

Geothermal Energy – Its Global Development Potential & Contribution to Mitigation of Climate Change

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Current use and potential - Low temperature resources

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Worldwide direct uses 1995, 2000 and 2005

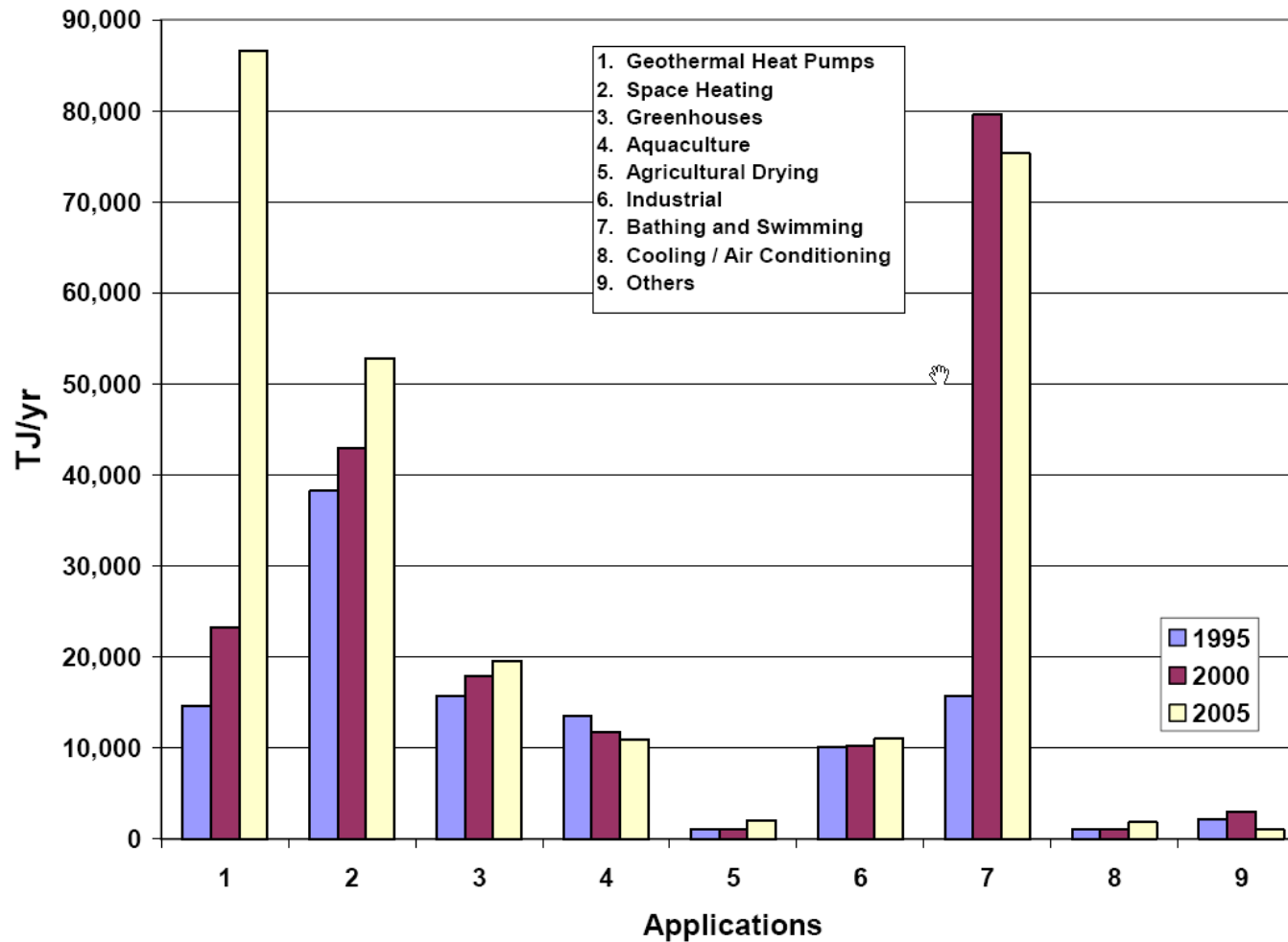


Figure 1: Comparison of worldwide energy use in TJ/yr for 1995, 2000 and 2005.

Worldwide relative direct uses in 2005 measured
as
(a) capacity and (b) energy use

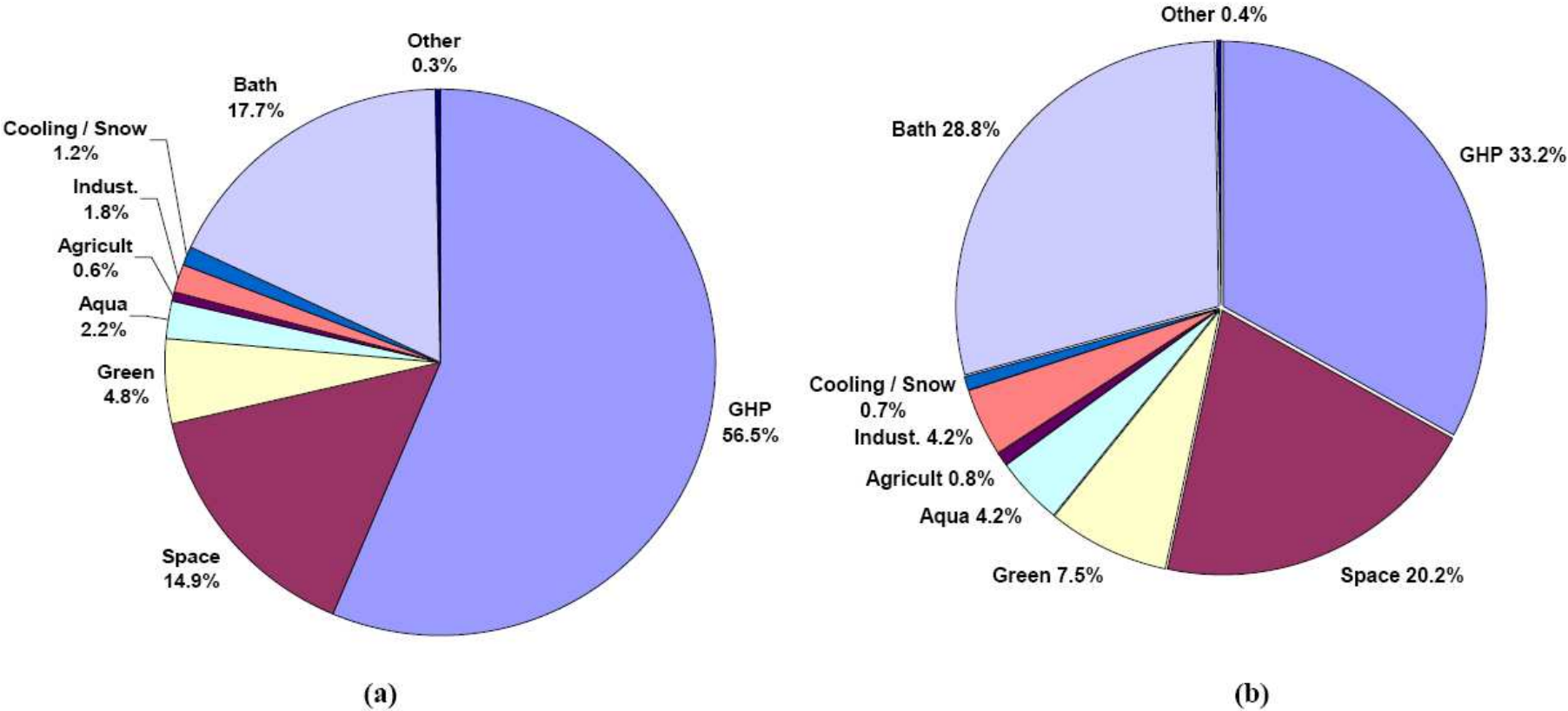
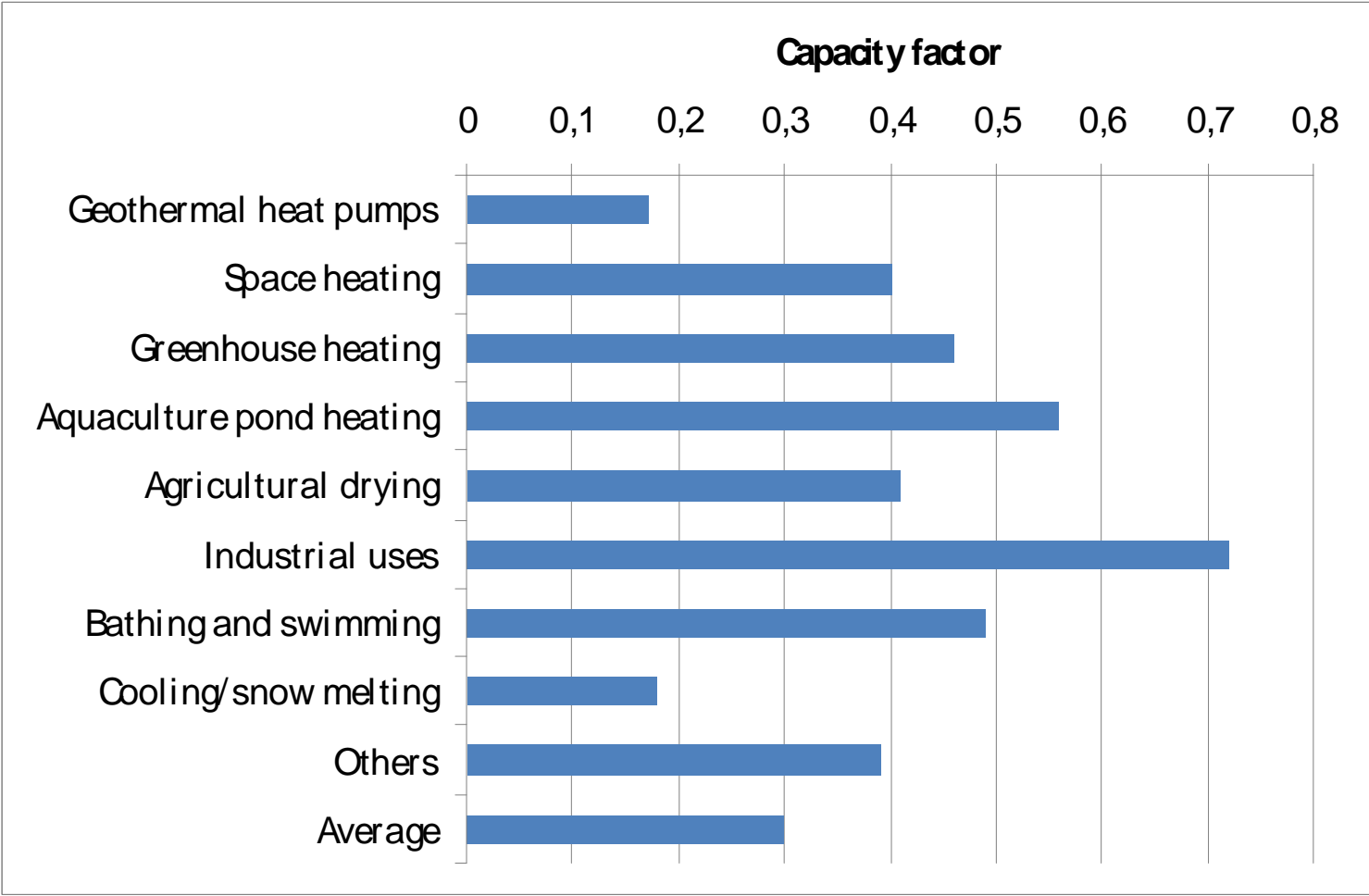
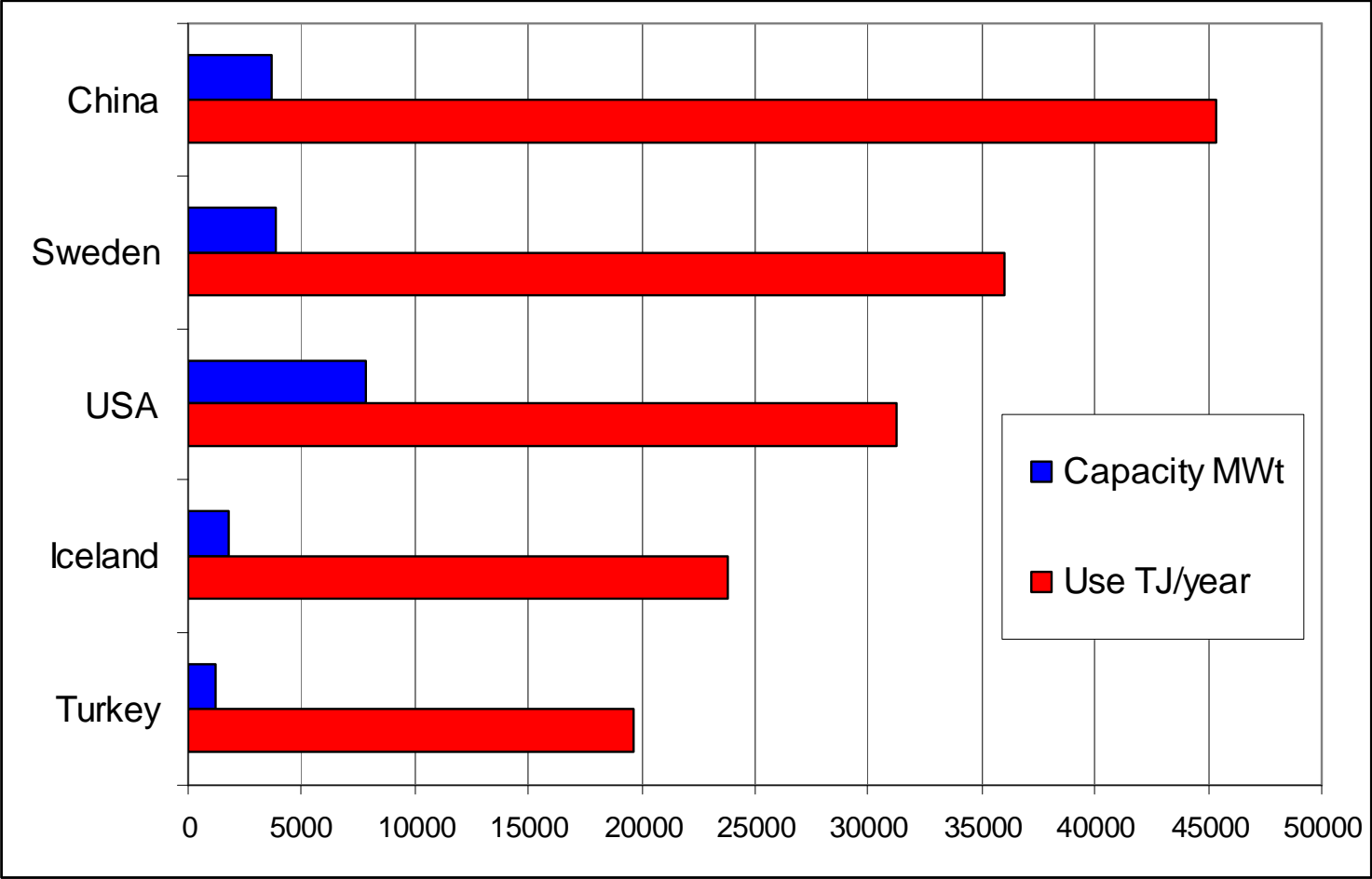


Figure 2. Categories of capacity in % for 2005 (a); and energy use in % (b), 2005.

Capacity factor for different direct uses



Ranking of geothermal direct use 2005



GSHP Markets



Ground Source Heat Pump market and deployment in Europe

(base map showing geothermal DH)

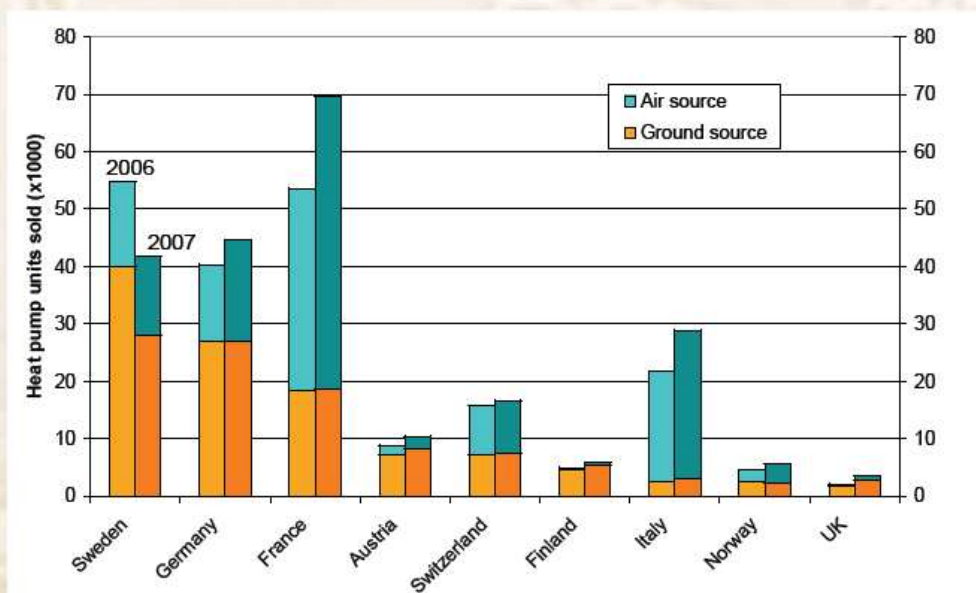
- old and strong
- recent and strong
- emerging

Burkhard Sanner, 2009

GSHP Markets

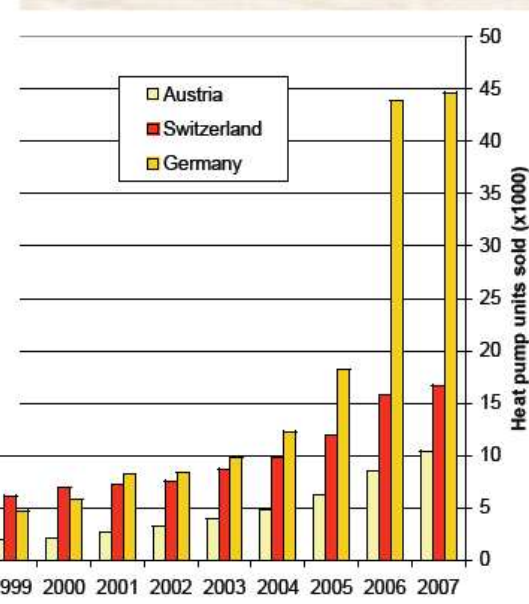


Market Data Europe



Heat pump sales in Austria, Germany and Switzerland

(after data from LGWA, BWP, FWS)



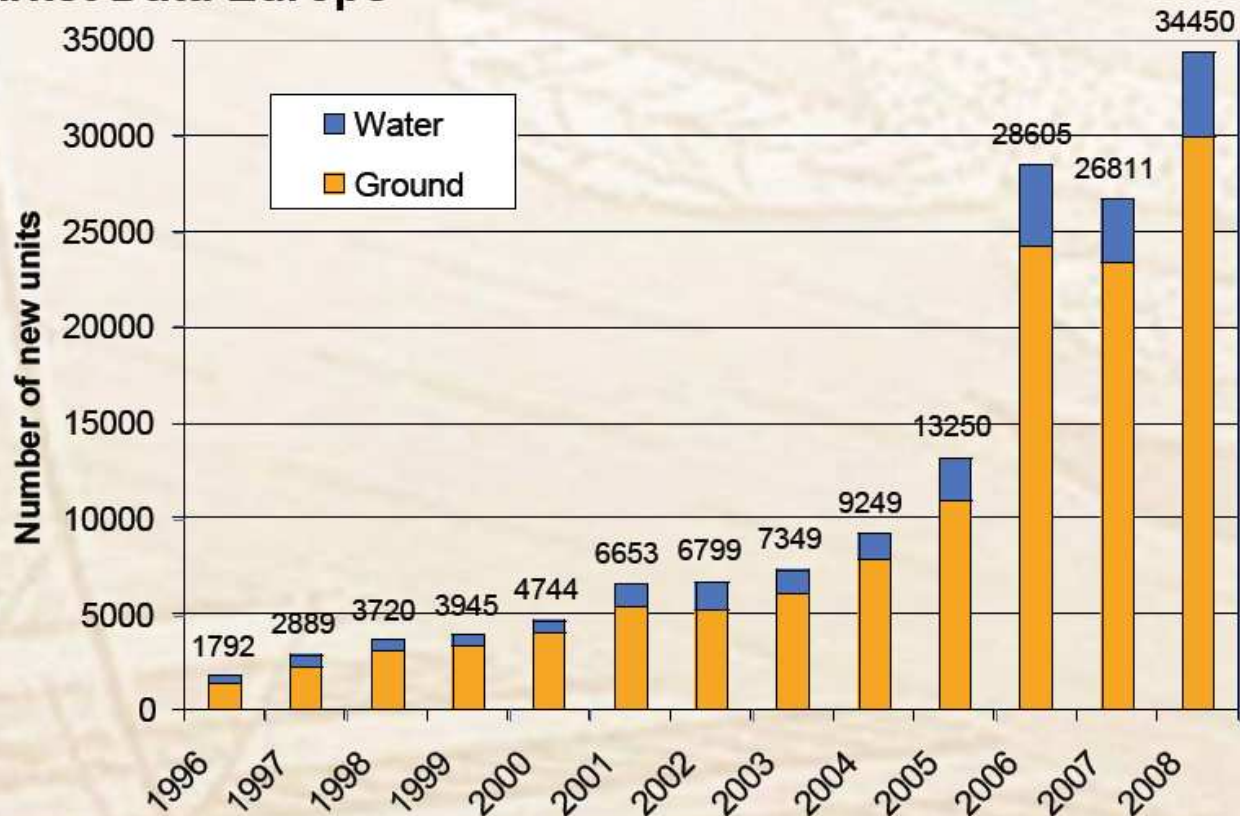
Heat pump sales for air source or ground source

(after data from EHPA)

GSHP Markets



Market Data Europe



GSHP sales in Germany, 1996-2008

(after data from BWP)

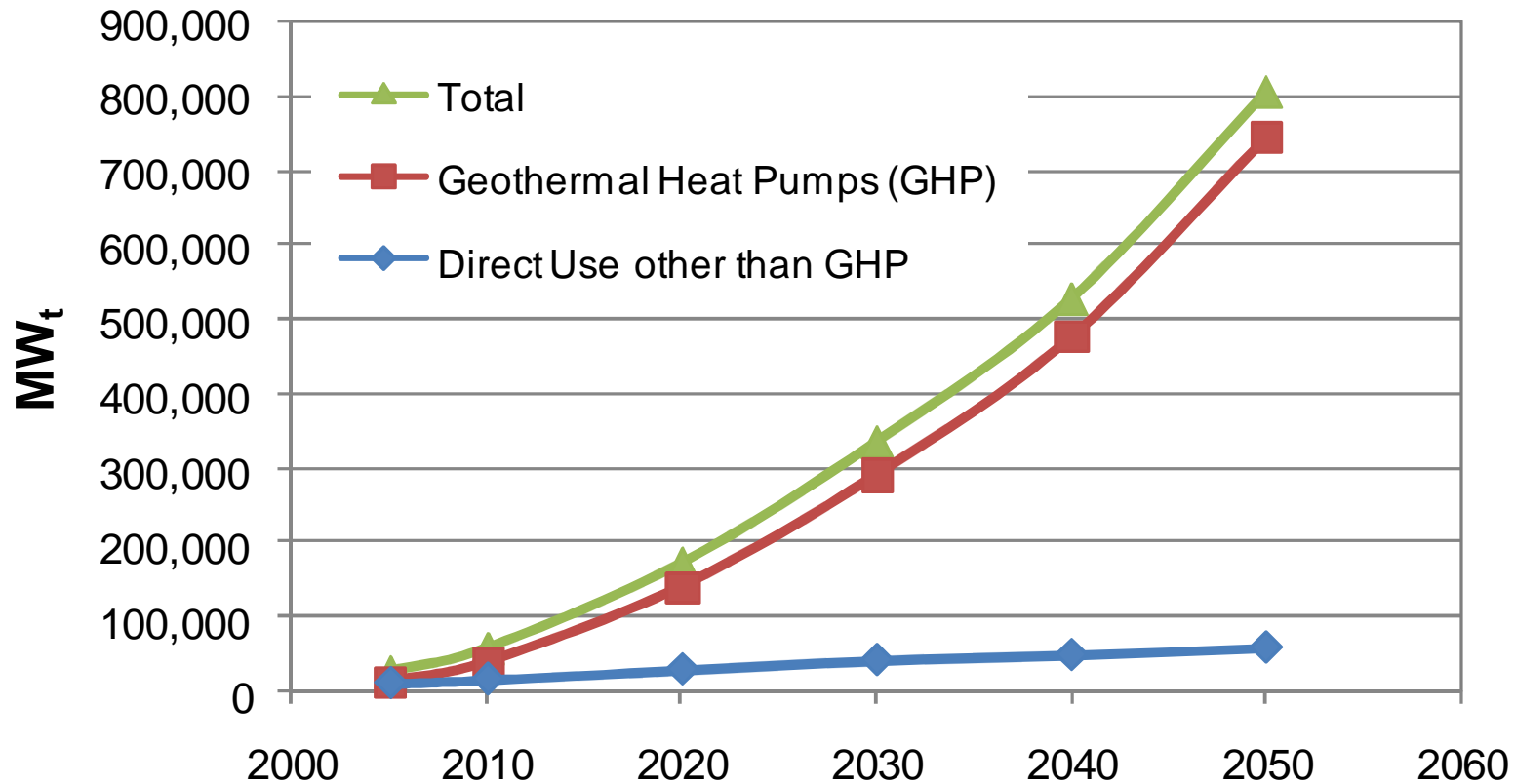
Geothermal heat pumps

- Rapidly growing popularity as a measure to increase energy efficiency in buildings
- USA was earlier the world leader in market development, now it is Europe
- Europe: 135-190 thousand installations annually
- USA: 60 thousand installations annually
- Rapid market growth also in China and Canada
- GHPs have the potential to offset 35-40% of the growth in building energy consumption in the US up to 2030
- Why should building owners finance the outside-the-building part of the GHP system (ground heat exchanger)? It is similar to a utility infrastructure.

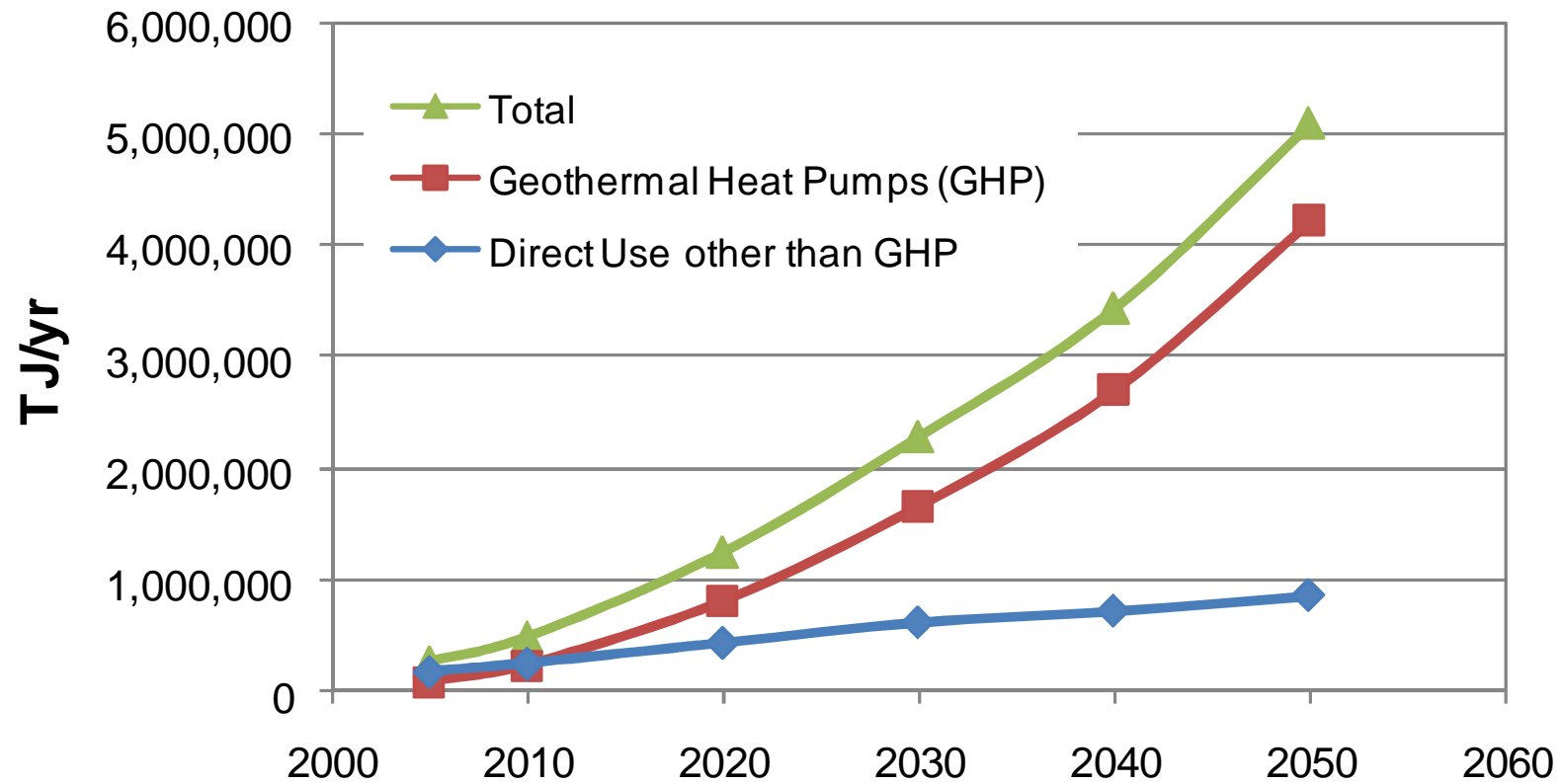
Likely case scenario for direct use to 2005

Year	Average annual growth rate from 2005		Direct Use other than GHP		Geothermal Heat Pumps (GHP)		Total	
	Direct Use (%)	GHP (%)	MW _{th}	TJ/yr	MW _{th}	TJ/yr	MW _{th}	TJ/yr
2005			12,855	185,869	15,384	87,503	28,239	273,372
2010	7	22	18,000	260,000	41,500	236,000	59,500	496,000
2020	6	16	30,900	446,000	143,000	811,000	173,000	1,260,000
2030	5	12.5	43,600	630,000	292,000	1,660,000	336,000	2,290,000
2040	4	10	50,800	734,000	476,000	2,710,000	527,000	3,444,000
2050	3.5	9	60,500	874,000	744,000	4,230,000	804,000	5,100,000

Likely case scenario for growth in direct use and GHP installed capacity



Likely case scenario for growth in direct use and GHP energy production



Direct uses - opportunities

- Many possible direct-uses of geothermal fluids
- Number of parameters will limit choices:
 - Temperature, flow rate, chemistry and land availability
 - Market available, and do you have the expertise to provide the product (i.e. heat and/or flowers/fish, etc.)
 - Can you get the product to the user economically (i.e. pipelines or truck/rail/airline transportation)
 - Availability of capital, income and ROI/payback
 - Can you attract investors (i.e. minimize the risk)
- Alternative to consider – combined heat and power project – to better utilize the resource and help the bottom line

Source: John Lund

Binary power plants

- Combined cycle power plants are becoming increasingly popular
- Results in higher overall utilization efficiency