SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

TASK60
PVT SYSTEMS

Overview of the PVT Industry and Perspectives

IEA SHC Task 60 2018-2020

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DUALSUN

DualSun ? PVT manufacturer since 2010

France – 600 PVT

Norway– 110 PVT

Netherlands – 308 PVT

Switzerland– 40 PVT

Production
And innovation
Made In France

France – 12 PVT

Australia – 30 PVT

Hong-Kong – 128 PVT

DUALSUN

- ✓ **> 1,100** installations around the world
- ✓ **15,000 m²** of panels sold
- ✓ **573 %** growth over 3 years (Deloitte Fast 50 Prize)
- ✓ **6** international family patents
- ✓ **3rd** version of PVT module Wave, Flash, now Spring
- ✓ **17** trophees of best product over the world

PVT = profitable electricity + cheap heat

Photovoltaic market

Total capacity : 505 GW (2018) [i]

Global weighted-average LCOE of utility-scale solar PV : 85€/MWh (2018) [ii]

LCOE residential PV <9kWc :
DE, 2016 : 155€/MWh [iii]
FR, 2017 : 130€/MWh [iv]
20-25 gCO2e /kWh [v]

Solar thermal market

Total capacity : 473 GW (2017) [vi]

Average LCOH :
Pool heating : 10€/MWh [vi]
District heat : 40€/MWh [vi]
Residential DWH :
WORLD : 80€/MWh [vi]

Carbon impact 2 times lower than PV [vii]

Photovoltaic market is more profitable and fast growing.
Solar thermal is the cheapest solar solution for heating.

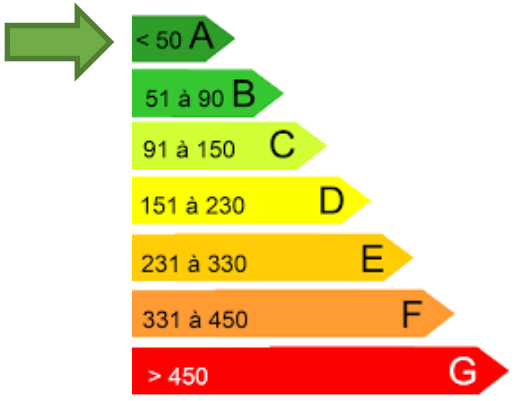
[i] REN21, renewables global status report, 2019
[ii] Irena, Renewable Power Generation Costs in 2018
[iii] Taylor *et al.,* Irena, True-costs-of-renewables, Lecture at Bonn, 2017
[iv] Etude de la compétitivité filière solaire française, iCare, Enerplan, Ademe, 2017
[v] Louwen et al., 2016, https://www.nature.com/articles/ncomms13728
[vi] Solar Heat Worldwide, 2019
[vii] INIES https://www.base-inies.fr/iniesV4/dist/consultation.html (files of French Ministery for PV and ST)

Towards positive energy and low carbon buildings

Buildings and construction: 39% of energy-related carbon dioxide (CO2) emissions
World Green Building Council : Coordinated action towards 100% Net Zero carbon buildings by 2050

In the French label E+C- (2019) : constraints in energy consumption and GHG emissions (LCA).

E+ C- ÉNERGIE POSITIVE & RÉDUCTION CARBONE
Bâtiment à Énergie Positive & Réduction Carbone

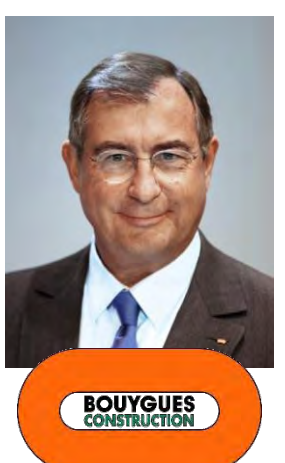


GHG emissions threshold : LCA of the building	*Ex : multihouse building*
Global	*<1550*
For construction products and equipments	*<800*

EXCESS

https://positive-energy-buildings.eu

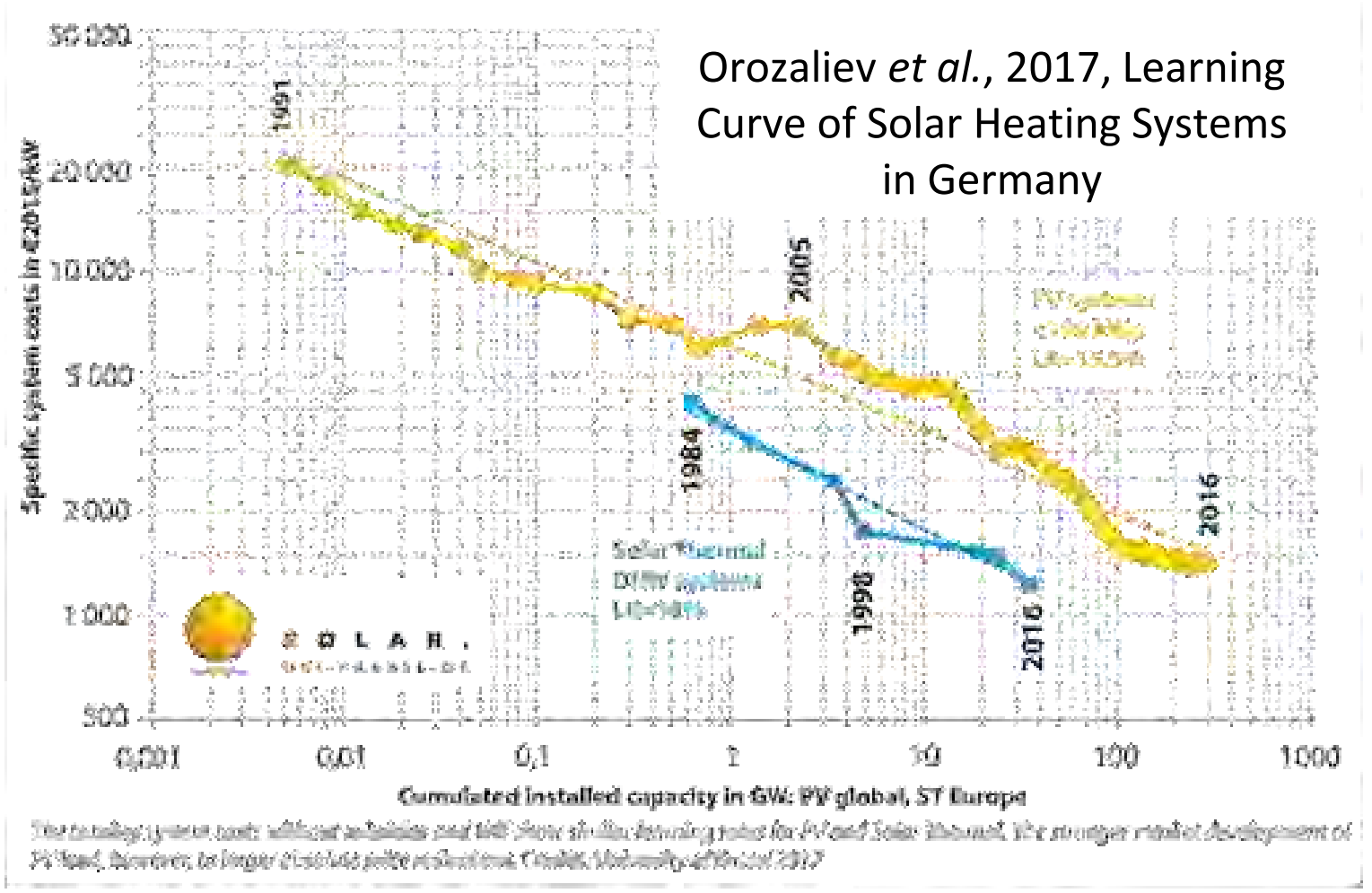
H2020 EXCESS PEB demosites:
PVT + GSHP
for refurbishment and new building



*« One thing is certain: we will always need to produce domestic hot water (DHW) and **the space on our buildings' rooftops is not infinite**…*
… the "2-in-1" technology (DHW and photovoltaic production), that combines two essential energy needs of buildings today and tomorrow, is very efficient.
We use this technology for our own buildings and we observe its excellent performance every day.»

- *Martin Bouygues, CEO of Bouygues*

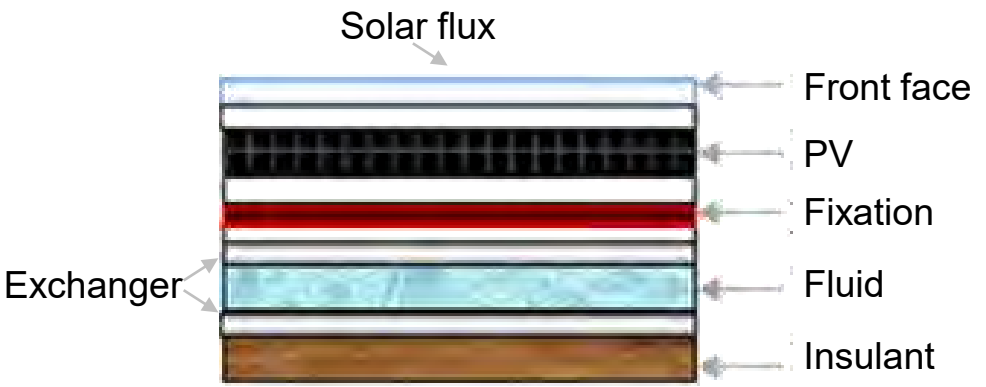
Price learning curve



PVT is an opportunity for **solar thermal** to benefit from the quick reduction in **PV** costs

/!\ the clients expect to see the same % in price reduction for PVT than they have with PV : a challenge as the selling volume is really not the same

PVT = {PV + ST}, design variations in all layer

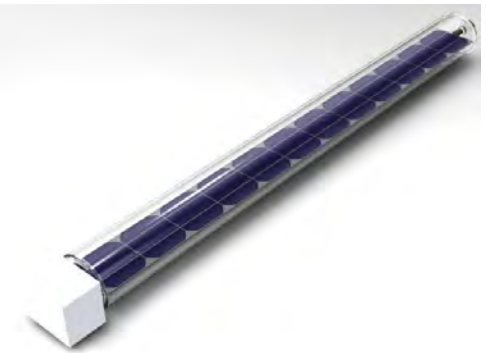


	Variants
Solar flux	**Flat plate collector**
	Concentration CPVT
	Trackers
Front face insulation	**« WISC »***
	Low emissivity coating
	Overglazed
	Vaccum
PV	**Crystalline cells**
	Thin film
	Semi-transparent
	Lower packing factor

*** « WISC » :** Wind and Infrared Sensitive Solar Collector
sometimes said "uncovered"

Fluid	**Water/ glycol water**
	Air
	Nanofluid
	Heat pipe
	Refrigerant
	Bi-fluids
Exchanger material	**Copper**
	Aluminium
	Stainless steel
	Polymer
Exchanger geometry	**Sheet-and-tube**
	Serpentine
	roll bond
	chanel
	Free
	With fins
Contact exchanger (or fluid) with PV module	**Below**
	Above
	Both
	Multiple passes
	Direct (without PCM)
	Indirect via PCM
Exchanger Fixation (if applicable)	**Gluing**
	Encapsulation
	Mechanical fixing
Back face insulation	**With rear insulation**
	Without insulation

Illustration of the wide diversity in PVT concepts in the market



vaccum [Naked]

concentration on tracker [SunOyster]

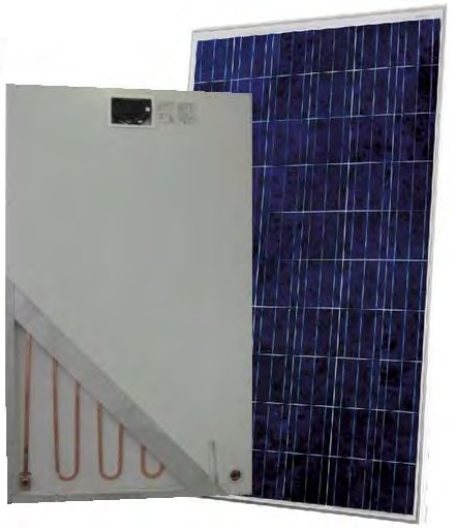
without tracking [Solarus]

air-based [Systovi]

overglazed [Endef]

stainless steel
[DualSun Wave]

polymer
[DualSun Spring]



copper
[Fototherm]

aluminium : serpentine
[3S]

roll bond
[Sunerg]

extruded
[Li-Mitra]

Norms : PV (IEC 61215+61730) + ST (ISO 9806)

Since 2013, SolarKeymark clearly identifies the quality norm approval for flat plate PVTs :

- the **whole PVT module** has to repass the IEC61215+61730 for photovoltaic quality, even if the PV laminate is already certified

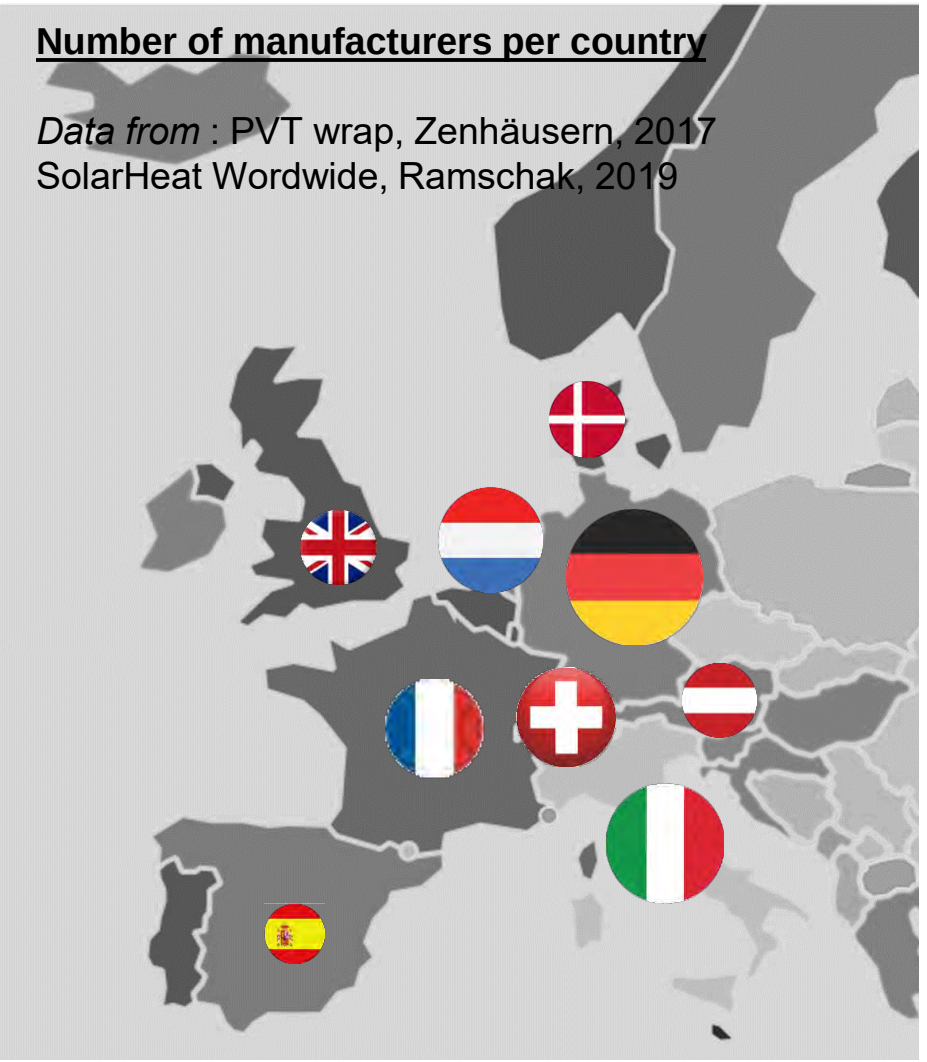
- the whole PVT module has to pass ISO9806 in MPPT mode, for solar thermal quality.

/!\ PV ageing cycling = up to +85°C only
If stagnation >85°C, no guaranty with the certifications that the PV part of the PVT stands cycles at the stagnation temperature with no degradation on PV performances

PVT manufacters are mainly european

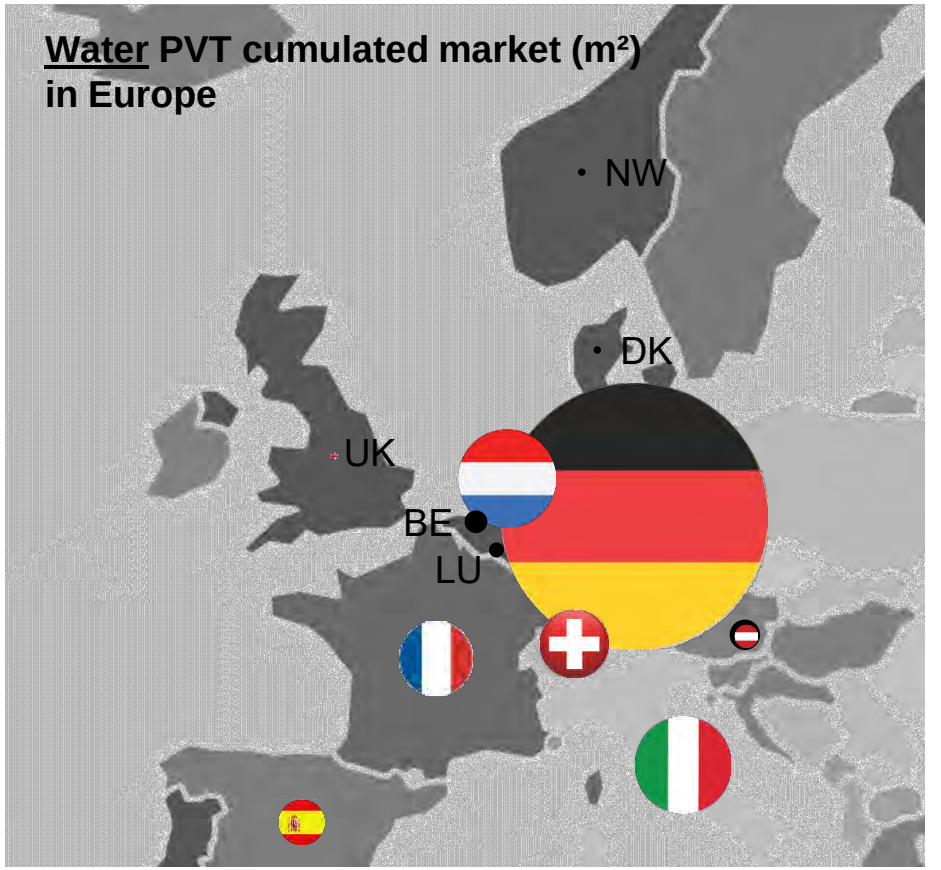
Number of manufacturers per country

Data from : PVT wrap, Zenhäusern, 2017
SolarHeat Wordwide, Ramschak, 2019



USA China Israël Australia

Water PVT cumulated market (m²) in Europe

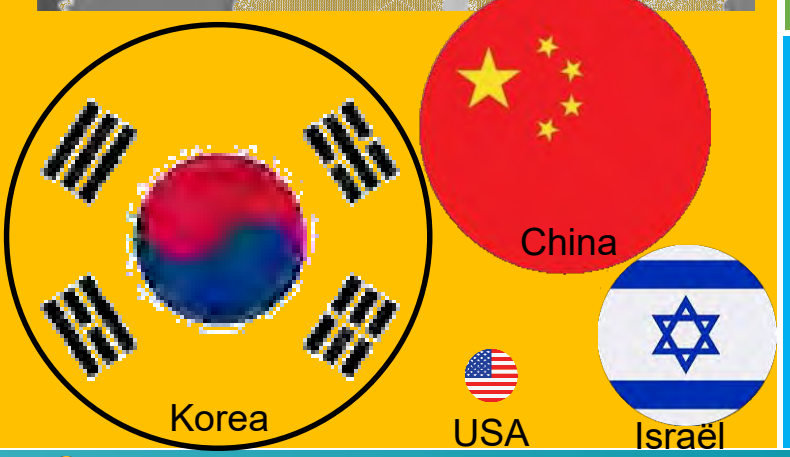


Data from :
SolarHeat Wordwide, Ramschak, 2019

Each manufacturer mainly sells in its domestic market.

Excluding France (air), WISC wPVT largely dominates the market

WISC water PVT cumulated market
0,61M m²
Asia : 68%
Europe : 23%
Israël : 9%
USA : 1%



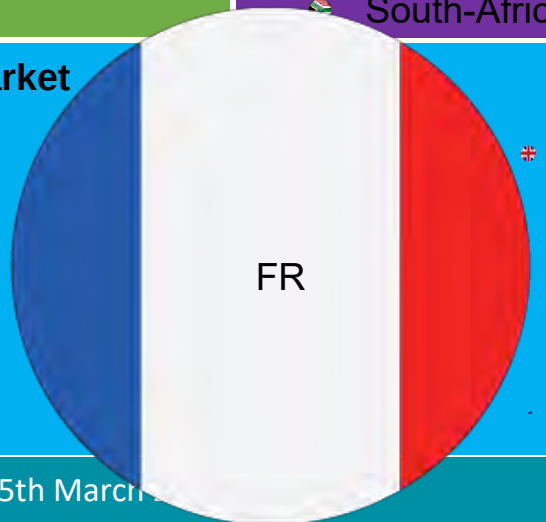
Glazed and vaccum cumulated market
0,02M m²
Europe : 85%
Unknown location : 15%

China

Concentrated cumulated market
0,003M m²
Europe : 60%
Africa : 23%
Asia : 13%

South-Africa India China

WISC air cumulated market
0,44M m²
Europe : 100%



UK
DE
BE
LUX
CH
Australia

Data from :
SolarHeat Wordwide,
Ramschak, 2019

Applications : wide typology of clients, and systems

Individual homes (DHW, Pools)

Multihouse building, social housing

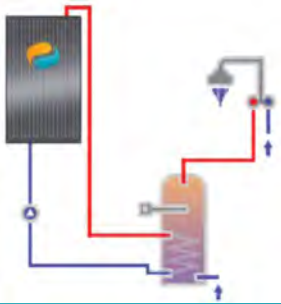
Schools, nursery

Campsites, restaurants and hotels

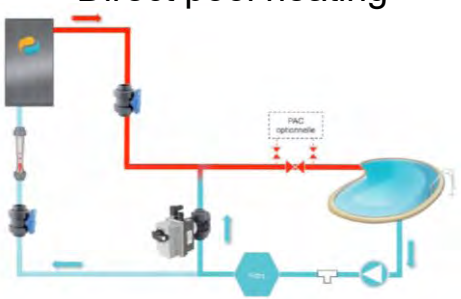
Public pools, gymnasium

Establishments for Elderly, hospitals

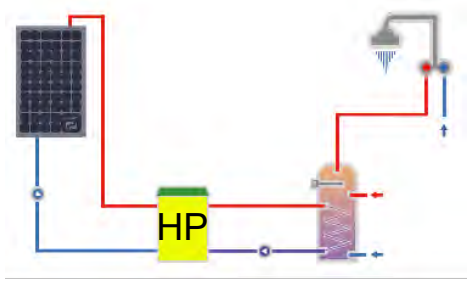
Direct SDHW



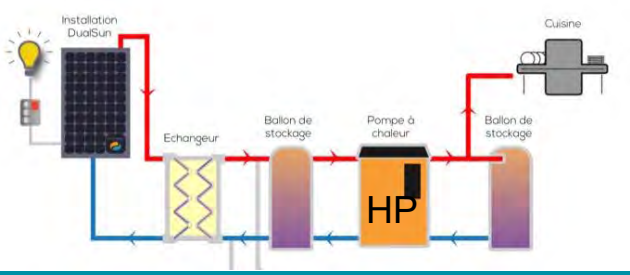
Direct pool heating



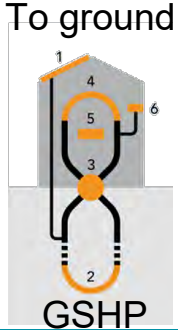
Direct glycol to heat pump



Cold side storage to heat pump



To ground



Barriers : unfair supports

Production : 6000kWh$_{el}$ + 1500kWh$_{th}$

(6kWc+SDHW in France)	PV+ST	PVT
PV support	1740€	1740€
ST support	2000€	1000€

For the same production,
PVT most of the time is less supported
than the side by side PV+ST
due to **unfavorable criteria for PVT**
(power at high temperature, minimum kWh/m², energy labelling, classified as « unglazed », PVT excluded …)*

* Data required for CDR (EU) N°811/2013 and N°813/2013 for energy labelling is not adapted to PVT (calculated at dT=40°C) !

SWOT : GO PVT !

Strengths	Weaknesses
- PVT already competitive //PV - >55 manufacturers in the market IEA Task 35 : technical issues behind us - Norms IEC/ISO already in place - Already thousands of successful PVT installations	- Lack of awareness from prescribers (still a young technology) - More complex than PV - Unfair public supports
Opportunities	**Threats**
- Taking advantage of PV costs - Best energy solution for positive buildings - Many plumbers already qualified in solar heating - Synergy with heat pumps	- As all REN : fossil price ! - Follow the rhythm of PV prices - Difficulty in Europe in financing massive investments for industrial companies in fast growing - Emergence of poor quality with a growing market?

https://dualsun.com/en/

www.iea-shc.org

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Linkedin #PVT

https://en.wikipedia.org/wiki/Photovoltaic_thermal_hybrid_solar_collector

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