Photo by Michael Dziedzic

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Protheus Smart Grid Project for Urban e-Mobility

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This article is a summary of the activities implemented in the framework of the "Protheus Smart Grid Project for Urban e-Mobility" project undertaken by the municipality of Paks and presents an integrated approach to e-mobility. The cornerstone of the project is a holistic vision of how urban mobility should work in the XXI. Century: intertwined with built-in RES and energy storage systems, moving towards the digitalization of such services. This article highlights some of the most important aspects of this project.

The City of Paks is home of Hungary's only nuclear power plant. The four reactors were commissioned from 28th December 1982 to 16th August 1987. The last of the four reactors will be shut down in 2037, therefore following a decision made by the National Assembly of Hungary preparatory works for the construction of a new power plant started in 2017. The municipality, on the other hand, seeks to explore new frontiers locally including renewable energy sources, modern energy storage solutions for better grid integration and e-mobility facilities to decrease GHG emissions and improve quality of life in the city and the surrounding area. The ultimate goal is to create a vertical integration by bringing together production steps involved in the local transport service, increasing efficiency, decreasing emissions, operation and energy costs. The means to reach these objectives is the Protheus project, which successfully applied to be funded by the ELENA (European Local Energy Assistance) facility. The project includes the following activities:

- studies to collect all the information necessary for the business plan, the operational working structure of the project and the public procurement documentation
- a detailed business plan providing essential business information,
- how to set up a sound business structure for the operational phase of the project including the decision-making and responsibility roles
- a set of documentation that will enable the realisation of successful public procurement processes
- the work needed to agree on the financing contract with the likely financing bank and to organise the smooth transition from preparation into the implementation phase

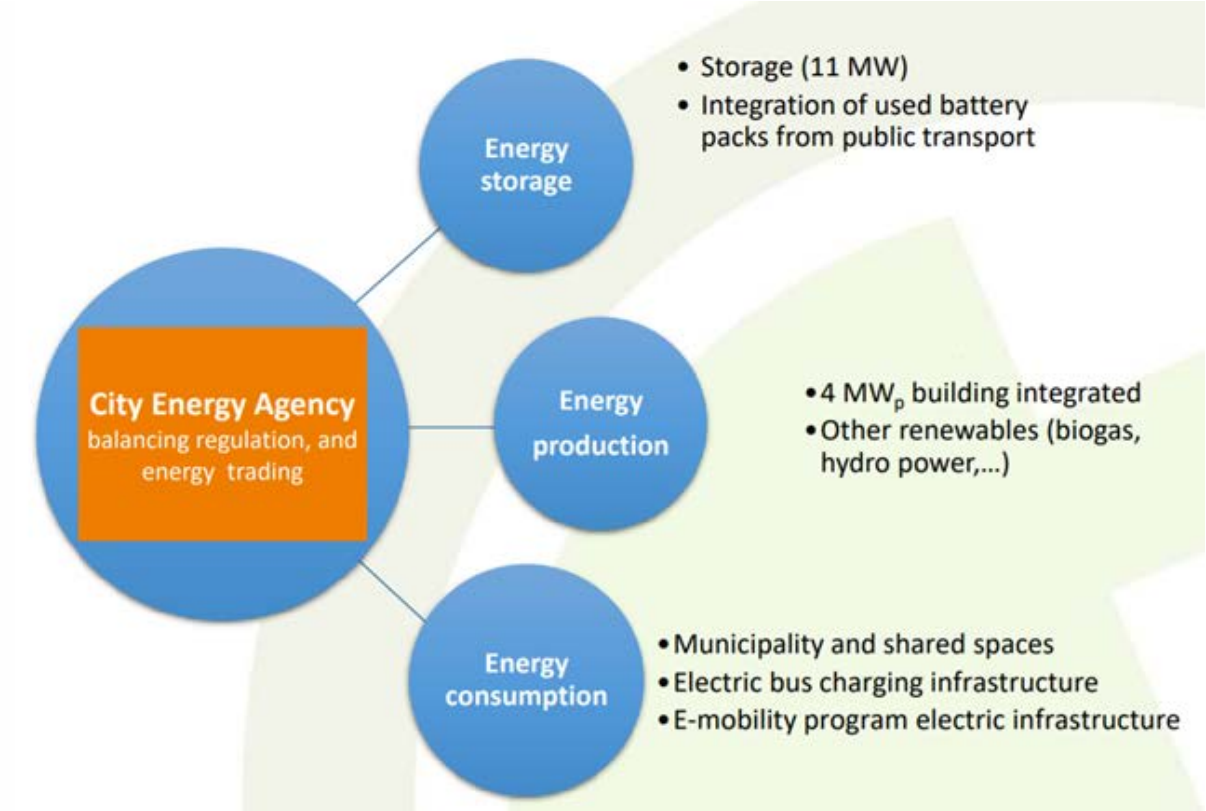
The ELENA-project, therefore, is instrumental in creating not only the operational concept for the project and the company but to prepare the municipality of Paks to involve external funding to realize the investments into RES, the electrical grid, vehicles and the necessary facilities.

The energy aspect

The public face of e-mobility - passenger cars producing unbelievable power and torque numbers or e-bikes and e-scooters making every day commuting much easier – is very popular due to the flexibility it is offering and the closeness to the end-user. The fuel used in these vehicles, on the other hand, is a deciding factor in terms of eco-friendliness, as the associated CO2 emission for each kWh electricity was roughly 207 g as of 2017[1]. Installing RES capacities is a simple and clean solution, however, the electricity generated – mostly by building-integrated PV - should be stored in order to use it later for charging electric vehicles.

Smart grids are gaining ground all over Europe and are yet to reach their full potential. There are many benefits to implementing smart grids and the municipality of Paks is set on a mission to implement a quite integrated system, that controls the flow of electricity from RES capacities based on the current load to feed to the grid or store the energy in batteries instead. This serves two purposes: firstly, it will balance the grid by matching the supply of RES-generated energy to demand, and secondly, it creates an economical background to the whole project as battery stored energy can be sold during peak load.

The RES generation mostly comes from building-integrated capacities located on buildings owned by the municipalities participating in the Protheus project. The smart grid therefore not only includes the municipality of Paks but 18 neighbouring municipalities, which have joined the smart grid initiative.



[1] https://www.mvmpartner.hu/-/media/MVMPartner/Documents/Dokumentumtr/Erdekes-segek/20170616/Elektromos-es-belso-egesu-motoros-autok-energiafelhasznalasa_final.pdf?la=hu-HU

The planned capacities require a significant amount of battery capacity to be installed, most of which is planned to be installed at a central site supplemented by a decentralized storage network. The central storage is one of the most crucial elements in the system – to help save costs in the future, battery packs no longer used by e-buses will also be incorporated in the central storage (the currently procured buses have an overall battery capacity of 2300 kWh, which still adds a significant amount of capacity when being repurposed in its used state with a decreased capacity).

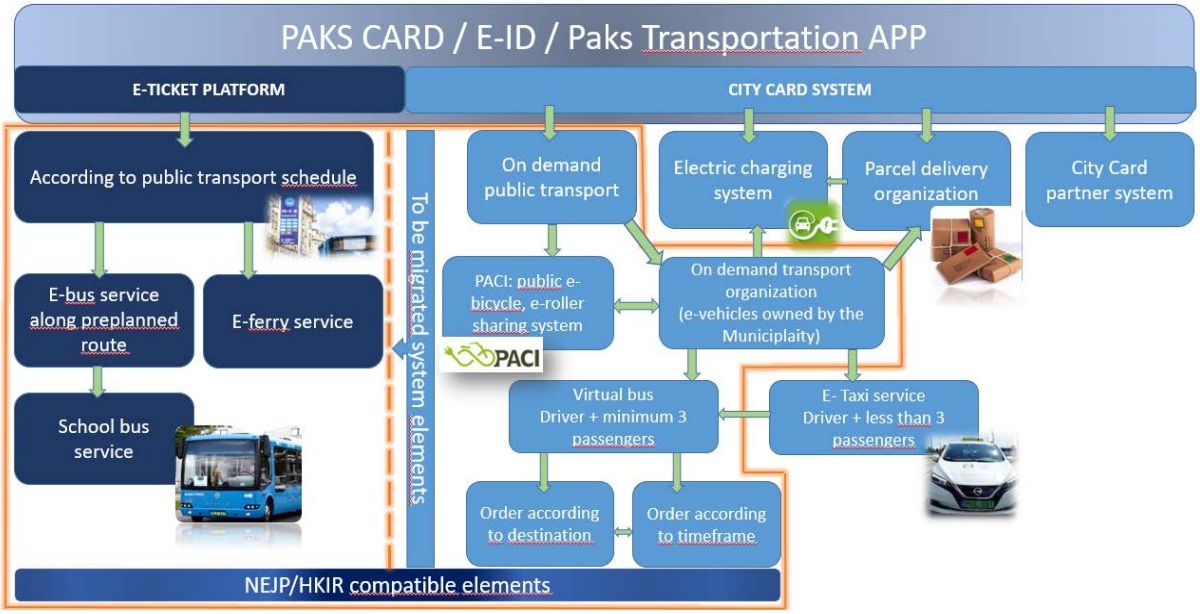
The energy will be spent on charging electric buses and other e-mobility appliances (e-bikes, e-ferry, e-taxis) and to provide electricity to public buildings, but this also can be a subject to balancing regulation (when and where to feed), and the smart grid provides this flexibility to implement such features.
Building on the economic advantages provided by the self-produced and distributed renewable energy, the operation of the transport fleet can be more cost-effective especially with close integration into this smart grid-ecosystem.

The transport aspect

When it comes to urban bus transport, most Hungarian municipalities are supplied by Volánbusz, a state-owned company also providing long-distance bus transportation in Hungary. There are few exceptions, however, most notably the capital Budapest with its own Budapest Transport Company operating not only buses but trams, a subway network, trolleybuses, ships and several other modes of public transport. A few bigger cities also have their own transport companies, however, it is becoming more common to contract Volánbusz, as it is increasingly difficult for municipalities to run their own transport company from an economic and professional point of view, not to mention that economies of scale favour Volánbusz as well. It is considered by most that local public transportation systems operated by Volánbusz are more cost-effective, however, the company is lacking the experience in operating e-buses and as a state-owned company, Volánbusz is not very flexible regarding the ever-changing transportation needs of communal transportation.

With an integrated approach linking together electricity generation and transport aspects, it is quite a necessity for the municipality of Paks to be able to handle all aspect by themselves, not just because they operate electric vehicles, but because this operation needs to be demand-based and also has to deal with electricity generation, storage and trade. Therefore the representative body voted for establishing their own transportation company, Paksi Közlekedési Ltd. The company operates all kinds of transport interfaces in the city, such as:

- E-taxis/virtual e-bus system
- E-buses, and demand-based minibuses
- E-bicycle sharing system
- E-ferry
- E-vans for municipality and municipality company use
- Charging infrastructure for the buses and private car owners



The E-taxi/virtual bus is quite an innovative economic case for taxi drivers and municipalities alike. These cars usually reach a high mileage relatively quickly and most taxi drivers are using diesel cars, which puts a big load on local emissions values. The daily mileage demand of these taxis, however, can usually be met with an electric car, which on the other hand would be a very significant investment for these small companies. The municipality, therefore, decided to make an interesting proposition: they invest and procure electric cars, which they lease for the taxi companies. The lease price includes the rent of the car, and the needed fuel (electricity), and it is based on the mileage of each car. The lease price for 100 km is not higher than the average fossil fuel consumption on 100 km of a diesel taxi. With the electricity coming from the municipality's sources, the investment has a less than 5-year return, upon which the taxies reach around 200,000 kilometers in their clock. This investment could be considered as market distortion by some, but there is another element to reflect on the virtual bus. The taxis can be recognized by the e-ticket system as a bus if there are at least 3 passengers using them to go in the same direction with their local transportation pass or ticket. This helps the company to deal with the quite common problem of using the capacities of e-buses unnecessarily since bus routes with low passenger demand can be covered with virtual buses.

A completely new e-card system will be put to test in the frame of the Protheus project to accommodate for the wide range of services offered and the experience gained in this piloting phase will be used during the set-up of a national e-ticket system. The local e-ticket will let its users access several modes of transport – not only riding buses but renting e-bikes, using the virtual bus and accessing the charging points in a similar fashion to how Mobility Stations in Leipzig work. A definite advantage of testing this e-ticket system here is that all the function have to be there from the start, so the system will be set up accordingly.

Conclusion

There are no extraordinary, novel technical elements to be implemented in the Protheus-project, however,m,löl,.- there are not many other transport investments with such an extensive scope. It is not just a step forward in the direction of procuring a few e-buses and building the necessary infrastructure, but profound changes are being made considering all aspects of local mobility and building a vertical integration that can be a good example for all cities looking to create an environmentally and economically viable and sustainable urban transport system. Not being bound by previous investments, the new public transportation concept gives the municipality a great opportunity to shape all aspects of the project to meet local needs and requirements.