



华北电力大学



中国能源研究会
能源互联网专业委员会

How Does Energy Internet Support the Energy Revolution

PROF. MING ZENG

Energy Internet Research Center, North China Electric Power University
Energy Interconnection Special Committee, China Energy Research Society

June 2017

Background

With the socio-economic development, energy production and consumption continue to rise, burning of fossil fuels leads to various issues like environmental pollution and global warming, posing a great challenge to sustainable development. On the one hand, fossil fuel-based energy encounters significant difficulties, and renewable energy faces bottleneck and problems with capital costs, technical development and market mechanisms, on the other.



Therefore, employing systematic thinking, intervening with energy technology, generation, consumption and institutions of governance simultaneously, and fundamentally changing the way of energy use, so as to build a new energy supply-demand system, are the urgent needs and the key.

How Does Energy Internet Support the Energy Revolution

1 Energy Internet – A Future Energy Supply-Demand Ecosystem

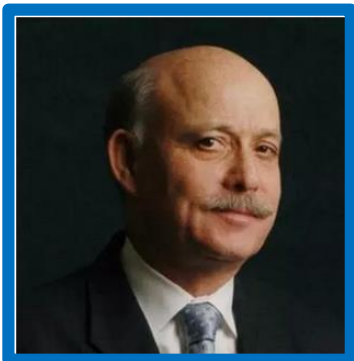
2 Rationale & Urgency of Building the Energy Internet

3 Energy Internet Underpins Energy Revolution

1、 Energy Internet – A Future Energy Supply-Demand Ecosystem

With the rapid development of renewable energy, communication technology and automatic control systems, a new energy supply-demand ecosystem, i.e. the fundamental framework of “Energy Internet” was proposed, having power system as its core, centralized and distributed renewable energy systems as the major energy units, underpinned by real-time high-speed two-way information/data exchange technology, and aggregating multiple forms of networks and flows.

1、 Energy Internet – A Future Energy Supply-Demand Ecosystem



Jun. 2011 “The Third Industry Revolution”

Jeremy Rifkin for the first time raised Energy Internet in his book “The Third Industry Revolution” . The Concept was later introduced to China and soon attracted wide attention.

Feb. 2016 “Guiding Opinions on Promoting the Development of “Internet Plus Smart Energy”

The “Guiding Opinions” issued by the Chinese national government states that : Energy Internet is a new form of energy industry with deep fusion of the Internet and energy production, transmission, storage, consumption and market. It is aiming to build a energy supply-demand ecosystem, with power system as the core and link, interconnecting with grids of multiple energy types and traffic network, driven by energy-information-economics, so as to build a smart, open, synergic, fair, low-carbon, safe and sustainable energy ecosystem.



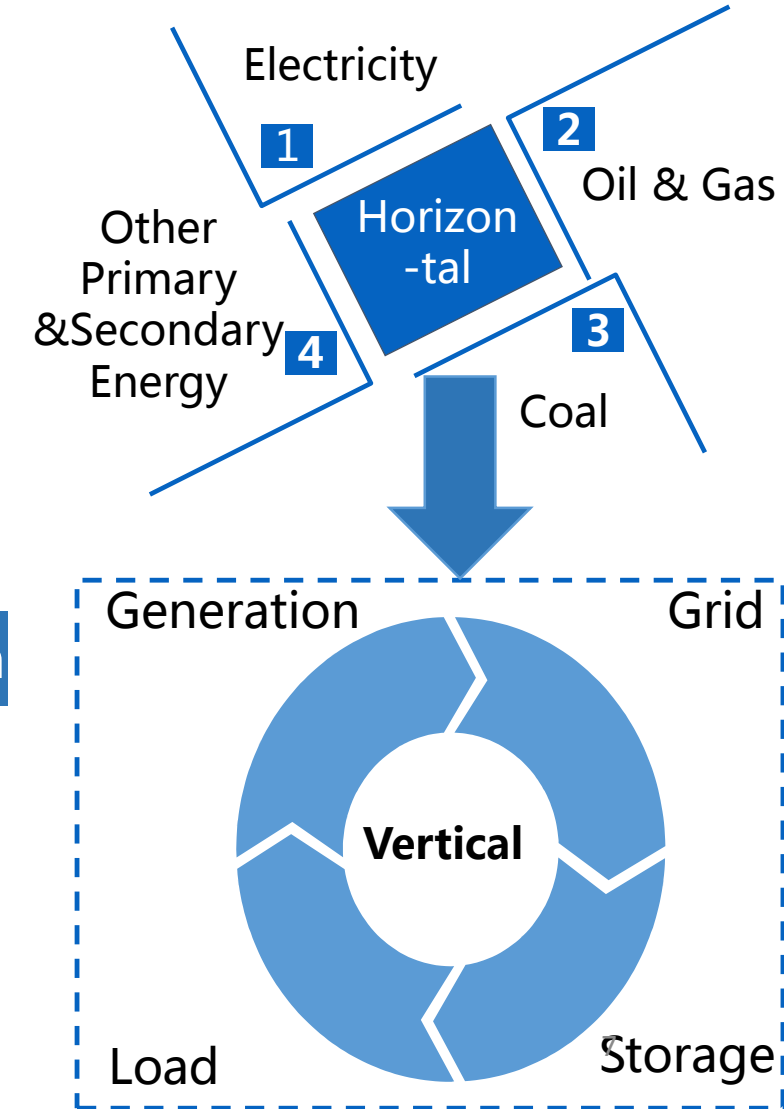
1、 Energy Internet – A Future Energy Supply-Demand Ecosystem

In the context of “energy interconnection” , the conventional energy supply-demand model will be subverted. Pro-sumers, i.e. “consumers “who are also “producers” will become a common feature of the Energy Internet. Sharing and interconnecting will be its core value. “Horizontal multiple energy system and vertical generation-grid-load-storage synergic operation” are the essential characteristics of the Energy Internet.

1、 Energy Internet – A Future Energy Supply-Demand Ecosystem

“Horizontal Multiple Energy System”

- referring to synergistic integration of multiple energy systems including power system, coal, oil system, heating supply, gas supply and etc.;
- highlighting possible substitutability between different energy forms.



Vertical Generation-Grid-Load-Storage Synergic Operation

- achieving synergy among the energy sources development and utilization, resource transportation and energy transmission;
- expanding the demand-side management for electricity to the integrated management for all the energy forms.

2、 Rationale & Urgency of Building the Energy Internet

Energy Internet was proposed under the pressure of imbalances in energy supply and demand, intensified environmental problems, needs of supply side reform. Its necessity and urgency are self-evident, specifically from the following three aspects :

1) The imbalances in supply and demand as well as the environmental pollution issues require a reform of energy production and consumption.

2) Energy supply side reform and change in energy mix call for an up-to-date energy market.

3) Being smart, self-consistent, fair, open, green and low carbon put high requirements on energy technology development.

2、 Rationale & Urgency of Building the Energy Internet



Energy supply-demand imbalances and environmental pollution issues call for innovations in energy production and consumption

China's imbalanced energy mix has led to increasing gaps between supply and demand and poses challenges to absorb renewable energy. Meanwhile, energy intensified, inefficient and blind energy production have caused great environmental problems. All these issues will hinder our social development and put energy security at risk. Therefore, a paradigm shift in energy production and consumption patterns is needed to address these problems. The Energy Internet, as a new energy supply-demand ecosystem, is a comprehensive platform integrating cross-cutting advanced technology, models and idea, which is able to foster new energy production and consumption patterns that adapt to the new economic form, and thus maximize energy efficiency and promote renewable energy, so as to achieve clean, efficient, safe, convenient and sustainable use of energy.

2、Rationale & Urgency of Building Energy Internet



2

Energy supply-side structural reform put a request for a up-to-date energy market

China is now at a crucial time for supply-side reform, of which energy sector is a key area. The conventional “supply-follows-demand” scheme, which has led to severe overcapacity in energy sector, needs urgent change to balance the energy supply and demand in the new normal. The "invisible hand" is the key. The Energy Internet is a iterative industry form with strong adaptability and features of the new age, underpinned by physical systems, information and market. It will enable the reform of market players, transaction models and products by means of its self-balancing units and multi-energy information communications. It will promote innovation and development of market mechanism by technical transformation and prompt response to the new normal, so as to meet the active demand for energy supply-side reform.

2、 Rationale & Urgency of Building Energy Internet



3

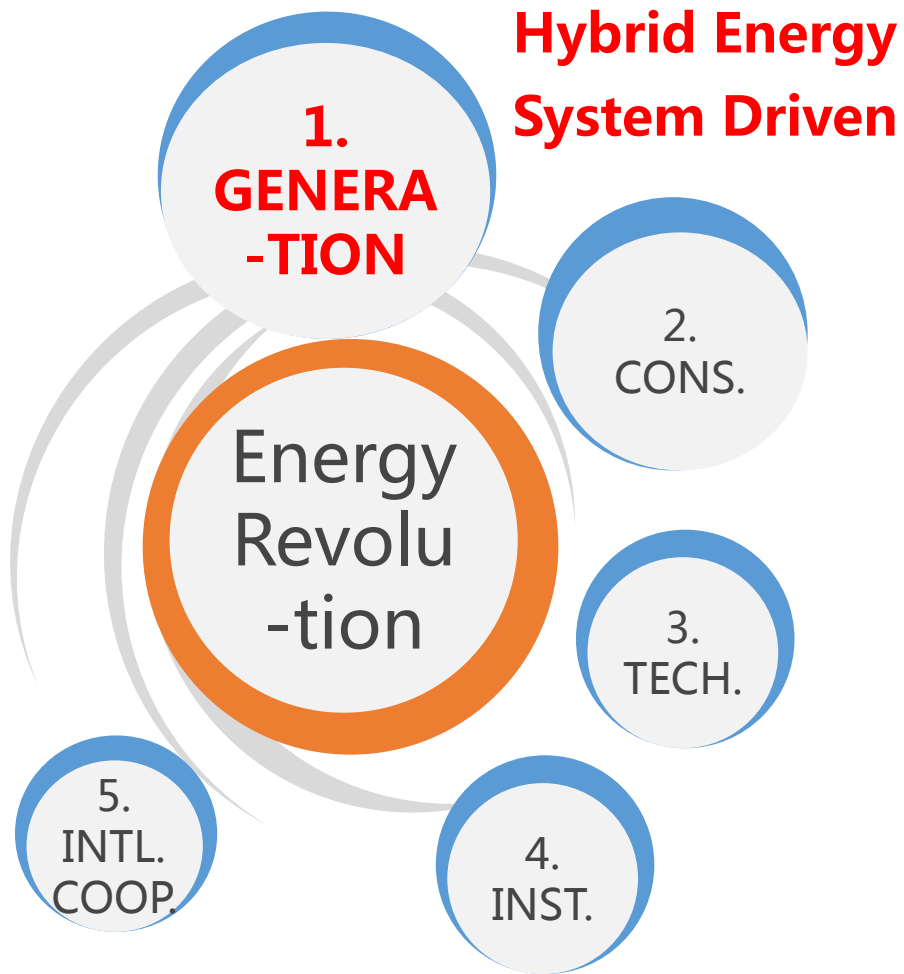
Being smart, self-consistent, fair, open, green and low carbon put high requirements on energy technology development

In a new era of low-carbon, interconnected and open societies, energy industry is required to be green, environmental friendly, smart, self-healing, open and fair as well as achieving multi win-win outcomes. Conventional energy technologies are having difficulties to offer economic efficient and effective solutions while meeting these new requirements. Therefore, technical transformation is urgently needed. The energy Internet is driven by innovation, and its development is inseparable from technology development and integration at every segment of the industry. Technologies, such as power grid interconnection technology, hybrid energy systems and energy storage technologies, and automatic demand response technology, are the cornerstones to ensure healthy, sustainable development of energy industry, and also the prerequisite to meet these new requirements.

3、 Energy Internet Underpins Energy Revolution

Instead of making moderate changes to the existing energy production and consumption patterns, the institutions and market mechanisms, the Energy Internet is aiming to push forward production and consumption reform, institutional transformation, shift in global energy landscape, and better cooperation, so as to promote China' s technology-driven energy revolution.

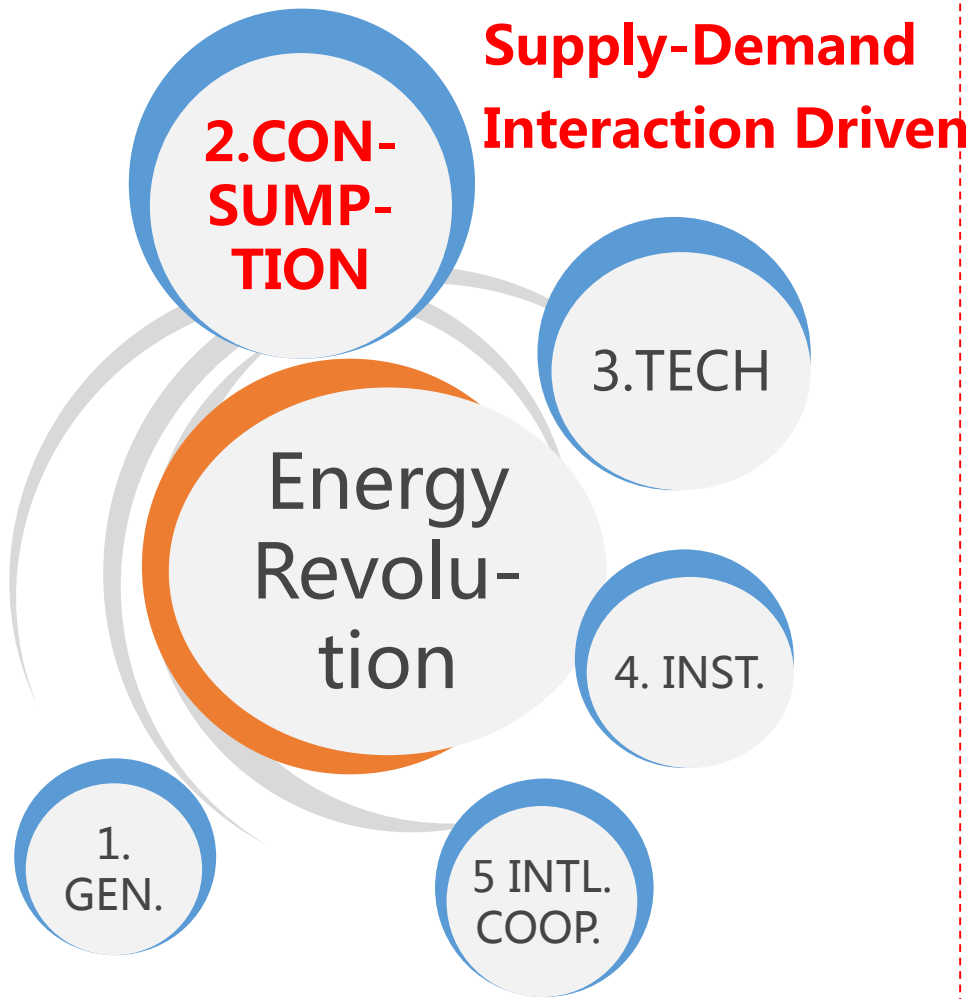
3、 Energy Internet Underpins Energy Revolution



On the one hand , the Energy Internet features high integration, which allows "plug and produce, plug and store, plug and play" of various distributed devices, as well as peer-to-peer interconnections. This enables the scale-up and efficient use of distributed energy such as wind, solar, and of mobile storage devices such as EVs, improves energy generation and consumption patterns, and increases the share of clean energy in the energy mix.

On the other hand, energy generation and supply market is expecting a significant change. It will shift from single-to multi-utility models, including the diversification of market players, products and services, and business models. Besides, the emerging markets will continuously stimulate new players. All these will contribute to the fundamental changes of energy market and drive energy generation revolution.

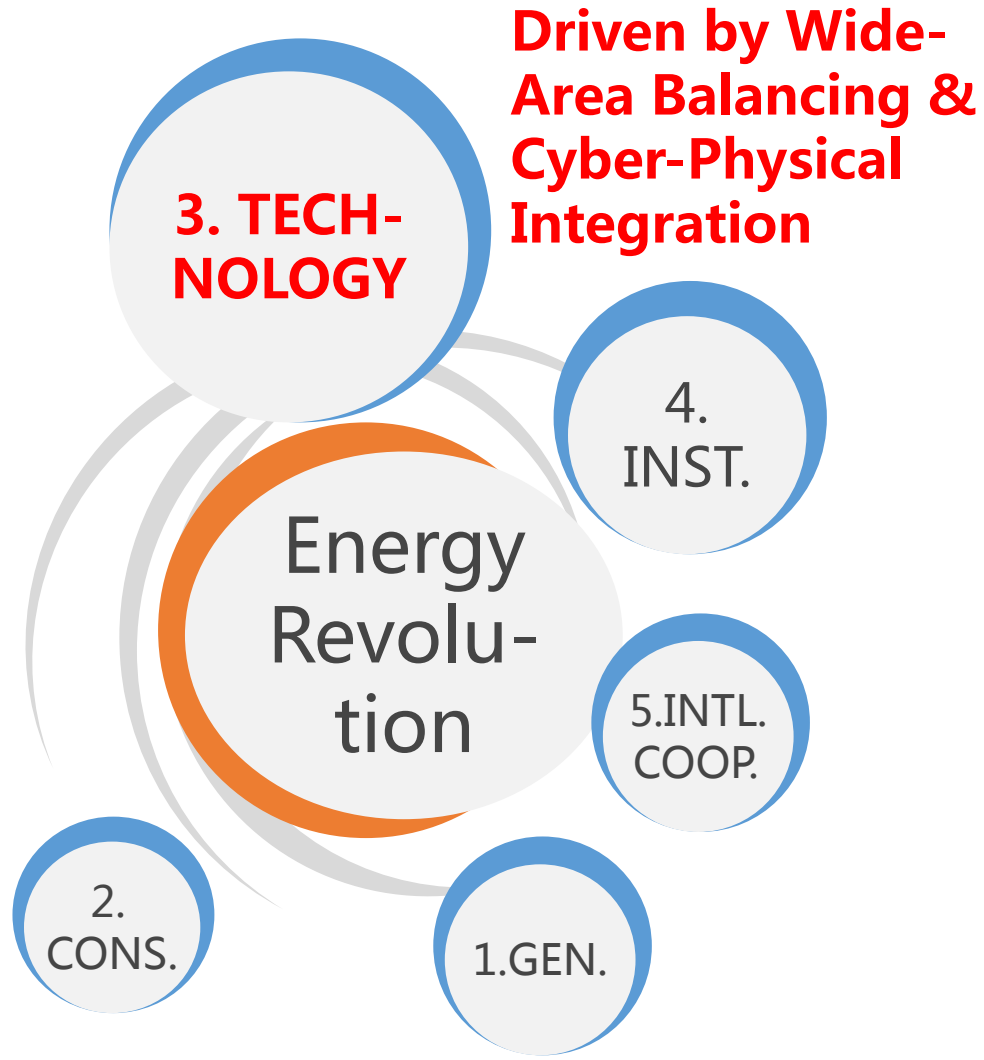
3、 Energy Internet Underpins Energy Revolution



On the one hand, Energy Internet's real-time information and diversified utilities and products offer more options and better services. End users will be able to communicate instantly and make smarter decisions and switch among various energy sources, thanks to smart terminals and information technologies. Meanwhile, consumption of physical energy will see a shift to consuming both services and physical energy, which will spur new consumption patterns.

On the other hand, Energy Internet will promote smarter consumption, improve energy efficiency and optimize operations. Widely applications of smart consumption tools will facilitate the full-scale internal supply and demand monitoring, comprehensive consumption analysis and cross-section coordination and optimization. In addition, real-time smart response system is able to adjust consumption strategy dynamically, and thereupon optimize and improve Energy Internet operation.

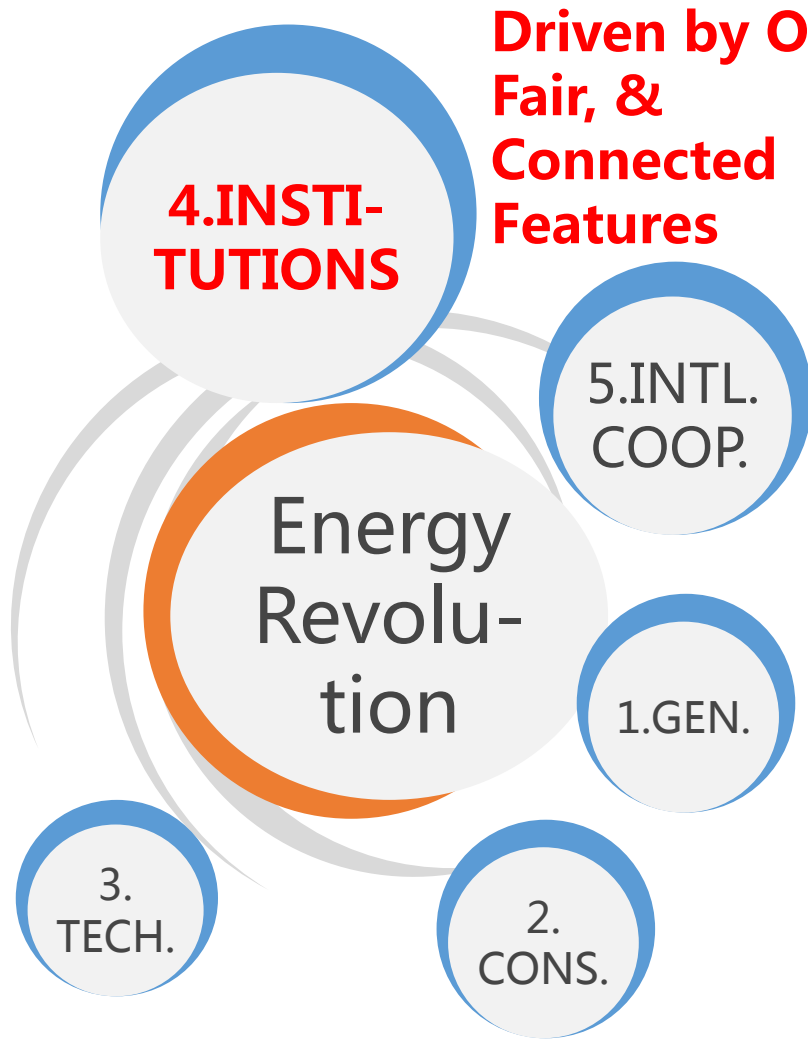
3、 Energy Internet Underpins Energy Revolution



The Energy Internet, an integrated platform, breaks the silos among energy subsystems, achieves self-balancing of multiple energy sources at local level, and load balancing among connected grids, which needs several key technologies.

All the data and devices within the Energy Internet platform are required to be of high intelligence, accuracy, which puts high requirements on energy technologies. The self-balancing of local network and balancing across regions in particular pose great challenges to current energy system planning, control and operations. Therefore, cross-sector technologies as well as integration of energy infrastructure with ICT, such as energy router, energy big data, energy block chain, are promoted, opening up new research fields and driving energy technical revolution.

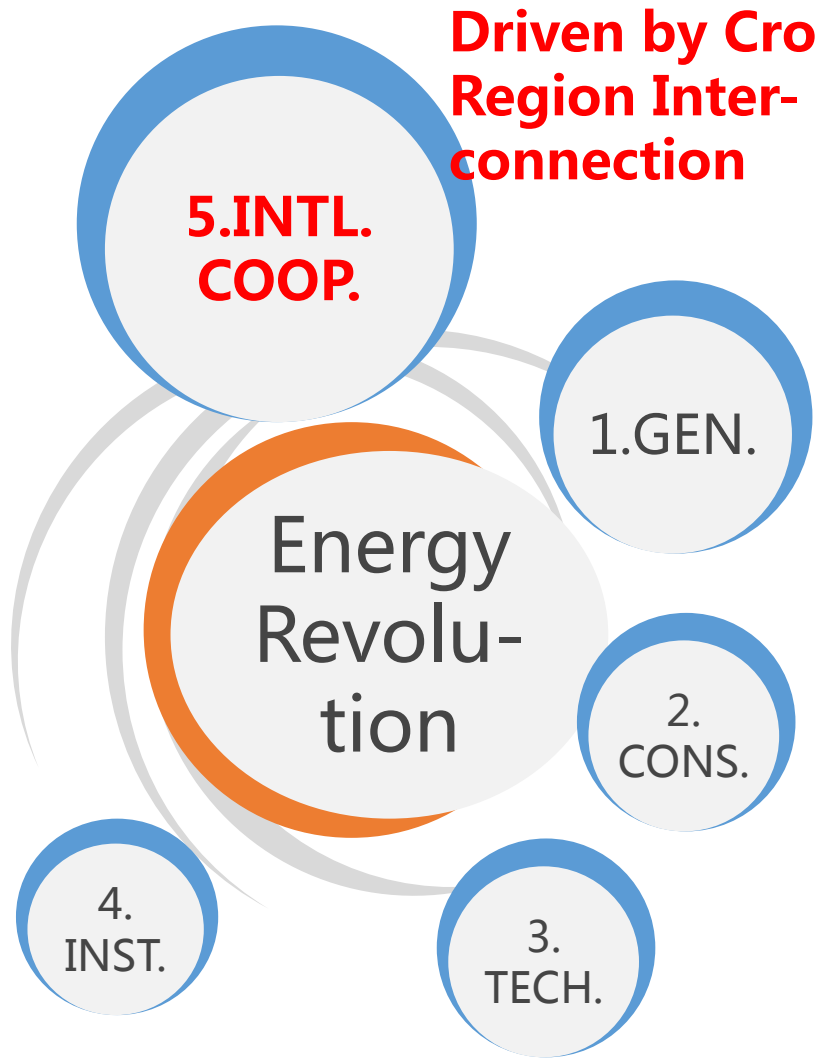
3、 Energy Internet Underpins Energy Revolution



A functioning energy market is the key to ensure the efficient development of the industry while improving policy environment is essential to the industry' s health. Both driving forces have synergies in the context of Energy Internet.

“Fair, open, and widely connected” are the elemental features of the Energy Internet, while open, fair and efficient market is essential for the Energy Internet to achieve these features, driven by new technologies and idea. However, new market mechanisms and transaction models can only address the efficiency issues. Market will be at great risks, if the institutions such as policy, laws, regulations remain unchanged. Therefore, the aforementioned features put requirements on energy market reform, which in turn pushes the institutional changes, which then contributes to realization of these features. This closed loop cycle will facilitate the energy revolution.

3、 Energy Internet Underpins Energy Revolution



China has unique energy resource endowments, which can be complementary to the resources of other countries. It is thus crucial to seize the opportunities brought by the BR initiative, develop full-scale partnerships, and seek win-win development. The Energy Internet comprises both centralized and distributed systems. The Global Energy Internet, as a centralized system, strives for the cross-border and continent-wide interconnection of power grids, particularly promoting the efficient use of renewable electricity across countries and targeting at establishing global new energy power systems.

This centralized Energy Internet has rich contents, touching upon multiple areas such as energy technologies, global energy market and politics with numerous interwoven elements. It is strongly suggested for the Global Energy Internet to embrace the BR initiative and promote the international cooperation in developing global energy market.



华北电力大学



中国能源研究会
能源互联网专业委员会

Thank You !

Please follow us on Wechat

Energy Internet Research Center, North China Electric Power University

