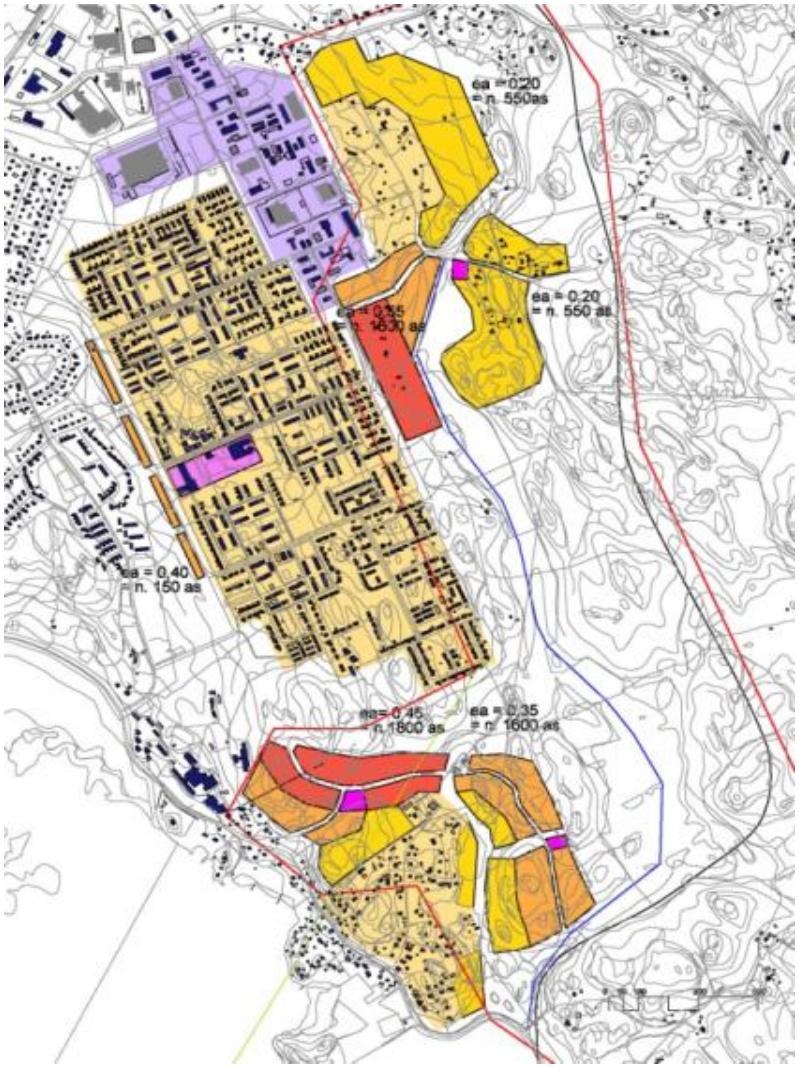
M3

Energy Demand Reduction Strategies: Urban Planning



INTELLIGENT ENERGY EUROPE

UP-RES
Urban Planners with Renewable Energy Skills

Content

1. Introduction

1.1. EE and RES Integrated City Planning

- Integration of EE and RES to urban planning will reduce primary energy consumption and green house gas emissions, but sometimes also costs of utility infrastructure construction and operation.
- The local municipality would benefit financially from the reduced utility investment and operation costs
- Reduced energy need and lower emissions together with eventually lower utility costs would improve the attractiveness of the municipality

How is this possible?

Let us demonstrate the benefits of the new EE and RES integrated urban planning approach through through two examples from Freiburg, Germany and Porvoo, Finland.

2. Case Freiburg

2.1. City Facts

Freiburg with some figures

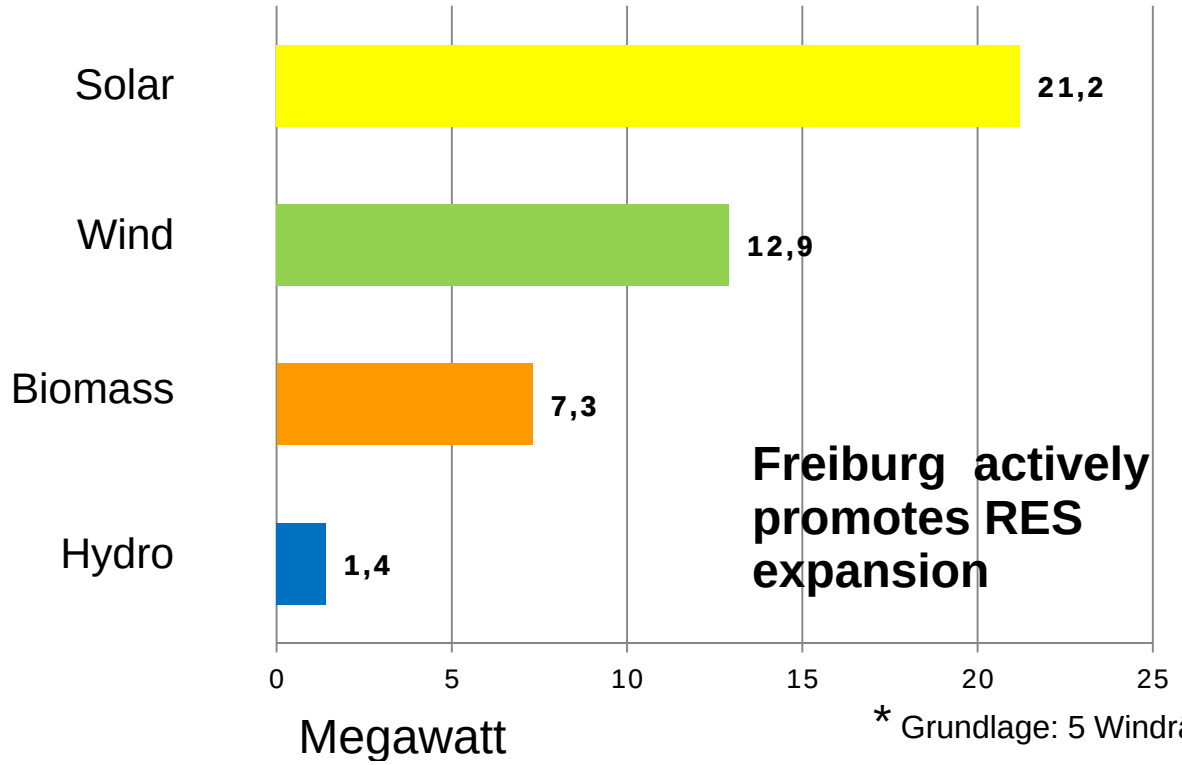
Freiburg is situated in South Germany near to French and Swiss borders

Source: Innovation Acedemy e.V., Freiburg

2. Case Freiburg

2.2. RES Integrated City Planning

Electricity from renewable energies (2011)



Freiburg actively promotes RES expansion

* Grundlage: 5 Windräder auf Freiburger Gemarkung

Source: Innovation Acedemy e.V., Freiburg

Source: Stadt Freiburg

2. Case Freiburg

2.3. CO2 Reduction Strategy

CO2 reduction strategy comprises 63 measures on the following fields:

1. Municipal development planning: solar optimization in development areas while arranging and orienting buildings, avoiding shadows, orienting/inclining roofs as well as introducing new EE standards to buildings
2. Municipal buildings and facilities: pilot EE projects and solar panels on public roofs, building modernization to meet passive house standards
3. Mobility: Extension of public transport network to cover all citizens with not more than 500 m walking distance
4. Internal organisation and communication: Exhibition on low energy building and refurbishment,
5. Supply – disposal: development of district heating and micro-scale CHP

In the following slides some examples of the ”1. Municipal Development Planning” and ”3. Mobility” are illustrated.

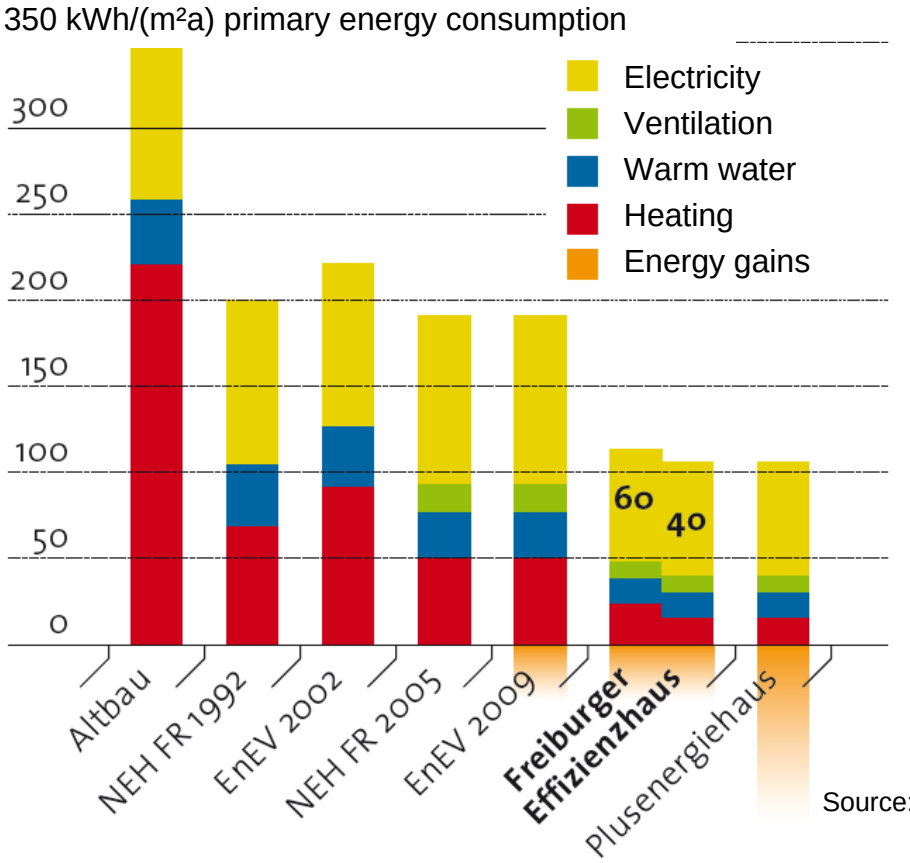
Source: Innovation Acedemy e.V., Freiburg

2. Case Freiburg

2.4. Municipal Development Planning

New energetic standards for new buildings to come were issued:

Fotos: Innovation Academy

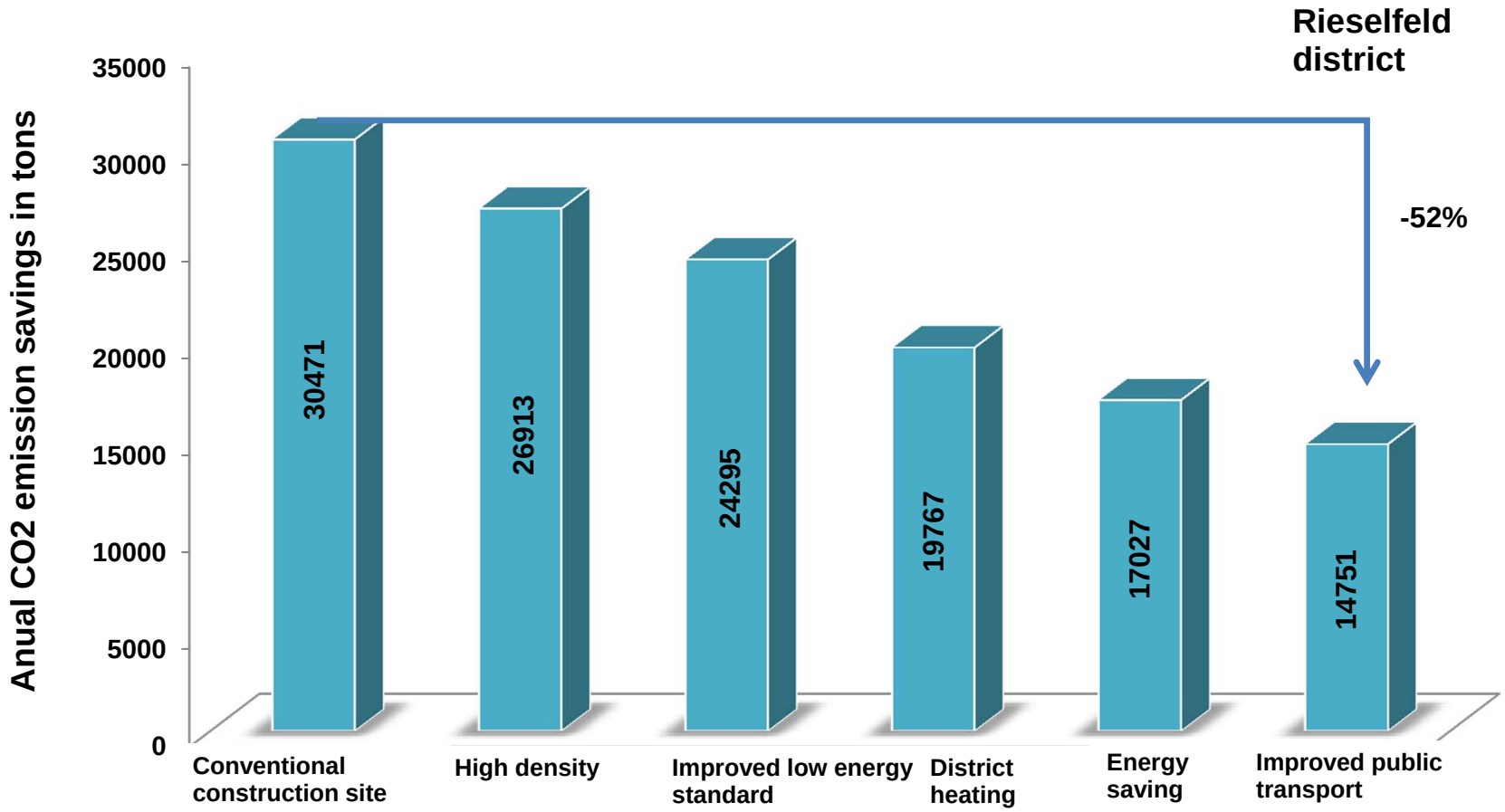


Source: Stadt Freiburg

2. Case Freiburg

2.4. Municipal Development Planning

Freiburg-Rieselfeld – CO_2 Emissions reduction



Source: Innovation Acedemy e.V., Freiburg

Source: Stadt Freiburg

2. Case Freiburg

2.5. Mobility

Public transport (VAG Freiburg) achievements:

- In 2010 some 74,4 million passengers travelled with the VAG's trams and buses. On average, that meant 200,000 passengers a day who saved the environment from exhaust emissions and traffic noise! This is an astounding number for a city with a population of 215,000.
- The backbone of the network is based on four tram lines providing services every seven and a half minutes. Optimally coordinated with the tram service are 26 bus lines taking passengers from the most important interchange points to surrounding areas

Source: Innovation Acedemy e.V., Freiburg

Source: VAG Freiburg 2011

2. Case Freiburg

2.5. Mobility

Local public transport in Freiburg

Bus

- 274,3 km bus network
- 73 buses
- 30% of all passengers

Tramway

- 36,4 km railroad network
- 83 vehicles
- 7,5 minutes interval during the day
- 70% of all passengers

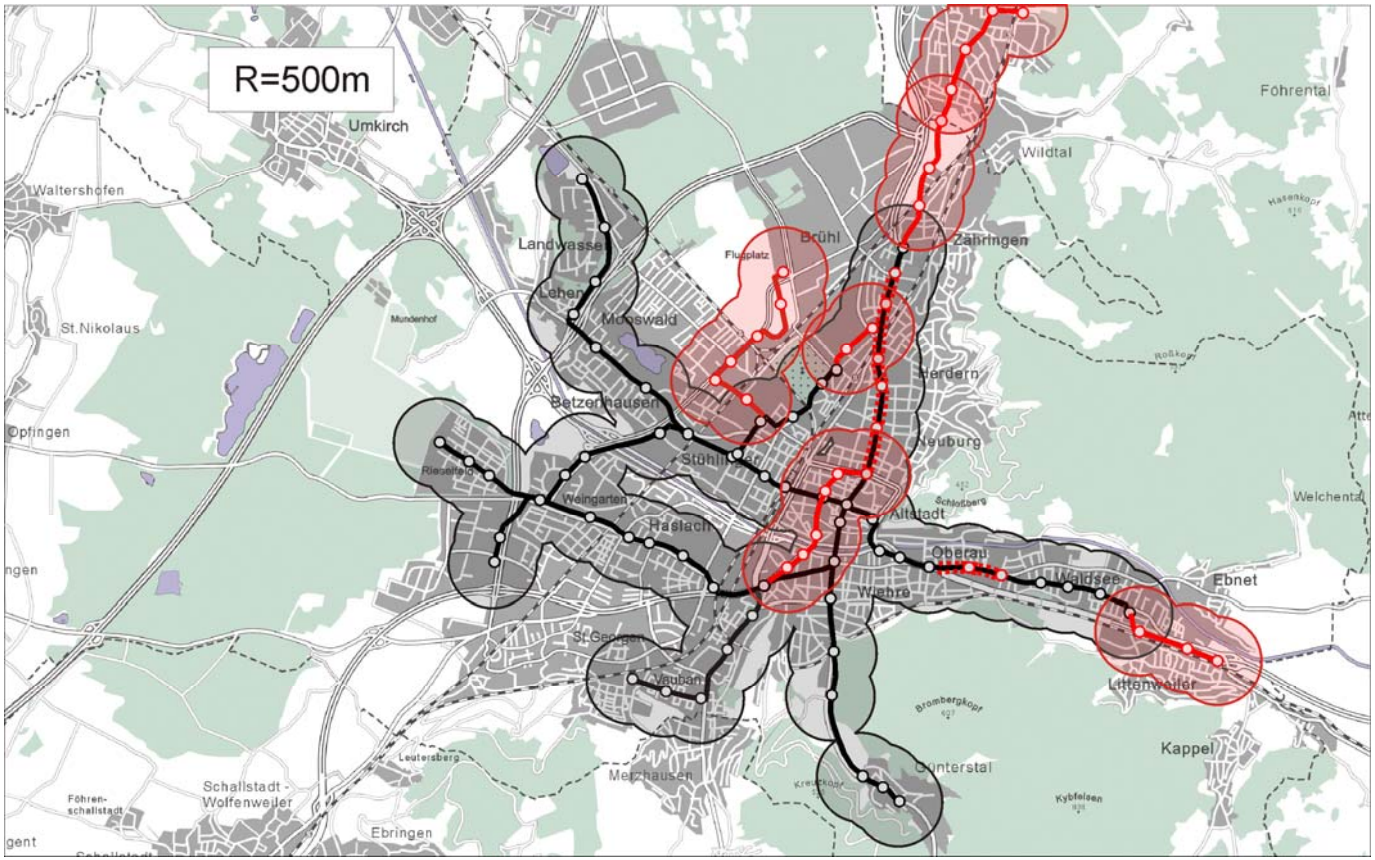
Source: Innovation Acedemy e.V., Freiburg

Source: VAG Freiburg 2011

2. Case Freiburg

2.5. Mobility

Extension of public transport network (red) to be reachable by the inhabitants in less than 500 m walking radius



Source: Stadt Freiburg

2. Case Freiburg

2.5. Mobility

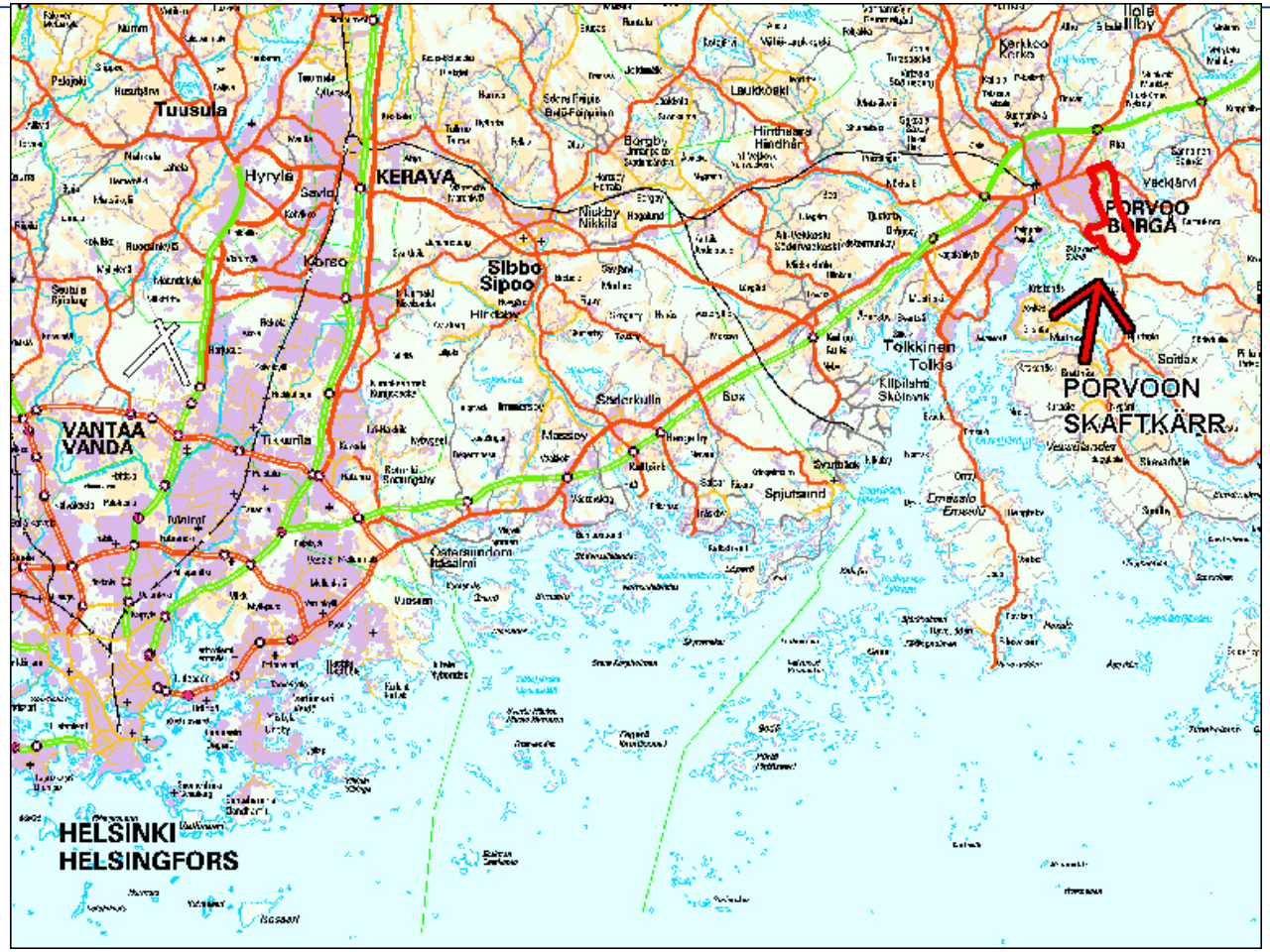
Other CO2 reduction strategy achievements in Mobility:

- In Rieselfeld, thanks to improved public transport, the car density is as low as 28,5 cars/inhabitant compared to the average of 35 in Freiburg.
- The bicycle parking house for some 1.000 bikes was built near to the main railway station in year 1999 already. It is in constant use to integrate rail transport to biking.
- Additionally, a city biking system and extensive biking routes reduce the need of private cars.

Source: Innovation Acedemy e.V., Freiburg

3. Case Porvoo - Integral Energy and Urban Planning

3.1. Location of Porvoo and the Planned Skaftkärr Expansion



Porvoo Skaftkärr Case in Finland

- Land area 400 ha
- Population target: > 6000
- Mainly small houses
- About 1000 lots
- Distance from the city center 2,5-5 km

Source: 11.2.2011, Mr. Eero Löytönen, City Architect of Porvoo, Finland at the UP-RES Training Course

3. Case Porvoo - Integral Energy and Urban Planning

3.2. EE and RES Integrated to City Planning

Objectives

1. A city area that can be used both as **national and international pilot** of energy efficiency integrated city planning;
2. **Instructions** to energy efficiency integrated city planning;
3. **"The Living Lab" area**, where the constantly improving energy efficiency will be targeted; and,
4. **Business models** to the local energy utility (Porvoo Energy) that respond to the challenges of the low-energy buildings to come.

Source: 11.2.2011, Mr. Eero Löytönen, City Architect of Porvoo, Finland at the UP-RES Training Course

3. Case Porvoo - Integral Energy and Urban Planning

3.3. Energy Supplier – Porvoo Energy Ltd

PORVOON ENERGIA
BORGÅ ENERGI

Heat production:

- 92% from CHP that is 70% based on bio fuel (wood chips)

Other fuels:

- 28% natural gas
- 1% landfil bio gas
- 1% oil

The plan is to add solar collectors to the heating mix.

Source: 11.2.2011, Mr. Eero Löytönen, City Architect of Porvoo, Finland at the UP-RES Training Course

3. Case Porvoo - Integral Energy and Urban Planning

3.4. Reference Case **0⁺** - Business as Usual

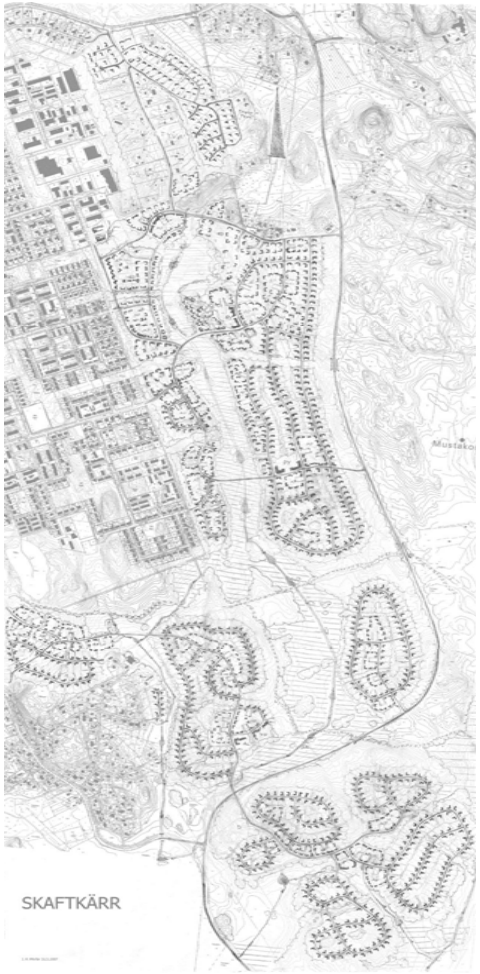
Reference Case:

OLD CITY PLAN FROM
YEAR 2007

BUT WITH PASSIVE-
ENERGY BUILDINGS

Energy in reference case:

A mix of DH, electric and heat pump heating as typical in Finland in loosely built one-family house districts



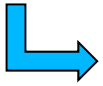
Source: 11.2.2011, Mr. Eero Löytönen, City Architect of Porvoo, Finland at the UP-RES Training Course

3. Case Porvoo - Integral Energy and Urban Planning

3.5. Reference Case **0⁺**: Energy Consumption and Carbon Balance of Porvoo City

Based on research carried out:

- Private cars: 30% of energy but 50% of emissions
- Heating: 27% of energy but 19% of emissions
- Domestic hot water: 12% of energy but 9% of emissions
- Electricity: 30% of energy but 21% of emissions



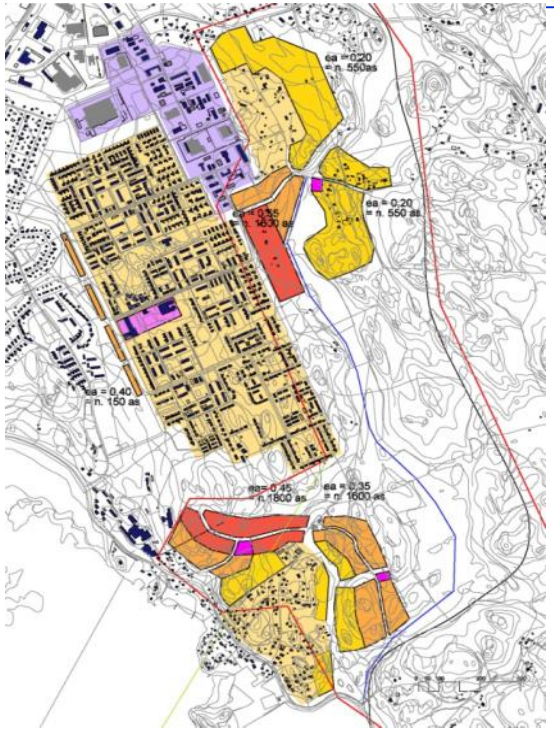
Focus on three components:

- private cars,
- heating
- electricity.

Source: 11.2.2011, Mr. Eero Löytönen, City Architect of Porvoo, Finland at the UP-RES Training Course

3. Case Porvoo - Integral Energy and Urban Planning

3.6. Planning Option **M1**



Features:

A dense new area that is supported by the existing city structure.

The passive energy buildings are connected to the DH.

Effective public and light transport routes are created to the city center.

Compared to Reference case:

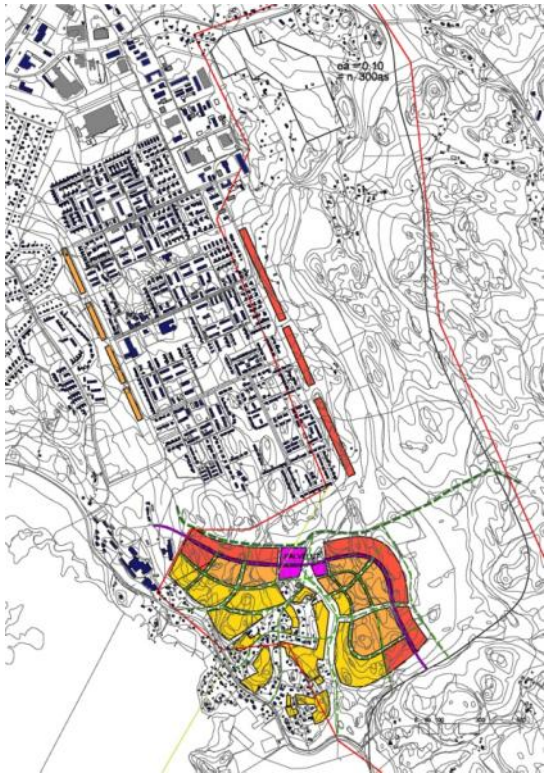
- Primary energy consumption 40% lower
- CO_2 emissions 34% lower

PÖYRY

Source: 11.2.2011, Mr. Eero Löytönen, City Architect of Porvoo, Finland at the UP-RES Training Course

3. Case Porvoo - Integral Energy and Urban Planning

3.7. Planning Option **M2**



Features:

Effective small-house characterized Option, where 50% of heat is based on DH and the balance of other 50% on ground water heat pumps.

Effective public and light transport routes are created to the city center.

Compared to Reference case:

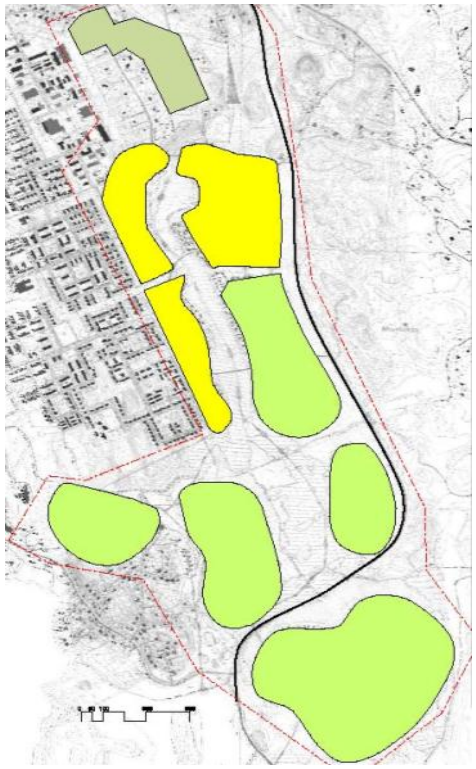
- Primary energy consumption 36% lower
- CO_2 emissions 31% lower

PÖYRY

Source: 11.2.2011, Mr. Eero Löytönen, City Architect of Porvoo, Finland at the UP-RES Training Course

3. Case Porvoo - Integral Energy and Urban Planning

3.8. Planning Option **M3**



Features:

A loose land use Option, where heat and power are produced inside the buildings 100% based on RES.

Passive energy houses.

Traffic like in Reference Case based on private cars and a little public transport.

Compared to Reference case:

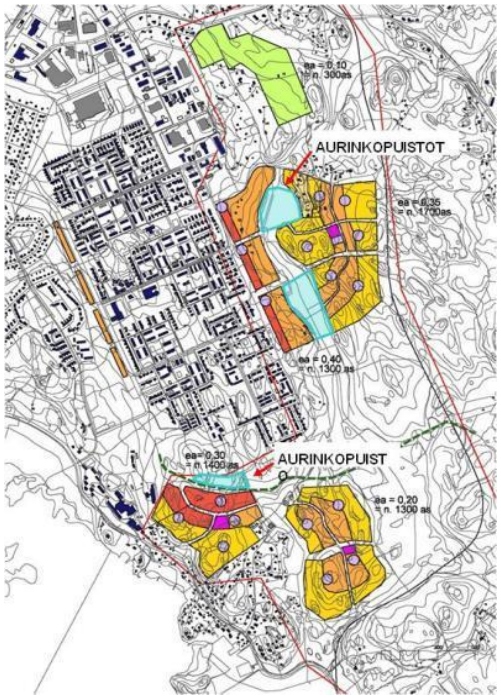
- Primary energy consumption 67% lower
- CO_2 emissions 48% lower

PÖYRY

Source: 11.2.2011, Mr. Eero Löytönen, City Architect of Porvoo, Finland at the UP-RES Training Course

3. Case Porvoo - Integral Energy and Urban Planning

3.9. Planning Option **M4**



Features:

Community type land use Option, in which the focus was on reducing the need of transport and by locating working places and services in the area.

Effective public and light transport routes are created to the city center.

Passive energy houses served 100% by solar heating. The area will supply solar heating to all citicens of Porvoo.

Compared to Reference case:

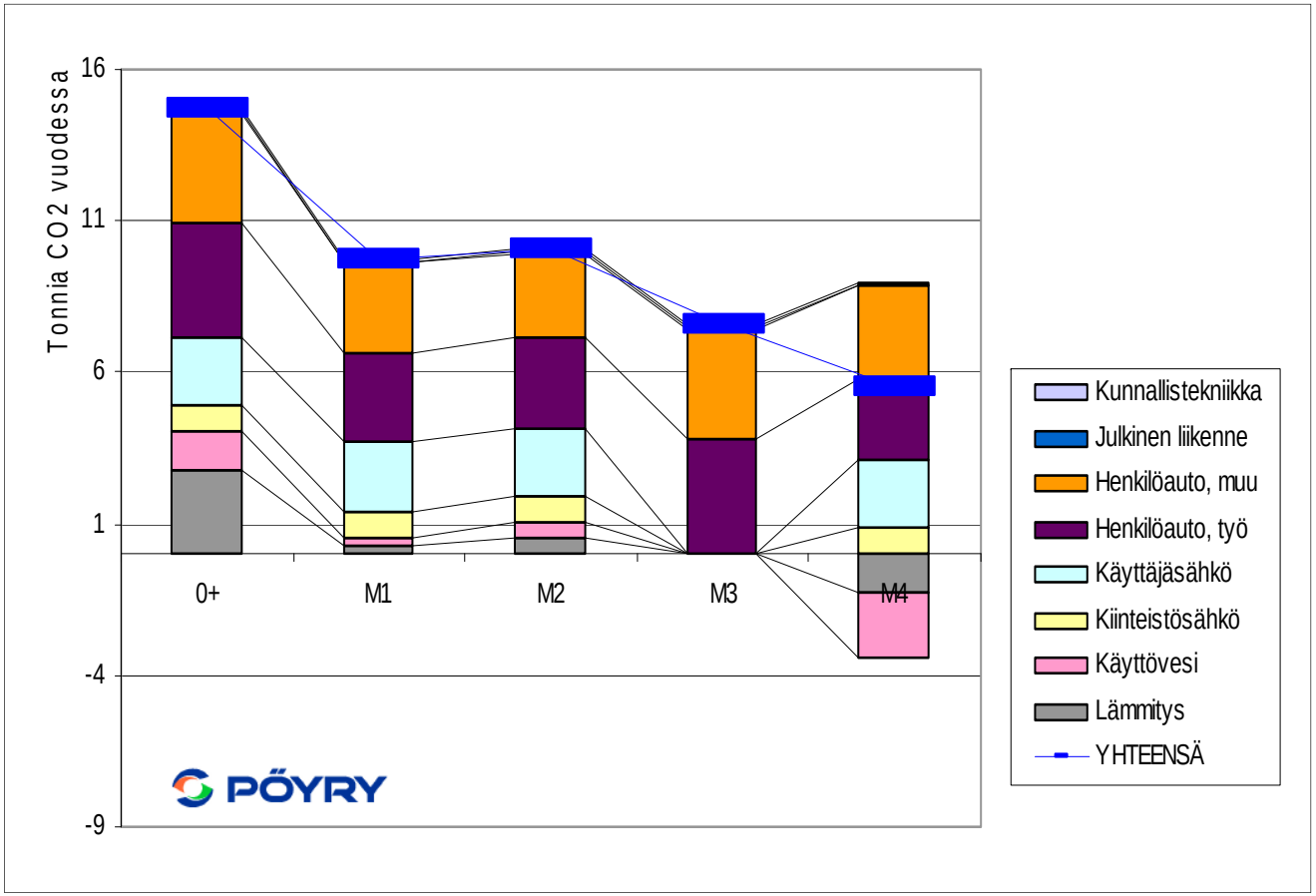
- Primary energy consumption 45% lower
- CO_2 emissions 62% lower

PÖYRY

Source: 11.2.2011, Mr. Eero Löytönen, City Architect of Porvoo, Finland at the UP-RES Training Course

3. Case Porvoo - Integral Energy and Urban Planning

3.10. Carbon Balance of the Options



All four Options cause lower emissions than the Reference case.

Infra tech

Public transport

Private cars, other

Private cars, work related

Electric applications

Electricity of common building parts

Tap water heating

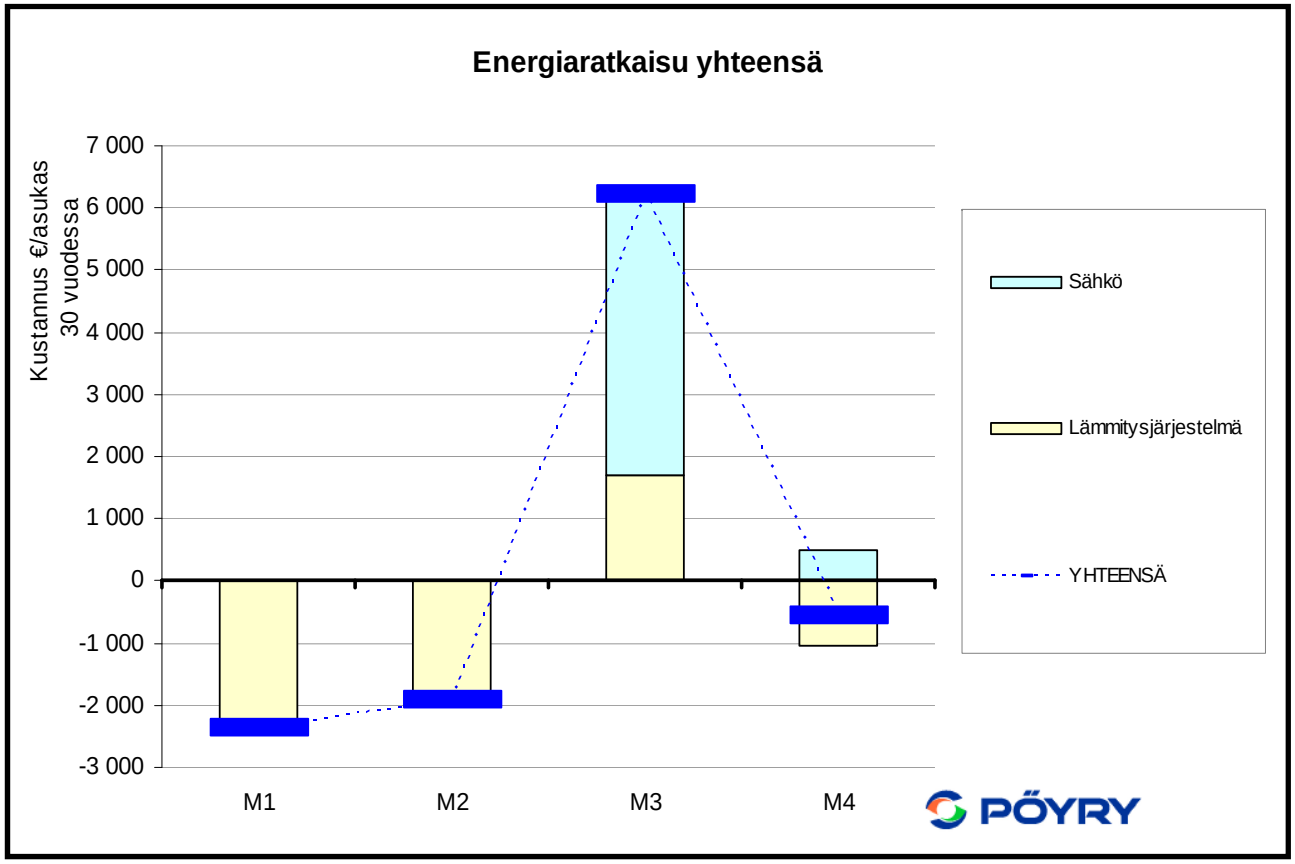
Room space heating

Total

Source: 11.2.2011, Mr. Eero Löytönen, City Architect of Porvoo, Finland at the UP-RES Training Course

3. Case Porvoo - Integral Energy and Urban Planning

3.11. The Costs of the Options in € per Resident during 30 years



Cost savings obtained in Options 1, 2 and 4 but substantial excess costs in Option 3.

Electricity

Heating

In total

In Table the additional costs compared to the 0^+ reference option are presented.

Source: 11.2.2011, Mr. Eero Löytönen, City Architect of Porvoo, Finland at the UP-RES Training Course

3. Case Porvoo - Integral Energy and Urban Planning

3.12. Conclusions

- Low Energy Efficiency has its price;
- Carbon Footprint costs as well;
- Down-sizing the Footprint may reduce the costs of living;
- EE integrated city planning costs more (consulting, meetings) but may reduce the costs of implementation (shorter utility pipelines, benefits of scale, etc.);
- The city plan options have to be communicated to the decision makers in quantitative terms: not only investment cost but energy consumption and emissions of each option matter much as well.

Source: 11.2.2011, Mr. Eero Löytönen, City Architect of Porvoo, Finland at the UP-RES Training Course

The UP-RES Consortium

Contact institutions for this module: **Aalto University**

- **Finland : Aalto University School of science and technology**
  www.aalto.fi/en/school/technology/
- **Spain : SaAS Sabaté associats Arquitectura i Sostenibilitat**
  www.saas.cat
- **United Kingdom: BRE Building Research Establishment Ltd.**
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  www.unideb.hu/portal/en