Solar Cooling, Heating and Electricity Generation for a Residential Building

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Outline

1. Introduction
2. Literature Review
3. Proposed Systems
4. Results
5. Conclusion
Introduction

Shortage of the non-renewable energy sources.

Thermal Non-renewable Power Plants

87% of the gas emissions are from thermal power plants.

Power demand is higher than the generation.

Cooling and heating systems consume the greatest power.
Passive Cooling and Heating Systems

Double Glazing           Shading               Blinds and Curtains      Heat Resistive Wall

Applied Cooling and Heating Systems

- Comfort conditions in **summer** season are 24 °C and 50%RH
- Comfort conditions in **winter** season are 22°C and 30%RH

Cooling Systems

- Vapor Compression Refrigeration Cycle
- Absorption Refrigeration Cycle
- Adsorption Refrigeration Cycle
- Desiccant Refrigeration Cycle

Heating Systems

- Furnaces
- Boilers
- Heat pumps
- Electric heating
- Solar heating system
Proposed Systems

Lebanon is located in the high irradiance region

RELATIVE HUMIDITY REACHES 90% IN THE COASTAL REGION IN SUMMER

Schematic Diagram of the Desiccant Cooling System
Proposed Systems

Schematic Diagram of the Solar Heating System

Lebanon is located in the high irradiance region

Eco-friendly
Proposed Systems

Lebanon is located in the high irradiance region

Schematic Diagram of the Solar Electricity Generation System
## Results

### Desiccant Cooling System

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of desiccant wheels (1.5 meter diameter)</td>
<td>3</td>
</tr>
<tr>
<td>Number of Rotary heat Exchanger</td>
<td>1</td>
</tr>
<tr>
<td>Number of air water heat Exchangers</td>
<td>1</td>
</tr>
<tr>
<td>Number of I.D.E.C</td>
<td>5</td>
</tr>
<tr>
<td>Number of fans</td>
<td>2</td>
</tr>
<tr>
<td>Number of circulating pumps</td>
<td>4</td>
</tr>
<tr>
<td>Number of driving motors</td>
<td>5</td>
</tr>
<tr>
<td>Area of solar collectors needed (m²)</td>
<td>5.35</td>
</tr>
</tbody>
</table>

### Solar Heating System

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of air water heat Exchangers</td>
<td>1</td>
</tr>
<tr>
<td>Number of fans</td>
<td>3</td>
</tr>
<tr>
<td>Number of circulating pumps</td>
<td>1</td>
</tr>
<tr>
<td>Area of solar collectors needed (m²)</td>
<td>10.71</td>
</tr>
</tbody>
</table>

### Solar Electricity Generation System

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of solar collectors needed (m²)</td>
<td>180.5</td>
</tr>
<tr>
<td>Inverter Capacity (kW)</td>
<td>55.2</td>
</tr>
<tr>
<td>Number of Batteries with rating of 24 v 1000Ah</td>
<td>9</td>
</tr>
</tbody>
</table>
Results

**Energy Savings and Economical Validity $**

![Graph showing energy savings for cooling and heating systems]

- **Cooling System**
  - Energy Required (kWh)
  - 83.05% Energy Saving

- **Heating System**
  - 87.74% Energy Saving

![Graph showing cost comparison for cooling and heating systems]

- **Cooling**
  - Desiccant Cooling System: $36,550
  - Commonly used Split Units: $4,590
  - Solar Heating System: $20,979
  - Commonly used Heating System: $10,000

- **Heating**
  - Desiccant Heating System: $960
  - Commonly used Heating System: $800

![Graph showing payback period]

- **Payback Period is 7.5 years**

- 30 Amperes PV System Capital Cost: $18,000
- Government Utility and Private sector power supply
Conclusion

DEMAND IS GREATER THAN THE GENERATION

SHORTAGE OF THE NON-RENEWABLE ENERGY

High Temperatures and pressures for thermal power plants.

HIGH POLLED GAS EMISSIONS

HIGH ENERGY CONSUMPTION AND HIGH OPERATION COSTS

ALTERNATIVE TO THE PUBLIC AND PRIVATE SECTOR ELECTRICITY GENERATION

AVAILABILITY OF THE SOLAR RENEWABLE ENERGY

Operates on atmospheric pressure.

ECO-FRIENDLY SOLAR POWER.

LOW ENERGY CONSUMPTION AND LOW OPERATION COSTS
Think SMART: Increase the value of your home

Think Affordable

Think about LEBANON

Thank You

Think Green