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DELTA

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DELIVERABLE D7.5
LCA and LCC analysis for DELTA solutions and Use Cases v1

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Authors List

Leading Author				
First Name		Last Name	Beneficiary	Contact e-mail
Christof		Amann	e7	christof.amann@e-sieben.at
Co-Author(s)				
#	First Name	Last Name	Beneficiary	Contact e-mail
1	Andreas	Bauer	e7	andreas.bauer@e-sieben.at
2	Paul	Lampersberger	e7	paul.lampersberger@e-sieben
3	Camilla	Rampinelli	e7	camilla.borgesrampinelli@e-sieben.at
4				
5				

Reviewers List

Reviewers			
First Name	Last Name	Beneficiary	Contact e-mail
Carolina	Fernandes	Kiwi	cfernandes@kiwipowered.com
Dawn	Lonergan	CARR	dawn@carrcommunications.ie

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Executive Summary

In this deliverable (D7.5), we will present the methodology for the Life Cycle Assessment (LCA) and the Life Cycle Cost Analysis (LCCA) for the DELTA solutions and Use Cases. Both LCA and LCCA will be performed in this project, taking into account the scenario building in Demand Response (DR), as compared to conventional practices. Novel approaches had to be developed for implicit and explicit Demand Response because no applicable research is available.

A life cycle assessment (LCA) is a structured and comprehensive method to quantify material and energy flows and their associated emissions caused during the entire life cycle. A life cycle covers raw material and primary energy extraction; material and energy supply; manufacturing; use and end of life, including transport and waste management services when needed. The results from the LCA will show the Global Warming Potential (GWP) which will be provided in Carbon Dioxide Equivalents (CO_{2eq}).

According to ISO 14044, LCA studies are further divided into 4 phases:

- goal and scope definition phase,
- inventory analysis phase,
- impact assessment phase, and
- interpretation phase.

LCCA is a method that evaluates the total costs of a product or service along the whole life cycle, including production, operation, maintenance, and disposal. In order to be consistent with the LCA, the goal and scope as well as system boundaries will be the same. This enables an integrated interpretation of results.

Both LCA and LCCA were carried out for the two pilot sites in Cyprus and United Kingdom. However, a suitable methodology for demand response activities is not available. We (e7) developed one from scratch, at least for major parts. This methodology will have to distinguish between implicit demand response, where dynamic energy tariffs are used to adjust or adapt energy consumption patterns and explicit demand response, where changes in energy profiles are rewarded directly. For implicit demand response, the entire electricity production system is the framework for investigation (case 1), while explicit demand response refers to the balancing and ancillary market, where grid stability is secured within the regulated area of the electricity market (case 2). Most elements are similar in both cases, for example necessary hardware and data processing. The main distinction between the two cases is the definition of the reference framework in the electricity system and the assignment of monetary flows.

The following elements will be considered for the LCA/LCCA of the DELTA solution:

- FEID
- [Additional] Components
- Energy System (different for implicit and explicit DR)
- Server/Cloud-computing

A template was developed for the data collection which started in July 2020 for the demo sites. This included data for hardware, software/computing, energy consumption, and costs.

Lastly, an outlook is provided for the coming activities and the preparation of the final deliverable (D7.8) due in M36.

Table of Contents

List of Figures

List of Tables

List of Acronyms and Abbreviations

Term	Description
BEMS	Building energy management system
BRP	Balancing Responsible Party
D	Deliverable
DR	Demand Response
DSO	Distribution System Operator
DVN	DELTA Virtual Node
EPEX	European Power Exchange
FEID	Fog Enabled Intelligent Device
GWP	Global warming potential
HVAC	Heating, Ventilation and Air Conditioning
ICT	Information and communication technology
LCCA	Life Cycle Cost Analysis
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
T	Task
TSO	Transmission System Operator
UCY	University of Cyprus
WP	Work Package

1. Introduction

1.1 Scope and objectives of the deliverable

In this deliverable, we present the methodology for the Life Cycle Assessment (LCA) and the Life Cycle Cost Analysis (LCCA) for DELTA solutions and Use Cases. Impacts on the environment and on the economy will be assessed for the two pilot cases in the United Kingdom and Cyprus. Both LCA and LCCA will be performed taking into account a scenario building on Demand Response (DR) as compared to conventional practices. Novel approaches had to be developed for implicit and explicit Demand Response. The results from the LCA will show the Global Warming Potential (GWP) which is given in Carbon Dioxide Equivalents (CO_2-Equ).

In this version of the deliverable, the methodology is elaborated and templates for data collection at the pilot sites are developed and presented. Results of the analysis will be documented and analysed in D7.8, which is version 2 of the LCA and LCCA, at the end of the project in M36.

1.2 Structure of the deliverable

This deliverable is structured in two parts: a general part on the LCA/LCCA concept (section 2) and a specific part for DELTA (section 3ff.).

Section 2 describes the general concept of LCA and LCCA according to the ILCD handbook and ISO 14040 and ISO 14044.

Section 3 the goal and scope of the LCA/LCCA for DELTA solutions and Use Cases are defined and discussed.

Section 4 specifies necessary data for LCA as well as for LCCA. Data collection will be carried out in close cooperation with WP2 and other tasks in WP7, mainly T7.4 and T7.5.

Lastly, section 5 summarizes further steps and gives an outlook on version 2 of this deliverable.

Data collection templates are documented in the Annex.

1.3 Relation to Other Tasks and Deliverables

Data collection will be carried out in close cooperation with WP2 and other tasks in WP7, mainly T7.4 and T7.5. The primary source of data will be the pilot site managers, who will collect energy data as well as monetary data.

2. Overview on LCA and LCCA methodology

2.1 Life Cycle Assessment (LCA)

A life cycle assessment (LCA) is a structured and comprehensive method to quantify material and energy flows and their associated emissions caused during the entire life cycle. A life cycle covers raw material and primary energy extraction, material and energy supply, manufacture, use and end of life, including transport and waste management services when needed. The authorised and widely applied framework for LCA is provided by ISO 14040 and 14044[1] [1][2]. This framework offers a range of choices that affects the results and conclusions of an LCA study depending on the individual practitioner [3].

According to ISO 14044, LCA studies are further divided into 4 phases (Figure 1):

- goal and scope definition phase,
- inventory analysis phase,
- impact assessment phase, and
- interpretation phase.

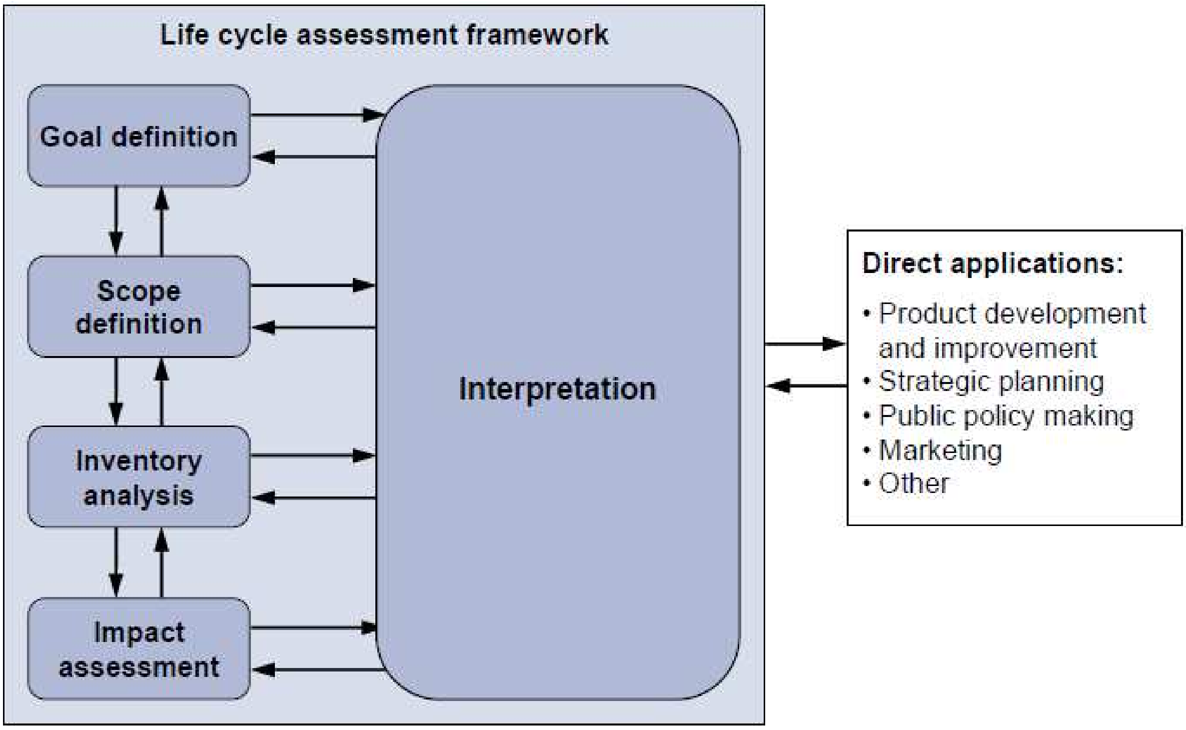

Figure 1: LCA framework [4]

"The scope, including system boundary and level of detail, of an LCA depends on the subject and the intended use of the study. The depth and the breadth of LCA can differ considerably depending on the goal of a particular LCA.

[1] These international standards have been approved by CEN and are available as European Standards EN ISO 14040 and EN ISO 14044.

The life cycle inventory analysis phase (LCI phase) is the second phase of LCA. It is an inventory of input/output data with regards to the system being studied. It involves the collection of the data necessary to meet the goals of the defined study.

The life cycle impact assessment phase (LCIA) is the third phase of the LCA. The purpose of LCIA is to provide additional information to assess a product system's LCI results, so as to better understand their environmental significance.

Life cycle interpretation is the final phase of the LCA procedure, in which the results of an LCI or an LCIA, or both, are summarized and discussed as a basis for conclusions, recommendations and decision-making in accordance with the goal and scope definition." [2]

In practice, LCA is an iterative endeavour, where elements from all phases of an LCA are improved and adapted during the process (Figure 2).

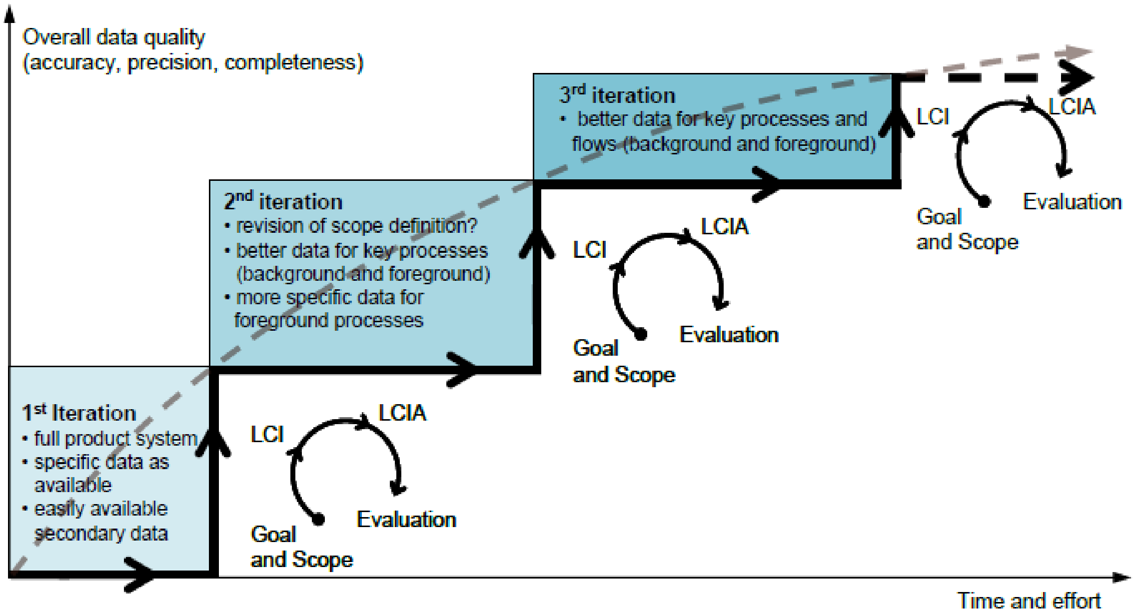

Figure 2: Iterative nature of LCA [4]

For a typical LCA, a cradle-to-grave approach is applied, which considers all materials and energy used during the life-cycle from the raw material acquisiton to final disposal (Figure 3).

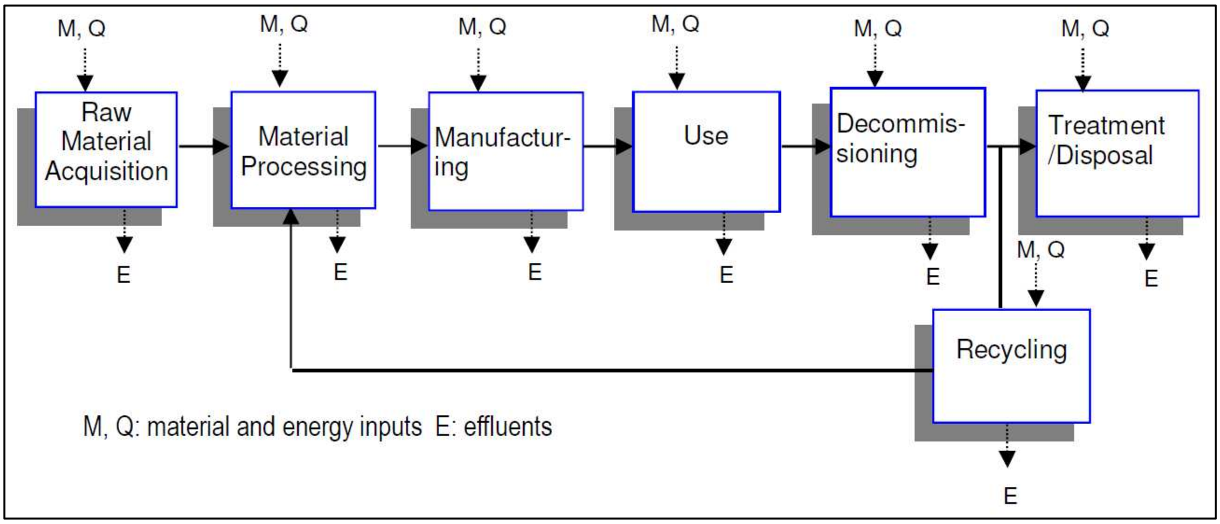

Figure 3: Flow of the life-cycle stages, material, energy and effluents [5]

2.2 Life Cycle Cost Analysis (LCCA)

A Life Cycle Cost Analysis (LCCA) evaluates the total costs of a product or service along the whole life cycle, including production, operation, maintenance, and disposal. In order to be consistent with the LCA, the goal and scope as well as system boundaries will be the same, enabling an integrated interpretation of results. Similarly to LCA, LCCA is widely applied in some areas like sustainable building design, but there are still only a few examples of relevant Demand Response cases.

3. Methodological Approach for Life Cycle Assessment (LCA) and Life Cycle Cost Analysis (LCCA) of DELTA Pilot Sites

3.1 General Description of DELTA Pilot Sites

Two pilot sites were selected for deployment of the DELTA solution. They are:

- The Cyprus pilot site: The University of Cyprus (UCY) Campus
- The UK pilot sites: Moor House, Woodland Grove Estate, and Tom Smith Close Estate

Detailed descriptions of the pilot sites and the deployment of the DELTA solution are described in D7.2 “DELTA framework deployment and pilot realisation v1” and D7.6 “Pilot premises energy context analysis and end-users engagement/training v2”.

3.1.1 The University of Cyprus Campus

Five buildings of the UCY campus, located on the outskirts of east Nicosia, were selected for deployment of the DELTA solution (Figure 4). They are:

- UCY Library
- Administration building (ADM)
- Finance Economics & Business building (FEB)
- Residential blocks
- PV Technology Laboratory facilities (PV Lab)

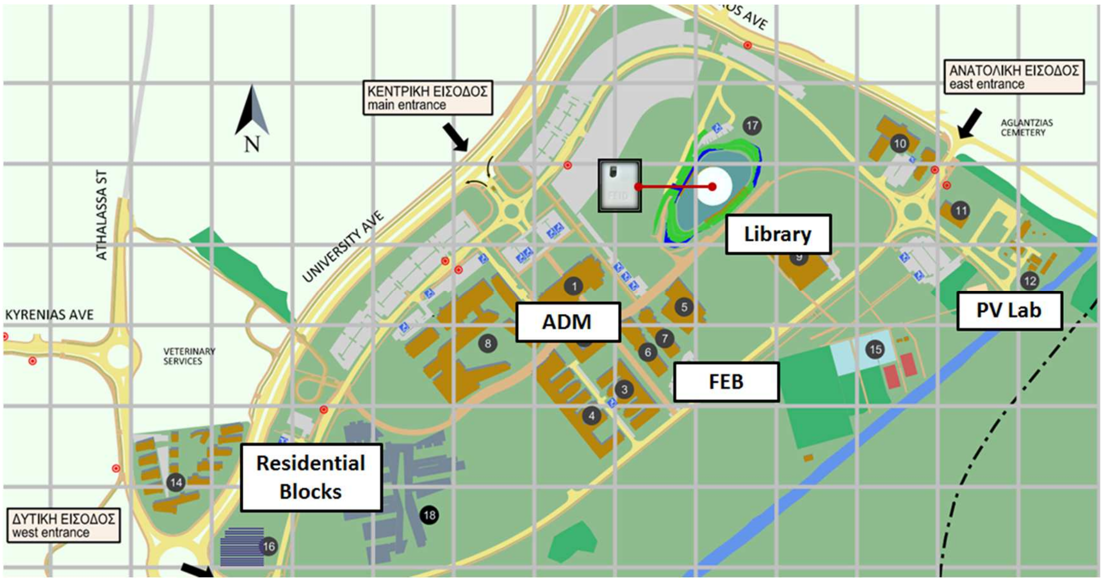

Figure 4. UCY campus map: Location of buildings [UCY]

The HVAC system of the first three buildings is uniform, hence, it is used for an explicit DR scenario as one medium-sized customer. Each building of the student’s residential dormitories is equipped with smart meters and one FEID. These dormitories are considered small-sized electricity customers. Due to the lack of control capabilities, students will be exposed to day-ahead and instant DR scenarios through implicit DR. Unfortunately, the largest capacity load of the PV technology laboratory- the climatic chamber- is excluded from the pilot deployment. The PV technology laboratory is considered as a small-sized customer. The remaining facilities include smart appliances, where both day-ahead and instant DR programmes can be applied through explicit and implicit DR.

3.1.2 Moor House, Woodland Grove Estate, and Tom Smith Close Estate

Pilot sites in the UK consist of one large office building (Moor House, Central London), and two residential buildings (Woodland Grove Estate and Tom Smith Close Estate) (Figure 5).

Figure 5. Moor House, Woodland Grove Estate, and Tom Smith Close Estate [Kiwi]

Moor House will follow an explicit DR scenario by participating in the Static Fast Frequency Response (SFFR) programme, where a minimum of 1 MW of assets is required.

Residential buildings will participate as small-sized customers in price-based (implicit) DR programmes. Three markets will be assessed: day-ahead, intraday, and imbalance market.

3.2 Goal and Scope

The goal of the LCA and the LCCA is to assess impacts on the environment and economics of the DELTA solution, as compared to conventional practice. This general goal constitutes the guideline for the definition of the scope, including system boundaries and the level of detail of the analysis.

LCA and LCCA are carried out for the two pilot sites in Cyprus and United Kingdom. However, a suitable methodology for demand response activities is not available and has to be developed from scratch, at least for major parts (with the few exceptions of [6], [7], [8], [9], and [10]). Furthermore, this methodology will have to distinguish between implicit demand response, where dynamic energy tariffs are used to adjust or adapt energy consumption patterns and explicit demand response, and where changes in energy profiles are rewarded directly. In implicit demand response, the entire electricity production system is the framework for investigation (case 1), explicit demand response refers to the balancing market where grid stability is secured within the regulated area of the market (case 2). Most elements are similar in both cases, for example: necessary hardware and data processing. The main distinction between the two cases is the definition of the reference framework in the electricity system and the assignment of monetary flows.

The system boundaries are main elements of the scope definition for LCA and LCCA. Based on the goal to compare the DELTA solution with conventional practices, it is an important and far-reaching decision to focus solely on additional efforts, equipment and activities.

3.2.1 Overview on main elements of LCA/LCCA for the DELTA solution

The following elements will be considered for the LCA and LCCA of the DELTA solution:

3.2.1.1 FEID

This is the main component necessary to deploy the DELTA solution. The LCA and LCCA will include production (material, energy), operation (energy), and final disposal (material, energy) of the FEID. Costs will be divided in investment costs, installation costs, running costs, and disposal costs.

3.2.1.2 Additional components

This comprehends all components necessary to deploy the DELTA solution., for example (additional) sensors and actuators, routers, bus systems, cables, clamps and all other components that would not have been installed in the case of the conventional solution. Smart appliances will also be considered, however, only in comparison to conventional appliances. In the case of end-of-life replacement, smart appliances will be treated as conventional. LCA/LCCA will include the whole life-cycle (material, energy; investment, installation, running and disposal costs).

3.2.1.3 Energy System

For the impact on the energy system, novel methods had to be developed. For implicit DR, the whole energy system will be considered, however, only the alteration of the energy production in terms of energy production and associated GWP as a result of DR activities will be considered. For explicit DR, impacts will be assessed compared to conventional practices, which will be defined for the two DELTA pilot sites, both located in quite different regulatory environments, resulting in different conventional practices as well.

3.2.1.4 Server/Cloud-computing

Compution is related to direct or indirect energy consumption, finally leading to emissions of greenhouse gas (displayed as GWP) and related costs. Compution will be needed for the following purposes:

- Data storage
- Blockchain processing
- DVN operation
- Data exchange (FEID and smart appliances; FEID and DVN, ...)
- Redundancies

Both, internal (server, FEID, DVN, ...) computing and external (cloud) computing will be included in the analysis. Analysis of impacts of computing will be built on an assessment methodology proposed by GeSI (Global Sustainability Initiative) [11] and “The Shift Project” [12], both focusing on environmental impacts of ICT applications.

3.2.2 Case 1: Scope and system boundary for implicit DR

The scope of this investigation defines which elements of the system (deployment of implicit DR scenarios at the DELTA pilot sites) will be considered in the analysis and which elements will deliberately not be considered. This overview is depicted in Table 1 and in Figure 6.

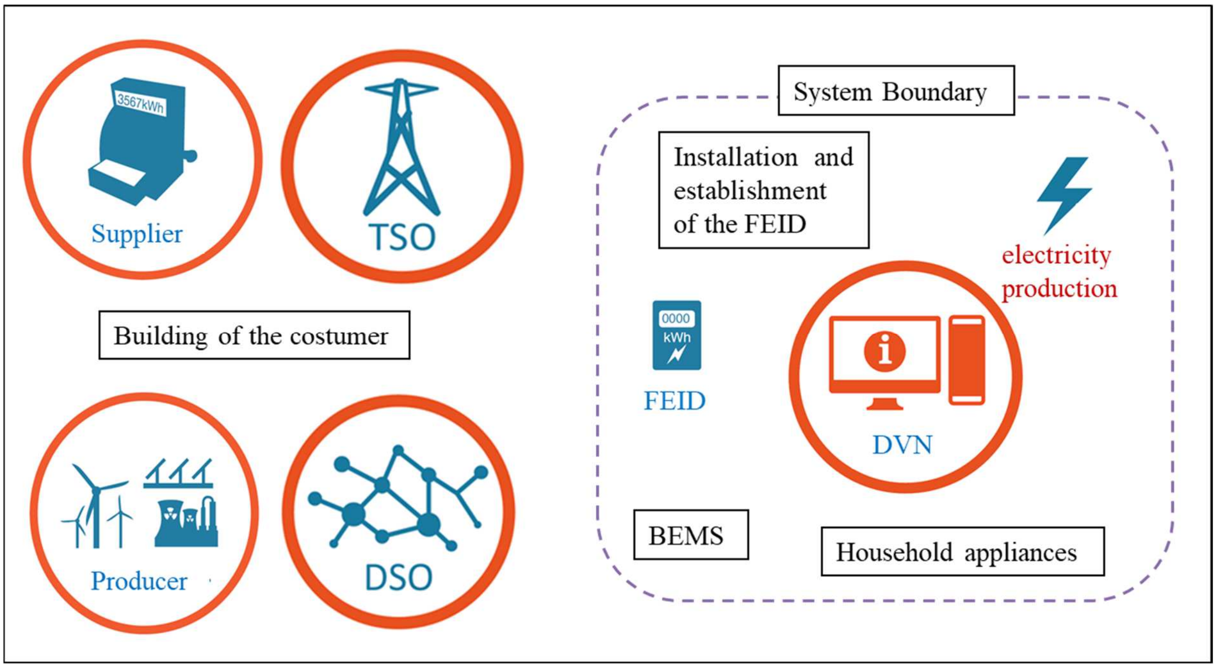

Figure 6: Scope and system boundary of the investigation – implicit DR [e7]

Table 1 below summarizes elements that are inside the system boundaries and will be considered in the LCA and LCCA, and which elements are outside this consideration.

Table 1: Scope of the investigation – implicit DR

Inside of the system boundary	Outside of the system boundary
• Electricity production (wholesale market, **overall energy demand**) • Induced losses in the grid • FEID (energy used for production, electricity consumption) • Installation and establishment of the FEID (additional components) • BEMS ([additional] electricity consumption) • DELTA Virtual Node (DVN) (electricity consumption) • [Additional] Hardware (routers, switches, sensors, actuators, ...) • Other computing resources (WiFi, electricity consumption) • [Additional] Installations and household appliances • Disassembling, recycling and disposal of FEID and [additional] hardware	• Power plants (construction, operation, maintenance and destruction) • Electricity grid (construction, operation, maintenance and destruction) • Building of the client (construction, operation, maintenance, destruction) • Existing equipment in buildings • Transport of FEID and [additional] hardware

For the assessment of the effects of demand response on the energy system a novel approach had to be developed. For the analysis of the DELTA pilot sites, the national energy system will be used as reference system. The basic assumption of this approach is that energy is produced along the merit-order where marginal costs of electricity production determine the energy clearing price. In Figure 7, coal power plants define the marginal price and the marginal CO_2 emissions as well. Reducing demand could decrease the clearing price towards marginal costs of nuclear power plants and also reduce marginal greenhouse gas emissions. Due to differences in primary energy costs (coal is cheaper than gas), it is clear that marginal costs do not directly correlate with marginal greenhouse gas emissions.

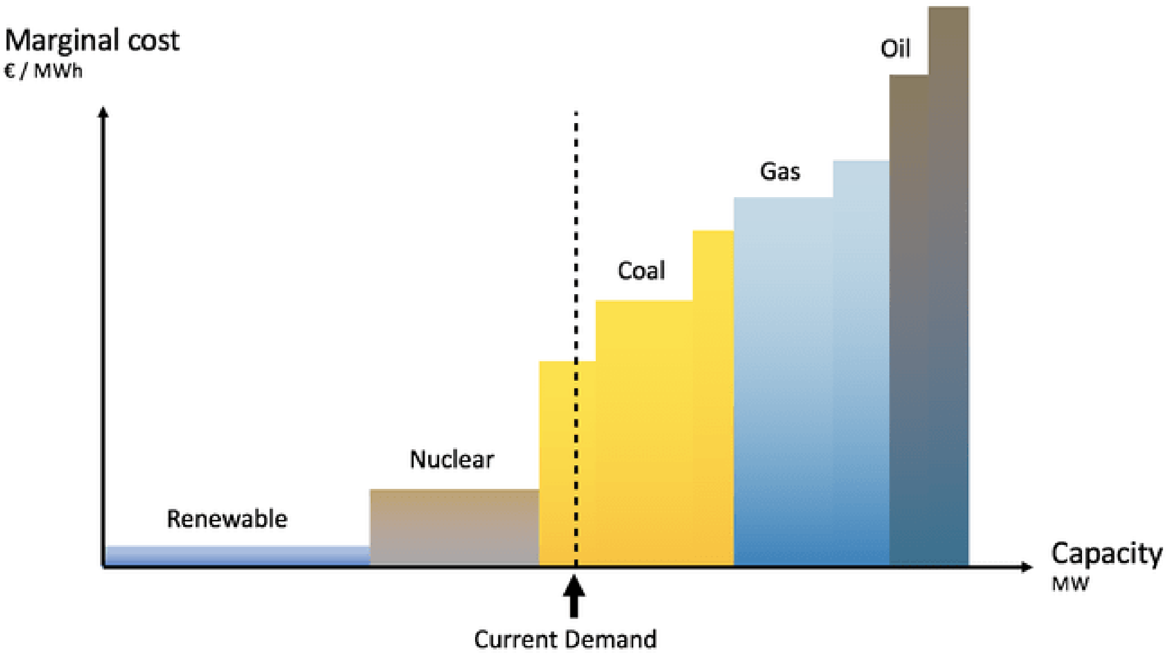

Figure 7. Merit-order of electricity production [6]

Electricity is traded on intraday markets down to 15-minutes contracts resulting in a 15-minutes resolution for the clearing price and resulting greenhouse gas emissions.

For DELTA, a statistical approach will be applied: greenhouse gas emissions will be correlated to electricity demand, resulting in a regression function. This regression function will be used for the calculation of the marginal greenhouse gas emission factor which will then be used for the assessment of impacts of demand response activities [14]. It is important to mention that only the difference to the conventional practice (i.e. greenhouse gas emissions associated with the baseline energy consumption) will be considered in the LCA for the DELTA solution. The following Figure 8 shows the principle of this approach. Load adaptation due to demand response (DR) will lead to an increase or decrease of CO_2 emissions. Calculations will use a 1- or 15-minutes timestep.

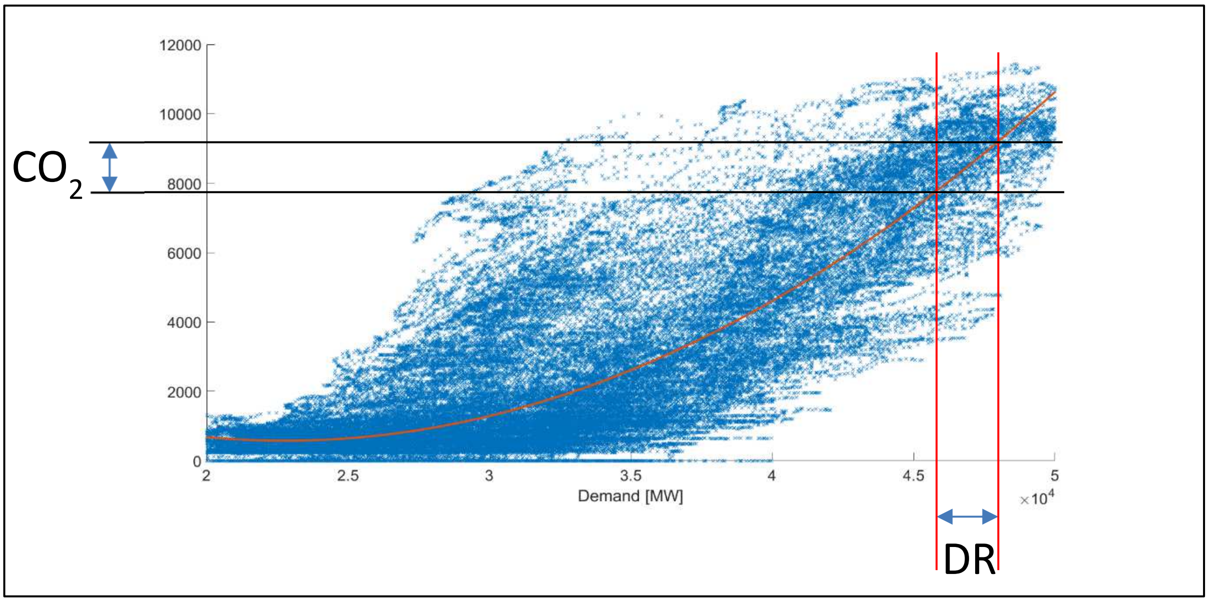

Figure 8: Methodological approach for Case 1: implicit DR

The main data source for the regression function will be national data based on electricity production (where available in appropriate detail) and – most importantly – data from the electricity map platform (www.electricitymap.org), where historical data, as well as live data, is available for numerous countries, featuring a high time resolution and import and export data options. Figure 9 shows an example for the electricity consumption in Austria for 20 November 2019, at 13:56.

For an appropriate application of this method, it is of utmost importance to have sound baseline data that represent the conventional case, ie. no implicit demand response.

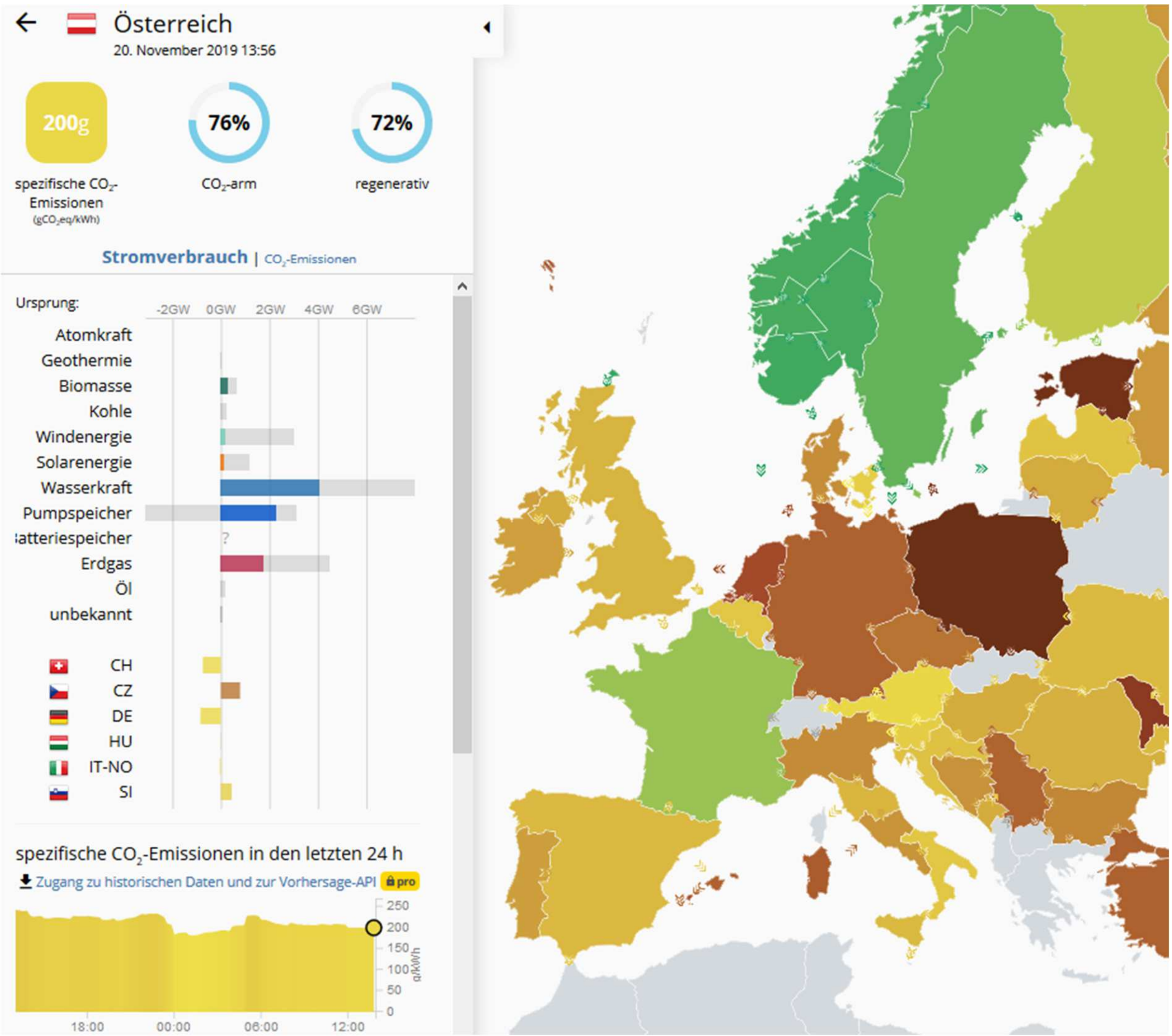

Figure 9: Structure of electricity production (www.electricitymap.org)

3.2.3 Case 2: Scope and system boundary for explicit DR

In general, case 2 of explicit demand response has a similar scope, similar assumptions, and system boundaries. However, there is one significant difference relating to the energy market under consideration. In case 1, the whole energy production system is used to assess impacts of demand response activities. In contrast, case 2 considers the balancing market and the ancillary service market. Both markets are in the sphere of the regulated sector of the electricity market and therefore follow a completely different rationale. In case 1, demand response is used to benefit from dynamic tariffs which simultaneously should allow an increased amount of renewable energy sources to be brought into the electricity system. Balancing (and other ancillary services) help to operate the grid in a secure way. Markets are still quite different in terms of development in European Member States, hence, a case-to-case approach needs to be applied where the reference case is defined along with the national market framework conditions.

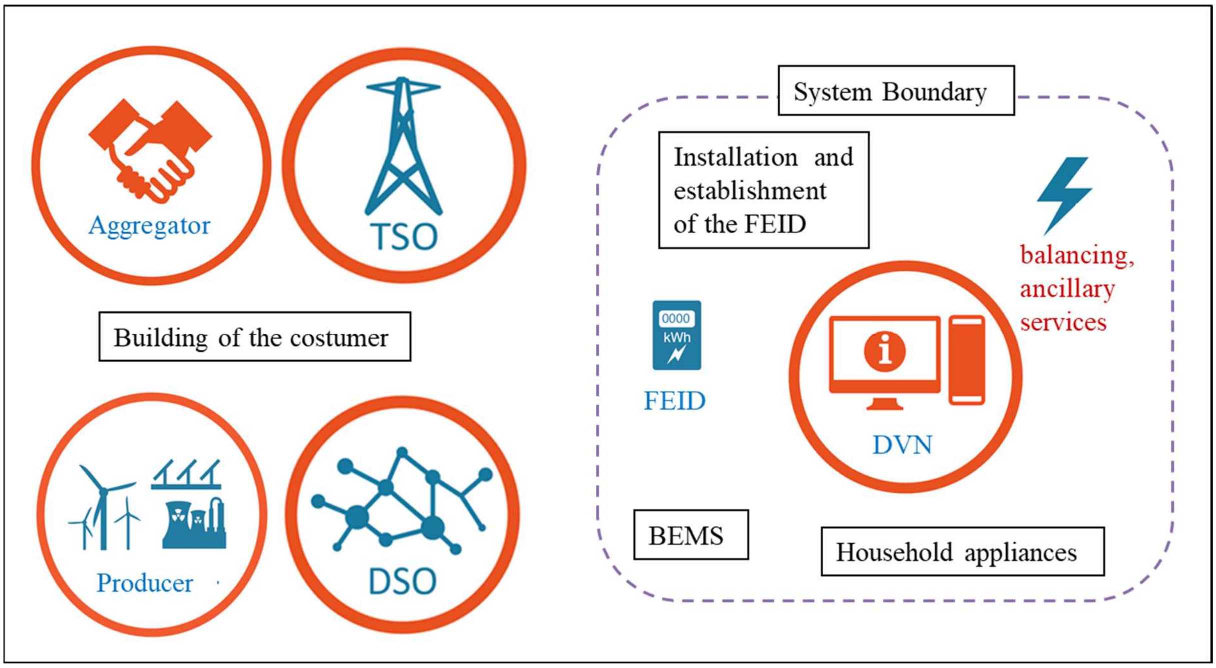

Figure 10: Scope and system boundary of the investigation – explicit DR [e7]

Table 2 below summarizes which elements are inside the system boundaries and will be considered in the LCA/LCCA and which elements are outside.

Table 2: Scope of the investigation – explicit DR

Inside of the system boundary	Outside of the system boundary
• Electricity (overall energy demand) • Opportunity case: **conventional control energy and reserve capacity market** (balancing, ancillary services) • Induced losses in the grid • FEID (energy used for production, electricity consumption) • Installation and establishment of the FEID (additional components) • BEMS ([additional] electricity consumption) • DELTA Virtual Node (DVN) (electricity consumption) • [Additional] Hardware (routers, switches, sensors, actuators, ...) • Other computing resources (WiFi, electricity consumption) • [Additional] Installations and household appliances • Disassembling, recycling and disposal of FEID and [additional] hardware	• Power plants (construction, operation, maintenance and destruction) • Electricity grid (construction, operation, maintenance and destruction) • Building of the client (construction, operation, maintenance, destruction) • Existing equipment in buildings • Transport of FEID and [additional] hardware

3.3 LCA software and database

The LCA of the DELTA solution will be executed using "openLCA" tool (www.openlca.org) and the "ecoinvent" database (www.ecoinvent.org).
"openLCA" is a free high performance open source LCA software that includes the following features:

- fast and reliable calculation of your sustainability assessment and/or life cycle assessment;
- detailed insights into calculation and analysis results throughout the life cycle;
- life cycle cost analysis.

"ecoinvent" is one of the leading life cycle inventory (LCI) databases. "openLCA" is reseller of "ecoinvent". The latest version is 3.6, however, older versions can be used too.

3.4 Life Cycle Impact Assessment

The Life Cycle Impact Assessment (LCIA) will be elaborated and discussed in version 2 of this deliverable.

3.5 Methodological Approach for Life Cycle Cost Analysis (LCCA) of DELTA Pilot Sites

The Life Cycle Cost Analysis (LCCA) will be carried out for the two DELTA pilot sites in Cyprus and the UK. This will include additional efforts for the pilot sites but it will also be considered that these efforts will be reduced in real-life implementation. Hence, data collection will include data from the pilot site implementation but there will also be estimations of cost likely to occur in a real-life implementation. It will also be necessary to build scenarios where the implementation of the DELTA solution will be scaled up, reducing the share of fixed cost in comparison to running costs. These scenarios will also consider effects of economy-of-scale.

For the LCCA of the DELTA solution, the following costs will be considered:

- Information costs: clients have to be informed about the DELTA solution, its application, possibilities and requirements to participate. Costs will mainly include staff cost and a minor share of material costs (website, mail, handouts).
- Training costs: groups of clients, e.g. residents or facility management staff have to be trained on how the DELTA solution works and how it can be applied to a most beneficial way. Similar to information costs, staff cost will have the largest share, including material costs and infrastructure costs (meeting rooms, catering). With an increasing number of clients, these costs will decrease significantly as the prepared materials can be used for future activities with only small adaptations required.
- Investment costs: all materials that are additional to the conventional case will be considered in this cost category. It includes the FEID, additional sensors and actuators (if any), replacement of appliances in the case that the replacement takes place before the end-of-life of the replaced appliance. It also includes extra routers, switches and other equipment necessary to run the DELTA solution.
- Installation costs: all costs required to install the FEID and additional equipment will be considered in this cost category.
- Setup costs: equipment (FEID, routers, DVN, ...) has to be setup, with functionality tested and secured.
- Running costs: Running costs include energy costs for the FEID, other equipment, local computers/servers and maintenance costs for external computation.
- Energy costs: energy costs will be considered as costs compared to conventional practice (baseline), with this meaning that it could be savings or additional costs. The energy costs for the FEID must be secured. Other equipment such as local computers and servers are excluded in order to avoid double counting.
- Disposal costs: finally, all costs related to the disposal of equipment will be assessed.

The method for the LCCA is consistent with the LCA as scope and system boundaries are similar.

4. Data requirements

In this section, data requirements are presented as templates for both the LCA and the LCCA.

4.1 General comments

The scope of the investigation is the implementation of the DELTA solution in the pilot sites located in Cyprus and the UK. All elements within the system boundary will be considered. However, according to the presented system boundary, only additional elements that are compareble to the conventional case, are relevant for the analysis.

Data is collected for each pilot site and then further divided in each building/customer under consideration. Further details on pilot sites and the deployment of the DELTA solution can be found in D7.2 and D7.6.

4.2 Hardware data

According to the scope of the investigaton, only additional hardware compared to the conventional case has to be documented.

Table 3: Hardware data.

Hardware element	Necessary data
DELTA fog enabled intelligent device (FEID)	No of FEIDS: ... Version of FEIDS: ...
(Additional) Sensors	No of (additional) sensors (per type): ... Type of sensors [Temp., Humidity, CO_2, brightness; combination]: ... Energy consumption per sensor [kWh per h/day, other units]: ...
(Additional) Actuators	No of (additional) actuators (per type): ... Type of actuators: ... Energy consumption per actuator [kWh per h/day, other units]: ...
Building energy management system (BEMS)	• Only if a *new BEMS* is installed: Type of BEMS: ... Energy consumption [kWh per h/day, other units]: ... Share of energy used for other purposes than DR activities [%]: ... • If an *existing BEMS* is already in place: Type of BEMS: ... Additional energy consumption (if any): ...; or Share of energy used for DR activities [%]: ...

(Additional) Routers or similar facilities (switches, bus-systems, gateways, ...)	No of (additional) routers/switches/etc. (per type): ... Type of router/switch/...: ... Energy consumption [kWh per h/day, other units]: ...
(Additional) On-site server/data processing units/data storage	No of units: ... Type of units: ... Energy consumption [kWh per h/day, other units]: ...
(New and/or additional) Smart appliances	Type of appliance: ... Energy consumption [kWh per h/day, other units]: ... Type of replaced appliance: ... Energy consumption [kWh per h/day, other units]: ...
Installation materials	Materials used for installation of FEIDs, sensors, actuators, BEMS, smart appliances (cables, plugs, switches, clamps, ...), including waste material: ...

4.3 Software/Processing data

Table 4: Software/Processing data.

Unit	Necessary data
Data exchange between FEID and prosumer (BEMS, sensors, actuators, smart appliances)	Mbits/second; 1-15 minutes resolution, differentiated in upload/download
Data exchange between FEID and local compution/data processing/data storage	Mbits/second; 1-15 minutes resolution, differentiated in upload/download
Data exchange between FEID and DVN	Mbits/second; 1-15 minutes resolution, differentiated in upload/download
(Additional) Data exchange between DVN and market participants (TSO, EPEX, BRP, ...)	Mbits/second; 1-15 minutes resolution, differentiated in upload/download
Other data exchange processes	Mbits/second; 1-15 minutes resolution, differentiated in upload/download

4.4 Energy consumption data

Table 5: Energy consumption data.

Indicator	Necessary data
Baseline for building/customer	Baseline data (kWh/kW, 1 or 15 minutes resolution, incl. time-stamp)
Energy consumption of all consumers (total energy consumption of building/customer)	Metering data (kWh/kW, 1 or 15 minutes resolution, incl. time-stamp)
Demand Response data	Documentation of all DR events (time-stamp of activation, ramp, duration, power variation (kW), ...)
Energy consumption of FEID	Energy consumption per FEID (measured, calculated or estimated)
Energy consumption of (additional) sensors	Energy consumption per sensor (measured, calculated or estimated)
Energy consumption of (additional) actuators	Energy consumption per actuator (measured, calculated or estimated)
Energy consumption of (additional) equipment (server, on-site processing unit, data storage, ...)	Energy consumption per unit (measured, calculated or estimated)
Energy consumption of (additional) smart appliances	Energy consumption per smart appliance (measured 1-15 minutes resolution, calculated or estimated)

4.5 Cost data

Table 6. Cost data for the DELTA solution

	Preparation phase	Operation phase	Disposal
Planning	Effort for planning of implementation of DELTA solution: ... [hours, hourly rate] Costs for material (website, handout, mails, ...): ...		

Information, training and support	Effort for information of clients: ... Effort for training of clients: ... [no of participants per information/training, hours, hourly rate] Costs for material: ... Cost for infrastructure (room, catering): ...	Support efforts: ... [hours, hourly rate]	
Installation of equipment	Installation costs for FEID and other equipment (please specify): ... [hours, hourly rate] Costs for installation material (cables, claps, ...): ...		
Investment costs FEID	Cost per FEID (version xy): ...		Disposal costs for electronic devices: ...
Investment costs (additional) sensors and actuators	Costs for sensors and actuators (please specify): ...		Disposal costs for electronic devices: ...
Investment costs (additional equipment; routers, switches etc.)	Costs for additional equipment (please specify): ...		Disposal costs for electronic devices: ...
Investment costs smart appliances	Costs for additional appliances (please specify): ...		Disposal costs for appliances: ...
Setup costs	Cost for setup of the DELTA solution (connection to devices, DVN, testing) : ... [hours, hourly rate]	Cost for update of the DELTA solution (connection to devices, DVN, testing) : ... [hours, hourly rate]	
Computing costs: (additional) WLAN	Costs for (additional) WLAN hardware: ... Installation costs for (additional) WLAN: ...	Running costs for (additional) WLAN, per month: ...	
Computing costs: Cloud data processing		Costs for external data processing/data	

		storage (per month, per data unit): ...	
Energy costs		Energy tariff (fixed and variable part): ... Energy costs will be calculated on the basis of energy consumption	
Revenues from DR activities		Revenues from implicit DR will be calculated on the basis of the baseline and DR activities Revenues from explicit DR will be calculated from DR activities in demo sites	

5. Next steps and outlook

The methodology for the LCA and LCCA for the pilot sites in Cyprus and UK was defined within this deliverable. The results will be presented in D7.8 "LCA and LCC analysis for DELTA solutions and Use Cases v2", due at the end of the project in M36. Installation of the equipment for the deployment of the DELTA solution has already started and due to be finished in July or August, 2020.

For the preparation of version 2, the following steps will be carried out:

- Data collection will start in July 2020 in close cooperation with the DELTA demo site responsible persons. e7 will directly contact these persons. For cost data, this step will be carried out in close cooperation with WP2 and T7.4/T7.5.
- Data collection for the FEID started in April 2020 and is still in progress. Data has to be further elaborated and the computing metrics and data will be prepared with CERTH/HYPERTECH, starting in July 2020.
- For demo site countries (Cyprus and the UK) data for the whole electricity system has to be collected for recent years. It is not clear yet if data will be available within public databases with the necessary level of detail (time resolution, production units etc.) or if historical data will have to be purchased, e.g. from the www.electricitymap.org platform which offers these data in a directly usable format on a commercial basis.
- The first iteration of the LCA and LCCA with first draft results is due to be ready in November 2020.
- For the second and final iteration data, and where necessary also methodology, this will be constantly updated and improved.
- The final version of D7.8 will be ready one month after finishing the demo site activities for the deployment of the DELTA solution in M36.

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