

Arctic Energy Summit Helsinki 18.-21.09.2017

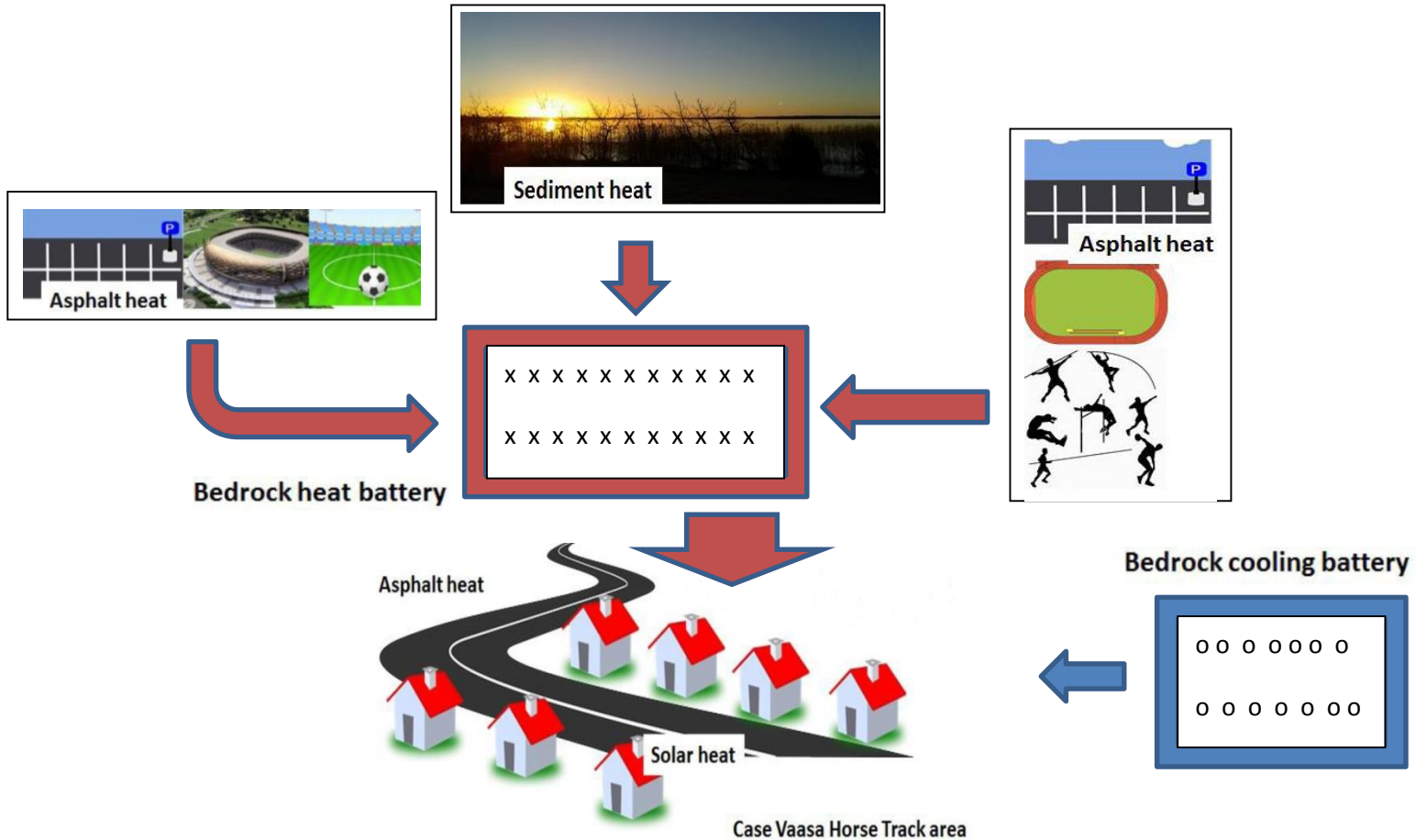


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Urban Energy

- A lot of (renewable) energy is available inside the urban areas, built areas.
- More efficient way to use energy, is to utilize this urban energy, instead of the fossile energy.
- Basic technology exists already in many cases.
- Less transportation.
- Less energy losses and waste.
- Less costs.
- Cleaner energy.

Building a new area, like Horse Track Valley. What kind of local energy is available?



Heating and cooling; seasonal heat and cool storage

Potential use of heat sources:

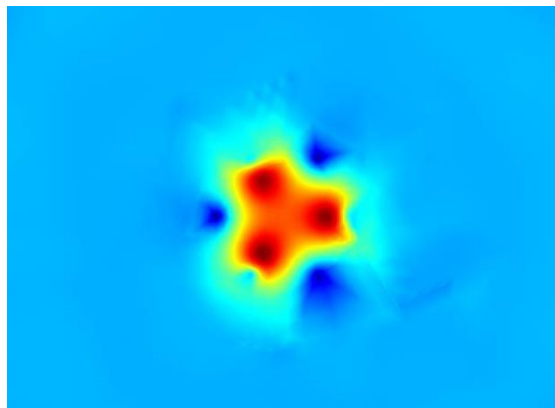
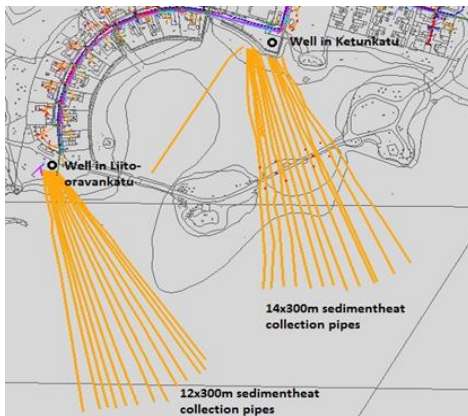
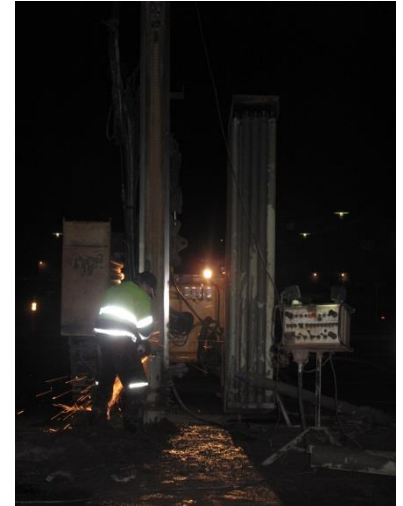
- the sediment energy from the close shallow bay
 - the energy from asphalt parking lots of the close football stadium and the track-and-field stadium
 - solar energy.
- solar heat supply varies daily (day and night) and monthly (seasonal variation). The seasonal storage could be a bedrock heat battery (BHB). Short time energy storage could simply be some liquid tank.
- another storage, cool storage, is needed for cooling houses in the summer time. The heat bedrock battery can be cooled during the winter time in a way that during summer time it can be used for cooling houses.

There is need for a concept to use sediment energy and energy from covered areas.

Geo(thermal)energy as an example

A term geoenergy means here energy from the ground or water.

- Sediment heat (clay heat)
- Asphalt heat
- Bedrock boreholes
- Water heat exchanger
- Seasonal storage



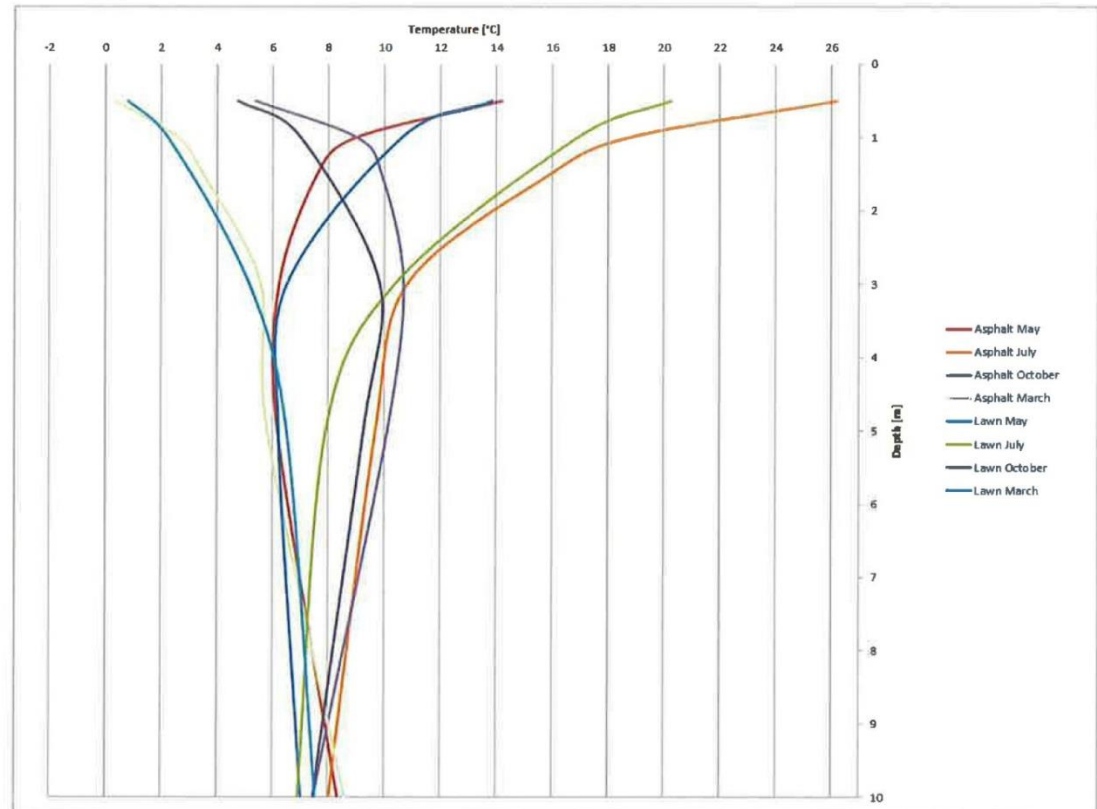
Sediment heat in Suvilahti, Vaasa

- Totally 26 collecting pipes, á 300 meters
- Sediment heating for 42 houses
- System has been operating since 2008 in Suvilahti
- Sediment energy can be used on seaside and close to the lakes
- System is always re-loaded in the summer time



Why asphalt heat?

- In built areas a notable portion of the land is covered with asphalt or concrete. Both asphalt and concrete layers absorb effectively the solar heat.
- Under the asphalt the sand and gravel layers conduct energy to the lower layers.
- Even without special seasonal storage, the asphalt fields can act as a heat storage.



Three years temperature measurements from 0.5 m to 10.0 m under an asphalt paved area and a lawn.

Results

Here is compared temperatures under the asphalt parking lot and the lawn. The highest temperatures are measured in July (summer) and the lowest temperatures in March (begining of the spring). Even though the surface temperatures are under 0 °C, already in the depth of half meter under the surface (in these measurement) the temperatures were positive growing smoothly to about 7 °C at the depth of 10-15 m.

Month /Surface temperature	Asphalt [°C]	Lawn [°C]
May	10	2
July	31	19
October	-1	0
March	-3	-5

In March the temperatures are close to each other. The temperatures in May and October on different fields differ most at about 1 m under the surface. The biggest differences at over three meter depth can be seen in July. The temperature difference between summer and winter can be about 5 °C. In 0.5 m difference can be even 20 °C. At about 9 – 10 m temperatures are stable and no difference between seasons can no more be seen. Energy is mainly Earths geothermal energy.

Applications of the asphalt energy

- In United Kingdom: heat collected from the pavements is used in heating houses (under floor heating, seasonal heating)
- In Netherlands: heat collected from the roads is used in heating public buildings
- Canada, Drake landing: solar energy storage
- In Nordic countries and in generally in colder climate: how to arrange the seasonal storage?

Geoenergy from bedrock boreholes for the block of flats

- Technology has been developed efficient enough to heat also block of flats: houses, hospitals, hotels, libraries, schools, kinder gardens and so on.
- Cooling besides or instead of heating is also becoming more and more important: houses block of flats, industry.
- **An example in Vaasa, Finland:**
- Research object: two houses of four block of flats; eight floors each
- Use of renewable energy: 200 m bedrock boreholes (14+12) for heating. On the roofs 36.6 m² solar collectors for heating the warm household water.
- The amount of energy produced was about 40 % of the total energy; warm water about 20 %.
- Solar collectors were used also for heating the boreholes.
- Source: Tapani Hahtokari: Maa- ja aurinkolämmön hyödyntäminen matalaenergiakerrostalorakentamisessa (University of Applied Sciences, Vaasa, Finland).

WATER HEAT EXCHANGER

to collect heat from the water
(GeoPipe Oy)

- 9,6 kW:s water heat exchanger
- Length 1450 mm
- Diameter: about 1300 mm
- To be installed at least 3 m depth under water surface: depends on thickness of the ice (60 cm ?) and the variation of the water surface 100 cm ?)
- Heat pump power 13 kW.



Energy Efficiency in Built Environment:

Waste treatment and recovery of energy

- Oy Stormossen is a regional waste management company for appr. 100,000 inhabitants. The waste treatment plant is located about 10 km from Vaasa.
- The organic waste of the households in the Vaasa region as well as the sludge from the waste water of Vaasan Vesi is transported to Stormossen.
- Stormossen promotes re-use and recycling of waste: the recovery of materials and the recovery of energy.
- Stormossen can produce biogas for about 1000 cars in addition to the buses. This year there will be 12 brand-new gas busses in Vaasa.
- A slow fuelling station for gas buses has been opened near Stormossen. The tanks of the gas are filled up during the night time.
- Close to the bus refuelling station, there is also a fast fuelling station for cars.
- This is a good example of circulation economy. Biomass and biogas is produced in urban area and the produced energy is used in this same area.

Summary

Important research topics to increase the use of urban energy and to improve energy efficiency in built environment are

- seasonal storage, short time heat storage and cool storage for cooling houses, hospitals, schools, department stores, ...
- storing (and using) urban heat would diminish the heat island effect.
- storing asphalt energy directly under the asphalt might need new layers under the asphalt: sand, gravel or some new material .





Thank you for your attention