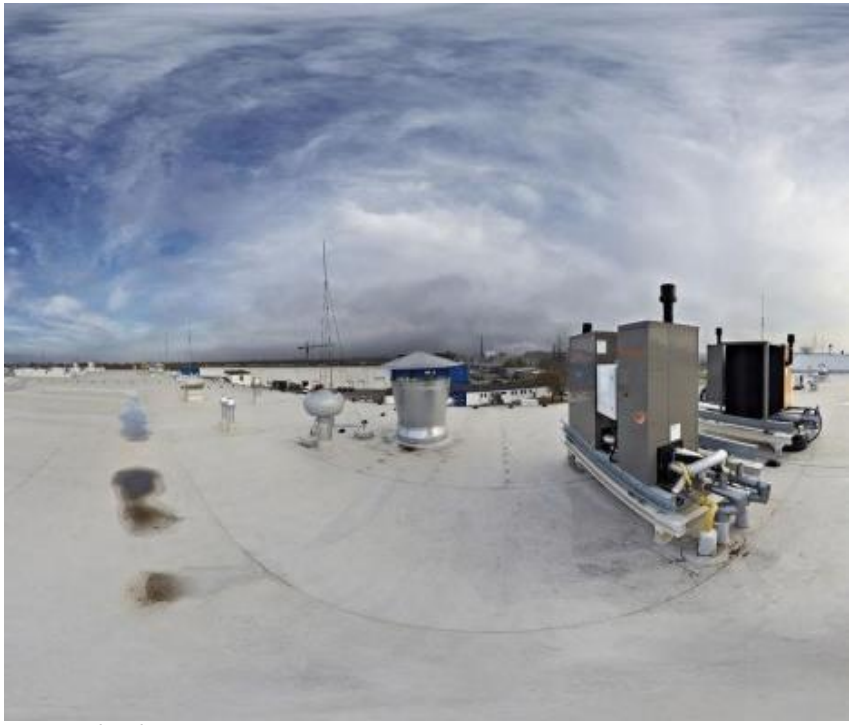
Recent status of fuel driven heat pump in Europe



Source: Flowair

Dipl.-Ing. Marek Miara
Dr.-Ing. Peter Schossig
Dipl.-Ing. Ivan Malenkovic

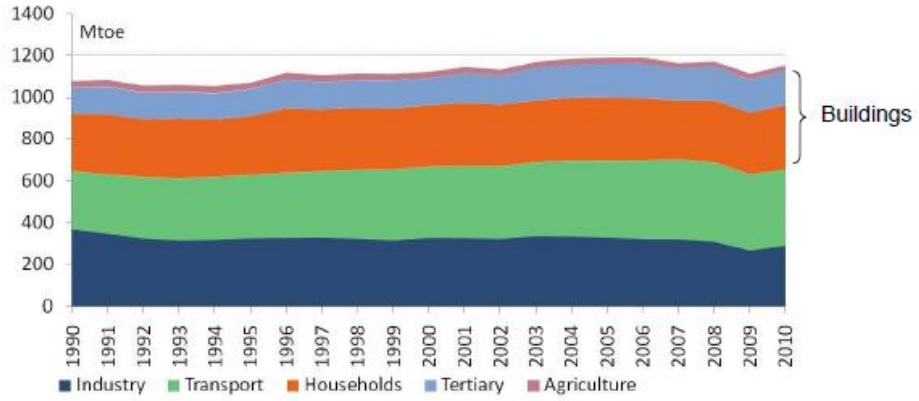
Fraunhofer Institute for
Solar Energy Systems ISE
www.ise.fraunhofer.de

HPP ExCo Meeting
Tokyo, 13-15 November 2013

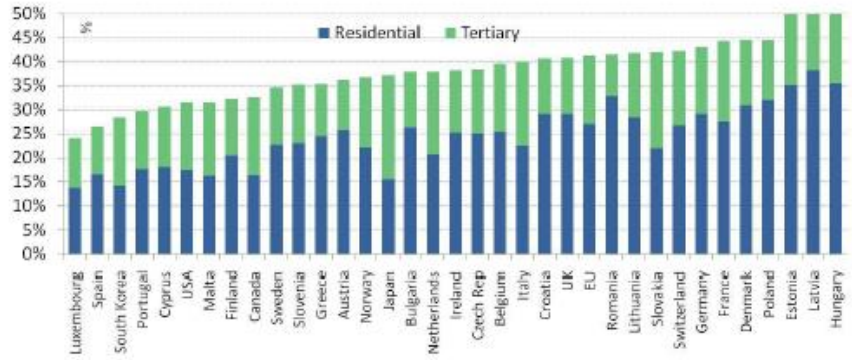
Outline

- Boundary conditions in Europe for the implementation of FSHP
- Fuel driven sorption heat pumps: motivation and technology
- Product overview and ongoing development
- Practical experience
- Annex 43 ï Fuel Driven Sorption Heat Pumps

Energy consumption in Europe



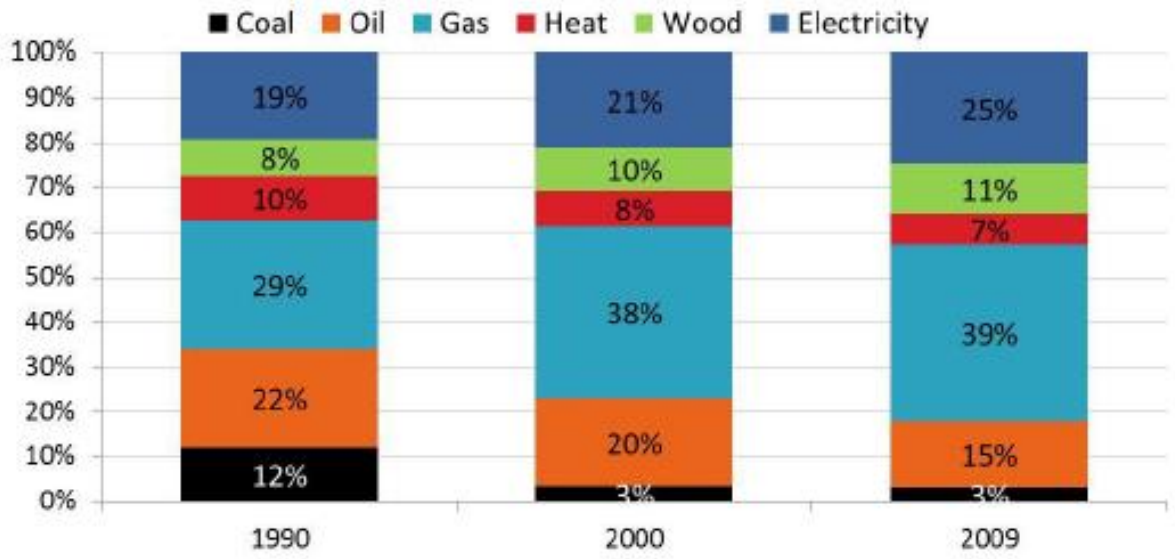
Source: Eurostat



Source: Eurostat

- About 41% of energy consumption in Europe is used for space heating and cooling and DHW of buildings in residential, public and commercial sector
- Thereof, residential sector is responsible for 27% of the final energy consumption
- There are substantial differences in the share of energy consumption for buildings among the member countries

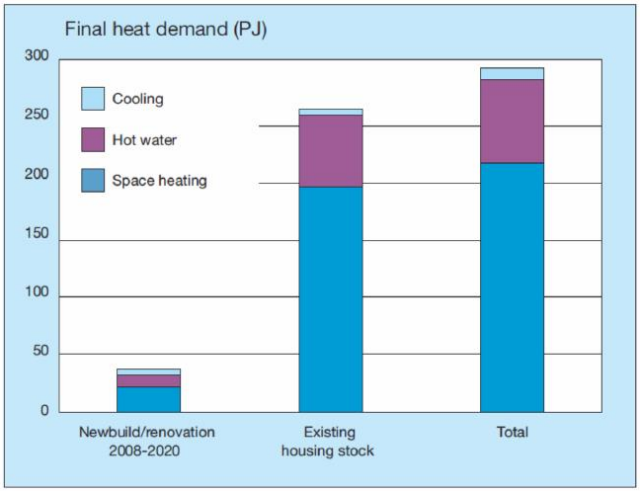
Household energy consumption by energy source (EU)



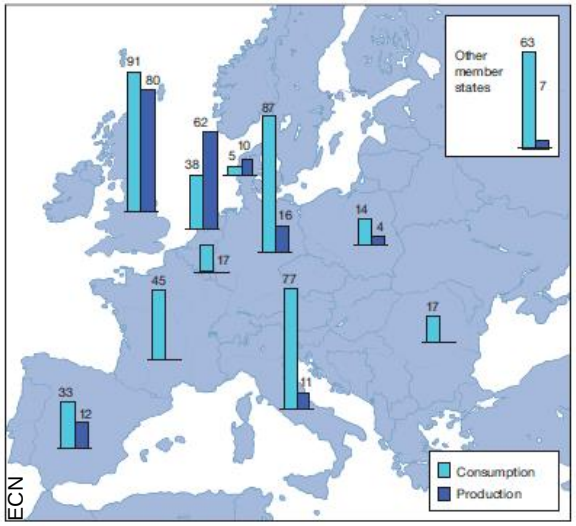
Source: Odyssee

- Electricity, biomass and natural gas have gained on importance in the last decades in the household final energy mix
- Oil consumption is decreasing, coal has been marginalised in most countries

Final heat demand in the residential sector



Source: Ecofys



Source: CE Delft, ECN

- More than 80% of the final heat demand will be in the existing housing stock.
- Boiler replacement market is the biggest market in Europe.
- Rather conservative market regarding final energy usage.

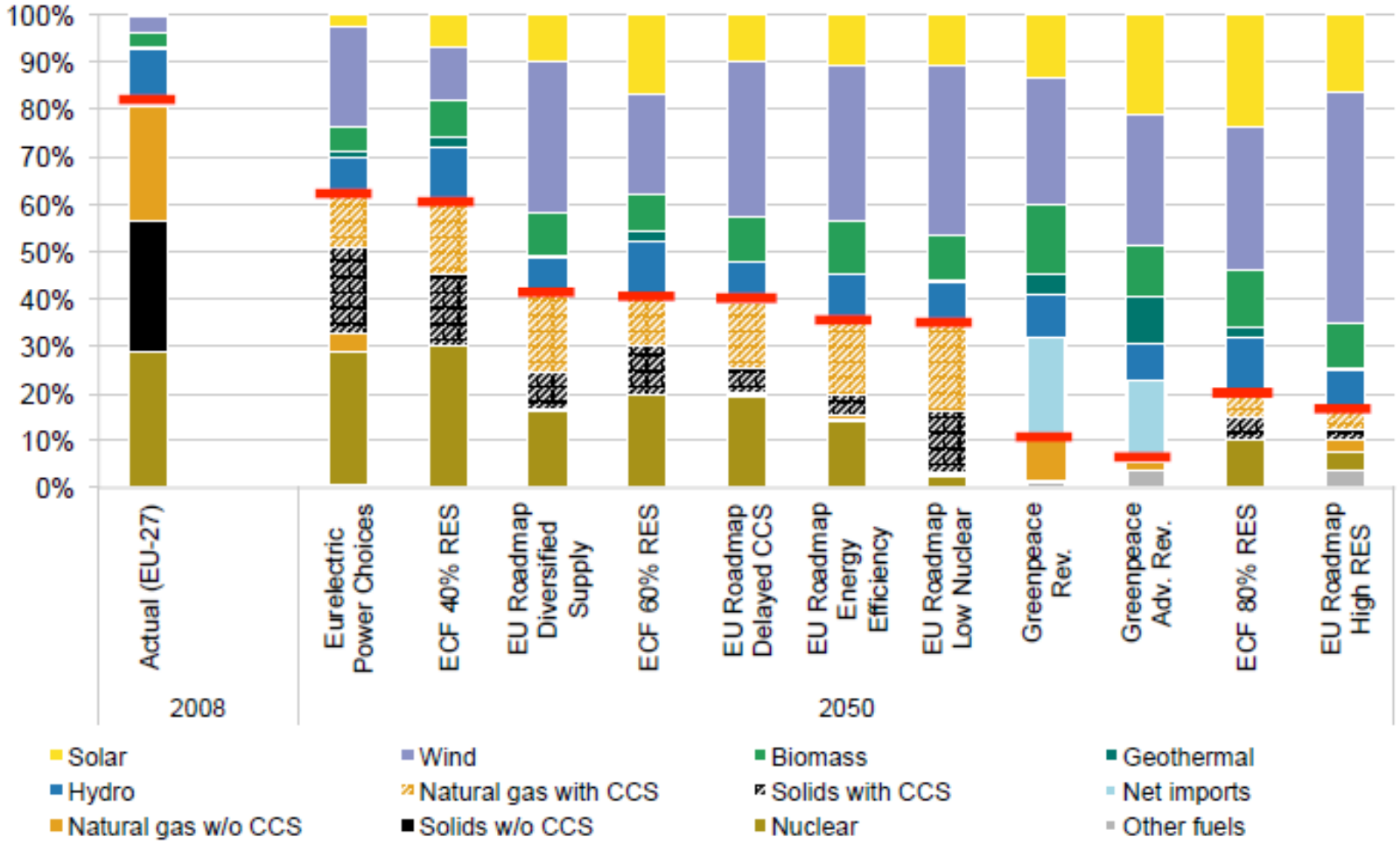
- Gas is dominant fuel for heating and DHW preparation in many important European markets

International Energy Agency

heat pump centre

Fraunhofer ISE

Gas will continue to play an important role in energy supply



Source: SEFEP 2012, Metastudy Analysis on 2050 Energy Scenarios

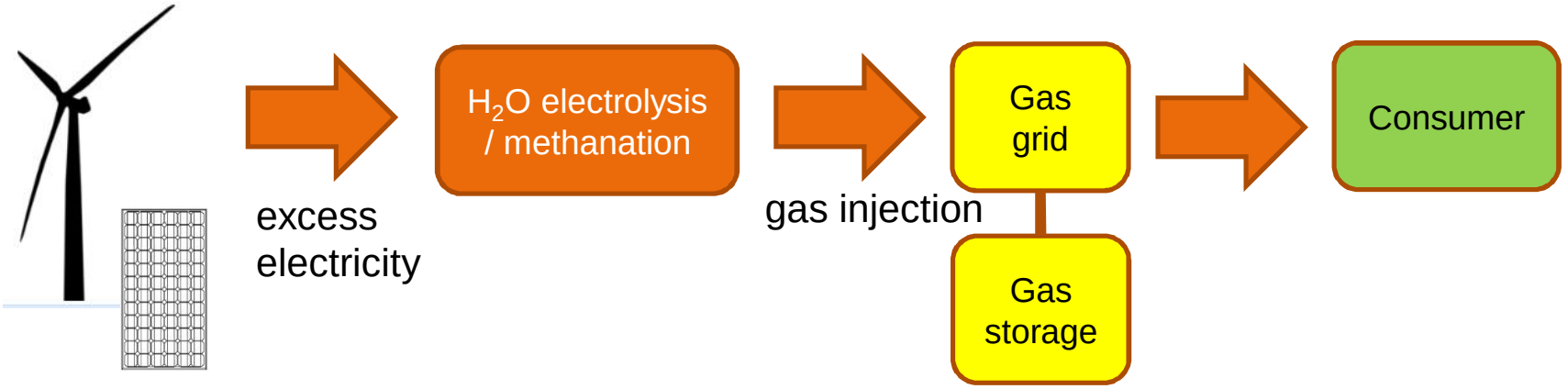
International Energy Agency

heat pump centre

Fraunhofer ISE

Decarbonisation of gas grid in the future?

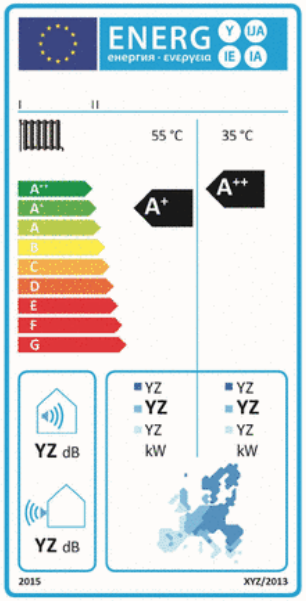
- Biogas from biological waste: agriculture, landfill, waste (sewage) water
- Usage of biogas: heat and power generation, grid injection and vehicle fuel
- Substantial potential to inject biomethane into existing gas grid to lower the net CO_2 emissions
- There are some plans in countries with well developed gas grids to do so (e.g. Germany: 7%, The Netherlands 2% by 2020, France: 17% by 2030)
- Power2gas from wind and solar electricity production



Energy policy within the EU

20% of GHG emission reduction by 2020 compared to 1990 level

Eco Design



RES Directive

DIRECTIVES

DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

EPBD

Eco Label

F-Gas Regulation

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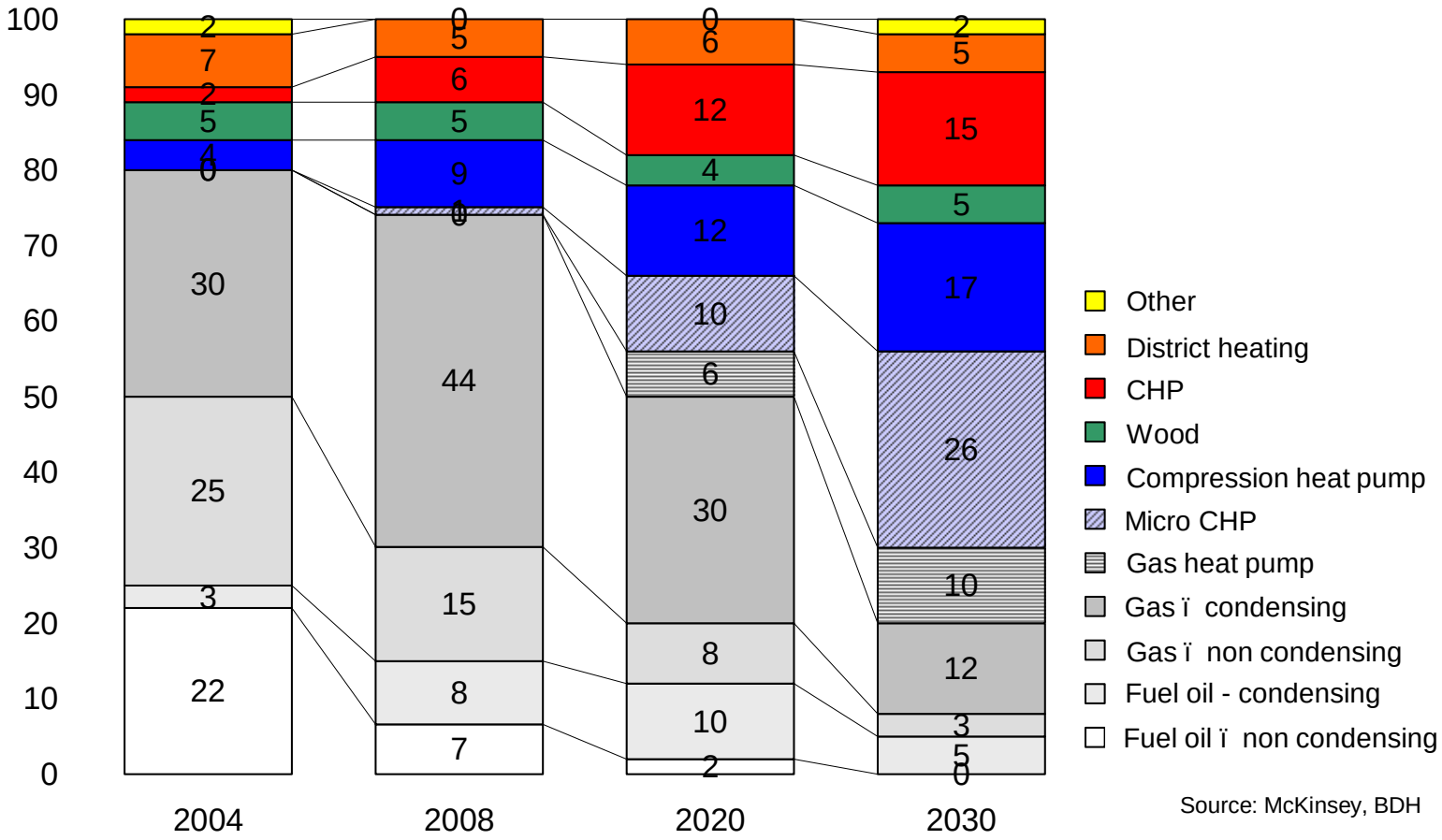
Development of the boiler market (EU)



Source: McKinsey, BDH

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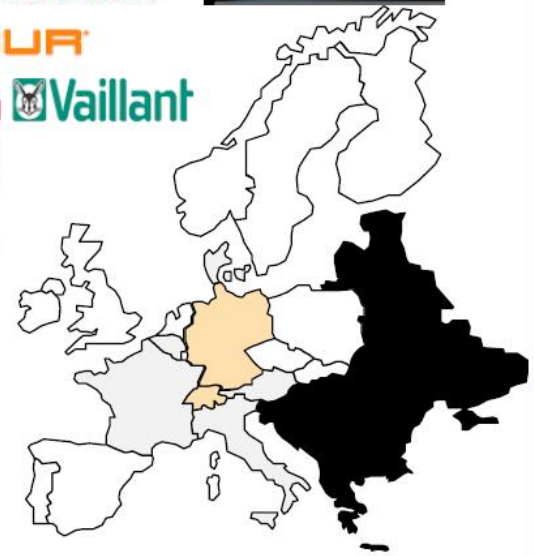
Projection of market development for GHP

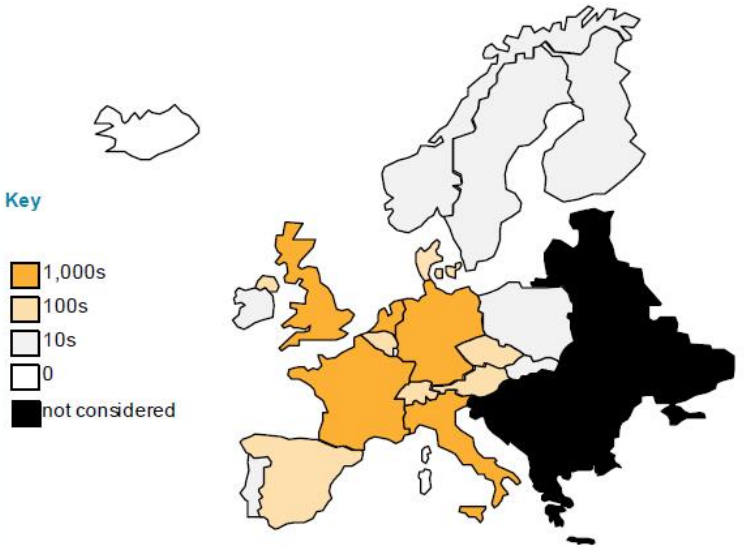
2013: Residential GHP market status

BAXI BOSCH SORPTION ENERGY ROBUR VIESMANN Vaillant British Gas Looking after your world



- Few products (none for residential in UK)
- Mainly new build
- Policy framework not yet including GHP fully
- Low awareness of GHP

2018: Residential GHP market an order or magnitude bigger?



- Product emergence, development
- More retrofittable products
- Bigger push from boiler companies, utilities
- Policy support
- Increasing awareness

Source: Delta EE

International Energy Agency heat pump centre Fraunhofer ISE

Reasons for fuel driven heat pumps

Demand side

- Buildings with high temperature heat distribution systems
- Easy boiler replacement, minimum changes on existing system
- Conservative user behaviour regarding energy carrier
- Comparatively smaller size of the heat source

Supply side

- Gas is expected to play an important role in future energy supply
- Security of supply
- Diversification of energy supply / grid balancing
- Net decarbonisation of gas grid
- Power2gas perspective as net decarbonisation

Recent developments

Products

- New market entries in different market segments
- New companies and further products expected soon

Legislation

- Ecodesign Directive, Lot 1
- EPBD
- RES Directive
- F-Gas Directive

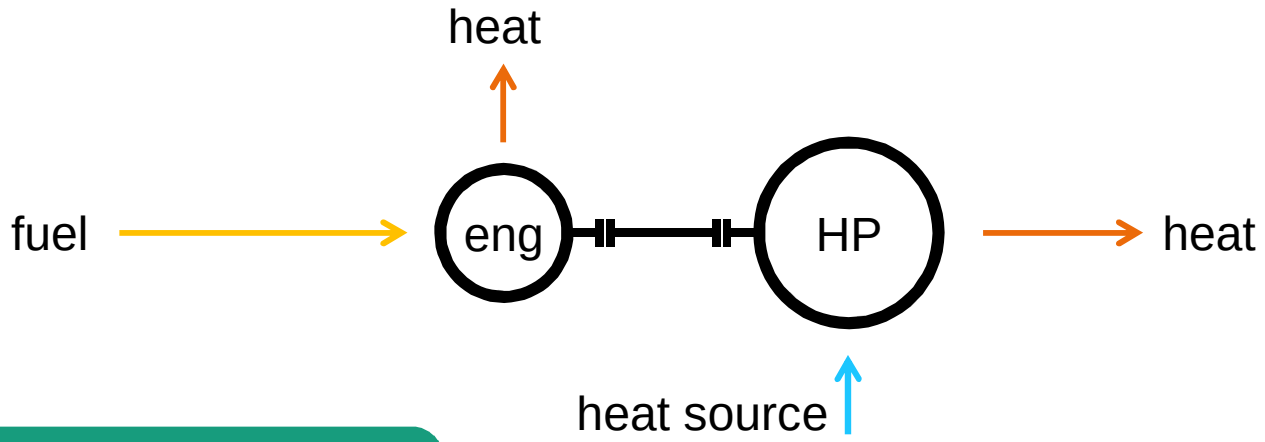
Standards

- Revision of EN 12309
- VDI 4650-2

Activities

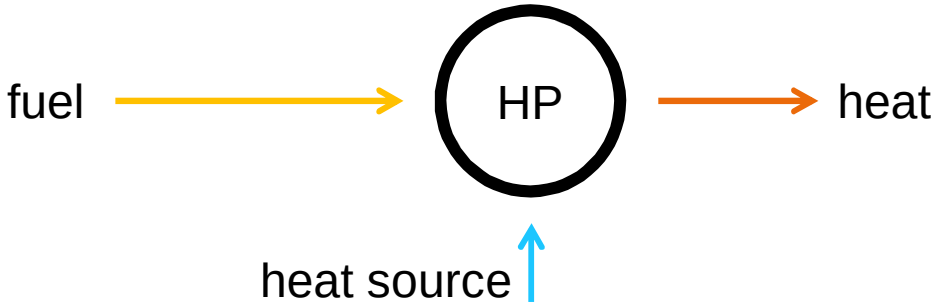
- IGWP: 2008 ï 2012
- New WG within EHPA on TDHP
- EU ï Project ñHeat4Uò
- IEA HPP Annex 34
- IEA HPP Annex 43

Fuel driven heat pumps



Source: Aisin

R&D focus Europe



Source: Robur

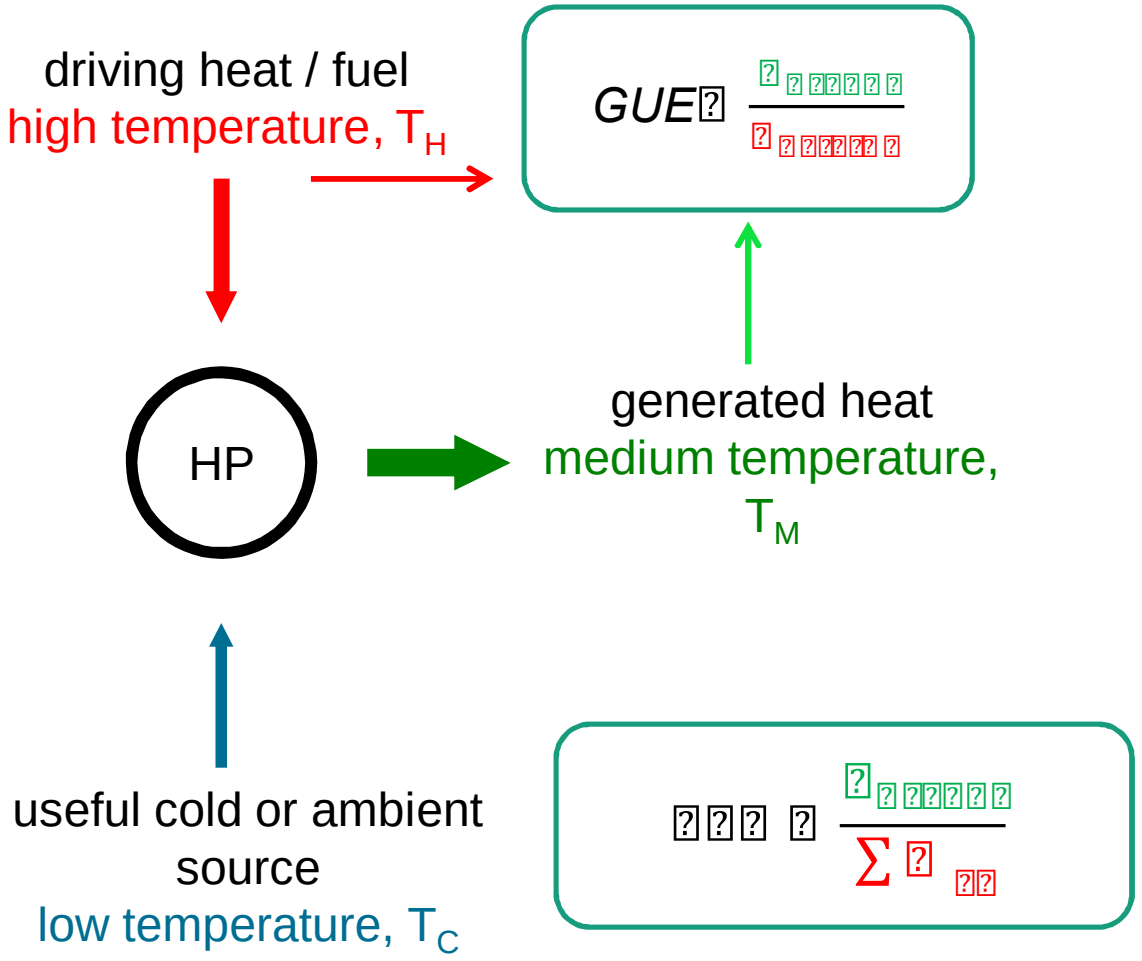
Fuel driven sorption heat pump

Principle

- 3 Temperature levels
- generated heat = driving heat + low temperature heat

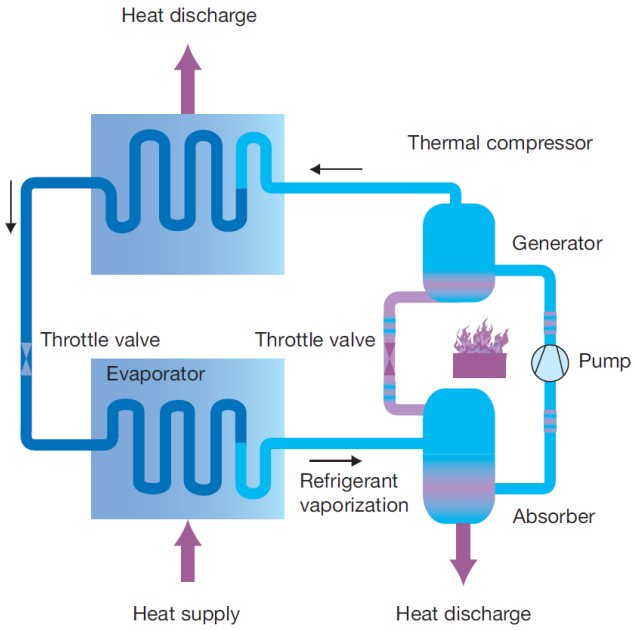
Technologies

- Absorption
- Adsorption



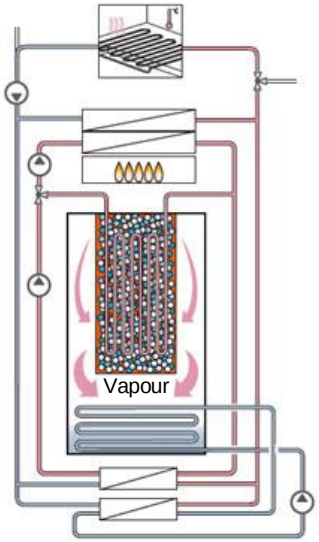
Fuel driven sorption heat pump: Technologies

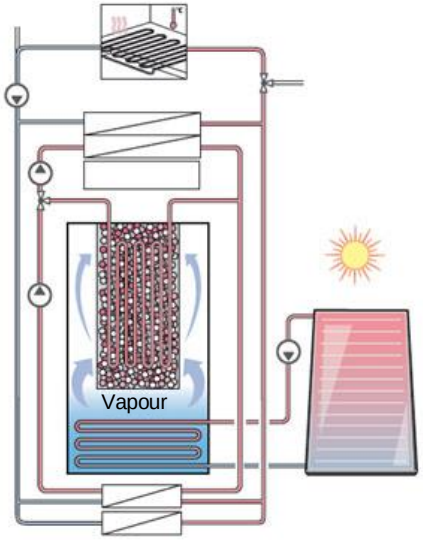
- Absorption with solution pump



Source: BDH

- Adsorption heat pump





Source: Vaillant

Fuel driven sorption heat pump: Products and developments

Market products

Vaillant / 10 kW

← Single family, new buildings

15-40 kW - multi family, light commercial →

Robur

Buderus

Remeha/Oertli

Developments

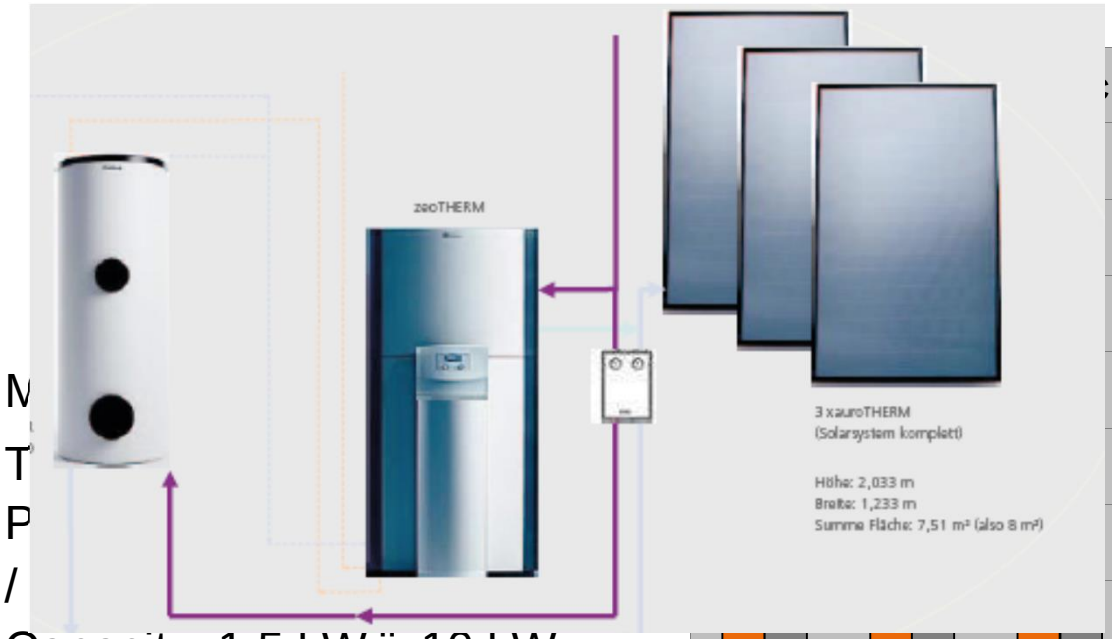
Viessmann / 10 KW

Sorption Energy / 10 kW

Buderus / 10-15 kW

Robur / 18 kW

IGWP: Lab test results



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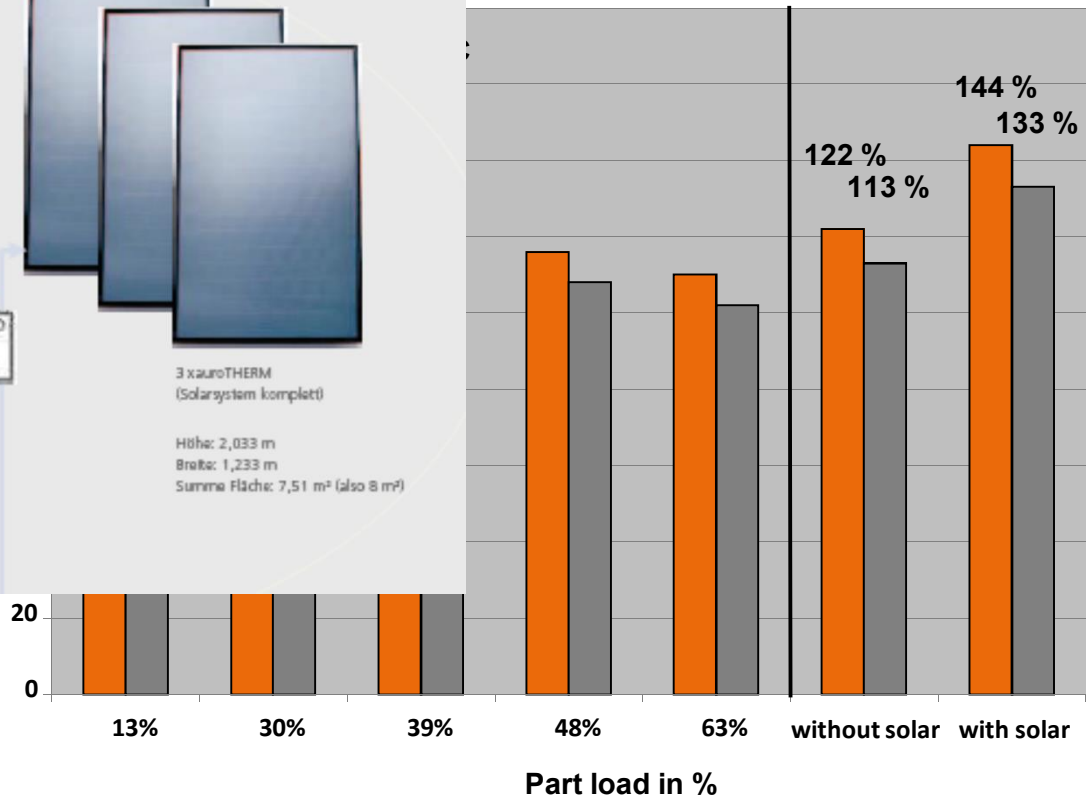
Capacity: 1,5 kW ï 10 kW - modulating

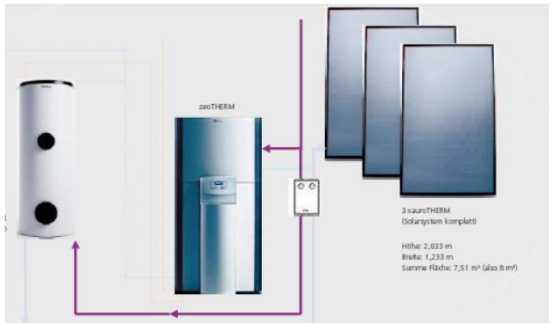
Heat source: Solar collector

Heat sink: Floor heating



Source: IGWP, 2012

IGWP: Lab test results



Manufacturer: Vaillant

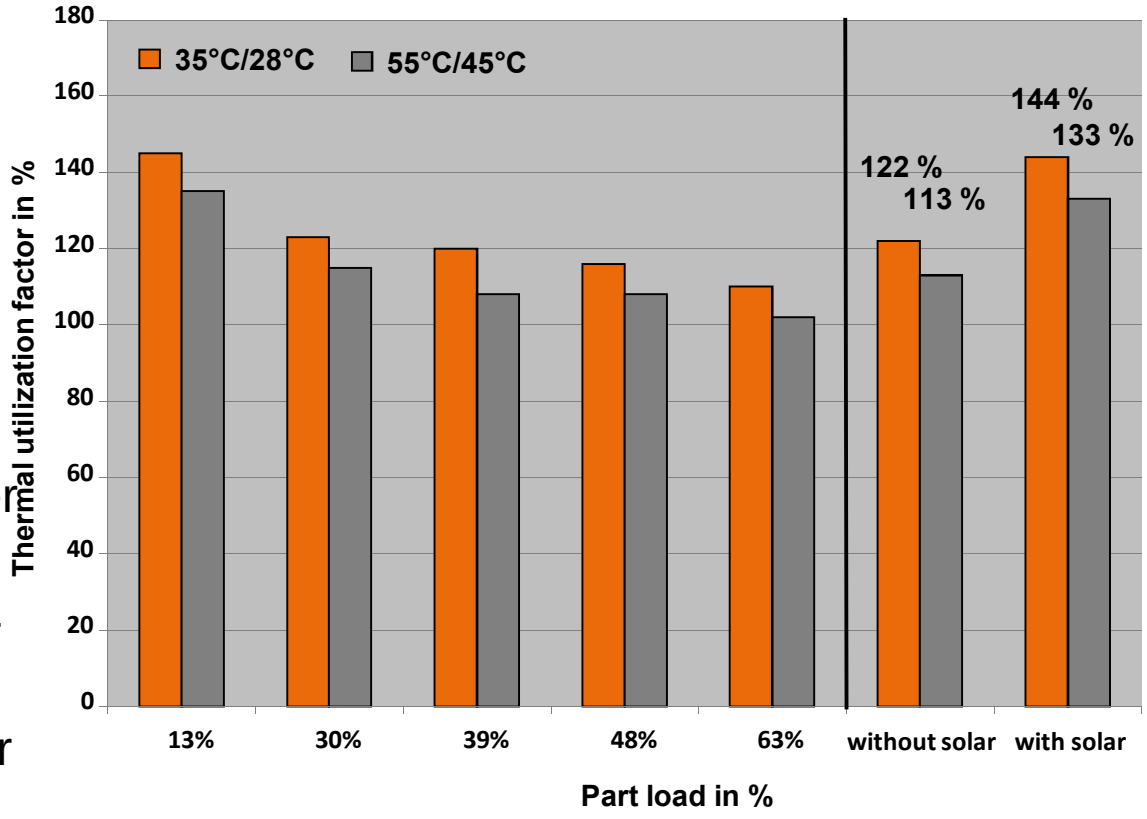
Type: zeoTHERM

Process: Adsorption ï water / zeolithe

Capacity: 1,5 kW ï 10 kW - modulating

Heat source: Solar collector

Heat sink: Floor heating



Source: IGWP, 2012

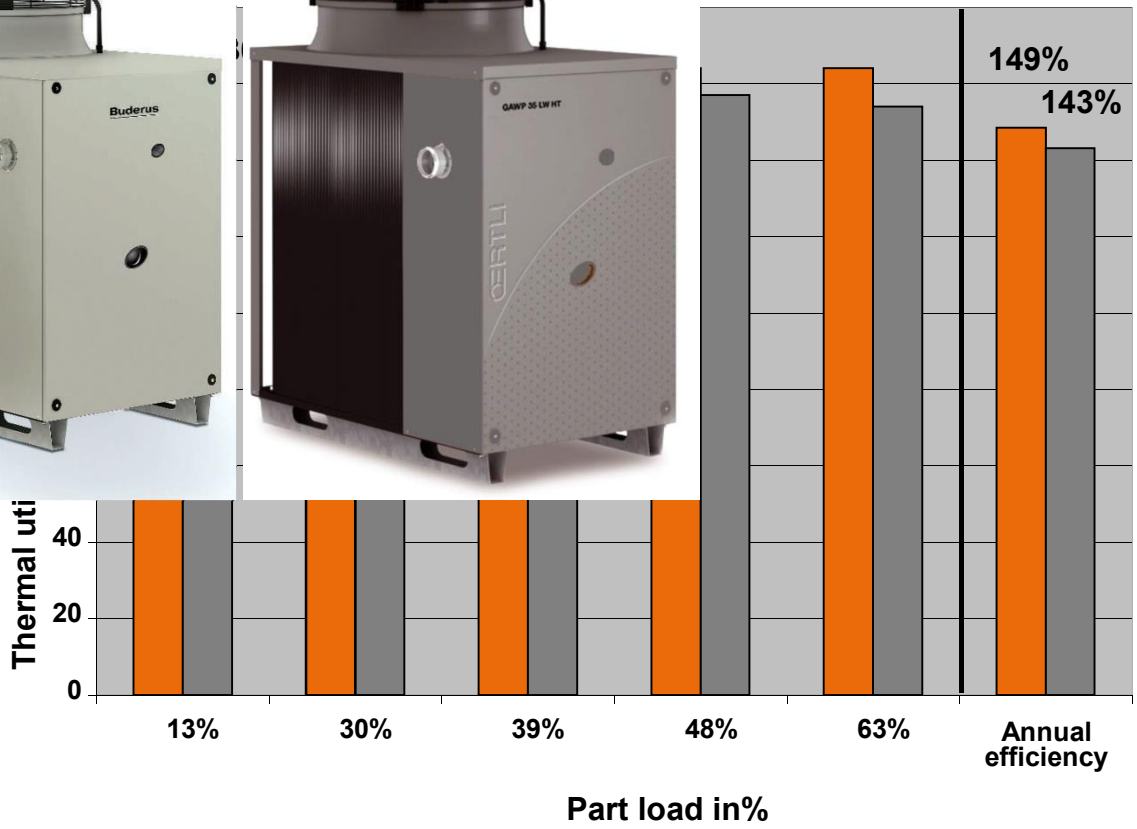
IGWP: Lab test results

ammonia / water

Capacity: 15 kW ï 40 kW - modulating

Heat source: ground / water / air

Heat sink: Floor heating or radiator heating



Source: IGWP, 2012

IGWP: Lab test results

Manufacturer: Robur / Bosch / Oertli

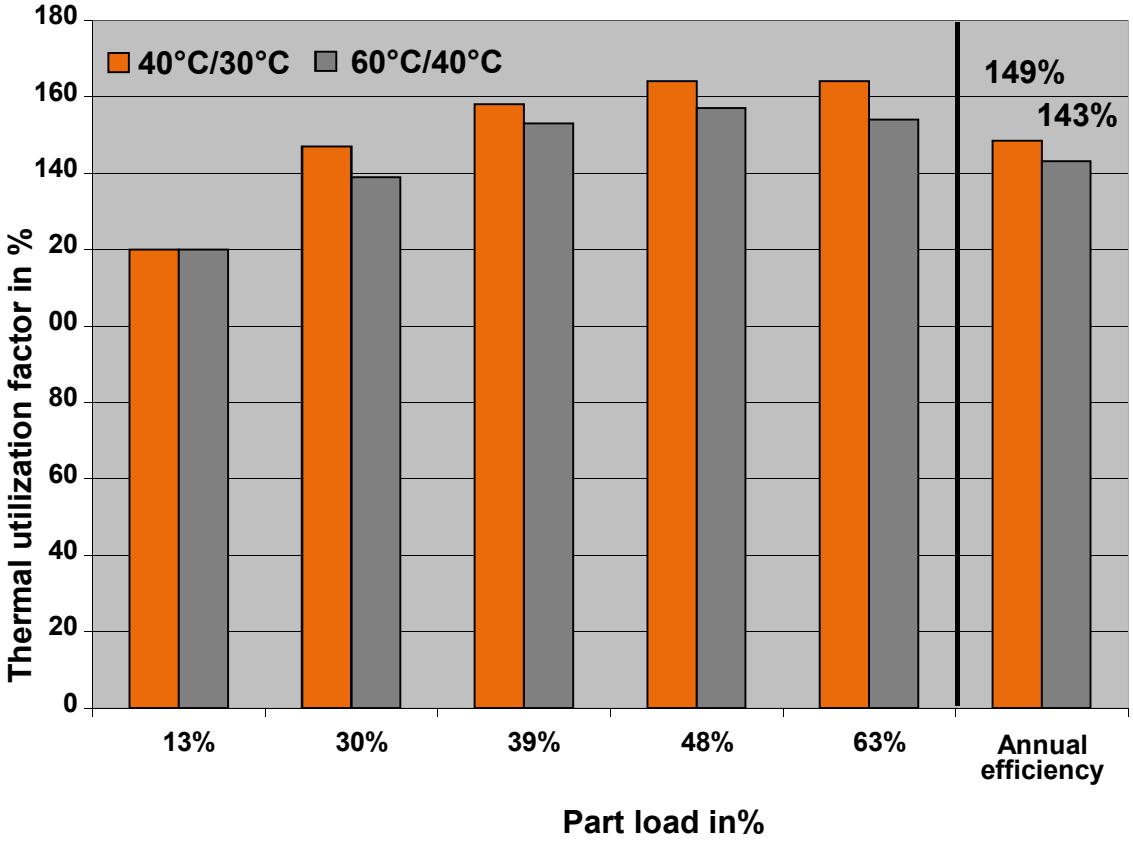
Type: E³ HT

Process: Absorption ï ammonia / water

Capacity: 15 kW ï 40 kW - modulating

Heat source: ground / water / air

Heat sink: Floor heating or radiator heating

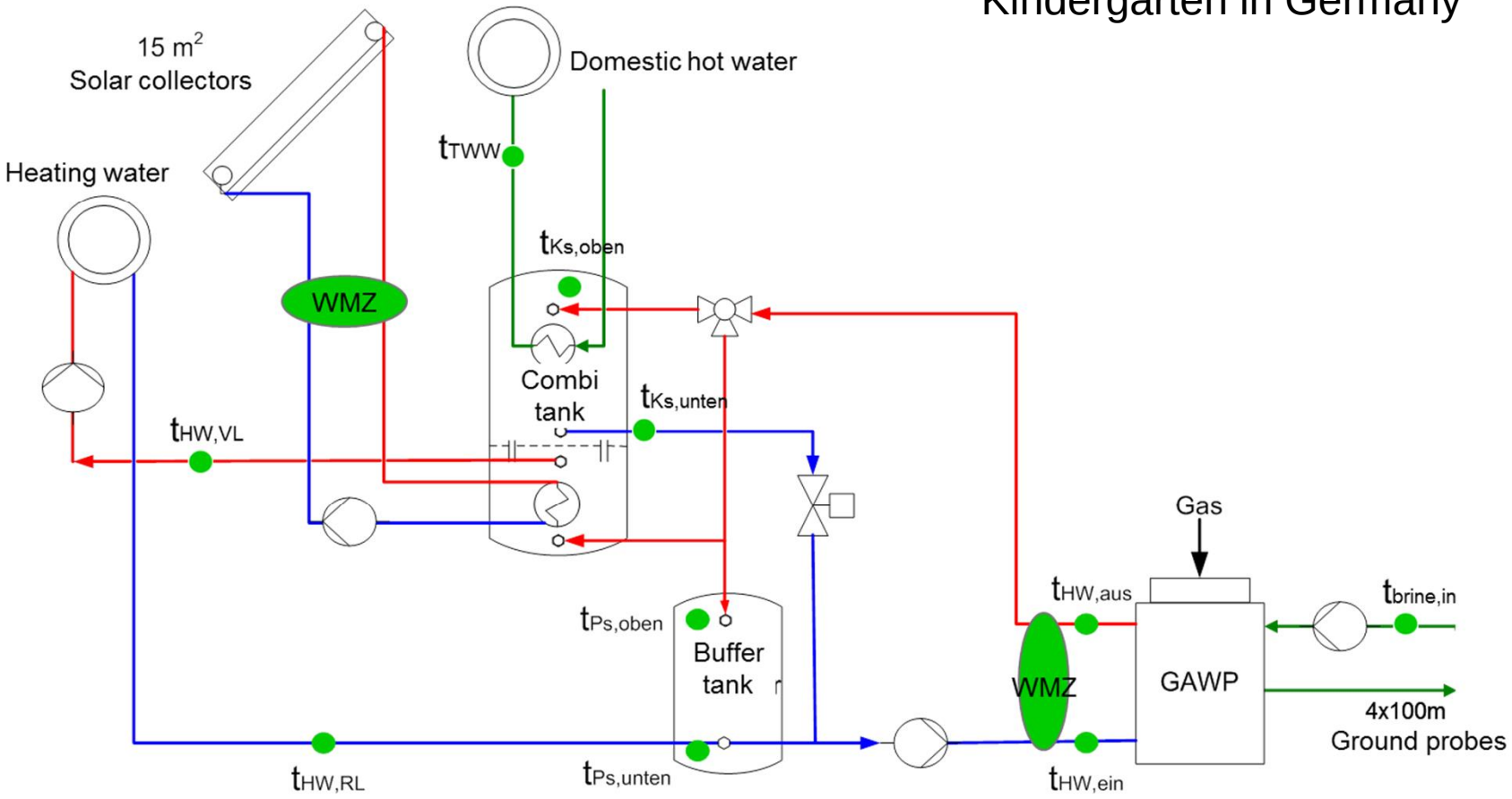


Source: IGWP, 2012

TU Berlin: Field test results

Scheme of the heating installation

Kindergarten in Germany



Source: TU Berlin

TU Berlin: Field test results

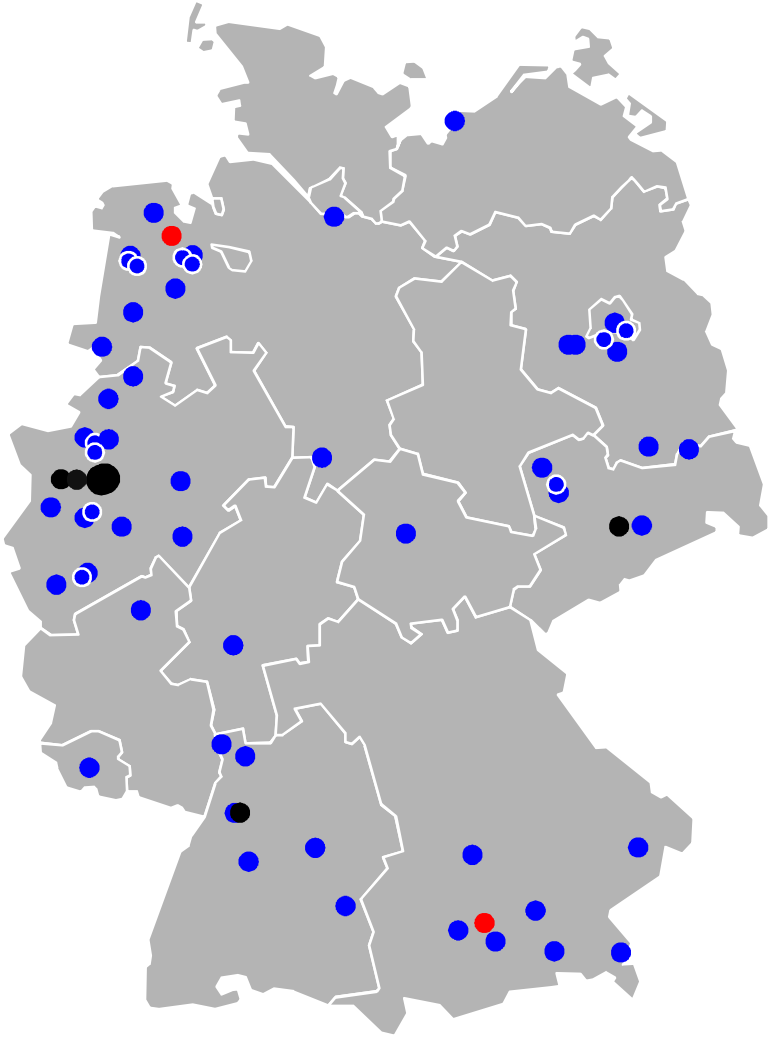
Analysis 2012- 2013

	June-Aug	Dec-Feb	Apr-June
$t_{HW,out}$ [°C]	57	63	50
$t_{Brine,in}$ [°C]	12	5	9
Temperature lift [K]	45	58	41
$GUE_{Manufacturer}$ [-]	1,52	1,35	1,58
GUE_{Mess} [-]	1.16 ± 0.10	1.24 ± 0.10	1.30 ± 0.10
Deviation to manufacturer data [%]	24	8	18
Burner on [% of solution pump on]	65	92	53
Burner on [% of overall time]	13	78	15

AEF [-]	25*	46	31
PER [-]	-	1.06	1.08

Source: TU Berlin

IGWP: Field test results

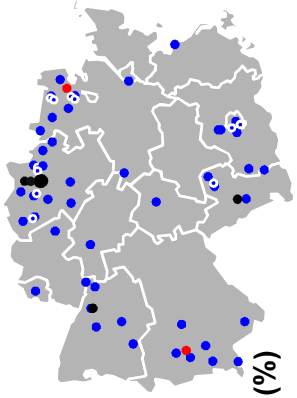


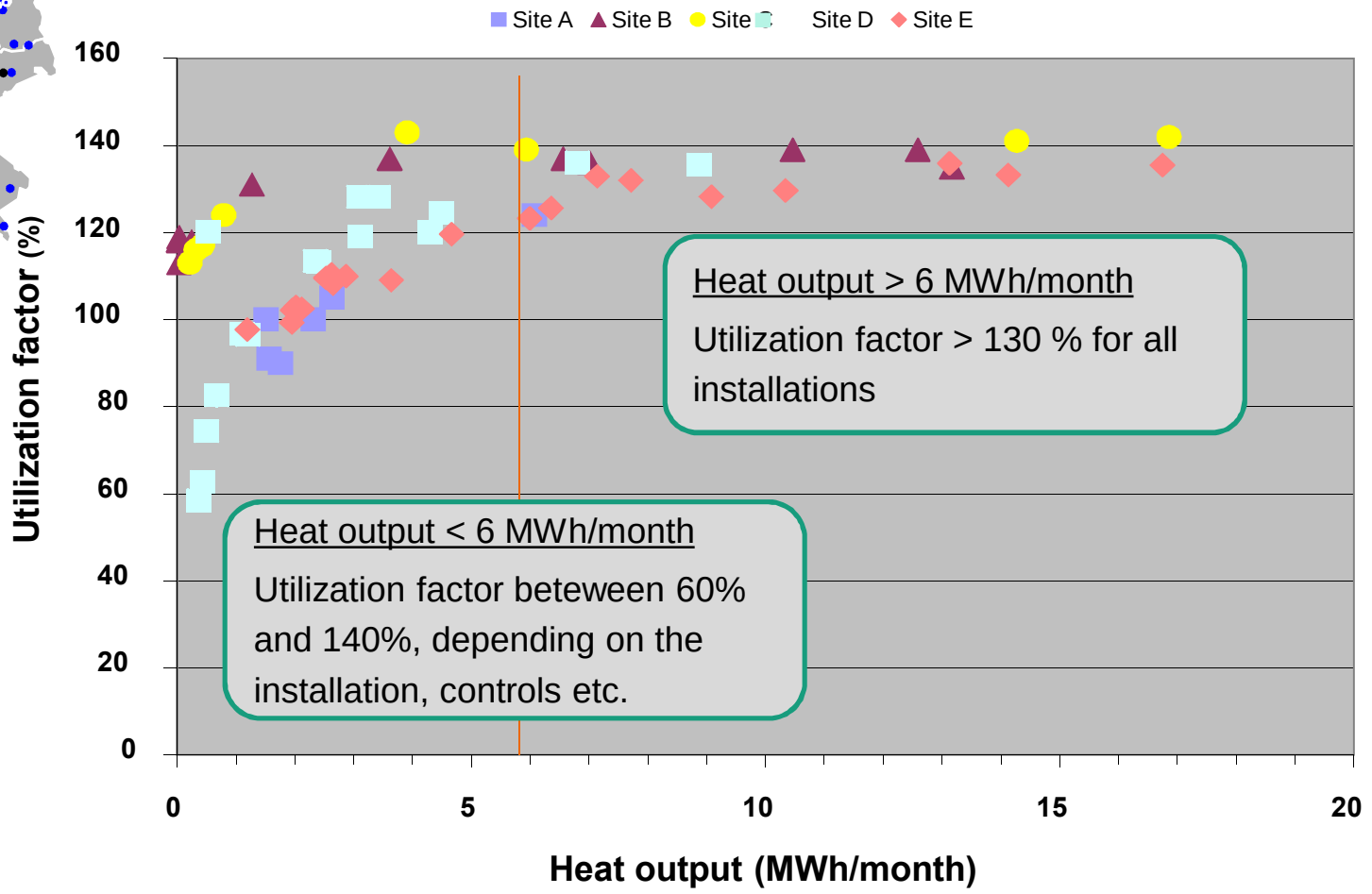
56 installations in field test trial

+2 units in preparation
+ 10 units under lab tests

Source: IGWP, 2012

IGWP: Field test results





Source: IGWP, 2012

New HPP Annex 43: Fuel Driven Sorption Heat Pumps
(Germany OA, Italy, France, UK, USA, Korea, NL, Austria, Poland)

Motivation

- Market for fuel driven heat pumps is developing
- Emerging technology just starting to enter market
- Need for further standards on test procedures
- Big need for quality insurance measures
- Big need to optimize best system configurations for different applications
- Need for common understanding regarding field tests
- Raise awareness about the technology among all market players

Annex 43: Scope and goals

Scope

- Fuel driven sorption heat pumps for residential and light commercial
- Focus on heating mode, reversible allowed

Goals

- Identification of market opportunities and barriers
- Identification of the potential applications and importance in future energy systems
- Identification of market supporting measures
- Easy and sustainable market entrance and development

Annex 43: Structure

Task A: Generic systems and system classification

Task B: Technology transfer

Task C: Field test and performance evaluation

Task D: Market potential study and technology roadmap

Task E: Policy measures and recommendations, information

Thank you for your attention!

www.annex43.org

Operating Agent:

Peter Schossig

Fraunhofer ISE

peter.schossig@ise.fraunhofer.de