

Joint workshop by the International Energy Agency and the Electric Vehicle Initiative of the Clean Energy Ministerial

Batteries for electric mobility

Wednesday 7 March 2018

*Centre de Conférence Ministériel Convention, 27 rue de la Convention, 75015
Paris*

Summary

The Clean Energy Ministerial, International Energy Agency and Electric Vehicle Initiative are organizing a technical workshop on batteries for electric mobility, scheduled for 7 March 2018 in Paris (France).

The goal of this workshop is to discuss some of the key developments in the battery sector that underpin the recent and projected increase in electric mobility. The event will focus on four main topics:

1. Battery chemistries: implications for current cost/performance estimates and potential cost reductions/performance improvements
2. Battery manufacturing: scale-up challenges and opportunities as a result of increased adoption of EVs
3. Material demand for batteries and potential supply constraints
4. End-of-life: second/third life opportunities and battery recycling

The format of the workshop will be a sequence of four roundtables - one on each of the topics above. Each roundtable will be opened by two 'scene setters', followed by a structured discussion involving participants from academia, industry, governments and NGOs.

The workshop follows the Chatham House Rule: participants are free to use the information received, but without attribution to specific speakers or participants.

AGENDA

9:00 **Registration & Welcome**

9:30 **Introduction and overview of the agenda**

Speakers *Laszlo Varro*, Chief Economist, International Energy Agency
Pierpaolo Cazzola, Transport Analyst, International Energy Agency

- Opening
- Overview IEA and the CEM-EVI work on electric mobility
- Aim of the event

9:45 **Session 1 - Battery chemistries: implications for current cost and performance estimates and potential cost reductions/performance improvements**

Speakers *Marcel Meeus*, Sustesco/EMIRI
Elizabeth Endler, Shell

- Review of status of the main battery chemistries currently used and under consideration for the electric vehicle market
- Potential new chemistries that could shake up the market
- Factors influencing cost developments and expected floor costs for existing and future technologies
- Main parameters determining the competitiveness of chemistries and their applicability to electric mobility:
 - Energy density, (dis)charging speed
 - Durability (longevity, risk of malfunction, changes in characteristics, charge/discharge cycles)
 - Resilience (flammability, safety)
 - Potential for cost reduction

10:15 **Discussion**

Moderator *Pierpaolo Cazzola*, Transport Analyst, International Energy Agency

Discussion questions:

- Is there a clear winner? Are future battery technologies going to be much better than current chemistries? What have been the limiting factors for technologies that might replace current chemistries, and how likely are these limitations to be overcome in the coming decade or two?
- Are there chemistries that clearly ensure greater durability and/or resilient performance? For example, are there chemistries that have a better capacity to deliver in particularly cold/hot environments?
- Will battery technology need to differ with different end-uses? For example, are we going to need different technologies for short-distance vs. long-distance transport applications? Or for vehicles operating for longer periods and at higher mileages (such as taxis or heavy-duty trucks)?
- To what extent do costs matter (e.g. are more costly technologies for lighter batteries suitable for aviation, and not necessary/viable in cars)?

11:15 **Coffee break**

11:30 **Session 2 - Battery manufacturing: scale-up challenges and opportunities from increased adoption of EVs**

Speakers *Zhao Tong, Managing Director, Global Sales, BYD Battery Group*
Shabbir Ahmed, Project Manager, Argonne National Laboratory

- Current applications requiring the use of batteries: implications on the scale of production.
- Current and future leading global regions for battery manufacturing, links with the industrial clusters requiring the use of batteries.
- Prospects for changes in demand and the scope of application of batteries in case of a strong uptake in the automotive sector. Need for a significant scale-up: car industry scales are at a far larger scale (2+ million engines per factory) than current battery production (100-500 thousand batteries per factory).
- What are the strategies that could accelerate this scale-up? Is increased automation likely? Why or why not? Is this scale-up and the likely global dimension of this sector in the future likely to lead to a convergence of battery chemistries and types manufactured?
- To what extent will scaling up lead to cost reductions? Are there constraints for this?
- EVs imply very different architecture for vehicle manufacture, and the replacement of ICEs with batteries is part of this. Are there synergies possible in ensuring that battery production facilities and vehicle manufacturing plants are strongly integrated?
- Are batteries currently produced in the same global regions where the industry using them is also located? Are there advantages in decoupling battery production from vehicle manufacturing/assembly? Will this coupling (or the absence of it) remain/disappear if the automotive industry will drive most of the demand for batteries?

12:00 **Discussion**

Moderator *Laszlo Varro, Chief Economist, International Energy Agency*

Discussion questions:

- Is automation a 'must' if we want to produce batteries for the automotive industry? Is this a disruptive requirement, or something that could change the current distribution of the battery manufacturing industry?
- Could a surge in demand from the automotive industry and the subsequent increase in the scale of production change the current geographical distribution of suppliers? Why? Are there advantages in proximity to the material supply likely to have an impact? How relevant are labour costs in battery manufacturing? To what extent do labour costs influence decisions on the location of battery production facilities?
- What is the scale of investment needed to restructure existing vehicle manufacturing sites? Are green field investments for EV production larger than investments in converting ICE manufacturing facilities to EV production facilities?
- Who is investing on what today? Why? Who will invest in what tomorrow?

13:00 **Lunch break**

14:00 **Session 3 - Material demand for batteries and potential supply constraints**

Speakers *Cyrille Jouin and David Brocas, Nickel and cobalt departments, Glencore*
Colin Hamilton, Managing Director Commodities Research, BMO Capital Markets and Ben Jones, Managing Consultant, CRU Group

- Current material demand and prospects for demand increase
- Overview of main materials being mined for EV batteries, companies that are responsible for this, price formation mechanisms for raw materials/commodities, impacts of an increase in demand for batteries (are these relevant? Are there materials that will be more affected than others?), possibility to anticipate structural changes in material prices (what does the Volkswagen example on the cobalt bid mean?)
- Current versus future mining operations, prospects/strategies for increased production
- Potential bottlenecks in supply over the short-/medium-/long-term (reserves, planned mining operations), main geopolitical issues and solutions being considered to address them by the mining industry, and potential implications for price developments
- Mining sustainability. Main sustainability issues (social, environmental, political) related to battery materials. How relevant will sustainability issues be in a context of scale up of material extraction, and what are the strategies used and considered to address these issues.

14:30 **Discussion**

Moderator *Evi Petavratzi, Senior Mineral Commodity Geologist, Ore Deposits and Commodities, British Geological Survey*

Discussion questions:

- To what extent might price dynamics induced by material shortages impact the competitiveness/cost reduction potential of batteries?
- Are bottlenecks and supply chain issues pose substantially difficulties for the growth in market shares of electric vehicles?
- What is the role of technology (change in battery chemistries, optimization of material use) in managing and ameliorating material availability constraints?
- Is there a role for policy to mitigate negative impacts?
- Will an increase in the demand for battery material have beneficial or detrimental effects on the environmental and social sustainability of mining operations? Why?
- Is there a role for policy to foster good practices?

15:30 **Coffee break**

15:45 **Session 4 - End-of-life: second/third life opportunities and battery recycling**

Speakers *Makoto Dave Yoshida*, General Manager, Nissan Motor Company
Gabrielle Gaustad, Associate Professor, Rochester Institute of Technology

- LCA of battery production and CO₂ footprint
- Current end-of-life regulations and enforcement
- Opportunities/strategies for reusing/recycling of various batteries (chemistries, quality, costs): the example of second life applications for batteries
- Relevance of the end-of-life treatment on the environmental performance of batteries
- Barriers imposed by existing regulations: is there a need for change in the existing regulatory framework to enable the possibility to ensure improved material productivity? What are the key areas requiring changes? Why?

16:15 **Discussion**

Moderator *Alissa Kendall*, Professor, University of California Davis

Discussion questions:

- Role of second life applications from EV batteries: is this possibility only relevant for the short term? Is the market big enough in the long term (i.e. with a major scale up in battery demand for automotive applications)?
- How relevant is this as a factor influencing material availability issues? How relevant is this to improving sustainability?
- Is the size of the markets demanding used batteries from automotive application big enough?
- In what timeframe associated with the battery market development (automotive + 2nd/3rd life applications) will recycling be needed on a large scale? How and when should policies anticipate this? How can policies ensure that a large scale, global battery market does not lead to negative environmental impacts of dangerous materials disposal (is there any experience from the consumer goods battery market to learn from)?
- Are there chemistries that are likely to facilitate recycling? To what extent could this be a driver for R&D? What are the regulatory challenges associated with this? Is it necessary to develop adaptive regulations? Are performance-based regulatory requirements the way to go?

17:15 **Conclusion**

Moderator *Pierpaolo Cazzola*, Transport analyst, International Energy Agency

- Final considerations from each participant and recommendations for key take away messages for the IEA.

17:45 **End of meeting**

Day 2

The workshop will be held back to back with another event on materials demand for transport vehicles and implications for industry energy use, on March 8. This workshop is only open to participants who registered for this session.