PROJECT PERIODIC REPORT

Nov 14 to October 15 – 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:

26th Oct 2015

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

Period covered: **from** **November 2014** **to October 2015**

Project website address:

http://origin-concept.eu/

ORIGIN Summary Period 3 - November 2014 to October 2015

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.

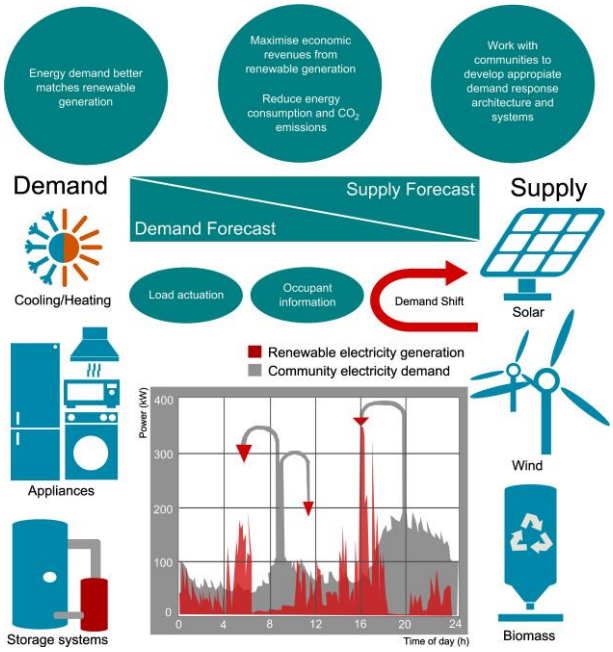

Fig 1 Typical Community electricity demand and renewable electricity generation

ORIGIN has 8 beneficiaries: Heriot Watt University (HWU), Virtual power Solutions (VPS), 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 VPS has been 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 has been piloted. These 3 communities have very different climatic and renewable energy generation conditions.

A number of objectives have been completed in the 3 year project as follows:

O1: The ORIGIN smart ICT architecture has been developed and deployed in each of the three

validation communities (Damanhur, Findhorn Foundation Community, Tamera).

O2: The acceptability of the ORIGIN approach to end users has been evaluated and demonstrated

O3: Community energy development plans have been delivered to the three communities

O3: The potential increase in the uptake of locally generated renewable energy in each of the validation communities and other communities has been established

O4: A transferable implementation process has been defined and delivered

O5: A range of appropriate business models for energy-aware communities has been established

O6: Project results have been disseminated widely.

The timescale for the project has been:

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

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

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

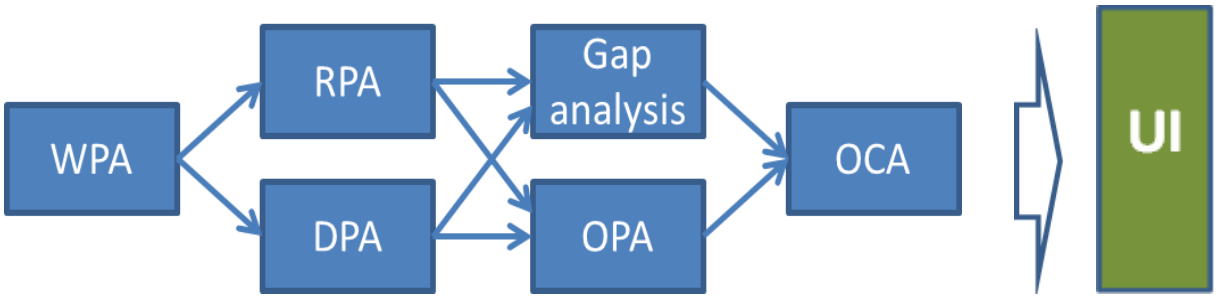

Fig 2 Main High Level Components of the ORIGIN algorithm and the User Interface (WPA - weather prediction algorithm, RPA- renewable prediction algorithm, DPA - demand prediction algorithm, OPA - opportunities prediction algorithm, OCA - orchestration and control algorithm and UI - user interface)

Work performed in year 3

In year 3, the main focus for the ORIGIN team has been as follows:

- Supporting and developing further the end to end ORIGIN demand response system in Tamera, Damanhur and Findhorn
- Sustaining and understanding end user engagement in the three communities by using 'local ORIGIN champions and in the case of Findhorn trialling a dynamic wind tariff.
- Disseminating project results through conferences, journal publications, press releases, social media and through other channels
- Creating a replication process for ORIGIN for other suitable communities
- Exploring suitable business models for the ORIGIN system taking into account the emerging demand response market and how to interface with national supply requirements
- Developing further the commercialisation and future research opportunities though a series of prototypes
- Evaluating scenarios for expansions and integration of additional complementary technologies (energy efficiencies, energy generation, energy storage, and energy transfer systems) in all three communities in the future
- Advising the three communities on the most promising scenarios for additional investment and developing criteria for the local prioritisation of energy supply options in other communities
- Improving further the weather prediction algorithm so that it can produce forecasts up to 72 hours in advance, and can be used for *any* location, whether or not site-dedicated weather sensing hardware is installed at that location
- Contextualising demand response using behavioural surveys and also statistical approaches (using occupancy sensing data and load profile data) to provide a richer understanding of user behaviour
- Creating a general approach to modelling the power system of community energy systems which could be utilised in planning, upgrading and troubleshooting such networks
- Measuring and evaluating the impact of the ORIGIN system in the 3 communities and from this determining the potential applicability of ORIGIN in a wider national/EU market situation.

Main achievements in year 3

In a nutshell, ORIGIN has delivered a smart energy management system that enables communities to optimally align their energy demand with the supply available from their renewable sources. It incorporates new software technology for accurate localized short-term weather forecasting and US patent application 14/933211 (pending) was filed on 5th November 2015, concerning technology for accurate localized forecasting of weather variables. This patent emerged entirely from one of the innovative aspects of the ORIGIN approach, specifically the inclusion of predictive software technologies as a core component, thereby enabling control decisions to be informed by a significantly better predicted picture of renewables availability in the next 1--48 hours. A spin out company, Auraventi, has been formed to commercialise the weather forecasting IP developed during ORIGIN

The system achieves demand-response from community-level actions. Table 1 highlights the range of demand response approaches that were taken in each community.

Demand response project	**Type of response**	**Percentage increase in use of Community Renewables**	**GHG Emissions Savings / $kgCO_2e$ per annum**
1. Building electricity demand (Damanhur)	Informational – feedback (Measured)	3%	374
Total Demand Response (Damanhur)		3%	374
2. Improved micro-grid control (Tamera)	Quasi-actuated (Modelled)	22%	5,400
3. Electric Vehicle Charging (Tamera)	Actuated (Modelled)	10%	1,250
Total Potential Demand Response (Tamera)		32%	6,650
4. Household electrical demand (Findhorn)	Informational – incentivised (Measured)	5.8%	12,900
5. Household thermal demand (Findhorn)	Actuated (Modelled)	11%	24,400
6. Community electrical demand (Findhorn)	Informational - with feedback (Measured)	2.5%	5,500
TOTAL Response without tariff incentives (Findhorn)		13.5%	29,900
Total Response with tariff incentive (Findhorn)		16.8%	37,300

Table 1 Impact of Demand Response Opportunities

The biggest potential positive impact upon increasing uptake of community generated electricity was shown to occur where community generation is curtailed by an inability to export to a national grid infrastructure. This is the situation in the validation community in Portugal where the research concludes

that demand response and associated energy management could result in an increase of 33% in the uptake of photovoltaic generation and an associated saving in GHG emissions.

In the wind generation dominated community in Scotland a maximum demand response of up to a 16% increase in uptake of renewable generation was estimated via a combination of an incentivised participatory demand response system, driven by price signals and energy information supplied via the user interface, and the modelled impact of automated actuation of thermal space and water heating.

In the Italian validation community the ORIGIN demand management system achieved a 3% increase in the take up of roof mounted photovoltaic electricity through active participatory involvement of the residents via the user interface. This application of ORIGIN highlighted the need for repeated engagement with the end users to relate the ongoing impact of their participation in the demand management of their energy lifestyles.

Ten prototypes or innovations have been established through the ORIGIN project. These are listed in figure 3. Currently these innovations are at TRL 6/7 and 11 applications have been made for further funding to prepare these prototypes for market. At the time of writing two of these proposals have been successful. A Joint Venture Agreement is in place to ensure partners can easily exploit shared IP following the conclusion of the research effort. VPS, the SME partner responsible for installing the hardware, has enhanced a number of its sensing products as a result of ORIGIN.

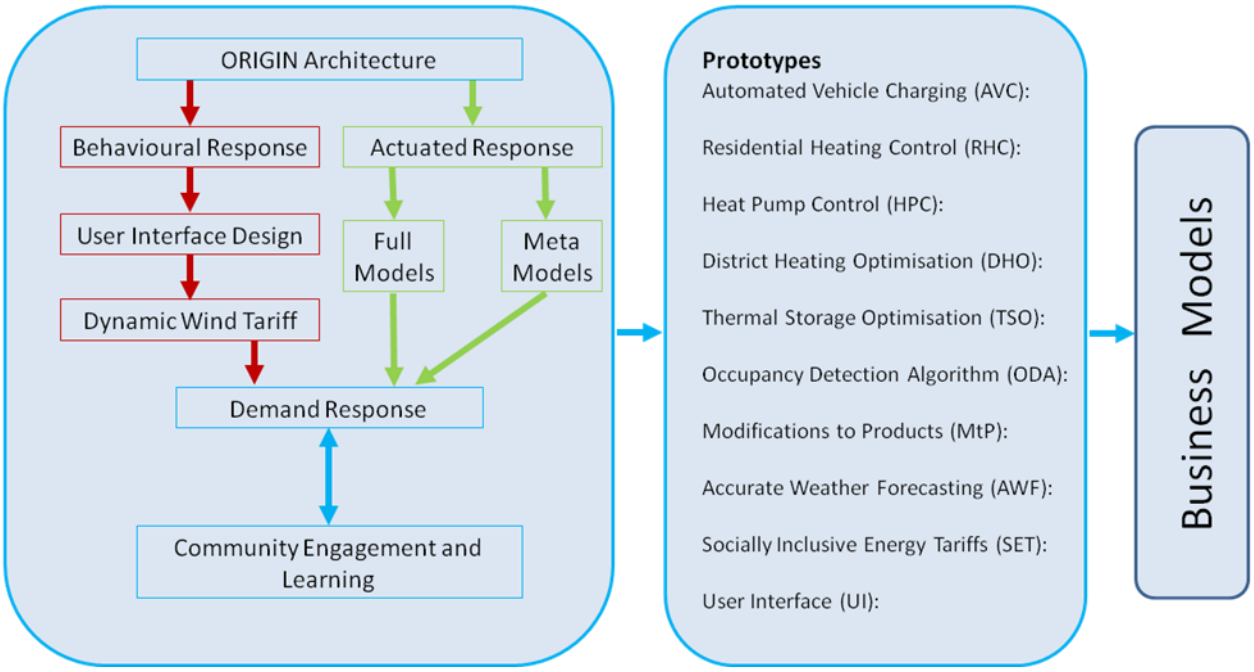

Fig 3 ORIGIN Project Components and architecture

Our findings show that **currently** there is no clear path to mass market penetration for an ORIGIN type system and economic benefits for residential customers are still very low and only result in small annual

budget savings. However, with the increasing rise in the penetration of renewables into the EU energy market and other market drivers and trends such as customer behaviour, policy, technology advancements and grid constraints, the emerging market for novel ICT-based customized solutions for energy management will be strengthened.

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