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PREFACE

The **CARISMA** project ("**C**oordination and **A**ssessment of **R**esearch and **I**nnovation in **S**upport of climate **M**itigation **O**ptions") intends, through effective stakeholder consultation and communication leading to improved coordination and assessment of climate change mitigation options, to benefit research and innovation efficiency, as well as international cooperation on research and innovation and technology transfer.
Additionally, it aims to assess policy and governance questions that shape the prospects of climate change mitigation options and discuss the results with representatives from the target audiences to incorporate what can be learned for the benefit of climate change mitigation.
Knowledge gaps will be identified for a range priority issues related to climate change mitigation options and climate policy making in consultation with stakeholders.

Guidelines for policy makers to address contextual factors

July 2018

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1 Introduction

1.1 Background

Climate change mitigation efforts have been underway in the EU for many years. EU Member States (MS) have acknowledged the need to reduce greenhouse gas (GHG) emissions and have developed strategic national plans aimed at achieving the environmental goals set by the EU, and by the worldwide community through the United Nations Framework Convention on Climate Change (UNFCCC). It is widely acknowledged that the energy sector is responsible for a major proportion of the total GHG emissions, and the EU is focusing on actions to decarbonise it, including the promotion of renewable energy and energy efficiency upgrades. The "Winter Package", which was published in November 2016 by the European Commission, addresses all areas of the energy system and is anticipated to shape the policy framework for many years post-2020 (Rosenow, et al. 2017). European countries will have to (re-) formulate their climate policies and develop Integrated National Energy and Climate Plans (INECPs), in order to comply with the mandates of the Winter Package and meet the EU emission targets for 2030 and beyond (Hancher and Winters 2017). This complements the requirements of the Article 4, Paragraph 19 of the Paris Agreement, which states that all member states should strive to formulate and communicate their long-term low greenhouse gas emission development strategies by 2020 (United Nations 2015). In both the 2030 package and the long term low emission development strategies, as inspired by the Paris Agreement, contextual issues are fundamental and must be taken into account. Especially for long-term planning, the scope is a genuine development agenda with more complex/complicated synergies and trade-offs where contextual issues are even more relevant.

However, despite careful planning, using best available knowledge, energy and climate policy makers often face situations in which actual policy outcomes differ from policy expectations. Such deviations can occur due to unexpected impacts of the social, economic or political context on the deployment of mitigation technologies and relevant policy outcomes[1]. Climate change mitigation technology relevant negative contextual factors also affect negatively the effectiveness of energy and climate policies. A complexity of contexts is that they usually cannot be controlled by the policy makers (or if so, only partly); at best, policy makers anticipate possible impacts of contexts on policy performance and consider these during policy design.

The influence of contextual factors on climate policy-making processes and the anticipated outcomes of these processes has long been the focus of energy and climate policy research (Heiskanen and Matschoss 2017, Amelie and Brandt 2015, Mills and

[1] For example, the context may change during the policy implementation due to elections, economic shocks, technical breakthrough, growing public acceptance or resistance to a policy, etc. Moreover, a policy which has worked well in one Member State, may be less effective in another Member State, due to different contexts in both countries.

Schleich 2014, Spyridaki, Ioannou and Flamos 2016, Sasaki, et al. 2015), and the Winter Package aspires to address key challenges in the entire energy value chain, from supply-side to demand-side policies. Factors influencing the success or failure of national energy and climate policy strategies and mechanisms are mainly country-based (depending on each country's context), and may include (among others) economic factors (e.g. the economic recession), political views (e.g. the contradicting political ideology of political parties), social concerns (e.g. acceptance/opposition or public demand), country-specific historical data (e.g. outcomes of previous policies) and environmental factors (Koduah, van Dijk and Agyepong 2015). These imply conditions shaping the environment for policymakers, that may result due to overlooking such factors (e.g. due to ignorance, short-sightedness or lack of control) (Fujiwara, Williges and Tuerk 2017).

Amid MS efforts to develop and adapt their national long-term low-emission strategies, identifying strategies to address contextual factors, with a focus on barriers, is an important enquiry. Hence insights on the influence of contextual factors, and how they can be handled nationally would be beneficial for policy-makers to be better prepared when considering and prioritising such influences while (re)designing their domestic energy and climate policy mix. This forms the scope of this deliverable.

1.2 Aim and motivation

Throughout this report the focus is set on the factors that broadly hinder the deployment of energy and climate mitigation policies and technologies, and on suggestions for policy makers on how these can be overcome. This report's work is based on results of the CARISMA D6.3 (Fujiwara, Williges and Tuerk 2017), which explored the effects of contextual factors on implementing climate change mitigation options with the help of a set of case studies. More specifically, the research questions for D6.3 were the following:

(i) how can contextual factors affect the outcome of policy instruments, and
(ii) how are they considered during policy-making processes.

For the first question, stakeholders provided some useful insights on key contextual factors which were considered important for further investigation. As regards the second question, stakeholders engaged in the interviews reported difficulties in providing evidence on how such factors were considered during policy making processes. A potential explanation for these difficulties could lie within the broader scope and frame of the case study analysis which was broadly focused on mitigation options (i.e. policies or technologies) during policy decision making. Hence engaged stakeholders (i.e. market actors, policy makers, independent researchers) have not directly been involved in the policy design of relevant support measures. Instead, considering the broader scope of the case study analysis, engagement with a broader spectrum of stakeholders was necessary.

The difficulty in adequately answering the above questions, led to the **need to provide more concrete suggestions and guidelines for national and EU policy makers** on how to account for contextual factors. Thus our main research question was formed as "how the policy mix can be re-adjusted to account for contextual influences". To make the scope more operational, accounting also for the aforementioned inherent limitations, the main research question was narrowed down to the following complementary inquiries:

- What are the most inhibiting contextual factors reported for selected case-studies?
- How did their influence manifest?
- How has the country under assessment dealt with identified influences thus far (policy actions, practices considered)?
- Can examples of different countries which addressed similar influences be of aid?

Narrowing down from the cases studies included in D6.3 was first driven by considerations on relevance and clarity as well as practical access to stakeholders/case study leaders to define the guidelines for a broad EU MS/national audience facing similar or connected challenges. The selection of the case countries (see Table 1) was also interesting in terms of analyzing contextual factors relevant to more traditional supply-side (i.e. RES support Croatia and the UK) versus demand-side mitigation options (i.e. smart-grid deployment the Netherlands and building innovation technologies in Greece).

Table 1: Countries selected for assessment and proposition of guidelines

Case studies considered	Barriers to:	Resources for the meta-analysis
Netherlands	Smart grid deployment	Scientific Literature, European and National Policy Reports
Greece	Smart and energy efficient technologies uptake in the building sector	
Croatia	RES investment	
UK	RES support instruments	

By answering the research questions mentioned above, this report's dual aim is:

(i) to synthesise the influence of contextual factors hindering mitigation policy and technology options across different MS contexts
(ii) to derive (more) concrete suggestions for policy makers on how to deal with the contextual factors identified.

The report continues with section 2, in which we present the methodology, followed by proposed country-specific and EU-wide policy recommendations on considering contextual factors in policy-making processes. In section 3, we present the outcomes of the analysis for contextual factors considered within each case study along with the proposed guidelines and policy practices. Following is section 4, which consists of a comparative overview on the lessons learned from several case-studies. In section 5, we extend the lessons learned to propose general guidelines/policy implications relevant to the MS country's INECP formulation process.

2 Methodology

We performed a qualitative meta-analysis focusing on the inhibiting factors for technology diffusion, based on observations from the country case-study factsheets (as developed in Task 6.3). The meta-analysis consisted of a secondary analysis of the primary qualitative findings aiming to provide a more comprehensive description of the contextual factors and their influence, as identified through the case-study analysis and interviews. Figure 1 summarizes the main steps, outputs and questions.

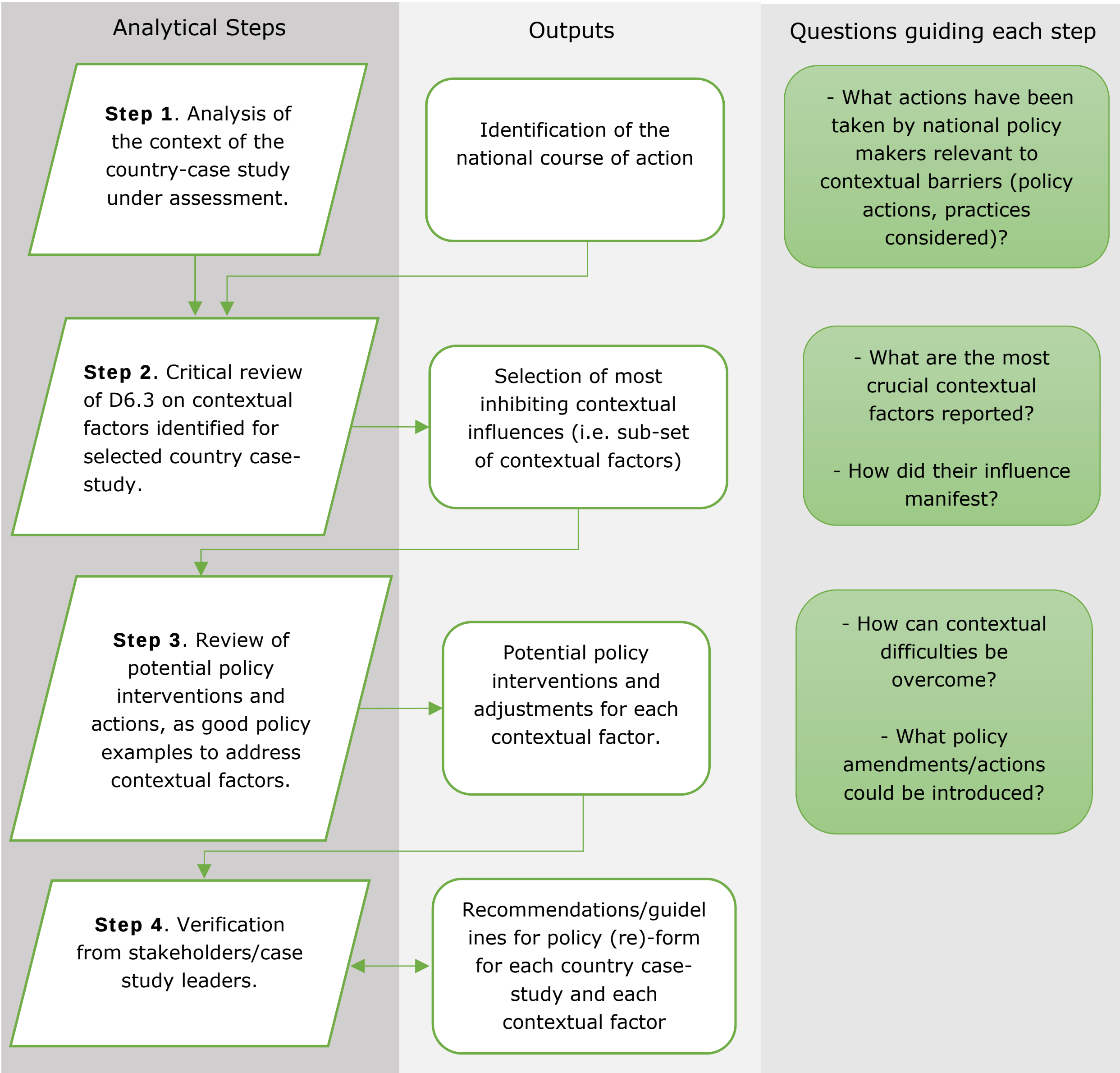

Figure 1: Approach followed for conducting a meta-analysis on (and providing guidelines for) addressing contextual factors during policy-making.

The individual barriers identified in each case study were categorised in the three contextual factor categories as defined in Deliverable 6.3:

(i) institutions and governance,
(ii) innovation and investment-related issues and
(iii) attitudes, behaviour and lifestyle.

The categorization was made in a manner to facilitate comparison of the lessons learnt from the various case studies. Furthermore, the categorization helped propose more general guidelines at the EU level, to which other interested member states can look into when designing their national energy and climate policies. Figure 1 summarizes the rationale followed (analytical steps and questions answered through each step).

3 Practical suggestions & guidelines for policy makers to address contextual influences: case study results

3.1 Summary – Overview of cases

The following section takes forward the work of D6.3 and focuses on four EU member-state case studies (the Netherlands, Croatia, Greece, and the UK). As discussed in section 2, the focus here is on the key barriers affecting policy success in each of the cases, with a goal of finding commonalities in both barriers and (if possible) means of addressing them. D6.3 provides a more in-depth look at the case study approaches, policy background, and contextual factors, while here we provide a short overview of the policies in question and focus rather on the key barriers identified, with an aim of highlighting steps to be taken to either prevent or alleviate the effects of such barriers. The following sections provide the context for each case, identify barriers (grouped into three themes: Innovation & Investment, Institutions & Governance, and Behaviour & Lifestyle), and address how these barriers may be overcome. Table 2 provides a concise overview of the barriers discovered in each case, and highlights commonalities between cases. Section 4 follows with generalizing lessons learned from the case studies.

Table 2: Overview of key barriers and their individual country effects

Barrier	Countries affected	Explanation
Innovation and investment		
Low fossil fuel prices	NL	NL- lower willingness to invest in low carbon technologies
Market reaction to variability	NL	NL- long periods of negative prices led to revenue losses for producers
Investment framework into new technologies	NL, HR, GR, UK	NL- lack of incentives to invest in smart grids HR- Lack of private investment due to lack of clear information for investors GR- Difficulty implementing EE projects through EPC and GPP mechanisms due to debt restrictions for municipalities UK- Market design favours centralized power generation over RES (lack of consideration of high capital expenditure of RES)
Desire for local value-added	HR	HR- Investments in PV and wind seen as benefitting nations which export tech to Croatia & foreign installers
Policy continuity	UK	UK- Changes to PV feed-in-tariff remuneration too frequent, with negative impact on instrument performance
Institutions and governance		

Presence of EU regulatory framework	NL	NL- limitations in cooperation of DSOs with private companies
Inter-ministerial coordination	HR, GR	HR- Lack of clarity as to which Ministry should handle RES policy / adversarial atmosphere in policymaking GR- Multiple EE measures need financing from single pool of funds, but no coordination or policy integration exists
Coordination of EU and national institutions	HR	HR- National ministries had difficulty understanding & implementing directives
	Behaviour and lifestyle	
Public opinion / awareness / social acceptance	NL, HR, UK	NL- Concerns over data privacy and security HR-Initial lack of public interest in RES policies changed to negative opinion not taken into account by policymakers UK- Vocal opposition to RES installations in rural areas GR- Very few EE informative actions implemented by (until recently) the monopoly electricity supplier
Projected costs of RES to final consumers / indirect social costs	HR	HR- Growing concern of social effects of RES deployment
Intellectual frame of free markets	UK	UK- Lack of support of RES due to focus on price, costs, and economic efficiency only

3.2 Smart grid deployment in the Netherlands

3.2.1 Context

In the Netherlands, three policies in favour of smart grid technologies were designed and implemented. The first policy instrument mandated the rollout of smart meters, defining distribution system operators (DSOs) as the owners and responsible parties for the installation of smart meters. During the second policy instrument, 12 pilot projects were conducted to test new tariff designs and smart appliances complementary to smart grids, which provided useful insights for policymakers tackling matters of new standards, laws, services and products for Smart Grids. Finally, the third instrument is a public-private research and development (R&D) programme, called TKI Switch2SmartGrids, which was launched in 2012. Despite the contextual difficulties encountered in promoting smart grids, the Netherlands is at an early stage in terms of acting to develop smart grids with evidence of steady and careful steps forward to their wider deployment (Fujiwara, Williges and Tuerk 2017).

As regards the efforts to phase out carbon as well as fossil fuel subsidies[2], the Netherlands – as a member of the EU and a party ratifying the Paris agreement – adheres to these commitments, while more recently, the government signed a communiqué in 2015 urging other countries to abolish inefficient fossil fuel subsidies (Friends of Fossil Fuel Subsidy Reform (FFFSR) 2015). Nevertheless, as reported in a policy brief published in September 2017 by the Overseas Development Institute (ODI) think tank, despite these commitments the Dutch government continues to offer support nationally (and internationally) to all sectors (except for households) reviewed through national subsidies, public financing and investments through state-owned enterprises[3]. In 2016 the Netherlands reintroduced a tax-exemption for the use of coal in electricity generation after it was stopped in 2012 for environmental reasons (van der Burg and Runkel 2017). Positive efforts to the fossil-fuel subsidy phase-out include the governments' decision in 2013 to end tax breaks for diesel and heating oil. The incoming Dutch government has recently pledged to introduce a Carbon Price Floor (CPF)[4] from 2020 to restore appropriate price signals for low carbon technologies, to close all coal-fired power plants by 2030 and buy EUAs to offset negative market impacts (S&P Global PLatts 2017).

In terms of market structure, the Dutch electricity system used to be run by central companies, responsible for both electricity generation and grid operations. Since the introduction of the EC Third Energy Package in 2009, the market regime changed, the liberalization of the electricity market was promoted and the unbundling of the energy system separated large energy companies into grid operators (TSOs and DSOs) and energy suppliers. In parallel to the return to a bundled energy market model as stipulated by European legislation, a government-supported experimental scheme (in Dutch: Experimenteer Regeling) was deployed which created pilot areas (Special Economic Zones) where unbundling regulations for DSOs are suspended (Fujiwara, Williges and Tuerk 2017), meaning that DSOs are able to cooperate with commercial

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[2] Subsidies for fossil fuels, such as oil, gas and coal, have several forms and are offered along the entire value chain from exploration, to production, and consumption. According to the World Trade Organization (WTO) subsidies include: 1) all government financial contributions or direct support; 2) transfer of risk through provision of debt, equity and guarantees; 3) forgone revenue through tax breaks; 4) provision of infrastructure, goods and services below market value; and 5) royalty breaks and investment in infrastructure" (Whitley and van der Burg 2015).

[3] Post-tax subsidies in US$ per capita in the Netherlands for petroleum, coal and NG amount to: $126.53, $158.94, $309.74 respectively, projected for 2015. For an overview of fossil fuel subsidies across EU Member states you may refer to (Hayer 2017).

[4] A price floor guarantees a minimum rate of return for a prospective investor considering an investment decision, hence mitigating uncertainty over future investment profitability that is especially important for investments in the power sector (Brauneis, Mestel and Palan 2013). This will likely consist of the EU allowance Unit (EUA) price plus an add-on tax, similar to the UK price floor model. The price will likely be set at Eur18/mt of CO2 emitted in the power sector, expected to rise in Eur43/mt including the ETS price. The additional levy that generating companies will have to pay will depend of the ETS price.

entities and store/supply energy, thus facilitating the operation of smart grids. In addition, the Dutch Energy Data Service Netherlands[5] (EDSN), has evolved from a bilateral (between market entities) communications agency to a central hub in 2007, aiming to facilitate operations and increase entity synergies while more recently (since 2013) it has evolved into a central agency with additional benefits being the information ease of access by market entities, increased simplicity and the lower cost for consumers (EDSO for smart grids 2014).

Regarding tariff design, a capacity-based tariff is implemented in the Netherlands (Mandatova, et al. 2014) which is set by the DSOs with the aim (legislation driven) to eliminate discrimination among consumers (AF-Mercados, REF-E and Indra 2015). The Dutch legislation does not yet allow the DSO to make time/place-based variations on the electricity price, so that there is no discrimination in electricity pricing for areas with capacity problems (Eid, et al. 2016). In addition, the Dutch DSOs are obliged to install smart meters for every consumer by 2020, to comply with the EU Third Energy Package instructions. Yet the current incentives on DSO grid-works are mainly based on effective decision making. This means that regardless of the technology in question, grid operators receive a return on investment equivalent to what they would get in a competitive market, so that they are able to pay their capital suppliers[6]. However, if a grid operator makes investments with high costs and low added value, the actual return will be lower compared to what they would actually get to keep, if they had made more strategic choices (Autoriteit Consumert & Markt 2017). In sum, although the incentive regulation and tariff structure for electricity networks implemented in the Netherlands allows for a full recovery of network costs, it does not yet offer incentives for providing grid-oriented flexibility. At the same time, the Dutch government is hastening collaboration with energy companies, grid operators, research organizations and other interested parties across the country through pilot projects for smart grid deployment. The smart meter rollout introduced in 2011 is promoted through non-obligatory measures. Every customer chooses whether or not to install smart metering devices in their premises and if he opts for smart meter installation, he has the ability to limit its functionality at will (Fujiwara, Williges and Tuerk 2017).

3.2.2 Identified Barriers

The Dutch case study, conducted in the context of the task 6.4, focused on the identification of contextual factors that influenced the development of smart grids in the

[5] The Dutch DSOs created a company called Energy Data Service Netherlands (EDSN) in 2002 that had initially been working with external IT partners to provide standardized bilateral communication between market entities.

[6] The regulation is technology-neutral. It supports efficient investments, not considering their nature. *"System network operators are currently expected to make the investments that are necessary to contribute to a more sustainable and renewable energy chain, for example, infrastructure for solar panels or wind farms. The method of regulation enables system operators to make an appropriate return on these investments"*. (Autoriteit Consumert & Markt 2017)

Netherlands. Relevant stakeholders expressed their perceptions on the main factors influencing smart grid deployment. As stated in the original analysis, *"market and regulatory reform was the most important contextual factor for implementing Smart Grids"* in the Netherlands (Fujiwara, Williges and Tuerk 2017). Below we present and discuss the individual barriers, structured around the three categories presented in section 2, namely: (i) institutions and governance, (ii)innovation and investment-related issues and (iii) attitudes, behaviour and lifestyle.

Institutions and Governance

Concerns have been voiced for the current **market and regulatory framework** prescribing an **unbundled energy market model** that was characterized by Dutch stakeholders as a blocking factor since reportedly it limits free communication and collaboration among market entities, which is a prerequisite for the successful deployment of smart grids. The unbundling of the energy system made the adoption of smart grids a complex issue with many actors involved. The fact that grid operators are regulated public entities with limits to their cooperation with energy supplying companies, was especially considered to be in contrast to the mandate of smart grid technologies for close cooperation of these entities (Fujiwara, Williges and Tuerk 2017). Dutch experts also highlighted that due to this limitation, DSOs are not allowed to provide smart devices to consumers as this would interfere with the competition of energy supplying companies, and they cannot exchange data with retailers. Furthermore, DSOs are not allowed to own, develop, manage or operate storage assets (eurelectric 2017). Such communication/technology dissemination restrictions between DSOs, utilities and consumers in the Netherlands are contrary to the operational requirements of smart grids, demonstrating that EU policies can cause significant barriers to technology diffusion if not co-designed with the active involvement of all member states.

Innovation and investment-related issues

In regard to market and investment-related issues, the fact that **fossil fuels remain widely used as a cheaper and more reliable supply source,** despite their greenhouse gas emissions, was considered and highlighted as barrier to the evolution of smart grid technologies by stakeholders (Fujiwara, Williges and Tuerk 2017). Smart grids can lead to significant GHG emission reductions from the power sector through increased energy efficiency (EE) and increased penetration of non-carbon-based, renewable-energy resources. Yet the willingness to invest in low-carbon technologies can indeed be mitigated by more competitive fossil-fuel supply technology alternatives, mainly due to lowered Operational Expenditure (OPEX) costs. At the same time, CO_2 prices in the Emission Trading System (ETS) sector have been lower than expected in recent years, while the acceleration of the EU's efforts to toughen up the GHG reduction regime demonstrates widespread acknowledgement of the need to encourage innovation and promote the use of low-carbon technologies.

On the other hand, the **impact of RES variability in the market** as well as the effect of negative electricity prices was considered to further underline the necessity of smart grid deployment to enable demand response (Fujiwara, Williges and Tuerk 2017). Simulations implementing the targets of the Netherlands to increase its renewables share have shown that very high and negative prices are likely occur especially post 2030 (Frontier Economics 2015). The possibility of negative electricity prices at times of low demand and high RE generation raised concerns among stakeholders, who were quoted as saying that *"energy companies will have to pay users for using energy to relieve the grid from the stress"* (Fujiwara, Williges and Tuerk 2017). Although the occurrence of negative prices may incentivize consumers to shift their consumption patterns to benefit themselves with 'free' energy and further push the deployment of smart grids, a number of implications can be envisioned for other actors in the power market. On the one hand, negative prices are acceptable, and many times preferred by central fossil fuelled generation stations because it is cheaper to pay users to consume the 'extra' electricity for a little while, than to shut down and power up later. On the other hand, distributed renewable generators see negative prices as revenue loss since they have to return part of the infeed remuneration they have received. While this is a counter-incentive for renewable generators, it has the potential to act as a bottom-up auto-correction in case of allocation of a sum of small subsidies to many small RE power producers, which can lead to increased volume of subsidies (Benedettini and Stagnaro 2014).

At the same time, **policy incentives given to DSOs and ESCOs** to invest in smart grids were deemed insufficient. Interviewees remarked that "Grid operators in the Netherlands (TSOs & DSOs) consider the development of smart grids to be crucial for the market survival however they claim that they are restricted by law". It was also mentioned that if grid operators start developing smart grids, ESCOs will follow (Fujiwara, Williges and Tuerk 2017). Lack of sufficient financial incentives was seen by stakeholders as an important constraint to smart grid deployment in the Netherlands for key market actors (i.e. both DSOs and ESCOs). We interpreted this barrier to relate to the state of the current regulatory framework with regard to the grid tariff structure, which would allow dynamic pricing, as well as other incentives of innovative grid works that can be introduced by governments to incentivize both DSOs and ESCOs to invest in smart grid business-cases.

Attitudes, behaviour and lifestyle

Finally, the **public resistance to smart grid deployment** already caused delay in the smart meter roll-out and mandates further action from the government to increase costumer awareness and participation. As highlighted in the Dutch case, the announcement of the roll-out of smart meters raised serious concerns and opposition from both the public and members of the government, mainly due to reasons of data privacy and consumer security in the Netherlands. This fact resulted in halting the original rollout phase (which was planned to begin in 2004) for 8 years. During this period, consumer organizations were formed which expressed worries about the fact that smart meters share consumption data with energy companies. These worries were also expressed by members of the Dutch parliament. Furthermore, smart grid expansion also met public resistance mainly due to cost and privacy issues or a lack of interest (Fujiwara, Williges and Tuerk 2017).

3.2.3 How to overcome?

In the context of addressing the **externality of low fossil fuel prices** (that weakens the competitiveness of low-carbon options including innovative investments in smart grids), the Dutch government should continue their efforts in assessing and communicating the potential costs and benefits of introducing the Carbon Price Floor (CPF) option especially to the market actors directly affected by its introduction. The CPF will most likely succeed in increasing generation costs from fossil fuel generation in the Netherlands. In fact, it will lift generation costs for the remaining coal plants more than for the gas-fired ones due to their higher carbon intensity eventually leading to an increase in the coal-to-gas switching in the Dutch market. Yet, the increase in generation costs for coal and gas is not expected to have a direct effect on smart-grid deployment. Essentially, carbon pricing policies can only significantly steer industry towards innovative low-GHG technology development if allowance prices are sufficiently high or if allowance auctioning revenues can be channelled directly to promote innovative technologies (Clochard and Alberola 2017).

With regard to **fossil fuel subsidy reforms,** the Dutch government should proceed with coherent actions to reduce the reliance on fossil fuel through a more robust subsidy reform for coal-generation, accounting for the resources that would be required to support many of the essential elements of such a reform in the sector. In addition, political interventions into the energy market (e.g. such as the coal-phase out mandate or the CPF introduction) should be continuously monitored. Most importantly during such a market reform, new policy mechanisms should be implemented in co-operation with the industry and other market stakeholders to raise trust among them and increase the potential for effective implementation. Last but not least, one of the main implications of introducing a CPF also relates to indirect costs borne by consumers. This may create an implicit drive for end-users to search for alternative options to decrease their energy costs and thus potentially boost engagement in smart-grids. Nevertheless, the Dutch government should closely monitor the operation of the CPF and the related costs burdening consumers and consider the potential adoption of cost-containment measures to offset excessive costs.

Lessons learnt from international experiences to handle negative electricity prices

In the European Union, negative power prices have been allowed in countries participating in the European Power Exchange (EPEX), that is, Belgium, France, Germany, Austria, Switzerland, and The Netherlands. For example, Germany experienced 56 hours of negative prices in 2012 and 48 hours in 2013. Other power exchanges, however, do not allow prices to fall below zero (Benedettini and Stagnaro 2014). In the event of negative power prices, an option that Germany often uses is to export electricity to other MS, who in turn have to be remunerated to consume Germany's electricity. By exporting electricity to other countries when there is congestion in the national grid, the network is relieved from the stress, meaning that consumers are not paid to relieve it, electricity prices remain positive, and the only revenue that is lost is the remuneration that has to be paid to the countries that absorb the exported energy (Brunekreeft, et al. 2015). Germany also allows TSOs to set price limits for their day-ahead and intraday bids, to avoid extremely negative prices. The price limit is randomly set within a specific range, and the price-limited hours as well as the specific prices are anonymously published for transparency reasons (Brandstatt, Brunekreeft and Jahnke 2011). On the other hand, the U.K.'s Department of Energy and Climate Change (DECC) made a modification to its Contracts for Difference[1](CfD) in 2014, so that there are no incentives for generators to produce electricity in case of negative prices. Applying to contracts signed in 2016 and onwards, if negative day-ahead prices occur for 6 consecutive hours or more, the CfD values are set to zero. For the period from 0 to 6 hours of negative prices, the CfD values are set to the strike price (Baringa 2015). The zero-electricity price limit is also established in Spain, Portugal and Italy (Höfling, et al. 2015).

The case of negative pricing due to **variability of renewables** should be handled with caution instead of precaution. Allowing negative prices to a certain lower limit and for a certain amount of time, could incentivize consumers to shift their consumption and drive smart grid deployment, and at the same time control the priority-dispatch of renewables, achieving a more fair and balanced market for central generation stations.

As a member of EPEX, the Netherlands allows negative electricity prices, but a transition to a smart grid which enables load shifting has raised concerns by Dutch stakeholders for extremely[7] negative prices which would lead to great revenue losses for distributed producers. On such evidence, the imposition of a zero-price limit to avoid prolonged negative price periods, could be assessed by policy makers in combination with the INECP's country-specific security of supply plans. Furthermore, in line with the target for EU market interconnectivity till 2030, NL policy makers should promote transnational interlinkages of the Dutch energy market with those of other EU MS, to facilitate energy trading and reduce negative price occurrences. Transnational collaboration, as part of the INECP, should be designed based on the EU guidelines for a trans-European energy infrastructure (Sasaki, et al. 2015).

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[7] In Germany, there have been brief periods when electricity prices dropped under -100€/MWh, due to increased RE generation and low demand, meaning that energy companies actually paid customers to consume electricity.

Regarding the **investment framework and related tariff structure** for smart grids deployment in the Netherlands, dynamic network prices are reportedly being explored through pilot projects. With a wider application of dynamic pricing users would be able to shift their consumption patterns to benefit themselves with 'cheaper' electricity, which would be a driver for smart grid development. At the same time, DSOs would be enabled to control the distribution network via ICT which would lead to less costly grid expansion operations (Mandatova, et al. 2014). Dynamic prices can also reflect the real cost of electricity production (Simple Energy 2012), so ESCOs would benefit in times of low generation and high demand, during which until today led to less revenues for ESCOs because consumers are charged a fixed price.

Lessons learnt from international experiences for investment frameworks and dynamic pricing

Dynamic pricing schemes in an hourly resolution are available to EU member states such as Finland, Estonia and Norway (eurelectric 2017). With regard to incentives for innovative grid works, in 2013 the UK government built a regulatory framework, based on elements of the RPI-X@20, called RIIO (Revenue using Incentives to deliver Innovation and Outputs) to support effective and efficient energy supply to consumers (OFGEM 2017), with simultaneous, continuous innovation encouragement (Crispim, et al. 2014). RIIO is a safeguard to make sure that grid costs do not exceed a certain limit, rewarding successful companies and punishing the unsuccessful ones (OFGEM 2010). Specifically, if a network company provides solutions to problems via innovation while staying under budget, a proportion of the savings is kept as revenue from the network company, and end-user costs are also reduced. But if the company uses expensive, non-innovative solutions, the network company loses revenues (OFGEM 2010, eurelectric 2016). The companies are also eligible to raise funding for innovation through electricity bills, but they lose the money if they do not spend it on innovation. In a similar manner, the Italian Regulatory Authority (AEEGSI) in an effort to incentivize DSOs to promote smart grids, runs pilot programs in the framework of which a 2% premium over the cost of capital was offered to the DSO for 12 years (Crispim, et al. 2014, eurelectric 2016). In France, efficiency measures are imposed on DSOs, meaning that if a DSO achieves the predefined OPEX productivity under budget, it can keep all of the remaining revenue. The stimulus for grid innovation in this system is that the budget for innovation is separate and efficiency measures do not apply to it. This means that DSOs are driven to innovation without compromising their efficient operation (eurelectric 2016). Finally, in the USA smart grid deployment began much sooner with the establishment of the USA's Energy Policy Act in 2005, which mandated all entities to provide customer-requested time-based rate schedule and time-based metering. This fact implicitly pushed utilities towards smart grid development (Zame, et al. 2017). Later on in 2009, with the American Recovery Act, the USA's congress has decided to make upfront investments in smart grid development, aiming to stimulate further investments from the private sector and achieve long-term investment willingness from all stakeholders (Zame, et al. 2017, Zhang, Chen and Gao 2017). The Recovery Act was a general measure to end the great recession in the U.S. (The Balance 2017) and among its actions it promoted investments in many sectors, energy as well (US Department of Energy n.d.).

Currently, the Netherlands is running pilot projects to test both dynamic electricity prices (the lack of which until now was considered to be a barrier to smart grid implementation) and incentive-based mechanisms to drive smart grid development by DSOs. With an aim to improve the county's INECP, incentive-based mechanisms already applied in European countries could be studied and integrated by regulators in the design process of an Energy Efficiency Obligation (EEO) scheme, which would incentivize utilities to promote smart grid technologies. A separate innovation budget could also be beneficial in upscaling the relevant incentive-based mechanisms. In creating a more enabling environment for DSOs and ESCOs in promoting smart grids, policy makers should also closely examine the results of the implemented pilot projects and consider the introduction of a cost-reflective tariff system, such as dynamic tariffs, so that demand shifting is for the benefit of both consumers and suppliers. Furthermore, a combined tariff taking into account both the localized capacity and the aggregated local feed of distributed systems could be introduced, which would be for the benefit of both DSOs and prosumers (Mountouri, et al. 2015).

The new **EU-prescribed unbundled energy market model** defines grid operators as regulated public entities, which have limitations in their cooperation with commercial entities (generators, electricity suppliers and consumers) (eurelectric 2017). According to Dutch stakeholders, this situation conflicts with smart grid implementation principles, since the latter requires close coordination between DSOs and energy supplying companies (Fujiwara, Williges and Tuerk 2017). The unbundling of the energy market has raised coordination issues for smart grids due to the limitation of the unbundled DSO for cooperation with commercial entities. On such evidence, many European countries have introduced a DSO-regulated entity responsible for the data management and exchange between DSOs and energy retailers.

Lessons learnt from international experiences to overcome the unbundling restrictions

In Denmark, the unbundled DSOs are responsible for the installation and maintenance of the smart meters, while the supplying companies are responsible for the services provided to customers. The data of smart meters are also collected from the DSOs and transferred to a central data hub. The existence of a central hub facilitates data access to the customers and to supplying companies which have been approved by consumers. This market model has increased the flexibility and supplier-option-range for customers. In the U.K. smart meters are rolled-out by the supplying companies. The metering data are managed by a Data Communications Company (DCC) which is regulated by the U.K. DSO (OFGEM). If a customer, supplying company or other entity wants to have access to the data, it has to make a request to the DCC. In Sweden, the 2009 regulation that mandated monthly readings to be available to consumers, led DSOs to the installation of smart meters. Smart meters are owned and installed by the unbundled DSOs, who are also responsible for the data provision to energy supplying companies and the balancing of suppliers and customers (van der Burg και Runkel 2017).

A similar approach has been followed in the Netherlands too, through the Energy Data Service Netherlands (EDSN), evolving from a bilateral communication facilitator to a central agency in 2013, to increase synergies of various market entities. While this has been a logical first step to overcome the coordination issues, stakeholders interviewed in the consultation process conducted in 2017 remarked on coordination and collaboration difficulties. Continuing the efforts to overcome this issue, the Dutch government already ran the "Experimenteer Regeling" in some areas where the unbundling regulations were suspended. Concurrent to the current activities of the NL government, close monitoring of the pilot project should take place, to compare its outcomes with the INECP objectives regarding market integration, flexibility in the power sector and smart grid deployment. On the same basis, the potential of the EDSN to provide instant metering and active consumer load control would further aid achievement of market flexibility targets prescribed in the INECP formulation guidelines.

Despite the mandate for nationwide smart meter deployment, the Dutch government has opted for a gradual transition to this goal, mainly through the means of a voluntary roll-out and pilot projects**, in order to increase policy acceptance**. Evidence from the latter shows that information and progressive implementation are key parameters to consumer attraction (Mandatova, et al. 2014). The case of public opposition to smart grid development has been observed in several regions inside and outside Europe. While other countries focused on giving users the right to control their own data such as the UK (Connor , et al. 2014) and Texas (C. Brown 2013), the Netherlands decided to give users the choice of whether or not to install the smart meter at all, and if they do, to limit its operation. This option may be based on the concept of attracting users through evidence[8] and peer learning. This approach's efficiency should be tactically compared with the INECP's objectives and amended if necessary with similar approaches of other EU examples. Complementary to this approach would be the inclusion of data ownership and exchange regulations in the context of smart meter rollout policy, to ensure the secure operation of smart grids without compromising data privacy and consumer security. Two suggestions to increase the pace of smart grid adoption under the current roll-out policy could thus be (i) the consideration of introducing regulation alternatives on data ownership and management, reassuring customers' ownership of their own data, and (ii) governmental efforts on communicating the benefits of smart grids to further attract customers' participation and awareness by upscaling pilot and demonstration projects.

[8] Italy chose an evidence-based strategy to increase public acceptance for smart grids. Since 2012 Italy's Autorità per l' Energia Elettrica e il Gas (AEEG) has put in place a Time-of-Use tariff, addressing residential and small commercial consumers. With these tariffs, consumers are able to see the difference in electricity charges, leading in a change of consumption patterns and a general awareness growth about the benefits of smart grids (Crispim, et al. 2014).

Table 3: Dutch externalities affecting the development of smart grids and suggestions

	Specific externality/barrier	Manifestation of impact	Description of main contextual considerations	Summary of suggested options
Institutions & Governance	Presence of EU regulatory framework	Limitations in the cooperation of DSOs with commercial entities.	Evolution of the Energy Data Service Netherlands (EDSN) from a bilateral communication facilitator to a central agency promoting synergies of the various parties.	• Close monitoring of the "Experimenteerregeling's" data, examining the regional unbundling regulation suspension. • Examination of the potential of the NL central data agency to provide instant metering and active consumer load control.
Innovation & Investment	Low fossil fuel prices	Reduction of willingness to invest in low-carbon technologies such as renewables and energy conservation measures promoted by smart grids.	The Dutch government is exploring the optimal pathway to phase-out fossil fuels by considering growth of renewables, financial aspects, potential carbon leakage to other countries, security of supply and innovation.	• Further investigation of the costs and benefits of a Carbon Price Floor (i.e. minimum price for GHG emissions) introduction. • Consider the option of linking revenues for the CPF to funds utilised for investments in innovative low-carbon options. • Close monitoring of the CPF for distributional effects – timely consideration of cost-containment measures. • Stronger political support for a more robust reform of the coal-based power sector

Innovation & Investment	Market reaction to variability	Possibility of long periods with extremely negative prices, leading to revenue losses for producers.	Day-ahead and intraday price balancing, taking into account international energy trading with coupled markets.	• Effort to increase collaboration with other MS markets by assuring undisrupted market access for all countries and alignment of trading and market clearance periods and methods. This would promote regulatory harmonization towards a single European energy market, more flexible in negative price management. • Assessment of the option to introduce a zero-electricity price limit after a certain period of negative prices. •
	Investment framework for DSOs/ESCOs to invest in smart grids	While smart grid development is considered important by both ESCOs and DSOs, none of them actually invests due to lack of incentives.	Efficient operation incentives are provided to DSOs. Pilot projects run to test new tariff structures and increase consumer willingness to change consumption patterns.	• Introduction of a regulatory framework to monitor grid costs, rewarding successful companies such as the UK RIIO. • Consideration of introducing a separate innovation budget in line with (and not affected by) efficiency operation targets • Exploration of the costs and benefits of replicating national Dynamic/Time-Based electricity pricing mechanisms, based on other EU examples.
Behaviour & Lifestyle	Public resistance to smart grids	Concerns over data privacy and consumer security	Optional smart meter installation	• Consideration of introducing regulation alternatives on data ownership and management, reassuring customers are the owners of their own data • Efforts on communicating the benefits of smart grids to further attract customers' participation and awareness

3.3 Barriers to RES investment in Croatia

3.3.1 Context

As a part of the process of accession into the EU, the Croatian government in 2008 began establishing a strategy aimed at increasing the prevalence of renewable energy sources in the country. The first background energy strategy was adapted into law in 2009, and set a low bar for success (e.g. a target capacity of under 50 MW of photovoltaic electricity). The prices for the first feed-in-tariff for PV generation were high and the quota was reached shortly after adoption of the law. Policies were refined over time, adding new quotas for PV, wind, biomass and biogas with the country's first renewable energy plan adopted in 2013 (Narodne Novine 2015). The plan adjusted targets and projections of future growth to be more realistic, as compared to previous plans (e.g. taking into account uncertainties and effects of the financial crisis, which had resulted in prior plans being based on higher consumption than observed in actuality). The 2013 plan was criticized by stakeholders in terms of the decision-making system and underlying assumptions due to a lack of transparency.

New governments had implemented their own revisions to the main acts as well as secondary legislation, leading to problems of policy continuity, with some strategies and legislation not being implemented at all, or with changed targets. This lack of transparency and heightened uncertainty were previously cited as barriers to investment, along with barriers in the form of construction, environmental, and other legal issues. In 2016, a new law was introduced which abandoned the previous feed-in-tariff mechanism and introduced a new premium support system in its place.

Recent progress in development of legislative and regulatory frameworks is underlined by the assessment of the current imbalance in Croatia's energy trade and its ambition to source from renewable energy (Mesarić 2016). Croatia currently imports 40% of its electricity needs. While the country has high potential to meet the needs domestically, the existing legislative and regulatory frameworks are not supportive and hinder investment. The only Croatian producer of solar panels (as of November 2017) export most products to countries such as Germany, France, the Netherlands, Italy, and Austria because there is no local market (Ilic 2017)

This case assessed the evolution of renewables policy in Croatia and focused on the contextual factors which were influential in the design and implementation of the 2016 law (described in further detail in section 3.2.2) to determine to what extent taking these factors into account could have improved the policy process, to inform stakeholders and policymakers in the future. Here we provide an overview of the main barriers found, and highlight ways in which they were addressed either in this case, or in other experiences via literature review, and provide recommendations for both a national and EU level.

In 2016, the Croatian government introduced a new policy to promote renewable energy in the country, meant to replace previous iterations of policies enacted since 2009. The

"Law on Renewable Energy and High-efficiency Cogeneration" was adopted, which (for generation sites > 30 kW) shifted the support mechanism for renewables from a feed-in-tariff scheme to a premium support scheme.

The new law was comprised of three main components, (i) a feed-in premium support mechanism (introduced via auctioning) for a predetermined quota of wind, PV, biomass and biogas technology plants, (ii) a continuation of Feed-in Tariff (FiT) support for plants up to 30 kW, also via auctioning; and (iii) a net metering scheme for "prosumer" installations up to 500 kW, which allowed for charging the prosumer for net energy production or consumption.

This new law, along with including about 30 PJ of biomass energy production into accounting of the share of renewables in total electricity generation, appears to have set Croatia on a path to meeting EU targets for 2020 to have 20% of total energy demand met by renewables and allowing policymakers to focus on further (e.g. 2030 and 2050) climate and energy goals.

Under the current scheme, growth of wind and PV capacity is unlikely into the future; quotas for wind power have almost been reached, with the limit (744 MW) either currently in production or in planning stages by 2017 (Hrvatski Operator Tryista Energije 2017), with no expected increases in the quota forthcoming. While previous PV contracts will be honoured, no new contracts for generation will be offered under the plan, but biomass and biogas quotas have been increased, ostensibly to promote technologies with more local impacts, as support for investment in PV and wind (e.g. increase in electricity prices to subsidize renewable energy) is mostly seen as benefiting the regions from which the equipment originates (e.g. foreign equipment and installation of PV and wind generation in Croatia). In terms of hydropower, limited potential for new generation exists in the country, but 500 MW of capacity increases are planned.

3.3.2 Barriers

Stakeholder interviews were carried out to identify the key contextual factors serving as enabling or blocking factors for the 2016 law; further information on the method and results can be found in the CARISMA Deliverable 6.3. We here highlight the main results and discuss the key blocking factors highlighted by interviewees. Generally, interviews reflected what was previously mentioned about the development of RES policy being seen as lacking transparency and being made with an objective of optimizing response to EU targets and regulations. A major barrier to policymaking prior to the 2016 law was the division of responsibilities regarding RES to two separate ministries dealing with environmental protection and energy, which were streamlined by the government in 2012 into one Ministry of Environmental Protection and Energy. Interviews also indicated a shift of government planning to be motivated by increasing local value added and promoting linear growth of renewables. As mentioned, technologies like wind and PV have been seen as adding little benefit to local communities, as investment is perceived as flowing out of the country. Additionally, policymakers are wary of promoting aggressive growth in RES, to avoid situations seen in the Czech Republic and Slovenia with rising electricity prices for consumers.

We found that the main contextual factors affecting the 2016 policy were related to aspects of institutions and governance, innovation and investment, with attitudes, behaviour and lifestyle issues playing a smaller, but growing role.

Institutions and governance

Two major contextual factors identified in this area were that *no single governing body existed to govern energy, with no agency with a mandate to design policy*, and that there existed much *difficulty of coordination between national and EU-level institutions.* Both factors reflect aspects of **institutional coordination**, which conveys how coordination between multiple ministries and between different levels of government affects policymaking, and was consistently seen by stakeholders as having high importance in the policymaking process in this case, both in terms of historically being a hindrance to efficient / effective policymaking, and also a factor that was considered and addressed, notably through the creation of the new Ministry of Environment and Energy. While the contextual factor may not have been considered at the outset of policymaking, the conflicts and inefficiencies which arose due to having no single body to govern energy and no special agency with a mandate to design policy were addressed over the course of the evolving renewables policy.

However, the definition of institutional coordination was seen as lacking in one regard; there is mention of coordination between national and sub-national institutions, but a factor highlighted repeatedly was the interaction of EU-level agencies and the national level. EU regulation was mentioned as being the main motivator for initial policymaking decisions. Additionally, there was an impression that new EU regulation comes at a fast pace, creating some difficulty for e.g. smaller countries to keep up with the complexity.

Innovation and investment

In terms of market aspects, the case further highlighted *unclear regulatory frameworks for RES support mechanisms* as being an influential blocking factor, with the **market framework** in Croatia having a detrimental impact on investment in renewables, as regulatory frameworks were unclear, which deterred investors. Policymakers at the time were seen mainly as being uninterested in solving the problem and shifted the burden of considering any possible changes towards future policies.

Decreasing technology costs (e.g. solar PV, wind) were highlighted as being important in policy development, but there was some disagreement to what extent they were taken into account. Comments from University researchers maintained that such costs were taken into consideration to a large extent via consultation with modelers and engineers who tried to explicitly and accurately assess costs. However, possibly due to a lack of transparency in the process, others felt that there was not so much information or explanation as to how and why goals and prices were set as they were, at least initially, a view which is seen as improving with increased political will.

The final factor viewed as having a blocking impact on RES development was the need for *Import/Export balance or self-sufficiency in production and consumption*; most of the returns for investment support in PV electricity are perceived as leaving the country and going back to Germany from where solar panels are exported; and the country has little gain in the way of energy trade with its neighbours. Therefore, there is a desire for technology that provides local value added. Consideration of this factor was perceived as important in the previous policymaking processes.

Attitudes, behaviour and lifestyle

While not as large a blocking factor as the aforementioned, the *lack of strong public opinion on development of RES* was seen as a rising influence which would need to be addressed. While **public perception** was stated to have had little bearing on initial policymaking (as most of the general public did not hold strong opinions on the development of RES), later consultation with experts found the situation to be changing, with recent public agitation and backlash surrounding announcements of increasing levies for RES (HRT Vijest 2017).

Similarly, and in the vein of **public perception**, the *projected costs of RES to final consumers and the indirect social costs* were also mentioned as a growing concern in the policymaking process. In part, this reflects a growing consideration of how increasing shares of PV will have broader societal effects, as well as an increasing consideration of the costs to final consumers in a country that has a far higher energy poverty risk that for example Western European countries. To some extent, this is similar to the remarks on self-sufficiency e.g. promoting technologies that provide local value added.

3.3.3 How to overcome?

The case has served to highlight barriers to effective policymaking and implementation at both national and supra-national levels, and as the focus was on RES development over time, has allowed for observation of how those barriers were addressed (or not). In the following section, we provide a snapshot of how these barriers were mitigated in the Croatian case, as well as examples from literature of similar effects seen elsewhere, and the recommended actions needed to overcome them.

As time and experience of policymakers wore on, we found that to a large extent, consideration of and addressing contextual barriers increased in the country, particularly in regard to **institutional coordination**. While initially two separate ministries (Environment and Energy) were relevant authorities involved with RES development, the inefficiencies involved in having two separate bodies was made apparent and as a solution, the Ministries were merged. While this may seem like a simple solution to a simple problem, it does warrant mentioning, and can serve also as a positive example of *mainstreaming* climate change and moving the issue to the forefront of discussions, rather than a peripheral consideration.

Similarly to institutional complexity and resulting barrier above, the **market framework** in Croatia was consistently cited as a limiting factor for policy success. Indeed, these findings aren't an outlier or particularly new; (IRENA 2013) in a study on barriers to RES in south-eastern Europe find many of the same conclusions as we do here. They pinpoint four barriers related to the energy market relevant for the region, two of which interviewees feel are adequately addressed (administrative and legal barriers; lack of awareness, capacity, and skills), and two not (market, technical and regulatory barriers; economic barriers):

(i) Market, technical and regulatory barriers – e.g. insufficiently competitive regulatory environments for private companies which restricts market access for new entrants due to administrative and institutional complexities.
(ii) Economic barriers – e.g. lack of bank experience with RES development, and lack of public funding, restricts development to incumbent utilities with access to state aid, limiting the participation of independent investors
(iii) Administrative and legal barriers – e.g. bureaucratic hurdles, complex permitting, legal uncertainty due to changing legislation, lack of clear delineation of responsibility among authorities
(iv) Lack of awareness, capacity and professional skills

The creation of the Ministry of Environment and Energy serves as an example of addressing point three of the above, but further barriers remain. In terms of market, technical and regulatory barriers, (IRENA 2013) recommends the "creation of a competitive integrated energy market between the countries [of] South East Europe and their neighbours in the European Union, ultimately involving the integration of South East Europe into the unified EU energy market, [which] would help set cost-reflective energy price signals" necessary to attract new investment. Additionally, while our findings indicated that a lack of awareness and capacity were non-issues, that may be changing; at least in terms of awareness. As to the latter point of professional skills and capacity, perhaps this is an alternative formulation of the expressed idea of wanting "local value-added" renewable technology e.g. biomass and biogas. If more human capacity for e.g. wind and PV existed in the region, it would lead to more potential value-added from future RES policy. (Atanasiu 2013) also support the existence of an economic barrier, finding that banks serve as an important source of finance, e.g. offering dedicated credit lines for household RES investment. (Nasirov 2015) emphasize the need for the state to provide funding for RES deployment beyond tariffs or premiums, e.g. offering loan guarantees or issuing "green bonds" for local commercial banks to encourage long-term funding.

Finally, in regards to increasing **public perception**, there exists a healthy body of research from which to draw. (Heiskanen and Matschoss 2017) undertake a review of studies' findings on the issue and find a number of factors reducing the barrier at local and national scales. They find that local organizations such as solar initiatives serve an important role in diffusion of RES technologies by providing advice and information, but also local knowledge in terms of engineers and architects, real estate agents and house managers can positively influence acceptability and adoption. At the national scale, policies such as Croatia's are naturally a driver for development of RES, but they emphasize that focus on such policies obscures the role of less observable policy measures undertaken earlier in market development, e.g. demonstrations or training, qualification and certification of installers etc. (Kowalska-Pyzalska 2018) provide a number of recommendations for reducing barriers to adoption of innovative energy services, but emphasize the need to (i) increase awareness and understanding, (ii) reduce perceived difficulty of adoption via information, ease of use, and focusing on benefits, and (iii) encourage positive word of mouth and confident information to and from mass-media in order to create strong social norms.

The contextual factor **policy continuity** may also provide a co-benefit in this regard, as noted in (Prendergast 2010), with countries having a longer history of policies thus having more institutions and less public perception issues, e.g. long-running and consistent RES policies can lead to increased uptake socially.

While most of the factors identified were seen in a national context, the solutions as discussed above could logically be applied to other EU countries or regions, and some solutions, e.g. creating a competitive market in South East Europe with links to the EU is certainly an issue for the broader EU to deal with, but the Croatia case highlighted a specific instance of a contextual barrier due to the interaction of EU and national level, which we highlight here.

Initially, policymakers implemented RES legislation in order to meet EU targets, and following accession, have implemented plans to meet EU-stipulated goals. However, stakeholders found it difficult to implement directives handed down from the EU and described them as coming at too fast a pace for the national government to adequately address. This thus could lead to inefficient or ineffective policies at the national level, thus frustrating the meeting of either national or EU climate and energy targets. While the EU has long emphasized reducing administrative barriers (e.g. Article 6 of (European Commission 2001) and (European Commission 2008)), but seemingly always with a focus on member states' reduction of barriers, with less focus on vertical integration. Emphasizing that EU-level policy may have varying effects on different member countries would be beneficial in terms of future success of policies at both levels. However, such administrative barriers are less well documented in the literature, as noted by (del Río 2018), who find only anecdotal evidence of barriers to concentrated solar development for two EU countries, but conclude that streamlining administrative procedures is still important in regards to reducing costs due to permitting. Similarly, we find little other research or policy recommendations in this regard, with a general focus on administrative barriers at a single governance level, but less emphasis on interaction between Member States and the EU, leaving this an open question for further work.

Table 4: Croatian externalities affecting RES investments and suggestions

	Specific externality/barrier	Manifestation of impact	Description of main contextual considerations	Summary of suggested options
Institutions & Governance	No single governing body to govern energy and no agency with mandate to design policy	Lack of clarity as to which Ministry should handle RES policy and adversarial atmosphere surrounding policymaking process	The Croatian government initially had two separate ministries (Energy and Environment) both of which assumed responsibilities relating to RES policy, with no clear mandate	• Ministries were merged into a Ministry of Energy and Environment, reducing uncertainty and adversarial policymaking atmosphere
	Difficulty of coordination between national and EU-level institutions	National ministries had difficulties understanding and implementing EU directives	National stakeholders felt EU directives came at too fast a pace to be effectively implemented due to a lack of capacity	• Greater focus at EU level on reducing administrative barriers between member states and EU (current focus is mainly on reducing member-state barriers only) • Streamline administrative procedures may additionally reduce costs e.g. of permitting processes
Innovation & Investment	Unclear frameworks for RES support mechanisms	Lack of private investment into RES technology	Information on regulatory frameworks was seen as unclear, not well-conveyed or disseminated by government, deterring investors	• Creation of competitive integrated energy market between neighbouring countries and other EU members, i.e. integration into unified EU energy market • Banking institutions should be encouraged to offer dedicated credit lines for RES investment • State funding for RES deployment beyond tariffs or premiums, e.g. offering loan guarantees or issuing green bonds for local commercial banks

Innovation & Investment	Desire for "import/export balance" or self-sufficiency	Lack of RES policies with a focus on PV and wind, and subsequent lack of investment into the technologies	Most of the revenues of capital-intensive technologies such as PV and wind are seen as benefitting outside countries which provide technology and skilled workers e.g. installers, while little revenues seen as remaining in-country	• increase human capacity for RES installation and maintenance e.g. for wind and PV • Focus on training, qualification and certification of installers etc. • Reduce perceived difficulty of adoption via information, ease of use, and focus on benefits of RES
Behaviour & Lifestyle	Lack of strong public opinion on development of RES	Little public interest in initial RES policies	Initial lack of strong public opinion on development of RES led policymakers to not consider the contextual factor, but public opinion is now shifting, with public agitation and backlash surrounding recent policy updates	• Encourage local organizations such as solar initiatives to serve role in diffusion of RES tech by providing advice and information • Improve knowledge of RES among engineers, architects, real estate agents, house managers, etc. to positively influence acceptability and adoption • Early policies in market development, e.g. demonstration projects can assist in reducing barriers to adoption • Generally, increase awareness and understanding and encourage positive word of mouth and confidence in information to and from mass media to create strong social norms
	Projected costs of RES to final consumers and indirect social costs	Growing concern of the effects of RES deployment on e.g. employment, inequality in distribution of costs / benefits, etc.	In a country with far higher levels of energy poverty than other Western EU countries, concern over the costs to final consumers and distributional impacts is growing, leading to increased public resistance	• Improve human capital locally (increased relevant professional skills and capacity), e.g. training and certification of installers, engineers, etc.,

3.4 Encouraging building innovation technologies in Greece

3.4.1 Context

In Greece, energy efficiency (EE) policies, relevant to the promotion of innovation technologies in buildings, have shown slow progress in a post-crisis environment, due to critical restraints in public budget and subsequent lack of political will. Existing subsidy programs have experienced low participation levels both by citizens and enterprises, while other, post-subsidy policies (voluntary agreements, tax exceptions etc.) remain idle. The new Energy Efficiency Obligation (EEO) scheme introduced in 2017 is considered a first important step towards the transformation of the Greek energy market (Fujiwara, Williges και Tuerk 2017).

Nevertheless, the Greek regulatory framework with regard to the public sector has shown a slow development route towards its harmonization with EU requirements and legislation. This pertains mainly to Energy Performance Contracting[9] (EPC) and Green Public Procurement[10] (GPP) implementation in the public sector (Fujiwara, Williges and Tuerk 2017).

The Greek government has thus far made some efforts in expanding EPC projects for public buildings. In fact, the Greek Ministry of Environment, Energy and Climate Change has developed a national pilot project (running for the period 2011-2020) as part of the program "Htizodas to mellon" (Eng.: Building the future) which targets the refurbishment of public buildings via EPC. The main target of the pilot project is to investigate and clearly define the technical, procedural and legal parameters and requirements for the implementation of EPC projects in the public sector (Μαρκογιαννάκης 2012). Furthermore, in order to remove the regulatory and non-regulatory barriers that impede the establishment of EPC in the public sector, the Center of Renewable Energy Sources (CRES) has developed a project[11] entitled "Support and monitoring of the pilot project for the implementation of energy efficiency projects in public Buildings by Energy Service Companies (ESCOs)", which was funded by the operational program "Environment &

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[9] With Energy Performance Contracting, an energy project is financed from the cost reductions incurred by the energy upgrades. The project is implemented by an external organization, which in turn is paid by part of the energy savings of the consumer (European Energy Efficiency Platform (E3P) 2018).

[10] With Green Public Procurements, public entities supply goods and services with low environmental impact.

[11] The scope of the project was to support the state, the public authorities and the ESCOs in developing and promoting the Greek energy services market, through standardization of the required procedures. Through this project the following activities were implemented: (i) identification of the institutional barriers to the implementation of EPC projects from ESCOs in the public sector, (ii) identification of the most appropriate process for procuring EPC projects for public bodies and assigning them to ESCOs and (iii) identification of barriers and specific issues related to tax procedures, compatibility with public accounting and insurance regulations (Ιατρίδης 2016).

Sustainable Development" 2007-2013 and presented in detail in the 3rd National Energy Efficiency Action Plan (NEEAP) (ΥΠΕΚΑ 2018).

Regarding the public procurement framework in Greece, there are currently no clear regulations on how to make the procurement process more environmentally-friendly, and GPP was not included in the country's 3rd NEEAP. (Spyridaki, Banaka and Flamos 2016) In the 4th NEAAP published in December 2017, the need for establishing a national strategy for the implementation of green procurements from public entities has been recognized and specific action steps have been proposed towards this direction. The main action-steps include (i) the development of an action plan to promote GPP, (ii) the timely update of public body suppliers, as well as other interested parties, (iii) the consideration of drafting environmental criteria or adopting those issued by the European Commission, (iv) the choice of products, services and projects to which environmental criteria will be applied, (v) the evaluation, monitoring and update of the national policy and National Action Plan (NAP) (ΥΠΕΚΑ 2018).

3.4.2 Identified Barriers

In the Greek case study, as conducted under D6.3 - Report on the knowledge gaps about key contextual factors (Fujiwara, Williges και Tuerk 2017), a set of contextual factors inhibiting the diffusion of building innovation and EE technologies in the building sector was analysed. Stakeholders engaged in the consultation process expressed concerns which were mainly relevant to institutions and governance, innovation and investment-related issues in the domestic energy services market. Factors related to attitudes, behaviour and lifestyle were also deemed quite influential.

Institutions and governance

The lack of an enabling **institutional framework**, with regard to EPC and GPP, has been mentioned as an inhibiting factor to the diffusion of energy saving technologies across sectors. While an EPC framework for public buildings exists in Greece (Csaszar, et al. 2015), contracting is viewed as deficit in a municipality's balance sheet, which has limits in the amount of debt it can present at the end of a fiscal year (Fujiwara, Williges and Tuerk 2017). More specifically, the problem is that even though EPCs are paid via energy consumption reduction (no instant payment is done), municipal debt regulations restrict pubic debt (including contracted debt) to a percentage of the last year's revenues, which can easily be surpassed with EPC projects. For the case of GPP, the lack in trained personnel to conduct GPP, with a parallel lack of coordination between pertinent authorities and special services across ministries were mentioned as causes. On that subject, in the 4th NEEAP the General Secretariat for Trade and Consumer Protection of the Ministry of Economy, Development and Tourism is assigned as the pertinent authority for the development of a National Policy and the elaboration of a National Action Plan for the Promotion of GPP. The General Secretariat is expected to cooperate with all pertinent ministries, public and private sector bodies to promote the necessary legislative arrangements and to take the necessary measures required for the implementation of the relevant provisions for GPP. Additionally, where necessary, the ministry applies measures to remove regulatory and non-regulatory barriers that hinder the implementation of EPCs and other energy efficiency services (ΥΠΕΚΑ 2018). Nevertheless, no coordination procedures are yet specified to foster and establish a more efficient cooperation across different authorities and public entities.

The **lack of ministerial coordination** or established procedures between ministries regarding the design and implementation of EE measures in Greece, is a major obstacle for policy makers responsible for the design of financial incentives for the promotion of building innovation technologies (Fujiwara, Williges and Tuerk 2017, multEE 2017). The inefficient inter-ministerial coordination was attributed to (i) the lack of cooperation and communication among ministries and authorities in different governance levels as well as (ii) the lack of regulatory alignment with non-climate policies and their objectives (integration[12] of EE policy objectives) that have to be met often through the same available funds. Reportedly, the lack of horizontal coordination between different governmental institutions and ministries have led to a delay or even obstruction of EE measures implementation, setting back the country's progress on EE (Fujiwara, Williges and Tuerk 2017).

In addition, in terms of policy consistency, even though EE is mentioned as a priority in the national renewable energy roadmap until 2020, the current macroeconomic environment (with the ongoing economic recession) and the lack of adequate funds has led ministries to allocating limited available budget to more urgent matters (e.g. social policy issues), making the EE actions promotion of secondary importance (Fujiwara, Williges and Tuerk 2017).This is also reflected in the developments as regards the set-up of a National Energy Efficiency Fund. Even in the fourth NEEAP issued in August 2017 (ΥΠΕΚΑ 2018), it still remains unclear whether necessary structures and resources are available to form such a fund.

Innovation and investment

The currently underdeveloped **corporate and investment culture** was mentioned as a major obstacle inhibiting the diffusion of smart building technologies. More specifically, the lagging **Greek energy services market** and the lack of initiatives by utilities to promote smart technologies to final electricity consumers and their idle role of stiff compliance with governmental directives (such as the recently introduced Suppliers Obligation), were reported by Greek policy experts to shape the lack of innovativeness in the energy service market. The deregulation of the Greek electricity and gas market has

[12] Policy integration of policy objectives and measures in the entire/national policy mix relates to the consistency of objectives as well as of legal acts (complementarities with existing legislation) (Spyridaki, Banaka and Flamos 2016).

also been lagging behind and only recently has actual market opening occurred[13]. This inactivity is closely correlated with the Greek behavior and lifestyle driven by unawareness of Greek citizens regarding the benefits of energy efficiency let alone smart building technologies. Reportedly this was mainly due to the absence of a well-coordinated nationwide marketing campaign promoting national EE support programmes (Fujiwara, Williges and Tuerk 2017). In the 4th NEEAP it is mentioned that with the Article 19 of Law 4342/2015 (Government Gazette A, 143, 09-11-2015) entitled "Energy Services", the Article 18 of the European Directive for Energy Efficiency is transposed in the National Legislation. The Greek ministry of energy, which has the responsibility for the proper operation of the energy services market including the access of SMEs, identifies and publishes on its website[14] contact points where final consumers can receive information on energy services.

Attitudes, behaviour and lifestyle

At the same time, the adoption of smart technologies is made even harder due to inhibiting social attitudes, such as **low public environmental consciousness** and EE familiarity. In a period of economic recession / crisis which all but facilitates the leveraging of capital in a market lacking liquidity from financial institutions, citizens are even more unwilling to invest due to the big upfront costs. This also results in lack of interest to keep up with the recent EE opportunities. A national financial subsidy for residential EE refurbishments, called "Exoikonomisi kat' oikon II'' (Energy Savings at Home II[15]) has recently been re-activated targeting low income households, yet with significant budget constraints (Fujiwara, Williges and Tuerk 2017). Some actions regarding EE to attract consumer awareness have been implemented but were mainly ad-hoc practices developed by the until recently monopolistic electricity supplier (Public Power Corporation - PPC). For example, electricity bills have changed and become more transparent and to a large extent understandable by the citizens. Moreover, several flyers containing tips for the reduction of the overall consumption were included from time to time.

[13] Electricity prices were fully liberalized in July 2013 but effective entry into the market has only recently started to take place, yet the Public Power Company (PPC) still remains the dominant supplier. In gas, the continued independent operation of gas TSO DESFA after its privatization needs to be ensured by the national regulatory authority fostering competition also on the retail level thus allowing consumers to switch suppliers and reap the benefits from the liberalized market (European Commission 2014).

[14] http://www.escoregistry.gr/

[15] Energy Savings at Home II is the reactivation of the successful Energy Savings at Home I project which ran for the period 2007-2013 and succeeded in EE refurbishments to more than 60,000 homes (Ministry of Envitonment and Energy 2018).

3.4.3 How to overcome?

Current trends in support mechanisms for EE and stimulating investments in the energy services market reveal that efforts are made towards a transition to a post-subsidy era where investments are leveraged primarily from the private sector and less from a usually overburdened government budget through public private partnerships (PPP) (Hockenos 2017). At the same time, the critical role of municipalities in promoting EE has been recognized, and a relevant **regulatory framework** enabling public entities to conduct contracts and investment projects by utilizing third party financing is considered a primary condition (Hockenos 2017, Energy efficiency in municipalities 2017). Such

Lessons learnt from international experiences for GPP and EPC frameworks

Austria has demonstrated years of experience with EPC and GPP projects. The Austrian government established the Art. 15a B-VG agreement, which serves as an agreement between the central government and federal states for the promotion of EE measures, clearly defining a maximum 15-year payback period as a decision criterion, to overcome the annual debt restrictions of municipalities (Grazer Energieagentur 2012, Garnier 2013, Auer and Bayer 2013). Regarding the municipality debt restriction, the Slovenian government during the years 2006 and 2007 opted to exclude EPC contracts from the municipality debt quota, to enable EPCs for the public sector (Staničić 2010). In France, with the introduction of the "Grenelle 1" law (2009), EPCs for the public sector were allowed, including design, implementation and O&M - under the umbrella of a single contract. (Ministry of Ecology, Sustainable Development, Transport and Housing; Ministry of the Economy, Finance and Industry 2011). In Germany, municipalities are allowed to perform EPC with private companies, but they are audited by federal or local authorities which are also responsible for the approval of the EPC contract. During the approval process of a contract by the authorities, the competition of the bidders before the tendering is secured and the comparison between EPC costs and self-financing is evaluated. If a project can be implemented more economically with municipal funds, the EPC is not approved (Berger and Schäfer 2009). Finally, additional incentives for EPC implementation in cities lies in the formation of national and regional competence centres promoting EPC, the formation of trade associations of ESCOs promoting EPC as a business model and the promotion of inter-municipal cooperation and/or pooling for public projects (PROSPECT 2018).

As regards the implementation of GPP, the Slovenian government initiated the operation of the Public Procurement Agency in 2011, which implements GPP for the supply of electricity, paper, office IT equipment and vehicles, and considers environmental and award criteria during the supply of specific products and services (GPP in practice 2011). Similarly, the city of Kolding in Denmark implements GPP for the supply of goods, services and the construction sector after adopting the municipal GPP policy in 1998. An initial call for tender was published by the city's environment department for the replacement of conventional light bulbs with more efficient ones. Ever since, almost all tenders are performed using GPP criteria, which consider environmental requirements and award criteria. Finally, another example is that of Hungary, which conducts GPP for public authorities through the Public Procurement and Supply Directorate General (European Commission 2012).

regulatory environments include frameworks for the implementation of EPC and GPP, the lack of which has been mentioned by Greek stakeholders as an inhibiting factor to the diffusion of energy saving technologies across sectors (Fujiwara, Williges and Tuerk 2017). Reportedly, a framework[16] enabling the conduction of energy service contracts for the public sector by third parties in the UK has been mentioned as catalysing to the expansion of the UK energy services market (Nolden, Sorrell and Polzin 2016).

The pilot projects for EPCs in the public sector, developed by the Greek Ministry of Environment, Energy and Climate Change and the Greek energy agency is a necessary next step, however these efforts need to be strengthened. To enhance the pilots' outputs and effects, the examples of other countries to address similar difficulties should be examined. For instance, the most straightforward suggestion would be to exclude EPCs from the municipality's debt quota, while accounting for settings required to monitor and preserve the sound financial state of municipalities. Towards this direction, a maximal payback period as a criterion for public EPC approval could be beneficial in not exceeding the debt limit of municipalities. Concurrently, the introduction of an auditing authority responsible for the approval and smooth implementation of public EPC projects could be advised. Additional incentives for EPC implementation such as the formation of a national competence centre promoting EPC, the formation of trade associations of ESCOs promoting EPC as a business model and the promotion of inter-municipal cooperation and/or pooling for public projects should be considered by the Greek policy makers (PROSPECT 2018).

Regarding the **GPP regulatory framework**, Greece has recognized the need for establishing a national strategy for the implementation of green procurements from public entities. Greek policy makers could take direct actions to develop the Greek GPP framework which should include: the allocation of responsibility to pertinent authorities, the determination of product and service groups mandatorily purchased through a GPP process and the determination of environmental and award criteria. Furthermore, regulators could consider introducing GPP implementation targets as part of the public procurement ensemble. Finally, the introduction of a qualified entity for the joint supervision of GPP processes and EPC projects should also be considered by policy makers.

To mitigate cases where **EE targets are under-prioritized over other policy objectives**, EE should be better integrated into other economic and social policy areas. This mandates close cooperation between competent ministries for the re-design of the various policy targets and the identification of policy complementarities. It would also be advisable for Greek policy makers to consider EE with equal priority as other national policies, by integrating EE targets into mainstream economic planning, local government, business development processes in general and other social policy areas. Better **policy integration and design across different policy themes** should be of primary focus

[16] Public procurement frameworks for energy service contracts (PPF)

during the NCEAP development and target setting. While this is a recurring issue, there is little evidence of substantive progress in the country's EE policy formulation process to maintain durable policy commitments when it comes to EE. Corrective actions should be directed towards a better design of grants to ensure synergies between the different policy priorities. In addition, to directly promote the deployment of innovative mitigation options, careful policy design should also include the creation of innovation funds with appropriate criteria specifying the eligibility of options for direct support. The development of innovation funds specifically targeting less mature options in the market, such as building innovation technologies, is highly recommendable to reassure the use of revenues to fund and scale up the implementation of technologies with high savings potential.

Awareness raising actions and incentives for the promotion of building innovation technologies, and EE measures, are almost non-existent in Greece. Nevertheless, since the Greek EEO scheme was adopted in 2017, Greek policy makers hope that utilities will gradually have a more active role to play improving thus the maturity of the energy services market. As the Greek EEO has only recently been introduced such actions should first aim at improving consumer awareness and should take stock of existing examples from other utilities programs and experiences. A suggestion continuing the initial efforts of the PPC to clarify the energy bills could be the inclusion of consumption statements to electricity bills to motivate consumers to change their consumption habits. This could be done along with the introduction of a personalized consumption index informing the consumer of his "consumption efficiency" in comparison to other similar houses and proposing measures to improve it. Furthermore, utilities should also consider providing soft measures to consumers, such as vouchers for old appliance and light bulb replacement, as a motivation for consumers to see the change in consumption levels. These actions should also be reached out through information campaigns lead by the utilities including a big diversity of mass media. The development of advice centres, such as those in the UK, offering personalized advice to consumers, should also be considered as an initiative by Greek utilities.

From the side of regulators, as prescribed in the 4th NEEAP, actions **towards stimulating the energy services market** so far include the dissemination of informative material regarding the financial instruments, incentives, grants and loans to support projects for energy efficiency. More specific actions could be derived from successfully implemented mechanisms in other EU member states. A flexible tariff system, providing customers with two billing periods (peak and off-peak) is already existent in Greece, motivating consumers to shift their consumption to off-peak periods.

Lessons learnt from international experiences for energy services awareness raising incentives

The 2001 initiative of the UK NGO, Energy Saving Trust, founded the Energy Efficiency Advice Centres (EEACs), aimed to increase citizens' awareness of EE and GHG emissions by helping them adopt environmentally friendly habits and purchasing options. The success rate of the EEACs is significant, with over 750,000 occupants acting more efficiently in their consumption habits annually (Dahlbom, et al. 2009). In Austria, as part of the "Fair Energy" programme, initiated in 2005 by the electricity utility of Upper Austria, Energie AG, an energy check service was provided to households, aiming to inform the occupants of their annual level of consumption, compare it to the median of the Upper Austria's similar residences and give advice to reduce the household's electricity consumption, including several services/incentives such as vouchers for the replacement of non-environmentally-friendly appliances (including old light bulbs). The first year of implementation saw 3,000 household checks (Dahlbom, et al. 2009). A similar action was promoted since 2004 by the Spanish utility company, Unión FENOSA. The utility developed a system which calculated an Energy Efficiency Domestic Index (EEDI) according to a person's consumption habits in his household. Until 2009 (when the company went out of business) over 22,000 consumers have had their EEDI calculated and around 10,000 visits to the online platform had been recorded (Dahlbom, et al. 2009). The French Agency for Environment and Energy Management and the Nicolas Hulot Foundation for Nature and Mankind launched the Défi pour la terre (challenge for the earth) campaign in 2005. The campaign uses a large number of mass media, such as TV, radio and media popular among younger ages to communicate energy awareness to the public. Apart from information, the campaign offers volunteers ten environmental protection actions (including everyday habits and purchasing options) to select from and adopt in their everyday life. Up to 2009, more than 700,000 citizens participated to the campaign (Dahlbom, et al. 2009). In Ireland, the Commission for Energy Regulation (CER) ran a trial in 2010 to investigate the possibility of shifting consumption to off-peak periods and reducing the aggregated electricity usage, by providing more informative electricity bills to citizens. Usage statements were added on the electricity bills consisting of (i) the time of use rates structure, (ii) advice on device operation hours based on the rates structure, (iii) consumption comparison between the last two bills as well as with other participating households and (iv) analysis of the electricity cost per day and Time of Use rate. The trial's results showed that 82% of the consumers participating actually changed (even to a small degree) their consumption habits and 54% know their actual consumption. However, the long-term results (after the trial's end) were not as effective, with much fewer people knowing how (~22%) and willing (~24%) to further decrease their electricity consumption perhaps owing to the trial's short duration (VaasaETT; World Energy Council; ADEME 2015). Finally, in Switzerland, the SwissEnergy Programme, initiated by the Swiss Federal Councilor Moritz Leuenberger is aimed at the "sensitisation, information, advisory services, training and further education, quality assurance, networking and the promotion of progressive projects relating to EE and the use of renewable energy" as stated in the programme's official page. (Swiss Federal Office of Energy (SFOE) 2017) In the program's most recent annual report it is stated that in 2013 approximately 67% of the randomly selected citizen group were aware of the SwissEnergy Programme, from which 80% believed that the mascot was a good practice (SwissEnergy 2014).

A potential next step could be the inclusion of extra billing periods (such as the intermediate tariff/shoulder period applied in Austria) or the establishment of cost reflective tariffs (reflecting the electricity generation costs entailing producers and suppliers) in order to increase the flexibility and transparency of the market, further incentivize demand shifting and attract more suppliers.

Furthermore, in continuation of the recently introduced Energy Efficiency Obligation (EEO) scheme, regulators should periodically monitor its progress, applying amendments when necessary, and incrementally increase the obligation target, so that to ensure its successful implementation and incentivize the utilities to promote EE measures by strengthening the binding savings targets. Regulators should also drive their efforts to develop a public-private partnership (PPP) framework, to enable collaborative actions between the public and the private sector. PPPs attract private investments that would not otherwise be implemented by the private sector. The active involvement of private entities in such projects that set continuous service quality improvement requirements (aiming in being competitive), could greatly benefit the energy service market's maturity. The frameworks should clearly define the partnership types, the obligated and eligible product and service groups, and the training procedures of authority personnel regarding legislative and technical matters.

Table 5: Greek externalities affecting the diffusion of building innovation technologies/energy efficiency measures and suggestions

	Specific externality/barrier	Manifestation of impact	Description of main contextual considerations	Summary of suggested options
Innovation & Investment	Lack of regulatory investment framework	Difficulty in implementing EE projects through EPC and GPP mechanisms, especially for the public sector, due to debt restrictions for municipalities.	The Greek Ministry of Environment, Energy and Climate Change is exploring technical, procedural and legal parameters for the implementation of EPC projects for the public sector through a pilot program, part of the "Htizodas to mellon" project for EE actions. No clues of GPP development are available.	• Consideration of excluding EPC projects from the municipality debt quota. • Investigation of introducing a maximal payback criterion for EPC projects, protecting municipalities from exceeding the debt restrictions. • Design of an auditing authority, assessing and approving municipal EPC projects, while supervising the actions of municipalities. • Inclusion of the GPP processes in the country's NAP. • Assessment of the GPP parameters (GPP implementation targets, personnel training, product/service groups, environmental/award criteria). • Consideration of introducing a supervising authority for GPP processes.

Institutions & Governance	Inter-ministerial coordination	Policy-makers face difficulties in developing financial incentives for EE measures because multiple targets have to be financed by the same available funds.	Currently no coordination and policy integration mechanisms exist	• Investigation of methods enabling inter-ministerial coordination and cooperation with local authorities including: o Local representatives' participation in policy formulation o Development of consultation committees with representatives across all governance levels o Horizontal coordination • Development of the country's INECP considering cross-sectoral policy integration to achieve maximum efficiency.
Behaviour & Lifestyle	Lack of maturity and innovativeness in the energy services market and consumers' awareness on building innovation technologies	Observation of an idle role of the Greek utilities regarding EE, following mainly governmental regulations and mandates. Concurrent low environmental consciousness of consumers.	Very few EE informative actions have been implemented in the until recently monopolistic electricity supplier.	Utility actions consideration: • Consideration of adding consumption statements on electricity bills. • Design of a metric, calculating consumers' consumption efficiency and proposing measures to improve it. • Assessment of the possibility to provide financial incentives for appliance and lighting upgrade. • Design of public consultation activities (advice centres/mass media campaigns). Regulatory enabling environments: • Investigation of tariff designs promoting demand shifting. • Continuous monitoring and improvement of the EEO scheme • Design of a PPP framework to attract the private sector in public EE projects, improving the energy service market's maturity.

3.5 United Kingdom: Barriers to efficient RES support policies

This case study looked at two support instruments for renewable energies (RES) in the United Kingdom (UK), the Feed-in Tariff (FiT) and the Renewables Obligation (RO). Using semi-structured interviews as well as a literature review, we were able to identify several contextual factors and barriers which have led to the sub-optimal performance of some aspects. We also identified potential strategies to overcome these barriers.

3.5.1 Context

The UK was one of the first countries in the EU introducing binding, long-term emissions reduction targets by means of its flagship legal framework, the Climate Change Act of 2008. The act requires 80% of emission reductions by 2050 and sets so-called carbon budgets for multiannual timeframes, i.e. a yearly amount of emissions which can't be surpassed (CCC n.d.). By 2015, the UK had successfully reduced its emissions by about 38% compared to 1990 (BEIS 2017), due to its low share of coal power (and a switch to gas), energy efficiency measures, and an increase of RES (Fujiwara, Williges, and Tuerk 2017). Indeed, the share of RES in the electricity mix jumped from 4.8% in 2007 to an impressive 24.6% in 2016.[17] However, a closer look at the UK's RES uptake revealed that due to shortcomings in the transport and heating sector, the UK is still likely to miss its EU RES targets of 15% in final energy consumption by 2020.[18]

This shortfall is also due to some weaknesses in the policy sphere, where two of the main renewable support instruments, the FiT and the RO, were not free from controversy and ran into several barriers.

3.5.2 Analysed Instruments and policies

The Renewable Obligation was introduced in most parts of the UK (Wales and Scotland have different schemes) in 2002 and requires electricity producers to generate an increasing share of their power from RES. Certificates accounting for this share can be traded amongst companies, not unlike carbon allowances in the EU ETS. The instrument underwent some significant changes throughout its history, becoming increasingly complex (Grubb and Newbery 2018) such as the introduction of a differentiated number of certificates for different RES technologies (the so called 'banding' process) to reflect variable cost structures of each of these technologies (Woodman and Mitchell 2011). For instance, solar PV generators received a number of x certificates per kWh, wind developers y number. In order to incentivise small scale RES development as well, the UK government introduced a FiT (a fixed tariff for each kWh generated from RES) for small-scale installations (up to 5MW) in 2010 to complement the RO policy. Both policies have been replaced by a contracts for difference (CfD) scheme in the wake of a major overhaul of the UK electricity market, the 2013 electricity market reform bill. Now,

[17] Eurostat, dataset nrg_ind_335a
[18] Eurostat, dataset t2020_31

owners of low-carbon installations are paid a difference between a prior agreed-upon strike price (recently increasingly decided by auctions) and the actual market price of electricity (HM Government 2013). FiTs are still paid to installations operational prior to the legal change, but both instruments (CfD and FiT) are subject to the levy-control framework policy, which sets a ceiling of low-carbon remuneration, amounting to £7.6 billion in 2020/21 (HM Government 2016).

3.5.3 Identified barriers

Our research revealed several major contextual factors which had a negative impact on the RO and FiT support policies.

Innovation and Investment

Most interviewees saw the **macro-economic environment** as a key contextual factor influencing UK RES support instruments. Most notably, policy makers were surprised at the fast rate of cost reductions for solar PV, which more than halved between 2010 and 2017 for, for instance, a 4kW installation (Green Business Watch 2017). This development widened the gap between the fixed tariff producers received, the actual costs of generating electricity and the actual worth of electricity on the markets, with the average consumer paying for this discrepancy via their electricity bill. This observation is echoed in the literature where some sources point to the unanticipated falling costs of solar PV as reason for some major political bargaining and policy overhaul to bring those costs down (Smith et al. 2014; Cherrington et al. 2013). However, this was done in a subpar manner, thus illustrating the importance of the contextual factors of **policy continuity**. Degression rates of FiTs to reign in the costs were judged to be too steep[19] and changes to FiT remuneration became too frequent which had a negative impact on the performance of the instrument.[20] Moreover, interviewed stakeholders identified the financial crisis and the economic recession as a major impact on the UK's RES support instruments due to the decrease of financial capital to carry out RES projects[21] and rising (fossil) fuel prices had a negative impact on the government's ability to spend on RES support instruments.[22]

Another contextual factor identified was the **market framework**, which was not very accommodating to renewable energies according to stakeholders. RES, in contrast to thermal power generators, are high in capital expenditure (CAPEX) and low in operating expenditure (OPEX). Current market design would favor centralised, thermal power generation over flexible RES generation and would not sufficiently price-in carbon pollution,[23] an argument echoed in the literature (D. Newbery et al. 2017; Poudineh and Peng 2017). Meanwhile, increasing fossil fuel prices on global markets set the prices on

[19] 2.NGO; 03.NGO
[20] 07.GOV. 01.ACA; 03.NGO.
[21] 04.GOV
[22] 04.GOV
[23] 02.NGO

the UK wholesale market (Grubb and Newbery 2018) with the RO favouring large utilities and not small-scale RES developers since only large sized companies were able to shoulder the risk (and pay for the administrative costs) of investing in RES under the current market design.[24]

Attitudes, Behaviour and Lifestyle

Looking at contextual factors in the attitudes, behaviour and lifestyle category (Fujiwara, Williges, and Tuerk 2017), two factors stood out in the UK case study. On the one hand, **public opinion** was seen as influencing UK RES policy. For example, consulted stakeholders opined that the banding of technologies under the RO was not only done to incentivise more expensive technologies (instead of only low hanging fruits) but also to move wind power from onshore to offshore, away from concerned citizens.[25] Because while the population seems to overall support RES policies, some rural areas often prove to be quite vocal in their opposition to RES installations.[26] On the other hand, **social attitudes and belief systems** seem to play a significant role in UK policy making. Several interviewees[27] argued that the intellectual frame of free markets is a strong guiderail for UK policy makers and the question of price, costs and whether a policy is economically efficient would form strong arguments.

3.5.4 Recommendations on how to overcome barriers and account for contextual factors

When it comes to the **macro-economic environment** of UK RES policies and the failure to take technological learning curves adequately into consideration, several strategies might facilitate the overcoming barriers. In order to ensure that remuneration schemes and costs of those schemes are proportional, regular reviews of policies should take place (Held et al. 2014). Some consulted stakeholders opined that the nature of any given support instrument should provide for flexibility in order to reflect falling technology costs. One of those options mentioned was to adopt auctioning mechanisms for RES capacity as an alternative to FiTs as this would provide flexibility on which technology would be the best solution in a given geographical location under specific economic circumstances.[28] In the case of the UK where auctions for CfD have been carried out, this has led to astonishing price reductions, with one project developer offering offshore wind development for £57.5/MWh[29] for a project planned to come online in 2021 (Grubb and Newbery 2018). However, it is noteworthy that auctions have not been free from criticism (Kitzing et al. 2016) and several design options should be respected.

[24] 06.ACA
[25] 02.NGO; 07.GOV
[26] 03.NGO
[27] 01.ACA; 06.ACA;
[28] 03.NGO
[29] For comparison, the controversial Hinkley Point C nuclear power plant was awarded a CfD of £92.5/MWh for 35 years

When it comes to barriers in the **market design and framework**, it is important to bear to mind that electricity markets have come under pressure in the whole of the EU, since an increasing share of decentralised, intermittent renewables has to compete on a market conceived for centralised, baseload and fossil-fuel-heavy electricity production (Poudineh and Peng 2017). Moreover, due to years of physical as well as economic market integration, it would be absurd to discuss UK electricity markets separately from EU electricity markets, both of which being quite complex constructs of wholesale markets, transmission and distribution regulations and retail markets (Poudineh and Peng 2017). Also, smart meter rollout has been hit by delays (Pfeifer 2018) and addressing those delays might enable consumers to play a bigger role in the energy market. In addition, more geographically granulated prices for generation and transmission could be advantageous. Britain, despite having only one price zone for generation (D. M. Newbery 2017), is one of the few countries having several location dependent transmission tariffs (ENTSO-E 2017). A next logical step might be nodal pricing, despite concerns about the political feasibility of different counties paying significantly different electricity prices (Poudineh and Peng 2017; D. M. Newbery 2017).

With regards to the contextual factors of **policy continuity** and predictability are seen as important for assuring investors (Lipp 2007). However, once renewable technologies become more mature (as has happened globally and in the EU), RES policies need to adjust to changing markets and technology learning and other contextual factors as shown above (Gawel, Strunz, and Lehmann 2016). Here, policy makers seem to need to square a circle, changing policies without spooking investors. A good example for this predictable management of RES support instruments might be Germany, where a yearly review cycle as well as the rules on how to calculate remuneration for renewable installations are enshrined in the energy transition laws, thus providing stability and predictability (Held et al. 2014). Each year, a monitoring report of the energy transition is conducted by the German Federal Ministry for Economic Affairs and Energy (BMWi) and the report is then approved by the government and the parliament. An independent expert commission accompanies this process and provides a scientific opinion which is published parallel to the report.[30] In addition to those continuity-providing measures related to the support instruments directly, policy continuity can also be assured by adopting medium and long term strategies in the form of energy, climate and decarbonisation plans (Abdmouleh, Alammari, and Gastli 2015). EU law mandates Member States to adopt several long term strategies and plans, proposed to merge into Integrated National Energy and Climate Plans (INECP).[31] Such plans send a strong market signal to RES developers that despite potential changes to the instruments themselves, the overall decarbonisation target remains intact. Literature argues that in the period after 1997, the UK caused confusion by adopting no less than four energy white papers between 2003 and 2011, thus creating policy instability (Grubb and

[30] https://www.bmwi.de/Redaktion/EN/Artikel/Energy/monitoring-implementation-of-the-energy-reforms.html
[31] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/governance-energy-union

Newbery 2018). Also, the recent hesitation of the UK government to adopt a new legal climate target of zero emissions by 2050 might hinder increasing RES uptake and put UK climate leadership into doubt (Harvey 2018).

While economic and policy related contextual factors might be addressed in a rather straightforward way (provided there is political will), contextual factors such as **public opinion or lifestyle and behaviour** might be more difficult to address. One of the most salient features of public opinion affecting RES support is the notorious 'not in my backyard attitude' or NIMBY, where people oppose RES installations, particularly on-shore wind farms, close to their dwellings. And while the NIMBY concept might only insufficiently explain opposition by glossing over more nuanced reasons why people oppose certain RES installations (Botetzagias et al. 2015), many forms of public opinion and opposition can hinder RES uptake. One way forward might be to address fairness and cost reservations of concerned citizens. Studies indicate that the perceived unfairness of site selection as well as the divergence between (localised) costs and (delocalised) benefits for people close to the site matter most when it comes to rejection of a project (Botetzagias et al. 2015) thus pointing to the importance of addressing fairness issues when it comes to NIMBY (Wolsink and Devilee 2009). A strategy to address buy-in, could come from Germany, where almost a third of RES capacity is owned by its citizens (trend:research 2017). The local population is often invited to participate in the planning process, for instance by means of citizens' reports which have been adopted in several cases in Germany. This level of citizen participation is unheard of in the UK. Overcoming opposition in Britain has been achieved by the shift from onshore to offshore wind power developments, which is more like avoiding contextual factors than addressing them, although offshore wind has become significantly cheaper over the years. In avoiding some problems, other problems might arise. For example, bringing the high volume electricity from offshore to the consumption centres onshore might prove as difficult as installing onshore wind farms since high voltage power lines are often as controversial as wind farms (Devine-Wright 2013) and underground cables are more expensive than over-ground options (Vidal 2012). Moreover, as one stakeholder opined, one can't understand British policy without taking into consideration the local political context where rural Britain is often the heartland of the support for the conservative party[32], thus putting the shift from onshore to offshore into the context of simple political calculations.

Taking political calculations and public opinion into consideration is also strongly related to belief systems, norms and culture. In the UK case, according to several interviewees, this world view was guided by the 'dogma' that liberal markets would address climate change issues most efficiently. And while literature explores how policy makers could change such norms and beliefs with the right informational policies and monetary incentives (Kinzig et al. 2013), literature remains more silent on what happens if decision makers themselves might be a barrier to low-carbon development and have little

[32] 07.GOV

intention of changing their belief system. Here, a lesson from the UK would be that policies and its instruments should never forget the cultural context and the belief system they are (or will be) operating in. From this perspective, more market-oriented RES support instruments such as auctions or CfD might be more acceptable to public opinion in countries like the UK, while simple (and deemed most efficient) FiTs might be more acceptable in a country with a stronger consensual and communal tradition such as Germany.

3.5.5 Lessons learnt on the European level

Policy and policy instruments to support the deployment of renewable energies in the UK have a strong European dimension although the locality of contextual factors, i.e. their embeddedness in local context which differ from jurisdiction to jurisdiction, must be emphasised.

Unexpected cost reductions and the impact of the economic crisis and the following recession were a global phenomenon. Ensuing austerity policies as response to this crisis certainly put a strain on public budgets thus making FiT policy susceptible to criticism for being too expensive, particularly since the costs for RES installations kept dropping faster in practice than expected in the UK as well as in all of the EU. Having flexible policy instruments to address the issue of the increasing difference between falling costs and stable remuneration has been put forward as a solution to these developments and first experiences with auctioning off RES capacity in the UK show some promising cost reductions. However, it is important to keep in mind very local contextual factors. Auctions tend to benefit large-scale companies and utilities which might be less of a problem in the UK than for example in Germany, where the energy transition is driven from the bottom-up by its citizens who are less well positioned to participate in large scale auctioning processes due to higher transaction costs and organisational disadvantages.

When it comes to market reform, the European dimension is even more pronounced. The UK is interconnected to grids in continental Europe and Ireland (ENTSO-E 2018) and trades electricity freely beyond borders. But this increasingly deep market integration of EU countries leads to the fact that policy decisions taken in one EU country might influence other Member States (Grossi et al. 2018). Therefore, electricity market reform in the UK always goes beyond the national context, something which is further rendered even more complex due to Brexit, which might impact the EU in some aspects (Frederiksson et al. 2017) and particularly Ireland (Ward 2017). Therefore, concertation with neighbours about important energy policy decisions such as capacity markets or market reforms, perhaps even joint committees would mitigate some adverse effects unilateral decisions might have. In this context, it is important to point out that the European Commission even floated the idea of joint, cross-border feed-in tariffs and auctions, but only few countries like Sweden, Norway, Germany and Denmark made use of this instrument.[33]

Concerning policy continuity, the UK provides a telling example of how frequent changes and debates around RES support might do a disservice to rapid deployment of renewable energies, urgently needed to meet domestic, European and indeed global climate change mitigation objectives.

[33] http://europa.eu/rapid/press-release_IP-16-4471_en.htm

Table 6: UK externalities affecting the development of RES and suggestions

	Specific externality/barrier	Manifestation of impact	Description of main contextual considerations	Summary of suggested options
Innovation & investment	Policy continuity	Fast rate of cost reductions for solar PV Changes to FiT remuneration became too frequent	Negative impact on the performance of the instrument.	Adopt auctioning mechanisms for RES capacity as an alternative to FiTs
Innovation & Investment	Market framework	Current market design would favour centralised, thermal power generation over flexible RES	Lack of consideration of the high capital expenditure of RES	Keep alignment with EU electricity market reforms
Behaviour & Lifestyle	Intellectual frame of free markets	Lack of support of RES policies	The question of price, costs and whether a policy is economically efficient form strong arguments	More market-oriented RES support instruments such as auctions or CfD might be more acceptable to public opinion in countries like the UK
	Social acceptance of wind	Banding of technologies also to move wind power from onshore to offshore, away from concerned citizens	Some rural areas often prove to be quite vocal in their opposition to RES installations	Taking better into consideration the local political context in particular the rural UK

4 Lessons learned

The analysis of the case studies revealed ways in which the contextual factors inhibiting the diffusion of mitigation technologies can be addressed via careful design/enrichment of policies in each country's INECP. Our analysis showed that besides the different maturity levels of the countries' energy markets, there are externalities and market failures that restrain these technologies from reaching their maximum market potential. For instance, even though the Dutch energy services market is more mature than in Greece, in both countries inertia was observed regarding the diffusion of innovative mitigation technologies and practices (i.e. smart grid technologies), from the side of important markets actors such as utilities and DSOs (i.e. price makers), limiting also the activity of smaller market actors.

The following list provides a comparative presentation of the four case studies' key considerations and suggests priorities that should be considered during their ongoing INECP formulation. Following the selection of the case study countries under assessment, the lessons learned (as well as the guidelines presented in the section to follow) provide important insights on the key contextual factors inhibiting both traditional supply-side (i.e. RES support Croatia and the UK) as well as demand-side mitigation options (i.e. smart-grid deployment the Netherlands and building innovation technologies in Greece) and ways to address them.

- **Markets have to evolve with technologies.** Case studies revealed that while regulatory and support incentives are required to stimulate market actors in the adoption/promotion of new technologies, the maturity level of the energy market is a significant factor to consider while developing the appropriate stimulus. Indicatively, in the Netherlands, smart grid development is considered important by DSOs and utilities, affecting their survival and competitiveness in the energy market. As such, a regulatory framework to make a business case relevant for the promotion of smart grids (such as rewards for network upgrade via innovation or a cost reflective tariff system), is considered important. On the contrary, to improve the embryonic energy service market in Greece, an EEO scheme was introduced providing a different type of stimulus package to start the business activity in the energy services market. Lack of private investment is additionally noted in Croatia, and emphasizes the need for additional support incentives such as state funding for RES loan guarantees or issuance of green bonds for local banks to encourage long-term funding. The UK example and indeed experiences in the whole of the EU demonstrates that increasing climate technology uptake such as RES and smart grids can only reveal their full potential when the market on which they are deployed keeps pace. EU electricity and energy markets might need some flexibility here as well in order to better reflect the profile and behavior of renewables and their supporting technologies. The specific form of this flexibility may vary, but to graft new technologies onto an old market is not a good idea and allowing for the co-evolution of market designs is key to enable the uptake of low-carbon technologies. The Croatian case emphasizes the need for evolution in market structure as well, with a need for an integrated South East

Europe market and ultimately integration into the unified EU market, which would enable setting cost-reflective energy-price signals needed to attract new RES investment.

- **Allowing for flexibility when designing support instruments while stimuli is key.** As the UK study has shown, unanticipated developments such as the rapidly falling costs of RES technologies might contribute to driving up prices for consumers if the support instrument is inflexible. Here, policy makers have to find a careful balance in providing market stability (and long term visibility) by avoiding abrupt (or even retroactive) changes while simultaneously adjusting the support to reflect market maturity of technologies such as solar PV. Switching for example from FiTs to auctions might be a good way forward at this point as long as those auctions don't stifle bottom-up, small scale renewables investment which has been quite substantial in countries like Germany. Flexibility for the Netherlands case relates to improvements in the design of grant schemes such as linking revenues from the CPF to funds utilized for investments in innovative low-carbon options. On the other hand, to better incentivize DSOs and ESCOs to invest in smart grids, the introduction of well-targeted innovation budget in line with (and not affected by) efficiency operation targets was found as an important consideration. For the Greek case, EE targets should be better integrated into financial, social and business policy making processes. Such actions can incentivise market players to sustainably innovate, free of overlapping and contradicting policies.
- **Social parameters greatly affect the effectiveness of mitigation policy and technology uptake.** In the Netherlands, smart meter rollout was halted due to public opposition and was resumed as a non-obligatory measure, while in Greece building innovation technologies have low dissemination levels due to low consumer awareness of their benefits. Perceived social benefits (or lack thereof) were manifest in Croatia by favouring technologies with more local capacity, limiting the dissemination of RES technologies such as wind and solar which are capital intensive with perceived revenues mainly flowing out-of-country. On such evidence, preparatory actions, such as consultations with the private sector and consumer awareness campaigns, should be of priority in the components of the INECP formulation process. Also, taking public concerns better into consideration and addressing perceived fairness issues on renewables distribution (to counter NIMBY attitudes) are key to foster public acceptance of RES technologies.
- **Regarding regulatory coordination, deficiencies in both transnational and domestic coordination mechanisms persist and hamper the implementation of mitigation options.** The Croatian case emphasized the inefficiencies and adversarial nature of policymaking under unclear regulatory authority and coordination, with marked improvement upon merging the relevant regulatory bodies into a single ministry. In the Greek case, open dialogues and consultation between different governmental levels are essential, the lack of which have so far caused major obstacles in target setting and fund allocation regarding EE. Cooperation of different governmental levels could help policymakers elaborate on problems that

would otherwise not be considered (such as the formulation of an EPC framework without taking into account the debt restriction of municipalities). On the other hand, in the Dutch case study, communication restrictions between DSOs and utilities was contrary to the operational requirements of smart grids demonstrating the necessity for a trans-European coordination when EU policies are formulated. As such, INECPs, apart from domestic coordination, should also largely be based on regional consultations and cooperation. Coordination between EU and member states was also highlighted as a deficiency in Croatia, with inefficient and ineffective national policy due to the speed and complexity of new EU regulation, indicating a need for streamlining administrative procedures vertically between EU and members, especially smaller member states.

5 Guidelines / Discussion on policy implications

Building on the lessons learned from the case studies analyzed in this report, this section aims to provide general guidelines/policy implications, which will help policy makers to have a clearer understanding on the role of contextual factors during the INECPs development and summarizes some key actions on how to account such influences during the policy (re-)formulation process. We see four major areas from which to address contextual factors, each addressing a different context, focusing on markets, instrument flexibility, social parameters, and institutional coordination. These areas emerged inductively by comparing our findings on contextual hindrances and mitigation strategies across case studies. To a large extent, the clustering of areas was associated with the three contextual factors categories (i.e. institutions and governance, innovations and investments, attitudes and lifestyle), that structured the factors' identification and our entire case-study analysis. Strategies and actions relevant to the electricity market structure and design as well as supporting instruments relate to contextual hindrances classified under innovation and investments, while the remaining strategies correspond to the remaining two categories of contextual hindrances. Figure 2 provides an overview of the broad recommendations presented here, followed by specific policy examples derived from the case studies presented previously.

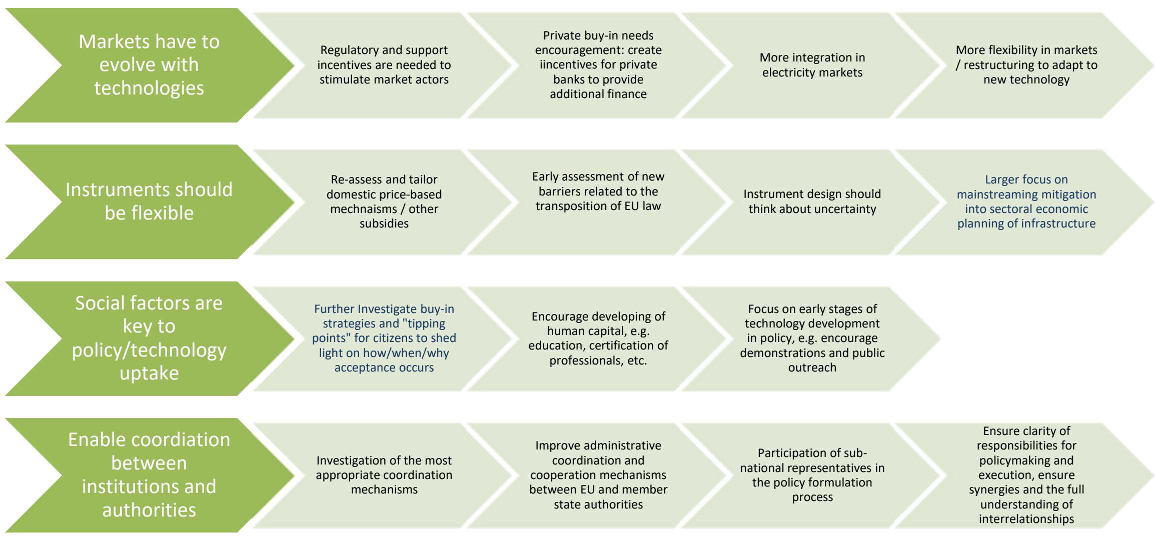

Figure 2: Guidelines for addressing barriers to effective climate policy-making

5.1 Ensure markets can evolve with emerging technologies

The cases have demonstrated in various ways the need for well-functioning markets to send the correct price signals and to encourage development of new technologies.

Policies to encourage demand-side investments or the development of RES may need to be accompanied by regulatory and support incentives to stimulate market actors; beyond feed-in-tariffs or premiums e.g. for RES, additional encouragement may be necessary to ensure private buy-in, such as creating incentives for private / local banks to provide additional finance and encourage long-term uptake of technology. In some cases, such as in South East Europe, electricity markets may require greater integration regionally, and with the larger EU market, along with more flexibility and restructuring to adapt to new technologies. The cases-study countries provide a number of more explicit policy examples. Particularly for the Netherlands case, in the case of **distortionary price signals owing to internal market failure** (i.e. negative electricity prices) which raise concerns about revenue losses from technology providers and businesses of less competitive or mature mitigation technologies (e.g. smart-grids, energy services), both domestic and international actions towards their addressing can take place. Domestic actions refer to direct price regulations forbidding electricity prices going below zero, while international actions include the promotion of international collaboration aiming to stabilize national markets through power exchange.

- Similarly to the case of fossil-fuel price regulations, policy makers should assess the option of introducing contingency price limits, to protect producers from losing revenue. The price limits as well as their application interval should be thoroughly assessed in order to protect generators, without removing the incentives that low prices give to consumers for consumption shifting.
- Price balancing can also be achieved through increased cooperation with other member states, in terms of electricity exchange, so that excessive generation can be channeled to neighboring countries before prices turn negative. Such cooperation could minimize national market failures and increase energy security, while promoting a unified European market. The cooperation agreements should clearly define the amount of energy a country is allowed to export, the amount of energy that neighboring countries can absorb without destabilizing their system, as well as the compensation rates for the absorbing country. Furthermore, the cooperation strategy should be continuously evaluated against the imposition of the aforementioned price limitations, to determine the optimal trade-off for each country.

Apart from correcting price signals, the still **immature investment framework for DSOs and ESCOs** and the consequent **low maturity of the energy services market** should be supported through incentive schemes specifically targeting innovation and smart investments. Actions include both incentive-based regulations enabling them to see a business case in innovation projects as well as measures enabling joint implementation of projects that go beyond one-off financial support. Direct consequence of market initiatives would also be the elevation of the current **weak environmental consciousness of citizens**. More specifically, regulations could include:

- The introduction of reward criteria to incentivize market entities to address network issues via innovative actions. Rewards could range from revenue shares from innovative grid infrastructure relating to energy efficiency savings, to capital raising eligibility from consumers, as long as it is utilized for innovation projects. The reward criteria could also be embedded in energy obligation schemes to ensure maximal policy efficiency. Existing or new obligation schemes need to be continuously monitored to ensure successful implementation/promotion of innovative technologies.
- The redesign of electricity pricing framework to allow for more flexible tariffs. Cost-reflective tariffs should be designed so that the revenue increase from their implementation surpasses the cost of the technology required.
- Non-financial support policy actions to improve and optimize the conditions for the creation of long-term relationships of key market players (e.g. between grid operators and third parties). These are more likely to yield incentives for collaboration among key market actors. Joint development of innovation projects can be promoted not only by offering financial incentives, but also by requiring, for instance, joint intellectual property rights arrangements among grid operators and other parties. Dissemination of high-profile jointly developed projects can also create reputational benefits which may in turn encourage and convince organizations to invest in a smart technology project. Regulations such as the ones stipulating price-driven tendering procedures should also be carefully re-assessed and updated to include criteria for joint collaboration of projects rewarding attributes such as transparency, shared targets and risks as well as learning during project development. Policy makers can also stimulate long-term relationships among market actors that extend the energy industry to include citizens' associations, by steering the public debate around the implementation of smart-grid innovation projects.
- Enhancement of public private partnership frameworks to enable the public sector to perform innovation projects, while attracting the private sector, leading to a maturity increase for the energy services market. For successful implementation of public private partnerships, the clear determination of the partners' responsibilities, the risk sharing ratio, the capital shares and the revenue streams should be carefully specified and established collectively across key interested actors.
- A last but definitely not least course of action relates to the proper representation and assessment of supply against demand side options in the policy decision making process. New decision rules and metrics are required to be introduced at all stages from policy planning to evaluation to steer energy utilities and regulators to start comparing – in practice – demand-side options with supply-side technologies before committing to major energy projects or new market rules.

5.2 Instruments should be flexible (or: a broader focus on instrument design)

Beyond the need for evolving markets, the design of policy instruments in question needs a broader perspective, with a focus on flexibility, as demonstrated by the case of the UK. Additionally, instrument design should take into account the lessons of the previous decade, such as the sudden financial crisis, low fossil fuel prices, and rapidly-dropping costs of RES technologies. This entails a greater consideration of uncertainty in the formulation of policies, via assessing performance of an instrument under a range of possible future scenarios, to anticipate possible issues. More generally, member states should further efforts to mainstream climate policy into decision-making processes, with a focus on mainstreaming mitigation into social and economic planning of infrastructure.

In this area as well, the cases can provide more concrete examples of the need for further thought as to how instruments can be designed to address issues dealing with uncertainty, e.g. the persistent issue of **low fossil fuel prices** inhibiting **the competitiveness and uptake of innovative yet less mature mitigation technologies** such as smart grids or building innovation technologies, which should be a key concern during the INECPs formulation and beyond. Policy makers should carefully re-assess and tailor their domestic price-based mechanisms as well as other non-financial measures to determine whether adjustments and updates need to be introduced to mitigate these effects. In addition, key market actors in the energy industry and technology providers need to be oriented towards expanding their existing portfolios, business activities and partnerships. To this end, policy actions may include the introduction or amendments in existing financial support measures as well as setting a broader focus on sectoral policy planning integrating mitigation policy objectives. More specifically:

- Financial incentives may include the introduction of new price-based mechanisms to internalize the costs of fossil fuel production, or the removal of distortionary ones. The introduction of price-based mechanisms to support the ETS price as well as the removal of distortionary fossil-fuel subsidies should be carefully assessed to determine their cost-effectiveness as well as the potential distributional effects of their introduction in specific country settings.
- To directly promote the deployment of innovative mitigation options, careful policy design should also include the creation of innovation funds with appropriate criteria specifying the eligibility of options for direct support. The development of innovation funds specifically targeting less mature options in the market, such as smart grids or building innovation technologies, is highly recommended to ensure the use of revenues from aforementioned price-based mechanisms to fund and scale up the implementation of such technologies.
- Finally, mainstreaming mitigation into social and economic planning of infrastructure emerged as strong concern, mainly in relation to energy efficiency objectives. Better policy integration and design across **different policy themes** should be of primary

focus during the NCEAP development and target setting. While this is a recurring issue, there is little evidence of substantive progress, especially in light of the eminent reforms in the electricity market structure. One way forward would be the integration of mitigation objectives such as requirements for energy efficiency into sectoral policies. It would provide an enabling environment as would the development of sector-specific requirements or guidelines for implementing the NDCs. Disaggregating the NDCs into key-sectors, defining priority areas and interventions for each sector towards the creation of clear road maps with time frames for identified actions to attain a complex set of policy objectives, hence enhancing policy synergies and limiting contradictions within and across sectors.

Barriers relevant to the imposition of **EU regulatory frameworks** or the **poor design of regulatory investment frameworks** should also be lifted in order to allow the promotion of new technologies. These mostly refer to the appropriate representation and enabling of new business models required for the diffusion of smart technologies in regulations, which were not considered during the first round of the reform of the energy regulatory market framework. More specifically:

- Redesign of the regulations accompanying the unbundled energy market model is strongly suggested, to account for the specificities of the smart innovation technologies. While the unbundled energy model increased the competitiveness of the electricity market, it caused communication issues between entities participating in smart grids. Towards that direction, communication policies should be developed to facilitate data transactions, with central pillars being the preservation of the market's fairness and the protection of consumers' privacy.
- Focusing mainly on the public sector, careful redesign of EPC and GPP frameworks is considered an important task for policymakers during the INECP formulation. Issues relating to determination of award criteria consider environmental as well as efficiency and innovation requirements, personnel training, auditing processes, eligible goods and services groups, municipal debt restrictions etc. should be resolved within the INECP actions, to allow for more innovation projects to be conducted in the public sector.

5.3 Social factors are key determinants

Moving beyond the more concrete recommendations for reforming markets and better tailoring instruments for success, the cases showed unanimously that technology **acceptance by the public was a large factor in policy success**, or for the majority, a lack thereof. From a lack of public buy-in in the Netherlands and Greece to the growing social discord over renewables in Croatia and NIMBYism in the UK, future policymaking needs to do better at gaining social acceptance. Such buy-in can be fostered by addressing the problem early in technology development, by encouraging demonstration plants (in case of RES) or facilities for innovations in the building sector / smart meters etc. Human capital relevant to new technologies can be encouraged by providing education and certification in relevant fields, e.g. engineers or installers, and by educating related workers, such as real estate agents and architects.

5.4 Enable coordination between institutions and authorities

Finally, in order to ensure policy coherence, regulators should investigate **methods for enabling inter-ministerial and sub-national as well as supra/national coordination and cooperation** during the target setting of the INECP policies. Towards that direction, investigation of the most appropriate coordination mechanism, including the formulation of consultation committees, the participation of local representatives in policy formulation processes and any other mechanism promoting open dialogues should be examined. While the EU has long focused on reducing administrative complexity, more can be done to reduce frictions, particularly between smaller member states and the supra-national administrative bodies.

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