Deliverable 1.2

Energy plans in EU cities

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Executive Summary

This report describes the outcome of WP 1 "*European framework assessment*" for deliverable 1.2. It describes the energy plans in EU cities and analyses three relevant European cities, in order to determine the possibilities and space the SWTs have within the future concept of those cities and particular restrictions for the demo sites.

At the moment, there are hardly any examples of *city energy plans* taking into account the possibility of installing SWT's. Some EU cities mention SWTs in their municipality regulations, and also several local SWT's-projects are being carried out around Europe. E.g. urban wind is mentioned by the local municipality regulations from a small Belgium city (Sint-Katelijne-Waver) and also the city of Berlin (Germany) reports on several urban wind projects. For Denmark, the Danish Energy Agency estimated that there are 3.000 households with SWT established. Local projects with SWT's involved cover several research areas from *Micro Smart Grid initiatives*, to *pilot projects* on e.g. electric mobility and combined studies on "PV systems & SWT's". A comprehensive database on EU cities undertaking actions against climate change is the "Covenant of Mayors" (CoM). Participating communes commit themselves to implement *Sustainable Energy Action Plans,* and the amount already exceeds 3.600 plans. SWT's can be considered as being part of some of these plans (e.g. Cornwell County plan).

For the countries represented in the project, 3 coastal cities are selected and presented in information sheets (Nantes, Rotterdam and Klaipeda) and one inland city (Kaunas). These cities are located in characteristic locations for good wind conditions in Europe and are representative for their countries. For the three demonstration sites in the SWIP project, different types of turbines will be piloted. A process path for the legal requirements is set up and analysed for the three pilot sites. From this, it can be concluded that eg. no *planning permission* or *building approval* is needed for the 3 kW turbines at the Choczewo demo-site. However noise and vibration is still bounded to existing legislation. The 10-20 kW turbine for the Kokoszki demo site falls within the scope of existing planning permissions and building approval requirements, just as noise and vibration issues. For the Zaragoza demo site a 6 kW turbine is planned, which requires planning permission as well as building approval. General laws are applicant for noise and vibration.

Conclusion: It is of increasingly importance for *city energy plans* to take into account SWT solutions in urban planning. The productivity of SWTs heavenly depend on the 'micro conditions' around the turbine (e.g. wind conditions at a given location, architectural and structural conditions of the building and environment), which only can be used in an optimal way when these are taken into account in the city energy plans (a city plan is able to focus on these 'micro conditions'). Also the interaction with other developing energy technologies plays a large role in exploiting the potential of distributed SWT's. The amount of applications for SWT's increases due to this developing technology, where SWT's can be used in a combination with e.g. electric bicycles, city buses, street lighting, electric vehicles etc. Also a synergy for combined systems of PV and SWT offers partial solutions to intermittency problems of Renewable energy sources. To benefit from these synergies city energy plans need to take into account these possibilities and chances for SWT's.

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1 Introduction

As significant as the study of the funding and legal status, is the assessment of the energy plans, which are being deployed in the main cities that may be objective and affected by this project.

These plans constitute the key to count with the legal permission to install the WTs, and this study shall ensure a better approach to the market niche related to the project.

Several cities throughout Europe have shown their intention to become greener and fulfil with the foreseen regulation in terms of energy efficiency and share of renewable energy.

Therefore, the main and most advanced cities in terms of **energy plans** are assessed, analysing the possibilities and space the SWTs have within the future concept of that cities.

Two main possible ways to evaluate cities energy plans have been selected. The first one refers to available information on advanced European cities in the area of urban wind energy, used as examples of wind energy use in these cities. The second group includes cities from the project partners countries, proposed and selected by the project consortium. It has been decided that, at least, three relevant representative cities are analysed.

The aim of this study is to recommend the most representative scenario for European cities.

2 Energy plans in EU cities

2.1 EU cities and wind energy

2.1.1 Examples of cities active in wind energy

There are rare examples of cities demonstrating their achievements and planned activities in the field of urban wind.

In **Belgium**, there is one municipality, **Sint-Katelijne-Waver**, that mentioned small wind turbines in municipality regulation.

In **Denmark** the Danish Energy Agency has estimated that there are 3 000 established household turbines, representing a total capacity of 30-50 MW, mostly in rural areas.

The city active in introducing renewable energy, including wind, is **Berlin, Germany** and several urban wind projects have been reported.

Research project 'Use of small wind turbines on buildings in urban areas'

It has been decided that use of urban wind has potential to increase the renewable share in electricity generation. For this reason, the State of Berlin promotes as part of the Environmental Relief Programme (ERP II) a study on small wind power.

In the research project, five small wind turbines are installed on roofs in the city of Berlin and measured extensively over a period of 2 years. This is worked out to what extent exposed roofs are suitable for economical operation and the system size in terms of flow around buildings, energy yield and acceptance makes sense.

In the energy concept of Berlin, the potential for integration of small wind turbines and the climate of relevance are researched. Permit legal framework are examined through the project partners. These results are bundled in form of recommendations for lawmakers and plant operators in order to simplify the planning permission.

http://kleinwind.htw-berlin.de/

Project 'Electricity from renewable energy smart grid'

Wind power by GASAG for Micro Smart Grid on the EUREF - site in Berlin –Schöneberg. On the site of the old Gasometer, the first in this form smart grid (Micro Smart Grid) Berlin was started in 2012. The smart grid is to promote the production of renewable electricity in the capital. Part of generation comes from several small wind turbines.

Project 'Intelligent Mobility Southern Cross Station'

Rebuilt station will be part of a pilot project at a transport hub for electric mobility. Small vertical and horizontal axis wind turbines will be installed to supply the station demand.

Project 'Energy Self-Sufficient Living'

The self-sufficient solar residential ship shall be powered from renewable sources. Small wind turbine together with PV system shall cover the demand.

Project 'International Centre for Ecology, Culture and Community'

The ufaFabrik is an international centre for ecology, culture and community. Small wind turbines are included in the supply system.

2.1.2 Covenant of Mayors

The most comprehensive database of European cities undertaking actions against climate change is the list Covenant of Mayors (CoM) signatories. Participating communes commit themselves to implement Sustainable Energy Action Plans, including renewable energy sources. The number of SEAPs has exceeded 3600 and, in some of their SEAPs, urban wind must be considered as the renewable source.

SEAPs are available in local languages and access to the information is not unproblematic.

One of SEAPs actively promoting wind energy is plan for the **Cornwell County**.

Consumers are allowed to place micro wind turbines since 2011.

Essentially, a turbine that complies with the MCS Planning Standards[1] is not located on "safeguarded land" and would not exceed either 15 metres in height, if attached to a building, or 11.1 metres, if ground mounted may be permitted development. Many other factors shall be considered to obtain confirmation from the relevant Planning Team whether a turbine requires planning permission or is considered permitted development. Installed wind turbines are identified on provided county maps.

The Council supports energy generation projects, including wind turbines.

http://www.cornwall.gov.uk/media/6012200/Wind-turbine-operational-east.pdf

http://www.cornwall.gov.uk/media/6012212/Wind-turbine-screenings-county.pdf

SEAP:

http://www.cornwall.gov.uk/media/3626665/SEAP-2013-final.pdf

The other form of promoting good solutions by the CoM are Benchmarks of Excellence, relevant examples of local initiatives which Covenant actors have realised in their territories.

An example is given for Lund, where the municipal dwelling company LKF is the part-owner of a wind-power plant.

http://www.klein-windkraftanlagen.com/welcome-to-the-german-small-wind-turbine-portal/

[1] MCS (Microgeneration Certification Scheme) Planning Standards must be complied with for domestic installations of wind turbines and air source heat pumps to be "permitted development" in UK.

2.2 Selected cities

2.2.1 Wind conditions

Topography and meteorology vary significantly across Europe as well as wind conditions. Onshore wind energy potential is concentrated in agricultural and industrial areas of north-western Europe, along the Atlantic Ocean, the North Sea and the Baltic Sea coasts.[2]

Local wind conditions in terms of full-load hours per year are shown in Figure 1. The wind power is given for 50m height so values for urban wind are lower, the map shows distribution of wind potential.

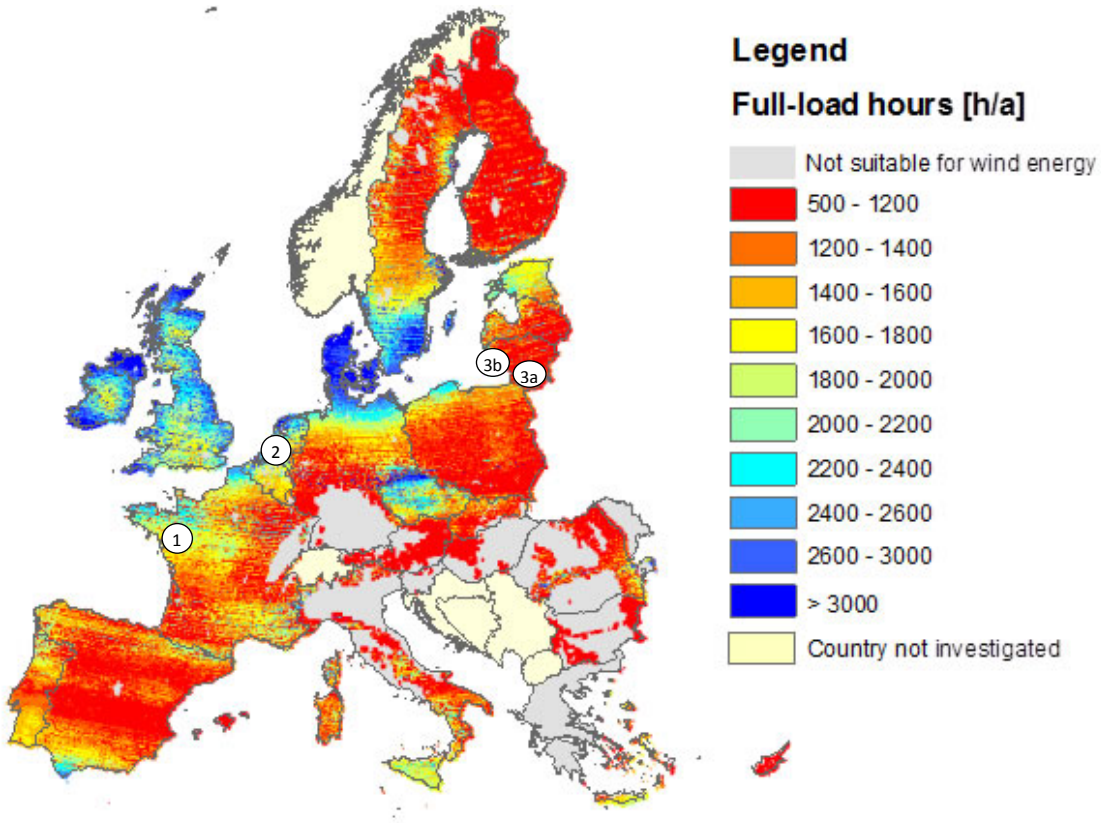

Figure 1 Annual full-load hours for onshore wind energy in the EU. 1 – Nantes, 2 – Rotterdam, 3a – Kaunas, 3b – Klaipeda; *Source: (Held 2011)*[3]

For the countries represented in the project, , 3 coastal cities have been selected for the evaluation (Nantes, Rotterdam and Klaipeda) and one inland city (Kaunas).

[2] Europe's onshore and offshore wind energy potential, EEA Technical report No 6/2009

[3] Long Term Potentials and Costs of RES, Ric Hoefnagels, Martin Junginger, COPERNICUS INSTITUTE / UTRECHT UNIVERSITY, Christian Panzer, Gustav Resch, Lukas Liebmann, EEG / TU VIENNA, Anne Held, FRAUNHOFER ISI; IEE project

These cities are located in characteristic locations for good wind conditions in Europe and are representative for their countries. While selecting the cities, accessibility to input data has been taken into consideration.

The next two cities: Zaragoza (Spain) and Gdansk (Poland) are analysed more closely in chapter 3 where energy plans and specific legal requirements will be considered for the demo-sites of WTs.

2.2.2 Cities from the project consortium countries

Data collected for selected cities from France, Netherlands and Lithuania allow for presenting approach in these cities to energy planning, including installation of small WTs.

Information sheet for each town includes:

- Basic information on country and city level policies in the field of wind energy
- Information about city size, population, energy use, CO_2 emission, energy mix used for electricity generation and estimated wind speed.
- Legal requirements for small WTs installation and operation
- Local documents on energy planning
- Incentives to support S&M WTs
- Other important issues

Process of data collecting has revealed that this is not easy firstly to find the source of information and then to get required data.

Nantes

France

Figure 2. Nantes view

As stated in the National action plan for the promotion of renewable energies, France intends to position itself as the leader in RE technologies including wind power. Results in implementation of SWTs are not encouraging. Average wind speed for France is below 4 m/s, however north-west coastal areas are characterized by wind speed exceeding 5 m/s (at 10m).
Nantes Metropole has adopted strategic plans on wind energy; these plans concern machine around 50 kW, at 35m (hub).

About the City Nantes

Table 1. Nantes information

City characteristics	Parameter	Unit
Size	523	km²
Population [2013]	580 000	-
Estimated CO_2 emission	N/A	
Estimated wind speed at 10m	N/A	

Legal requirements

- As required by the Town Planning Code, wind-turbines having a mast height higher than 12 m are subject to planning permission.
- The Construction and Housing Code submits wind- turbines having a mast higher than or equal to 12 m to technical inspection.

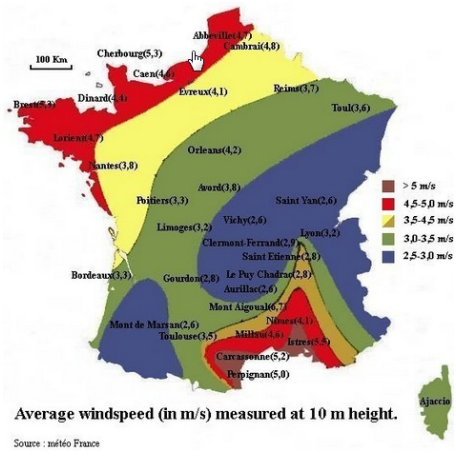

Figure 3. Average Wind speed in France

Energy (electricity) mix - France

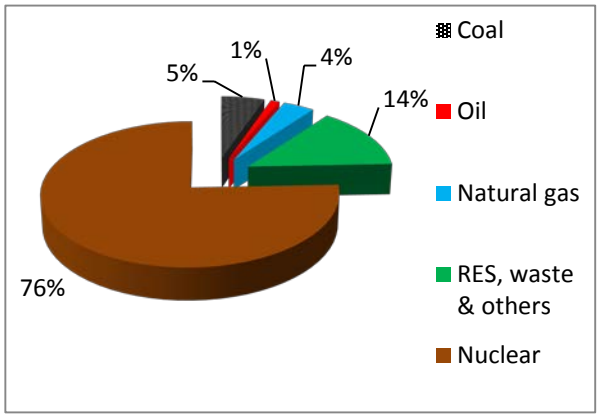

Figure 4. Electricity mix in France

Local documents on energy planning

Plan Climat Energie Territorial

Table 2. Other issues for Nantes

Other issues	
WT considered in local plans	No
Capacity of planned STWs	N/A
Impact of the city terrain	Positive

Incentives to support S&M WTs

N/A

Other remarks

Results from testing 50 kW WTs have shown low yield.

Rotterdam

The Netherlands

Figure 5. Rotterdam view

The Netherlands are market leader in urban wind turbines; more than 20 manufacturers of urban wind turbines have developed and installed urban turbines. Dutch manufacturers are front-runners in developing new technologies. Urban turbines are not certified, although the Dutch Wind Energy Association (NWEA) and some developers have started a pilot project in certification their turbines. In the Netherlands most urban turbines are installed at industrial companies and at municipal buildings to enlarge their green image.
Presently, in the Rotterdam Energy Approach and Planning (REAP), wind energy is reported as having little significance, however urban SWTs are considered as effective energy source in the future.

About the City Rotterdam

Table 3. Rotterdam information

City characteristics	Parameter	Unit
Size	319,35	km²
land	206,44	km²
water	112,91	km²
Population [2013]	628 279	-
District heating (gas&waste)	336	GWh
Estimated CO_2 emission	26 500	kt/year
Estimated wind speed at 10m	5 to 7,5	m/s

Legal requirements

- Building permit according to "Activiteitenbesluit": Noise: L_{day} 47 dB and L_{night} 41 dB, Shadow: max 6 hrs per year.
- "Bouwbesluit": Safety aspects and load calculations for construction.

Other remarks

There is no inventory of SWTs installed in the city so far.

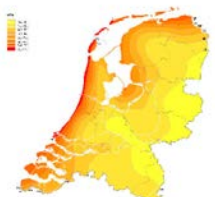

Figure 6. Average Wind speed in Holland

Energy (electricity) mix - Rotterdam

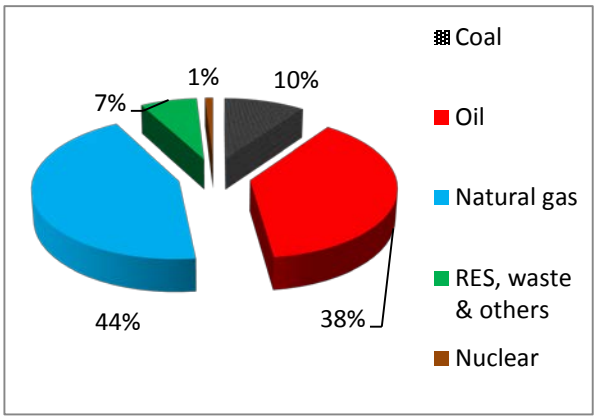

Figure 7. Energy mix of Rotterdam

Local documents on energy planning

Rotterdam climate initiative;
http://www.rotterdamclimateinitiative.nl/

Table 4. Other issues for Rotterdam

Other issues	
WT considered in local plans	No
Capacity of planned STWs	N/A
Impact of the city terrain	Positive

Incentives to support RES – including S&M WTs

Subsidies: Stimulering Duurzame Energie (SDE+)

Tax release: 44% tax reduction on the investment costs

Kaunas
Lithuania

Figure 8. Kaunas view

As stated in the National renewable energy action plan, Lithuania is planning to increase the total installed capacity of wind power plants to 500 MW. The plan Equipping of Small-Capacity Wind Power Plants is financed. Electricity produced should be used only for satisfying the needs of the holding.

About the City Kaunas

Table 5. Kaunas information

City characteristics	Parameter	Unit
Size	158	km²
Population [2013]	306 888	-
District heating (gas)	1 530	GWh
Estimated CO_2 emission	14 930*	kt/year
Estimated installed power in SM WTs*	55	kW
WTs considered in local plans*	4 000	kW
Estimated wind speed at 10m	3,98	m/s

* Kaunas Region

Legal requirements

- For the individual house: if the WT with blades do not reach 15 meters height and the noise is very low no permit is required.
- For bigger WTs a simple permit is required.

Other remarks

There is no inventory of SWTs installed in the city so far.

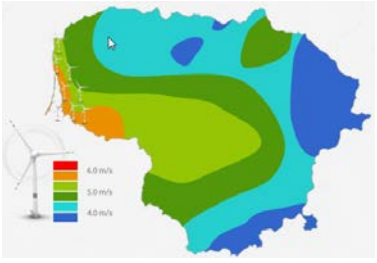

Figure 9. Average Wind speed in Lithuania

Energy (electricity) mix - Lithuania

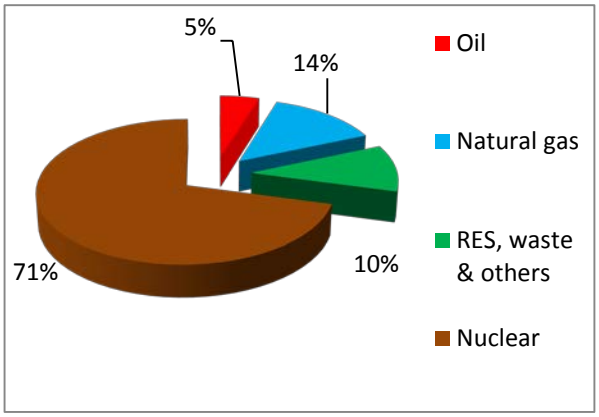

Figure 10. Energy mix of Lithuania

Local documents on energy planning

For a single WT of capacity not exceeding 250 kW properly located detailed plans are not required.

Table 6. Other issues for Kaunas

Other issues	
WT considered in local plans	No
Capacity of planned STWs	N/A
Impact of the city terrain	Positive

Incentives to support S&M WTs

Support scheme is voluntary.

Klaipeda

Lithuania

Figure 11. Kaunas view

As stated in the National renewable energy action plan Lithuania is planning to increase the total installed capacity of wind power plants to 500 MW.

The plan Equipping of Small-Capacity Wind Power Plants is financed. Electricity produced should be used only for satisfying the needs of the holding.

About the City Kaunas

Table 7. Kaunas information

City characteristics	Parameter	Unit
Size	98	km²
Population [2012]	160 142	-
District heating (gas)	850	GWh
Estimated CO_2 emission	14 930*	kt/year
Estimated wind speed at 10m	> 4	m/s

* Lithuania

Legal requirements

- For the individual house: if the WT with blades do not reach 15 meters height and the noise is very low no permit is required.
- For bigger WTs a simple permit is required.

Other remarks

There is no inventory of SWTs installed in the city so far.

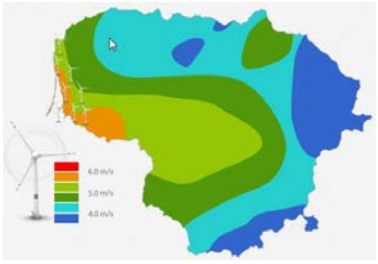

Figure 12. Average Wind speed in Lithuania

Energy (electricity) mix - Lithuania

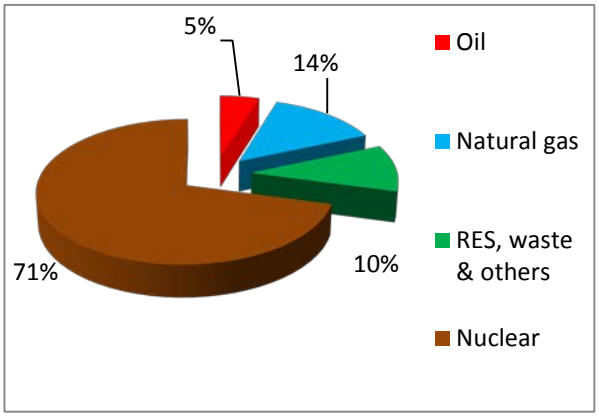

Figure 13. Energy mix of Lithuania

Local documents on energy planning

For a single WT of capacity not exceeding 250 kW properly located detailed plans are not required.

Table 8. Other issues for Kaunas

Other issues	
WT considered in local plans	No
Capacity of planned STWs	N/A
Impact of the city terrain	Neutral

Incentives to support S&M WTs

Support scheme is voluntary.

3 Particular legal requirements for each demo-site

3.1 Pilot - Demonstration Sites

There are 3 demonstration sites in the SWIP project. Two of them, Choczewo (a medium rise village/town centre) and Kokoszki (an industrial estate) are in Northern Poland. The third site is a new building currently under construction for Circe within a university campus in Zaragoza, Spain.

Different turbine types are being piloted at the various sites. At Choczewo, a 3kW vertical or horizontal cross wind turbine will be installed while, at Kokoszki, a standard horizontal axis wind turbine on a free standing tower (near the adjacent industrial buildings) of between 10 and 20 kW will be installed. The Zaragoza site will comprise a smaller (6kW) horizontal turbine.

As such the combination of sites and turbines proposed to be installed represents a wide spectrum of diversity in terms of application for urban and peri urban wind generators in Europe.

Similarly the legal and regulatory requirements that must be complied with to install them are representative of the range of legislative and procedural regimes likely to be encountered across Europe in similar urbanistic contexts.

The legal requirements which influence the installation of wind turbines in urban and peri urban areas in general, and specifically at our 3 pilot sites, can be generally categorized as follows;

- Spatial Development Plan (Zoning)
- Planning Permission
- Building Approval
- Operation Regulations

Planning permission is generally positioned under and in the context of, a spatial Development Plan or, in some States, national planning rule which may govern wind.

In certain situations, particularly small turbine in peri urban or rural sites, many of these regimes may be set aside and the installation deemed to be exempt from the need to seek the permissions and approvals below, usually within some limits (locations, size of turbine, noise level etc.).

The range of potential legal requirements which can govern wind turbine installations at the 3 SWIP pilot sites can be set out in terms of level, likelihood, and procedure in the following table 1;

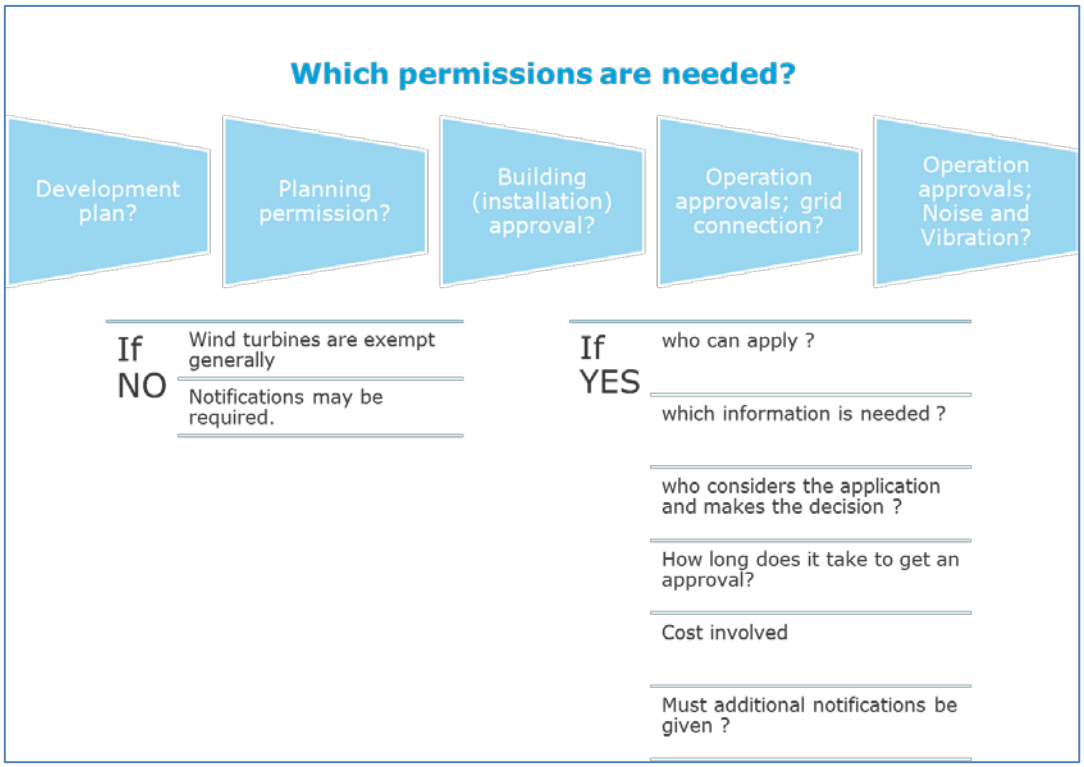

Figure 14. Permissions needed

3.2 Choczewo

The proposal is a roof mounted 3kW turbine.

Permission for Wind Generators in Poland

In Poland the position, size, shape, etc. of building (and structures) is governed by the district or city Spatial Development Plan. The intermediate level of Planning Permission does not exist per se and the compliance of the buildings construction details, safety, noise, etc. are controlled by a Building Permit system. For certain types of developments, including wind generators, the Development Plan (in principle and if it exists in that area) may permit the windturbine. Larger windturbines may require a building permit. If a spatial Development Plan does not exist, as is the case in Choczewo, then the developer of the turbine must apply for a decision on the conditions for construction and land development (under the Act of 27 March 2003 on Spatial Planning and Land Development).

Planning Permission;

The 3kW turbine at Choczewo is exempt from the need for planning permission.

Building Approval

Installing small wind devices on buildings does not require a building permit.

However, above 33 metres, a notification to the appropriate authority is required and the authority has 30 days to object (Act of 7 July 1994 on Building Law).

The notification would specify the type, scope, manner of execution of works and the date of their commencement. The notification would include a statement of the title to the property and, if it is necessary, relevant sketches or drawings, as well as permits, agreements and opinions required by separate regulations. If it is necessary to supplement the notification, the competent authority shall request from the applicant to supplement, within a specified period, missing documents, and if they are not delivered, the authority prohibits the installation. To apply, one has to have title to use the land/building.

In case of notification, construction may start after 30 days from the date of submitting the notification if the authority does not object.

It is permissible to attach these devices onto a building or install them on a roof.

Given the WT to be installed in the pilot site is not larger than 33 metres, no notification (or indeed overall building approval) is required and nor is a planning permit.

Ownership and Title

To submit the above notification (of intention to construct a turbine over 3m) one has to have title to use the land/building.

A wind generator can be installed and operated by someone different than the building site owner if one has the owners consent e.g. by leasing a piece of land or being allow to use building.

Noise and Vibration - Context

A wind turbine installation must comply with the Regulation of the Minister of Infrastructure of 12 April 2002 on the technical conditions to be met by buildings and their location (Part IX – protection against noise and vibrations) §327.2. Under this installations and devices (being technical equipment) of residential, multifamily and public buildings, cannot create excessive noise or vibration that would limit usability of the building or fail to protect users of the premises..

Noise Restrictions

Wind generators must adhere to the Regulation of the Minister of Environment on permissible noise levels in the environment (14.06.2007 with amendments) as follows;

The values of permitted sound levels in the environment (equivalent, denoted as LAeq, T), for both daylight and night, are defined in the table below (extract from the Regulation of the Minister of Environment On Permissible Noise Levels in the Environment). These levels relate to the areas requiring protection against noise. Averaging time (determination or the measurement of sound level) is enshrined in the regulation as 16 hours during the day and 8 hours at night for road traffic noise sources and for other sources as 8 hours during the day and 1 hour at night.

Table 9. Permitted noise levels in the environment

No.	Land appropriation	Permitted noise level in dB Other facilities and activity being the source of noise LAeq D day T=8h	 LAeq N night T=1h
1.	a. A-protective zone of health resort b. Area of hospitals outside the city	45	40
2.	a. Single-family residential areas b. Building area associated with a permanent or temporary stay of children and youth c. Area of nursing homes d. Area of hospitals in towns	50	40
3.	a. Areas of residential buildings and collective residence b. Areas of farmsteads c. Recreational and resting areas d. Residential and service areas	55	45
4.	Downtown areas of cities with over 100 thousand residents	55	45

Additionally, the standard PN-B-02151-02:1987 Building Acoustics - Protection against noise in buildings (Permissible values of sound levels in premises) must be complied with:

Vibration Limitations

Generators must adhere to Polish standard PN-B-02171:1988 on evaluation of the impact of vibration on people in buildings (in accordance with ISO standards). It defines the limits of mechanical vibration to provide the required comfort in the occupied areas, depending on:

- Usage of the premises (residential, offices, workshops, hospitals, laboratories, etc.);
- Time of vibrations (day &/or night);
- Nature and repetition (regularity) of vibration;
- Direction of vibration (horizontal or vertical) and the position of a receiver (person) during experience of vibration (standing or lying position).

Environmental Impact or Appropriate Assessment

If the wind turbine is lower than 30 metres in height and the land is not protected for environmental reasons, as is the case at Choczewo, then, environmental impact or appropriate assessment is not required.

Grid Connection Protocols and Procedures (Choczewo)

In Poland, renewable power devices with installed power up to 40 kWe and 120kWt is defined as micro-installation and connection of such installation to the power distribution grid is free of charge.

In the case of Choczewo, the addition of the micro-installation will not increase the required capacity of the connection beyond the capacity of the existing one, and, therefore, the developer (owner) of the new installation does not have to apply for 'connection conditions' from a Distribution System Operator.

If the - previously connected (to the grid)- customer does not generate the additional power with the main aim of being an energy vendor (which is the case in Choczewo), then any excess electricity generated can be distributed to the grid (and a credit claimed) without applying for an electricity production licence. In this case, the customer has to notify DSO about intention to connect micro-installation to the distribution grid to ensure current harmonisation.

Then, the customer (the developer of our turbine) has to sign a DSO agreement covering the distribution of electricity from micro-installation and details on the crediting of the excess electricity produced in the micro-installation. The DSO is obliged to grant the credit at a guaranteed rate (80% of the average selling price of electricity on the competitive market in the previous year)."

3.3 Kokoszki

The proposal is a 10kW to 20kW freestanding turbine.

Permission for Wind Generators in Poland

See above (for Choczewo)

Planning Permission;

In the case of the Kokoszki 10-20kW turbine, the proposal (turbine and site) falls within the current spatial Development Plan (and planning permission per se does not exist) with the result that the developer must simply apply for the building permit.

Building Approval

Installing wind generators on the ground requires a building permit regardless of their size or height.

The application for the building permit must be accompanied by:

1) four copies of a construction project, including the opinions, agreements, permits and other documents required by specific provisions and a valid certificate of the designer.
2) a statement about the title to use the property for erection of a wind turbine;
3) documents that illustrate adherence to any conditions for construction and land development, under the regulations , conditions etc. in the governing Spatial Development Plan

The Authority has 65 days to issue the building permit.

No maximum height for a wind turbine is indicated in the local spatial Development Plan. However, the site is located in the vicinity of the Gdańsk airport. Therefore no building structure, including a wind turbine can exceed a height of 45 meters on the proposed site

Ownership and Title

To apply for a building permit, one has to have title to use the land/building.

A wind generator can be installed and operated by someone different than the building site owner if one has the owners consent e.g. by leasing a piece of land or being allow to use building.

Noise and Vibration - Context

Given the installation is a free standing turbine it does not need to comply with Regulation of the Minister of Infrastructure of 12 April 2002.

Noise Restrictions

Wind generators must adhere to the Regulation of the Minister of Environment on permissible noise levels in the environment (14.06.2007 with amendments) as follows;

The values of permitted sound levels in the environment (equivalent, denoted as LAeq, T), for both daylight and night, are defined in the table - Annex to the Regulation of the Minister of Environment on permissible noise levels in the environment. These levels relate to the areas requiring protection against noise. Averaging time (determination or the measurement of sound level) was adopted in the regulation as 16 hours during day hours on and 8 hours at night for road traffic noise sources and for other sources as 8 hours during the day hours and 1 hour at night.

See Table 9.

Vibration Limitations

Given the turbine will be a free standing and not connected to nearby buildings, it is not governed by Polish standard PN-B-02171:1988 on evaluation of the impact of vibration on people in buildings..

Environmental Impact or Appropriate Assessment

If the wind turbine is lower than 30 metres in height and the land is not protected for environmental reasons, as is the case at Kokoszki, then environmental impact or appropriate assessment is not required.

Grid Connection Protocols and Procedures - Kokoszki

In Poland, renewable power devices with installed power up to 40 kWe and 120kWt is defined as micro-installation and connection of such installation to the power distribution grid is free of charge.

In the case of Kokoszki, the addition of the micro-installation will not increase the required capacity of the connection beyond the capacity of the existing one, and therefore the developer (owner) of the new installation does not have to apply for ‘connection conditions’ from a Distribution System Operator.

If the - previously connected (to the grid) -)- customer does not generate the additional power with the main aim of being an energy vendor(which is the case in Kokoszki), then any excess electricity generated can be distributed to the grid (and a credit claimed) without applying for an electricity production licence. In this case, the customer has to notify DSO about intention to connect micro-installation to the distribution grid to ensure current harmonisation.

Then, the customer (the developer of our turbine) has to sign a DSO agreement covering the distribution of electricity from micro-installation and details on the crediting of the excess electricity produced in the micro-installation. The DSO is obliged to grant the credit at a guaranteed rate (80% of the average selling price of electricity on the competitive market in the previous year)."

3.4 Zaragoza (Circe)

The proposal is a building integrated 6kW turbine. The proposal is a 6kW turbine integrated in a building.

Permission for Wind Generators in Zaragoza

Planning Permission and Building Approval is required for wind turbines, including at the size proposed in our pilot building, in Zaragoza.

Planning guidelines do not stipulate a maximum height in that each planning or building approval application, is considered on its own merits. However, sites in an urban area or near an airport would be likely to have height restrictions imposed on them. The pilot site is located on a university campus.

Building Approval

Installing wind generators requires a building (installation) permit regardless of their size or height. The application is for a License of Mayor Works and is made to relevant Urbanism Area of the City Council.

The application for the building (installation) permit must be made by a qualified engineer (registered member of the Institute /College of Engineers) that signs the major work project.

Turbines can be installed on independent masts or integrated into buildings (as on the pilot site). However, full technical justification like loadings, anchorages etc. must be made in the building (installation) permit application.

The application is accompanied by:

1. A technical report justifying the installation calculations and including the topics below should be attached to the permit application:

- Objective
- Applicant
- Location
- Regulations
- Basic concepts about wind technology
- Wind turbine parts

- Component description
- Installation works description
- Justifying calculations required by regulations (Electrical installation, grounding facilities, mast height limitations, load and foundation detailed calculations)
- Estimated wind turbine production
- Estimate total budget
- Health and safety study
- Installation maintenance requirements

2. Installation authorization issued from the Building Owner's Community.

- Fulfilment of technical regulations:
  - REBT (Low Voltage Electrical Regulation)
  - CTE (Edification Technical Regulations)
  - ITC-BT (Low Voltage Complementary Technical Instruction) number 7, 18, 21 and 40

The Authority may take up to several months to issue the permit.

Ownership and Title

To install a turbine or apply for a building permit, one has to have permission from or be the title holder.

Noise and Vibration - Context

Specific regulations for WTs do not exist. However, wind generators must adhere to the noise and vibration limits (emanating from any structure/device, etc.) according to Zaragoza's bye-laws.

Noise Restrictions

Noise limits in interior environments, in dB (A):

No activity or sound source, other than normal background noise (ambient eg traffic and natural phenomena), may generate sound levels higher than the limits stated below in indoor environment of a home or other building:

Table 10. Noise limits in indoor environments (Zaragoza)

Use	Rooms	**Daytime** (8.00 - 22.00 h)	**Night-time** (22.00 - 8.00 h)
Sanitary	Bedrooms	35	27
	Common areas	40	30
Residential	Living zones	40	27
	Corridors, restrooms and kitchens	45	30
Educational	Classrooms	40	30
	Preschool dorms	35	27
Tertiary services	Lodging	40	40
	Offices	45	45

Noise limits in exterior environments, in dB (A):

No activity or sound source, other than normal background noise (ambient eg traffic and natural phenomena), may generate sound levels higher than the limits listed below in the external environment:

Table 11. Noise limits in outdoor environments (Zaragoza)

Acoustic area	Daytime (8.00 to 22.00 h)	Night-time (22.00 to 8.00 h)
Type I	55	45
Type II	65	55
Type III	55	55
Type IV	75	70
Type V	According to Environmental impact stated values, will not exceed levels applicable to their acoustic area.	

Type I: Includes high acoustic sensitivity areas (hospitals, educational and cultural centres).

Type II: Includes sections of territory dominated by urban land or developable residential, commercial and service use.

Type III: Comprising "E areas" referred to in the General Urban Plan. (E area: Areas of new urban planning, motivated by the renewing of use of the territory).

Type IV: Includes sections territory of industrial land use, freight terminals and logistic activities.

Type V: Includes sections of area affected by zones of special acoustic conditions. These easements are considered linked to the general system of transport infrastructure and other public facilities that require it, such as railways, and will be defined in each case by the Council.

Vibration Limitations

The vibratory discomfort impact of a wind turbine (or any other device, equipment, etc.) must be assessed against the Vibratory Perception Index K of ISO 2631 – Standard 2. This must be carried out at a minimum for horizontal surfaces. The determination of discomfort follows Annex 7 of the standard.

As assessed above, no activity or vibrating source (eg from a wind generator) may transmit a vibration value (K curves) as defined in Annex 8 of the Standard, which is greater than the following Coefficient K limits (values of vibration reception indoors):

Table 12. Coefficient K limits for Zaragoza

Use	Rooms	Continuous vibrations	Transient vibrations (less than 3 impulses per day)
Sanitary	Daytime	2	16
	Night-time	1.4	1.4
Residential	Daytime	2	16
	Night-time	1.4	1.4
Educational	Daytime	8	128
	Night-time	8	128

Environmental Impact or Appropriate Assessment

If the land is not protected for environmental reasons, then environmental impact or appropriate assessment is not required. The Circe site being a university campus falls within this classification.

Grid Connection Protocols and Procedures

A formal application for a connection to the electricity grid must be made. The most viable connection (coupling) point dependents on the installation voltage and the process of grid point selection and connections must adhere to the provision of Law RD 1699/2011 (Simplified Process) as authorized by the distribution grid operator (DSO). A Harmonics and EMI compatibility certificate for the wind turbine and components is part of the requirements.

The full process is as follows;

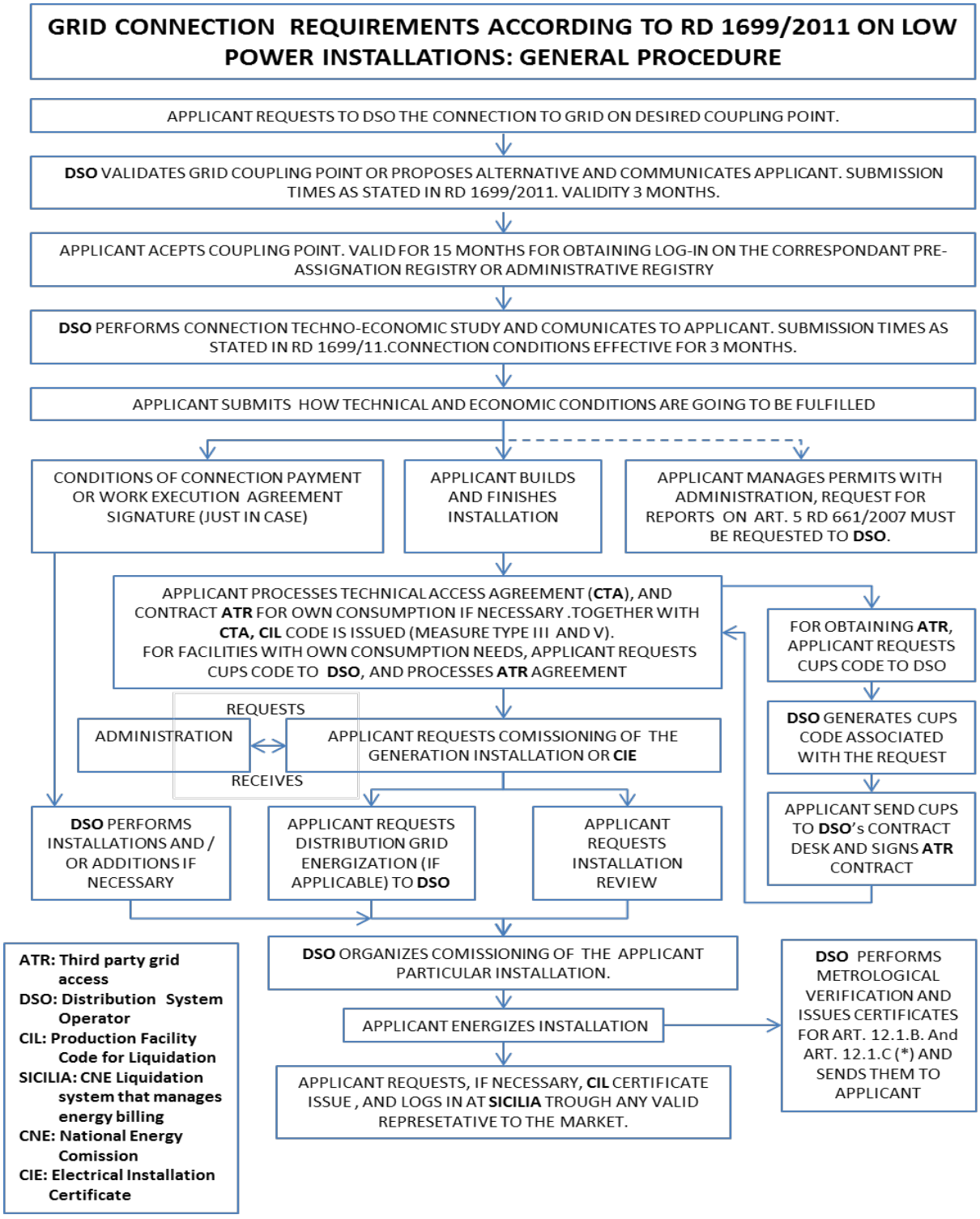

Figure 15. Full process for WT grid connection in Zaragoza

Process to execute and times for logging in an installation with rated power inferior to 100 kW:

Table 13. Process and times for logging in a WT in Zaragoza

P ≤ 10 kW	10 kW ≤ P ≤ 100 kW
	Endorsement submission (20 €/kW)
Coupling application, including Technical memory for the installation. **10 days**	Coupling application, including Technical project for the installation. 1 month
If the coupling application is accepted INSTALLATION IS PERFORMED	
	Grid coupling agreement request 1 month - ATR - CIE
WT -Grid physical coupling request **10 days** - **ATR** - **CIE**	WT -Grid physical coupling request
Commissioning communication. **5 days.**	

4 Conclusions

1. There are hardly any examples of energy planning taking into account the possibility of installing small wind turbines in cities. This is mainly due to the fact that the productivity of small wind turbines is dependent on the 'micro conditions' around the turbine and requires in each case test wind conditions at a given location, but also architectural and structural conditions of the building and the environment play an important if not decisive role.
2. There are more and more applications of SWTs due to the developing technology of renewable energy sources in accordance with the principle of life-cycle assessment - for example, turbines supporting charging points of vehicles and electric bicycles, and even city buses, street lighting, etc. At present, the location of these devices is dictated by terms of the existing infrastructure and implementation of pilot projects.
3. It is increasingly important to take into account such solutions in urban planning by identifying areas with favourable wind conditions, and to address architectural issues of incorporating installations in the cities while taking into account parameters of noise, vibration and public safety.
4. For the three demonstration sites in the SWIP project different types of turbines will be piloted. A process path for the legal requirements is set up and analysed for the three pilot sites. From this it can be concluded that eg. no *planning permission* or *building approval* is needed for the 3 kW turbine at the Choczewo demo-site. However noise and vibration is still bounded to existing legislation. The 10-20 kW turbine for the Kokoszki demo site falls within the scope of existing planning permissions and building approval requirements, just as noise and vibration issues. For the Zaragoza demo site a 6 kW turbine is planned, which requires planning permission as well as building approval. General laws are applicant for noise and vibration.
5. Besides the three pilots sites also four European cities are investigated to give a broader overview of the potential across Europe and in particular of the SWIP countries. The three coastal cities Nantes, Rotterdam and Klaipeda and the inland city Kaunas show great potential, but it is typical that none have included SWTs in their city energy plans. The conclusion is therefore that SWTs need to be put on the agenda of policy makers.

5 Literature

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[2] Long Term Potentials and Costs of RES, Ric Hoefnagels, Martin Junginger, COPERNICUS INSTITUTE / UTRECHT UNIVERSITY, Christian Panzer, Gustav Resch, Lukas Liebmann, EEG / TU VIENNA, Anne Held, FRAUNHOFER ISI; IEE project