Overview of Microgrid R&D in China

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Outline:

- Overview of Renewable Energy Development Policy in China
- R&D Projects Supported by Chinese Government
- Some Testbeds for Microgrids
- Conclusion

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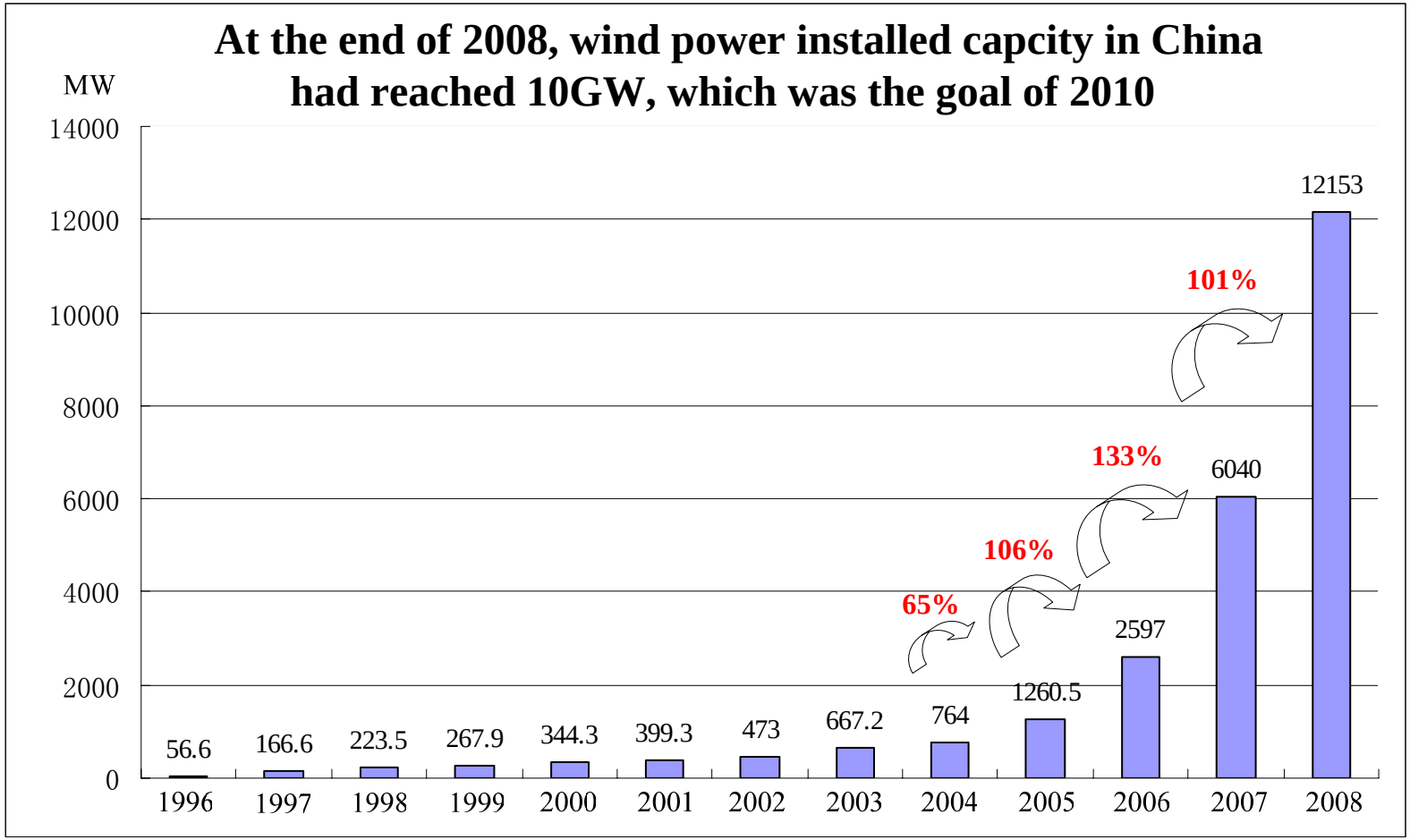
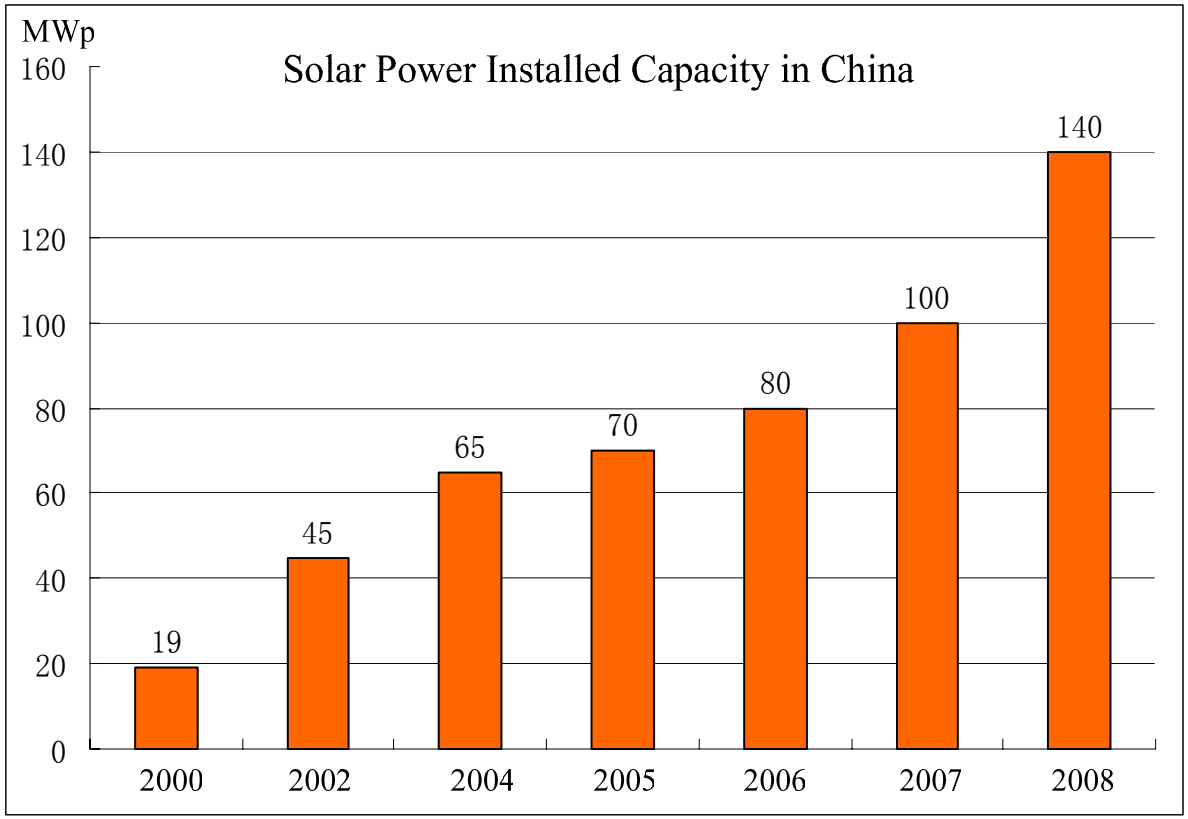
National Renewable Energy Power Generation Plan

Target Year		2010	2020	2030	2050
Wind Power	Installed Capacity（GW）	10	30(50)	100(xx)	400(xx)
	Power Generation（TWh）	210	1150	2300	9200
Biomass Power	Installed Capacity（GW）	5.5	30	50	100
	Power Generation（TWh）	212	1250	2250	5000
Solar Power	Installed Capacity（GW）	0.3	1.8(20)	10(XX)	100(XX)
	Power Generation（TWh）	4.2	23.4	140	1500

Wind Power Installed Capacity



Solar Power Installed Capacity



- **The National Energy Administration has decided to expand China's solar power installed capacity to 2 GW by 2011, with a subsidized price for solar power of 1.09 yuan per kWh in some areas.**

Some Policies to Support Renewable Energy Development

- Regulation and Management Measure of RE power (by NDRC)
- Regulation on Renewable Power Pricing and Cost Sharing (by NDRC)
- Guided Catalog of RE industry development(by NDRC)
- Some national standards (Standard for solar building, Geothermal heat pump by Ministry of Construction, Standard for Solar PV power and wind turbines etc by Standardization Administration of China.)
- Fund earmarked for RE (by Ministry of Finance)
- … …

Wind Power Price Policy (July, 2009 by NDRC)

Resource Area Grade	Standard wind power price (Yuan/kWh)	Area
Grade I	0.51	Inner Mongolia Autonomous Region except Chifeng, Tongliao, Xingan, Hulunbeier； Urumqi, Ili, Changji, Karamay, Shihezi of Xinjiang Uygur Autonomous Region
Grade II	0.54	Zhangjiakou, Chengde of Hebei Province； Chifeng, Tongliao, Xingan, Hulunbeier of Inner Mongolia Autonomous Region； Zhangye, Jiayuguan, Jiuquan of Gansu Province
Grade III	0.58	Baicheng, Songyuan of Jilin Province； Jixi, Shuangyashan, Qitaihe, Suihua, Yichun, Daxinganling of Heilongjiang Province； Gansu Province except Zhangye, Jiayuguan, Jiuquan； Xinjiang Uygur Autonomous Region except Urumqi, Ili, Changji, Karamay, Shihezi； Ningxia Hui Autonomous Region

Solar Power Stimulus Policy

- **Solar Energy Roof Plan (March, 2009)**

  （1）Emphases on building integrated photovoltaic demo projects

  （2）Subsidies 20 Yuan/W of the BIPV system.

- **Golden Sun Pilot Program (July, 2009)**

  （1）Subsidies more than 500 MWp in the next three years.

  （2）Offer 50-70 percent of investments for solar power projects.

- **Some Policy by local Government**



Biomass Power Policy

- **Price for biomass power: feed-in-tariff**

  In the first 15 years, adopt the subsidy Price:

  Coal fired plant :0.25Yuan/kWh,

  biomass power : 0.50-0.72 Yuan/kWh

- **Others**

  Provide a long-term policy and ensure the fixed price

  etc.





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R&D Projects Supported by Chinese Government

"973" National Basic Research Program — 4 Programs

"863" National High Technology Research and Development Program — 24 Programs

National Key Technology R&D Program

National Natural Science Foundation — 21 Programs

Other founding agencies — Programs

Industry

Institutes of Higher Education & Research Institutes

International Partners

Advanced Energy Technology R&D Program

Biomss | PV Power | Fuel Cell | CHP | Energy Storage | DG Systems | MicroGrid

Advanced Energy Technology R&D Development






National 973 Project, *4 Programs*

Program	PI	Institution
Research on MG system	C. S. Wang	Tianjin University
Research on new battery & related energy materials	F. Wu	Beijing Institute of Technology
Research on high efficiency redox flow cell energy storage technology	H. M. Zhang	Dalian Institute of Chemical & Physics
Research on multi-energy CHP system	H.G. Jing	Institute of Engineering Thermophysics

National 863 Project, *24 Programs*

Program	PI	Institution
The key technology and demonstration project of grid-connected CHP MicroGrid	C. S. Wang	Southern Power Grid, Tianjin University
Microgrid control and protection technology	Y. L. Li	Tianjin University
DG system planning, operation and protection	B. H. Zhang	Xian Jiaotong University
Multi-energy Microgrid control and energy management technology	M. Ding	Hefei University of Technology
DG system & MicroGrid	L. Kong	Institute of Electrical Engineering, Chinese Academy of Sciences
Microgrid protection control technology based on distributed intelligence	X. N. Lin	Huazhong University of Science and Technology
Distributed biomass system based on CCHP technology	J. F. Li	Shandong University
High efficiency gas CCHP system integration technology	L. Fu	Tsinghua University
……	……	……

National Natural Science Foundation, *21 Programs*

Program	PI	Institution
Simulaiton and control of distributed generation system	C. S. Wang	Tianjin University
DG system based on the hybrid excitation synchronous machine - matrix converter combination	B. Zhou	Nanjing University of Aeronautics and Astronautics
Multi-agent intelligent control of Distributed power systems	S. X. Wang	Tianjin University
Basic research of wpm distribution system communication for DG coordination and control	Y. B. Zhang	Zhejiang University of Technology
DG impacts with high penetration and inverter-type DG on distribution network	L. Kong	Institute of Electrical Engineering , Chinese Academy of Sciences
Control of DG system based on expection theroy	S. Gao	Southeast University
Control and stability study of power inverters in MicroGrid	J. H. Su	Hefei University of Technology
… …	… …	… …

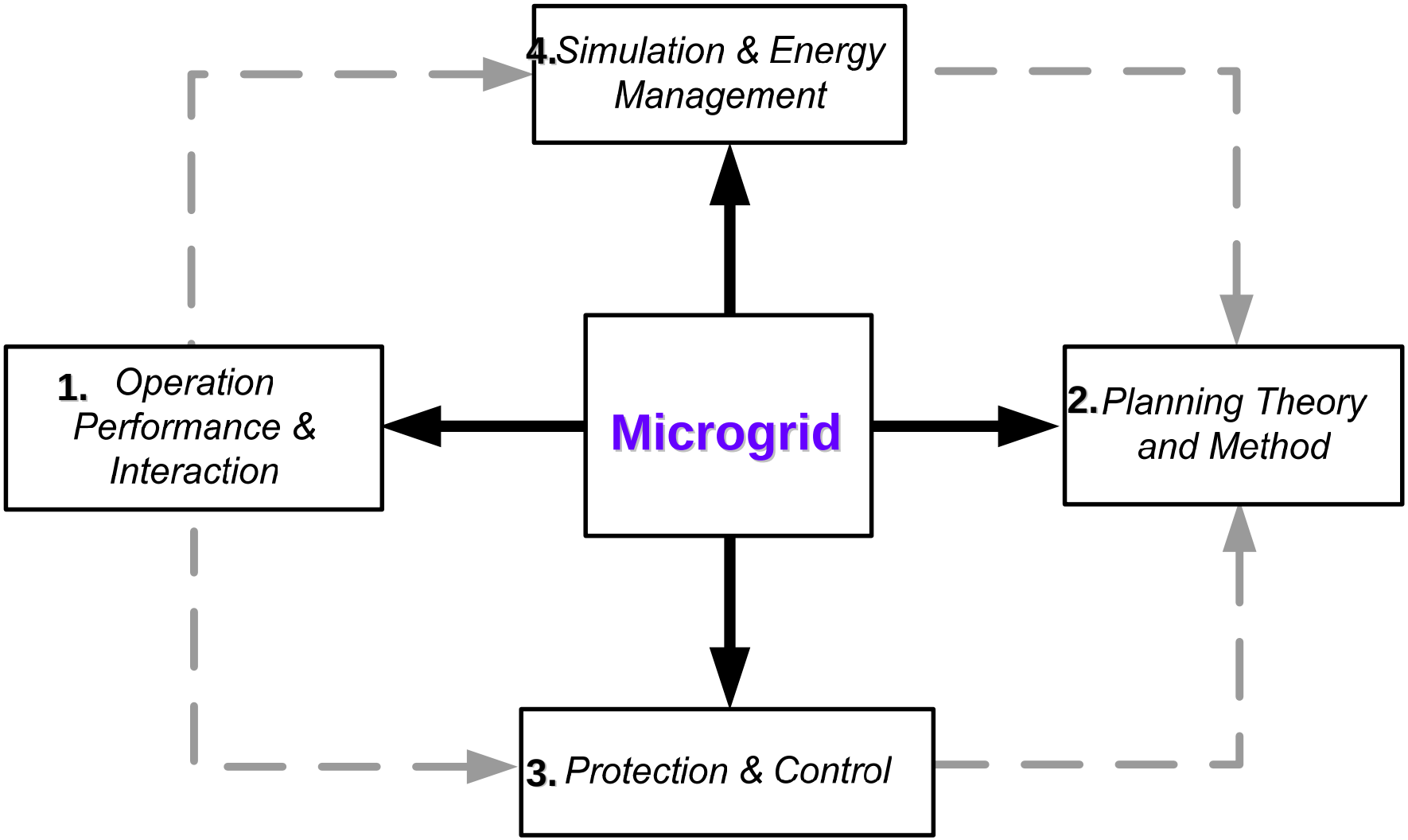
Other Projects

Program	PI	Project	Institution
The key technology and theory research on distributed energy system	**C. S. Wang**	**Key Scientific and Technical Innovation Project, Ministry of Education of China**	Tianjin University
Research of distributed generation system with green energy	**M. Ding**	**The Key Research Program of Education Ministry**	**Hefei University of Technology**
Control system of photovoltaic power and water purification	**J. H. Su**	**The Key Research Program of Education Ministry**	**Hefei University of Technology**
Demo of 20kW grid-connected PV power station construction	**J. H. Su**	**National "Tenth Five" Technology Project**	**Hefei University of Technology**
Research of grid-connected PV roof powr system and 5kW dual inverter	**J. H. Su**	**National "Ninth Five" Technology Project**	**Hefei University of Technology**
3kW GC/SA dual inverter	**J. H. Su**	**National "Ninth Five" Technology Project**	**Hefei University of Technology**
……	……	……	……

Research on the Key Issues of Distributed Generation System (MG)
(973 Program)

- **Research Team**
  - 7 Universities
  - China Southern Power Grid
- **Funding: ￥30,000,000 (4,400,000$)**
- **Duration: 2009 – 2013**
- **PI: Prof.Chengshan WANG**

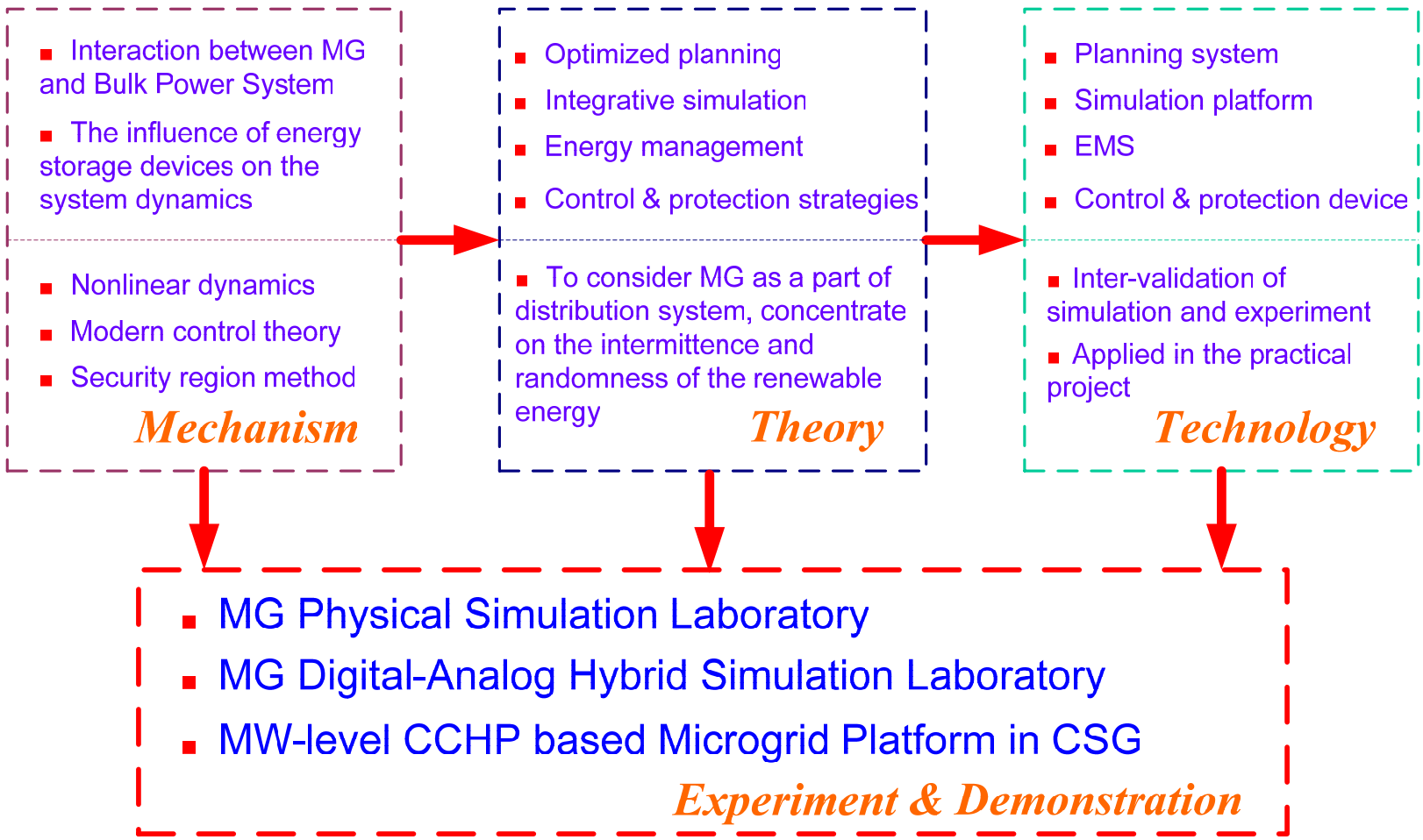
The Key Issues to Be Solved:



Target – To supply a theoretical and technological support for the scientific development and secure & high-efficiency operation of MGs and distribution systems

- **Mechanism Exploration** – To reveal the law of energy exchange inside the MG and its interaction with the distribution system under normal and faulted conditions;
- **Theoretical Innovation** – To develop the theories on modeling, analysis, simulation, protection and control of MG; to develop novel planning theory for MG integrated distribution system;
- **Technological Breakthrough** – To develop up-to-date EMS with the function of simulation, analysis and computer aided decision-making support for MGs integrated distribution system; to design integrative control devices for MGs and MG integrated distribution system;
- **Validation & Demonstration** – To construct the advanced simulation-experiment platform; to apply some results to demonstration projects.

Technique Route



To supply a theoretical and technological support for the scientific development and secure & high-efficiency operation of MG and distribution system

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MicroGrid Testbed in HFUT, China

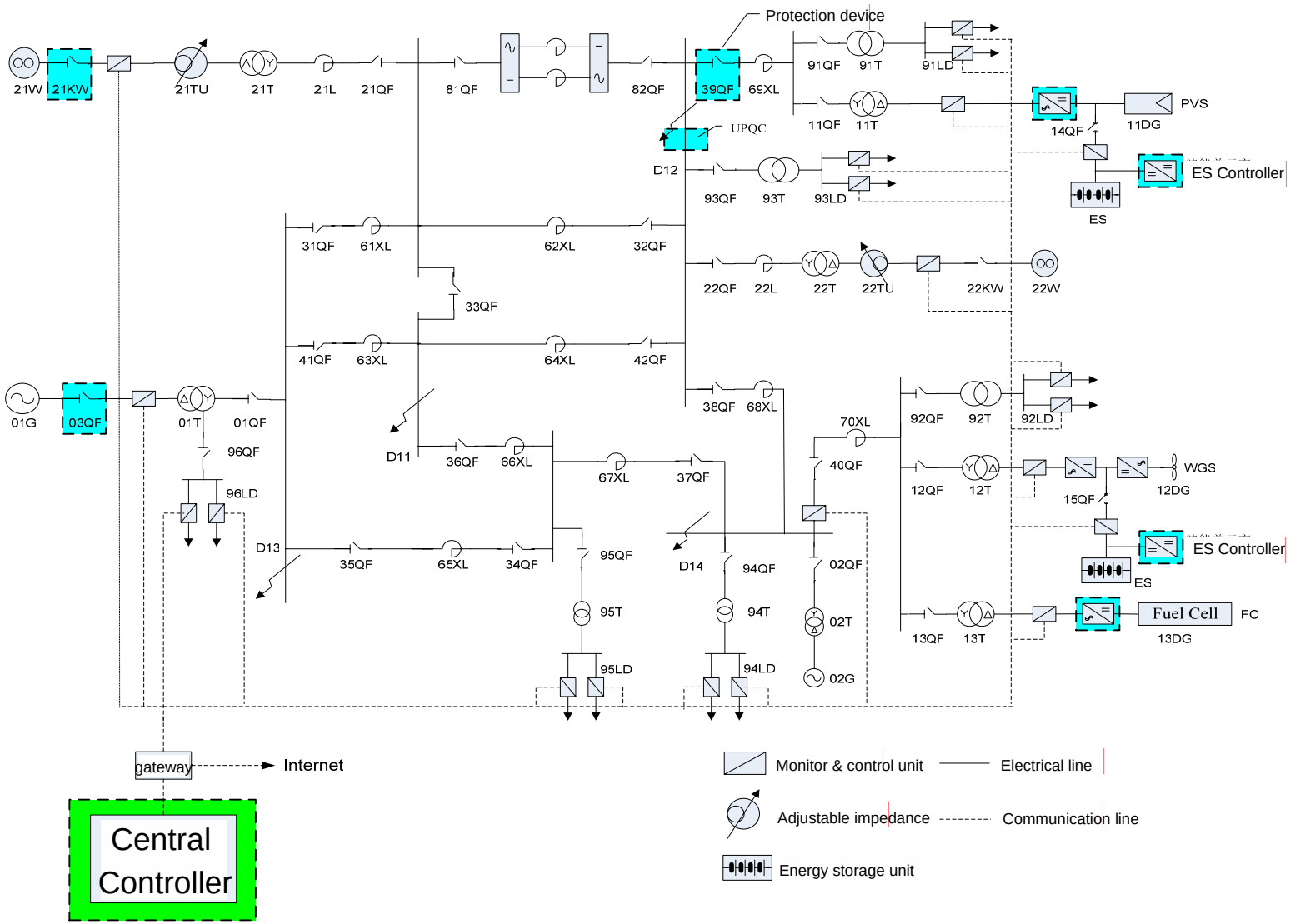
- The Distributed Generation lab in Hefei University of Technology built in 2006 .
- The lab consists of conventional power units, hydro power units, PV system, wind power, fuel cell and energy storage system of battery and capacitors.
- DG control system based on profibus technology

20kW Co-generation of PV and wind power

Fuel cell and Battery control system

DG control system based on profibus technology

System Structure of the Testbed in HFUT

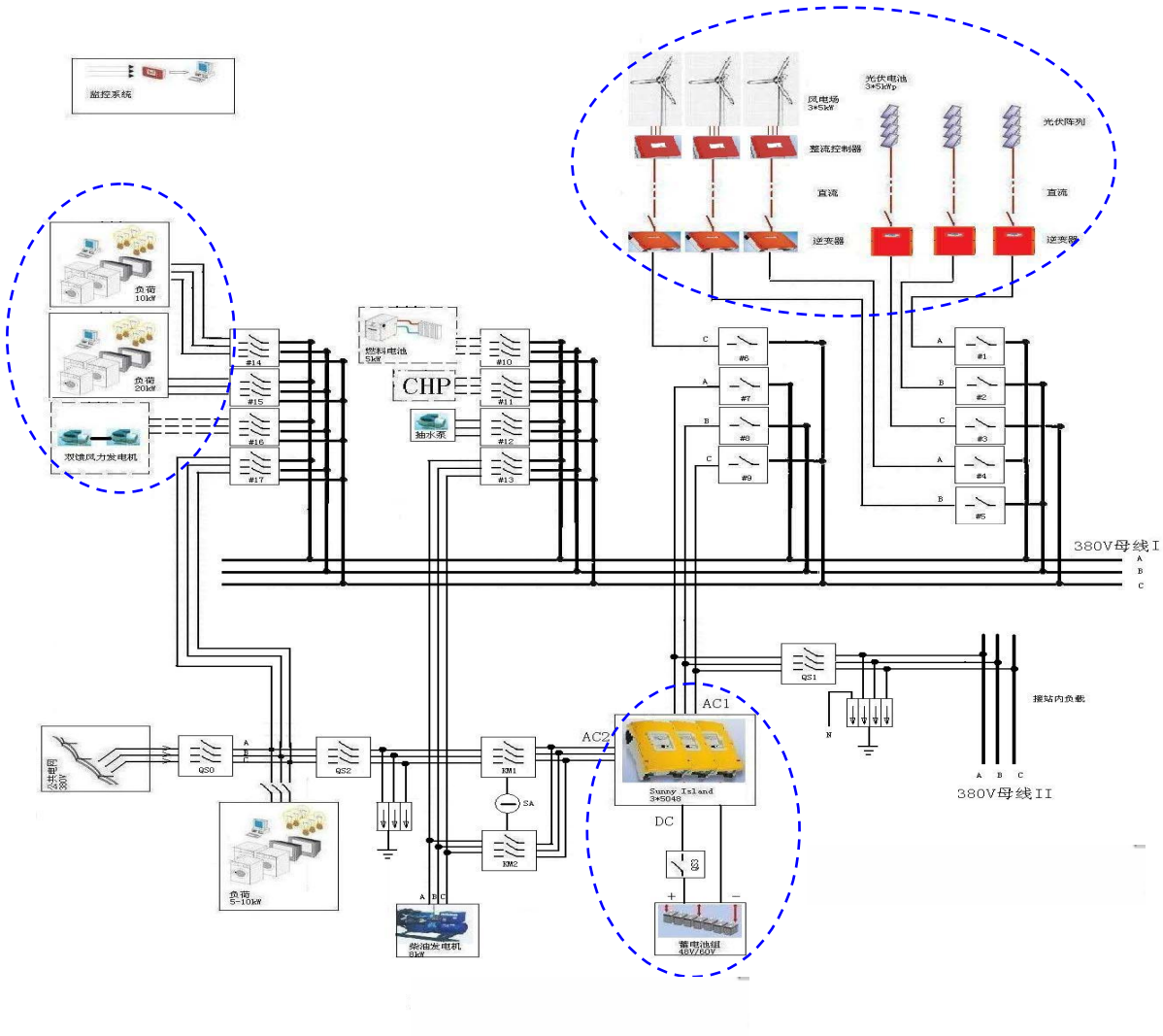


MicroGrid lab in Shandong, China

Shandong Power Institution PV, Battery and wind generation MicroGrid Lab

- 15 kWp PV array
- 15kW wind generator
- 30kW DIFG dynamic simulation system
- 43kW Smart load system
- Battery, measure and control system
- Simulation analysis system (DigSilent, PSASP, BPA)

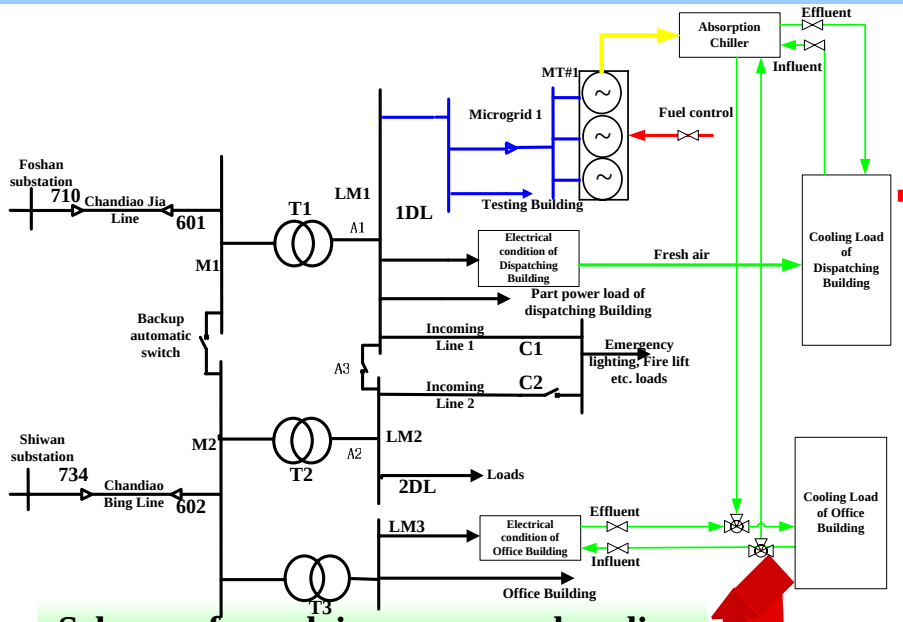
System Structure of The MG in Shandong Power Institution



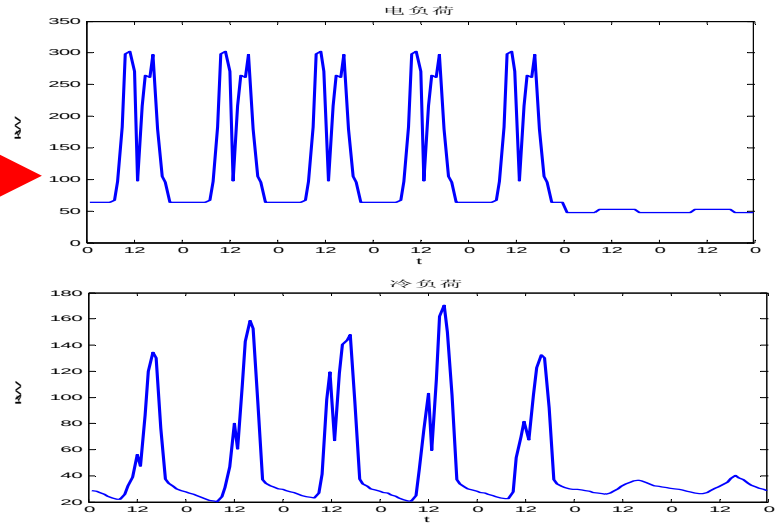
PV, Battery and wind generation MicroGrid Lab

- Research on DG and MicroGrid connecting with the Grid
- Dynamic and steady state simulation of wind farm system
- Dynamic and steady state simulation of PV system
- Research on Smart load system
- Research on Energy management system of Microgrid

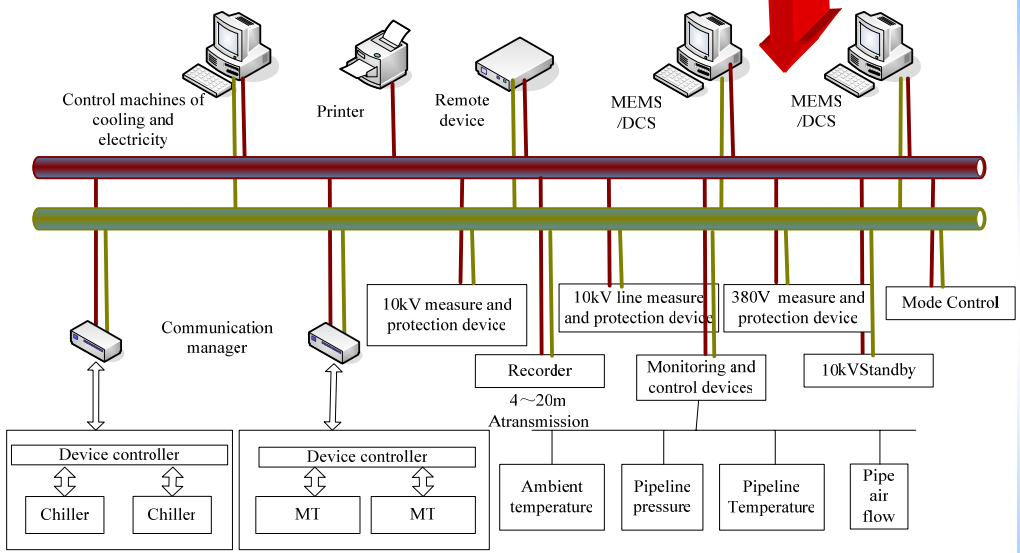
Demonstration project of CHP MicroGrid



Scheme of supplying power and cooling



Cooling and electrical load forecasting in some week

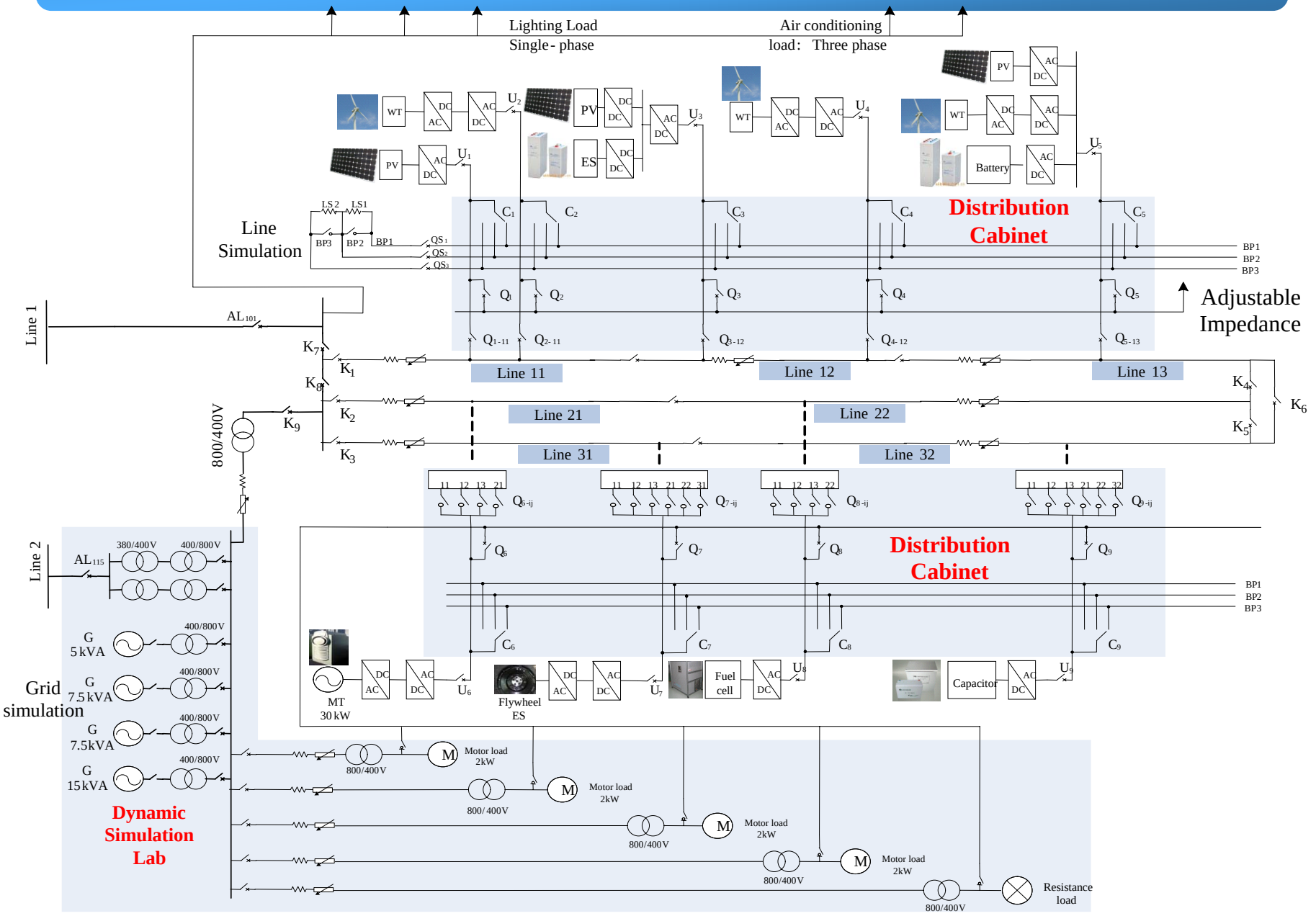


Energy management system of Microgrid

A new energy optimization and management model

- Generation plan for MT
- The cooperation of CHP and electric air conditioning
- The influence of price of electricity from public grid, price of fuel and price of the electricity sold to grid

MicroGrid lab in Tianjin University, China

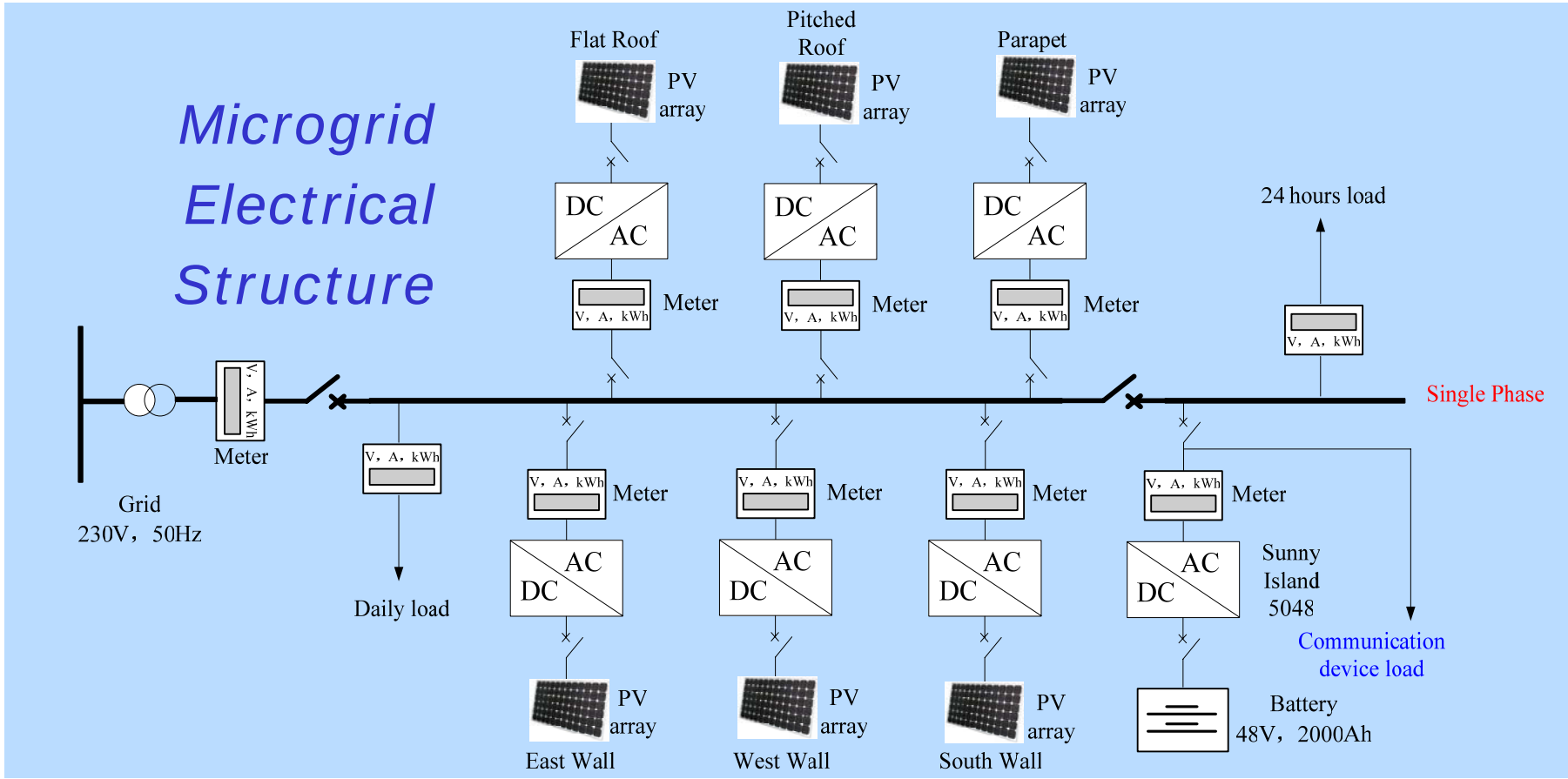


Solar Decathlon Europe 2010, Tianjin University Participation

The Solar Decathlon Europe 2010 came about from a commitment by the Government of Spain together with the Government of the United States to organize the competition in Europe for universities to design and build a self-sufficient house using solar power as the only source of energy.

We are aiming at achieving the maximum level of sustainability in a Solar-powered, energy self-sufficient, user- and environmental- friendly house.

Solar Decathlon Europe 2010, Microgrid Design



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Questions?