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STEP-IN

D5.4 - Energy Poverty Assessment and Reduction Tools Version V3

Deliverable lead beneficiary: LIST
Authors: Mickaël Stefas, Ulrich Leopold
Contributor(s): Philippe Pinheiro, Roderick McCall

Internal Technical Auditor	Name (Beneficiary short name)	Date of approval
Task leader	Mickaël Stefas	01.03.2020
Internal technical reviewer	Philippe Pinheiro	10.03.2020
WP5 Leader	Ulrich Leopold	05.08.2020
Project Coordinator	Roderick McCall	06.08.2020
WP3 leader	Dimitris Damigos	06.08.2020
WP5 leader	Ulrich Leopold	07.08.2020
ARTTIC	Audrey Bretaud-Kelle	10.08.2020

Abstract: This deliverable contains an overview of version 3 of the STEP-IN ICT tools (e.g. the architecture, web platform and server).

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Dissemination Level

PU Public

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Glossary

Abbreviation / acronym	Description
DB	Database
LL	Living Lab
UI	User Interface, what the user sees on the screen.
Client	The web system which is used to enter or see data.
Server	This is what is used to allow users to reach the website. It's where the main code runs.
Users	The types of users and roles. For V1, only consumers, advisors, researchers and super administrator are implemented. Advisors and researchers act as administrators.
HTTP / HTTPS	HyperText Transfer Protocol. This is the protocol used for the communication between client and server. HTTPS is the secured variant.
HTML	HyperText Mark-up Language. That's a programming language used to develop web pages.
JavaScript (or JS)	A programming language used to create scripts, which allow a website to be dynamic.
CRUD verbs	The most commonly http used methods: POST, GET, PUT/PATCH and DELETE. CRUD stand for Create Read Update and Delete
SQLite	SQLite is the library used as SQL database engine. This is what we use to store and access data.
Angularjs	This is a framework used to develop reliable code in JavaScript.
D3Js	This is a library used to draw graph on the web app.
JSON	JavaScript Object Notation. It is a textual file format used to describe object (data) for a use in JavaScript.
CSV	A file format using commas to create a tabular data structure

1. Executive Summary

This document outlines the implementations for version 3 of the STEP-IN ICT tools applied during the third round of Living Labs (V3). This document provides a progress report for version V3 and is not the output deliverable itself for work package 5. The STEP-IN software tools and platform provides the actual deliverable which can be accessed at https://step-in.list.lu. This document is primarily of technical nature and is of interest to those considering deploying or developing similar software tools and solutions.

Following on from discussions within the STEP-IN project consortium and during workshops it was identified that the primary users of the first version of the ICT tools and platform during the first living lab cycle were the energy advisors. In the second version of the software tools, further functionalities were introduced to provide access and information to the consumers on the platform. Version 3 built on the previous developments and the interim review (DL5.5) of the ICT tools used during the Living Lab cycles V1 and V2. These improvements are reflected in the User Interface, with its design and layout, an improved knowledge base, and the questionnaires for Nyírbátor and Metsovo with automated data processing and analysis algorithms. The knowledge base received a new design and was populated with documents where consumers can access general information specific to their country, region and city on how to improve quality of life regarding energy. The ICT platform now increasingly acts as a way for the energy advisors to collect data from individual consumers and then provide relevant advice to the individual consumer either through the energy advisor or to the consumer directly.

This document outlines the further developed components and functionalities of the system, ranging from software architecture and its deployment, to the user interface with access possibilities for 4 different type of users (researchers, energy advisors, consumers, public) and its tools depending on the permission a user has. The system supports features from the uploading of consumption data from sensors and questionnaires, through analysis of energy consumption and visualisation of energy consumption and advice reports for individual consumers.

Version V3 of the ICT tools main focus was on the improvements of the user interface including usability, the implementation and improvements of the energy advice tools for individual advice of consumers and the knowledge base for general advice to the public *without* having to log in. The iterative (V1-V3 cycles) process in the project means that lessons learned from the Living Labs and, in particular, the ICT tools have been used to improve the platform during version V3 (as previous versions), including behaviour change advice and connections to third party systems. Version V3 of the platform is a direct result of extensive work between the Living Labs and LIST after the mid-term review from the Living Labs described in D5.5 and testing from identified users, i.e. energy advisors, consumers and researchers, of the platform.

As not all consumers are able to use ICT based tools due to non-availability of internet connections, digital devices and/or knowledge of their usage, paper-based diaries were introduced in V2 and V3. In Manchester there were no returns and there is an attempt to redistribute them in V3. In Metsovo, energy diaries were distributed to households and 20 returned in V2. In V3, another 50 energy diaries will be expected. In Nyírbátor, energy diaries will be distributed in V3 with an expected return rate of 10%, i.e. 20-30 diaries. An assessment of the diaries will be done after V3 and will be included in the DL 5.6, the final review of ICT and non-ICT tools.

2. Introduction

This document is intended to summarise the ICT tools platform within STEP-IN which form the actual deliverable D5.4. It provides an overview of the progress of the ICT tools. The previous deliverables D5.3 and D5.2 provided an overview and first implementations of the architecture features. All three, D5.2, D5.3 and D5.4 should be read in conjunction with D5.1, which documents the underlying requirements and platform design. It should be noted that version V1 of the ICT tools focussed primarily on data collection and interoperability to make information available to energy advisors (see also D5.2). Version V2, described in D5.3 improved functionalities and architecture as well as remote deployment and local processing of the required data through the first generation of questionnaires and analysis algorithms to create energy advice reports. Version V3 of the ICT tools focussed on the improvements of the web interface to improve usability, the implementation of an energy advice tool for individual advice of consumers and the implementation of a knowledge base for general advice to the public without having to log in. The iterative (V1-V3 cycles) process in the project means that lessons learned from the Living Labs, and the ICT tools have been used to improve the platform during version V3 (as previous versions). This includes more behaviour change advice and connections to third party systems such as energy analytics tools through the platform. Version V3 of the platform is a direct result of extensive work between the Living Labs and LIST. Improvements were due to intensive feedback from the Living Labs and testing from identified users, energy advisors and researchers and consumer groups, of the platform. During the early stages of the project it was intended for consumers to be the end users; however, it emerged that many consumers will not have continuous access to mobile devices or the internet. Therefore, it was decided to focus on providing a platform for use by energy advisors. This was corrected in version V2 as consumers also needed to access the platform to retrieve their personal advice reports. The system is web based, which means that no installation for the individual user is required, and the users do not need to update any software parts. Instead, updates will be available automatically on the individual servers of each Living Lab (LL).

STEP-IN is not the only project which is working with ICT tools to assist in understanding energy consumption and behaviour change. In the UK, and Manchester, a national project LEAP has been established which developed a mobile app to gather data from energy vulnerable people. As this is linked to a funding program and energy advisors are already having made good experiences with this commercial application, Manchester LL decided to make use of this tool. Nevertheless, the STEP-IN platform provides a functionality to upload gathered data from other tools, such as the LEAP app and provide additional tools and visualisation for other tools used in STEP-IN. As STEP-IN progresses, the ICT development team from LIST has sought to build further upon best practice and the existing work of partners (in particular LIST) to provide a range of ICT tools to assist those who are facing challenges in managing their energy bills and consumption.

This summary report presents an overview of the objectives of the STEP-IN ICT tools and the underlying architecture. It then explains the core components including the web interfaces, front and back end along with an overview of aspects such as user management and visualisation. It also includes an overview of deployment and data protection issues and then describes the improvements and added features of version V3 and concludes with final steps.

3. Platform description

3.1 Reminder about platform objectives

As already specified in D5.1, D5.2 and D5.3, WP5 focuses on designing and implementing ICT tools used by energy advisors, researchers, consumers and the public for the following tasks:

- To support data collection and integration in the Living Labs;
- To provide analysis to help in the understanding of energy poverty;
- To provide advice for the consumers;
- To find solutions for energy poor households.

D5.1, provides the overall implementation decisions for the platform and D5.2, D5.3 provide the description of the developed tool for the 2 first cycles. Here, we focus on providing a summary of the advancements of ICT tool to be deployed for LL cycle V3 (see below). These are all provided in the context of the improved and adapted platform architecture, which needed adaptation according to GDPR rules and processing tools:

- Sensors integration and data uploads of consumer households;
- A central platform (described later) used to further implement the tasks raised in D5.1 and progressed in D5.2;
- The platform is deployed in each LL and connects to a data analysis engine to enable effective analysis of energy consumption patterns;
- Multiple types of devices (smart phones, tablets, PCs) are able to connect to the platform and to interact with it to send, gather and display information (e.g. questionnaires, diaries, sensors data, charts).

As for the two previous versions of the platform, we organised feedback sessions with the LL leaders to improve the usability and the design as well as to develop new components such as the questionnaires status page, or visualisation tools. Furthermore, we improved the web interface with the help of a graphics designer from LIST's communication team.

During the two first iterations of the platform implementations, we aimed at implementing and testing, with the help of the LL leaders, the required features to assist consumers. During V2 we verified that researchers and energy advisors are able to input questionnaire and sensor data and that their methods for questionnaire analysis were usable directly on the platform. During V3, we will have implemented all the methods required for the analysis to produce the personalised energy advice for consumers.

3.2 V3 Addition Overview

During the second cycle of the LL, we got feedback about the necessity to improve some points and add some additional features. Here, we describe a list of what was requested and what has been done to reply to these demands.

3.2.1 Improvement of the User Interface and User Experience

One of the most asked for improvements was the UI design and icons. For this specific task, we integrated a graphics designer from LIST to help improving layout and design of the web interface for

a better the look and feel. This collaborative work resulted in a reorganisation of some of the navigation bar, changes in the general layout of the User Interface, choosing a new colour scheme and using new icons. Results are shown in figures 1 and 2.

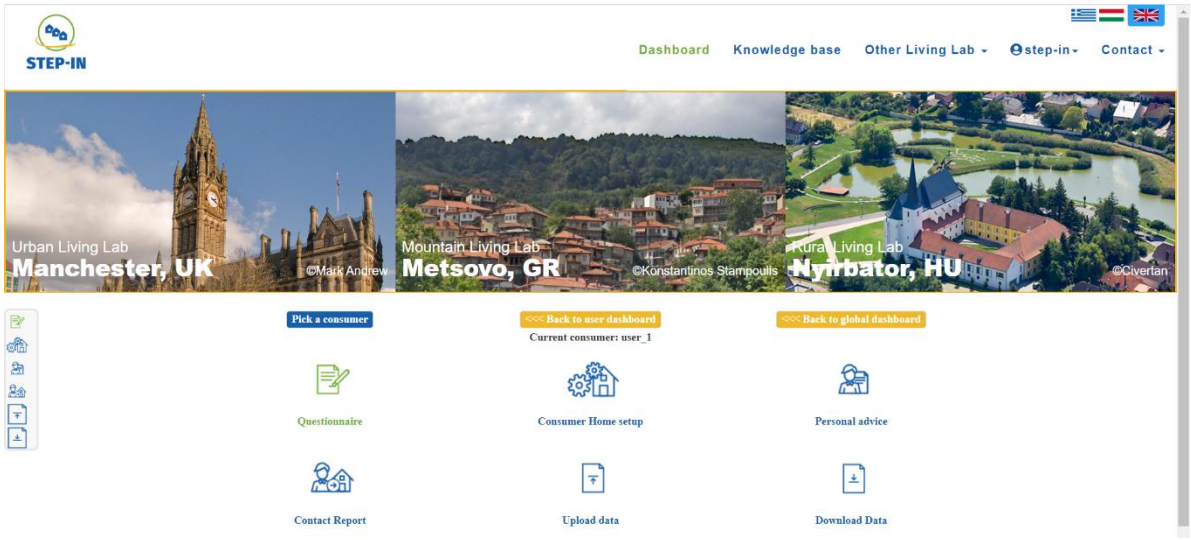

Figure 3-1: New dashboard page

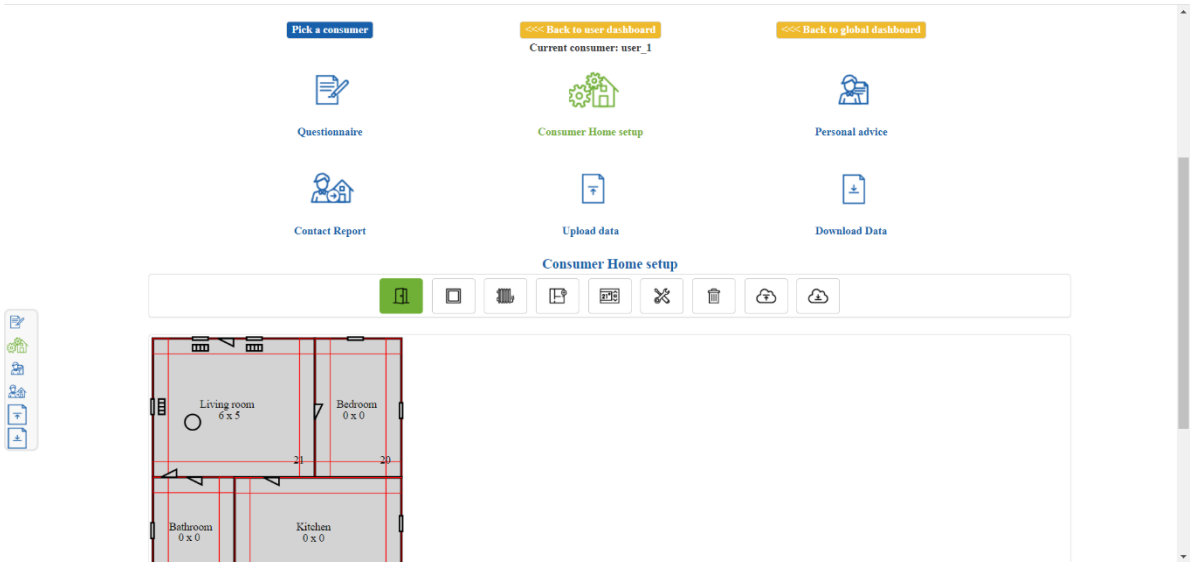

Figure 3-2: New Home setup icons

The layout was also improved for usage of mobile phones and tablets (see Figure 3).

Figure 3-3: Mobile phone display for Manchester

3.2.2 Implementation of a Translation dictionary

During V2, we started to translate some content of the website to let it be more comprehensible by LL local users and for other contents we suggest that they use Google Chrome Translate. In V3, LIST implemented a dedicated translation dictionary, which is gradually improving with the help of the LL partners. Each LL platform has its own default language setup where the user can also switch the display language by selecting the corresponding flag on the top right of the User Interface (see Figure 4).

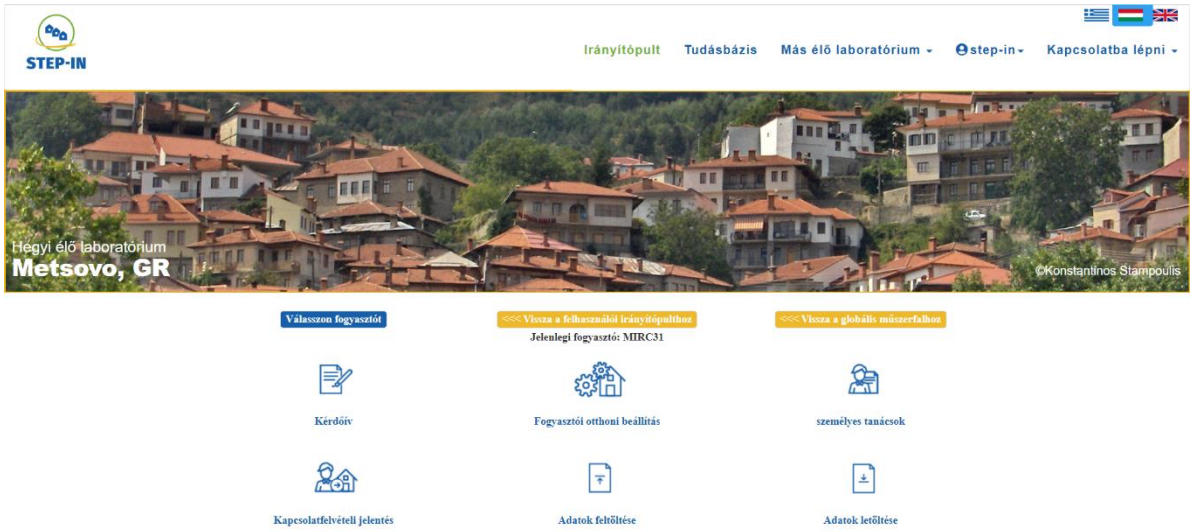

Figure 3-4: Metsovo LL instance of the platform, displayed in Hungarian.

3.2.3 New Knowledge Base

With the growing amount of documentation available for the consumers, it became clear that the simple UI we implemented during V2 was not sufficient and that a feature to filter information must be provided. Thus, we implemented a new feature for filtering and displaying documents.

Currently it is possible to filter the list of documents by text present on the document title, by type of files (word, pdf, excel or video), by language or by country of relevance (See figure 5).

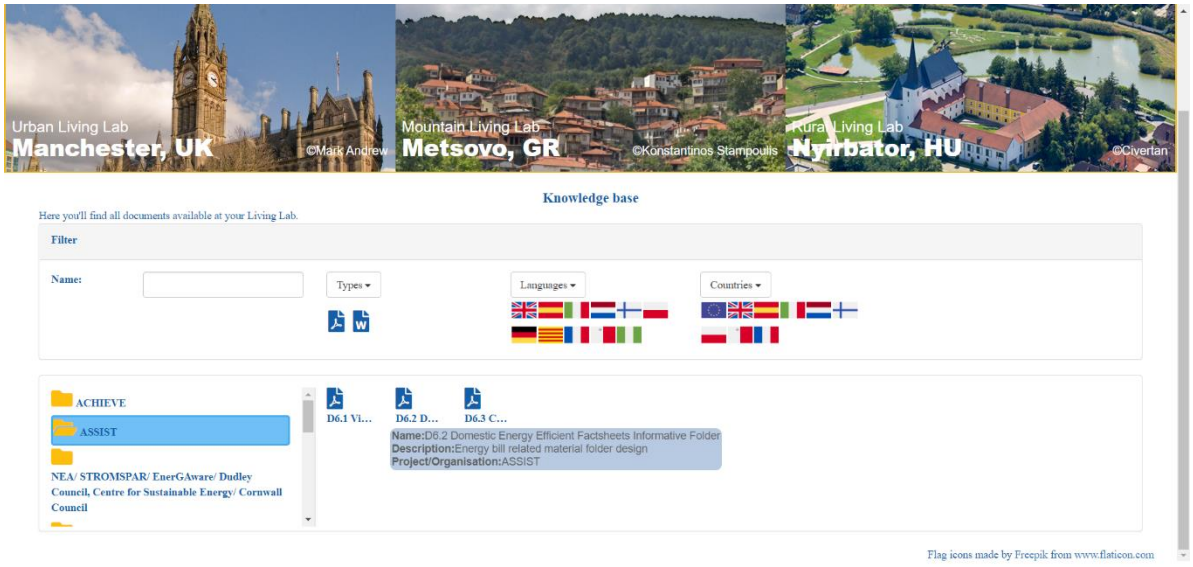

Figure 3-5: New knowledge base UI

On the left side the user can see the folder where the document is stored (its name usually corresponds to the project providing this document). On the right side the user can see the documents from the selected folder. Clicking on a document displays information about it as a tooltip, clicking again will download the document.

This feature is not yet available on the public website because we are still waiting for the feedback from document producers about the right to share them.

3.2.4 Questionnaire Status Page

Upon request from the Living Labs users, in particular the energy advisors and researchers, we implemented a global view of consumers in the platform, listing all consumer filled questionnaires at once and provide the possibility export all questionnaire data (answers) as a tabulated CSV file. This CSV file contains a column for each question and a line for each filled questionnaire, each cell contains a code value or a string for textual response.

We also added the possibility to generate multiple reports at once by allowing the selection of multiple questionnaires.

In order to easily see the completion status of each consumer questionnaire, we added a flag next to the consumer id on the column named 'Filled'. The same is used for the generated reports on the column 'Report exists'. Missing questionnaires and reports are marked with an X, valid or generated ones with a green V. For reports that can be generated (only when the questionnaire is filled properly) instead of the X there is the message "Run it now!" followed by a button to generate it (see figure 6).

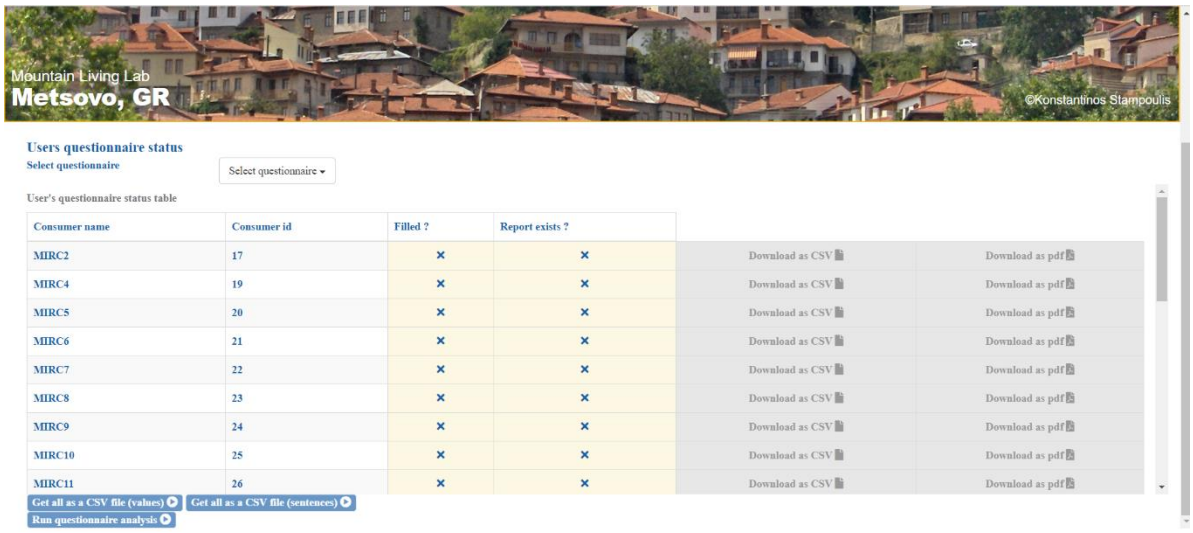

Figure 3-6: The new questionnaire status page. The column "Consumer name" holds anonymised consumer name codes.

3.2.5 Sensor Data Visualisation

We added a brush line chart to explore uploaded sensor data. It lets the user, e.g. an energy advisor, pick a data file among the list of data which was uploaded for a selected user, and then, select a data set for display with the start and end date and its temporal resolution.

Once the data have been plotted, the user can "brush" the timeline to "zoom" into a specific time period. the user can also choose to display the mean value as a continuous red line by checking the corresponding checkbox (see figure 7).

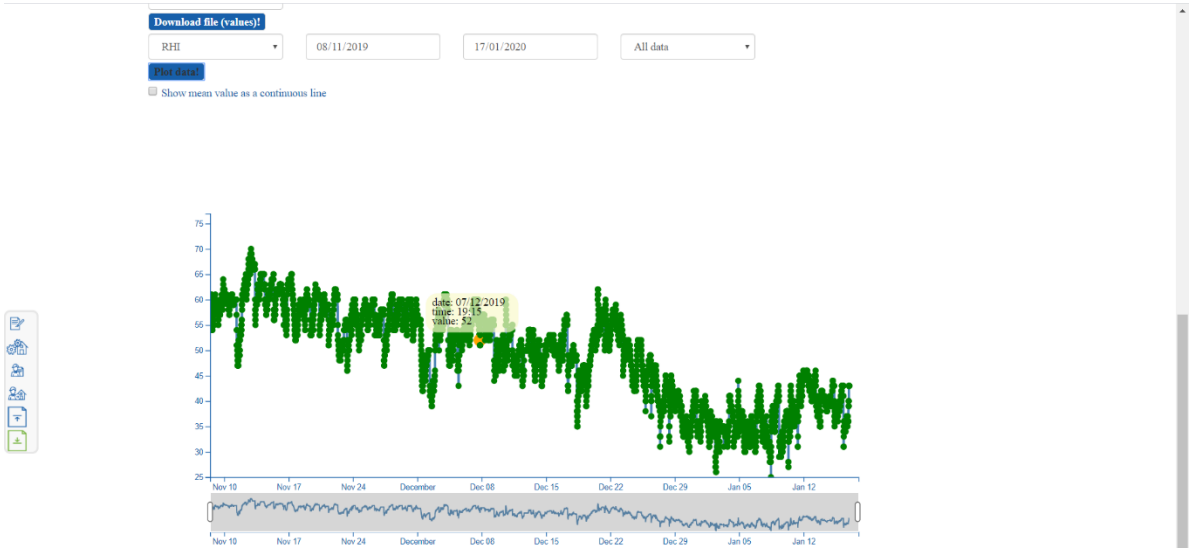

Figure 3-7: New sensor data visualisation feature

When the user hovers over a point with the mouse pointer, he/she can see a tooltip containing information about it.

3.2.6 Users Feedback and Survey

We added the survey feature to provide the possibility to get feedback about the project and the platform in general. This reuses parts of the code and work done for the consumer questionnaires (see figure 8).

The user must be logged in to complete the questionnaire. Currently it is only available in English and has not yet been translated to other languages, but the hope is that this can be changed in the future.

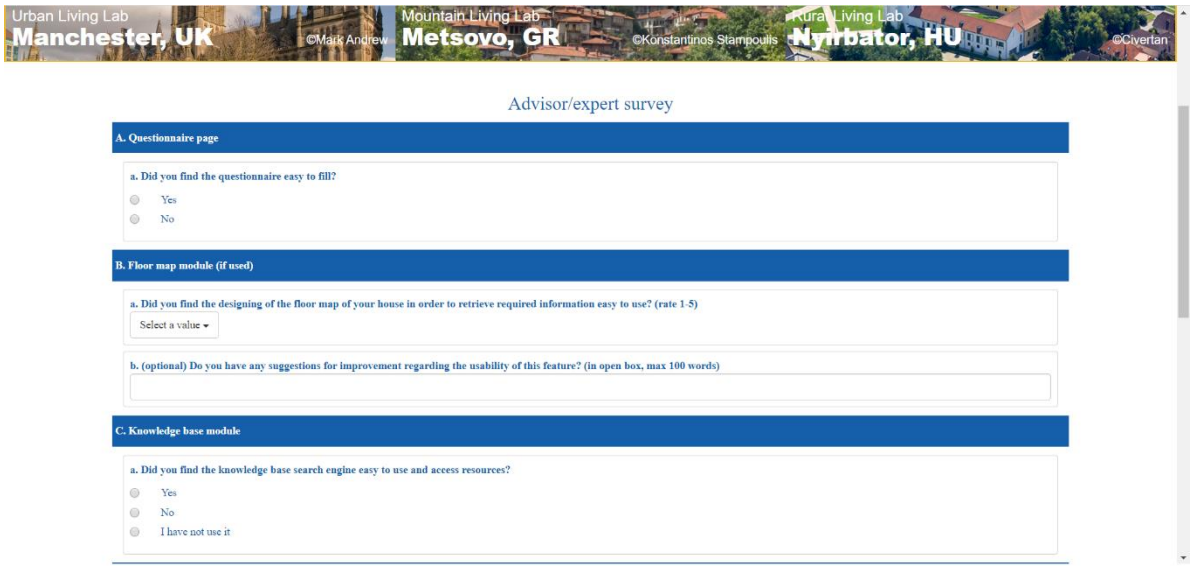

Figure 3-8: Example of survey

The questions of this survey were provided by people working on the project Work Package 6.

3.3 Data protection

In order to preserve privacy and reduce the risk of any data protection issues, each LL is responsible for the storage and use of the data at their location. Furthermore, identifiable data will never be exchanged between LLs nor with LIST. To further protect users, data will only be referred to using an ID, and not a name or similar piece of data. This should ensure that when data is exchanged it will not be possible to identify who provided the data, also the table(s) storing any personalised information can be removed when the data is sent between locations

More detail about ethics and data protection are available in D7.3 and D1.3[1].

3.4 Reuse of existing tools and methods

The platform reuses many existing elements from previous work from LIST. For instance, the credentials system, the general layout of the page, the map system and the libraries used for the prototype are the same that are used in the LIST developed iGuess platform. Compute engines used as a service are also implemented on the same basis as used in iGuess (they can be to compute layers). New features that were requested by the LLs were the developments of the floor map section and the integration of an improved analysis and report engine developed at the Hungarian partner Ariosz and integrated by LIST, as well as a report analysis engine rewritten in R for Metsovo Lab and implemented by LIST.

We also reuse components, where we can, in multiple pages. For instance, anytime there is a questionnaire, the same component is used to display it, the same methods are used to store and gather filled values.

Furthermore, the existing LEAP mobile app at Manchester LL is going to be evaluated on how linking to the STEP-IN platform can be done. Currently, data are sought by UMAN to be exported from the LEAP app to upload them for further analysis to the STEP-IN platform as aggregated anonymised data.

3.5 Non-ICT tools

Not all consumers are able to use ICT based tools due to non-availability of internet connections, digital devices and/or knowledge of their usage. For this purpose, we also introduced non-ICT tools, such as paper-based diaries, and energy cafés for general exchange. In Living lab round V2 paper-based diaries have been distributed throughout all Living Labs.

In Manchester there were no returns and there is an attempt to redistribute them in V3. In Metsovo, 30 energy diaries were distributed and 20 returned in V2. In V3, another 50 energy diaries will be distributed, mainly in September/October when the cold season starts. In Nyírbátor, 200 paper-based energy diaries will be distributed in V3 with an expected return rate of 10%, i.e. 20-30 diaries will probably be returned. An example of a paper-based energy diary, used in Metsovo, is shown in Figure 3-9.

An assessment of the diaries will be done after V3 and will be included in the DL 5.6 “Final Review of ICT Tools.

1 Both D1.3 and D7.3 are confidential reports.

HH id: ENERGY CONDITIONS CERTIFICATE CALENDAR DATE:

	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	09:00 - 10:00	10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	18:00 - 19:00	19:00 - 20:00	20:00 - 21:00	21:00 - 22:00	22:00 - 23:00	23:00 - 00:00	00:00 - 01:00	01:00 - 02:00
Electric Stove																				
Electric Water Heater																				
Washing Machine																				
Clothes Dryer																				
Dish washer																				
Air - Condition																				
Heating Electrical Appliances																				
Boiler, Coffee Maker, Toaster																				
Other																				
Wood stove or Energy fireplace or wood boiler. Note what hours it is running																				
Thermostat. What time do I set it up?																				
Thermostat. At what temperature do I set it up?																				

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Figure 3-9: Example paper-based energy diary for Metsovo (translated to English).

3.6 Further improvements

Some further aspects of the platform will be added or improved during the lifetime of project, including the following:

- Add more visualisations to display the stored data (simple graphs or combination of multiple ones);
- Implement a map which can display aggregated data (gathered during V1, V2 and V3 of the LLs) if it makes sense (depends on geo-localisation of data);
- Connect external tools, such as LCA impact assessment tools to analyse data from questionnaires or data from sensors in a more aggregated approach per LL and across LLs. Until now, data from Nyírbátor and first data from Metsovo;
- We will add the possibility to add documents to the Knowledge Base and the General advice part of the web platform directly on the website;
- The STEP-IN ICT tool platform will also need to be better linked to the project web page.
- A final discussion will happen around IP of the STEP-IN platform. In a first discussion round amongst STEP-IN partners an open IP policy has been favoured as the platform is the result of a joint development of Living Labs and LIST. This will have to be finalised in the coming

months and a decision can hopefully be taken by end of 2020. The consortium will have to decide on a potentially dual licence model, e.g. open source with potential of commercial exploitation if envisaged by any of the partners. But as the focus is on improving life of the vulnerable people in society, these tools should be made available as much as possible freely which was a first conclusion from the partner discussions.

4. Conclusions

This document has presented an overview of the ICT tools developed for version V3 of the STEP-IN LLs. For version V3, the ICT tools have been improved on for usability in form of an improved user interface with a modern look and feel and more intuitive design, improved energy analysis through improved analysis code for personal advice as well as including a knowledge base. In addition, a user feedback and Survey was implemented to provide the possibility for user to give feedback.

The STEP-IN platform enables multiuser access for researchers, energy advisors, consumers as well as the public. This is now the near final version for Living Lab cycle V3 with currently further small improvements to allow stable functionality for the last Living Lab cycle. All improvements and additions are based on the midterm review and its feedback. The document outlined the core features along with issues relating to user experience and personalised energy advice for consumers. The approach leverages existing components, tools and techniques and adds some new features, such as user interface, improved knowledge base, sensor data visualisation and a user feedback option to gather more feedback for the final part of the STEP-IN project and allow for future use and improvements in other Living Labs outside of STEP-IN.

Furthermore, as it is web based, it does not require the installation of an application and can run on any Internet enabled device with a suitably sized screen, i.e. desktop computer, tablet or mobile phone. A web-based approach avoids problems connected to installing or updating software. This potentially increases its uptake and use in STEP-IN and outside. The platform in such form can be easily deployed to new or other living labs within the same country of each living lab and with smaller adaptations for personalised energy advice from one country to another, as it can differ from country to country.

As not all consumers are able to use ICT based tools due to non-availability of internet connections, digital devices and/or knowledge of their usage, paper-based diaries were introduced in V2 and V3. In Manchester there were no returns and there is an attempt to redistribute them in V3. In Metsovo, energy diaries were distributed to households and 20 returned in V2. In V3, another 50 energy diaries will be expected. In Nyírbátor, energy diaries will be distributed in V3 with an expected return rate of 10%, i.e. 20-30 diaries. An assessment of the diaries will be done after V3 and will be included in the DL 5.6 "*Final Review of ICT Tools*".

5. Bibliography

Nodejs documentation: https://nodejs.org/en/
Angularjs documentation: https://angularjs.org/
Related project website: https://edi-net.eu/en/home.html
iGuess project website: https://smartcity-energy.list.lu