PROJECT PERIODIC REPORT

Nov 13 to October 13 – Publishable Summary

Grant Agreement number: 314742

Project acronym: ORIGIN

Project title: Orchestration of Renewable Integrated Generation in Neighbourhoods

Funding Scheme: FP7

Date of latest version of Annex I against which the assessment will be made:

2014-07-20

Periodic report: **1st** ☐ **2nd** X **3rd** ☐ **4th** ☐

Period covered: **from** **November 2013** **to October 2014**

Project website address:

http://origin-concept.eu/

ORIGIN Summary Period 1 - November 2013 to October 2014

Project context and objectives

Many thousands of householders, businesses and communities have installed renewable energy systems in the last few years. However, often the energy produced is intermittent and is not generated when it is needed locally.

Working in conjunction with commercially available control and sensing hardware, the ORIGIN (Orchestration of Renewable Integrated Generation In Neighbourhoods) control system is orchestrating energy demand within a community with the aim of better aligning it to local renewable generation.

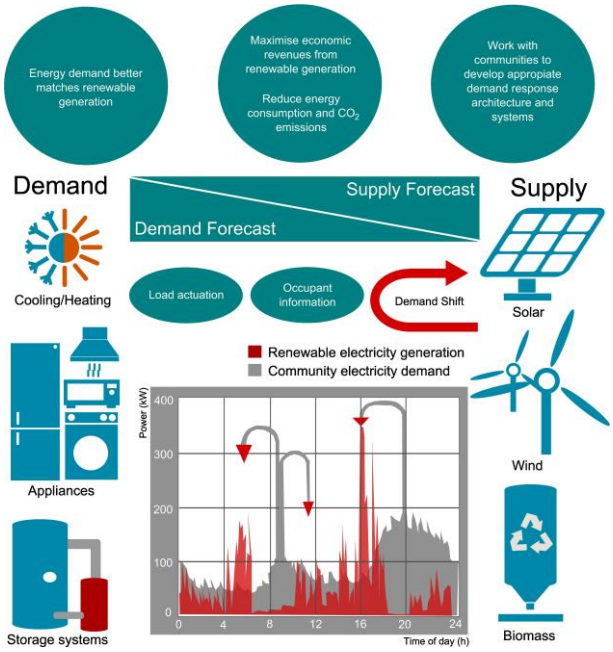

Fig 1 Typical Community electricity demand and renewable electricity generation

ORIGIN has 8 beneficiaries: Heriot Watt University (HWU), ISA – Intelligent Sensing Anywhere, University of Strathclyde (UoS), Insituto Tecnologico de Informatica (ITI), Fraunhofer Gesellschaft Institute for Solar Energy Systems (FISE) , Findhorn Foundation, ILOS and Solera SV. Heriot Watt University is the project coordinator with the UoS, FISE and ITI acting as academic partners. The key role of ISA is to provide monitoring and actuation hardware and the associated software customised to the project's needs. Findhorn Foundation, ILOS and Solera SV represent the 3 communities: Findhorn Foundation community in Northern Scotland; Tamera in Southern Portugal; and Damanhur in Northern Italy where the ORIGIN system is being piloted. These 3 communities have very different climatic and renewable energy generation conditions.

The primary objective is to demonstrate significantly increased uptake of local embedded renewable generation, and associated carbon emissions reductions, via the use of the ORIGIN smart ICT architecture. Below is a list of subsidiary and associated objectives in the order in which we expect to meet them during the project with progress to date:

- **O1**: Develop the ORIGIN smart ICT architecture and deploy it in each of the three validation communities (Damanhur, Findhorn Foundation Community, Tamera). **Complete**
- **O2:** Evaluate and demonstrate the acceptability of the ORIGIN approach to end users. **End users have been actively involved in the user interface development. In year 3, a post ORIGIN survey will identify the acceptability of the ORIGIN approach.**
- **O3**: Demonstrate significant increased uptake of locally generated renewable energy in each of the validation communities. **Baseline figures now established so measurement of increased uptake can be made in year 3**
- **O4**: Define and deliver a transferable implementation process. **Ongoing**
- **O5**: Define a range of appropriate business models for energy-aware communities. **Business models have been defined and will be further detailed in year 3**
- **O6**: Widespread dissemination of project results. **Ongoing**

The timescales of the project are as follows:

Year 1 – 2013 – ORIGIN ICT Hardware System deployed in each pilot

Year 2 – 2014 – On-going community energy monitoring and software/algorithm development

Year 3 – 2015 – Activated energy control phase and system performance assessment; Initial commercialisation of system.

Work performed in year 2 and main achievements

In year 2, the main focus for the ORIGIN team has been on gathering and monitoring data in all three communities, developing the algorithms deployed in the ORIGIN smart energy management system, designing and interfacing the end user display and creating a commercialisation plan.

At the start of year 2, all 3 communities had successfully installed the hardware and software to start collecting relevant data. Data for all three communities is stored in a secure cloud. A script is used to highlight any issues with devices /sensors. From this data, baseline energy use in all 3 communities has been established and in year 3 this will be used to identify any increase in utilisation of locally supplied renewables as a result of the ORIGIN system.

At the heart of the ORIGIN system are a number of algorithms. In year 2, these algorithms have been designed, developed and validated. A Weather Prediction Algorithm (WPA) specifically forecasts a set of weather variables that are appropriate to the community in question. This algorithm supplies data to help forecast in advance both the electrical energy demand in the community (Demand Prediction Algorithm – DPA) and the supply of renewable energy (Renewable Prediction Algorithm – RPA). The DPA also uses historic community consumption data obtained from the sensors installed in the community. A straightforward 'Gap Analysis' is generated, to characterise the forecast surplus renewable energy over the next 48 hours, and, a collection of opportunities for load shifting are calculated by the Opportunities Prediction Algorithm (OPA).

These opportunities each indicate an individual or community action, which can be suggested or automated. The Optimisation and Control Algorithm (OCA) considers the surplus forecast and the opportunities, and proceeds to generate a 'schedule', indicating an optimised list of actions that will achieve better renewables utilisation over the next 24 hours. Finally, the outcomes of the OCA, together with a variety of other information useful to (or simply of interest to) the community and its individuals is presented to the community (and individuals) via a user interface (UI) to which all participants have access.

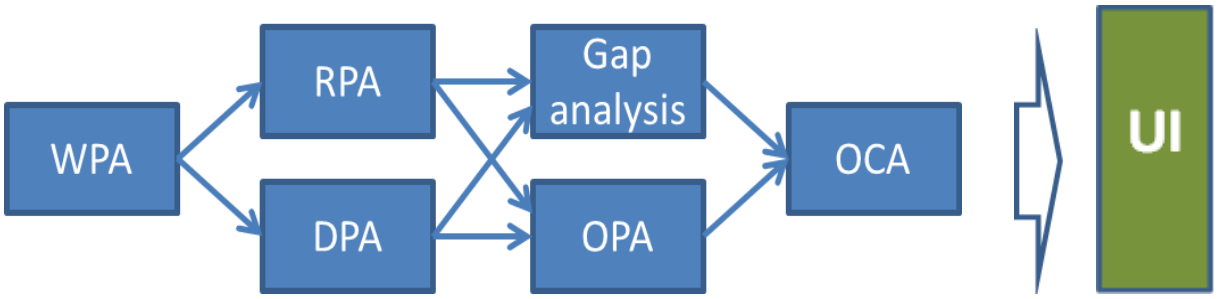

Fig 2 Main High Level Components of the ORIGIN algorithm and the User Interface

The end user interface has been developed in consultation with all 3 communities. This interface supplies historical information on electrical energy consumption, import and export data and resultant CO^2 savings. It also highlights current and forecast weather data and renewable generation availability now and in the near future. It also gives recommendations of when surplus renewable energy is likely to occur. This system was launched in all 3 communities in November / December 2014 thus achieving the major milestone, full energy control system activation in the validation communities.

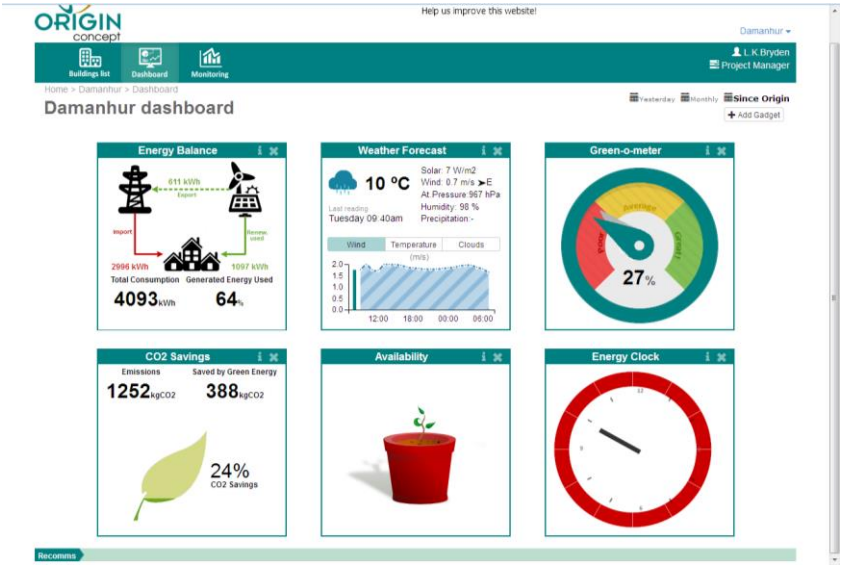

Fig 3. ORIGIN End Used display

Also, during the second year, the ORIGIN team created a commercialisation plan for the ORIGIN system. This plan looked at a number of business models that could generate revenues and achieve

established goals in a real market application. At present the 2 most promising business models for further consideration are developing the informational demand response model (actuation will be considered for future applications as well) combined with expanding the renewable energy prediction service. The plan will be detailed and refined along with the Joint Venture agreement during the third year of the project

During the second year, all beneficiaries have been actively promoting the project. An ORIGIN website, Facebook page, Twitter account and Linkedin account are actively being used and Community engagement is continuing. The project has also generated a number of academic outputs including journal and conference papers.

Expected final results and their potential impact and use

Previous projects and studies have focussed on the management of energy in selected individual building. The ORIGIN system addresses the mismatch between energy supply and energy demand by integrating consumption and generation subsystems on a neighbourhood or community scale.

In brief, ORIGIN's advances beyond the state of the art can be summarised as the following list of distinct elements, while a key advance in itself is the integration of all these elements within a single solution:

- Prediction of energy demand at both individual building and community levels.
- Prediction of renewables supply.
- Optimisation to deliver control actions and suggestions.
- Development and deployment of a hierarchical coordination structure to organize and enable community level energy demand coordination.
- Empowerment of residents, occupants, and facilities managers with clear and rich information about current usage, predicted demand, and predicted availability of renewable, along with justified suggestions for behaviour and control actions.

Through these advances, energy and carbon savings are expected from four main routes.

- Changes in household occupants' behaviour;
- Per-household optimization;
- Community-level optimization;
- Device efficiency monitoring.

Extended data gathering both pre and post deployment, will clearly identify the energy and carbon savings at each site. Demand reductions of 15% to 60% via demand shifting for individual appliances have previously been demonstrated during periods of high domestic demand without centralised co-ordination of demand shifting. Assuming conservatively that ORIGIN can replicate a 15% reduction in peak demand, it will be possible for the validation communities to save a minimum of 15% of their carbon emissions, with higher savings likely. ORIGIN's ambitious target will be of the order of 25% reduction in the carbon footprint of

the validation communities. The impact of ORIGIN to the wider EU community will be

- Quantifiable and significant reduction of energy consumption and CO2 emissions achieved through smart ICT, demonstrated at both individual and neighbourhood scales.
- A contribution to the opening of a market for novel ICT-based customized solutions for building operation and maintenance integrating numerous products from different vendors.

For more information on ORIGIN visit http://origin-concept.eu/