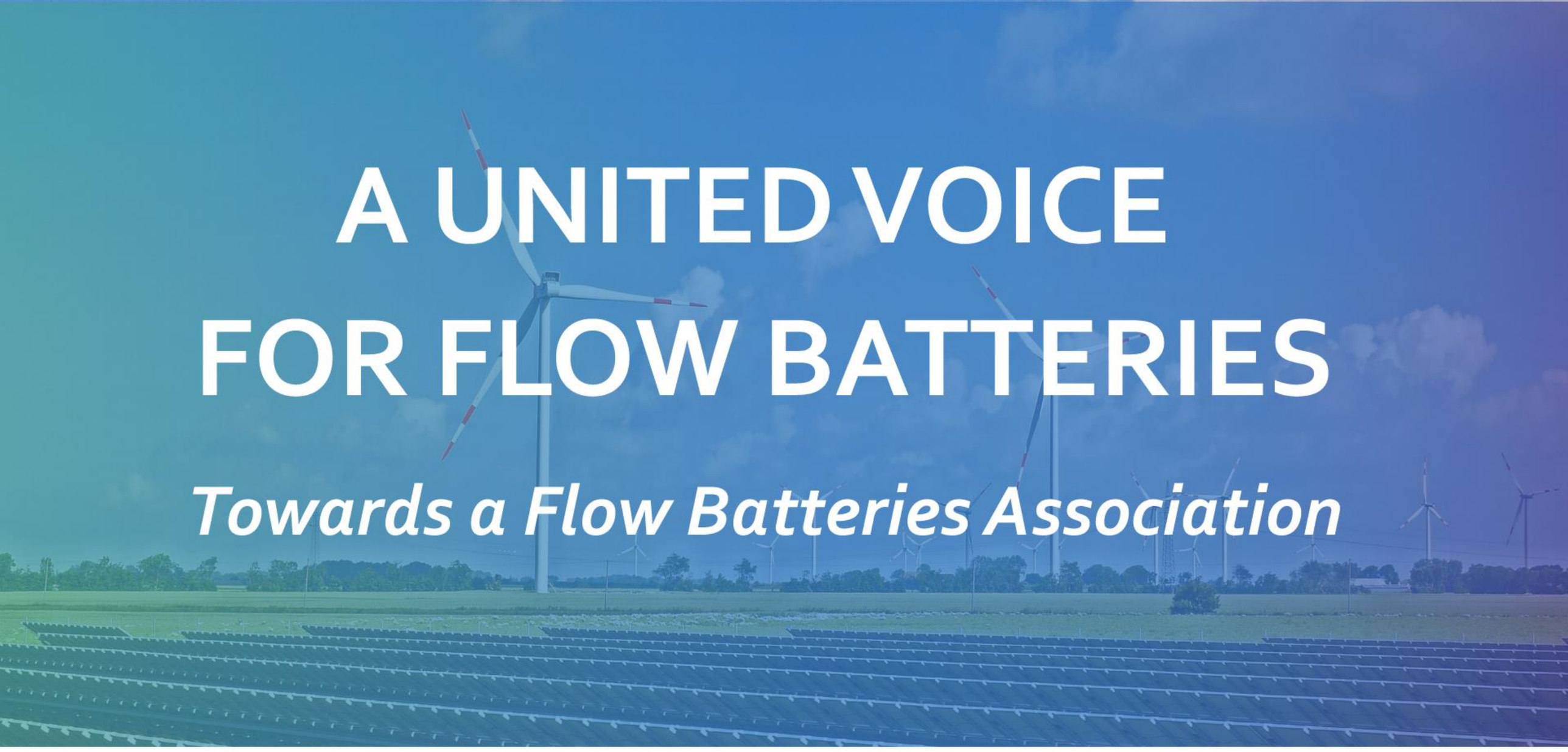

A UNITED VOICE FOR FLOW BATTERIES

Towards a Flow Batteries Association

Organised by

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IFBF
The International Flow Battery Forum

The State of the Art of Flow Batteries: Challenges and Opportunities

Anthony Price - Secretary, International Flow Battery Forum

17 December 2020

Energy storage is doing well, but where are the flow batteries?

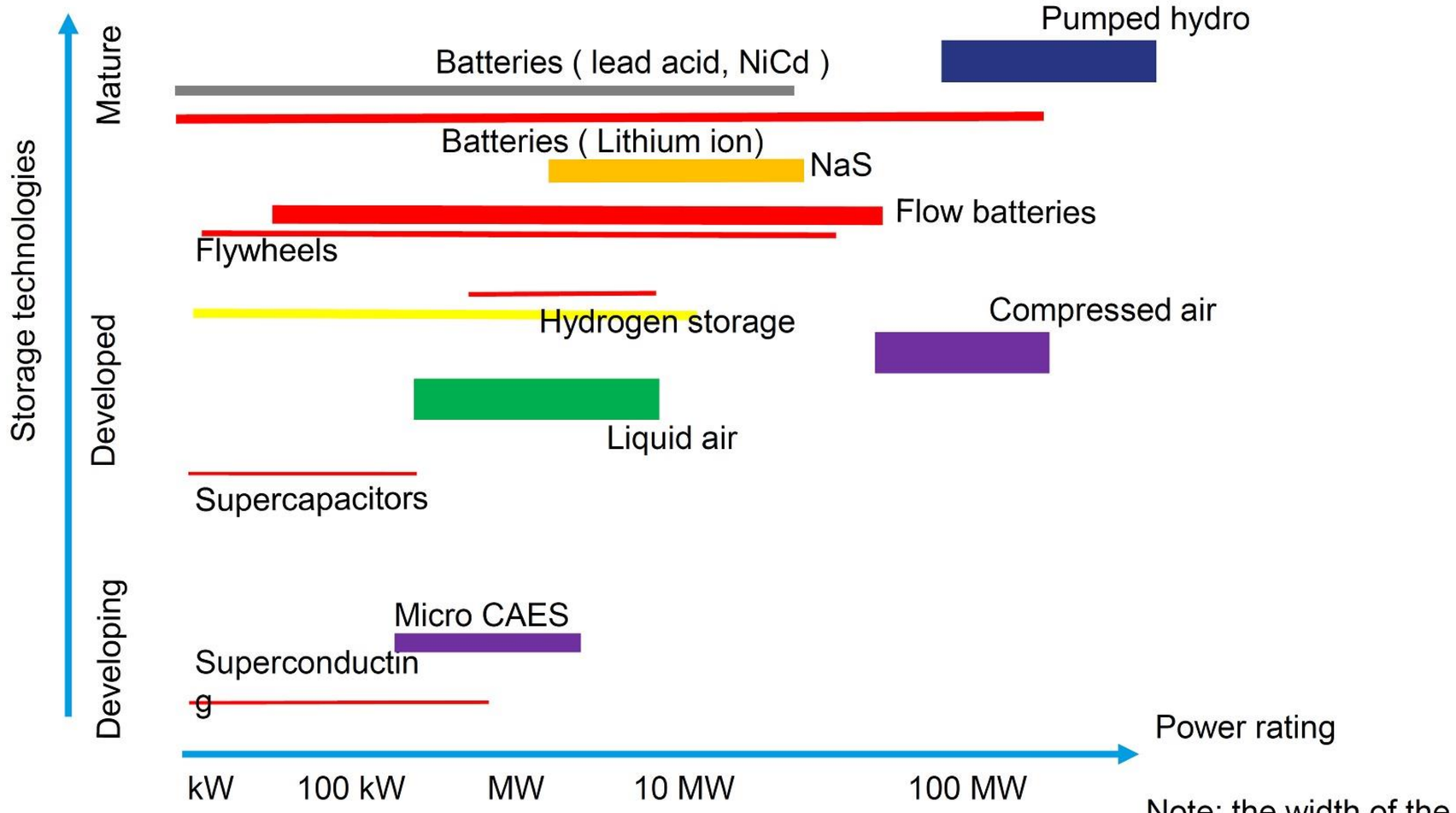
Classification of electricity storage by technology

Type	Sealed systems			Separate power / energy	
Mechanical / kinetic	Flywheels			Pumped hydro	
Thermodynamic	Heat engines			Cryogenic storage	Compressed air
Electrical	Capacitors	SMES			
Batteries	Lead acid	Lithium	High temperature		Flow Batteries
Hydrogen / electrolyser				Electrolyser / fuel cell or ICE	H2 / organic cycle
Thermal	Molten salt	Ceramics	Ice		Pumped heat, heat engines

Technology characteristics

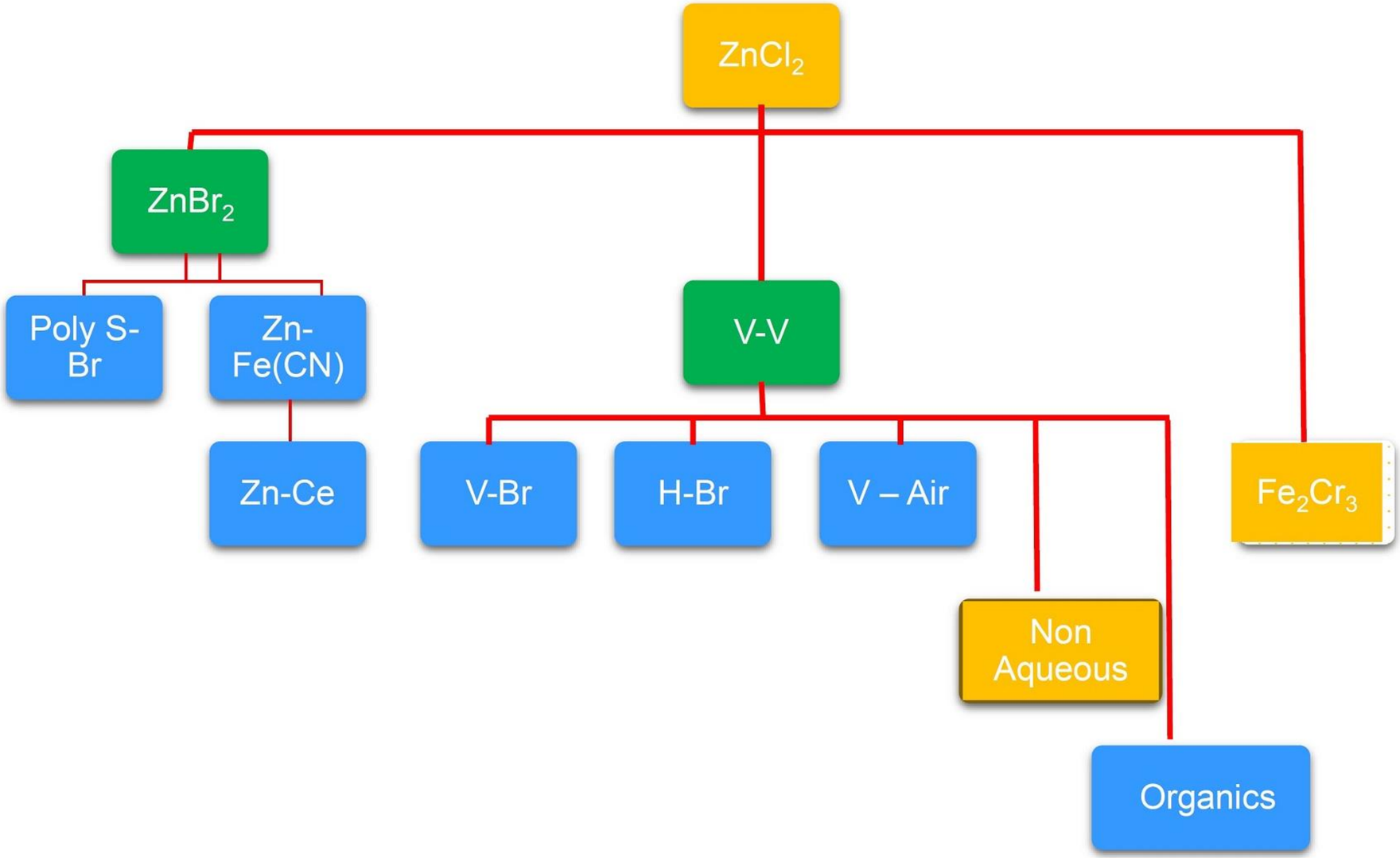
Technology type	Power rating	Energy storage capacity	Speed of response	Self discharge	Lifetime	Environmental acceptability and siting requirements
Flywheels	Small to large scale	Limited	High	Low	>15 years	Good. Easily located.
Compressed air	Medium to large scale	High	Low	Low	>15 years	Good environmental, but complex siting requirements
Liquid air	Medium scale	High	Medium	Low	>15 years	Good environmental. Suitable for industrial areas
Lead acid batteries	Small to large scale	Medium (up to 3h)	High	Low	<15 years ~ 2000	Acceptable. Battery electrolyte containment important
NiCd	Small to large scale	Medium (up to 3h)	High	Low	<15 years	Restrictions in place on use of Cd. Battery electrolyte containment important
High temperature batteries	Medium to large scale	Medium (up to 6h)	High	Low	~ 2500 full cycles	Good environmental. Suitable for industrial areas
Flow batteries	Small to large scale	High	High	Low	Varies. Can be ~ 15 years	Battery electrolyte containment important
Lithium batteries	Small to large scale	Low	High	Low	~ 10 years	Acceptable.

Development status of storage technologies



Note: the width of the bar indicates storage capacity

A simplified flow battery family tree



The good, the bad..

Good

- Cycle life degradation
- Calendar life degradation
- Separable power and energy
- Low fire risk
- Safer maintenance
- Simple monitoring
- Accurate S0C

Bad

- Complex balance of plant
- Low gravimetric energy density
- Low dc round trip efficiency

Source: Adapted from Linkedin
11 Jan 2019 Jamie Daggett9

..& the ugly

The ugly

- Far behind in commercial deployment
- Fewer sales
- Variety of different systems
- No clear market
- Lower perceived operating experience

Impact

- Fallen behind in commercial acceptability

Opportunities, applications and parameters

Traditional applications

- Large scale / bulk energy storage
- Mid size – domestic energy storage
- Microgrids
- Integrated smart networks
  - Multi functional
    - frequency svcs
    - Energy management
    - Standby power

Opportunities for non-traditional applications

- Mobile
- Refuellable
- Power by flow
- Micro storage

Parameters

- Energy density
- Power density
- Performance
- Degradation / Lifetime
- Incremental cost / kWh
- Incremental cost / kW
- Capital cost
- Recyclability

Market changes

- Time of day energy pricing
  - Load levelling, peak shaving
- Reserve power
  - Line stability, frequency, reactive power,
- Renewable integration: generation 1 – mainly wind
- Distribution line reinforcement/ asset deferral
- Reserve power, primary, secondary
- Fast acting frequency response

Subsidy for renewables

- Renewable integration: generation 2 – mainly solar
- Behind the meter support
- Data centre and digital technology support
- EV management
- Renewable integration: generation 3, domestic PV
- Push towards longer duration storage

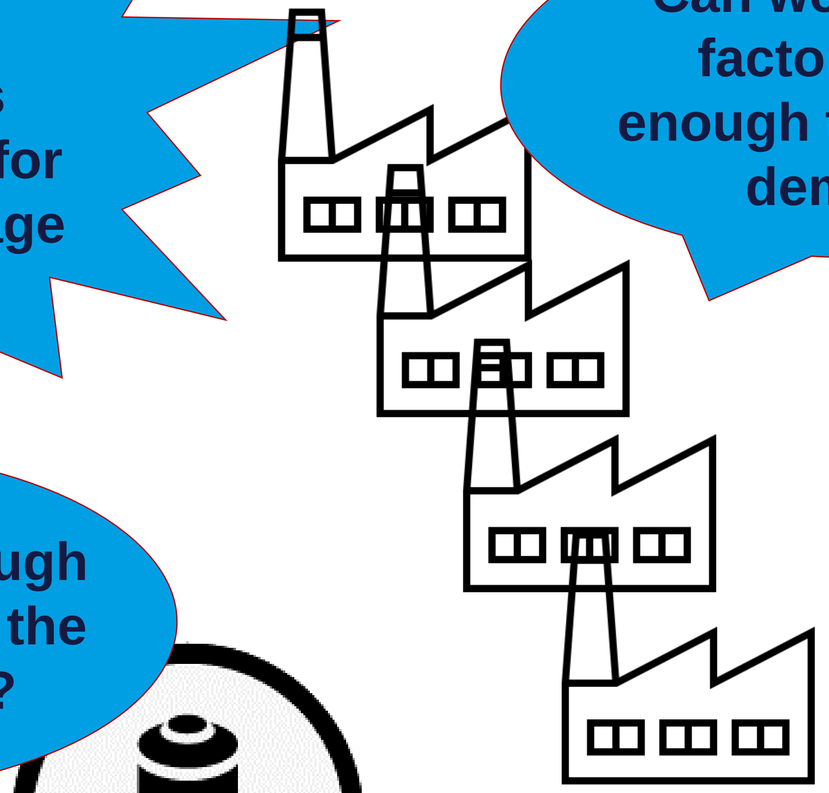
Reduced or no Subsidy

Our big challenge

Enormous market size for energy storage

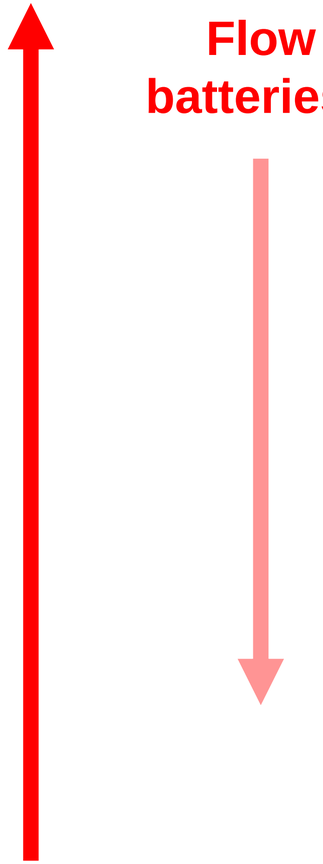
Can we build the factories fast enough to meet the demand?

Do we have enough raw materials in the supply chain?



Energy storage: technology drift

- Large scale: stationary
  - kW to MW and kWh to MWh
  - Energy and power important
  - Reliability critical
  - Lifetime cost
  - Speed of response / efficiency / weight & volume are less significant
- Mobile – electrically powered transport / hybrid power
  - Weight / volume / reliability critical
- Portable:
  - Performance / weight / volume critical



Where are the flow batteries?

One day……we'll be big too

EU ACTIVITIES IMPACTING FLOW BATTERIES

Patrick Clerens – Managing Director, **CLERENS**

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ABOUT CLERENS

We are a family run boutique consultancy founded in 1991

- Specialised in Energy and Environment topics
- Thanks to our 30 years of presence in Brussels, we have a large network inside the EU Institutions and have gained a reputation for our scientific and technical knowledge
- We establish, represent and manage associations in the Energy and Environment sector, allowing for strategic synergies for policies and logistics
- Our very international team hails from 10 different countries and includes a complementary set of skills

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FLOW BATTERIES IN THE EUROPEAN LANDSCAPE

- The European Leaders have recently agreed on the ambitious target of **55% GHG emissions avoidance by 2030 and climate neutrality by 2050**
- Batteries are fundamental to achieve such decarbonisation objectives and the related ambitions of sustainable competitiveness of the industry, green transport, and clean energy
- Today, Li-ion batteries are the fastest growing market and have the highest visibility from the European legislators. In the European Green Deal, no mention is given to the role of flow batteries in the energy transition
- EC sees that Li-ion batteries alone are not enough to achieve the 2050 goals: while looking for alterative innovative technologies, **the role of flow batteries is overlooked**

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FLOW BATTERIES IN THE EUROPEAN LANDSCAPE

- The market penetration of flow batteries is hindered by the existing challenges of power and energy density and high costs
- Efforts are needed to improve components and business approach to bridge the gap with defined targets and aim at cost competitive flow batteries
- Furthermore, **more research and development efforts** are needed at the European and international level to guarantee the market development of flow batteries

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FLOW BATTERIES IN THE EUROPEAN LANDSCAPE

- For this to happen, the attention of the policy makers is needed. Unfortunately, **flow batteries struggle to compete for attention with more widely available battery technologies**
- Since decades, battery stakeholders groups (EUROBAT, RECHARGE) are lobbying and consulting the European Commission on the priorities for the battery value chain. In there, no entity is specifically representing Flow Batteries
- Without representation, the priorities of the flow batteries sector will never reach the political and legislative discussion and their development will be never promoted fast enough by the European institutions

➢ **Flow batteries need to professionalise their representation and narrative**

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FLOW BATTERIES IN THE EUROPEAN LANDSCAPE

- Limited representation leads to **no consolidated push for flow batteries**, and potentially **fragmented lobbying** by various stakeholders (who goes to the EU Commission with which message?)

- **Less funding available** to develop R&D&I for the sector (e.g: flow batteries are scarcely mentioned in the draft calls of the forthcoming Horizon Europe programmes)

- **Less business opportunities for flow batteries**: without any R&D support, flow batteries will give up better market opportunities and will struggle to ensure the competitiveness of the technology

A UNIFIED VOICE FOR FLOW BATTERIES

A UNIFIED VOICE FOR FLOW BATTERIES

- The IFBF is an overarching international body representing and coordinating the flow batteries sector
- Complementarily, a local flow batteries representation can support the work of the IFBF by approach issues from the perspective of their region
- Europe is the best candidate for the first regional chapter: the European Union climate neutral ambitions, providing strong support to the means to get there.
- The European **Flow Battery Association** will gather public and private organisations working together to escalate the development, industrialisation and deployment of flow batteries
- The association will be able to effectively convey the view of the members and be part of the ongoing regulatory discussion within the institutions.

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A UNIFIED VOICE FOR FLOW BATTERIES

Throughout an association, the sector will be represented with **one voice, one message and one vision**. The Association will pursue the following main missions:

- Create/reinforce networks between the flow battery industry;
- Support the development of EU and international regulations on flow battery standards, safety, and sustainability;
- Promote R&D efforts at the EU and international level;
- Actively promote and monitor innovation uptake in the market

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A UNIFIED VOICE FOR FLOW BATTERIES

Why becoming a member?

- **Representation**

To represent the Flow Battery sector with one single voice, message & vision. One single association gathering all the major stakeholders will get more attention from policy makers as well as more credibility towards them, ultimately strengthening the sector.

- **Strategy alignment**

To contribute to shaping a coherent long-term strategy for the flow battery sector. The broader the strategy alignment, the more support can be gathered and the more powerful the message will become.

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A UNIFIED VOICE FOR FLOW BATTERIES

Why becoming a member?

- **Visibility and networking**

Members will have the opportunity to gain visibility and strengthen their network within the flow battery industry.

- **Decision making**

To be directly **involved in the EU decision-making process**. Members will have the opportunity to actively shape the legal framework for flow battery at the EU level and be part of the ongoing regulatory discussion within the institutions.

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A UNIFIED VOICE FOR FLOW BATTERIES

Why becoming a member?

- **Define the R&D priorities**

To directly contribute to the definition of the R&D priorities for the sector. Research & Development (R&D) efforts are of vital importance for developing cost-effective and more efficient flow batteries both at the European and international level. This will allow you to actively promote innovation uptake in the market.

- **Coordination**

By gathering all the relevant stakeholders in one single association, lengthy & time consuming process of building up a lobbying & communication strategy will be outsourced to the association – hence money & time saved

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WHY NOW ?

- With the start of the European Green Deal and the definition of the European decarbonisation targets, the political energy priorities are being shaped. Flow batteries need to establish themselves as a **strategic opportunity** to reach this goal
- The European Carbon Border Adjustment Mechanism will place a carbon price on imports of certain goods from outside the EU, in order to push third countries to raise their climate ambition and reduce the risk of 'carbon leakage'. As a consequence, low cost, high environmental impact li-ion batteries will not be politically welcome anymore
- The push for a greener energy is opening the floor to new innovation opportunities, giving flow batteries the chance to **gain momentum and visibility** in Europe and abroad
- For this to happen, the flow batteries stakeholders need to understand the challenges and opportunities of the sector and join forces towards **a united voice for flow batteries**

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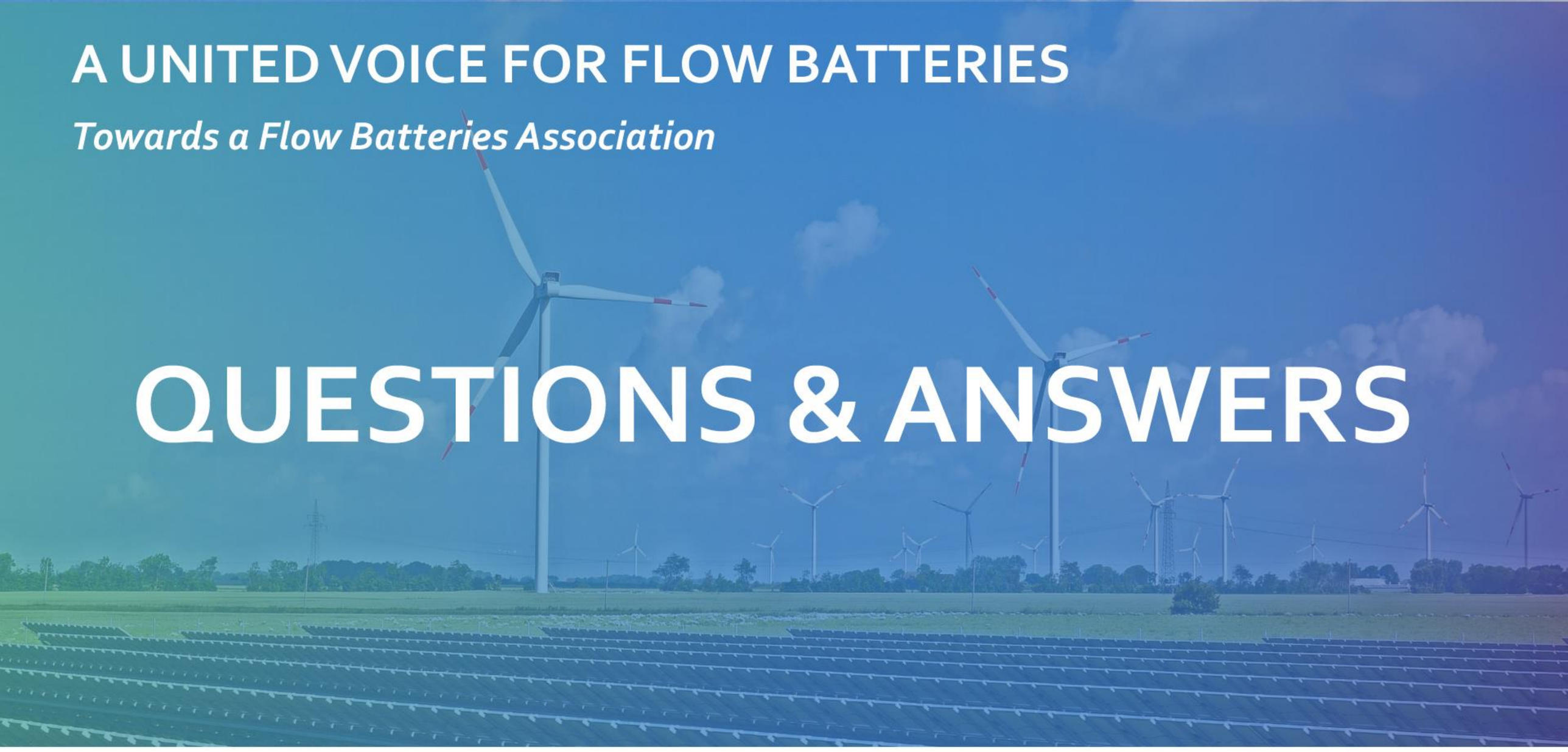
A UNITED VOICE FOR FLOW BATTERIES

Towards a Flow Batteries Association



QUESTIONS & ANSWERS

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ROUND-TABLES

Room A: The need for R&D activities and the priorities for R&D funding for Flow Batteries

Room B: What commercial, marketing and regulatory lobbying activities are required

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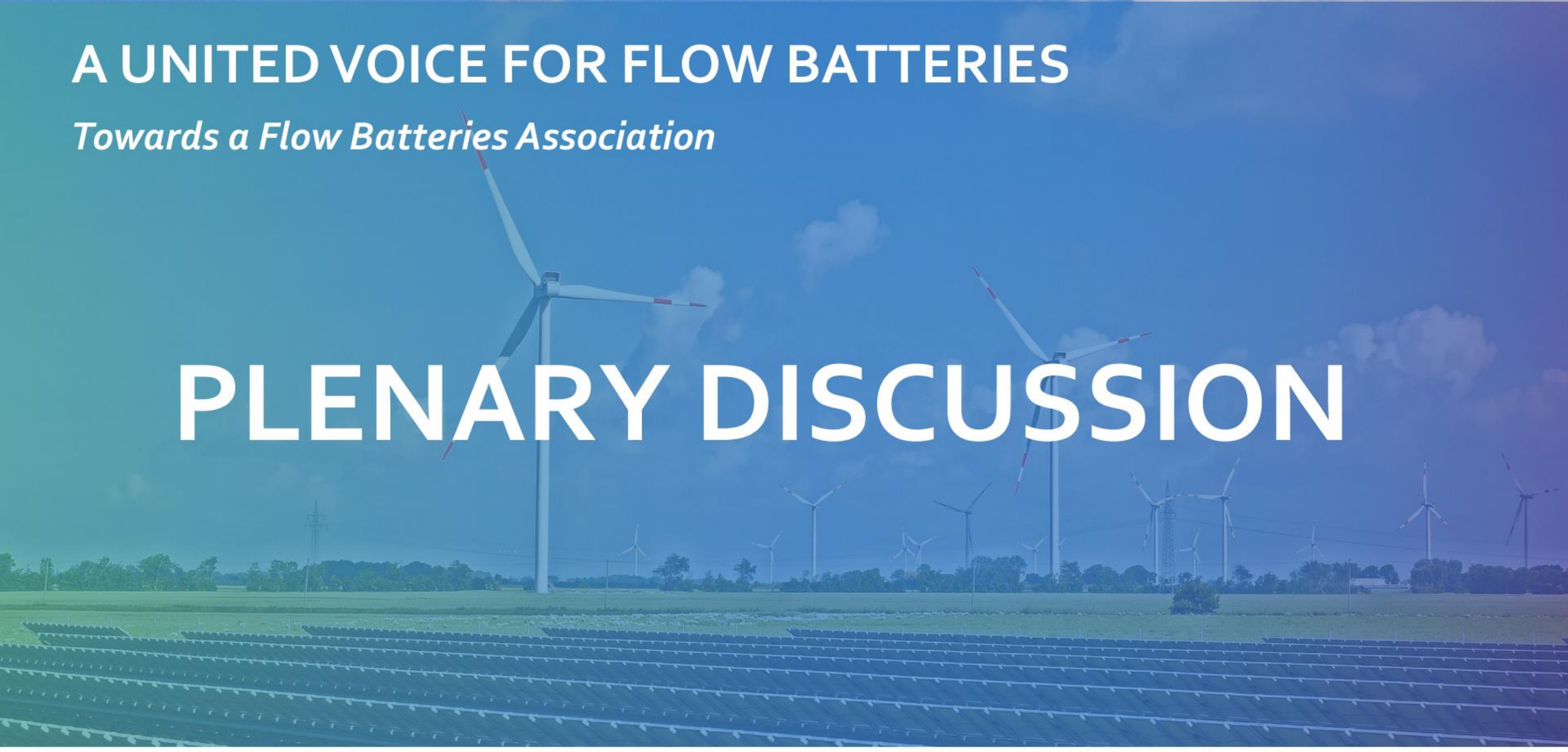

PLENARY DISCUSSION

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The International Flow Battery Forum

WHAT NOW?

We are looking for volunteers!

If you are interest in the work of the Flow Batteries Association, you can become a **member of the steering committee** that will support the initiative and provide guidance on the development of the association

Please contact Patrick Clerens, p.clerens@clerens.eu to know more!

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WHAT NOW?

Meanwhile, let’s keep talking about flow batteries!

We will see you at the **International Flow Battery Forum**
Virtual Conference - “Let's talk flow batteries"

19-21 January 2021

Register now!

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A UNITED VOICE FOR FLOW BATTERIES

Towards a Flow Batteries Association

THANK YOU!

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