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European Innovation Partnership
on Smart Cities and Communities

Finland case

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Positive Energy Blocks and Deep Retrofitting

1. Financing: Innovative solutions for new and retrofitted buildings;

2. Regulation for buildings (data and energy - energy exchange within buildings, self consumption, data management);

3. Energy solutions: local active and passive solutions for energy efficiency.

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1. Financing: Innovative solutions for new and retrofitted buildings

For pilot phase there is different options for funding e.g.

- TEKES Finnish Agency for Innovations
- Finnish Academy programs
- H2020
- 6-aika, co-operation and funding via TEKES
- Local smaller support

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1. Financing: Innovative solutions for new and retrofitted buildings

- Esco models typically for technical/HVAC system improvement
- Changes in ownership of the building in existing buildings own by cities (still under discussion, currently only in health care buildings, where focus in process)
- Extra apartments on top of the building (only viable in bigger cities)

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Energy targets can be achieved at many cost levels

global costs - sensitivity analysis

	Commercial						Macro				
Oil	2 %	2 %	2 %	6 %	6 %	6 %	2 %	2 %	6 %	6 %	
Electric	2 %	2 %	2 %	4 %	4 %	4 %	2 %	2 %	4 %	4 %	
District heating	2 %	2 %	2 %	4 %	4 %	4 %	2 %	2 %	4 %	4 %	E-luku/
Dicount rate	1 %	6 %	10 %	1 %	6 %	10 %	3 %	4 %	3 %	4 %	E-luku ref.
PT perus	-2008	-1108	-794	-3358	-1598	-1038	-1153	-1025	-1748	-1511	1,00
PT1	-1860	-1152	-901	-2918	-1537	-1092	-1137	-1036	-1604	-1417	0,80
PT2	-1624	-965	-731	-2500	-1283	-890	-977	-882	-1366	-1200	0,97
PT3	-1616	-968	-738	-2476	-1280	-894	-976	-883	-1359	-1195	0,96
PT4	-1863	-1127	-869	-2915	-1509	-1059	-1126	-1021	-1590	-1400	0,80
PT5	-1647	-1147	-964	-2344	-1400	-1091	-1077	-1005	-1385	-1257	0,56
PT6	-1443	-1009	-847	-1986	-1207	-946	-950	-888	-1192	-1085	0,63
PT7	-1385	-1040	-910	-1793	-1189	-984	-950	-900	-1132	-1048	0,49
PT10	-1377	-894	-722	-1959	-1106	-828	-871	-801	-1130	-1013	0,67
PT11	-1431	-1012	-862	-1894	-1181	-946	-950	-889	-1156	-1058	0,55
PT12	-1451	-1150	-1035	-1770	-1266	-1093	-1028	-984	-1170	-1100	0,40
PT13	-1450	-1006	-841	-2009	-1209	-942	-951	-886	-1199	-1089	0,65

the lowest global costs.....the highest global costs

requirement E-luku/E-luku ref. < 0,8

2. Regulation for buildings (data and energy - energy exchange within buildings, self consumption, data management)

- In Finland the regulation gives maximum primary energy value, and additional minimum requirements for thermal insulation.
- Typically the main principle is to first reduce the energy consumption with improved heat recoveries, low energy appliances, thermal insulation (in renovation) and with active control systems (building automation etc.)
- More and more predictive and self-learning systems are coming but not yet common.

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2. Regulation for buildings (data and energy - energy exchange within buildings, self consumption, data management)

- Smart meters are deployed widely
- Data is owned by the end users
- Energy exchange between buildings in heat or in electricity if local network
- Some running two way district heating systems (e.g. in city of Tampere)
- If the energy exchange is via network, permission from energy utility. Energy companies have been positive for connecting buildings.

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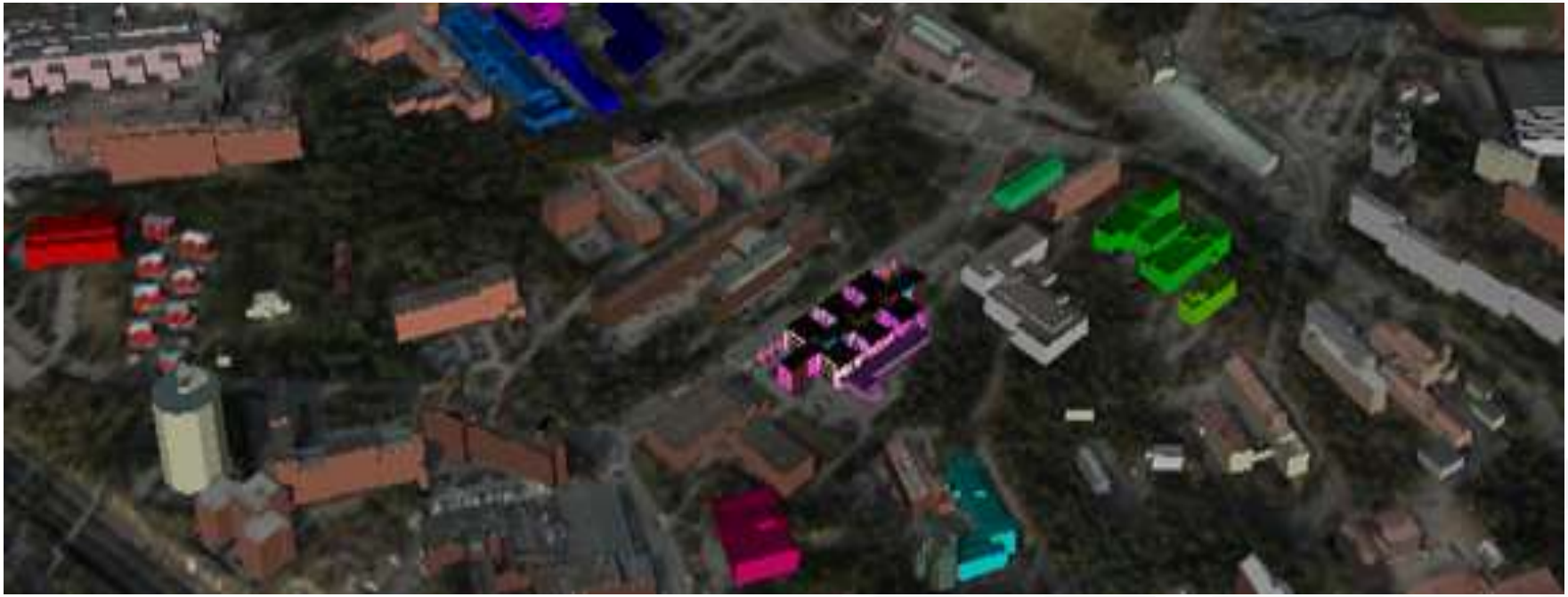
3. Energy solutions: local active and passive solutions for energy efficiency



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Net zero energy building, Kuopio

www.nollaenergia.fi

Energy demand	
Space heating	12 kWh/m^2
Water heating	13 kWh/m^2
Electricity, facility	6 kWh/m^2
Total	31 kWh/m^2
Renewable energy	
PV	7 kWh/m^2
Solar thermal	16 kWh/m^2
Ground heat	12 kWh/m^2
total	35 kWh/m^2
Excluded	
Residents electricity	16 kWh/m^2

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Net zero energy house, Mäntyharju

- Systems integration, building system
- Ground source heat pump heating
  - Low-temperature floor heating
- Solar collectors for hot water heating (50 %)
- Water saving fixtures (25 % savings)
- Lighting: LED (30 – 50 % savings)
- Shading / blinds
- Ventilation pre-heating/cooling
- Energy classified household appliances
- Energy demand 7000 kWh = 45 kWh/m^2
- Solar collectors 5 m^2
- PV panels 8 kW_p

www.suutarinen.fi

IEA5-Solar House

- Ground source heat pump
- Solar thermal
- PV
- Quality
- Professional use
- High insulation level

	Pietarsaari 1993	Typical 2017
Component	**U-value [W/m²K]**	
Wall	0,12	0,17
Roof	0,09	0,09
Floor	0,1	0,16
Door	0,4	1,0
Window	0,7	1,0

Nearly zero energy house

- Pietarsaari 1993: Purchased energy < 50 kWh/m^2
- Technical development: Purchased energy < 40 kWh/m^2
- PV:
  - Present system 2 kW_p
  - Possible renewal ~8 kW_p

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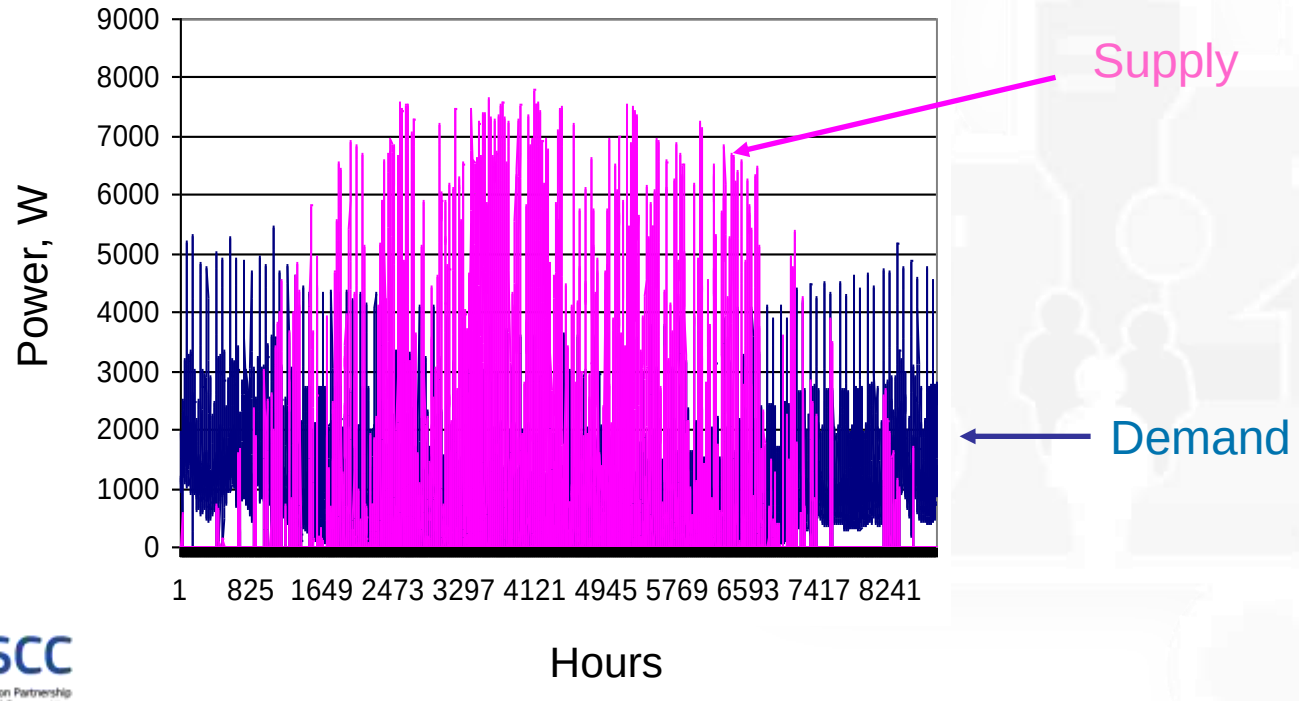
Missmatch hourly level

Total consumption (appliences + heating) 8400 kWh/m^2. 10 kW PV (60 m^2)



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Building integrated PV

PV integrated in the roof od apartment building (floor area 903.6 m^2, roof area 222 m^2). PV size 56 m^2 (=25% of roof surface) and 111 m^2 (=50% of roof surface).

Over production (56 m^2) 1913 kWh (912 h)
”Under” production (56 m^2) 29 371 kWh (7848 h)
Own use 12%

Over production (111 m^2) 5674 kWh (1344 h)
”Under” production (111 m^2) 27 137 kWh (7416 h)
Own use 19%

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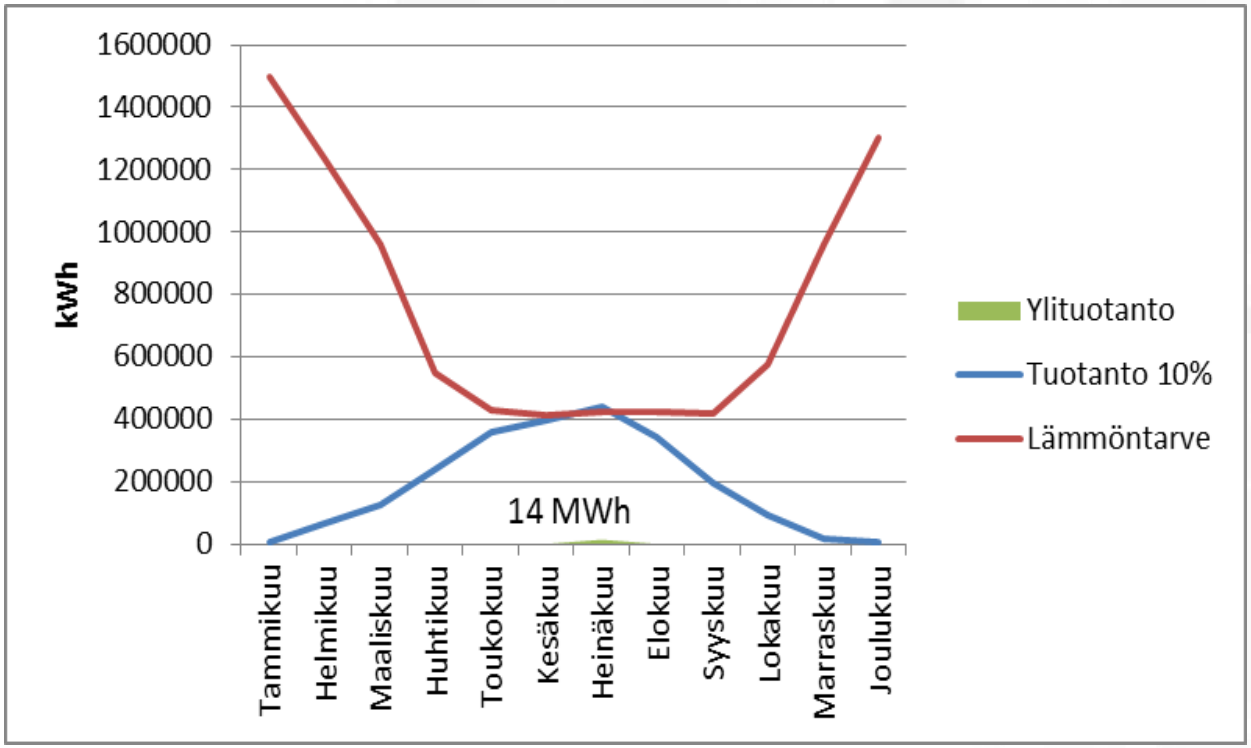
District in Tampere
Solar thermal

- 10% of all roof surfaces covered by solar thermal collectors



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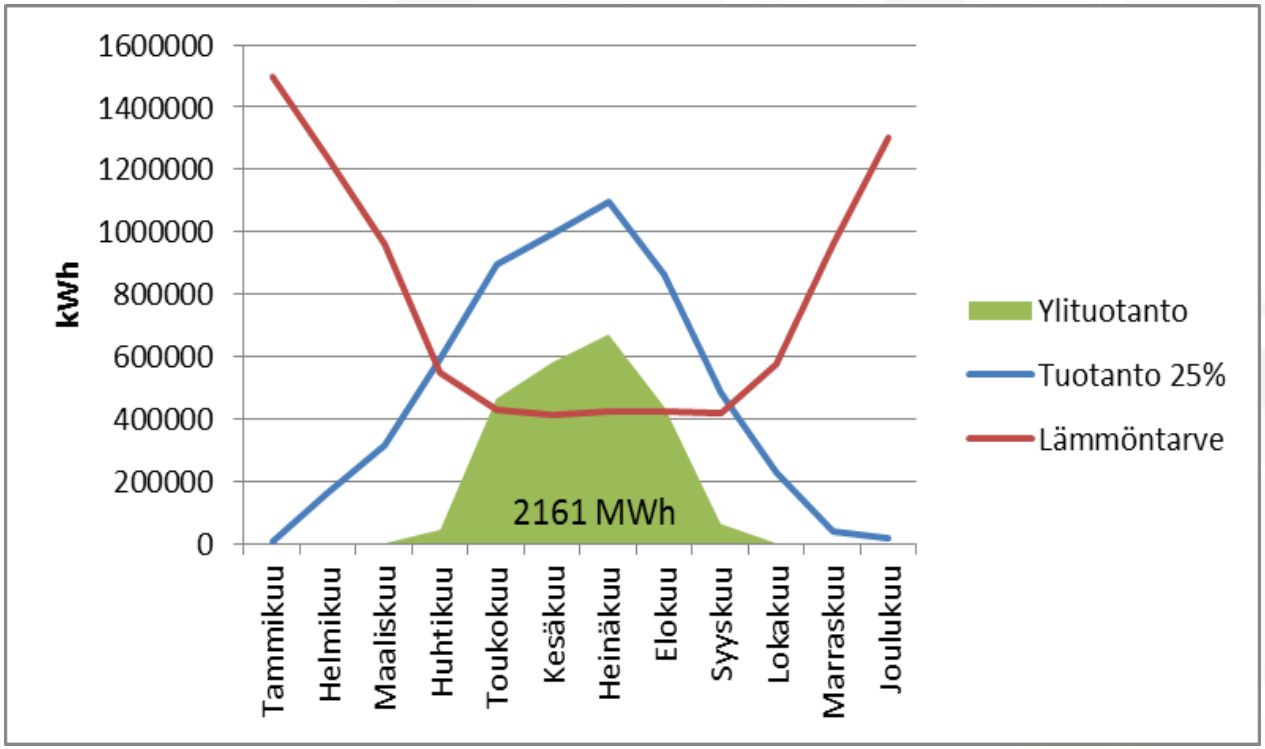
District in Tampere
Solar thermal

- 25% of all roof surfaces covered by solar thermal collectors



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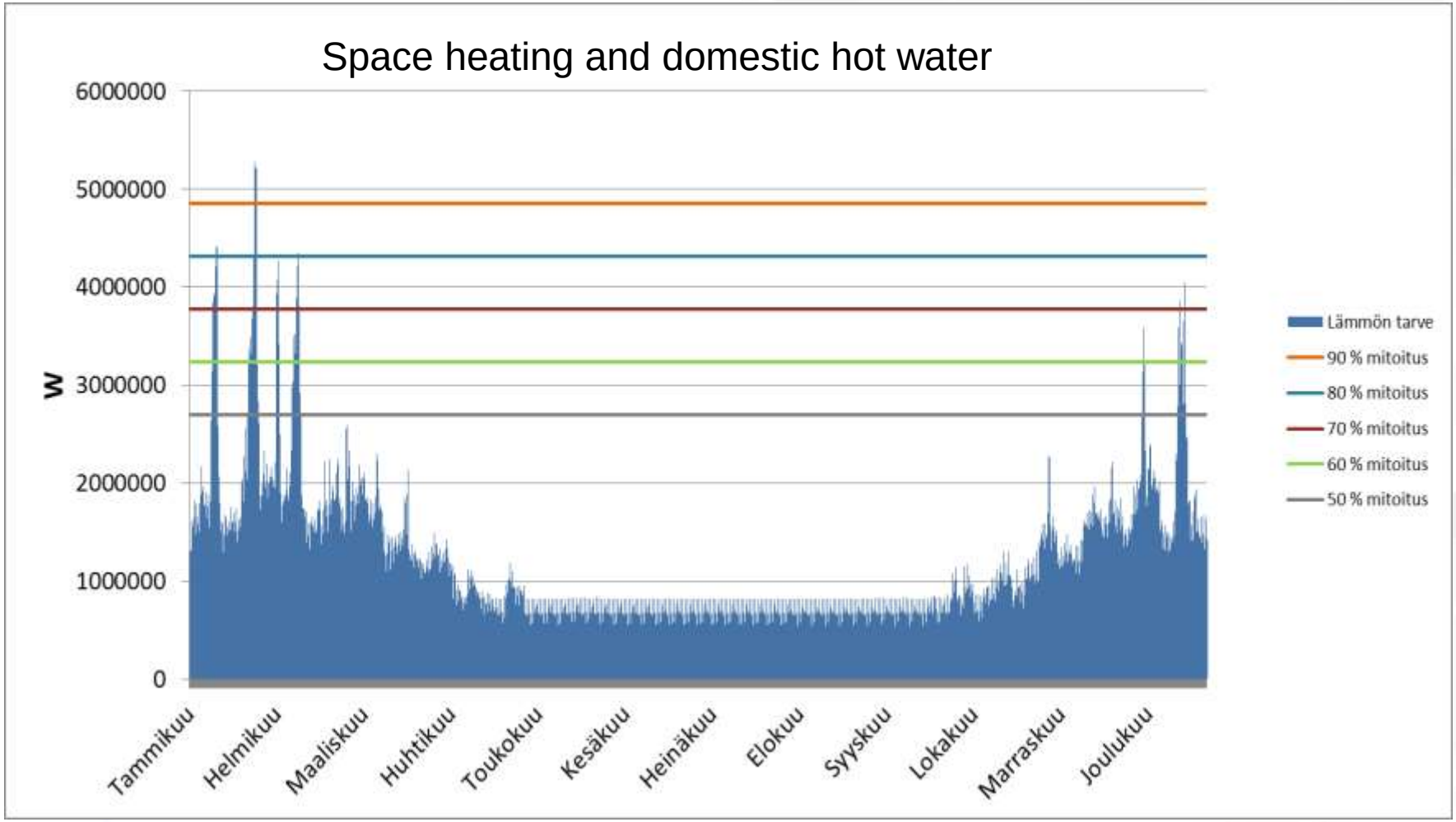
Peak power demand and investment => integrated district solutions



Helsinki: Kalasatama - district of smart urban development

mySmartLife Lighthouse project

- A living lab for new sustainable solutions
- Bigger area to be finised at 2036
- Smart buildings
  - Requirements in district plan
  - Demand response possible
- Efficient tri-geneation with RES
- Electricity storage
- New SunZEB blocks of buildings: buildings as solar energy collectors for district heating
- Underground waste collection system
- Sustainable mobility, MaaS, the Last Mile
- Open data and open interfaces

Picture from: http://www.uuttahelsinkia.fi/fi/kalasatama/rakentaminen/kaavoitus-suunnitteilla-moni-ilmeinen-alue

Espoo: T3 District: Otaniemi, Tapiola, Keilaniemi

(Tiede, Taide & Talous: Science, Art and Economic)

Figure from: http://rym.fi/fi/espoon-kaupunki-otti-eue-ohjelman-organisaatioonsa

- Smart and sustainable development
- District heating and cooling
- nZEB apartments
- Smart building monitoring
- Demand response demos
- Deep geothermal heat pump plant in 2018
- Online energy information application
- Wood construction show cases in Tapiola
- Energy Self-Sufficient Otaniemi Campus by 2030[1]

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[1] http://smartnclean.helsinkibusinesshub.fi/projects/energy-self-sufficient-otaniemi-campus-by-2030/

Tampere: Hiedanranta

Figure from: http://valiaikainenhiedanranta.fi/

- Former brown field to be transformed energy positive living and working area
- Development bases strongly on circular economy including all fields of activity also food production
- 4th generation smart low temperature district heating network including hybrid heat production, two-way heat trade between utility company and users as well as between users
- Solar energy and lake cooling network

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Vaasa: House Fair district

- 40 small family houses and
  3 apartment buildings
- Built in 2008
- Electricity positive: extra 20% of electricity
  - Wärtsilä's New Energy fuel cell plant (SOFC, 20 kW and 14-17 kW_{heat}) & Sarlin's microturbine (30% electricity and 60% heat; 130 $kW_{electricity}$ and 230kW_{heat},)
  - Biogas from landfill site
- Heat positive: 60% extra heat annually: sea water source heat pump
  - Collection pipes in the sediment of the sea

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Porvoo Skaftkärr

- RES district heating
- Low energy buildings
- Smart energy management
- Active citizen engagement and feedback

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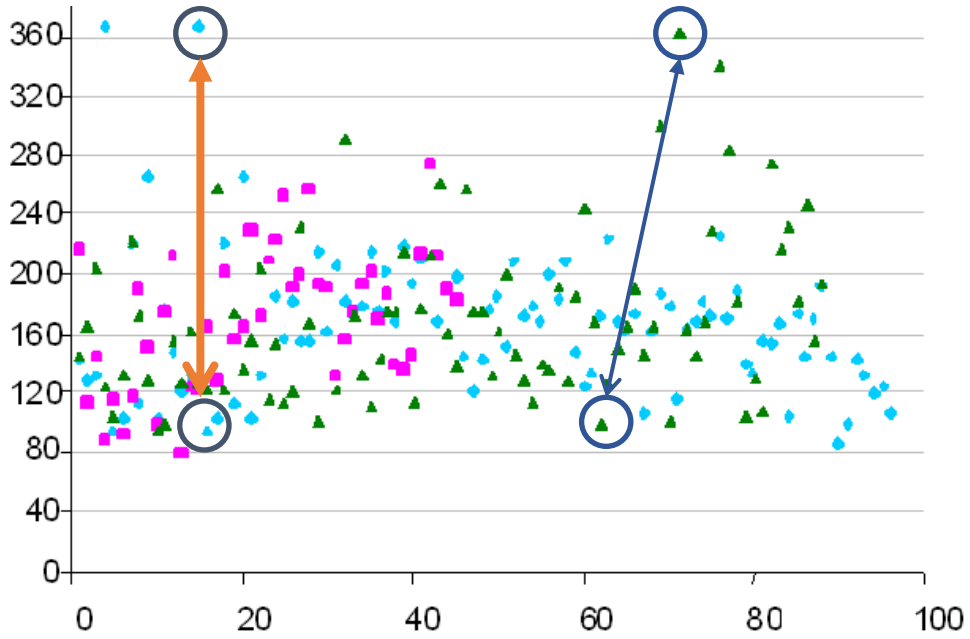
Heating energy consumption (space + DHW) in building built between years 2001-2005



- Apartment
- Row house
- Dwelling

Source TTY 2009

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KPIs are important

	7 m²/person 6 h/d	7 m²/person 8 h/d	7 m²/person 12 h/d	10 m²/person 12 h/d	15 m²/person 6 h/d
kWh/m²					
kWh/hlö					
kWh/m², occupied hours					

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Welcome to Finland

September 15th in Tampere

http://smarttampere.fi/

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