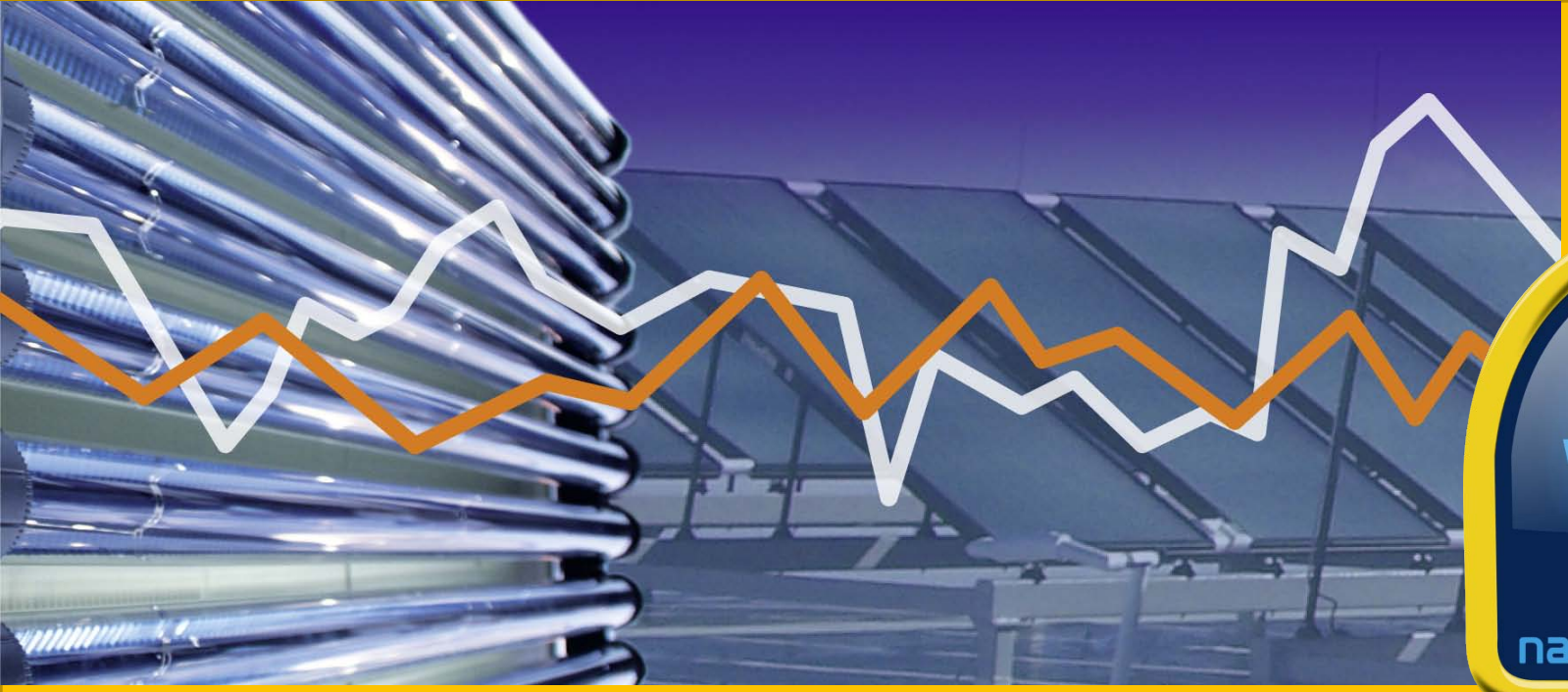

How to design a successful support scheme? Best practise and lessons learned

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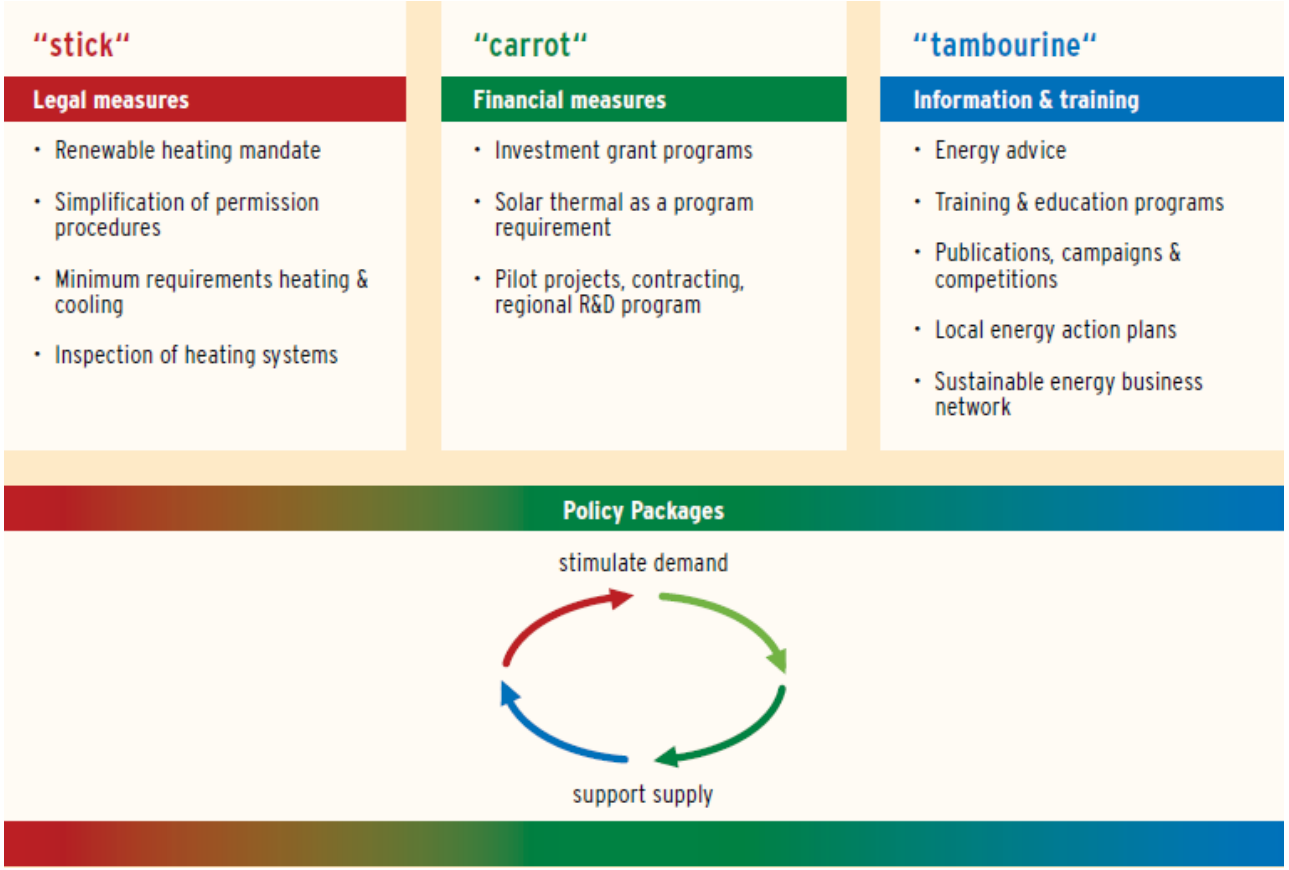
Content

Market support: Mix of measures

Sticks, carrots and Tambourine – a mix of measures

Only a coherent bundle of complementing measures will lead to a long-lasting, sustainable solar thermal market. The most famous model of this kind is the one from Christiane Egger, Vice Director of the Oberösterreichischer Energiesparverband from Austria: „Sticks, Carrots and Tambourine“ (see figure below).



„In the USA for example the carrots work much better than the stick. So in many country it will be a combination of stick and carrot that brings the market forward, but the percentage of both is depending on the culture of the country”, says Lucio Mesquita, Consultant from Canada with long-term experience in the solar thermal sector.

A coherent bundle of measures will be successful

The following two schemas show different ways of expressing the same ideas that only a mix of measures overcomes the challenges of the solar thermal sector successfully.

Consultant Uwe Trenkner, Brussels, July 2010: „If only one measure is missing or falling short, the market growth will remain limited

Solar Thermal Action Plan for Europe, July 2007from European Solar Thermal Industry Federation (ESTIF) “a coherent strategy to promote solar thermal”

Why do governments support solar thermal technology?

Good reasons to use ST: It is a mature, market-ready technology that uses an endless free source of energy and does not produce any kind of emission.

However, governments have far more motivations to support solar thermal heating and cooling:

- Job creation (American Recovery and Reinvestment Act in USA)
- Improving energy security, both on a household basis and on a grid wide basis
- Demand Side Management: Electricity saving: solar water heaters save energy in peak load times (South Africa, Brazil, India)
- Fulfill climate protection targets (Renewable Energy Action Plans in Europe)
- Reducing the annual budget for subsidizing fossil fuels (Barbados or Tunisia)
- Satisfy increasing energy demand (Solar India Mission)
- Reduce air pollution in cities (Poland´s latest subsidy programme)
- Implementing quality standards by making them mandatory in subsidy schemes (China´s first federal subsidy scheme)
- Improving efficiency by replacing existing solar water heaters (Cyprus)
- Reducing the monthly energy bill of low-income families (Berlin, Brazil, Turkey)

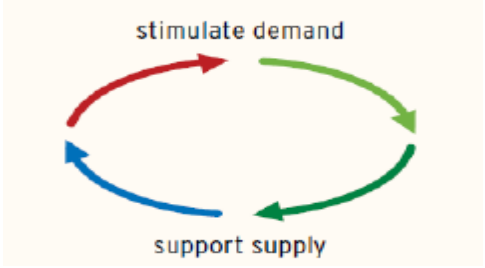
Where does the budget come from?

Less and less subsidy schemes are financed by public funds. There are a lot of alternatives:

- Levy to electricity bills (Slovenia, USA, Cyprus, South Africa)
- Levy to gas bills (California)
- Sales of Assigned Amount Units = AAUs (Eastern Europe for example Czech Republic)
- European structural funds (Poland, Bulgaria, Serbia)
- Long-term scheme funding through developing Aid funds like GEF/UNDP/GIZ (Albania, Montenegro, Mexico)
- Tax reduction schemes (Chile, USA, France, Italy, Brazil)
- Renewable Portfolio standards of utilities (Brazil, USA)
- Certification Trading (Australia)
- Levy on import tax of new cars and air conditioning (Tunisia)
- Removing subsidies on fossil-based energy sources such as electricity, gas or oil (Egypt, Barbados)
- Alternative Compliance Payments - fees that an US-based utility have to pay if it does not fulfill the Renewable Portfolio Standard (New Hampshire)

Classification of demand side support measures

Demand and supply side



Carrots

- Tradable certificates
- Direct financial incentives
- Fiscal instruments

Stick

- New business models like Leasing or ESCOs or selling renewable heat to district heating suppliers.
- Solar obligations / renewable building laws

Tambourine

- Simplifying permitting processes and reducing permitting fees
- Awareness raising (not part of this presentation)

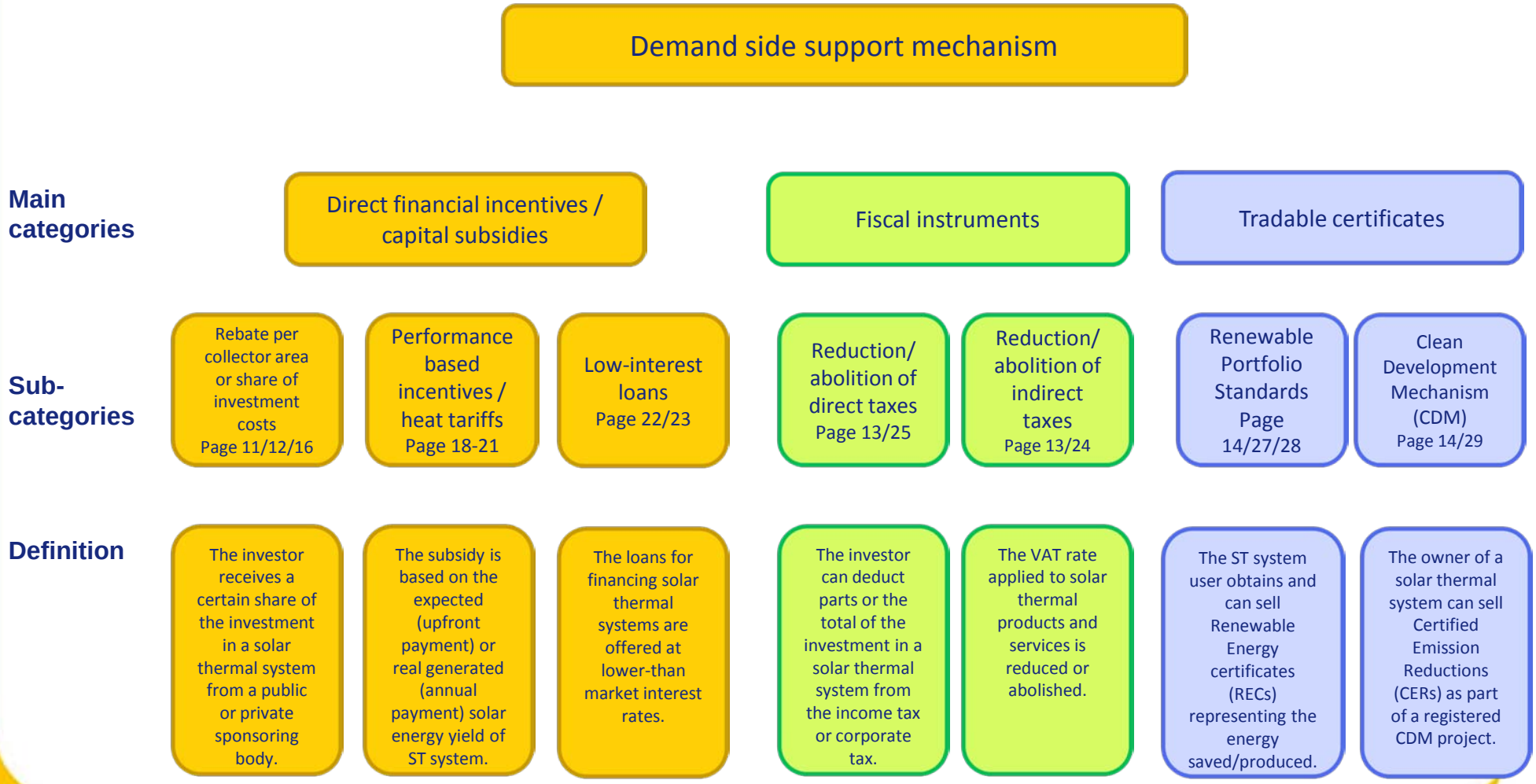
Market Demand ↔ Market Supply (manufacturers & installation)

- Fiscal instruments (reduction or abolition of corporate taxes)
- Training and education
- Direct financial incentives (e.g. support in export activities, R&D), demonstration projects
- Quality control (e.g. label or inspection of sites)
- Certification scheme and national test laboratories
- Associations / sustainable energy business network
- Simplification of building permissions

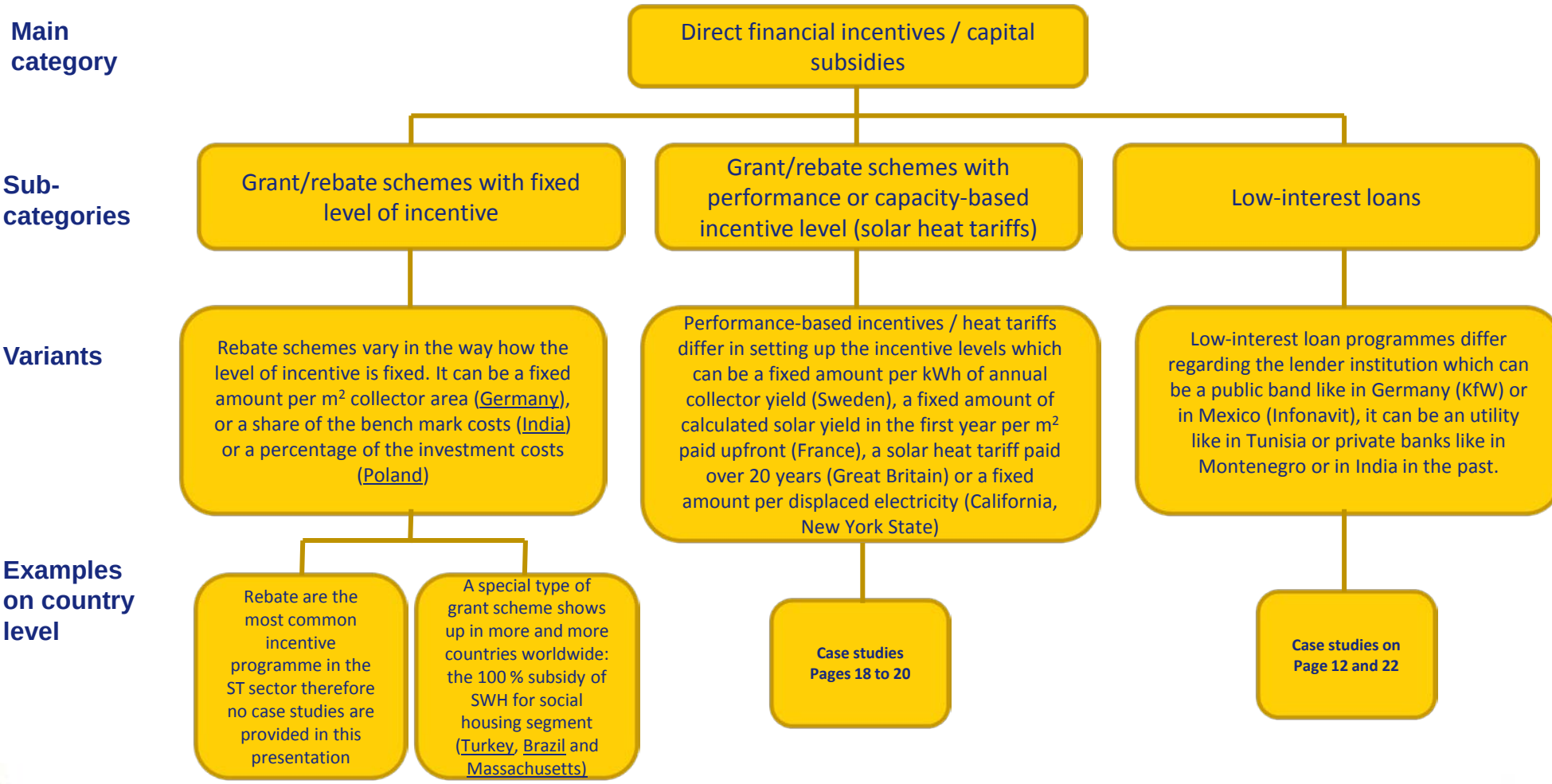
Considered in this presentation
Not (yet) considered in this presentation

Source: Oberösterreichischer Energiesparverband / Vesa Rutanen (UNDP)

Classification of demand side support and definition



Schema of direct grants / rebate schemes



Schema of direct grants / rebate schemes

Main category

Demand Side Support Mechanism

Sub-categories

Combination of grant schemes and low-interest loans

Examples on country level

Tunisia: Private investors profit from an investment subsidy of TND 200 (EUR 100) for a system with a 200 litre tank and TND 400 (EUR 200) for a system with a 300 litre tank and also receive a loan that they can pay back in five years through their monthly electricity bill. The scheme is recently extended to 2016.

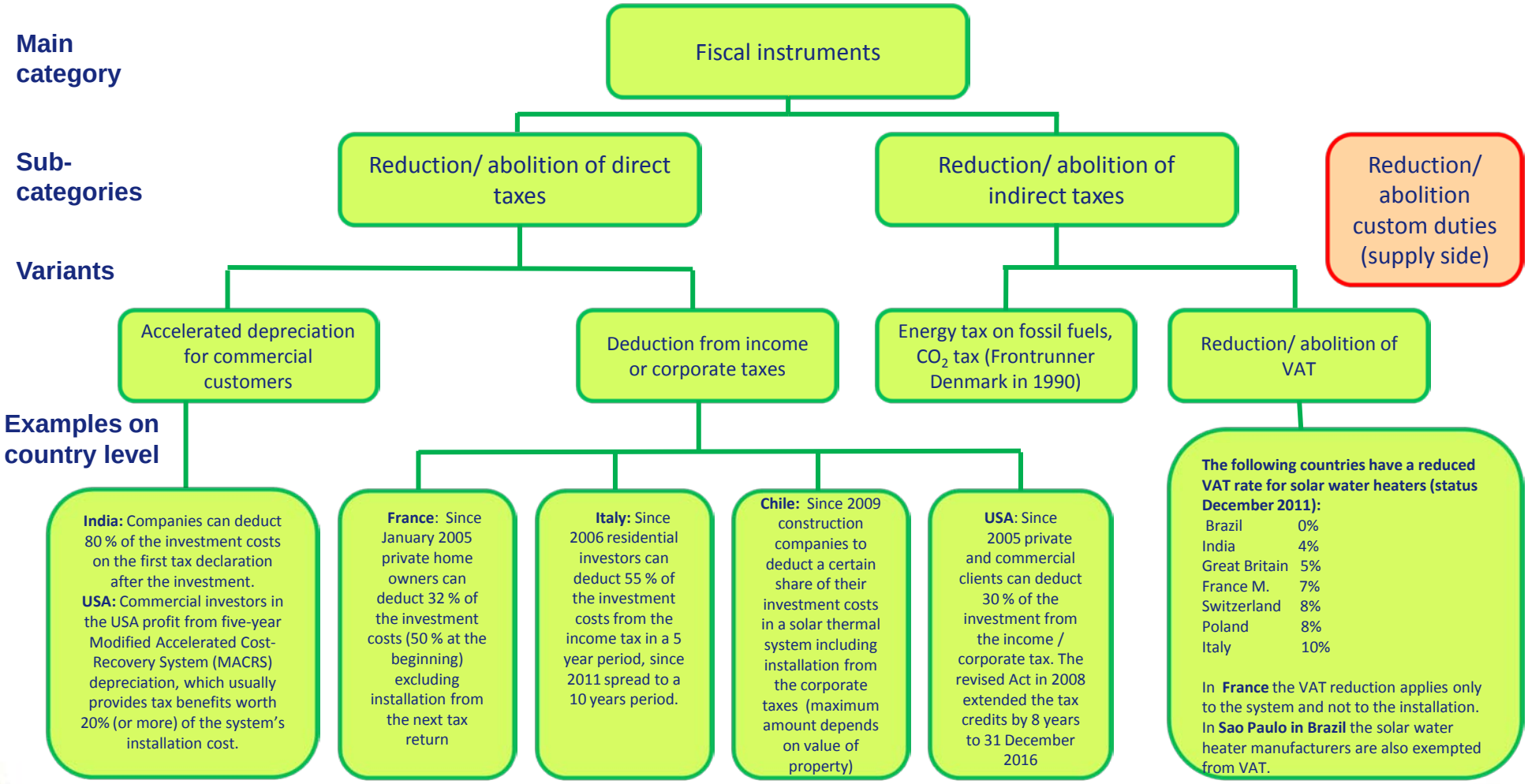
Lebanon: The 200-USD-subsidy scheme started in October 2010. 1,717 applied for a subsidy for a certified system in 2011 . Also, 3,557 clients profited from the interest-free loan up to 5 years regardless whether their solar system supplier is qualified or not.

Poland: National Fund for Environmental Protection and Water Management Poland (NFOŚiGW) requires that each applicant for the investment subsidy of 45 % also signs a credit with a bank for at least three months. The subsidy scheme is administered through six major commercial banks - which want to reap some profits from it as well.

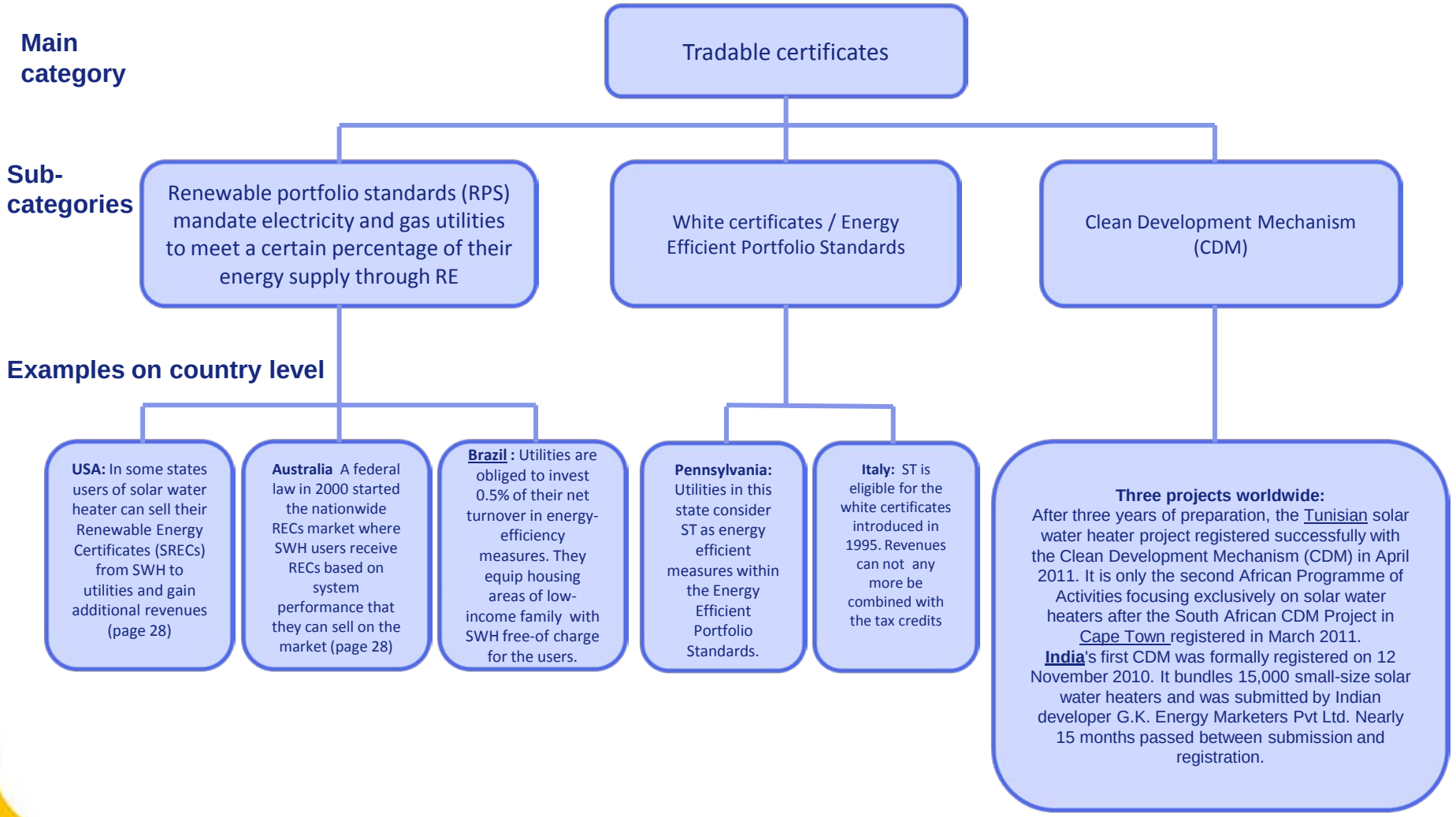
Bulgaria: Between July 2012 and July 2015, individual home owners and associations of flat owners in the thirty-six biggest cities in Bulgaria can apply for grants and loans to install a solar heating and cooling system. Applicants can cover 50 % of their project costs with a grant and can apply for a low-interest loan at the Corporate Commercial Bank for the second half of the costs.

Source: solarthermalworld.org

Schema of fiscal instruments



Schema of certification trading schemes



Source of case studies: Solarthermalworld.org

Schema of new business models

Main category

New Business Models

Sub-categories

- Energy Service Company (ESCO)
- Leasing Solar Thermal Systems to Costumers
- Selling Solar Heat to District Heating Companies

Definition

High upfront costs are one of the major barriers in the solar thermal sector. Energy Service Companies (ESCOs) are one way to fill that gap. The ESCO finances, installs, owns and maintains the solar thermal system and closes an solar heat supplying contract with the client. To be profitable the ESCO uses all eligible forms of demand side support mechanism and signs a long-term contract with 15 to 20 years. The crucial point is the financing. A lot of banks or financial institutions do not like to run the risk with long-term energy supply contracts. One way out of this dilemma is the closing of a financial guarantee service contract with a third party (case studies on page 31)

Examples on country level

Florida (USA): Utility Lakeland Electric and energy service company Regenesis Power started in October 2010 to lease SWH to residential home owners that pays a monthly fee. The user profits from no upfront-costs, from 20-year fixed, monthly energy costs and maintenance-free hot water. The 100,000 customers of Lakeland can profit from this offer. Despite optimistic announcements, only 180 clients used this offer until July 2013 and non other utility in the US followed this show case. The reason: electricity prices decreased in many Regions in the USA in the last three years.

Japan started a short term leasing project for residential systems in 2009/2010 where the users had to pay back the investment costs of 65 % during a period of 10 years before they become owner of the system. The subsidy was paid to the leasing company.

Sweden: Around 20 users of large-scale solar thermal systems sell surplus heat to district heating system operators in Sweden. The tariff is based entirely on a negotiated contract between the user of the solar thermal system and the owner of the district heating system. E.ON Sverige for example, the second largest utility in Sweden, runs many district heating networks and buys solar heat for 75 % of the sales price of heat.

In **Hamburg** two district heating providers encourage their customers to feed solar heat into the grid: Hamburg Energie buys renewable heat for a fixed price per kWh and E.ON Hanse Wärme offers to store the solar heat in summer for up to 8 months at a price of 0.005€/kWh.

Pros and cons of different support schemes

Rebates per collector area or share of investment costs

Definition: **The investor receives a certain share of the investment in a solar thermal system from a public or private sponsoring body.**

Pros

- Lowers the overall investment costs for the end consumer immediately
- Transparent and easy to understand by the customers
- Different sources of funding outside the public budget can be opened.
- Increases reputation when the government financially supports investments in a certain technology.

Cons

- Biggest burden on public spending
- High risk for “stop and go” if dependent on annual public fund allocations
- Tend to create high administration burden with the application procedure (for clients and for administrators)
- Limited budget creates uncertainty, because the programme might be stopped suddenly if the budget is spent.
- Create no motivation to improve the efficiency of the system therefore must be combined with technical requirements for the system / installation
- Tend to increase system prices, if the subsidy is paid as a fix percentage of the investment costs.

General assessment: Rebates are the most common subsidy scheme worldwide, therefore no case studies are included in this presentation. Financial schemes can be extremely pushing. Decreasing or stopping financial support has had very negative impact on solar thermal markets like in Czech Republic or Portugal.

Performance-based incentives / heat tariffs

Definition: The subsidy is based on the expected (upfront payment) or real measured (annual payment) solar energy yield of the solar thermal system.

Pros

- Raises awareness on systems' quality, performance and maintenance
- Increases the confidence of investors into solar thermal, thus suitable for commercial applications
- Attracts third-party financers like ESCOs to offer Guaranteed Solar Result contracts
- Level of tariff can be oriented to reaching a certain pay-back time (see case study UK on following page)
- Monitoring data helps to identify performance irregularities, as well as to design future programmes or policies and can be used in trainings for planners and engineers

Cons

- Technical questions on calculating or metering delays political decision and implementation
- Complexity adds effort and thus costs in implementing the incentive programme
- Additional costs for monitoring
- High burden on public funds, if no alternative funding source is tapped

See case studies on the next pages

Performance based incentives / heat tariffs

Case studies: France, Sweden and Great Britain

Lessons learned from Sweden: The market size tripled, vacuum tube collectors privileged in the scheme, local manufacturers lost market share

- Frontrunner Sweden: Between 2000 and 2011 there was a performance-based incentive in place in Sweden for glazed ST collectors based on the calculated annual collector yield (kWh/a) of aperture area of eligible collectors under standard test conditions (until 2008 the program was restricted to residential). **2.5 Swedish Kronor (SEK) = 0.25 EUR/kWh**) were paid per kWh annual collector yield equaling to around 100 EUR/m². The market tripled from 7,195 m² newly installed in 1998 to 26,813 m² newly installed in 2008. The import rate increased from 20 to 70 %, national manufacturers lost market share, because vacuum tube collectors received higher specific funding per aperture area.

Lessons learned from France: Fonds Chaleur increased market segment of collective ST systems, could be more, but ST companies are afraid of the high administrative burden

- Fonds Chaleur in France subsidises larger ST systems in existing residential and commercial buildings since 2009. It pays maximum of **0.85 to 1.16 EUR/kWh of heat produced in the first year** (equals 400 to 500 EUR/m² of collector area) (at the beginning it was 2.5 EUR/kWh). Monitoring for at least 10 years is required. The market segment of multi-family houses has doubled between 2008 (56,000 m²) and 2011 (104,000 m²). 20 % of the subsidy is paid only after the solar yield of the first year is confirmed by measurement. Among the 1,656 approved applications by 11 October 2012 of which 52 % are based on solar thermal systems (866 systems).

Lessons learned UK: Defining the frame conditions is very complex and led to delays, strong competition of renewable heat technologies, low market impact for ST in the first 1.5 years (3.9 % of the approved appliations).

- After 2.5 years of delay the Renewable Heat Incentive (RHI)* started 28 November 2011 with a solar heat tariff of **0.085 GDP/kWh (0.09 EUR/kWh) for 20 years – fixed to set up a return of investment of 6 % (lowest compared to the other renewable technologies).** First phase targeted at non-domestic sector including businesses, public sector, charities, not-for-profit organisations or industry**.** Collector array sizes of up to 200 kW (286 m²) are currently supported. The RHI is being administered by Ofgem E-Serve, the office of the gas and electricity markets, who is responsible for paying the tariff to the owner of the solar thermal system. Among the total of 1,238 accredited applications between November 2011 and 31 March 2013 only 3.9 % (48 applications) are using solar thermal.

Source: solarthermalworld.org * search RHI as key word on the website to find around 10 articles

Performance-based incentives / heat tariffs

Case studies from the USA: California has the most popular performance-based incentives in the US – independent from public funds

- Private (since 1 May 2010) and commercial (since 8 October 2010) building owners as well as developers of multi-family buildings for low-income families (since March 2012) can apply for subsidise within the 8-year California Solar Initiative (CSI – Solar Thermal) programme*. The level of incentive is a fixed amount per annual therm displaced in the first year (1 Therm = 100,000 BTU = 29.3 kWh) and is paid upfront. A residential gas-displacing SWH receives **18.59 USD/Therm displaced = 0.77 USD/kWhth displaced**. A residential SWH displacing an electric boiler **receives 0.54 USD/kWhel displaced.** The performance of systems below 30 kW is calculated, the performance of systems greater than 30 kW is also calculated using the programme calcluater based on OG-100 SCRR, though the systems must have customer performance metering. All systems larger than 250 kWth are monitored and incentives are paid on a 70/30 true-up metering basis, in which the programme administrators pay a portion of the funds upfront and then pay the remaining incentive adjusted to the actual metered performance of the system. The programme is rate-payer financed by a levy on the electricity or gas bill of all energy consumers in California. 200,000 systems ware planned to be subsidised, in the first three years only 1,400 ST systems were accredited.

- The incentive programme in New York state started at the end of 2010 with the target of reaching a pay-back time of four years for home owners that wants to replace the electric boiler with a SWH. The tariff-based incentive should cover 10 to 20 % of the investment costs and can be combined with the federal and state tax credits. **Approved SWH receive a maximum of 1.50 USD per displaced kWh of electricity simulated with SRCC certification or RETScreen up to USD 4,000 for residential systems and up to USD 25,000 for non-residential systems**. Typical ST hot water systems can displace 50 to 80 % of the electric energy demand for the hot water of the user.

The table on the following page shows the major features of the five case studies at a glance.

Source: solarthermalworld.org * use key word CSI to find several articles about the programme

Performance-based incentives / heat tariffs

Programme	Country	Programme period	Level of tariff	Date of payment	Eligible sector	Source of funding	Market impact
Stöd för investeringar	Sweden	2000 to 2011	0.25 Eur/kWh annual collector yield = 100 EUR/m^2	Upfront	Residential + commercial	Public budget	Market tripled from 7,000 m^2 to 26,000 m^2
Fonds Chaleur	France	Start: Dec 2008 , approved till end of Dec 2013	0.85 to 1.16 EUR/kWh of heat produced in the first year = 400 to 500 EUR/m^2	80 % upfront + 20 % after yield is measured in first year	Multifamily houses and commercial buildings	Public budget	Market of multi-family houses doubled between 2008 and 2011.
Renewable Heat Incentive (RHI)	Great Britain	November 2011 to 2020	0.092 GBP/kWh produced heat for 20 years	Annually, aims at return of investment of 6 %	Commercial sector	Public budget	Almost no impact, only 3.9 % of all approved RHI applications (1,238) include ST technology
California Solar Initiative	California	May 2010 / Oct /2010 to Dec 2017	Residential: 0.77 USD/kWh gas displacing and 0.54 USD/kWh electricity displaced in first year	Upfront, combined with state and federal tax credits / systems above 250 kW only 70 % upfront	Residential+ commercial + low-income	Rate payer financed	Slow motion, only 1,400 were accredited in the first three years (200,000 systems were planned)
NYSERDA SWH Program	New York State	Dec 2010 to Dec 2015	maximum of 1.50 USD per displaced kWh of electricity simulated with SRCC certification first year	Upfront, combined with federal and state tax credits	Residential + commercial	RPS (replacing electric water heaters	50 were approved in the first six months, 6,500 subsidised systems are planned

Lessons learned: Small number of case studies worldwide with extremely different levels of tariffs as well as models to calculate/measure related yields / displaced electricity. Most schemes aim at reaching a high subsidy level. RHI was the first tariff worldwide for ST that aimed at reaching a certain return of investment, unfortunately created by a government that has no confidence in ST therefore too small. New York State aims at a payback period of 4 years by combining the NYSERDA scheme with federal and state tax credits. Four programmes pay upfront related to first year yield / displaced energy, only in UK – the only pure commercial programme – pays on an annual basis.

Low-interest loans

Definition: The loans for financing solar thermal systems are offered as a lower-than market interest rate.

Pros

- Eligible to both private and commercial customers.
- Can be combined with a rebate to a zero-investment decision for the investor
- Rates of the low-interest loan can be paid by the monthly energy cost savings.
- Attracts Energy Service Companies (ESCOs) that profit from the low-interest loans and sell the solar heat to commercial customers
- Smaller financial burden on public budgets than direct financial incentives
- Receiving loans by banks makes ST to a consumer product like a TV or a car

Cons

- Relatively high overhead costs for small loans for residential solar water heaters.
- It is costly and time-consuming for the lender to collect the small monthly installments of many residential clients.
- Stand-alone loans are not as attractive to end consumers as direct subsidies especially in countries with high system prices.

See case studies on the following page.

Low-interest loans

Case studies: Germany, Tunisia, Lviv Region in Ukraine, India in the past, Montenegro

Lessons learned: Loan schemes do not have a significant impact in European countries

- Germany: During many years the German KfW banking group paid low-interest loans to commercial customers that covered part of the investment costs (around 30 %), however this scheme has not been attractive enough to increase the demand for process heat installations. Therefore the German Federal Environment Ministry implemented a subsidy of 50 % of the net investments of process heat installations in August 2012.
- Montenegro: The Montesol programme launched in July 2011 paid zero-interest loans to solar thermal customers, however the demand was very small. The Ministry of Economy increased the total amount of the loans to EUR 5,000 in the second round of Montesol in May 2012. Solar thermal system suppliers note that they still sell more cheaper imported systems then certified systems within the Montesol programme.

Lessons learned: Loan schemes perform well in sunbelt countries.

- India: When the policy changed in the mid-1990 from capital subsidy to interest subsidy the number of solar thermal system suppliers in the state of Karnataka jumped from 5 to 60 by 2005. The involvement of the banks (both commercial and rural) ensured the sustainability of the programme – since solar water heaters were now seen like any other consumer product.
- Mexico: The public mortgages bank Infonavit offers green mortgages (Hipoteca Verde) to private home builders that want to purchase a solar water heater. This had an high impact on the solar thermal market because Infonavit finances 1 million housing units annually (before the North-American building crises). With about 55,000 SWH in 2012 (approx. 110,000 m²), Hipoteca Verde accounted for half of the newly installed glazed collector area in the country.

See further case studies of rebate + loan combinations on page 12.

Source: Solarthermalworld.org see links on country names

Reduction / abolition of indirect taxes (VAT)

Definition: The VAT rate applied to solar thermal products and services is reduced or abolished.

Pros

- VAT rate reductions or abolitions immediately lowers the overall investment costs for the end consumer.
- Can apply for both hardware (system) and services (installation).
- It is very simple to apply, since no processing of tax declarations is needed.
- No additional allocation of public funds is necessary therefore easier to perceive by public authorities or political bodies.

Cons

- More relevant for private customers than for commercial.
- The size of the incentive is limited to the VAT rate.
- Can be in conflict with the government target of increasing the state tax revenues.
- VAT rate reductions or abolitions can be withdrawn by polititians any time, therefore no long-term investment security.

Case studies: China, India, Italy, Great Britain, France, Poland, Switzerland (see page 13)

Reduction / abolition of direct taxes

Definition: The investor can deduct parts or the total of the investment in a solar thermal system from the income tax or corporate tax (used terms: tax credits / tax reductions / tax allowances).

Pros

- No allocation of the public budget is necessary, therefore a more credible long-term commitment of the government likely
- Eligible to both private and commercial customers
- No time consuming paper work for subsidy applications necessary before the investment.
- Lower administrative burden than direct subsidiese for administrator
- No limitation in the number of accepted applications.

Cons

- Does not lower the initial upfront investment, therefore not the same psychology effect like a direct grant, since the investor receives the payback with the next tax declaration
- Socially unfair: Without effect for low-income client groups who pay no or rather low taxes.
- Can be in conflict with the government target of increasing the state tax revenues
- Does not support improvements in quality or performance of the solar thermal systems.
- Impact depends on the level of taxation of the target group and general tax payment discipline

See case studies: Italy, USA, France, Chile (see page 13 and table on the following page)

Reduction / abolition of direct taxes

Country	Time span of regulation	Tax credit regulations (cap)	Eligible Sector	Impact
Italy	Since 2006, extended on annual basis	Deduct 55 % of investment cost over 10 years, first 55 % to deduct over 5 years	Residential	Small impact, because regulations are not any more attractive
USA	Since 2005, in 2008 extended to Dec 2016	Deduct 30 % of the investment cost in the first year	Residential and commercial	Generous subsidies because combined with state tax credits, sales numbers still small
France	Since January 2005, latest extension to Dec 2015	Deduct 32 % of investment costs in the first year, people who do not pay taxes receive a subsidy (first 50 % to deduct) Capped at EUR 8,000 per person in five years	Residential	Unclear, residential sector is declining because of different reasons (new-built market down and heat pump competition
Chile	Since 2009, end of 2013	Deduct a certain share depending on the type of the building	Construction companies	30,000 flats are said profit from SWH until the end of the programme
Holland	Since 1997, no expiring date	41.5 % of the investment costs	Commercial	

Lessons learned: Tax credit schemes are generally in place for a long-term. Italy is the only country that approved the extension on an annual basis, all the other countries have a long-term commitment. However, Italy and France degraded the measure significantly over time. A lack of monitoring can be observed, so it is not know in all countries how the tax credits were used. Only Italy published an implementation report once stating that "Solar Thermal Energy was the cheapest energy-saving measure in 2010 within the tax deduction scheme", however solar thermal only made up 12 % of all tax deduction applications in Italy in this same year. Tax credits in the housing industry in Chile are seen as very efficient and the association is fighting for extending the scheme. The four-years scheme was far to short since development periods for housing projects extend over several years.

Renewable Energy Certificates

Definition: The owner of a solar thermal system obtains certificates representing the energy saved/produced through the system that can be sold on the certificate market, which is typically driven by a requirement on electric or gas utilities to cover a share of their sold energy with renewables.

Pros

- Public budget neutral, adds no new costs to tax payers
- Displaced energy from SWH is usually cheaper than for example from solar electric systems, so the utility have to spend less for meeting the quotas or portfolio standards.
- Lower-income residents and small businesses can profit from this scheme
- Commercial metered systems: Raises awareness on systems' quality, performance and maintenance

Cons

- The price for the certificates is depending on supply and demand and therefore not stable. Consequently, the revenues from the certification trading are not predictable for the solar thermal investor, hence they do not stimulate long-term investments in the sector
- Solar quotas within Renewable Portfolio Standards of US-American utilities start small (increasing over time) and therefore are fast fulfilled.
- RECs in the residential sector require a kit-oriented market, becauses otherwise high costs and efforts will be needed for the ST suppliers to let all system configurations be tested from an independent test laboratory to determine the number of RECs a system receives in a certain climate zone

Case studies: Several states in the USA, Australia (see following page)

Renewable Energy Certificates

Case studies: SRECs fulfill Renewable Portfolio Standards of utilities in the USA

- More and more state governments in the USA approve Renewable Portfolio Standards (RPS) with a certain share of solar energy. An RPS requires utilities to retrieve a certain percentage from renewable sources every year. Three states - Washington D.C., North Carolina and Maryland (New Hampshire in preparation) have allowed utilities to meet requirements by also buying Solar Renewable Emission Certificates (SRECs) produced by solar water heaters. This is a great advantage, since SRECs are traded at a much higher prices (100 to 500 USD) than renewable RECS (10 to 50 USD). The SRECs calculation bases on OG-300 SRCC certification. Each SWH OG 300 certificate includes the Solar Energy Factor (SEF), which is a performance rating depending on the system and on the region the system is installed. The SEF can be converted to an equivalent Solar Savings (QSOLAR) through a simple formula given on the SRCC website. QSOLAR is the calculation base of SREC generation. One SREC is issued as soon as 1,000 kWh of energy savings are generated. This requirement also counts for commercial solar thermal systems, only that the energy production must be metered. Individual ST system users sell the SRECs to professional aggregators.

Case study: RECs in Australia are an add-on support mechanism with fluctuating prices since 2011

- The Renewable Energy Certification (REC) scheme started in Australia 2001 with a Renewable Energy Act that forces energy retailers to obtain a certain part of their energy suppliers from RE annually. The SWH user receives a certain number of credits determined by performance tests of an independent institution. 1 REC is 1 MW of electricity generated or displaced over a 10-year period. Residential SWH receive between 10 and 45 RECs per year after purchasing the system. The RECs became a key factor for the 30 % annual growth of the Australian solar thermal market until 2004 with REC spot prices of around AUD 35. The following two years market growth dropped because of the declining value of RECS. In June 2009 an PV multiplier was introduced that allowed PV installations to multiply their RECs 5 times, but it is said to be phased out now. The RECs spot market prices are round about AUD 30 in the last 1.5 years.

Lessons learned: RECs and SRECs can drive ST markets by creating an additional revenue stream, although not stand-alone, but in combination with other financial schemes. Caution have to be exercised because of jumping / falling certificate prices and cost-intensive system tests. Besides, high efforts and good arguments are needed to lobby for solar thermal being accepted in the Renewable Portfolio Standards.

Clean Development Mechanism

Definition: The owner of a solar thermal system can sell Certified Emission Reductions (CERs) as part of a registered CDM project.

Pros

- Create an additional revenue stream without a burden to the host country state budget
- Also small-scale residential systems can be bundled within a **Programme of Activities (PoAs)**. It enables individual projects – which apply the same basic methods and monitoring technology - to jump under the umbrella of one single programme and to be funded by selling CDM's Certified Emission Reductions (CERs).

Cons

- The price for the certificates is depending on supply and demand and therefore not stable.
- Relatively complex and time consuming application and approval procedures that might need specialised CDM project developers.
- CDM projects are only eligible in certain countries defined in the Kyoto Protocol

Case studies: India, South-Africa and Tunisia (see page 14)

Energy Service Companies (ESCOs) – pros and cons

Definition: The Energy Service company sells solar heat instead of solar thermal systems and signs long-term energy supply contract with the clients.

Pros

- No upfront costs for the user of the solar thermal system
- Increasing the confidence of potential heat consumers to invest into solar
- Well monitored and maintained systems since the client pays per delivered heat
- Low-risk investment for the ESCO when focusing on creditworthy commercial customers or public institutions
- Better Return of Investment when the installation of the SWH is bundled with other energy improving measures

Cons

- High financial risk of long-term energy supply contracts makes it difficult for the ESCO to receive loan financing
- High administrative burden because several contracts have to be signed
- Requires some scale to be profitable for investors
- Lack of engineering capacity of the contractor to run and maintain large-scale solar thermal systems
- Will have small impact on market if the question of financial guarantees for shortfall in monthly payments of clients is not solved

Case studies on the following page

Financial Guarantees for Energy Service Companies (ESCOs)

Case study: Austria – ESCO successfully finances two projects with EUR 10 million

- The Austrian company S.O.L.I.D. signed a guarantee contract with the Austrian Control bank ÖKB covering any shortfall in payments of the monthly energy costs by the client. Over a period of 12 years ÖKB guarantees 50 % of the energy costs in case of illiquidity of the client and even 100 % in case of political riots in the country that causes lack in monthly payments. Without ÖKB's guarantees the credit financing for two international solar cooling projects with a total investment of EUR 10 million would not have been possible: 3,900 m² of collector area and a cooling unit of 1,500 kW at the United World College in Singapore and 4,645 m² of collector area and a cooling capacity of 1,750 kW in the Desert Mountain High School in the USA.

Case study: Brazil – Pilot project for Energy Efficient Guarantee Mechanism

- In Brazil the Inter-American Development Bank (IDB) has started a programme called Energy Efficiency Guarantee Mechanism (EEGM). The EEGM offers partial credit guarantees that cover up to 80% and the BRL equivalent of USD 800,000 per energy efficiency project for which solar water heaters are one eligible technology among others. The Technical Risk Guarantee limits the risk of low-performing energy saving measures deriving from technical failures. It covers a maximum of 80 % of the energy savings value up to 7 years. EEGM is a small pilot project with a budget of USD 25 million approximately covering 200 partial credit guarantees in the period up to 2016.

Case study: Spain – promising plans for a feed-in tariff, but not implemented yet

- In Spain the Renewable Energy Plan 2010 - 2020 (PER) approved in November 2011 includes an incentive mechanism called ICAREN, which allows ESCOs to receive an incentive for every kWh of renewable heat which they sell to their customers. The level of the granted fees must be fixed in a way that the ESCOs receive a good return of investment within a minimum of 10 years. However the necessary regulations (Real Decreto) are not yet published.

Conclusion: There is yet a rather small number of solar thermal projects realised by ESCOs. The financing is one barrier that needs to be overcome by third-party financing guarantees either issued by private or public institutions.

Summary of lessons learned

Pros and cons as well as case studies from 11 different sub-categories of demand side support schemes were put together in this presentation. What have we learned?

- The most successful countries are the once combining different sub-categories of support schemes.
- The number of alternative funding sources is long (see page 7), public funds should be absolutely avoided.
- Performance-based incentives / solar heat tariffs perform well in the commercial segment. A pragmatic approach is mostly used based on a first-year yield and a 70 to 80 % up-upfront payment plus a last installment after measurements have confirmed the calculated yield in the first year. However, the programmes tend to be over-regulated.
- Loan schemes for the residential sector have their place outside Europe successful in combination with small grants. Loan schemes can attract third-party financing in Europe in the commercial ST sector together with a direct funding. Stand-alone loan schemes in Europe have no relevant impact on the market.
- USA is the frontrunner in reaching short payback times with combining incentive schemes, Europe has to learn to discuss ST on this commercial basis even with administrators / politicians (transferring the US schemes to Europe would explode the market)
- The new generation of support schemes (tax credits and SRECs) in the USA have created interest in third-party financing. This momentum is missing in Europe.
- Governments seem to have a longer breath with tax credits, since the annual public budget is not concerned. Five years should be a minimum lifetime of a tax deduction scheme in the commercial segment.
- Certification trading is a nice to have additional stream of revenues. Making ST eligible in certification schemes should also have a high priority in lobbying in Europe.
- Energy Service Companies need credit security providers that guarantee underperforming systems or outstanding client payments.

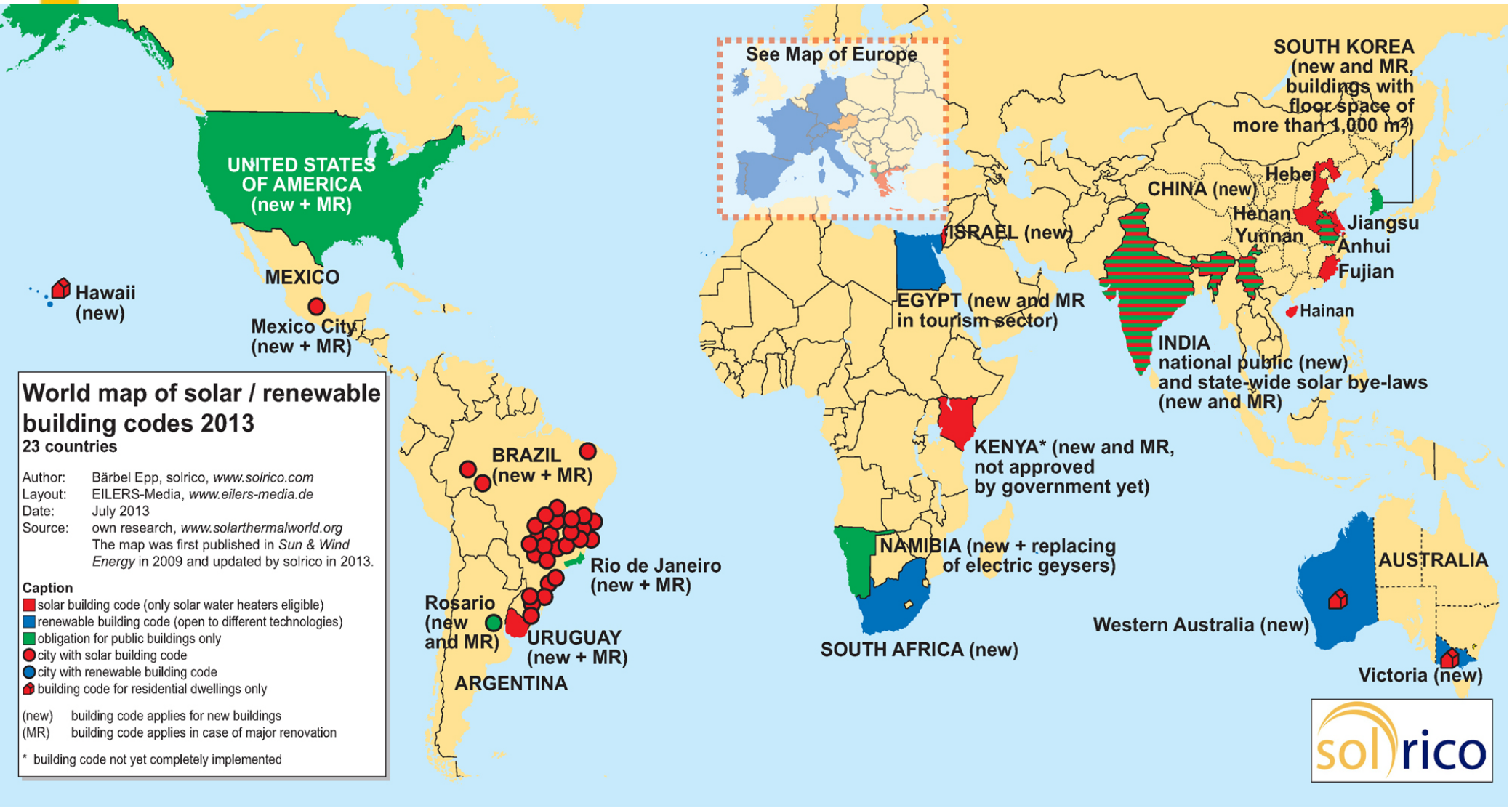
The stick: Solar obligations worldwide

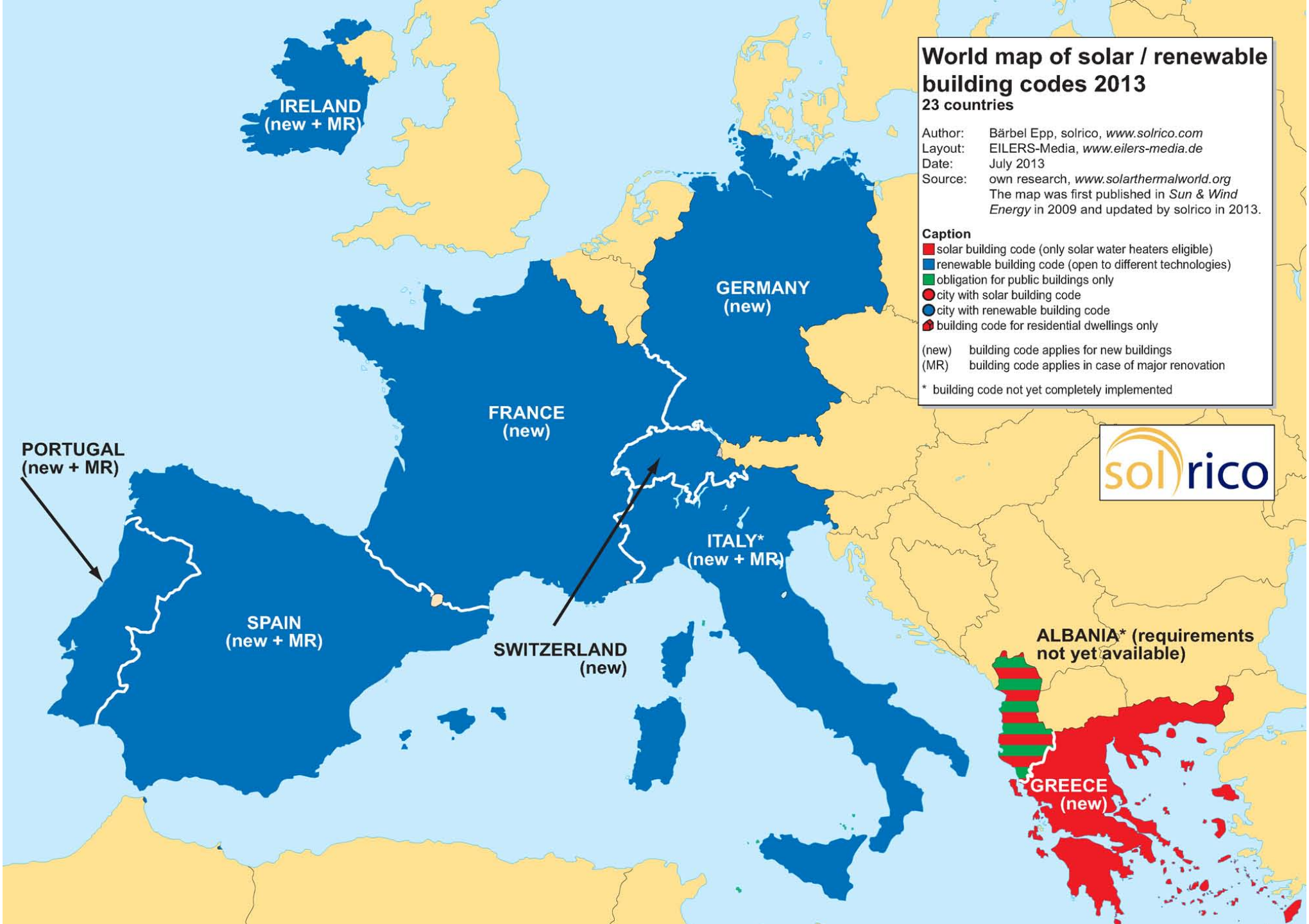
Classification of different “Solar Obligations”

Solar obligation / renewable building regulation / bye-law / solar ordinance / solar building codes (one political instrument with many names)

Distinguishing features	Examples on the country level
Applying for residential, commercial and/or public buildings	▶ Germany: From 1 January 2009 owners of *private*, *commercial* and *public buildings* will have to provide a minimum share of at least 15 % of the *heating demand* by *renewable energies.*
Applying for new-built and/or in case of (major) renovation	▶ Spain: Since March 2006 the Technical Building Code (CTE) stipulates that 30 to 70 % of the *domestic hot water demand* in *new buildings* and those with *major renovations* must be covered by *renewable energies.*
Applying to hot water demand or also to space heating	▶ Namibia approved a building code in August 2007 for all *new public* and *parastratal* buildings.
Applying at the municipality, province or national level	▶ The *state of Victoria*, Australia, implemented the so called 5 start standard in 2005 which lets the *private homeowners* choose between two options - a solar water heater or a rainwater tank - in case of *new-built* and *major renovation.*
Eligible technology solar thermal only or a bundle of renewable technologies and energy saving measures	▶ In Brazil building laws are approved on the *municipality level*. The association Abrava started the campaign “Cidades Solares” to convince more municipality administrators to implement solar building standards. The first law was approved 2007 in Sao Paulo mandatoring the installation of a *solar water heating system* for covering 40 % of the annual energy demand for the domestic hot water or pool heating in *new-built residential* and *commercial buildings*. Around 100 municipalities followed so far.

World map of Solar/Renewable Obligations




IRELAND
(new + MR)
GERMANY
(new)
FRANCE
(new)
PORTUGAL
(new + MR)
SPAIN
(new + MR)
SWITZERLAND
(new)
ITALY*
(new + MR)
ALBANIA* (requirements
not yet available)
GREECE
(new)
World map of solar / renewable building codes 2013
23 countries
Author: Bärbel Epp, solrico, www.solrico.com
Layout: EILERS-Media, www.eilers-media.de
Date: July 2013
Source: own research, www.solarthermalworld.org
The map was first published in Sun & Wind Energy in 2009 and updated by solrico in 2013.
Caption
solar building code (only solar water heaters eligible)
renewable building code (open to different technologies)
obligation for public buildings only
city with solar building code
city with renewable building code
building code for residential dwellings only
(new) building code applies for new buildings
(MR) building code applies in case of major renovation
* building code not yet completely implemented
solrico

World map of solar / renewable building codes 2013

Conclusions from the world map:

- Solar obligations are spread over all five continents and they include very many different types of regulations.
- In Central Europe the technology-neutral building codes are dominating that can be fulfilled through several renewable technologies or energy efficiency measures (blue). In the rest of the world building regulations are focused on solar thermal technology only (red), for the simple reason that solar water heaters are a cheap measure to save electricity which is used to heat domestic hot water in many sunbelt countries.
- In the majority of the countries the building laws are national laws and an amendment is binding for all provinces, states and municipalities of the country. In this case the country is coloured uniformly in the world map, like Germany, Portugal, Spain, Greece, Ireland and Israel.
- In the other countries the province (state) or the municipality level is in charge of implementing and amending building codes. Like in Brazil where the 5,564 municipalities needs to be convinced to adapt solar building codes. In India, Italy and China the situation is slightly different, as in these countries the provinces play a crucial role in pushing the municipalities to implement the solar building codes. In Switzerland building codes are the responsibility of the canton level, that means that cantons can showcase additional regulations to the recommendation of the Conference of Cantonal Energy Directors.
- The majority of the building regulations worldwide apply for residential and non-residential buildings, only the two Australian states Victoria and Western Australia and the state of Hawaii in USA showcase special regulations only for the residential sector (marked with a building in the map).
- A special category of regulations in marked “green” in the world map representing obligations that only apply to public buildings like in Namibia, the province of Rio de Janeiro and some Chinese provinces.

Latest new building regulations

- Greece: As of January 2011, all new buildings in Greece have to cover at least 60 % of their domestic hot water demand by solar technology. This regulation is part of law L3851/2010 to implement Directive 2009/28/EC, in combination with L3661/2008, which is part of the implementation process of the European Energy Performance of Buildings Directive (EPBD).

- France: Since October 2011, the Réglementation Thermique 2012 (RT 2012) has made it a requirement for all new non-residential buildings to adhere to a minimum energy consumption level between 40 and 65 kWh/m^2 per year (primary energy) depending on the location, including demand from space heating and cooling, ventilation, hot water and lighting. During the first phase, the requirements applied to all new office buildings and educational facilities in urban areas which require important short-term renovation, the so-called ANRU zones (Agence Nationale pour la Rénovation Urbaine). Since January 2013, the RT2012 also covers all buildings (particularly single- and multi-family houses) in France except for overseas territories.

- Albania: The new law on Renewable Energy Sources No. 138/2013 from 2 May 2013 requires builders to adhere to a minimum share of solar thermal heat for public, residential and commercial building types**.** It is now up to the Council of Ministers to decide to which building categories the solar obligation should apply.

- Egypt: At 2 June 2013 a Memorandum of Understanding was signed from the Solar Energy Development Association (SEDA), National Bank of Egypt, Egypt's Minister of Tourism and the Egyptian Hotel Association (EHA) which is thought to increase the share of solar energy and improve energy efficiency in Egypt´s tourism sector**.** One aim of the Memorandum is to equip 100,000 hotel rooms with clean energy technologies during the next five years – including solar thermal, photovoltaics and smart lighting systems.

- Argentina: In July of 2011, the city council of Rosario - a city located between Buenos Aires and Santa Fé - agreed to establish a solar ordinance which was officially approved in September 2012. It requires all public buildings to cover at least 50 % of their hot water consumption by solar energy. The regulation applies to both new and renovated buildings. However, to put it into practice, the authorities would have to also work out and publish an actual regulation.

- South Korea: The latest requirements of the renewable obligation came into effect in April 2012 stimulating that all governmental buildings with a floor space of more than 1,000 m^2 have to cover 10 % of the heating and electricity demand of a building by renewable energies.

- India: Since January 2010 all new government and public sector buildings in India are obliged to use a solar water heater that cover at least one fifth of the hot water design capacity. The Indian government refers to the voluntary Energy Conservation Building Code (ECBC) from 2007 that was mandated in 2010 for governmental buildings.

- Uruguay: The new Decreto N 451/011 which was implemented on 19 December 2011 mandates a 50 % solar share for hot water generation in hospitals, hotels and sports clubs – for both new-built and soon-to-be-renovated houses.

Solar obligations – pros and cons

Solar obligation: Solar obligation is the name for an political instrument of making a certain solar/renewable share of the hot water demand and/or space heating demand of different kinds of buildings mandatory.

Pros

- Increasing the market penetration of solar thermal systems in a long run in the existing building stock as well as the new-built market segment
- Getting solar technology in at the early planning stage of new buildings
- Opening up new market segments if the implementation is intensively checked
- Increasing awareness for solar thermal of new market players like construction companies or housing industry
- Tackling the tenant-owner dilemma, since the building requirement also applies if the energy bill is paid by tenants, who cannot decide on structural investments.

Cons

- Lack of social acceptance since it is a “must to do”
- Avoiding the fulfilling of obligations by “cheating”, hence “What is not controlled is not built”
- Technology neutral obligations where renewable energies and energy efficiency measures are eligible often have a small impact on the solar thermal market, since solar thermal technology is seen as an expensive technology compared to other measures
- Increasing the trend towards cheap solar water heater solutions to fulfill the obligation by the smallest investment possible

Case studies on the following pages. Please note that the impact of solar obligations is hardly analysed, so case studies are rare.

Case studies: front-runners Israel, Barcelona, Spain and Victoria

- Israel: The first solar obligation worldwide came into effect in Israel in 1980 which makes it mandatory in new buildings such as residential housing, hotels, guest houses and old people´s homes up to 27 m high to use solar water heaters. Nowadays more than 80 % of the households in Israel obtain their hot water from solar rooftop heaters. SWHs save the country about 4 % of its energy imports and replaces 9 % of the electricity production. In the residential sector the Israel Standards Institute monitored the implementation of the solar requirements intensively, but not in the commercial sector with hotel and guest houses. Therefore there are hardly any commercial SWHs, hence the conclusion is: "Whatever is not checked, is also not installed."

- Barcelona (Spain): In August 2000 Barcelona was the first municipality in Europe that implemented a renewable building code which was then revised in 2006 applying for more building types with an increased solar fraction. Before 2000 there were 1,650 m² solar collectors installed in the city (1.1 m²/1,000 inhabitants). At the end of 2008 it was already 40,095 m² (25 m²/1,000 inhabitants).

- The Barcelona example was followed by around 50 cities and municipalities in Spain leading to the national Technical Building Code (CTE) approved in March 2006 being the first country in Europe with a national building code applying to new building as well as those undergoing major renovations or/and change of use. Solar energy is supposed to cover 30 to 70 % of the domestic hot water demand, depending on the climate zone. Three years later the Spanish consultancy eclareon analysed the impacts on the market drawing the following conclusion:
  - any kind of obligation leads to a certain degree of non-compliance, therefore authorities and market players needs to be motivated and an official monitoring system needs to be in place
  - Training of authorities as well as installers is necessary
  - Price pressure and competition increases since new players from the construction industry enter the market
  - Quality assurance measures for installation and performance recommended

- Victoria was the first state in Australia to approve a building code in 2005 requiring the installation of a solar water heater systems or a rainwater tanks in new residential buildings. The regulation was well received. Three years later Sustainability Victoria published the statistics that every second new-built house in Victoria contains a solar water heater.

Case studies from Germany and India

- Germany: Since the January 2009 all new-built residential, commercial and public buildings are obliged to apply one sort of renewable technology (solar thermal, biomass, geothermal) or additional efficiency measures (insulation). When using solar thermal energy, at least 15 % of the total heating demand must come from solar energy. In the interim report from December 2012 the German Environmental Ministry shows that solar thermal systems come at third place (20 % of the homeowners) after 48 % who fulfill the obligation with additional insulation and 27 % install a heat pump. Biomass boilers are used in 5 % of the cases. Conclusion: Solar thermal does not profit from technology neutral renewable building regulations as much as other technologies.

- Maharashtra, India: Since 2007, 16 of the municipality in the Indian state of Maharashtra have passed solar bye-laws which mandate the use of solar water heaters in all newly constructed and residential one-family houses. Two of the municipal corporations - Thane and Kalyan-Dombivli - also implemented laws on mandating the use of solar water heater in large residential buildings with a floor space of 150 m^2 or above. Conclusion: The majority of the manufacturers organised in Maharashtra Solar Manufacturers' Association (MASMA) are satisfied with the bye-laws, according to a survey carried out by MASMA. Several system suppliers experience steady growth rates of 15 to 20 % since the first mandatory laws where implemented 4 years ago.

- Karnataka, India: Karnataka State has chosen a completely different way of implementing the solar obligation. Since 2007, solar water heaters are mandatory for new houses that require a permanent electricity connection for the simple reason that it is difficult for the regional utilities to meet the high electricity demand in the morning hours, if all households turn on their electric boilers to take a shower. For example the Bangalore Electricity Supply Company (BESCOM) denied access to the electricity grid, if a household does not install a solar water heater. This situation was criticized and BESCOM officials concluded that more public awareness campaigns are necessary about the advantages of solar water heaters to make the Demand Side Management regulations acceptable for the population.

How to design a successful building code?

Check list for designing a successful solar / renewable building code

- ✓ Set up clear, easy to understand and transparent requirments
- ✓ Define long-term quantitative targets and implement a monitoring system that documents the compliance of the building code
- ✓ Apply the building code to as many building types as possible, because building segments that are not included in the building obligation, do not profit
- ✓ Carry out awareness raising and marketing campaign to convince authorities and companies ot the benefits of solar thermal (especially important for technology-neutral building codes) Offer training for installers, building permit authorities and architects
- ✓ Carry out random checks to control the compliance of the building code and to prevent cheating
- ✓ Link the building code to quality standards for system and installation

Check lists:
How to design a successful support scheme?

How to design a successful support scheme?

Check list for designing a successful demand side support scheme for the solar thermal market – **the basic twelve criteria**

- ✓ Choose a coherent bundle of complementing measures
- ✓ Set up short-term and long-term quantitative targets supported by a well-developed action plan
- ✓ Define a long-term, predictable and transparent scheme (☹ New requirements every year cause uncertainty in the industry (Malta, Slovenia, Italy)
- ✓ Involve industry and trade in design and changes of the support scheme
- ✓ Start with the most promising market sector for solar thermal in your country
- ✓ Avoid announcement previous to the implementation or allow retroactive applications (☹ Early announcement make customers hesitate to invest Germany, Czech Republic, Portugal)
- ✓ Tap financial sources independent from public funds
- ✓ Establish a mechanism of monitoring and evaluation the scheme including checking installations
- ✓ Drum the tambourine: make sure that all potential clients know about your scheme
- ✓ Quality is key: link your scheme to quality standards for components and systems which also include durability and reliability tests
- ✓ Encourage local manufacturing and local system integration to increase industry jobs in your country
- ✓ Provide trainings for installers, architects, planers and administration authorities

How to design a successful support scheme?

Check list for designing a successful demand side support scheme for the **residential, non-commercial** solar thermal market segment

- ✓ Avoid support regulations that favor one technology over the other (☹ India's bench mark system profits vacuum tubes and German's per square metre gross area subsidy profits flat plate collectors Germany profit flat and India vacuum)
- ✓ Ensure eligibility criteria are clear and easily to be checked (☹ incentives depending on a certain amount of income is difficult to check and invites for cheating)
- ✓ Analyse the financial needs of your target group (☺ Acceptance of loans, tax credits or grants of home owners differ from country to country, from culture to culture)
- ✓ Ensure the application process fits in with the standard purchase process (☺ Allow home owners to install a SWH before application, since they have to react quickly, when the old boiler is broken)
- ✓ Minimise paperwork for purchasers (☺ the Prosol support scheme in Tunisia reduced the paper work to a one page form)
- ✓ Encourage reduction of system prices by digressive support (☺ California Solar Initiative announced digressive support levels from the very first start)
- ✓ Make sure that resellers do not have a huge financial burden (☹ In India the Channel partners pre-financed the grants for the households and did not receive their money in time from the government)
- ✓ Make sure that also tenants (not only house owners) can profit from the support mechanism (☺ overcome the tenant-house owner dilemma)
- ✓ Plan the exit strategy from the start, e.g. digressive support, regular revisions, transitional periods etc. (☹ several residential programmes stop earlier than planned and leave the market players with strongly decreasing demand: (Czech Republic, Australia, Canada)

How to design a successful support scheme?

Check list for designing a successful demand side support scheme for the **commercial, large-scale** solar thermal market segment

- ✓ Analyse the financial needs of your target group (☺ Acceptance of loans, tax credits or grants of commercial investors differ from country to country, from culture to culture)
- ✓ Minimise paperwork for purchasers (☹ Fonds Chaleur in France could have had a stronger impact, but the ST companies were afraid of the high administrative burden)
- ✓ Provide a long-term perspective of the support schemes since the development of commercial investments extend over several years
- ✓ Make the amount of support attractive to purchasers (☹ Renewable Heat Incentive in UK fixed a ROI of 6 % for ST – the lowest compared to other renewable technologies)
- ✓ Provide support for project design consultancy and monitoring costs (☺ the Austrian large-scale ST subsidy scheme provides free-of-charge consulting for potential clients)
- ✓ Provide support related to monitored solar yields (☺ performance-based incentives increase the confidence of investors)
- ✓ Make sure that also third parties besides the user of the SWH can profit from the support mechanism (☺ Attracts third-party financing like ESCOs that finance, install and maintain the ST system)
- ✓ Provide financial guarantee support mechanism for long-term energy supply contracts (☺ examples from Austria and Brazil)
- ✓ Plan the exit strategy from the start e.g. digressive support, regular revisions, transitional periods etc.

Sources

This presentation basis on the following sources:

- Enabling Solar Thermal Policies and Financial Mechanism. Review of International Experiences and Best Practise by Vesa Rutanen (35 pages), April 2010 (not published)
- Solar Heating and Cooling. Best Practices in State Policies to Support Commercial and Industrial Market Development (26 pages) by US Environmental Protection Agency (EPA), December 2012
- Guidelines for policy and framework conditions (33 pages). European Solar Thermal Industry Federation (ESTIF), February 2012
- 770 news and background articles researched and written on solarthermalworld.org between 2008 and 2013
- Database of incentive programme with tables for 44 incentive programmes worldwide solarthermalworld.org/incentive
- Database of solar obligations in the filter section “policy” on solarthermalworld.org

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