CIGRE Study Committee C6

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG C6.42	**Name of Convenor: Liana Cipcigan (GB)**
Strategic Directions #[2]: 1, 2, 3	**Sustainable Development Goal #[3]: 9, 11**

The WG applies to distribution networks: Yes

Potential Benefit of WG work #[4] : 1, 2, 3, 4

Title of the Group: Electric Transportation Energy Supply Systems

Scope, deliverables and proposed time schedule of the WG:

Background

Transportation systems are among the largest consumers of fossil fuels, after electric power generation, in most jurisdictions. These systems include passenger vehicles, busses and urban light rail systems, trucks for local delivery and long-distance transport of merchandise, and diesel-powered railway systems. Transportation electrification is therefore one of the important approaches to achieve decarbonization of the economy, and reduction of greenhouse gas emissions, and to reduce the global consumption and reliance on fossil fuels.

On-board electricity for transportation electrification can be provided in several ways, including battery energy storage systems, hydrogen fuel cells, and electrochemical supercapacitors. Other options considered are flywheel and compressed air energy storage systems. Electrochemical batteries are today the more common solution for transportation electrification, particularly for passenger vehicles, and to a lesser extent, city busses. Hydrogen fuel cells have also been developed and prototypes have been installed and are in operation since the 1980s in passenger vehicles and busses. Several issues technical and economic issues are being currently investigated, including the cost and life of the fuel cell and the required hydrogen distribution infrastructure.

One of the issues common to all on-board energy storage systems is the need to recharge them, in the case of batteries and supercapacitors, and refuel them, as in the case of fuel cells. This requires the deployment of an appropriate infrastructure. These infrastructures differ significantly in their impact on the overall energy system from which they are supplied: the electric recharging stations are connected to the existing electric distribution system, and can therefore impact distribution grids negatively or help the operation of the grid; in the case of hydrogen recharging stations, the hydrogen needs to be produced and distributed using a dedicated installations.

The recharging infrastructure can be associated with and exploit renewable energy resources, such as wind and solar power generators. In the case of electric vehicle batteries, the charging stations can be fed directly from these generators. In the case of hydrogen, it can be produced using these generators by electrolysis.

The working group will produce a brochure that addresses, in the area of electric transportation energy supply systems, the general problem of on-board power sources, with a focus on the more common available at this time, namely batteries and fuel cells. The brochure is intended to provide a comprehensive assessment and comparative evaluation of the available technologies from the key aspects related to a successful deployment, including technical, economic and environmental considerations.

Scope:

The scope of this working group is the study of the available on-board electric transportation energy supply systems from perspectives related to the relative costs of the equipment, including capital and operating costs, volume, weight and installation requirements, reliability, availability and maintainability considerations, and the recharging infrastructure requirements. Environmental impact, life expectancy and life cycle considerations will be covered. Systems considered include batteries, hydrogen fuel cells, electrochemical supercapacitors, flywheel and compressed air systems. Propulsion equipment and transportation systems supplied from ground-based infrastructures are not covered. Topics included are the following:

1. Review of electric propulsion systems state-of-the art power requirements – Electric transportation modes and systems: electric vehicles, light rail, busses and trucks – Electric propulsion supply system requirements: power, energy, range, performance (steady state and acceleration), volume and weight, operating environment, efficiency, relative cost and business case – On-board energy storage system options for electric propulsion systems: batteries, electrochemical supercapacitors, flywheels, hydrogen fuel cells, hybrid systems – General requirements for recharging infrastructures.
2. Comparative evaluation of on-board energy supply systems – Power and energy considerations, range and losses, operating temperatures and environment, safety, security and risk mitigation – Recharging frequency and duration – Relative capital costs, weight, volume, and thermal efficiency – Installation considerations – Operating costs – Reliability, availability and maintainability – Life expectancy – Life cycle assessment, material use and environmental impact, and repurposing and recycling – Specific considerations for on-board energy storage (batteries, capacitors, flywheels): charging and discharging rates and lifetime cycles, idling losses – Technology readiness and expected developments, standardization initiatives.
3. Comparative evaluation of recharging infrastructures – Requirements: size, capacity, location – Design and implementation – Reuse of existing infrastructures – Impact on the existing infrastructures (electric power grid, energy supply infrastructures) – Environmental impact and mitigation.
4. Regulatory and legal framework – General considerations and constraints.
5. Business cases for electric propulsion selection and deployment: tools, use cases, stakeholders (single, multiple), implementation considerations – Experiences and case studies, regional considerations, ownership and maintenance.
6. Guidelines and best practices – Technology deployment, business case and economic considerations, environmental and regulatory considerations.

Joint work with other SCs: Liaison experts from SC C1 and D2 will be invited.

Deliverables:

☒ Technical Brochure and Executive Summary in Electra
☒ Electra Report
☒ Future Connections
☐ CSE
☒ Tutorial
☒ Webinar

Time Schedule: start: October 2020 **Final Report**: December 2022

Approval by Technical Council Chairman:

Date: September 27th, 2020

Notes: [1] Working Group (WG) or Joint WG (JWG), [2] See attached Table 1, [3]See attached Table 2 and CIGRE reference Paper: Sustainability – at the heart of CIGRE's work. [4] See attached Table 3

Table 1: Strategic directions of the Technical Council

1	The electrical power system of the future reinforcing the End-to-End nature of CIGRE: respond to speed of changes in the industry by preparing and disseminating state-of-the-art technological advances
2	Making the best use of the existing systems
3	Focus on the environment and sustainability (in case the WG shows a direct contribution to at least one SDG)
4	Preparation of material readable for non-technical audience

Table 2: Environmental requirements and sustainable development goals

	CIGRE selected the 7 SDGs that are the most relevant to CIGRE. In case the WG work refers to other SDGs or do not address any specific SDG, it will be quoted 0.
0	Other SDGs or not applied
7	**SDG 7: Affordable and clean energy** Increase share of renewable energy; e.g. expand infrastructure for supplying sustainable energy services; ensure universal access to affordable, reliable, and modern energy services; energy efficiency; facilitate access to clean energy research and technology
9	**SDG 9: Industry, innovation and infrastructure** Facilitate sustainable infrastructure development; facilitate technological and technical support
11	**SDG 11: Sustainable cities and communities** Increase attention on sustainable and resilient buildings utilizing local (raw) materials, power for electric vehicles, strengthening long-line transmission and distribution systems to import necessary power to cities, developing micro-grids to reinforce the sustainable nature of cities; protect and safeguard the world's cultural and natural heritage; reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and waste management
12	**SDG 12: Responsible consumption and production** E.g. Promote public procurement practices that are sustainable; address reducing use of SF6 and promote alternatives, encourage companies to adopt sustainable practices and to integrate sustainability information into their reporting cycle, address inefficient fossil-fuel subsidies that encourage wasteful consumption
13	**SDG 13: Climate action** E.g. Increase share of renewable or other CO_2-free energy; energy efficiency; expand infrastructure for supplying sustainable energy; strengthen resilience and adaptive capacity to climate-related hazards and natural disasters; integrate climate change measures into national policies, strategies and planning; improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
14	**SDG 14: Life below water** E.g. Effects of offshore windfarms; effects of submarine cables on sea-life
15	**SDG 15: Life on land** E.g. Attention for vegetation management; bird collisions; integration of substations and lines into the landscape

Table 3: Potential benefit of work

1	Commercial, business, social and economic benefits for industry or the community can be identified as a direct result of this work
2	Existing or future high interest in the work from a wide range of stakeholders
3	Work is likely to contribute to new or revised industry standards or with other long term interest for the Electric Power Industry
4	State-of-the-art or innovative solutions or new technical directions
5	Guide or survey related to existing techniques; or an update on past work or previous Technical Brochures
6	Work likely to contribute to improved safety.