



Overview of the PVT Industry and Perspectives

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DualSun ? PVT manufacturer since 2010



France – 600 PVT



Norway – 110 PVT



Netherlands – 308 PVT



- ✓ **> 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** trophies of best product over the world



Switzerland – 40 PVT



Production
And innovation
Made In France



France – 12 PVT



Australia – 30 PVT



Hong-Kong – 128 PVT

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 Ministry 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).



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

EXCESS

<https://positive-energy-buildings.eu>

H2020 EXCESS PEB demsites:

PVT + GSHP

for refurbishment and new building



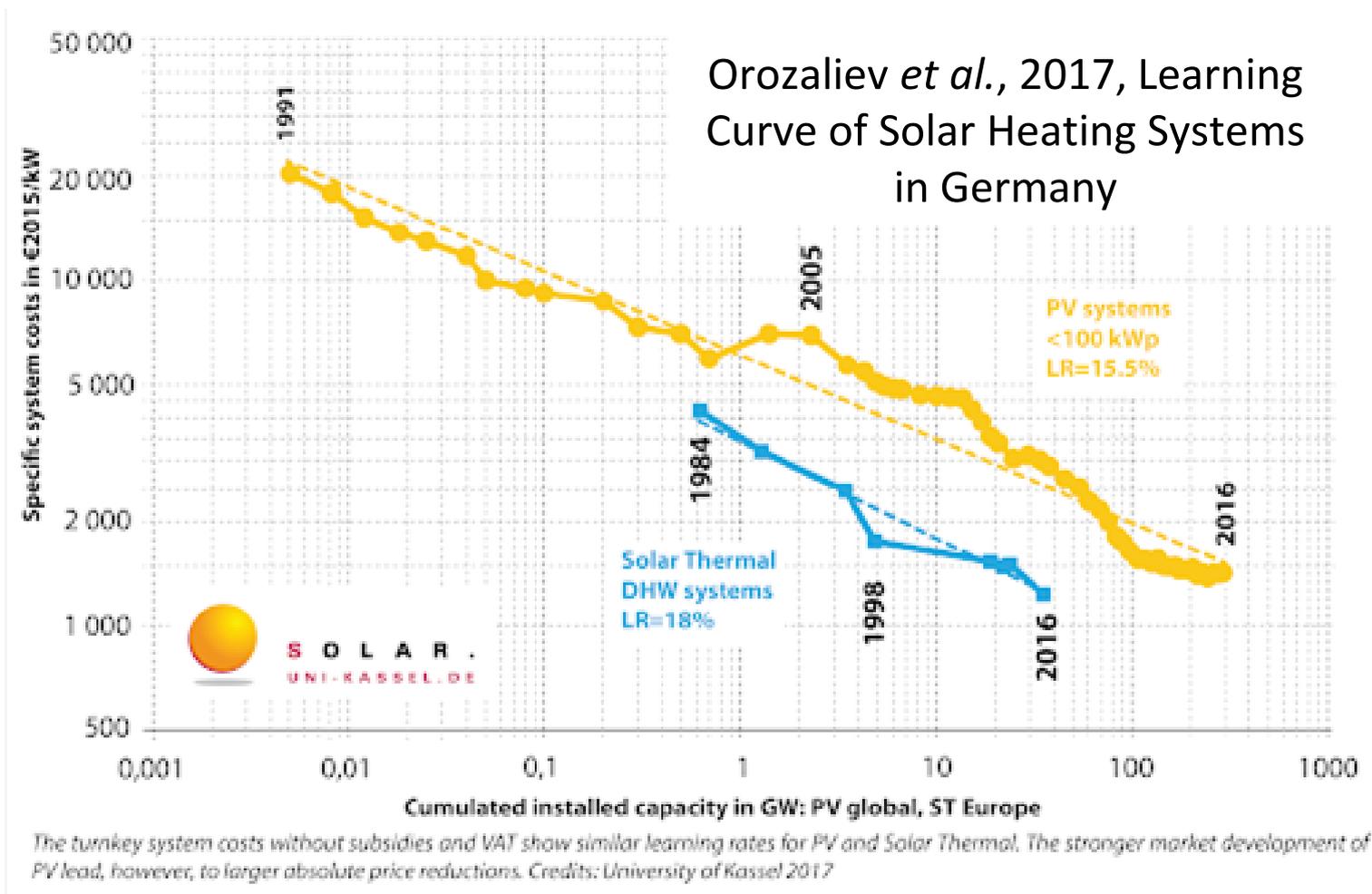
« One thing is certain: we will always need to produce domestic hot water (DHW) and **the space on our buildings' rooftops is not infinite...**

... 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

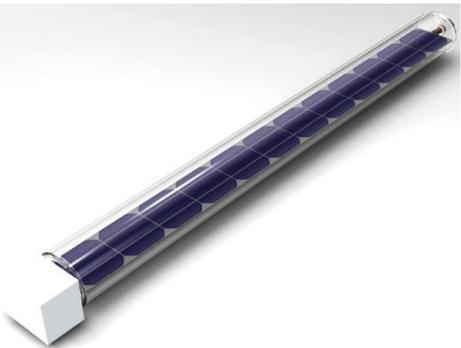


	Variants
Solar flux	Flat plate collector Concentration CPVT Trackers
Front face insulation	« WISC »* Low emissivity coating Overglazed Vaccum
PV	Crystalline cells Thin film Semi-transparent Lower packing factor

* « 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]



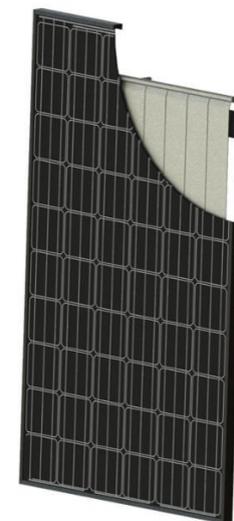
copper [Fototherm]



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 re-pass 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

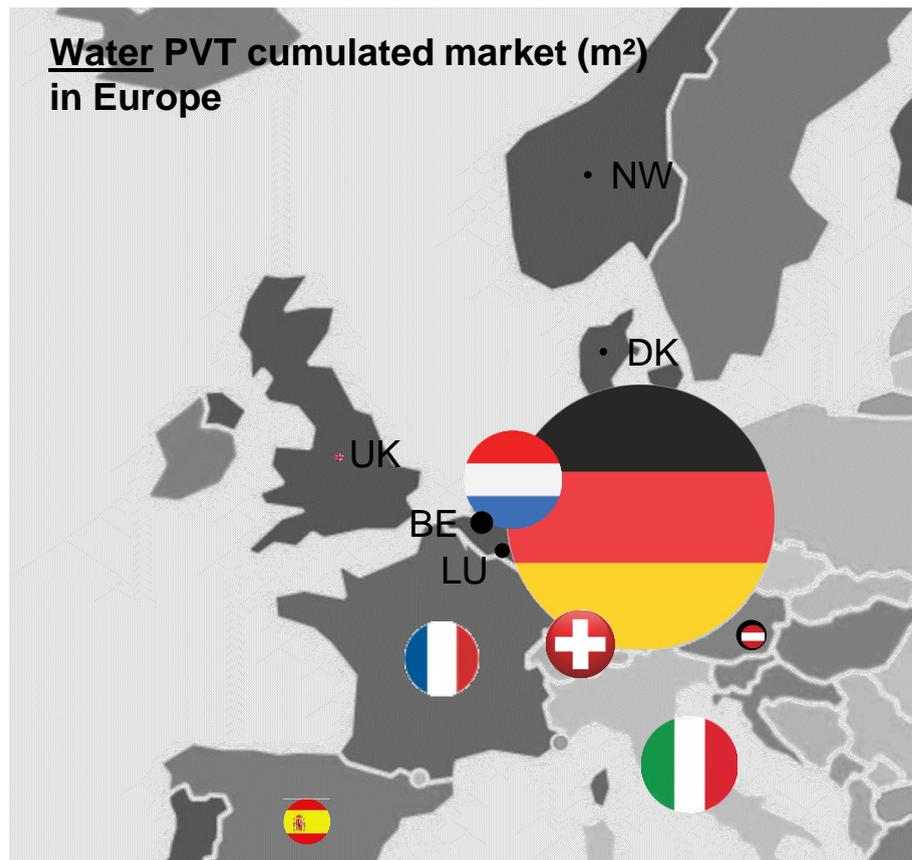
PVT manufacturers are mainly european

Number of manufacturers per country

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



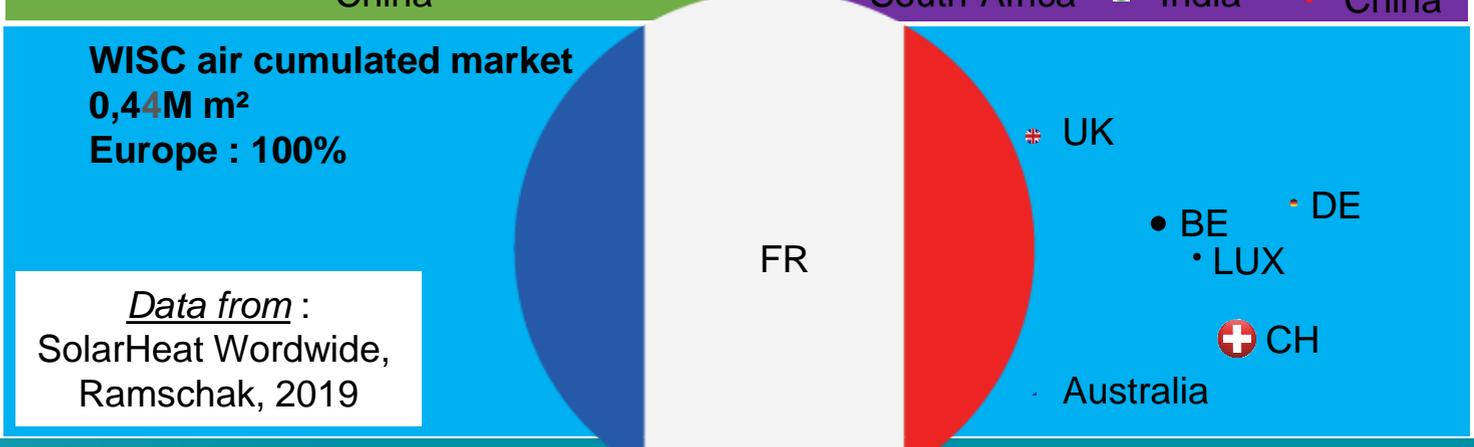
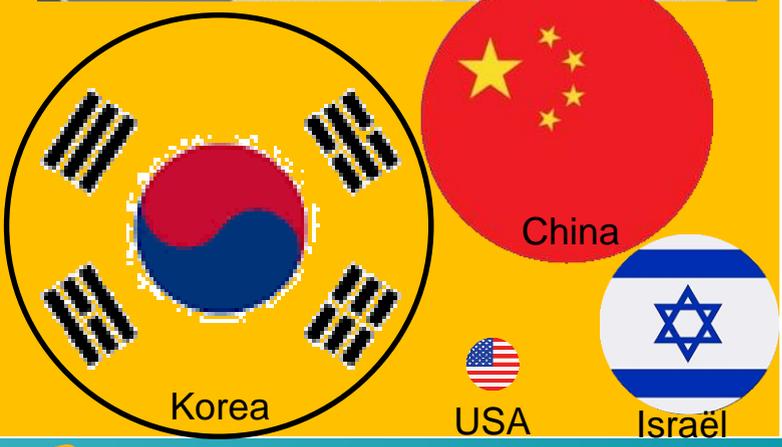
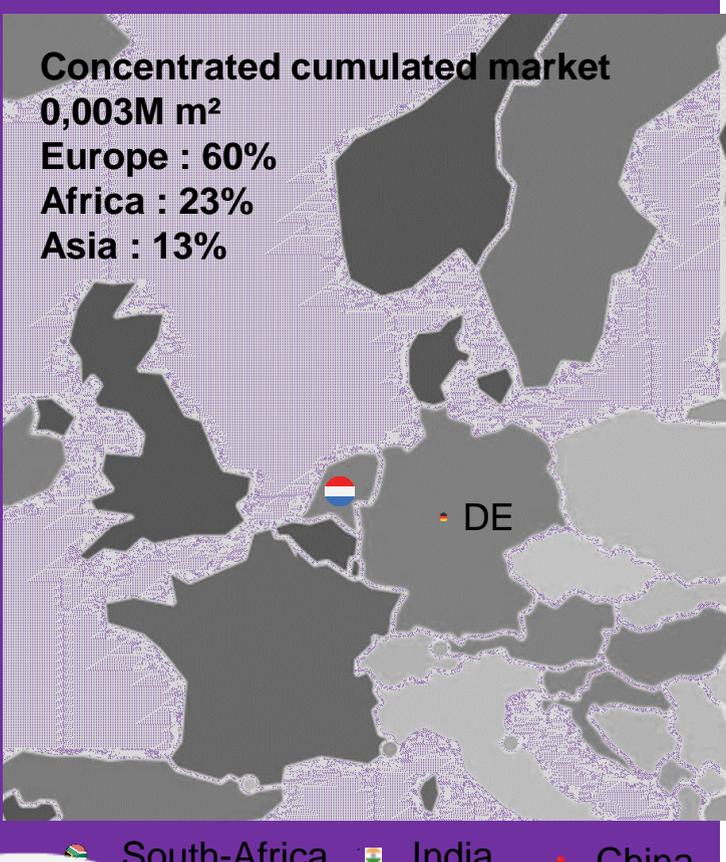
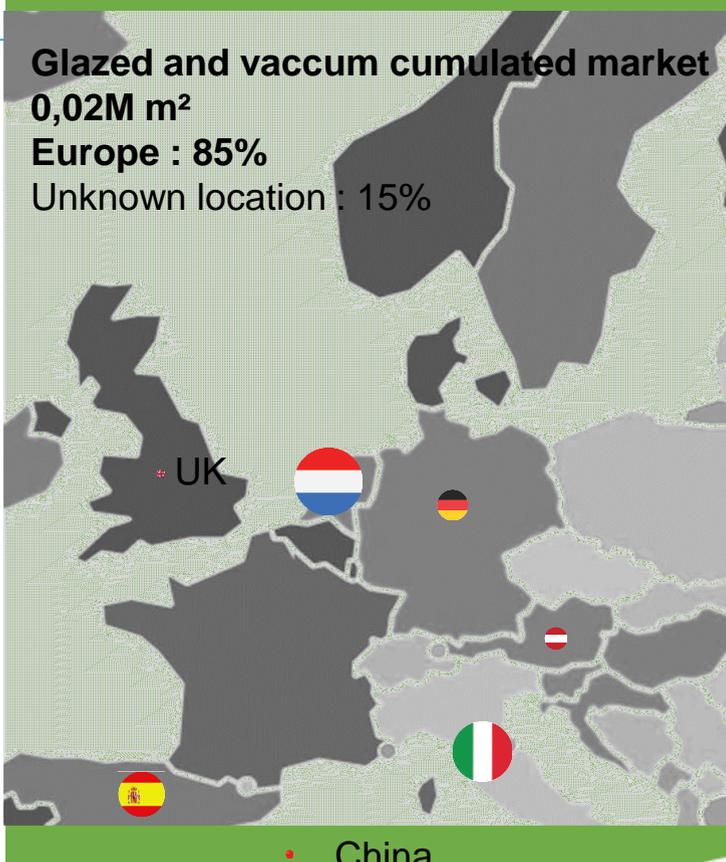
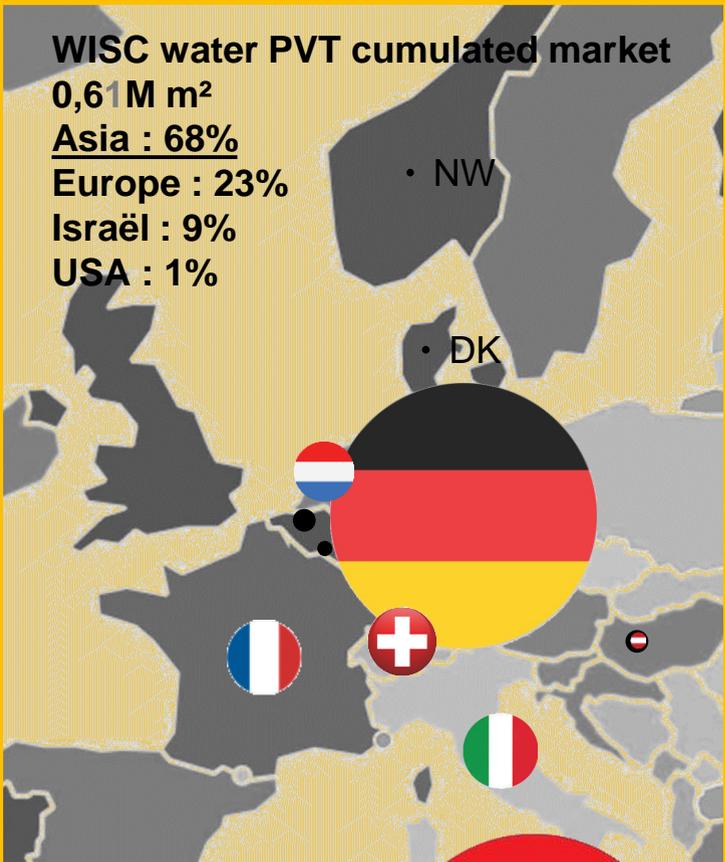
Water PVT cumulated market (m²) in Europe



Data from :
SolarHeat Worldwide, Ramschak, 2019

Each manufacturer mainly sells in its domestic market.

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



Applications : wide typology of clients, and systems

Individual homes (DHW, Pools)



Multihouse building, social housing



Schools, nursery



Campsites, restaurants and hotels



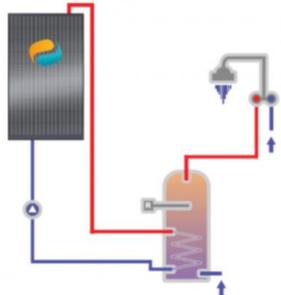
Public pools, gymnasium



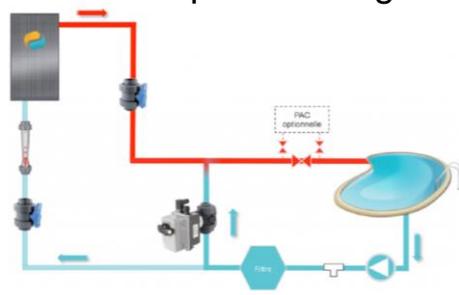
Establishments for Elderly, hospitals



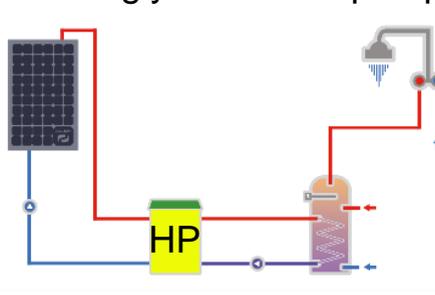
Direct SDHW



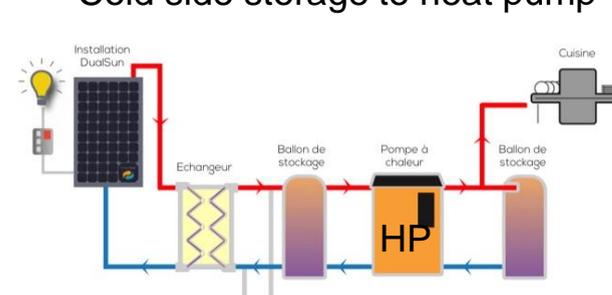
Direct pool heating



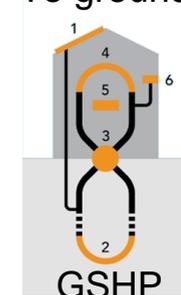
Direct glycol to heat pump



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
<ul style="list-style-type: none"> - 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 	<ul style="list-style-type: none"> - Lack of awareness from prescribers (still a young technology) - More complex than PV - Unfair public supports
Opportunities	Threats
<ul style="list-style-type: none"> - Taking advantage of PV costs - Best energy solution for positive buildings - Many plumbers already qualified in solar heating - Synergy with heat pumps 	<ul style="list-style-type: none"> - 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?

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Linkedin #PVT

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



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