

# SEPEMO-Build

## SEasonal PErformance MOnitoring

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13 November 2012  
London



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## SEPEMO-Build – project aims

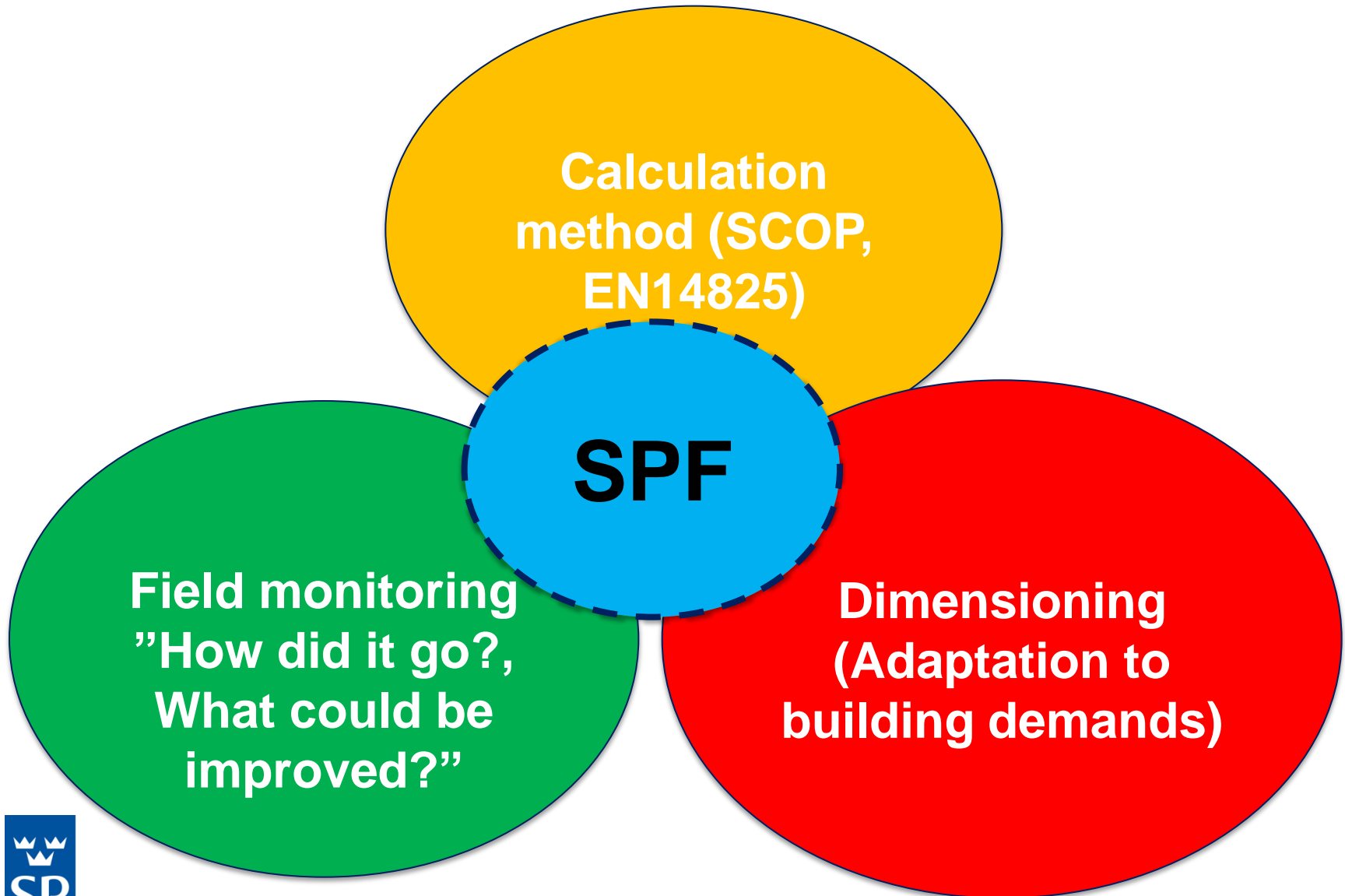
- Overcome barriers to a wider deployment of heat pumps
- Robust data of factors influencing heat pumps **seasonal performance factor (SPF)**
- Wider acceptance of heat pumps, and **increased quality assurance of installations**



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# The importance that SPF delivers what is promised



# Monitoring sites



SP Sv

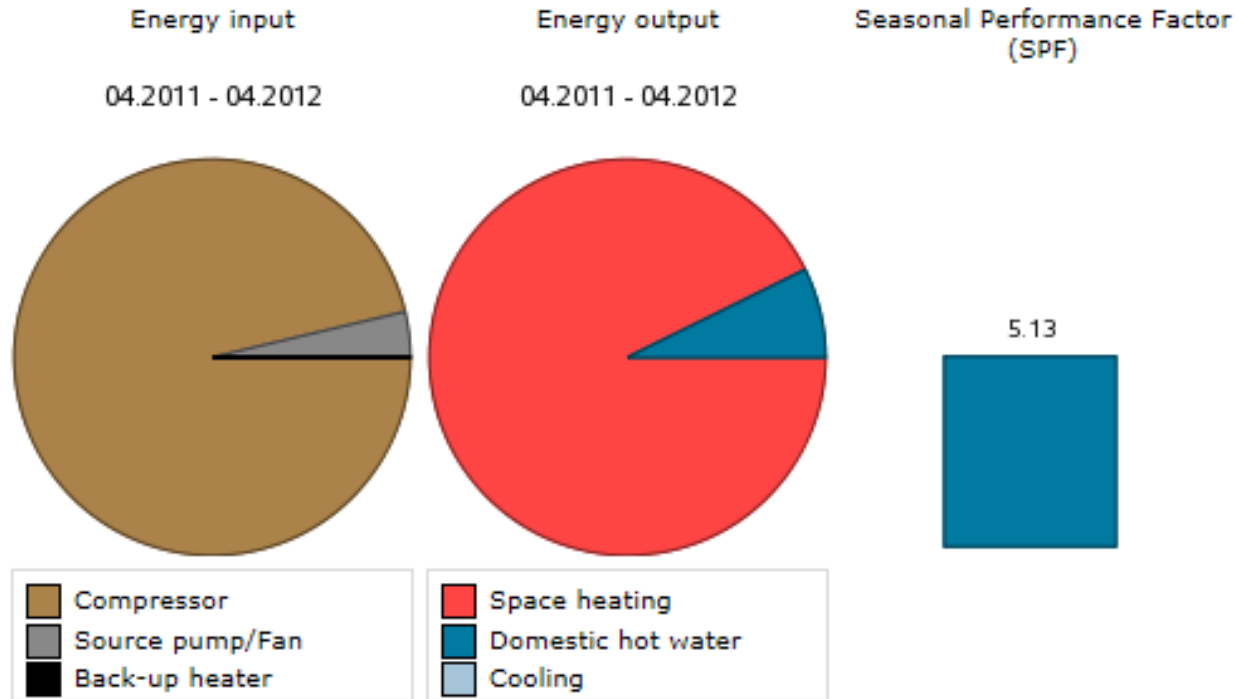
# Monitoring, types of buildings



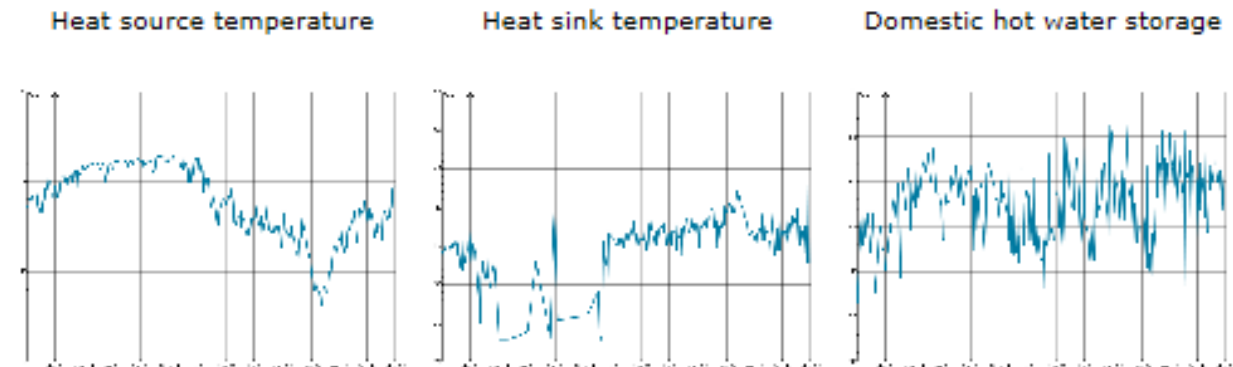
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# Different ways to show results, [www.sepemo.eu](http://www.sepemo.eu)

i



## Average supply temperatures



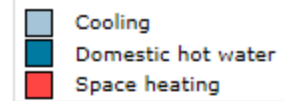
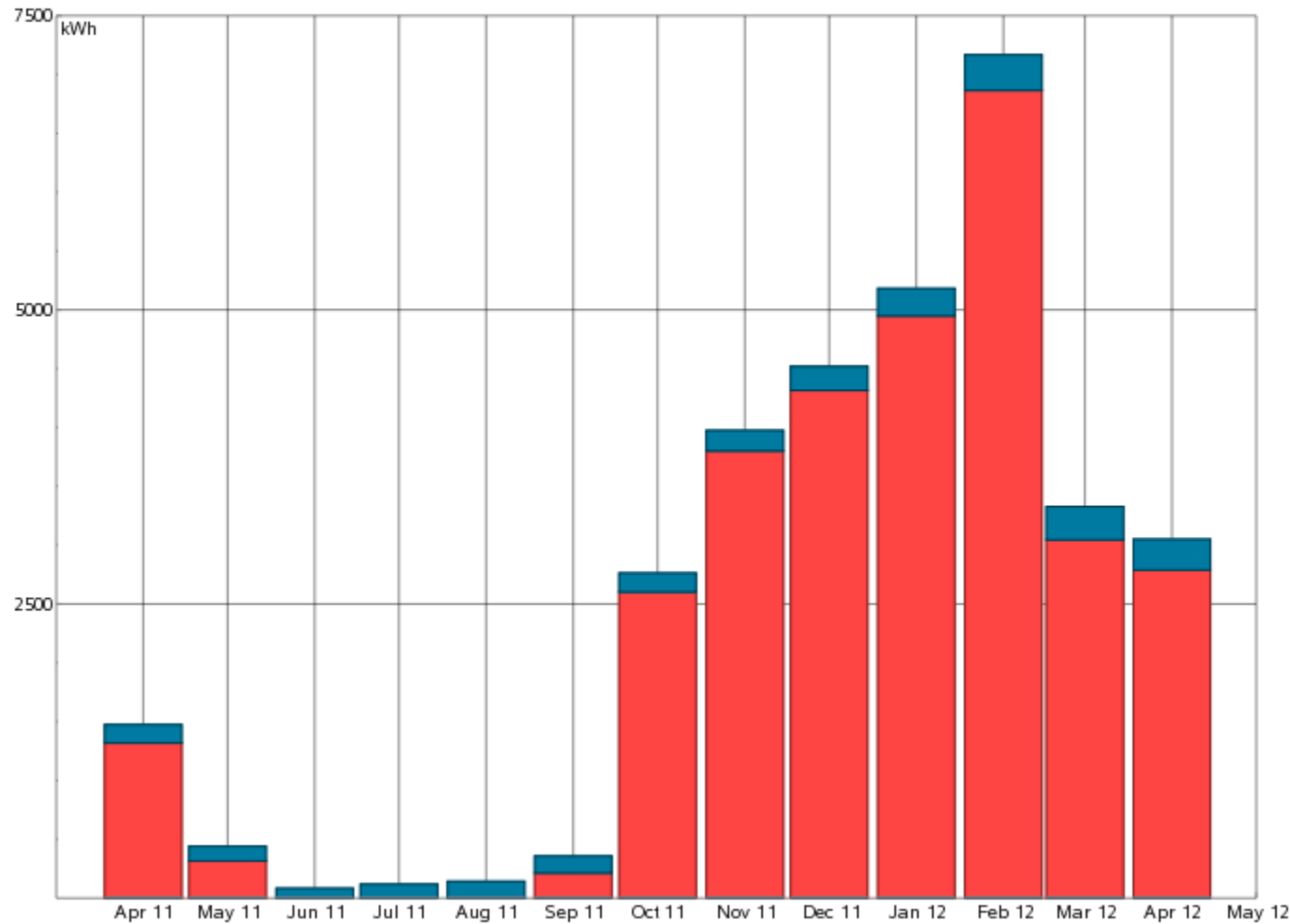
Click the diagrams to enlarge



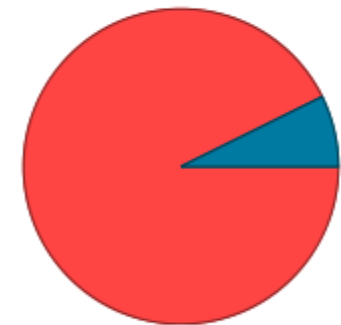
SP Sver

# Detailed view, [www.sepemo.eu](http://www.sepemo.eu)

## Energy output



04.2011 - 04.2012

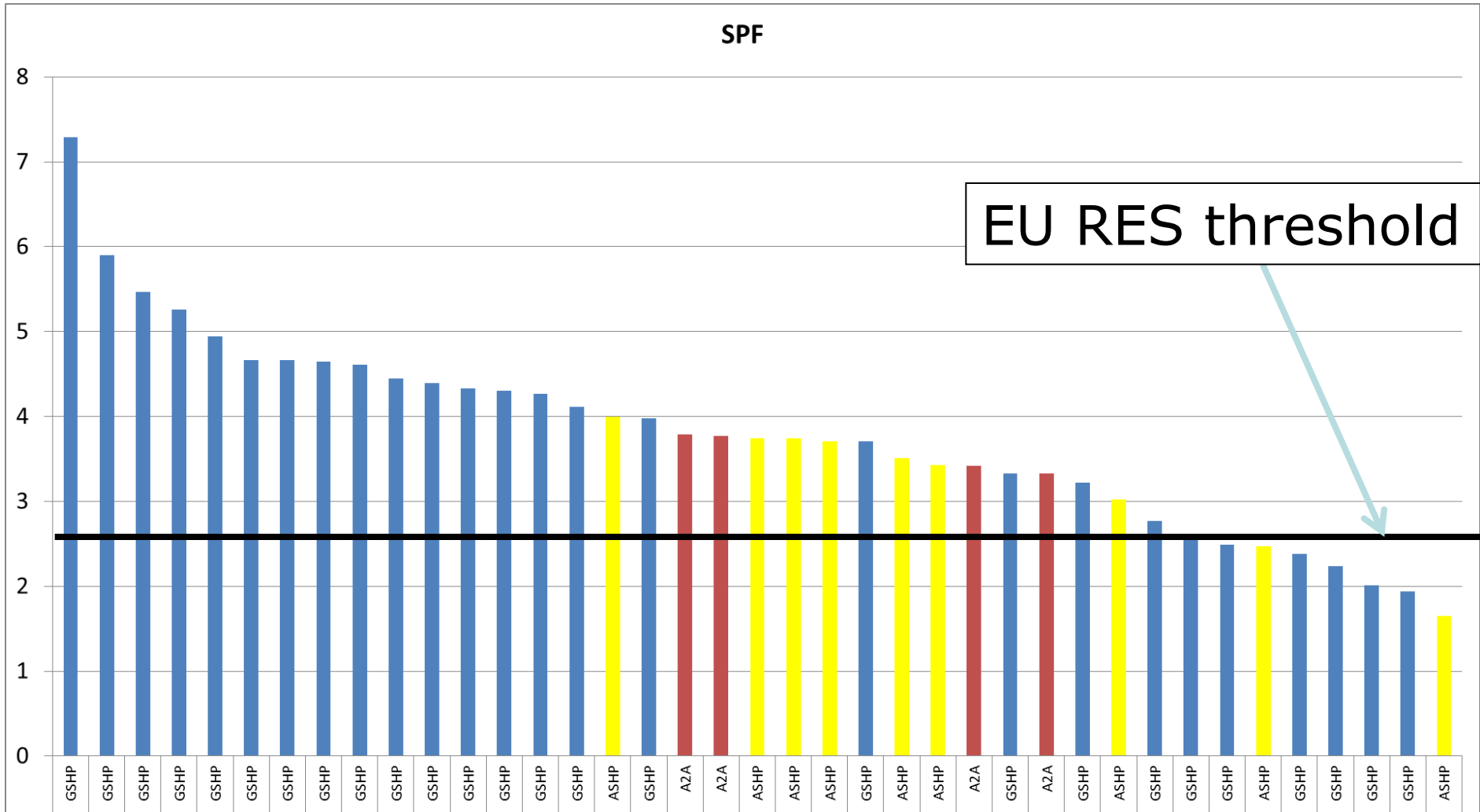


Space heating	30210.1 kWh (92.7%)
Domestic hot water	2379.9 kWh (7.3%)
Cooling	0.0 kWh (0%)
<b>Total</b>	<b>32590.0 kWh</b>

# Summary results

SPF

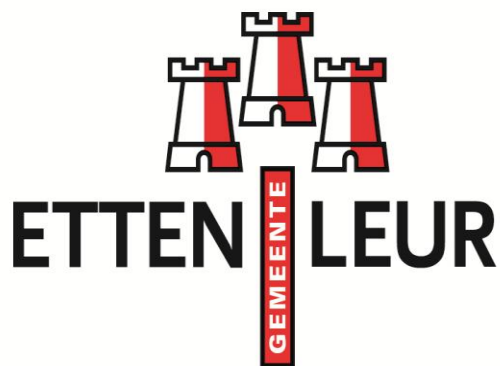
EU RES threshold



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NL Agency  
Ministry of Economic Affairs,  
Agriculture and Innovation



## Lessons learned from the Etten Leur project

European Heat Pump City of the  
Year Award 2012  
An example from the  
Netherlands

14 december 2012

Onno Kleefkens



» Focus on energy  
and climate change



## Lessons learned from the Etten Leur project

- EHPA City of the Year Award
- Introduction to Etten Leur
- Type of houses
- Start of the project
- Choices made
- *Examples from SEPEMO*
- *How to use SPF in Policy and the market*
- Future developments



Reference: Witte, H.J.L., van Gelder, A.J. & Klep, P. A Very Large Distributed Ground Source Heat Pump Project For Domestic Heating: Schoenmakershoek, Etten-Leur (The Netherlands).  
Published in: 2006. Proceedings Ecstock, the Tenth International Conference on Thermal Energy Storage. May 31 – June 2 2006, the Richard Stockton College, New Jersey (USA).



## Lessons learned from the Etten Leur project

The European City of the Year Award:

- The trophy has been to that very city that has shown the biggest effort in integrating heat pumps into its energy infrastructure (measured as additional heat pump installations per 10 000 inhabitants). The winner is selected by an expert jury from the heat pump industry.





## Lessons learned from the Etten Leur project

The Jury report about Etten Leur?

"it actually is the best "city" example – several types of buildings connected, no gas grid anymore, already first installations in place since a longer time with good experience. Start small and then develop into larger areas."

"it is the long term policy of a city council where they based upon experience show the courage to go on."



# Etten Leur project





## Lessons learned from the Etten Leur project

### Introduction to Etten Leur

- Etten Leur is located in the South West of Netherlands
- Energy Vision focused on an 'all electric' and energy-neutral development
- From the onset of the project heat pumps are an integral part of this vision
- Etten-Leur is to achieve energy-neutral building for new developments by 2020.
- Schoenmakershoek as part of this ambition is a new housing development, of about 1400 houses

**19 City Councils in Brabant signed in 2007 the 'Verklaring van Dussen' on the reduction of CO2 emissions of 30%, 20% Renewables in 2020**



# Lessons learned from the Etten Leur project

## Type of houses





## Lessons learned from the Etten Leur project

### Start of the project

- From the start of the project the city council has been deeply involved. A research project was started and two concepts for ground sources were built. The Keen started in 2003.

**Project:**

*Opdrachtgever:*

*Architect:*

*Plaats project:*

*Specifieke kenmerken:*

**21 energiebalanswoningen de Keen**

Bouwfonds

Bear architecten

Etten-Leur

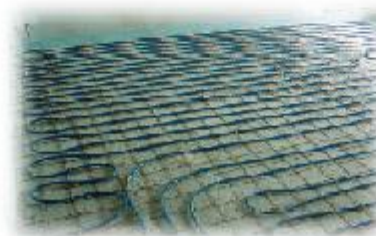
Door de wijk ligt een distributienet wat aangesloten zit op een open bron systeem.

*Bouwjaar:*

*Installatie per woning:*

2003

Individuele warmtepomp aangesloten op een centraal distributienet en balansventilatie met warmteterugwinning.





## Lessons learned from the Etten Leur project

### Choices made

- After the first pilot in 'De Keen' it was decided to go on with heat pumps based on individual closed loop groundsources.
- The City Council decided that it was:
  - › More cost effective, no large up front investments
  - › Cheaper to maintain
  - › Reliable
  - › Each house owner had its own source
- The conditions were established for the design and implementation of individual heat pump systems (typically consisting of 50 - 100 units each)
- In the second phase was entered especially the feasibility of long-term use of ground source closed loop heat pump technology was evaluated



## Lessons learned from the Etten Leur project

### Choices made (project boundary conditions)

- Clear guidelines for the implementation of balanced ventilation with heat recovery.
- Use of a heat pump for space heating and domestic hot water, that has a Quality label
- Noise emissions better than 45 dB
- COP for space heating at least 4.9 at design conditions, at least 2.1 for DHW production
- Free cooling option standard, including control system to prevent condensation on the floor
- Borehole Heat Exchanger designed and constructed according to the 2DEN-03.24 Quality Guideline
- Average fluid temperature should not drop below 0 °C.
- At least between 50 - 60% of the heating demand of the house needs to be recharged to the ground, in practice this means there will virtually be a seasonal thermal energy balance in the ground.

**To ensure that the individual projects comply with the requirements a certificate based on a qualitative checklist has been developed.**



## Lessons learned from the Etten Leur project

### Results

Projects were built in Schoenmakershoek by different project developers using various types of heat pumps





## Lessons learned from the Etten Leur project

### Results

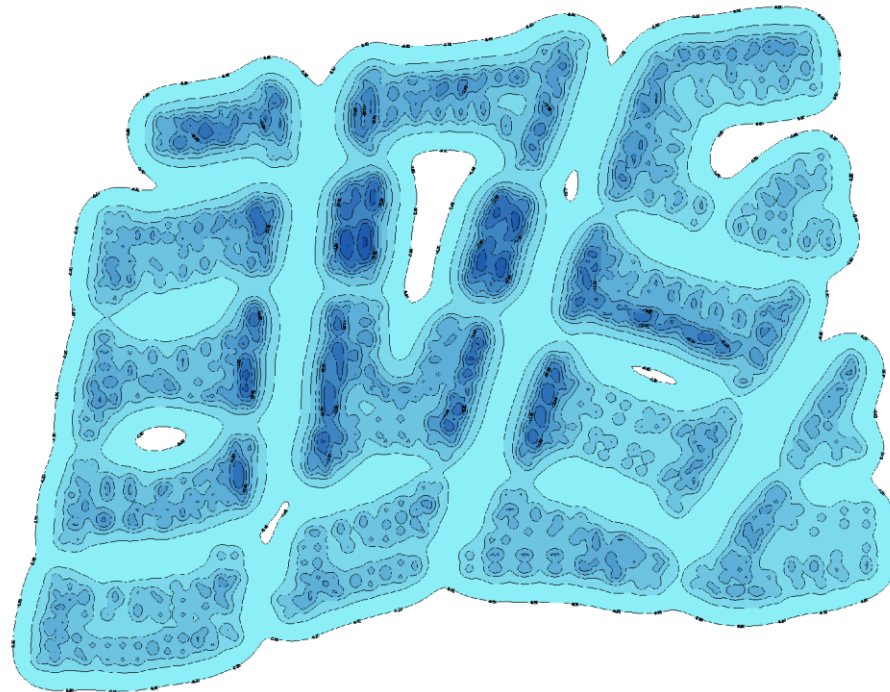
Heat pump data and temperature design limits

PARAMETER	Detached	Semi-detached	Terraced
Peak capacity heat pump (kW)	8	6	4
COP heat pump (heating)	4.5	4.2	4.0
System flow (m <sup>3</sup> /hour)	1.15	1.14	1.05
$\Delta T$ borehole heat exchanger (K)	4.75	3.5	2.5
Number of houses in calculation	1	2	10

## Lessons learned from the Etten Leur project

### Results

- Change in temperature after 5 years of simulation, energy use profile terraced house type with 0% recharge load (6.84 MWh heating, 0 MWh recharge load).

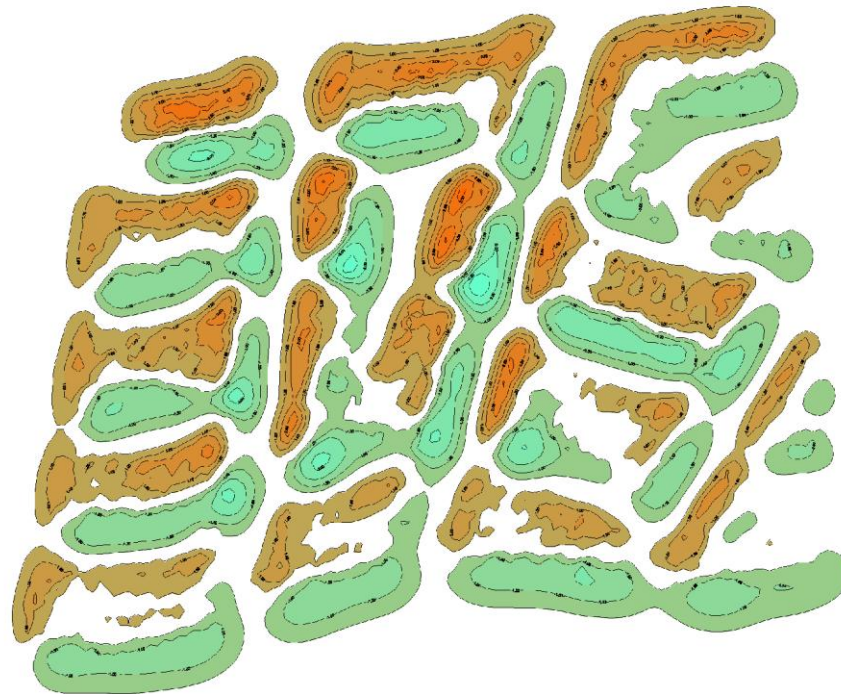




## Lessons learned from the Etten Leur project

### Results

- Effect of groundwater flow, temperature difference between simulation with and without groundwater flow. Energy use profile detached, 50% recharge.





## Lessons learned from the Etten Leur project

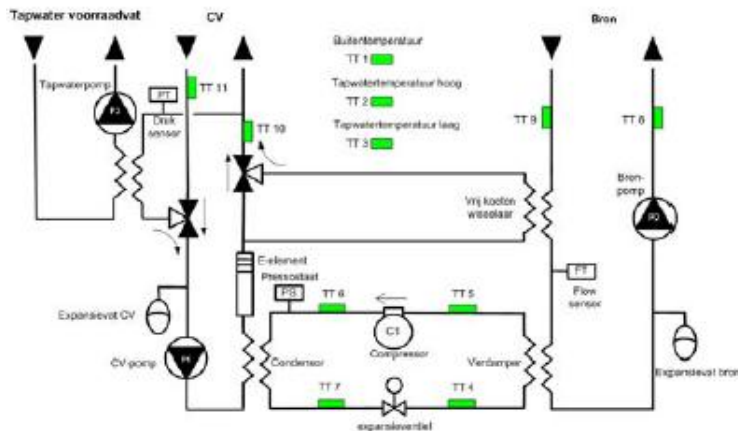
### Lessons learned

- To successfully realize such a large scale, high density ground source heat pump project, it is paramount to pay special attention to the feasibility, performance, long-term sustainability and installation quality.
- The conditions for the design and implementation of individual heat pump systems (typically consisting of 50 - 100 units each) within the total plan project needs to be well defined.



## Examples from SEPEMO: Ypenburg – De Bron

- o Low Energy buildings:
- o Individual ITHO heat pumps at Ypenburg – De Bron
- o Servicing and performance guarantee by manufacturer
- o 264 heat pumps monitored



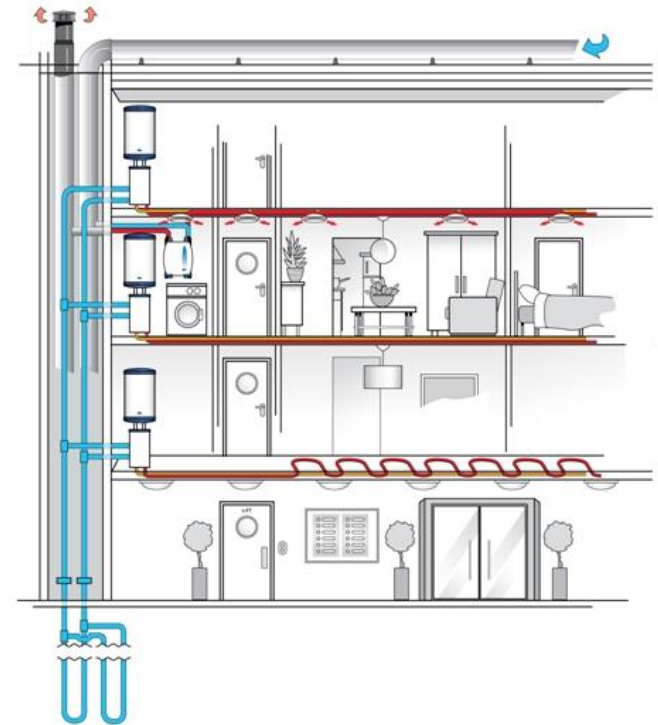
Monitoring set up (remote read out)





## Examples from SEPEMO: De Tas te Biddinghuizen

- Low Energy buildings
- Individual heat pumps by ITHO at De Tas te Biddinghuizen
- Number of units monitored: 54





## Examples from SEPEMO: analyses



### Conclusions

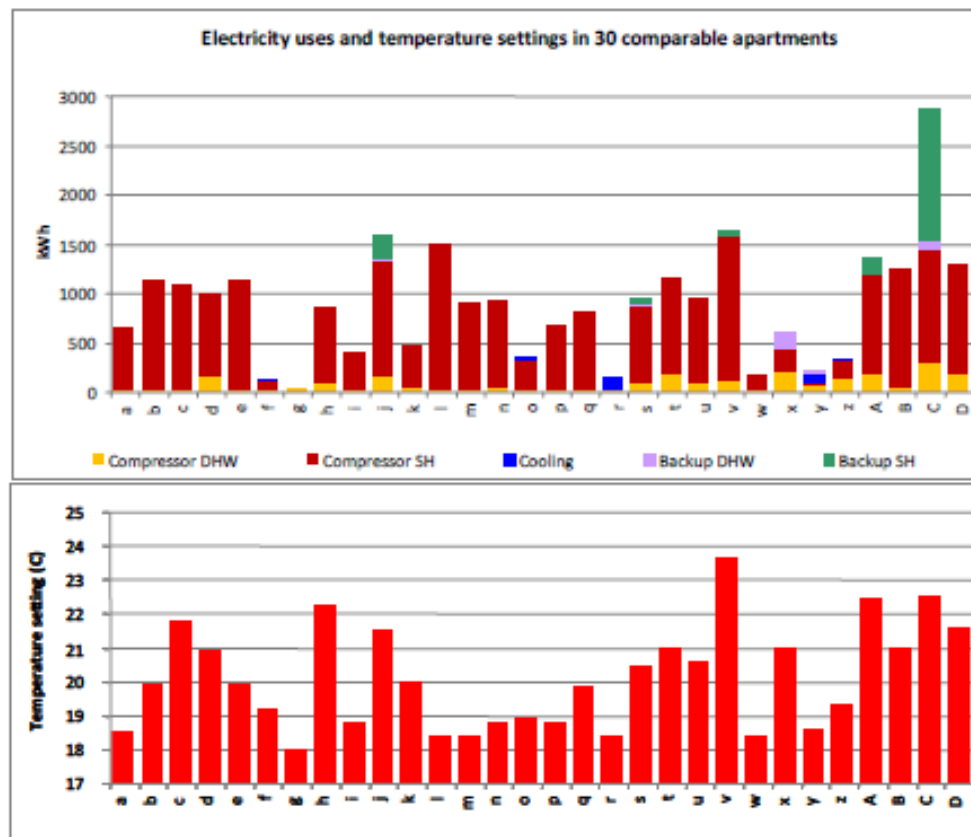
- *Ground sources*: After three full seasons with relatively cold winters in practice a far better result can be found than expected in theory and calculation with EED-program.
- *Behaviour*: The energy use of the end user varies largely. SPF is not much influenced for space heating and not for DHW if the control strategy is optimized.
- *Thermostat setting*: often 2 degrees higher than in calculation models resulting in 15% higher energy use per degree thermostat setting.
- The use of DHW is increasing and storage capacities are in some cases at their limits.

**Overall conclusion calculation models (in NL ISSO 51) have to be updated.**



## Monitoring analyses

End user behaviour as monitored under SEPEMO:





## How to use SPF in policy and the market?

The SEPEMO project gives directions for the road forward:

- Policy measurements
- Market developments

Focus is often on technology and installation.

More is needed as we found under SEPEMO!

- > Quality of building envelope
- > End user behaviour
- > Quality of Ground sources





## How to use SPF in policy and the market?

Good performance of systems can be guaranteed, starting from design towards installation and maintenance.



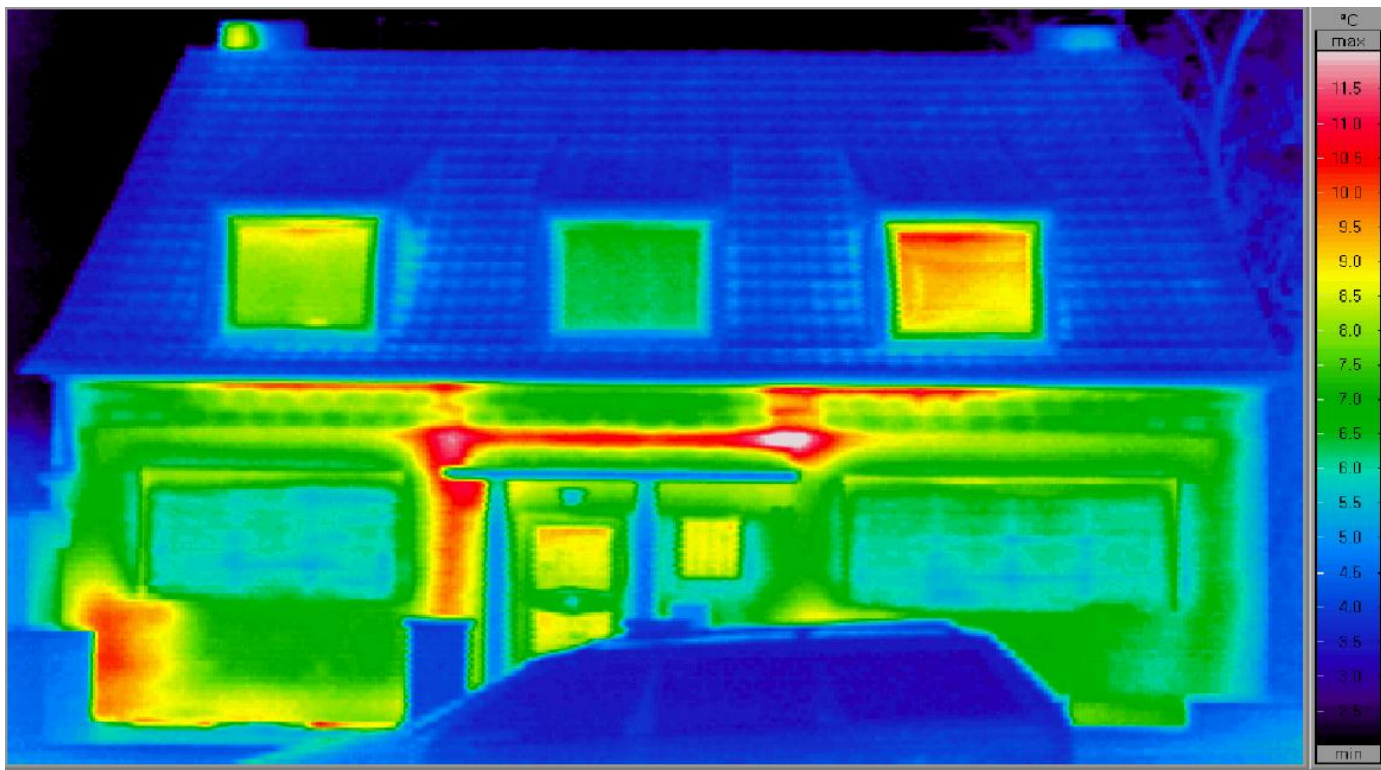
- Updating calculation models (ISSO 51)
- Updating existing installation guide lines for heat pumps (ISSO 98 for air source hp's has already taken up the SPF methodology according to SEPEMO)
- Training programs for installer certification are based upon ISSO
- Stimulate and communicate this to the market end users





## How to use SPF in policy and the market?

Quality of building envelope is important:





## *How to use SPF in policy and the market?*

### *National legislation on ground sources*



Parliament has asked for a legislative act on minimum efficiency requirements in the permit for ground sources for heat pumps on order to optimally use the potential.

Legislative action:

- Mandatory certification on design, installation and maintenance of open sources and for design and installation only for closed sources
- Permits based upon life cycle models (EED)
- Permits based upon SPF 0 (should be >.....). As the level of performance requirements are still unknown these are now monitored in line with SEPEMO methodology.



## *How to use SPF in policy and the market?*

It is getting busy in the underground!





## *How to use SPF in policy and the market?*

**Good maintenance of heat pump systems without monitoring is  
'impossible'**

### *Market response towards competitive performance*

- New technology is competing with a well established technology thus the proof of success is in the performance.
- Bad examples are highlighted in the press (De Teuge)
- Heat pump manufacturers are installing monitoring equipment:
  - › Show the performance of their systems
  - › Prevent failures during operation
  - › Give guarantee on maintenance
- Dutch companies have since febr 2011 installed more than 5000 systems with monitoring equipment.
- **Important to relate to smart grid developments**



## Lessons learned from the Etten Leur project

### Lessons learned

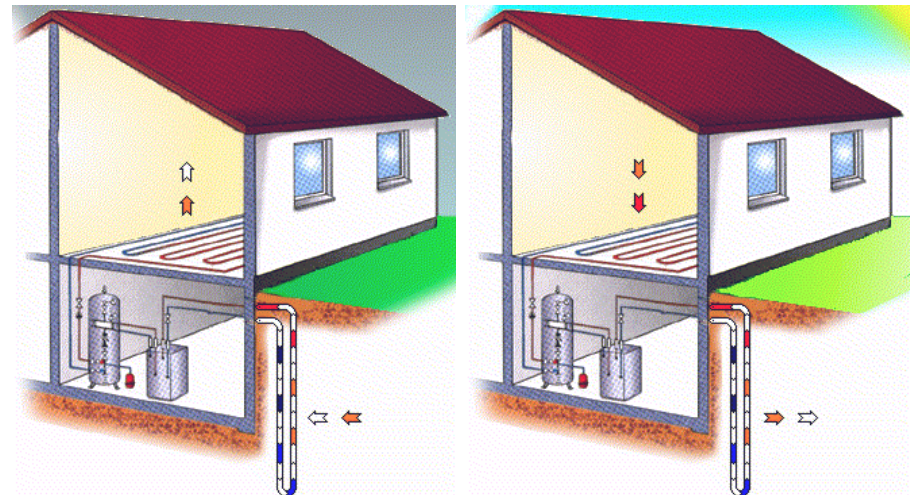
- Key factor is that the City Council of Etten Leur took the final responsibility for the 'end result' of the project and did set the strict boundary conditions in order to achieve this
- Important is a clear communication to the end users, owners of the houses, on what to expect.



## Lessons learned from the Etten Leur project

### Conclusions

- Etten Leur has now set the basis for energy neutral concepts on a large scale by creating an all electric environment based upon heat pumps.
- The next phase will be the erection of a set of wind turbines near the city at Moerdijk, as integral part of the overall project.





## Lessons learned from the Etten Leur project

When clear goals are set an environmentally friendly and sustainable use of the groundsources can be made for heating and cooling even for very large scale projects.

