The key role of HVDC in future AC/DC systems

DG Energy HVDC Workshop

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Bruno Luscan

SuperGrid Institute
Shaping power transmission

Outline

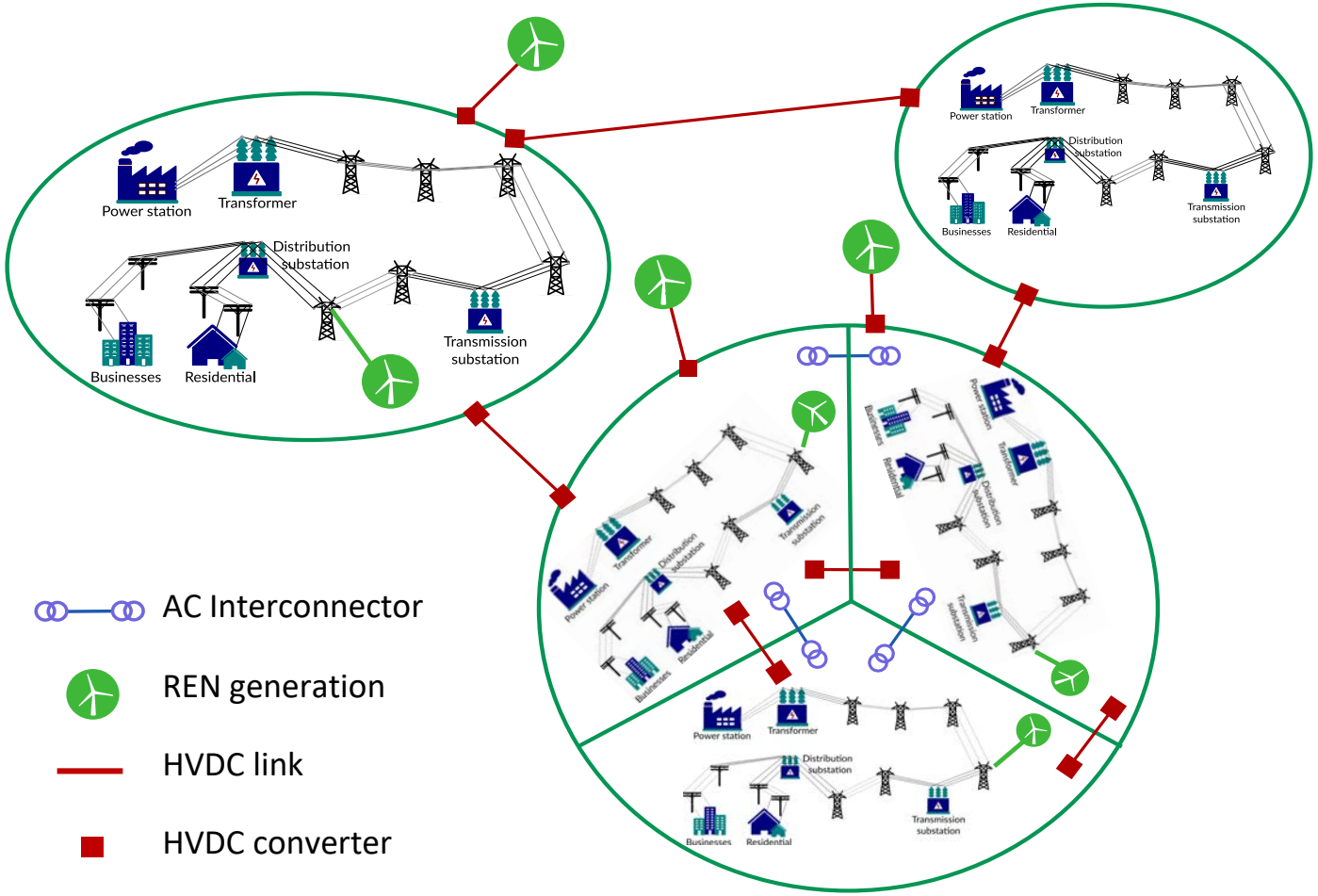
The key role of HVDC in future AC/DC systems

- **HVDC role in future power flows**
- **HVDC role in stability control**

TODAY

HVDC role in future power flows

Facing energy transition challenges



HVDC development to date driven by:

- Offshore energy harvesting
- Submarine links
- Cross boarder interconnections

Triggered by local and “short term” visions

E.U : Only PtP connection for VSC

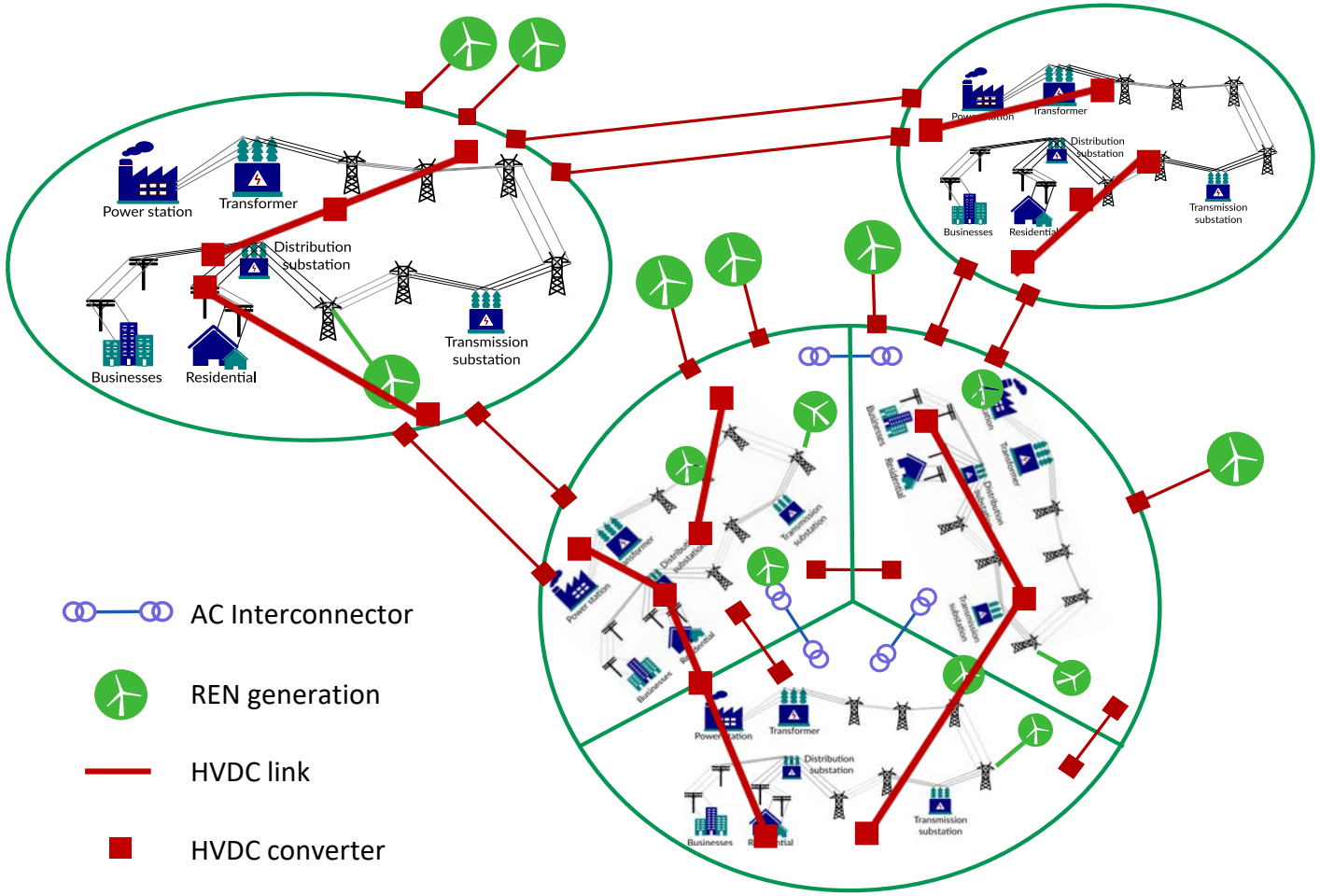
Grid evolution drivers :

Production mix decarbonisation
Market integration

Increase interconnections
Connect more renewables

HVDC role in future power flows

Facing energy transition challenges

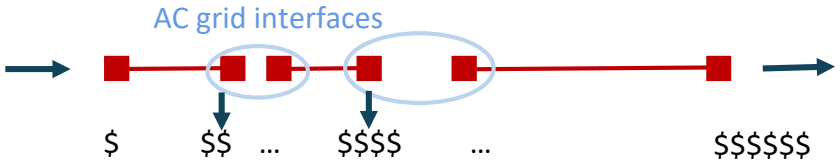


Numerous interconnections
More RES generation

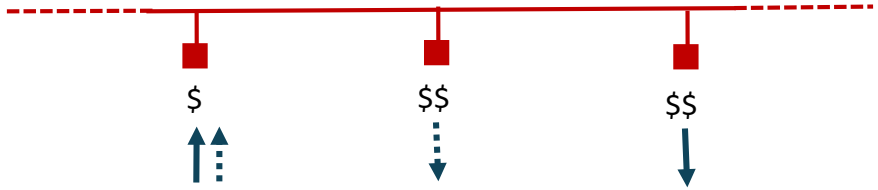
? Capability of AC grids
Public Acceptance & Right of ways

Build inland reinforcements and explore HVDC technologies :

Multiple HVDC Point-to-Point ?



MTDC Large power corridor !



MTDC solution is more sustainable than multiple Point to Point roll out

MTDC large power corridors

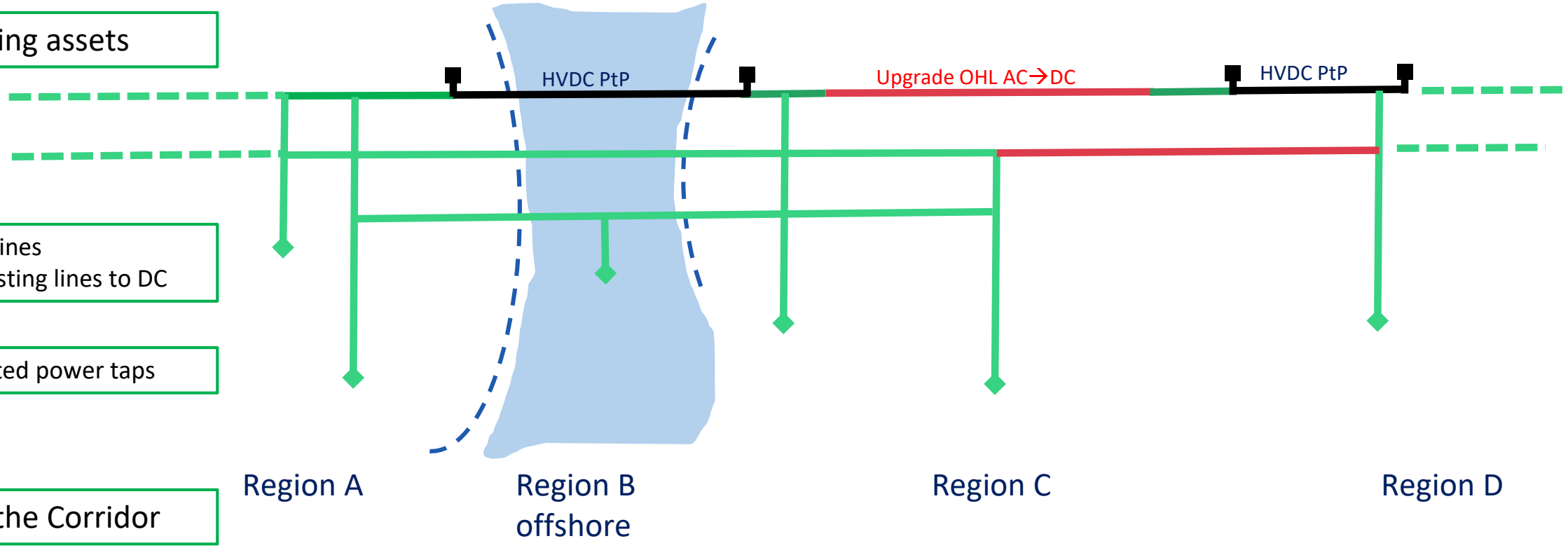
Step by step development

Using existing assets

Building new lines
Upgrading existing lines to DC

Building adapted power taps

Extending the Corridor



Grid planning & high level architecture principles are key

Stepwise implementation is possible

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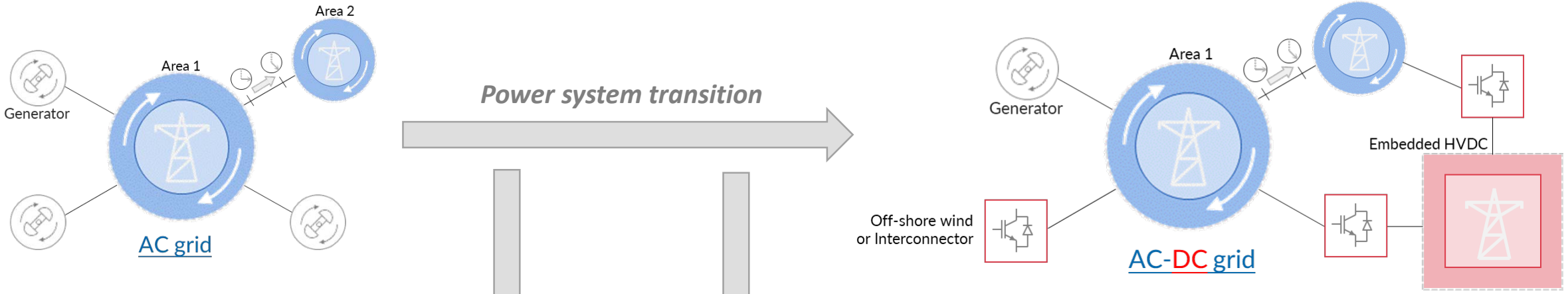
- **HVDC role in future power flows**
- **HVDC role in stability control**

HVDC role in addressing AC stability challenges



New stability challenges

Less Synchronous Generation

More PE-connected Generation

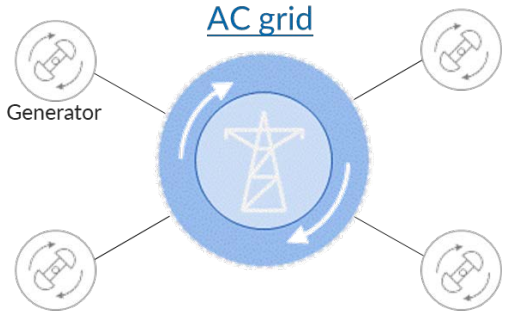
Reducing physical inertia
Reducing system strength

Challenges with frequency, rotor angle and voltage stabilities

HVDC will provide essential stability services

	All VSC-HVDCs		Embedded-HVDC links
P control	*Synthetic inertia* *Fast frequency support*	&	*Synchronizing torque* *Power oscillation damping* *Fast compensation of disturbance*
Q control	*Transient reactive power support (eg: faults)*		
P&Q control	*Grid forming*		

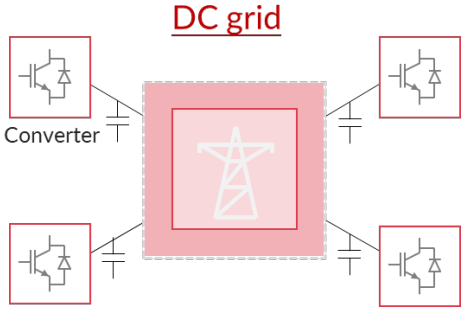
Stability control: AC vs DC



Frequency stability

Synchronism

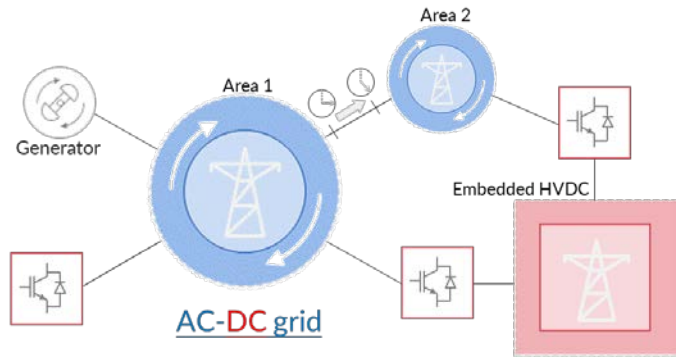
Loss of synchronism has major impact
→ system design / operation, to **suppress** this risk



DC voltage stability

After major disturbance compromising voltage stability, DC grid can be restored quickly (<200ms)

Loss of DC voltage stability has minor impact
→ System design to **minimize** DC voltage instability risk
→ System design to **ensure** fast DC grid restoration



Area 1 and Area 2 with low inertia

Frequency event, in Area 2

Fast Frequency Containment Reserve (FCR) is necessary (low inertia)
Risk of system split if Fast FCR is activated in wrong Area

Embedded HVDC can be controlled to enhance inter-area stability
Fast FCR can then be shared between Area 1 and Area 2

AC system split between Area 1 and Area 2

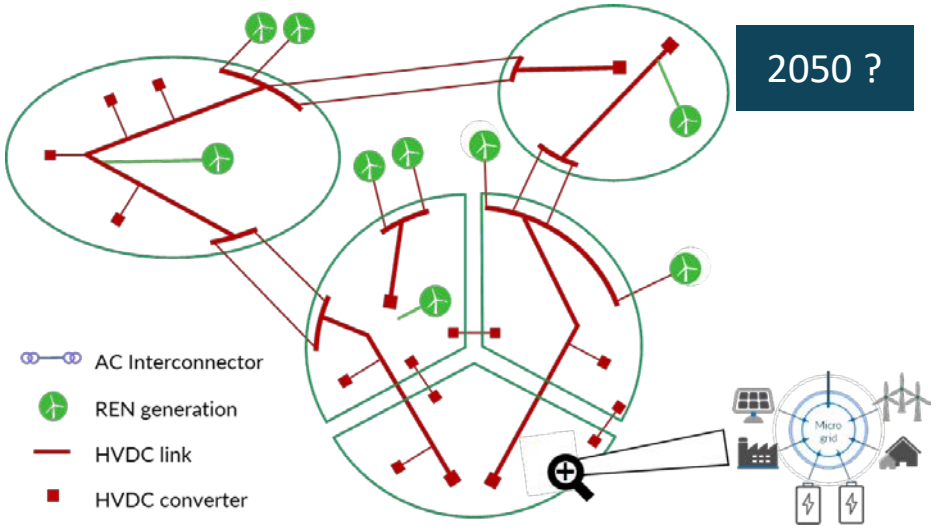
Islanding situation is managed by Embedded HVDC which can be controlled to quickly resynchronize both AC areas

New stability services offered by HVDC, will lead to new ways of operating AC-DC system

Conclusion

The key role of HVDC in future AC/DC systems

- **MTDC large power corridors will play a major role in future power flows, exhibiting key long term benefits**
- **Their stepwise development is a must, is accessible and requires top-down orchestration**
- **HVDC will provide essential stability services, leading to new ways of operation**
- **AC vs DC, Large vs Local grids should not be opposed but must converge to best optimum in a coordinated way**
- **<u>Leadership and cooperation are required</u> to propose:**
  - Interoperability framework
  - A EU-level planning approach for a stepwise development



Q&A, Open discussion

SuperGrid Institute contacts:

Collaboration projects Manager – Mr. Paul VINSON

paul.vinson@supergrid-institute.com

Cel. +33 6 80 87 13 17

Chief Technology Officer – Mr. Bruno LUSCAN

bruno.luscan@supergrid-institute.com

Cel. +33 6 33 36 56 96

Sales & Marketing Director – Mr. Benoît DURETZ

benoit.duretz@supergrid-institute.com

Cel. +33 7 60 77 32 31