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Kuching, Sarawak, Malaysia

New Power & Power Quality Situation in China



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Outline

- Energy in China
- Electricity
- Smart Grid
- Power Quality



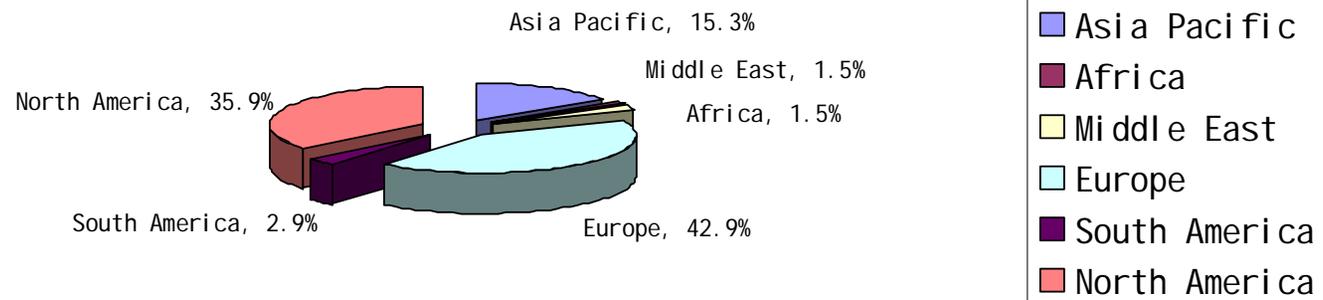
About China.....

Population; 1st
GDP; 2nd (2011)

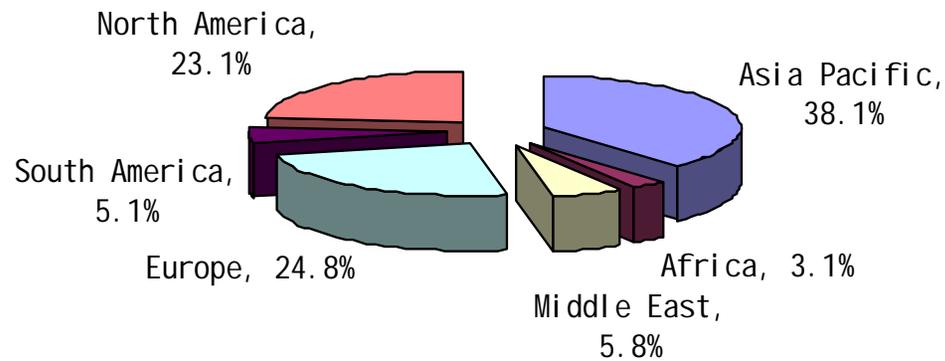
What about the
energy?

Energy consumption in world

1971, Primary Energy Consumption



2010 Primary Energy Consumption



Proved reserves of fossil energy

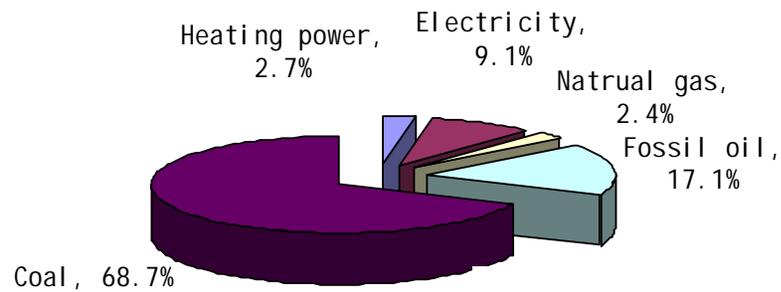
Top 5 countries

Rank	Coal		Fossil oil		Natural gas	
	Country	Reserves (Billion tons)	Country	Reserves (Billion barrels)	Country	Reserves (K billion m ³)
1	US	237.3	Saudi Arabia	264.5	Russia	44.8
2	Russia	157.0	Venezuela	211.2	Iran	29.6
3	China	114.5	Iran	137.0	Qatar	25.3
4	Australia	76.4	Iraq	115.0	Turkmenistan	8.0
5	India	60.6	Kuwait	101.5	Saudi Arabia	8.0

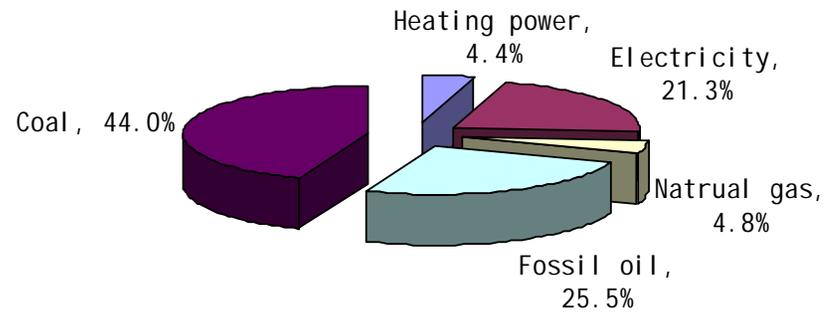
Proved reserves of fossil oil per capita China vs World Avg

Type	China	World	China/World
Coal (Tons)	85.9	122.7	70.0%
Fossil oil (Tons)	1.5	27	5.6%
Natrual gas (m ³)	1840	27843	6.6%

Structure of energy end-use consumption in China



1990



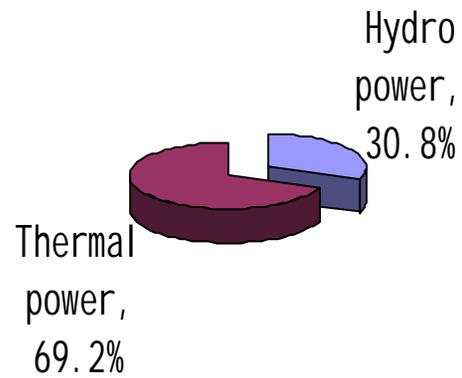
2010

Electricity vs Energy end-use

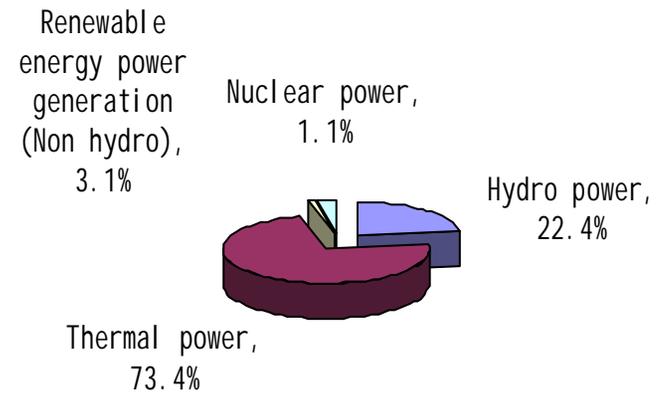
Unit: %

Country	1971	1980	1990	2000	2005	2009
USA	10.1	13.3	17.5	19.5	20.3	21.4
Japan	14.7	19.0	21.5	23.6	24.3	25.5
British	13.4	15.4	17	18.8	19.9	21.0
France	8.6	12.7	18.1	20.2	21.4	22.7
Germany	10.7	13.6	16.2	17.9	18.5	19.0
India	3.1	4.3	7.3	10.0	11.5	13.8
Brazil	5.8	10.6	16.2	17.8	17.9	18.3
Russia	NA	NA	11.4	12.4	13.4	13.9
China	2.9	4.3	6.3	11.7	15.8	18.5

Structure of power generation capacity in China

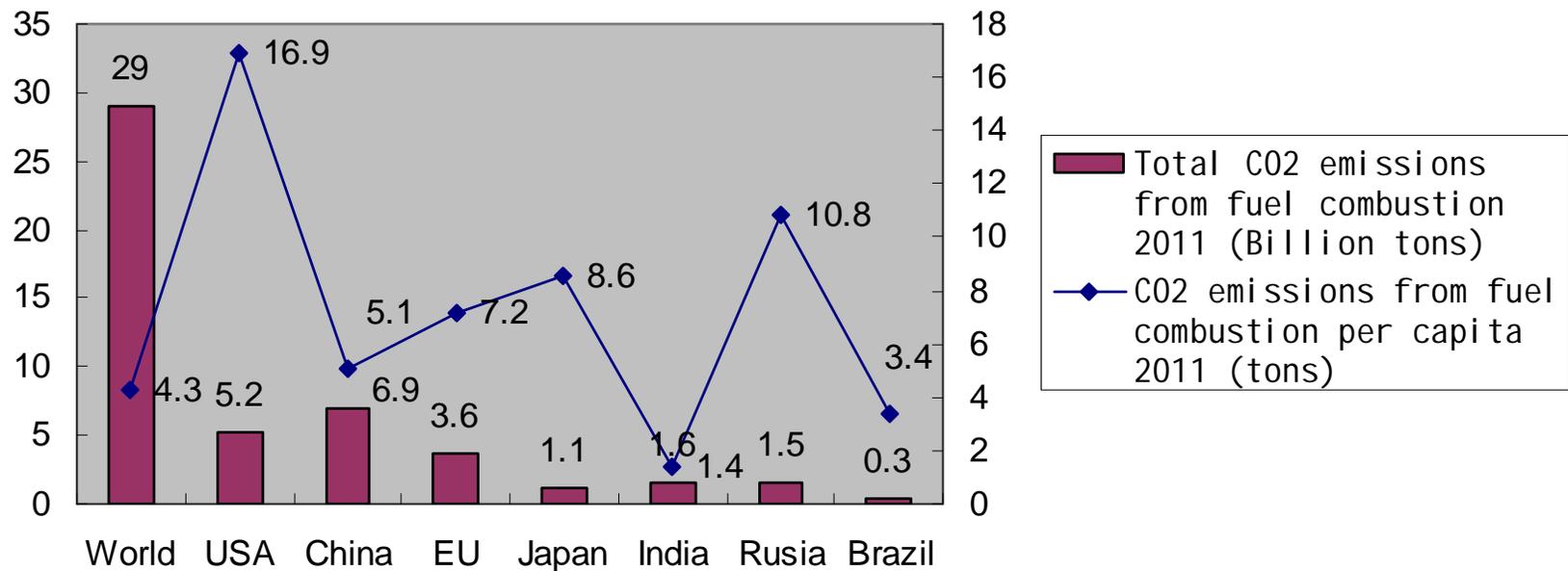


1980



2010

CO2 Emissions from Fuel Combustion 2011



- Chinese government decided by 2020 China's carbon dioxide emissions per unit of GDP than in 2005 fell by 40%-45%.

Principles of energy utilization

- Security
- Intension
- High efficiency
- Diversity
- Cleaning

Hydro power resources



Nuclear power stations in operation and under construction



$E=MC^2$

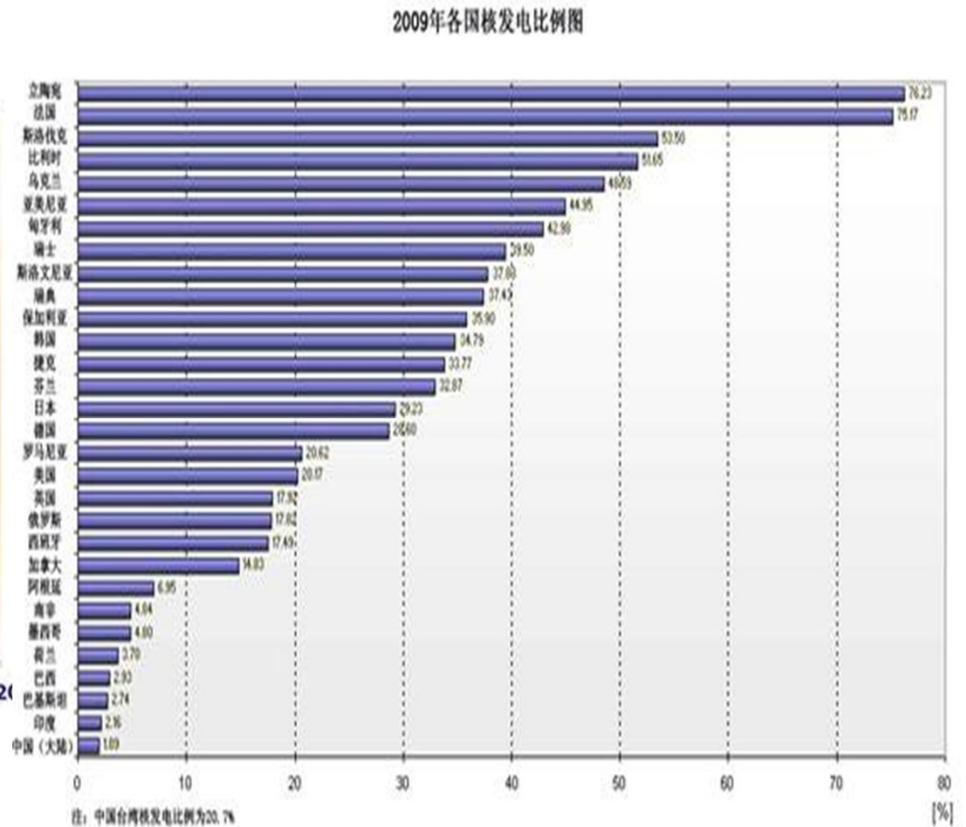
- Nuclear waste
- Calentation- Thermal pollution
- Radiation

Nuclear power generation

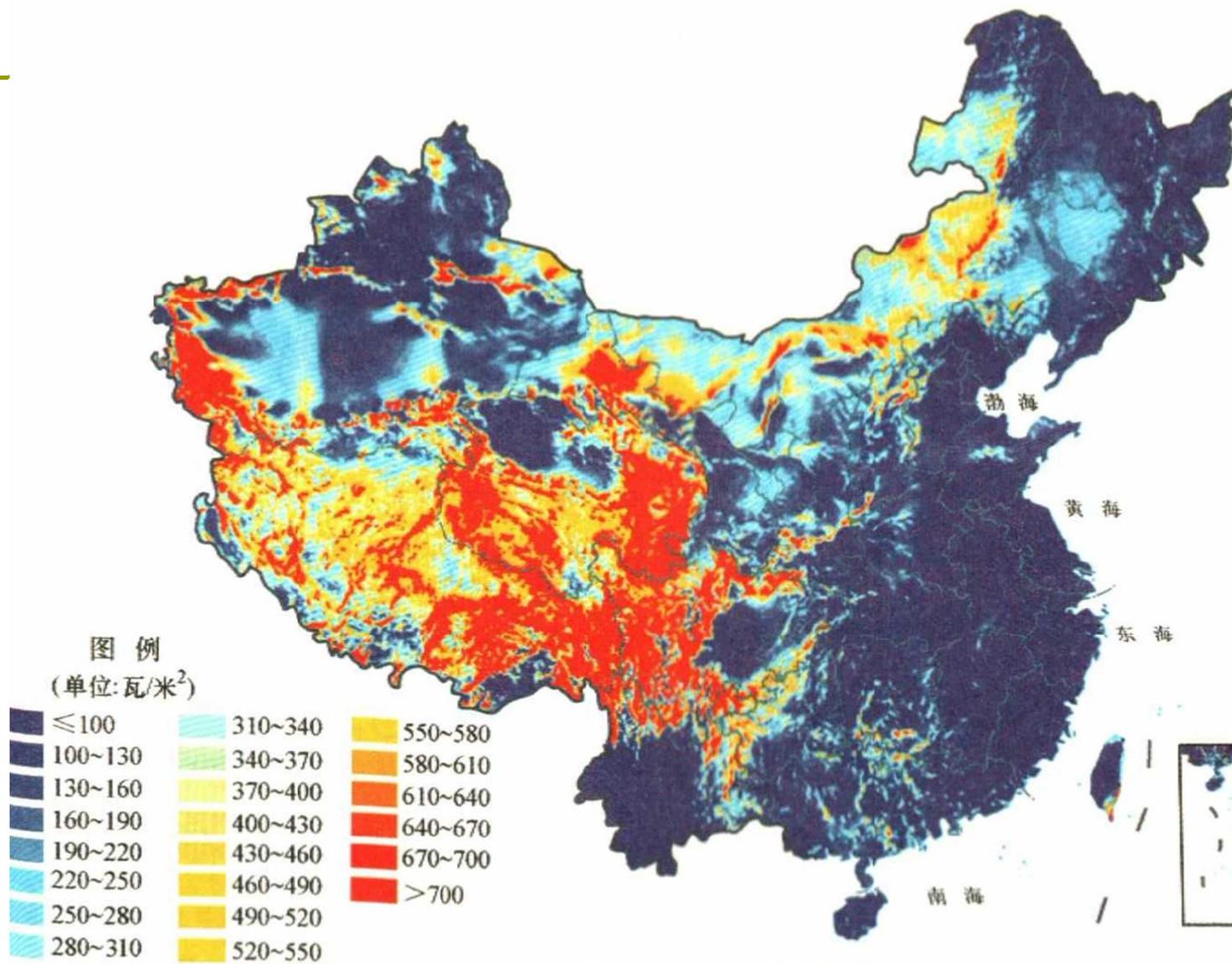
- Total # of nuclear generators in world: >440



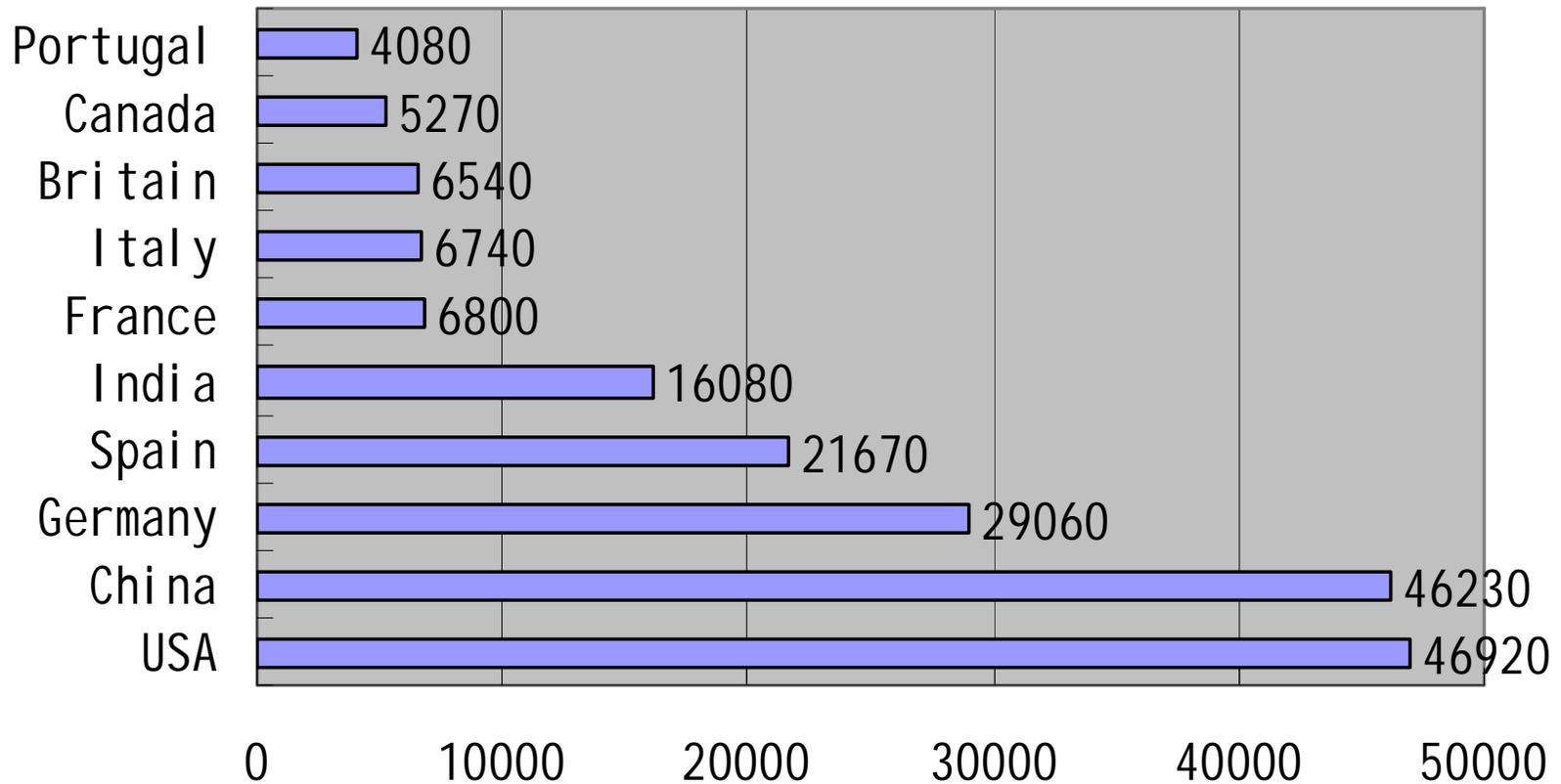
图6：全球核电站运行机组数量图



Wind resources



Top 10 countries with installed capacity of wind farms (MW)



Large wind farms (>10,000 MW)

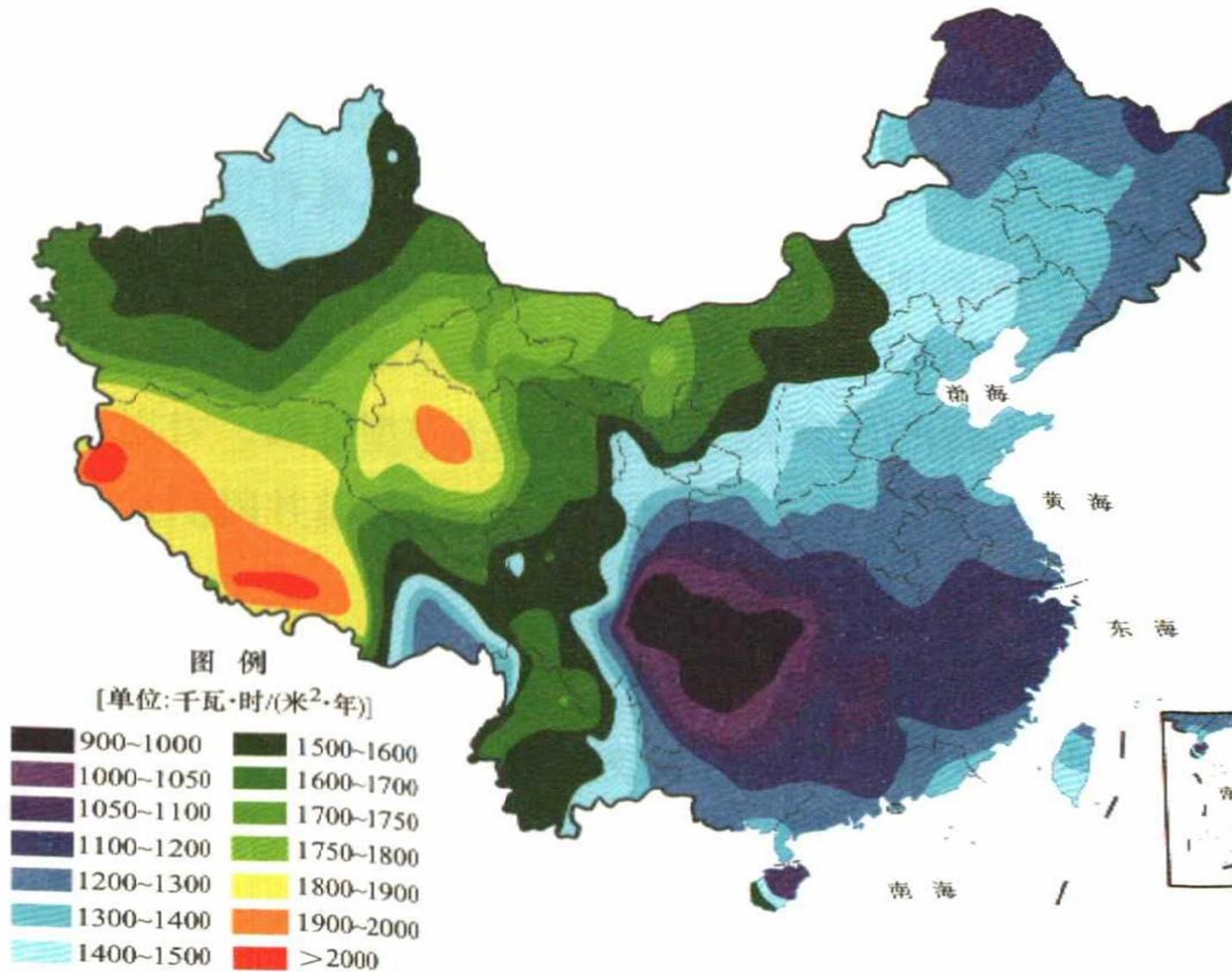


Plan for wind farm development

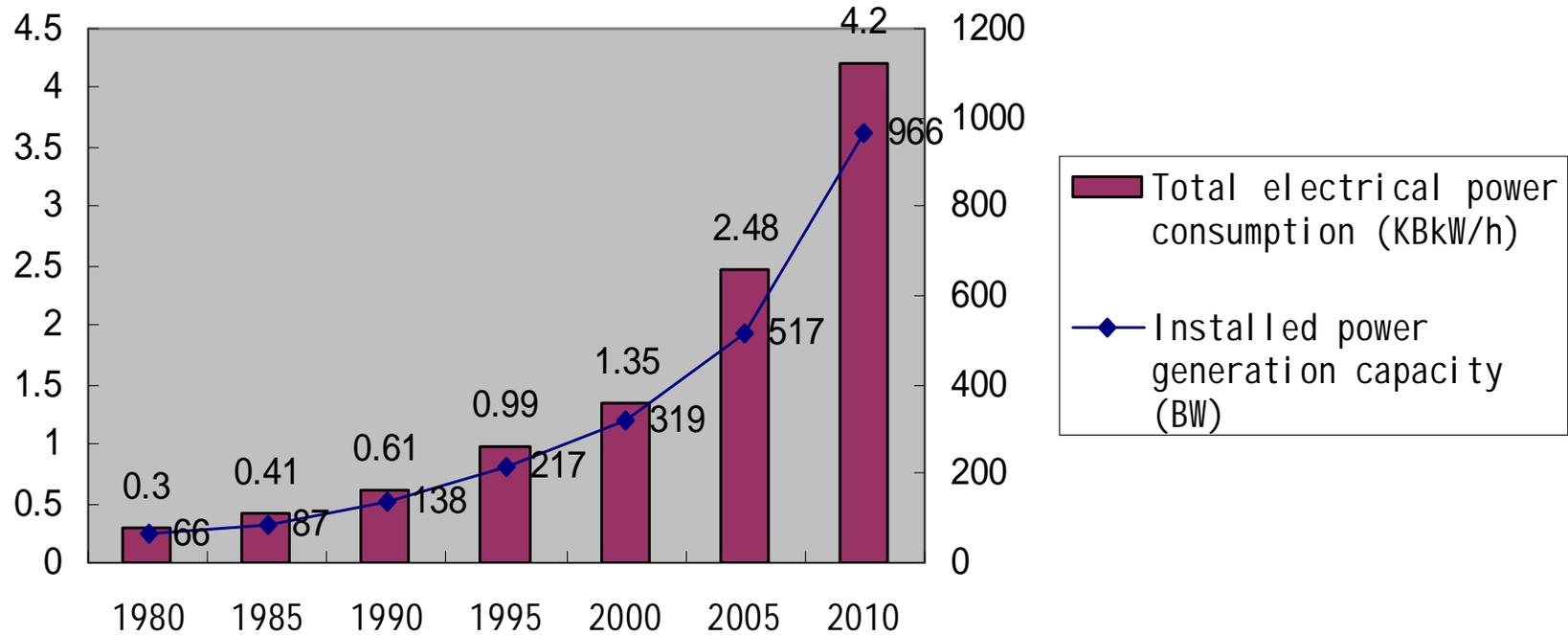
Unit: MW

Wind farms	Installed capacity by 2020	Installed capacity by 2030
Jiu Quan	20000	32000
Ha Mi	10000	20000
He Bei	16000	18000
Inner Mongolia West	27000	40000
Inner Mongolia East	12000	27000
Jilin	10000	27000
Coast Jiangsu	10000	20000
Coast Shandong	15000	25000
Total	120000	209000

Solar power resources

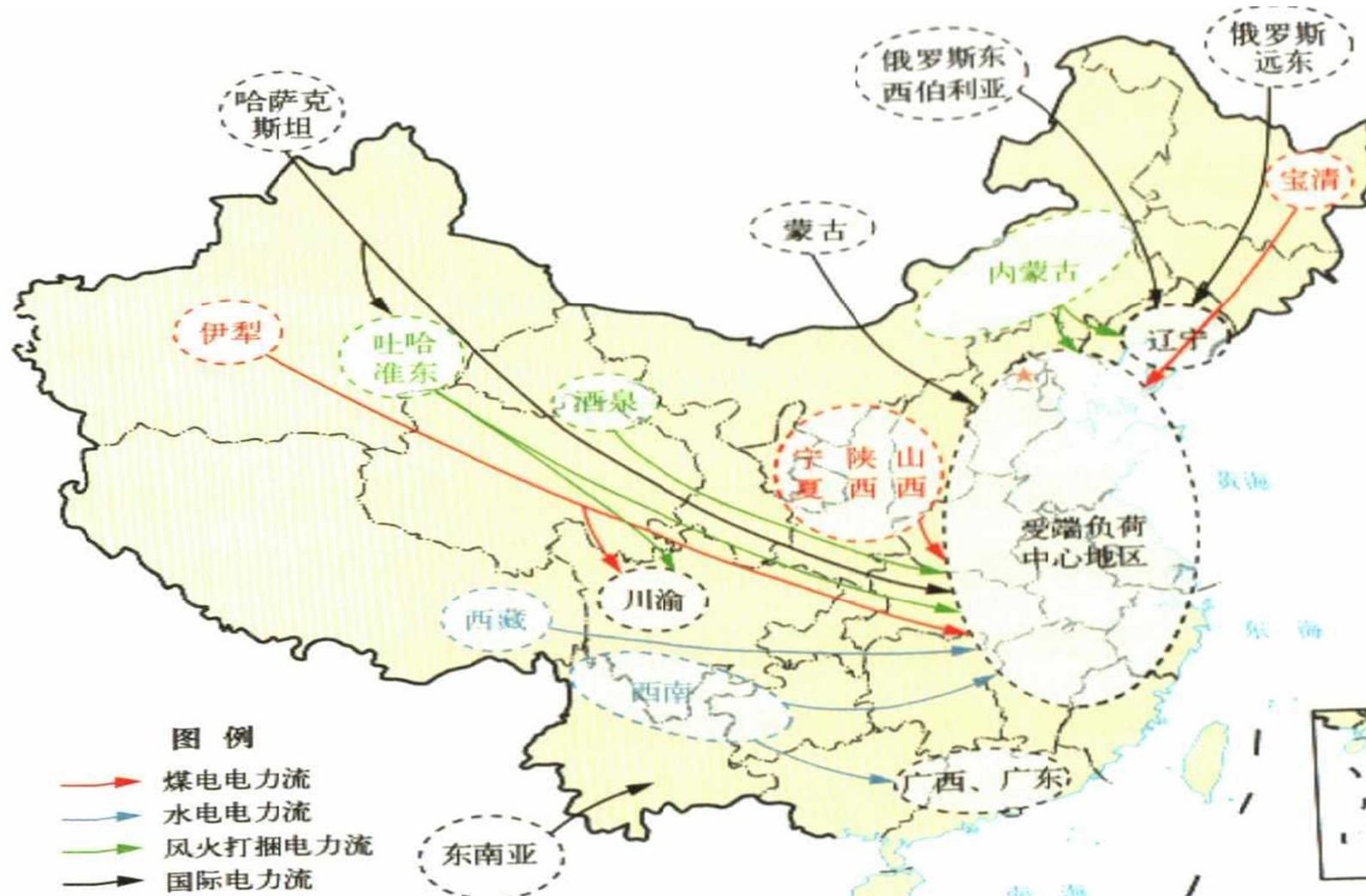


Total Electricity consumption and installed power generation capacity



	1980	1985	1990	1995	2000	2005	2010
Total electrical power consumption (KBkW/h)	0.30	0.41	0.61	0.99	1.35	2.48	4.20
Installed power generation capacity (BW)	66	87	138	217	319	517	966

Plan for future power flow



Strategy for smart grid

- Renewable energy power generation
 - Distributed power supply system
- Improve technology of power transmission and distribution.
- Smart electricity utilization
- Standards-for HV transmission, clean energy, electric automobile and charging, smart dispatch.—49 related enterprise standards were published in 2011 by China State Power Grid Corp.
- Information based smart grid.
 - Communication automation

Target of SG development

Power generation

- 2012: Realize development of co-ordination between power generation side and power grid.
- 2020: Realize power overall planning,
 - Automatic control power generation from power grid.
 - On line monitoring to major equipment
 - Provide alarm information
- 2030: Realize intelligent operation for both power generation and distribution

Target of SG development

Power transmission (1)

- 2012: Builds strong transmission network, constructs flexible and reasonable distribution grid architecture.
- 2020:
 - More reliable, economical for clean and variety of energy.
 - A system with on-line monitoring, fault forecast and alarming, partly self-healing.
 - GIS based SG.
 - Distributed power generation with sequential switch in and out.

Target of SG development

Power transmission (2)

- 2030:
 - Full coordination for different grids.
 - Resources configuration most optimized.
 - Realize fully closed loop for system measurement and control
 - High capable self-healing
 - Intelligent power dispatching system

Target of SG development

Power distribution (1)

- 2012: Establishing advanced marketing and management system.
- 2020:
 - Strong client experience and service. A new model of customer interact relation.
 - Meet variety of needs of customers. Two way management system.
 - Smart building, home, transportation with new tech and renovation.
 - Significantly increasing the portion of electricity in energy end-use.

Target of SG development

Power distribution (2)

□ 2030:

- Promote economy with comprehensive services of power grid.
- Providing custom service.
- Allow power contribution to power grid from electricity users or customers.
- Automotive power grid finished.
- Customer voltage self adjusted.
- Customer power and energy storage connection.
- Charging stations for EV.

Power quality in China

□ PQ Challenge:

■ Most variety of factories.

□ Reasons for factories in China

- Labor cost
- Labor availability.
 - Foxconn: >1.3 million employees in China.
 - Plan using 300,000 robots due to labor shortage.
 - Making 1000 robots/ per day since 2012.
- Local market

Factories with sensitive loads.

Factories with impact loads.

Located nearby.

PQ Challenge

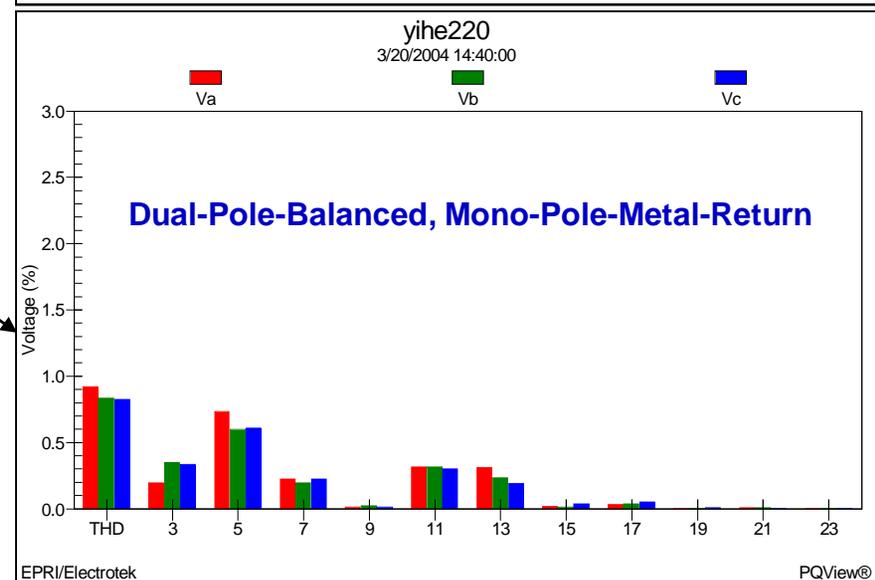
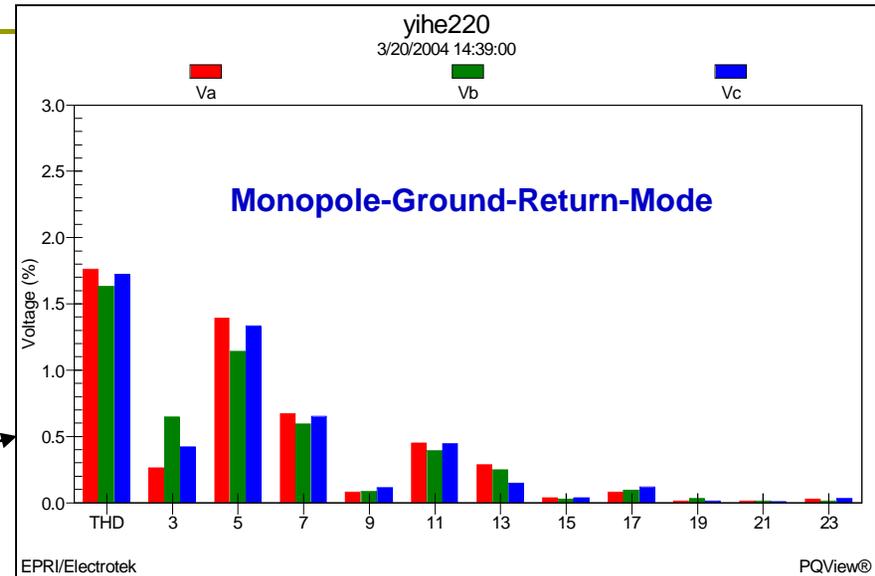
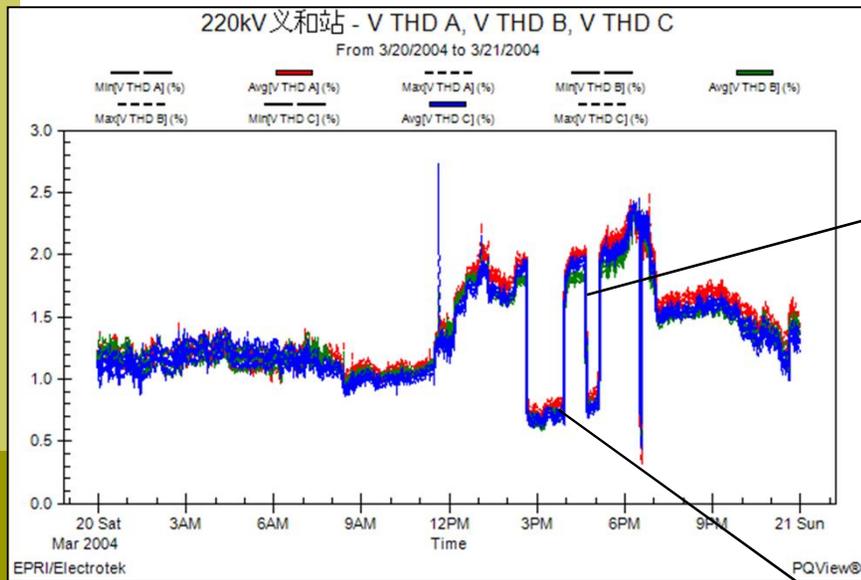
- Renewable energy
 - Wind farms
 - Solar power plants.
 - Wave power (in future)

High voltage DC/AC transmission

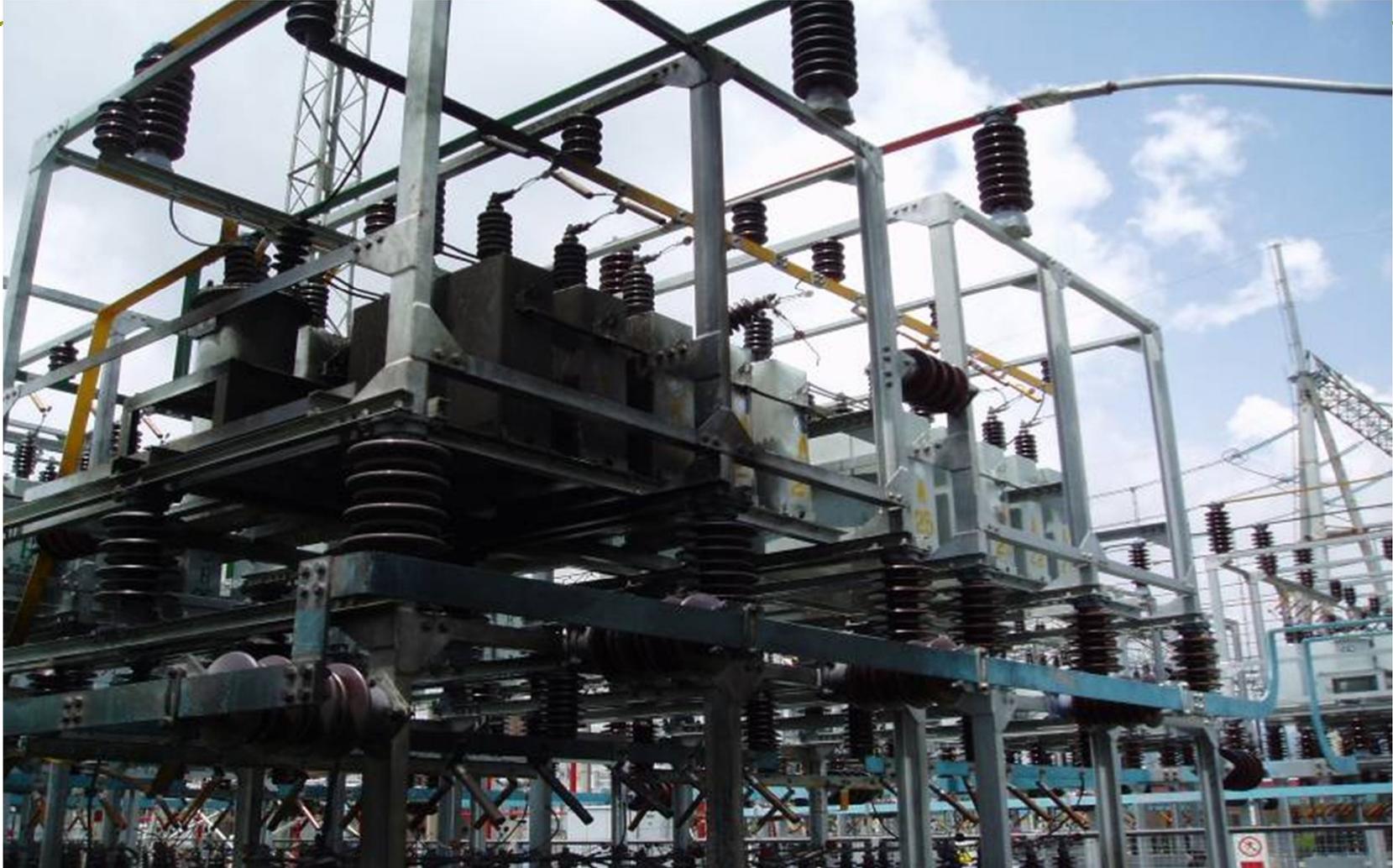
- 1000KV AC transmission (Planning)
- 800KV DC transmission (Planning)



Example of Voltage Harmonic Distortion Impacted by HVDC Link



Substation Capacitor Bank Failure by HVDC in GR



Substation Capacitor Bank Failure by HVDC



PQ Challenge

- Electrical railway
- EV charging



Vehicles in Beijing

- ❑ >1 million applicants each month
- ❑ 1/50 (appx 20,000) quota by draw each month
- ❑ Qualification; Beijing citizenship and driving license
- ❑ Traffic restrictions based on the last digit on a license plate.

An example of PQ problems

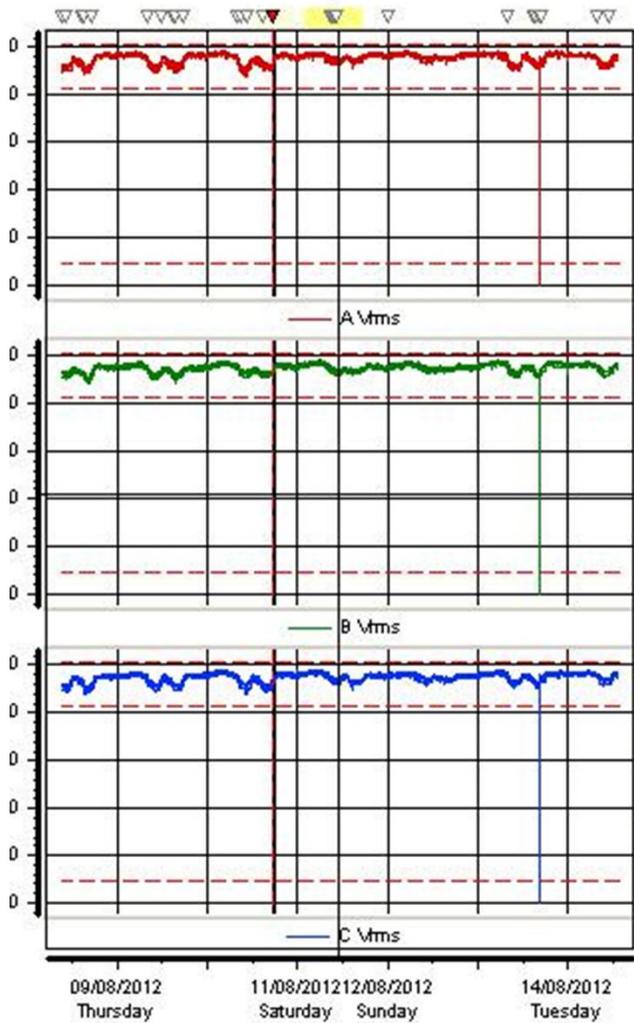
- ❑ A large company making (VFC) variable frequency converters.
- ❑ 80KW power module damaged
- ❑ The power module was used for a large machine tool.



#509 10/08/2012 17:30:43.259 CV Misc at -120.5 Deg

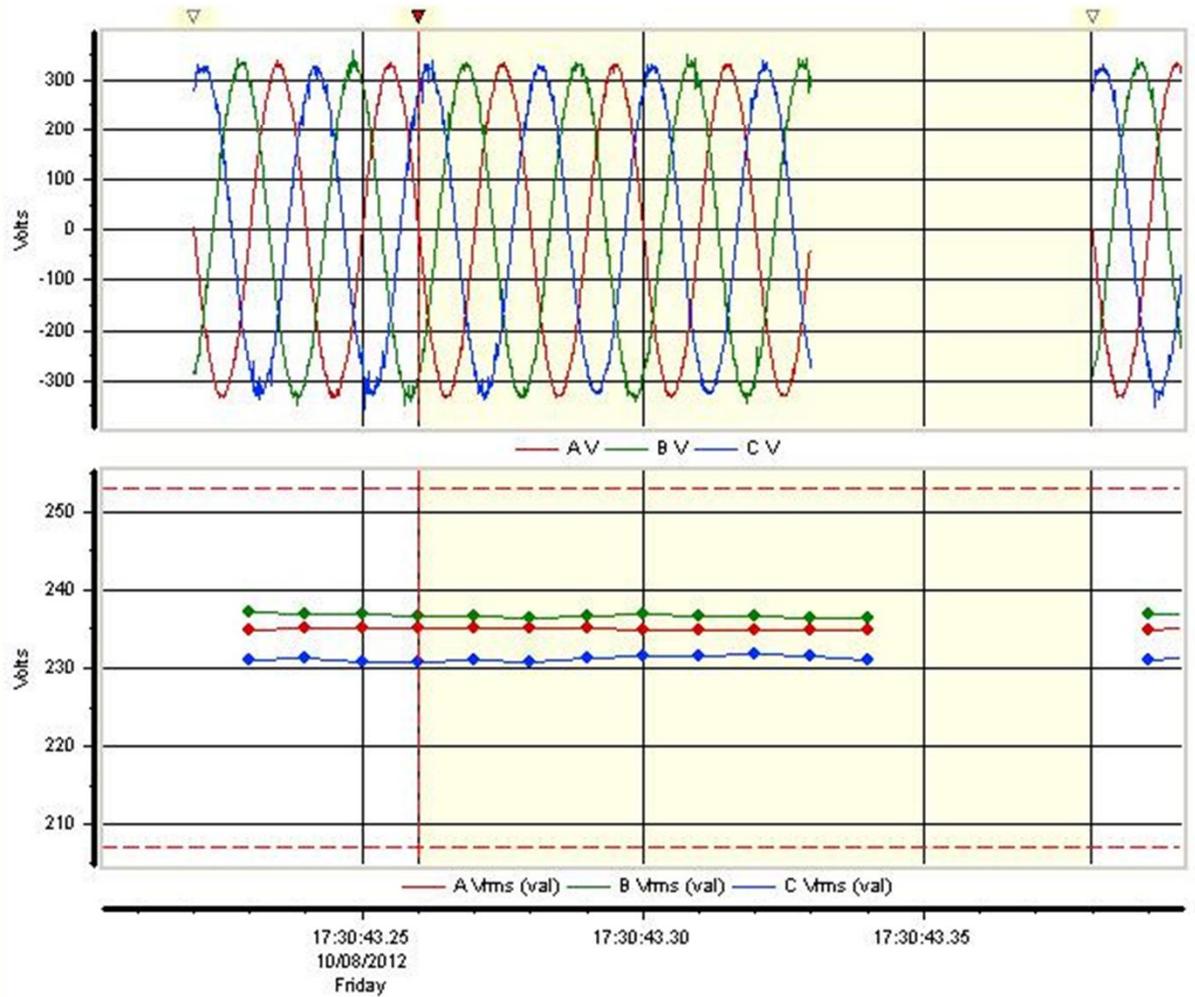


Timeplot



Event #509 at 10/08/2012 17:30:43.259
CV Misc

Event Details/Waveforms



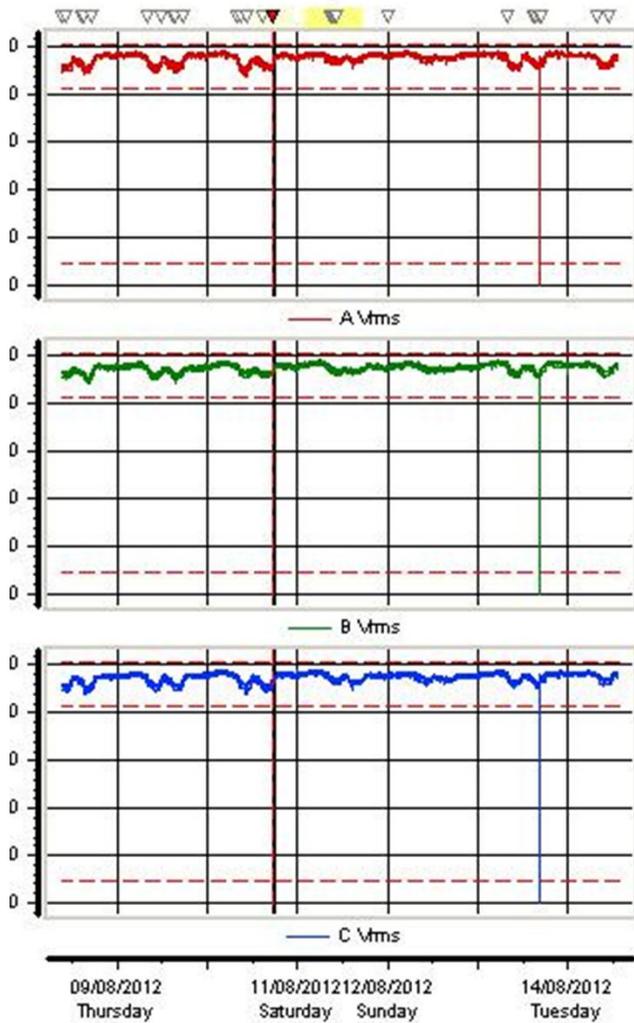
Event #509 at 10/08/2012 17:30:43.259
CV Misc
Phase -120.5 Deg.



#518 10/08/2012 17:30:49.010 BV Misc at 119.3 Deg

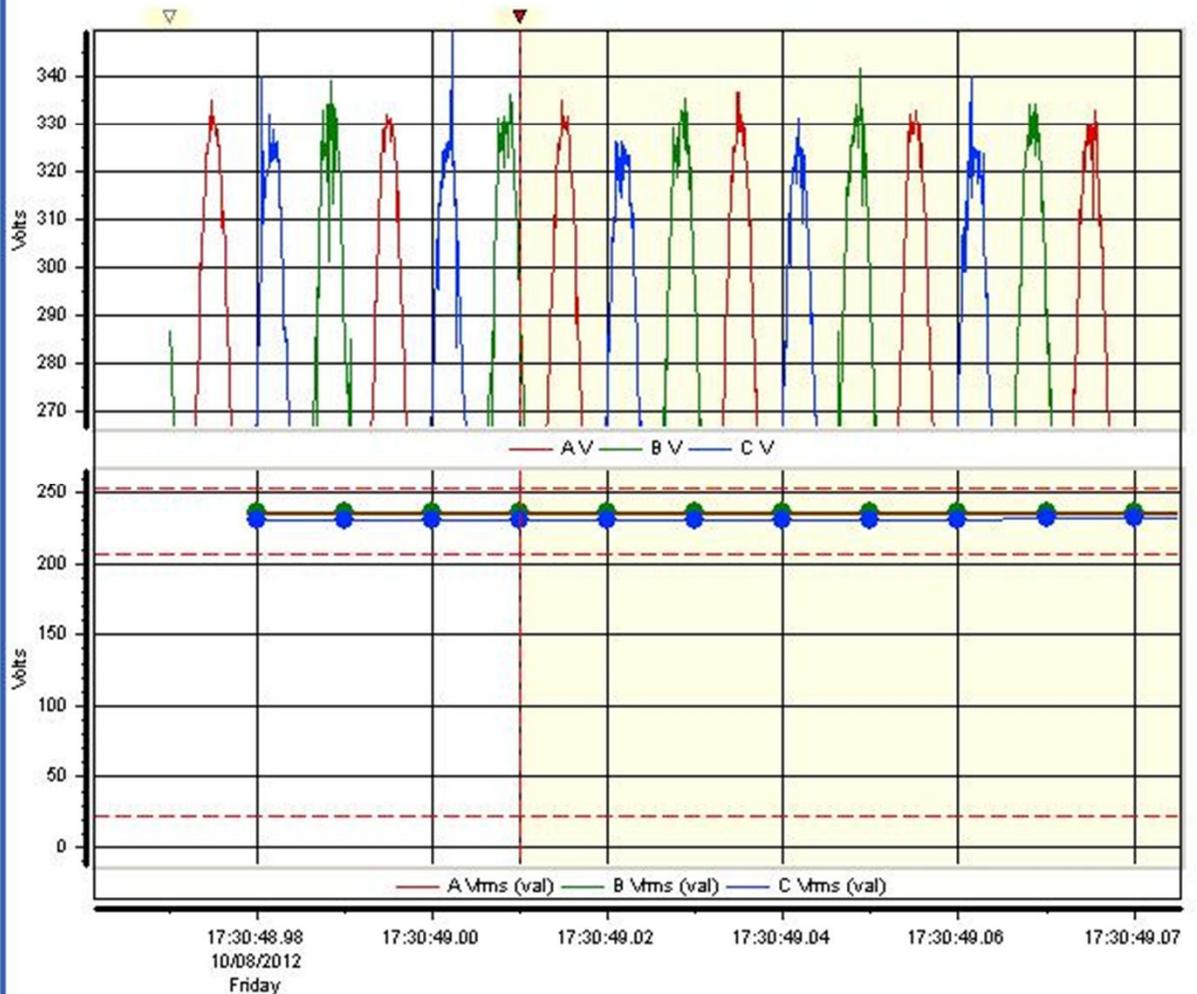


Timeplot



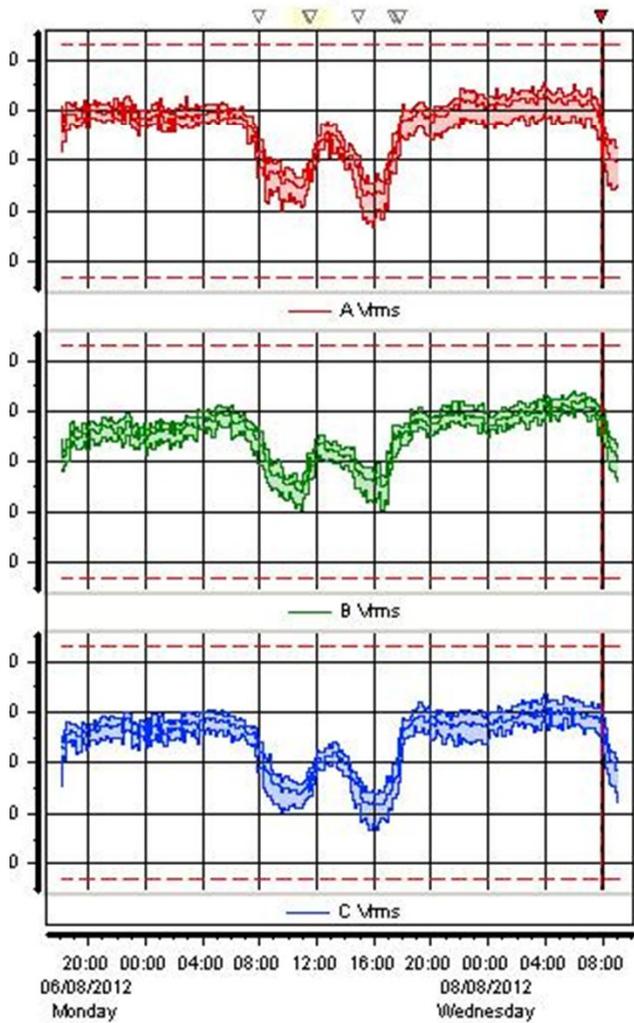
Event #518 at 10/08/2012 17:30:49.010
BV Misc

Event Details/Waveforms



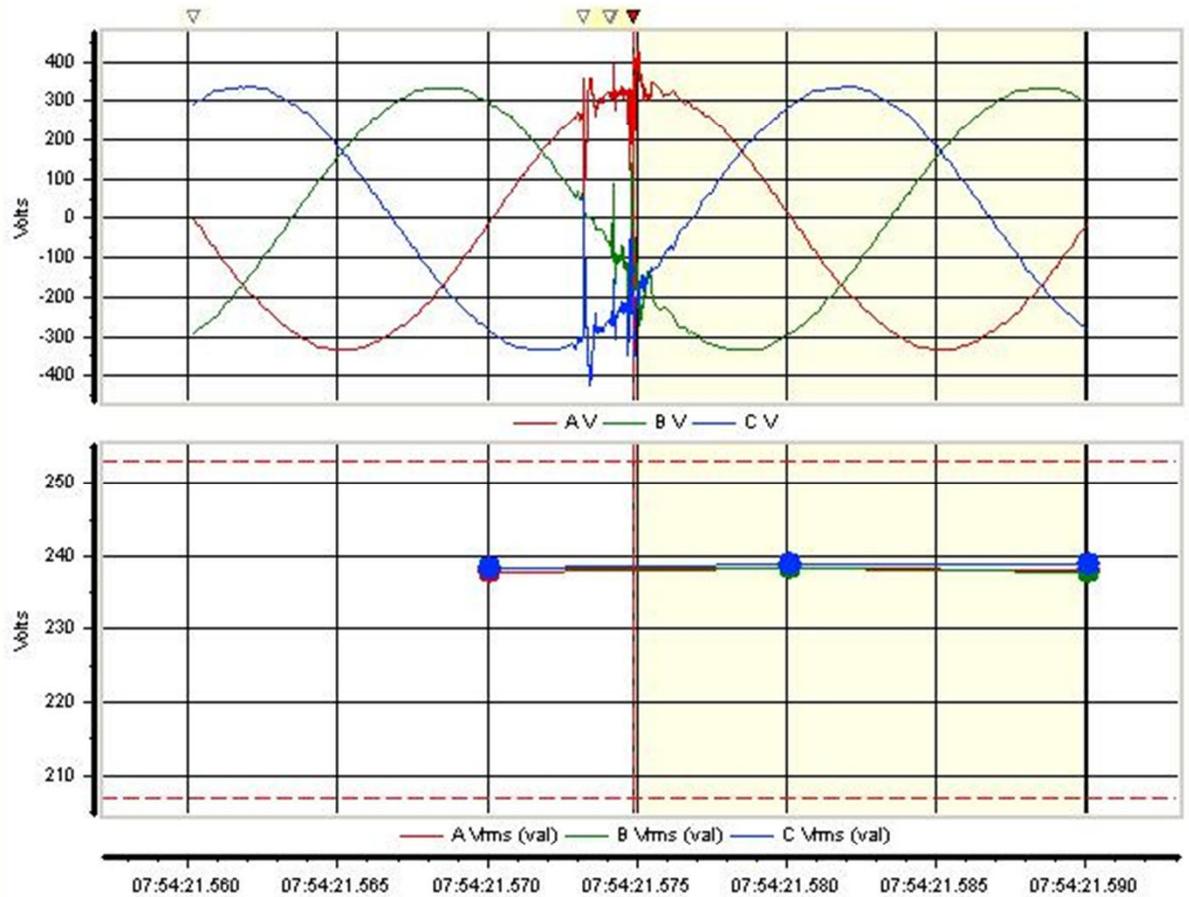
Event #518 at 10/08/2012 17:30:49.010
BV Misc
Phase 119.3 Deg.

Timeplot



Event #315 at 08/08/2012 07:54:21.574
Post-trigger

Event Details/Waveforms



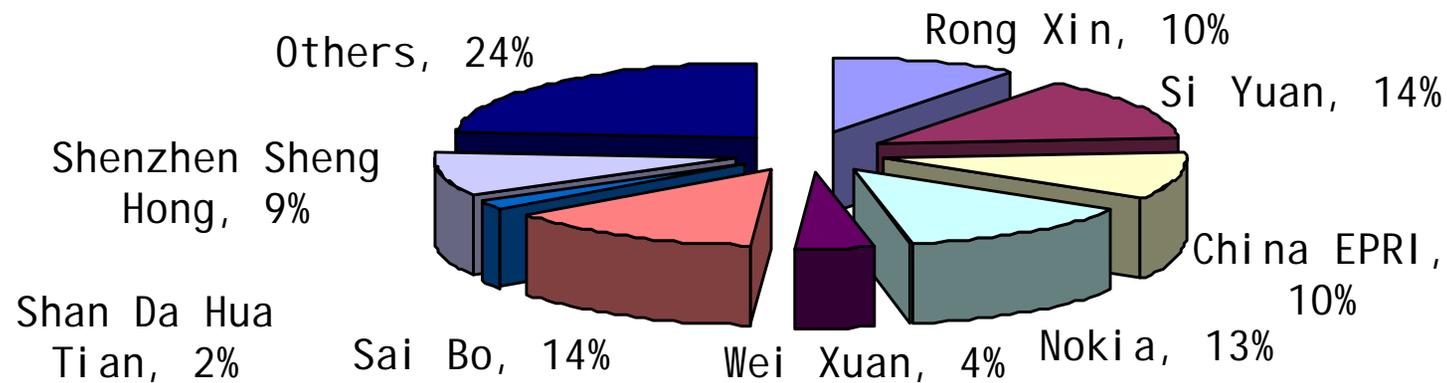
07:54:21.560 07:54:21.565 07:54:21.570 07:54:21.575 07:54:21.580 07:54:21.585 07:54:21.590
08/08/2012
Wednesday

Event #315 at 08/08/2012 07:54:21.574
Post-trigger

	A	B	C	D	A-B	B-C	C-A
Vrms	238.4	238.3	238.8	0.1297	412.6	413.1	412.5
VPeak	431.5	334.4	417.9	0.4811			

PQ mitigation equipment in China

- 120+ companies
- Sales Appx RMB 5 Billion in 2011



Data sources

- Yearbook of China Electric Business (Saier) 2011-2012
- Annual report – Energy and Electricity 2012 (Energy Research Institute of China)
- Statistical Review of World Energy 2011 (BP)



Thank you !