PERFORMANCE COMPARISION OF DIFFERENT WATER HEATER SYSTEMS WITH & WITHOUT SOLAR CONTRIBUTION, IN URUGUAY

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SUMARY

Uruguay is promoting a change in the energy matrix betting on the use of renewable energies. The energy consumption for hot water is mainly electrical, representing approximately 30% of electricity consumption of households, and more than 10% of national electricity consumption. Using water heating system with solar energy is not widespread. In part, by the absence of data and research on the subject. This paper models the saving consumption of a typical family of 3 members, by adding a solar heating system. Several consumer profiles are designed. Water-heating costs with a thermo-electric tank or a gas heater are studied and analyzed the savings by introducing solar contribution. It is noted that the time of repayment of investments are high, requiring government subsidies to ensure penetration of solar technology at the household level.

Table 1 – Consumption comparison of heating with Gas, with and without solar system support

Scenario	Consumption (kWh) without solar support	Consumption (kWh) with solar support	Monthly Save (kWh)	Consumption (US$) without solar support	Consumption (US$) with solar support	Monthly Save (US$)
1	1950	529	**1421**	190	51	**139**
2	1950	681	**1269**	190	7	**123**
3	3250	1495	**1755**	315	145	**170**

Table 2 – Investment Return time of a solar system with gas support

	Scenario 1	Scenario 2	Scenario 3
Solar system cost with goberment benefit (US$)	1497.5	1497.5	1497.5
Annual consumption without solar support (US$)	234.4	234.4	389.3
Annual consumption with solar support (US$)	63.3	82.2	179.1
Return time (years)	**8.8**	**9.8**	**7.1**

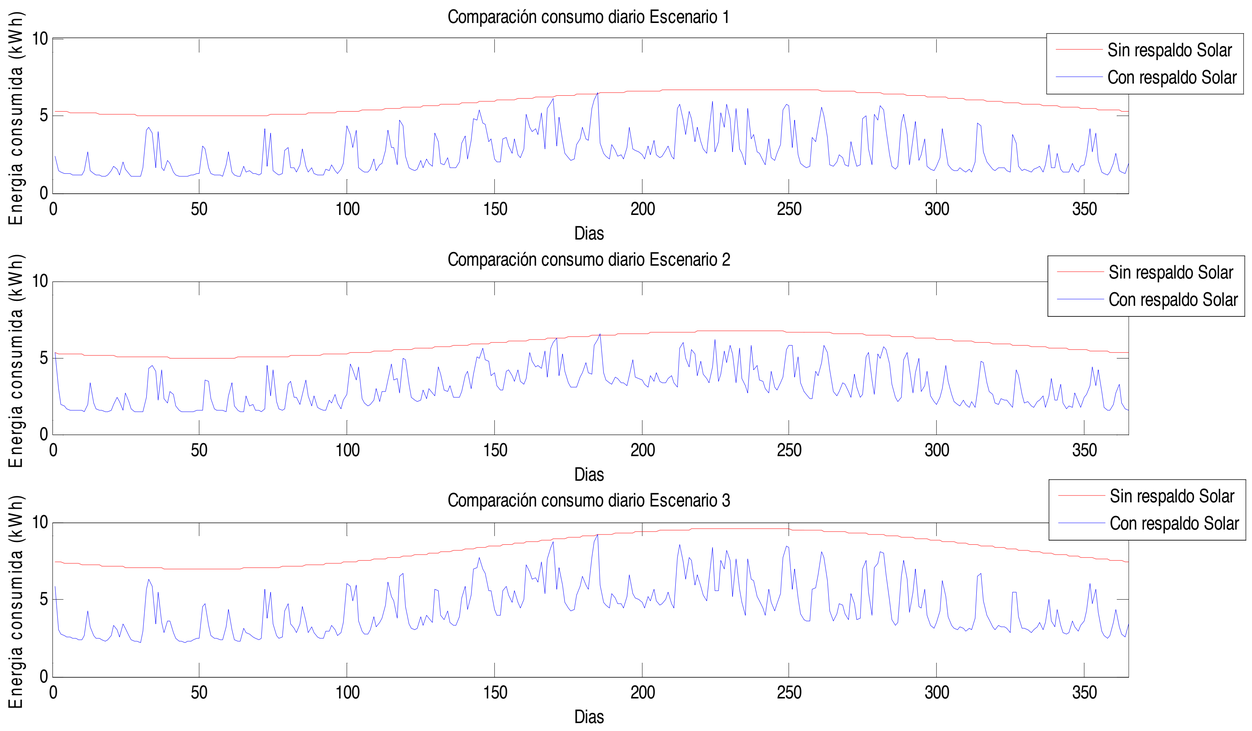

Table 3 – Consumption comparison of heating with electricity, with and without solar system support

Scenario	Consumption (kWh) without solar support	Consumption (kWh) with solar support	Monthly Save (kWh)	Consumption (US$) without solar support	Consumption (US$) with solar support	Monthly Save (US$)
1	2137	926	**1211**	437	189	**248**
2	2137	1137	**1000**	437	232	**204**
3	3023	1628	**1395**	618	333	**285**

Table 4 – Investment Return time of a solar system with electricity support

	Scenario 1	Scenario 2	Scenario 3
Solar system cost with goberment benefit (US$)	1497.5	1497.5	1497.5
Annual consumption without solar support (US$)	613.9	613.9	851.8
Annual consumption with solar support (US$)	217.8	285.3	401.1
Return time (years)	**3.8**	**4.6**	**3.3**

CONSUMPTION PROFILE

The demand for domestic hot water depends heavily on cultural factors, climate, socio-economic conditions of the family nucleus and number of members thereof, access to the resource, energy source to heat water, and specific system used. No studies exist on the profile of hot water consumption in Uruguay. To perform the analysis, this work is based on measurements of said profiles conducted in other countries. However, to reduce the errors introduced by such extrapolation, different scenarios of consumption are studied (number of daily showers, and at what times). It is known that these scenarios are arbitrary, but were chosen trying to cover as much as possible the differences outlined above.

This work considered an ideal comfort for a shower 10 liter per minute for 5 minutes at 38 °C. However, consumption used in modeling depends strongly on the heating system used: thermo-tank or gas heater. While the thermo-tank provides a fixed water volume (approximately) at a temperature given by the setting of the equipment, the gas heater provides an instantaneous heating power fixed supplied to the water flow inlet. Both different technical characteristics generate different (flow and temperature) consumptions.

The consumption depends also on the cold water temperature of the network. There are also no data of this temperature in the country. It will not be the same for those households directly connected to the distribution network, that for those with a water tank on the roof of their home. In this work, RETScreen model for water distribution temperature from atmospheric temperature was used.

In all cases a type of three family members was modeled. This value corresponds to the average number of members of the Uruguayan families.

RESULT & CONCLUSIONS

The amount of assumptions and partial data that were used in this work prevent draw firm conclusions. Moreover, results were obtained showing certain general characteristics.

The energy saved when there is a solar preheating is greater in a gas heater than in a electric thermo-tank. However, as electricity is much more expensive than gas, the economic savings is much higher (between 65 and 80% more) with an electric water heater.

However, the cost of a solar water heating system is also very expensive in Uruguay. Therefore repayment times are around 6 years if a thermo-tank is used. In the case of having a gas heater times are even higher, at around 13 years.

The government has given a subsidy that reduces the time of repayment by approximately 35%. This subsidy has been fundamental in promoting the use of solar heating technology, without which a family almost have not considered an investment with such long repayment periods.