Capabilities & Challenges for Power Equipment Suppliers

CII National Conference on Emerging Opportunities for Capital Goods Industry

THERMAX babcock&wilcox Energy Solutions

Mr. Deepak Chopra
COO, TBWES

51%

49%

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THERMAX

B&W thebabcock&wilcoxcompany

Leading Indian Energy, Environment Company

TBWES
A World-Class
Super Critical Technology
Boiler Manufacturer

Leader In Advanced Energy Technology Innovation in Nuclear, Fossil Power & Environmental Control

- Phase-I Investment : INR 835 Cr/ 170million USD
- Phase-I Manufacturing capacity : 3000 MW
- Plant Operational date : March 2013

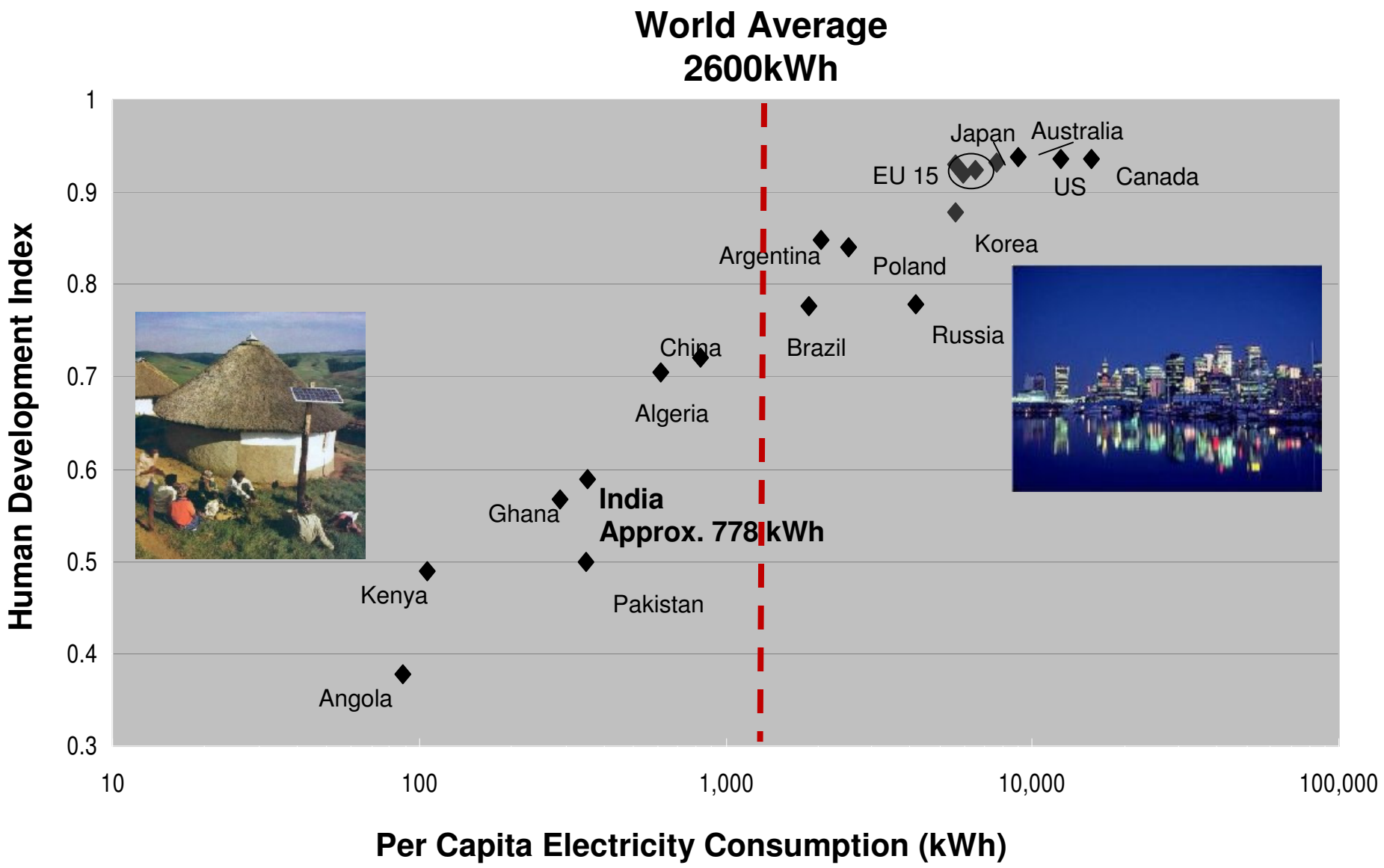
Discussion Framework

1. CONTEXT
2. OPPORTUNITIES
3. CHALLENGES

Agenda

1. CONTEXT
2. OPPORTUNITIES
3. CHALLENGES

INDIA'S PER CAPITA ENERGY CONSUMPTION WELL BELOW GLOBAL AVERAGE



AGENDA

1. CONTEXT
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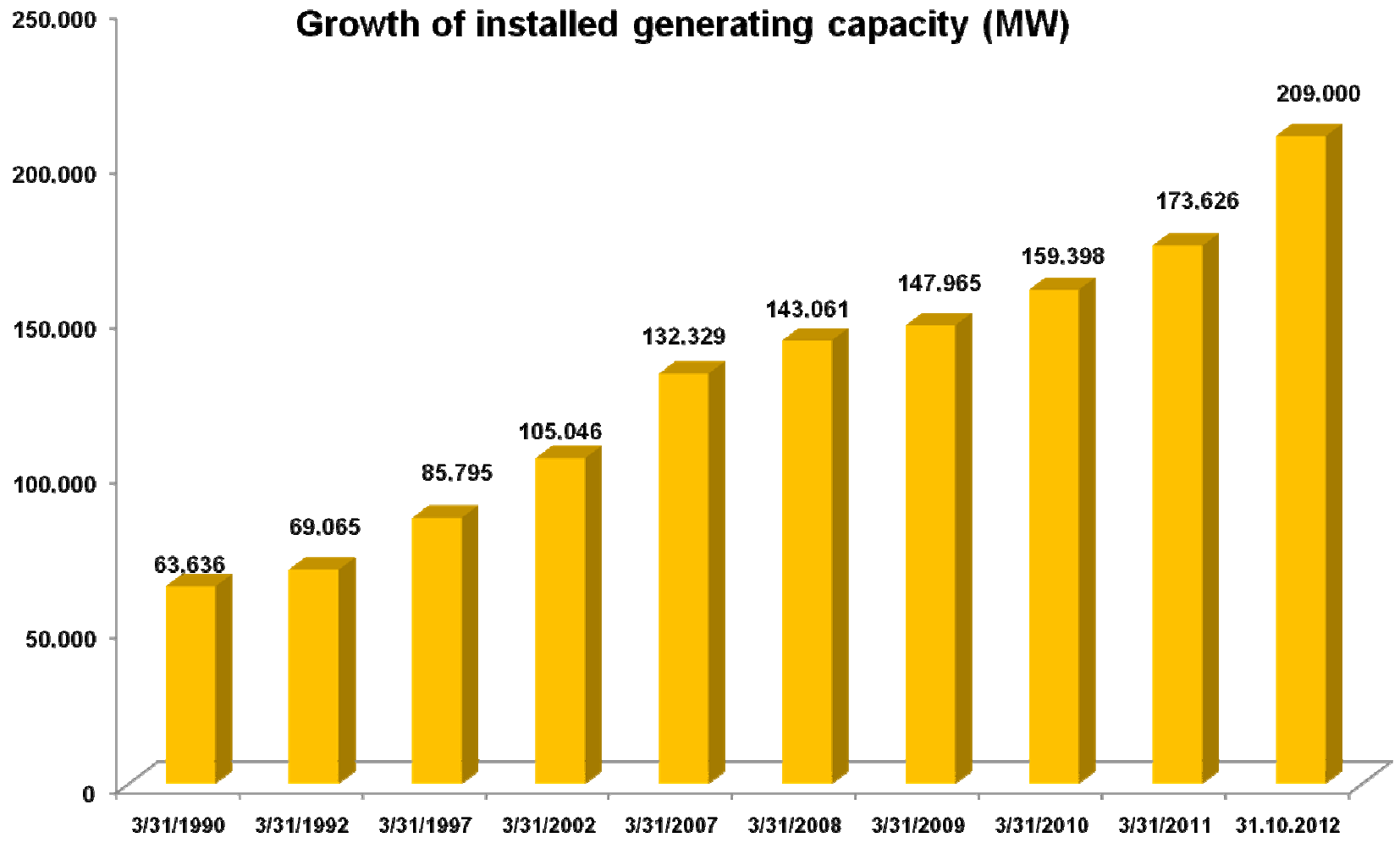
3. CHALLENGES

APPRECIABLE CAPACITY ADDITIONS, YET…



Source : CEA

MAJOR DEMAND SUPPLY GAP PERSISTS

	FY 09	FY 10	FY 11	FY 12
Energy Demand Growth	5.4%	6.7%	3.8%	8.6%
Peak Demand Growth	2.9%	6.1%	4.1%	6.4%
Energy Supply Growth	3.9%	7.8%	5.7%	8.9%
Peak Supply Growth	3.2%	7.4%	6.5%	6.5%
Energy Deficit	**(11.0%)**	**(10.1%)**	**(8.5%)**	**(8.3%)**
Peak Deficit	**(13.7%)**	**(12.6%)**	**(10.7%)**	**(10.5%)**

Electrical energy a key for sustained economic growth

Source: CEA, CERC

GOVERNMENT PROCUREMENT POLICIES

1. Creation of Domestic Manufacturing Capacity
2. Creation of Jobs & Skill Base
3. Creation of Strong Indigenous Supply Chain

AGENDA

1. CONTEXT
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3. **CHALLENGES**

THE INDIAN ENTREPRENEURS RESPONDED ENTHUSIASTICALLY

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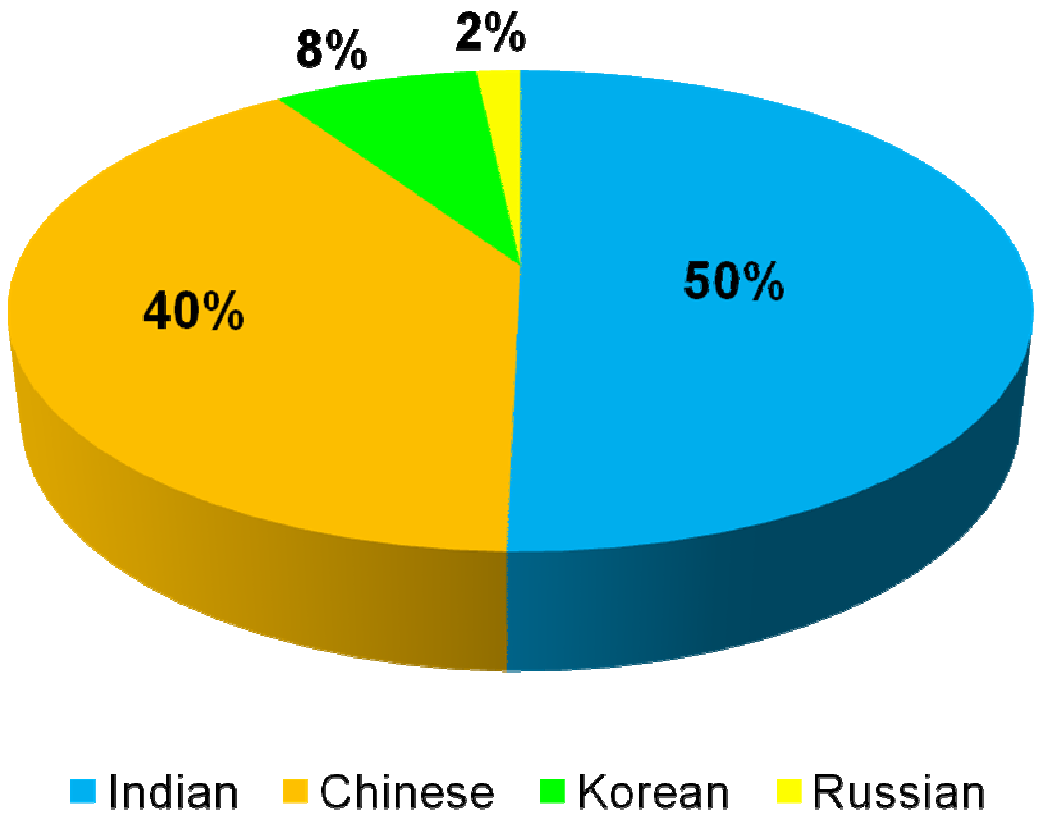
1. **Technology Transfer Facilitation**
2. **Greenfield Investments**
3. **Modern Capacity, Job & Skill Development**

Name	Capacity installed MW	New Capacity/Expansion Announced	Remarks
BHEL (Alstom)	15000	5000	BLR/TG
L&T (JV with MHI)	4000	1000	BLR/TG
TBWES		3000	BLR
Doosan (Doosan Babcock)		1000	BLR/TG
BGR (JV with Hitachi)		3000	TG
Ansaldo	1500		BLR
CVL (Riley)	5000		BLR
Dong Fang			BLR/TG
Alstom Shanghai JV		3000	BLR/TG
IJT (Fooster Wheeler)		2000	BLR/TG

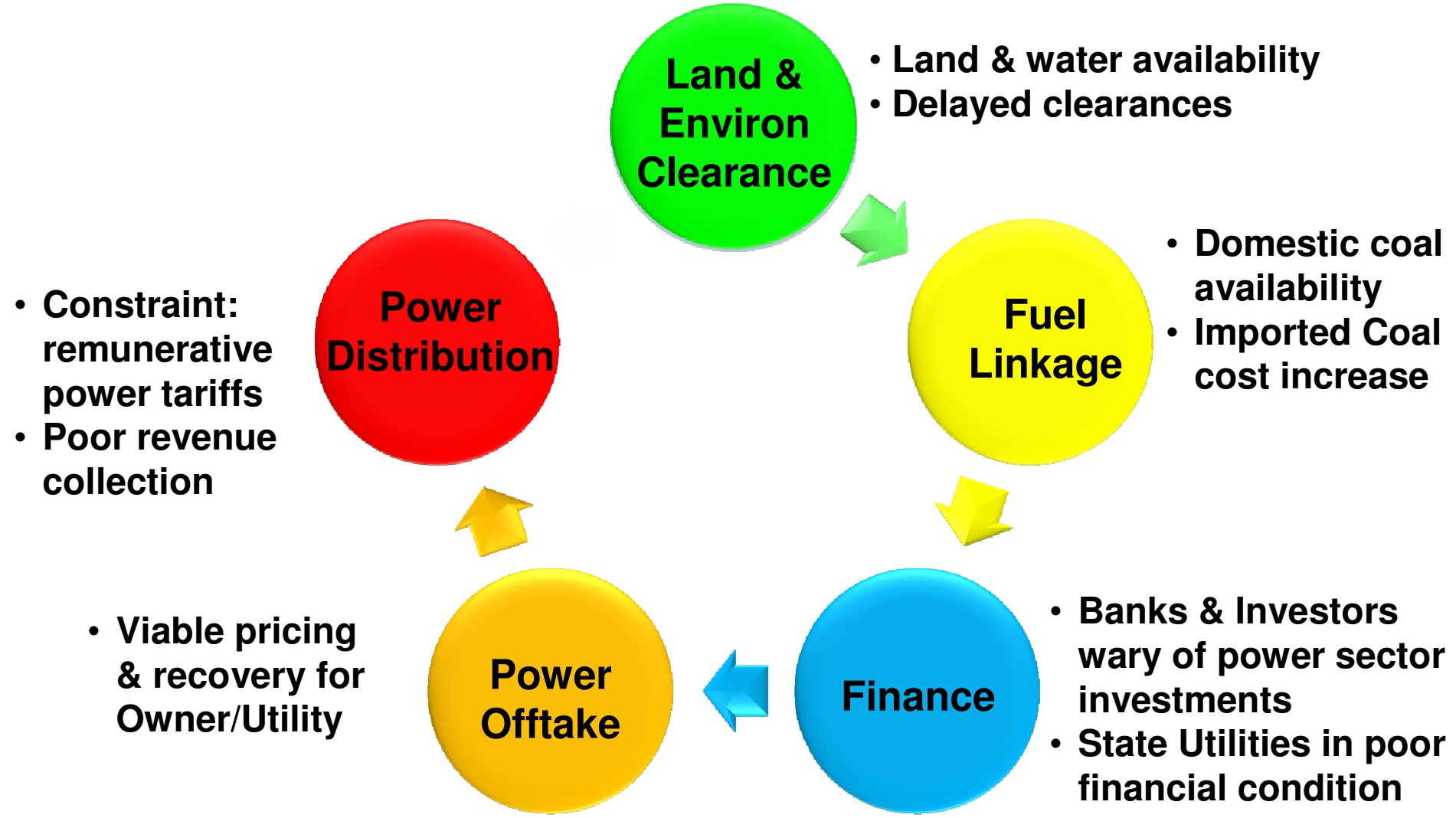
AS DOMESTIC CAPACITY WAS BEING ADDED, CHINESE & KOREAN IMPORTS CONTINUED



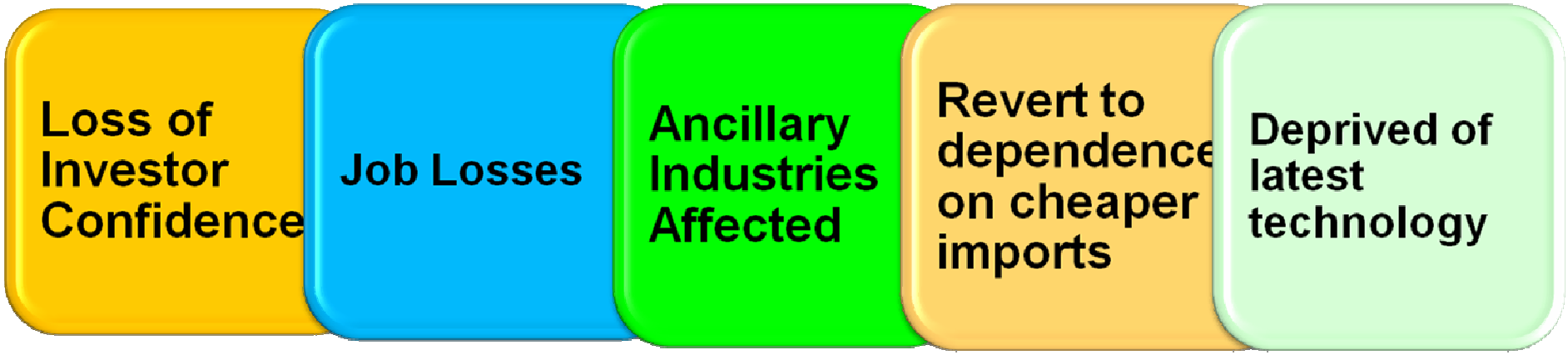
Significant opportunity loss for domestic manufacturers

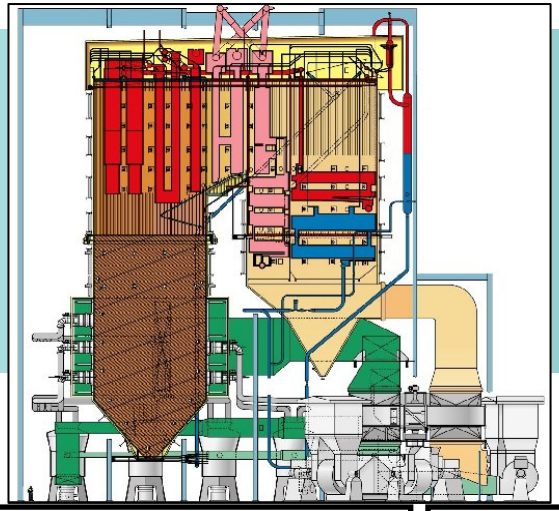
Source: Industry

POWER SECTOR HOBBLED BY NEGATIVE SENTIMENTS

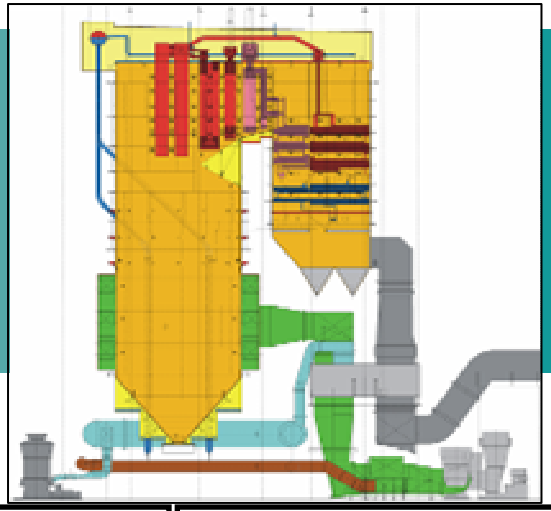


REPERCUSSIONS FOR POWER INDUSTRY





Supercritical vs. Subcritical



247 kg/cm2

565ºC/593ºC or

565ºC/600ºC or

600ºC / 600ºC

Cycle efficiency ~ 4% more then subcritical

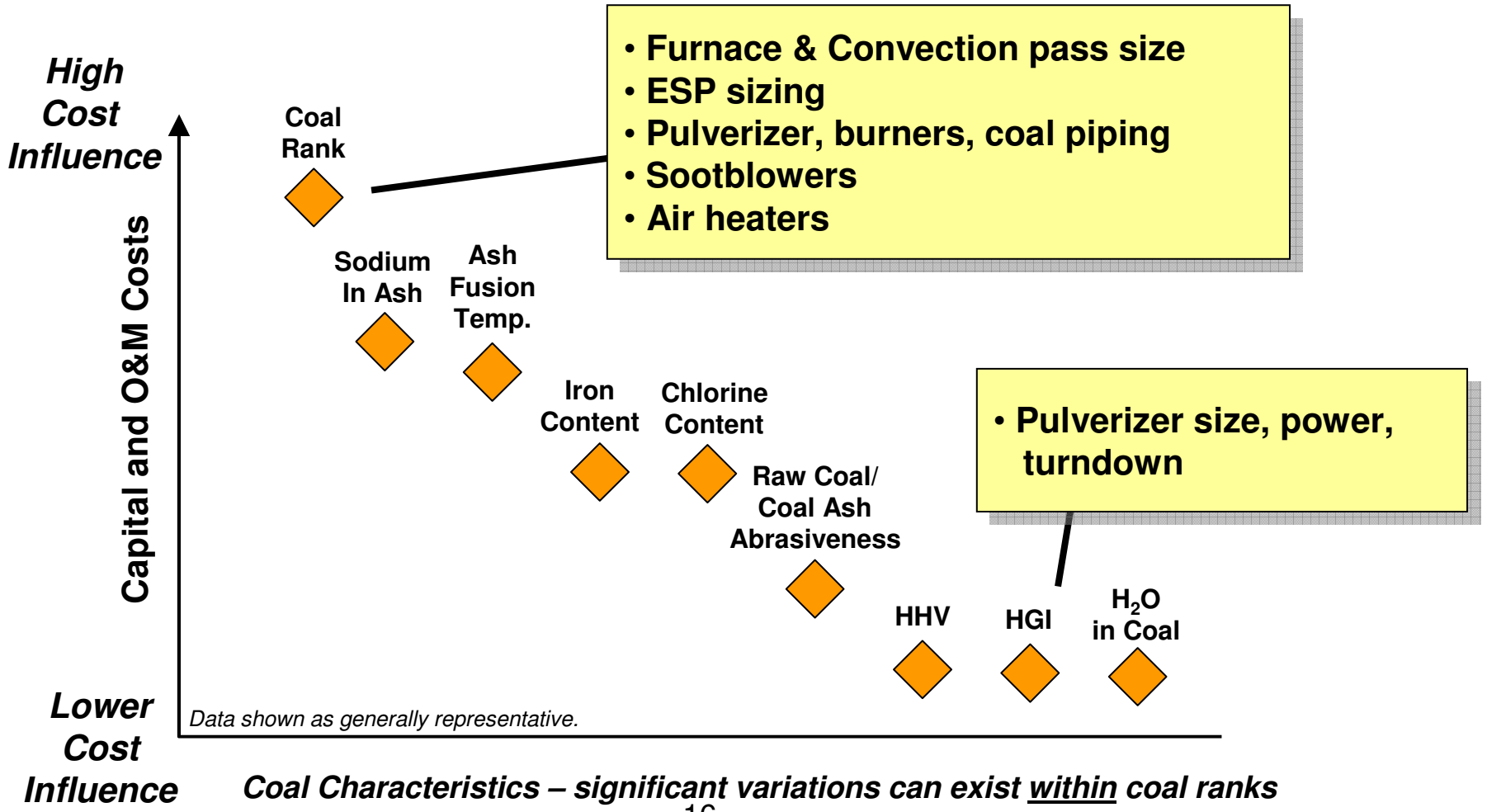
- Same gas side design arrangement
- Same boiler efficiency
- Better steam cycle efficiency
  - Lower fuel consumption
  - Reduced emissions per kW
- Requires high purity water
- Controls are more complex

175 kg/cm^2

540ºC / 540ºC

Fuel Flexibility

Coal Characteristics Drive Boiler Cost



Coal Characteristics – significant variations can exist <u>within</u> coal ranks

Unique Characteristics of Indian Coals

- Low ranking coal
- Highly abrasive due to quartz content
- Medium slagging and medium fouling potential
- Widely varying constituents
- High inerts require special combustion system design
- Low heating value – increased sizing of fuel handling equipment
- High fly ash erosion potential.
  - High ash content
  - High SiO_2 + Al_2O_3 content (high quartz)

Indian Coal Challenges

- High ash Indian coals call for burner designs suitable for low ignition factor and low load flame stability
- B&W's Enhanced Ignition burners suited for fuels with high percentage of inert matter
- B&W's burner and combustion system meets NOx emission standards
- Development programs to address future emission norms

Customer Expectation

- **Equipment design for varying coal quality**
- **Reliability & Availability**
- **Stable operation at optimum efficiency**
- **Ability to support varying coal quality**
- **Long term service & maintenance support**
- **Local supply chain**

Are fulfilled when…….

…..Supplier Partner has:

- **Developed proven technology**
- **Ability to customize design for local conditions**
- **Track record to meet committed performance**
- **In-house R&D capability**
- **Long term commitment through investment and access to technology**
- **Developed local supply chain**

TBWES and B&W committed to….

- Offer customized solutions
- Develop local fuel & emission testing facility
- Maximize Indigenous manufacture of critical technology components
- Offer local operation & service support

Spiral Wound Furnace Design

- Proven design – over 425 units worldwide
- Tolerant of heat flux upsets from:
  - Fuel variability
  - Furnace cleanliness (slagging conditions)
  - Different mill combinations
  - Future upgraded firing systems
- Successful operation at subcritical and supercritical pressures
- Long furnace enclosure life

High Ash Coal Experience at Millmerran 420 MW

COAL CHARACTERIZATION		Millmerran Design Coal	Millmerran Ranges (± 2σ)	Typical Indian Coal 1	Typical Indian Coal 2
Slagging	-	Medium	Medium	Medium	Medium
Fouling	-	Medium	Medium	Medium	Medium
Ash Type	-	Lignitic	Bituminous or Lignitic	Bituminous	Bituminous
$SiO_2 + Al_2O_3$	wt %	89.20	90.35	90.10	89.58
Ash Loading	lb/MKB	44.77	63.26	56.30	70.71
Velocity Limit	m/s (ft/s)	~12 m/s (35 ft/s)	~10 m/s (30 ft/s)	~10 m/s (30 ft/s)	~12 m/s (35 ft/s)

Suggestion points

- **Technical specs of ESP, RGAH & other auxiliaries are with over specified margins**
- **Specs rationalization for optimal cost**
- **Numerous performance guarantees…maturing market calls for rationalizations**

Future - USC Materials Development Challenges

- **Fireside Corrosion and Coatings**
- **Steam Side Oxidation**
- **Welding and Manufacturing Development**
- **Header Design 600C and 700+C**

Future - USC Materials Development Challenges

MATERIALS FOR ADVANCED STEAM CYCLES - TUBING

Recent B&W Experience

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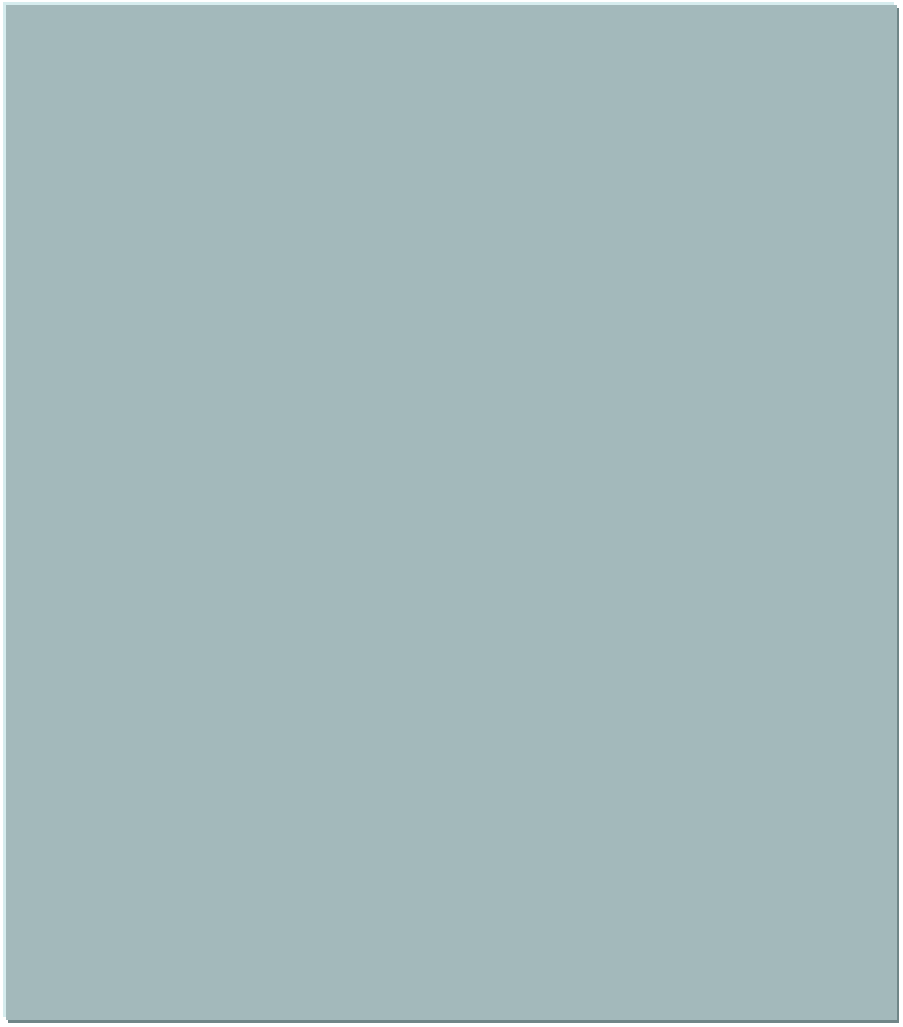
Contract Number	Owner	Station	Country	Nominal Capacity (MW)	Maximum Capacity (MW)	Steam Flow (ton/hr)	SH Outlet Pressure (bar)	SH Steam Temp (C)	RH Steam Temp (C)	Fuel	Boiler Type	Order Year	Start-Up Year
2009G11	China Resources Power Holding Co Ltd	Weishanhu 2	China	600	691	1909	265	585	585	PC	SWUP	2008	2014
2009G10	China Resources Power Holding Co Ltd	Weishanhu 1	China	600	691	1909	265	585	585	PC	SWUP	2008	2014
2010G1	China Guodian Corporation	Boxing 2	China	1000	1095	3035	276	605	603	PC	SWUP	2007	2014
2009G3	China Guodian Corporation	Boxing 1	China	1000	1095	3035	276	605	603	PC	SWUP	2007	2014
2010G4	China Resources Power Holdings Co Ltd	Liuzhi 2	China	1000	1085	3129	263	571	603	PC	SWUP	2008	2012
2010G3	China Resources Power Holdings Co Ltd	Liuzhi 1	China	1000	1085	3120	263	571	603	PC	SWUP	2008	2012
2008G2	Guizhou Xingyi Power Development	Xingyi 2	China	600	697	1900	254	571	569	PCa	VTUP-W	2008	2012
2007G16	Guizhou Xingyi Power Development	Xingyi 1	China	600	697	1900	254	571	569	PCa	VTUP-W	2008	2012
2010G12	Hebei Construction and Investment	Sha He 2	China	600	658	2015	254	571	569	PC	SWUP	2009	2011
2010G11	Hebei Construction and Investment	Sha He 1	China	600	658	2015	254	571	569	PC	SWUP	2009	2011
2010G6	China Guodian Corporation	Bulian 2	China	660	711	2103	263	605	603	PC	SWUP	2008	2011
2010G5	China Guodian Corporation	Bulian 1	China	660	711	2103	263	605	603	PC	SWUP	2008	2011
UP-150	Prairie States Generating Company	Prairie State Energy Campus	USA	750	825	2681	262	568	569	PC	SWUP	2007	2011
UP-157	AEP Southwestern Electric Power Company	John W Turk, Jr 1	USA	600	709	2056	262	601	608	PC	SWUP	2006	2011
2009G15	China Power International Holding Ltd	Wuhu 2	China	660	741	2091	262	585	585	PC	SWUP	2008	2010
2009G14	China Power International Holding Ltd	Wuhu 1	China	660	741	2091	262	585	585	PC	SWUP	2008	2010
2009G1	China Guodian Corporation	Xingyang 2	China	600	676	1950	254	571	569	PCa	VTUP-W	2007	2010
2008G11	China Guodian Corporation	Xingyang 1	China	600	676	1950	254	571	569	PCa	VTUP-W	2007	2010
2008G9	China Resources Power Holdings Co Ltd	Heze 2	China	600	691	1850	265	603	585	PC	SWUP	2007	2010
2008G8	China Resources Power Holdings Co Ltd	Heze 1	China	600	691	1850	265	603	585	PC	SWUP	2007	2010
UP-149	Prairie States Generating Company	Prairie State Energy Campus	USA	750	825	2681	262	568	568	PC	SWUP	2007	2010
2008G6	China Datang Corporation	Jinzhushan 1	China	600	666	1913	254	571	571	PCa	VTUP-W	2007	2009
UP-151	TXU	Monticello 4	USA	858	945	2833	262	585	585	PC	SWUP	2006	2008[2]
UP-147	Wisconsin Public Service	Weston North 4	USA	530	599	1651	261	585	585	PC	SWUP	2004	2008
2007G2	Zhejiang Power Bureau	Lanxi 4	China	600	658	1910	254	571	569	PC	SWUP	2003	2007
2007G1	Zhejiang Power Bureau	Lanxi 3	China	600	658	1910	254	571	569	PC	SWUP	2003	2006
2006G6	Zhejiang Power Bureau	Lanxi 2	China	600	658	1910	254	571	569	PC	SWUP	2003	2006
2006G5	Zhejiang Power Bureau	Lanxi 1	China	600	658	1910	254	571	569	PC	SWUP	2003	2006
2006G3	Hebei Electric Power Admin	Xibaipo III-2	China	600	669	1950	254	543	569	PC	SWUP	2003	2006
2005G7	Hebei Electric Power Admin	Xibaipo III-1	China	600	669	1950	254	543	569	PC	SWUP	2003	2006
UP-144	Intergen	Millmerran 2	Australia	420	454	1275	249	568	596	PC	SWUP	1999	2002
UP-143	Intergen	Millmerran 1	Australia	420	454	1275	249	568	596	PC	SWUP	1999	2002

Future - Advanced USC Concept for Indian coal



A-USC

Indian Coal

5,057,900 lb/hr 4550 psi 1298F/1347F

637.3 kg/s 31.3 MPa 703C/730C

90ft W x 54ft D x 310ft H

27.4 m W x 16.5m D x 94.5m H

Why B&W & TBWES ?

Proven Technologies **– conservative designs; high reliability and low maintenance costs; ongoing R&D**

Project Execution Experience **– market leadership; single point responsibility; working relationships**

Low Life Cycle Cost **– competitive capital costs; design for constructability; lower O&M costs**

Long Term O&M Support **– B&W & TBWES Service Business focus, Field Engineering, Maintenance, Users Groups**

Thank You!