



Workshop on Promoting Renewable Energy and Sustainable
Development in Myanmar



Renewable Energy Development Technologies, Policies and Planning in China

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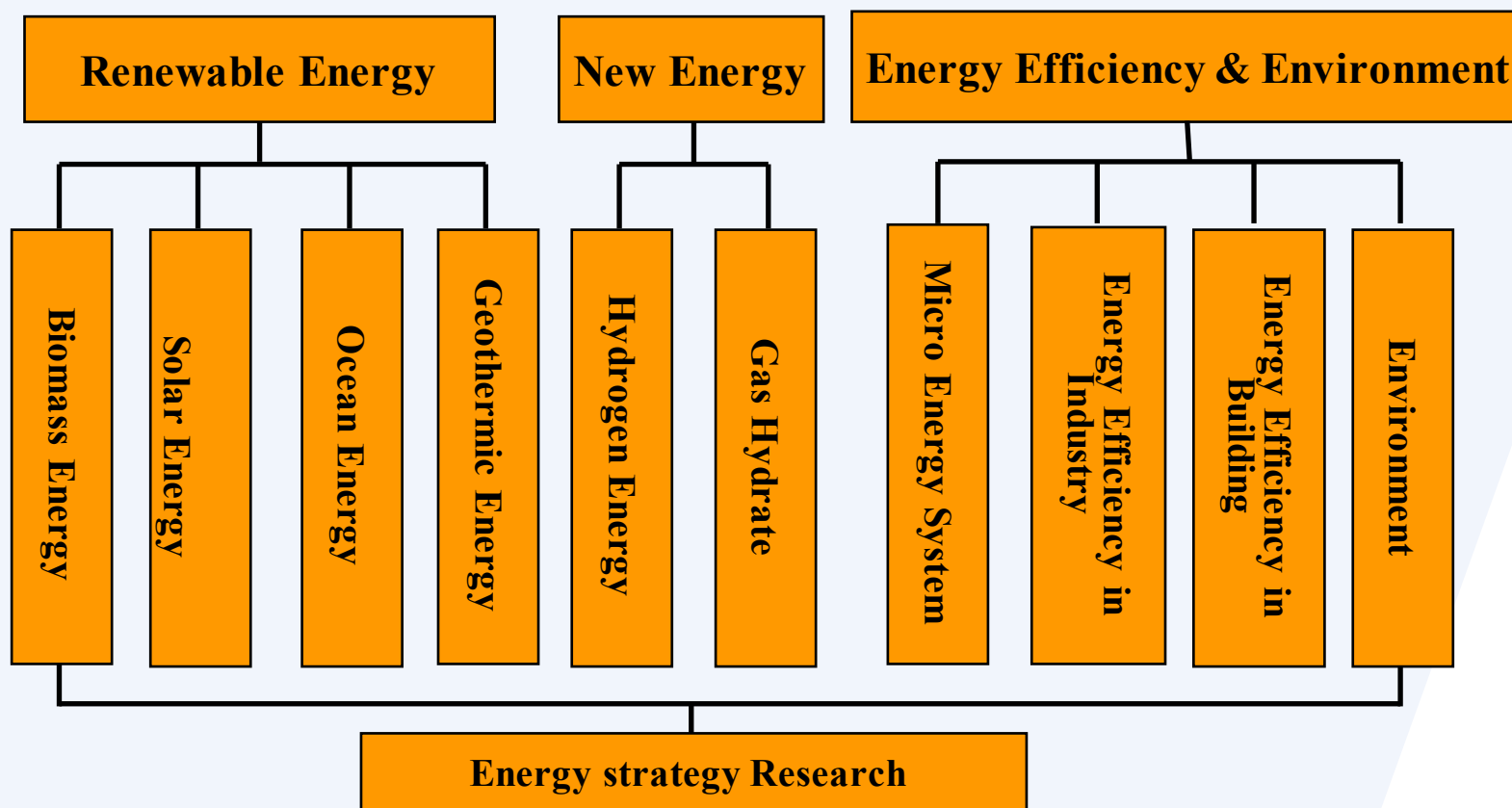
About GIEC

- ❖ GIEC, CAS was founded in 1978, whose predecessor was known as **Guangzhou Geothermal Energy Research Lab.**
- ❖ Staffs: 368
- ❖ Students: 168 (PhD students: 81)

Locations



Research highlights

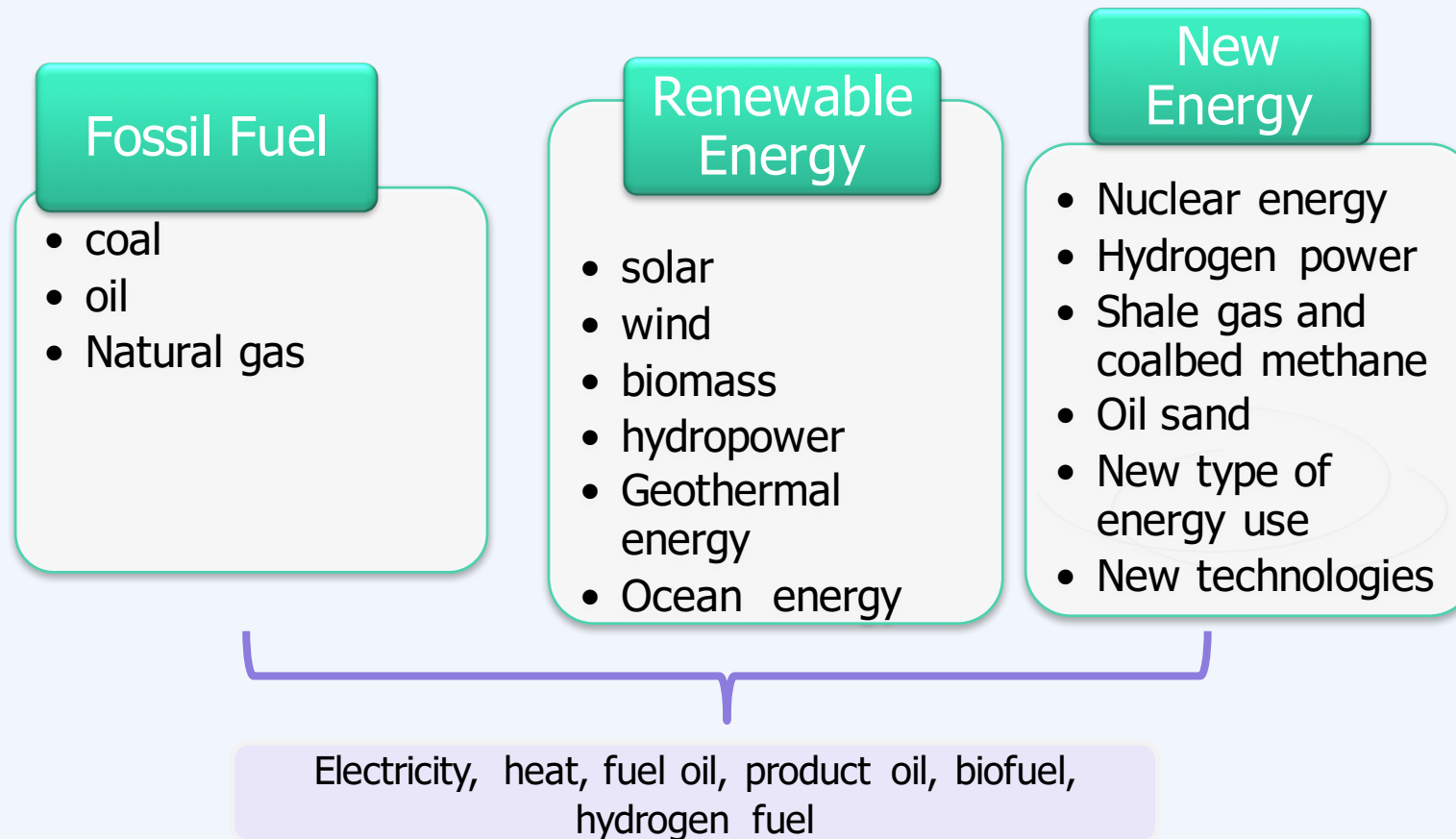


outline



- ❖ **Renewable Energy Development Technologies**
- ❖ **Renewable Energy Planning**
- ❖ **Renewable Energy Policy**

Energy is the material basis for the social and economic development



Imagine a world without energy would be?

Areas for future technology development



Fossil fuel power	Renewables	New energy	Energy system	Demand side
<ul style="list-style-type: none">• Clean coal power generation(IGCC + CCS)• Nature gas power plant (NGCC+ CCS)	<ul style="list-style-type: none">• Off-shore wind power• Energy storage technology• Smart grids• Renewable power and electric vehicles (EVS, VTG, GTV)	<ul style="list-style-type: none">• Nuclear Generation III and Generation IV reactor• Nuclear fusion	<ul style="list-style-type: none">• Distributed energy system• Smart grids• Energy management system• Internet plus smart energy	<ul style="list-style-type: none">• Energy efficiency improvement in transportation and building sector

MULTIPLE TECHNOLOGIES EXIST TO PROVIDE CENTRALIZED SOLAR POWER AND PV POWER

	Photo example	Assessment
Concentrated solar power (CSP)	Parabolic Trough	<ul style="list-style-type: none"> Most mature CSP technology, already commercialized
	Central Receiver (Power Tower)	<ul style="list-style-type: none"> Reasonably mature with strong potential given high temperatures
	Dish Engine	<ul style="list-style-type: none"> Extremely high capital costs with questions around manufacturing feasibility
	Linear Fresnel	<ul style="list-style-type: none"> Unproven technology utilizing low cost components at lower temperatures
	Solar Chimney	<ul style="list-style-type: none"> Large footprint makes it an unlikely large-scale technology
Photovoltaics (PV)	Wafer-based (C-Si)	<ul style="list-style-type: none"> Highly commercial though primarily as a distributed technology (on rooftops)
	Thin Film	<ul style="list-style-type: none"> Rapidly commercializing with low theoretical cost. Inability to store energy may be a barrier

Key takeaways

- Winner unclear, so policies should be **technology independent**
- Parabolic trough and central receiver are currently the most promising technologies due to their **relative maturity and storage potential**
- PV will have a large impact as a distributed technology but suffers from lack of dispatchability as a centralized source of solar power

Most likely to succeed

WIND POWER GENERATION



- On-shore, off-shore wind power technologies:
8-10MW wind turbines
- Low –wind speed wind turbines
- Smart controlled and adjusting manage
system for wind farm

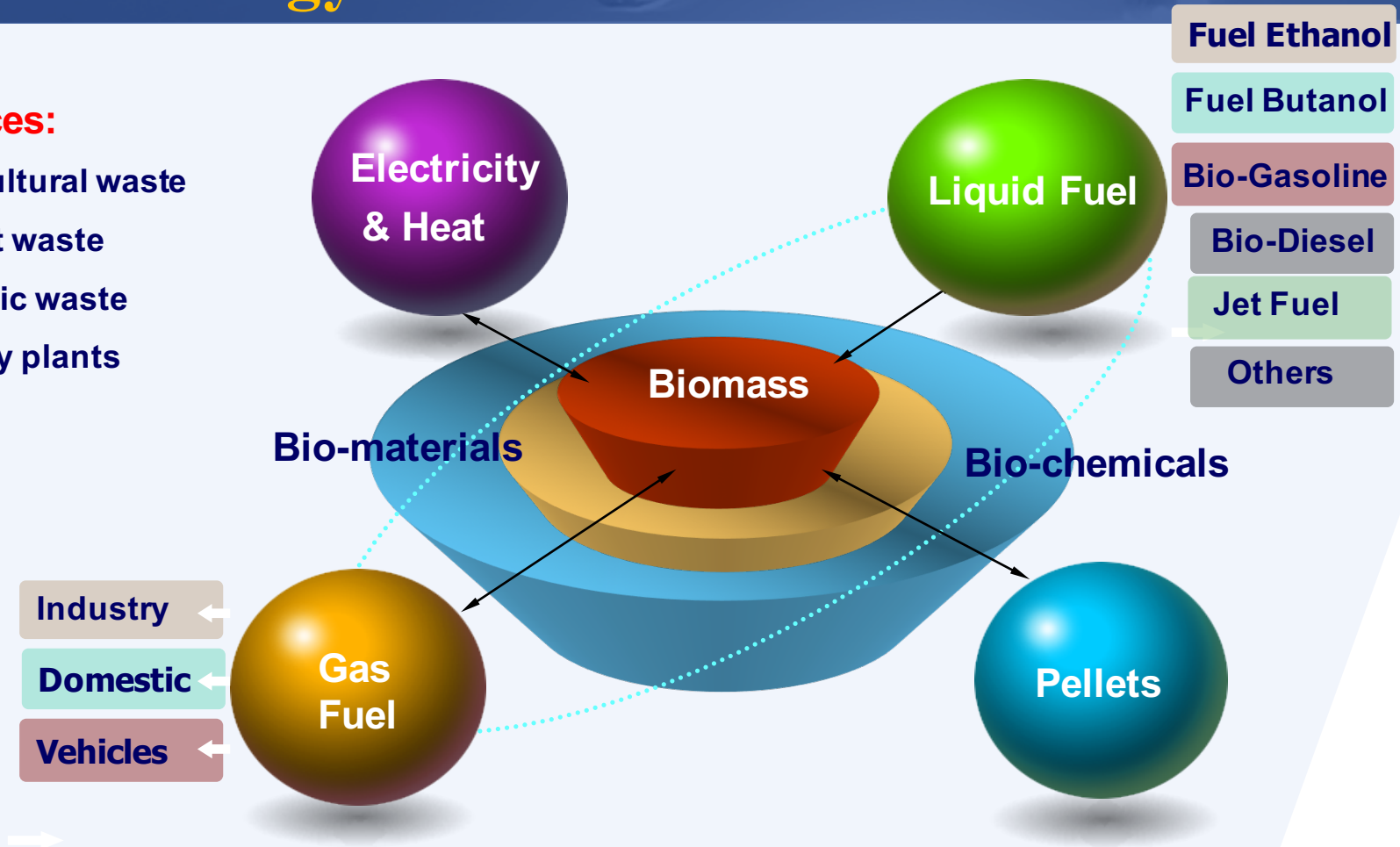
图片Source: BP网站

Biomass Energy



Resources:

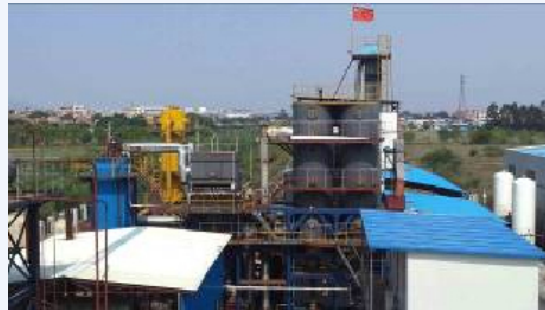
- Agricultural waste
- Forest waste
- Organic waste
- Energy plants
- Algae





Biomass Gasification Power and Heat Co-generation System

- Integrated device for biomass gasification power generation and waste heat utilization
- 2MW Pilot Plant of biomass gasification power and heat cogeneration system, whose integrated thermal efficiency reaching 52.3%



2MW Pilot Plant of biomass gasification power and heat cogeneration system

Funded by: Ministry of Science and Technology of China
National Natural Science Foundation of China
Guangdong Provincial Government
Corporate Sponsor

Biodiesel



100,000 ton/year biodiesel plant in Wenzhou, Zhejiang(1st phase, 30,000 ton/year)



5,000 ton/year plant in Vietnam

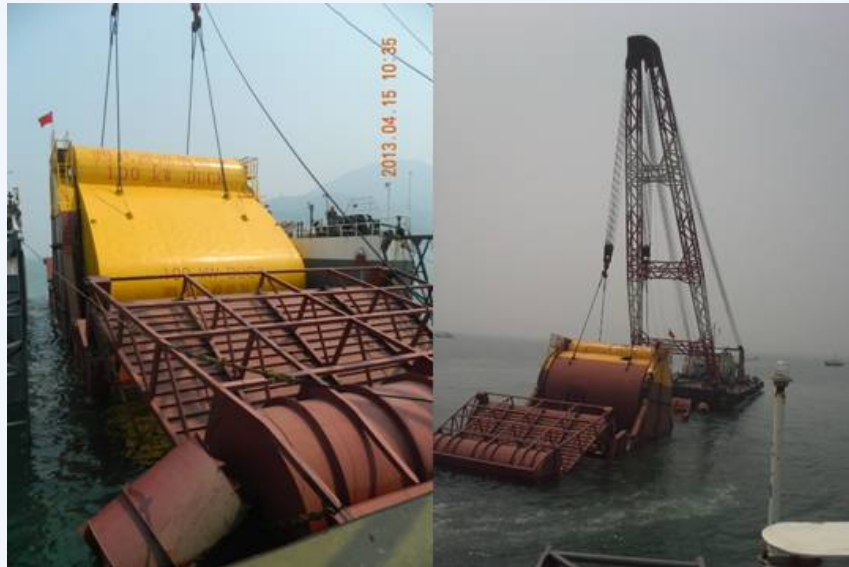
Ocean Energy



Wave energy & desalination



Wave energy power generation

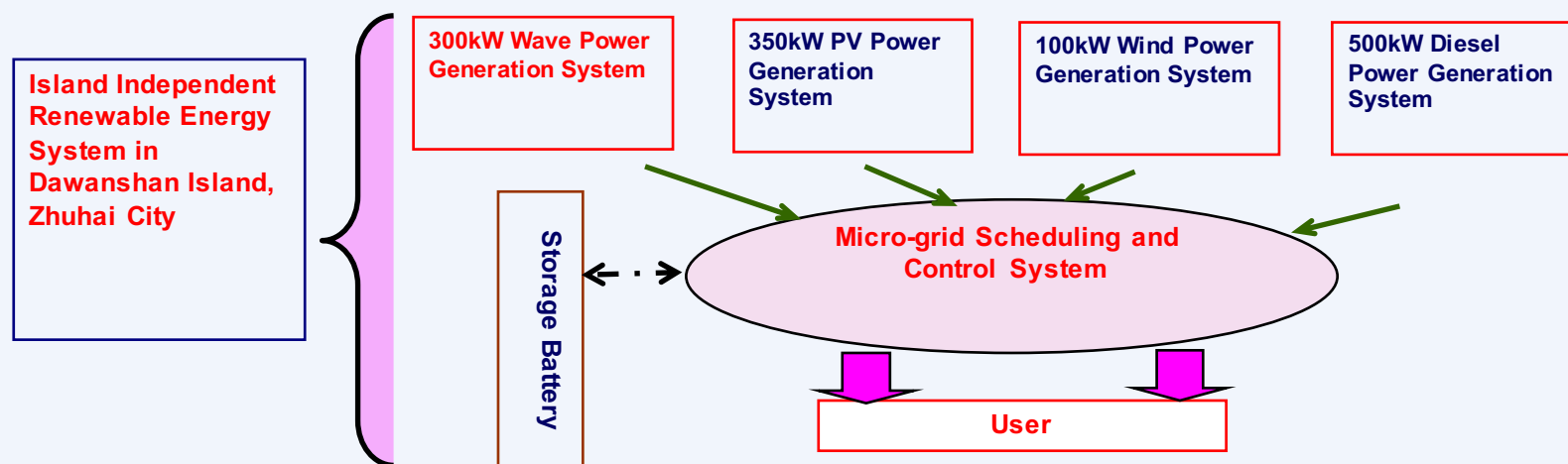


100kW nodding duck



10kW eagle type

MW-scale island independent renewable energy systems



150 ton/year pilot plant for jet fuel and alkanes production



Geothermal Energy

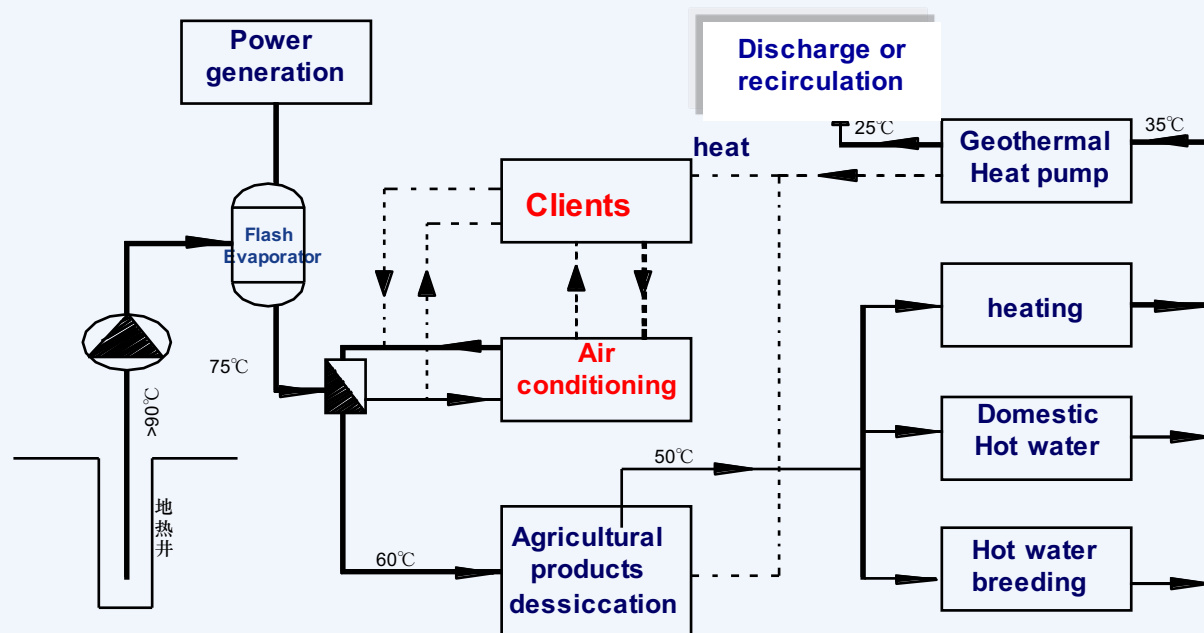


300kW Geothermal power generation, Guangdong



Integrated thermal power generator (100kW)

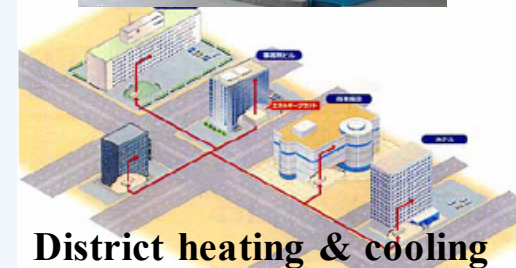
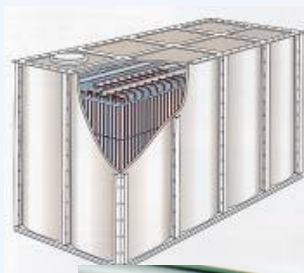
Geothermal gradient utilization system



Energy Saving & Environment Protection



- ◆ Building energy saving technologies
- ◆ Industry energy saving technologies
- ◆ Waste treatment & reutilization



District heating & cooling

Smart grid and energy storage technologies



Smart grid:

- To satisfy need for the large-scale, high-variable renewable energy connecting to the grid
- To solve the wind-, solar-, hydropower- abandoned issues

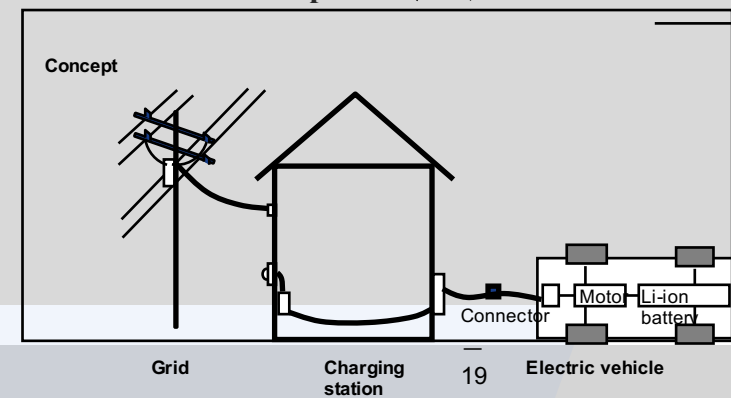
Major research issues:

- ① Key technical equipment of DC power grid
- ② ultra High Voltage alternating current transmission technology
- ③ Large capacity UHV HVDC transmission technology
- ④ Information collection and communication technology of smart grid
- ⑤ Smart grid dispatching control system
- ⑥ Key technology of flexible DC transmission
- ⑦ Real time simulation technology of AC and DC large power grid

Energy storage and energy Internet technology

Main research direction

- ① New high efficiency battery energy storage technology
- ② Large capacity and long life energy storage battery device
- ③ Energy Internet demonstration
- ④ Energy storage technology for all vanadium redox flow battery
- ⑤ Interactive intelligent power consumption and demand side response (EV)



the Barriers of implementation for the new technology toward Low-carbon Electricity



Technology maturity

bring down the generation cost and make it competitive

Financial supports

Subsides for renewable energy : equipment manufacturing and feed-in tariff

Resources limitation

Renewable energy resources and human resources

Lack of policy

Reformation of electric power system, power transmission and distribution price reform, electricity pricing reform

Match of supply and demand

abandoned Re resources: infrastructure, localization demand, coordinating planning of Re energy and other energies

outline



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The Strategic direction of Energy Revolution in China

Ensure safety as a starting point

Forming a energy supply system that drives coal ,oil, gas, nuclear and renewable energy into coordinated development. Construct a broad community of interests to achieve energy security under open conditions

Saving Priority as policy

Control the total amount of energy consumption and change the extensive energy consumption mode. Improve the efficiency of energy utilization, promote the optimization of industrial structure and energy consumption structure and accelerate the formation of energy saving society

Energy Revolution

Mechanism Reform as Protection

Restore the attributes of energy products, build effective and competitive market structure and market system, form a mechanism to determine the energy price mainly by the market, and improve the international competitiveness of energy industry.

Technology innovation as drive

Achieve major energy technologies breakthrough, speed up the integration of energy conversion technology, transmission and distribution, energy storage, information technology, and build a new generation of energy system to support energy supply and consumption revolution.

strengthening international cooperation.



• Renewable Energy Planning

The national security strategy of the energy revolution is put forward

	Key points	targets
Energy supply revolution	<ul style="list-style-type: none">• Diversified supply system, vigorously promoting clean and efficient utilization of coal• to develop non coal energy resources, and simultaneously strengthen the construction of energy transmission and distribution network and reserve facilities.	<ul style="list-style-type: none">• Form a multi wheel drive energy supply system of coal, oil, gas, nuclear, new energy and renewable energy.
Energy consumption revolution	<ul style="list-style-type: none">• Resolutely control the total amount of energy consumption• Implementing the priority policy of energy conservation• Promoting energy efficiency• optimize the energy structure	Realizing the transformation of industrial economic structure
Energy mechanism revolution	<ul style="list-style-type: none">• Formulating the overall plan for the reform of the power system• Formulating the overall plan for the reform of petroleum and natural gas system	<ul style="list-style-type: none">• Push forward reform and break the monopoly• Restore the attributes of energy products, build effective and competitive market structure and market system, form a market mechanism of energy price• establishing and improving the rule of law system of energy
Energy technology revolution	<ul style="list-style-type: none">• increase the innovation of energy science and technology, and promote the revolution of energy science and technology.	<ul style="list-style-type: none">• The development of energy technology and related industries will be a new growth point for China's industrial upgrading.• improve the international competitiveness of energy industry
international co-operation	<ul style="list-style-type: none">• Omni-directional strengthening of international cooperation	To achieve energy security under open conditions



• Renewable Energy Planning

Renewable Energy Targets: Achieve major energy technologies(wind, solar & biomass breakthrough and scaling-up utilization. Newly-added energy consumption supplied by non-fossil fuel energy

timeline	energy consumption (10^8 tce)	non-fossil fuel energy		
		energy consumption (10^8 tce)	percentage (%)	change
2015	43	5.0	12	
2020	50	7.3	15	+ 3%
2030	60	12	20	+ 5%

- “thirteenth five-year”plan of Energy technology innovation
- The Strategic direction of Energy supply and demand Revolution in China
- “thirteenth five-year” plan of renewable energy

• Renewable Energy Planning



	2015		2020		total
	Installed capacity (10mw)	Increase yearly	Power generation (104kwh)	Installed capacity (10MW)	
Solar PV	4318	122%	1245	10500	2015 51248 10⁴tce/yr Account for 10% total primary energy consumption
On-grid wind	12900	33%	4200	21000	
Biomass power	1030	13.4%	900	1500	
hydropower	31954	8.1%	12500	34000	2020 Commercial utilization : 57828 10⁴tce/yr Heating and civil use: 1.5 10⁸tce/yr Power generation: 56188 10⁴tce/yr Installed capacity: 6.8 10⁸kW Power generation: 1.9 10¹²kWh Account for 15% total primary energy consumption
biogas (10 ⁸ m ³)	190	6.3%		190	
Solar water heater (10 ⁴ m ²)	44000	21.2%		80000	
geothermal (10 ⁴ tce/yr)	460			4000	
Biomass briquette fuel (10 ⁴ ton)	800			800	
Bio-ethaneol (10 ⁴ ton)	210	3.1%		400	
biodiesel (10 ⁴ ton)	80	9.9%		200	

Source: "thirteenth five-year" plan of renewable energy



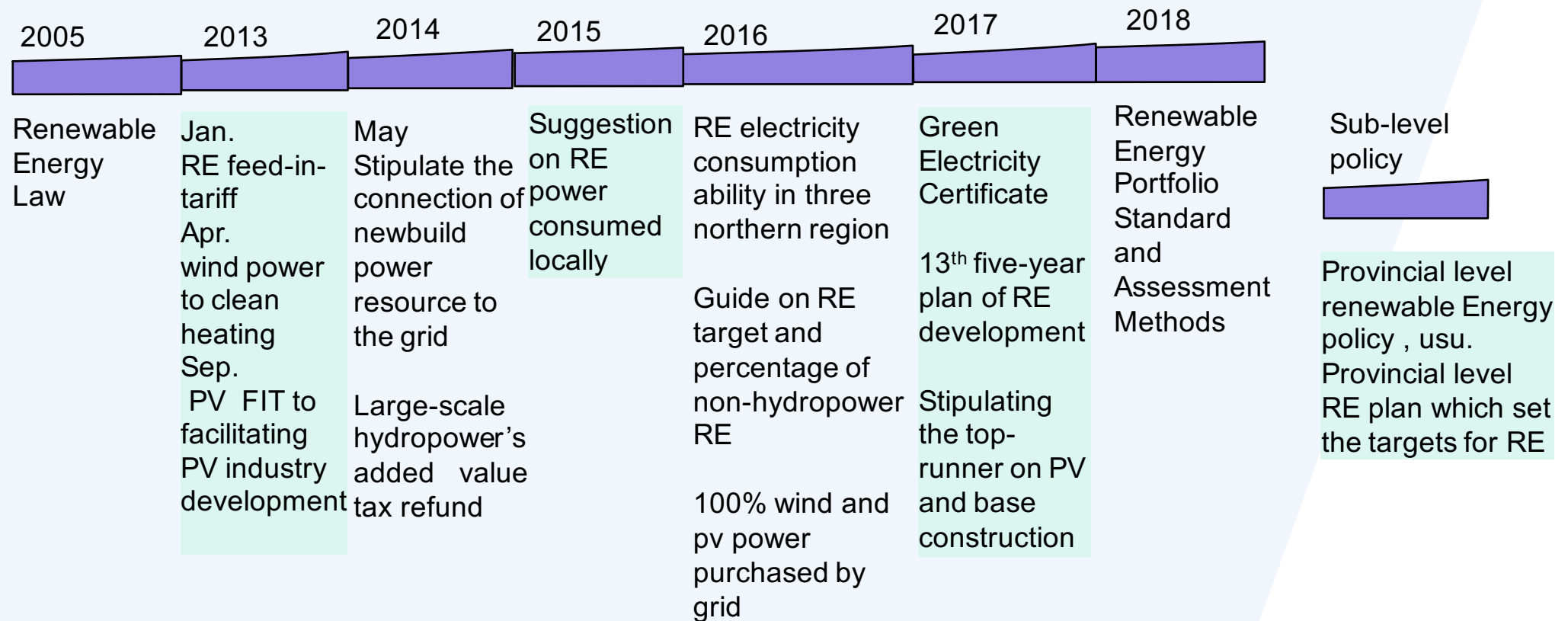
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Policy is the embodiment of national strategy



Renewable Energy Policy



Timeline policy



Renewable Energy Policy

Set the targets

The 13th five-year energy plan (2016-2020) :

- Non fossil energy accounts for more than 15%
- The CO₂ emissions per unit of GDP is 18% lower than that in 2015

Energy production and consumption revolution strategy:

- 2021-2030: non-fossil energy has 20% of the total energy consumption
- 2050: the proportion of non-fossil energy is over 50%

R&D support policies

Provide R&D funds and support to major technological research project

- National High-tech R&D Program of China (863 Program)
- National Program on Key Basic Research Project (973 Program)
- National key R&D program ()
- Made in China 2025, Intelligent Solar PV Industry Development Plan, etc
- R&D by MOST, MOE, CAS, NSFC etc.

Economy Incentive Policies

- Feed-in-Tariff for Electricity from RE & Fund for renewable energy development
- Tax Preferences: Tax-free or lower policy
- Low-Interest Loan: RE generation projects can be prioritized by banks for infrastructure loans
- The central government project will be subsidized by treasury department, local project will be subsidized by local finance.
- Subsidies: Subsidies from central government is mainly for R&D and pilot demonstration

Market Development Policies

- Golden Sun Project
- regulation of RE generation price and cost sharing management
- Regulation of full guaranteed purchase of RE power generation by power grid
- Monitoring Regulation of newly built power source access to grid
- Suggestion on RE locally-consumption pilot work
- Renewable Energy Portfolio Standard and Assessment Methods



Non-hydropower Renewable Energy Portfolio Standard and Assessment Methods

- ❖ The provincial RE power quota target will be determined annually by National Energy Administration
- ❖ Main market players: All kinds of power grid and related entities in the power trading market
- ❖ Provincial Government and power grid companies make sure to fulfill the annual quota target given by the standard.
- ❖ RE power certificate:
 - Supervising the quota target completion status
 - Recording the RE power production, actual consumption and trading
- ❖ Annual supervision and inspection report on the quota completion status

Renewable Energy Portfolio Standard and Assessment Methods

- ❖ If the Province don't complete its RE quotas:
 - Reduction of the fossil energy power projects
 - Cancellation of the qualification for applying demonstrative project
 - Restriction on the high energy consumption project approval
- ❖ If the market players and entities don't complete their RE quotas
 - Reduce or cancel their trading amount in the power market
 - Poor credit record if they refuse to complete their quota



THANK YOU FOR YOUR ATTENTION

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