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SMART CITIES

RESEARCHES, PROJECTS AND GOOD PRACTICES FOR THE BUILDINGS

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Contents

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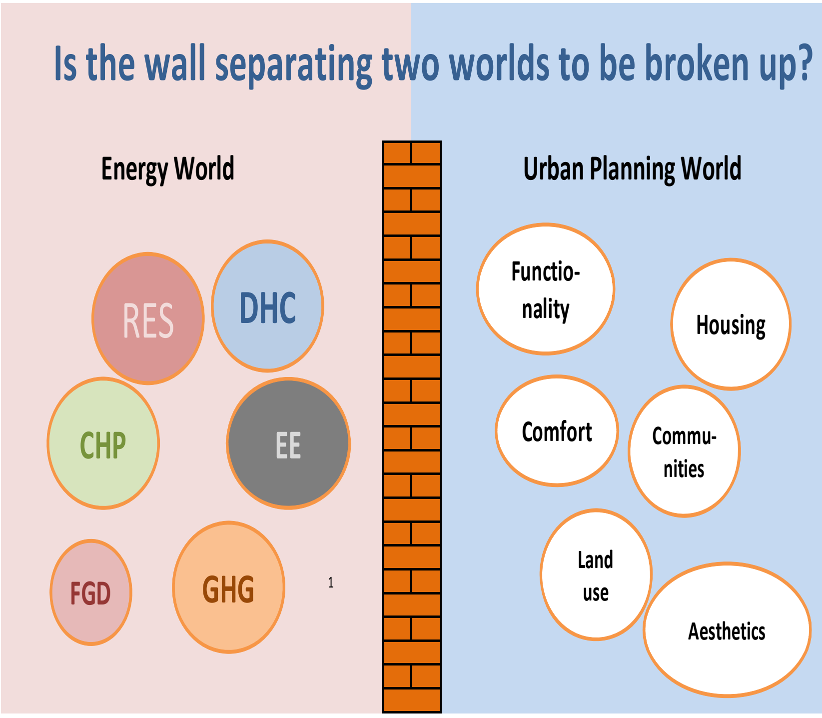

URBAN PLANNERS WITH RENEWABLE ENERGY SKILLS

TRAINING DESCRIPTION

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ABSTRACT

The paper at hand describes the need, methodologies and results of pilot training of urban planners in order them to become familiar with renewable energy systems (RES) and energy efficiency (EE).
There is little tradition in the world to integrate energy and emissions to urban planning even though energy mainly used in housing and transportation is the main reason to Climate Change, and the urban planner is the first actor to decide how renewable energy and energy efficiency can or cannot be applied in the community to be planned.
Therefore, pilot training of urban planners with energy skills has been carried out in five European countries to start filling the gap of the needed skills.
The objective is that similar training be extended to other countries and universities both to continuing professional as well as master level training of urban planners.
Thus, a training package of 3 000 slides and related explanatory texts have been made freely downloadable in 10 European languages.

KEYWORDS:
urban planning, renewable energy, energy planning

1 NEED OF CO-PLANNING OF ENERGY AND URBAN STRUCTURES

In very few planning schools in the world, the urban and regional planners are educated with understanding on energy, and on renewable energy sources (RES) and energy efficiency (EE) in particular. Based on the survey made in year 2009, only one such planning school was identified in North America (Canada) and three in Europe, namely in Germany (Stuttgart), Denmark (Arhus) and Finland (Oulu). Later on, a few other planning schools have adopted energy issues to their urban planning curricula.

AESOP – the Association of European Schools of Planning is the largest global association in the area of urban planning – not only European anymore. In the annual conferences of AESOP there are about 700 participants from both Europe and elsewhere. More than 1 000 papers have been submitted for review every year. In the last three annual conferences (2012 Ankara, 2011 Perth, 2010 Helsinki) there has been only a session or two with only some 20-40 participants to learn of how energy should be adopted as a new element to urban planning. The international urban planning audience has not yet recognized energy and emissions as a new element in urban planning, but traditional topics dominate discussion.

Therefore, there is rather no research available on combined energy and urban planning as the subject is new to the research community. Otherwise, any training is based on the results of the relative research. In this case, however, training had to start from the scratch as research material was not available.

Nevertheless, such combined skills of energy and urban planning have become vital while fighting the Climate Change: the urban planner is the first actor in the planning process, the plans of whom will either restrict or enable optimal RES and EE implementation later on.

The traditional way is that a municipality creates a general location plan in which the buildings can be easily built and connected to reads, and defines the physical dimensions of the buildings. The building code ensures the new buildings meet the EE norms. Thereafter, the energy and water utilities connect the buildings to their infrastructure in the best way still possible. In such away, however, it may be too late to optimize the RES and EE!

In the existing urban structures we have barriers to introduce RES and EE as well as district heating to integrate them to customers.

Therefore, training of urban planners with energy skills has been carried out as pilot training in five countries such as Germany, Hungary, Spain, U.K. and in Finland, the latter country to cover the coordination responsibility of the project with the acronym UP-RES (Urban Planners with Renewable Energy Skills). Because the training topic was new, it was challenging to attract participants to the pilot training courses. Normal marketing of training was not adequate as most urban planners considered the energy and emission issues too mathematical and complicated, and they were afraid of that the energy issues would set new constraints to the already challenging and comprehensive urban planning task. Without strong financial support from the EU amounting to 70% of the total project costs, the pilot training would not had materialized.

2 MANAGEMENT INNOVATON – CO-PLANNING OF CITY AND ENERGY INFRA

In the new way, the energy experts and the urban planners start working together in the general plan stage already. The impacts of various plans will be quantified in terms of energy consumption, investment and operation costs as well as emissions. The particular plan will be chosen for implementation which offers the lowest lifecycle costs and emissions. In city of Porvoo case in Finland, for instance, the new urban plan that was based on maximizing the share biomass fuelled CHP and DH appeared to be the best choice from environmental point of view, and moreover, with the overall life-cycle costs much lower than the traditional plan would have caused. In other words, the new combined energy and urban planning was a win win approach from both the reduced emission and the lowest cost point of view that was highly appreciated by the local decision makers.

In the Finnish city of Porvoo, a new management approach was adopted in planning of the new urban area, named Skaftkärr. In the very initial stage of planning both the urban and energy planners were invited to work together. As the reference for their co-planning, the Skaftkärr plan from year 2007 was adopted, but assuming that passive energy houses would be used apart to those assumed in the plan of 2007. The reference plan was a sub-urban plan traditionally dominated by small houses to be located so that personal cars would need to be used. As heating sources in the reference plan, a combination of district heating, electricity and heat pumps was assumed.

Co-planning started with a few studies about how people live, move and what are their expectations. Co-operation among the urban and energy planners was not that simple in the beginning, but some time was needed for them to learn each others' way of work and thinking. A year was mentioned as a period of time that was needed to harmonize their co-operation.

Finally, the co-planning methodology provided four options to the urban scheme to be applied in Skaftkärr. All four options had the primary energy consumption and the emissions 30-70% lower than the reference plan.

The four options generated by the co-planning were as follows:

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.

Compared to Reference case:

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

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.

Compared to Reference case:

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

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.

Compared to Reference case:

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

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 citizens of Porvoo.

Compared to Reference case:

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

The life-cycle costs of the four options (M1 - M4) in terms of Euro per inhabitant during 30 years to come are presented in the next picture. In three of four options the life cycle costs were lower than in Option 3. In the latter one, the investment costs of RE as well as the individual heat pumps using the electricity produced in the building itself became extremely high.

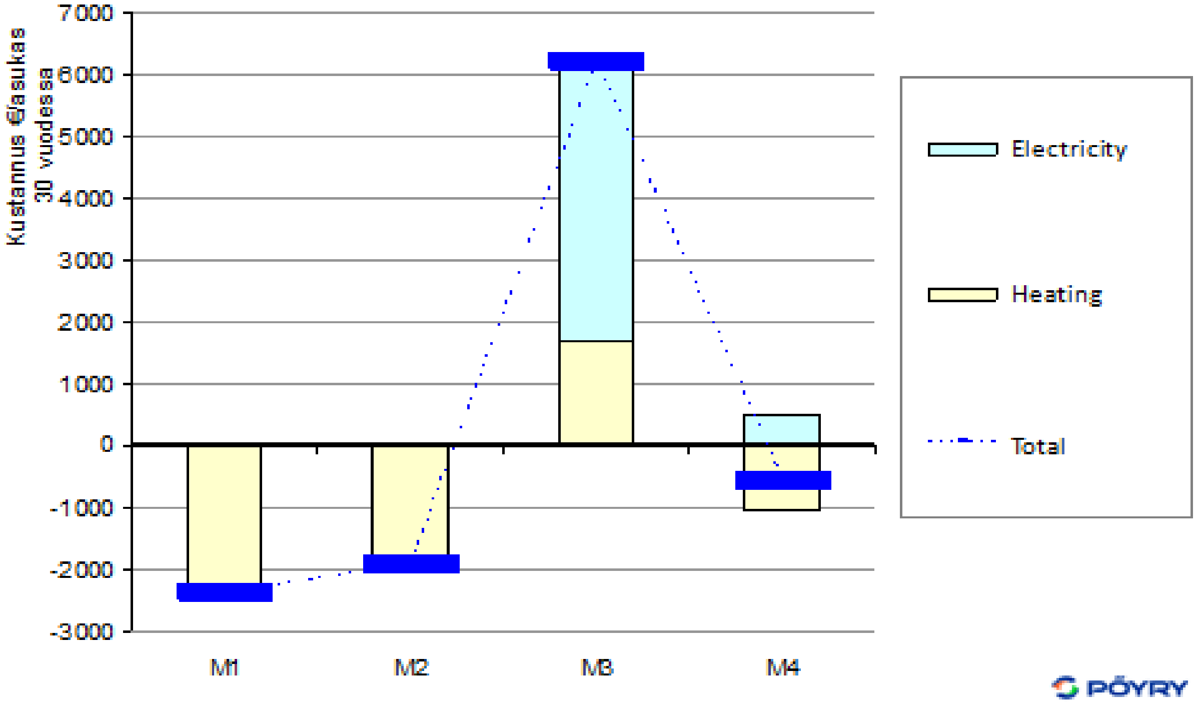

Fig. 1 - The life-cycle costs of the different options (M1 - M4) in terms of Euro per inh. during 30 years

The final option selected for implementation was based on prioritizing light and public transport (biking highway, for instance), using district heating in most buildings and enabling solar heating to be used later on. District heating as the primary source in Porvoo is a special case as 92% of the heat energy in Porvoo is from the co-generation of heat and power (CHP) plant, the fuel of which is 70% from biomass (wood chips).

The city management of Porvoo was happy with the results as well, as the infrastructure costs (streets, pipelines, etc.) were substantially reduced as well.

The new co-planning approach in Porvoo was supported and monitored by the Finnish Ministry of Environment and the Finnish Innovation Fund - Sitra. The co-planning approach is currently expanding to other cities in Finland, sooner or later maybe to other cities in Europe as well. Such expansion, however, will need training similar to that used in UP-RES pilot courses and adjusted to local conditions and country specific differences.

3 COUNTRY SPECIFIC DIFFERENCES

Designing and implementing the training depends on the local circumstances, and should therefore be adjusted to the local needs and conditions. The awareness and establishment level of various RES components in the five countries is different as illustrated in Table below:

RES	Initial	Scarce	Dense	Established
Solar	FI	UK	DE, HU	ES
Wind	FI	UK	ES, HU	DE
Biomass	ES, HU	DE, UK		FI
Waste heat	ES, HU, UK		FI, DE	
District heating	ES , UK	HU	DE	FI
District cooling	HU, UK	DE, ES	FI	
Level:	Awareness	Knowledge	Competence	Professional practice

Tab.1 - The awareness and establishment level of various RES components in the five considered countries

District heating and cooling, for instance, is a well-established practice in Finland, but neither in U.K. nor Spain. On the other hand, solar and wind power are largely used in Spain and Germany, but are still at a very initial stage in Finland.

For instance, different approaches were taken in the five countries, in which the pilot training was carried out, including the following:

– In Finland, there was the 9 month 'long' course taught to urban and regional planners. The course consisted of 8 modules each of two days duration from Fall 2011 to Spring 2012. The trained planners now work in the different parts of the country to adjust their plans to adopt new features that favor RE and EE. The training of 20 CETS took place in Aalto University.
– In Hungary, the long pilot course was organized as a normal university course to students. The course having had lasted 9 months as well as comprised even 60 ECTS credits was organized at University of Debrecen.
– In Germany, the long two-year lasting long has started to both urban and energy planners combined. The benefit of educating both professions to together is expected to create mutual understanding on the way of thinking, terms and objectives, way of working. All training takes place in Frankfurt.
– In Spain, the long course of 9 months duration both for students and officers of urban planning was organized in Barcelona.
– In the United Kingdom, there were no such long course, but 20 charettes of three days each were organized in different cities of the country. To each charette, the local stakeholders such as city planners, developers, politicians, energy experts were collected to learn the main features of Climate Change oriented urban planning. Based on the outcome, the attending stakeholders were asked to select a real planning case in their city to which RE and EE could be incorporated.

In the five countries above, the pilot training covered about 500 experts, which can be considered a decent start towards co-planning of energy and urban structures in the future.

4 LEARNING OBJECTIVES OF TRAINING

There is very little tradition of spatial planners and energy experts working together anywhere in the world. Their educational backgrounds (physical versus visual sciences) and their linguistic backgrounds are different, which creates a communication barrier between the two professions.

The training was focused on introducing the energy technologies, together with the opportunities and implications associated with them from the urban planning perspective.

5 TRAINEES

The trainees comprised urban and regional planners and developers working in city planning offices, regional councils, planning schools, construction and consulting companies. In Germany in particular, energy experts were also invited to participate the pilot training. Moreover, in U.K. all key stakeholders who would need to work closely with the planners in developing future energy systems were also invited – notably including environmental, sustainability and housing professionals.

In all five partner countries, the UP-RES materials and methodologies will be used for Master level education as well.

6 PILOT TRAINING APPROACH

The structure of the long pilot courses comprises ten modules, from M1 to M10. Each module typically consisted of two days of training.

The module titles and summarized motivations to urban /spatial planners are as follows:

M1	SUSTAINABILITY CONCEPTS IN REGIONAL AND URBAN PLANNING: A HOLISTIC VISION As introduction, the main reason to Climate Change is energy production based on fossil fuels. Housing and transportation cover more than half of all primary energy consumption, both sectors being under influence of regional and urban planners. Many countries in the world (mainly EU) have set targets to reduce primary energy consumption and greenhouse gas emissions. In practise, however, behaviour of people and scattered urban structures create barriers to expansion of EE and RES. Those barriers should be phased out, in which the urban planner has an important role. Measures and policies to phase out such barriers are discussed in the 9 modules to follow.
M2	ENERGY. FORMS - TRANSFORMATION - MARKET OUTLOOK Fossil fuels increasingly dominate the energy market, and new reserves are found constantly. How to convert various forms of energy to uniform concepts of primary energy and GHG emissions in order to compare “energy” to “energy”. How can be fossil fuel replaced by RES, and what would such replacement require from planning. A spreadsheet tool was used which gives the energies and emissions of various power and heat production plants and fuels.
M3	ENERGY DEMAND REDUCTION STRATEGIES: POTENTIAL IN URBAN PLANNING The module introduces two real examples, in which RES and EE have been successfully adopted, (i) one implemented in Germany (Freiburg), where solar and biomass have successfully penetrated to the local energy market as well as both public transport and bicycles have successfully conquered market share from private cars; (ii) and another one introducing a new integral urban and energy planning concept in Finland (Porvoo), which was described in Management Innovation Chapter in detail. In both cases new ways of city planning have taken place as having integrated RES and EE issues with the traditional urban planning process
M4	ENERGY DEMAND REDUCTION STRATEGIES: POTENTIAL IN NEW BUILDINGS AND REFURBISHMENT The Module presents the possible ways how RES and EE can be adopted in the building level. Integration of solar panels and collectors to structures based on appropriate facing of the building walls and roofs,, waste heat recovery allowing air conditioning and high energy efficiency in parallel, for instance, are examples of such measures. In the life cycle analysis, the relative importance of construction materials increases as expanding RES and EE reduce primary energy consumption and emissions. Energy labelling of buildings sets requirements to the planners and designers of buildings.

M5	ENERGY RESOURCES AND RENEWABLE ENERGY TECHNOLOGIES There are several forms of RES to be considered such as solar, wind, biomass, wastes, sea water, geothermal heat, hydro power, and new ones (wave energy) are invented as well. The planner needs to understand the feasibility of the RES options in the urban structures. Solar energy requires surfaces facing the sun in an optimal way, bio mass can be most economic and ecological in large scale, municipal and industrial waste can be integrated to local energy palette either as distributable heat or fuel to be used for power and/or heat generation, etc. Gasification instead of traditional combustion offers environmental and economic benefits to the community, but requires different technologies.
M6	ENERGY DISTRIBUTION: DISTRICT HEATING AND COOLING District heating (DH) and cooling (DC) are effective ways to enhance the economy of scale and integration of various RES options, mainly bio fuels and waste energies to be used in energy supply of the community. Co-generation of heat and power (CHP) as the most efficient way to use any fuel to produce electric energy will be introduced. Existing DH system is the precondition to CHP as much as waterfall to hydropower. Nevertheless, feasibility of DH, DC and CHP sets requirements to city planning in terms of location of energy sources, piping networks, consumer connections. Sufficient heat load density is vital to economy of DH and DC. Urban planner is the first actor to influence the heat and cooling load density of any community.
M7	THE RIGHT SCALE FOR EVERY ENERGY CONCEPT: HEAT AND COOL DENSITY (DEMAND SIDE), POTENTIAL ON SUPPLY SIDE The Module introduces various modes of energy, and their feasibility in terms of optimal scale. Some energy modes are transmittable to short (district heating and cooling) or long (electricity, fuels) distance, but some other not (steam). Some can be optimal in small and local scale (solar, hydro power) whereas others require large scale (biomass, municipal waste). Many energy modes are easy to be stored (fuels) but some others face challenges in long term storing (steam, hot water, electricity). The objective of the module is to let the planner understand the restrictions set and opportunities offered by various modes of energy.
M8	NEW MANAGEMENT CONCEPTS IN THE ENERGY MARKET There are different ways to extend RES and EE market in a community. Various management methods, such as energy service companies (ESCO) and agencies are introduced in the Module to give an idea to the planner how RES and EE expansion can be effectively organized.
M9	ENERGY PLANNING Both spatial and energy planning use maps, have interdisciplinary approaches, customer surveys and other common methodologies. In practice, however, real co-planning of urban and energy seldom takes place due to different educational backgrounds and planning objectives of the planners. The module offers tools and ideas for integrated energy and urban planning.
M10	NEW TRANSPORT MODELS AND URBAN AND INTERURBAN MOBILITY All transport creates emissions, some more than the others. Spatial planning influences the need of mobility and the feasibility of various means of transportation. In the Module some facts are given on sustainability of various transportation modes as well as examples of best practices to the planner to consider. Such examples emphasize public transport, car pooling and light transport (walking, bicycles) to private cars. Success stories are available from some cities to be shared with many others.

Tab.2 - The training modules

7 EXAMPLE OF TRAINING MODULE

Here is an example of the contents of a training module. It is a combination of delivered lectures, team-work, and a site visit.

M5	**ENERGY RESOURCES AND RENEWABLE ENERGY TECNOLOGIES**
Fasilitator: N.N.	**13.-14.2.2012**
Time	**1st Day: Familiarization with RES**
9.00-9.15	Introduction to Module Topics
9.15-10.30	Presentation of RES technologies and applications
10.30-10.45	*Break*
10.45-12.00	Based on the presentation, five groups of trainees search for information from Internet. One group specifically for solar electric, solar heat, wind, biomass and the fifth group for waste to energy.
12.00-12.45	*Break*
12.45-14.00	Five groups continue
14.00-14.15	*Break*
14.15-15.30	Presentation of the results of five group works
15.30-16.00	Conclusion
	2nd Day: Rural Energy Supply
9.00-10.30	Local economy: impacts of RES on rural economy and survival
10.30-10.45	*Break*
10.45-12.00	Off-grid village based on RES (Kempele, Finland)
12.00-12.45	*Break*
12.45-14.00	Agricultural waste to liquid fuel
14.00-14.15	*Break*
14.15-16.15	Excursion to a bio mass fuelled CHP plant

Tab.3-Structure and contents of a training module

8 TRAINING METHODS

In the pilot training several methodologies were applied, as follows:

- Facilitator to be chosen for each module to link the learned energy issues to urban planning. As the topic of integrated energy and urban planning is new, guidance and stimulation is needed to emphasize the key issues and links of energy to urban planning.
- Lectures based on slides and discussions. Discussions among the trainees and the trainer were found useful to stimulate the learning process.
- Excursions both locally and internationally to best practice locations. Excursions helped the trainees understand the lessons learned on a real practical level.

- Exercises carried out by the trainees in small groups and individually about issues combining RES and EE to spatial planning helped trainees quantify the energy issues, not only use qualitative expressions and terms in their plans.
- Simple spreadsheet tools developed for specific planning areas such as heat planning of a city or urban district, quantification of energy balance and emissions of various heat and power sources, economy of district heating depending on the heat load density, life-cycle cost analysis comparing fossil to biomass fuelled boilers in district heating.
- Distance learning reduced the need of travelling of trainees, thus a little contributing to cleaner environment
- Movies (Inconvenient Truth, District Cooling,..) as ready-made and well-designedaudio-visual means clearly expressed the key messages of Climate Change and applicable measures to fight the Change to the trainees.
- Expert panel (clinic) advisory services to support the trainees to carry out their exercises was found helpful to support the trainees to carry out their homework. In the middle of the homework, the trainees met with the top experts of either energy or urban planning to learn to which direction to carry out the homework.

9 TOOLS

Six simplified tools using common spreadsheets were developed for energy and urban planning in Germany and Finland, and used in the pilot training of the country of tool origin. The tools and their short descriptions are as follows:

- **Energy and emission balance of energy production:** the energy balance comprising inserted fuel, output heat and electric power as well as CO_2 and SO_2 emissions can be calculated for various types of energy sources such as heat only boiler, power only plant, CHP based on natural gas, coal, fuel oil and biomass.
- **Energy and GHG balance of a community:** The spreadsheet calculates the rough estimate of an energy and greenhouse gas (GHG) emission balance in a community. The word "balance" does not really apply at the moment, because only energy consumption is summed up. Energy supply is only modelled through emission factors, which assign a certain amount of emissions to an energy unit.
- **Economy of district heating**: the economy f district heating depends on the linear heat load density in terms of sold heat energy divided by the network length. As a rule of thumb, the densities equal and larger than 2 MWh/m clearly indicate that DH is the least cost heating option, whereas at the densities below 1 DH would not succeed under commercial terms but individual solutions should be considered instead. If DH is regulated, as in Denmark for instance, even low density values may allow DH survive on the market. On the economic basis, the density values between 1 and 2 MWh/m require a life-cycle analysis of the available heating options to be carried out before the heating selection can be made.
- **Economy of heat pumps in a CHP system:** Economy of individual heat pumps may be questionable in a CHP system as the heat pump substitutes the heat load of the CHP plant. as the heat load of CHP declines, so does the efficient power generation of CHP. Conclusively, power alone production is needed to compensate the not generated power of CHP and the power need of heat pumps, thus leading to increased primary energy consumption and GHG emissions.
- **Life-cycle costs of fossil and biomass fuel boiler in DH**: The spreadsheet tool can be used to compare the economy of fossil fuel boiler to biomass boiler depending on the investment costs, fuel and other operation and maintenance costs.
- **Heat demand of residential buildings**: The tool provides an estimate to a building's transmission heat loss, based on predefined surface parts. Solar radiation, physical properties of the building envelope and the size and location (city) are taken into account. As example the climate conditions of the cities Barcelona,

Budapest, Glasgow, Hamburg, Helsinki, London, Munich, Oulu and Sevilla are available in the tool, and new ones can be inserted as necessary. The tool calculates the heat demand of various buildings.

10 TRAINING MATERIAL IN 10 LANGUAGES

The training material had to be compiled from existing practices, as no research material combining energy to urban planning was available.

The major deliverable of the pilot training is the compilation of the selected material to a training package.

The package can be used in other planning schools in Europe as it has been translated to 10 languages. The package comprises the material of ten modules, each in about 300 slides and explanatory texts. In addition to Italian, the package is freely downloadable in English, Finnish, French, German, Hungarian, Polish, Romanian, Spanish and Swedish.

The pilot training was a part of Intelligent Energy Europe (IEE/EACI) research program that promotes RES access on the energy market. The other partners of UP-RES were the universities of Augsburg and Debrecen, University of Technology in Munich, The District Heating Association in Germany (AGFW), BRE Ltd (Watford) U.K.), and SAaS (Barcelona).

11 CHALLENGES

The pioneering UP-RES training was first of its kind implemented on the European level. In a few planning schools such combined urban and energy planning has been adopted already, but it still a rare practice in Europe. UP-RES training implementation faced five major challenges, as follows:

- Traditionally at any education branch, there is first research and thereafter outcome of the research, which creates the basis for training. In UP-RES, however, as there was practically no research tradition combining urban planning with energy and emission issues anywhere, the controversial approach had to be adopted: Teaching had to be started from scratch as no research results on integrating urban planning with energy and emissions was available.
- Energy and emissions as engineering, mathematics and physics based science did not fit with the urban planners background being mainly architectural. Some fear was identified among the urban planner towards quantitative analysis of energy and emissions, even though the quantitative analysis of energy and emissions related to the individual plans should be crucial for evaluation of various planning schemes .
- Urban planning is already a multidisciplinary, comprehensive and a challenging activity. No new expansions such as economy, energy, emissions, for instance, are welcomed to come in anymore.
- The actual financial crisis in Europe has reduced training budgets of public institutions, such as municipalities, regional councils and planning schools. The reduced budgets made the pioneering UP-RES training more challenging to implement as less funding for even the traditional training was available. In Finland, for instance, even though not being on the worst side of the crisis, more than 100 phone calls were made to city planning offices, regional councils and consultants in order to have 25 trainees on the long training course, still five less than the targeted 30 trainees. Traditional invitations based on emails and public advertisement were rather ineffective.
- In all partner countries, lack of co-operation between the urban and energy planners was identified. Typically, those two planner professions work in different organizations. Traditionally and typically, the co-operation between the two organizations has been based on commenting the plans of the others in writing, having common meetings rather rarely, asking and providing comments sometimes without response from the other, neglecting requests or comments because of misunderstanding the idea, etc.

In general, the main challenge was to attract trainees to the courses because of the challenges mentioned above. Finally, after completion of the pilot training courses in five countries, the trainees (and other stakeholders) expressed their satisfaction in an independent evaluation survey. The satisfaction level ranged from 5 to 6 as medians out of the maximum of 7 in the sample of 53 replies.

	Finland	Germany	Hungary	Spain	United Kingdom		mean	median	deviation
The UP-RES project has communicated effectively on its goals and objectives.	5,4	4,3	6,5	5,4	6,9		**5,7**	5	1,0
The UP-RES project has communicated effectively on its activities (such as courses).	5,4	3,2	6,2	5,9	6,8		**5,5**	6	1,4
The UP-RES project has improved the awareness of the role of renewable energy sources in urban planning in my country.	5,1	4,7	6,5	5,6	5,7		**5,5**	6	0,7
The UP-RES project has increased the interest on renewable energy sources in urban planning in my country.	4,9	3,1	5,8	5,3	5,0		**4,8**	5	1,0
The UP-RES project has fulfilled its promises with its actions.	5,5	4,2	6,2	4,8	6,1		**5,4**	6	0,9
The UP-RES project has increased the practical skills of urban planners.	5,5	4,4	6,3	6,3	6,8		**5,9**	6	0,9
The UP-RES project has motivated the participants to deepen their professional development.	6,2	4,7	6,6	5,9	6,9		**6,1**	6	0,9
The UP-RES project has created a community of interested urban planners in the field renewable energy sources.	4,5	3,8	4,4	5,1	4,9		**4,5**	5	0,5
The UP-RES project has created a sustainable training concept for urban planners.	5,1	4,2	5,6	5,8	5,5		**5,2**	6	0,6
The UP-RES project has improved the communication and co-operation between the different key actors in professional development according to renewable energy sources in urban planning in my country.	4,6	4,5	5,6	4,8	4,6		**4,8**	5	0,4

Tab.4- Human Capital Investments as UP-RES project evaluator.

12 CONCLUSION

During the past decades, Urban Planning has been complemented with social and environmental assessments. Now RES and EE shall be included as a means to reduce primary energy consumption and extend RES to fight Climate Change. It is the time now to include quantitative analysis energy and emission impacts on the urban planning.

Finland, for instance, has been famous for its nature related architecture and highly efficient energy systems. However, combined urban and energy planning was a virgin area until UP-RES and Porvoo cases were implemented. Situation is likely even worse in most European countries.

Both above together indicate a huge **training demand** in order to make urban and energy planners, not only to co-operate, but to co-work together in the near future.

In addition to training, **planning guidelines** in all levels should take into account RES implementation and EE. This would change and direct planning practices, enable impact assessment and also reinforce co-operation and co-planning.

REFERENCES

As there is practically no research material available so far on integrated energy and urban planning, the below listed links provide support in search of moredetailedinformation.

The training material package: http://aaltopro2.aalto.fi/projects/up-res

The Skaftkärr case in the city of Porvoo, Finland: http://www.skaftkarr.fi/en

AESOP - Association of European Schools of Planning: http://www.aesop-planning.eu
Advanced city planning in Germany: http://www.freiburg.de/pb/,Lde/232045.html

IMAGES SOURCES

Cover Image, Tables 1,2,3,4: elaborated by the Authors.

Fig. 1: http://www.skaftkarr.fi/en

AUTHORS' PROFILE

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