Construction of a Heat Storage

- short history
- economy of

Photos with courtesy of Dronninglund Fjernvarme amba Denmark, Johan Freylund
Presented by Per Ken Åberg

[→] Wednesday, September 30, 2015
History of heat storage in Denmark

• Developed since 1980….
• Different techniques used, steel tanks, groundwater (Aquifer), bored holes, concrete tanks.
• One of the most efficient are PTES; Pit Thermal Heat Storage
• Comes originally out of government spend for renewable energy development
• Gram and Vojens are commercially self-bearing as per 2014-15

Existing GSE heat storages
• Sunstore 4, 75,000 m³, 2012
• Sunstore 3, 69,000 m³, 2013
• Vojens, 195,000 m³, 2015
• Gram, 122,000 m³, 2015
Alternatives in design and future progress since 2012

- Liner development
- Insulation
- Filling with water
- After care
- Leak control
- Floating liner installment options
- Known issues after heating

*State of the art at 2015 is with GSE*

Costs for Danish Market:

**Conventional tech cost; insulated steel tanks** + 150€ per m³ 2105

**Cost for same storage function PTES**
- at Sunstore 4 39€ per m³ 2012
- at Sunstore 3 25€ per m³ 2013
- at Vojens 21€ per m³ 2015
Location an old gravel pit, Dronninglund, in Denmark April 2013
Foundation for the diffusor pipes, April 17
Laying the pipes to the diffusor April 25
Installing the diffusor May 2
INSTALLING THE GSE HIGH TEMPERATURE LINERS
Installing the Heat Resistant Liner and Protective Geotextile May 21
Closing up baseliner installation June 3, 2013
Seam tightness installation test June 3
Locking trench photo and the finished base of the heat storage June 12, 2013. (dig start April 11)
Baseliner are tested for tightness June 12-15
Center for softening of the water established June 14
Flow area and tank overflows
New buffer tank of 30 cubic meters installed, July 24, now it works…. 
Enjoying the filling process, summer 2013
Cheers! We made it, and walk on water…. August 12, 2013
THE GSE FLOATING COVER
Time to start installing the floating cover… August 19, 2013 VIDEO
Float liner installation continues August 20
Walk on the…. 2 mm High Temperature Resistant Liner, Aug 20 VIDEO
Weight pipe work in progress September 16
Weight pipes in position and weighed down, Sept, 19
Start of insulation Sept 17
The upper High Performance Grey 1,5 mm Liner installs, September 20
Drainage sections for lid are constructed October 2, 2013
Cut up for hole to drain bottom liner, vacuum test of extrusion welds, Oct, 22
Fence are up and fastening vacuum vents are installed Oct 30, 2013
Upper weight pipes to direct free water to low area, laid out November 14
FINISHED STORAGE
MARCH 15 TO NOV 11, 2013
VOLUME 69 000 M³
Functional facts

- Effect: 27 MW (up to 50 % of consumers use)
- Design temp: 90 C / 6 C
- Sun collector area: 37 500 sqm
- Flow in collectors: 2 x 300 cubicmeters per hour
- Storage dimensions: 91 x 91 meters, depth 16 meters
- Insulation thickness: 240 mm
Finished construction Nov, 19, 2013

Photo Nov, 19, 2013

Photo from 2014, Dec, 3, below
MERCI!

Per Ken Åberg
Wednesday, September 30, 2015

Questions…?