HORIZONS

EXECUTIVE SUMMARY

MEDITERRANEAN ENERGY TRANSITION: 2040 SCENARIO

ome

MED ENER

ADEME

Agence de l'Environnement et de la Maîtrise de l'Energie

This document is the summary of the Mediterranean energy transition scenario findings elaborated and developed within the framework of the cooperation between MEDENER, OME and ADEME.

The results were presented at the occasion of the 4th MEDENER international conference "Enhancing energy transition in the Mediterranean, towards a sustainable energy mix". This conference is organised in partnership with the Agency for the promotion and the rationalisation of energy (APRUE), the 25th May 2016 in Algiers.

Following Medcop Climate in Tangier 18 and 19 of July and ahead of COP 22 in November in 2016, this work will be revised by assessing the energy sector contribution to the NDCs submitted by each Mediterranean country to the Paris Agreement of Paris at the occasion of COP21, with the ultimate objective to put all the countries of the Mediterranean region on a trajectory of + 2°C by 2040.

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FOREWORD

The Mediterranean is the only region on Earth where three continents meet. Mediterranean countries account for 7% of world population and they consume about 8% of the world's primary energy demand. Primary energy demand in the Mediterranean is expected to grow substantially over the next 25 years spurred by sustained population (+105 million compared to 2013) and economic (+2.3% per year on average) growth in the region.

In this situation, according to OME's "Business-As-Usual" scenario, final energy consumption would double by 2040 in the South Mediterranean countries and electricity consumption would triple, notably on account of the increase use of air conditioning and new electrical appliances. Carbon dioxide emissions would increase by 45% for the whole region and more than double in the South Mediterranean, despite the COP21 Paris conclusions, aiming for carbon neutrality by mid-century.

It is thus necessary to change the Mediterranean energy trajectory by favouring the implementation of energy efficiency measures and renewable energy deployment. Beyond environmental benefits, infrastructure needs and the energy bill will be reduced while strengthening energy security in the region. Furthermore, reduced geopolitical tensions and job creation will improve social wellbeing at regional level and within the framework of the Union for the Mediterranean.

Countries in the region have committed to embark upon the energy transition path, testimony of a will to fulfil ambitious national and regional objectives. Reinforcing Euro-Mediterranean cooperation takes on its full meaning, notably through the implementation of a regional platform to exchange on energy efficiency and renewable energies.

In this context, MEDENER, the association of national agencies for energy efficiency and renewable energy, and OME, the Observatory for Mediterranean Energy, have decided to join efforts to define and develop a voluntarist energy scenario, the Mediterranean Energy Transition Scenario to 2040; based on the prospective methodologies of ADEME (Agence de Maitrise de l'Environnement) and OME. The Energy Transition Scenario assumes the implementation of those measures that are currently the most technically, economically, and politically mature for large-scale rollout of energy efficiency and renewable energies. Compared to the business-as-usual scenario, the transition scenario would lead to a sizeable reduction in primary energy demand (-30%) and finale energy consumption (-23%), a substantial increase of the share of renewables in the energy mix, mainly solar and wind (27% in 2040), and a decrease in GHG emissions of 38%.

This vision is based on the implementation of tailored and sustainable policies and measures for all countries of the region, without impacting their comfort levels and using existing technologies MEDENER, OME and ADEME will carry-on their cooperation in this field in order to update these works and disseminate the results. This first foray in Mediterranean energy transition forecasting opens new fields of action to provide individual and collective answers to the energy and climate challenges of the 21st century.

Bruno Lescoeur
President of OME

Hamdi Harrouch
President of MEDENER

Bruno Lechevin
President of ADEME

The Mediterranean Energy Scenario covers 25 Mediterranean countries, of which 19 are modelled individually.

NORTH MEDITERRANEAN

- **The following countries have individual models: Cyprus, France, Greece, Italy, Malta, Portugal, Slovenia and Spain.**
- **The countries gathered in Other North, are modelled in one model (only the historical data are collected individually by country), and include: Albania, Bosnia Herzegovina, Croatia, Macedonia, Montenegro and Serbia.**

SOUTH MEDITERRANEAN

All the countries of the South of the Mediterranean are modelled separately and include:

- **In South-West (North Africa): Algeria, Egypt, Libya, Morocco, and Tunisia.**
- **In South-East: Israel, Jordan, Lebanon, Palestine, Syria, and Turkey.**

EXECUTIVE SUMMARY

THE MEDITERRANEAN ENERGY TRANSITION: 2040 SCENARIO

The stakes of embarking upon a Mediterranean Energy Transition is essential for countries from both shores of the Mediterranean, especially taking into account the increasing demographics (+105 million by 2040) and the fast growing energy demand in an increasingly constrained context both in terms of energy availability and environmental impacts of conventional energy sources uses. There is a huge, but yet untapped, potential for energy efficiency and renewable energy sources, especially in the South Mediterranean region.

By improving energy efficiency and deploying renewables on a large scale, the Mediterranean region would reduce tensions on energy security for importing countries, improve opportunities for exporting ones and reduce energy costs and environmental damages for the whole region. Embarking on an energy transition path will also help improve social welfare in the region and contribute to job creation, among other positive externalities.

OME regularly conducts prospective works to 2040, assessing the impact of prolonging current energy trends. Under this Business-As-Usual or so-called "Conservative" Scenario the situation would evolve critically on all counts over the next 25 years: doubling of energy demand and tripling of electricity consumption, soaring infrastructure and import bills (+443 GW to be installed and doubling of the fossil-fuel imports) and a critical rise in carbon emissions (+45%). Such a scenario, based essentially on fossil fuels, would put further strain on the environment and exacerbate geopolitical tensions in the region.

A change of energy trajectory is therefore necessary for all Mediterranean countries to help change current trends and to increase efforts promoting energy efficiency and renewable energies.

In this context, MEDENER and OME, based on the 2030-2050 visions of ADEME[1] and the prospective tools of OME[2], have decided to jointly investigate a Mediterranean Energy Transition Scenario, an ambitious scenario that goes beyond the plans and targets announced by governments and policy makers. The Energy Transition Scenario[3] assumes the implementation of those measures that are currently the most technically, economically, and politically mature for large-scale roll-out of energy efficiency and renewable energies. This Scenario assumes no major technology breakthrough, but the deployment of existing technologies and sound energy efficiency policies and measures across all Mediterranean countries.

Compared to the Conservative Scenario (Business-As-Usual), by 2040, the Mediterranean Energy Transition Scenario would lead to:

- **30% reduction** in energy demand and **23%** reduction in final energy consumption,
- **Increased share of renewable energy to 27%** of the energy mix in the region, with renewables becoming the primary source of electricity production,
- **Avoiding an additional 200 GW** of fossil-fuel based electricity production infrastructure,
- **Reducing CO_2 emissions by 38%.**

[1] ADEME contribution to the elaboration of the 2030-2050 energy visions; http://www.ademe.fr/contribution-lademe-a-lelaboration-visions-energetiques-2030-2050
[2] Presentation of the prospective model in Annex A
[3] The scenarios assumptions are summarized in Annex B

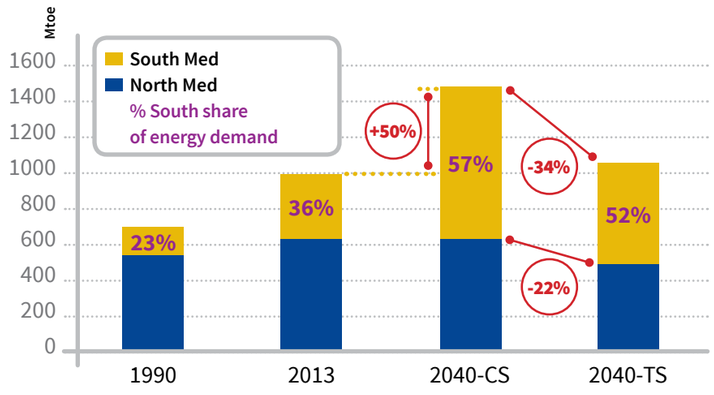
ENERGY DEMAND: A TALE OF TWO SHORES

Under the Energy Transition Scenario, the Mediterranean regional energy demand would only increase by 7% over the next quarter century from today's level of 990 million tonnes of oil equivalent (Mtoe) up to 1055 Mtoe, way below the 50% increase expected if current trends endure.

Expected trajectories for energy demand in the region are very contrasted across the two shores of the Mediterranean:

- The North countries, indeed, have already somewhat embarked upon a transition path with substantial levels of renewables and effective demand-side management. The energy demand in the North has indeed decreased by 4% since 2010. However, this decrease is not totally linked to its energy efficiency efforts but has also to be put into perspective with its very moderate population growth (+0.5%) and decreasing gross domestic product (-2%). As a result, in the Energy Transition Scenario, by 2040, energy demand in the North Mediterranean would continue to decrease. **In 2040, North Mediterranean energy demand would be 22% lower than current levels, standing at 502 Mtoe down from 634 Mtoe in 2013.**
- The South Mediterranean, on the other hand, has experienced sustained economic and population growth over the past years (+6% and +5% respectively), translating in an energy demand growth of +6% since 2010. South Mediterranean Energy demand reached 355 Mtoe in 2013 up from 335 Mtoe in 2010. **In the Energy Transition Scenario, energy demand would continue to increase to reach 552 Mtoe in 2040 – a 55% increase from current levels; however, the energy savings would be of 34% compared to the Conservative Scenario energy demand forecasts.**

FIGURE-1 **PRIMARY ENERGY DEMAND BY REGION**

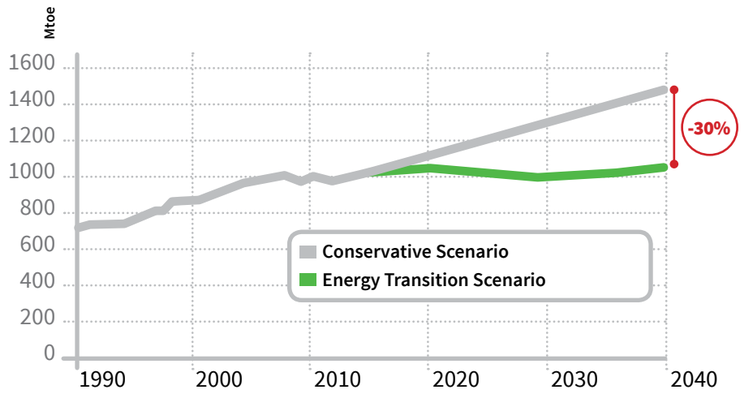


Note: CS = Conservative Scenario; TS = Energy Transition Scenario
Source: MEDENER/OME, 2015.

By the end of the outlook period, the South Mediterranean energy demand would thus have exceeded that of the North.

Under the Energy Transition Scenario, 30% of primary energy demand can hence be saved by 2040 for the whole region.

FIGURE-2 **PRIMARY ENERGY DEMAND BY SCENARIO**



Source : MEDENER/OME, 2015.

ENERGY AND CLIMATE CHALLENGES

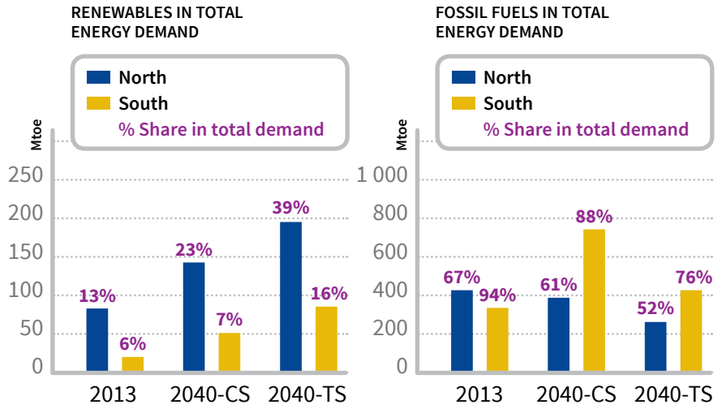
In the Energy Transition Scenario, fossil-fuels as a whole are set to remain the dominant component of the mix. However, while oil alone is expected to remain the dominant fuel of the energy mix, renewable energy sources would overtake natural gas and coal demand and become the second most used fuel in the Mediterranean energy mix at horizon 2040.

Fossil fuel share would drop to 64% down from 76% currently – an all-time historical low. And renewables would account for 27% of the total energy mix in 2040, up from 11% currently.

In the South Mediterranean this would be reflected by the share of fossil fuel dropping 18 percentage points from 94% down to 76%, while renewables would nearly triple their share in the energy mix from 6% currently up to 16% in 2040.

In the North Mediterranean, fossil fuels would account for only half the mix (52% in 2040) while renewables would make-up for most for the remainder (39%) – a decidedly more balanced energy mix.

FIGURE-3 **TOTAL PRIMARY ENERGY FUEL SHARES BY TYPE**

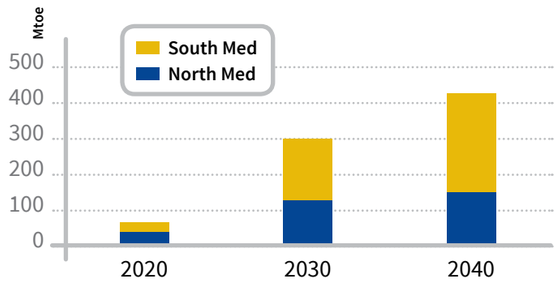


Note: CS = Conservative Scenario; TS = Energy Transition Scenario.
Source : MEDENER/OME, 2015.

ENERGY SAVINGS: SIZEABLE POTENTIAL AND A PRIORITY

The potential for energy efficiency is substantial in the Mediterranean region, particularly in the South. Despite some improvements, energy efficiency is still, at present, in its infancy stage in the region.

FIGURE-4 **MEDITERRANEAN PRIMARY ENERGY SAVINGS BY REGION**



Note: CS = Conservative Scenario; TS = Energy Transition Scenario.
Source: MEDENER/OME, 2015.

Under the Energy Transition Scenario, 30% of primary energy demand and 23% of final energy consumption can be avoided by 2040 in the whole region compared to 2013. The cumulative potential of final energy savings over the next 25 years would amount to nearly 6 billion toe which is equal to nearly six times the current final energy consumption of the whole region.

Overall, energy intensity – the amount of energy needed to generate a unit of gross domestic product - is decreasing in the region, largely related to shifts in the buildings, industry and transport sector.

By 2040, energy intensity could decrease by 42% from current levels. Today per-capita energy consumption in the South Mediterranean countries is less than half of the level of that in the countries in the North. By 2040, per-capita consumption in the South reaches nearly 65% that of the North in the Energy Transition Scenario.

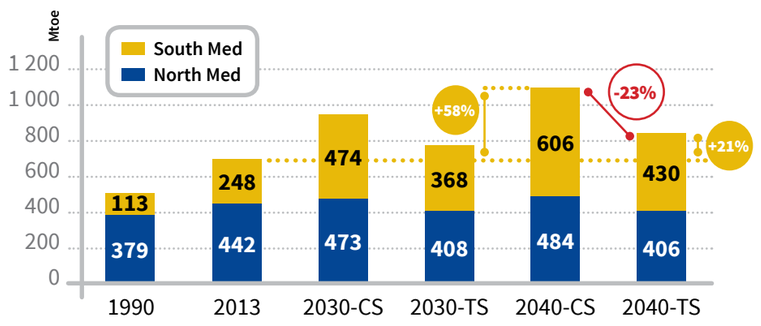
Final intensities are also generally decreasing with economic development and converging between sub regions.

ENERGY EFFICIENCY, HIGH STAKES FOR THE REGION

Compared to the Conservative Scenario which leads to an increase of 58%, overall, in the Energy Transition Scenario, final energy consumption increase to 2040 would be limited to 21%, representing an addition of nearly 150 Mtoe.

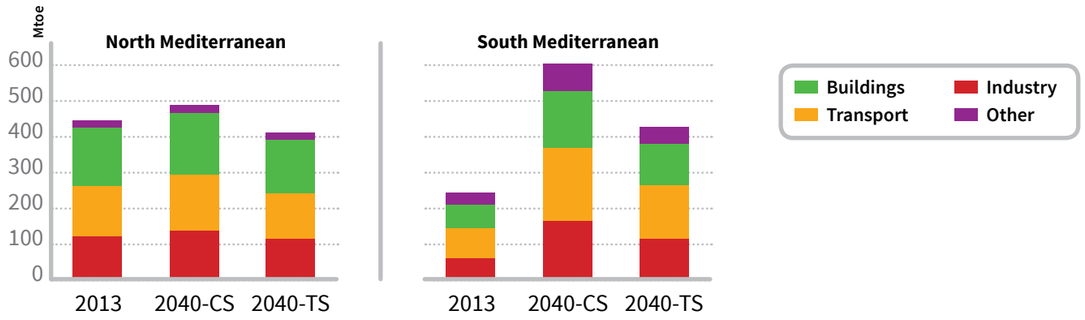
Substantial energy savings are forecasted in the buildings sector (residential and tertiary sectors), especially in the South Mediterranean where over 50 million new dwellings are expected to be built over the next decades. The Energy Transition Scenario also takes into account efficiency standards for all electrical equipment (including household appliances, cooling and heating of office space). **In 2040, buildings consumption would be 22% lower in the Energy Transition Scenario. This represents savings of 72 Mtoe by 2040 of which 47 Mtoe for the residential sector alone.** For the South countries energy savings would reach 29% in 2040.

FIGURE-5 **FINAL ENERGY CONSUMPTION BY REGION**



Note: CS = Conservative Scenario; TS = Energy Transition Scenario.
Source: MEDENER/OME, 2015.

FIGURE-6 **FINAL ENERGY CONSUMPTION BY SECTOR**



Note: CS = Conservative Scenario; TS = Energy Transition Scenario.
Source: MEDENER/OME, 2015.

For **the industry sector, energy savings could reach 25%,** especially taking into account substantial efforts on heavy industry, through standards and through cleaner and more efficient technologies.

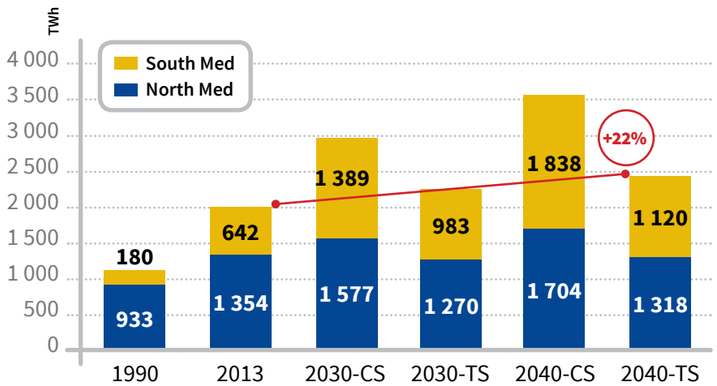
Energy demand **in the transportation sector would also fall by approximately 21%** taking into account, major efforts in terms of energy and societal policies and measures for private transport (more efficient vehicles), but also in the design of new cities and the organization of public transport.

The bulk of the efforts will target **the electricity sector** the most, especially in the buildings sector. Electricity could account for a third of total savings in final energy consumption with 81 Mtoe electricity savings in 2040.

REVAMPING THE ELECTRICITY SECTOR

Electricity demand growth could be considerably curtailed with gains in energy efficiency in the coming years according to the Energy Transition Scenario (0.9% per year on average to 2040 instead of 2.1% under current trends). This would also be complemented by a reduction in electricity losses.

FIGURE-7 **ELECTRICITY GENERATION BY REGION**



Note: CS = Conservative Scenario; TS = Energy Transition Scenario.
Source: MEDENER/OME, 2015.

Mediterranean power generation would only increase by 22% to 2040 in the Energy Transition Scenario compared to the 77% increase expected in the current context. This would equate to the cumulative potential savings of electricity in the whole region to reach over 14 000 TWh over the outlook period, which is more than the electricity consumption of the South in the last forty years.

The outlook is that the gap between the South and the North in electricity consumption on a per-capita basis narrows somewhat, but remains rather high even by 2040 with 2500 kWh in the South compared to 5200 kWh in the North in 2040.

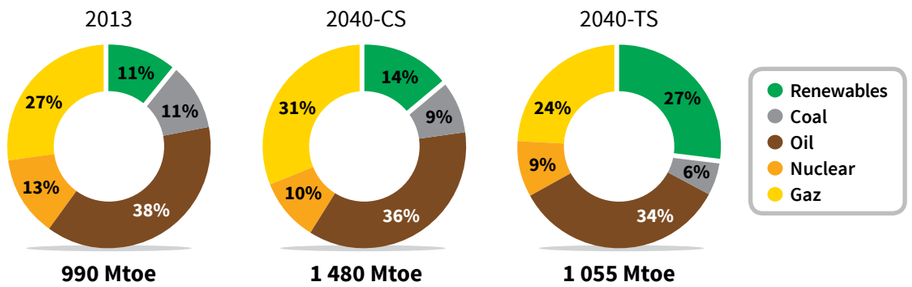
Under the Energy Transition Scenario, Electricity intensity would decrease across the Mediterranean region throughout the outlook period, largely driven by the buildings sector. Electricity intensity is expected to decrease substantially in the South converging with levels in the North by 2040.

In the outlook to 2040, to provide for the increase in electricity generation, an additional 240 GW of installed capacity would be needed for the region to increase in the Energy Transition Scenario (nearly half that needed under current trends in the Conservative Scenario).

PROMISING OUTLOOK FOR RENEWABLE ENERGY

The Mediterranean region has abundant renewable energy resources. Yet, today renewables only account for a limited share of the region's primary energy supply (11% in 2013). Traditionally the most exploited renewable energy sources have been biomass and hydropower. Geothermal energy contributes in a few countries. In recent years, wind and solar, both for electricity and heat production, have entered the energy mix.

FIGURE-8 **PRIMARY ENERGY DEMAND IN THE MEDITERANEAN ENERGY MIX**



Note: CS = Conservative Scenario; TS = Energy Transition Scenario.
Source: MEDENER/OME, 2015.

In the Energy Transition Scenario the share of renewables would triple to reach 27% in 2040 at an average annual growth rate of 4.3%. Most of the increase is expected to come from wind and solar. Among the various renewable energy technologies, solar is expected to grow at the fastest pace in both sub-regions. End usage of solar thermal energy, in particular solar water heaters, offers great potential in the South and is efficient with good return on investment. Solar water and cooling demand could increase six fold from its current level in the energy mix by 2040.

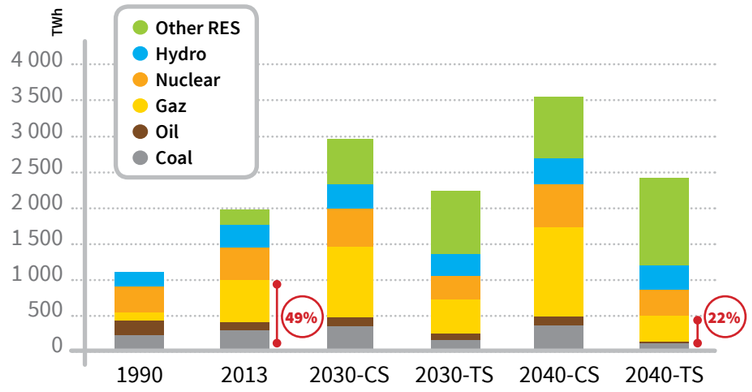
The most significant change ahead is a substantial increase in the contribution of renewables to power generation. Renewable energy sources would alter completely the installed capacity mix. By 2040, renewables would account for about 80% of total installed capacity and two thirds of electricity generation in 2040.

The share of Fossil fuel based electricity production could drop from 49% in 2013 to 22% in 2040, of which 15% from gas and 5% from coal.

In the North, the increase in the share of renewables in electricity generation will stem mainly from solar photovoltaic power with about 125 GW brought online by 2040, followed closely by wind (+113 GW added by 2040).

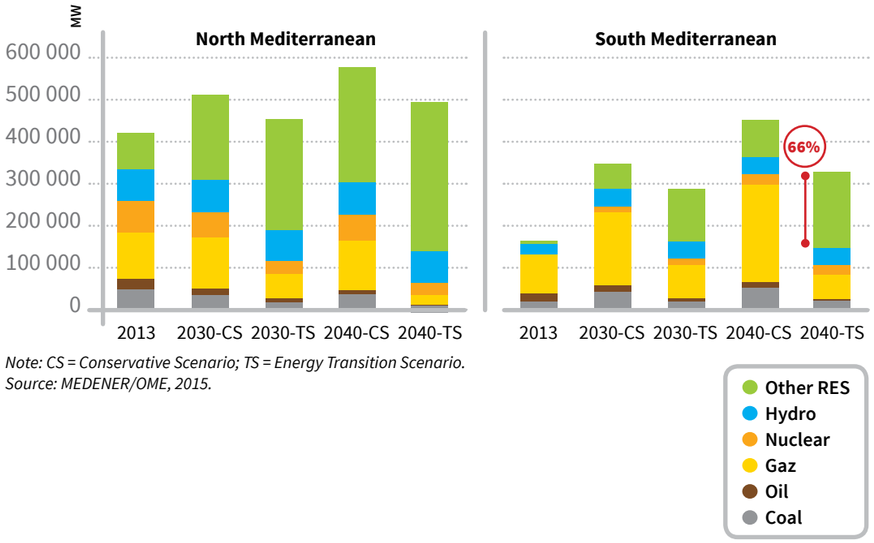
In the South, non-hydro renewables would expand to provide 66% of total installed electricity capacity in 2040, equating to 179 GW of which 59% from solar photovoltaics alone. Electricity generation from renewables would grow from 2% in 2013 to 35% in 2040, and thus become the first source of electricity generation.

FIGURE-9 **MEDITERRANEAN TOTAL PRIMARY ENERGY FUEL SHARES**



Note: CS = Conservative Scenario; TS = Energy Transition Scenario.
Source: MEDENER/OME, 2015.

FIGURE-10 **INSTALLED CAPACITY BY FUEL AND REGION, BY SCENARIO**



Note: CS = Conservative Scenario; TS = Energy Transition Scenario.
Source: MEDENER/OME, 2015.

A SUSTAINABLE FUTURE FOR THE MEDITERRANEAN

The Energy Transition Scenario would have two major striking impacts on energy security and environment. Net fossil fuel imports would be divided by three in 2040, bringing them down to 160 Mtoe – similar to early 1970s levels. In the North, energy dependence would be reduced down to 45% compared to 60% currently. The South Mediterranean would become a net exporter again with a net export of nearly 70 Mtoe of fossil fuels in 2040 compared to a net import slate of 17 Mtoe in 2013.

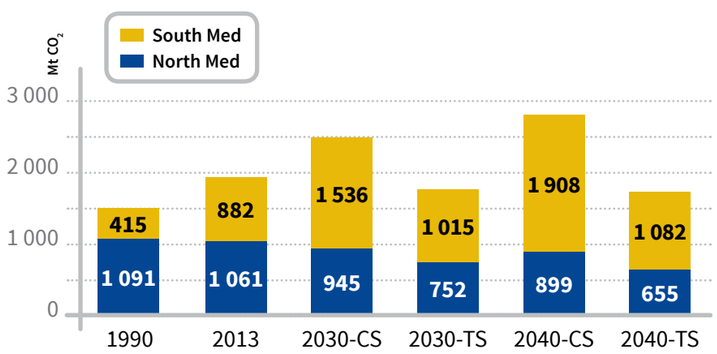
The Energy Transition Scenario would thus reduce the import bill of importing countries and increase substantially the export revenues of producing countries, which is key for energy security and more largely to reducing tensions in the region.

LESSENING THE BURDEN OF ENERGY ON THE ENVIRONMENT

Energy-related carbon dioxide emissions would double in the conservative scenario to reach 4 billion tonnes of CO_2.

The Energy Transition Scenario, foresees a reduction of 38% of CO_2 emissions compared to the conservative scenario and emissions would actually be reduced by 11% from current levels. CO_2 emissions would be 15% higher than the 1990 level compared to 29% higher today. In the North Mediterranean, CO_2 emissions would actually be 40% below the 1990 levels reaching 655 Mt of CO_2 in 2040, while in the South emissions would double to 1082 Mt of CO_2.

FIGURE-11 **CO_2 EMISSIONS BY REGION**



Note: CS = Conservative Scenario; TS = Energy Transition Scenario.
Source: MEDENER/OME, 2015.

REGIONAL COOPERATION

The Mediterranean region, with its diversity, offers an extended spectrum for regional and bilateral cooperation, including in the energy field, which gathers the two shores in shared objectives of energy security, competitiveness and the fight against Climate disruptions, particularly significant in the region.

Important disparities characterize the Mediterranean countries.

In the north, if fossil fuels are predominant, the EU is marked by the increasing share of renewable energies to at least 27% in 2030, the relative stabilization of energy consumption resulting from the rise of European policies energy efficiency.

In the South, all countries are characterized by high population growth that induces significant growth in energy demand, also fueled by inefficient pricing policies. Thus, there are net importing countries such as Morocco or Lebanon, currently importing respectively around 95% and 98% of their energy needs. Other countries see their situation deteriorate like Turkey, which energy dependence rose from 29% in 1971 to 72% today and Tunisia, which became a net energy importer since 2007. Even producing countries, such as Algeria, Libya or Egypt could ultimately see their energy situation deteriorate with a decrease in their energy exports potential.

A major development is highlighted by the « Mediterranean Energy transition scenario 2040 ». At this horizon, the energy consumption of the South could exceed that of the North shore.

Faced with this economic, social and environmental situation, energy and climate challenges are of major importance. Accelerating the energy transition in the Mediterranean would help to control the energy demand, to promote renewable resources and finally to optimize the use of fossil resources. The optimisation of the regional energy system, would pass through a better integration of markets, increased interconnection and intelligent management of networks, including the facilitation of access for renewable energy and demand side management .

The national agencies for energy efficiency and renewable energy are key players, already heavily involved in the framework of bilateral or regional cooperation actions within MEDENER. These actions allowed important progress such as the implementation of energy regulations in the building sector, display the energy performance of equipment, energy audit methods in the services and industry sectors, programs for solar water heaters deployment, etc. For MEDENER and its members, the challenge of accelerating the path to the energy transition in the Mediterranean is to enhance the skills locally, to mobilize the private sector, banking and local authorities, as part of ambitious and proactive programs based on the NDCs submitted by states at the occasion of the COP21 in Paris.

The Euro-Mediterranean dialogue, under the chair of the European Commission and the Kingdom of Jordan, and at the Rome conference in November 2014, decided to establish three platforms for exchange and partnerships. The ultimate goal for these platforms is to operate as permanent consultation forum on strategic objectives and measures to be implemented under the auspices of the Union for the Mediterranean. The three platforms cover: (i) the gas sector and is managed by OME, (ii) the electricity market with support provided by MEDREG and MEDTSO and finally (iii) the renewable energy and energy efficiency with support of MEDENER, RCREEE and RES4Med.

To support the Euro-Mediterranean dialogue on energy transition, MEDENER and OME jointly initiated a prospective study assessing the «Mediterranean energy transition scenario 2040» in terms of NDCs. The results of this work will be presented at the COP22 in Marrakech in November 2016.

APPENDIX A

MODEL DESCRIPTION

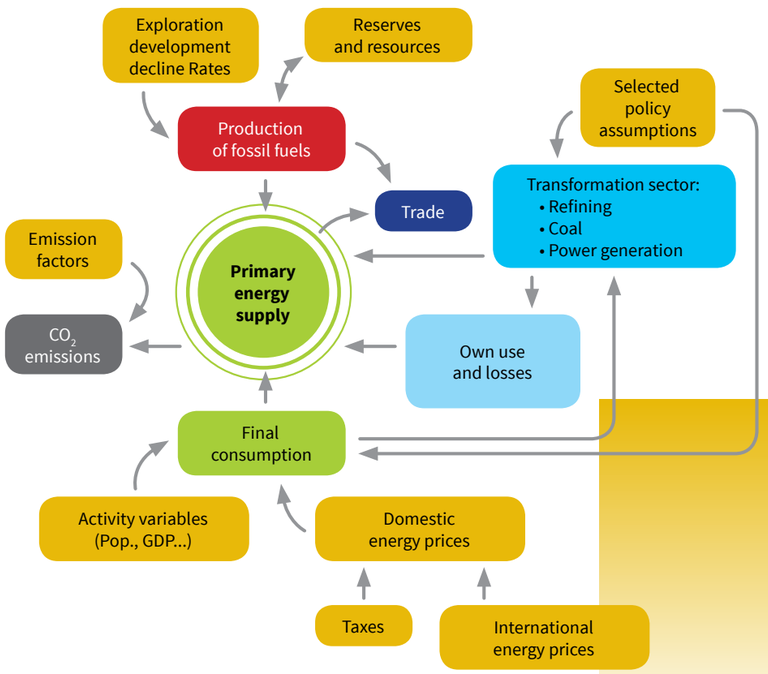
OME has developed an econometric model called the MEM (Mediterranean Energy Model) which, from exogenous variables and historical data, performs long-term scenarios. This model was developed and commissioned in 2008. Since then, the MEM has been updated, improved and more detailed. The latest version was presented in the MEP 2015 (Mediterranean Energy Perspectives), published in December 2015. The OME model is a «bottom-up» demand model. This econometric model is based on three exogenous variables. The last reference year for the data is 2013 and projections are for 2040.

In all scenarios, the OME follows a structural econometric approach that combines economic theory and statistical methods to produce a system of equations establishing causal relationships between energy demand and activity variables (such as GDP, population etc.). This system of equations is then used to generate medium and long-term forecasts of future energy demand.

MEM uses for its energy balances, the same methodology as that of the International Energy Agency (same definitions of flows and energy products).

Thus, the flow of demand and supply generated by the MEM model of OME, including Conservative Scenario and Transition Scenario, are fully compatible and comparable with those of the IEA.

In the outlook of the energy sector, key exogenous variables used in the model are **population**, economic growth and fossil fuels international prices. Assumptions full details are explained in the complete document of the scenario. By 2040, the Mediterranean population will increase by 105 million, almost all of which in the South. **Economic growth** in the region should be fairly strong, with an average annual growth of 2.3% by 2040. The econometric model considers for the scenarios developed here, **international fossil fuel prices** as a reference to estimate domestic prices (before tax) per sector. The level of the tax by fuel and by sector is assumed to remain constant in the model, the same level as the second quarter of 2015. In addition, the model does not anticipate major changes in energy pricing policies than those in place mid- 2015



APPENDIX B

ENERGY SCENARIOS ASSUMPTIONS DESCRIPTION

Two scenarios were considered in this study. The first is a baseline scenario – the Conservative Scenario, which was taken from OME's Mediterranean Energy Perspectives (MEP 2015 edition). The second is the Mediterranean Energy Transition Scenario jointly defined by MEDENER and OME with the assistance of ADEME. Both Scenarios description and underlying assumptions are detailed below.

THE CONSERVATIVE SCENARIO

The Conservative Scenario takes into account past trends, current policies and ongoing projects, but adopts a cautious approach regarding the implementation of new policy measures and planned projects. It does not assume large-scale efficiency programmes or major efforts for energy conservation. This is a bleak scenario.

For the EU countries the Conservative Scenario is based on the country projections of the European Commission, EU Energy, Transport and GHG Emissions Trends to 2050 (the 2014 edition). However some adjustments had to be made where actual data had already exceeded the 2015 projections and where the trends were quite different from what had been anticipated.

In the South, as the population and economy expand, energy demand rises significantly. Increased demand for electricity in this scenario will be met with the usual primary energy sources and others that reasonably will be available in the future.

For nuclear power, this scenario takes into account average lead times for plant commissioning plus the financial and other uncertainties inherent in project development. Therefore the expected operation times for each unit of the nuclear power plants differ from the ones announced by governments.

For renewable energy sources, this scenario takes into account the plans released by governments, but assumes a slow rate of deployment. It remains cautious.

In this scenario, the utilization rate of power generation plants remains sensibly the same throughout the projection period. However, efficiencies differ, especially for coal power plant efficiencies, as well as gas power plant efficiencies, which are expected to improve somewhat over time as new and more efficient plants are brought online. Distribution losses, as well as own use, are assumed to be reduced over time reflecting past trends.

THE MEDITERRANEAN ENERGY TRANSITION SCENARIO

The Mediterranean Energy Transition Scenario assumes strong efforts to diversify the energy supply mix to favour domestic energy resources, clean energy technologies and to implement effective energy efficiency programmes.

The Mediterranean Energy Transition Scenario is much more ambitious than the Conservative Scenario in terms of energy efficiency integration and renewable energy development. It assumes a massive implementation of those measures that are currently the most technically, economically and politically mature for large-scale roll-out. It assumes, on one hand, a move towards diversification of supply, with a decisive push for renewable energy projects and, on the other hand, it assumes effective implementation of large-scale energy efficiency measures, particularly in the end-use sectors. Correspondingly, the Mediterranean Energy Transition Scenario assumes prompt implementation of the necessary policy actions and measures to reduce energy intensity.

SUPPLY-SIDE ASSUMPTIONS: DEPLOYING RENEWABLES ON A LARGE SCALE

The Mediterranean Energy Transition Scenario is based on the assumption that all official renewable programmes and targets announced have been followed-through (based on official targets and plans).

This scenario even goes beyond government plans in some cases where renewable deployment announcement are still limited. The assessment was made on a country-per-country basis, based on the expertise of regional and national agencies.

All renewable energies were considered for all energy usages. These include renewables for electricity generation and also renewables for end-use consumption such as biofuels for transport, biomass and waste, geothermal heat, solar water heaters etc.

DEMAND-SIDE ASSUMPTIONS: ENHANCING ENERGY EFFICIENCY

Most countries have set targets for energy savings in the short to medium term under the framework of their programs of energy conservation.

In the North, especially in EU countries, energy efficiency programmes are already well on their way and are defined by the European Union[1]. However, even for North Mediterranean countries, the Mediterranean Energy Transition Scenario goes beyond by using as benchmark other studies which have been made such as the Energy Transition vision developed by ADEME for France (Vision 2030-2050) and the 450 scenario of the IEA.

In the South, current objectives are highly variable and most often merely indicative, rarely deploying means of action targeting all sectors. For the majority of the South Mediterranean countries, current action plans represent their first official national energy efficiency plan, with the exception of Tunisia, which has already successfully implemented the first two plans, and is the only one country that included transport sector in its third action plan (2013-2020).

For the rest, countries mostly focused on the power sector, and more specifically on the residential sector. Action plans include for the most measures promoting energy efficiency lighting, solar water heaters, and energy audits in industrial facilities. Other measures include the development of standards and labelling for household appliances, the design of energy efficiency regulations for buildings and the improvement of energy efficiency in water pumping.

However, at present, and especially in the South, plans announced have rarely followed suit. The Mediterranean Energy Transition Scenario assumes that these plans will follow through and even go beyond.

THE BUILDINGS SECTOR

The buildings sector currently accounts for 35% of total final energy consumption in the Mediterranean, with 24% for the residential sector alone and a booming services sector in the South.

In the buildings sector several assumptions were taken into consideration while building the Mediterranean Energy Transition Scenario:

- Potential energy savings of 40% for new buildings especially in the South Mediterranean countries, compared to business-as-usual scenario based on a forecast of an additional 50 million dwellings by 2040.
- 10% to 15% additional savings for the renovation of existing buildings.
- An increased use of more efficient space and water heating equipment as well as the development of solar water heaters etc.
- Enforcing the use of the most efficient appliances both for residential and services usages (fridges, washing-machines, dish-washers, TV etc).
- Efficiency gains were calculated based on the 2030-2050 vision designed by ADEME in its Energy Transition Scenario for France[2] (see table below).

Type of appliance	Expected efficiency gains by 2030
Fridge	**-67%**
Freezer	**-75%**
Washing-machine	**-37%**
Dryer	**-12%**
Dish-washer	**-63%**
Television	**-37%**

- In the services and public administration sectors, ensuring maximum efficiency specifications notably for air conditioning.
- Specific efforts for public and private lighting, using the most efficient technologies (LED and OLED) and promoting demand-side management to effectively limit their usage.

THE TRANSPORT SECTOR

The transport sector accounts for a third of total final consumption at present and mainly (95%) oil. In the South especially the average retirement of vehicles is very high (+14years old for most southern countries) which entails a large number of very inefficient engines still on the road. Moreover public transport is not always developed to its full and, as entire cities emerge with population and urbanization rates increasing, there is a real place for efficient management and implementation of public or shared transport modes.

The following assumptions have been taken to build the Mediterranean Energy Transition Scenario:

- Rejuvenating the vehicle fleet in all countries especially in the South Mediterranean countries. Ensuring a speedier turn-over of vehicles.
- All new vehicles to follow the most advanced specifications equipped with the most energy efficient engines (new vehicles to be 20-30% more efficient in South countries). With and expected average consumption in 2040 of 3.9 to 4.6L/100km for thermal vehicles and 10 to 15kWh/100km for electric vehicles.
- Increase in the share of hybrids.
- Reducing the use of diesel vehicles especially for private usage
- Promoting electric and natural gas vehicles for public and private usage
- Modal shift: more efficient design of transport systems, developing further collective means of transport for public and private usage. Assuming, one passenger.km in public transport consumes one third of the energy of the same journey in private transport (ANME estimates, Tunisia).
- Modal shift for freight transport: one tonne.km of rail freight consumes one third of the energy of road freight (ANME estimate, Tunisia).

One passenger.km in public transport consumes one third of the energy of the same journey in private transport (ANME estimates, Tunisia).

THE INDUSTRY SECTOR

Industry accounts for 25% of total final energy consumption at present, with more heavy industries in the South.

Assumptions in this sector include the implementation of stricter standards specifically for the manufacturing industry and service sectors. These standards and measures are aligned with those implemented in EU countries.

Were considered in the Mediterranean Energy Transition Scenario the following efficiency measures:

- More efficient industrial equipment. Favoring technology innovation. Replacement of equipment with high efficiency equipment (electric motors and pumps, ...)
- Equipment maintenance
- Adjustment of boilers (combustion, insulation, ...)
- Insulation of the steam cycle, of the hot water, of cold surface and Improved performance of coolers. Recycling of condensates
- Implementing organizational and policy tools, Installation of an energy management system
- Enhancing good practices, reducing wasted energy
- Developing the use of waste and renewable energy especially in the North countries. Utilization of renewable energy for energy production (preheating and water heating, water pumping or solar roofs)

These measures are expected to yield around 15% electricity savings to 2030, up to 65% energy savings in thermal energy (for the new equipment installed: additional or in replacement of inefficient equipment) and 10 % energy savings for steam and compressed air cycles.

THE TRANSFORMATION SECTOR

The transformation sector (electricity generation, refineries, gas works, coke plants etc) currently accounts for nearly 50% of total primary energy demand.

Most of the energy gains in this sector will result directly from the savings in the end-use sectors mentioned above, especially with the reduction of electricity demand in the buildings sector. However, some specific improvements are assumed to be undertaken in the transformation sector itself.

In the Mediterranean Energy Transition Scenario, plant efficiencies are expected to improve over time assuming that all new plants (coal and gas-fired plants) that come online would be built with the most efficient technology. Some older plants are also assumed to be replaced and upgraded to increase fuel efficiency. Losses as well as own use in general, and especially electricity transmission and distribution losses, are assumed to be reduced at a much faster pace compared to the Conservative Scenario. Own-use and losses in the electricity sector alone are assumed to be reduced by 25% on average to 2040.

[1] *European Directive 2006/32/ EC on energy end-use efficiency and energy services (ESD).*
[2] *ADEME, Technical Document, ADEME energy transition scenarios 2030/2050, Paris, mai 2014.*

APPENDIX C

ABBREVATIONS AND ACRONYMS

ABBREVATIONS

CO_2	Carbon dioxide
GDP	gross domestic product
Gt	billion metric tonnes/gigatonnes
GW	gigawatt (1 watt x 10^9)
GWh	gigawatt-hour (1 watt x 10^9)
km	kilometre
km^2	square kilometre
kWh	kilowatt-hour (1 watt x 10^3)
mbd	million barrels per day
Mt	million metric tonnes/megatonnes
Mtoe	million tonnes oil equivalent
MWh	megawatt-hour
MW_{th}	megawatt thermal
TWh	terawatt-hour (1 watt x 10^{12})

ACRONYMS

ADEME	Agence De l'Environnement et de la Maîtrise de l'Énergie, France
ADENE	Agencia para a Energia, Portugal
ADEREE	Agence nationale pour le Développement des Energies Renouvelables et l'Efficacité Energétique, Morocco
ALMEE	Association Libanaise pour la Maîtrise de l'Énergie et l'Environnement
Alnaft	Agence nationale pour la valorisation des ressources en hydrocarbures/National Agency for the Development of Hydrocarbon Resources
ANME	Agence Nationale pour la Maîtrise de l'Énergie, Tunisia
COMELEC	Comité Maghrébin de l'Electricité
CRES	Centre for Renewable Energy Resources, Greece
CSP	concentrating solar power
EIA	US Energy Information Agency
ENTSO-E	European Network of Transmission System Operators for Electricity
EU	European Union
IEA	International Energy Agency
IMF	International Monetary Fund
IMME	Intégration des Marchés Maghrébins de l'Electricité/ Maghreb electricity market integration
IPP	Independent power production
LNG	liquefied natural gas
MEDENER	Association Méditerranéenne des agences Nationales pour l'Efficacité Energétique et le Développement des Énergies Renouvelables
NTC	net transfer capacity
OECD	Organization for Economic Co-operation and Development
PPP	purchasing power parity
PV	photovoltaic
TPES	total primary energy supply
TSO	transmission system operators
UNFCCC	United Nations Framework Convention on Climate Change
UNWPP	United Nations World Population Prospects
IPCC	Intergovernmental Panel on Climate Change
NREAP	National Renewable Action Plan
MEDREP	Mediterranean Renewable Energy Programme
EEA	European Environment Agency
UNEP	United Nations Environment Programme
PROMASOL	Programme de Développement du Marché Marocain des Chauffe-eau Solaires
UNDP	United Nations Development Programme
SHIP	solar heat for industrial processes

HORIZONS

IN BRIEF

Founded in 1997 as an international non-profit organisation, it brings together 12 national energy agencies from both northern and southern shores of the Mediterranean. The association will soon welcome other countries such as Turkey and Egypt. MEDENER , platform of regional expertise, aims to promote the exchange of experiences and best practices, transfer of skills and methods for energy efficiency and renewable energies. It also supports the development of sectorial programs, regional pilot projects and adaptation of tools and standards in the field of energy management. The association participates in the work carried out in the framework of the Union for the Mediterranean (UfM), including the Mediterranean Solar Plan, and has thus become a key player in the energy transition in the Mediterranean.

The Presidency of MEDENER network is provided for two years and alternately by the agencies of North and South of the Mediterranean.

www.medener.org

Observatoire Méditerranéen de l'Energie, is the association of the Mediterranean Energy Industry. For over 25 years, OME has been committed to promote energy dialogue in the Mediterranean Region to strengthen regional cooperation. OME analyses energy with an integrated and cross-cutting approach and is a Think-Tank of reference in the region.

Studies are conducted through an original cooperation between experts from member companies, OME Technical Committees and the permanent staff of OME. OME participates in several European Commission and other international projects, promotes knowledge exchange and capacity building.

OME has signed MoUs to promote cooperation with other regional organizations. OME is involved as stakeholder in the UfM REM and REEE platforms and acts as Secretariat of the UfM Gas Platform. OME notably publishes a Mediterranean energy outlook, the "Mediterranean Energy Perspectives".

www.ome.org

The French Environment and Energy Management Agency (ADEME) is active in the implementation of public policy in the areas of the environment, energy and sustainable development. The Agency provides expertise and advisory services to businesses, local authorities and communities, government bodies and the public at large, to enable them to establish and consolidate their environmental action. As part of this work ADEME helps finance projects, from research to implementation, in the areas of waste management, soil conservation, energy efficiency and renewable energy, air quality and noise abatement.

ADEME is a public agency under the joint authority Ministry for the Environment, Energy, Oceans and International Climate Relations, and the Ministry for primary, secondary and Higher Education and Research.

www.ademe.fr

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