cmr Energy

Shallow Geothermal Energy for Future Buildings

Kirsti Midttømme[1] & Helge Skarphagen[2]

[1]Christian Michelsen Research, [2]Gether

GeoEnergi 2013

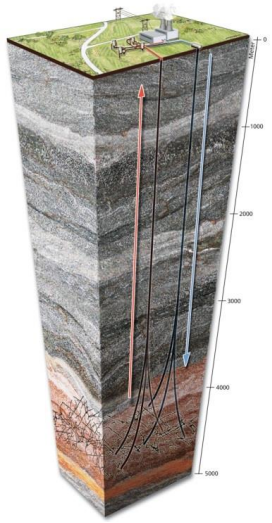
Content

- Status Shallow Geothermal in Norway
- Energy Directives and Regulations
  - Need for monitoring and better documentation
- Future Geothermal Energy Systems
  - Optimized system
  - Energy storage
- Conclusions

What is shallow geothermal energy ?

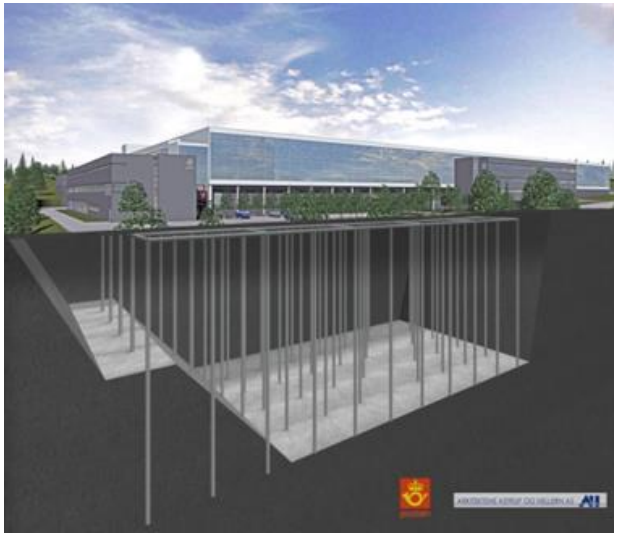
in Norway today

Deep geothermal



- Renewable energy
- Power and heat production
- No installations
- Source: Geothermal energy
- Theoretical approach

Shallow geothermal < 500 m

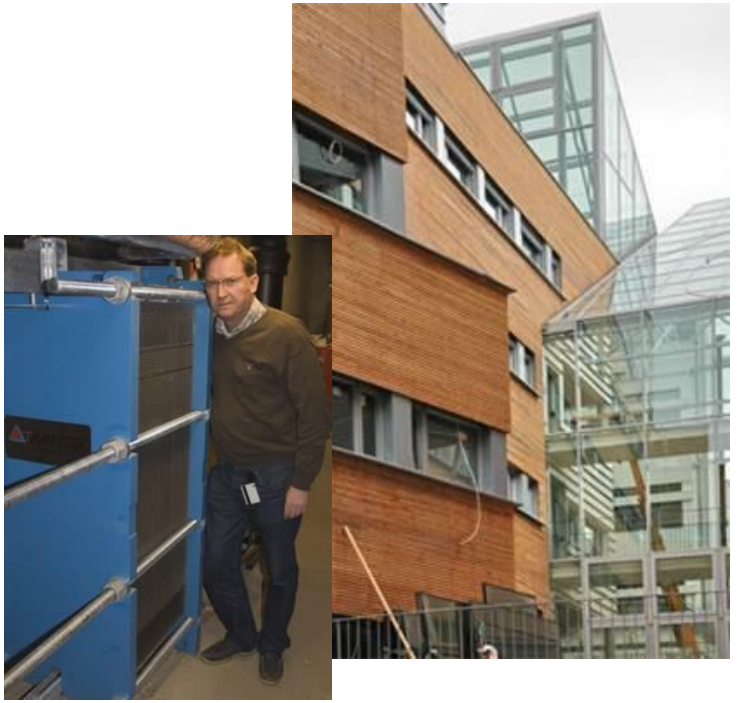


- Energy efficiency
- Heat and cold production
- Above 40 000 installations - >3,5 TWh
- Utilized by heat pump
- Commercial
- Can be used everywhere
- Source: Mainly stored solar heat
- Practical approach and experience

Heat pump

Air source heat pump

Geothermal heat pump



- 90 % of the heat pumps are air source heat pumps
- 4,5 % of the heat pumps are water to water heat pumps (Geothermal heat pumps)
- Geothermal heat pumps lower the power consumption

Large shallow geothermal systems

Oslo flyplass Gardemoen	Groundwater	8 MW	18 wells	1998
A-hus	BHE	8 MW	228 boreholes	2007
Nydalen Næringspark	BHE	6 MW	180 boreholes	2004
Østfold Hospital	BHE		100 boreholes	2013
Ullevål Stadion	BHE	4 MW	120 boreholes	2009
Arcus, Gjelleråsen	BHE		91 boreholes	2012
Postterminalbygget	BHE	4 MW	90 boreholes	2010
Thon Kristiansand	BHE		90 boreholes	2011
IKEA, Slependen	BHE	1.2 MW	86 boreholes	2009

Nydalen næringspark

Postterminalbygget

Ullevål Stadion

2011

Kleppestø skole
19 x 180m

2010

Clampon
5 x 180m

2001

Ahlsell Åsane
6 x 160m

2010

Olav Grevstad AS
6 x 190m

2012

4buildings Varden
12 x 160m

1984

2012

Høgskolen Bergen
80 x 220m

2013

Haukeland
75 x 250m

2012

Kolstien
11 x 200m

Ådnamarka skule
14 x 190

2009

2010

Spar Kjøp Kokstad
18 x 170m

2012

Sælenveien 91
18 x 170m

2010

Chr M Vestreheim
7 x 170m

2012

Espehaugen 45
6 x 200m

2003

Apeltun skole
10 boreholes

Targets and directives

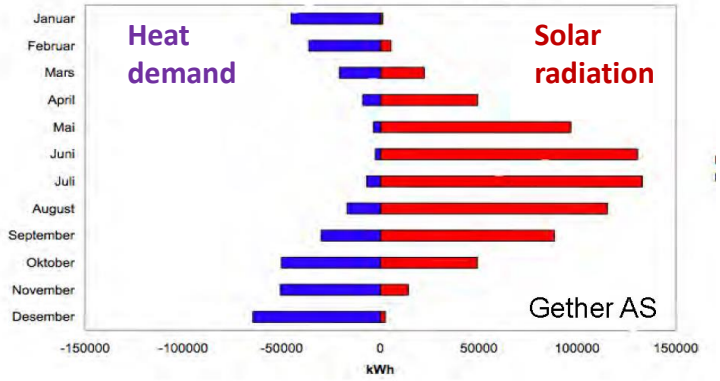
- **Europe 2020 targets**
  - 20% lower greenhouse gas emission than 1990
  - 20 % of energy from renewables
  - 20 % increase in energy efficiency

- **Norwegian directives and regulations**
  - EUs Energy Efficiency Directive (October 2012)
    - Norway: 23TWh saving, total saving 2014-2020: 73 TWh
  - TEK 10
    - Regulations on technical requirements for constructions restriction of energy use in new building
    - Buildings above 500 m^2: a minimum of 60 % of the energy required for heating must be supplied by energy carriers other than electricity and fossil fuels

Smart shallow geothermal systems

Blindern studenthjem	BHE	150 kW	16 boreholes	1999
Høgskolen i Bergen	BHE	1.4 MW	81 boreholes	2012
Stavanger Forum	BHE		85 boreholes	2011
Mære landbruksskole	BHE		16 boreholes	2010

Blindern studenthjem utilize
waste heat from
cooling of technical equipments at
Meteorologisk Institute, Blindern, Oslo
by geothermal energy storage



Mære landbruksskole utilize solar heat
by geothermal energy storage

Integrated energy systems

Climate

Energy use

Geology

Power requirements

Available Space

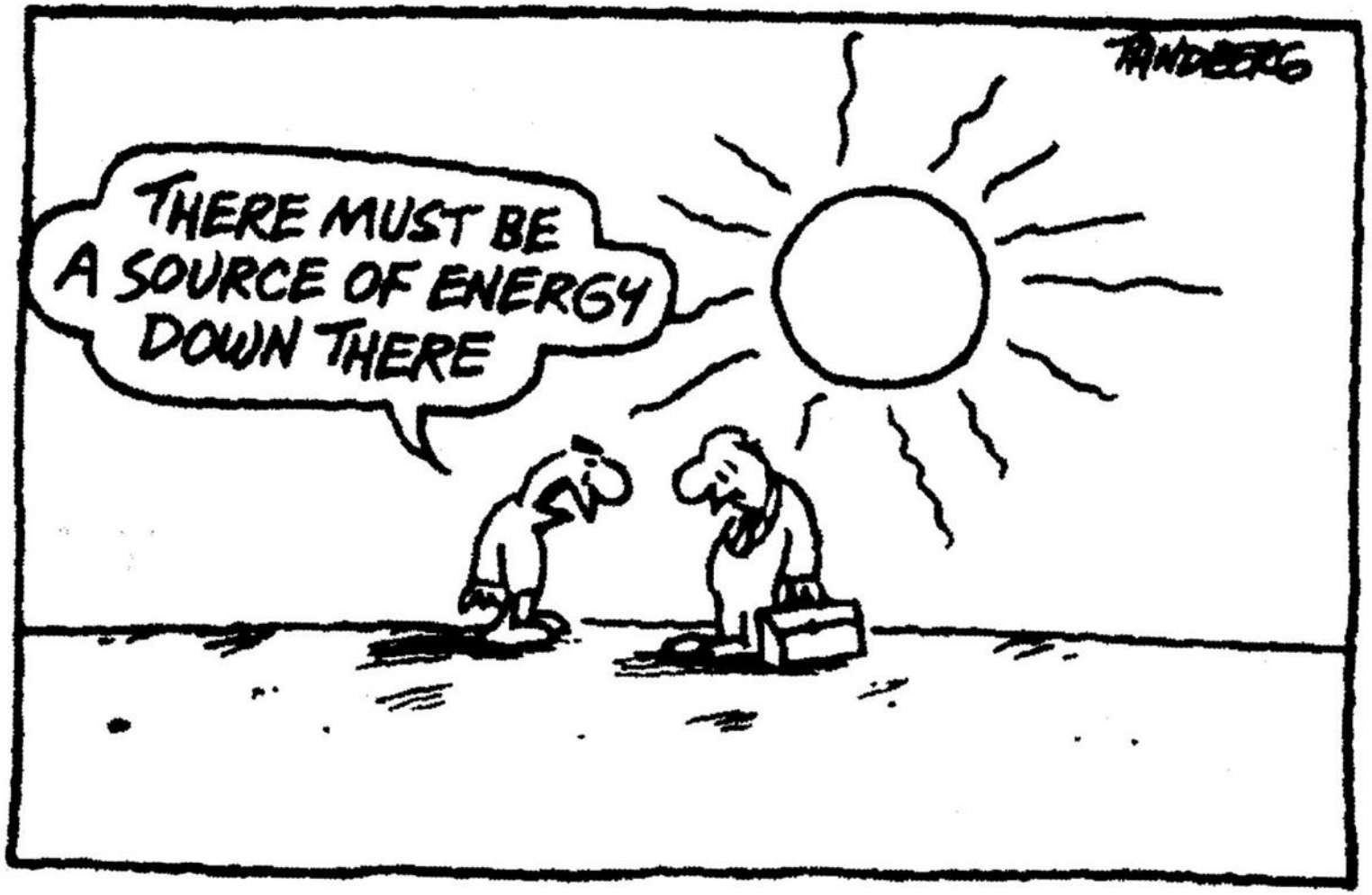
Regulations

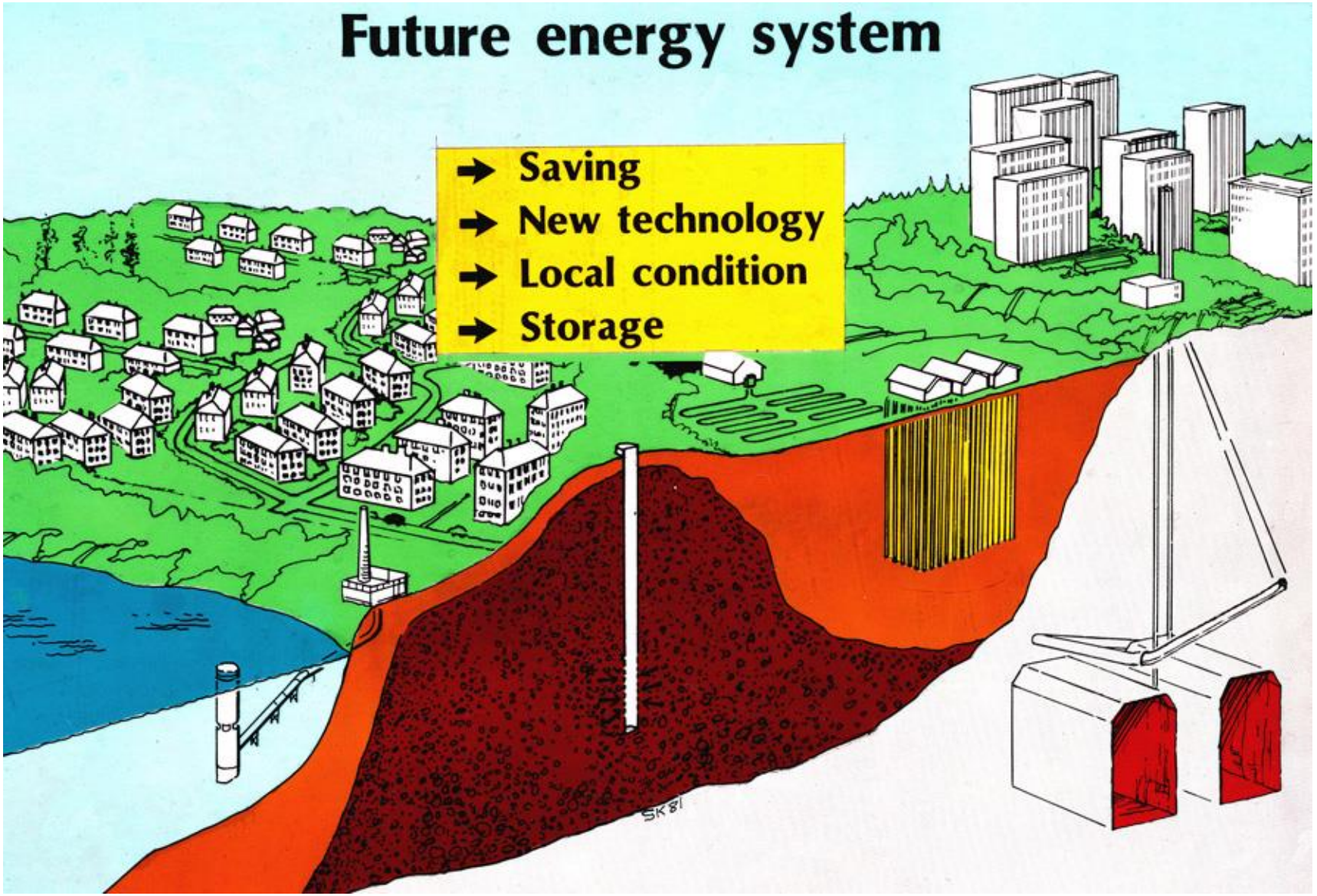
Indoor air quality

Local energy sources

Building mass

Energy Storage
-utilizing of local available energy




Future energy system
Saving
New technology
Local condition
Storage
SK 81

Conclusions

- The last 35 years have shown that shallow geothermal is an environmentally friendly and economically energy alternative.
- Energy savings and environmental benefit are poorly documented
- A optimizing shallow geothermal energy system has to be designed due to the local conditions and the buildings energy demand
- Energy Storage will be a key factor in the future geothermal systems