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e-balance

Deliverable D1.10

Periodic Report 2

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Abstract

This Deliverable provides a brief summary of the progress of work and the management aspects of the e-balance project in the period M13-M24

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Impressum

[Full project title] Balancing energy production and consumption in energy efficient smart neighbourhoods

[Short project title] e-balance

[Number and title of work-package] WP1 Project Management
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List of Abbreviations

CMU	Customer Management Unit
DER	Distributed Energy Resources
DSO	Distribution Service Operator
FAN	Field Area Network
HAN	Home Area Network
KPI	Key Performance Indicator
LV-FAN	Low Voltage Field Area Network
LVGMU	Low Voltage Grid Management Unit
MU	Management Unit
MV-FAN	Medium Voltage Field Area Network
MVGMU	Medium Voltage Grid Management Unit
SGAM	Smart Grid Architecture Model
TLGMU	Top Level Grid Management Unit
TSO	Transmission Service Operator
WAN	Wide Area Network

1 Publishable Summary

The aim of the e-balance project is to investigate and develop an energy management system for balancing energy production and consumption that considers also non-technical aspects related to the socio-economic and legal context it shall be deployed within. The general technical solution shall thus be realized as a holistic approach, also covering the security and privacy aspects. It employs a hierarchical architecture of the management units that corresponds to the structure of the energy grid and enables decentralised control decisions.

Within the second reporting period, technical and scientific work was focused on six work packages:

- WP2 addressed the validation of the identified use cases and business ideas defined in the previous reporting period.
- WP3 addressed the definition of the detailed system specification based on the high-level one defined in the previous reporting period and the input from WP2. The requirements were mapped onto the blocks that make up the system.
- WP4 addressed the implementation and integration of the communication part of the ICT solution. The communication platform is responsible for efficient and secure data exchange and management of the network of management units. The middleware that is the major part of the communication platform hides the communication details from the main energy management logic.
- WP5 addressed the implementation and integration of the energy balancing mechanisms, as well as the energy resilience mechanisms that constitute to the energy management platform. Further, security and privacy related aspects were addressed also.
- WP6 addressed the definition of the methods for evaluation of the project results. In the second reporting period we finalized defining the demonstrators and started integrating the prototypes. First activities towards the deployment were also undertaken.
- WP7 addressed all communication requirements of the European Commission, including maintenance of the project website (http://www.e-balance-project.eu/), update of dissemination material and preparation of news about the e-balance project. In the second reporting period the consortium has contributed and participated on 26 events (conferences and workshops) presenting the results of the work within the year. Several publications (15) were submitted and already accepted for publication, several others were submitted. In addition, preliminary steps to establish synergies with similar projects have been started in order to enhance the exploitation of results.

The e-balance project faced some delays in the current reporting period, but finally the milestones and most of the deliverables planned for this reporting period have been submitted within this period.

2 Progress of technical work and achievements

In the following sections we describe the tasks that were active in the second reporting period, the work that was done as well as the results of the tasks. An overview on all tasks of the project is shown in Figure 1.

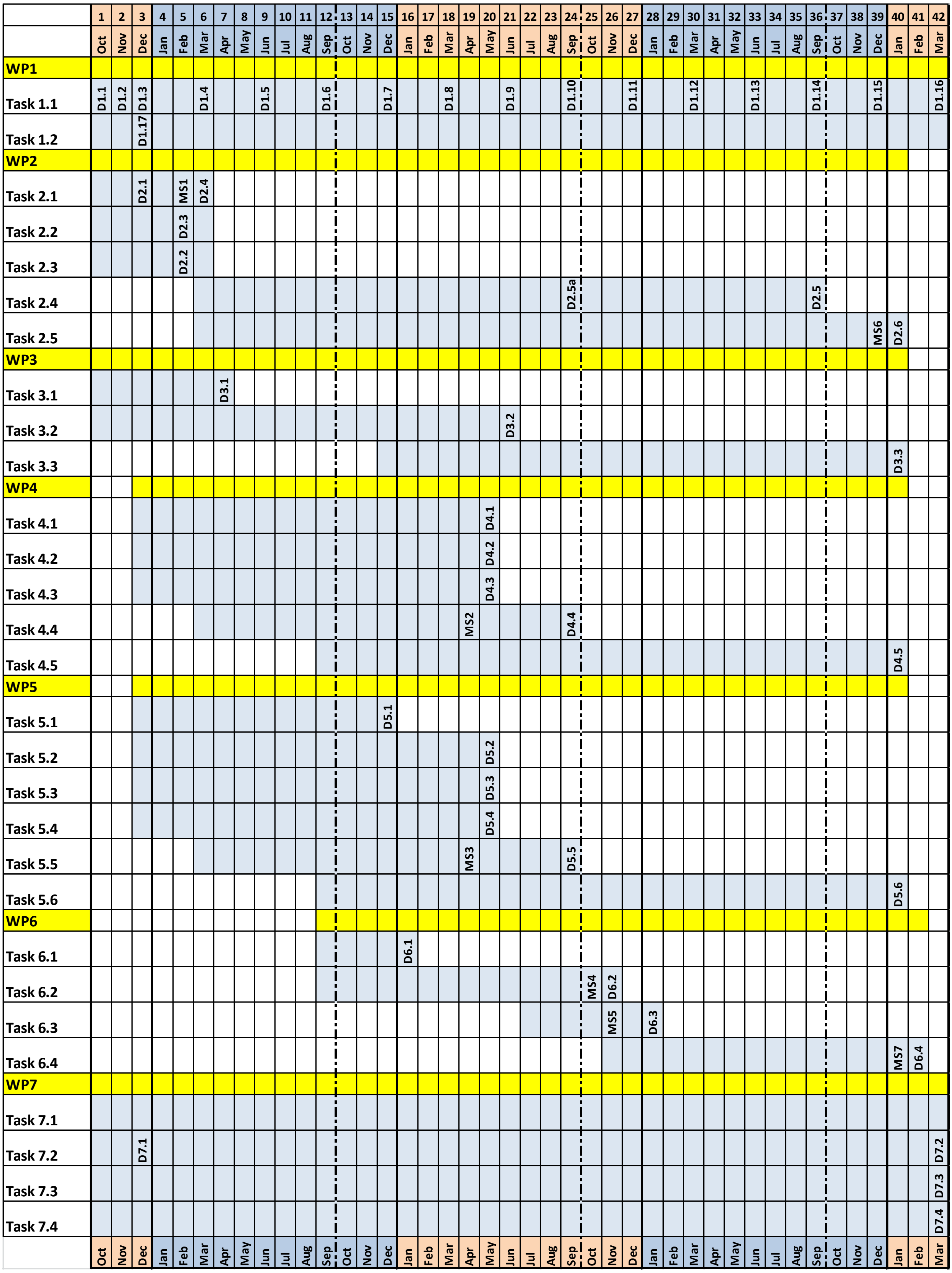


Figure 1: Project plan on the task level for the e-balance project

It is important to mention that most of the numbers on effort plan are based on linear effort allocation over the task duration. Since this does not necessarily express the actual effort allocation, some deviations appear, especially due to the dependencies between different activities, but also due to internal resource availability changes like vacation or illness. However, this approach provides the simplest and basic measure to estimate the effort distribution.

2.1 WP2 - Use cases and socio-economic aspects (M1 – M40)

During Y1 in WP2 use cases were defined and technical and socio-economic analysis over use cases were done as well as user studies (survey-based). The aim of this analysis was to ensure proper definition of the overall architecture and features taking into account proper allocation of system components, the correct flow of information etc. In addition, this knowledge helped to identify where and which information is required and whether it needs to be protected against misuse or loss.

The user study will be realized in two waves, the results of the first one (that was executed in the initial phase of the project) provided us with the input for the system specification, where the results of the second one (that will be executed at the end of the project) will help us to evaluate the proposed system in general and against the changes in the users' needs. Potential users of the proposed solution will be interviewed between the two phases in order to obtain their early opinions. This process includes face-to-face interviews with the users at the demo sites as well as interviews with external experts, e.g., suggested by the consortium or the advisory board. For the demo site users we will also prepare the portal to provide their feedback, so they can get more information and also provide their feedback on the technical and socio-economic aspects of the solution as well as the user interface means (GUI) even before actually using it.

In addition, in order to incorporate internal Research or Development, as well as external factors that influence the project specifications a tune is being done to incorporate more details, corrections and decision taken in system and communications specifications.

From the user acceptance perspective, the technical and socio-economic aspects are essential for development of appropriate and holistic approach providing security and privacy means. Overall, WP2 defines the socio-economic framework for the technical solution.

WP2	**Reporting Period: M13-M24**											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	8.31	2.61	12.05	0.3	9.72	2.30	2.67	27.18	1.21	7.64	2.35	**76.34**
PM plan for Y1	9.24	2.44	12.07	0.0	9.22	2.22	3.62	28.27	1.22	9.33	2.44	**80.09**
PM spent in Y2	0.80	1.08	1.25	0.0	0.58	0.75	2.54	11.06	0.32	2.50	1.59	**22.47**
PM plan for Y2	0.80	1.08	1.25	0.0	0.28	0.70	2.33	11.06	0.32	2.50	1.59	**21.91**
Total spent	9.11	3.69	13.30	0.3	10.30	3.05	5.21	38.24	1.53	10.14	3.94	**98.81**
PM plan total	**12.00**	**4.00**	**15.00**	**0.0**	**10.00**	**3.00**	**5.00**	**46.00**	**2.00**	**14.00**	**4.00**	**115.00**

2.1.1 The WP2 results in Y2

- Intensive research towards the validation of the approach in T2.4.
- Fine tune of use cases and business models regarding system and communication specifications.

In the following the tasks are introduced and the accounted work and the results are described briefly.

2.1.2 Task 2.4 Validation of the proposed Use Cases an Business Models (M6 – M36)

Description according to Annex I

In this task the potential users of the proposed solution will be interviewed in order to obtain their early opinions.

This process is located between the two waves of the user study and includes face-to-face interviews with the users at the demo sites as well as interviews with external experts, e.g., suggested by the consortium or the advisory board. For the demo site users we will also prepare the portal to provide their feedback, so they can get more information and also provide their feedback on the technical and socio-economic aspects of the solution as well as the user interface means (GUI) even before actually using it.

Work done

- ❖ Preparation of separate social study dedicated to the privacy issue.
  The first wave of quantitative social study showed importance of the privacy and control issues, which can be significant barriers in adoption of the e-balance system. In order to deeply understand these factors, IPI conducted separated quantitative research fully dedicated to the privacy in context of Smart Grid. The research was conducted on over 1000 Polish electricity users. Scope of work includes: scripting of the online questionnaires and setup of IT resources for the study; coordination and supervision of collecting data from respondents; analysis of the obtained data, preparation of tables and visualizations.

  The research show:
  - the level of feeling that technology threatens the people's privacy
  - the level of feeling that particular e-balance system features threatens the privacy
  - detailed place of privacy in the hierarchy of e-balance system features

- ❖ Restatement of market approach and business models (coordinated by LODZ) in order to include the results of the social research.

- ❖ Restatement of users and stakeholders' requirements (coordinated by CEMOSA) in order to include the results of the social research.

- ❖ Preparation of the researches in the demo sites which aim at validation of the system architecture and functionalities as well as gathering feedback concerning the user's current experiences.

  This work is postponed due to technical issues and extended by 1 year till M36 (extended D2.4). Designed interviews include validation of the proposed use cases and business models. It will be performed through individual f2f interviews and online discussion forum in cooperation with UTWENTE (Bronsbergen demonstrator) and EDP (Bathala demonstrator) as soon as the system is deployed. The preliminarily expected number of interviews to be conducted in both demo sites may be a subject to change due to expected difficulties of access to the respondents permanently residing in these locations.
- ❖ Expert assessment of the preliminary version of Graphical User Interface (GUI). Preparation of an eye-tracker study.

- ❖ Design, implementation, and validation of energy net consumption prediction model prototype. The e-balance system design involves a module for prediction of energy load 24 hours ahead. We have prepared a fully working prediction model. To some extent the definition of the prediction problem was predetermined by energy load data available at the moment. We have used an Open Data database obtained from Liander Company. This database contained a set of time series, the prediction model had to be built around 15 minutes' time intervals. The prediction problem implied estimation of a future (24 hours = 96 15-minutes intervals ahead) net consumption value based primarily on several measurements of net consumption values: one located at present interval t0 and the remaining measurements located backwards in the past. An Artificial Neural Network (ANN) - a Multilayer Perceptron (MLP) was chosen as the tool for the energy load predictions. Decisions had to be made as to number and structure of the ANN inputs. First of all we employed a heuristic to establish how many net consumption measurements to include as predictors of the 24 hours ahead value. Another heuristic had to be employed in order to establish the number of 15 minutes intervals between consecutive measurements of load values – the so called optimal lag. We have determined 18 15-minutes intervals as the optimal lag - both at neighbourhood level and on average for the 75 households. Additional ANN inputs were included into the model to account for exogenous factors: weather conditions, natural cycles, calendar days.

Tools used for the implementation of the prediction model included: R programming language, R package RSNNS for neural networks, R packages used for data preprocessing, signal analysis, results analysis and results visualisation, our own R code wrapped over the RSNNS package, our own R code for data preprocessing, signal analysis, results analysis and results visualisation.

Mean Absolute Error (MAE) of model fit and Mean Absolute Error of prediction were used as a Key Perfomance Indices for the prediction model. In-depth analysis of the fit MAE distributions has been provided in the Delivarable 5.2 “Detailed specification, implementation and evaluation of energy balancing algorithms”.

❖ Dissemination of the project results:
- Presentation the results of the e-balance project on 9th Mediterranean Conference on Power Generation, Transmission Distribution and Energy Conversion (MedPower 2014); 3-7 November 2014.

- Publication of the paper How to balance the energy production and consumption in energy efficient smart neighbourhood in IET Digital Library

  Author(s): K. Piotrowski, J.J. Peralta, N. Jiménez-Redondo, B.E. *Matusiak*, J.S. Zieliński, A. Casaca, W. Ciemniewski, K. Krejtz, J. Kowalski
  Source: MedPower 2014, 2014, p. 33 (8 .) - 33 (8 .)
  Type: Conference Paper

  - Location: Athens, Greece
  - Conference date: 2-5 Nov. 2014
  - ISBN: 978-1-78561-146-9
  - Conference number: CP665

- Promotion of the e-balance project on The Science Picnic - the Europe’s largest outdoor event aimed to promote science. (9 of May 2015).

- Participation in workshops at Findhorn Foundation - a sustainable Scottish community based on renewable energy sources and recycling. Presenting e-balance project principles within workshops concerning user’s engagement and behavioural changes. (June 2015).

The main activities by the partners

IHP (0.2 PMs)	• Investigation of the business model validation
EDP (0.35 PMs)	• Analysis of business models for UC restated and balancing algorithm • Identification of possible approach in Batalha for social studies to be conducted • Identification of DSO key users to interview
IPI (6.64 PMs)	• Review of the use cases in terms of social aspects and coherence with the user study findings

	• Contribution to the user requirements and ongoing analysis of social studies data • Implementation of the social research results into the business model conception • Development of KPI's within business model description • Work on the new business models description • Preparation of the second wave of the social research for business model validation Research is postponed till the specification of the system is completed by the consortium partners within other tasks • Exploitation of the current results of social studies for the project • Execution of the privacy study
ALLI (0.53 PMs)	• Validation of use cases with respect to applicability to the demonstrators • Work on business models, to comply with reviewer requests • Bronsbergen customer contact related activities • Customer interaction, Organisational activities related to user studies
LODZ (0.16 PMs)	• Redefinition of the Market model, ownerships and BM overall descriptions

2.1.3 Task 2.5 Use Case, Market and Requirements Restatement (M6-M40)

Description according to Annex I

During the course of the project, internal Research or Development, as well as external factors may influence the above specifications developed earlier on in the project – for example a new requirement identified, a change in regulation can happen or a business hypothesis prove not to be valid.

The second wave of the survey based user requirements study will be performed in Poland, Portugal and in the Netherlands in order to research the changes in the user requirements and energy efficiency related attitude during the project time. This will show how the social aspects are evolving and how fast this process is, depending on the country. The features of the proposed solutions will be also evaluated within the second wave of the user study.

Work done

Work has been developed in order to fine tune use cases, business models and requirements regarding system and communication specifications.

The main activities by the partners

IHP (0.6 PMs)	• Work on the use cases and business models restatement
INOV (1.08 PMs)	• Work on the restatement of use cases 18, 20, 21, 22, 23 and 24 • Analysis of the possible integration of microgeneration providers into the Batalha demonstrator
EDP (0.9 PMs)	• Restatement of use cases
CEMOSA (0.58 PMs)	• Contribution to use cases restatement. Evaluation of energy balancing rationale of each use case and connection with stakeholders and systems • Contribution on the restatement and description of business models • Restatement of the conceptual map according to the use cases' restatement (version 3.0) and current system architecture • Workshop in Barcelona (June 23, 2015) to share with other European projects the current approach of business models and receive their feedback. • Discussion regarding the aggregator figure and its role inside the e-balance approach: compatibility, price mechanisms, owner, etc. • Agreement with other European project to prepare a workshop for Sustainable Places 2015 (17th September 2015) focused on business model developments. • Assessment and definition of price mechanisms for business models restatement regarding Aggregator-DSO-Customer
UTWE (0.75 PMs)	• Refinement of the use cases and the business models

<table>
<tr><td>IPI (4.42 PMs)</td><td>
Review of literature regarding privacy issues, users’ concerns and acceptance of smart grids solutions
Preparations of the quantitative customers research in demo-sites - restatement of the system functionalities and architecture
Preparation of the theoretical framework and preparation for system concept validation in the demo sites - interview scenarios, users involvement, details related to the implementation of the studies in the field
Preparation for system concept validation in the demo sites - interview scenarios, users involvement, details related to the implementation of the studies in the Bronsbergen and Bathala
</td></tr>
<tr><td>ALLI (2.01 PMs)</td><td>
Restatement and more in-depth formulation of the use cases, to support WP3,4,5 and 6
Restatement of use cases and business models
</td></tr>
<tr><td>LW (0.32 PMs)</td><td>
Contributions to the use cases restatement
Contribution to Market and Requirement Restatement
</td></tr>
<tr><td>LODZ (2.34 PMs)</td><td>
Literature studies and the BM canvas preparation for BM.
Contribution to the business model development. System of incentives and KPIs proposition.
Control and monitoring of the legal changes and proposals on polish energy market
Participation in the restatements of business models
The KPIs theoretical proposition for e-balance BM assessment – preliminary analysis.
Ownership and users’ perspective analysis.
Current and future market model analysis. The e-balance system compatibility with current market model.
Business model according Osterwalder’s canvas - improved description.
Discussions - other business aspects of e-balance system.
Added values analysis for all e-balance stakeholders- new approach and analysis prepared.
Business model definition - user’s and demo site perspectives (new version prepared).
Added values analysis for all e-balance stakeholders (improved version).
Ownership analysis – improved version.
How to release added value on the market and how to involve users into e-balance system usage - new analysis.
Business case proposal – users’ perspective and e-balance mechanism- new analysis.

Win-win strategy analysis for each stakeholder in e-balance system –draft version.
An expanding and reshaping of the Business model in aspect of market, new value for the users, price mechanism, ownership and users’ engagement.
Consultations with partners (additional meetings teleconferences, discussions) which are the base for preparation the document with new analysis and results.
</td></tr>
<tr><td>EFA (1.59 PMs)</td><td>
Deep analysis of all 28 Use Cases and assessment of their usability regarding the demonstrators at Batalha and at Bronsbergen; in the same scope, inclusion of 3 new Use Cases: UC 29, UC 30 and UC 31
Contributions for the restatement of Use Cases: UC 5, UC 6, UC 13, UC 14, UC 17, UC 23, UC 24, as well as recommendations for restating Use Cases: UC 3, UC 7, UC 9, UC 19
Restatement of grid balancing and of grid resilience Use Cases
Assessment of the recommendations by the Reviewers, and preliminary contributions regarding the restatement of Market and Business Models
Restatement of grid balancing and of grid resilience Use Cases, namely
</td></tr>
</table>

	regarding those meant for implementation, deployment and demonstration in Batalha and in Bronsbergen

2.1.4 Deliverables in WP2 the consortium worked on in Y2

- D2.5 “Validation of the proposed use cases and business models” within Task 2.4 (M6-M36) – ongoing.

D2.5	Reporting Period: M13-M24											
Participant	IHP	INOV	EDP	UMA	CEMOSA	UTWE	ALLI	IPI	LW	LODZ	EFA	TOTAL
PM spent in Y1	0.00	0.00	0.50	0.00	0.00	0.00	0.31	13.54	0.00	0.56	0.00	**14.91**
PM plan for Y1	0.80	0.00	0.40	0.00	0.00	0.00	0.40	5.60	0.00	0.00	0.00	**7.20**
PM spent in Y2	0.20	0.00	0.35	0.00	0.00	0.00	0.53	6.64	0.00	0.16	0.00	**7.88**
PM plan for Y2	0.20	0.00	0.35	0.00	0.00	0.00	0.53	6.64	0.00	0.16	0.00	**7.88**
Total spent	0.20	0.00	0.85	0.00	0.00	0.00	0.84	20.18	0.00	0.72	0.00	**22.79**
PM plan total	1.50	0.00	0.60	0.00	0.00	0.00	1.65	25.69	0.00	3.92	0.00	**33.36**

This deliverable will provide the summary of the obtained feedback during the validation and actions we made, e.g., for the integration of the improvements.

- D2.6 “Restatement of the selection of the representative use cases” within Task 2.5 (M6-M40) – ongoing.

D2.6	Reporting Period: M13-M24											
Participant	IHP	INOV	EDP	UMA	CEMOSA	UTWE	ALLI	IPI	LW	LODZ	EFA	TOTAL
PM spent in Y1	0.30	0.48	0.15	0.00	0.60	0.00	0.01	6.33	0.15	0.32	0.35	**8.69**
PM plan for Y1	0.44	0.44	0.67	0.00	0.22	0.22	0.22	2.67	0.22	1.33	0.44	**6.89**
PM spent in Y2	0.60	1.08	0.90	0.00	0.58	0.75	2.01	4.42	0.32	2.34	1.59	**14.59**
PM plan for Y2	0.60	1.08	0.90	0.00	0.28	0.70	0.99	4.42	0.32	2.10	1.59	**12.98**
Total spent	0.90	1.56	1.05	0.00	1.18	0.75	2.02	10.75	0.47	2.66	1.94	**23.28**
PM plan total	2.19	1.87	3.00	0.00	0.88	0.70	1.00	12.00	0.94	2.42	2.00	**27.00**

This deliverable will provide an evaluation of the use case definitions, as well as the requirement and business analyses done in the initial phase of the project and reasoning for the needed adaptations as lessons learnt during the integration and testing phase.

Deviations

The difference of the effort planned and actually spent for all activities in the work package WP2 is minor.

There are two partners that already spent all the planned effort (ALLI and UTWE) and overspent. However, the overspending is very small (0.05 PMs in case of UTWE and 0.21PMs in the case of ALLI) and both the partners did not overspend in general. This overspending was due to the fact that these two partners were very active with restatements of the market models.

2.2 WP3 – System specification (M1 – M40)

The goal of this work package is to develop a blueprint for building energy management systems that allow for balancing energy production and consumption on very local basis. In order to achieve this goal the needed components will be identified and specified. In addition the data flow between the components and the required features are defined, based on the results of WP2. WP3 defines the technical framework (identifies modules and defines interfaces between them) for WP4, WP5 and WP6. After evaluating the interaction of the components in early integrations in these work packages, the architecture was refined gradually to ensure quality and consistency between the concept and the implementations and to guarantee that the architecture can be re-used by other projects or in case of commercial exploitation.

WP3	**Reporting Period: M13-M24**											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	5.96	5.14	3.10	5.40	0.40	3.80	1.00	3.35	5.20	0.47	3.51	**37.33**
PM plan for Y1	5.50	4.50	3.34	5.20	2.40	4.60	1.80	7.00	5.20	3.00	5.60	**48.14**
PM spent in Y2	3.00	1.89	0.60	5.38	2.60	2.10	0.55	5.09	1.57	0.23	2.49	**25.50**
PM plan for Y2	1.08	1.00	1.40	3.70	3.00	2.20	1.16	4.60	1.18	0.40	4.11	23.83
Total spent	8.96	7.03	3.70	10.78	3.00	5.90	1.50	8.44	6.77	0.70	6.00	**62.83**
PM plan total	**9.00**	**6.00**	**4.70**	**6.50**	**3.00**	**7.00**	**3.00**	**19.00**	**8.00**	**5.00**	**8.50**	**79.70**

2.2.1 The WP3 results in Y2

- Delivered deliverable D3.2 “Detailed system architecture specification”
- Work towards the restatement of the system architecture specification in Task 3.3

In the following the tasks are introduced and the accounted work and the results are described briefly.

2.2.2 Task 3.2 Technical Specification (M1 – M21)

Description according to Annex I

This task will use the functional specification as above and define the technical details of the project including interfaces, available packages, common features, interface guidelines, message bus structures, parameterisation etc.

Work done

The aim of the technical specification is to define the technical building blocks (modules) that define the e-balance system together with their interdependencies. The technical modules were identified and described for the implementation in the technical work packages WP4 and WP5. The deliverable D3.2 defines the final shape of the e-balance ICT system.

In the reporting period we finalized the technical specification of the e-balance system. This technical specification defines the modules with finer granularity, compared to the functional specification done in task T3.2 and is defining the interfaces between them. We also identified the data exchange, i.e., the data sets required by the system modules and their flow within the system.

The main activities of the partners

IHP (3.0PMs)	• Contributions to deliverable D3.2 • Activities towards the detailed system specification. Coordination of the task • Finalizing the deliverable D3.2
INOV (1.89 PMs)	• Definition and specification of modules related to the Network stacks, of the DERMU and of the flows related to Networks stacks, having in view their inclusion in D3.2 • Contributions to D3.2 and discussion on the detailed architecture of e-balance
EDP (0.6 PMs)	• Contributions and review of D3.2
UMA (5.3 PMs)	• Writing of deliverable D3.2: - Description of the communication platform modules. - Description of the Data Interface • Review and contributions to the deliverable D3.2
CEMOSA (2.6 PMs)	• Review of system architecture functionalities • Contribution on describing information flows and review of different versions of deliverable D3.2 – Detailed system architecture specification • Review of the current version of the deliverable D3.2 and description of specific information flows • Follow up and review of D3.2 versions. Checking compatibility with energy balancing algorithms
UTWE (2.1 PMs)	• Contribution to refinement of the system architecture • Contributions to and discussion of deliverable D3.2 • Review of the deliverable D3.2
ALLI (0.55 PMs)	• Minor discussions regarding DERMU and relations between architecture, use cases and demonstrators • Review of D3.2 elements and general architecture related discussions • Architecture related discussions
LW (1.34 PMs)	• Contribution to the technical specification • Contribute experiences from the implementation to the specification
LODZ (0.23 PMs)	• Discussion and contribution in area of technical and functional specifications for the e-balance system, energy balancing mechanism and market aspects
EFA (1.0 PMs)	• Contributions for the restatement of D3.1 (T3.1) and active role on tuning and preparing D3.2 (T3.2), regarding the system requirements and the technical specification of different units

2.2.3 Task 3.3 Architecture and Specification Restatement (M15 – M40)

Description according to Annex I

During the course of the project, internal research or development, as well as external factors may influence the above architecture and specifications. Thus this task provides time for end-project activity to ensure a final iteration in which deliverables will be updated to ensure synchronicity with the factual final results for wider publishing. In addition practical aspects i.e. those that have impact on deployment will be emphasized where ever possible. To reflect that the lead is taken by an industrial partner.

Work done

Initial activities towards the restatement of the technical specification were performed. They are mainly from the social perspective, but include also some technical restatements.

The main activities of the partners

IPI (5.09 PMs)	• Analysis of social studies data in terms of functional specifications • Transforming knowledge outputs of social research on specific recommendations related to system architecture. Preparation of research dedicated to the theme of privacy - threats and opportunities of the system. • Analysis of the data from the additional study on privacy in terms of system architecture, its functionality and data protection aspects. Translating research findings into recommendations for the system. • Execution of additional UI study on GUI
LW (0.23 PMs)	• Contribution to Architecture and Specification Restatement
EFA (1.49 PMs)	• Task management • Contributions for the restatement of D3.1 (T3.1) and of D3.2 (T3.2), regarding the system requirements and the technical specification of the LVGMU – Low Voltage Grid Management Unit – and of the MVGMU – Medium Voltage Grid Management Unit • preparation of contents for the Plenary Meeting

2.2.4 Deliverables in WP3 the consortium worked on in Y2

- D3.2 "Detailed system architecture specification" within Task 3.2 (M1-M21) – submitted

D3.2	**Reporting Period: M13-M24**											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	2.02	1.70	0.60	2.80	0.00	0.20	0.04	0.00	3.22	0.00	1.19	**11.77**
PM plan for Y1	2.00	2.00	1.44	5.20	2.40	1.60	0.80	0.00	3.20	0.00	3.60	**22.24**
PM spent in Y2	3.00	1.89	0.60	5.38	2.60	2.10	0.55	0.00	1.34	0.23	1.00	**18.69**
PM plan for Y2	0.48	0.80	1.20	3.70	3.00	1.80	0.96	0.00	0.78	0.00	3.31	**16.03**
Total spent	5.02	3.59	1.20	8.18	2.60	2.30	0.59	0.00	4.56	0.23	2.19	**30.46**
PM plan total	**2.50**	**2.50**	**1.80**	**6.50**	**3.00**	**2.00**	**1.00**	**0.00**	**4.00**	**0.00**	**4.50**	**27.80**

This deliverable outlines the detailed technical specification of the entire system covering the all system levels and the interaction between the different grid levels.

- D3.3 "Restatement of the system architecture specification" within Task 3.3 (M15-M40) – ongoing

D3.3	**Reporting Period: M13-M24**											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y2	0.00	0.00	0.00	0	0	0.00	0.00	5.09	0.23	0.00	1.49	**6.81**
PM plan for Y2	0.60	0.20	0.20	0	0	0.40	0.20	4.60	0.40	0.40	0.80	**7.80**
PM plan total	**3.00**	**1.00**	**1.00**	**0**	**0**	**2.00**	**1.00**	**12.00**	**2.00**	**2.00**	**2.00**	**26.00**

This deliverable will restate the detailed technical specification of the entire system covering the all system levels and the interaction between the different grid levels.

Deviations

During this reporting period in this work package most of the partners were very busy with the technical specification of the system. Due to that several partners overspent the planned effort for this task for this period. But only two spent already all the efforts planned for the work package.

The partners, INOV and UMA went over the effort planned for the respective partner for the whole work package. The coordinator is monitoring the overall state of the efforts and none of these partners overspent the total number of planned person months nor went over the planned budget. In addition these partners are aware of this fact and ensured that they will fulfil all their tasks.

The finalized deliverable D3.2 had an overspending of about 10%.

In the restatement task most of the partners did not used the planned efforts, but this is due to the fact that the plan was a linear distribution of the effort over the task duration.

2.3 WP4 – Communication Platform (M3 – M40)

WP4 is devoted to the development of the communication platform. In this work package, the modules for the communication layer of the system architecture are chosen, adapted and integrated into a common communication platform. Its tasks cover all the levels of the energy grid, i.e., communication with individual home appliances but also communication between higher level management units.

The primary objectives and goals of this work package are:

- Development of a communication platform for heterogeneous devices ranging from high performance computers in charge of running the energy production and consumptions models to resource-constrained battery-powered wireless sensor nodes.
- Integration of communication technologies for decentralized power management with increased local decision support.
- Real time requirements, security and privacy of the communication.

WP4	**Reporting Period: M13-M24**										
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	4.58	4.55	1.65	11.50	0	2.4	0	0	4.60	0	1.92	**31.20**
PM plan for Y1	9.45	4.56	2.09	8.89	0.59	4.76	0	0	4.69	0	3.40	**38.44**
PM spent in Y2	6.95	7.52	1.70	5.30	1.00	8.42	0	0	5.59	0	5.40	**41.88**
PM plan for Y2	12.52	5.65	2.25	6.10	1.20	8.10	0	0	4.70	0	4.38	44.90
Total spent	11.53	12.07	3.35	16.80	1.00	10.82	0	0	10.19	0	7.32	**73.08**
PM plan total	**21.00**	**11.00**	**4.70**	**20.00**	**2.00**	**14.00**	**0**	**0**	**11.00**	**0**	**8.00**	**91.70**

2.3.1 The WP4 results in Y2

- Network infrastructure: During the second period, the e-balance network architecture was refined and finished. As a result of this, deliverable D4.1 (Detailed Network Stack Specification and Implementation) was submitted. The main achievements were:
  - Final definition of the e-balance network architecture including selected technologies and protocol stack at different levels (e.g. FAN and HAN). This definition includes a network protocol stack flexible enough to be able to fulfil the information flow requirements of e-balance in particular and grid control and monitoring systems in general. The design takes care of

security and privacy mechanisms and it is supported by a data exchange middleware providing a generic data interface which can be used by application layers.
  - Comprehensive state-of-the-art compilation and analysis. Existing communication technologies and protocol stacks were analysed and assessed regarding their applicability in Smart Grid applications. The selected technologies are:
    - HAN: Z-Wave, Bluetooth, IEEE 802.15.4
    - FAN: PLC PRIME, IEEE 802.15.4, LTE
    - WAN: Broadband technologies, including cabled and wireless
  - Tests of communication technologies and protocols to be used for implementing the e-balance network stack at different architecture levels (e.g. HAN), performance analysis (e.g. IEEE 802.15.4)
  - Detailed specification, simulation and analysis of an alarm aggregation scheme for multi hop field area networks.
  - Network requirements extracted from information flows. The information flows were characterized regarding data rate, latency and reliability requirements. From these information flows, two realistic scenarios were defined: one in Batalha and another one in Bronsbergen.
- Security and privacy: During this period, security and privacy solutions progressed with the identification of the crypto blocks in e-balance that composes the e-balance security architecture. As a consequence of the fractal nature of e-balance, security can be applied at different levels: device, communication platform or energy management platform. Symmetric, asymmetric or homomorphism encryption can be used. Several mechanisms have been implemented including user management, roles and data access control. Main achievements during this period include:
  - Definition of the security architecture, security modules and choice of the security mechanisms. Definition of the security related functionality to be covered by the system architecture and identification of available solutions covering the above functionality. In addition, the security solution in the communication platform has been discussed.
  - Studies covering security analysis regarding demonstration implementation, security mechanisms use in primary substations and identification of best practice in terms of security and privacy regarding DSO services. Security and privacy mechanisms impact assessment regarding the management units, namely the LVGMU and the MVGMU.
  - Implementation of library including mechanisms for privacy and security. This library works with privacy homomorphism, concealed data aggregation, scalable security mechanisms and public key infrastructure (PKI). Some work of this task is related to integration (T4.4/T5.5) including authentication, certificates (also revocation), group management, trust, etc.
- Data exchange middleware: During the second period, the data exchange middleware was implemented and tested. As a result, deliverable D4.3 (Detailed middleware specification and implementation) was submitted. The main achievements were:
  - Specification and design of the middleware. This middleware is in charge of facilitating and making the exchange of data transparent to all the components (e-balance applications on the management units) involved in the e-balance system.
  - Implementation and testing of the middleware. The middleware is implemented over ServiceStack and Mono/C# as software development platform. It can be executed on different devices (e.g. BeagleBone) and operating systems. Implementation includes the middleware modules (e.g. data persistence, data interface, data processor, user management, data access control) and two APIs (data interface API and functional API).
  - Data interface API. This API can be used with RESTful Web Services, which make the middleware fully interoperable with remote devices as its operations can be triggered from any operating system and the data consumers can be implemented using any programming language.

  - Functional API. It does improve the usability of the data interface when it is used from internal e-balance software modules (e-balance applications). For instance, a LVGMU could request information from several CMUs using broadcast in a transparent way.
- Integration tasks: Integration is being carried out at different levels: protocols - devices, middleware – energy platform, middleware - G-Smart devices, middleware - security. Some activities have been carried out in parallel with tasks T4.2, T4.3 and T5.5. The main achievements were:
  - Definition of the integration strategy, test card definition and tests. Virtual machines have been configured in such a way that we can test the full chain from the energy management algorithms to devices.
  - Integration of energy and communication platform: a Java wrapper has been developed in order to be used by the energy platform. This wrapper assists to the energy platform in security and communication aspects between management units.
  - Integration between middleware and web applications. In a similar way, a Javascript wrapper has been developed to help in the development of web applications.
  - G-Smart – middleware integration. G-Smart devices are going to be used to get information from sensors and to provide this information to management units. Integration activities were carried out in order to enable communication between G-Smart devices and the data exchange middleware: G-Smart to management unit and management unit to G-Smart.
  - Integration of the security modules with the middleware. This integration allowed using security mechanisms within the middleware.
  - Implementation of wireless sensor communication protocols. Integration of communication protocols in the sensor boards.
  - Appliance steering framework. Integration for communication with smart appliances.

In the following the tasks are introduced and the accounted work and the results are described briefly.

2.3.2 Task 4.1 Networking Layer (M3 – M20)

Description according to Annex I

This task is responsible for the development of the integrated networking solution that will support the energy balancing system, providing efficient and reliable communication between the system components.

The main activities are:

- Selection of communication technologies,
- Development of the protocol stack.
- Development of protocols for efficient and reliable real-time/near-real-time services and applications,
- Development of network reliability and self-healing mechanisms,
- Development of node energy consumption management algorithms,
- Planning of the deployment.

Work done

The networking layer provides the low level communication support to the e-balance system, interconnecting both physically and logically the relevant system entities, such as Management Units (MUs), sensors, actuators and smart meters. It will support the transmission of e-balance information flows between those entities, granting the performance required by the respective services, while minimizing the costs associated with network deployment and operation.

The objective of task T4.1 is to specify and to implement the networking layer. It started in M3 and finished in M20 with the delivery of D4.1. Between M13 and M20, the following results were attained:

Analysis of E-Balance information flow requirements: The information flow requirements on the networking layer were specified, namely for the energy balancing and fault detection mechanisms. This resulted in a raw coarse estimate of the generated amount of traffic (data rate and message size), as well as the specification of the delay bounds for the respective components.

Specification of e-balance deployment scenarios for the evaluation of communication technologies: two technology validation scenarios were defined, based on the Bronsbergen and Batalha demo scenarios. These technology validation scenarios are extended versions of the latter to encompass a more realistic number of nodes and amount of network traffic. Aggregate traffic patterns were defined taking into account Energy Balancing and Neighbourhood Monitoring information flows (this is based on the information flow characterization accomplished in Y1). For the holiday park Bronsbergen scenario, 208 cottages are connected with SS Roelofs (where the LV-GMU is located) through the respective LV-FAN. From these, 92 cottages are or will be equipped with solar panels. An area of 500×200 m^2 is assumed. For the Batalha LV grid scenario, 9000 clients are distributed by 133 SSs, which results into an average of 68 clients per SS.

Analysis of candidate communication technologies was completed: based on the evaluation scenarios mentioned in the previous item, the analysis of candidate communication technologies was completed. Regarding LV-FAN technologies, it was concluded that PLC PRIME, IEEE 802.15.4 and UMTS are all able to comply with the information flow requirements. A mix of these technologies can optimize the balance between data rate, coverage and cost, as already proposed in the preliminary specification achieved in Y1. For the HAN, it was found that the traffic volume is not a critical issue. Other requirements, such as those related with security and compliance with standards are more important for technology evaluation and selection.

Specification and design of the e-balance network architecture was completed: Based on the communication technology evaluation addressed in the previous item, the communication technologies were selected, the protocol stack was specified and the network topology was completed. The communication technology environment will be heterogeneous even within each network area, since it is unlikely that a single technology will be able to comply with the requirements in every part of the WAN, FAN or HAN. IP over MPLS over optical fiber will constitute the core of the WAN. A combination of PLC, RF-Mesh and 3G mobile technology will be employed in the FAN. The ZigBee and/or KNX protocol stacks will be employed in the HAN. The integration between different communication technologies will be performed at network layer 3 by the IP protocol. The use of IPv6 is considered at least for the FAN, when based on RF-Mesh technology. The preliminary specification will have to be validated based on the results from analysis of communication technologies. During the network design phase, network adaptors were selected for the implementation of e-balance demonstrators.

Deliverable D4.1 was completed and delivered: The new material produced during Y2 was integrated into D4.1. The text was then consolidated and the document was finally delivered.

The main activities of the partners

IHP (1.75 PMs)	• Specification and tests on the network protocols in the HAN • Definition and implementation of the HAN communication stack • Contributions to the specification and implementation of the network stack and deliverable D4.1
INOV (2.84 PMs)	• Coordination of T4.1 and of writing of D4.1 • Work on alarm aggregation scheme, performance analysis and FAN specification • Completion of the design of the FAN and HAN • Final editing of D4.1
EDP (0.8 PMs)	• Contribution to communication protocols

	• Contribution with communication scenarios for defined use cases • D4.1 review
UMA (0.3 PMs)	• Deliverable 4.1 review
CEMOSA (1.0 PMs)	• Review of different versions of deliverable D4.1 (Detailed network stack specification and implementation)
UTWE (2.6 PMs)	• Contribution to network requirements • Contribution to and review of D4.1
LW (2.0 PMs)	• Development of a basic e-balance CMU firmware
EFA (2.11 PMs)	• Follow-up and review of the "Detailed network stack specification and implementation" deliverable • Review of deliverable D4.1

2.3.3 Task 4.2 Security and Privacy Mechanisms (M3 – M20)

Description according to Annex I

Security and privacy are key when it comes to acceptance of the energy balancing technology. This holds true for end users and operators. Since we are working on energy efficiency, low-power, resource constraint devices are the majority of the connected devices. Thus, here we focus on efficient means for providing security which is the basis for privacy. We are aiming at an integrated and scalable solution which is applicable for all types of devices. In the following we are listing technologies and ideas that need to be investigated concerning their applicability in this specific application area while taking into account the heterogeneity of the devices.

Work done

In this task we studied the available solutions for the different aspects of security and privacy that can be applied in the communication platform. These include mechanisms for the protection of the communication, but also for the protection and maintenance of the devices. Due to the diversity of networking technologies and devices this task relies on the input from other tasks in defining the final set-up of the security and privacy solution.

We have identified the security aspects related to the mechanisms for infrastructure protection and prepared the requirements for solutions to be applied at each level. Here the choice is between own non-standard implementation and standard solutions. We favour the latter.

Mechanisms to be applied for protecting and maintaining the devices in the smart grid depend very much on the used hardware and software platforms. General solutions have been investigated.

Once the demonstrator set-ups are defined, the concrete solution providing security and privacy build from the general set of investigated mechanisms can be defined and integrated.

The main activities of the partners

IHP (2.5 PMs)	• Definition of the security modules • Definition and implementation of the security mechanisms for the communication platform • Specification and implementation of the security and privacy software blocks and contributions to the deliverable D4.2 • Defining the security architecture of the e-balance
EDP (0.9 PMs)	• Identification of best practice in terms of security and privacy regarding DSO services • Contribution with security mechanisms use in primary substations

	• Security analysis regarding demonstration implementation
UMA (0.6 PMs)	• Java security wrapper development
LW (0.2 PMs)	• In-lab tests of the basic firmware
EFA (2.29 PMs)	• Security and privacy mechanisms impact assessment regarding the management units to be developed by Efacec, namely the LVGMU and the MVGMU • Contributions for the detailed design of the security and privacy mechanisms regarding the LVGMU development, by Efacec

2.3.4 Task 4.3 Data Exchange Middleware (M3 – M20)

Description according to Annex I

In this task a common communication middleware platform for energy control and management will be designed and implemented. The middleware uses the developed communication protocols, security and privacy means. This platform will support the distribution of the information required by the algorithms developed for energy control and management. It includes:

- The well-defined interfaces the middleware provides
- A middleware for handling and distributed processing of the data in the network
- Hierarchical data handling architecture corresponding to the system architecture
- Data access interfaces according to the user class and data ownership.

Work done

In this task, a communication middleware platform for energy control and management has been designed and implemented. The middleware uses the communication protocols developed in the task T4.1, and the security and privacy mechanisms proposed in task T4.2. Furthermore, the platform provides the distribution of the data required by the algorithms developed in WP5 for energy control and management. In our system the middleware is thought to run on the different management units, namely, the TLGMU, the MVGMU, the LVGMU, the DERMU and CMU. The activities carried out so far within the task T4.3 can be summarized in the following points:

Specification and design of the middleware: This middleware is in charge of facilitating and making the exchange of data transparent to all the components (e-balance applications on the management units) involved in the e-balance system. It allows exchanging the data between the devices, hiding the communication between them and offers a homogeneous API for accessing the data.

The middleware is based on four main modules: Data Persistence, Request Processor, Data Access Control and Maintenance and Group Management. The data persistence module is in charge of storing all the information generated in the system in a persistent form. The request processor module is the one in charge of attending the different requests coming either from the data interface or from the networking layer. All requests go through the submodule of the request processor – the data access control module that grants or denies permission to access the data. And finally, the maintenance and group management module manages the communication network and keeps track of the connected devices, like management units, sensors and actuators.

Data interface implementation: The data is represented by e-balance variables. A variable defines the meaning and location of the data while its instance represents a single sample of the data. The data structure allows addressing the data in several dimensions, i.e., according to time, space and owner. The result of this work is an API, through which the data consumers can interact with the functionality offered by the middleware which is basically to exchange of data.

This API can be used with RESTful Web Services, which make the middleware fully interoperable with remote devices as its operations can be triggered from any operating system and the data consumers can be implemented using any programming language. There are four simple functions:

- *Write()* – allows updating/modifying the value of an e-balance variable.
- *Query()* – allows reading the value of a specific e-balance variable in a given moment.
- *Event()*. Through this function an e-balance user can subscribe to the system to receive information of a particular e-balance when a defined condition is satisfied.
- *Periodic()*. It allows receiving information about an e-balance variable in a periodical way.

Functional API implementation: In addition to the RESTful API, a functional API was also developed. It was designed to be used by the device software applications that need to interact with the middleware using functions. This API is built on top of the RESTful Web Service API and offers high level functions designed for the developers to simplify and accelerate the implementation of e-balance applications. For instance, the functional API offers the function QueryFromChildMUs(ebVariable) which is an extension to the basic function Query().

Implementation of the middleware: The middleware has been implemented using the ServiceStack, which is an open source framework designed to create web services under the .NET environment (Mono). ServiceStack allows modularizing the functionality of the middleware in two levels: plugins and services. The basic functionality of the middleware has been implemented as services and the plugins act as modules able to host multiple services. The plugin concept has been used to implement all those components which are part of the middleware.

The main activities of the partners

IHP (2.1 PMs)	• Definition of the middleware modules • Definition and implementation of the middleware • Contributions to deliverable D4.3
UMA (2.44 PMs)	• Study and testing of the CMU provided by Lesswire (HomeWaveControl) • Implementation of part of the data processor module • Implementation of part of the data persistence module • Configuration and testing of the BeagleBone: installation of Mono, a web server and ServiceStack • Middleware modules implementation (RequestProcessor module). Improvements over other modules currently implemented (data processor, data persistence). • Middleware modules implementation, Deliverable 4.3
EFA (1.0 PMs)	• Preparation of the API documentation– describing the interface to the Efacec module supporting the LVGMU • Assessment of the middleware specification and implementation, aiming at being integrated in the LVGMU • Preparation of the testing infrastructure and subsequent testing of the middleware integration with the LVGMU

2.3.5 Task 4.4 Integration of the Communication Platform (M6 – M24)

Description according to Annex I

In this task the common communication middleware platform for energy control and management is integrated (in-lab integration) with the protocols and mechanisms developed in this WP. The integrated communication platform is evaluated according to a defined expected behaviour (test cards). For this purpose we will use the in lab demonstrators.

Work done

Integration tasks: Integration has been carried out at different levels: protocols - devices, middleware – energy platform, middleware - G-Smart devices, middleware - security. Some activities have been carried out in parallel with tasks T4.2, T4.3 and T5.5. Between M13 and M24, the following results were attained:

Definition of the integration strategy: The evaluation of the communication platform is composed of two different types of tests. On the one hand, the different levels of the communication architecture (e.g. HV grid, MV grid, etc.) are evaluated separately. This evaluation can be carried out in parallel to evaluate the correct implementation of each level of communication and detect possible issues. On the other hand, the system is integrated in-lab as a global communication platform and is evaluated with scenarios where different levels of communication are involved. In order to facilitate testing, we have configured several virtual machines in such a way that we can test the full chain from the energy algorithms to devices.

Test card and tests definition: The requirements of the communication platform have been tested by comparing obtained results to expected results when specific inputs are fed into the system. This behaviour is controlled by a set of tests that are specified in what is called a “test card”. A test card describes a test for specific part of the system and presents the details of it by describing the pre-requirements of the test, the input that the system is given and the expected results, among others. If the expected results and obtained results are the same then the test is successful. Results of the tests are collected in what is called a “result card”. A result card describes the results and the outcome of a particular test card. The evaluation process consists of defining a set of test cards and filling the corresponding result cards based on the results obtained from the tests. Several tests have been defined (e.g. testing the middleware) and carried out with the test card template.

Middleware wrappers: Two wrappers have been developed. One of the wrappers has been implemented using the Java programming language to facilitate the development of Java applications (e.g. energy platform) that cannot interact with the middleware. Furthermore, this wrapper will also facilitate the communication between smart appliances and the middleware as they are controlled through FPAI (Flexible Power Application Infrastructure). A second wrapper has been developed using Javascript to facilitate the development of web applications (e.g. the e-balance GUI).

G-Smart – middleware integration: G-Smart devices get information from sensors and this information has to be provided to management units. Integration activities have been carried out in communication of G-Smart devices with the data exchange middleware in both directions: G-Smart to MU (e.g. LVGMU) and MU to G-Smart.

Security integration: This integration allowed using security mechanisms within the middleware.

Protocols integration: Implementation of wireless sensor communication protocols in sensor boards.

Appliance steering framework: Integration for communication with smart appliances.

The main activities of the partners

IHP (0.6 PMs)	• Integration of the security modules with the middleware
INOV (4.68 PMs)	• Detailed specification of communication protocols having in view the integration of the demonstrators • Integration of communication protocols in the sensor boards • Implementation of wireless sensor communication protocols for the platform integration
UMA (1.96 PMs)	• Contributions for D4.4 • User management • Data access control. Roles management • Energy management platform – Middleware library • Unitary tests, virtual machines configuration
UTWE (5.82 PMs)	• Appliance steering framework • Discussions and developments for the communication platform

LW (1.68 PMs)	• Development first prototypes of the CMU, delivering to some partners • Set up of automatic build environment for the CMU firmware • Evaluation of development environments for CMU • Integration of framework for CMU • Contributions for the in lab demonstrator • Integration of mathematical libraries to CMU

2.3.6 Task 4.5 Communication Platform Restatement (M12 – M40)

Description according to Annex I

During the course of the project, internal research or development, as well as external factors may influence the above architecture and specifications. Thus this task provides time for end-project activity to ensure a final iteration in which deliverables will be updated to ensure synchronicity with the factual final results for wider publishing.

Work done

No significant progress has been made until works of other tasks of the work package has a higher degree of maturity.

The main activities of the partners

LW (1.71 PMs)	• Evaluation of frameworks for CMU • Contribution to Communication Platform Restatement

2.3.7 Deliverables in WP4 the consortium worked on in Y2

- D4.1 “Detailed network stack specification and implementation” within Task 4.1 (M3-M20) – submitted

D4.1	**Reporting Period: M13-M24**											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	1.04	3.56	1.45	4.20	0	2.30	0	0	3.33	0	1.52	**17.40**
PM plan for Y1	1.94	2.50	1.06	2.50	0.56	2.78	0	0	3.33	0	1.11	**15.78**
PM spent in Y2	1.75	2.84	0.80	0.30	1.00	2.60	0	0	2.00	0	2.11	**13.40**
PM plan for Y2	2.46	0.94	0.45	0.30	1.00	2.70	0	0	2.67	0	0.48	**11.00**
Total spent	2.79	6.40	2.25	4.50	1.00	4.90	0	0	5.33	0	3.63	**30.80**
PM plan total	**3.50**	**4.50**	**1.90**	**4.50**	**1.00**	**5.00**	**0**	**0**	**6.00**	**0**	**2.00**	**28.40**

The networking mechanisms provide the low level communication support to the e-balance system, interconnecting both physically and logically the relevant system entities, such as Management Units (MUs), sensors, actuators and smart meters. It will support the transmission of e-balance information flows between those entities, granting the performance required by the respective services, while minimizing the costs associated with network deployment and operation. This deliverable presents the work done in the context of task T4.1, whose objective is to specify and to implement the networking mechanisms. The structure of this deliverable follows closely the methodology that was adopted to reach the e-balance network implementation.

The definition of the e-balance network started from the overall e-balance system architecture, from which the e-balance network architecture was derived. Preliminary studies were then carried out in order to identify the communication technologies, protocol stacks and standards that are applicable in each part of the e-balance network architecture, constituting potential candidates for inclusion in the specification. Additionally, networking requirements were extracted for significant use cases of e-balance, based on which the networking mechanisms were specified. This includes the selection of communication technologies and protocol stacks. It also includes the specification of additional algorithms and mechanisms that were developed within the project in order to improve network performance. A subset of this specification was then selected for practical implementation in the demonstrators, which is also described in this deliverable.

- D4.2 “Detailed security and privacy specification and implementation” within Task 4.2 (M3-M20) – ongoing

D4.2	**Reporting Period: M13-M24**											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	1.92	0	0.20	0.30	0	0	0	0	0.55	0	0.40	**3.36**
PM plan for Y1	3.06	0	1.00	1.94	0	0	0	0	0.56	0	1.11	**7.67**
PM spent in Y2	2.50	0	0.90	0.60	0	0	0	0	0.20	0	2.29	**6.49**
PM plan for Y2	3.58	0	1.60	3.20	0	0	0	0	0.45	0	1.60	**10.43**
Total spent	4.42	0	1.10	0.90	0	0	0	0	0.75	0	2.69	**9.86**
PM plan total	**5.50**	**0**	**1.80**	**3.50**	**0**	**0**	**0**	**0**	**1.00**	**0**	**2.00**	**13.80**

This deliverable presents the specification of the e-balance security and privacy solution, including the selected technologies, protocols and algorithms. This deliverable also presents the detailed information about the design, implementation and evaluation of the e-balance security and privacy solution.

- D4.3 “Detailed middleware specification and implementation” within Task 4.3 (M3-M20) – submitted

D4.3	**Reporting Period: M13-M24**											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	1.62	0	0	5.80	0	0	0	0	0	0	0	**7.42**
PM plan for Y1	3.06	0	0	3.06	0	0	0	0	0	0	1.11	**7.22**
PM spent in Y2	2.10	0	0	2.44	0	0	0	0	0	0	1.00	**5.54**
PM plan for Y2	2.88	0	0	0.00	0	0	0	0	0	0	2.00	**4.88**
Total spent	3.72	0	0	8.24	0	0	0	0	0	0	1.00	**12.96**
PM plan total	**5.50**	**0**	**0**	**5.50**	**0**	**0**	**0**	**0**	**0**	**0**	**2.00**	**13.00**

This deliverable describes the specification of the e-balance middleware together with the detailed information about the design, implementation and evaluation of the e-balance data handling middleware.

This deliverable describes the specification of the e-balance middleware together with the detailed information about the design, implementation and evaluation of the e-balance data handling middleware. It describes the middleware architecture and the different modules it is composed of, including the exposed API, implementation details and results obtained from the evaluation. It also provides a related work section where this middleware architecture is compared to other existing ones.

The deliverable takes into account the results from previous tasks, but mainly in the results obtained from the deliverable D3.2. The deliverable is structured as follows: Section 2 analyses the state of the art of middleware focused on smart grid infrastructures and generic high level distributed systems. Section 3 describes the middleware design based on the specification presented in the D3.2. Section 4 details the implementation of the middleware. Section 5 presents the evaluation of the middleware and finally Section 6 summarizes the main conclusions of the task T4.3.

- D4.4 “Implementation of an integrated communication platform” within Task 4.4 (M6-M24) – ongoing

D4.4	Reporting Period: M13-M24											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	0	0.99	0	1.20	0	0.10	0	0	0.72	0	0	**3.01**
PM plan for Y1	1.29	2.03	0	1.29	0	1.84	0	0	0.74	0	0	**7.18**
PM spent in Y2	0.60	4.68	0	1.96	0	5.82	0	0	1.68	0	0	**14.74**
PM plan for Y2	3.50	4.51	0	2.30	0	4.90	0	0	1.28	0	0	**16.49**
Total spent	0.60	5.67	0	3.16	0	5.92	0	0	2.40	0	0	**17.75**
PM plan total	**3.50**	**5.50**	**0**	**3.50**	**0**	**5.00**	**0**	**0**	**2.00**	**0**	**0**	**19.50**

This deliverable shall present the detailed information about the integration and evaluation of the e-balance communication platform.

- D4.5 “Restatement of the communication platform specification” within Task 4.5 (M12-M40) – ongoing

D4.5	Reporting Period: M13-M24											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	0	0	0	0	0	0	0	0	0.01	0	0	**0.01**
PM plan for Y1	0.10	0.03	0.03	0.10	0.03	0.13	0	0	0.07	0	0.07	**0.60**
PM spent in Y2	0	0	0	0	0	0	0	0	1.71	0	0	**1.71**
PM plan for Y2	0.10	0.2	0.2	0.3	0.2	0.50	0	0	0.30	0	0.30	**2.10**
Total spent	0	0	0	0	0	0	0	0	1.72	0	0	**1.72**
PM plan total	**3.00**	**1.00**	**1.00**	**3.00**	**1.00**	**4.00**	**0**	**0**	**2.00**	**0**	**2.00**	**17.00**

Restatement of the communication platform specification: This deliverable shall provide an evaluation of the technical specification of the communication platform components and reasoning for needed adaptions as lessons learnt during the integration and testing phase.

Deviations

The total effort spent in WP4 in the current reporting period is about 10% below the planned one. Most of the partners were involved in the implementation and integration of their respective modules for the communication platform and contributing to deliverables describing these modules.

In the finalized tasks (T4.1 and T4.3) we can see a slight overspending, while the still active ones (T4.2 and T4.4) show underspending.

Only one partner, INOV spent already the effort planned for the whole work package. The coordinator is monitoring the state of the effort and partner INOV is still below the total number of person months and did not went over the planned budget. In addition INOV aware of this fact and ensured that it will fulfil all its tasks.

Other partners are in line with the planning or show an underspending, like partner IHP. This underspending was caused by problems with resources, but the partner IHP plans to increase the efforts for integration in the following reporting period.

The finalized deliverable D4.1 had an overspending of about 8%, while the effort for the deliverable D4.3 was almost exactly as planned.

2.4 WP5 – Energy Management Platform (M3 – M40)

In this work package we have developed the different modules in the energy management platform of the e-balance architecture that was defined in WP3. Also, we have developed various models that allow us to validate the designed algorithms in an early stage of the developments.

Within the energy balancing module the algorithms for prediction of energy consumption and production have been developed. These will be used by the developed balancing algorithms to ensure a well-balanced grid.

Furthermore, in the resilience and self-healing module a set of mechanisms has been developed that monitor the state of the grid and can optimize the power flows within the grid.

On top of these two modules, the security and privacy module provides the mechanisms to ensure the secure data handling by the system.

All these parts are separately developed and tested, and finally integrated together with the communication platform, developed in WP4, into the various management units of the e-balance system.

WP5	**Reporting Period: M13-M24**											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	3.15	3.93	1.95	1.80	2.15	9.00	0.19	8.93	7.75	0	3.28	**42.13**
PM plan for Y1	6.90	4.44	3.52	8.71	6.27	11.41	0.56	6.43	7.78	0	11.94	**67.94**
PM spent in Y2	4.90	3.38	3.05	9.40	6.85	10.32	1.01	2.15	6.86	0	24.64	**72.56**
PM plan for Y2	9.09	5.57	3.65	11.42	8.25	10.30	0.87	2.01	5.55	0	18.72	**75.43**
Total spent	8.05	7.31	5.00	11.20	9.00	19.32	1.19	11.08	14.61	0	27.92	**114.69**
PM plan total	**14.00**	**9.00**	**5.60**	**16.50**	**14.00**	**22.00**	**1.00**	**16.00**	**14.00**	**0**	**26.50**	**138.60**

2.4.1 The WP5 results in Y2

- Definition, implementation and integration of energy balancing mechanisms
- Definition, implementation and integration of energy resilience mechanisms
- Definition, implementation and integration of the privacy protocol for energy management platform

In the following the tasks are introduced and the accounted work and the results are described briefly.

2.4.2 Task 5.1 System Models (M3 – M15)

Description according to Annex I

This task defines and implements the models used for the verification of the developed mechanisms.

Work done

- Development of LV resilience model

  The developments of a low level resilience model that started in the first year of the project, have been continued. This model allows you, in the scenario of a house or neighbourhood that is equipped with both local generation and storage, to compute the probability the system can supply its own energy demand in case of a grid failure. This probability depends on the moment the failure occurs, and can be easily computed for any given repair time distribution. This model and the first results have been presented as full paper in the 45th IEEE/IFIP International Conference on Dependable Systems and Networks (Ghasemieh, Haverkort, Jongerden, & Remke, 2015).

- Writing D5.1

Next to the LV resilience model, the deliverable describes the two other models that have been developed in the first year of the project; a high level and low level simulation model for the e-balance system. The high level model allows for relative easy and fast analysis of new ideas, and focusses on the high level energy flows in the system. Whereas, the low level model needs a more detailed input of the scenario of interest, and supplies you with a more detailed analysis that includes information on the power quality.

The main activities of the partners

IHP (0.5 PMs)	• Contribution to the system models, revision of the deliverable D5.1
EDP (0.3 PMs)	• Consumption data/ profiles analysis • Data from EDP demo site. Analysis of system model taking in account EDP demo site
UMA (1.26 PMs)	• Study of the energy platform for communication platform integration
CEMOSA (0.5 PMs)	• Review of models' description and validation of functionalities for demo implementation
UTWE (2.3 PMs)	• Model development and writing D5.1
IPI (0.01PMs)	• Completion of the general research model proposition for energy demand modelling and forecasting

2.4.3 Task 5.2 Energy Balancing (M3 – M20)

Description according to Annex I

This task selects, implements and evaluates the load balancing mechanisms for the energy control and management together with concepts for device classification and control. It uses the system models to select and verify the developed balancing mechanisms, i.e., implemented mechanisms are evaluated within a system model in simulation and emulation. The most appropriate mechanisms are implemented to be integrated in the prototypes. It covers:

- Analysis of available device control concepts to consider the different device profiles, features and parameters,
- Definition of the energy balancing mechanisms,
- Verification of the mechanisms,
- Implementation of the mechanisms.

Work done

- Definition, verification and implementation of energy balancing algorithms: implementation in libraries (libdsmdata and libdsmplanning) and validation of the profile steering algorithm to satisfy the requirements of the stakeholders related to the following use cases defined in task T2.1:
    - Use case 1 (Strategy-driven decision on the use of produced energy) and 5 (Strategy-driven decision on the usage of grid-connected DER) are inputs for planning the power profile optimisation regarding production sources.

- Use case 3 (distributed generation balancing and resilience): The profile steering algorithm and the respective device planning algorithms optimise how the generation is used, and keeps it balanced.
- Use case 4 (energy consumption and production agreement/contract): The profile steering algorithm negotiates the flexibility of the household on behalf of the customer with the party interested in this flexibility.
- Use case 9 (intelligent home appliance energy consumption balancing) and Use case 10 (additional sensors for appliance energy consumption balancing)
- Use case 11 (Microgrid energy balancing)

The steering signal concept is based on a desired profile to each house, which is a vector that indicates the desired power for each 15 minute interval for one day ahead (i.e. a vector of 96 power values). Each house (i.e. the management unit) aims at minimising the Euclidean distance between its own planned profile and the desired profile, and then the negotiation process continue to upper levels both the system architecture and electric grid. This set of algorithms have been design, implemented into C libraries and validated by the University of Twente in simulators.

A complementary algorithm called "power limitation algorithm" has been created to support the energy balancing out of normal operation, i.e. the system is approaching to energy supply limitation and the interaction of prosumers' management units is mandatory to keep the entire system operative until restoration tasks can turn the system into normal mode. This algorithm presents a simple logic that disconnect the users' appliances, according to order or priority level established by the user, when the corresponding management unit receives the power limitation signal until the maximum power is below the requested limit. Due to the simplicity of this algorithm, it has been tested using a visual basic routine.

- Designing and implementation of the prediction models to foresee the energy production and consumption at neighbourhood and household level. The prediction models are based on artificial neural networks (ANN) with an intensive assessment of all the energy consumption and production data collected by Liander Company from 80 houses of the Netherlands during 2 years.
- Design and implementation of the graphical customer interface (GUI): the GUI will provide a friendly interface with the basic information that algorithms requires to operate successfully and to perform the management unit negotiation. The design of the GUI is an on-going activity that is based on social studies, business models and the technical architecture of e-balance. The GUI architecture has been designed following specifically the requirements defined in the deliverable D2.4 concerning user-friendly criteria, security, basic informative graphs and easy information, etc. The beta version of the GUI is currently running in the UMA premises under a web server installed in the corresponding management units. The frontend has been developed using HTML, CSS and JavaScript.

The main activities of the partners

IHP (0.35 PMs)	• Contributions to the energy balancing mechanisms – data exchange • Working on the energy balancing aspects in the HAN
EDP (0.95 PMs):	• Analysis of balancing mechanisms taking account EDP demo site • Consumption data and profile consumption based on regions and contract power. Analysis of and contribution to GUI interface • Verification of mechanisms and systems for energy balancing
UMA (8.14 PMs)	• Implementation of the GUI for the customer • Design and implementation of GUI web interfaces needed to interaction with middleware • Porting to graphical interfaces previously implemented • Interaction library between energy balancing algorithms and the communication platform

	• GUI modifications, Setup and testing of GUI on BeagleBone, D5.2 GUI section
CEMOSA (4.95 PMs)	• Identification of inputs and outputs of the balancing algorithms • Identification of TRIANA functionalities that enable the implementation of balancing algorithms (home and grid level) • Draft version of GUI for prosumers: graphical design with interactive buttons, Definition of GUI inputs/outputs • Specification of preliminary algorithms and procedures to be implemented in the corresponding management units (formal description of the sequence of events, block diagram and checklist) • Description of energy balancing algorithms • Coordination of task T5.2 (Energy Balancing) (T5.2): prediction models, GUI, energy balancing algorithms, complementary algorithms, system compatibility with algorithms. • Description and implementation of power limitation algorithm (PL-a) • Edition and coordination of deliverable D5.2, Review of deliverable D5.2 •
UTWE (2.9 PMs)	• Further development of balancing algorithms • Energy balancing research • Contributions to energy balancing service • Finalizing D5.2
ALLI (1.01 PM)	• Discussing balancing method detail design choices in relation to business models, market models and implementation for the demonstrators • Conceptual explanatory activities regarding balancing • Data gathering for consortium prediction activities • Investigating prediction basics for better collaboration with consortium partners • Investigating possible input data sources for prediction methods of IPI • GUI design input, Support for IPI regarding energy exchange forecasting
LW (5.1 PMs)	• Enhance CMU firmware to provide modularized application development • Enhance virtualized development environment for enhanced modularized application development, so partners can develop/test applications in a virtualized environment with an asynchronous deployment to the device (after various development cycles) • Evaluation of mathematical libraries for CMU
EFA (0.8 PMs)	• Balancing algorithms integration impact assessment, regarding the grid resilience algorithms implementation, aligned with the definitions for the Use Case 5 (Strategy-driven decision on the usage of grid-connected DER) and for the Use Case 11 (Microgrid energy balancing) • Balancing algorithms detailed design, regarding the grid resilience algorithms implementation, aligned with the definitions for the Use Case 3 (Distributed generation balancing and resilience) and for the Use Case 11 (Microgrid energy balancing)

2.4.4 Task 5.3 Energy Resilience and Self-healing (M3 – M20)

Description according to Annex I

This task selects, implements and evaluates the resilience and self-healing mechanisms for the energy control and management. It uses the system models to select and verify the developed mechanisms, i.e., the implemented mechanisms are evaluated within a system model. The most appropriate mechanisms are to be integrated in the prototypes. It includes:

- Definition of the energy resilience and self-healing mechanisms,
- Verification of the mechanisms,
- Implementation of the mechanisms.

Work done

- Literature study

  All involved partners studied the literature that is relevant to their role in this task, e.g. [19][20], [21], [22], [23].

- Task management

  Management of all studies, designs and implementations done by the involved parties.

  Follow-up of team's outcome progression.

- Assessment of energy resilience and self-healing mechanisms in LV and MV grids

  The involved parties have concluded all detailed assessment towards grid resilience on both LV and MV grid levels [19], [20], [21][22] and [23]. The related implementation was started.

- Implementation of energy resilience and self-healing features, suitable for coping with selected use cases

Implementation of energy resilience and self-healing mechanisms for both LV and MV grids, aligned with the definitions for the following Use Cases, aiming at being deployed and demonstrated:

  - Use Case 3 (Distributed generation balancing and resilience)
  - Use Case 11 (Microgrid energy balancing)
  - Use Case 13 (Neighbourhood Power Flow)
  - Use Case 14 (DER Power Flows)
  - Use Case 15 (Optimal Power Flow)
  - Use Case 17 (Validation of Optimized Solutions)
  - Use Case 18 (Quality of Supply Measurement)
  - Use Case 20 (Fraud Detection)
  - Use Case 21 (Losses Calculation)
  - Use Case 22 (LV Fault Detection and Location)
  - Use Case 23 (Fault Detection and Location of Fused Luminaires)
  - Use Case 24 (LV Fault Prevention)
  - Use Case 29 (MV Fault Detection and Location)
  - Use Case 30 (MV grid Self-healing)

Assessment and adaptation design of the current 3-phase Smart Meter, by Efacec, in order to be adapted for the Bronsbergen and for the Batalha demonstrators, namely according to the requirements defined by Alliander for external split-core current sensors.

- Results within the reporting period
  - Full implementations achievement for the following Use Cases
    - Use Case 13 (Neighbourhood Power Flow)
    - Use Case 14 (DER Power Flows)
    - Use Case 15 (Optimal Power Flow)
    - Use Case 21 (Losses Calculation)
    - Use Case 22 (LV Fault Detection and Location)
    - Use Case 23 (Fault Detection and Location of Fused Luminaires)
    - Use Case 24 (LV Fault Prevention) – voltage control only
    - Use Case 29 (MV Fault Detection and Location)
    - Use Case 30 (MV grid Self-healing)
  - Implementations was started for the following Use Cases
    - Use Case 17 (Validation of Optimized Solutions)
    - Use Case 18 (Quality of Supply Measurement)
    - Use Case 20 (Fraud Detection)
    - Use Case 24 (LV Fault Prevention) – thermal stress only

The main activities of the partners

<table>
<tr><td>IHP (0.45 PMs)</td><td>Contributions to the energy resilience mechanisms – data exchange
Design of energy resilience mechanisms to be also applicable in in-lab</td></tr>
<tr><td>INOV (2.43 PMs)</td><td>Simulation of the algorithms for control of photovoltaic inverters
Refinement of algorithm for control of photovoltaic inverters</td></tr>
<tr><td>EDP (1.3 PMs)</td><td>Analysis of resilience mechanisms in EDP demo site
Contribution and definition of resilience methods for MV automation approaches with benefits for end customers
Definition of resilience and self-healing mechanisms solutions for the demonstrator</td></tr>
<tr><td>UTWE (1.72 PMs)</td><td>Energy resilience analysis and research
Contributions to energy resilience service
Contributions to and reviewing of D5.3</td></tr>
<tr><td>EFA (17.3 PMs)</td><td>Assessment and verification of energy resilience and self-healing mechanisms for both LV and MV grids under the task “Energy resilience and self-healing”
Implementation of energy resilience and self-healing mechanisms for both LV and MV grids under the task “Energy resilience and self-healing”
Implementation of energy resilience and self-healing mechanisms for both LV and MV grids, comprising unit tests
Assessment and adaptation design of the current 3-phase Smart Meter, by Efacec, in order to be adapted for the demonstrators
Implementation of energy resilience and self-healing mechanisms for both LV and MV grids, comprising unit tests
Implementation status:
LV Neighbourhood and DER Power Flows – concluded
LV Losses Calculation – concluded
LV Fraud Detection – partially concluded, as a result of the Use Case restatement
Aggregated check at the secondary substation – concluded
Distributed check at the distribution cabinets – pending
LV Fault Prevention – in progress, as a result of the Use Case restatement
Prevention of voltage limits violation – in progress
Prevention of thermal limits violation – pending
LV Fault Detection and Location on LV grid segments and on public lighting segments – concluded
MV Optimal Power Flow – implementation concluded; unit tests in progress
MV Validation of Optimized Solutions – in progress
MV Fault Detection and Location – in progress
MV Self-healing – in progress</td></tr>
</table>

2.4.5 Task 5.4 Security and Privacy (M3 – M20)

Description according to Annex I

This task selects, implements and evaluates the security and privacy mechanisms for the energy control and management. It uses the system models to select and verify the developed mechanisms, i.e., implemented mechanisms are evaluated within a system model. The most appropriate mechanisms are to be integrated in the prototypes. It includes:

- Definition of scalable security and privacy mechanisms,
- Verification of the mechanisms,
- Implementation of the mechanisms.

Work done

Within this task we have designed, implemented and evaluated the privacy and security protocol.

Based on the inputs from WP2 and WP3 we proposed a security and privacy framework that combines flexibility with transparency. The concept is built around the Data Interface that connects the Communication Platform and the Energy Management Platform. The Data Interface is data centric and allows exchanging defined data elements (variables) between these two parts of the e-balance system.

The protocol supports access control for the data accesses. This means that the sources of the data access requests are identified and only allowed accesses are executed. The data access requests are generated by the processes in the energy management platform that request data from the communication platform on behalf of the respective stakeholder. Thus, prior to the actual data access a process has to identify itself, as well as the stakeholder it works for. The access to the data is granted or denied according to the data specific access strategy (privacy policy definitions) defined by the data owner (data source). The data owner can specify individual access strategy for each data item (variable) separately. This definition is stored and transmitted together with the data structure containing the value of the variable. This approach allows checking and enforcing the access policy without the need to obtain this policy from the data source. Additionally, it allows changing the access policy without affecting the data that was generated prior to this policy change.

The data structure containing the variable stores also the meta-data that is used to address the data in the middleware. This meta-data provides a multidimensional address space allowing to identify the data in temporal and spatial domain.

Deliverable D5.4 describes the implementation details.

The main activities of the partners

IHP (2.5 PMs)	• Enhancement of the privacy and security concept taking into consideration the exchanged data • Design and implementation of the security and privacy approach • Specification and implementation of security and privacy modules and protocol, contributions to deliverable D5.4 • Implementation of the privacy and security protocol for the energy management platform
EDP (0.5 PMs)	• Verification of security mechanisms regarding demonstrators and proposed use cases
LW (1.26 PMs)	• Enhance firmware for security mechanisms • In-lab tests of the chosen security mechanisms with the firmware

2.4.6 Task 5.5 Integration of the Management Platform (M6 – M24)

Description according to Annex I

In this task the common management platform for energy control and management is integrated (in-lab integration).

The integrated management platform is evaluated according to a defined expected behaviour (test cards). For this purpose we will use the in lab demonstrators before moving the platform into the real life demonstrators.

Work done

The integration of the various modules within the energy management platform has been started. This work is aligned with the integration of the communication platform of Work Package 4, in order to ensure that the two platforms work together, and to make the testing of the platforms possible.

The balancing algorithms have been integrated on the Beaglebone hardware and the interface with the middleware is tested. The balancing algorithms, in the end, steer the smart devices. For this purpose, the steering framework FPAI has been integrated with the balancing module.

With respect to the energy resilience and self-healing module, the in-lab integration is done for the following features:

- grid monitoring
- optimised power flows
- voltage regulation
- MV fault detection and location
- MV self-healing

Also, the integration of the security and privacy module has been started. This work is aligned with the integration of the security and privacy module of the communication platform.

The main activities of the partners

IHP (1.1 PMs)	• Integration of the privacy and security protocol within the platform
INOV (0.95 PMs)	• Implementation of the algorithm for microgeneration voltage control
CEMOSA (1.4 PMs)	• Contributions on integrating predictions models in the corresponding management units
UTWE (3.4 PMs)	• Further development of appliance steering framework • Task management and discussions • Integration activities • Contributions to integration of the balancing module
EFA (5.66 PMs)	• Full in-lab integration at Efacec, comprising the outcome of LV and MV grid mechanisms Integration status: o LV Neighbourhood and DER Power Flows – in progress ▪ Grid Monitoring – concluded o Set-up of the integrated platforms to perform the following integration tests ▪ LV Fault Detection and Location on LV grid segments and on public lighting segments ▪ Fault Prevention – prevention of voltage limits violation ▪ MV Fault Detection and Location ▪ MV Self-healing • Full in-lab integration at Efacec, comprising the outcome of LV and MV grid mechanisms Integration status: o Fault detection, location, isolation and restoration ▪ Optimised Power Flows – concluded o Fault Prevention ▪ Voltage regulation – concluded ▪ MV Fault Detection and Location – concluded ▪ MV Self-healing – concluded • Assessment of the outcome of task T4.2 and validation of the integration of the security and privacy mechanisms into the LVGMU

2.4.7 Task 5.6 Energy Management Platform Restatement and Revision of the System Models (M12 – M40)

Description according to Annex I

In order to provide very accurate system models, developed in Task 5.1, for future research and the community, in this task the system models will be revisited after feedback from the integration and evaluation tasks in WP6.

Work done

- Initial restatement activities, mainly driven by the results of the social studies

The main activities of the partners

IPI (2.14PMs)	• Preparation and description of requirements for household energy consumption databases • Progressive work on predictive neural network model for next day energy load forecast • Description of energy load prediction model prototype for neighbourhood and household levels • Software implementation of the prediction model prototype • Positive validation of the prediction model prototype • Guidance for implementation of the designed prediction model into the integrated system • Preliminary preparation for the revision of the prediction model after the system integration phase • Revision and potential restatement postponed till the system integration phase is completed by the consortium partners within Work Package 6 • Consultation of possibility of C++ implementation of the demand profile prediction algorithms (prototype in R-code prepared by IPI)
LW (0.5 PMs)	• Start of integration of mathematical libraries in CMU firmware
EFA (0.88 PMs)	• First assessment of the Energy Management Platform implementation and specification, aiming at restating the designed system models • Restatement of the designed system models

2.4.8 Deliverables in WP5 the consortium worked on in Y2

- D5.1 “System models specification and implementation” within Task 5.1 (M3-M15) – submitted

D5.1	**Reporting Period: M13-M24**										
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	1.00	0	0.75	1.80	0.60	5.30	0	8.85	0	0	0	**18.30**
PM plan for Y1	1.92	0	1.46	3.46	1.54	5.38	0	6.15	0	0	1.54	**21.46**
PM spent in Y2	0.50	0	0.30	1.26	0.50	2.30	0	0.01	0	0	0	**4.87**
PM plan for Y2	1.00	0	0.30	1.12	0.50	1.90	0	0.01	0	0	0	**4.83**
Total spent	1.50	0	1.05	3.06	1.10	7.60	0	8.86	0	0	0	**23.17**
PM plan total	**2.00**	**0**	**1.05**	**2.92**	**1.10**	**7.20**	**0**	**8.86**	**0**	**0**	**0**	**23.13**

This deliverable defines the system models and provides the implementation of these.

- D5.2 “Detailed specification, implementation and evaluation of energy balancing algorithms” within Task 5.2 (M3-M20) – submitted

D5.2	**Reporting Period: M13-M24**										
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	0.50	1.50	0.20	0	1.55	2.20	0.13	0	6.08	0	0.50	**12.66**
PM plan for Y1	1.39	1.39	1.00	4.44	3.88	2.22	0.56	0	6.11	0	3.06	**24.06**
PM spent in Y2	0.35	0	0.95	8.14	4.95	2.90	1.01	0	5.10	0	0.80	**24.20**
PM plan for Y2	0.50	0	0.80	8.00	5.45	1.80	0.87	0	4.92	0	0.50	**22.84**
Total spent	0.85	1.50	1.15	8.14	6.50	5.10	1.14	0	11.18	0	1.30	**36.86**
PM plan total	**1.00**	**1.00**	**1.00**	**8.00**	**7.00**	**4.00**	**1.00**	**0**	**11.00**	**0**	**1.00**	**35.00**

This deliverable presents the specification and the detailed information about the design, implementation and evaluation of the e-balance energy balancing algorithms.

- D5.3 “Detailed specification, implementation and evaluation of energy resilience algorithms” within Task 5.3 (M3-M20) – ongoing

D5.3	**Reporting Period: M13-M24**										
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	0.45	2.43	0.90	0	0	1.20	0.06	0	0	0	2.78	**7.82**
PM plan for Y1	1.39	1.94	0	0	0	2.22	0	0	0	0	3.33	**8.89**
PM spent in Y2	0.45	2.43	1.30	0	0	1.72	0	0	0	0	17.30	**23.20**
PM plan for Y2	2.19	3.07	0.75	0	0	2.60	0	0	0	0	9.72	**18.33**
Total spent	0.90	4.86	2.20	0	0	2.92	0.06	0	0	0	20.08	**31.02**
PM plan total	**2.64**	**5.50**	**1.65**	**1.58**	**0.90**	**3.80**	**0**	**0**	**0**	**0**	**12.50**	**28.57**

This deliverable shall present the specification and the detailed information about the design, implementation and evaluation of the e-balance energy resilience algorithms.

- D5.4 “Detailed specification, implementation and evaluation of security and privacy means” within Task 5.4 (M3-M20) – submitted

D5.4	**Reporting Period: M13-M24**										
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	1.20	0	0.10	0	0	0	0	0	1.67	0	0	**2.97**
PM plan for Y1	1.39	0	1.06	0	0	0	0	0	1.67	0	1.67	**5.78**
PM spent in Y2	2.50	0	0.50	0	0	0	0	0	1.26	0	0	**4.26**
PM plan for Y2	3.30	0	1.80	0	0	0	0	0	0.33	0	2.00	**7.43**
Total spent	3.70	0	0.60	0	0	0	0	0	2.93	0	0	**7.23**
PM plan total	**4.50**	**0**	**1.90**	**0**	**0**	**0**	**0**	**0**	**2.00**	**0**	**2.00**	**10.40**

This deliverable presents the specification and the detailed information about the design, implementation and evaluation of the e-balance security and privacy means.

- D5.5 “Implementation of an integrated management platform” within Task 5.5 (M6-M24) – ongoing

D5.5	Reporting Period: M13-M24											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	0	0	0	0	0	0.30	0	0	0	0	0	**0.30**
PM plan for Y1	0.74	1.11	0	0.74	0.74	1.47	0	0	0	0	2.21	**7.00**
PM spent in Y2	1.10	0.95	0	0	1.40	3.40	0	0	0	0	5.66	**12.51**
PM plan for Y2	2.00	2.50	0	2.00	2.00	3.70	0	0	0	0	6.00	**18.20**
Total spent	1.10	0.95	0	0	1.40	3.70	0	0	0	0	5.66	**12.81**
PM plan total	**2.00**	**2.50**	**0**	**2.00**	**2.00**	**4.00**	**0**	**0**	**0**	**0**	**6.00**	**18.50**

This deliverable shall present the detailed information about the integration and evaluation of the e-balance management platform.

- D5.6 “Restatement of the energy management platform specification and revision of the system models” within Task 5.6 (M12-M40) – ongoing

D5.6	Reporting Period: M13-M24											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	0	0	0	0	0	0	0	0.08	0	0	0	**0.08**
PM plan for Y1	0.07	0	0	0.07	0.10	0.10	0	0.28	0	0	0.14	**0.76**
PM spent in Y2	0	0	0	0	0	0	0	2.14	0.50	0	0.88	**3.52**
PM plan for Y2	0.10	0	0	0.30	0.30	0.30	0	2.00	0.30	0	0.50	**3.80**
Total spent	0	0	0	0	0	0	0	2.22	0.50	0	0.88	**3.60**
PM plan total	**1.86**	**0**	**0**	**2.00**	**3.00**	**3.00**	**0**	**7.14**	**1.00**	**0**	**5.00**	**23.00**

Restatement of the energy management platform specification and revision of the system models: This deliverable shall provide an evaluation of the technical specification of the energy management platform components as well as of the defined system models and reasoning for needed adaptions as lessons learnt during the integration and testing phase.

Deviations

The total effort spent in the current reporting period in WP5 is almost perfectly equal to the planned one. For the tasks related to the energy management services there is a slight overspending. This is due to the fact that the efforts related to both these tasks were underestimated.

Most of the partners are in line with the planning and did not reach the total planned effort for the work package. Small deviations are due to linear planning. Only EFA spent already the effort planned for the whole work package and went over. The coordinator is monitoring the state of efforts and EFA is still below the total planned amount of effort and below the planned budget. In addition EFA aware of this fact and ensured that it will fulfil all its tasks.

As already said – other partners are in line with the planning or show an underspending, like partner IHP. This underspending was caused by problems with resources, but the partner IHP plans to increase the efforts for integration in the following reporting period.

2.5 WP6 – System Integration and Evaluation (M12 – M41)

In this work package we define the demonstrators, integrate, validate and evaluate the results. The integration of the subsystems developed in WP4 and WP5 will allow performing an early test to check the system behaviour.

The experience gained from the early integration in the laboratory will help in the adaptation of the detailed specifications and implementations done in WP4 and WP5 and will be fed back to WP2 and WP3 in order to ensure the compliance of the system specification with the final implementation.

The solutions researched and developed in the WP4 and WP5 will be integrated into real life demonstrators using the premises of EDP and Alliander in Portugal and Bronsbergen in the Netherlands, respectively. The demonstrator in Portugal will be focused on the management and control part in the distribution network including the required security and privacy mechanisms. The demonstrator at Bronsbergen will focus on the building automation and related energy management issues. The means for energy storage as well as production of renewable energy are available to the consortium at Bronsbergen. The evaluation will be done on the basis of the test cases defined using the use cases specified in WP2.

The third demonstrator will be based on our in lab test bed. In this demonstrator the real life will be emulated and will allow for differentiating the test cases with respect to the energy production and consumption patterns. Due to higher responsiveness and the ability to verify the proposed energy management platform against the collected real life data, the in lab demonstrator allows broad verification means not available in the real life sites. Further, the in lab emulation means will be used for evaluation of our platform against real life data provided by potential customers to estimate achievable benefits, depending on the target system parameters. This demonstrator emulates the real life behaviour and allows generating test situations not allowed or hardly possible in the two real life demonstrators.

WP6	**Reporting Period: M13-M24**										
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	0.20	0.73	0.90	0	0	0.20	0.75	0	0.13	0	0.50	**3.41**
PM plan for Y1	0.80	1.00	0.87	1.07	0.27	1.27	0.53	0	0.13	0	0.93	**6.87**
PM spent in Y2	4.81	10.17	6.60	4.92	0.95	5.50	3.83	0	1.60	0	9.22	**47.60**
PM plan for Y2	5.00	9.77	6.60	8.50	1.90	10.80	3.95	0	1.50	0	11.50	**59.52**
Total spent	5.01	10.90	7.50	4.92	0.95	5.70	4.58	0	1.73	0	9.72	**51.01**
PM plan total	**11.00**	**18.00**	**14.00**	**16.00**	**5.00**	**22.00**	**9.00**	**0**	**2.00**	**0**	**19.00**	**116.00**

2.5.1 The WP6 results in Y2

- Specification of the real life demonstrator in Batalha (D6.1).
- Specification of the real life demonstrator in Bronsbergen (D6.1).
- Specification of the in-lab demonstrator in IHP (D6.1).
- Definition of the inter-unit interfaces for the demonstrators (T6.2).
- Identification of the different units to be integrated for each of the demonstrators (T6.2).
- On-going integration of the units for the Batalha and Bronsbergen demonstrators.
- On-going implementation of the units for the in-lab demonstration.

In the following the tasks are introduced and the accounted work and the results are described briefly.

2.5.2 Task 6.1 Definition of the demonstrators (M12 – M16)

Description according to Annex I

In this task the detailed definition of the demonstrators is performed, based on the use cases chosen in work package WP2, deliverable D2.1. This includes:

- Specification of the required functionality/modules for each demo site,
- Specification of different parameter scenarios for each demonstrator,
- Specification of the expected demonstrator behaviour for the validation procedure (test cards).

Work done

The task started in M12, and should have finished in M16. Actually, the work for this task continued until M18 and deliverable D6.1 was submitted in M19.

For the definition of the demonstrators, activities have occurred for the real life demonstrators in Batalha, Portugal and in Bronsbergen, The Netherlands, and also for the in-lab demonstrator in IHP, Germany. The activities were centred on specification of the functionalities and modules for each demo site and on definition of the expected behaviour for each of the demonstrators, considering the different use cases to be shown. The selected use cases have been taken from those defined in D2.1.

The main focus of the Batalha demonstrator is on testing the use cases concerned with new functionalities from the point of view of the DSO and on checking the quality of supply improvements, the LV grid automatic detection and location of faults both for the consumers energy supply and for the public lighting system, the detection of fraud occurrences in the neighbourhood distribution grid and the impact of the integration of micro-generation into the LV grid. Tests will be done also in the MV segment of the grid, having in view the MV fault detection and location and also the automatic grid service restoration. The e-balance demonstrator will be installed in a MV feeder of the São Jorge primary substation situated in the Batalha region and in two LV grids from two secondary substations electrically attached to the same primary substation. The several segments in the grid demonstrator will be monitored by sensors, whose exact quantities and location are being determined in T6.3.

The main focus of the second demonstrator, located in the holiday park Bronsbergen, is on testing the use cases concerned with demand response, demand side management and interaction with end users, studying the benefits of demand side management for micro-grid operation, demand and solar production predictions and neighbourhood power flow analysis. The deployed CMUs together with the LVGMUs will enable demand side management based on the profile steering mechanism Triana. The exact location of the CMUs is being determined in T6.3.

The third demonstrator is located at the premises of IHP in Frankfurt (Oder), Germany. It consists of a table top emulation of an electricity grid, with all the major components and connections implemented. It allows studying the e-balance system more in-depth, while maintaining a tactile interface. The in-lab demonstrator facilitates the testing of e-balance enabled equipment and intelligent energy devices, before they are rolled out at consumer premises. The demonstrator will be built up out of modular components, each emulating a part of the physical grid or a connection.

The main activities of the partners

IHP (2.86 PMs)	• Definition of the demonstrators, especially the in-lab demonstrator • Definition of the in-lab demonstrator and contributions to the deliverable
INOV (3.3 PMs)	• Coordination of WP6 and T6.2. Collaboration in the definition of the demonstrator in Batalha, Portugal • Contributions to D6.1
EDP (3.5 PMs)	• Demonstrator definition regarding use cases. Characterization of Batalha demonstrator

	• Contributions for the specification of the required functionality/modules and different parameter scenarios for EDP demonstrator • Contribution and review of D6.1
UMA (2.36 PMs)	• Study of client and server frameworks for web developing • Review and update of the deliverable D6.1
CEMOSA (0.65 PMs)	• Contribution to the demonstrator definition and checking the consistence of use cases' definition and system architecture • Graphical design of use cases' figures of deliverable D6.1 (Specification of the demonstrators) • Contribution on demonstrator description and demonstrator's objectives, specified in deliverable D6.1 • Review of deliverable D6.1
UTWE (3.8 PMs)	• Contribution to the demonstrator definition • Contributions and review of D6.1
ALLI (2.29 PM)	• Gathering and improving information regarding the Bronsbergen demonstrator, writing D6.1, managing T6.1 • Specifying the Bronsbergen demonstrator for D6.1. Writing D6.1 and coordinating D6.1 contributions by other partners • Providing finale input from ALLI to D6.1, finalisation of deliverable D6.1 as Task Leader • investigating how solutions described in D6.1 can be integrated at Bronsbergen • Minor revisions of D6.1 • Minor changes to an internal version of D6.1
EFA (2.22 PMs)	• Tuning of the demonstrators for the "Definition of the demonstrators" task • Review and contributions for the Deliverable D6.1

2.5.3 Task 6.2 Integration and set-up of the prototypes (M12 – M26)

Description according to Annex I

In this task the individual prototypes are integrated and evaluated. The integrated platform incorporates all the layers used in the individual prototypes, the communication platform, management platform and the specific underlying grid hardware.

Work done

The task started in M12, and finishes in M26. In this task, the work done in WP4 (Communication Platform) and in WP5 (Energy Management Platform) was integrated for the different units to be deployed in all the demonstrators. The integration work is on-going.

The first activity to be concluded was the definition of the inter-unit interfaces. There is a table for each interface between units. Each table has a number of entries equal to the number of communication layers. Each entry has the communication protocol to be used. Only standard protocols are used.

Following the e-balance architecture defined in D3.1 and D3.2, it was concluded that the following units should be integrated for the two life-demonstrators: Medium Voltage Grid Management Unit (MVGMU), Low Voltage Grid Management Unit (LVGMU), Customer Management Unit (CMU) and Sensor units. Due to the different characteristics of each of the demonstrators the integration of these units is different for each of the demonstrators. Each unit integrates the developed communication (WP4) and energy management (WP5) platforms as appropriate in each case. The integration work was significantly advanced for each of the units during the reported period. In the following some details of the integration of each unit are given.

The MVGMU for Bronsbergen is based on a Beaglebone board. The communication software was already integrated in the board and the energy management software integration is on-going. The LVGMU for Bronsbergen is based on the GSmart equipment from Efacec plus a Beaglebone board. The integration between both equipments is done and the integration of the energy management software is on-going. The

CMU for Bronsbergen will be based on a Beaglebone board and its integration is on-going. In Bronsbergen, smart meters will be used as sensor units, which are already available.

The MVGMU for Batalha is based on an embedded PC, which integrates different types of application software for the distinct use cases. The integration of this software is on-going. The LVGMU for Batalha is based on the GSmart equipment from Efacec plus a Beaglebone board. The software under integration is for the distinct use cases to be tested. The CMU for Batalha has the objective of controlling a photo-voltaic inverter in order to keep voltage variation in the LV grid within allowed limits. The CMU is based on an embedded PC, which includes a specific control algorithm developed in WP5. The sensors for Batalha have been specially developed to measure the required grid parameters and they are being integrated.

For the in-lab demo, the following work was achieved: i) the building blocks of the grid emulator were defined; ii) the building boards to represent consumption are done; iii) the building blocks representing production are currently under development; iv) the building block for measuring is developed, but a proper frontend is needed; v) the sizes and physical properties of the grid emulator building blocks were planned. On top of the grid emulator we will deploy the e-balance devices (management units).

The main activities of the partners

IHP (1.86 PMs)	• Implementation of the in-lab demonstrator • Implementation and integration of the in-lab grid emulator
INOV (6.87 PMs)	• Checking of outputs from communication and energy management platforms for system integration. Decision on laboratories to perform the demonstrator integration • Continuation of checking of outputs from communication and energy management platforms for system integration; global planning of integration activities • Leadership of T6.2; integration of a prototype sensor board for the Batalha pilot; planning of the integration of use cases for the Batalha pilot in the sensor boards to be produced • Work for the integration of the communication platform with the energy management platform
EDP (2.1 PMs)	• Defining main needs for deployment in Batalha demonstrator based on definitions from T6.1 • Definition of integration process into Batalha demonstrator • Definition of equipments/ prototypes to be installed in Batalha demonstrator
UMA (2.56 PMs)	• Inter-unit interfaces document • G-SMART – Middleware interaction • Inter-unit interfaces document, BeagleBone setup, install, configuration
CEMOSA (0.3 PMs)	• Contribution in the definition of the scope of demonstrators related to use cases and balancing algorithms to be tested • Support on the integration and development of Bronsbergen demonstrator regarding management units (to-do list)
UTWE (1.7 PMs)	• Discussion on demonstrator development • Discussions and research for demonstrator development • Discussions and contributions towards demonstrator development
ALLI (1.28 PM)	• Checking the status of Bronsbergen demonstrator • Work related to Privacy&Security of the Bronsbergen demonstrator, visualising internal Alliander IT landscape required for the Bronsbergen demonstrator, choosing appliances, project meeting
LW (1.6 PMs)	• Enhance CMU firmware for update ability • Evaluate mechanisms for in field control ability of the CMU devices (VPN infrastructure, access mechanisms, pervasive logging, embedded VPN possibilities) • Enhance CMU firmware for in field control ability, access mechanisms,

	pervasive logging, embedded VPN • Evaluated technology and methods for update at runtime • Adaption of the toolchain in preparation for shipment • Updating the build environment with toolchain for future integration tasks and software deliveries
EFA (7.0 PMs)	• Energy resilience and self-healing o Setup of the integrated system, comprising the Energy Management Platform and the Communications Platform o Integration and assessment • Prototypes software bug fixing and tuning • Energy resilience and self-healing o Integration of new features, assessment and validation • Prototype software bug fixing, tuning and deployment

2.5.4 Task 6.3 Deployment of the demonstrators (M22 – M28)

Description according to Annex I

The integrated demonstrators are to be deployed in this task.

Work done

This task started in M22 and ends in M28. Initial activities towards the deployment of the demonstrators in Batalha and Bronsbergen were undertaken. These activities were focussed into defining the exact locations and quantities of equipments required for each of the demonstrators. These activities are on-going.

The main activities of the partners

IHP (0.09 PMs)	• Initial work towards the deployment of the in-lab demonstrator
EDP (1.0 PMs)	• Definition of equipment/ prototypes deployment in Batalha demonstrator
ALLI (0.26 PM)	• Determining the consequences of ALLI Privacy and Security requirements for the IT infrastructure and the Bronsbergen demonstrator as a whole. Working on required deployment steps

2.5.5 Deliverables in WP6 the consortium worked on in Y2

- D6.1 “Specification of the demonstrators” within Task T6.1 (M13-M16) – submitted

D6.1	**Reporting Period: M13-M16**										
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	0.20	0.73	0.90	0	0	0.20	0.75	0	0	0	0.50	**3.28**
PM plan for Y1	0.60	0.40	0.60	0.80	0.20	0.80	0.40	0	0	0	0.40	**4.20**
PM spent in Y2	2.86	3.30	3.50	2.36	0.65	3.80	2.29	0	0	0	2.22	**20.98**
PM plan for Y2	2.80	1.27	2.10	4.00	1.00	3.80	1.25	0	0	0	1.50	**17.72**
Total spent	3.06	4.03	4.40	2.36	0.65	4.00	3.04	0	0	0	2.72	**24.26**
PM plan total	**3.00**	**2.00**	**3.00**	**4.00**	**1.00**	**4.00**	**2.00**	**0**	**0**	**0**	**2.00**	**21.00**

This deliverable shall define in detail the demonstrator architecture and functionalities.

- D6.2 “Integration of the prototypes” within Task 6.2 (M13-M26) – ongoing

D6.2	**Reporting Period: M13-M24**											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	0	0	0	0	0	0	0	0	0.13	0	0	**0.13**
PM plan for Y1	0.20	0.60	0.27	0.27	0.07	0.47	0.13	0	0.13	0	0.53	**2.67**
PM spent in Y2	1.86	6.87	2.10	2.56	0.30	1.70	1.28	0	1.60	0	7.00	**25.27**
PM plan for Y2	2.00	7.00	3.00	3.00	0.50	5.00	1.50	0	1.50	0	6.50	**30.00**
Total spent	1.86	6.87	2.10	2.56	0.30	1.70	1.28	0	1.73	0	7.00	**25.40**
PM plan total	**3.00**	**9.00**	**4.00**	**4.00**	**1.00**	**7.00**	**2.00**	**0**	**2.00**	**0**	**8.00**	**40.00**

This deliverable shall describe the actions taken for the prototype integration and the results of the integration.

- D6.3 “Deployment of the demonstrators” within Task 6.3 (M22-M28) – ongoing

D6.3	**Reporting Period: M22-M24**											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y2	0.09	0	1.00	0	0	0	0.26	0	0	0	0	**1.35**
PM plan for Y2	0.20	1.50	1.50	1.50	0.40	2.00	1.20	0	0	0	3.50	**11.80**
PM plan total	**2.00**	**4.00**	**4.00**	**4.00**	**1.00**	**5.00**	**3.00**	**0**	**0**	**0**	**9.00**	**32.00**

This deliverable shall describe the actions taken for the deployment of the demonstrators and the results of the deployment.

Deviations

The efforts spent in total in the WP6 in the current reporting period show an underspending of about 20%.

The efforts for the finalized T6.1 are slightly above the plan, while the T6.2 shows an underspending. This is due to the fact that integration is now in focus and will be in focus at the beginning of the following reporting period. There were only minor activities towards the deployment of the demonstrators and thus, due to the linear effort allocation there is a large underspending in the short task T6.3.

Most of the partners are in line with the planning, with deviations due to the linear effort allocation for planning.

The finalized D6.1 had an overspending of about 15%.

2.6 WP7 – Dissemination and Exploitation (M1 – M42)

Efficient dissemination and exploitation are fundamental aspects in any research project, since the success of related activities contributes decisively to the short and long term success of the project. This WP has been responsible for ensuring that all these activities have been appropriately developed and managed throughout the project duration.

Moreover, this WP is responsible to monitor the regulatory and standardisation activities directly related to the research work, in order to assure the overall viability and coherence of the project results, and formulate guidelines for developing pre-normative documents for energy management systems.

This work package started in M1 of the project and finishes in M42. The work package consists of four tasks.

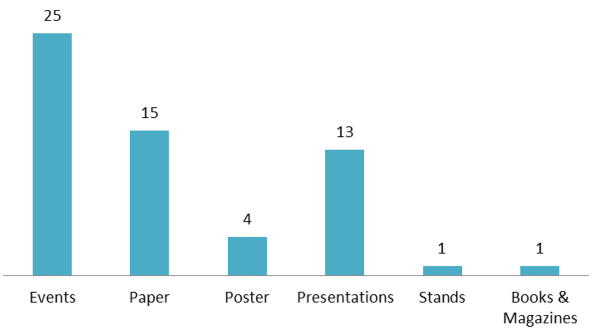
The objectives of WP7 during the second period have been:

- Ensure an appropriate project dissemination activities and exploitation of the results.
- Improve and update the project website.
- Prepare material for dissemination (self-stickers).
- Cooperate with other related projects in order to reach synergies.
- Perform dissemination activities:
    - Participation at relevant conferences, workshops, seminaries or related events.
    - Publication of papers, press releases, and reports in relevant journals.

WP7	**Reporting Period: M13-M24**											
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFAC**	**TOTAL**
PM spent in Y1	0.50	0.52	0.23	0	1.89	0.30	0	0.71	0.28	0.20	0	**4.63**
PM plan for Y1	0.57	0.57	0.86	0.29	1.14	0.86	0.57	0.57	0.29	0.57	0.29	**6.57**
PM spent in Y2	0.36	1.38	0.45	0	1.09	1.60	0	0.26	0.28	0.20	0	**5.63**
PM plan for Y2	0.54	0.55	0.79	0.29	1.07	0.79	0.54	0.54	0.29	0.54	0.29	**6.22**
Total spent	0.86	1.90	0.68	0	2.98	1.90	0	0.97	0.56	0.40	0	**10.26**
PM plan total	**2.00**	**2.00**	**3.00**	**1.00**	**4.00**	**3.00**	**2.00**	**2.00**	**1.00**	**2.00**	**1.00**	**23.00**

2.6.1 The WP7 results in Y2

- The **website has been updated** with last news with pictures related to dissemination activities and project meetings and a new look has been prepared to make it more attractive.
- **Flyers** (>25) have been dispatched in the Conference **CIRED 2015** by EFA.
- The project partners have participated in **25 events** (workshops, conferences, publications), which they have presented 16 scientific papers, 4 posters, 13 presentations, 1 expositor stand and 1 magazine.



Dissemination activities

- **Identification related FP7 and Horizon2020** projects to establish a procedure for the exchange of information and mutual collaboration
    - Dispersed Renewable Generation: Challenges, Current Developments and Technology Trends (ENERGEIA Project Seminar) – March 2015 – Faro (Portugal) [EFA]
    - Origin Project: Harnessing Community Energies – June 2015 – Findhorn (Scotland). Workshop with several projects [IPI]
    - Workshop "Energy efficiency and Smart solutions" – June 2015 – Barcelona (Spain). Presentation of e-balance and business model developments together 4 projects (URB-Grade, BESOS, NobelGrid and District of the Future) and regional authorities [CEMOSA]
    - Sustainable Places 2015 – September 2015 – Savona (Italy). Presentation of "Social and Business dimensions in energy efficient districts" together the projects CityOpt, INDICATE, AMBASSADOR, IURBAN, URBGRADE, READY4SMARTCITIES, BESOS, OPTIMUS and District of the Future. [CEMOSA].

In the following the tasks are introduced and the accounted work and the results are described briefly.

2.6.2 Task 7.1 Communication Plan (M1 – M42)

Description according to Annex I

This task develops a communication plan that aims to raise the profile of the project and to stimulate a high level of market, stakeholders and policy awareness through various actions at an international level, which includes liaison with relevant funder research projects, developers of similar and attractive technologies and potential user communities. Inter-project cooperation will focus on coordination and cooperation between EU and other projects, and activities within the energy domain.

Work done

The main activities within this task include:

- Research on similar initiatives and other communication possibilities. The main conclusion is the necessary presence in specific social networks (e.g. LinkedIn) and expositions regarding smart cities.
- Search and identification of other FP7 and Horizon 2020 projects in order to explore the potential of synergy between e-balance project and these projects and exchange best practices, data, among other. This activity started in Y1 and will continue until de end of the project. In the Y2, a special **collaboration between the project BESOS, URB-Grade and District of the Future** has allowed participating in workshops and events to detect potential synergies. Other projects with potential collaboration will be studied:

- CityOpt: Holistic simulation and optimization of energy systems in Smart Cities
- READY4SMARTCITIES - ICT Roadmap and Data Interoperability for Energy Systems in Smart Cities
- IURBAN - Intelligent URBAn eNergy tool
- INDICATE - Indicator-based Interactive Decision Support and Information Exchange Platform for Smart Cities
- AMBASSADOR: Autonomous Management System Developed for Building and District Levels
- OPTIMUS: Optimising energy use in cities through smart decision support systems
- NobelGrid: New cost-efficient business models for flexible Smart grids

The main activities of the partners

IHP (0.18 PMs)	• Contacts with other related projects • Communication between Projects • Activities related to communicating project results • Activities in the task T7.1 • Activities towards inter-project cooperation • Research on possible collaboration with other projects
CEMOSA (0.54 PMs)	• Improvement of the content of the e-balance website • Analysis of the F7 projects related to e-balance and contact with some of the project coordinators of these projects

2.6.3 Task 7.2 Dissemination (M1 – M42)

Description according to Annex I

This task includes the proactive dissemination of project information and results to a broad public audience. In particular this task includes dissemination plan, activities & reporting, based on agreed strategy and plan to promote project among market entities, policy makers, and scientific community.

Work done

Regarding the official website http://www.e-balance-project.eu/, during the Y2 (Oct 2014 to Sep 2015) has **received 31499 visits**, what means it is the main tool for communication and dissemination purposes, providing relevant information on the projects activities and objectives. As mentioned in T7.1, the webpage has been updated according to project progress. In addition, at the end of this period and the beginning of Y3, the project has launched the LinkedIn company page to extend the impact of the dissemination activities to a wider range of stakeholders.

LinkedIn website

Regarding the dissemination material, the leaflet and the poster created in Y1 will be updated according to the last project development, trying to be more attractive for the target audiences and general public. Following the rules of the EC research funding programmes, a set of self-stickers for the developed devices and management units has been prepared with the corresponding *QR identification logo*.

Self-stickers

Regarding the participation of conferences, workshops, exhibitions, during this period, the consortium has participated in several events to present the results of the research and development related to e-balance project, **see Annex A of this document.**

The main activities of the partners

IHP (0.18 PMs)	• Preparing publications • Dissemination activities • Preparation of an abstract submitted to the EnergyCon2016
INOV (1.38 PM)	• Start of writing of one paper for the CIRED 2015 conference. Contribution into the e-balance web page • Final version of paper towards CIRED 2015 • Presentation of an e-balance poster (Innovative methodology to define stakeholders' requirements for smart systems) at the CIRED 2015 conference in Lyon, France

	• Planning and writing for submission of an abstract to the conference EnergyCon 2016
EDP (0.45 PMs)	• Contributions and review for two submitted and approved papers in conferences: CIRED 2015 and European Energy Market • Final review of paper to European Energy Market and poster presentation in respectively conference • Contributions and review for 2 abstracts submitted and approved for EnergCon2016
CEMOSA (0.53 PMs)	• Preparation of the full paper: Innovative methodology to define stakeholders' requirements for smart systems for 23rd International Conference on Electricity Distribution (CIRED2015) • Preparation and submission of the full paper: Innovative methodology to define stakeholders' requirements for smart systems for 23rd International Conference on Electricity Distribution (CIRED2015) • Preparation of contents for the internal exploitation workshop. • Follow up of dissemination activities • Contribution in specific papers (writing and review) • Poster design for the conference CIRED 2015 (Lyon 17 June) • Workshop to find synergies between related projects (Barcelona 23 June). • Web-site updates • Preparation of internal exploitation workshop (on going) • Preliminary activities to prepare a workshop for Sustainable Places 2015 (Savona, Italy) • Update webpage contents (news and design) • Tracking of dissemination activities carried out within the consortium • Seeking potential dissemination and exploitation events • Presentation of e-balance project and business models in Sustainable Places 2015 (Savona) with other 9 European Projects
UTWE (1.6 PMs)	• Contribution to publications • Dissemination activities • Contributions to dissemination activities o Attending and presenting paper at PowerTech2015 o Attending and presenting paper at DSN 2015 o Presenting poster at "An innovative Truth 2015" o Contributing to paper on system architecture
IPI (0.26 PMs)	• Preparation and oral presentation of the article on MEDPOWER 2014 • Preparation and presentation of the poster for Sustainable Places 2014
LODZ (0.21 PMs)	• Preparation and Submission Paper to Conference: Zarządzanie energią I teleinformatyka , Zet 2015 conference, Poland (Piotrowski K., Matusiak B., Zieliński J.: "Internet of things in e-balance project") • Participation in Sosnowiec /Gliwice conference (5.11.2014), slides preparation for Medpower14 (Athens) • Preparation and Submission paper to Conference: EEM15 European Electricity Market 2015, Lisbon • Participation in local conference: " „Energetyka Prosumencka w Wymiarach Zrównoważonego Rozwoju" 05.11.2014 in Sosnowiec/Gliwice (2 papers) • EEM15 Lisbon, International Conference – participation/paper

2.6.4 Task 7.3 Dissemination and contribution to standards (M1 – M42)

Description according to Annex I

An active approach towards exploitation of results will be carried out within the project. Exploitation will be based on appropriate technology assessment as well as market condition and business opportunities analysis.

Another important component will be monitoring and contributing to standards bodies and to standards developments as may be appropriate.

Work done

CEMOSA participated in the Conference Sustainable Places 2015 within a group of FP7 and H2020 projects that discussed different aspects regarding business models for future smart-grids and smart-cities. Given that collaboration and contributions in this activity, potential synergies between e-balance and similar projects were detected for the exploitation of the project results and comparison of different approaches and technologies, obtaining other ways for dissemination in turn.

Next period (Y3), the project consortium will establish a common strategy for exploitation and standardisation through internal workshops and the support of dissemination activities from task 7.2 (conferences, internet, etc.).

The main activities of the partners

CEMOSA (0.02 PMs)	• Presentation of e-balance project and business models in Sustainable Places 2015 (Savona) with other 9 European Projects

2.6.5 Task 7.4 Guide Book (M1 – M42)

Description according to Annex I

All the results achieved in the project relevant to the application of the developed energy management platform will be collected together in the form of a guide book. The guide book will explain the provided means to estimate the achievable energy savings. It includes the detailed description of the energy platform test bed together with the methodology to prepare the input data to represent a specific target deployment.

Additionally, the guide book will explain how to estimate the costs of the solution for both, installation and run time. This will be complemented by the description of the developed business models.

Work done

- Initial studies realized and notes taken

The main activities of the partners

LW (0.28 PMs)	• Contributions to collecting Guide Book notes

2.6.6 Deliverables in WP7 the consortium worked on in Y2

- D7.2 "Dissemination activities" within Task 7.1 and Task 7.2 (M1-M42) – ongoing

D7.2	Reporting Period: M1-M12										
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	0.19	0.52	0.13	0	1.82	0.23	0	0.71	0	0.20	0	**3.80**
PM plan for Y1	0.14	0.19	0.19	0.10	0.19	0.24	0	0.19	0	0.19	0	**1.43**
PM spent in Y2	0.27	1.15	0.37	0	0.81	1.30	0	0.22	0	0.17	0	**4.29**
PM plan for Y2	0.20	0.25	0.25	0.15	0.25	0.30	0	0.25	0	0.25	0	**1.90**
Total spent	0.46	1.67	0.50	0	2.63	1.53	0	0.93	0	0.37	0	**8.09**
PM plan total	**0.50**	**0.67**	**0.67**	**0.33**	**0.67**	**0.83**	**0**	**0.67**	**0**	**0.67**	**0**	**8.89**

This document will summarize our dissemination activities.

- D7.3 "Exploitation activities" within Task 7.1 and Task 7.3 (M1-M42) – ongoing

D7.3	Reporting Period: M1-M12										
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	0.15	0	0.10	0	0.07	0.07	0	0	0	0	0	**0.39**
PM plan for Y1	0.24	0.33	0.48	0	0.29	0.38	0.29	0	0	0	0	**2.00**
PM spent in Y2	0.09	0.23	0.08	0	0.28	0.30	0	0.04	0	0.04	0	**1.06**
PM plan for Y2	0.20	0.30	0.40	0	0.25	0.35	0.25	0	0	0	0	**1.75**
Total spent	0.24	0.23	0.18	0	0.35	0.37	0	0.04	0	0.04	0	**1.45**
PM plan total	**0.83**	**1.17**	**1.67**	**0**	**1.00**	**1.33**	**1.00**	**0**	**0**	**0**	**0**	**5.00**

This document shall describe the public part of the exploitation activities. If there will be confidential parts of the exploitation plans, they will be delivered separately to the EC and will be identified as such.

- D7.4 "Guide book" within Task 7.4 (M1-M42) – ongoing

D7.4	Reporting Period: M1-M12										
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	0.05	0	0	0	0	0	0	0	0.28	0	0	**0.33**
PM plan for Y1	0.14	0	0.14	0.14	0.57	0.14	0.29	0.29	0.29	0.29	0.29	**2.57**
PM spent in Y2	0	0	0	0	0	0	0	0	0.28	0	0	**0.28**
PM plan for Y2	0.14	0	0.14	0.14	0.57	0.14	0.29	0.29	0.29	0.29	0.29	**2.57**
Total spent	0.05	0	0	0	0	0	0	0	0.56	0	0	**0.61**
PM plan total	**0.50**	**0**	**0.50**	**0.50**	**2.00**	**0.50**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**9.00**

This deliverable will describe in short the Guide Book - a manual for third parties that contains the extract of the project results, covering the applicability suggestions for the proposed energy management platform including the researched aspects of energy efficiency, like social triggers for increasing the willingness to be energy efficient, the economic aspects - the proposed new business models, as well as technical aspects of the proposed solution with means to estimate the initial and running costs and improvement in the energy efficiency. Please note that the manual text is not part of the deliverable document; it is going to be a separated document to be disseminated among potential users (DSOs, city authorities, large energy producers with distribution capacities) to further increase the exploitation potential.

Deviations

With respect to dissemination and exploitation of the project results, thus activities related to deliverable D7.2 and D7.3, respectively, we see a trend towards overspending in the first aspect and underspending in the latter. Some of the partners already consumed all the effort planned for these activities and went beyond. The coordinator is monitoring the state.

The deviation with respect to the effort spent on activities related to deliverable D7.4 are due to the fact that the focus on the work on this deliverable will be rather in the second half of the project runtime. However, some initial activities were already present in the current reporting period.

3 Project management and administrative issues

WP1	Reporting Period: M1-M12										
Participant	**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
PM spent in Y1	1.91	0	0	0	3.00	0	0	0	0	0	0	**4.91**
PM plan for Y1	3.00	0	0	0	3.00	0	0	0	0	0	0	**6.00**
PM spent in Y2	1.81	0	0	0	0	0	0	0	0	0	0	**1.81**
PM plan for Y2	2.00	0	0	0	0	0	0	0	0	0	0	**2.00**
Total spent	3.72	0	0	0	3.00	0	0	0	0	0	0	**6.72**
PM plan total	**8.00**	**0**	**0**	**0**	**3.00**	**0**	**0**	**0**	**0**	**0**	**0**	**11.00**

After fixing the administrative and financial conditions (Consortium Agreement and money transfer by the coordinator) the partners focused on the technical work in the second year. The progress was monitored at the quarterly meetings. During the meetings the status of each partner was reported and also the plans for the next months were elaborated. The dates of the meetings were set before deadlines of the deliverables in order to discuss their structures and to distribute the editorial work among the partners. Additionally several teleconferences were arranged, what helped to monitor the progress.

All planned communication issues have been met properly. The shared project workspace and email lists for scientific (scientist@e-balance-project.eu) and administrative (admin@e-balance-project.eu) issues have been set up. Templates for deliverables and presentation slides in MS Word and MS PowerPoint were used by the partners. We are maintaining the project's website (http://www.e-balance-project.eu/).

The progress of the e-balance project was reported to the EC quarterly. Three reports (Q5-Q7) containing the status of each partner and efforts spent were prepared and submitted to the PO.

In the current reporting period we have realized an amendment to the Grant Agreement. It covered the partner change (EFACEC was replaced by EFA). This partner change was caused by the fact that the business unit by Efacec that is involved in the e-balance project was transferred between two Efacec units. In fact the scope and the team remained the same.

3.1 Status of Deliverables and Milestones

Table 1 shows the status of deliverables which were due in the second reporting period of the project according to the Annex I "Description of work".

Regarding the Milestones, Table 2 shows all Milestones planned for the current reporting period.

Table 1: Project deliverables in the reporting period

Del. no.	Deliverable name	Version	WP no.	Lead beneficiary	Nature	Dissemination level	Expected Delivery Date	Actual Delivery Date	Comments
1	D2.3 "Definition of new business models"	2.0	WP2	LODZ	R	PU	M5	14.10.2015	The deliverable partly accepted after the first reporting period, but an update was requested. The deliverable was completely reworked and also contains elements that are results of some restatement activities performed in period two
2	D3.2 "Detailed system architecture specification"	1.0	WP3	IHP	R	PU	M21	10.09.2015	
3	D4.1 "Detailed network stack specification and implementation"	1.0	WP4	INOV	R	PU	M20	31.07.2015	
4	D4.2 "Detailed security and privacy	1.0	WP4	IHP	R	PU	M20		Draft version to be

	specification and implementation”								provided before the review meeting two
5	D4.3 “Detailed middleware specification and implementation”	1.0	WP4	UMA	R	PU	M20	04.09.2015	
6	D4.4 “Implementation of an integrated communication platform”	1.0	WP4	UMA	R	PU	M24		Draft version to be provided before the review meeting two
7	D5.1 “System models specification and implementation”	1.0	WP5	UTWE	R	PU	M15	24.02.2015	
8	D5.2 “Detailed specification, implementation and evaluation of energy balancing algorithms”	1.0	WP5	CEMOSA	R	PU	M20	31.07.2015	
9	D5.3 “Detailed specification, implementation and evaluation of energy resilience algorithms”	1.0	WP5	EFA	R	PU	M20		Draft version to be provided before the review meeting two
10	D5.4 “Detailed specification, implementation and evaluation of security and privacy means”	1.0	WP5	IHP	R	PU	M20	09.11.2015	
11	D5.5 “Implementation of	1.0	WP5	UTWE	R	PU	M24		Draft version to be

	an integrated communication platform”								provided after the review meeting two
12	D6.1 “Specification of the demonstrators”	1.0	WP5	ALLI	R	PU	M16	15.04.2015	

Table 2: Project milestones in the reporting period

Milestone no.	Milestone name	WP No.	Lead beneficiary	Expected Delivery Date	Achieved Yes/No	Actual Delivery Date	Comments
MS2	Communication platform components available	WP4	UMA	M19	Yes	31.07.2015	The milestone is summarized by an internal document.
MS3	Energy management platform components available	WP5	UTWE	M19	Yes	31.07.2015	The milestone is summarized by an internal document.

3.2 Resources and Spending

A quick overview of the planned vs. reported efforts of the project beneficiaries in the reporting period is shown in Table 3 and Table 4. For most of the partners, the plan figures were determined as linear distribution of the efforts planned for the respective task over the duration. The figures show an underspending of about 7% for the second reporting period. In this reporting period we focused on the implementation and integration of the communication platform and the energy management platform what can be recognized in the efforts spent in WP4 and WP5 that are almost equal to the planned ones.

Table 3: Overview of the spent vs. planned efforts of the project beneficiaries in the second period

Participant		**IHP**	**INOV**	**EDP**	**UMA**	**CEMOSA**	**UTWE**	**ALLI**	**IPI**	**LW**	**LODZ**	**EFA**	**TOTAL**
WP1	spent Y2	1.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.81**
	plan Y2	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**2.00**
	total spent	3.72	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	**6.72**
	plan total	**8.00**	**0.00**	**0.00**	**0.00**	**3.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**11.00**
WP2	spent Y2	0.80	1.08	1.25	0.00	0.58	0.75	2.54	11.06	0.32	2.50	1.59	**22.47**
	plan Y2	0.80	1.08	1.25	0.00	0.28	0.70	2.33	11.06	0.32	2.50	1.59	**21.91**
	total spent	9.11	3.69	13.30	0.30	10.30	3.05	5.21	38.24	1.53	10.14	3.94	**98.81**
	plan total	**12.00**	**4.00**	**15.00**	**0.00**	**10.00**	**3.00**	**5.00**	**46.00**	**2.00**	**14.00**	**4.00**	**115.00**
WP3	spent Y2	3.00	1.89	0.60	5.38	2.60	2.10	0.55	5.09	1.57	0.23	2.49	**25.50**
	plan Y2	1.08	1.00	1.40	3.70	3.00	2.20	1.16	4.60	1.18	0.40	4.11	**23.83**
	total spent	8.96	7.03	3.70	10.78	3.00	5.90	1.50	8.44	6.77	0.70	6.00	**62.83**
	plan total	**9.00**	**6.00**	**4.70**	**6.50**	**3.00**	**7.00**	**3.00**	**19.00**	**8.00**	**5.00**	**8.50**	**79.70**
WP4	spent Y2	6.95	7.52	1.70	5.30	1.00	8.42	0.00	0.00	5.59	0.00	5.40	**41.88**
	plan Y2	12.52	5.65	2.25	6.10	1.20	8.10	0.00	0.00	4.70	0.00	4.38	**44.90**
	total spent	11.53	12.07	3.35	16.80	1.00	10.82	0	0	10.19	0	7.32	**73.08**
	plan total	**21.00**	**11.00**	**4.70**	**20.00**	**2.00**	**14.00**	**0.00**	**0.00**	**11.00**	**0.00**	**8.00**	**91.70**
WP5	spent Y2	4.90	3.38	3.05	9.40	6.85	10.32	1.01	2.15	6.86	0.00	24.64	**72.56**
	plan Y2	9.09	5.57	3.65	11.42	8.25	10.30	0.87	2.01	5.55	0.00	18.72	**75.43**
	total spent	8.05	7.31	5.00	11.20	9.00	19.32	1.19	11.08	14.61	0	27.92	**114.69**
	plan total	**14.00**	**9.00**	**5.60**	**16.50**	**14.00**	**22.00**	**1.00**	**16.00**	**14.00**	**0.00**	**26.50**	**138.60**
WP6	spent Y2	4.81	10.17	6.60	4.92	0.95	5.50	3.83	0.00	1.60	0.00	9.22	**47.60**
	plan Y2	5.00	9.77	6.60	8.50	1.90	10.80	3.95	0.00	1.50	0.00	11.50	**59.52**
	total spent	5.01	10.90	7.50	4.92	0.95	5.70	4.61	0	1.73	0	9.72	**51.01**
	plan total	**11.00**	**18.00**	**14.00**	**16.00**	**5.00**	**22.00**	**9.00**	**0.00**	**2.00**	**0.00**	**19.00**	**116.00**
WP7	spent Y2	0.36	1.38	0.45	0.00	1.09	1.60	0.00	0.26	0.28	0.20	0.00	**5.63**
	plan Y2	0.54	0.55	0.79	0.29	1.07	0.79	0.54	0.54	0.29	0.54	0.29	**6.22**
	total spent	0.86	1.90	0.68	0	2.98	1.90	0	0.97	0.56	0.40	0	**10.26**
	plan total	**2.00**	**2.00**	**3.00**	**1.00**	**4.00**	**3.00**	**2.00**	**2.00**	**1.00**	**2.00**	**1.00**	**23.00**

Table 4: Overview of the total spent vs. planned efforts of the project beneficiaries in the period

Participant		IHP	INOV	EDP	UMA	CEMOSA	UTWE	ALLI	IPI	LW	LODZ	EFA	TOTAL
TOTAL	spent Y2	22.63	25.42	13.65	25.00	13.07	28.69	7.93	18.56	16.22	2.93	43.34	217.45
	plan Y2	31.03	23.62	15.94	30.01	15.70	32.89	8.85	18.21	13.54	3.44	40.59	233.81
	total spent	47.24	42.90	33.53	44.00	30.23	46.69	12.51	58.73	35.39	11.25	54.90	417.40
	plan total	77.00	50.00	47.00	60.00	41.00	71.00	20.00	83.00	38.00	21.00	67.00	575.00

3.3 Project Meetings and other Key Events

During the reporting period M13-M24 project meetings were organized and executed. In all project meetings representatives of most of the consortium partners were present (one exception). The regular project meetings have ensured a close cooperation between all tasks and partners. The list of meetings executed in the reporting period is shown in Table 5.

Table 5: Project meetings and other key events

Event	Date/Venue	Purpose	Participants
Project meeting	October 30th to 31st, 2014 Lisbon, Portugal	Discussion on the project results so far from the demonstration perspective. Identification of required refinements and restatement	All partners
Project quarterly meeting	February 2nd to 4th, 2015 Frankfurt (Oder), Germany	Discussion on project progress and achievements in WP2, WP3, WP4, WP5 and WP7. PMC meeting	All partners
Project quarterly meeting	April 22nd to 24th, 2015 Lodz, Poland	Discussion on project progress and achievements in WP2, WP3, WP4, WP5 and WP7. PMC meeting	All partners
Project quarterly meeting	July 7th to 10th, 2015 Porto, Portugal	Discussion on the project progress and achievements in WP2, WP3, WP4, WP5 and WP7. PMC meeting	All partners
Project quarterly meeting	September 16th to 18th, 2015 Duiven, the Netherlands	Discussion on the project progress and achievements in WP2, WP3, WP4, WP5 and WP7. PMC meeting	All partners, except LW

3.4 Deviations and Delay

Deviations

With the amendment to the Grant Agreement we have addressed most of the planning issues mentioned in the previous periodic report.

The deviations in the execution of the plan are mainly related to the initial error in estimating the distribution of the effort for each partner in the respective tasks. We experience a slight overspending in the recent deliverables related to the implementation of the modules. The coordinator is monitoring the overall state of the reported efforts and no critical overspending was detected yet, i.e., no partner went over the total planned amount of effort or over the planned budget.

Delays

We experienced some delays at the beginning of the project, but we are working on limiting the influence of this initial delay to the further work. The delay transferred from the first reporting period is about 2-3 months. But it did not increase in the current reporting period and we are working on actually reducing it. The mitigation means for that include close collaboration between partners and focus on the implementation and integration of the solution to reduce the delay of the deployments of the demonstrators to minimum. In order to monitor that we defined fine grained milestones for the integration.

The delays of the deliverables due in the second reporting period have several reasons. One is the above mentioned delay transferred from period one. But additionally, we realized that we made mistake in the project planning, i.e., we have planned seven deliverables in a single month. The effort related to these activities were not possible to be distributed among the partners without resource conflicts and additionally the delivery date moved towards summer due to the initial delay in the project. This caused the delay for the deliverables to grow. However, after recognizing the situation we decided to focus on the implementation and integration activities and gave these activities priority over the preparation of textual description. These textual descriptions will, however, be provided as soon as possible. But as said we have set the priority on implementation and integration of the solution to be evaluated.

Another source of the delay is the issue with the partner Lesswire. The company was sold resulting in a significant loss of personnel, thus, the partner was not able to provide the necessary contributions in Q6-Q8. This caused an enormous impact on the progress, especially on the integration activities. The coordinator took already actions to cope with the issue. We are monitoring the situation at Lesswire with regular phone calls and the partner Lesswire is looking for new personal heavily. On the technical level the consortium decided to move to an alternative available hardware platform to implement the CMU (customer management unit). But this also added to the delay.

We also have a slight delay with respect to the definition of the final set-up for the Bronsbergen demonstrator. Partner ALLI had an agreement with Indesit with respect to providing the smart appliances, but Indesit was bought by Whirlpool and the new owner is no longer interested in the cooperation. Thus, the consortium was looking for alternatives. IHP had set-up contact with Candy and UTWE had set up contact with the FPAI Alliance tested Miele devices that support the FPAI framework. We are in the final phase of defining the set-up, but even though this activity ensured that the consortium will be capable to control real world appliances, it did cost some time also contributing to the delay.

The main reason for delays in submission of the quarterly reports was the problem with getting reliable data on resource consumption. The partners needed about 4 weeks to gather the information about efforts spent in the reporting period and after that some time was needed to integrate all the inputs into one document.

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Annex A

This section presents the dissemination results in Y2.

Event name	Type [(*)]	Role	Date and Venue	Partner/s
International Conference 'ICT for sustainable places' (ICT4SP)	Conference	Poster	October 1-3, 2014 Nice (France)	IPI
5th IEEE PES Innovative Smart Grid Technologies Europe 2014 (ISGT-EU 2014)	Conference	Paper	October 12-15, 2014 Istanbul (Turkey)	UTWENTE
18th LEIBNIZ Conference of Advanced Science	Conference	Paper	October 16-17, 2014 Lichtenwalde (Germany)	IHP
9th Mediterranean Conference on Power Generation, Transmission, Distribution and Energy Conversion (Medpower2014)	Conference	Speaker (paper)	November 2-5, 2014 Athens (Greece)	LODZ, IHP, INOV, CEMOSA, IPI
Energetyka Prosumencka w Wymiarach Zrównoważonego Rozwoju" (EPwWZR)	Conference	Speaker (paper)	November 5, 2014 Gliwice (Poland)	LODZ
Kommunikation in der Automation (KommA 2014)	Workshop	Paper	November 18, 2014 Lemgo (Germany)	IHP
SPS/IPC/Drives Kongress 2014	Conference	Paper	November 25-26, 2014 Nuremberg (Germany)	IHP
Workshop on Smart Electric Energy	Workshop	Speaker	January 22, 2015 Porto (Portugal)	EFACEC
Zarzadnie energia i teleinformatyka (ZET 2015)	Conference	Speaker (2 papers)	February 18, 2015 Nałęczów (Poland)	LODZ, IHP
InovGrid Suppliers - Opportunities for the National Industry	Workshop	Speaker	March 16, 2015 Évora (Portugal)	EFACEC
II Konferencja Naukowo-Przemyslowa KKBS 2015	Conference	Paper, Book chapter	March 17-18, 2015 Poland	IHP, CEMOSA
Dispersed Renewable Generation: Challenges, Current Developments and Technology Trends (ENERGEIA Seminar)	Seminar	Speaker	March 24, 2015 Faro (Portugal)	EFACEC
ICT.OPEN The Interface for Dutch ICT-Research	Conference	Poster	March 24-25, 2015 Amersfoort (the Netherlands)	UTWE
EEM2015 Conference	Conference	Speaker (paper)	May 19-22, 2015 Lisbon (Portugal)	LODZ, EDP, IHP
4th International Conference on Smart Cities and Green ICT Systems (SMARTGREENS 2015)	Conference	Paper	May 20-22, 2015 Lisbon (Portugal)	INOV
Origin Project: Harnessing Community Energies	Workshop	Speaker	June 4, 2015 Findhorn (Scotland)	IPI
An Innovative Truth VII congres over duurzame ICT & Energie	Meeting	Poster	June 15, 2015 Eindhoven (the Netherlands)	UTWE
23rd International Conference and Exhibition on Electricty Distribution (CIRED2015)	Conference	Speaker (paper and poster)	June 15-18, 2015 Lyon (France)	CEMOSA, INOV, EDP, IHP
23rd International Conference and Exhibition on Electricty Dsitribution (CIRED2015)	Conference	Exhibitor (flyers)	June 15-18, 2015 Lyon (France)	EFACEC

Event name	Type [(*)]	Role	Date and Venue	Partner/s
The 45th Annual IEEE/IFIP International Conference on Dependable Systems and Networks (DSN 2015)	Conference	Paper	June 22-25, 2015 Rio de Janeiro (Brazil)	UTWE
Workshop "Energy efficiency and Smart solutions"	Workshop	Speaker	June 23, 2015 Barcelona (Spain)	CEMOSA
PowerTech 2015	Conference	Paper	June 29 - July 2, 2015 Eindhoven (the Netherlands)	UTWE
EUCNC2015 European Conference on Networks and Communications	Conference	Speaker (paper)	June 29 - July 2, 2016 Paris (France)	IHP, CEMOSA, UMA, IPI
INTERNET RZECZY W POLSCE	Magazine	Editor	August 31, 2015 Poland	IPI
Sustainable Places 2015	Conference and Workshop	Speaker	September 16-18, 2015 Savona (Italy)	CEMOSA
Energycon 2016 - IEEE International Energy Conference [(1)]	Conference	Paper	April 4-8, 2016 Leuven (Belgium)	IHP, UMA, UTWE, CEMOSA, EDP, INOV, ALLI

[(1)] This dissemination activity will take place during the second period, but the abstract submitted have been accepted and the consortium is working on the full paper.