Maximizing the benefits of Solar Energy in Smart Energy Communities

Susan Roaf[1], Julie Tubia[2], Andrew Peacock[1], Edward Owens[1] and Monica Oliphant[3]

[1] Heriot Watt University, Edinburgh (Scotland)

[2] Institut National des Sciences Appliquées, Toulouse (France)

[3] University of South Australia, Adelaide (Australia)

Abstract

The first decades of phenomenal growth in the solar industry the focus was on getting more systems installed. Today, with the plummeting costs of photovoltaics, the emphasis in many projects has shifted towards getting as much economic, social and environmental value as possible from the installed systems, and this is increasingly made possible by installations at the community scale. Increasingly individuals, communities and cities are looking to utilize the ability to balance supply and demand with energy storage and controls in local energy micro-grids to maximize the use of locally generated energy within the generating communities. This paper review a range of European projects that aim to manage the production and the consumption of electricity within communities that generate their own energy with renewable energy resources and compares the approaches and results of these projects and discusses what appears to work best at motivating and engaging communities in the orchestration of local energy demand and supply. Building on experiences of community energy projects in South Australia it then provides a summary of the real world market constraints with the related issues of writing lease agreements, models and IP agreements and concludes with a short discussion of the drivers and barriers encountered in the market led model in Australia and in the European research domain of funded research.

Keywords: *Smart grid, Demand Response, Load energy management, Energy storage.*

1. Introduction

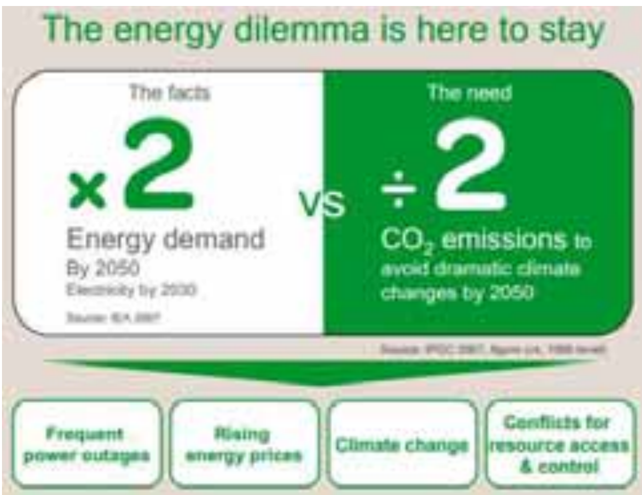

Fig.1: Diagram simplifying the universal Energy Dilemma

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Globally nations are caught in the same energy dilemma, with multiple and complex drivers pushing consumers away from the use of large scale, fossil fuel derived power sources to more regionally sourced, secure and renewable energy supplies. However it is increasingly appreciated that it is not only a modal shift in energy sourcing but also a step change approach to the yield that can be harvested from different energy sources that is needed to meet the ever more stringent ghg emissions reductions targets mooted to deal with the rapidly evolving climate threats. The European union, under its FP7 research funding round, has financed over two dozen community energy projects with a view to exploring the relative merits of different approaches to the orchestration of local energy supply and demand models. This paper outlines these projects and characterizes their properties and rationales. In order to start on the path of orchestration of supply and demand it is important to understand the nature of energy demand patterns in a region.

1.1 Electricity consumption in European households

Despite the fact that the production of construction materials emits CO_2 which increases the ecological footprint of buildings, the bulk of the CO_2 emissions from a building stem from use throughout its service life, proportionally depending on the life of the building. Energy and CO2 emissions, however, are not limited to our housing and transport needs. Higher living standards lead to a rising demand for goods such as computers, phones, music systems etc. that require regular re-charges of energy, particularly in the high tech, electric loads dominated lifestyles of many in Western Europe. The growing peak loads associated with such lifestyles have stimulated a plethora of European research projects by research centers, universities, product suppliers and electric power companies, often working together to explore the extent to which the orchestration of local renewable energy supply and local energy demand can be achieved in micro-grid systems and communities. The objectives of these European projects are largely driven by pressing need to meet climate change targets, the need to integrate a bigger share of renewable energies sources in the electricity generation to reduce carbon footprint, greenhouse gas emissions and dependence on fossil fuels and the desire to grow and flourish in the burgeoning markets for related products. The new markets promise not only profits from new product ranges and environmental benefits but also stimulation of local economy, new jobs, the ability to develop locally ‘self-repairing’ systems and in turn a degree of energy resilience and security which explains why there are high levels of support for investment in such projects by some politicians.

A major challenge is seen to be the turning of a generation of entrenched energy ‘consumers’ into the next generation of people involved also in the generation of their own electricity generation and consumption, turning consumers into ‘prosumers’. Whether this goal can be achieved by raising environmental awareness, reducing power bills or helping consumers to install innovative technologies in their homes to participate actively in the process is explored in many of the local micro-grid projects outline below.

While across Europe there has been a decline in space heating consumption (-25 Mtoe) , water heating figures remain fairly constant (13% of load), while the share of load for electrical appliances from rose from 9 percent to 11 per cent between 2004 and 2012. Average dwelling sizes across Europe increased by c. 4 per cent since 2000 being now around 87 m2 per dwelling on average and consequently energy consumption per dwelling decreased slightly less, at 2 percent per year, than consumption per m2 at 2.4 per cent per year. This means that almost 20% of the energy efficiency progress for thermal uses has been offset, all things being equal, by the larger size of dwellings.

A major part of the story has been the soaring use of energy in appliances and in 2012 EU house-holds consumed around 40% more for small appliances than in 2000 (~ 990 kWh/year up from 700 kWh/year) although there has been a slight decreases of the annual consumption per dwelling for large appliances (- 142 kWh). Refrigerators, freezers and washing machines’ consumption decreased, mainly due to substantial electricity savings with the diffusion of efficient new equipment.

Fig. 1: Specific consumption per European dwellings, energy price and income. The figure shows the average price of gas, electricity and heating oil weighted with energy market shares (at constant prices). Income capture by private household consumption. Energy prices in Europe for households have increased by 64% between 2004 and 2012[1] (6.4%/year).

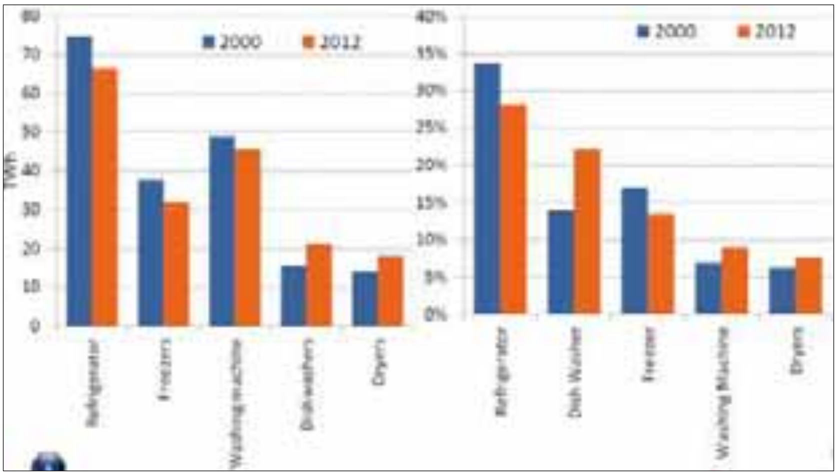

Fig. 2: Consumption of large electrical appliances by type (EU 27). Average number of appliance per dwelling in the EU shown here.

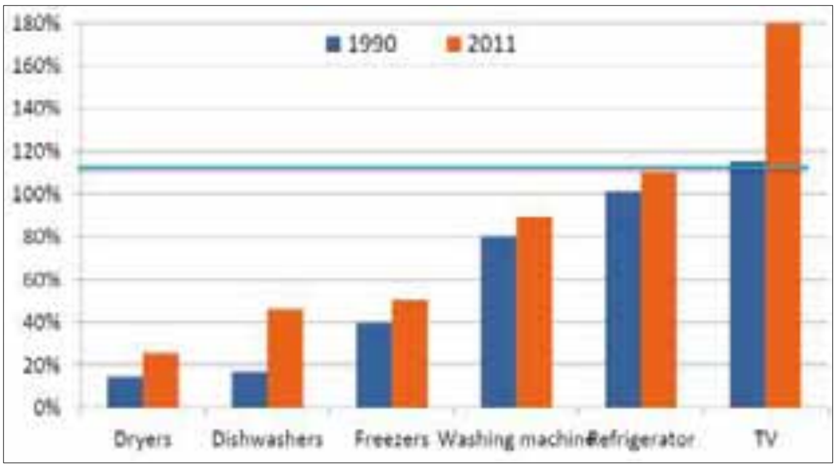

Fig. 3: Average number of appliance per dwelling in the EU

[1] http://www.odyssee-mure.eu/publications/efficiency-by-sector/household/

Energy efficiency improved for EU households by 21 percent over the period 2000-2013, ie by 1.8 per cent per year. The efficiency improvement for heating reaches 20 per cent since 2000, 15 per cent for water heating, and 14 per cent for large electrical appliances.

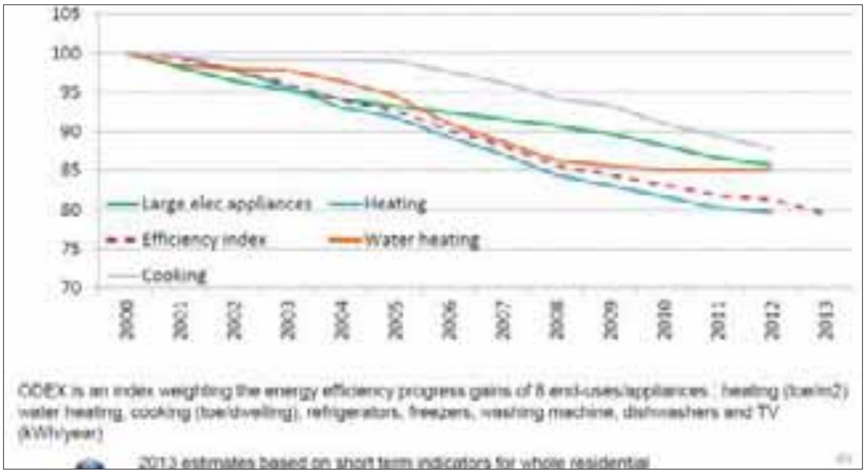

Fig. 4: Energy efficiency progress for households in the EU: ODEX

However, set again the overall trends for increased space size of households and increased use of appliances the equipment efficiency gains in themselves do not offer the hope of any radical reduction energy consumption per household and hence the widescale interest in more radical schemes to effect major emissions reductions from the energy sector and the growing interest in renewable energy micro-grids structured at a community level where the benefits of the final emissions reductions achieved can be accrued by the local users in the form of reduced costs per household in imported fossil fuel, or nuclear generated electricity.

Within the EU countries are required to develope National Energy Efficiency Action Plans (NEEAPs) set out estimated energy consumption, planned energy efficiency measures and the improvements individual EU countries expect to achieve. Under the Energy Efficiency Directive, they must draw up these plans every three years and also provide annual reports. Central to new thinking here is the idea of the Smart Grid.

2. European Initiatives: The Smart Grid

A Smart grid is defined in the report about Smart Grids by Felix Covrig et al. (2014) for the Joint Research Center of the European Commission as "an electricity network that can intelligently integrate the behavior and actions of all users connected to it in order to deliver sustainable economic and secure electricity supplies" and is an emerging concept for electricity networks across Europe[2].

The development of electric utilities and generation from renewable energy creates new constraints on electrical systems. These trends, together with the high price of primary energy sources and an awareness of climate issues at a national level, make a better management of electricity demand, a better pilotage and better efficiency of the whole electrical system necessary. Issues for the consumer and the citizen are three: improvement of the quality and continuity of the electrical supply necessary to allow the supply of the required services to the consumer, guarantee the safety of supply and the management of energy billing.

According to the International Energy Agency (IEA), European electricity consumption is projected to

[2] http://ec.europa.eu/research/energy/pdf/smartgrids_en.pdf

increase at an average annual rate of 1.4 percent up to 2030 and the share of renewables in Europe's electricity generation will double; from 13 percent now to 26 percent in 2030. Smart Grids do not represent a simple product development step and cannot be developed 'in-house'. Their supply chains are not the same as their procurement chains which brings risks with it that have to be managed. New grid technology cannot be fully proven in the laboratory or on a simulator but needs real world pilot operations, in a controlled situation on a real grid as a prerequisite for adoption. However there is little value in one-off new technology installations and as wide area adoption, through commercial mechanisms, is needed to attain its benefits the EU instituted a large funded trench of projects under its FP7 research programme to explore and develop such pilot schemes.

3. 12 European Micro-Grid Research Pilot Projects Described

The 12 demonstration sites reviewed here are located in different climate zones and are characterized by different energy generation and consumption habits. Their characteristics are review in Table 1. With their project titles, locations and climates summarised. They are grouped by types of project under headings covering projects that cover distributed renewable energy systems, district energy management, user participation of users in the projects, scoping different approaches to the challenge of engaging users in managing demand.

3.1 Electricty generation: distributed RES.

EEPOS

Energy management and decision support systems for Energy POSitive neighborhoods

The EEPOS system shows a semi-centralized structure where energy management is carried out on two levels: neighborhood (centralized) and building (decentralized). The main aims of the neighborhood level energy management system are described by **Klebow et al. (2013)**, and they are: matching of local electricity generation and consumption, congestion management in local electricity grids and power balancing on electricity market level. These objectives will be achieved by shifting of controllable electrical loads. Additional functions of the EEPOS system are statistical data analysis and end-user involvement in energy management processes.

At high RES penetration, in times of low renewable energy production, energy shortages can occur, whereas in times of high wind or PV power production, electricity production rates may even exceed those of consumption. Without proper energy management, grid instabilities can occur, and generated energy may be lost. **Automation of low voltage distribution grids** is one of the steps towards smart grids and successful integration of RES.

Bidirectional energy management systems can, for instance, help to cope with the mentioned challenges by the automated exploitation of load shifting or virtual storage potentials. Additionally, bidirectional data communication allows smart meters to send information on current electricity prices to the end-user. In this way, the end-user obtains the opportunity to manually maintain energy consumption in a cost effective and grid supporting way.

http://eepos-project.eu/eepos/eepos-project/energy-management-on-the-neighbourhood-level/

Project	N.	Sites	Climate	Average T°C (Summer)		Average T°C (Winter)	
				MIN	MAX	MIN	MAX
AMBASSADOR	1	INES, Chambery, FRANCE	Temperate Cfb	15	28	-1	9
	2	Lavrion, GREECE	Continental Csa	23	28	10	15
	3	BedZED, Wallington, UNITED KINGDOM	Temperate Cfb	12	23	2	9
CoSSMic	1	Konstanz GERMANY	Oceanic Cfb	13	25	-1	4
	2	Caserta ITALY	Temperate Csa	20	31	4	13
DIMMER	1	Turin ITALY	Humid subtropical Cfa	17	28	-2	8
	2	Manchester UNITED KINGDOM	Moderate Cfb	12	21	2	8
e-balance	1	Park Bronsbergen Zutphen, THE NETHERLANDS	Oceanic temperate Cfb	15	21	1	6
	2	Region of Batalha, PORTUGAL	Mediterranean Cfb	19	29	8	15
EEPOS	1	Helsinki, FINLAND	Humid continental Dfb	12	22	-7	1
	2	Langenfeld, GERMANY	Temperate Cfb	14	24	0	7
EINSTEIN	1	Building level Bilbao, SPAIN	Oceanic Cfb	17	24	6	14
	2	District level Warsaw, POLAND	Humid continental Dfb	14	25	-4	2
EPIC-HUB	1	Port of Genoa, ITALY	Temperate Csa	20	29	3	13
	2	Belgrade airport, SERBIA	Humid subtropical Cfa	17	28	-2	6
	3	Bilbao exhibition, SPAIN	Oceanic Cfb	17	24	6	14
NEXT-Buildings	1	Amsterdam, HOLLAND	Oceanic Cfb	13	23	1	6
	2	Lyon, FRANCE	Oceanic Cfb	17	28	1	7
	3	Helsingborg, SWEDEN	Oceanic Cfb	13	22	-1	5
Nice Grid	1	Carros, FRANCE	Mediterranean Subtropical Csa	20	28	6	14
NRG4Cast	1	Municipality of Miren, SLOVENIA	Humid subtropical Cfa	18	29	2	10
	2	Athens, GREECE	Mediterranean Subtropical Csa	22	28	7	13
	3	Turin, ITALY	Humid subtropical Cfa	17	28	-2	8
	4	Reggio nell Emillia, ITALY	Mediterranean Cfa	19	30	-1	7
	5	Aachen, GERMANY	Temperate Cfb	14	24	1	7
ORIGIN	1	The Findhorn Community, SCOTLAND	Temperate Cfb	10	19	0	7
	2	The Damanhur Community, ITALY	Warm and temperate Cfb	17	28	-2	8
	3	Tamera Healing Biotope, PORTUGAL	Temperate Csa	17	26	8	15
RESILIENT	1	Ebbw Vale, UNITED KINGDOM	Temperate Cfb	10	19	1	6
	2	Cordium, BELGIUM	Oceanic temperate Cfb	12	22	2	6
	3	Savona, ITALY	Temperate Csa	20	29	3	13

Table 1. Characteristics of the 12 reviewed FP7 micro-grid projects

One of the subsystems of the Information and Decision Support System is the end-user collaboration tool that engages and motivates end-users to decrease their energy consumption and to shift energy appliances from peak hours to off-peak hours of the day. To achieve this, the main functions of the tool are end-user energy performance reporting, benchmarking and guidance, neighbourhood discussion forums, energy saving games or contests in the neighbourhood, and targeted energy saving group actions trough **crowdsourcing**[3].

NEXT-buildings project:

Next zero energy buildings at lowest cost using competitive sustainable technology.

The innovative technologies[4] developed in Next-Buildings are some dual function building elements (insulation/photovoltaic), innovative windows, and ICT solutions. The first one will be applied cost-effectively and will improve aesthetics and easiness of handling. Then the second one will enable daulight steering based on micro-lamellas in the glass. Finally the third one will optimize the use of locally produced electricity, heat and cooling, and will provide inhabitant feedback based on smart metering and near real time data gathering. This project shows the next generation of low energy buildings. However, the scope goes beyond low energy buildings only. At the demonstration sites also smart technologies and ICT are applied, to enable efficient integration of locally generated renewable energy. Solutions will reduce CO_2 at negative or no cost.

Nice Grid

NICE Grid in the south of France has been developed with a consortium of 10 companies and with funding from the European Commission (FP7 scheme) and the French Agency ADEME also this larger is dealing with PV integration within a 10,500 inhabitant city with the objectives of: 1) PV integration, load shedding and islanding in 7 identified district called “solar districts”; 2) energy storage and the shift of residential appliances consumption allows for reducing the grid constraints due to PV. Load shedding consists in reducing the peak demand in winter by 3.5 MW at the primary substation level, by combining residential and commercial demand side management and 3) disconnecting for a limited duration a commercial district from the main grid, and supplying it only with PV generation and grid batteries.

3.2 Electricty generation: district energy management

Demand Response (DR) is defined as: “Changes in electric usage by customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardised.”

AMBASSADOR project

Real-time optimization **strategies**[5] at district level by combining ecosystem awareness (models, usages, prediction), flexibility (through horizontal energy flows), resources sharing (centralized and mutualized) and energy management strategies (advanced analytics, ICT, anticipation).

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[3] Definition : it is the process of obtaining needed services, ideas, or content by soliciting contributions from a large group of people, and especially from an online community, rather than from traditional employees or suppliers (from https://en.wikipedia.org/wiki/Crowdsourcing).
[4] http://next-buildings.com/images/next-buildings%20d7.3%20v1.0.pdf
[5] http://ambassador-fp7.eu/wp-content/uploads/2013/01/AMBASSADOR_ICT4SusPlaces.pdf

EPIC-HUB project

The Energy-Hub model identifies and optimises the interactions between different input energy sources in order to satisfy electricity and heating/cooling demands. In the energy hub model, you consider a given load (or loads, electricity, heating or cooling demands); the system will optimise the hub's inputs (energy imports, from the grids or RES) by using the consumption forecasts (future demand in a given time horizon). In addition to these data, in this model, you know the hub nodes (e.g. CHP, batteries, boilers, and so on) where each of them has its own configuration parameters.

The optimisation process will state which the best configuration of the "battery element" (node of the hub) by selecting/suggesting: a) the best technical solution if you are planning investments in your facility or b) the best strategy to manage/control that energy system (i.e. batteries) at operation time in the given time horizon of the optimisation process. In this last case, you have to consider that the strategy optimises the overall energy behaviour of the hub (facility or district) without any specific optimisation of the usage related to the specific energy system (e.g. battery or boiler).

3.3 Participation of users in the projects: surveys

In many countries, the transition to sustainable energy supply and the emergence of smart grids are in progress. The deployment of distributed Renewable Energy Sources (RES) for the energy supply for buildings and residential areas has been increasing significantly in the recent years. Many people living in residential areas have already begun to produce electricity locally, e. g. through the installation of photovoltaic (PV) panels on the roofs of their houses. Their role has thus evolved from being only consumers of energy to becoming prosumers, not only consuming but also producing energy.

e-balance project

The project has been created to develop solutions for residential customers by taking into account technical and non-technical aspects, with the goal of improving the energy efficiency in small scale communities. The moto is to involve participants to offer innovative technologies that suit them most. Therefore e-balance project collects participants' views through online survey. By assessing users' feedback it can know what is appreciated about the energy management system (EMS). Among their three demonstration sites in Portugal, the Netherlands and Poland, with respectively 1661, 1632 and 1647 participants, they discovered what the habitants like most about the system was to save money (reduction of the power bills), although for Dutch habitants the benefits from energy consumption monitoring and data analyses made by the system are more appreciated than the savings. On the other hand, 71% of Polish people want free installation be encouraged joining the project and a 50% share of them will enjoy free maintenance of the system. Finally half of the Portuguese are very interested in forecasting of their monthly energy consumption.

Moreover, they have questioned the habitants about their enthusiasm to join the project to be aware of the factors that could discourage them to enable the EMS be implemented in their houses. Generally people are afraid of losing control of their home appliances and that frequent failures will appear that require repairs too expensive for them. One third of the respondents think that they will not get any return on the initial investment they have made. The last factor discouraging from using the system is about privacy reasons.

ADDRESS project

In this project the incentives of participants[6] on the French demonstration site of the ADDRESS project in Houat and Hoëdic are for 30% about the protection of the environment and the same share for their attraction

[6] More than 7% of the consumers participate in the field tests (among the 373 consumers of the two islands).

to the new technologies. And then, 20% of the respondents' motivation is about saving money and also an equal part of them desire to obtain a secured electrical supply.

ORIGIN project

In the ORIGIN concept, a behavioral study has been made among two of its communities, Tamera and Findhorn, with respectively 19 and 40 participants. On a five-step scale from strongly agree to strongly disagree, when it is asked how much they feel concerned about data protection there is an average value for Tamera of 3.8 and only 2.9 for Findhorn. Both communities agree on an average of 4.2 to have access to personal historical consumption data. They are also mostly interested in the forecast on the availability of renewable energy with a total average of 4.3. Finally it is asked what should be the main aim of the project. In average, the optimization of CO2 emissions and protection of the environment is seen as most important. And then economic benefits for the community are rated second highest.

3.4 Participation of users in the projects: variable tariffs

CoSSMic project

"In the CoSSMic concept the user leaves to the control system to decide exactly when an appliance is used, for example the user readies the washing machine in the evening and states when it should be finished, for example the next afternoon. Then the control system will start it when at the most optimal times taking into account both the output from local (to the neighborhood) PV system and the grid price."

"Yes, the users must provide constraints on that are adhered to by the control system, and the control system take into account predicted variation in prices. In the trial site only static price schemes are available, where the variation over the day is known in advance, but we plan to do simulations with more dynamic market driven pricing."

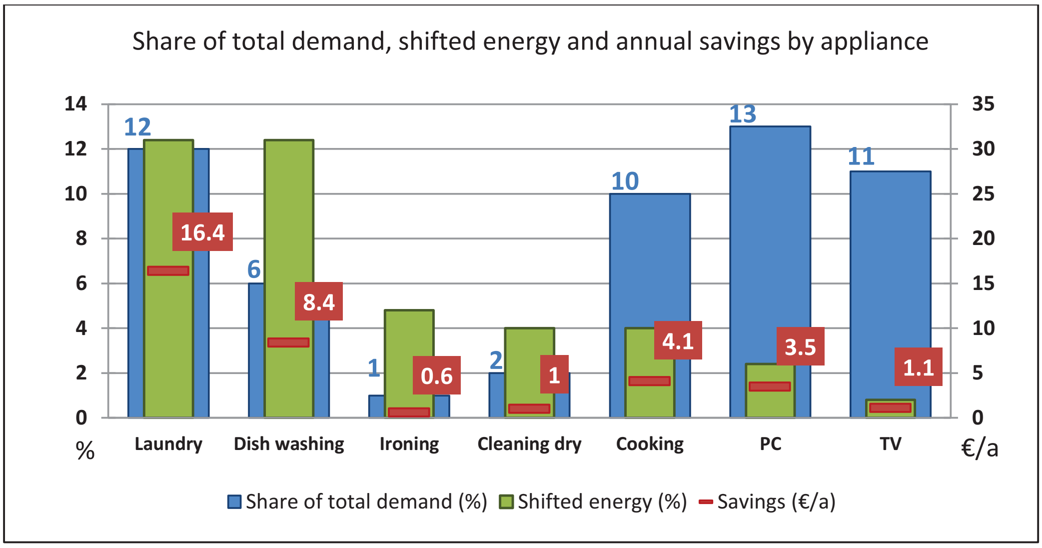

Figure 5. ORIGIN project Chart based on Fischer et al. (2015)'s paper (see references).

EEPOS project
Energy management and decision support systems for Energy POSitive neighbourhoods.

It was aimed at developing a new system for energy management and automated load control on the neighbourhood level, the EEPOS Neighbourhood Energy Management System. With the new system, designed to use automated load shifting of controllable electrical loads and active end-user envolvement in energy management processes to:

- Match of local electricity generation and consumption
- Management congestion in local electricity grids
- Increase energy efficiency within the system

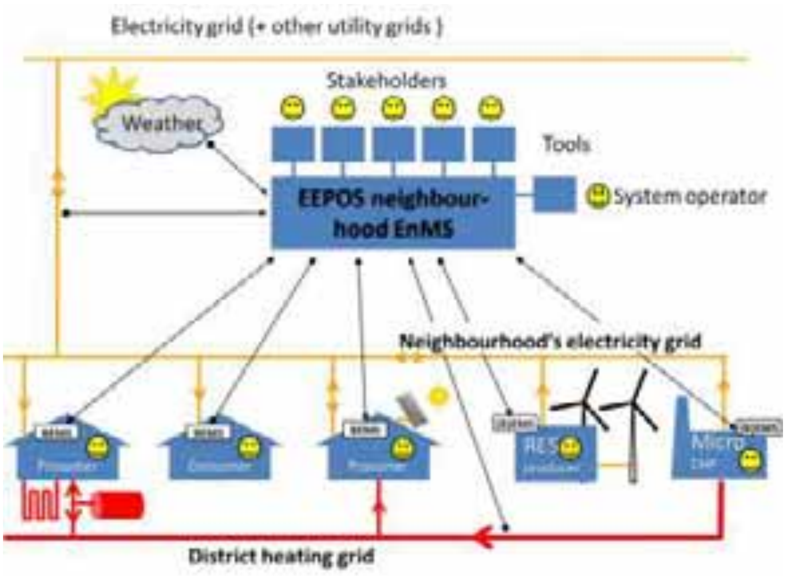

Figure 6. System diagram for the EEPOS project
http://eepos-project.eu/eepos/eepos-project/an-eepos-neighbourhood/

4 Thermal and Electrical storage in the projects

A range of different kinds of energy storage are described by Mohd et al. (2008), and they discuss the difficulty of their integration into a smart grid, not least because of it expense. However due to the pressing need to integrate increasing shares of renewable energy generation in future power supply systems and to shave ever growing peak loads on energy supply systems energy storage is expected to take place at all grid levels in the electrical network in future. Some projects within the twelve reviewed have no storage at all like the EPIC-HUB project while others like **Nice Grid** have storage media and strategies integrated at every stage of the project. The AMBASSADOR project includes 30 kWh Zebra batteries (sodium), 25 kWh Li-ion batteries and 50kWh Lead acid batteries.

RESILIENT incorporates both thermal and electrical storagewith two diffent storage media being both sodium nickel molten salts (sonick fiamm - 470 ah, voltage: 278 v so 104,5 kwh - total charge/discharge maximum time: 2 hours an inverter maximum power 70 kw) and hitachi li-on batteries with a 25 kwh capacity (c. 30 minutes charging/discharging time). This demosite is deemed to be a polygenerative site where Electrical and Thermal Energy production are constantly monitored and managed in an optimal way that enables them to respond to demand (over which they have no control) in with optimal energy responses.

The EU EINSTEIN project was implemented to reduce the consumption of primary energy in buildings using solar thermal energy in combination with heat pumps and Seasonal Thermal Energy Storage (STES) for space heating and domestic hot water requirements[7]. The research is turned to existing building which have particular requirements and constraints that requires new developments and adaptation of existing technologies. Two pilot plants have been build, one at building level in Bilbao, Spain, and the other at district level in Warsaw, Poland. The decision for a certain type of storage mainly depends on the local requisites like the geological and hydro-geological situation in the underground of the respective construction site. Above all an economical rating of possible storages according to the costs for a kWh of thermal energy that can be used from the storage allows the choice of the best storage technology for every single project. The installation of solar panels is not the main objectives of the project, this is why there is no electrical storage created on the demonstration sites: the electricity is entirely fed back in the main grid when it is not consumed.

5 Legal and Fiscal Frameworks for Community Energy

What is not being funded within such European projects is research into the legal and fiscal mechanisms that will be essential for locally owned micro-grid and other distributed energy supply and generation systems including legal frameworks for the drafting of lease agreements, company models and IP agreements, such as are being pursued currently in the South Australian solar community movement. Monica Oliphant Research, in collaboration with Finlaysons and Solar Wind Systems has been developing one such model is being developed for the City of Campbelltown in South Australia[8].

The Model has been designed to lower energy use costs across the community through the application energy efficiency strategies and embedded solar installations. Electricity pricing will be locked in for life of the project which is between 7-10 years depending on the site, paid for in part by the capital raised through sale of $600 shares. Shareholders are given a return on investment annually for life of the project. Governance is through a new Trading Cooperative or through an existing organization whose constitution allows them to raise capital. Approval of a prospectus needs to be gained from the Office of Consumer and Business Affairs and at the end of the project (7-10 years) shareholders have their $600 returned and the installed equipment is transferred to the building owner providing fee electricity for the remaining life of the equipment. All measures are tailored to suit each building/site and are ‘behind the meter’ to avoid having to operate as an electricity retailer. An initial audit determines the current energy usage and identifies energy efficiency options. This provides sufficient preliminary data to enable building owners to determine if they wish to go to next step. The cost of this preliminary audit is $1,500. A full audit costs between $5,000 and $10,000 depending on size and complexity of the facility. This will provide accurate costing and data for input into the model to verify ‘return on investment’ to shareholders. The prospectus is prepared and approval sought from OCBA (Office of Business and Community Affaires) and voted on at a local public with a local board of directors. The lease agreement is signed with building owner and at that point the capital raising commences and the fully subscribed Community Energy Project is launched. In South Australia the Bendigo Bank is supporting the project and will maintain bank records and provide advice on engagement, capital raising etc.

6 Conclusions

Much research in Europe is currently being funded through the strategic European research mechanisms and within the ‘Big Energy’ industry on mechanisms for maximizing the growing contribution of distributed renewable generation through the use of energy demand and supply orchestration, through the exploitation of changing behaviors and local energy controls and management, with or without energy storage integrated into local distributed energy micro-grids. The South Australian case study has been included to emphasize the multiply complex nature of not only optimizing the value of distributed energy within national grids in theory and reality, but also enabling them to happen locally in practice, in the emerging energy revolution.

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[7] EINSTEIN’s leaflet: http://www.einstein-project.eu/fckeditor_files/D_9_2_EINSTEIN_leaflet_English.pdf
[8] https://www.lga.sa.gov.au/webdata/resources/files/Campbelltown_Final_Report_October_2012_-_Case_Studies.pdf

7 References

About ORIGIN

Fischer, D., Flunk, A., Kreifels, N., Lindberg, K., Wille-Haussmann, B., 2015. Modelling the Effects of Variable Tariffs On Household's Electric Load Profiles by Use of Occupant Behaviour Submodels. http://www.origin-energy.eu/system/files/Origin_DSM_DaF.pdf

Peacock, A.D., Owens, E.H., Roaf, S., Corne, D.W., Dissanayake, M., Tuohy, P.G., Stephen, B., Galloway, S., 2014. Autarkic energy systems: balancing supply and demand with energy storage and controls in local energy micro-grids, in: 2014 Asia-Pacific Solar Research Conference.

About EEPOS

Klebow, B., Purvins, A., Piira, K., Lappalainen, V., Judex, F., 2013. EEPOS automation and energy management system for neighbourhoods with high penetration of distributed renewable energy sources: A concept, in: Intelligent Energy Systems (IWIES), 2013 IEEE International Workshop on. IEEE, pp. 89–94. http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6698567

About Nice Grid

Lannez, S., Foggia, G., Muscholl, M., Passelergue, J.C., Lebosse, C., Mercier, K., 2013. Nice grid: Smart grid pilot demonstrating innovative distribution network operation, in: PowerTech, 2013 IEEE Grenoble. IEEE, pp. 1–5.

Michiorri, A., Girard, R., Kariniotakis, G., Lebossé, C., Albou, S., 2012. A local energy management system for solar integration and improved security of supply: The Nice Grid project, in: Innovative Smart Grid Technologies (ISGT Europe), 2012 3rd IEEE PES International Conference and Exhibition, pp. 1–6.

About storage

Mohd, A., Ortjohann, E., Schmelter, A., Hamsic, N., Morton, D., 2008. Challenges in integrating distributed energy storage systems into future smart grid. IEEE International Symposium. 1627–1632. http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4676896

About consumers

Darby, S.J., McKenna, E., 2012. Social implications of residential demand response in cool temperate climates. Energy Policy 49, 759–769. http://ac.els-cdn.com/S0301421512006076/1-s2.0-S0301421512006076-main.pdf?_tid=c569bc64-4a6f-11e5-9975-00000aab0f27&acdnat=1440428141_31d195ad11a96c0f3f9d079fbd302af9

Darby, S.J., 2013. Load management at home: advantages and drawbacks of some active demand side options. Procs. of the Institution of Mechanical Engineers, Part A: Journal of Power and Energy 227, 9–17. http://pia.sagepub.com/content/early/2012/10/30/0957650912464623.full.pdf+html

About EUROPE – General papers

Felix Covrig, C., Ardelean, M., Vasiljevska, J., Mengolini, A., Fulli, G., Amoiralis, E., Sánchez Jiménez, M., Filiou, C., European Commission, Joint Research Centre, Institute for Energy and Transport, 2014. Smart grid projects outlook 2014. Publications Office, Luxembourg. http://www.researchgate.net/profile/Eleftherios_Amoiralis/publication/269763242_Smart_Grid_Projects_Outlook_2014/links/5495ab8c0cf29b94482411d5.pdf

Boughen, N., Castro, Z.C., Ashworth, P., 2013. Understanding the residential customer perspective to emerging electricity technologies: Informing the CSIRO Future Grid Forum. Brisbane, Queensland: CSIRO.

Albadi, M.H., El-Saadany, E.F., 2008. A summary of demand response in electricity markets. Electric Power Systems Research 78, 1989–1996.

Downing P. Understanding consumer attitudes to 'sustainable community infrastructure'. Icaro Consulting Report for the UK Green Building Council and the Zero Carbon Hub (2009).

Belhomme, R., Tranchita, C., Vu, A., Maire, J., Huet, O., 2011. Overview and goals of the clusters of smart grid demonstration projects in France, in: Power and Energy Society General Meeting, IEEE, 1–8.