PROJECT PERIODIC REPORT

Nov 12 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:

2012-07-20

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

Period covered: **from November 2012 to October 2013**

Project website address:

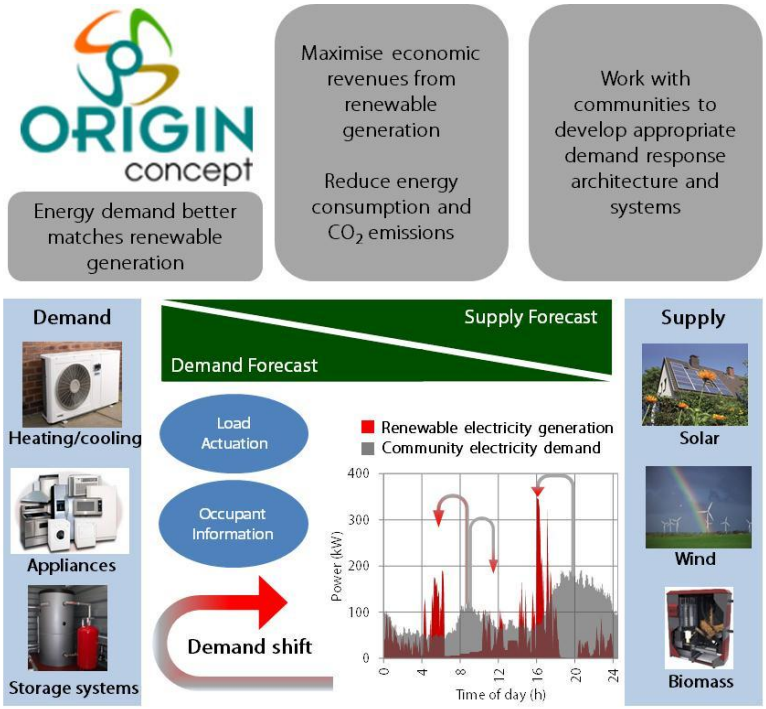
http://origin-concept.eu/

ORIGIN Summary Period 1 - November 2012 to October 2013

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 hence frequently does not coincide with local energy demand. For example, wind generation may occur at night when a small community may not historically have sufficient demand to guarantee uptake of the generated electricity.

Working in conjunction with commercially available control and sensing hardware, the ORIGIN (Orchestration of Renewable Integrated Generation in Neighbourhoods) control system will orchestrate energy demand within a community with the aim of better aligning it to local renewable 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 locally installed embedded renewable generation, and associated carbon dioxide emission 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.

O1: Develop the ORIGIN smart ICT architecture and deploy it in each of the three validation communities (Damanhur, Findhorn Foundation Community, Tamera).
O2: Evaluate and demonstrate the acceptability of the ORIGIN approach to end users.
O3: Demonstrate significant increased uptake of locally generated renewable energy in each of the validation communities.
O4: Define and deliver a transferable implementation process
O5: Define a range of appropriate business models for energy-aware communities
O6: Widespread dissemination of project results.

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 to date and main achievements

At the start of year 1, an energy audit was conducted in the Findhorn Foundation Community, Damanhur and Tamera. This gave extensive information on infrastructure, people and buildings from an energy demand and supply perspective. This helped to identify the most suitable orchestration opportunities (load saving and or demand shifting) taking into account the current renewable generation technologies deployed in in each of the communities and the varying climatic conditions. To fully explore the orchestration opportunities, a mixture of self-actuated and purely informational systems was planned and the choice of hardware equipment was based on fulfilling these orchestration opportunities.

This monitoring hardware comprises two different but flexible and modular solutions based on bespoke versions of ISA's commercially available ICT energy systems:

- Cloogy solution – Mainly for use in residential buildings;
- iHub solution – Mainly for use in community buildings;

Although the solutions are distinct, both communicate with a single data server, and their data is stored and made available to end users using a single M2M interface.

An initial demand and behaviour survey was carried out in all the communities with the aim of highlighting the attitudinal relationship to energy consumption in homes and office buildings, including an analysis that indicates implications for outcomes and system design (e.g. influence the manner in which the information is dispersed for informational orchestration opportunities). A second survey will be conducted in 2015 to contrast the behavioural differences pre and post installation of the ORIGIN system. The surveys also aim at measuring the effect of the ORIGIN system at the subjective data level. Examples of this could be changed consumption patterns

(flexibility) and raised acceptance of the system. These two surveys have been developed in order to construct reliable measurements for flexibility and acceptance.

At the end of year 1, monitoring and actuating hardware linking with ISA's cloud data and monitoring software has been installed in all 3 communities. Approximately 75 buildings are participating in the Findhorn Foundation community comprising a mix of residential and community buildings. There are 4 buildings that are participating in the ORIGIN project at Damanhur. These are comprised of three nucleos (a residential building housing approximately 20 people) and a 4000m^2 office building. In Tamera 7 buildings / areas are being monitored including a guest house, kitchen areas, the community hall and laundry / bathroom area. Approximately 1100 sensors, transmitters, hubs and actuators have been installed in the three communities as well as a weather station at each site. The electricity consumption dataset created by the ORIGIN installations will be among the most comprehensive datasets collected in the EU because of the level of disaggregation and number of dwellings involved.

Data from the hardware equipment is now being collected via ISA's server and the integrity of this data is currently being established. A secure website has been established for remote access to data and to enable future control of individual components.

Energy network maps for each community have been created showing how the loads and generators interconnect. An interactive 'Energy Map website' has been created that currently shows static information regarding capacity of renewables installed, building characteristics and historical consumption information benchmarked against national statistics at both community and building scale. The quality assured monitoring data that is now being collected will allow the project team to extend the capability of the website to create a portal for the communities that displays dynamic energy supply and demand data in near real time.

Information from the initial building audit has permitted numerical models of energy networks to be created for each community. These are being augmented with monitored, temporally precise data to create numerical environments that will support the development of the ORIGIN algorithms.

The ORIGIN algorithms have been partitioned into component parts. These include a weather prediction algorithm, renewable generation prediction algorithms, electrical and thermal demand prediction algorithms, load shift opportunity prediction algorithms and orchestration/control algorithms. The development of these algorithms is ongoing.

An energy saving calculation method has been detailed based on a simple, bottom up accounting procedure that addresses explicitly the requirements of the ORIGIN project. This will be developed with a view to inclusion within existing, standardised approaches for quantifying the energy consumption and associated GHG emissions for communities, e.g. BREEAM Communities. Work has also started on identifying and addressing the prerequisites for the business model development and the economic evaluation process of the business models. Special attention has been given to the analysis of the communities' local energy economics framework conditions.

During the first year, all beneficiaries have been actively promoting the project. An ORIGIN website, Facebook page, Twitter account and Linkedin account were created in early 2013. 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 will address 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/