GOLDWIND
金风科技

www.goldwind.com.cn

Goldwind Smart Microgrid and Industrial Park Smart Energy Internet

Reporter: Dehua Zheng

October 2016

Contents



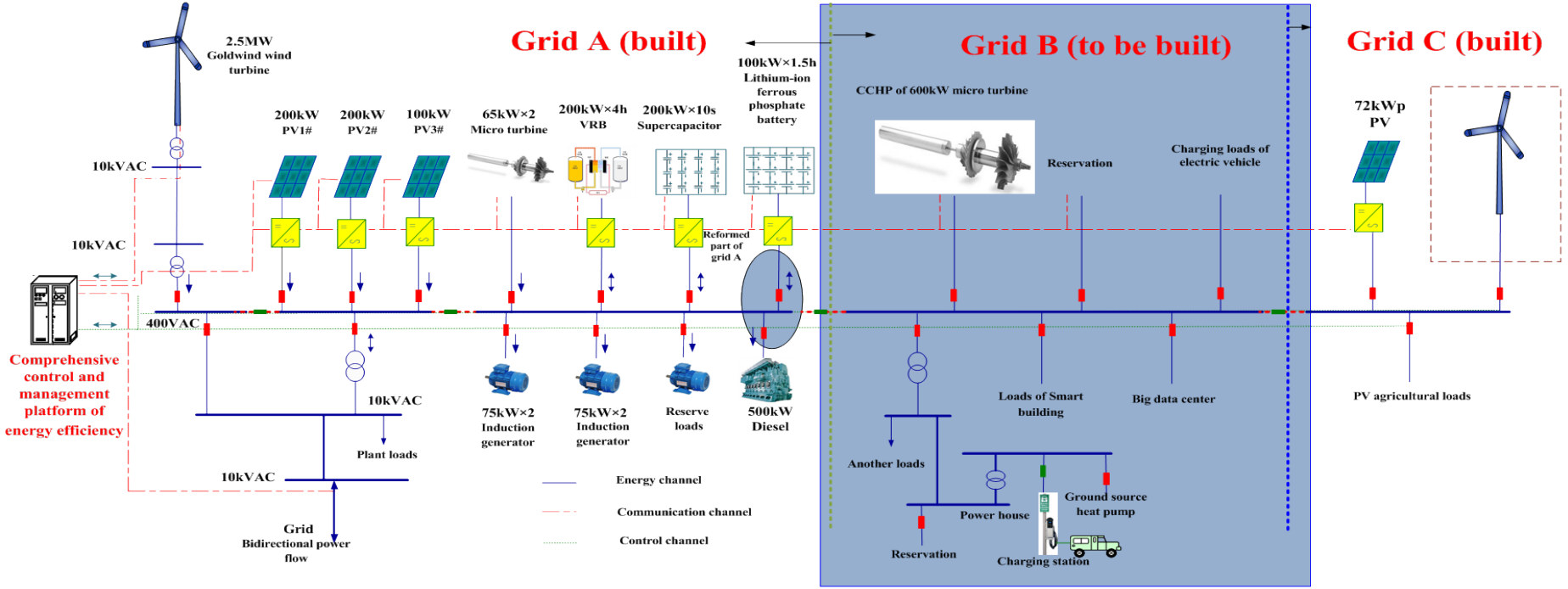


The introduction of Goldwind microgrid and products

What is the energy internet and the relationship between energy internet and microgrid?

The energy internet is the internetwork consisted of multiple energy recourses with the electrical power system and microgrid at the core. It is a new ecological energy system with high integration of energy and information, achieving horizontal multiple energy compensation and vertical coordination with DERs, utility grid, loads and energy storage, based on internet thinking and energy technology reform.

The introduction of Goldwind microgrid and products

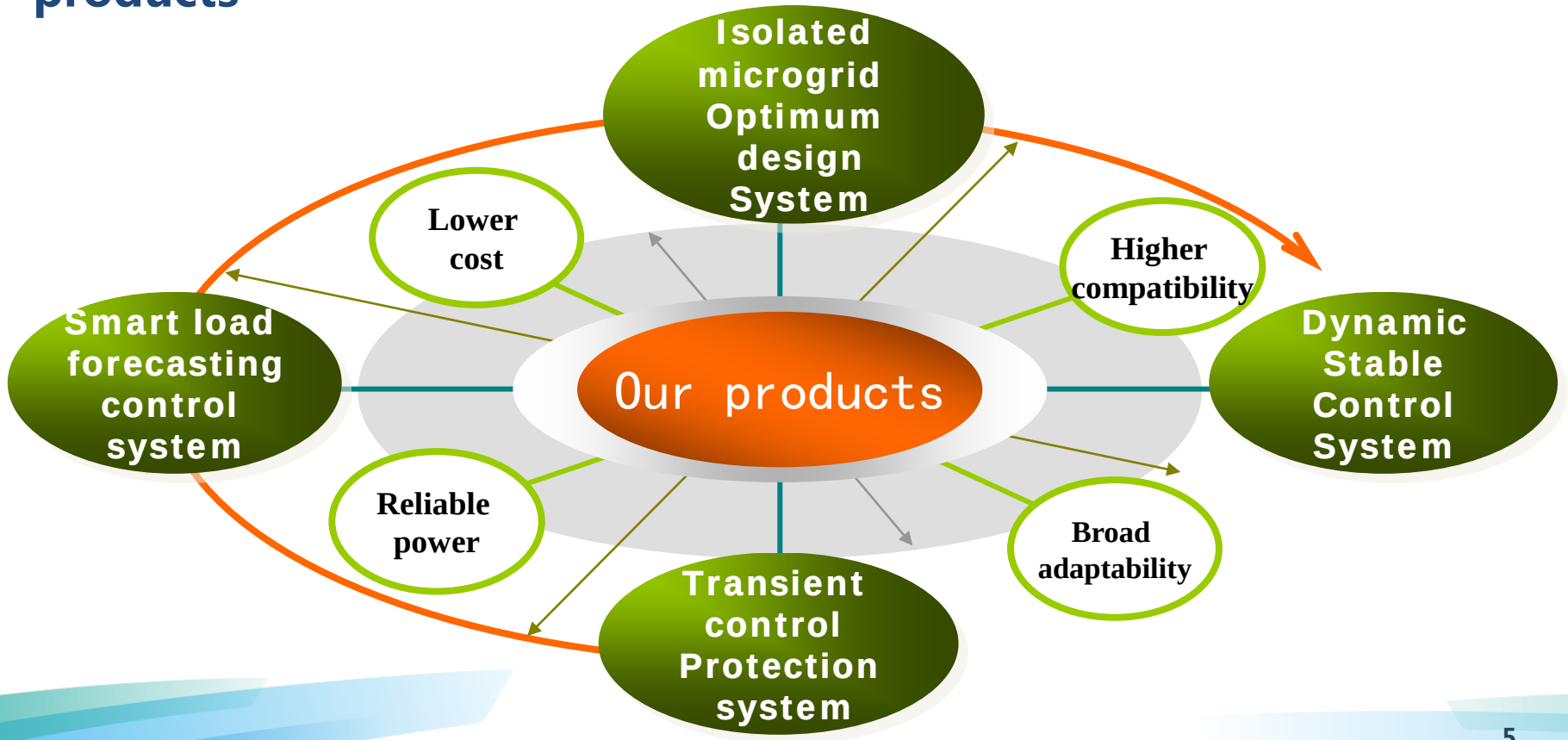


Reformed part of Grid A--the connection of lithium battery and diesel

To be reformed part of Grid C--communication control access of Grid A and Grid C

To be built part of Grid B--600kW micro turbine CCHP system and comprehensive control and management platform of energy efficiency

The introduction of Goldwind microgrid and products



The aerial view of Beijing Goldwind microgrid

Smart energy building (under construction)

PV generation

500kWp Capacity: 500 kWp
Polysilicon/490 kW
Monocrystal silicon/5 kW
Cadmium telluride/5 kW

Reserve power supply

Diesel: 300kW * 1 , 200kW * 1
Micro turbine：
65kW*2+600kw*1

Energy conservation

Reach fractional energy saving of 14.3
5.8% Lighting system energy saving counts 5.8% of the total energy consumption.
8.5% Air conditioning system energy saving counts 8.5% of the total energy consumption.

Energy storage system

VRB： 200kW*4h
Lithium battery ： 125kW*2h
Supercapacitor： 200kW*10s
Lead carbon battery 100kw*1.5h

Goldwind Beijing

BDA
Floor space ： 91271.6 m^2
Load capacity：200kW – 2200kW

Wind turbine

Model number：GW 106/2500kW
Tower height：80m

Contents

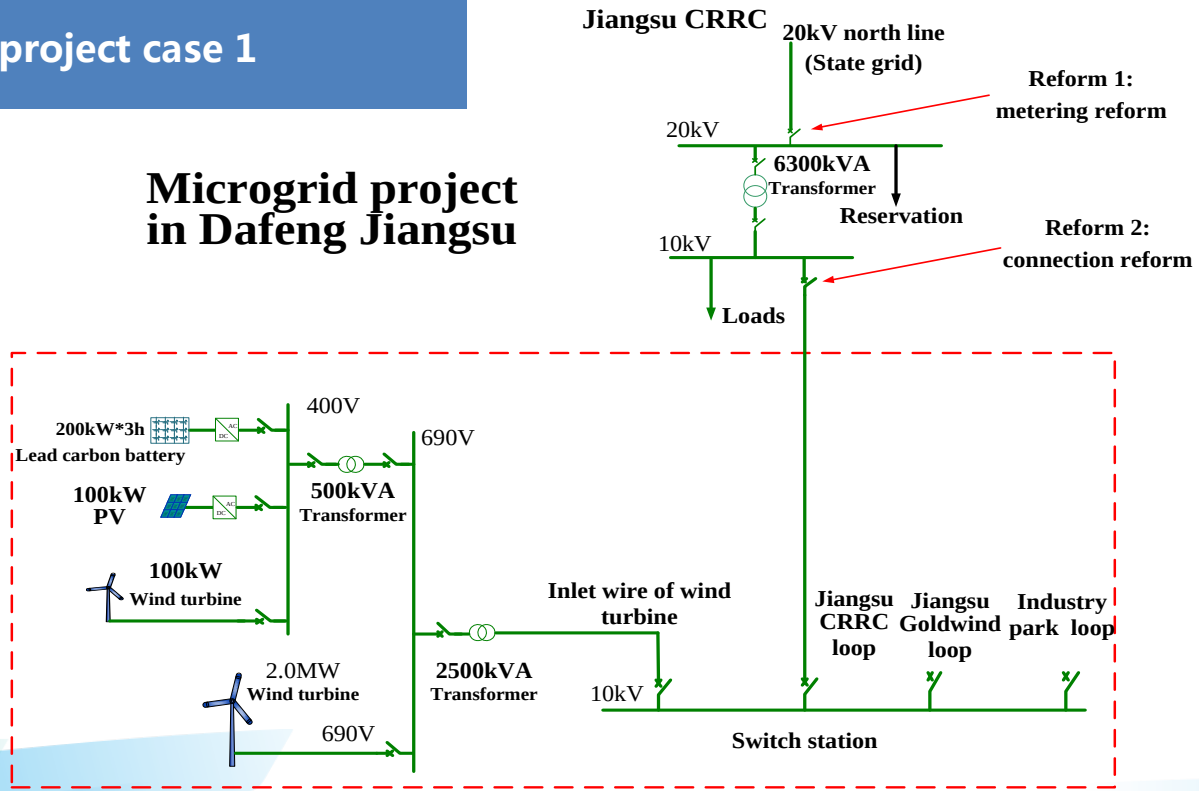




The classic cases of Goldwind microgrid project

Microgrid project case 1

Microgrid project in Dafeng Jiangsu



Note: The dashed parts is the newly-built.

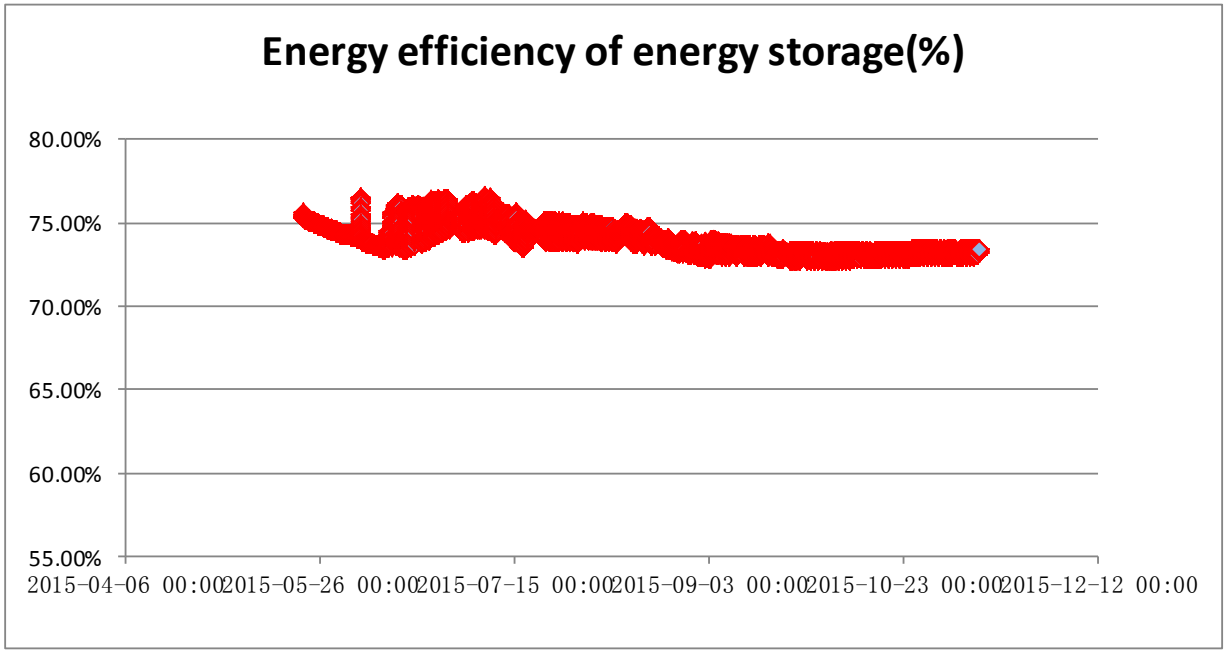
Microgrid project case 1

It is the first commercial grid-connected microgrid project of industrial park

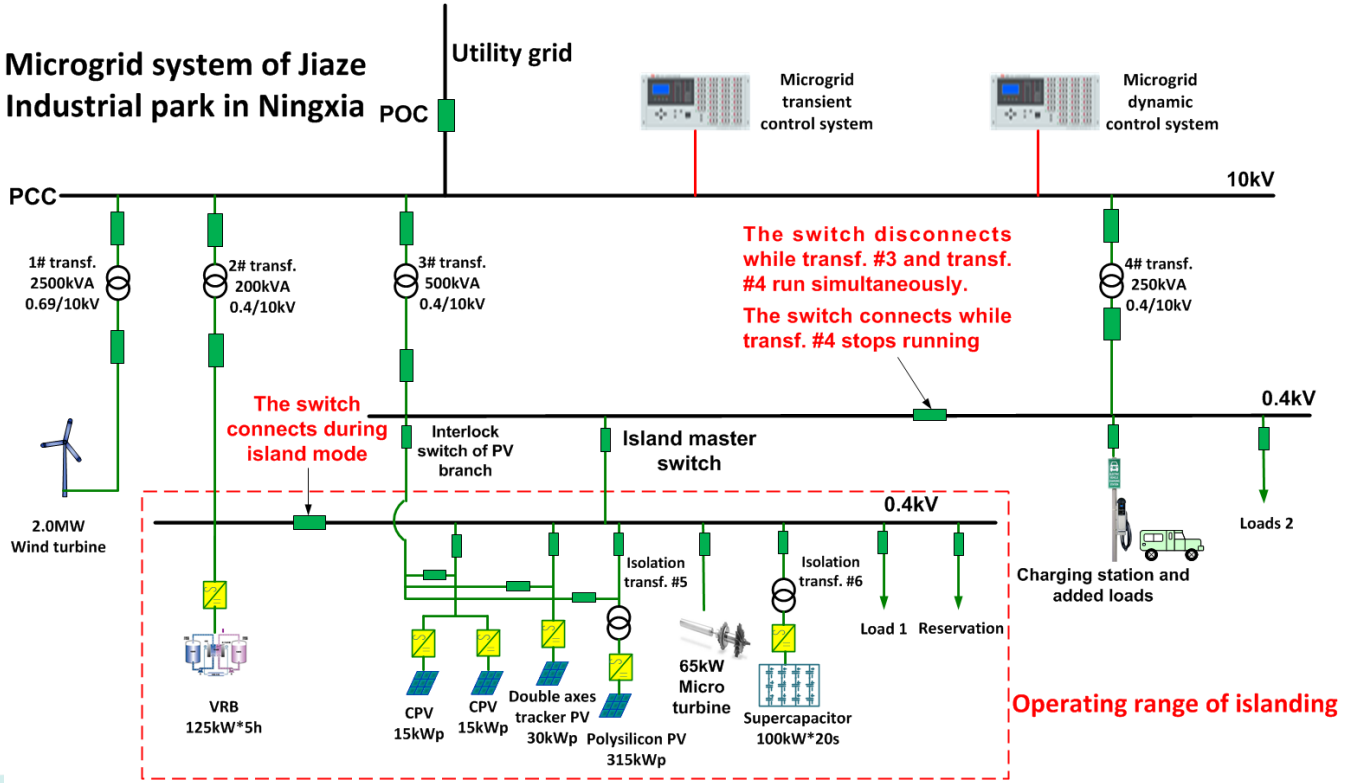
It connected to the utility grid on 26 March 2015. The gross generation is
2, 120 kWh up to 17 December 20 15.

It saves electricity cost, improves the power quality and capacity cost. Above advantages produce direct economic benefit near RMB 1 million.

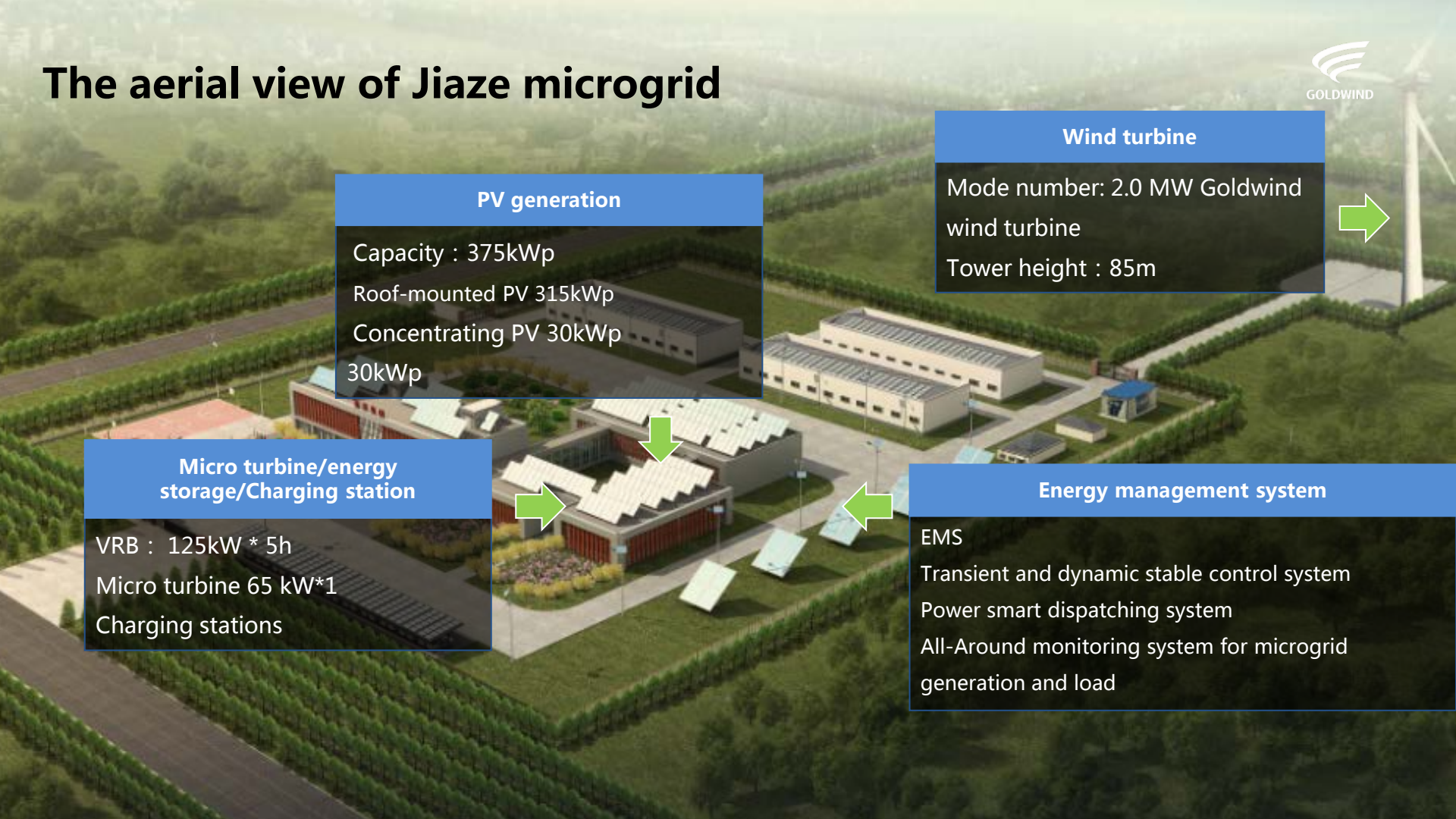
Microgrid project case 1



Microgrid project case 2



The aerial view of Jiaze microgrid



PV generation

Capacity：375kWp

Roof-mounted PV 315kWp

Concentrating PV 30kWp

30kWp

Wind turbine

Mode number: 2.0 MW Goldwind wind turbine

Tower height：85m

Micro turbine/energy storage/Charging station

VRB： 125kW * 5h

Micro turbine 65 kW*1

Charging stations

Energy management system

EMS

Transient and dynamic stable control system

Power smart dispatching system

All-Around monitoring system for microgrid generation and load

The features of Jiaze microgrid project in Ningxia automatic operation

- **The microgrid transient stable control system and isolated combined control system of micro turbine and energy storage, the self-developed products, have been applied in Jiaze microgrid project, both of which have passed the technical evaluation of the first major technical equipment by National Innovation Model Zhongguancun Area.**

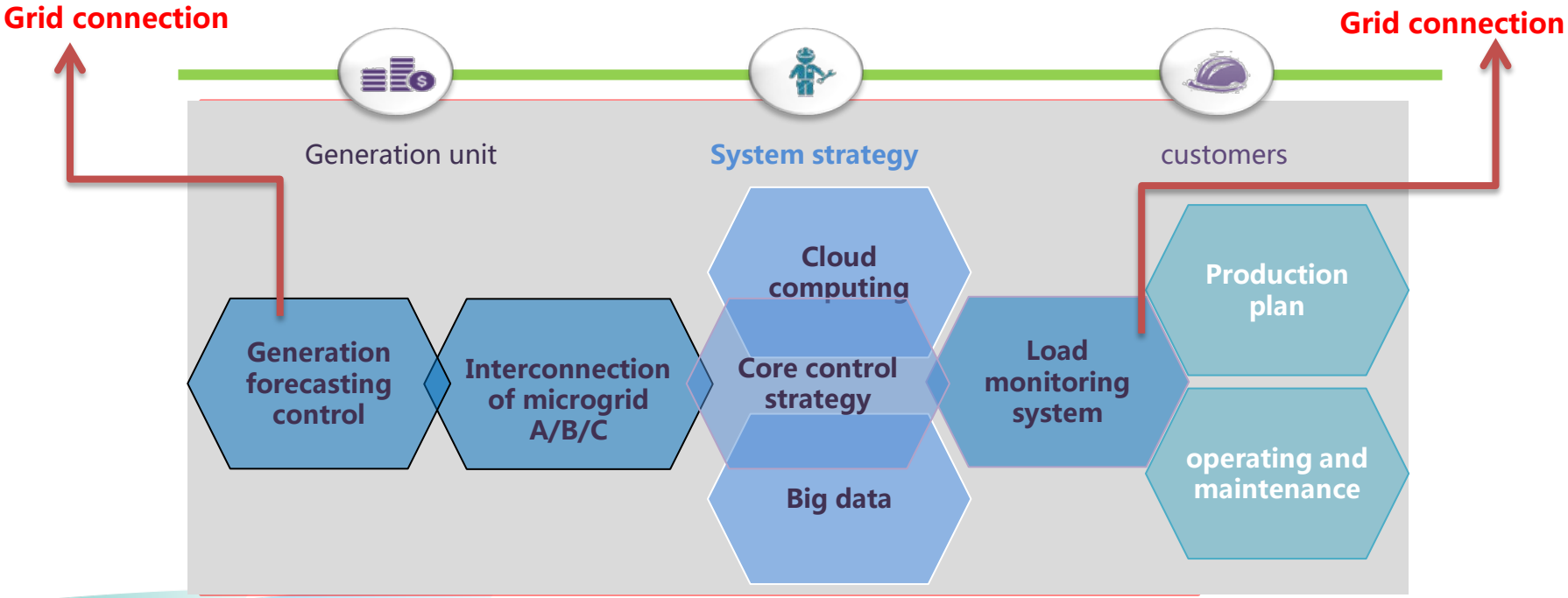
Contents





The core technology and achievements

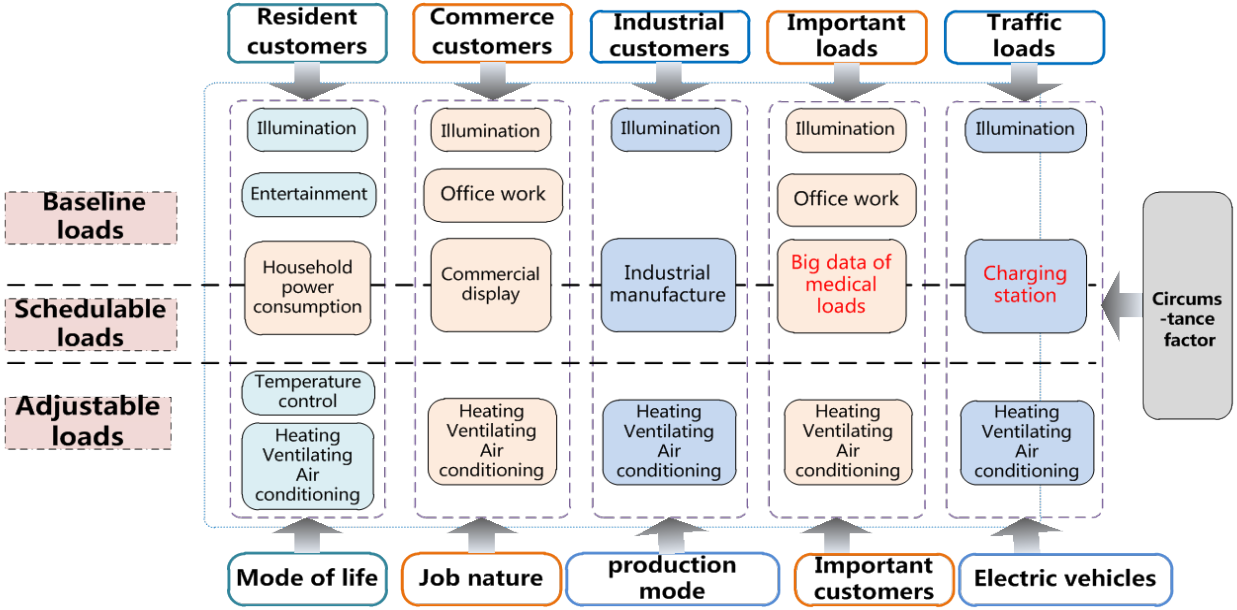
Combine the generation units and customers via the reasonable application strategy, to achieve stable smart power supply



Goldwind industrial park smart energy internet/local smart grid

The core technology and achievements - data structure

The classification and influencing factors of loads

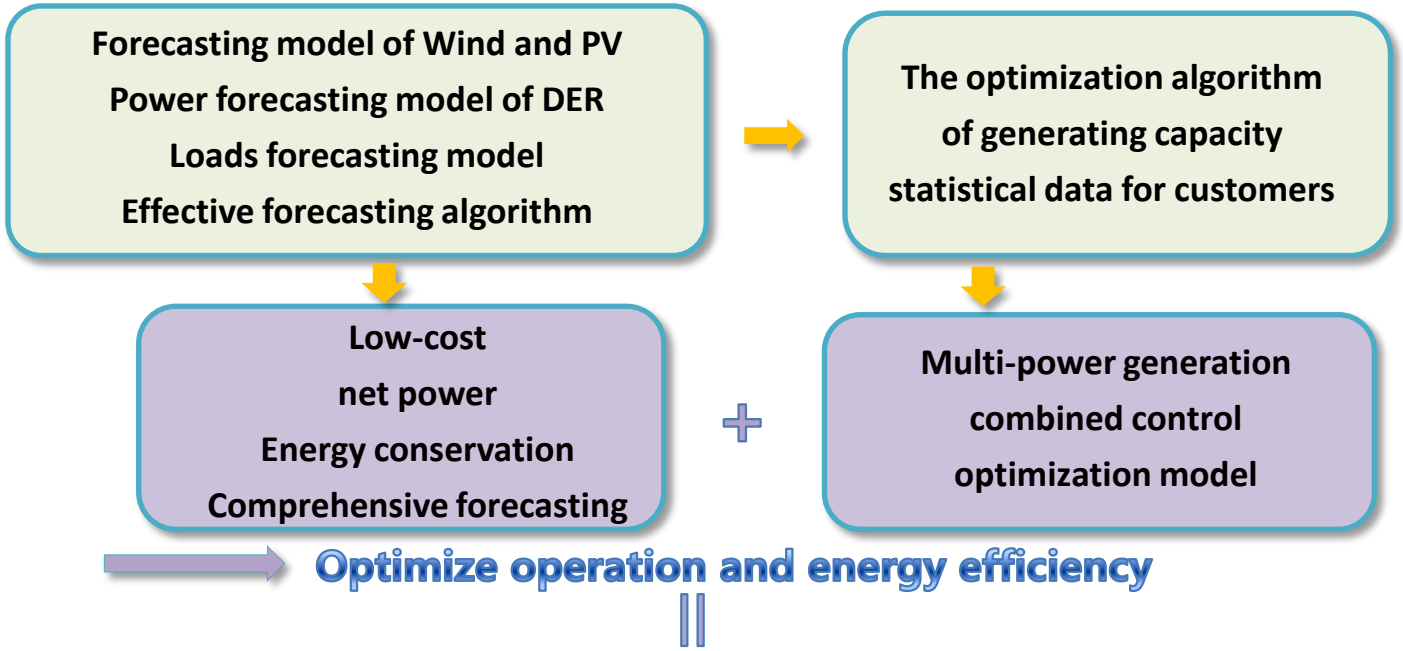


Baseline loads : The loads with coerciveness and randomness, are not regulated, occurs naturally according to the demand of the life and work;

Schedulable loads : The loads with fixed schedule of operation, are not very convenient to regulate, of which the running time can be flexible;

Adjustable loads : the loads with long time running, affected by temperature and other factors, of which the power can be adjustable or interrupted intermittently.

The core technology and achievements - data model

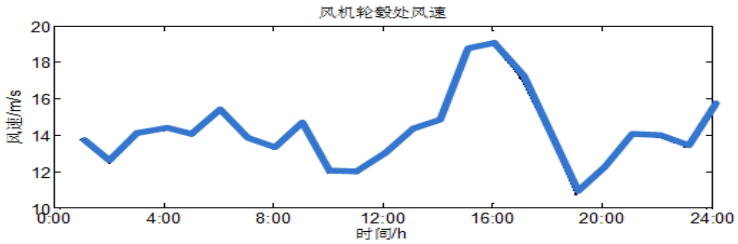


Industrial microgrid and central controller of smart energy internet can meet to the requirements of State active distribution network project.

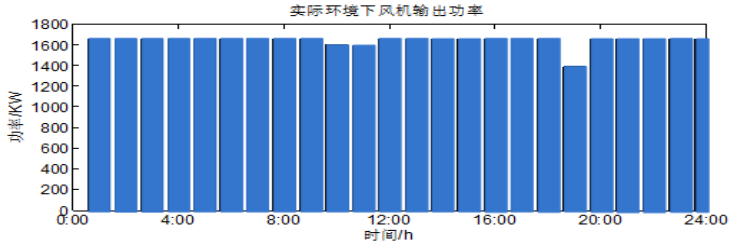
Smart bi-directional metering, monitoring, EMS and integrated dispatching terminals

The core technology and achievements - wind power forecasting model

Wind power forecasting: The wind power is estimated efficiently and the corresponding dynamic mathematical model is established.



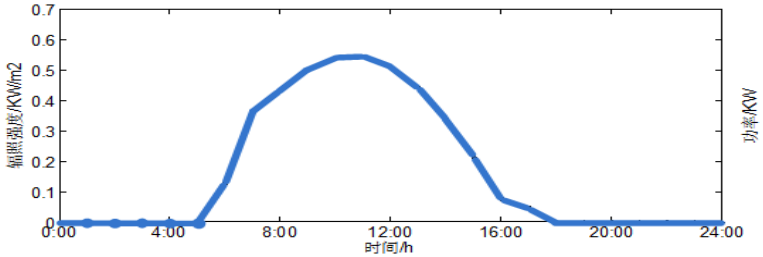
The curve of wind speed forecasting at hub



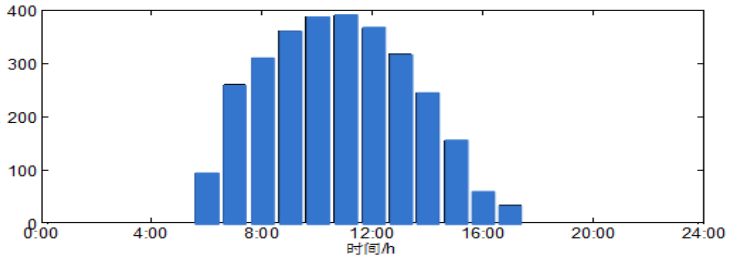
The diagram of actual output power

The core technology and achievements - PV power forecasting model

PV power forecasting: The PV power is estimated efficiently and the appropriate mathematical model is established based on effective information from mass data.

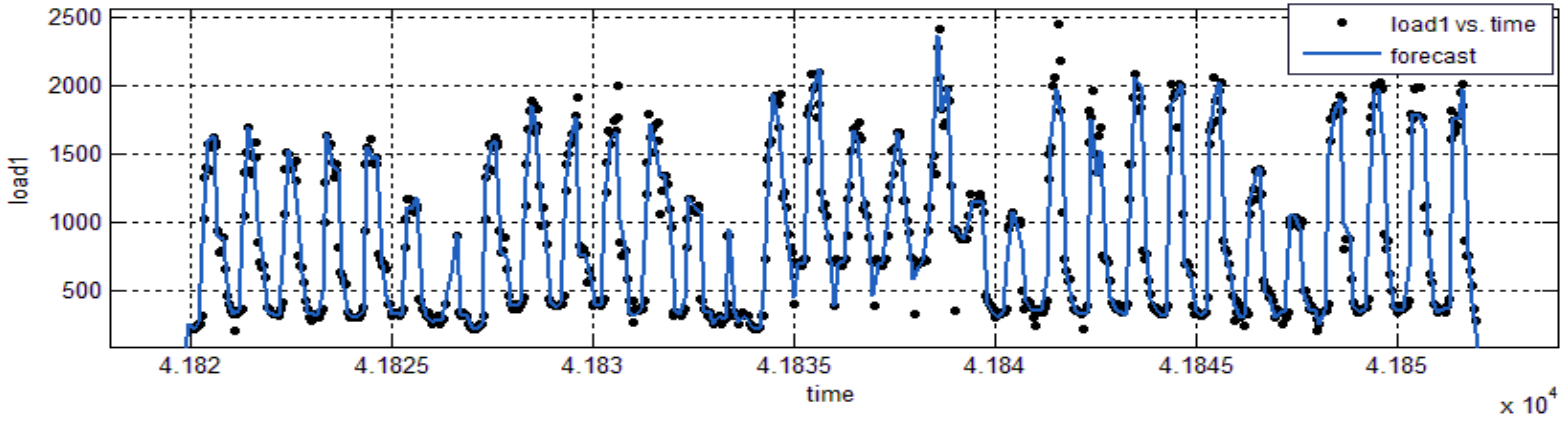


The curve of irradiation intensity forecasting



The curves of PV output power

The core technology and achievements - load forecasting model



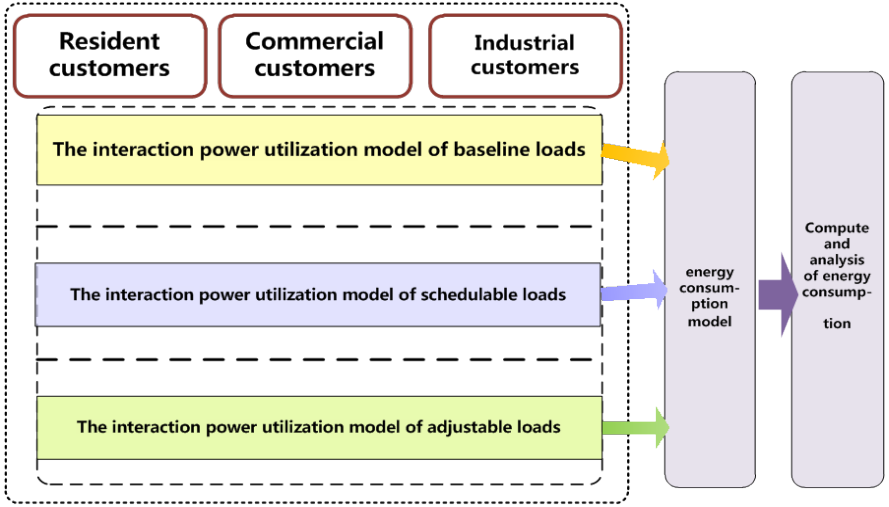
Load prediction in realistic condition

Accurate forecasting of wind power and PV power can increase absorption ration of new energy in utility grid.

The core technology and achievements – mathematical model

Loads monitoring

The energy consumption analysis of Goldwind industrial smart energy internet



Analysis method of energy consumption

The energy consumption models of baseline loads, scheduled loads and adjustable loads are established respectively based on the classification and characteristics of loads, to compute and analyze the energy consumption of equipment.

The core technology and achievements – mathematical model

Objective functions of economic operation

- **Objective function significance**

➢ Microgrid optimized economic operation must be taken into account from the point of the lowest operation costs and the most generation profit.

➢ The basic question is the microgrid stability which should be always the priority.

- **Objective functions design input**

➢ The cost, profit and maintenance of wind turbine and PV

➢ The cost and maintenance of energy storage, release and receive power of Grid.

➢ In addition, the objective function requires micro-grid running in the best State and the minimum cost

The core technology and achievements – mathematical model

Objective functions 1 of economic operation—Lowest operation cost

$$minM_{ope} = \sum_{i=1}^{24}[o_{wt}C_{OM}(P_{wt-i}) + o_{pv}C_{OM}(P_{pv-i}) + o_{MT}C_{OM}(P_{MT-i}) + o_{BA}C_{OM}(P_{BA-i})]$$
$$+ \sum_{i=1}^{24}[\eta_{wt}o_{wt}(P_{wtdep-i}) + \eta_{pv}o_{pv}(P_{pvdep-i}) + \eta_{MT}o_{MT}(P_{MTdep-i}) + \eta_{BA}o_{BA}(P_{BAdep-i})]$$
$$+ \sum_{i=1}^{24}(P_{bulwtdep} + P_{bulpvdep} + P_{bulMTdep} + P_{bulbatdep})$$
$$+ o_{MT}\sum_{i=1}^{24}F + \sum_{i=1}^{24}\frac{W}{Q_{lifetime-i}\sqrt{\eta_{rt}}} + \sum_{i=1}^{24}\xi P_{\mathrm{loadloss}-i}$$

$minM_{ope}$ - Minimum value of operation cost

$C_{OM}(P_{wt-i})$ -maintenance cost of wind power per KWH

$\eta_{pv}P_{wtdep-i}$ -Depreciation cost of wind power per KWH

$P_{bulwtdep}$ -Construction depreciation cost of wing turbine cover area

F - Labor cost

$\sum_{i=1}^{24}\frac{W}{Q_{lifetime-i}\sqrt{\eta_{rt}}}$ -Energy storage efficiency

$P_{\mathrm{loadloss}-i}$ -Load loss for power off

o_{wt} -Operation state

The core technology and achievements – mathematical model

Objective functions 2 of economic operation—most generation profit

$$
\begin{aligned}
max(Profit) = & \sum_{i=0}^{7} p_{low}[\eta o_{wt-i}P_{wt-i} + o_{pv-i}P_{pv-i} + o_{mt-i}P_{MT-i} + Model_{Bat}o_{BA-i}P_{BA-i}] \\
& + \sum_{i=7}^{10} p_{normal}[\eta o_{wt-i}P_{wt-i} + o_{pv-i}P_{pv-i} + o_{mt-i}P_{MT-i} + Model_{Bat}o_{BA-i}P_{BA-i}] \\
& + \sum_{i=10}^{15} p_{high}[\eta o_{wt-i}P_{wt-i} + o_{pv-i}P_{pv-i} + o_{mt-i}P_{MT-i} + Model_{Bat}o_{BA-i}P_{BA-i}] \\
& + \sum_{i=15}^{18} p_{normal}[\eta o_{wt-i}P_{wt-i} + o_{pv-i}P_{pv-i} + o_{mt-i}P_{MT-i} + Model_{Bat}o_{BA-i}P_{BA-i}] \\
& + \sum_{i=18}^{21} p_{high}[\eta o_{wt-i}P_{wt-i} + o_{pv-i}P_{pv-i} + o_{mt-i}P_{MT-i} + Model_{Bat}o_{BA-i}P_{BA-i}] \\
& + \sum_{i=21}^{23} p_{normal}[\eta o_{wt-i}P_{wt-i} + o_{pv-i}P_{pv-i} + o_{mt-i}P_{MT-i} + Model_{Bat}o_{BA-i}P_{BA-i}]
\end{aligned}
$$

max(Profit)- Maximum generation

η -Failure rate

o_{wt-i} - Equipment is running or not

$Model_{Bat}$ - Storage running mode

P_{wt-i} - Wind turbine output power

-Time section power price

The core technology and achievements – mathematical model

Objective functions 3 of economic operation

Function of reducing carbon emission/ Objective function 3

$$CO_2(emission) = \sum_{i=1}^{24}[o_{wt}P_{wt-i}(C_{coal} - C_{wt-i}) + o_{pv}P_{pv-i}(C_{coal} - C_{pv-i}) + o_{MT}P_{MT-i}(C_{coal} - C_{MT-i}) + o_{BA}P_{BA-i}(C_{coal} - C_{BA-i})]$$

Constraint condition of generated power

$P_{wt-\min} \le P_{wt-i} \le P_{wt-\max}$ Constraints of wind power

$P_{pv-\min} \le P_{pv-i} \le P_{pv-\max}$ Constraints of PV power

$P_{MT-\min} \le P_{MT-i} \le P_{MT-\max}$ Constraints of micro turbine power

$P_{BA-\min} \le P_{BA-i} \le P_{BA-\max}$ Constraints of energy storage power

C_{coal} -Carbon dioxide emissions per 1 KW of coal burn

C_{wt-i} -Carbon dioxide emissions per 1 KW of wind power

Energy Saving constraints of load

$Load_{low\cdot\min} \le Load_{low} \le Load_{high\cdot\max}$ Constraints of load energy conservation at the trough price

$Load_{normal\cdot\min} \le Load_{normal} \le Load_{normal\cdot\max}$ Constraints of load energy conservation at the fair price

$Load_{high\cdot\min} \le Load_{high} \le Load_{high\cdot\max}$ Constraints of load energy conservation at the peak price

The core technology and achievements – microgrid transient stable control system

Microgrid transient stable control system

- **Identification: Mater station and slave station device have been passed the type test of Cape LABS，including EMC, electrical properties and safety test. It also has been certified as the first major technical equipment by National Innovation Model Zhongguancun Area.**

The core technology and achievements – microgrid transient stable control system

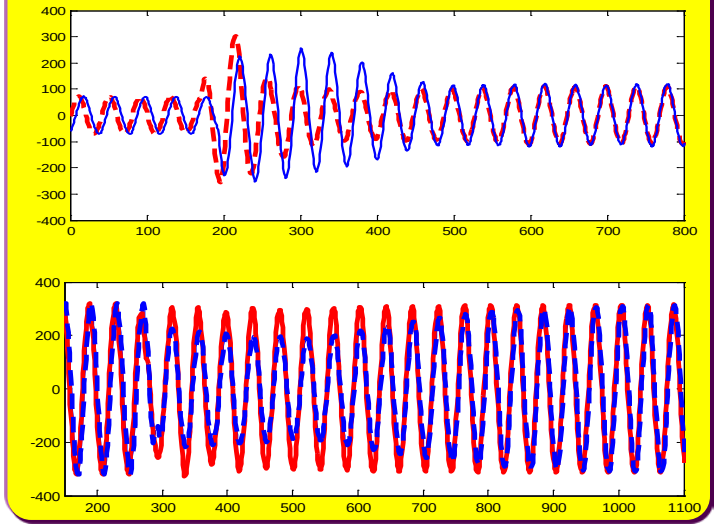
Microgrid transient stable control system

It has been certified as the first major technical equipment by National Innovation Model Zhongguancun Area.

The core technology and achievements – the core achievements

Better power quality

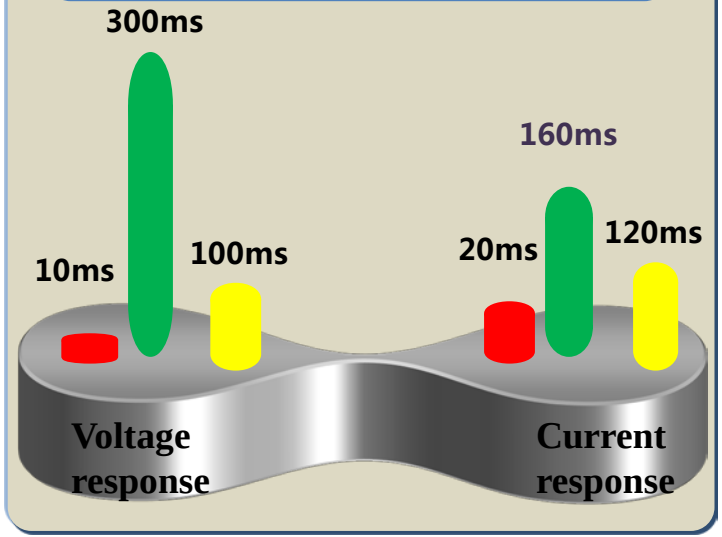
Curves of voltage and current at load fluctuation



With our products

Without our products

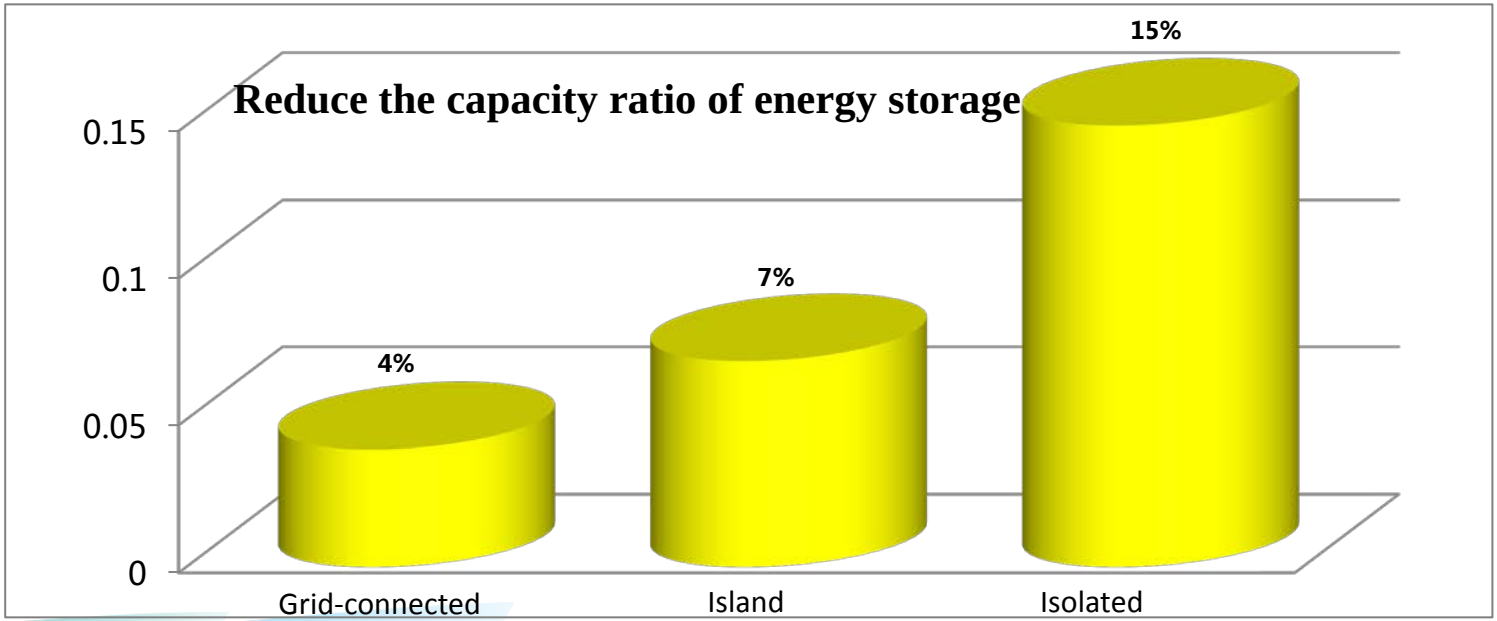
our products promote power quality meet IEC microgrid standards



Through IEC standards the advantage of our product can be verified

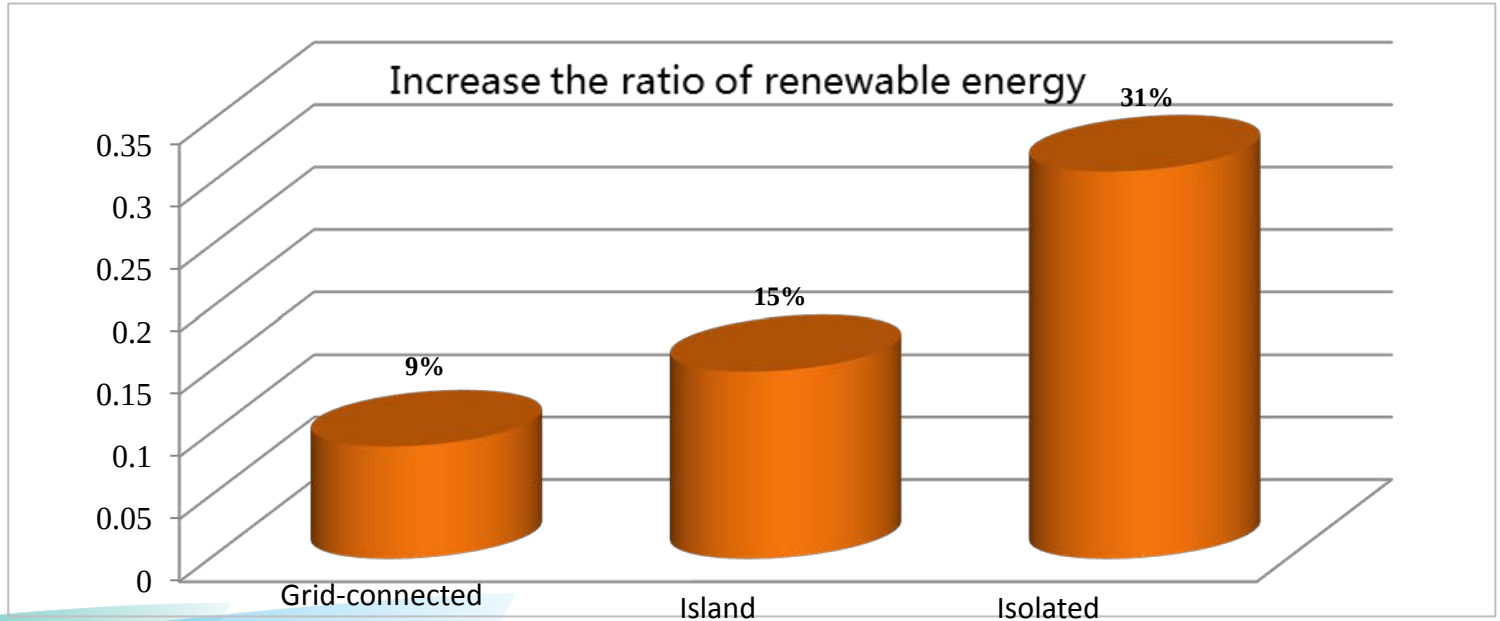
The core technology and achievements – core achievements

What our products can solve



The core technology and achievements – core achievements

What our products can solve



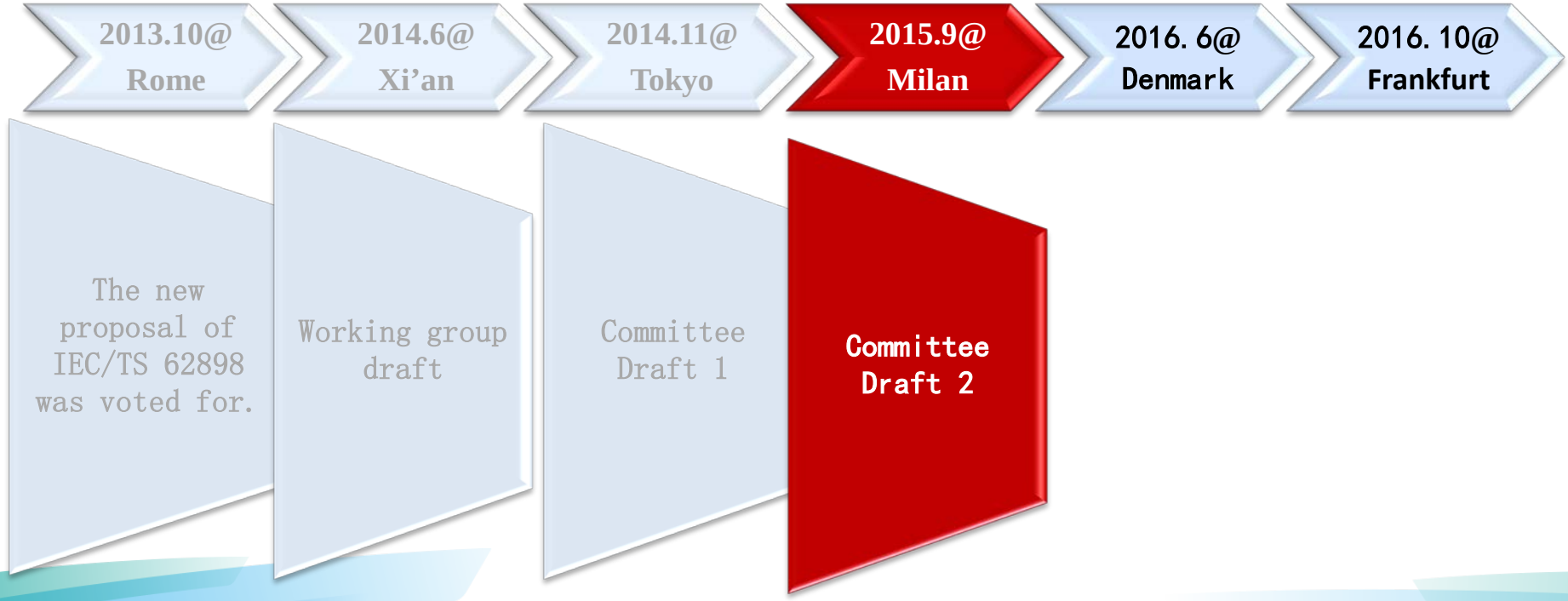
The core technology and achievements – international standard IEC TS 62898-1 and 62898-2

The new proposal of IEC/TS 62898 was voted for.

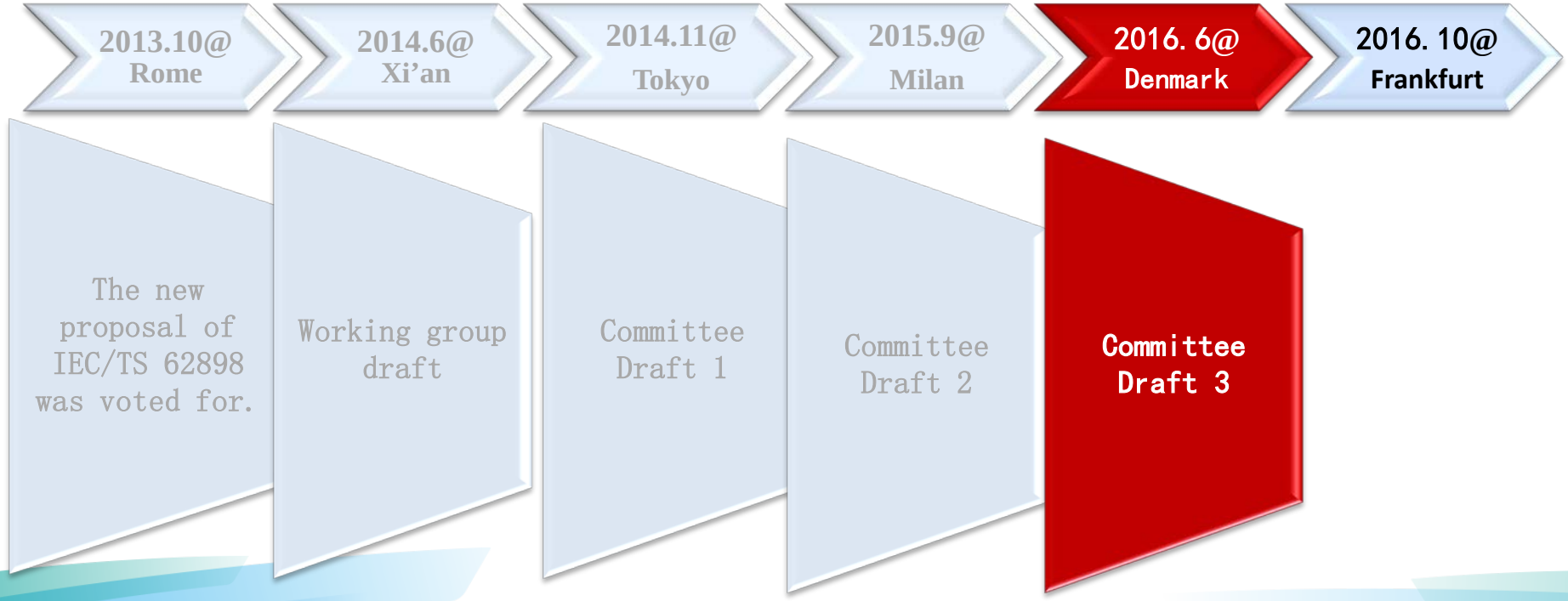
The core technology and achievements – international standard IEC TS 62898-1 and 62898-2

The core technology and achievements – international standard IEC TS 62898-1 and 62898-2

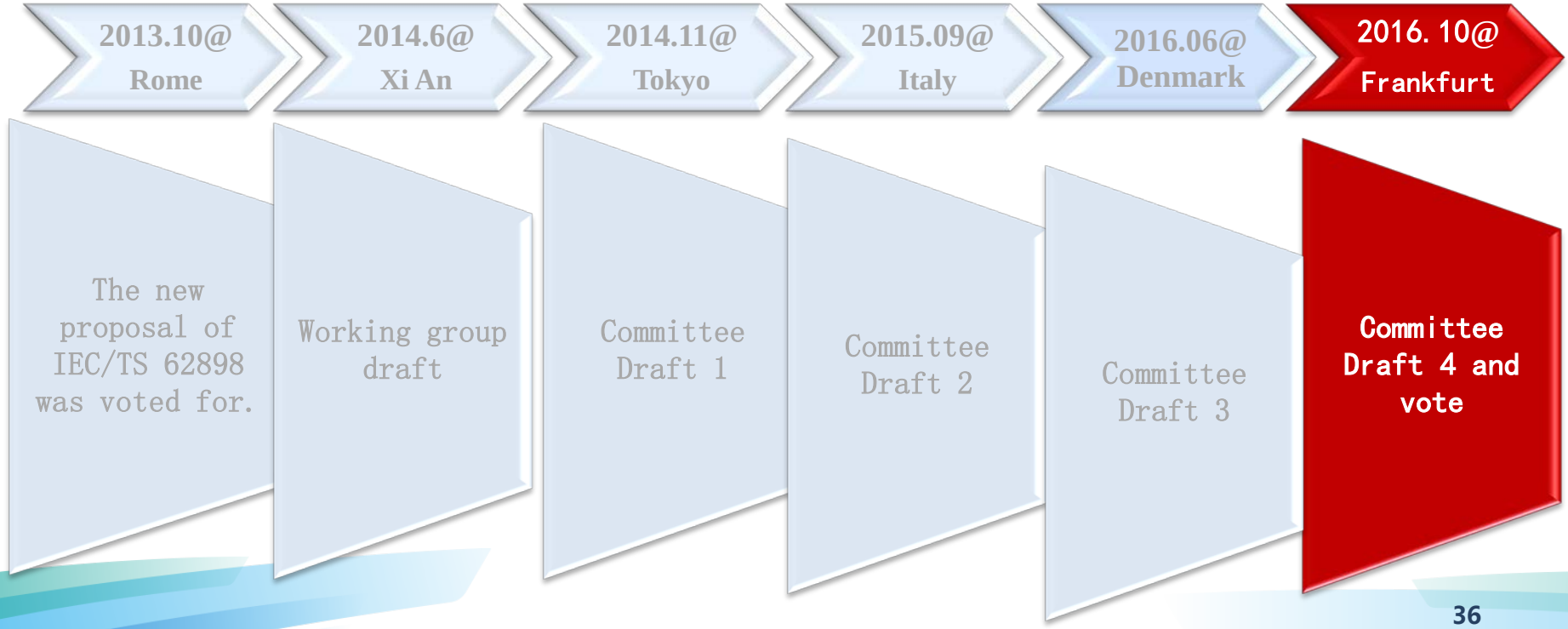
The core technology and achievements – international standard IEC TS 62898-1 and 62898-2



The core technology and achievements – international standard IEC TS 62898-1 and 62898-2



The core technology and achievements – international standard IEC TS 62898-1 and 62898-2



The core technology and achievements – international standard IEC TS 62898-3-1

IEC International Electrotechnical Commission

myIEC | Subscribe | Sitemap | FAQs | Contact us

International Standards and Conformity Assessment for all electrical, electronic and related technologies

You & the IEC | About the IEC | News & views | Standards development | Conformity assessment | Members & experts | Developing countries | Webstore | Search... | Advanced search

Standards development > How we work > Technical Committees & Subcommittees > TC 8 Dashboard

TC 8 Systems aspects for electrical energy supply

Scope | Structure | Projects / Publications | Documents | Votes | Meetings | Collaboration Tools

Working Documents > Voting Result: 8/1427A/NP

Log in | En | Fr

Approval

P-Members Voting	P-Members Approving	Approval %	Criteria	Result
22	18	81.8	>50%	APPROVED

Participation

Number of P-Members	P-Members approving and participating	Criteria	Result
24	6	>=4 (if <=16) >=5 (if >=17)	APPROVED

Voting Result APPROVED

Document 8/1427A/NP

Project : PNW 8-1427 Ed. 1.0

Future IEC/TS 62898-3-1: Microgrids - Technical Requirements - Protection requirements in microgrids

Reference	Circulation date	Closing date	Downloads
8/1427A/NP	2016-06-10	2016-08-12	157 kB
Compilation of Comments			
CC file			

The core technology and achievements – international standard IEC TS 62898-3-1 8/1438/RVN

☒ The proposal is supported by a simple majority of the P-members voting	☒ At least 4 P-members in the case of a committee with 16 or fewer P-members, or at least 5 P-members in the case of committees with more than 16 P-members, have nominated or confirmed the name of an expert and approved the new work item proposal

Under the voting criteria for the acceptance of new work items (see ISO/IEC Directives, Part 1, 2.3.5

☐ the proposal is not approved

☒ the proposal is approved and the new work item has been introduced in the programme of work under the following title:

IEC/TS 62898-3-1 Ed.1: Microgrids - Technical Requirements - Protection requirements in microgrids

(Titre F):

The project is assigned to	project team/working group no. WG7	name of project leader Mr. ZHENG DEHUA

Draft attached to Form NP will be

☐ distributed as a CD ☒ discussed (with comments annexed) on 2016-10-11 WG 7 meeting ☐ distributed as a CDV

Proposed target date for submission of a CD: 2017-04	DTS: 2019-06	FDIS:	TS: 2019-12

The date and place of the first PT or WG meeting are: 2016-10-11 or arrangements for electronic operations are annexed ☐.

The list of experts nominated is annexed ☒.

Proposals for further modifications are annexed ☐.

Secretariat	Name or signature of secretary
ITALY	N. CAMMALLERI

Contents

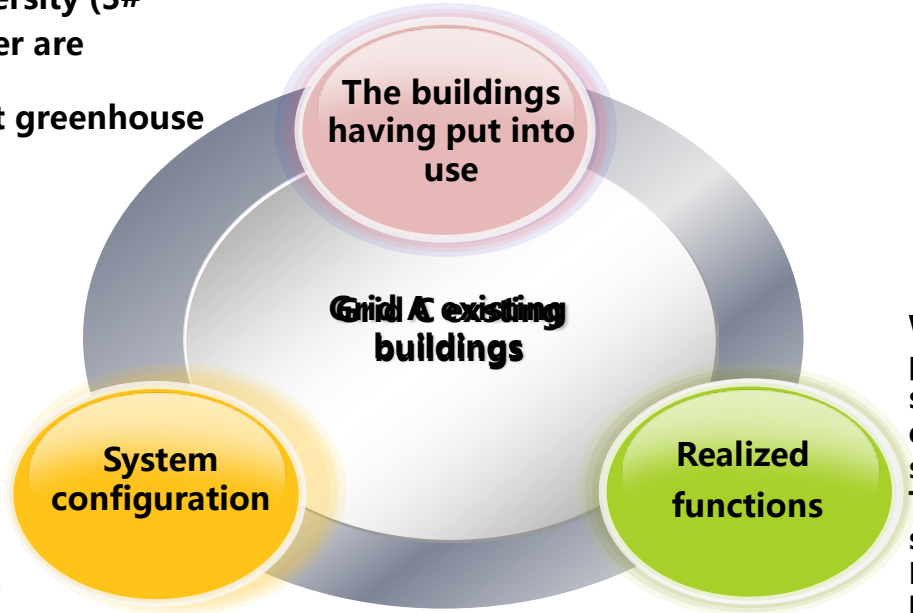




The smart energy internet of Goldwind industry park

Grid A: Etechwin (1# building), Goldwind (2# building), Goldwind university (3# building), above part of power are supplied by grid A.

PV smart greenhouse



Power generation: wind turbine 2.5 MW*1+PV 500 kW+ micro turbine 65 kW*2 +diesel 500 kW*1

Energy storage: VRB 200kW*4h+ supercapacitor 200kW*10s+ lithium battery 100kW*1h

PV 71.28kW (to be accessed microgrid)

Wind and PV generate power stably

sell the redundant electricity to On/Off grid switch if microgrid

Transient support of supercapacitor

Profit of energy storage between peak price and trough price

The PV can generates stably

Contents





The development and planning of Goldwind smart energy internet

1

- Active distribution network: to realize the friendly interaction between 1000 kW major support power source and utility grid, including the previous 500 kW diesel, 65kW*2 micro turbine and the new 600 kW micro turbine, forming the CCHP system.

2

- Interconnect grid B (the new big data building) with grid A (microgrid in Etechwin building) and grid C (PV smart greenhouse), to develop the relevant business on smart energy internet through smart industrial loads management and efficient power supply.

3

- Establish the integrative energy control management platform (to achieve the intelligent energy consumption management of industrial electricity, heat, cooling, gas and water , 10% energy conservation), to provide future commercial project a series of competitive products and service.

The development and planning of Goldwind smart energy internet

4

- IEC/TS 62898-3-1 Ed.1 *Microgrids-Technical Requirements-Protection Requirements in Microgrid*
- IEC/TS 62898-2 Ed.1 *Technical Requirements for Operation and Control of Microgrids*
- IEC/TS 62898-1 Ed.1 *Guidelines for general planning and design of microgrids*

5

- It replicates business at the base of Dafeng, Jiaze and Beijingaccording to the Goldwind industrial park, meanwhile radiating its influence across the whole country , Southeast Asia and Africa.

6

- Include flexible voltage and frequency control system of high permeability new energy within power distribution network / microgrid dynamic stable control system

The development and planning of Goldwind smart energy internet

7

- Isolated combined control technology of micro turbine and energy storage

8

- Transient and dynamic simulation system of microgrid hardware and software

9

- Microgrid + CCHP of micro turbine and diesels + energy conservation + loads monitoring + integrative energy control management platform of energy internet
- integrative loads monitoring system, smart loads and energy conservation analysis system, new energy generation monitoring system, smart wind power forecasting system, smart PV power forecasting system, integrative energy optimization system

GOLDWIND
金风科技

www.goldwind.com.cn

Thanks

新疆金风科技股份有限公司
XINJIANG GOLDWIND SCIENCE & TECHNOLOGY CO., LTD.

北京金风科创风电设备有限公司
BEIJING GOLDWIND SCIENCE & CREATION WINDPOWER EQUIPMENT CO., LTD.