Ad hoc Group
on Environment, RES and Energy efficiency
(RES AG)

Case study on the application of Article 9 on flexibility mechanisms in the EU Directive 2009/28/CE

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1.- Objective of the case study

The objective of this report is to present the basic framework to develop a case study on application of the article 9 of Directive 2009/28/EC, towards to achieve respective mandatory target in year 2020.

2.- The Mediterranean Solar Plan

The Mediterranean Solar Plan (MSP), born under the scope of the “Barcelona Process: Union for the Mediterranean (UfM)”, launched in July 2008, is one of the strategic processes for sustainable development, facing the foreseeable increase of energy demand in the Euro-Mediterranean region, and the need to cut back greenhouse effect gas emissions.

Its main objective is to develop 20 GW of renewable electricity capacity on the South Shore of the Mediterranean, as well as the necessary infrastructures for the electricity interconnection with Europe. The Plan also envisages Saving and Energy Efficiency, as well as Technology Transfer.

A key element for the development of this Plan is the establishment of a suitable, new regulatory framework to promote the deployment of renewable energies, and facilitating the exchange of electricity.

The MSP must be a huge step ahead in the development of the euro-mediterranean co-operation policy in the field of energy, started with the Barcelona Process in 1995, integrated in the European Neighbourhood Policy since 2007 and reinforced with the creation of the Union for the Mediterranean since 2008.

This objective would permit countries of the Mediterranean region to use their high potential in resources on renewable energy generation for energy self-sufficiency as well as trading. Furthermore, there would be social advantages of capacity building and accordingly, local qualified employment creation. For EU Countries, the MSP means a great opportunity of achieving renewable targets defined in 2009/28/CE Directive.

According to the strategy paper, the MSP complements existing Euro-Mediterranean activities and will co-operate fully with existing structures in the field of renewable energy and associated grid infrastructure development, saving and energy efficiency, as well as technology transfer. The specific focus are on the following areas:

- Establish an adequate legal, regulatory, economic, institutional and organizational environment to enable the development and massive deployment of solar energy and other renewable energy technologies, and to facilitate their exchange or trade.
- Examine and promote, in cooperation with European and International Financial Institutions, the best use of all possibilities to finance investments in renewable energy.
- Promote the development of electricity interconnections, in order to establish a viable “green electricity” import and export framework.

- Support energy efficiency initiatives and energy savings to achieve energy saving goals by 2020.

- Facilitate extensive co-operation on all technology aspects.

- Study of all EU carbon mechanisms for the benefits of both Mediterranean sides with the purpose of improving the economics of projects under the MSP.

- Continue regular dialogue between stakeholders of the MSP for close coordination and successful implementation.

Most Governments of Mediterranean Partner Countries (MPC) are aware of the **benefits** (in terms of economic and environmental impacts) of promoting renewable, clean and efficient technologies in their countries along with demand side management measures. Some of this benefits are:

- Reduced environmental impact by eliminating mining and drilling pollution.

- To develop overall economy with the new jobs provided by the new industries, necessary to produce and support renewable energy technology.

- A healthier population with the reduction in pollutants caused by burning fossil fuels.

- A stronger national security with a reduction in dependence on foreign oil.

- A reduction in potential conflicts as the focus shifts away from the control of oil.

- An improvement in developing countries as new opportunities arise in the untapped renewable energy industry.

- A more efficient overall economy as people are able to save in the heating and cooling bills by using solar and wind power.

In order to meet their growing electricity demand, the MPC countries are **facing three major challenges** related to the development of their respective electricity sectors:

- Difficulties in mobilizing financial resources for new power generation capacity and transmission/distribution networks.

- Electricity interconnections increasing and the creation of regional power markets (both South-South and South-North).

- Promoting sustainable development (rational use of energy and deployment of renewable energy sources).

Among the main **obstacles** posed by the mass development of renewable energies in the area, we can enumerate the following:

First, the high estimated costs, aggravated in the current economic context, which make implementation unfeasible if the appropriate funding is not available.

Second, and closely related with the previous problem, is the urgent need to have a stable institutional context, which reduces the regulatory risk and encourages necessary investments (both national and foreign). In this context must establish appropriate aid programs, at least in the first stages of development/implementation of the Plan.

Lastly, the lack of appropriate infrastructures and interconnections as well as the legal and institutional barriers that persist in many of the interested countries require a process of modernization and adaptation, impossible to carry out without the design of ambitious technical co-operation and training programs.

3.- The EU Directive 2009/28/CE

The Directive 2009/28/EC of the European Parliament and the Council of 23 April 2009 on the promotion of the use of energy from renewable sources sets as a general target to get a 20% gross final consumption of energy in the EU region in 2020 coming from renewable sources.

The Directive facilitates a cross border trade of RES energy compatible with National support schemes, in order to facilitate to reach national mandatory targets. Those flexibility mechanisms are statistical transfers between Member States, join projects between Member States, join projects between Member States and third countries and joint support schemes, all of them, between EU countries.

- Statistical transfers between Member States:

It is an agreement between EU Member States, making arrangements from a one Member State producer of RES energy to another Member State, consumer of this energy.

There is a statistical transfer for a specified amount of renewable energy. For the producer (origin) country, this energy is deducted from total renewable energy taking into account in measuring compliance with the targets. For the consumer (destination) country this energy is added to the energy that is taken into account for the compliance with the targets.

Therefore, a EU Member State purchase production of RES Energy (non-physical, statistical only) to another EU Member State for the fulfillment of its objectives.

- Joint projects between Member States

One of the Member States invest in new renewable generation plants located in other member state. The amount of electricity produced by renewable sources is taken into account in the compliance with the national targets of the first Member State.

It is necessary interconnection lines between both countries.

- Joint support schemes

Two or more Member States can agree to coordinate their national support schemes. The participating members must set up a distribution rule to allocate amounts of energy from renewable sources between the countries.

This energy produced in the territory of one of the countries may counts towards the national overall target of other participating country, according this rule.

Interconnection lines between countries are also necessary

But there is other flexibility mechanism which involved EU and non-EU countries:

- Joint projects between Member States and third countries

In this mechanism, one Member State cooperates in a project located in a non-EU country. The aim of the project must be the production of electricity from renewable sources. This cooperation also may involve private operators. It is also possible Joint projects with the participation of several countries.

According Article 9, the main criteria to develop this flexibility mechanism are the following:

1- "An equivalent amount of electricity to the electricity accounted for has been firmly nominated to the allocated interconnection capacity by all responsible transmission system operators in the country of origin, the country of destination and, if relevant, each third country of transit[1]", and "the nominated capacity and the production of electricity from renewable energy sources by the installation…refer to the same period of time";
2- "*the electricity is produced by a newly constructed installation that became operational after 25 June 2009 or by the increased capacity of an installation that was refurbished after that date, under a joint project as referred";*
3- "the amount of electricity produced and exported has not received support from a support scheme of a third country other than investment aid granted to the installation".

[1] Whereas:

(37) …In order to guarantee an adequate effect of energy from renewable sources replacing conventional energy in the Community as well as in third countries it is appropriate to ensure that such imports can be tracked and accounted for in a reliable way…

4.- Study case analysis.

The project under analysis consists on the construction and operation of a Concentrated Solar Power plant, 10 MW nominal installed capacity, located in a country in North Africa. The aim of the analysis is to calculate adequate incentive to be given to the investors, to assure a reasonable profit, taking into account the WACC estimated in the EU country for the electric renewable energy sector, which will be taken into account for measuring compliances with the national targets in a member estate country, according to article 9 of Directive 2009/28/CE.

- **Flexibility Mechanism involved in the project**

The most suitable flexibility mechanism for this study case is described in Article 9 of the Directive 2009/28/CE: "Joint projects between Member States and third countries".

The electricity produced from renewable sources must be taking into account for measuring compliances with the national targets, with the following requirements:

- Energy must be produced by a new installation plant located in a non-EU country.

- Electricity must be consumed in the EU.

- Interconnection lines between countries are also necessary.

-The electricity produced (in the origin country) and exported (to the destination country) has not received support from a third country other than investment aid granted to the installation.

- The amount of electricity exported must be firmly nominated to the allocated interconnection capacity by all responsible transmission system operators involved: in the country of origin, the country of destination and, if relevant, each third country of transit.

- The nominated capacity and the production of electricity from renewable energy sources by the installation are referring to the same period of time.

- **Technology**

This section describes the different technologies currently available for Concentrated Solar electricity generation.

The basic principle of Concentrated Solar Power plants is the use of concentrating parabolic reflector systems in large-scale, which direct the solar radiation onto a receiver. The concentrated radiation is then transformed into thermal energy at temperatures ranging from around 200 to over 1000° (depending on the system). As in a conventional power plant, this thermal energy can then be converted into electricity via steam and powered turbines, or it can also be used for other industrial processes.

Currently, there are four types of concentrating reflector systems: Linear concentrating systems such as parabolic trough and Fresnel collectors and point focus concentrating systems such as solar towers and Stirling o parabolic dishes.

The following briefly describes the four types of technologies:

1. Solar Tower Plants

Solar Tower plants use a circular arrangement of hundreds of automatically positioned reflectors (heliostats) to concentrate sunlight onto a central receiver mounted on top of the tower. Temperatures can reach up to 1000 ℃ – significantly higher than with parabolic trough collectors. These higher temperatures enable greater efficiency. This heat is transferred to a fluid to generate steam, which expands in a turbine coupled to a generator to produce electricity.

To date, this technology has been developed in large-scale pilot plants in the United States, Israel and Spain.

2. Stirling o parabolic dishes

A parabolic concave reflector (the dish) concentrates sunlight in a receiver. The operation consists of heating a fluid located in the receiver to a temperature around 750 º C. This energy is used for power generation by the Stirling engine or microturbine, connected to the receiver.

Parabolic dishes achieve the highest concentration of solar flux and therefore the highest performance. Therefore, these systems can achieve a degree of efficiency in excess of 30 %.

However, the electricity generation costs of these systems are much higher than those for trough or tower power plants, and only series production can achieve further significant cost reductions for Dish–Stirling systems.

3. Fresnel Collectors

So-called Fresnel collectors use flat reflectors, simulating a curved mirror by varying the adjustable angle of each individual row of mirrors, in relation to the absorber.

The mirrors are controlled by electric motors that track the position of the sun, focusing sunlight on the absorber tube in the most efficient way. The parallel mirrors focus the energy radiated by the sun in a tube, placed 8 meters above the mirrors. The water flows through the absorption tube, which is heated to temperatures up to 450º C. This produces steam (as in a conventional power station), which is converted into electricity in a steam turbine.

Fresnel collectors are more recent and optically very similar to the parabolic trough. Nevertheless, the basic foundation that develops the Fresnel collector is simpler than the parabolic trough. However, the annual yield is also slightly lower, because the temperatures at which they are able to reach are more limited.

4. Parabolic trough

The parabolic trough collector consists of large curved mirrors, channel-shaped, which concentrate the sunlight, by a factor of 80 or more, onto absorber tubes placed in the focal line of the channel. The tubes are a fluid heat transfer that reaches temperatures up to 390° C and pumped through a series of heat exchangers for produce steam. The heat in the steam is converted into electricity in a conventional steam turbine.

Parabolic trough technology is currently the most proven and mature Concentrated Solar Power electric technology. This technology has been available since the 80, currently, there are numerous plants under construction and in operation, most of them located in the United States and Spain.

The technology selected for the analysis of the project is the Parabolic trough, without storage. This decision has been made taking into account variables such us maturity of technology and know-how, technical risk, prospects of profitability, suitability of the site, etc.

In reference to maturity of technology and know-how, among the four technologies described, the parabolic trough is the most developed one. Plants with parabolic trough collectors have been commercialized since late 80's, and have achieved a large presence in countries like Unites States and Spain. Other technologies have not yet achieved a desirable implementation. Parabolic trough has also a modular architecture.

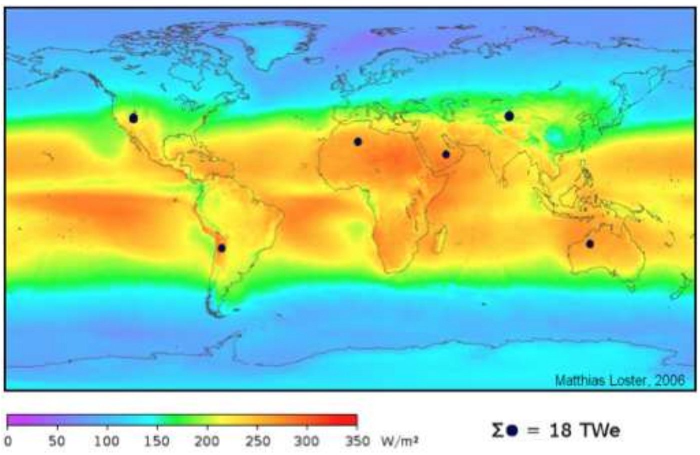
As regards technical risk, we consider it very low because of the high tested experience in the use of this technology (number of accumulated hours of operation of existing plants) and the high degree of learning.

Nowadays, Fresnel collectors, Solar Towers and parabolic Stirling dishes have higher costs than parabolic trough collectors. Even more, Fresnel and Stirling technologies are not cost-effective jet.

- **Location of the Concentrated Solar Power (CSP) plant**

The most appropriate places for the development of Concentrated Solar Power plants are those located in the "sun belt" (area is between 35 degrees north latitude and 35 degrees south latitude). Countries of the Arabian Peninsula, northern and southern Africa, parts of India, Australia, South America, Central and North America are located in this area. In Europe, places with better conditions are in Spain, Italy, Greece and some islands of the Mediterranean.

The graphic below shows that the area of North Africa is a similar area at levels of radiation to localized regions in southern Europe.



In reference to the suitability of the situation of the plant, it has been taken into account the geographic area of North Africa, where there is a high level of direct solar radiation and a low cloudiness index, a good electrical interconnection, water enough for the maintenance of the plan as well as an appropriated field to install 10 MW equipments.

The potential for Concentrated Solar Power plants is enormous: for instance, about 1% of the area of the Sahara desert covered with CSP plants would theoretically be sufficient to meet the entire global electricity demand. Therefore, Concentrated Solar Power systems will hopefully play an important role in the world's future electricity supply.

- **Cost analysis**

Hypothesis data

For the case study of the CSP plant, following information has been taken as starting point:

- The selected plant under analysis has 10MW power installed. This information has been selected taking into account technical and economic parameters from European plants samples.

- The economic life for the installation has been estimated at 25 years. Some studies show that the economic life of a CSP plant oscillates between 20 and 40 years.

- The installation is estimated to be straight-line amortized in 25 years.

- Information taken as a hypothesis is the average hours of operation of a Concentrated Solar Power plant located in the south of Europe (3.048 hours) increased by 10% (3.353 hours), due to the estimation of irradiation in the area where the plant is supposed to be installed is slightly higher than in the referred area.

- The WACC considered to calculate the price to remunerate the installation, is the estimated for the renewable energy sector in the European country.

- The Inflation Rate (IR) used is 3%. Incentives are increased every year by IR-x. We take x=0.5, according to some European support schemes..

- Capital investment of the installation has a 50% non-refundable subsidy, that proceeds from the international aids to development (from countries, Institutions and Banks). It is developed in the 7 chapter of this report.

  The concept of capital investment has been divided into the following headings: major equipment, civil works, grid connections and others.

  It has been assumed that the data of the capital investment of the installation are similar to those for developing a CSP plant in Europe.

- Installation is expected to operate the first year of operation to 70% of its capacity, second year, in the remaining 90% and 100% for the rest of the life of the installation.

- 50% of the production generated will be used for domestic consumption (in the domestic market of the origin country) and 50% is consumed in the EU country.
  - The 50% of the electric generation consumed in the origin country will receive the regular market price. In the case study, the price for electricity consumed in domestic market is 51€/MWh, which is the referred price in the some European electricity markets.
  - The other 50% consumed in the EU country will be sold at a fix price or tariff (Feed-in Tariff system) calculated taking into account parameters described in this section.
- The concept of operating costs of the installation was divided into the following headings:
  - **Operation and maintenance**
  - **Fuel**: For operational and technical reasons, it has been considered that 15% of the energy of the plant will be produced using natural gas. Therefore this variable cost has been calculated based on the energy production.
  - **Management.** Purchasing of electricity from electric system.
  - **Other costs**, as insurance and outsourcing services.

  In this case, it is also assumed that the data of the operating costs of installation are similar to those of developing a CSP plant in a European country.
- Regarding the cost of water, it has been considered the price of water for industrial use is 0,51 € / m3 plus an annual fixed fee of 7,56 €. This water it is not to refrigerate the plant, only to the steam and to clean the mirrors. The plant is refrigerated by air.
- The Corporate Tax is 35%.

Results

With de hypothesis above mentioned, the results of the project are:

- Half of the generation (consumed in domestic market of the origin country) paid to 51€/MWh.
- The other half of the generation (consumed in the destination country) paid by a fix price of 182,63 euros/MWh[2]
- Internal Rate of Return (IRR): 8%

[2] The right support scheme for the generation will be study in chapter 7.1.

5.- Regulatory framework

5.1. Renewable energy certification

In order to apply the mechanism defined in article 9 of the Directive, it is important to certify and guarantee that the energy coming from the plant installed in the origin country (In the north of Africa, in the study case) and consumed in the destination EU country come from renewable sources.

It is necessary setting certification organisms in the participant countries, at a national level, with the international recognition of the EU and the non-EU members.

This organism must certify that the energy comes from renewable sources, according to objectives and transparent criteria. Also must set transparent rules and the appropriate controls.

There are several options to guarantee and certify the renewable generation and the tracking of the electricity:

- **Guarantees of origin**

Guarantees of origin are set in the Directive 2009/28/EC for the purposes of proving to final customers the share or quantity of energy from renewable sources in an energy suppliers energy mix.

According to the Directive, it is important to distinguish between green certificates used for support schemes and guarantees of origin.

Some of the advantages of this system are:

- The Directive sets clearly all parameters must specify the guarantee of origin: (Energy source, start and end dates of production, identity of installation, etc.)
- Is a very common system used in many European countries. There are years of experience and it has been proved as a effective tool to verify the origin of the electricity.
- EU Member States shall recognize guarantees of origin issued by other EU Member States in accordance with the Directive.

Some of the disadvantages of the Guarantee of origin system could be:

- There is no legislative support in the Directives to recognize guarantees of origin between EU Member States and other countries.
- Could be any kind of legislative uncertainty, because according to the Directive, the guarantee of origin shall have no function in terms of a Member States compliance with the mandatory national targets.

Another option is to designate an independent certifier to verify the source of the electricity.

The main advantages of this system are:

- To design an “Ad hoc” system verification.

But an independent certifier system involves some cons that can invalidate this option:

- Difficulty to assure the independence of the certifier from companies, governments, etc.
- There is no support from any existing legislative or regulatory framework, and there is no previous experience.

5.2 Support systems

There are several support schemes that have already demonstrated to be successful in contributing to the development of RES plants. These schemes could be applied in both EU and non-EU countries. Most relevant and effective are the following:

Multilateral Supports: Multilateral institutions like the EIB, World Bank or European Commission Bodies, can provide financing tools to mitigate financial/technology risk, which assist in mobilizing capital not only from Governments but from other public and private sources.

Direct Subsidies: Attribution of subsidies to project developers for CSP plant construction.

Loan guarantees: Ensuring access for RES project financing is very important to for instance overcome current financing obstacles for private financial institutions, like banks.

Clean Development Mechanism (CDM): RES are comprised of a legislator framework that demands investment in clean energy sources to offset effects of fossil fuel combustion. Specific CDM can be created to direct investment for RES projects.

R&D Support: Grants, Soft loan guarantees and risk sharing mechanisms can be used to develop innovative technologies as well as further speed-up the rate of cost reductions resulting from technological improvements.

Feed-in-tariff: FiT are electricity price supplements that governments establish through long-term contracts to encourage the adoption of renewable energy based on the cost of electricity production for the technology in question. Most EU countries with solar power potential already have FiT systems in place, hence inclusion of CSP is a very straight forward option, where not already employed.

Feed-in-Premium: Fix or variable premium are paid to the producer on top of the electricity market price. Usually total retribution is limited or guarantee by a “Cap and Floor System”.

Tenders: a tender is announced for the provision of a certain amount of electricity from a certain technology source, and the bidding should ensure the cheapest offer is accepted. Investors are chosen by reverse auctions process, where governments invite bids from investors regarding the minimum Feed-in-Tariff at which they would agree to deliver power.

Market mechanisms (Quota obligations): Governments impose an obligation on consumers, suppliers or producers to source a certain percentage of their electricity from renewable energy. This obligation is usually facilitated by tradable green certificates (TGC). Accordingly, renewable electricity producers sell the electricity at the market price, but can also sell green certificates, which prove the renewable source of the electricity. Suppliers prove that they reach their obligation by buying these green certificates, or they pay a penalty to the government.

Build-Operate-transfer (BOT) Contracts: Launch of CSP BOT contracts for power supply in areas where energy is required is an additional mechanism to attract investment and justify subsidization.

RES Portfolio Standards: Creation of required targets for share of CSP and other renewable sources can provide long-term governmental target setting for state-owned and private power generators. To implement portfolio standards, utilities could be permitted to roll over some additional cost to end-consumers where possible.

Investment tax credits: Attribution of tax credits for the development of RES plants can allow improved project economics without requiring direct government subsidies.

6.- Energy Transmission

- **Direct infrastructure investments**

The prospects of increasing generation of electricity from renewable sources and the need to connect customers with the areas where renewable energy installations are located require a significant effort in order to upgrade, modernize and extend electricity grids and interconnectors among countries in the Mediterranean region.

Developing the enormous renewable potential in Southern Europe and in the countries East and South of the Mediterranean will be impossible without additional interconnection within the EU and with neighbouring countries.

The development of grid interconnections in a way that investments could be deployed in a timely manner and in order to reap the full benefits of an integrated energy network require to address specific issues, including the identification of links among the regions involved, connection procedures for RES facilities, ways to speed up the permitting process and promote cross-border cooperation.

The development of energy infrastructures within the EU and with its neighboring countries is receiving increasing attention at the European level. On 17 November 2010, the European Commission has adopted the Communication "Energy infrastructure priorities for 2020 and beyond - A Blueprint for an integrated European energy network" which identifies priority for future energy infrastructures (including interconnections in South

Western Europe to make, *inter alia*, best use of RES from countries East and South of the Mediterranean) and proposes a new method for strategic planning aimed at supporting the implementation of projects of European interest. This initiative is expected to be transposed into a legal proposal by end of 2011 and it might represent an opportunity for the advancement of the Mediterranean Solar Plan as well as related interconnection infrastructures, bringing economic benefits for the countries in the Mediterranean region.

- **Interconnections and transit countries**

The identification of relevant interconnection links between regions and countries represent a first important step for the development of an integrated electricity network able to accommodate increasing RES flows. Operational interconnections and potential projects in the Mediterranean region include in particular:

- Morocco-Spain (operational)
- Morocco-Algeria (operational), reinforcement under preparation
- Tunisia-Italy (under preparation)
- Algeria-Italy (under-study)
- Libya-Italy (under-study)
- Tunisia-Algeria
- Tunisia-Libya (existing cables, but not operational)
- Turkey-Greece and Turkey-Bulgaria (existing cables, but not operational).
- Egypt-Libya (operational)
- Egypt-Jordan-Lebanon-Syria (operational)
- Syria-Turkey (partially operational)
- Egypt-Greece (under-study)
- Greece-Italy (operational)
- Montenegro-Italy (under preparation)
- Albania-Italy (under preparation)
- Croatia-Italy (under-study)

The only south-north operational interconnection in the west side is between Morocco-Spain. It has a capacity of 900 MW. Moreover there is an important bottleneck in this interconnection between Spain and the rest of the EU. In particular the interconnection between France and Spain (4 tie-lines: 2 of 220 kV and 2 of 400kV) suffers continuous congestions. A new line in the Eastern Pyrenees should be ready by 2014, increasing the interconnection capacity to about 2,800 MW, but some congestions might remain in view of the large increase of RES electricity generation expected in the future.

- **RES network integration: access rules and priority of dispatch**

In order to connect to the power system, any form of generation connecting to a transmission (or distribution) network will be required to meet certain technical criteria. It is essential to have and agree on such connection criteria to ensure the operational security of the network, to ensure that the performance of the generator in response to varying conditions can be foreseen and to ensure that it is not unduly disruptive to the safe and secure operation of the network.

It is important to develop connection procedures for RES facilities. Non-discriminatory access rules and priority of dispatch have to be properly defined for electric energy from renewable sources.

Each country involved shall ensure that network operators in their territory guarantee the transmission and distribution of electricity produced from RES. They shall also provide for non-discriminatory connection to the grid system of electricity produced from RES. Harmonized principles should also operate regarding the dispatch priority and balancing responsibilities. International rules shall clearly define any technical specifications which must be met by RES equipment and systems in order to be connected to the grid.

For Transmission System Operators to guarantee the security and the adequacy of the power systems installations, new generators, have to comply with the grid codes and technical specifications prior to being connected to the grid.

- **Supporting the implementation of interconnection projects**

Different obstacles can delay the implementation of interconnection projects, including a lack in international cooperation, complex permitting procedures, numerous stakeholders and decision makers to be involved, as well as inadequate financing for the projects.

As regard international cooperation, initiatives like the Mediterranean Solar Plan (MSP) involving the two shores of the Mediterranean Sea should be reinforced and strongly supported, for example, ensuring open and transparent debate among parties involved in order the accelerate agreement about the design and project implementation.

Permitting issues are also crucial factors that hinder timely construction of new lines, in particular cross-border. Experiences in several EU Member States indicate that national permitting and licensing processes, complemented by European legislative procedures require several years (up to 10 years).

Therefore tools to expedite permitting procedures should be supported. In that sense, the identification of national contact or coordination authorities on cross-border projects, as long as they do not cause additional bureaucracy, might result beneficial in order to ensure acceleration of the procedures.

The implementation of interconnection projects as well as the realisation of substantial new RES generation capacity, as in the case of the Mediterranean Solar Plan, will require unprecedented investments in the energy sector of the countries involved over the future years. This means that significant financial resources need to be raised in order achieve the targets and that existing and innovative tools need probably to be considered to bridge the financial gap. The financing of the project will be the focus of chapter 7.

- **Cross border trade and transit mechanisms**

Article 9.3 of the RES Directive acknowledges the need for new interconnections with a long lead-time to be built between Member States and third countries so as to allow power originated by joint projects to flow. A specific time frame is defined, applying to interconnectors started by 2016 and expected to become operational between 2020 a 2022 and aforementioned criteria to be met fully apply also here: electricity to be accounted for must be firmly nominated to allocated interconnection capacity by all responsible transmission system operators —TSOs— involved, in the origin and destination countries and, where relevant, also in transit ones.

In this regard, due consideration must be given to pertinent provisions in Regulation Nos. 714/2009[3] and 838/2010[4]. These Regulations lay down principles on access to the network for cross-border exchanges, including the establishment of a compensation mechanism for cross-border flows of electricity (the so-called Inter-TSO compensation mechanism, ITC) and the setting of harmonized principles on related transmission charges. The rationale behind this is that TSOs should be compensated for costs incurred as a result of hosting cross-border flows of electricity on their networks. The value of the fund providing for such costs (increased losses, infrastructure made available) is expected to run into —few— hundreds of millions but is yet to be properly assessed. This, together with the harmonization of average charges for access to the network within a certain range[5], should enhance the free trade of electricity, paving the way to achieve the single internal market.

In connection with transit compensation issues, and even more relevant for this document's scope, TSOs from third countries which have concluded reciprocity agreements with the European Union —thus applying Union law in the field of electricity— should be entitled to participate in the ITC mechanism as any other Member State's TSO; in the absence of such an agreement, they are allowed to enter multi-party agreements with EU's TSOs 'which enable all parties to be compensated for the costs of hosting cross-border flows of electricity on a fair and equitable basis.'

Until either a reciprocity or a multi-party agreement is reached with a third country's TSO, a transmission system use fee shall be paid on all scheduled electricity imports from (and exports to) third countries; this fee will be collected by the EU Member State through whose network import (or export) is fulfilled and added to the main compensation fund to be eventually shared among ITC agreement signatories.

So, if the origin country is not a participant of the ITC compensation mechanism, its TSO shall pay the above mentioned fee. In this case study, the fee is set at 4,56 Eur/MWh by the energy exported.

[3] Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003.

[4] Commission Regulation (EU) No 838/2010 of 23 September 2010 on laying down guidelines relating to the inter-transmission system operator compensation mechanism and a common regulatory approach to transmission charging.

[5] Annual average transmission charges paid by producers lay currently within a range of 0 to 0,5 EUR/MWh, except for Scandinavian countries, the British Isles and Romania.

7.- Financing of the project

Many project developers identify lack of access to financing as one of the key reasons why numerous project concepts never materialize. In general, the largest costs associated with a project are incurred at the construction stage.

Therefore, a critical point to take into account is to develop a strategy covering the suitable mechanisms for financing the projects. The incentives must provide reasonable expectation for all parts, and all stakeholders involved must take a reasonable profitability, including the most cost-effective solutions to ensure active private sector involvement.

There are different forms of finance available that can be used to develop projects. In the case of the project under study, the terms financing that have been chosen are a mix of resources:

- Non-refundable subsidy:50%
- Private initiative: 50%.

This financing structure has advantages of the investment support (simplicity, risk reduction) and also advantages of the production support (maximize generation, optimize plant operation).

In relation to the non-refundable subsidy which proceeds normally from Official Aid Development, it should be noted that grants are typically provided by government organizations, many of them international, and only cover a percentage of project. In our research project could be involved European Investment Bank, World Bank and the different regional aid Banks. Also international financial institutions may finance those projects through long term low interest rate debt.

The hypothesis adopted in the case of study is to reach in this part an amount of money that permit to sell half of the generation to the domestic market of the origin country . Price market for the study is set at 51€/MWh.

In relation to private initiative, it is important to remark that the project must be profitable and attractive for private investors.

7.1 Choosing a support system for generation:

This project has very specific features, and is important to analyze the pros and cons of the different support schemes options. The criteria must take into account the Efficiency and the effectiveness of the support schemes, but also must minimize investment uncertainty and it has to be easy to implement.

According these criteria, there are some schemes more suitable than others:

- **Tenders**: This is a competitive and transparent mechanism, and is a very cost-effective solution. But the case study is a totally new project with no previous experience and with a new regulatory framework no developed, so the security for investors is a key point. Tenders usually involves an extra uncertainty, so this is not a suitable mechanism for this project.

- **Market Mechanisms (Quota**) The main advantage of these systems is the market compatibility, but there is not an only market for all the Mediterranean region. Also, this system can increase the uncertainty, so the cons are quite strong to consider it a right mechanism in this case.

- **Feed-in-Premium**: It is a very effective and efficient system. But it needs a electric market to give a right reference of the price. Many Mediterranean countries this market is still under development.

- **Feed-in-Tariff**: It is also an effective and efficient system. It is not difficult to implement. The main advantage of the Feed-in-Tariff system is to reduce the uncertainty. For all these reasons, this system is the more suitable for the case study.

8.- Conclusions

After having analyzed the case study, the proposal of constructing a Concentrated Solar Power plant could be identified as an opportunity for achieving targets defined by the European Union energy and climate change package, as well as to increase the production of energy from renewable sources in suitable economic conditions. But it is necessary to develop infrastructures in transmission and interconnection lines and to agree at least a renewable energy certification system, and a cross border trade and transit mechanism between the EU and non-EU countries.

9.-Economic data summary

	5 MW. Energy for export to EU		5 MW. Energy for domestic use	
	By unit	Total	By unit	Total
Private investment	5,61(M€/MW)	28,05 M€	5,61(M€/MW)	28,05 M€
Subsidies			-5,61(M€/MW)	-28,05 M€
Production (year) at 100% of performance	3.353 h/ year	16,76 GWh	3.353 h/year	16,76 GWh
Operating costs (year)	67,49(€/MWh)	1,131 M€	67,49(€/MWh)	1,131 M€
Income: Electricity market price (year)			51 €/MWh	0,85 M€
Income: Feed in Tariff (year)	182,6 €/MWh	3,06 M€		