



Strategy for Northeast Asia Power System Interconnection – Way Forward

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KIREC 2019, the 8th International Renewable Energy Conference

Sakari Oksanen, International Energy Policy Advisor

NAPSI Strategy Study

- A two-year (2017-2019) study sponsored by ADB and executed by Mongolian Ministry of Energy for developing a Strategy for Northeast Asia Power System Integration (NAPSI).
- Study supported by Korea's e-Asia and Knowledge Partnership Fund (EAKPF)
- Study team led by EDF (France) working together with Novaterra (Mongolia), State Grid (China) and Rosseti (Russia).
- A highly consultative process with 30 to 70 representatives from stakeholding organisations of five countries attending Supervisory Committee workshops (from governments, academia, think-tanks, utility companies, regulators etc.).
- Three masterplans (2016 to 2036):
 - **Electricity market analysis** in an interconnected NEA system and associated with a cost-benefit analysis.
 - **Wind and solar potential of Mongolia**
 - **Transmission grid development** towards NEA interconnection
- Supported by numerous technical and economic analysis (such as least-cost expansion plan for Mongolia, comparison of AC and DC systems, load flow and fault current analysis of various grid extension options).



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Why Interconnecting NEA?



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- Tapping marginal cost differences opens an economic opportunity to lower electricity costs.
- System safety and higher flexibility
- Targets to increase RE supply in all countries. Significant RE resource potential in Russia and Mongolia.
- Managing intermittency
- Reducing CO₂ and other emissions
- Economic cooperation

Electricity Trade Flows



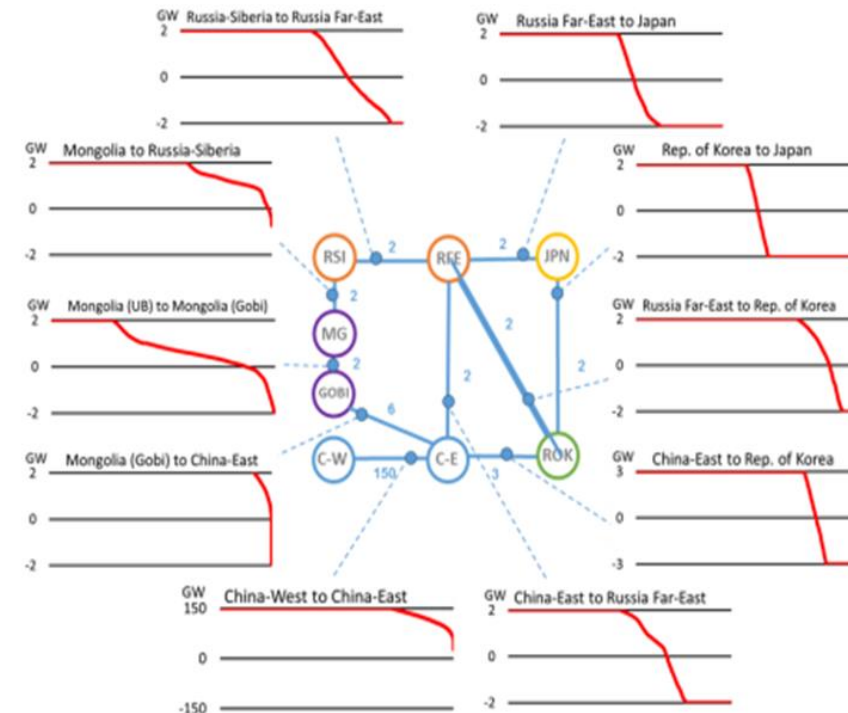
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Optimised Network Configuration

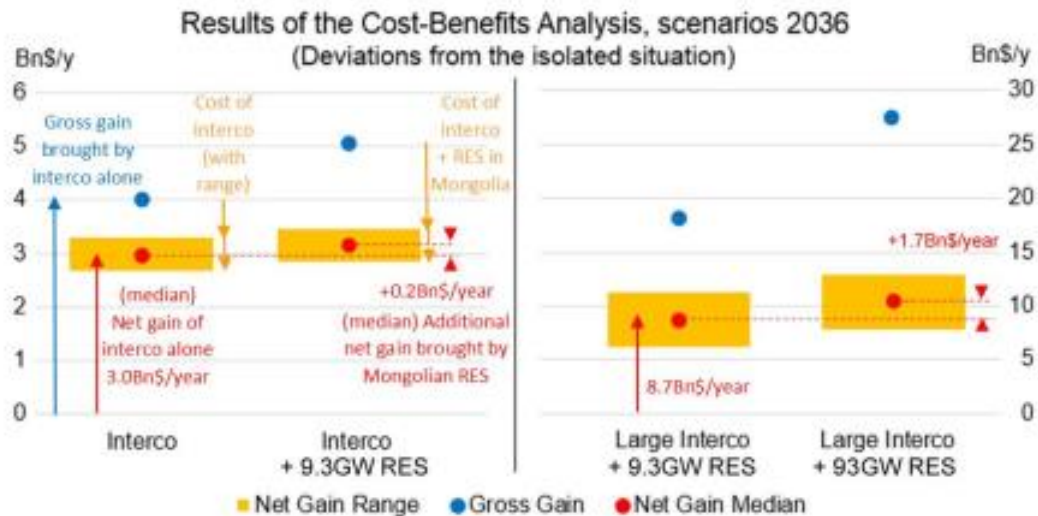
- Most of the lines would be used in both directions, depending on the dispatch situations occurring along the year. That means that the interconnection lines are not only used as for bilateral export or import but have a shared function that contributes to a collective value covering the whole system.
- Moreover, the fact that most of the lines are saturated at the maximum or minimum load a large part of the time, is an indication of appropriateness of the transmission capacities chosen for the study.

Power Flows between the Nodes (2036, 10 GW RES in Mongolia)

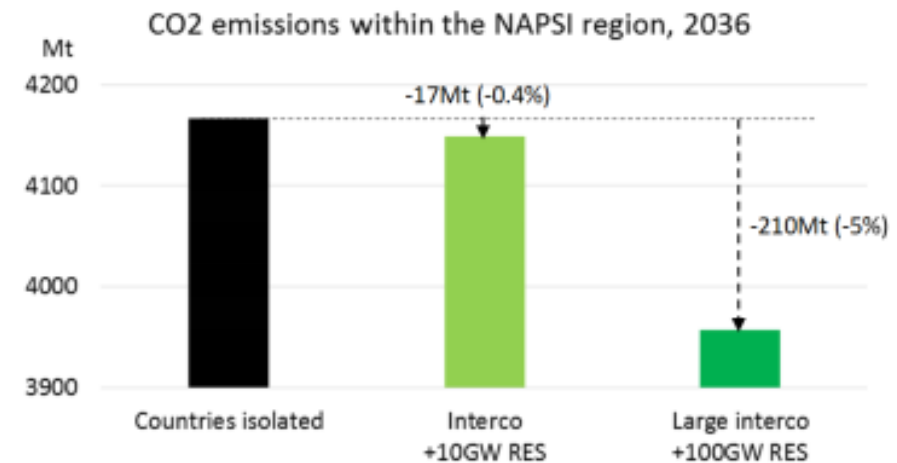


Economic Analysis

Interconnections are cost effective

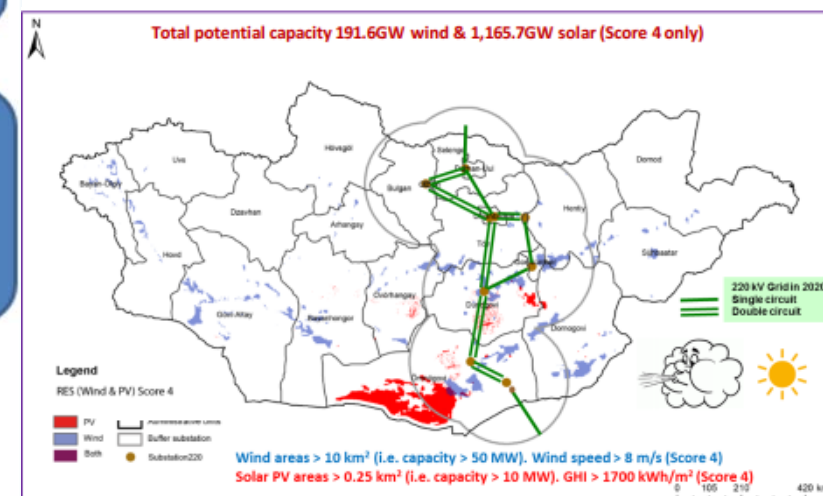
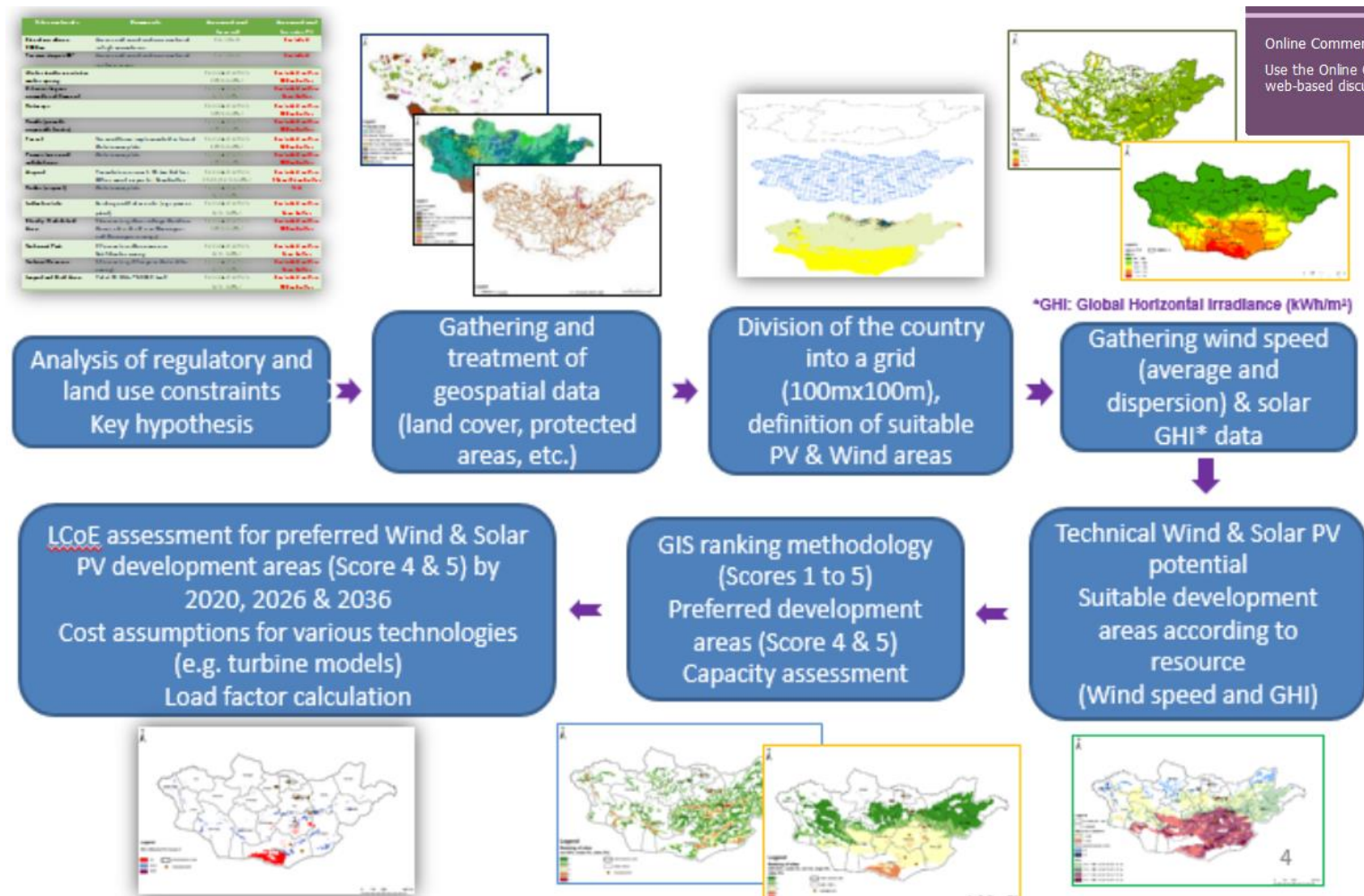


CO₂ emission reductions by reduced gas (3/4) and coal (1/4) combustion



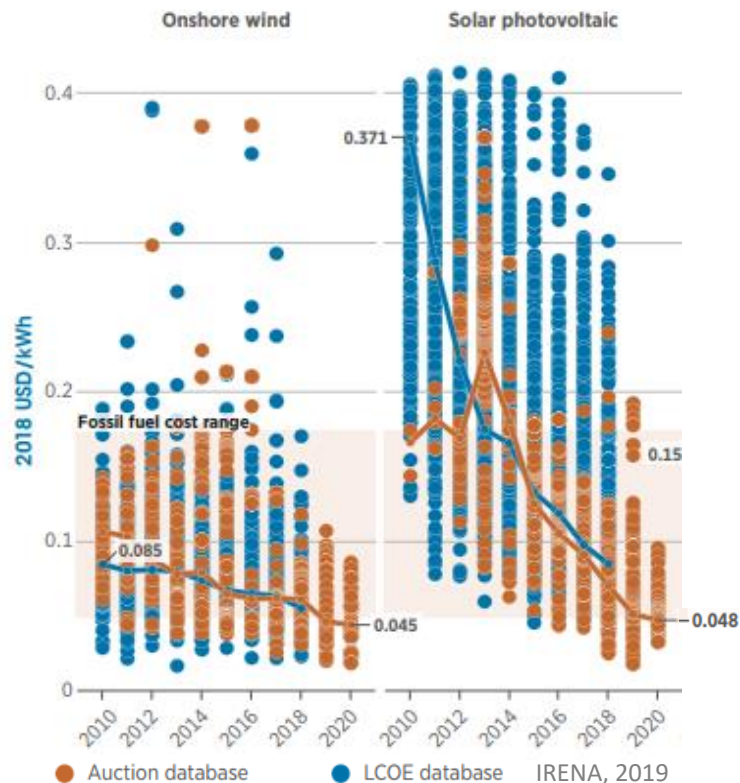
RE Resource Analysis

- **200 GW** of wind power
- **1200 GW** of solar PV power
- Key locations in the direction of exports to China
- Enables a major economic stimulus



Solar and Wind in Mongolia

Mongolia can potentially produce the lowest cost kWh in the region



PV factors	2020	2026	2036
Mongolia	18%	20%	23%
China East	16%	18%	21%
Japan	15%	17%	19%
Republic of Korea	16%	18%	21%



Wind factors	2020	2026	2036
Mongolia	42%	44%	48%
China East	23%	26%	33%
Japan	26%	27%	30%
Republic of Korea	21%	22%	30%



Interconnection Development



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- NEA ring
- Case RES Gobi 10 GW, 2036

Investments by scenario, USD billion

Export from Mongolia to NEA	Gobi Solar & Wind Investments	Grid Investments in NEA	Total
5 GW	5.5	6.5	12
10 GW	10	8	18
100 GW	85	63	148

Strong High Level Support



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- Presidents of China, Russia, Republic of Korea and Mongolia have all urged for the development of Northeast Asia Super Grid and energy cooperation.
- President of Mongolia, Khaltmaagiin Battulga has encouraged the establishment of *"an organisation with appropriate involvement of six countries that share responsibilities to successfully implement the 'North East Asian Super Grid' project."*



Barriers & Issues (1)



- Unbalanced cost burden between the contracting countries.
 - Costs of domestic transmission lines, which de facto serve cross-border interconnections
 - Cost of balancing capacity for variable RE in another country
- Overall low generation cost levels of China. Cross-border margins are there but they are thin. Oversupply + RE in North China.
- Lack of mechanism for transboundary hour-ahead trading.
- Differences in electricity sector regulation (e.g. third party access, electricity wholesale tariff structure).
- Energy independence aspirations, low valuation of CO₂ benefits, investment restrictions and changing political sentiments between the countries with associated long-term uncertainties.

Barriers and Issues (2)



- China, Japan, Korea and Russia are large countries and economies, and their organisational, institutional and regulatory systems are different. NAPSİ alone does not drive their regulatory developments.
- In countries such as China, Russia and Japan, the cross-border connections and power trade would have most impact to the regional utility companies and their supply-demand balance, rather than to the national level.
- Even if marginal cost differences exist, harnessing all of those in day-to-day cross-border trading under NAPSİ condition and under the national/regional power dispatch regimes, is not a realistic assumption.

Good Bilateral Relations

Case: Mongolia-Russia



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Agreement on economic and near-border cooperation of 1999

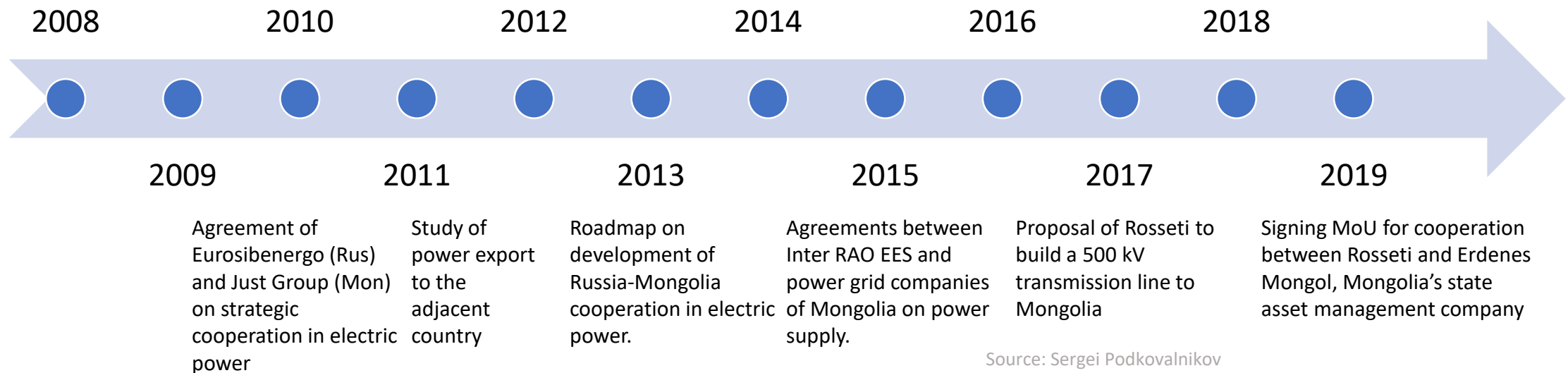
Russia – Mongolia electricity trading on-going ----->

Russia-Mongolia Intergovernmental Commission on Trade, Economic, Scientific and Technical Cooperation

Agreement between Russian and Mongolian System Operators on operations, dispatch and technical data exchange.

Study of Russia-Mongolia power trading expansion and export to the adjacent country.

1st meeting of the Russian-Mongolian working group on energy cooperation



Source: Sergei Podkovalnikov

Current Status with NAPSII



- There is a web of bilateral agreements aiming at increasing energy cooperation in the NEA power sector.
- Bilateral trade agreements promote transparency and trust which are necessary preconditions for increased power system integration.
- Numerous studies, including this comprehensive NAPSII Strategy analysis as the latest, have confirmed the economic rationale of NAPSII.
- The region is not comparable to the EU or other economic cooperation regions with politically agreed goals for harmonisation.
- A gradual process towards a multilateral framework is necessary for the implementation of NAPSII.

Future Direction



- Establishment of an integrated system will be a gradual process.
- Developing and deepening electricity cooperation can and must be built on the basis of bilateral agreements, each of which should be feasible and stand on its own merits, but be coordinated to align with the broader NAPSI strategy.
- A permanent and effective institutional coordination mechanism (NAPSI Authority) is needed. Ministries of Energy (or equivalents) should take the leading role in implementing such mechanism.

Three Priority Areas



Establishing Interim Secretariat

- Coordination, planning, administration
- To guide the process for NAPSI forward
- Practical, lean, interim
- Implemented by Member States, ADB and UN ESCAP



Advancing Investments

- Identifying priorities
- South Gobi Renewable Energy Base
- Institutional and Regulatory prerequisites of Gobi RE base for export
- Commercial agreements
- Gobi – Baotou (China)
- Oyutolgoi – Hohhot (China)
- Weihai (China) – Sinsiheung (South Korea)



Preparing for a Permanent Multilateral Coordination Framework

- Process towards a permanent NAPSI Authority
- Governments mobilised
- Feasibility study of a corporatised NAPSI Authority as a Joint Venture of the Member States

Interim Secretariat



- The Interim Secretariat would be established technically as ADB/UN ESCAP TA Project(s) and be supervised and guided by a Board (Steering Committee/Council of Delegates/Executive Committee) with representatives from sector ministries, regulators and utilities.
- Responsibility for collecting a registry of all bilateral and multilateral agreements, letters of intent and memoranda of understanding pertaining to NEA region power system interconnections and cross-border electricity trading.

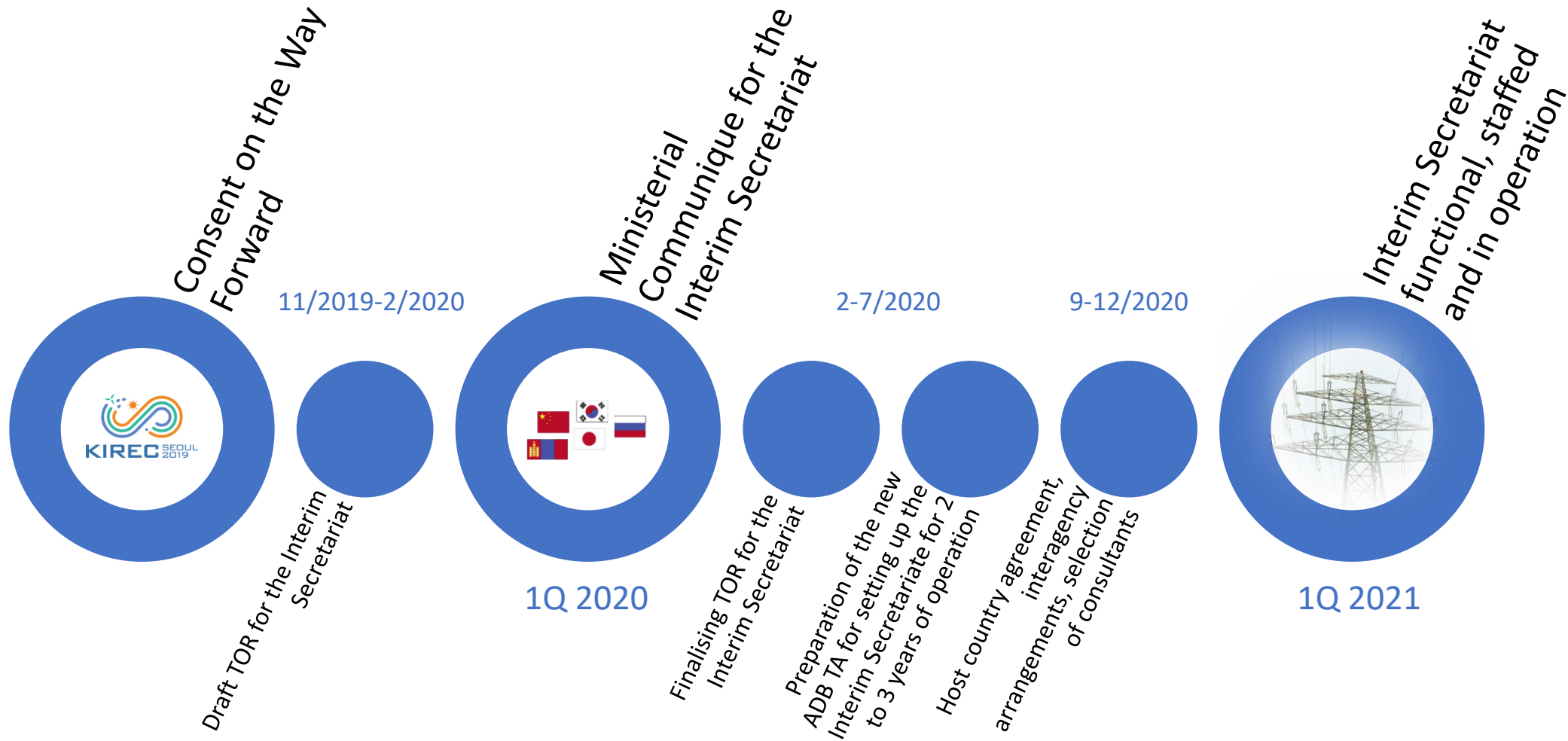
The secretariat would act as:

- a body drafting proposals and updates for the strategic priorities for NAPSI development and preparing the draft work programme and budget for the Board approval;
- a focal point mobilising studies and providing information about the state and trends of HV interconnections, regulation and institutional development of cross border interconnected power systems;
- a facilitator and organiser of international cooperation to mobilise knowledge and expert resources for the promotion of NAPSI;
- an initiator of negotiations to promote investments in cross border transmission lines and generation facilities and to help conclude associated agreements for trading with electricity and grid services;
- a coordinating body, ascertaining that multilateral interest is considered also in the bilateral interconnection plans;
- a supervisory body dedicated to ensuring that the agreed actions and intentions of bilateral MoUs for studies and investments on interconnections are fully implemented by all relevant parties in NEA region;
- a body for developing, according to the specific needs of the NAPSI strategy, recommendations of its own and recommendations supplementary to measures imposed by member countries and international organisations.

Next Steps - Schedule



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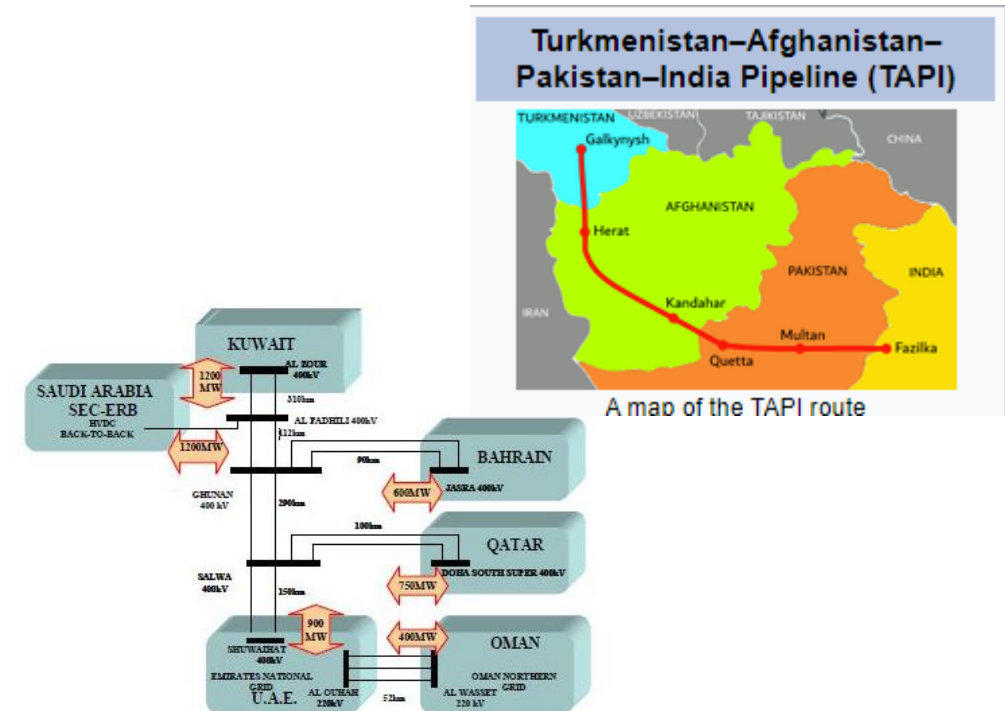
NAPSI Authority as a Joint-Stock Company of Members?



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- Different NAPSI member states have varying roles and capacities, which vary over time as the NAPSI scheme evolves:
 - Renewable energy generation
 - Off-take
 - Transmission and grid services
 - Manufacturing, construction and EPC capacities
 - Investments and financing
- Imbalances in the distribution of costs and benefits between countries can be evened out among the member states if all investments and operations (develop, invest, build, own, operate) are carried out by a joint stock company, in which all of the NAPSI framework parties are shareholders.
- A JV may have subsidiaries for selected “projects” in which the shareholding structure might somewhat vary.
- A corporate structure would increase agility and dynamism in the NAPSI scheme, enable private sector participation and make it more easily financeable.



Advancing Investments RE – Mongolia – China - Korea



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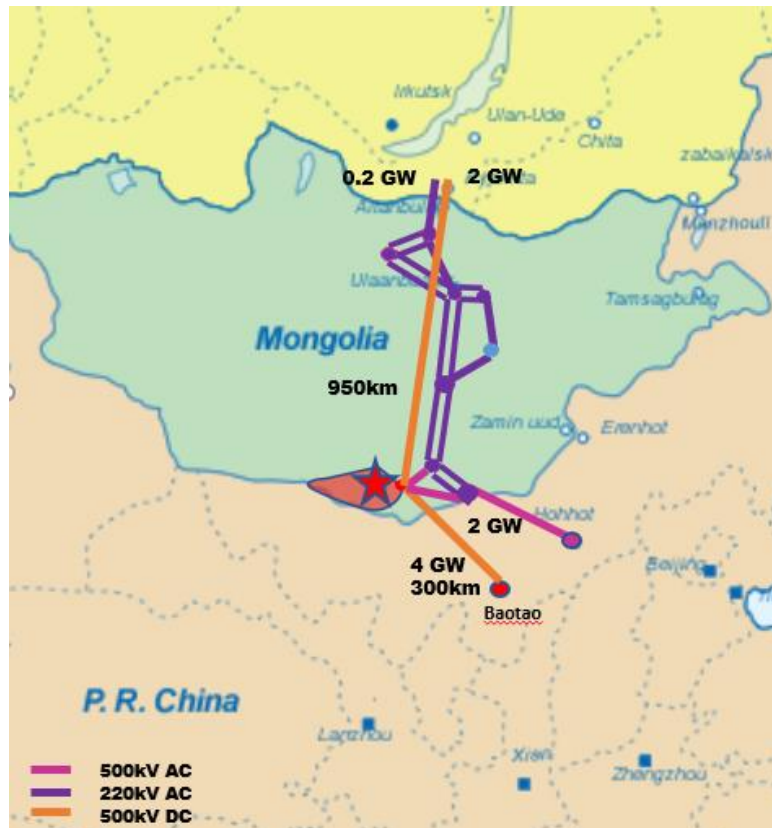
Advancing Investments Mongolia – Russia (a) and (b)



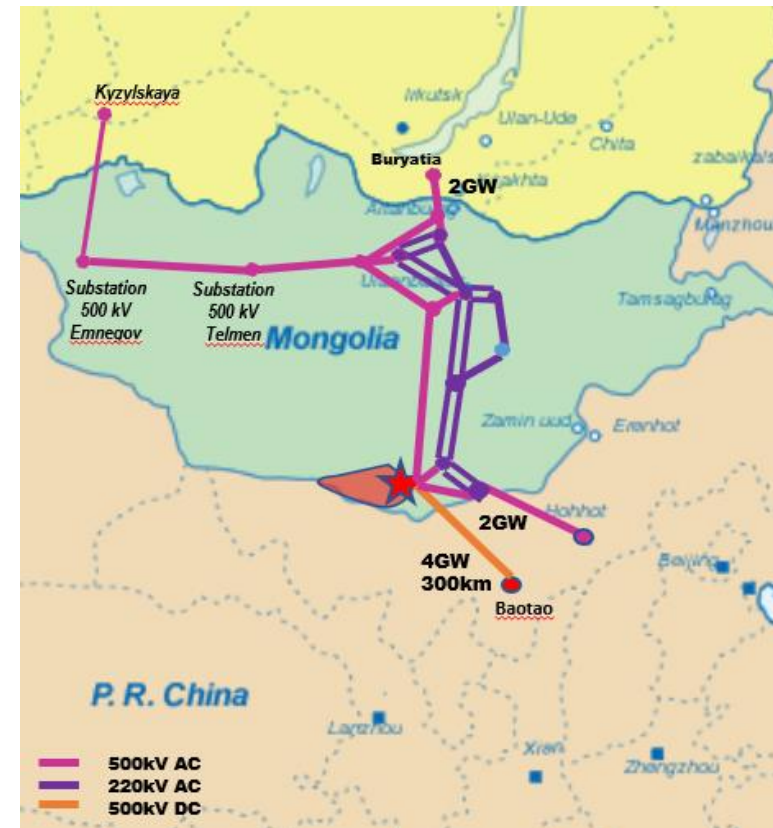
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Integrated DC



Integrated AC



Conclusions



- **Benefits of NAPS**

- Cost savings, increased flexibility and possibility to avoid power plant investments
- Increased capacity for system services and managing RE intermittency
- Reduction of CO₂ and particle emissions
- Economic benefits exceeding the cost of the interconnection infrastructure

- **Renewable Energy Development**

- RE energy produced in Mongolia's South Gobi has the prerequisites of being the lowest cost production in the region.
- Russia has vast untapped hydropower potential in Far East.
- Investments in RE production can drive industries and job creation and provide an economic stimulus.

- **Way Forward**

- The technical set up (transmission line interconnections) can be developed through a step by step approach.
- Bilateral cooperation and various studies have now led to the point where an institutionalized NAPS coordination mechanism must be established as a multilateral government-led activity.
- An Interim Secretariat is proposed as Technical Assistance programme for three years by ADB and UN-ESCAP.
- Focus should be set to prioritize NAPS investments and proceed to investment development in a coordinated manner.
- Member countries should explore and study the feasibility of a NAPS Authority as a corporatized Joint Venture of the members.



Thank you!
