Ηλιακή Ψύξη και Εξοικονόμηση Ενέργειας στη Γεωπονική Σχολή του Πανεπιστημίου της Άγκυρας στην Τουρκία

Δρ Ελευθερία Αλεξανδρή

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Solar cooling and energy savings in the University of Ankara, in the context of Hellenic Aid

Within WP1 "*Installation and Operation of the Solar Air-conditioning System in buildings in the University of Ankara*" in the project "*Action Plan Development for the Reinforcement of Cooperation with Turkey in the Field of Renewable Energy Sources*", under the funding of **Hellenic Aid 2006**, RES and energy saving actions will take place in buildings of the **Farm Machinery Department, School of Agriculture**, encouraging scientific interaction and the development of business collaboration in the RES field between the two countries.

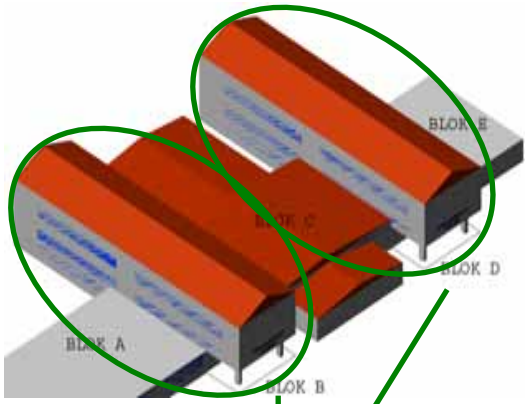
The role of HELLENIC AID

MINISTRY OF FOREIGN AFFAIRS OF GREECE

The Hellenic International Development Cooperation Department Hellenic Aid was established in 1999 in the Ministry of Foreign Affairs of Greece, and is mainly responsible for the supervision, coordination, monitoring and promotion of emergency humanitarian aid actions, as well as aid for the reorganisation and restoration of the infrastructures of developing countries. Within the latter, it has promoted actions of **Renewable Energy and Energy Saving Applications**.

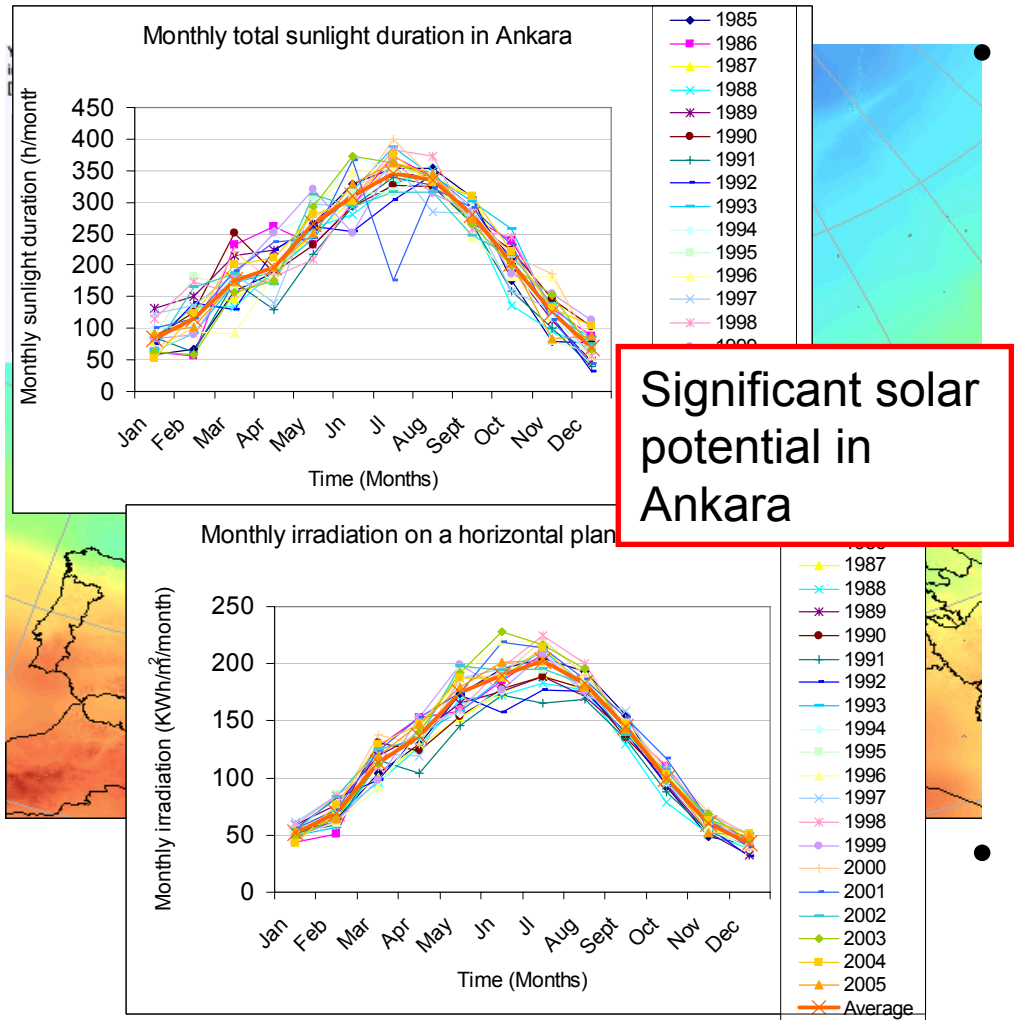
Project’s object – existing situation

Office buildings with lecture rooms and laboratories in the Farm Machinery Department of the School of Agriculture.



Buildings where energy upgrade will take place

Climatic Data – Solar Potential



Significant solar potential in Ankara

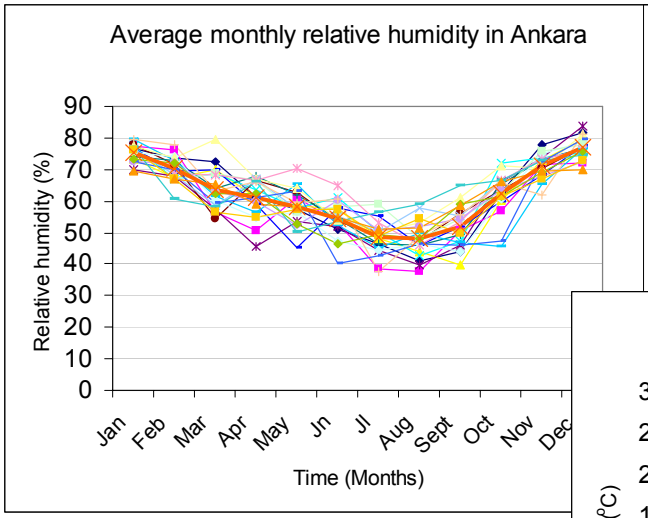
Data derived from the University of Ankara

- Maximum solar radiation in July, with average solar radiation on a horizontal plane 202KWh/m^2 (*min 165 KWh/m^2 in 1990 and max 228KWh/m^2 in 2003*)

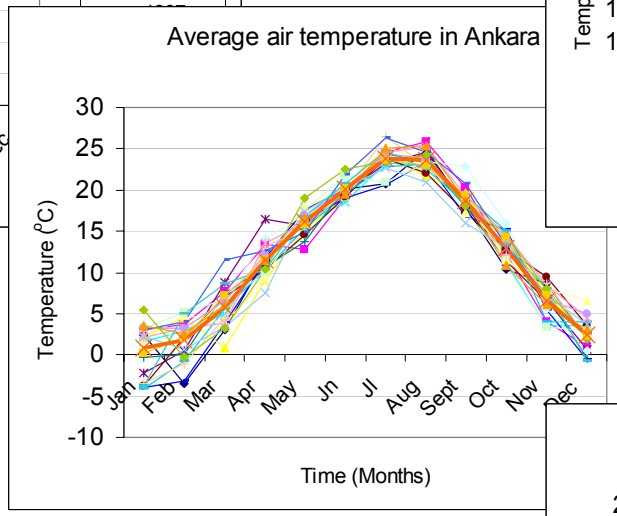
Minimum solar radiation in December, with average solar radiation on a horizontal 42 KWh/m^2. (*min 30 KWh/m^2, in 1992 and max 51 KWh/m^2 in 2004*).

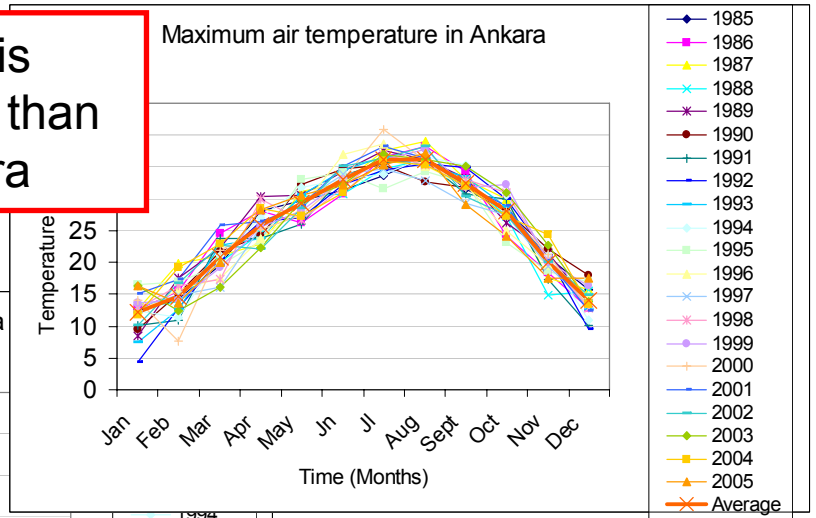
- The duration of the sunlight reaches 344 hours in July, while it lowers to only 69 hours in December.

Climatic Data – Hydrothermal Data



Thus more energy is needed for heating than for cooling in Ankara





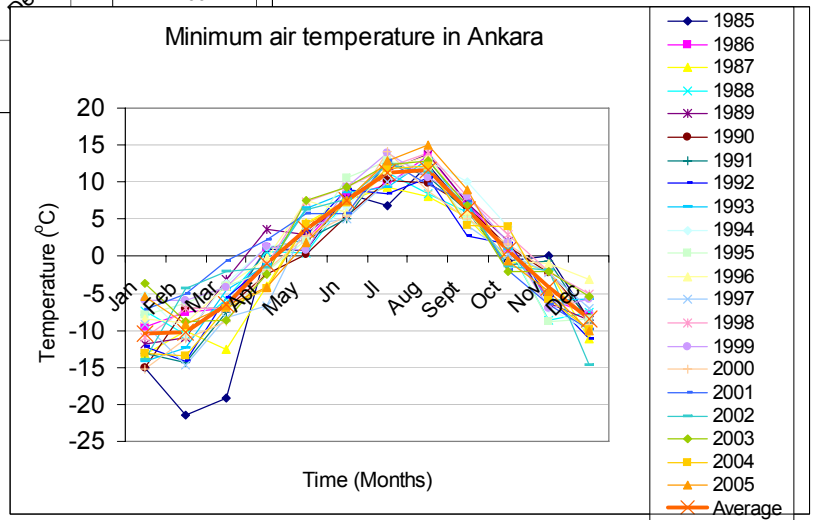
Data derived from the University of Ankara

Steppe climate (semi-arid), with dry season in summer (warm and dry summers) and cold winters with snow

Air temperature in summer: 24.0°C with average maximum 36.0°C (*max 41.0°C in 2000*)

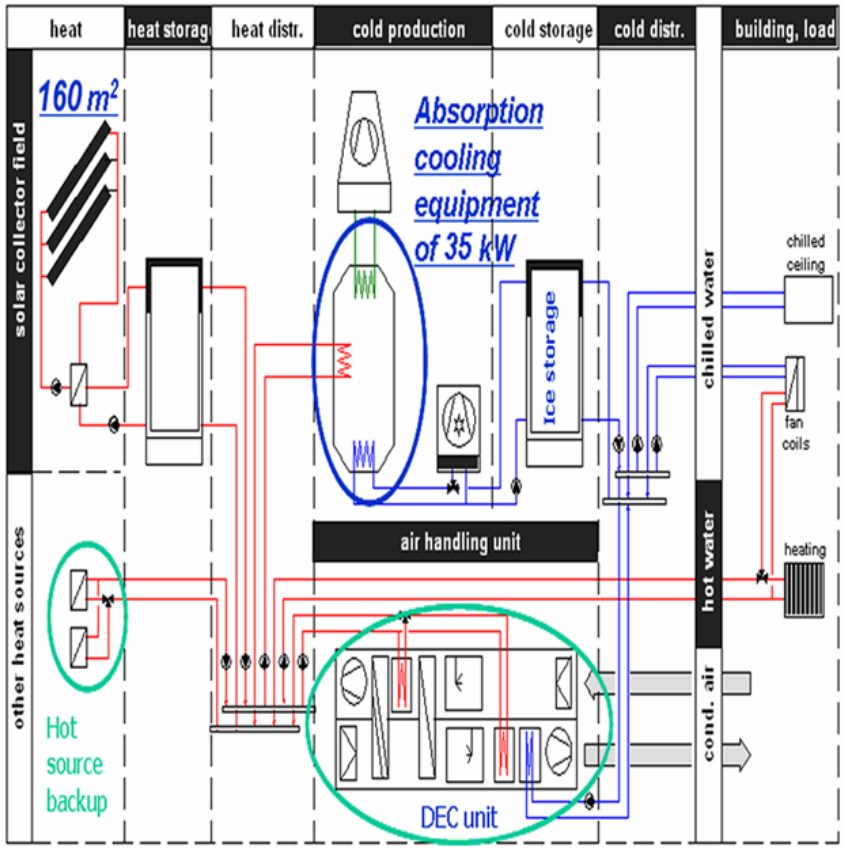
Air temperature in winter: 0.8°C with average minimum -10.0°C (*min -21.5°C in 1985*)

Relative humidity from 48% in summer to 77% in December



Energy upgrading scenarios; Only solar cooling

Absorption cooling is applied, with 35KW nominal power of absorption cooler and 160m^2 solar collectors.



Heating energy savings: only **14%** for heating only building B

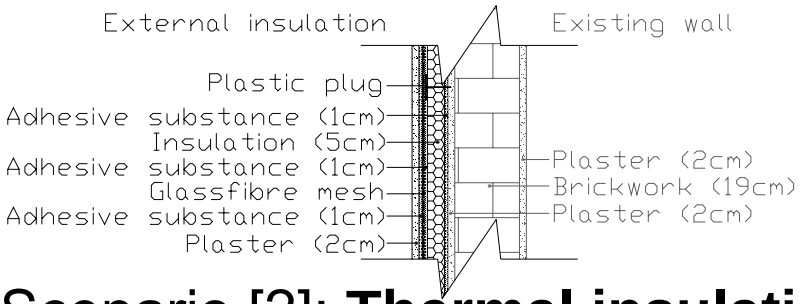
Cooling energy savings: **93%** for offices of the 1st and 2nd floor of building B

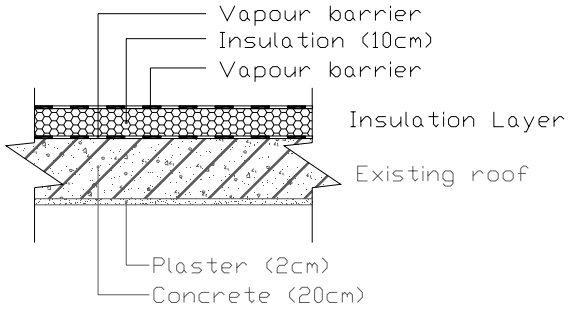
Not reducing significantly the energy demand and the CO_2 emissions of the building.

With the cost of solar cooling installation (~140,000€), this is not a profitable installation on its own.

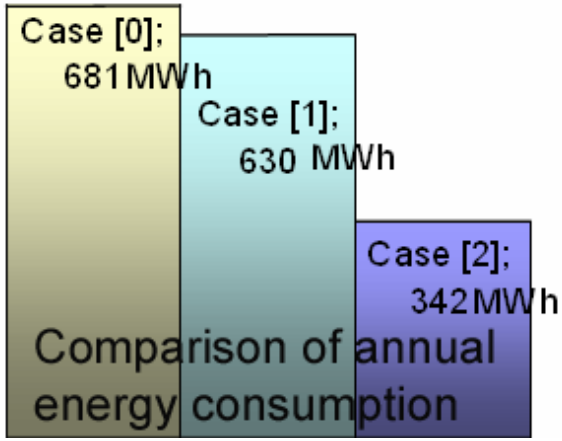
Energy upgrading scenarios; thermal insulation

- Scenario [1]: **Thermal insulation of the roofs only**
  Heating energy savings: **9%** for both buildings B & D
  Cooling energy savings: **25%** for offices of the 1st and 2nd floor
  Annual CO_2 emissions: **159tn**





- Scenario [2]: **Thermal insulation of both roofs and walls**
  Heating energy savings: **54%** for both buildings B & D (*specific space heating energy 137 KWh/m²*)
  Cooling energy savings: **28%** for offices of the 1st and 2nd floor
  Annual CO_2 emissions: **87tn**



Energy upgrading scenarios; thermal insulation & external shading devices

External shading devices are placed in the places that need cooling; in the South-oriented offices of building B & D.

- Scenario [3]: **Thermal insulation of both roofs and walls & external shading devices**

  Heating energy savings: **54%** for both buildings B & D

  Cooling energy savings: **67%** for offices of the 1st and 2nd floor

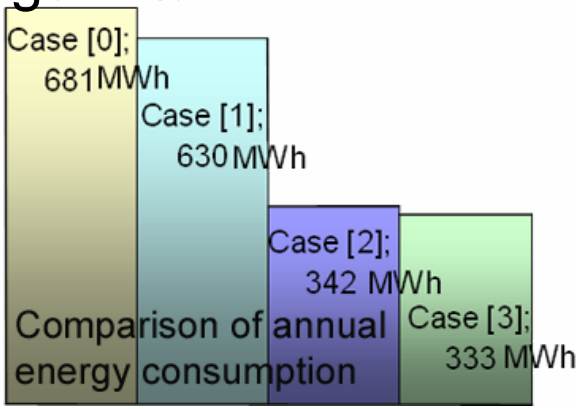
  Annual CO_2 emissions: **68tn**

- Scenario [3+]: **Thermal insulation of both roofs and walls & external shading devices + night cooling of offices**

  Heating energy savings: **54%** for both buildings B & D

  Cooling energy savings: **69%** for offices

  Annual CO_2 emissions: **67tn**



Energy upgrading scenarios; thermal insulation, external shading devices & solar cooling

- Solar cooling is placed in the offices of the 1st and 2nd floor of building B (cost ~140,000 €)
- External shading devices are placed on the South-oriented openings of the offices of the 1st and 2nd floors of buildings B and D (cost ~15,000 €)
- External wall insulation and roof insulation is placed on both buildings B and D (cost ~55,000 €)

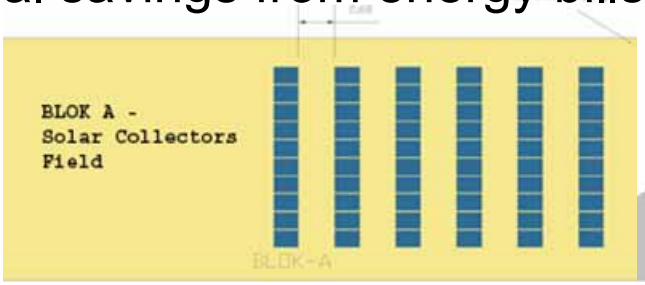
  Heating energy savings: **65%** for both buildings B & D

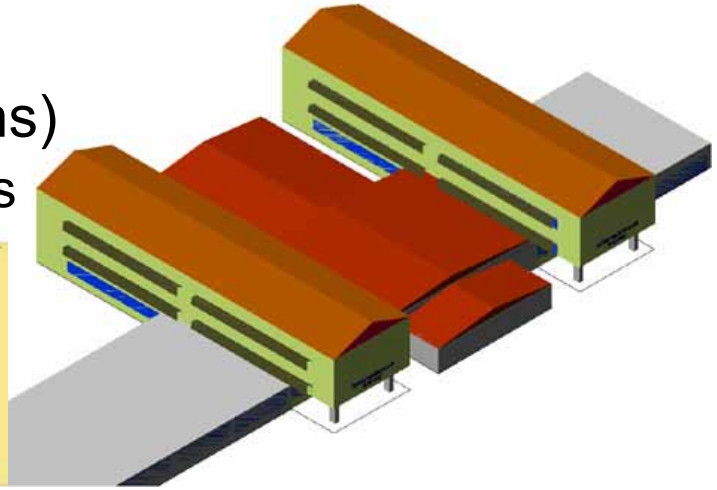
  Cooling energy savings: **84%** for offices of the 1st and 2nd floor

  Annual CO_2 emissions: **51tn**

  (**70%** decrease of annual CO_2 emissions)

  ~12,500 € annual savings from energy bills





Conclusions

- Expensive technologies such as solar cooling are not adequate on their own to offer large energy saving for uninsulated buildings in the geographical latitudes of the Mediterranean.
- Thermal insulation and external shading devices can offer large energy savings for heating and cooling.
- The combination of energy saving applications and solar cooling is capable of decreasing considerably the building needs in auxiliary heating and thus its CO_2 emissions.