

Renewable-based Power Interconnections in North-East Asia: Securing electricity supply and promoting low carbon energy

North-East Asian countries are richly endowed in energy resources and have significant potential for harnessing complementarities in energy production and consumption through power interconnections. The benefits of power interconnections involving multiple countries include (a) improving economic efficiency by collectively utilizing power capacities, thereby reducing investment and operational costs, (b) securing a stable supply of electricity with the integration of large numbers of power plants and consumers, and (c) supporting the integration of more renewables to the grid by stabilizing output fluctuation of solar and wind. This report looks at the linkage between renewable energy and power interconnection in North-East Asia.

During 2007-2016, the installed capacity of solar and wind energy has rapidly increased in North-East Asia, particularly, in China (6 to 226 GW) and Japan (3 to 44 GW)¹. However, renewables (excluding hydropower) still occupy a relatively small fraction of electricity generation, 5% in China, 4.8% in Japan, and 1.6% in the Republic of Korea (ROK) in 2016.² Meanwhile, renewable potentials of Mongolia and the Russian Far East could provide neighbouring countries with sustainable, affordable and low-carbon sources of energy and reduce their dependency on fossil fuels. The renewable potentials include about 15 million GWh/year for wind and solar in the Gobi Desert of Mongolia³, and over 1 million GWh/year for the hydropower in the Russian Far East, which far exceeds the total electricity generation of China (5.8 million GWh), Japan (1 million GWh) and the ROK (0.5 million GWh). The scale of the renewable potential offers the opportunity for North-East Asian countries to move towards low carbon energy pathways, thereby making the idea of cross-border power interconnection more attractive. In Europe, the cross-border electricity flow among 35 countries in 2015

accounted for 14% of the total generation through seven interconnected electricity markets and 24 power exchanges. Furthermore, 12 countries exported more than 10% of their annual national generation to neighbouring countries. The European experience proves the benefits of power interconnections for expanding renewables (excluding hydro), which increased by 70% during 2011-2015 and shared 17% of electricity generation in 2015,⁴ by absorbing temporary excessive generations of electricity and reinforcing the security of power supply.

Figure 1: Existing Power Interconnections in North-East Asia



(Source: Renewable Energy Institute, 2017)

In North-East Asia, three countries, i.e. China, Mongolia and the Russian Federation, are currently involved in power interconnection and trade. In 2016, the Russian Federation exported 3,320 GWh to China, equivalent to 0.05% of China's total electricity consumption. China and the Russian Federation in 2013 agreed to build a new grid connection that will enable the Russian Federation to increase its electricity exports up to 30,000-50,000 GWh per year. Despite its vast renewable potential to be an energy exporter, Mongolia has increased its electricity import from China and the Russian Federation from 434

¹ IRENA, Renewable Capacity Statistics 2017

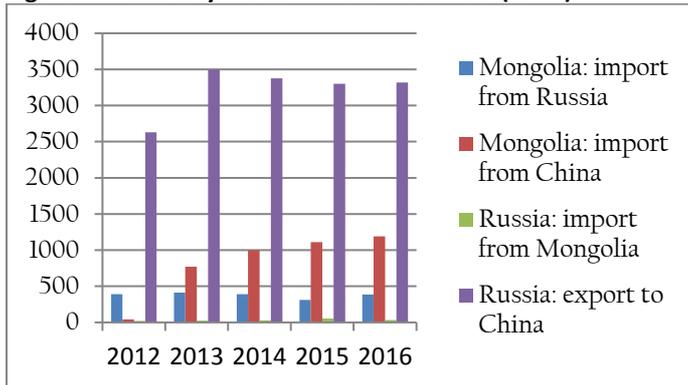
² IEA, Monthly Electricity Statistics 2017 (for Japan and the ROK); Energy Brain Blog, 2017, Power statistics China 2016

³ Renewable Energy Institute, 2017. Asia International Grid Connection Study Group: interim report

⁴ ENTSOE, Electricity in Europe 2015

GWh in 2012 to 1,576 GWh in 2016 which accounted for over 20% of its national electricity consumption.⁵

Figure 2: Electricity Trade in North-East Asia (GWh)



(Source: Energy Systems Institute, Russia, and Ministry of Energy, Mongolia)

Meanwhile, there have been several new initiatives for multilateral power interconnections that aim to connect all North-East Asian countries. Mongolia together with a Japanese company, Softbank, has been promoting the Asia Super Grid; China with the creation of the Global Energy Interconnection Development and Cooperation Organization (GEIDCO) in 2016 has begun the implementation of its initiative starting from power interconnections in North-East Asia; and power companies of the Russian Federation have also proposed power interconnection projects based on Russian hydropower.

In this connection, energy institutes and companies have conducted studies on energy connectivity including a joint feasibility study by Russian Skoltech and Energy Systems Institute (ESI) on creating Asian Energy Super Grid as well as studies by Japanese Softbank, Mitsui and Korea Electric Power Corporation (KEPCO). A pioneering study by Skoltech and ESI in 2014 showed potential benefits of power system interconnection in NEA in terms of capacity, investment and fuel cost saving. The study suggested that power exchange among North-East Asian countries through interstate transmission infrastructure can reach 400 TWh/year. A joint study by Skoltech, En+ Group (Eurosibenergo) and KEPCO indicated that the creation of a power grid connecting all North-East Asian countries (excluding Mongolia) could

save operation expenditures by more than US\$ 17 billion per year and investment costs by more than \$50 billion.

Figure 3 A Mongolian project for power interconnection⁶



These emerging and converging interests resulted in the signing of a Memorandum of Understanding (MOU) in 2016 and the launching of joint feasibility studies and business evaluation studies by GEIDCO, KEPCO, Rosseti of Russia and SoftBank Group of Japan. Power interconnection has also gained political support through statements of the Chinese President Xi Jinping on Global Energy Interconnection in September 2015 and the Russian President Vladimir Putin on proposing the “East Asia Super Energy Ring” and an intergovernmental working group on the power interconnection in September 2016. Thus, there is need for a multilateral mechanism which would provide North-East Asian countries with a platform for dialogue and cooperation such as the Northeast Asia Regional Power Interconnection Forum (NEA-RPIC), which was proposed by the China Electricity Council (CEC), and supported by other stakeholders during the Conference on North-East Asia Regional Power Interconnection held in Irkutsk, Russian Federation, August 2017. The proposed NEA-RPIC aims to facilitate sharing information of studies and projects on power interconnection, coordinate various multilateral processes, and promote renewable energy development and integration.

The ENEA Policy Briefs aim at providing a subregional-level review on common challenges and opportunities, and generating forward-looking discussions among key stakeholders. The views and options expressed in the briefs are the author's own and do not necessarily reflect the official policy of the UN. ESCAP East and North-East Asia Office welcomes proposals from officials and experts for the Briefs. For further information, please contact the Office (escap-sroenca-registry@un.org).

This issue is prepared by Sangmin Nam, Head of Office, a. i., ESCAP East and North-East Asia Office, and issued without formal editing.

⁵ The rapid increase was due to the demand from the Oyu Tolgoi mine near the Mongolia-China border that consumed 98% of imported electricity from China.

⁶ The proposed Shivee project consists of coal, wind and solar plants with the capacity of 5GW.



UNESCAP_ENEA



@UN_EastAsia



escap-sroenea-registry@un.org



<http://enea.unescap.org>

United Nations ESCAP
East and North-East Asia Office
7th Fl. G-Tower, Art center-daero
Yeonsu-gu, Incheon
Republic of Korea
Tel: +82-32-458-6600
Fax: +82-32-458-6699