

Smart Grid Demand-side Management and Demand Forecasting for the Residential Sector

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Rowena McCappin Project Director, Glen Dimplex

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Sean Hello everyone. I'm Sean Esterly with the National Renewable Energy Laboratory, and welcome to today's webinar, which is hosted by the Clean Energy Solutions Center in partnership with the International Smart Grid Action Network, also known as ISGAN. Today's webinar is focused on the Smart Grid Demand-Side Management and Demand Forecasting for the Residential Sector.

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We encourage anyone from the audience to ask questions at any point during the webinar. We do keep all attendees muted so to ask a question simply type it into the "Questions" pane and submit it there and then those will be submitted to the panelists during the question and answer session. If you are

having difficulty viewing the materials through the webinar portal, we did post PDF copies of the presentation at cleanenergysolutions.org/training and so you may follow along as our speaker presents. Also, an audio recording of the presentations will be posted to the Solutions Center training page within about a week of today's broadcast. We are also adding the recordings to the Solutions Center YouTube channel where you will find other informative webinars, as well as video interviews with thought leaders, on clean energy policy topics.

Today's webinar agenda is centered around the presentation from our guest panelist Rowena McCappin. Rowena has been kind enough to join us to discuss the RealValue Project, a Smart Electric Storage Project storage project that involves smart grid demand-side management and demand forecasts. Before Rowena begins her presentation I will provide a short informative overview of the Clean Energy Solutions Center Initiative. Then, following the presentation is when we will have a question and answer session where your questions can be addressed by the panelist and then we'll quickly have some closing remarks and a brief survey before wrapping up.

This slide provides a bit of background in terms of how the Solutions Center came to be. The Solutions Center is one of 13 initiatives of the Clean Energy Ministerial that was launched in April of 2011 and is primarily led by Australia, the United States, and other CEM partners. Some outcomes of this unique initiative include support of developing countries and emerging economies through enhancement of resources on policies relating to energy access, no-cost expert policy assistance, and peer-to-peer learning and training tools, such as the webinar you are attending today.

There are four goals for the Solutions Center. The first goal is to serve as a clearinghouse of clean energy policy resources. Second is to share policy best practices, data, and analysis tools specific to clean energy policies and programs. Third is to deliver dynamic services that enable expert assistance, learning, and peer-to-peer sharing of experiences. And then lastly, the Center fosters dialogue on emerging policy issues and innovation around the globe.

Our primary audience is energy policymakers and analysts from governments and technical organizations in all countries, but the Solutions Center also strives to engage with the private sector, NGOs, and civil society.

One of the marquee features that the Solutions Center provides, which is the no-cost expert policy assistance known as "Ask-an-Expert." The Ask-an-Expert program has established a broad team of over 30 experts from around the globe who are each available to provide remote policy advice and analysis to all countries at no cost. For example, in the area of Demand and Policies Evaluation we are very pleased to have Bruno Lapillone, Vice President and Co-Founder of Enerdata, serving as one of our experts. If you have a need for policy assistance in demand and policy evaluation, or any other clean energy sector, we do encourage you to use this valuable service. Again, it is provided to you free of charge. If you have a question for our experts please simply submit it through our simple online form at cleanenergysolutions.org/expert, or to find out how the Ask-an-Expert service can benefit your work feel free

to contact me directly at sean.esterly@nrel.gov or you can give me a call at 303.384.7436. We also invite you to spread the word about this service to those in your networks and organizations.

Now, I'd like to provide a brief introduction for today's panelist. Our speaker today is Rowena McCappin. Rowena is Project Director for Glen Dimplex working mainly in the area of energy storage and demand side management. In her current role Rowena is managing a large European Horizon 2020 funded project and is involved in lobbying in the European level and is also active in a number of key lobbying associations in the energy sector in Brussels. With that, I would now like to welcome Rowena to the webinar.

Rowena Good afternoon everybody. Well, good afternoon for myself. I'm currently in Ireland so it's the afternoon for me. Welcome everybody. I'm delighted to be here today speaking at this webinar. As Sean has introduced me, my name is Rowena McCappin. I am Project Director at a company in Ireland called Glen Dimplex and today I am going to give you an overview of a large Horizon 2020 project that we are currently leading as the lead beneficiary.

Just to give you a bit of background as to who I am and where I am coming from, the Glen Dimplex group is an Irish, privately owned organization. It's a global organization. My headquarters in Dublin was founded in 1973. Today we pride ourselves as being the world's largest electrical heating business. We are manufacturers of heating equipment and we also hold significant positions in the domestic appliances markets. Our annual turnover is 2 billion Euros and we are still privately owned.

Before I go into the main body of the presentation, I would like to acknowledge two associations here in Ireland, which have been a great support to the work of Glen Dimplex and its partners in the smart grid area and demand side area. Firstly is Smart Grid Ireland, who is a non-profit all-island advocacy network whose mission is to facilitate the delivery of a secure affordable and sustainable energy infrastructure and to Possession Ireland at the global forefront of smart grid development creating long-term economic wealth for the people of Ireland. Glen Dimplex is a member of Smart Grid Ireland and is a keen advocate of the work that Smart Grid Ireland does. The second association is the Sustainable Energy Authority of Ireland, the SEAI. The SEAI has been a great support to Glen Dimplex and its partners over the last years and has been one of the key advocates and supports in the RealValue Horizon 2020 Project. SEAI's mission is to play a leading role in transforming Ireland into society based sustainable energy structures, technologies, and practices. To fulfill this mission the SEAI aims to provide well-timed and informed advice to governments and to provide a range of programs efficiently and effectively, while engaging and motivating a wide range of stakeholders and showing continuing flexibility innovation in all activities. So, thank you to Smart Grid Ireland and SEAI for making this possible.

Just to give you a bit of background to the energy landscape in Europe and the background to where our work is being focused on and the RealValue

project where it comes from. In 2014 the EU 2030 climate and energy goals were updated and amended so the old 20, 20, 20 targets were updated to 40, 27, 27, which isn't as catchy as 20, 20, 20 but that's what it is. Basically that is there is a reduction in greenhouse gas emissions need by 40% below the 1990 levels by 2030 in Europe, the target of renewable energy of at least 27% by 2030, and a 27% increase in energy efficiency. These policies, these drivers, obviously affect EU policies but also national policies. This is where Glen Dimplex and its partners have been looking at focusing on.

This next graph is extremely interesting. This is a graph from the International Energy Agency and basically this is saying that to avoid catastrophic global warming the average global temperature cannot rise above 2 degrees C above the long-term norm. The IEA uses the measurement of the amount of CO2 in the atmosphere in gigatons and if you look at 2008 there was 10 gigatons of CO2 in the atmosphere. This is a reference scenario. So if you follow the reference scenario line, which is the red line, you will see that if nothing is done by 2030 - and we have population increase, we have development of economies - if nothing is done on the end user side of energy, so how we use that energy if nothing changes, this will rise to 15 gigatons a year, which is a 50% increase. If you look now at the light blue section of the graph, this is basically saying that if we do focus on some of the end-use, for example we have more efficient cars, maybe electric cars, we're looking at energy efficiency in buildings, and we can hold it to 12 gigatons a year. The real interesting bit is the 450 scenario, which is the green line. This is where we need to get to achieve the 2 degrees C limit and what this is showing us is we need to bring this 10 down to 7 gigatons a year, which is 30% reduction for 2030. This is what drives EU policy for renewable energy, energy efficiency, and CO2 and this reduction this translates into national energy and climate policies.

We know that the electrification of heat is needed to some extent as part of the 2050 roadmap. You can see from this graph. This shows the comparison of heat and electricity demand across a full year in the UK in 2010. What we're seeing here is that UK heat peaks at 350 gigawatts but the electricity provider, the yellow on the grid, is only 60 gigawatts. What we're saying here is we can't electrify all heat as we would need five times more electricity but it is possible to electrify or at least double or three times the amount of heat being electrified at the minute.

If we are going to tackle energy efficiency problems, we are going to need to look at buildings. One third of all primary energy consumed in our society is used for space heating and water heating in buildings. So we need to look at this area.

This is the end of the background and what I'm saying here is that Glen Dimplex, our company, is looking in this area. We are the world's leader in electric heating and we are investing in technologies to achieve a decarbonized electric future for space and water heating.

Moving on I set the scene for energy storage and on site management. If you look at this screen, this is showing that now currently in Europe there is

approximately 100 gigawatt hours of pumped hydro available for energy storage. If you look at the right hand side of the slide, this is the thermal storage, which is actually today available. What we are seeing here is that with all the existing space heating and water heating and products, which have been installed, which are for storage products, which are installed and they are linked up to the grid there is nearly 4 times more energy storage available in this thermal load in winter than there is in pumped hydro. In summer, just with the water systems connected, there's 1.7 times more thermal energy available.

Looking now at energy storage technologies and costs of this, if you look at an electric car and a battery, the typical energy stored per day in a battery in a car is 10-kilowatt hours of electricity per day. The cost per kilowatt hour of that storage capacity is about 300 Euros. For smart water heating and smart space heating, there's 13 kilowatt hours in water and 50 kilowatt hours in space heating, which equates to about 70 kilowatt hours of energy storage available in a home, in a smart water space heating system, and the cost of that medium is practically nothing because obviously, well, some country's water doesn't cost anything and the actual storage mass in the heater is about 15 Euros. So in other words, to be able to store that 70 kilowatt hours of energy that's stored in the space and water heating system in a battery, that would cost approximately 25,000 Euros.

The RealValue Horizon 2020 Project involves, say, installation of thousands of smart electric thermal storage systems into three deployment sites over three member states and I will talk about that in more detail in a second.

This is the Quantum system. The Quantum system is a smart electric thermal storage system, which is designed to use low cost low carbon energy from renewable sources.

It also has a demand side management functionality that brings flexibility to the system by storing heat from renewable electricity generated at times of high supply and low demand and turns it then into cheap efficient heat only when it's needed.

Quantum is really controllable and it's designed for integration into smart grid systems. The heating system itself is up to 25% cheaper to run and used up to 20% less energy than other comparable electric storage heaters.

Quantum really is a groundbreaking technology we believe. It's the first true smart grid enabled electric heating system. It has the potential to revolutionize home heating delivering affordable comfort and very low levels of carbon emissions. It goes farther also by facilitating connection of higher levels of renewable generation onto the grid.

From the consumer point of view, there are many benefits: high efficiency, low losses, accurate electronic time and temperature control, up to 25% reduction of energy bills in comparison to other electric storage heating systems and advanced apps for user interaction and info. Also, there are many benefits for the power system, overall demand reduction, reduction of

demand during peak periods, increased system flexibility, provision of ancillary services, and facilitation of increased electricity generation. Again, this is just recapping the benefits for the consumer.

Moving on to the RealValue Project, which is really why we're here today, which is what I want to share with you. The background to this is it's a Horizon 2020 funded project. Horizon 2020 is the biggest European Union research and innovation program ever with nearly 80 billion Euros of funding available over 7 years from 2014 to 2020.

In addition to the private investment that this money will also attract, it promises more breakthroughs, discoveries, and world firsts by taking great ideas from the lab to the market. It's true to say that Horizon 2020 will play a pivotal role in achieving the 2030 climate and energy policies. Europe and Ireland are leaders in renewable energies; however, we don't believe it's enough. We need to develop these markets and as we know, as renewable energy becomes more available on the grid, more energy storage will be needed.

The importance of energy storage flexibility can be seen in the funding priorities from the European Commission in FP7, which is a 7-year program, which was the predecessor of Horizon 2020. It was 52 million Euros dedicated to energy storage. At Horizon 2020 there are 70 million dedicated to energy storage in the first two years and in fact this will actually be in the region on 90 million because a further 20 million has been taken away from another section and put into energy storage, hence showing the value that the European Union and European Commission puts on the whole area of energy storage and demand side management.

The calls for energy storage cover small and large-scale storage and development of the next generation of energy storage technologies. Furthermore, I think it's fair to say that demand response and demand side management will play an increasing role in the future of energy, of electricity markets. This has been recognized recently in the energy union communication from the European Commission and furthermore, consumer engagement and demand side management have a clear and proven role in enabling the European Union 2020 and update 2030 targets.

So, on to the main reason for us being here today, the RealValue Project. The RealValue Project is a Horizon 2020 funded project under low carbon economy [inaudible 19:06], that's the call. It call is for local small-scale storage. There are 12 partners in the RealValue consortium with Glen Dimplex as the coordinating partner.

The project will commence in June 2015 and RealValue aims to demonstrate how local small-scale energy storage, optimized across the EU energy system, with advanced ICT, can bring benefits to all market participants. The expected total project costs of RealValue is 15.5 million Euros with a European Commission contribution of 12 million Euros and the project will last three years, 36 months. The Glen Dimplex Quantum Smart Electric Thermal System will be installed in 1,250 homes in Germany, Latvia and

Ireland and each of these territories represent unique market conditions and represent the diversity of the EU energy markets. Furthermore, to validate the model at large scale, RealValue is going to use modeling and virtual demonstration techniques to prove the technical and commercial potential of local small-scale energy storage in millions of homes across representative EU regions.

RealValue spans the entire value chain including householders to supply, distribution, transmission, generation, and system operators. The business keys for small-scale storage will be evaluated and the barriers associated with its integration and in the electricity grid and energy markets will be identified and presented to the European Commission.

RealValue seeks to address the barriers presently limiting the integration of such technologies into the distribution grid at building and house level. The demonstrations, the physical demonstrations, will thus further enhance the synergy between two different energy vectors, being heat and electricity as the underpinning technology, Smart Electric Thermal Storage of efficient, high performance electric, space, and water heating with thermal energy space capability. RealValue will apply ICT and optimization techniques to provide benefits at overall energy system levels and it is anticipated that the resulting benefits from RealValue will include cost savings, reduction of CO2 emissions, and improvements in the flexibility and reliability of power systems across the globe. The project will continue until 2018 and through the implementation of the physical demonstrations and results from broader modeling tasks it's hoped that RealValue will be the catalyst in creating a greener future for hard consumers to use and store energy.

The RealValue Consortium is a truly complementary partnership with full participation and commitment from the whole energy team - twelve partners in total from five member states - Ireland, UK, Germany, Finland, and Latvia.

To ensure delivery of this complex project, this complex dispersed aggregated local small-scale energy storage project, RealValue's secured key participants from various specialisms across industry, energy services, research organizations, and energy network operators. Each partner brings a distinct added value to the European Consortium. From industry, we have Glen Dimplex and Intel. Both were leaders in their respective fields who will bring their expertise in electric and heat storage devices and advanced ICT, respectively. The energy services will be provided by SSE in Ireland, a vertically integrated energy company with a large renewable energy portfolio whose core values are predicated around its customer engagement; NVV, a large German based energy supplier bringing broad experience from field trials of power customers, and additional industry expertise provided by energy network operators ESBN and Ergrid, who operate within the All Ireland energy market, which incorporates trans-boundary operations within different regulatory and currency environments. Underpinning the RealValue consortium are world-renowned research organizations. We have input from technical on the technical side the University College Dublin and the National

University of Ireland and the Rigas Tehniska University. On the market side, market study, we have VTT from Finland. Economic studies, we have DIW, Deutsches Institute for...I'm not even going to pronounce that. My German's not the best. And on the social side, we have the University of Oxford who are going to be carrying out our social studies and consumer impact studies.

The RealValue objectives are many and I will just give you a handful to just give you a flavor of the project. We will implement the technically rigorous and informative physical demonstrations of a domestic load aggregation platform that will link the electricity and heating sectors in three geographically dispersed European regions - Ireland, Germany, and Latvia. Each of these areas has uniquely interesting and distinct power and energy system characteristics. We will refine existing information and communications technology systems and procedures to interface distributive populations of local small scale thermal storage devices so they can be intelligently controlled at the aggregate electric power system level while insuring that individual household's space and water heating energy requirements are maintained. We will also demonstrate how this aggregation functionality can integrate with the electricity market communication and electrical power system control systems, enabling coordination of individual storage devices with the needs of the wider electricity system. RealValue will also refine the optimization techniques and principles required to determine desirable aggregated demand response profiles when participating in rural electricity markets and system services. This will facilitate the inherent flexibility of local small scale storage devices to exploit synergies with the needs of variable and uncertain renewable energy sources. RealValue will also coordinate the response of the local small scale storage devices with low and medium voltage electricity distribution network operator requirements. This will ensure that local network congestion levels are managed and will also explore possibilities for local small scale storage to mitigate network expansions at distribution level. One area which is extremely unique in the RealValue project, and which I believe has really impressed the European Commission, is the extensive desktop modeling and analysis and virtual demonstration studies to be carried out by the ERC and the University College Dublin. These will extend the scope of the RealValue project well beyond what contemporary small scale demonstrations in a few countries can achieve alone. It will also allow a robust quantification of the cost benefit and the CO2 reduction value of local small-scale storage expansion at a greater scale and will still regard many future uncertainties in the power and energy systems of wider Europe.

We will also combine experiences derived from the physical demonstrations with future projections from desktop modeling studies in order to further identify and propose solutions to any current or planned regulatory and market barriers that may apply to this type of equipment at scale in the European energy system. Furthermore, through our partners in Finland and Germany, we will carry out third market and regulatory policy investigations to identify current barriers to the integration of small-scale storage and will give recommendations on what is needed to overcome these barriers.

Another extremely important part of the RealValue project where we have a lot of investment, and a lot of budgets in the actual project, is around the consumer side. Obviously for the Horizon 2020 project this is an extremely important piece. RealValue will develop a better understanding of consumer assistance. Electricity supplier tariff preferences, technology interaction, and adoption issues related to smart electric thermal storage. This will be done through surveys and interviews to elicit customer views on the technology. We will also devise robust business models across all stages of the smart local small scale thermal storage concept. Finally, last but not least, we will disseminate the experiences, findings, and conclusions of the project to a wide audience of the European industry regulatory policy and academic stakeholders.

The fundamental premise of RealValue is that a population of smart electric thermal storage systems used for space and water heating in consumers' homes can be aggregated in order to realize additional value for the electricity system. That is the basic principle of the RealValue project.

The main beneficial aspects of a distributed domestic load resource can be distilled into the following aspects of par and energy system planning - energy arbitrage value, system services value, network investment deferment value and capacity value. Excuse me. All these areas will be looked at in the RealValue project.

Two of the key areas of operational flexibility fall under the category of frequency response and ramping duty. However, the market for such system service products and the corresponding financial arrangements necessary to provide these services are not yet in place in many countries. Providing such services from deeply embedded demand is a new concept and it will potentially require the cooperation and the development of data flows from a large number of sources and project partners. It is anticipated that both smart meter data and third party regulation data can be used in order to monitor the ramping performance and capability of demand side technologies.

Just to go back a bit to the Smart Electric Thermal Storage System to give you a bit more information on that. The Smart Electric Thermal Storage System has a significant cost advantage over other forms of energy storage. It typically costs less than 5% of the cost of electric-chemical systems per kilowatt-hour of energy stored. With these types of SET devices, the intra-day scheduling of electric power demand required can be decoupled from the time of thermal energy end-use by the domestic consumer, which obviously is a key area here in this project and a key fact. When enabled with advanced communications and aggregate level control functionality these devices thus constitute an intelligent and responsive form of demand shifting, demand shifting demand-side management (DSM).

The potential value from Smart Electric Thermal Storage System participation within the EU power system is significant. In 2013 there was a report commissioned by Kema, now DNV GL, Dutch Research Agency that estimated that based on retrofitting all night storage heaters in the EU in the 27 member states, Smart Electric Thermal Storage can potentially introduce

55 gigawatts of controllable capacity by 2050, avoid 7.4 terawatt hours per annum of heating energy, and avoid 2 million tons of CO₂ emissions per year. This report was presented to the European Commission at an event in the European Parliament in February 2013. I think it's true to say that the European Commission really didn't have much idea about this sleeping population of energy storage systems already installed around Europe. That, as I said, was nearly...that was two years ago and since then there has been a lot of discussion in Brussels about using storage and using heat and using systems within people's homes for demand-side management purposes and for energy storage.

Back to the RealValue Project and one of the key areas that we are also looking at is also the aggregation and system integration. ICT and optimization techniques will be applied to demonstrate benefits of the overall energy system level. This is going to be delivered by an aggregation platform or an aggregator and the aggregator will apply advanced algorithms to provide data management and control, which balances domesticating of power system requirements, capture and prioritize individual consumer occupancy patterns, comfort needs and preferences, forecast heat demand, and interact with electricity grid control systems at both the aggregate market and local distribution level. Two different aggregator models will be deployed for this project. In Ireland and Latvia RealValue will use the Intel aggregator system being developed by Intel and in Germany we will use a dedicated energy management system developed by NVV and its subsidiary BG. They have developed a virtual power plant platform in cooperation with Greencom Network. These have both been chosen in order to leverage previous learning and investment in this area.

This is a diagram, which shows the aggregation and system integration and it basically shows that it involves all areas from generation through the transmission system and distribution and supply. To validate the model at large scale, RealValue will use modeling and virtual demonstration to prove the technical and commercial potential of local small-scale energy storage in millions of homes across the EU region. This will be carried out by the electricity research center at the University College Dublin. Through third desktop economic modeling and virtual demonstration elements, this will help assign the benefits and the challenges associated with small-scale storage penetration and electricity and domestic electric heating co-optimization at a more significant scale, millions instead of thousands of homes.

In short, a third modeling and virtual demonstration component of RealValue can extrapolate the scope of the real physical demonstration in a relatively small but statistically significant number of homes in three regions to a much broader European energy system cost-benefit analysis context. This will add significant robustness and transferability to the RealValue project as a whole with affordable additional resource requirements.

The physical deployments in Ireland and in Latvia will apply aggregation, optimization, and electricity system control interfacing to a significant number of homes. However, physical demonstrations have limitations in the

extent to which the software ICT system tools, the optimization, and online network congestion analysis techniques will be regularly tested by conditions experienced in the demonstration. RealValue has real added value with this novel virtual demonstration process to encapsulate some of the challenges within the testing and performance verification stages of the aggregation and local small-scale storage controls. A third modeling and virtual demonstration component of RealValue can extrapolate the scope of the real physical demonstration in a small number of homes and extrapolate it to a much broader European energy system.

The modeling aspects of RealValue will perform detailed cost-benefit analysis of Smart Electric Thermal Storage within all value streams of the co-optimized electricity and heat sectors. Technical and economic heat comparisons with other local heating and storage options with just heat pumps, combined heat and power, CHP, and electric chemical batteries will also be easily integrated within the modeling work without the need for physical comparative demonstrations. The cost-benefit modeling aspects of RealValue will also project much further into the European system context establishing sensitivities to any anticipated changes or uncertainties in electricity system generation portfolios, renewable energy build-out levels and future building thermal efficiency standards.

RealValue recognizes the important role that customers have to play in this project. Customer experience during the early years of any product deployment can have long-term repercussions. With bad experiences during trials, it's sometimes taken years to get over. However, effective customer engagement throughout the product development stage can go some way to avoiding this, particularly during early stages market design. Regular communication helps manage customer expectations. A modified design and response to their preferences, resulting in a more controlled development with better energy and social outcomes. RealValue recognizes the important role that customers have to play in the development of distributed energy storage as a viable system tool. RealValue has dedicated significant resources in the project, understand the impact that controlled energy storage and demand-side management can have on users and the ways in which they will respond to and learn about how to employ this mode of heating and network management.

This activity within RealValue will be led by the SSE, who brings a track record of excellence in customer service. Excellent customer service will also be backed by a comprehensive mixed method research lab at the University of Oxford, culminating in an overall customer impact study. The study, which will run in parallel with physical trials, is going to provide valuable feedback on customer protections, preferences, and actions in relation to storage heating. There will be a particular emphasis in comparing the experiences of customers in Germany and Latvia who have no real prior experience with storage heating with those in Ireland, who have already learned how to manage storage heaters in order to achieve acceptable levels of comfort. There will also be comparisons between Ireland, Germany, and Latvia in terms of the level of customer service on offer.

RealValue will seek to demonstrate how the introduction of a controllable energy demand through local small-scale thermal energy storage deployment can deliver value across the whole electricity supply chain - from generation, transmission, distribution through the wholesale market suppliers and thus, ultimately, back to the consumer - the European citizen.

By building on the results of three distinct and complimentary consumer trials within Ireland, Germany, and Latvia and performing rigorous techno-economic modeling extended to a wider European case study under a large number of future scenarios, RealValue will be able to demonstrate the effect and quantify the benefits of integrated, small-scale thermal energy storage on energy balancing, grid-security and supply, network congestion management at the local level, societal issues, and the introduction of a domestic load aggregator into the market, will enable RealValue's player companies to access new revenue streams and thus facilitate benefits flow back to the consumers through effective tariff designs, decarbonization, and integration of renewables impact of demand-side measures under different market structures and incentive regimes for policymakers and regulators.

RealValue will also develop aggregator and supplier company business models for exploitation of aggregated local small-scale storage. Scalable deployment of technology will increase market share by electrification of key target sectors such as heating.

RealValue will develop business models to maximize the market uptake of penetration of such systems. Because the value of distributed small-scale energy storage is dispersed throughout the whole energy supply chain, RealValue will also address the interactions between wholesale and retail markets and identify how that value can be realized and shared between the various stakeholders to achieve large-scale deployment through mutual economic advantage.

Dissemination is an extremely important part of the RealValue project and we have one work package dedicated to this. It is an extremely important part of will for the European Commission obviously. RealValue will generate a wealth of information throughout its execution and we have dedicated outputs, which are scheduled to be disseminated in stages to raise the awareness of the project within all key stakeholders within the scientific community and among industry, other stakeholders and wider publics. We will obviously have a dissemination plan, which will be put in place at the beginning of the project, which will outline all the dissemination activities throughout the 36 months, which will include, as you can see there, our website, literature, videos, conferences, publications, press, social media plan, workshops, and seminars.

You'll be happy to hear that I'm coming to the end of my presentation but this slide here basically shows how RealValue has impact across the whole electricity value chain - right through from generation to transmission and distribution, to wholesale supply and society.

I have one final remark. There currently around 14 million homes in Europe with electric space and water heating, with a combined connected load of 140 gigawatts. There are considerable benefits to be obtained by updating these heating systems to provide energy storage and response capability. As new homes and buildings are constructed in the future, the application of an integrated approach incorporating localized generation and energy storage and demand response with advanced ICT will provide a valuable resource to optimize future energy systems. Thank you.

Sean

Thank you Rowena for the presentation and we will now move on to any questions from the audience. Just a reminder to the audience, if you do have any questions you'd like to ask you can submit those through the Questions pane and I will present those as we go.

So Rowena, we'll jump right in. We did receive a couple questions. The first one, from one of the attendees asks - does the Glen Dimplex system react to the cost of electricity and how much control does the consumer have over the system?

Rowena

Okay, well, yes. The Glen Dimplex system will be able to react to the cost of electricity when the aggregation platform has been developed. So that is one of the key principles, so yes. The whole idea between, behind, RealValue is that eventually time of use tariffs will be in play and the consumer will be able to benefit from the cheaper electricity coming onto the grid, which will be controlled, obviously, by the aggregation system. So yes, the Quantum system can react to that and that is one of the key learnings, which will be taken out of the project. How much control does the consumer have over the system? The consumer, one of the key things, which I probably should have brought out clearer in the presentation, is that the consumer will have...there will be no change in the consumer's comfort throughout this, okay. So the consumer, basically, can set the comfort that they require from their heating system from their space and water heating system. They can control the temperature that they want. They have different settings that they can do, a 24 hour setting or 48 hour setting or 7 day setting, but yes, they have full control of that system. In other words, their comfort and their heating requirements and water requirements will not be affected by this type of trial. That is obviously something, which we need; we will make very clear to the participants taking part in this trial. At no stage will their system be switched off, for example by the aggregator, and that would mean that they will have an interruption in their heating. No, very much the contrary. They shouldn't notice any difference in their comfort but that is a key part in the learning of this project as well and that is why we have University of Oxford engaged in this because, you know, when you are obviously using demand-side measures within somebody's home, the very idea of that to people is quite daunting because they don't understand. They don't understand how or why or how somebody is going to interact with appliances in their home. They obviously need that reassurance that that will not affect their day to day living. That's why we have Oxford engaged in the whole behavioral study as well because we want to understand the psychological reasoning and the psychological

questions that I suppose these consumers have when they're taking part in this trial. That's a very big part of the learnings of RealValue.

Sean Great Rowena. Moving on to the next question - have local regulators been engaged in the planning of the project?

Rowena Yes, the regulator in Ireland has been engaged and has been engaged for a long time. Ireland is extremely progressive in terms of renewable energy integration and smart grid so the regulator in the summers of Ireland has been engaged and is very aware of the project. Glen Dimplex and its partners in Ireland have already engaged on two smaller scale demand-side management trials involving this technology and the regulator has been involved in those trials so yes.

Sean Great, thank you and also what is the schedule for the project? Will you be making results publicly available and if so when will people be able to see those?

Rowena Okay, the schedule. The project starts in June 2015 and you will appreciate that first of all, the very first thing that we need to do is actually identify the homes for the trial. Those homes have been loosely identified but as soon as the project begins in June 2015 then they have to be recruited. That will take place first. The homes will be recruited and then the technology will be installed. We are hoping that we will have at least half of the 1,250 homes installed with the system by the time the first heating season comes around. For us in Europe that would be, we would need to have approximately 500 homes installed over the three member states by October/November 2015 and really, to get the full extent of the results, we probably need to be running those systems for at least 12 months and have them running over one full heating season. So in theory the results will probably start coming through or robust results will start coming through half-way through the project, which will be month 15. With regard to will those be made public, there are obviously, because this is a Horizon 2020 project, yes, there are stipulations from the European Commission about making results public. This is public. This is European citizen money and so the benefits of this project have to be spread around Europe and for the greater good of the European citizens. So, yes, the results will be public. However we also have IP concerns, and some of the partners have IP concerns, so not everything will be public but everything that is of interest to the European and wider energy world, the European citizens, yes. It will be available.

Sean Great, thank you Rowena. Somewhat related to that, where might someone be able to find more documentation about the RealValue project if they wanted more information?

Rowena Okay, well at the moment, because the project hasn't started, we haven't got our project website up and running but the project website is due to be launched in month three. That would be in August so at that stage we will have a project website. It will be, from the top of my head, www.realvalueit2020.eu but obviously I can clarify that address with yourselves and we can get that on your website at a later stage. Everything

that is public that is publicly available on the project will be on the website and then we will have information, obviously, on all the partner websites as well. As I mentioned before, Smart Grid Ireland and SEAI in Ireland are advocates of the project and all the information on the project will be available through them too and through the other associations, energy associations, and the other member states. Glen Dimplex and some of the other partners are also members of Eurelectric and the European Association Storage of Energy so all the information on this project will be disseminated through those bodies as well.

Sean Great, thank you Rowena and also if one of our attendees wanted to contact you directly is there an email address that you could share or a place that they could submit anything?

Rowena Yes, of course, of course, yes. My email address is...do you want me to spell it out or?

Sean Yeah, I can send it out through the, through the question pane actually. I could...

Rowena Yes, yes, there's no problem at all. You have it Sean. It's Rowena.McCappin@GlenDimplex.com.

Sean Great, I'll send it out through the question pane in a second here. So this next question asks, and it might be a little technical but you might have some insight into it also - does the research include anything on standards for communications between inverters, thermal energy storage, and electric storage? They note that there is a lot of work on electrical integration, but not sure what communication issues come up when thermal energy as storage is added to a grid.

Rowena Yeah, there will be work carried out on that I believe. Yes, it's a little technical for me so I couldn't go into the detail but yes, there will be work carried out in that field. We will be looking at standards as well. Some of the partners involved are obviously...they're obviously involved in making standards in the European context so there will be a good body of work around standards, European standards in particular.

Sean Thank you Rowena. What is the payback period for a typical system? Is it 25? So there are a couple questions here. I'll just read through them and then I'll be happy to repeat any of them if you'd like. So the first question is - what is the payback period for a typical system? Is the 25% energy bill savings from Quantum systems calculated or realized? And then the final question, are there any time based electricity pricing programs employed in the project?

Rowena Okay, the second question about the 25% savings that is realized. The Quantum system has been commercialized for 4 years now so in the UK, for example, there are probably about 50,000 homes already with the Quantum system installed. So, we have already a very robust body of work around savings. That's all being verified and clarified by independent bodies. The savings are realized, however, I'd like to stipulate at this point again that those

savings are versus traditional electric storage equipment so it's not...those savings are not in regards to calculating against gas or another form of renewable heating. It's versus traditional electric storage heating equipment. The Quantum system, because of its increased insulation properties, and also its increased controllability, that is why the energy savings and then the cost savings for Quantum. The first question was around payback?

Sean

Yes.

Rowena

And that, well, payback obviously depends on any different parameters so it's quite difficult to calculate that but if, for example, here in the UK and to put a Quantum Smart Electric Thermal Storage System into average or small sized flat sized home, it's approximately, let's say in Euros, it's approximately 5, say 6,000 Euros to install a system like that in the home. So it's not the most expensive and it's not the cheapest to install but in comparison to, for example, heat pump or an oil system, it is a cheaper option. When you look at payback then, obviously you're going to have, if you already have electric storage heating in your home and you're upgrading to this Quantum system, then you're obviously saving 25% on your electricity bill every year. It depends on how much you are paying on electricity to work out your payback but the thing about this is that as this, as this market moves forward, you know, when the value has been calculated and realized, so when RealValue can put results on the table and say this is the value for using this type of equipment in somebody's home and say this is the pound. This is the Euro, which are being saved through all the different levels of the energy chain, at that stage there then some of that value needs to go back to the consumer in the form of better tariffs, maybe in the form of an incentive to, an incentive to be able to use their heating system as a the demand-side tool. So there are many other ways in this project that savings can be generated for the consumer. So the payback question, I know I have not answered it, in 2, 3, 4, 5 years but it's not as simple as that to answer. This project is...one of the key premises of this project is to try and actually quantify what and how much money all these different players in the energy chain can actually save or not spend by using this type of system for demand-side management purposes and then, obviously, pass some of that savings back to the consumer. And the third question was? Sorry.

Sean

Oh yeah, um, let me...

Rowena

Electricity?

Sean

Are there any time-based electricity programs employed in the project?

Rowena

Okay, what...do you know what is meant by time-based?

Sean Esterly

I'm not sure.

Rowena

I do believe, just from my limited technical knowledge of the aggregation platform, yes. I believe so and I believe that that will be a key part of the Intel and piece of work on this project around the whole aggregation platform. So yes.

Sean Great, thank you. Do you have any examples of community bundling of value from such advanced control solutions?

Rowena Umm, here and Europe, no. I don't off the top of my head. I don't have any examples but I do know that this has been done already in the states and I have access to case studies from the states that I can share with anybody if they want them.

Sean Great, thank you Rowena and we did just send out your email address as well so if any attendees would be interested in that information you can find her email address in the chat and I also sent it out through the questions pane as well. A few more questions that we have and they are still coming in.

Rowena Okay.

Sean What solutions can you imagine for cities where there is a large amount of renters?

Rowena Yeah, uhh, good...very very good question. Um, I need to think about that one. I mean I suppose...at the start of this project we are obviously targeting homes that are owned by the tenant. Well, not necessarily actually. Some of the clusters of homes that we're talking about targeting at the moment are actually social housing. So, those homes are actually not owned by the tenant. They're owned by social housing organizations or local councils and they are still keen to get involved in that project. So what it actually means is the landlord himself, they get a benefit in that they are upgrading their heating system to the Quantum system. Their tenants are generally happier because they have this upgrade and they are saving money on their electricity bills so it works for the landlord. For the person that's in that home, whether they're renting or they're in it, you know, on a social basis, they're also getting benefits, obviously from the decreased electricity bills and the comfort. So, in the RealValue project there are people that are going to be involved that don't own the property so it hasn't caused us a major problem up until now. I see where the question is coming from. I can understand that it might not be of as much interest for people that don't actually own a property but I don't see why they can't get involved in a similar scheme. I mean, you know, even if you're renting a property you're still going to have to...more than likely you're obviously going to be paying for your own electricity and you're going to be signed up to an electricity supplier so there's probably no reason why you can't, through that electricity supplier, why you can't get involved in a scheme like this. Or, outside the project going forward, if this is something, which is happening all the time, then even if you only rent the property you can still sign up for demand-side management facilities in the future. It would just be, literally, it would just be part of your contract with your electricity supplier or, obviously, there could be other players in the market, other aggregation players in the market that may not be the electricity player. It could be any company, any type of company offering those services. So, I don't think it limits it too much.

Sean Right. Great Rowena. To scale up in the future, would all homes need to buy the Quantum systems or do you know if there are any plans or could smart

thermostats be incorporated into the aggregator network? Are there any plans for that?

Rowena

Umm, it depends, well...I mean, the smart, the Quantum system it, obviously, the main characteristic of the Quantum system is that it is a thermal storage unit so you would need to have...you would need to be able to use...sorry. Demand-side management, obviously, and energy storage are two different things but obviously we are linking them here together in this project. If, as regards, their Quantum system, the Quantum system is an energy storage unit and thus it is able to take...it is able to...Taking of the electricity or the loading of the electricity into the product is decoupled from when a person actually needs the heat and that's the beauty of this system. The whole reason why storage heating was invented 30 years ago was because the electricity supply companies had an issue with peak demand during the day and excess electricity at night that was being dumped and that was the whole premise for storage heating. So, it's not just the demand-side tool. It's becoming a demand-side tool now but the actual basis of the product was more an actual energy storage, thermal storage so that you could help smooth the peaks and the troughs of electricity on the grid. So that's the benefit of the Quantum system so not all homes obviously...a system like this is only a part of the whole picture. It is only part of the solution and we do not believe that every single home in Europe is going to have a Smart Electric Thermal Storage System installed. I mean, for example, here in Ireland, the majority of our homes are still oil fired and then natural gas is very popular. The homes that are electrically heated tend to be the homes that are either large apartment blocks or they are rural and they don't have access to gas. So we're under no illusion that not all homes in Europe are going to be electrically heated in the future. It's going to be a mix. A mix of all sorts of different heating solutions, including renewable energy, renewable heating energies like heat pumps, also electrically.

Sean

Thank you Rowena, and do target homes need to make a contribution to the installation cost of the heating or thermal storage devices?

Rowena

It, well, if you're asking about the RealValue project, at the minute, it's a mixture. We have, we are, we are targeting, in Ireland, for example, we are targeting housing associations and local authorities that already have refurbishment plans in place. So basically they are already planning to upgrade old electrical heating systems. We are going to them and saying, well, okay. We can offer you this smart electric thermal storage heating system at a reduced price, not at the commercial price, and then as part of that your tenants will have to take part...not have to, but will be eligible to take part in a trial for three years. After that trial finishes, that system belongs to that house. Obviously, it goes in a standalone mode and it functions as a space and water heating system. In some of the member states, in Germany and Latvia, yes, there will be a contribution from the householder and in Ireland, at the minute, we're not sure. So it's a bit of a mix. I suppose it just depends on the member state and it depends on the relationships already there with the associations and local authorities that we're working with but in the future, yes, obviously, in the future this Quantum system will be...somebody

will have to pay for it and whether or not that is the consumer alone or whether that is combination of incentives from an aggregator, incentives from an electricity supply company, who knows. That's something that will be looked at with the RealValue project as well.

Sean Great, and is that Quantum technology developed just by Dimplex alone or are there other vendors that were involved in that development?

Rowena No, the Quantum technology is just...has just been developed by Dimplex. So we...the product design arm of the product was carried out in the south of Ireland and by Dimplex and the manufacturing of the product is actually in Northern Ireland and so it's very much an All Ireland success story, the Quantum system. It was developed in conjunction with SSE. SSE was heavily involved in the early stages because obviously SSE being the leading renewable generator or renewable supplier in Ireland and have a big interest in this area. We are working with SSE. They are one of the key partners on the RealValue project and we're also working with them on other demand-side management projects within the UK and Ireland. The technology itself, yes, is a Dimplex technology.

Sean Great, and you talked about the additional technologies out there in relation to the thermostats. Are you aware of any plans or any discussions to expand the aggregation system to the electric vehicles?

Rowena Intel I believe has worked in the past on an aggregation platform for electric vehicles but I can't confirm that at the minute. I don't see why not. Obviously, this is in the RealValue project the scope...we're very careful that we can't, we can't, we can't extend the scope. Obviously, we will incur major costs that aren't covered in the project but I don't see why the aggregator platform couldn't be further developed outside the RealValue project or Intel through their own capabilities or their own resources so that. We are also looking at future Horizon 2020 goals to see whether we can develop what we start in RealValue and further develop that into new projects under Horizon 2020.

Sean Great and Rowena, what has been the greatest challenge in planning the project?

Rowena Yeah, um, the biggest challenge so far in planning project was, to be honest, I was giving a presentation last week and I realized that I have been working on this project for more than a year and it hasn't even started yet. So, the European Commission...this is the first time Glen Dimplex has led a project of this size under a European Commission funded program. It really, it is, it's a lot of work and it is a very very steep learning curve. However, I would strongly recommend anybody or any organization that has an innovation that they believe could benefit from European funding and obviously the European PR platform to investigate the Horizon 2020 platform. The hardest, I think, so far, the hardest thing in planning the project has been the fact that we have 12 partners. There are 5 member states. There's a lot of coordination needed between all the different partners and unfortunately everything was going to plan on our partners and we were all on track and then literally about 5 weeks ago Ion in Germany, one of our beneficiaries and one of our partners,

they were obviously going to be the largest energy supplier in Germany and unfortunately they pulled out about one month ago. So it was very very late stages. They pulled out basically because they're restructuring their company. It wasn't anything to do with our project but a lot of projects fall by the side so that has been the biggest challenge because we had to then find a replacement for them and we have done. We are replacing them with MVV who is the 5th largest utility in Germany and they are extremely excited and keen about getting involved with the project. I think that has been the biggest challenge. The biggest challenge is coordinating all the partners so that everybody is on the right track and everybody is going in the right direction and our partners are all excellent and everybody is extremely excited about finally being able to start the project in June. The European Commission, for anybody that is thinking about getting involved in Horizon 2020 or looking into any of the goals, the European Commission house been extremely helpful. They organize regular event days in Brussels around a cause where you can go and meet other potential and consortium and partners and get ideas for projects. They really do give you support the whole way through the process. They've been extremely supportive but also the agencies they have here in Ireland, for example the SEAI, I mean they supported our sales and our partners throughout this project from day one and given us a lot of, you know, lobbying support within Brussels and pointing us in the right direction and helping us to put our proposals together. There are lots of challenges around and, you know, I'm sure the project hasn't even started yet so I'm sure it's going to be a very steep learning curve but I believe it's going to be an excellent experience.

Sean

Great, thank you again Rowena. That is the last question that I have for you so we can move on now to the quick survey that we have for our attendees. That just helps us to evaluate how we did and improve for the future so Heather will go ahead and display that first question. So the question statement is that the webinar provided me with useful information and insight. Audience, if you could just mark which reflects your opinion - strongly agree, agree, not sure, disagree, or strongly disagree. The next statement is - the webinar's presenters were effective. And then the final one is that overall the webinar met my expectations.

Great, thank you very much for answering our survey and before I wrap up Rowena if you have any final remarks or anything, otherwise I'll go ahead and wrap up.

Rowena

No, no final remarks. Just wanted to say thank you to everybody who attended today and hopefully you were able to get something out of the session and please feel free to contact me by email if you have any further questions.

Sean

Great, thank you so much Rowena and thank you to our attendees for participating in today's webinar. We very much appreciate all of your time. I do invite you to check the Solutions Center website if you'd like to view or download the slides. They are available on this webinar announcement page. Also, we'll be posting a recording within about a week of today's broadcast.

Additionally, you can find recordings of previously held webinars. Just a reminder we are adding webinar recordings and other videos to the Clean Energy Solutions Center YouTube channel, so please feel free to check that out as well.

We also invite you to inform your colleagues and those in your networks about Solutions Center resources, our services, including the no-cost policy support known as Ask-An-Expert. With that I hope you have a great rest of your day and hope to see you again at future Clean Energy Solutions Center events. This concludes our webinar.

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