KAJAANI
DATA CENTER
ECOSYSTEM

Otanmäki Circular Economy Park 2040 Master Plan

November 2025

Co-funded by the European Union

KAMK • University of Applied Sciences

CSC

Luke
NATURAL RESOURCES INSTITUTE FINLAND

Konesalien hukkalämmöt hyödyksi –projekti
Utilisation of the data center excess heat -project

Otanmäki 2040
Circular Economy Park

KAJAANI
city centre

Process water

Local industry

Other potential biowaste and streams from nearby farms

CH_4

BIOGAS

CO_2

Side streams

Food production

Other industries

Data center

Excess heat from data center

Excess heat from data center

Otanmäki settlement

Otanmäki outdoor pool

Recreatrional activities

Ecology support actions

This plan has been developed in the 'Utilisation of the Data Center Excess Heat' -project.
More information: www.kdce.fi

How the Master Plan has been developed

- Otanmäki region provides combination of adequate space and access to core infra --> supports many types of industries
- Kajaani Otanmäki region provides possibilities for new kinds of symbiosis than other dc-locations within Kajaani region
  - We look forward to having new bio-based industry
  - Heading to Net-zero -direction
- Preliminary ideas on circular economy concepts have been processed with academic, professional and municipal stakeholder groups

- This plan has been developed by 'Utilisation of the Data Center Excess Heat' –project staff members from KAMK and LUKE, co-operation with KAMK colleague.

Otanmäki Circular Economy Park Operations

1. Heating
2. Greenhouse production
3. Aquaculture
4. Biogas production
5. Heat to X
6. Other industries

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1. Heating

- Nearby Otanmäki settlement
  - Yearly heat demand 8-9 GWh

- Nearby Skoda Transtech workshop/factory
  - Yearly heat demand 8-9 GWh

1. Heating – Otanmäki outdoor swimming pool

- Current situation
  - The northest outdoor swimming pool in Finland, operating currently 3 months a year.
  - Need for renovating.
  - Current energy consumption: 0,3 GWh per year (pool & sports hall together)

- Future scenario
  - All-year-round open modern outdoor spa and training facility
  - The facility includes an Olympic-sized pool (50 × 25 m), a therapy pool (10 × 10 m), and a children's pool (8 × 8 m), with a total surface area of approximately 1 414 m².
  - The annual heat demand appr. 10 GWh

2. Greenhouse production

Otanmäki area provides good possibilities for greenhouse production.

Some examples for the potential greenhouse production:

- Bell Pepper or smaller tomatoes
  (products where Finland is not self-sustainable)
- Tropical fruits
  - Avocados, bananas, mangoes…
- Seasonal greenhouse production
  - Strawberries, Grapes, Flowers, Asparagus, Early season/spring potato/vegetables

2. Greenhouse production – example about growing of tomatoes

These calculations are done to get a rough scale for the need of the space and heat

- 50 ha tomato production (natural sunlight + lamps, all-year-round)
- 25 t tons of tomatoes produced
- Amount of heat required: 300 GWh
- Amount of biowaste produced: 5 000 t (for biogas production)

3. Aquaculture - potential

- Rainbow trout
  - Production of marketable sized fish (~9-12 months from egg to marketable size fish)
    - High investment and operating costs. High volumes needed to become successful.
  - Hatchery & juvenile production (for further RAS or open-water grow-out)
    - High seasonality in demand (for open-water transfer)
    - Yearly demand in Kainuu area to be checked
- Freshwater shrimp
  - We are trying to find data in order to provide production cost calculations
  - Swedish Bio-RAS?
- Algae production
  - Binds CO_2 --> component towards net-zero production
  - Possibilities to use algae as secondary nutrient uptake solution after greenhouse production or aquaculture

3. Aquaculture - example

Estimates for rainbow trout production in RAS (recirculating aquaculture system)

- RAS-production of 1,000,000 kg/year of rainbow trout in recirculatory system, using Lake Oulujärvi water, requires
  - 500,000 m^3 lake water (1 kg of trout growth = 1 kg of feed = 500 l water)
  - 4.6 GWh for heating the raw water from Lake Oulujärvi (when lake water below 15.5 °C, for ca. 9 months)
  - One million kg RAS production produces around 350-550 tonnes biowaste.

- For comparison
  - Total rainbow trout production in Finland ca. 14,400,000 kg/year

4. Biogas production – biomass potential

Estimations of the potential biomass for the biogas production – altogether around 126 500 t

- Biowaste from the greenhouse 5 000 t
- Fish farming residues (1 million kg fish) -> 450 tonnes biowaste
- Household biowaste 16 000 t
- Agriculture 90 000 t
- Sewage sludge 15 000 t

Other potential sources for biomass:

- Sludge from datacentre cooling water treatment
- Lake biomass

4. Biogas production – heat demand

Heat demand of the biogas process (feedstock 126 500 t/a)

- Heating the biogas reactor 3,8 – 4,4 GWh
- Separation and drying of the digestate solids 16 GWh
- Heat treatment of digestate for inactivating pathogens, as well as stripping nitrogen compounds from digestate's liquid fraction consume significant amount of heat

Typically biogas plant uses ~15% of produced gas for heating up the process
-> extra heat provides biogas process enhancement

Digestate valorization

With additional components and energy-efficient drying, digestate can be turned into organomineral fertilizer product.

4. Biogas production – CO2 utilisation

Biological process for biogas forms CO_2, which can be synthetized with H_2 into synthetic methane CH_4 – this can be done either

1) By bringing H_2 straight into biogas reactor
2) By adding H_2 into recovered CO_2 during the gas upgrading

Possibility for the CO_2 use:
Utilising CO_2 in the greenhouses to speed up vegetable production (additional CO_2 is needed in the greenhouse production).

5. Heat to X

- Organic Rankine Cycle (ORC) and other possibilities for heat to electricity.
- Absorbtion and adsorbtion for heat to cooling.
- Hybrid solutions, like a multistage cascade system where waste heat is first converted to electricity using ORC, then used to drive an adsorption chiller, and finally directed to low-temperature heating.

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5. Other industries / possibilities

- Mushrooms and insect farming
- Cellular agriculture
- Chemical industry processes
- Semiconductor industry
- Pharmacy
- Brewery and distillery
- Water resources
- Drying the peatless bedding and growing media (e.g. saw dust, straw…)

Summary for the excess heat use cases

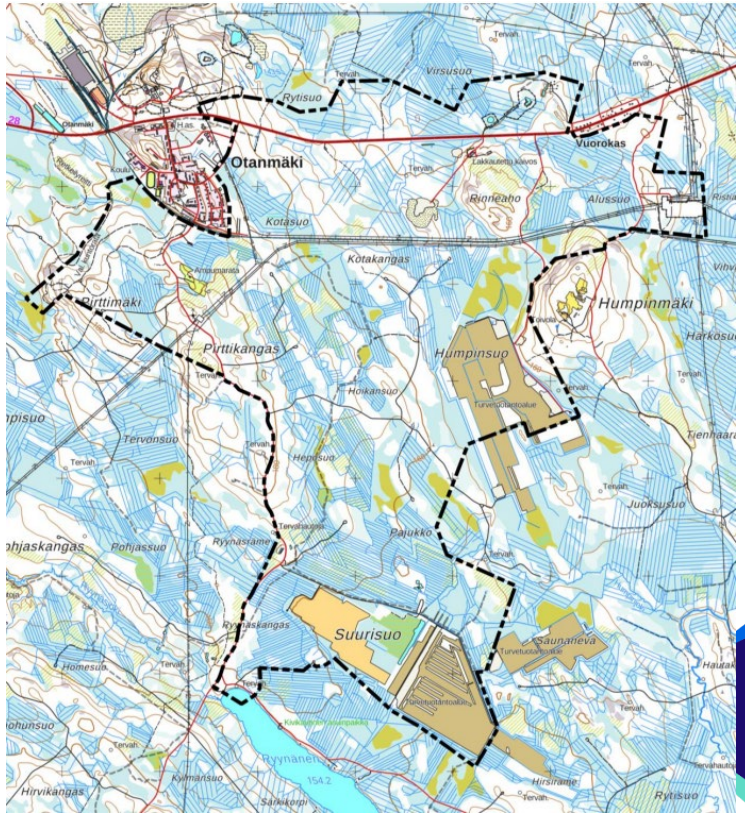
This gives a very rough summary of the potential excess heat amount that could be utilised for different purposes. These numbers are not comparable 100 %, as the temperature used an needed varies.

1. Heating	Otanmäki settlement district heating	9 GWh
	Skoda Transtech heating	9 GWh
	Future outdoor swimming pool + training hall	10 GWh
2. Greenhouse production	50 ha tomatoes (example)	300 GWh
3. Aquaculture	RAS production (1 million kg)	5 GWh
4. Biogas production	126 500 tpa feedstock	20 GWh
5. Others / Heat to X		?

Why to invest in Otanmäki

Otanmäki area combines many advantages for the circular economy park and potential investors.

- There is highway and railway passing next to the area.
- There is excellent electricity supply just next to the area (Vuolijoki electric station operating already, Höyttikangas electric station under construction)
- There is Otanmäki settlement with some accommodation and basic services available
- There is 30 min from Otanmäki to the Kajaani city centre
- Kajaani Data Center Ecosystem organisations, support and co-operation possibilities available.



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More information about Kajaani Data Center Ecosystem: Kajaani Data Center Ecosystem

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Thanks!