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MED-DESIRE

MEDiterranean DEvelopment of Support schemes for solar Initiatives and Renewable Energies
ENPI CBC MED - Priority 2 - Topic 3 - Solar energy

Survey on Solar obligations (SOs)

Introduction

Solar Obligations (SOs), sometimes also defined as "Ordinances", are legal provisions requiring the installation of solar systems to cover a fraction of new or renovated buildings' energy demand (for hot water and/or heating, or for electricity).

This legislation tool has become quite popular thanks to an important city in Spain, Barcelona, which pioneered in this field by issuing a SO already back in 1999. This created an imitation effect and several SOs started to operate in different European cities and countries.

The importance of this tool was then made official by its explicit inclusion in the European Directive 28 of 2009, in which Article 13.4 clearly stated that "Member States shall introduce in their building regulations and codes appropriate measures in order to increase the share of all kinds of energy from renewable sources in the building sector."

From that situation, some changes have taken place, which are of main relevance:

- positively, the legislation measure of SO has not been limited to Europe only but, as described in this report, it was applied in many cities and countries all around the world;
- from so-called "solar thermal only" laws, like the first one in Barcelona, the concept has been extended in many countries to "renewable heat" laws, thus allowing also other technologies to compete with solar thermal in complying with the legislation requirements;
- the economic crisis in many developed countries has prevented new constructions and building renovation to grow at a relevant speed and this, as a consequence, influenced the effectiveness of the SO tool.
- So far mainly heat oriented obligations have been introduced worldwide: this is probably due to the fact that photovoltaic costs used to be high and have dramatically decreased only in recent years and also to the feed-in tariff operating in many countries which have been the main option for fostering the photovoltaic market.

In the Med Desire project, several SOs from different countries all around the world have been deeply analysed and compared. The main goal of such a wide survey was to summarize success factors and recommendations to guide the development of effectively operating SOs in the Local Local or Central Authorities belonging to the countries partners of Med Desire.

MINISTERO DELL'AMBIENTE E DELLA TUTELA DEL TERRITORIO E DEL MARE

POLITECNICO MILANO

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1. Methodology of the survey

In order to make the survey of SOs as comprehensive as possible, a number of factors has been taken into account for choosing and selecting the pieces of legislation to be analyzed, namely;

- geographical outreach: collection of SOs operating in different nations and continents;
- validity scope: SOs have been collected, which are in force at different levels, such as local (city or province), regional and national;
- date of start: both "historical" SOs (such as the one in the Spanish city of Barcelona) and brand new ones have been included in the survey;
- technologies: also one piece of legislation on photovoltaic obligation, implemented in Barcelona, has been included;
- scope of application: not only SOs have been analyzed which are applicable exclusively to new buildings, but also SOs which include renovations and modifications as well as SOs which apply even to existing buildings;
- results: it is quite hard to find SOs with quantifiable results of their application; therefore some SOs which could be regarded as of less relevance (such as the small one operating in Hawaii) have been included because of the availability of practical figures about their success.

The two main sources of information for finding the most suitable SOs according to the needs above listed, have been:

- the EU-supported "ProSTO" project (www.solarordinances.eu);
- the information portal "solarthermalworld.org" (www.solarthermalworld.org) which did in the past an extensive research work on the SO tool for fostering the solar thermal market at national and local level.

So far, 15 SOs have been analysed but the collection is considered as open, so that, if an additional interesting piece of legislation comes into force, it can be easily added to the survey.
For each of the examples, a sheet has been prepared reporting, in a concise but exhaustive way, the main characteristics of the law, such as:

- brief summary:
- general information: starting date, duration, geographical scope, building typologies targeted, exceptions, building stages included in the scope of the law, quantitative obligation, technologies admitted for complying with the obligation, responsible actors and working mechanism;
- development and implementation: legal background, political objectives, quality requirements, soft support measures, implementation costs, checks and sanctioning fees;
- results: buildings affected by the SO, amount of solar thermal installed, competition with other technologies, buildings exempted from the law and reasons for the exceptions, additional building cost, other indicators;
- lessons learned: barriers, success factors, improvement opportunities, recommendations;
- references;
- sources and contributors.

A first draft of the sheets have been developed by the Med Desire partners, who then have contacted reference persons (see chapter 2 below for details about the contacts) for all SOs, asking them to review and complete the sheet with first-level direct information. Not for all SOs, however, it was possible to receive reliable answers. In such cases it was decided to delete the SO from the list. Regarding this point, please also refer to chapter 3 below about the quality of the obtained results.

In addition to this "vertical analysis" done through the SO sheets, a summary table (annexed to this document), reporting the key features of the assessed SOs, has been prepared, in order to allow an easy "horizontal comparison" between the different pieces of legislation.

2. Analysis of the SOs

15 SOs, collecting experiences from all over the world, have been analysed and reported. The following table shows the list of assessed SOs together with the main contributors and/or sources which provided information.

	AREA	LEVEL	CONTRIBUTOR/S and SOURCES
1	Barcelona - Spain	Local	Fermin Jimenez, Barcelona Energy Agency
2	Portugal	National	Joana Fernandes, ADENE Joana Freitas, Apisolar
3	Shandong - China	Provincial	Simon Goess, Delft University of Technology
4	Jinan - China	Local	Simon Goess, Delft University of Technology
5	Sao Paulo - Brazil	Local	Carlos Artur Alencar, Past President of DASOL / ABRAVA – Brazilian Association for HVAC, CEO of Enalter Ind. Com. Ltda
6	Hawaii	National	Information portal "solarthermalworld.org"
7	Kenya	National	Information portal "solarthermalworld.org"
8	Mexico City - Mexico	Local	Oscar Vázquez, Federal District Government of Mexico
9	Namibia	National	Information portal "solarthermalworld.org"
10	Chandigarh - India	Local	Jaideep Malaviya, specialist for solar thermal technology, Information portal "solarthermalworld.org"
11	Uruguay	National	Information portal "solarthermalworld.org"
12	Sevilla – Spain	Local	Julio Escudero, Andalusian Energy Agency
13	Spain	National	Julio Escudero, Andalusian Energy Agency
14	Baden-Württemberg	Regional (Federal State)	Thomas Pauschinger, SFZ Solites
15	Barcelona – Spain (Photovoltaic Ordinance)	Local	Fermin Jimenez, Barcelona Energy Agency

A complete analysis and comparison of the SOs is available in the summary table, where the PV Ordinance, due to the too many differences with the solar thermal laws, has not been included.
It is worth mentioning some common and general outcomes of the horizontal analysis, which could help building a solid ground for the development of the new SOs foreseen for the Local Administrations in the Med Desire project:

- the additional building cost needed for complying with SOs is often very low, usually below 1%;
- the building stages under the scope of the law can easily include not only new buildings but also renovation and extension activities;
- the exceptions are often included in the SOs with too vague definitions, with the consequence of risks of not complying with the law very easily;
- the minimum quantitative obligation can be defined in different ways; however it is crucial that this minimum threshold is on the one hand reachable and reasonable and, on the other hand, relevant with respect to the whole energy demand of the building;
- quality requirements should be put in place, possibly referring to already existing standards; too complicated quality rules should be avoided since they are hardly verifiable;
- checks should be done in all stages of the project development and corresponding fees should be foreseen and applied;
- monitoring of results of SOs should be put in place from the very beginning and the results themselves should be used to develop improved versions of the laws;
- the involvement of all stakeholders already from the preparation phase is a key success factor;
- capacity building of the actors in the supply chain is crucial: training of installers, preparation of common software tools, etc.;
- other soft support measures, such as information days for citizens, training of municipality staff, etc., are welcome.

3. Quality of information

Thanks to the combination of sources and contributors described above, including high-level online portals and direct contacts, it was possible to develop a good level of information for most of the collected SOs.
Moreover, the organization of received information in this compact summary sheet allows the reader to have a quick but, at the same time, exhaustive look at each piece of legislation described.
However, it must be highlighted that the weakest point of all the process is the one about results: quantifiable outcomes of the laws are available just for a few SOs. This negative aspect is due to two main factors:

1. many SOs did not put into place an adequate monitoring system for checking the results of their applications;
2. some SOs, even though having in theory a monitoring system foreseen, do not make these results available or accessible; it is as one said “we do have some results, but we do not know where they are” or “we do have some results, but they are not public”.

As already reported above, it is therefore of utmost importance that, in the SOs specifically developed within the Med Desire project, a key relevance is given to the monitoring of the results from the very beginning of the development of the law.

Annexes

Summary sheets of analyzed SOs
Summary table for comparing SOs

Med Desire

Solar photovoltaic obligation (SPVO)

Description

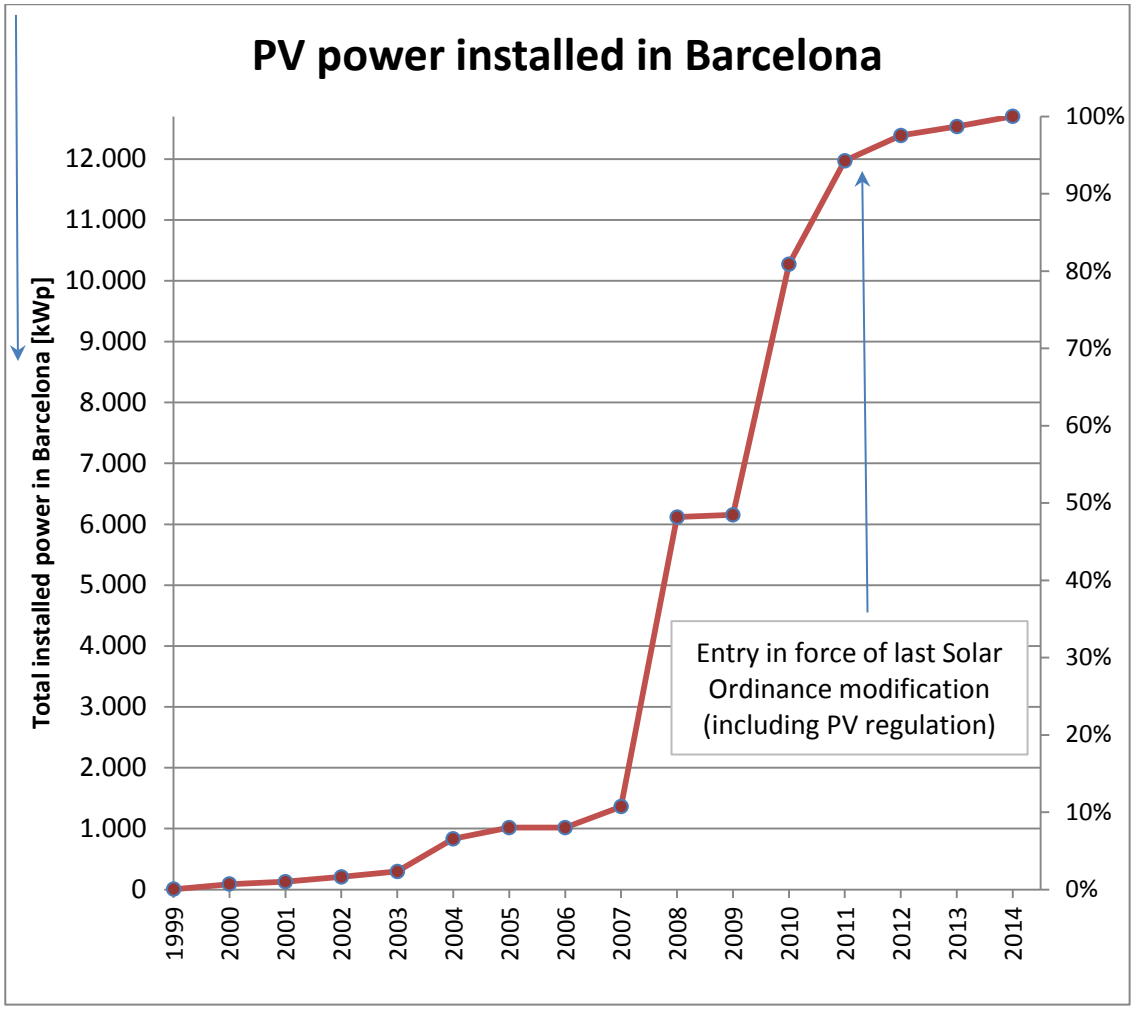
Barcelona – Spain

The National Building Technical Code (CTE), including a document about PV obligation, was published in 2007 in Spain, more or less at the end of the positive period for the construction sector, since the crisis of that sector started in 2008.
In May 2011, a new text on PV obligation in the Solar Ordinance in the city of Barcelona was issued. At the same time, however, 2011 was also the "black year" when the Spanish government cancelled the existing feed-in-tariffs foreseen for renewable electricity.
Therefore, in spite of the fact that the updated Solar Ordinance increased the minimum PV power requirements per m^2 of building, the feed-in tariff cut and the crisis of new building construction, caused the impact of the new law to be not so relevant as originally expected.
The following table show the PV power installed in Barcelona, as well as the yearly energy production.

yearYear	Total Power according to the Catalonian Goverment [kWp]	**Total installed power in Barcelona [kWp]**	Total installed power in public buildings [kWp]	Total energy photovoltaic production [kWh/year]	Total energy photovoltaic production [MWh/year]
1999	0	3		0	0
2000	29	88	40	109.625	110
2001	34	128	40	160.000	160
2002	289	208	183	259.875	260
2003	335	296	215	370.125	370
2004	412	832	657	1.040.375	1.040
2005	461	1.016	657	1.269.625	1.270
2006	479	1.016	657	1.269.625	1.270
2007	946	1.361	657	1.700.750	1.701
2008	6.107	6.117	1.619	7.645.625	7.646
2009	6.145	6.155	1.619	7.694.219	7.694
2010	10.265	10.276	1.664	12.844.688	12.845

2011	11.963	11.973	1.664	14.966.641	14.967
2012	12.377	12.388	1.694	15.484.453	15.484
2013	12.525	12.536	1.703	15.669.766	15.670
2014	12.693	12.703	2.221	15.879.141	15.879

The following graph, reporting the evolution of the installed PV power at municipal level, shows the strong impact of the Technical Building Code (CTE) operating at national level. At the same time, a clearly more moderate increase has been caused by the improvement in the local Solar Ordinance, which includes now a PV regulation since, as above explained, construction crisis and cut in the feed-in tariffs prevented the new law to be really effective.



Sources and contributors

Contributors:
Fermin Jimenez, Barcelona Energy Agency

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Solar thermal obligation (STO)

Description

Barcelona – Spain

1. Brief summary of the STO

In 1999 the city of Barcelona enacted regulations unprecedented in Europe, mandating the installation and use of solar thermal panels in new buildings, renovated buildings and buildings changing their use. The Solar Thermal Ordinance (or Obligation, STO) made it compulsory for 60 percent of domestic hot water to be supplied through solar energy in both private and public buildings. The legislation has resulted in a significant increase in the use of solar energy.

2. General information

a. Starting date

1999.

b. Duration

Unlimited.

c. Geographical scope

Local (city of Barcelona).

d. Targeted buildings (e.g. residential, commercial, etc.)

- residential, health, sports, commercial, industrial
- any other use with the presence of dining rooms, kitchens or collective laundries.

e. Exceptions (e.g historical buildings, buildings with too low heat consumption, etc.)

Partial or total exceptions are:

- more than 25 % of losses due to shadows
- insufficient available surface
- renovated buildings that do not have enough resistance to extra weight in their roofs
- historical buildings with some protection related to their roof or included in a historic proximity area
- buildings with some urbanistic restriction that makes not suitable solar panels installation; a set of criteria and resources to define the acceptability is under development
- too low heat consumption, under 50 l/day at 60 °C
- buildings including a solution that provides hot water and space heating with an energy supply considered as 100 % renewable (like waste energy, cogeneration or heat pumps)

f. ***Building stage***

- new buildings
- deep renovation or change of use of the whole building, thus meaning more that 50 % of the surface of the building is affected by the intervention
- increase of building surface (additional roof surface)

g. ***Quantitative obligation*** (e.g. 50% of the heat demand should be covered by solar thermal)

Starting from a minimum of 60 %, the obligated share increases as the demand of hot water increases over 10.000 l/day at 60 °C, except when Ecoefficiency (decret d'Ecoeficiencia) regional regulation is more restrictive with a 50 % solar contribution but a higher l/day/occupation unit parameter.

h. ***Admitted technologies*** (e.g. solar thermal, heat pumps, etc.)

See exceptions.

i. ***Responsible actor/s and working mechanism*** (in particular, who is the actor in charge of releasing the building permits?)

Responsible for the management of municipal permissions is the owner or promoter of the building, or the person designed to manage this permission in the name of the owner. See more information in the English version of solar thermal ordinance in www.bcn.cat/energia

3. Development and implementation

a. Legal/political background

When the STo was first issued, the municipal elections in Barcelona resulted in a new coalition, where a Green Party candidate was appointed for the first time in the city's history. The new government was based on a political agreement that included the creation of a new political entity (the Sustainable City Councillor) and was committed to push programs for the development and diffusion of renewable energies.

b. Political objectives

The use of renewable energy has created new jobs within the Barcelona City, has lowered CO_2 emissions, fostered energy independence and enhanced the international reputation of the city. Thanks to that, today Barcelona is seen as a leader in the field of solar energy use.
The main goals for 2020 are:

- Solar thermal: 166.400 m^2 installed surface
- Photovoltaics: 24 MW_p installed power

c. ***Quality requirements*** (on products, on installation, etc.)

The quality requirements are the national ones, reported in the CTE (Technical Building Code)

d. ***Soft support measures*** (training, communication, etc.)

After the STO was put into place, the city moved to strengthen their environmental position and began enacting further initiatives with measurable outcomes. The city passed the Barcelona Energy Improvement plan (PTMB), which ran from 2000 – 2010. The plan comprised 55 local action measures, ranging from financing to education, and aimed at lowering emissions and increasing energy efficiency. The 10 year PTMB influenced the city's energy framework.
In 2002 the city again demonstrated its commitment to increasing energy efficiency through establishing the "Barcelona Energy Agency". This body is in charge of implementing, managing and monitoring Barcelona's Energy Improvement Plan.

e. Implementation costs

Not available.

f. Checks and sanctioning fees

Monitoring of the Barcelona Ordinance is performed both from the standpoint of objective and from an administrative point of view, by:

- Administrative Procedure Control overseen by the Energy Agency:
  - before the commencement of works: by reviewing basic project where the owner describes and justifies the technical proposal;
  - completion of works: by inspection and consequent audit and certification that the executed installation has been performed under the project submitted and according to the rules;
  - during the operation: through inspections to detect anomalies due to misuse or maintenance and observe the administrative process improvements and relationships with stakeholders.

• Manager (GIOS) which facilitate the processing, keeps track of solar installations and allows indicators of achievement of objectives.

• Energy Observatory: the set of tools to interact with stakeholders and have an updated picture of the energy balance of the city, monitoring indicators and define future scenarios based on trends in different sectors of city.

4. Results

a. How many buildings were affected by the STO?

3,000 buildings.

b. *How many m^2 of solar thermal were installed thanks to the law*?

Licenses requested for the installation of solar panels increased from 1,650 m^2 in 2000 to 87,600 m^2 in 2010. Barcelona has increased the surface of solar thermal square meters in the city 50 fold, from 1.1 m_2 per 1,000 inhabitants in 2000 to 59 m^2 per 1,000 inhabitants in December 2010.
46 % of the total solar thermal capacity approved for buildings has been installed.
Consequently, energy savings are over 70,000 MWh per year, corresponding to 4,300 tons of CO_2 emissions per year.

c. If ST is competing with other technologies, what is the share of buildings choosing ST for fulfilling the obligation?

See point *d.* below.

d. How many buildings were exempted by the obligation and for which reasons?

5% (161 buildings).
About 53% of exceptions are alternatives to solar thermal (heat pumps, connection to district heating and cooling network, etc.). 47% are exceptions due to technical, urbanistic or heritage conditions or limitations.

e. *Additional building cost for including solar thermal in the construction phase* (e.g. 1%, 0.5%, etc.)

Not available.

f. *Other indicators* (number of trained installers, number of new companies born in the ST sector, etc.)

Training
408 professionals, developers, designers, technicians and technical planning of Inspection Agencies and Control (EIC) on municipal regulations and requirements for the design, execution and processing.
Publications
90 disclosure documents and awareness of energy efficiency and renewable energy, dissemination of Solar Thermal Ordinance and technical guidelines for the implementation of the STO.

Integral Manager of the Solar Ordinance Barcelona (GIOS)
Web application since 2005 that allows designers, developers, municipal and EIC: register and validate solar projects. 1460 users electronically processed 86% of the reported projects.

Enabling technicians
20 EIC technicians are authorized to validate solar thermal installations executed. Communication is done through: workshops, collaborations audits, meetings and technical consultations.

5. Lessons learned

a. Barriers

One of the difficulties in pursuing the solar objectives has been a lack of public knowledge towards the upkeep and maintenance of solar panels. Solar panels require regular and repeated maintenance to ensure their continued efficiency and cannot be simply installed and left to run without frequent attention.

b. Success factors

In order to successfully increase the uptake of solar energy, it is important that there is political will, coupled with citizen support. Local governments can take the initiative to promote stricter regulations than the ones imposed at federal level and, in doing so, provide new market opportunities.
To ensure the successful application of the legislation, the city ran educational and information campaigns. Furthermore the Environment Department of the City Council gives advice on solar use and maintenance and it also runs targeted awareness campaigns via several media.

c. Improvement opportunities

In 2006, Barcelona upgraded the STO through expanding the scope of buildings it applies to. The minimum solar energy demand requirements were eliminated in order to incorporate as many buildings as possible into the ordinance.
In 2011 the city revised their existing legislation and approved the Barcelona Environmental Ordinance. The legislation also made photovoltaic systems mandatory in new buildings.
Later that year the City Council approved the Barcelona Energy, Climate Change and Air Quality Plan. The energy plan will run between 2011 – 2020 and contains 108 projects, focusing on improving technology and raising awareness. The document encompasses a range of environmental topics, with a particular emphasis on energy demand management.

d. Recommendations

There has been the need to further train staff (especially the technical staff) on solar energy. In some cases, the Council also detected either an indifference to, or a negativity towards, solar panels amongst architects (notably for aesthetic reasons). A positive campaign and several meetings that outlined the benefits of the energy source managed to generate sufficient

enthusiasm and overcome this problem. This example also illustrates that a potential first negative attitude is not necessarily a barrier to success, if the proper steps are taken to address it.
Political and legislative will are imperative. Public administrations must be willing to cover the initial financing costs of setting up the scheme (this has numerous positive returns for the administration, such as boosting the local economy). The administration must be willing to work with citizens to help them secure maximum benefit from the plan. They must engage in promoting the scheme and ensure that citizens are supportive and can see the benefit both for themselves and their wider community (local / global context).

6. References

Barcelona Energy Agency: www.bcn.cat/energia

7. Sources and contributors

Contributors:
Fermin Jimenez, Barcelona Energy Agency

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Solar thermal obligation (STO)

Description

Sevilla – Spain

1. Brief summary of the STO

This Ordinance sets the rules for the energy management in the city of Seville. It is intended to improve saving and energy efficiency and to promote the use of renewable energy in the municipality of Seville, in order to help avoid harming the environment.
After the first text published in 2002, the "Municipal Ordinance for Local Energy Management of Seville" was modified in 2012 based on the need to comply with the commitments made by the city of Seville in three specific areas: sustainable development, following the Aalborg Charter and the European Sustainable Cities & Towns Campaign; climate change, having joined the Covenant of Mayors; continuous improvement in energy management at the local level, a task that has already been developing since 1997, and which requires a normative and regulatory adaptation.

2. General information

a. Starting date

The text for the "Municipal Ordinance for the Local Energy-Management of Sevilla" was published July 2002. Its revision, attending new legal text such as CTE and other, was approved in March 2012, consequently changing its name to "Ordinance for Energy, Climate Change and Sustainability Management of Sevilla".

b. Duration

Unlimited.

c. Geographical scope

Local (City of Sevilla).

d. Targeted buildings (e.g. residential, commercial, etc.)

Solar water heating (SWH) is compulsory for:

- Housing
- Dwellings (including military facilities and jails)
- Hotels
- Educational facilities
- Hospitals
- Sports centers
- Commercial malls
- Industries (whether hot water is for processes or staff shower rooms)

- Any building aimed to serve as dining room, kitchen or laundry facility
- Swimming pool hot water production

e. Exemptions (e.g historical buildings, buildings with too low heat consumption, etc.)

In buildings, urban cataloged elements or those classified by its uniqueness in the townscape with high protection levels, the location of energy devices will be restricted with the exception of those authorized by the urban planning authorities of Seville.

f. ***Building stage*** (only for new buildings or also for renovation?)

The Obligation applies to all cases in which the following circumstances appear together:

- New buildings or renovation, including the change of use of all the existing building, whether they are public or private.
- Buildings where hot water is used for:
  - Domestic use.
  - Industrial processes.
  - Swimming pool heating.
- Buildings with an annual hot water consumption of more than 100,000 liters, according to specific consumption parameters (hot water consumption at 45 °C per day for different building types and uses).

g. ***Quantitative obligation*** (e.g. 50% of the heat demand should be covered by solar thermal)

Criteria for SWH sizing is to design it in order to achieve the minimum annual solar contribution that exceeds 2/3 of the expected energy demand. In some cases, specifically established by City Hall, the solar contribution to the energy demand will be 80 %.

h. ***Admitted technologies*** (e.g. solar thermal, heat pumps, etc.)

Solar thermal, solar PV and biomass.

i. ***Responsible actor/s and working mechanism*** (in particular, who is the actor in charge of releasing the building permits?)

Local authorities release building permits. Building promoters, the owner of the property, the project designer, and the building construction manager are responsible of the compliance of the Ordinance. Also other actors carrying out in the buildings or structures with solar power devices are likewise subject to the compliance of the Ordinance

The compliance with the Ordinance is checked to the Energy and Sustainability Agency of Seville (local public energy agency). This body is responsible of the actions in terms of obligations, recommendations or orientations upon local public and private facilities.

3. Development and implementation

a. Legal/political background

In 2002 the STO was named "Ordinance for the Local Energy Management" and it was enacted to achieve the UE objectives for 2010 regarding a 12 % energy consumption coming from RES, and a raise in energy savings and efficiency. The local energy policies aimed at setting restrictions to the per capita energy demand and, at the same time, the establishment of a framework to integrate the management of the energy sector in the municipality of Seville, promoting energy efficiency and renewable energy, especially solar, together with building energy certification.

In 2012 the Municipal Ordinance was modified to comply with the commitments acquired by the city of Seville in three domains: Sustainable Development (consequence of the city signing

of the Charter of Aalborg and the European Campaign for Sustainable Cities and Towns;) Climate Change, (after the signature of the Covenant of Mayors against Climate Change); and a continuous improvement in energy management at the local level.

b. Political objectives

The main purpose of the Ordinance is to achieve a substantial energy improvement in Sevilla as a prerequisite to sustainability. To this end, this Ordinance aims:

a) at promoting and encouraging greater energy savings and a more efficient energy use;

b) at establishing and promoting adequate energy management in all actions carried out in the city of Seville;

c) at promoting, demanding and determining the implementation at a local level of renewable energy devices, mainly low temperature solar water heaters.

c. ***Quality requirements*** (on products, on installation, etc.)

Before allowing the building occupation, opening license or authorizing the use and operation after completion of the building works, it is compulsory the submission of:

- A certification stating that the installation is carried out according to the project and applicable regulations.
- A certification stating that a maintenance contract of at least one year duration has been subscribed.

d. ***Soft support measures*** (training, communication, etc.)

To support the use of local energy resources and awareness of institutions, businesses and citizens about the scarcity of energy resources and the need for diversification and introduction clean energy, the Ordinance enhances the Local Energy and Sustainability Agency to conduct:

a) An analysis of the energy situation in the city.
b) Planning for a municipal energy optimization.
c) Planning and implementation of local projects that promote a more sustainable energy model.
d) Promotion of the use of renewable energy in public buildings and facilities owned by the Town Hall and throughout the city.
e) Energy saving and efficiency measures in buildings and facilities, public lighting, urban mobility, etc.
f) The provision of an energy information and awareness service to citizens in different social networks.
g) The coordination and promotion of energy projects in various areas, businesses and municipal entities.
h) The promotion and support of projects that promote sustainable energy actions in the city.
i) The promotion of R&D in companies involved in the field of energy technology.
j) Any other activity that complements the above, according to the aims and objectives entrusted to the Agency.

e. Implementation costs

Not available.

f. Checks and sanctioning fees

The Local Energy and Sustainability Agency is the public body to carry out verification actions and interventions concerning the building compliance on savings and energy efficiency, the use of the most appropriate RE technologies, mainly the mandatory installation of SWHs.

Since the 2012 Ordinance revision, the text update reminds that buildings energy certification must follow technical procedures provided in the National Technical Building Code (CTE).
An energy certification must be granted by the Energy and Sustainability Agency, upon direct visit to the building or with the signature of the project manager.

Sanctions foreseen:

A. Strong sanctions
    1. Non-installation of a solar energy device when compulsory.
B. Soft sanctions
    1. The incomplete installation of a solar energy device when compulsory.
    2. Inadequate handling or maintenance that lead to an inefficient energy output of the energy device.
    3. The misuse of the solar energy device by the manager in charge of the activities driven in the building.
    4. Non-fulfilment of the requirements dictated in order to accomplish the Ordinance

4. Results

a. How many buildings were affected by the STO?

Not available.

b. ***How many m^2 of solar thermal were installed thanks to the law***?

Not available.

c. If ST is competing with other technologies, what is the share of buildings choosing ST for fulfilling the obligation?

Not available. Anyhow ST is widely the main implemented technology.

d. How many buildings were exempted by the obligation and for which reasons?

Not available.

e. ***Additional building cost for including solar thermal in the construction phase*** (e.g. 1%, 0.5%, etc.)

Not available.

f. ***Other indicators*** (number of trained installers, number of new companies born in the ST sector, etc.)

Not available.

5. Lessons learned

a. Barriers

When this Ordinance entered into force, solar market was not developed as it is nowadays. Main barrier at that time was a still young and emerging market for RES installers as well as an unsufficient quality control system. Citizens did not trust their utility neither they were aware, as are today, about the benefits to health, environment and economy.

b. Success factors

- This municipal ordinance was one of the first to implement advanced technical specifications for renewable energy installations in Spain, mainly for SWH.
- A legal reinforcement for the energy efficiency and renewable sectors.
- An awesome kick-off for local and regional solar market.

c. Improvement opportunities

The lack of a proper monitoring to check compliance with the ordinance, in the initial year after the Ordinance enter into force. Fortunately this situation has being offset today with the added municipal control procedures provided with the National Technical Building Code.

d. Recommendations

Still a work to do in citizens' awareness in energy matters with the support of local administration, mainly regarding those related to building and the implementation of renewable energy appliances.

6. References

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7. Sources and contributors

Julio Escudero, Andalusian Energy Agency.

Med Desire

Solar thermal obligation (STO)

Description

Baden-Württemberg – Germany

1. Brief summary of the STO

In November 2007 the parliament of the state of Baden-Württemberg approved its Erneuerbare-Wärme-Gesetz Baden-Württemberg (Renewable Heat Law Baden-Württemberg). Initially it effects only new residential buildings started after April 1st, 2008, for which house builders are obliged to cover 20 % of the yearly heat demand with renewable heat sources. Besides the use of solar thermal, geothermal, biomass and ground coupled heat pumps the law also foresees alternative measures such as improved house insulation, cogeneration or the connection to district heating networks fed by RES or cogeneration.
Starting from January 1st, 2010 the law also affects existing residential buildings. The regulation of this law for new buildings was replaced by federal law EEWärmeG on January 1st, 2009.

2. General information

a. Starting date

April 2008.

b. Duration

Unlimited.

c. Geographical scope

Regional-Federal State (Baden-Württemberg).

d. Targeted buildings (e.g. residential, commercial, etc.)

Residential buildings

e. Exceptions (e.g historical buildings, buildings with too low heat consumption, etc.)

A project can be exempted from the law if technical or constructional reasons make solar thermal not applicable (in this case not even another RES technology is necessary): e.g. not enough roof surface, wrong orientation or slope of the roof, photovoltaic already covering the roof, no space for buffer storage.

f. ***Building stage*** (only for new buildings or also for renovation?)

- New buildings
- Existing buildings under modernisation of the heating system

g. ***Quantitative obligation*** (e.g. 50% of the heat demand should be covered by solar thermal)

0,04 m² collector area per m² of living area of the building.

h. ***Admitted technologies*** (e.g. solar thermal, heat pumps, etc.)

Solar thermal, heat pumps, bio-oils, biogas, wood, house insulation, cogeneration or the connection to district heating networks fed by RES or cogeneration.

i. ***Responsible actor/s and working mechanism*** (in particular, who is the actor in charge of releasing the building permits?)

The building authorities on communal or district level are competent for building permits.
The compliance with the law is to be certified by an authorised expert and shall be presented to the competent building authority within three months after the heating system starts operating.

3. Development and implementation

a. Legal/political background

The lion share of Germany's end energy consumption is used for heating and cooling of buildings. The national goal in this sector is a contribution of 14 % by RES, whereas the today's share is only 6 %. It is recognized that subsidies and incentives are helpful but not sufficient. After a controversial discussion at national level between heat-feed-in-tariffs and obligation models, BW was the first state taking initiative for implementing its renewable heat law.

b. Political objectives

- climate and environmental protection;
- sustainable energy supply in BW;
- increase of the share of RES within the heat supply in BW;
- planning security for the implementation of RES heat technologies;
- lower cost for the end-users.

The law was developed in a top-down approach, initiated by political decision makers. Hearings have been carried out with: association of communes, housing companies, manufacturers, handicraft, architects, engineers, consumers, welfare, RE suppliers, fossil fuel enterprises, unions and environmental organisations. More than 80 positions were presented and incorporated in the law. Almost all of them confirmed the overall objective of the law.
The preparation phase, including three rounds of hearings, had an approximate duration of 6 months.

c. ***Quality requirements*** (on products, on installation, etc.)

Not available.

d. ***Soft support measures*** (training, communication, etc.)

- The law is being promoted through press releases and an information campaign
- BW runs numerous promotion initiatives regarding RES/RUE in buildings

e. Implementation costs

Approximately 1.1 Mio € per year.

f. Checks and sanctioning fees

Random inspections are foreseen.

Fees range from 50,000 to 100,000 €.

4. Results

a. How many buildings were affected by the STO?

Results have been collected for 2,500 cases, about 42 % of the expected total figure.

b. ***How many m^2 of solar thermal were installed thanks to the law***?

Not available.

However, a calculation can be performed through the following steps:

- as an average in the region, CO_2 emissions avoided when saving 1 kWh is 0.239 kg;
- the CO_2 emissions avoided thanks to solar are known (see point "f" below);
- therefore primary energy saved by solar thermal plants can be calculated;
- since an average yield of 400 kWh/m^2 can be assumed for solar thermal, assuming also a boiler efficiency of 0.85, the final results of the total solar thermal installed surface is:
    - 11,300 m^2 in new buildings;
    - 44,100 m^2 in existing buildings.

c. If ST is competing with other technologies, what is the share of buildings choosing ST for fulfilling the obligation?

Solar thermal has been chosen in 612 cases (24.4 %) in new buildings and in 702 cases (41.9 %) in renovations.

d. How many buildings were exempted by the obligation and for which reasons?

The law could not be applied in about 6 % of the cases.

e. ***Additional building cost for including solar thermal in the construction phase*** (e.g. 1%, 0.5%, etc.)

20 to 34 € per m² of living.

f. ***Other indicators*** (number of trained installers, number of new companies born in the ST sector, etc.)

Emissions of CO_2 avoided for solar thermal:

- 1,274 tons/year in new buildings
- 4,963 tons/year in renovations

5. Lessons learned

a. Barriers

In 2008 the federal parliament Bundestag decided on the federal law EEWärmeG. The initial plan for this law was to exempt obligatory measures from public funding.
Finally this regulation was not enacted.
The regulation of EWärmeG BW for new buildings was replaced by federal law EEWärmeG on January 1st, 2009.

b. Success factors

- simple and understandable approach of the law
- compact preparation phase of approximately 6 months
- freedom of choice between cost-effective alternatives
- participated process of hearings with the associations

It is also interesting to report the main results of a survey done among energy agencies:

- regarding the acceptance of the law, 14 answered "neutral", 7 answered "pretty bad", 1 answered "pretty good";
- awareness among citizens: 50% of energy agencies answered that "the majority of people is not aware", while 35% said "the majority of people is aware";
- regarding the source of the awareness: 15% from awareness raising activities, 15% newspapers, 25% from installers, 5% from friends, 10% from the web;
- problems with solar thermal: for old citizens, who often live alone, the obligation leads to too high collector areas and therefore is not economically viable;
- about support measures: information has shown to be crucial. Advantages of RES must be communicated though the web, but also with different means for non-internet users

c. Improvement opportunities

There is a clear request from technicians that local administration should increase the technical support (e.g. tables showing for each insulation material its lambda value)
Moreover, a discussion is taking place about increasing the renewable share of the law: however all energy agencies think it is technically feasible, but 12 out of 22 think citizens cannot afford it. On the other hand, consumers associations are against increasing the share.

d. Recommendations

Early coordination of legislation projects of different legislative bodies, e.g. at regional and federal level, is recommendable.

6. References

Regional Government web site:
http://um.baden-wuerttemberg.de/

7. Sources and contributors

Sources:
ProSTO project web site: www.solarordinances.eu

Contributors:
Thomas Pauschinger, SFZ Solites

Med Desire

Solar thermal obligation (STO)

Description

Chandigarh – India

1. Brief summary of the STO

Chandigarh city issued a building law in October 2008 which came into effect on the 21st December 2008.

This piece of legislation foresees that commercial, institutional and hotel buildings which use hot water shall install solar thermal plant. Furthermore, within one year from the date the law is published, even the existing buildings shall adopt solar thermal systems. The law also allows residential building owners a transitional period of 2 years.

2. General information

a. Starting date

December 2008.

b. Duration

Unlimited.

c. Geographical scope

Local (city of Chandigarh).

d. Targeted buildings (e.g. residential, commercial, etc.)

All buildings (commercial, public, hotel, residential).

e. Exceptions (e.g historical buildings, buildings with too low heat consumption, etc.)

No exceptions are foreseen in the law.

f. ***Building stage*** (only for new buildings or also for renovation?)

Both new and existing buildings (see above for details).

g. ***Quantitative obligation*** (e.g. 50% of the heat demand should be covered by solar thermal)

For residential buildings:

- Houses built on a parcel of 506 m^2 must install a 100 litre solar water heater
- Houses built on a parcel of 1,012 m^2 must install a 200 litre solar water heater

h. ***Admitted technologies*** (e.g. solar thermal, heat pumps, etc.)

Solar thermal only.

i. ***Responsible actor/s and working mechanism*** (in particular, who is the actor in charge of releasing the building permits?)

Not available.

3. Development and implementation

a. Legal/political background

Chandigarh is a main city in India, since it is the capital of the two Indian states Punjab and Haryana in the north of the territory.

The issue of solar obligation in buildings had been under consideration for a long time and eventually it has been implemented thanks to a municipal law issued in 2008.

b. Political objectives

- Use the large solar resource available in the city.
- Allow a good level of comfort, providing users with hot water without pollution and with no operating costs.

c. ***Quality requirements*** (on products, on installation, etc.)

Not available.

d. ***Soft support measures*** (training, communication, etc.)

Not available.

e. Implementation costs

Not available.

f. Checks and sanctioning fees

Not available.

4. Results

a. How many buildings were affected by the STO?

Not available.

b. ***How many m^2 of solar thermal were installed thanks to the law***?

Not available.

c. If ST is competing with other technologies, what is the share of buildings choosing ST for fulfilling the obligation?

No other technologies are foreseen in the STO.

d. How many buildings were exempted by the obligation and for which reasons?

No exceptions are foreseen in the STO.

e. ***Additional building cost for including solar thermal in the construction phase*** (e.g. 1%, 0.5%, etc.)

Not available.

f. ***Other indicators*** (number of trained installers, number of new companies born in the ST sector, etc.)

Not available.

5. Lessons learned

a. Barriers

- Older citizens living alone in their houses may have problems in meeting the obligation for existing buildings.

b. Success factors

- Very simple rules for sizing the solar thermal plants.
- No exceptions foreseen.
- Inclusion of a transitional period for the obligation on existing buildings.

c. Improvement opportunities

- Include a monitoring system for checking the results and the impact of the law.

d. Recommendations

No specific recommendations have been reported.

6. References

City of Chandigarh: http://chandigarh.nic.in/

7. Sources and contributors

Sources:
http://solarthermalworld.org/content/india-building-byelaws-chandigarh-city-far-reaching-rules

Contributors:
Jaideep Malaviya, specialist for solar thermal technology

Med Desire

Solar thermal obligation (STO)

Description

Hawaii – USA

1. Brief summary of the STO

Hawaii Revised Statutes**,** in particular chapter 196-6.5, introduced mandatory solar water heating systems on all new single-family dwellings.

2. General information

a. Starting date

The law, published in 2008, came into force in January 2010.

b. Duration

Unlimited.

c. Geographical scope

National (Hawaii).

d. Targeted buildings (e.g. residential, commercial, etc.)

Single-family residential buildings.

e. Exceptions (e.g historical buildings, buildings with too low heat consumption, etc.)

- Low solar resource, for instance due to shadowing.
- Solar is not economically viable (based on a life cycle cost-benefit analysis).
- A different renewable energy technology is used for heating water.
- A water heater device approved by Underwriters Laboratories, Inc., is installed, provided that at least one other gas appliance is installed in the building.

f. ***Building stage*** (only for new buildings or also for renovation?)

New buildings.

g. ***Quantitative obligation*** (e.g. 50% of the heat demand should be covered by solar thermal)

Not available.

h. ***Admitted technologies*** (e.g. solar thermal, heat pumps, etc.)

Though the law focuses on solar thermal, Act 204 allows homeowners to apply for a number of alternative technologies ("variances"), such as tank-less gas water heaters, photovoltaic systems or wind generators (see also point *e.* above about exceptions).

A variance is only accepted if submitted by a licensed architect or mechanical engineer. A request for a variance shall be submitted to the energy resources coordinator and it is automatically approved if not explicitly rejected within thirty working days after receiving the variance request.

i. ***Responsible actor/s and working mechanism*** (in particular, who is the actor in charge of releasing the building permits?)

Not available.

3. Development and implementation

a. Legal/political background

The key statement of the STO law is that "No building permit shall be issued for the single-family dwelling that does not include a solar water heater system on or after January 1st, 2010".
In 2009, then, some modifications to the law were introduced, also including regulations on how to handle tax credits. Since 2006, tax credits for solar thermal, covering 35 % of installation costs (up to US$ 2,250 for single family houses), have been available in Hawaii.
However, when a solar water heating system is installed because it is mandatory due to the new law, it can no longer be eligible for either tax credits or rebates offered by some public utilities.
Multi-family residential and commercial properties are still fully eligible for tax credits, because installing a solar water heater in such buildings is still voluntary.

b. Political objectives

Hawaii is the state with the biggest solar thermal market in the United States. To keep this position, the Hawaii government introduced a solar obligation law during the summer of 2008.

c. ***Quality requirements*** (on products, on installation, etc.)

Not available.

d. ***Soft support measures*** (training, communication, etc.)

Not available.

e. Implementation costs

Not available.

f. Checks and sanctioning fees

New houses require no independent third-party inspection.
The public benefits fee administrator shall be responsible for verification inspections after installation.

4. Results

The results come from the analysis of 3 years from the issue of Act 204.

a. How many buildings were affected by the STO?

The figures for the three years are (see graph below):

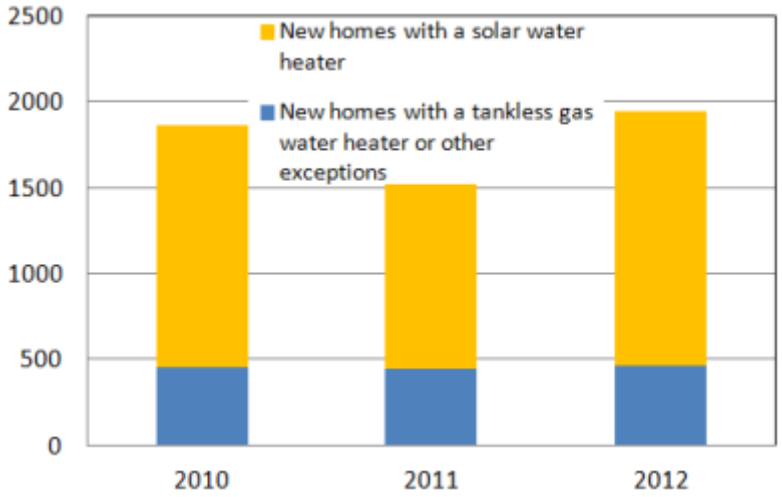
- 2010: about 1,800 homes (about 1,400 chose solar).
- 2011: about 1,500 homes (about 1,100 chose solar).
- 2012: about 1,900 homes (about 1,500 chose solar).

b. ***How many m² of solar thermal were installed thanks to the law***?

Not available.

c. If ST is competing with other technologies, what is the share of buildings choosing ST for fulfilling the obligation?

The number of new residential houses equipped with a solar water heater has risen to 75 %. Before the mandate, only 40 % of the new residential homes had solar water heaters.
The amount of exceptions ranged from 21 % to about 27 % and the list of variances shows that 91÷ 97 % apply for the installation of a tank-less water heater.



Source: http://www.solarthermalworld.org/content/hawaii-results-three-years-solar-obligation

d. How many buildings were exempted by the obligation and for which reasons?

See point *c.* above.

e. ***Additional building cost for including solar thermal in the construction phase*** (e.g. 1%, 0.5%, etc.)

Not available.

f. ***Other indicators*** (number of trained installers, number of new companies born in the ST sector, etc.)

Not available.

5. Lessons learned

a. Barriers

Still too many exceptions and almost all of them chose a tank-less water heater, which does not really reduce the dependency on oil.

b. Success factors

- Already mature solar market.
- Saving fossil oil, which needs to be transported to the islands and is therefore expensive.

c. Improvement opportunities

A possible improvement regards independent third-party inspection that, at the moment, is not foreseen for new houses, because they do not receive any funding from local utilities.

d. Recommendations

Not available.

6. References

Hawaii Solar Energy Association: www.hsea.org
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Hawaii State Energy Office: http://energy.hawaii.gov/

7. Sources and contributors

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Med Desire

Solar thermal obligation (STO)

Description

Jinan – China

1. Brief summary of the STO

Since 2014, solar water heating has been mandatory in the city of Jinan for new residential buildings below 100 meters height or with less than 33 floors.

2. General information

a. Starting date

2014.

b. Duration

Unlimited

c. Geographical scope

Local (city of Jinan).

d. Targeted buildings (e.g. residential, commercial, etc.)

New residential buildings below 100 meters height or with less than 33 floors.

e. Exceptions (e.g historical buildings, buildings with too low heat consumption, etc.)

Not available.

f. ***Building stage*** (only for new buildings or also for renovation?)

New buildings

g. ***Quantitative obligation*** (e.g. 50% of the heat demand should be covered by solar thermal)

40 litres of hot water per occupant.

h. ***Admitted technologies*** (e.g. solar thermal, heat pumps, etc.)

Solar thermal only.

i. ***Responsible actor/s and working mechanism*** (in particular, who is the actor in charge of releasing the building permits?)

The implementation of the mandatory installation requirements is to be carried out by the respective Construction Bureaus. So-called Construction Document Evaluation Centres review the construction documents. If the solar water heater systems are in line with the specified

requirements and technical standards, the centre will issue a certificate to the developer. Only this certificate will allow the builder to apply for a building permit.
The construction site, including the solar water heater installation, will be inspected regularly by the local construction bureau. The inspection following completion of the structure will include an energy efficiency check of insulation, shading and solar water heaters systems. If all regulations are fulfilled, the developer receives a certificate which enables him to apply for a sales permit.

3. Development and implementation

a. Legal/political background

The starting point for the implementation of solar building codes was the Chinese Renewable Energy Law, which came into effect on 1st January 2006.
Article 17 in this law makes clear that "the government encourages companies and individuals in the installation and use of solar water heating systems, solar heating systems and solar cooling systems." Furthermore, this article states that "local construction authorities should cooperate with relevant authorities of the state council in establishing technical and economical standards with regard to the combination of solar energy systems and constructions." The solar retrofitting of buildings is also mentioned in the Chinese Renewable Energy Law. "For already existing buildings, residents may install solar thermal systems according to technical standards under the condition that their quality and safety is not affected, unless agreements have been otherwise."

b. Political objectives

With the "opinion on the implementation of comprehensive promotion of green building development" (济南市人民政府关于全面推进绿色建筑发展的实施意见) issued in December 2013 and which will be valid for 5 years, the government of Jinan further intensified the efforts to promote solar thermal installations.

c. ***Quality requirements*** (on products, on installation, etc.)

A Shandong province building-integrated solar thermal system design standard atlas has been established by the company Linuo in 2008, entailing all relevant provincial and national standards for design and construction.
It is thus also applicable in Jinan, the capital of Shandong.

d. ***Soft support measures*** (training, communication, etc.)

Workshops are organized and held by either solar energy associations or companies, where new technological developments and policies are discussed and communicated to decision makers from the industry and the political sectors.

e. Implementation costs

Not available.

f. Checks and sanctioning fees

See point *2.i* above.
Checks are made by the Jinan Construction Bureau, which also assesses the implementation of the solar thermal system and can then decide on issuing the building or sales permit.

4. Results

a. How many buildings were affected by the STO?

Not available.

b. *How many m^2 of solar thermal were installed thanks to the law*?

Not available.

c. If ST is competing with other technologies, what is the share of buildings choosing ST for fulfilling the obligation?

The STO is a solar-thermal-only piece of legislation.

d. How many buildings were exempted by the obligation and for which reasons?

Not available.

e. ***Additional building cost for including solar thermal in the construction phase*** (e.g. 1%, 0.5%, etc.)

Not available.

f. ***Other indicators*** (number of trained installers, number of new companies born in the ST sector, etc.)

Not available.

5. Lessons learned

a. Barriers

Lack of financial, but especially human resources that are technically educated and are able to work in advanced engineering project management.

b. Success factors

Involvement of all relevant stakeholders, where especially the solar energy associations played a big role in disseminating knowledge.

c. Improvement opportunities

Stronger cooperation between real-estate business and solar project engineering companies. In that way more solar thermal projects can be developed in a more concerted way.

d. Recommendations

Accompanying the implementation of STO by quantifying their importance for supporting the ST market. Until now, little quantitative data on the results are available. This would make the evaluation of the STO possible.

6. References

Link to the Chinese Renewable Energy Law (in Chinese): **www.mep.gov.cn/law/law/200802/t20080202_117982.htm**

Goess, S. (2014). *Which innovation environment makes renewable energy successful in China? A case study of solar water heaters in Shandong province, China.* (Master Thesis). Delft: Delft University of Technology

7. Sources and contributors

Sources:
http://solarthermalworld.org/content/china-no-sales-permit-without-solar
http://solarthermalworld.org/content/solar-building-codes-china

Contributors:
Simon Goess, Delft University of Technology

Med Desire

Solar thermal obligation (STO)

Description

Kenya

1. Brief summary of the STO

THE ENERGY (SOLAR WATER HEATING) REGULATIONS 2012 were issued on May 2012 in Kenya. This piece of legislation states that all buildings with hot water requirements exceeding 100 litres per day shall use solar thermal heating systems.
Furthermore, within a period of five years from the date of coming into force of this STO, even existing premises with hot water demand higher than 100 hundred litres per day shall install solar heating systems.

2. General information

a. Starting date

May 2012.

b. Duration

Unlimited.

c. Geographical scope

National (Kenya).

d. Targeted buildings (e.g. residential, commercial, etc.)

All premises with hot water demand of more than 100 litres per day.
The regulation applies mainly to urban areas, because rural households do not use hot water at all.

e. Exemptions (e.g historical buildings, buildings with too low heat consumption, etc.)

- technical limitations and special circumstances
- existing hot water supply from a cogeneration plant
- use of renewable electricity with the surplus production used to heat water

f. ***Building stage*** (only for new buildings or also for renovation?)

The law applies to all new buildings (both residential and commercial) that have a hot water demand of more than 100 litres per day and also to existing buildings within the transition time of 5 years.
It also applies to extensions or alterations of existing buildings.

g. ***Quantitative obligation*** (e.g. 50% of the heat demand should be covered by solar thermal)

60 % of the building's annual hot water demand. The daily hot water demand shall be calculated using the values specified in the regulation.

h. ***Admitted technologies*** (e.g. solar thermal, heat pumps, etc.)

Solar thermal only.

i. ***Responsible actor/s and working mechanism*** (in particular, who is the actor in charge of releasing the building permits?)

The subject in charge of complying with the STO could be: A developer of a housing estate, a promoter of the construction, an owner of the premises or an Architect or an Engineer responsible for design and/or construction of the building.
The owner or the tenant, then, must carry out the maintenance needed to keep the installation in good and efficient working condition.
An electric power distributor or supplier shall not provide electricity supply to premises where a solar water heating system has not been installed.

3. Development and implementation

a. Legal/political background

The Energy (Solar Water Heater) Regulations are a follow-up to the 2006 Energy Law, in which it is clearly stated that all types of renewable energies should be promoted and that the ministries can enact respective regulations.

b. Political objectives

The residential sector in Kenya needs about 820 GWh/year of electricity just to heat water. This is strongly challenging the power infrastructure, especially in the morning and the evening. The use of solar plants could then reduce the demand during peak times.

c. ***Quality requirements*** (on products, on installation, etc.)

- Solar components need to comply with Kenyan technical standards.
- The storage capacity shall not be less than one and a half times the daily hot water demand of the installation.
- The design, installation and maintenance shall comply with the Code of Practice – Solar Water Heating For Domestic Hot Water; Kenya (Standard KS 1860:2008) and also be in accordance with the building code made under the Local Government Act, Cap. 265.
- A technician, when commissioning a solar thermal system, shall issue an installation certificate, reporting the installation date, the capacity of the solar plant and the details of the installer as well as of the warranty.
- Installers need to be licenced by the Energy Regulatory Commission (ERC).
- The ERC will maintain a register of all eligible solar water heater technicians and contractors.
- A glazed, evacuated tube collector or any other type that meets the Kenya Standards for collectors shall be used in all installations except in installations for heating swimming pools where unglazed collectors may be used.

d. ***Soft support measures*** (training, communication, etc.)

Not available.

e. Implementation costs

Not available.

f. Checks and sanctioning fees

The National Commission may inspect houses, to check the installation of solar water heating systems.

The Commission shall issue a compliance certificate, upon request, where a solar water heating system has been installed in compliance with these Regulations. If the Commission finds that the provisions of these Regulations have been not met, it may issue a compliance notice to the owner or the tenant.

A person who contravenes the provisions of the regulation shall be liable to a fine not exceeding one million Kenyan shillings (about 9,000 €), or to imprisonment for a term not exceeding one year, or to both.

4. Results

a. How many buildings were affected by the STO?

Not available.

b. ***How many m^2 of solar thermal were installed thanks to the law***?

Not available.

c. If ST is competing with other technologies, what is the share of buildings choosing ST for fulfilling the obligation?

Not available.

d. How many buildings were exempted by the obligation and for which reasons?

Not available.

e. ***Additional building cost for including solar thermal in the construction phase*** (e.g. 1%, 0.5%, etc.)

Not available.

f. ***Other indicators*** (number of trained installers, number of new companies born in the ST sector, etc.)

Not available.

5. Lessons learned

a. Barriers

- Too vague definitions of “technical limitations” and “special circumstances” for buildings that could be exempted.
- Though the law aims at reducing electricity, renewable electricity for producing heat is considered as equivalent to solar thermal.

b. Success factors

- The law also applies to existing buildings with a time delay of 5 years.
- Good and exhaustive reference to available standard and certification.
- Detailed definition of checks and also of liability in case of buildings not meeting the law requirements.

c. Improvement opportunities

Define more precisely the exceptions (see point *a.* above).

d. Recommendations

It is advisable to list all solar thermal technicians and providers of turn-key systems.

6. References

Energy Regulatory Commission: http://www.erc.go.ke/

7. Sources and contributors

Sources:

http://solarthermalworld.org/content/kenya-regulation-increases-solar-water-heater-uptake

Med Desire

Solar thermal obligation (STO)

Description

Mexico City – Mexico

1. Brief summary of the STO

In April 2006 Mexico City introduced an Environmental Norm (NADF008-AMBT-2005) which makes it mandatory for new and totally refurbished facilities (using domestic hot water in kitchens and for washing and cleaning) to cover at least 30 % of their hot water demand through solar thermal systems.

The law establishes criteria for the use of solar energy water heating, minimum quality requirements as well as technical specifications regarding installation, operation and maintenance of systems.

2. General information

a. Starting date

April 2006.

b. Duration

Unlimited.

c. Geographical scope

Local (Mexico City).

d. Targeted buildings (e.g. residential, commercial, etc.)

Any building using hot water for sanitary and kitchen purposes, washing and cleaning, including swimming pools and companies with more than 51 employees.

e. Exceptions (e.g historical buildings, buildings with too low heat consumption, etc.)

- Private households and companies with less than 51 employees
- It is possible to install a smaller capacity, in case the solar thermal installation would not reach 30 % of the warm water consumption due, for instance, to insufficient available area or high shading.

f. ***Building stage*** (only for new buildings or also for renovation?)

- New constructions
- Building under total refurbishment

g. ***Quantitative obligation*** (e.g. 50% of the heat demand should be covered by solar thermal)

30 % of the hot water demand should be covered by solar thermal. The law also include a calculation method for estimating the total yearly water demand.

h. ***Admitted technologies*** (e.g. solar thermal, heat pumps, etc.)

Solar thermal only.

i. ***Responsible actor/s and working mechanism*** (in particular, who is the actor in charge of releasing the building permits?)

The Federal District Government (Department for Environment) is responsible for checking the correct implementation of the law. There is also the possibility of a self-declaration by the user which should then be sent to the Government.

3. Development and implementation

a. Legal/political background

Mexico City is one of the ten most populated cities in the world and the need for lowering the emissions of polluting agents for heating is a must.

b. Political objectives

The goal of this new Environmental Norm was to set solar thermal as a standard way to heat water in buildings, in both the cases of new construction and total renovation.

c. ***Quality requirements*** (on products, on installation, etc.)

- 5 years performance guarantee on solar collectors
- 1 year guarantee for pumps, controls and other electrical and electronic devices
- Collectors must meet the NMX-ES-001-Normex-2005 standard, within 1 year after the regulation came into force
- Thermosiphon systems are allowed only up to 20 m^2 of collector area

d. ***Soft support measures*** (training, communication, etc.)

Not available.

e. Implementation costs

Not available.

f. Checks and sanctioning fees

See point *2.i*.

4. Results

a. How many buildings were affected by the STO?

Not available.

b. ***How many m^2 of solar thermal were installed thanks to the law***?

Not available.

c. If ST is competing with other technologies, what is the share of buildings choosing ST for fulfilling the obligation?

No other technologies are foreseen in the law.

d. How many buildings were exempted by the obligation and for which reasons?

Not available.

e. ***Additional building cost for including solar thermal in the construction phase*** (e.g. 1%, 0.5%, etc.)

Not available.

f. ***Other indicators*** (number of trained installers, number of new companies born in the ST sector, etc.)

Not available.

5. Lessons learned

a. Barriers

No specific barriers have been reported.

b. Success factors

- Good requirements on quality and on guarantee of products.
- No exception in case of non-optimal technical conditions, but just a reduction of the system size.

c. Improvement opportunities

A clearer definition of how and when checks are performed and of the consequent fines should be introduced.

d. Recommendations

No specific recommendations have been reported.

6. References

Full text of the law (in Spanish):
http://solarthermalworld.org/taxonomy/term/57441

7. Sources and contributors

Sources:
http://www.solarthermalworld.org/content/mexico-city-shows-way-solar-obligations-central-america

Contributors:
Oscar Vázquez, Federal District Government.

Med Desire

Solar thermal obligation (STO)

Description

Namibia

1. Brief summary of the STO

In 2007 Namibia has successfully implemented a piece of legislation, named "Code of Practise on Solar Water Heater for public and state-controlled buildings", which makes it mandatory to install solar thermal plants on all new public buildings, on existing public buildings which have no water heaters or have electric heaters.

2. General information

a. Starting date

August 2007.

b. Duration

Unlimited.

c. Geographical scope

National (Namibia).

d. Targeted buildings (e.g. residential, commercial, etc.)

- New public or state-controlled buildings
- All additions to existing public or state-controlled buildings with no water heaters
- All additions to existing public or state-controlled buildings with electric water heaters

e. Exceptions (e.g historical buildings, buildings with too low heat consumption, etc.)

- Private households

f. ***Building stage*** (only for new buildings or also for renovation?)

- New buildings
- Additions to existing buildings

g. ***Quantitative obligation*** (e.g. 50% of the heat demand should be covered by solar thermal)

Not available.

h. ***Admitted technologies*** (e.g. solar thermal, heat pumps, etc.)

Solar thermal only.

i. ***Responsible actor/s and working mechanism*** (in particular, who is the actor in charge of releasing the building permits?)

Not available.

3. Development and implementation

a. Legal/political background

In 2003, the Namibian government launched the Namibian Renewable Energy Programme (NAMREP). The first phase was completed in 2006 and was mainly addressed at increasing the public awareness, as well as reduce organisational and technical barriers. By the end of phase one, the number of annually installed solar water heaters had increased from 135 in 2003 to 400 systems in 2006.

However, the potential for solar water heating installations was seen as much higher. Namibia has more than 97,000 electric water heaters, which could be easily replaced by solar thermal plants. The government therefore launched a second phase of the NAMREP, characterized by an energy saving initiative including the promotion of solar thermal through the STO.

b. Political objectives

- Reduction of peak electricity demand by almost 20 MW.
- Reduction of the number of poor-quality products and poor manufacturing, by setting minimum quality requirements
- Fulfilment of the given goals stated by the NAMREP programme and the White Paper on Energy Policy

c. ***Quality requirements*** (on products, on installation, etc.)

- Only closed circuit systems are allowed; no drinking water should circulate directly through the collectors
- In a closed system, heating must operate through the thermosiphonic effect
- The SWH system has to be able to deliver hot water through the use of solar radiation energy alone; one has to be able to heat up its full-rated storage tank capacity of hot water from 20°C to at least 55°C during a nominal sunshine day (1,000 W/m2) at any location in Namibia
- Solar water heaters must have a warranty for manufacturing defects, faulty material / assembly and leakage from corrosion over a minimum of five years, if installed according to manufacturer's instructions.

d. ***Soft support measures*** (training, communication, etc.)

Not available.

e. Implementation costs

Not available.

f. Checks and sanctioning fees

Not available.

4. Results

a. *How many buildings were affected by the STO?*

Not available.

b. ***How many m^2 of solar thermal were installed thanks to the law***?

Not available.

c. *If ST is competing with other technologies, what is the share of buildings choosing ST for fulfilling the obligation?*

No other technologies are foreseen in the law.

d. *How many buildings were exempted by the obligation and for which reasons?*

Not available.

e. ***Additional building cost for including solar thermal in the construction phase*** (e.g. 1%, 0.5%, etc.)

Not available.

f. ***Other indicators*** (number of trained installers, number of new companies born in the ST sector, etc.)

Not available.

5. Lessons learned

a. *Barriers*

- Poor social acceptance of solar thermal.
- High investment costs for installation.
- Lack of technical know-how for commissioning and maintenance.
- Lack of information to final users.

b. *Success factors*

- Top conditions for solar energy: 300 days of sunshine per year and up to 10 hours a day.
- Large number of electric heaters with high electricity costs.

c. *Improvement opportunities*

The law could be extended to private household also.

d. *Recommendations*

No specific recommendations have been reported.

6. References

Ministry of Mines and Energy:
http://www.mme.gov.na/

7. Sources and contributors

Sources:

http://www.solarthermalworld.org/content/solar-obligation-public-buildings-namibia-2007
http://www.solarthermalworld.org/content/namibia-solar-water-heaters-mandatory-public-buildings

Med Desire

Solar thermal obligation (STO)

Description

Portugal

1. Brief summary of the STO

The national Portuguese law "RCCTE" imposes the usage of solar thermal collectors for hot water production if there are favourable conditions for installation (if the roof runs between South East and South West without significant obstructions), in a basis of 1 m^2 per person (the total can be reduced up to 50%).

The RCCTE has been recently revised (August 2013) and replaced by REH (Regulamento de Desempenho Energético dos Edifícios de Habitação). The STO continues as before with just a slight change: now the solar thermal systems must have a maintenance contract instead of a 6 years guarantee.

2. General information

a. Starting date

July 2007 (1st phase); July 2008 (2nd phase)

b. Duration

Unlimited.

c. Geographical scope

National (Portugal).

d. Targeted buildings (e.g. residential, commercial, etc.)

All buildings.

e. Exceptions (e.g historical buildings, buildings with too low heat consumption, etc.)

- Buildings associated with Industrial, agriculture and livestock farming activities
- Religious buildings
- Warehouses, parking lots and garages
- Abandoned commerce and services buildings
- Buildings in ruins
- Military infrastructures and buildings
- Historical buildings or classified buildings

f. ***Building stage*** (only for new buildings or also for renovation?)

- New buildings.
- Deep building renovations, meaning renovations where the total cost of the intervention is 25 % above the building's market value.

g. ***Quantitative obligation*** (e.g. 50% of the heat demand should be covered by solar thermal)

1 m^2 of solar thermal per occupant.

h. ***Admitted technologies*** (e.g. solar thermal, heat pumps, etc.)

- Solar thermal.
- The regulation also accepts different renewable energy sources (PV, biomass, wind, geothermal, etc.) as long as the same amount of energy is produced.

i. ***Responsible actor/s and working mechanism*** (in particular, who is the actor in charge of releasing the building permits?)

Building permits are issued by local authorities, while building certification must be performed and released by a qualified expert.
The compliance with the law is to be verified by a qualified expert and the process shall be presented to ADENE, the national energy agency (or AREAM, for the Madeira island), which emits the building energy certificate.

3. Development and implementation

a. Legal/political background

In 2006, the legislation transposing the EU Directive 2002/91/CE (EPBD) was concluded and this was the final step for the implementation of the first STO in Portugal. This obligation was integrated in the Portuguese Thermal Performance Building Regulation, recently revised within the Decree-Law 118/2013.
The law was developed through a top-down approach, initiated by political decision makers. Hearings have been carried out with professional associations (architects, engineers, and technical engineers), housing construction companies, etc. in a public discussion, with special open sessions with all the stakeholders.
The law was enacted in April 2006. The preparation phase, including a Government change, lasted approximately 3 years and 6 months.

b. Political objectives

- To reduce the Portuguese energy dependence.
- To increase energy efficiency and to reduce CO_2 emissions.
- To reduce the energy cost as well as to increase the service quality.

c. ***Quality requirements*** (on products, on installation, etc.)

- For performance calculation, the product certification according to the European Standards is needed.
- Performance calculation must be done using a programme developed by INETI (now LNEG), the SolTerm code.
- Installers must be certified.
- Solar thermal plants must have a maintenance contract.

d. ***Soft support measures*** (training, communication, etc.)

- Training courses for installers.
- Dissemination campaigns on good practices.
- Certification scheme for installers.

e. Implementation costs

Not available.

f. Checks and sanctioning fees

- Check of the overall design process concerning the Thermal Performance of the Building.
- Check after the building construction.
- No fees are foreseen.

4. Results

a. How many buildings were affected by the STO?

30,000 dwellings.

b. ***How many m^2 of solar thermal were installed thanks to the law***?

110,500 m^2.

c. If ST is competing with other technologies, what is the share of buildings choosing ST for fulfilling the obligation?

90 %.

d. How many buildings were exempted by the obligation and for which reasons?

Not available (this information is a responsibility of the local governments, who approve the construction/renovation licensing).

e. ***Additional building cost for including solar thermal in the construction phase*** (e.g. 1%, 0.5%, etc.)

Not available.

f. ***Other indicators*** (number of trained installers, number of new companies born in the ST sector, etc.)

5. Lessons learned

a. Barriers

- Qualification of the market, from the designers to the installers, responsible for the maintenance and the qualified experts.
- A lot of effort was placed in training courses and supervision actions.

b. Success factors

- Simple and understandable law.
- Freedom of choice between alternatives

- Participated process with the stakeholders.

c. Improvement opportunities

No relevant bottle-necks were identified. Only it was necessary to clarify some requirements through the answers to FAQs.

d. Recommendations

To implemented a STO, qualified people, qualified products and qualified enterprises are needed.

6. References

Text of the law (in Portuguese): http://www.adene.pt/sce/legislacao-0

7. Sources and contributors

Contributors:
Joana Fernandes, ADENE
Joana Freitas, Apisolar

Med Desire

Solar thermal obligation (STO)

Description

Sao Paulo – Brazil

1. Brief summary of the STO

The Sao Paulo solar law (Lei N° 14459, 3 July 2007) highly increased the awareness among policy makers. The city has 19 million inhabitants and a GDP of US$ 102 billion. Its authorities made solar water heaters a mandatory part of both new and in-refurbishing buildings, for both residential and non-residential estates by applying the law to hotels, sport clubs, schools, swimming pools, restaurants, etc.

After this law solar thermal's sector has never been the same. The powerful media, technical community, construction industry, became mobilised for a new and irreversible perspective, helping to spread a new awareness level. Despite being unmeasurable, this might has been the main positive impact of this law.

2. General information

a. Starting date

July 2007.

It will affect only building permits approved after July 2008.

b. Duration

Unlimited.

c. Geographical scope

Local (city of Sao Paulo).

d. Targeted buildings (e.g. residential, commercial, etc.)

- Hotels and touristic buildings
- Health services
- Sport clubs
- Barracks
- Schools and nurseries
- Public swimming pools
- Private residential buildings with more than three bathrooms (to install solar must be installed). This reference is about the buildings luxury level, not the water consumption so the law considers as bathroom each room with a toilet bow instead of a shower or tube.

- Private residential buildings with up to three bathrooms (only infrastructure for future solar connection must be prepared)

The buildings covered are those intended for the following uses: commercial (in special cases), industrial (if hot water is needed for the industrial process or if showers are to be installed for the staff), and, in general, any other use that entails the presence of dining rooms, kitchens or collective laundries. It also includes heated swimming pools.

e. Exceptions (e.g. historical buildings, buildings with too low hot water consumption, etc.)

The provisions shall not apply to buildings in which it is technically impossible to achieve the conditions to meet the mandatory share of annual energy demand, for instance due to high shadowing.

f. ***Building stage*** (only for new buildings or also for renovation?)

For new buildings and for in-refurbishing buildings .

g. ***Quantitative obligation*** (e.g. 50% of the heat demand should be covered by solar thermal)

Minimum 40 % of the domestic hot water demand must be covered by solar thermal.

h. ***Admitted technologies*** (e.g. solar thermal, heat pumps, etc.)

Solar thermal only.

i. ***Responsible actor/s and working mechanism*** (in particular, who is the actor in charge of releasing the building permits?)

The municipality checks whether the building permission complies with the law. After construction is complete, the owner has to get the "habite-se" certificate from a specific city hall department that declares the building has been constructed according to approved plans and ready to be used.
At national level, the "Cidades Solares" initiative is additionally starting a monitoring programme as a follow-up between plan approval and "habite-se". However this monitoring action did not reach sustainability and it was cancelled.

3. Development and implementation

a. Legal/political background

A very successful campaign for solar thermal technology is the Cidades Solares (Solar Cities) in Brazil. There were two major associations that initiated the campaign in 2005: DASOL/ABRAVA, the association of the solar thermal industry, and the international network Vitae Civilis.
In Brazil, decisions on building laws are mostly made at the municipality level. More than 5,500 municipal districts show very diverse demographic and climatic characteristics and Cidades Solares directs its work to the main and strategic cities, expecting its effects to spread across the regions.

b. Political objectives

The Cidades Solares' two main objectives are:

- to implement STOs at provincial and municipality level
- to organise training for engineers, architects and representatives of local authorities
- so far, Cidades Solares already initiated and supported the approval of 40 laws, about 70 % in the Southeast region, 20 % in the South, 7 % in the Mid-west and 3 % in the Northeast At present, there are also 94 draft laws going through the approving process – 61 in the Southeast region, 20 in the South, 7 in the Mid-west and 6 in the Northeast. There has not yet been any activity in the North region.

- The São Paulo law could have a huge local direct influence, from 3 to 4 % of the national market. Perhaps the indirect effect on awareness is even more relevant.

c. ***Quality requirements*** (on products, on installation, etc.)

Products must be certified in compliance with the National Institute of Metrology, Standardization and Industrial Quality (INMETRO).

d. ***Soft support measures*** (training, communication, etc.)

To support the regulations DASOL / ABRAVA has been developing several actions:

- It structured the standards to define the solar fraction in buildings according to the solar code.
- It gives regular training courses on solar thermal systems design as well as on Brazilian certification program.
- It releases reference cases in "Revista do DASOL", its monthly magazine.
- It offers technical support for constructors, institutions, law makers and opinion makers.

e. Implementation costs

Not available.

f. Checks and sanctioning fees

At its start, to get the building license, the project must comply with the codes and, therefore, the Municipality will evaluate whether the project is in accordance to the rules.
In the latest building step, once the construction is completed, to occupy the building it is necessary to receive the business license. Then the execution of works will be checked for verifying if it respects the approved design.

4. Results

a. How many buildings were affected by the STO?

Not available.

b. ***How many m^2 of solar thermal were installed thanks to the law***?

Not available.

c. If ST is competing with other technologies, what is the share of buildings choosing ST for fulfilling the obligation?

The law accepts only solar thermal (heat pumps are excluded). In the free market, the strongest competitors are electric showers and continuous flow gas heaters.

d. How many buildings were exempted by the obligation and for which reasons?

Not available.

e. ***Additional building cost for including solar thermal in the construction phase*** (e.g. 1%, 0.5%, etc.)

From 0.3 to 0.9%. In social dwellings (not the case of the law) it might reach 2.5%.

f. ***Other indicators*** (number of trained installers, number of new companies born in the ST sector, etc.)

Not available.

5. Lessons learned

a. Barriers

In a very dense occupation city, the number of very vertical buildings is dominant. The consequence is the lack of roof area for the minimum needed.
Furthermore, building companies, naturally following the market perception, prefer to use the top area to build duplex apartments.

b. Success factors

As said above, development and spreading of awareness on solar thermal is amazing. A code coming from official institutions, from such an important city, conquers the confidence of the population over the technology, provoking a chain reaction across its influence area, possibly the whole country.

c. Improvement opportunities

Since solar thermal needs a high initial investment cost, controlling the energy losses becomes a highly important aspect. Therefore the improvement of the heat water distribution technology across the building is rather important. Comparing the classical solutions to the new concepts, the losses in the building's distribution grid might be lowered from 50 % to 15 %.
Now the constructors are realizing the marketing worth of an apartment using a solar water heater so the use of the solution is becoming more and more frequent even for cases not covered by the STO.

d. Recommendations

That code could be less subjective about the statement "technical viability" because in some cases, for instance, solar collectors could be installed in the building's wall, despite the lower efficiency. Or even, the constructor could give up of the top-duplex apartment lowering its profits.

6. References

Cidades Solares programme: http://www.cidadessolares.org.br/
Rede Solar Procel: www.redesolar.eco.br
São Paulo Municipality:
http://www3.prefeitura.sp.gov.br/cadlem/secretarias/negocios_juridicos/cadlem/integra.asp?alt=04072007L%20144590000
http://www.nossasaopaulo.org.br/portal/node/200

7. Sources and contributors

Sources:

http://solarthermalworld.org/content/solar-obligation-municipality-sao-paulo
http://solarthermalworld.org/content/brazil-solar-water-heaters-will-become-culture
http://solarthermalworld.org/content/sao-paulo-feels-first-effects-its-solar-building-code
http://solarthermalworld.org/sites/gstec/files/Sizing%20tool%20Sao%20Paulo.pdf

Contributors:
Carlos Artur Alencar, Past President of DASOL / ABRAVA – Brazilian Association for HVAC, CEO of Enalter Ind. Com. Ltda.

Med Desire

Solar thermal obligation (STO)

Description

Shandong – China

1. Brief summary of the STO

Since 2009, solar water heating has been mandatory for new buildings with less than 13 floors.

2. General information

a. Starting date

2009.

b. Duration

Unlimited.

c. Geographical scope

Provincial (Province of Shandong).

d. Targeted buildings (e.g. residential, commercial, etc.)

- Residential buildings below 13 floors.
- New public buildings (hospitals, schools, nurseries) with a centralized hot water supply.

e. Exceptions (e.g historical buildings, buildings with too low heat consumption, etc.)

Not available.

f. ***Building stage*** (only for new buildings or also for renovation?)

- New buildings
- Renovated buildings
- Extended buildings

g. ***Quantitative obligation*** (e.g. 50% of the heat demand should be covered by solar thermal)

40 litres of hot water per occupant in case of residential building.

h. ***Admitted technologies*** (e.g. solar thermal, heat pumps, etc.)

Solar thermal only.

i. ***Responsible actor/s and working mechanism*** (in particular, who is the actor in charge of releasing the building permits?)

The implementation of the mandatory installation requirements is to be carried out by the respective Construction Bureaus. So-called Construction Document Evaluation Centres review the construction documents. If the solar water heater systems are in line with the specified requirements and technical standards, the centre will issue a certificate to the developer. Only this certificate will allow the builder to apply for a building permit.
The construction site, including the solar water heater installation, will be inspected regularly by the local construction bureau. The inspection following completion of the structure will include an energy efficiency check of insulation, shading and solar water heaters systems. If all regulations are fulfilled, the developer receives a certificate which enables him to apply for a sales permit.

3. Development and implementation

a. Legal/political background

Shandong is among the Chinese provinces with the most advanced solar thermal industry in China, producing about 30 % of the total solar thermal industrial output in China. However, the market is very fragmented due to a large number of suppliers (about 500).
There are about 200 companies of greater importance in Shandong and 20 of them are really big ones, which supply more than 80 % of the province's market.
The starting point for the implementation of STO was the Chinese Renewable Energy Law, which came into effect at the beginning of 2006.
Article 17 of this law states that "the government encourages companies and individuals in the installation and use of solar water heating systems, solar heating systems and solar cooling systems." Furthermore, this article reports that "local construction authorities should cooperate with relevant authorities of the state council in establishing technical and economical standards with regard to the combination of solar energy systems and constructions."
Furthermore, the use of solar in building renovation is also include in this Renewable Energy Law. "For already existing buildings, residents may install solar thermal systems according to technical standards under the condition that their quality and safety is not affected, unless agreements have been otherwise."

b. Political objectives

The penetration of solar thermal systems should increase from 20 % to 40 % in urban areas and from 5 % to 19 % in rural areas in the period from 2009-2012.

c. ***Quality requirements*** (on products, on installation, etc.)

Standards in Shandong have been tighter than at national level. However, all standards in China are not mandatory but only recommended.
However, as already reported above, 80 % of the market is covered by the 20 biggest companies in Shandong and all of these companies meet the provincial standards.
A Shandong province building-integrated solar thermal system design standard atlas has been established by the company Linuo in 2008, entailing all relevant provincial and national standards for design and construction.

d. ***Soft support measures*** (training, communication, etc.)

A current support measure of the Shandong provincial government is the promotion of the national green building standard, which requires energy efficiency of public buildings to increase by 65 % during the 13th Five-Year Plan.
Shandong province requires the installation of solar thermal heaters in buildings which aim at reaching the one-star class (the lowest of the three green building standards). The Province

announced the creation of new green buildings with a total area of more than 50 million m² by the end of 2015. More than 50 % of the new buildings must use renewable energies by then.

e. Implementation costs

Not available.

f. Checks and sanctioning fees

See point *2.i* above.
Checks are made by the Jinan Construction Bureau, which also assesses the implementation of the solar thermal system and can then decide on issuing the building or sales permit.

4. Results

a. How many buildings were affected by the STO?

Not available.

b. ***How many m² of solar thermal were installed thanks to the law***?

No official data are available.
However, by 2012, around 27 million m^2 of solar thermal are installed in Shandong, where the STO might be responsible for around 5÷10 million m^2 (based on comparison between data before and after 2009).

c. If ST is competing with other technologies, what is the share of buildings choosing ST for fulfilling the obligation?

Not available.

d. How many buildings were exempted by the obligation and for which reasons?

Not available.

e. ***Additional building cost for including solar thermal in the construction phase*** (e.g. 1%, 0.5%, etc.)

Not available.

f. ***Other indicators*** (number of trained installers, number of new companies born in the ST sector, etc.)

Increased collaboration between real-estate business and solar thermal project engineering companies.

5. Lessons learned

a. Barriers

- Lack of financial, but especially human resources that are technically educated and are able to work in advanced engineering project management.
- Chaotic market, as the provincial standard is only used by big companies.
- Great reliance of some companies on policy support. Those companies are mostly small-scale, low quality manufacturers with only little proactive entrepreneurial spirit.

- Opening up of new markets not achieved by the industry but by STO.

b. Success factors

Great network of solar thermal companies, solar energy associations, governmental departments, quality supervision center. All stakeholders are involved in the application of the STO.

c. Improvement opportunities

New large-scale and higher temperature applications should be focused on, for instance by realizing demonstration projects with potential industrial users in the agriculture or drying sector.
Restructuring of the market is inevitable, mainly because the retail business declines, while more sophisticated building-integration projects are more important.

d. Recommendations

Standards on the provincial level should be mandatory, thus increasing trust and helping to target a more international market.
The implementation of STO should be monitored by quantifying its importance for supporting the solar thermal market. Until now, unfortunately, little quantitative data on the results are available.

6. References

Shandong Solar Energy Industry Association: **http://www.sd-solar.com.cn/**
National Supervision and Inspection Center for Energy-Saving Product Quality: **http://www.gjjn.net**
Energy Conservation Office of Shandong Province: **http://www.sdetn.gov.cn/jnb/**
Link to the Chinese Renewable Energy Law (in Chinese):
www.mep.gov.cn/law/law/200802/t20080202_117982.htm
Goess, S. (2014). *Which innovation environment makes renewable energy successful in China? A case study of solar water heaters in Shandong province, China.* (Master Thesis). Delft: Delft University of Technology

7. Sources and contributors

Sources:
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http://solarthermalworld.org/content/solar-building-codes-china

Contributors:
Simon Goess, Delft University of Technology

Med Desire

Solar thermal obligation (STO)

Description

Spain

1. Brief summary of the STO

The “Codigo Técnico de la Edificación (CTE)” or Technical Code for Building, is the regulatory framework that establishes and develops the basic requirements of quality of buildings and its facilities, and which allows to demonstrate that the Basic Requirements of the Building under the Building Regulation Law (LOE) are satisfied. The CTE provides those Basic Requirements for each of the basic building needs on "Structural security", "Safety in case of fire", "Safety in use and accessibility", "Hygiene, health and environmental protection", "Protection against noise" and, of course, "Energy saving and thermal insulation".

These Basic Requirements are written down on the so called “Basic Documents”, technical texts that transfer to the practical level the detailed requirements of the CTE. Each document includes limits and quantification of the basic requirements and a list of procedures to help meet the requirements. The Basic Document to regulate the energy saving requirements in the CTE is the “Basic Document of Habitability and Energy” (DB HE). At the same time this Basic Document is divided in five Sections which stand for the basic exigencies at the specific level:

HE 1 Limitation of energy demand.

HE 2 Thermal appliances performance.

HE 3 Energy efficiency in lighting installations.

HE 4 Minimum solar contribution for domestic water heating.

HE 5 Minimum PV contribution for power generation.

2. General information

a. Starting date

The CTE was approved by the Royal Decree 314/2006 of 17 March. It entered into force in 2006 but was strictly required to technicians in 2007, in order for them to get used to the new regulation.

b. Duration

Unlimited.

c. Geographical scope

National (Spain).

d. Targeted buildings (e.g. residential, commercial, etc.)

The CTE shall apply to any public and private buildings which require the proper building license or legally enforceable building authorization.

e. Exceptions (e.g. historical buildings, buildings with too low heat consumption, etc.)

The CTE exempted in technical simplicity and low constructive entity one-floor buildings, with a no residential or public use, either temporary or permanently, and not affecting the safety of inhabitants.

For the Basic Document of Habitability and Energy" (DB HE) there are different exemption depending on each of its five Sections (HE 1 to HE 5.)

(E.g. in Section HE5, Minimum PV Contribution for power generation, PV systems are only compulsory in hotels and hostels over a 100 bed capacity).

f. ***Building stage*** (only for new buildings or also for renovation?)

The CTE applies to new buildings and to works of existing-building extension, modification, renovation or rehabilitation, and in certain protected buildings from an environmental, historical or artistic point of view.

g. ***Quantitative obligation*** (e.g. 50% of the heat demand should be covered by solar thermal)

There is a previous common filter that separates different quantitative obligations, having into account the several predefined climatic zones of the Spanish territory, where buildings are or are to be settled. See Annex I)

Each section of the "Basic Document of Habitability and Energy" (DB HE) has its own quantitative obligations:

- Section HE 1 **Limitation for energy demand**, based upon quantitative limits on:
  - Maximum thermal transmittance walls and interior partitions of the thermal envelope.
  - Mean Relative Humidity to avoid condensations.
  - Air permeability for building windows, doors and skylights.

- Section HE 2 **Performance of thermal installations**
  Quantitative obligations are referred, for this section, in the "Regulation for Thermal Installations in Buildings" document, known as RITE.

- Section HE3 **Energy Efficiency of Lighting Installations,** based upon quantitative limits on**:**
  - A "Value of Energy Efficiency of the Installation" indicator.
  - Control and regulation of lighting systems and systems to take profit from natural light for the different building zones.

- Section HE4 **Minimum Solar Water Heating Contribution**
  - A "Minimum Solar Contribution" (ratio between annual expected SWH contribution values and annual water heating demand, obtained from monthly values), expressed in percentage. This MSC is variable depending on the specific climatic zone in Spain and the heated water demanded by the building. Under a technical point of view a SWH in Andalusia could provide a 100% of the hot water demand. But in practice these solar appliances are design to contribute with a 70%, as a way to optimize its performance. **This 70% is the MSC in Andalusia**.

- Section HE5 **Minimum PV Contribution for power generation**
  - PV installations are only compulsory for big facilities. Buildings for domestic purposes are excluded of the obligation.
  - The "Minimum PV Contribution" will be determined having into account several factors as the type of building (i.e. malls, warehouses, government facilities, hospitals,…), the climatic zone and the building surface.
  - In any case, minimum peak power considered will be 6,25 kWp. The PV inverter unit will have a minimum 5 kW power capacity.

- General conditions requested for the PV installation also specified.

h. ***Admitted technologies*** (e.g. solar thermal, heat pumps, etc.)

Under the CTE, solar thermal and PV are the mainly admitted regulated technologies for energy generation. Anyway other clean energy technologies may as well could be considered, as long as they are previously specified in the building project. About energy saving and efficiency many different technologies can be foreseen if they accomplish with the CTE standards (i.e. building lighting).

i. ***Responsible actor/s and working mechanism*** (in particular, who is the actor in charge of releasing the building permits?)

- Building permits: local authorities and building professional associations (not strictly specified by the Royal Decree).
- Responsible for the implementation of the CTE are the actors involved in the building process, and have been determined and regulated by the Building Regulation Law (LOE): promoter, builder, designer, construction and execution management, suppliers, subcontractors and owners.
- The owners and users are requested to inform about any anomaly observed in the normal operation of the building.

3. Development and implementation

a. Legal/political background

The Technical Building Code was adopted by Royal Decree 314/2006, creating a legal framework to harmonize existing national regulations in building matter with other EU countries. First, with respect to the free movement of construction products within the single European market (EU Directive 89/106/CE); and second considering, Directive 2002/91 /CE on the energy efficiency in buildings, under which are incorporated in the Technical Building Code requirements.

On the other hand, the CTE emerges from and fulfills the basic requirements for building established by the Spanish Law 38/1999 for Building Management, cornerstone for the building process. This Law authorized the Government to approve a Technical Building Code (CTE) in which the basic requirements to be met for buildings were set in relation to the basic requirements for safety and habitability. The CTE, as established by the Law, can also be completed with other regulation issued by the competent authorities (regional and/or local regulations).

Updated changes in the CTE were introduced by Law 8/2013, for urban, rehabilitation, regeneration and renovation.

In addition to the CTE other external basic technical regulations references are mandatory: concrete standard, seismic building standard, Spanish Regulation for Thermal Installations in Buildings (RITE) ,etc. Moreover, the CTE, as basic technical framework, can be complemented with the requirements of other regulations issued by the competent authorities.

b. Political objectives

As set in Law 38/1999 for Building Management, the political objectives of the CTE are:

- Improvement of building quality.
- Promotion of innovation and sustainability.

- Giving satisfaction to certain basic building requirements related safety and welfare of the inhabitants, which refer, to structural safety, fire protection, sanitation, protection against noise, **energy saving** and accessibility for people with reduced mobility.
- Contribution to the development of sustainability policies, namely the Spanish Action Plan Strategy for Energy Saving and Efficiency.
- Becoming an instrument of government long commitments scope in environmental matters such as the Kyoto Protocol or the Göteborg Strategy.

c. ***Quality requirements*** (on products, on installation, etc.)

The Quality control of building works includes:
A. Control in the supply reception.
B. Control over the building execution.
    1. Control in supplies documentation.
    2. Control by means of quality labels or suitability technical evaluations.
    3. Control by technical tests.
C. Control of the finished work

The Basic Document of Habitability and Energy" (DB HE) recommends objectives parameters and procedures compliance to ensures meeting basic requirements and overcoming minimum quality standards for energy saving and generation. For materials, installations, testing and technical limitations calculations, the DB HE points out different standard such as UNE-EN or UNE-ISO, according to European Standards. These Standards are enlisted in the appendices of each DB-HE section.
Relevant for solar thermal and PV are the technical documents "Documents Regulation of Thermal Installations in Buildings" (RITE) and its "Technical Instructions" (ITE); as well as the "Electro-technical Low Voltage Regulation".

d. ***Soft support measures*** (training, communication, etc.)

Before the approval of CTE in 2006, legal building regulation was *prescriptive*, thus establishing accepted procedures or technical guidelines to be followed when constructing a building. Such codes mean in practice a technical barrier that hinders the application of technological innovations to the process of building.
The CTE is responsible for stating the criteria to be met by buildings but leaves open the way these rules must be met. This peculiarity allows the configuration of a more flexible regulatory environment, and favors the development of R&D and the use of new technologies in the construction sector by integrating more directly advances achieved from these activities.

To justify that a building meets the basic requirements laid down in the CTE may be chosen:
a) Adopt technical solutions based on the Basic Documents (DB) (standard solutions).
b) Alternative solutions, defined as those that deviate wholly or partly from the DB. The designer or project manager may, under its own responsibility and prior consent of the promoter, adopt alternative solutions, providing documentary proof that the designed building meets the basic requirements of CTE because its performance are, at least, equivalent to those obtained by applying the DB.

e. Implementation costs

Not available.

On the other hand, and according to the Ministry of Housing, implementing RES system and other measures to reduce energy consumption included in the CTE will mean savings between 30% and 40% in terms of energy, and a 40% to 55% CO^2 emissions reductions.

f. Checks and sanctioning fees

Up to date, the CTE lacks of a sanctioning administrative legal apparatus.

4. Results

a. How many buildings were affected by the STO?

All Spanish buildings submitted to the CTE after it entered into force.

b. ***How many m^2 of solar thermal were installed thanks to the law***?

A close indicator can be the percentage of STH installed after CTE enter in force in 2007, without de support of any incentive, (public support is not possible due to the compulsory nature of the CTE). For the Andalusian region this percentage was yearly increased from 2007-2011, compared to previous years, thus indicating the CTE "positive effect".

c. If ST is competing with other technologies, what is the share of buildings choosing ST for fulfilling the obligation?

In 2013 a legal modification of the CTE entered into force making STHs installation not compulsory anymore, as they were in original 2006 CTE text. It made possible a shift to other thermal RES alternatives, or even "*…cogeneration processes or sources of residual energy coming from heat recovery technologies…"*.

The specific share information requested is not available. It should be noticed that the election of one or another technology is market-driven and not dependable on public incentive, (for the reason indicated in the previous question), apart from specific building limitations.

d. How many buildings were exempted by the obligation and for which reasons?

Not available.

The reason for exceptions in the CTE for STH installation are, as follows:

- In cases where the location of the building does not have enough access to sunlight due to external barriers.
- In cases when there are irremediable limitations arising from the previous configuration of the existing building rehabilitation.
- In cases where there are irremediable limitations arising from the urban planning regulation application that obviously prevent the provision of the collection surface required in new buildings or the building rehabilitation.
- When determined by the competent body ruling on historical and artistic building protection.

e. ***Additional building cost for including solar thermal in the construction phase*** (e.g. 1%, 0.5%, etc.)

For a mean new household, the additional cost could be estimated in 1% of the building budget. (Basic key figures for calculation: a mean household price of 150.000 €, with a 100 m^2 surface, 4 residents and a 2 m^2 STH with a mean price of 1.500€.)

f. ***Other indicators*** (number of trained installers, number of new companies born in the ST sector, etc.)

Not available. STH market was really grown-up in Andalusia at the moment of the CTE enter in force.

5. Lessons learned

a. Barriers

- The technical complexity of the CTE is most probably the main barrier to consider.
  A private study about the CTE Talking about procedures, there is a unanimous feeling that the so called "performance nature" of the CTE (see answer to question 5.b), has been overrated. The large "procedures" and "quantification" under the DB are of a so exhausting density that leave no enough space for innovative performance solutions, especially if in cases where the project has to go through external controls in which the regulator or controller is not equipped with the same innovative powers and techniques tools used by the building designer. In the end, the cheapest and easiest way is "to follow the common rule".

- Difficulty in monitoring the compliance of the DH HE. The failure to comply with it is not "perceptible" in the way that other DBs on structural requirements or security procedures, for example, are visible when they are absent.

b. Success factors

- Different building solutions for the same purpose can be implemented under the CTE.
  The CTE is a text based on "performance" or "targets" principles, unlike other traditional prescriptive-type codes. A prescriptive code sets standards, technical guidelines and specific solutions which not do stimulate innovation and may even pose technical barriers to the market. Conversely, a performance or targets based code responds to a logic of achieving certain proposed objectives - or even other equal ones if they are plenty justified - and therefore it is more open to innovation.

- Reduced buildings energy maintenance costs of, and therefore, the national energy imports budget for the medium and long term.

c. Improvement opportunities

- A whole world opens up to a new market for innovative and sustainable building materials and solutions, mainly in the field of renewable energy and energy saving and efficiency technologies.

d. Recommendations

- It is essential to ensure compliance with Basic Documents ("Basic Document of Habitability and Energy" (DB HE) in our case).
  It is peculiar that the CTE (probably the largest of all the Spanish legal system legal norm), structured as an enormously large amount of prescriptions, is hardly affected by effective sanctions.

- It should be clear who is responsible for complying the CTE.

- Enforcement mechanisms would also be desirable.

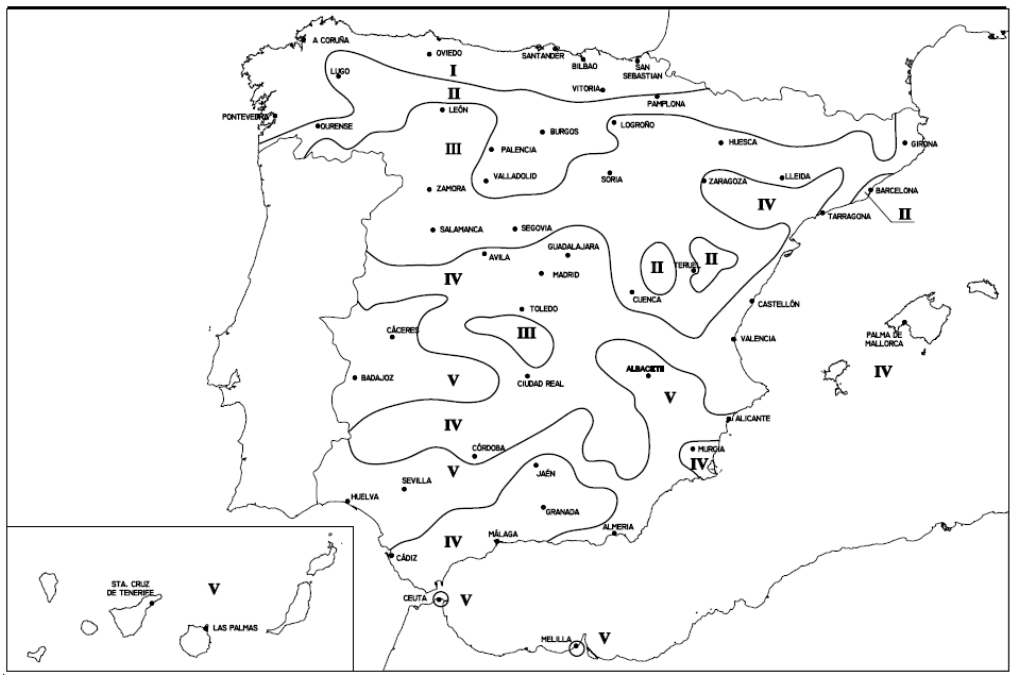
6. References

Official Web of the CTE: http://www.codigotecnico.org/web/recursos/documentos/
A legal introduction to the CTE: http://www.indret.com/pdf/358_es.pdf

7. Sources and contributors

Contributors:
Julio Escudero, Andalusian Energy Agency.

Annex 1. Climatic zones in Spain as set in the CTE



Med Desire

Solar thermal obligation (STO)

Description

Uruguay

1. Brief summary of the STO

The Solar Thermal Law (Nº 18.585) was approved by both the Chamber of Senators and the Chamber of Representatives of the Oriental Republic of Uruguay in September 2009 and implemented by the government through Decree 352.
This piece of legislation foresees a solar obligation which, in a first stage, makes it mandatory for newly built sports clubs, hospitals and hotels to install a solar thermal plant.
Furthermore, since May 2014, technical specifications, known as Especificaciones Técnicas Uruguayas (ETUS), are mandatory for all registered solar thermal installations in the country.

2. General information

a. Starting date

September 2009.

b. Duration

Unlimited.

c. Geographical scope

National (Uruguay).

d. Targeted buildings (e.g. residential, commercial, etc.)

- First phase: health care facilities and hospitals, hotels and sports clubs.
- Second phase: all public buildings whose share of hot water in the building's total energy demand is above 20 %.
- Potential further extension: Article 7 of the law also allows the Ministry of Industry, Energy and Mines to ask industrial or agro-industrial enterprises for a feasibility study on the use of solar thermal systems in their new buildings.

e. Exceptions (e.g historical buildings, buildings with too low heat consumption, etc.)

In Article 10 of the law it is stated that the Government can include some exceptions due to several reasons: amount of hot water demand, available area, shadowing and presence of other energy sources.

f. ***Building stage*** (only for new buildings or also for renovation?)

Only new buildings or also major renovation, depending on the step of the law.

g. ***Quantitative obligation*** (e.g. 50% of the heat demand should be covered by solar thermal)

50 % of the hot water demand.

h. ***Admitted technologies*** (e.g. solar thermal, heat pumps, etc.)

It is a "solar thermal only" law, but the Government can include exceptions if different energy sources are used (see point "e" above).

i. ***Responsible actor/s and working mechanism*** (in particular, who is the actor in charge of releasing the building permits?)

Not available.

3. Development and implementation

a. Legal/political background

The STO foresees that each step is coming into effect after a certain time span.
After six months of promulgation of the law, building permits for health care facilities, hotels and sports clubs in which the planned hot water consumption is more than 20 % of the total energy consumption shall only be authorized if the new structure includes the relevant pipes and works to facilitate the future installation of solar thermal.
After 2 years, then, solar thermal systems should cover at least 50 % of the hot water demand.
As a following step, after 5 years, all new public buildings in which the hot water demand is more than 20 % of the total energy consumption must use solar thermal for covering at least 50 % of the hot water demand.
The first two regulations mentioned above cover building permits for new structures, as well as for major renovations of already constructed ones, while the last one applies only to new public buildings.

b. Political objectives

- Increasing the use of solar thermal energy.
- Fostering applied research on solar thermal energy applications.

c. ***Quality requirements*** (on products, on installation, etc.)

The ETUS were designed by a Spanish solar consultant, in collaboration with the technicians of the Ministry of Industry, Energy and Mining (MIEM), after a consultation held in several workshops. Furthermore, a public consultation about the ETUS was carried out by Mesa Solar, the multi-sector network for the promotion of solar energy, as well as representatives of industry association Cámara Solar del Uruguay and independent technicians.
The key ETUS requirements are:

- Flat plate or vacuum tube collectors should meet different technical requirements.
- Direct solar hot water systems are not allowed.
- Plastic materials are not allowed neither for the collectors, nor for the piping.
- The solar water tank material must be copper, enamelled steel or Inox steel 316L.
- Minimum insulation thickness for tanks and pipes.
- Large installations must have a closed solar loop; open-loop plants must be approved by the MIEM and only for small projects and with special improvements.
- Three eligible tools for analysis of potential shading effects.

- The project must have detailed technical documentation and must be registered.

The so-called Responsible Registered Technicien (RTI) is in charge of designing the plant and registering it on MIEM website. The RTI will also be responsible for the system for a period of 10 years.
Both the architect and the builder are responsible for the building for 10 years and the ETUS consider solar thermal plants as part of the building.

d. ***Soft support measures*** (training, communication, etc.)

Since December 2012, some free-of-charge training courses for technicians and professionals from architecture, engineering and construction were held.

e. Implementation costs

Not available.

f. Checks and sanctioning fees

The state regulation authority URSEA carries out random inspections to installations.

4. Results

a. How many buildings were affected by the STO?

Not available.

b. ***How many m^2 of solar thermal were installed thanks to the law***?

Not available.

c. If ST is competing with other technologies, what is the share of buildings choosing ST for fulfilling the obligation?

No other technologies are foreseen in the STO.

d. How many buildings were exempted by the obligation and for which reasons?

Not available.

e. ***Additional building cost for including solar thermal in the construction phase*** (e.g. 1%, 0.5%, etc.)

Not available.

f. ***Other indicators*** (number of trained installers, number of new companies born in the ST sector, etc.)

Not available.

5. Lessons learned

a. Barriers

- Ambiguous definition of possible exceptions.

b. Success factors

- URSEA has a good tool to check the installations made in the whole country.
- MIEM has a complete database of technicians and professionals working in the sector.

c. Improvement opportunities

- Include also the residential buildings in the scope of the law.

d. Recommendations

No specific recommendations have been reported.

6. References

Full text of the law (in Spanish):
http://www.parlamento.gub.uy/leyes/AccesoTextoLey.asp?Ley=18585&Anchor

7. Sources and contributors

Sources:
http://www.solarthermalworld.org/content/uruguay-new-solar-thermal-regulations
http://solarthermalworld.org/content/solar-obligation-uruguay

NO.	AREA	LEVEL	START DATE	BUILDING USE	BUILDING STAGE	EXCEPTIONS	ALTERNATIVE ENERGY SOURCE	MINIMUM REQUIREMENT	QUALITY REQUIREMENTS	CHECKS	BUILDINGS AFFECTED	SOLAR THERMAL INSTALLED	HOW MANY EXCEPTIONS?	WHICH EXCEPTIONS?	OTHER SUPPORT MEASURES	BARRIERS	SUCCESS FACTORS	RECOMMENDATIONS FOR A SUCCESSFUL STO
1	Barcelona - Spain	Local	1999	Residential, health, sports, commercial, industrial, any other use with dining rooms, kitchens or collective laundries	New, deep renovation or change of use, additional roof surface	Shadows, available surface, roof resistance, historical buildings, low heat consumption	Waste energy, cogeneration, heat pumps	60 % of the hot water demand	Yes	Review of the project, inspection after the works, during the operation	3000	87600 m2 (in 2010)	5% (161 buildings)	53% other energy sources, 47% urbanistic restrictions	90 information documents, 408 professionals trained, local energy agency established, web application for the STO, 20 technicians authorized to validate solar thermal installations	Lack of technical knowledge about solar thermal	Poltical committment coupled with citizen support, good information and awareness raising campaigns	Training of technical staff in the Municipality, consultation with stakeholders to overcomeprejudices towards the technology
2	Portugal	National	2007	All buildings	New, deep renovation	Industrial, agriculture, farming, religious buildings, warehouses, parking lots and garages, abandoned commerce and services buildings, barracks, historical or classified buildings	Other renewables (PV, biomass, wind, geothermal, etc.)	1 m2 of solar thermal per occupant	Product certification, calculation software, certified installers, maintenance contract	Review of the project, inspection after the works	30000	110500 (total)	Not available	90 % of the buildings chose solar thermal	Training courses for installers, dissemination campaigns on good practices, certification scheme for installers	Qualification of the market needed, lack of technical knowledge, supervision needed	Simple and understandable law, freedom of choice between alternatives, participated process with the stakeholders	Qualified people, qualified products and qualified enterprises are needed
3	Shandong - China	Provincial	2009	Residential buildings below 13 floors, new public buildings with centralized hot water supply	New, renovation, extension	Not available	Solar thermal only	40 litres of hot water per occupant in case of residential building	Not mandatory, only recommended	Review of the project, inspection during and after the works	Not available	Not officially available; estimated data: 5÷10 million m2	Not available	Not available	Promotion of the national green building standard	Lack of technically educated human resources, chaotic market (no mandatory quality standard)	Great network of solar thermal companies, solar energy associations, governmental departments, quality supervision center, all stakeholders involved in the application of the STO	Mandatory standards, quantitative monitoring of STO results
4	Jinan - China	Local	2014	Residential below 100 meters height or with less than 33 floors	New	Not available	Solar thermal only	40 litres of hot water per occupant	Not mandatory, only recommended	Review of the project, inspection during and after the works	Not available	Not available	Not available	Not available	Technology and policy workshops	Lack of technically educated human resources	Involvement of all relevant stakeholders	Quantitative monitoring of STO results
5	Sao Paulo - Brazil	Local	2007	Hotels and touristic buildings, health services, sport clubs, barracks, schools and nurseries, public swimming pools, private residential buildings with more than three bathrooms	New, renovation	Technical restrictions (e.g. high shadowing)	Solar thermal only	40 % of the hot water demand	Product certification	Review of the project, inspection after the works	Not available	Not available	Not available	Not available	Standards to define the solar fraction in buildings according to the solar code, training courses on solar thermal systems design, reference cases in magazines, technical support for constructors, institutions and opinion makers	Lack of roof area	Development and spreading of awareness on solar thermal is amazing	No subjectivity in the exceptions due to technical restrictions
6	Hawaii	National	2008	Single-family residential	New	High shadowing., solar is not economically viable	Other renewables (also PV or wind), a water heater device approved by Underwriters Laboratories, Inc., is installed, provided that at least one other gas appliance is installed in the building	Not available	Not available	New houses require no independent third-party inspection	5200 (from 2010 to 2012)	4000 buildings chose solar	21 % to 27 %	91÷ 97 % apply for the installation of a tank-less water heater	Not available	Too many exceptions and almost all of them chose a tank-less water heater, which does not really reduce the dependency on oil	Already mature solar market, savings of fossil oil, which needs to be transported to the islands and is therefore expensive	Independent third-party inspection needed
7	Kenya	National	2012	Buildings (both residential and commercial) with hot water demand of more than 100 litres per day. The regulation applies mainly to urban areas, because rural households do not use hot water	New, extensions or alterations of existing, existing buildings (transition time of 5 years)	Technical restrictions	Cogeneration, renewable electricity with the surplus production used to heat water	60 % of the hot water demand	Product certification, design, installation and maintenance standards, certified installers and installation certificate	The National Commission may check the installation of solar. Fines up to about 9,000 € or imprisonment for a term not exceeding one year or to both	Not available	Not available	Not available	Not available	Not available	Too vague definitions of "technical limitations" and "special circumstances" for buildings that could be exempted. Though the law aims at reducing electricity, renewable electricity for producing heat is considered as equivalent to solar thermal	The law also applies to existing buildings. Good and exhaustive reference to available standard and certification. Detailed definition of checks and also of liability.	Advisable to list all solar thermal technicians and providers of turn-key systems
8	Mexico City - Mexico	Local	2006	Any building using hot water for sanitary and kitchen purposes, washing and cleaning, including swimming pools and companies with more than 51 employees	New, total renovation	Households and companies with less than 51 employees. Possible to install a smaller capacity, in case the solar thermal installation would not reach 30 % of the hot water consumption	Solar thermal only	30 % of the hot water demand	Product certification, performance guarantee, product guarantee	The Federal District Government is checking the correct implementation. There is also the possibility of a self-declaration by the user which should then be sent to the Government	Not available	Not available	Not available	Not available	Not available	No specific barriers	Good requirements on quality and on guarantee of products. No exception in case of non-optimal technical conditions, but just a reduction of the system size.	No specific recommendations
9	Namibia	National	2011	New, additions to existing buildings with no water heaters or with electric water heaters	New, additions	Private households	Solar thermal only	Not available	Technical requirements, product guarantee	Not available	Not available	Not available	Not available	Not available	Not available	Poor social acceptance of solar thermal. High investment costs for installation. Lack of technical know-how for commissioning and maintenance. Lack of information to final users.	Top conditions for solar energy: 300 days of sunshine per year and up to 10 hours a day. Large number of electric heaters with high electricity costs.	No specific recommendations
10	Chandigarh - India	Local	2008	All buildings	New, existing (transition period of 2 years)	No exceptions	Solar thermal only	Houses built on a parcel of 506 m2 must install a 100 litre solar water heater Houses built on a parcel of 1,012 m2 must install a 200 litre solar water heater	Not available	Not available	Not available	Not available	Not available	Not available	Not available	Older citizens living alone in their houses may have problems in meeting the obligation for existing buildings	Very simple rules for sizing the solar thermal plants. No exceptions foreseen. Inclusion of a transitional period for the obligation on existing buildings.	Include a monitoring system for checking the results and the impact of the law
11	Uruguay	National	2009	First phase: Health care facilities and hospitals, hotels and sports clubs. Second phase: all public buildings whose share of hot water in the building's total energy demand is above 20 %. Potential further extension: Industrial or agro-industrial enterprises	New, major renovation	Amount of hot water demand, available area, shadowing and presence of other energy sources	Not defined in details (see "EXCEPTIONS")	50 % of the hot water demand	Technical requirements, project registration	Random inspections	Not available	Not available	Not available	Not available	Training courses for technicians and professionals from architecture, engineering and construction	Ambiguous definition of possible exceptions	Tool to check the installations made. Complete database of technicians and professionals working in the sector	Include also residential buildings
12	Sevilla - Spain	Local	2012	All buildings	New, renovation	Historical buildings	Photovoltaic, biomass	66 % (or 80 %) of the hot water demand	Certification of installation, maintenance contract	Checks after the work	Not available	Not available but ST is widely the main implemented technology.	Not available	Not available	Pilot projects in public buildings Energy information service to citizens Municipal energy planning Promotion of R&D	Too young market Unawareness of citizens	Use of advanced technical specifications Legal reinforcement for the energy efficiency and renewable sectors	Work should be done on citizen awareness
13	Spain	National	2006	All buildings	New, renovation, extension	One-floor buildings, with no residential or public use, shadows, historical buildings	Any clean energy technology	Minimum solar contribution depending on the specific climatic zone	Product certification, technical requirements	Review of the project, inspection during and after the works	Not available	Not available	Not available	Not available	Not available	Technical complexity of the law Difficulty in monitoring the compliance	Different building solutions can be implemented	Clear responsibilities for complying with the law
14	Baden-Württemberg - Germany	Regional (Federal State)	2008	Residential buildings	New, renovation of the heating system	Technical or constructional reasons, e.g. not enough roof surface, wrong orientation or slope of the roof, photovoltaic already covering the roof, no space for buffer storage	Heat pumps, bio-oils, biogas, wood, house insulation, cogeneration or connection to district heating networks fed by RES or cogeneration	0,04 m² of solar thermal per m² living area	Not available	Random inspections; fees from 50,000 to 100,000 €.	Results have been collected for 2,500 cases, about 42 % of the expected total figure	Solar thermal has been chosen in 612 cases (24.4 %) in new buildings and in 702 cases (41.9 %) in renovations; from a calculation about 11,300 m2 have been installed in new buildings and 44,100 m2 in existing buildings	The law could not be applied in about 6 % of the cases	Not available	• Promotion through press releases and an information campaign • Regional Government runs numerous promotion initiatives regarding RES in buildings	No specific barriers	• simple and understandable approach of the law • compact preparation phase of approximately 6 months • freedom of choice between cost-effective alternatives • participated process of hearings with the associations	Early coordination of legislation projects of different legislative bodies, e.g. at regional and federal level, is recommendable