WORKSHOP

IEA PVPS & IEA SHC

Solar Hot Water Collaboration
Group Online Workshop

International Energy Agency
Photovoltaic Power Systems Programme

SHC
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Multi-criteria Comparison of Domestic Hot Water Solutions

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Context of the work

The Energy Performance of Buildings Directive, European Directive 2010/31/EU (known as EPBD) requires Member States to apply a comparative methodology for the calculation of cost-optimal levels of minimum energy performance requirements for buildings and building components. This is done in order to keep national regulatory requirements up to date.

Regarding residential buildings, a significant share (ca. 20%) of the final energy demand in Portugal is for domestic sanitary water heating (DWH). This falls under the scope of EPDB «regulated uses» and so cost-optimal solutions should be examined for DHW.

Research questions

What is the cost-optimal technological solution for DWH?

Does the cost-optimal solution coincide with
optimal solutions according to other criteria?

- Renewable Share ← >75% for new buildings
- Local Renewable Share ← improves Energy Class
- Roof area occupied, space required, value chains, aesthetics, …

Does the cost-optimal solution changes according to the climatic zone?

DHW solutions examined

- Solar Thermal – DHW use only, with electrical backup
- Electric boiler – DHW use only, with grid electricity
- Electric boiler – DHW use only, with self-consumption PV electricity
- Natural gas boiler – DHW use only
- Biomass boiler – Space heating + DHW
- Heat pump – Space heating + DHW, with grid electricity
- Heat pump – Space heating + DHW, with self-consumption PV electricity

Methodology and assumptions

The methodology used follows the guidelines of Annex I of Regulation (UE) 244/2012.

Performance was computed according to Portuguese regulations for buildings: standard temperatures and hourly profile of DHW demand, hourly simulation for solar thermal and PV, monthly mean performance for heat pumps and biomass

Performance and costs were estimated for 30 years (but 20 years lifetime of equipment)

OPEX and equipment characteristics were obtained from commercial surveys

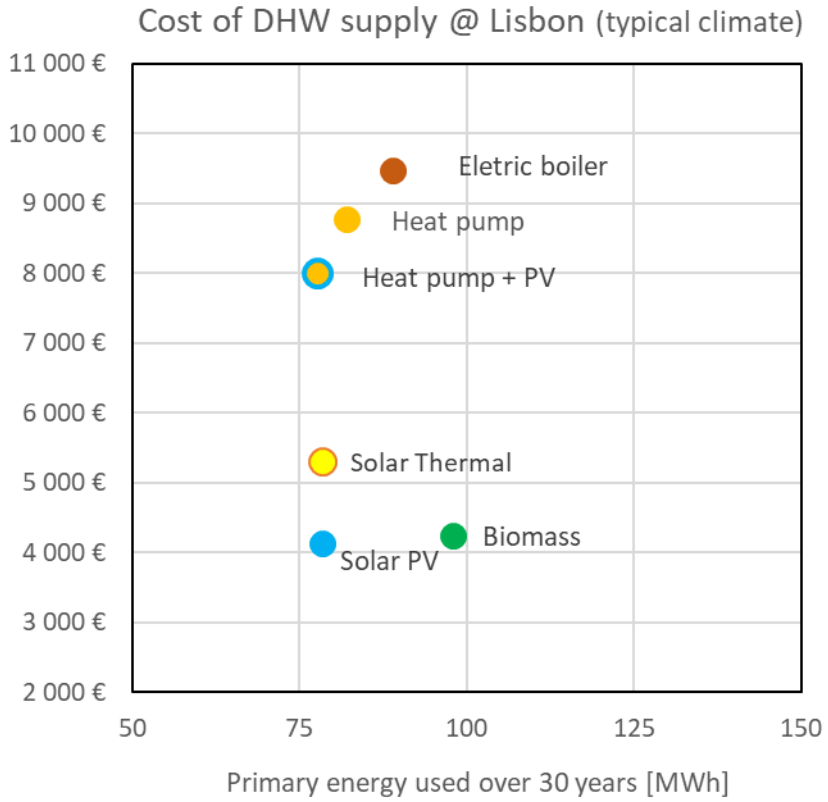
CAPEX was estimated considering each equipment type and cost projections of biomass, gas, electricity and GHG emissions

Discount rate 3%

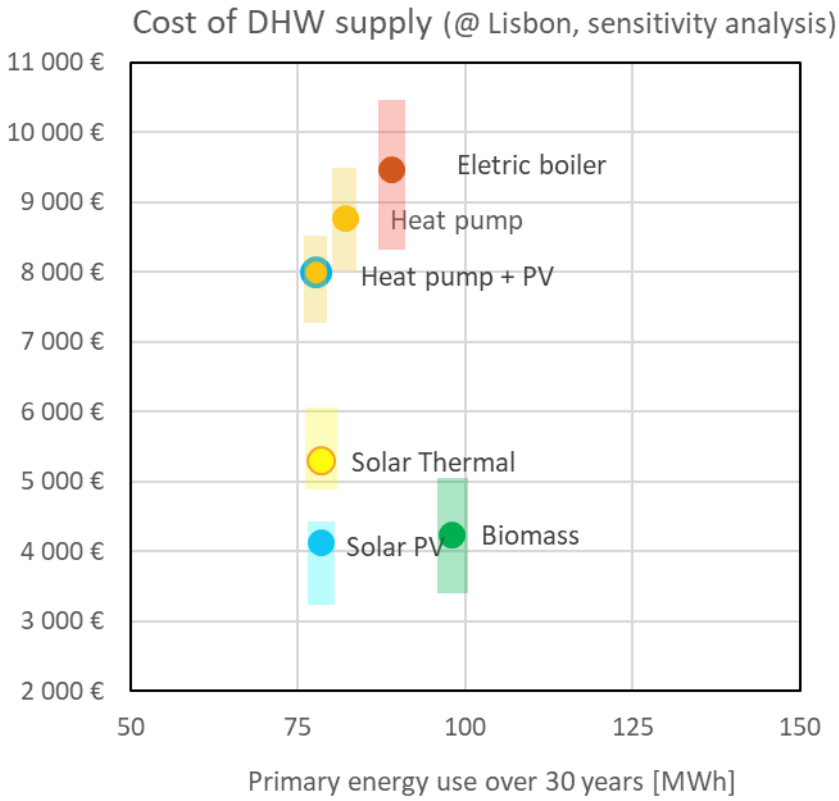
The study was mostly done during 2023, but although absolute values have changed somewhat, relative results should still hold

Remember that «natural» gas and grid electricity are being decarbonised by public policies
(renewable share ca. 70% now for electricity, and 98% for electricity and 20% for gas by the end of the assessment period)

Typical results

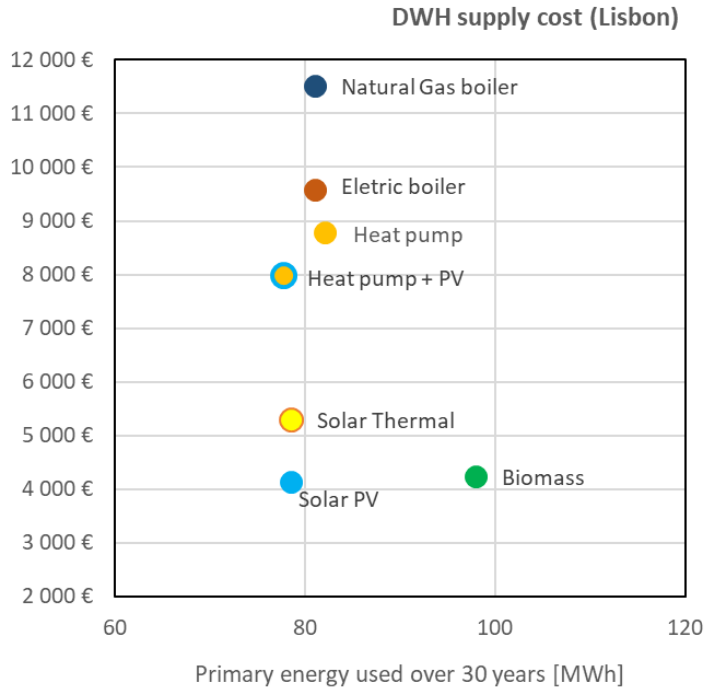


Sensitivity analysis



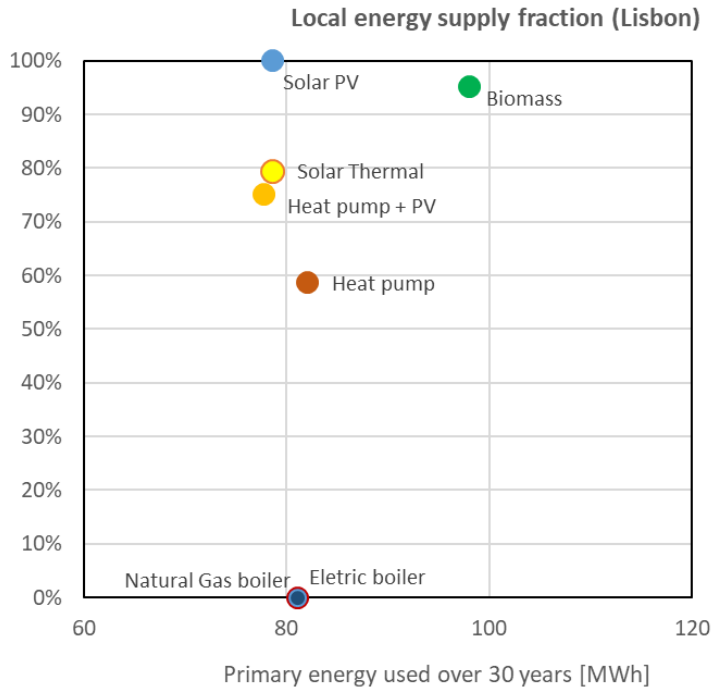
- CAPEX
- Efficiencies
- Grid electricity cost

Consumers' point of view



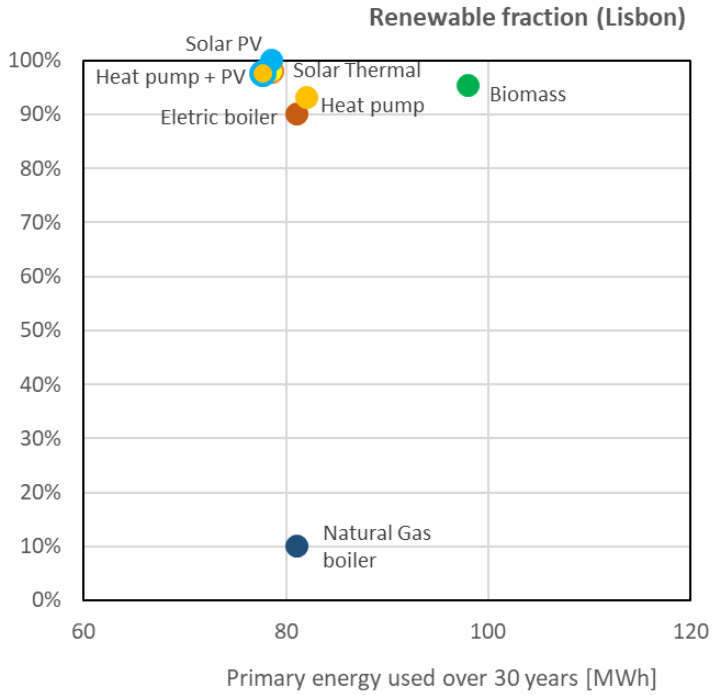
Strictly by least cost the best is a DHW electric boiler attended by self-consumption PV

Building regulations' point of view



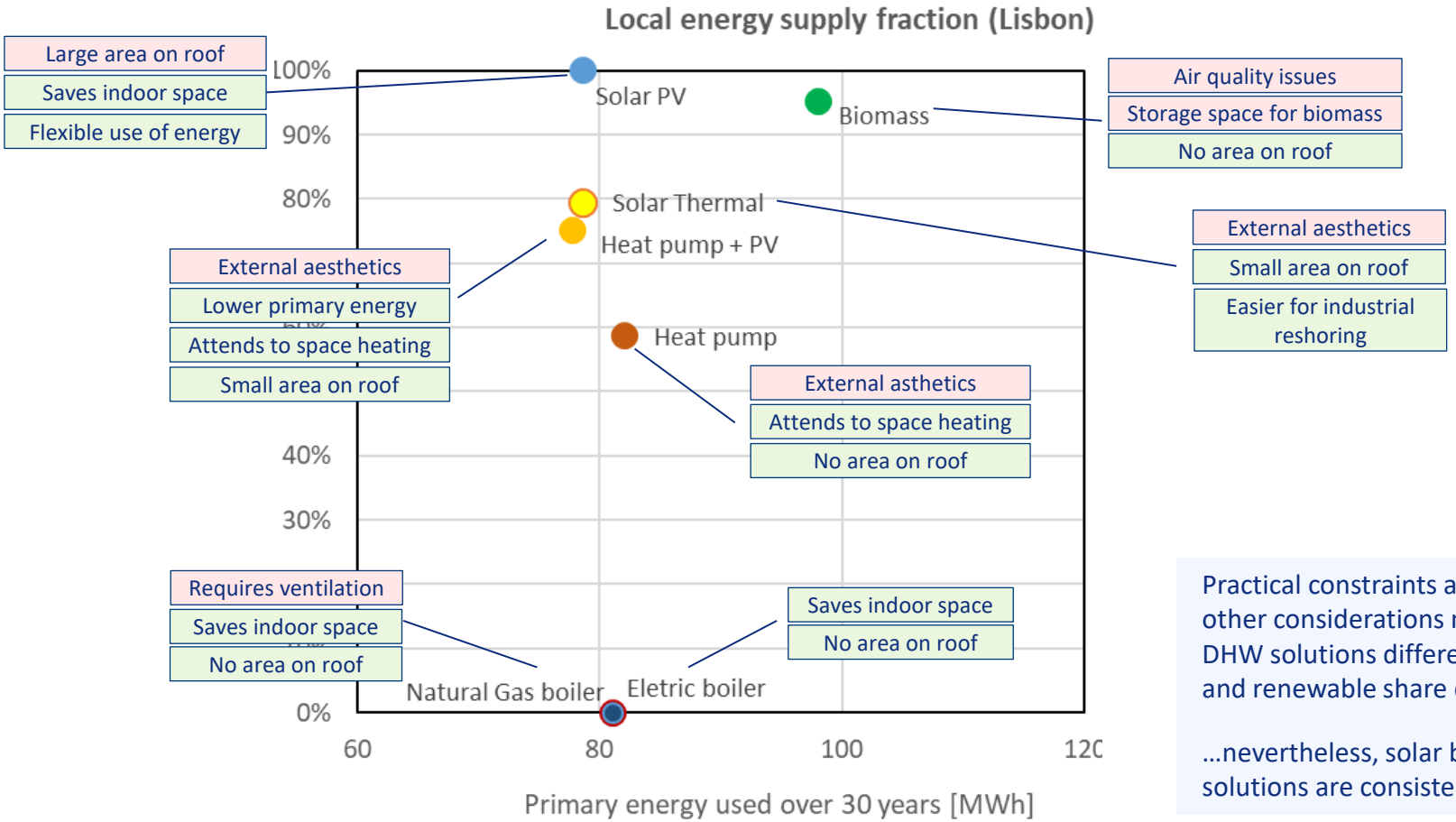
Again, a DHW electric boiler attended by self-consumption PV maximizes **local** renewable share, but a biomass boiler is not far

National energy policies' point of view



Although a DHW electric boiler attended by self-consumption PV still ranks best,
except for natural gas boilers, all other solutions also deliver > 90% renewable energy share

Other criteria



Practical constraints and other considerations may rank DHW solutions differently from costs and renewable share criteria alone…

…nevertheless, solar based hot water solutions are consistently superior

Thanks

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