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PROMOTING ENERGY EFFICIENCY INVESTMENTS FOR CLIMATE CHANGE MITIGATION AND SUSTAINABLE DEVELOPMENT

CASE STUDY: TUNISIA

Policy reforms that were implemented to Promote Energy Efficiency in the Industrial Sector

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December 2014

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List of Abbreviations

ANME: National Energy Conservation Agency

PEEI: Energy Efficiency Project in the Industrial Sector

FNME: Energy Control National Fund

WEF: World Environment Fund

WB: World Bank

AFD: French Development Agency

EE: Energy Efficiency

CP: Program-based Contracts

Toe: Ton of oil equivalent

GDP: Gross Domestic Product

ESE: Energy Service Institutions

IGCE: Large Energy Consuming Industries

IMCCV: Construction materials, Ceramic and Glass Industries

IAA: Agro-food Industries

ICH: Chemical Industries

ID: Various industries

ITHC: Textile, Clothing and Leather Industries

IME: Mechanical and Electrical Industries

PST: Tunisian Solar Plan

1. Energy Context in Tunisia

Since the early years 2000, Tunisia has fully integrated the net energy importing countries category, due to the double effect of exhaustion of its oils reserves and the growing increase of its domestic needs.

This situation has made Tunisia more and more vulnerable to international oil prices that have supervened since 2005. Tunisia's energy bill today exceeds 13% of its GDP.

In the last two decades, the level of hydrocarbon resources ranged between 6 and 7 million toe (Mtoe) while energy consumption grew from 4.5 Mtep in 1990 to 8.5 Mtep in 2012.

In 2012, the energy deficit reached 1.6 Mtoe representing 20% of the primary energy demand.

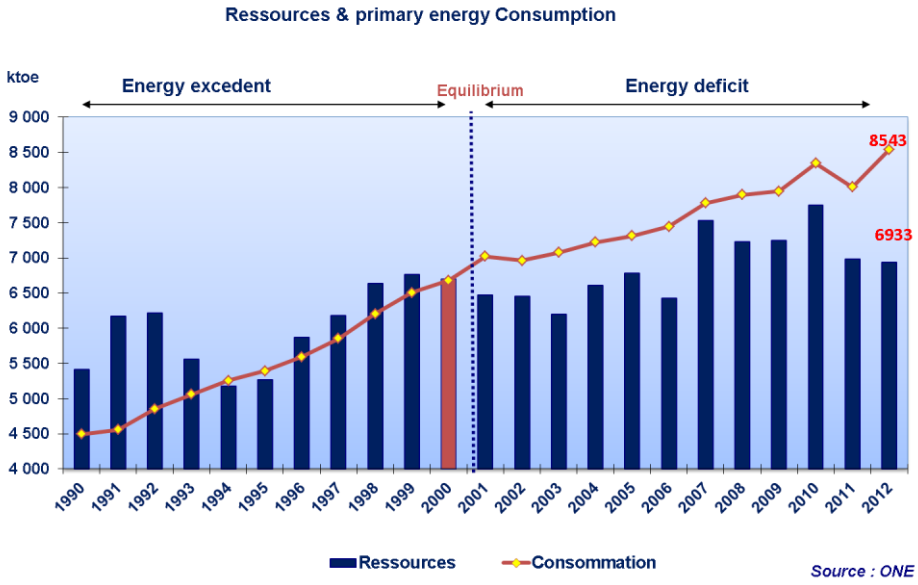


Figure 1: Ressources et primary energy Consumtion

With regard to the trade-off between domestic and international prices (legitimized by the necessary support to disadvantaged social categories and competitiveness) – the Tunisian State had to compensate considerable amounts of money to subsidize energy fees, estimated at 20% of the public budget in 2012.

The effect of the international context was alleviated to some extent thanks to a sustainable policy for energy conservation adopted in Tunisia since the 1980s, combined with economic choices geared oriented to the expansion of the service sector economy and the development of high added value industries. In this way, the primary energy intensity has been falling over the last two decades, with an overall decrease of 27% between 1990 and 2011.

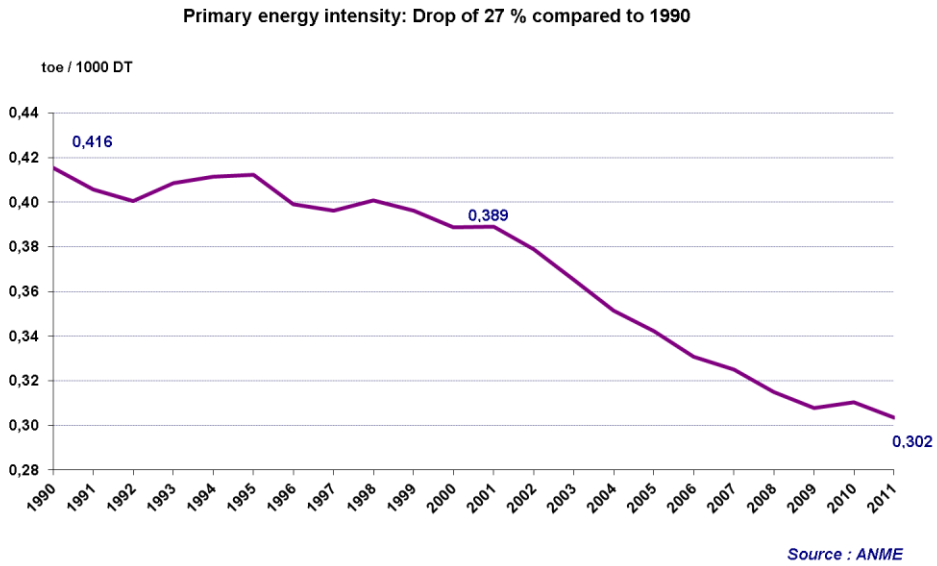


Figure 2: Primary energy intensity: Drop of 27% compared to 1990

2. Industrial sector characteristics in Tunisia

2.1 A diverse sector with crucial economic importance

Tunisia holds a relatively dense and diversified industrial tissue. It currently relies on about 6000 manufacturing units employing 10 workers and more. The "Textile and Clothing" sector represents 36% of industrial workers, followed by agro-food industries (18%). The Tunisian industrial sector is also heavily oriented to exports as about half of the industrial companies are fully exporting firms.

In terms of shares to the GDP, the industry holds the second position after services, with a net share of sectors' added value amounting to 35%.

Within the industrial sector, non-manufacturing industries including mines, energy industries and construction sector, represent the most important added-value share accounting for 40%. Mechanical & electrical industries and the textile & leather industries are in the second position with a 14% share for each.

The manufacturing industry also contributes considerably to employment, as it offers about 500,000 jobs, two thirds of which are held by fully exporting companies. The textile and clothing industry represents the most labor intensive sector as it employs more than 40% of industry workers, followed by food industries (14%) and the mechanical and electrical industries (13%).

Finally, the manufacturing industry is by far the most important source generating foreign currency in Tunisia, representing 80% of the county's exports of goods and services. About two thirds of all exports are made by Mechanical and Electrical Industries as well as Textile industries.

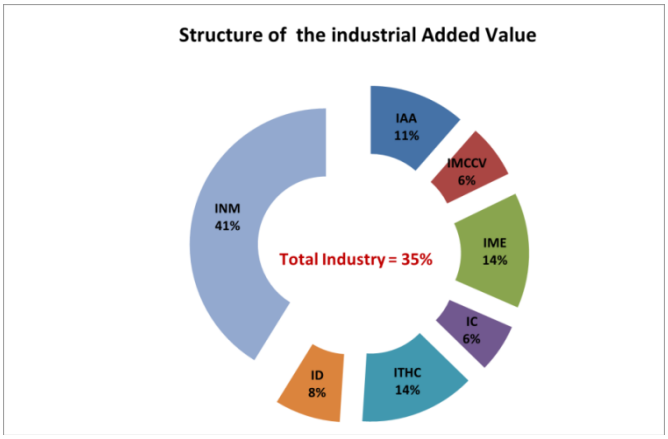


Figure 3: Structure of industrial Added Value

2.2 An important weight in the national energy balance

With an annual final energy demand accounting for 2.2 million toe in 2012 representing 35% of the total final energy consumption , the industrial sector (manufacturing and non-manufacturing industries)shares the first position with the transport sector in the country's final energy balance, followed by the building sector including services and the residential sector (27%).

The energy consumption structure in the industrial sector is still dominated by oil products representing about 42% of all consumption. Nevertheless, this share considerably dropped in the last twenty years in favor of natural gas, which share almost doubled since 1990. This trend has emerged further to a voluntary public policy to diversify energy based on the substitution of oil products by natural gas, particularly in industry.

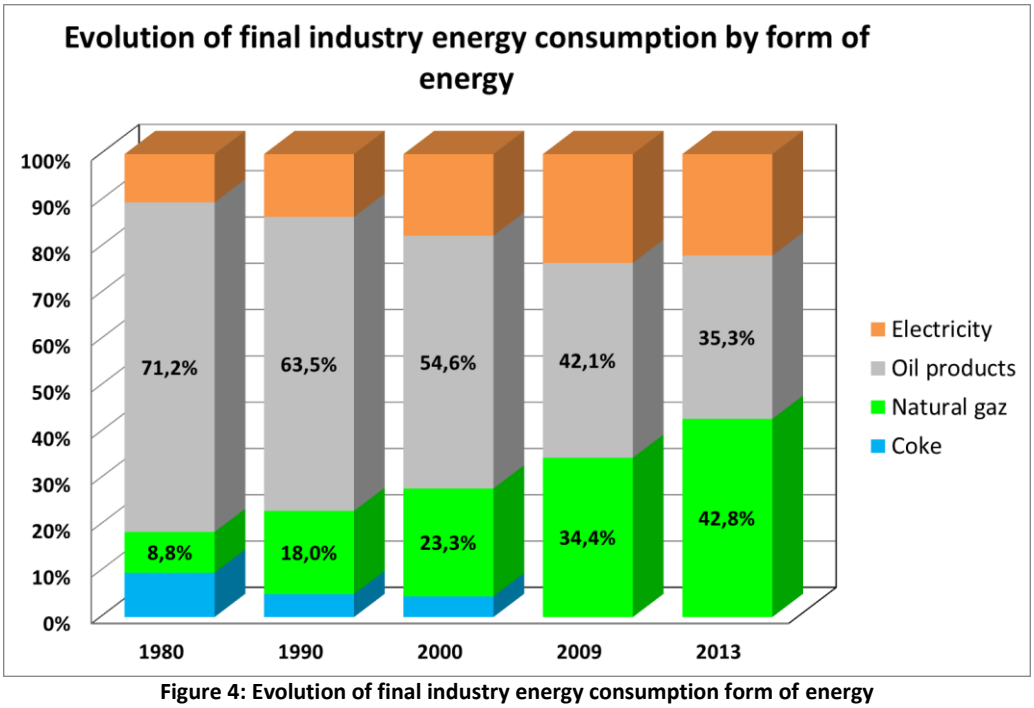


Figure 4: Evolution of final industry energy consumption form of energy

Within this sector, the distribution of energy consumption is still largely dominated by the IMCCV sector (about 60%) followed by chemical industries (12%).

Of the 6000 manufacturing companies, 320 units register a unitary energy consumption exceeding 800 toe/ year, totaling up 75% of the industrial sector's total consumption. These companies are subject to mandatory and regular energy audits in compliance with the EE Law n. 2009-7 dated February 9, 2009.

Finally, 55 companies with consumptions exceeding 5000 toe/r year, referred to as Large Energy Consuming Industries (IGCE) represent 40 % of the industrial sector's energy consumption. These companies are persistently targeted by the energy efficiency policy in Tunisia.

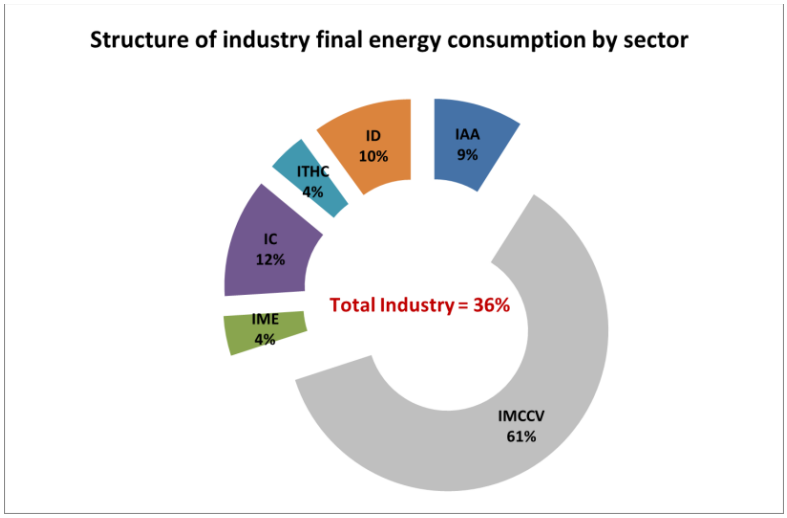


Figure 5: Structure of industry final energy consumption by sector

3. Current Energy Efficiency Policy in the Industrial Sector

3.1 Varied and complementary EE policy tools

Tunisia has a long tradition in energy efficiency

Tunisia has been a pioneer among developing countries in terms of energy conservation policy, having formulated and implemented a policy for rational use of energy and promotion of renewables as early as 1985.

*…**and a well-established policy, legal and institutional framework for energy efficiency and development of domestic resources***

The EE policy in the Tunisia's industry relies on three types of complementary and coherent tools: institutional, regulatory and financial tools. These are combined with technical support programs: technical assistance for industrial companies, monitoring of their projects, technical studies, capacity building….

The institutional instrument is mainly represented by the National Agency for Energy Conservation which has a specific department dedicated to energy efficiency measures in the industry "DEEI" .The main role of the department is to assist the public authorities to define the energy efficiency policy in the industrial sector and ensure its implementation..
The National Fund for Energy Conservation is the financial branch of the institutional framework. Its role is to provide long-term funding to the incentive system for energy efficiency in Tunisia.

The DEEI department is at the heart of the support system to project developers and to different stakeholders to increase the adoption by Tunisian companies of EE technologies and Energy Management with consequent increased productivity and competitiveness.

Regulatory tools are defined by a set of legal texts and regulatory framework mandating the practice of energy auditor industrial facilities according to certain criteria. Accordingly, in September 2004, a decree was promulgated in order to set, the conditions for the subjection of large energy consuming companies to a mandatory and periodic energy audit (today Industrial undertakings with total energy consumption equal to or greater than 800toe /year.) and to detail arrangements for its implementation.
Similarly, new large energy consuming companies, prior to their implementation is subject to the preliminary authorization of the Ministry in charge of energy and must also undergo an energy audit of their plans (Energy Performance assessment).
ESCOs and Energy auditors are accredited by ANME according to proper regulatory conditions.
An energy efficiency fund (FNME) was created in 2005 to provide investment subsidies for energy efficiency and renewable projects and is managed by ANME.A decree issued on the same day stipulates the new rules and procedures for eligibility to the FNME investment subsidy.
A legal framework was established to encourage cogeneration and self-generation from renewables, by giving third party access to STEG transmission network and setting the rules for buy-back of excess production by STEG.

Incentive tools are made up of several complementary measures:

Regulatory incentives: they include on the one hand subsidies for energy cost audits and on the other direct subsidies granted to tangible and intangible energy efficiency investments.

EE Financial incentives

- *Energy Audit : 70% with a limit of 30,000 TD*
- *Immaterial investments: 70% with a limit of 70,000 TD*
- *Material investments: 20% with a limit, depending on the annual consumption, of 100 kDT (less than 4 ktoe), 200 kDT (4 to 7 ktoe) or 250 kDT (more than 7 ktoe)*
- *Cogeneration: 20% of the investment with a limit of 500 kDT*
- *Connection to natural gas: 20% of the investment with a limit of 400 kDT*

Fiscal benefits*: Exemption of VAT and minimal customs fees*

All these financial subsidies come from sustainable funding sources, the National Energy Conservation Fund "FNME" administered by ANME and are provided to industry through the framework of EE Program-based Contract (EEPC) between industrials and ANME.

In addition to these lines, fiscal incentives are granted upstream on EE equipment needed for the implementation of the industrial action plan.

Financial Mechanisms are very important instruments to support the development of the EE market. In this framework, credit lines dedicated to energy efficiency granted by commercial banks provide industrials with funding opportunities for their EE projects at very advantageous conditions in terms of interest rates, maturity periods and grace periods.

AFD Credit Line :

- *Amount : 40 M€*
- *Credit period : 8 to 12 years*
- *Grace period : 2 to 3 years*
- *Improved interest rate*
- *Technical assistance to projects developers free*

World Bank's Credit Line:

- *Amount : 40 M$*
- *Credit period :up to 15 years*
- *Grace period : 3 to 5 years*
- *Improved interest rate*
- *Technical assistance to projects developers: Free*

Energy service Companies (ESCOs):They constitute a very interesting tool for fostering EE market thanks to the technical and financial facilities they can provide to EE project holders. The creation and operation of these structures are regulated by minimal criteria in order to ensure the quality of services provided to industrials.

ESCOs' Mission in Tunisia ;

- *Conduct studies aimed at saving energy resources*
- *Prepare energy-saving projects and ensure their implementation, management, follow up and eventually their funding*
- *Achieve target energy saving indicators.*

Technical assistance to industrials: is essential to develop an EE market **whereas capacity building (awareness, coordination, and training) is critical.**

The Tunisian experience showed that regulatory and incentives were not immediately effective because there were serious obstacles to overcome: awareness about energy

efficiency, low technical capacity, and lack of trust among key stakeholders (ESCOs, banks, industrial companies and ANME). The role of a proactive DEEI as a driver for market development was important at an early stage to raise the level of awareness and to support the large scale dissemination of EE technologies and best practices.

3.2 Mandatory Energy-audits &EEP program-based Contracts in the Industry: ANME's Flagship Activity

The audit and Energy Efficiency Program-based Contracts activity "EEPC" is one of ANME's flagship programs since its foundation in 1985. This activity is so important mainly because of the considerable energy saving potential it may generate.

The energy audit is the fine diagnosis of a company's energy consumption used to identify and assess energy saving actions that must be undertaken.

After the energy audit, the company has the possibility to sign an "EECP" with ANME, opening up opportunities to profit from benefits granted by the National Energy Conservation Fund "FNME".

Box 1
Content of the Energy Audit

For companies undergoing an energy audit for the first time:

- Description of the institution and its main characteristics in terms of energy use and consumption ;
- Evaluation of the institution's energy performances;
- Evaluation of the organization system aimed at the control, follow up and management of energy use;
- Recommendations to improve the level of the energy performance of the company's installations, combined with the economic evaluation of actions suggested;
- Action program aimed at improving the institution's energy performance and recourse to substitution.

For companies having already been subject to energy audits, the new audit shall also include:

- Description of energy use developments since the previous audit;
- Report of main actions undertaken since the previous audit and their results;
- Updating of evaluations previously performed in the field of energy consumption and the organization system that has been adopted;
- Possible recommendations to realign and develop the action program.

Access to investment allowances for energy efficiency actions depends on signing an "EEPC" between ANME and the industrial company.

The "EEPC" contains a list of selected EE measures to be implemented over a period of 3 years, detailing the investments required for the implementation of each EE measure selected, as well as target impacts in terms of primary energy saving by action, energy savings cost, pay-back period.

The EEPC summarizes at the end final data (total investments, total savings, and allocated subsidies).

The summary of primary energy saving for each action selected in the program-based contract constitutes the main energy saving appreciation data. Savings will however depend on four other factors:

- Lifetime of the program-based contract
- Efficiency in the execution of actions
- Actions implementation times
- Execution quality and follow up of actions.

BOX 2

Generic Energy Efficiency measures in industry

The EE measures identified in the industry are divided into four types:

a) Adoption of more efficient heating equipment: boilers, furnaces, heat exchangers;

b) Heat Recovery and use of exhausted gas, heat and residual pressure;

c) Hunting for leakages and thermal losses;

c) Installation of high performance mechanical and electrical equipments: motors, pumps, ventilation and heating equipment;

d) Designing and implementing Energy Management system to optimize the energy consumption.

3.3 Launch of the Energy Efficiency Project in the Industry: An EE scale change catalyst in the industry

The revitalization of the Energy Efficiency projects in the industry was supported by a restructuring process of the industrial activity; with the creation of a department within ANME specifically focusing on energy efficiency in the industry, the launch of the Energy Efficiency in the Industry Program (PEEI) funded by GEF/WB and the creation of 3 taskforces, supported by dedicated funding lines.

- Task Force for large industrial energy users, to assist large industrial energy users in their energy conservation efforts
- Task Force on cogeneration, with the mandate of supporting the establishment of the required legal and regulatory framework to achieve the cogeneration objectives, and to work with industrial companies to assist in the development and implementation of projects
- Task Force on natural gas, to encourage the expansion of gas use, first in industry, and now in the residential and commercial sectors

All these initiatives boosted the energy efficiency process facilitated by ANME, more particularly in the industrial sector.

PEEI, objective and content

The PEEI project was developed by ANME with a FEM/WB funding line amounting to 8.5 M$ over a 7 year period starting in 2005.

The goal of the Energy Efficiency Project in Industry (PEEI) is to overcome barriers facing the development of a sustainable market for energy efficiency investments and with this achieve latent energy saving potentials in the Tunisia's industrial sector. It should improve the competitiveness of Tunisian industrials by reducing production costs related to energy, while contributing to the reduction of greenhouse gas effects.

PEEI also aims at promoting the Energy Service Companies (ESCOs) as an instrument to boost the EE market in the industry, by implementing pilot financial incentives in favor of these structures.

PEEI's components:

To reach these goals, PEEI focused its activities on three components:

- Providing additional subsidies of 10% to EE investment in complementarity to the 20% subsidy of FNME. Support investments in energy efficiency projects by granting an additional allowance of 10% on top of benefits granted through the Industrial Competitiveness Development Fund or/and by the Energy Control National Fund;
- Guaranteeing energy efficiency investments implemented through Energy Performance contractors to ensure their bankability and to facilitate the creation of ESCOs;
- Providing technical assistance to improve the understanding of all stakeholders (companies, financial institutions, government ministries and agencies, and technical centers) on how such investments could be made.

4. Energy Efficiency Potential

4.1 Assessment methodology

The assessment of the energy efficiency potential can be completed through 2 different approaches: the top down approach and the bottom up approach.

Top down approach

In this case a long term target of energy intensity for the industry sector is fixed on the based on the benchmark with other leading countries. In the same time, the value added of the sector is forecasted, based on realistic economic scenario.

In this case, the cumulated energy potential saving during the period from the base year 0 and the year of observation n is calculated as following:

$$\sum_{i=0}^{n}(I_0 - I_i) x V_i$$

Where,

I_0: Final energy intensity of the industry sector at the base year

I_i: Final energy intensity of the industry sector at the year i

n: the year of observation

V_i: the value added of the industry sector at the year i

Of course, the energy saving and a given year I is **$(I_0-I_i) \times V_i$.**

Based on the energy mix of the industry sector consumption, it is possible then to estimate the GHG emission reductions by using the emission factor of its energy product.

Bottom up approach

The bottom up approach consists at identifying the energy efficiency measures that can be developed in the industry sector. Then, quantify the physical potential, such as the number of MW of cogeneration, the number of EE contract program, etc.

For each measure, we can then estimate its impact in term of energy saving. The aggregation of all the measures provides the energy saving potential.

The GHG emission potential is calculated by multiplying the energy consumption of each product by its emission factor.

4.2 The EE potential

Top down approach

In the last 20 years, the energy consumption of the industrial sector has slightly increased by 2.3% a year versus a considerably more important increase of the sector's added value estimated at 4% over the same period.

This dissociation between energy consumption and added value reflects a considerable improvement of the sector's final energy intensity.

These performances result of the implementation of a voluntary energy efficiency policy based on a wide range of specific institutional, regulatory and incentive instruments.

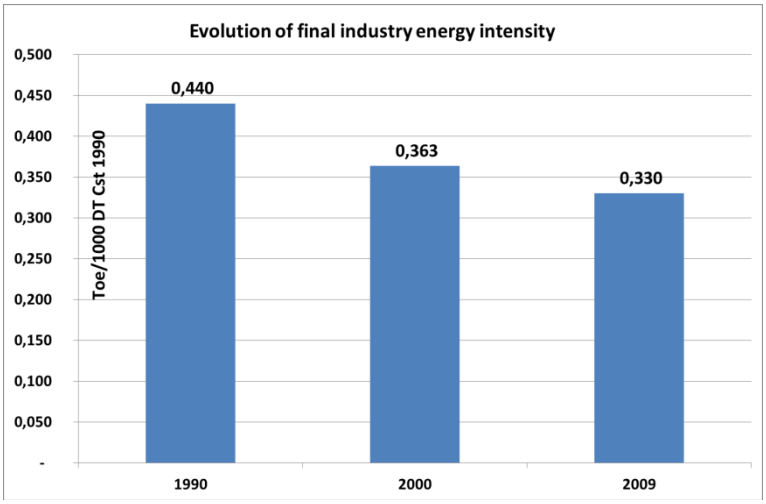


Figure 6: Evolution of final industry energy intensity

In the long-term, the final energy saving potential in the industrial sector is estimated at about **18 Mtoe** accumulated over the period 2010-2030 and will contribute at least about 30% in the total energy saving potential and will avoid **45 MTECO2** over the same period.

Top down approach

The following table presents the EE measure identified in the industry sector from 2015 to 2020, with the framework of the preparation of the 12th plan of development:

	2015	2016	2017	2018	2019	2020	TOTAL
Contract-Programmes (number of enterprises)	**70**	**70**	**70**	**60**	**50**	**40**	**360**
EE Actions on utilities (number of enterprises)							
Compressed air	10	20	35	40	80	100	285
Efficient motors	20	40	80	100	145	-	385
Cooling	30	50	60	60	65	60	325
Cogeneration (MW)	**50**	**55**	**61**	**63**	**65**	**67**	**361**
Energy Management (number of enterprises)	**-**	**10**	**30**	**50**	**70**	**100**	**260**

Figure 3: EE measures identified in the industry sector during the period 2015-2020

Based on some technical assumption, the estimated energy saving potential during the same period will be around 2 Mtoe, as presented in the following table.

Ktoe

	2015	2016	2017	2018	2019	2020	TOTAL
Contract-Programmes (number of enterprises)	33	66	99	127	150	136	**611**
EE Actions on utilities (number of enterprises)	11	32	66	107	164	174	**554**
Energy Management (number of enterprises)	-	2	6	14	23	32	**75**
Cogeneration (MW)	29	61	96	132	170	208	**695**
Total	**73**	**160**	**267**	**379**	**506**	**550**	**1 935**

Figure 4: Energy saving potential in the industry sector during the period 2015-2020

5. Economic, Environmental and Policy Analysis:

Achievements of the Energy Efficiency in the Industry Program for the period ranging between 2004 and 2012 are very promising from an energy, environment and economic perspectives.

5.1 Evolution of the number of EE program-based contracts concluded between 1987 and 2012:

Three distinct periods have marked the twenty years of implementation of Industrial EE program:

- **1987-1999** : These years witnessed the launch of the first EE Program-based Contracts "EEPC" targeting the largest energy consumers (IGCE)

  At the end of this phase that may be referred to as the Energy Efficiency "*learning period*", 111 EEPC contracts were concluded with industrials. These actions resulted in an annual energy saving of about 100 ktoe or 1.6% of the national primary energy demand.

- **2000-2003**: This is a downturn period, marked by both an institutional uncertainty with regard to the vocation of the agency in charge of energy conservation and some passivity in terms of energy prices, while the oil barrel price started to be reconsidered, modestly at the beginning to suddenly rise later. "EEPC" as well as the annual energy savings during this period did not mark any change compared to their 1999 level, hence 100 ktoe that mainly resulted from actions mostly initiated before the year 2000.

- **2004-2012**: The increase of oil prices, considerably amplified after 2004 put energy conservation and especially EE back under the light with the institution of task forces and the launch of concrete measures.

  The first results appeared in 2005 with the considerable increase of signed energy efficiency program-based contracts (EEPC) reaching **616 EEPC** (at an annual rate of 80 EEPC), versus 117 EEPC only over the 1987-2004 period.

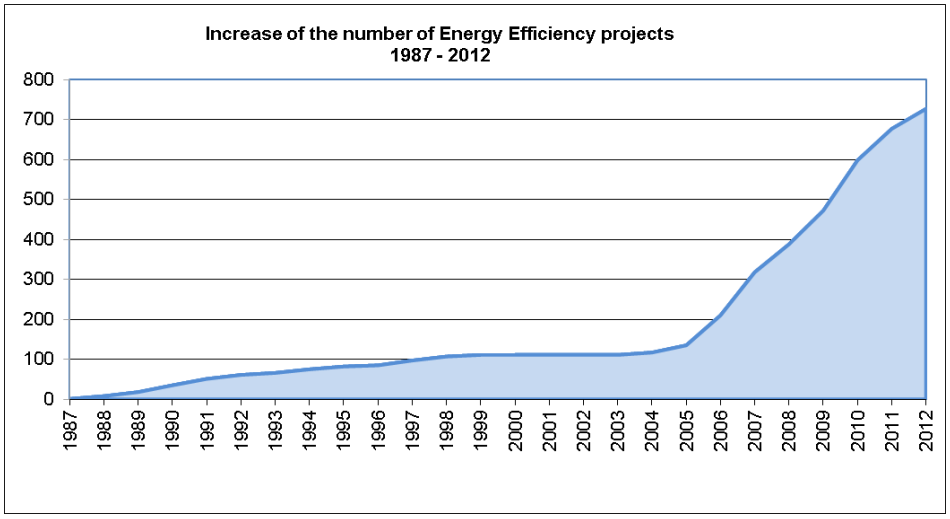


Figure 7: Increase of the number of Energy Efficiency projects 1987-2012

5.2 Energy impact in the industry

From an energy perspective, the EE industrial program contributed to quantified, energy savings for that period amounting to **1616 ktoe** hence an annual average of 160 ktoe **per year** and representing a 10% reduction of the annual consumption of industrial companies concerned by the program (320 companies).

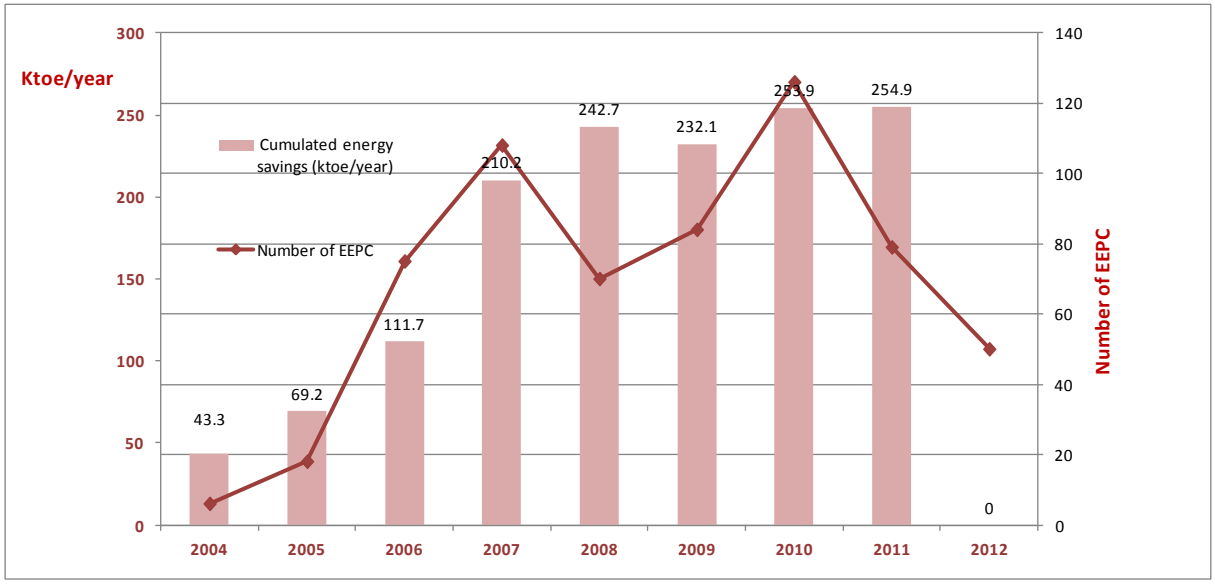


Figure 8: Evolution of EEPC and energy savings achieved in the Industry

2005-2010

The distribution of energy saving potentials by type of energy varies according to the type of industry and its energy profile. Over the period 2004-2012, the reduction of the thermal energy consumption represented nearly **70%** of the total EE potential mobilized in the industrial sector versus **30%** of Electrical energy.

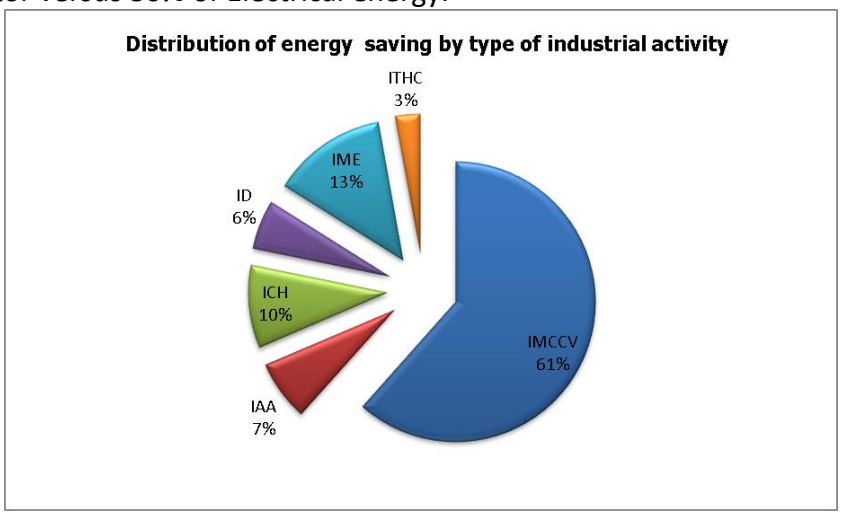


Figure 5: Distribution of energy saving by type of industrial activity

The following graphs show the distribution of EE potential identified by form of energy in the food industry and construction materials sectors.

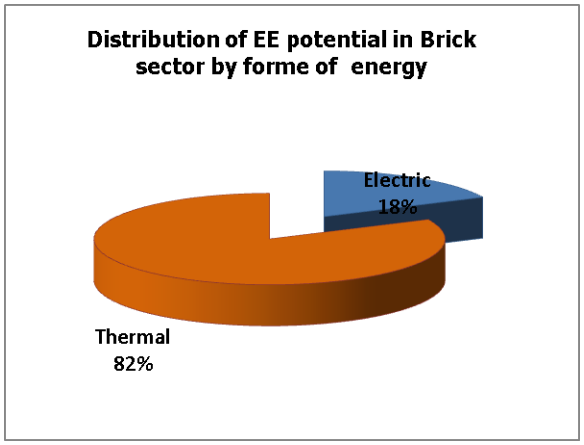


Figure 10: Distribution of EE potential in Brick sector by form of energy

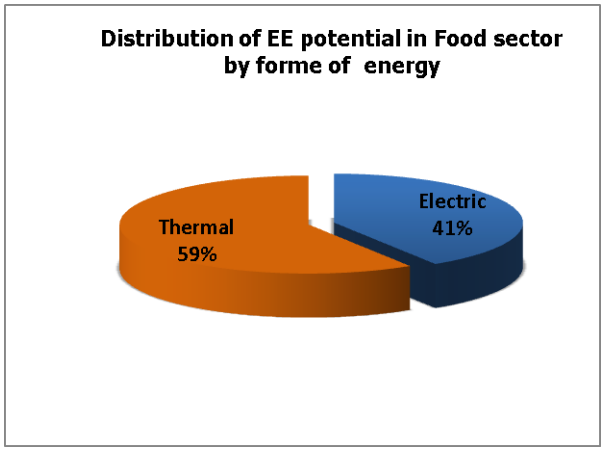


Figure 11: Distribution of EE potential in Brick sector by form of energy

5.3 Economic impact in the industry

From an economic perspective, the volume of investments in s in favor of EE industries has reached about **336 MTND** including 40 MTND provided by the FNME while the rest was invested by the private sector.

Investments made for EE reinforce the win-win approach between public and private sector. In fact, the average pay back-period of the EE investment did not exceed 2 years for industrials and less than one year for the State (period required to recover the FNME allowance).

Finally, the program enabled the creation of new branches and new specialties related to energy efficiency.

ESCOs have since then flourished, with 10 now in operation in Tunisia they have started to develop this business as they have already signed thirty Energy Performance Contracts for a total EE investment amount of 23 MTND.

We also refer to the promotion and development of the natural gas cogeneration as an efficient technology to produce simultaneously electrical power and heat. Over the period 2005-2012, nearly 55 MWe have been installed in the industrial sector for a total investment amount of 61 MTND enabling savings in primary energy of 32 ktoe per year.

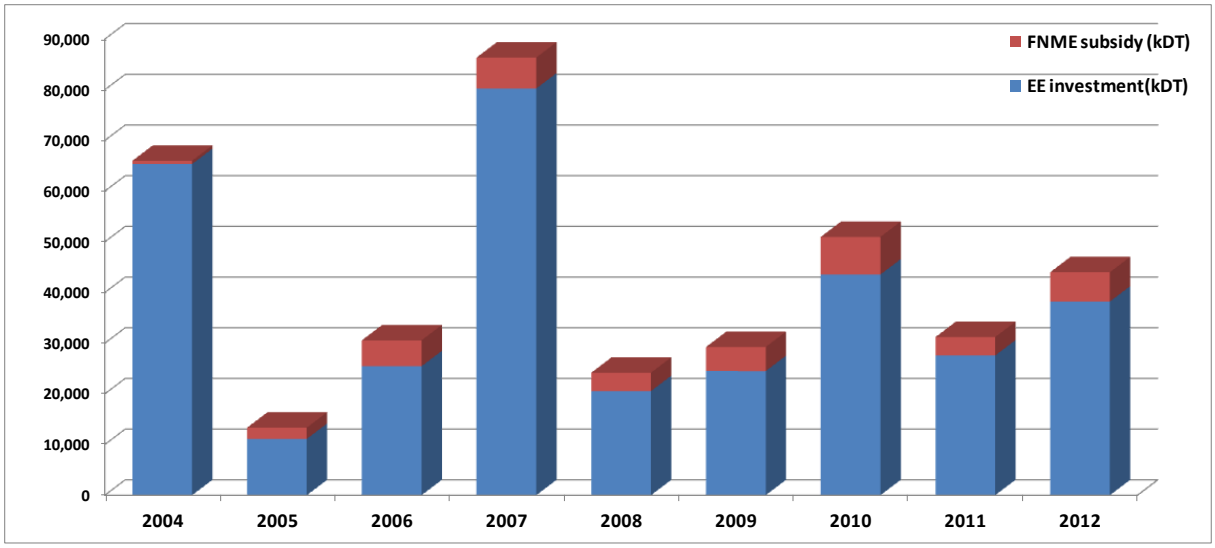


Figure 12: Evolution of EE investments in the industry

2004-2012

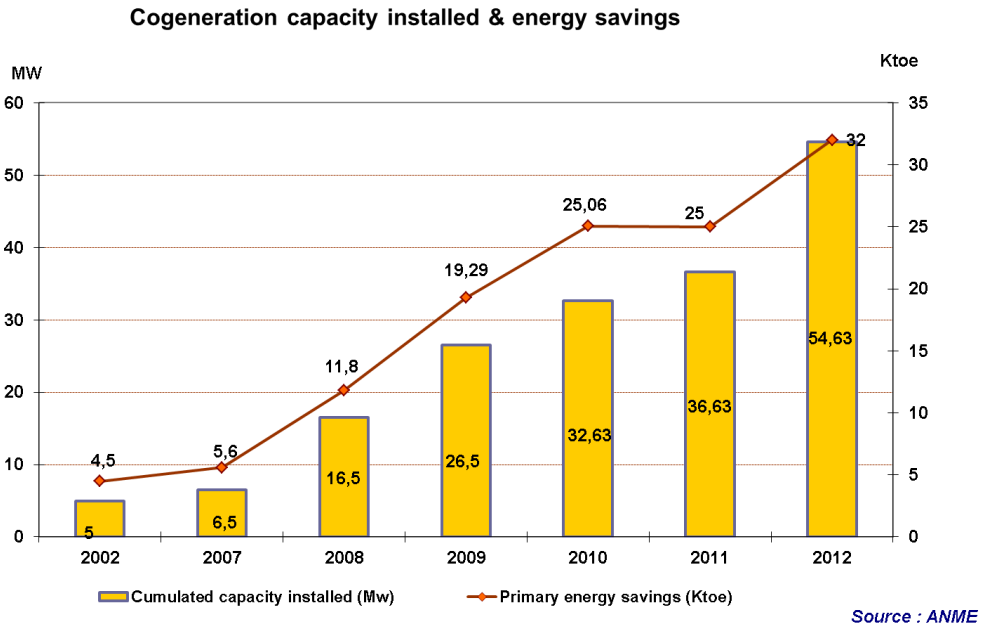


Figure 13: Cogeneration capacity installed & energy savings

5.4 Environmental impact in the industry

From an environmental perspective CO_2emissions that have been avoided[1] further to the implementation of the Industry Energy Efficiency i.e. Program are estimated at 4180 thousand TéCO_2over theperiod2004-2012, or an annual average of 465 000 TéCO_2.

Graph N° 14: Reduction of téCO_2emissions due to CP in the industry sector starting from de 2005.

[1]Calculation hypothesis: CO_2 Emissions : 1 saved toe = 2,5 TE-CO_2 avoided

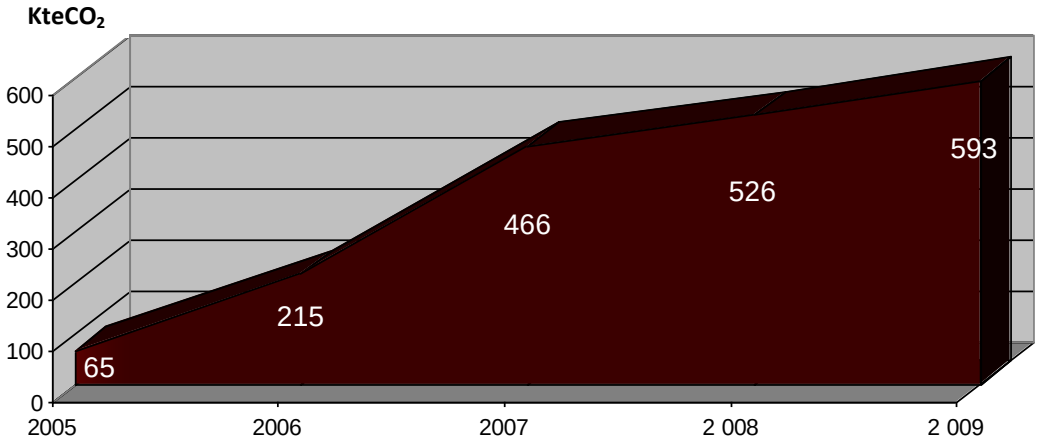


Figure 14: Reduction of téCO2emissions due to CP in the industry sector starting from de 2005.

6. Policy Design Considerations…

Tunisia has a long tradition in energy efficiency

Tunisia has been a pioneer among developing countries in terms of energy conservation policy, having formulated and implemented a policy for rational use of energy and promotion of renewables as early as 1985.

…and a well-established policy, legal and institutional framework for energy efficiency and development of domestic resources

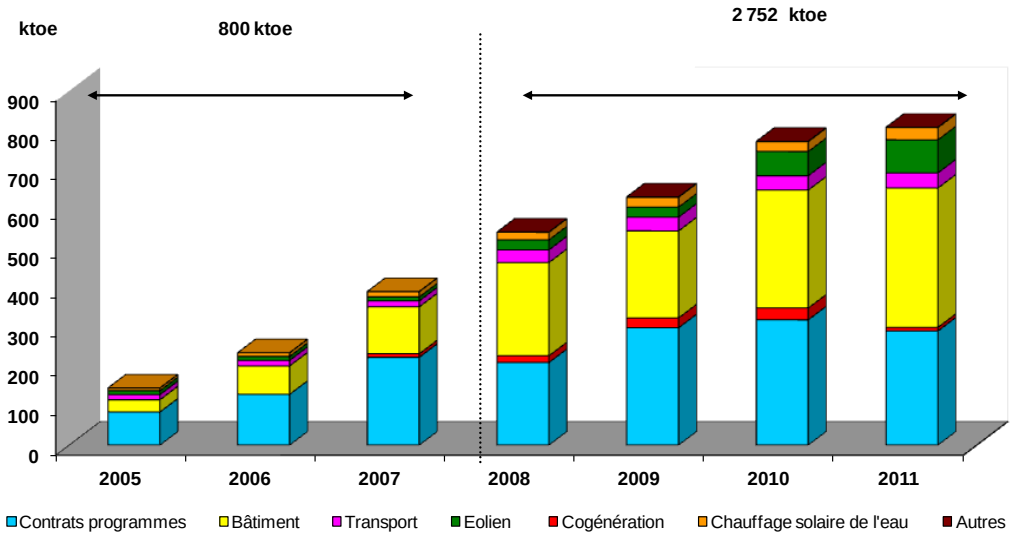
In order to scale up energy efficiency (EE) market, the Government of Tunisia (GoT) adopted an ambitious strategy and important public efforts were made since the middle of the years 2000.

To implement this strategy into actions, the Government has formulated a 3year energy conservation program for the period2005-2007followed by the 4 year energy conservation program (4ECP) for the period 2008-11.

The 2 programs have been adopted by the Council of Ministers and presented to the public in a National Conference on Energy Management (NCEM) to get the involvement and the commitment of the main key stakeholders.

An ex-post evaluation of these two programs has shown that cumulative energy savings over the period 2005-2011 reached 3500 **ktoe**.

The Energy Efficiency program targeting the industrial sector (Energy Efficiency Performance contracts EEPC, and cogeneration) contributed about **42% in the total energy savings**, reflecting the role played by this sector in the Tunisian energy conservation strategy.



Source : ANME

Figure 15: Energy savings resulting from the energy conservation program

Given the urgency to intensify energy conservation efforts, Tunisia is planning to further reinforce its energy conservation policy and strategy by setting more ambitious objectives for energy efficiency and renewable energy in the framework of the Tunisian Solar Plan (PST).

The new EE action plan aims at reducing primary energy by **17% in 2020**and 3**4% in 2030**, and reinforcing the extension of trends.

The industry would greatly contribute to these savings, mainly through cogeneration and energy efficiency innovative actions directly geared towards the industry processes optimization.

7. Barriers/obstacles against implementation and learned lessons …

To further mobilize the potential of energy saving in the industrial sector in Tunisia and to achieve the planned goals, it is necessary to overcome a certain number of economical, technical, financial and legal barriers.

7.1 Economic barriers

In principle, the most efficient measure to encourage energy efficiency and use of renewables is the application of pricing principles that are cost reflective and indicate to consumers that energy should be saved and that renewables should be preferred to conventional fossil fuels. However, implementing such pricing principles may be difficult (even straightforward subsidy reform is a lengthy process). Therefore other incentives need to be put in place even before subsidies are reduced, in order to kick-start investment in energy efficiency (EE) and renewable energy (RE). Moreover, it is easier to implement a subsidy reduction scheme in an economy with good EE performance, as the resulting consumer price increase has less of a negative impact on the economy and on the standard of living.

7.2 Technical barriers

For the decision makers of the industrial sector:

Many industries are still unaware of the benefits of energy efficiency for competitiveness, and their focus remains on productive investment and quality development.

There is an uncertainty and lack of information about best available technologies and practices for each industrial branch. For this reason, a comparative analysis of technologies and processes employed in certain Tunisian industrial branches compared to those employed in the whole world constitutes a significant tool to evaluate the current performance status of industry in Tunisia.

Currently, there are no comparative studies on cross-cutting technologies and practical operation in Tunisia. In spite of the multiple incentives currently granted to energy efficiency investments in the industrial sector and the awareness-raising campaigns carried out until now, the establishments belonging to this sector remain not very sensitive to such investment.

Indeed, with the economic opening of the country, the industrialists are exposed to an increasingly stiff competition and the investment in the energy efficiency measures does not constitute necessarily a top priority for the companies.

Most of industries and company strategies are tend to focus on output growth rather than cost management. Most of industrialists have limited technical skills on energy efficiency, are not able to follow the energy performance indicators and to propose the necessary actions.

On the other hand, it should be noted that the planning of the investments of the companies does not take into account the future evolution of the costs of energy.

For local expertise:

Most of specialized consulting firms in the field have a limited knowledge of the energy management systems. Their interventions are generally focused on specific technologies and not on processes and systems. Overall knowledge of energy management systems is also limited.

In addition, a regular upgrading of consulting firms is needed to ensure the desired quality of energy audits in a context where technological progress has changed significantly.

There is a need to build technical capacities of all the stakeholders (consulting firms, technical centers, technical managers in industries...) on energy management systems, system optimization, and data measurement, reporting and analysis.

7.3 Financial Barriers:

The FNME has limited resources and its range of applications is too narrow. EE investment is not attractive to commercial banks because of small deal sizes, high transaction costs, priority given to productive investment, lack of experience with EE, difficulty in structuring arrangements for preparation, financing and implementation of EE projects, etc.

ESCOs have not been able to assist in the removal of those barriers, as they do not have better access to financing resources than industrial companies because they are not yet well established. As a result they have been acting more as technical consultants than financial advisor and intermediary.

7.4 Legal Barriers:

In view of the experiences in energy efficiency, gaps in the regulatory framework have been identified. These gaps are essentially linked on the one hand, to defects of updating the regulations to make them consistent with the evolution of EE activities in the industry (ex: Regulations regarding cogeneration and the development of wind energy under IPP or self-generation arrangements are still inadequate) on the other hand, to problems of enforcement of the regulations (Communication, support and control).

Continuous improvement of the regulatory framework related to energy efficiency in industry is therefore a strategic activity in more than one way, and will allow:

- To measure the impact of the existing EE regulation, in order to assess their effectiveness.
- To develop an action plan in order to enforce existing EE regulations and ensure their effectiveness
- To introduce new EE regulations to the smooth market development of energy efficiency (EE) and renewable energy (RE)
- To strengthen collaboration and coordination among all stakeholders.

8. Conclusion and Recommendations:

Building on these assets, Tunisia has launched new programs and actions to further mobilize its energy saving potential in the industrial sector.

In fact and in spite of promising results achieved mainly thanks to ANME's actions essentially reflected in reduced demands for energy, the dissociation of energy demand with regard to the economic growth and the quantities of saved energy, major challenges **must still be overcome.** In the meantime however, energy markets have witnessed new fluctuations, and the energy bill should further increase for Tunisia.

Moreover, energy has become a key factor for competitiveness, and the proximity advantage with the European Union may be overlooked if the "energy competitiveness" with regard to European Union countries is not improved, as well as with regard to economies highly depending on exports to the European market (Turkey, South6eastern Asia, etc…).

The rational use of energy must always be considered, reinforced, accelerated and must follow the pace of technological developments.

In this context, a new ambitious Energy Efficiency strategy has been launched for the 2013-2020 period targeting various economic sectors, to enable accumulated quantitative primary energy savings of **16.5 Mtoe**.

With **4.4 Mtoe**, or **16%** of savings targeted for the period2013-2020, the industry should be the second pillar of the Tunisian Energy Efficiency Policy.

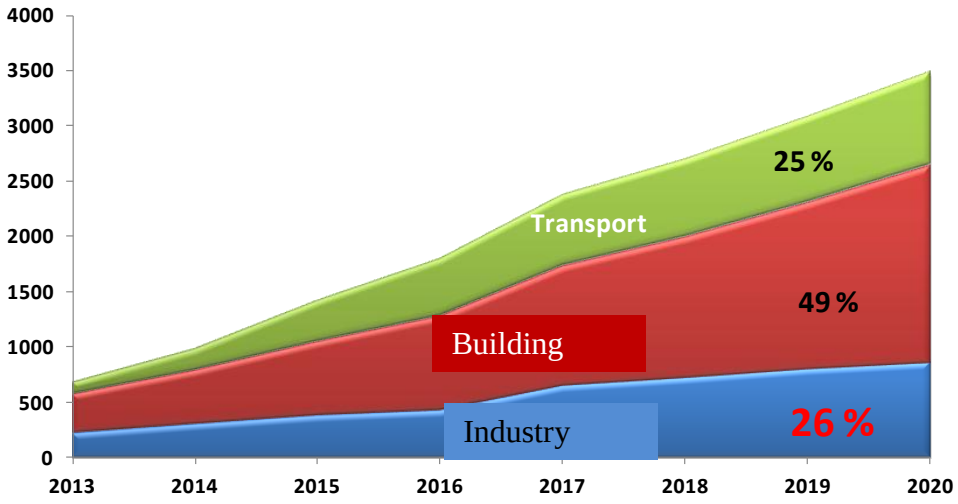


Figure 6: Energy impact of the EE action plan in the industry

As recognized in the NEEAP, scaling up EE in Tunisian's industry would need more voluntary and coherent policy, especially when energy prices do not provide the correct signal.

The new ambitious EE Policy is based on three main support and strategic axes which have to operate in a coherent and simultaneous way:

1) Strengthening institutional and legal framework (Capacity building as a tool boosting energy efficiency actions, Institutional and organizational mechanisms, Regulatory mechanisms, Minimum Energy Performance standards)

2) Providing innovative supportive mechanisms (Attractive financing mechanisms, *targeted financial incentives*, *loan guarantees*, real energy prices, ESCOs ….)

3) Providing closer support to project developers especially SME's (Improving EE services to customer, guarantee Energy savings, MRV, etc.)

A wide range of EE measures have been identified and that will constitute the key actions for the direct support to industry, including the following:

- Reinforcement and consolidation of Mandatory Energy audit and EEPC programs aimed for the industrial sector while upgrading the quality of EE programs, through the progressive introduction of the guarantee of Energy savings and the systematic enforcement of Monitoring & Verification; *to enable progressively the market for energy performance contracting 'EPC"*
- Progressive integration of Energy Management system (ISO 50001 standard) to the management of the company ma.
- Adoption MEPS for industrial-scale electric motors and consider MEPS for other categories of industrial equipment in common use, e.g., compressors, pumps and boiler, consistent with international best practices. Development and consolidation of the cogeneration program by reinforcing the legal and incentive framework and by intensifying awareness programs targeting industrials;
- *Reinforcement of the role of En*ergy Services Companies by enhancing their technical capacities and by providing them with new funding mechanisms;
- Implementation of an Energy Efficiency information system in industry based on pertinent indicators in order to enable the continuous evaluation of the Energy Efficiency policy in this sector.

9. Case study of industrial companies in Tunisia

-TUNISIA PORCELAINE-
Recovery of the oven's hot air to the dryer

Presentation:
Creation date: 1982
Activity sector: IMCCV
Sub-activity and products: Manufacturing of porcelain products
Number of employees: 881 including 172 managing staff
Turnover in 2010: 30 MTD
Annual production in 2010: 8,068 Tons

Energy challenges:

Primary energy consumption in 2010: 6 048 toe broken down in:
- Electrical consumption: 1 733 toe
- Thermal consumption: 4 315 toe

Energy spending: 1 889 kTD/year.
Rate of energy in production costs: 8,8%

Energy Efficiency Action Plans
- Thermal insulation of the concrete dryer
- **Recovery of hot air from the FCR oven to the under pressure pouring concrete dryer.**
- Installation of a centralized computer system to manage production and energy consumption;
- Optimizing the manual air cooling system;
- Energy management;
- Installation of condensation batteries;
- Recovery of hot gazes from TSR60 oven for the dryers;
- Installation of a heat skimmers for the TSR34 oven;
- Improvement of ovens' insulating systems;
- Optimizing ovens control tools;
- Improving the compensation of reactive energy at the level of the factory;
- Optimizing the factory's external lighting system;
- Optimizing the compressed air system;
- Substitution of the electric steam generator in the decalcomania chamber;
- Reduction of leaks from walls of the TSR36 oven;
- Reduction of leaks from the walls of the two plate dryers;
- Improvement of the energy monitoring system;
- **Substitution with natural gas**: substitution of heavy fuel with natural gas

Impact of the program:

Global energy saving	toe/year	973
	% energy consumption	**16 %**
Gain financier	**kDT/year**	**285**
	% bill	**15%**
Global investment (kTD)		**559,5**
Avoided GHE (TE-CO2)		**2 285**
Return period on investments		**2 years**

Action: Recovery of the oven's hot air to the dryer.
Hot gases generated by the FCR oven are discharged by the funnel to the open air. The factory has therefore decided to recover these hot gases and to reintroduce them in the dryer as combustion air at the level of burners by means of a heat insulating jacket.

- ETS SLAMA FRERES Company – Nejma Oils -

Cogeneration with gas engines

Presentation:

Creation date: 1972
Activity sector: ICH
Sub activity or products: Refinery and conditioning vegetal Oil and fat, and manufacturing of home soap.
Number of employees: 366 including 53 managing staff
Turnover in2009:90 MT without tax
Annual production in 2010: 78,705 Tons

Energy Challenge:

Primary energy consumption in 2010:7122 Toe broken down in:

Electrical energy: 2 294tep
Thermal energy: 4 828 toe

Energy spending: 2 657 kDT/year.

Energy Efficiency Action Plans

- Insulating fat tanks ;
- Acquisition of a condensate recycling system ;
- Acquisition of steam flow meters;
- Insulating the boilers' food tanks;
- Recovery of the condensates' flash steam;
- Acquisition of automatic drain devices at the level of the boiler room;
- Replacement of the oil/thermal oil exchanger at the level of the deodorization unit;
- Optimizing the factory's lighting system;
- **Cogeneration project with gas engines**

Action: Cogeneration project:

The Nejma Oil factory acquired a cogeneration system with a nominal power of 1131 MWe (ISO) operating with natural gas to fulfill a portion of its electrical and thermal needs (hot water and steam).
The cogeneration system includes:
- A gas engine powered 1 131 kW
- A steam generator at 4 bars abs.
- a hot water recovery system at 90°Coperating with the engine's cooling water and gas produced by the steam generator.

Impact of the program:

Global energy saving	toe/year	2 257
	% Energy consumption	**32 %**
Financial profit	**KDT/year**	**964**
	% bill	**36 %**
Global investment (KTD)		**2 742,5**
Avoided GHE (TE-CO2)		**6 186**
Return period on investments		**2 years 10 months**

Global energy saving	toe/year	1 249
	% Energy consumption	**17 %**
Financial profit	**kDT/year**	**663**
	% bill	**25 %**
Global investment (KTD)		**2 351**
Avoided GHE (TE-CO2)		**3 085**