



SKAFTKÄRR

An energy-efficient residential area



16.09.2013

Maija-Riitta Kontio

Inhabitants 49028



Land area 655 km²
Water area 1 484 km²

Number of jobs 20200



Primary production	2%
Industry	28%
Construction	8%
Trade	11%
Other services	51%



PLANNING PROCESS IN FINLAND

NATIONAL GOALS FOR LANDUSEPLANNING

REGIONALPLAN

GENERALPLAN

CITYPLAN

THE SKAFTKÄRR PROJECT

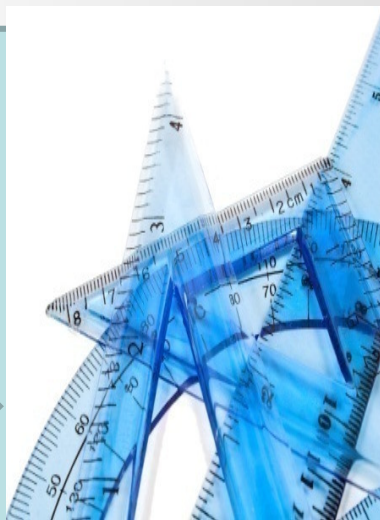
- Duration 2008-2012
- Co-funders
 - City of Porvoo
 - Sitra
 - Porvoon Energia Oy
- Other partners:
 - Posintra Oy (project co-ordinator)
 - Ministry of the Environment (in steering group)
 - Uusimaa Centre for Economic Development, Transport and the Environment (in steering group)
- Construction of Skaftkärr area 2012-2020



OBJECTIVES AND TARGETS

- To create a residential district that functions as a national and international **pilot area for energy-efficient planning**
- To create **guidelines** for energy-efficient town planning
- To create a "Living Lab" area for continuous pursuit of better energy efficiency
- To develop business activities for the municipal energy company that respond to the needs of future low-energy construction
- To **promote** energy-efficient **construction**
- To **minimize greenhouse gas emission** and to curb climate change

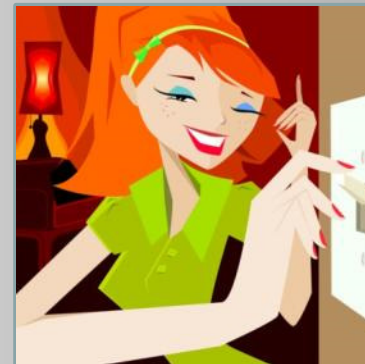
An energy-efficient residential area: Skaftkärr in the City of Porvoo, Finland



Development of
spatial planning
processes



Development of
business
models for
energy
companies



Energy
LivingLab:
Development
of counselling,
cooperation
and feedback

QUESTIONS

Can town planning address the **energy efficiency of areas** ?

What ways are there to reduce carbon footprints ?

Do we need to **change planning practices** and **develop our planning process** ?

SKAFTKÄRR OUTLINE PLAN

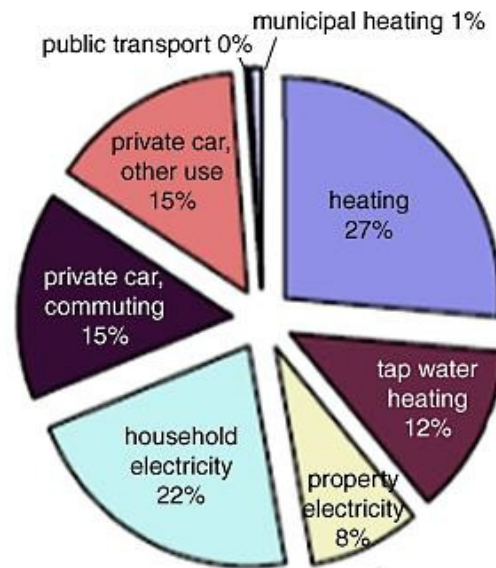
TOUKOVUORI CITY PLAN

ENERGY CONSUMPTION AND CARBON BALANCE

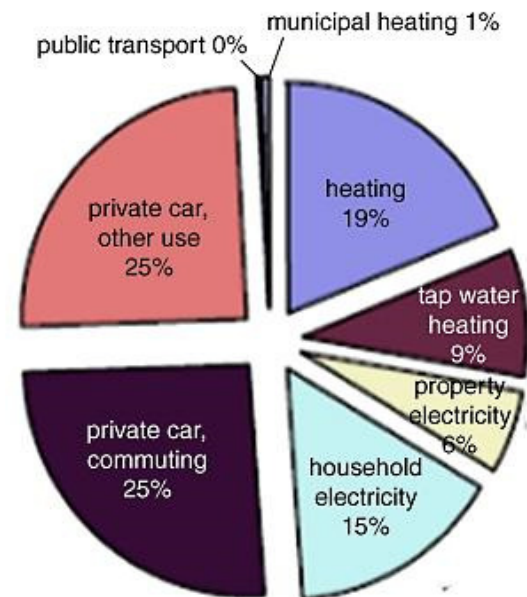


COMPARISON LEVEL: OLD OUTLINE PLAN FROM 2007

Primary energy use in Skaftkärr alternative 0+



CO2 emissions in Skaftkärr alternative 0+



Comparison level 0+ 'Business As Usual'

SENSITIVITY ANALYSES

Changes to comparison level 0+



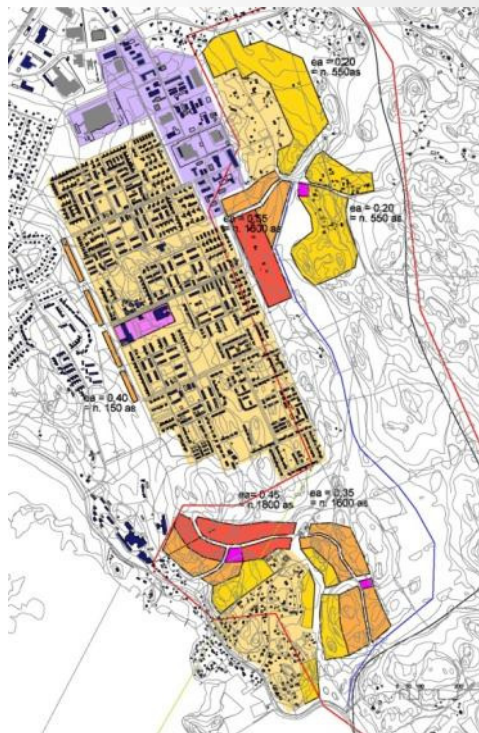
	Primary energy	CO2 Emissions
Low-energy level heating	- 12 %	- 8 %
Passive level heating	- 19 %	- 14 %
Passive house, electrical heating	- 6 %	- 4 %
Solar heating	- 6 %	- 4 %
Passive houses and solar heating	- 26 %	- 18 %
District heating	- 33 %	- 22 %
Low-energy and district heating	- 35 %	- 24 %
Area with geothermal heating	- 18 %	- 13 %
All workplaces in Porvoo	- 11 %	- 19 %
Facilities for teleworking	-3 %	- 4 %
Half of commuting with electrical cars	-7 %	- 19 %
Average Finnish district heating area	- 16 %	+ 27 %

Comparison level 0+

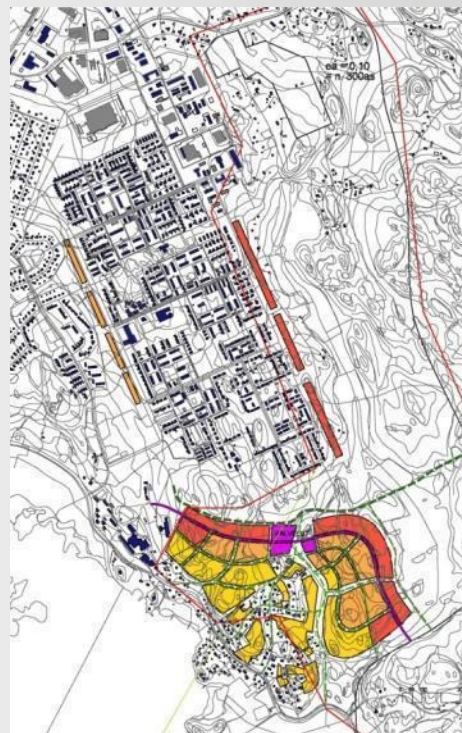
In the sensitivity analyses, the relation between passive and low-energy houses was also calculated with regards to energy consumption, emissions and costs.

SOLUTION MODELS

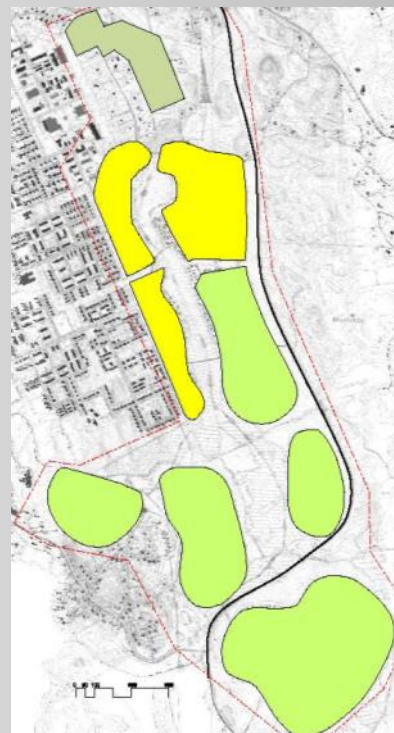
LAND USE



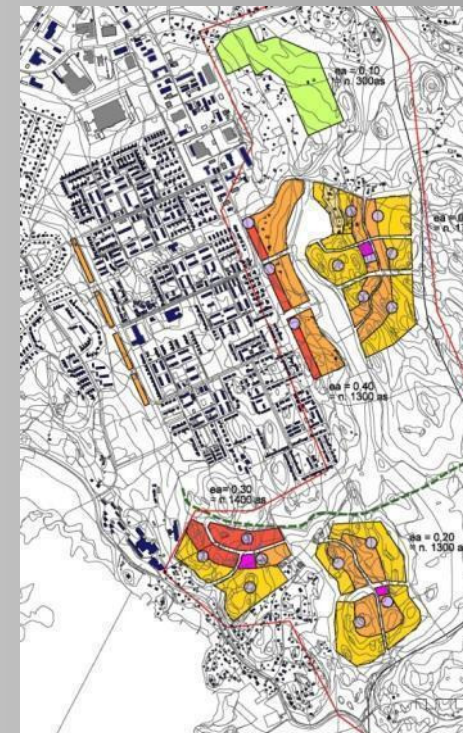
M1



M2

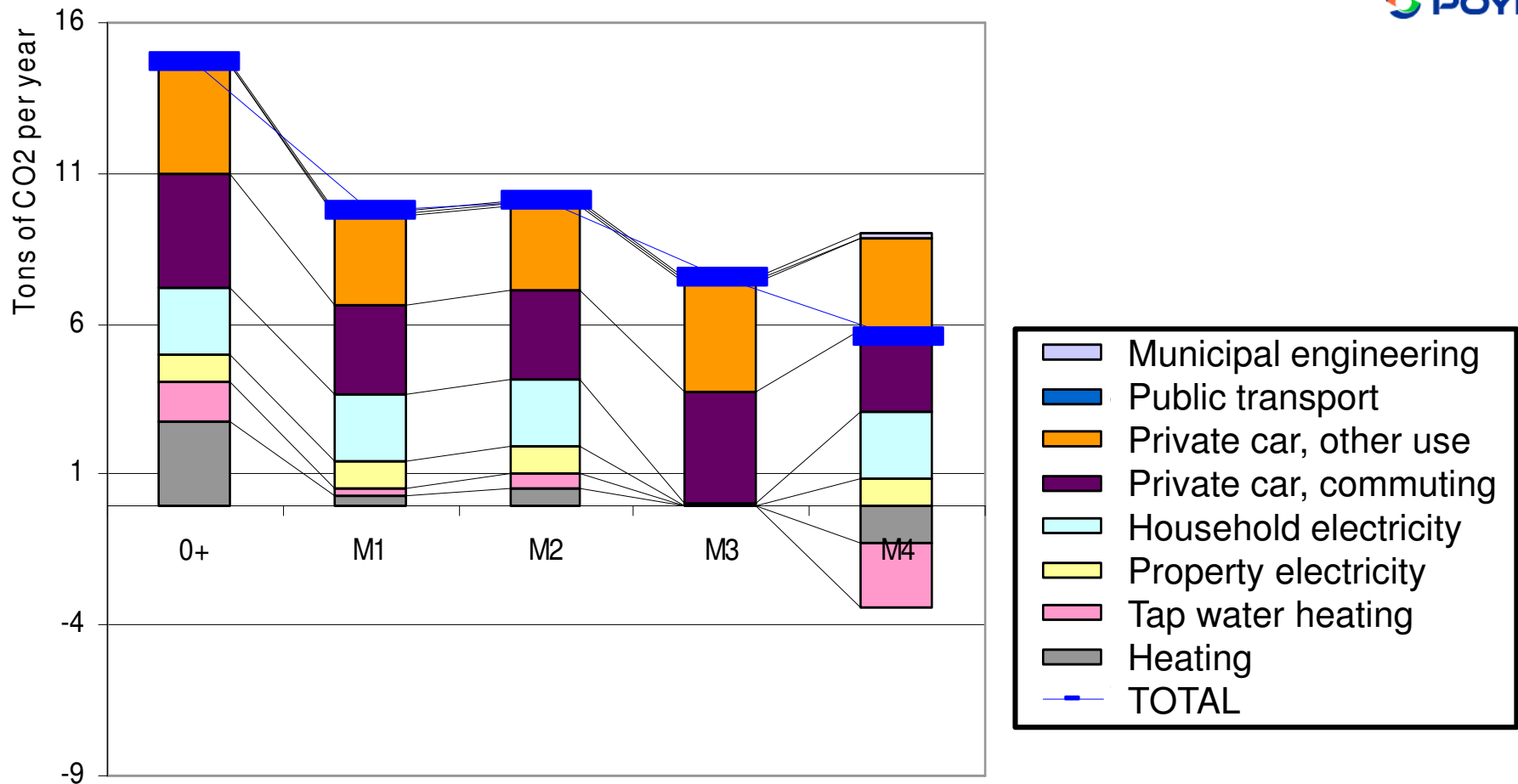


M3



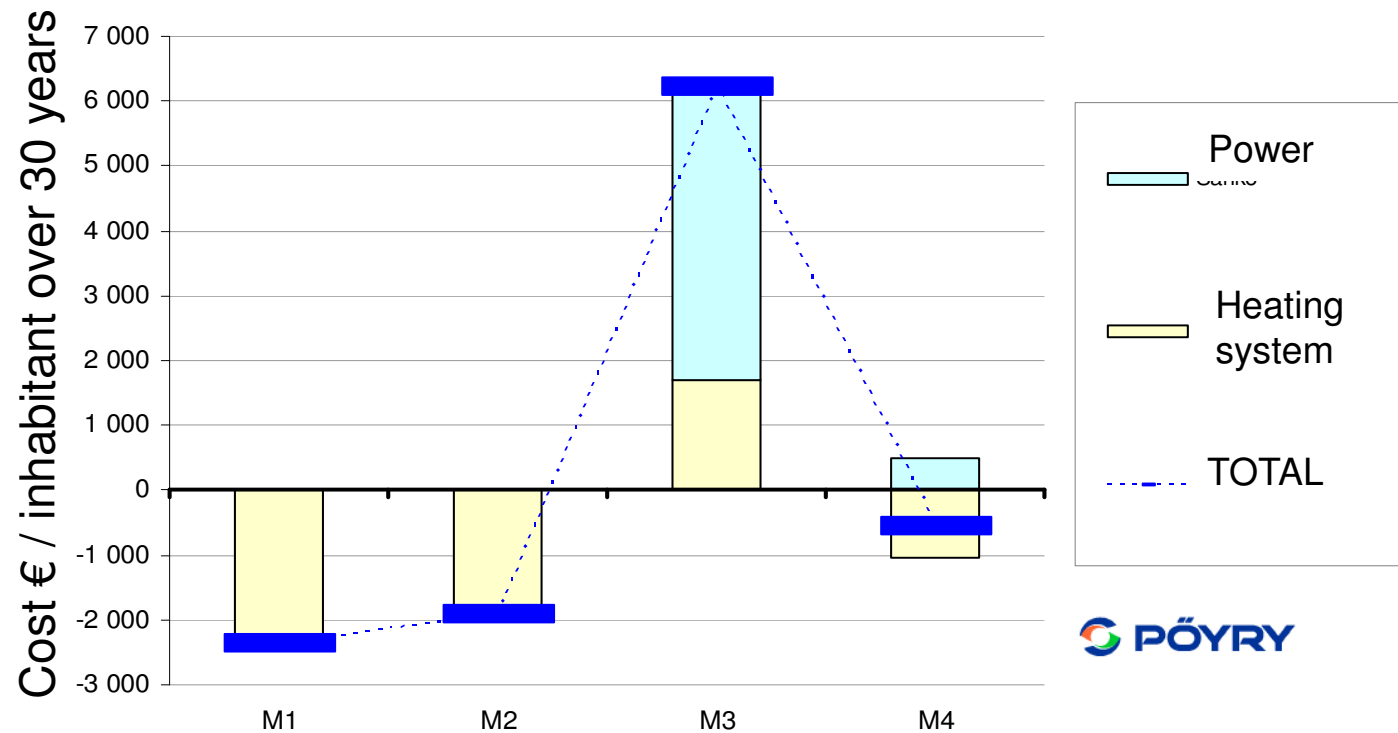
M4

CARBON BALANCE



COSTS OF ENERGY SOLUTION

ENERGY SOLUTION IN TOTAL



The chart shows the cost of the energy alternative as compared to model 0+

COSTS OF ENERGY SOLUTIONS

Cost of reducing CO2 emissions in models 1 to 4 as compared to model 0+



Heating	Model 1	Model 2	Model 3	Model 4	
CO2 reduction	3 505	3 026	4 065	7 105	CO2 tons / year
CO2 cost	-207	-193	128	-45	€ / CO2 tons
Power					
CO2 reduction	0	0	3 116	3 116	CO2 tons /year
CO2 cost	-	-	443	49	€ / CO2 tons
Total	-207	-193	571	4	€ / CO2 tons

Porvoon Energy investments*

€	Model 1	Model 2	Model 3	Model 4	
District heating network	5 400 000	2 700 000	0	5 400 000	€
Solar collectors**	0	0	0	7 100 000	€
Total	5 400 000	2 700 000	0	12 500 000	€

* The costs are transferred to all consumers in the price of district heating

** The investment in solar collectors (incl. 40 % investment support) is expected to pay itself back in the form of decreased fuel costs

The chart shows the cost of the energy alternative as compared to model 0+

COSTS OF INFRASTRUCTURE

0+	38 Million €
----	--------------

M1	18 Million €
----	--------------

M2	15 Million €
----	--------------

M3	38 Million €
----	--------------

M4	20 Million €
----	--------------

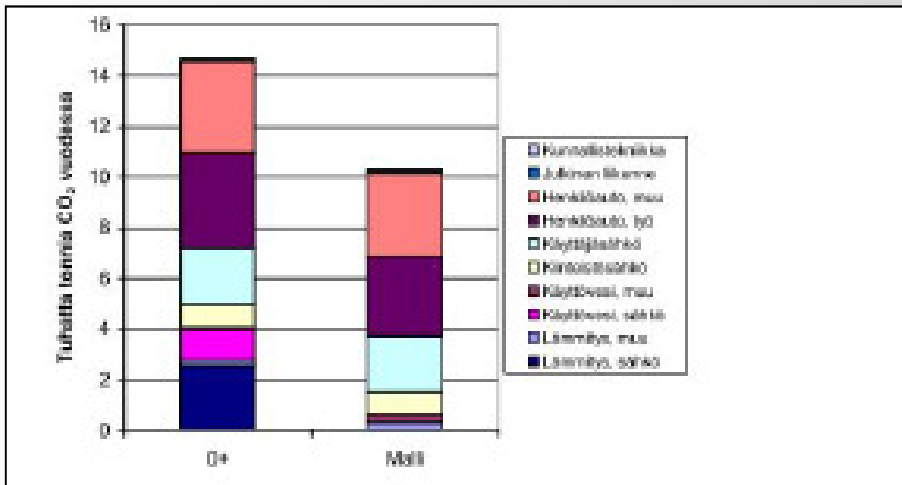
The Infra.net application was used for calculation. Model 0+ is the comparison level. Model 3 is equivalent in land use and therefore the infrastructure costs are the same. The other models are more economical, because land use is denser and there are fewer municipal engineering systems and fewer park areas. The soil conditions, too, were taken into account in the calculations.



SKAFTKÄRR

OUTLINE PLAN

A new energy-efficient residential area for 6,000 people will be built in Porvoo's Skaftkärr. The entire area will be designed and built for energy efficiency in buildings, services, living environment and traffic arrangements.



The energy-conscious town plan reduces the consumption of primary energy by **38 %** and CO₂ emissions by **30 %** when compared to traditional planning principles.

Modellernas beräkningar								Förändringar		
	Förbrukning köpenergi MWh/a	Förbrukning primärenergi MWh/a	Fördelning primärenergi	Utsläpp ton CO2/a	Fördelning CO2	Specifik förbrukning primärenergi	Specifika utsläpp	Köpenenergi	Primärenergi	Utsläpp
Uppvärmning, el								- 100 %	- 100 %	- 100 %
Uppvärmning, annan	13 735	2 747	4 %	330	3 %	9 kWh/hm ²	24 g/kWh	+ 58 %	+ 58 %	+ 58 %
Bruksvatten, el								- 100 %	- 100 %	- 100 %
Bruksvatten, annan	12 018	2 404	4 %	288	3 %	8 kWh/hm ²	24 g/kWh	+ 199 %	+ 199 %	+ 199 %
Fastighetsei	4 386	8 771	13 %	877	9 %	30 kWh/hm ²	200 g/kWh			
Användare	11 197	22 395	33 %	2 239	22 %	76 kWh/hm ²	200 g/kWh			
Kommunaltjänst	774	872	1 %	89	1 %	3 kWh/hm ²	115 g/kWh			
	tk m/a					trafik				
Personbil, arbete	18 462	12 554	13 200	19 %	3 139	30 %	8,3 km/pers/dag	170 g/km	- 17 %	- 17 %
Personbil, annan	19 216	13 067	13 739	20 %	3 267	32 %	8,6 km/pers/dag	170 g/km	- 10 %	- 10 %
Kollektivtrafik	111	30	441	1 %	69	1 %	0,05 km/pers/dag	623 g/km	+ 44 %	+ 44 %
SAMMANLAGT		84 688		10 288					-38 %	-30 %

Om elproduktionen i sin helhet skulle vara möjlig att förverkliga med förnybara energiformer skulle utsläppsförändringen bli -51 %

PROMOTING BICYCLING

HIGH SPEED BICYCLE LANES

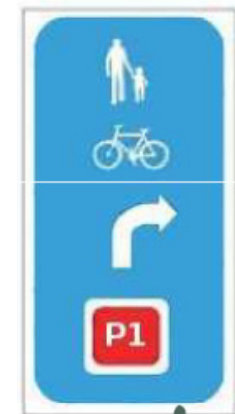
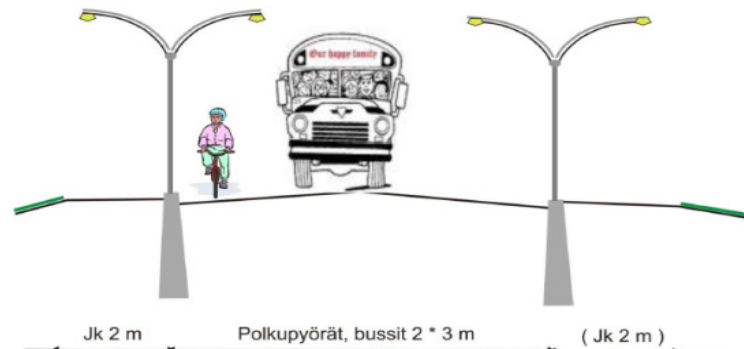


The City of Porvoo have explored the feasibility of high-speed bicycle lanes. Fewer obstacles for pedestrians and cyclists give better energy efficiency.

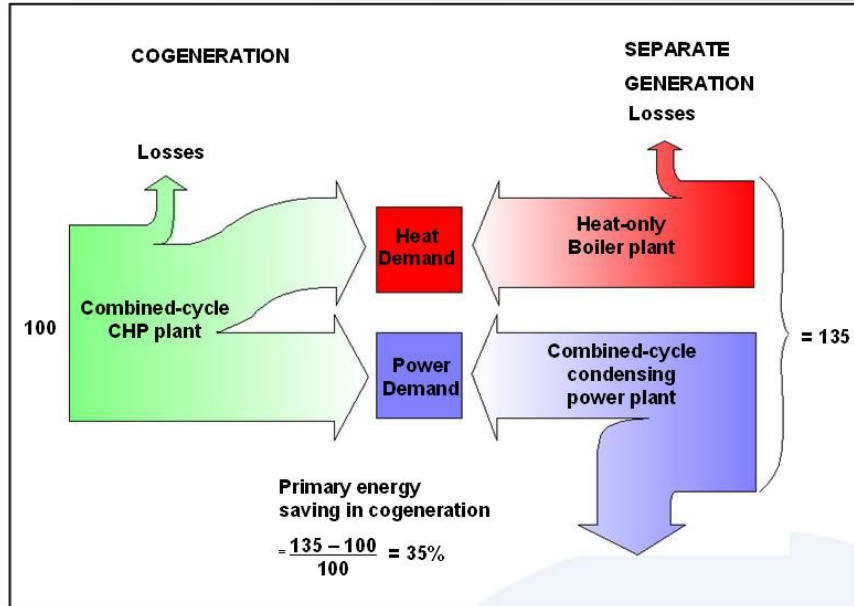
The purpose is to build a high-quality rapid bicycle connection between Skaftkärr, the city centre and vicinity services. One alternative is to cover bicycle lanes with solar panels. Rapid bicycle lanes are presently being planned for the entire city centre.

KATOS/ENERGIAPANEELIT

Aurinkokennolla katettu osuus



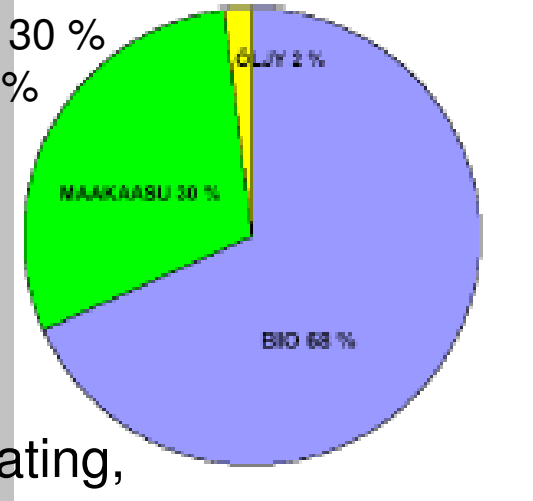
DISTRICT HEATING IS THE BEST PRODUCTION MODE FOR SKAFTKÄRR WITH REGARD TO ENVIRONMENT AND COSTS



Combined heat/power production saves fuel
 Thanks to the large portion of biofuels and the combined production of heating and power, no other solution can even in theory achieve lower CO₂ emissions that district heating.

In Porvoo, district heating also pays off in low-energy and passive-energy buildings.

Natural gas 30 %
 Biofuels 68 %
 Oil 2 %



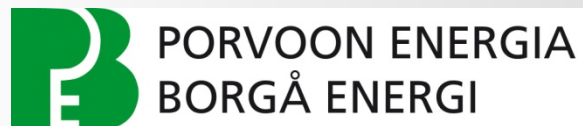
Fuels for district heating,
 Porvoo Energia Oy 2011

For local production of heat and power, wood-based fuel from vicinity forests is a very good solution regarding total costs and the environment. 92 % is combined production, and 70 % uses biomass (chip wood).

Aim: to increase renewable energy to 90 % by 2015

PORVOO INVESTS IN CLEAN ENERGY SOLUTIONS

- The City Council of Porvoo has granted Oy Porvoon Energia – Borgå Energi Ab a guarantee for a loan of 42.5 Million € to build a biopower plant in Tolkkinen.
- With the project, biofuels will stand for 90 % of all district heating produced in Porvoo in 2014.
- The City of Porvoo owns the municipal energy company Oy Porvoon Energia – Borgå Energi Ab.





SOLAR DISTRICT HEATING

- When implemented, it would be a project of significant magnitude on a European scale
- With this solution, the production of heating for Skaftkärr would become carbon neutral on an annual basis
- The existing district heating network would be extended to give residents in other parts of Porvoo access to solar district heating
- Presently under exploration

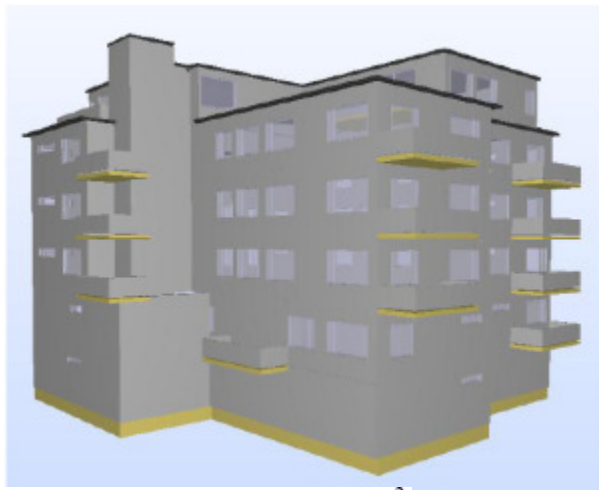
SKAFTKÄRR OUTLINE PLAN

TOUKOVUORI CITY PLAN

CARBON FOOTPRINT COMPARISON OF BUILDINGS TYPES AND STRUCTURES

The objective is to analyse the climate change impact of the production of building materials and compare it to the environmental impacts of energy consumed when the building is in use.

COMPARED HOUSE TYPES:



Kohteen bruttoala on 2 100 brm².

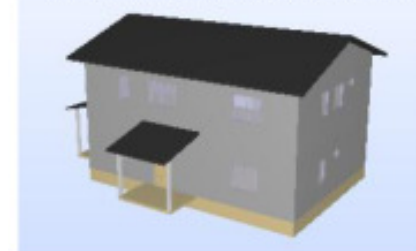
- yksikerroksinen, 4 huoneiston kohde, jonka bruttoala on 360 brm²



- kaksikerroksinen, 4 huoneiston kohde, jonka bruttoala on 474 brm²

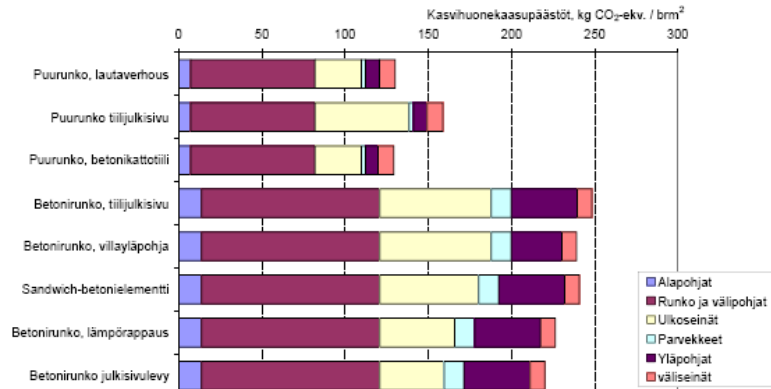


- Yksikerroksinen pientalo, jonka bruttoala on 175 brm²

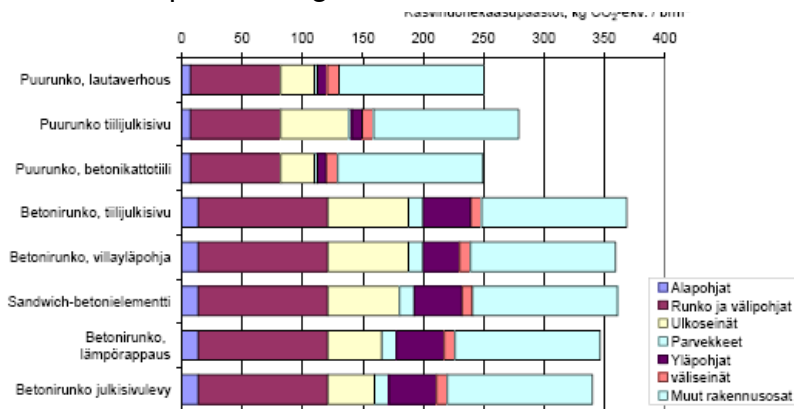


- Kaksikerroksinen kohde, jonka bruttoala on 200 brm²

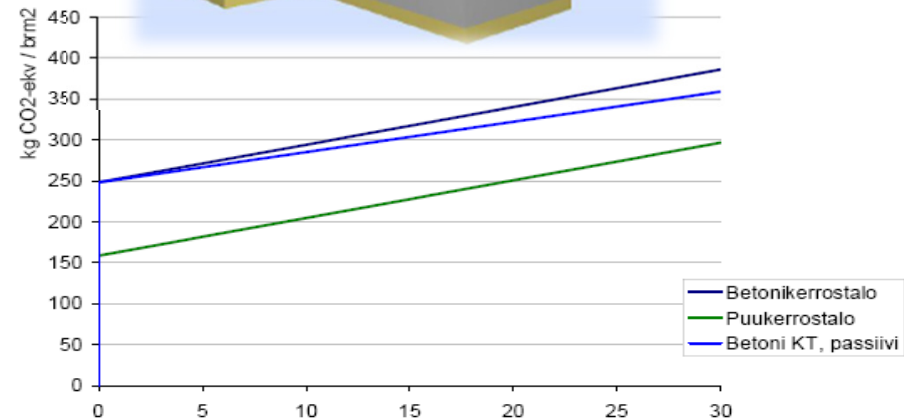
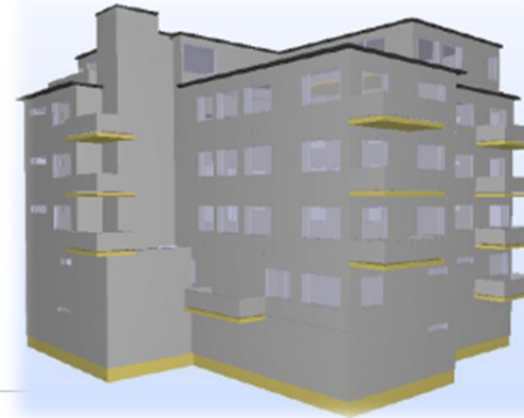
COMPARISON OF CARBON FOOTPRINT OF BUILDINGS



Multi-storey residential buildings: Main sources of carbon footprint during construction and use



Multi-storey residential buildings: carbon footprint caused by construction and 30 years of use



30-year perspective of carbon footprint in multi-storey residential houses built according to new 2012 norms and using district heating (Concrete frame / Wooden frame / Concrete frame, passive)



RAILWAY LINE
TÖUKOVIÖREN
ASEMA



SKAFTKÄRR

ENERGY EFFICIENCY IN CITY PLAN

- THE LOCATION AND EFFICIENCY OF BUILDINGS
 - Social rooms, workrooms
- TRAFFIC SOLUTIONS
 - High-speed bicycle lanes/ public transport
 - Connections from sites and standards for parkingplaces for cars and bicycles
- ENERGY SOLUTIONS
 - District heating
 - Solar heating possible, utilization of passive solar energy
- BUILDING
 - 2012 standards
 - Wooden building in lower building, i.a. detached houses
 - Recommendations for wooden buiding in blocks of flats
 - Reducing of energy consumption in housing



PORVOON KAUPUNKI BORGÅ STAD
TOUKOVUOREN ASEMAKAAVA JA
ASEMAKAAVAN MUUTOS
MAJBERGET DETALJPLAN OCH
DETALJPLANEÄNDRING

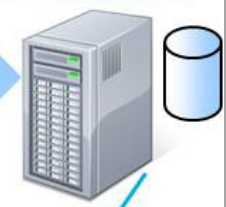
Näkymäkuva / Perspektiv

Asemakaavaehdotus / Förslag till detaljplan 20.9.20
PÖYRY FINLAND OY, ARKKITEHTIT AJTTILA & RUSANEN OY

SKAFTKÄRR



asem ⚡



ENERGY EFFICIENCY STARTS FROM PLANNING

- The Skaftkärr project has clearly demonstrated that significant emissions reductions can be achieved in Finland if the evaluation of energy and emissions impact is included in all town planning

TOWN PLANNING DOES IMPACT ENERGY EFFICIENCY

THE KEY FACTORS ARE:

Lower energy consumption and emissions caused by traffic

Energy solutions (energy production modes)

Buildings (energy efficiency and materials)



DEVELOPING THE SPATIAL PLANNING PROCESS

Infrastructure has direct and indirect impact on emissions

INFRASTRUCTURE

Looking at the emissions, municipal decision-makers are aware of the impacts their planning choices have on the climate.



ENERGY SUPPLY



BUILDINGS



TRAFFIC



Analyses of emissions and of ways of energy supply need to be integrated in the environmental impact analysis of spatial planning processes.

EMISSIONS FROM THE BUILT ENVIRONMENT

An action model and guidelines for emission monitoring is developed in the Skaftkärr project.

GOOD NEWS

Energy efficiency has a pricetag
Carbon footprints cost, too
Smaller footprints can reduce
residential costs

Spatial planning has its pricetag,
too, but it can reduce the costs
of implementation

SPATIAL PLANNING IS NOT ENOUGH

- **We need to focus the whole process from strategies, Zone planning, City planning, building guidance and permitting to housing and every day's living and clarify, what are the impacts in energy efficiency and emissions**
- Process is important, how to deal information is even more
- Spatial planning is co-operation or more: working together
- We have to change and renew our ways of working
- We have to be open-minded for new practices and at the same time:
- We have to offer different possibilities to act and choose, both for citizens and decision makers
- Living Lab for monitoring and dissemination

CONSISTENT ENERGY AND EMISSION CRITERIA FOR PLANNING AT ALL LEVELS

NATIONAL LAND USE GUIDLINES

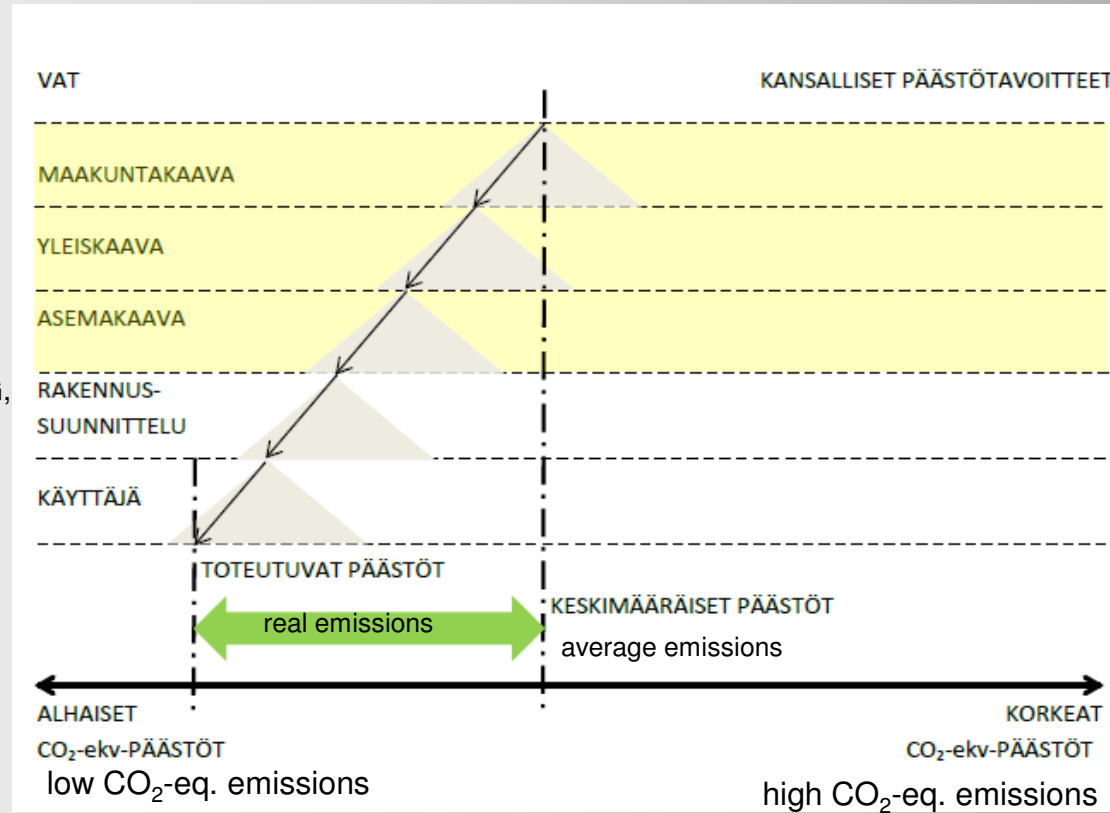
REGIONAL LAND USE PLAN

LOCAL MASTER PLAN

LOCAL DETAILED PLAN

CONSTRUCTION PLANNING,
PLANNING OF THE BUILDINGS

USER/RESIDENT



Source of picture: Kimmo Lylykangas, Pekka Lahti, Tuukka Vainio, Ilmastotavoitteita toteuttava asemakaavoitus, loppuraporttiluonnos 20.12.2012

The creation of a built environment is guided by a land use planning system. Building planning is guided by a local detailed plan. Choices made by the user of the built environment has a significant impact on emissions.

PORVOO, A CITY OF CARBON-FREE HOUSING

- Today, the City of Porvoo is about to take a giant leap to become the **number one** place of residence in Finland in terms of energy efficiency.
- Energy efficiency is one of the key priorities in the new city strategy.
- The Skaftkärr project has given the City of Porvoo an opportunity to become a city of carbon-free living.
- Inspired by the Skaftkärr project, the City of Porvoo has launched a versatile action plan that will systematically take Porvoo towards carbon-free housing. Such a substantial and genuine investment in energy efficiency is unique in the Finnish context.





Intelligent neighbourhood Energy Allocation & Supervision

EU FP7 funded R&D project

8 Partners from the EU & Israel

Just over 4 million euros

3 years

Nov 2012 – Oct 2015





IDEAS-project is currently working on

- IT tools and
- business models

that can be exploited in

- planning of energy positive residential areas
- energy production and
- energy consumption.

PILOT SITES



University Campus Bordeaux

Buildings area : 40 000 m²

Buildings : 11 buildings (1970s): Offices, workshops, computer rooms, laboratories, ...

Occupants : 2300 people : Students, teacher

Heating system : Heating network connected to a gas boiler

Electric consumption : 1 200 MWh/an

Heating consumption : 3500 MWh/an

Smart meters : not yet

Energy Production : None



Residential area Porvoo

Buildings area : 20 000 m²

Buildings : newly built residential (single-family) houses

Occupants : 500 users : Household with children

Heating system : District heating from CHP plant

Electric consumption : 900 MWh/an

Heating consumption : 2100 MWh/an

Smart meters : yes

Energy Production : Possibly solar collectors, PV panels

The IDEAS Concept The Concept



Demonstrate how energy positive neighbourhoods can be cost effectively & incrementally implemented by designing & validating



Neighbourhood energy management tool to optimise energy production & consumption



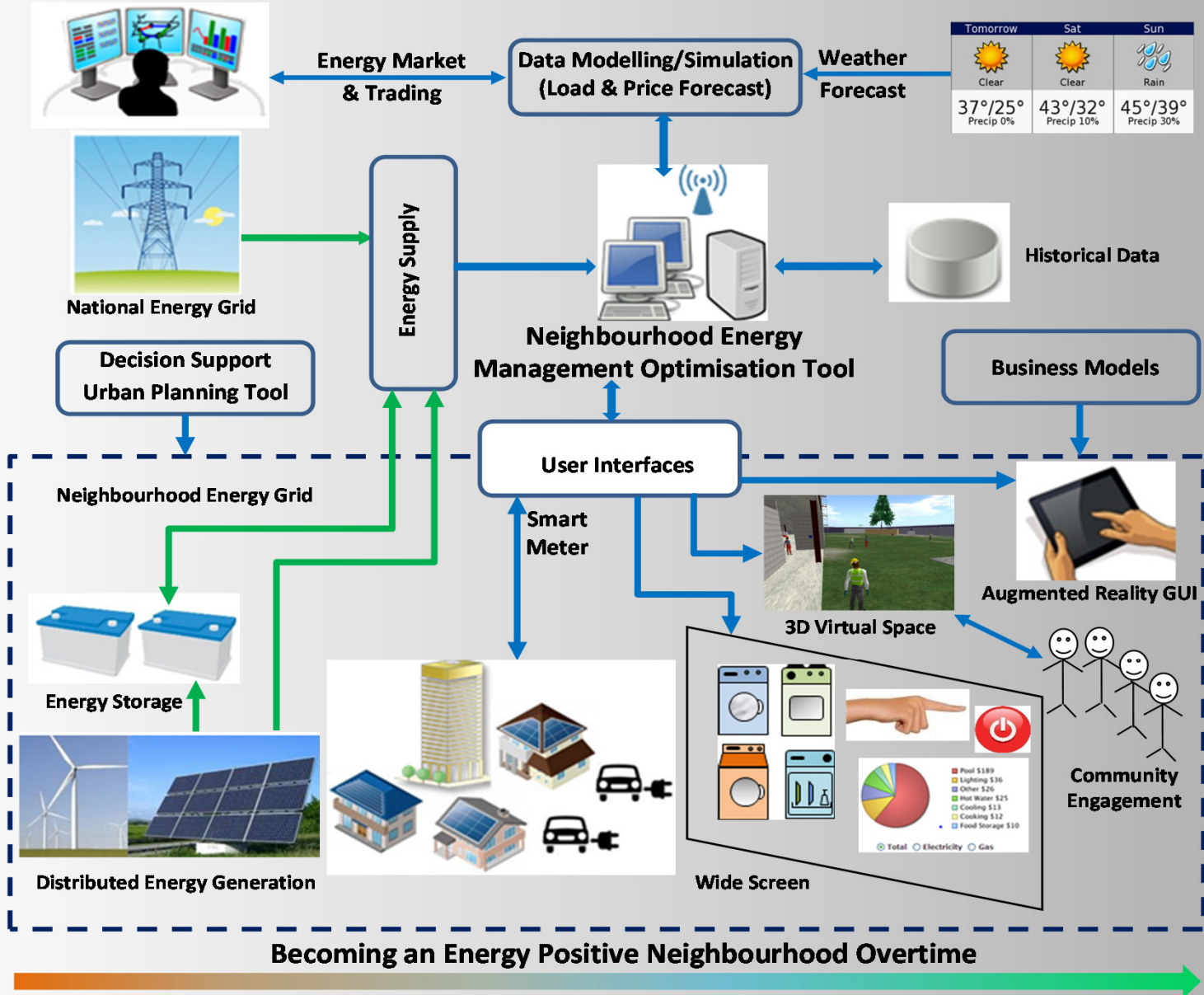
User interfaces that engage communities & individuals in the operation of energy positive neighbourhoods



Decision support urban planning tool to optimise the planning of neighbourhood energy infrastructures

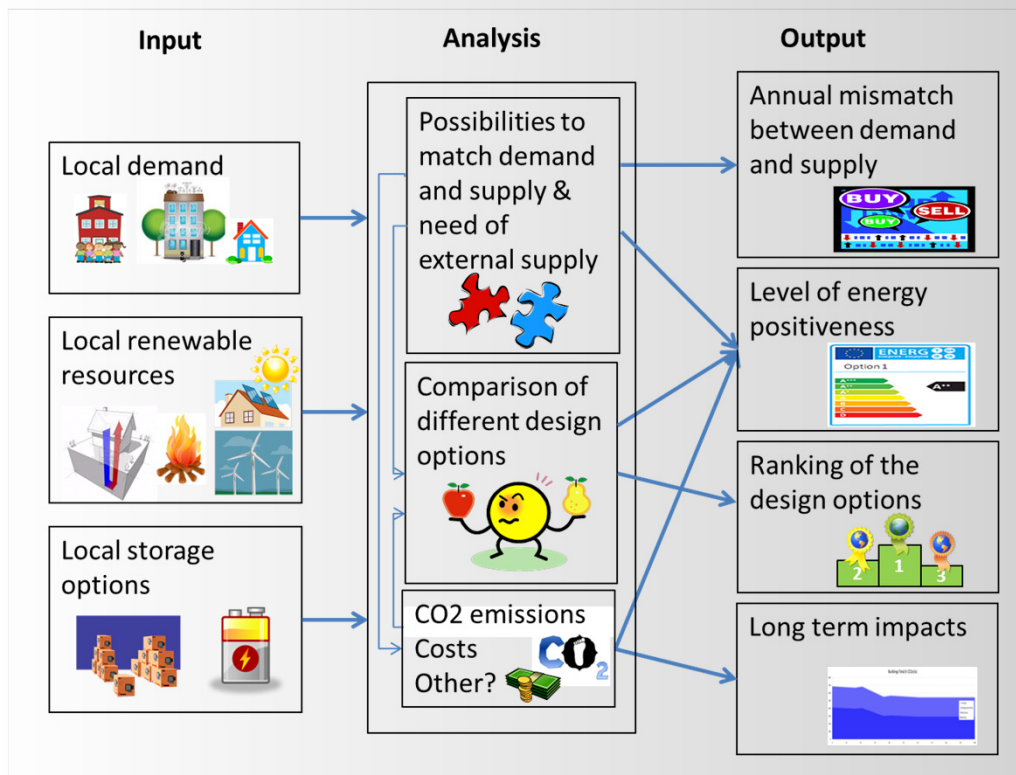


Business models to underpin energy positive neighbourhoods that engage end users public authorities & utility companies





A decision support urban planning tool to optimise the planning of neighbourhood energy infrastructures



Enable future development

- ✓ To optimize the use of local renewable energy resources
- ✓ Design local energy networks that match local capacity to generate energy with local energy demand

Thank you for your attention!

www.skaftkarr.fi

www.porvoo.fi

www.sitra.fi

www.porvoonenergia.fi

www.posintra.fi