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New Buildings Energy Renovation Business Models incorporating dual energy services

NOVICE

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Recommendations and guidelines for policy makers and regulatory bodies fostering the dual energy services scheme

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LIST OF ABBREVIATIONS

ACER	Agency for the Cooperation of Energy Regulators
AIEA	Association of Irish Energy Agencies
BEIS	Department of Business, Energy and Industrial Strategy
BRP	Balancing responsible parties
CAF	Climate Action Fund
CCC	Committee on Climate Change
CIPE	Inter-Ministerial Committee for Economic Planning
CNMC	National Commission of Markets and Competition
CORES	The Strategic Reserves Corporation
CRU	Commission for Regulation of Utilities
D/EPO	Energy Performance Officer
DCCAE	Department of Communications, Climate Action and the Environment
DEFRA	Department of Environment, Food and Rural Affairs
DPER	Department of Public Expenditure and Reform
DR	Demand response
DSO	Distribution system operator
DSU	Demand Side Units
EED	Energy Efficiency Directive
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Contracting
ESCO	Energy Services Company
EU	European Union
GHG	Greenhouse Gas
IDEA	Institute of Energy Diversification and Saving
IEA	International Energy Agency
IRHC	Institute for Restructuring and Alternative Development of Coal Mining Regions
JRC	Joint Research Centre
LED	Light Emitting Diode

M&V	Measurement and Verification
MATTM	Ministry for the Environment, Land and Sea
MSE	Ministry of Economic Development
NECP	National Energy and Climate Plans
NES	National Energy Strategy
NREAP	National Renewable Energy Action Plan
Ofgem	Office of Gas and Electricity Markets
OGP	Office of Government Procurement
OJEU	Official Journal of the European Union
SEAI	Sustainable Energy Authority of Ireland
SME	Small and medium sized enterprises
TSO	Transmission system opperator
UK	United Kingdom
UN	United Nations

EXECUTIVE SUMMARY

The NOVICE project aims to develop a new business model for integrating demand response services into energy efficiency projects. It builds on the Energy Performance Contracting business model for implementing energy efficiency projects and provides a new contracting agreement between the Energy Services Company (ESCO) and the aggregators providing demand response services. The NOVICE model intends to make better use of the end-user's assets and to offer them more saving opportunities, while providing much needed flexibility to the grid to accommodate for the evolving needs of the energy market.

From research carried out under Work Package 3 of, the NOVICE approach can only be successfully deployed in countries that have both a mature ESCO market and a mature demand response market. Lack of one or the other prevents the use of EPC as a vehicle for combining revenue streams from energy efficiency and demand response to improve the business case for building refurbishment projects. The aim of this report is, therefore, to make recommendations that policy makers can use to inform the development of policies and regulations that will accelerate market maturity, thus opening the possibility for wide scale deployment of the NOVICE approach. This is based on reviewing the success factors of EU Member States which have thriving ESCO and demand response industries, as well as reviewing the barriers in EU Member States where these industries are still relatively immature.

Energy policy and legislation is driven by the Clean Energy for all Europeans package, which consists of eight legislative acts as part of the EU's implementation of the Energy Union Strategy, adopted in 2015, which was in itself, the EU response to its Paris Agreement commitments. The implementation of the Energy Union, via the Clean Energy for all Europeans package is composed primarily of:

- a revamped Energy Efficiency Directive (EED) that sets a new, higher target of reducing energy consumption through improvements to energy efficiency by 32.5% by 2030
- the new Energy Performance of Buildings Directive (EPBD) which aims to maximize the energy saving potential of smarter and greener buildings.
- an ambitious new target of at least 32% renewable energy by 2030
- a new requirement for each Member State to draft a National Energy and Climate Plans (NECPs) for 2021-2030 setting out how to achieve their energy union targets, and in particular the 2030 targets on energy efficiency and renewable energy.
- more rights for consumers wishing to produce, store or sell their own energy.
- a smarter and more efficient electricity market with new laws that will increase security of supply. (European Commission, 2019b)

The ESCO and demand response markets for four member states have been chosen for analysis as part of this deliverable. At the time of writing, all four of the sample EU member states, Ireland, the UK, Spain and Italy, were still within the EU. While the UK is now in the Brexit transition period moving towards a full exit from the EU, it remains included in this report because its current energy policy and legislation remains as it was as a member of the EU. The purpose of this analysis was to compare energy policy, market size and market growth in different countries and identify the regulatory and policy measures that have helped or hindered market development.

Clear differences were identified between the countries examined:

- Ireland has a well-developed and mature demand response market due to regulatory reform that opened a number of flexibility programmes to aggregators. However, its ESCO market is

still very small and use of Energy Performance Contracts (EPCs) as a tool is very rare, despite the development of a National Energy Services Framework. The key difference between Ireland and countries with thriving ESCO markets appears to be a lack of public sector procurement frameworks (which have proved successful in the UK) or mechanisms that place value on energy efficiency (such as the White Certificate scheme in Italy).

- The UK has a well-developed and growing ESCO market, largely because of the creation of national procurement frameworks that assisted public sector bodies to undertake full build renovation projects using EPCs delivered by prequalified ESCOs. This has built a large appetite for EPCs in the public sector but has done little to develop the market in the private sector. After initially favouring generators, the flexibility market has also reformed and matured making it more attractive to aggregators providing demand side response.

- Italy has one of the largest ESCO markets in Europe and this has largely been driven by the White Certificate scheme, which is a way to certify the implementation of energy efficiency measures in both the public and private sectors (Boza-Kiss, Bertoldi, & Economidou, 2017b). The scheme has been successful in increasing the number of companies that identify as ESCOs, increasing acceptance of EPC as a means of achieving deep energy efficiency refurbishments and reaching both public and private sector organisations. In contrast, the Italian demand response market is one of the most immature in Europe, with aggregation only recently being made legal and most flexibility markets remaining open only for generators.

- Spain has a modest market for EPCs and ESCOs and has committed to doing more to boost the market in its NECP. To date, most EPCs have been linked to upgrading municipal lighting with little growth into other technologies due to a lack of awareness of the benefits among building owners and a lack of successful case studies showing the variety of energy efficiency projects available (Luque, Briano, & CREARA - Energy Experts, 2018). Like Italy, the Spanish demand response market is immature with aggregation not yet legally allowable and many flexibility markets remaining closed to all but the largest sites.

The market analysis identified a number of barriers to growth of the ESCO and demand response markets. In order for the NOVICE business model to be deployed in all member states, actions must be taken to overcome these barriers and accelerate the level of ESCO and demand response market maturity. A number of potential policy actions were identified that could assist with the development of the EPC market including:

- **Commit to increasing uptake of EPC in NECPs:** Many EU Member States promote the use of ESCOs in their NECP and include plans to drive the uptake of EPCs, as both are key drivers for energy efficiency, but in most cases these commitments could be stronger.
- **Set up Procurement Frameworks for Energy Performance Contracting:** Countries that have set up national procurement frameworks for the public sector have seen a greater increase in uptake of EPCs among public sector bodies and bigger growth in the ESCO market compared to those that have not.
- **Increase level of information, support and guidance available to stakeholders:** It is imperative that EU countries provide clear information and guidance to all stakeholders in order to develop the market. It is also important to note that information and support alone does not grow the market and more direct interventions, such as the development of a procurement framework, are needed in addition to information to drive market uptake.

- **Ensure access to suitable finance is available:** EU countries must provide access to financial support, in addition to awareness and education, to enable and incentivise capital restricted organisations to invest in energy efficiency. Policy makers should ensure that the finance sector is considered and included in any policies or actions to increase uptake of EPC and mobilise sources of private finance.
- **Consider ways of promoting EPC in the private sector:** The White Certificates energy efficiency obligation scheme has played a huge role in driving the development and uptake of EPCs across both public and private sectors in Italy. Similar cap and trade schemes could help develop the market in other EU Member States, as it puts a value on energy saving that can be traded.

This report has also identified a number of policy recommendations that can assist with the development of the demand response markets including:

- **Encourage regulatory reform that promotes demand side response:** Electricity market regulations are highly complex and when considering adjustments, a high degree of expertise is needed to ensure that any modifications are suitable. Regulatory reform should: include consultation with all stakeholders throughout the energy value chain; test policies in practice and redesign if necessary; ensure that regulations do not disproportionately favour generation over demand side action; simplify contracting arrangements between market actors including Transmission System Operator, Balancing Responsible Party, Energy Supplier, demand response aggregator and customer.

- **Educate and raise awareness of demand response among stakeholders** to create a market pull. This is most critical among building owners, ESCOs and EPC facilitators. Building owners need to understand the opportunities that demand response presents and the low risk nature of participation in terms of its impact on building operation. Ensuring that ESCOs and EPC facilitators understand the opportunities presented by demand response could accelerate its uptake among building owners.

- **Support and facilitate further research into new demand response (DR) technologies:** The EU, National Governments and research institutions should provide resources to facilitate and incubate further research into future technologies and business models to transform the energy sector. This could include: investigating new business models (such as NOVICE) to drive uptake of demand response; investigating technologies to enable the transition to a local, decentralised energy network; and investigating how blockchain can be applied to the energy sector.

1 INTRODUCTION

1.1 NOVICE IN BRIEF

The NOVICE project aims to develop a new business model for integrating demand response services into energy efficiency projects. It builds on the Energy Performance Contracting business model for implementing energy efficiency projects and provides a new contracting agreement between the Energy Services Company (ESCO) and the aggregators providing demand response services. The NOVICE model intends to make better use of the end-user's assets and to offer them more saving opportunities, while providing much needed flexibility to the grid to accommodate for the evolving needs of the energy market.

1.2 OBJECTIVES

From research carried out under Work Package 3 of the NOVICE project, the NOVICE approach can only be successfully deployed in countries that have both a mature ESCO market and a mature demand response market. Lack of one or the other prevents the use of EPC as a vehicle for combining revenue streams from energy efficiency and demand response to improve the business case for building refurbishment projects. The differing levels of market maturing across EU Member states is currently limiting the potential for roll out of the NOVICE model. The objectives of this report are therefore to:

- Review and understand current policies at European level that are driving the maturity of the ESCO and demand response markets;
- Review policies and regulations in a sample of countries to understand which policies have contributed to market growth in countries exhibiting high levels of market maturity and which policies have had little impact to date;
- Identify common barriers to the growth of the ESCO and demand response markets;
- Make recommendations and propose guidelines that policy makers can use to develop or reform policies and regulations that govern the ESCO and demand response markets in ways that will accelerate market maturity.

1.3 METHODOLOGY

In order to provide an overview of the current state of ESCO & demand response policy and regulatory enablers and barriers across Europe, several resources from industry, academia, EU Commission and National Governments were used. A comprehensive list of all resources is included in the references section. Two of the principal reports used give a comprehensive and unbiased overview of the ESCO and demand response industries in Europe;

1. "Explicit demand response in Europe – Mapping the Markets 2017"
2. "Energy Service Companies in EU – Status review and recommendations for further market development with a focus on Energy Performance Contracting".

An existing mechanism, namely the EU Energy Efficiency Directive, was reviewed in terms of its suitability to support the implementation of the dual energy services scheme. In addition, a questionnaire was sent to a global multinational company with a significant footprint in Europe, to get a sample of feedback on the effectiveness of the EU Energy Efficiency Directive on the ground; this

was also used to determine the awareness of ESCO and demand response services available to the company locally.

A study into the application of a key future trend in technology and financial management, blockchain, was reviewed to determine the applicability and applicable regulatory landscape.

2 CURRENT POLICIES

2.1 EXISTING POLICIES AT EUROPEAN LEVEL

Energy policy and legislation is driven by the Clean Energy for all Europeans package, which consists of eight legislative acts as part of the EU's implementation of the Energy Union Strategy, adopted in 2015, which was in itself, the EU response to its Paris Agreement commitments. The Paris Agreement, adopted at the Paris Climate Conference of Parties, COP21 in December 2015, is a legally binding global climate agreement between almost 190 parties, to limit global warming to below 2 degrees ("European Commission / Paris Agreement,"). According to the European Commission, the vision for the Energy Union is of an Energy Union with citizens at its core, where citizens take ownership of the energy transition, benefit from new technologies to reduce their bills, participate actively in the market, and where vulnerable consumers are protected (European Commision, 2015).

The Energy Union strategy is based on the five dimensions as follows:

- Energy security, solidarity and trust;
- A fully integrated European energy market;
- Energy efficiency contributing to moderation of demand;
- Decarbonising the economy;
- Research, Innovation and Competitiveness.

"The goal of a resilient Energy Union with an ambitious climate policy at its core is to give EU consumers - households and businesses - secure, sustainable, competitive and affordable energy. Achieving this goal will require a fundamental transformation of Europe's energy system." (European Commision, 2015).

The implementation of the Energy Union, via the Clean Energy for all Europeans package is composed primarily of:

- a revamped Energy Efficiency Directive (EED) that sets a new, higher target of reducing energy consumption through improvements to energy efficiency by 32.5% by 2030
- the new Energy Performance of Buildings Directive (EPBD) which aims to maximize the energy saving potential of smarter and greener buildings.
- an ambitious new target of at least 32% renewable energy by 2030, with specific provisions to foster public and private investment, in order for the EU to maintain its global leadership on renewables.
- a new energy rulebook under which each Member State must draft a National Energy and Climate Plans (NECPs) for 2021-2030 setting out how to achieve their energy union targets, and in particular the 2030 targets on energy efficiency and renewable energy.
- more rights for consumers by making it easier for individuals to produce, store or sell their own energy, and strengthening consumer rights with more transparency on bills, and greater choice flexibility.
- a smarter and more efficient electricity market with new laws that will increase security of supply by helping integrate renewables into the grid, manage the associated risks, and improving cross-border cooperation. (European Commission, 2019b)

The eight legislative measures that form the Clean Energy Package are as follows:

1. Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December 2018 amending Directive 2012/27/EU on Energy Efficiency

2. Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the Energy Performance of Buildings and Directive 2012/27/EU on Energy Efficiency

3. Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the Promotion of the Use of Energy from Renewable Sources

4. Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council

5. Regulation (EU) 2019/941 of the European Parliament and of the Council of 5 June 2019 on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC

6. Regulation (EU) 2019/942 of the European Parliament and of the Council of 5 June 2019 establishing a European Union Agency for the Cooperation of Energy Regulators

7. Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the Internal Market for Electricity

8. Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the Internal Market for Electricity and amending Directive 2012/27/EU

The first directive on the list above is Directive (EU) 2018/2002 on Energy Efficiency, which is an amendment of Directive 2012/27/EU on Energy Efficiency. This is particularly relevant to the NOVICE project due to its focus on energy efficiency in itself, and with respect to supply-side and demand-side of energy markets. It describes itself as follows:

> *Directive 2012/27/EU of the European Parliament and of the Council (5) is an element to progress towards the Energy Union, under which energy efficiency is to be treated as an energy source in its own right. The energy efficiency first principle should be taken into account when setting new rules for the supply side and other policy areas. The Commission should ensure that energy efficiency and demand-side response can compete on equal terms with generation capacity. Energy efficiency needs to be considered whenever decisions relating to planning the energy system or to financing are taken. Energy efficiency improvements need to be made whenever they are more cost-effective than equivalent supply-side solutions. This ought to help exploit the multiple benefits of energy efficiency for the Union, in particular for citizens and businesses. (Text Extracted directly from the Directive)*

The second directive listed (2018/844) the EPBD aims to improve the energy performance of buildings through the use of energy assessment procedures, energy certification of buildings, and increases in the minimum standards for energy efficient in national building regulations when transposed.

The third one listed, (2018/2001), the Directive on the promotion of the use of energy from renewable sources sets targets for the percentage of renewable energy as a part of the overall consumption of EU member states. Increasing the level of renewables such as wind and solar, which are intermittent in nature, can create imbalances in the grid, and challenges for transmission operators. One approach to alleviate this is to develop market solutions to allow for flexible consumption and storage, including the demand response model proposed by the NOVICE project.

The fourth Directive listed above, (2018/1999), relates to the governance of the overall energy union and EU actions towards climate change efforts between now and the end of the 2050 target period. These directives are not directly relevant to business model development in the area of energy services.

The remaining four legislative instruments refer to new electricity regulations in terms of electricity market design, risk preparedness and outlining a stronger role for the Agency for the Cooperation of Energy Regulators (ACER). The adoption process for all eight elements of the Clean Energy Package is outlined in the following table (European Commission, 2019a):

Table 1: Legislative Adoption Process (European Commission, 2019a)

Legislative Instrument	**European Commission Proposal**	**EU Inter-Institutional Negotiations**	**European Parliament Adoption**	**Council Adoption**	**Official Journal Publication**
Energy Performance in Buildings	30/11/2016	Political Agreement	17/04/2018	15/05/2018	19/06/2019- Directive (EU) 2018/844
Renewable Energy	30/11/2016	Political Agreement	13/11/2018	04/12/2018	21/12/2018 – Directive (EU) 2018/2001
Energy Efficiency	30/11/2016	Political Agreement	13/11/2018	04/12/2018	21/12/2018 – Directive (EU) 2018/2002
Governance of the Energy Union	30/11/2016	Political Agreement	13/11/2018	04/12/2018	21/12/2018 – Regulation (EU) 2018/1999
Electricity Regulation	30/11/2016	Political Agreement	26/03/2019	22/05/2019	14/06/2019 – Regulation (EU) 2019/943
Electricity Directive	30/11/2016	Political Agreement	26/03/2019	22/05/2019	14/06/2019 – Directive (EU) 2019/944
Risk Preparedness	30/11/2016	Political Agreement	26/03/2019	22/05/2019	14/06/2019 – Regulation (EU), 2019/941
ACER	30/11/2016	Political Agreement	26/03/2019	22/05/2019	14/06/2019 – Regulation (EU) 2019/942

2.2 SAMPLE EU MEMBER STATE ANALYSIS

Four member states have been chosen for analysis as part of this deliverable. At the time of writing, all four of the sample EU member states, Ireland, the UK, Spain and Italy, were still within the EU. While the UK is now in the Brexit transition period moving towards a full exit from the EU, it remains included in this report because its current energy policy and legislation remains as it was as a member of the EU. For example, for now, Brexit does not mean any change to the UK's statutory commitments to reducing greenhouse gas emissions under its Climate Change Act for example.

In almost all EU Member States, ESCO markets grew between 2010 and 2013, with the strongest growth experienced in Denmark, France, Ireland and Spain (Bertoldi & Boza-Kiss, 2017). However, this is not to say that the ESCO markets in Ireland and Spain are now necessarily mature. According to the IEA (International Energy Agency, 2019a), the ESCO market in Ireland has not taken off as expected, and there is still plenty scope for capacity building.

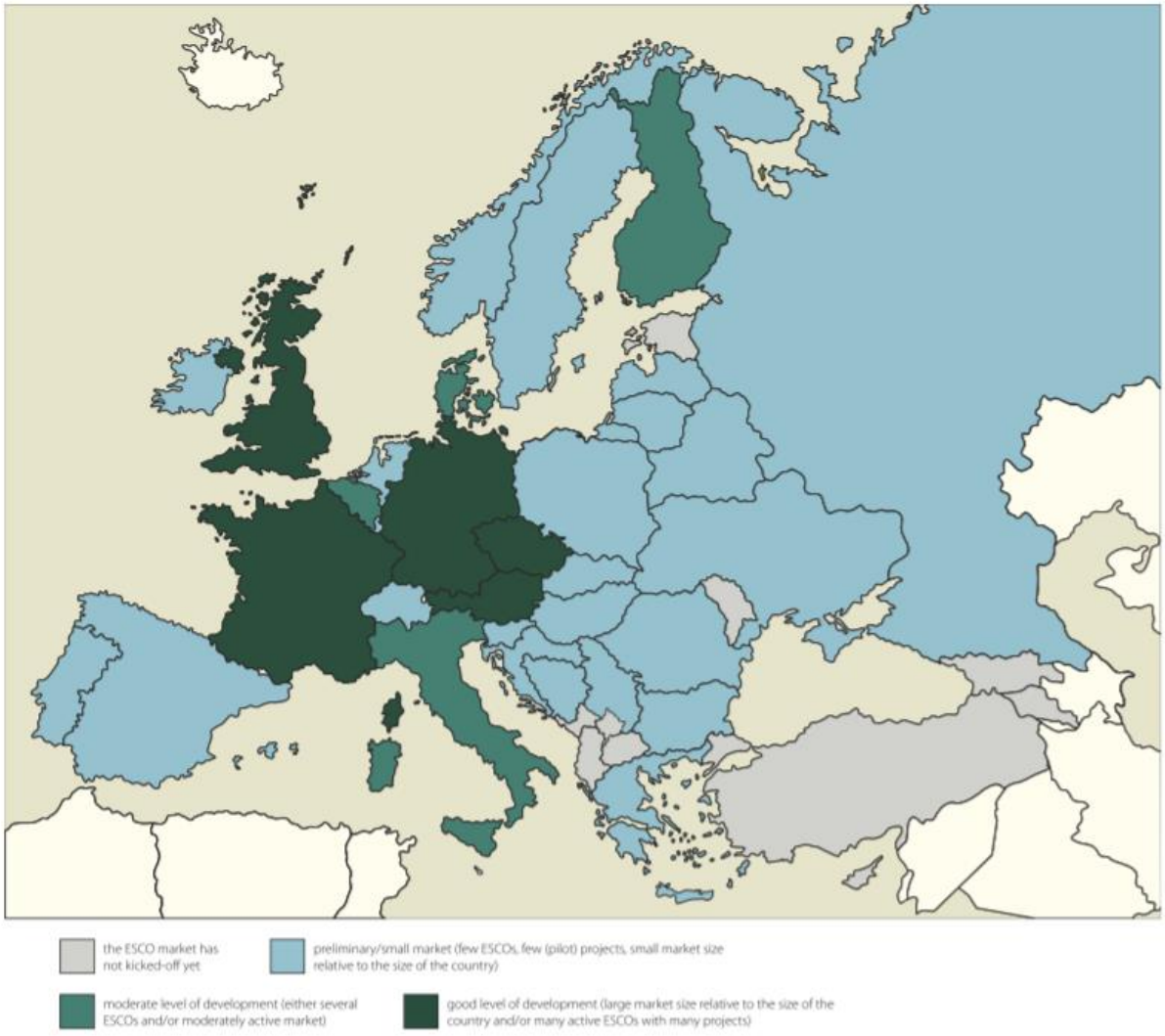

Figure 1: Level of Development of National ESCO Markets in 2013 (Bertoldi & Kiss, 2017:348)

2.2.1 Ireland

Energy policy and legislation in Ireland is currently led by the Department of Communications, Climate Action and the Environment (hereafter DCCAE), previously known as the Department of Communications, Energy and Natural Resources, and with the Climate Action and Environment briefs

having been transferred to it from the Department of Environment, Community and Local Government in 2016. The Sustainable Energy Authority of Ireland (SEAI) formerly SEI, was established as Ireland's national energy authority under the Sustainable Energy Act 2002. SEAI's role is to deliver on sustainable energy programmes for the Irish Government, such as grant schemes for installation of renewables, administration of the Building Energy Rating Certification scheme, and implementing programmes for conducting energy research, and providing policy guidance on energy matters.

Ireland launched its first ever National Energy Efficiency Fund in March 2014. The fund was intended to act as a catalyst to develop energy efficiency projects in the Irish Market. The fund provided finance to two main types of energy efficiency projects in public and commercial sectors: Energy Performance Contracts (EPCs) where funding was loaned to an Energy Services Company (ESCO); and direct lending to the client company (Department of Communications Climate Action & the Environment (DCCAE), 2019). Unfortunately, only 3 projects were funded under this scheme and a large proportion of the budget remained unspent so the fund was closed in 2018 and has been replaced by the Climate Action Fund (CAF). The CAF funds large energy infrastructure projects that improve energy efficiency and reduce carbon emissions but no longer specifically focusses on supporting EPCs or loan based financing.

2.2.1.1 Irish ESCO market

The government in Ireland has been actively engaged in enabling an ESCO market over a number of years. This has been driven through a campaign of conferences, workshops and guidance content. The government set up the National Energy Services Framework, which is the key platform for helping to develop projects, support with finance and establishing energy performance contracting (EPC) projects both within the public and private sectors (Boza-Kiss et al., 2017b). The National Energy Services Framework is facilitated and run by the Sustainable Energy Authority of Ireland (SEAI), which is the government body responsible for driving the sustainable energy agenda in Ireland. The SEAI regularly disseminate clear guidance on energy efficiency services, hosting workshops and supporting project owners from initial project scoping, partnering with suitable contractors, supporting project management, providing grant finance or financial advice, project delivery and measurement & verification. The SEAI have a number of panels where ESCOs are pre-qualified based on their different competencies and then partnered with suitable project owners. This support gives businesses and public-sector bodies confidence and trust in the process. Financial support is another key enabler to getting ESCO and EPC projects off the ground. An example of a very effective grant support from SEAI is a programme called EXEED (Excellence in Energy Efficiency Design), where up to 30% of the capital investment is available and up to 50% of the cost of ESCO professional services. This level of financial support is a key accelerator, particularly for companies or public bodies who have limited capital available to invest in energy efficiency.

There are presently a number of successful ESCOs in the Irish market, with a real opportunity to scale up market penetration (Bertoldi, Boza-Kiss, Panev, & Labanca, 2014). However, the Irish ESCO market is in an early stage of development when compared to other European countries, and the main barriers remain the lack of trust and lack of understanding of the contracting model.

In the Climate Action Plan 2019 (Government of Ireland, 2019b), the Irish government sets out a plan for all the energy sectors to achieve the 2030 targets drawn by the UN Sustainable Development Goals. With respect to the ESCO market, a specific action list was developed to remove the barriers to the up-take of EPCs (Figure 2).

The Irish Government recognises the ESCO model as a key way to contribute towards the 2030 energy efficiency targets. It makes sense to enable ESCOs in both the public and private sectors. The

government has had to overcome the typical barriers for ESCO market uptake i.e. trust, contract understanding, transparent M&V, education & awareness, project support and especially financing.

Action 68: Support the wider deployment and use of EPCs by building capacity and expertise in the public sector			
Steps Necessary for Delivery	**Timeline by Quarter**	**Lead**	**Other Key Stakeholders**
SEAI will continue to promote awareness and understanding of EPC, and provide Project Assistance Grants, training and other supports to public and private sector organisations to implement EPC projects	Ongoing	SEAI	
Instigate analysis of the further potential for EPC to deliver energy efficiency projects in the Irish Public Sector as part of the EU structural fund (SRSS) support study	Q2 2019	DPER	DCCAE, SEAI
Highlight more widely the potential of EPC and resources already in place to help PSBs to help public bodies identify opportunities for its appropriate use (e.g. guidance, standardised forms of contract and project assistance grants); examples of where EPC is being used effectively.	Q4 2019	SEAI D/EPO	D/EPO
Develop and deliver EPC facilitator training	Q2 2020	SEAI	AIEA (Association of Irish Energy Agencies)
Facilitate PSBs and sectors, as part of their energy efficiency improvement plans, to develop, embed or access, the competencies and resources needed to avail of EPC, (whether centralised EPC expertise or dispersed/tailored approaches)	Q2 2020	SEAI	
Develop procurement frameworks as required to facilitate more cost effective and efficient procurement of ESCO (Energy Service Companies) services	Q4 2020	OGP	SEAI
Consider the findings of the (SRSS) study and develop Recommendations for PS Bodies which clarify (from a DPER perspective) the role of EPC in PS energy efficiency projects and sectors, including the on/off Government Balance Sheet consideration, and where it can and/or should be used for delivering the project investment pipeline needed to achieve the 2030 target.	Q4 2020	DPER	DCCAE

Figure 2: Irish Climate Action Plan 2019 - Action 68 (Government of Ireland, 2019: 41)

2.2.1.2 Irish Demand Response market

In May in 2011 the regulators in Ireland and Northern Ireland worked with all relevant stakeholders to develop a roadmap for demand response, named “Demand Side Vision for 2020”. The report was developed as regulators and the different stakeholders involved all recognised “the potential which demand side management has to deliver significant economic and environmental benefits to the All-Island market” (EirGrid, 2013). The creation of “Demand Side Vision for 2020” helped to identify many key barriers for effective demand response, as well as methods for removing the barriers to promote an effective demand side participation across the country.

This is an important action that displays cross-border cooperation of energy regulators. Regulation (EC) No 713/2009 (and subsequent amendments to No 2019/842) is one of the eight regulatory

components of the Clean Energy Package, which established the Agency for the Cooperation of Energy Regulation (ACER) to improve coordination on cross-border issues. In light of Brexit, it is all the more relevant that cross-border work that takes an All-Island approach to electricity in Ireland is being carried out, as Member States (and future non-member states like the UK), can have a tangible positive, or negative, effect on the energy markets of their neighbours, supply and demand.

Furthermore, Directive (EU) 2019/944 on common rules for the internal market of electricity, aims to deliver real choice for all Union final customers, citizens and businesses by organising a competitive electricity market across country borders. The Commission Communication of 15 July 2015, entitled 'Delivering a New Deal for Energy Consumers', put forward the Commission's vision for a retail market that they say better serves energy consumers, including by better linking wholesale and retail markets. Directive 2019/944 also states that Member States should foster the integration of their national markets and cooperation among system operators at Union and regional level, that consumers have an essential role to play in achieving the flexibility necessary to adapt the electricity system to variable and distributed renewable electricity generation, and that in order to foster competition and ensure the supply of electricity at the most competitive price, Member States and regulatory authorities should facilitate cross-border access for new suppliers of electricity from different energy sources as well as for new providers of generation, energy storage and demand response.

The roadmap developed from the Demand Side Vision for 2020 (Commission for Energy Regulation Utility Regulator Electricity Gas Water, 2011) was a catalyst for EirGrid to develop the DS3 programme; Delivering a Secure, Sustainable Electricity System (EirGrid, Single Electricity Market Operator, & SONI, 2014). EirGrid plc is the state-owned electric power transmission operator in Ireland. The Irish government recognised that enabling demand response would play an important role in decarbonising the energy generation mix in Ireland and help to achieve the national target of 16% of the country's total energy consumption to come from renewable energy sources by 2020. In order to achieve this, a sub-target was set for 40% of electricity generation to come from renewable sources (EirGrid et al., 2014). The pathways to reaching these targets are set out in the National Renewable Energy Action Plan (NREAP).

In December 2018, Ireland drafted its National Energy and Climate Plan (NECP) for 2021-2030, as a response to the Clean Energy for all Europeans package. The final versions of the NECPs were set to be published by the end of 2019. However, in March 2020 Ireland's final NECP was still not published. In the draft version, the Irish government set a target for renewables to generate 55% of the country's electricity supply by 2030 (Government of Ireland, 2018).

To help achieve these targets, the DS3 programme is split into 3 pillars as shown in Figure 3.

Figure 3: The three pillars of the DS3 program (EirGrid, 2014: 6)

Considering the broad scope of the DS3 programme, it was essential that all stakeholders and customer representatives were involved early on to ensure its success (EirGrid et al., 2014). A key goal of the DS3 programme is to ensure the development of a long-term operational policy for a full market penetration of demand response. It is perceived due to its flexibility that demand response will help to facilitate the management of more renewable energy generation (EirGrid et al., 2014). As the demand response market is developing in Ireland, there are demand response trials for 1 MW as opposed to 4 MW, which will enable more players to enter the market in 2018; though aggregation is allowed, the minimum bid size is 4 MW for Demand Side Units (DSUs) (EirGrid, 2016).

A decision was taken in September 2018 by the Single Electricity Market Committee to split the DS3 programme into two separate procurement streams – Volume Capped and Volume Uncapped Contracts (Single Electricity Market Committee, 2018). This approach has enabled EirGrid and SONI to increase the maximum levels of renewable generation that may be accommodated on the Irish grid from 50% to 65%, with the ultimate target being 75%.

The DS3 Volume Capped Contracts include the Fast Frequency Response and Tertiary Operating Reserve Services. The procurement of these contracts is divided into two stages. Following the conclusion of the Pre-Qualification Process, the tender process began in early June 2019 and the contracts are to be awarded on a fixed term basis for a maximum period of six years with final contract signing due to take place on 1 September 2019.

The Volume Uncapped procurement process relates to a separate range of technical system services (fourteen types are being procured) and is open to any party seeking to provide one of the relevant services. The contracts are given for a period of five years and the procurement process involves a qualification system which runs until April 2023. Tenderers have repeated opportunities (every six months) to apply for Volume Uncapped Contracts, under an iterative gate process.

The demand response market in Ireland is reasonably well developed. This has resulted from the effective Demand Side Vision for 2020 roadmap published in 2011 which highlighted the opportunities and barriers to demand response. This was used as a foundation input to the effective DS3 programme, which strategically enabled demand response as a mechanism to further mobilise renewables generation due to its inherent flexibility. A key success factor for the demand response market in Ireland is the engagement and involvement of all relevant stakeholders from the outset.

Due to the complex nature of energy markets, it is important to have medium to long term plans to develop and implement an effective demand response market. With this regard, the Roadmap for the Clean Energy Package's Electricity and Renewables Directives (Commision for Regulation of Utilities, 2020) was published in March 2020. The Commission for Regulation of Utilities (CRU) has been charged with the remit of two pieces of legislation in Ireland:

- Regulation on the internal market for electricity (EU) 2019/943 (under remit of the CRU and the Utility Regulator in Northern Ireland)
- Directive on common rules for internal market for electricity (EU) 2019/944

Taking into consideration requirements from the Irish Climate Action Plan (Government of Ireland, 2019a) and the Renewables Directive 2018/2011, CRU has published a detailed plan of Action of transposing the Directive. This plan of action shows the short term goals for achieving an effective demand response market in Ireland. The main points of action are relating to updates to retail markets, prosumer development involving the roles of the distribution system operators (DSOs) and transmission system operators (TSOs).

In its report on the National Energy Projection 2019 (Sustainable Energy Authority of Ireland, 2019), the Sustainable Energy Authority Ireland suggested some policy measures that could help to meet the Government's increased targets. Among them, the following measures are proposed to help the acceleration of the demand response market:

- Creating markets for grid services such as energy storage and other services supporting high levels of renewables on-grid.
- Establishing corporate power purchase agreements mechanisms with mandated minimum renewable energy purchases or self-generation for large electricity demand users to leverage private investments in renewable electricity.
- Encouraging prosumers by consideration of communication methods, market mechanisms, market rules, frameworks and setting a price for export to the grid from point source generation, in line with the ambitions outlined in the Clean Energy Package.
- Developing community energy and small-scale renewable generation projects to enable a shift to a more distributed generation system with demand response capabilities

2.2.2 UK

Energy policy and legislation in the UK is now led by the Department of Business, Energy and Industrial Strategy (BEIS). The department was created in 2016 as a merger of the Department of Energy and Climate Change, and the Department of Business, Innovation and Skills. They work closely with the Department of Environment, Food and Rural Affairs (DEFRA), which is in charge of environmental policy and regulation. BEIS and DEFRA work together to ensure specific government policies on low-carbon energy and decarbonisation measures are sustainable and in line with DEFRAs environmental objectives. The devolved governments of Northern Ireland, Scotland and Wales work on the more specific and localised elements of such policies and regulations. For example, Building Regulations,

which include provisions for the conservation of fuel and energy in buildings (residential and commercial) differ for England, Scotland, Wales and Northern Ireland.

In 2008 the UK Government passed the Climate Change Act which put in place legally binding targets to ensure that the UK's net carbon emissions are reduced. Originally the Act required a reduction in carbon emissions of 80% by 2050 compared to a 1990 baseline but this was increased to 100% reduction, (net zero), by 2050 on the advice on the Committee on Climate Change (an independent body of experts set up to assess the evidence and monitor progress towards targets) in 2019. Under the Act, the UK Government must set 'carbon budgets' which caps the level of emissions in each 5-year period since the Act came into effect and sets evidence-based targets on cost effective emission reduction in period.

In October 2017 the UK Government published its Clean Growth Strategy, which outlined its proposals for continuing to deliver increased economic growth whilst reducing carbon emissions as per the requirements under the Climate Change Act. The strategy includes measures to increase the use of renewable energy in electricity, heating, and transport. The Clean Growth Strategy includes a commitment to expand renewable energy capacity so that it can meet 50% of UK electricity demand by 2032 (International Energy Agency, 2019b). In its review (Committee on Climate Change, 2018), the Committee on Climate Change (CCC) acknowledged the Government's strong ambition but identified a gap in the ability to meet the fourth and fifth carbon budgets which cover the period 2023 to 2032. In short, the CCC recommended urgent policy development to address this gap.

2.2.2.1 UK ESCO Market

Despite the decision to leave the European Union, the UK Government has nevertheless developed a draft National Energy and Carbon Plan (NECP) outlining its strategy to meet the EU wide targets on energy efficiency and carbon reduction (Department for Business Energy & Industrial Startegy, 2019). The plan includes a description of the UK's strategy for promoting energy services and removal of the barriers that impede the uptake of energy performance contracting. The strategy involves building on the market that already exists in the UK by:

- supporting public sector bodies in England to access energy services via existing procurement frameworks and revolving loan schemes.
- publishing the standard EPC recommended by the Government for public sector use, including notes on best practice.

The aim of these actions is to reduce the transactional costs associated with procuring an EPC by prequalifying ESCOs through a standard procurement framework and using standardised contracts to avoid lengthy legal discussions on the details and content of performance based contracts. To date, a final version of the NECP has not been submitted by the UK.

A study carried out by Navigant Research on the size and growth potential of the UK energy efficiency services market found that the UK market was worth around £349m in 2017 (Department for Business Energy & Industrial Startegy, 2018). In comparison to other countries with similarly sized economies this is relatively small and shows that there is still huge potential for growth. The sector has been mainly driven by public sector procurement frameworks (such as the Re-Fit Framework) that make use of a standardised EPCs and prequalified frameworks of ESCOs to reduce the transactional costs of EPC procurement for public sector bodies. Annual market growth is currently estimated at around 7%, but would need to accelerate to 20% per year if the UK energy efficiency services market is to play a significant role in achieving the UK's targets under the Clean Growth Strategy.

The Navigant Research study also identified a number of barriers that are preventing the growth of the energy efficiency service market through surveys with key stakeholders. The main barriers identified include the following:

- Energy efficiency is a low priority for most businesses and not a factor that is taken into consideration by most business decision makers. This can prevent potential clients from engaging with the energy services sector and this was highlighted as one of the main barriers to growth of the ESCO market.
- Clients lack trust in energy services as a viable solution and therefore hesitate to invest unless they trust the particular service provider with whom they are working.
- The length of time needed to procure an EPC and the high transactional costs associated with the process prevent ESCOs from working with smaller organisations.

Any new policy developed in this area should therefore focus on actions that help to overcome these barriers.

2.2.2.2 UK Demand response market

The UK already has one of the most advanced and open demand response markets in Europe. Almost all ancillary services programmes are open to demand side response and aggregated loads, and the capacity mechanism allows the participation of demand side resources. In the early stages regulations governing the participation in these programmes were heavily weighted towards energy generators rather than demand side response units, but this is changing after a process of consultation between BEIS, Ofgem, the TSO (National Grid) and key market stakeholders. As a result, there are more opportunities available now for smaller sites to be involved in various markets which has boosted the number of aggregators in the market.

The UK's NECP states that it is the UK Government's aim to: "remove the barriers to smart technologies including storage; enable smart homes and businesses; and make electricity markets work towards flexibility." The detailed plan for achieving this is recorded in a report published by BEIS and Ofgem in 2017 which outlines 29 actions that must be taken by Government, Ofgem and industry to enable this transition to take place. By the end of 2019, (at the time of publication of the draft NECP), 15 of the 29 actions were already implemented or in progress, with the remaining actions planned for completion by 2022. The ultimate goal is to unlock £17-40 billion worth of savings in the system by 2050 (Department for Business Energy & Industrial Startegy, 2019).

Whilst the changes that are taking place in the UK energy system are positive as they allow more sites and assets to participate in demand response programmes which ultimately improves system flexibility, it has meant that there is a great deal of uncertainty in the sector. Prices offered by the TSO for various grid services have changed dramatically year on year, making it difficult for aggregators to predict revenues for their clients with any certainty. This state of constant change is likely to continue for some time until all the action plan points are implemented but ultimately it is hoped that the resulting energy system will be able to cope with the demands of increased capacity on the grid due to the electrification of heat and transport and the greater need for flexibility to cope with the intermittency of renewables on the grid.

2.2.3 Italy

Italy is organised into 20 Regions, including four autonomous Regions and two autonomous Provinces, all of which are part of the constitutional structure of the country. The Ministry of Economic Development (MSE, Ministero dello Sviluppo Economico) is the ministry responsible for formulating and implementing Italy's energy policy. The Ministry for the Environment, Land and Sea (MATTM,

Ministero dell'Ambiente e della Tutela del Territorio e del Mare) has responsibility for co-ordinating climate policy issues. It also co-signs policy measures promoting renewable energy and energy efficiency with the MSE. The Inter-Ministerial Committee for Economic Planning (CIPE) is a collective governmental body chaired by the President of the Council of Ministers responsible for the co-ordination and horizontal integration of national policies. Its competences, among many others, include climate change. The committee approves national GHG emissions reduction programmes (International Energy Agency, 2016) .

Italy drew up its National Energy Efficiency Action Plan (NEEAP) in 2010, and in 2013, adopted the National Energy Strategy (NES). Prior to that, the regions and autonomous provinces developed their own Regional Energy-Environment Plans, which established regional energy policy objectives on GHG emissions (International Energy Agency, 2016). The new NES defines objectives, key policies and priority measures for the energy sector. The measures defined in the new Strategy, which has both medium- and long-term elements (2020 and 2050), aim at fostering sustainable growth by strengthening the competitiveness of the Italian economy. The Strategy also recognises that the consequences of climate change must also be addressed while granting secure and accessible energy to all citizens (International Energy Agency, 2016). In Italy Legislative Decree 115/2008 was the most relevant legislation for ESCOs. It defined ESCOs, Energy Service Contracts, and Energy Service Plus Contracts (Bertoldi & Boza-Kiss, 2017).

2.2.3.1 Italian ESCO market

In Italy the ESCO market is regarded as one of the biggest and most developed in Europe (Bertoldi et al., 2014). EPC and ESCO projects have been established for many decades, so the markets are mature and well developed. A key driver of the ESCO market in Italy was the introduction of the White Certificates scheme, which is a way to certify the implementation of energy efficiency measures in both the public and private sectors (Boza-Kiss et al., 2017b).

The White Certificate System is an Energy Efficiency Obligation scheme, which is the main tool adopted in Italy in order to promote energy efficiency and accomplish the targets of the 2012/27 EU Directive.

The White Certificates scheme enabled ESCOs to increase their market and generation of revenues from projects, as well as encouraging new players to enter the market. The scheme was put in place in 2001 and requires energy service providers with greater than 50,000 customers to achieve a defined level of energy savings each year or face a financial penalty (Boza-Kiss et al., 2017b). White Certificates are tradeable between energy service providers, whereby energy service companies who exceed their annual savings targets can trade their White Certificates with companies who have fallen short of their targets (Pela, 2014). The Italian government provides financial incentives and makes €800 million available for energy efficiency projects across both the public and private sectors.

Also in its National Energy and Climate Plan (Government of Italy, 2019), the Italian government discusses the intention to continue to simplify access to the scheme for public bodies, also through promotion of the ESCO model and the use of EPCs. Article 14(4) of Italian Legislative Decree 102/2014, transposing the Energy Efficiency Directive, ensured the improvement of the EPC contractual model by specifying the minimum elements that must be included in the energy performance contracts agreed with the public sector. As a result, the government agency ENEA has prepared a document entitled “Guidelines for Energy Performance Contracts (EPC)” which is currently being distributed across Italy. A major barrier for the widespread use of EPCs is the regulatory uncertainty about its legal classification which, in the absence of legislative characterisation, opens itself up to multiple interpretations. To this end, the Italian government plans to introduce into the Italian Code of Public Contracts (Legislative Decree 50/2016 as amended and supplemented), the definition of the EPC for

buildings as a special contract. These will include mandatory savings clauses, as well as legal obligations relating to energy efficiency, sanction and reward systems. Some other key measures that are planned, include structuring and monitoring the process for the qualification of ESCO workers, simplifying the authorisation process for access to incentive schemes and improving control activities in relation to standards and regulations.

In markets where ESCOs are not as well known or developed, education and awareness is normally a key barrier to an effective ESCO market. Italy has already undertaken significant amount of education and awareness work in the past and the ESCO market is now thriving, which demonstrates the importance of disseminating information in stimulating markets. The main barrier to furthering ESCO market maturity in Italy is general political uncertainty relating to the general government and overall political stability (Boza-Kiss et al., 2017b).

2.2.3.2 Italian Demand Response market

The Italian government has announced in its National Energy and Climate Plan (Government of Italy, 2019) that they are planning to "accelerate the transition from traditional fuels to renewable sources, by promoting the gradual phasing out of coal for electricity generation in favour of an electricity mix based on a growing share of renewables and, for the remainder, gas". The closure of coal plants is announced to happen by the end of 2025. In order to secure the supply of electricity, a market-wide capacity mechanism was launched at the end of 2019. Italy will only allow participation in the auction for those capacity provider that comply with CO_2 emission limits that are prescribed in the Electricity Regulation(European Parliament and the Council, 2019). Even though under the regulation, Member States can decide to only apply those limits as of 2025, Italy has decided to impose them right away. The CO_2 emission limits will prevent high-emission electricity generation, such as coal-fired power plants, from participating in the Italian capacity mechanism. In order to ensure that the mechanism remains competitive, Italy will apply several measures that ensure the polluting coal power plants are gradually replaced by greener generation capacity and other technologies, such as demand response and storage(European Commission, 2019c).

Evidence from other EU Member States illustrates a coordinated effort with clear guidance from the regulators and input from all stakeholders will most likely enable a functional demand response market. The European Commission found that Italy had clearly identified and quantified the security of supply risks and that the mechanism was well designed to mitigate such risks, while ensuring the it remains competitive.

2.2.4 Spain

While Spain is a Constitutional Monarchy, its rule is relatively decentralised. Spain consists of 17 autonomous regions, each with its own parliament, and each with its own responsibility for energy within their region (with some exceptions such as power plants of over 50MW). Spain's Ministry of Industry, Energy and Tourism leads energy policy formulation. Within the ministry, the responsible body is the State Secretariat for Energy whose main responsibilities include: issuing regulations concerning energy and mining matters; legislation on the tariff structure, prices of energy products, and levies and tolls; legislation to save energy, promote renewable energy and support new energy and mining technologies; legislation and, if needed, adoption of measures to ensure energy supply (International Energy Agency, 2015). The ministry is supported by several bodies including the Institute of Energy Diversification and Saving (IDEA), The Strategic Reserves Corporation (CORES), and the Institute for Restructuring and Alternative Development of Coal Mining Regions (IRHC) (International Energy Agency, 2015).

Spain also has an independent organisation that ensures fair competition and regulates markets and all productive sectors of the Spanish economy, including regulation of the gas and energy sectors, the National Commission of Markets and Competition (CNMC). The CNMC is financed from electricity and natural gas tariffs and a levy on the wholesale of oil. The Ministry of Agriculture, Food and Environment is responsible for several energy-related policies, such as air pollution and climate change. The Ministry of Economy and Competitiveness is in charge of Spain's research and development (R&D) policy. The Ministry of Public Works and Transport covers the development of transport infrastructure and is in charge of managing transport demand (International Energy Agency, 2015).

2.2.4.1 Spanish ESCO market

According to JRC's report on energy services, the Spanish market for ESCOs is dominated by small and medium sized enterprises which make up 93% of the 1,238 companies in Spain that identify themselves as ESCOs. This has partly been driven by a number of smaller installers of renewable energy technologies becoming ESCOs in order to be able to offer upfront finance for their clients to improve their competitiveness. Despite the large number of SMEs in the sector, the 7% of ESCOs that are large organisations account for approximately 50% of the market share (Boza-Kiss, Bertoldi, & Economidou, 2017a).

In its draft NECP (Government of Spain, 2019), Spain introduced a number of policies aimed at promoting the growth of the energy services market. In particular, the NECP stated that:

- energy service providers are considered necessary to ensuring that the 2030 energy efficiency targets can be met.
- the recent Eurostat Guidance on off-balance sheet financing removes one of the main barriers to uptake of EPC in Spain by enabling public sector bodies to invest in energy efficient upgrade of their building stock without increasing the public deficit.
- national and regional energy agencies will be responsible for providing new EPC contract templates that take the Eurostat Guidance into consideration.
- the national energy agency will be responsible for investing in energy efficiency measures and recovering the investment through a shared savings model.
- projects funded through the national energy agency will be used as case studies to show case the feasibility of energy services and boost uptake in the private sector.

These measures will help to boost the ESCO market in Spain but do little to remove the main barrier to the growth of the ESCO market – lack of information and lack of awareness of the EPC and energy services business models. Although some information and support schemes are available through the Spanish national energy agency (IDEA), these do not appear to be particularly successful in assisting the growth of the EPC and ESCO market. ESCO activity in Spain appears to be often focussed on delivering contracts that upgrade municipal lighting to LEDs with little growth into other technologies due to a lack of awareness of the benefits among building owners and a lack of successful case studies showing the variety of energy efficiency projects available (Luque et al., 2018).

2.2.4.2 Spanish Demand Response market

The Spanish market for demand response is one of the least mature in Europe. Until now it has relied on hydro power and gas power stations to provide the country's flexibility needs so there has been little incentive to open flexibility markets to demand side response (Smart Energy Demand Coalition, 2017). There is currently only one scheme open to explicit demand response and its design limits participation to large consumers as an emergency action only. As there has never been a need for

additional flexibility, aggregation of demand side loads is not yet legal which prevents any development of this market. The only way for most building owners to participate in demand response at the current time is through implicit demand response since it is common for Spanish electricity tariffs to reflect hourly spot prices on the wholesale market and therefore there is a financial incentive for energy managers to shift consumption away from peak times.

This situation could be set to change in the coming years as Spain's recently submitted draft of its NECP (Government of Spain, 2019) recognises that new mechanisms will be required to stabilise the electricity system as the proportion of renewable electricity increases. The plan states that the 'new figure of the demand aggregator' will be necessary to be able to open additional demand response markets and allow smaller customers to participate. It is envisaged that demand side management will become standard practice for most customers in due course as the prevalence of electric vehicles, battery storage and distributed generation increases. However, the exact policies that are being considered in Spain at this time are unclear from the NECP as are the time frames for implementation.

2.3 GAP ANALYSIS

This section discusses the main policy differences between mature and immature markets from the sample states analyses previously presented.

2.3.1 Demand response markets gap analysis

Some lessons learned from the successful demand response markets in Ireland and United Kingdom are:

- Engagement and involvement of all relevant stakeholders is beneficial, especially if they are included from the beginning of the development of the market.
- Establishing robust power purchase agreement mechanisms that mandate the purchase of renewable energy will drive the need for demand side management and encourage growth of the demand response market.
- Drawing out a plan on how to develop and implement an effective demand response market which outlines the main growth barriers and how they should be addressed will provide some certainty to the sector and encourage new players to enter the market, driving its growth.
- Allowing smaller sites access to the flexibility market leads to an increase in the number of aggregators.
- Ensuring that the regulations governing the flexibility markets do not disproportionately favour generators over demand-side response will drive the market for aggregators and encourage smaller sites to participate.

The Italian demand response market has recently opened at the end of 2019. Even though the market is in the commencement phase, the Italian government has acknowledged that clear guidance from the regulators and input from the stakeholders involved are necessary for an efficient development of the market. They have introduced a regulation where no high CO_2 emitters are allowed to participate in the flexibility market as a way to reduce the greenhouse gases in Italy.

Spain's main barriers to the development of the demand response market are mainly driven by the fact that there was never any need for more flexibility than that provided by the hydro and gas power stations. As a result, the two main barriers are the lack of incentives to open the flexibility market to demand side response and the fact that aggregation is not allowed. However, in its NECP, Spain recognises the necessity of having aggregators to allow for smaller customers to participate in the market.

In conclusion, for countries with an immature demand response market, it is important to draft a plan for implementing a robust demand response market, taking into account the stakeholders, the procurement mechanism and offering clear guidance and regulation. This will offer some certainty to new market entrants and encourage growth of the sector.

2.3.2 ESCO markets gap analysis

The Irish, the UK and the Spanish ESCO markets have faced lack of trust in the energy services and lack of knowledge and understanding around the EPC model. As a result, the Irish government has put in place a framework to help with finance and with the drawing of the EPC contracts. Many events have already taken place focusing on spreading awareness and educating the stakeholders on the technical benefits of the EPC, as well as the financial and contractual implications. The uptake of EPCs in Ireland has been much lower than in other European countries to date, so efforts must continue to convince stakeholders of its benefits. A small number of successful case studies now exist and it is hoped that this will accelerate uptake of EPC as a successful tool for deployment of energy efficiency projects in the public sector.

The success of UK is due in part to the establishment of the procurement framework, the revolving loan schemes for the public sector and the publishing of the standard EPC template and notes on best practices. The UK government has identified additional barriers relating to energy services that forthcoming policies should address. For example, although EPC has been relatively successful in the public sector, it is not commonly used as a tool for energy efficiency in the private sector. This is largely due to the typically long contract duration of EPCs, the low priority nature of energy efficiency for many businesses and the complexity of a typical EPC. To ensure that the benefits of EPC extend into the private sector, action must be taken to promote this as a viable tool for businesses.

In Italy the development of the ESCO market has been triggered by the White Certificates Obligation Scheme. The generation of revenues encouraged new players to join the market and the government has provided incentives to tackle the financial barriers leading to widespread use of EPC in the private sector. The Government has also published a guideline for EPC handbook which specifies the minimum requirements to be included in an EPC. Another important tool for the growth of the market was educating and spreading awareness to the stakeholders. Since a main barrier for the uptake of EPC contracts has been the ambiguity around the legal classification of the EPCs, the Italian government has introduced the definition of the EPCs in the Italian Code of Public Contracts.

The Spanish ESCO market lacks awareness of the main benefits of energy efficiency projects among building owners. The policy makers should therefore concentrate their efforts on raising awareness of the different benefits of EPCs among key stakeholders. At the same time, Spain needs more successful case studies showing the benefits of different technologies.

The countries with immature ESCO markets could therefore benefit from making standard EPC templates publically available, having in place a procurement framework to reduce the complexity and cost of procurement, and developing incentive programmes to assist with financing energy efficiency projects.

3 BARRIERS TO THE GROWTH OF THE ESCO MARKET

3.1 BARRIERS TO GROWTH OF THE ESCO MARKET

The strength of legislation in Europe to support the growth of ESCOs is growing steadily and the introduction of the EU Energy Efficiency Directive (2012/27/EU) played a central role in this (Boza-Kiss et al., 2017a). Regulation (EU) 2019/941 on Risk Preparedness also recognises the transformation of the electricity sector in the EU now characterised by more players, more energy from renewables, and increased interconnectedness of systems. The regulation also aims to prepare for both market and non-market risks to the electricity sector in general including natural disasters, cyberattacks on grids, and extreme heat or cold for example. The barriers that are specific to ESCO markets are well defined and echoed throughout the EU (Boza-Kiss et al., 2017a) and include the following:

- **Information & Awareness:** In many EU Member States there are few recent examples or success stories, demonstrating the advantages of entering into an EPC with an ESCO. This has resulted in a low awareness of the range of possibilities that can be achieved with ESCO services. Without sufficient education or awareness content from government representatives, the end-user is unsure of the certainty of energy efficiency benefits. ESCOs can find it difficult to build trust with the end-user, without additional support in terms of information and awareness from other sources. Although there is a requirement for local and national governments to reduce improve their own energy efficiency, many have not yet embraced EPC as a standard approach. Doing so would create exemplar projects that give confidence to stakeholders whilst also creating a stable pipeline of projects that will help to grow the EPC market.

- **Legislative and accounting:** The legal implications of Energy Performance Contracts (EPCs) can be unclear, particularly when related to public sector projects which are off-balance sheet investments (sometimes known as non-appropriation financing). Off-balance sheet financing is an accounting practice that allows organisations to exclude liabilities such as operating leases and partnerships from its balance sheet. Where the public sector is prohibited from increasing its public debt, off-balance sheet accounting could allow them to participate in EPC's without increasing public debt figures. For example, in an operating lease agreement between an ESCO and a public sector organisation, the ESCO is the owner of the equipment, and while they are renting it to the public sector organisation, this does not appear as an increase in debt by the public sector organisation. The financier, or lessor, the ESCO, retains title/ownership of the equipment. This allows public sector organisations to remain in compliance with debt and deficit thresholds. Often contracts are intensely detailed, confusing and don't appear to be transparent. This results in additional lack of trust in the process and brings into question the likelihood of the desired outcome of achieving the planned energy reductions.

- **Behavioural:** A change in user behaviour can have negative implications for the investor or energy supplier. If the framework conditions are not clearly defined this may change the payback period of the investment

- **Market & external:** External factors can also impact on the viability of energy efficiency services. Low energy costs can extend the payback period for investors, especially on medium to large investments. Energy price volatility creates additional uncertainty in terms of return on investment and may present a business risk. During the economic downturn overall market and growth uncertainty meant energy efficiency investments became less of a priority for many businesses.

- **Financial:** Access to capital is highly competitive both in the public and the private sector. Public authorities often run on extremely tight budgets, while companies (SMEs and large multinationals) often have multiple capital investment requirements. In the private sector energy is often considered a constant and directly proportional to production or service output; this results in energy investment not being a priority and requires additional education and awareness to change this mind set. Grants, tax incentives and affordable investment financing needs to be made available.

- **Technical & administrative:** Technical and administration competence and experience in effective EPCs and ESCOs is a barrier cited by many EU Member States. Quite often this is linked to awareness, where there are limited examples or success stories of ESCOs in practice. Recent research illustrates that ESCO markets were found to be equally impacted or driven by external forces (i.e. energy price, levels of awareness, stakeholder partnerships), as they are by regulation, policy or financial measures (Boza-Kiss et al., 2017b).

3.2 BARRIERS TO GROWTH OF DEMAND RESPONSE MARKET

In comparison to ESCO markets, demand response barriers are not as well defined or are at least not as uniform across EU Member States. This is due to the complex nature of energy networks and regulation requirements across Europe. The directive on Risk Preparedness aims to address crisis and risk management for Europe's interlinked energy markets to maintain security of supply by placing the onus on all member states to take responsibility for security of supply within their own borders, but to also work collectively to ensure security of supply across the EU through a common approach to electricity crisis management.

The purpose of Regulation (EU) 2019/943 on internal markets for electricity (and previous iterations thereof), is to provide final customers, households and business, with safe, secure, sustainable, competitive and affordable energy, which has historically been dominated by a vertically integrated market dominated by monopolies. According to the text of the regulation, in the past, electricity customers were purely passive, often buying electricity at regulated prices which had no direct relation to the market. The regulation further states that in future, customers need to be enabled to fully participate in the market on equal footing with other market participants and need to be empowered to manage their energy consumption.

The EU allowed its Member States to develop and design their energy markets and regulatory frameworks to meet their own national requirements, meaning some markets could be suitable for demand response, though many are not (Torriti, Hassan, & Leach, 2010). Besides the engagement of major energy users in system balancing, the presence of demand response in European electricity markets has been traditionally low. There are several key factors as to why demand response has not been effective in Europe:

- consumers do not have access to real-time pricing information

- regulated retail prices in some EU Member States
- out-dated metering systems
- system operators who are focused more on the supply side of resources (Agence internationale de l'énergie, 2003).

In some EU Member States there is a question over the true potential value of demand response, which is linked to either a lack of awareness or lack of existing success stories (Nolan & O'Malley, 2015).

The Energy Efficiency Directive (2012/27/EU) constituted a significant step towards the development of demand response in Europe. This was a definitive instruction from the EU for all Member States to implement a framework to allow for demand response (Smart Energy Demand Coalition, 2017). A key inclusion in the Directive is Article 15.8, which states that:

"Member States shall ensure that national regulatory authorities encourage demand side resources, such as demand response, to Explicit demand response in Europe. Subject to technical constraints inherent in managing networks" (Smart Energy Demand Coalition, 2017).

Due to their market complexity and subject to their own requirements or technical constraints, EU Member States were not forced to facilitate demand response; rather, they were strongly encouraged to do so. There are relevant legal provisions included in the Energy Efficiency Directive, though the framework is not suitable to cater for a mass uptake in demand response, despite the high potential for demand response within the EU (Van Nuffel & Yearwood, 2017). For Energy Pool, one of Europe's aggregators, demand response is a change of paradigm requiring strong political support. Policy should therefore be concerned with removing market barriers for aggregators and harmonizing market rules between countries (Energy Pool, 2015).

The Smart Energy Demand Coalition have identified four key regulatory criteria required to enable demand response (Smart Energy Demand Coalition, 2017):

1. **Demand Response Access to Markets**

   As a first step, EU Member States are required to authorise demand response in their electricity markets. This foundational step is not fully met by the majority of EU Member States. In some markets only a small number of programmes are open to demand-side resources, while in markets such as Italy or Spain, the market is effectively closed to demand response (Cherrelle, 2015) although this is slowly changing in these countries. To make a significant quantity of demand-side flexibility resources available to the system, TSOs and market operators must open the markets to aggregated load.

2. **Service Providers Access to Markets**

   New players, small and large, need fair access to the market to allow healthy competition with established companies. This will help to offer a range of services to consumers. It is important to enable independent aggregation to foster market competition. Evidence from other markets globally shows consumers require flexibility to be unbundled from the sale of electricity, to result in these services being successful and to enable market growth. The roles and responsibilities of independent aggregators need to be clearly defined. The relationships between retailers, balancing responsible parties (BRPs) and independent aggregators are clear

and fair; encouraging fair competition. The regulatory framework in each EU Member State should be proportionate to the challenges faced by aggregators.

3. **Product Requirements**
   Product offerings need to meet the system needs. Historical requirements typically satisfy generation capacity and TSO preferences, as opposed to actual system needs e.g. peak grid system requirement might be for 30 mins – 2 hours, but demand response would be set for 12 – 60 hours; coal-fired power plants have high start-up costs, but low incremental running costs.

4. **Measurement and verification, payment and penalties**
   Measurement and verification, also known as M&V, measures the performance of a service by quantifying and validating the service provision according to the specifications of a product. Effective M&V will help to facilitate a transparent calculation of the amount of product delivered by each resource and accurately determine financial payments or penalties to be paid by the relevant party.

The demand response regulatory framework in the EU is progressing, though further regulatory advancements are needed. Although the demand response market in the EU has matured in the last few years, it is still very much fragmented. A positive indicator of progress is the cooperation that exists between some EU Member States in terms of cross-border trade on the wholesale and balancing markets. There are still significant barriers (i.e. penalties, product requirements, consumer access, etc.) that need to be addressed for the EU to reach the intended harmonised Internal Energy Market (Smart Energy Demand Coalition, 2017). Despite these barriers, in 2013 Europe was effectively closed to demand response, whereas today many consumers can participate in effective demand response programs across a number of EU Member States (Bertoldi, Zancanella, & Boza-Kiss, 2016).

4 FACILITATING MASS UPTAKE OF ESCO AND DEMAND RESPONSE

4.1 BUILDING ON EXISTING MECHANISMS

As discussed earlier in the report, the EU Energy Efficiency Directive is credited with helping to establish and mandate a position on demand response from each EU Member State. Although a good starting point, there is much more that could be done leveraging this existing Directive as a mechanism to further enable both ESCO and demand response markets as well as potentially the dual energy services model. EU EED applied in each Member State typically requires energy efficiency audits to be carried out by large organisations or high energy consumers. Across many Member States the requirement is organisations with greater than €50m in revenues or more than 250 employees are required to conduct an energy efficiency audit every 4 years. While this is the requirement, it is not being enforced and therefore the engagement is poor. For a quicker uptake of energy efficiency projects, enforcement should therefore be improved and the purpose of audits should move towards becoming environmental strategy proposals to organizations.

A brief questionnaire was circulated to a manufacturing multinational with a significant footprint across Europe, who are required to comply with the EU EED in its different guises throughout the EU. The overwhelming response is that the energy efficiency audits don't really generate cost effective ways to reduce energy consumption. They are expensive to conduct and there is very little policing from national governments on whether or not the audits were carried out. Although some respondents had heard of the term demand response before, nobody had come across the term as part of their EU EED energy efficiency audits or had it offered as part of a service or opportunity. Although demand response is included as part of the EED at EU level, the messaging is evidently not coming through to organisations that could benefit from it the most. The catchment of organisations required to conform to the EU EED are the perfect target market for ESCOs and demand response providers; they have high energy consumption, high turnovers and are quite often stable organisations.

Government bodies, such as the SEAI in Ireland, could facilitate sharing the results from energy efficiency audits or at least share the list of eligible organisations with pre-qualified ESCOs and demand response service companies. It is important this is facilitated by a government body to ensure typical barriers are overcome such as trust, transparency, confidentiality & data protection, contract simplification, education & awareness and, most importantly, financial support. In this way they would incubate and enable effective ESCO and demand response markets, in a trusted manner, matching expert energy service and demand response companies with organisations who need their help the most.

This approach is a potential way to accelerate the uptake of ESCO and demand response markets, truly contributing to the EU 2030 energy efficiency targets, by utilising an existing EU directive as a mechanism for change.

4.2 FUTURE TECHNOLOGY CATALYSTS

A recent study called SmartBlocks carried out by Cork Institute of Technology at the Nimbus Centre in Cork, Ireland, with support funding from the SEAI, looked at how blockchain could be applied to the energy sector. More specifically the study investigated how blockchain could be used in an ESCO

application. Until now, much of the focus on blockchain has related to finance applications and more specifically cryptocurrencies, such as Bitcoin. Blockchain has the potential to do so much more outside of financial applications.

Blockchain technology is a peer to peer transaction platform that is based on decentralised storage that records all transactional data among peers (SmartBlocks, 2017). Using blockchain for ESCO and demand response could mean contracts are clear, transparent and independently reviewed by peers to ensure they are fair; this can be done by using what are called Smart Contracts. As the transaction process is independently verified, once there is sufficient education and awareness disseminated, there would be much more trust by all stakeholders in the process. The technology also has the ability to seamlessly and accurately measure and verify performance against the specified requirements, ensuring correct revenues or penalties are communicated and paid, effectively in real-time. Blockchain has the potential to remove ambiguity from the ESCO and demand response process and once set up, could seamlessly process all contract administration for the life of the contract.

The research team at Cork IT applied a prototype blockchain platform to their Nimbus Centre building in Cork, see figures below for more information.

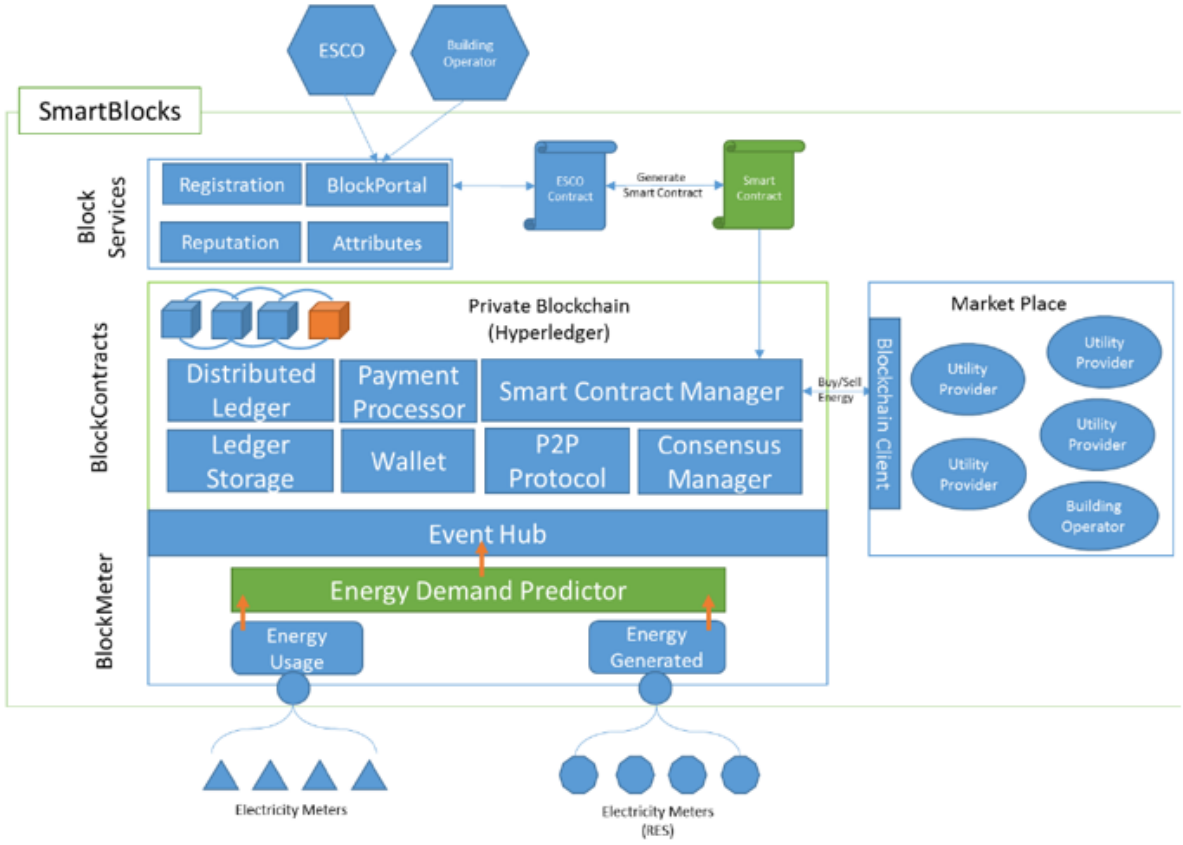

Figure 4: SmartBlocks Conceptual Architecture (Susan Rea, Alan McGibney, & Witheephanich, 2017)

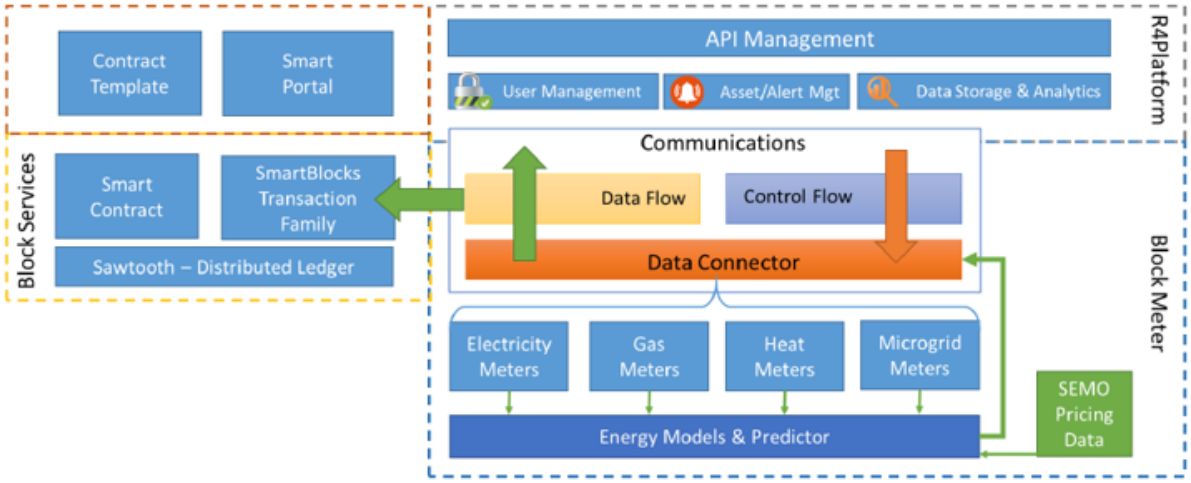

Figure 5: SmartBlocks Integrated Prototype (Susan Rea et al., 2017)

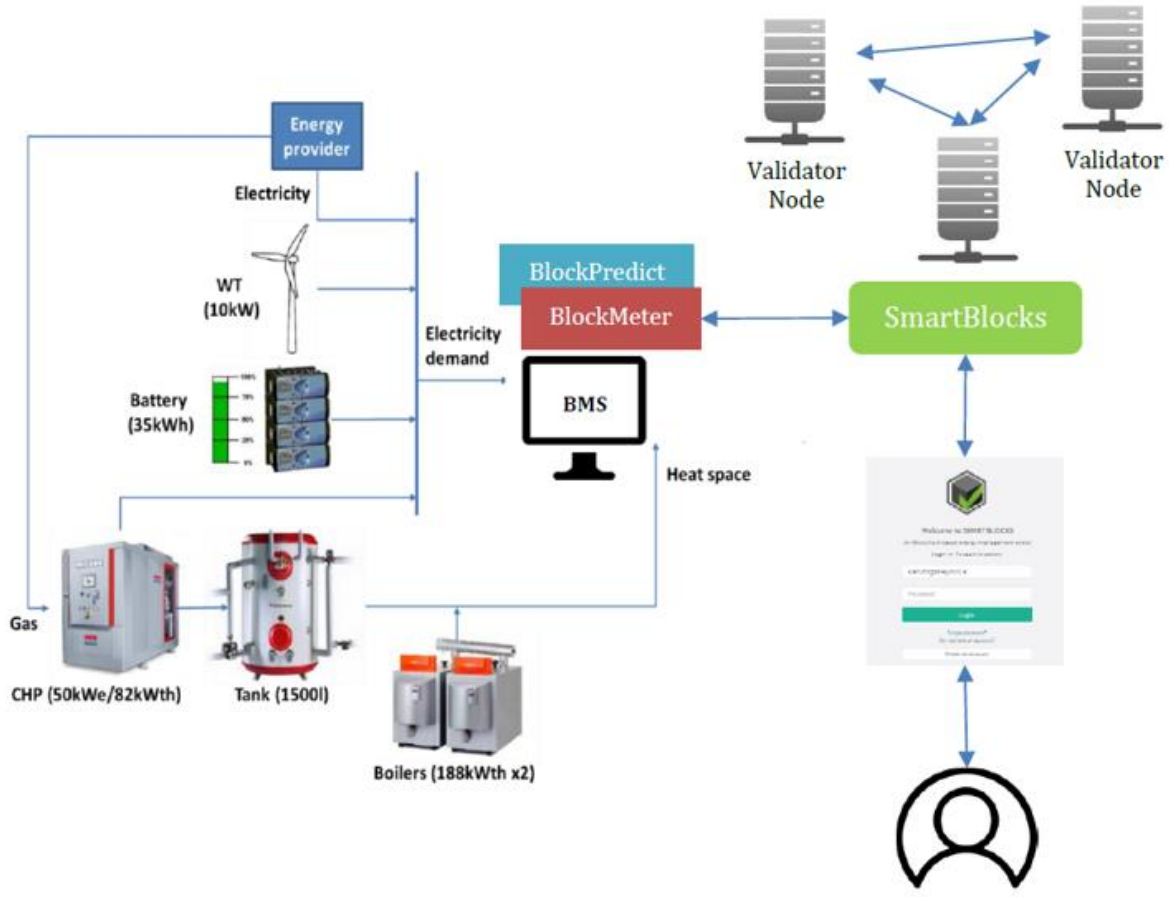

Figure 6: SmartBlocks deployment at CIT (Susan Rea et al., 2017)

5 SUMMARY & CONCLUSIONS

5.1 POLICY RECOMMENDATIONS TO PROMOTE ESCO MARKET

It is clear from the study that ESCO markets are more developed and mature than demand response markets across Europe. The main barriers for ESCOs are relatively uniform across different Member States and are well documented and include; education & awareness, trust & contract transparency and access to finance. It is critical that regulatory and policy bodies address these barriers and facilitate ways to overcome them. The following recommendations for policy makers draw on the best practice examples described in the previous sections.

5.1.1 Commit to increasing uptake of EPC in NECPs

National Energy and Climate Plans (NECPs) are drawn up by all EU countries and were due to be submitted by the end of 2019. They were introduced under the Regulation on the governance of the energy union and climate action (EU/2018/1999) and they present how the countries are planning to achieve the EU's energy and climate targets for 2030. The Commission receives a progress report every two years which is used to monitor the EU progress towards achieving the targets. Many EU Member States promote the use of ESCOs in their NECP and include plans to drive the uptake of EPCs, as both are key drivers for energy efficiency, but in most cases these commitments could be stronger. The progress reports that are sent to the European Commission every two years could be used as a mechanism to track the evolution of the EPC markets.

In particular, public sector bodies are under obligation to lead by example, and have already set stringent targets on reducing their own energy consumption and carbon emissions. Promoting EPC as a mechanism to achieving these targets where appropriate, particularly in cases where central government buildings are in need of refurbishment, is one option for driving EPC in the public sector. Not only will this help the growth of smaller markets but it will also give confidence to smaller public sector bodies (e.g. local authorities, health authorities, education, emergency services etc.) to adopt a similar approach by building trust in the business model through successful case studies.

5.1.2 Set up Procurement Frameworks for Energy Performance Contracting

Countries that have set up national procurement frameworks for the public sector have seen a greater increase in uptake of EPCs among public sector bodies and bigger growth in the ESCO market compared to those that have not. EPC procurement frameworks help and guide public sector organisations through the complex procurement process which would otherwise be too difficult, lengthy and expensive for individual clients to engage with. For example, in the UK there are a number of regional procurement frameworks that provide:

- mentoring and support for public sector bodies wishing to undertake energy efficiency refurbishments of their building stock;
- a clear and simplified procurement procedure that is OJEU compliant, prequalifies ESCOs every 4 years and then runs a mini-competition for each individual contract;
- standardised contract documentation which reduces the administrative burden and legal costs associated with performance contracting
- standardised methods of calculating costs and savings to ensure that proposals can be compared on a like for like basis.

There is usually no upfront fee to the public sector body for accessing the services of the framework. Instead the framework is funded through either adding a small percentage based management fee on top of the total project costs or by applying for other structural funds such as ELENA.

This type of framework gives organisations the confidence to engage with EPCs, while cutting through the complexity of the process. One drawback to this type of contracting model is that it tends to attract only large multinational ESCOs, and is inaccessible to SMEs due to the very high value of the contracts on offer. Never-the-less, countries that have adopted this kind of approach have seen significant growth in their ESCO market and engagement from public sector bodies on using EPCs.

Historically, procurement frameworks have been highly prescriptive in the method by which savings and returns on investment are calculated, including what kind of technologies can be included and whether maintenance or other cost savings outside of reductions in energy bills can be accounted for. This is necessary to standardise the process and reduce the cost of procurement. However, it would be beneficial if these models were somewhat flexible to allow new technologies, (such as demand response), and new business models (such as the NOVICE dual services approach) to be included. Standardised contracts can include some level of flexibility by choosing to include or exclude particular clauses depending on the business model being followed. This is already done for the guaranteed saving and shared saving EPC model, so this could be extended to also cover the NOVICE approach.

5.1.3 Increase level of information, support and guidance available to stakeholders

Some key barriers to the uptake of ESCOs and EPCs is awareness, fear of complexity and trust that the contract will deliver what it promises, namely, energy reduction and savings. This problem is common among both clients (building owners) and ESCOs (or organisations that could potentially become ESCOs). It is imperative that EU countries provide clear information and guidance to all stakeholders in order to develop the market.

It is also important to note that information and support alone does not grow the market and more direct interventions, such as the development of a procurement framework (see section 5.1.2), are needed in addition to information to drive market uptake. An example of this is Ireland, where the National Energy Services Framework consist only of support, information and guidance without the associated procurement framework. Although it has been in existence for several years and many organisations have received support through the service, Ireland still only has a handful of EPCs in operation, and the business model has not yet gained traction among stakeholders.

5.1.4 Ensure access to suitable finance is available

Most public and private sector organisations have either very limited capital expenditure budgets or many other investment priorities, meaning energy investments are often low on their to-do list. EU countries must provide financial support, in addition to awareness and education, to enable and incentivise capital restricted organisations to invest in energy efficiency. This could be in the form of revolving loan schemes, third party finance, tax incentives, or subsidies according to what is most suitable in each country due to their level of market maturity.

A known issue with access to finance is that many third party investors look for high value projects and most EPC projects are too small to be of interest to them. In general, project developers and finance providers use different metrics to assess the value or risk associated with a project or investment. This can lead to misunderstanding between the parties and projects failing to receive finance after they have already been designed and the ESCO has already committed significant resources to a particular course of action. Policy makers should ensure that the finance sector is considered and included in any policies or actions to increase uptake of EPC and mobilise sources of

private finance. This could include ensuring that suitable financing mechanisms are incorporated into any procurement frameworks, and ensuring that any information and support services also target the financial sectors as well as ESCOs and building owners. The work of the EU supported Sustainable Energy Investment Forums has already begun to tackle these issues at national level and should continue to be supported in future.

5.1.5 Consider ways of promoting EPC in the private sector

As highlighted in this report, the ESCO market in Italy is one of the most mature ESCO markets in Europe. The White Certificates energy efficiency obligation scheme has played a huge role in driving the development and uptake of the ESCO market. Similar cap and trade schemes could help develop the market in other EU Member States, as it puts a value on energy saving that can be traded. This can help to drive the growth of the sector as it increases the economic viability of energy efficiency projects, bringing return on investment into a range that is more acceptable to private companies. The focus on M&V, which is necessary in a white certificate scheme in order to receive a tradable certificate, has also boosted the prevalence of performance contracting as a business model as ESCOs can only be awarded a tradable certificate once their project and its savings have been verified.

5.2 POLICY RECOMMENDATIONS TO PROMOTE THE DEMAND RESPONSE MARKET

The barriers to demand response are not as clearly understood as the barriers to the EPC market, due to the inherent complexity of electricity markets across the EU. Typical barriers seen include regulations not allowing or facilitating demand response in each country and the lack of a fair environment in which new and existing players can compete, irrespective of size or capability. By their nature, any changes to policies in energy markets will be slow to embed. The following recommendations for policy makers draw on the best practice examples described in the previous sections.

5.2.1 Encourage regulatory reform that promotes demand side response

Electricity market regulations are highly complex and when considering adjustments, a high degree of expertise is needed to ensure that any modifications are suitable. What is clear from the above examples is that the following points should be considered:

- **Include all stakeholders in consultations on demand response:** It was evident from the Ireland example that it is beneficial to get started early on road mapping the regulatory requirements to enable demand response and that it is critical to invite all stakeholders to the discussion table from the beginning of the process to have holistic input into the policy development and design.

- **Test policy in practice and redesign if necessary**: The example from the UK demonstrated that if the initial policy framework and designs are not working, then policy makers should not be afraid to overhaul of the entire approach. This was done effectively with the launch of the UK's Power Responsive programme.

- **Use regulation as a mechanism to drive change:** There are existing EU Directives in place such as the Energy Efficiency Directive, which can act much more effectively as a mechanism to drive the ESCO and demand response markets. Doing so would create a two-pronged approach, a market push through regulation requirements coupled with a market pull by closing the loop and involving ESCO and demand response companies to offer solutions in a vetted, trusted environment facilitated by the government or similar trusted body. In addition,

it is essential to create a plan on how to develop and implement an effective demand response market which clearly outlines what the barriers are in each country and how they will overcome them. All EU countries have to write a National Energy and Climate Plan which should include actions relating to demand response market. All the countries have to submit a progress report every two years so these could be used to track the demand response markets progress.

- **Ensure that regulations do not favour generation over demand side action:** In the UK and Irish markets the initial design of flexibility programmes significantly favoured sites with large, easily controllable generation capacity at the expense of demand side flexibility. This does not help to reduce carbon emissions overall as many generators that can be powered up quickly enough to be of use to the network operator will be fossil fuel based. Changes to the regulations that enabled demand side response to compete more effectively with generators (e.g. reducing the minimum capacity requirements and opening up programmes that require faster response times) has opened the market for a larger number of aggregators, sites and energy assets. Once again, this was only possible because all the key stakeholders were consulted, therefore strengthening the need to involve all the stakeholders as early as possible. Allowing the smaller demand side units to participate in the flexibility programmes has created work for aggregators, thus resulting in an increased numbers of aggregators, which will drive the evolution of the market maturity.

- **Simplify contracting arrangements between market actors:** As detailed in Deliverable 3.4 SWOT analysis, some European countries are struggling to develop their demand response markets because of the complexity of the interactions between Transmission System Operator, Balancing Responsible Party, Energy Supplier and customer. For example, in Germany, although aggregation is legal and demand response markets are open, regulations require that an aggregator must have permission from all four of these stakeholders in order to be able to offer the flexibility to the market. In practice the cost and complexity of doing so is prohibitive which has significantly limited the growth of the market. Regulations need to consider these relationships to ensure that they cannot hamper the development of the markets. Clearly defining the legal status and responsibilities of each stakeholder in the supply chain will go some way towards solving these issues, as will defining fair payment tariffs and compensation mechanisms between the parties.

5.2.2 Educate and raise awareness of demand response among stakeholders:

The use of regulation will only be successful if the market is educated around what is possible. A regulatory push alone can result in a reactive approach, where organisations will react to legislation as late as possible until they absolutely must conform to requirements. Closing the loop and adding a market pull will create a vacuum for uptake and market penetration. Education and awareness raising is required among all stakeholders but in order to create a market pull, it is most critical among building owners, ESCOs and EPC facilitators. Building owners are often concerned with minimising thermal comfort complaints and ensuring smooth operation of the building with no disruption. They need to understand the opportunities that demand response presents and the low risk nature of participation in terms of its impact on building operation. ESCOs and EPC facilitators are consistently talking to building owners and advising them on suitable technologies that result in good returns for their clients. Ensuring that ESCOs and EPC facilitators understand the opportunities presented by demand response could accelerate its uptake among building owners.

5.2.3 Support and facilitate further research into new DR technologies

The EU, National Governments and research institutions should provide resources to facilitate and incubate further research into future technologies and business models to transform the energy sector: Examples include:

- **Investigating how blockchain can be applied to the energy sector:** The potential of this dynamic technology is incredibly exciting, though much more work needs to be done. There are possible risks, concerning decentralised ownership and who is responsible if something goes wrong. Only further research and simulated applications will help to identify risks and further potential of such technologies.

- **Investigating technologies to enable the transition to a local, decentralised energy network:** The focus to date has been in providing stability to the transmission system and thus it is usually the transmission system operator that pays for any demand response programmes. Research should also be carried out into balancing the network at a local level, engaging with distribution system operators to understand the barriers preventing a transition to a flexible network of prosumers. This could open up further markets that may be more suited to smaller buildings and fewer energy assets.

- **Investigate new business models to drive uptake of demand response:** The current technologies must sit in the existing framework of traditional utility companies that make more profit when they sell more kWh of energy. In order to really transform the network, new business models need to emerge that will drive the energy transition by making it possible for building owners with flexible energy assets to access the value of that flexibility. This not only requires a mature and open demand response market and the right technology solution, but also a business model that is accepted by the market. NOVICE is one such business model that looks to combine energy efficiency with demand response to accelerate the market uptake of smart building renovations. Other business models need to be developed and tested for different sectors. Initially this will be driven by entrepreneurial innovators and market disruptors, but once a critical mass is achieved it could drive the traditional utilities to consider changing their business models away from a commodity based model and towards an energy as a service based model.

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