# D2.2: Toolbox for design of PEB including e-mobility and distributed energy resources

+CityxChange | Work Package 2, Task 2.2

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# Document Information

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# Revision History

| Date | Version | Author | Substantive changes made |
|---|---|---|---|
| 01-01-2020 | v.01 | Kai Erik Dahlen (POW)<br>Klaus Livik (POW) | Initial version built from working documents and software |
| 20-03-2020 | v.02 | Mladen Antolic (Mpower) | Version built from working document and software |
| 30-03-2020 | v.03 | Nick Purshouse (IESRD)<br>Simen Karlsen (POW)<br>Lukas van Vuuren (Mpower) | Version built from working document and software |
| 17-04-2020 | v.04 | Klaus Livik (POW) | Fixed minor errors and updated chapters 1 and 5 |

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# Executive Summary

This report, deliverable D2.2 of the +CityxChange project Task 2.2, describes a toolbox of three prototypes of software models for design, analyses and grid operation of a local energy system including use of storage and grid balancing. The developed software prototypes in the toolbox are in the context of Positive Energy Blocks (PEB) to be created within the project. It is IES, Powel and Mpower that contribute with three different tools covering several tasks of a distributed energy system.

The three models will be implemented and demonstrated in WP4 and WP5. They are delivered as IT prototypes and will support how to operate a community grid and local energy system with the actual available energy resources including flexible consumption.

The tools are developed to propose the most cost effective design of an area within the scope to become a PEB. The calculations will make precise consequences for the local grid topology for day ahead operations. Forecasts of generation and load in each connection point is calculated and identifies precisely how the local resources will influence the local grid. Energy storage including emobility resources with V2G is a part of this evaluations. In the figure it is presented how the different processes towards a PEB is supported by features realised in the three models which make the Toolbox presented in this report.

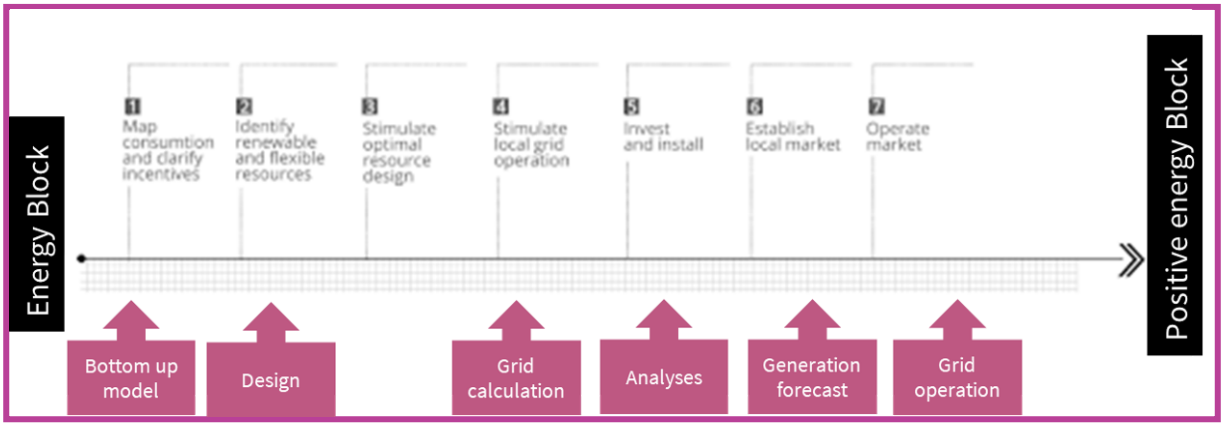


Figure 1.1 Toolbox support to the process towards a PEB in operation.

They have features to include energy resources in a PEB and analyse how they will contribute. The functions of the tools address and calculate how local energy resources influence grid balance and operation in a short term perspective. The toolbox includes features for analyses and simulations suitable for city modelling and 3D presentations. For example, the Powel tool has advanced calculations for how the design will influence planning of generation with either surplus or deficit of energy and power. It includes battery optimisation and includes a simplified management of emobility with electric vehicles' batteries.

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The main partners involved - IES, Mpower and Powel - are commercial companies. By the development of the actual three tools, the toolbox makes an integrated solution fit for design and operation of local energy systems and market. The following tools are developed as prototypes to be demonstrated in the Lighthouse Cities:

- Tool A-IES: A "bottom-up" model that starts with calculations on building level and calculates demand curves at building level from a bottom up approach. The model will predict load curves for a given period of time based on variations in a range of parameters. The model includes grid calculations for actual areas and groups of buildings. The model is suitable for system design and scenario analyses. User interfaces are dashboards and 3D maps. The model will interact with other project tools in the Task through APIs. To be demonstrated in Limerick. Main contributor: IES.

- Tool B - Powel: A "top-down" model that designs a local energy system with a variety of energy and power resources - including consumer flexibility. The model calculates how available energy resources will be applied the best way for next day hour by hour forecast based on availability and predictions (weather forecasts, load forecasts etc.) with the scope to schedule the total load within the area in a way that maximise the value of the resources - and calculates how this will influence on possible grid constraints each hour the next day. The model imports energy metered data and weather data. The data is addressed to connection points in the grid topology imported with the CIM model from NIS/GIS model for the actual local grid area. Then it is for the coming day calculated detailed load balance for the actual points every hour for actual grid topology. If grid constraints are met or observed for the coming day, it is addressed by alarms/warnings or as an export to the grid operator's ADMS/SCADA . This will be demonstrated in LHC Trondheim. Main contributor: Powel.

- Tool C - Mpower: A community grid optimisation model that is part of the application layer responsible for grid balancing. It is based on a bottom-up approach by collecting real time data from loads and generation sources from the community grid. The model will feed in data about the availability of energy and flexibility, its source, type and amount. The model will communicate directly with the Mpower enerXchange platform that enables energy and flexibility trading inside the community grid and with a Grid Stabiliser for optimisation and balancing purposes. With other project tools it will interact through APIs mainly as a source of actual measured data and aggregated data for KPI checking. It will be demonstrated in Limerick. Main contributor: Mpower.

The toolbox is made as scalable prototypes ready to be refined for the purposes of the LHCs and possible adaptation for FCs later on. The models in the toolbox include reports presented as dashboards/tables with results of calculations. It also includes topology descriptions of the local grid which is a part of the community grid and/or PEB. The calculated results are easily exported to third parties for further processes and tasks like

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settlement and invoice. This is supported in other tasks of the project. The eMobility is managed as local energy storage and is included as local energy resources with information represented like time series in the same way as other local resources and/or forecasts.

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