

Urban Planners with Renewable Energy Skills

Training Material



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General

The training material at hand has been made available in 10 European languages to help the European planning schools to adopt modules, materials, approaches and also ideas to their curricula as a means to educate urban planners to understand the basics of renewable energy systems (RES) and energy efficiency (EE). The material is based on the experiences and the lessons learned from the pilot training carried out in the five countries.

Reduction of both energy consumption and greenhouse gas emissions has become vital in the world. The selection process initiated by the spatial planner influences the long-term selection of energy systems in the locality, for the next 50 or even 100 years ahead. They are therefore in a key position to help or hinder the eventual uptake of RES alternatives. The purpose of the UP-RES materials is to provide them with the tools and information to help them to successfully liaise with energy experts in order that the opportunity for optimal energy solutions is envisioned at the outset.

Learning Objectives of Training

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

Focus

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

Trainees

The trainees comprise urban and regional planners and developers working in city planning offices, regional councils, planning schools, in construction companies 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.

Pilot Training Approach

The training structure comprises ten modules, from M1 to M10. Each module typically comprises two days of training.





The module titles are as follows:

M1	SUSTAINABILITY CONCEPTS IN REGIONAL AND URBAN PLANNING: A HOLISTIC VISION
M2	ENERGY. FORMS - TRANSFORMATION - MARKET OUTLOOK
M3	ENERGY DEMAND REDUCTION STRATEGIES: POTENTIAL IN URBAN PLANNING
M4	ENERGY DEMAND REDUCTION STRATEGIES: POTENTIAL IN NEW BUILDINGS AND REFURBISHMENT
M5	ENERGY RESOURCES AND RENEWABLE ENERGY TECHNOLOGIES
M6	ENERGY DISTRIBUTION: DISTRICT HEATING AND COOLING
M7	THE RIGHT SCALE FOR EVERY ENERGY CONCEPT: HEAT AND COOL DENSITY (DEMAND SIDE), POTENTIAL ON SUPPLY SIDE
M8	NEW MANAGEMENT CONCEPTS IN THE ENERGY MARKET
M9	ENERGY PLANNING
M10	NEW TRANSPORT MODELS AND URBAN AND INTERURBAN MOBILITY

The above listed Modules will be described in the attached documents, including the objectives, the contents and sources of relevant further information.

Country Specific Differences

Designing and implementing the training may depend strongly on 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:	Awardness	Knowledge	Competence	Professional practice

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

Finland:

- One-day 'short' courses were delivered in 7 cities in Spring 2011.
- Subsequently a 9 month 'long' course of 8 modules each of two days duration was taught to 26 urban and regional planners from Fall 2011-Spring 2012.
- A voluntary excursion of three days to Germany was arranged.

Hungary:

- 4 short courses delivered by fall 2011
- The long pilot course started during Oct. 2011 and July 2012 at the University of Debrecen and comprised as much as 60 ECTS credits

Germany:

- 6 short courses delivered by fall 2011
- Long training course with about 15 trainees started in June 2012

Spain:

- 4 information sessions and one technical workshop delivered in Spain
- The long course started was implemented during Oct 2011 and June 2012. The long term course was structured in ten modules with an extension between 12 and 18 hours each.

United Kingdom:

- 13 short courses delivered in UK some 2-3 days each
- No long course according to the project scope

Structure of Training Material

The material at hand consists of the training materials presented as ten modules, for each of which a general description of module objectives, approaches and contents has been presented in the pages to follow. As annexes slides are included to highlight 3-5 key topics of the particular training module, totaling some 300 slides in all. Links to sources of further information available in the English language are also provided.

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
- Lectures based on slides and discussions
- Excursions both locally and internationally to best practice locations
- Exercises carried out by the trainees in small groups and individually about issues combining RES and EE to spatial planning
- Distance learning
- Movies (Inconvenient Truth, District Cooling,..)
- Expert panel (clinic) advisory services to support the trainees to carry out their exercises

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	<u>1st Day: Familiarization with RES</u>	
9.00-9.15	Introduction to Module Topics	
9.15-10.30	Presentation of RES technologies and applications	
10.30-10.45	<i>Break</i>	
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	<i>Break</i>	
12.45-14.00	Five groups continue	
14.00-14.15	<i>Break</i>	
14.15-15.30	Presentation of the results of five group works	
15.30-16.00	Conclusion	
	<u>2nd Day: Rural Energy Supply</u>	
9.00-10.30	Local economy: impacts of RES on rural economy and survival	
10.30-10.45	<i>Break</i>	
10.45-12.00	Off-grid village based on RES (Kempele, Finland)	
12.00-12.45	<i>Break</i>	
12.45-14.00	Agricultural waste to liquid fuel	
14.00-14.15	<i>Break</i>	
14.15-16.15	Excursion to a bio mass fuelled CHP plant	

Partner Contacts

Partner	City	Country	Web page (www)	Contact person	Email
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Module 1

SUSTAINABILITY CONCEPTS IN REGIONAL AND URBAN PLANNING: A HOLISTIC VISION

1 Learning Objectives

This module is to help the trainee to understand:

- the possible impact of Climate Change now and in the future
- the relation of energy consumption to GHG and other emissions globally and locally
- the three components of sustainability, and the need for energy system reform
- Realise the crucial role of spatial planning in promoting and developing RES and EE

Based on this module, the trainee will be made aware of the importance of RES and EE in achieving future sustainability.

2 Contents

This module sets out:

- Indications of Climate Change in various parts of the world
- The role of various sectors of society in reducing energy consumption and greenhouse gas emissions, in EU and in the particular country (EU and national statistics)
- Concept of sustainability: introduction of its components with particular reference to energy
- Carbon footprint: comparison of cities and reasons for differences
- Policies, programs and targets regarding RES expansion and EE improvement globally, in EU and at the national level

The Best Practice cases and the developed Tools will be included in the training material of the Module as found suitable.

3 More information

3.1 Attached Slides

3.2 Literature

3.3 Web Pages

- International Panel for Climate Change - IPCC: ipcc.ch
- European Union: ec.europa.eu/dgs/clima

- United Nations' Environmental Program: www.unep.org/climatechange
- Greenpeace: www.greenpeace.org.uk/climate
- United States government: www.epa.gov/climatechange
- The World Bank: climatechange.worldbank.org

3.4 Other Sources

- The movie "Inconvenient Truth" facilitated by Mr. Al Gore

Module 2

ENERGY FORMS - TRANSFORMATION - MARKET OUTLOOK

1 Learning Objectives

The module is to help the trainee to:

- Understand the availability of various energy (fuels) sources globally and locally as well as the environmental issues related to their exploration, transportation and usage
- Convert the commonly used energy units to others
- Estimate the flue gas emissions of various fuel based energy sources by means of a spreadsheet tool

Based on the module learning, the trainee will be able to carry out simple calculations of fuel consumption and emissions of most typical energy sources as well as to understand environmental issues related to exploration and transportation of various fuels.

2 Contents

This module comprises:

- Statistical data of various fuels globally and locally
- Environmental issues related to oil shale, coal, (peat in Finland), oil and biomass supplies
- Conversion of energy forms - concept of "primary energy factor" as a uniform measuring unit
- Introduction of performance factor " CO2 equivalent/capita"
- Calculation of flue gas emissions of various types of power and heat production plants using the spreadsheet tool
- Flue gas cleaning technologies and usage of their waste products
- Best Practice examples and the Fuel Consumption and Flue Gas Emissions tool will be included in the training material of the Module as found suitable.

3 More information

3.1 Attached Slides

3.2 Literature

3.3 Web Pages

3.4 Other Sources

Module 3

ENERGY DEMAND REDUCTION STRATEGIES: POTENTIAL IN URBAN PLANNING

1 Learning Objectives

This module has been designed to help the trainee to:

- Understand the influence of the urban model on energy consumption and related carbon emissions, for example: dense vs. scattered, RES vs. fossil energy
- Energy and emission reduction potential of
 - electricity consumption through new and focused lighting and electric devices
 - heat consumption through building aspect, windows, thermal insulation, heat recovery and control systems
 - cooling demand through building aspect, windows, thermal insulation, heat recovery and control systems

Based on the module learning, the trainee will be able to understand that the energy demand reduction is the best way to address climate change and that there are various options to do it in urban planning stage already.

2 Contents

The module comprises the following elements:

- Building envelope: economy and impact of various measures such as window replacement, additional thermal insulation and heat recovery on GHG emissions
- Aspect and sizing of buildings as an influence on the viability of various types of RES
- Modern lighting based on LED: quality of lighting, energy savings, suitability to various applications and conditions, expansion prospects
- Modern lighting and electric appliances (these slightly increase heat demand but reduce cooling demand)
- Examples of cooperation between urban planners and energy planners, municipal authorities and non-governmental organizations (NGOs)
- ?'housekeeping' campaigns to help building users to achieve better levels of energy saving
- ?better controls.

Best practice case studies and developed tools will be included in the training material of the module as found suitable.

3 More information

3.1 Attached Slides

3.2 Literature

3.3 Web Pages

- www.freiburg.de
- www.berliner-e-agentur.de/en/projects
- www.skaftkarr.fi

3.4 Other Sources

Module 4

ENERGY DEMAND REDUCTION STRATEGIES: POTENTIAL IN NEW BUILDINGS AND REFURBISHMENT

1 Learning Objectives

The Module is to help the Trainee to:

- Understand the different phases of a building's life-cycle and the related environmental impacts
- Obtain knowledge of the relevant European Directives and their national transpositions affecting a building's energy performance as well as of voluntary sustainability assessment methodologies and labels
- Understand the parameters that influence a building's energy demand during occupation and the related potential and measures for energy efficiency improvement
- Understand the main hybrid and active building systems and the energy impact of good specification and installation
- Understand the importance of building control and management systems and integration of information and communication technologies.
- Understand the key importance of the renovation market as well as new build developments

Based on the Module learning, the Trainee will become aware of his/her role in improving the sustainability concept applied to new buildings and refurbishments, taking into account life-cycle cost and emission analysis.

2 Contents

The Module implementation contains the issues as follows:

- Life-cycle analysis: territory, material, energy, water
 - Embodied energy of construction materials and energy consumption during the occupation phase
 - Strategies to reduce the environmental impact through the selection of materials, construction processes and waste management.
- Energy in the use of buildings: legislative framework
 - The European Directives 2002/91/EC and 2010/31/EC
 - Voluntary sustainability assessment methodologies and labels
- Energy demand reduction in buildings
 - Energy demand in buildings and the potential for its reduction in new build and refurbishment
 - Passive measures to achieve demand reduction in buildings: thermal inertia, insulation, solar gains control, ventilation, daylighting
- Energy efficient installations in buildings
 - Hybrid systems: mechanical ventilation, free cooling, heat recovery, desiccant cooling, earth tubes, etc.

- Active systems: radiant surfaces for improved comfort, energy efficient installations such as heat pumps, condensing boilers, adiabatic cooling machines, taking into account locally available sources, low carbon (eg CHP) and renewables
- Control strategies and building management systems to enhance the different applications (HVAC, shading devices, building access)

3 More information

3.1 Attached Slides

3.2 Literature

- CUCHÍ, A., WADEL, G., RIVAS, P. (2010). *Cambio Global España 2020/50 – Sector Edificación*. Ed.: Societat Orgànica amb Green Building Council España, Asociación Sostenibilidad y Arquitectura, Centro Complutense de Estudios e Información Ambiental, Madrid.
- HEGGER, M., AUCH-SCHWELK, V, FUCHS, M., ROSENKRANZ, T. (2007). *Construction Materials Manual*. Ed.: Birkhäuser, Basilea.
- MC DONAUGHT, W., BRAUNGART, M. (2002). *Cradle to cradle*. Ed.: North Point Press.
- NEILA, F. (2004). *Arquitectura bioclimàtica en un entorno sostenible*. Ed.: Munilla-Lería, Madrid.
- PETERS, C. (2009). *Estalvi i eficiència energètica en edificis públics*, Col·lecció Quadern Pràctic, Ed.: Institut Català d’Energia, Generalitat de Catalunya, Barcelona.
- SABATÉ, J. (2008). *Nul·la estetica sine ètica*, “Vivienda y Sostenibilidad en España. Vol.2 colectiva”. Ed.: Gustavo Gili, Barcelona.
- WALTJEN, T., et al. (2008) *Bauteilkatalog Passivhaus - ökologisch bewertete Konstruktion*. Ed.: IBO, Österreichisches Institut für Baubiologie und -ökologie, Wien

3.3 Web Pages

- www.lima.cat
- www.marie-medstrategic.eu
- www.nhbcbfoundation.org/
- www.passive-on.org

3.4 Other Sources

Module 5

ENERGY RESOURCES AND RENEWABLE ENERGY TECHNOLOGIES

1 Learning Objectives

The module is to help the trainee to:

- Understand the opportunities for and requirements of various RES technologies during urban planning

Based on completing this module, the trainee will be able to prepare urban plans that integrate RES technologies.

2 Contents

This module comprises the technical background, market development and costing of the technologies:

- Photovoltaic panels for electricity production
- Solar collectors for heat production
- Wind turbines for electricity production
- Geothermal and ground water sources for heat production by means of heat pumps
- Bio-fuels
- Municipal waste: selection, collection, refining, combustion
- Industrial waste: typical types of industries releasing waste heat that can be recovered to DH systems

3 More information

3.1 Attached Slides

3.2 Literature

3.3 Web Pages

- www.solarenergy.com
- www.energy.gov/science-innovation/energy-sources/renewable-energy/solar
- renewablefuel.org
- www.solardaily.com
- www.solar-district-heating.eu/
- American Solar Energy Society: www.ases.org
- photovoltaic.com

3.4 Other Sources

Module 6

ENERGY DISTRIBUTION: DISTRICT HEATING AND COOLING (DHC)

1 Learning Objectives

The module is to help the trainee to:

- Understand DHC as a means to use RES and CHP in a unique and highly efficient way
- Adjust the urban plan to coordinate DHC infrastructure with other infrastructure
- Calculate the economy viability for DH in the selected area
- Understand the benefits of various CHP plants given that DHC infrastructure is already in place

This module equips the trainee with the knowledge necessary to identify at the planning stage financially viable ways to extend the use of RES through DHC.

2 Contents

The module implementation contains the issues as follows:

- Basic technical features of DHC
- Requirements of DHC to deal with during urban planning: sufficient heat load density, land area for networks and plants
- Investigation of the economic viability of district heating by using the spreadsheet tool
- Environmental and economic comparison of DHC with individual heating and cooling modes (Helsinki examples)
- Towards a global boom of DHC and CHP to fight the Climate Change? Example systems.

3 More information

3.1 Attached Slides

3.2 Literature

- Co-Generation and Renewables: Solutions for a Low-Carbon Energy Future, 2011, International Energy Agency - IEA (www.iea.org/papers/2011/CHP_Renewables.pdf)
- Sipilä, K. et al: District heating for energy efficient building areas, IEA DHC/CHP Annex IX, report 8DHC-11-02, NL Agency, 100 p. (www.iea-dhc.org)
- Nuorkivi, A: Long-term Views of District Heating and CHP in the Nordic and Baltic Countries, 2011, (www.norden.org/en)

3.3 Web Pages

- www.ecoheat4.eu
- www.euroheat.fi

- www.agfw.de
- www.energia.fi

3.4 Other Sources

Module 7

THE RIGHT SCALE FOR EVERY ENERGY CONCEPT

1 Learning Objectives

This module aims to enable the trainee to:

- Assess the amount and type of energy demand at a municipal level
- Understand importance of demand reduction and energy efficiency
- Identify, localise and quantify local renewable energy sources
- Develop a sustainable, regional energy concept
- Understand crucial factors for its successful implementation

2 Contents

The module will contain the following topics:

- Short overview on energy forms, their occurrence and uses
- Reasons for and benefits from creating a local/regional energy concept
- The effect of scale (temporal, spatial) on the capabilities and limits of different energy forms
- Data requirements for developing an energy concept
- Methodological approach for developing a techno-economic energy concept
- Implementation

4 More Information

4.1 Literature

Peter Droege, *Urban Energy Transition*, Elsevier 2008, ISBN 978-0-08-045341-5

<http://www.sciencedirect.com/science/book/9780080453415>

OECD, *Urban Energy Handbook*, OECD Publishing 1995, ISBN 92-64-14335-1

<http://books.google.de/books?id=ucqLbOjFq0gC>

4.2 Web Pages

Inspire—Infrastructure for Spatial Information in the European Community

<http://inspire.jrc.ec.europa.eu/>

UP-RES Tools, especially Heat map

<http://aaltopro2.aalto.fi/projects/up-res/materials.html>

4.3 Other Sources

- Local, regional or national spatial data
- GIS data from participants for homework assignments

Module 8

NEW MANAGEMENT CONCEPTS IN THE ENERGY MARKET

1 Learning Objectives

This module is to help the trainee to:

- Be aware of new financial and managerial concepts for delivering EE and RES: Energy Service Companies (ESCOs) and Performance Contracting
- Be aware of legal and contractual aspects of energy networks and consumer connections
- Use energy experts for a sophisticated analysis of urban and regional planning options
- Opportunities and implications of Smart Grids

This module will enable the trainee to understand the institutional opportunities and barriers related to RES in urban planning.

2 Contents

The module will comprise:

- Contractual arrangements between energy customers and the service provider
- New energy management concepts - examples of ESCO arrangements
- Examples of integral co-operation of urban planners with energy experts
- New technologies such as smart grids to enable energy transfer from customers to the grid.

3 More information

3.1 Attached Slides

3.2 Literature

NUORKIVI A, Cogeneration and District Heating - Best Practices for Municipalities, Energy Charter Secretariat, 2005 (email:info@encharter.org)

3.3 Web Pages

- www.ecoheat4.eu

3.4 Other Sources

Module 9

ENERGY PLANNING

1 Learning Objectives

The aim of this module is to help the trainee to:

- Understand the motivation and goals of energy planning
- Appreciate different methods of energy planning
- Learn about data sources and GIS
- Integrate energy planning with traditional urban planning
- See examples of energy planning

Based on the module, the trainee will be able to reduce emissions related to mobility in urban planning and to adjust the plans to enable modern applications to come.

2 Contents

The module contains the following:

- Motivation and goals of energy planning
- Overview of target groups and stakeholders of energy planning
- Stages of energy planning: analysis, development and implementation
- Useful data sources
- Using GIS-based systems
- Best practice examples and methods of implementation

Best practice examples and developed tools will be included in the training material of the Module as found suitable.

3 More information

3.1 Publications

- European Commission 2012: *Energy Roadmap 2050*. Brussels. ISBN 978-92-79-21798-2
- European Commission 2011: *Roadmap to a Resource Efficient Europe*. Brussels. COM(2011) 571 final
- Schrattenholzer, L. 2005: *Energy Planning Methodologies and Tools*. Oxford. www.iiasa.ac.at

Module 10

NEW TRANSPORT MODELS AND URBAN AND INTERURBAN MOBILITY

1 Learning Objectives

This module will help the trainee to gain an appreciation of:

- The greenhouse gas emissions and energy consumption related to various mobility options at present
- Future opportunities for liquid bio fuels for transportation
- The urban structures required for charging electric vehicles
- When to prioritise light traffic over private cars in modern communities
- the need to reduce every day transportation in communities

Based on this module, the trainees will be able to reduce emissions related to mobility in urban planning and to make appropriate adjustments to plans to enable this

2 Contents

The module will comprise:

- How and why we move: work, shopping or hobby related
- Greenhouse gas emissions related to various modes of transportation per capita and per km
- Status and development of liquid bio fuels for transportation
- Status and development of electric and hybrid vehicles, and requirement for charging stations
- Experiences and future of car sharing.

3 More information

3.1 Attached Slides

3.2 Literature

3.3 Web Pages

- www.biofueldaily.com
- www.bio-fuel.eu/Products_detail.asp?P=3
- <http://www.carsharing.net/tools.html>
- <http://www.zipcar.com/>
- www.ehow.com/electric-cars
- www.electriccars.com

3.4 Other Sources