电力规划设计总院
Electric Power Planning & Engineering Institute

Development of Micro-gird in China

中国微网发展介绍

China Electric Power Planning & Engineering Institute

Sept,2018

目 录 Catalog

1、能源发展新趋势
New trends in energy development

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能源发展面临新的挑战和新的需求

Challenges and Requirements Faced by Energy Development

温室气体的排放对全球气候环境造成严重威胁
Serious threat to the global environment caused by emission of greenhouse gases

能源开发利用方式不合理造成环境污染问题
Environment pollution caused by unreasonable energy exploitation methods

资源紧张与社会发展之间的矛盾日益突出
Worsening contradiction between the resources shortage and social development

加快能源转型发展，构建清洁低碳、安全高效的现代能源体系，推动**新一轮能源变革**

Accelerating energy transition, building the modern energy system, being clean, low-carbon, safe and efficient, to promote a new round of energy revolution

在国际上形成了共识，并引导了一系列的动作
International consensus has been reached, followed by a series of actions

1、能源发展新趋势
New trends in energy development

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能源转型发展趋势
Tendency of Energy Transition

可再生能源逐步替代化石能源(From fossil fuel to renewable fuel)
从火、水等传统能源为主向风、光等新能源与传统能源协同互济转变，逐步实现能源的清洁替代。
Changing from the domination of traditional energy sources to the complement of all sources(including new energy sources and traditional sources)

分布式能源逐步替代集中式能源(From centralized sources to distributed sources)
从集中式、一体化的能源供给向集中与分布协同、供需双向互动的能源供给转变，促进能源供应的多样化、扁平化和高效化。
Changing from centralization, integration to cooperative distribution, interaction between supply and demand, energy supply system is promoted to be diversified, flat and efficient.

传统化石能源的清洁高效利用(Clean and efficient utilization of of traditional fossil fuel)
推进化石能源，特别是煤炭的清洁高效和可持续开发利用，依靠技术创新、机制创新不断提升传统化石能源的利用效率。
Promoting the clean, efficient and sustainable utilization of fossil fuel, improve efficiency by innovation in technology and mechanism.

多种能源网络融合与交互转变(Integration and interaction of multi-energy systems)
利用自动化、信息化、智能化手段，实现多种类型能源的协同优化和跨系统转换，统筹电、热(冷)、气等各领域的能源需求，实现能源综合梯级利用，提升能源的整体利用效率。
Accomplishing the complement of multi-energy system by automatization, informatization and intellectualization, improve the overall efficiency through the coordination of multi-energy systems

1、能源发展新趋势
New trends in energy development

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微网：作为适应分布式能源发展的产能、用能的基本单元，以局域（区域）能源网络控制技术及多种能源互补运行、源网荷耦合利用技术为核心，将在能源发展的新趋势中发挥重要的作用。

Micro-grid：is the basic unit of energy production and utilization. It is centered on local (regional) energy network control technology and multi-energy complementary operation and supply-network-load utilization technology. Micro-grid will play very Important role in the new trend of energy development.

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2、微网与区域能源网络

Micro-grid and regional energy grid

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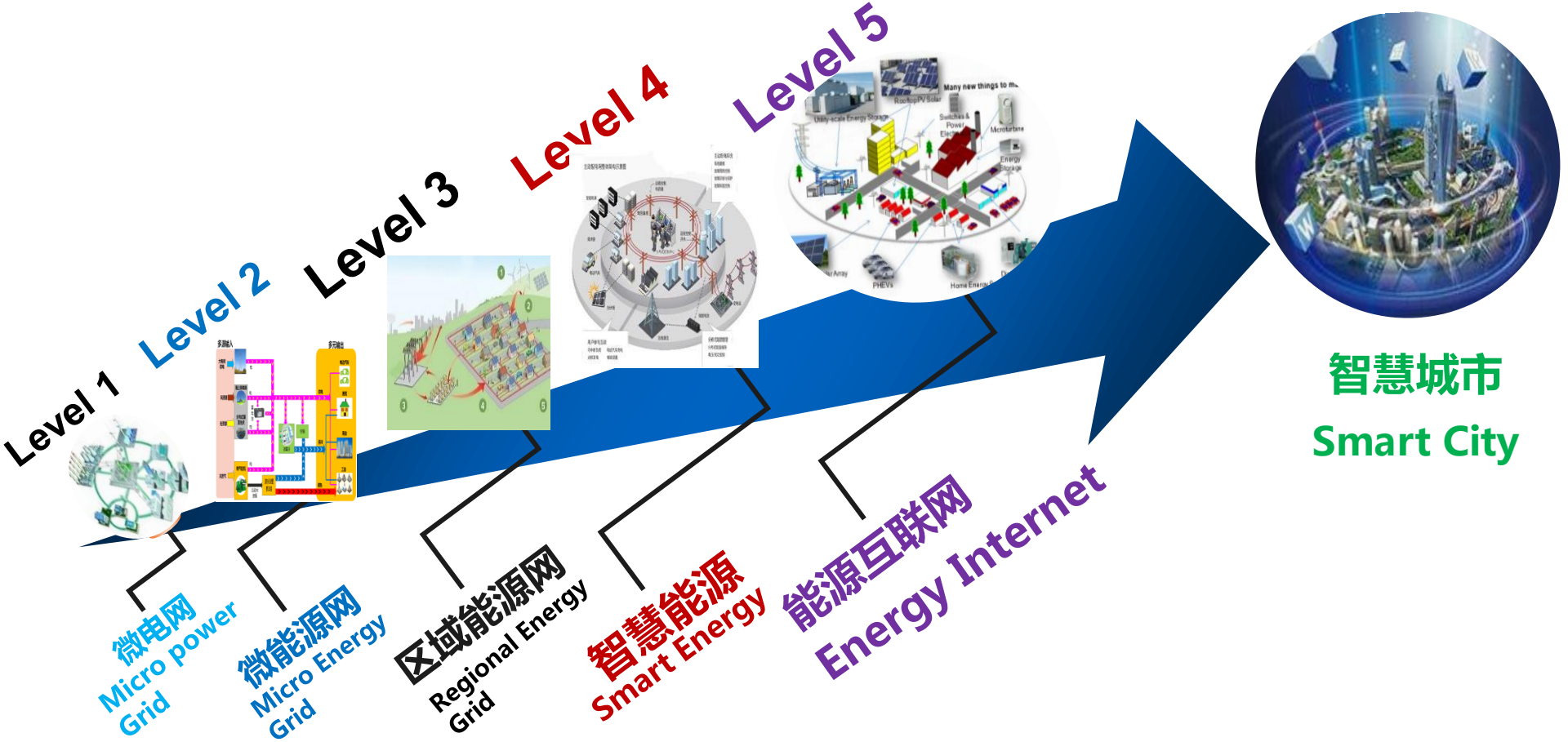
微网是加快可再生能源和分布式能源发展，深化能源供给侧结构性改革，建立多元融合、供需互动、高效配置的能源生产与消费模式的有效方式，它能更好地发挥市场配置电力资源的基础性作用，进一步提高能源使用效率，推进电力体制改革。

Micro-grid has many benefits： Micro-grid can take full advantage of the fundamental role of the market in electricity resource allocation. It can establish effective production and consumption of energy with localized grouping of electricity supply and demand interaction. And further, it can promote the reform of the power system.



2、微网与区域能源网络

Micro-grid and regional energy grid

政策 Policy

- 《微电网管理办法》、《推进并网型微电网建设试行办法》
- Management Measures of the Micro-grid in China (Draft)， Pilot Measures to Promote Grid-Connected Micro-grid Construction

微电网定义与范围/Definition and scale of Micro-grid

- 其电压等级一般在35kV及以下，容量不大于20MW.
- Generally voltage level is at 35kV and below, the capacity is not more than 20MW.

建设管理方面/Construction and Management

- 微电网项目需纳入地区配电网规划.
- The projects must be included in the regional distribution power grid planning

并网管理方面/Grid Integration Management

- 应符合技术、安全等有关要求.
- Should meet the technical, safety and other standards of power grid.

积极推动典型示范/Demonstration Project

- 因地制宜探索各类分布式能源和智能电网技术应用。
- The project must have a typical demonstration and pilot role. It could be promoted to other regions.

2、微网与区域能源网络

Micro-grid and regional energy grid

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试点示范项目 Pilot projects

- 2017年中国发布28个新能源微电网示范项目.
- In 2017, China released **28 new energy micro-grid** demonstration and pilot projects.
- They are distributed in various provinces in China. Many of them are in industrial parks, or island energy supply system.

序号 /No.	工程名称 Project	省份 /Location	序号 /No.	工程名称 Project	省份 /Location
1	北京延庆新能源微网 New Energy Microgrid of YanQing in Beijing	北京 Beijing	7	澳能工业园智能微网 Smart Micro Grid of Macaoenergy Industrial Park Development Co.LTD	贵州 Guizhou
2	太原西山生态产业区新能源示范园区 New energy demonstration project of Xishan ecological industrial zone in Taiyuan	山西 Shanxi	8	北京市海淀北部新区新能源微网 New Energy Micro Grid of The Haidian northern New Area in Beijing	北京 Beijing
3	张北云计算基地绿色数据中心新能源微网 New Energy Microgrid of Green Data Center in Zhangbei Cloud Computing Base	河北 Hebei	9	国网嘉兴新能源微网关键技术研究与示范应用 Key technology research and application demonstration project of State Grid Company in Jiaxing	浙江 Zhejiang
4	合肥市高新区微网 Micro Grid of the new and high-tech development zone in Hefei	安徽 Anhui	10	中德生态园启动区泛能微网 Multi-energy complementary combined heat and power system in Sino-german ecopark	山东 Shandong
6	风光氢储互补型智能微网 Smart Microgrid consisting of power generated by wind ,solar, hydrogen energy and energy storage system	陕西 Shanxi	12	上海电力学院临港新校区智能微网示范项目 Smart Microgrid demonstration project of Shanghai University of electric power new campus in Lingang	上海 Shanghai

2、微网与区域能源网络

Microgrid and regional energy grid

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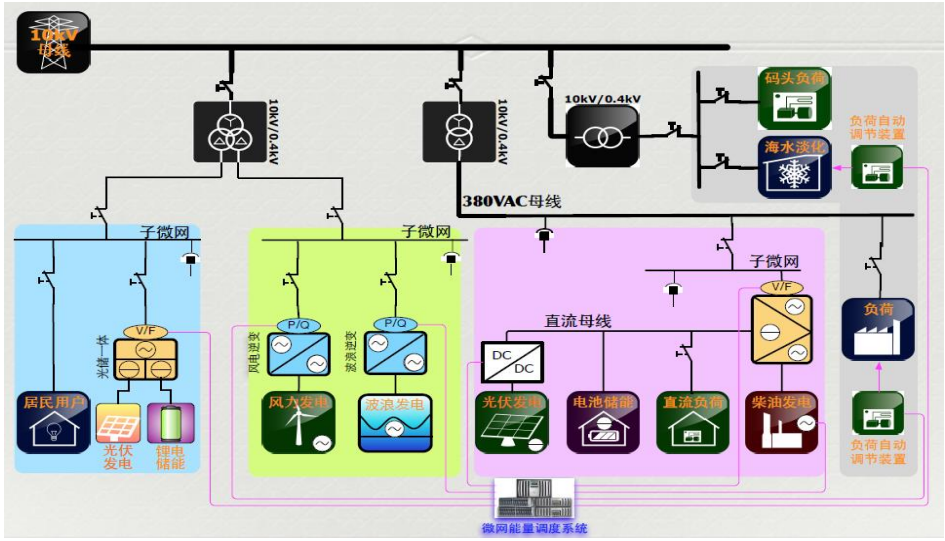
案例1 瑞安市北龙岛独立微电网

Demonstration Project 1: Beilong Island Mirco-grid in Ruian city, Zhejiang.



- 光伏1.35MWp、柴油：0.6MW
- 能量型储能系统3MWh，功率型储能系统1MWh
- 可控负荷：制冰厂200kW,蓄水池抽水系统50kW
- 微电网配有能量管理、数据采集和监控系统

- PV 1.35MWp、Diesel generator system ：0.6MW
- Energy storage system 4MWh
- Controllable load：Ice-making factory 200kW, Pumped storage system 50kW
- Energy Management System、Data acquisition and monitoring system

The project effectively solved the island power supply problem. At the same time, more than 50% of the clean power supply is achieved.

2、微网与区域能源网络

Microgrid and regional energy grid

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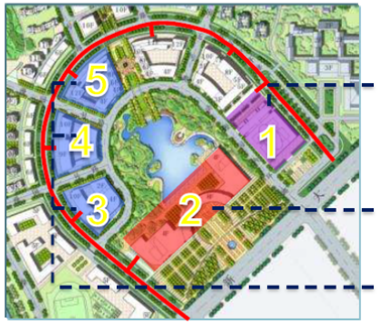
案例2　中新天津生态城智能微网

Demonstration Project 2: Smart Micro-grid in Sino-Signapore Eco-city

Achievements

效果

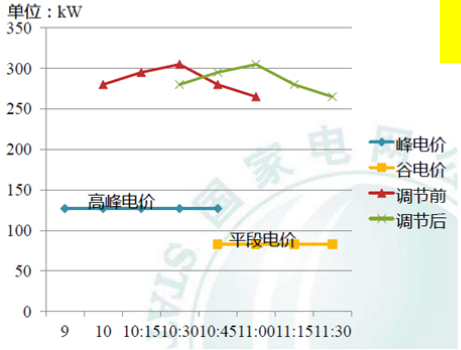
Micro grids cluster	Automatic DR	Smart House	Monitoring Platform
MW级别区域微网群	自动需求响应	智能家居	基于智能电网的监控平台
分布式光伏渗透率>15% 光伏就地消纳率达100% 供电可靠性达到99.999%	200户专变用户和5000户常住居民参与需求响应，实现削峰填谷	100户安装家庭能源中心 10户安装即插即用光伏发电装置	基于能源大数据的能源信息服务平台



燃气三联供1.489MW、停车场光伏400kWp 、地源热泵机组1MW、电池储能300kWh

屋顶光伏173.2kWp
电池储能400kWh

屋顶光伏344.3kWp



The system runs for 6 months.

Environmental protection effect

Emissions	Reduce scale
Dust	**79.5吨**
CO2	**291.7吨**
SO2	**8.8吨**
NOx	**4.4吨**

Saving standard coal consumption **by 117 tons**

Renewable energy utilization ratio exceeds 20%. Green buildings and green travel ratios are 100%

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3、面临的机遇与挑战
Challenges & Opportunities

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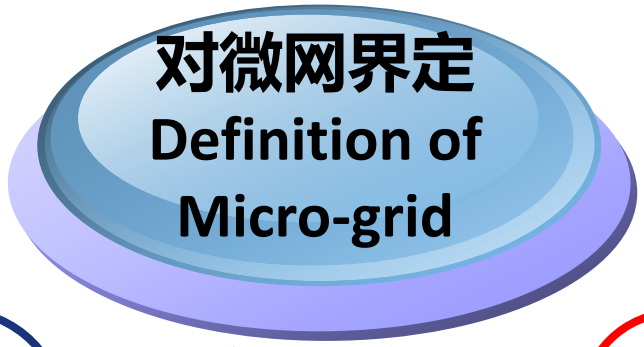
1 管理层面 Management Aspect

- **微网范围的界定：对微网的界定大体上一致，但是对于部分技术还存在一定差异**
  Definition of Micro-Grid： Consensus and Disagreement Coexistence



共识 Consensus

- 微网是相对独立的控制区、自治区域
- 必要时微网可独立运行

- Independently controlled area
- A microgrid can disconnect from the power grid to enable it to operate in island-mode.

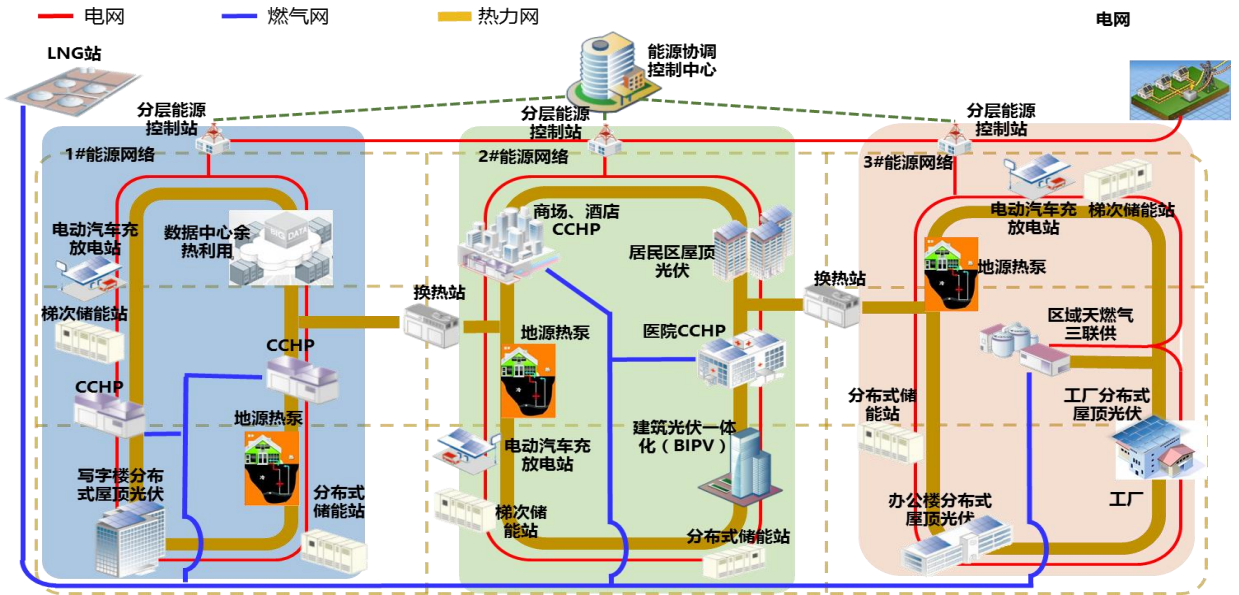
分歧 Disagreement

- 并网电压等级及容量
- 增量配电网改革进程中的微网

- The voltage level and capacity of Micro-Grid
- The role of the Micro-grid in the reform of distribution power grid

2 技术层面——多技术融合 Technical Aspect

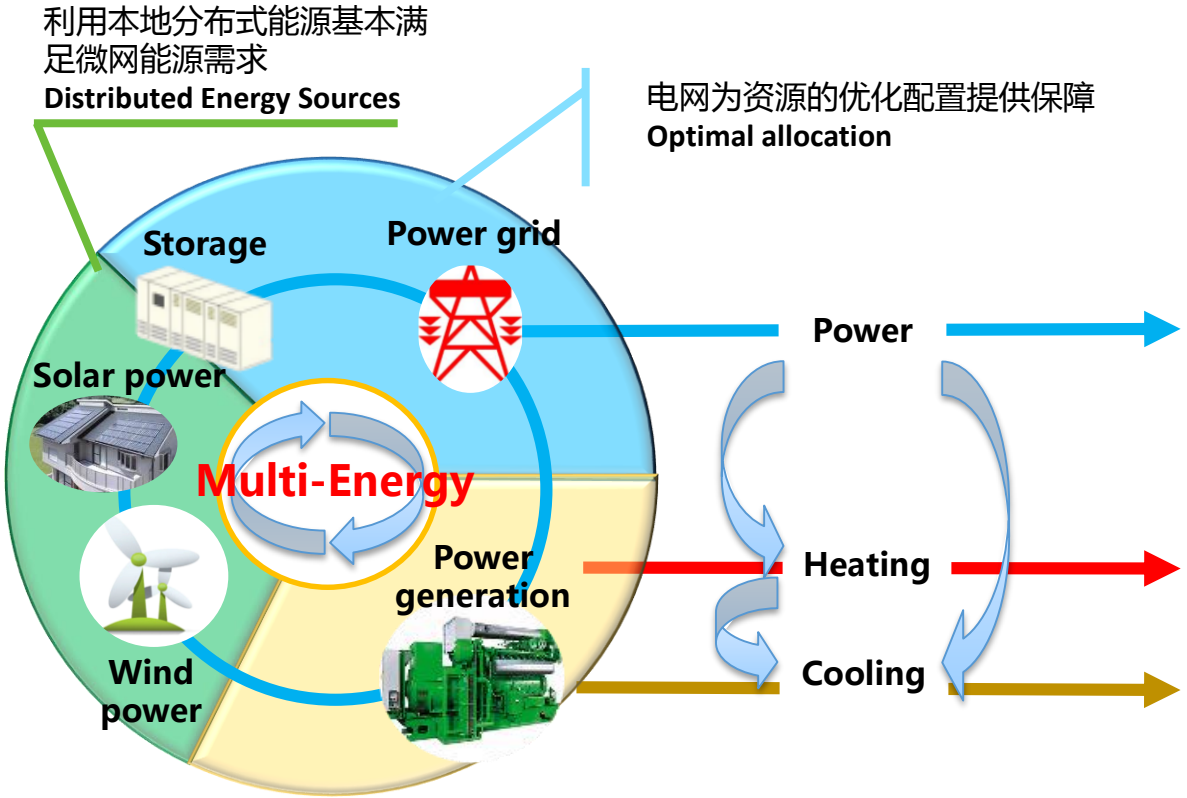
- **多种需求**（冷、热、电等）的准确预测与协调优化解决方案
- **多种能源**（风、光、燃气、生物质、储、热泵等）的互补优化配置方案
- **多种管网**（冷、热、电、燃气等）的综合建设，交直流配电网、无功设备配置方案
- Microgrid contains the complementation, coupling and cascading utilization of the energy , construction of Municipal Utility Tunnel , optimization of the multiple demands and the source-grid-load friendly interaction. Therefore, the micro-grid needs a lot of technology in the planning, design, construction and operation, as well as the integration of various technologies.



2 技术层面——供应端 Technical Aspect—— Supply Side

- **多能互补：多种能源的优化配置及互补运行对微网的经济、高效运行至关重要。**
- Multi-energy complementation and optimal allocation play an important role in the supply side of the Micro-Grid.

- 储能在微网中配置方案
- Configuration of Energy Storage
- 三联供机组在微网中配置方案及运行方式
- Configuration and operation of the CCHP
- 各种能源耦合及协调运行方案
- Coupling and operation of Multi-energy
- 与公共电网的连接及运行
- Operation mode and connection with the public power grid

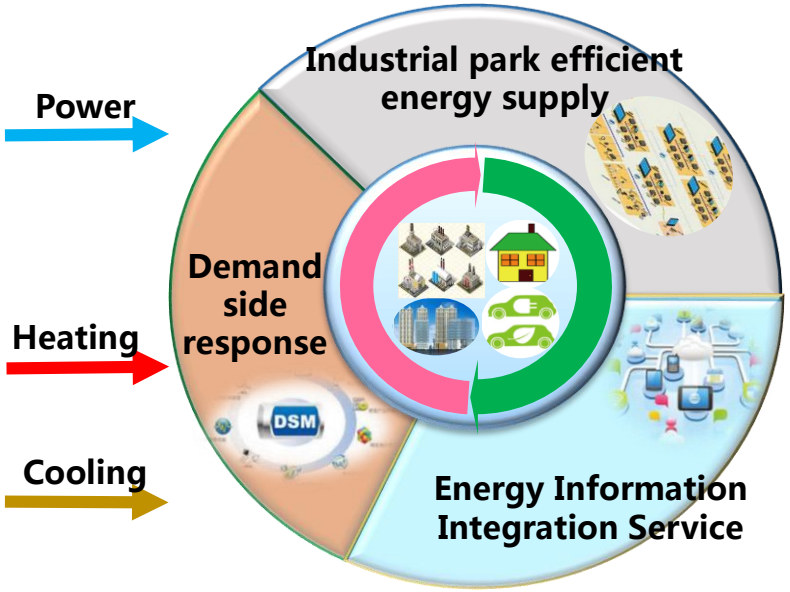


多种能源供应 Multi-energy Supply

2 技术层面——需求端
Technical Aspect——Demand Side

需求侧响应是综合能源服务中重要的组成部分

Demand Side Response play a very important role in Integrated Energy Services



负荷侧综合能源服务
Integrated service in load side

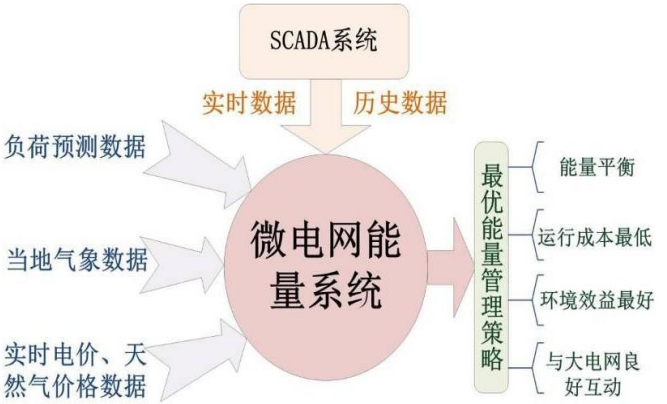
- **需求侧响应：**微网可以作为一个整体参与电网的需求侧响应，提高微网运行的经济效益。它也可在微网内部开展需求侧响应，提高系统的运行效率。
- **Demand Side Response:** Microgrid can be used as a whole to participate in the demand side response of the power grid side ; Also in internal microgrid , the demand side response can be carried out to improve the operating efficiency of the system.

2

技术层面——源网荷储协调优化运行
Technical Aspect——Coordinated Operation

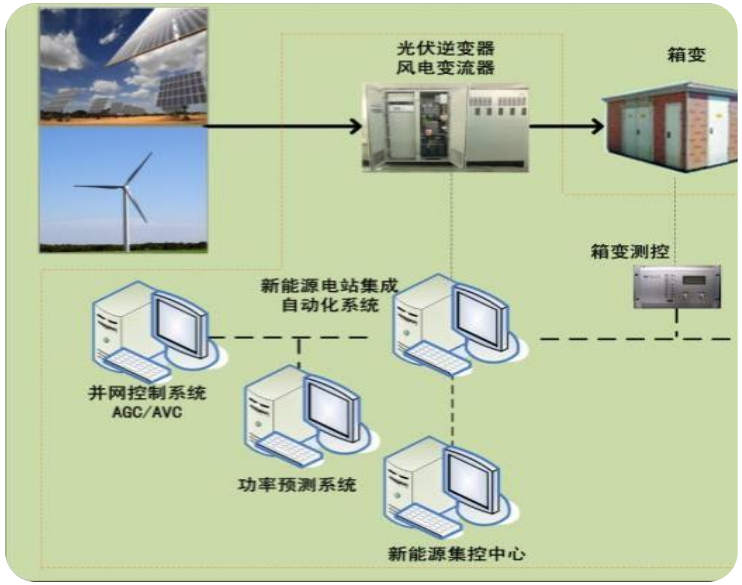
关键技术 ：

- ✓ 网、源、荷特性分析与建模、仿真技术
- ✓ 微网动态态势感知技术
- ✓ 分布式新能源精准预测技术
- ✓ 多目标自适应协调优化运行模型与决策技术
- ✓ 网源荷储的分布式协调控制技术



Key Technologies

- ✓ Network, source, load analysis and modeling, simulation technology
- ✓ Micro - network dynamic situational awareness technology
- ✓ Distributed New Energy Precision Prediction Technology
- ✓ Multi-objective adaptive coordination and optimization operation model and decision- making technology
- ✓ Distributed Coordinated Control Technology



3 经济层面 Economic Aspect

有利的一面 Advantages

- 多种能源互补、多种能源需求的耦合利用，可提高能源利用效率，降低综合用能成本
- The coupling of a variety of energy complementary and energy needs , can improve energy efficiency, reduce the total cost.
- 目前中国新能源发电有一些的补贴和支持政策。
- At present, China has certain subsidies and support policies for renewable energy power generation in Micro-grid system.

不利的一面 Disadvantages

- 储能费用高，独立控制系统、保护，客观上增加投资；
- The cost of energy storage equipment is still relatively high
- 中国提出将逐步实现新能源平价上网，减少补贴。
- China proposed to gradually realize to push renewable power at a reasonable price and reduce subsidies.

整体来看 Overall

- 微网对提高能源利用效率、节能减排，促进清洁能源发展等社会效益
- Microgrid can improve energy efficiency, conservation and emission reduction, and promote the development of clean energy and other social benefits

4 体制层面 Mechanism Aspect

促进行业间融合 Promoting industry integration

- 微网、区域能源网络等需要打破传统行业壁垒，开展多能互补和综合供能，对现有的体制机制提出了新的要求
- Microgrid, regional energy grid etc. need to break the traditional industry barriers. Carrying out complementary and comprehensive energy supply, and put forward new requirements to the existing system
- 目前供电、供热、供气、供冷等均是由各个行业独自提供，能源供应主体之间相互独立，需要建立起综合能源服务供应商模式，促进多种能源供应行业间的跨界融合
- The current power supply, gas supply, heating, cooling and so is provided alone by each industry, need to establish a comprehensive energy service provider model, promote cross-border integration among various energy supply.

推进改革 Accelerating the reform of energy system with electricity as the core

- 实现能源市场主体多样化
- Gradually realizing energy market diversification.
- 随着“互联网+”技术的深度融合，信息网也将扩展到能源服务的各个环节
- With the deep integration of "Internet +" technology, the information network will also be extended to all aspects of energy services.

- Micro-grid is essentially a kind of control technology. It should adapt to the development of the energy and power industry and meet the needs of economic and social development.
- Micro-grid should be based on promoting the development of renewable energy and distributed energy, improving the efficiency of comprehensive energy utilization, and saving energy and reducing emissions. So that it makes each part a clean, efficient, friendly, autonomous, intelligent energy unit that becomes an integral part of the big power grid system.
- There are still many problems in the development progress of China's micro-grid. We are looking forward to discuss with experts from APEC economies to strengthen exchanges and cooperation.

谢 谢!
Thank you!