国家电网公司
STATE GRID
CORPORATION OF CHINA

Research Frontiers and Development Dynamics of Demand Response under Deregulated Electric Power Retail Market

China Electric Power Research Institute

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国家电网公司 STATE GRID CORPORATION OF CHINA

1. BackGround

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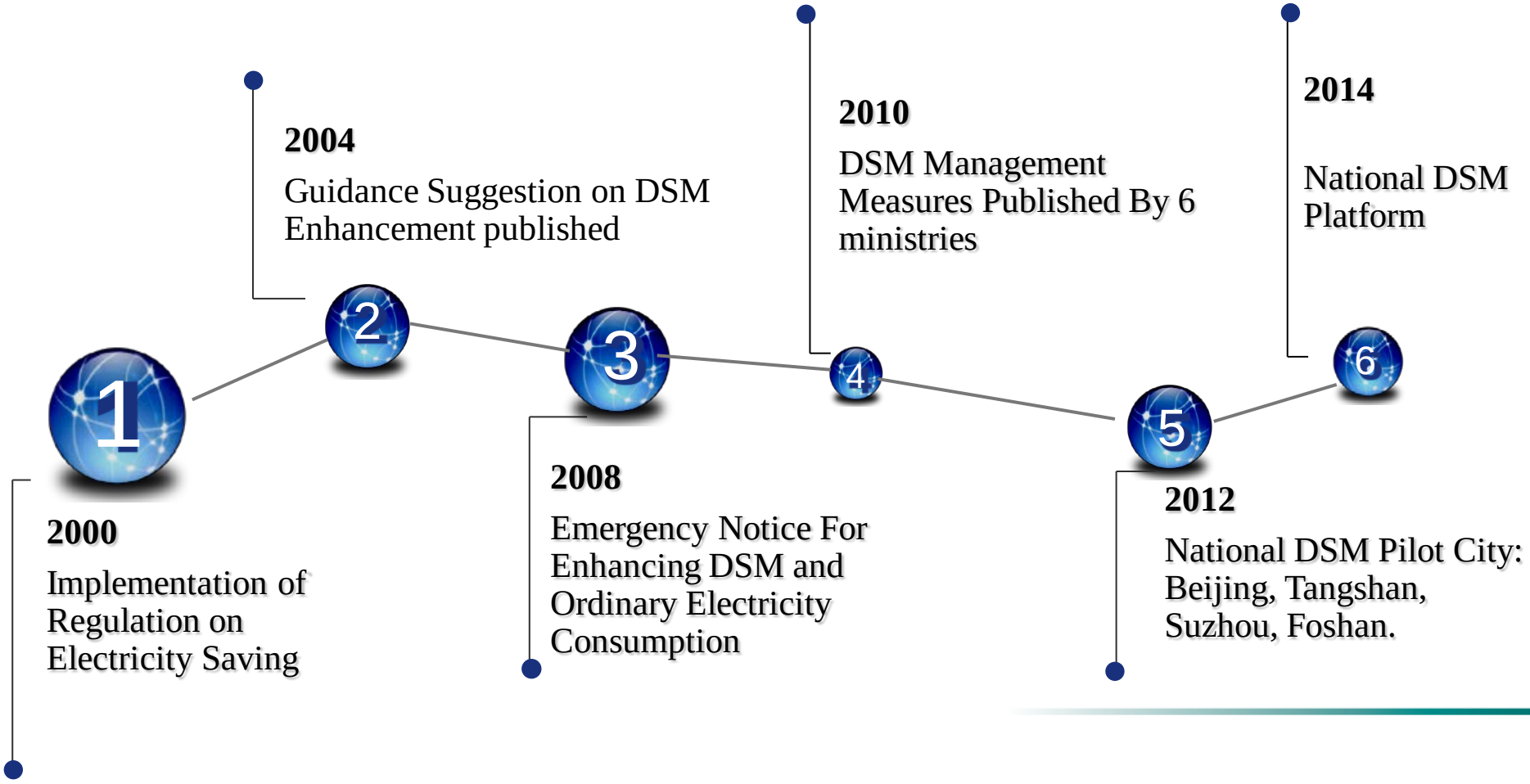
➢ Related Policies

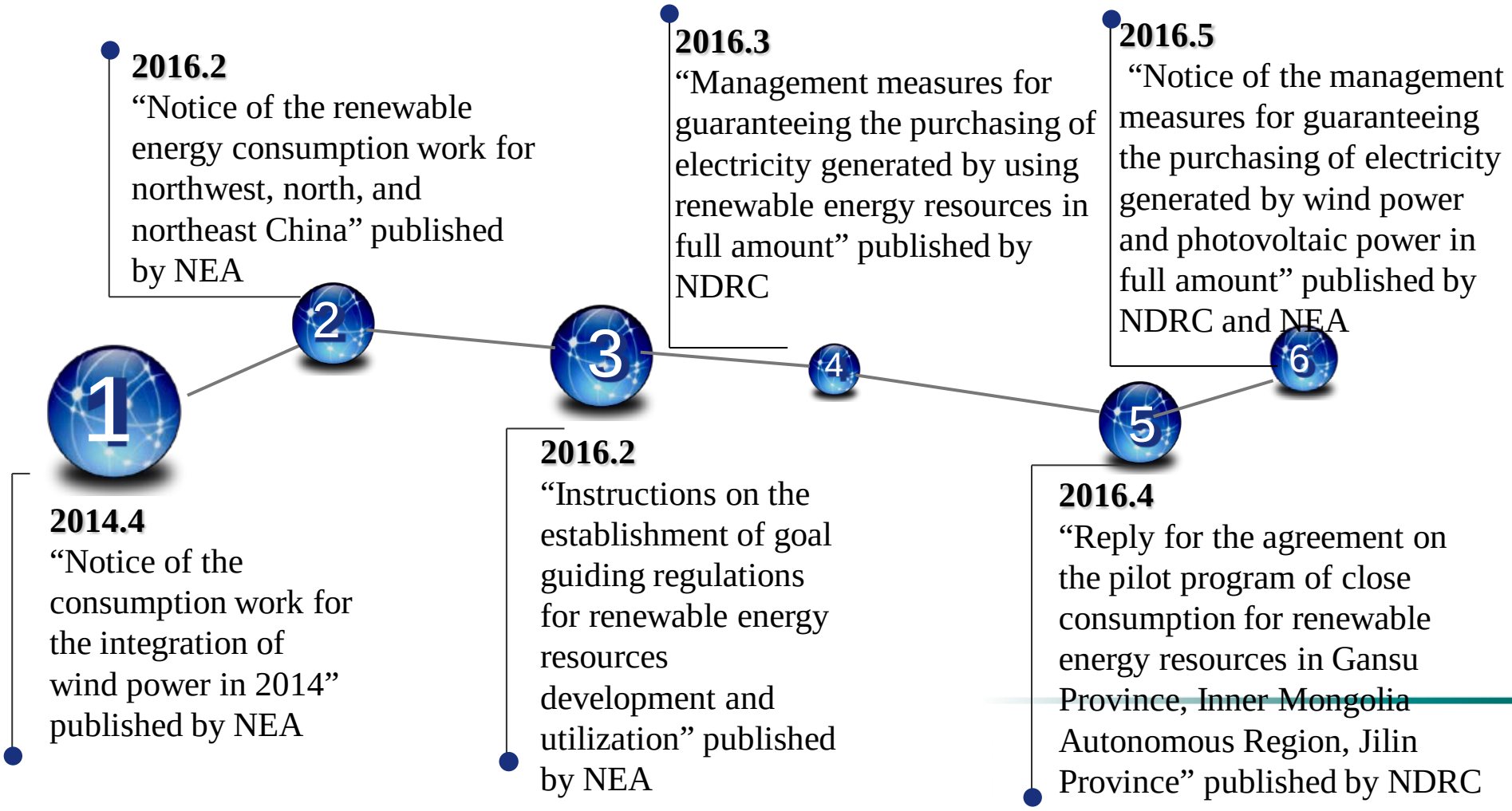
Power Demand Side Policies Published In China



1. BackGround

➢ Related Policies

Renewable Energy Absorption Policies Published In China



1. BackGround

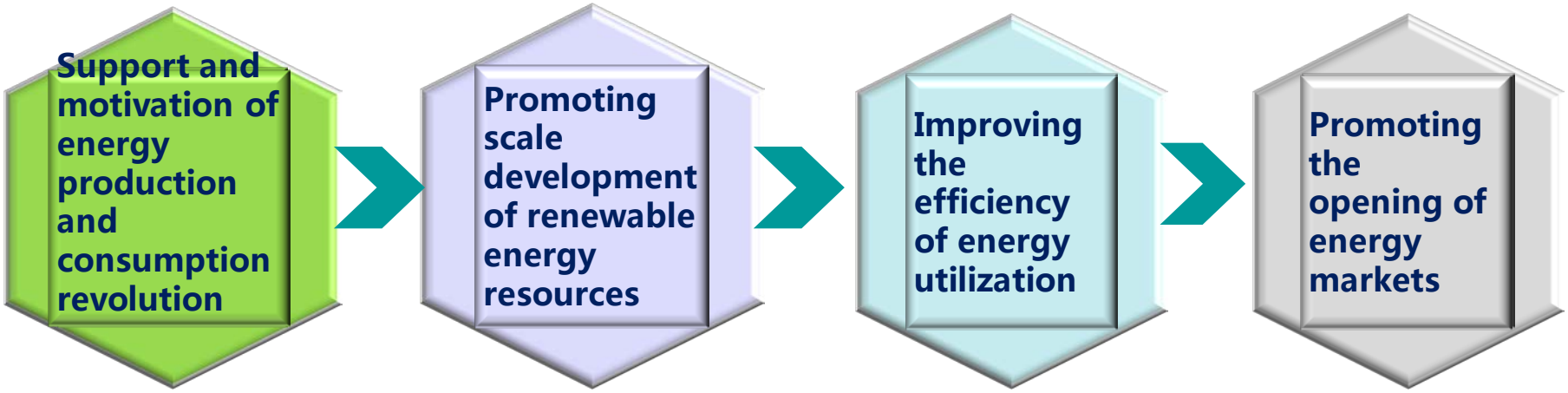
国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Related Policies

In July 2015, the State Council issued the "*Instructions of actively promoting the action of 'Internet+'*" .

In February 2016, NDRC, NEA and MIIT jointly issued "*Instructions of promoting the development of 'Internet+' smart energy*" .

Importance of Internet+ smart energy



1. BackGround

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Related Policies

Suggestions on Deepening the Reform of Electric Power System has been developed by CPC Central Committee in March 2015, which means a key step on electricity market deregulation in China.

Key Mission

- Promote reformation of electricity price, gradually improve the market-oriented trading mechanism and help the business of power retail open orderly to social capital.

"Implementation opinions on promoting power-sold side reformation" explains the entry conditions, rights and obligations, encourages power retail companies to provide contract energy management, comprehensive energy conservation, electricity consulting and other value-added services.

1. BackGround

➢ Technology Development Requirement

The scale of flexible resource capacity is increasing gradually, having a great potential of regulation.

Demand response is an important measure to enhance the energy efficiency of power system and promote the greenization of energy production and consumption.

Contents

2. Demand Response Development Status

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Research Situation

- **The construction of DR System——System Architecture**

Mobile APP

ICS

SMS

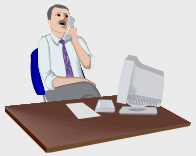
Demand Response Platform (System)

Load management system for power grid enterprises

Internet or "Mobile communication network + Electric power network"

Artificial

DR load integrator



Artificial or automatic

DR user **DR user** **DR user**

Artificial or automatic

DR user

DR user

Artificial or automatic

DR user **DR user** **DR user**

Notes : Dashed part points only part of the pilot provinces and cities have this content

2. Demand Response Development Status

➢ Research Situation

- **Building Demand Response System-Present Platform**

◆ **National power demand side management platform**

To cooperate with the development of national power demand side management, NDRC plays a leading role in development and construction, including two levels, the main station and the sub-station.

◆ **Grid Power Service Management Platform**

Sales Department of State Grid plays a leading role of development and construction.

2. Demand Response Development Status

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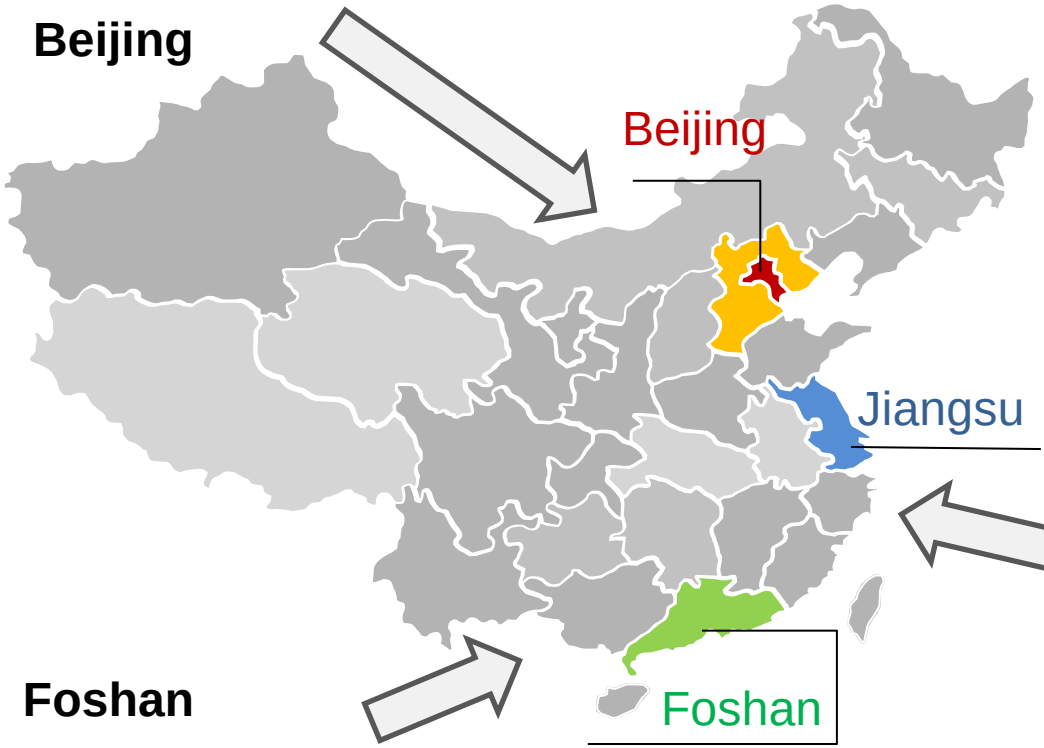
➢ Pilot Situation

74 Customers	71MW	2015

Beijing



129 Customers	176MW	2015
75 Customers	376MW	2016

Foshan

National DSM Pilot Construction & DR Project Tests

2716 Customers	2037MW	2015
3154 Customers	3371MW	2016

Jiangsu

Shanghai

34Customers	55MW	2014

Customers： Industrial Customers, Commercial Customers, Residential Customers

2. Demand Response Development Status

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Pilot Situation

- **Demand Response Pilots——Jiangsu Province**

Management mode： The government led DR pilot work, the Power Grid Corp is charge of the specific implementation, load integrators and power users actively participate

Program type	Program profile	Subsidy standard *2 (yuan per kW)
Contract DR	Complete response contract * 1 and confirmation process the day before response day, response at the agreed time and complete the agreed response load reduction.	100
Real-time DR	After receiving the response instruction, confirm participation at the real-time and complete the response.	100

Notes：

1. Contract: DR information
2. Subsidy funds comes from increased electricity fee during annual CPP program implementation

2. Demand Response Development Status

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Pilot Situation

- **Demand Response Pilots——Beijing**

Management Mode: The government led DR pilot work and entrust the third party institution to implement DR, load integrators and power users actively participate, and the Power Grid Corp cooperate with the government to implement the relevant work.

Program type	Number	DR program type	Subsidy standard * (yuan per kW)
Artificial DR	1	30 minutes in advance	120
	2	4 hours in advance	100
	3	24 hours in advance	80
ADR	1	Prior notice confirmation	>120

Notes：

1. Subsidy funds mainly come from the central financial arranging issued special incentive funds, and the city's financial arranging matching incentives

2. Demand Response Development Status

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➢ Pilot Situation

- **Demand Response Pilots——Shanghai**

Management mode： The government led DR pilot work, the Power Grid Corp is charge of the specific implementation, load integrators and power users actively participate

Program type	Program profile	Subsidy standard * （yuan per kW）
Monthly plan	7 days in advance	2
Weekly plan	3 days in advance	
Daily plan	1 days in advance	
Interrupt plan	Day notice, response in15 minutes	
Automatic plan	Day notice, response real-time	

Notes：

1. Huangpu District users can get additional 2 yuan per kilowatt hour of the district government subsidies.
2. Electricity reduction=Load reduction* Cut duration.
3. Source of subsidy funds: peak price, high reliability electricity price earnings.

2. Demand Response Development Status

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Pilot Situation

- **Demand Response Pilots——Foshan**

Management mode： The government led DR pilot work, the Power Grid Corp is charge of the specific implementation, load integrators and power users actively participate

Program type	Program profile	Subsidy standard * (yuan per kW)
ADR	The participation of users participating in the response is not less than 10 times in 3 years, each time participating load in response is not more than 15% of the total load.	130

Notes：

1. Subsidy Source: The implementation special funds of power demand side subsidies pilot "peak project”

2. Demand Response Development Status

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Pilot Situation

The existing problems of the pilot work:

1. There are deviations on the calculating results of current baseline load defining way and the actual electricity utilizing requirements of enterprises.
2. China still lacks price signals based on market mechanism in the power industry, including price signals such as power generation capacity, energy resources and ancillary service markets.
3. In the process of pilot implementation of demand response, there are still problems that the demand response location is ambiguous, the incentive mechanism is single and the load resource management is not elaborate enough.
4. The operation and maintenance level of energy efficiency acquisition and management system is insufficient, and multi-energy coordination application level is not high.

2. Demand Response Development Status

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Standardization Situation

Relevant Domestic Standardizing Organizations

Established in August 2014 , committee expert members include over 40 Chinese experts.

The interface area among grid side, third-party service providers and users, as well as intelligent electricity utilizing service areas such as demand response and energy efficiency management.

2. Demand Response Development Status

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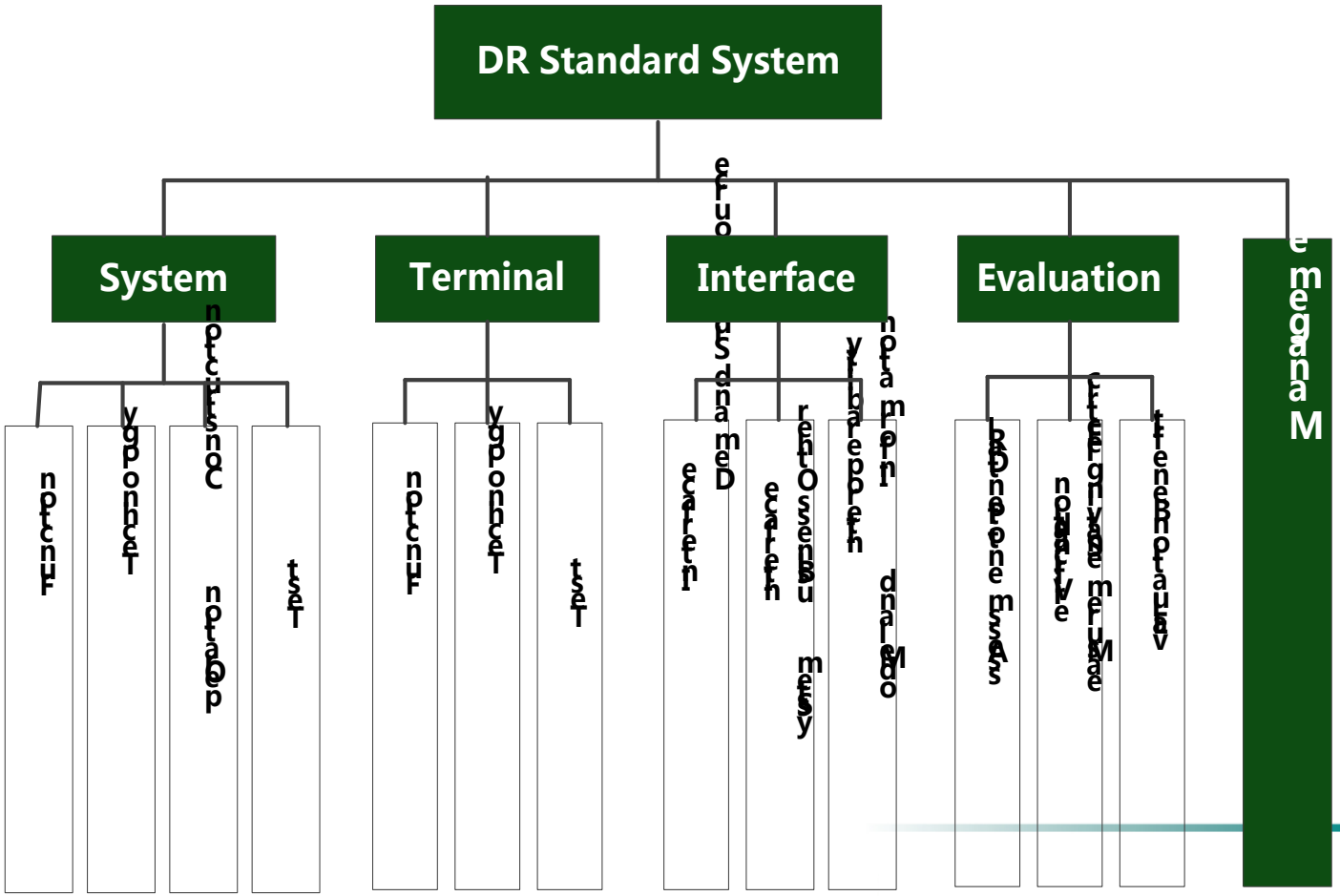
➢ Standardization Situation

DR standard system architecture



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3. Demand Response Development Tendency

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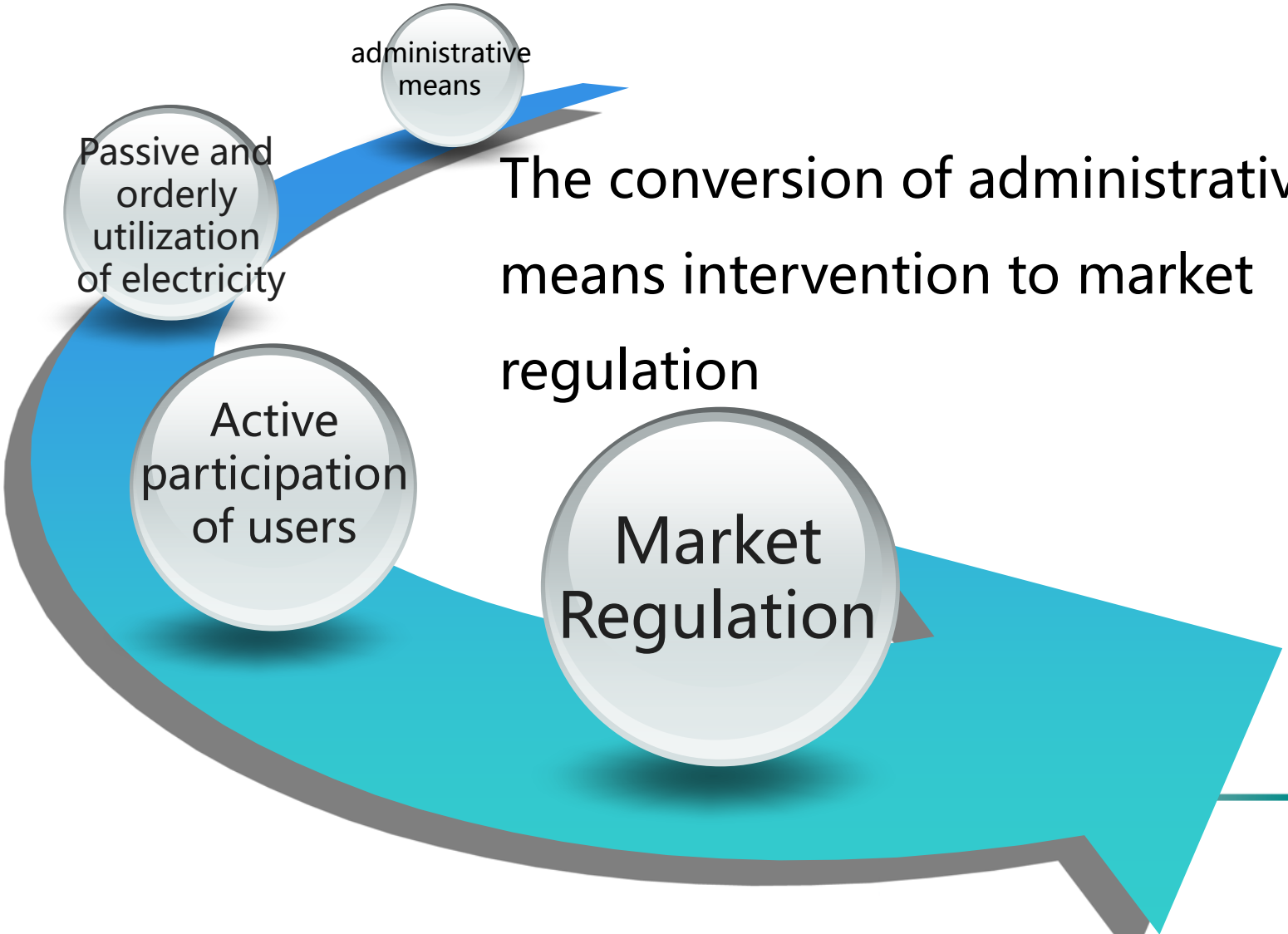
➢ Demand Response Implementation Method



The conversion of administrative means intervention to market regulation

3. Demand Response Development Tendency

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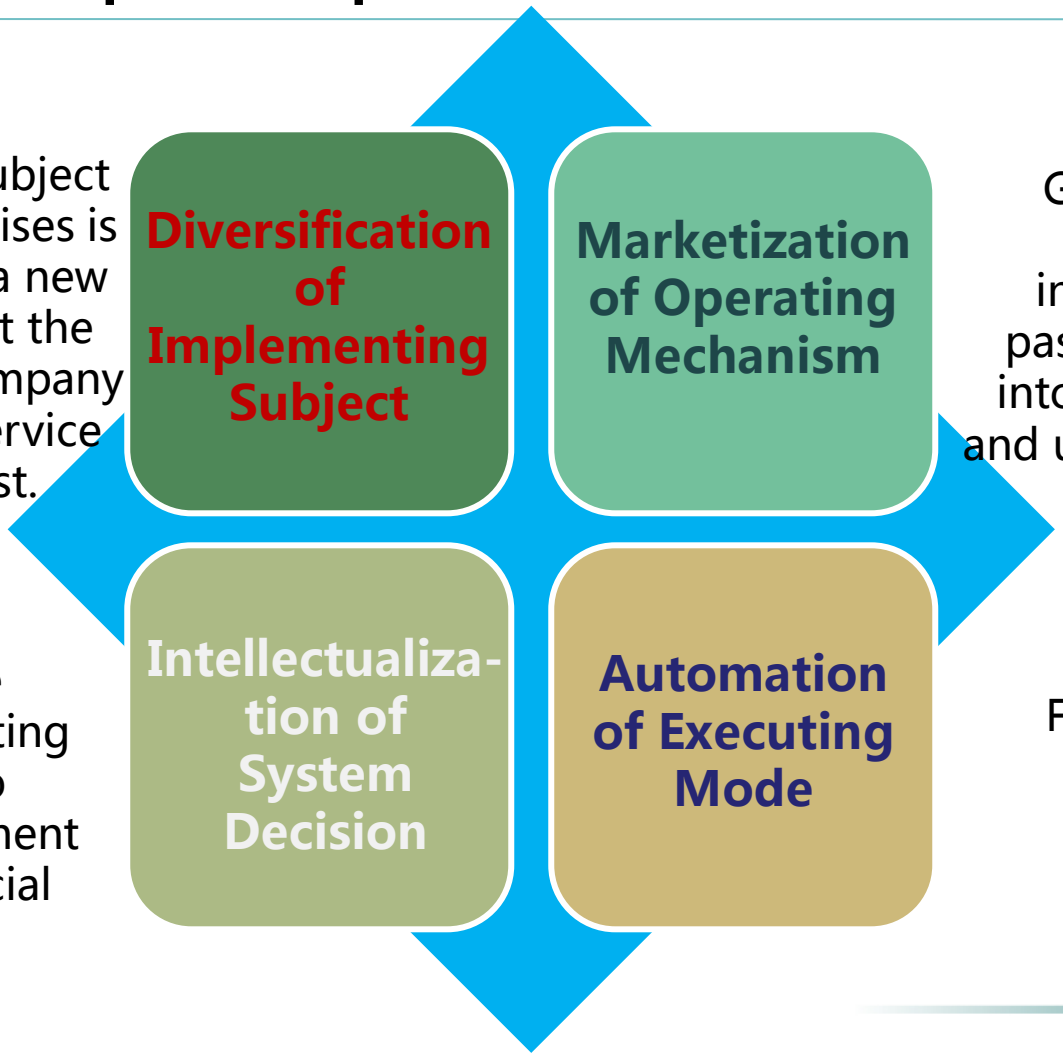
➢ Demand Response Implementation Method

The single main subject of the grid enterprises is transformed into a new type of mode that the electricity sales company and the energy service provider coexist.



Government-led, administrative intervention, user passive participation into market guidance and user active response

From passive execution adjusting instruction to adaptive adjustment based on artificial intelligence

From artificial, semi-automatic to fully automatic

3. Demand Response Development Tendency

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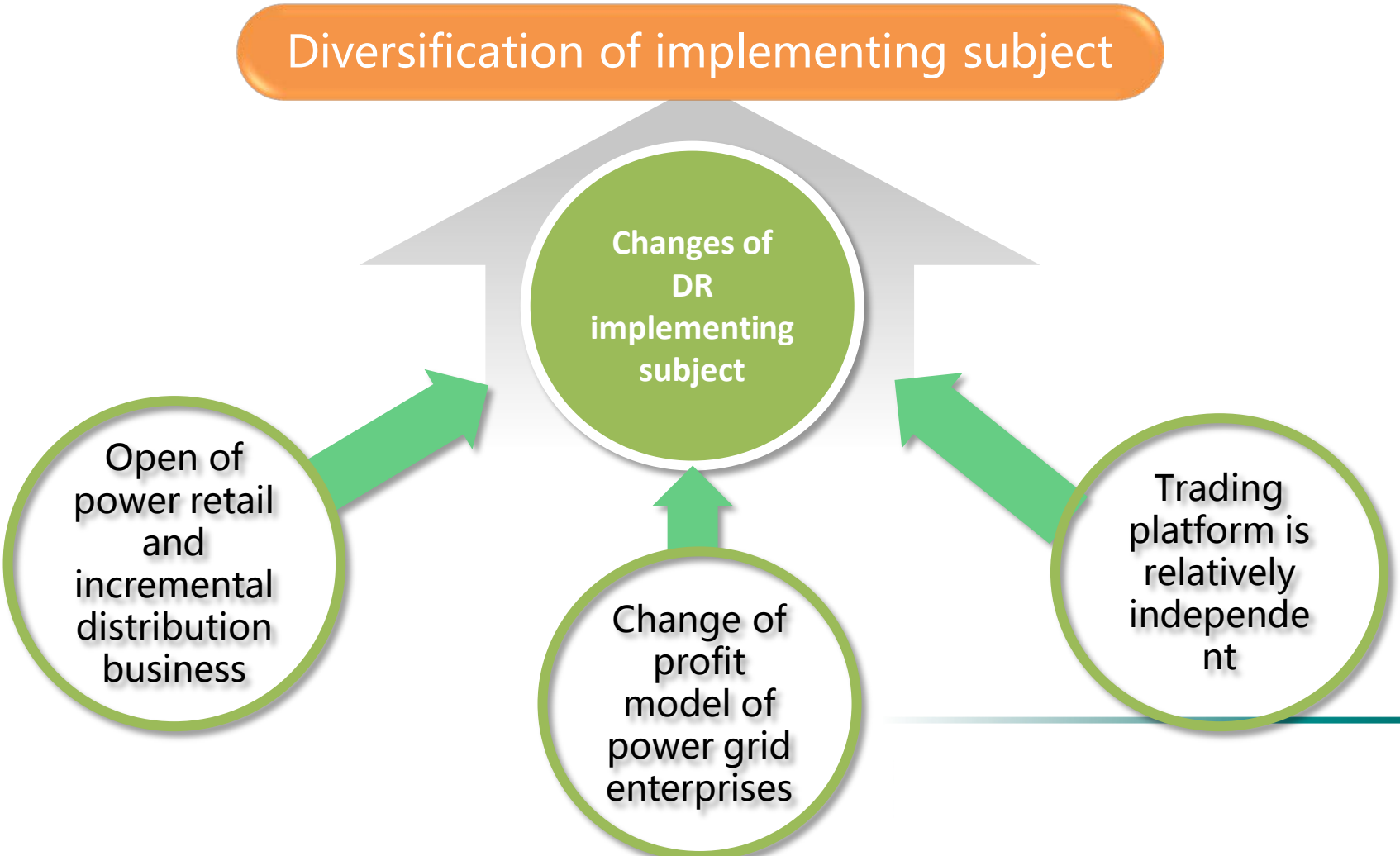
➢ Demand Response Implementation Method

Diversification of Implementing Subject



3. Demand Response Development Tendency

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➢ Demand Response Implementation Method

Marketization of Operating Mechanism

Incorporate it into the category of power trading center, achieve the marketable operation of power DR work.

The marketization trade of power load shedding indicators should be studied continuously.

Relax the restrictions of shedding-load indicators to large users.

3. Demand Response Development Tendency

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➢ Demand Response Implementation Method

Intellectualization of System Decision

JUMP1

Information technology, artificial intelligence technology development, demand response system, terminal products continue to introduce new.

JUMP2

In the future, the adaptive adjustment of user side equipment based on artificial intelligence will be gradually developed.

JUMP3

a demand response runtime strategy library with self-learning function will be built, which will provide decision-making function for demand response service provider, the aggregators, and users who participate in the response.

3. Demand Response Development Tendency

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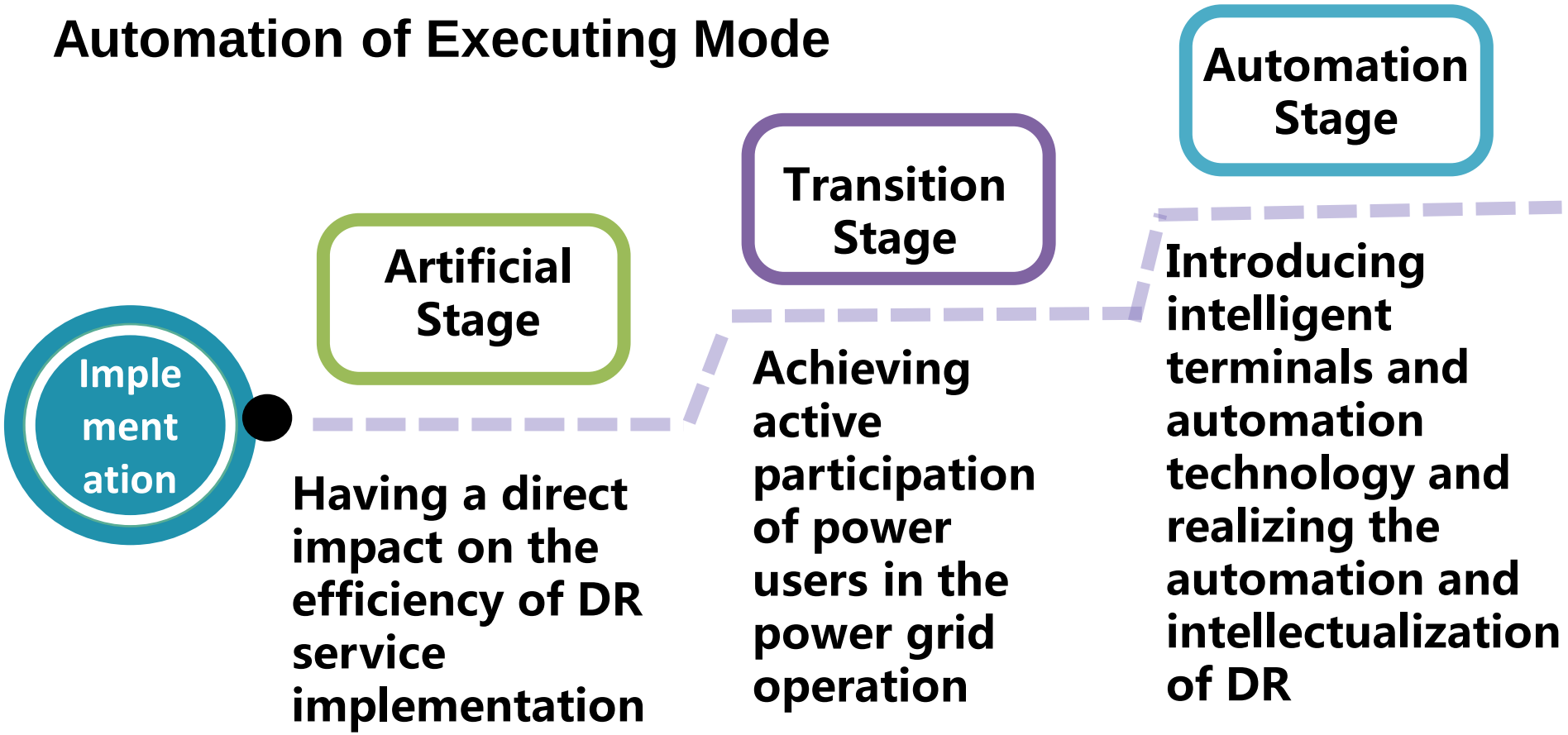
➢ Demand Response Implementation Method

Automation of Executing Mode



3. Demand Response Development Tendency

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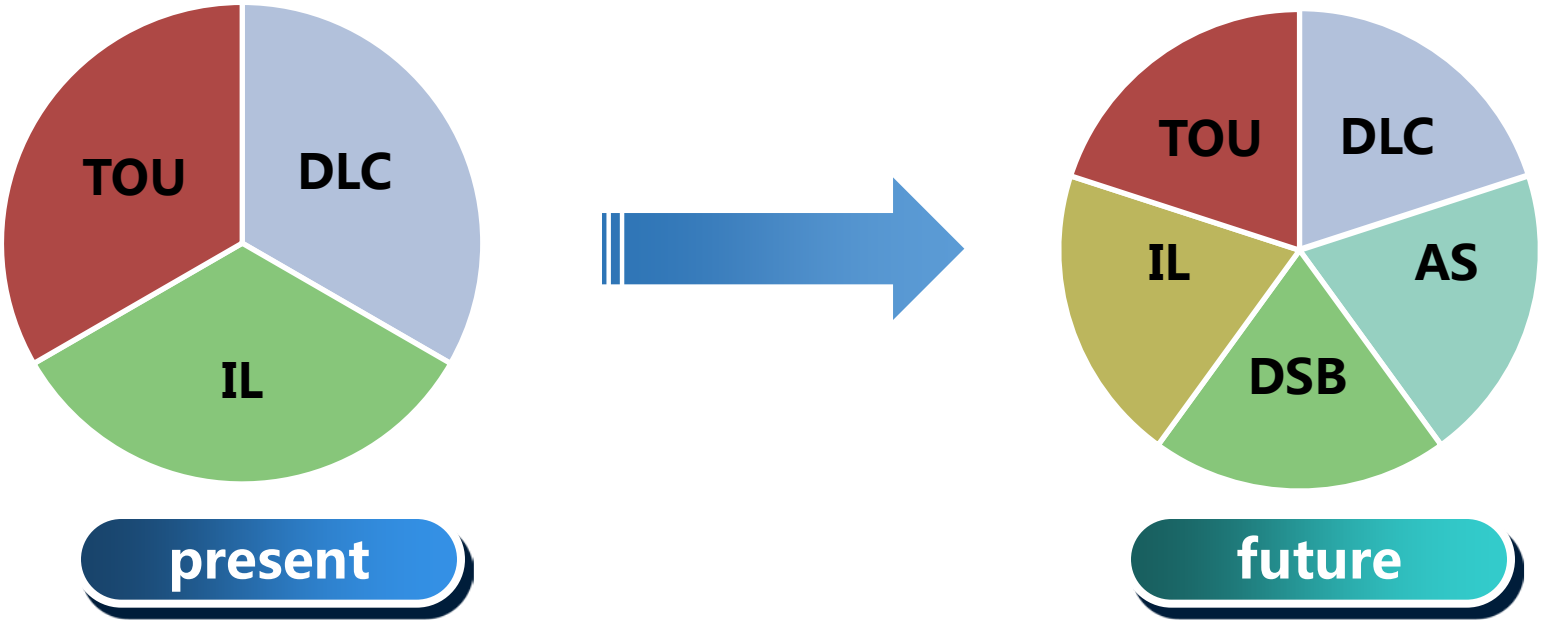
➢ Demand Response Implementation Mechanism

Adding measures such as demand side bidding and capacity ancillary services



3. Demand Response Development Tendency

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➢ Main Participants of Demand Response

The new electricity retail company will actively explore the implementation of demand response business with the newly introduced No.9 Electricity Reform Document and the supportive documents.

➢Stabilize the distributed energy generation power fluctuations of user side; delay or avoid the investment of increasing capability of power distribution facilities

➢ In the future, load resources equal to power generation resources.

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4. Future Work of Demand Response

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➢ Research and Development of Key Achievements

Overview

The continuous promotion of energy consumption revolution and power system reform (with the electricity retail side open) has brought important opportunities to the development of demand response services. Demand response implementation institutions, research institutions and testing agencies are in their urgent needs for relevant achievements of demand response technologies.

Centering on large-scale flexible resource interaction of supply and demand as well as research directions of demand response, and aiming at the urgent needs of the above-mentioned institutions and agencies, we focus on the research and development work of demand response hardware terminals, software systems, simulation platforms, testing systems and so on.

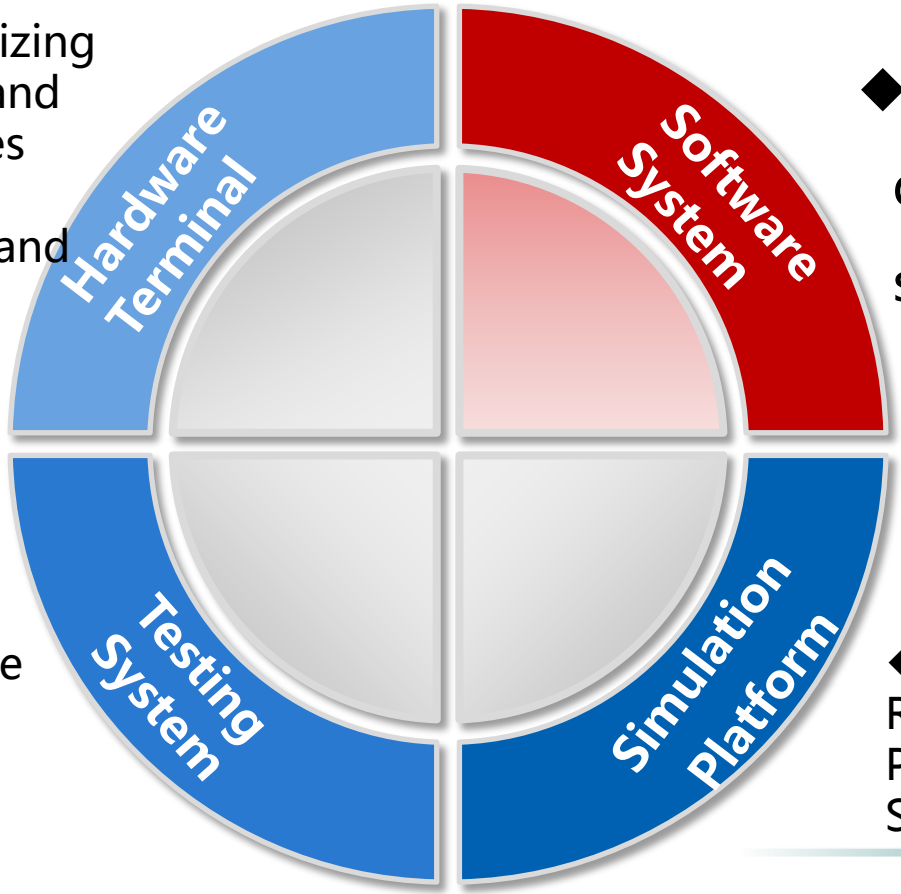
4. Future Work of Demand Response

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Research and Development of Key Achievements

Technical Achievements List

◆Typical electricity utilizing device automatic demand response terminal series
◆Electrical energy alternative device demand response interacting module series



◆Automatic demand response service system

◆Demand response communication consistency testing system

◆Automatic Demand Response Digital Physics Hybrid Simulation Platform

4. Future Work of Demand Response

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Research and Development of Key Achievements

Typical electricity utilizing device automatic demand response terminal series

◆**Main Function:** Receive demand response event information through a unified interactive interface, support the automatic participation of electricity utilizing device for demand response according to the built-in demand response strategy.

◆**Terminal Type：Central air conditioner, decentralized air-conditioner, water pump, fan system** class.

◆**Potential Customers：** Demand response implementation agencies such as the subsidiary energy-saving companies, electricity retail companies inside and outside the system.

Example

Appearance sketch of central air conditioning system automatic demand response terminal

4. Future Work of Demand Response

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Research and Development of Key Achievements

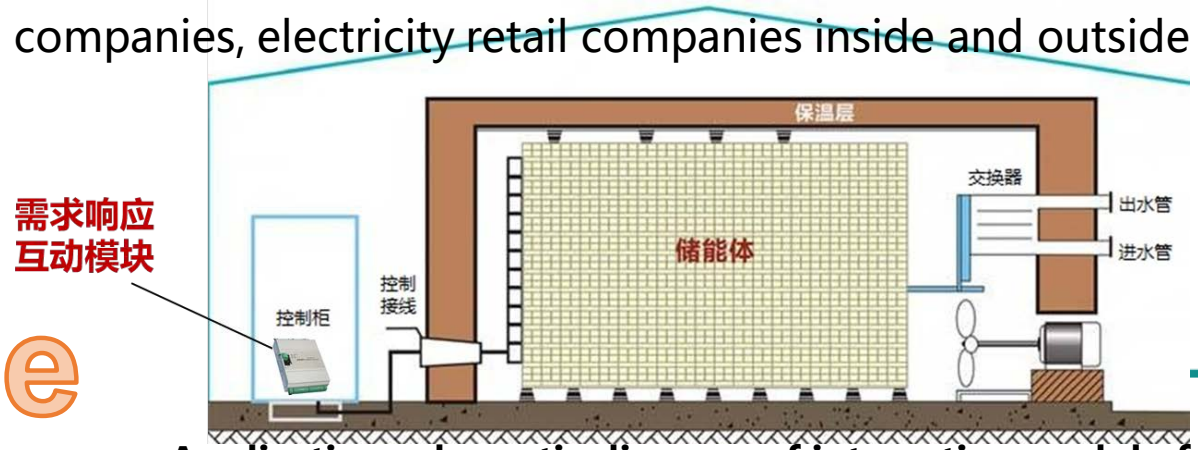
Electric power alternative device demand response interacting module series

◆**Main Function:** Receive demand response event information through a unified interactive interface, support the automatic participation of electricity utilizing device for demand response according to the built-in demand response strategy.

◆**Terminal Type：Electric heat storage boilers, electric heating equipment, electric furnace equipment** class.

◆**Potential Customers：** Demand response implementation agencies such as the subsidiary energy-saving companies, electricity retail companies inside and outside the system.

Example



Application schematic diagram of interactive module for electric heat storage boiler-oriented demand response

4. Future Work of Demand Response

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Research and Development of Key Achievements

Automatic Demand Response Service System

◆Main Function ：
Support the standardized organization and implementation of demand response services based on functions such as **user management, resource management, project management, planning implementation management, assessment of the implementation effect.**

Interface sketch of automatic demand response service system

◆Potential Customers： Demand response implementation agencies such as the subsidiary energy-saving companies, electricity retail companies inside and outside the system.

4. Future Work of Demand Response

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Research and Development of Key Achievements

Automatic Demand Response Digital Physics Hybrid Simulation Platform

◆Main Function:

Provide support for simulation deduction, personnel training, evaluation for strategy and effect for demand response services based on functions such as **power supply system simulations, demand response service operating simulations, hardware-in-loop simulation tests.**

Interface sketch of automatic demand response digital physics hybrid simulation platform

◆Potential Customers:

✓Demand response implementation agencies such as the subsidiary energy-saving companies, electricity retail companies inside and outside the system.

✓Colleges and research institutions engaged in intelligent electricity utilization and interactions between supply and demand.

4. Future Work of Demand Response

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Research and Development of Key Achievements

Demand response communication consistency testing system

◆Main Function:

Provide automatic detection and problem analyzing tools of sample detection for demand response communication consistency test based on functions such as **test case management, test parameter management, test report template management.**

需求响应通信一致性测试系统界面效果图

◆Potential Customers:

✓Testing organization engaged in communication consistency test for demand response.

4. Future Work of Demand Response

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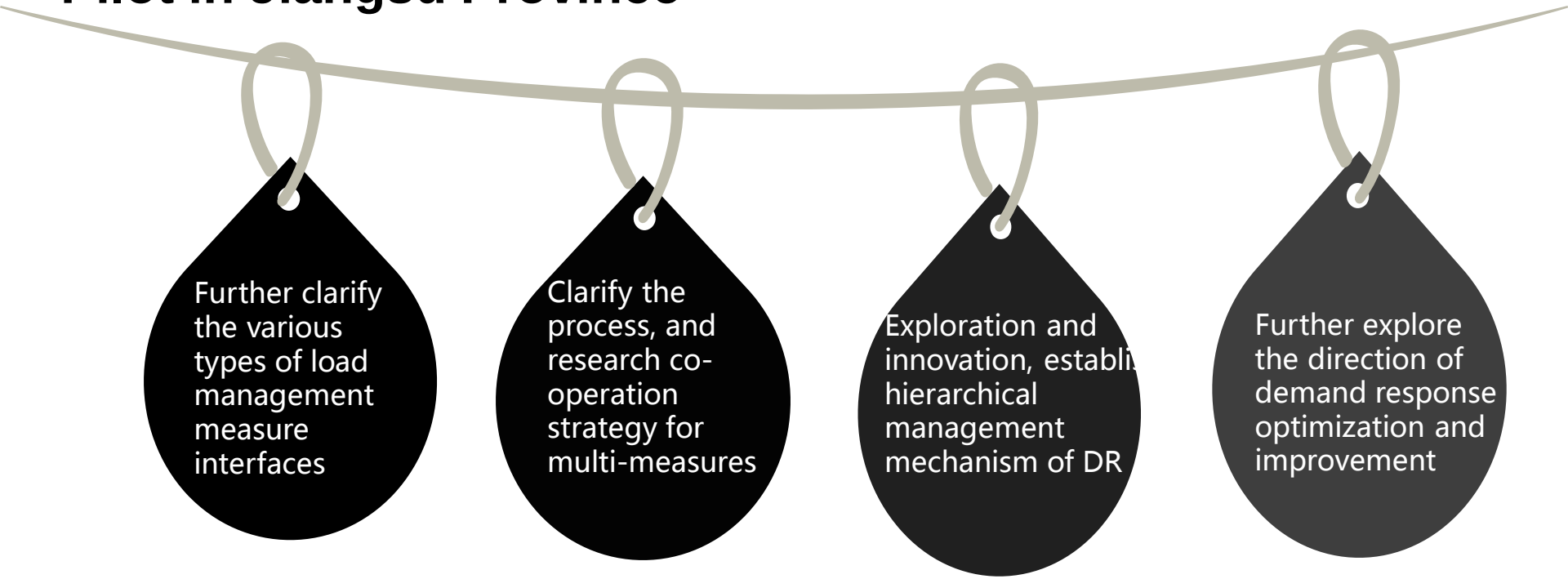
➢ Demand Response Pilot

Pilot in Jiangsu Province



4. Future Work of Demand Response

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Demand Response Pilot

Pilot in Beijing

1

Focus on promoting demand response application for users in the list of electricity orderly usage and users who stop or limit the production when there is air pollution, and optimize producing methods of users.

2

Enhance the public awareness of users for demand response work, encourage users to implement air conditioning measurement and control transformation, and form a propagable and replicable participation mode of demand response.

3

Continue to promote the pilot demonstration of demand response in resident side, enhance social awareness, exploiting response potential of resident side users, and implement measures and methods innovatively.

4. Future Work of Demand Response

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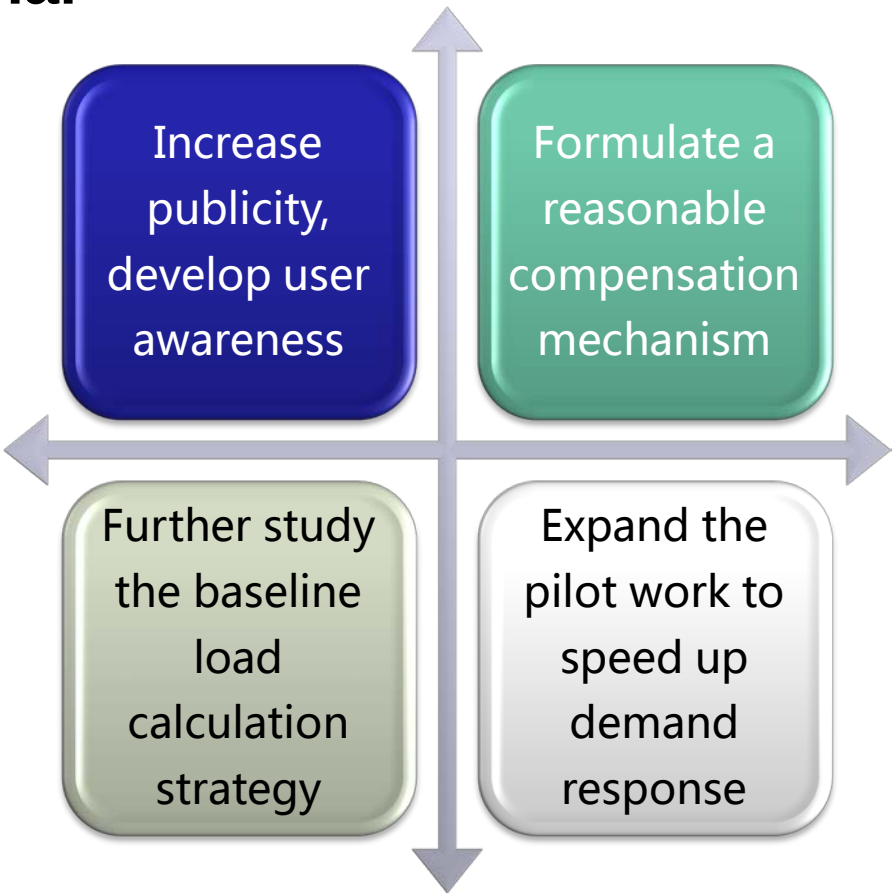
➢ Demand Response Pilot

Pilot in Shanghai



4. Future Work of Demand Response

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➢ Demand Response Pilot

Pilot in Foshan

In the future, resources of demand side market will be regarded as the system resource equivalent to the supply side, blaze new trails and penetrate demand side idea into every step and every participant in the system operation.

Establish a long-term mechanism for responding in order to compensate for the reduction in funding subsidies

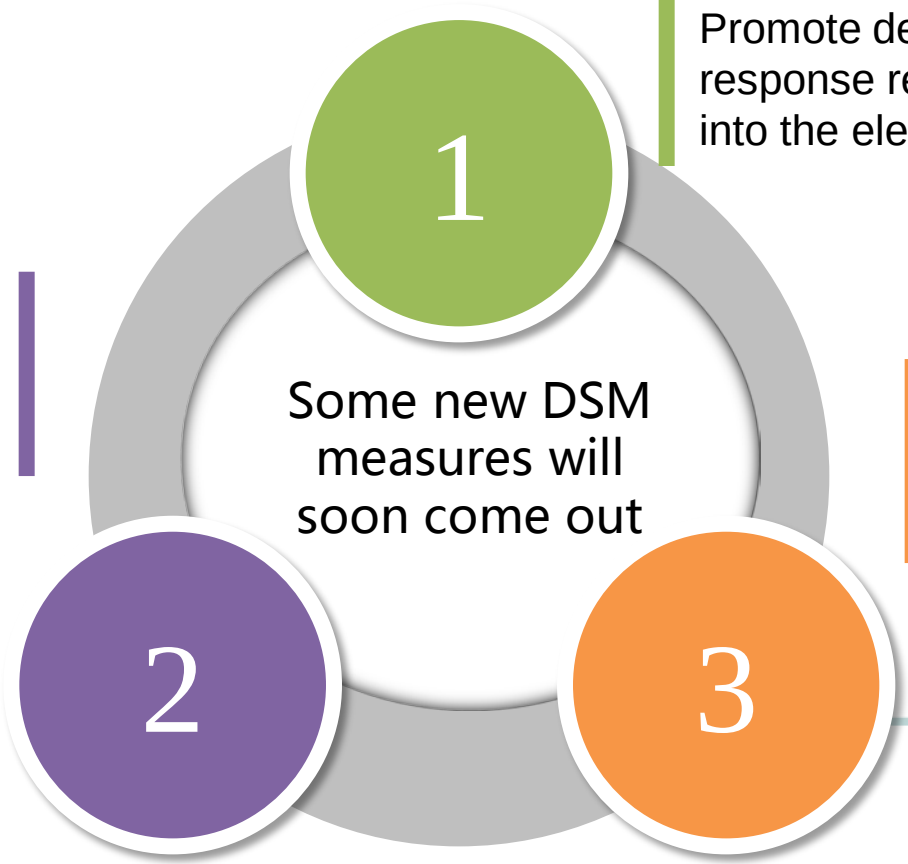
Solve problems of too many types of demand side projects and data upload difficulty caused by the situation that different enterprises are using different data acquisition systems.

4. Future Work of Demand Response

国家电网公司 STATE GRID CORPORATION OF CHINA

➢ Demand Response Policies

In order to improve the efficiency of energy usage, promote the optimal allocation of power resources and guarantee electricity using order, *DSM Management Measures* Published in 2010 is being revised.



4. Future Work of Demand Response

➢ Exploration of Demand Response Developing Way

Take the initiative to communicate with the relevant government departments, and actively seek flexible pricing policy or other supporting policies for demand response pilots.

01

02

Explore modes of intervention into demand response services of agencies like subsidiary energy-saving companies, develop demand response pilot operation work instructed by relevant government departments, and take the initiative to participate in optimizing operation of system and electricity market transactions by using integrated user-side adjustable load resources.

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国家电网公司
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5. Summary

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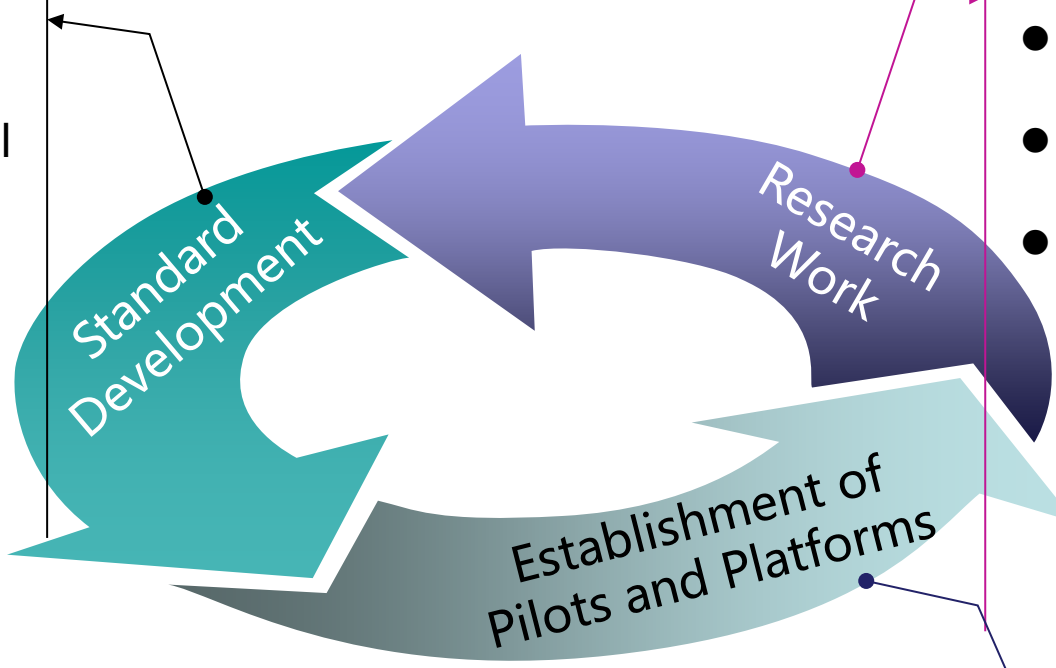
- Continuously apply for and formulate national/industrial /enterprise standards.
- Establish a sound standard system of demand side management.



- Analysis of load characteristics
- Research on Demand Response Mechanism
- Explore new energy service modes
- Further study the model, strategy and interface of the demand response resources participating electricity market operation.

- Demand response projects led by government or grid enterprises will continue to be carried out
- Construction of the power service management platform enhances the level of China 's power management
- In the future, China will continue to expand the scale of the pilot and improve demand response platform functions

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Thank You!