant

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Power Generation Solar Steam Augmentation
Technology challenges

Solar augmentation / technology tradeoff

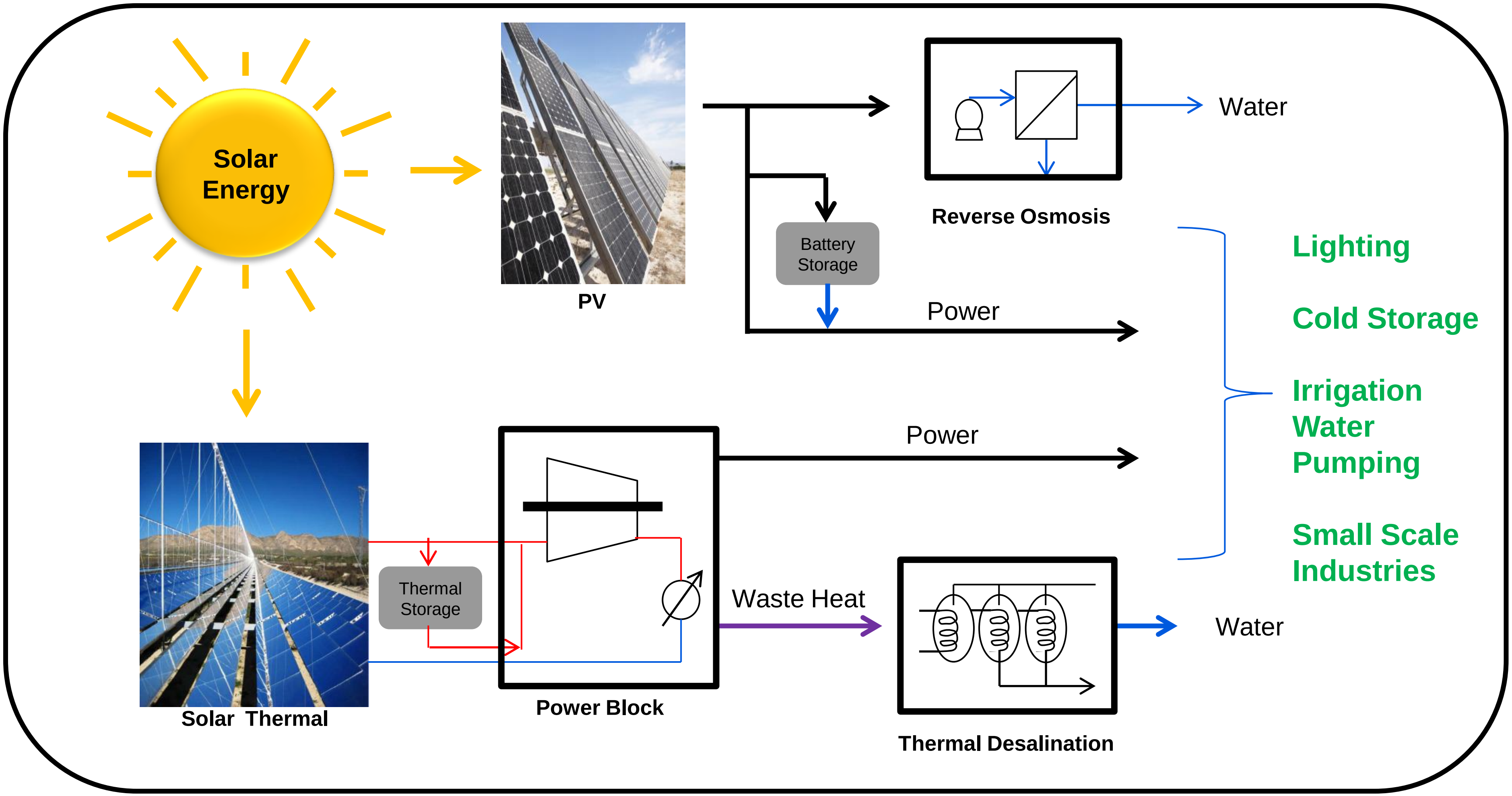
- Identification of the best possible solar thermal technology
- Design optimization and integration strategies
- Potential savings economic benefits study and recommendations

Advanced control and operations

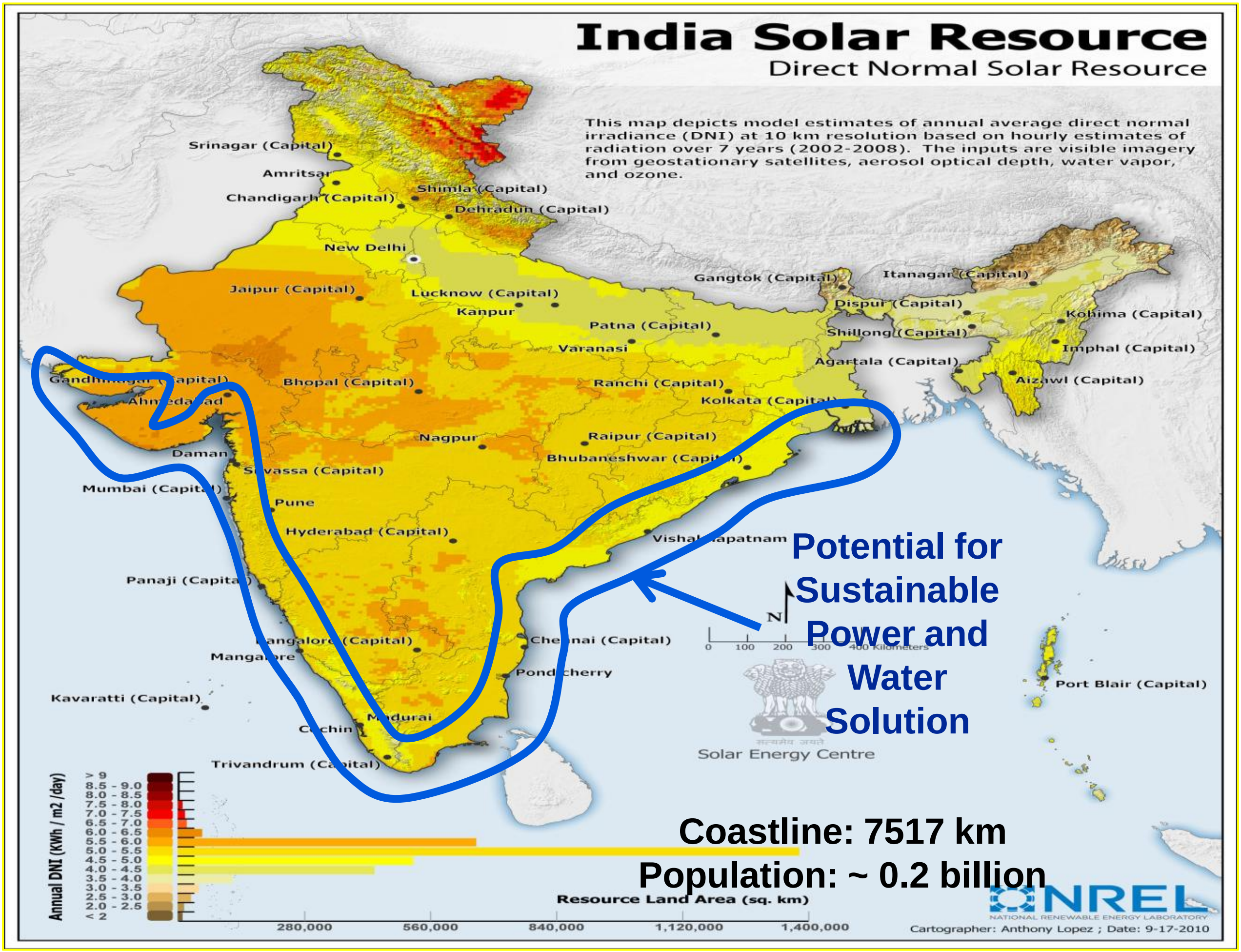
- Overall steam integrated system optimization through advanced control and optimal allocation of solar steam
- Integration with the DCS for ease of operation and maintenance

Power & Water using solar energy
Renewables for sustainability

Power and Water
Solar Energy is the Key to Sustainability



Sustainable Power and Water
Solar Solution for India



Source: NREL

Power and productivity
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