D8.2: Report on the identification and assessment of exploitable results

+CityxChange | Work Package 8, Task 8.4

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Table of Contents

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
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 overview of the exploitable results of the +CityxChange project identified during the first four years of the five-year project. This work has been conducted as part of Work Package 8: Scaling-up, Replication and Exploitation and specifically as part of Task 8.4: Competence analysis, identification and management of exploitable results. 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-five exploitable results have been identified which are summarised under four categories: 12 Products & Applications, 2 Services, 9 Knowledge & IP and 2 Processes. It is envisioned that 17 of the results will be exploited on a commercial basis and the remaining 8 results will be made available for public or scientific exploitation for free, under appropriate open licences, or similar paths.

For each of the exploitable results, an Exploitable Results (ER) manager has been assigned and two templates have been completed: i) Partner market analysis template and ii) ER template. Together with the SWOT analysis, they form the basis for the exploitation strategy and exploitation activities for the final year of the project. Requirements for IP protection have been identified and appropriate protection mechanisms have been put in place. The levels of maturity vary across the exploitable results and the effectiveness of the results will be validated during the +CityxChange demo projects.

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 replication and exploitation plans that will be delivered in Month 54.

1 Introduction

This report presents the assessment of the exploitable results of the +CityxChange project as conducted within Task 8.4 "Competence analysis, identification and management of exploitable results". As such, this report will provide guidance to the project partners with the preparation of exploitation plans for the +CityxChange solutions related to the establishment of a number of Positive Energy Blocks (PEBs) or districts (PEDs) as part of Task 8.4 and Task 8.5 and the preparation of commercialisation plans as part of Task 8.6. 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 business and exploitation vision of their related exploitable results. This report builds on D8.1: Report on market and Stakeholder analysis[1] and repeats some content from there, as well as on respective already completed deliverables on the solutions, which are noted in each of the results.

Starting with the list of exploitable results as presented in the Grant Agreement, this Task has periodically evaluated the +CityxChange solutions and assessed their innovation and exploitation potential. Based on the results of this assessment, the list of exploitable results has been kept up-to-date. Updates on the list of exploitable results have been reported in the General Project Review Consolidated Report for Reporting Periods 1, 2 and 3.

Chapter 3 provides a summary overview of the project results identified as suitable for commercial or free exploitation. In total 25 exploitable results have been identified to date split out in 12 of the type "Product", 2 of the type "Service", 9 of the type "Knowledge & IP", and 2 of the type "Process". The summary overview shows the type of result, the assigned ER manager and envisioned type of exploitation, for each of the results.

Chapter 4 provides the expanded view of the exploitable results, presenting more detailed information for each of the results. A short description, ownership, maturity level, exploitation vision, IP, and related Work Package, Demonstration Projects, and deliverables are described for each of the ERs. For the commercially exploitable results, the business vision and a SWOT analysis have been included. This analysis forms the starting point for the development of the exploitation plans.

[1] https://cityxchange.eu/knowledge-base/d8-1-report-on-market-and-stakeholder-analysis/

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.

2.1 Exploitable results

As a base definition, **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 text[2], 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] https://ec.europa.eu/jrc/communities/en/community/tto-circle-community/news/horizon-results-platform-explore-wealth-eu-funded-research

2. **Impact**: Economic, scientific, environmental and/or societal impact

2.2 Overall strategy for the management of exploitable results

The exploitation of the project's results means to make use of the results produced in further activities (other than those covered by the project, e.g. in other research activities; in developing, creating and marketing a product, process or service; in standardisation activities).
The overall strategy for the management of exploitable results can be broadly divided in the three phases as shown in Figure 2-2.

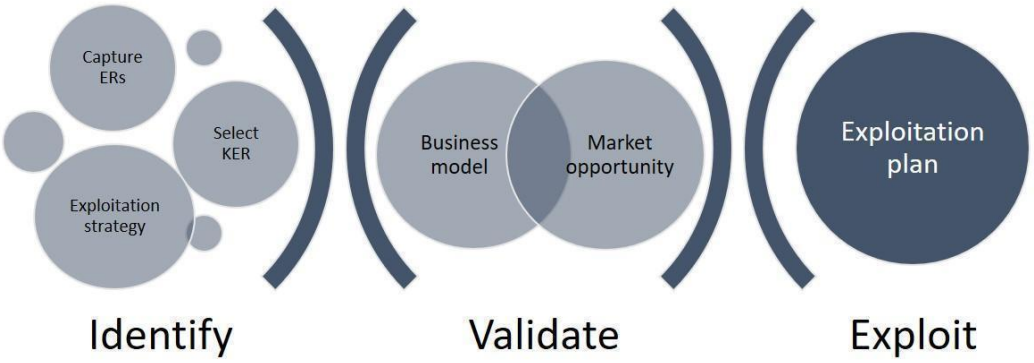


Figure 2-2 Overall strategy for exploitation management (source: R2M Solution)

The phases consist of a range of activities and are supported by a set of tools. Each phase is explained briefly below.
Identify: In this phase, exploitable results are being identified, collected, and analysed. Starting point is the list of project results as defined by the participating partners in the Grant Agreement. 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. For the collection of this information, a Partner Market Analysis-questionnaire (Annex 1) and an ER-questionnaire (Annex 2) has been distributed to the ER managers. 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. The content of the questionnaires has been used for market analysis as presented in Deliverable 8.1 "Report on Market and Stakeholder Analysis" and the description of the results in this report . An impact assessment will be done to identify the Key exploitable results from the project. This assessment is described in more detail in the following paragraph.

Validate: In the Validation phase, together with the industry partners it is being explored what kind of value propositions are being enabled by the ER. The focus shifts from the technical capabilities of the ER to the customer value and accompanying business model. A quick market analysis is being conducted and by engaging with target customers, end-users and other stakeholders, a check is done if the ER addresses a real need or problem. Goal is to come to a validated viable, feasible and desirable business model supported by the ER owner(s). Tools typically used in this phase are the business model canvas, value network model or value proposition canvas.
Exploit: In the Exploit-phase the exploitation plan is being detailed out. After having developed the business model in the previous phase, arrangements need to be made to secure post-project exploitation of the ER. This involves setting up partner agreements, IPR agreements and secure funding for further commercialisation or development of the ER. This phase ends with the kick-off of the exploitation plan.

This three-phase strategy is a continuous process where during any time in the project, new project results can be identified as an exploitable result. To ensure timely identification of exploitable results, meetings with all project partners will be organised on a regular basis to discuss and review the list of (key) exploitable results.

2.3 ER prioritisation and identification of key exploitable results

For the prioritisation of ERs, an ER assessment has been developed. The goal of the ER assessment is to identify the exploitable results with the highest expected return and the lowest innovation risk. This enables the project to define targeted and focused exploitation activities and spend their resources in the most efficient way.
The assessment comes in the form of a questionnaire. 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.
The indicators are the variables used for measuring the expected impact and innovation risk. For each project a set of indicators need to be defined to do justice to the specifics of the business domain and developed foreground. The indicators for this project can be found in Annex 2.
The Value describes the score of the value of the indicator. The way indicators are scored differs per indicator but in general indicators score in a spectrum with two extremes, e.g. small-large, weak-strong, low-high etc. Where possible, indicators can be quantified, e.g., 15% reduction, 2 million households etc.

Evidence needs to be provided and 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. The following table shows examples of weak and strong evidence.

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

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

For each indicator, the ER manager is requested to rank the value for each indicator and provide supporting evidence. Each completed questionnaire will be discussed with the Innovation Manager and the ER manager together to ensure the result of the assessment is unambiguous. The Innovation Manager assesses the completed questionnaire and ranks the expected impact and innovation risk. Scores can be "low" or "high", reflecting the scores on the exploration board which is explained in the next paragraph. The result of this assessment has been submitted to the ER manager for approval.

2.4 Managing and tracking exploitable results

Based on the results of the ER assessment, each ER is positioned on the Exploration Board. 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[3]. 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] Osterwalder A. et al., 2020, The Invincible Company, John Wiley & Sons, ISBN 978-1119523963

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.

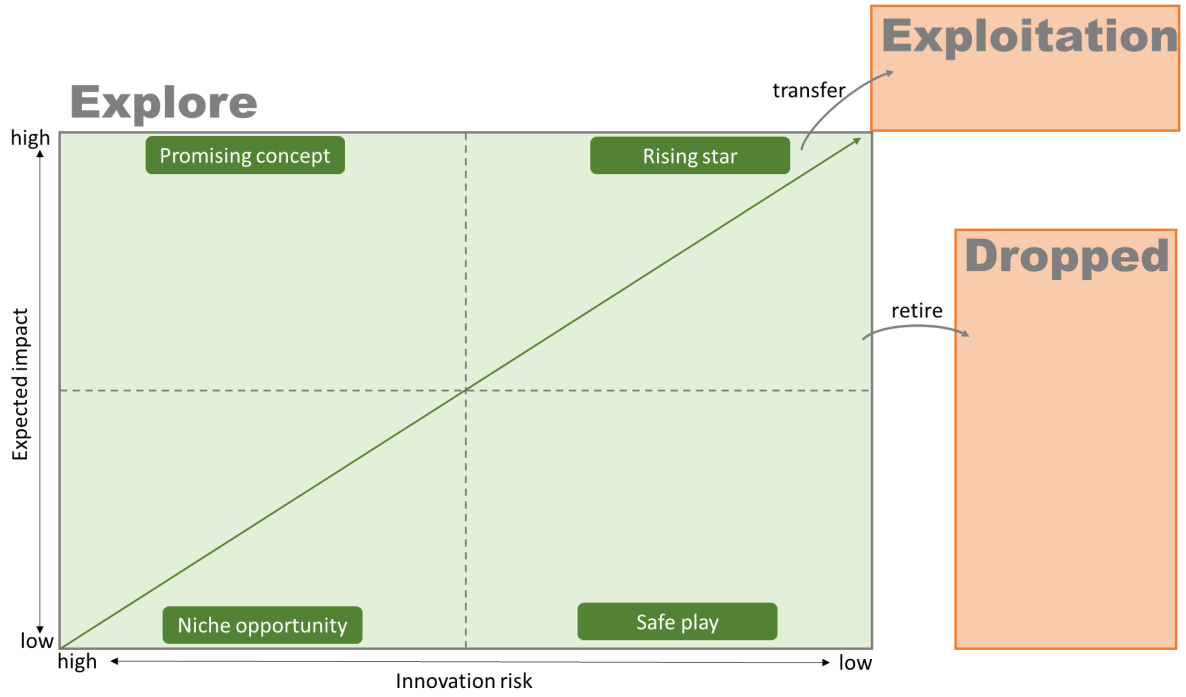


Figure 2-3 Exploration board

During the project, the board is used for tracking the ERs. Each ER is plotted on the board with the results of the ER assessment determining in which quadrant the ER will be positioned. Throughout the project, actions are defined for increasing the expected impact, reducing the innovation risk or both, and moving the ER towards the "Rising Star" quadrant, ensuring maximum impact of the project. When an ER is successfully being exploited, it will be removed from the Exploration Board and transferred to the Exploitation Board. When it is concluded that an ER cannot be exploited in any viable manner, the ER will be dropped and will also be removed from the Exploration Board. The aim is to have the Exploration Board cleared when the project is finished.

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 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 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.

Table 2-3 Linkage of Demo Projects and exploitable results

Demo Project	Linked ER
DP01 - Model	ER01 - Integrated Planning and Decision Support tool ER16 - Monitoring and evaluation reporting tool ER20 - CxC PED Development methodology
DP02 - Vision	ER21 - Bold City Vision
DP03 - Engage	ER11 - Citizen participatory platform ER12 - Learning framework ER13 - Positive Energy Champions framework ER21 -Citizen Participation Guidebook
DP04 - Regulatory Zone	ER10 - Regulatory mechanisms for delivering DPEBs

DP05 - Playground	ER11 - Citizen participatory platform ER14 - Innovation labs towards DPEB solution ER15 - Innovation playground for DPEBs
DP06 - DPEB	ER7 - Tidal turbine for shallow rivers ER23 - PED planning and design process
DP07 - Microgrids	ER2 - Grid optimisation and balancing technologies ER3 - Community grid technology ER8 - Heat pump exchange system ER22 - Device wallet ER25 - 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 ER24 - Local energy market
DP10 - Flexibility Market	ER4 - Energy Trading Platform ER18 - P2P energy marketplace ER19 - Data integrity and trade verification service ER17 - Energy community utility franchise model ER24 - Local energy market
DP11 - Invest	ER9 - Service based ICT eco-system and enterprise architecture ER17 - Energy community utility franchise model

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 Exploitable results - Consolidated view

The following ER's 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 4 years 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 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/Volue	Commercial
3	Community Grid Technology	Product	MPower	Commercial
4	Energy Trading Platform	Product	POW/Volue	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	Product	NTNU	Commercial
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	PED Planning & Design processes	Process / Knowledge & IP	TBD	Commercial
16	Local Energy Market	Product	TBD	Commercial
17	PED Grid Design toolbox	Product	POW/Volue	Commercial
18	Bold City Vision	Process	TK	Public
19	Service Based ICT Eco-System and Enterprise Architecture	Knowledge & IP	NTNU	Public

20	Regulatory mechanisms for delivering DPEBs	Knowledge & IP	TK	Public
21	Citizen Participation Guidebook	Process	COL	Public
22	Learning Framework (targeting next generation of smart citizens)	Knowledge & IP	UL	Public
23	Positive Energy Champions Framework	Knowledge & IP	UL	Public
24	Innovation Labs	Knowledge & IP	UL	Public
25	Innovation Playground, including beta-project and crowd-funding	Knowledge & IP	SE	Public

4 Exploitable results - Expanded view

This chapter presents a more detailed overview of the exploitable results of the +CityxChange project as listed in Chapter 3. The results are listed in no particular order. For each result, the type of result, owner, exploitation vision, IP ownership and protection measures, their relation to project deliverables and DPs, and a SWOT analysis 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.

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.

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

IP:

IP is owned by IESRD.

Business vision:

IESRD is planning to commercially exploit the Integrated Planning and Decision Support tool. The development of the tool is complete. Validation is ongoing. The tool goes beyond state of the art because it 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.
Some key competitors are:

- *Autodesk Tandem:* *https://www.autodesk.com/solutions/digital-twin/autodesk-tandem?mktvar002=4284214%7CSEM%7C12602538204%7C122801727754%7Ckwd-1208799054467*
- Microsoft: Azure Digital Twins: https://azure.microsoft.com/en-gb/services/digital-twins/
- Bentley Systems iTWIN: https://www.bentley.com/en/products/product-line/digital-twins/itwin
- ESRI - https://www.esri.com/en-us/digital-twin/overview
- CityzenitH - https://cityzenith.com/

SWOT analysis

STRENGTHS	**WEAKNESS**
- Multi vectoral-approach combining data from the building, grid infrastructure, and socio-economic domain.	- Users need to have expert knowledge from other domains, e.g. a technical user needs to know about socio economics etc.
- European focus and funds for smart and climate neutral cities. - Decreasing price levels for sensors, IoT and cloud solutions.	- Resistance to public data sharing including operational data sharing.
OPPORTUNITIES	**THREATS**

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.

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

IP:
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.

Business 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.

SWOT analysis

STRENGTHS	WEAKNESS
- Import from third parties short term forecasts. - Suitable for making scenario analyses and simulations.	- Business model not yet clear.
- Emobility is a fast developing area. - Trade of flexibility and local market operation within a PEB/PED is evolving.	- Adoption of the DPED concept is still in its infancy.
OPPORTUNITIES	**THREATS**

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).

Linked deliverables:

D2.6 - Framework for Community Grid Implementation

D4.4 - Limerick DPEB Implementation Guide 1

D4.12 Community Grid Implementation Guide (not published yet)

IP:
MPower is the single owner of the IP and plans to protect this IP through trademark protection.

Business vision:
MPower is preparing commercial exploitation of the Community Grid technology. 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 2022 and prototypes have been implemented in Lighthouse Cities Trondheim and Limerick. Existing alternative solutions are microgrid solutions by Siemens, Electric Schneider, and ABB.

SWOT analysis

STRENGTHS	**WEAKNESS**
- Disturbance neutral local energy community - Can be applied in any city.	- Not clear which market actor will pick up role of Community System Operator (CSO[4])
- Opportunities arising from the EU Clean Energy Package	- Non-favourable legal framework in some member states.
OPPORTUNITIES	**THREATS**

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

[4] A Community System Operator (CSO) is a legal entity that oversees the management and safe operation of a Community Grid System.

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 prototype is not formally named, but for this purpose it may be called the "Powel-Trade Platform". The trade platform for local energy resources is innovative in its design and operation due to the fact that it gives all local energy resources – independent of size – market access. It operates the market by using algorithms in an intraday market. Trade verification inclusive dispatch is executed by ABB and IOTA technology.

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

IP:
IP is shared by Powel, ABB and IOTA. No arrangements have been made yet for usage of each other's IP after project end.

Business vision:
Currently the Energy Trading Platform is a prototype. Plans for commercialisation depend on the results of the pilot in Trondheim.

SWOT analysis

STRENGTHS	**WEAKNESS**
- Fully digitalised market access and operation.	- Local trading is not allowed yet by regulators.
- Increased rollout of distributed energy resources. - Customers/consumers growing focus on climate change and energy transition.	- Required regulatory changes on national and EU level to support local trading can take a long time
OPPORTUNITIES	**THREATS**

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. Ideally, payment would have been done through IOTA distributed ledger technology, with IOTA digital assets. Since a full integration was not possible, instead, as a proof-of-concept, 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.

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

IP:
IP is owned by 4C and the software is protected by copyright.

Business vision:
The eMaaS solution by 4C provides a one-shop stop for various mobility and micromobility modes in one solution. It facilitates the transition from traditional transport modes into eMaaS.
eMobility is a cross-disciplinary sector where eMaaS solutions are developed both by private and public companies, and by both transport and ICT companies. Examples of public companies in Norway that work on such solutions include atb atb.no, entur entur.no.

SWOT analysis

STRENGTHS	WEAKNESS
- Multimodal mobility	- Complex integration of data and systems from multiple operators
- Cities are banning cars[5]	- Requires changes in individual travel behaviour[6]
OPPORTUNITIES	**THREATS**

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

[5] https://www.businessinsider.com/cities-going-car-free-ban-2018-12?international=true&r=US&IR=T

[6] https://www.ptolemus.com/insight/mobility-as-a-service-maas-challenges-multimodal-behaviour-and-trip-purpose/

when you feel is the right moment. With V2G, the momentary electricity consumption spikes in the building can be balanced with the help of electric cars and no extra energy needs to be consumed from the grid.

Related deliverable:
D5.11 - Trondheim DPEB Demonstration (not published yet)

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

Business vision:
The V2G and V2B technologies are planned to be exploited by ABB. 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. As an example, where the battery of electric (rental) cars previously was kept idle when the car was not used, it can now be utilised for generating revenue through e.g. offering ancillary services, or peak loading or shifting.

SWOT analysis

STRENGTHS	**WEAKNESS**
- Bi-directional charging	- Continuous charge and discharge of EV batteries may lead to battery degradation and shortening its life.
- V2G and V2B have not been implemented in many places yet	- Regulation is hindering the uptake of eMaaS - Rate of EVs supporting bidirectional charging is still low
OPPORTUNITIES	**THREATS**

4.7 Tidal Turbine for Shallow Rivers

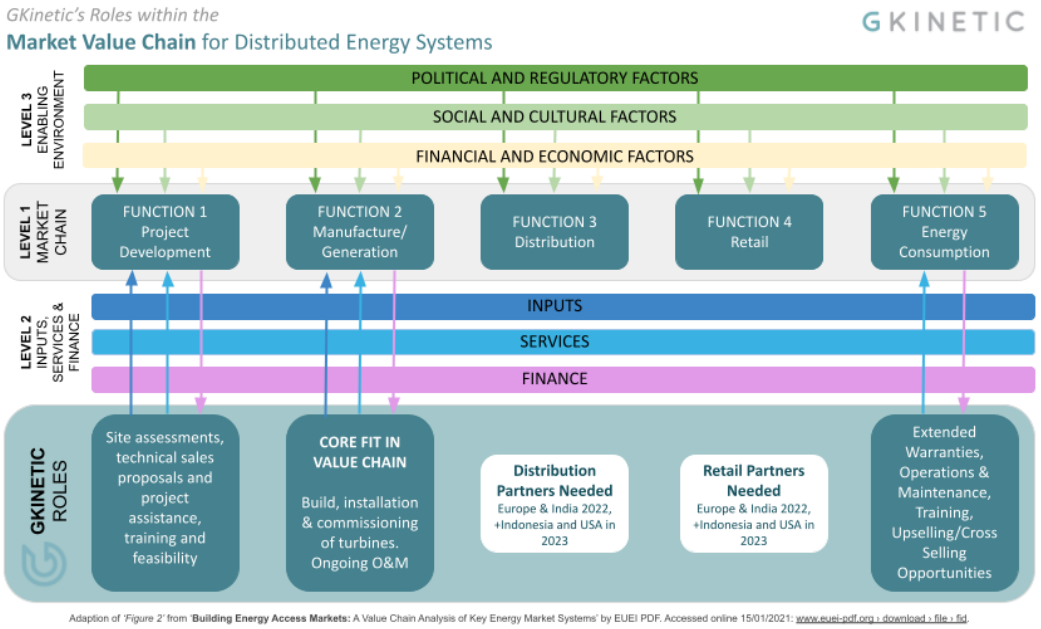
ER type	Product	**ER manager**	GKinetic
TRL before +CxC	6	**TRL after +CxC**	8
Related WP	WP4	**Related DPs**	DP06

Short description:
The exploitable result is a 10kW Hydrokinetic Turbine that can be deployed in a variety of sites. Two vertical axis tidal turbines (GK5s) are fixed to a standard deployment platform to provide a 10kW floating hydrokinetic solution, the CEFA10. The CEFA10, 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. 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 (mps).

Related deliverables:
D4.4: Limerick DPEB Implementation Guide 1
D4.11 Limerick DPEB Implementation Guide 2 (not published yet)

IP:
IP is owned by GKinetic

Business 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 manufacture, installation and commissioning of these turbines. Other services offered by GKinetic include site assessments and feasibility reports as well as project management and ongoing service and maintenance contracts.



Direct competitors, i.e. other hydrokinetic turbines developers include:

➔ HydroQuest - https://www.hydroquest.fr/

➔ SmartHydro - https://www.smart-hydro.de/

➔ Guinard Energies - https://www.guinard-energies.bzh/en/guinard-energies-2/

➔ Emrgy - https://emrgy.com/

➔ ORPC - https://www.orpc.co/

➔ Orbital Marine Power - https://www.orbitalmarine.com/

SWOT analysis

STRENGTHS	**WEAKNESS**
- Does not require high flow speed	- Anchor line can break
- Many shallow rivers	- Regulation hinders the deployment of the turbine
OPPORTUNITIES	**THREATS**

4.8 Heat pump exchange system

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 heatpumps 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 is therefore beneficial to have large scale pilot installations documenting the profitability and reliability under real life conditions.

Related deliverable:
D5.3: Campus Microgrid Model Prototype

IP:
The IP is owned by NTNU and copyright protected.

Business 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.[7]
2. Evaluation of possible heat pump configurations for waste heat recovery at +CityXChange Sluppen, by Erlend Nytrø Balstad. Master Thesis EPT-NTNU, June 2020[8].

There are no plans for implementation of the researched configurations.

[7] https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/2779592
[8] https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/2779610

SWOT analysis

STRENGTHS	WEAKNESS
	- SV has no plan for actually building the proposed solution - Requires substantial investments
- Increase in number of installed heat pumps	- Less advanced heat pumps can achieve the same results for hot water production
OPPORTUNITIES	**THREATS**

4.9 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 provides an online platform where the performance of the 33 +CityxChange KPIs are tracked and disseminated. The user interfaces provided for each KPI also enables KPI/data owners to submit data points for the calculation of the KPI. The MERT provides a consolidated view of all KPI performance. Each KPI has a unique calculation that is performed in the back-end to calculate and track KPI performance.The MERT will enable automated data sharing with partners through the use of APIs. Each KPI has an individual interface with a summary overview, and downloadable data into various formats for external use.

Workshops have been held with KPI partners to provide the most up to date data to the MERT. The MERT is currently up to date with the most recent KPI data from CityxChange partners. Visualisation of KPI data on the MERT is also being updated per this information and feedback from consortium members. Integration of other systems with MERT within the CxC IT eco-system for data sharing is pending KPI owner confirmation.

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)

IP:

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.

Business vision:

The data that is captured, modelled and displayed in the MERT, has been made available for download to enable external use. The data is made available to the public domain to comply with the European Commission regulations and +CityxChange Data Management Plan of open access to data and making data findable and accessible.
Public users will have access to monitoring data, be able to download the aggregated data for the KPI, and a '.pdf' summary report, whilst not able to modify any of the captured data. The data displayed in the MERT's individual KPI interface includes the KPI number, description, expected or targeted impact, unit of measurement, frequency of reporting, annual performance of the KPI presented as a percentage, visual representation of data (graphs), and other key information relevant to each KPI. From this interface, the accredited users will be able to modify data, and accredited and public users alike will be able to generate the summary report

SWOT analysis

STRENGTHS	**WEAKNESS**
- Visual representation of KPI's - KPI data ownership remains at data providers	- Dashboard depends on quality of underlying data sources
- Increase of number of energy communities across Europe who could be target users of the tool	- Already many providers of smart energy / smart city dashboard solutions
OPPORTUNITIES	**THREATS**

4.10 Energy Community Utility Franchise Model

ER type	Knowledge & IP	**ER manager**	MPower
TRL before +CxC	NA	**TRL after +CxC**	NA
Related WP	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. 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.

Related deliverable:
D2.6 - Framework for Community Grid Implementation
D4.14 - Energy Profile of Community Grid and EV Users (not published yet)
D4.15 - Limerick Energy Investment Models White Paper (not published yet)

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

Business 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.

SWOT analysis

STRENGTHS	WEAKNESS
- Standardised process	- Business model has not been validated
- European legislation for energy communities	- Blockchain technologies might make the role of community grid operator redundant
OPPORTUNITIES	**THREATS**

4.11 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:

The IOTA-enabled P2P energy marketplace platform and IoT asset modules provides 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 real time M2M micropayment 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.

The result is innovative as it will fully decentralise energy markets and allow the entrance of community owned renewable energy sources. It will not only decentralise trading settlement but also payments through the use of cryptocurrencies.

Related deliverable:

D2.7 - Local DPEB trading market demonstration tool

IP:

IOTA is the owner of the IP. No IP protection measures are foreseen. Software is protected by copyright.

Business vision:

The target market is the P2P local energy systems. IOTA plans to include the platform and modules to their product portfolio and will search for 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. An alternative solution is offered by the Energy Web Foundation.

SWOT analysis

STRENGTHS	**WEAKNESS**
- Increases the number and availability of renewable resources - Better planning of energy resources	- Cryptocurrency volatility and lack of adequate stable coins
- Incentivises creation and sharing of renewable resources - New business models for marketplace operators	- Regulations are still in progress - Disrupted markets might slow down innovation process
OPPORTUNITIES	**THREATS**

4.12 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 type 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 and immutable data transaction ledger to enable data integrity and trade verification.

Related deliverable:
D5.5 - Energy Trading Market Demonstration

IP:
IOTA is the owner of the IP. No IP protection measures are foreseen.

Business vision:
The target market is the one of peer to peer energy trading. IOTA will offer the feature as a service to market operators. The service has been developed and APIs deployed and provided to potential integrators from the CxC consortium (ABB, Powel/Volue, TronderEnergi). It will take 3-6 months to integrate standards and it is expected that the market will be ready in 2 years
There are no known alternative solutions which are based on green and sustainable blockchain technology like IOTA. Energy Web Foundation is trying something similar but forcing market operators into one consortium and using less scalable and green technologies like Ethereum.

SWOT analysis

STRENGTHS	**WEAKNESS**
- Increased security on shared data - No need for central repository - No more single point of failure	- Need to deploy and maintain a ledger infrastructure (in case of required compliance, i.e., GDPR)
- Reduced settlement time - Reduced number of disputes - Fully auditable transactions	- Interoperability can only be guaranteed at data level, not ledger level - Some ledgers have high transactions fees - Storing data in a ledger could be only temporary or costly
OPPORTUNITIES	**THREATS**

4.13 CxC PED Development Methodology

ER type	Process	**ER manager**	NTNU
TRL before +CxC	NA	**TRL after +CxC**	NA
Related WP	WP1-6	**Related DPs**	All

Short description:
Bundling of lessons learned, recommendations, processes etc, obtained throughout the project. This results in an integrated methodology that covers the lifecycle of a PED project, from planning to design and deployment.

Related deliverables:
The original project proposal and ongoing refinements. All key deliverables of the project by the respective partners.

IP:
IP belongs to the partner who developed the IP.

Exploitation vision:
Plan is to make the methodology available to public organisations and other stakeholders under open licenses or publications, use for replication, and explore other options..

SWOT analysis

STRENGTHS	**WEAKNESS**
- Covers technical, economic and social aspects of a PED project	- No clear owner of the methodology
- Increasing attention for PED concept from the EC and cities	- PED is a relatively new concept and not widespread adopted
OPPORTUNITIES	**THREATS**

4.14 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:
IOTA Device Wallet uses decentralised identities and verifiable credentials in order to allow trusted authentication of Smart Link Units (SLUs) and Energy Meters in P2P energy markets. The digital device wallet is a UI framework based on the Self-sovereign identities, Audit Trail, and 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.
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.
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.

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

IP:
IOTA is the owner of the IP. The option of filing a patent to protect the design of the PUF is being investigated.

Business vision:
IOTA will commercially exploit the device wallet, including it in its service portfolio or in one of dedicated spin-offs. The target market is the market of local energy systems. The device wallet is expected to be ready for market launch in 2023.
No alternative solutions have been found. Other solutions are centralised, require centralised Identity management systems and create vendor and service provider lock in.

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.

SWOT analysis

STRENGTHS	**WEAKNESS**
- Wallet and Identity based on interoperable standards - Increases security of devices and data	- SLUs hardware might be still limited to fully exploit wallets capabilities
- SLUs can be authenticated in different energy network - SLUs are true economic agent offering more opportunities for revenues to their owners - SLUs can seamlessly connect to different marketplaces (i.e., the one with more demand)	- Traditional HW/SW business models will be disrupted, with resistance from established industry players - Ledger infrastructure needs to be accessible and some ledger might have high transaction fees
OPPORTUNITIES	**THREATS**

4.15 PED Planning & Design processes

ER type	Process	**ER manager**	TBD
TRL before +CxC	NA	**TRL after +CxC**	NA
Related WP	WP4	**Related DPs**	DP01, DP06, DP07, DP09, DP10

Short description:

Bundling of the Integrated Planning and Decision Support Tool as described in paragraph 4.1 and the PED Grid Design Toolbox as described in paragraph 4.25. The aim of the integrated set of processes is to support cities in an early stage withe the planning and design of PEDs

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

IP:
IP is owned by IESRD and SE who remain owners of their own IP.

Business vision:
No exploitation strategy has been defined yet.

SWOT analysis

STRENGTHS	WEAKNESS
- Integrated process making it easier for cities to plan a PED project	- No owner for this result yet
- Increasing attention for PED concept from the European Commission	- PED is a relatively new concept and not widespread adopted
OPPORTUNITIES	**THREATS**

4.16 Local Energy Market

ER type	Product	**ER manager**	TBD (POW/Volue, TE, ABB, IOTA, TK)
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. 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: Algotrader for market participation.
- Volue: Digital Marketplace for market operation.
- IOTA: for secure third party data verification to ensure consistency between executed trades and the following settlement.
- TE: Operator software for forecasting, flexibility optimization and settlement.

Related deliverables:
D2.7 - Local DPEB trading market demonstration tool
D5.5 - Energy Trading Market Demonstration

IP:
IP ownership remains with the developer of the IP. No IPR arrangements have been made yet.

Business vision:
The Volue ETP, local market solution, and full impact of the market side of the solution is based on open P2P trade of energy resources and products. This is not (yet) allowed today according to national legislation and central parts of the prevailing concession regulations.

SWOT analysis

STRENGTHS	**WEAKNESS**
- Based on open P2P trade	- No owner for this result yet - Requires modernisation of the power system infrastructure coupled with appropriate policy and regulatory support.
- European Union is supporting energy communities	- Regulation prevents implementation of local energy markets
OPPORTUNITIES	**THREATS**

4.17 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.

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

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

Business vision:
Further commercialisation and new features are not decided or discussed.

SWOT analysis

STRENGTHS	WEAKNESS
- Integrated solution fit for design and operation of local energy systems and market. - Support optimal usage of local storage/batteries	- Three different owners of the toolset
- Uptake of microgrids and local energy grids in Europe	
OPPORTUNITIES	**THREATS**

4.18 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).

Related deliverables:

D3.1 - Framework for Bold City Vision, Guidelines, and Incentive Schemes (SDG City Transition Framework)

IP:

TK is the owner of the IP which is protected by copyright.

Exploitation vision:
The Fellow Cities have replicated the Bold City Vision. Plan is to make the framework available to public organisations and other stakeholders on a free to use basis.

4.19 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**	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

Related deliverables:
D1.2 - Report on the Architecture of the ICT Ecosystem

IP:
IP is owned by NTNU and protected by copyright.

Exploitation vision:
The resulting framework has been published and is being used in further work. No specific further exploitation activities are foreseen.

4.20 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.

Related deliverable:
D2.1 - Report on Enabling Regulatory Mechanism to Trial Innovation in Cities

IP:
IP is owned by TK and protected by copyright.

Exploitation vision:
Public exploitation: The results of the analysis have been published. No further scientific or policy related exploitation is foreseen.

4.21 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 starts by providing a review of the best practices in order to understand the key principles driving successful citizen participatory processes. Next, it helps local authorities to identify the desired outcome of the participatory process and match with one of the four processes described in the guidebook: A physical intervention in the city? A new municipal legislation or plan? A participatory budgeting campaign? An open call for citizens' proposals? Next, it supports local authorities selecting the most appropriate physical tools

from the catalogue based on the defined steps of the selected participatory processes. Finally, 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.

Related deliverable:
D3.2 - Delivery of the citizen participation playbook

IP:
IP is owned by COL and protected by copyright.

Exploitation vision:
COL has presented the +CityxChange Citizen Participation Guidebook to FCs and LHCs. Implementation of the Citizen Participatory Guidebook in the LHCs is being finalised and is also being replicated in the FCs. COL has participated in presenting the +CityxChange Citizen Participation Guidebook in a number of seminars organised by Smart Cities and Communities' projects and others European projects, targeting local authorities and engagement consultants.

4.22 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 a portfolio of learning activities, including descriptions and links to original and existing content, adapted for different age groups, backgrounds and types of situations.

Related deliverable:
D3.4 - Framework for DPEB Learning and Education

IP:
The IP is owned by UL and protected by copyright.

Exploitation vision:
Scientific exploitation: The Learning Framework has been made publicly available. No further exploitation activities are foreseen.

4.23 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 Positive Energy Champions Framework 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.

Related deliverable:
D3.5 - Framework for a Positive Energy Champion Network

IP:
The IP is jointly owned by UL and SE and protected by copyright.

Exploitation vision:
Scientific exploitation: The Positive Energy Champions Framework has been made publicly available. No further exploitation activities are foreseen.

4.24 Innovation Labs

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

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.

Related deliverable:
D3.6 - Framework for DPEB Innovation Labs

IP:
The IP is jointly owned by UL and COL and protected by copyright.

Exploitation vision:
This result has been implemented in Limerick, where it is called the Citizen Innovation Lab. UL and LCCC are exploring how the result might be evolving and replicated further.

4.25 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.

Related deliverable:
D3.3 - Framework for Innovation Playgrounds

IP:
The IP is owned by SE and protected by copyright.

Exploitation vision:

The Innovation Playground for DPEBs has been made publicly available. No further exploitation activities are foreseen.

5 Conclusion

This report presents an overview of the exploitable results of the +CityxChange project identified during the first four 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-five exploitable results have been identified which are summarised under four categories: 12 Products & Applications, 2 Services, 9 Knowledge & IP and 2 Processes. It is envisioned that 17 of the results will be exploited on a commercial basis and the remaining 8 results will be made available for free for public or scientific exploitation.

An assessment of expected project foreground conducted within the project reveals 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. Experiences gained in the +CityxChange project ensure compatibility of the technical components and when used in combination with the +CxC methodology, commitment of all involved stakeholders, public, private, and citizens, is warranted.
- The +CxC methodology will lower the barrier for cities to consider investing in PED projects by providing a methodology that covers the planning and implementation phase. By covering the social, technical and economic aspects of a PED project and being built upon the experiences of all project partners and project activities, risks of doing an innovative PED project are reduced significantly.
- The individual results enable future research projects to build upon the results +CityxChange and strengthen the product and service portfolio of the individual project partners. For example, the P2P Energy Marketplace Platform contributes to IOTA's commercial services for businesses in decentralised energy markets, the Innovation Lab is an opportunity for LCCC to engage and co-create future services with their citizens and the Tidal Turbine gains GKINETIC access to new market segments.

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 exploitation plan that will be delivered in Month 54.

Annex 1 - Market analysis – Partners questionnaire

1. Exploitable result

Include the name of the exploitable result and a brief description

2. Lead partner

Partner who has the lead in the development of the result – include contact details

3. Support partners

If any - partner who are involved in the the development of the result – include contact details

4. Sector

Include the sector of the exploitable result as indicated in T8.3 Results sectors

5. Innovative aspects

Result value proposition and why it is innovative

6. Present trends in the relevant market

How is the market behaving? Is it growing? Are there any emerging trends?

7. Future trends in the relevant market

What innovation are likely to be included in the market in the future?

8. Competitors

List the key competitors for the results including company website

9. Relevant studies/research/papers

Include titles of relevant material and if available upload a copy in the project shared folder

Annex 2 - ER questionnaire

Exploitable Result: ER01

ER Manager:

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 year 2.

As a next step in the exploitation process is to re-assess the status of the exploitable results and further refine the exploitation vision and IP arrangements. This is the purpose of this questionnaire.

Please review the prefilled information and update where needed and fill in all blocks marked:

If you have any questions about this questionnaire please contact Sander Smit, sander.smit@r2msolution.com

Admin

This questionnaire is completed by:

Please state your name and organisation:

Status of your ER

ER description:

Type of result

Please put your answer in bold letters:

- Product
- Service
- Process / Methodology
- Know-how/IP
- Other (specify)

Innovation

Please explain why the result is innovative:

Level of development

Please put your answer in bold letters:

- Under development
- Already developed but not yet being exploited
- being exploited

Current development status

Shortly explain the status of the work and list major open work items like integration with other components, field testing, prepare publication etc:

Related deliverables

Dx.x

TRL

Current TRL (1-9): Expected TRL at project end (1-9):

Linked to Demonstration Project(s)

Please put your answer in bold letters:

- DP01: Model - DP02: Vision - DP03: Engage - DP04: Regulatory zone - DP05: Playground - DP06: DPEB - DP07: Microgrids - DP08: EMaaS - DP09: Local trading - DP10: Flexibility market - DP11: Invest

Exploitation vision

Type of exploitation

Please put your answer in bold letters:

- Commercial - Scientific - Public

Sector addressed

Please put your answer in bold letters:

- Digital twin urban planning - Local energy systems - Electric mobility - Renewable energy sources - Other (please specify):

Target market

What is the target market? What is the type and size of the market addressed?

Value proposition

What is the value for the customer? What problem does this solution solve?

Alternative solutions

Please list existing alternative solutions:

Regulatory hurdles

Please list regulatory or legal barriers:

Expected time for marketability

Please state when you expect your solution to be ready for the market:

IP

Owner(s) of the IP:

Used background:

Please refer to background as listed in the Consortium Agreement (see appendix B)

IP protection measures:

Please put your answer in bold letters:

- Patent
- Industrial design
- Copyright
- Trademark
- Trade secret
- Other (please specify):

Actions and need for support

Only for ERs with commercialization perspectives

Indicate the step(s) in order to bring the innovation to (or closer to) the market:

	Done or ongoing	Planned	Not planned but desirable	Not planned & not needed
Market study				
Feasibility study				
Business Plan				
A partner's research team and business units are both engaged in activities relating to this innovation				
Raise funding from public sources				
Raise capital				
Pilot, Demonstration or Testing activities				
Prototyping in laboratory environment				
Prototyping in real world environment				
Complying with existing standards				
Contribution to standards				
Technology transfer[9]				
Licensing the innovation to a 3rd party				
Launch a start-up or spin-off				
Other (please specify)				

Indicate your needs to fulfil the market potential.	Your needs ('X' when needed)
Executive Training	

[9] Technology transfer (TT) refers to the process of conveying results stemming from scientific and technological research to the market place and to wider society, along with associated skills and procedures.

Mentoring or Coaching	
Business plan development	
Partnership with other SME(s)	
Partnership with large corporates	
Legal advice (IPR or other)	
Investor readiness training[10]	
Expanding to more markets	
Incubation/Startup accelerator	
Introduction to investors	
Other	

[10] Investor Readiness means understanding the criteria that the investors are using to assess your business opportunity so that they can decide whether they want to make an investment. This training aims to acquire knowledge to prepare for a round of funding.