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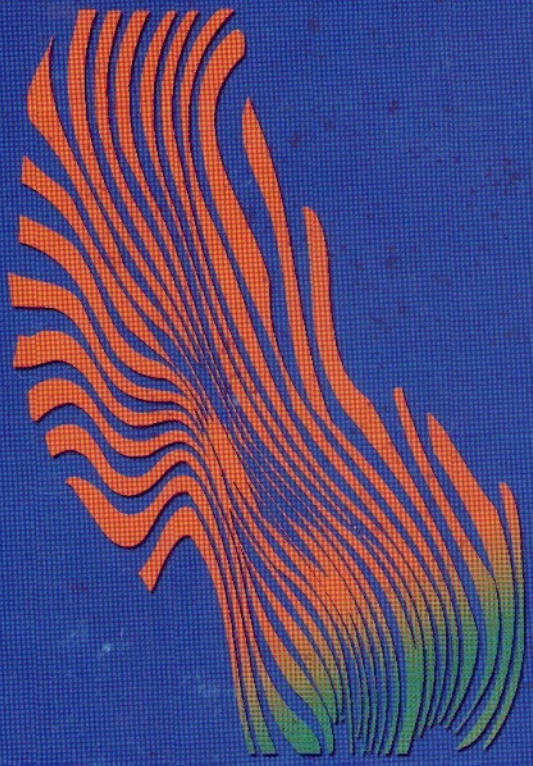

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SPAIN'S FOCUS ON SOLAR ENERGY: A VISION FROM CATALONIA

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1 Introduction

Spain has a huge energy source based on the Sun. But despite this fact, the use of Solar Energy has been marginal till a short time ago. Spain continues its dependency from imported fossil fuels (75 % dependency).

In this paper there is a description of the evolution and the present situation of Solar Thermal Energy in Spain. The paper is also focussed on the most effective policies to increase the use of Solar Thermal Energy, pushed by some Spanish Regions and Cities: the PROSOL Program in Andalucía and the Solar Ordinance in Barcelona. They were the most well known active Solar policies in Spain.

The average solar radiation received on Spain ranges from 11,5 MJ/m^2.day (3,2 kWh/m^2.day) in the northern part of the Iberian Peninsula to more than 18,7 MJ/m^2.day (5,2 kWh/m^2.day) in the southern part. It means that the solar radiation all over Spain, received in a normal, year is equivalent to 525 times the total primary energy consumption or 800 times of the final energy consumption.

2 The use of Solar Energy in Spain

The Spanish solar thermal market started in the seventies and early eighties. At that time the rate of installed solar water systems was 30.000 m^2/year, but at the end of the decade it collapsed to a rate of less than 10.000 m^2/year. In the beginning of nineties the rate of installing solar thermal systems was less than 4.000 m^2/year, with no growth during the main part of the decade, but recovered after 1997 and has been growing since then.

The official explanation to this evolution (during the eighties and the first part of nineties) was the lack of equipment, quality and the poor installation works.

But the new century started looking quite promising for solar thermal systems in Spain. In the first years of the 21st century, the Spanish market is currently installing over 50.000 m^2/year of solar thermal systems.

On Table1 there is the evolution of the Spanish Solar Thermal market since 1982 annual, and accumulated surface installed.

On Table 2 there is the evolution of the Solar Market in all the Regions of Spain during 1999, 2000 and 2001. At present the fastest growing markets (yearly installed surface) in Spain are: Andalucía, Canary Islands, Comunidad Valenciana and Catalunya. But if you compare the absolute numbers in m^2/1000 inhabitants the reality looks quite different: Balearic Islands (97,19 m^2), Canary Islands (44,45 m^2), Castilla – La Mancha (28,20 m^2), Andalucía (19,48 m^2), Navarra (16,36 m^2). The remaining Regions are below the Spanish average of 11,46 m^2/1000 inhabitants.

Table 1 (Evolution of Spanish Solar thermal market)

Year	Installed (10^3*m^2)	Acumulated (10^3*m^2)
		93,83
1982	30	123,83
1983	30	153,83
1984	30	183,83
1985	29,1	212,93
1986	11,9	224,83
1987	10	234,83
1988	9,1	243,93
1989	11,2	255,13
1990	9,4	264,53
1991	3,984	268,51
1992	8,382	276,90
1993	7,384	284,28
1994	7,313	291,59
1995	9,8	301,39
1996	10,6	311,99
1997	12,677	324,67
1998	16,4	341,07
1999	21,582	362,65
2000	40,487	403,14
2001	51,357	454,50
2002	75	529,50
2010	Goal to be reached	4.841,00

Table 2 (Solar thermal market in the Spanish Autonomous Regions)

	Population inhab.	1998 acum. m^2	1999 m^2	1999 acum. m^2	2000 m^2	2000 acum. m^2	2001 m^2	2001 acum. m^2
Andalucía	7.234.873	88.102	9.459	97.561	18.095	115.656	25.291	140.947
Aragón	1.187.546	2.468	0	2.468	172	2.640	443	3.083
Asturias	1.087.885	560	0	560	1.833	2.393	483	2.876
Baleares	760.379	67.463	3.287	70.750	2.236	72.986	916	73.902
Canarias	1.606.534	59.029	2.740	61.769	4.806	66.575	4.838	71.413
Cantabria	527.437	200	0	200	0	200	188	388
Castilla y León	2.508.496	7.952	1.343	9.295	1.023	10.318	2.810	13.128
Castilla - LM	1.712.529	3.101	319	3.420	566	3.986	844	4.830
Catalunya	6.090.040	20.114	1.375	21.489	5.457	26.946	4.613	31.559
Com. Valenciana	4.009.329	34.581	1.496	36.077	4.013	40.090	4.355	44.445
Extremadura	1.070.244	1.874	604	2.478	36	2.514	335	2.849
Galicia	2.742.622	1.548	0	1.548	0	1.548	1.255	2.803
Madrid	5.022.289	38.823	0	38.823	613	39.436	516	39.952
Murcia	1.097.249	8.865	150	9.015	773	9.788	1.881	11.669
Navarra	520.574	5.833	396	6.229	561	6.790	1.724	8.514
País Vasco	2.098.055	674	173	847	303	1.150	865	2.015
Ceuta	68.796	46		46		46		46
Melilla	59.576	36		36		36		36
La Rioja	264.941							
TOTAL	**39.669.394**	**341.269**	**21.342**	**362.611**	**40.487**	**403.098**	**51.357**	**454.455**

2.1 The present main drivers of the Spanish Solar thermal market

The first region that started strong policies for solar energy was Andalucía when it enacted the PROSOL Program in 1993. This program establishes financing facilities and some subsidies for installing solar thermal systems. It has made possible that Andalucía is, at present, the Spanish region with most solar thermal systems installed.

Another Spanish initiative has been the so-called Barcelona Solar Ordinance, adopted by the city Council in July 1999. It represents an interesting and innovative process to involve municipalities in solar thermal energy. Now the city of Barcelona is in the process to install more than 20.000 m^2 of solar thermal systems in the city.

The Spanish Promotion Plan of Renewable Energies to implement the goal to have 12 % of all the primary energy consumption covered with renewables by 2010, fixed the solar thermal goal to reach 4.841.000 m^2 installed by 2010, a figure not available with the present path of growth. This has been the reason why the government agreed to facilitate the growth of solar thermal market, providing financing facilities combined with some subsidies (ICO-IDAE Program) in order to make a complementary effort to reach the fixed goal.

2.1.1 The innovative Solar Ordinance of the city of Barcelona.

The city of Barcelona made an incredible step forward to push Solar Energy. It was July 1999 when the city adopted a Solar Ordinance that it makes mandatory in Barcelona that all the new buildings to be built in the city (and all the integrally refurbished ones) must have solar heating systems to cover the 60% of all the sanitary water-heating needs. Since the 1st August 2000, this local law became mandatory in Barcelona.

Why Barcelona decided to adopt a law like this one? Until 1995 the city only had less than 700 m^2 of solar heating systems. But the city has 2.351 Sunshine hours/year and a solar radiation of 14,5 MJ/m^2 .day or 1.470,1 kWh/m^2.year. And the city has water heating needs. This means that the area of Barcelona municipality receives 524,35 PJ/year or 145,65 TWh/year of energy from the Sun. It is 10 times the energy consumption of the city or 28 times the electricity consumption.

On the other side, in a normal year, the families living in Barcelona use to heat the sanitary water with natural gas and electricity (natural gas: 558.139.535 kWh/year and electricity: 407.942.893 kWh/year). In total 966.082.427 kWh/year (average year). But to heat all the hot domestic water which the city uses for sanitary purposes with the Sun, it will be necessary to cover only 1,61 km^2 of surface (1,62 % of municipal surface or 2,82 % of built surface). This means: 1,07 m^2/inhabitant or 2,4 m^2/apartment or 20,15 m^2/building (residential). Also, the buildings in Barcelona have enough available surface to install solar systems, because mainly they have flat terraces on top. Depending on the concrete neighbourhood, the available surface comes from 14 m^2/apartment to 43 m^2/apartment.

So, if the city has the resource, if the city has the demands, if the city has the available surface and if the city did not have the opportunity to use the sun in the past to heat the water the city needs, why not to enact a local solar law that makes the use of Sun to heat the water possible?

The opportunity became when I was elected as city councillor in 1995. I devoted my responsibility as a Sustainable City Councillor to work in partnership with other local actors pushing solar energy in the city where I live. We had some primary results (Table 3): between 1995 and 1999 the solar surface more than doubled (from 700 m^2 to 1,632 m^2).

Table 3 (Solar thermal systems in Barcelona)

year	Total
	m^2
1995	700
1998	1.181
1999	1.350
July 2000	1.632

Source: Barcelona Grup d'Energia Local – BarnaGEL

Also we worked to adopt a mandatory solar law. On Table 4 there are the main steps taken by the city in order to have a Solar Ordinance. The city adopted such a law in the summer of 1999 and this law became mandatory in August 2000. At that time there were 1.632 m^2 of solar thermal systems in Barcelona, only 1,08 m^2/1000 inhabitants.

Table 4 (Chronology of the process to adopt the Barcelona Solar Ordinance)

September 21st, 1995	The Berlin Parliament authorised the Senate by almost unanimous vote to enact an ordinance on the use of solar energy.
March 26-29, 1996	It is presented in the '4th. European Conference on Architecture' the Berlin Solar Collector Ordinance Draft, reflecting the status as of March 1996 after detailed discussions within the administration and following a public hearing.
June 1997	The Sustainable City Councillor's Office translates to catalan language the Berlin Solar Collector Ordinance Draft and discusses it to interested individual people, organisations (NGO, professionals, etc.) and public officials.
June 24th,1997	The Sustainable City Councillor informs the Barcelona Mayor and the Chairman of the Urban Planning Commission about the Berlin Solar Collector Ordinance Draft
January 21st, 1998	The Barcelona Civic Table on Energy adopts a resolution to work on developing a Solar Ordinance for the city of Barcelona and to present it to the Plenary Council of the City.
January-June 1998	The First Draft of the Barcelona Solar Energy Ordinance is sent to environmental organisations, solar energy business, solar energy technicians, etc, asking them to give suggestions and proposals.
June 30th, 1998	During the celebrations of Sun Day the Sustainable City Councillor's Office organises a lecture on "The Berlin Solar Action Plan", inviting Dr. Klaus Müschen, Head of Energy Planning Division of the Berlin's Ministry of Urban Development, Environmental Protection and Technology.

December 23rd, 1998	The Barcelona Civic Table on Energy starts the discussions on the Barcelona Solar Ordinance First Draft.
January 15th, 1999	Workshop between the Civic Table on Energy and Urban Planning officials of the city in order to agree a Solar Energy Ordinance Draft to be submitted to the City Council's Plenary.
February 19th, 1999	The Sustainable City Councillor presents the Plenary Session of the City Council the initial text of the Barcelona Solar Energy Ordinance. The text is adopted.
February - May 1999	It is open a time period for people or organisations to present written proposals to modify the adopted initial text. The City Council receives 10 written pleas and introduces in the new text the main part of them.
July 16th,1999	The Vice-Mayor presents the Plenary Session of the City Council the definitive text of the Barcelona Solar Energy Ordinance to be adopted definitively. The text is adopted. The Mayor asks officials to work during one year period in order to do the necessary steps to make possible the implementation of the Ordinance in the City.
August 1st, 2000	The Barcelona Solar Energy Ordinance is mandatory.

The adoption of the Barcelona Solar ordinance made it possible that the city started a process of growing for solar thermal water heaters. On Table 5 you can see the evolution of solar heating systems in Barcelona after the Solar Ordinance became mandatory.

Table 5 (Solar heating systems in Barcelona)

year	nº of buildings	Residential	Hotels	Sports	Hospitals	Other	Total
		m^2	m^2	m^2	m^2	m^2	m^2
August 2001							5.233
Dec. 2001							6.321
June 2002		6.425,73	2.114,72	1.458,00	349,21	421,10	10.768,76
Dec. 2002	159	8.130,41	2.071,67	1.822,00	545,71	1.458,10	14.027,89
Dec. 2003	232	12.821,22	2.416,71	2.125,50	545,70	1.684,24	19.593,37

Source: Barcelona City Council (All figures in the process to be built, not all already built)

2.1.2 The example of the Barcelona Solar Ordinance: when the impossible becomes real.

The adoption of a Solar Ordinance was considered impossible by some politicians and technical staff of the Barcelona city council. But in reality there wasn't any written local law saying that a municipality had not the power to adopt a Solar Ordinance to make mandatory the use of solar energy in buildings. The cities in Spain have the capacity to adopt local ordinances in many municipal fields, from wastes to urban landscape. Why not to use this kind of laws for solar energy?

The Barcelona Sustainable City Councillor Office decided to go ahead and see what will happen during the process to adopt the Solar Ordinance.
Today more than 15 municipalities in Catalonia have adopted or are in the process to adopt similar Ordinances (Table 6). Now 37 % of the inhabitants of Catalonia are living in cities with Solar Ordinances.

Table 6 (Cities in Catalonia with Solar Ordinances)

Municipality	Inhabitants		date
Barcelona	1.503.884	adopted	August 1999
Sant Joan Despí	24.977	adopted	Nov. 1999
Montcada i Reixac	26.356	adopted	Nov. 2000
Esplugues de Llobregat	48.310	adopted	Dec. 2001
Terrassa	158.063	adopted	June 2002
Cardedeu	9.040	adopted	Dec. 1002
Palafrugell	17.417	adopted	Dec. 2002
Sant Cugat del Vallès	38.937	adopted	Dec. 2002
Hospitalet de Llobregat	239.019	adopted	2003
Cornellà de Llobregat	79.979	adopted	2003
Sant Boi de Llobregat	78.738	adopted	2003
Vilanova i la Geltrú	54.230	adopted	2003
Vic	32.703	adopted	2003
Sabadell	183.788	in process	
Rubí	61.159	in process	
Lleida	112.199	under study	
Girona	74.879	under study	
Sant Feliu de Llobregat	40.042	under study	
Afected population	2.311.653		
Total Catalunya	6.262.000		
Afected population (%)	36,9		

This process didn't only affect Catalonia but also other cities of Spain (Table 7). By now, more than 20 municipalities have already adopted or are in the process to adopt a Solar Ordinance.

Table 7 (Solar Ordinances in Spanish cities)

Municipality	Province	Inhabitants	
Madrid		3.016.788	adopted
Sevilla		700.114	adopted
Granada		240.522	adopted
Pamplona		189.364	adopted
Fuengirola	(Málaga)	53.270	adopted
Eivissa		37.408	adopted
Rota	(Cádiz)	26.257	adopted
Almansa	(Albacete)	24.210	adopted
Murcia		377.888	in process

Burgos		167.962	in process
Utrera	(Sevilla)	45.947	in process
San Fernando de Henares	(Madrid)	36.658	in process
Vigo		288.324	under study
San Sebastián		181.700	under study
Jaén		112.921	under study
Alcobendas	(Madrid)	95.104	under study
Coslada	(Madrid)	79.862	under study
Chiclana de la Frontera	(Cádiz)	63.719	under study
San Lúcar de Barrameda	(Cádiz)	61.908	under study
Andújar	(Jaén)	37.920	under study
Narón	(La Coruña)	29.263	under study
Camas	(Sevilla)	25.109	under study
Camargo-Muriendas	(Cantabria)	23.914	under study

3 Conclusion

Today the Barcelona Solar Ordinance can be seen as clear example for how the impossible can become real. It happened, because three conditions met: political will (the City Council), technical capacity (Renewable Energy companies) and people's involvement (local energy and environment NGOs).

Solar activists are present in Barcelona since the late seventies, when a group of people organised the first Sun Day in Spain (June 23rd. 1979). In this frame, 25 years ago, they organised one of the first Workshops on Renewable and Solar Energy at the University of Barcelona. They also showed, for the first time in a public park, a solar thermal system in operation. All that was organised by a group of people around two pioneering alternative magazines, Userda and Alfalfa, which introduced the debate around energy alternatives to fossil and nuclear energy during the seventies.

To celebrate this anniversary, at the end of last June 2004, in Barcelona a special event called 'From the Sun Day 1979 to the Sun Factory 2004: 25 years of solar activism was organised. The goal was to made to know a special solar project named Sun Factory, now being developed in Barcelona, the first building which is 100 % based on renewable energies, mainly Sun Energy. A clear example to follow cities like Barcelona, located on the Mediterranean basin.