



Climate Technologies Sustainability Initiative

Low-C Emissions Energy Technologies Workshop

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IEEE
FUTURE DIRECTIONS



Workshop Structure

- ▶ Introduction
- ▶ Briefings: 6 topics + PES roadmap
- ▶ Goals: Road to NetZero in 2050 – The role and challenges of the power industry
- ▶ Break
- ▶ Break-out session 1: Current maturity status for each topic
- ▶ Break-out session 2: Challenges and Opportunities for each topic
- ▶ Group reports
- ▶ Lunch – provided if you have signed up
- ▶ Break-out session 3: Outlook for each topic
- ▶ Break
- ▶ Wrap-up

Power and Energy

2050 Goals

- ▶ Accessible (available and affordable) – to everyone
- ▶ Emission free – NetZero goals
- ▶ Reliable and resilient
- ▶ Waste free - Circular Economy

- ▶ How do we get there?
 - Today we examine **6 topics** from the points of view of **maturity, challenges** and **outlook**
 - Future of Fossil Fuels and Transition
 - Large Scale Renewable Energy Deployment
 - Energy Storage Systems
 - Decarbonization of the Transportation Sector
 - Grid Modernization
 - From Consumer to Prosumer

Questions for each of the 6 topic areas

▶ Break-Out #1: Current Status of Technology and Deployment

- Available technologies
- Geographically appropriate
- TRL – readiness levels

▶ Break-Out #2: Challenges and Opportunities

- gaps, barriers to development and deployment at scale
- metrics and KPIs

▶ Break-Out#3: Outlook

- How do we close the gaps and eliminate the barriers
- Need for roadmaps and standards

▶ Wrap-Up:

- Prioritizations by:
 - Urgency of the problem to solve
 - Likelihood of success
 - Impact

Session 1 – Current Status of Technology

Topic 1: Fossil Fuels Transition

- ▶ Decarbonization technologies
 - Carbon Capture Usage and Storage (CCUS)
 - Change/Mix Fuel (Hydrogen or Ammonia)

Topic 2: Large Scale Renewables

- ▶ Technologies for deployment
 - Wind Generation
 - Off-shore
 - In Land
 - Photovoltaic
 - Geothermal
 - Biomass
 - Tidal Wave/Current
 - Nuclear

Session 1 – Current Status of Technology

Topic 3: Energy Storage Systems

- ▶ Technologies
 - Batteries
 - Fuel Cells
 - Hydrogen
 - Ammonia

Topic 4: Transportation Sector

- ▶ Decarbonization of Transportation Sectors
 - Cars
 - Trains
 - Vessels
 - Airplanes
 - Other: Drones...

Session 1 – Current Status of Technology

Topic 5: Grid Modernization

► Technologies

- Smart Grid
- Inverter Based Resources (IBR)
- From Grid Following to Grid Forming
- Converter Based Load (CBL)
- Distributed Energy Resources
- Microgrid and Virtual Power Plant (VPP)

Topic 6: From Consumer to Prosumer

► Technologies

- Demand Response
- V2X
- Behind the Meter PV/Storage

Session 2 - Challenges and Opportunities

- ▶ **Topic 1** – Fossil Fuels Transition
- ▶ **Topic 2** – Large Scale Renewables Deployment
- ▶ **Topic 3** – Energy Storage Systems
- ▶ **Topic 4** – Transportation Sector Decarbonization
- ▶ **Topic 5** – Grid Modernization
- ▶ **Topic 6** – From Consumer to Prosumer

Use same technologies as for Session 1

Session 3 - Outlook

Use same technologies as for Session 1

- ▶ **Topic 1** – Fossil Fuels Transition
- ▶ **Topic 2** – Large Scale Renewables Deployment
- ▶ **Topic 3** – Energy Storage Systems
- ▶ **Topic 4** – Transportation Sector Decarbonization
- ▶ **Topic 5** – Grid Modernization
- ▶ **Topic 6** – From Consumer to Prosumer

Wrap-Up - Identify gaps for standards and roadmaps

