SOLAR THERMAL & COLLECTIVE HOUSING:

Optimum Sizing - Opticube

27/09/2017

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CEO (Sunoptimo SA)

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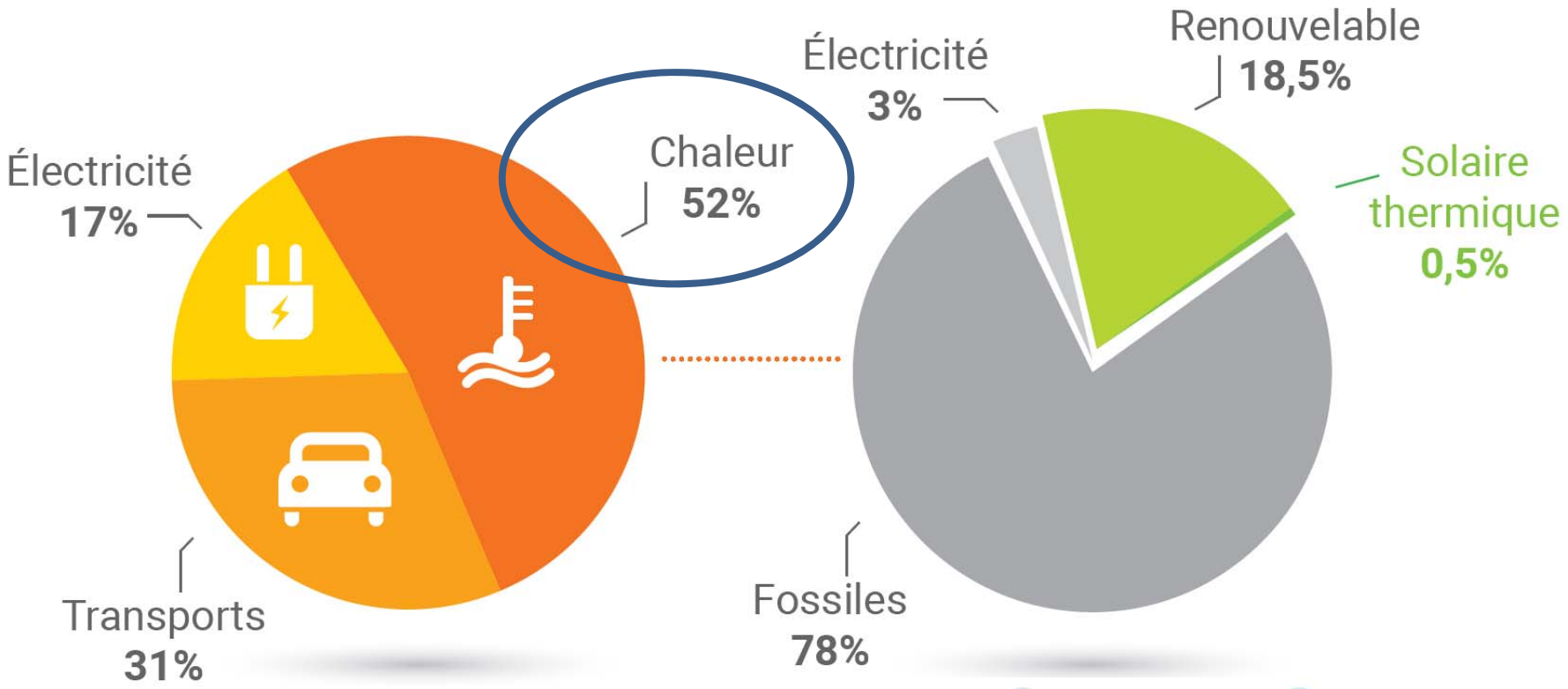
Solar Thermal?... The forgotten source of energy



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World Contribution of Renewable energies (2015)

Renewable power capacity (total, not including hydro)	GW	785
Renewable power capacity (total, including hydro)	GW	1,849
Hydropower capacity [2]	GW	1,064
Bio-power capacity [3]	GW	106
Solar hot water capacity [4]	GW_{th}	435
Geothermal power capacity	GW	13.2
Solar PV capacity	GW	227
Concentrating solar thermal power capacity	GW	4.8
Wind power capacity	GW	433

Source: RENEWABLES 2016 GLOBAL STATUS REPORT: REN21

Solar thermal ≈ Wind power ≈ 2X > Solar PV

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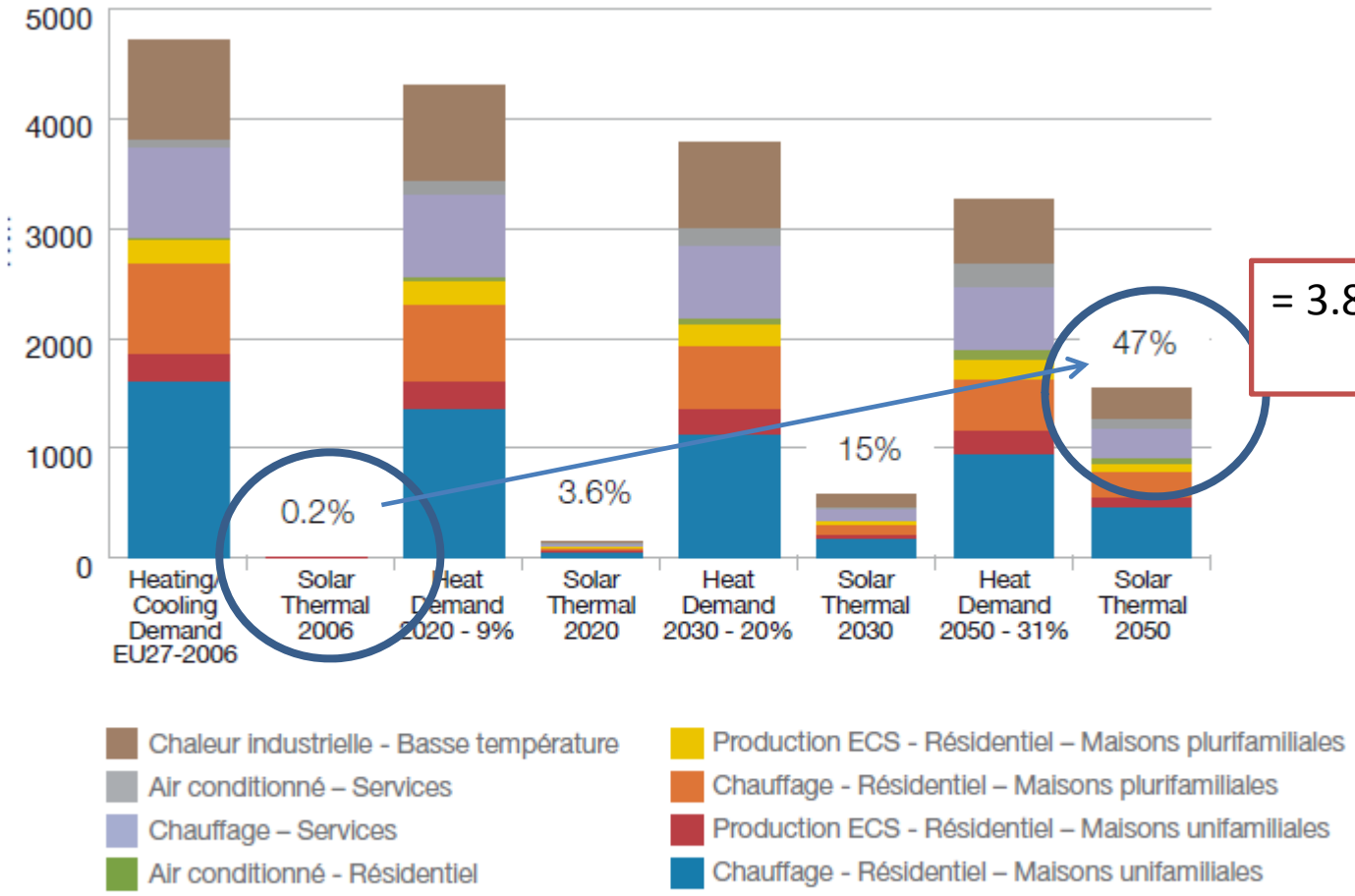
Solar thermal market opportunity



= 3.88 billions m² in EU

Figure 2: Demande de chauffage et de climatisation totale des 27 pays de l'UE et contribution du solaire thermique

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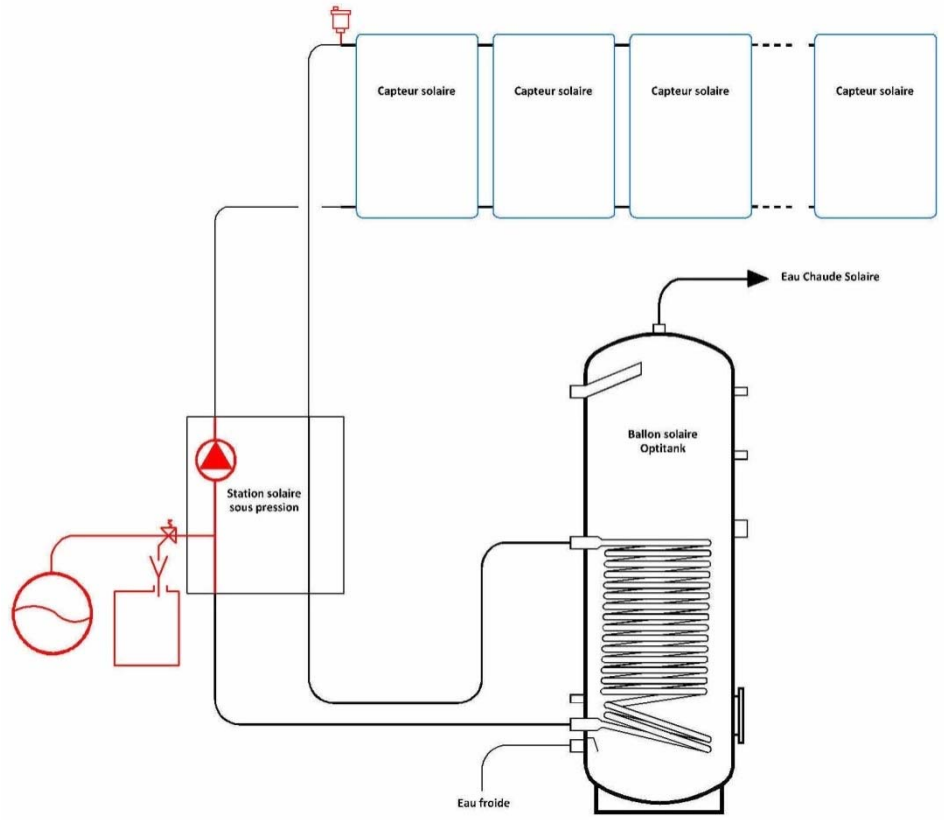
THIS IS <u>NOT</u> PV!

2 types of technologies

Pressurized

→ Circuit = full of liquid

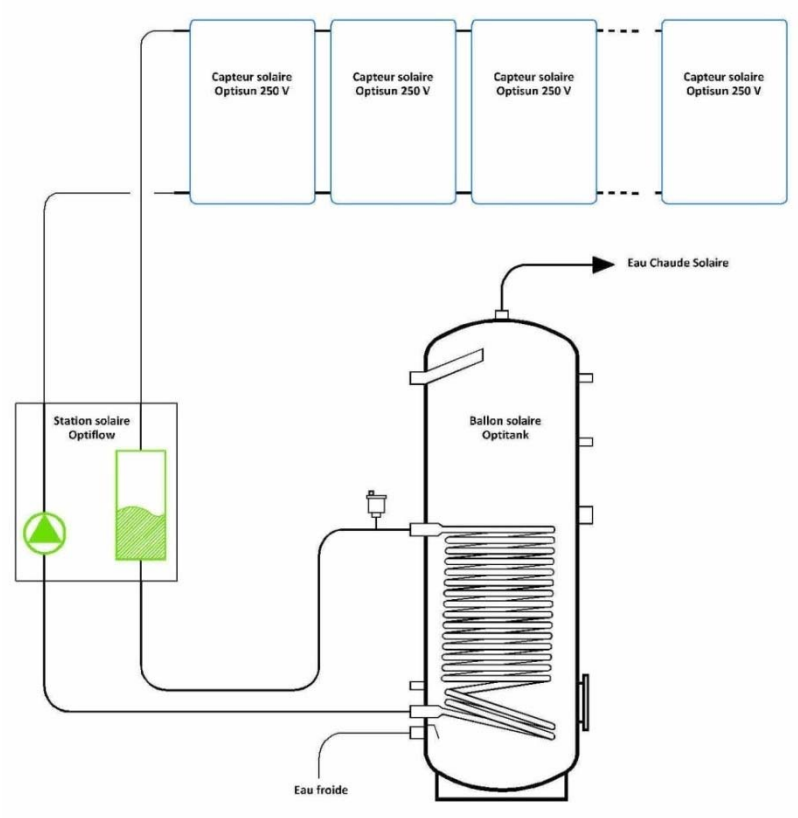
→ <u>Overheating</u>, limited solar surface



Drainback

→ Circuit = sealed air + liquid

→ <u>No overheating</u> , security



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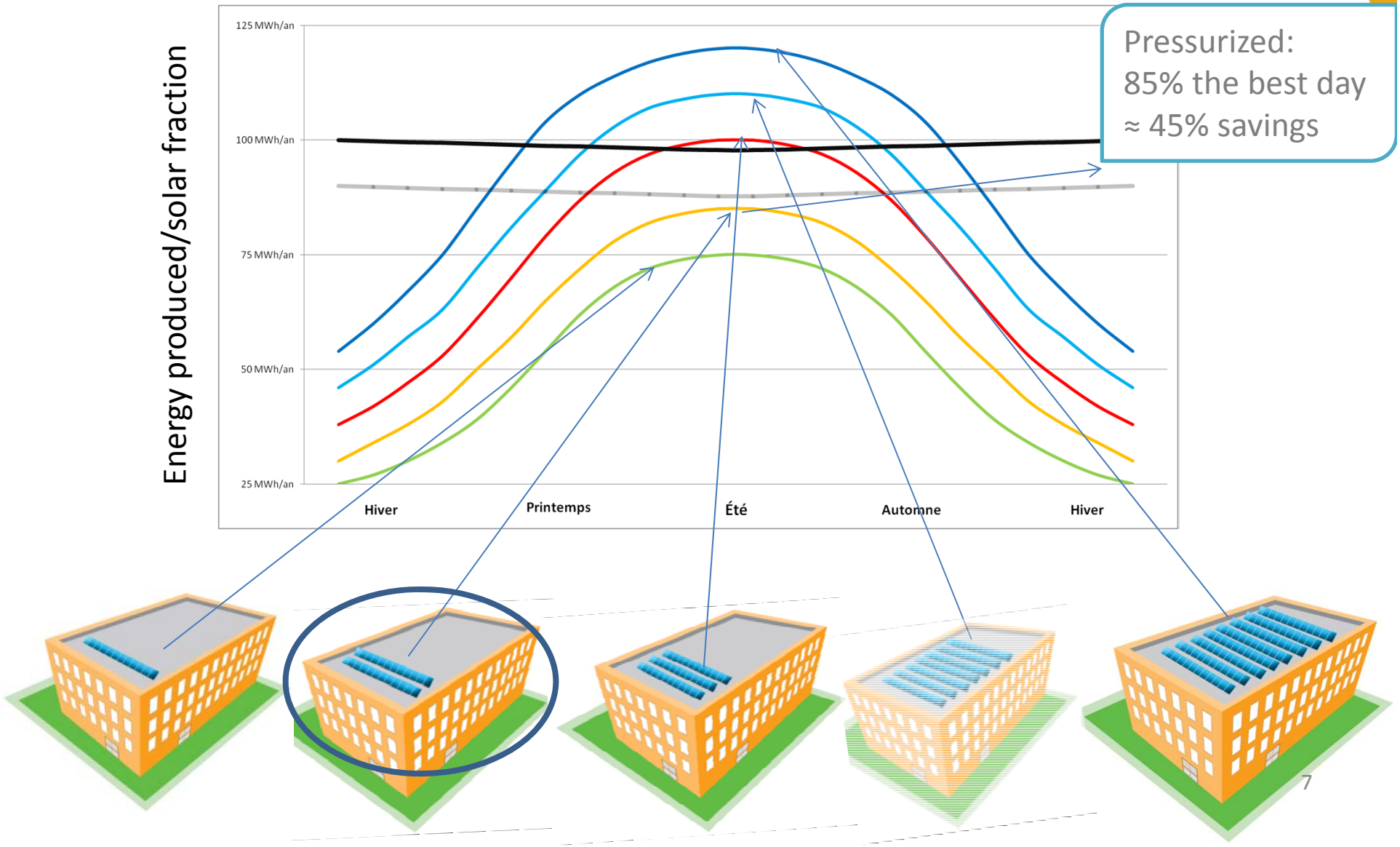
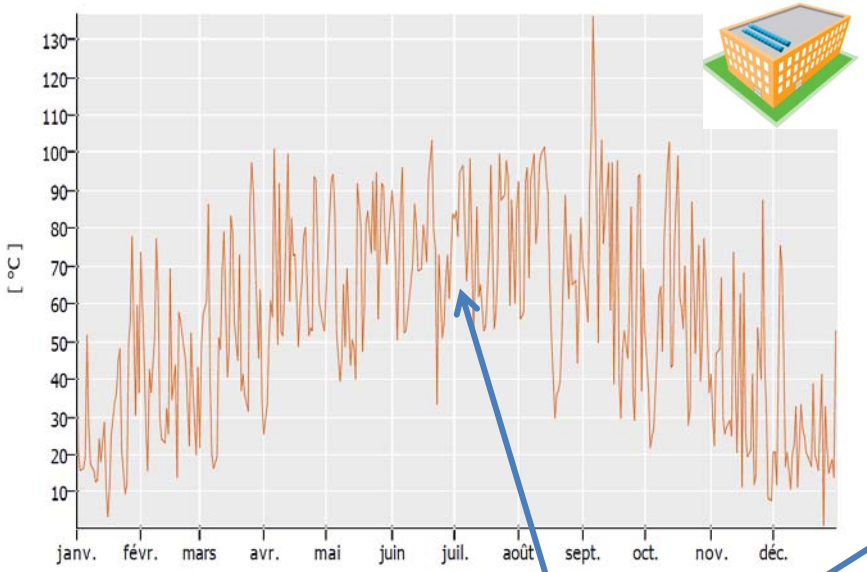
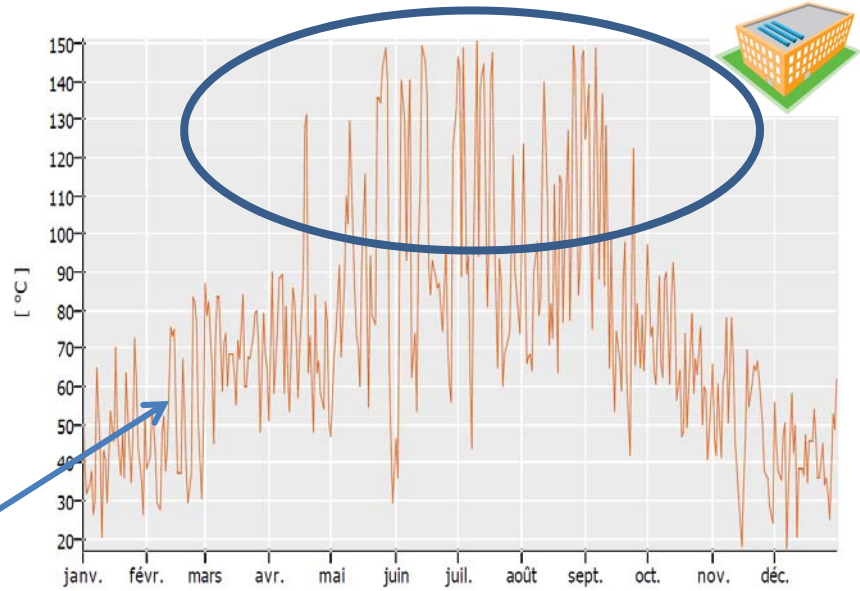
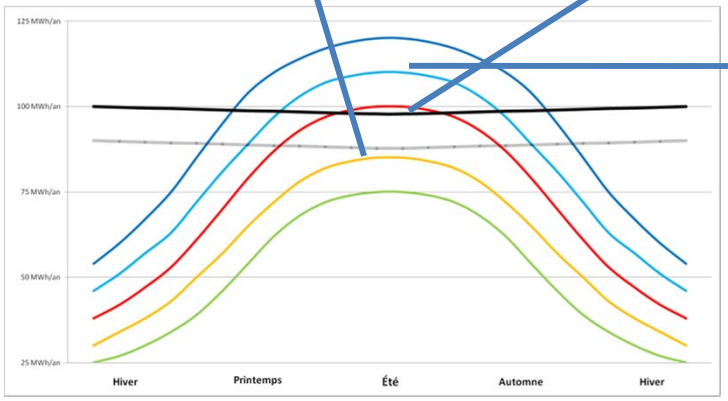
How is it usually sized?
Based on Domestic Hot Water (DHW) needs…

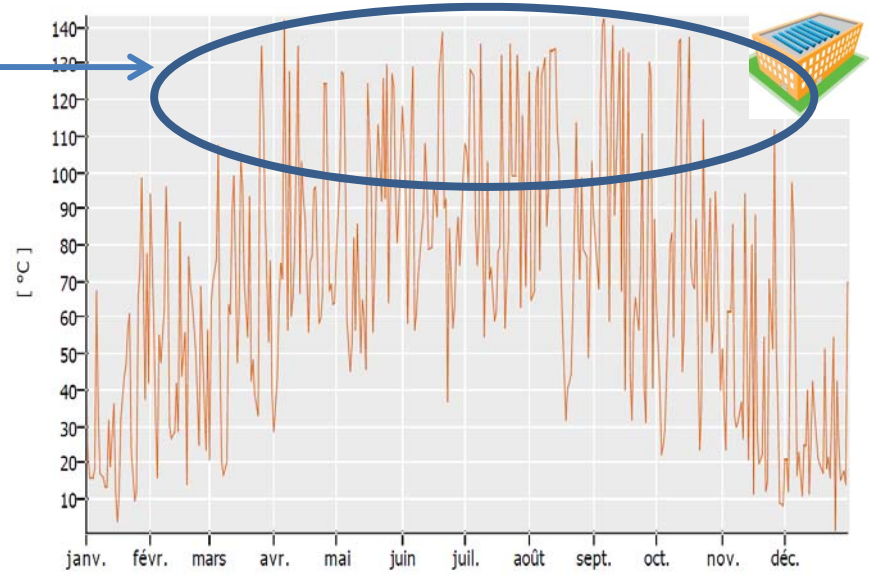


Energy produced/solar fraction
≈ T° in the system/collectors









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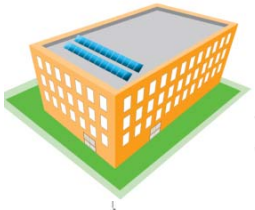
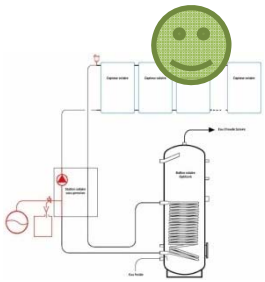
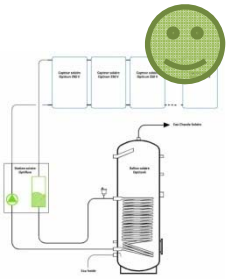
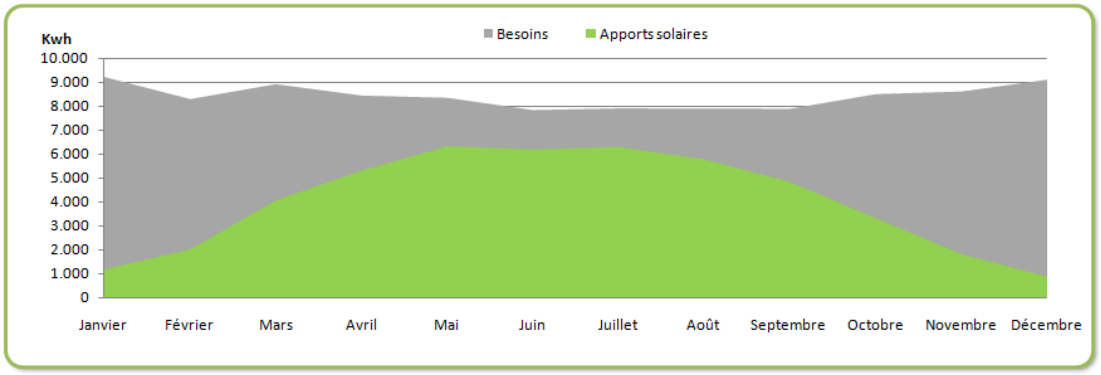
40-45% Solar Fraction (max pressurized)









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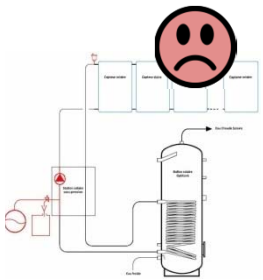
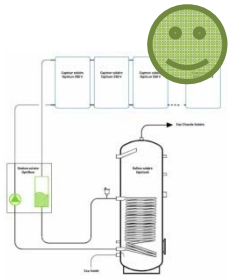
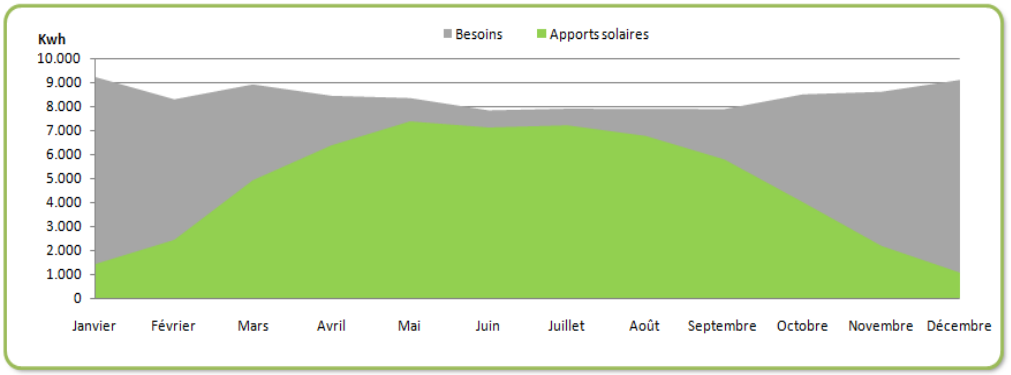
50-55% Solar fraction





1. Overheating = problems for pressurised syst.
2. Loss of energy production opportunity (or free heat capacity for inter-seasonal application)



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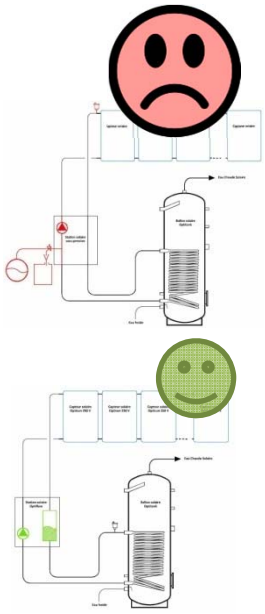
70% Solar Fraction



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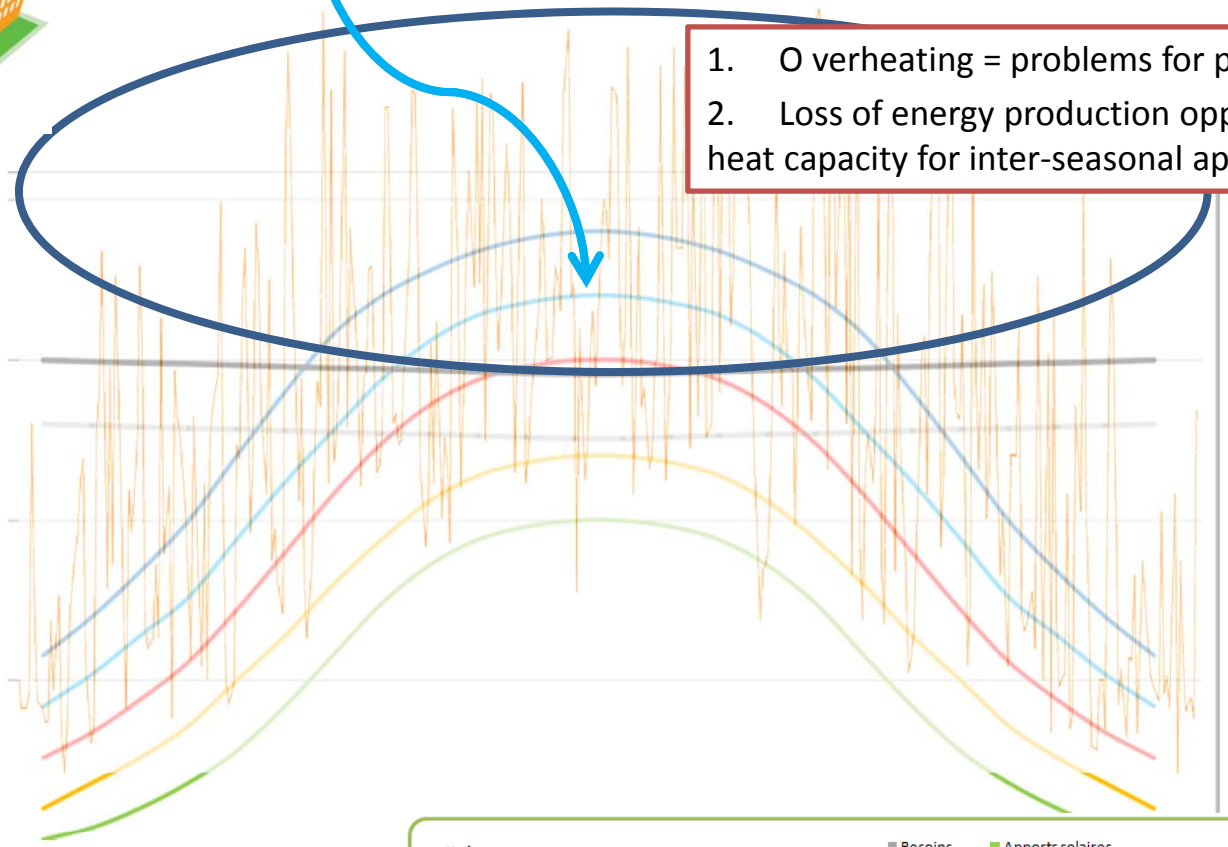

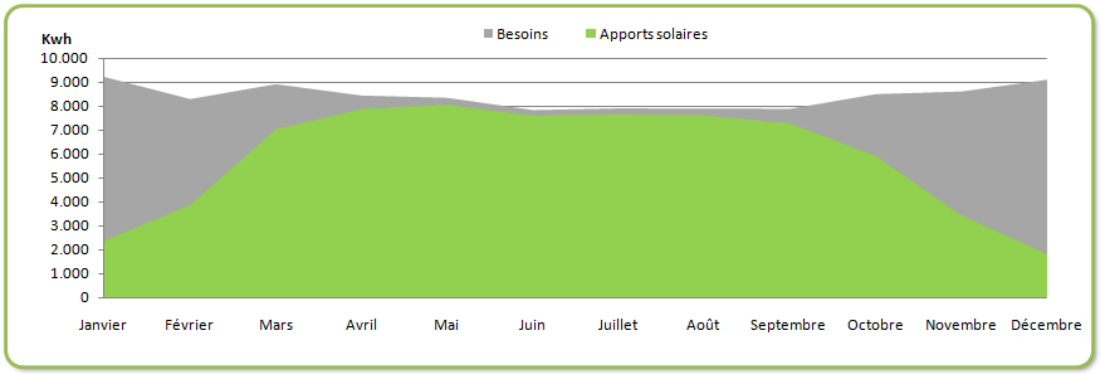

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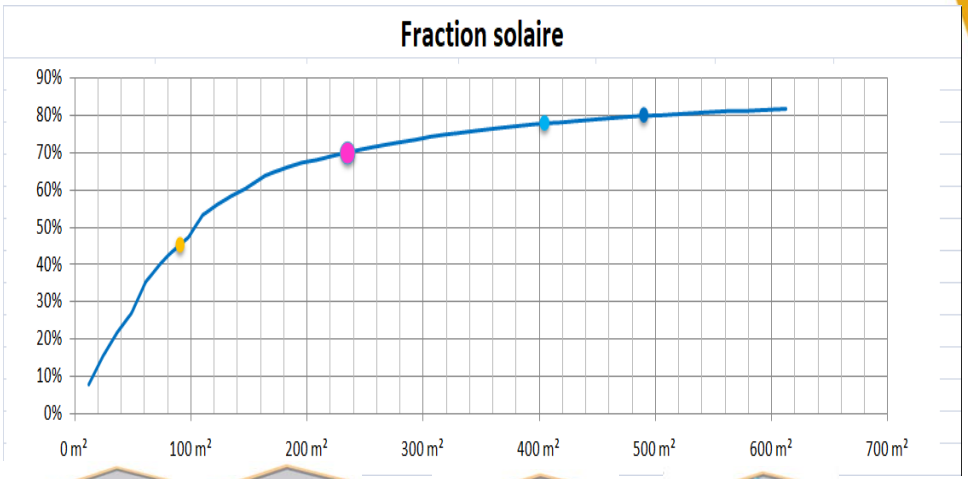
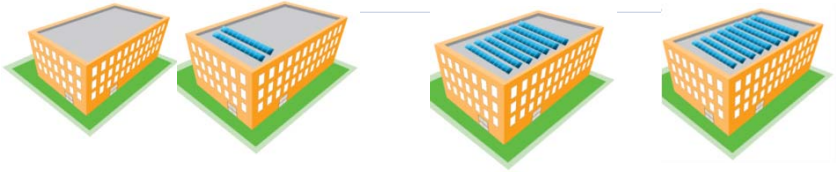
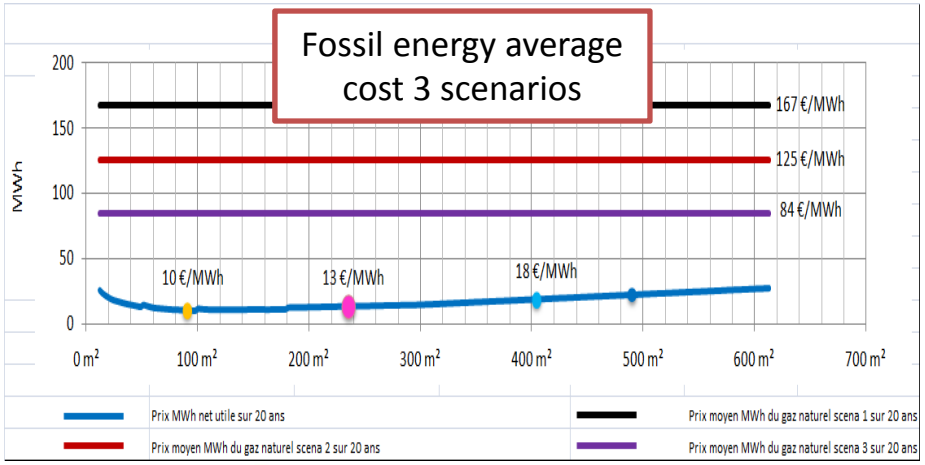
+ collectors = + free energy produced
… Yes but…







Solar MWh cost=

Total net cost/Total MWh produced

Question?

10 €/MWh or 18 €/MWh?

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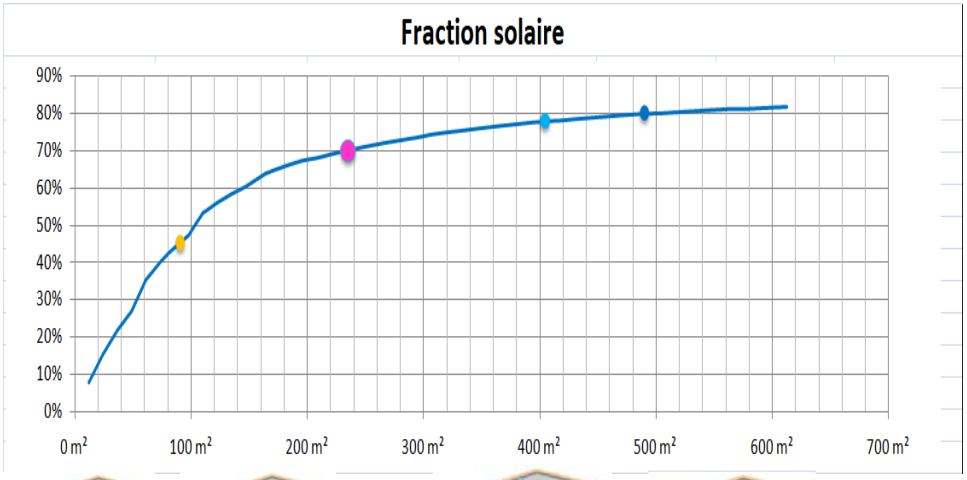
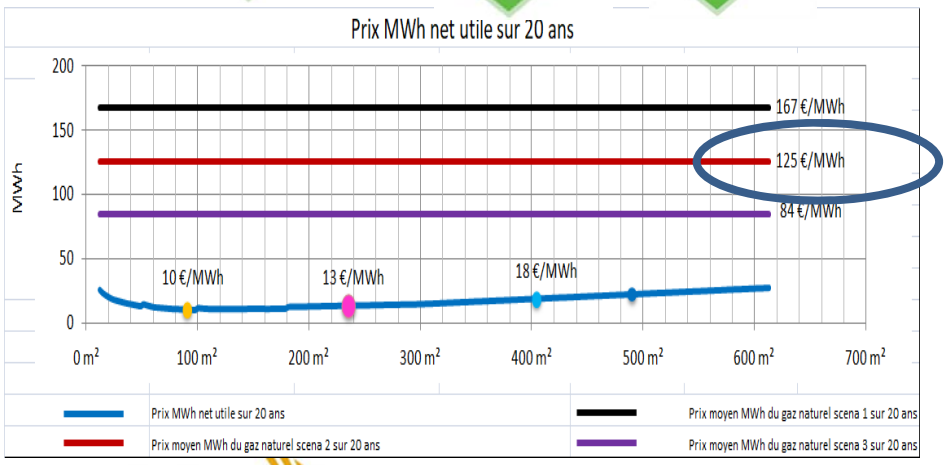
Economically Optimum Sizing?





45% @ 10 € or
78% @ 18 € ?

Answer:

0.45 x 10 + 0.55 x 125 = 73.25 €/MWh (+95%)
0.7 x 13 + 0.3 x 125 = 46.6 €/MWh
0.78 x 18 + 0.22 x 125 = 37.64 €/MWh

Dividing by 3 the cost of heating water for the next 20 years (125->38)

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Example: 1 simulation

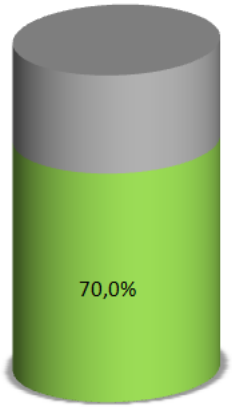
Résultats de l'installation

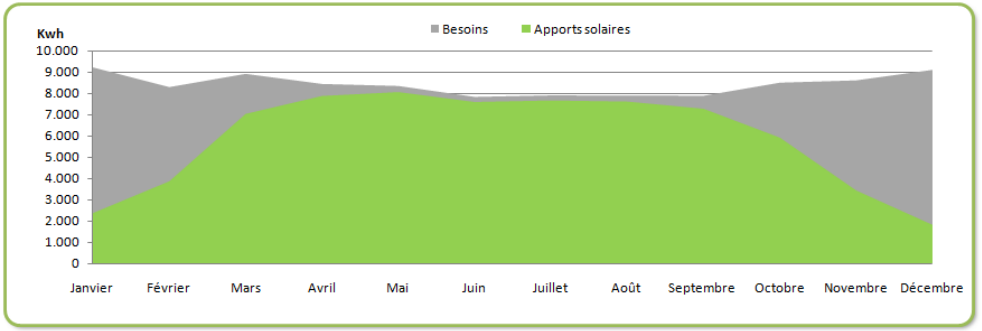
Nb capteurs Optisun	**96**	soit 235,296 m²	Nb de ballon	3 pce(s)
Estimation L. tuyauterie	270,00 m au total		Volume d'un ballon	3.000 litres
Diamètre tuyauterie	47 mm		Diamètre de la cuve	120 cm
			Volume total:	9.000 litres

Remarques

Les résultats présentés ne sont que des approximations. En effet la méthode de calcul SOLO (développée par le CSTB) se base sur des calculs mensuels de la production solaire. De plus les pertes thermiques d'une éventuelle boucle de distribution ne sont pas prises en compte par cette méthode.

	Besoins (en kWh/mois)	Apports solaires (en kWh/mois)	Taux de couverture
Janvier	9.238	2.379	25,8%
Février	8.313	3.880	46,7%
Mars	8.935	7.061	79,0%
Avril	8.461	7.906	93,4%
Mai	8.364	8.091	96,7%
Juin	7.850	7.622	97,1%
Juillet	7.922	7.697	97,2%
Août	7.915	7.642	96,6%
Septembre	7.902	7.304	92,4%
Octobre	8.520	5.938	69,7%
Novembre	8.629	3.443	39,9%
Décembre	9.126	1.820	19,9%
TOTAL annuel	**101.175 kWh**	**70.783 kWh**	**70,0%** soit 301 kWh/m².an





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250 simulations

Nombre de capteurs	Surface de capteurs solaires	Production solaire	Fraction solaire	Prix MWh net utile sur 20 ans	Volume Stockage	Apport solaire total annuel (MWh)
5	12,26 m²	646 kWh/m².an	**8%**	18,28 €	1.500 litres	7,9
10	24,51 m²	638 kWh/m².an	**15%**	13,17 €	1.500 litres	15,6
15	36,77 m²	600 kWh/m².an	**22%**	11,14 €	1.500 litres	22,1
20	49,02 m²	557 kWh/m².an	**27%**	9,69 €	1.500 litres	27,3
25	61,28 m²	583 kWh/m².an	**35%**	9,12 €	3.000 litres	35,8
30	73,53 m²	551 kWh/m².an	**40%**	8,47 €	3.000 litres	40,5
33	80,88 m²	532 kWh/m².an	**43%**	8,21 €	3.000 litres	43,0
40	98,04 m²	489 kWh/m².an	**47%**	7,83 €	3.000 litres	47,9
45	110,30 m²	489 kWh/m².an	**53%**	8,36 €	6.000 litres	53,9
50	122,55 m²	463 kWh/m².an	**56%**	8,35 €	6.000 litres	56,7
55	134,81 m²	438 kWh/m².an	**58%**	8,41 €	6.000 litres	59,1
60	147,06 m²	415 kWh/m².an	**60%**	8,51 €	6.000 litres	61,1
67	164,22 m²	394 kWh/m².an	**64%**	8,54 €	9.000 litres	64,6
70	171,57 m²	382 kWh/m².an	**65%**	8,63 €	9.000 litres	65,6
75	183,83 m²	364 kWh/m².an	**66%**	9,68 €	9.000 litres	66,9
80	196,08 m²	348 kWh/m².an	**67%**	9,85 €	9.000 litres	68,2
85	208,34 m²	330 kWh/m².an	**68%**	10,10 €	9.000 litres	68,9
90	220,59 m²	317 kWh/m².an	**69%**	10,29 €	9.000 litres	69,9
95	232,85 m²	304 kWh/m².an	**70%**	10,48 €	9.000 litres	70,8
100	245,10 m²	292 kWh/m².an	**71%**	10,67 €	9.000 litres	71,6
105	257,36 m²	281 kWh/m².an	**72%**	10,86 €	9.000 litres	72,4
110	269,61 m²	271 kWh/m².an	**72%**	11,06 €	9.000 litres	73,1
115	281,87 m²	262 kWh/m².an	**73%**	11,25 €	9.000 litres	73,8
120	294,12 m²	253 kWh/m².an	**74%**	11,44 €	9.000 litres	74,4
125	306,38 m²	245 kWh/m².an	**74%**	11,75 €	12.000 litres	75,2
130	318,63 m²	238 kWh/m².an	**75%**	12,13 €	12.000 litres	75,8
135	330,89 m²	230 kWh/m².an	**75%**	12,52 €	15.000 litres	76,2
140	343,14 m²	224 kWh/m².an	**76%**	12,90 €	15.000 litres	76,7
145	355,40 m²	217 kWh/m².an	**76%**	13,28 €	15.000 litres	77,2
150	367,65 m²	211 kWh/m².an	**77%**	13,66 €	15.000 litres	77,6
155	379,91 m²	205 kWh/m².an	**77%**	14,04 €	15.000 litres	78,0
160	392,16 m²	200 kWh/m².an	**78%**	14,42 €	15.000 litres	78,4
165	404,42 m²	195 kWh/m².an	**78%**	14,80 €	15.000 litres	78,8
170	416,67 m²	190 kWh/m².an	**78%**	15,21 €	18.000 litres	79,0
175	428,93 m²	185 kWh/m².an	**78%**	15,59 €	18.000 litres	79,4
180	441,18 m²	181 kWh/m².an	**79%**	15,96 €	18.000 litres	79,7
185	453,44 m²	176 kWh/m².an	**79%**	16,34 €	18.000 litres	80,0
190	465,69 m²	172 kWh/m².an	**79%**	16,72 €	18.000 litres	80,3
195	477,95 m²	169 kWh/m².an	**80%**	17,10 €	18.000 litres	80,6
200	490,20 m²	165 kWh/m².an	**80%**	17,47 €	18.000 litres	80,9
205	502,46 m²	161 kWh/m².an	**80%**	17,90 €	21.000 litres	80,9
210	514,71 m²	158 kWh/m².an	**80%**	18,28 €	21.000 litres	81,2
215	526,97 m²	155 kWh/m².an	**81%**	18,66 €	21.000 litres	81,5
220	539,22 m²	152 kWh/m².an	**81%**	19,03 €	21.000 litres	81,7
225	551,48 m²	149 kWh/m².an	**81%**	19,41 €	21.000 litres	81,9
230	563,73 m²	146 kWh/m².an	**81%**	19,79 €	21.000 litres	82,2
235	575,99 m²	143 kWh/m².an	**81%**	20,23 €	24.000 litres	82,1
240	588,24 m²	140 kWh/m².an	**81%**	20,60 €	24.000 litres	82,3
245	600,50 m²	137 kWh/m².an	**82%**	20,98 €	24.000 litres	82,5
250	612,75 m²	135 kWh/m².an	**82%**	21,36 €	24.000 litres	82,7

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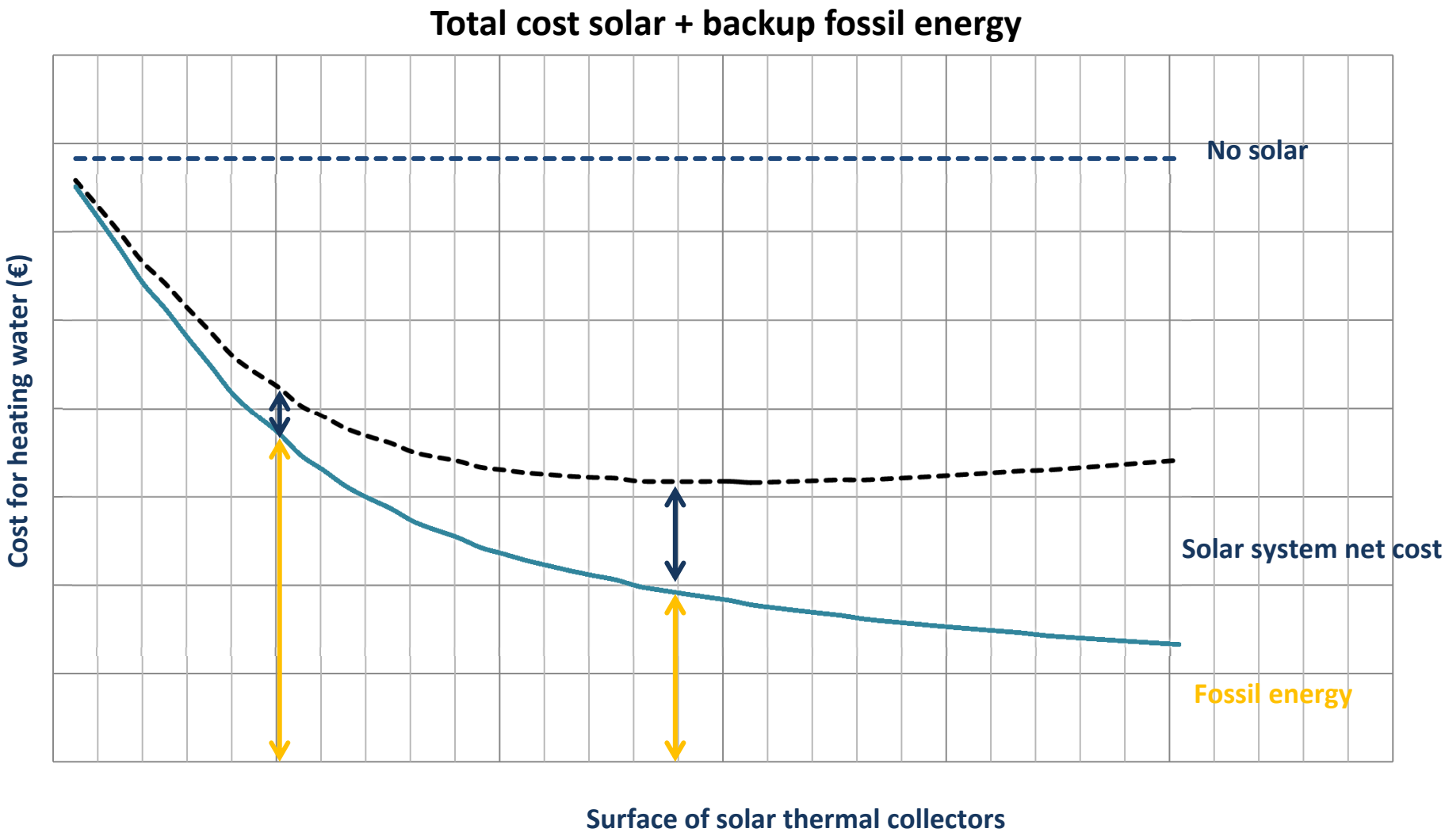
Total cost for DHW during 20 years



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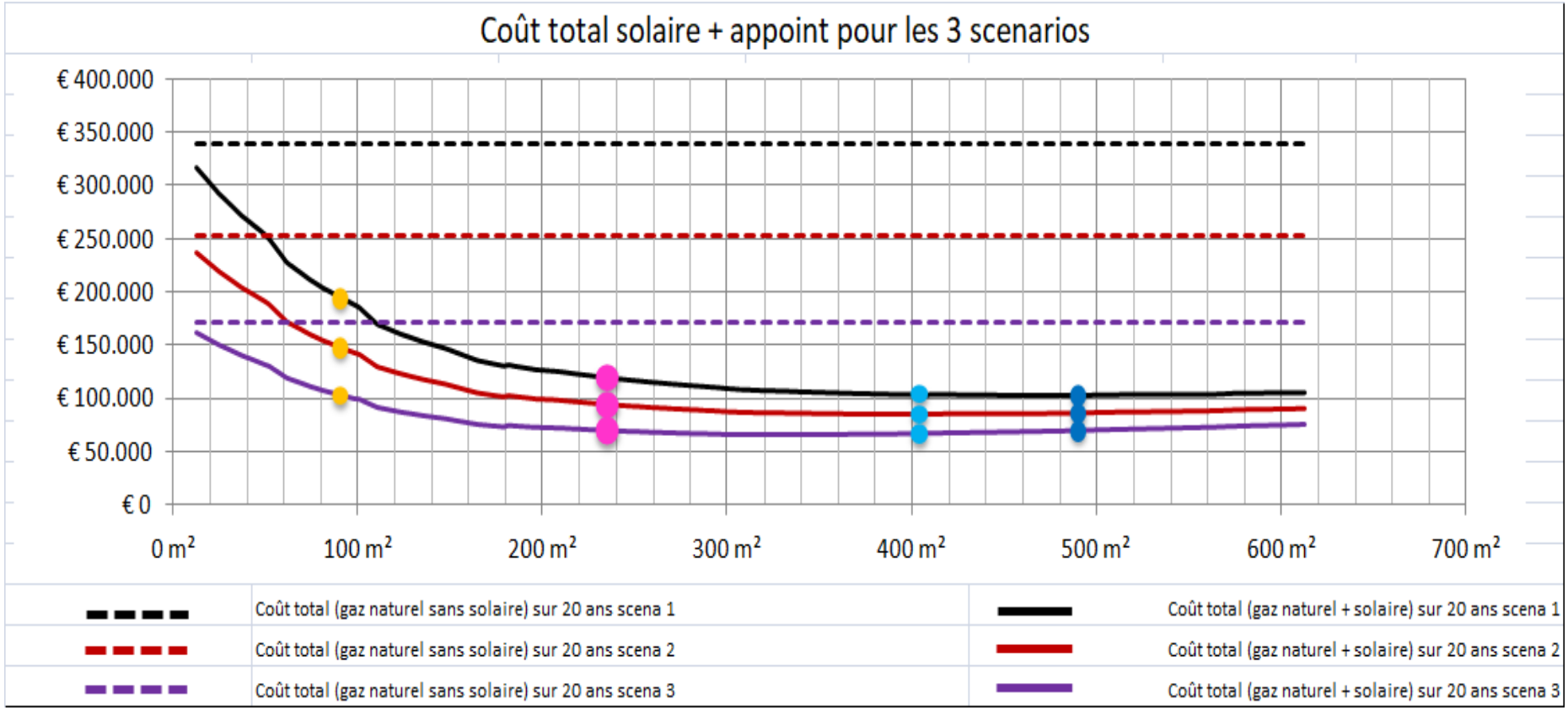
Optimum Sizing:
depending on customer's goals



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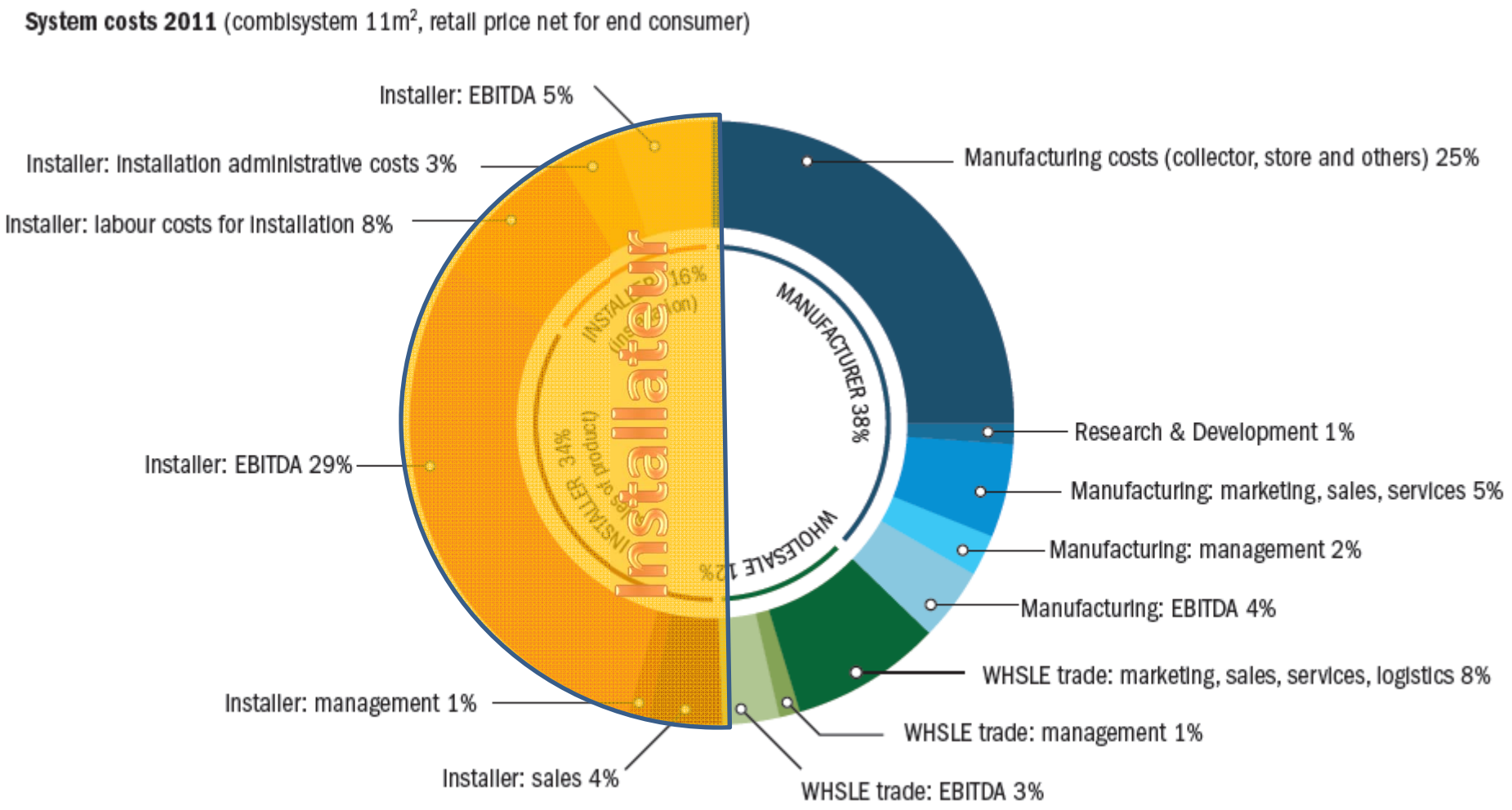
Total cost of a solar installation



Note: **EBITDA** = earnings before interest, taxes, depreciation and amortization **WHSLE** = Wholesale

Source: ITW, Technomar

Why? Complexity!







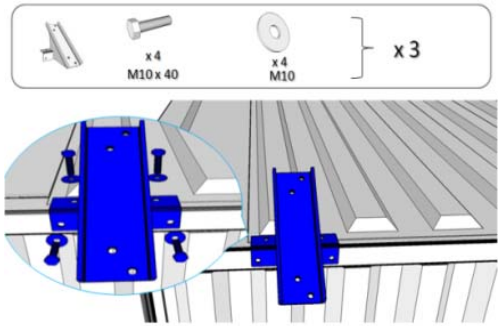
Complexity + installation time = ↗ installation cost

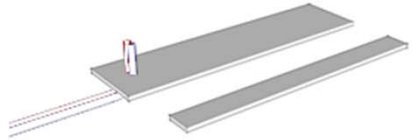





Unique solution: Opticube

- Complete "**Ikea like**" large thermal solar kit
- Complexity integrated into a pre-assembled container
- Illustrated mounting manual so that anyone can mount it
- Patent





Advantages

- ~~Specialized~~ company for installation/distribution:
- **Installation costs** ↘ **= Total cost** ↘ (-40% -50%)
- Resulting cost/MWh < 20 $/€ for 30 years
- 100% renewable

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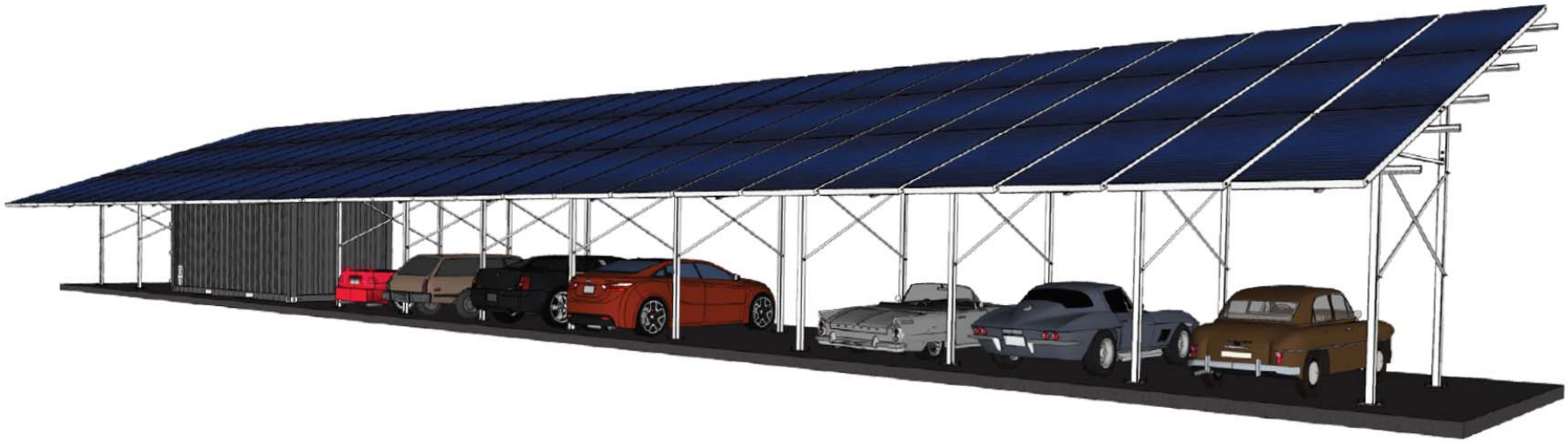
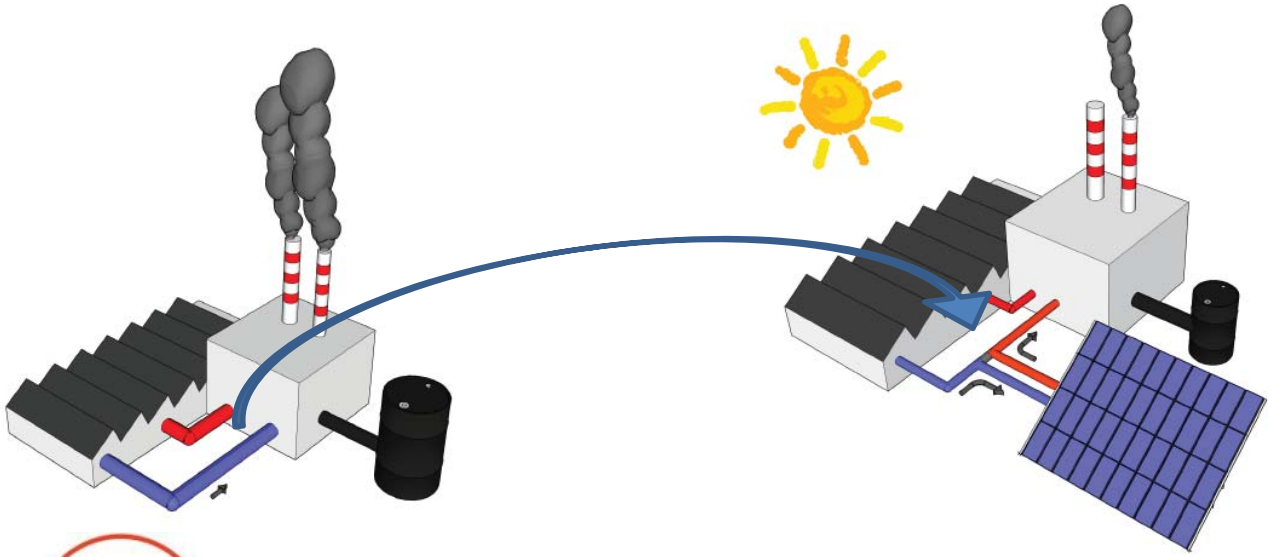
Variants



Easy integration



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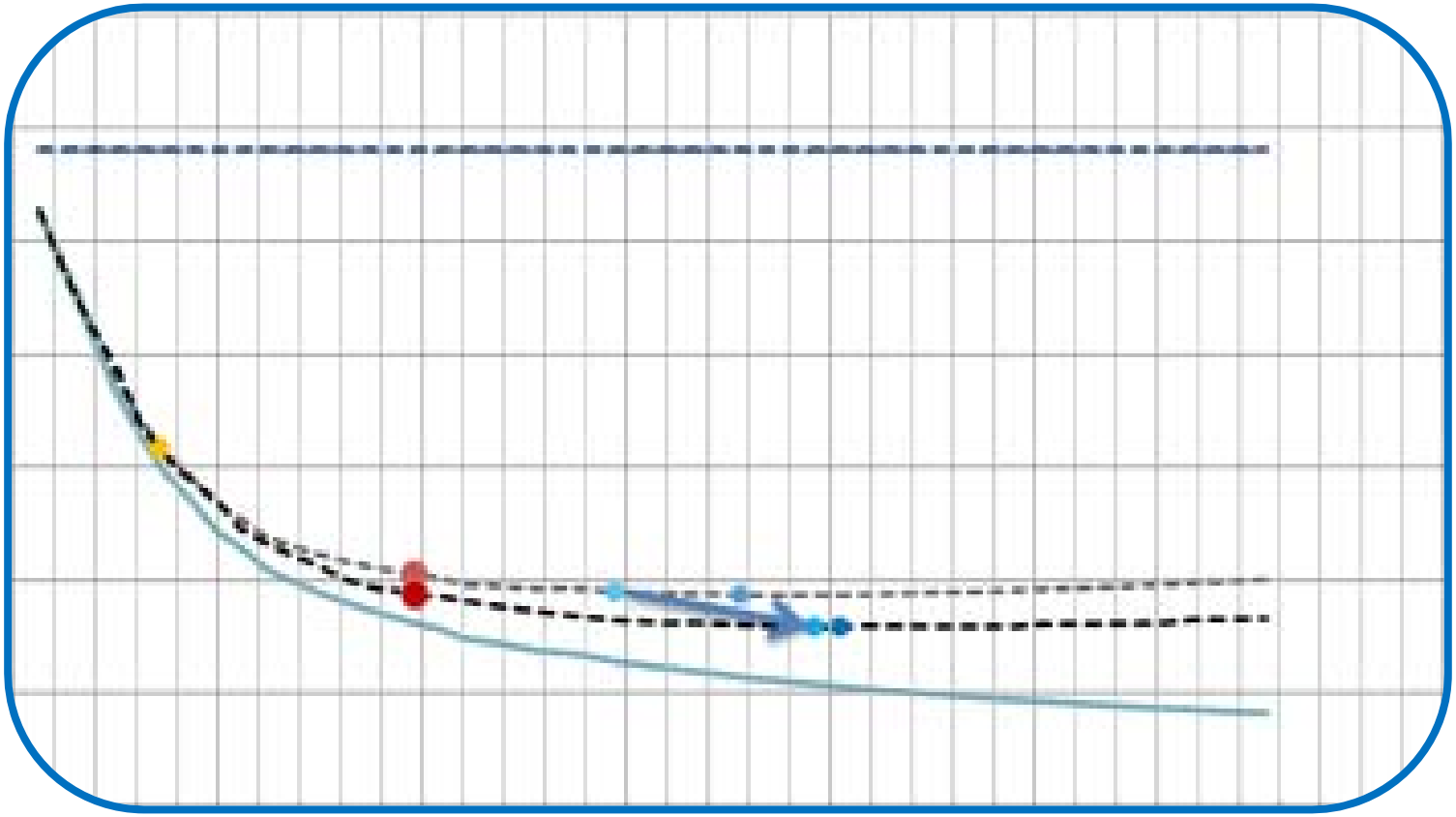
Optimum Sizing with Opticube



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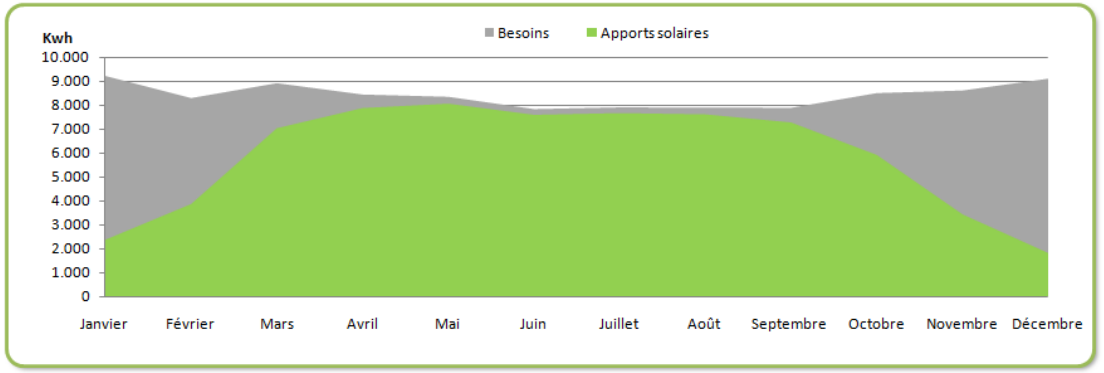
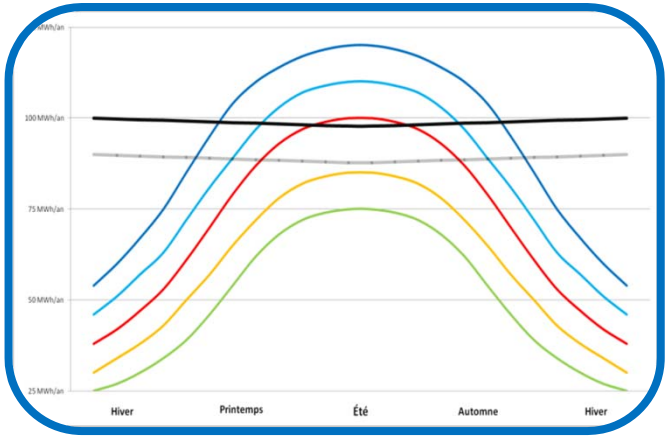
70% savings/solar fraction



DWH Only



	Besoins (en kWh/mois)	Apports solaires (en kWh/mois)
Janvier	9.238	2.379
Février	8.313	3.880
Mars	8.935	7.061
Avril	8.461	7.906
Mai	8.364	8.091
Juin	7.850	7.622
Juillet	7.922	7.697
Août	7.915	7.642
Septembre	7.902	7.304
Octobre	8.520	5.938
Novembre	8.629	3.443
Décembre	9.126	1.820
TOTAL annuel	**101.175 kWh**	**70.783 kWh**

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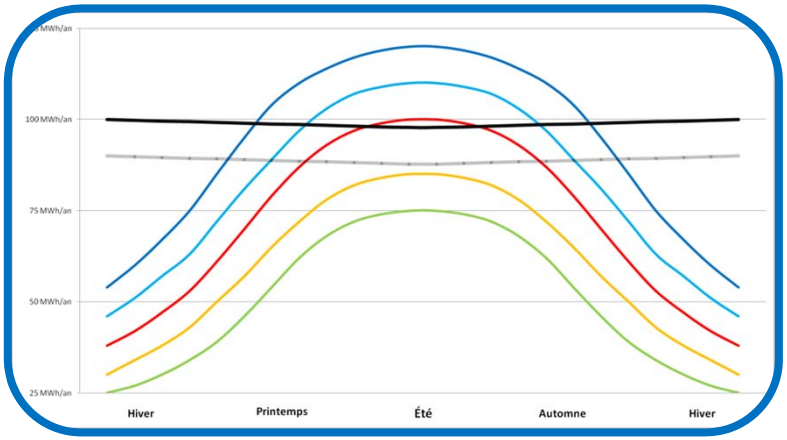
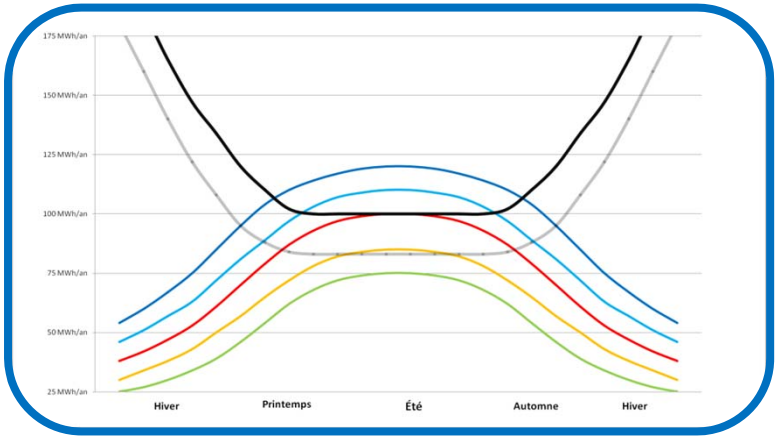
DHW -> Space Heating?

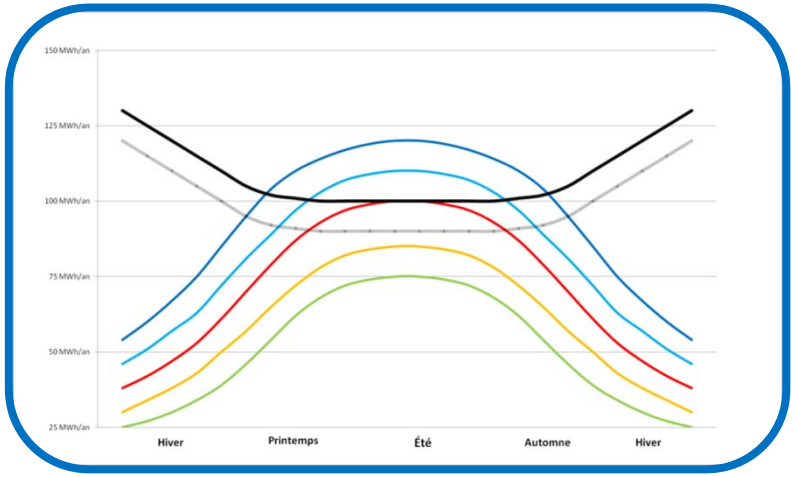
DWH Only



DWH + Space heating (trad.)



DWH + Space heating (Low energ.)



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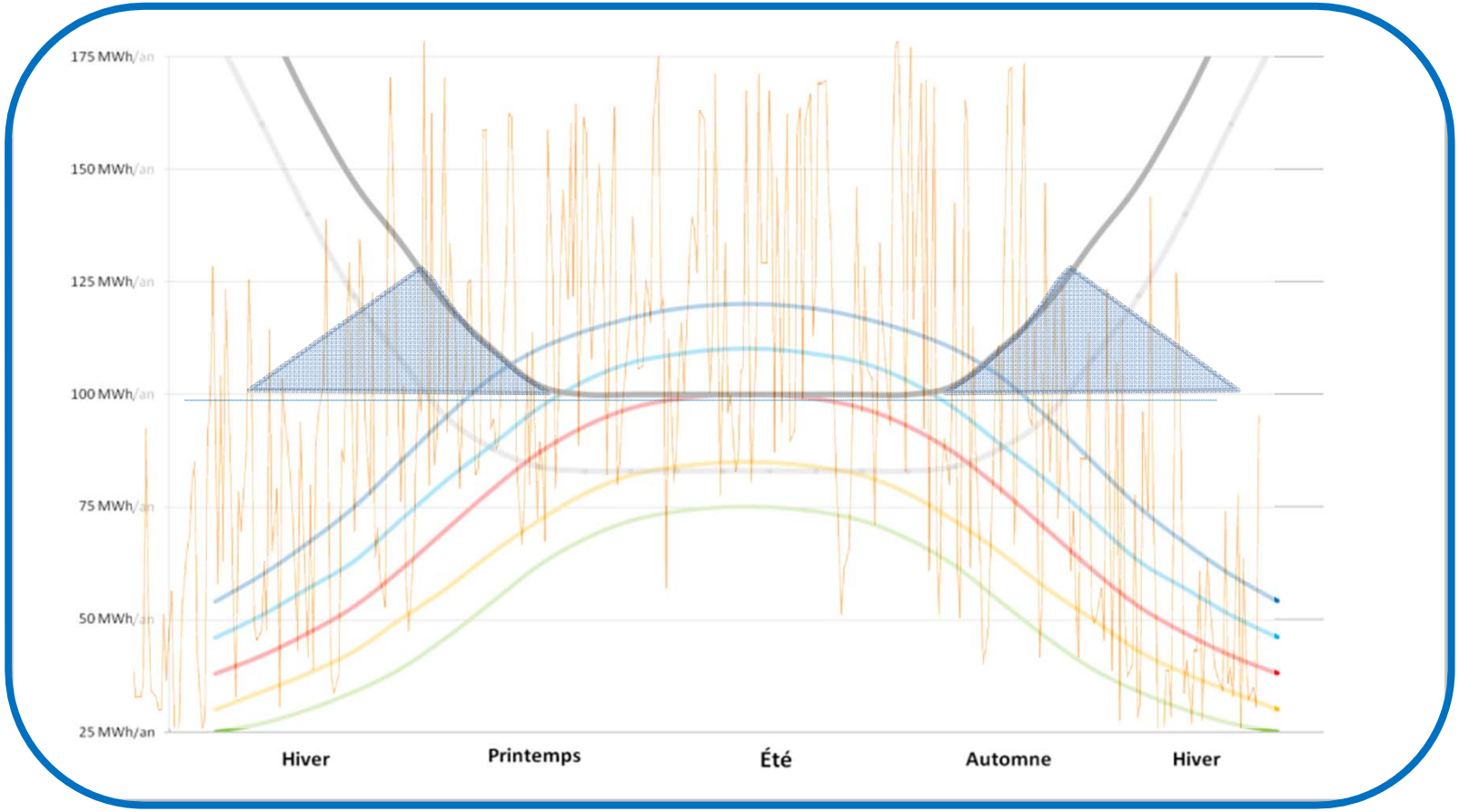
DWH + Space heating (trad.)



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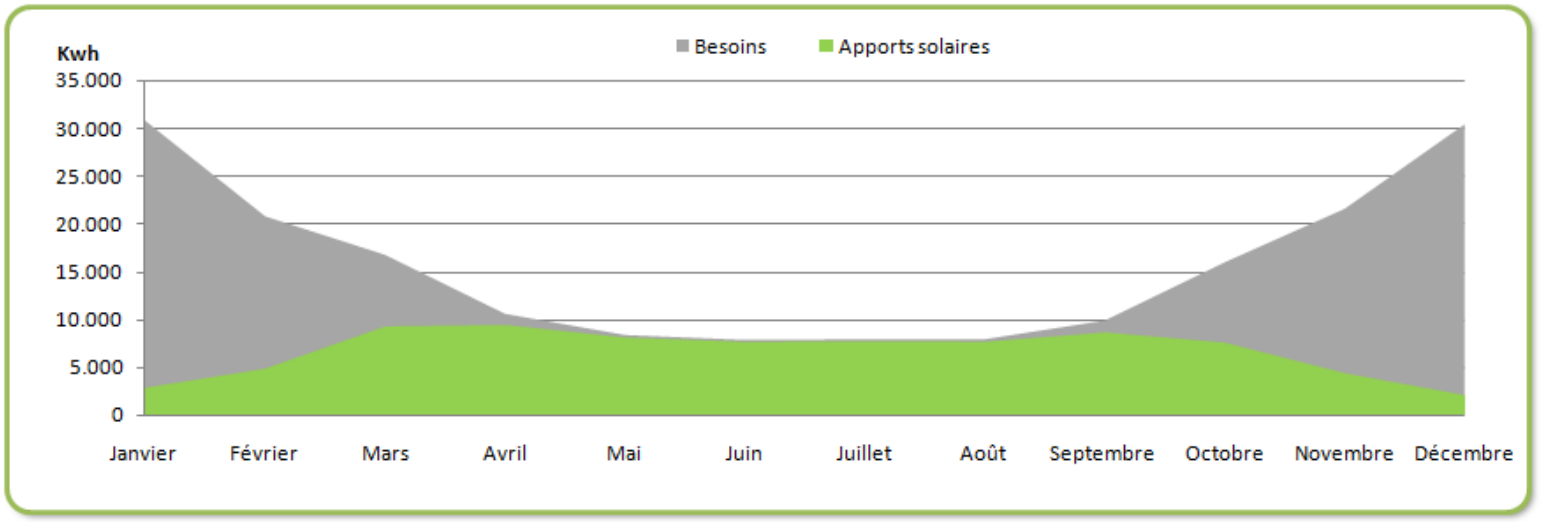
DHW + Space heating (trad.)



DWH: 70% (ex. 71 MWh),

Space Heating: 10% out of the needs (9/88 MWh)

	Besoins (en kWh/mois)	Apports solaires (en kWh/mois)
Janvier	30.794	2.829
Février	20.782	4.829
Mars	16.754	9.247
Avril	10.577	9.395
Mai	8.364	8.091
Juin	7.850	7.622
Juillet	7.922	7.697
Août	7.915	7.642
Septembre	9.878	8.629
Octobre	15.975	7.542
Novembre	21.572	4.345
Décembre	30.419	2.057
TOTAL annuel	**188.801 kWh**	**79.925 kWh**

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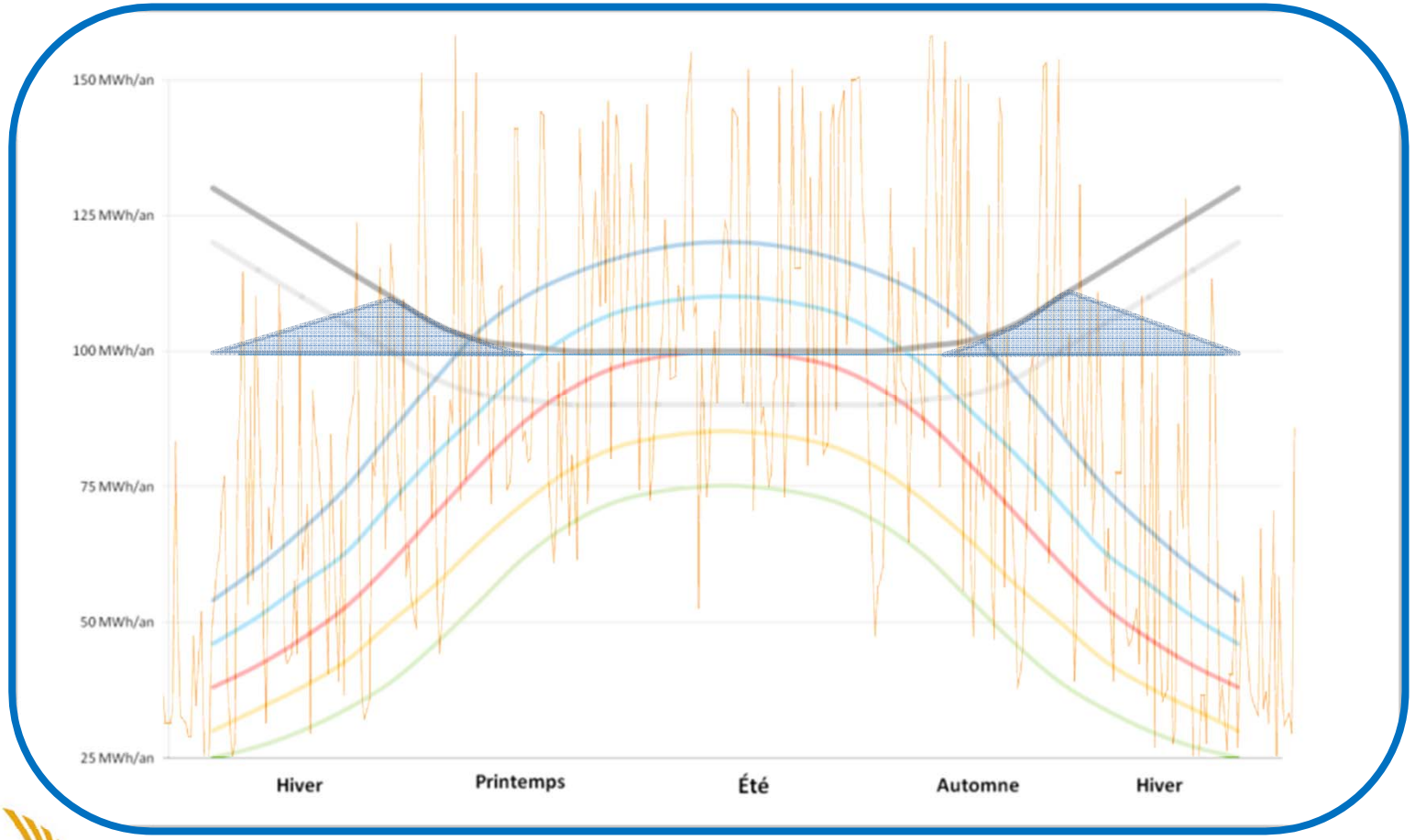
DWH + Space heating (Low energ.)



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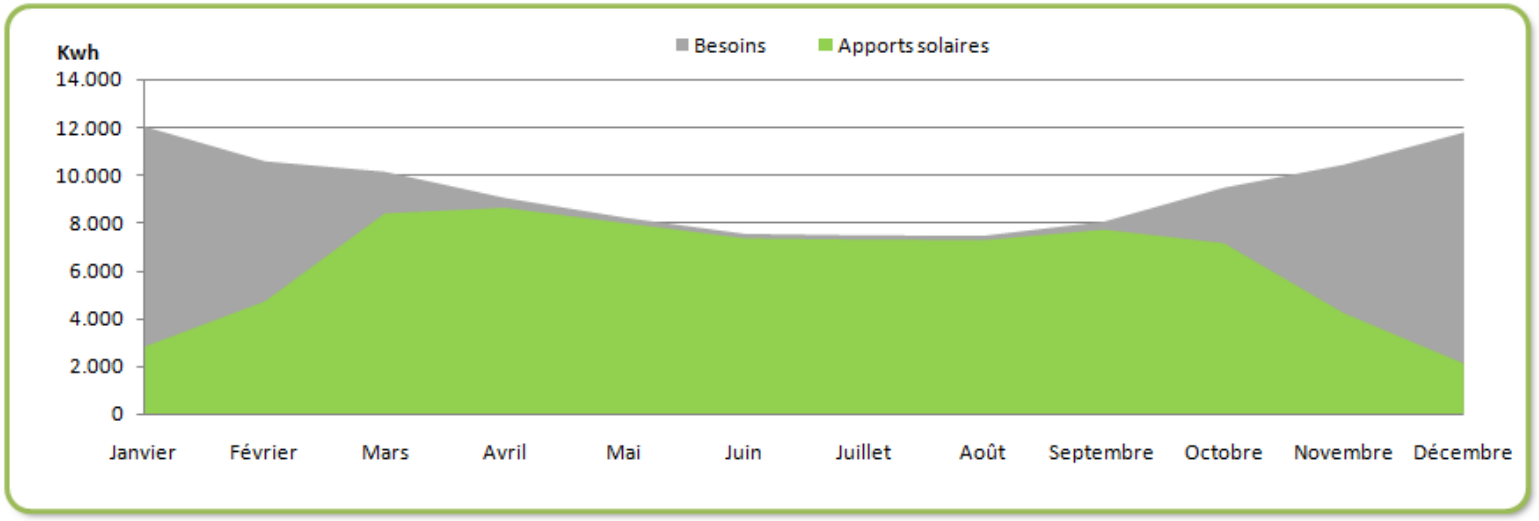
DWH + Space heating (Low energ.)



DWH: 70% (ex. 71 MWh),

Space Heating: 45% (5/11 MWh)

	Besoins (en kWh/mois)	Apports solaires (en kWh/mois)
Janvier	12.038	2.817
Février	10.592	4.714
Mars	10.152	8.398
Avril	9.054	8.628
Mai	8.225	7.986
Juin	7.550	7.349
Juillet	7.483	7.292
Août	7.471	7.273
Septembre	8.064	7.715
Octobre	9.488	7.144
Novembre	10.451	4.222
Décembre	11.804	2.111
TOTAL annuel	**112.371 kWh**	**75.649 kWh**

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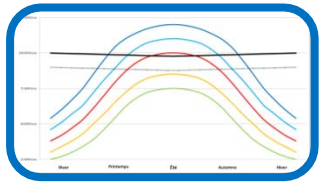
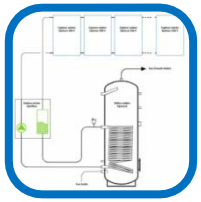
Conclusion

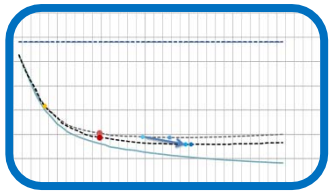
1. Sizing based on DHW



2. Selection of the Economically Optimum size: **2 to 5 times larger** then usual

(Drainback ! - Opticube !)

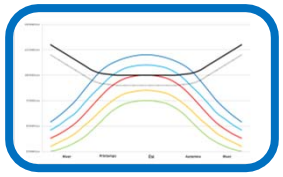




3. Space Heating :

1. cherry on the cake

2. More coherent for low energy buildings



4. Important free heating capacity during summer for inter-seasonal applications

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Thank you/Merci/Dank u

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Bertrand@sunoptimo.com

www.sunoptimo.com

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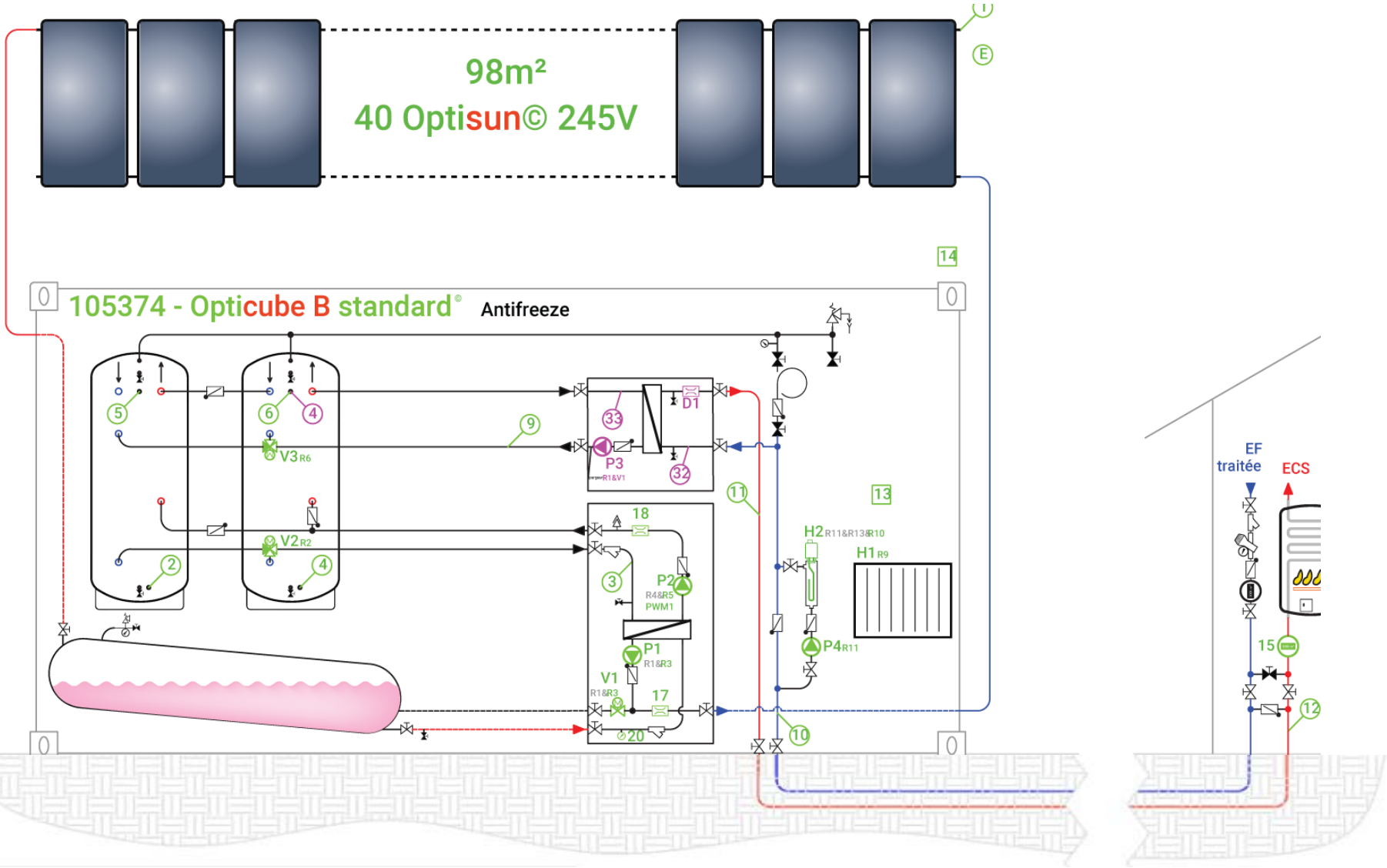
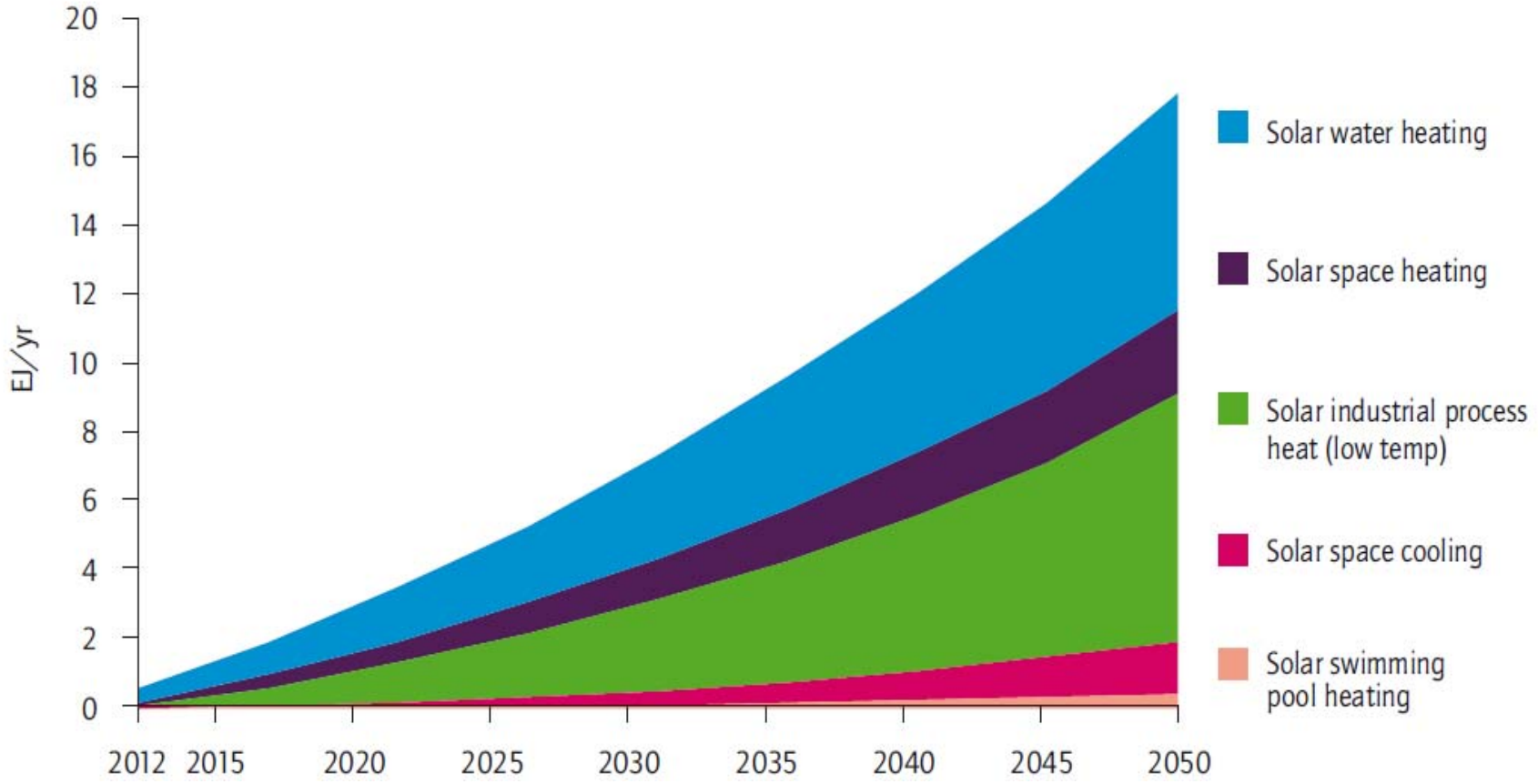
Opticube: Ready to heat



Evolution by 2050: segmentation

Figure 10: Roadmap vision for solar heating and cooling (Exajoule/yr)



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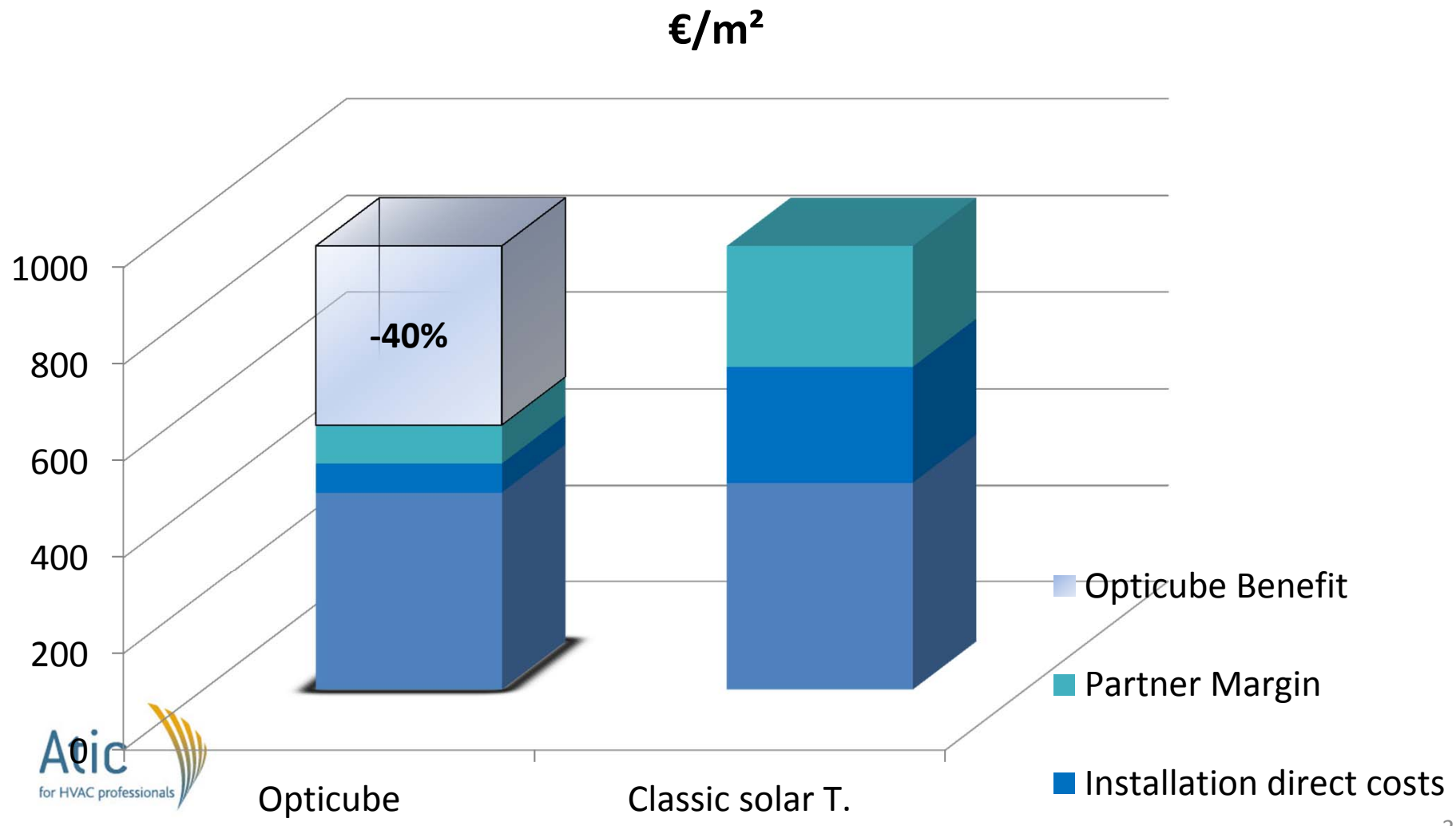
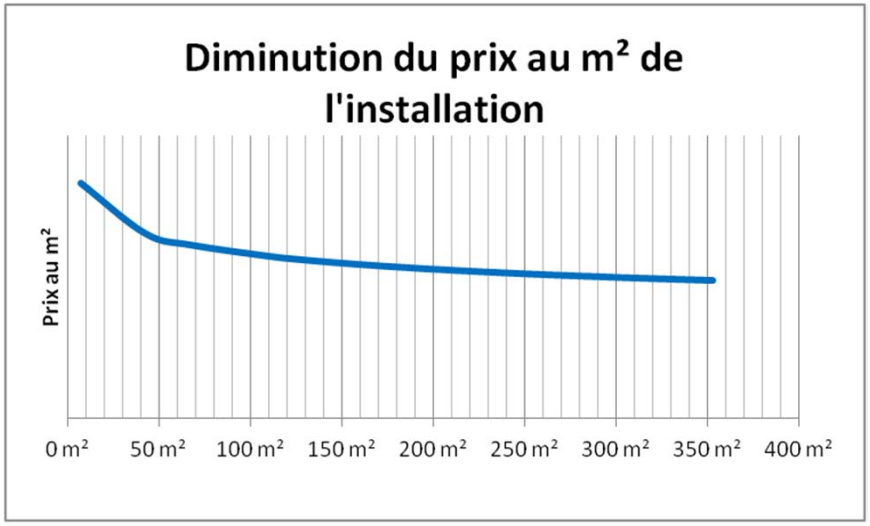
Traditional Vs. Opticube

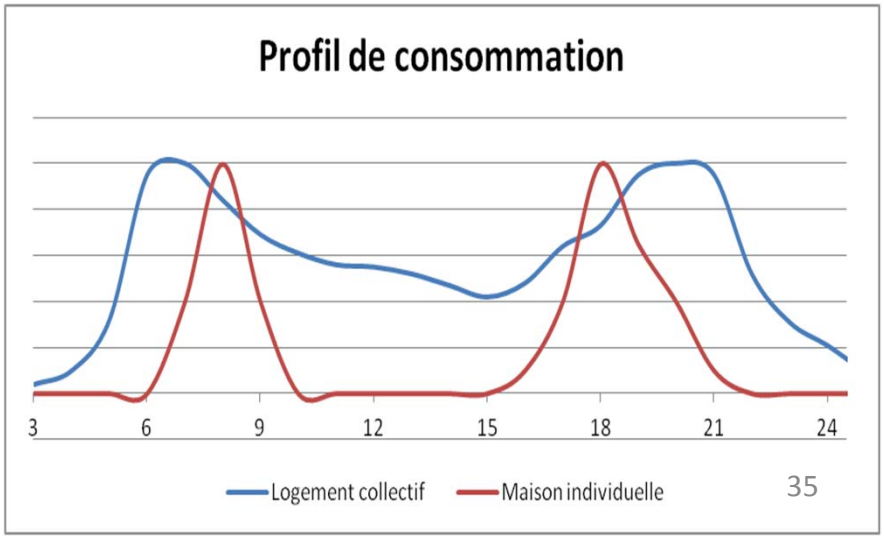


Logements collectifs

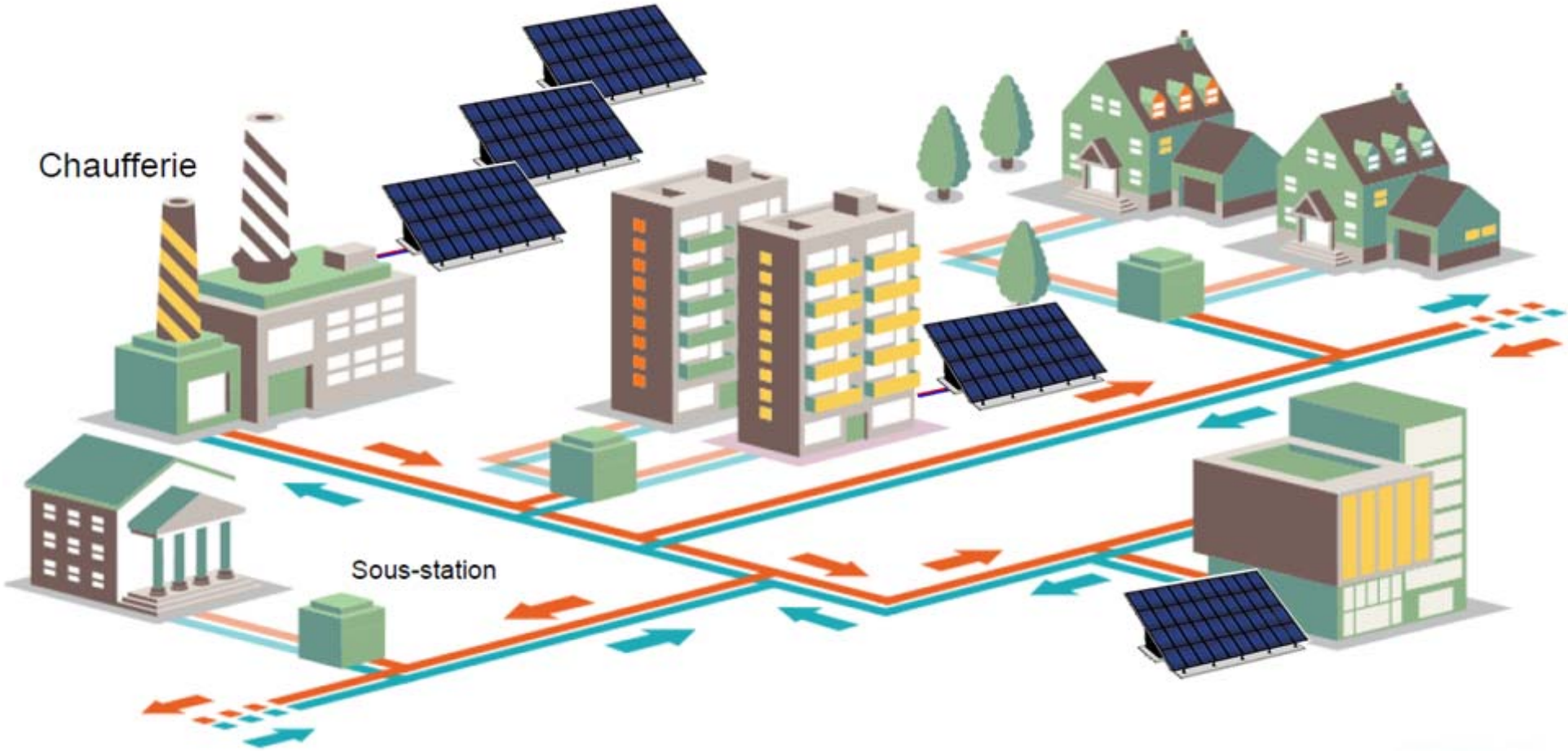
- ✓ Coût d'une installation solaire au m²:



- ✓ Profil de consommation ECS d'un logement coll. vss particulier



Les réseaux de chaleur



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- Le solaire thermique dans les bâtiments collectifs : le dimensionnement optimum = économie optimisée, autonomie énergétique en Eau Chaude Sanitaire en saison et potentiel d'apport de chaleur supplémentaire pour application d'énergie de stockage inter saisonnier

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