Towards A Breakdown Energy Scenario in The Mediterranean?

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Introduction

Plan Bleu carries out analysis and prospective studies on a regional scale with the aim of building visions for future and strengthening policy-making. It therefore has a role in developing contrasting resource usage scenarios and studying their impact on the environment and development. On the energy issue, increase in energy efficiency and development of renewable energies are approaches that could help foster an energy transition towards a model with a strong local dimension and low carbon content.

Various prospective studies were carried out by Plan Bleu in 2005 and 2009, in particular a publication on the state of the environment in the Mediterranean. One specific study, "Infrastructure and Sustainable Energy Development in the Mediterranean: Outlook 2025", carried out in 2009-2010 with the support of the French Development Agency (AFD) analysed two scenarios, a business-as-usual scenario and an alternative scenario, with projections for 2025.

The *Observatoire Méditerranéen de l'Energie* (OME) regularly carries out prospective studies on developments in the energy situation in the Mediterranean region as a whole and in each country. Its most recent publication, "Mediterranean Energy Perspectives" (MEP), was published in late 2011 (the previous edition came out in 2008). This report presents possible energy trends in the form of two scenarios for 2030 - a conservative scenario and a proactive scenario. Both scenarios are considered to be achievable in the light of energy policies in the Mediterranean region.

The energy perspectives in the MEP conservative (business-as-usual) scenario and the proactive scenario show that there is room for manoeuvre to reduce tensions and steer towards a more sustainable energy path **(see I)**.

This is particularly important in Southern and Eastern Mediterranean countries (SEMCs), which are seeing the strongest growth in energy demand. For Northern countries, the European Union (EU) commitments (20-20-20 then 30-30-30) are very ambitious goals.

In this context, Plan Bleu and OME worked together to define a so-called "breakdown or rupture scenario" that is even more ambitious than the MEP proactive scenario **(see II)**. The breakdown scenario 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, with all the inherent and related opportunities for job creation, industry, and land-use development, etc. The benefits of this scenario were quantified and compared to the OME scenarios.

This project involved two phases:

- Firstly, in 2009 and 2010, several "breakdown" hypotheses were sought from a panel of experts on the Mediterranean energy situation, and these hypotheses were then implemented in the OME's MEP 2008 model.
- The publication of MEP 2011 required re-implementation of these hypotheses in order to generate up-to-date information and compare the recent MEP scenarios (conservative and pro-active scenarios) with the breakdown scenario.

The impact of a breakdown policy, particularly with regard to changes in power generation infrastructure and developments in construction demand management, were further studied in two specific analyses of the construction industry and interactions with employment and training.

It is important to highlight certain limits to this exercise, in particular the interaction with climate change, which was not retroactively analysed in the energy model, meaning that its energy impact is "overlooked", particularly with regard to power generation (increased air conditioning needs, desalination, etc.).

Part III makes recommendations for fine-tuning the results and for their use. Hypotheses for each sector and subsector and for each country still need to be developed and improved. Detailed demand analysis exercises could also be used to simulate the impact of energy policies.

A next step could be to incorporate a further level of ambition, taking into account potential changes in individual behaviour, technological developments, and potential changes in international corporation/regional governance.

The development of such scenarios is an important source of information for informing choices at a time in which energy issues are discussed in an increasingly collaborative manner, for instance through wide-reaching projects such as the Mediterranean Solar Plan.

I. Elements for building Mediterranean energy scenarios

In 2005, Plan Bleu published a report entitled "A Sustainable Future for the Mediterranean: The Blue Plan's Environment and Development Outlook"[1]. The business-as-usual and alternative energy scenarios for 2025 were developed in 2003/2004 in close collaboration with the OME.

Because the international, European, and Mediterranean context and the situation in the Mediterranean countries had changed significantly, Plan Bleu and OME worked together again from 2009 to continue the reflections on the energy future in the Mediterranean, taking this new context into account in an alternative breakdown scenario.

This report involved studying the impact of stronger energy demand management and renewable energy development hypotheses. The objective is to highlight the interactions between these hypotheses and the energy-related factors but also the major socio-economic factors in the Mediterranean region, in particular Southern and Eastern Mediterranean countries (SEMCs).

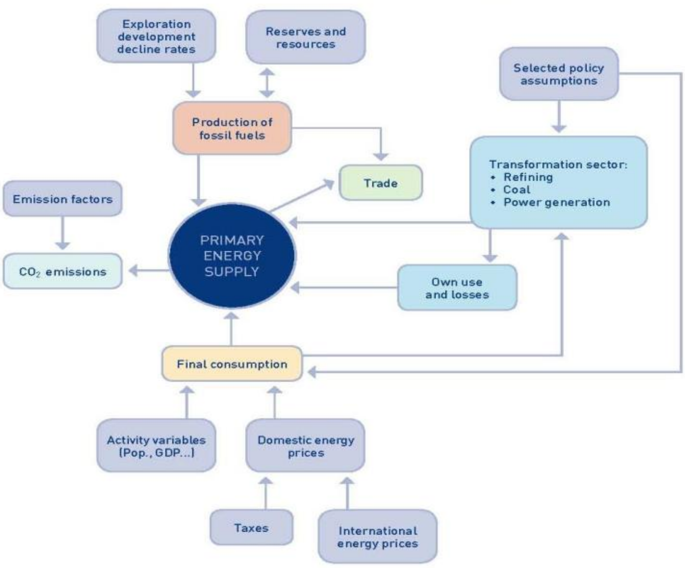
1. Models

1.1. Primary assumptions for modelling

OME model

Having previously used externally-developed tools for its energy prospective studies, the OME developed an economic model called the Mediterranean Energy Model (MEM). The MEM can be used for long-term scenarios based on exogenous variables and historical data. The model was developed and first used in 2008 (refer to MEP 2008 for a presentation and analysis of the scenarios). The MEM has since been updated, improved and fine-tuned, in particular to incorporate the effects of the economic crisis. The 2011 version was presented in the MEP 2011 report, published in November 2011.

Figure 1 - Schematic representation of OME MEM model



Source: OME, 2011

[1] Since this publication, Plan Bleu has observed developments in the energy context of the region, particularly focusing on energy efficiency, renewable energies and links with climate change. In 2006/2007, Plan Bleu was involved in monitoring the "Energy" chapter of the Mediterranean Strategy for Sustainable Development. In 2007/2008, Plan Bleu published a further report entitled "Climate Change and Energy in the Mediterranean" which emphasized the CO2 emissions reduction options via renewable energy and energy efficiency and the vulnerability of the energy system to climate change. These reports are available at: http://www.planbleu.org/publications/energieUk.html

The OME model is a bottom-up demand model (see Figure 1). This econometric model is based on three exogenous variables. The most recent data reference year is 2010 and the projections run to 2030. The OME developed two scenarios: a conservative (business-as-usual) scenario and a proactive (alternative) scenario.

Geographical coverage

The Mediterranean zone as defined in MEP 2011 covers 24 countries, of which 19 are separately modelled. These countries include all SEMCs, all of which have their own econometric model. The SEMC results are presented in the following blocks: South-West (Algeria, Egypt, Libya, Morocco, and Tunisia) and South-East (Israel, Jordan, Lebanon, Syria, Palestinian Territories and Turkey).

Exogenous variables

The model is based on the following three exogenous variables:

- economic growth (GDP),
- population,
- international fossil fuel prices.

Historical data

For each country, the OME collected historical data from its members, national authorities and various other bodies. Data was collected about energy but also other variables such as added value in various sectors (in particular manufacturing industry), the vehicle fleet (transport sector), equipment and equipment take-up (for the residential sector), infrastructure (transport networks, refineries, etc..), rates of use, efficiency etc.

The OME energy balances use the International Energy Agency (IEA) nomenclature to ensure that data projections are compatible and comparable.

OME scenarios

The business-as-usual scenario, referred to as *conservative scenario*, takes into account past trends, policies and current projects, but uses a prudent approach with respect to the implementation of new projects, measures and policies. This scenario does not incorporate the implementation of large-scale energy efficiency programmes or major energy conservation efforts. It is a fairly pessimistic scenario whereby energy demand grows in line with economic and demographic growth. Increased electricity demand will be met by conventional primary sources and new energies that could reasonably be assumed to be available in the future. With respect to the deployment of nuclear power, this scenario takes into account construction and commissioning time periods, the delays inherent in national constraints and the uncertainty relating to these projects. According to this scenario, renewable energies will be deployed under the plans already drawn up by governments, but at a slower pace.

The alternative scenario, referred to as *proactive scenario*, is more ambitious, but still relatively prudent. It is based on the implementation of significant energy efficiency programs and a heightened diversification of the energy mix. This leads to a larger proportion of renewable energies in the electricity mix and final usage, but also a relatively higher penetration of nuclear power in some Southern Mediterranean countries. This scenario foresees a falling proportion of oil and coal in power generation in favour of clean energies, and assumes that all demand reduction goals and renewable energy development goals will be met, as established or anticipated in Mediterranean countries. The proactive scenario therefore anticipates the rapid implementation of the policies and measures required to reduce energy intensity and develop renewable energies and nuclear power.

1.2. Limitations and reservations

An econometric model is clearly a simplified view of reality, represented by econometric equations based on past data and hypotheses for the future. Even the best econometric model is no better than the data and hypotheses it is built on.

Two major factors therefore limit any model: available data and future hypotheses.

Available data: it is vital for the SEMCs to segregate data by subsector and source/technology; however this level of detail is not always available. This is often due to the lack of systematic data collection and the lack of comparable and comprehensive national analysis. Problems also arise with data missing from historical series, because of definitions that change over time. This is due to reclassification or changes of the nomenclature that are not always documented or adjusted. Finally, some historical data series simply have not been collected. This lack of historical perspective is a hindrance to any prospective study.

Future hypotheses: in the MEM econometric model, three exogenous variables determine all the endogenous variables, namely GDP, population and international fossil fuel prices. This data is collected from international and national bodies. The decision to apply one trend rather than another can lead to very significant variation in results, particularly with regard to economic growth. There is very little difference of opinion with regard to population growth trends. International fuel prices have a moderate effect on trends. However, economic growth is a controversial, much revised piece of information, particularly in the current economic context.

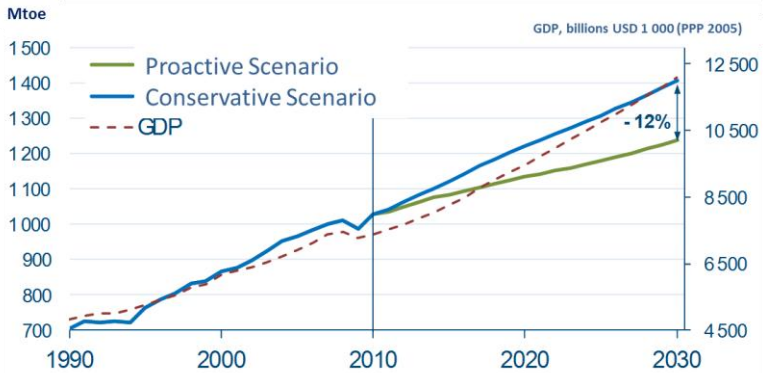
2. Energy trends in the Mediterranean: opportunities for a breakdown approach?

2.1. Strong growth in energy demand, driven by economic and demographic growth

It is obvious that primary energy demand in the Mediterranean will grow over the next few years, driven by various phenomena. The primary factors of growth and new demand for energy services and infrastructures are high demographic growth (1.2% on average per annum in Southern countries and 0.3% in Northern countries between 2009 and 2030), combined with rapid urbanization and major socio-economic development needs. Economic growth is forecast to be 3.9% annually in the South and 1.9% in the North on average.

According to the conservative scenario (OME, 2011), demand will grow more than 40 % by 2030 to over **1 400 Mtoe**. Demand is projected to increase less rapidly under the proactive scenario with greater energy efficiency and more room for renewable energies. By 2030, it would only increase 23% compared with today's values.

Figure 2 - Projected changes in primary energy demand in the Mediterranean (1990-2030)



Source: OME database.

The increase in energy demand will be more pronounced in Southern Mediterranean countries in parallel with their demographic and economic growth. The proportion of demand from Southern countries in regional consumption will increase from 34% in 2009 to 44% or 47% in 2030, depending on the scenario.

The gap in energy consumption per capita between the North and the South is also projected to fall. **However, depending on the scenario, an NMC inhabitant will by 2030 consume 1.7 to 2 times more energy on average than an SMC inhabitant.**

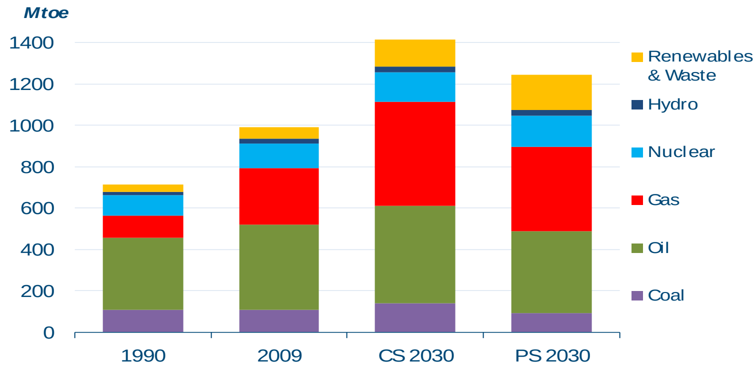
Analysis of the results from the MEP scenarios highlights the following key findings:

- The Mediterranean **energy mix** will still be **dominated by fossil fuels** and the region will enter the **natural gas era** from 2020,
- The **power generation industry** will continue to expand,
- **Renewable energies will** grow strongly, by the equivalent of two Mediterranean Solar Plans by 2020 and two others between 2020 and 2030,
- **Energy efficiency** offers significant and attainable potential and is a priority,
- **Environmental challenges** will be exacerbated (climate change, interaction with water resources).

2.2. Energy mix dominated by fossil fuels and advent of the natural gas era (2020)

Regardless of the scenario, the Mediterranean energy mix will remain heavily dominated by fossil fuels. They will account for 79% of primary energy demand in 2030. Natural gas demand will overtake demand for oil over the next ten years and some changes to the energy mix are anticipated, in particular a greater renewable energy contribution. Nevertheless, gas demand is expected to increase by 30% by 2030 and overtake demand for oil. By 2030 Egypt will top the league table for gas consumption in the region.

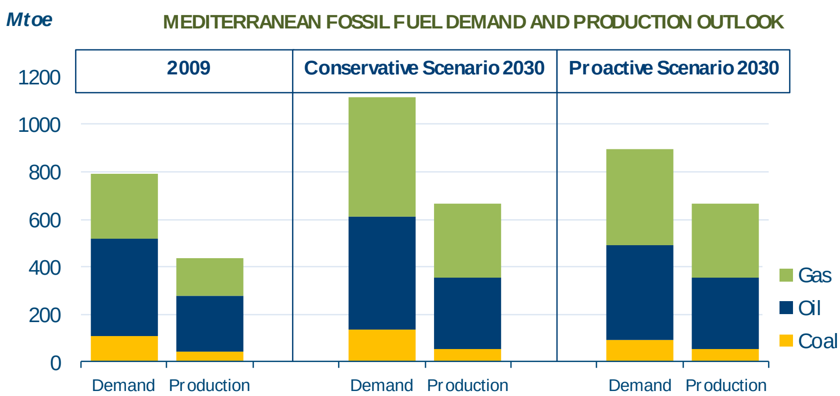
Figure 3 - Projected energy demand by source (1990-2030)



Source: OME database

Oil production should slow down after 2020. The Mediterranean is a net oil importer and will remain so over the next twenty years. However, gas production should more than double over the same period.

Figure 4 - Projected fossil fuel demand and production in the Mediterranean

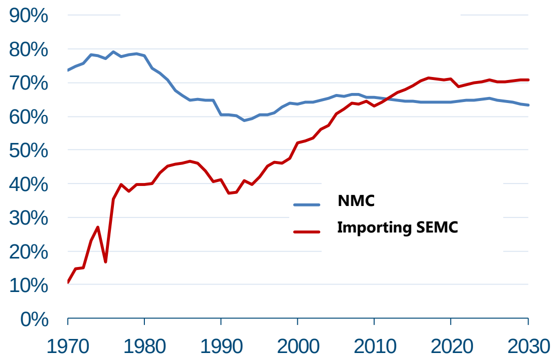


Source: OME database

Electricity generation will remain the most gas-hungry industry, accounting for more than half of total demand in 2030. The Mediterranean as a whole will remain a net gas importer.

Across the Mediterranean, energy dependence could thus hit 40% by 2030, which would exacerbate tension around the security of supply. This dependence will be all the more marked for importing countries (excluding Algeria, Egypt, Libya and Syria). In these countries energy dependence under the business-as-usual scenario would be 63% for NMCs and 71% for fuel-importing SEMCs (see Figure 5).

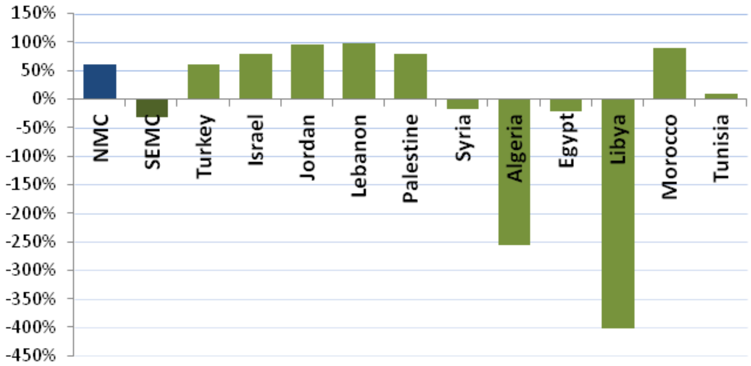
Figure 5 - Energy dependence of importing countries in the Mediterranean



Source: OME database

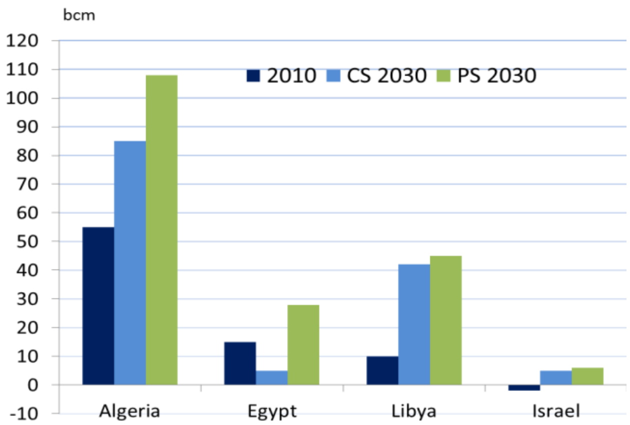
Compared with the conservative scenario, the proactive scenario would enable the region to reduce its fossil fuel imports by 30% and would allow Southern Mediterranean countries to double their export capacity by 2030 (Figure 7). From a fuel supply security standpoint for importing countries and from an economic perspective for exporting countries, this projection is significant. Exporting countries would benefit from additional resources and importing countries would make import savings.

Figure 6 - Energy dependence by country



Source: OME database

Figure 7 - Natural gas export potential in SEMCs



Source: OME database

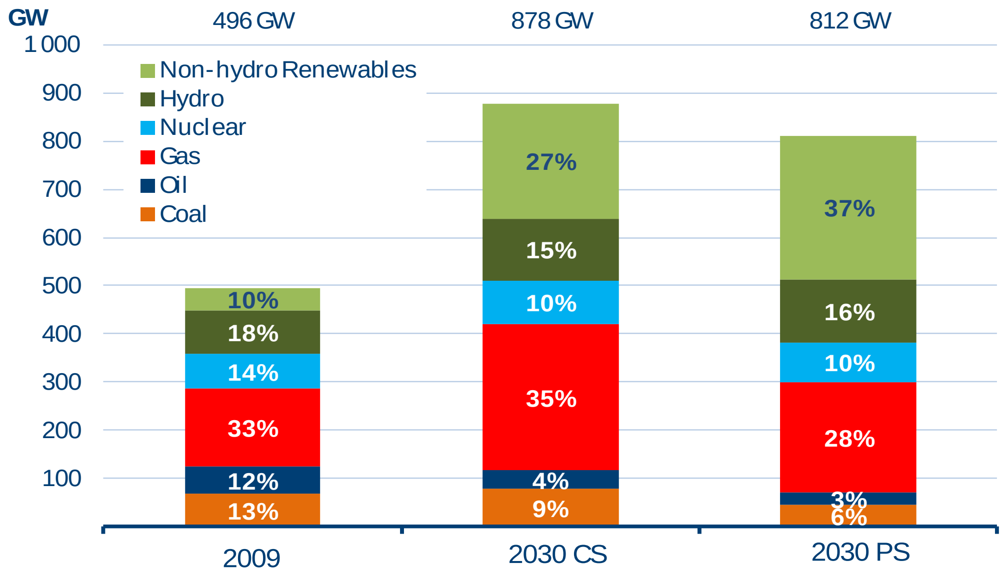
2.3. Continued expansion of the power generation industry

Energy generation accounts for an increasingly significant proportion of total energy demand and this trend is projected to continue over the next twenty years as a result of strong growth in demand.

Electricity demand is likely to grow strongly with average annual growth of approximately 2.8% between now and 2030 and 5% in Southern Mediterranean countries. Depending on the scenario, this growth will mean the installation of 317 to 383 gigawatts (GW) of new capacity by 2030, more than half of which will be installed in the South of the region. Again, depending on the scenario, natural gas and renewable energies will account for 62% to 65% of the electricity mix and 73% to 78%, if hydroelectric power is included.

Although natural gas is likely to be the fuel of choice for power generation and although renewable energies (in particular solar power) will develop, it is also thought that nuclear power will play a role in the energy mix in some countries of the region, notably Turkey and Egypt on the Eastern and Southern shores. Although the Fukushima accident has made the future of nuclear power more uncertain in the region, some southern countries are still expressing their intent to start nuclear power programmes.

Figure 8 - Structure of power generation in the Mediterranean (2009-2030) under conservative and proactive scenarios



CS= conservative scenario PS= proactive scenario
Source: OME database

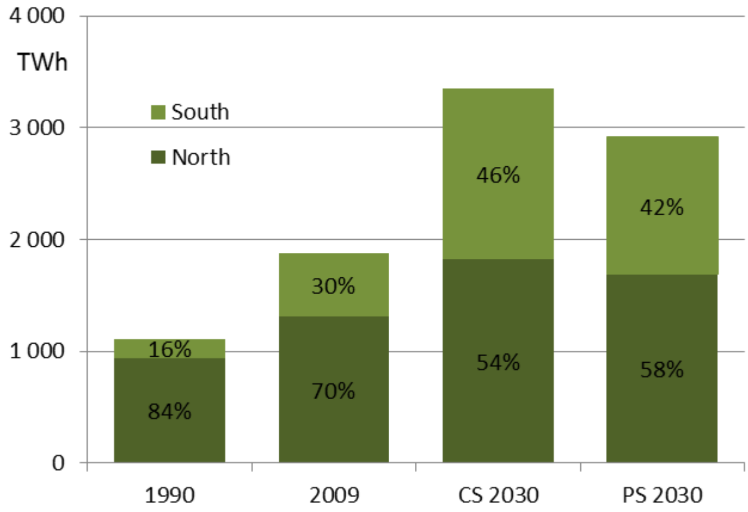
Table 1 - Structure of power generation in Southern Mediterranean countries (2009-2030)

GW	Coal	Oil	Natural Gas	Nuclear	Hydroelectric	Renewable Energies	TOTAL
2009	19	20	58	0	21	2	120
CS-2030	45	21	161	10	45	40	321
PS-2030	14	15	116	17	45	82	289

Source: OME, MEP 2011

Compared with the conservative scenario, the proactive scenario offers total potential electricity consumption savings of approximately 3800 TWh across the region over the next twenty years, the equivalent of 1.4 times the electricity consumption of the whole region in 2030 under the conservative scenario or the equivalent of the total power production in Southern Mediterranean countries over the next ten years. It will also mean a 66 GW saving in installed capacity. This evidence perfectly illustrates the significance of issues related to energy demand management.

Figure 9 - Power generation in the Mediterranean region



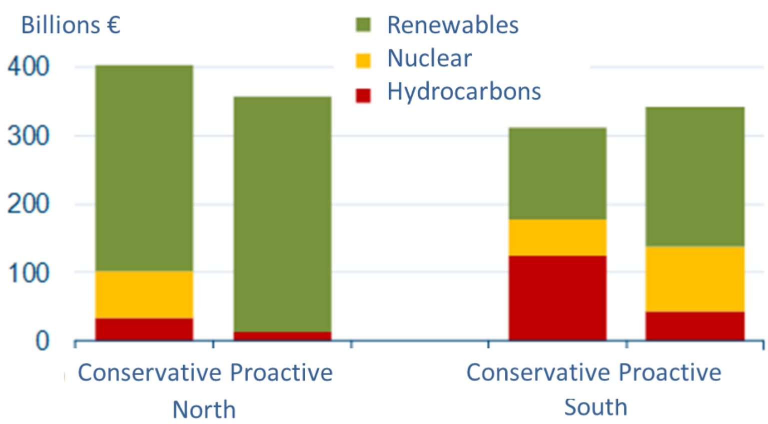
Source: OME database

The OME estimates that more than €700 billion to €715 billion of investment will be required by 2030 to build the additional capacity required across the power generation industry.

Under the proactive scenario, additional investment in clean technologies in Southern Mediterranean countries could be offset by income generated through gas consumption savings.

An improvement of the electrical connections between North and South and between East and West would also have multiple beneficial effects across the region.

Figure 10 - Power generation investment



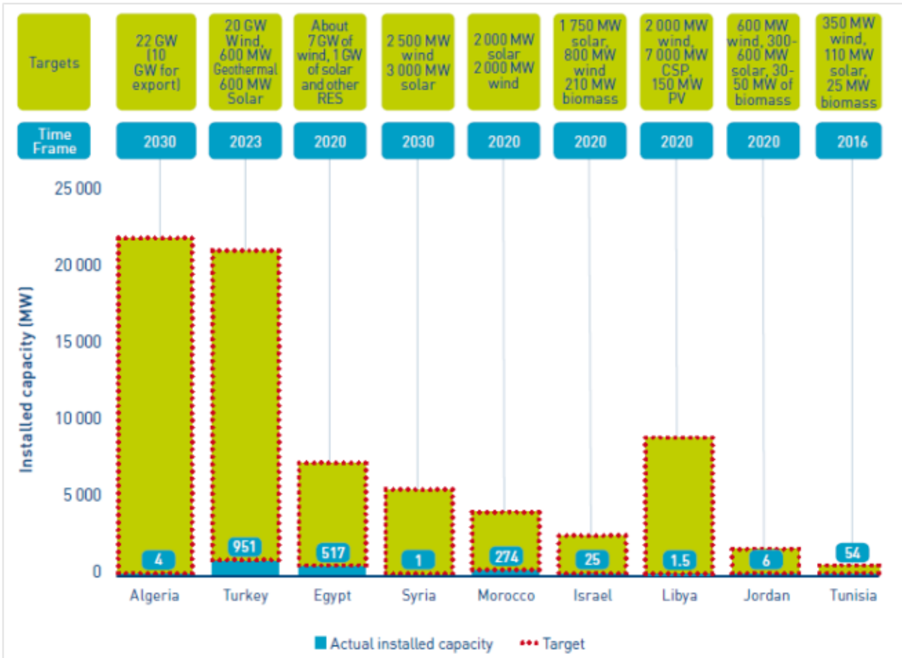
Source: OME database

2.4. Renewable energies: potentially equivalent to two Mediterranean Solar Plans in 2020 and two others between 2020 and 2030

It is widely acknowledged that the Mediterranean has significant potential, particularly the SMCs. The Mediterranean has outstanding renewable energy resources, particularly in solar and wind power, especially in the South and East. Carlo Rubbia, Nobel Prize winner in Physics, notes that, in the Sahara, the equivalent of one barrel of oil per square meter, "rains down" each year in solar radiation. In addition, all Southern Mediterranean countries have stated their goal of developing this fantastic potential as a contribution to meeting growing demand, loosening constraints and promoting sustainable development.

On a regional scale, the Mediterranean Solar Plan (MSP), which was launched in 2008 under the Union for the Mediterranean set a target of 20 GW of new installed renewable energy capacities in SEMCs by 2020. This plan has boosted the dynamic and catalysed efforts leading to the launch of several ambitious national solar plans, in particular in Algeria, Morocco, and Tunisia. Figure 11 illustrates the current situation and national targets for renewable energy within the energy mix of Southern Mediterranean countries.

Figure 11 - Installed renewable energy capacity in Southern Mediterranean countries: current situation and national targets



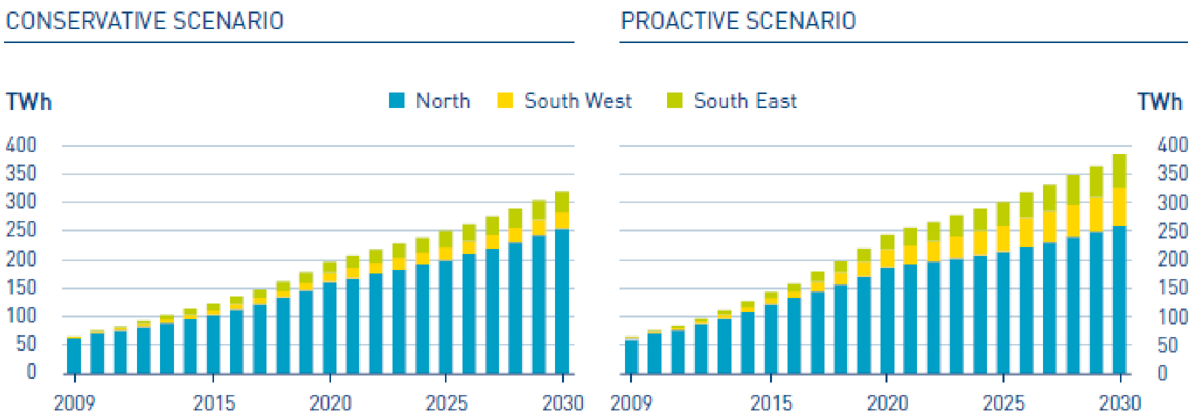
Source: OME, MEP 2011

Projections for 2030 show that the share of renewable energies including hydroelectric power will rise to 42% of total installed capacity under the conservative scenario and more than half the capacity under the proactive scenario. Alongside natural gas, renewable energies will be the leading sources of electricity generation by 2030.

The conservative scenario forecasts the installation of more than 20 GW of renewable energies (excluding hydroelectric) by 2020 and 17 GW between 2020 and 2030, which confirms that the targets of the Mediterranean Solar Plan are realistic. In addition, MEP 2011 demonstrates that more ambitious policies to promote energy efficiency and renewable energies could lead to the equivalent of four solar plans: two by 2020 and two more between 2020 and 2030.

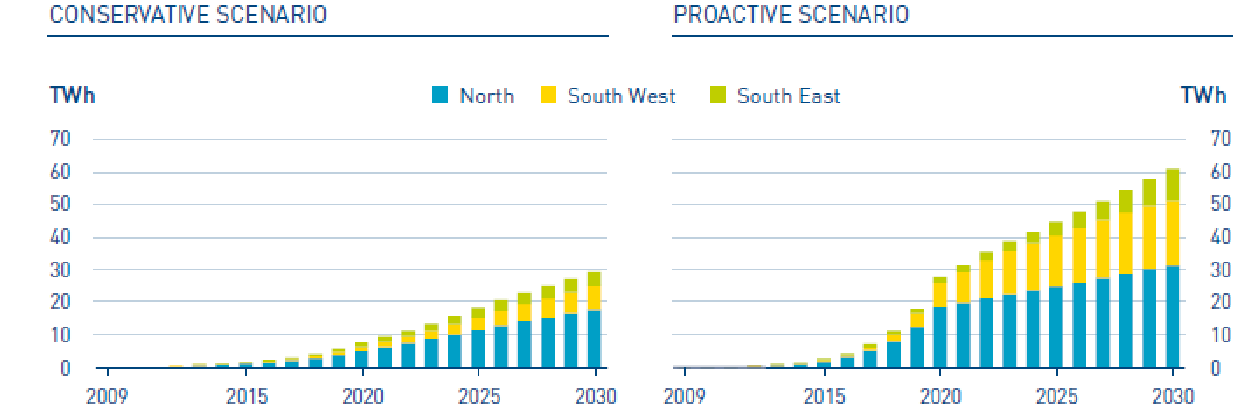
Figure 12, Figure 13 and Figure 14 show the regional outlook for wind power, concentrating solar power (CSP) and photovoltaic (PV) solar power by 2030. Of these technologies, solar power will grow fastest, in particular in South-Western countries.

Figure 12 - Outlook for wind power development



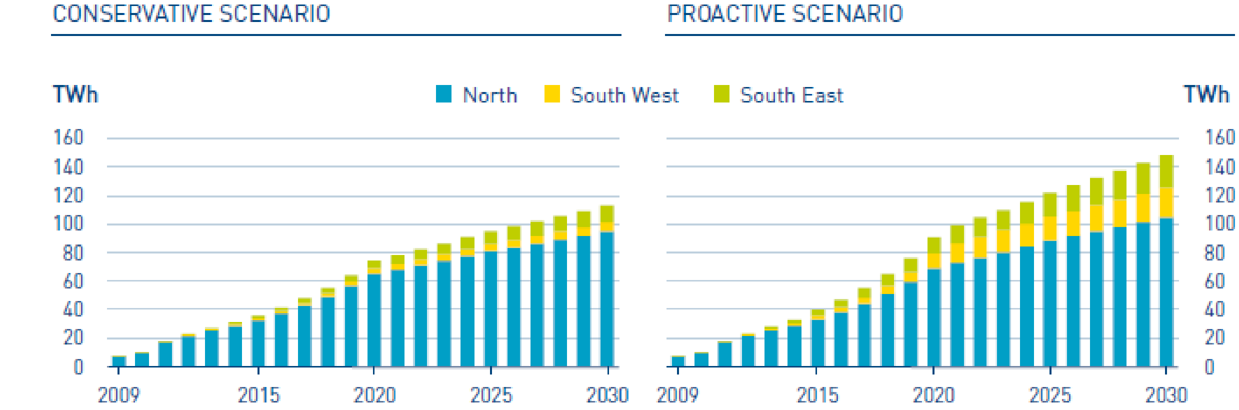
Source: OME database

Figure 13 - Outlook for CSP development



Source: OME database

Figure 14 - Outlook for PV development

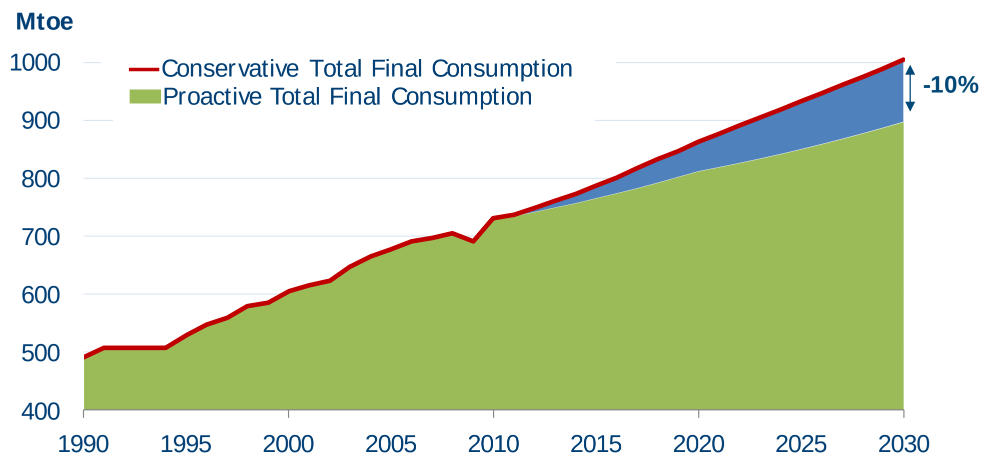


Source: OME database

2.5. Energy efficiency: significant attainable potential and a priority

By 2030, the proactive scenario estimates potential savings at 2% of the total energy demand and 10% of final consumption in the region (Figure 15), the equivalent of more than 70 Mtoe. The cumulative potential savings are equivalent to the energy consumption of the whole region in 2030 or the consumption of Southern Mediterranean countries over the next five years.

Figure 15 - Final energy consumption savings (SEMCs 1990-2030)



Source: OME database

Within a context marked both by the need to meet growing energy demand and falling availability of oil resources, the implementation of energy efficiency measures and the development of renewable energies are vital key issues for the future in Southern and Eastern Mediterranean countries:

- Unless ambitious energy management policies are implemented, current energy exporting countries such as Egypt or Algeria will see falls in export capacity and a consequent reduction in funding for national economic activities in the face of their internal demand,
- The energy dependence of importing countries, such as Lebanon, Morocco or Tunisia, will increase and their energy costs will increase because of the significant rise in procurement costs due to tension around reserves. The social and economic risks related to higher procurement costs and repercussions for the energy costs of the countries, their households and businesses mean that demand must be controlled in order to encourage levels of consumption that are lower and more appropriate,
- In addition, the socio-economic and financial crisis and the aspirations of people in SEMCs to improve their standard of living require the implementation of policies and measures to ensure that the significant potential from energy savings is achieved as of now, since these opportunities are much cheaper to implement now than if the decisions are made later (particularly in the construction sector, which is a major power consumer with potential savings of up to 40% in some SEMCs).

Energy efficiency has gradually developed in SEMCs to become one of the priorities in the energy development plans of Mediterranean countries. The regulatory framework in place in most SEMCs has significantly changed over the last five years to promote the deployment of energy saving policies. However, the commitment of SEMCs to energy efficiency varies greatly from one country to another. Tunisia and Turkey, for instance, are significantly ahead of energy-producing countries such as Libya or Egypt. It should nonetheless be noted that the institutional and legal frameworks required for the development of a real energy management market are progressing, but in some cases, this needs further work to ensure the effort is more visible, longer-lasting and more efficient.

Figure 16 shows the situation and outlook for changes in energy intensity by sub-region.

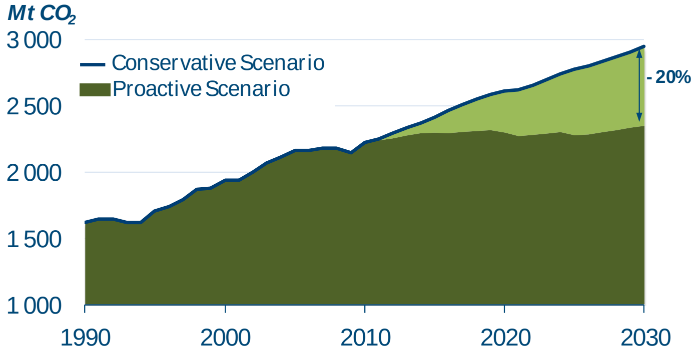
Figure 16 - Outlook for primary energy intensity (1990-2030)

Source: OME database

2.6. Exacerbated environmental challenges

The conservative scenario projects that CO_2 emissions in the Mediterranean region will increase by more than 40% to 3000 Mt in 2030, but an increase of only 9% is projected in the proactive scenario, representing 600 Mt less CO_2 (Figure 17). The conservative scenario is therefore unsustainable, particularly given the region's vulnerability to climate change.

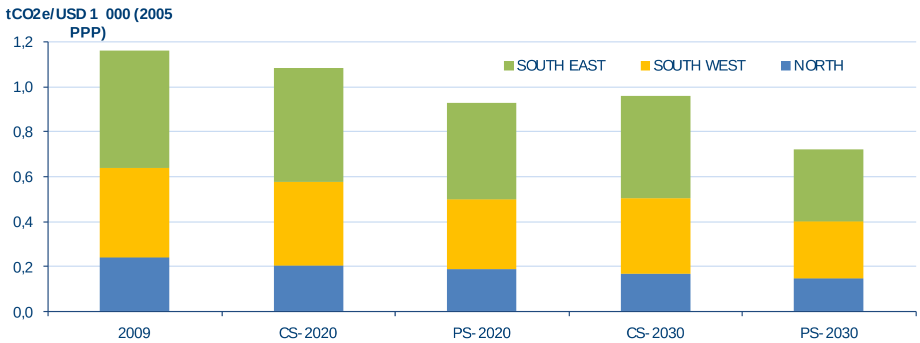
Figure 17 - CO_2 emissions in the Mediterranean region (1990-2030)



Source: OME database

Figure 18 shows projected changes in carbon intensity by sub-region. Carbon intensity should decrease throughout the region. Although the situation varies from country to country, decarbonisation of the region's economies is nonetheless underway in almost all countries.

Figure 18 - Carbon intensity in the Mediterranean region (1990-2030)



Source: OME database

2.7. Incorporating the effects of climate change

Change to the climate in the Mediterranean region due to global warming is a hypothesis that needs to be taken into account in the scenarios. Several sectoral studies have highlighted the worsening energy problems inherent in pessimistic climate change scenarios, in particular with regard to water-energy interactions, the potential impact of proximity to the coast, and changes in heating and cooling needs for buildings. Electricity generation needs for desalination projects were not taken into account in the scenarios, nor was the variation in potential hydroelectricity production as a result of climate variations.

One of the key resources affected by climate change in the Mediterranean will be water. Two case studies, in Morocco and Syria, have highlighted the interaction between energy, water, and climate change[2].

A dedicated study into the sensitivity of buildings to climate change has highlighted that "if an average increase of 3°C in summer and 2°C in winter during the housing lifecycle is assumed, [...] this would lead to a 21% increase in air-conditioning needs and a 6% reduction in heating needs. The need for electricity generation investment would thus increase by 5%."

The integration of a climate feedback loop in the models (i.e. adjusting the output data according to the sensitivity of the input data to climate change) still remains to be implemented on an overall level.

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2 "Water, energy and climate change nexus, perspective for the Syrian Arab Republic up to 2030," Mr. Kordab, 2011 and " Adaptation of the water-energy system to climate change: National Study - Morocco", M. El Badraoui, M. Berdai, 2011

II. Proposals for a breakdown scenario

The breakdown scenario is an even more ambitious 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.

The breakdown scenario assumes the same hypotheses as the proactive scenario for Northern countries and more ambitious measures for Southern countries, particularly from 2020.

An analysis of the business-as-usual scenario shows that there is currently a move towards diversification of supply, with new build of commercial power plants (e.g. gas) and renewable energy projects. The breakdown scenario is based on an enhancement of this dynamic and the penetration and effective implementation of energy efficiency measures, particularly in the transport and construction sectors. This is clearly a theoretical exercise, and the success of the scenario will largely depend on land use development policies, particularly in urban areas and the political, economic, and industrial choices of national governments, etc.

The targets of this type of breakdown scenario, in line with the EU climate and energy package (20-20-20 by 2020) would represent roughly **30-30-30 by 2030 for Mediterranean countries (around 30% increase in energy efficiency, increase of renewable energies to around 25% of the energy mix and CO_2 emission reduction of more than 30% by 2030).**

1. Scenario-building methods

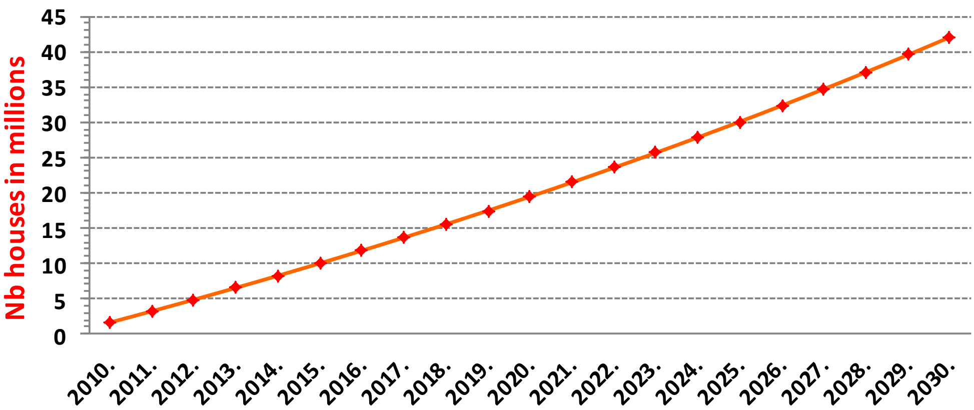
The energy perspectives in the MEP conservative and proactive scenarios show that there is still room for manoeuvre to reduce tensions and steer towards a more sustainable energy path.

Indeed, a breakdown scenario that promotes improved energy efficiency and thus lower needs, alongside the deployment of renewable energies, appears fundamental in order to reduce tension around the security of energy supply over the next few years, particularly after 2020. However, given the time period required to deploy new technologies and for policies and measures to take their effect, the chief benefits of a breakdown scenarios need to be envisaged between 2020 and 2030.

As previously emphasised, electricity demand should grow strongly. This strong growth will lead to the installation of 320 gigawatts of additional capacity by 2030, at a cost of more than €700 billion, with more than half of the capacity installed in SEMCs. Improved energy management should curb growth and demand, particularly in high growth sectors such as buildings.

The transport and construction sectors have high current and future consumption and will play a decisive role. The expected growth of these sectors alongside their high consumption potential, make them crucial sectors for energy policy. Energy savings and the use of renewable energy in these industries will have a significant impact on future trends.

Figure 19 - Projected number of new housing units in SEMCs (2010-2030)



Source: Plan Bleu

Figure 19 shows that in SEMCs, the number of new housing units to be built will exceed 40 million by 2030. It is much easier and cheaper to implement energy saving measures for new build projects, by incorporating energy efficiency measures from design phase onwards, than to implement them in existing housing (although a specific action plan is required in the sector too). The breakdown scenario was thus built around this observation, incorporating existing and accessible technical and technological advances. A detailed study of the implementation of the sectoral hypotheses, particularly in the construction sector, is presented in the Plan Bleu study "Energy, climate change and the building sector in the Mediterranean."

Moreover the potential for integrating renewable energies is not exclusive to the power generation industry. Although most renewable energy policies target electricity generation, there is significant under-exploited potential for the use of renewable energies directly for final consumption, in technologies such as solar water heaters.

The development of a breakdown scenario can generate data to assess the benefits of rolling out existing technology and applicable measures now (energy costs, dependence, employment) even if new technological advances are not incorporated. We are therefore not talking about a proper breakdown scenario in technological terms.

2. Hypotheses

2.1. General hypotheses

The policies and measures already in place in Northern Mediterranean countries are taken into account in the proactive scenario, and the breakdown scenario is therefore based on the same hypotheses as the proactive scenario for these countries. In addition, the outlook for growth and therefore increased demand on the Northern shore of the Mediterranean is limited due to the maturity of most of its economies.

However, for the SEMCs, the breakdown scenario goes much further than the proactive scenario, particularly from 2020 onwards. The hypotheses used are as follows:

- Reductions in energy intensity as recommended in the MSSD (between 1% and 2% reduction per year);
- Greater use of the renewable energy potential in SEMCs than in the business-as-usual scenario, particularly with the widespread introduction of renewable energies for final consumption. The potential is analysed individually for each country and each sector. Renewable energy penetration rates are summarized in Table 2.

Table 2 - Renewable energy penetration hypotheses

Part of renewables (RE)	Breakdown scenario					
	Mediterranean		SEMC		NMC	
	2020	2030	2020	2030	2020	2030
RE part of the primary energy demand	15%	18%	10%	14%	17%	21%
RE part of the electric production	31%	37%	22%	30%	35%	42%
RE part of the final energy consumption	9%	10%	7%	9%	9%	10%

Source: OME

The potential for energy savings was taken into account for each sector. Two sectors appear crucial: construction and transport. The breakdown scenario is based on the use of Plan Bleu data on specific consumption for the manufacturing industry, transport, and housing sectors.

2.2. Construction hypotheses

The breakdown scenario assumes potential energy savings in buildings of more than 40% for new build in SEMCs, as compared with the business-as-usual scenario, and 10% to 15% in existing buildings.

The breakdown scenario is based on a forecast doubling of the housing stock in SEMCs by 2030.

This breakdown scenario also assumes intensified demand management with respect to household appliances but also in terms of behaviour and standards for new housing projects and new appliance design.

2.3. Transport hypotheses

The transport sector is not highly flexible in terms of energy substitution, but there is genuine potential for the implementation of targeted energy efficiency policies and measures, particularly for private cars and publically-owned vehicles. The breakdown scenario is based on various technical studies, which have concluded that there is potential for 15% energy savings in SEMCs. This potential reflects the use of more efficient technologies and better, more efficient design of transport systems, particularly in the development of new cities in the south, along with development of public transport networks. This also takes into account the greater penetration of energies other than oil, such as gas, electricity, and biofuels.

The hypotheses used for the transport sector assume the following:

- The contribution of new information and communication technologies (ITC) towards reducing transport consumption is 16%,
- 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).

2.4. Other hypotheses

The breakdown scenario also assumes the implementation of stricter standards for the manufacturing industry and service sectors. These standards and measures are aligned with those implemented in EU countries. Finally, nuclear power is not incorporated in the energy mix of Southern countries by 2030.

This scenario thus develops energy trends that are based solely on renewable energies and energy savings.

3. Results and comparison between scenarios

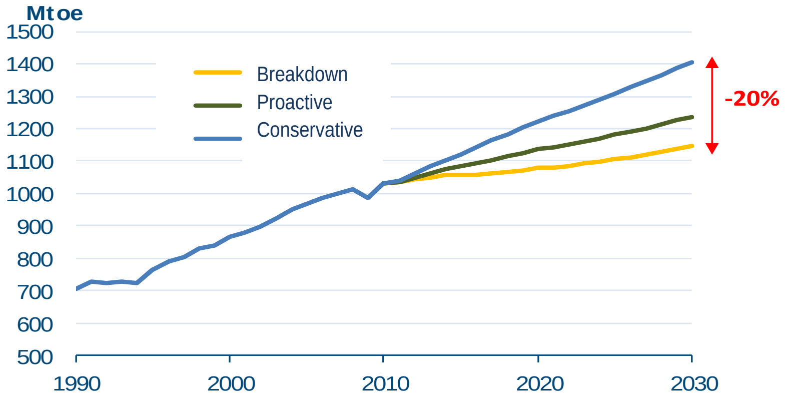
3.1. Results

3.1.1. Energy demand under the breakdown scenario

Primary energy demand in the Mediterranean by scenario

The business-as-usual scenario envisages 1.7% annual growth in energy demand in the Mediterranean from 2009 to 2020, rising to more than 1400 Mtoe in 2030, compared with less than 1000 Mtoe in 2009. This represents total anticipated growth of more than 40%, clearly an unsustainable trend. The proactive scenario, introducing more renewable energies and initial energy savings would lead to growth of more than 25% by 2030 (see Figure 20).

Figure 20 - Primary energy demand in the Mediterranean by scenario



Source: OME database

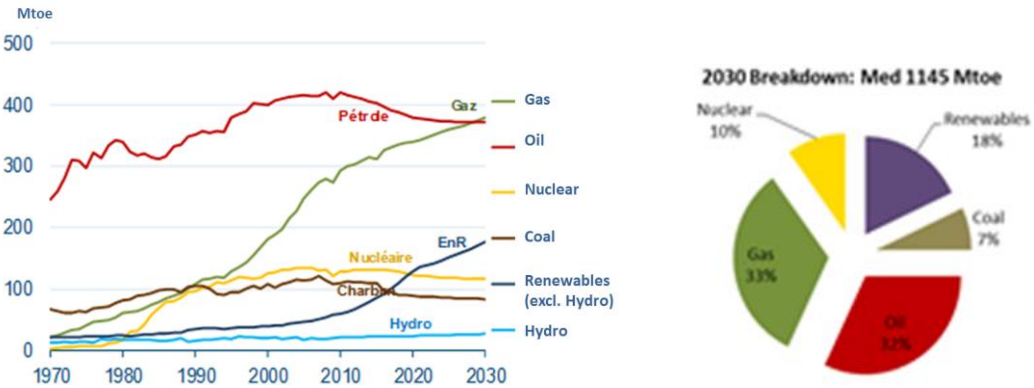
The **breakdown scenario** would not halt growth in energy demand, but would lead to a more than 20% reduction in demand by 2030, compared with the business-as-usual scenario. Total energy demand in the Mediterranean would thus grow 0.7% per year (lower than demographic growth) to **1145 Mtoe, an increase of less than 16% over the next 20 years.**

Primary energy demand by source under the breakdown scenario

Although the breakdown scenario anticipates a nearly 16% increase in demand, the energy source trends are very different. Although the energy mix would remain carbon-dominated by 2030 (more than 70% of primary energy demand), renewable energies (excluding hydroelectric power) would become the third energy source, behind gas and oil and ahead of coal and nuclear power. In 2030, renewable energies as a whole (including hydroelectric power) would thus account for more than 18% of the energy mix, well ahead of coal (7%) and nuclear power (10%).

The anticipated growth of gas is around 1.4% per year; however, coal and oil demand is expected to decrease by 1.4% and 0.5% respectively, compared with a 5.5% annual increase in renewable energy demand (excluding hydroelectric power) between now and 2030.

Figure 21 - Primary energy demand in the Mediterranean by source under the breakdown scenario



Source: OME database

The implementation of a breakdown scenario would lead to **total savings of 2.8 Gtoe by 2030**, compared with the business-as-usual scenario and would promote the introduction and development of renewable energies to the detriment of fossil fuels. In terms of financial savings for consumers (in particular households), this energy saving would represent approximately €1500 bn [3] in total savings by 2030.

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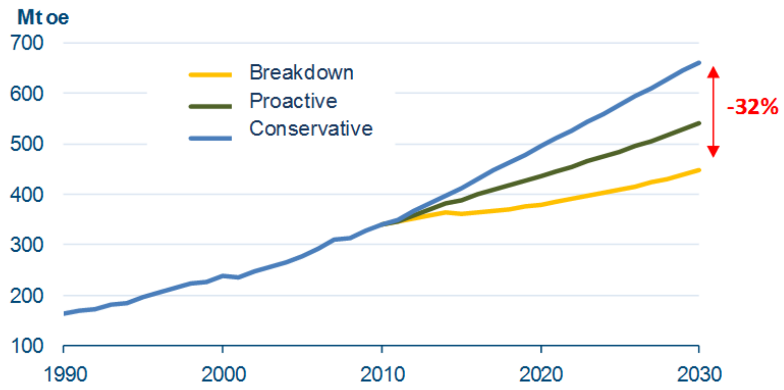
[3] The financial savings generated by energy savings can be approximately estimated by applying a hypothetic cost of USD 100 per barrel to the 2.8 Gtoe of consumption. This estimate could be fine-tuned according to variations in oil prices and discount rates in the economies.

Primary energy demand for SEMCs under the breakdown scenario

The trend will be even more marked for SEMCs with more than 32% energy savings compared with the business-as-usual scenario. Energy demand would be 447 Mtoe in 2030 compared with 661 Mtoe in the business-as-usual scenario, representing savings of 214 Mtoe in 2030 and **cumulative savings of 2.3 Gtoe** (equivalent to more than 7 years of consumption) over 20 years (see Figure 22).

Figure 22 - Primary energy demand in SEMCs by scenario



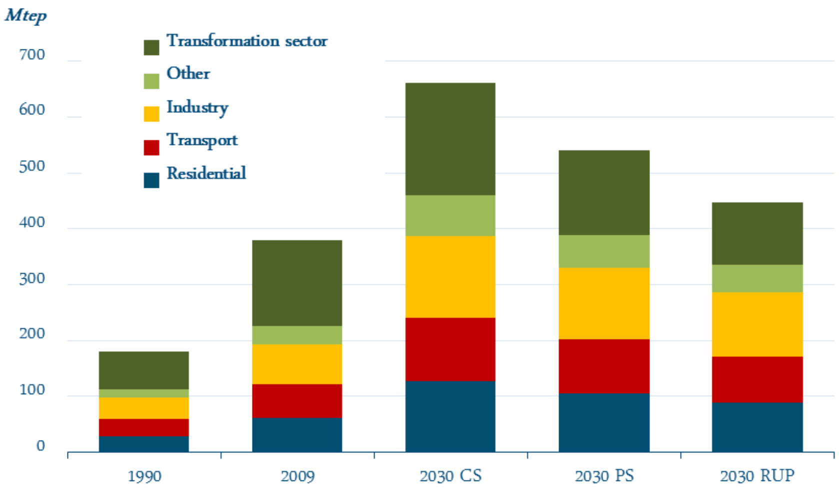
Source: OME database.

3.1.2. Energy demand by sector in SEMCs

The business-as-usual scenario anticipates 3.4% annual growth in energy demand in SEMCs from 2009-2030, for a total of 661 Mtoe in 2030. This compares with 3.7% growth between 1990 and 2009 and 1.5% in the breakdown scenario. Up to 32% energy savings could be achieved, with significant variation between different sectors.

The transformation sector – chiefly electrical transformation – would reduce its consumption by 50% compared with the business-as-usual scenario. These substantial energy savings are due to the combination of two effects: energy savings in electricity consumption but also efforts to **reduce losses** (transformation and distribution losses in the grid).

Figure 23 - Energy demand by sector in SEMCs under different scenarios



Source: OME database

Energy savings are easier to quantify and implement in the residential and tertiary sectors. Examples include **new build projects** over the next few years in SEMCs and standards for electrical equipment. In 2030, therefore, residential consumption should be 30% lower in the breakdown scenario than in the business-as-usual scenario. This represents savings of 39 Mtoe by 2030. In the tertiary sector, energy savings will also approach 30%, representing savings of nearly 23 Mtoe by 2030.

Energy demand in the **transportation and manufacturing industry** sectors could fall by approximately one quarter (27% for transport and 22% for manufacturing):

- For the transport sector, major efforts are required 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,
- In manufacturing industry, efforts will need to focus on heavy industry, through standards and through cleaner and more efficient technologies.

In these two sectors, energy savings of close to 63 Mtoe could be made by 2030 across all SEMCs.

Final energy consumption by source in SEMCs

Final consumption in these countries is currently 226 Mtoe. Under the business-as-usual scenario, this should almost double to 438 Mtoe by 2030. With the breakdown scenario, energy savings of nearly 23% are possible, reducing consumption to 336 Mtoe in 2030, representing savings of 102 Mtoe.

The disparities between energy sources are very significant because renewable energies grow substantially (increase of more than 60% compared with the business-as-usual scenario), whereas fossil fuel and electricity demand is significantly reduced.

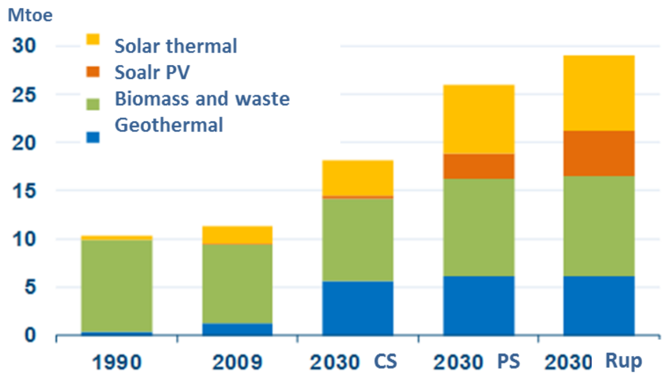
Nearly 30% savings in fossil fuels can be made with the breakdown scenario. This demand could be reduced by close to 100 Mtoe in 2030 in SEMCs.

There would also be substantial savings in electricity demand – more than 35%, equivalent to 40 Mtoe.

These savings in fossil fuel and electricity demand will be the result of the cumulative effects of improved energy efficiency and to the substitution of fossil fuels and electricity with renewable energies, in particular solar power.

End usage of solar thermal energy, in particular solar thermal panels is still limited, despite significant potential in SEMCs. This technology is efficient with good return on investment and could be developed further. Solar thermal demand could quadruple from its current level and double with respect to the business-as-usual scenario by 2030, rising to 8 Mtoe.

Figure 24 - Details of renewable energies end consumption by scenario in SEMCs



Source: OME database

At the moment, **photovoltaic** power is almost non-existent in SEMCs for direct end-usage (less than 0.2 Mtoe in 2009). The business-as-usual scenario envisages slow growth in demand to 0.3 Mtoe in 2030. The breakdown scenario envisages the promotion of photovoltaic end-use, due to the high levels of sunlight in SEMCs and the steadily falling cost of this technology. Photovoltaic demand would increase 17-fold by 2030 under the breakdown scenario, compared with the business-as-usual scenario, rising to 5 Mtoe across all the SEMCs (see graph above). The breakdown scenario also anticipates the increased use of **biomass**, in particular waste incineration, with demand of 10 Mtoe in 2030 in SEMCs.

Energy demand in the residential sector

Potential energy savings of nearly 40 Mtoe could be made by 2030 in the residential sector in SEMCs, levels 30% lower than the business-as-usual scenario. Most of the savings will be made through measures applied to new build projects. These savings are based on the assumption that the 42 million additional housing units that need to be built by 2030 in these countries will benefit from optimum energy efficiency, leading to 40% savings compared to existing buildings.

Five breakdown hypotheses, specific to the formal new build sector, were developed in the 2010 study "Energy, climate change, and the building sector in the Mediterranean." These hypotheses were incorporated with the following penetration rates:

Table 3 - Energy efficiency hypotheses for the construction sector in the breakdown scenario

	Existing residential accommodation			New build residential accommodation		
Large-scale measures	**2010**	**2020**	**2030**	**2010**	**2020**	**2030**
Large-scale roll-out of efficient cladding for new buildings				13 %	50 %	80 %
Thermal upgrade to existing buildings	1 %	10 %	30 %			
Efficient lighting	20 %	100 %	100 %	20 %	100 %	100 %
Widespread uptake of efficient household appliances, heating and air-conditioning units	10 %	50 %	100 %	10 %	50 %	100 %
Widespread uptake of solar water heaters	7 %	20 %	30 %	5 %	25 %	35 %

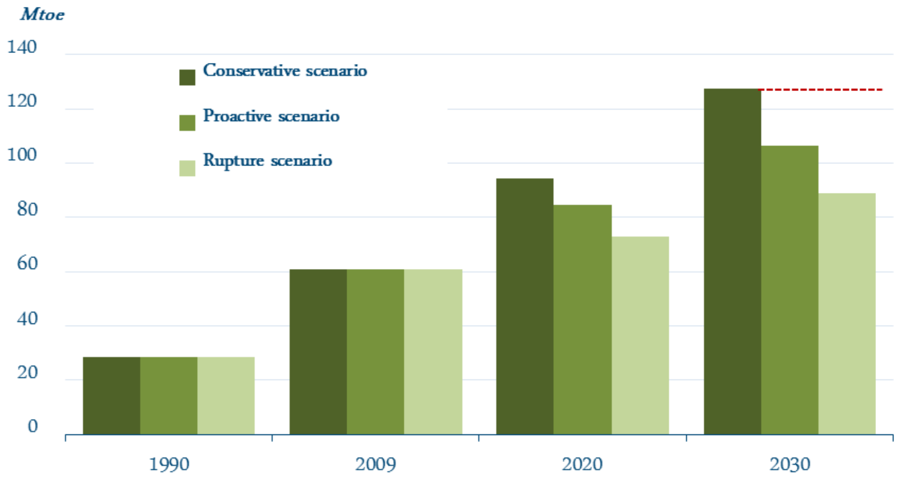
Source: Hypotheses adopted by the Plan Bleu expert working group

The efficiency of each measure is tailored to the climate zone to which it is applied.

Significant efforts are also taken into account for older buildings, but to a lesser extent. Existing residential housing is also assumed to benefit from improved energy efficiency. The breakdown scenario is also based on the fact that stricter standards are applied to **household appliances**, to align them with European standards, particularly for very energy-hungry appliances such as washing machines, freezers, and air conditioning, but also for smaller devices. This will have a significant effect on electricity demand in particular.

Energy demand in the SEMCs would thus increase 45% from current levels, which is half the anticipated increase under the business-as-usual scenario.

Figure 25 - Energy demand in residential sector by scenario and SEMCs

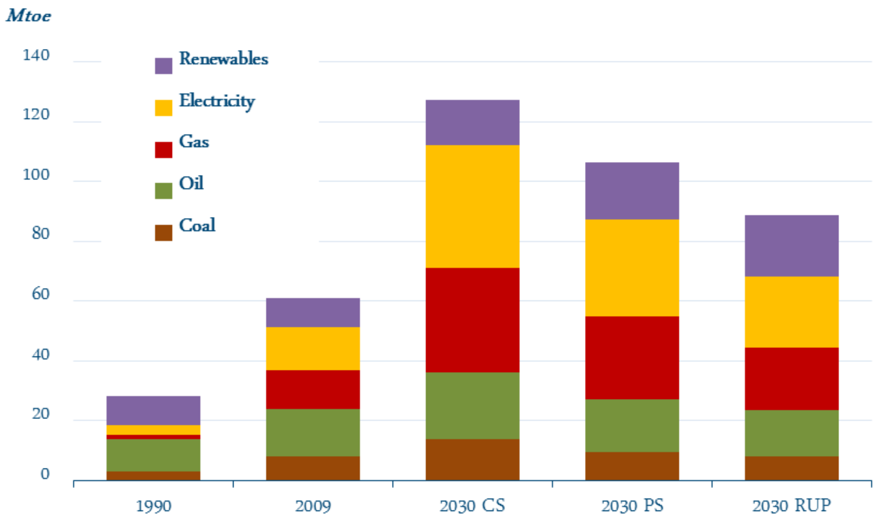


Source: OME database

The contrast is even greater in an energy source analysis, due to a partial substitution of fossil fuels with renewable energies. Fossil fuels would be reduced by more than 26 Mtoe and electricity by 18 Mtoe compared with business-as-usual scenario, whereas renewable energies would increase by more than 5 Mtoe by 2030 (Figure 26).

In renewable energies, the emphasis would be placed on developing solar thermal which would increase from 1.6 Mtoe in 2009 to more than 5.6 Mtoe in 2030 (more than 2.4 Mtoe higher than in the business-as-usual scenario). The breakdown scenario also assumes the roll-out of private end-usage of photovoltaic energy. Photovoltaic solar power would be more than 2.8 Mtoe in 2030, compared with 0.15 Mtoe currently (2.5 Mtoe higher than in the business-as-usual scenario).

Figure 26 - Energy demand in the residential sector by source and scenario in SEMCs

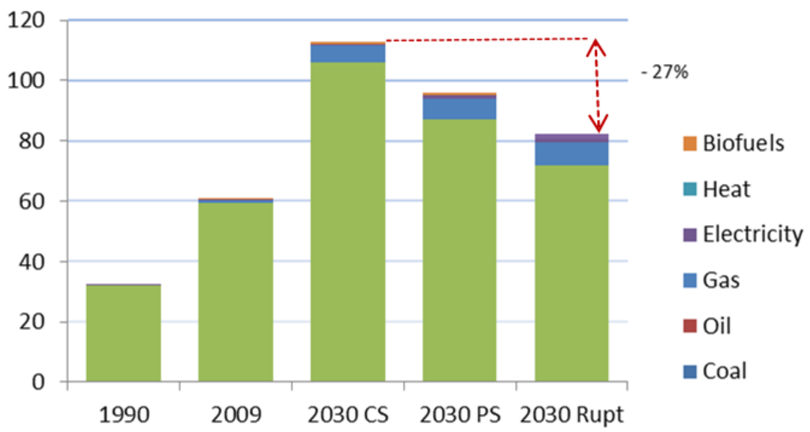


Source: OME database

Energy demand in transport for SEMCs

The business-as-usual scenario anticipates transport demand almost doubling by 2030 in SEMCs (anticipated increase of approximately 90%). In the breakdown scenario, demand would still increase but to a much lower extent (36%), which is still significant but would enable energy savings of more than 27%.

Figure 27 - Energy demand in the transport sector by source and by scenario



Source: OME database

These overall energy savings estimates should be analysed alongside the demand by energy source (Figure 27). Oil demand would increase by 21% and some substitution would be seen towards gas and electricity, with a larger number of vehicles powered by gas and electricity, and higher usage of public transport. This would lead to increased gas demand in the breakdown scenario (8-fold increase over 2009 figures) and an increase in electric transport (5-fold increase). Biofuels would also be developed (to the extent that each country's natural resources allow), increasing biofuel demand to more than 2 Mtoe in 2030.

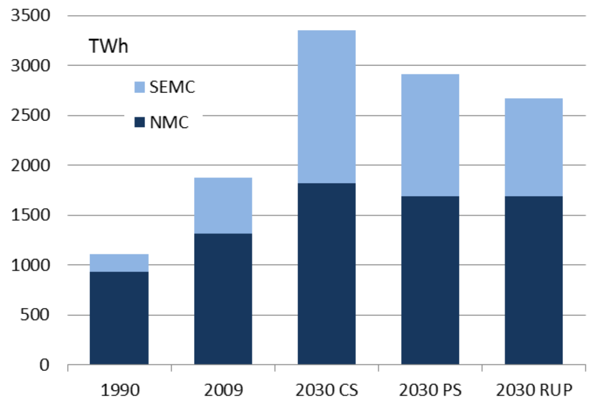
In 2030, in the SEMCs, energy demand in the transport sector will therefore be 82 Mtoe under the breakdown scenario compared with 118 Mtoe under the business-as-usual scenario, a saving of 36 Mtoe.

3.1.3. Electricity in SEMCs

Electricity generation

According to the business-as-usual scenario, electricity generation will double by 2030 to meet the demand of the Mediterranean countries. Power generation should triple in SEMCs, where electricity demand is expected to grow by more than 5% per year, with more than 1534 TWh generated in 2030 (Figure 28).

Figure 28 - Electricity generation by region and by scenario



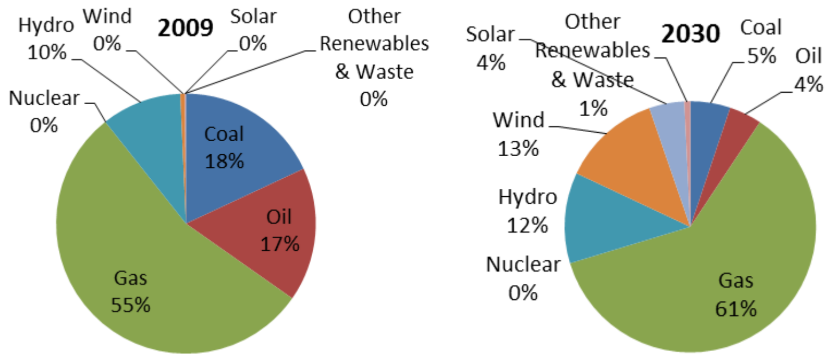
Source: OME database

Under the breakdown scenario, energy savings in the most electricity-hungry sectors, in particular the residential sector and services, would lead to a decrease in electricity needs. This effort would be boosted by a reduction in generation losses and improved performance across the distribution networks. The cumulative effects of reduced losses and improved energy efficiency in the breakdown scenario would mean **a reduction in electricity generation in SEMCs of nearly 36% in 2030, compared with the business-as-usual scenario.**

However, despite substantial savings in the breakdown scenario, electricity generation will still need to almost double in SEMCs by 2030, implying **significant investment needs in the electricity industry.**

Moreover, the increased use of renewable energies in the breakdown scenario would limit fossil fuel needs, bringing them down to 70% of total power generation in 2030, compared with 90% in 2009. **Gas** would partially replace coal and oil. In 2030, the proportion of gas is projected to be greater than 61% (compared with 54.6% in 2009), and the combined share of coal and oil in the electricity mix would fall from nearly 35% to 9% by 2030.

Figure 29 - Electricity generation in SEMCs by source in the breakdown scenario (2009 and 2030)



Source: OME database

More than 30% of electricity would thus be generated by renewable energies. Wind power would be the leading renewable energy, accounting for more than 13% of the electricity mix in 2030, compared to less than 1% currently. **More than two thirds of SEMC wind power production would be concentrated in two countries: Turkey and Egypt**.

Installed electricity generation capacity

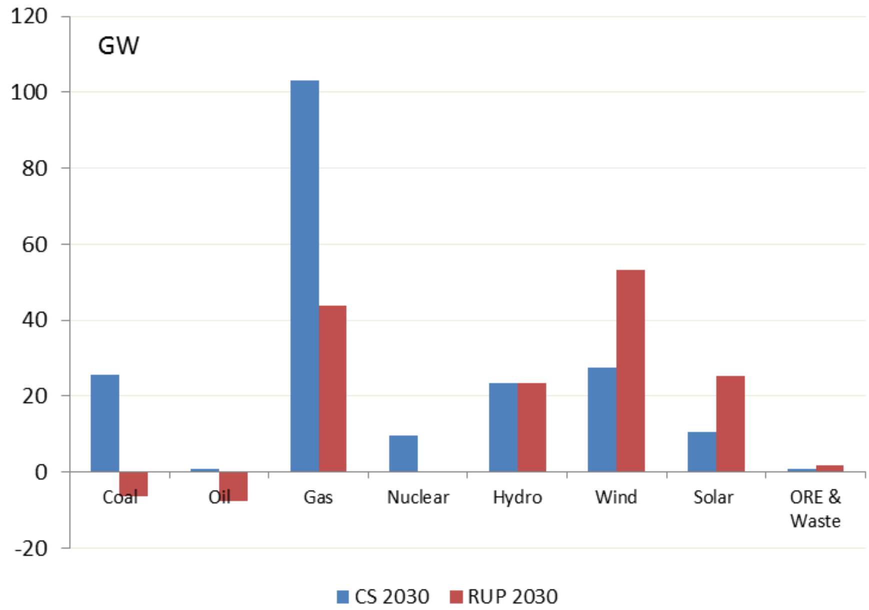
Installed capacity will have to increase substantially to meet electricity demand. The current capacity across the whole Mediterranean region is close to 500 GW, of which more than two thirds is installed in NMCs. By 2030, capacity will need to increase by 60% under the business-as-usual scenario to 878 GW, requiring 382 GW to be installed over the next 20 years, including 200 GW in SEMCs (see Table 4).

Table 4 - Installed electrical capacity by source and scenario (GW)

	2009	2030 CS	2030 PS	2030 RUP
Fossil energy	287	420	300	282
Nuclear	71	91	82	64
Renewables	138	368	431	431
Total	**496**	**879**	**813**	**777**
NMC	*376*	*557*	*523*	*523*
SEMC	*120*	*321*	*289*	*253*

Source: OME

Figure 30 - Additional electricity generation capacity by 2030 (GW)

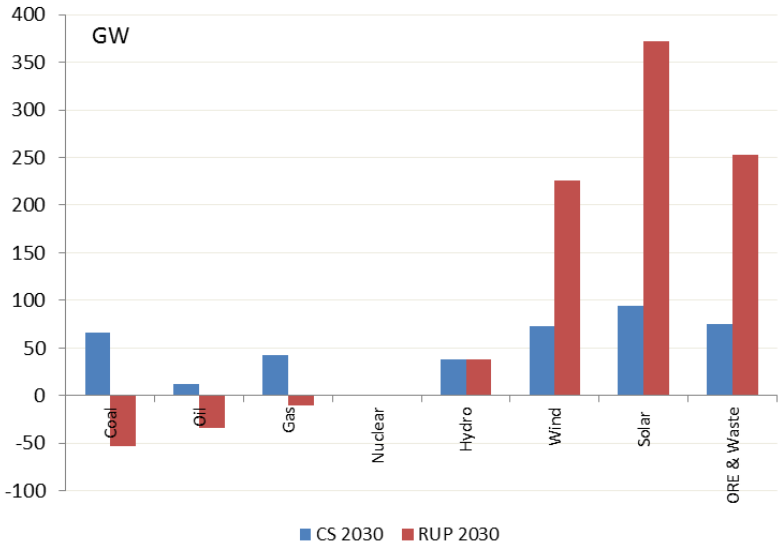


Source: OME

In total, more than 100 GW could be saved under the breakdown scenario, of which 68 GW in SEMCs. **Additional capacity needs are reduced by nearly 34% in 2030 compared with the business-as-usual scenario**. Nonetheless, in parallel with electricity generation, installed electrical capacity in the Southern Mediterranean countries will need to more than double by 2030 to meet needs. 253 GW will need to be installed by 2030 to meet the electricity demand, an increase of **133 GW in SEMCs**.

A greater contrast is seen in the changes by technology. The business-as-usual scenario would see fossil fuel capacity increase by more than 133 GW (nearly 35% additional capacity), whereas the breakdown scenario would enable thermal power plant capacity to be reduced in favour of renewable energies (from 287 GW thermal in 2009 to 282 GW in 2030 for the Mediterranean region). **Renewable energies would thus account for more than 55% of installed power generation capacity in the Mediterranean in 2030**, under the breakdown scenario.

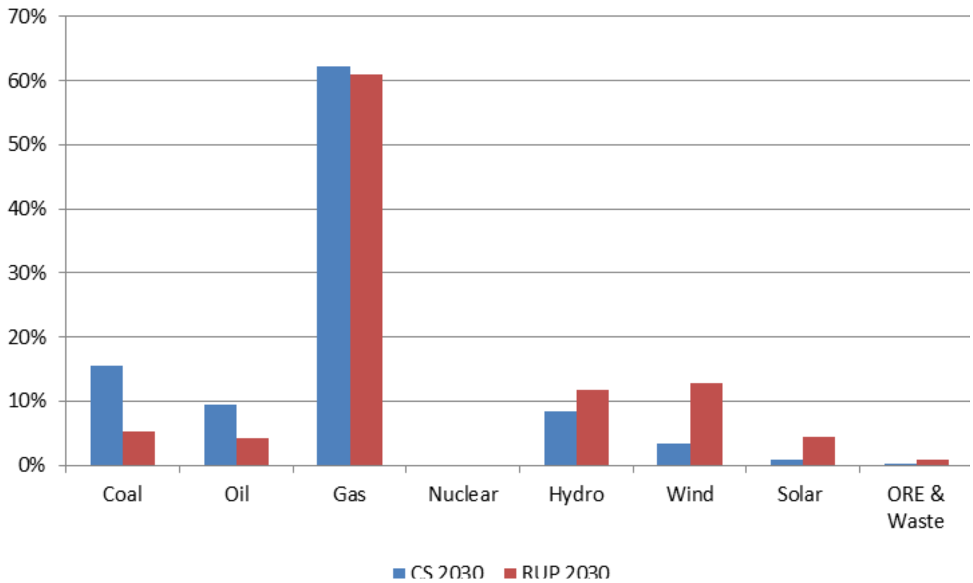
Figure 31 - Increase in capacity between 2009 and 2030 by scenario



Source: OME.

Regardless of the scenario, thermal power generation needs will continue to grow in SEMCs, but to a lesser extent under the breakdown scenario. 30 GW additional thermal capacity would be required in SEMCs by 2030, compared with 130 GW under the business-as-usual scenario. The power generation fleet in SEMCs in 2030 would thus be composed of 50% renewable energy plants, compared with 26% under the business-as-usual scenario.

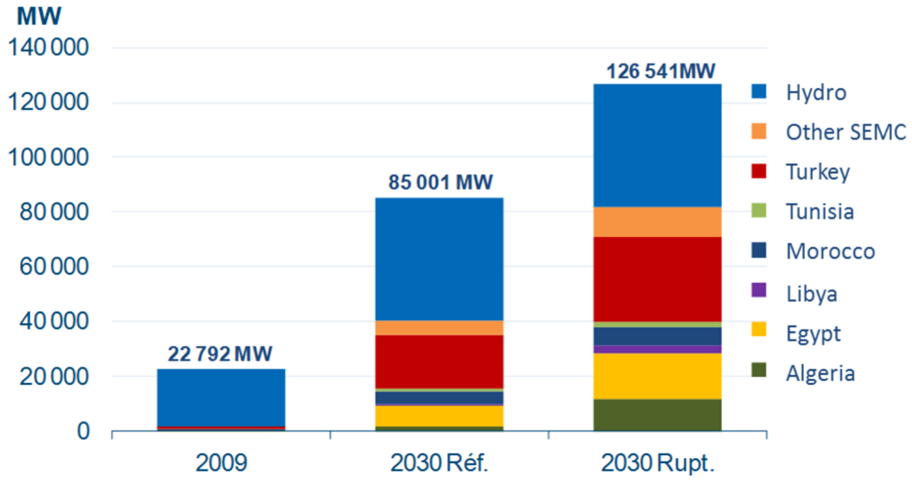
Figure 32 - Proportion of each energy in the electricity mix by scenario by 2030



Source: OME

Renewable energy capacity in SEMCs should increase more than five-fold by 2030 under the breakdown scenario, to more than 126 GW in 2030, compared to only 85 GW under the business-as-usual scenario. Across these countries, **Turkey, Egypt and Algeria have the highest potential for renewable energy plants** (excluding hydroelectric power). These three countries would account for nearly half of all installed renewable energy capacity in 2030 (Figure 33).

Figure 33 - Installed renewable energy capacity in SEMCs by country

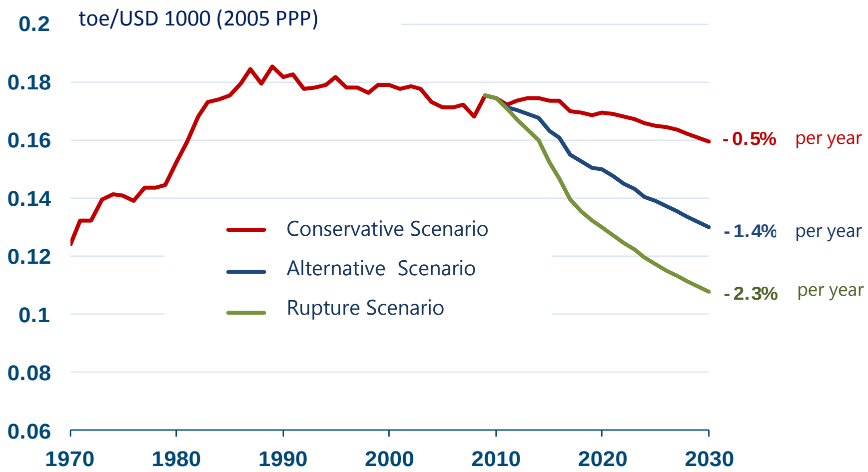


Source: OME database

3.1.4. Energy intensity

Energy intensity is defined as units of energy required to produce one additional unit of GDP. Energy intensity will fall in all the scenarios and all Mediterranean countries, but the reduction will be more significant in SEMCs under the breakdown scenario. It will fall to a level below that of the 1970s.

Figure 34 - Energy intensity by scenario in SEMCs

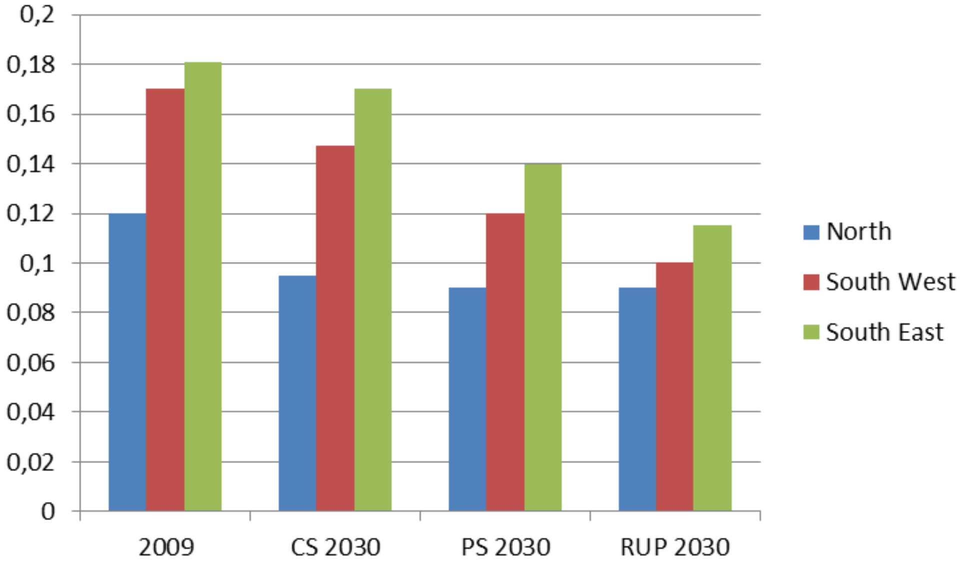


Source: OME database

Energy intensity in the SEMCs was growing strongly until the 1990s, meaning that energy demand was increasing faster than economic growth. After the turning point in the early 1990s, there is a falling trend, but it is a gentle fall with ups and downs. No significant increase in the pace of this drop is anticipated under the business-as-usual scenario, with decrease of 0.5% per year on average.

Under the breakdown scenario, the energy intensity of SEMCs would reflect the achievement of potential energy savings and the effect of this on various sectors. Energy intensity would decrease by more than 2.3% per year on average till 2030, five times faster than in the business-as-usual scenario. Figure 35 illustrates the disparities between sub-regions, showing that regardless of the scenario, the Southern countries will tend to close the gap on the North.

Figure 35 - Energy intensity by scenario and by sub-region

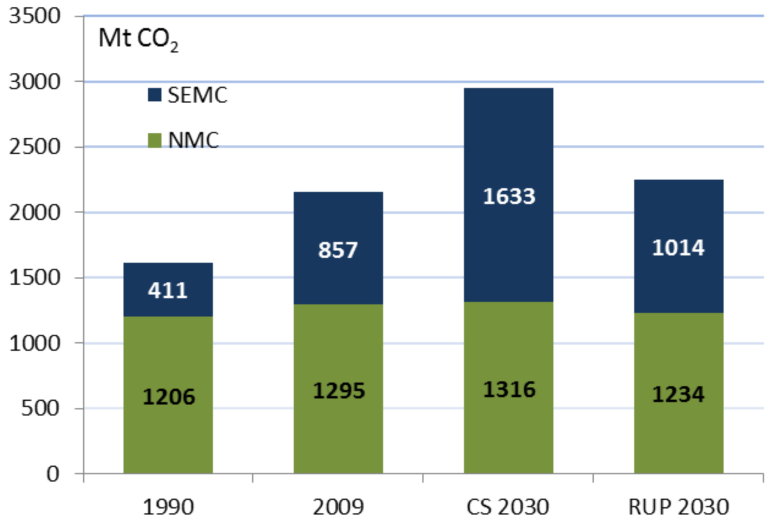


Source: OME database.

3.1.5. CO_2 Emissions

The cumulative effects of reduced energy demand (compared with the business-as-usual scenario) and increased diversification of the energy mix with greater use of renewable energies would lead to a significant decrease in CO_2 emissions under the breakdown scenario – one quarter lower than the business-as-usual scenario by 2030. **In total, nearly 1000 Mt of CO_2 could be saved** by implementing the breakdown scenario in the Mediterranean region. By 2030, NMCs would return to levels close to what they were in 1990.

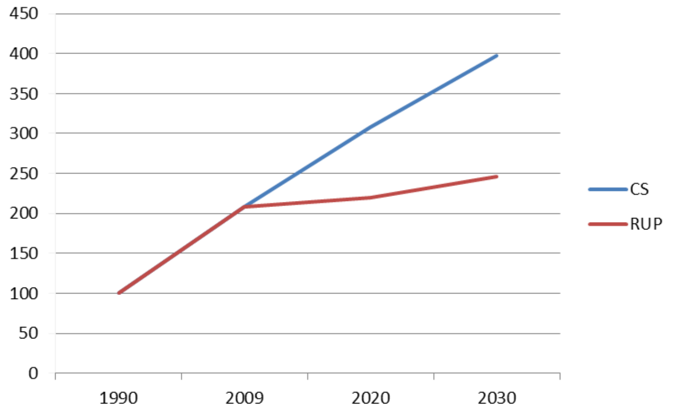
Figure 36 - CO2 emissions by region and by scenario - Mediterranean



Source: OME database

Under the business-as-usual scenario, CO_2 emissions in SEMCs would double, but the increase would only be 18% under the breakdown scenario, to 1014 Mt of CO_2 in 2030, compared with 1633 Mt in the business-as-usual scenario (Figure 37). Despite the increased carbon emissions, additional CO_2 releases would be limited to less than 160 Mt more than current levels in 2030.

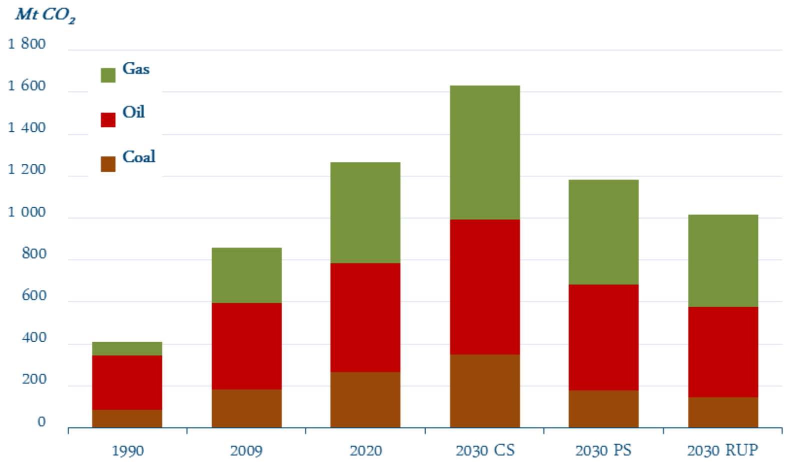
Figure 37 - SEMCs: Changes in CO_2 emissions by scenario 1990-2030 (base 100 in 1990)



Source: OME

Gas is destined to become the leading fossil fuel for CO_2 emissions in SEMCs regardless of the scenario – accounting for approximately 40% of CO_2 emissions by 2030. Nevertheless, the contribution of oil will remain almost identical to current levels, whereas emissions from coal will fall by more than 21% by 2030.

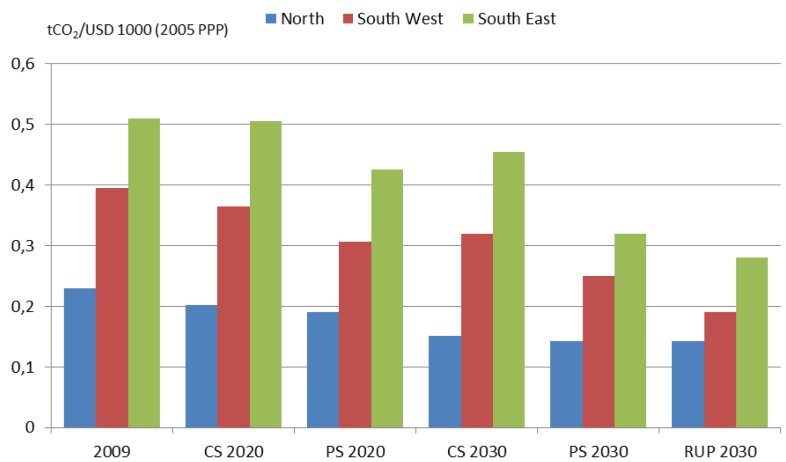
Figure 38 - CO_2 emissions by source and by scenario in SEMCs



Source: OME database

Figure 39 confirms the decarbonisation trend across the region's economies with fairly significant disparities. The North-South gap will remain significant, even under the breakdown scenario, in particular the gap between the North and the South-East.

Figure 39 - Carbon intensity by sub-region



Source: OME database

III. Recommendations

1. Improving the scenario hypotheses

The **following hypotheses** were adopted:

- Homogenous application of sectoral hypotheses across the region, particularly in the construction and transport sectors;
- Climate change not taken into account, particularly with the impact on hydroelectric production and electricity demand (peak demand due to air-conditioning) and on water-energy interactions, particularly for desalination-related energy needs.

These hypotheses need to be fine-tuned by seeking the opinions of various national and regional partners. Formal consultation and long-term follow-up is required, in particular drawing on the network of existing partners of the OME and Plan Bleu. This consultation will be first step towards the long-term organised follow-up and feedback that is required to update a breakdown energy scenario.

2. Organising methods for data collection

One key element for accurate modelling is the breakdown of data by sector and subsector. Accurate knowledge of consumption sites also helps in the reconstitution of demand for specific sectors such as tourism. This important task requires contextual data which is currently almost non-existent, particularly in SEMCs. Accurate modelling will thus depend on the existence of broader gathering and transmission processes. Within the EU, this type of procedure is now governed by a directive (directive 2007/2/EC INSPIRE).

Energy modelling thus requires detailed and accurate contextual data and knowledge of the determinants of demand, by sector and of the interactions between sectors.

Data collection could be managed by:

- Forming an organized network of data producers for prospective energy studies in each country and each sector. This would involve the identification of source data producers in the energy field. Ad hoc institutional methods may have to be developed to organise the process (methodological support for the body responsible for information integration, training, etc.). This process will need to be carried out in parallel with a process for tracking energy efficiency indicators, which requires the collection and updating of the same data that is required for prospective studies.
- Taking into account the heterogeneous structure of energy demand from country to country and from sector-to-sector: urbanisation type, housing type, industry type, agriculture type, etc.
- More accurate models to better understand the determinants of demand, particularly in sectors and usages with high energy savings potential: tourism, development of new information and communication technologies (ITC), etc. Methodologies do exist and need to be shared.

A more ambitious objective that could be targeted in the context of work on regional statistical cooperation would be to network the various information production structures within a single regional information system.

3. Developing a simulation capability

One of the goals of the energy prospective scenarios is to highlight the sensitivity of the major parameters to certain input hypothesis. The conditions for the fulfilment of these hypotheses then depend on actions both in the public sphere (regulations, financial support, etc.) and private sector (organisation of professional bodies, changes in consumption practices and consumer behaviours).

All this requires the tools to have a simulation capability. The simulation capability could be sector-based in particular for priority sectors such as construction and transport. Simulation will then be a decision-making tool for public policy and infrastructure investment.

Further optimisation modules based on various criteria (CO_2, price, employment impact, etc.) could also be built in so as to run forced-outcome exercises (and where applicable, to comply with certain targets). Various policy options could be tested and compared, depending on the selected criteria.

4. Assessing the sensitivity of energy balances to different scenarios

When the results of the three scenarios are compared, very significant differences in the potential energy balances are highlighted. These differences have an impact on:

- Energy generation infrastructure, particularly with the advent of renewable energies, whose production may take place in different areas to where current conventional generation facilities are located. This will require the development of electricity transmission networks in the event of a diffuse deployment of renewable energy production,
- Electrical interconnections between countries, a subject that requires more detailed study, particularly in SEMCs,
- The possibility of using renewable energies and energy efficiencies to optimize electrical load management, particularly peak demand.

Specifically with regard to energy efficiency, savings could be made in operating budgets in the context of new economic models with higher levels of incentives. On a like-for-like basis, it may be advantageous for countries to redistribute their support for production towards greater support for energy savings.

The **use of local renewable resources** leads to wealth creation across all SEMCs. Different strategies will be implemented in producer countries and importing countries:

- Increased revenues for fossil fuel exporting countries,
- New resources for importing countries that could contribute to enhancing energy independence and export capacity.

This point requires further specific study in order to assess the interaction between the deployment of energy efficiency and renewable energies and the future changes in fossil fuels and their use.

Finally because of the new technology used, the introduction of renewable energies and energy efficiency will have consequences on industrial and logistical infrastructure of countries and on job creation, depending on the level of local industrialization.

5. Combining the regional prospective study with national and local prospective studies

Local energy prospective studies are being developed both in NMCs and SEMCs, often as part of planning exercises (urban planning, land use planning, economic development, etc.).

Energy issues (and in a wider sense climate issues) are now increasingly included in these exercises. Dedicated assessments, for instance of local renewable resources are also carried out. In NMCs, this is promoted by national regulations (e.g. Territorial Climate and Energy Plans in France).

These exercises, which are generally commissioned by a local authority, must draw on the same methodologies that are used for other national or regional exercises. The transfer and adaptation of these methodologies to SEMCs must be continued.

A bottom-up approach could be used to feed in the results of local energy prospective studies to national and regional prospective studies. The local studies could form reference data sources by territory type and sector type.

The regional prospective studies must also be linked in with other exercises to provide methods and interpretation but also to observe the needs for prospective studies on a local level.

6. Envisaging an even more breakdown scenario over a longer timeframe?

The breakdown hypotheses used in this study are very ambitious. They target a major improvement in the countries' existing energy systems. The fulfilment of this scenario is nonetheless realistic from a technical standpoint. Looking further to the future, a technological disruption could also be anticipated by simulating the deployment of new energy sources (e.g. hydrogen), new management methods (smart grids, energy storage) and the associated economic models. This approach could be tested using data from specific case studies (especially in urban environments), over a longer timeframe than 2030.

IV. Table of illustrations

V. Appendices

Output tables for conservative, proactive, and breakdown scenarios: MED, South, South-West, South-East.