

DELIVERABLE 2.2.

Set of the existing regulations and legislative framework related to RES implementation in islands

STORIES PROJECT

JUNE 2008

Revised May 2009

Index

1. Introduction	3
1.1. National Targets	3
1.2. Distance to Target Situation in EU-27	5
2. Support schemes for RES in EU Member States and Croatia	7
2.1. Current situation	7
2.2. Greece	9
2.2.1. Overview	9
2.2.2. Renewable Energy Sources	9
2.2.2.1. Feed-in Tariffs	9
2.2.2.2. Photovoltaic Development Plan	10
2.2.2.3. Investment Incentives	11
2.2.3. Hybrid Power Plants	11
2.2.3.1. Pricing of Electricity	11
2.2.3.2. Hybrid Power Plants in Operation or Under Construction / Projects	13
2.3. Finland	13
2.4. France	13
2.5. Germany	14
2.6. Ireland	15
2.7. Spain	16
2.7.1. Energy Regulatory Framework in the Canary Islands	16
2.8. United Kingdom	17
2.8.1. RES on UK Islands	17
3. Conclusions	18
4. References	20
5. Appendix	21

1. Introduction

The purpose of this report is to provide an overview of existing regulations and the respective legislative framework related to RES implementation at a European level. The study was conducted in the frame of the STORIES project and comprises deliverable of Task 2.2 “European regulatory and policy framework relevant to energy storage systems”. The report was prepared by the Regulatory Authority for Energy of the Hellenic Republic (RAE) with contributions from five STORIES partners namely CERA, FSB-UZ, ITC, IDMEC-IST and SOFTECH.

Successful European experiences as well as actions for the promotion of renewable energies in the EU-27 member states and also Croatia, in terms of regulations, financial schemes, fiscal incentives, awareness activities and other actions complementary to energy policies for maximization of renewable energy penetration were identified and critically appraised. To this end a detailed review of national and EU legislation over the last at least fifteen years was carried out. Additional information was collected from a number of sources including the EU, the International Energy Agency (IEA), the national energy regulators, the European Wind Energy Association etc. The study revealed that considerable progress has been made in the design and implementation of RES support schemes at country levels. However there is a strong lack of integration and harmonization at an EU level (e.g. different scheme or different level of support per country). The coupling of RES with energy storage technologies, in the form of a so called hybrid system, comprises a relatively new approach to increase RES penetration particularly at small or isolated electrical systems (e.g. non interconnected islands). As a result, hybrid specific support schemes are either non existent or extremely limited in most member states. In an effort to attain as much information as possible concerning support and experience from coupled RES and storage systems, RAE compiled a detailed questionnaire that was forwarded to the project partners. The questionnaire is included in the report appendix and the responses where available, have been added in the text.

The report is structured as follows. In the remaining of this introductory section, an overview of the national targets on RES implementation as set by Directive 2001/77/EC and definitions on the types of existing RES support schemes are provided. An overview of the progress made so far per EU member state towards meeting the 2001/77/EC targets is also given. Section 2 presents briefly the current (2008) RES support scheme in each EU member state and Croatia. Special reference is made to support schemes for the promotion of RES and energy storage systems as well as to incentives for promoting RES on islands or remote areas. Then the report focuses and discusses in detail the legislation of those countries which adopted such incentives or developed positive policy elements (e.g. projects) towards the promotion of hybrid systems.

1.1. National Targets

Directive 2001/77/EC on the promotion of electricity produced from RES in the internal electricity market set indicative RES-targets at EU and national level. In detail the indicative target at EU-25 is to provide 21% of the electricity by 2010 from RES. Table 1 summarizes the national targets [1].

Table 1.: National indicative RES-targets [1]

Country	National target RES-E % 2010	Country	National target RES-E % 2010
Austria	78	Latvia	49.3
Belgium	6	Lithuania	7
Bulgaria	11	Luxemburg	5.7
Cyprus	6	Malta	5
Czech Republic	8	Netherlands	9
Denmark	29	Poland	7.5
Estonia	5.1	Portugal	39
Finland	31.5	Romania	11
France	21	Slovakia	31
Germany	12.5	Slovenia	33.6
Greece	20.1	Spain	29.4
Hungary	3.6	Sweden	60
Ireland	13.2	UK	10
Italy	25		

In order to stimulate the energy production from RES and to meet the targets set by Directive 2001/77/EC a number of support systems have been developed and adopted by the EU member states. These schemes can be classified into five groups: feed-in tariffs, green certificates, tendering systems, tax and investment incentives [2]. Details on each of these schemes are provided in the next paragraphs.

1. **Feed-in tariff** systems are characterized by a specific price normally set for a period of several years, which must be paid by electricity companies, usually distributors, to domestic producers of green electricity. The additional costs of these schemes are paid by suppliers of conventional energy forms in proportion to their sales volume and are passed through to the power consumers by a way of a premium on the kWh end-user price. A variant of the feed-in tariff scheme is the **fixed premium mechanism**. Under this system the government sets a fixed premium or an environmental bonus, paid above the normal spot electricity price to renewable electricity generators.
2. Under the **green certificate system** RES-E is sold at conventional power-market prices. In order to finance the additional cost of producing green electricity and to ensure that the desired green electricity is generated, all consumers (or in some countries producers) are obliged to purchase a certain number of green certificates from RES-E producers according to a fixed percentage, or quota, of their electricity consumption/production. Penalty payments for non-compliance are transferred either to renewable research development and demonstration fund or to the general government budget.
3. Under a **pure tendering procedure** the state places a series of tenders for the supply of RES-E which is then supplied on a contract basis at the price resulting from the tender. The additional costs generated by the purchase of RES-E are passed on to the end consumer of electricity through a specific levy.
4. **Tax incentives** are used as an additional policy tool. Tax incentives may be a tax credit or a cash payment or an exemption from tax obligations or low VAT.
5. **Investment incentives:** A common investment subsidy is a grant for the installation of capacity.

The strict categorization of RES support schemes into five groups is a fairly simplistic representation of the actual situation in member state level. In practice, each member state typically uses a combination of the above described systems with some differentiation based on the RES type. As shown in Figure 1, the member states are continuously fine-tuning existing policy measures with the aim of improving their performance [3].

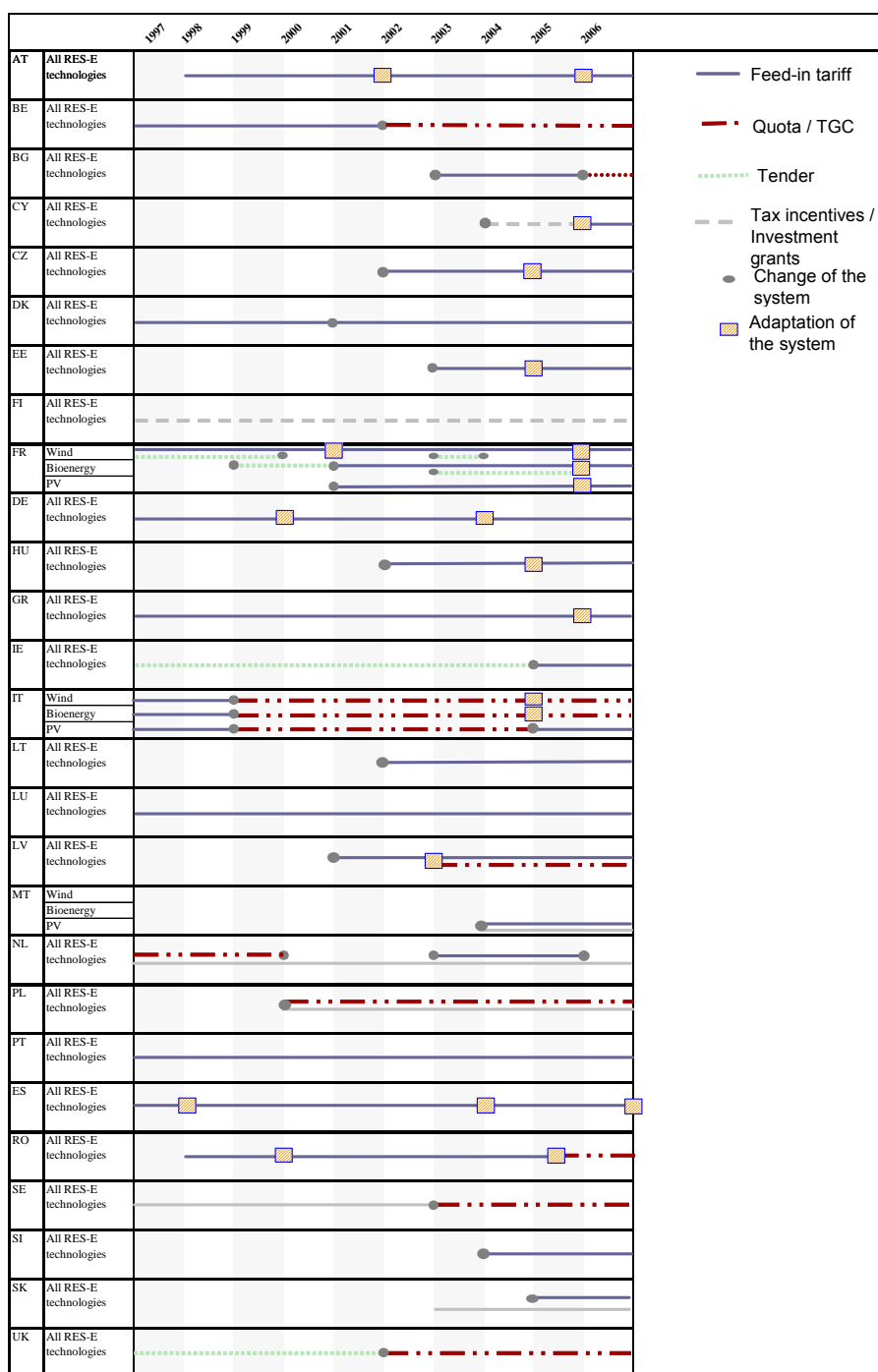


Figure 1.: Support schemes in all countries during the last decades [3]

1.2. Distance to Target Situation in the EU-27

Figure 2, shows share of renewable energy sources in the EU-27 member states in 2007 and compares the level of RES penetration to the indicative targets of Directive 2001/77/EC. It can be seen that a number of EU countries, as for example Latvia, Denmark, Finland, Germany, the Netherlands and Hungary have made considerable progress towards the targets of Table 1. Ireland, Luxembourg, Spain and Sweden provide a good opportunity to reach 2010 target. Czech Republic, Lithuania, Poland, Slovenia and United Kingdom have a good change with additional effort of reaching 2010 target. Austria, Cyprus, Estonia, France, Italy, Malta and Slovak Republic are far from commitment [4].

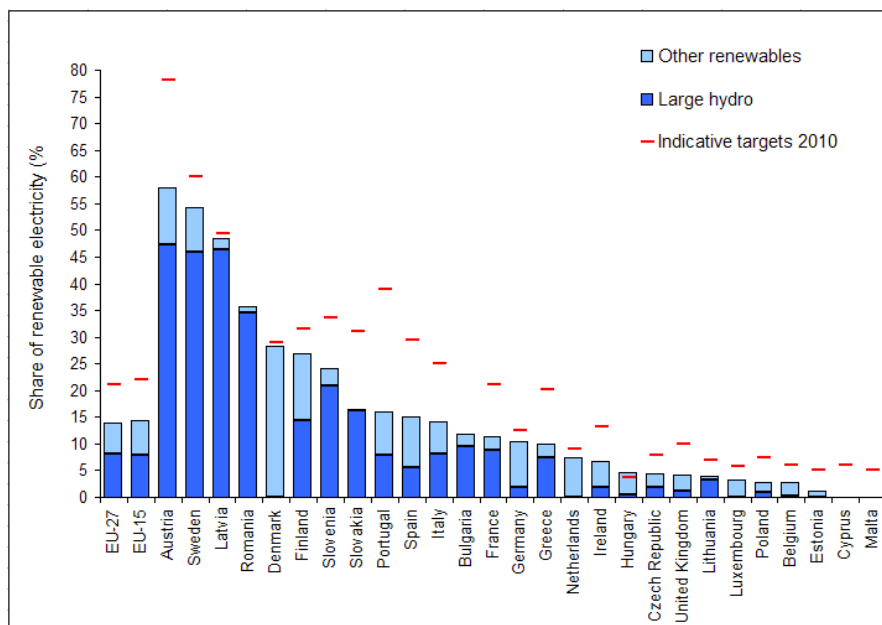


Figure 2.: Share of renewable electricity in EU-27 (2007) [5]

For the sake of completeness, Figure 3 presents an analysis of RES penetration per RES type (2004 level). Note that Figures 2 and 3 are not directly comparable as in the latter RES penetration is presented as percent share of the gross inland consumption.

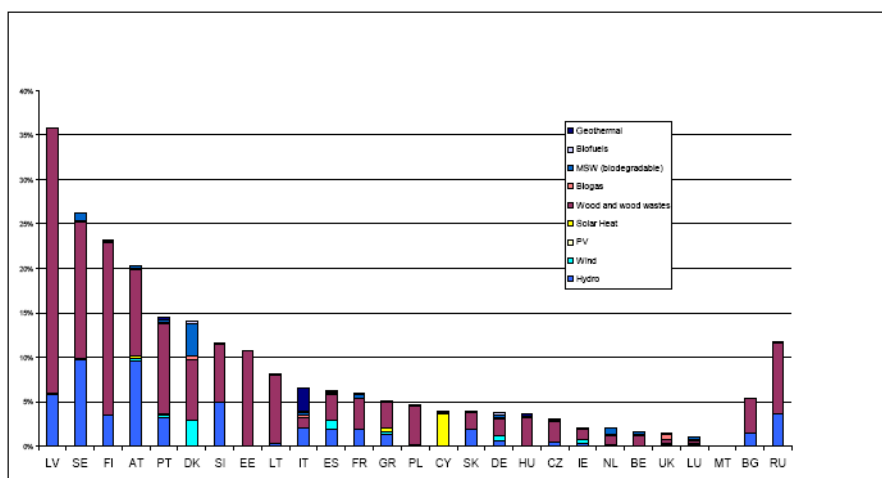


Figure 3.: Renewable energy source share of gross inland consumption in 2004 [3]

The next pages present the legislative framework in those EU member states which adopted special measures to support RES penetration in remote areas or areas with islands as well as schemes for hybrid power stations. As already described in the Introduction, a hybrid power station is a power plant producing RES electricity (wind, photovoltaic etc) and coupled with an energy storage system. RES electricity in excess is stored in the energy storage system (e.g. battery, hydroplant, hydrogen storage system and fuel cell etc) to be consumed at a latter stage

2. Support schemes for RES in EU member states and Croatia

2.1. Current situation

The current (2008) legislative framework related to RES implementation in the EU-27 member states as well as the candidate member state Croatia is summarized in Table 2.

As it can be concluded considerable experience exists with most of the support schemes outlined in Section 1.1. in the EU-15 older member states, i.e. the member states that entered the EU prior to 2004 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden and U.K). Feed-in-tariffs is the dominant support scheme for the promotion of RES however tariff levels vary considerably between member states and as a function of technology type and the year of implementation. Green certificates and tendering are adopted by Belgium, Italy, Sweden, UK and Denmark, France, Portugal respectively. Tax and investment incentives are applied by a number of states complimentary to any other scheme.

As far as it concerns the EU-12 "newer" member states (Bulgaria, Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia) feed-in-tariffs is also the dominant support scheme for the promotion of RES while Green certificates are adopted by Poland and Romania.

The Republic of Croatia, as candidate country, is in process of EU integration which means that it tries to harmonize its legislation with EU laws and Directives. The Electricity Market Act sets out the legal obligation to purchase electricity produced from RES in the manner that a quota or a minimum obligatory share of RES in electricity production is determined by a Government ordinance combined with a feed-in tariff system.

Complementary to the support schemes presented in Table 2, each country developed special programs in order to promote specific types of RES according to its needs.

Table 2.: RES-E national support schemes (2008)

Member State	Feed-in tariffs	Green Certificates	Tendering	Tax Incentives	Investment incentives
Austria					
Belgium					
Bulgaria					
Cyprus					
Czech Republic					
Denmark					
Estonia					
Finland					
France					
Germany					
Greece					
Hungary					
Ireland					
Italy					
Latvia					
Lithuania					
Luxemburg					
Malta					
Netherlands					
Poland					
Portugal					
Romania					
Slovakia					
Slovenia					
Spain					
Sweden					
UK					
Croatia					

The main concern of this study was the identification of successful European experiences as well as actions for the promotion of renewable energies in different countries for maximization

of renewable energy penetration through the implementation of energy storage technologies. The investigation showed that although a number of support schemes are in force for promoting RES there is no special legislation or policy framework for hybrid power plants with the notable exception of Greece. Despite the absence of a favorable legislative and regulatory framework however, on going projects were identified in a number of EU member states such as Finland, Germany and Ireland that investigate technically feasible and economically viable methods to store RES energy produced from intermittent energy sources. Construction of hybrid power plants is also ongoing in a few member states including Germany, Greece and the UK.

Additionally special legislation or supportive schemes for promoting RES on islands and remote areas was investigated. Greece, France and Spain have in place legislation that foresees special tariffs for RES plants on these areas. It is notable that no one of the “newer” member states adopted special legislation or supportive schemes for promoting RES on islands and remote areas, although two of them – Malta and Cyprus- are islands themselves. In Croatia according to the Spatial Planning and Building Act (OG 76/07) it is forbidden to plan and construct wind power plants on the islands or other coast line less than 1000 m from the sea. The projects that had already obtained the location permits prior to this are excluded. This act was explained as a measure to protect the Croatian coastal area. That, unfortunately, includes a lot of best wind potential locations on the Croatian islands and along the Adriatic coast.

Table 3 summarizes the current situation regarding RES support schemes for hybrid plants and islands or remote areas while it depicts member states with projects on storage systems and hybrid plants under construction.

Table 3.: Special support schemes for islands, hybrid power plants and on going projects

Member State	Special support scheme for islands or remote areas	Special support scheme for hybrid power plants	Projects on storage systems	Hybrid power plants under construction or in use
Austria				
Belgium				
Bulgaria				
Cyprus				
Czech Republic				
Denmark				
Estonia				
Finland				
France				
Germany				
Greece				
Hungary				
Ireland				
Italy				
Latvia				
Lithuania				
Luxemburg				
Malta				
Netherlands				
Poland				
Portugal				
Romania				
Slovakia				
Slovenia				
Spain				
Sweden				
UK				
Croatia				

In the next pages the regulatory and policy framework relevant to energy storage systems developed in Greece is described in details. Studies conducted in Finland, France, Germany, Ireland, UK and Spain investigating technically feasible and economically viable methods to store RES energy produced from intermittent energy sources are also presented. A brief description of the policy plan in the Canary Islands is given in Section 2.7.2..

2.2. Greece

2.2.1. Overview

As already mentioned Greece is the only country which set special regulations for RES systems installed in non-interconnected islands as well as hybrid systems. For the sake of completeness a briefly overview of the support systems adopted in Greece is given in the following section focusing on hybrid systems. Information was collected from the review that has been elaborated under the RES 2020 Project [5] and the national laws and Codes [6].

The development of renewable energy sources has been among the major Greek energy goals for the past 15 years. Hydropower has been traditionally important and active solar thermal systems (mainly domestic hot water systems) have grown due to supportive policy measures since the early 1980s. Although Greece has set up a wider range of support mechanisms for other RES types, the market uptake has been lower than expected due to time consuming licensing and administrative procedures and grid related issues. Additionally the areas of high wind potential are mainly isolated islands, non-interconnected to the mainland grid where also technical limits on the wind penetration exist. The New Renewable Energy Source Act, favorable Law 3468/2006, sets a new reality and a landmark in the production of energy from geothermal sources, wind farms, photovoltaic systems, hydro power plants, solar systems, biomass, cogeneration and wave energy, by reducing the administrative burdens, speeding up the licensing procedures and setting new feed-in tariffs for RES promotion. It also foresees a Photovoltaic Development plan in order to boost this technology, described in section 2.2.2.

The new law sets also the fundamentals for the promotion of hybrid power plants in the non-interconnected islands. According to the law, hybrid power plants are remunerated for capacity availability as well as for the amount of energy supplied to the grid and pay for the electricity absorbed from the grid in order to fill their storage systems.

In July 2008, RAE has published for public consultation [7] a proposed Code for the operation of hybrid power plants. The Code includes principles regarding the operation of hybrid plants in the daily market and the methodology for their remuneration. Details on existing and proposed regulations and schemes towards the promotion of hybrid systems and on hybrid projects in the pipeline are provided in section 2.2.3. Hybrid power systems and the development of a favourable framework, is of great importance, while the Greek islands are characterised as saturated, which means that there is no possibility to install new wind or photovoltaic plants despite to the already installed or taken the production licence [8].

2.2.2. Renewable Energy Sources

2.2.2.1. Feed-in Tariffs

Law 3468/2006 [21], stipulates feed-in rates for renewable and CHP. The tariffs differentiate for RES plants in mainland and non-interconnected islands. Table 4 depicts the revised, current in use feed-in tariffs. The feed-in tariffs are guaranteed for 10 years with a unilateral extension for 10 more years.

The prices included in Table 4 shall be revised annually by a decision of the Minister of Development following an opinion from RAE. That revision is based on the weighted adjustment of the approved bills of the Public Power Corporation (PPC S.A.). By “weighted adjustment” of the bills of PPC S.A., is meant the average of the separate changes per category of pricing, as that average shall be weighted according to the type of electricity consumption during the previous year.

Table 4.: Currently feed-in tariffs in Greece

Electricity production from:	Electricity Price (€/MWh)	
	Interconnected System	Non-Interconnected Islands
(a) Wind power	75,82	87,42
(b) Wind power from offshore wind farms	92,82	
(c) Hydro power utilised by small hydroelectricity plants with installed power load up to fifteen (15) MWe	75,82	87,42
(d) Solar power utilised by photovoltaic units, with installed power load smaller than or equal to one hundred (100) kWpeak, installed in properties or legally owned buildings or bordering buildings owned by the proprietor or legal owner	452,82	502,82
(e) Solar power utilised by photovoltaic units, with installed power load more than one hundred (100) kWpeak	402,82	452,82
(f) Solar power utilised by units using different technology, other than photovoltaic with installed power load up to five (5) MWe.	252,82	272,82
(g) Solar power utilised by units using different technology, other than photovoltaic, with installed power load more than five (5) MWe.	232,82	252,82
(h) Geothermic power, biomass, landfill gases, sewage treatment plant gases and biogases	75,82	87,42
(i) Other R.E.S	75,82	87,42
(j) H.E.C.	75,82	87,42

2.2.2.2. Photovoltaic Development Plan

A Photovoltaic Development Plan has been set up with a Ministerial decision, on 18/7/2007, in conjunction with the high feed-in tariffs that are foreseen for electricity produced by PVs. According to this plan a total of 540MWp will be installed in the interconnected system of mainland, 200MWp in the islands and 50MWp for off-grid applications, over the period of 2007-2010. The plan has to be realized according to Table 5.

Table 5.: Photovoltaic Development Plan

Year	Percent of total capacity
2007	50%
2008	70%
2009	90%
2010	100%

A specific geographical distribution of this installations has been decided (setting upper limits per region) taking into account the solar radiation distribution over the country and the technical limits set by the systems of non interconnected islands [9].

In order to speed up the licensing procedure plants with an installed capacity of less or equal to 150 kWp are exempted from the obligation to obtain a production license.

Producers who install a photovoltaic plant in a non-interconnected island with installed capacity of less or equal to 20kWp and who expressed their interest before 24.05.2007 are

also exempted from all license procedures and they have simply to inform RAE and TSO about the installation [10].

2.2.2.3. Investment Incentives

National Development Law (Law 3299/2004) set subsidies that vary from 30-40% of the installation cost depending on RES technology, region and type of enterprise and 50% subsidy for connection costs.

Subsidies from local authorities, whose amount of subsidy vary, are also available. Table 6 presents the level of support according to each RES type.

Table 6.: Investment subsidies

RES-type		Support level (% of total investment)
Hydro		35
Wind	Onshore	35
	Offshore	35
PV		30-45
Geothermal		35

2.2.3. Hybrid Power Plants

2.2.3.1. Pricing of Electricity

Law 3468/2006 sets the fundamentals for the promotion of hybrid power plants in the non-interconnected islands. According to the law hybrid power plants are remunerated for capacity availability as well as for the amount of energy supplied to the grid and pay for the electricity absorbed from the grid in order to fill their storage systems. The next paragraphs provide details on the remuneration of hybrid plants. Note that there is no distinction between different technologies and also that the system refers to non-interconnected islands. According to Law 3468/2006 and the proposals of RAE in the frame of public consultation taking place in July 2008 [6, 7]:

a) The capacity availability of the firm output units of the hybrid plants connected to the island's grid is to be priced on a monthly basis, in Euro per MW of firm power output. For the pricing of the capacity availability, the estimated construction cost and the fixed operation cost of a new incoming conventional plant to serve the autonomous system of the island are taken into account. The price to be paid to the producer for the availability of the firm output units of the hybrid station cannot be less than the price paid for the availability of the units of a new incoming conventional plant of corresponding capacity. As new incoming conventional plant in the autonomous system of the island, is considered a power plant which uses conventional fuel and is regarded as being constructed at the time the application for the issuing of the production authorization is under consideration, and aims at the uninterrupted power supply of the island according to the provisions of the Operation Code of the Non-interconnected islands.

The cost refers to the construction cost of a new incoming conventional plant although in some islands the construction of a new plant is not possible or probable.

While the hybrid plant is paid for the capacity availability of its firm output units, a penalty should be set in case of continuous unavailability to provide the guaranteed energy to the TSO. This penalty may be activated after some days of unavailability and will increase linear when the days of unavailability increase [7].

b) The remuneration of the power produced from the hybrid station's firm output units, exploiting the energy stored in the storage system, and supplied to the grid of the island is specified in the production license of the hybrid station. This is conducted on the basis of the mean marginal cost of the conventional peak units operating on the island during the last year

(annual mean variable cost). As conventional peak units are considered, units which were in operation time less than 30% of time of the reference year. This cost is calculated for the total electricity these units supplied to the grid in reference to the fuel cost, operation and conservation cost, as well as emission expenses.

The annual cost of the conventional units changes during the years, fact that should be taken into account in the remuneration. Prices may also change because of changes in the whole production system of the island (e.g. introduction of natural gas, new units e.t.c.).

The hybrid station's firm output units might replace conventional peak, medium or base units, which provide spinning reserve, primary frequency and voltage regulation. In this concept hybrid station's firm output units should also provide these services, which should not be remunerating as ancillary services [7].

c) The pricing of the overall amount of electricity the hybrid station absorbs from the Network for fulfilling its storage system is done on the basis of the mean variable cost of the conventional base units operating on the island during the last year (annual mean variable cost). As conventional base units are considered, units which were in operation time more than 70% of time of the reference year. This cost is calculated for the total electricity these units supplied to the grid in reference to the fuel cost, operation and conservation cost, as well as emission expenses.

The total amount of electricity taken from the Network on an annual basis in order to fulfill its storage system should not exceed 30% of the total amount of energy consumed for the filling of the storage system of that station. The absorption of electricity from the grid should only be permitted if the TSO requires guaranteed energy. In all cases the energy absorption from the grid should be planned in the load "valley" [7].

d) The total amount of electricity the RES units of the hybrid station supply directly to the Network of the island is to be priced as indicated in Table 15 according to the type of RES technology. The guaranteed power can be provided also from the RES units of the hybrid power station in an amount described in its contract.

e) The power produced in the RES units of the hybrid station and directly supplied to the Network of the island may be compensated to the power the hybrid station absorbs from that network for fulfilling its storage system.

4. If an island is [subsequently] connected to the mainland's interconnected System, the contracts between the Network Operator of the islands not connected to the mainland's interconnected System and the Producer shall continue to be valid without the possibility of extension.

In the frame of the public consultation RAE made also some proposals about the technical requirements of these systems. To this point of view and especially for stations using as storage system pumped-hydro, stations with

- a) Production and pumping possibility at the same time by using a double pipeline and appropriate size of reservoir in order not to reject RES energy because of fulfillment of the reservoir or because of production of guaranteed energy
- b) Water turbines with possibility to operate in low load conditions with good efficiency
- c) Variable speed pumps
- d) Wind turbines with fault ride through capability

are preferable.

The principals are described in Law 3468/2006 and suggestions are made by RAE in the frame of the public consultation. The details of operation and remuneration of such systems are under investigation. The Code of non-interconnected islands will include all appropriate information.

2.2.3.2. Hybrid Power Plants in Operation or Under Construction / Projects

The Public Power Corporation, Greece's dominant electricity producer, has already installed a hybrid power plant in the island of Kythnos. The system consists of photovoltaics, using as storage system batteries. PPC is planning to install one more hybrid power station in the non-interconnected island of Ikaria. The station in Ikaria will consist of a wind park and a pump-hydro plant as storage.

It is also worth mentioning that RAE has already received two applications for installing hybrid power plants in Crete (wind park + pump/hydro power plants) of 100 and 12 MW capacity. Both applications are currently being reviewed.

2.3. Finland

Finland is close to achieve its 2010 RES-E target. Renewable energy amounting to 28% of the Finnish total electricity consumption is supplied by two key sources: hydro power (70%) and biomass (30%). There are only a few wind farms located off the Finnish West coast. Many coastal areas are designated as National Park which also makes it difficult to introduce wind farms in these areas. However Finland continues to adjust and refine its energy policies in order to further enhance the RES competitiveness.

Through subsidies and energy tax exemptions, Finland encourages investment in RES. New investments are eligible for subsidies up to 30%. Especially for wind energy installations as well as solar an investment subsidy of up to 40% can be awarded, depending on the novelty of the project. In addition to the investment subsidy, a price premium of 7 €/MWh is awarded. This corresponds to the tax on the electricity that is paid by household consumers. The information Centre for Energy Efficiency (Motiva) is also promoting wind energy by publishing best practice guides and handbooks. The Finnish Wind Energy Association is also actively promoting wind energy through seminars and political lobbying [21]. Additional support in the form of feed-in tariffs based on purchase obligations or green certificates is being considered for onshore wind power.

As a large number of other EU member states, Finland has no special legislation in place for the promotion of RES storage systems. However energy storage applications in distributed power systems were investigated as part of the Finnish national technology programme for distributed energy systems (DENSY).

During the DENSY programme various storage types to support wind power and weak networks were investigated. Different types of storage systems as batteries, flywheels and supercapacitors have been studied and their use in distributed power system has been evaluated from an economical and technical point of view. The results show that different types of storages can be incorporated in distributed power systems and provide a proper energy management, better power quality and improve energy efficiency and flexibility. More information about the program can be found in [10].

2.4. France

Electricity production in France is dominated by nuclear energy amounting approximately to 78%. RES such as biomass and hydro also participate to some extent to the energy mix.

France is developing policies aiming at a more diversified mix towards increased wind and photovoltaic electricity, solar energy for heat and biofuels. France has the second biggest potential in the EU in terms of wind energy and a very good potential in terms of solar and geothermal energy. Its RES approach is centred on feed-in tariffs on the one hand and tendering procedure on the other hand. Special feed-in tariffs are foreseen for PV installations in Corsica and overseas French islands. These tariffs are depicted in Table 7. As it can be

derived tariffs for PV installation on islands are 25% higher than those of the Métropole although the total support level (including the premium) is equal. A premium considers improvements of air quality and reduction of greenhouse gases. Tax credits as well as reduction of VAT-Tax are foreseen.

Table 7.: Feed-in tariffs in France [11]

Resource	Technology	Support level [€cents/ kWh]	Start year	Duration (years)
PV	Métropole : 30 c€/kWh , + premium for building integration of 25 c€/kWh - Corsica, Overseas departments, Mayotte : 40 c€/kWh , + premium for building integration of 15 c€/kWh .		2006	20

Additionally to the special feed-in tariffs for RES installations in French islands Renewable Energy Development in Overseas French Islands has been operating since the 1980s and is still in place today. It is a fiscal scheme designed for financial, institutional or industrial companies to develop investments for renewable energy in French islands [15].

2.5. Germany

Germany is an EU leader in wind energy, photovoltaics, solar thermal and biofuel sectors, both as RES-E producer and manufacturer. A suitable and predictable policy framework has created favorable conditions to RES penetration. Germany has the highest installed wind power capacity in the world and has already clearly surpassed its declared goal to step up the share of renewable energies in electricity consumption by 2010. Feed-in tariffs for renewable electricity, market incentives for renewable heat (RES-H), and tax exemptions for biofuels have proven a successful policy mix leading to a very dynamic market for renewable energy sources. Details on the policy framework in Germany can be found in [5].

Although no specific support schemes for hybrid plants are in place, there is some growing interest in exploring the potential of combined RES and energy storage systems particularly for hydrogen production applications.

The Brandenburg-based company Enertrag and experts from the University of Applied Sciences in Stralsund, the Technical University of Brunswick and the international hydrogen community have been working together for a year to develop a fully-fledged power plant which can generate energy even if the wind isn't blowing. By linking-up over 120 MW of wind farms and biogas plants and by developing complex data and control technology, it will now be possible to supply a variable mix of electricity, heat and fuel at any time. The excess electricity of the RES plant will be used for the production of hydrogen. According to Enertrag, the hydrogen plant of output capacity of 500 kW will be located close to Prenzlau in Uckermark, the plant should be on-grid by 2008. Figure 4 shows a flow diagram of the power plant [14].

The policy framework for the remuneration of the electricity produced from its firm output units, the remuneration of its capacity availability –if any- as well as the way of its operation are not yet clarified.

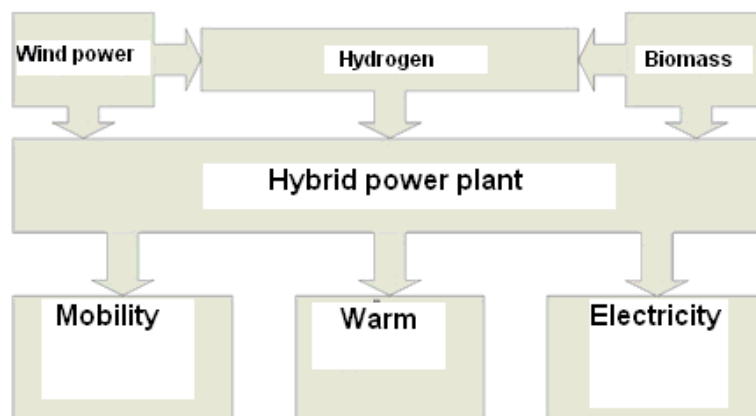


Figure 4.: Diagram of the power plant [14]

2.6. Ireland

Ireland's energy policy as described in the "White Paper" published in March 2007 is built around the three pillars of security of supply, environmental sustainability and economic competitiveness.

It is widely acknowledged that renewable energy has a significant role to play in meeting all three objectives. According to the White Paper, RES-E is an integral part of Ireland's climate change strategy and sustainability objectives. The additional diversity, which renewables bring to Ireland's energy demand will also make a direct contribution to the goal of ensuring secure and reliable energy supplies. Until 2006 the major support system for promoting RES was a tender scheme, but on May 1st 2006, the Minister for Communications, Marine and Natural Resources announced the official launch of the renewable energy feed in tariff (REFIT) scheme [16].

There are no special regulations or schemes for the support of RES storage systems however investor interest is growing and a number of feasibility studies have been carried out. A desalination plant coupled with wind turbines of total power output of 0.7 MW is already installed and in operation in the area of Inis Mean in the county of Galway in the mid-western part of island.

Recently Sustainable Energy Ireland (SEI) [16] has published the results of a feasibility study for the implementation of a wind energy storage facility at Sorne Hill Wind Farm, Buncrana Co. Donegal. The analysis into the feasibility of using an innovative energy storage system showed how such a system could support an uninterrupted supply of wind-generated electricity to the national grid and significantly improve the efficiency of the energy produced.

Another study on electricity storage technologies and their potential to address wind energy intermittency in Ireland has been conducted. The storage technologies examined by this study include pumped hydro energy storage, compressed air energy storage, flywheels, capacitors, superconducting Magnet Energy Storage, batteries, flow batteries (Regenerative Fuel Cells/Redox Flow), hydrogen energy storage. The results showed that pumped hydro systems and compressed air systems have the advantage of technical maturity, economic viability and operational experience and are therefore viewed as a realistic and appropriate first stage in the development of an energy storage solution to wind energy intermittency. Wind - hydrogen storage is a promising prospect for the future because of the ability to decouple the input power, output power and storage capacity. Furthermore, wind hydrogen systems are attractive from the standpoint of achieving zero emissions energy. It has not yet matured from an economic perspective however and the overall energy efficiency remains poor.

One of the first applications of storage RES systems was the desalination plant with load management on Inis Meán. Wind energy was used to desalinate water from the Atlantic in order to cover the island needs in water during the summer. Surplus power generated by the turbines is sold to the national grid.

2.7. Spain

The Spanish energy policy is described in the Renewable Energy Plan (*Plan de Energías Renovables en España, PER*) for 2005-2010. This represents a revision of the Spanish Promotion Plan for Renewable Energy (*Plan de Fomento de las Energías Renovables en España*) 2000-2010 in force until 2005. A suitable legal framework is based on feed-in tariffs with premium price recognising the environmental benefits promotes the development of renewables. Regional support for planning, simple administrative procedures, especially in the case of wind energy, are the key elements for the rapid growth of RES-E in Spain. However issues such as updating and improvement of the regulatory procedures regarding grid access and operating conditions and establishment of a single operation centre for the special regime plants should be taken into account in the future policy developments.

The Canary Islands at the southern western part of the Iberian Peninsula are non-interconnected the mainland. Despite that there is an interconnection between the island of Lanzarote and Fuerteventura. Local schemes and policies related to the promotion of RES to the islands have been conducted and are summarised in the following however no specific measures for the promotion of hybrid plants are in place [17].

2.7.1. Energy Regulatory Framework in the Canary Islands

Table 8 presents the policy measures adopted in the Canary Islands.

Table 8.: Overview of the main support schemes in the Canary Islands [15]

Measures in Canary Islands	Year
Energy Plan of the Canary Islands PECAN, 2006-2015	2006
Strategy for the Development of the Canary Islands for the period 2007-2013	2007
Order of October 3, of 2007	2007
Order of May 25, 2007 (981)	2007
Decree 161/2006, of 8 of November of 2006	2006
Decree 130/2004 of 15 of September of 2004	2005
Spanish Strategy of Energy Efficiency 2004-2012	2004
Law 1/2001 of 21 of May of 2001	2001

Although there is an Energy Plan developed for RES on these islands the main support schemes on promoting RES is feed-in tariffs with no differentiation to the mainland. Current tariffs in Spain can be found in [5].

The Energy Plan of the Canary Islands PECAN, 2006-2015 expresses the basic principles of the islands' energy policy. Its main guidelines are:

- To guarantee the provision of energy to all the consumers in optimal conditions regarding regularity, quality and price
- To reduce as much as possible the consumption of energy without diminishing the degree of comfort of the population nor the competitiveness of the companies and to adopt all the necessary measures so that the impacts produced by the energy in their different facets are minimized
- To foster the maximum use of renewable energy sources, especially wind and solar, as a means of reducing the vulnerability of the system and protecting the environment.

Although the Canary Islands have a special energy plan the main support scheme on promoting RES is the same as in mainland Spain, namely feed-in tariffs. The amount of tariff does not differentiate to the one of Spain.

As already mentioned the islands are autonomous and have an installed capacity of 2206 MW. As it came out from studies high levels of wind penetration, above 20-30% can be reached. To achieve this a storage system is necessary. The most promising storage technology is reversible hydro, where orography permits. Spain has declared that El Hierro, one of the smallest of Spain's Canary Islands, will soon be completely carbon neutral. The island, with a population of around 10,000, will be powered by a combination of wind and hydroelectric power. A project investigating an innovative system for pumped storage is on going, on the island El Hierro. Additionally thoughts of repowering the existing hydropower in La Palma adding a pumped storage station exist. Although there is no special legislation for hybrid power plants in these islands.

2.8. United Kingdom

Until recently, the United Kingdom (UK) was largely self-reliant for energy, producing significant quantities of oil, gas and coal. The gradual depletion of oil and gas reserves and as well as a decrease in domestic coal production has led to a growing dependence on imports. In the electricity sector, gas has replaced coal as the principal fuel. Since 2005, rapidly increasing energy prices, growing concerns on security of supply and awareness of climate change have raised the profile of energy in the UK. The government has come out strongly in favour of new nuclear build, while some regions are putting particular focus on renewable energies (particularly wind and tidal).

The UK Government set out its energy policy on 23 May 2007 when it published its Energy White Paper *Meeting the Energy Challenge*. The Government's main support mechanism for renewables is the Renewables Obligation (RO), which was introduced in April 2002.

The Energy Act 2004 received Royal Assent in 22 July 2004. Energy Act 2004 puts in place a comprehensive legal framework for offshore renewable energy projects - wind, wave and tidal - beyond the UK's territorial waters. The Act establishes a Renewable Energy Zone (REZ), adjacent to the UK's territorial waters, within which renewable energy installations can be established. The Act enables the Crown Estate to award licenses for wind farm sites in the REZ on much the same basis as it currently leases sites within territorial waters.

The Act gives the Government the additional power it requires to regulate renewable energy projects in the REZ, principally by extending the requirement for consent under Section 36 of the Electricity Act 1989. The Act also facilitates a streamlining of the consents process for projects within the REZ and in inshore waters by providing for navigation matters within Section 36.

The legislation introduces two new features - a safety zone scheme and a statutory scheme for the decommissioning of offshore renewable energy installations and related electricity lines [18].

2.8.1. RES on UK Islands

In the UK islands, there is an interest in implementing RES technologies [19].

Western Isles are established as an 'Energy Innovation Zone' with incentives targeted towards energy activities, not just for generating renewable energy but also to accelerate the process of devising viable technologies for distributing, storing and using it. Fuel cells and hydrogen storage systems are studied in order to increase wind energy penetration on the island. Within the targets is to build the largest wind farm in the world located on the island of Lewis in the Western Isles. An ambitious vision is finally to construct an offshore electricity transmission grid along the west coast of Britain and up to the Western Isles. Marine energy

resources to the Isle West are significant. Special projects investigating the wave and tidal potential in the area of Outer Hebrides are on-going.

Wind potential is also high on the island. Currently, one school on the island of Benbecula receives power from a wind turbine, which was a demonstration project developed in the 1980's. Two moorland sites on Lewis (one with 3 turbines and one with 6), contracted under the Scottish Renewables Obligation (3) in 1999, are subject to interest. A planning application for the smaller site, with a 2.25 megawatt capacity was approved by the Comhairle (September 2001).

As far as it concerns Shetland the principal opportunities for renewable energy development are:

1. Embedded Energy Schemes
2. Local Energy Storage
3. Inter-connector to the UK national grid and the export of renewable energy
4. Energy recovery and Energy Conservation Schemes
5. "Green Island" economies

In reference to local energy storage two projects geared towards the storage of renewable energy in Shetland are the PURE Project and SCORE, both based in the North Isles.

PURE aims to store wind generated electricity in the form of hydrogen. It will then be used either as an alternative fuel for a range of hydrogen applications, or in the form of a dry fuel cell to produce electricity. The timescale for implementation of the hydrogen storage component of the PURE Project is summer of 2004. SCORE intends to use a large quantity of electrolyte charged from a renewable energy source (e-fuel) to provide effectively a large battery reserve for stored electrical power. The timescale for the implementation of this project is still unknown.

Orkney Islands have a significant world-beating wind, wave and tidal potentials. The EMEC wave and tidal test centres have been established over the last few years and deployments of various technologies are underway. A big project on investigating different technologies in order to exploit tidal energy is on-going. Some 200 MW of onshore wind energy potential has been identified and is actively being developed.

The Isle of Wight will meet 10% of its electricity requirements by 2010, coming primarily from on-shore wind, biomass CHP, and the existing waste-to-energy plant. Options that are close to being economic, and could become economic by 2010, and that could make a significant contribution to meeting island's energy demand are: biomass heat and power production, using energy crops (most likely short rotation coppice) and forestry residues as feedstock; anaerobic digestion, both farm-scale and centralised; biodiesel production as a substitute for diesel fuel for transport; and off-shore wind. These technologies will most likely require grants or some form of price support in the short term to make them economic. Photovoltaics will also contribute to the island's energy demand. There is one further RES option possible for the Island, which is still at an R&D stage. This is tidal stream, or marine current turbines, which make use of tidal currents to generate electricity. The island is one of the few sites in the UK with suitable resource.

3. Conclusions

This report focuses on the investigation of the existing regulation and legislative framework related to RES implementation in the EU-27 member states as well as Croatia. It can be concluded that there is a strong lack in harmonization of the different support schemes and that each member state adopted different measures on promoting RES, depending on the RES type and the year of implementation.

Although a number of support schemes are in force for promoting RES, even if not harmonized, there is no special legislation or policy framework for hybrid power plants with the notable exception of Greece. The fundamentals of the remuneration of such systems are set in the national Law, while details on the way of operation and remuneration are under

discussion. The main concern is to set the rules in a way that such investments are viable and increase the penetration of RES in islands or remote areas.

Despite the absence of a favorable legislative and regulatory framework however, on going projects were identified in a number of EU member states such as Finland, Germany and Ireland that investigate technically feasible and economically viable methods to store RES energy produced from intermittent energy sources. Construction of hybrid power plants is also ongoing in a few member states including Germany, Greece and the UK.

Taking all these into account the project's contribution will be of great importance. It will investigate possible solutions for integrating such systems in autonomous islands and give general guidelines on the market organization to incorporate them, make some suggestions on their remuneration and in this way increase RES penetration in islands.

4. References

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5. Appendix

In an effort to attain as much information as possible concerning support and experience from coupled RES and storage systems, RAE compiled a detailed questionnaire that was forwarded to the project partners. The questionnaire is presented in the following pages.

Table 1: General information

General information	
Implementation of Directive 2001/77/EC in the national law (Yes/ No)	
Special regulations or support schemes for RES-E produced by hybrid power plants (Yes/ No, Law/Act Number or other Legislation)	
Special regulations or support schemes for RES-E produced in interconnected/ non-interconnected islands or remote areas (Yes/No, Law/Act Number or other Legislation)	

Table 2: Support schemes

(Please provide a tick to indicate the type of support scheme available to your country.)

Support schemes		Hybrid- Type							
		Wind energy + storage system				PV + storage system		Wave & Tidal + storage system	
		Onshore		Off-shore		Energy from RES	Energy from storage system	Energy from RES	Energy from storage system
		Energy from RES	Energy from storage system	Energy from RES	Energy from storage system				
1	Feed-in tariffs (Fixed/ Adjustable)								
2	Quota obligations/ Tradable Green Certificates								
3	Premium System								
4	Fiscal incentives (Tax reduction/ exemption)								
5	Tendering system								
6	Investment subsidies								
7	Voluntary systems or Green Marketing Programmes								
8	Indirect support (Environmental taxes/ taxes on CO2 emissions)								
9	Others								

According to the information provided in the table above (Table 2), please fill in Tables 3-9 where applicable. Tables 10 and 11 can be completed independently from all others.

Table 3: Details about the Feed-in tariff support scheme

Feed-in tariff	Hybrid-Type								
	RES- Type (Energy from RES)			Storage Technologies (Energy from storage system)					
	Wind energy		PV systems	Wave & Tidal	Battery	Hydrogen and fuel cells	Pumped hydro	Desalination	Other (*)
Onshore	Off-shore								
Implementation date									
Tariff level (€/MWh or €/MW) (if not fixed, please provide details or reference on the calculation method)									
Inflationary adjustment of price (yes/no, value)									
Guaranteed duration of tariff (year or duration)									
Extra cost is borne by (e.g. consumers, non res electricity producers)									
Limit on the additional charge for the costumer (if extra cost is borne by the customer) yes/no/value									

Table 4: Details about Quota obligations/Tradable Green Certificates

Quota obligations/Tradable Green Certificates	Hybrid - Type								
	RES- Type (Energy from RES)				Storage Technologies (Energy from storage system)				
	Wind energy		PV systems	Wave & Tidal	Battery	Hydrogen and fuel cells	Pumped hydro	Desalination	Other(*)
Onshore	Off-shore								
Implementation date									
Obligated capacity or share of total supply (MW or %)									
Obligation on (e.g. Consumer-Supplier-Producer-Trader)									
Technology bands (baskets) within overall quota									
Floor price (if not fixed, please provide details or reference on the calculation method)									
Penalty (€/MWh, €/MW)									
Use of penalty revenues									
Supported type (e.g. energy produced or energy fed into the grid)									
Trading scheme									
International trade allowed (yes/no)									
Extra cost is borne by (e.g. consumers, non res electricity producers)									
Limit on the additional charge for the costumer (if extra cost is borne by the customer)									

Table 5: Premium system details

Premium System	Hybrid - Type								
	RES- Type (Energy from RES)				Storage Technologies (Energy from storage system)				
	Wind energy		PV systems	Wave & Tidal	Battery	Hydrogen and fuel cells	Pumped hydro	Desalination	Other (*)
Onshore	Off-shore								
Implementation date									
Tariff level (if not fixed, please provide details or reference on the calculation method)									
Guaranteed duration of tariff (year or duration)									
Extra cost is borne by (e.g. consumers, non res electricity producers)									
Limit on the additional charge for the costumer (if extra cost is borne by the customer)									

Table 6: Fiscal incentives details

Fiscal incentives (Tax reduction/ exemption)	Hybrid - Type								
	RES- Type (Energy from RES)				Storage Technologies (Energy from storage system)				
	Wind energy		PV systems	Wave & Tidal	Battery	Hydrogen and fuel cells	Pumped hydro	Desalination	Other (*)
Onshore	Off-shore								
Implementation date									
Tax reduction/ exemption <ul style="list-style-type: none"> for RES equipment (yes/ no, value) RES production (yes/ no, value) 									

Table 7: Tendering system details

Tendering system	Hybrid - Type								
	RES- Type (Energy from RES)				Storage Technologies (Energy from storage system)				
	Wind energy		PV systems	Wave & Tidal	Battery	Hydrogen and fuel cells	Pumped hydro	Desalination	Other (*)
Onshore	Off-shore								
Implementation date									
Duration of Agreement									
Extra cost is borne by (e.g. consumers, non res electricity producers)									
Limit on the additional charge for the costumer (if extra cost is borne by the customer)									
Succeed tendering competitions/ price caps									

Table 8: Details about Voluntary systems or Green Marketing Programmes

Voluntary systems or Green Marketing Programmes	Hybrid - Type								
	RES- Type (Energy from RES)				Storage Technologies (Energy from storage system)				
	Wind energy		PV systems	Wave & Tidal	Battery	Hydrogen and fuel cells	Pumped hydro	Desalination	Other (*)
Onshore	Off-shore								
Implementation date									
Duration of system (year or duration)									
Description of the system									
Extra cost is borne by (e.g. consumers, non res electricity producers)									
Limit on the additional charge for the costumer (if extra cost is borne by the customer)									

Table 9: Investment subsidies details

Investment subsidies	Hybrid - Type								
	RES- Type (Energy from RES)				Storage Technologies (Energy from storage system)				
	Wind energy		PV systems	Wave & Tidal	Battery	Hydrogen and fuel cells	Pumped hydro	Desalination	Other (*)
Onshore	Off-shore								
Implementation date									
Duration of support scheme (year or duration)									
Level of subsidy									
Investment grants in the frame of different Programmes									
Regional investment subsidies (yes/no)									
Total Budget Available									

(*) Please explain in short the type of storage system

Table 10: Hybrid system in operation or under construction

(Please provide a tick to indicate the type of storage and RES system in operation or under construction in your country. Please provide additional information about the way the plant is (going to be) operated)

Hybrid system in operation or under construction				
Storage system	RES- Type			
	Wind energy		PV system	Wave & Tidal
	Onshore	Off-shore		
Battery				
Hydrogen and fuel cells				
Pumped hydro				
Desalination				
Other				

Table 11: Special projects / incentives for promoting RES on islands or remote areas

(Please provide information regarding any particular projects or / and incentives for promoting RES (with or without a storage system) on islands or remote areas (e.g. projects about tidal stream in the Isle of Wight and others). Please mark the name of project / incentive, its duration and target.)

Special projects / incentives for promoting RES on islands or remote areas			
	Name / Description of the project / incentive	Date of implementation	Target of the project / incentive
1			
2			
3			
4			
5			
6			
7			

