Photovoltaic powered Heat Pumps

Heating, Domestic Hot Water and Cooling

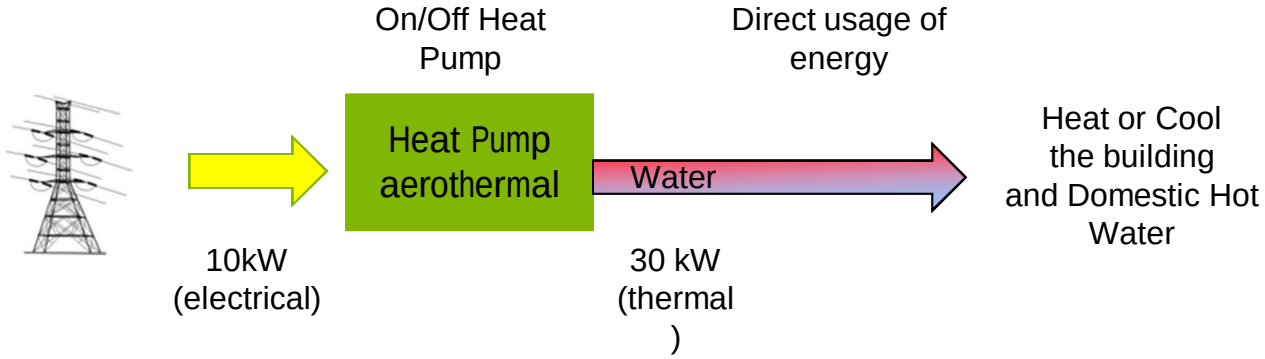
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

22.10.2013

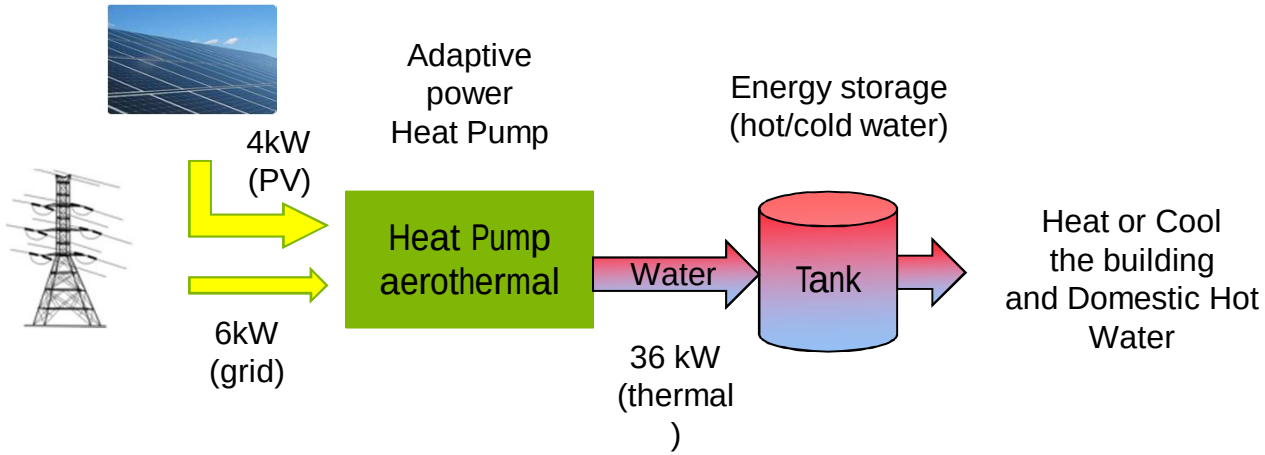
Solarline – Presentation to SHC task - IEA

COSSECO Solarline: Heat and Cool buildings with direct PV electricity consumption (no inverter)

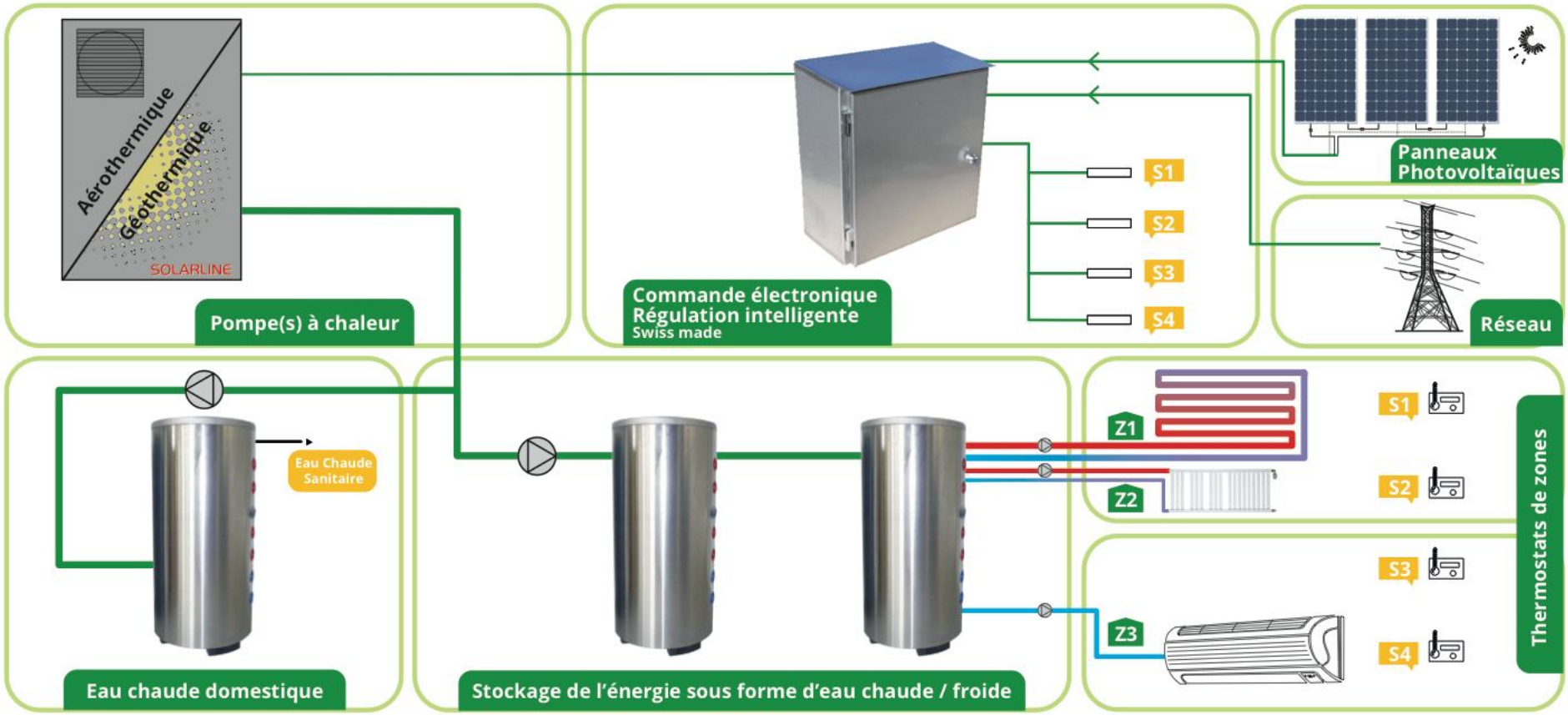
Traditional Heat Pump



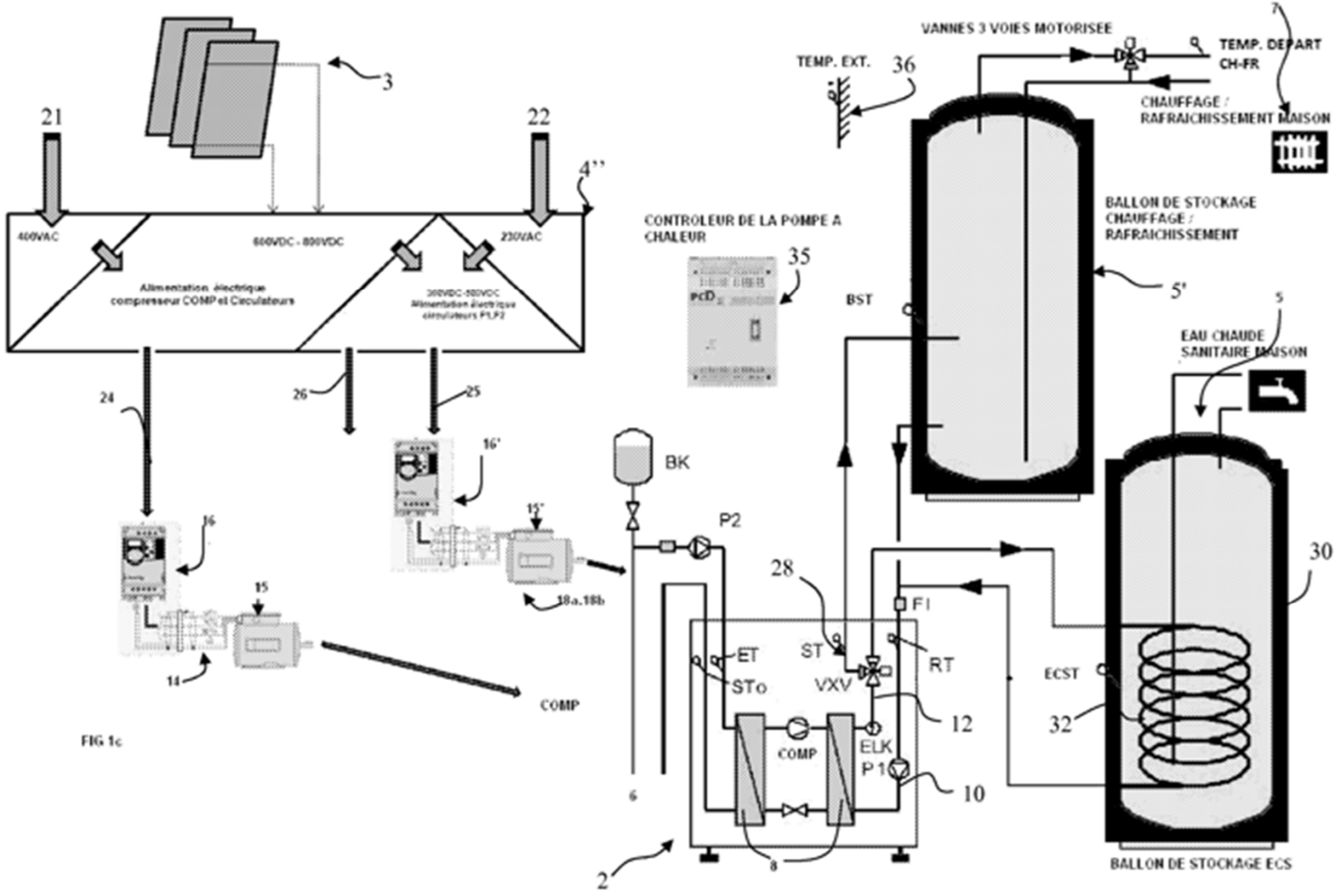
Solarline



Solarline: a complete kit



Solarline: technical principle



How COSSECO reduce energy consumption?

- Annual Performance Factor = 5.3 (geothermal)
  - Power modulation & low temperature (Carnot cycle)
  - Anticipation of thermal requirements (PID regulation)
  - Lowest power level possible

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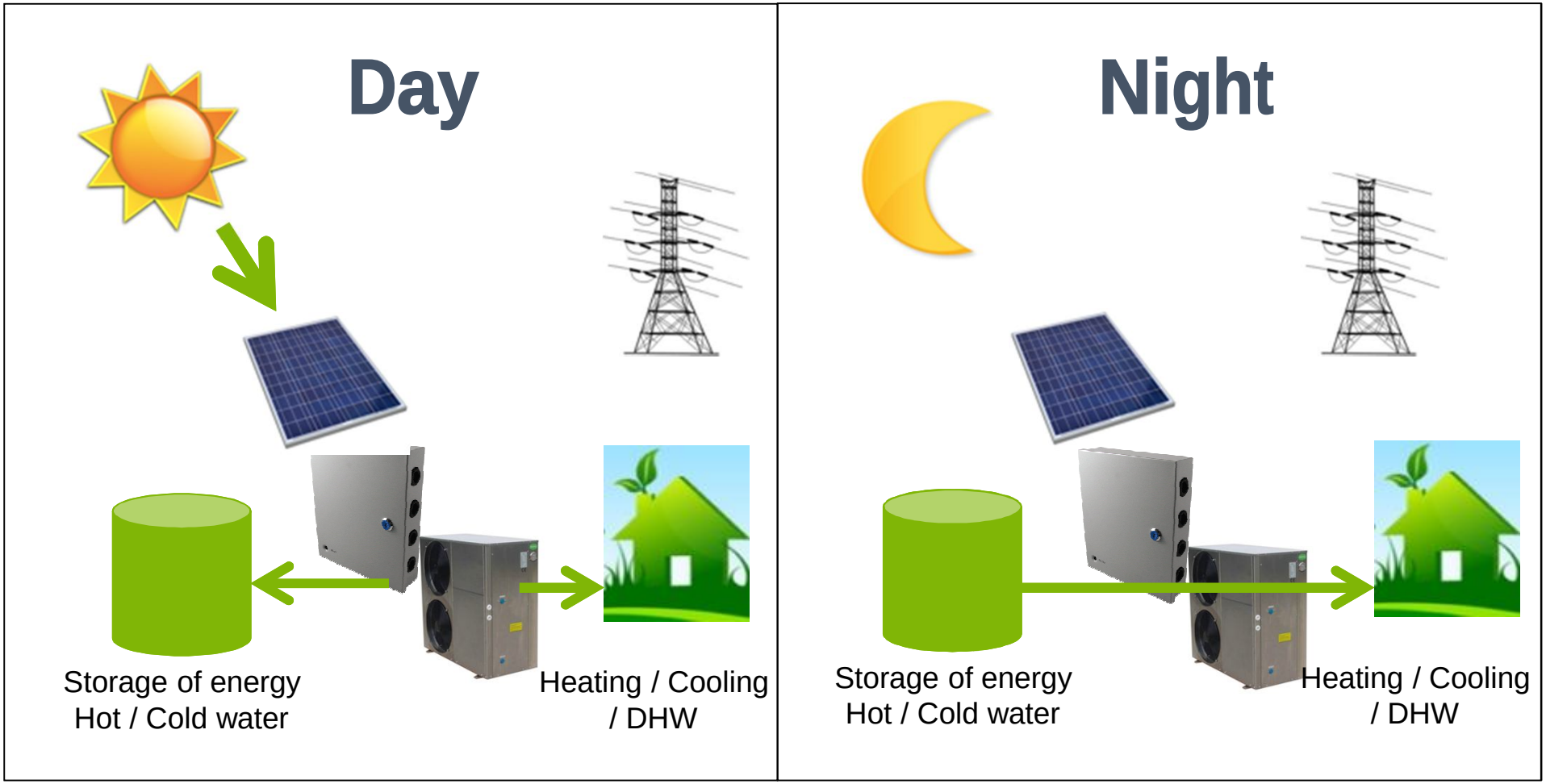
- Performances analysed by the EIA Fribourg

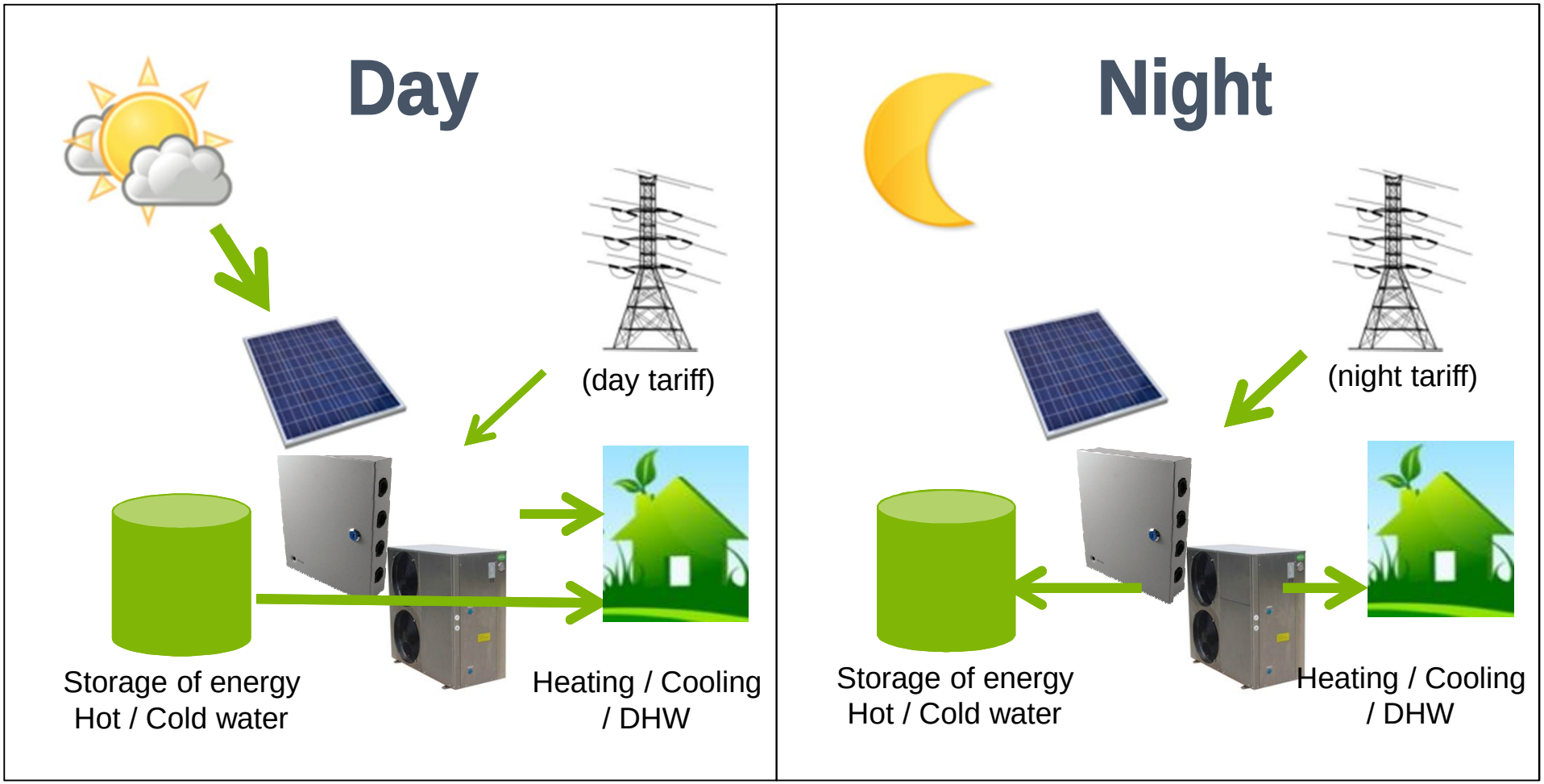
Solarline – Optimal functionning

Day light produce enough electricity to be used directly and stored in the Hot/Cold water tank. During the night the Cold/Heat is provided by the storage tank.



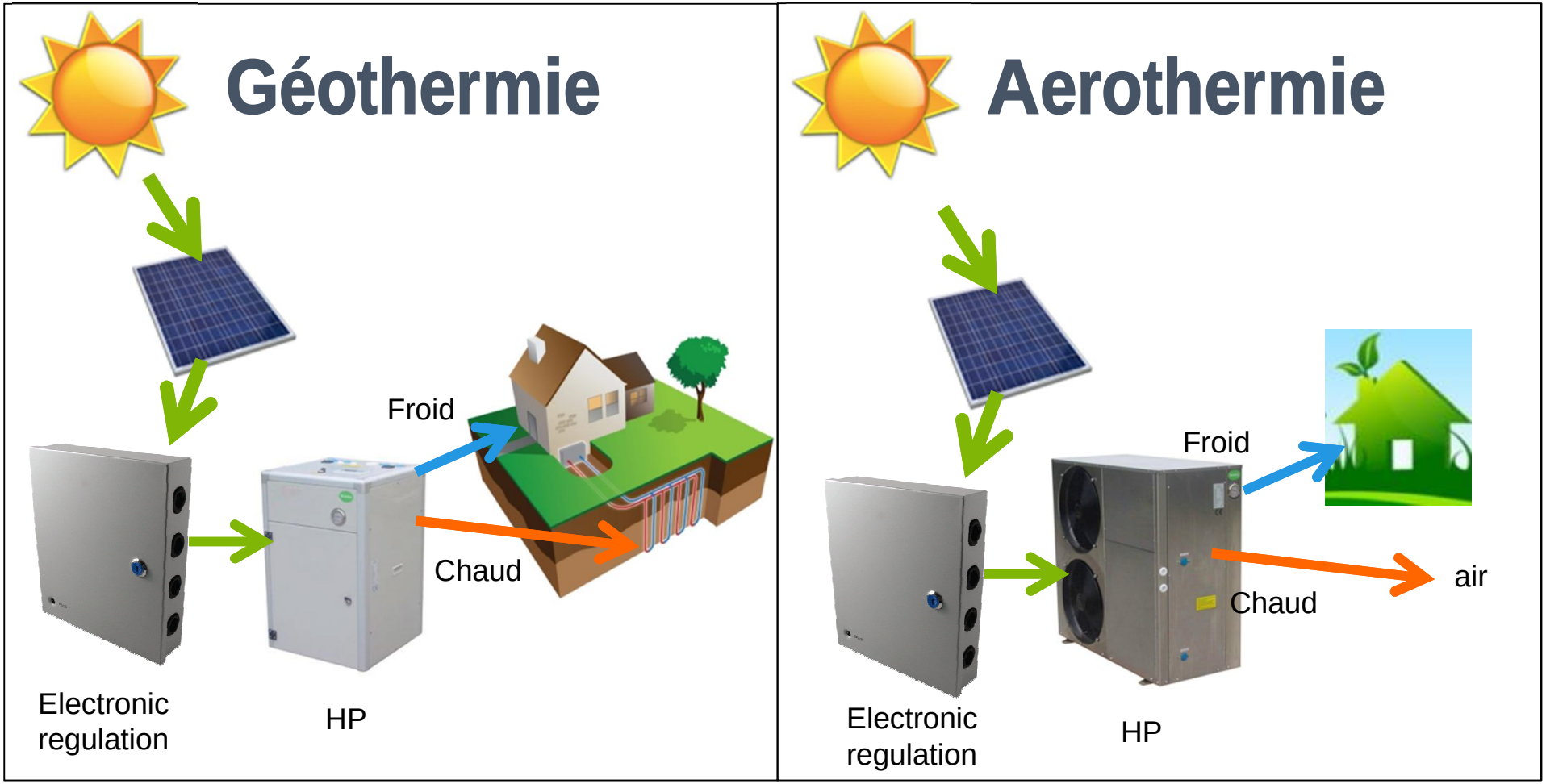
Solarline – Functionning with high thermal demand

PVs do not produce enough electricity and some electricity is supplied by the grid. It is possible to use the cheaper night tariff to store energy for day usage.



Freecooling : 100% solar Cooling

During the hot season the PV production and cooling need are aligned. It is possible to setup our Solution with a 100% PV mode (HP & circulating pumps).



Some references: 7kW to 750 kW (thermal)

220 m2 villa
Place: Penthéréaz, Suisse

Solarline Geothermal
Thermal power: 7kW
Water storage: 1000l
Domestic hot water: 1000 l
Photovoltaic: 6 * 250W

Hôtel de 10’000 m2
Lieu : Tripoli, Liban

Ecoline Aquathermie
Puissance thermique : 3* 250kW
Water storage: 10’000 l
Photovoltaic: not yet

Office building RUIDA 1800 m2
Place: Châtel-St-Denis, Suisse

Solarline Géothermie
Puissance thermique : 3 * 17kW
Water storage: 2400l
Domestic hot water: 500 l
Photovoltaic: 4800Wc

COSSECO & SHC ?

- What?
  - Monitor & analyse the performances (subtask C)
- How?
  - COSSECO can provide access to a range of Solarline systems in service which can be monitored & analysed (total 20):
    - Individual houses – aerothermal & PVs
    - Individual houses – geothermal & PVs
    - Commercial building – geothermal & PVs
    - Residential building – mix aeor. & geothermal & PVs
    - Residential building – aeorthermal & PVs

Focus: office building RUIDA
Total renewable share of energy: 85%

Bâtiment RUIDA

Address: route de Pra de Plan 5
1618 Châtel St Denis
Surface: 1'800 m2
+ 1 flat: 200 m^2
commissioning: 2010

Temperature setup: 22°C all year long

- Heating: 101 MWh
- Cooling: 15 MWh
- Domestic Hot Water: 17 MWh

Solarline Solution

- Heat Pmp: **51kW** (3 * 17 kW)
- PV: **4.8 kWc**
- PV surface: **30 m²**
- Water storage: 3 *500 litres

Performancs

- Thermal need: **133 MWh**
- Grid consumption: **19 MWh**
- PV self-consumption: **5 MWh**

Annual Seasonal Performance Factor: 5.3 (and 6.9 with PV)

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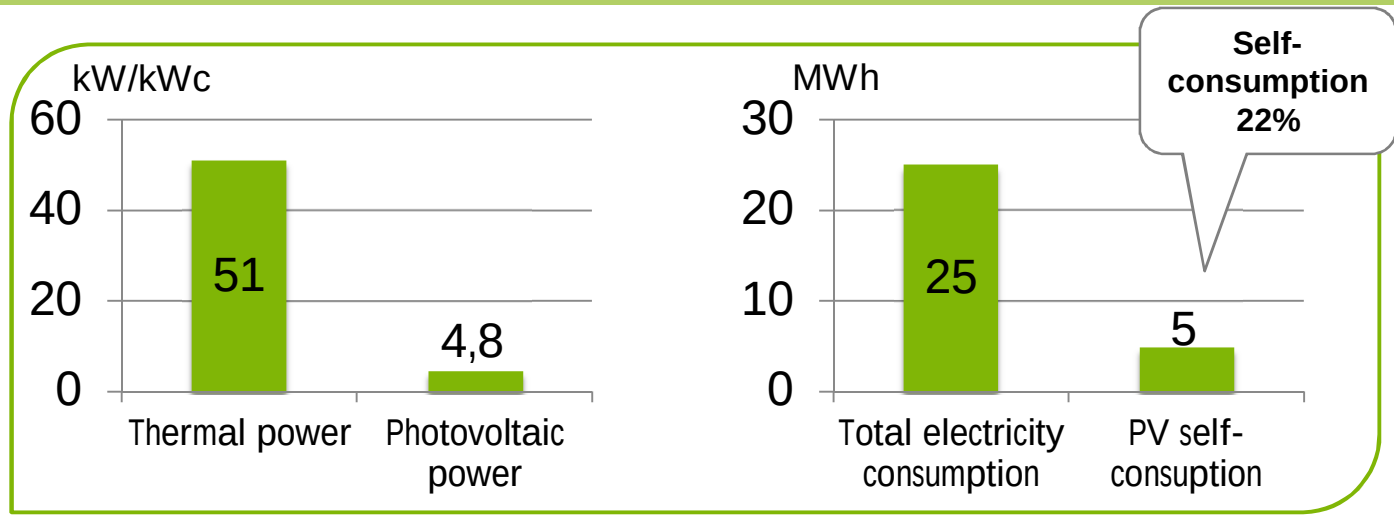


Production thermique total annuel (kWh)	133'517
Consommation électrique (kWh)	19'430
Part d'énergie renouvelable	**85%**

	Thermique					Consommation électrique				Facteurs de Performance Annuels et Mensuels avec pompes de circulations				
Mois	**Production Chauffage + ECS [kWh]**	**CHAUFFAGE [kWh]**	**Production ECS [kWh]**	**Part ECS [%]**	**Production Refroidissement [kWh]**	**Production Solaire [kWh]**	**Energie consommée réseau [kWh]**	**Energie totale électrique [kWh]**	**Part photovoltaïque %**	**Chauffage**	**ECS**	**Froid**	**Global Sans solaire**	**Global Avec solaire**
Janvier	23'332	21'552	1'780	8%	0	235	4'340	4'575	5%	5.17	4.38	0	5.1	5.4
Février	21'720	20'300	1'420	7%	0	298	3'873	4'171	7%	5.29	4.26	0	5.2	5.6
Mars	11'720	10'240	1'480	13%	0	657	1'968	2'625	25%	4.61	3.67	0	4.5	6.0
Avril	5'320	3'885	1'435	27%	0	518	690	1'208	43%	4.73	3.71	0	4.4	7.7
Mai	2'843	1'461	1'382	49%	1'390	621	287	908	68%	4.76	3.82	5.8	4.7	14.7
Juin	1'719	345	1'374	80%	4'198	583	373	956	61%	5.72	5.16	6.67	6.2	15.9
Juillet	1'536	215	1'321	86%	3'250	578	139	717	81%	6.46	5.49	6.82	6.7	34.4
Août	1'197	0	1'197	100%	5'150	678	321	999	68%	0	5.72	6.52	6.4	19.8
Septembre	3'290	1'910	1'380	42%	1'138	573	173	746	77%	6.31	4.91	7.03	5.9	25.7
Octobre	9'176	7'705	1'471	16%	0	446	1'134	1'580	28%	6.11	4.61	0	5.8	8.1
Novembre	16'340	14'818	1'522	9%	40	317	2'540	2'857	11%	5.87	4.58	0	5.7	6.4
Décembre	20'198	18'618	1'580	8%	45	128	3'592	3'720	3%	5.53	4.47	0	5.4	5.6
Annuel	118'391	101'049	17'342	15%	15'211	5'632	19'430	25'062	**22%**	5.35	4.45	6.62	**5.3**	**6.9**

Comparison with Fuel

Solution COSSECO réelle (incluant géothermie)				
Investissement			**175'000**	CHF
Solution Solarline, hors installation incluant :				
- 3 PAC géothermiques				
- Panneaux photovoltaïques 5kWc				
- Régulation intelligente Swiss Made				
- Systéme de stockage 1500l				
- Cuve ECS de 500l				
Coût annuel			**4'730**	CHF
Maintenance			650	CHF
Electricité consommée du réseau	19'430	kWh	4'080	CHF
Les années suivantes une augmentation des prix est estimée à			5%	
Coût total sur 20 ans			322'917	CHF

Solution classique simulée (Fuel + Panneaux thermique)		
Investissement	**105'000**	CHF
Solution Fuel + panneaux thermique hors installation incluant :		
- Chaudière à Fuel 40kW		
- Panneaux thermiques 10m^2		
- Cuve ECS 1500l		
Coût annuel	**14'805**	CHF
Maintenance	1'000	CHF
Electricité (pompes de circulation)	200	CHF
Fuel	13'605	CHF
Les années suivantes une augmentation des prix est estimée à	5%	
Coût total sur 20 ans	581'487	CHF

Comparatif		
Retour sur investissement en	7	ans
Taux de retour sur investissement	29%	
Economies totales sur 20 ans	258'569	CHF

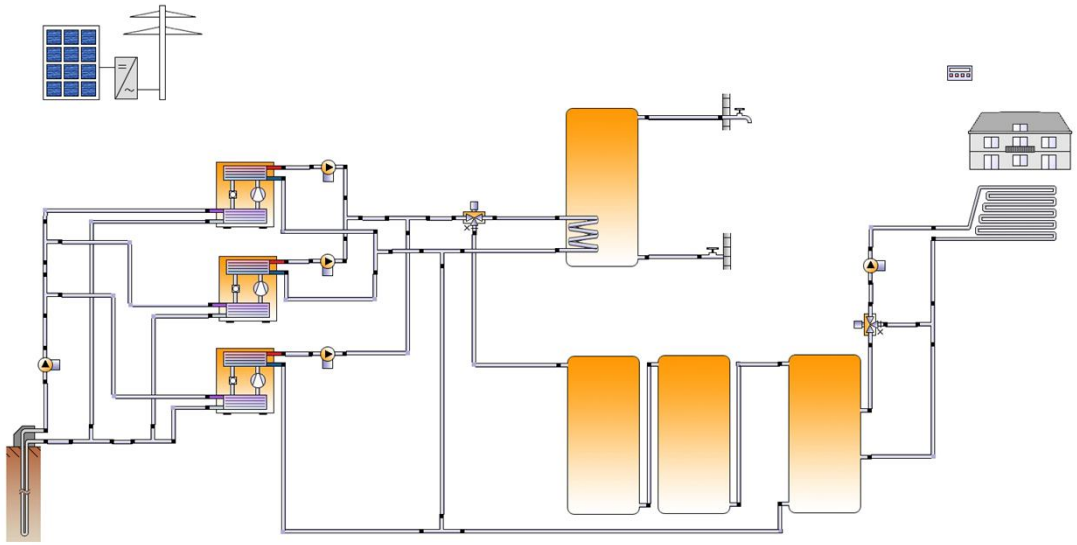
Supporting slides

Technical references

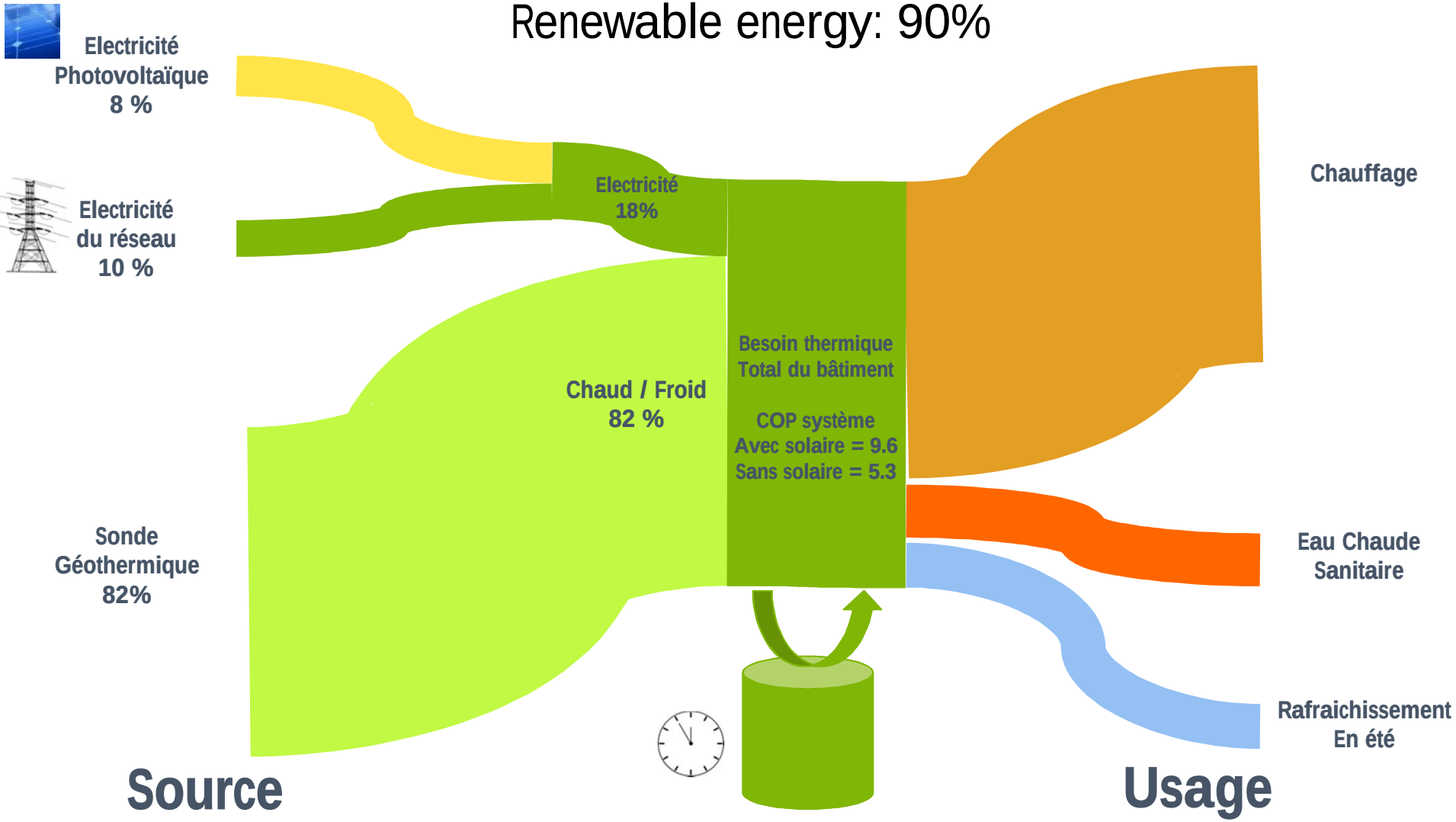
polysun
SIMULATION SOFTWARE

CLEANTECH
FRIBOURG - FREIBURG

réseau énergie & bâtiment



Annual energy balance



Some references in Switzerland

Solarline - 5 * Aero 10kW Hiseer - St Sylvester	
Solarline - Aero 10kW Hiseer - ULDRI & Cie - Bruno Sallin - Polla - Firas Awilé - Châble	
Solarline - Aero 12kW + 10kW EVI - Marchat - Corcelle	
Solarline - Aero 13kW Hiseer EVI - Projet Lonay - Abdo	
Solarline - Grangettes Colantonio - Aero 32kW Hiseer	
Solarline - 2 * Geo 15 kw - Enthalpie - Châtelard - Cesteli - Orlando	
Solarline - 2* Aero 32KW - BATI.CH YVES KOCHER - VAULRUZ	
Solarline -Aero 2 * 13kW EVI - La Molleyres	
Solarline - Géo 15kW - Hiseer - Famille Rouge - Estavayer	

Description
Photovoltaique en m2, Puissance PV, Stockage d'eau, ECS Pompe à chaleur
Villa familiale 200 m2 type Minergie 8 m2 PV 1 KW, 500l, 500l 1X PAC sol/eau 8 KW
Villa de 300 m2 10 m2 PV 1,8 KW, 3x800l , 500l 1x PAC air/eau de 15 KW
Villa familiale 180 m2 4 m2 PV 0,6 KW, 1000l, 500l 1x PAC sol/eau 7 KW
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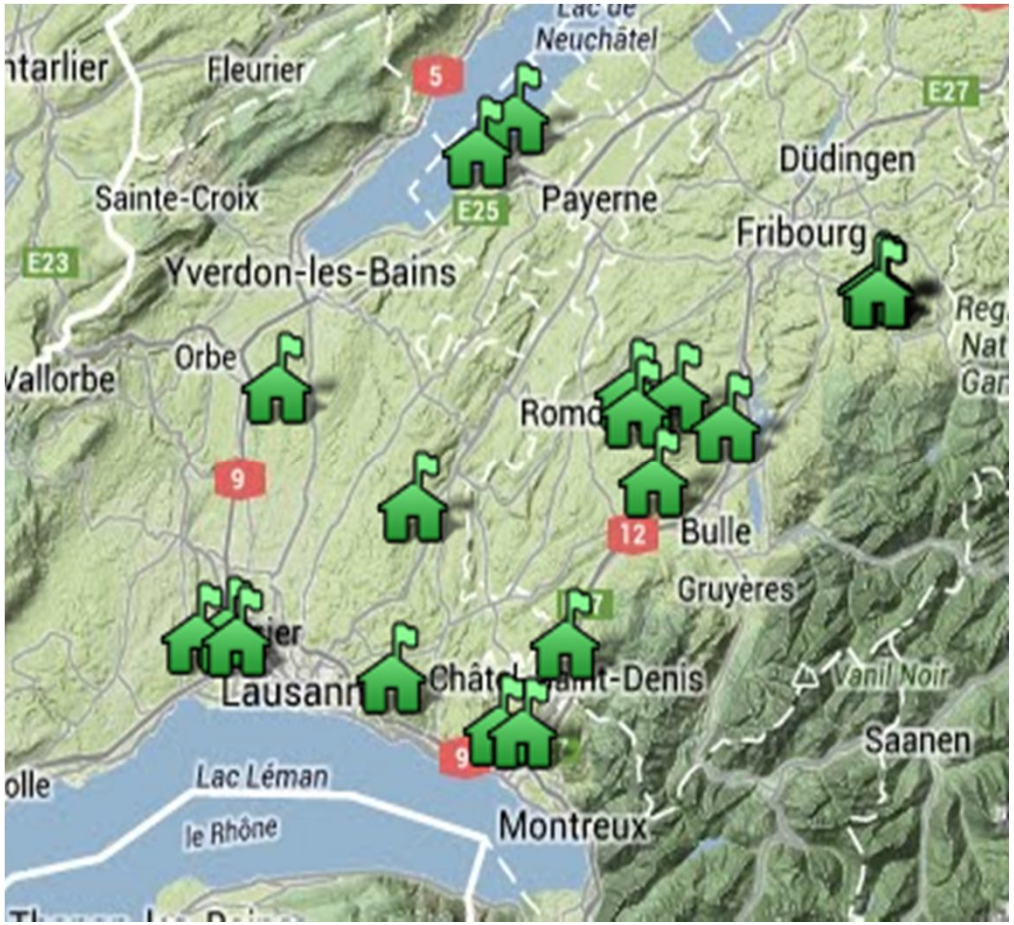
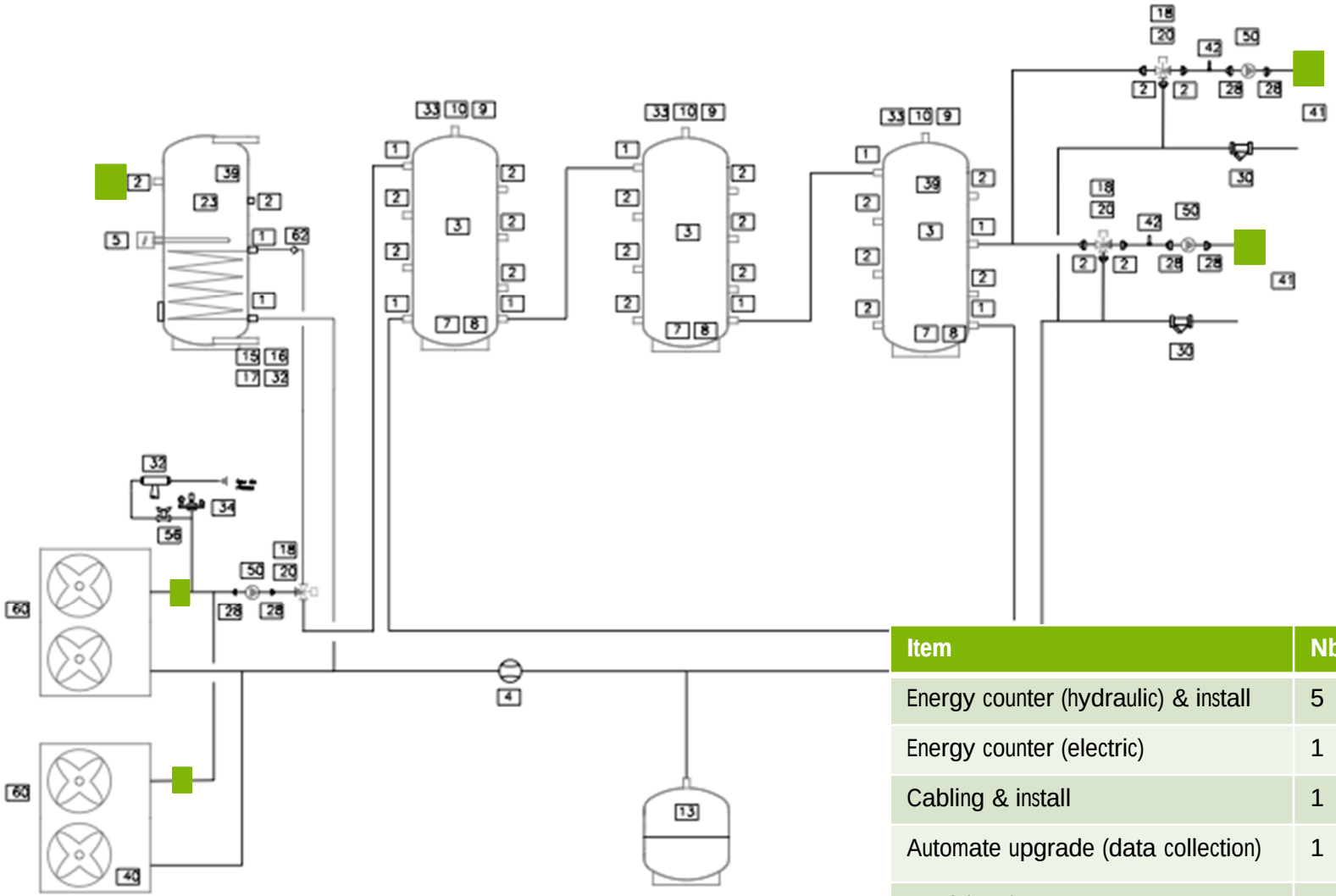
Bâtiment administratif de 1'800 m2 30 m2 PV 4,8 KW, 3x800l, 500l 3x PAC sol/eau 17 KW x 3 = 51 KW
Villa familiale 160 m2 (altitude 900m) 10 m2 PV 1,5 KW, 1000l, 500l 1x PAC sol/eau 7 KW
Villa de 180 m2 10 m2 PV 1,5 KW, 1500l, 500l 1x PAC sol/eau de 7 KW



Detailed monitoring: extra cost



Item	Nb	Cost	Total
Energy counter (hydraulic) & install	5	350	1’750
Energy counter (electric)	1	350	350
Cabling & install	1	900	500
Automate upgrade (data collection)	1	500	500
Total (CHF)			4’000