CLEAN ENERGY SOLUTIONS CENTER
ASSISTING COUNTRIES WITH CLEAN ENERGY POLICY

INTERNATIONAL SOLAR ALLIANCE

International Solar Alliance Expert Training Course: Session 45

Policy Options to Scale-up Solar Heating and Cooling

In partnership with the Clean Energy Solutions Center (CESC)

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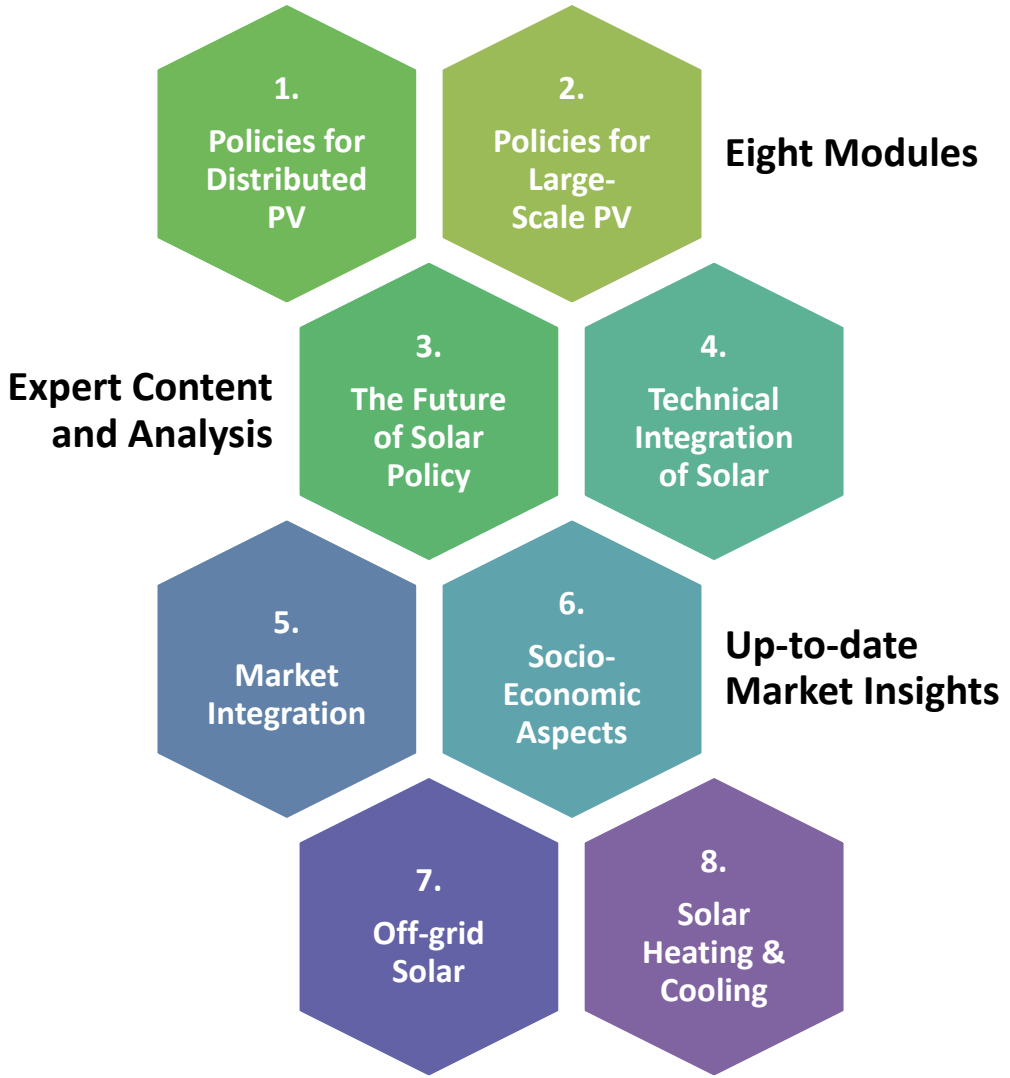
Supporters of this Expert Training Series

Overview of Training Course Modules

This Training is part of Module 8, and focuses on the issue of Solar Heating and Cooling



Overview of the Presentation

1. Introduction: Learning Objective
2. Main body of presentation
3. Concluding Remarks
4. Further Reading
5. Knowledge Check: Multiple-Choice Questions

1. Introduction: Learning Objective

Learning Objectives

- Understand solar heating and cooling policy
- Understand how policies can be used to scale-up the use of solar H&C technologies
- Understand which policies have proved most effective
- Understand the role of policy in driving technological change and cost reduction

2. Solar Heating and Cooling Policy

Solar H&C

Heating and cooling demand matters:

Water heating, space heating, and space cooling accounted for over 70% of the energy used in an average household in the U.S.

In the EU, the share of energy used in heating and cooling is estimated at over 50%

https://www.solarthermalworld.org/sites/gstec/files/news/file/2015-02-27/irena-solar-heating-and-cooling-2015.pdf
http://www.estif.org/fileadmin/estif/content/projects/prosto/downloads/ProSTO%20Blueprint%20EN.pdf

Solar H&C

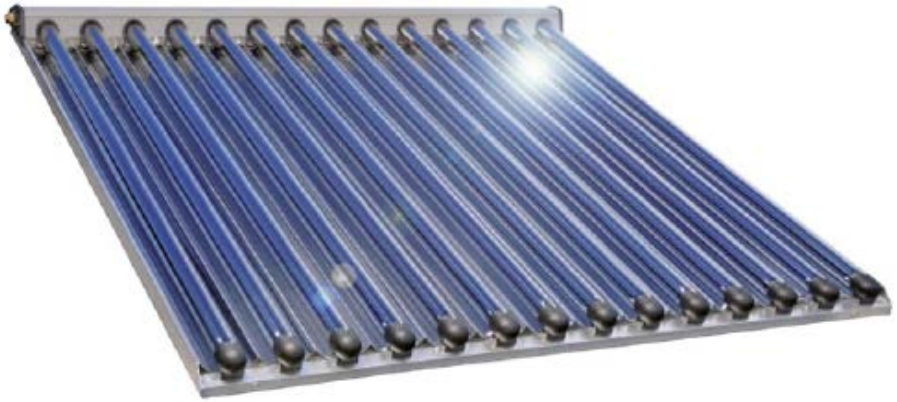
Most of the markets with substantial solar heating and cooling usage (Barbados, Cyprus, Israel, Spain, etc.) have relied on **mandates** to install the technologies in new or existing construction

They have also often been coupled with direct financial incentives, including rebates, grants, and low-interest loans

Solar H&C Technologies

The importance of solar H&C technologies is likely to grow significantly in the years ahead

While much of the focus historically has been on the heating sector, **solar cooling** is likely to be more important in the long-term



http://www.sci-network.eu/fileadmin/templates/sci-network/files/Resource_Centre/Innovative_Technologies/SOTA_solar_heating___cooling.pdf

The Importance of Solar Cooling

- Air conditioning demand is growing at a rapid pace, driven by economic growth and rising living standards.
- Air conditioning is often an aspirational purchase: one fo the first things that households purchase when they have sufficient resources.
- E.g. in **India,** AC sales have grown from roughly 2 million in 2006 to approximately 30 million in 2018
- Air conditioning represents approximately 40% of the electricity demand in cities like Mumbai (India)

https://www.straitstimes.com/asia/south-asia/making-the-world-hotter-indias-expected-ac-explosion
International Energy Agency, (2018). Future of Cooling, http://www.iea.org/publications/freepublications/publication/The_Fu-ture_of_Cooling.pdf

The Importance of Solar Cooling

- Of the 2.8 billion people worldwide living in the hottest parts of the world, **only 8% currently have air conditioning systems**.
- This represents a tremendous market need, and a tremendous opportunity
- And, yet policy on solar cooling has been largely silent

https://www.seforall.org/sites/default/files/gather-content/SEforALL_CoolingForAll-Report.pdf

The Importance of Solar H&C

- In rapidly industrialising countries like India, estimates suggest that fully 75% of buildings that will exist in 2030 have not yet been built

- This represents a tremendous opportunity, via smart policy, to influence the future trajectory of energy demand, and emissions

https://www.seforall.org/sites/default/files/gather-content/SEforALL_CoolingForAll-Report.pdf
http://www.iea.org/publications/freepublications/publication/The_Fu-ture_of_Cooling.pdf

3. Solar H&C Policies

Why Is Policy Needed? Short Answer

- **Short answer:** despite increasingly attractive economics, there are many barriers that continue to hold the sector back

Why Is Policy Needed? Long(er) Answer:

- Solar thermal technologies often have a **high upfront cost**
- Most potential customers do not have the **disposable income** (or would rather spend it elsewhere)
- Widespread **lack of awareness**
- Concerns over **performance**, reliability, etc. persist
- Lack of **qualified manufacturers and installers**

Why Is Policy Needed? Long(er) Answer:

- **Lack of reliable quality standards** (in many markets)
- Solar H&C systems typically **require suitable roof space**, which can be a major barrier for many
- **Solar H&C can be blocked** by nearby construction, adding another important risk
- Construction industry in most countries has not yet mainstreamed the installation of solar H&C in their practices: **skills are often lacking**

Overview of Solar H&C Policies

- Solar H&C technologies have historically been supported by a wide range of **policy tools**

- In addition to rebates and grants, a growing number of jurisdictions are starting to use **mandates, low interest loans, and bulk buying programs** to support the adoption of solar H&C technologies

- Solar thermal technologies are also starting to be purchased on a **third-party PPA** basis, effectively purchasing heat on **$ per therm** basis from locally-sited solar thermal projects

Overview of Solar H&C Policies

- Innovations in business models like third-party leasing and third-party PPAs have the potential to significantly reshape the market for solar thermal technologies

- However, in many cases, **such business model innovations also require changes in enabling regulations**, and sometimes even changes in law

- **Improved metering technologies** are also making it possible for systems to be invested jointly (e.g. in multi-unit residential buildings)

https://www.epa.gov/sites/production/files/2014-11/documents/multi-family-webinar.pdf

1. Mandates and Obligations

- Mandates are obligations to install solar H&C on particular buildings. They can apply either to existing buildings or strictly to new construction.
- Also referred to as “Solar Thermal Ordinances”
- Mandates are typically **technology-specific** (in contrast to building codes, which are often technology-neutral)

E.g. China, Spain, Israel, France, California (US)

http://www.estif.org/fileadmin/estif/content/projects/prosto/downloads/ProSTO%20Blueprint%20EN.pdf

1. Mandates and Obligations

- Barcelona (Spain) was one of the first European cities to approve a building mandate for solar thermal systems with its Solar Building Ordinance in 1999, which came into force in 2000.
- The mandate requires all new and renovated buildings to use solar energy to supply a minimum of 60% of the building's running hot water needs.
- While hot water needs represented on average 13% of households' energy consumption across the EU in 2009, the share in Spain has been estimated at 27%, and 28% in Barcelona itself.

http://www.ajsosteniblebcn.cat/solar-bcn-iclei-case-study_61656.pdf

2. Grants and Rebates

- **Direct cash incentives** offered for the purchase of RES-H&C technologies.
- Grants are typically offered upfront, and are often capacity-based (e.g. $/kW installed)
- Rebates are also often structured in $/kW, and are available upon demonstrating proof of purchase
- Can also be structured as a percentage of project costs
- Often include various caps and eligibility restrictions

E.g. Spain, Tunisia, Australia, US, EU, Japan

2. Grants and Rebates

- The Concerto project in the EU offers grants, capped as a percentage of total project costs, to support solar heating and cooling technology investments
- Such additional funding played a critical role in mobilizing investment in a wide range of solar thermal projects
- The cirty of Itabashi in Japan offers grants for the installation of solar thermal systems covering 5% of initial cost, up to a maximum of 45,000 yen (USD 425)

https://www.concertoplus.eu/impacts/business-models/
carbonn Climate Registry - www.carbonn.org [http://bit.ly/2GL3B0k]

3. Fiscal incentives

- **Fiscal incentives** are instruments that specifically use the tax code to encourage particular choices
- They can be used to offset a portion of the upfront cost, as well as the operating cost, of certain renewable energy heating and cooling technologies
- Fiscal incentives include property tax exemptions, reductions on import duties, investment tax credits, reductions on personal income taxes, as well as production-based tax credits

Examples: US, Australia, France

3. Fiscal incentives

- In a sign of how cities can use tax exemptions to fuel the uptake of renewable energy technologies, the City Council of Washington, D.C. (USA) has introduced a personal property tax exemption for investments in various renewable energy technologies, including solar thermal and solar PV systems.
- The US federal government also offers tax incentives for renewable energy investments, including in solar thermal systems

http://programs.dsireusa.org/system/program/detail/5245

4. Fees and Levies

- Instead of offering rebates and grants, some jurisdictions are trying instead to level the playing field by requiring non-solar (or non-renewable) alternatives to pay for their environmental and human health-related externalities
- **Fees and levies** in the H&C sector most often consist of energy taxes or carbon taxes on fossil fuel-based heating fuels such as natural gas or home heating oil.
- Such fees can help provide an important signal to the market, while helping narrow the cost gap

E.g. Netherlands, Norway, Denmark, Tunisia

4. Fees and Levies

- In countries such as the Netherlands and Denmark, several energy and environmental **taxes** are imposed on fossil fuels, including on home heating fuels, which help tilt the playing field toward renewable fuels and sources.
- In Vermont, representatives voted to increase the taxes on home heating fuels in order to encourage the greater adoption of renewable sources of heating, such as solar thermal systems

For the Netherlands:
https://www.pbl.nl/sites/default/files/cms/publicaties/pbl-2015-green-tax-energy-tax-challenges-for-the-netherlands-1501.pdf;
for Denmark: https://green-budget.eu/wp-content/uploads/The-most-successful-environmental-taxes-in-Denmark-2_FINAL.pdf
For Vermont: https://vtdigger.org/2019/03/21/house-tax-committee-votes-double-heating-fuel-tax-fund-weatherization/

5. Financial incentives

- Direct financial incentives include measures such as **revolving loan funds, soft loans, on-bill financing, as well as performance-based incentives** that facilitate access to financing or help improve the bankability of solar H&C technologies
- Such incentives can play an important role in driving adoption, as access to the full upfront cost of a new solar H&C system is often beyond households and businesses threshold for cash expenditures: financing can help unlock this untapped potential
- **E.g. Germany, UK, Australia**

5. Financial incentives

- The Municipality of Shelburne (Nova Scotia, Canada) has adopted a PACE financing program that enables local homeowners to invest in solar thermal installations up to CAD $8.000 per home and to repay the loans to the municipality via an increase on their annual property tax assessment.
- Germany's KfW Bank offers low-interest loans for solar thermal systems, as well as well as on other innovative thermal technologies

- https://municipalityofshelburne.ca/sustainability/296-pace-brochure/file.html
- https://www.kfw.de/inlandsfoerderung/Unternehmen/Energie-Umwelt/F%C3%B6rderprodukte/Erneuerbare-Energien-Standard-(270)/?wt_cc1=umwelt&wt_cc2=unt|energie-umwelt&wt_mc=52499124904_216268898310&wt_kw=b_52499124904_%2Bkfw%20%2Bsolarenergie&wt_cc3=52499124904_kwd-532964255672_216268898310

6. Building Codes

- **Building codes** are similar to mandates, except that they are typically **technology neutral**
- Building codes set out a minimum technical standard to be met by new (or existing) construction
- Such standards can drive the adoption of solar H&C technologies, as the latter may be one of the most cost effective ways of complying with the new codes

- **E.g. Spain, France, Brazil**

6. Building Codes

- Spain has adopted new building codes that include a minimum contribution of renewable energy to cover demand for hot water.
- While the policy has been introduced at a national level, adoption and enforcement occurs at the city-level, leading to a number of local zoning, planning, and regulatory measures at the city level to comply with the codes
- The new building codes stipulate the standard, which builders and owners can meet using a range of different technologies: solar thermal remains among the most cost-effective ways of complying

https://www.codigotecnico.org/images/stories/pdf/ahorroEnergia/DBHE.pdf

7. Public Procurement and Investment

- **Direct public investment** is one way of catalysing investment in solar H&C technologies, while creating awareness and visibility for solar H&C technologies
- A growing number of governments and companies around the world are investing directly in solar H&C technologies, using their procurement policies to help drive the market forward

- **E.g. France, China, India, Austria, Czech Republic**

7. Public Procurement and Investment

- A large-scale district thermal network investment has been made by Graz in Austria to develop a centralized large-scale solar thermal system that feeds solar thermal energy into the city's district heating supply grid throughout the year.
- **The largest solar thermal system in the world**: total of 154MW_{th} of solar thermal capacity and almost 1 million m^3 of water storage.

- Zlín in the Czech Republic aims to reduce its fossil fuel use by 33% by using solar thermal and solar PV technologies: a large solar thermal project has been developed to provide households, a local industrial plant, as well as the municipal swimming pool with hot water in a district heating system.

REN21 GSR 2018
https://www.euwid-energie.de/big-solar-graz-soll-weltgroesste-solarthermie-anlage-werden/

8. Soft cost reduction strategies

- Soft costs are defined as “non-hardware costs”: they represent the additional costs associated with permitting, customer acquisition, inspections, etc.
- Reducing such soft costs can significantly reduce the upfront cost of the technology for end-users, while also helping save valuable time
- Can represent over 60% of total project costs (!)
- Easier procedures can help catalyse more rapid market growth

E.g. US, Australia

8. Soft cost reduction strategies

- Soft cost reduction strategies have been adopted across a wide range of jurisdictions in the U.S. including in Sebastopol, California

- The city introduces a range of measures to streamline permitting, inspection, and other requirements

- Soft cost reduction is also one of the major goals of the U.S. “Sunshot Initiative”

https://law.lclark.edu/live/files/17499-shrinking-solar-soft-costs
https://www.energy.gov/eere/solar/sunshot-initiative

9. Bulk-buying policies

- Bulk buying strategies consist of government- or organization-led processes to purchase particular technologies in bulk to benefit from volume discounts
- In addition to lower unit costs, bulk buying can also be used to structure competitive tenders to identify the best installer(s) to ensure a high and consistent level of quality in the systems installed

E.g. US, Australia

9. Bulk-buying policies

- **Bulk buying programs** for renewable heating and cooling technologies have been used in many jurisdictions throughout Australia
- A number of communities including Darebin and Stonnington have used bulk buying for solar water heating technologies, while other cities such as Sutherland Shire are offering bulk buying for hot water heat pumps while Healesville offers a bulk buying option to local residents for both solar hot water systems as well as heat pumps.

https://www.energymatters.com.au/darebin-city-council-solar-power-bulk-buy-directory/
https://www.positivecharge.com.au/councils/stonnington/
http://sunnyshire.org.au/hot-water-heat-pump-bulk-buy/
https://www.healesvillecore.org.au/solar-hot-water-heat-pumps-info/

10. Bans and phase-outs

- Bans and phase-outs refer to restrictions on other non-solar, or non-renewable technologies
- Such bans or restrictions can help drive demand for solar H&C technologies
- Bans also help catalyse awareness among citizens and businesses, and can lead to investments across a wide number of building types
- As the market for solar H&C grows, customers can benefit from more competition, and a more dynamic market

E.g. Sweden, Denmark, Krakow (Poland)

10. Bans and phase-outs

- Starting on September 1 2019, Krakow (Poland) prohibits the burning of coal and firewood in boilers, stoves and fireplaces across the city, making it the first city in Poland to do so. Polling has revealed that over 96% of residents living in the City support the ban.

- Similarly, certain cities in China have banned the use of coal for residential heating in certain applications.

- Such bans drive the adoption of alternatives, including cost-effective alternatives like solar thermal technologies

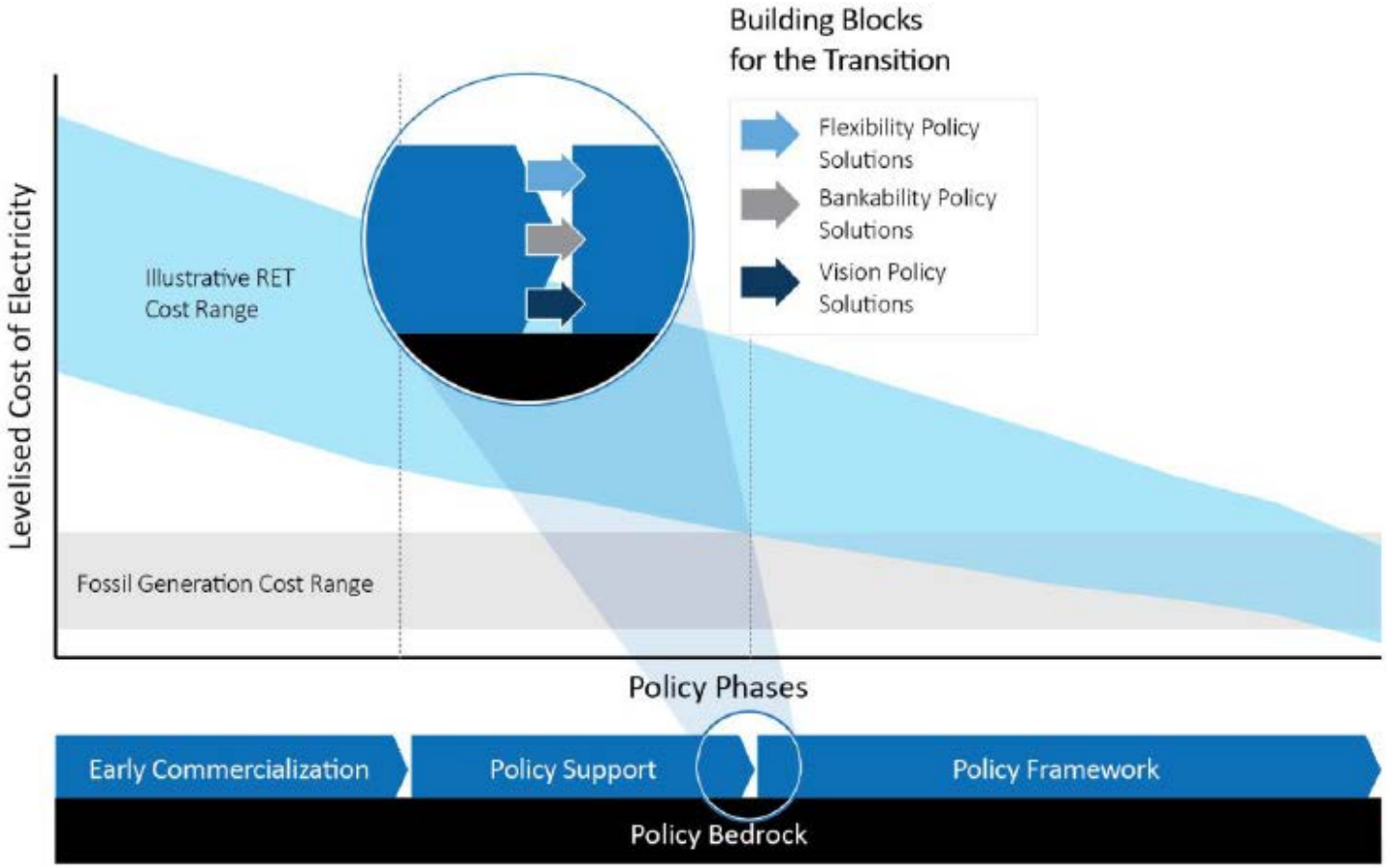
For Krakow:
https://powietrze.malopolska.pl/en/news/ban-on-the-use-of-solid-fuels-in-krakow-from-september-2019/
For China: https://www.nytimes.com/2018/02/10/world/asia/china-coal-smog-pollution.html.

Policies for Solar H&C

- In addition to all the policy instruments listed above, there are a number of important enabling measures, or **"flanking" policies** that can further support the growth of the sector:
  - Clean technical standards and certifications
  - Streamlined inspection procedures
  - Streamlined permitting procedures,
  - Enabling regulations for third-party ownership of solar H&C systems: e.g. for ESCOs
  - Etc.

Policies for Solar H&C

Flanking policies are part of the "Policy Bedrock"



Source: IEA-RETD 2016: RE TRANSITION

4. Concluding Remarks

Policies for Solar H&C

- The policy toolkit for solar H&C technologies is broad

- Strategies have been shown to work best when different policy support measures are used in combination with flanking measures

- **Policy stability and predictability** are also key ingredients: sudden changes in programs or in incentives can have significant negative impacts on market growth, and on company formation

Lessons Learned

- In short, **continuity is key**

- Avoid creating an incentive to ***delay*** a purchase of a solar H&C system: **new schemes are best introduced when they are announced**, rather than ahead of time.

- **Clear eligibility requirements** for technologies and materials need to be articulated, including potentially via lists of eligible products, or certified installers (i.e. via an installer registry)

https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/k4res-h_financial_incentives_for_renewable_hc.pdf

Lessons Learned

- **Awareness** matters
- Application procedures should be **simple, and streamlined**
- Financial incentives are most effective when they are carefully calibrated and linked to system size
- **Access to financing is critical**: low interest loans and revolving loan funds can play important roles

https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/k4res-h_financial_incentives_for_renewable_hc.pdf

Concluding Remarks

- Solar H&C has an important role to play in energy security
- Can help reduce electric grid loads at times of peak cooling demand, as well as in the evenings when residential hot water use is high
- Increases resilience against rising energy prices
- Solar H&C also creates substantial jobs – a large portion of the value chain cannot be de-localised.

Concluding Remarks

- In light of the importance of solar heating and cooling technologies, and the tremendous untapped potential, the need for stable, long-term policy frameworks to scale-up the market is increasingly clear

5. Further Reading

Further Reading

- http://www.estif.org/fileadmin/estif/content/publications/downloads/unep_report_final_v04_lowres.pdf
- http://iea-retd.org/wp-content/uploads/2011/10/Renewables-for-Heating-and-Cooling_book.pdf
- http://iea-retd.org/wp-content/uploads/2011/09/IREHC-Final-Report-20100726.pdf
- http://iea-retd.org/wp-content/uploads/2011/09/IREHC-Best-Practices-Guide-20100726.pdf
- https://ec.europa.eu/energy/en/topics/energy-efficiency/heating-and-cooling

Further Reading

- http://publications.jrc.ec.europa.eu/repository/bitstream/JRC72656/eur%2025407%20en%20-%20heat%20and%20cooling%20final%20report-%20online.pdf
- http://www.sci-network.eu/fileadmin/templates/sci-network/files/Resource_Centre/Innovative_Technologies/SOTA_solar_heating___cooling.pdf
- https://setis.ec.europa.eu/system/files/Technology_Information_Sheet_Heating_and_Cooling.pdf
-
- https://ec.europa.eu/energy/sites/ener/files/documents/overview_of_eu_support_activities_to_h-c_-_final.pdf
- https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-51-EN-F1-1.PDF

Further Reading

- https://de.slideshare.net/amanece13/solar-heating-and-cooling-system
- https://www.seia.org/initiatives/solar-heating-cooling
- https://ec.europa.eu/energy/en/topics/energy-efficiency/heating-and-cooling
- https://www.irena.org/publications/2015/Jan/Solar-Heating-and-Cooling-for-Residential-Applications
- International Energy Agency, (2018). Future of Cooling, http://www.iea.org/publications/freepublications/publication/The_Future_of_Cooling.pdf

Thank you for your time!

6. Knowledge Checkpoint: Multiple Choice Questions