Seasonal Thermal Energy Storage:

Heat or Cold — Saved for Days or Many Months

- ... Underground — UTES
  - In Aquifers — ATEs
  - In Boreholes (any strata) — BTES

Larry Edwards
ATES

The Reichstag, Berlin

Cold & Heat Storage

In operation since 1999

Provides:
summer cooling &
winter heating

The Netherlands —
> 1600 ATES Systems.
A standard design option.

ATES will replace
15 PJ energy by 2020
BTES Borehole Field — 144 boreholes, 155 feet deep

Okotoks, Alberta
Drake Landing Solar Community
90% solar heat fraction for the homes. In operation since 2007.
Borehole Heat Exchanger: Double U

- Bentonite Fill Tube
- Accessories
- Heat Exchanger tubes
- Pendulum
GROUNDHIT PROJECT

Double-U pipes

Simple coaxial pipes
Avantor – Nydalen, Oslo Norway

6 MW heating, 9 MW cooling

Floor Area: 2,000,000 sq. feet

Completed 2004 — 4.1 year pay-back
Avantor development area in Nydalen, Oslo

- University
- Radisson Hotel
- BHE-field
- Office Buildings
- Residential

160 boreholes, 650 to 850 feet deep.
Heating/cooling for 2-million square feet.

(Photo: Avantor)

Power requirement 60-70% less than other alternatives
400 boreholes, 425 feet deep, 3.5 acres

Heat loss: 2% over 6 months

Richard Stockton College, Pomona, N.J.

Buildings: 400,000 square feet

CO2 reduction = 2300 tons/year

Completed 1990 — 4.6 year pay-back
Heat gradient in a BTES field

Red: at most 195° F for heating, at minimum 23° F for cooling.
Nasby Slott (Castle), Sweden

Seawater source heat pumps (Baltic Sea)

48 boreholes, 590 feet deep.

Heating 200,000 square feet.

Bought energy reduced 57% (oil reduced by 79%)

Payback: 4.3 years.

GREENPEACE -- April 2011
Thought: 1st increment for an STES / seawater-HP district heating system.
Sitka Numbers — Back of the napkin:

In 2020, **dry year** hydro capacity: 85 GWh electric

In 2020, **medium demand** forecast: -136 GWh electric

**Shortfall:** - 41 GWh electric

Freezer power recovery (3 fish plants) 6 GWh **heat**

plus heat extracted from fish 3 GWh **heat**

**Interruptible power** (8 GWh electric)

Converted to heat w/ seawater HP 32 GWh **heat**

**Shortfall** (reduced by STES & heat pump): 0
Fig 2.4. The principal configuration of the Sundsvall snow storage
Solar-thermal district heating system

Heat storage in a gravel pit & a water pit

Marstal, Denmark
Jobs!