D8.4: Report on IPR protection plans, agreements and exploitation plans

+CityxChange | Work Package 8, Task 8.5

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17-1-2023	v.01	Sander Smit (R2M)	Initial version
13-4-2023	v.02	Sander Smit (R2M)	Added results KER assessment
28-4-2023	v.03	Sander Smit (R2M)	Draft for QA review
16-5-2023	v.04	Sander Smit (R2M)	Final version

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List of Acronyms

+CxC	+CityxChange
CSO	Community System Operator
DER	Distributed Energy Resources
DHC	District Heating and Cooling
DP	Demonstration Project
DR	Demand Response
DSO	Distribution System Operator
DT	Digital Twin
EE	Energy Efficiency
eMaaS	electro-Mobility as a Service
ER	Exploitable Result
EV	Electric Vehicle
FC	Fellow City
KER	Key Exploitable Result
KPI	Key Performance Indicator
LEM	Local Energy Market
LFM	Local Flexibility Market
LHC	Lighthouse City
OASC	Open & Agile Smart Cities
P2P	Peer to Peer
PEB	Positive Energy Block
PED	Positive Energy District
PPP	Public Private Partnership
SLU	Smart Link Unit
SWOT	Strengths Weaknesses Opportunities and Threats
TRL	Technology Readiness Level
UDT	Urban Digital Twin

V2B	Vehicle to Building
V2G	Vehicle to Grid
WP	Work Package

Executive Summary

This report presents an updated overview of the exploitable results of the +CityxChange project identified during the first fifty-four months of the five-year project and builds upon the work presented in Deliverable 8.2 "Report on the identification and assessment of exploitable result"[1]. This work has been conducted as part of Work Package 8: Scaling-up, Replication and Exploitation and specifically as part of Task 8.5 "Exploitation, IP protection and agreements". The report provides an overview of the plans for adoption and exploitation of results generated by the +CityxChange project and the arrangements for the protection and management of the IP developed in the project. As such, it provides a framework for identifying, developing, and optimising the exploitation of the project results during the project and after its completion.

Twenty-six exploitable results have been identified which are summarised under four categories: 11 Products & Applications, 2 Services, 8 Knowledge & IP, 3 Processes, and 2 Other (Policies). Compared to D8.2, two new results have been identified (ER26 - "PEB Policies Recommendations" and ER27 - "Integrated Investment Models for PEBs") and one result has been marked as duplicate (ER15 - "PED Planning and Design Process"). It is envisioned that 14 of the results will be exploited on a commercial basis and the remaining 12 results will be made available for public or scientific exploitation for free, under appropriate open licences, or similar paths.

Together, the results cover the technical, social, economic and cultural aspects of a PED, both individually and in an integrated manner, reflecting the complexity and collaboration needs of PEBs. For example, the Local Energy Market combines the various technologies developed in the project to enable local energy and flexibility trading. Equally important are the process- and engagement related results like the Innovation Lab, Learning Framework, Bold City Vision, and regulations that set the conditions for the PED framework.

For each of the exploitable results, together with the ER Manager, a KER Assessment has been performed. The results have been used to categorise the results across expected impact and innovation risk and to further detail the exploitation- and IP management strategy. The results are distributed across four categories: 2 Rising Star, 12 Promising Concept, 3 Niche Opportunity, and 9 Safe Play. The levels of maturity vary across the exploitable results and the effectiveness of the results will be validated during the +CityxChange demo projects.

[1] https://cityxchange.eu/knowledge-base/d8-2-report-on-the-identification-and-assessment-of-exploitable-results/

It can be expected that the methods and products developed in +CityxChange will contribute to the adoption of PEDs/PEBs and can be of great benefit for all stakeholders involved. This report forms the basis for the commercialisation plans that will be delivered in Month 60.

1 Introduction

This report presents the exploitable results of the +CityxChange project as identified within Task 8.5 “Exploitation, IP protection and agreements". As such, this report will provide guidance to the project partners with the preparation of exploitation plans for the innovative +CityxChange solutions related to the establishment of a number of Positive Energy Blocks (PEBs) or districts (PEDs) as part of Task 8.5 and the preparation of commercialisation plans for the products, tools and services developed within +CityxChange as part of Task 8.6. This report also links to Task 11.4 “Legal and Knowledge Management” which manages the IPR issues arising from the project activities. Furthermore, this report aids Task 8.2 “Replication across EU cities” with the further detailing and assessment of the Demonstration Projects (DPs) by providing the exploitation vision and innovative elements of their related exploitable results. This report builds on D8.2: “Report on the identification and assessment of exploitable result”[2] and in general is reusing content from there, as well as on respective completed deliverables on the solutions, which are noted in each of the results.

Starting with the list of exploitable results as presented in Deliverable 8.2, this Task has periodically evaluated the +CityxChange solutions and assessed their innovation risk and exploitation potential. Based on the results of this assessment, the list of exploitable results and their status has been kept up-to-date. Updates on the list of exploitable results have been reported in the Technical Board meetings. Changes compared to the list of results presented in D8.2 are as follows:

- Newly identified results in this period are:
    - ER25 - “PEB Policies Recommendations”, resulting from LCCC’s ongoing discussions with regulatory bodies.
    - ER26 - “Integrated Investment Models for PEBs” capturing the work of OV on investment- and business models in the LHCs.
- Results removed from list of exploitable results:
    - ER15 - PED Planning and Design Process. Reason: Duplicate with ER - PED Grid Design Toolbox. The toolbox combines three design tools and guides the user through the planning and design process which is an integrated part of the toolbox.

Together with the partners, exploitation plans and IPR protection plans have been defined, using the outcome of the assessment of exploitable results as presented in Deliverable 8.2 as a starting point.

[2] https://cityxchange.eu/knowledge-base/d8-2-report-on-the-identification-and-assessment-of-exploitable-results/

Chapter 3 provides a summary overview of the project results identified as suitable for commercial or public exploitation. In total 26 exploitable results have been identified to date separated out in 11 Products & Applications, 2 Services, 8 Knowledge & IP, 3 Processes, and 2 Other (Policies). The summary overview shows the type of result, the assigned ER manager and envisioned type of exploitation, for each of the results.

Chapter 4 presents the exploitation plans for the commercially exploitable results. The exploitation plans include a short description, ownership, maturity level, short- and mid-term exploitation vision, IPR protection plan, and related Work Package, Demonstration Projects, and deliverables are described for each of the ERs.

Chapter 5 presents the exploitation plans for the non-commercially exploitable results. The exploitation plans include a short description, ownership, maturity level, exploitation vision, IPR protection plan, and related Work Package, Demonstration Projects, and deliverables are described for each of the ERs.

Appendix 1 includes the KER assessment template as used for the assessment of the exploitable results;
Appendix 2 presents a summary of the results of the KER assessment.

2 Methodology

This chapter describes the methodology used for the identification and management of the exploitable results of the project. It clarifies the different steps that led to the definition of the exploitable results, exploitation strategies and exploitation plans presented in this report. In doing so, it explains how the outcomes of this work will drive future activities and contributes to the impact of the project. This is a follow-up of the methodology as presented earlier in Deliverable 8.2 "Report on the identification and assessment of exploitable result" and in part repeated here.

Within +CityxChange, we consider that **Exploitable Results (ER) are the achieved and/or expected results coming from the project that will have an impact on the economy, environment and/or society as a whole. These results have commercial or social significance and can be exploited as stand-alone products, processes, services, etc**. In principle, these exploitable results might need further R&D, prototyping, engineering, validation after the project ends and before they become commercially exploitable. Exploitable results can be categorised into several areas. They are not rigid but, for here, the following areas are considered:

- Products & applications – items for sale (e.g., hardware or software)
- Processes – ways to make or do something
- Knowledge – valuation of "how to"
- Services – by offering the above products, processes, equipment, or knowledge
- Other – Platform, publications, patent….

According to the Horizon 2020 description[3], Key Exploitable Result is defined as:
"Any tangible or intangible output of the action, such as data, knowledge and information whatever their form or nature, whether or not they can be protected, which are generated in the action as well as any attached rights, including intellectual property rights".
A Key Exploitable Result (KER) is an identified main exploitable result (as defined above) which has been selected and prioritised due to its high potential to be "exploited" – meaning to make use and derive benefits- downstream the value chain of a product, process or solution, or act as an important input to policy, further research, or education. The following two criteria have been used to select and prioritise results:

1. Innovation risk: Degree of innovation and exploitability
2. Impact: Economic, scientific, environmental and/or societal impact

[3] https://ec.europa.eu/jrc/communities/en/community/tto-circle-community/news/horizon-results-platform-explore-wealth-eu-funded-research

During the periodic WP8 meetings, the list with ERs has been reviewed and updated to include additional results and project innovations or adaptation or clustering of results where needed. For each identified result an ER manager has been assigned and key information has been collected like the type of ER, the used background, the co-developers, the current and expected TRL, development status and initial exploitation vision. The collected information has been stored in the ER-tracker, a spreadsheet that is being kept up-to-date throughout the lifetime of the project and tracks the status for each of the ERs.

For the prioritisation of ERs, an ER assessment has been performed. The goal of the ER assessment was to identify the exploitable results with the highest expected return and the lowest innovation risk. This enabled the project to define targeted and focused exploitation activities and spend their resources in the most efficient way.
The ER assessment comes in the form of a questionnaire, see Annex 1. The questionnaire contains two sets of questions, one covering the set of indicators for the expected impact of the ER, the other covering the set of indicators for the innovation risk of the ER. The indicators have been selected based on the impact requirements of the Horizon 2020 programme. Both sets of questions have the same structure, consisting of three elements: Indicator, Value and Evidence.

Evidence needed to be provided and was used to support the underlying hypothesis of the ER indicator. The strength of a piece of evidence determines how reliably the evidence helps support or refute a hypothesis. The following table shows examples of light and strong evidence.

Table 2-1 Examples of light and strong evidence used in ER assessment

Light evidence	Strong(er) evidence
Opinions (beliefs)	Facts (events)
What people say	What people do
Lab setting	Real world setting
Small investments: signing up by email to show interest in an upcoming product or service is a small investment	Large investments: Pre-purchasing a product or service or putting one's professional reputation on the line is an important investment

For each indicator, the ER manager has been requested to rank the value for each indicator and provide supporting evidence. Each completed questionnaire has been discussed with the Innovation Manager and the ER manager together to ensure the result of the assessment is unambiguous. The Innovation Manager has assessed the completed questionnaire and ranked the expected impact and innovation risk. Scores could be "low"

or "high". The result of this assessment has been submitted to the ER manager for approval.

Based on the results of the ER assessment, each ER has been positioned on the Exploration Board as shown in Figure 2-1. The Exploration Board is used to track the status of each ER and have one dashboard-like overview of the status of all ERs of the project. The Exploration Board is adapted from the Portfolio Map as developed by Osterwalder[4]. The two axes of the board represent the expected impact and the innovation risk of the ER and are both ranged from low to high. This results in four quadrants on the board, being:

1. Rising Star (high impact, low risk): ERs with significant impact, either economic, societal, or otherwise and with low innovation risk, e.g., because the evidence shows clear market demand, are placed here. In general, his quadrant will contain most of the key exploitable results.
2. Safe Play (low impact, low risk): ERs with low innovation risk but also low impact because of limited marketability or serving a niche market are placed in this quadrant.
3. Niche Opportunity (low impact, high risk): ERs with low impact and high risk are in general not very attractive for exploitation and to invest resources in but sometimes they can be input for follow-up research.
4. Promising concept (high impact, high risk): ERs with high impact and high innovation risk are often more disruptive innovations or innovations opening new markets. Key exploitable results are also likely to be found here.

[4] Osterwalder A. et al., 2020, The Invincible Company, John Wiley & Sons, ISBN 978-1119523963

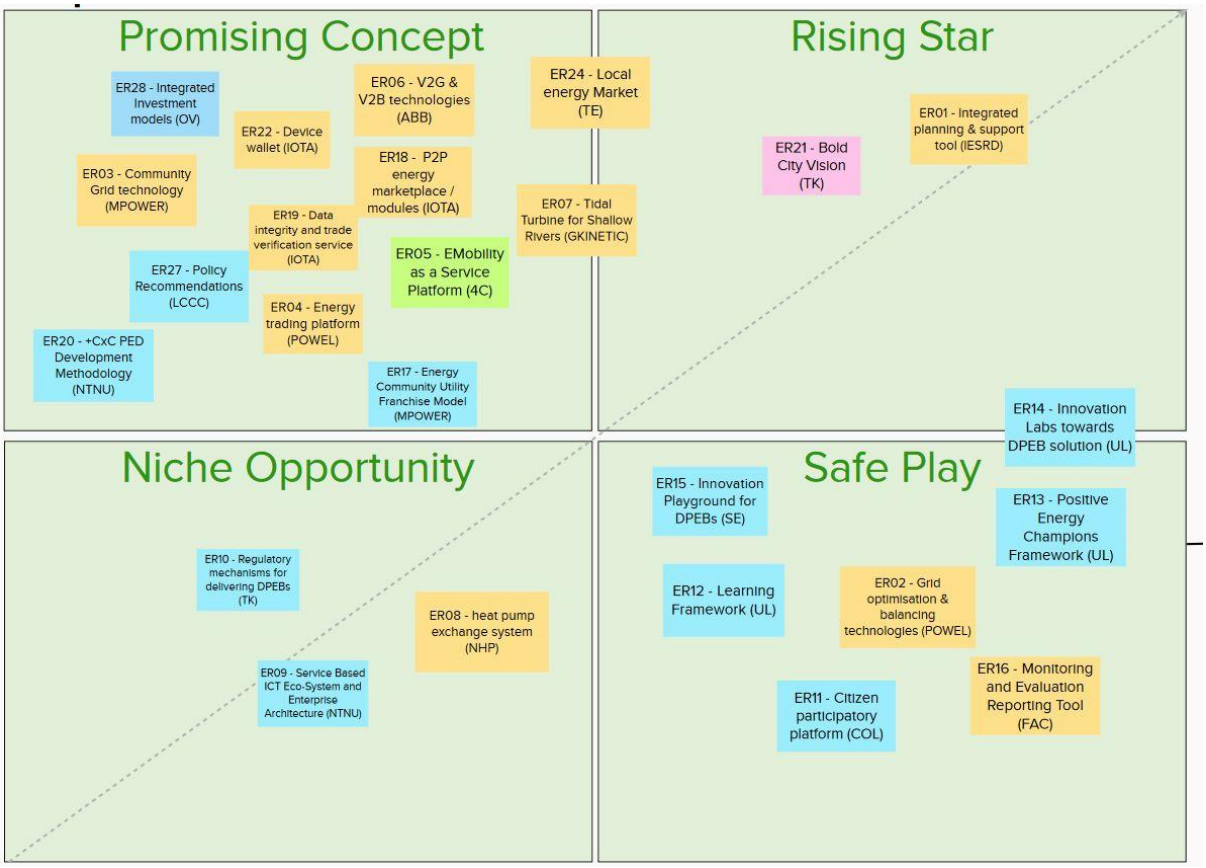

Figure 2-1 Exploration board (status April 27, 2023)

The exploitation activities are strongly linked to the replication activities as conducted in WP6, and to WP4 and WP5 where Lighthouse Cities implement project solutions within their city. Demonstration Projects (DP) are a way to structure the project innovations and are carried out in each Lighthouse City to prove the +CityxChange solutions, and in the Fellow Cities to prove the replicability of the +CityxChange solutions. Each ER is part of one or more DP and the implementation of the DPs is ongoing. The results of the measurement and evaluation of the DPs will be used to shape the exploitation and commercialisation plans of the ERs. The DPs are defined as follows:

Table 2-2 Overview of +CityxChange Demo Projects

Demo project	Description
DP01 - Model	Record data and provide integrated decision support to cities
DP02 - Vision	Co-create a Bold City Vision, to plan, implement, replicate, and scale-up to positive energy districts and cities
DP03 - Engage	Co-create positive energy blocks
DP04 - Regulatory Zone	Enable innovation through regulatory mechanisms

DP05 - Playground	Accelerate change and disruptive solutions through innovation playgrounds
DP06 - DPEB	Create DPEBs through improved energy performance and integration with the energy system
DP07 - Microgrids	Balance and optimise energy in the PEB through microgrids
DP08 - eMaaS	Integrate seamless e-mobility within the PEB
DP09 - Local Trading	Enable peer-to-peer trading within the PEB
DP10 - Flexibility Market	Enable a fair deal to all consumers through a flexibility market
DP11 - Invest	Enable consumers to invest in their buildings, which is critical to the creation of a PEB

Table 2-3 shows how ERs are linked to DPs. Compared to the overview presented in D8.2, the two new ERs, ER25 and ER26 have been added to the table.

Table 2-3 Linkage of Demo Projects and exploitable results

Demo project	Linked ER
DP01 - Model	ER01 - Integrated Planning and Decision Support tool ER9 - Monitoring and evaluation reporting tool ER13 - CxC PED Development methodology
DP02 - Vision	ER17 - Bold City Vision
DP03 - Engage	ER21 - Learning framework ER22 - Positive Energy Champions framework ER20 -Citizen Participation Guidebook
DP04 - Regulatory Zone	ER19 - Regulatory mechanisms for delivering DPEBs ER25 - PEB Policy recommendations
DP05 - Playground	ER11 - Citizen participatory platform ER23 - Innovation labs towards DPEB solution ER24 - Innovation playground for DPEBs
DP06 - DPEB	ER7 - Tidal turbine for shallow rivers ER16 - PED grid design toolbox
DP07 - Microgrids	ER2 - Grid optimisation and balancing technologies ER3 - Community grid technology ER8 - Heat pump exchange system ER14 - Device wallet ER16 - PED grid design toolbox
DP08 - eMaaS	ER5 - eMaaS platform

	ER6 - V2G and V2B technologies
DP09 - Local Trading	ER4 - Energy Trading Platform ER18 - P2P energy marketplace ER19 - Data integrity and trade verification service ER15 - Local energy market
DP10 - Flexibility Market	ER4 - Energy Trading Platform ER11 - P2P energy marketplace ER12 - Data integrity and trade verification service ER17 - Energy community utility franchise model ER24 - Local energy market
DP11 - Invest	ER18 - Service based ICT eco-system and enterprise architecture ER10 - Energy community utility franchise model ER26 - Integrated Investment Models for PEBs

The linkage of ERs with DPs is also used to manage and track replication of ERs beyond the LCs and FCs. For each DP, a Replication Profile will be prepared as part of Task 8.1. These Replication Profiles will support cities other than the LHCs and FCs with the replication of +CityxChange solutions and are a vehicle for stimulating exploitation of the ERs embedded in the DPs.

3 Overview of +CityxChange Exploitable Results

The following ERs are an expansion of the preliminary list of technologies and results proposed in the Grant Agreement and include results identified by the partners during the first 54 months of the project. Each ER is assigned to an ER manager who is responsible for providing information and updates on the result, defining the steps needed to reach full exploitation and launching it eventually into the market or in follow-up research activities.

Table 3-1 Overview of +CityxChange exploitable results

#	Name and description	Type of ER	ER manager	Exploitation vision
1	The integrated Planning and Decision Support Tool	Product	IESRD	Commercial
2	Grid Optimisation and Balancing Technologies	Product	POW	Commercial
3	Community Grid Technology	Product	MPower	Commercial
4	Energy Trading Platform	Product	POW	Commercial
5	eMobility as a Service platform	Service	4C	Commercial
6	Vehicle to Grid and Vehicle to Building technologies	Product	ABB	Commercial
7	Gkinetic Tidal Turbine for Shallow Rivers	Product	GKINETIC	Commercial
8	Heat pump exchange system	Knowledge & IP	NTNU	Public
9	Monitoring and Evaluation Reporting Tool (MERT)	Product	FAC	Commercial
10	Energy Community Utility Franchise Model	Knowledge & IP	MPower	Commercial
11	IOTA-enabled P2P energy marketplace / modules	Product	IOTA	Commercial
12	IOTA Data integrity and trade verification service	Service	IOTA	Commercial
13	+CxC PED Development Methodology	Process	NTNU	Public
14	Device wallet	Product	IOTA	Commercial
15	Local Energy Market	Product	TBD	Commercial
16	PED Grid Design toolbox	Product	IES/POW	Commercial
17	Bold City Vision	Process	TK	Public

18	Service Based ICT Eco-System and Enterprise Architecture	Knowledge & IP	NTNU	Public
19	Regulatory mechanisms for delivering DPEBs	Other (Policies)	TK	Public
20	Citizen Participation Guidebook	Process	COL	Public
21	Learning Framework (targeting next generation of smart citizens)	Knowledge & IP	UL	Public
22	Positive Energy Champions Framework	Knowledge & IP	UL	Public
23	Innovation Labs	Knowledge & IP	UL	Public
24	Innovation Playground, including beta-project and crowd-funding	Knowledge & IP	SE	Public
25	PEB Policy recommendations	Other (Policies)	LCCC	Public
26	Integrated Investment Models for PEBs	Knowledge & IP	OV	Public

4 Commercially Exploitable Results +CityxChange

This chapter presents a more detailed overview of the commercially exploitable results of the +CityxChange project as listed in Chapter 3. The results are presented in no particular order. For each result, the type of result, owner, short- and mid-term exploitation vision, IP background, ownership, protection measures, and their relation to project deliverables, project solutions and DPs, is presented.

4.1 The integrated Planning and Decision Support Tool

ER type	Product	**ER manager**	IESRD
TRL before +CxC	6	**TRL after +CxC**	8
Related WP	WP4	**Related DPs**	DP01, DP02, DP03, DP06

Short description:
The exploitable result of the project is the integration of and enhancement of previously existing separate software that has been joined together for the specific purpose of creating PEB/Ds and accelerating cities towards net zero by 2050.

The integrated software allows for the assessment of energy consumption and supply at building, block/district and city levels to support cities in creating Positive Energy Blocks (PEBs) and in identifying replication opportunities.

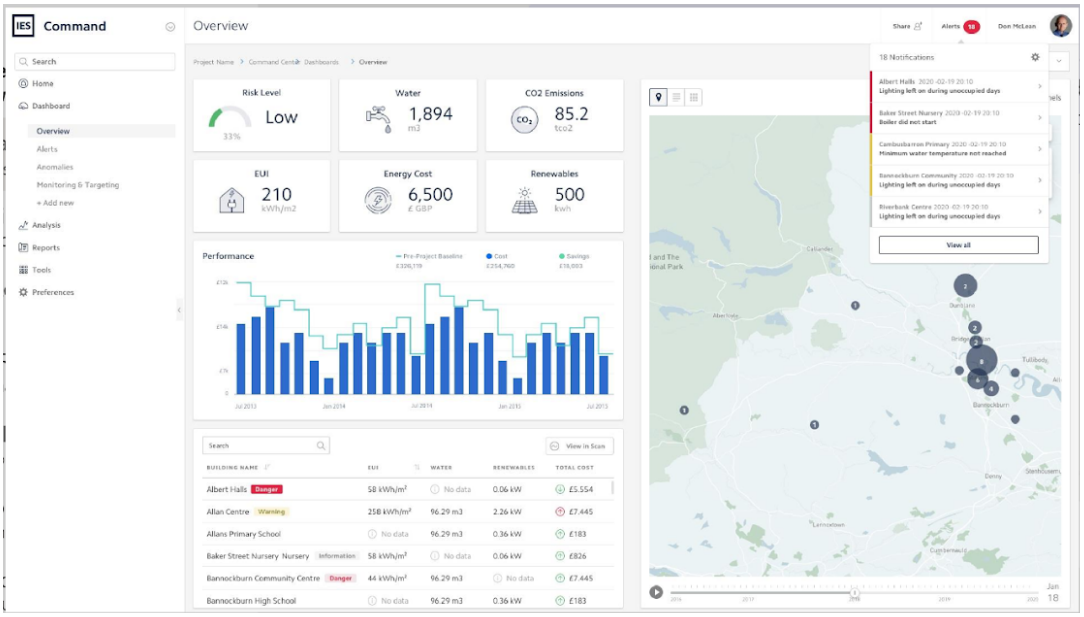

Figure 4.1 - Urban Planner Dashboard

As well as allowing users to gain a detailed understanding of their current energy demand, how this can be reduced, which renewable energy systems are most suitable, and potential constraints on the electricity network, the tool can also model the impact of energy related actions on the citizens of the cities through socio economic analysis. The addition of socio-economic data means that the effect of decreasing carbon emissions can be viewed through the lens of health and economic prosperity as well as the environment.

The resulting visualisations can be tailored to different users (urban planners, building owners, citizens) enabling improved citizen participation and ownership of solutions for the transformation towards a positive energy city.

Innovation:
The tool goes beyond energy analysis and carbon reduction targets, to also assess the impact on other socio-economic factors, such as health, sustainable population growth, regional mobility, job growth, and improved GDP. This creates a holistic approach to city/urban planning, which is a core asset of the tool. The tool combines detailed current and future modelling of urban areas in terms of energy demand and supply as well as joining them with socio economic implications. The tools' ability to show these implications in space (through interactive 3D map visualisations) and time (through the ability to simulate across given points in time to 2050) makes this tool innovative and potentially disruptive to the market.

Demonstration in +CityxChange:
City of Limerick

Linked deliverable:
D4.1 - Limerick DST (Integrated Modelling and Decision Support Tool) including manuals/videos

IPR protection plan:
IP is owned by IESRD. The software is protected by copyright, trademark and licences.

Short term exploitation vision:
Internal validation by IESRD is ongoing and needs to be finalised before the tool can be offered to customers on a commercial basis. A 3D model of the Georgian Neighbourhood in the City of Limerick[5] visualising energy consumption data and real-time information on renewable energy generation and storage, has been made publicly available through the +CityxChange project website.

[5] https://cityxchange.eu/ies-3d-model/

Mid-term exploitation vision:
IESRD is planning to commercially exploit the Integrated Planning and Decision Support tool and make it part of the iCD Sustainable Masterplanning toolset. The tool will be offered on a licence-based basis.

4.2 Grid Optimisation and Balancing Technologies

ER type	Product	**ER manager**	Powel + MPower, IESRD
TRL before +CxC	6	**TRL after +CxC**	8
Related WP	WP2	**Related DPs**	DP07

Short description:
This result includes the documentation and demonstration of a software toolkit that models, design and operate DPEBs - including grid balancing. The toolkit consists of three tools that are developed as prototypes by three companies, IES, MPOWER andPowel. 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 are calculated and identify precisely how the local resources will influence the local grid. Energy storage including e-mobility resources with V2G is a part of these evaluations.

Innovation:
The innovation lies in the integration of previously separated tools.

Demonstration in +CityxChange:
City of Trondheim
City of Limerick

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

IPR protection plan:
The toolbox models from IES, Powel and MPOWER are the result of significant and rather advanced IT tools which are brought into CityxChange as a project background. Each company will retain the IP for their own software, the solution will be integrated through APIs.

Short-term exploitation vision:
The toolbox integrates three modelling tools from three commercial companies being IES, Powel and MPOWER. Further commercialisation of the integrated toolbox and new features are not yet decided or discussed. It is however during the project addressed that the toolbox could be suitable for further development and extensions.

Mid-term exploitation vision:
No mid-term exploitation strategy has been decided by the project partners. The development and further exploitation of the individual tools will be managed by the respective owners of the tools. Interoperability with the other tools in the toolbox will be watched upon.

4.3 Community Grid Technology

ER type	Product	**ER manager**	MPower
TRL before +CxC	3	**TRL after +CxC**	6
Related WP	WP4	**Related DPs**	DP06,DP07, DP09, DP10

Short description:
Community Grid Technology connects Community Grid participants into the local energy network (grid). The infrastructure enables two-way communication between each part of the Community Grid and empowers final consumers to actively participate in a local energy/flexibility market with their available assets and flexibility. It gives the necessary technical foundation for utilising the consumer centric approach in smart grid applications without disturbing the outer power grid (it is disturbance neutral).

Innovation:
The Community Grid Technology enables the deployment of a Community Grid,which is a group of grid-connected electrical resources, within a clearly defined electrical boundary in the Distribution System (e.g. sub-station), with a single defined logical connection point to the grid. Compared to a traditional Microgrid, the Community Grid is represented by a logical rather than a physical connection point and it autonomously maintains disturbance-neutrality at that point.
Existing alternative solutions are microgrid solutions by Siemens, Electric Schneider, and ABB.

Demonstration in +CityxChange:
City of Trondheim
City of Limerick

Linked deliverables:

D2.6 - Framework for Community Grid Implementation

D4.4 - Limerick DPEB Implementation Guide 1

D4.12 Community Grid Implementation Guide (forthcoming)

IPR protection plan:

MPower is the single owner of the IP and plans to protect this IP through trademark protection under the name enerXchange.com.

Short-term exploitation vision:

MPower is preparing commercial exploitation of the Community Grid technology under the name enerXchange.com. Target markets are property owners, business owners, tenants, local urban and rural energy communities who are willing to join the prosumer group. They will be able to leverage the energy consumption, utilise installed renewable sources and share/trade the surplus across the established network (Community Grid). Problem of intermittency and disturbance is managed by the system efficiently. The technology is expected to be ready for the market by the end of 2023 and prototypes have been implemented in Lighthouse Cities Trondheim and Limerick.

Further deployment and validation of the technology is stalled by rejection by one partner (DSO) of key Quality Assurance and Management/Regulation Component. It is not clear when this Irish DSO restriction will be lifted. MPOWER has commenced a new project TRIDENT (Funded by Irish State & MPOWER). This is a +CxC elevator project and will credit +CxC for work to date. Here the project starts with a fresh base seeking a Regulatory Sandbox to bring the community grid technology to TRL8. MPOWER identified heat as a key problem and have Heat Exchange incorporated into a second elevator project, GeoCoHorT, with partner's Ireland's Tyndall National Institute, USA Dept of ENERGY NETL and MDU Sweden (4GDH Expert Group). Funded by USA, Sweden and Irish Government.
Peer-To-Peer Trading (at scale) is turning out to be a "battleground" in the Energy Transition.

Mid-term exploitation vision

Regulatory barriers need to be resolved first before the community grid technology can be commercialised.

4.4 Energy Trading Platform

ER type	Product	ER manager	POW/Volue
TRL before +CxC	6	TRL after +CxC	8
Related WP	WP2	Related DPs	DP09, DP10

Short description:
The Energy Trading Platform is developed as an IT-prototype for trade of power in a local energy market. The delivered prototype is characterised by setting up a local trade platform which is accessible for all local energy resources with a digitalised communication and control. The solution is about to be implemented and demonstrated in the demonstration areas in Trondheim. The energy trading platform for local energy resources consists of two modules: Algotrader which ensures the market participants' (assets') automated participation in the local market, and the Digital Marketplace which matches corresponding bids and offers to enable automated trades. The energy trading platform operates the market by using algorithms in an intraday market. Distributed energy resource management and trade verification inclusive dispatch is executed by ABB and IOTA technology.

Innovation:
The innovation is in the concept of a local energy market itself and the . This encompasses the software and technological infrastructure, the cooperation processes between building/asset owners and technology partners, and market strategies.

Demonstration in +CityxChange:
City of Trondheim

Linked deliverable:
D2.7 - Local DPEB Trading Market Demonstration tool
D5.5 - Energy Trading Market Demonstration

IPR protection plan:
Volue is the owner of the Algotrader and Digital Marketplace. The Energy Trading Platform makes use of technology from ABB and IOTA. Dialogue on arrangements for usage of each other's IP after project end are ongoing.

Short-term exploitation vision:
Currently the Energy Trading Platform is a prototype and being exploited by Trønderenergi (TE). Plans for commercialisation depend on the results of the pilot in Trondheim. Volue is reviewing their strategy regarding the trading platform internally.

Mid-term exploitation vision
There is currently no plan for further rollout but Volue is having discussions internally and with Trondheim Kommune with regards to upscaling of the trading platform.

4.5 eMobility as a Service Platform

ER type	Service	**ER manager**	4C
TRL before +CxC	5	**TRL after +CxC**	7
Related WP	WP2	**Related DPs**	DP08

Short description:
FourC has developed a functional proof-of-concept eMaaS solution. It includes a backend system, named FourC Total Traffic Control (FourC TTC). FourC TTC retrieves, stores, and provides transport data. It collects data from various data providers and makes them available in a normalised and standardised format. A demonstration end-user Android app has also been developed. It connects to the TTC backend and shows the mobility options that are available for the user near a chosen position on the map. Mobility objects on the map are interactive, and can show further information about the chosen object. Each mobility object is graded according to its environmental "friendliness". The user can choose the types of mobility modes they would like to see, create location favourites, and "auto-jump" to the nearest favourite. As the mobility modes have very different payment schemes, the app will redirect the user to the mobility provider's own app or webpage to reserve or order each type of mobility option. A digital asset payment system was developed by IOTA , where users can book and pay for a multi-modal journey, offered by different transport providers, seamlessly in one step.

Innovation:
The integration of multiple mobility modes and the presentation of the environmental impact of a user's journey.

Demonstration in +CityxChange:
City of Trondheim

Linked deliverables:
D2.5 - Seamless eMobility System including user interface
D5.13 - +Trondheim eMaaS Demonstration

IPR protection plan:
IP is owned by 4C and the software is protected by copyright. Discussions about IPR agreement between TK and 4C are ongoing.

Short-term exploitation vision:
A specific brand – Mobee2 – including a brand strategy was developed. The Mobee brand is owned and managed by TK. The Mobee app[6] is built on top of the FourC TTC platform and displays various mobility modes in realtime around a user's present location. At present, the platform doesn't include options for booking and payment. Plan is to develop this functionality throughout and beyond the course of the project.

Mid-term exploitation vision
TK wants to continue the exploitation of the Mobee app after the project ends and extend the functionality of the app.

4.6 Vehicle to Grid and Vehicle to Building technologies

ER type	Product	**ER manager**	ABB
TRL before +CxC	7	**TRL after +CxC**	8
Related WP	WP5	**Related DPs**	DP08

Short description:
Vehicle to Grid (V2G) and Vehicle to Building (V2B) technologies allow interaction and transaction of energy from a vehicle to the grid, or from a vehicle to a building. These technologies have been developed in the ABB organisation outside the project. A prototype product has been brought in the +CityxChange project to test it in a market and local energy microgrid setting. V2G supports in balancing the grid and smoothly integrating renewables, it enables utilities to become less dependent on fossil fuel power plants. Since V2G solutions are expected to become a financially beneficial feature for utilities, they have a clear incentive to encourage consumers to take part. Consumers will be rewarded if they make their battery available to the utility to be used for V2G. This will result in a lower total cost of ownership. V2G helps in the storage of renewable energy and consuming it again when you feel is the right moment. With V2G, the momentary electricity consumption

[6] https://www.mobee.no/

spikes in the building can be balanced with the help of electric cars and no extra energy needs to be consumed from the grid.

Innovation:
The inclusion of an EV in a local energy market through the bi-directional charges and underlying platform.

Demonstration in +CityxChange:
City of Trondheim

Related deliverable:
D5.11 - Trondheim DPEB Demonstration

IPR protection plan:
ABB is the single owner of the V2G and V2B technologies. The IP is protected by copyright, industrial design and trademark.

Short-term exploitation vision:
ABB is preparing the V2G and V2B technologies for market introduction

Mid-term exploitation vision
The V2G and V2B technologies are planned to be exploited by ABB as part of their EV charging solutions portfolio. Target markets are utilities, EV owners, fleet operators and building owners. It is expected that these technologies in the future will generate new revenue streams for rental car services, or others. ABB's V2G solution is being prepared for market introduction and already announced on the corporate website (https://new.abb.com/ev-charging/abb-s-vehicle-to-grid-technology).

4.7 Tidal Turbine for Shallow Rivers

ER type	Product / Standardisation	**ER manager**	GKinetic
TRL before +CxC	6	**TRL after +CxC**	8
Related WP	WP4	**Related DPs**	DP06

Short description:
The exploitable result is a 12kW Hydrokinetic Turbine that can be deployed in a variety of sites. Two vertical axis tidal turbines (GK6s) are fixed to a deployment platform with a flow accelerating profile to provide a 12kW floating hydrokinetic solution, the CEFA12. The CEFA12, is a plug and play hydrokinetic turbine that extracts the kinetic energy from flowing

water and converts it to electricity. The power generated is clean, zero carbon, locally generated and 100% predictable unlike solar or wind.

Figure 4.2: Test set-up of the tidal turbine

Innovation:
The unique selling point of the GKinetic hydrokinetic turbine system is the ability to generate significant power at relatively low flow speeds, averaging 2 metres per second (m/s). The outward rotating turbines deflect water borne bodies, removing the need for any screening. Due to the pitch control system, optimum power is achieved at a Tip Speed Ratio of >1, which greatly minimises the potential for aquatic life to be injured by the turbine blades. The floating/freestanding construction allows the device to access many more sites than other devices of its type.

Demonstration in +CityxChange:
City of Limerick

Related deliverables:
D4.4: Limerick DPEB Implementation Guide 1
D4.11 Limerick DPEB Implementation Guide 2 (forthcoming)
D4.15: Limerick Energy Investment Models White Paper (forthcoming)

IPR protection plan:
Background is the key knowledge items relating to this device include the 'bluff body' and the 'blade pitch control system'. Core technology is protected by a patent. The IP for the turbine device is owned by GKinetic Energy Ltd.

Short-term exploitation vision:

In 2023 GKinetic pitched at 'The Startup Tank Climate Investor Pitch Show' and was voted 'StartUp of the Night'. Due to inflexibility in the current permitting process in Ireland, no derogation was given to allow the testing of the prototype CEFA12 hydrokinetic energy converter developed by GKinetic for the +CxC project, at the proposed installation site in the Limerick PEB. In response to this, GKinetic succeeded in gaining access to the Queen's University Belfast Marine Research Lab Tidal Test Center, the only licenced tidal test center in the island of Ireland, and the installation used to field trial the assessment methodology proposed by the IEC. In this work, GKinetic is working alongside researchers from QUB who also sit on and report to the AHG. This allows for both the practicalities of the methodology to be tested and the veracity of its suppositions to be ascertained. Regular meetings are held to discuss the results of testing methods and development of the standards. This work with the NSAI & IEC is ongoing and expected to be finalised this June.

This allows GKinetic to carry out all power performance testing of the prototype in line with the methodology, assuring that they are in keeping with best practice and that the CEFA 12 will be best placed to have its performance certified by the IEC upon completion of testing and transition to the commercial phase.

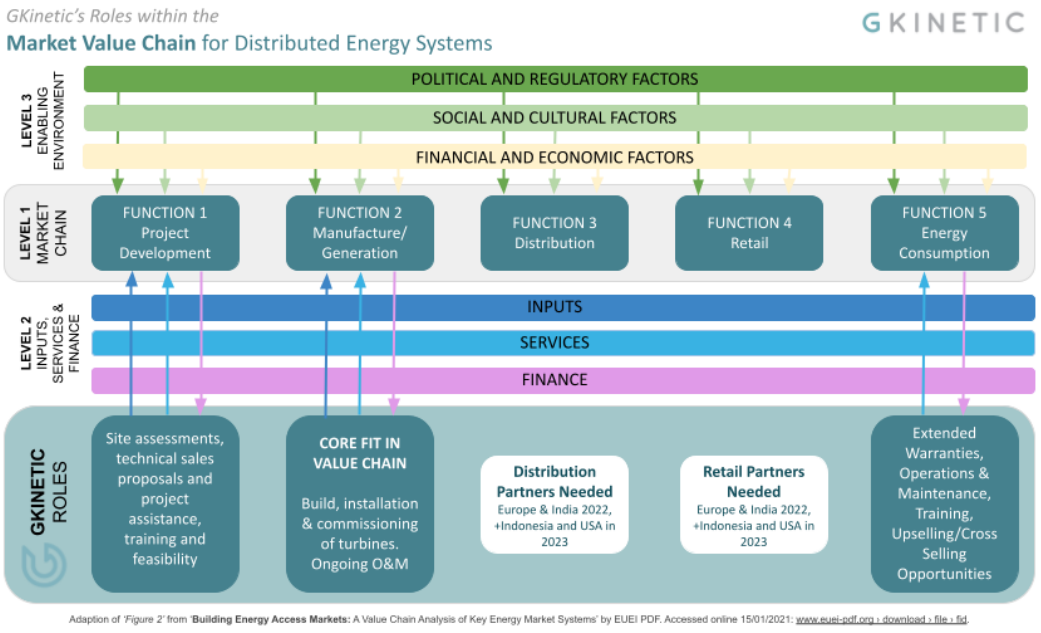

Figure 4.3: GKinetic's role within the market value chain for distributed energy systems

GKinetic have been asked by the NSAI (National Standards Authority of Ireland) to sit as an industry member on the AHG (Ad-Hoc Group) advising on the development of the draft IEC (International Electrotechnical Commission) 62600 - Marine Energy - Wave, Tidal and other water current converters - Part 300: Electricity producing river energy converters - Power

performance assessment. As this is a relatively new field in renewable energy production, a specific standard was required to give assurance in the certification of a rated power value. This involved advising on the development of the draft assessment methodology for this standard.

Mid-term exploitation vision

GKinetic will add the tidal turbine to its product portfolio and offer the turbine via its existing channels to energy companies and municipalities. GKinetic's core function in the value chain is the development of hydrokinetic energy converter technology for a broad range of applications. The manufacture, installation, commissioning and maintenance of these turbines will be licenced to partners in different regions worldwide with specialised parts and electronics supplied by GKinetic. This allows for a much quicker roll out of technology worldwide which can in turn have a greater impact on displacing fossil fuels. It is hoped this model will benefit customers in the developing world as the non-technical aspects of the device can be manufactured in the country of use, thereby creating employment and lowering the sale price of the devices and making them more accessible for developing community energy schemes.Other services offered by GKinetic include site assessments and feasibility reports. In November 2022 GKinetic announced the opening of a €2 million funding round focused on ramping up Commercialization activities, building out the sales pipeline to 2025 and execution of a hiring and expansion plan.

In reality GKinetic are "In advanced discussion with a distribution partner in Southern Africa, have distribution arrangements already in place for Europe, North Africa and the Middle-east with the EU branch of a well established Japanese pump manufacturing company and in discussions with their US branch for US distribution. A visit by the Japanese managing director to view and examine the device in operation while tow testing on the Shannon estuary was instrumental to the development of our relationship. GKinetic plans to use the future installation in Limerick as a sales showcase for the technology to close key commercial deals. The progress made thanks to the CityxChange project has accelerated the commercial readiness of the product and GKinetic have sales targets of 18 units for 2023 (€960,000 in revenues), 120 units in 2024 (€6.75m in revenues) and 720 units in 2025 (€56.9m in revenues). Enquiries have also been made from South and South-East Asia and discussions are ongoing".

4.8 Monitoring and Evaluation Reporting Tool

ER type	Product	**ER manager**	FAC
TRL before +CxC	6	**TRL after +CxC**	8 or 9
Related WP	WP7	**Related DPs**	DP01

Short description:

The MERT[7] was developed to store, manage, process, display and share project monitoring data. To enable these functions, the MERT was developed as an interactive web-based dashboard to analyse and represent the data. The MERT was developed to be part of the ICT Ecosystem of the project and provide an online solution for capturing and managing quantitative and qualitative data and information according to the Key Performance Indicator (KPI) Framework. The MERT was developed using a flexible NoSQL database structure to allow for future integration and necessary alterations to the functionalities of the MERT to ensure that it can provide the necessary and accurate data modelling, display and sharing required for each KPI.

- **Capture**
  The KPI owners generate the data based on the demo project(s) implemented within their LHC. Once the data has been generated from the demo projects by the KPI Owner, it is then reviewed and aggregated at source (by the KPI owner). The data reported to the MERT is based on the frequency as set out in D7.1. Due to the varied nature of the KPI data there is a variability in how frequently the data can be processed and reported to the MERT and SRT. The ways in which the KPI Owners can report data is detailed in Section 3.2
- **Manage**
  Partners can submit the data to the MERT via a login which has been provided by KPMG FA. Partners have the ability to submit data based on the reporting frequency (monthly, bi-annual, annual) of the KPI. The MERT also provides an option to record any additional comments/notes that the partners wish to submit against the data for a specific reporting month. The submitted data is stored in the database for processing in the next step.
- **Process**
  The stored data undergoes the calculation steps as defined per KPI. The calculations are performed when new data is submitted to the MERT. The calculated values are then stored in the database to be displayed on the KPI dashboard.
- **Display**
  The MERT was developed to have a dashboard-style look and was split into 3 stages: i) Landing ii) KPI Highlights and iii) KPI info. The submitted data and calculated fields are displayed on the KPI information page with additional graphics. Viewers of this page have the option to filter the graph data based on the City and Date range.
- **Share**
  The end user has the capability to download the content from the KPI display page on the MERT into a formatted PDF file.

[7] https://cityxchange.eu/fac-tool/

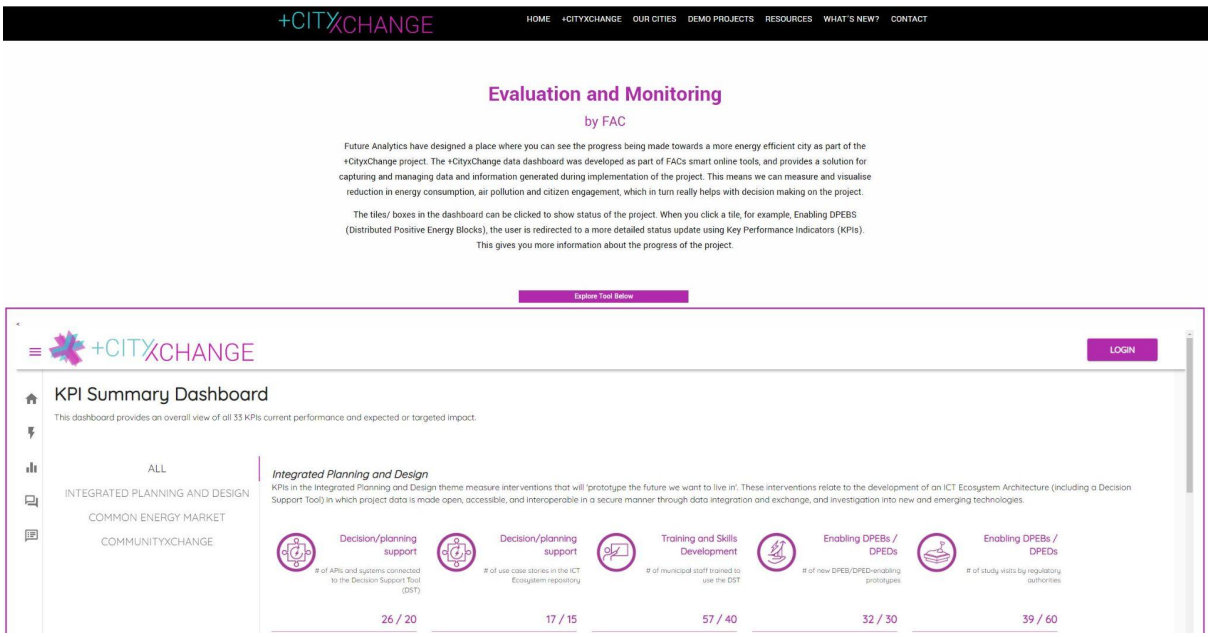

Figure 4.4 - Screenshot Monitoring and Evaluation Reporting Tool

Demonstration in +CityxChange:
The MERT (link to dashboard)

Related deliverables:
D7.2 - Reporting to the SCIS system
D7.3 - Data Collation, Management and Analysis Methodology Framework
D7.4 - Monitoring and Evaluation Framework
D7.5 - Data Collection and Management Guideline Report
D7.6 - Reporting to the SCIS System (2)
D7.7 - Reporting to the SCIS System (3)
D7.8 - Data Collection and ManagementGuideline Report
D7.9 - Reporting to the SCIS System (4)
D7.12 - Reporting to the SCIS System (6)
D7.13 - Reporting to the SCIS System (7)

IPR protection plan:
KPMG FA has created the dashboard and owns 100% of it; The KPI data ownership remains with the KPI data providers. The MERT software is protected by copyright. No further IP protection measures are currently foreseen for the MERT.

Commercial Exploitation Vision/Plan
T8.3 identified the role, needs and challenges of different stakeholders such as:

I. City planners;
II. Building owner/managers;

III. Energy managers;
IV. Investors (e.g., ESCo);
V. Designers;
VI. Policymakers;
VII. Citizens and Communities
VIII. Grid operators.

These eight groups will be the target groups for commercial exploitation of the Monitoring and Evaluation Report Tool (MERT) developed with Work Package 7 of this project. In addition, academic universities and institutions can be considered as another target group.

The following table sets out these target groups and the associated exploitation plan.

Table 4-1: MERT Target Groups & Exploitation Plan

Target Group	Exploitation Plan
City/Urban Planners	Offer the tool as a comprehensive solution to assist city/urban planners make informed decisions and plan for energy-efficient infrastructure development.
Building Owners/Managers	Highlight the benefits of using the tool for energy monitoring and management examples, such as, identifying inefficiencies, reducing energy consumption, and lowering costs. Partner with industry associations and offer them bulk discounts for their members.
Energy Managers	Promote the tool as a one-stop-shop for identification of energy management and monitoring methods and approaches.
Investors	Highlight the tool's ability to track the progress and impact of energy-efficient projects and provide them with accurate reporting and reflection of data within the +CxC Project. Partner with investment firms and offer them the tool as part of their investment packages.

Architects/Urban Designers	Promote the tool as a valuable resource for identifying policies and challenges for the creation of energy-efficient buildings and infrastructure. Partner with design firms and offer them access to the tool as part of their services.
Policymakers	Showcase the tool's ability to monitor and evaluate the impact of energy policies and initiatives. Conduct targeted marketing campaigns to reach out to policymakers and demonstrate the tool's benefits.
Citizens and Communities	Educate citizens and communities on how the financial and economic payback of smart city projects can benefit them. Offer the tool as a community engagement and awareness-raising tool, and partner with local governments to make the tool accessible to their citizens.
Electricity Grid Operators	Offer the tool as a resource on how to monitor and manage energy supply and demand and the potential challenges involved. Partner with utility companies and offer them access to the tool as part of their services.
Academic Universities/Institutions	Promote the tool as a valuable resource for research and education in the field of smart energy cities. Partner with academic institutions and offer them access to the tool as part of their academic programs.

Different organisations have varying needs when it comes to monitoring and evaluation, which is why KPMG will offer a three-tier subscription plan. The basic plan is designed for those who require essential features and functionalities, while the standard plan provides additional capabilities for more complex projects. Additionally, KPMG will offer a one-time subscription option for those who have a specific project or need and do not require ongoing access. With this tool, you can streamline your monitoring and evaluation processes and gain valuable insights into your project's progress and impact.

Plans for Subscription to the MERT:

- **Basic Plan:** This plan would include basic features such as data visualisation. The Basic Plan would be targeted towards small businesses, start-ups, citizens and communities who are looking to reference the MERT and the data visuals for their

own businesses or journal articles/research. The pricing for the Basic Plan would be affordable and accessible.

- **Standard Plan**: This plan would include more advanced features such as reporting and charts, data breakdown per partner etc. The Standard Plan would be targeted towards mid-sized businesses, energy managers, grid operators, building owners, colleges/research institutions and local governments who are looking for more comprehensive energy management and monitoring solutions.
- **One Time Purchase:** In addition to these subscription plans, the tool could also offer one-time purchase options for customers who require a single, comprehensive report or chart reflecting KPIs pre and post +CxC intervention. The pricing for these one-time purchases would be based on the specific scope and complexity of the report.

To cater towards the various needs and resources of the various target groups listed above, WP7 will provide a variety of subscription plans to the MERT. The pricing of the three subscription plans will be discussed in further detail with the +CxC consortium and agreed upon before the projects end.

In regards to the lifespan of the MERT after +CxC has ended, this will require engagement with the relevant +CxC partners to discuss the viability and timeline of maintaining the MERT after the end of the project.

4.9 Energy Community Utility Franchise Model

ER type	Knowledge & IP	**ER manager**	MPower
TRL before +CxC	NA	**TRL after +CxC**	NA
Related WP	WP2, WP4	**Related DPs**	DP10, DP11

Short description:
Energy Community Utility Franchise Model is a business model for companies who are operating the Community Grid. Since it is a critical operation, which needs appropriate licence from the national energy system regulator, the management and operation must be unified based on the validated system concept of Community Grid. Franchising gives the necessary high standardisation of the operation and services.

Innovation:
The innovation is in the possibility to franchise the energy service where each part of the process is optimised, standardised, and validated so that the quality of the service meets the regulator's requirements.

Demonstration in +CityxChange:
City of Limerick

Related deliverable:
D2.6 - Framework for Community Grid Implementation
D4.14 - Energy Profile of Community Grid and EV Users (forthcoming)
D4.15 - Limerick Energy Investment Models White Paper (forthcoming)

IPR protection plan:
MPower is the single owner of the IP and will protect the IP by trademark.

Short-term exploitation vision:
The business model is currently under development. MPower plans to implement the Energy Community Utility Franchise model using it for the exploitation of commercial services. Target customers are energy retailers who will receive a standardised system with all what is needed to connect and manage local Community Grid. The Positive City Exchange Project identified that the Energy Community Utility Franchise Model and the Citizen Energy Community model is the essential structure, permissible under the EU Directives, to house the Energy Community Utility Franchise Model. The latest report by the Commission for Regulated Utilities (CRU) Ireland was published in November 2021 and actively supports this structural approach for the common good. However, the Framework for Citizen Energy Communities has not been completed, and made legal, in Ireland as of this point in time. It remains underway but under-resourced at Public service level due to the extraordinary pressures created by the Energy Emergency in Ireland.

Mid-term exploitation vision
Key to the Energy Community Utility Franchise Model, as per the findings of +Cityxchange, is the appropriate enactment of the regulatory structures appropriate to the enablement of Citizen Energy Communities as set out in EU Directives.

Efforts are on-going in Croatia and other work is on-going in the Energy Community Utility Franchise for Community Grid quality assurance, management and safety SOPs (Standard Operating Procedures). There are three possible ways of enabling the Clean Energy Package Directive facilitation of the collective Self-consumption Energy Communities which require the ability to trade energy in the and on the Electricity System Distribution System Network:

1. The development of a large scale Amalgamation structure for energy communities to ensure that Self-consuming energy Communities do not create disturbances to other non-participating Electricity System Distribution Network Users and the Distribution System Operator.

2. The development of a Utility specifically to enable small independent energy communities have the control, management, quality assurance, accountability and safety systems of a much larger entity - fit for purpose - Disturbance Neutral to the Distribution Network.
3. To allow Peer-To-Peer Trading by local communities on the basis of the rights conveyed under the Clean Energy Package as transposed by each member State.

The work on Positive City Exchange has been very strong in ruling out both 1 and 3 as safe and democratic/people-friendly options. MPOWER continues with the development of the Energy Community Utility Franchise Model in Dublin City, the Aran Islands, County Kilkenny, Croatia, Buffalo City (USA) and Limerick City. Early work continues in Germany, Austria and Romania.

4.10 IOTA-enabled P2P energy marketplace / modules

ER type	Product	**ER manager**	IOTA
TRL before +CxC	3	**TRL after +CxC**	5
Related WP	WP2	**Related DPs**	DP09, DP10

Short description:
An IOTA-enabled P2P energy marketplace platform and IoT asset modules can provide a decentralised energy marketplace for enhanced trust, auditability, interoperability and more adaptability to participants needs and preferences. The solution also provides the technological feasibility for near-real time M2M payment to allow future smart meters/devices to act as autonomous economic agents and settle transactions peer to peer without intermediaries. In the longer run, the platform can be expanded to serve open peer to peer energy trading.

Innovation:
The result is innovative as it holds the potential to fully decentralise energy markets and would allow the entrance of community owned renewable energy sources. It could not only decentralise trading settlement but also payments through the use of cryptocurrencies.

Demonstration in +CityxChange:
City of Trondheim

Related deliverable:
D2.7 - Local DPEB trading market demonstration tool

IPR protection plan:

The IOTA Foundation is the owner of the IP. The core protocol layer will continue to be freely available as open-source software, primarily under the Apache 2.0 license, which gives users the right to freely use the software and to build their own developments on top of it for both commercial or non-commercial purposes.

Short-term exploitation vision:

The target market is the P2P local energy systems. IOTA explores plans to include the platform and modules to their product portfolio and potential channel partners operating in similar traditional markets. Current market regulations on cryptocurrencies and payments for energy are considered a barrier for the widespread deployment of the P2P energy marketplace but IOTA is preparing to be ready for P2P trading once these barriers have been lifted.

IOTA Foundation leadership has decided to reclaim its role as a pure research and engineering organisation. This means, while the IOTA Foundation might build core components to streamline and enable decentralised products, it will most probably not build, operate or offer those products itself. E.g. the IOTA Foundation provides the IOTA Smart Contract protocol and another party builds an energy marketplace on top of it. In regards to developments, which foster a monetized product, there might be licence or further agreements between the IOTA Foundation and its spin-offs.

Due to further development and evolution of the core protocol(s) some layer 2 components are not up to date anymore (e.g. IOTA Integration Services), meaning their migration might increase the development efforts one would have to put into them, before they can be exploited commercially.

Mid-term exploitation vision

It is expected that in the mid-term regulation will be more favourable for decentralised energy trading and will support the use of cryptocurrency.

4.11 IOTA Data integrity and trade verification service

ER type	Service	**ER manager**	IOTA
TRL before +CxC	5	**TRL after +CxC**	7
Related WP	WP5	**Related DPs**	DP09, DP10

Short description:

The Data Integrity service provides a way to prove the integrity and immutability of information previously stored centrally in various stakeholders systems, by using the IOTA Tangle through a set of provided APIs. Additionally the service provides the ability to verify integrity of specific types of transactions, such as energy trading ones. This component is utilised by the +CxC energy trading platform developed together with POWEL, ABB and Tronder Energi.

Heterogeneous cyber physical ecosystems such as smart grids and peer to peer energy marketplaces are subject to cybersecurity threats and risk of data tampering as the data is shared across silos. The service leverages a new Distributed Ledger Technology called the IOTA Tangle as a transparency, immutability and trust layer to enable data integrity and trade verification.

Innovation:

A shared and single source of truth without a centralised controlling entity. There are currently no known alternative solutions which are based on green and sustainable distributed ledger technology like IOTA. Energy Web Foundation is trying something similar but forcing market operators into one consortium and using less scalable and green technologies.

Demonstration in +CityxChange:

City of Trondheim

Related deliverable:

D5.5 - Energy Trading Market Demonstration

IPR protection plan:

The IOTA Foundation is the owner of the IP. The core protocol layer will continue to be freely available as open-source software, primarily under the Apache 2.0 license, which gives users the right to freely use the software and to build their own developments on top of it for both commercial or non-commercial purposes.

Short-term exploitation vision:
The target market is the one of peer to peer energy trading. IOTA Foundation will offer the core technology feature to be used as a service to market operators. IOTA Foundation leadership has decided to reclaim its role as a pure research and engineering organisation. This means, while the IOTA Foundation might build core components to streamline and enable decentralised products, it will most probably not build, operate or offer those products itself. Discussion with potential integrators from the CxC consortium (ABB, Powel/Volue, TronderEnergi) are ongoing. It will take 3-6 months to integrate standards. Due to further development and evolution of the core protocol(s) some layer 2 components are not up to date anymore (e.g. IOTA Integration Services), meaning their migration might increase the development efforts one would have to put into them, before they can be exploited commercially.

Mid-term exploitation vision
It is expected that the market will be ready in 2 years.

4.12 Device wallet

ER type	Product	**ER manager**	IOTA
TRL before +CxC	5	**TRL after +CxC**	7
Related WP	WP2	**Related DPs**	DP07, DP10

Short description:
An identity wallet based on the IOTA Identity framework could use decentralised identities on the IOTA ledger and verifiable credentials in order to allow trusted authentication of Smart Link Units (SLUs) and Energy Meters in P2P energy markets.
A digital device wallet could be a UI framework utilising Self-sovereign identities, Audit Trails, and general Distributed ledger technology, created to allow seamless generation of the identities for devices, access to a devices' data, and monetization (tokenization) features.
The current development has enough level of maturity to be used in implementation, apart from the payment features which are still under development.
SLUs and Energy Meters connected to renewable energy sources (i.e. PV panels) can not be cloned and replaced thus making untrustworthy information on flexibility energy shared on P2P local energy marketplaces. Also authenticating these devices can be cumbersome and lock in their owner to only one marketplace operator.

Innovation:
The device wallet is innovative as it brings together key concepts required to have a secure data and value exchange. The technology will provide data transparency and peer-to-peer

transactions able to open new business models for autonomous processes between devices, secured with decentralised identities, and data anchored in the Distributed Ledger Technology. No alternative solutions have been found. Other solutions are centralised, require centralised Identity management systems and create vendor and service provider lock in.

Demonstration in +CityxChange:
City of Trondheim

Related deliverables:
D2.6 - Framework for Community Grid Implementation

IPR protection plan:
The IOTA Foundation is the owner of the IP. The core protocol layer will continue to be freely available as open-source software, primarily under the Apache 2.0 license, which gives users the right to freely use the software and to build their own developments on top of it for both commercial or non-commercial purposes.

Short-term exploitation vision:
The initial plan is that the IOTA Integration Services will be picked up by an IOTA Foundation spin-off (Spyce5), which focuses on operating infrastructure and services on top of it. The target market is the market of local energy systems. Due to further development and evolution of the core protocol(s) some layer 2 components are not up to date anymore (e.g. IOTA Integration Services), meaning their migration might increase the development efforts one would have to put into them, before they can be exploited commercially.

Mid-term exploitation vision
Exploitation of the device wallet could benefit from further standardisation activities, especially further development of the work of the W3C DID Working Group for decentralised identities in the Internet of Things.

4.13 Local Energy Market

ER type	Product	**ER manager**	TE
TRL before +CxC	4	**TRL after +CxC**	7
Related WP	WP5	**Related DPs**	DP09, DP10

Short description:

This result encompasses the software solution serving the local energy market as demonstrated in Lighthouse City Trondheim. A local energy market in the +CityxChange context, is a smaller area where sales of local production/capacity and user flexibility (kWh/kW) between local actors, and sales of system services to the DSO is optimised. It is connected to the larger power system, and can also be seen as a submarket in the global market.

The software for market access and trade is developed by Volue (former Powel) and specially customised and innovated to serve the +CityxChange project. The following building blocks are integrated and included in the solution deployed:

- ABB: OPTIMAX® for asset operation.
- Volue: Digital Marketplace for market operation.
- IOTA: for secure third party data verification to ensure consistency between executed trades and the following settlement.

TE acts as the Local Market Operator.

Innovation:

Local sales of energy between prosumers, consumers and the grid.

Demonstration in +CityxChange:

City of Trondheim, (public dashboard with live energy trades available[8])

Related deliverables:

D2.7 - Local DPEB trading market demonstration tool
D5.5 - Energy Trading Market Demonstration
D5.11 - Trondheim dPEB Demonstration
D5.16 - +Trondheim Sustainable Investments and Business Models and Concepts
+CxC_D 5_16_Financial Risk Sharing Model_PEB_Trondheim_2 (XLS sheet)

IPR protection plan:

IP ownership remains with the developer of the IP. No IPR arrangements have been made yet. Discussion between TE and the technology providers for the continuation of the use of their IP are ongoing.

Short-term exploitation vision:

Two local energy markets are operational in the City of Trondheim as part of the deployed dPEBs. Analysis shows that the PEB demo-case in Trondheim is financially profitable but

8 https://ai-cxc-grafana.azurewebsites.net/public-dashboards/17d14f55e73449489e7411fb698894b9?orgId=1&refresh=10s

upscaling or replication is costly and has a long payback period. Also the avoidance of paying double or triple grid tax needs to be resolved with the regulator before the local energy market can be replicated on a commercial basis.

Mid-term exploitation vision

Technology providers Volue, ABB and IOTA, and local market operator TE are developing commercialisation plans to explore the viability of further roll-out of the local energy market concept in a commercial setting after project end.

4.14 PED Grid Design toolbox

ER type	Product	**ER manager**	Powel
TRL before +CxC	4	**TRL after +CxC**	7
Related WP	WP2	**Related DPs**	DP07

Short description:

The toolbox consists 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 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 settlement and invoice. 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.

Innovation:

Different software models, for PED grid design.

Demonstration in +CityxChange:

City of Trondheim
City of Limerick
City of Sestao

Related deliverables:

D2.2 - Toolbox for design of PEB including e-mobility and distributed energy resources
D8.3 - Report of replication assessment and profiles for each CityxChange demonstration project (forthcoming)

IPR protection plan:

IES, Powel and Mpower contributed with three different tools. The IP remains with the original developers of the tools.

Short-term exploitation vision:

MPower: MPower replicated the Community Grid experience to the Aran Islands Energy Community – Ireland through the SECURE (eStablishing Energy Community Utilities for Remote Energy grids) SEAI project, making use of the tools in the PED Grid Design toolbox.
POW/Volue: The Volue Design Tool is developed further into the fully commercial product Grid Calculator[9].

Mid-term exploitation vision

Further commercialisation and new features are not decided or discussed.

[9] https://www.volue.com/power-grid

5 Non-commercially Exploitable Results +CityxChange

This chapter presents a more detailed overview of the non-commercially exploitable results of the +CityxChange project as listed in Chapter 3. Many of these are process innovations and supporting frameworks towards PEB development. The results are presented in no particular order. For each result, the type of result, owner, exploitation vision, IP ownership, protection measures, and their relation to project deliverables, project solutions and DPs, is presented.

5.1 Heat pump exchange system design

ER type	Product	**ER manager**	NTNU
TRL before +CxC	1	**TRL after +CxC**	4
Related WP	WP5	**Related DPs**	DP07

Short description:
NTNU supported the project partners in the Sluppen demo with designs for heat pumps in the specific circumstances. In addition, the work was further explored in a Master Thesis at NTNU which had the objective to evaluate possible heat recovery heat pump configurations for waste heat recovery at Sluppenveien 10, a part of developing PEB at Sluppen-Tempe in Trondheim. Both heat recovery to the district heating grid and for hot water production are considered.
High temperature heat pumps (HTHPs) capable of heat sink temperatures >100°C exist, few are commercially available and even fewer capable of waste heat recovery below 30°C. The main obstacles to development in HTHP technology are limitations in compressor suction and discharge temperatures, high initial costs and few installations tested in real life conditions. It would therefore be beneficial to have large scale pilot installations documenting the profitability and reliability under real life conditions.

Innovation:
The simulations show the feasibility of an operational heat pump cycle with a heat source of 35-50 °C (surplus heat expected from a distribution centre and a hydrogen production / fueling station) and a heat sink of 90-120°C, using only natural working fluids with no greenhouse warming potential such as CO2 and hydrocarbons.

Demonstration in +CityxChange:
None.

Related deliverable:
D5.3: Campus Microgrid Model Prototype

IPR protection plan:
The IP is owned by NTNU and is copyright protected.

Exploitation vision:
Results have been published in two publications:

1. Development of local energy recovery and distribution, by Susanne Vestgren. Master Thesis EPT – NTNU, June 2020.[10] (61 views on 22-2-2023)
2. Evaluation of possible heat pump configurations for waste heat recovery at +CityXChange Sluppen, by Erlend Nytrø Balstad. Master Thesis EPT-NTNU, June 2020[11]. (71 views on 22-2-2023)

There are currently no plans for implementation of the researched configurations, as the local PEB and asset structure was adapted and a heat source became unavailable.

5.2 +CityxChange PED Development Methodology

ER type	Process	**ER manager**	NTNU
TRL before +CxC	NA	**TRL after +CxC**	NA
Related WP	WP1-3, 4-6, 9, 11	**Related DPs**	All

Short description:
The +CxC PED development methodology is a bundling of applied processes and frameworks, lessons learned, and recommendations obtained throughout the project, specifically focussed on the various processes affected by or shaping a PED project. The result includes learnings from all LHCs, FCs, and partners and shows the importance of adapting existing processes or establishing new processes to smoothen the implementation of PED projects.

Innovation:
The +CityxChange project demonstrated the importance of process innovation for the successful implementation of a PED project. Examples of new or significantly improved

[10] https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/2779592
[11] https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/2779610

processes are overall project structure and setup, strategy alignment, citizen engagement processes, industry and stakeholder partnerships, or procurement processes.

Demonstration in +CityxChange:
City of Trondheim
City of Limerick
City of Pisek
City of Voru
City of Alba Lulia
City of Smolyan
City of Sestao

Related deliverables and publications:
All key deliverables of the project by the respective partners.

Co-Creation of Positive Energy Blocks. Dirk Ahlers, Patrick Driscoll, Håvard Wibe, Annemie Wyckmans. NordicZEB+, 1st Nordic conference on Zero Emission and Plus Energy Buildings. IOP Conference Series: Earth and Environmental Science. 2019. https://doi.org/10.1088/1755-1315/352/1/012060

The Sense and Non-Sense of PEDs — Feeding Back Practical Experiences of Positive Energy District Demonstrators into the European PED Framework Definition Development Process. Han Vandevyvere, Dirk Ahlers, Annemie Wyckmans. Energies, 2022, 15(12), 4491. Special Issue "Advanced Energy Systems in Zero/Positive Energy Buildings, Communities and Districts". https://doi.org/10.3390/en15124491

IPR protection plan:
The IP of the cookbook will be owned by NTNU and ISOCARP and protected by copyright. The underlying IP belongs to the partner who developed the IP.

Exploitation vision:
Plan is to make the lessons learned available to public organisations and other stakeholders via the "How to PEB" cookbook, which will be delivered at the end of the project. This and other key documentation is made available under an open Creative Commons licence.

5.3 Bold City Vision framework

ER type	Process	ER manager	TK
TRL before +CxC	NA	TRL after +CxC	NA
Related WP	WP3	Related DPs	DP02

Short description:

The +CityxChange Bold City Vision (BCV) Framework, Guidelines and Incentive Schemes helps cities identify and address key opportunities and actions on their way towards becoming smarter and more sustainable. The framework incorporates the process of creating a city vision and goals that situate the actions aimed at creating Positive Energy Cities firmly within the cities' overarching planning and management process. The focus on smart energy needs to be aligned with a broader concern with sustainable development, covering social, financial, technical, and urban aspects, and linking to the overall European Strategies for 2050 as well as the United Nations Sustainable Development Goals (SDGs).

	Engage	Design	Activate	Accelerate	Support
Standardisation	Evaluation	Visualisation	Simulation	Funding	Sharing
Policy development	Review	Revision	Planning	Budgeting	Analysis
Innovation partnerships	Appointment	Linking	Collaborating	Prioritising	Portfolio management
Organisational development	Idenification	Leadership	Intrapreneurship	Self organisation	Twinning
Citizen engagement	Acknowledgement	Deliberation	Localisation	Connection	Amplification
Project development	Pitching	Prototyping	Delivering	Capitalising	Storytelling

BOLD CITY VISION FRAMEWORK FOR 2050

Figure 5.1 The +CityxChange Bold City Vision Framework

Innovation:
The +CxC Bold City Vision approach merges technical, social, spatial, economic, innovation and other perspectives, supporting cities in their quest to achieve the United Nations Sustainable Development Goals and contribute to a climate-neutral Europe by 2050.

Demonstration in +CityxChange:
City of Trondheim
City of Limerick
City of Pisek
City of Voru
City of Alba Lulia
City of Smolyan
City of Sestao

Related deliverables:
D3.1 - Framework for Bold City Vision, Guidelines, and Incentive Schemes (SDG City Transition Framework)
D4.7: Limerick 2050 Vision, Integrated Action Plan and Digital Guide
D5.7: +Trondheim 2050 Bold City Vision and Guidelines (Vision for Sustainable Urban Transition)
D6.2 - Bold City Vision 2050 for each FC

IPR protection plan:
TK is the owner of the IP. The framework has been made available under the CC-BY4.0 Creative Commons Attribution licence.

Exploitation vision:
The framework has been made available to public organisations and other stakeholders through the project website on a free to use basis. The Fellow Cities have replicated the Bold City Vision. Asker Municipality, located southwest of Oslo, Norway's capital, has used the BCV framework in their municipal planning. In addition to being implemented in the +CxC cities, the framework has been adopted by the Norwegian Association of Local and Regional Authorities for testing in multiple Norwegian municipalities, and is being introduced to the global United for Smart Sustainable Cities network.

5.4 Service Based ICT Eco-System and Enterprise Architecture

ER type	Knowledge & IP	**ER manager**	NTNU
TRL before +CxC	NA	**TRL after +CxC**	NA
Related WP	WP1	**Related DPs**	DP1 - DP11

Short description:

The Enterprise Architecture Framework is a structured way to model and describe the ICT components, data and other relevant entities to create value added services for cities and their citizens. The Enterprise Architecture Framework is designed to capture the context of the ICT ecosystem such as the needs of citizens, the value-added services and the collaborating organisations. It also provides a structured way to model the data and their sources. Furthermore, it takes into account the stakeholder and data perspectives to support data governance. Several "scenarios" or models describing the ICT ecosystem for PEB solutions are available. The context of the ICT ecosystem also captures the DPs of the project.

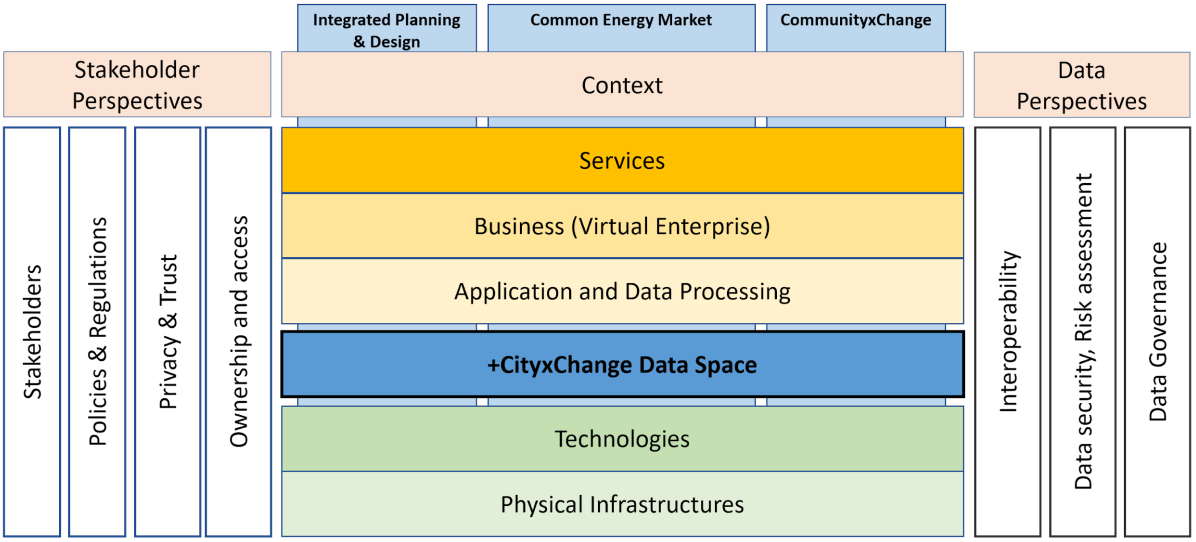

Figure 5.2 Proposed layered EA for the +CityxChange project

Innovation:

The main ideas of the +CityxChange Enterprise Architecture Framework (+CxC EAF) is inspired by Enterprise Architecture approaches and anchors around a data space called the +CityxChange Data Space and value added services provided through collaborations among several partners. The approach is to provide a consistent architecture with clear separation of concerns and a strong integration and interoperability support, following requirements of the cities.

Demonstration in +CityxChange:

City of Trondheim
City of Limerick

Related deliverables and publications:

D1.2 - Report on the Architecture of the ICT Ecosystem

Bokolo, Anthony Junior; Petersen, Sobah Abbas. A Practice Based Exploration on Electric Mobility as a Service in Smart Cities. Lecture Notes in Business Information Processing 2020; Volum 381. s. 3-17
https://link.springer.com/chapter/10.1007/978-3-030-44322-1_1

Petersen, Sobah Abbas; Evjen, Tor Åsmund. Enterprise Architecture to Identify the Benefits of Enterprise Building Information Model Data: An Example from Healthcare Operations. I: ICEIS 2022 - 24th International Conference on Enterprise Information Systems. SciTePress 2022 ISBN 978-989-758-569-2. s. 567-576
https://www.scitepress.org/PublicationsDetail.aspx?ID=6qw1028NND0=&t=1

Bokolo, Anthony Junior; Petersen, Sobah Abbas; Torkelsen, Eldar Hauge. Investigating the Impact of Enterprise Architecture Adoption in Smart Cities. I: CENTERIS / ProjMAN / HCist 2021 Book of industry papers, poster papers and abstracts. SciKA 2021 ISBN 978-989-54617-2-1. s. 83-95.
https://www.scika.org/centeris/2021/CONTENTS/downloads/boa2021.pdf

Sobah Abbas Petersen, Zohreh Pourzolfaghar, Iyas Alloush, Dirk Ahlers, John Krogstie, Markus Helfert. Value-Added Services, Virtual Enterprises and Data Spaces inspired Enterprise Architecture for Smart Cities. PRO-VE 2019 (20th IFIP WG 5.5 Working Conference on Virtual Enterprises), IFIPAICT, vol. 568.
https://link.springer.com/chapter/10.1007/978-3-030-28464-0_34

Dirk Ahlers, Leendert Wienhofen, Sobah Abbas Petersen, Mohsen Anvaari. A Smart City Ecosystem enabling Open Innovation. 19th International Conference on Innovations for Community Services (I4CS 2019).
https://link.springer.com/chapter/10.1007/978-3-030-22482-0_9

IPR protection plan:

IP is owned by NTNU and partly UL (Lero) and is protected by copyright. The documentation and related scientific publications are openly available under open licences.

Exploitation vision:

The resulting framework has been made public through the project website and is being used in further work within the +CityxChange project. In addition, the +CxC EAF is included in the curriculum for the Masters course Enterprise Architecture for Enterprise Innovation at NTNU and is actively used by masters students in related topics.

5.5 Regulatory mechanisms for delivering DPEBs

ER type	Knowledge & IP	**ER manager**	TK
TRL before +CxC	NA	**TRL after +CxC**	NA
Related WP	WP2	**Related DPs**	DP04

Short description:
This result shows how EU legislations and national regulations influence the process of establishing positive energy blocks (PEBs), positive energy districts (PEDs) and community grid systems (CGSs) - and how they could be processed and operated within the framework of a local energy market. Some of the main findings are:

- There are little or no existing regulations at national levels that are promoting processes towards establishment and operation of PEBs.
- Current regulations are made mainly for power market operation.
- Digitalisation of energy operation issues happens fast and gives incentives for new products and services .
- The regulatory framework is experienced to develop slowly and actual changes to support the fast introduction of local renewables as market resources are not coordinated.
- In local energy systems , the grid operator must be given the freedom to establish tariffs and agreements based on local conditions.

Demonstration in +CityxChange:
City of Trondheim

Related deliverable:
D2.1 - Report on Enabling Regulatory Mechanism to Trial Innovation in Cities
D5.9 - Playbook of regulatory recommendations for enabling new energy systems

IPR protection plan:
IP is owned by TK and partners for the local process and protected by copyright.

Exploitation vision:
The results of the analysis have been published and shared with the relevant regulatory bodies.

5.6 Citizen Participatory Guidebook

ER type	Process	**ER manager**	COL
TRL before +CxC	NA	**TRL after +CxC**	NA
Related WP	WP3	**Related DPs**	DP03

Short description:
The +CityxChange Citizen Participation Guidebook supports local authorities in transforming citizen participation into local impact, which increases community engagement and builds citizen trust. The guidebook is not a mere catalogue of physical and online participatory tools, but a detailed roadmap of four distinctive citizen participatory processes to co-design PEBs and PED including phases, steps, stakeholders, outcomes and a catalogue of physical tools and a set of online tools.

The +CityxChange Citizen Participation Guidebook adopts a holistic approach of the citizen participatory process providing local authorities with a comprehensive roadmap. The guidebook helps local authorities to identify the desired outcome of the participatory process and supports local authorities selecting the most appropriate physical tools from the catalogue based on the defined steps of the selected participatory processes. The guidebook assists in pairing these physical actions with the most suitable online tools from the Participatory platform based on the existing online tools and resources available in the municipality.

Innovation:
The Citizen Participation Guidebook is built upon experiences on citizen participation shared by smart city projects, EU initiatives and other European organisations. The guidebook combines physical tools together with a set of online tools providing an integrated and synchronised approach to citizen participation capable of adapting to the notable diversity of cities in terms of culture and smart city readiness.

Demonstration in +CityxChange:
City of Limerick
City of Trondheim

Related deliverables:
D3.2 - Delivery of the citizen participation playbook
D4.8 - Limerick Citizen Observatory
D5.8 - +Trondheim Citizen Observatory

IPR protection plan:
IP is owned by COL and protected by copyright, IP for implementations is shared by the implementing partners. The guidebook has been made available under the CC-BY4.0 Creative Commons Attribution licence.

Exploitation vision:
The Citizen Participatory Guidebook has been implemented as part of the Citizen Observatories (CO) in Trondheim and the Citizen Innovation Lab in Limerick. In Trondheim, TK wishes to further develop and integrate the COs in the municipality. Both as a tool for becoming an Energy Positive City before 2050, but also as part of the organisational work in the municipality. For two of the five COs in Trondheim, funding for long-term exploitation has been secured, one CO will discontinue operation and funding is being sought for the remaining two COs. Funding for a permanent location for the Citizen Innovation Lab in Limerick has been secured by Limerick City and County Council.
COL plans to use the Citizen Participatory Playbook for educational purposes and for commercial exploitation via consultancy services.

5.7 Learning Framework

ER type	Knowledge & IP	**ER manager**	UL
TRL before +CxC	NA	**TRL after +CxC**	NA
Related WP	WP3	**Related DPs**	DP03

Short description:
The Framework for DPEB Learning and Education developed is a research-informed model comprising a set of principles, accompanied by an online portfolio of learning activities, including descriptions and links to original and existing content, adapted for different age groups, backgrounds and types of situations.

Innovation:
The key innovative approach is integrating youth learning programmes at different age levels with active ageing society programmes.

Demonstration in +CityxChange:
City of Trondheim
City of Limerick
City of Pisek
City of Voru
City of Alba Lulia

City of Smolyan
City of Sestao

Related deliverable:
Portfolio of learning activities (+CityxChange website)
D3.4 - Framework for DPEB Learning and Education
D4.10 - Limerick Innovation Lab Solutions Catalogue 2
D8.3 - Report of replication assessment and profiles for each CityxChange demonstration project (forthcoming)

IPR protection plan:
The IP is owned by UL and protected by copyright. Contributing partners own the IP for their own contributions or courses, usually under open licences.

Exploitation vision:
The Learning Framework has been made publicly available and formed the basis of citizen engagement activities in the Lighthouse and Follower Cities. In Smolyan and Alba Lulia, dedicated urban spaces were established giving these activities a more permanent character.

5.8 Positive Energy Champions Framework

ER type	Knowledge & IP	**ER manager**	UL
TRL before +CxC	NA	**TRL after +CxC**	NA
Related WP	WP3	**Related DPs**	DP03

Short description:
The Framework for a Positive Energy Champions Network contains guidance on how to initiate a Positive Energy Champion Network. A Positive Energy Champion Network will comprise a network of local influencers who can help translate the ideas, plans and innovations associated with +CityxChange implementation and the clean energy transition into local knowledge and actions.

Innovation:
The innovation is in the adaptation of existing citizen participation frameworks to the +CityxChange project and to the creation of DPEBs in order to champion individual citizens as co-innovators, who share knowledge and influence their networks and communities regarding the changes needed to become a positive energy city.

Demonstration in +CityxChange:
City of Limerick
City of Pisek
City of Voru
City of Alba Lulia
City of Smolyan
City of Sestao

Related deliverable:
D3.5 - Framework for a Positive Energy Champion Network
D4.10 - Limerick Innovation Lab Solutions Catalogue 2
D8.3 - Report of replication assessment and profiles for each CityxChange demonstration project (forthcoming)

IPR protection plan:
The IP is jointly owned by UL and SE and protected by copyright. Contributing partners own the IP for their own contributions or courses, usually under open licences.

Exploitation vision:
The Positive Energy Champions Framework has been made publicly available and has been replicated by the Follower Cities in varying formats.

5.9 Innovation Labs

ER type	Knowledge & IP	**ER manager**	UL
TRL before +CxC	NA	**TRL after +CxC**	NA
Related WP	WP3	**Related DPs**	DP03

Short description:
This result describes a framework for the implementation of DPEB Innovation Labs in +CityxChange LHCs and FCs and the enhancement of existing centres where they exist. A +CityxChange DPEB Innovation Lab is defined as a dedicated centre for digital innovation within a city focused on the creation and replication of DPEBs. It comprises a Programme, and virtual and physical locations, or network of locations, where the implementation of the +CityxChange Innovation Playground can become manifest. Located physically and conceptually within the +CityxChange Innovation Playground, key stakeholders and users of DPEB Innovation Labs include government, academia, business, and civil society representing the four actors of the quadruple helix model of innovation.

Innovation:
Innovation Labs comprises a Programme and virtual and physical locations available to stakeholders using the DPEB Innovation Lab – citizens, business, academia and government agencies – to support competition and innovation. It has a collaborative operating structure and supports an Open Innovation 2.0 ecosystem for entrepreneurs and start-ups.

Demonstration in +CityxChange:
City of Limerick
City of Pisek
City of Voru
City of Alba Lulia
City of Smolyan
City of Sestao

Related deliverable:
D3.6 - Framework for DPEB Innovation Labs
D4.3 - Limerick Innovation Lab Solutions Catalogue 1
D4.8 - Limerick Citizen Observatory
D4.10 - Limerick Innovation Lab Solutions Catalogue 2
D5.8 - +Trondheim Citizen Observatory
D8.3 - Report of replication assessment and profiles for each CityxChange demonstration project (forthcoming)

IPR protection plan:
The IP is jointly owned by UL and COL and protected by copyright, IP for implementations is shared by the implementing partners.

Exploitation vision:
This result has been implemented in Limerick, where it is called the Citizen Innovation Lab. One of the major replications was in Alba Iulia, where through the exchange on Limerick's citizen engagement initiative, the Innovation Centre of the city – Conventum – was established. UL and LCCC are exploring how the result might be evolving and replicated further.

5.10 Innovation Playground

ER type	Knowledge & IP	**ER manager**	SE
TRL before +CxC	NA	**TRL after +CxC**	NA
Related WP	WP3	**Related DPs**	DP05

Short description:
This result provides a spatial and socio-economic "Framework for Innovation Playgrounds", including an overview and practical guidance on putting an Innovation Playground in place. An Innovation Playground, as defined in +CityxChange, is a designated area of a city where different physical and virtual places and activities relating to innovation are brought together into a coherent whole to facilitate collaboration, empower citizens, and find new ways of addressing challenges that matter to people. The Framework is made up of three parts: a System, a Journey, and a Localised Innovation Playground.

Innovation:
The result is a new spatial and socio-economic Framework for Innovation Playgrounds related to the energy transition in cities.

Demonstration in +CityxChange:
City of Limerick
City of Pisek
City of Voru
City of Alba Lulia
City of Smolyan
City of Sestao

Related deliverable:
D3.3 - Framework for Innovation Playgrounds
D4.8 - Limerick Citizen Observatory
D4.10 - Limerick Innovation Lab Solutions Catalogue 2
D5.8 - +Trondheim Citizen Observatory
D5.10 - Trondheim Innovation Lab Solutions Catalogue
D8.3 - Report of replication assessment and profiles for each CityxChange demonstration project (forthcoming)

IPR protection plan:
The IP is owned by SE, protected by copyright, and made publicly available under the CC-BY4.0 Creative Commons Attribution licence. IP for implementations is shared by the implementing partners.

Exploitation vision:
The Innovation Playground for DPEBs has been made publicly available. All LHCs and FCs adopted the Innovation Playground, each city tailoring the framework to its local context.

5.11 PEB Policy Recommendations

ER type	Knowledge & IP	**ER manager**	LCCC
TRL before +CxC	NA	**TRL after +CxC**	NA
Related WP	WP4	**Related DPs**	DP04

Short description:
This result shows how EU legislations and national regulations influence the process of establishing positive energy blocks (PEBs), positive energy districts (PEDs) and community grid systems (CGSs) - and how they could be processed and operated within the framework of a local energy market. The +CxC project has advanced innovation in a number of key areas in the area of building retrofits for "heritage" & "traditional" buildings, including those buildings located within Architectural Conservation Areas (ACA) or listed as protected structures. The project has identified weaknesses in the regulatory framework in this area which were related back to the relevant regulatory body and other stakeholders who were interacting with the project. Similarly, the development of the tidal turbines has both led considerable regulatory innovation and exposed considerable weakness in the regulatory framework for such devices. The electricity sector, both at large utility scale and, in particular, at the smaller local level, has seen significant regulatory evolution over the project time frame with +CxC contributing to several consultation processes undertaken in this area.

Innovation:
Recommendations for new policies required to speed up the establishment of PEDs and other innovative distributed energy concepts.

Demonstration in +CityxChange:
City of Limerick

Related deliverable:
D2.1 - Report on Enabling Regulatory Mechanism to Trial Innovation in Cities
D4.9 - White Paper "Regulations Unlocking Innovation Potential

IPR protection plan:
IP is owned by LCCC and protected by copyright.

Exploitation actions:
LCCC has had multiple consultation meetings with the following Irish regulatory bodies:

- **Single Electricity Market Committee (SEMC)**: LCCC has responded to the SEM-20-028 Consultation paper Implementation of Regulation 2019/943 in relation to Dispatch and Redispatch, asking for no requirement for sub-groups. No decision has been made and SEMC requests for further workshops (Through CRU/TSOs).
- **Department of Communications, Climate Action and Environment (DCCAE)**: LCCC responded to the draft Terms and Conditions for Renewable Electricity Support Scheme (RESS) 1. A submission has been made requesting to reduce the minimum offer quantity for Community Led Projects, and to reduce the number of shareholders. As a result, the two changes requested were implemented in RESS 1.
- **Department of Environment, Climate, and Communications (DECC)**: LCCC responded to the Terms and Conditions for the Second Competition under the Renewable Electricity Support Scheme Consultation Document. Responded specifically on two questions - Hybrid makeup & comments on Community Project terms and conditions. In RESS 2 terms and conditions the hybrid makeup was unchanged from draft. Suggestions on Community questions (proximity/supports) have not yet been addressed. The issue of hybrid makeup may be commented on as part of RESS 3 (2023).
- **Commission for Regulation of Utilities (CRU):** LCCC responded to CRU's Consultation on Energy Communities and Active Consumers document. A submission made addressing most questions inc specific question on REC proximity rules. CRU position set out in doc 211126 Conclusion-on-EC,-AC. No decision has been made on REC proximity. The CSO option is also for further investigation.
- **Department of Housing, Local Government and Heritage (DHLGH):** LCCC responded to the consultation on Planning exemptions for Solar and identified an issue with the handling of Protected structures/ACAs where the size of free standing panels was too conservative As a result rules on Protected Structures changed as per submission, and industrial/commercial buildings free standing areas increased to 75m2.

5.12 Integrated investment models for PEBs

ER type	Knowledge & IP	**ER manager**	OV
TRL before +CxC	NA	**TRL after +CxC**	NA
Related WP	WP4, WP5	**Related DPs**	DP11

Short description:

The result demonstrates how novel business and investment models have contributed or not to the creation of concrete (in the case of Trondheim) and virtual (for Limerick) PEB/PED. Planned and implemented actions and activities have involved stakeholders in the

PEB ecosystem, supporting them in planning business and investments in local green energy projects. Innovative Tools for providing economic-financial analysis and assessment of foreseen investments in both LHCs have been designed, tested and implemented to be adapted and replicated in other cities.
Tools have been designed and tested to assess the financial and economic feasibility and profitability of investments for energy building renovations, for the Tidal Turbine, in Limerick. One of the most helpful and useful tools designed and developed to evaluate the financial and economic feasibility of PEB's interventions in Trondheim is the Financial Risk Sharing Model (FRSM) that supports procurement of equipment necessary to establish and operate a PEB. It provides concrete outputs and results for the calculation of reduced simple payback times and increased return on investment for a variety of green and renewable energy measures. FRSM also supports community development giving the picture of players, investments, revenues, risks and how they can be shared to optimise business scenarios.

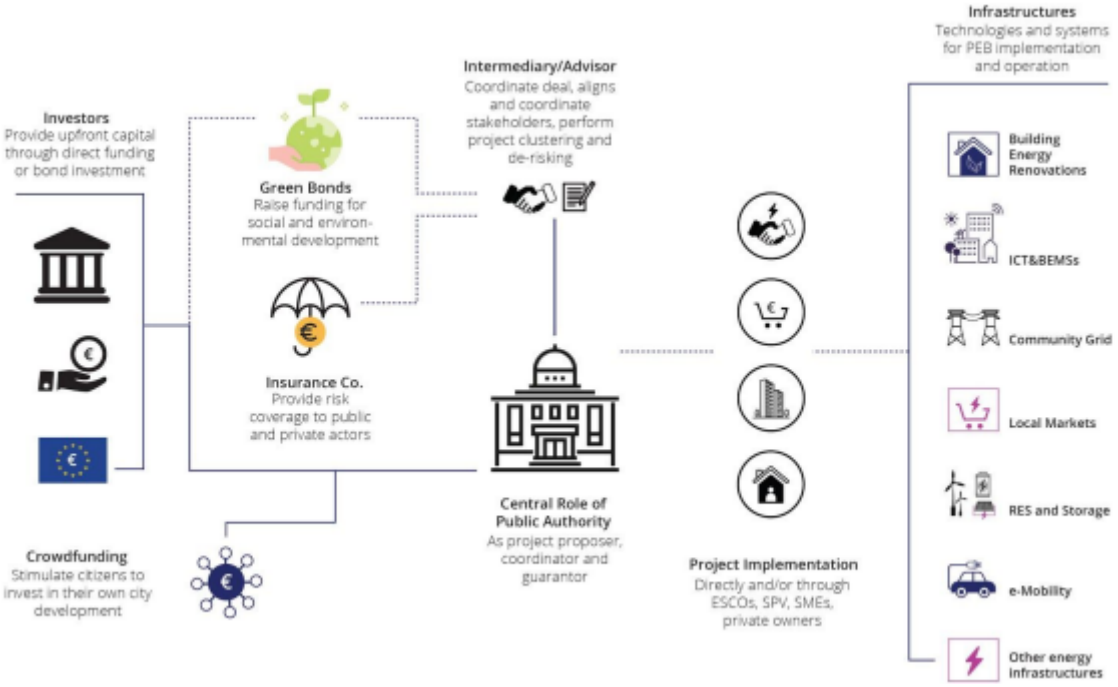

Figure 5.3 Generic Integrated Investment Model for implementation and operation of PEBs and Local Energy Markets. Source: +CityxChange report D2.4 - Report on the bankability of the demonstrated innovations (Cimini, Giglio, Carbonari, 2019)

The developed business and investment models have been implemented in the LHCs and FCs and adapted to the local context.

Innovation:
The models include innovative applied technologies and citizen engagement strategies that contribute to increasing the value of the PEB in terms of economic, environmental, social

and governance impacts. The models are described on ecosystem level and show how costs and revenues from energy assets and buildings can be shared among different business models for the main stakeholders involved and how the entire PEB could be settled and managed.

Demonstration in +CityxChange:
City of Trondheim
City of Limerick

Related deliverables:
D2.4 - Report on Bankability of the Demonstrated Innovations
D4.15 - Limerick Investment Models White Paper (forthcoming)
D5.16 - +Trondheim Sustainable Investment and Business Models and Concepts
D6.4 - Report on Investment Pipelines and Novel Business Models for FCs (forthcoming)

IPR protection plan:
OV, TK and LCCC are joint owners of the IP which is protected by copyright. The table below shows the list of models and related ownerships connected to the work in Trondheim.

Table 5.1 List of developed individual models, who is the owner(s), whether implemented or not, and where to find details/descriptions in the D5.16 report.

Model	Developed by	Report reference	Comment
Certification of buildings	NHP (Relog Property)	6.2 Annex 6	Not implemented.
Energy efficiency measures	RK	6.8	Implemented at Sluppen.
Heat pumps	NTNU / TK	6.6	Not implemented. All HPs (8) however integrated with the PEBs and local energy market. HPs integrated with sector coupling (7.8). Specific model developed for projecting/engineering of new HPs (Annex 8).
Rooftop PV	TK	6.3 Annex 8	Implemented. Sales of production (kWh) and capacity incl. peak shaving (kW).
Battery storage	TK	6.4	Implemented. All 4 use-cases will be implemented

V2G	TK	6.5 Annex 10	Implemented. EV sharing company centric model implemented
Sector coupling	TE (Aneo)	6.6	Implemented at Sluppen. Shift between HP and district heating
Local Energy Market	TE (Aneo)	6.7	Implemented. Sales of local production, user flexibility, incl capacity + system services
Financing Risk Sharing Model	OV	5 Annex 9	Implemented. Overarching model for PEB and LEM value creation
PEB value capture	OV	6	

Exploitation vision:

The business and investment models, including their implementations in the LHCs, will be made public through the project website and are being used in further work within the +CityxChange project.

6 Conclusion

This report presents an overview of the exploitable results of the +CityxChange project identified during the first four and a half years of the five-year project. The report provides an overview of the strategies and actions needed for adoption and exploitation of results generated by the +CityxChange project. As such, it provides a framework for identifying, developing, and optimising the exploitation of the project results during the project and after its completion.

Twenty-six exploitable results have been identified which are summarised under four categories: 11 Products & Applications, 2 Services, 8 Knowledge & IP, 3 Processes, and 2 Other (Policies). In the past six months, two new results have been identified ("PEB Policies Recommendations" and "Integrated Investment Models for PEBs" and one result has been marked as duplicate "PED Planning and Design Process". It is envisioned that 14 of the results will be exploited on a commercial basis and the remaining 12 results will be made available for public or scientific exploitation for free, under appropriate open licences, or similar paths.

Together, the results cover the technical, social, economic and cultural aspects of a PED, both individually and in an integrated manner. For example, the Local Energy Market combines the various technologies developed in the project to enable local energy and flexibility trading. Equally important are the process- and engagement related results like the Innovation Lab, Learning Framework, Bold City Vision, and regulations that set the conditions for the PED framework.

For each of the exploitable results, together with the ER Manager, a KER Assessment has been performed. The results have been used to categorise the results across expected impact and innovation risk and to further detail the exploitation- and IP management-strategy. The results are distributed across four categories: 2 Rising Star, 12 Promising Concept, 3 Niche Opportunity, and 9 Safe Play. The assessment revealed a number of opportunities for the post-project exploitation of project results.

- The Local Energy Market combines key results from four industry partners and offers a turn-key solution to cities who wish to implement a local energy market. The Trondheim case shows that the local energy market is technologically and economically viable and plans for commercialisation and upscaling are being developed.
- Policy related results resulting from experiences gained in the +CityxChange project potentially lower the barrier for new PED projects. Examples are the contributions of GKINETIC and IOTA on improving existing standards or the recommendations of

LCCC and TK for regulatory bodies to make new regulation more favourable for local energy communities and PED concepts.

- Social oriented results of the project like the Innovation Lab, Learning Framework or the Innovation Playground but also the Bold City Vision, have been replicated and institutionalised by cities within and beyond the +CityxChange project. This not only shows the need for tools like this but also the importance of the social and cultural aspects of PED projects.
- The individual results enable future research projects to build upon the +CityxChange results and strengthen the product and service portfolio of the individual project partners. For example, GKinetics' tidal turbine is expected to generate over €60 million revenues in the coming years, the citizen innovation labs as first established in the City of Limerick and replicated in the City of Alba Lulea and the City of Smolyan, give citizen engagement activities a permanent character, and the Integrated Planning and Support tool gives IES access to new market segments.

An interesting observation is the non-product nature of many of the +CityxChange innovations. The process innovations and 'social/soft' processes like the Bold City Vision framework, regulatory and policy recommendations, or the Innovation Labs, have been proven to be essential for setting the right conditions for a PED and are highly valued by the involved cities. These results are like the "glue" that brings and keeps together the various stakeholders in the PED domain and provide a much needed foundation for the design and deployment of a PED. Measuring the impact of such results is difficult as the impact of a single intervention in the social domain is not only hard to quantify, but it is also hard to determine their ripple effects like increased social cohesion in a PED area, avoided costs for healthcare, or more politically engaged citizens. A risk is that such non-product innovations are not valued as highly compared to the more tangible and product-like innovations, which is why we highlight them in this report and promote them through the project.

The methods and products developed in +CityxChange will contribute to the adoption and replication of PEDs/PEBs and can be of great benefit for all stakeholders involved. This report forms the basis for the commercialisation plans that will be delivered in Month 60.

Annex 1 - KER Assessment Questionnaire

Key Exploitable Result Assessment

1) Context and objective

For the record, "results" are outputs generated during the project, which can create impact during and/or after the funding period. Results are owned by the beneficiary that generates them; they can be used either by the project partners or by other stakeholders. According to our Grant Agreement, each beneficiary must take measures aiming to ensure exploitation of its results. **A first step in the exploitation process is the identification of Exploitable Results (ERs)**, which was done in the previous years.

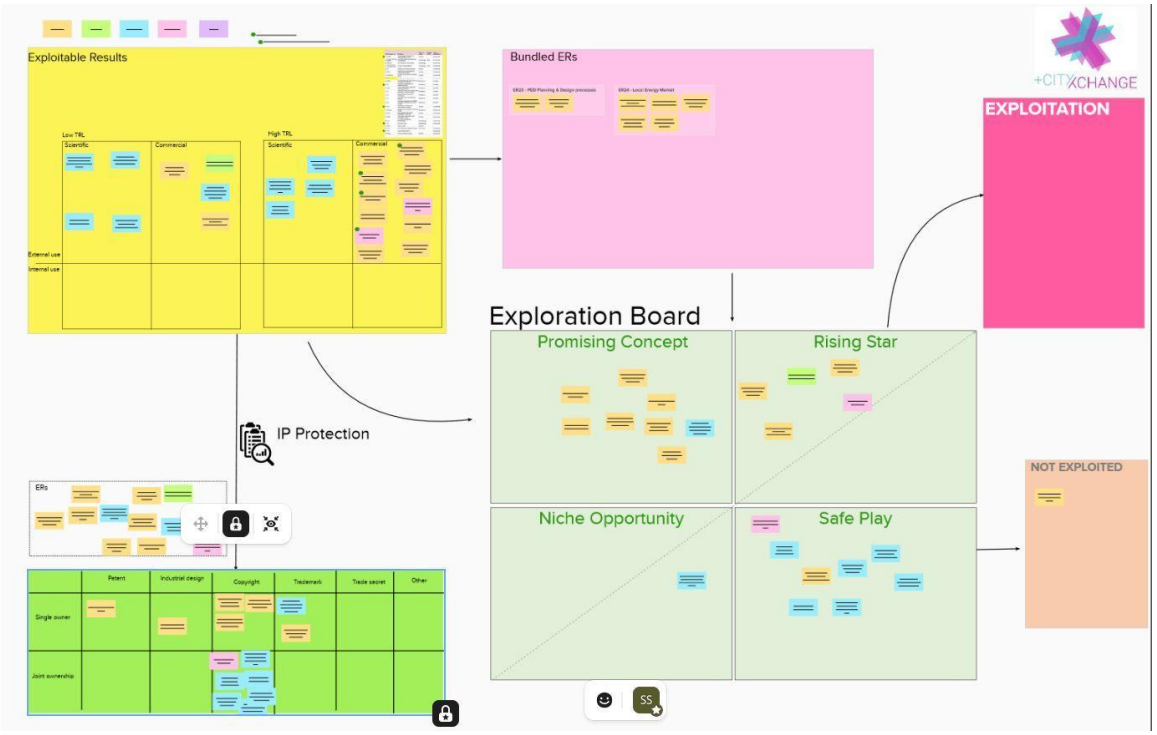

Figure 1 - +CxC ER tracking board

The second step in the exploitation process is the identification, amongst the exploitable results listed, of the KEY exploitable results (KERs). This is the purpose of this assessment. KERs will be selected in order to define focused exploitation activities and maximize economic, scientific and societal impact of the project. The KER differentiate the project from similar projects and initiatives and are what remains once the project has finished (legacy). KERs must be innovative, have significant socio-economic impact and have

a (business) owner. Based on the outcome of the assessment, the ER will be placed in one of the four quadrants of the exploration board, see Figure 1.

2) Your ER

Please review the text below, check if the information is up-to-date and complete where needed.

ERXX -

ER type		**ER manager**	
TRL before +CxC		**TRL after +CxC**	
Related WP		**Related DPs**	

Short description:

Innovation:

Demonstration in +CityxChange:

Linked deliverable:

IPR protection plan:

Short term exploitation vision:

Mid-term exploitation vision:

3) Assessment of your ER

ERs will be considered as KERs if they score "high" on expected impact and "low" on innovation risk. Evidence is used to support the underlying hypothesis of the ER indicator. The strength of a piece of evidence determines how reliably the evidence helps support or refute a hypothesis.

Weak evidence	Strong(er) evidence
Opinions (beliefs)	Facts (events)
What people say	What people do
Lab setting	Real world setting
Small investments: signing up by email to show interest in an upcoming product or service is a small investment	Large investments: Pre-purchasing a product or service or putting one's professional reputation on the line is an important investment

Assessment of the expected impact of your ER

Please review the assessment, check if the information is correct and adapt where needed.

Indicator	Value	Evidence
Economic impact		
Area of deployment (internal / external)	Within the organisation - On the market	
If external (market) deployment:		
Size of the untapped market	Small - Large	
Type of addressable market	Existing - Upcoming - New	
Market need	Not clear - Clear	
Market grow	None - High	
Scalability of the business model	Poor - Very good	
Environmental impact		
Carbon footprint reduction	None - Large	
Reduction of local pollution	None - Large	
Impact on circular economy	None - High	
Societal impact		
Social exclusion	Increased - Reduced	
Energy poverty	Increased - Reduced	
Stimulation of citizens' involvement in policy making	None - High	

Comments:

Assessment of the innovation risk of your ER

Indicator	Value	Evidence
IP protection	Weak - Strong	
Type of innovation	Incremental - Adjacent - Transformational	
Alternative solutions	Better alternatives - No alternatives	
Completeness of technology	TRL1 - TRL9	
Regulatory hurdles	Yes - No	
Additional development needed	Major - none	
Management support	None - Committed	
ER ownership	None - Clear	

Comments:

Result of the assessment

Expected impact: Innovation risk: Quadrant:

Annex 2 - Results KER Assessment

ER name	Expected Impact	Innovation risk	Quadrant
The integrated Planning and Decision Support Tool	**HIGH** The addressable market is large, especially in Europe where European and national policies force cities to actively work on becoming climate neutral and the current energy crisis forces governments to take measures for preventing energy poverty. Impact on CO2 reduction, climate, energy citizenship and quality of living in neighbourhoods is high although this depends on the measures actually being taken by the decision makers. Overall expected impact is high.	**LOW** The integrated planning and decision support tool is finalised and being tested in Limerick. IP ownership is clear and the tool fits the product portfolio of IES. IES is actively managing the commercialisation of the tool. This results in a low innovation risk.	Rising Star
Grid Optimisation and Balancing Technologies	**LOW** The combination of tools is considered incremental innovation, a logical evolution of these design tools. The integrated suite will not address new markets. The expected impact is expected to be low.	**LOW** The toolkit integrates three existing tools which are already being exploited. Ownership of the tools is clear and IP protection of the individual tools is clear. Usage of IPR by each of the partners needs to be worked out in more detail and set-out in an agreement. The innovation risk is considered low.	Safe Play

Community Grid Technology	**HIGH** The technology is disruptive and connects to the shift towards a decentralised and carbon neutral energy system. The addressable market is worldwide. The community based system is not only a technological shift but also empowers citizens and businesses to become producers and traders of energy, democratising the energy system. Therefore the overall expected impact is high.	**HIGH** The technology is available and prototyped in two cities. The energy market is in transition and it is not clear what technologies or solutions will be adopted by the majority of energy solution providers. It is a competitive market where many market players are developing microgrid-based solutions. The CCT connects many different stakeholders. Not for every stakeholder there is a clear business case for adopting the CCT. This results in a high innovation risk.	Promising Concept
Energy Trading Platform	**High** The energy trading platform allows assets from every size to participate in local energy markets. There is a global need for distributed energy solutions and the market is driven by new regulations and policies to reach a carbon neutral society which is in favour of RES. Overall expected impact is high.	**High** The result has been tested as a prototype in one LHC. For the energy trading platform to work, technologies from multiple partners need to be combined. IP usage agreements have not yet been put in place, This results in a high innovation risk.	Promising Concept
eMobility as a Service platform	**High** - Once operational, the economic and environmental impact are high. Travellers can choose the cleanest or fastest route, getting insight in the footprint of their travelling behaviour. This could also result in a shift in mobility modus, creating a societal impact. Overall expected impact is high.	**High** The eMaaS solution has been tested as a proof of concept. The planned payment system could not be realised and an alternative has been developed. Before this solution is market ready, significant development and testing needs to be done. Replication of the solution to other cities requires integration with the systems of local mobility providers. This results in a high innovation risk.	Promising Concept

Vehicle to Grid and Vehicle to Building technologies	**High** V2G and V2B solutions promise to unlock a new set of flexibility and energy trading services on local grids. This will positively impact the transition to renewable energy sources and reaching climate goals in cities worldwide. This will also allow citizens to participate in local energy communities Overall expected impact is high.	**High** The bi-directional charger is a key element in the V2G and V2B applications. An uncertain element is how car manufacturers will implement bi-directional charging in their cars. Current national regulation and legislation, like in Ireland, does not always allow local energy trading between buildings and cars and needs to be adapted first. This results in a high innovation risk.	Promising Concept
Gkinetic Tidal Turbine for Shallow Rivers	**High** The tidal turbine fills a gap in the market. It can be expected that the increasing demand in renewable energy and the transformation to a more distributed energy system will drive demand for the tidal turbine. The energy production is more predictable compared to wind or solar. GKinetic serves a global market. Overall expected impact is high.	**High** IP is well protected. Fluctuating energy prices and a dynamic energy market makes it difficult to prepare a positive business case, especially when the turbine has to compete with solar and wind. Regulatory issues are a barrier for installing the turbine. This results in a high innovation risk.	Promising Concept
Heat pump exchange system	NA	NA	Being exploited
Service Based ICT Eco-System and Enterprise Architecture	NA	NA	Being exploited
Regulatory mechanisms for delivering DPEBs	**Low** - The result addresses policies on a national level. Impact could be higher when the results/recommendations would be presented to relevant policy makers via a policy brief and impact policies on EU level. Overall expected impact is low.	**Low** - Ownership is clear. The conclusions have been published. This results in a low innovation risk.	Safe Play
Citizen participatory guidebook	**Low** The results in the LHCs are positive and the guidebook will continue to be used after project end. Impact is limited to the +CxC cities. Overall expected impact is low.	**Low** The Citizen Participatory Guidebook has been used to implement citizen engagement processes in the two LHSc. No further development is needed and IP ownership and usage is clear. This results in a low innovation	Safe Play

		risk.	
Learning Framework (targeting next generation of smart citizens)	**Low** The result is primarily used within the project. There is no plan for further commercialisation or development of the framework. Overall expected impact is low.	**Low** The used tools and techniques are not new. The framework has been tested in the LHCs (and FCs?). No further development is needed. IP is protected by copyright. This results in a low innovation risk.	Safe Play
Positive Energy Champions Framework	**Low** The framework is ready and validated in the LHCs. Result has being replicated in the FCs. No further exploitation of the results is foreseen. Overall expected impact is low.	**Low** The framework is ready and validated in the LHCs. IP is protected by copyright. This results in a low innovation risk.	Safe Play
Innovation Labs towards DPEB solution	**Low** The innovation labs have been deployed within the +CxC cities. The impact could be high when the Innovation Lab was promoted actively towards other EU cities and support was provided with the replication of the lab. For now, overall expected impact is low.	**Low** No further development is needed now the labs are operational. IP is protected by copyright. This results in a low innovation risk.	Safe Play
Innovation Playground for DPEBs, including beta-project and crowd-funding	**Low** - The framework has been applied within the project with no intention of active commercial exploitation of the framework. Overall expected impact is low.	**Low** - Development is finished and the innovation playgrounds have been established in the LHCs. IP ownership is clear and IP usage is covered by a CC licence. This results in a low innovation risk.	Safe Play
Monitoring and Evaluation Reporting Tool (MERT)	**Low** Unclear if the MERT will be exploited outside of the +CxC project. If yes, it would target a niche market. Overall expected impact is therefore low.	**Low** - The MERT is operational. Ownership of the tool and the data is clear. This results in a low innovation risk.	Safe Play
Energy Community Utility Franchise Model	**High** When delivering value as expected the model is very scalable and replicable. Overall expected impact is high but only if the model can be applied on a larger scale.	**High** The model has been demonstrated in Limerick but needs adjustment. The CSO as a new business actor has not yet materialised in the energy domain. Not all elements of the business model have been positively validated (viability, feasibility, and desirability).	Promising Concept

		IP ownership is clear. This results in a high innovation risk.	
IOTA-enabled P2P energy marketplace / modules	**HIGH** Once local energy markets become more common, economic and environmental impact is expected to be high. The addressable market is global and IOTA's business model is very scalable. Overall expected impact is high.	**HIGH** Although the technology might be ready, the energy market and its regulations are not yet ready for decentralised energy trading. This results in a high innovation risk.	Promising concept
IOTA Data integrity and trade verification service	**HIGH** Once the P2P energy trading market has reached its full potential, economic, environmental and social impact is expected to be high due to the uptake of local energy communities which democratises the energy market. Overall expected impact is high.	**HIGH** The technology is nearly ready but the P2P energy trading market is still in its infancy. This results in a high innovation risk.	Promising concept
CxC PEB development methodology	**HIGH** Because of the combination of technological and social aspects and the focus on key innovation and collaboration processes,it can be expected that when adopted on a large scale by cities across Europe,, the impact on the energy transition is high.	**HIGH** The methodology has not yet been fully fleshed out and is not yet published.	Promising concept
Bold City Vision	**High** The proposed methodology is of interest for every city administration. When implemented well, it contributes to more inclusive decision making. Social, environmental and possibly also economic impact can be expected to be significant in the cities adopting the BCV. Overall expected impact is high.	**LOW** The framework has been finalised and adopted by the +CxC cities. No technical development is needed. IP ownership is clear. This results in a low innovation risk.	Rising Star

Device wallet	**HIGH** Once local energy markets become more common, economic and environmental impact is expected to be high. The addressable market is global and IOTA's business model is very scalable. Overall expected impact is high.	**HIGH** The technology is not completely ready, payment functionality needs to be developed. The energy market and its regulations are not yet ready for decentralised energy trading. This results in a high innovation risk.	Promising concept
PED Planning & Design processes	*Duplicate of ER17 PED Grid Design Toolbox*		
Local Energy Market	**High** Economic, environmental and societal impact are considered high, once local energy markets can be implemented on a larger scale. Transforming the energy system as well as the roles of the business actors and citizens/prosumers in the business ecosystem.	**High** Current regulation is not yet favourable for the deployment of Local Energy Markets.	Promising concept
PED Grid Design toolbox	**Low** The toolbox builds upon the functionality of the three existing tools. The market for PED grid design is expected to grow but still in its infancy. Overall expected impact is low.	**High** Ownership and exploitation model of the toolbox is not clear yet. Unclear if management of the three tool owners wishes to further develop the toolbox as a value proposition. This results in a high innovation risk.	Niche Opportunity
PEB Policies Recommendations	**High**.The result addresses policies on a national level. Plan is to present the results/recommendations to relevant policy makers on local and national level via a policy brief. Overall expected impact is high.	**High** - Ownership is clear. The conclusions have not been published yet. This results in a high innovation risk.	Promising concept
Integrated investment models for PEBs	**HIGH** Once local energy markets become more common, economic and environmental impact is expected to be high. Their is a clear need for financial models and structures for the upscaling of PEBs. Overall expected impact is high.	**High** - Ownership is clear.The developed models need to be tailored to the context of cities willing to replicate them. Financial and regulatory barriers exist and the PEB market is still in its infancy. This results in a high innovation risk.	Promising concept