E-Port Smart Energy Master Plan

Executive Summary

Cheshire Energy Hub

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Overview

This report presents the E-Port Smart Energy Master Plan concept which has been developed by the E-Port Energy consortium during a six-month study from February to July 2019. The project was part-funded by the UK Government through Innovate UK as part of the Prospering from the Energy Revolution challenge. The E-Port Energy project consortium consists of EA Technology, Burns & McDonnell, University of Chester, Cheshire Energy Hub, Peel Environmental, SPEN, Cadent, Cheshire West & Chester Council, Cheshire & Warrington LEP and Urenco.

The output of the E-Port Smart Energy Master Plan is an optimised concept design with an associated ten-year investment plan for the industrial heartland around Ellesmere Port (Figure 1), identifying opportunities for private sector investment and providing a nationally replicable model for delivery of multi-vector, low cost, low-carbon energy.

The concept study is a high-level feasibility study which can be developed further in the future to full detailed design. During this phase of the project the consortium gathered energy and infrastructure data from local stakeholders and established a technical concept which would have the potential to meet the project aims. An associated business plan was developed at a high level and will be developed further during the next phase.

Figure 1: The E-Port Energy project study boundary[1]

E-Port Energy Master Plan Concept

A significant proportion of the efficacy of this project is dependent on the energy data collected from users in the area. To that end a large amount of effort was invested in engaging stakeholders, particularly the industrial users in the area, explaining the project and asking these major energy users to get involved and to harvest and then release their energy data. Requested data included electrical consumption/generation, natural gas consumption, heating consumption, and data on any generation assets. A large amount of data was provided from multiple users in the area and incorporated into a model of the known and estimated heating and electrical consumption/generation in the area. The energy consumption in the region is particularly high due to the energy intensive industry in this location.

After quantifying existing data, two potential time horizons were studied: near term 2030, and long term 2050. The goal of the 2030 evaluation was to examine a potential concept option for the future delivery of heat and electricity within the Ellesmere Port study boundary based on established or soon to be expected technology. The 2030 concept option examines the value of a potential solution for delivering heat and electricity to the entire Ellesmere Port region in a manner that significantly lowers emissions and energy bills. The long term 2050 evaluation is a qualitative discussion of potential technologies that were not utilised in the 2030 concept option but could be integrated if assumptions change, the technology matures, or costs come down. These concept options seek to develop a truly multi-vector holistic energy solution for the E-Port Energy region, considering short and long-term needs of the community covering heat, mobility, lighting and industrial processes, as represented in Figure 2.

[1] Imagery and map data: Google, 2019

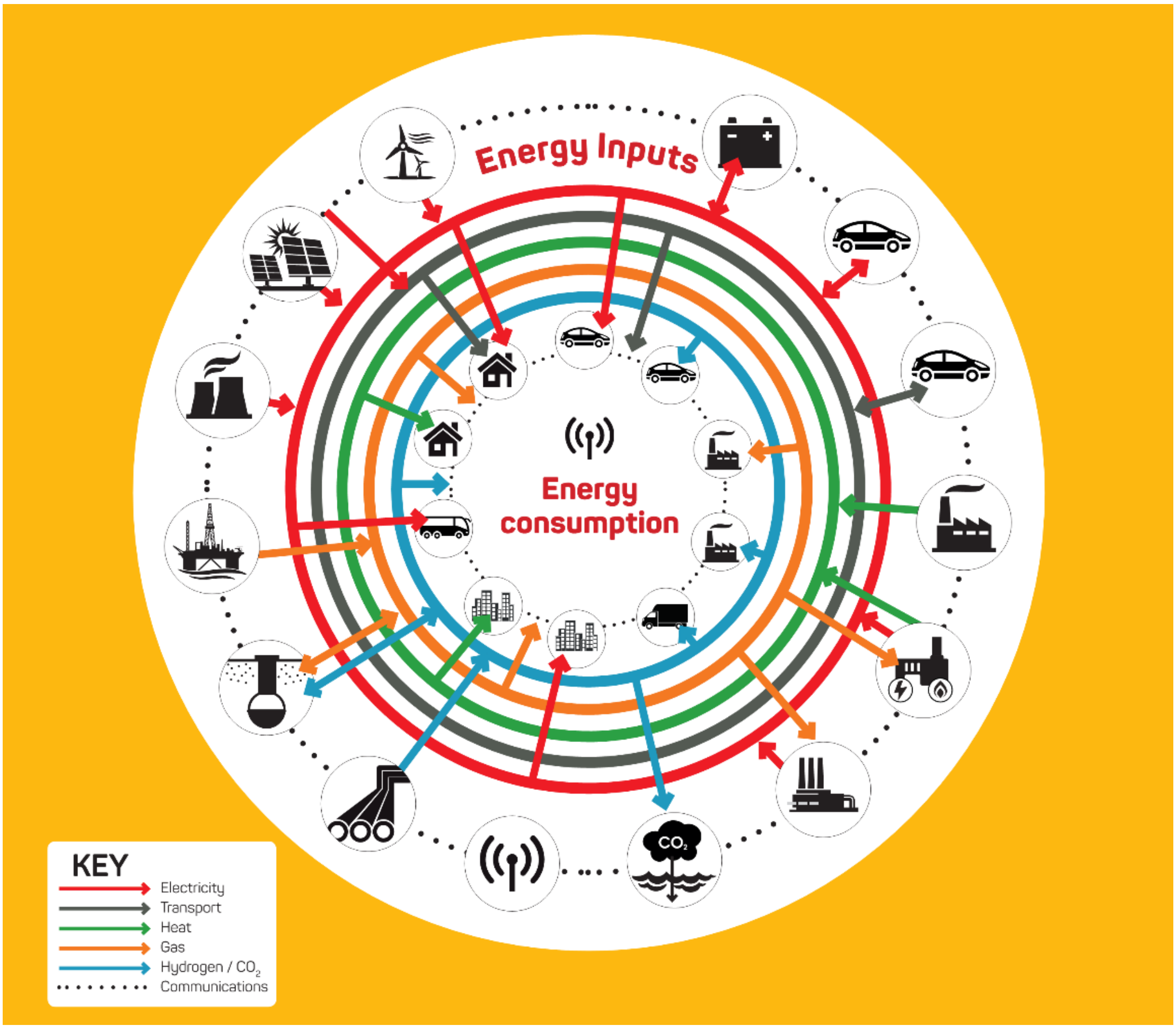

Figure 2: E-Port Energy vectors

The 2030 concept option purposefully seeks to maximise utilisation of existing electrical distribution infrastructure to the extent possible, acknowledging this may require regulatory change. The concept option also relies on building new heating distribution infrastructure to distribute heat from a central source to individual users within the Ellesmere Port area. Finally, the concept option directly links to the delivery of the planned hydrogen infrastructure as outlined in the HyNet project report[2] from Cadent. Existing electrical and heating assets were incorporated into the 2030 concept option where possible and new generation assets were incorporated to balance load across the region. The required energy generation needs for the 2030 concept option are shown in Table 1 below.

[2] Progressive Energy, 2017. *The Liverpool-Manchester Hydrogen Cluster: A Low Cost, Deliverable Project*. [Online] Available at: https://hynet.co.uk/app/uploads/2018/05/Liverpool-Manchester-Hydrogen-Cluster-Technical-Report-Cadent.pdf

Table 1 – Equipment Planned for 2030 Concept Option and annual MWh generation/demand

Technology	Electrical (MWh)	Heating (MWh)
East Region		
Existing - Frodsham Windfarm	110,975	
Existing - Waste Heat Source		36,307
Existing - Protos Biomass facility	188,340	
By Others - Protos Energy from Waste	306,600	
New - Electricity Storage	50	
New - Electrolysis	(10,000)	
South Region		
New - Small Modular Reactor	83,220	
By Others - Solar PV	10,270	
New - CHP Hydrogen Turbines	166,440	237,000
New - Thermal Storage		264
New - Solar PV	26,000	
West Region		
New - CHP Hydrogen Turbines	116,508	184,158
New - Thermal Storage		264
New - Hydrogen Boilers		78,840
Central Region		
Existing - User 9 Heat Source		41,429
Existing - Waste Heat Source		30,475
Total (Not Including Storage)	**1,008,353**	**608,209**

Life cycle cost analysis of the 2030 concept option was examined assuming users in the area paid electrical and heating costs at 75% of their expected future electrical and heating costs, assuming Business-As-Usual (i.e. if there were no intervention). With significantly long simple payback and negative mIRR, the analysis for this scenario indicated that a project which assumes the 75% structure likely would not be economically justified. Because of this, additional life cycle costs were evaluated assuming a price structure of 100% of the future Business-As-Usual prices. The results from this analysis were far more favourable with an approximate 8-year payback and mIRR of 8.5%. A higher carbon tax could enable the 25% reduction in the energy price to consumers, whilst maintaining an attractive investment proposition in this low-carbon concept.

The 2030 concept option is forecast to save nearly 60,000 tonnes CO_2e in yearly electrical production and nearly 95,000 tonnes CO_2e in yearly heat production, equivalent to removing approximately 33,000 vehicles from the road. This is a 34% reduction on current carbon emissions from energy usage in the region. If a cost of carbon were introduced to the life cycle cost model, savings to the end users would become significant. The whole system approach taken for the concept provides flexibility between the energy vectors and storage, and therefore unlocks capacity on the networks.

Control system

A multi-vector control system is fundamental to reaching the target goal of reducing energy cost and carbon emissions by 25% in the E-Port Energy region. Such a system would be required to monitor and control energy-creating and energy-using assets, and to balance their operation to ensure optimum generation and usage of clean fuel. Two approaches to the control system have been considered for E-Port Energy: a centralised approach and decentralised approach.

The centralised control system would consist of a hierarchical structure where one central controller has the ability to control the child local controllers in the system, thus managing load and constraints for both the gas and electricity networks. This would have a top-down approach where the information transmitted is collated to one central location. The market platform plug-in would use the information from the control system to initiate the process of load transfer and also dictate energy flows between the different locations on the network. The control signals would be sent using existing communications networks via a secure access gateway from the control system to the respective local controller and provide functionality such as demand side response and fast frequency response.

The decentralised system would be a further continuation of the centralised control system, with the addition of a local area layer in the hierarchy. The concept of a local area controller would be required to manage the local controllers in smaller geographical areas with the ability to talk with neighbouring local area controllers.

In theory, the decentralised model provides greater control of the assets in manageable portions of the network and provides better redundancy than the centralised control system. Data processing also becomes more manageable with local area controllers with an added advantage of reduction in data processing power compared to the centralised control system.

Market Platform

To facilitate energy trading within the E-Port Energy area and out of the area, a functional specification for a multidirectional market platform was developed during the concept study. The purpose of the E-Port Energy market platform is to balance energy supply and demand by maximising usage of low carbon, low cost and secure sources of local energy. The E-Port Energy market platform would be operated by an E-Port Energy market operator independently and in cooperation with external market operators such as Energy Distribution Market Operators. Furthermore, the E-Port Energy market operator would encourage participation of low carbon energy resources into the market and maximise local energy asset use for the benefit of the local community and industrial users.

E-Port Energy Business Model

A new energy company would need to be set up to run the E-Port Energy market platform. The company structure recommended in this report is a community interest company. The company's market platform and control system would operate the energy system and provide a platform for the trading of energy between local consumers and generators. The four energy products which would be available on the platform are heat, natural gas, electricity and hydrogen. Building customer relationships and effective marketing will be crucial to the success of the business. It is a unique solution so offers a different proposition to other energy suppliers. The value to all customer segments is the increased competitiveness of the region as the UK transitions to a low-carbon economy, with the ensuing local job creation.

Transport and Mobility

E-Port Energy would act as an enabler for clean transport and mobility across the Ellesmere Port and surrounding region. Two factors are significant in this respect; the availability (and capacity to expand) locally produced transport fuels in the form of electricity and hydrogen, and the siting of existing infrastructure which would allow development of transport hubs with ready access to both the region's arterial routes and centres of population. Given that transport and mobility provision is a dynamic, rapidly evolving sector, E-Port Energy would not be the primary provider of such solutions; rather, it would act as an enabler to attract innovative transport solution providers to the region by providing them with access to their most basic requirement: low cost, low carbon energy sources.

Regulation

There are a number of key barriers in the current regulatory model that would require modification to enable the proposed innovative local trading arrangements. Five energy supply models were considered for E-Port Energy: licensed energy supplier, license exempt supply, License Lite, peer-to-peer trading, and local energy market. The License Lite or Local Energy Market models were recommended for consideration in the future detailed design phase of the project due to their suitability for the local, low-carbon energy trading requirements of the E-Port Energy project. However, both have only been used in trials so far.

Skills Assessment

A skilled workforce is vital to the growth of any industrial region. Both European and UK Government policy have had a galvanising effect on the Clean and Renewable Energy Industry, propelling it forward on many parallel fronts. The E-Port Energy project will always sit at the forefront of these developments, since its modular approach allows the integration of new technologies as they come forward.

However, there is a danger that the pace of growth is leaving the job market behind and it is crucial that all parties involved – from schools through to the industrial players themselves – take ownership of this problem. Areas such as Ellesmere Port must feel part of these new developments and feel that they can aspire to the skills that will inevitably be needed. The Cheshire Energy Hub provides a Graduate Programme which involves placements in three well established Cheshire Energy Hub companies, providing each graduate access to a range of working environments. This graduate programme is taking a lead on developing skills in multi-vector energy engineering. Whilst degree programmes can deliver theory across multiple disciplines, and individual organisations can provide apprenticeship routes, partnerships are required to equip future multi-disciplinary engineering skills.

Conclusions and Next Steps

The E-Port Smart Energy Master Plan has created a pathway for the region of Ellesmere Port to reduce its energy related carbon emissions by up to 34%. To achieve the reduction in the cost of energy by the target of 25%, however, is more challenging. Introduction of a higher carbon tax would enable the competitiveness of investment in the low-carbon concept described in this report, and a reduction in the cost of energy to consumers.

The most important aspect of this project is the whole system approach. By enabling flexibility between the different vectors including use of energy storage, the concept unlocks capacity on the energy networks.

To realise the benefits of the E-Port Energy concept study, this 6-month study needs to progress into the detailed design phase followed by project implementation. There is still a long way to go before the low-carbon, low-cost energy aspirations of the project become reality. Investment and regulatory change will be required for E-Port Energy to fulfil the huge positive impact it has the potential for. This study has been collaborative and it’s important that the concerted effort is maintained in subsequent phases to harness the expertise and input of multiple stakeholders to solve these big challenges.

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