CIGRE C1 ITALIA

Power system development and economics

Agenda

14:30 – 15:00	Saluti di benvenuto	*Ch. Vergine*
15:00 – 15:45	Cigre 2023: aggiornamenti Cigre internazionale, attività C1 e meeting in Cairns	*A. Iliceto*
15:45 – 16:15	Partecipazione Italiana WG e JWG – Parte 1	*all*
16:15 – 16:30	Coffee break	
16:30 – 17:00	Partecipazione Italiana WG e JWG – Parte 2	*all*
17:00 – 17:30	Articoli per Showcase NGN e Generale Session	*M. Forteleoni*
17:30 – 17:40	Conclusioni e saluti	*B. Cova*

Saluti di benvenuto

Chiara Vergine - Presidente CIGRE C1 ITALIA

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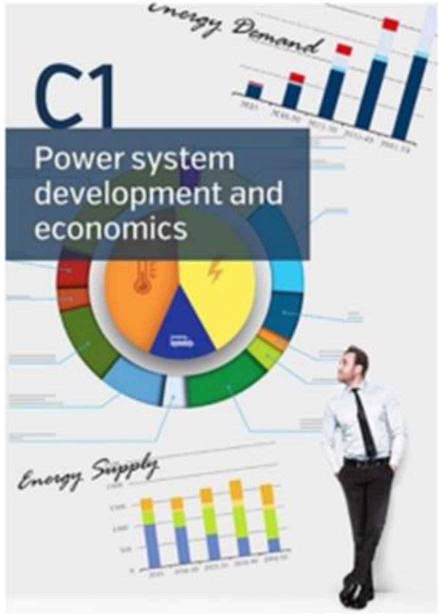

Chiara Vergine -
Terna (regular 2022)

chiara.vergine@terna.it

Segretario : Carmelo Mosca *(TERNA)*

carmelo.mosca@terna.it

Key contacts

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Antonio ILICETO
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Webmaster
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Mission

To support energy system planners, asset managers and decision makers worldwide in anticipating and successfully managing the **system changes raised by Energy Transition**. To address emerging needs, seize opportunities and tackle growing uncertainties, while respecting multiple constraints: **security of operations, adequacy, resilience, affordability** and **sustainability**.

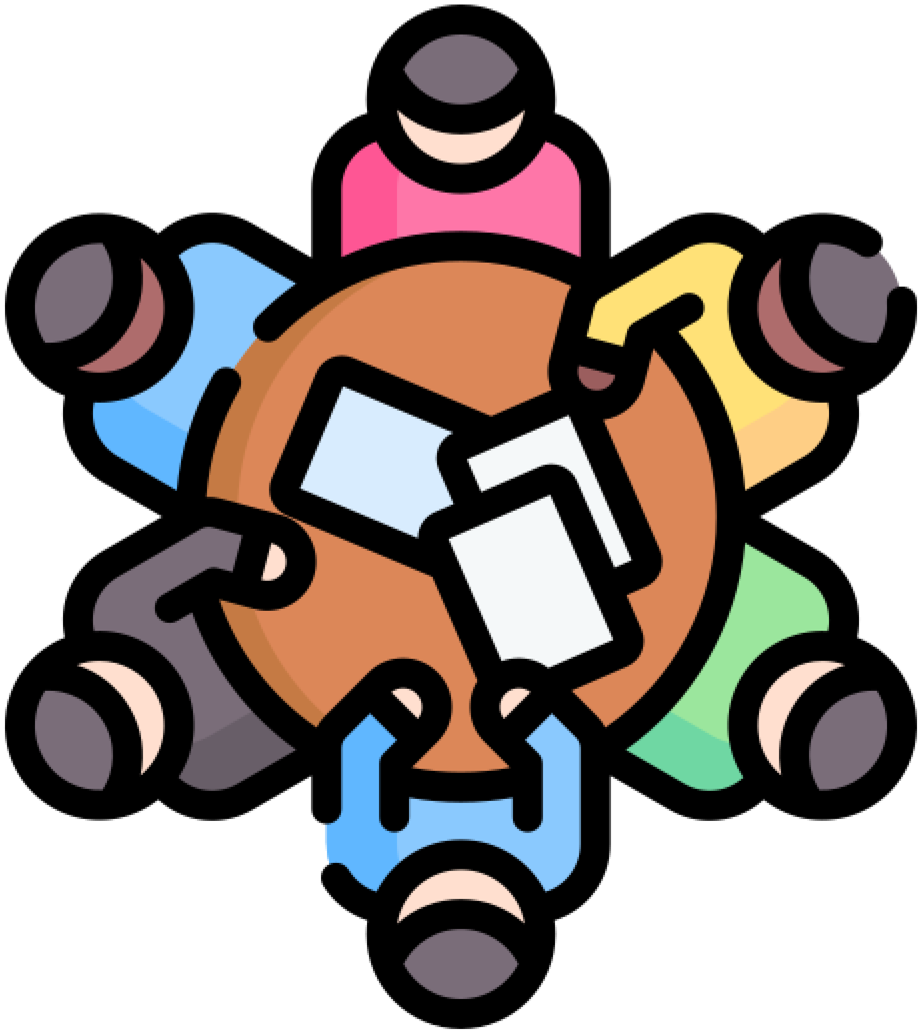
To facilitate and promote the progress of engineering and planning methods, to share state-of-the-art, best practices and recommendations.

Scope

To elaborate scenarios and investment economics, identify mega trends and game changers, develop approaches for energy sectors integration and hydrogen economy deployment. To improve planning criteria and methodologies, in particular analysis of projects' costs, benefits & risks, to modernize asset management strategies. To introduce in system development processes all flexibility means, all forms of storage (short and long term) and the new active role of end users / demand management; to leverage on Digitalization, on results of innovation in technology and in processes, to strengthen stakeholders' involvement for the realisation of the planned infrastructures, to support evolution of environmental and regulatory frameworks.

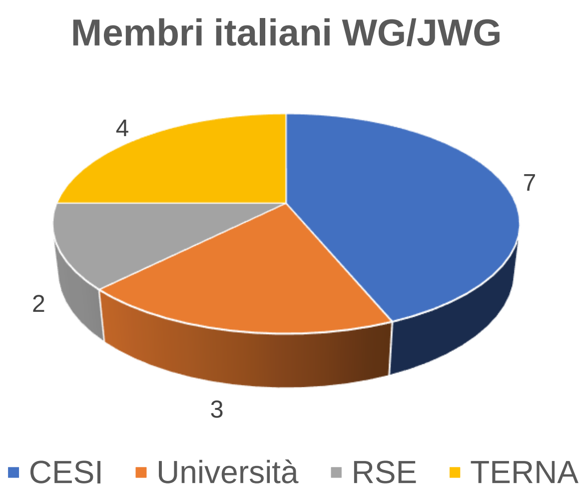
Areas of attention include

System planning, Asset management, Business management, Interconnections – horizontal, vertical

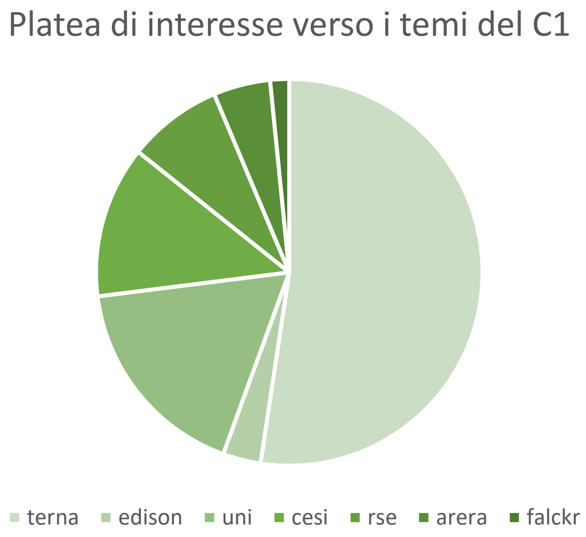


Membri italiani dei WG - Numeri

- Partecipazione a **14 Working Groups** (di cui 4 JWG)
  - 3 JWG/WG per System Planning
  - 3 JWG/WG per Business Management
  - 2 JWG/WG per Asset Management
  - 3 WG per Interconnection
  - 3 New Working Groups
- **16 membri italiani** impegnati nei Working Groups
- **2 convenorship italiane** (WG C1.33 e WG C1.45)



- Circa 60 "**simpatizzanti**" ai temi del comitato C1



Membri italiani dei WG - Partecipanti

System Planning		
JWG C1/C4.36 (V. Jesus/S. Utts) *[Syst. Plan]*	contributor: Bruno Cova (CESI)	
JWG C1/C6.42 (Rama Ganguli) [Syst. Plan]		
WG C1.47 (N. Zhang) *[Syst. Plan]*	Fabio Riva (CESI)	
Business Management		
WG C1.23 (R. Marais) [Bus. Mgmt]		
JWG C1/C6/Cired.37 (J. Araneda) *[Bus. Mgmt]*	Fabrizio Pilo (UNI CA), Federco Silvestro (UNI GE)	membri CIRED
WG C1.48 (A. Oudalov) *[Bus. Mgmt]*	Marco Cabano (1a parte)	
Asset Management		
JWG C1/C4.46 (C. Schaefer) *[Asset Mgmt]*	F. Marzullo (Terna), Emanuele Ciapessoni (RSE)	
WG B2/C1.86 (Y. Tsimberg) [Asset Mgmt]	Alessandro Valsecchi (CESI)	
Interconnection		
WG C1.33 (A. Iliceto) *[Interconnect.]*	Antonio Iliceto (Terna)	***Convenorship italiana***
WG C1.44 (G. Sanchis) *[Interconnect.]*	Angelo L'Abbate (RSE), Antonio Iliceto (Terna)	
WG C1.45 (P. Vicini) *[Interconnect.]*	Pierluigi Vicini (CESI); Fabio D'Agostino (UNI GE)	***Convenorship italiana***

New Working Gropus	**Italian Membership**
WG C1.50 (Nicolas Chamollet)	Luciano Masotti (CESI)
WG C1.49 (Cornelis Plett)	Davide Negri (CESI), Michela Migliori (Terna)

CIGRE 2023 Cairns

Antonio Iliceto - Presidente CIGRE C1

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Partecipazione Italiana a WG e JWG – Parte 1

Membri italiani dei WG/JWG

WG C1.47

Energy Sectors Integration and Impact on Power Grids

Convener: Ning Zhang, China
Secretary: Kangping Li, China

➢ Terms of Reference of C1.47

■ The mission of this WG is to

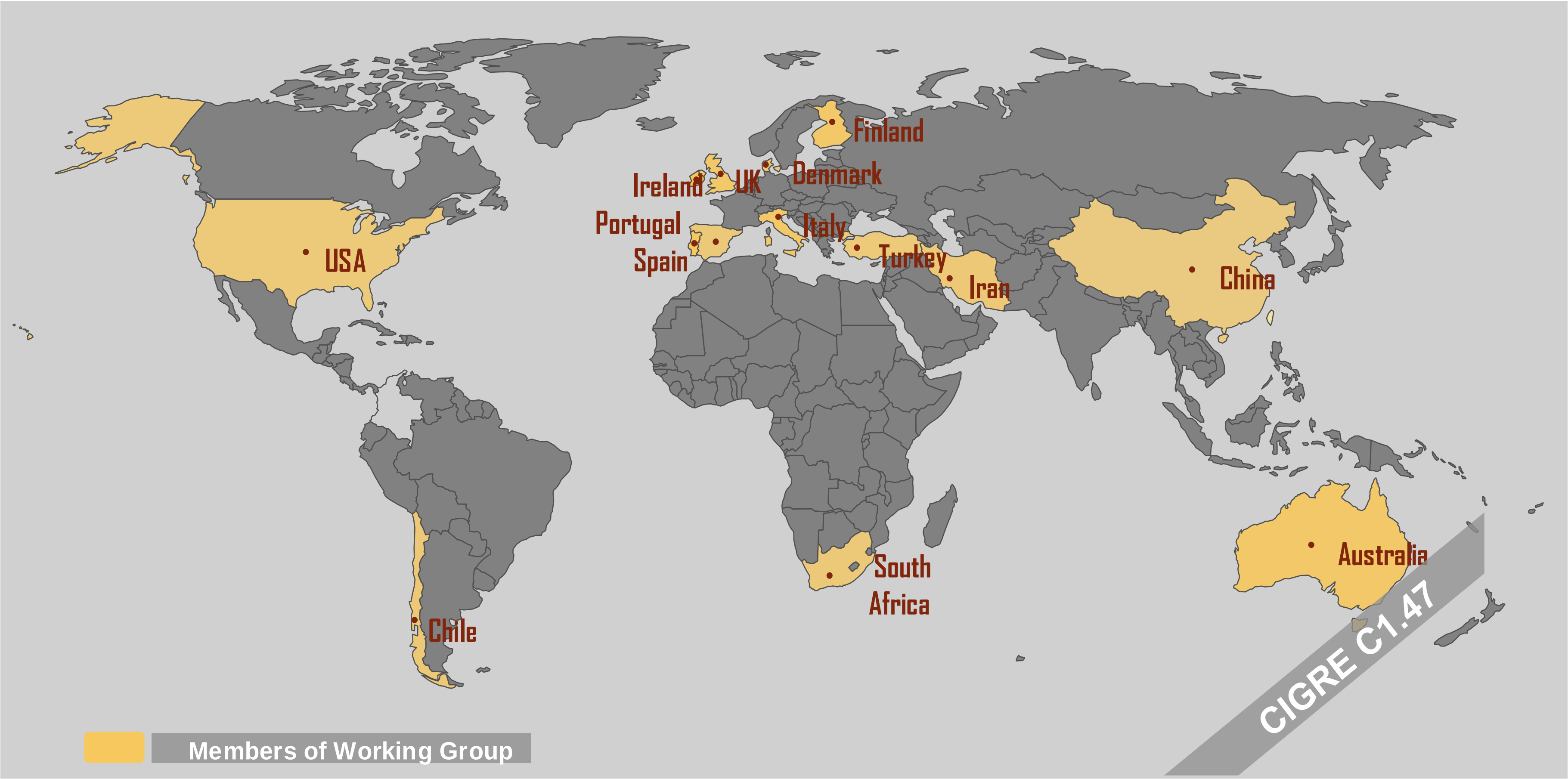
address the **technical, business, economic and regulatory issues** for the developing of concrete use cases of energy systems coupling and **assess state-of-the-art research** in different countries around the world. The WG will also bridge the gap between academy research and industry on the energy sector integration to reveal the key issues that should be addressed in the future.

■ The scope of this WG is to

- Identify **technical / business / institutional challenges** and benefits from energy sectors integration at transmission grids level.
- Review the methodology and technologies on the **modeling, operation, market analysis and planning** towards multi-region level ESI.
- Summarize **lessons learned** and introducing **best practice** of energy sectors integration.
- Propose suggestions for **policies and market regulations** towards the energy sectors integration at transmission grids level.
- Promote **technical papers, technical panel sessions, and workshops** for the dissemination of academic research and real-world applications of energy sectors integration.

➢ Membership of the WG

The working group includes 24 power system planning experts coming from 14 countries covering all the continents.



F. Riva

Members of C1.47 (10 experts from University, 14 from industry)

Ning Zhang, Convenor	CN	Kangping Li, Secretary	CN
Jiakun Fang	CN	Chen Fang	CN
Gülcan Koca	TUR	Dan Wang	CN
Alfredo Cardenas	CL	Deepak Ramasubramanian	USA
Polly Osborne	UK	Mehtap Alper Sağlam	TUR
Spyros Skarvelis-Kazakos	UK	Graeme Hawker	UK
Fabio Riva	ITA	Christian Schaefer	AUS
Laura López	ESP	Filipe Soares	PT
James Smith	USA	Birgitte Bak-Jensen	DK
Mo Cloonan	IRL	Jarrad Wright	ZA
Iñigo Palacio	ES	Moein Moeini-Aghtaie	IR
Hossein Farzin	IR	Sara Haghifam	FI

F. Riva

➢ The progress

Time	Activity
Dec. 2020	Agreed ToR
Dec. 2020-Mar. 2021	Invite experts and update the KMS space of C1.47
Apr. 2021	Kick-off meeting(on Zoom)
May 2021 –Jun. 2021	Draft the questionnaire and sent to members for suggestions
Jul. 2021-Nov. 2021	Finalize the questionnaire and distribute them for reply. Collect the answer and analyze the results.
Dec. 2021	Choose the best practice and invite experts to provide more details
Jan.2022-Sept. 2022	Determine the outline of the brochure and write the brochure
Oct. 2022-now	Revise the brochure

➢ Two WG meetings in 2022

➢ Regular WG meeting (Apr. 2022)

➢ Hybrid WG meeting in Paris General Session (Sept. 2022)

➢ Discuss the outline of the brochure
➢ Assign tasks

➢ Discuss how to revise the brochure
➢ Assign tasks

F. Riva

Outlines of the Technical Brochure

Executive summary

1. Introduction(Finished)

1.1 Background

1.2 Definition of energy sector integration

1.3 Scope and aim of this working group

2. Literature review of energy sector integration (Finished)

2.1 Technologies for energy sector integration

2.2 Current status of energy sector integration in different countries

3. The impact of ESI on power transmission system (Finished)

3.1 Overview (Opportunity and Challenge)

3.2 Impacts on power transmission system planning

3.3 Impacts on power transmission system operation

3.4 Impacts on market and regulation

4. Methodologies considering energy sector integration impacts (Finished)

4.1 Energy hub and network modeling

4.2 Planning methods considering ESI

4.3 Operation methods considering ESI

4.4 Market clearing and decoupling methods considering ESI

Outlines of the Technical Brochure

5. Applied Software Considering Energy Sector Integration (Finished)

5.1 PLEXOS

5.2 IESP

5.3 Calliope

5.4 EnergyPro

5.5 EnergyPlan

5.6 PyPSA

5.7 Hypatia

6. Best Practice and Lesson Learned (Finished)

6.1 Chinese case

6.2 Italian case

6.3 British case

6.4 American case

6.5 Australian case

7. Main barriers and prospect of future (To be summarized)

7.1 Main barriers

7.2 Prospect

8. Conclusion

F. Riva

Impact of ESI on Power Grid

Opportunities

➢ From the perspective of operation

- Improve the flexibility of power systems
- Improve the reliability of power systems

➢ From the perspective of economy

- Reduce total operational costs
- Postpone the reinforcement of transmission system

➢ From the perspective of environment

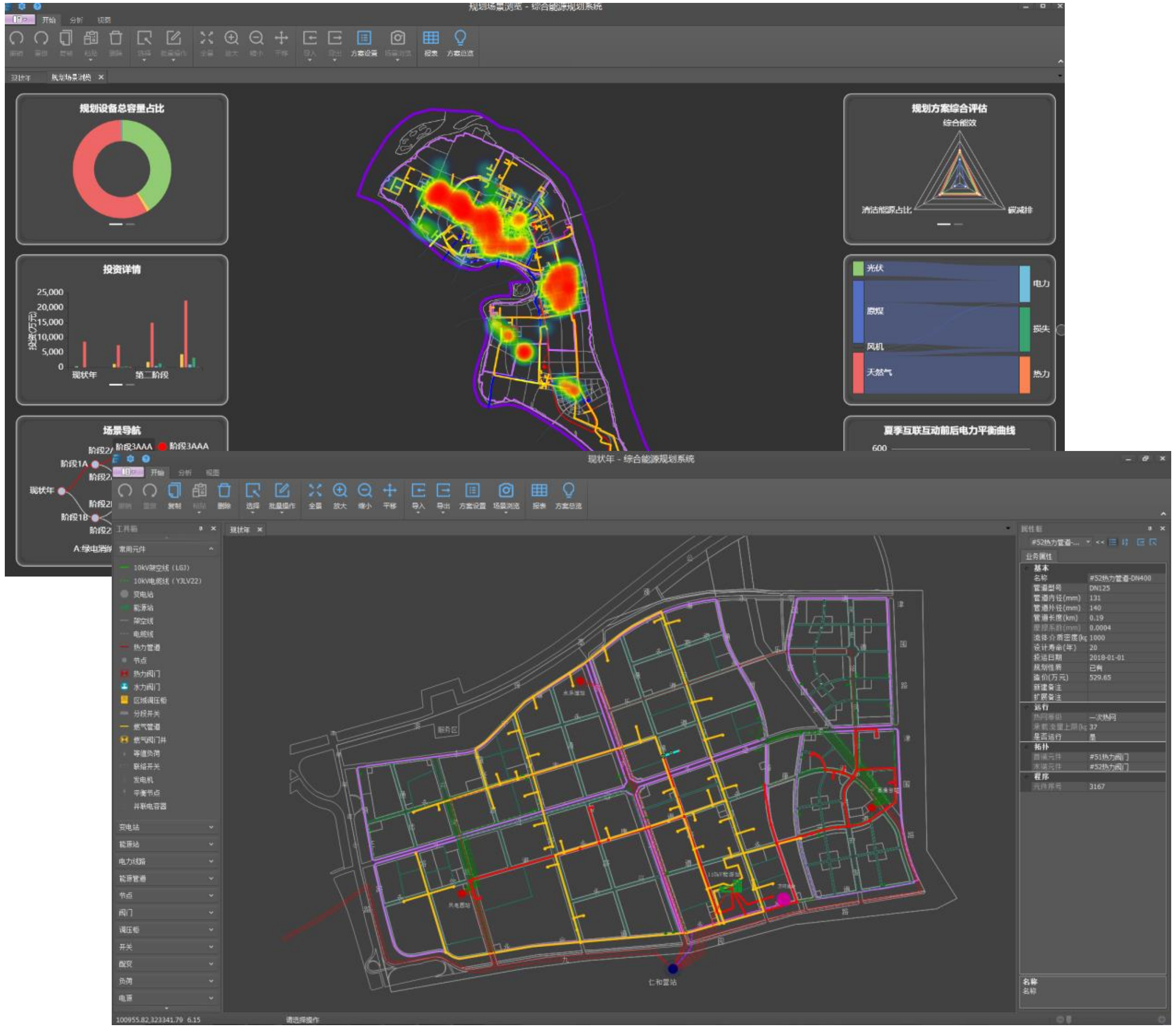
- Enhance the consumption of renewable energy
- Reduce carbon emission

Challenges

- Investment in interface infrastructures must be increased to promote collaboration among sectors
- Increased complexity in the technical operation and management
- Regulations regarding taxation and emission as well as energy markets’ rules should be changed

➢ Applied software

- PLEXOS (Australia)
- IESP (China)
- Calliope (Netherlands)
- EnergyPro (Demark)
- EnergyPLAN (Demark)
- PyPSA (Germany)
- Hypatia (Italy)



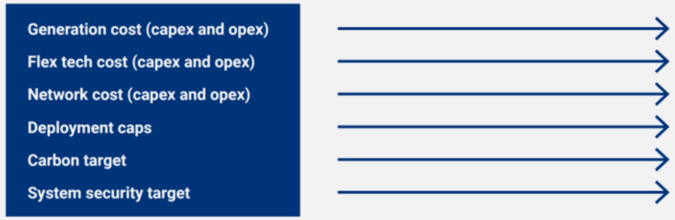
IESP developed by Tianjin University, China

Best practices

✓ An example from the Great Britain

The Flexibility in Great Britain project analyzed the system-level value of deploying flexibility across the heat, transport, industry and power sectors in Great Britain to provide a robust evidence-base on the role and value of flexibility in a net zero system using the **integrated whole energy systems (IWES) model** developed by Imperial College London.

Step 1 Inputs



Gathering input data and setting constraints on the model

Step 2 Modelling

Setting up extreme scenarios to explore the link between different heating solutions and the value of flexibility

Step 3 Scenarios

Exploring sensitivities to understand more about the interactions between different forms of flexibility

Step 4 Outputs

Annual system cost (£bn/yr)	Hydrogen production by technology (GWh/yr)
Electricity demand by sector (TWh/yr)	Hydrogen production capacity (GW)
Heat demand met by heating technology (TWh/yr)	Carbon captured ($MtCO_2$/yr)

Results and conclusions will be drawn from the analysis of the core scenarios and sensitivities

✓ **An example from the Great Britain**

Scenario setting—three core pathways

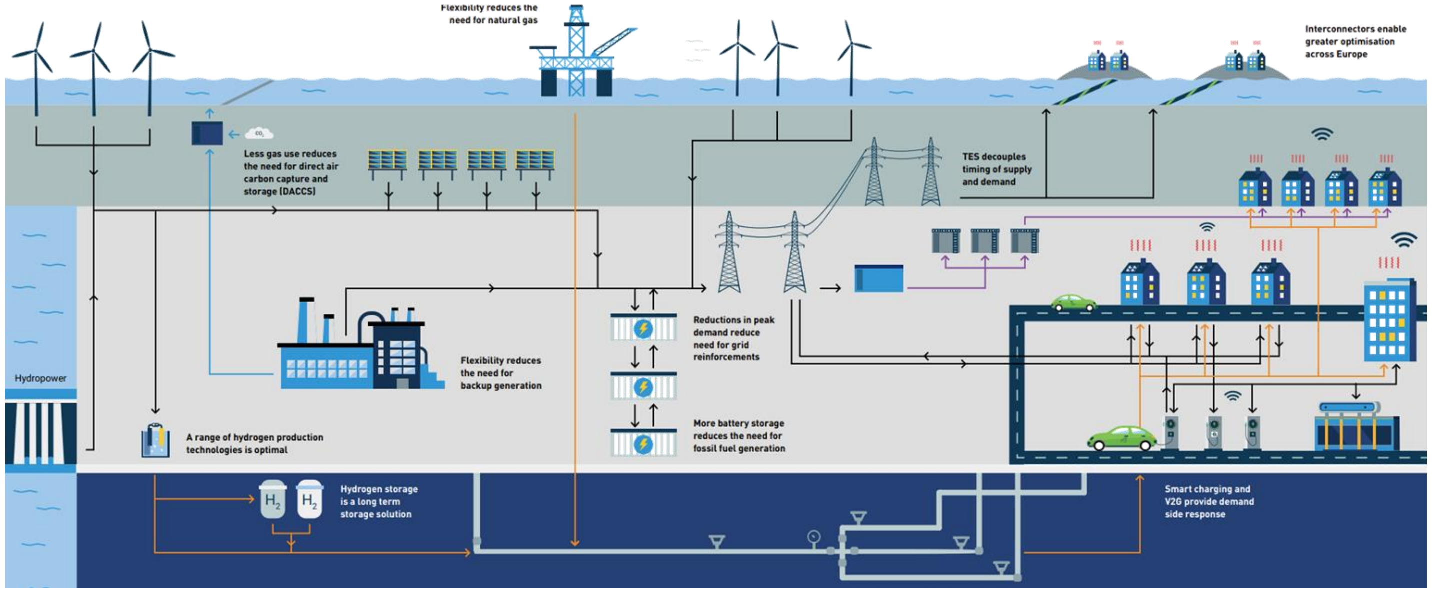
- **Electric heating pathway**

  Heating demands met through individual air source heat pumps (ASHP) and resistive heating
- **Hybrid heating pathway**

  Heating demands met through individual ASHP coupled with a small nature gas boiler
- **Hydrogen heating pathway**

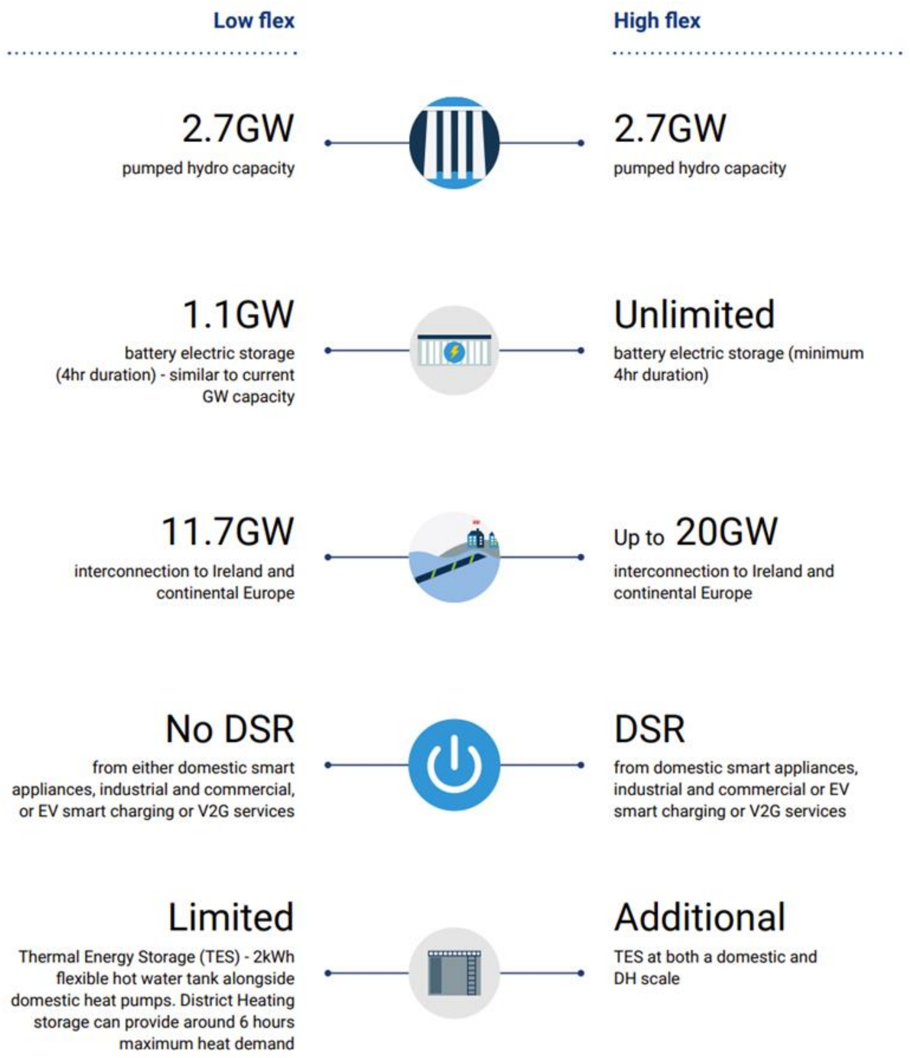
  Heating demands connected to the existing gas network met by hydrogen boilers

The actual future scenario is likely to involve a combination of these pathways, individually exploring each option provides valuable insights into how flexibility is applied within each energy system.



Lessons learned

- Unprecedented scaling up across the energy system is required
- Decarbonization of heat has a significant bearing on the corresponding cost optimal energy system in 2050
- Investing in flexibility is a no-regrets decision
- Flexibility beyond the power sector, including that integrated with zero carbon heat and transport solutions, is critical to unlock value
- The use of hydrogen across the energy system brings carbon and cost benefits, but requires careful planning



Flexibility deployment limits in the low and high flexibility scenarios

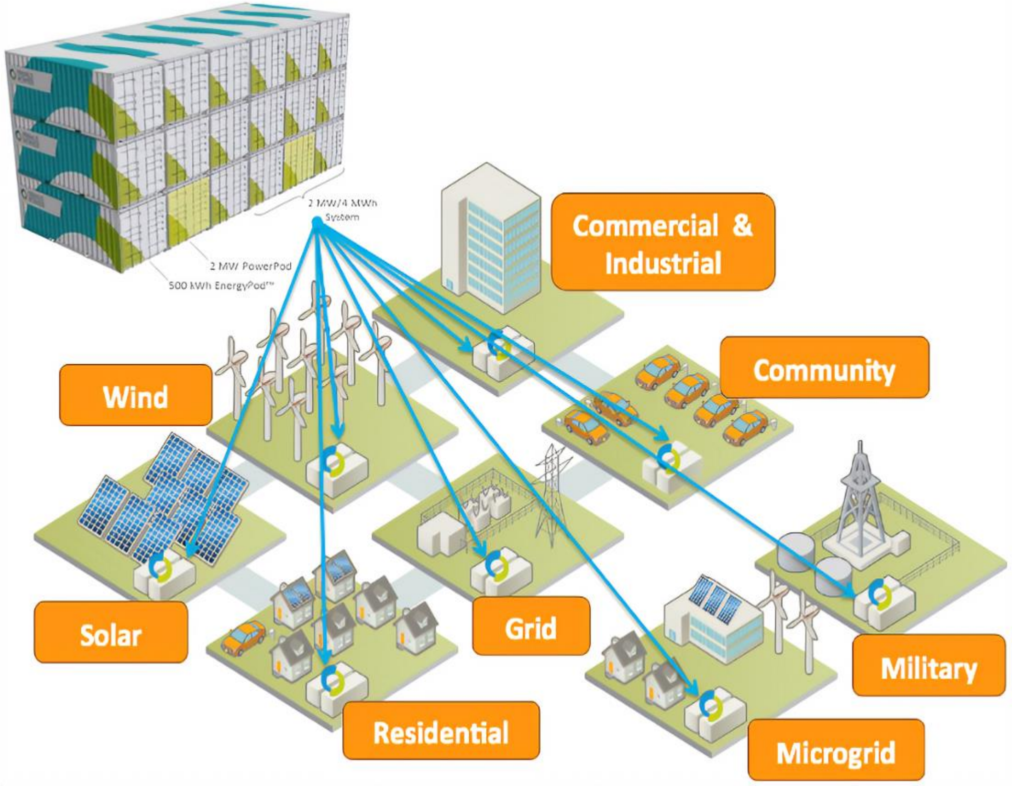
✓ An example from National Renewable Energy Laboratory(NREL), USA

NREL takes buildings as an integral part of the future energy system and has developed modeling and simulation, laboratory testing, and data analysis capabilities to be at the forefront of grid-buildings integrated energy systems.

- Buildings account for more than 70% of all U.S. electricity use and 40% of all primary energy use. The efficiency of building energy consumption, and the electrification of heat and transport, will determine the level of investment needed in critical grid infrastructures across the U.S.
- The interface between buildings and the grid is critical for achieving electrification and demand-side sustainability. NREL researchers are advancing building controls and automation, efficiency of end use, and deployment of onsite generation and storage to reshape the future energy system.
- Buildings have the potential to greatly assist in the integration of renewable energy resources by using demand-side flexibility to balance the variability of wind and solar generation.

Lessons learned

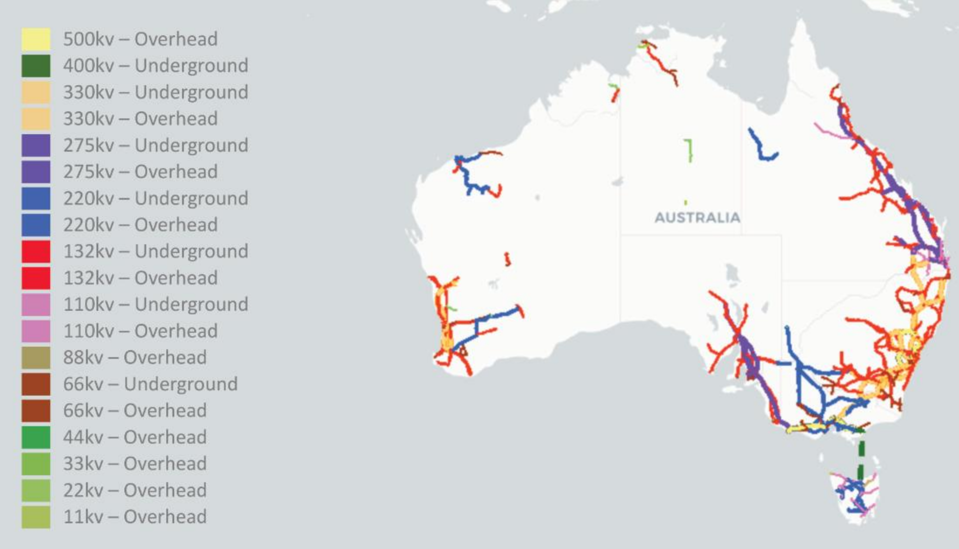
- Understanding market trends and drivers
- Developing participation models (forecast/bid parameters, related ISO/RTO scheduling processes)
- Understanding potential opportunities and regulatory challenges of utility business models.
- Regulating integrated energy systems participation in state policy mandates.
- Understanding how hybridization impacts the integrated energy system's technology costs and values.
- Standardized methods for evaluating economic performance.

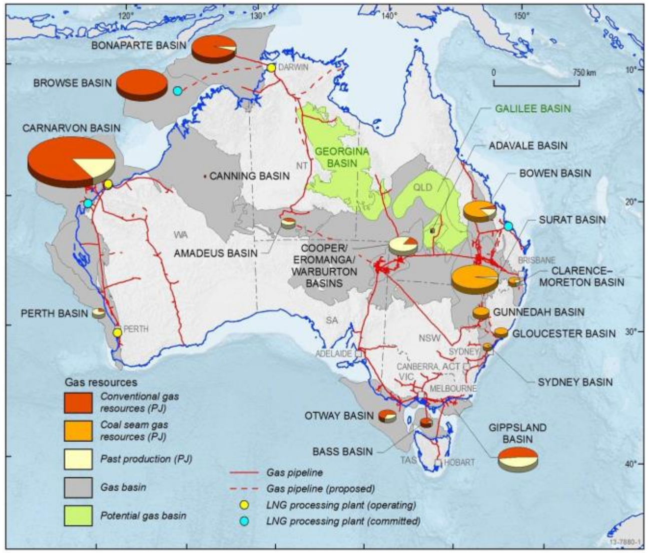


Best practices

✓ Australian South Eastern Electricity and Gas Network

Australian South Eastern Electricity and Gas Network comprise the transmission towers, substations, poles, wires and pipes which supply gas and electricity to most household and business in the country.



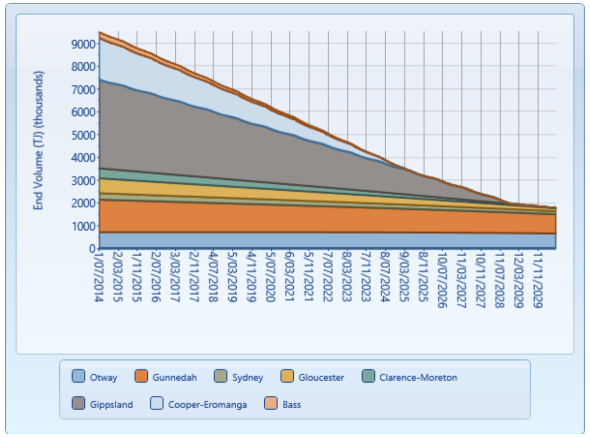


- It is proposed for this example a co-optimized expansion planning of the electricity and gas system which implicitly includes dynamics of the consumption and production of the different basins connected to the gas network.

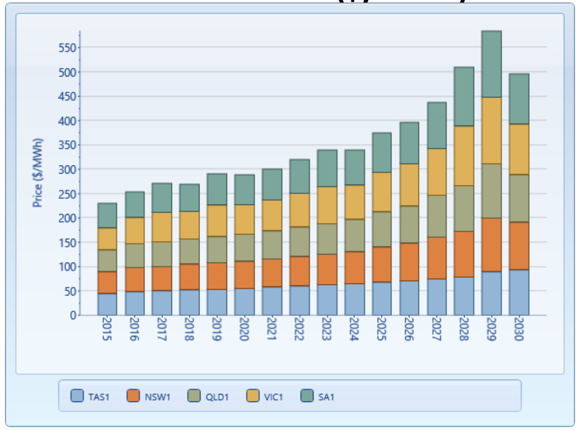
Lessons learned

- Both long-term uncertainties and short-term uncertainties should be considered
- Consider the impact of international energy markets
- Sensitivity analysis of natural gas output is required
- Importance of environmental costs
- Consider the Policy and Regulatory
- Integrated planning leads to a lower overall cost and a more efficient allocation and utilization

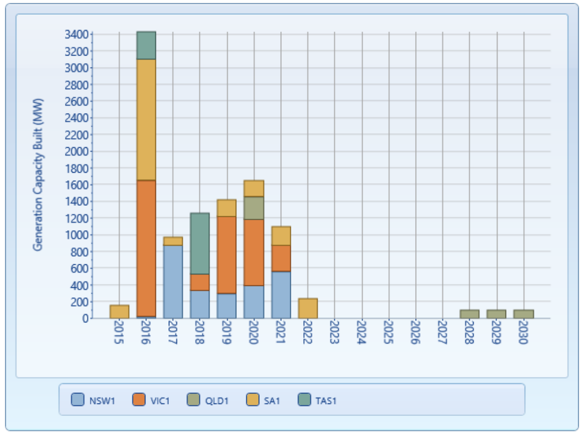
End volume basin (TJ) not including Bowen-Surat in the domestic



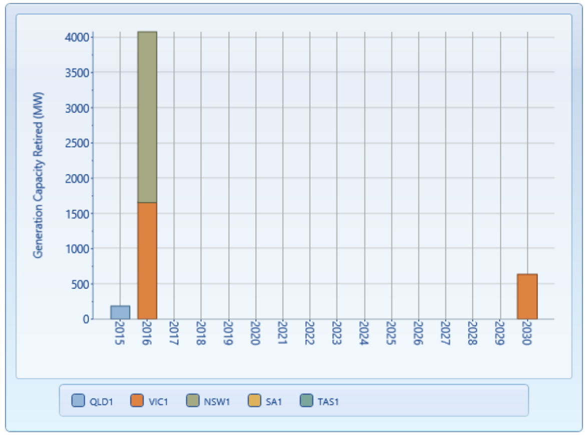
Electricity Price over the period simulated ($/MWh)



Generation Capacity Built (MW)



Generation Capacity Retired (MW)



➢ Time Schedule of Future Work

- September 2023: Summary of the main barriers and prospect of future
- October 2023: Further refinement and modification of the TB
- November 2023: Milestone report to C1
- December 2023 :Final report

WG C1.48

Role of green hydrogen in energy transition opportunities and challenges from technical and economic perspectives

Convenor C1: Alexandre Oudalov, Hitachi Energy, Switzerland

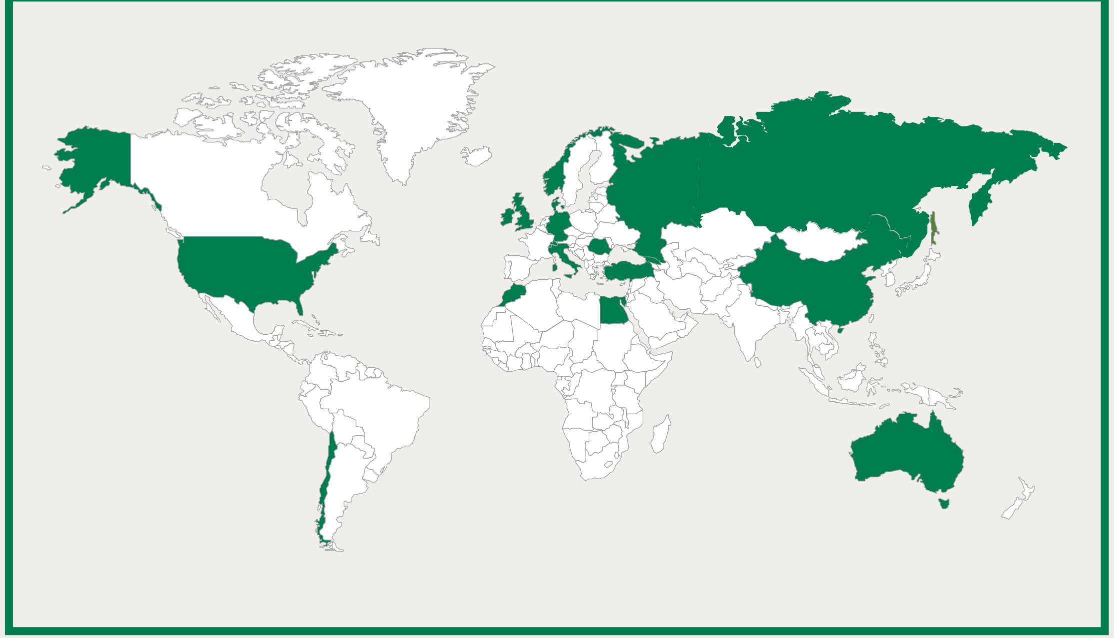
Contributor: Antonio Iliceto, Terna, Italy

Secretary: various

Working group administration

- 25 active members.
- We use Microsoft Team to jointly edit TB sections.
- The draft technical brochure (some sections are still missing) is under internal review.
- Tutorial was presented on 06.09.2023 in Cairns
- We plan to complete TB in the next few weeks

We cover all continents



Working group progress

Task 1: Supply chain
TL: Shi You

The draft chapter covers production, conversion, transport and storage of H2 and is currently under review by task members.

Merged with task 3
Task 2: Green H2 demand
TL: a.i. Alexandre Oudalov

Methodology for both bottom-up and top-down estimation of sectoral H2 demand. Focus geographic area is Europe.

Task 3: Final use cases
TL: Jaydeep Deshpande

Analysis completed for refining, ammonia, methanol and steel production. Additional use case to complete: industrial heat, transport, gas to power.

Task 4: Grid integration and services
TL: Jiakun Fang

Completed: multi-physical comparison of 3 electrolyzer types, grid vs isolated H2 production. Work in progress on grid code compliance across different jurisdictions.

Task 5: Future role as energy storage and carrier
TL: Andres Leal-Ayala, Daniel Chartouni

The draft chapter covers various H2 storage technologies and compare them with alternative long duration energy storage as well as hydrogen pipeline and ship transport and is currently under review by task members.

Task 6: Scenario analysis and simulations
TL: Alexandre Oudalov

Multi-zonal, period, sector energy system capacity expansion model developed by Hitachi Energy applied for assessment of infrastructure needs in Europe (incl. Türkiye) to achieve carbon neutrality by 2050.

Task 7: Policies, support schemes and regulations
TL: Dejan Ostojic

The main scope is defined in a kick-off call, the work is about to start with regular task calls. A link to C5.35 is established.

- FEB 2021: Kick-off
- MAY 2021: Scope definition
- AUG 2021: 1st plenary
- NOV 2021: 2nd plenary
- JAN-JUL 2022: Chapter drafts
- AUG 2022: first f2f meeting
- FEB 2023: Draft TB
- SEP 2023: Tutorial
- NOV 2023: TB Final

TB structure

1. Motivation and Scope
2. Hydrogen System
3. Hydrogen Final-Use Cases
4. Green Hydrogen Production
5. Green Hydrogen Long Duration Storage
6. Green Hydrogen Delivery
7. Grid Integration of Electrolyzers: Challenges and Opportunities
8. Hydrogen in the Future Energy System Modelling
9. Strategies and Policies to Accelerate Green Hydrogen Deployment
10. Regulation and green labelling
11. Key Take Away Messages

CAIRNS 2023
INTERNATIONAL SYMPOSIUM

Study Committee C1 Tutorial - Sept 6 2023

Role of green hydrogen in energy transition

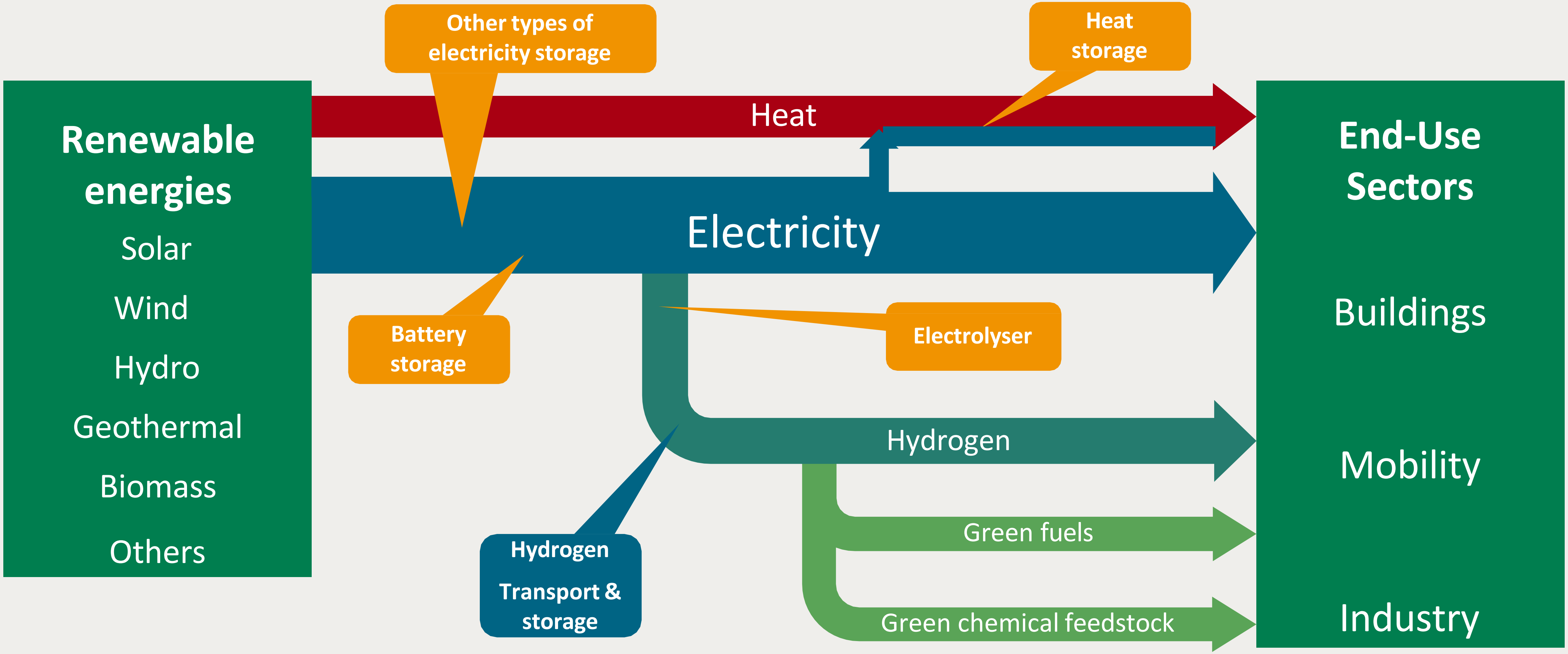
opportunities and challenges from technical and economic perspectives

Presenters: Alexandre Oudalov (convener), Jaydeep Deshpande (secretary), Antonio Iliceto, Herath Samarakoon, Kewei Hu

cigre Australia

Cairns Convention Centre
Queensland Australia
4-7 September 2023

Future Energy System:
dominant role of green electricity



Source: Fraunhofer Institute

The need of a hydrogen system

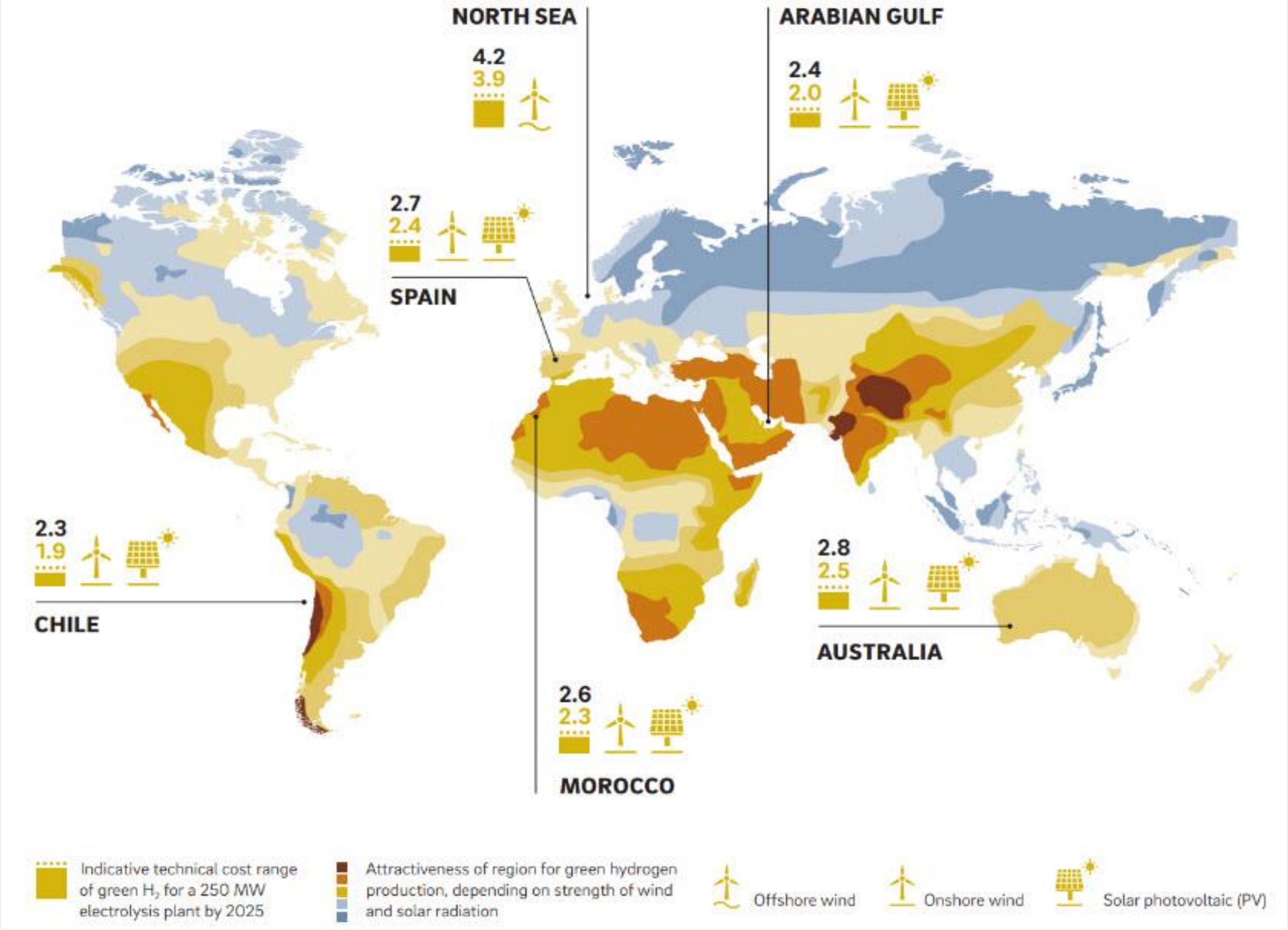
Getting hydrogen from global production sites to end users at the lowest possible cost will be key to the success of the green hydrogen economy.

The potential for onsite green hydrogen production is limited due to

- Requirement of a large amount of green electricity (wind and solar)
- Space requirement
- Expansion of electricity grid

Thus, green hydrogen could be largely produced near the most cost competitive renewable electricity hubs and then transported to the areas of demand.

Many H_2 production sites are distant from major demand areas



Source IEA, Roland Berger

Energy storage technology landscape

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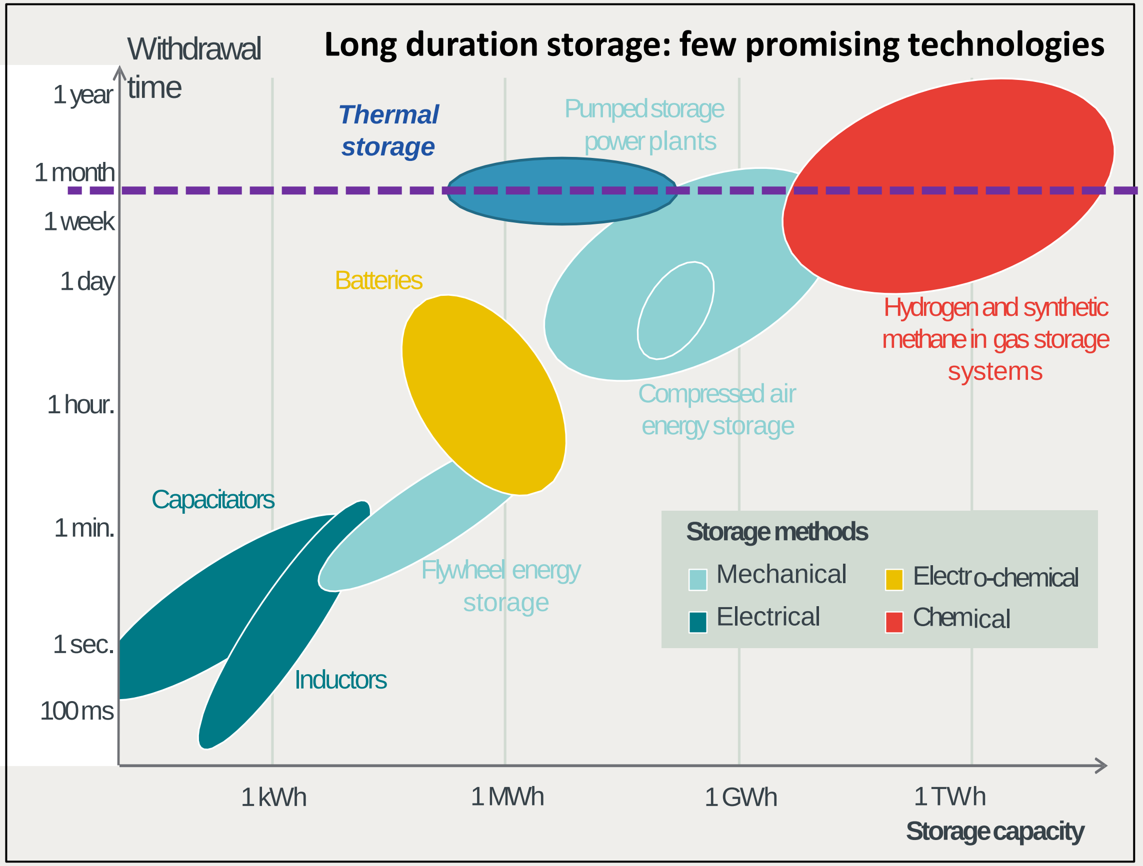
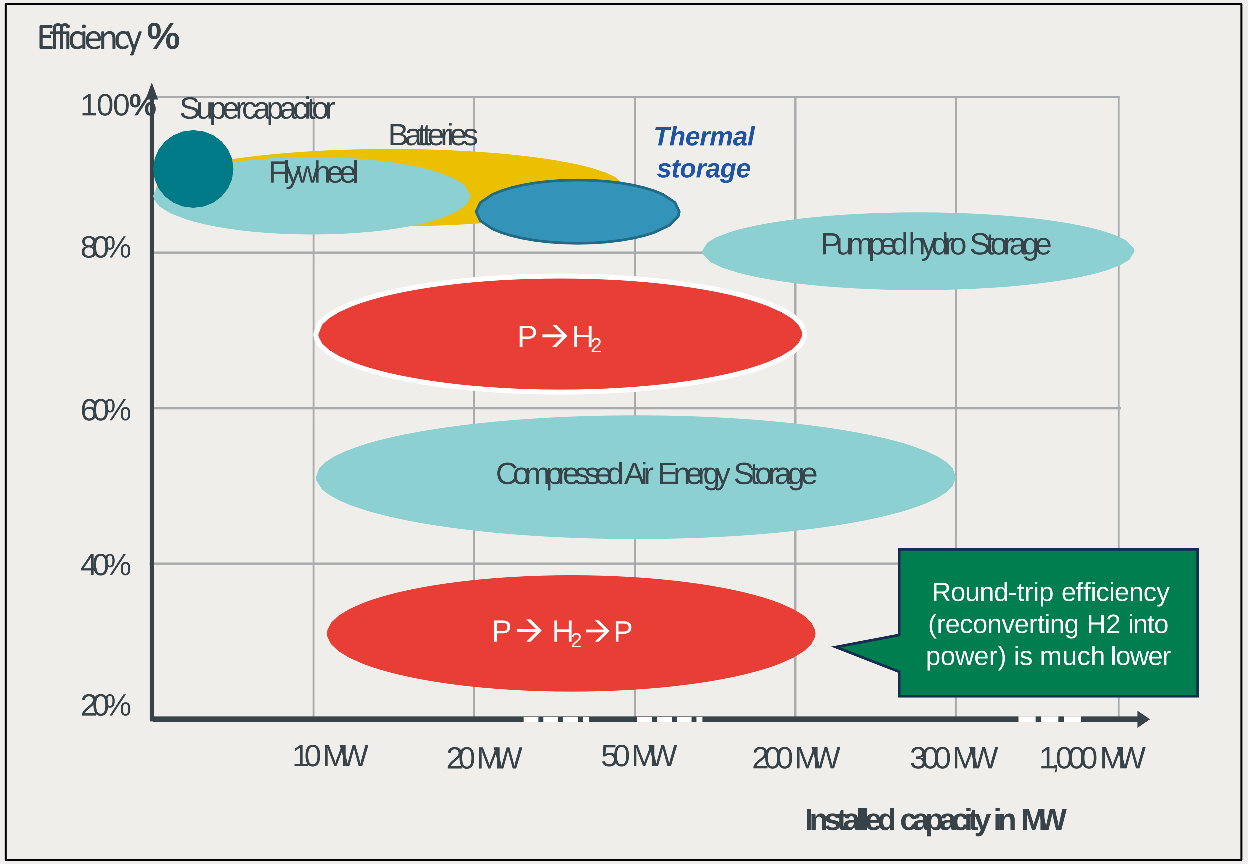
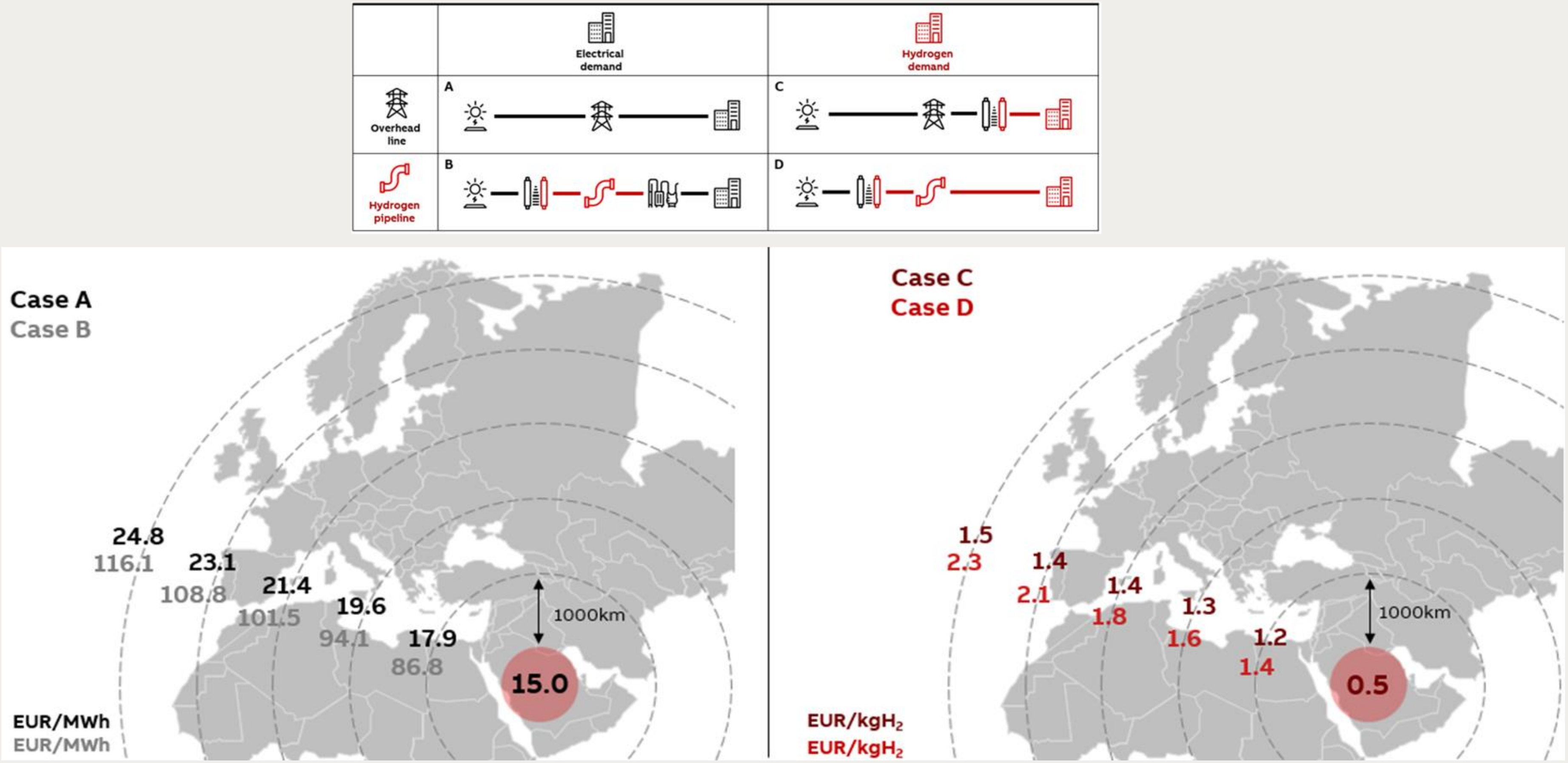




Pumped hydro sites in EU are already utilized; thermal storage and compressed air are in development stage → molecules are a promising candidate

Hydrogen as energy carrier: comparison vs electricity - 2

Scenarios for point-to-point connection



For mid length distances, localization of large electrolyzers is a system planning decision

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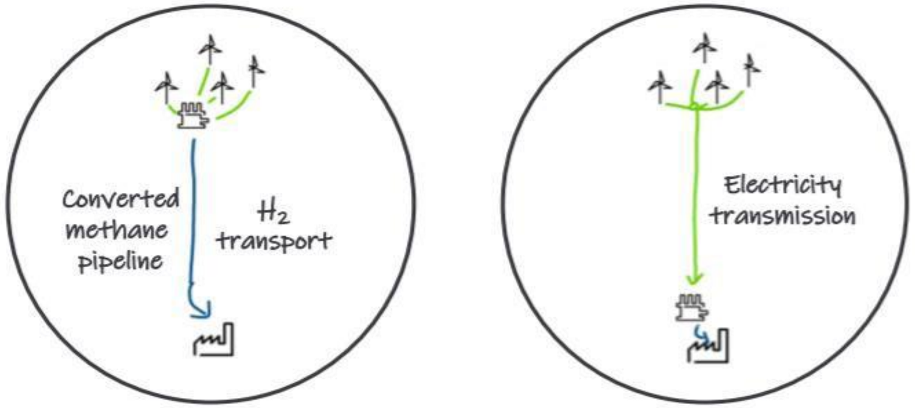
Placement of electrolysers determines energy transport technology and infrastructure costs



Planning of electrolysers and H_2 network in TYNDPs
(EC hydrogen strategy)

entsoe

Distance		Morphology: Overland	Morphology: Sea traits
		Overland	**Sea traits**
	Short	H2 valleys	H2 pipeline or electric cable
	Mid-long (country / region)	H2 pipeline or OHL electric line	H2 pipeline or electric cable
	Very long (inter-continents)	H2 pipelines	H2 ships

Localisation of electrolysers is an energy strategy decision, which should optimise the overall energy system (Capex, Opex, energy efficiency, infrastructure utilisation, etc.)

Taxonomy of operational configuration and business cases (system perspective)

			Grid Congestions risk	Flexibility short term	Flexibility long term
Non electrolyser H2			no	no	no
RES-dedicated Electrolysers (Off- Grid)			no	no	no
On-Grid electrolysers	User demand driven	No storage elements	yes	no	no
		Storage elements	no	yes	yes
	Market price driven	No storage elements	No, decongestion effect	no	no
		Storage elements	no	yes	yes
	Baseload	No storage elements	yes	yes	no
		Storage elements	no	yes	no
	System supportive	Storage elements	no	yes	yes

Electrolysers could provide most system services

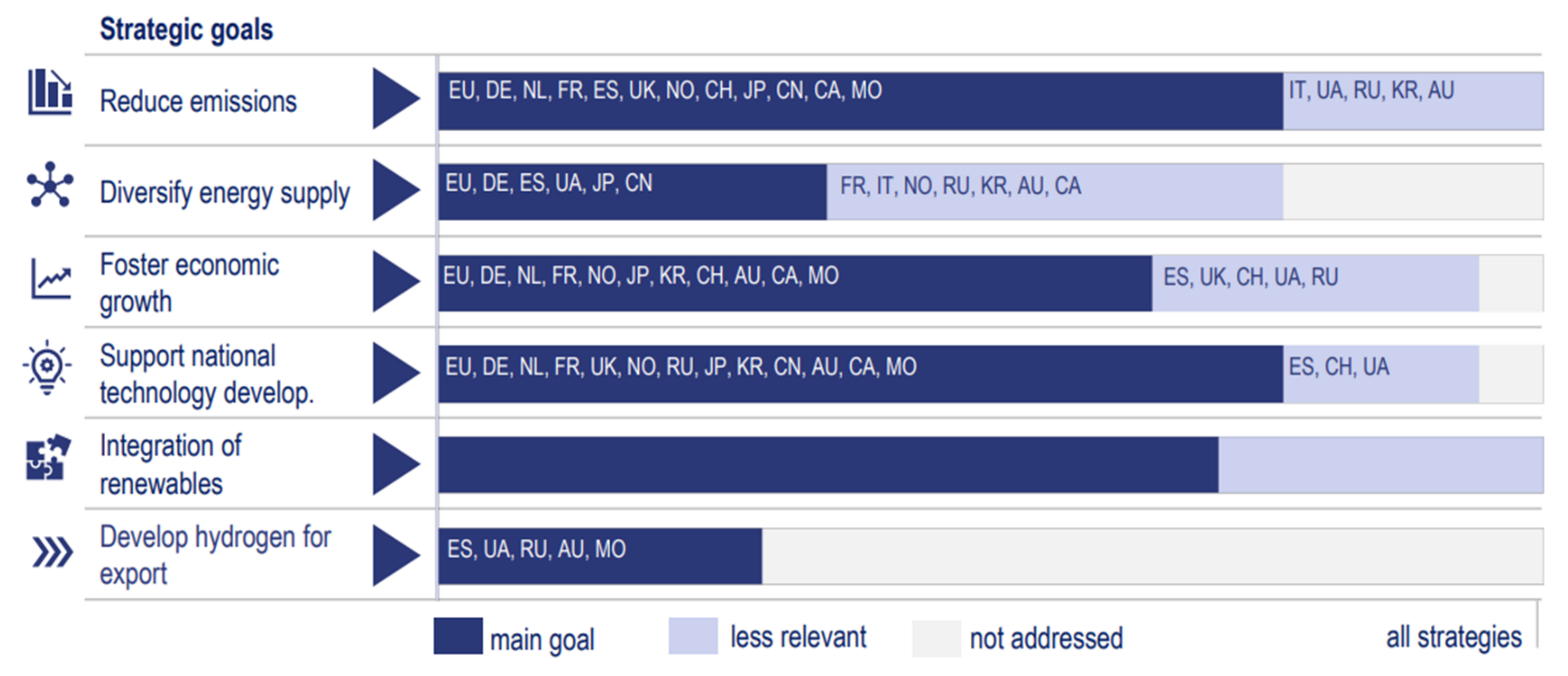
	Alkaline		PEM		SOEC	
	Today	2030	Today	2030	Today	2030
FCR	Yes with limits	Yes with limits	Yes with limits	Yes with limits	No	Uncertainty about flexibility
aFRR	Yes with limits	Yes with limits	Yes	Yes	No	Uncertainty about flexibility
mFRR	Yes	Yes	Yes	Yes	No	Uncertainty about flexibility
RR	Yes	Yes	Yes	Yes	No	Uncertainty about flexibility
Voltage control	Electrolysers can provide reactive power if they are equipped with self-commuted rectifiers					
Congestion management	Yes	Yes	Yes	Yes	No	Uncertainty about flexibility

Source: ENTSO-E

Regulation and green labelling

- Need of a new ad-hoc system for labelling green hydrogen
- Additionality - electrolyzers use “new” renewable electricity accordingly to robust and unambiguous definitions
- Methodology for harmonized calculations and assessment is needed
- Geographical correlation - same country/same bidding zone
- Time correlation - at daily / 1h / 15minutes granularity, rather than on yearly average
- Lifecycle analysis of use of hydrogen as a decarbonisation effect should be implemented

Strategic goals set in national strategies



Source: Ludwik Bolow Study, 2022

Main conclusions

HYDROGEN ECONOMY ADVENT

- Demand for hydrogen is expected to increase significantly and diversify in the upcoming decades
- The cost of hydrogen is the cheapest when it is produced at the same place and time (hydrogen valleys); longer supply chains (conversion, storage, transport and delivery) can increase the costs up to 5 times
- Expect decrease in electrolysers’ CAPEX and economies of scale shall make economical investments

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IMPACT ON POWER SYSTEM

- Location, logistic configuration and operational mode of new electrolyzers is a strategic system architecture question
- Appropriate coordination of planning between hydrogen projects and electric/gas grid development is needed to ensure compatibility and optimality at energy system level (NOT JUST A NEW CONNECTION REQUEST)
- Important to assess also how much non-electrolyzer H2 and how much imported H2 will be present in a given area, since they reduce the need of additional RES and the impact on existing power grids
- Hydrogen systems have a great potential to provide a number of grid services, supporting higher VRES integrated into the power system, through appropriate grid codes to provide operation flexibility as an additional income

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MATCHING SYSTEM NEEDS AND BUSINESS NEEDS

- Green labelling conditions are relevant for system planning and flexibility provision: geographical correlation (same country/same bidding zone) and time correlation (daily / 1h / 15 minutes granularity, or on yearly/monthly level)
- Additionality Principle: need to align evolution of additional RES capacity with new electrolysers, to avoid cannibalisation in decarbonisation targets vs electrification of other end uses

JWG C1/C6.37

Optimal Transmission and Distribution Investment Decisions Under Increasing Energy Scenario Uncertainty

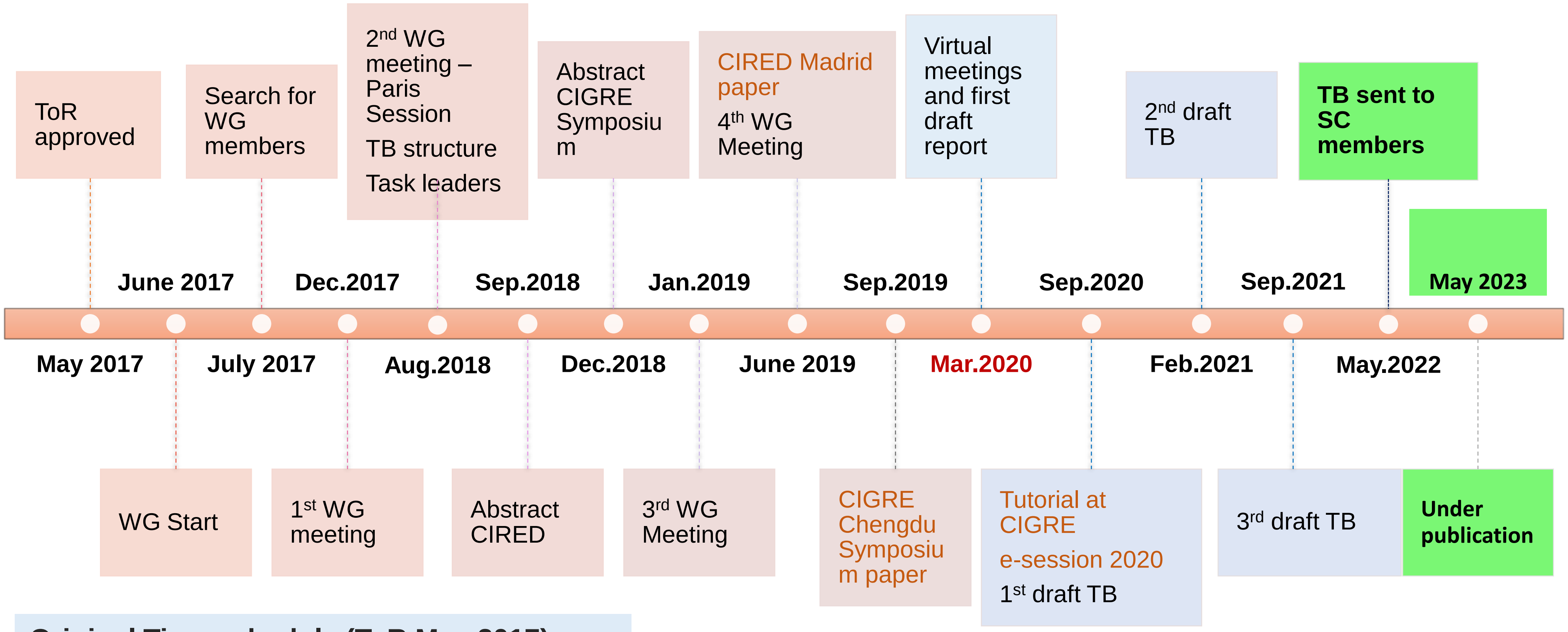
Convenor C1: Juan Carlos Araneda (CL) /Co-Convenor C6: Fabrizio Pilo (IT)
Secretary: Federico Silvestro (IT)

Objective of JWG C1/C6.37

- This Joint Working Group is required to investigate how transmission and distribution planning scenarios are consistently used to ensure holistic investment decision-making by ISO/TSOs and DSOs.

- The investigation is in the context of growing uncertainty in future energy scenarios due to increasing distributed energy resources (DER), electrification of transport, interconnection, consumer heating, global emissions targets, etc.

JWG Milestones



Original Time schedule (ToR May 2017):
- WG Start: June 2017
- WG meeting to revise draft report: Q4 2018
- Final report: 2019

Deliverables: TB, Tutorial, Electra report

Current Status:
- TB revised by C1
- Review by C6 pendant
- Final revision by Convenors

Outline of the TB

OPTIMAL TRANSMISSION AND DISTRIBUTION INVESTMENT DECISIONS UNDER INCREASING ENERGY SCENARIO

WG C1.C6/37

Members

Juan Carlos Araneda, **Convenor (C1)**	CL	Federico Silvestro, **Secretary**	IT
Fabrizio Pilo, **Convenor (C6)**	IT	Ricardo Prata	PT
Jason Taylor	US	Martin Braun	DE
Marie-Cecile Alvarez-Herault	FR	Florian Schaefer	DE
Fabian Heymann	PT	Alexandra Donners Muhammed	SE

Corresponding Members

Maxwell Cury	BR		
Sergio Barrientos	CL		

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Figures and Illustrations

F. Silvestro, F. Pilo

Membership of the JWG

No.	Country	Name	Company
1	**Chile**	**Juan Carlos Araneda**	**Coordinador Electrico Nacional**
2	**Italy**	**Fabrizio Pilo**	**University of Cagliari**
3	Ireland	Mario Duarte	Eirgrid
4	**Italy**	**Federico Silvestro**	**University of Genova**
5	South Africa	Popi Melato	Eskom
6	South Africa	Barend van der Merwe	Eskom
7	United States	Zillur Patwary	Burns & McDonell
8	**United States**	**Jason Taylor**	**EPRI**
9	**Sweden**	**Alexandra Donners Muhammed**	**Vattenfall Eldistribution**
10	Serbia	Branko Perunicic	Elektromreza Srbije
11	United States	Michael Longoria	Smart Wires, Inc.
12	Switzerland	Stephan Koch	Adaptricity Ltd.
13	Switzerland	Andreas Ulbig	Adaptricity Ltd.
14	Ireland	Brendan Kelly	Smart Wires, Inc.
15	Canada	Steve Blackburn	Hydro-Québec, TransÉnergie
16	Canada	Mehdi Vafaei	Engineering Consultant
17	Canada	Charles Desbiens	HQ
18	Germany	Ben Gemsjaeger	Siemens AG
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20	Japan	Harufumi Hoshino	The Kansai Electric Power Co.
21	Japan	Makoto Murata	
22	Australia	Alex Baitch	BES (Aust) Pty Ltd
23	**Portugal**	**Fabian Heymann**	**INESC TEC/ University of Porto**
24	**Portugal**	**Ricardo Prata**	**EDP Distribuicao**
25	**Chile**	**Sergio Barrientos**	**Surenergia SA**
26	UK	Geev Mokryani	University of Bradford
27	France	Baptiste Denize	RTE
28	**France**	**Marie-Cecile Alvarez-Herault**	**University Grenobles Alpes**
29	**Germany**	**F. Schaefer**	
30	**Germany**	**Martin Braun**	**Fraunhofer**

SURVEY ON RISK MODELLING IN TRANSMISSION AND DISTRIBUTION

The JWG developed a questionnaire about current planning methods and tools of transmission and distribution networks.

The survey investigated the current planning studies of operators through 44 questions. The main topics were:

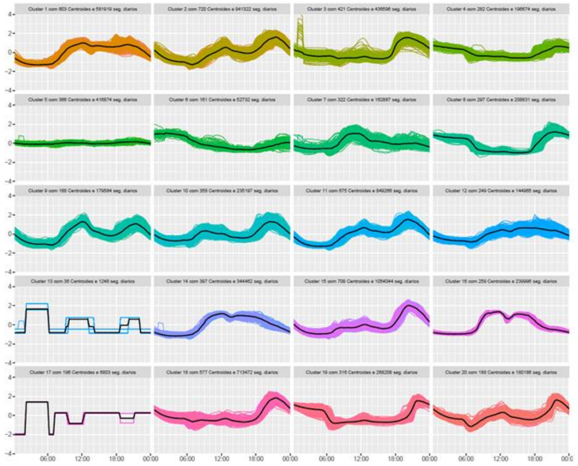
- Statistical information about the company
- Planning scope (horizon and responsibility)
- Scenarios, uncertainties and decisions
- Regulatory regime of network investment remuneration
- Scenario and decisions
- Barriers/tools for the information exchange between TSO and DSO planning

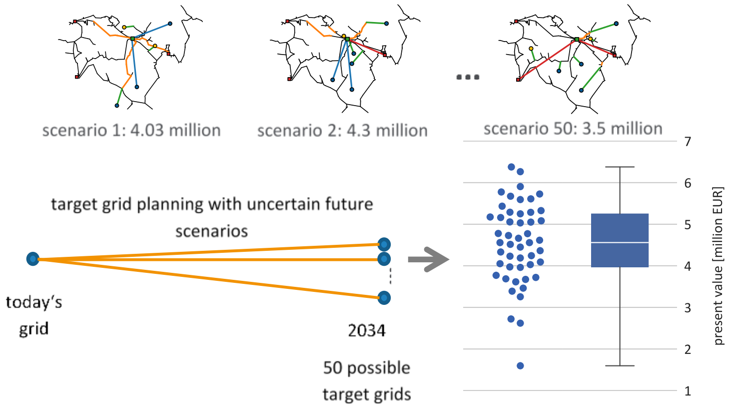
43 responses have been received: 63% DSOs and 37% TSOs/ISOs), from operators of Oceania (5), North America (4), South America (5), Europe (21) and Asia (8).

NETWORK PLANNING METHODOLOGIES UNDER UNCERTAINTY

Cases reported:

- Probabilistic network analysis associated to distribution networks (EDP and Porto University, Portugal).
- Customer profiling in Italy (e-Distribuzione and University of Cagliary).
- Probabilistic DER scenarios (Germany).

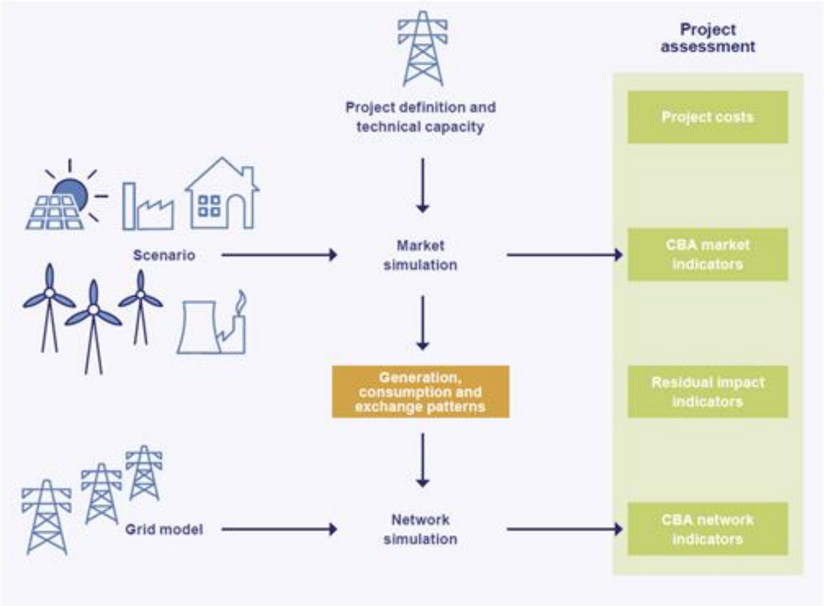




INVESTMENT DECISION MAKING PROCESS

Cases reported:

- Ten Year Network Development Program (TYNDP) by ENTSO-E.
- Case of RTE (TSO in France), including integration of DER in the decision procedure.
- Case of Alectra Utilities in Ontario, Canada.
- Case of Chilean transmission planning process. Coordinador's experience.



F. Silvestro, F. Pilo

MAIN LEARNINGS AND RECOMMENDATIONS

The main learnings and recommendations for optimal investment decisions under uncertainties in transmission and distribution (T&D) are as follows:

- Decisions at respective network owners (TSOs and DSOs) are taken in the respective company as long as they are separate legal entities. The entities' strategies and risk inclination will lead to different conclusions about grid optimal investments. Successful coordination requires either steering within one company or participation of ISO (in some jurisdictions) or the regulatory body.
- The increased complexity, uncertainty, and speed of change by the fast integration of RES, means that grid operation, development and management require a stronger integration of ISOs, TSOs and DSOs in the planning processes due to the stronger integration of T&D systems. The new structure of power system with so much generation and flexibility allocated at distribution level makes the boundaries between T&D planning and operation narrower than in the past.
- Expansion plans that do not properly consider the mutual interactions of T&D systems might be far from techno-economic optimality, with possible negative consequences in terms of reliability, resilience, or operational costs. Users' measurements and data are available at both ISO/TSO and DSO level, including active power exchange measurements, load and generation data and interconnection capability data, which could be used to develop robust plans with efficient resource allocation through an appropriate data exchange methodology and IT architecture.

CONCLUDING REMARKS

JWG C1/C6.37 main results were presented at:

- CIRED 25th International Conference on Electricity Distribution, Madrid, Spain, June 2019
- CIGRE Symposium, Chengdu, China, September 2019
- CIGRE Session 48 (e-session 2020), SC C1 Tutorial “Optimal Power System Planning and Investment Decisions under Growing Uncertainty”, jointly presented with WG C1.39, August 2020

Lessons learnt:

- KMS complexity
- Covid-19 meant additional timing
- Dedication in extra time by most members

JWG C1/C4.46

Optimising power system resilience in future grid design

Convenor C1: Christian Schaefer, Australia

- *Pubblicazioni*
- *Attività nel WG C1/C46*
  Optimising power system resilience in future grid design

CIGRE C1/C4
papers

C1 Activity

- Partecipation to CIGRE Session 2022

10793
C1
PS 1

Session 2022

Validation and application of the methodology to compute resilience indicators in the Italian EHV transmission system

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SUMMARY

Given the increasing frequency and severity of extreme weather events in the last few years, transmission grid planning and operation cannot be performed without catching these changes. In this context a risk based methodology for power system resilience assessment in the grid planning context has been elaborated in a joint effort between the Italian TSO, Terna, and Ricerca sul Sistema Energetico RSE S.p.A.. This methodology is aimed to define a resilience indicator which can capture the benefit of a grid hardening intervention in terms of resilience increase of the system exposed to extreme weather events, in the context of the Cost Benefit Analysis (CBA) required by the Italian energy regulating entity.

The two main outputs of the methodology are the return period for the outage of each substation connected to the transmission grid and the Expected Energy Not Served (EENS) due to contingencies. The return period of the substation depends on the meshing level of grid and on the return periods of the lines. The resilience benefit is evaluated as the difference of EENS indicators before and after the deployment of grid interventions. This paper intends to describe the implementation of the methodology in a professional tool, its validation against real data, and its application to a portion of the transmission grid with a case study.

After recalling the methodology, the validation process regarding the overhead line (OHL) vulnerability model is described in depth. This validation consists in two steps: the former step compares the wet snow loads calculated by a reanalysis dataset against the load recorded during significant snowfall events. The second validation step is carried out by performing a statistical comparison between the outage return periods (i.e. mean time between outages) due to wet snow events computed by the methodology - combining the vulnerability model with the abovementioned reanalysis dataset- and the empirical return periods of line outages derived with their uncertainties from the available dataset of historical failure events. Finally, a simple case study illustrates an application of the methodology which shows the process of identification of the grid portions with higher risk of outage due to severe weather events alongside with the selection of the interventions following the criteria of cost-efficiency and effectiveness.

Study Committee C1

POWER SYSTEM DEVELOPMENT AND ECONOMICS

Paper 10793_2022

VALIDATION AND APPLICATION OF THE METHODOLOGY TO COMPUTE RESILIENCE INDICATORS IN THE ITALIAN EHV TRANSMISSION SYSTEM

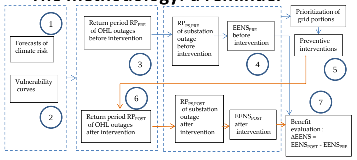
E. Ciapessoni (1), D. Cirio (1), E. Ferrario (1), M. Lacavalla (1), P. Marcacci (1), G. Pirovano (1), A. Pitto (1), F. Marzullo (2), F. Falorni (2), F. Scavo (2), A. Lazzarini (2), S. Costa (2), S. Pierazzo(2), C. Vergine (3)

(1) Ricerca sul Sistema Energetico RSE – S.p.A. (2) Terna S.p.A. (3) Terna Rete Italia S.p.A.

Motivation

- Given the **increasing frequency and severity** of **extreme weather** events in the last few years, transmission grid planning and operation cannot be performed without catching these changes.
- Developed a **risk based methodology aimed to compute indicators to capture the benefit** of a grid hardening intervention **in terms of resilience increase** of the system exposed to extreme weather events, in the context of the Cost Benefit Analysis (CBA) required by the Italian energy regulating entity

The methodology: a reminder



Using a 7-step approach:

1. Calculate the probability of occurrence of meteorological phenomena in the future (use of a climatological model).
2. Quantify the vulnerability of grid components (development of vulnerability curves in a georeferenced grid model)
3. Combine the probabilistic weather model with the vulnerability curve of the grid components, specifically lines and compute the outage Return Periods in "pre-intervention phase" (RPPRE)
4. Determine the Return Period (RPPS,PRE) of the substations and the corresponding value of expected energy not served (using a cascading outage simulator).
5. Identify possible interventions aimed at increasing resilience
6. Evaluating the impact of the interventions identified, for instance measured in terms of increase of the Return Period of the line (RPPOST) and re-compute the new return period for the outage of substations.
7. Calculating the resilience benefit associated with each identified intervention in terms of reduction of the Expected Energy Not Served (EENS).

The validation process

- General objective: verify that the outputs of the whole **methodology** are **in line with the statistics regarding OHL outages** due to extreme weather events.
- Two main aspects are validated: (1) the models of component vulnerability to threats (focus of the paper), (2) the climatological models.

Preparing database of recorded OHL failures

- Exclusive extraction of the failures associated with direct or indirect actions of a threat (e.g. wet snow) on OHLs
- Accounting for the history of the performed "infrastructure upgrades" in the observation period
- Filtering out the lines where interventions determine a large discrepancy between the behaviour of the OHL modelled by the methodology and the actual behaviour of the line modified by the upgrades

Validating the vulnerability models

- Comparing two terms:
  1) "Benchmark": the set of OHL failures provoked by wet snow and recorded during the observation period,
  2) Outage return periods of OHLs obtained by combining vulnerability models with the best meteorological dataset available (i.e. RSE MERIDA with Optimal Interpolation –OI – of observed values)
- Defined a two-step process:
  1. Validation of the meteorological dataset versus real wet snow events: check wet snow loads recorded during specific events against the ones reconstructed by applying the MERIDA OI dataset to the Makkonen accretion model
  2. Validation of the OHL calculated return periods versus empirical failure data, performed on clusters of lines which are grouped into clusters
- Due to the limited set of historical events, the validation is performed on clusters of lines. These clusters are defined according to specific physical quantities (line length, voltage level, maximum altitude or any combination of these quantities)

The validation criterion

- For each cluster with cardinality N, one can define:

  mean number of historical failures

$$\mu_f^S = \frac{1}{N}\sum_{j=1}^{N} g_j^S$$

  sample standard deviation of the number of historical failures

$$\sigma^S = \sqrt{\sum_{j=1}^{N}\left(g_j^S - \frac{1}{N}\sum_{j=1}^{N} g_j^S\right)^2 \Big/ (N-1)}$$

  mean number of failures evaluated by the methodology over the observation period of 16 years (under Bernoulli assumption)

$$\mu_f^I = \frac{1}{N}\sum_{j=1}^{N} g_j^I$$

$$g_j^I = 16 \times (1/TR_j)$$

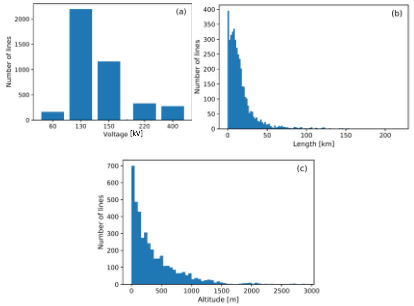
- The validation is successful on the cluster iff:

$$\mu_f^S - \frac{3*\sigma^S}{\sqrt{N}} \le \mu_f^I \le \mu_f^S + \frac{3*\sigma^S}{\sqrt{N}}$$

- A successful validation means that the **mean number of failures computed** by the methodology over the lines of the cluster **is in line with the empirical mean of the number of failures** recorded for the same lines.

Test system under study

- A relevant and representative part of the Italian EHV and HV transmission system



Definition of clusters

Cluster for voltage level
60 kV (40-90 kV)
130 kV (110-140 kV)
150 kV (141-170 kV)
220 kV (195-250 kV)
400 kV(360-400 kV)

V

Cluster for line length (km)
L<= 5.5
5.5 < L <= 11.4
11.4 < L <= 20
L > 20

L

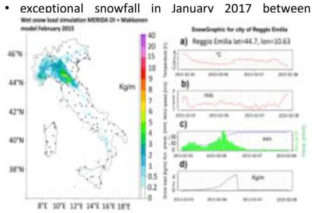
Cluster for max altitude (m)
H <= 200
200 < H <= 800
H > 800

H

Step1: Validation of MERIDA dataset outcomes versus real events

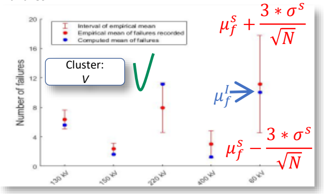
Comparison of **recorded wet snow loads versus** wet snow **loads calculated by MERIDA dataset** for the following severe events:

- December 2013 event with blackouts in the area of Belluno and Cortina d'Ampezzo (25 lines affected)
- wet snow event in February 2015 with widespread failures in the North (150 lines affected).
- exceptional snowfall in January 2017 between

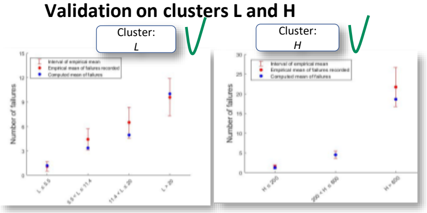


Step2: Validation of OHL outage return periods

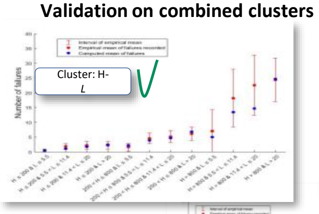
Checking the position of the calculated mean number μ_f^I of failures for the lines of each cluster in the 99.9% confidence interval of the empirical mean number of failures

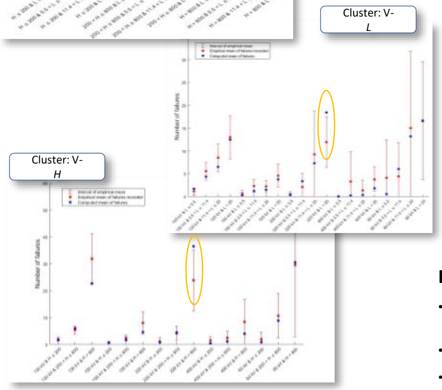


Validation on clusters L and H



Validation on combined clusters





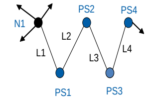
Discussion on validation

- Validation rate is the ratio between nr of clusters with successful validation and the total number of clusters
- 100% validation rate for individual clusters (V, H, L)
- Validation rate is 100% for HL clusters, and 95% and 93% respectively for VL clusters and VH clusters
- Few mismatches due to the presence of lines with old design criteria dating back to early 50's

Application

Goal: **demonstrate the effectiveness** of the resilience-oriented cost-benefit analysis implemented by the methodology **to identify the critical and priority areas** and the **hardening interventions** on the grid

Case study



Substation	Load (MW)
PS1	30
PS2	20
PS3	10
PS4	30

RP_{L1}=3 years; RP_{L2}=13 years; RP_{L3}=13 years; L4 resilient line

correlation submatrix corresponding to the set of lines {L1, L2, L3, L4}

	L1	L2	L3	L4	...
L1	1	0.987	0.995	0.137	
L2	-	1	0.959	0.136	
L3	-	-	1	0.107	
L4	-	-	-	1	
...	-	-	-	-	1

EENS in pre-intervention phase

Probabilities of detected multiple contingencies

RP*	Ctg ID	Outaged lines			Prob(ctg_h) [p.u./year]
		L1	L2	L3	
3	A	1	0	0	0.209877
13	B	0	1	0	0.000465
	C	1	1	0	0.018467
	D	0	0	1	0.000463
	E	1	0	1	0.018469
	F	0	1	1	0.000057
	G	1	1	1	0.055354

Contingencies causing PS1 disconnection

Contributions to the risk of lack of energy supply to PS1

RP*	Ctg ID	Unserved substation	Unserved load at "average loading" grid condition [MW]	Prob(ctg_h) [p.u./year]	$EENS_h$ [MWh/year]
13	C	PS1	30	0.018467	8.9
	E	PS1	30	0.018469	8.9
	G	PS1	30	0.055354	26.6

- Total EENS related to PS1 substation = 44.3 MWh/year
- RP of PS1 substation outage = 11 years

EENS in post-intervention phase

- Cost-effective solution identified via the CBA: partial undergrounding of the lines L2 and L3
- Lines L2 and L3 are made resilient to the threat.
- Benefit $\Delta EENS = EENS_{POST} - EENS_{PRE}$ = -44.3 MWh/year

Conclusion

- The paper described the **validation process of the methodology** jointly developed by **RSE and Terna** for resilience oriented grid planning
- The **very high validation** rates of the mean number of failures demonstrate the **reliability of the analytical model for OHL vulnerability** to wet snow actions

➢ C1 Activity

- Partecipation to 4th SEERC (Istambul)

Electric Transmission

4th SEERC CONFERENCE ISTANBUL

Oral Presentation Article ID: 101

Impact of the Hydrological Risk on the Power Grid: A Case Study on a Portion of the Italian Transmission Power System Exposed to the Hazard of Flooding

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ENRICO MARIA CARLINI, FRANCESCO MARZULLO (1), SILVERIO CASULLI *, FRANCESCA SCAVO, GRETA MAGNOLIA , FEDERICO FALORNI, ALESSANDRO LAZZARINI
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EMANUELE CIAPESSONI, DIEGO CIRIO, ANDREA PITTO, LEONARDO MANCUSI,
Ricerca sul Sistema Energetico – RSE S.p.A.

Italy

SUMMARY

The increasing frequency and severity of extreme events in the last few years poses new challenges for the planning of more resilient power grids. This calls for new tools and methodologies to perform a resilience informed planning of modern grids. To this purpose, the Italian TSO Terna and Ricerca sul Sistema Energetico – RSE S.p.A have developed a risk-based methodology with the aim to assess the resilience of the electricity system to prioritize the interventions for resilience enhancement in the context of long-term grid planning.

Due to its geomorphologic configuration and geological characteristics, more than one third of the Italian Peninsula territory is "exposed" to hydrogeological hazards (mainly landslides and floods), which represent the third cause of failures in the Italian electric system, after wind and wet snow events.

In this work the authors propose probabilistic models for floods and for the grid asset vulnerability to the same hydrological hazard and integrate them in the resilience risk-based assessment methodology, thus extending its application domain to flooding events, with the goal to evaluate the failure return periods of the grid assets due to floods, a first step to quantify the risk associated to such threat. The case study related to some sample areas of the grid particularly exposed to floods demonstrates the possibility of application of the methodology to hydrological threats.

➢ C1 Activity

■ Abstract submitted to CIGRE Session 2024

Abstract approved by C1

2024 Paris Session

C1 Power system development & economics
Resilience as pivotal criterion for system development

Application of a multi-hazard risk-based Resilience assessment methodology to real cases in the Italian Transmission System

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➢ C1 Activity

- Paper published to CSE

CSE N.30
October 2023

[Power System Resilience: definition, features and properties | CSE (cigre.org)]

CSE030

Power System Resilience: definition, features and properties

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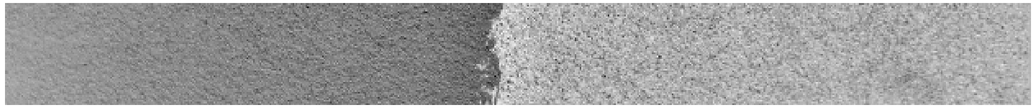

CIGRE WG C1/4.46

Optimising power system resilience in future grid design

Convener: Christian Schaefer, Australia

➢ Terms of Reference of C1/4.46

- The mission of this WG is to

  Establish the suitability of current system planning and asset management standards to support the energy sector transition to a low emission one and where possible recommend opportunities for improvements. Also find the break-even condition between preventive, containment and restoration measures and propose guidelines for determining an optimal mix of resilience.

- The scope of this WG is to:
  - Establishing current practices and standards;
  - Development a gap analysis;
  - Propose opportunities for improving existing planning methods and standards.

- Main tasks are:
  - **Build on work done by prior WGs on power system resilience topics** (C2.25, C4.47, C1.17) and consider their recommendations in the proposed WG scope of works;
  - **Adapt and document suitable metrics** to define power system resilience for interconnected electrical power network;

➢ Terms of Reference of C1/4.46

- Main tasks are (continued from previous page):):

- **Review existing planning methods** and standards used for power system infrastructure investments by system operators and identify notable challenges associated with these in meeting the needs of a decarbonizing energy sector;
- **Consider the resilience of power system equipment** in view of changing climatic conditions and identify emerging constraints and limitations;
- **Investigate the most used system restart techniques** and consider whether these are viable in a highly decentralized, variable generation and inverter-based resource power system. A global review of new restart technologies and methods will also be considered;
- **Investigate the concept of flexible grid design, potential barriers presented by market/regulatory frameworks and investigate decision-making/cost benefits analysis**, using a holistic approach that combines network and non-network augmentations and operational procedures which can meet the requirements for building a resilience grid;
- **Promote technical papers, technical panel sessions and workshops** for the dissemination of academic research and real-word applications of power system resilience for a decarbonizing energy;
- **Coordinate activities where appropriate with ither Cigrè committees**, subcommittees and groups about power system resilience;
- **Develop a final report and Technical Brochure**

Deliverables:

The JWG document their findings and share insights and knowledge gained by the investigation with broader Cigrè community:

- **Tutorial and Survey**
- **Technical Brochure**
- **Electra Report**

JWG B2/C1.86

Approach for Asset Management of Overhead Transmission Lines

Convenor B2: Viktor Lovrenčić (SL) /Co-Convenor C1: Yury Tsimberg (CA)
Secretary: XXX

Objective of JWG.B2/C1.86

This Joint Working Group is required to

1. Review previously published CIGRE Technical Brochures and Green books on OHLs
2. Design a survey and collect the survey results
3. Identify typical data sources for both “static” and “near real time” input data
4. Define desired outputs and their intended usage in facilitating AM decision making
5. Analyse the survey results and establish a recommended set of APM tool requirements, Key Performance Indicators, AHI formulae and criticality matrices
6. Prepare a Technical Brochure and ELECTRA article
7. Tutorial

JWG Task Forces

The working group is divided in four task forces.

Subgroup	Scope	Membership
TF1: Review of previously published CIGRE TBs	Review previously published CIGRE TBs in both SC B2 and SC C1 and prepare a brief synopsis of each plus overall findings	*Leader:* ***Kerstin Weindl*** Members: Callum Maloney, Alex Levinzon, Balint Nemeth, Stephen Connor, Michał Kołtun, Flavia Buratti, Vusi Phiri, Marián Mešter, Heiko Hembach, Alessandro Valsecchi, Ruben V Rodriguez, Jean-Marie George, Konstantinos Kopsidas.
TF2: Survey	Design, conduct and analyse the survey to see what is TSOs experience with implementing AM processes from both strategic perspective (processes, decision making mechanisms, performance measurement) and tactical perspective (input data, analytics to generate information, outputs, etc.)	*Leader:* ***John Lauletta*** Members: Ivana Mitić, José Moreira, Stephen Connor, Jialun Yang, Thomas Schiml, Daisuke Sakamoto, Miha Bečan, Marián Mešter, Yuto Moriwake, Mario Križić, Daniel Marginean, Konstantinos Kopsidas.

JWG Task Forces

Subgroup	Scope	Membership
TF 3: Strategic aspects of AM for OHTL	Focused on strategic aspects of AM for OHTL: decision making approach, prioritization, KPIs, AHI, overall AM process, reporting, compliance.	*Leader:* ***Misra Mohit and Konstantinos Kopsidas*** Members: Tony McGrail, Lionel Figueroa, Klemens Reich, Alex Levinzon, Balint Nemeth, Stephen Connor, Jialun Yang, Bruno Jurišić, Mohammad Reza Shah Mohammadi, Vusi Phiri, Branko Đorđević, Marián Mešter, Shahrokh Zangeneh, Eveline Vranken, Ruben V Rodriguez Keith Keady, Sundariyal Vivek.
TF 4: Tactical aspects of AM for OHTL	Focused on tactical aspects: IT systems, analytics used to generate information to support decisions, input/output data collection and dissemination, end-of-life actions.	*Leader:* ***Gary Brennan*** Members: Ivana Mitić, Tony McGrail, Figueroa Lionel, José Moreira, Balint Nemeth, Mohit Misra, Mohammad Reza Shah Mohammadi, Antonio Laudani, Marián Mešter, Kerstin Weindl, John Lauletta, Keith Keady, Sundariyal Vivek, Konstantinos Kopsidas.

TF 3 & 4 based on results from TF1 and TF2 + team members experience (should work closely together, 2 subgroups)

WG C1.33

Interface & Allocation Issues

in Multy-Party and/or Cross-Jurisdiction Interconnection Projects

Convener : Antonio ILICETO (Terna, Italy)

New Secretary : Niccolò ZARETTI (Terna, Italy)

Recap from previous situation

- **WG has been "on hold" for quite some time for a number of reasons**
- **Key barrier was the drafting capability, in terms of time to be dedicated**
- **Recently a young and talented resource has been found, ("new Secretary") who took over the whole drafting with fresh eyes**
- **Lesson learnt: drafting phase crucial point, to be assigned / shared since the beginning** → *drawback: need to harmonise the "patchwork" text*
- **Materials collected**
- **Questionnaires received and analyzed**
- **Structure of the Technical Brochure defined**

Steps achieved in previous stages of WG

- **Tutorial already given at Cigre SEERC conference May 2022 in Vienna**

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Status

- Drafting of the first version completed

- Present step: global revision by Convenor for:
  - ✓ robustness and consistency of the storyline
  - ✓ completeness of the analysis
  - ✓ Addition of figures and graphic representation of the analysis
  - ✓ updating of regulatory framework and of solutions envisaged; nice to see: this shows that the topic raised, which was first-time-addressed in a systematic way, was real and that Cigre has been anticipatory of upcoming trends
  - ✓ addition of further considerations, conclusions and recommendations

- Next steps:
  - ✓ review of the first version of Technical Brochure by the Members of the Working Group → possible additions and updating of the case-studies, but analysis and conclusions should be mostly valid
  - ✓ Review by Study Committee members, for enlarging the knowledge base and endorse conclusions and recommendations
  - ✓ Prepare the publication set for Central Office
- Estimated timing: 4Q 2023

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Technical Brochure status, around 40 pages

Interface & Allocation Issues in Multy-Party and/or Cross-Jurisdiction Interconnection Projects

WG C1.33

Members

A Iliceto, **Convenor**	IT	C A. Plet, **Secretary**	NE
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J Lin	USA	G Doorman (Liason Member C5)	NOR
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ISBN : [to be completed by CIGRE]

Executive Summary

Working Group C1.33 ("WG C1.33") has produced this Technical Brochure to carry out a comparative analysis on a number of case studies of International Multy-Party and/or Cross-Jurisdiction Interconnection Projects and to draw a summary of lessons learned useful to pro-actively manage and anticipate the challenges that typically arise in this type of projects.

In particular, the focus was placed on the recurring issues of interconnection projects: the challenges in terms of Interface, coordination between the different Parties, and the challenges of Allocation of costs, benefits and risks.

Given the increasing number of cross-jurisdiction and multi-party electrical interconnections, this Technical Brochure assesses how these Interface and Allocation issues are and/or should be taken into account by implementation schemes (public, private, mixed public-private investment) and related Business Models and how these are diversifying at times, from traditional symmetric to innovative asymmetric models, to find tailor-made solutions adapted to the specific characteristics of the project. The discipline of "Merchant Lines" is also described, which in theory should concern fully private investment implementation schemes, but which over time has also developed and extended to mixed public-private partnership schemes, being adopted in various case studies examined and cross-jurisdiction projects promoted by TSO investment. Intrinsic flexibility of the merchant line mechanisms and the possibility of asymmetric cost/benefit sharing between investors in the interconnection gives raise to innovative and case-tailored implementation schemes, and some case studies present interesting and diversified examples of "business models".

The Technical Brochure outlines the main drivers determining the Interface and Allocation Issues, such as the diversity of investors' objectives, diversity of regulatory frameworks and national legislations, technical and technological aspects of interconnection. The different implementation schemes (traditional public investment, private merchant, innovative mixed public-private) are described and related to the Business Models that are increasingly conceived in innovative, tailor-made ways, to solve the complex issues of Interface and Allocation.

Survey Findings

Working Group C1.33 ("WG C1.33") developed a questionnaire entitled "**Interconnectors Business Models – Format scheme for case studies analysis**" which was shared among the WG Members. Thanks to the questionnaire, original information and considerations on twenty interconnection projects were collected. The analysis of these case studies formed the basis for the identification and description of Allocation and Interfaces issues

Literature Review

Working Group C1.33 ("WG C1.33") did not find consolidated literature on the topic under examination, but rather information from direct experience of participation and work in interconnection projects.

Suggestions for Future CIGRÉ Work

Working Group C1.33 ("WG C1.33") recommends exploring the topic of the study by updating the results obtained with the analysis of new case studies, if any, not taken into account in the previous questionnaire

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Sections of Technical Brochure (1/2)

- **Executive Summary**
- **Introduction**
  - Scope of work and targets of the study
- **Description of Interface and Allocation Issues**
  - Approach and definition of the concepts of Multy-Party and Cross-Jurisdiction
  - Interface Issues
  - Allocation Issues
  - Combination of both Interface and Allocation Issues
  - The main drivers of the occurred issues
- **Methodology**
  - Case Studies
  - Questionnaires
- **Options for Implementation Schemes**
  - Traditional implementation schemes for interconnections
  - Public Investment
  - Private Investment
  - Mixed Public-Private Investment
  - Focus: Investment in the case of Merchant Lines

Sections of Technical Brochure (2/2)

- **Business Models and their Drivers**
  - The Traditional Business Model for Public Lines
  - Business Models for Internal Lines
  - Innovative Business Models for Public Interconnections: asymmetric sharing
  - Different Business Models addressing the Interface and Allocations Issues
  - Drivers determining the Business Models
  - Costs Drivers systematically differ from Benefits Drivers
  - Drivers of evaluation principles and allocation criteria
  - Drivers of Allocation Criteria
  - Decoupling of Ownership and Utilization rights
  - Offshore Grids
- **Conclusions and recommendations**
- **Literature survey and reference documents**
- **Appendix A – Questionnaires received**
  - List of Questionnaires received - Working Group C1.33 (“WG C1.33”)
- **Appendix B - TPA exemptions and merchant lines: applicable concepts and references**
  - Business Models for Merchant Lines

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Matrix analysis

- **Business Models and their Drivers:**

The presence of these issues, and their envisaged solution, should constitute the reason / driver for the selected business model

Number of jurisdictions affected ↑ / Number of investing Parties →	One	More than one
More than one	<u>INTERFACE ISSUES</u> *(between jurisdictions)* -Border point -Routing costraints - Different Legislation - Different Authorisation process - Diff. regulation for capacity use - Assets located in foregin territory	COMBINATION OF THE TWO TYPES + FURTHER ISSUES: *(due to different jurisdictions and/or different Company policies)* - Different rationale for investment - Different role of interconnector - Different assessment criteria -Different evaluation metrics
One	NO PECULIAR ISSUES	<u>ALLOCATION ISSUES</u> *(between Parties)* -Sharing of costs -Sharing of risks - Sharing of benefits

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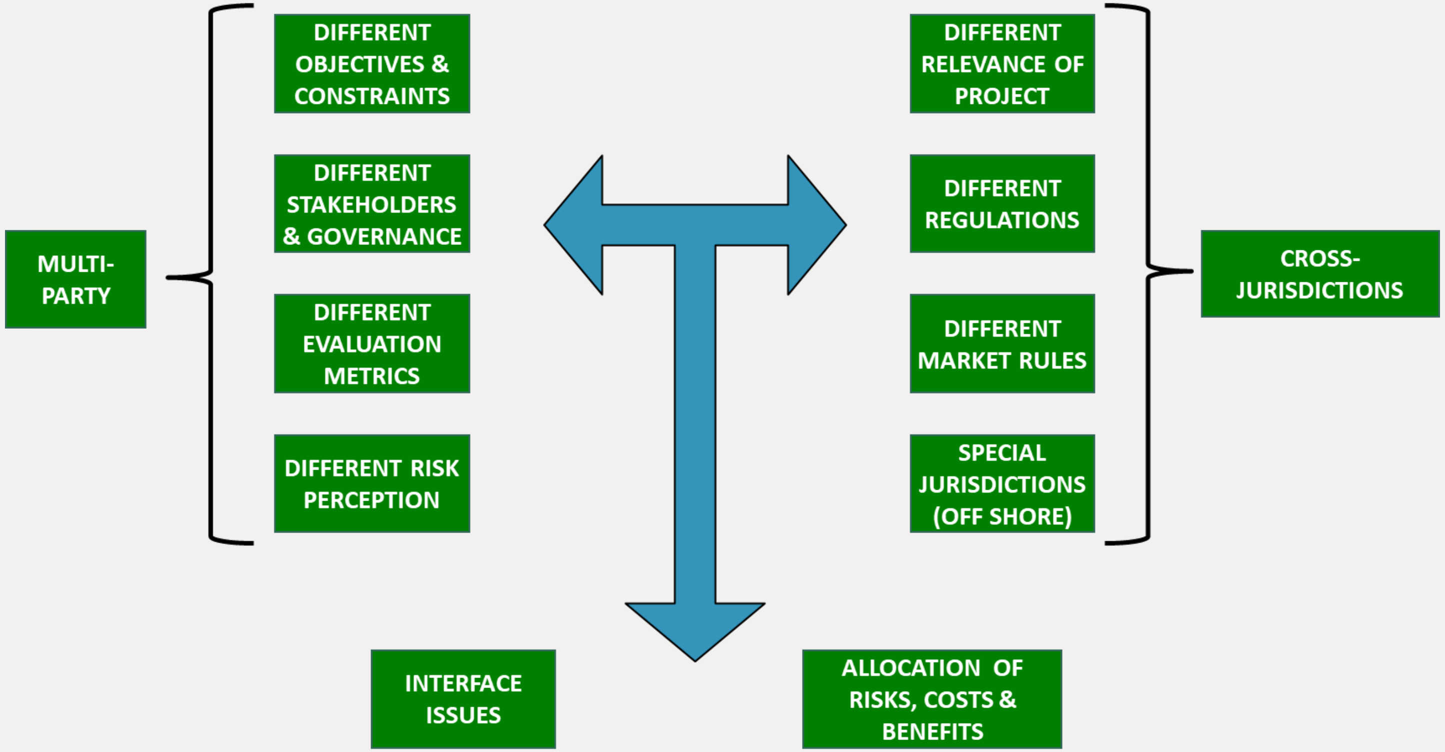
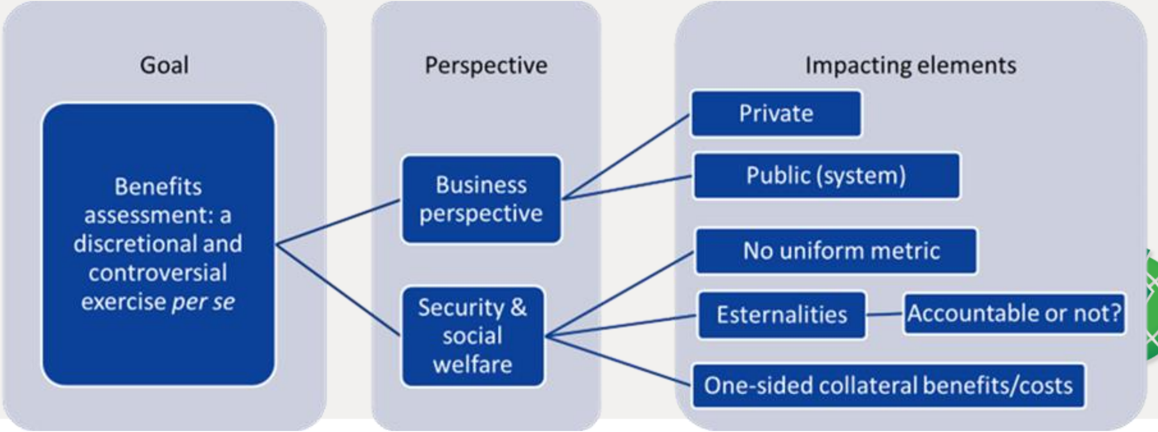
Analysis and categorisation of the interconnection issues

- Drivers of occurred issues in interconnection projects due to allocation and/or interface

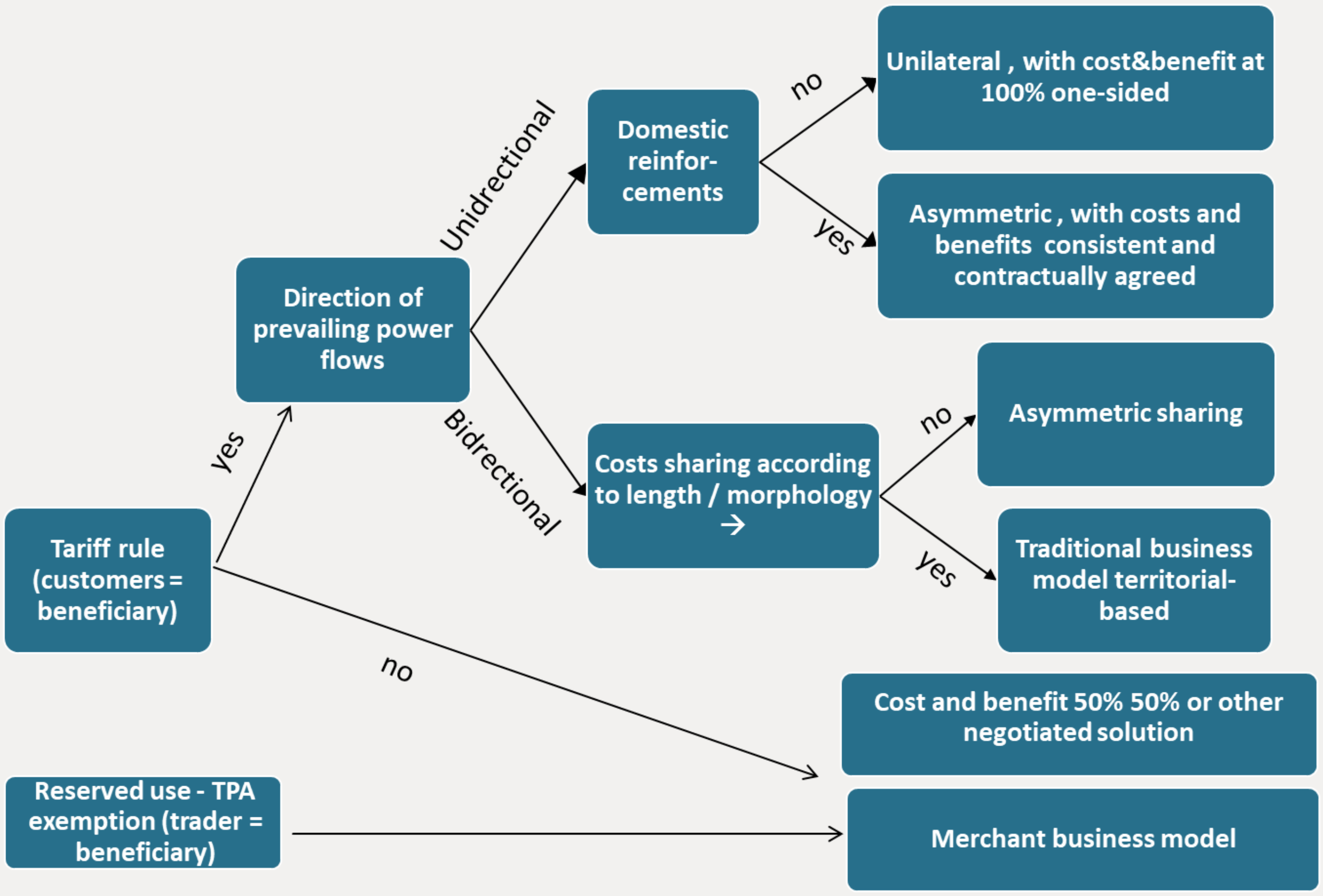


- Benefit assessment is the most complex part in Cost-Benefit-Analysis



Draft conclusions

- **Which configuration and organisational solution was chosen , on the basis of which main drivers (barrier/opportunity)**



Original members and contributors

Name	Gender	Country	Affiliation	Role
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WG C1.44 Task 7

Trading rules and governance issues

Convenor B2: G. Sanchis

Milan, 23 November 2023
Cigre SC C1 Italy Workshop

Cigre WG C1.44 Task 7
Trading rules and governance issues

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Key issues

- the need and effects of continental-scale electricity trading rules and governance issues
- impact of **continental-scale electricity trading rules** on global grid developments
- impact of **continental-scale governance issues** on global grid developments

Focus on trading and governance impact

Combined approach:

- **Bottom-up** -> collection of background experiences concerning power system structure, cross-border regulation and trading rules
  - The case of European (EU, UK) region systems
  - The case of African regions systems
  - The case of Russian regions system
  - The case of Chinese regions system
  - The case of Indian region systems
  - The case of North American regions systems
  - The case of South American regions systems
  - The case of Arab region system
- **Top-down** -> best practices from mature and under development markets

Background: African regions

Source: UNEP, Atlas of Africa Energy Resources, 2017

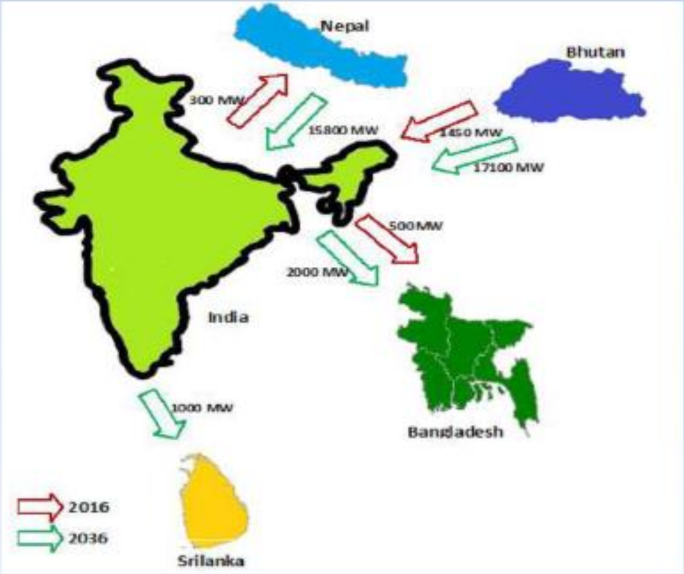
Overview of African Power Pools

- **North African Power Pool (NAPP)/COMELEC** since 1975
  - Best infrastructure in Africa
  - Highly depending on fossil fuels
  - Low imports and exports
- **Southern African Power Pool (SAPP)** since 1995
  - Most advanced power pool
  - Implemented Day-Ahead- and Intra-Day-Market
  - Lack of generation and interconnection capacity preventing further development
- **Eastern Africa Power Pool (EAPP)** since 2005
  - Plans to have a centralized trading market in place between 2020 and 2025
  - Resigning of Egypt in 2016
- **West African Power Pool (WAPP)** since 2001
  - Small compared to other pools
  - Weakly developed connections between the members
- **Central African Power Pool (CAPP)** since 2005
  - Small compared to other pools
  - Demands are expected to increase in future
  - More hydro-generation compared to other pools

Background: Indian region

Cross-border trading in Indian subcontinent

- As of 2019, **only 3000 MW of power** is traded in south Asia
- Seven countries: India, Bhutan, Bangladesh, Myanmar and Nepal (existing trading), Sri Lanka and Pakistan (possibility for future trading)
- India – largest power system in the region, centrally located for cross-border trading
- Two possibilities for cross-border trading:
  - **Traditional –** bilateral agreements between Indian entities and entities of India's neighbours
  - **Liberalized –** competitive bidding over the Day-Ahead Market of the Indian Energy Exchange (IEX) and Power Exchange India Limited (PXIL), since 2019-20



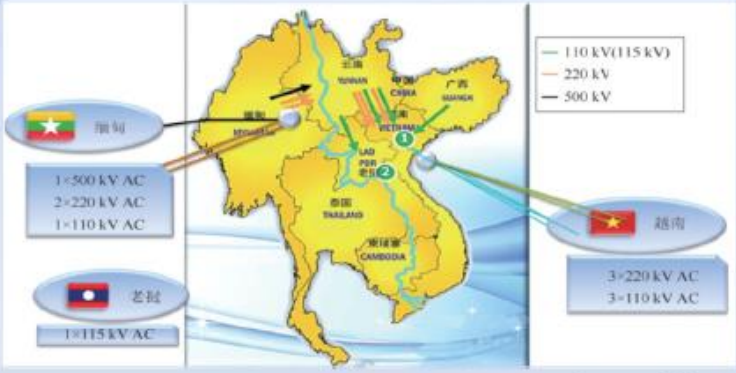
Source: CERC, India

Background: Chinese region

Cross-border trading in Chinese region – with southern neighbours

- Current contracts with neighboring southern countries are based on a single electricity price, to be confirmed every year when determining the level, comprehensively considering the local supply and demand conditions in the involved countries/regions.

At present, China exports electricity unidirectionally to Vietnam and Laos, with no import from them. On the other hand, Myanmar relies on two hydropower stations, and conducts two-way power trading with China.



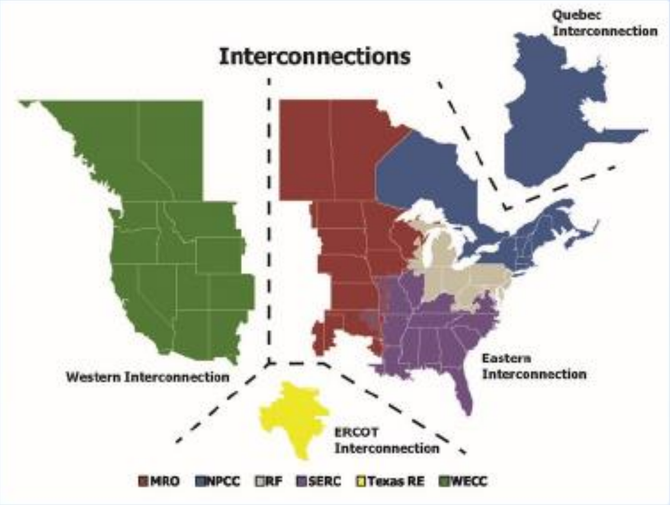
Source: CSG

Cross-border interconnections (planning/study) in Chinese region in 2035

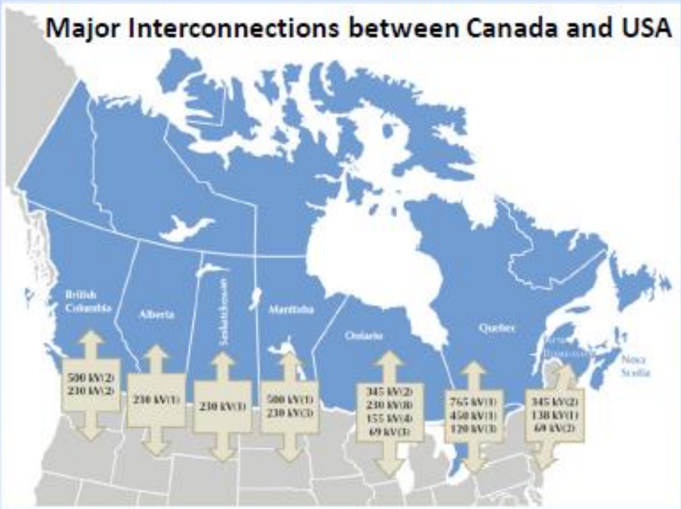
Source: GEIDCO (2020)

Background: North American region

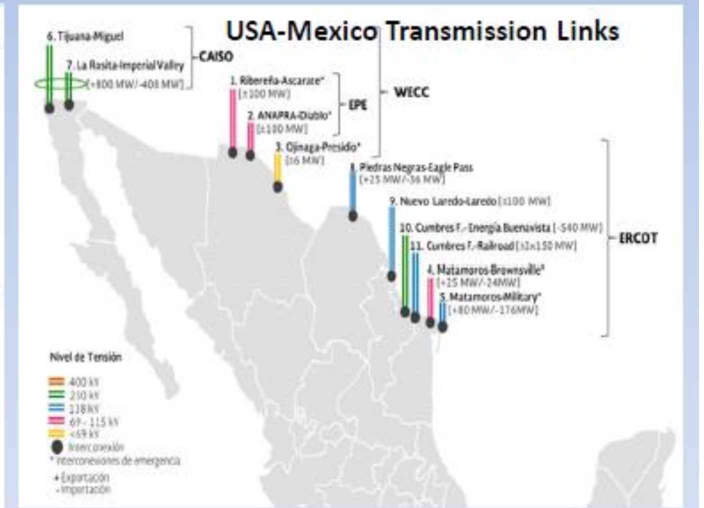
North American power transmission and market overview



Source: NERC



Source: CER



Source: CFE

Background: South American region

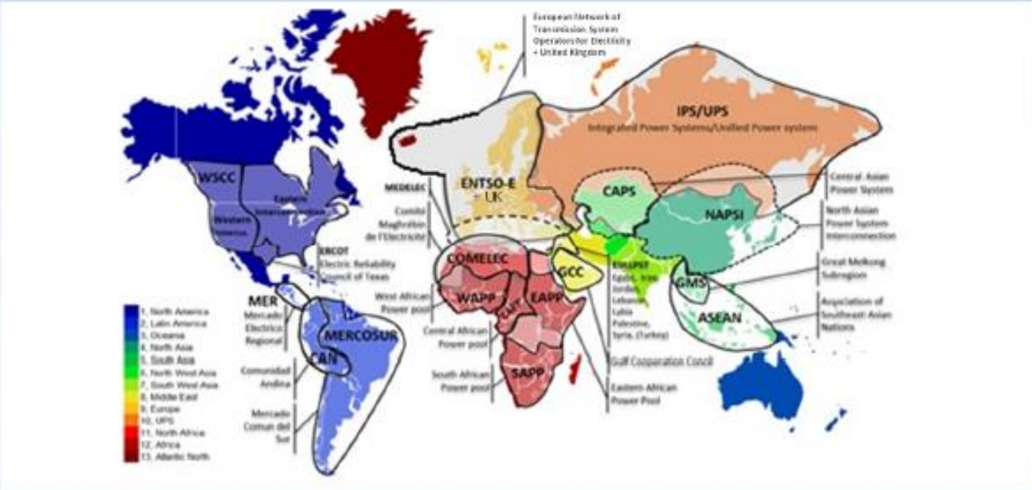
Cross-border trading regulation in South American region – success stories

- **Colombia** and **Ecuador** have been electrically interconnected since 2003. The main **financial agreement** between Colombia and Ecuador is established in the form of **splitting the congestion rents produced in the cross-border line**.
- **Bi-national Itaipu agreements** between **Paraguay** and **Brazil** and between **Paraguay** and **Argentina** were established **to make efficient use of the available hydro capacity**. They establish the financial bases on the exploitation of the hydro power plant. These agreements will be reviewed by 2030.
- Some countries have implemented **intermediate solutions** with **direct subsidies or price controls** (that operate as indirect subsidies) to protect local markets. E.g., the **agreement between Chile and Argentina** states that the exchange of power is based on an **interruptible interconnection agreement with a price control rule**, where only generation units that are not dispatched to meet the domestic demand are able to export power.

Source: CIER

Granularity of trading arrangements

- **Multilateral trading arrangements** can take place among countries, or among established organisations spanning across several countries
- In view of global grid, it seems **natural to leverage** on **existing/upcoming power sector supranational organisations**, especially if trading rules are already in place inside them
- This occurs in case a **wider framework is in place**, beyond trading rules, including network codes, connection rules, commercial standards, legal/regulatory framework, operational agreements for interconnectors, etc.



Source: updated from CIGRE TB 775 (WG C1.35), 2019-2022

Source: adapted from Middle East – PAEM initiative, 2020-2022

Enablers for accelerating Cross-Border Electricity Trading (CBET)

Political

- Regional Outlook/Vision
- Political Consensus
- Intergovernmental agreement(s)
- Implementation Mechanism
- Power Market Reform

Regulatory

- Permissibility to use intermediary transmission network under open access
- Rules for identification of transmission capabilities & congestion
- Rules for measurement of imbalance and settlements
- A conducive & friendly ecosystem for investors

Technical and Commercial

- Harmonisation of grid codes & standards, Grid Connectivity
- Transmission pricing & transit charge
- Co-ordinated Regional Transmission Grid Planning
- Settlement & payment mechanism
- Dispute resolution mechanism

Institutional

- Institutional arrangements
- Regional Coordination Forums are desirable
- Will foster long term sustainability

Source: SAARC Region CBET, 2020

Set-up of common frameworks

Cross-border electricity trading regulation: local peculiarities and general issues

- Bilateral, multilateral, regional, continental trading patterns
- Is it necessary a common market set-up or trading agreement can suffice as a start, especially for point-to-point interconnections?
- Is it necessary to include trading/utilisation patterns in the interconnection realisation agreement?
- Business models for interconnector utilisation: merchant, national public grid, special status, reserved use
  - Merchant: transport fee, wheeling charge, etc. -> users are energy sellers/buyers in the interconnected jurisdictions
  - Public grid in open market: utilisation embedded in advanced spot/future market mechanisms
  - Public interconnector without open market: reserved use, monopolists suppliers/purchasers -> coordination of rules across the different jurisdictions
- Utilisation scheme of the interconnections: capacity allocation, congestion management, inter-TSO compensation mechanisms (if any), etc.
- Main reasons and barriers for cross-border electricity trading
  - Different legislative set-up: institutions, decision bodies, regulators -> map of decisional path in all jurisdictions involved
  - Different regulation and market
  - Technical issues
  - Economic issues
  - Environmental issues
- Private commercial agreements or public common rules? Role/need of governmental back-up
- Evolution to a regional/multiregional common market (example of Europe with ENTSO-E)

Preliminary recommendations

- **A gradual approach – from bilateral to multi-lateral, regional, continental up to global level trading – is necessary** and should be followed given different conditions and local constraints
- **Political support is needed** for realisation of interconnectors, but also for backing-up general trading arrangements and individual commercial transactions
- **Legal risk** and **investment protections** considering the **huge upfront investment effort in transmission assets** and new power plants and **a stable legal framework** at macro-regional level **are essential** to attract private investors and cross-border trade
- **Bilateral energy trading — The market model** for energy trading and using transmission capacity **should be as simple as possible**, especially **in the early stages of interconnected operations.** Therefore, the starting point could be based on the use of **bilateral contracts in the form of PPAs** between generators and buyers, plus relevant arrangements for transfer capacity
- **Regional market model —** The regional market model in a **mature restructured power system** would see the **coexistence of bilateral energy trading and short-term energy transactions on a spot market** where the various market agents (sellers, purchasers, traders) operate

Preliminary recommendations

- **Access to the transmission grid —** The transmission system should be open to connection of IPPs. Remuneration for using the grid should be transparent, non-discriminatory and, as far as possible, stable over the time. Transmission fees should reflect costs
- **Regional institutions should be promoted and created**, in the form of Regional Energy Committee, with tight operational links with the involved TSOs and utilities
- **Regulatory harmonization —** While some national reforms may well be needed, regional rules should minimize interference with domestic policies. This will allow the intercontinental/interregional Interconnection to be developed more quickly, and this will continue to give national governments freedom to set domestic policy

Gradual development of common trading schemes

WG C1.45

Harmonised metrics and consistent methodology for benefits assessment in Cost-Benefit Analysis (CBA) of electric interconnection projects

Convenor B2: Pierluigi Vicini (IT)
Technical Secretary: Fabio D'Agostino

WG C1.45

Introducing the Team

P. Vicini, F. D'Agostino

Who we are

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  CESI Middle East FZE

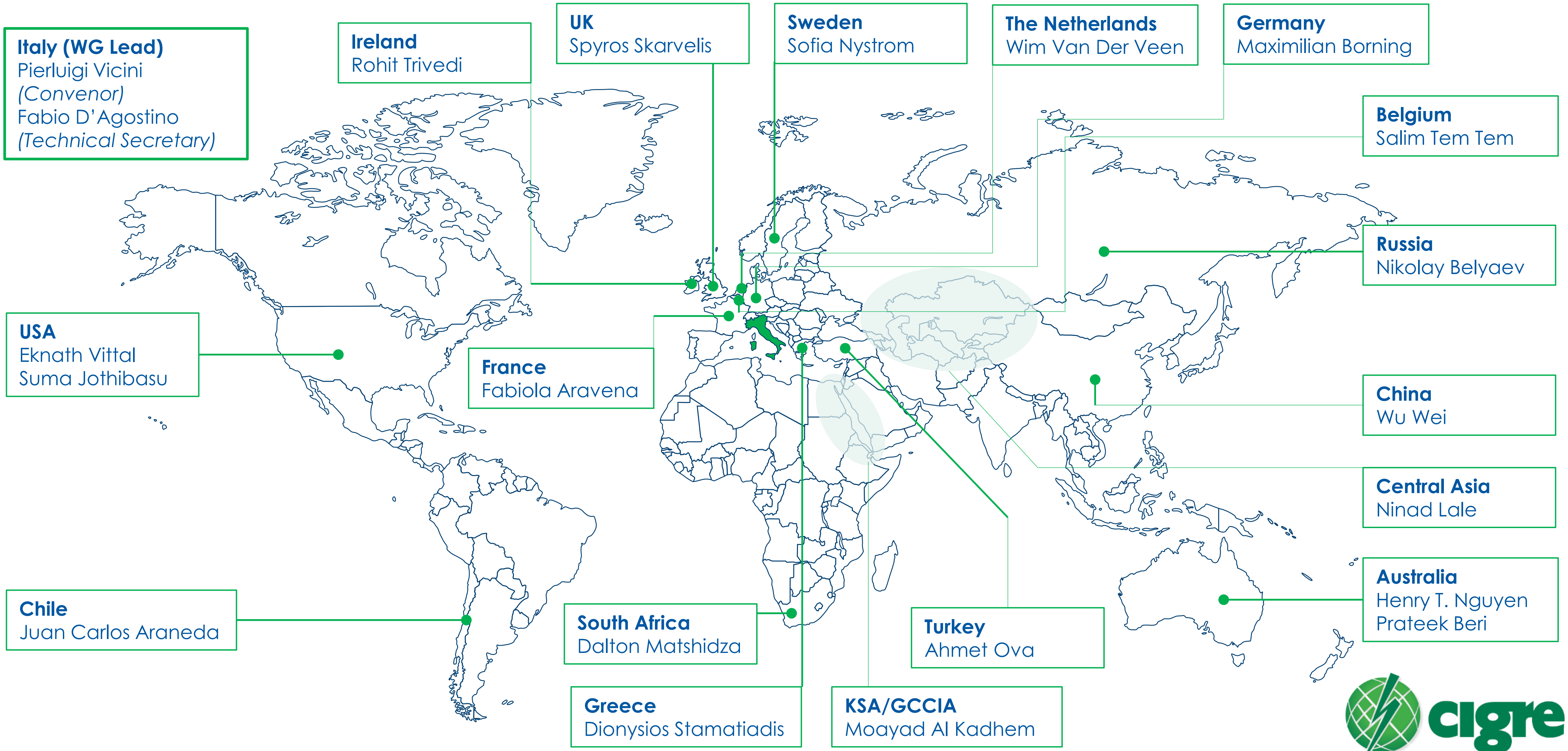
Technical Secretary

Fabio D’Agostino, PhD

- *Tenure Track Professor*
  University of Genova

For power system expertise

Who we are



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P. Vicini, F. D’Agostino

Milestone 2

List of WG Members

Name	Membership	Company
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Fabiola Aravena	Representative	RTE
Nikolay BelYaev	Representative	-
Prateek Beri	Representative	Tasnetworks
Maximilian Borning	Representative	RWTH Aachen
Bruno Cova	Representative	CESI Spa
Antonio Iliceto	External	Terna
Suma Jothibasu	Representative	EPRI

Milestone 2

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Dalton Matshidza	Representative	Eskom
Ngoc Nguyen Tho (Henry)	Representative	ElectraNET
Sofia Nystrom	Representative	RISE
Ahmet Ova	Representative	TEIAS
Spyros Skarvelis-Kazakos	Representative	University of Sussex
Dionysios Stamatiadis	Representative	Smartwires
Salim Temtem	Representative	Elia Grid International
Rohit Trivedi	Representative	DNV GL
Wim Van Der Veen	Representative	Electric Power Research Institute
Eknath Vittal	Representative	GEIDCO
Wei Wu	Representative	GEI

The WG in brief

- Approved by Technical Council Chairman on November 28, 2020
- KO meeting: 2021, February 25th
- Number of active members: 20
- Number of meetings: 16
- Number of Task Forces: 4
- Plenary Paris Session meeting: 2022, August 29th
- Tutorial: presented at 4th SEERC Conference Istanbul, 2023 October 11-12, 2023
- Current activity: Finalizing Technical Brochure

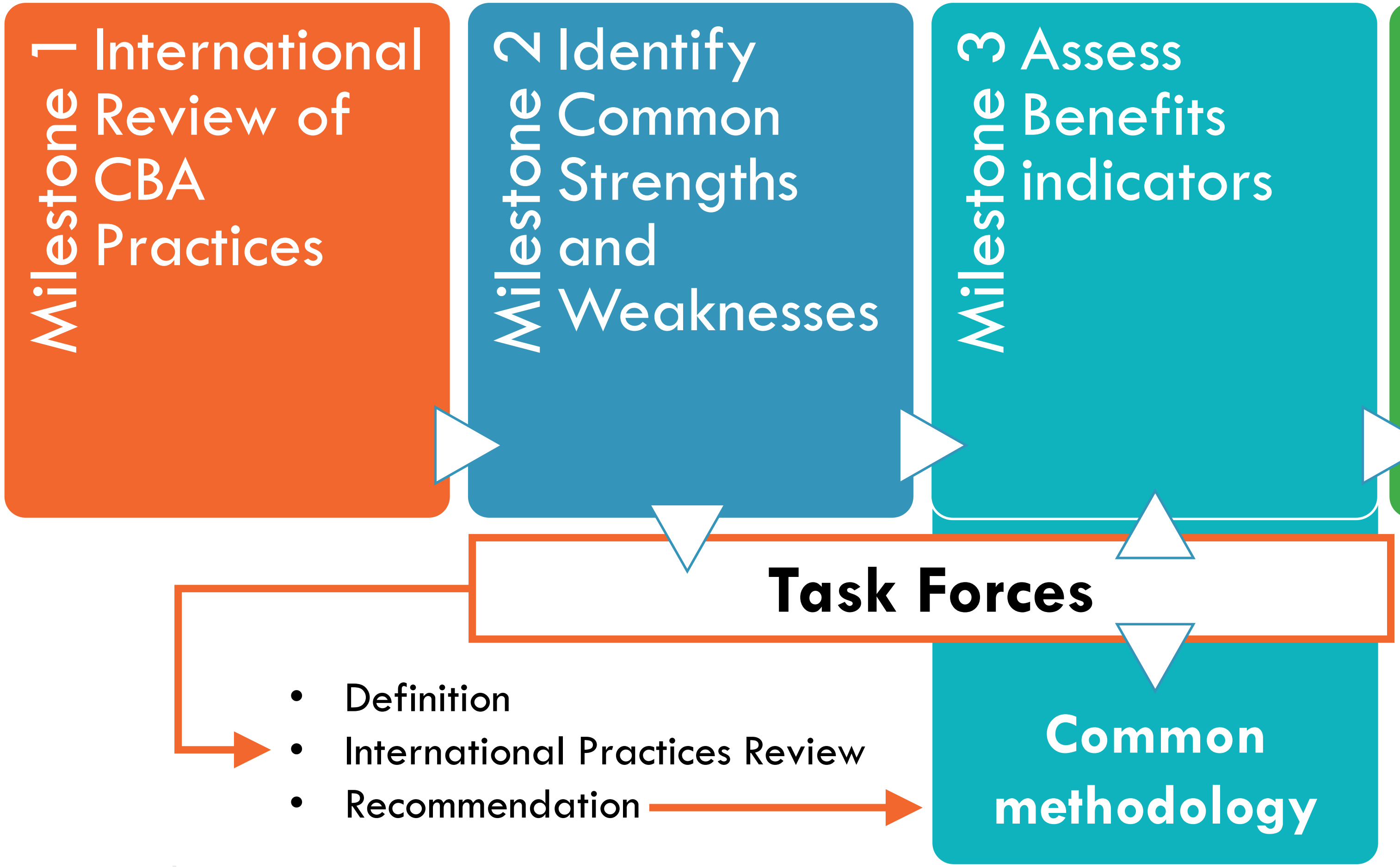
Scope of the WG in detail

1. To **identify the benefits indicators** (economic, social, technical, environmental) associated to an interconnection project, considering the various markets and regulatory frameworks worldwide.

2. To **define a procedure to quantify the benefit indicators** and how to combine them in consistent way when they have different metrics.

Work methodology

Preparation – Analysis – Action



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Milestone 1

International Review of CBA Practices

P. Vicini, F. D'Agostino

Milestone 1

International Review of CBA Practices

Considered country/jurisdictions (21):

- Italy
- Belgium
- Central Asia
- Chile
- China
- France
- Germany
- Greece
- Ireland
- United Kingdom
- Russia
- Sweden
- The Netherlands
- Turkey
- USA
- Japan
- Australia
- GCCIA
- ENTSO-E
- World Bank
- ADB

Milestone 2

List of Benefits

Economic Benefits				
Social Economic Welfare	RES Curtailment reduction - local level	RES Curtailment reduction - area level	Avoided CAPEX	Avoided OPEX
Avoided Must-Run Units	Ancillary Services	Anticipation of benefits	Price competitive	Improved competition

Milestone 2

List of Benefits

Technical Benefits						
Adequacy	Losses	Resilience	Stability	Power Quality	Robustness	Flexibility

Environmental Benefits				
CO_2 Emission Reduction	Other Pollutants Reduction	Visual Amenity	Social Impact	Efficient Use of Territory

Milestone 2

Common Strengths and Weaknesses

P. Vicini, F. D'Agostino

Milestone 2

Table of results

Topic	Benefit	Method of calculation
Economic	Social Economic Welfare	Dispatching simulations
	RES Curtailment – Area Level	Dispatching simulations
	Avoided Capex	Case by case analysis
	Avoided Opex	Case by case analysis
	Avoided Must Run Units	Case by case analysis (Historical Costs/Dispatching simulations)
	Ancillary Services	No common methodologies – TASK FORCE
	Anticipation of benefits	Case by case analysis. Inclusion in the cash flow analysis

Milestone 2

Table of results

Topic	Benefit	Method of calculation
Technical	Adequacy	Probabilistic Analysis and valorization of EENS
	Losses	Static or Probabilistic Analysis. Monetization using average generation costs coming from dispatching simulations
	Resilience	No common methodologies – TASK FORCE
	Stability	Risk based approach based on simulations.
Societal and Environmental	Several potential benefits	No common methodologies – TASK FORCE

For power system expertise

Milestone 3

Assess the Benefits Indicators

Milestone 3

Task Force activities

Resilience

Ancillary Services

Social and Environment

Definition → Review of international practices → Recommendation for benefit calculation

Thank you for your attention.

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For power system expertise

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For power system expertise

WG C1.50

Global sustainable energy system coupling electricity and hydrogen

Convenor C1: Nicolas CHAMOLLET (FR)

Working group Objective

Based on the deep analysis of the C1.44 and C1.48, the main objective of the WG C1.50 is to perform a **quantitative pre-feasibility study** of a global power system including electricity and green hydrogen by 2050.

This pre-feasibility study shall explore the economic costs and benefits:

- of **interactions** between **electricity** and **hydrogen** supply chain including production, conversion, transport, and storage
- of electricity and H2 **storages** and **transport** between the continents
- of the optimal combinations of **power** and **hydrogen infrastructures** developments.

Working group Steps

Step 1: Demand forecasting

Forecast and map hydrogen demand and production potential/cost in each region and corresponding amount of renewable electric energy supply and installed capacity.

Step 2: Methodology

Develop and apply a methodology for modelling hydrogen layer on a global scale including potentials of production, conversion, transport, and storage.

Step 3: Modelling

Build a higher granularity global power model including interactive green hydrogen layer.

Step 4: Case studies definition

Define pertinent cases studies and sensitivities for a broad analysis based on various options such as equipment's cost, technology options, RES potentials, energy policies criteria, etc..

Step 5: Identification of synergies

Run the model and identify the costs and benefits of synergies between electricity and hydrogen in a globally optimised power mix system.

Step 6: Results analysis

Analyse the results in order to capture the fundamental interdependencies / alternative solutions, the key drivers and barriers..

Step 7: Final consideration

Summarize results and make recommendations for how and where the most important obstacles to the development of inter-continental electricity hydrogen mix power system could be addressed..

Working group Progress

Time schedule:

•Recruit members (National Committees)	Q2 2023
•Develop final work plan	Q2 2023
•Draft TB for Study Committee Review	Q3 2024
•Final TB	Q4 2024
•Tutorial	Q3 2024
•Webinar	Q1 2025

Progress:

The working group has not yet started

WG C1.49

Offshore Grid Planning

Convenor C1: Cornelis Plett

D. Negri, M. Migliori

➢ Terms of Reference of C1.49

- The mission of this WG is to

  build on the findings of previous and ongoing working groups and projects, drawing together key issues and international experience, **provide insight into and guidelines for how offshore transmission grids can be planned, developed, deployed and operated**, **considering** the purpose to be fulfilled, **the limits of onshore AC grids**, limited planning horizons, and technology characteristics.

- The scope of this WG is to:
  - To review **existing and planned offshore transmission systems/concepts and drivers**.
  - To discuss **offshore transmission purposes & multi-purpose infrastructure and associated requirements** (capacity, availability, reliability, cost efficiency, environmental impact, power quality, etc.).
  - To provide an **overview of offshore transmission technologies & their range of application**.
  - To discuss **basic offshore grid topologies, functions & associated performance**.
  - To analyse the **interface with onshore grids & associated impact on offshore grid design**.
  - To research and discuss **offshore grid growth models**.

➢ Terms of Reference of C1.49

- The scope of this WG is to (continued from previous page):
  - Provide an overview of **applicable governance & ownership frameworks** and their potential impact on offshore grid design and operation.
  - Research and discuss **offshore grid planning considerations**.
  - explore necessity and models for **coordination of offshore grid planning**.
- Remarks:
  - The working group foresees liaisons with the following other working groups:
    - ➢ **JWG C1-C4.46: Optimising power system resilience in future grid design.**
    - ➢ **WG C1.45: Harmonised metrics and consistent methodology for benefits assessment in CBA of electric interconnection projects.**
    - ➢ **WG C1.44: Global interconnected and sustainable electricity system - Effects of storage, demand response and trading rules.**
    - ➢ **JWG C2-B4.43: The impact of offshore wind power hybrid ACDC connections on system operations and system design.**
  - Moreover, tight collaboration with both SC B4 for HVDC technologies and with B1 (on submarine cables), B3 (on offshore stations) and C5 (on regulation of off-shore grids) is envisaged.

➢ Time schedule

■ Recruit members (National Committees):	Q4 2023
■ Develop final work plan:	Q4 2023
■ Draft TB for Study Committee Review:	Q4 2024
■ Final TB:	Q2 2025
■ Tutorial:	2025
■ Webinar:	2025
■ Green book:	2026

The progress of C1.49

- 21-Aug-2023: Agreed ToR
  - The activities of the WG have not started yet.

Foreseen deliverables

- Annual Progress and Activity Report to Study Committee
- Technical Brochure and Executive Summary in Electra
- CIGRE Science & Engineering (CSE) Journal
- Tutorial
- Webinar

Partecipazione a Parigi 2024

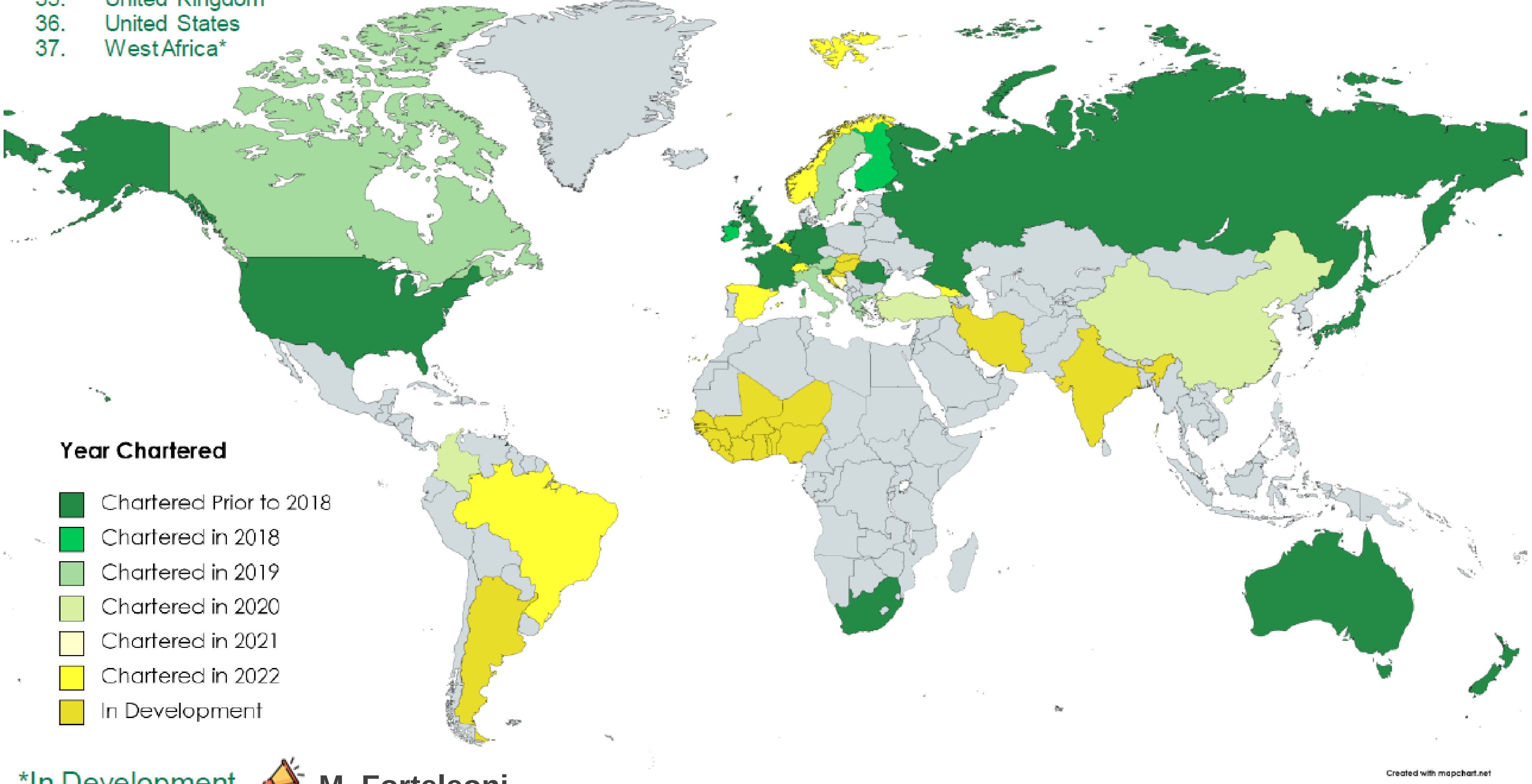
Articoli per Showcase NGN e Generale Session

Marco Forteleoni - Presidente NGN Italia

cigre
For power system expertise

Gruppi NGN nel mondo

1. Argentina*
2. Australia
3. Austria
4. Belgium
5. Bosnia & Herzegovina
6. Brazil
7. Canada
8. China
9. Colombia
10. Croatia*
11. Denmark
12. Finland
13. France
14. Georgia
15. Germany
16. Greece
17. Hungary*
18. India*
19. Iran*
20. Ireland
21. Italy
22. Japan
23. Netherlands
24. New Zealand
25. Norway
26. Romania
27. Russia
28. Slovakia*
29. Slovenia
30. South Africa
31. Spain
32. Sweden
33. Switzerland
34. Turkey
35. United Kingdom
36. United States
37. West Africa*



*In Development

M. Forteleoni

Paris NGN Showcase Challenge 2024

In cosa consiste

- Proposto dal Comitato NGN UK nel 2015
- Prima edizione nel 2016
- Piattaforma per giovani e studenti in cui poter esporre i propri lavori ad un pubblico internazionale
- Opportunità di networking con altri giovani YM nel Mondo
- Scambio di esperienze internazionali tra giovani
- Driver per potenziare la membership Cigrè

M. Forteleoni

Paris NGN Showcase Challenge 2024

Come funziona

- Partecipanti Young Members (età inferiore a **35 anni**)
- I candidati devono essere **membri Cigre** (individuali, studenti, **collettivi**)
- Ciascun paese può proporre sino a **4 contributi** (massimo 1 proposta per SC)

- Presentazioni e abstract coerenti con I **Preferential Subject 2024**
- Ogni SC Chair può selezionare al massimo 2 presentazioni
- I **due candidati selezionati** potranno partecipare **gratuitamente** alla conferenza di Parigi 2024 ed esporre la propria presentazione nella Sessione giovani dedicata**.** L'articolo sarà inoltre pubblicato tra i **Session Proceedings.**

M. Forteleoni

Paris NGN Showcase Challenge 2024

NGN Showcase edizione 2022

NGN Showcase & Presentation Competition

- **NGN Showcase:**
  - 26 candidates were selected to participate
  - 24 presented during the Paris Session
  - ConfTools (papers) and KMS (presentations and supporting information forms) worked well to organize the application materials
  - Increase the number of countries participating in 2024
    - No membership restrictions for 2024 other than being an NGN member

- **Presentation Competition:**
  - Event was very successful and it is suggested to hold the event again during the 2024 Paris Session
  - 13 NGN Showcase participants presented
  - Publicize the presentation competition in the program
  - Provide feedback to the presenters in the competition
  - Make sure to bring enough paper copies of the score sheets for the judges

M. Forteleoni

Paris NGN Showcase Challenge 2024

Sottomissione proposte

- Entro **<u>8 Gennaio 2024</u>**

  invio all'indirizzo email

  cigre.italy@rse-web.it

1. **Full paper (min 500 parole, max 12 pagine)**
2. **Presentazione draft**
3. **Application Form (one pager)**

Template standard -> **2024 Synopses template_2.docx (live.com)**

Date successive

- **6 Febbraio 2024:** sottomissione massimo 4 articoli da parte del NC
- **7 Maggio 2024**: notifica ai candidate sugli esiti della selezione
- **Agosto 2024:** partecipazione gratuita alla Sessione Generale di Parigi da parte dei seelzionati e presentazione del proprio contributo.

Paris General Session 2024: sottomissione articoli

Tempistiche

- Conclusa il **6 Novembre** scorso la selezione degli abstract, da parte del Comitato Internazionale Cigre, per la Sessione Generale 2024 di Parigi.
- Il processo di valutazione ha visto l'accettazione del **90% delle proposte inviate ad Agosto** da parte del Comitato Italiano, suddivisi nei vari SC.
- L'autore al quale è stata notificata l'accettazione del paper dovrà inviare l'articolo completo alla segreteria tecnica nazionale Cigre (cigre.italy@rse-web.it) entro **e non oltre lunedì 8 gennaio 2024**, per permettere di completare il processo d controllo e di sottomissione sulla piattaforma Cigre internazionale entro il **6 Febbraio**.
- La notifica sull'accettazione finale degli articoli, dal parte del Central Office, avverrà entro il **6 Maggio 2024.**

26 Aug 2023 — **Receipt of synopses at Central Office**

6 Nov 2023 — **Synopses notification of acceptance**

6 Feb 2024 — **Receipt of full papers at Central Office**

- **Instructions for papers at the Paris Session 2024** (.pdf - 1.36 MB)
- **2024 full papers sample pages** (.pdf - 250 KB)
- **2024 full papers sample pages** (.docx - 67 KB)

6 May 2024 — **Full papers notification of acceptance**

M. Forteleoni

https://session.cigre.org/the-session/call-for-papers.htm

Notizie sulle attività del Comitato Nazionale

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Fabbricazione di apparecchi elettrici, materiali elettrici e componenti elettronici

Benvenuto nella pagina ufficiale del Cigre Italia per tutte le informazioni sulle attività ed eventi dell'associazione

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M. Forteleoni

Conclusioni

Bruno Cova