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Microgrid Technology Implementation and Standardization

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Agenda

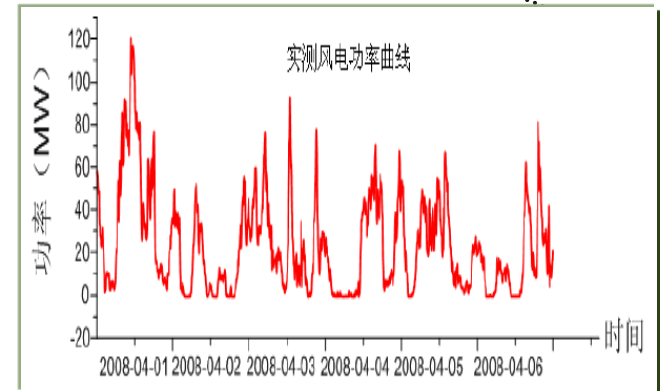
- 1. Microgrid and background information**
- 2. Energy storage applications and examples**
- 3. Standardization efforts**

Distributed Generation (DG)



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- At or near the customer site
- Operation mode
 - Generation mainly for self use
 - Surplus can be sold to the grid
- Solar, wind, biomass, geo-thermal, hydro, gas and comprehensive use of multi-types energy
- Challenge: uncertain, partially unpredictable

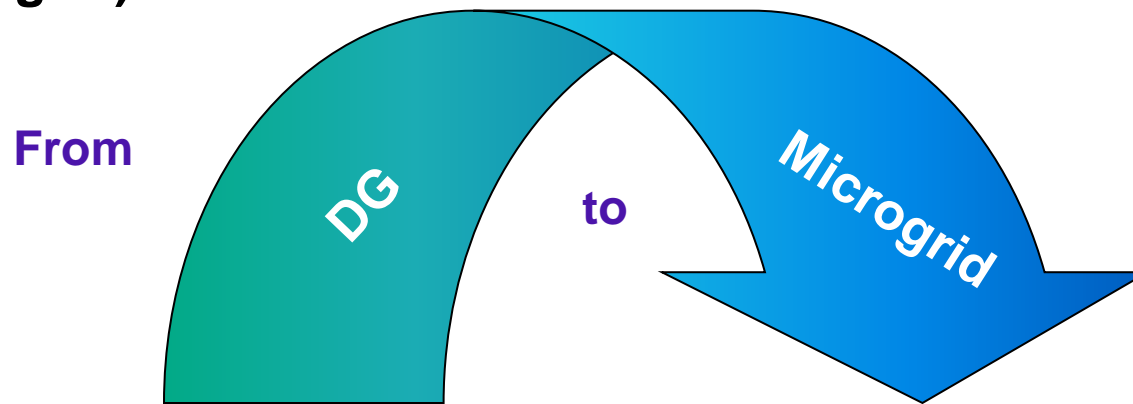


Controllable DG Integration



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Technical solution: consider the DG and local load as a small system (i.e. microgrid)



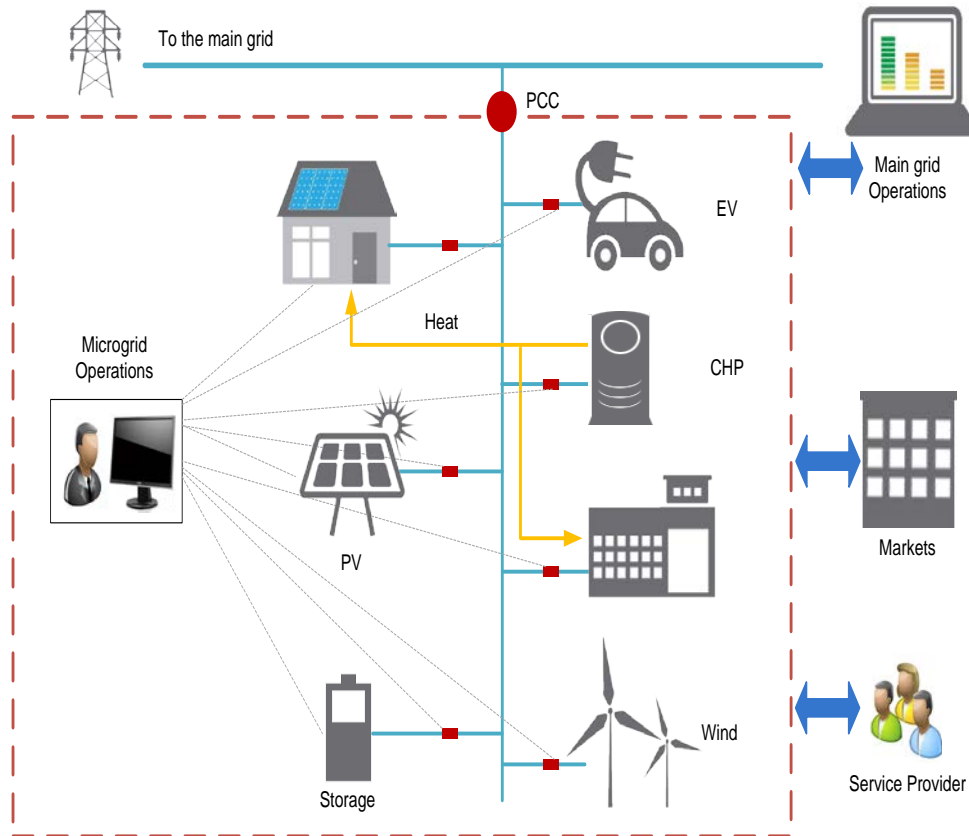
- Distributed integration
- Independent individual uncontrollable power source
- Multiple connection points with local grid

- Group integration
- Controllable load/power source
- Single connection point with local grid

Microgrid Solution



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- A controllable power resource/load from the main grid perspective
- Grid integrated/ islanded mode operation

Major Microgrid Application Scenarios



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- **Facilitate the DER integration in high penetration**
- **Provide power supply to remote area with weak/or no link to the main grid**
- **Meet customer's higher requirement on power quality and reliability**

Characteristics



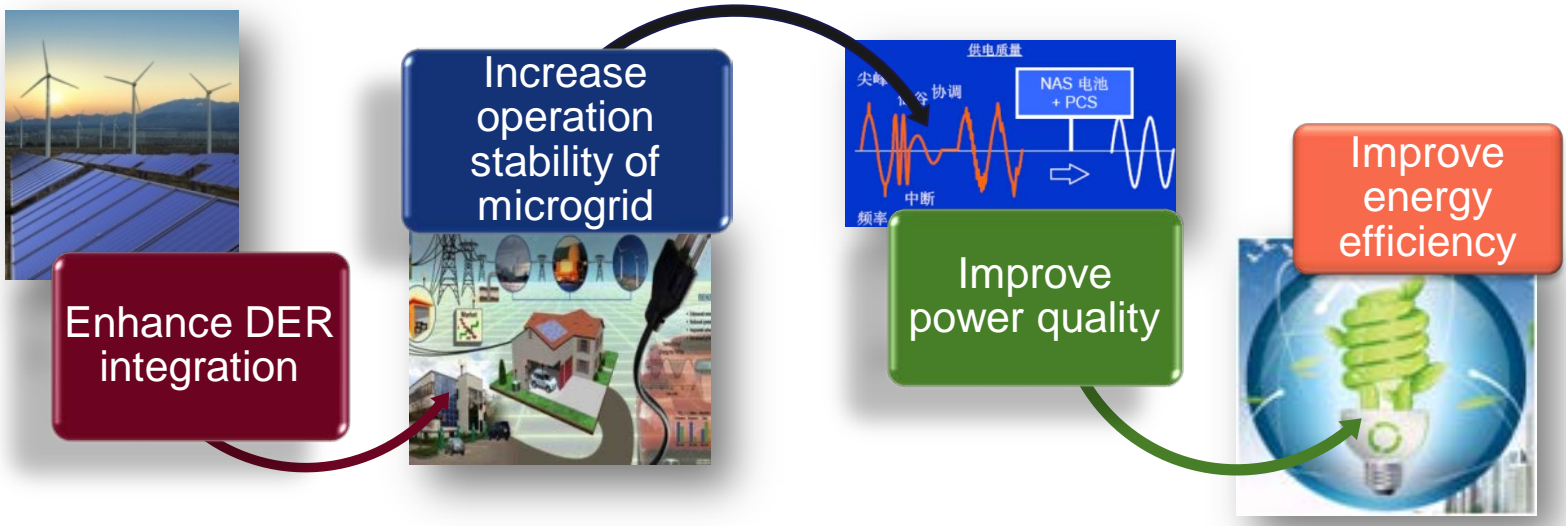
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- **Mainly rely on distributed energy resource with small capacity and low inertia, intermittent and uncontrollable output**
- **Close to customer, with local utilization of power/heat energy**
- **Dynamic load control**
- **High utilization of power electronic devices, such as inverter**
- **Capable of independent and stable off-grid operation**
- **Multiple operation modes: connected/islanded**

Energy Storage in Microgrid



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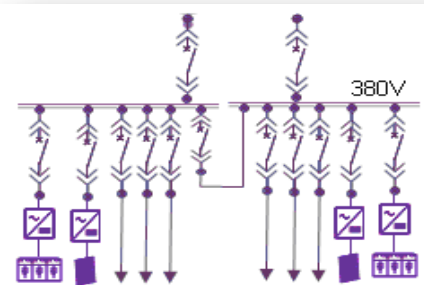


Enhance the integration of intermittent DG

- **Requirement:** Smooth DG power fluctuations, balance the generation and load inside microgrid
- **Storage type:** battery
- **Technical requirement**
 - Fast response
 - Sufficient storage capacity to meet the requirement of smoothing fluctuation
- **Technical parameters:**
 - **Dynamic response time:** 20ms~few seconds
 - **Storage capacity:** matching to generation capacity, usually from dozens of kW to several MW

Case: PV/Storage Microgrid in Henan

- **Power:** PV 380kW
- **Storage:** 2 × 100kW/100kWh Lithium battery



Energy Storage in Microgrid



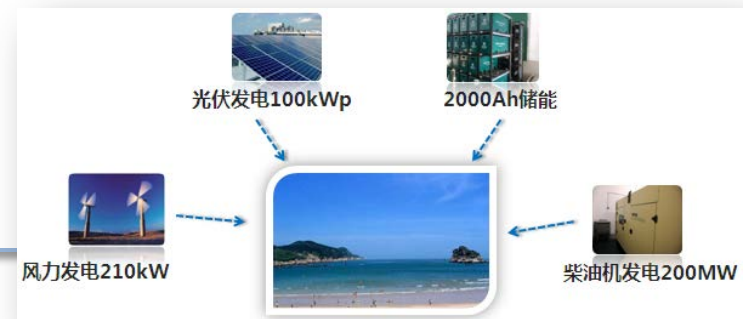
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Increase the operation stability of islanded microgrid

- **Functional requirements:** provide power support to increase the stability of power inside microgrid
- **Technical requirement**
 - **Fast response:**
Dynamic response time: < 20 ms
 - **Sufficient storage capacity**
matching load capacity, dozens of kW to several MW

Case: Islanded Microgrid with wind/PV/storage in Dongfushan

- Power: 210kW wind turbine, 100kWp PV and 200kW diesel generator
- Storage: 2000Ah battery



Energy Storage in Microgrid



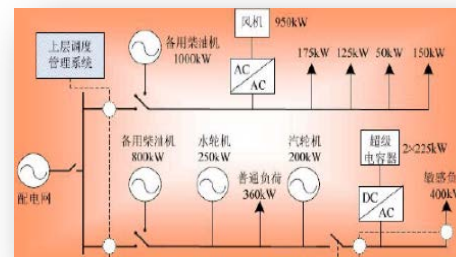
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Improve the power quality of microgrid

- **Requirements:** provide fast power buffer to resolve the momentary outage, voltage dip and fluctuation, etc.
- **Storage:** super-capacitor, flywheel, superconducting magnetic energy storage
- **Technical requirements**
 - Faster response
 - Longer cycle life
- **Technical parameters:**
 - Dynamic response time: <20ms
 - Recycling times: > 50,000 times

Case: Palmdale Microgrid in U.S.

- **Power:** Wind turbine 950kW, gas generator 200kW, hydro-power 250kW, diesel generator 800kW
- **Storage:** Super capacitor 450kW



Energy Storage in Microgrid



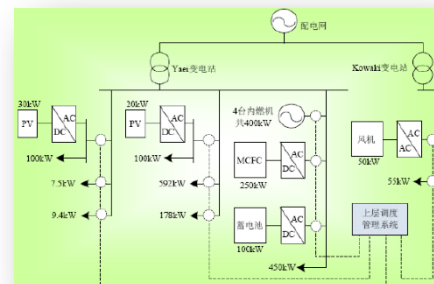
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Improve energy efficiency

- **Requirements:** peak shaving
- **Storage type:** battery
- **Technical requirements:**
 - Larger storage capacity
 - Longer cycle life
- **Technical parameters:**
 - **Storage capacity:** usually dozens kW to several MW
 - **Cycle life:** > 5,000 times

Case: Kyotango Microgrid in Japan

- **Power:** gas generation 400kW, fuel cell 250kW, wind turbine 50kW
- **Storage:** 100kW lead-acid battery



Microgrid Implementation in China



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■ The typical microgrid projects in China

No.	Projects
1	PV and Storage pilot projects in Henan
2	CCHP Microgrid system in Feshan, Guangdong
3	Wind/PV/Diesel/Storage Microgrid in Dongao Island in Guangdong
4	Smart business hall Microgrid projects in Sino-Singapore eco-city
5	Wind/PV/Diesel/Storage and Desalination project in Dongfu Island, Zhejiang
6	Immigrant village Microgrid in Inner Mongolia
7	Langfang Eco-city Microgrid project
8	Zuoan Microgrid pilot project in Beijing
9	Wind/PV/Storage Microgrid project in Xian International Horticultural Exposition Park
10	PV and storage Microgrid project in Yangzhou development zone
11	Microgrid pilot project in Gongqing, Jiangxi
12	PV and storage Microgrid in Xiamen Island in Fujian
13	Wind/PV/Storage/Diesel and super capacitor island Microgrid in Nanlu, Zhejiang
14	Wind/PV/Storage/Diesel and super capacitor Microgrid in Luxi island in Zhejiang
15	Wind/PV/Storage village Microgrid projects in Chengde

■ Characteristics of the typical microgrid projects

① **Power source: mainly wind power and PV**

② **Voltage:**

380V: 11 projects (71%)

10kV: 4 projects (29%)

③ **Installed capacity:**

11 ≤ 1MW, 4 ≤ 5MW

④ **Energy storage: 14 deployed ESS**

⑤ **Operation mode: integrated operation, islanded operation**

Implementation Example in China



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■ Microgrid project in east Inner Mongolia

- **Voltage level:** 380V
- **Capacity:** PV 110kW ;
Wind power 50kW;
lithium battery
42kW/50kWh
- To provide power supply
for 100 households
farmers and diary farm

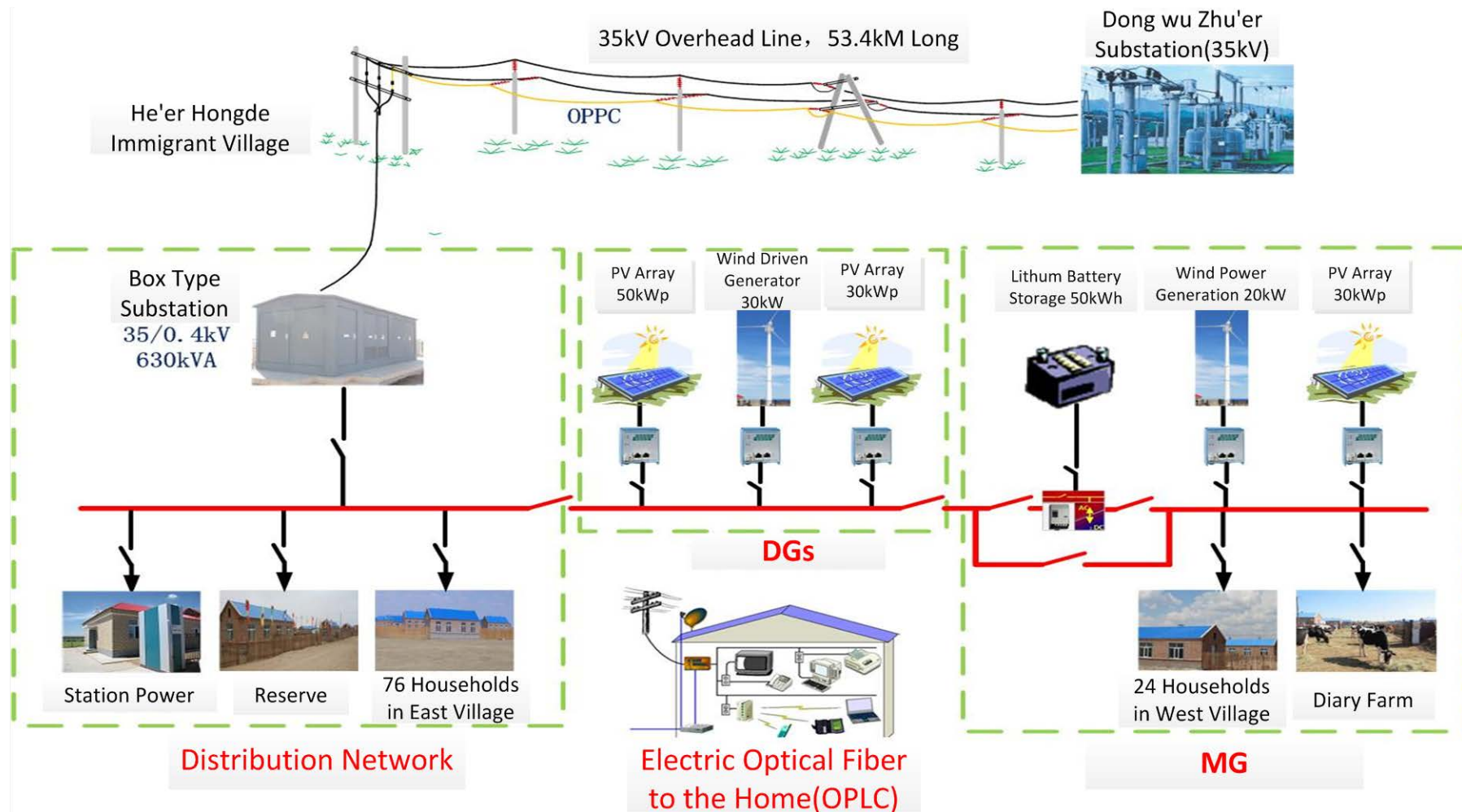


Implementation Example in China



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System Overview-Microgrid project in east Inner Mongolia



■ Key technology areas for Microgrid standardization

- Optimal planning and design
- Coordinated operation and control of multiple DERs
- Hybrid energy storage
- Power quality control and improvement
- Smart protection
- Economic operation and optimized energy management

Standardization Efforts in China



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- **Establishment of National microgrid and DER integration TC**

Responsible for developing microgrid and DER integration standards system and yearly development plan; developing related standards and standards promotion; participating international standardization activities on behalf of SAC

- **Publish of microgrid and DER integration standards system**

Covering planning and design, commissioning, integration test, operation and control, etc.

- **Development of 8 national standards, 6 industry standards, and 3 SGCC standards**

Standardization Efforts in China



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■ Microgrid standards under development in China

No.	Type	Standard
1	National	Integration of microgrid to power system TS
2	National	Design specification of integrated microgrid
3	National	Commissioning specification of integrated microgrid
4	National	Test of integrated microgrid TS
5	National	Operation and control specification of microgrid integrated to distribution network
6	National	Monitoring system of microgrid TS
7	National	EMS of microgrid TS
8	National	Project design specification of microgrid

Standardization Efforts in China



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■ Microgrid standards under development in China

No.	Type	Standard
9	Industry	Experimental standard for integrating microgrid to power system
10	Industry	Function of microgrid control and operation system specification
11	Industry	Operation specification of islanded microgrid
12	Industry	Monitoring of islanded microgrid TS
13	Industry	Guide for microgrid planning and design
14	Industry	Microgrid operation and control TS
15	SGCC	Microgrid integration to distribution network TS
16	SGCC	Common microgrid configuring TS
17	SGCC	Test specification for integrating microgrid to distribution network

International Standardization Efforts



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- IEC has established **Ad Hoc Group 53 Microgrid** and **IEC SEG6 Nonconventional Distribution Grid/Microgrid** to develop the strategic plan in the microgrid area
- IEC has published *Microgrid for Disaster Preparedness and Recovery*
- IEC is going to set up SC8B “Decentralized Electrical Energy Systems” in TC8
- IEC standards under development
 - IEC/TS 62898-1 Guidelines for the General Planning and Design of the Microgrid
 - IEC/TS 62898-2 Technical requirements for Operation and Control of Microgrid
 - IEC/TS 62898-3-1: Microgrids - Technical Requirements - Protection requirements in microgrids



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Any question?

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