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Report on

Nordic-India discussion on Battery and Energy Storage Technologies (BEST)

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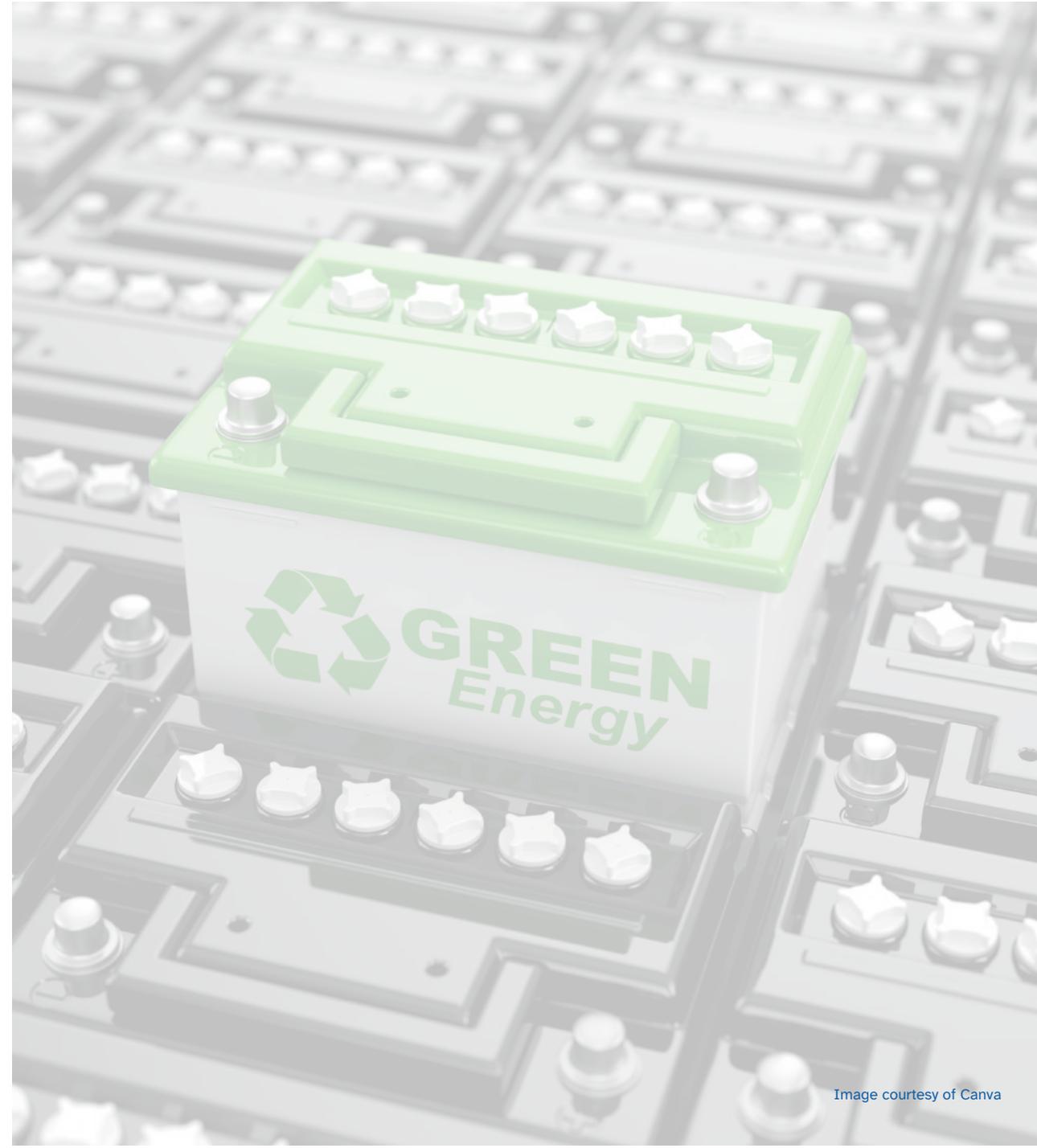


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Motivation

The Nordic Embassy Cooperation accepted a project proposal of the Nordic team in India to showcase and promote the best of Nordic technologies and research within the field of battery and energy storage systems. On behalf of the Nordic cooperation, Innovation Norway took the role and responsibility as project manager and the main partners in this project included top researchers and industry leaders from the Nordic countries (Norway, Sweden, Finland and Denmark), working alongside key stakeholders in India. Through this collaboration there were two events organised in Bengaluru and Pune, bringing together experts to share practices, experiences and the latest advancements in the battery and energy storage technologies. This collaborative effort provided a platform for exploring industry collaborations and forging new partnerships.

The objective of this report is to understand the landscape of battery energy storage systems (BESS) in the Nordic countries and the Indian subcontinent, and to highlight ecosystems and initiatives for fostering battery storage research and innovation in both regions.



A special focus is on two Indo-Nordic events held in Pune (19th November) and Bengaluru (21st November) to promote collaborations in the areas of battery and energy storage technologies.

I. Background

A Nordic ecosystem, bringing together international resources, skills, knowledge, investments and the materials is needed for a scalable and sustainable battery production. In a time where traditional industries are changing and new value chains are emerging, the Nordics are leading the way with a blueprint for the future of industrial collaboration. By 2030, the Nordic Council of Ministers has set out to make the Nordics the most sustainable and integrated region in the world. The Nordic Battery Collaboration is a key initiative of Norway, Sweden and Finland established on the shared similarities and relative strengths across the battery value chain. The battery value chain is based on traditional Nordic focus areas such as automotive, maritime, chemicals, manufacturing and mining.¹ The key players in the Nordic battery ecosystem are driven with dedicated ambitions and devotion to sustainability. With the backdrop of green transition of the global markets and economies the new battery industry is established driven by climate goals and electrification. The focus on sustainable batteries is rapidly becoming a priority, putting pressure on the industry and strengthening the Nordic position. Finland, Norway and Sweden are working together to utilise their collective strength in the battery value chain.²

¹ <https://www.eba250.com/wp-content/uploads/2023/02/NordicBatteryReport.pdf>
² <https://www.nordicbatterycollaboration.com/>

In Denmark, Better Energy deployed its first BESS in March 2024, at one of its solar PV plants.³ The BESS has presented an opportunity to store excess renewable energy at peak generation times to increase the availability of that renewable energy on the grid. This BESS being directly behind the meter at the solar park makes it presumably one of the first hybrid power plants in the Nordics. Better Energy is active in solar project development in and around its home market of Denmark with projects also in Poland, Sweden and Finland. In relation to this, the Danish Technological Institute worked on a BESS project that had been deployed at Copenhagen Airport in March 2024. The project is a part of the EU-funded Alight programme aimed at showcasing sustainable airports through sustainable fuels, e-mobility energy storage and waste heat recovery.⁴ Another case study is of an ongoing battery project in Denmark that uses battery storage to implement decarbonisation strategies. This battery technology project is developed and installed by BattMan Energy with Hitachi BESS, with the aim to reach Denmark's climate change goals.⁵

For India there are huge economic opportunities in energy storage.⁶ India aims to reduce its emission intensity up to 33-35 percent from the 2005-level by 2030. The Energy Storage System Roadmap for India (2019-2032) is an initiative of the India Smart Grid Forum with a primary goal of estimating the energy storage system requirements for grid support for integrating renewable energy into the grid.⁷ In 2018, over 4GWh of BESS were either under-construction, contracted or announced.⁸ Out of these more than 80 percent are Lithium-ion battery based projects.

³ <https://www.energy-storage.news/developer-better-energy-deploy-first-large-scale-bess-denmark-solar-plant/>

⁴ ibid



The Central Electricity Regulatory Commission (CERC) Staff Paper on Energy Storage⁹, highlights that transmission companies can deploy energy storage systems at grid-level substations and use the assets to participate in energy markets for grid support such as the ancillary services. The Indo-Nordic investment collaborations are parallelly growing by exploring common synergies between India's IT, R&D, Digitization and Telecom capabilities and Nordic countries' expertise in renewable energy, pharmaceuticals, finance, and textiles.¹⁰ A shared commitment towards collaborative and collective action is observed with Indo-Nordic Cooperation Summits in Sweden (2018), Denmark (2022) and Norway (2024). In July 2024, a roundtable was hosted by Det Moderne India in collaboration with the Ministry of Commerce & Industry, Government of India, Invest India, Indian Danish Chamber of Commerce and Industry and Sweden India Business Council.¹¹

Establishing platforms for cross-sector collaboration, matching financing, new technologies, and knowledge partners to foster innovative business models for green transition and emphasizing on the role of trade as an essential component for sustainability, were the key facilitating actions discussed in the roundtable.¹² A recent bilateral meeting between the Prime Minister of India and Prime Minister of Norway held in November 2024, focused on enhancing cooperation in areas like blue economy, renewable energy, green hydrogen, solar and wind projects, geo-thermal energy, green shipping, Carbon Capture Utilisation and Storage (CCUS), fisheries, space, and the Arctic.¹³

⁵ <https://www.energystorage.com/renewables/article/55246886/how-battery-storage-is-powering-denmarks-renewable-energy-revolution-and-driving-global-decarbonization>

⁶ <https://www.niti.gov.in/sites/default/files/2019-10/ISGF-Report-on-Energy-Storage-System-%28ESS%29-Roadmap-for-India-2019-2032.pdf>

IAs part of a bilateral research agreement between Denmark and India, two research calls on green fuel with a special focus on green hydrogen were announced in 2022 and 2024.

One of the core objectives of the Nordic Embassy Cooperation project is to position the Nordics as preferred partners in India's green transition. The aim is to facilitate market entry and expansion for Nordic companies in India by providing Nordic solutions. This can be achieved through regional collaboration and providing the necessary platform for Indo-Nordic engagement between experts from research institutions and industry from both the regions.



Image courtesy of Canva

⁷ Ibid

⁸ DOE database and Customised Energy Solutions (CES) analysis

⁹ https://cercind.gov.in/2017/draft_reg/SP.pdf

¹⁰ <https://www.linkedin.com/pulse/strengthening-indo-nordic-cooperation-sustainability-fw1sf/>

¹¹ <https://dmi.no/event/indo-nordic-industry-dialogue-on-sustainability-mid-year-session-2024/>

II. Models For Collaborative Innovation

Based on the importance of regional collaborations, there were two events conducted in Pune and Bengaluru in November 2024. A roundtable was conducted in Pune with participants ranging from leading research institutions to industry experts in India and the Nordics. The Pune roundtable was organised by the Embassy of Sweden, Embassy of Finland, Business Finland, Innovation Norway, Embassy of Norway and Innovation Centre Denmark, in partnership with India Energy Storage Alliance (IESA). In Bengaluru the local partner was the Bengaluru Science and Technology (BeST) Cluster and included a series of moderated panel discussions with representatives from research institutions and industry experts from the Nordics, alongside participants from Indian academia and industry. The two events brought out a unique opportunity of collaboration to harness diverse strengths in the development of cutting-edge energy storage technologies. There is a high potential to drive the global energy storage landscape, using a combination of India's talent pool, growing demand for energy solutions, and the expertise in research and innovation of the Nordics. These events have and will hopefully continue to enhance creating collaborative innovative solutions for advancing renewable energy systems and sustainable industrial practices.

¹² Ibid

¹³ https://www.pmindia.gov.in/en/news_updates/pm-meets-with-prime-minister-of-norway/



Pune Roundtable

The event brought together delegates from over 40 organisations from India, Denmark, Norway, Finland and Sweden. The roundtable was introduced by the Deputy Consul General of Norway in Mumbai, followed by opening remarks from Nordic Battery Project managers who put forward the agenda for the day and highlighted how the Nordic’s Multiple Helix system complements India’s ANRF framework. The first session of the roundtable was focused on the status of Nordic research & development in batteries across the globe. Potential collaboration opportunities between the participating research institutions, academics and scientists were also discussed. A table with their main points can be found in Annexure I. The second session on ‘Industry’ started with Dr. Gunnar Rohde from the Danish Technological Institute and the Danish Battery Society.

He gave an overview of the Danish Battery Industry, enumerating the involved players and accounting for their current as well as announced production capacities. He went on to highlight the Danish Technological Institute’s role in the European R&D network. He also guided the Indian innovators to reach out to the Danish Center for Energy Storage, Danish Battery Society and Innovation Center Denmark for collaboration.

Mr. Rahul Fotedar, CTO, Morrow Batteries elaborated the attributes of the entity as an industrial technology company. He described the in-house developed technologies on LFP and LNMO chemistry cell types and Morrow Batteries’ market segment classification into utility, C&I and residential BESS. Mr. Fotedar then elucidated the company’s strategy for expansion into niche markets for energy storage systems.



Presentations by Mr. Rahul Fotedar, CTO, Morrow Batteries



Discussions at Roundtable, Pune



Presentations by Asst. Professor Sulalit Bandyopadhyay, NTNU



He further elaborated on how LFP chemistry is best suited for BESS applications based on its low prices, higher cycle life, better safety and low toxicity.

Dr. Rakshith Nugehalli Sachitanand representing Echandia (Sweden), gave an overview of the company highlighting the market segments catered to by Echandia. India was Echandia's first market and they now have over 67 energy storage solutions delivered worldwide in heavy-duty segments.

Dr. Richa Chaudhary, representing a Startup from Chalmers gave a detailed account of the technical feasibility of Massless Structural Batteries. Next presentation was from Ms. Shandra Pandey, Smartcell, a Pre-Startup from Tampere University. She initiated her talk with a brief overview of Tampere University, covering details such as faculty, available research infrastructure, current research projects going on in the campus. She went on to list some of the research topics such as carbon capture and storage, solid state electrolyzers & fuel cells, photocatalytic electrochemical cells, solid state batteries and hydrogen storage technologies. The presentations were followed by a discussion between the presenters and the audience, moderated by Dr. Per Arne Wikstrom, Swedish Counsellor for Science and Innovation. After the Q&A session, Mr. Suhas Suthar, Replus Engitech gave a presentation on the status of the BESS market segment and Replus' experience in BESS project development in India. The last presentation of the day was made by Mr. Ashay Ghogare, Director and Head of R&D, Kairus Energies on the topic 'Battery Manufacturing and India Market Opportunities'.

He highlighted the critical issues being faced by the energy storage sector such as low performance, safety, low energy density, poor weather proofing and high operating expenditure. He described the features of special advanced ESS applications offered by Kairus for the defense sector. These advanced ESS applications are suited to extreme range, high humidity and high-power demand. They are built for fire protection and multi-layer security.¹⁴

Bengaluru Roundtable

This roundtable was organised differently from Pune with less presentations and instead an emphasis on panel discussions, as well as an interactive session with different "stations" for reflections and discussion under three main areas:

- Readily achievable goals
- Long term ideas, academia / industry partnerships
- Dropbox for other ideas



Per-Arne Wikström Head of Office of Science and Innovation, Embassy of Sweden

The more detailed overview of the points that came up in the discussion can be found in Annexure I, but some of the main points that can be highlighted:

- The participants see value in increased collaboration between academia and industry especially through staff/student exchange and co-funded programmes such as industrial PhD which is a collaboration between industry and academia.
- Collaborate on finding common solutions for recycling of batteries.
- Create an Indo-Nordic SME industry partnership for Greentech.
- Create Centres of Excellence for continued collaboration.
- Lay the groundwork for a consortium for potential EU project proposals.



Participants from the Nordics and India at the Bengaluru roundtable

III. Challenges and Opportunities

► Funding

The battery value chain is a capital-intensive industry, ranging from mining and refining of raw materials to large gigafactories and recycling facilities. The CAPEX and OPEX for battery cell production are highest in Europe compared to other industries, predominantly due to high energy and labour costs.¹⁵ For instance, early-stage companies in Norway stress on the need for financial support beyond start-up stages, given the challenging capital market. In 2023, the Union Cabinet in India approved the Scheme for Viability Gap Funding (VGF) for development of Battery Energy Storage Systems (BESS).¹⁶ The scheme aims a development of 4,000 MWh of BESS projects by 2030-31, with a financial support of up to 40 percent of the capital cost as budgetary support in the form of VGF. This scheme being a turning point compared to other pro-environment measures undertaken by the Government, is expected to cut down the cost of battery storage systems and increase their viability. On the contrary, the pace of the funding from industry has been gradual, however the increase in the talent pool in the country has led to development of newer and more practical solutions in battery storage.

¹⁵ chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.capgemini.com/wp-content/uploads/2024/08/Battery-industry-PoV_v6_21_8_print.pdf

¹⁶ <https://pib.gov.in/PressReleasePage.aspx?PRID=1955112>

¹⁷ https://year-of-skills.europa.eu/green-deal-industrial-plan-plugging-skills-gap_en

¹⁸ <https://nordicbatteries.com/news/morrow-batteries-nordic-batteries-and-eldrift-join-forces-to-build-norwegian-battery-supply-chain>

► Competency

With the advancement of technology and time, the battery industry will require a highly competent workforce. The perception of newer technologies varies within industry types and the applicability of these technologies is typically undermined due to lack of expertise in operating. For enhancing competency needs, it is crucial to look internationally in terms of skills and quantity. Competency needs need to be met with lucrative work offers and adequate and appropriate compensation to maintain the existing workforce along with additional hiring. For instance, the European Union's (EU) Green Deal Industrial Plan has identified the need to train and reskill approximately 800,000 employees by 2025 to meet the growth in electrification through battery technologies.¹⁷

► Collaborations and Partnerships

Battery production is a complex process; due to high interdependence in the industry and risk of overcapacity, the battery companies are continuously and increasingly integrating along the value chain to boost supply-chain resilience. As a consequence, this further brings out the risk of over-reliance and intensified competition. In most countries, the battery industry is still at a nascent stage with a small market size. Due to this it is challenging for companies to find domestic partners even though there are examples of existing strategic partnerships such as the one between Morrow Batteries, Nordic Batteries and Eldrift.¹⁸ Seeking international partners is another option, however smaller and new companies entering the market face limited negotiation power due to the trend of larger companies acquiring partnerships.

► Environmental Social Goals

While the International Energy Agency (IEA) put emphasis on the positive developments in several areas, there is research that identifies negative patterns such as increased mineral waste generation per unit produced.¹⁹ The strain on social, environmental and integrity challenges, scarcity of raw materials, incomplete ESG goals and lack of refining capacity are a result of the rapid growth of the battery industry.

The battery companies rely on the support and cooperation of small communities to expand, establish their facilities, however gaining their support can be challenging as these communities typically bear the brunt of the negative impacts of production. On this backdrop, a new regulatory framework for batteries was established in 2023 with a goal to make batteries sustainable throughout their entire life cycle – from the sourcing of materials to their collection, recycling and repurposing.²⁰

► Cost of Technology Adoption

Globally, the cost of raw materials saw large price fluctuations with a 75 percent surge in lithium prices followed by a 30-45 percent decline in the prices of other key materials such as nickel, cobalt, manganese and graphite.²¹ The cost of technologies can be decreased with economies of scale in industry.

¹⁹ <https://www.iea.org/reports/global-critical-minerals-outlook-2024>



IV. Way Forward – Importance and Need for Collaboration

India's competitive advantage lies in its vast scale and business opportunities, and the Nordic countries can bring invaluable expertise in support for developing the market both from a business and industry research point of view. The Nordic "Triple Helix System" involving government, industry and academia collaboration, has a proven record of successfully driving swift progress in different fields. In India, the government funding has played an integral role in research compared to that of the industry and academia. Adopting a model similar to the Nordic Triple Helix approach could accelerate progress in India and make India-Nordic collaboration easier. The Anusandhan National Research Foundation envisions to enable this in India and also aims to create best management practices at par with best global practices for the promotion of basic research.²² The collaboration between India and the Nordic countries holds significant promises for the future. The integration of complementary strengths - India's scale and demand and the Nordic regions' advanced system for research and technology - the Nordics and India can potentially spearhead the development of next-generation battery technologies. Bridging the gaps between academia and industry, focusing on sustainable practices and overcoming the barriers to recycling and in-house production will be crucial steps in realising the full potential of this collaboration.

²⁰ https://environment.ec.europa.eu/topics/waste-and-recycling/batteries_en

²¹ <https://www.iea.org/reports/global-critical-minerals-outlook-2024/executive-summary>

²² <https://serb.gov.in/>

The collaboration can be enhanced between the two regions with a focus on bilateral funding supporting research and innovation exchange. Joint projects can lead to commercialisation and financial support. India and the Nordic countries together can lead the way towards a more sustainable and energy-efficient future through unlocking the potential of regional resources for mutual benefit. Increased collaboration between academia and industry representatives on joint-research projects, technology and knowledge transfer and research outputs will enable successful fruition of these ideas.

The roundtable discussions held in Pune and Bengaluru, set a foundation for future collaborations between the research institutions and industries in Nordic countries and India. For instance, the battery research IIT Bombay conducted at the EV Powertrain Lab overlaps with the research efforts taken by the Battery Coast at University of Agder. Both the labs focus on sustainability in BESS, a common streak to further research collaboration between both the institutions.



All the participants from the Nordics and India at the Pune roundtable



Annexure I

List of research organisations and industries



Below is a list of participating research organisations (including links to their web pages) and their respective areas of expertise and focus areas:

[Indian Institute of Technology \(IIT\), Bombay, India](#)

Overview	Focus Areas
<ul style="list-style-type: none"> Centres of Excellence in Data Science, Machine Learning, AI and Cloud Computing, Sustainability, Manufacturing, and Healthcare. EV Powertrain Lab. EV education for students with project-based learning. Modelling/Simulation. Materials/ Electrochemistry. Pilot Scale. EV Powertrain Battery Management System (BMS)/Packs. Pack Thermal Dissipation. Echem Char Diagnostics. Recycling 	<ul style="list-style-type: none"> Interface engineering - materials sodium-ion batteries. Flow batteries. EV mobility - power circuits. Large-scale energy storage for grid-level integration.

[Norwegian University of Science and Technology \(NTNU\), Norway](#)

Overview	Focus Areas
<ul style="list-style-type: none"> Under the Department of Chemical Engineering, the Environmental Engineering and Reactor Technology Group focuses their research on carbon capture, chemical reactors, process design, membranes, crystallisation, biorefinery and fiber technology. 55 partners with industry- academia collaboration. Particle Engineering Centre - application-based and fundamental research. Motivation - future LIB demands and EU Critical Raw Materials Act. Expertise in black mass production, black mass pre-treatment, hydrometallurgy, and characterisation. Approach different from conventional recycling with early stage recovery of Lithium ion. Recycling is a last resort, focusing rather on innovation in reusing and repurposing. 	<ul style="list-style-type: none"> Lithium-ion batteries. Sodium batteries. Flow cells.

[University of Agder \(UiA\), Norway](#)

Overview	Focus Areas
<ul style="list-style-type: none"> Connecting the battery industry, research, and education at the Norwegian Battery Coast and beyond. Fostering the co-creation of battery competence. Research spanning from material characterisation to recycling, from commercial cell analysis, modelling and control systems to life-cycle assessment and sustainable business models. 	<ul style="list-style-type: none"> Battery Components and Design. Automation in the Battery Industry. Circular Battery Value Chains.

[Chalmers University of Technology, Sweden](#)

Overview	Focus Areas
<ul style="list-style-type: none"> Battery Research Funding from Horizon 2020, Battery 2030, Graphene Flagship, and BIG-MAP. Battery Research Networks: ALISTORE, destiny programme and mesc+ Foresee collaboration in battery research at Chalmers. 	<p>Next-gen batteries like lithium-sulphur, Al-metal batteries, techno-economic analysis.</p>



Aalto University, Finland

Overview	Focus Areas
<ul style="list-style-type: none">• EU directive.• Safety measures are crucial while recycling.• Battery casing material determines the corrosiveness of the battery.• Strategic corporate partners - SAAB, Nokia.	<ul style="list-style-type: none">• Discharge and diagnostics.• Black mass separation.

Danish Technological Institute, Denmark

Overview	Focus Areas
<ul style="list-style-type: none">• Largest and oldest research and technology institute in Denmark with almost 1.200 employees and more than 12.000 customers or collaboration partners.• Primary research and development divisions within building and construction, energy and climate, food and production, environmental technologies, and materials.• Institute is a member of EUROTECH with 9 other biggest Research and Technology Organisations: CEA, Fraunhofer, TNO, VTT, SINTEF, RISE, IMEC, TecNALIA, and AIT.• Work based on expertise, integrity, achieving results, and ground-breaking development.• Concrete examples: augmented data for battery state estimation, Indian Danish collaboration on energy storage, battery recycling, and battery thermal runaway.	<ul style="list-style-type: none">• Global challenges: climate crisis, geopolitical crisis and growth/recession.• Institute's development focus: food, materials and energy, together with digitalization, resilience, and sustainability.



Image courtesy of Canva

Below is a list of participating companies (incl links to their web pages), the area where they operate and the target markets:

[Morrow Batteries, Norway](#)

Overview	Focus Areas
<ul style="list-style-type: none"> • Developing and manufacturing cost-effective and sustainable batteries. • Decarbonising the manufacturing of battery cells and the battery material supply chain. • Building a circular battery value chain where our waste is recycled and recycled content is used to produce new battery cells. • Creating new chemistries that encompass battery materials with lower environmental impact and are available in abundance. • Producing Lithium Ion Phosphate (LFP) batteries with renewable energy methods leading to low carbon footprint. 	<ul style="list-style-type: none"> • By concentrating on developing mobility and energy storage systems, we will be able to meet the battery requirements of over 96% of the world's expected demand. • Manufacture the current industry-leading battery technologies for energy storage and automotive - Lithium Iron Phosphate (LFP) and Nickel Manganese Cobalt (NMC). • Commercialise a new generation of battery technologies on the high-voltage material LNMO (Lithium Nickel Manganese Oxide). • Two product offerings, LNMO-X can supercharge heavy mobility (trains and ferries) and the long-life BESS markets, are designed to meet the unique demands of the markets and help customers achieve their sustainability goals. • LNMO-C offers the highest practical single-cell voltage in the world (>4.5V)

[Echandia Marine, Sweden](#)

Overview	Focus Areas
<ul style="list-style-type: none"> • Currently investigating localisation of production and R&D in India for local and Asian customers. • Proven product market fit in Maritime applications. 	<ul style="list-style-type: none"> • Offshore and Energy • Ferries • Tugboats • Naval • RORO/ROPAX • Commercial vessels • New segments: Cruise and Shore power.



Image courtesy of Canva



Replus Engitech, India

Overview	Focus Areas
<ul style="list-style-type: none"> • Energy storage solutions through generation, transmission and consumption. • Integration of renewable energy. • Transmission and distribution to T&D stations, residential and commercial & industrial. • Electric mobility and automation through robotics, AGV/Drones, and e-mobility. • In-house manufacturing, testing facility and R&D laboratory centre. 	<ul style="list-style-type: none"> • Providing cutting edge and advanced solutions for battery energy storage needs of the industry. • Deliver complex solutions from concept to commissioning to most reliable operation and maintenance service needs.

Banashree Renewable Energy System, India

Overview	Focus Areas
<ul style="list-style-type: none"> • Banashree is the low power solution partner for novel companies developing electronic products. • To explore, design, develop innovative solutions catering to the semiconductor industry. • Provide SOC solutions for renewable energy systems with lowest carbon footprint. • To develop affordable electronics solutions to serve the society. 	<ul style="list-style-type: none"> • Consulting on optimising existing methodology, adding new tools, and implementing new sub-flows. • Optimising customers' chips for power, performance, and area. • Physical design consultants deploy a new flow, perform the physical design tasks, and ultimately help your team become self-reliant on future COT handoff projects.

Kairus Energies, India

Overview	Focus Areas
<ul style="list-style-type: none"> • Primary focus on technology and engineering of advanced energy systems. • State-of-the-art lithium-ion battery modules designed to deliver powerful, reliable energy solutions for industries that demand high performance and durability. 	<ul style="list-style-type: none"> • Deliver innovative and cutting-edge solutions through applications of electric vehicles, energy storage, and renewable energy projects. • Highly advanced products strike a perfect balance between cost, performance, safety, scalability, and versatility across all areas of application.

First Energy Private Limited (FEPL), India

Overview	Focus Areas
<ul style="list-style-type: none"> • First Energy Private Limited (FEPL), a Thermax Group company, is uniquely positioned to assist customers in their journey towards green energy. • FEPL offers sustainable solutions, including solar, wind, wind-solar hybrid and storage batteries in commercial and industrial segments. 	<ul style="list-style-type: none"> • Innovative BESS solution augments the capabilities of solar setup, providing backup power and optimising energy utilisation. • Deploy battery energy storage systems for solar PV plants, leveraging advanced Li-ion technology for reliable performance. • This hybrid system operates seamlessly alongside solar PV and grid connections, ensuring uninterrupted service and efficient monitoring. • With integrated RPMS and BMS technologies, the solution guarantees hassle-free operation and maximum uptime for renewable energy infrastructure.



Startups

Smart Cell, Tampere University, Finland

Overview	Focus Areas
<ul style="list-style-type: none"> • Next-generation Solid Oxide Cell (SOC). • A pre-startup funded by Aalto University, Business Finland, and Tampere University. • Identifies the challenge of a need for large scale energy storage. • Focus on lean manufacturing including screen printing, tape casting, and 3D printing. 	<ul style="list-style-type: none"> • Identifies limitations of current market solutions; expensive and use of critical raw material. • Solutions include material synthesis, fabrication of cells, and fuel cells. • Providing low-cost and high-performance cells than existing competing technology. • Making process is less energy intensive and has lower degradation issues. • Smart Cell solutions are free from reliance on critical and scarce materials.



Image courtesy of Canva

Sinonus, Chalmers Ventures, Sweden



Image courtesy of Canva

Overview	Focus Areas
<ul style="list-style-type: none"> • Massless structural battery technology. • Groundbreaking technology of carbon fibers that can double as battery electrodes. • Carbon fiber is a strong and light construction material that can store energy electrochemically. Sinonus uses this multi-functionality to make true carbon fiber-based structural batteries that not only store energy but also become an integral part of the product's structure • Identifies limitations to innovation, leveraging from monofunctional conventional Li-ion battery to multifunctional structural battery laminate. 	<ul style="list-style-type: none"> • The introduction of carbon fiber-based structural batteries could increase the driving range for lightweight EVs by 70 percent. • The lower energy density of structural batteries would make them safer than standard batteries, especially as they would also not contain any volatile substances.



Annexure II

Insights from Interactive sessions with participants at the Bengaluru event



Readily Achievable Goals

Academia:

- Student and faculty exchange programme co-funded (Industry / Masters / Academics Ph.D) programs.
- Collaborating through workshops, smaller projects and through digital conferences.
- Creating a consortium for EU Application (Erasmus).
- “Lessons Learnt”: Exchange of knowledge, models, and tools that are already exploited in either of the countries.
- Possible project on collect and aero-used batteries (from Volvo, Morrow) to India and use them for stationary storage.

Industry:

- IoT solution for lead acid battery monitoring.
- Co-innovation and collaboration with already existing IP (Open-Innovation).
- Operando diagnosis (cell \square module).
- Direct Industry funding (6 months to 1 year) on the focused area.
- Technology transfer and evaluation.
- Risk Identification and Mitigation (Project-Specific)
- Joint research project with joint Ph.D student for 3-4 years (involve exchange visit).
- Collaborative solutions on recycling battery.
- Indo- Nordic SME Industry Partnership for Greentech.
- Supply of “scale” materials from India for research on Nordics.
- Definitive Problem Statements from Industry (Example: safety / thermal management / prediction / state-of-health (SoH)).

Other goals:

- India EU Joint Battery Management Policy
- Operando diagnosis (cell \square module)



Image courtesy of Canva

Long-Term Ideas, Academia/Industry Partnerships

Academia:

- Academic Support for Battery recycling startups
- Vision setting white papers on sustainability and bottom-up picking of low carbon foot-print materials
- Create Centres of Excellence for continued collaboration
- Studies on the reliability of the Battery Energy Storage System (BESS) Bill of Materials (BOM)

Industry:

- Sustainable, cost-effective and eco-friendly, safe recycling methods for all types of cell chemistries.
- Training and capacity building in critical areas
- Industry Projects / Competence projects – Different needs
- Industry people should be ready to invest in indigenous development other than purchase and import for a short-term benefit
- Identifying problem statements for the “startups”
- Detailed Project reports in the battery recycling sector
- With manufacturing and recycling (LFP, NMC recycling)
- Open-source designs for various components to accelerate product development with the most modern, efficient and sustainable attributes
- Start-up “Needs” vs Established Company “Responsibilities”
- Battery as a service business model.
- The industry can help to identify the exact problem for advanced cells.

Other goals:

- Joint research programmes and internships funded and offered by industry-academia collaboration
- Maintaining regular interactions and connections between Academia, Research R&D, Industry R&D
- Technology transfer agreements between academia-industry on mutual benefits, for a long-term co-operation
- Streamlined communication between industry and academic experts
- Focus on short-term and long-term goals
- Influence on and by policy makers
- Power on demand
- Industry partnership to upgrade the existing infrastructure in academia related to e-mobility and energy storage
- Solutions for a completely recyclable battery
- Focus more on advanced materials that can improve the life cycle or end of life of the cell
- Project-level association and development of risk mitigation and makeup strategies
- Identification of alternative materials
- Joint virtual / automated lab, for collaboration, which can be operated remotely

Dropbox for Other Ideas

- Platform for communication between India and Nordic battery players
- Safety solution for use of lithium-Ion Batteries in a system (external to a cell)
- Industrial research collaboration to occur in large scale industrial level funding
- Seed-funding to test possible collaborations
- Standardisation and compliance clarification support on new tech products
- Time-bound programs
- Based on Lead Acid Battery Refurbishment-
 - CSR Offset model
 - Carbon Offset model
- Differentiate between the role of CSIR and Universities
- More industry collaboration and increased research funding



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Annexure III



List of Attendees: Pune Roundtable (19th November 2024)

Speakers

Ashay Ghogare, Director and Head of Research and Development, Kairus Energies
Bharatkumar Suthar, Assistant Professor, IIT Bombay
Dr. Neha Garg, Postdoctoral Researcher, Aalto University
Dr. Per-Arne Wikström, Counsellor for Science and Innovation, Embassy of Sweden, New Delhi
Elisabeth Strand Vigtel, Counsellor, Science, Technology & Higher Education, Innovation Norway, Royal Norwegian Embassy, New Delhi
Dr. Richa Chaudhary, Postdoctoral Researcher, Chalmers University of Technology, Sweden
Dr. Tomooki Hosaka, Visiting Researcher, Chalmers University of Technology
Dr. Gunnar Rohde, Research and Development Specialist, Danish Technological Institute
Erik af Hällström, Consulate General of Finland in Mumbai, Ministry of Foreign Affairs of Finland
Hiren Praveen Shah, CEO, Replus Engitech
Johannes Landesfeind, Associate Professor, University of Agder
Kottarathil Aginmariya, PhD student, Chalmers University of Technology

Rahul Fotedar, Chief Technical Officer (CTO), Morrow Batteries
Rakshith Nugehalli Sachitanand, Senior Strategist, Echandia Marine
Shandra Pandey, Commercialisation Lead, Smart Cell, Tampere University
Sulalit Bandyopadhyay, Assistant Professor, Norwegian University of Science and Technology (NTNU)

Attendees

Amala George, Scientist Entity 2 Energy Storage Pvt Ltd.
Ambika Oberoi, Senior Market Advisor, Innovation Norway
Dr. Priya Nagaraj, Chief Executive Officer (CEO), Pune Knowledge Cluster (PKC)
Dr. Sudipto Chakraborty, Associate Vice President, Navin Fluorine International Limited (NFIL)
Geeny George Shaju, Senior Adviser - Innovation and Science, Embassy of Sweden, New Delhi
Jayaprakash Srinivas, Head of Business Development, Legion Energy Products
Kshitij Naik, Co - Founder & Director, Kairus Energies

Milind Kulkarni, Scientist 'F', Centre for Materials for Electronics Technology (C-MET)
Nandan C. Bapat, Deputy General Manager R&D, Hind Rectifiers Limited
Partha Pratim Mondal, Chief Technical Officer (CTO), Back2Basics Recycle Private Limited
Pawan Bhatnagar, Managing Director, Kasvu Consulting Pvt Ltd.
Prashant Tajne, Director, VerveTronics
Shailee Khandelwal, DGM Business Development, Godrej Agrovet
Shrinivas Tukdeo, Research Director, Everest
Suhas Sutar, President ESS Business, Replus Engitech
Suwendu Lenka, Sr.GM-Business Development, Reliance Energy
Tanveer Alam, Back2Basics Recycle Private Limited
Vaishnavi Dudhe, Application Engineering, MTU India Pvt. Ltd. (Rolls Royce)
Vaishnavi Satpute, Consultant, Pune Knowledge Cluster (PKC)

Annexure IV



List of Attendees: Bengaluru Roundtable (21st November 2024)

Panelists

Dr. Gunnar Rohde, Research and Development Specialist, Danish Technological Institute
Dr. Mohanraj, Joint Director, Central Manufacturing Technology Institute
Dr. Neha Garg, Postdoctoral Researcher, Aalto University
Dr. Per-Arne Wikström, Counsellor for Science and Innovation, Embassy of Sweden, New Delhi
Dr. Sundaraaman K V, Director COE Energy Storage, Schneider Electric
Dr. Tomooki Hosaka, Visiting Researcher, Chalmers University of Technology
Eske Bo Knudsen Rosenberg, Consulate General, Head of Trade and Innovation Centre Denmark
Johannes Landesfeind, Associate Professor, University of Agder
Kottarathil Aginmariya, PhD student, Chalmers University of Technology
Naga Phani, Professor, IISc Bangalore, India
Narasimha Mummedy, General Manager-Technology, First Energy Private Limited
Rahul Fotedar, Chief Technical Officer (CTO), Morrow Batteries
Rakshith Nugehalli Sachitanand, Senior Strategist, Echandia Marine
Satish Rajkumar, Director, Volvo IT
Shandra Pandey, Commercialisation Lead, Smart Cell, Tampere University
Sulalit Bandyopadhyay, Assistant Professor, Norwegian University of Science and Technology (NTNU)

Attendees

Abhilash K, Assistant Professor, Christ University, India
Ambika Oberoi, Senior Market Advisor, Innovation Norway, Royal Norwegian Embassy, New Delhi, India
Anamika S Ghosh, Project Lead, Centre for Responsible Business (CRB), India
Aninda Jiban Bhattacharyya, Professor, IISc Bangalore, India
Elisabeth Strand Vigtel, Counsellor, Science, Technology & Higher Education, Innovation Norway, Royal Norwegian Embassy, New Delhi
Benson Money, Assistant Professor, Christ University, India
Chandramohan Umopathy, Chief Technology Officer, Banashree Renewable Energy System, Global Battery Innovation and Recycling Alliance, India
D. Chetan, SEE (Ele), Karnataka Power Transmission Corporation Ltd., India
Dharmesh Sharan, Senior Advisor, Business Finland, New Delhi
Dr. Dhamodaran S, Professor, Amrita Vishwa Vidyapeetham, India
Dr. Hariprakash, Chief Technical Officer, Godi Energy, India
Geeny George Shaju, Senior Adviser - Innovation and Science, Embassy of Sweden, New Delhi
H S S Ramakrishna Matte, Scientist D, Centre for Nano & Soft Matter Sciences, India
Dr. Prem Senguttuvan, Professor, NCASR, India
G. Guruswamy

K. P. Rudrappaiah, Managing Director, Karnataka Renewable Energy Development Ltd., India
Karthik Ganesh, Fawkes Energy, Sweden
Liisa Toivonen, Senior Specialist, Embassy of Finland, New Delhi
Mohan Satyaranjan, Managing Director, Taqanal Energy Private Ltd., India
Omkabilayan R, Karkaru Climate Action Corporation Global LLP, India
Parag Jose, Assistant Professor, Christ University, India
Partha Kumbhakar, Assistant Professor, Christ University, India
Prabeer Barpanda, Professor, IISc Bangalore, India
Pradeep Kumar, RDI - R&D Industries
Raja Subramanian, Associate Director, Office of International Affairs, Christ University, India
Reghu V R, Professor, Christ University, India
Siddharth Naithani, Senior Advisor ICT, Business Finland
Søren Tranberg Hansen, Science Consul, Deputy Head of Mission, Innovation Center Denmark, Consulate General of Denmark
Sunitha V R, Associate Professor, Christ University, India
Vijay Singh, IP Manager and Licensing, IPTeL, IISc Bangalore, India



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