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for Climate, Environment
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Centre de Recherche en
Economie Appliquée pour le
Développement (CREAD)

Algeria – A Future Supplier of Electricity from Renewable Energies for Europe?

Algeria's Perspective and Current European Approaches

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Terms and Abbreviations

AC	Alternating current
ANDI	Agence nationale de développement de l'investissement (Algerian National Agency for the Development of Investment)
ANIREF	Agence nationale d'intermédiation et de régulation foncière (Algerian National Agency for Land Intermediation and Regulation)
APRUE	Agence nationale pour la promotion et la rationalisation de l'utilisation de l'énergie (Algerian National Agency for the Promotion and Rationalisation of Energy Use)
CC	Combined Cycle
CDER	Centre de développement des energies renouvelables (Algerian public institution for research in the domain of renewable energies)
CNI	Conseil national de l'investissement (Algerian National Council of Investment)
COMELEC	Comité maghrébin d'électricité (Electricity Committee of the Arab Maghreb Union)
CREDEG	Centre de recherche et de développement de l'électricité et du gaz (Centre for Research and Development of Electricity and Gas)
CREG	Commission de régulation de l'électricité et du **g**az **(**Algerian Regulatory Commission of Electricity and Gas**)**
CSP	Concentrating Solar Power
CTF	Clean Technology Fund
DC	Direct current
Dii	Desertec Industry Initiative
DLR	Deutsches Zentrum für Luft und Raumfahrt, German Aerospace Center
DNI	Direct Normal Irradiation
ENPI	European Neighbourhood and Partnership Instrument
EPC	Engineering, Procurement and Construction
EU	European Union
HVDC	High Voltage Direct Current
IAEREE	Institut algérien des énergies renouvelables et de l'éfficacité énergétique (Algerian Institute for Renewable Energy and Energy Efficiency)
IAP	Immediate Action Plan (Policy instrument of the European Union)
IPP	Independent power producers
ISCC	Integrated solar combine cycle
MEM	Ministère de l'énergie et des mines (Algerian Ministry of Energy and Mining)
MENA	Middle East and North Africa
NEAL	New Energy Algeria (company)
PV	Photovoltaic
RE	Renewable energies
SONELGAZ	Société nationale de l'électricité et du gaz (Algerian Electricity Utility)
SONATRACH	Société nationale pour la recherche, la production, le transport, la transformation, et la commercialisation des hydrocarbures (Algerian National

	Society for Research, Production, Transportation, Transformation and Commercialisation of Hydrocarbons)
TSO	Transmission system operator
UfM	Union for the Mediterranean

1. Introduction

In the present discussion about the role of renewable energies in a future European energy supply scheme, certain scenarios envision the exploitation of the substantial North African solar and wind energy potentials in order to supply Europe with green electricity. In greater detail, these concepts propose the installation of large-scale solar power plants and wind parks as well as an intercontinental power grid in order to transport the electricity to Europe. These projects currently enjoy keen attention by the European media, particularly since the *Desertec Industrial Initiative* (*Dii*), an initiative primarily constituted by German companies, has been founded in October 2009. The *Dii* claims to be willing and able to invest a total sum of €400 billion into the construction of future North African solar power plants and their connection to the European grid through submarine cables. Parallel to that, the political climate in Europe seems to be favourable towards these ideas. Launched already at the end of 2008, the new European renewable energy directive allows the import of green electricity from non-EU states into the Union. Also, the *Union for the Mediterranean*, the new political instrument of dialogue and cooperation between the EU and non-EU states of the southern and eastern Mediterranean, has in its core a large-scale energy partnership programme, the *Mediterranean Solar Plan*.

In spite of these promising initiatives it needs to be underlined that concepts such as the *Mediterranean Solar Plan* and *Desertec* are based almost exclusively on largely generalist technical-economic studies that principally represent the European outlook on these projects.

When it comes to more detailed, country-specific issues, for instance regarding the related political frameworks and economic or legal implications for the different North African export states, a thorough investigation is still missing. It is the aim of this study to overcome this deficit by providing first insights into the particular situation and position of one North African country, Algeria. Due to its geographical situation and strategic position within the energy sector, Algeria is very likely to play a key role in a future trans-Mediterranean renewable electricity supply scheme. The study sets out to examine the following research questions:

- How is Algeria regarded by the European proponents of the renewable electricity export scenarios?
- What are the technology options for Algeria to generate renewable electricity and transmit it to the European Union?
- What is the current institutional, legal and regulatory framework for these projects in Algeria?
- What is the position of the relevant Algerian actors?
- To what extent are renewable electricity exports in line with the strategic development goals of the country?

An interdisciplinary team of both Algerian and European researchers has been set up to examine these questions. The main intention of the study is to put the European renewable energy supply initiatives that are currently discussed for North Africa into a distinctly “Algerian” context. For that purpose, the research group has analysed various country-specific aspects, such as the regulatory framework of the Algerian electricity/energy sector, the legal framework for potential investors, tax issues, etc. In addition to that, industry and public sector stakeholders have been interviewed in order to obtain a clearer picture of the position of the relevant actors.

2. Trans-Mediterranean Renewable Electricity Exchange - State of Concepts, Research and Support Instruments

Establishing large-scale electricity projects between North Africa and Europe is not a completely new idea: Already in the 1920s Herman Sörgel, a German architect, published construction plans for his Atlantropa project, a colossal seawater dam to be placed into the Strait of Gibraltar. Hydroelectric generators, driven by the different water levels of the Atlantic and the Mediterranean Sea, would supply large amounts of electric power to North Africa and Europe and thereby contribute to the welfare of the citizens of both continents (Gall 1998). It is obvious that Sörgel's utopian plan never materialised; from today's perspective, it would be considered undesirable merely for its unpredictable ecological impacts. Nevertheless, Sörgel's ideas can be honoured as an early commitment to a peaceful and cooperative utilisation of natural resources between two neighbouring continents and cultures. These ideas need to be seen in the context of politically uniting countries by interlinking their infrastructure, such as highways and power grids (Schot/Misa 2005). After the ambitious plans of the interwar period had failed dramatically in World War II, they were picked up again in the prenegotiations of the *Treaties of Rome* in the mid-1950s. Again, however, a unified system could not materialise. As a consequence, energy policy in terms of power production and in terms of grid structures was largely kept out of the early European Communities (Schot/Lagendijk 2008), a decision that has kept European energy policy structures inherently national(istic) until the present day.

The revival of transnational and eventually transcontinental energy exchange structures came about in the late 1990s with the rise of renewable energy technologies. At that time, experts started to develop concepts of how the exceptionally high wind and solar potentials of North Africa could be integrated into a clean electricity supply scheme for Europe. The concepts – which will be described below in greater detail – essentially promote the construction of large solar power plants or wind farms, combined with the installation of a HVDC (high voltage direct current) grid for the long-distance, intercontinental electricity transmission. Today, both the renewable power plant technologies and the concept of transcontinental HVDC lines can be considered technologically mature.

In recent years, these ideas have become the subject of national and international political discussions. Noticeably driven by the promising prospects, various industrial and political support initiatives were launched to support the realisation of a transcontinental renewable electricity supply scheme. Although the evolving process is difficult to monitor due to its rapidly changing nature, this chapter attempts to present a brief overview of the current implementation efforts, as well as the status of the related scientific research. In accordance with the overall character of the study, special emphasis has been put on the Algerian situation.

2.1. Results from Existing Publications

It has to be stressed that most of the currently available publications are the product of European researchers who had only restricted insights in the political and economic realities of North African countries. As a consequence, many of the discussed documents display a noticeable "Western" bias due to which the North African countries appear at times to be reduced to mere subjects of infrastructure planning. An enhanced participation of research institutes from the South is strongly desired in order to avoid similar shortcomings in future research.

Among the first to address the topic of long-distance renewable electricity transfer are the studies of Staiß (1994) and Knies (1999), who proposed extensive solar electricity exports from North Africa to Europe through HVDC transmission lines running across the Mediterranean Sea. Kurokawa (2003), in his study titled *Energy from the Desert*, mentions the same possibility, but his focus remains limited on photovoltaic (PV) technology. Kurokawa drafted a large PV system with an overall rated power of 1.5 GW consisting of 300 dispersed 5 MW plants alongside a transmission backbone crossing all North African countries from Morocco to Egypt.

An early quantitative approach accounting for all renewable technologies (including wind, biomass, and geothermal energy) and likewise considering the economics of electricity supply and transmission was developed by Czisch (2005). Here, a linear optimisation model was used to simulate a cost-minimising, 100 percent renewable electricity scheme for Europe and its neighbouring regions. Precondition for the feasibility of such a concept is a powerful HVDC transmission system that is capable of outbalancing the fluctuating wind and solar power generation over distant regions and the availability of large hydro storage facilities, for example in Northern Europe. The overall simulated supply area encompasses 19 subregions, each of which features its specific renewable electricity generation and demand pattern. Regions with a power surplus due to high renewable energy potentials will transfer electricity to regions where demand is higher than production, or where storage capacities are available. Algeria as a country is merged into a supply area together with Morocco and the Western Sahara territories in the study (see Fig. 2-1). The levelised electricity cost of CSP electricity for this region amounts to 10.6 €cents/kWh while wind generation ranges between 3.8 and 6.6 €cents/kWh. Due to the cheaper generation costs, the Moroccan wind potential alongside the Atlantic coast dominates the electricity generation of this supply area amounting to 159 GW capacity and an annual production of 495 TWh. Solar energy, the main renewable energy asset of Algeria, therefore contributes only to a smaller extent (5 GW capacity and 53 TWh production, mostly CSP technology). However, the study does not show which amount of solar electricity is produced in Algeria and which in Morocco. With the predominance of Moroccan wind generation, it is a necessary conclusion of the model that the bulk of the electricity is exported via a powerful HVDC line across the Strait of Gibraltar with a capacity of 139 GW; a smaller HVDC branch from Algeria to Tunisia has only a minor capacity of 8 GW.

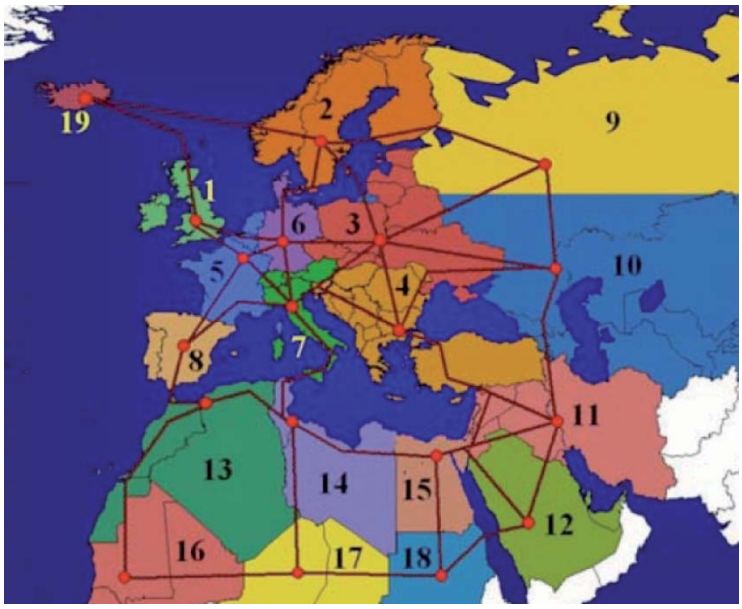


Fig. 2-1. HVDC supply network. Czisch 2005.

In *DLR* (2005) – the so-called *MED-CSP* study – a more thorough, country-focused analysis of the renewable electricity potential in North Africa can be found. The study was compiled by the *German Aerospace Center* with partners in the MENA region (in Algeria this was *NEAL*). Contrary to Czisch's approach, which consisted of finding a renewable generation optimum for a large intercontinental supply scheme, the *MED-CSP* study took the specific renewable energy potentials of the various Mediterranean countries as a starting point of the investigation. For Algeria, the analysis stated a theoretical CSP potential of around 170,000 TWh/y (the current national electricity demand is 35 TWh/y), proving that the country could easily become self-sufficient with renewable energies. The study also drafted a roadmap for a supply situation until 2050, where more than 80 percent of Algeria's electricity demand is covered by renewable energies. As Fig. 2-2 shows, in 2050, most of the renewable supply would be covered by CSP plants. In the scenario, a total capacity of 30 GW and

an annual production of 166 TWh is featured. Wind farms, biomass and photovoltaic plants would only contribute to the overall power generation in a minor way. The *MED-CSP* study – as its title indicates – shows a strong focus on CSP technology, which the authors justify by the low levelised electricity cost (LEC) that would be obtained through technology innovation and economies of scale once the technology reaches mass production. In *DLR*'s scenario for Algeria, the levelised electricity costs of CSP plants range will already range at levels of below 8 €cents/kWh by 2010 (DLR 2005).

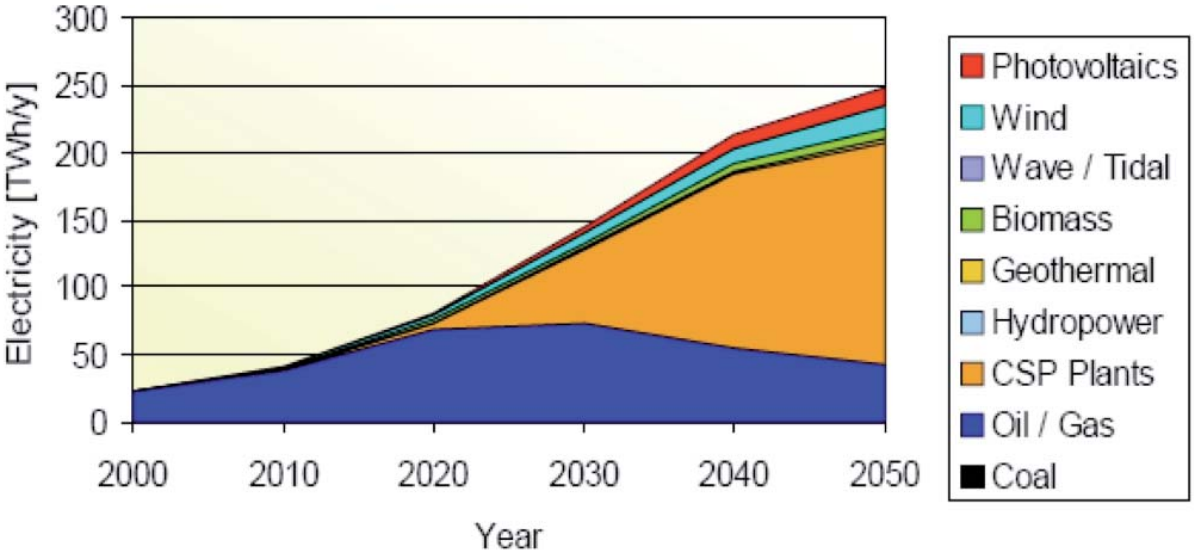


Fig. 2-2. Electricity supply scenario for Algeria. *DLR* 2005.

In the subsequent year, the *German Aerospace Center* released a follow-up study, *TRANS-CSP* (DLR 2006), which investigates the HVDC transmission of CSP-generated solar electricity from North Africa to Europe in greater detail. Like in Czisch 2005, a HVDC supply network is proposed for the transcontinental transfer of bulk electricity from renewable sources (see Fig. 2-3).

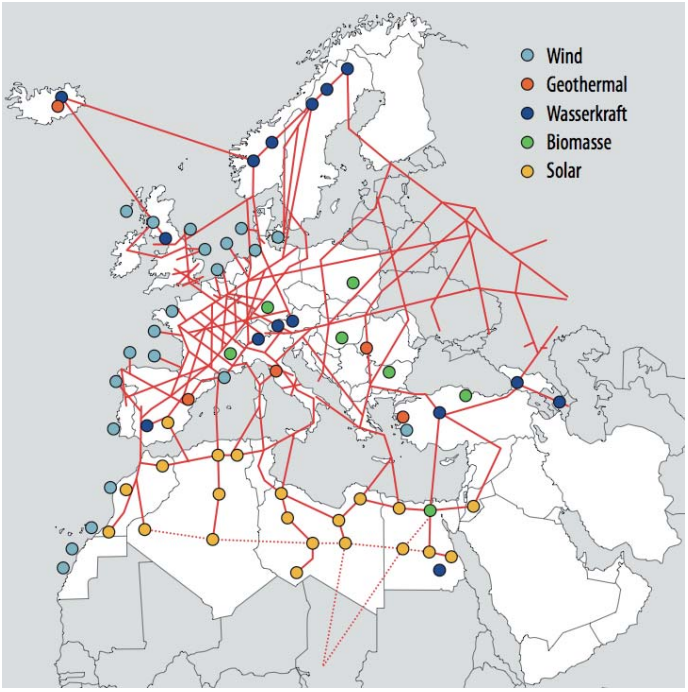


Fig. 2-3. HVDC backbone grid integrating different types of renewable energies. *DLR* 2009.

The study outlines a scenario in which MENA-based CSP plants would supply around 700 TWh/y of solar electricity to Europe by 2050, thereby covering more than 15 percent of the continent's electricity demand. 20 power lines of 5 GW capacity each would be needed for electricity transfer,

requiring investments of €45 billion in addition to the €350 billion that would be needed for the CSP plants. The levelised electricity costs (including the transport) are estimated even lower than in the *MED-CSP* study: They amount to 5 €cents/kWh. The *TRANS-CSP* also provides examples for the possible geographical location of such transmission lines (see Fig. 2-4). For Algeria, one of the proposed 5 GW lines would start at Tindouf, and follow along a 3,100 km track to final destinations in France and Western Germany. However, most of these transmission lines would cross Moroccan territory as the Strait of Gibraltar provides the shortest underwater connection to Europe.

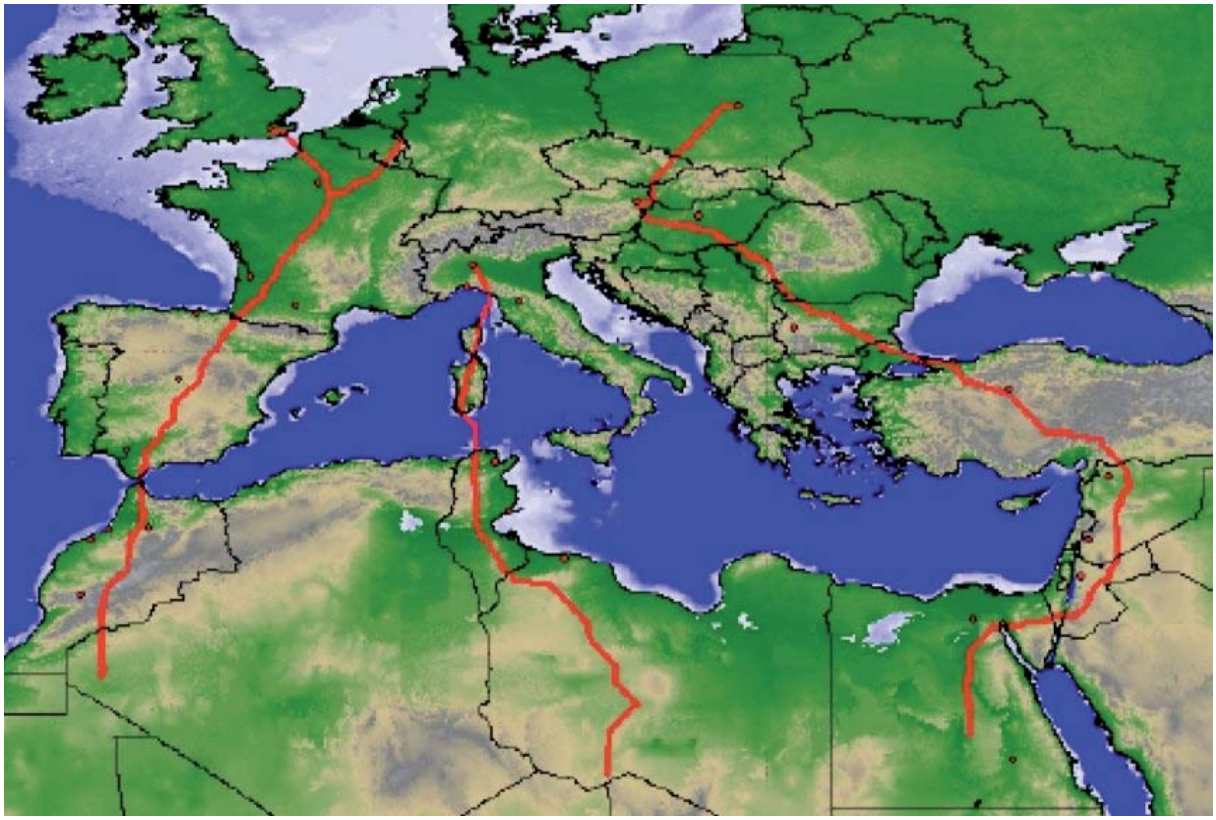


Fig. 2-4. Proposed HVDC transmission lines. *DLR* 2006.

In a subsequent survey (*DLR* 2009), the *DLR* applied GIS-based digital exclusion maps in order to identify suitable and cost-efficient HVDC transmission corridors for solar electricity. The analysis was carried out for eleven (hypothetic) CSP production sites in North Africa being connected to 27 load centres in Europe (see Fig. 2-5). According to the study, the HVDC transmission lines would feature a capacity of 3,200 MW and a voltage of 600 kV. For Algeria, the study proposes two submarine interconnectors, one with Spain, the other with Sardinia (Italy). The same locations for potential submarine links have also been identified in feasibility studies which were performed in 2003 and 2004 on behalf of *Sonelgaz* and the Spanish and Italian transmission system operators *REE* and *TERNA* (Eurelectric 2007). However, the planning context for those lines was entirely different: The interconnections had the purpose to export gas-generated electricity from Algeria to Italy and Spain, and it was even planned to build gas-fired power plants exclusively for electricity export.

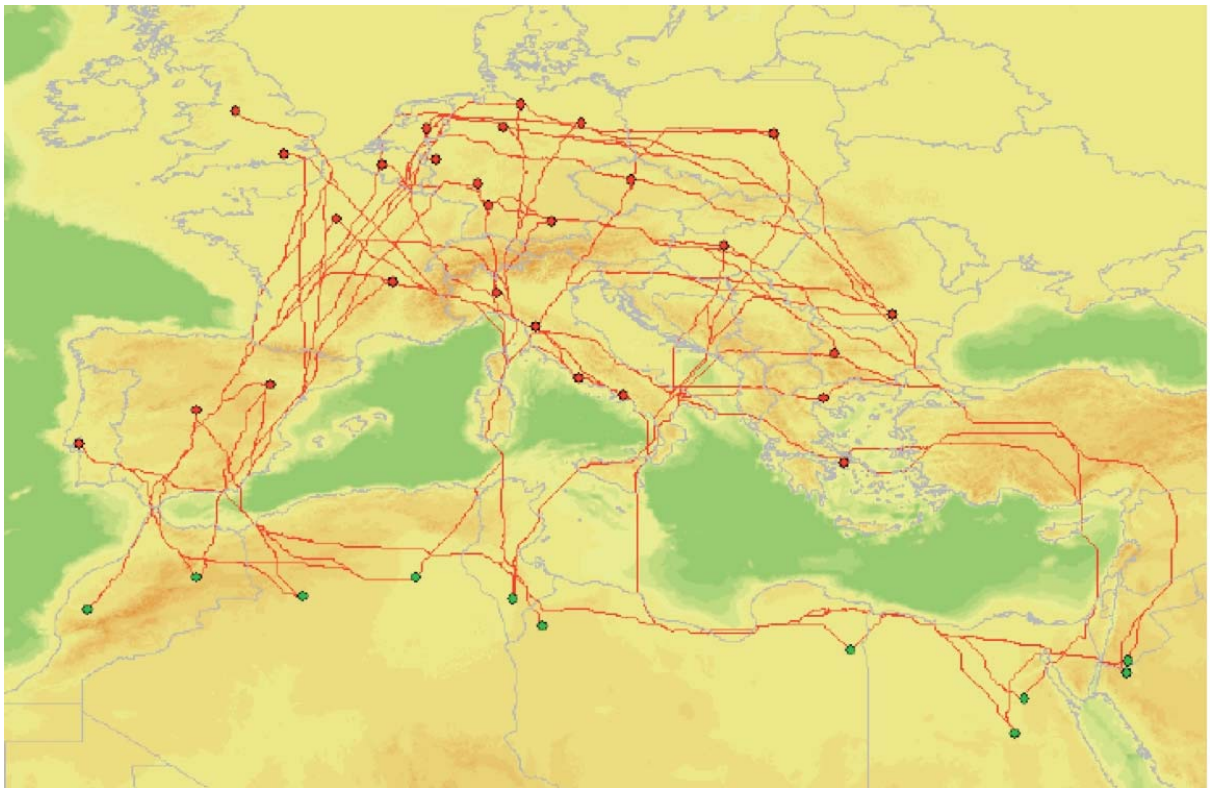


Fig. 2-5. Proposed HVDC transmission corridors between eleven CSP production sites and 27 European load centres. *DLR* 2009.

2.2. Industrial Promotion and Political Support

Given this point of origin, it is striking that these plans – although highly relevant for North African industry and policy makers – have largely been developed without local researchers. In many ways, they subscribe to a strongly Eurocentric view in terms of their agenda as well as in the disregard shown to the "host" countries of the Maghreb themselves. Many studies show a limited insight into the political and economic realities of North African countries and often entirely neglect all regional governance aspects. However, even a partial realisation of these plans will depend on a European-North African cooperation regarding all key points of discussion, amongst them technology (transfer), finance and grid connection scenarios.

2.2.1. *TREC* and the *Desertec Industrial Initiative*

Apart from ambitious and successful domestic programs in several member states like Spain, Germany and Denmark, European research and policy-making have increasingly taken interest in power production and transport to the EU from outside Europe.

Next to the researchers involved, various civil society and industry stakeholders promote the construction of large-scale renewable energy power plants in North Africa. One major group was the political lobby group *TREC* (*Trans-Mediterranean Renewable Energy Corporation*) that began working with the German section of the *Club of Rome* and focused its activities on Berlin and Brussels. Its plans have been in the German political discourse for well over a decade. *TREC* contributed to the discussions by launching its "Desertec White Book", which has recently appeared in its fourth edition (Desertec Foundation 2009). The *TREC* concept was taken up by various committed individuals and a series of national groups (e.g. *TREC-UK, Desertec-Méditerrané,* etc.) was founded. In 2008, the group transformed and renamed itself into *Desertec Foundation* and registered in Berlin as an incorporated association.

Also, between 1998 and 2005, the German government promoted this topic through research support for the above-mentioned *DLR* studies as well as within the European Union. Moreover, a series of

MENAREC Conferences (Middle East & North Africa Renewable Energy Conferences) supported these efforts on an international level.

These activities have recently sparked the interest of German industry: on July 13, 2009, a group of major German and international corporations (*ABB, Abengoa Solar, Desertec Foundation, Deutsche Bank, E.ON, HSH Nordbank, MAN Solar Millennium, Munich Re, M+W Zander, RWE, SCHOTT Solar, Siemens* and the Algerian company *Cevital* announced in a press conference a memorandum of understanding seeking to promote the above-mentioned *Desertec* initiative and intending to found a *Desertec Industrial Initiative* (*Dii*). The formal registration of the consortium as a limited company has taken place in October 2009 (Dii 2009). In its founding declaration, the *Dii* announced overall costs of €400 billion, which it claimed to be willing and able to invest over the next 20 years into large-scale renewable power projects in the MENA region. In early 2010, five other companies joined the consortium (*Enel, Nareva, RED Electrica de Espana, Saint-Gobain Solar*). The enrolment of these Italian, Spanish, Italian and Moroccan groups was an important step for *Dii* both in terms of its outreach to the Mediterranean countries as well as to move public perception away from the misconception that the *Dii* is predominantly a German initiative. Now the *Dii* is officially supported by former UNEP-director Klaus Töpfer.

The 2009 announcements met very different responses in Europe and North Africa. In Algeria, Chakib Khelil, at that point minister of Energy and Mines, was quoted saying,

"I do not have any idea about that project and I cannot make any statement. This project has never been presented at the ministry nor at the relevant institutions." (EE 2009)

In Morocco, on the other hand, the situation is much different. The Moroccan energy minister Amina Benkhadra generally conveyed the notion that Morocco wanted to become a major *Desertec* partner and advocated for investment in her country in Europe. In February 2010, for instance, minister Benkhadra gave a seminar in the British House of Commons that was attended by the UK energy minister Lord Hunt. In this meeting, she advocated Morocco's plan to build the first 500 MW CSP plant close to the southern town of Ouarzazate and invited power companies to bid on that US$9 billion project.

Reactions in Europe largely depended on the institutions' stance on solar and nuclear power, major non-EU energy infrastructure investments and on their views regarding decentralised or centralised power generation. Apart from welcoming statements by parties, environmental NGOs and research institutions, there have also been critical voices. *Eurosolar*, a German solar energy lobby group, dubbed the plans "mirages in the Sahara desert" and "centralistic plans of the German power sector" that were designed to perpetuate the dominance of a few corporations in the national power sector (Eurosolar 2009).

The European Parliament, however, has so far expressed cautious support of the initiative. In a recently adopted resolution on external aspects of energy security it "calls on the Council and Commission to cooperate with the Member States of the Mediterranean region and the countries of North Africa; […it] welcomes the recent progress made with the *Desertec Industrial Initiative* to develop the vast potential for solar energy in the Middle East and North Africa; stresses that EU action in relation to the *Desertec* project must be coherent and make an active contribution to the development of North African and Middle Eastern countries; calls, therefore, on the companies and Member States involved in this project - in close cooperation with the Commission – to promote development by means of genuine technology transfer and capacity-building aimed at local companies and civil society in order to ensure ownership and build a lasting partnership with the Mediterranean countries in which *Desertec* will be developed." (European Parliament 2009)

At the time of writing, the *Dii* is working on a detailed implementation strategy that defines a road map until 2020. This roadmap is supposed to be finalised by 2012 and it will entail a long-term vision beyond 2020. In talks and press announcements, *Dii* partners have stressed that the current *Dii* consortium is by no means intended to remain closed to potential partners that are willing to join, be it in the current scoping phase, be it in the later operational business. Also, the decision has been taken

to temporarily halt all further accessions of German firms which currently form the majority amongst the shareholders (eleven out of 17 companies). This move can be seen as a reaction to criticism about the current dominance of European, especially German companies in the *Dii* and might be an important strategic move in the internationalisation of the *Dii*.

2.2.2. The *Solar Plan* of the *Union for the Mediterranean*

On a general level, the European Community/Union has worked on outreach programs towards the non-EU member countries on the Southern and Eastern shores of the Mediterranean for at least the last 15 years. First multilateral efforts were structured by the *Barcelona Process* launched in 1995 as a framework of cooperation in social, political and economic affairs. Due to the poor performance of this process, the EU's efforts were redrafted and refounded as *European Neighbourhood and Partnership Instrument* (ENPI) in 2007. This development has been paralleled by the realisation of a French policy initiative, the *Union for the Mediterranean/Union pour la Méditerranée* (*UfM*) in 2008.

The *UfM* consists of the EU member states, Jordan, Mauritania, and all countries bordering the Mediterranean while the Arab League has been invited to join the biannual summits as an observer. In order to guarantee a balanced system of power-sharing, the *UfM* will be co-presided over by an EU and a non-EU member respectively. The first two states having assumed these rotating positions are France and Egypt. While it is the stated intention of its founders to reinvigorate the stalled *Barcelona/European Neighbourhood Process*, a joint permanent committee in Brussels and a bureau in Barcelona will ensure that day-to-day working processes are followed up and the summits are prepared.

One of the *UfM*'s flagship projects is the *Mediterranean Solar Plan* (*MSP*) that was included in the final declaration of the *UfM*'s founding summit in Paris on 13 July 2008.

In the first phase, the German *Federal Ministry for the Environment, Nature Conservation and Nuclear Safety* and its French counterpart are leading on the project. The *Mediterranean Solar Plan* has been divided into three work phases. The immediate preparatory phase until 2010 will be followed by a two-year long pilot phase that will result in the production of an *Immediate Action Plan* (*IAP*) and a *Master Plan Study* that will be informed by the project currently set up by the European Union ("Paving the way for the Mediterranean Solar Plan") (Lorec 2010).

The main goal of the *IAP* is to start a sequence of pilot projects for the integration of renewable energies into the various national grid systems as well as policy programs for energy efficiency. It aims to facilitate in the short term a series of projects in the Mediterranean region, asking partner countries for a selection of priority projects to ensure broad political support.

The bureau of the *MSP*, that regards itself as a facilitator and a mediator in terms of donor organisations, distinguishes between public and private projects. Integrating wind energy and both PV and CSP, the scope of the *MSP* is wide, which explains the roughly 200 projects registered. In general, projects are registered on the *MSP* list (that remains unpublished) through the member states' ministries or executing agencies. This implies that the registered projects differ strongly in terms of scope, size, and feasibility. In spite of this, the *MSP* secretariat has so far chosen not to introduce a transregional binding methodology, as the multilateral process to agree on such a mechanism would have taken years and would arguably have been a rather useless undertaking, given the large number of member states and heterogeneous renewable energy policy frameworks, technology preferences and funding schemes. Thus, flexibility and transparency, rather than a total control of the projects, is what is achieved by the *MSP* administration.

Parallel to that, the *MSP* will produce a major study characterising potential sites for RE production, identifying the best possible policies incentivising the deployment of renewables with a target share of 20 GW of renewable power capacity and 20 percent energy savings compared to a business as usual scenario until 2020. The study will build on the results of the work by *Resources and Logistics* (2010), which presents a useful overview of the current situation and identifies a way ahead. However, it might be the case that stakeholders will abandon the concept of the *IAP* in the future and put

additional focus on improving the regulatory frameworks with regards to renewable energy and energy efficiency in the Mediterranean states beforehand.

Concerning the overall investment costs, a total sum of €45 billion is forecast until 2020. While various projects have been registered with the *CTF* and other investment banks, the financing of most projects should not be the key problem. Instead, it is the differing funding conditions, loan times and other details of the financial architecture for the larger projects in this scheme that currently needs attention on behalf of the *MSP*.

As next steps, stakeholders have identified three main aims: the production of a master plan study, the construction of the Moroccan Ouarzazate CSP plant, and the test of the application of article 9 of the new EU energy directive (see chapter 2.2.3). Stakeholders stressed, however, that the *MSP* is not a goal in itself, nor can it take up the work of national renewable energy policy plans. It can only serve as a coordinator and facilitator of the national initiatives and can assist member states in developing a conducive regulatory framework and in acquiring funds. The genuine initiative, however, must stem from the member states themselves, which is why the *MSP* secretariat also welcomes the developments such as the Moroccan or Tunisian solar plans as a step in the right direction. It would be desirable for Algeria to develop a plan similar to the ones of its neighbours, as the Algerian *programme indicatif* cannot yet be seen as a fully-fledged national renewable energy policy programme.

2.2.3. The EU Renewable Energy Directive

In December 2008, the member states of the European Union signed a far-reaching agreement about the increased use of renewable energies in the community's energy supply. In the *Directive on the Promotion of the Use of Energy from Renewable Sources* (EU 2009) all member states committed themselves to binding renewable energy shares in their national energy balance (Tab. 2-1). Each member is obliged to present an individual roadmap outlining how the state intends to meet its renewable energy goal. It is up to the member states to choose their own, individual means for the goal's implementation. These could include various sectors, such as transport, industry, or heating, but also renewable electricity production.

As a remarkable innovation, the EU renewable energy directive facilitates the import of renewable electricity generated by third countries. Such a third country could, for instance, be Algeria. The third country provision is given in Article 9 of the directive, which stipulates that energy produced outside the EU can be financially supported through laws promoting renewable energies as long as this energy export does not lower the previous RE quota of the country of origin. Also, this power can be added to the respective countries' quotas for renewable energy power production/consumption. Further, the directive demands that all "green" power to be exported to the EU need to be documented by the Transmission System Operators (TSOs). In detail, it has to be proven that the amount of imported electricity from a third country is transported via a firmly nominated interconnection capacity by all TSOs involved. Moreover, the equivalent amount of electricity has to be registered in the schedule of balance of the European TSO, and the transmission capacity for the renewable export has to be nominated at the same period of time (Article 9, 2a).

An interesting feature of the directive is that it also allows a kind of non-physical electricity export via a not yet existing interconnection to the European grid. For this exception, it has to be proven that actual power lines will be built within a realistic time frame. Thus, according to the directive, Algeria, for instance, could promote the construction of renewable energy power plants even before their electricity physically reaches the EU. It remains to be seen whether this energy trade option could develop into a key element of kick-starting large-scale electricity exports from North Africa to Europe. The EU energy directive explicitly limits this provision to cases where construction of the physical interconnectors has started before 2016 and their operation is scheduled by 2022 (Article 9, 4.).

Tab. 2-1. Share of energy from renewable sources in gross final consumption of energy 2005, 2020. EU 2009

European National Renewable Energy Targets 2005 and 2020					
	2005	2020		2005	2020
Austria	23,3%	34,0%	Latvia	32,6%	40,0%
Belgium	2,2%	13,0%	Lithuania	15,0%	23,0%
Bulgaria	9,4%	16,0%	Luxembourg	0,9%	11,0%
Cyprus	2,9%	13,0%	Malta	0,0%	10,0%
Czech Republic	6,1%	13,0%	Netherlands	2,4%	14,0%
Denmark	17,0%	30,0%	Poland	7,2%	15,0%
Estonia	18,0%	25,0%	Portugal	20,5%	31,0%
Finland	28,5%	38,0%	Romania	17,8%	24,0%
France	10,3%	23,0%	Slovak Republic	6,7%	14,0%
Germany	5,8%	18,0%	Slovenia	16,0%	25,0%
Greece	6,9%	18,0%	Spain	8,7%	20,0%
Hungary	4,3%	13,0%	Sweden	39,8%	49,0%
Ireland	3,1%	16,0%	United Kingdom	1,3%	15,0%
Italy	5,2%	17,0%			

These efforts need to be placed in the broader context of developing a common and diversified European energy supply strategy. In September 2009, this was also the subject of a debate during the European Parliament plenary sitting. Then EU energy commissioner Andris Piebalgs and several MEPs reiterated the need for the development of a robust EU energy supply structure. While pipeline projects such as *Nabucco* enhance the diversification of European fossil energy supply, the physical power interconnection with North Africa – assisted by the commercial incentive of the new renewable energy directive – is to further promote development in that field. Similarly, his successor Günther Oettinger voiced clear support for the *Dii* in a meeting of the three Maghreb energy ministers in Algiers that he attended in June 2010. The new energy commissioner stated that the EU would continue to support grid upgrade and country interconnectors between North Africa and Europe and would decide on European subsidies or feed-in-tariffs once the consortium had presented a detailed business plan. It must be stressed, however, that the funding option of the EU energy directive has been designed as a tool for the individual member states, not as a RE-promotion instrument of the European Commission. Commissioner Oettinger has repeatedly hinted at the idea of a pan-European renewable electricity support scheme, which could then also entails the support of electricity imports from the Maghreb states. This, however, would necessitate a new legal instrumentation and would represent a major change in European energy policy. It is thus rather unlikely that such an instrument will be introduced in the near and mid-term future.

As regards national renewable energy import plans, it remains unclear whether the new renewable energy directive will indeed become a success. While the possibility of EU support remains open, it remains doubtful whether individual countries will open their national renewable energy funding schemes to renewable energy production abroad. In their submissions of the preparatory documents by

the end of 2009, however, some of the member states have voiced support for such a mechanism. France and Spain have explicitly mentioned the *MSP*, while Italy's communication has integrated projects that were part of the *MSP* without mentioning the plan itself. All three countries, however, have not indicated fixed targets or capacities for renewable electricity import yet, and there is also no guarantee that these states will integrate their plans into the binding national renewable energy action plans. Germany and Greece have also expressed the general possibility of renewables imports but, again, no detailed decisions have been taken. What the new energy directive yields for the field of renewable electricity import from the Maghreb will thus be revealed in late 2010.

2.2.4. *World Bank* Support for CSP Projects in North Africa

In October 2009, the *World Bank* announced that it would finance 13 solar thermal power plants in selected countries of the Middle East (Egypt, Algeria, Tunisia, Morocco and Jordan), corresponding to an investment volume of US$5.5 billion. It is envisaged that these plants will have an accumulated capacity of 900 MW, which would equal a 300 percent increase in global power production based on CSP. Tab. 2-2 provides an overview of *World Bank* CSP projects in the Middle East.

Tab. 2-2. List of CSP Projects in planning or implementation phase. World Bank/CTF 2009

Country	No. of Projects	Location	Capacity (MW)	Est. cost (US$ million)	CTF Contribution (US$ million)
Algeria	3	Megahir	80	322	58
		Naama	70	285	51
		Hassi R'mel II	70	285	51
Egypt	2	Kom Ombo	70	370	51
		Marsa Alam[2]	30	270	44
Jordan	2	Maan Province	100	418	72
		Aqaba-Qatrana transmission		410	40
Morocco	3	Tan Tan[3]	50	240	35
		Ain Beni Mathar	125	525	90
		Ouarzazate	100	440	72
Tunisia	3	IPP-CSP Project	100	450	73
		ELMED-CSP	100+	450	73
		Tunisia-Italy transmission		1140	40
Total	13		**~900 MW**	**5,604**	**750**

The *CTF* favours its multi-country approach not only because of its own multilateral nature, but has put forth three core arguments for that. Primarily, it argues that only the development of a multitude of CSP plants that stretch over the entire region will serve as a major demonstration project. Secondly, only this approach could bring about the much-needed economies of scale for construction and maintenance, while, thirdly, only in the case of a promising large-scale business opportunity power companies would be willing to go ahead with the necessary grid upgrades between the EU and its neighbouring countries. Cooperation between the *CTF* and other initiatives is good: all 13 projects and, in addition to that, two power line schemes, are registered with the *MSP*.

With a scheduled accumulated capacity of 230 MW, the three projects envisaged for Algeria (see Tab. 2-2) would fit well into the national renewable energy plan (see below chapter 4), which has outlined CSP to be the key technology for Algeria (*CREG* 2008).

2.2.5. The *Transgreen* Consortium

While the *Dii* has begun to work on the realisation of its projects during the last year, it has not always been welcomed by all European countries. Particularly in France, where the government has worked hard to establish the *Union for the Mediterranean* and the *Mediterranean Solar Plan, Desertec* has since (wrongly) been perceived as a German initiative that might endanger the "French" *Solar Plan*.

In light of this context, a recent development is particularly noteworthy.

On 25 May 2010, the *Transgreen* project was founded in Cairo during an energy ministers' meeting of the 43 member states of the *Union for the Mediterranean*. Led by the French utility *EDF*, the project intends to bring together power companies, network operators and high-tension equipment makers. The consortium itself is structured in a very similar way to the *Dii*. It likewise plans to launch a feasibility study as a first phase before actually constructing any lines. In total, eleven mostly French companies, such as *ABB*, *Alstom/Areva*, *Nexans*, *Prysmian*, *Cap Gemini* or *Atos Origin*, *RTE* have joined the consortium; Spanish and North African companies are expected to join in due course as well. In addition to these, *Transgreen* has also taken in *Siemens* and the French group *Saint-Gobain*, both also part of the *Dii*.

At a first glance, the *Transgreen* project appears to be a competitor to *Desertec* – this, however, seems to be a misconception as both sides have announced strong cooperation and excellent interaction with each other on the working level. *Desertec* CEO Paul van Son has openly welcomed the establishment of this consortium, which might be headed by André Merlin, president of the board of *RTF*.

Thus, there is full potential that the two consortia add to each other in a mutually beneficial way: *Transgreen* could deliver to Europe the energy (or part of it) that has been generated by the *Dii* in North Africa. After feasibility studies, a first step of *Transgreen* might be the upgrade of what is currently the only power connection between the two continents, linking Morocco and Spain, with a capacity of 1,400 MW. This – in addition to another power cable (probably from Tunisia to Italy) – could facilitate the work of the *Dii* in a major way.

2.2.6. Common Strategies and Cooperation between Public and Private Sector Initiatives?

To a certain extent, it is an open question in which way the four projects outlined in this chapter – the *MSP*, the *Dii*, the *CTF* and *Transgreen* – will interact with each other. Given their similar scope, similar technology focus and similarly high ambitions, there is potential for both substantial competition or for constructive cooperation enabling the initiatives to overcome the various burdens.

While the *CTF* initiative is located at the *World Bank*, the *MSP* operates in the at times ineffective and politically loaded framework of the *UfM*. However, there seems to be a strong willingness to cooperate with each other on behalf of both public sector initiatives, possibly also owed to the fact that the *MSP* does not have own major funds to facilitate large-scale power projects. The private sector character of the *Dii* and *Transgreen* as industry initiatives makes these initiatives less exposed to negative developments on the political level, but, at the same time, they might lack political clout in negotiations.

Unfortunately, the initiatives on the European side and of the *World Ban*k are currently not matched by North African initiatives of similar size, although, as shown, most states have recently developed national renewable energy strategies. Indeed, North African countries are yet to identify a common answer or at least a common voice in this transcontinental setting. As it has been announced that the recent meeting of the three Maghreb energy ministers in Algiers (June 2010) also focused on the various international renewable energy initiatives, it can be hoped that a more coordinated approach will soon be developed amongst North African political and business elites.

In the following sections the situation of Algeria will be assessed as a first approach to bring the North African perspective – industrially, legally, and developmentally – into the discussion.

3. Renewable Generation Technologies and Transmission Options for Algeria

The following section discusses the possible technology options in the Algerian context. General characteristics will be given in order to draw a broad picture of renewable energy technologies for export options as well as for domestic supply.

3.1. Selection of Technologies

Algeria is endowed with various types of renewable energies, namely solar and wind energy and to some extent also hydro energy and biomass. In this chapter, however, some technologies were excluded from the assessment for lack of natural potentials and lack of potential for the export of electricity. These are hydropower, biomass and geothermal energy. Some other technologies were excluded because they are currently not available for larger scale applications, among them solar dish Stirling systems, solar chimneys and ocean wave energy.

The technology options are characterised according to the following criteria:

- Natural potentials
- Technological status
- Base and peak load capability
- Ecology

The topic grid integration is discussed in a separate section for the whole range of renewables technologies.

3.2. Renewable Energy Potentials in Algeria

The assessment of potential is based on two different types of sources: assessments of the Algerian government (also used in UbiFrance 2009) and the in-depth studies conducted by the *German Aerospace Center* (*DLR*). *DLR* calculated data mainly from satellite imaging and further processing to derive technical and eventually economic potentials. Tab. 3-1 summarises solar, wind, geothermal and biomass potentials for electricity generation. There is a large difference between PV and CSP economic potentials. This is somewhat distorting because at the time when the assessments of potentials were made, the cost difference and expected cost differences in the near future were very large. However, this situation has changed significantly during the last three years as PV technology prices decreased sharply; hence, investment costs for power plant investors have decreased. The effect is an increase in the economically utilisable potential on the PV side, which will lead to a decrease of CSP potential. The major advantage of the *DLR* study is that all renewable energy potentials were assessed with an identical set of methodologies.

Tab. 3-1. Economic electricity supply side potential of renewable energies in Algeria, TWh/a. For comparison: power production in Algeria in 2005 stood at 35 TWh. DLR 2005

Algeria	CSP	Wind-power	PV	Hydro-power	Geothermal	Biomass
Economic potential	168,972	35	13.9	0.5	4.7	12.1

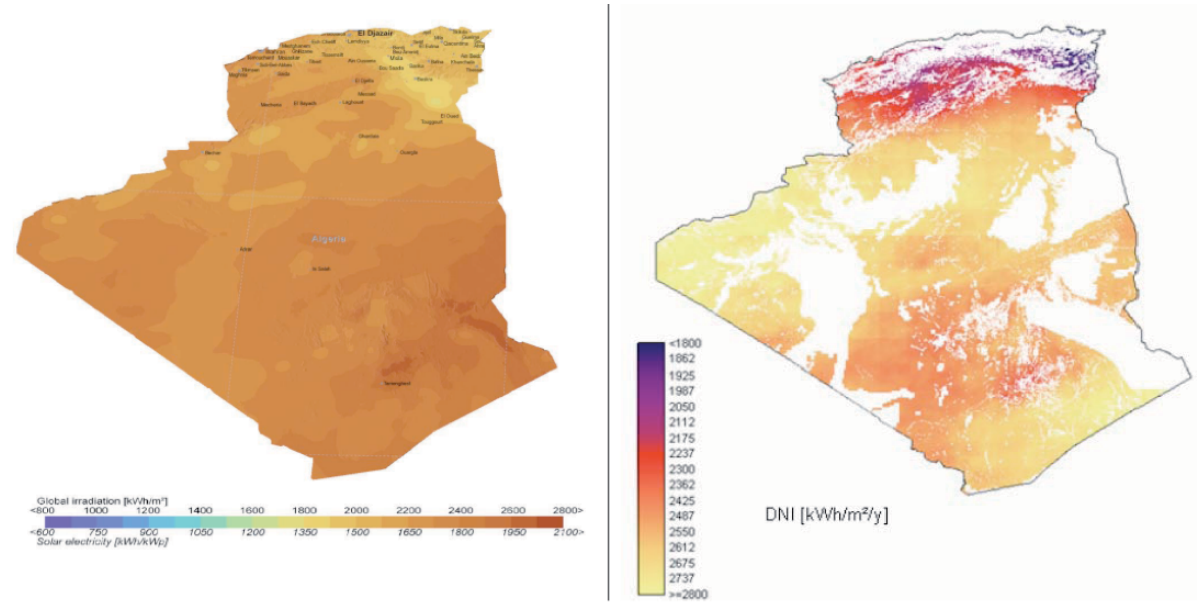
In addition to the *DLR* study, assessments by Algerian institutions have to be analysed. The *Center for the Development of Renewable Energies* (*CDER*) surveyed different types of renewable energies. Data are gathered in the "Guidelines to Renewable Energies" report by the *Ministry of Energy and Mines* (MEM 2007). Algeria's *MEM* concludes that "the biggest potential in Algeria is solar" (MEM 2007) (see Tab. 3-2).

Tab. 3-2. Data on solar radiation in Algeria. MEM 2007

Region	Coastal	Highlands	Sahara
Average sun hours per year	2650	3000	3500
Average energy received, kWh/m2/a	1700	1900	2650

The data presented by the *MEM* (2007) is supported by data compiled by the *World Energy Council* that stay in the same range: Annual average insolation for Algeria is rated at 2,000 hours while the high plateaus receive about 3,900 hours. This results in an average solar energy potential of 2,400 kWh/m2/a (compare Fig. 3-1).

Fig. 3-1. Solar irradiation maps for Algeria. Left: Global irradiation on optimally inclined PV surface. PVGis 2010. Right: Direct normal irradiation (DNI) for CSP systems, excluding unsuitable sites (white). DLR 2005



National onshore wind energy potential is rated as being low (MEM 2007). However, according to an analysis comparing wind data from 75 locations in Algeria (published in 2000), there are several promising wind power locations (Hamane/Khellaf 2000), see Fig. 3-2. Offshore data were not available.

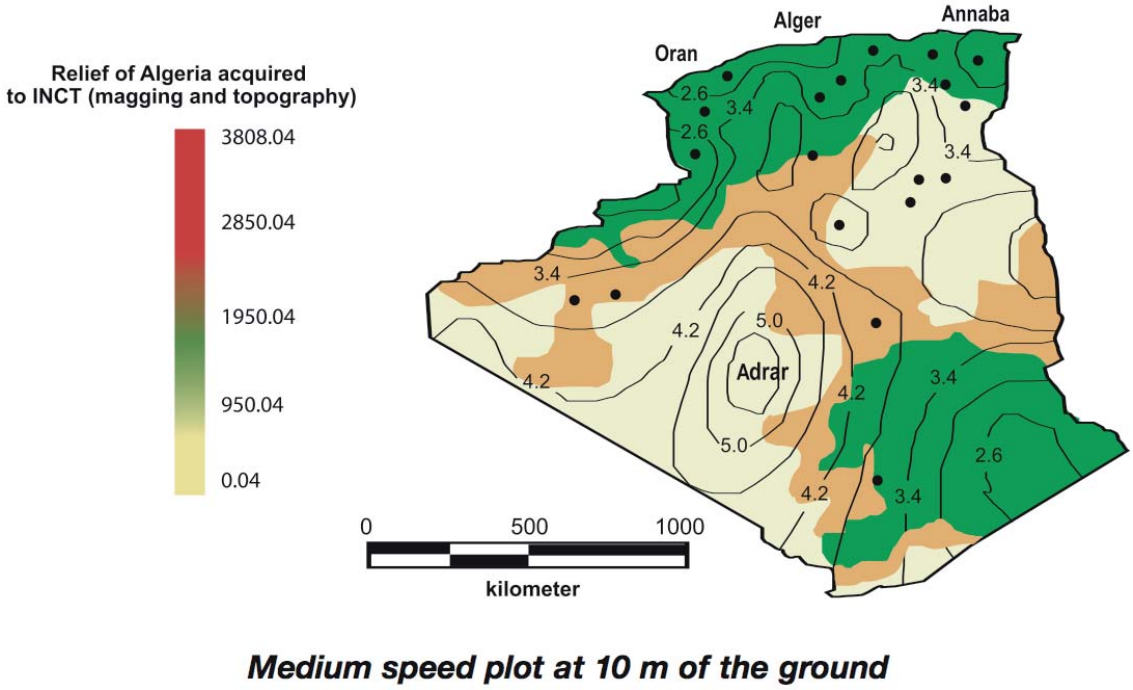


Fig. 3-2. Wind map showing onshore potential. CDER, from MEM 2007.

According to the *Ministry of Energy and Mines*, Algeria has potential for low-temperature geothermal applications (hot springs) in the range of 700 MW (MEM 2007).

Hence, in the light of sufficient potentials for the export of electricity, in the following only solar and wind energy will be discussed.

3.3. Solar Energy Technologies

3.3.1. State of Technology

In general, there are two different approaches for the utilisation of solar energy: direct conversion of sunlight to electricity – photovoltaics – and the collection of heat for steam generation that can then be converted to electricity by a generator. Both technology approaches will be assessed in the following section.

3.3.1.1. Concentrating Solar Power (CSP)

Parabolic trough systems are the best-established CSP technology. Currently, a total capacity of about 500 MW is installed and more than 2,000 MW are in the planning phase globally (SM 2009). Parabolic through systems consist of long, parabolic metallised collectors that are adjusted to the sun to concentrate sunlight. In the focal line, a fluid-filled pipe (using thermal oil or water) absorbs the heat. The fluid transports the heat to the power generation system (usually a conventional steam turbine cycle). Efficiencies are in the range of 11-16 percent. Typical plant sizes are between 50 and 80 MWel. However, larger plants are also planned, reaching 250 – 350 MW.

Fresnel systems are similar to parabolic through systems but use several flat mirrors to concentrate the sunlight. Fresnel reflector pilot plants are currently under development. They can have lower production costs than parabolic through systems, but are also of lower efficiency.

Central receiver technology uses a large array of mirrors (heliostats) that follow the sun in two dimensions and concentrate the sunlight on a receiver on top of a tower. Temperatures can reach 1,000 °C. These high temperatures can be used for the vaporisation of working fluids to drive steam turbines and generators. Further applications are industrial steam production or solar chemical processes. The maximal plants size is currently 11 MWel; larger power stations are under construction

3.3.1.2. Photovoltaic Systems

Photovoltaic systems use the photoelectric effect of turning light energy (photons) into electricity. As sunlight is directly converted to electricity, the irradiation conditions rule over the power output of a PV plant, which in consequence shows an intermittent electricity generation behaviour. Therefore, PV electricity cannot satisfy base load requirements. This is a major disadvantage in comparison to CSP systems on the one hand. On the other hand, PV bears several structural advantages, among them low operation and maintenance costs and its independence from cooling water, which could prove as a major advantage in desert regions compared to CSP systems with high water demand. PV plants can be built over a wide size range from 10 kWel to 200 MWel and are thus adaptable to local requirements (Hennicke/Fischedick 2007). They can also be used for combined heat/cold and power generation (so-called co- and trigeneration) and for desalination (BMU 2006). The largest PV plants are currently in the range of about 50 MW.

3.3.2. Costs of Technologies, Including External Costs

Currently, solar thermal power plants on the basis of parabolic troughs are the cheapest option to use solar radiation for power production. Photovoltaic electricity generation has in previous years been considered as the most expensive solar electricity option with investment and generation costs about three times as high as for solar thermal plants. However, scale effects (build-up of surplus production capacities for economies of scale) and the global financial crisis have lead to a reduction of costs and prices.

Fig. 3-3 summarises specific investment costs for renewable energy power generation technologies today and in the future. Capital investment costs for renewable energy technologies are expected to remain higher than for fossil fuel power stations except for wind power and PV. In contrast to the falling costs for other renewable energy technologies, CSP costs will increase until 2020, assuming that the increasing solar share from 25 % to 90 % requires expensive storage technologies.

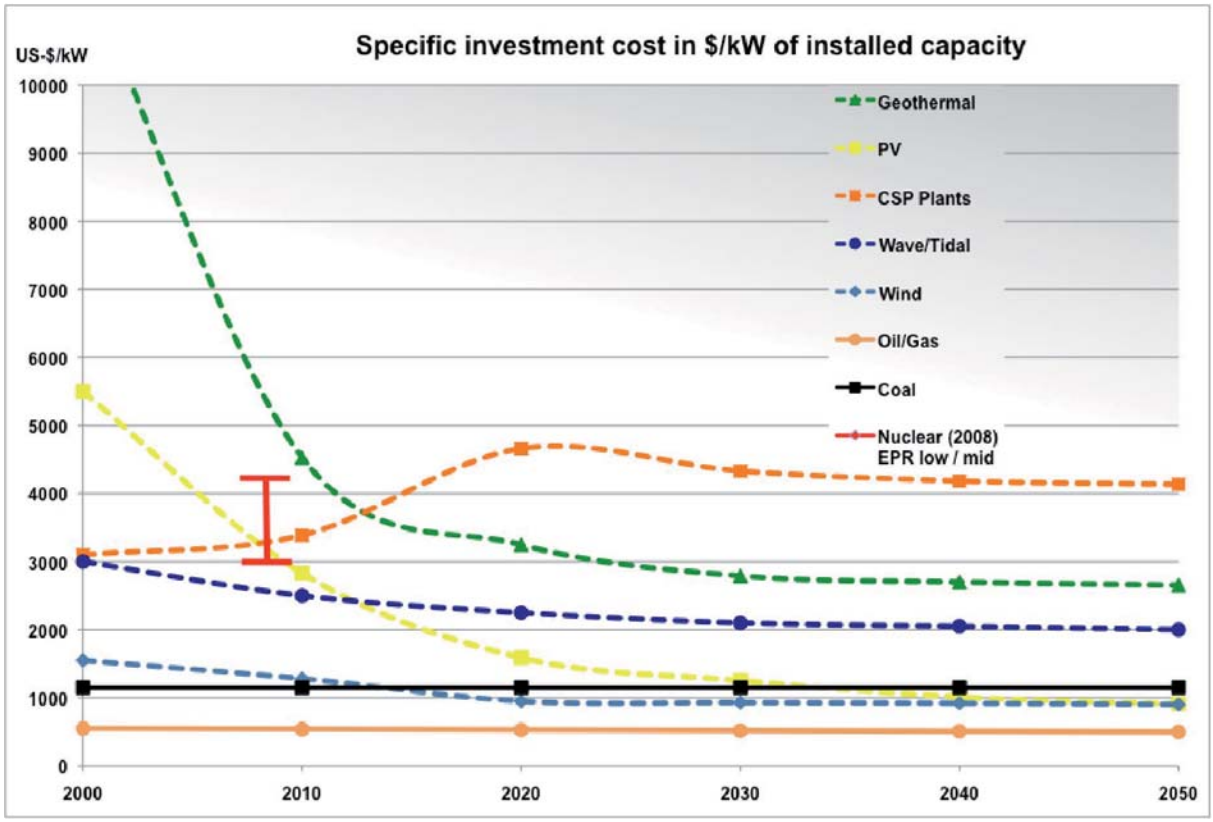


Fig. 3-3. Specific investment costs in US-$$_{2000}$ per kilowatt on timescale. Irrek 2008 (nuclear), DLR 2005 (others).

The costs described above are direct costs from an investor's perspective and exclude costs for damages caused by the use of the technology to the global climate system, human health, crop production, etc. It is generally difficult to express such damages in monetary terms; however, these are real costs, just listed on another bill. External costs of renewable energies are about one order of magnitude lower than those of fossil and nuclear fuels. More details are given in DLR/ISI (2006).

In sum, two divergent tendencies are visible regarding technology costs. While capital investment and electricity generation costs of renewable energy technologies are likely to decrease further due to learning effects on the one hand, costs for fossil energy based technologies will increase due to escalating fuel and CO_2 certificate prices. As a consequence, electricity from most renewable energy sources will be cheaper than fossil fuel based electricity in only a few years. By internalising external costs, RE technologies are already in the same range as fossil power generation at the moment.

3.3.3. Base and Peak Load Capabilities

Solar electricity generation in general, PV as well as CSP and solar towers, is peak load capable because there is a good correlation of electricity supply and demand (WI/DLR 2008), especially electricity demand for air conditioning at noon. In combination with efficient heat storage and/or an optional additional firing, a CSP plant is even base load capable (BMU 2006). In perspective to future system development when traditional base load will become increasingly obsolete, especially CSP solutions will be able to provide so-called balancing power: intermittent sources like PV, but all the more wind, will feed into grids, and in times of low feed-in, CSP will be able to react flexibly to such intermittency.

3.3.4. Ecological Aspects

The analysis of ecological aspects includes two different sectors: First, the direct impact on the surrounding area during the use of the technology needs to be considered. Second, the total contamination and long-term aspects over the whole life-cycle of the technology will be analysed (see Fig. 3-4).

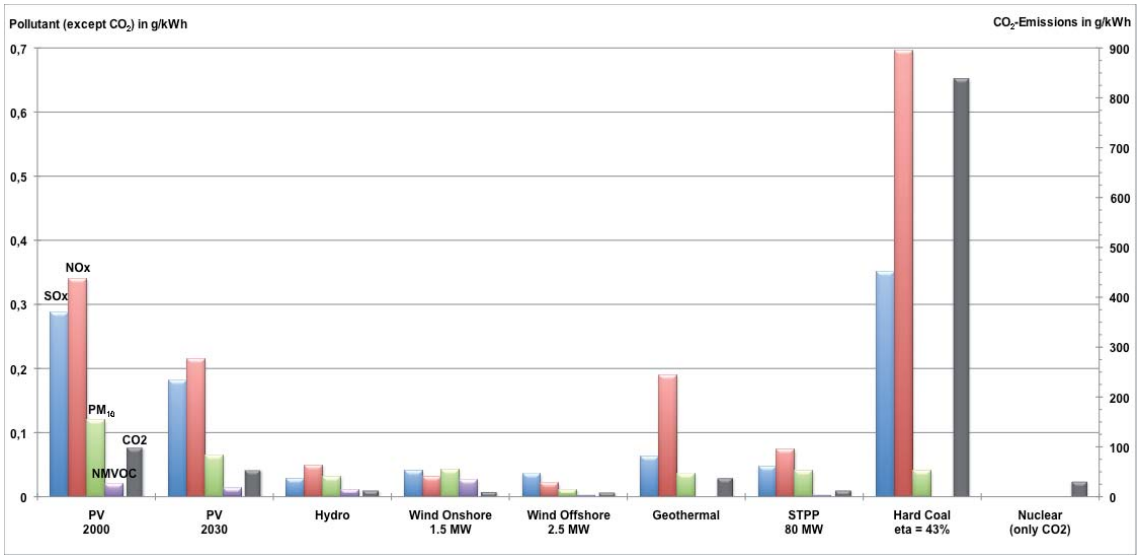


Fig. 3-4. Specific LCA emissions of pollutants (left axis) and the greenhouse gas CO_2 (right axis) of renewable, fossil and nuclear technologies. Öko-Institut 2007, DLR/ISI 2006.

CSP. Land-use intensity of CSP systems – parabolic troughs as well as Fresnel systems and solar power towers – can harm ecological habitats, e.g. through shading. A comparatively large area of land (approximately one square kilometre for 20-60 MW of generation capacity) is required. However, shading may also have positive effects from the perspective of human life, e.g. the possibility of land use for agriculture. Considering the life-cycle use of land including raw material mining, mine operation, raw material upgrading, infrastructure and disposal, solar technologies are considered to be

the most area-efficient renewable electricity generating technologies (DLR 2005). Operating a non-hybrid CSP plant does not cause air pollution (WI/DLR 2008, DLR 2005). The heat transfer fluid (usually a type of thermal oil) of some CSP plants can be hazardous and needs to be disposed of regularly (DLR 2005). Apart from this, there are no critical components or substances correlated to CSP plants. The ecosystem at the location can be completely restored (WI/DLR 2008) after dismantling of the CSP plant. Water supply for CSP plants can be problematic in desert regions. Therefore, dry-cooling systems have to be taken into consideration

PV. Photovoltaic systems also require large areas. Additionally, PV modules contain amounts of heavy metals and therefore need to be recycled after the end of their lifetime.

3.4. Wind Energy

3.4.1. State of Technology

Wind turbines convert kinetic energy from air movement into electric energy using a rotor that drives a generator. Wind turbine sizes range from some kilowatt to several megawatt (Hennicke/Fischedick 2007). Today, the largest turbines have a conversion capacity of 6 MWel. On a suitable location, such a plant can deliver electricity of more than 15 GWh/a, enough to supply about 5,000 German three-person-households with electricity.

3.4.2. Costs of Wind Turbines Including External Costs

Costs of wind turbines have decreased due to the production of large quantities and optimised production processes. According to recent studies, wind power generation costs have become competitive to those of newly constructed conventional power plants (BWE 2009). Future cost development can be seen in Fig. 3-3.

3.4.3. Base and Peak Load Capabilities

Due to intermittent generation, wind power is only capable of base load supply in a combination with back-up systems (like diesel generators for single stand-alone systems or gas and steam power stations for large wind farms) or with energy storage technologies (WI/DLR 2008). The combination with renewable energy sources is also possible in the form of “virtual power plants” that combine different distributed energy generation technologies Fluctuating feed-in is a problem for system integration of wind power electricity, but the quality of wind forecast has increased steadily (Hennicke/Fischedick 2007). Bottlenecks in transmission lines have to be removed by grid extension, grid upgrade (e.g. from 220 kV up to 380 kV) and by intelligent grid management. Modern wind generators can provide adjustable idle power to support grid stability.

3.4.4. Ecological Aspects

Environmental impacts of wind turbines include noise emissions, disturbances for animals and detraction of the landscape. The erection of offshore wind plants can destroy benthic ecosystems and possibly disturb whales through infrasound. Offshore wind farms can also have a positive effect on animal populations (in terms of number of individuals) as water columns in wind farms serve as nursery grounds for larvae of a multitude of marine animals.

There is no ecological impact after use of wind turbines (WI/DLR 2008). According to life cycle assessments, offshore wind plants cause total emissions of around 24g CO_2eq/kWhel (Öko-Institut 2007).

3.5. Grid Integration and Electricity Transmission

The provision of sufficient infrastructure for the generation and transport of large amounts of renewable electricity in Algeria can only be achieved by a substantial, innovative upgrade and modernisation of the Algerian power transmission system. This chapter provides an overview of the

status quo of the Algerian grid and discusses possible technological options for the future transmission of renewable electricity to Europe.

3.5.1. Current Status of the Algerian National Transmission Network

Algeria has an extensive AC network, not only covering the densely populated coastal areas, but also – due to the presence of its oil and gas industry – reaching far into the largely unpopulated centre of the country. Owner of the grid is the state utility *Sonelgaz*, which is also responsible for operation, management and development of the grid. The grid is displayed in Fig. 3-5.

Fig. 3-5. Algerian electricity grid. Sonelgaz 2009.

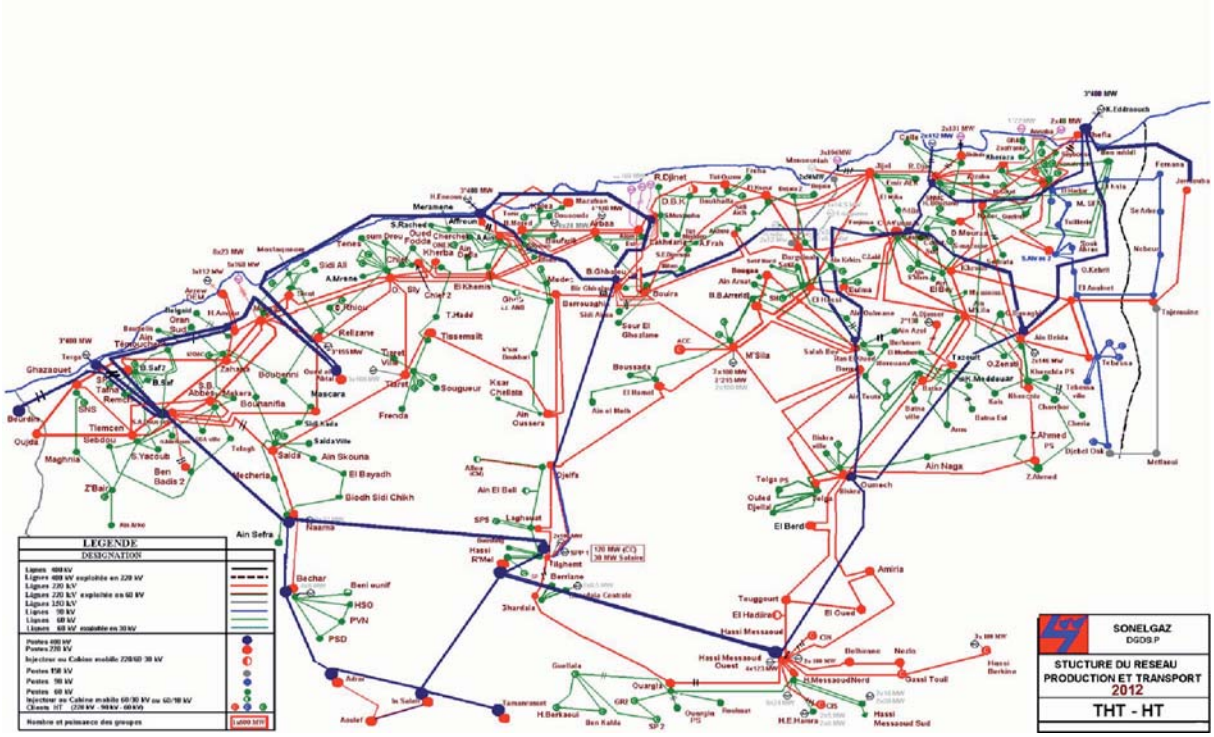


Fig. 3-5. Algerian electricity grid. Sonelgaz 2009.

Sonelgaz states that the total length of its transmission network is around 18,000 km. According to the company's definition, this number includes lines with voltage levels down to 60 kV. Transmission lines with 400 kV sum up to less than 1,300 km length. Currently, *Sonelgaz* is putting strong efforts into upgrading these grid lines. Projects under construction include a 400 kV east-west transversal line, as well as a 400 kV line reaching into the deep south of the country. Reinforcements of cross-border connections with the neighbouring countries Morocco, Tunisia and Libya, also on the basis of 400 kV technology, are progressing. In September 2009, a new interconnection with Morocco, featuring a transfer capacity of 1,000 MW, was inaugurated. Algeria's transnational interconnection projects with its Maghreb neighbours are part of a larger framework programme, the so-called *Mediterranean Ring Project* (*MED-RING*), a 400 kV electricity circuit encompassing all countries of the Mediterranean basin.

Besides the terrestrial interconnections, Algeria also has plans for submarine electricity links with its European neighbours on the other shore of the Mediterranean. Discussion of interlink projects with Italy and Spain already started in the late 1990s – a time long before the ideas of *Desertec* or the *Mediterranean Solar Plan* appeared on the international agenda.

For the interconnection with Spain, a feasibility study was carried out in 2003. It foresees a 250-km-long 400 kV DC underwater cable spanning from the western Algerian coast (at the location Terga) to Almeria in southern Spain. The underwater link to Italy via the island of Sardinia represents a similar,

but more ambitious project due to the longer distance. The feasibility study for this project was accomplished in 2004. It has to be pointed out that the main driving force behind the above-mentioned studies were the low gas prices in the 1990s. The assumption was that by exporting (gas-generated) electricity, Algeria could achieve higher revenues than by selling the gas itself to the European markets, where prices were low. It was forecast that the export lines would be constructed in parallel with large gas power plants exclusively designed for export purposes. At the moment, however, these projects seem to have been put on hold, most likely due to the higher gas prices of the last years.

3.5.2. Options for Renewable Electricity Transmission to Europe

From a technical point of view, HVDC undersea cables are without alternative when it comes to long-distance transmission across the Mediterranean sea. However, for the part of the overland transport through Algerian territory, two different approaches are possible.

Direct export approach. The electricity could be converted into HVDC already at the generation sites (wind farms, solar power plants). In this scenario, power would flow directly towards the export destination (Europe), meaning that the power lines, as well as the renewable generation plants, would be exclusively set up for the purpose of electricity export to Europe ("direct export"), see Fig. 3-6.

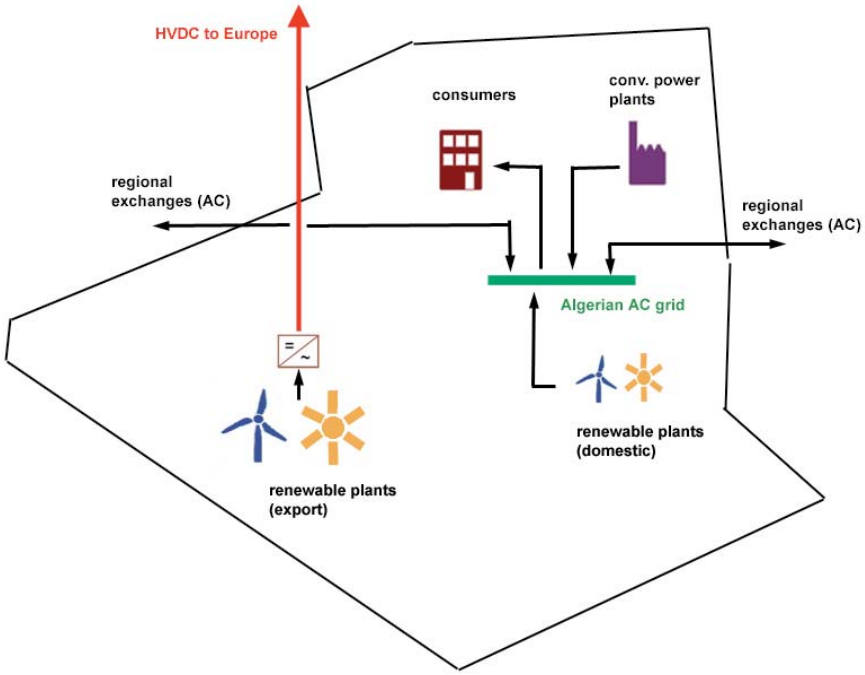


Fig. 3-6. Option *Direct Export* to Europe. Brand, unpublished.

Grid integration approach. The second option is the feed-in of renewable electricity into the Algerian (AC) electricity grid prior to being exported ("grid integration"). This would allow the Algerian consumer to (partly) consume the green electricity himself. The Algerian grid operator could hold sway over the quantities being exported, and allow, for instance, only residual generation ('surplus power') to be dispatched to Europe. In this scenario, AC-DC converter stations would only need to be installed close to the Algerian shore, see Fig. 3-7.

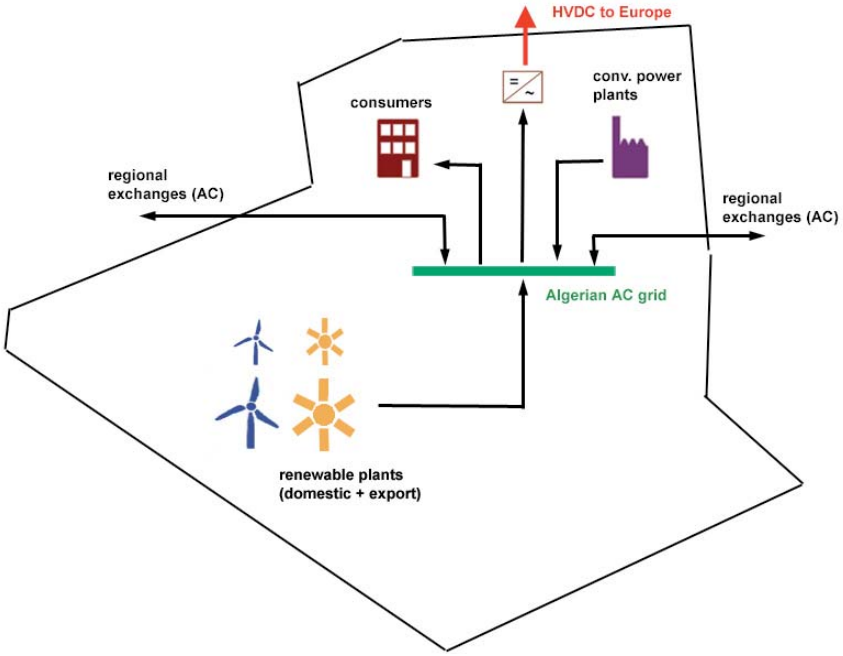


Fig. 3-7. Option *Grid Integration*. Brand, unpublished.

3.5.3. Assessment of Direct Export and Grid Integration Options

The *Direct Export* option can be interpreted as the 'best match' to the initial *Desertec* concept. Therefore, it might be preferred by the European proponents of renewable electricity imports from Algeria. From their point of view, the required framework conditions are simple: With the Algerian electricity system not being involved – neither technically nor commercially – Algerian authorities would only have to provide the necessary authorisations as well as the land rights for the solar power plants and the respective transmission lines. The straightforwardness of the concept has a further appeal, especially for investors: all project assets (generation units and the gridlines) could entirely remain in the hands of one single legal entity, allowing for a simple setup in financing and operation. On the other hand, the *Direct Export* concept might be prone to criticism due to its entirely unilateral character: firstly, it would not provide any contribution to the Algerian energy supply; secondly, there is the risk that the Algerian power sector might not sufficiently profit from the project, if it is, for instance, entirely carried out by foreign consortia.

The *Grid Integration* approach, on the other hand, appears to fit better with the preferences of Algerian industry policy. In the first place, the task of integrating renewable generation units into the national power grid requires a high involvement of Algerian engineering and industry capacity, which, in consequence, would very likely create more added value for the national economy. As a drawback, it has to be mentioned that with increasing feed-in of renewable power, the Algerian electricity system will also have to deal with the intermittent nature of wind parks or solar plants. For this challenge, however, the country's conventional power generation system appears relatively well prepared: It is mostly based on flexible gas turbine power plants, known as good balancers of fluctuating electricity. By integrating and balancing renewable power within the Algerian electricity system, the power could to a certain extent even be "processed" prior to export: It might become possible that Algeria exports the amount of renewable electricity in the form of "renewable base-load" to European countries.

Despite these advantages, it needs to be underlined that the *Grid Integration* approach is only viable if (smaller) renewable generation units are successively added to the power system, and if there is sufficient time for the transmission grid to undergo the necessary upgrading process. When it comes to vast export-oriented wind or solar thermal energy projects the size of the Algerian power system (GW-scale), only the *Direct Export* scheme can be considered a viable solution.

In order to complete the picture of renewable export possibilities, a further potential renewable electricity transfer scheme from Algeria to Europe has to be mentioned. It involves the utilisation of the Moroccan AC transmission network, its undersea interlink to the Iberian peninsula and (depending on the final export destination) further European transmission system operators (TSOs). Solar electricity, generated for example by a CSP plant in Algeria, could be conducted to the destination country via a chain of various TSOs (Brand, 2009). Precondition for that operation is that the needed transmission capacities are in advance reserved for the time slot when the CSP plant is productive. From a current perspective, it seems unlikely that very large amounts of renewable electricity could be transferred by this relatively complicated scheme. Nevertheless, it offers the advantage that it is compatible with paragraph 9 of the European energy directive (see chapter 2.2.3) and does not require the construction of export lines. First pilot projects could already be performed with this setup.

4. Legal and Regulatory Aspects for Renewable Electricity Export

4.1. Energy Policy in Algeria

Like other energy producing countries, Algeria reserves a strategic role for fossil energies. On the one hand, this is due to the fact that hydrocarbons constitute the country's main export products and by far the largest source of foreign currency income for the country. On the other hand, this is because the way different governments have used hydrocarbons has not only characterised the different energy policies, but has also constituted the prime mover of economic development in Algeria. As a matter of fact, the (fossil) energy sector yields more than 97 percent of Algeria's export incomes and contributes to more than 60 percent of the country's national budget.

Beyond the central position the energy sector occupies in the Algerian national economy, its dimensions have periodically triggered questions about its position as key resource. Indeed, public debate has often appealed to decision-makers to promote a diversified economy in order to establish an export equilibrium and to reduce the dominant role of hydrocarbons. In other words, the questions is how to reconcile the permanent imperative to develop export capacities and the satisfaction of growing domestic energy demands with the non-sustainable character of hydrocarbons and the quest for clean, sustainable and economically feasible forms of electricity generation.

Both on the international and on the Algerian level, the sustainability debate is not a recent one. Initiated in the 1970s, Algerian public policy has first outlined its policies in the 1980s in the framework of a national energy policy adopted in December 1981. This institutional framework remains the legal reference for political debates on energy policy until the present day.

This energy policy doctrine rests on three fundamental principles:

- first and foremost, to provide domestic electricity consumers with a comprehensive and uninterrupted power supply
- to preserve energy resources to guarantee the future energy independence of the country
- to promote exports in order to provide the finances for Algerian socio-economic development

Those three key goals of national energy policy have constituted the foundation for the formulation of the "model of national energy consumption" that was adopted by the council of ministers on 20 June 1984. This model introduced a new concept of energy use by differentiating between promotion and rationalisation of energy use. The major points developed for energy consumption are:

- the preferential use of natural gas
- the use of liquefied natural gas, LNG
- the progressive reduction of the share of hydrocarbon products in the national energy balance
- the orientation of electricity towards specific usages
- the rational use of energy through the introduction of low-energy technologies
- the promotion and development of renewable energies

Encouraged by the international environment favourable towards renewable energies in the 1990s and the 1992 Rio Summit, Algeria has worked for the formalisation of energy-related innovation since the late 1990s. A legal framework for energy regulation has been voted for on 28 July 1999 (law n°99-09). This law defined the means and conditions of Algerian policy and reaffirmed the 1980s option of energy consumption models. In its core philosophy, this law strengthens the option of energy efficiency. The law introduced norms and standards for energy efficiency in new buildings and electrical appliances. Further, it introduced energy efficiency controls on new and imported goods enforced by *APRUE*, the *Algerian National Agency for the Promotion and Rationalisation of Energy Use (Agence nationale pour la promotion et la rationalisation de l'utilisation de l'énergie)*.
A national energy efficiency policy was adopted in 2003. It implemented the law n°99-09 of 29 July 1999, introducing a broad concept of energy efficiency (*maîtrise de l'énergie*). The implementation instruments for this strategy are constituted by three elements:

- *PNME, National Energy Efficiency Programme (Programme national de maîtrise de l'énergie)* forms the legal basis of the energy law in the national energy efficiency programme
- *FNME, National Energy Efficiency Fund* (*Fonds national de maîtrise de l'énergie*) constitutes the principal instrument of this programme
- *CIME, Intersectoral Energy Efficiency Committee* (*Comité intersectoriel de la maîtrise de l'énergie*). This committee has been founded on 19 July 2005 as a consultative organ to control and evaluate the national energy programme

4.2. Actors and Instruments in the Electricity Sector

The following section provides a list of key players in the Algerian electricity sector:

The *National Energy Council* (*Conseil national de l'énergie*). Founded through the presidential decree n°95-102 (8 April 1995), this council is charged with supervising and controlling the long-term national energy policy. Its mission statement underlines that it has been created to

- put to work a long-term plan to safeguard the energy future of the country
- follow the national energy consumption model and the long-term national strategic objectives
- control the preservation of strategic energy reserves of the country
- put in place long-term strategies to renew, develop and use national hydrocarbon reserves.

In article 4 of the mentioned presidential decree, the tasks of the *National Energy Council* are defined. It is presided over by the President of the Republic and further consists of key Algerian officials, such as the head of government, the minister for national defence, the foreign minister, the energy minister, the finance minister, the governor of the Algerian central bank, and the head of the planning committee.

The *Ministry of Energy and Mines* (*Ministère de l'énergie et des mines*). Headed by Minister Youcef Yousfi, the *Ministry of Energy and Mines* controls most of the technical, regulatory and economic aspects in the power generation sector through its directorate of electricity, and is responsible for the formulation and the application of a national energy policy. It also houses the *Directorate-General for Renewable Energies*.

***CREG* – The *Regulatory Commission of Electricity and Gas* (*Commission de régulation de l'électricité et du gaz*).** The national regulatory framework has been defined by law n°02-01 released on 5 February 2002. Articles 132 and 133 form the legal basis for the *CREG*. Apart from the standard tasks of a regulatory body, this commission observes and enforces the transparency of electricity markets and the well-functioning of a healthy competition.

The *Programme Committee for Investments in the Electricity and Gas Distribution Sectors* (*Comité de programmation des investissements dans les secteurs de l'électricité et de la distribution du gaz par canalisation*). This committee has been created by the ministerial decree n°68 on 16 May 2004 as a result of the regrouping of the *Ministry of Energy and Mines*, *CREG* and *Sonelgaz*.

The *Ministry of Land Use Planning, Environment and Tourism* (*Ministère de l'aménagement du territoire, de l'environnement et du tourisme*). Through its *Directorate for Energy and Development*, this ministry secures the technological aspects of the power sector and is responsible to enact laws for the promotion of sustainable development.

The *National Observatory for the Promotion of Renewable Energies* (*Observatoire national de promotion des énergies renouvelables*). The law n°04-09 decreed on 14 August 2004 founded the *National Observatory for the Promotion of Renewable Energies*. This institution is under the authority of the *Ministry of the Environment*. The areas of competence for this agency will be defined by administrative order.

***CDER* – The *Centre for the Development of Renewable Energies* (*Centre de développement des énergies renouvelables*).** The centre was founded in March 1988, as a consequence of the restructuring of the *High Commission for Research* (*Haut commissariat à la recherche*). It elaborates

and implements scientific and technological R&D programmes focusing on solar, wind, geothermal and biomass energy. The centre's activities range from the creation of a renewable energies Ph.D. programme (*Ecole Doctorale)* at the university of Tlemcen to the provision of an extensive virtual library, endowed with scientific publications and multimedia material. The *CDER* is based in Algiers, but further research and development units are deployed in the oasis of Ghardaia, in the coastal city of Tipaza and the in desert town of Adrar.

***IAEREE* – The *Algerian Institute for Renewable Energy and Energy Efficiency* (*Institut algérien des énergies renouvelables et de l'éfficacité énergétique*).** Announced by President Bouteflika in September 2009, the *IAEREE* will be established in the new village of Bellil in the district of Hassi R'Mel (wilaya of Laghouat). The institute will work on technology and economic issues regarding the spread of renewable energies in Algeria and will closely cooperate with *NEAL* and other public and private sector companies (Anon. 2010a). It will also host expert courses for the construction of renewable energy technology and the spread of energy efficiency measures on different skill levels. Unlike the already existing *CDER*, the *IAEREE* will be under the supervision of the *Algerian Ministry of Energy and Mines* (Anon. 2010b), a fact that might enhance its political influence and might thus develop into an influential high-level renewable energy stakeholder, in the mid-term future.

***APRUE* – The *Algerian National Agency for the Promotion and Rationalisation of Energy Use* (*Agence nationale pour la promotion et la rationalisation de l'utilisation de l'énergie*).** The new institution was founded by law n°99-99 on energy efficiency on 28 July 1999. Originally created in 1985 by executive decree, this institution works regarding the utilisation of natural gas, subsidising petroleum products and rationalising energy use according to the above-mentioned national energy consumption model.

***Sonelgaz* – The *National Society for Electricity and Gas* (*Sociètè nationale de l'électricité et du gaz*).** Law n°02-01 on energy and gas distribution was decreed on 5 February 2002 and rearranged the institutional framework in the electricity sector. Since that date, the traditional operator *Sonelgaz* has been transformed into an industrial group consisting of the following seven branches:

- *Sonelgaz Electricity Production* (*Sonelgaz production d'électricité - SPE*)
- *Electrical Grid Systems* (*Gestionnaire réseau de transport électricité – GRTE*)
- *Gas Transport and Grid Systems* (*Gestionnaire réseau de transport gaz - GRTG*)
- *Distribution Society for Algiers* (*Société de distribution d'Alger - SDA*)
- *Distribution Society for Central Algeria* (*Société de distribution Centre - SDC*)
- *Distribution Society for Eastern Algeria* (*Société de distribution Est - SDE*)
- *Distribution Society for Western Algeria* (*Société de distribution Ouest - SDO*)

***Independent Power Producers* (*IPPs*).** As a consequence of the liberalisation process starting in 2002, about 13 percent (1,200 MW) of the Algerian electricity are currently produced by private operators. So far, all IPPs have formed joint ventures with *Sonelgaz* in order to enter the Algerian power market (*Tipaza*: financed by Abu Dhabi's *Mubadala* and *SNC Lavalin*). *Skikda* and *Kahraba Hadjret En Nouss* are jointly owned by *Sonatrach* and *Sonelgaz*, while the Algerian company *Cevital* owns two smaller cogeneration plants of 25 MW in the Bejaia area for its own use.

4.3. Electricity Sector Framework

4.3.1. History of the Electricity Sector

The Algerian electricity sector has gone through various phases of institutional reform and rearrangement. To a large extent, these reforms were tailored for *Sonelgaz*, the national electricity and gas company – still the predominant actor in electricity generation, transmission and distribution. In recent times, innovations have brought new mechanisms to the sector, for example the admission of new foreign, private actors to the domestic electricity production regime. In the history of the Algerian electricity sector, which is mainly a history of *Sonelgaz*, the following phases can be identified:

The pre-independence phase (until 1962). Before independence, the Algerian production and distribution of gas and power was conducted by the *Algerian Electricity and Gas Company* (*Entreprise d'électricité et du gaz d'Algérie - EGA).* This enterprise had been created through the nationalisation of the former local power producers *Lebon*, *Cie* and *SAE* (*Société algérienne de l'électricité et du gaz*). Right before independence, however, law n°62-157 established *EGA* as a company with an industrial, commercial character on 31 December 1962.

The nationalisation period and the creation of *Sonelgaz*. The former supplier *EGA* was dissolved by decree n°69-59 on 28 July 1969. Its successor became the Algerian *Société nationale de l'électricité et du gaz* (*Sonelgaz*).

The restructuring of the electricity sector. In 1983, in accordance with other national companies, *Sonelgaz* underwent a major institutional reorganisation. This project had the goal of externalising all works that were on the periphery of the organisation. As a consequence, six company branches (*Kahrif, Kharakib, Kanagaz, Inerga, Etterkib* and *AMC*) have developed, representing different parts of the electricity and gas sector.

The creation of a public enterprise of industrial and commercial character. In 1991, *Sonelgaz* changed its legal status and became a public company of industrial and commercial character (*EPIC, établissement public à caractère industriel et commercial*) by decree n°91-475 on 14 December 1991.

The creation of the *Sonelgaz SPA group*. In 2002, a new electricity and gas transportation law (see chapter 4.3.2) brought changes to the sector, allowing private IPPs to enter the electricity generation business for the first time. Following this, *Sonelgaz* had to change its legal status and transformed into an industrial holding (*société par actions - SPA*). Today, *Sonelgaz* consists of various specialised companies (decree n°02-195, 1 June 2002) with legally unbundled activities (generation, transmission and distribution) As a new element of the reform, *Sonelgaz SPA* was also entitled to perform commercial operations (and equity investments) on the international level. An indicator that such operations actually materialise is *Sonelgaz'* recent registration as a trading entity on the Spanish electricity exchange *OMEL*.

The introduction of distribution concessions. The distribution concession regime began in 2008 by *CREG's* declaration of decree n°08-114 on 9 April 2008. These concessions are mandatory for electricity and gas transports.

Although having lost is monopolistic position, *Sonelgaz* has become the holder of concessions for 58 electricity and 56 gas distribution plots and is thus undoubtedly the dominant actor in the Algerian national electricity scene.

4.3.2. Current Legal Framework for Electricity

In 2002, the Algerian government started to introduce liberalisation reforms in the domestic electricity sector. The objectives of the reforms were to bring the market closer to international standards and to open it for private investors on the basis of the principles of non-discrimination. A central outcome of the reform is the new gas and electricity law n°02-01 (*loi n°02-01 du 5 février 2002 relative à l'électricité et à la distribution du gaz par canalisation),* which was enacted in February 2002. It can be considered as the general framework law for the reorganisation of the electricity sector. Since its coming into force, the law has undergone several alterations in the form of decrees and additional implementing regulations. It has to be stressed that the implementation process is still ongoing and that not all of the reform efforts have been successfully performed yet.

The electricity law n°02-01 introduced the following features to the sector:

- The creation of an independent electricity and gas regulatory commission, in charge of supervising the transparency and competitiveness of the Algerian electricity and gas market (article 111 of the law). This commission was established in 2005 under the name *Commission de régulation de l'électricité et du gaz* (*CREG*). *CREG* has three major tasks: (1) Providing and controlling the public electricity service (2) Consulting the authorities about market

regulation and organisation, (3) Ensuring that laws and regulations are respected. *CREG* can be considered the central element of public authority in the Algerian electricity sector.

- The opening of the power generation sector to private and public operators (articles 6 and 7). The law introduces competition in the electricity generation segment, by principally permitting any natural or legal person to install electricity generation capacities. For this activity, however, authorisations have to be given by *CREG* for installations with a capacity exceeding 25 MW.
- Only the transmission system is considered a natural monopoly (article 29), being operated by one single grid operator. The law attributes the ownership and the utilisation of the electricity transmission grid to the grid operator *GRTE, Gestionnaire réseau de transport électricité*, a subsidiary of the *Sonelgaz* group (article 169).
- Concessions for electricity distribution shall be given out by *CREG* following a public tender process (article 73). Details are outlined in decree n°08-114. Although private actors in the electricity distribution business are principally admissible, currently, all distribution companies are owned by *Sonelgaz*. *Sonelgaz'* distribution companies are: *Société de distribution d'Alger* (*SDA*), *Société de distribution Centre* (*SDC*), *Société de distribution Est* (*SDE*) and *Société de distribution Ouest* (*SDO*).
- The law envisages the creation of an independent system operator (article 35), responsible for the dispatching of the electricity (supply-demand equilibrium). The system operator shall be an independent commercial company. However, at present, the system operation is still performed by *Sonelgaz* (article 172).
- The law also stipulates the creation of an independent "market regulator" (*opérateur du marché*) organising the commercial electricity trading (articles 41 and 42). This agency shall be in the hands of a commercial company and in charge of handling the market operations and of communicating the obtained (marginal) market prices to the market participants.

  As of now, such a market operator has not yet been introduced, and the law remains unclear about the details how the electricity trading is to be organised (e.g. whether the market operator will become an equivalent to electricity trading platforms in Europe). At the moment, the tasks of a market regulator are carried out by *Sonelgaz* (article 172).
- Article 85 of the law explicitly allows the export and import of electricity, which can be performed by any legal or natural person. International electricity transactions have to be confirmed by the regulatory commission (*CREG*), which can refuse export activities if they have strongly negative impacts on the national Algerian electricity supply (i.e. if demand cannot be satisfied). Power plants that have been constructed exclusively for export of electricity are exempted from this reservation (article 86) – a clause that opens a legal door for pure export projects, such as *Desertec*.

4.3.3. Impact and Consequences for Electricity Export

In the years following 2002, the new law has caused small, but already visible changes in the electricity landscape of Algeria. Although the state company *Sonelgaz* still holds a (quasi-)monopoly on grid use and electricity distribution, it had to perform a legal unbundling of its business units (generation, transmission and distribution) in order to comply with the new requirements set by the electricity legislation. A further, similarly remarkable sign is the emergence of private IPPs, which have already been listed in the previous chapter: The law n°02-01 has helped to launch various projects of independent power producers, most of which are owned by joint ventures or consortia of several investors, including international participation. An example for an IPP project was the 2005 gas power plant in Kahrama with 80 percent equity participation of the US company *Blach &Veach.*

In the renewable sector, a first major engagement of the international (private) power sector has been made for the solar thermal power plant (SPP1) in Hassi R'mel, which is currently under construction by a consortium of Algerian companies (*Sonatrach* and *NEAL*) and the Spanish *ABENER* group.

Despite these first signs of a partial liberalisation and opening for foreign investments, the situation of the Algerian electricity market is still far away from being fully open to outsiders. One major obstacle for private investors is the restrictive procedures for planning permissions of new power plants.

As Fig. 4-1 indicates, any new plant has to be authorised either by *CREG* or the *Ministry of Energy*. Exceptions are only made in case of plants that generate electricity for the owner's own demand (French *autoconsommation*) and that are smaller than 25 MW. In this case, a simple note to *CREG* is sufficient. Set aside this exception, it can be stated that for all large-scale electricity generation projects, the right to access the Algerian electricity grid is still restricted. Investors depend on the consent of the electricity regulator or the *Ministry of Energy*. This is also the case for export-oriented renewable power plants.

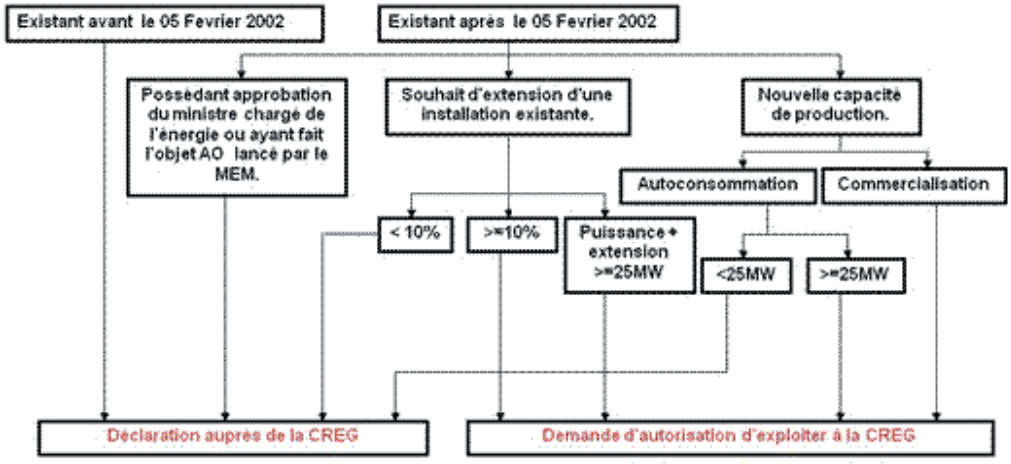


Fig. 4-1. Authorisation procedures for new and existing power plants. CREG, no year.

A further regulatory barrier concerns the transmission network. If, for example, renewable electricity, generated by private-owned solar plants in central Algeria, should be transported towards export hubs at the coastline via the national Algerian grid (see Fig. 3-7), part of the Algerian overland transmission capacities would have to be reserved for this power export. These capacities would have to be assigned by the grid monopolist (*Sonelgaz GRTE*) to the exporting company. A problem would arise if bottlenecks put physical limitations to the transmission of the additional (renewable) power transported through the domestic grid. In this case, an upgrade of the Algerian grid infrastructure for export purposes would be required. Such grid extensions, however, will be difficult to realise for two reasons: (1) the grid operator has no obligation to carry out investments for new transmission capacity that is not essentially needed for the national Algerian power supply, (2) third parties are not allowed to invest in the Algerian grid infrastructure due to the monopolistic structures provided by the electricity law.

For the *direct export* option (see Fig. 3-6), where the investor builds his own electricity transmission system without connection to the Algerian grid, the situation appears to be somewhat different. In that case, both the generation and the transmission infrastructure would be completely isolated from the Algerian electricity supply scheme and would therefore not interfere with the provision of public service. However, at the moment, the law on electricity n°02-01 of 5 February 2002 concerning electricity and gas distribution via a pipeline network does not allow national and foreign entities to own transmission lines destined exclusively for export. The use of transportation grids for electricity and gas via a pipeline system is still exclusively entrusted to the national grid administrator *GRTE/GRTG* (part of the *Sonelgaz* group). Whether this means that the electricity law does not apply for these projects, is unclear.

4.4. The Renewable Energy Framework

4.4.1. Legislative Provisions for Renewable Energies

From the 1980s until the year 2000, renewable energies in Algeria were regarded as part of the country's energy utilisation and efficiency strategy, rather than being seen as environmental protection measures, which is the case today. In 2001 and 2003, two environmental laws (law n°01-20 of 12 December 2001 and law n°03-10 of 19 July 2003) implicitly referred to renewable energies.

An explicit legal support of renewable energies came into force in 2004, when Algeria's first renewable energy law was enacted (law n°04-09 of 14 August 2004, "*loi relative à la promotion des énergies renouvelables dans le cadre du développement durable*", "law on the promotion of renewable energies in the context of sustainable development"). This law provides a general framework for a national promotion programme for renewable energies. Moreover, the law foresees the creation of the above-mentioned monitoring body (*Observatoire national de promotion des energies renouvelables*). A further element of the law is the introduction of a renewable certificate system. As of now, the realisation of this certificate system, as well as the monitoring body, are still pending.

4.4.2. Feed-in Tariffs

Independently of the above-mentioned renewable energy laws, in 2004, a decree on the diversification of electricity production (executive decree n°04-92 of 25 March 2004) was enacted by the Algerian government. The objective of the decree is to create incentives for other sources of electricity generation than the conventional ones. At the time of release, the decree was unique in Africa: for the first time, a precisely defined remuneration scheme for renewable electricity had been set out on the continent.

In detail, the decree defines technology-specific premiums that the electricity producer receives per kWh of renewable power injected into the grid.

In greater detail, the decree envisages the following bonuses, which are paid on top of the market electricity price:

- For wind electricity the bonus is 300 percent
- For solar electricity entirely produced by solar irradiation (e.g. PV or "solar only" CSP plants), the bonus is 300 percent
- For solar thermal electricity with gas co-firing the bonus is
- 180 percent for a solar contribution of 20 percent to 25 percent
- 160 percent for a solar contribution of 15 percent to 20 percent
- 140 percent for a solar contribution of 10 percent to 15 percent
- 100 percent for a solar contribution of 5 percent to 10 percent
- 0 percent for a solar contribution of 0 percent to 5 percent
- For hydroelectricity, the bonus is 100 percent
- For cogeneration plants, the bonus is 160 percent
- For waste incineration plants, the bonus is 200 percent

In combination with the obligation of the grid owner to allow third parties the access to the transmission grid (under the conditions set out by the electricity law n°02-01, 2001, see previous chapter), the decree can be considered as a feed-in law in the formal sense.

Nevertheless, it has to be stressed that the feed-in mechanisms have so far not succeeded in triggering any significant deployment of renewable energies in Algeria. The main reason is that until today, the definition of the base price (upon which the calculation of the feed-in bonuses is based) is pending. Consequently, it is unsurprising that uncertainty about return on investments forms a major disincentive for large-scale investors in renewable energies in Algeria. Moreover, due to the subsidised electricity generation (most power plants are operated with cheap gas supplied by the

national gas company *Sonatrach*), the base price for electricity can be expected to be very low. Therefore, it is unlikely that the current remuneration scheme will lead to major investments in renewable capacity in Algeria.

As Algerian authorities are aware of the fact that so far, its attempts to incentivise renewable energy investments have been of very limited success, a reformulation of its renewable energy law is currently under discussion, but it might take several years until its release. In order to bridge the gap for the time being, the 2010 financial law ("*loi de finances 2010*") envisages the creation of a new, special renewable energy investment fund. Financed by a 0.5 percent fee of the corporate oil taxes (*fiscalité petrolière*), this vehicle will have an estimated amount of €40 million p.a. at its command. One of its first projects will be the co-financing of Algeria's first wind park in Adrar that will be built by the French company *Vergnet*.

In sum, although renewable incentives in form of feed-in tariffs formally exist in Algeria, the country's current legal framework has so far not been able to render renewable energies attractive for investors. As of now, the few renewable power plant projects in the country have only received funding through subsidies or cross-financing with Algerian public funds or international development finance. It remains to be seen whether Algeria's new renewable energy investment fund or a future redraft of its legislation will yield more positive results. For now, however, the renewable export option will remain the only attractive investment opportunity. Only in the (unlikely) case that Algeria's government decides to raise its feed-in tariffs above the potential primes paid by European countries, investors would switch to set up renewable plants for local supply.

4.5. The Entrepreneurial Framework

4.5.1. The Situation for Foreign Investors

As has been outlined in chapter 4.2.2., Algeria's electricity market is open to any third party investment, be it domestic or foreign. Despite this formal liberalisation of the electricity sector, the Algerian government has recently set up a serious barrier regarding the general equity participation of foreign capital in Algerian companies. Since 2009, the new law of finances stipulates that foreign investors can only hold up to 49 percent of the capital of an Algerian company(article n°58). All foreign investment activities have to be declared at the *National Investment Agency ANDI* (*Agence nationale de développement de l'investissement*) and receive approval of the *National Council of Investments* (*CNI*, *Conseil national de l'investissement*). Also, the repatriation of profits, a key aspect for international investors, might prove difficult: although formally possible, companies are encouraged to reinvest their revenues in Algeria and receive a preferential tax rate. This, however, will not be of key interest for international shareholder-oriented companies. It is currently unclear whether this could deter large-scale renewable energy exporters or whether, like in the case of the oil industry, where the local content factor is not a new situation either, the business is still so attractive that investors are undeterred by those potential administrative issues.

Presently, it is difficult to anticipate the consequences of this investment restriction (before the law came into force, foreign companies were allowed to hold majorities in Algerian companies). At least for large-scale export projects following the *direct export* scenario (see chapter 3.5.3), the stipulation of an obligatory Algerian majority seems to represent a barrier:

(1) Even though powerful state-owned industrial companies exist, it might be generally difficult to find Algerian investors that are able to raise the majority of the massive investments needed to set up the electricity generation and transport infrastructure. (2) Moreover, domestic investors might be reluctant to put an equity majority into an enterprise whose only revenue basis depends on European subsidies for imported renewable electricity.

4.5.2. The Situation for Algerian Investors and Possible Partnership Frameworks

Also from the standpoint of Algerian investors, barriers exist, particularly in the case of the *direct export* scenario. As indicated in the previous chapter, the main obstacle for investing in a new export-

oriented transmission project will be the commercial risk for Algerian investors or lenders. They would want certainty about future cash flows, which are determined by quantities to be sold and future electricity prices. Both can only be provided via long-term contracts. An example of these contracts are *take-or-pay* contracts which are common practice in international gas business. They are also applied to existing or new pipeline projects between Algeria, Spain and Italy. *Take-or-pay* contracts for electricity transmission lines would guarantee electricity sales at steady price levels – the buyer has to pay the contractual amount of electricity even if demand falls short. A further trust-enhancing measure would be investment partnerships with the European downstream electricity sector. Here, the Algerian gas sector could serve as an example, too. The *Medgaz* project, a new trans-Mediterranean pipeline running from Algeria to Spain, involves five international operators from both the upstream and the downstream business. A similar setup could be imagined for investment-intensive HVDC transmission lines across the Mediterranean. Here, consortia of Algerian power (generation) companies, as well as European electricity traders could initiate powerful and successful partnerships.

4.5.3. Taxation and Export Duties

At present, no specific legal documents concerning the taxation and export duties for renewable electricity have been published.

4.5.4. Land Rights and Ownership

Land rights and ownership might become an issue for renewable power projects, particularly for area-intensive CSP or PV power plants. According to the *Dii*, an area of 17,000 square kilometres would be required to produce "green" power on the desired scale for the EU (Rhodes 2010). It is currently assumed that the land purchase or land ownership issues fall under the regulation of industrial land, mediated by the Algerian *Agence nationale d'intermédiation et de régulation foncière* (*ANIREF, National Agency for Land Intermediation and Regulation*). Land rights will be issued by concession tenders where the highest bidder in a public auction wins.

4.6. Summary

The Algerian electricity market is on a path of privatisation and liberalisation to bring its market closer to international standards.

From a general standpoint, there are no legal regulations prohibiting the export of (renewable) electricity. As has been shown, export activities are explicitly allowed by the Algerian electricity law – even for private, foreign IPPs. However, when looking at the details, one can at best be cautiously optimistic because of several reasons:

- Authorities can hamper potential renewable export projects of third parties as there is the requirement of a formal permission by the regulatory commission for each new power plant over 25 MW.
- There is uncertainty about the allocation of sufficient transmission capacity, which lies in the hands of the grid operator and the regulatory commission. This results from the fact that the transmission system for electricity is supposed to be a natural monopoly.
- The grid monopolist has no obligation to modernise or extend the existing grid to ensure the physical ability to export electricity, and private companies are not allowed to invest in such infrastructure.
- Transmission lines for export purposes only must not be owned by private entities (which is currently relevant in the natural gas sector).
- Currently, there are no sufficient support systems for renewable energies that would be able to bridge the gap from now to a stage in which renewable electricity can be sold to Europe.
- The new law of finances passed in 2009 (article 58) stipulates that foreign investors can only hold up to 49 percent of the capital of an Algerian company. Also, the repatriation of profits, a key aspect for international investors, might prove difficult: although formally possible,

companies are encouraged to reinvest their revenues in Algeria. This, however, will not be of key interest for international shareholder-oriented companies.

5. Players in the Algerian Electricity and Renewable Energy Sector

The previous chapter has shown that renewable energies have taken first roots in some areas of the Algerian legal framework. Important regulatory barriers, however, still remain, especially with regards to the large-scale export of renewable electricity. How (and if) these barriers can be overcome will finally depend on the Algerian government's attitude and actions. Although it is beyond the scope of this work to analyse in detail the governance processes in the Algerian (renewable) energy policy arena, we nevertheless want to give an overview of the main actors and stakeholders that might influence future discussions.

The first section of this chapter analyses the current state of the Algerian discourse about renewable energies in a general way, while the second part describes more specifically the positions of the actors regarding the question of electricity export.

5.1. The Algerian Discourse on Renewable Energies - Interest Groups and Their Arguments

The last ten years have been marked by profound transformations in the way renewable energies have been received within socio-political discussions in Algeria. Previously, the country, as a „prisoner of fossil fuels", had for a long time discarded renewable energies in its energy policy discourse. Today, this situation has changed and it appears that most of the concerned actors perceive Algeria's strong fossil focus as a general risk that might weaken the country's position in the long run. Among the crucial questions, which are currently debated, are:

- Which are the future equilibriums in terms of internal energy consumption?
- Which diversification of energies should be adopted?
- Should priority be given to export?
- What is the position of renewable energies in the context of internal consumption and in the light of large-scale development projects (five-year plans, industrial development programmes and the national land use plan *SNAT* (*schéma national d'aménagement du territoire*))

Over the past years, different types of discourse have emanated in Algeria. Each type is represented by a distinct group of protagonists. In order to distinguish the different positions, we have classified the positions of the actors into four main discourse types:

- The nationalist discourse
- The utilitarian discourse
- The environmentalist and civil society discourse
- The business discourse

The nature and the arguments of these discourses are briefly outlined in the following sections.

5.1.1. The Nationalist Discourse

This discourse is probably the most influential, as it is shared by the *Directorate-General for Electricity* of the *Ministry of Energy and Mines* and the regulatory commission *CREG*. Since the energy sector is regarded as extremely sensitive, these actors consider that it touches upon national sovereignty. As a consequence, the sector cannot be the object of market relations in the classical sense, for its administration must take place in a "special" framework. The advocates of this discourse expect a clear formulation of an affirmative policy regarding renewable energies. However, they do not conceal that they consider the deployment of renewable energy technologies rather as secondary. The proponents consider the following facts as given:

- National fossil fuels are sufficient in the long run.
- Natural gas, Algeria's dominating energy resource, is considered the least polluting among fossil fuels.

- On the one hand, Algeria does not consider itself a polluter and is hence in a less pressing situation than other countries; on the other hand, disposing of a large range of options in the domain of renewable energies, Algeria is concerned about the valorisation of its resources and the elaboration of a strategy in both the regional and the international context.

The advocates of the nationalist discourse, particularly the regulatory commission *CREG*, seem to prioritise the organisation of an electricity sector as prescribed by the 2002 electricity law (see chapter 4.3.2). Compared to this, strengthening the renewable electricity legislation, for example by formulating the long-awaited application texts to the 2004 renewable energy law, appears to be of minor importance. A reason for this reluctance on the part of the advocates of the nationalist discourse might be the frequently voiced concerns about the stability of electricity prices and the question how renewable technologies could provide added value for the Algerian economy.

One project that could be attractive to proponents of this discourse is the new attempt to establish a photovoltaic industry in Algeria. Thus, *Sonelgaz'* engineering branch *CEEG* has recently announced that it would begin the domestic production of photovoltaic modules no later than in September 2012 with its company *Rouiba Eclairage* (Bouazid 2010). However, it remains doubtful whether a comparatively small production line (30-45 MW) will be cost-competitive with the large-scale manufacturing facilities that have been built in Asia.

5.1.2. The Utilitarian Discourse

Advocates of the utilitarian discourse are the electricity service provider *Sonelgaz* as well as several national agencies that are in charge of carrying out government renewable energy programmes, such as *APRUE* or *CDER*. All these actors are characterised by a slightly technocratic and normative vision regarding the energy sector and are hence concerned with a strict compliance with their duties.

CDER and *APRUE* were established to promote renewable energies or energy efficiency measures in front of the general public. In other words, they are in charge of launching and following up on pilot projects and of organising activities to sensitise public opinion to "green" culture (solar villages, use of energy-saving lamps). *CDER* is a research centre focusing on technology and natural potentials for renewable energies in Algeria. Both *APRUE* and *CDER* position themselves on the future market for renewable energies – of which they already seem to be the precursors in Algeria – by approaching universities and research centres in order to render research and development in this domain more dynamic.

Sonelgaz, which has long experience in the management of conventional electricity, shows a reserved attitude towards renewable energies. Its interest in renewable energies will only increase in case of an implementation strategy that is in line with the company's main mission: the continuous and stable provision of electricity. Due to their high costs and their intermittent power feed-in, *Sonelgaz'* representatives do at the moment not consider renewable energies as one of their company's major fields of activity. However, this might change in future, also with the help of the planned photovoltaic manufacturing project of the *Sonelgaz* group.

As can be seen in the case of *APRUE*, some actors can be attributed to more than just one discourse. This results from their broad approach to renewable energies. Therefore, *APRUE* will be treated as an actor of the ecologist discourse in the following subchapter.

5.1.3. The Ecological and Civil Society Discourse and the Role of the Media

The ecological discourse emanates from a broad range of actors. While in a European context, one would typically expect environmental associations to be its central advocates, in Algeria, this is only the case to a certain extent as environmentalist civil society organisations are rather weak. Thus, public institutions gain in relative importance; particularly the *Ministry for Spatial Planning and Environment* should be considered a central stakeholder within this kind of discourse. As will be indicated, further actors comprise the civil society organisations and the media, whereas political parties seem indifferent to ecological concerns.

The *Ministry for Spatial Planning and Environment*

The Ministry regrets that issues in the energy sector are still badly placed on the hierarchy of national sustainability priorities; they have not yet been sufficiently considered in the development of long-term strategies for the national energy future. These issues are masked by a superficial vision that privileges the short term and suggests energetic ease and abundance. Consequently, fossil energies are used wastefully and irrationally. Environmentalists assert that all scenarios, even the most prudent ones, predict an increase in national energy consumption imposed by socio-economic developments with strong external effects on the environment, namely pollution. Renewable energies are regarded as the only reliable and sensible alternative for the environment and sustainable development in the long term. The notion that the visions of the *Ministry of the Environment* differ strongly from those of the *MEM* can be further backed up by the project *Nouvelle Ville Boughezoul*, the plan of a *Masdar*-style zero-carbon city that has been put forth by the *Ministry of Environment*. Without assessing the likelihood of success of the project as a whole, it can be underlined that such a project is in many ways diametrically opposed to what conservative development plans of the *MEM* stand for.

This discourse in favour of renewable energies links the Algerian situation to a supranational challenge comprising the whole African continent and points out the paradox of the present situation. The African continent is the geographical region that pollutes the least, but it is the area that bears the most dramatic effects for its development and its populations.

Civil Society Organisations

Due to recent Algerian history with the civil war from 1991 until 1998 and its aftermath, environmental questions are not accorded the highest priority among societal issues in Algeria. Officially registered ecological movements constitute only 3 percent of all 962 national associations and struggle with fluctuating mobilisation potentials, which often do not allow them to react appropriately to current environmental concerns. Still, the movement has known some successes, like the large-scale mobilisation preventing the route of the east-west highway from disfiguring the scenery of El Kala Park, classified *UNESCO* world heritage. Thus, the associational movement is perceived as the actor that is able to translate global environmental culture into its local variety. The association *Bariq 21*, for instance, aims at sensitising the population to renewable energies and sustainable development. Its activists have recently donated the first solar water heater for a local day nursery, hoping to contribute to the spread of renewable energies. Similarly, the association *El-Baraim* seeks to educate kids to (eco-) citizenship from a young age, organising eco-awareness workshops in kindergartens and primary schools. As can be gauged by those examples, however, most Algerian environmental civil society organisations do not have command of large organisational capacities in order to run large-scale campaigns for renewable energies and focus more on local or regional awareness building projects than on the sensitive issue of national policy-making.

The Media: a Daily Discourse with Educational Tendency

It is important to emphasise that in Algeria the media discourse on renewable energies contains a strong educational element of green culture. The media position themselves as the mouthpiece of the associational movement and distinguish themselves through their efforts to mobilise public opinion concerning sensitive questions of environment, ecology, pollution and renewable energies.

Political Parties

The political parties seem to a certain extent detached from the big ecological events and the issues at stake. At the moment, they mobilise all their capacities in order to assure a better rootedness in society and to acquire more visibility in the Algerian political landscape. Most parties advocate a more traditional, materialistic development model for the Algerian society and favour non-environmental topics for mobilisation campaigns. That said, also the Algerian political landscape slowly takes environmental issues into account and increases interaction with global environmental movements. In terms of renewable energies, it can be expected that once the national programme on renewable energies is better established, political organisations will increasingly discover the domestic and

international renewable energy agenda as well. The major political parties that are represented in the Algerian People's National Assembly are the ruling *National Liberation Front* (136 seats, left-wing) of president Bouteflika, the *National Rally for Democracy* (61, left-wing), the *Movement of Society for Peace* (52, Islamist), the *Workers' Party* (26, far-left) and the *Rally for Culture and Democracy* (19, secular-liberal Berber party). Further, there are 33 independent deputies and 17 minor parties, among them the *National Movement for Nature and Development* with seven deputies.

5.1.4. The Business Discourse

This group of actors forcefully demands state patronage for pre-investments in renewable energies, such as the abolition of restrictions, the reduction of regimentation, the access to land and the facilitation of the construction of a new market for renewable energies.

Essentially, the strategy of this group consists of organising its immediate immersion in the international power sector. Proponents (e.g. *Cevital*) aim to position themselves as an intermediary platform necessary for the megaprojects planned on the southern shore of the Mediterranean, especially for the export of electricity generated from renewables.

The immediate objective of these actors is to seek facilitation for the discharge of their overproduction onto the local or international markets, but also to position themselves well within export circuits for the sale of renewable energies on the national and global market. Hence, they have shown the will to be present in the sectors of both conventional and renewable energies.

These actors retain a critical stance vis-à-vis the regulation in force in this field. Indeed, they regard it as non-conform with the declared will of the state to liberalise the economy. They consider that this regimentation contains some obstacles for the comprehensive application of the laws on economic liberalisation that have been promulgated. Thus, they emphasise the absence of a transparent remuneration scheme and the delays in the effective implementation of a market operator.

5.2. The Position of Algerian Stakeholders with Regards to Renewable Power Export Schemes

The interviews with the Algerian stakeholders were conducted in Mai and June 2010. Not all of the questions asked concerning renewable electricity exports were welcomed by the interviewed actors. Particularly the interview with the *Directorate-General of Electricity* of the Algerian *MEM*, turned out to be fruitless as it explicitly refused to answer direct questions about the *Desertec* initiative and generally about other potential renewable energy export projects. This indicates that electricity export continues to be a sensitive area of Algerian energy policy. There are also different opinions within the Algerian government regarding the issue.

5.2.1. The Position of the Advocates of the Nationalist Discourse

The nationalist discourse, mainly expressed by the *MEM*, but also by the regulatory agency *CREG*, is characterised by general scepticism towards renewable electricity export projects, particularly those promoted by private initiatives. The *Desertec* project, for instance, was declared as "not officially existent" by the central authorities advocating this discourse. One of the first press statements made by the former energy minister Chakib Khelil – as a direct reaction to the *Desertec* announcement in July 2009 – illustrates the reservation of this important institution very well:

> "We have a clear policy with regards to solar energy. The precondition is that there is a partnership between Algerian and foreign companies and that there is a technology transfer in the area of engineering, manufacturing and construction. If these conditions are not fulfilled, we are not interested. [...]. We don't want foreign companies to exploit our solar energy resources." (*Algérius* 2009, own translation)

Likewise, Khelil's successor Youcef Yousfi showed suspicion towards the *Desertec* project and declared on 25 July 2010 that Algeria intended to realise larger projects own its own. According to the

news site *Algérie 360*, Algerian concerns regarding *Desertec* are focussing on sovereignty over planned foreign-owned installations and to the long project duration (Algérie 360 2010).

A similar attitude was reiterated during talks with representatives of the ministry: renewable electricity exports are only perceived positively as long as they promise perspectives of a real technology transfer within an equitable framework partnership with foreign players. Moreover, the advocates of the nationalist discourse do not see any major reasons why renewable export projects should – at the moment – be given priority in the Algerian energy policy. At the most, if electricity surpluses occur, occasional exports can be performed to neighbouring countries on a "complementary" basis. The actors declared themselves "not favourable" to proposals of a direct export scheme (solar and wind power plants exclusively built for export via separate electricity export lines). Representatives of the regulatory agency added that as far as independent export was concerned, the legal texts currently in force excluded ownership of transmission lines by third parties.

We could discern a slightly more favourable attitude among the stakeholders regarding the domestic integration of renewable energies and the export of electricity surpluses. Nevertheless, the actors mentioned the following administrative and political preconditions for the introduction of such an export scheme:

- It is necessary to create a tool that distinguishes between fossil-generated and renewable electricity.
- There should be coherent remuneration schemes for the different market sectors that take into account the cost of the different renewable energy technologies.
- There has to be a grid upgrade providing sufficient capacity and flexibility for the integration of the surplus of renewable energies

In addition to that, as a main political precondition, the actors argued for a clearly defined transnational electricity framework agreement including the Maghreb as well as other countries of the Euro-Mediterranean region.

As *MEM* is responsible for fossil fuels as well, it is possible that a certain conflict between *MEM*-internal interests arises. On the one side proponents of the increased utilisation of fossil fuels, mainly natural gas as an export good, could try to slow down the introduction of renewable energies. This could provoke a reaction on the other side, namely on the side of proponents of renewable energies would start to work against *MEM*-internal plans for fossil fuels.

5.2.2. The Position of the Advocates of the Utilitarian Discourse

Here, interviews were carried out with the electric utility *Sonelgaz* and its R&D subsidiary *CREDEG* (*Centre de recherche et de développement de l'électricité et du gaz; Centre for Research and Development of Electricity and Gas*). To a large extent, the utility's opinion matches the nationalist discourse advocated by the *MEM* and the electricity regulator. This particularly holds for the utility's reservation regarding *direct export* schemes where renewable generation is isolated from the domestic supply scheme. *Sonelgaz*, as a player in charge of securing continuous electricity supply, understandably favours domestic consumption of renewable power, while export is a secondary issue, considered only if surpluses occur. The export of this residual power, however, is regarded as unlikely due to the high internal demand growth expected for the next years.

In terms of transnational power exchange, *Sonelgaz* stresses the importance of balancing power exchanges within the neighbouring *COMELEC* (Comité maghrébin d'électricité; the Electricity Committee of the Arab Maghreb Union) countries.

5.2.3. The Position of the Advocates of the Ecological and Civil Society Discourse and of the Media

The ecological discourse is mostly advocated by a group of actors ranging from institutions like the *Ministry for Spatial Planning and Environment* and *APRUE* to the press and civil society. These

different proponents of the ecological discourse have slightly different approaches to and outlooks on the export of renewable electricity.

Institutional actors

Concerning the institutional actors, there is a slight inconsistency between their stated aims and interests and their concrete attitude towards energy exportation projects. While the *Ministry for Environment* and *APRUE* intend to reduce CO_2 emissions and promote renewable energies, they are not favourable to ventures like *Desertec* or to any export of renewable energies. Accordingly, spatial planning does not provide any land or infrastructure for such projects. As can be expected from an institutional actor, priority is given to Algerian interests, which means welcoming domestic photovoltaic projects and hoping for positive effects on human capacity building and job creation, while taking up a critical stance on foreign investments. Consequently, if this actor is to be convinced of *Desertec*, it is necessary to engage in a careful dialogue, reassuring him about possible negative environmental effects of large-scale energy projects and ensuring direct benefits for Algeria in terms of vocational training and development for the southern areas.

Civil Society Organisations

Regarding Algerian civil society, there does not seem to be great awareness of or concern for transnational renewable electricity export plans like *Desertec* or the *MSP*. Still, there are some exceptions to that rule, such as a *Facebook* group called "Let's be eco-responsible", where critical minds question the role of the state in the promotion of renewable energies in a thread entitled "Solar energy, stakes and applications of a clean and inexhaustible source of energy". Even though *Desertec* is not explicitly mentioned, users regret the „lack of a vision among politicians, which is blocking the country" (Facebook 2010).

The Media

Regarding the Algerian press, as a general tendency it covers the *Desertec* project in a quite descriptive manner, focusing on facts and figures rather than giving its opinion about it. Still, it is possible to discern a prevailing twofold attitude towards the project: On the one hand, *Desertec* is carefully appreciated and perceived as an asset for energy-exporting Algeria; on the other, there is awareness of the obstacles that the project still faces. Other projects, such as the *MSP* or the newly founded *Transgreen* consortium, have so far found the attention of Algerian national media only on rare occasions.

According to the business journal *Le Maghreb*, *Desertec* contributes to the development of its host countries, creating jobs and allowing for the construction of desalination plants (Larabi 2010). Apart from these very concrete benefits, *Desertec* is also perceived as a strategic asset for Algeria's energy future. Thus, *Le Maghreb* asserts that the Algerian solar potential lies at the heart of a (European) energy transition (Samira G., 2010a) and that the firms participating in *Desertec* are provided with unique chances to create business relations and partnerships (Samira G. 2010b), which will be useful in a future that „takes place in the south" (Yacine B. 2008). Along the same lines, *Liberté* claims that *Desertec* could help Algeria maintain the considerable weight it has as a provider of energy if the state embraced this project (Khaled R. 2010).

However, the Algerian press is also aware of the obstacles facing the *Desertec* project. First, this concerns possible difficulties with Algerian authorities, which have yet to be convinced of the project (Samira G. 2009a, 2009b). Second, some journalists expect Europe to actively help Algeria establish itself on the renewable energies scene by granting it access to European electricity markets (Salami 2010) and by ensuring an energy partnership on an equal basis, with technology transfers and local manufacturing of equipment (Khaled R. 2010). Finally, further problems related to *Desertec* include the threat of rising energy prices in Algeria as a result of a harmonisation of energy prices among Maghreb countries as well as the challenge of human capacity building posed by a project of that scale (ibid.).

Overall, the proponents of the ecological discourse seem more prone to accepting a project like *Desertec* than the "utilitarian" or "nationalist" actors. Hence, the environmentalists are the ones that need to be addressed and convinced of energy exportation projects because actors like the *Ministry for Spatial Planning and Environment* could possibly serve as an intermediary with other state institutions like the *MEM*.

The things said about the *Desertec* initiative can mainly be generalised to renewable electricity export schemes as such.

5.2.4. The Position of the Advocates of the Business Discourse

The main actor among the advocates of the business discourse is the Algerian agro-business group *Cevital*, a founding member of the *Desertec Industrial Initiative*. *Cevital*'s main interest concerning *Desertec* is to act as a principal player on the production side and as an intermediary between foreign investors and local firms. As a private company, *Cevital* is not primarily concerned with questions of public and national welfare, but prioritises business interests. Hence, unlike the aforementioned players, *Cevital* is favourable to the export of renewable energies and the establishment of an independent grid for electricity export, even preferring this option to domestic use. Further, *Cevital* is convinced that Algeria as a country could benefit from projects like *Desertec* through transfer of technology and know-how. Yet, *Cevital* also perceives some difficulties regarding the implementation of an energy export scheme and calls upon the Algerian state to respond to these. The following elements are considered as prerequisites for any export project:

- The institution of a market operator
- The development of a remuneration scheme
- The enhancement of regimentation
- The traceability of electricity from its source
- The development of a grid with upgrade capacities and the flexibility to integrate the surplus of renewable energies
- Grid access for the private sector
- Compliance with regulatory texts on behalf of IPPs
- Clarification of the interstate partnership frameworks (Maghreb and Euro-Mediterranean)

5.3. Summary

In the nationalist discourse, mainly represented by the *CREG* and the *Ministry of Energy and Mines*, renewable electricity export schemes are seen with scepticism. Algeria tries to make the most of its bargaining position as a potential site of renewable electricity: Renewable energy exports driven by foreign investors are only accepted if Algerian players can strongly participate via local content, technology transfer and value chain advantages. Whether such gains can be realised in the current Algerian industry infrastructures is not discussed among the Algerian players. *Direct export* schemes are not favoured by the representatives of the nationalist discourse, they only see exports as an additional option to domestic supply.

Moreover, the actors argue for a clearly defined transnational electricity framework agreement including the Maghreb as well as other countries of the Euro-Mediterranean region

The representatives of the utilitarian discourse, *Sonelgaz* and the *CREDEG*, share the position of the *CREG* and the *MEM*. In general, we noticed the absence of a reflection focused on administrative facilitation for investments in the green sector. Indeed, the state considers investment in the renewable energy sector just like classical industrial investment. There are no formalities or specific procedures for investment in renewable energies.

The actors within the ecological and civil society discourse favour renewable energies but are sceptical about private export schemes like *Desertec* as they fear that national Algerian interests – job

creation, welfare, etc. – could be neglected. Currently, there is almost no knowledge about renewable electricity export schemes among the Algerian civil society.

The Algerian media cover the export topic – mostly discussed under the term and approach *Desertec* – in a more or less descriptive style, being neither too much for nor too much against such plans. Aspects like renewable electricity export structures as "strategic assets" for the Algerian state are discussed in a similar way.

One of the largest Algerian companies, *Cevital*, is strongly in favour of *Desertec* and renewable energy export schemes. More so, *Cevital* is a member of the *Dii*. *Cevital* calls upon the Algerian state to create favourable conditions for export schemes.

6. Conclusions and Open Questions for Further Research

6.1. Relevant Questions Regarding Feasibility from an Algerian Perspective

The project yielded several new insights that have to be taken into consideration in the context of the establishment of transcontinental renewable electricity infrastructures.

The major actors within the Algerian debate see domestic development goals as prerequisites for the realisation of such structures. Among these goals are:

- creation of jobs in the Algerian economy
- establishment of a domestic renewable energy industry
- transfer of know-how and technologies from Europe to Algeria

Sometimes these preconditions are presented in a somewhat harsh way, e.g. by the *MEM*, as it was done by the former energy minister Chakib Khelil, who reached the following conclusion: "We don't want foreign companies to exploit our solar energy resources." It remains to be discussed whether such blunt statements are suited to create a climate of mutual trust between Algerian and foreign stakeholders. In general, however, it seems to be the case that such domestic concerns exist throughout all groups of actors in Algeria.

On the whole, the positions of different influential stakeholders within Algeria are diverging; hence, a coherent Algerian position towards powerful foreign stakeholders, e.g. the EU, is not yet in sight.

The yet unclear legal conditions regarding foreign investments represent a major obstacle for the future integration of Algeria into a transcontinental renewable energy grid.

The question whether the legal constraint for *direct export* projects (with a separate transmission infrastructure, built by the exporting IPP) could be removed by an amendment of the electricity law in the future remains currently unclear, and has to-date not been the subject of discussions.

6.2. Generalised Matrix for Analysis

Transcontinental electricity export is a big technical and technological challenge. However, taking the current technological status into consideration, these challenges seem solvable: The necessary technologies are already available: wind, photovoltaic and solar thermal power plants, as well as HVDC power lines. Costs are expected to decrease soon, thanks to economies of scale. As has been shown by *DLR* (2005, 2006, 2009), these results – concerning technological feasibility and economic costs – as well as life cycle costs and external costs, can be generalised to some extent for a large number of countries. For instance, economic costs of solar thermal power plants, wind turbines and PV plants will be roughly at the same level in Algeria as in Egypt or Morocco. Therefore, these criteria can be assessed independently of the country.

Other criteria need to be evaluated on a country-specific basis; these are mainly so-called soft criteria that do not involve "hard" technologies. These factors, however, are crucial for the overall feasibility of a transcontinental electricity grid.

Such general criteria are:

- Political frameworks of countries, including strategies and roadmaps
- Stakeholders' positions and influence, covering the broad scope of societal actors

The current project analysed these two general sets of criteria for the Algerian case. The major goal was to find out about the existing frameworks and stakeholders in the southern and eastern Mediterranean region regarding a future transcontinental renewable electricity grid with Europe. These structures and actors can be catalysers, barriers or neutral, i.e. neither facilitating nor slowing down developments.

For these criteria a matrix has been established that provides a consistent algorithm for the analysis of other countries in the mentioned region (see Tab. 6-1 and Tab. 6-2). Using that matrix, it will be possible to generate a consistent "landscape" of frameworks and stakeholders concerning future renewable electricity exports that could serve as a basis for transcontinental cooperation.

Tab. 6-1. Matrix for the analysis of legal frameworks in countries.

Analysis of legal frameworks
Current legal framework in the electricity sector and consequences for electricity export
Types of laws
Shape of electricity sector (state-owned, status of privatisation)
Current legal framework for renewable energies, focusing on the electricity sector
Legislative provisions for renewable energies: Feed-in tariffs, other instruments and measures
Investment policy – general situation and focusing on renewable energies
Status of foreign investments
Status of domestic investors
Taxation issues and export duties
Land rights and ownership issues

Tab. 6-2. Matrix for the analysis of actors and stakeholders and of existing discourses in countries.

Analysis of relevant actors and stakeholders
Discourses touching renewable energy issues existing in the analysed country
Different types of discourses existing in the analysed country
Example: Case study Algeria: The nationalist discourse The utilitarian discourse The ecological and civil society discourse, including the role of the media The business discourse
Localisation of the renewable energy export debate within existing discourses
Selection from discourses described before
Localisation of existing relevant actors and stakeholders within these discourses,

position towards renewable energy exports
Deduction of results from analysis of discourses and stakeholders

6.3. General Aspects to Be Considered During Future Analyses

From a European point of view, cooperation with actors in the Southern Mediterranean and scientific work there poses various challenges. Some result from intercultural conditions, some from the nature of the analysed topics themselves. In some countries, the topic of renewable electricity export schemes is considered politically sensitive as it touches upon national interests and is sometimes even perceived as a matter of national security. This has various consequences for scientific work. In general, the ambiance of scientific discussion is often not as open as it could be to gain a maximum of information. The central question regarding the general situation is therefore: How openly are matters of national interest discussed in the respective countries?

According to our experience, the general willingness to discuss is in some cases rather limited, as renewable electricity export schemes are considered somewhat sensitive, for Algerian governmental stakeholders have not adopted a final stance on them and are not willing to communicate an unofficial position. This directly leads to the problem that some actors were not ready to share their points of view with the project team. Other stakeholders were open for discussion, but did not want to be quoted by names.

6.4. Open Questions and Further Need for Research

The project revealed numerous questions and challenges that need to be solved before a country like Algeria will be able to participate in a transcontinental renewable electricity grid. The current focus on technological challenges among European actors distracts attention from non-technological aspects. There is significant need for further research in the fields of a) socio-economic impacts of a transcontinental renewable energy grid and b) policy formulation.

Research is necessary on different levels:

- Basic research regarding general options for the implementation of renewable energy technologies applying principles of sustainability
- Action research during immediate project implementation in terms of environmental non-degradation etc.
- Development of strategies and roadmaps on a country and regional level
- Research in the field of policies and legal frameworks
- Macro-economic benefits of a transcontinental electricity grid for Southern Mediterranean countries

In the field of **basic research,** as mentioned above, a lot of progress has been made. Sustainability has been accepted as a major guiding principle in societies and for technical systems. However, there are still branches that lag behind, and many countries are even rejecting responsibility for a more sustainable development of their economies. In the Mediterranean region, the concept of sustainability is starting to gain momentum on the political level, and a few countries are even trying to reconcile this approach with their traditional growth patterns.

Action research during immediate project implementation covers environmental aspects and direct impact on humans in various ways. Life-cycle-assessment is one of several instruments to be applied.

The **development of strategies** is of utmost importance in two directions: On the one hand, strategies for domestic energy supply need to be developed. On the other hand, as domestic energy systems are increasingly interacting with other systems via transborder connections (the most prominent currently being a EUMENA power grid for renewable electricity), strategies for such transnational cooperation

need to be devised. These potentially conflicting dimensions need to be reconciled to generate the best possible synergies in the mid to long term. Such strategies are not only necessary for energy system development, but also for networks in research and development, for economic cooperation and for the development of North African and European stakeholders.

Effective **policies and legal frameworks** are lacking in Algeria as well as in other southern Mediterranean countries. However, without reliable and effective administrative frameworks, no markets for renewable energies will develop. The transfer of policies and other frameworks from experienced countries to countries without significant experience and without appropriate industrial and other structures has failed in many cases. There is no "one type fits all" framework. Therefore, national frameworks need to be developed, taking national specifics closely into consideration. Such expertise is lacking in many Mediterranean countries.

Last but not least, **macro-economic benefits** of renewable energies and especially of a transcontinental renewable energy grid and cooperation are far from being fully recognised. This is especially true when it comes to a stakeholder-specific perspective. Central questions in this respect are: Which benefits can North African and the eastern Mediterranean region gain for their own economic and social development? Which steering functions do governments have to fulfil in order to realise these gains?

In sum, the following statements on open questions and further need for research can be made:

- Sustainability is currently not accounted for in energy system development in Mediterranean countries. There is a need for basic research in this field
- Currently, no research is carried out during project implementation. This would be relevant in terms of environmental protection standards and other local impacts
- There is a lack of appropriate policies and other frameworks (legal, social) for the promotion of renewable energies and for the attraction of foreign funding for the establishment of a transcontinental renewable electricity grid. Furthermore, there is also a lack of expertise for policy formulation in the mentioned countries. Thus, this is a major field for capacity building measures.
- Roadmaps and strategies need to be developed, covering national as well as transnational aspects. Such roadmaps will only be successful by combining these domestic and international dimensions.
- Macroeconomic costs and benefits of a transcontinental electricity grid for southern Mediterranean countries need to be fully assessed and communicated accordingly among national decision makers and other stakeholders.

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8. Annex - Executive orders (decrees) related to different energy laws

The concerned laws are:

- The law on energy efficiency (*Loi n° 99-09 du 28 juillet 1999 portant sur la maîtrise de l'énergie*)
- The electricity law (*Loi n° 02-01 du 5 février 2002 portant sur l'électricité et la distribution du gaz par canalisation*)
- The renewable energy law (*Loi n°04-09 du 14 août 2004 portant sur la promotion des énergies renouvelables dans le cadre du développement durable*)

Loi n° 99-09 du 28 juillet 1999 portant sur la maîtrise de l'énergie	Décrets d'application	
	1	Décret exécutif n° 05-16 du Aouel Dhou El Hidja 1425 correspondant au 11 janvier 2005 fixant les règles spécifiques d'efficacité énergétique applicables aux appareils fonctionnant à l'électricité, aux gaz et aux produits pétroliers (JO n° 5 du 12 janvier 2005).
	2	Décret exécutif n° 05-16 du Aouel Dhou El Hidja 1425 correspondant au 11 janvier 2005 fixant les règles spécifiques d'efficacité énergétique applicables aux appareils fonctionnant à l'électricité, aux gaz et aux produits pétroliers (JO n° 5 du 12 janvier 2005).
	3	Décret exécutif n° 2000-90 du 19 Moharram 1421 correspondant au 24 avril 2000 portant réglementation thermique dans les bâtiments neufs (JO n° 25 du 30 avril 2000).
Loi n° 02-01 du 05 /02 /2002 portant sur l'électricité et la distribution du gaz par canalisation	Décrets d'application	
	1	Décret exécutif n° 08-114 du 3 Rabie Ethani 1429 correspondant au 9 avril 2008 fixant les modalités d'attribution et de retrait de concessions de distribution de l'électricité et du gaz et le cahier des charges relatif aux droits et obligations du concessionnaire
	2	Décret exécutif n° 07-310 du 25 Ramadhan 1428 correspondant a 7 octobre 2007 fixant le niveau de consommation annuelle en électricité et en gaz du client éligible et les conditions de retour du client éligible au système à tarifs (JO n° 64 du 10 octobre 2007).
	3	Décret exécutif n° 07-293 du 14 Ramadhan 1428 correspondant au 26 septembre 2007 fixant les modalités d'alimentation et d'accès des tiers aux réseaux de transport et de distribution de l'électricité et du gaz (JO n° 62 du 3 octobre 2007).
	4	Décret exécutif n° 06-432 du 5 Dhou El Kaada 1427 correspondant au 26 novembre 2006 fixant cahier des charges relatif aux droits et obligations du gestionnaire du réseau de transport du gaz (JO n° 76 du 29 novembre 2006).
	5	Décret exécutif n° 06-430 du 5 Dhou El Kaada 1427 correspondant au 26 novembre 2006 fixant les règles techniques de conception, d'exploitation et d'entretien du réseau de transport de l'électricité (JO n° 76 du 29 novembre 2006).
	6	Décret exécutif n° 06-429 du 5 Dhou El Kaada 1427 correspondant au 26 novembre 2006 fixant le cahier des charges relatif aux droits et obligations du producteur d'électricité (JO n° 76 du 29 novembre 2006).
	7	Décret exécutif n° 06-428 du 5 Dhou El Kaada 1427 correspondant au 26 novembre 2006 fixant la procédure d'octroi des autorisations d'exploiter des installations de production de l'électricité (JO n° 76 du 29 novembre 2006).

	8	Décret exécutif n° 05-182 du 9 Rabie Ethani 1426 correspondant au 18 mai 2005 relatif à la régulation des tarifs et à la rémunération des activités de transport, de distribution et de commercialisation de l'électricité et du gaz (JO n° 36 du 22 mai 2005).
	9	Décret exécutif n° 04-92 du 4 Safar 1425 correspondant au 25 mars 2004 relatif aux coûts de diversification de la production d'électricité (JO n° 19 du 28 mars 2004).
	10	Décret exécutif n°7-294 du 26 septembre 2007 fixant les modalités d'alimentation et d'accès des tires au réseau de transport et de distribution de l'électricité et du gaz
	11	Décret exécutif n° 02-194 du 15 Rabie El Aouel 1423 correspondant au 28 mai 2002 portant cahier des charges relatif aux conditions de fourniture de l'électricité et du gaz par canalisations (JO n° 39 du 2 juin 2002).
	12	Arrêté du 14 Safar 1429 correspondant au 21 février 2008 fixant les règles techniques de raccordement au réseau de transport de l'électricité et les règles de conduite du système électrique (JO n° 25 du 18 mai 2008)
	13	Arrêté du 14 Rabie El Aouel 1428 correspondant au 2 avril 2007 fixant la procédure de déclaration des installations de production de l'électricité (JO n° 36 du 3 juillet 2007).
	14	MEM. Décision n°63 du 10 mi 2008, de Monsieur le ministre de l'énergie et des mines portant mise en place, pour une période transitoire, du comité de concertation sur les investissements dans les secteurs de l'électricité et de la distribution du gaz par canalisation
Loi n° 04-09 du 14 août 2004 portant sur la promotion des énergies renouvelables dans le cadre du développement durable*	Décrets d'application	
	1	Décret exécutif n°2007-207 du 30 juin 2007 réglementant l'usage des substances qui appauvrissent la couche d'ozone, de leur mélange et des produits qui en contiennent
	2	Décret exécutif 2007-300 du 27 septembre 2007 fixant les modalités d'application de la taxe complémentaire sur les eaux usées industrielles.
	3	Décret exécutif 2007-206 du 30 juin 2007 fixant les conditions et les modalités de construction et d'occupation du sol sur la bande littorale, de l'occupation des parties naturelles bordant les plages et de l'extension de la zone objet de non-aedificandi
	4	Décret exécutif n°205-443 du 14 novembre 2005 fixant les modalités de coordination, le champ d'application et le contenu des schémas directeurs sectoriels des grandes infrastructures et de services collectifs d'intérêt national ainsi que les règles de procédures qui leur sont applicables

**50 décrets à ce jour ont été répertoriés*