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Impacts of City Planning on Energy Consumption and GHG Emissions

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Seven partners of UP-RES

- **Finland:**
  - Aalto University (leader)
- **Germany:**
  - District Heating Association - AGFW
  - University of Augsburg
  - Munich University of Technology
- **UK:**
  - Building Research Establishment Ltd. - BRE
- **Spain:**
  - Association of Architecture and Sustainability in Catalonia
- **Hungary:**
  - University of Debrecen

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Pilot Training of Urban Planners

- "The urban planner" is not a uniform profession
- Five countries to pilot
- Different approaches - Common training module structure
- Different time schedules
- Compiling the summary of the training material (Spring 2012)
- Communicating the material and the approaches to other planning schools in Europe (2012)

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Common Challenges

- Micro size training budgets of municipalities
- Current financial crisis has cut the budgets even smaller if possible
- In general, the planners are busy – difficult to get them out of office for several days
- New type of training product – needed comprehensive and intensive marketing to commit trainees

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Common Successes

- Great interest every where in inclusion of EE and RES to urban planning
- Comprehensive understanding of the new task: EE and RES have to be taken in to account in urgan planning to fight the climate change
- Several other universities and planning schools have expressed their interest in using the training material and to learn on the different training approaches.
- Materialized success stories could be used as training material (best practices)

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Porvoo Skaftkärr Case

- 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

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Energy Efficiency Integrated City Planning in Porvoo

4 OBJECTIVES were adopted to Create:

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

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Porvoo Energy Ltd

PORVOON ENERGIA
BORGÅ ENERGI

Heat production:

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

Other fuels:

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

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

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0+ Business As Usual

Reference Case:

OLD CITY PLAN FROM YEAR 2007

BUT WITH PASSIVE-ENERGY BUILDINGS

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

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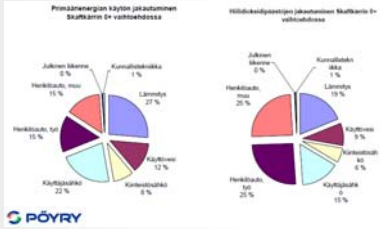
REFERENCE CASE: ENERGY CONSUMPTION AND CARBON BALANCE "0+"

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



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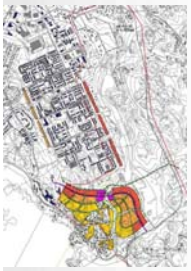
PLANNING OPTION 1

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.

PÖYRY	0+ Energia MWh/a	0+ Päästöt ton CO2/a	0+ CO2 jakauma	Malli Energia MWh/a	Malli Päästöt ton CO2/a	Malli CO2 jakauma	Muutokset Primäärienergia	Muutokset CO2 Päästöt	Muutokset CO2 kohtöä/a
Lämmitys, sähkö	25 538	2 554	17 %				- 100 %	- 100 %	
Lämmitys, muu	1 735	208	1 %	2 488	299	3 %	+ 43 %	+ 43 %	49
Käyttövesi, sähkö	12 063	1 206	8 %				- 100 %	- 100 %	
Käyttövesi, muu	805	97	1 %	2 177	261	3 %	+ 171 %	+ 171 %	43
Kiinteistösähkö	8 771	877	6 %	8 771	877	9 %			143
Käyttäjäsähkö	22 395	2 239	15 %	22 395	2 239	23 %			366
Kunnallistekniikka	872	89	1 %	872	89	1 %			15
Henkilöauto, työ	15 846	3 768	26 %	12 496	2 971	30 %	- 21 %	- 21 %	486
Henkilöauto, muu	15 224	3 620	25 %	12 496	2 971	30 %	- 18 %	- 18 %	486
Julkinen liikenne	306	48	0 %	441	69	1 %	+ 44 %	+ 44 %	11
YHTEENSÄ	103 554	14 706		62 137	9 777		- 40 %	- 34 %	1 599



PLANNING OPTION 2

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.

PÖYRY	0+ Energia MWh/a	0+ Päästöt ton CO2/a	0+ CO2 jakauma	Malli Energia MWh/a	Malli Päästöt ton CO2/a	Malli CO2 jakauma	Muutokset Primäärienergia	Muutokset CO2 Päästöt	Muutokset CO2 kohtöä/a
Lämmitys, sähkö	25 538	2 554	17 %	3 555	355	401 %	- 86 %	- 86 %	58
Lämmitys, muu	1 735	208	1 %	1 244	149	1 %	- 28 %	- 28 %	24
Käyttövesi, sähkö	12 063	1 206	8 %	4 032	403	455 %	- 67 %	- 67 %	66
Käyttövesi, muu	805	97	1 %	1 089	131	1 %	+ 35 %	+ 35 %	21
Kiinteistösähkö	8 771	877	6 %	8 771	877	9 %			143
Käyttäjäsähkö	22 395	2 239	15 %	22 395	2 239	22 %			366
Kunnallistekniikka	872	89	1 %	872	89	1 %			15
Henkilöauto, työ	15 846	3 768	26 %	12 460	2 963	29 %	- 21 %	- 21 %	484
Henkilöauto, muu	15 224	3 620	25 %	11 876	2 824	28 %	- 22 %	- 22 %	462
Julkinen liikenne	306	48	0 %	441	69	1 %	+ 44 %	+ 44 %	11
YHTEENSÄ	103 554	14 706		66 734	10 099		- 36 %	- 31 %	1 652

PLANNING OPTION 3

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.

PÖYRY	0+			Malli			Muutokset		
	Energia MWh/a	Päästöt ton CO2/a	CO2 jakauma	Energia MWh/a	Päästöt ton CO2/a	CO2 jakauma	Primäärienergia	CO2 Päästöt	CO2 kg/hlö/a
Lämmitys, sähkö	25 538	2 554	17 %				- 100 %	- 100 %	
Lämmitys, muu	1 735	208	1 %	622			- 64 %	- 100 %	
Käyttövesi, sähkö	12 063	1 206	8 %				- 100 %	- 100 %	
Käyttövesi, muu	805	97	1 %	1 089			+ 35 %	- 100 %	
Kiinteistösähkö	8 771	877	6 %	149	15	0 %	- 98 %	- 98 %	2
Käyttäjäsähkö	22 395	2 239	15 %	381	38	1 %	- 98 %	- 98 %	6
Kunnallistekniikka	872	89	1 %	872	89	1 %			15
Henkilöauto, työ	15 846	3 768	26 %	15 846	3 768	50 %			616
Henkilöauto, muu	15 224	3 620	25 %	15 224	3 620	48 %			592
Julkinen liikenne	306	48	0 %	306	48	1 %			8
YHTEENSÄ	103 554	14 706		34 488	7 577		- 67 %	- 48 %	1 239

PLANNING OPTION 4

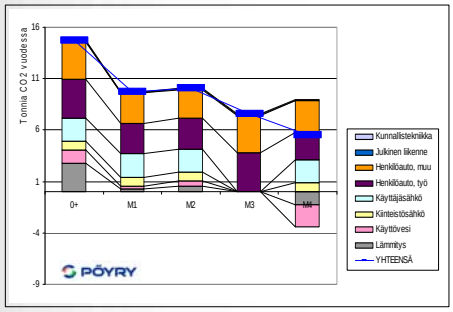
Community type land use Option, in which the focus was on reducing the need of transport and by locating working places and services in the area.

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.

PÖYRY	0+			Malli			Muutokset		
	Energia MWh/a	Päästöt ton CO2/a	CO2 jakauma	Energia MWh/a	Päästöt ton CO2/a	CO2 jakauma	Primäärienergia	CO2 Päästöt	CO2 kg/hlö/a
Lämmitys, sähkö	25 538	2 554	17 %				- 100 %	- 100 %	
Lämmitys, muu	1 735	208	1 %	622	-1 250		- 64 %	- 700 %	-204
Käyttövesi, sähkö	12 063	1 206	8 %				- 100 %	- 100 %	
Käyttövesi, muu	805	97	1 %	1 089	-2 188		+ 35 %	- 2367 %	-358
Kiinteistösähkö	8 771	877	6 %	8 771	877				143
Käyttäjäsähkö	22 395	2 239	15 %	22 395	2 239				366
Kunnallistekniikka	872	89	1 %	872	89				15
Henkilöauto, työ	15 846	3 768	26 %	10 757	2 689		- 29 %	- 29 %	440
Henkilöauto, muu	15 224	3 620	25 %	12 130	3 033		- 16 %	- 16 %	496
Julkinen liikenne	306	48	0 %	30	69		- 44 %	- 44 %	11
YHTEENSÄ	103 554	14 706		56 066	5 558		- 45 %	- 62 %	909

CARBON BALANCE



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

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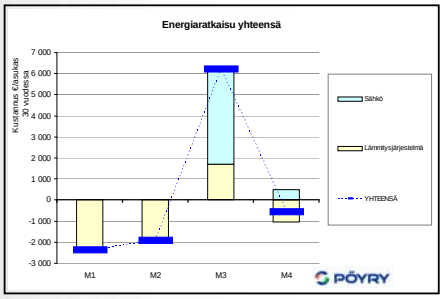
THE COSTS OF THE OPTIONS (€/Resident during 30 years)



Light blue – Electricity

Yellow – Heating

Dark blue – In total

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

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CONCLUSIONS

- **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 but may reduce the costs of implementation;**
- **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 as well.**

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

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