



国家电网  
STATE GRID

中国电力科学研究院  
CHINA ELECTRIC POWER RESEARCH INSTITUTE



**NEA SYMPOSIUM MARCH 8TH, 2018 IN LINO HALL TOKYO**  
**STRATEGY FOR NORTHEAST ASIA POWER SYSTEM INTERCONNECTION**  
**EDF TECHNICAL ASSISTANCE TO MONGOLIA**  
**ADB PROJECT**  
**MID-TERM INFORMATION ON THE PROJECT**

**PHILIPPE LIENHART EDF**

- EDF Group presentation with contributions and adaptations to EU PSI
- Strategy for NAPS I / Technical Assistance for Mongolia: objectives and organization
- Workshops and Steering Committees
- Assumptions for the studies
- Recommendations
- Generation Studies
- Market studies
- Conclusion



**EDF**

# EDF Group: a Responsible Industrial Firm with corporate social responsibility goals

## 1 Low carbon policy

Go beyond the requirements of the 2 °C trajectory set by COP21 by drastically reducing our CO<sub>2</sub> emissions.

17g/kWh in France

## 2 Respect for people

Integrate best practice in the way we develop our people: health and safety, gender diversity and internal development.

## 3 Responsibility

Offer all vulnerable people information about and support with energy use and energy benefits.

## 4 Innovation

Innovate through digital energy efficiency solutions to enable all customers to use energy better.

## 5 Concertation

Systematically organise a process of transparent and open dialogue and consultation for every new project around the world.

## 6 Environment

Launch a positive approach to biodiversity, not limited to understanding and reducing the impacts of our activities in the long run but having a positive effect on biodiversity.

**36.7 million**  
customers worldwide

**160 000**  
employees

**€71 billion**  
sales

**584TWh**  
electricity generation



## A long story of EDF contributions and adaptations

### PHASE 1: 1956-2000 Common System Operation

**Integration Goals:**

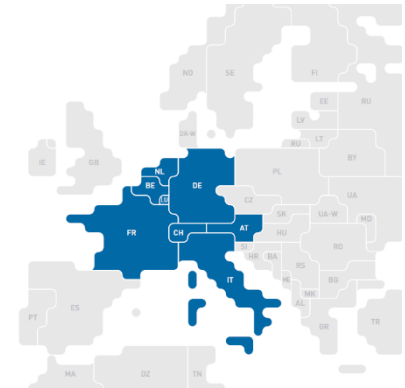
- Exchanges of electricity
- Grid Safety improvement
- Cost Optimization

**Harmonized Rules:**

- UCTE
- NORDEL
- ETSOE

**EDF adaptation**

- Many Cross border OHL
- Submarine HVDC interco with UK: IFA



### PHASE 2: Since 2000, EU Electricity Market

**TPA introduced deep changes:**

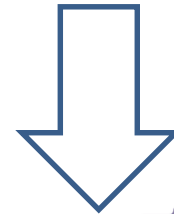
- Unbundling: 42 TSOs
- Private interconnections allowed
- Interconnections vs price zones

**EU GRID CODES:**

- ACER
- ENTSOE
- CORESO

**EDF adaptation:**

- Development of RES: EDF EN
- Reduction of coal-fired fleet
- Few new OCGTs & CCGTs



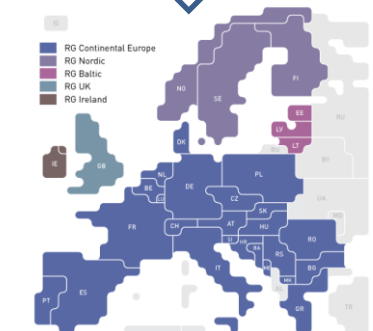
### Phase 3: EU Energy Policy, 20% of RES in 2020

**Interconnections are Key Assets**

- Intermittency Management
- More Flexibility
- No RES Curtailment

**EDF adaptation:**

- Interconnections more difficult to built in OHL: underground HVDC interconnector with Spain INELFE

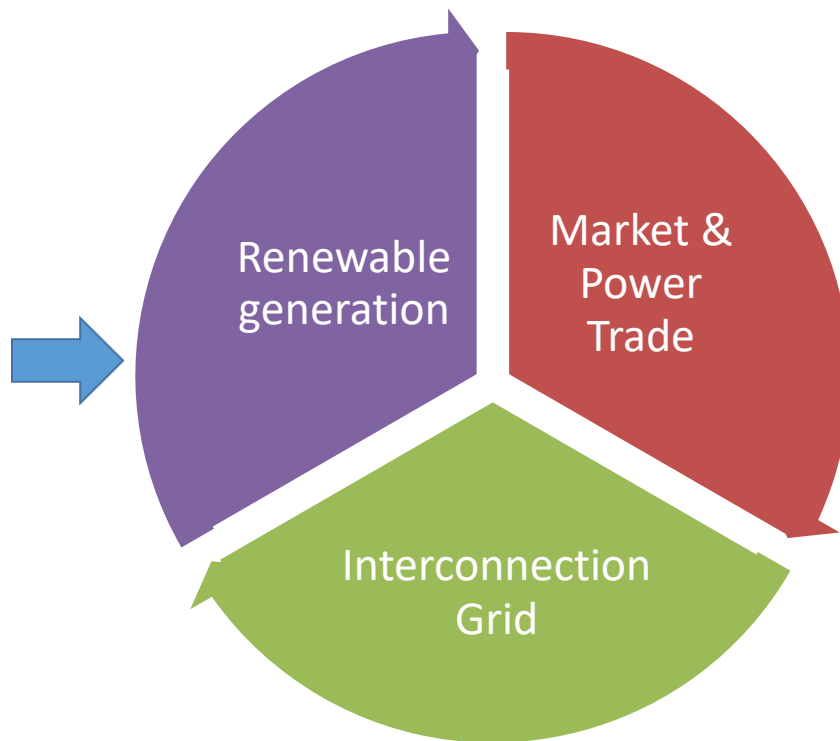


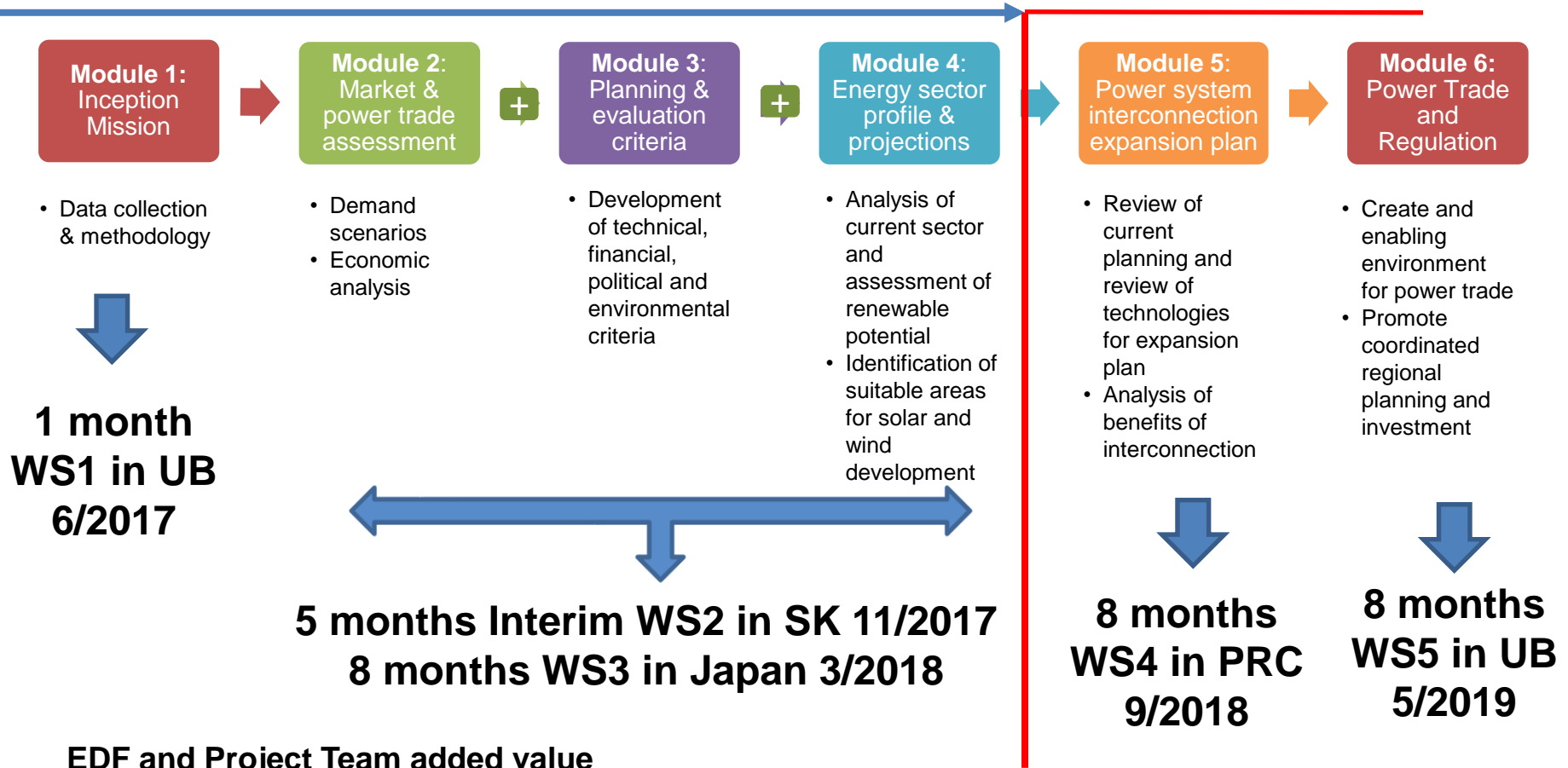
The contract consists of a support to Mongolia State (EA) for entering the NAPSI discussions with a consensual project based on the huge Renewable Energy Potential.

EDF's recognized experience in Power System Integration in a region representing 25% of the world GDP

EDF with:  
Nova Terra in Mongolia  
China EPRI

### 3 MASTER PLANS over 20 years





## EDF and Project Team added value

- **Updating work** with the latest data: a vision that integrates former studies
- **Coherent vision** of the five independent power systems
- **Innovation** with dedicated **RE potential analysis tool**
- **Innovation** with System **models that integrate intermittency**
- **Innovation with experience** EDF adaptation to the **European free electrical market**
- Demand and supply **coherent scenarios** suitable for the regional power systems

	GDP (in billion dollars) Figures in parentheses are GDP per capita (in thousand dollars)	Population (in million people)	Electricity generated (in TWh)	CO <sub>2</sub> emissions (in million tons CO <sub>2</sub> )
<b>China</b>	8,909 (6.5)	1,376	5,811	9,154
<b>Japan</b>	5,986 (47.2)	127	1,036	1,208
<b>South Korea</b>	1,267 (25.0)	50	522	649
<b>Mongolia</b>	12 (3.9)	3	5	18
<b>Russia</b>	1,616 (11.0)	143	1,063	1,483
<b>Northeast Asia</b>	17,790 (~10.5)	1,699	8,437	12,512
<b>World</b>	74,889 (10.2)	7,349	24,098	33,508
<b>Share of Northeast Asia</b>	20-25%	20-25%	30-35%	~37%
Source	World Bank *Constant 2010	United Nations	BP; For Mongolia, figure from IEA in 2014	BP; For Mongolia, figure from IEA in 2014

Source: Created by Renewable Energy Institute based on data released by national governments and international organizations.

## NAPSI

- **25% of Global GDP**
- **22% of Global population**
- **40% of Global CO<sub>2</sub> Emission**

## Mongolia

- **Central Key Position**
- **Huge Potential in Wind and Solar RES**
- **Main Stake: Private investor attractivity**

## Review of 4 key drivers for Mongolia, Russia, Japan, ROK and PRC

### Technical analysis

- **Generation**  
Cost of technologies  
Criteria for Generation planning,
- **Transmission,**  
Comparison HVAC vs HVDC  
Cost of Transmission Technologies  
Safety Systems Rules  
Overview of the organizational needs  
The NAPS Authority  
Overview of the HVDC Grid Code Needs  
Transmission: Existing and Expansion Plan

### Economic and Financial analysis

- Economies of Different Markets
- Electricity Consumptions

### Political and Regulatory analysis

- Demographics
- Geopolitical environment
- Foreign investment
- Regulation of Power Sector

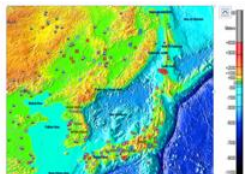
### Socio-Environmental analysis

- CO2 emissions
- Energy Mix
- Focus on Coal
- Export Driven RES capacity
- Interviews of 7 Mongolian Representatives

Assumptions for the landing points of interconnection



Not included Japan-Russia so far



Depth of the sea should not exceed 500m

UHV power grid development plan by SGCC:  
2 asynchronous power systems will be developed in the East and West. Assumption: 2030.



ROSSETI proposed an AC interconnection Mongolia Russia at a cost of 1bn USD. 1990 km. With a crossing West-East AC line enabling the unification of the Mongolian sub-systems.





## Principles:

- Different **synchronous electricity systems** in the Northeast Asian region have different characteristics, which need to be taken into account when setting the requirements for HVDC systems.
- **System security** depends partly on the technical capabilities of HVDC systems

## Harmonized rules for grid connection for HVDC systems should be set out :

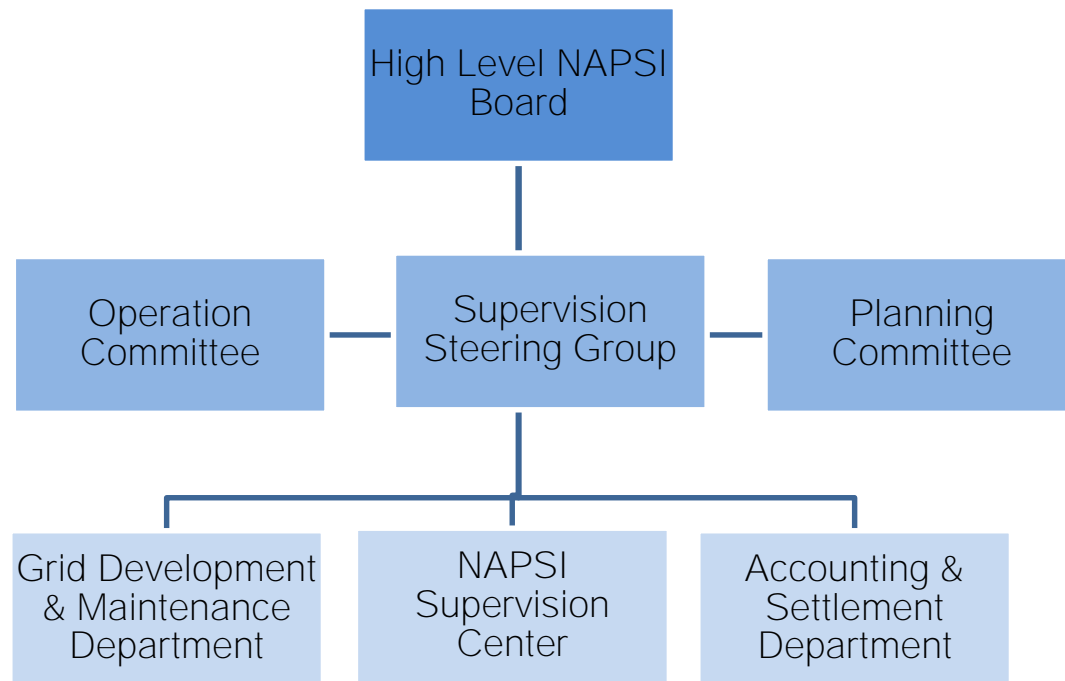
- To provide a **clear legal framework** for grid connections, facilitating Northeast Asian Region wide trade in electricity,
- To ensure **system security**,
- To facilitate **the integration of renewable** electricity sources,
- To develop **competition**, and
- To allow more efficient use of the network and resources, **for the benefit of consumers**.



**Co-operation** between Countries,  
**Mutual assistance** between Authorities, and  
**Fair competition** between Players

**Main Functions:**

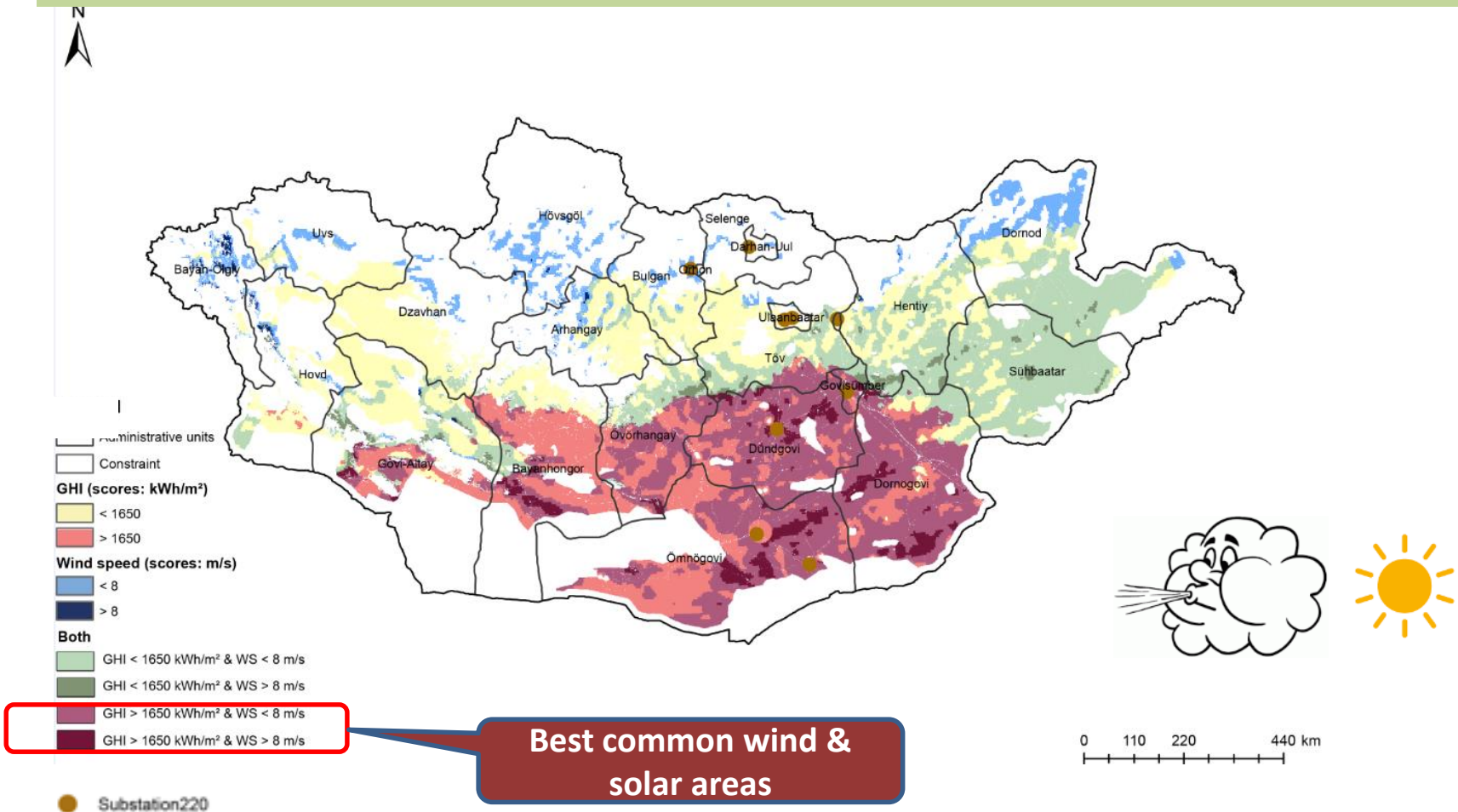
- To enable NAPSI implementation including **financing the interconnection assets** through capital injection from the relevant Authorities/Entities;
- To manage **the NAPSI-Supervision Center** including supervision of real-time power transfers, performing adequate technical studies and coordinating bilateral energy transactions;
- To provide a **transparent and efficient** decision process;
- To be **the owner** of the NAPSI assets;
- To organize **the operation and maintenance** of the equipment;
- To ensure **fair transaction** between players scattered all over the five interconnected Northeast Asian Countries.



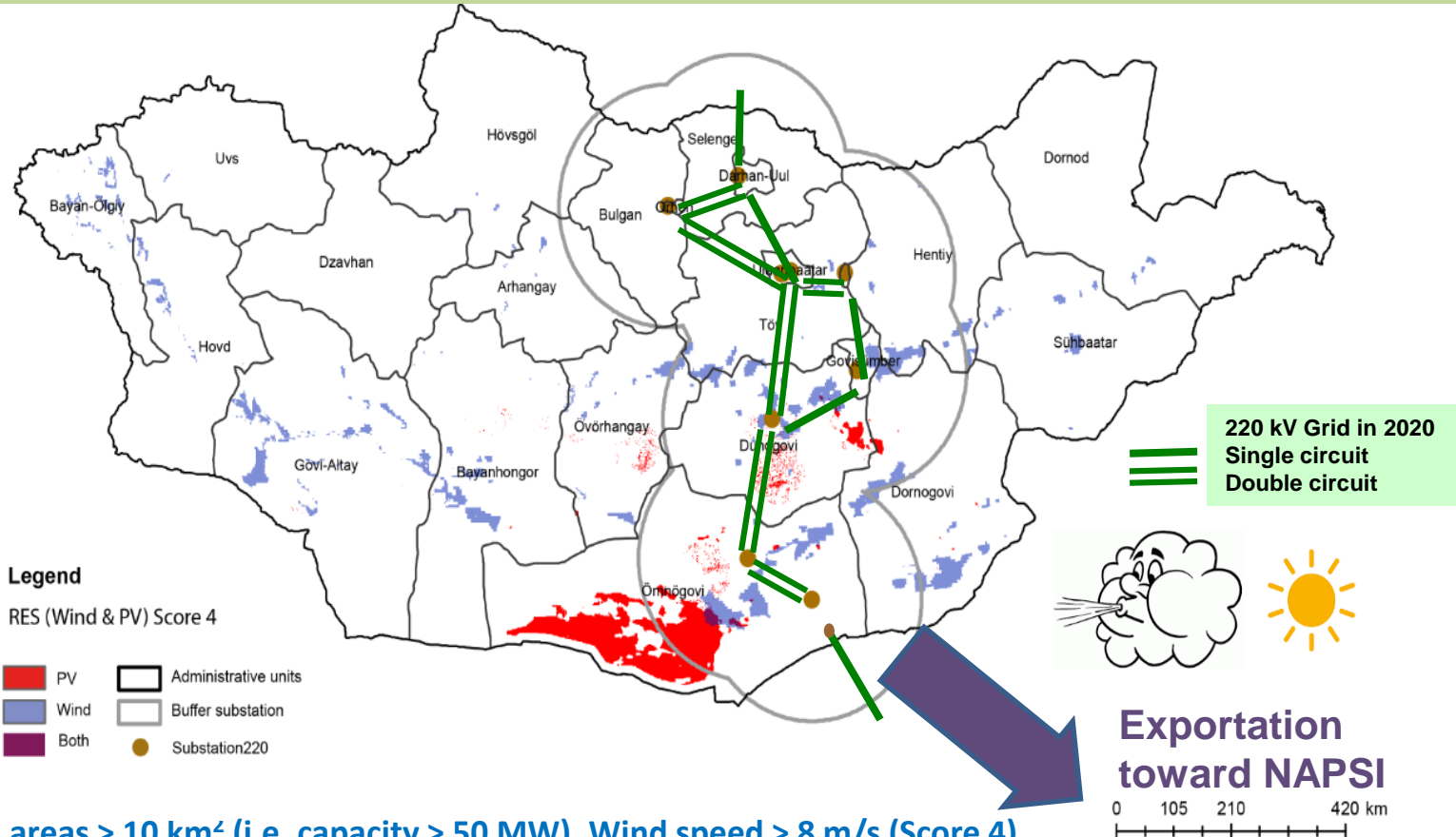
## **A specific Regulation framework will be necessary to favour private RES Investments**

- Stable Revenues
- Priority dispatch / curtailment
- Legal maturity
- Financing facilities
- Visibility on the renewable targets
- Pre-permitted sites,
- Grid connection

Specific GIS model with last updated data and most recent technologies  
Including grid and ranking methodology



Best score areas are close to exportation representing 200 GW Wind – 1200GW Solar PV  
 In the short term (2020), limited to grid capacity around 350MW-550MW

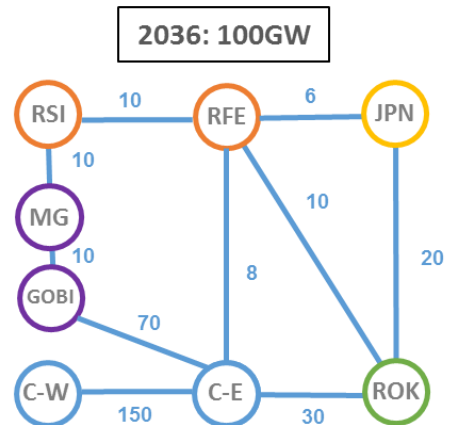
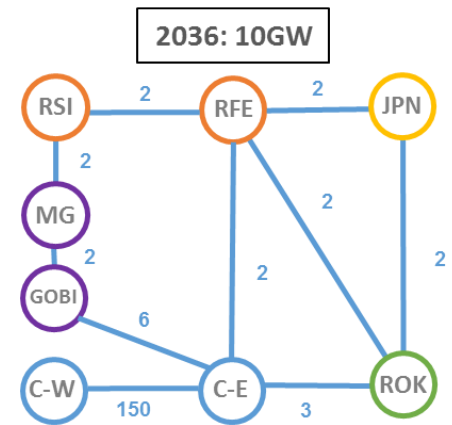
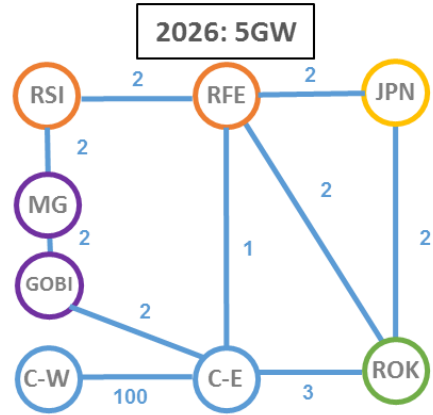
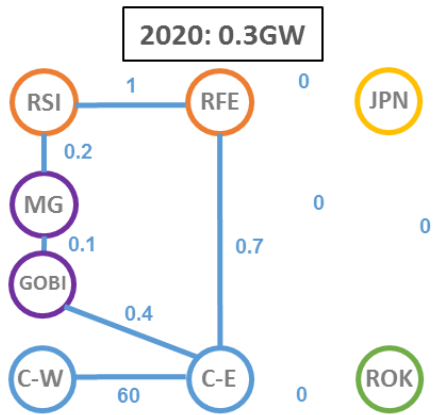


Wind areas > 10 km<sup>2</sup> (i.e. capacity > 50 MW). Wind speed > 8 m/s (Score 4)

Solar PV areas > 0.25 km<sup>2</sup> (i.e. capacity > 10 MW). GHI > 1700 kWh/m<sup>2</sup> (Score 4)

**A new strong national and exportation grid will be necessary**

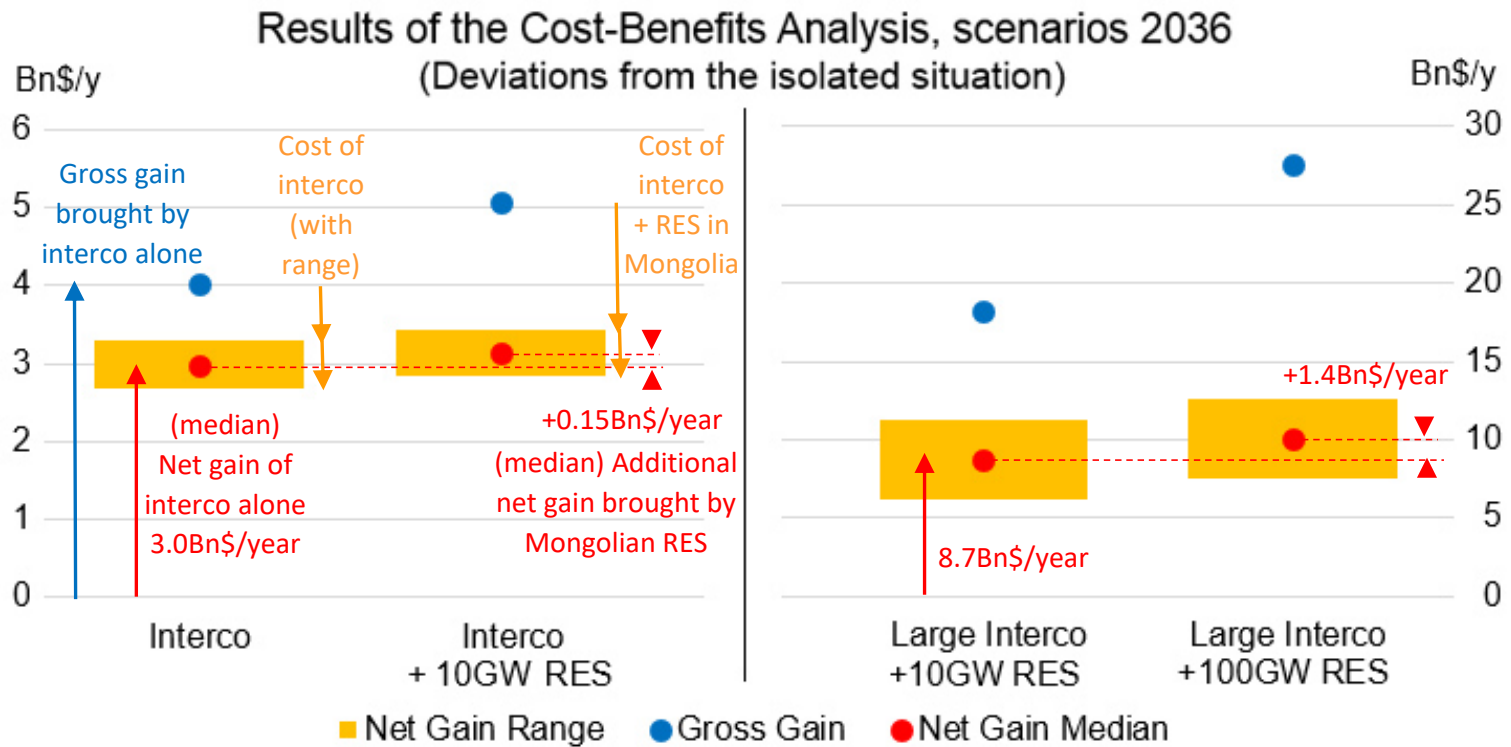
# Market Assessment: Scenarios



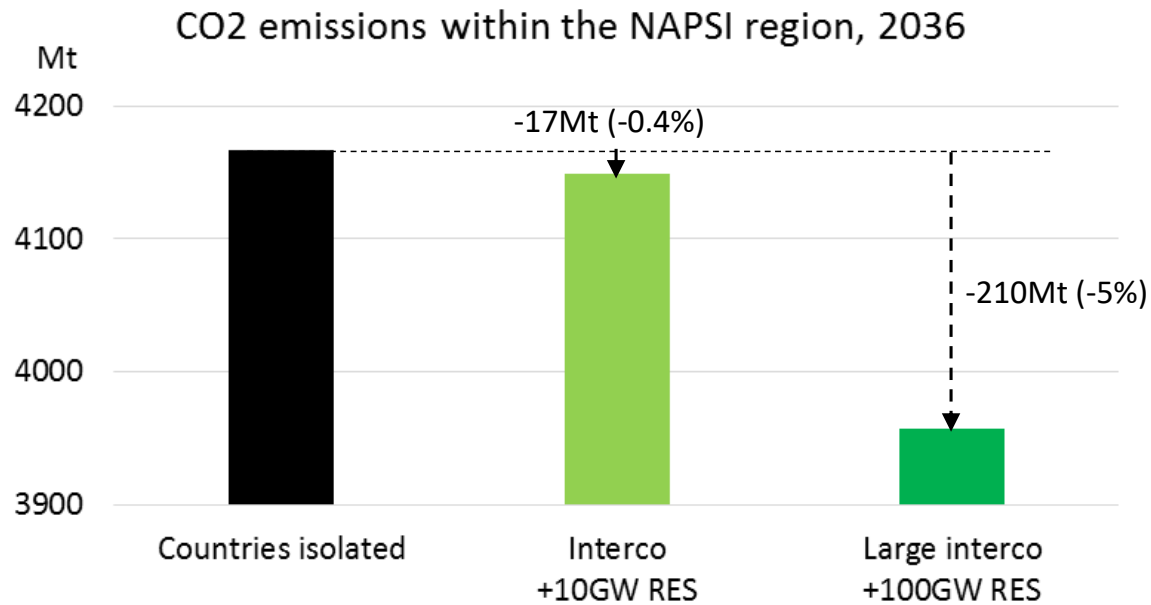
**XXXX: YGW** Renewable capacity Y connected at the GOBI node in the year XXXX

**A — Z — B** Transmission capacity Z (in GW) between countries/areas A and B

- MG Mongolia-Ulaanbaatar
- GOBI Mongolia-GOBI
- C-W China-West
- C-E China-East
- RFE Russia-FarEast
- RSI Russia-Siberia
- ROK Republic of Korea
- JPN Japan



- Gross gain : collective benefits, including the savings in terms of investment expenses and operation expenses, but excluding the investments linked to interconnection infrastructures and renewables in Mongolia
- Net gain : final collective profits including all expenses and revenues
- Consideration of a range around net gain to take into account uncertainties (particularly on interconnection infrastructure costs)



Impact of interconnection and RES in Mongolia on the CO2 emissions within the NAPSI region in the 2036 scenarios

Combined effect of interconnection and RES in Mongolia: significant CO2 emissions savings thanks to the substitution of coal and gas by renewables



## Generation in Mongolia

- Mongolia Wind and Solar Potential is confirmed:
  - . Short term limited by 2020 grid to 350 - 550MW
  - . Provided a new strong national and exportation grid , 5GW in 2026, 10 GW in 2036 and even 100GW are feasible

## NAPSI Market

- Interconnection is beneficial for exchange of electricity
- Wind and Solar RES Development in Mongolia is the most competitive
- NAPSI will reduce CO2 emissions

## Recommendations

- Mongolia: a specific Regulation framework will be necessary to favour private RES Investments
- NAPSI Grid code for rules harmonization
- NAPSI Authority for supervision, feedback analysis and decision making