



14 & 15 April 2016, Ain Essokhna

# Support Programme for Cogeneration: Tunisian Experience:

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*Key Expert.MED ENEC*

# WHAT IS COGENERATION?



This project is funded by the European Union

## PRODUCTION OF ELECTRICAL AND THERMAL POWER:

- ✓ At the same time
- ✓ In the same power machine.

Conventional energy

Natural Gas



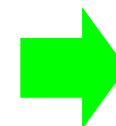
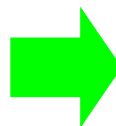
Heat:

- ✓ Steam
- ✓ Hot oil.
- ✓ Hot water

Power plant



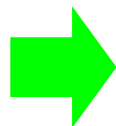
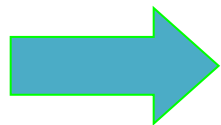
Mains



Electricity

## COGENERATION

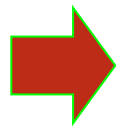
Natural Gas



Electricity

Heat:

- ✓ Steam
- ✓ Hot oil.
- ✓ Hot water

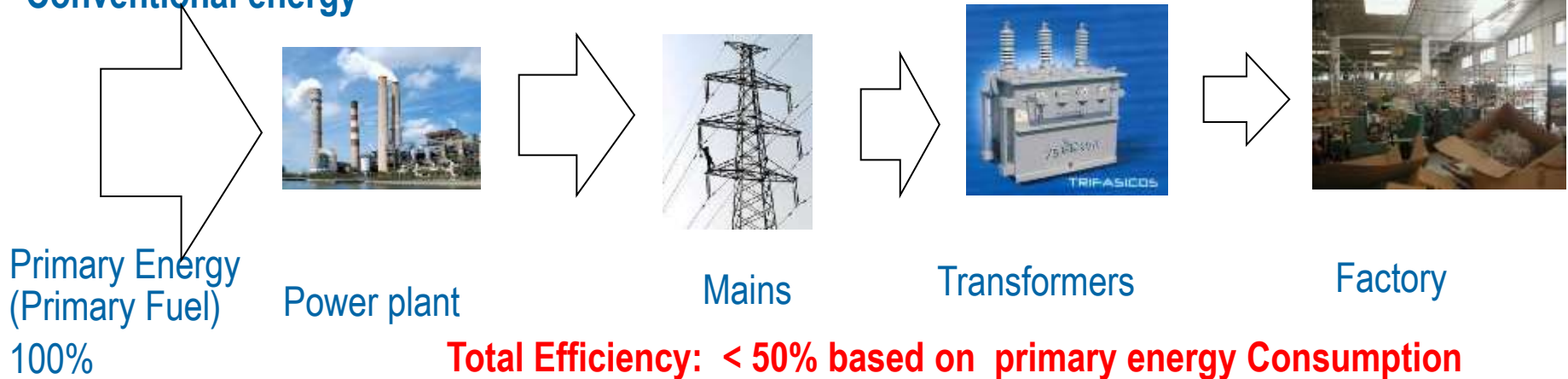


# Why Cogeneration is profitable for the country?



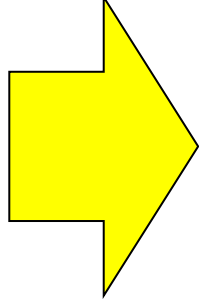
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## Conventional energy

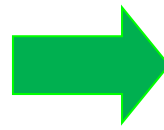


## COGENERATION

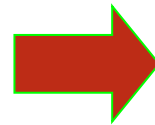
Natural Gas



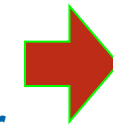
Gas Engine



Electricity (44%)



Heat:  
 ✓ Steam  
 ✓ Hot oil.  
 ✓ Hot water



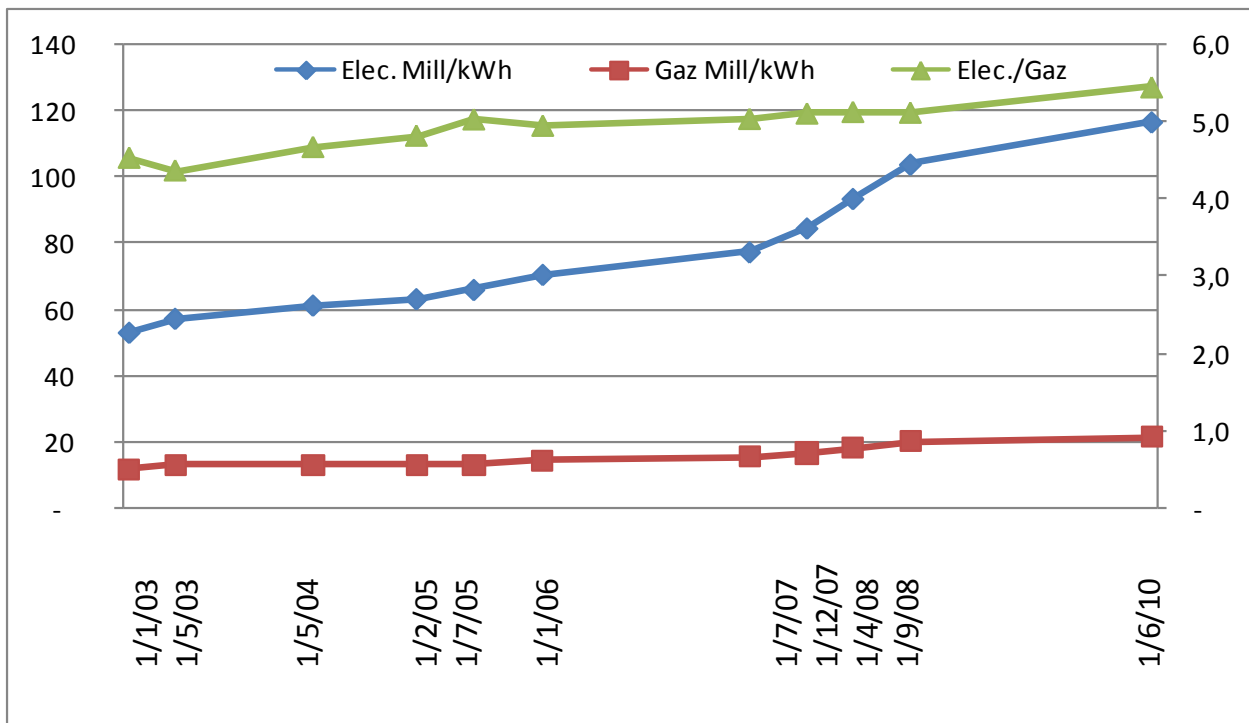
**Efficiency: > 70% based on primary energy Consumption**

# Why Cogeneration is profitable for the company?



Cogeneration  
=  
Substitution of electricity by Natural gas

## National Price of Electricity VS Nature Gas



# Why Cogeneration is profitable for the company?



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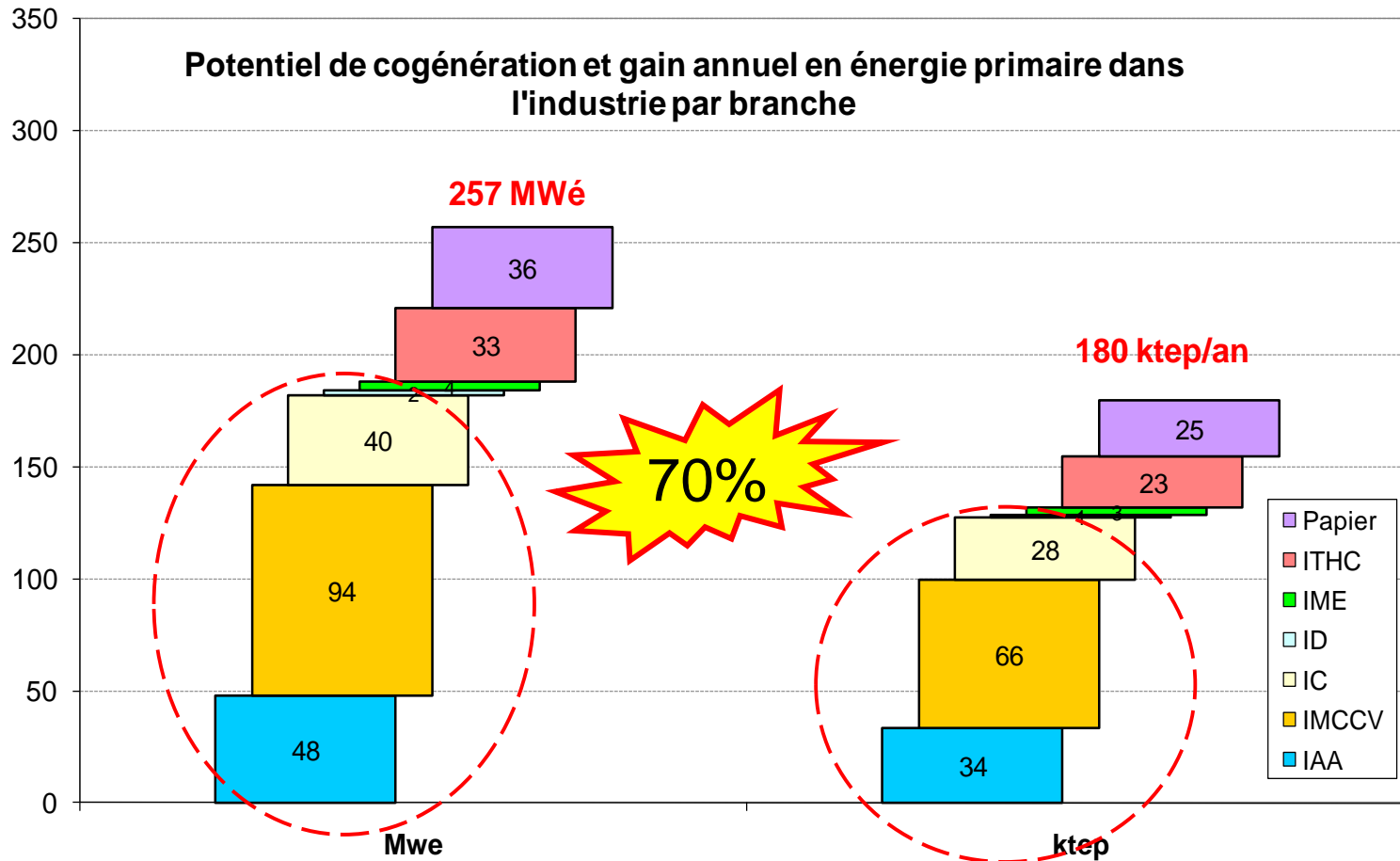
Paramètre	Unité	Sans cogénération	Avec Cogénération
Puissance Cogénérateur			1 000
Rendement électrique cogénérateur			40%
Puissance moyenne appelée	kW	1 000	1 000
Nombre heures de marche	h	7 000	7 000
Consommation	kWh	7 000 000	7 000 000
Coût	TND/kWh	0,12	0,12
Facture électricité	TND	840 000	
Energie thermique			
Rendement global cogénérateur	%		80%
Puissance thermique récupérée	kW		1 000
Chaleur récupérée	kWh		7 000 000
Puissance moyenne	kWh PCI	2 000	
Nombre heures de marche	h	7 000	7 000
Consommation	kWh	14 000 000	7 000 000
Coût	TND/kWh	0,023	0,023
Coût énergie thermique	TND	322 000	161 000
Consommation cogénérateur	kWh		17500000
Consommation cogénérateur	TND/an		402500
Facture Energie	TND/an	1 162 000	563 500
Economie	TND/an		598 500
Réduction facture	%		52%
Maintenance	TND/h		20
Maintenance	TND/an		140 000
Economie nette	TND/an		458 500
Réduction Nette	%		39%
Investissement	TND		2 000 000
Subvention FNME	TND		400 000
Investissement net	TND		1 600 000
Temps de retour	Année	3,5	

40% Reduction of the Energy Bill

# Cogeneration Potential in Industry: 260 MW



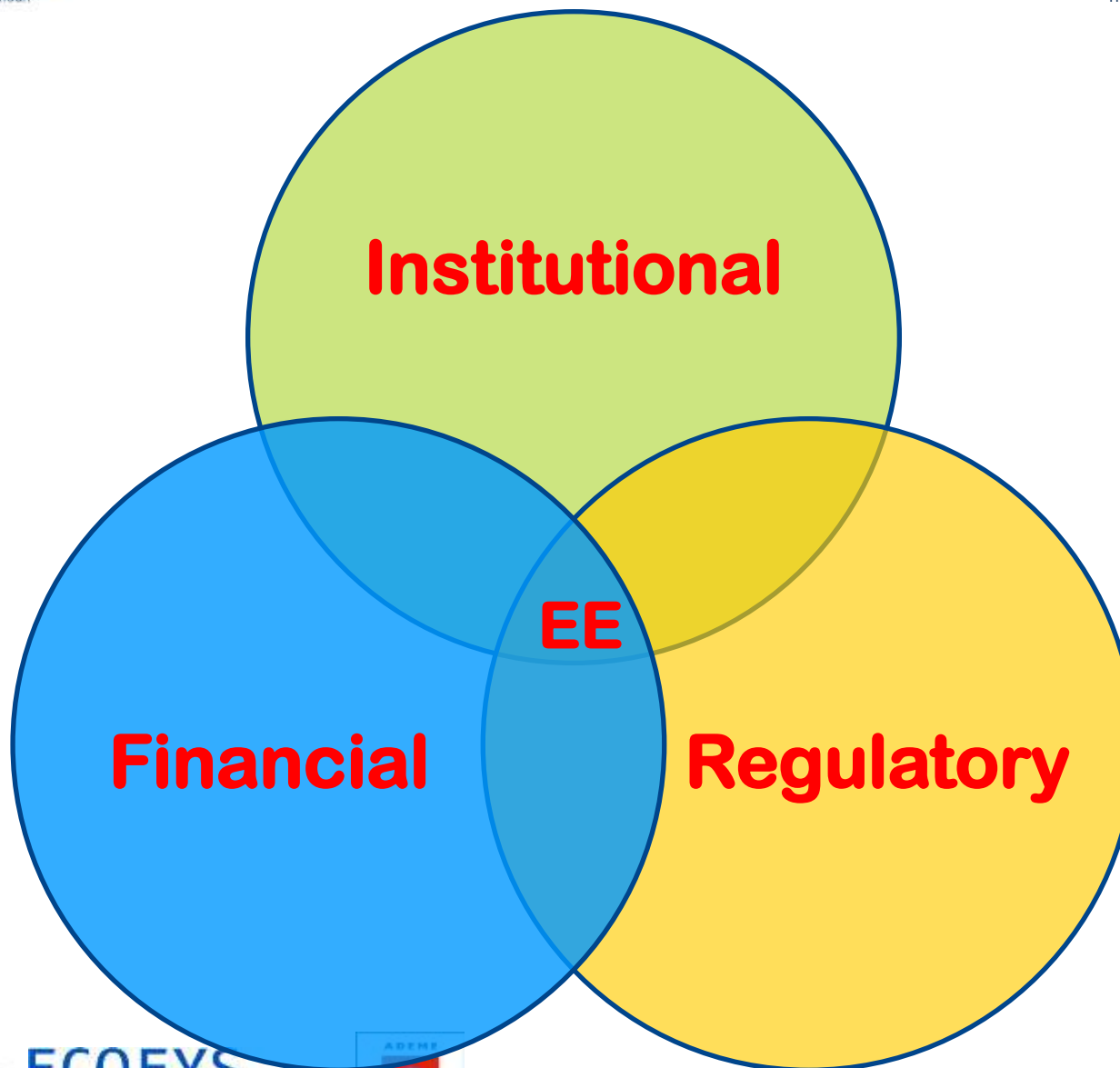
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# Energy Efficiency policy in Tunisia: Varied & Complementary EE policy tools



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- National Agency for Energy Conservation **ANME** created in 1985 and enforced in 2004.
- Creation of **4 Task forces** led by ANME in 2005:
  - ✦ **Task force for large industrial energy users:**  
To assist large industrial energy users in their energy conservation efforts
  - ✦ **Task force cogeneration:**  
**To support the establishment of the required legal framework to achieve the cogeneration objectives**  
**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 in industry & Commercial sector

## Decree 2009-3377 of 2 november 2009

- ❑ Defines the framework for the construction and operation of cogeneration plants.
- ❑ Defines the technical criteria for a cogeneration plant to be considered energy efficient.
  - Annual overall efficiency  $\geq 0,6$
  - Heat recovery ratio  $> 0,5$ .
- ❑ Defines the flow conditions of electrical power excess to electricity utility STEG
  - ❑  $\frac{1}{2}$  EEP  $\longrightarrow P \geq 3 \text{ MW}$
  - ❑  $\frac{2}{3}$  EEP  $\longrightarrow P < 3 \text{ MW}$

## Decree 2009-3377 du 2 novembre 2009

- ❑ Any new cogeneration project should conduct and submit a feasibility study to the National Agency for Energy Conservation (ANME)..
  - ❑ Certifies that the cogeneration project is Energy Efficient
  - ❑ The certificate is delivered after the approval of a national cogeneration commission
  - ❑ The certificate issued gives entitlement to advantages granted to cogeneration (incentive purchase price for the excess of electricity, Prime à l'investissement...)

## **Decree 24 December 2007 setting the technical requirements for connection of cogeneration systems to the electrical grid.**

### **• Voltage Requirements**

- ✦ The voltage variation shall not exceed 7% of the nominal voltage
- ✦ Low total harmonic distortion according to the standards and Norms
- ✦ Over voltage protection (asynchronous generator with capacitor bank)
- ✦ Voltage regulation of a synchronous generator

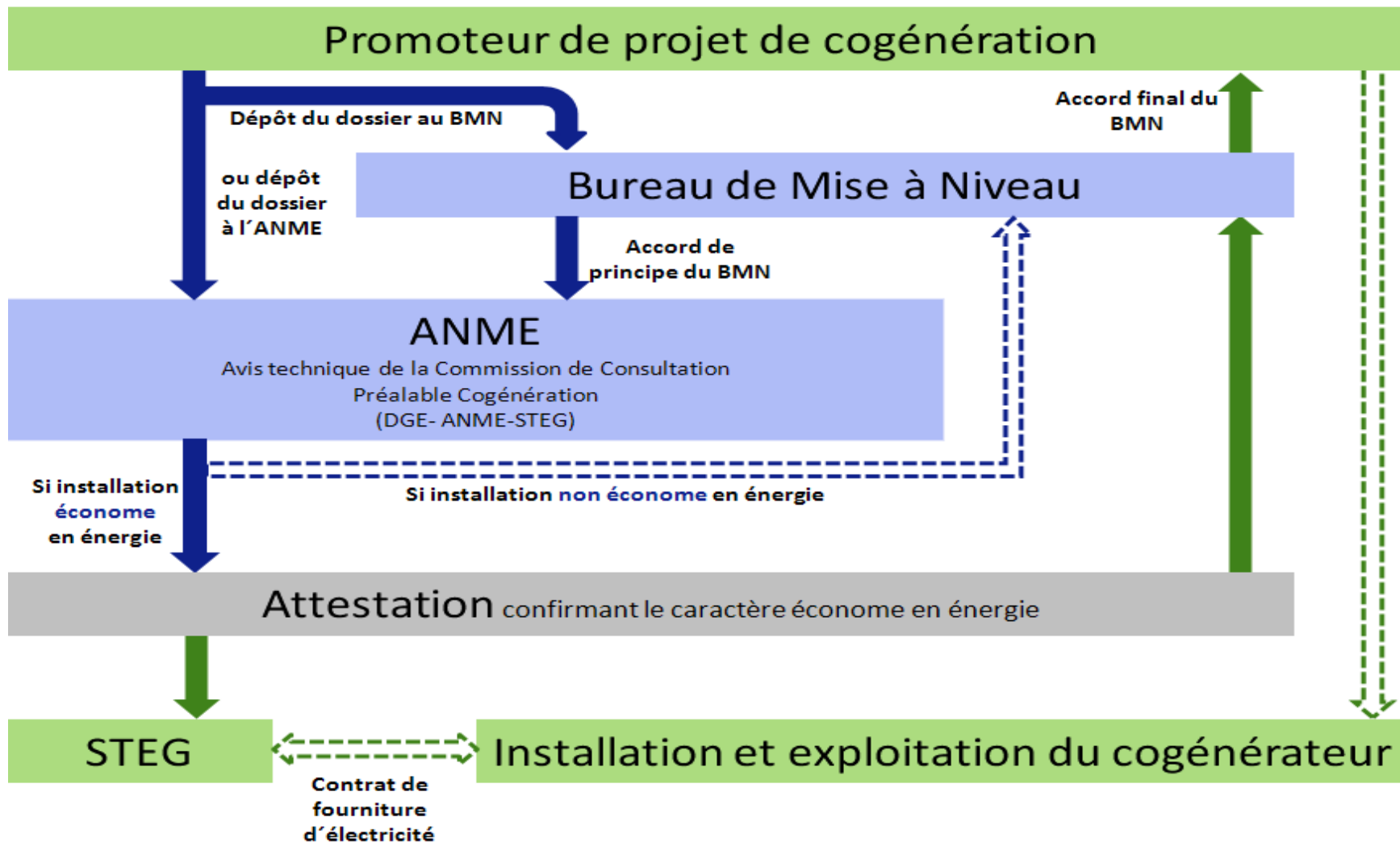
### **• Security System Requirements**

- ✦ Disconnect quickly and safely from the grid when a disturbance is detected on the grid.

- Specific Framework for the promotion of cogeneration
  - ✦ **20%** subsidy for cogeneration investment with a maximum of **500.000 dinars** per project from the sustainable Fund **FNME**.
  - ✦ **Obligation** for the utility company STEG to buy the excess of electricity produced by cogeneration plant.
  - ✦ Third part access to STEG transmission Network.
  - ✦ An **incentive purchase price** for the excess of electricity sold to the grid



- Prix Jour :  $0,2401 \times \text{Prix Gaz/tep} + 16$  (millimes)
- Prix Pointe :  $0,3110 \times \text{Prix Gaz/tep} + 60$  (millimes)
- Prix Soir :  $0,3039 \times \text{Prix Gaz/tep} + 40$  (millimes)
- Prix Nuit :  $0,2179 \times \text{Prix Gaz/tep}$  (millimes)



- **Credit line World Bank: 40 MUS\$**

- A long terme loan from the world bank with the guarantee from the Government of Tunisia
- 2 banks partners: **Amen Bank, Banque de l'Habitat**
- Cogeneration and Energy Efficiency in industries

- **Credit Line Environment AFD: 40 M€**

- A loan from AFD, bonifie par l'UE
- 3 banks partners: **BIAT, UBCI, BT**
- Cogeneration, Energy Efficiency and Renewable Energies

- **Technical and financial assistance to project developers**
  - The **ANME** in the center of the dispositif
  - Providing technical assistance to the commercial banks in the area of EE
  - Providing support to project developers.



### ■ Technical support to project developers

- Conducting **prefaisability studies** to the targeted customers in industrial and commercial sector.
- Conducting (20) **detailed faisability studies** in targeted industries Food ,Ceramic & Chemical .
- Supporting the project developers in preparing the Businee plan and in Financing their investment project.

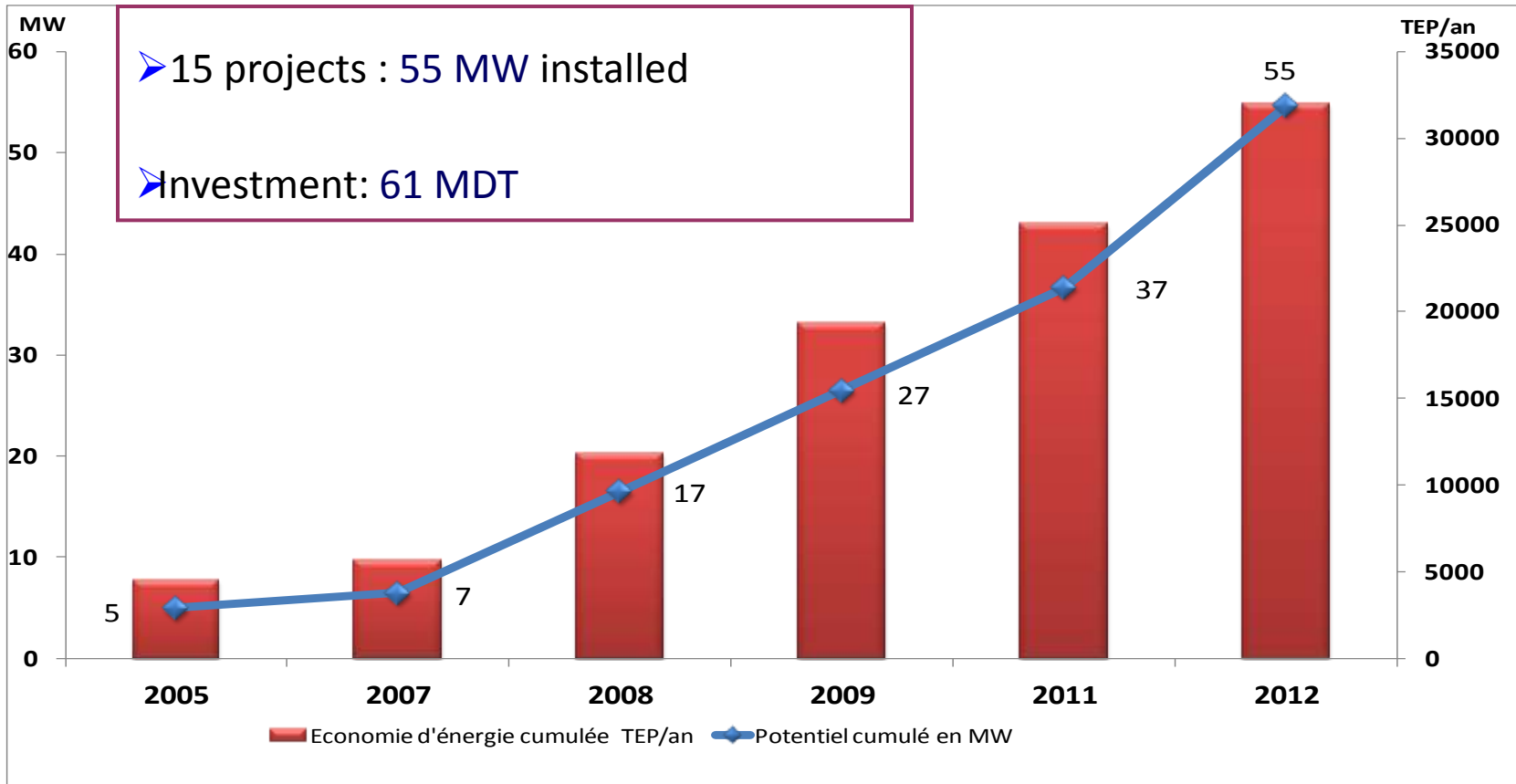
### ■ Enhancing the capacities of different stakeholders

- Training in conducting detailed faisability studies.
- Training in Implementing and operating cogeneration plant.

# Cogeneration Capacity Installed & Energy Savings



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## Applications in Chemical Sector

### ❑ SOTIPAPIER 2007

- Paper production
- Gas turbine 7 MW
- 12 to 20 tonnes of steam
- 2 gas Turbines of 5 MW each
- Connected to the grid STEG

### ❑ TEC T'PAP 2009

- Paper production
- Gas turbine 4.7 MW electrical
- Steam recovery 13 tonnes
- Connected to the grid STEG



## Applications in Ceramic Sector

### □ **CARTHAGO CERAMIC 2002**

- Creamic
- Gas Turbine 5,5 MW
- Connected to the grid STEG
- Using exhausted Gas in the atomizers

### □ **CARTHAGO GRES 2009**

- Ceramic
- Gas turbine 4.7 MW
- Using exhausted Gas in the atomizers
- Récupération de la vapeur pour une usine mitoyenne
- Connected to the grid STEG



## Applications in Brick Sector

### □ Briqueterie Bir M'Cherga - BBM 2011

- Produits rouges
- Gas turbine 4,47 MW
- Connected to the grid STEG
- Using exhausted gas in





## Applications in Food Sector

### ❑ **Nejma Huiles SA 2011**

- Refinery and Conditioning vegetal oil
- Gas Engine 1,13 Mw
- Connected to the grid STEG
- Using exhausted gas for producing steam.
- Hot water recovery system



## Applications in Buildings

### ❑ **INTERNATIONAL AIRPORT ENFIDHA 2011**

- Moteurs à gaz 4.07 MW électrique
- Trigeneration
- Using exhausted gas for producing hot water and cooling
- Connected to the grid STEG



# The programme has operated a real market transformation:



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## Objectif : 141 MW Capacity Installed in 2016

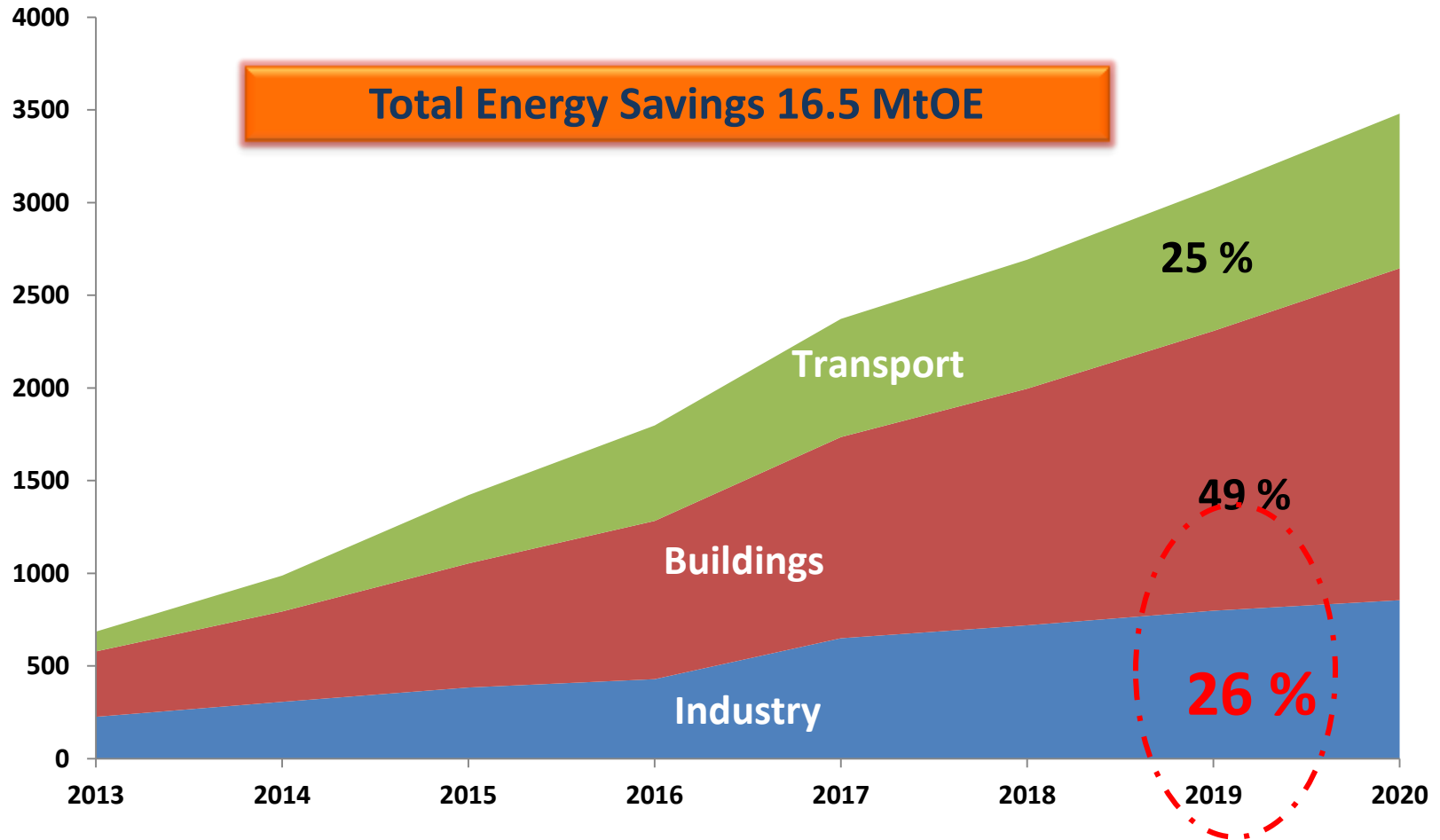
Pipe Line of the cogeneration project-2016		
Number of installations	Status	Capacity (MW)
22	Cogeneration facilities operational or significantly advanced in the implementation	81
5	Projects under construction	15
18	Projects approved by the national cogeneration committee	52
6	Faisability study	21
<b>51</b>	<b>TOTAL</b>	<b>141</b>



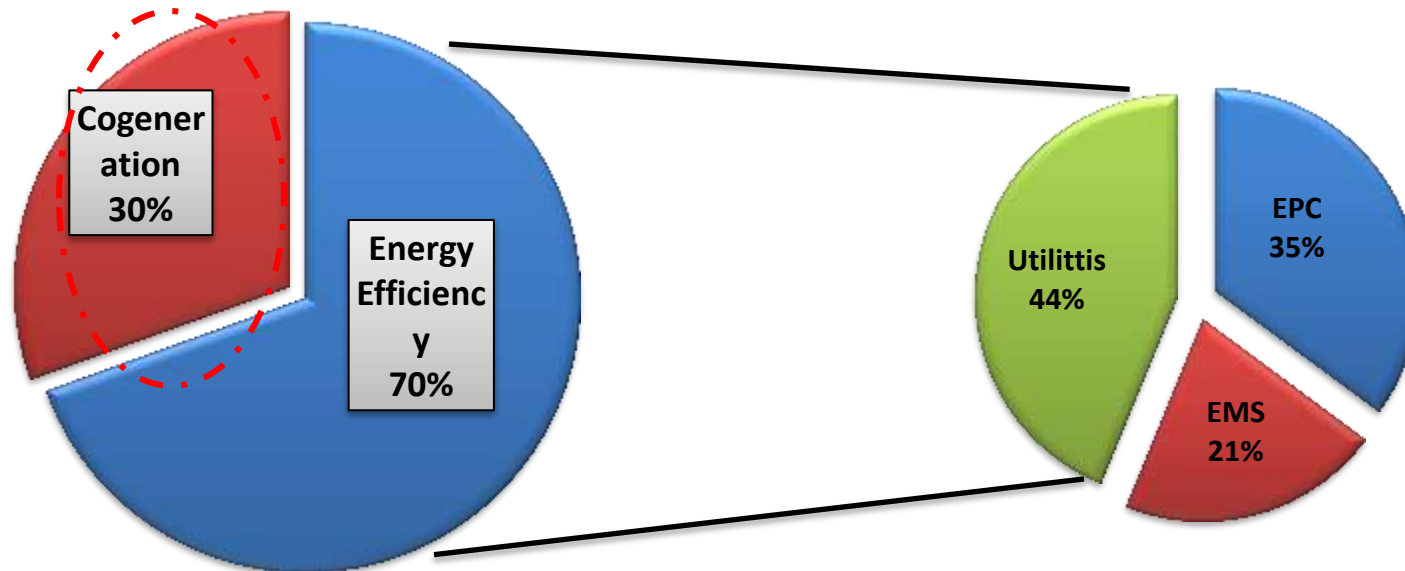
# Energy Impact- NEEAP-2013-2020



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**Energy Savings Industry 2013-2020 ---4.4 MtOE**



EE is a key for a sustainable economic development in  
the region

with a big market that is growing . . .  
but even more needs to be done to scale up....

- ❑ A **comprehensive policy package** is required to address market failures
- ❑ Financial support and **Innovative Mechanism are needed** for scaling up EE market
- ❑ **Increase awareness** of actors at all levels & build the capacities of all stakeholders
- ❑ Promote Public-Private Partnership strategy and actions to promote EE ( Super ESCOs, ESCOs)

# THANK YOU FOR YOUR ATTENTION

