STUDY

CLIMATE CHANGE, ENERGY AND ENVIRONMENT

ALGERIA 100% RENEWABLE ENERGY

Recommendations for a National Strategy of Energy Transition

Tewfik Hasni, Redouane Malek and Nazim Zouioueche

January 2021

The energy transition to renewable sources responds to various objectives, considering the economic dimension, energy efficiency, and ecological responsibility.

In addition to solving the crucial problem of energy availability at an acceptable cost, developing renewables is a safer economic growth potential for Algeria, which will thus emerge from its dependence on hydrocarbons.

The switch to this new model of energy production will reduce pollution, thus contributing to the global challenge of the fight against global warming.

FRIEDRICH EBERT STIFTUNG

CLIMATE CHANGE, ENERGY AND ENVIRONMENT

ALGERIA 100% RENEWABLE ENERGY

Recommendations for a National Strategy of Energy Transition

Content

In memoriam

We will hardly find comfort for the passing of our friend Nazim Zouioueche, former president of SONATRACH and renowned consulting expert that Mr. Hasni was pleased and honored to accompany during a major part of his career at SONATRACH and in consulting. Nazim left us on 4 November 2020, leaving an outstanding record, which his peers highly appreciate and recognize.

He held two engineering degrees (from Supélec and IFP for oil) and played a decisive role in the post-nationalization succession in 1971. He had a brilliant career: engineer at the El Gassi field then in a field department of oil wells, he was Manager of the Hassi Messaoud oil field Operation District, Hassi Messaoud District Manager, Head of Production, Deputy Director General for Hydrocarbons, and finally SONATRACH Chief Executive after leading its representation in Milan.

His administrative retirement was not restful. Consulting, technology watch and media were his main occupation, until his last hour. His last contribution to the energy transition study for FES was one week before his death, meaning that he left on his feet, as he had himself hoped.

Tewfik Hasni and Redouane Malek

1

INTRODUCTION

The Algerian economy is still heavily dependent on hydrocarbons. The multidimensional crisis facing the world does not spare Algeria. The near future is as highly uncertain as the approaches that countries may adopt to overcome the crisis. It is obvious that there is no universal model out of the crisis. Algeria would need to adopt a global vision for its development. It must define its priorities in view of its decreasing financial resources, just as it must also guarantee the four security levels, namely national security, energy security, food security and health security. For this study, we will focus on energy security.

Local funding resources being at their lowest, there is no other option but to comply with the conditions imposed by financial institutions. Funding will in fact be exclusively dedicated to sustainable development such as the green economy. The social constraints underlying an outdated economic vision, which has eroded the middle classes and sent the poorest classes in unemployment, are no longer accepted. Young people are expressing frustration at the narrowing of their horizons. The political classes in place are being blamed for climate change, giving rise to environmentalists' political power. For the sake of a smooth transition towards a more sustainable and environmentally responsible development, and especially towards a more hospitable planet, we must radically change our energy sector and adopt the right approach for a cleaner and fairer future, powered by 100% renewable energies. Political actors play a key role in this transformation. Therefore, it is essential for governments, politicians, and all stakeholders to meet and discuss the tools and best practices, which will promote this development.

This approach will illustrate the feasibility of the 100% renewable energy objective in 2050 in Algeria. The target of 30% renewable energies in energy use by 2030 will have to be met in accordance with our commitments in the Paris Agreement.

It will be necessary to set an objective that reflects a common political vision that should play a central role in the implementation of global, national, and local energy practices and strategies. An ambitious long-term goal reflecting political commitment will have to be set. It will allow both investors and the local population to have a long-term political vision. It will also provide the different actors involved a better understanding of their role in this change and the part they can play in achieving this common goal.

2

SITUATIONAL ANALYSIS

In Algeria, as elsewhere in the world, the energy sector is one of the main factors of climate change.

The report of the United Nations Economic Commission for Africa and its North Africa office reported in 2011 that Algeria has large reserves of oil and natural gas and largely depends on these resources to generate export revenue. The gas and oil sector represents 45.9% of GDP in Algeria. Total hydrocarbon exports accounted for almost 98% of the total export volume for 2007 (UNECA 2011).

With an export turnover of nearly 56.1 billion US dollars generated in 2010 by Sonatrach, Algeria is the fourth largest exporter of liquefied natural gas (LNG) in the world, the third largest exporter of liquefied petroleum gas (LPG) and the fifth largest exporter of natural gas. In addition, Algeria witnesses an increase in energy consumption linked to economic growth, population growth and increasing energy consumption per capita. Between 2002 and 2011, average energy consumption increased by 5.7% (UNECA 2011).

In Algeria, the average annual sunshine is estimated at 3000 hours, with an average sunshine of 6.57 kWh / m2 / day. With 86% of Saharan desert composing its territory and with its geographical position, Algeria has the most important solar field in the world. If we compared solar power to natural gas, Algeria's solar potential is equivalent to a volume of 37,000 billion cubic meters per year, more than 8 times the country's natural gas reserves, with the additional difference that the solar potential is renewable, unlike natural gas (UNECA 2011)

The renewable energy development company, New Energy Algeria (NEAL), has launched the first solar-gas hybrid project as part of a global solar and wind energy program, combining the two sources with the highest potential in Algeria. For the Hassi R'mel project, a financing request was submitted to the World Bank. It happens that five other projects in the world had already obtained a concessional credit agreement of 50 million dollars. Later, in 2006, a complementary program of three more solar-gas hybrid solar power plants was launched and these plants were twice the size of the original project of Hassi R'Mel. These were three 300 MW power plants in Meghaier (east), Hassi R'Mel (center) and Naama (west).

These projects, developed by NEAL, were meant to complement the solar energy program, which had started in July 2011 when the first hybrid natural gas-solar power plant in Hassi R'mel was installed. Four thermal power plants were planned for the period 2016-2020 with a storage of a total power of around 1200 MW, then the installation of 500 MW per year until 2023 and 600 MW per year until 2030. This was all undermined by the Oil lobby.

3

WHY AIM FOR 100% RENEWABLE ENERGY IN ALGERIA?

Why aim for 100% renewable energy in Algeria, or why develop renewable energies in Algeria? According to the 2011 UNECA report, Algeria, a central country in North Africa, has since its independence in 1962 and especially after the first oil shock of the 1970s, taken full advantage of the carbon energies (gas and oil) available in its subsoil. These carbon energies have represented until the present 95% of the country's foreign exchange earnings and more than half its GDP (UNECA 2011).

As the country's economy depends almost exclusively on these energies, it fully suffers the brunt of any drop in the price of these energies on the world market, and directly benefits from any rise. Over time, reserves began to run out, while domestic market needs increased particularly for gas, on which most of electricity production depends. This coincided almost exactly with the advent of shale gas and it turned out that Algeria contained large reserves of this energy in the shales or source rocks, the source rocks that had generated conventional hydrocarbons. We have learned that Algeria has the third largest reserves in the world. We received this information through the American geological authorities probably based on a satellite survey.

This was a godsend as this shale gas came at the right time to make up for the decline in conventional gas reserves and meet the increasing gas demand, which was highly needed for the double-digit growth in electricity consumption. At the same time, renewable energy use experienced a renewed interest, especially wind power and to a lesser extent solar power, to face the climate disruption that the planet was suffering, and which signaled a dark future for future generations. It is worth pointing that this climate disruption was almost totally due to an unbridled use of carbon energies.

At that time, high world energy prices led to a significant development of shale gas and at the same time of shale oil, particularly in the USA (allowing virtual self-sufficiency in energy when it had been a largely importing country).

Other countries more concerned with curbing climate change have preferred developing the renewables. It also allowed these countries to reduce their energy bills while increasing domestic production (the Paris Conference unanimously recommended limiting global temperature increase to avoid probable future disasters).

Algeria, the third largest shale reserve in the world according to American geological companies, also proved to be a country that can supply the entire planet with solar electricity or green electricity. With its surface area, Algeria can develop both photovoltaic and solar thermal energy. There are important differences between the two kinds of development.

Even if Algeria is ranked third world shale reserve (which remains to be proven by studies and works), it is undoubtedly among the top in solar energy. The big difference is that shale gas is a finite reserve while solar is infinite (or at least as long as the sun keeps shining on the planet). It is worth mentioning in this regard that the hydraulic fracturing technique used for shale gas production makes high demands on water resources, in a water-stressed country like Algeria.

There is a third climate-friendly source of energy: it is nuclear energy, which however suffers from many hazards such as the treatment of nuclear waste. In addition, the Chernobyl incident, following that of Three Mile Island in the United States, severely damaged general opinion on nuclear power, which was severely affected, and almost discredited after the Fukushima incident. For Algeria, the choice was between shale and solar.

For a limited period, shale gas as well as oil could perhaps cope with the issue of the declining conventional reserves and the continually increasing internal demand. However, what will become of this demand if the industry, only accounting for a small portion of the GDP, achieves the desired growth? Production must occur at an acceptable cost, allowing the country to reduce its expenses and not to produce at costs approaching or exceeding world prices.

If all the indicators are favorable, shale can only be a solution for a limited time, because like conventional sources, shale gas and oil only offer limited reserves. This is not the case with renewables (as their name suggests), which are mainly solar and wind power for Algeria. The reserves are

endless and as we said above, as long as the sun rises every morning to illuminate the planet, solar energy will be available. The same goes for wind power, which results from winds that have always blown.

The cost of shale has proved prohibitively high, especially during the present crisis we are facing because of the pandemic. Companies with a strong reputation of durability filed bankruptcy after a few weeks of falling international energy prices.

At the same time, the kilowatt cost of production from renewable sources seriously competes with the kilowatt cost of production from carbon energies (mainly gas). Its cost price is now lower, even with the costs of intermittency included. Indeed, solar and wind power are not permanently available (nighttime or windless period); but this disadvantage is already successfully bypassed. In Algeria, available carbon energies will still avoid the intermittency inconvenience in the event of renewables development until storage techniques are completely mastered.

In addition, carbon-based energies (particularly oil) seemed unbeatable for transportation, yet we note that for a large part through the car industry, first with the hybrid and now the all-electric, the central place of carbon has been highly overrated. We are already talking about carbon-neutral planes. Boats will come next!

In summary, due to infinite reserves and to limited and competitive costs, renewables in Algeria are gaining a foothold, with green electricity produced in abundance likely to become exportable. Why not imagine the two shores of the Mediterranean linked soon by cables carrying direct current electricity. Of course, beyond what we have just said, the development of renewable energy in Algeria would surely contribute to mitigate the effects of climate change. Along all other countries, Algeria must contribute to the fight against climate disruption and temperature rise.

Because it is infinite, renewable energy will benefit the country and bring a final answer to the issue of lack of energy security. While carbon energies have largely contributed to solving the employment problem, renewable energy will also be an important source of job creation of little appreciated jobs, and jobs requiring high-level training. This dual character will promote local participation and stimulate social development.

Finally, in addition to solving the crucial problem of energy availability at an acceptable cost, the development of renewables will end atmospheric pollution and contribute to improving human health.

Assuming that it is necessary to have energy, and with nature's blessing of finite reserves of energy, and of infinite energy at a competitive cost, with the possibility of exporting both, what would be your choice? Algeria must make the choice of renewable energy.

In fact, Algeria had initiated a program for renewable energy development since 2003 (UNECA 2011). However, as mentioned in the introduction, the program launched by NEAL, a commercial law company in charge of renewable energy development, with three hybrid power plants of 300 MW each, had earned a positive response by GEF, the climate fund run by the World Bank, which had granted a concessional credit of 160 million dollars (World Bank 2011).

These funds were a useful leverage to finance the entire program. However, the Oil Lobby was sufficiently powerful to ensure that the government of the time refuse this funding. Today, however, there is political will. We must therefore be in a process of attracting foreign investors, identifying the obstacles to renewable energy development, and supporting the social dimension.

MITIGATE THE EFFECTS OF CLIMATE CHANGE

To be part of sustainable development, our priority is to meet the country's commitments in accordance with COP21 acts. We can only achieve this aim with good governance, which is in any case required for reporting.

PROMOTE ENERGY SECURITY AND RESILIENCE

Energy security aspect is perceived through the lens of the energy consumption model. This consists in ensuring an energy supply to the country, covering all needs until 2050.

This model will of course include the rational energy needs of the various economic sectors. By rational, we mean standardized needs ending household waste. It is necessary to include the needs of the new sectors of development apart from hydrocarbons as well as demographic growth, which exceeds 2 %.

Energy use for Algeria would be 20 % in electricity and therefore 80 % in heat. Energy security therefore implies an adapted energy production. The political decision to reduce the share of thermal use to devote nearly 80 % to electricity in several technological fields is not consistent. In fact, priority is given to photovoltaic power alone. Solar thermal was banned by ministerial decree. There is no more resilience of the energy system with the end of conventional gas.

BENEFIT THE LOCAL ECONOMY AND CREATE JOBS

Being part of sustainable development allows achieving the main goal, that of the social dimension. Job creation in renewable energy industries is a reality. Technological choices are important. However, the potential for job

creation is not even. It would be a mistake, for example, to believe that manufacturing photovoltaic cells is a solution. It has been shown that job creation in the photovoltaic (PV) value chain in fact represents only 18% for cell manufacturing.

STIMULATE SOCIAL DEVELOPMENT AND LOCAL PARTICIPATION

With more than 2 million km^2, Algeria is a very large country. Its natural resources are mainly located in the South, while it is mainly the population of the North, representing more than 90 %, which benefits. The centralization of economic decision-making has crushed all local initiatives. As part of the development vision, we must now focus on lifting existing administrative constraints, which are the source of corruption. We should think of local development in the form of free zones. Good governance will imply a development model of the Block Chain type backed by a cryptocurrency. Administration will be limited to site security. Decisions to invest would be local. However, the technical and economic orientation will be defined beforehand, with respect for the sovereignty of the country, and will be part of the priorities of the four security aspects mentioned above.

REDUCE POLLUTION AND IMPROVE HUMAN HEALTH

We must now act responsibly creating services and therefore jobs with due regard to environment protection, such as selective sorting, waste treatment and extended recycling. In fact, in terms of recycling substances and materials, in a large country like Algeria, endowed with resources, organic waste recycling is becoming an unmanageable problem in the North, which requires urgent solving. One can indeed imagine building electric railways from North to South, to carry organic waste from the North to the South by train, and use it for sowing Saharan agriculture land. On the return trip, the train would carry sand, a scarce resource in the North, for construction.

Electrifying transport is easy in a country with the greatest solar potential. The Covid-19 crisis provided the results of a lesser use of internal combustion cars. Building infrastructure and electric vehicles is within reach of the Algerian workforce.

4

RENEWABLE ENERGIES IN ALGERIA

We shall begin with a precise assessment of renewable energies in Algeria. As we had previously mentioned, three other plants of 300 MW each were planned with the Hassi R'Mel Hybrid Plant, providing a 1050 MW program for the period 2006-2014. If we now look at the report of the UN Commission on the current situation and prospects, we see that it has endorsed the NEAL program submitted to GEF under the World Bank.

The plan consisted in building four thermal power plants with a total capacity storage of around 1200 MW, then installing 500 MW per year until 2023 and 600 MW per year until 2030 (UNECA 2011).

It was an 8,000 MW program, to be completed in 2020; but everything was blocked. A 22,000 W program was launched in 2011, giving a sizeable share to CSP. In 2014, it was revised to rule out CSP and dedicate 13,000 MW to PV.

Since then, and in the last two years, Chinese companies installed around 400 MW of PV and no information is available on the performance of these plants (UNECA 2011).

PROMOTE RENEWABLE ENERGY THROUGH RULES AND PRACTICAL MEASURES

We must admit that if we had to mention all the institutions created for renewable energy promotion, there would be so many of them, and their number keeps increasing. The rationale behind their creation is that only the State can make this happen.

Examples of similar experiences in other countries show the opposite, but in Algeria, the only company with a successful project was NEAL, a totally Algerian public-private partnership. Success stories in neighboring countries or elsewhere consisted in duplicating the Algerian company NEAL. As a project development company, NEAL deploys technical and financial engineering, and can hold shares in the project company in charge of construction, operation, and marketing.

In addition, in 2002, several acts addressed renewable energies, like the electricity law, which gave priority to renewable energies and defined a development framework. However, the framework was not implemented. Other laws were passed without going beyond the scope of the original text. Regarding regulatory arrangements, we may add that the Electricity and Gas Law of 2012 gave priority to renewable energies. It had disrupted the electricity market. The stock market, with a market operator, was halted. The law had enabled a feed-in law (law on renewable energy access to the electricity market). This whole process was called into question. A bibliography of related legislative texts is available in the annex.

The conclusion is that in the absence of demonstrated political will, no results could be expected. We will discuss the real obstacles to the development of renewable energies below. The most effective measure would have been to end fossil fuel subsidies, which had reached $ 15 billion per year (graph 1).

Graph 1
Energy subsidies (Billions$)

	2012	2020	2030	Observations
Electricity	0.197	4.352	7.232	
Fuel	0.46	15.51	20	2013 : 3 Billion dollars Imports
Gas	11	20.5	37	
Total	**11.6**	**40.3**	**64.2**	

Source : Hasni 2014

The above 2012 assessment results from a review of the Finance Law. Projections were later made by estimating the export price and deducing the domestic market tariff. Gas was estimated at $ 8 / MMBTU for export, with a domestic tariff at $ 0.27 / MMBTU. As far as electricity, the cost price of electricity produced was estimated at 8 DA / kWh, the price being 4 DA / kWh. For 2018, the Finance Law estimated the energy subsidy at $ 15 billion. IMF assessment was similar, nearly 10% of GDP (Hasni 2014).

SET UP INSTITUTIONS SUPPORTING RENEWABLE ENERGIES

Several institutions were indeed set up without, however, implementing a real renewable energy development policy. Thus, no laws on renewable energies, the environment, etc. were implemented (see annex 1).

INVEST IN LARGE RENEWABLE ENERGY PROJECTS

The 1050 MW program for the 2006-2014 period and 8000 MW for the 2016-2020 period have gone unheeded, due to a lack of political will, despite the uniqueness of the Algerian energy potential.

5

OBSTACLES TO ESTABLISHING 100% RENEWABLE ENERGY IN ALGERIA

While Algeria had significant financial resources, we found that access to capital and credit was very complicated, not to say impossible for some private investors. Only very large fossil fuel projects benefited from funding. External financing was prohibited on the pretext that it would put the State into debt.

We seemed to ignore the fact that the Hassi R'Mel project had followed a call for investors expected to finance the project themselves. In addition, the contractual arrangement design was under Project-Finance, meaning that the project guaranteed itself without State support. Putting the State in debt was not even an option.

Investments in renewable energies are long paying off. The latest projects required financial arrangements over a period of thirty-five years to ensure better competitiveness. This is how we are now getting hybrid solar power, CSP + PV, with storage likely to stabilize at costs of around $ 7 cts / kWh. The intermittency issue is over. Forecasts for 2021 and 2022 foresee 6 cts $ / KWh and 5 cts $ / KWh. This explains the threat to fossil fuels, whose price had exploded (IRENA 2020a).

The major source of obstruction was the oil lobby, which had not anticipated everything. The main obstacle that the oil companies raised consisted in fully subsidizing fossil fuels. We have seen above that this could reach 15 billion dollars in one year. The other protective measure that the Algerian oil lobby implemented, in addition to all the obstacles mentioned above, consisted in requiring that renewable energy investments be conditional upon local manufacture of equipment. The decisive action to block renewable energies was to challenge the law of 2012, which abolished monopolies and disrupted the markets.

An Executive Decree by the Ministry of Energy entrusted Sonelgaz alone with renewable energy projects. COP21 commitments were not honored. Externalities, such as environmental pollution, climate change, health costs, and the impact on energy security were not considered. This obviously created a distortion reflected in comparing renewable energy and fossil fuel costs.

As noted above, fossil fuel subsidies further enhanced the distortion. The legal and regulatory framework, as we can see, endeavored to remove all advantages gained through the Law of 2012 to curtail renewable energy projects. Let us now move to the absence of strategic vision for national economic development. The Rentier-State culture eventually annihilated any attempt at diversification.

The lack of a clear economic strategy, as defined above, prevented grasping that the only option currently accepted by financial institutions and investors is sustainable development and the low-carbon green economy. The health crisis has revealed the limits of current economic development. The current economic crisis signals the end of an era. The lack of political will and lack of commitment of Sonelgaz, in charge of the renewable energy program, combined with conflicts of interest, eventually caused all renewable energy programs to fail.

Decision-makers are unfamiliar with the field of Energy and have always believed that the energy security of the country rested exclusively on electricity, while electricity accounts for only about 20 % of energy use. They did not understand the intermittent nature of PV and wind, which reduced the importance of these energy forms in defining the energy consumption pattern. In the strategic vision of economic development, it will become visible that tomorrow's world will require a new set of human resources, which remain the determining resource for the success of the implementation program

Algeria lacks human resources adapted to the new vision of sustainable economic development. Special higher education schools and specialized training institutes for engineers and technicians specializing in fossil fuels or renewable energies have all been closed. Management training centers, preparing for artificial intelligence through Big Data creation and switching to 5G are lacking. The development of Block Chain concepts backed by crypto currencies could however be a solution to the funding problem.

6

EMBEDDING THE 100% RENEWABLE ENERGY STRATEGY IN THE NATIONAL ECONOMIC DEVELOPMENT PLAN

We have noted above that one of the decisive obstacles to renewable energy development was the lack of an integrative approach to mobilize most central and local actors and address, among others, the following four aspects:

A strong commitment to sustainable development, namely green economy, is required to make a start. It requires structuring the vision of sustainable economic development based on the four security objectives already mentioned

It would be desirable to consecrate this development by constitutionalizing it. A clearer idea of this vision of development is available in in the Annex. The subject of interest remains Energy. Only an energy consumption model is likely to identify the energy mix of tomorrow, by the years 2030 and 2050. Of course, the determining factor in this study is sustainability and its impact on climate and the social aspects.

The impact of energy transition on economy is on its way to becoming the real way out of the current crisis. In fact, we can turn a threat into an opportunity. IRENA studies show that the impact on growth would be significant. The impact on GDP alone is estimated at $ 367 per capita. Growth in social welfare would also follow (IRENA 2020d).

The 100% renewable energy strategy must be embedded in the national economic development plan. The energy transition can become a key factor for economic development and should represent the basis of a national economic strategy to ensure sustainable long-term prosperity in Algeria. To achieve this goal, the following main interventions are necessary.

CONSOLIDATING THE DOMESTIC ECONOMY

Transition to 100% renewables would induce the development of both large-capacity and small decentralized plants, particularly in off-grid areas. Let me remind that the Algerian energy model is quite specific. In fact, more than 90% of the population lives in the north along the coast while all energy production is in Hassi R'Mel and south of Hassi R'Mel. As the energy potential lies in the Sahara, technological and human capital should no longer be imported.

It turns out that the first Algerian potential is solar thermal energy, and it is easier to integrate solar thermal technology, widely within our reach. Photovoltaic energy can contribute only 18% of integration in the context of the value chain linked to it, namely 62% for installation and related activities (IRENA 2020c).

It will still be necessary to integrate the rest of its value chain. The size of the envisaged projects will require developing significant human resources. A relatively large requirement would have to be set for a target of 22,000 MW. We should be aiming for 12,000 to 20,000 jobs. Work would start with project management, installation and construction, commissioning, and maintenance, keeping in mind that the target markets are not reduced to local needs. Export markets will certainly be equally important.

SUPPORTING RESEARCH AND EDUCATION

You must trust innovation. Innovation, as we saw, reduces renewable energy costs. The start-ups-induced increase in performance brought the hybrid solar energy system (thermal + photovoltaic) to a sufficient degree of competitiveness to compete with fossil and nuclear power. We need to disseminate knowledge and technology as much as possible and encourage field research and international cooperation. This is possible if the Algerian market remains the most important in the world. There will be more on this further below. There are plenty of examples. Needless to remind that research should receive sufficient support.

Universities, colleges, and institutes should receive constant support for engineer and technician training. The best approach would be for the legislative framework to prioritize this training and research program for renewable energies as well as education policies.

THE ENERGY CONSUMPTION MODEL

A definition of an energy consumption model should rely on a concept of overall economic development. The prevailing conception in defining economic development strategies in the world integrates visions that include the scarcity

of resources, the need to reduce consumption – which is a major source of climate disruption – and the search for equity in sharing resources and financial means.

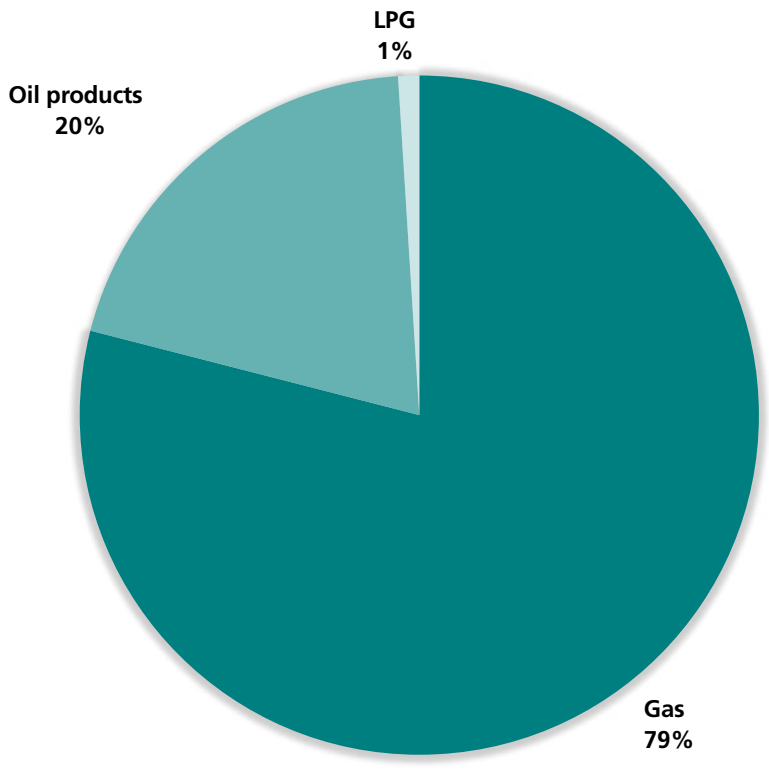
This approach should lead the States to ensure energy security, food security and social cohesiveness. Energy security is only one parameter. The other main parameters in an energy consumption model would be specific to each country. Thus, for Algeria, the criteria to keep in mind are as follows:

- The price corresponds to the comparison of cost of the different energies.
- Regarding supply security: energy is so important that users can neither store it, nor withstand an embargo or a supply failure.
- Regarding climate change and COP21: countries that have signed the Paris Agreement on climate should meet their commitments.
- Energy independence will get priority over electricity use: this point aims to ensure energy security and the best option is energy independence. However, one should not have a reductive vision in the energy options. Indeed, imposing photovoltaic (PV) as the only option, would penalize the impact of the selected system. It is important to note that PV was only useful for electrical use, which represented only 20% of overall energy use.
- In terms of sustainability, the best option of energy independence is the one that guarantees long-term energy availability.
- Industrial integration is necessary: among the producing countries, some suffer from high dependence on oil resources. The aim of economic diversification is therefore to develop an industry dedicated to energy.
- Alignment with electrical systems (*smart grid* and transmission and distribution network) should be favored.

ENDING THE ENERGY MIX BY THE YEARS 2030–2050

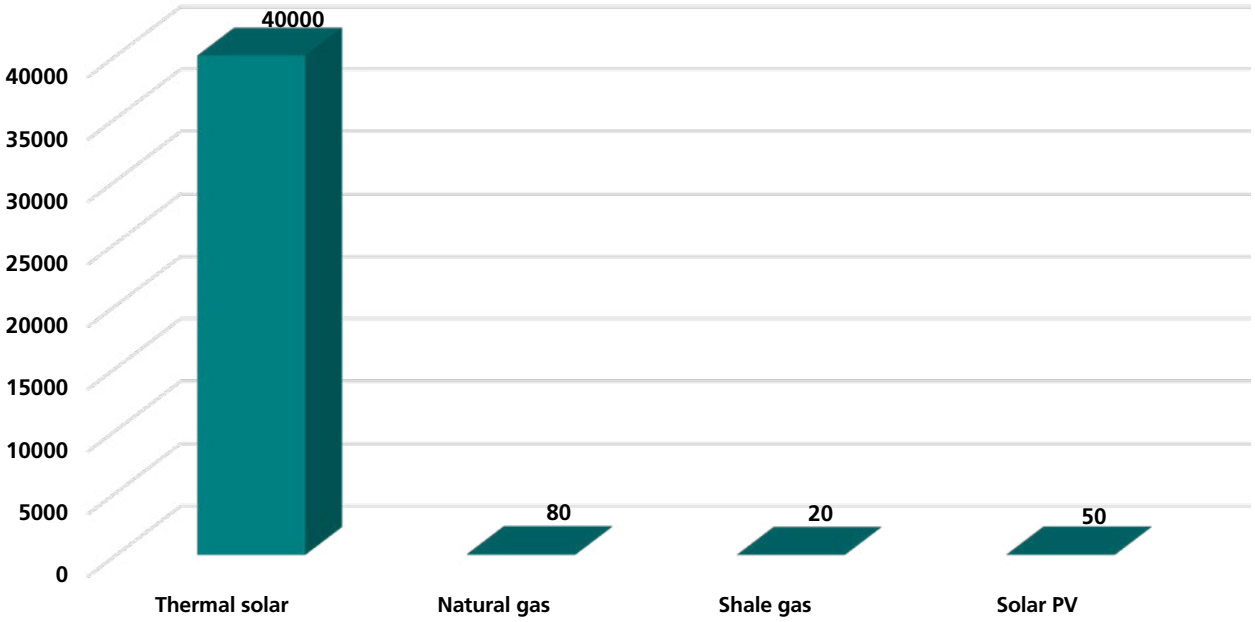
NEAL, the renewable energy development company in Algeria developed an energy consumption model scenario defined above by the seven evaluation parameters. Each model is specific. We argued that the energy security parameter and its counterpart, namely energy independence, are the most important ones The following diagram helps understand the specificity of Algeria. The energy consumption model does not fall under the public domain.

Graph 2
Energy mix in Algeria (2018)



Source: CREG 2018

Graph 3
Annual energy potential of the different energy sectors
(BTEP/year)



Source: Hasni, energy consumption model

Graph 4
Comparison of different energy sectors

	Thermal solar with storage	**Natural gas**	**Shale gas** (Without the cost of well abandoning)	**Solar PV** (Without storage Without SMART GRID)	**Nuclear** (Without cost of decommissioning Without cost of waste storage)
Potential MTEP	40 000	90	20	50	5
COST cts$/kWh	5 to 7	10	18	2.2	10 to 12
Energy independence	Yes	No	No	No	No
Climate mitigation	100%	No	No	30%	60%
Energy security	+ 100%	No	No	Limited	Very limited
Industrial integration	75%	30%	20%	40%	0
Export capacity	37 billion $	12 billion $	0	0	0

Source: Hasni 2019

PROMOTING SMALL PROJECTS INVOLVING LOCAL COMMUNITIES

We did mention Algeria's specificity with 90% of energy demand in the North and most production in the South. The absence of a smart grid will not allow having a significant decentralized production. Indeed, managing multiple electricity productions will require an intelligent network management tool (smart grid), while the demand for heat is the highest, at more than 70%. A simple measure would consist in having regulations requiring that all construction works have thermal insulation according to defined specifications. The installation of solar boilers should be mandatory, and their manufacturing should therefore occur according to the defined technical specifications; and they are already in place in several Mediterranean countries.

To achieve a decentralization of electricity production, there can only be renewable energy units of at least 10 MW for an electrical micro-grid, which represents an interesting market for Algerian SMEs. It is true that when electricity and gas are no longer subsidized, the size of the electricity or heat market will be much larger and micro grids in the South will be more important. We do not presently need to develop smart grids, but we can start planning for the new cities provided for in the National Land Use Plan, which will need revision to include occupancy of the South so that we stop suffocating in the North.

DEFINING THE ENERGY CONSUMPTION MODEL

Programs developed for renewable energies did not address the needs. You can see that even by maintaining the 13,000 MW target for photovoltaic energy, we will not be able to meet the needs, which are not assessed according to the non-hydrocarbon economic development program. We cannot support electricity generation with gas turbines, at the expense of export markets. Until 2050, gas will remain the vector of energy transition. To this end, we must limit Sonelgaz's electricity production to 60 TWh, which is the current level, with a capacity of 20 GW.

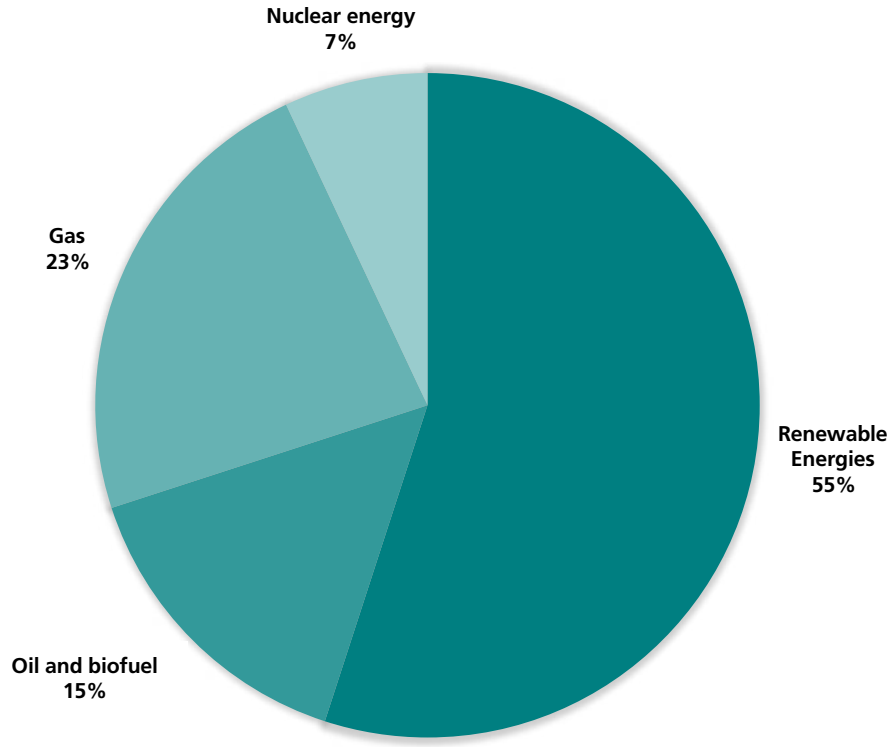
Solar energy (thermal + photovoltaic) will easily fill the remaining gap. It represents 93 TWh in the table above. We are aware that industrial and agricultural development will engender new energy needs, mainly heat. Our solar potential will meet such needs. The development program shall be reviewed later.

Graph 5
Electricity consumption estimates according CREG (Commission for Electricity and Gas Regulation)

	2015	2020	2024	2030
Global electricity consumption	61 %	88 %	112 %	150 %
Photovoltaic power 13 000 MW (2030)	0,18 %	16,6 %	17,6 %	23 %
Wind power	0 %	0,31 %	0,6 %	0,9 %
Hybrid solar thermal-gas flaring 14 000 MW (2030)	0,1 %	12 %	50 %	70 %
Combined gas cycle 14 000 MW (2020)	61 %	59 %	60 %	60 %

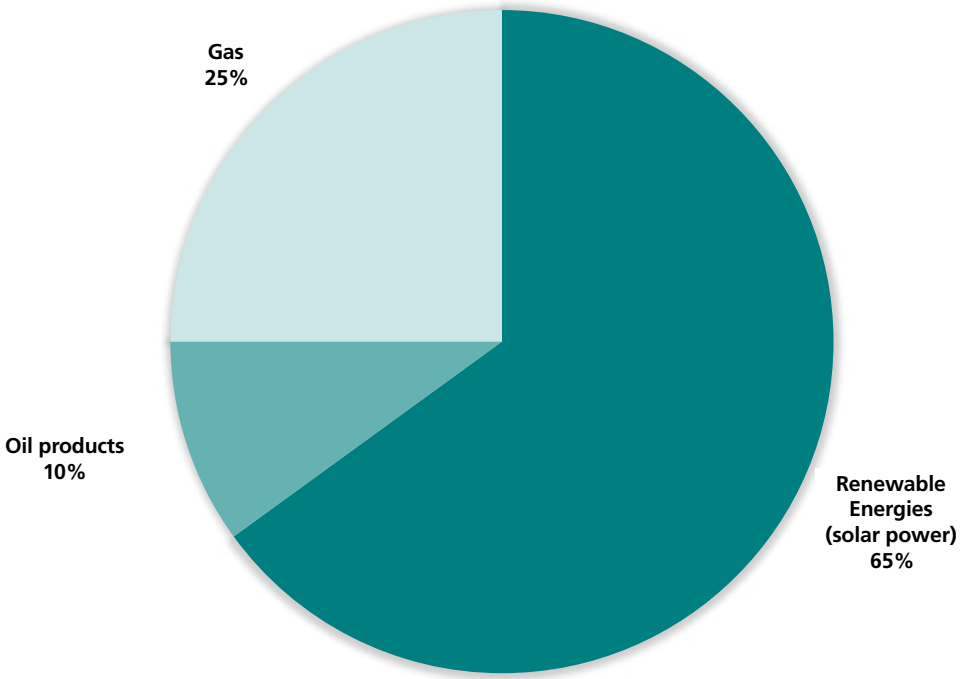
Source: CCREG, results according to the Hasni model

Graph 6
Average global energy mix (2050)



Source: CREG 2018

Graph 7
Energy mix in Algeria (2050)



Source: CREG 2018

ENERGY EXPORT NEEDS TO THE MAGHREB, EUROPE, AND AFRICA

Energy export needs to the Maghreb, Europe and Africa will be the subject of debates to be planned during the discussions underway in the context of the extended 5 + 5 Dialogue. Of course, we will need to fill the financing gap resulting from hydrocarbons. The assessment of such needs will certainly vary, according to national visions, the oil lobbies, and environment defenders; but we can draw a picture of these visions.

We will reach this average global energy mix in 2050:

The renewable energy development program, for the 2030 period, is compliant with COP21 commitments, and should be in place for the electrical transmission grid:

- 2800 MW in photovoltaic energy (PV)
- 11 200 MW in solar thermal energy (CSP: parabolic trough and solar tower)
- 10 MW in wind energy

The World Bank's gas flaring estimation in Algeria is over 6 billion M3 of flared gas per year.

The annual energy potential of Algeria would be:

- Oil 50 MTEP/year
- Gas 85 MTEP/year
- Shale gas 20 MTEP/year
- Solar thermal 40 000 MTEP/year i.e., 40,000 billion M3/year (DLR 2005)

THE MAGHREB MARKET

The Electricity and Gas Regulatory Commission's (CREG) estimation of electricity needs for Algeria is of 150 TWh in 2030. They should reach 250 TWh in 2050, if restraint and efficiency measures are implemented. Domestic consumption reaches 60% of electricity generation. Such wastefulness threatens the country's energy security and is likely to cause the depletion of our gas reserves in the short term. It is no longer necessary to use more than 60% of the imported gas for electricity generation. Likewise, European countries should abide by this rule.

In view of the solar thermal potential on the southern shore, it is possible to meet the world's energy consumption tenfold. By 2050, the global energy mix will be 55% electricity. What should happen is meet COP24 commitments and import green electricity available in ample quantity in the South and completely competitive with nuclear and fossil fuels.

Indeed, to meet its electricity needs by 2050 only, Algeria would need 250 TWh. For the 2030-2050 phase, 20,000 MW in thermal solar and 2,000 MW in PV should be added.

About the other Maghreb countries, you should know that:

- Morocco imports 15% of its electricity needs, and imports gas for 19% of its electricity production
- Tunisia too has an electricity deficit, which implies large investments since 56% of Tunisian electricity is produced with Algerian gas.
- As to Libya, it has a large deficit with a demand of nearly 14 TWh for a 9 TWh production.

THE EUROPEAN MARKET

Algeria exports nearly 65 billion M3 / year of gas, (People's Democratic Republic of Algeria, Ministry of Energy 2020). More than 60% is used for electricity generation (SONATRACH 2018). If we succeed to develop the renewable energy program by 2050, we will then have nearly 30 billion M3 / year that we will have saved by eliminating the gas turbines, which we had initially planned.

Our thermal potential is around 170,000 TWh, or 40,000 MTEP / year. Solar radiation maps for MENA countries were produced by the German Space Agency (DLR 2010). They show that sunshine is indeed the most important energy resource in the entire Mediterranean basin. This potential

Graph 8
2020–2030 program

Projects Phase 1	Generation capacity	Transmission capacity	Algerian market	EU market	Amount of generation invest. $10^9$$	Amount of transmission invest. $10^9$$	Price of electricity
Hassi R'Mel, Spain, France	8,000 MW	6,000 MW	6,000 MW	2,000 MW +Morocco	30	2	7cts$/KWh
Hassi R'Mel, Sardinia, Corsica, EU	8,000 MW	6,000 MW	4,000 MW	4,000 MW	30	1,5	7cts$/KWh
Ain-Amenas, Lybia, Tunisia, Malta	6,000 MW	6,000MW	4,000 MW	Malta 2,000 Lybia 1,000 Tunisia 3,000	22	1	7cts$/KWh
Ain-Amenas, Lybia, Tunisia, Malta	6,000 MW	6,000 MW	4, 000 MW	2,000 MW	18	0,5	6 cts$/KWh

Source: Hasni 2019

based on solar radiation is twice as high as in Europe. However, it is above all the availability of vast desert areas, where solar power plants can be installed, that offers this potential. Europe faces difficulties finding sites for solar power plant installation, which requires large spaces. The case of the solar power plant plan in Larzac (France) clearly demonstrates the difficulties in convincing the populations to accept the installation of such plants. Let us add that the European electricity market in 2050 will represent 4,750 TWh.

Acknowledging the limitations of energy dependence, we believe that 40,000 MW import of green electricity in 2050 from the Maghreb is quite possible. Renewable energies, and particularly solar, have indeed reached a high degree of competitiveness except for solar thermal which is still below maturity level. Compared to fossil fuels, solar energy today is highly competitive, despite the dumping due to oil and shale gas. So is nuclear power. The prospect of nuclear power plants sold to the private sector will only increase this competitiveness. European countries will then be able to honor their commitments made at COP21 and 24.

The important thing is that because of this competitiveness, renewable energies will no longer require subsidies. Funding can occur in project finance. It will be the case in the Maghreb. Funding will then be easier to find.

The approach we are proposing incorporates an electricity transmission grid, and it will address the divestment in the European network of electricity transmission. The cost of transport will be lower than that of gas. In addition, the proposed direct current network will prevent the current rectification stations from being directly connected to the existing electricity network. There will be no synchronization to run, and therefore no risk of blackout. For the Energy plan, we have the necessary elements to target a few objectives and decide on a portfolio of projects.

For Algeria, we must complete the overall objectives of phase 1 (2030), or nearly 27,000 MW in renewable energy. We favor hybrid solar systems (thermal and photovoltaic) with flared gas, which will save energy storage. Flared gas will feed the power plants at night. Electricity transmission will be direct current at very high voltage.

Our approach integrates investment constraints. The Algerian share cannot exceed 40%. This is the portion of goods and services of the investment that will become Algerian. At the same time, we challenge the previous rule, which limited foreign investment to 49%. Of course, as our production capacity for goods and services will develop, we will increase our share of financing. This does not mean that we will increase the Algerian share of the social capital of the future companies.

Amendments will go as far as establishing all the techno parks of energy development in the south of the country as Free Zone

- Hassi R'Mel will be the first. It alone represents a development potential of a hybrid solar power plant of more than 40,000 MW.
- Ain Aménas on the Libyan border
- Adrar in the southwest of the country.

DEFINING THE OVERALL POWER GENERATION PROGRAM IN HYBRID RENEWABLE ENERGIES

We must define the overall power generation program in hybrid renewable energies by the years 2030-2050 for the domestic and export market.

A reminder of the phases:

PHASE 1

For hybrid solar power plants, i.e., solar (thermal + photovoltaic) hybridized with flared gas, there is no thermal storage, and transmission is through HVDC electric cables, in direct current and 850 KV high voltage.

Graph 9
2030–2050 Program

Projects Phase 1	Generation capacity	Transmission capacity	Algerian market	EU market	Amount of generation invest. $10^9$$	Amount of transmission invest. $10^9$$	Price of electricity
Adrar, Hassi R'Mel	6,000 MW	6,000 MW		6;000 MW	18	0,5	6 cts$/KWh
Hassi R'Mel, Spain, Northern Europe	12,000 MW	12,000 MW		12;000 MW + Morocco	35	3	5 cts$/KWh

Source: Hasni 2019

PHASE 2

Solar power plants get thermal storage. Solar power plants are 80% parabolic solar concentrators (parabolic trough) and 20% PV fields. Storage is through solar towers using a heat transfer fluid accepting temperatures above 600 ° C. Transmission is through superconductor cables at high temperature. They are at the core of a pipe, which has an intermediate space to carry helium or liquid hydrogen, providing superconductivity. Pipes are laid along the French Atlantic coast to reach Germany. Of course, it is direct current. The pipes also carry hydrogen and helium to the European market.

BUILDING CENTERS TO DISSEMINATE INFORMATION

Another important undertaking consists in building centers which disseminate information and break the silence around successful renewable energy experience (particularly on Hassi R'Mel) and in shedding light on our failures. What impedes the development of renewable energies in Algeria is the lack of information from central and local authorities. A veil of silence has shrouded the solar thermal-gas plant of Hassi R'Mel, although it has operated under contract conditions by fulfilling all its obligations since 2011.

However, there is no precise assessment on the 400 MW of photovoltaic. It is important to have educational centers around pioneer projects, to enhance their impact and appreciate the potential of 100% renewable energy. Public decision-makers should give priority to citizen education, knowledge sharing and public communication.

EXPLORING THE POTENTIAL FOR JOB CREATION

An IRENA study analyzed job creation in the energy sector in the world (IREANA 2020c). In the light of this study, we expect job creation to be higher in renewable energies and energy efficiency than in fossil fuels, which will experience a job reduction despite 40% of jobs created. In renewable energy and energy efficiency, the solar sector will be the most important. The structure of employment in the value chain will be as follows: 80% technicians, 8% engineers, 8% experts, 4% in marketing and administration.

The overall need for Algeria is expected to reach 1 million jobs by 2050 according to the following structure: 800,000 technicians, 80,000 engineers, 80,000 experts and 40,000 in marketing and administration. The segments of the value chain include project development, manufacturing and supply, transportation and logistics, construction and installation, operation, and maintenance

The global trend confirms the study (IRENA 2020c). So according to Saul Griffith and Sam Calish who propose a total decarbonization of the US economy, the grid would require extension because almost everything would run on electricity, and therefore would require many workers.

"Millions of miles of new and improved transmission and distribution will be necessary to reach the end user. As far as demand, we will need to electrify our 250 million vehicles, 130 million homes, 6 million trucks, all manufacturing and industrial processes and 5.5 million commercial buildings covering 90 billion square feet", says the report (Griffith/Calish/Fraser 2020).

The plan would put the country's electrical system on steroids, increasing it from 450 gigawatts of electricity delivered today to 2,000 gigawatts. However, according to the report, as electric machines are generally more efficient than those that require combustion, the country's overall energy demand would be cut by more than half. According to the report, the overall energy needs of the United States would drop from about 98 quads to about 42 quads. A "quad" is 1 quadrillion of British thermal units and represents a staggering amount of energy.

The "Rewiring America" report calls for a "period of mobilization" like the effort made for World War II armament, which created a peak of 17.5 million jobs. This new hive of clean energy activities in the 21st century could create 25 million jobs over an intense three-to-five-year transition period, which would become 5 million jobs to maintain the system once in place. Currently, the US energy industry employs around 1.8 million people or 2.7 million if gas station employees are included. Aggressive decarbonization would create, rather than destroy, several million well-paying American jobs. According to the report, these jobs will be widely distributed geographically and difficult to relocate (Griffith/Calish/Fraser 2020).

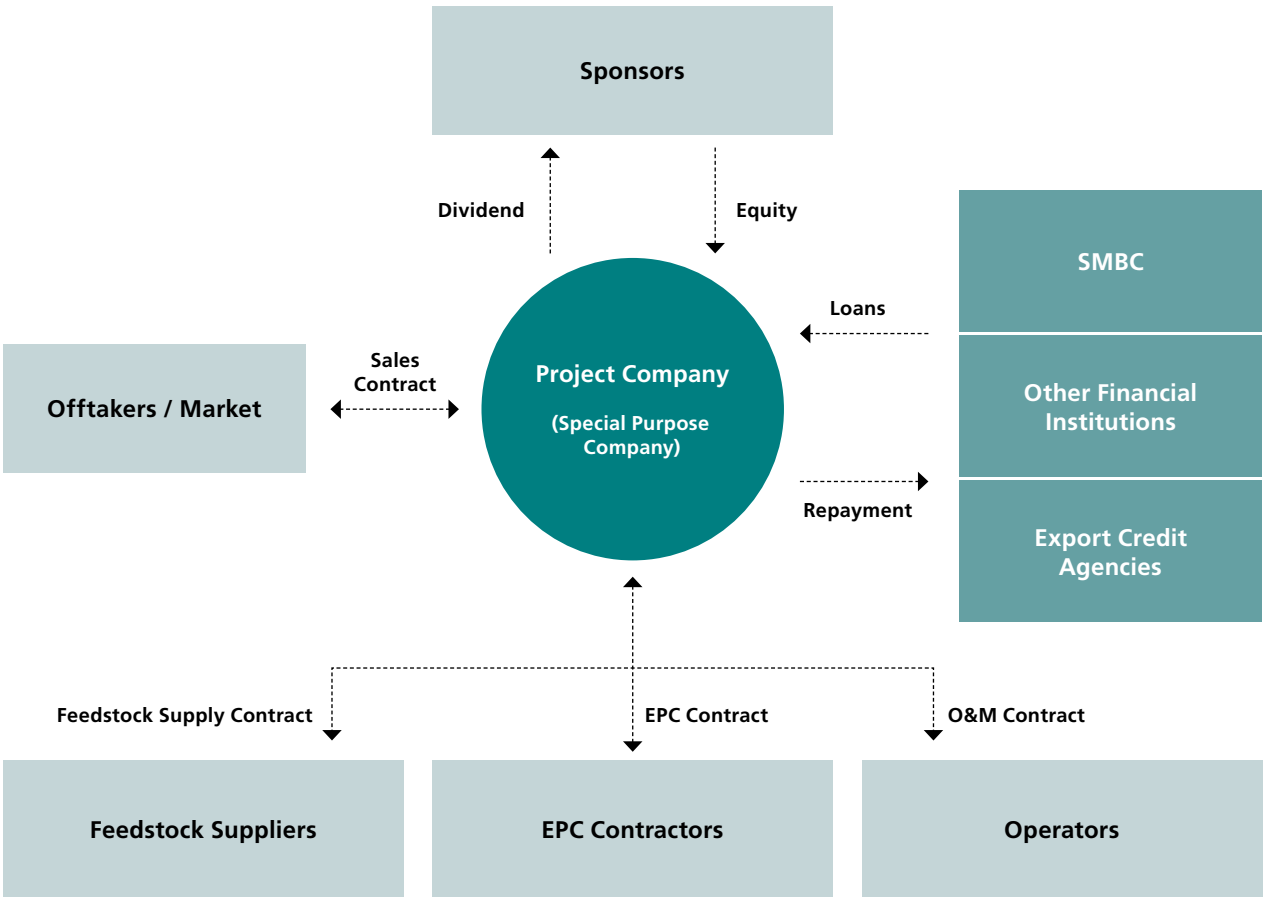
It should be noted that according to pre-Covid-19 forecasts, a median target between the oil lobby and the climate lobby was projected, which was to give an electricity share of 55% of global energy demand. The post-Covid-19 period should be a game changer.

MEANS OF FINANCING THE RENEWABLE ENERGY DEVELOPMENT PROGRAM

It will also be necessary to provide the means of financing the renewable energy development program without State debt. The most suitable model is that of Project Finance.

Such an arrangement undoubtedly requires a sufficiently transparent and unconstrained business environment for investors in capital-intensive projects. As we have noted above, the trend for accessing external financing is through subscribing to sustainable development and green economy. Good governance is essential to allow meeting COP21 commitments.

Graph 10
Structure of a Project Finance



Source: SMBC 2020

IDENTIFYING INVESTMENT CONSTRAINTS

It is important to identify investment constraints and propose the necessary measures to remove constraints. This requires reforming the investment rules. Revising the 51/49 rule is an initial step. We propose an approach based on the free-zone principle. It will allow more daring reforms restricted to the free zone.

PROPOSING REFORMS TO STIMULATE INVESTMENT

Finally, reforms capable of stimulating investment are necessary. Digitization, big data, and transition to artificial intelligence reflect moving to the fourth industrial revolution. Franz Fanon's revolutionary idea of avoiding following the development process of developed countries and taking the appropriate technological shortcut would be of high relevance. Our country, however, adopted the opposite approach of returning to the automotive revolution.

As mentioned above, we recommend enhancing our partnership with the EU by creating a specific pilot zone in the three main regions of the South. We propose making them free trade zones, thus removing the current constraints of the present restrictive investment code. The free zones will be autonomous, with customs duties exemption, access to foreign companies, tax reduction, land availability, etc. It is essential to stay abreast of the evolution of financing means and digital currencies. We will develop block chain technology in value chains.

Such zones will of course be restricted, with no public access. We will strengthen security, with special arrangements, not be available in the rest of the country for yet several years. The management of the free zones will be autonomous, making them an example of the country's desire for economic decentralization. The proposed projects stem from this definition of a free zone.

The free zone will be a techno park with training and research centers and industrial partnerships for solar equipment manufacturing. A financial authority will oversee the block chain management, and clusters will create SMEs, which will be involved through subcontracting with large companies in charge of important projects and approved by the existing training centers in the free zone. The approach is inclusive and gives an overview of all the partnership projects expected by the Maghreb countries.

COOPERATION BETWEEN THE SECTORS OF GOVERNANCE

It is essential to increase cooperation between different sectors and levels of governance. Cross-sectoral and interdisciplinary platforms for dialogue will contribute to developing a strong, coherent, and comprehensive policy framework that will facilitate transformation. The general objective is to formulate policy recommendations on how 100% renewable energy can strengthen the development of Algeria to benefit the population.

The first part of this report briefly describes the main reasons why renewable energies are not only a priority but also the first source of a wide range of opportunities for Algeria. After the concise summary of the current energy policy framework in Algeria, the study will highlight the main obstacles impeding change towards renewable energies in the country. Then we will make a few key recommendations based on such observations. They should serve as guidelines not only for the Algerian government and legislators, but also for all parliamentarians, political actors and decision-makers willing to implement the necessary measures for transition towards 100% renewable energy in Algeria.

A clear and coherent political framework is essential to effectively transform the energy sector and truly benefit the economy and the people of Algeria. This political framework should have certain characteristics and be structured around two main poles. The burden of the structural upheaval required to achieve 100% renewable energy must not lie on one sector alone. We have identified the following main types of collaboration.

VERTICAL DIALOGUE / CREATING ALLIANCES BETWEEN THE VARIOUS LEVELS OF GOVERNANCE

It is essential at first to enhance coordination and cooperation at national, regional, and local levels, as evidence of internal good governance. It will contribute to an image of credibility and attract international collaboration, at a time of a major global existentialist crisis, where funding will indeed be more difficult to secure and where investors will tend to reduce investment risks. It is necessary to be reassuring through partnerships between stakeholders and a deeper political dialogue. This can be achieved through regional organizations like the Greater Maghreb and the 5 + 5 Dialogue, including Germany.

Although it is member of IRENA, Algeria does not gain any benefit since the representative of Algeria is the Ministry of Foreign Affairs; the Ministry of Energy having, at the time, refused to be part. Interregional collaborations allow access to larger markets. For a better approach to 100% renewables, we must abandon the balanced distribution of projects. Energy potential is not equally available across the country.

We can impose neither a particular site to investors, nor a particular renewable energy sector. Investors bear the risk of the investment, and they are responsible for choosing the site. However, international studies have identified local renewable potential in the whole country. It would therefore be relevant to choose model areas for each renewable energy sector, and essential to organize raising awareness campaigns for the population.

HORIZONTAL DIALOGUE / IMPROVING COOPERATION BETWEEN THE VARIOUS ECONOMIC ACTORS

In this regard, the following factors require validation:

- Introduce a progressive eradication of fossil fuel subsidies in a socially acceptable way.
-
- Establish a strong and transparent source of financial support to renewable energy.
-
- Implement a sustained environmental policy, supporting renewable energy in the short and long terms.
-
- Promote the necessary technical and structural changes to ensure that renewable energy complies with the principles of the energy consumption model.
-
- Expand the digital system, creating Big Data for the entire economic sector.
-
- Implement policy measures that facilitate the use of renewable energy and clean energies in all aspects of energy use by 2050.

7

CONCLUSION

Climate change and the eradication of poverty and inequality are among the main fights of our times. We know that they are closely related, as we cannot end poverty without containing climate change. In Algeria, the population faces an additional challenge: the demand for energy is continuously increasing, in particular for electricity, due to economic growth, rampant industrialization, population growth and increasing individual wealth.

At the same time, Algeria has failed to achieve diversification. Its imports in general affect the country's market balance and energy subsidies weigh heavily on the national budget (10% of GDP). The forecasts of energy demand further predict that, as a result, greenhouse gas emissions, currently still low, will increase dramatically.

It is interesting to adopt this global vision while taking the energy burden into account, which shows that economic powers have relied on controlling the strategic resources. Energy remains the most important among them. The predators of the three industrial revolutions have succeeded to keep control over these resources in an indirect way. Their strategy had been to dispossess the minor countries of their wealth. The oil era will have been the toughest and will leave its mark in history. The predators had a hold even over sizable nation state

The threats inflicted upon these states were in proportion to the strategic importance of certain strategic resources, and primarily energies. The result consisted in maintaining these States in a constant state of underdevelopment.

If we go back to the rationale in the definition of the economic development strategies of these States, we will find aspects including the scarcity of resources, the need to reduce consumption as a major source of climatic disturbances, and the search for equity in sharing resources and financial means. These States were expected to ensure energy security, food security, and social cohesiveness through social equity.

The European program focuses largely on job creation, supporting major heavy European renewable technologies, onshore and offshore wind, and solar photovoltaic energy, which have admittedly experienced years of high growth but are facing a challenging year 2020 due to Covid-19. The European Commission has developed a vigorous recovery program, giving the European bloc € 1.85 trillion to boost economic recovery, with at least 25% of all funds going to support climate-friendly programs, while fossil fuels or nuclear projects gain no support under the 'do no harm' principle (European Commission 2020).

The reason is simple. The European program only targets wind and solar photovoltaic power because the solar thermal potential is non-existent in northern Europe and low in southern Europe. There is undoubtedly lower solar irradiation in Europe than in Algeria, but above all, no site land is available for large solar thermal projects. Citizen opposition to the establishment of a large PV plant in Larzac is an example of the general resistance to reducing farmland for these projects. For the European needs of around 4,000 TWh, the challenge is too great for wind and PV without storage and without site land.

During the People's National Assembly (APN) on May 22, 2020, Chinese Premier Li Keqiang presented an important tool for economic stimulation. It is the "special bonds" totaling 3.75 trillion yuan ($ 523 billion) in 2020, 74% higher than the amount in 2019 (Liu 2020). This funding, at the discretion of local governments, is for "special purpose" projects to support a mix of new and traditional industries. The promotion of electric vehicles, of renewable energies and of other environment friendly projects are eligible for this "special purpose" funding.*****

In the United States, energy has not featured prominently in economic recovery talks, whether it is conventional or green energy. However, those with interests in renewable energy are lobbying for this to change, calling Washington to their rescue amid major job losses: in fact, the number of clean energy jobs lost in March and April was more than twice the number of jobs created since 2017.

The European Energy Forum is increasing the number of dinner invitations to provide meeting opportunities to MEPs and industrialists. Are they briefing missions or examples of pro-fossil fuel lobbying? Brief winking to a "gray area" of

* Communication with Mr. Abderrahmane Hadj-Nacer, former Governor of the Bank of Algeria.

Brussels lobbying. A dinner meeting took place on February 17, at the European Parliament, before the Coronavirus disrupted everything. The event gathered several MEPs, attachés from Member State permanent representations, and officials around a very topical theme, namely "The role of gas and oil in the European Green Deal".

We now understand the dimension of the threat that renewable energies represent to fossil fuels. Climate change has only exposed the threat. Covid-19 accelerated it. This information only explained the motivation of the oil lobbies. The nuclear lobby is another to have also reacted against renewable energies for the same reasons, as indeed green power was a threat to the electricity market held by the nuclear sector.

The strategy that these two lobbies pursued had consisted in restraining Algeria to the sole PV use, knowing that our potential in this area did not exceed 7 MTEP / year. Solar thermal for its part reaches 40,000 MTEP / year. Our country has significant resources. The first colonizers were aware of this. It was El Dorado!

We have wasted precious years as Rentier State, a culture inherited in fact from the colonizer. There is no point in crying over the past. Our youth would not forgive us. We must rather address the challenge because no past-oriented approach is valid. Tomorrow's world will be very different. The participation of all the actors concerned without exclusion, is the only way of meeting the challenge. This is the main success factor.

Developing networks between the countries that actively and successfully develop their renewable energies is highly useful. Indeed, despite local success, government decision-makers and legislative actors are not aware of many good practices and effective policy instruments.

ANNEX 1: TEXTS ON ENERGY CONTROL

Decree No. 85-235 of 25 August 1985 creating an Agency for energy promotion and rationalization. https://www.energy.gov.dz/Media/galerie/decr_85-235_5b6861ef2a06e.pdf

Amended by: **Executive decree No. 04-314 of 25 September 2004** amending and supplementing decree No. 85-235 of 25 August 1985, amended and supplemented, establishing the creation of an Agency for the promotion and rationalization of energy use. https://www.energy.gov.dz/Media/galerie/decret_ exécutif_n_04-314_5b686241523c4.pdf

Law No. 99-09 of 28 July 1999 on energy control. https://www.energy.gov.dz/Media/galerie/loi_99-09_5b68630e15102.pdf

Executive decree No. 2000-90 of 24 April 2000 on thermal regulation in new buildings. https://www.energy.gov.dz/Media/galerie/decret_executif_n_2000-90_5b68637d205dd.pdf

Executive decree No. 04-149 of 19 May 2004 laying down rules for the development of the National Program of Energy Control (PNME) https://www.energy.gov.dz/Media/galerie/decr_04-149_5b6863c286420.pdf

Executive decree 15-319 of 13 December 2015 establishing the operating procedures for the special appropriation account No. 302-131 entitled "National fund for energy control, and for renewable energies and cogeneration". https://www.energy.gov.dz/Media/galerie/decret_executif_n_15-319_5b6864d0580c3.pdf

Amended by **Executive decree No. 16-121 of 06 April 2016** amending and supplementing executive decree No. 15-319 of Aouel Rabie El Aouel 1437 corresponding to 13 December 2015 establishing the operating procedures for the special appropriation account No. 302-131 entitled "National fund for energy control and for renewable energies and cogeneration". https://www.energy.gov.dz/Media/galerie/decret_executif_n_16-121_5b68655e7d14f.pdf

Executive decree No. 17-168 of 22 May 2017 amending and supplementing executive decree No. 15-319 of Aouel Rabie El Aouel 1437 corresponding to 13 December 2015 establishing the operating procedures for the special appropriation account No. 302-131 entitled "National fund for energy control and for renewable energies and cogeneration". https://www.energy.gov.dz/Media/galerie/decret_executif_n_17-168_5b694d563e1ab.pdf

Inter. order of 22 December 2016 determining the list of revenues and expenditures chargeable to the special appropriation account No. 302-131 entitled "National fund for energy control and for renewable energies and cogeneration". https://www.energy.gov.dz/Media/galerie/arrete_interministeriel_du_22_decembre_2016_nomenclature_des_recettes_et_des_depenses_imputables_sur_le_compte_d'affectation_speciale_n_302-131_5b694ef6d63dc.pdf

Inter. order of 22 December 2016 specifying the methods for monitoring and evaluating the special appropriation account No. 302-131 entitled "National fund for energy control and for renewable energies and cogeneration". https://www.energy.gov.dz/Media/galerie/arrete_inter._du_22_decembre_2016_precisant_les_modalites_du_suivi_et_de_l'evaluation_du_compte_d'affectation_speciale_nd_302-131_5b694f28a6ac6.pdf

Executive decree No. 05-16 of 11 January 2005 setting the specific energy efficiency rules applicable to devices running on electricity, gas and oil products. https://www.energy.gov.dz/Media/galerie/decret_executif_n_05-16_5b694f7b63e7a.pdf

Inter. order of 03 November 2008 establishing the appliances and categories of appliances for domestic use subject to specific energy efficiency rules and operating on electrical energy. https://www.energy.gov.dz/Media/galerie/arrete_inter._du_03_novembre_2008_5b694fe911ff0.pdf

Inter. order of 29 November 2008 defining the energy efficiency classification of household appliances subject to specific energy efficiency rules and running on electrical energy. https://www.energy.gov.dz/Media/galerie/arrete_inter._du_29_novembre_2008_appareils_a_usage_domestique_soumis_aux_regles_specifiques_d'efficacite_energetique_et_fonctionnant_a_l'energie_electrique_5b69503d5600a.pdf

Inter. order of 29 November 2008 defining the general provisions on the methods of organization and practice of energy efficiency control of household appliances subject to specific energy efficiency rules and running on electrical energy (point 12). https://www.energy.gov.dz/Media/galerie/arrete_inter._du_29_novembre_2008_modalites_d'organisation_et_d'exercice_appareils_a_usage_domestique_5b6950914075f.pdf

Decree of 21 February 2009 on energy labelling of refrigerators, freezers and combined household appliances subject to specific energy efficiency rules and running on electrical energy. https://www.energy.gov.dz/Media/galerie/arrete_du_21_fevrier_2009_etiquetage_appareils_usage_domestique_soumis_aux_regles_efficacite_energetique_5b6950da0ecc4.pdf

Order of 21 February 2009 on the energy labeling of household lamps subject to specific energy efficiency rules and running on electrical energy. https://www.energy.gov.dz/Media/galerie/-arrete_du_21_fevrier_2009_relatif_a_l'etiquetage_energetique_des_climatiseurs_a_usage_domestique_5b69515a43778.pdf

Executive decree No. 05-495 of 26 December 2005 on the energy audit of energy-intensive facilities running on electrical energy. https://www.energy.gov.dz/Media/galerie/arrete_du_21_fevrier_2009_relatif_a_l'etiquetage_energetique_des_lampes_domestiques_5b695196e4dec.pdf

Décret exécutif n° 05-495 du 26 Décembre 2005 relatif à l'audit énergétique des établissements grands consommateurs d'énergie https://www.energy.gov.dz/Media/galerie/decret_executif_n_05-495_5b69520e71cd1.pdf

Amended by: **Executive decree No. 13-424 of 18 December 2013** amending and supplementing executive decree No. 05-495 of 24 Dhou El Kaada 1426 corresponding to 26 December 2005 on the energy audit of energy-intensive facilities. https://www.energy.gov.dz/Media/galerie/decret_executif_n_13-424_5b6953b590506.pdf

Inter. order of 29 September 2010 on the specifications defining the methodology, the audit report and its summary, the methodological guide, the heating values, the conversion factors for consumption calculation, and the methods for approving auditors. https://www.energy.gov.dz/Media/galerie/arrete_interministeriel_du_29_septembre_2010_cahiers_des_charges_calcul_de_la_consommation_ainsi_que_les_modalites_d'agrement_des_auditeurs_5b69541eab3af.pdf

Amended by : **Presidential decree No. 12-416 of 11 December 2012** (point 3) ratifying the memorandum of understanding between the Government of the People's Democratic Republic of Algeria and the Government of the Republic of Tunisia in the fields of energy control and renewable energies, signed in Algiers on July 2, 2009. 9 https://www.energy.gov.dz/Media/galerie/decret_presidentiel_n_12-416_5b6954f9ea707.pdf

Amended by : **Executive decree No. 13-218 of 18 June 2013** setting the eligibility criteria for bonuses for the diversification costs of electricity production. https://www.energy.gov.dz/Media/galerie/decret_executif_13-218_(4)_5b684ba2e6348.pdf

Amended by : **Executive decree No. 17-166 of 22 May 2017** amending and supplementing executive decree No. 13-218 of 9 Chaâbane 1434 corresponding to 18 june 2013 setting the eligibility criteria for bonuses for the diversification costs of electricity production. https://www.energy.gov.dz/Media/galerie/decret_17-166_5b684c5741d24.pdf

Order of 2 February 2014 setting the guaranteed feed-in tariffs and the conditions of their application to the electricity generated from facilities using wind power. https://www.energy.gov.dz/Media/galerie/arrete_jo_23_2014_5b684cd5c6715.pdf

Amended by : **Order of 07 December 2016** supplementng the order of 2 February 2014 setting the guaranteed feed-in tariffs and the conditions of their application to the electricity generated from facilities using wind power. https://www.energy.gov.dz/Media/galerie/arrete_du_7_decembre_2016_tarifs_drachat_garantis_et_conditions_application_electricite_produite_installations_eolienne_5b684d86efebe.pdf

Order of 02 February 2014 setting the guaranteed feed-in tariffs and the conditions of their application to the electricity generated from facilities using solar photovoltaic power. https://www.energy.gov.dz/Media/galerie/arrete_(3)_5b684e77277a4.pdf

Amended by : **Order of 22 November 2016** supplementing the order of 2 February 2014 setting the guaranteed feed-in tariffs and the conditions of their application to the electricity generated from facilities using solar photovoltaic power. https://www.energy.gov.dz/Media/galerie/arrete_du_22_novembre_2016completant_arrete_du_2_fevrier_2014_5b684fa45ca67.pdf

Order of 01 September 2014 setting the guaranteed feed-in tariffs and the conditions of their application to the electricity generated from facilities using cogeneration energy. https://www.energy.gov.dz/Media/galerie/arrete_(21)_5b684fffb0fd4.pdf

Amended by : **Order of 07 December 2016** supplementing the order of 01 September 2014 setting the guaranteed feed-in tariffs and the conditions of their application to the electricity generated from facilities using cogeneration energy. https://www.energy.gov.dz/Media/galerie/arrete_du_7_decembre_2016_completant_arrete_du_1er_septembre_2014_5b68504c4cc61.pdf

Executive decree No. 17-98 of 29 Joumada El Oula 1438 corresponding to 26 February 2017 defining the tender procedure for the production of renewable or cogeneration energies and their integration into the national electricity supply system.

Law No. 04-09 of 14 August 2004 on promoting renewable energies in the context of sustainable development.

The National Energy Council, which will be headed by the President, will lead the energy strategy of the country. According to the Algerian President, this decision-making body must play a leading role in the country's energy strategy (30 June 2020).

Prime Minister Noureddine Bedoui stated, on Thursday 14 November 2019 in Algiers, that the creation of the National Commissariat for renewable energies and energy efficiency would help face the obstacles and difficulties hampering the implementation on the ground of the national program.

ANNEX 2: ADDITIONAL SOURCES OF INFORMATION

Energy Intelligence: https://www.energyintel.com/

European Solar Thermal Electricity Association (ESTELA): https://www.estelasolar.org/

Fraunhofer Research Institution for Energy Infrastructures and Geothermal Systems (IEG): https://www.ieg.fraunhofer.de/en.html

German Aerospace Center (DLR): https://www.dlr.de/EN/Home/home_node.html

International Energy Agency (IEA): https://www.iea.org/

International Renewable Energy Agency (IRENA: https://www.irena.org/

Institute for Advanced Sustainability Studies (IASS): https://www.iass-potsdam.de/en

National Renewable Energy Laboratory (NREL): https://www.nrel.gov/

Oil & Gas Business, The energy magazine: https://www.facebook.com/OilGasBusiness/

Oil Price: https://oilprice.com/

Solar Power and Chemical Energy Systems (SolarPACES): https://www.solarpaces.org/

Trans-Mediterranean Renewable Energy Cooperation (TREC): https://www.e5.org/cooperations-spin-offs/trec/

United States Department of Energy: https://www.energy.gov/

World Bank: https://www.worldbank.org/

World Watch Institute: http://www.climatenetwork.org/profile/member/worldwatch-institute

BIBLIOGRAPHY

Charlez, Philippe (2019): L'énergie: un projet structurant pour relancer l'Europe, Institut sapiens, https://www.institutsapiens.fr/lenergie-un-projet-structurant-pour-relancer-leurope/

CREG: Annual reports, https://www.creg.dz/index.php/publications/rapport-d-activite

DLR, German Aerospace Center (2005): Concentrating Solar Power for the Mediterranean Region (with the contribution of Tewfik Hasni), https://www.dlr.de/tt/Portaldata/41/Resources/dokumente/institut/system/publications/MED-CSP_complete_study-small.pdf

DLR, German Aerospace Center (2010): Renewable Energies in the MENA Region: Potential for Sustainable Energy Provision and Export to Europe (Hans Müller-Steinhagen and Franz Trieb, https://www.dlr.de/tt/Portaldata/41/Resources/dokumente/institut/DLR_Presentation_Renewable_Energies_in_MENA_Region_MAR08.pdf

European Commission (2020): Recovery Plan for Europe, https://ec.europa.eu/info/live-work-travel-eu/health/coronavirus-response/recovery-plan-europe_fr

Griffith, Saul / Calish, Sam / Fraser, Laura (2020): Rewiring America. A Field Manual for the Climate Fight, https://www.rewiringamerica.org/handbook

Hasni, Tewfik (2014): Les subventions à Energie (unpublished study)

Hasni, Tewfik (2017): La transition énergétique et les défis, European University Publishers

Hasni, Tewfik (2019): Le développement des deux rives, (unpublished study, presented for the discussion on energy transition in the context of 5+5 including Germany)

Hasni, Tewfik (2020): La « Guilde » et le Covid-19 face à la 4ième Révolution Industrielle, Generis Publishing

IRENA (2020a), Renewable Power Generation Costs in 2019, Abu Dhabi, https://www.irena.org/publications/2020/Jun/Renewable-Power-Costs-in-2019

IRENA (2020b), Global Renewables Outlook: Energy transformation 2050, Abu Dhabi https://www.irena.org/publications/2020/Apr/Global-Renewables-Outlook-2020

IRENA (2020c), Renewable Energy and Jobs – Annual Review 2020, Abu Dhabi, https://www.irena.org/publications/2020/Sep/Renewable-Energy-and-Jobs-Annual-Review-2020

IRENA (2020d): Post-COVID Recovery: An Agenda for Resilience, Development and Equality, Abu Dhabi, https://www.irena.org/publications/2020/Jun/Post-COVID-Recovery

Liu, Yishuang (2020): Ouverture de l'Assemblée populaire nationale, aucun objectif de croissance fixé pour 2020, *Le Quotidien du Peuple en ligne*, http://french.peopledaily.com.cn/Chine/n3/2020/0522/c31354-9693291.html

People's Democratic Republic of Algeria, Ministry of Energy (2020): National Energy Balance – Year 2019, https://www.energy.gov.dz/Media/galerie/bilan_energetique_national_2019_5f7b107553bcd.pdf

SMBC (2020): Products & Sevices, Turning Opportunity into Reality, https://www.smbcgroup.com/americas/products-services/project-finance/

SONATRACH: Annual Balance Sheets, https://sonatrach.com/rapports

UNECA (2011): The Renewable Energy Sector in North Africa: Current Situation and Prospects, Addis Ababa, https://www.uneca.org/sites/default/files/PublicationFiles/renewable_energy_sector_in_north_africa_fr.pdf

ABREVIATIONS

CREG	Commission de Régulation de l'Electricité et du Gaz (Electricity and Gas Regulation Commission)
CSP	Concentrateur Solaire Parabolique (Parabolic Solar Concentrator)
DLR	German Aerospace Center
EU	European Union
GEF	Global Environment Facility
IAP	Institut Algérien du Pétrole (Algerian Petroleum Institute)
IRENA	International Renewable Energy Agency
NEAL	New Energy Algeria
UN	United Nations
PV	Photovoltaic
SONATRACH	Société Nationale pour la recherche, la production, le transport, la transformation et la commercialisation des hydrocarbures Algérie (Algerian National Oil Company)
SONELGAZ	Société Nationale de l'électricité et du gaz (Algerian National Electricity and Gas Company)
UNECA	United Nations Economic Commission for Africa

LIST OF GRAPHS

ABOUT THE AUTHORS

Tewfik Hasni is an expert consultant in energy transition and an engineer in refining and petrochemicals. He spent most of his career at SONATRACH in the LNG division as a first level engineer until he reached the position of Vice-President. In 2002, as his interest shifted to sustainable development and renewable energies, he founded New Energy Algeria (NEAL), a renewable energy development company. He is also President of IAP's Association of Engineers and President of APEQUE, the Association for quality development, and for sustainable development in business.

Redouane Malek is director of a consulting and communication agency. He is the editor of the journal »Oil & Gas Business«.

Nazim Zouioueche is an engineer in telecommunication and reservoir engineering. He spent his entire career at SONATRACH, holding positions from head of oil field operation in the south, to SONATRACH Chief Executive Director. He contributed to raising SONATRACH from a hydrocarbon transport and marketing company to the 10th largest oil company in the world.

IMRPINT

Friedrich-Ebert-Stiftung | Algeria Office
175 blvd Krim Belkacem | Telemly | 1600 Algiers
https://algeria.fes.de/

To order publications:
info@fes-algeria.org

Translation from French: Saloua Essayah

ISBN 978-9931-551-16-4

ALGERIA 100% RENEWABLE ENERGY

Recommendations for a National Strategy of Energy Transition

Because of their infinite nature, their limited and competitive costs, renewable energies in Algeria have evidently gained a foothold, especially as the abundantly produced green electricity could be an interesting export item. The development of renewables in Algeria would help mitigate the effects of climate change. Like other countries, Algeria, must contribute to the fight against climate disorders and global warming.

Renewable energy will benefit the country and provide a definitive answer to the problem of lack of energy security. While carbon-based energies have largely contributed to solving the employment problem, renewable energy will be an important source for creating low appreciation jobs and jobs requiring high-level training. This dual character will promote local participation and stimulate social development.

An objective should be set, reflecting a common political vision, which should play a central role in the implementation of global, national, and local energy practices and strategies. It is essential to define an ambitious long-term goal, backed by political commitment. This will allow both investors and the local population to have a long-term political vision. It will also give the different actors involved the opportunity to better understand their role in this change and the part they can play in achieving this common goal.

Further information on the topic can be found here:
https://algeria.fes.de/

FRIEDRICH EBERT STIFTUNG