SDH
solar district heating

Malmö Sweden

Integration of solar energy in a district heating for a Southern European Ecodistrict

Operational study on a low temperature extension of a district heating for 500 low consumption housings in France

Bruno GEORGES presentation - April 09 2013

ITF
Bruno GEORGES

This work is supported in two ways

- A private contract with **SCDC** : Main high temperature district heating of Chambéry which makes party of COFELY group, (Claude MORTIER et Jean Louis LECOCQ).

- A collaboration with **INES** (Philippe PAPILLON and Cédric PAULUS) in the executive of the Intelligent contract Energy Europe programme through SDH+ project

We really thank these two entities for having made possible and to contribute to this project

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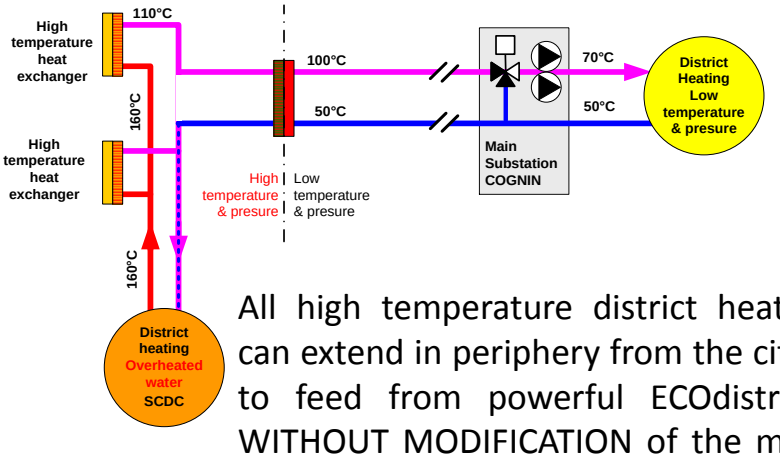
ines
INSTITUT NATIONAL DE L'ENERGIE SOLAIRE

CHAUFFAGE URBAIN SCDC

SCDC overheated (160/110°C) district heating on Chambéry city (100 000 inhabitants).

CHAUFFAGE URBAIN SCDC

We proposed a low temperature extension with this main district heating



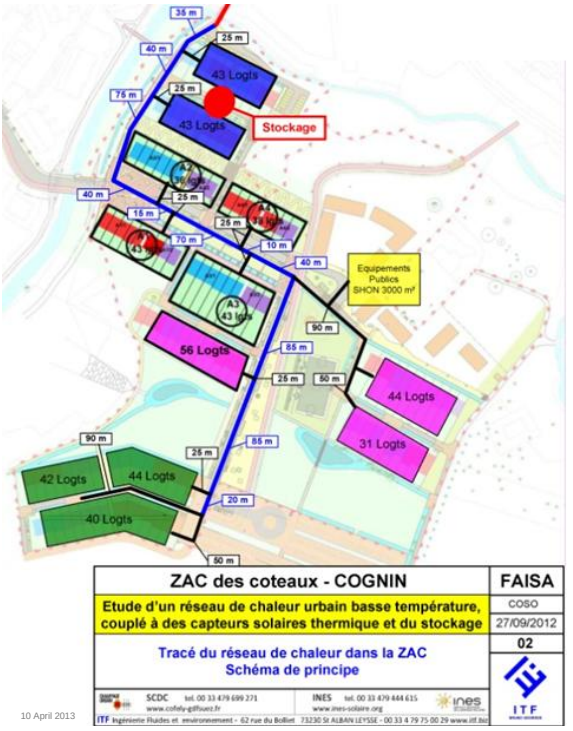
All high temperature district heating can extend in periphery from the cities to feed from powerful ECOdistricts WITHOUT MODIFICATION of the main structure

This new district proceeds in several phases :

Zone 1 : 501 residences 42 000 m², School facilities : Nursery 600 m², Nursery school 900 m², Elementary school 1300 m², Canteen 170 m²

Zone 2 : 390 residences

Zone 3 : 340 residences



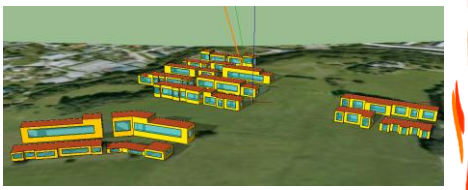
The developer took the party to provide energy of "Zac du coteau" with the district heating

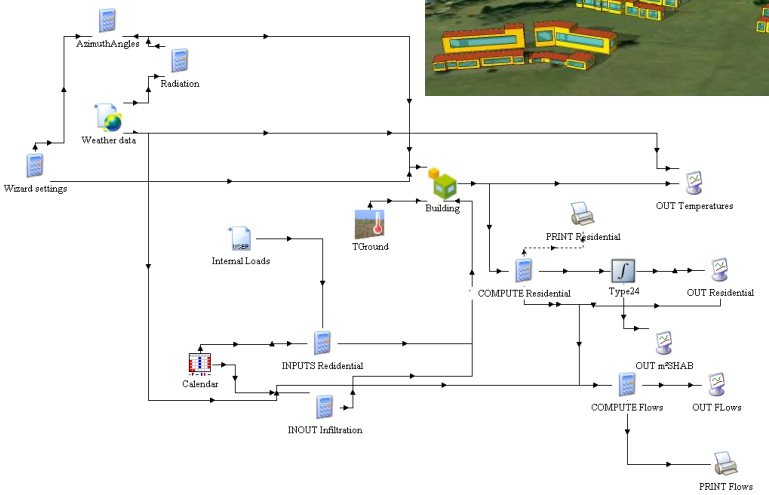
Energy loads estimating

Basic assumptions of our analysis

- Tree different buildings thermal performances
  - **HIGH** : Less 20% than RT2012 French Thermal regulation
  - **MEDIUM** : French RT2005 Thermal regulation
  - **LOW** : 20 years old construction
- Two weather data
  - **Chambéry** 45.57°N with 2 433 Degree Days (1996 – 2005)
  - **Malmö** 55.35°N, with 3 173 Degree Days (1996 – 2005)

Thermals loads evaluation





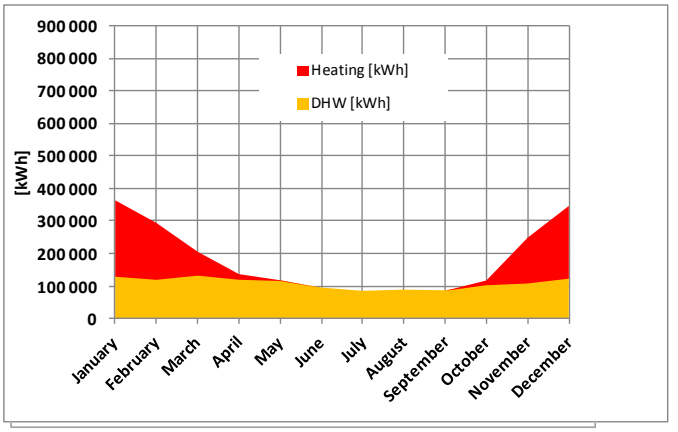
Basic assumptions of our analysis

	[unit : kWh / m². year]	Heating needs		Warm water needs		TOTAL needs
COGNIN						
1990	Not so good construction, quality of the years 1990	**92**	66%	47	34%	138
Med.	Approximately French Thermal regulation RT2005,	**48**	57%	36	43%	84
Good	Less 20% than actual French Thermal regulation (RT2012)	**24**	40%	36	60%	61
MALMÖ						
1990	Not so good construction, quality of the years 1990	**125**	73%	47	27%	171
Med.	Approximately French Thermal regulation RT2005,	**70**	66%	36	34%	106
Good	Less 20% than actual French Thermal regulation (RT2012)	**39**	52%	36	48%	75

Thermal loads 30% more in Malmö

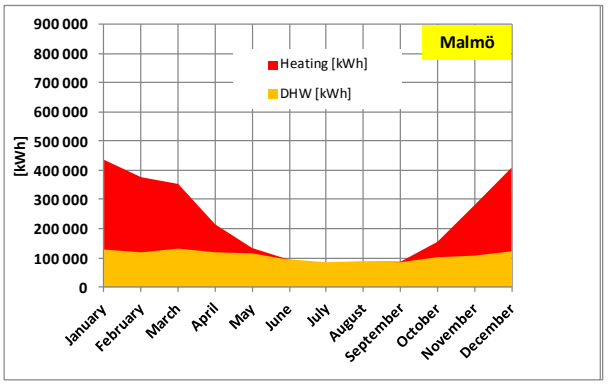
Global loads 25% more in Malmö

*Yearly warming loads in **Chambéry***



*From Low **to high performance***

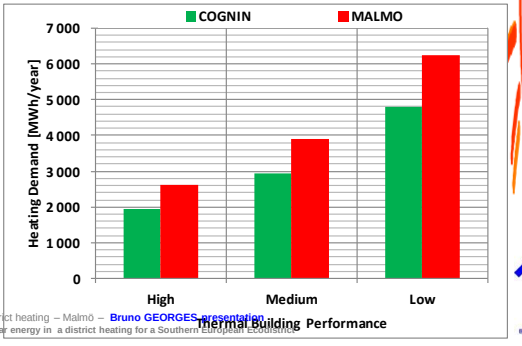
*Yearly warming loads in **Malmö***



*From Low **to high performance***

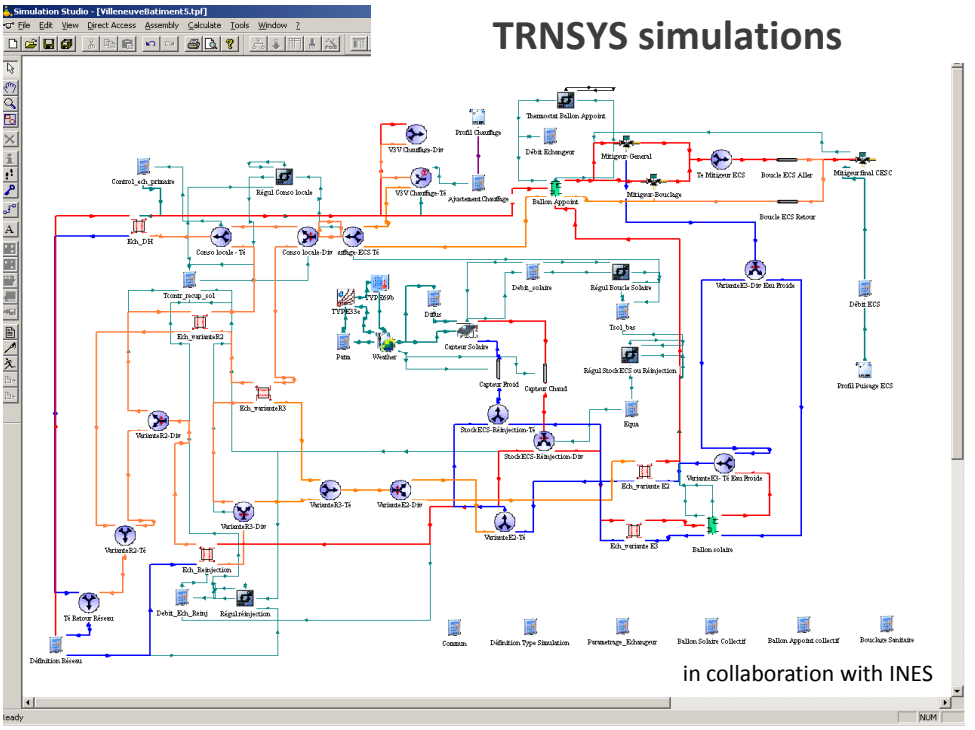
- Phase 1 : **480** residences
- Average size of one building : **40** residences
- **2160 m²** solar collectors distributed
- **3000 m³** of centralized storage
- **3** pipes low temperature district heating

Energy Loads



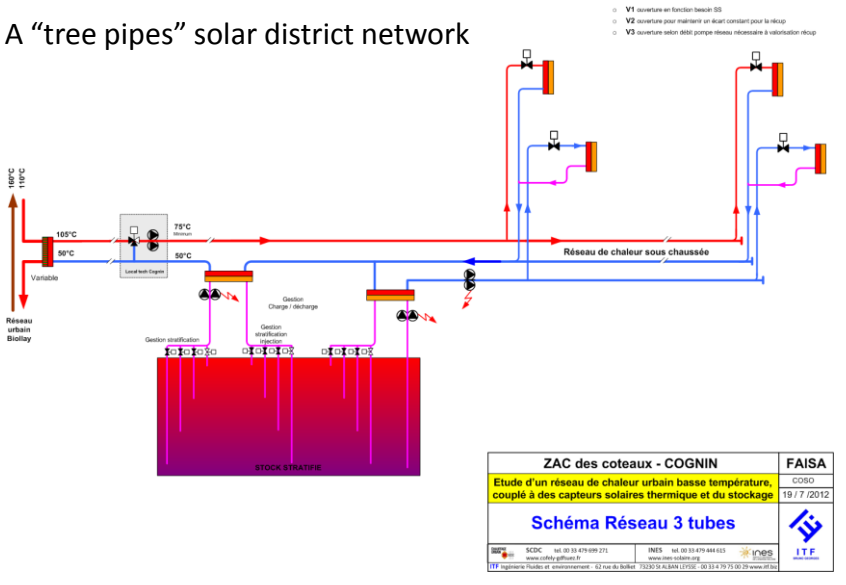
Energy consumptions evaluation

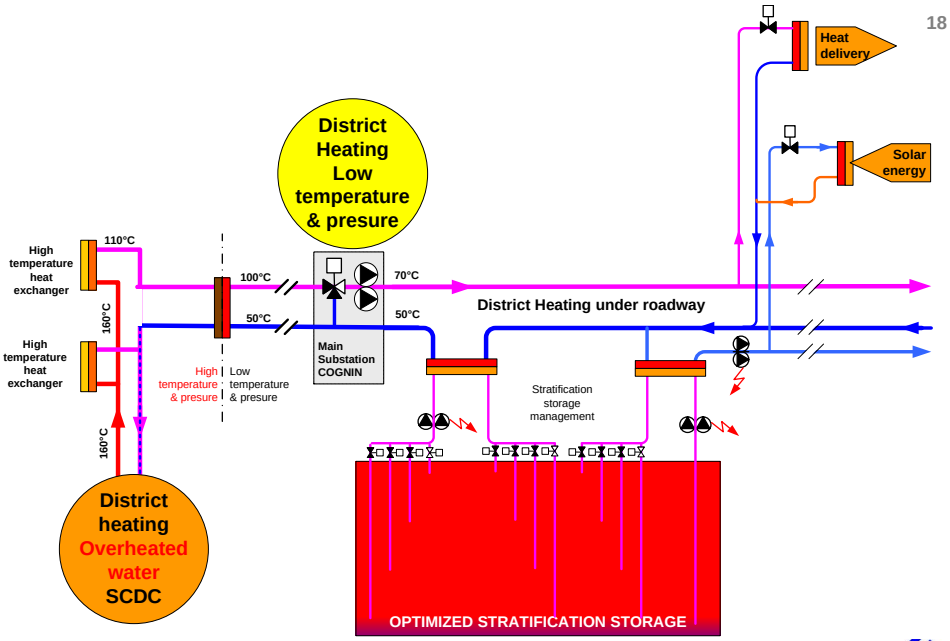
TRNSYS simulations

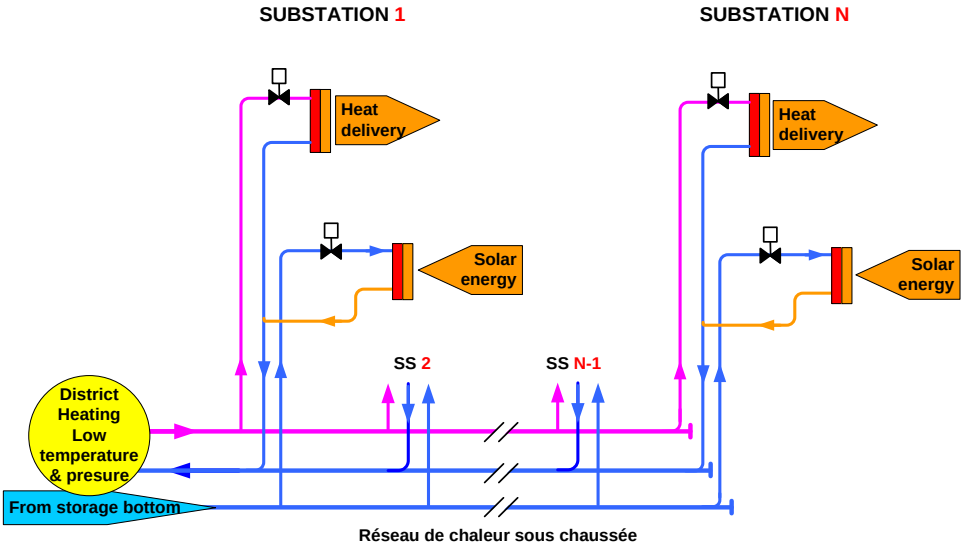


in collaboration with INES

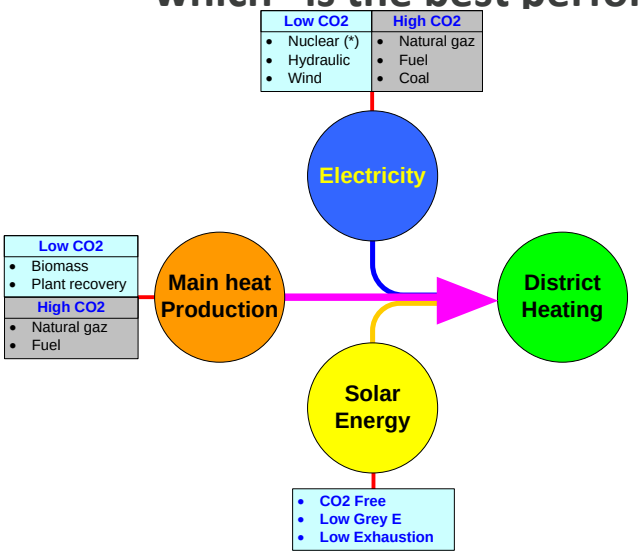
A “tree pipes” solar district network







Not so obvious to define
"which" is the best performance



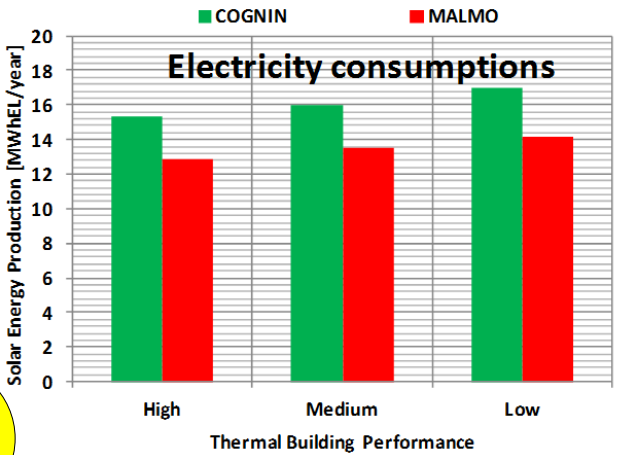
The performance is well also to take into account

CO2 emissions and **Gray energy**

(*) Nuclear energy
The people safety and the nuclear waste treatment, remains a real environmental problem

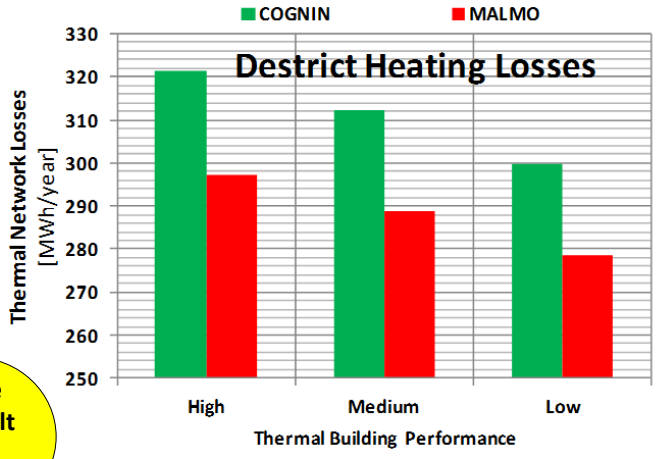
Results

More solar occurance in Cognin, more energy to transfer in the district heating



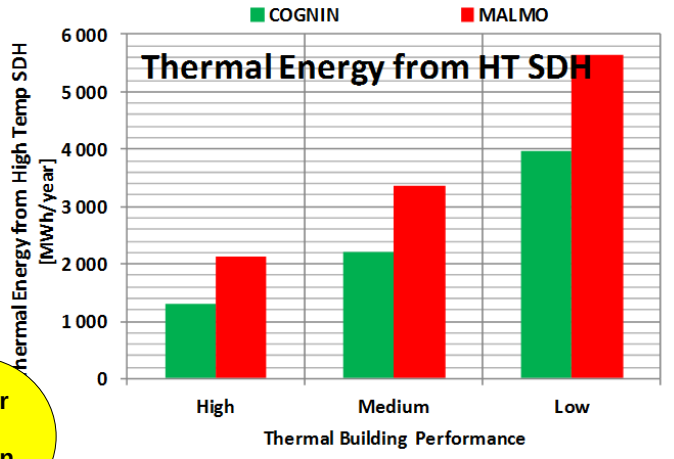
more difficult in Cognin

More losses for Cognin, due to the balance between heating needs and domestic hot water



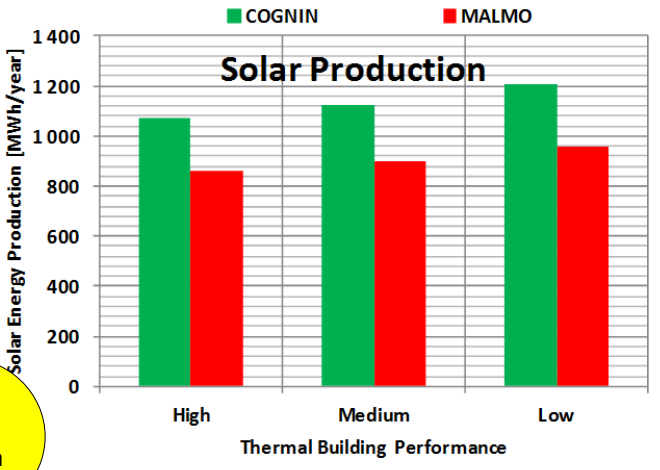
more difficult in Cognin

Energy consumption increases when weather data and building performance are degraded



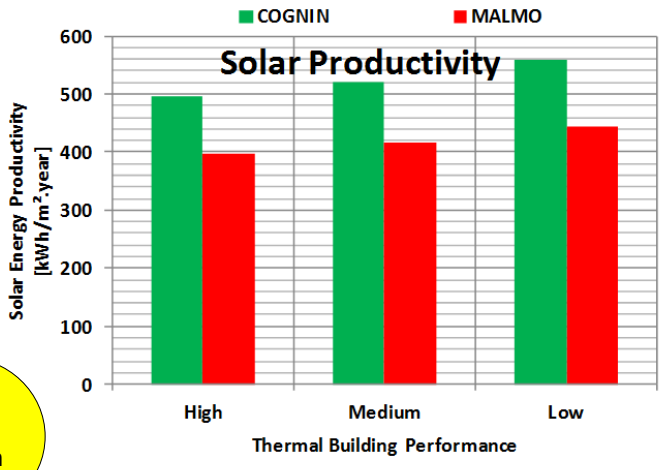
Easier in Cognin

Less good data weather or less favorable building
Stronger energy demand
The same quantity of solar collector can provide more heat

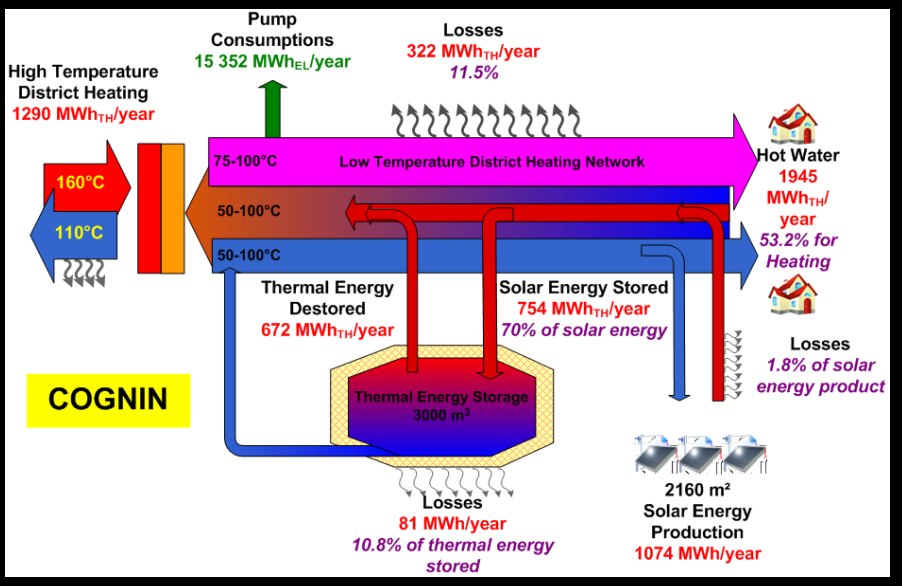


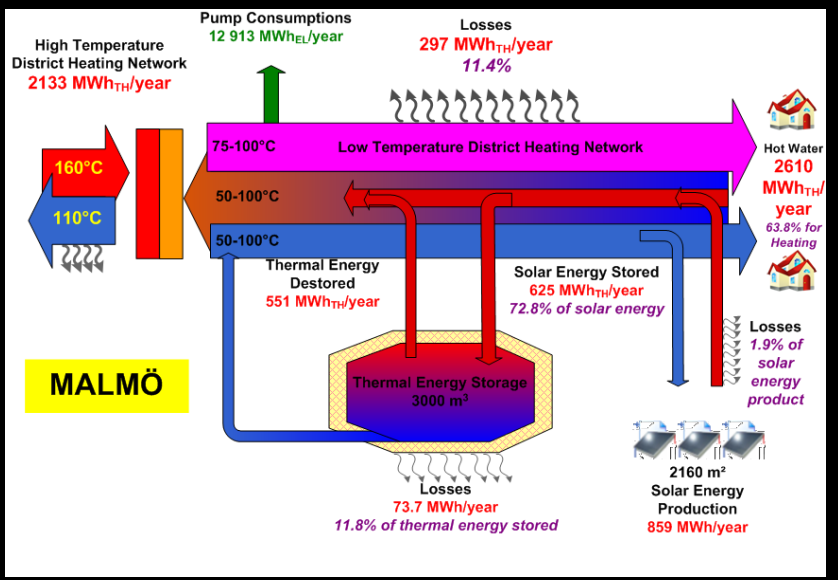
Easier in Cognin

Higher productivity (in kWh/m ².year)
for Cognin than for Malmö
The supplied energy is more important in the South



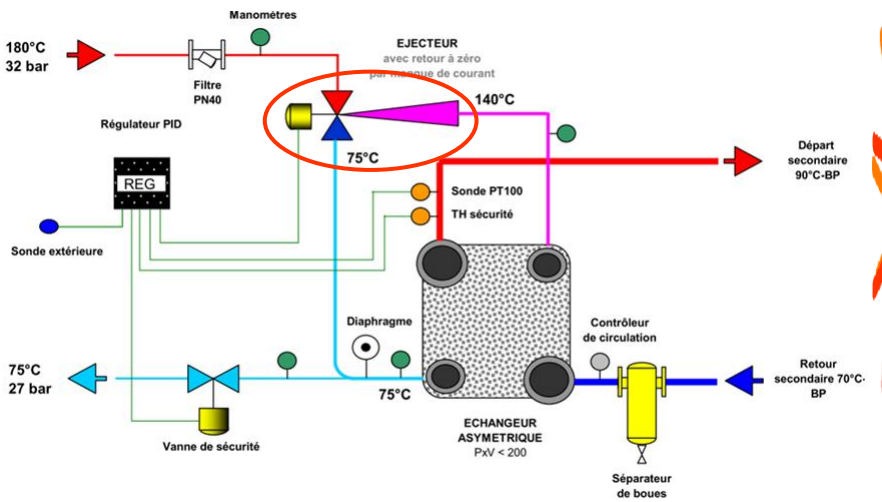
Easier in Cognin


Pump Consumptions
15 352 MWh$_{EL}$/year
Losses
322 MWh$_{TH}$/year
11.5%
High Temperature District Heating
1290 MWh$_{TH}$/year
160°C
110°C
75-100°C
Low Temperature District Heating Network
50-100°C
50-100°C
Hot Water
1945 MWh$_{TH}$/year
53.2% for Heating
Thermal Energy Destored
672 MWh$_{TH}$/year
Solar Energy Stored
754 MWh$_{TH}$/year
70% of solar energy
Losses
1.8% of solar energy product
COGNIN
Thermal Energy Storage
3000 m³
Losses
81 MWh/year
10.8% of thermal energy stored
2160 m²
Solar Energy Production
1074 MWh/year


Pump Consumptions
12 913 MWh$_{EL}$/year
Losses
297 MWh$_{TH}$/year
11.4%
High Temperature District Heating Network
2133 MWh$_{TH}$/year
160°C
110°C
75-100°C
Low Temperature District Heating Network
50-100°C
50-100°C
Hot Water
2610 MWh$_{TH}$/year
63.8% for Heating
Thermal Energy Destored
551 MWh$_{TH}$/year
Solar Energy Stored
625 MWh$_{TH}$/year
72.8% of solar energy
Losses
1.9% of solar energy product
MALMÖ
Thermal Energy Storage
3000 m³
Losses
73.7 MWh/year
11.8% of thermal energy stored
2160 m²
Solar Energy Production
859 MWh/year

Before conclusions

One small explanation about **hydro-ejectors** technology



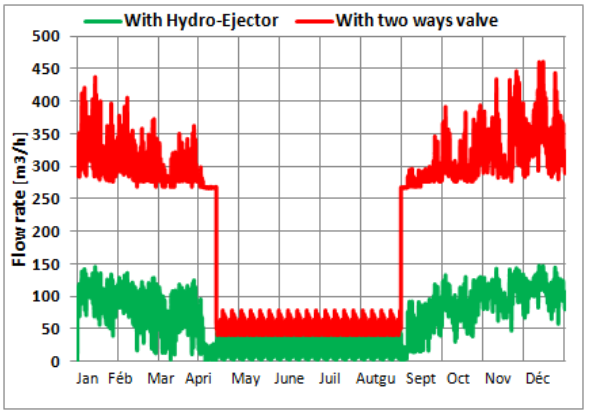
An other study on high T district heating, show an 9% profit in primary energy with hydro-ejectors valve for sub station control

	Two ways valve regulation	Hydro-ejectors regulation	Relative profit
Thermal production [MWh]	52 300	49 800	-5%
District heating thermal losses [MWh]	5 300 *10% of the production*	2 900 *5,8% of the production*	-59%
Electricity consumptions [MWh_{EL}]	384	155	-60%
Primary Energy [Mwh EP]	58 590	53 099	**-9%**

with the French conversion rate

This technique could be very interesting on solar district heating

The **return temperature** is very lowered and thus very favorable to solar collectors good efficiency



conclusions

- SDH are more delicate to balance in the South of Europe and/or with very powerful buildings
- The low temperature of the solar district heating is a real factor of powerfull
- The good performance strongly depend on many "**points of detail**" like district heating pipes and storage insulation, sub-stations regulation mode and pumps flow rate variation driving.
- Predictive management modes for the district heating energy level and storage operations seem convenient to find
- Limitation of the Carbone emission, renewable energies recourse and planet exhaustion to reduce **are the real stakes**

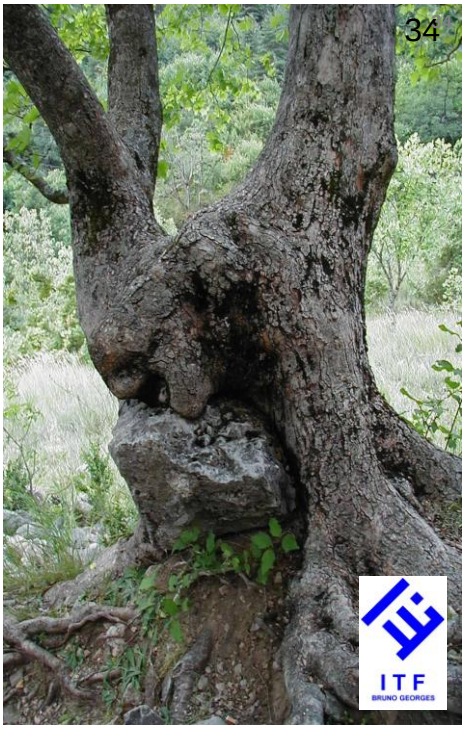
SDH solar district heating

Malmö

April 2013

Solar energy in a district heating for a French Ecodistrict

Thanks



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