World Federation of Engineering Organizations (WFEO)

Energy Internet

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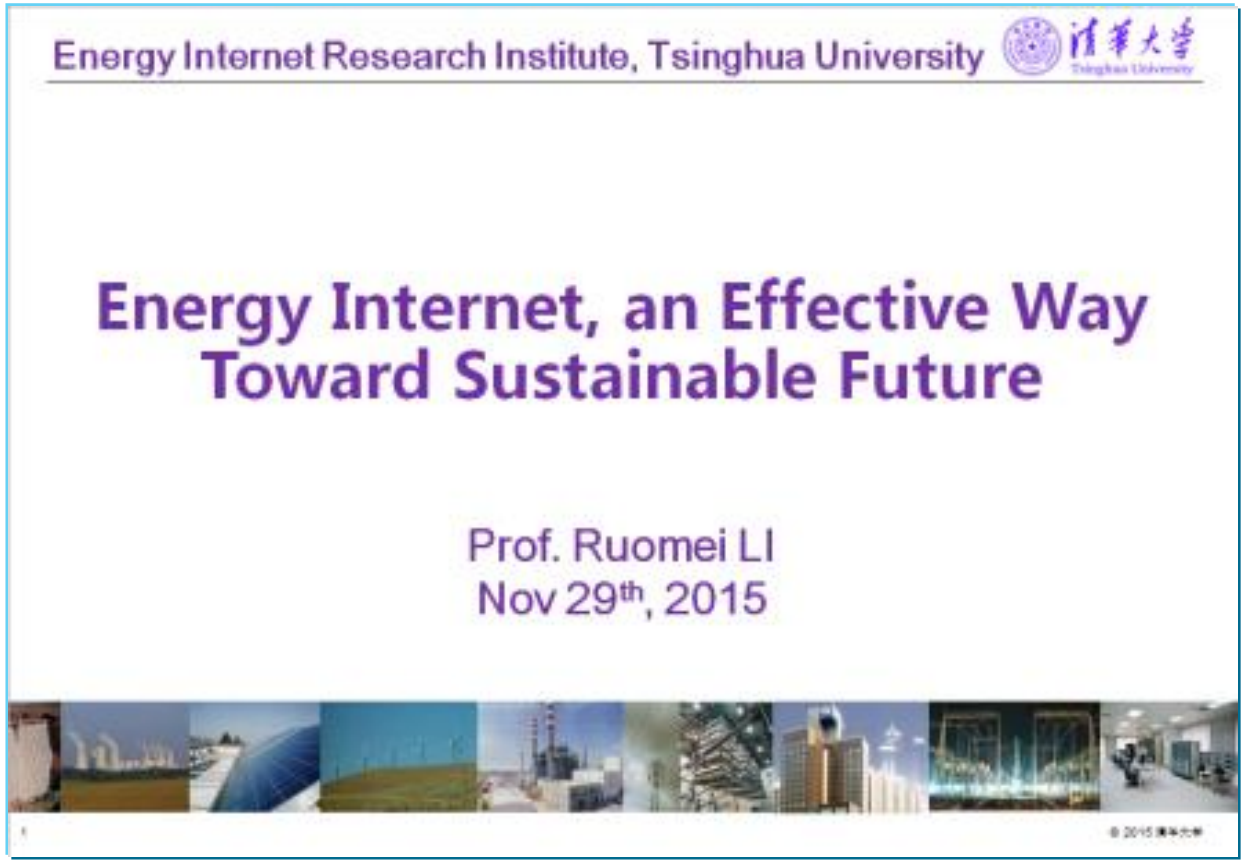
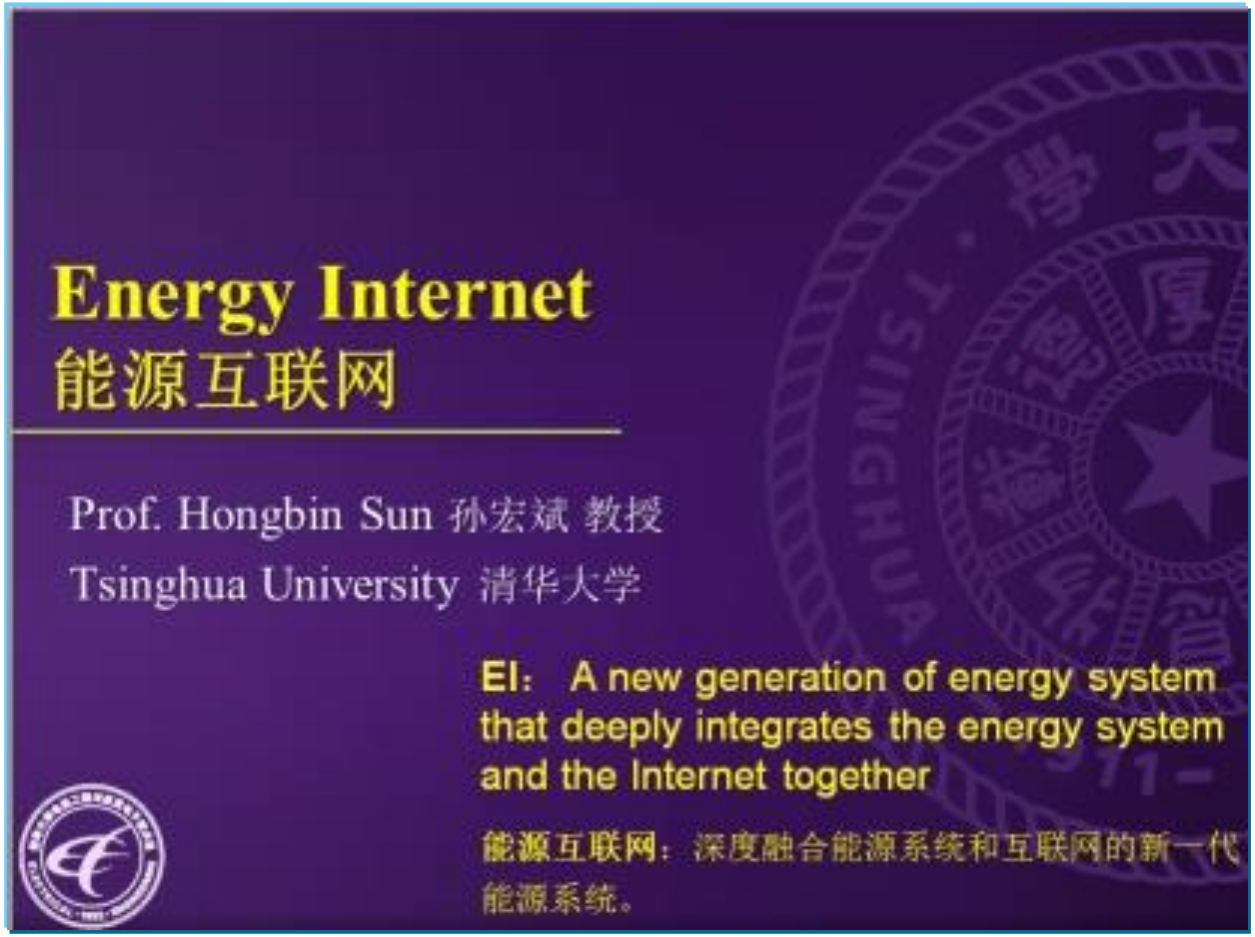
Contents

- Why?
- What?
- Recent Development
- Suggestion



In Dec. 2015, Prof. Ruomei Li gave a presentation on EI in the meeting of EC of WFEO



In June, 2016, I gave a presentation on Energy Internet in WFEO Conference, Beijing.

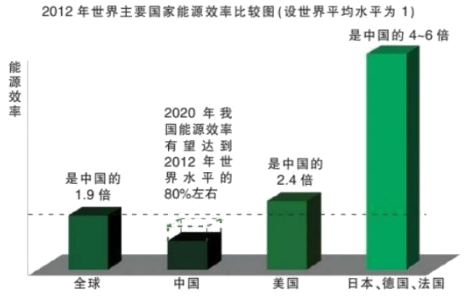
Why to propose the “Energy Internet” in China ?

Unsustainable energy production

- Coal: 70%
- Huge challenge for large-scale curtailment of renewable gen
- Serious air pollution

Goal of renewable energy development

- **2020:** 200 million kW wind power, 100 million kW photovoltaic
- **2030:** Consumption of non-fossil energy: 20%
- **2050:** RE generation: 80%



Low energy efficiency

- Energy consumption per GDP is 2 times of the world average.
- Low facility utilization: Transmission <50% , Distribution <30%

Goal of energy efficiency improvement

- **2020:** Energy consumption per GDP reduce by 40%-60%
- **2020:** Yearly carbon emission per GDP drop by 40%
- **2030:** Carbon emissions peak

Why?

Regulation in energy industry

- Lack of market competition, lack of bottom-up innovation
- Different energy system (electricity, heat, gas) isolates from each other

Energy deregulation

- The new round of electricity deregulation from 2015
- National innovation-driven development strategy
- National Internet + action plan
- National Energy Bureau: Energy Internet action plans

▪Therefore we proposed the concept of Energy Internet.

Beyond smart grid, What is more interconnected by Energy Internet?

What's more to be interconnected?

☐ Issue on interconnection at physical level

- **No connection?**
  - ✓ e.g. multi-energy has not connected, which is one of the major reasons of low energy efficiency
- **Bad connection?**

✓ RE Curtailment;

✓ Low efficiency in energy chain;

✓ Difficulty in DG Plug & Play;

✓ Inconvenient energy utilization, e.g. almost no energy WIFI

☐ Issue on interconnection at information level

- **Physical interconnection is enough? No!**
- **How to fully utilize ERs (flexibility) distributed in whole energy system?**

  Need IoT, the data interconnection, which can link the energy(/service) producer and consumer directly.

  (Sharing Economy on Energy)

Contents

- Why?
- **What?**
- Recent Development
- Suggestion

What?

Energy Internet (EI): A new generation of energy system that deeply integrates the multi-energy systems and the Internet together, which is an effective way toward sustainable future of energy.

There are Two Purposes of EI

- Better:
  - Green
  - Efficient
- Cheaper
  - Integrated
  - Deregulated
  - Sharing

Two-level architecture of Energy Internet

Internet +

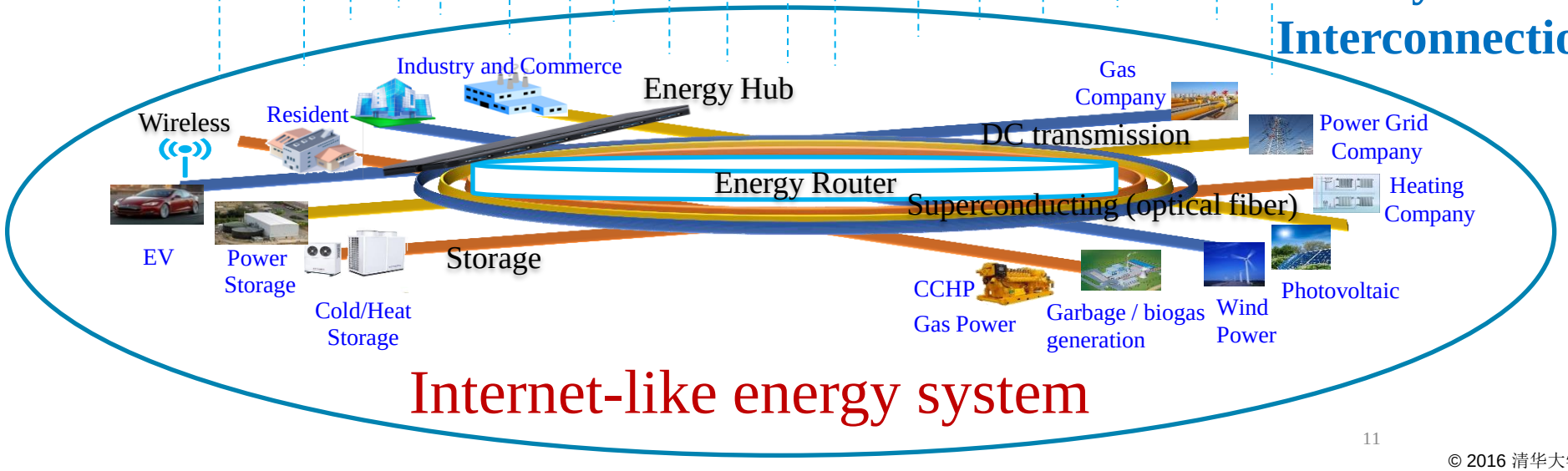
Smart Open Operating System

IoT; Energy management;
E-commerce of Energy;…

Information Interconnection

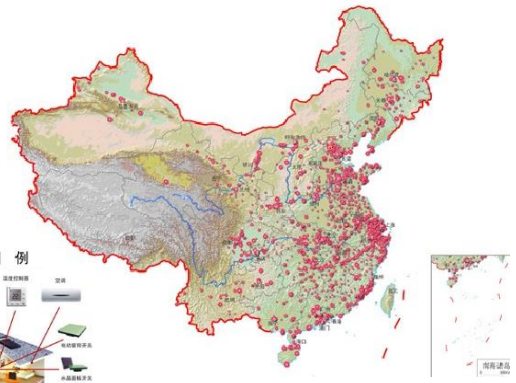
@

Physical Interconnection



Internet-like energy system

Perspectives of Energy Internet



The belt & Road Plan

Modernizations

New industrialization, Informatization, Urbanization and agricultural modernization ——18th CPC National Congress

Home/Building

Industrial/commercial campus

Town/district

City/province

National/ international

Smart city construction plan

>300 cities

Perspectives

Key technologies (In part)

IoT

- **Develop sensors applied in the internet of things**
- **Promote integration of energy and information**

EMS for Multi-Energy

- **R&D of new generation EMS which supports multi-type energy management and high energy efficiency**

Multi-Energy Demand Response

- **Develop appliances for smart home and industrial & commercial areas, coordination and control strategies, market rules**

E-Commerce platform for Multi-Energy

- **Set new policies and rules to introduce competition**
- **Create an open ecology to promote new business types emerge**

Big data & cloud computing

- **Analyze energy data and optimize energy system operation**
- **Portrait of customers based on collected data, customize energy packages**

Multi-Energy transfer/storage

- **High capacity, long cycle, low cost, high safety**
- **High-performance lead-carbon, li-ion, na-ion, compressed air, hydrogen**

Contents

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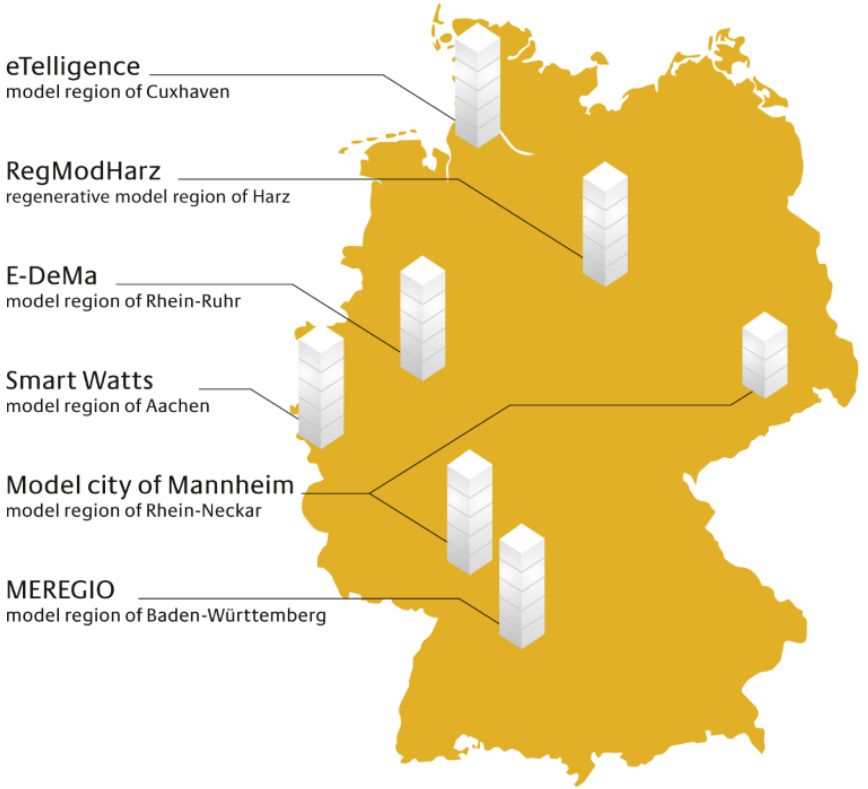
Six E-Energy demonstrative projects in Germany

2008 Germany
The BMWi & BMU

Internet of Energy

"For example, an **Internet-based incentive and marketing system** could offer battery-powered electric cars the option of purchasing electricity less expensively whenever large volumes of electricity are available at non-peak times."

http://www.e-energy.de/en/32.php

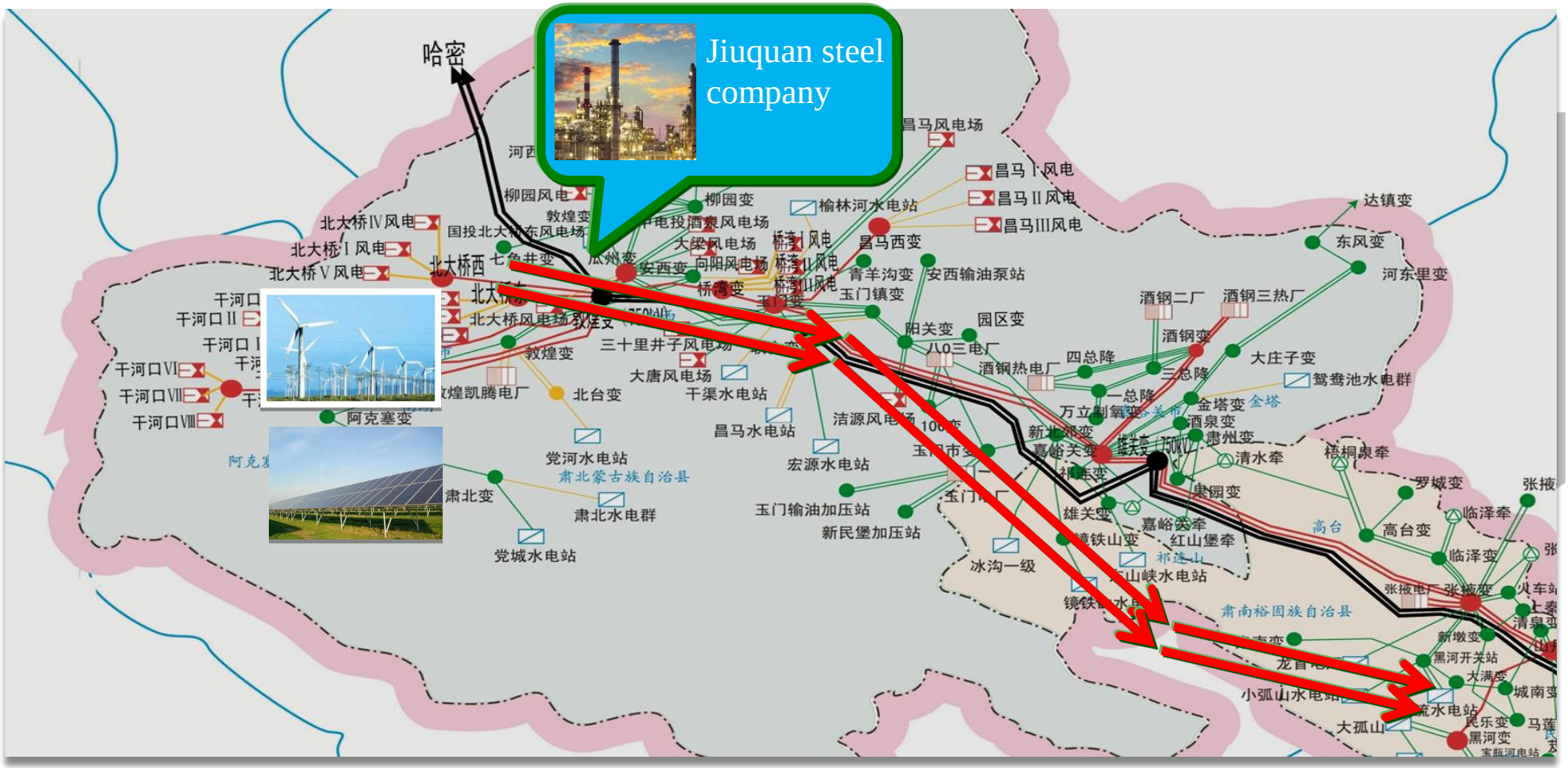


New-brand meeting and organization in China

April 2015, Xiangshan meeting , which is the most top-level academic meeting series managed by Chinese government, was held for EI topic.

- April 2015, Energy Internet Innovation Institute was founded in Tsinghua University.

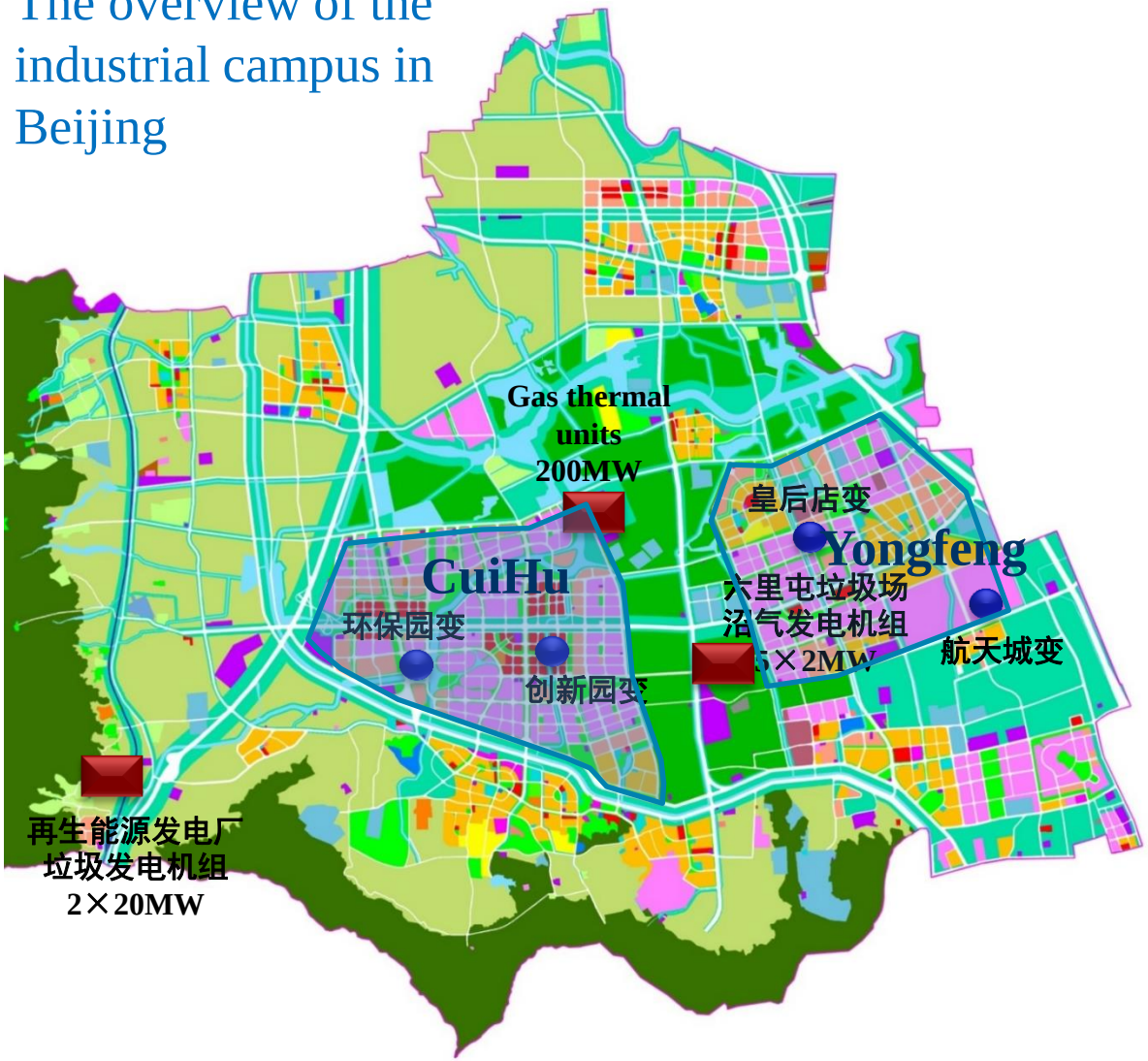
Project 1: Energy Uber (Started from Jun 2015)



<u>Link the supply and demand directly in Gansu Provice:</u> Link large-scale wind farms and the energy-consuming enterprises (Jiuquan Steel company) directly, so Jiuquan company gets cheaper electricity from wind farm to reduce the cost, while the wind farms reduce curtailment of wind, about 800 MWh/y.

Project 2：Energy Internet for industry campus

The overview of the industrial campus in Beijing



The construction area of "Cuihu sub-campus" is 13.66 million square meters;

The construction area of "Yongfeng sub-campus" is 13.99 million square meters;

Under construction:

Renewable power plants: 250MW;

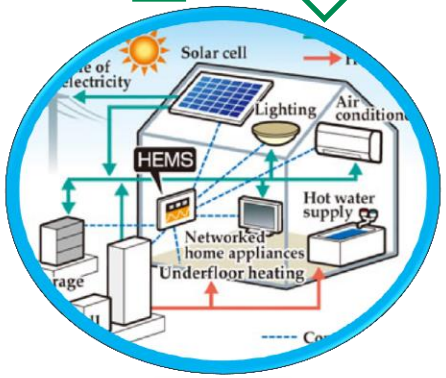
CCHP: 200MW

Garbage power stations: 2*20MW

Biogas power stations: 5*2MW

Cloud-EMS for Multi-energy Micro-grids and Multi-users

Cloud based Energy Management Service



Smart Home

Smart campus

Cloud-EMS for Multi-energy Micro-grids and Multi-users

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- What?
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First Phase Task: Study on Energy Internet

- **Deliverable in a year: Energy Internet Brochure**, similar as Solar Energy Brochure contributed by Prof. Carsten Ahrens delivered last year.

- **A Working Group on Energy Internet** is suggested to be set up, all committee members are invited to be involved in the group to contribute inputs, for example, the challenges and opportunities (data) on energy in different countries, including developing and developed countries.

- **As a contribution to UN Sustainable Development Goals**

Thank You
for your attention!

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