Renewable Energy International Market Developments: Issues and Opportunities — China Case

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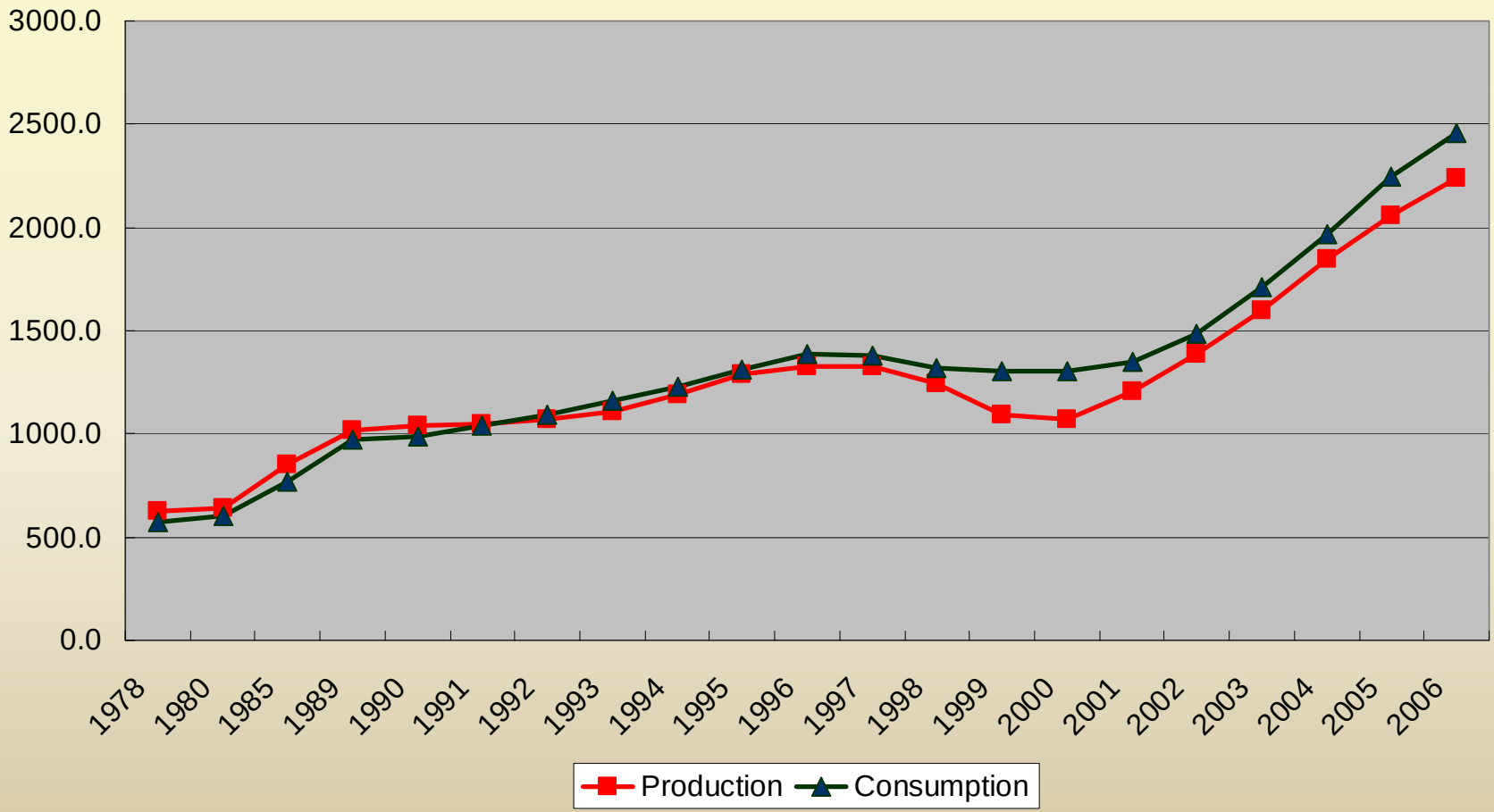
Energy Situation in China

Energy Issues Faced by China

- Energy demand and consumption continuously increased
  - The first billion tce, 1950-1990, 40 years
  - The second billion tce, 1990-2004, 14 years
  - The third billion tce, 2004-2010, only 6 years
    - In fact, 2001 – 2006: only 5 years, increased 1 billion tce
  - Live conditions: car and house, more energy demand?
- Environment issues
  - Coal fired pollution in town and country side
  - Greenhouse gases emission
- Energy security

History Development Trends of China Energy Consumption



China Strategy: Alternative Energy Strategy

- Three kind of alternative strategies:
  - New energy replace the traditional energy – mainly focus on nuclear and natural gas power generation
  - Advantage energy replace inferior energy – International replace domestic, domestic replace domestic
  - Renewable energy replace fossil energy – Develop renewable energy equipment technology

Renewable Energy Replace Fossil Energy: Technology

The Cost for RE Development

- Hydro power
  - Investment cost is around RMB Yuan6000/kW or US$800 /kW
  - Power generation cost is around US$3 cents/kWh
- Solar power
  - No distinguish by region and it can be use both in rural and urban area
  - With high and low cost for different final users

The Cost for RE Development (Continued)

- Solar thermal for power
  - Major type of technologies
    - Dish: technology is available, with cost of 6000-8000US$/kW and it can be declined to about 3000-5000US$/kW
    - Tower: R&D stage，cost is about 10000US$/kW and it can be reached about 5000US$/kW
    - Trough: technology is available, with cost of 3000-5000US$/kW and it can be down to 2000US$/kW
  - Efficiency is from 25 to 35%
  - Limitation：rotation components, high temperature and water required
- Solar PV
  - Major technologies
    - Silicon: efficiency is 15%-20%，price is 6000 - 8000US$/kW and it can be down to 2000 US$/kW, can be produced in large scale
    - Thin-film: with 5-10% of efficiency and large scale production technology needed be developed
  - Characteristics: no rotation and high temperature components, no water demand can be set up in remote area, such as desert

The Cost for RE Development (Continued)

- Biomass for power
  - Co-fires: with very little additional investment and very lower power generation cost, less than 0.3 Yuan/kWh
  - Direct-fired: investment cost is around 1200 to 1500 US$/kW and power generation cost is around 6-10US$ cents/kWh
  - Gasification for power: investment cost is around 800 to 1200 US$/kW and power generation cost is around 5-7 US$ cents/kWh
  - Characteristics: technologies are ready and the major constrains are resources availability and no much room for cost reduction
- Bio-fuels
  - The oil price is to keep the level of US$60/barrel, bio-fuel production with the present technology could get benefits
    - Corn ethanol: above US$55/barrel
    - Sugar cane ethanol: above US$35/barrel
    - Waste oil for bio-diesel: above US$40/barrel
    - Rapeseed bio-diesel: US$110/barrel
  - But the cellulosic ethanol is still not commercial

The Cost for RE Development (Continued)

- Wind power
  - Major technologies
    - Vertical VS horizontal, horizontal takes majority
    - Gear box driven vs gear-box-less
  - Cost for installation is around 1200 - 1400US$/kW and power generation cost from 5 to 10 US$ cent/kWh
  - characteristics：no water and no land required, depend on resource availability

Technology Priorities in 5 to 10 Years

- All the renewable energies are resources and technologies driven
- For short term, wind is the best market available technology, also solar water heater
- For long term, solar is the best
- Solar PV is most suitable renewable for power due to the characteristics of no water demand and maintenance less
- Biomass for power is constrained with the land availability, for example, 100 GW biomass power needs about 100 million hectares of land, which equals of 1 million km^2
- Bio-fuel: ?

Status and Potentials of Renewable Energy Development in China

Center for Renewable Energy Development (CRED) of ERI, NDRC

Hydro Power, Wind and Biomass

- Hydro Power
  - **Economical resource: 400GW**
  - **2006: 128GW**
- Wind Power
  - **Technical resource: 3000GW**
  - **2006: 2600MW**
- Biomass
  - **Resource: 0.8-1 Billion TCE**
  - **2006: low than 10 million TCE**

Solar

- Solar
  - **The resource is theoretically 1700 billion TCE per year. 2/3 land with sun light over 2200 hours, average 5000MJ/m^2**
  - **2006: 40 million TCE, over 95% for SWH**

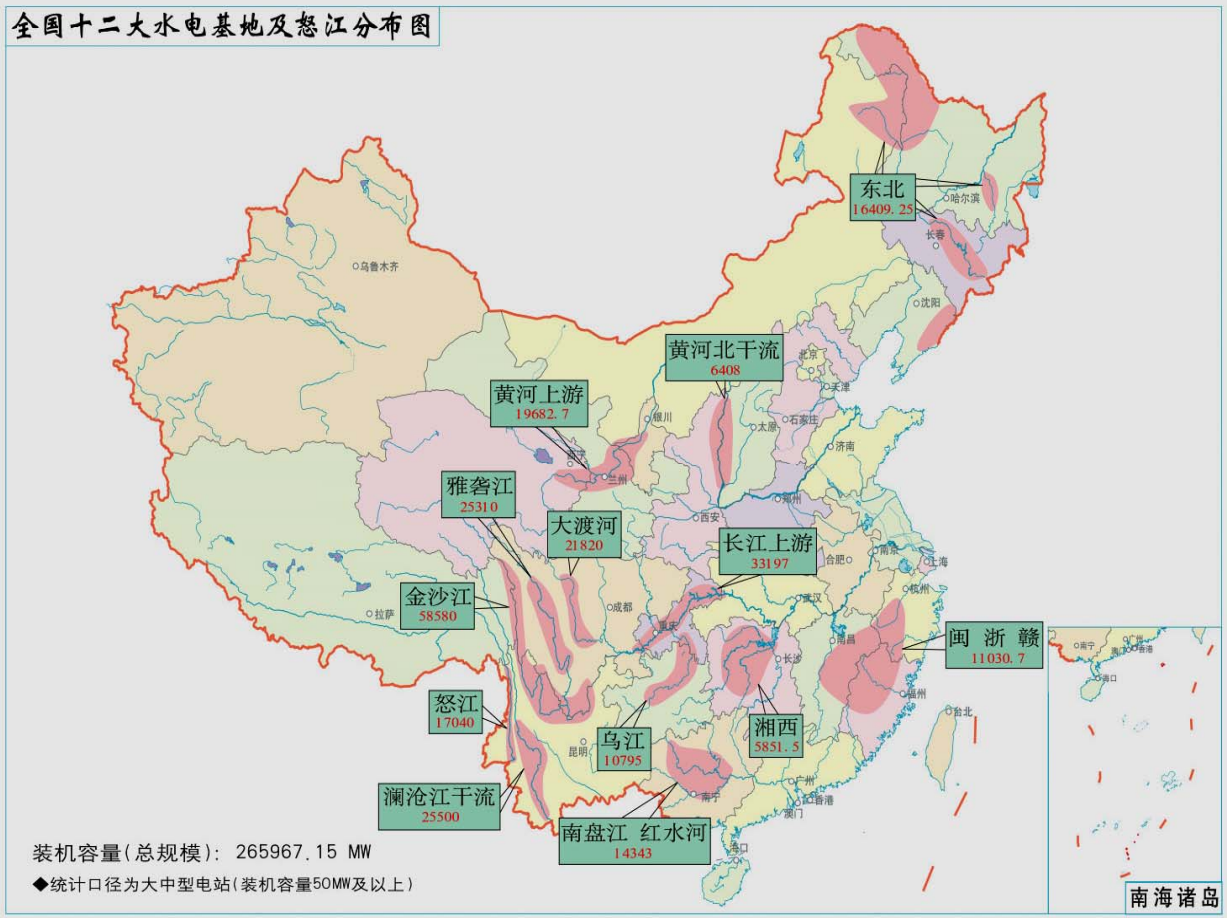
Manufacture Booming

- 30+5 wind turbine manufactures are ready for products
  - Include GE, Vestas, Suzlon, Gamsa and other
  - Most of people believe that by 2010, the annual production of WTG will be over 5 GW
- More than 300 solar PV and more than 3000 solar collector manufactures

National Development Plan

Hydro Power

- 2010: 190GW
- 2020: 300GW （Small hydro 70 – 80GW）



Wind

Through large-scale development, technological improvement and localization of wind power equipment, wind power can hopefully become competitive versus other fuel sources for power generation.

Goal: To build large and jumbo wind farms in the coastal and three North regions with mid-to-small wind farms developed in other regions appropriately.

2010：Total installed capacity of 5GW
2020：Total installed capacity of 30GW

Biomass

Biomass Power Generation	2010	2020
	（10MW）	
Waste power from agriculture and forest	400	2400
Garbage power	50	200
Landfill power	20	100
Large and middle scale biogas power	80	300
Total	550	3000

Biomass (continued)

- Pellet:
  - 2010: demonstration construction, national annual consumption of 1 million tons
  - 2020: national annual consumption of 50 million tons
- Biogas and gasification:
  - 2010: 19 billion cube meters
  - 2020: 44 billion cube meters

Biomass (Continued)

- Bio-liquid：2020：replace 10 million tons of refined oil product
  - Bio-ethanol：made from sweet sorghum, bagasse and cassava etc.
    - 2010: 3 million tons
    - 2020: 10 million tons
  - Bio-diesel: collection of catering waste oils; made from jatropha, curcas, pistacia chinensis and rapeseeds etc.
    - 2010: 200 thousand tons
    - 2020: 2 million tons

Solar

- PV：construction in areas without power supply, installation at rooftop or for public facilities, commercial application and large-scale power station in the desert regions
  - 2010：300MW
  - 2020：1800MW

Solar (continued)

Solar water heater

- City：
  Popularize solar integrated construction and centralized solar water heater engineering
  Construct solar heater and cooler demonstration projects
- Rural：
  Popularize household solar water heater, solar house and solar cooker

2010：solar water heater of 150 million sqm
2020：solar water heater of 300 million sqm

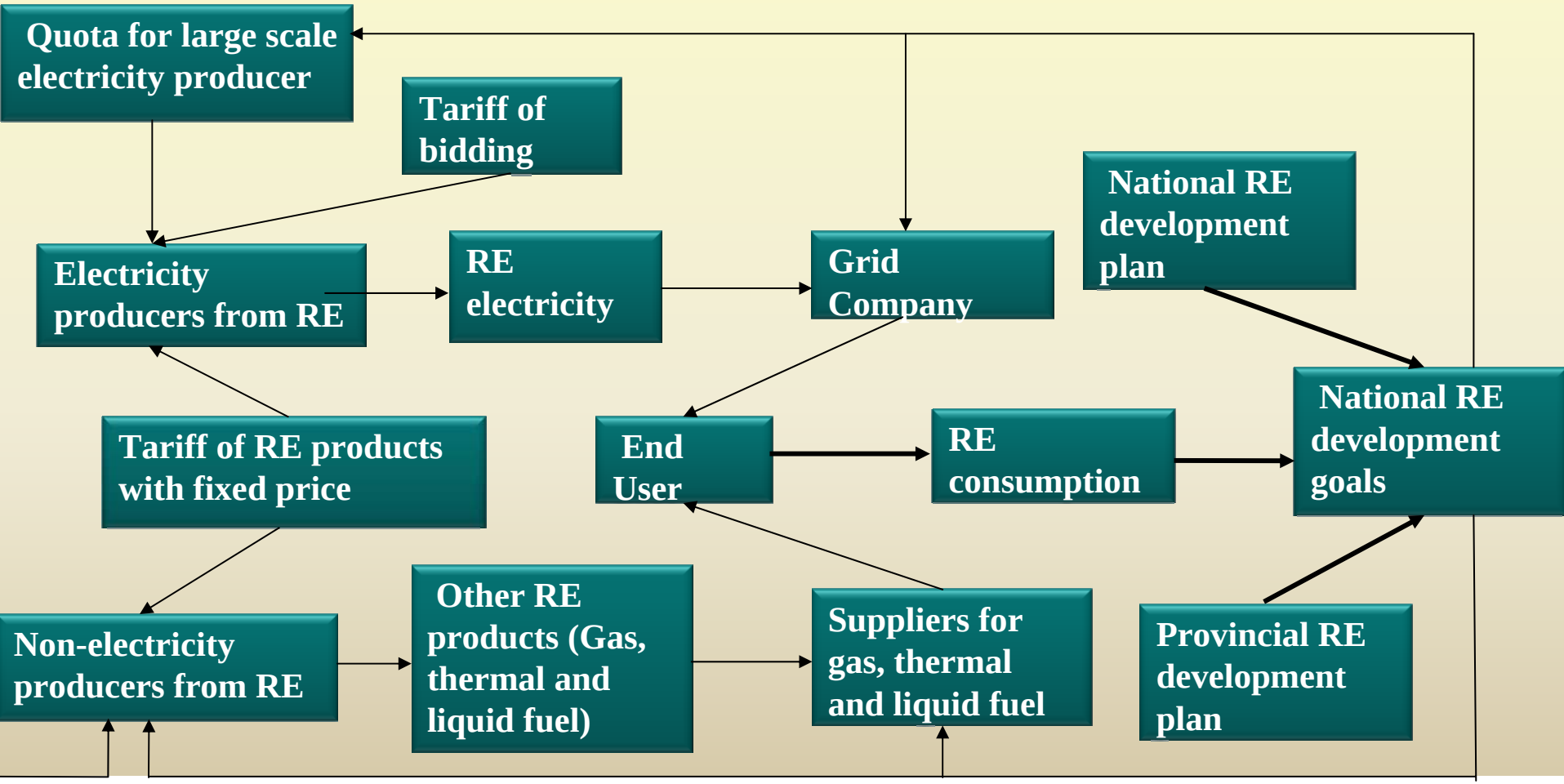
Summary for 2020

10% for 2010;
Potentially new capacity of 500-550 Million TCE
15% of Total Energy Consumption

Supported Policy Framework for RE development in China

Center for Renewable Energy Development (CRED) of ERI, NDRC

Policy Framework Under the RE Law of China



Strategies and Opportunities for RE Industry Development in China
—— Wind, Biomass, Solar

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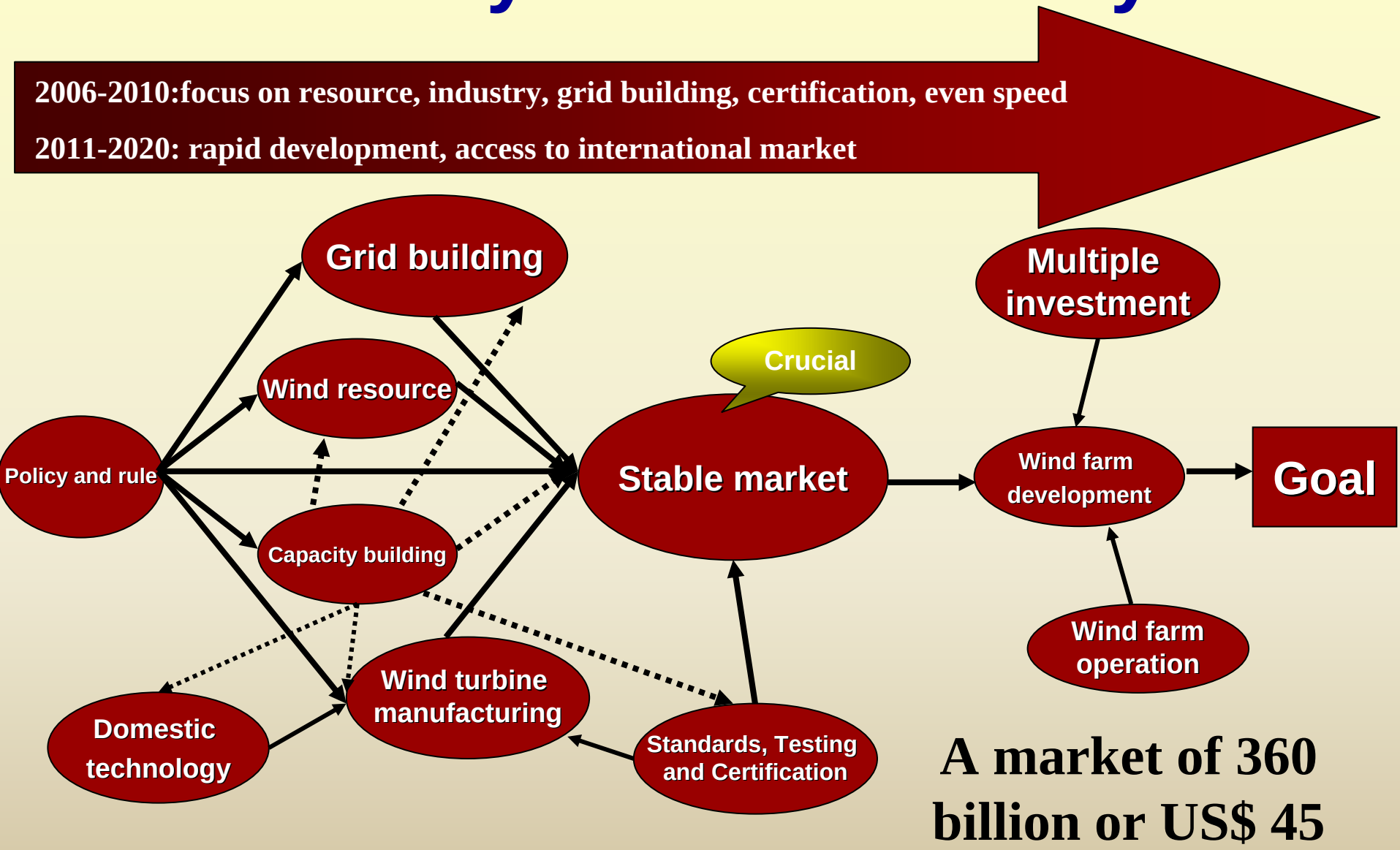
Issues and Barriers Faced by the Wind Industry Development

- Economically feasible wind resource?
  - wind resource assessment-planning-project distribution
- Technology and equipment
  - Design of the completed wind turbine
  - Components manufacturing
- Grid issue: lack of capacity

Pathway of wind industry



Issues and Barriers Faced by the Biomass Industry Development

- Not clear for biomass resources
  - Amount and kind of resource?
    - Waste agriculture and forest residues
    - Starch energy corps
    - Oil energy plants
  - Waste land or mounting could be used?
  - What's the real situation for these lands
    - Climate and environment
    - Water resource

Issues and Barriers Faced by the Biomass Industry Development

- Utilization driven by technology
  - Power generation and pellets
  - Limited bio-ethanol and bio-diesel
  - Cellulosic ethanol and gasification-synthesize disiel
- Market regulations
  - Entering in market

Strategies for Biomass Industry

- Government strategy: grasp the two ends
  - Resource guarantee: planting of energy crops
    - Preferential policies: taxes, subsidies
  - Market acceptance: compulsory regulations
    - Grid-connected power generation
    - Liquid fuel pemit
- Strategy of market based technology: attract investment
  - Power generation
  - Liquid fuel
  - Pellet fuel

Market Value of At Least RMB400 billion or US$ 50 billion

Issues and Barriers for Solar Industry

- High cost, decreasing is impossible in near future (solar power)
- Lack of incentive policy, unbalance development (PV)
- Development of different technologies, no clear direction

But solar could be the most potential or hope future energy

Development Strategies for PV Industry

- Government strategy: grasp the two ends
  - High-purity poly-silicon
  - Market exploitation
    - Roof top plan
    - Demonstrative power station in desert
    - Mandate measures
- Strategy of market driven technology
  - Focused on private investment

2006: China PV Industry Line

Item	Silicon Material	Silicon Ingot	Silicon Wafer	Cell	Module
Capacity（MW）	25	580	500	1400	1087

Pathway for Solar Industry

- Utilization based on local condition
  - Responsibility to be shared between central and local
- Integration with building
  - SWH
  - PV power station
- Demonstration projects
  - Solar thermal station
  - Solar PV station

400 billion RMB

US$ 50 billion

Total Investment for 2020 Goals

- 2000 billion RMB Yuan or
- US$ 270 biliion

Conclusions

- High speed development on economy in the developing countries
  - Energy consumption will continuously increase
- Energy consumption will be stable for developed countries
- Key elements for renewable energy development
  - Resource: developing countries
  - Technology: developed countries

Conclusions (Continued)

- World sustainable development
  - Renewable energy development
    - Technology transfer or cooperation
    - Relationship between government push and enterprise benefit
- Renewable energy will replace fossil energy
  - Developing countries will develop domestic RE equipment manufacture industry
  - Transfer technology from developed countries will speed up the replacing progress

Thanks for Attention!

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