CIGRE Study committe C1

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG C1.59

NAME OF THE CONVENOR
Wang Yi (CHINA)

TITLE
Power- Heat Sector Integration

THE WG APPLIES TO DISTRIBUTION NETWORKS: YES

ENERGY TRANSITION
1 / Storage
5 / Grids and Flexibility
8 / Sector Integration

POTENTIAL BENEFIT OF WG WORK
1 / commercial, business, social, economic benefits
2 / potential interest from a wide range of stakeholders
3 / likely to contribute to new or revised industry standards
4 / state-of-the-art or innovative solutions or directions
7 / Adressing environmental requirements & sustainable dev. goals

STRATEGIC DIRECTION
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-ofthe-art technological advances

SUSTAINABLE DEVELOPMENT GOAL
7 / Affordable and clean energy
9 / Industry, innovation and infrastructure

BACKGROUND :

The last decades have seen a global trend of power-heat sector integration, such as the rapidly increasing installations of combined heat and power plants in northern China and the widespread use of electric heat pumps in the UK and elsewhere worldwide. However, this integration also brings challenges due to the resultant complex coupling between power and heat sectors. This complicates power and heat sectors in their individual and interactive tasks related to load forecasting, modelling, planning, operations, and control

Power-heat sector integration is globally considered as one indispensable pathway towards low-carbon energy systems due to 1) its lower energy production costs and higher efficiency; 2) flexible power and heat conversion for environmental heating supply and increased renewable accommodation; 3) provision of flexibility to the power system exploiting synergies from heat consumtpions and storage.

Power and heat sectors can be integrated at both the network level and consumer level. The power-heat sector integration at the network level involves coupling power and heat networks through optimisation of resources allocation in the two sectors both in production and consumption patterns. Two typical pathways are 1) combined heat and power plants and 2) electric heat pumps. The former interconnects power and heat networks by simultaneous power and heat generation, while the latter does so by converting power into heat. The power-heat integration at the consumer level denotes the conversion of heat, cooling, and power loads in different terminal applications. For residential and commercial consumers, power-heat sector integration is mainly reflected in temperature regulation, such as air conditioning and HVAC, to convert power into heating. The power-heat integration of industrial consumers primarily refers to the recycling of waste heat in different types of production (e.g., data centers, iron and steel, coal mines, and chemical industries). Thermal storage can synergically complement other forms of storages, being characterised by competitive costs, mid-long term duration high thermal inertia, and optimal integration in the final user's heat+power load profiles.

Power-heat sector integration at the network level has drawn much attention due to its significant contributions to lowering energy production costs and improving efficiency. For example, combined heat and power plants simultaneously generate both power and heat. The primary energy lost as heat during power generation can be captured using various heat-exchange measures for heating supply, leading to both energy and cost savings, which encourages the coupling of power and heat networks. Another example is electric heat pumps. They can utilize renewable power to capture heat from a source, such as the surrounding air, geothermal energy stored in the ground, or nearby sources of water or waste heat from a factory. This heat production can save energy costs by fully utilizing zero-cost renewable power, making the coupling between power and heat networks more appealing.

With the increase of terminal electrification and the decarbonization of power and heat sectors, power-heat integration at the consumer level is also increasing. For residential consumers, the electric load is the major source of cooling (e.g., air conditioning, HVAC) and the increasing heating source in many industrial processes (e.g., electric heating furnace). Energy efficiency can be improved by utilizing thermal inertia in buildings. For commercial consumers, integrating renewable energy sources (e.g., rooftop photovoltaic) and heating/cooling sectors has become a new trend toward decarbonization. For industrial consumers, the proportion of electric heating is getting higher with the continuous upgrading of heat pumps; in the process of heat management, the graded utilization of different types of waste heat can be used to generate electricity inversely; the adoption of green power is potential to achieve zero-carbon data centers, and the recycling of waste heat can be used for heat supply to achieve negative carbon effect.

PURPOSE / OBJECTIVE / BENEFIT OF THIS WORK :

This working group follows ups C1.47 entitled "Energy Sectors Integration and Impacts on Power Grids" but focuses heavily on the research and applications of power-heat sector integration. This working group will address the technical issues in the developing of concrete use cases of power-heat sector integration and assess state-of-the-art research in different countries around the world. This working group will also bridge the gap between academy research and industry on power-heat sector integration to reveal the key issues that should be addressed in the future.

Based on the deliverables of this working group, the insights into and guidelines for how power and heat sectors can be integrated will be provided for their precise load forecasting, accurate modelling, economic and secure planning, operations, and control.

SCOPE :

The Scope of this WG is to

1. Sort out the main aspects of power-heat sector integration at both network level and consumer level.
2. Review the methodology and technologies for modeling, operation, optimization, and planning of power-heat integrated energy systems.
3. Identify technical / business / institutional challenges and benefits from power-heat sector integration and conduct tech-economic analysis.
4. Summarize typical applications in different industries of power-heat sector integration; on this basis, propose suggestions for policies and market regulations towards the integration between renewable power and heat sectors for decarbonization.
5. Promote technical papers, technical panel sessions, and workshops to disseminate academic research and real-world applications of power-heat sector integration.
6. Coordinate such activities where appropriate with other CIGRE committees, subcommittees, and working groups.

For the above topics, a survey of state-of-the-art technical advances and typical cases will be done, analyzing the drivers and solutions towards power-heat sector integration, with scope to infer some general principles as useful guidelines for decarbonizing future integrated power-heat systems.

Remarks:

The working group foresees liaisons with the following other working groups/ previous WGs:

- C1.47 Sector Integration, where Heat sector was addressed, of which this WG will be a follow-up / deep dive

- JWG C6/C1.33 which culminated in TB 863

DELIVERABLES AND EVENTS

Deliverables Types

Annual progress and activity report to Study Committee
Electra report
Technical Brochure and Executive Summary in Electra
Tutorial

Webinar

Time schedule

Q4	2025	• Recruit members (National Committees)
Q1	2026	• Develop final work plan
Q2	2027	• Draft TB for Study Committee Review
Q4	2027	Final TB
Q1	2028	Tutorial / webinar

APPROVAL BY TECHNICAL COUNCIL CHAIRMAN:
Rannveig S. J. Loken
December 16th, 2025