ENERGY INDUSTRY INSIDER

Q1 2020 | Pulse
Grid Scale Energy Storage

FutureBridge

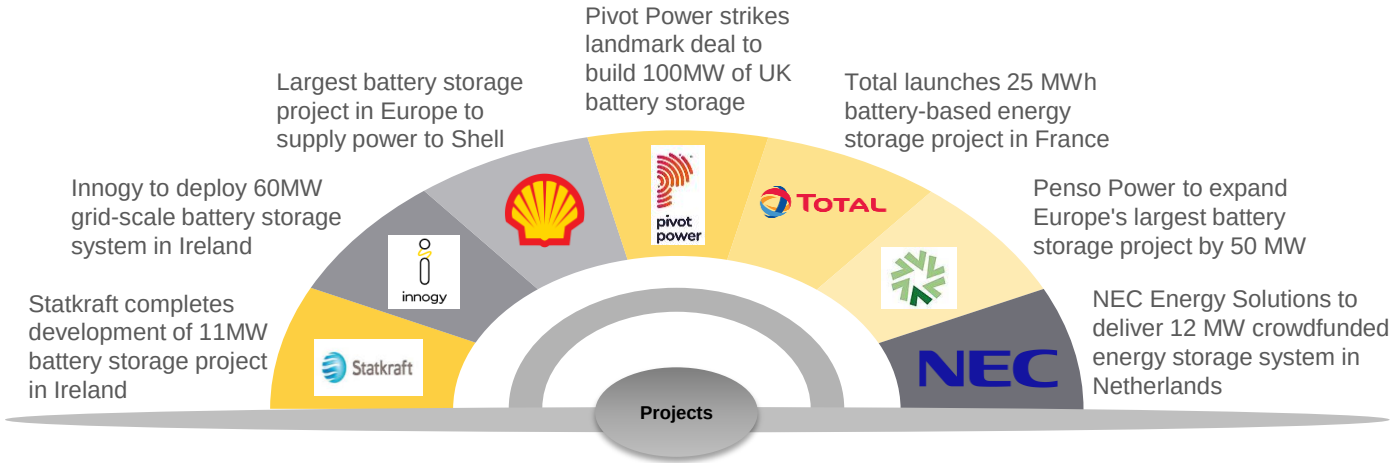
WHAT'S INSIDE!

- **Europe witnesses large scale energy storage projects**
- **Following the past quarter, investments, mergers and acquisitions remain in trend in this quarter**
- **Azelio demonstrates thermal energy storage system using Aluminum Alloy**

01 Emerging Trends

Europe is likely to see deployment of large scale battery storage projects in coming years as these projects benefit from economies of scale. Also, softened planning restrictions for stationary energy storage projects will promote the deployment.

Large Scale Energy Storage Projects Across Europe



DEVELOPMENTS

Emerging Trends

Following Q3 2019 and Q4 2019, this quarter witnessed announcement and development of new grid-scale energy storage projects. Europe seems to be at leading position in installing large scale projects.

Launch of the energy storage project by Total and Shell's off take agreement clearly depicts growing interest of oil & gas majors into low-carbon power.

FutureBridge Insight & What should you investigate ?

Large Scale Energy Storage Projects Across Europe

- **Statkraft**, in partnership with Fluence, has completed **11MW** battery storage project in **Ireland**
- The project is **first utility-scale battery** in the Republic of **Ireland**
- Statkraft to enter into a contract with transmission operator **EirGrid** through its DS3 flexibility market

- **Innogy** to construct its first battery storage facility of size **60MW** in **Ireland**
- Total investment for the project will be **US$27.57 million**

- **Shell** has signed a multiyear off take deal for **100 MW Minety** battery project to optimize local renewable power usage
- The project is backed by China Huaneng Group and Chinese sovereign wealth fund CNIC

- **Pivot Power** has placed an order with technology group **Wärtsilä** to deliver **100 MW** of energy storage in the **UK**
- The projects will provide balancing services for world's largest transmission-connected battery storage network

- **Total** has launched **25 MWh** battery-based energy storage project in **France**
- The project is **largest lithium-ion energy storage system** in **France**
- The project is a part of government policy to support the development of electrical capacity through capacity mechanisms

- Developer of the **Minet**y battery storage scheme in Wiltshire **Penso Power** has secured land rights, planning permission and a grid connection offer to extend the **100MW** project by a further **50MW**
- Penso Power is in discussions with potential off takers

- **NEC Energy Solutions** has been awarded a **12MW** energy storage project by **GIGA Storage** in **Netherlands**
- Fund of around **$4 Million USD** has been raised through **crowd funding** to develop the project
- It is the largest battery storage installation which has been funded primarily by means of a crowd funding program

Investments, Mergers & Acquisitions

With the investment by Sumitomo Heavy Industries in Highview Power, the trend of investments by big investors in long-duration energy storage start-ups continues. The second half of 2019 witnessed $110 million investment in gravity storage startup Energy Vault, $40 million investment in electrochemical seasonal storage startup Form Energy and $30 million investment in iron flow battery maker ESS.

e-Zn

- e-Zn, a Toranto based start-up, raised US $3.4 million seed round
- The company has developed a renewable grid-scale energy storage solution using zinc metal
- e-Zn claims its solution offers multiple days' worth of storage as well as the ability to scale energy capacity at a cost one-tenth that of lithium-ion batteries

Highview Power® / Sumitomo Heavy Industries, Ltd.

- Sumitomo Heavy Industries Ltd. has made a USD $46 million investment into Highview Power as a part of partnership to Expand Cryogenic Energy Storage Globally
- Sumitomo SHI FW (SFW) will act as technology center and hub for the CRYOBattery™ business

Eguana Technologies / ITOCHU

- Eguana Technologies Inc. has announced closure of $5 Million Strategic Investment by ITOCHU Corporation.
- The investment will be used to fund working capital and general corporate expenditures of the Company.

DEVELOPMENTS

Emerging Trends

Investments, mergers and acquisitions were in trend this quarter following Q3 2019 and Q4 2019 Sumitomo Heavy Industries strengthened its position in energy storage industry with investment in Highview Power.

Merger of redT and Avalon grabbed the market attention. The merger is envisaged to create global leadership by combining experiences of leading UK & US flow battery firms.

FutureBridge Insight & What should you investigate ?

Investments, Mergers & Acquisitions

Gresham House
Specialist asset management

- Gresham House Energy Storage Fund has acquired 49-MW battery energy storage project in England
- Total value of the acquisition was US$ 43.1 million
- The project brings the total capacity of operational battery storage projects in the fund's investment portfolio to 174 MW

diversified COMMUNICATIONS

ENERGY STORAGE NORTH AMERICA

- Diversified Communications has announced the acquisition of Energy Storage North America (ESNA) from producer ESNA EXPO LLC expanding its renewable energy portfolio
- Diversified Communications plans to identify other acquisition opportunities to make investments in this space

redT energy storage

AVALON BATTERY

- redT and Avalon, leading UK & US flow battery firms, have announced merger to create Invinity Energy Systems
- A £58 million global company which will be active across all key international energy storage markets: Europe, North America, Asia, Australasia and Africa

FutureBridge Insight on Grid Scale Energy Storage

Europe and the United States continued to develop grid scale energy storage projects. For the first time in Europe, very large scale projects are being developed. Europe is likely to witness development of such projects as a result of softened planning restrictions for stationary energy storage projects.

There have been continuous efforts across the industry to develop innovative long duration energy storage technologies.

What should you investigate ?

What are the promotional policies, rules and regulations in the energy storage sector?

What are the new energy storage technologies? How investors are strategically investing in these technologies?

Impacts of COVID-19 on the US Energy Storage Industry

Energy storage industry in the United States is leading in the world. COVID-19 spread has imposed limitations on growth of this industry creating immediate and mid-term impact.

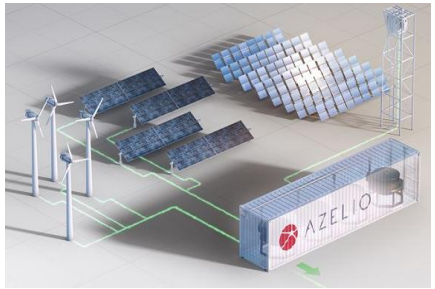
Project Delays - Significant impact on business is being witnessed due to cancelled shipments of project components, closed government permitting agencies, ceased direct contact with customers, travel restrictions on site visits and reduced end user demand.

Reduced Revenue and Employment - Energy storage companies are expecting reduced revenue in Q2 2020 than forecasted. The key causes include difficulty in obtaining equipment, supplies, or logistical delays, delays or cancellation of existing projects by customers and delays in obtaining approvals or permits.

Energy Storage Association has carried out survey to assess the impact of COVID-19 on various stakeholders in energy storage industry. It has also suggested some near-term economic stimulus options. Please find details here.

02 Energy Storage Technology

Azelio Thermal Energy Storage Using Aluminum Alloy



The storage system can be combined with:

- Concentrated solar power
- Solar PV
- Wind power

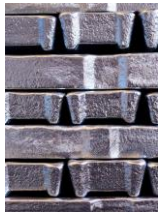
13 hours of electricity production at nominal power

Closed system that doesn't need any process water

Excellent heat storage ability

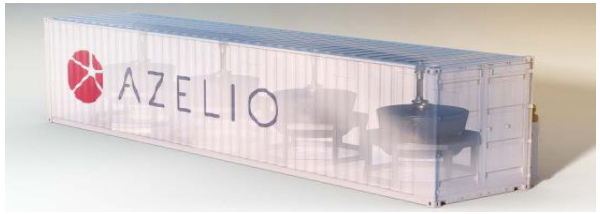
Can use recycled aluminum for zero carbon footprint

Azelio Thermal Energy Storage system uses aluminum alloy for its very specific phase changing characteristic since the greatest energy recovery is obtained in the conversion phase. The system has potential to reduce environmental impact by using recycled aluminum, produced with electricity from renewables.



Azelio Thermal Energy Storage System uses aluminium alloy as a Phase Change Material

- High degree of energy density
- Excellent heating storage ability
- Abundant availability



DNV·GL

Azelio has signed an agreement with DNV-GL for verification of its storage technology with production of electricity around the clock. The verification will begin during the first quarter of 2020 and aims to register data in real-life conditions and make the technology bankable.

Verification Projects

Noor Ouarzazate solar complex, Morocco

- Verification project carried out with Masen
- Thermal energy storage combined with concentrated solar power
- Objective to generate input to preparation of volume production in 2021 and to generate data for commercial purposes

Khalifa University, Masdar City

- Objective to test and demonstrate Azelio's system for renewable energy projects
- Evaluation of Azelio's Stirling engine system and thermal energy storage
- Evaluate the technology for Masdar's current and future renewable energy projects

Glava Energy Center, Sweden

- Objective to test and demonstrate Azelio's system for other renewable technologies and different grid configurations
- Varying test environments accelerate the verification for a wide area of uses

03 Startup Tracker Highlights

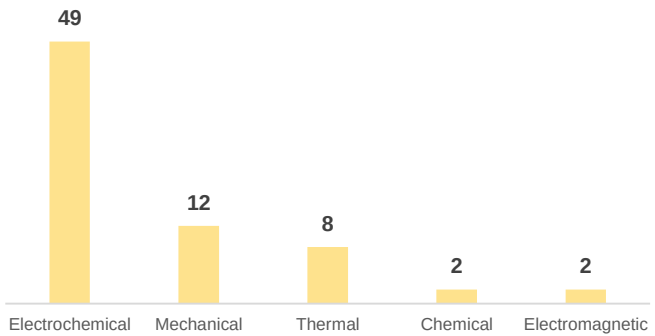
Startup Tracker summary Q1 2020

73

Total Startups

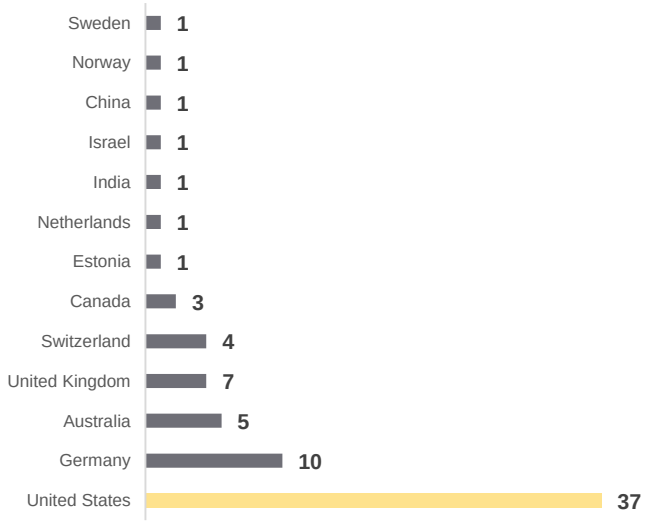
JENA BATTERIES

Distribution by technology segmentation



Note: Technology of one start-up is not disclosed while another start-up works on two technologies

Distribution of Start-ups by Country



- United States is the hot bed for startups with around 50% of the startups originating from the country
- Electrochemical technology is the preferred choice among startups with over 66% of them have their product based on the technology

Recent Activities

Recent Activities

JENA BATTERIES

Partnership

- Multinational chemicals company **BASF** has **partnered** with Germany based 'metal-free' redox flow battery startup **JenaBatteries**.
- The partnership seeks development of one of two electrolytes for the battery. BASF will make available its amine (ammonia-based compounds) for the same.

Penso Power

Project

- **Penso Power** has planned to expand **Europe's largest battery storage project** in Minety by **50 MW**.
- Shell had signed the off take agreement for original 100 MW Project.
- Penso Power is in discussions with potential off takers for the 50MW project extension.

The River Battery by JENA BATTERIES

The metal-free redox flow battery

SAFE

- Not flammable, not explosive
- Turnkey storage solution
- Low maintenance
- Can be operated independently of the network

ECONOMICAL

- Cheap raw materials
- Producible in Europe
- No supply shortages
- High planning security
- Long service life> 10,000 cycles

SCALABLE

- External energy storage
- Power: 100 kW to> 2 MW
- Capacity: 400 kWh to> 10 MWh

CLEAN

- No heavy metals
- No aggressive acids
- Resource-saving, recyclable
- Saline solution as an electrolyte

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