DEEPDIVE SESSIONS:
Energy Storage and Electric Vehicles
11:00-13:00, Thursday 12 May
Introduction Energy Storage & Electric Vehicles
IRENA Activities in Energy Storage and EV

Some insights from ongoing projects

- REmap – Roadmap for a renewable energy future
- REmap Transport Action Team
- Regional action plan on RE mini-grids
- Trainings on Grid Integration
- Outlook report for heating and cooling energy storage
- Small Island Developing States’ (SIDS) Lighthouses
- Global Renewable Energy Islands Networks (GREIN)
- Technology briefs Publications
- Power system transformation and impacts of storage
## Electricity storage technologies

<table>
<thead>
<tr>
<th>Principle</th>
<th>Subcategory</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical</td>
<td></td>
<td>Pumped hydro / Compressed air (CAES) / Flywheels</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Chemical</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hydrogen</td>
</tr>
<tr>
<td></td>
<td>Electro-chemical</td>
<td>(Advanced) Lead acid / Nickel Cadmium (NiCad) / Lithium ion (Li-ion)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sodium Sulphur (NaS) / Nickel / Aluminiumchloride</td>
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<tr>
<td></td>
<td></td>
<td>Vanadium Redox (VRB) / Zinc Bromine (ZnBr)</td>
</tr>
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<td></td>
<td></td>
<td>Zinc / Aluminium / Lithium / Iron</td>
</tr>
<tr>
<td>Electric field</td>
<td></td>
<td>Supercapacitors</td>
</tr>
<tr>
<td>Magnetic</td>
<td></td>
<td>Superconducting magnetic coils</td>
</tr>
<tr>
<td>Thermal</td>
<td></td>
<td>Molten Salt / Cement</td>
</tr>
</tbody>
</table>
Considerations for Battery Selection

- Safety
- Company warranty / performance guarantee
- Performance requirements
- Maintenance requirements / costs
- Power component availability and cost
- Battery cell and module cost
- Grid / utility Requirements
- Depth / length of discharge
- Calendar and cycle life
- Efficiency
- Space limitations
- Installation infrastructure
- Ambient conditions / temperature
- Technology and company track record
- Energy density
- Policy / regulatory treatment
- Application
Latest Deployment Data for Stationary Battery

Update in 2016: Electricity storage market status and outlook

- Existing capacity 2012
- Installed capacity 2013-2014
- Installed capacity 2014-2015

Graph showing MW deployment for different battery types:
- Other batteries
- Nickel-cadmium
- Advanced lead acid
- Redox flow battery
- Sodium sulphur
- Lithium-ion
**Electricity Storage Roadmap Structure**

**SYSTEM ANALYSIS FOR STORAGE**
- Engage and guide policy makers
- Provide systemic economic assessment models
- Support system analysis of electricity/heat/fuel/productive uses as storage options

**STORAGE IN ISLANDS AND REMOTE AREAS**
- Facilitate financing
- Create local value chains
- Develop a global database with practical example
- Guide policy makers to the required tools

**CONSUMER-LOCATED STORAGE**
- Comparative information sheets and labelling
- Accelerate standards on safety and recycling
- (Data) ownership and liability regulation

**GENERATOR-LOCATED STORAGE**
- Support the development of innovative regulation
- Support for localised/distributed systems

**GRID-LOCATED STORAGE (TRANSM. & DISTR.)**
- Pumped hydro and compressed air energy storage (CAES) analysis
- Demonstration projects for new business models
Electric Vehicles Technologies

- **Battery Electric Vehicle (BEV)**
  - BEVs \(\rightarrow\) electric motor and battery,
  - \(~160\) km

- **Plug-in Hybrid Electric Vehicle (PHEV)**
  - PHEVs \(\rightarrow\) ICE, electric motor and battery,
  - \(~15\) – \(~60\) km

- **Fuel Cell Vehicle (FCV)**
  - FCVs \(\rightarrow\) fuel cell and electric drivetrain

- **Super Capacitor Vehicle**

- **Mini-EV**

- **Electric Bicycle**

Currently sales are concentrated in locations with strong incentives: West Coast US, Northern Europe, Japan & China

Electric Vehicles Outlook

- Electric Vehicles are still in their early potential (REmap)
  - Transport is the sector with the smallest share of renewables ~3%

<table>
<thead>
<tr>
<th>TRANSPORT</th>
<th>Units</th>
<th>2013/2014</th>
<th>Reference Case</th>
<th>REmap</th>
<th>Doubling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Vehicles</td>
<td>million</td>
<td>0.8</td>
<td>60</td>
<td>160</td>
<td>173</td>
</tr>
<tr>
<td>- Passenger vehicles</td>
<td>million</td>
<td>0.8</td>
<td>59</td>
<td>158</td>
<td>158</td>
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<tr>
<td>- Buses</td>
<td>million</td>
<td>0.01</td>
<td>0.5</td>
<td>1.4</td>
<td>11</td>
</tr>
<tr>
<td>- Light duty vehicles</td>
<td>million</td>
<td>0.004</td>
<td>0.3</td>
<td>0.9</td>
<td>5</td>
</tr>
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</table>

- In reference case: RE share will rise to 5%
- With Remap options: RE share increase to 11%
- EVs will grow significantly, from ~0.5 to ~10 million (10% of world fleet)

- REMap Transport Action Team – expert network (email REMap@irena.org if interested)
- REMap Transport Sector Working Paper (forthcoming)

Source: (Roadmap for a Renewable Energy Future, 2016)
Invited Speakers
## Deepdive Session Structure

<table>
<thead>
<tr>
<th>Topics</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>Innovation in energy storage for renewables integration</td>
<td>Yoshiaki Shibata, IEEJ</td>
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<tr>
<td>Innovation in electric vehicle technologies</td>
<td>Guy Fournier, Pforzheim University</td>
</tr>
<tr>
<td>Electric vehicles for renewable energy integration</td>
<td>Bert Witkamp, AVERE</td>
</tr>
<tr>
<td>Electric vehicles in China: Technological development and policy priorities</td>
<td>Qunhong Shen, Tsinghua University</td>
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<tr>
<td>Contrasting technology pathways and policies for electric mobility in Europe and Asia</td>
<td>Tilman Altenburg, DIE</td>
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3 Questions & Answers
Guiding questions for the discussion (1/2)

- What are the priority innovation needs in which researchers should focus to close main technological gaps in:
  - Costs
  - Performance
  - Infrastructure
  - Storage usage for RE integration
  - Software and control systems

- Which ones of these innovations can be expected to be commercialized in the next 15 years? And in the next 30 years?
Guiding questions for the discussion (2/2)

◉ What will be the implications for energy and transport systems in 2030 and beyond?

◉ What kind of regulatory changes and policies are appropriate to accelerate the development and deployment of energy storage and electric vehicle technologies?

◉ Where (sectors/applications/countries) could we expect these innovations to emerge?
Thank you
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