Promotion of thermal insulation of roofs in residential buildings:

Set up of the financial mechanism "PROMO-ISOL"

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Review of objectives

Socio-economic characteristics of the residential building sector in Tunisia

Energy context

Proposition of an integrated financing mechanism

Pilot program for residential PROMO-ISOL

Accompanying measures for the proposed program
Development of an appropriate financing mechanism for the promotion of thermal performance enhancement in new and existing buildings:

- Conception of the mechanism in conjunction with key stakeholders
- Set up of an operational scheme for the mechanism
Socio-economic characteristics

Existing residential building stock: Typology

Distribution of residential building stock per housing type

- Houche (traditional)
- Villa
- Studio
- Apartment
- Rudimentary housing

<table>
<thead>
<tr>
<th>Year</th>
<th>Houche (%)</th>
<th>Villa (%)</th>
<th>Studio (%)</th>
<th>Apartment (%)</th>
<th>Rudimentary housing (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>63.6%</td>
<td>52.1%</td>
<td>27.8%</td>
<td>5.9%</td>
<td>2.7%</td>
</tr>
<tr>
<td>2004</td>
<td>27.8%</td>
<td>37.6%</td>
<td>2.0%</td>
<td>7.5%</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

Note: The percentages may not sum up to 100% due to rounding.
Socio-economic characteristics
Existing residential building stock: Distribution by climate zones

ZT1: Coastal area (mild winter & summer)
ZT2: Continental NW area (Harsh winter & summer)
ZT3: Continental southern area (mild to harsh winter / Severe summer)

Distribution of existing housing stock per type and climate zone

<table>
<thead>
<tr>
<th>Type</th>
<th>ZT1</th>
<th>ZT2</th>
<th>ZT3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rudimentary housing</td>
<td>775</td>
<td>141</td>
<td>31</td>
</tr>
<tr>
<td>Apartment</td>
<td>755</td>
<td>420</td>
<td>-</td>
</tr>
<tr>
<td>Studio</td>
<td>-</td>
<td>91</td>
<td>-</td>
</tr>
<tr>
<td>Villa</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Houch</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Thousands of homes

Milliers de logements
Socio-economic characteristics

Existing residential building stock: Distribution by unitary size

Distribution by housing unit floor area

Thousands of homes

- < 50 m²
- 50 – 99 m²
- 100 – 149 m²
- 150 – 199 m²
- > 200 m²
- unspecified

Legend:
- ZT1
- ZT2
- ZT3
- All zones
About 75,000 new housing units per year:

- 1/3 of new stock through real estate developers;
- And 2/3 of new stock through auto-construction.
Energy Context of the building sector
Stakes: National energy prospective

Provisional End use Energy Demand by Sector on the horizon 2030

- Industry: 4.6 Mtep
- Transport: 5.2 Mtep
- Building: 3.3 Mtep
- Agriculture: 1.5 Mtep

Units: Mtep
Contribution of about **300 MW** to the peak summer electrical demand;

Energy consumption: went from **22.6 GWh** (1.7% of Total Residential Electrical Consumption [TREC]) in 1994 to **131.3 GWh** (4.6% of TREC) in 2004.
Energy Context of the building sector
Heating and cooling energy needs by climatic zone

Seasonal heating and cooling loads for a typical 2-story individual housing unit (villa) / Floor area = 230 m²

KWh / (m².year)

- ZT1: Heating = 53, Cooling = 26
- ZT2: Heating = 72, Cooling = 28
- ZT3: Heating = 38, Cooling = 35
1. Roof thermal insulation,
2. Increased thermal insulation of exterior walls,
3. Double glazed wood frame windows,
4. Thermal insulation of roof and exterior walls \((1 + 2)\),
5. Thermal insulation of walls and double glazed windows \((2 + 3)\),
6. Thermal insulation of roof, exterior walls and double glazed windows \((1 + 2 + 3)\)
Energy Context of the building sector
Considered EE technical options for residential buildings

Seasonal heating loads for a typical 2-story individual housing unit (villa)
/Floor area = 230 m² - For each EE option considered

- **Base Case**
- Roof thermal insulation,
- Increased wall thermal insulation
- Double glazed wood frame windows,
- Thermal insulation of roof + walls
- Thermal insulation of roof, exterior walls and double glazed windows

<table>
<thead>
<tr>
<th>ZT1</th>
<th>ZT2</th>
<th>ZT3</th>
</tr>
</thead>
<tbody>
<tr>
<td>53</td>
<td>72</td>
<td>35</td>
</tr>
<tr>
<td>41</td>
<td>56</td>
<td>26</td>
</tr>
</tbody>
</table>

kwh/m²/an
Proposition of an integrated financing mechanism
Technical aspects

Mechanism targets

- **New** individual housing units:
  - More than **75 000** new units per year.

- **Existing** individual housing units:
  - A stock of about **1 million** units of villas and **1,4 millions** of traditional housing units.
Proposition of an integrated financing mechanism
Technical aspects

Selection of EE options

End use energy savings with respect to the base case:

<table>
<thead>
<tr>
<th>EE option</th>
<th>Heating</th>
<th></th>
<th>Cooling</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ZT1</td>
<td>ZT2</td>
<td>ZT3</td>
<td>ZT1</td>
</tr>
<tr>
<td>Roof insulation</td>
<td>23%</td>
<td>22%</td>
<td>26%</td>
<td>18%</td>
</tr>
<tr>
<td>Exterior wall insulation</td>
<td>22%</td>
<td>20%</td>
<td>27%</td>
<td>-3%</td>
</tr>
<tr>
<td>Wood frame Dble. glazed windows</td>
<td>6%</td>
<td>5%</td>
<td>0%</td>
<td>-2%</td>
</tr>
<tr>
<td>Roof &amp; Exterior wall insulation</td>
<td>45%</td>
<td>42%</td>
<td>53%</td>
<td>15%</td>
</tr>
<tr>
<td>Roof &amp; Wall Insul. + DG windows</td>
<td>48%</td>
<td>45%</td>
<td>53%</td>
<td>27%</td>
</tr>
</tbody>
</table>

Investment costs per saved kWh for each EE option (on the lifetime of the measure):
Proposition of an integrated financing mechanism
Technical aspects

Energy savings

Average primary energy savings: \(5 \text{ kgOE/}(\text{year.m}^2)\) for heating and \(3 \text{ kgOE/}(\text{year.m}^2)\) for cooling

(*) of insulated roof area.
Environmental impacts

→ GHG Mitigation: $14 \text{ kgECO}_2/(\text{year.m}^2(*)$)
End user savings on energy bill

<table>
<thead>
<tr>
<th>FORM OF ENERGY USED FOR HEATING</th>
<th>ZT1</th>
<th>ZT2</th>
<th>ZT3</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>1,233</td>
<td>1,469</td>
<td>1,277</td>
<td>1,326</td>
</tr>
<tr>
<td>Kerosene</td>
<td>2,334</td>
<td>2,876</td>
<td>2,079</td>
<td>2,430</td>
</tr>
<tr>
<td>LPG</td>
<td>1,556</td>
<td>1,881</td>
<td>1,512</td>
<td>1,650</td>
</tr>
<tr>
<td>Gasoil</td>
<td>2,528</td>
<td>3,124</td>
<td>2,221</td>
<td>2,624</td>
</tr>
</tbody>
</table>

In TND/(year.m²(*) [1 DT ~ 0.56 €]

- Average savings: 1,2 to 3,1 TND/(year.m²(*))
- Overall average saving(**): 2 TND/(year.m²(*))

(*) of insulated roof area.

(**) for all climatic zones and heating energy forms.
Payback periods for End user

<table>
<thead>
<tr>
<th>FORM OF ENERGY USED FOR HEATING</th>
<th>ESTIMATED PAYBACK PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ZT1</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>16.2</td>
</tr>
<tr>
<td>Kerosene</td>
<td>8.6</td>
</tr>
<tr>
<td>LPG</td>
<td>12.9</td>
</tr>
<tr>
<td>Gasoil</td>
<td>2.1</td>
</tr>
</tbody>
</table>

**Initial investment** can be a significant barrier for some end users categories!
Proposition of a financial incentive scheme

| Public Subsidy of Investment (Win-Win approach) | Subsidy contribution: 30% of roof thermal insulation cost  
Maximum amount per m²: 4.5 DT (in case of existing housing) / 3 DT (in case of new housing).  
Maximum roof area eligible for subsidy: 100 m² per housing unit.  
Funding source: FNME (the Tunisian national fund for energy conservation) |
| Bank loans (Existing products) | Amount for loan: 1050 DT per housing unit (in case of existing housing) / 700 DT per housing unit (in case of new housing).  
Loan reimbursement period: 7 years  
Loan interest rate: AMR+1.5% ~ 5.75% |
Impacts of public subsidy:

**Payback period (years)**

<table>
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<tr>
<th>FORM OF ENERGY USED FOR HEATING</th>
<th>ESTIMATED PAYBACK PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ZT1</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>13,0</td>
</tr>
<tr>
<td>Kerosene</td>
<td>6,9</td>
</tr>
<tr>
<td>LPG</td>
<td>10,3</td>
</tr>
<tr>
<td>Gasoil</td>
<td>6,3</td>
</tr>
</tbody>
</table>

→ A more attractive transaction for the end user.
Proposition of an integrated financing mechanism
Financial and economical aspects

Impacts of public subsidy

A profitable investment for the state.
Proposition of an integrated financing mechanism

Institutionnel aspects: Stakeholders

- ANME,
- The Financing institutions,
- The Operators,
- The Support agencies,
- The Monitoring network.
Proposition of an integrated financing mechanism

Institutionnel aspects: Stakeholders

- **ANME**
  - Allocation of subsidy
  - Qualification of operators and materials
  - Qualification of controllers
  - Awareness rising and Promotion
  - Training and capacity building of key operators
  - Quality control
  - Monitoring and evaluation

- **Financing institutions (banks)**
  - Providing specific loans
  - Promoting the mechanism with their customers

- **Operators**
  - Promotion and canvassing
  - Preparation of paper work for operation financing
  - Operations implementation
Proposition of an integrated financing mechanism
Institutionnel aspects: Stakeholders

- **The Monitoring network**: architects, consulting structural engineers, works control offices
  - Systematic in situ quality control of operations
  - Checking and acceptance of works

- **The Support agencies**
  - Building Technical Center:
    - Capacity building and actors qualification
    - Testing and certification of thermal insulation products
    - Consumer advising
  - Professional training centers:
    - Integration of EE in training programs
  - Professional chamber of real state developers
    - Promotion of mechanism
Proposition of an integrated financing mechanism
Organizationnal aspects

Organizational flow:
1. Canvassing
2. Processing of loan application
3. Checking and acceptance of works
4. Deposit of subsidy applications at ANME

Financial flow:
1. Payment of customer contribution
2. Payment of works checking fees to controller
3. Loan transfer to operator
4. Payment of subsidy to operator
5. Loan reimbursement

Flowchart:
- Customer
- Certified Controller
- Participating Bank
- Certified Operator
- ANME
Proposition of an integrated financing mechanism
Organizational aspects: Procedure steps

**Step 1**: Identification and customer approach.

**Step 2**: Processing of loan application.

**Step 3**: Works implementation.

**Step 4**: Works checking and acceptance.

**Step 5**: Deposit of applications at ANME.

**Step 6**: Deposit of applications at participating bank.

**Organizational flow**

**Financial flow**
Initial Customer payments:

- Fees for works checking and acceptance: 0.350 TND/m² of insulated roof area with a minimum of 50 TND/operation.
- Customer contribution to the works cost

- Payment of works controller fees;
- Payment of first installment to operator: FNME subsidy;
- Payment of second installment to operator: Bank loan;
- Loan reimbursement.

Proposition of an integrated financing mechanism

Organizational aspects: Financial flow chart
The program for promoting thermal insulation of roofs
Program target

Roof insulation of 65 000 housing units for the period 2012-2016

<table>
<thead>
<tr>
<th>Year</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of housing units</td>
<td>1 000</td>
<td>4 000</td>
<td>15 000</td>
<td>20 000</td>
<td>25 000</td>
<td>65 000</td>
</tr>
<tr>
<td>Roof areas (m²)</td>
<td>100 000</td>
<td>400 000</td>
<td>1 500 000</td>
<td>2 000 000</td>
<td>2 500 000</td>
<td>6 500 000</td>
</tr>
</tbody>
</table>

A pilot phase
A promoting phase
The program for promoting thermal insulation of roofs

Energy saving and environmental impacts

**Energy Savings:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary energy savings for the 2016 horizon (TOE)</td>
<td>32 500</td>
</tr>
<tr>
<td>Cumulated primary energy savings over program period (2012-2016) (TOE)</td>
<td>65 500</td>
</tr>
<tr>
<td>Cumulated primary energy savings over life cycle period (20 years) (TOE)</td>
<td>650 000</td>
</tr>
</tbody>
</table>

**Environmental Impacts:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG Mitigation for the 2016 horizon (TECO₂)</td>
<td>91 000</td>
</tr>
<tr>
<td>Cumulated GHG Mitigation over program period (2012-2016) (TECO₂)</td>
<td>183 400</td>
</tr>
<tr>
<td>Cumulated GHG Mitigation over life cycle period (20 years) (TECO₂)</td>
<td>1 820 000</td>
</tr>
</tbody>
</table>
The program for promoting thermal insulation of roofs
Economical impacts

**State Savings** (hypothesis for oil price: 120 $/barell over life cycle period)

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings on oil products subsidy due to roof thermal insulation (DT/m² of thermal insulated roof)</td>
<td>2</td>
</tr>
<tr>
<td>Savings on oil products subsidy for the 2016 horizon (MDT)</td>
<td>5</td>
</tr>
<tr>
<td>Savings on oil products subsidy over program period (2012-2016) (MDT)</td>
<td>13</td>
</tr>
<tr>
<td>Savings on oil products subsidy over life cycle period (20 years) (MDT)</td>
<td>100</td>
</tr>
</tbody>
</table>

**Savings for customers** (based on present local energy prices)

- 13 MTD over 2012-2016
- 100 MTD over life cycle period (20 years)
Accompanying measures for the proposed program

- Make necessary accommodations in the legal and regulatory framework
- Raise awareness and mobilize potential partner banks
- Devise and implement a training and capacity building program for potential program operators, namely **weather proofing and thermal insulation small business contractors**
- Implement a quality management program with a reliable certification system for operators and materials
- **Devise and implement a communication program**
- Provide ANME with the necessary means for managing the mechanism
- Implement, from the very beginning, a monitoring and evaluation system for the mechanism
- Register the program as a CDM programmatic project
Thank you for your interest!

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