38th International Electric Vehicle Symposium and Exhibition (EVS38) Göteborg, Sweden, June 15-18, 2025

Local DC-microgrid equipped Charging Energy Hubs enabling electrification and combatting grid congestion

A study based on the first year of the CEH (Charging Energy Hubs) project on the roll-out of DC-microgrids between neighbouring businesses – an NGF ((Dutch) Nationaal Groeifonds) project

Harm Weken[1], Rob Kroon[2], Edwin Bestebreurtje[3]

[1,2,3] *FIER Sustainable Mobility, 5708 JZ, Helmond, The Netherlands harmweken@fier.net*

Executive Summary

Faced with acute grid congestion, optimising the existing local energy systems is an essential pre-requisite to the electrification of the Dutch logistics sector. This paper describes the work done in the CEH project preparing the roll out of a DC-microgrid centralising energy generation, storage and usage amongst key businesses of logistics hub in Veghel (central-South-East), Netherlands. The central activity in the project has been preparing the adoption of a micro-grid by defining three key components: (i) individual and collective energy profiles to assess synergies; (ii) the business of the collective energy profiles; (iii) the shared functional requirements of the local DC-microgrid infrastructure. This paper presents the process of the first phases of the project, reflecting on the challenges and learnings of setting-up a local DC-microgrid between neighbouring businesses.

1 Introduction

CEH (Charging Energy Hubs) is a four-year (Dutch) Nationaal Groeifonds project accelerating the electrification of the logistics sector in the Netherlands, by removing existing financial, legal and organizational barriers to the development of integrated technological innovations facilitating the integration of, amongst other things, charging infrastructure, battery storage and renewable energy sources within existing electricity networks, even if these are subject to grid congestion. It is a 76 million euro project, including over 35 partners. These technological innovations are brought together at three use case sites serving as pilot and validation environments for an (inter)national rollout and scaling-up of the implemented technologies. Within this paper, the focus will be on the use case in Veghel, which is the larger and more complex use case of CEH.

Collaboration across the value chain and both the energy and the logistics sectors has not previously been demonstrated on this scale. Within the relationship of the CEH stakeholders, charging infrastructure can be deployed as an important flexible capacity and linking-pin to the energy markets; providing both a solution to grid congestion as well as the business case for investment in charging infrastructure.

The paper describes how the use cases have been set up following the NGF grant and co-investments from the private partners involved, the assets present and the steps taken to lay the foundations for an integrated energy system optimising for the broadest array of generation, storage and usage across business boundaries.

2 Stakeholders

The stakeholders are the different partners within the project. The partners that play a main role in the use case Veghel are the lot owners. Each plays a different role in the lot, with a different demand in energy production of usage patterns.

Fluidwell Hydrogen Systems develops and builds modular electrolyzer systems. Currently, the connection value on its lot in Veghel is limited but is also awaiting approval for an increased connection. There is onsite PV generation. Fluidwell is planning to test large electrolyzer systems in their new production facility. This demand will go over 1 MW. There is also a collective need for green hydrogen production at the Veghel business park, which can be met by the installation of Fluidwell's electrolyzer systems.

Renewable Energy Factory (REF) has advanced plans to construct a wind farm in Veghel, with four mills. The wind farm has a commitment for a connection of 18 MVA for supply, and a contracted connection for off-take from Enexis (DSO) has been requested. However, there will be a supporting BESS system of 10 MW / 15 MWh to ensure stable release.

Van Berkel Logistics is a logistics service provider with a fleet of trucks, terminal tractors and reach stackers in Veghel. It plans to electrify the fleet in the coming years, with the first electric truck already running since 2023. Van Berkel Logistics wants to be able to (fast) charge the trucks both via overnight charging and during the day. Their significant PV installation will also need to be taken into account. Since this is only partly possible with the current connection, the ambition of cooperation with REF and Fluidwell is key for fulfilling their ambitions.

Since the locations are all relatively close to each other, and there are possibilities in cooperation to create a scenario where all can benefit from, further research has taken place.

The lot owners are going to get support from the following partners. TNO, Elaad and Scholt Energy are going to be responsible for the energy assessment, as well as the analyses on the business case. The hardware providers like Heliox and Rocsys will develop the charging infrastructure. DC Systems Dynnic are playing a key role in the integration of the DC net. Recoy, Scholt energy and Maxem will work on the software systems and DENS will be responsible for the BESS.

3 Use case description

The use case in Veghel includes multiple features and assets. These will all be part of the living lab, and will be tested during the preparation, implementation and operation for multiple angles by research and knowledge institutes. The highlights of the most important features are listed in the table below.

Features	Veghel
Accessibility/ ownership structure	Public/private accessible assets with Multi-stakeholder
Other key features	Multimodal charging Electrolyser (120 KW capacity in phase 1; significantly higher in 2027) DC-microgrid for energy sharing, collective optimisation and reduced losses
Energy source	Windpark: 4 Windmills for wind generation (16.8 MW) Solar generation (1,7 MW)
Storage	Stationary (Location-based) BESS (battery) systems: Two units of 2 MWh & 2,5 MWh respectively
Depot charging	60 assorted vehicles (across several sites) ranging from 3 to 50 tonnes
Charging points innovations	Public and private charging sites

Figure 1. Overview of key features of CEH use case in Veghel

These features and assets combined will showcase a new level of Energy Hub not tested before on this scale.

System architecture and areas of experimentation

Individual assets are important and not easy to install and manage in their own, however, the significant areas of interest lie in how all the assets and businesses operate in one optimised system; operating on multiple layers such as business, functional, information, communications and component layers. As mentioned before, the project innovations thus allow (local) energy to be more effectively distributed and utilized as close to the source as possible: allowing the available capacity on the electricity grid can be used more optimally.

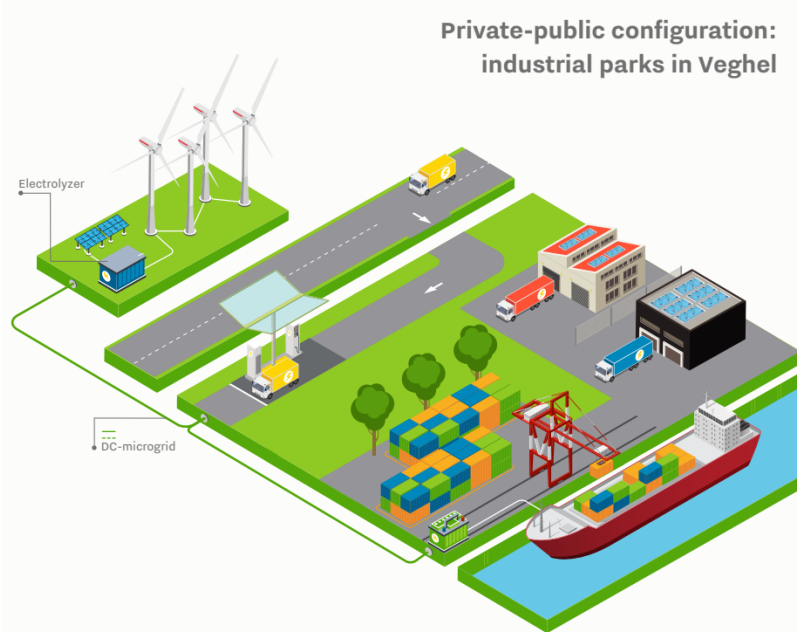

Figure 2. Graphic overview of how multiple systems are connected in a CEH Private-public configuration at the industrial park in Veghel

Technologies and systems which will be tested

In the pilot, the partners are currently exploring the use of DC-operated assets, because a local DC (direct current) grid on an industrial site can offer advantages, particularly when it comes to energy efficiency, sustainability, and cost reduction. Many assets in the Veghel Use case use DC power directly and connected to the grid, this needs to be converted from AC to DC. These assets are the PV installation, the windmill, the charging infrastructure for heavy vehicles as well as the BESS. By implementing a local DC grid, energy conversion losses (which occur during the AC to DC conversion) are minimized, leading to overall higher efficiency. The complexity in applying this DC system is that there is already a AC grid present. The advantages are of course easier in a green field location. But combining the DC architecture in a system where different companies and lots are working together in an energy hub, is one of the key studies of this pilot project.

Within the CEH project, energy management systems (EMS), forecasting technologies, and multimarket energy trading platforms play pivotal roles. These tools are critical in enabling the smooth operation of energy hubs, enhancing their economic viability, and contributing to the broader goals of energy transition and decarbonization.

The Energy Management Systems (EMS) are essential for the monitoring, controlling, and optimizing the performance of an energy hub. In the pilot project, the implementation of an EMS ensures that energy usage across various sources (renewable, conventional, storage, etc.) is maximized, while wastage is minimized. Accurate Forecasting is critical for managing the fluctuations in energy demand and supply, particularly in the Veghel energy hubs that rely heavily on renewable energy sources like the Windmilss from REF and the PV from Van Berkel and Fluidwell. Forecasting technologies predict energy demand, generation, and storage needs, allowing for better planning and decision-making. Multimarket Energy Trading Platforms are also going to be used in Veghel, to operate within the national energy markets, where energy can be bought or sold depending on supply and demand conditions. Multimarket energy trading platforms allow for the dynamic trading of energy across different markets, optimizing the economic performance of the hub.

The integration of Energy Management Systems, forecasting technologies, and multimarket energy trading platforms into an energy hub pilot project offers substantial added value. These technologies work synergistically to enhance the efficiency, cost-effectiveness, and sustainability of the energy hub.

4 Key objectives

The key objectives are the following:

Testing the Energy System: The first objective is to understand how an CEH would work as a (DC) energy system. The goal is to increase the self-consumption of locally produced and stored energy with lower losses from conversion by using DC to DC transport. Also, an enormous variety of new hardware and software must be tested which is destined to enable next-generation DC microgrids. For the hardware, it is all the DC integration of BESS, PV, Windmills, charging points, etc.. For the Software it is mainly the Energy Management Systems, Forecasting technologies, and Multimarket energy trading platforms.

Blueprint: Use gained knowledge and experience to accelerate sustainable energy solutions, making a clear path towards ZE transport as well. The CEH project will provide blueprints for other industrial parks which can benefit from the lessons learned. It will also lead to a better competitive advantage for the partners working on energy hub innovations.

5 Key challenges

The challenges that are foreseen are that governance and cooperation between partners will be challenging as access to energy is an existential risk to business operations and priority as well as minimum levels need to be guaranteed.

The establishment and operation of an energy hub is a complex endeavor that requires overcoming several key challenges to ensure its success. These challenges are crucial to the feasibility and long-term viability of the project and include the legal framework, energetic coherence and the development of a viable business case. Each of these elements must be carefully addressed to create a functional and sustainable energy hub.

Legal Framework: This framework includes regulations, policies, and laws that govern energy production, distribution, storage, and trading. Since energy hubs often involve multiple stakeholders—ranging from energy producers to consumers and external market actors—navigating the legal landscape is essential for ensuring compliance with local, national, and international laws.

Energetic Coherence: Energetic coherence refers to the ability to integrate and optimize various energy sources within an energy hub to ensure efficient energy flow and usage. An energy hub often consists of a combination of renewable and conventional energy sources, storage systems, and flexible loads. Achieving coherence involves harmonizing these elements to work synergistically.

Business Case: A viable business case is the foundation of any energy hub. Without a clear and sustainable financial model, the project will fail to attract investment or operational support. The business case must outline the financial benefits of the energy hub, including cost savings, revenue generation opportunities, and long-term value creation. This includes evaluating the economic feasibility of energy production, storage, and trading, as well as considering the costs associated with infrastructure, technology implementation, and regulatory compliance.

References

[1] *'Charging the electric truck fleet'* - Learnings from Dutch frontrunners in zero-emission logistics, S. van der Wilt, E. Bestebreurtje, W. Christiaens, R. Kroon / EVS36

[2] *'Zero-Emission road freight – an overview of a rapidly developing market'* - R. Kroon, S van der Wilt, H. Weken / EVS35

[3] ZEBRH, DKTI project with 12 full electric trucks (DAF and Renault) www.zebrh.com

[4] AZED, DKTI project with 60 N1 delivery vehicles and charging hub in Amsterdam

[5] SCALE, Horizon Europe project on upscaling of smart charging and V2X services https://scale-horizon.eu/

[6] W. Christiaens, S van der Wilt. M. Kindt, *Data op het Laadplein*, Analyses on challenges and opportunities with regards to data streams related to charging hubs for logistics fleets.

[7] S. van der Wilt, R. Kroon *Handreiking Depotladen*, Practical guidebook for the realization of depot charging of the logistic sector

[8] eGLM, Interreg project with 4 44ton full electric semi-trucks (FRAMO)- www.eglm.eu

Presenter Biography

	**Harm Weken** is since 1995 managing Partner of FIER Automotive, a business development company in the international automotive sector, with a focus on sustainable and electric mobility. The core of the work of Harm and his company FIER, is (EU and national) project initiation and business development in electric mobility for private companies, public authorities, and consortia. During recent years, the focus has been on: Stimulating electric vehicle (EV) uptake in fleet; Effectiveness of national EV incentives and policies; Stimulating electric trucks in distribution and inner-city freight and Electric car sharing and smart charging infrastructure. Harm is co-founder of GoodMoovs.com, one of the largest software platforms for all electric business-to-business car sharing in the Netherlands. Moreover, Harm supports electric mobility initiatives and the academic sector as board member, advisory council member and in scientific reviewing committees at universities and electric mobility foundations, in Europe and abroad.