

BATTERIES IN DUTCH ENERGY HUBS

Toward enhanced collaboration

Grid congestion: why we need batteries & energy hubs

The Netherlands is in midst of the transformation of the energy system. As electricity demand and (decentralized) renewable electricity generation grow, the grid is increasingly facing congestion. This threatens the pace of electrification, business growth, and sustainability goals. Energy hubs (EHs), local and decentralized energy systems, have emerged as a potential solution, especially including battery storage. This helps local energy balancing and efficiency.



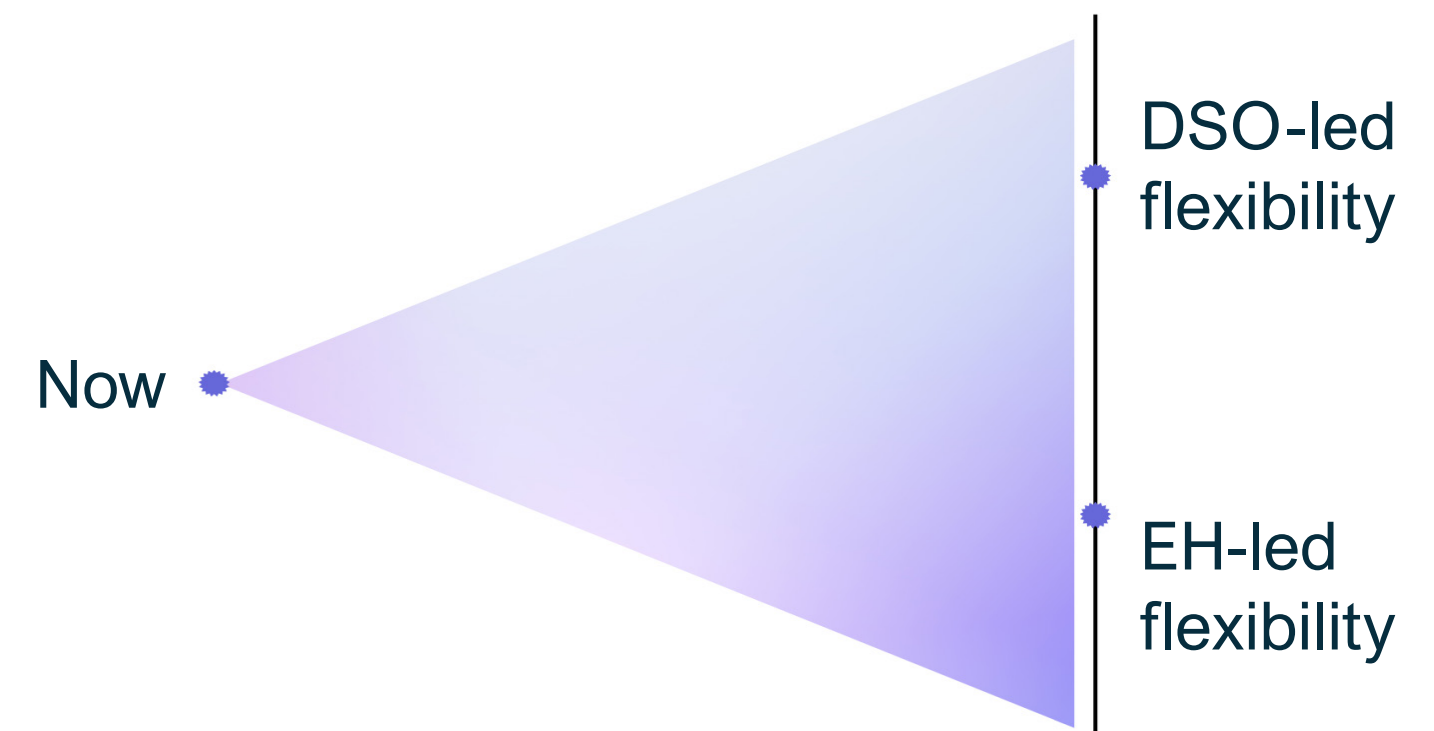
Tensions between stakeholders

In this research a strategic, participatory design approach combined with literature review, stakeholder interviews, and co-creation workshops to explore collaborative models for battery integration in energy hubs is used. The critical issue is the **misalignment between network operators (DSOs) and EH collectives**, about flexible battery use leading to uncertainties and stagnation of battery and EH investment and development processes.



Testing future scenarios

To explore different (future) decision-making processes, **two speculative scenarios** were developed: DSO-led flexibility and EH-led flexibility. These were tested and evaluated during co-creation workshops with stakeholders. The workshops led to a preferred hybrid collaboration model, where EHs manage battery optimization and DSOs provide data, flexible (firm & non-firm) contracts, and operational boundaries. The workshop also revealed boundary conditions, that were taken into account when designing the final roadmap.



"These two scenarios are indeed exactly the problem we face"

From insights to acceleration

Effective collaboration between the EH collective and DSO can be achieved through a participatory design and can be improved by using catalyzing concepts. Early in the EH development process, technical, organizational, contractual, and financial configurations have to be discussed and explored with stakeholders. A **morphological chart** is developed to explore these configurations. Complementary, a **strategic roadmap** is developed to guide stakeholders toward enhanced development of battery-based EHs as embedded flexible components of a decentralized and sustainable energy system.



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Collaboration toward strategic integration of
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