

Overcoming regulatory and certification barriers

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Opportunities for small wind turbines in urban areas

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Certification



Introduction |



Introduction | Definition SWT | Fields of application

Definition SWT:

- Wind turbines with a rotor swept area smaller than or equal to 200 m², ($d \approx 16$ m), <1000 V AC or <1500 V DC , on-grid and off-grid applications (IEC 16400-2)
- <100 kW (IRENA, windpower working paper, june 2012)

Fields of application

- Meet electricity needs of individual homes, farms, small businesses, or small communities (rural electrification schemes)
- LCOE requires niche applications, and is location dependent



Residential
0.3 - 5 kW



Agricultural
10 - 50 kW



Industrial
10 - 50 kW



Community sites
1 - 10 kW



Introduction | Why SWTs in urban areas?

CO₂ savings

Energy utility companies dependency

Fluctuating prices of electricity

Green image

Green electricity generation

Prevent energy transport losses

Self awareness

Expected synergies with other RETs.
(wind+PV)

Advantages

Barriers

Electricity production cost

Wind speed & turbulence due to surrounding objects

Neighbour disapproval

Space requirements & roof placement

Availability of energy when needed

Inconvenience (Installation/Flickering/ Noise/ Vibration)

Safety (loose parts, ice chunks)

Inadequate easily accessible information



Regulatory aspects |



Regulatory aspects | Energy plans in EU cities

- At the moment there aren't hardly any examples of city energy plans taking into account SWT's.
 - Examples of cities active in wind energy
 - Sint Katelijne Waver (Belgium)
 - Berlin (Germany)
 - Danish Energy Agency (Denmark) reports 3.000 household UW projects
- Comprehensive database – Covenant of Mayors
 - Participating communes commit “Sustainable Energy Action Plans”
 - >3600 plans already;
 - SWT's can be part of these plans (e.g. as in Cornwell County Plan)



<http://www.energy-cities.eu/-Members->

Take SWTs into account, via EU city energy plans!



Regulatory aspects |

Local, regional and national requirements

Gathering regional / national information:



- ☐ On country and city level policies in the field of wind energy
- ☐ City size, energy use, CO2 emission, energy mix and estimated wind speed.
- ☐ Legal requirements for small WTs installation and operation
- ☐ Local documents on energy planning
- ☐ Incentives to support S&M WTs

SWIP-checklist, local regulatory aspects



- ☐ Permission for Wind Generators?
- ☐ Planning Permission?
- ☐ Building (installation) Approval?
- ☐ Operation approvals, grid connections protocols and procedures?
- ☐ Noise Restrictions?
- ☐ Vibration Limitations?
- ☐ Environmental Impact or Appropriate Assessment?

If NO

- Wind turbines are exempt
- Notifications may be required.

If YES

- who can apply?
- which information?
- who considers the application?
- Who makes the decision?
- Time to approval?
- Cost involved?
- Additional notifications needed?

Regulatory aspects |

Local, regional and national requirements-checklist

Gathering regional / national information:



SWIP-checklist, local requirements, demo sites



Rotterdam
The Netherlands

The Netherlands are market leader in urban wind turbines; more than 25 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 (DWEA) 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

City characteristics	Parameter	Unit
Size	219.12	km²
Land	206.44	km²
Water	12.68	km²
Population (2013)	629.279	
District heating (peakload)	336	GWh
Estimated CO ₂ emission	26.500	kt/year
Estimated wind speed at 10m	5 to 7,5	m/s

Energy (electricity) mix - Rotterdam

Local documents on energy planning:
Rotterdam climate initiative;
<http://www.rotterdamclimateinitiative.nl/>

Other issues

WT considered in local plans	Yes
Capacity of planned 37Wt	N/A
Impact of the city terrain	Positive

Legal requirements:

- Building permits according to "Activiteitenbesluit"; Noise: L_{day} 47 dB and L_{night} 41 dB, Shadow: max 6 hrs per year;
- "Bouwenbesluit"; Safety aspects and load calculations for construction;
- "Wetlandcheck"; Architectural check.

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

Energy plans in EU cities

- 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 10-30 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, which requires planning permission as well as building approval. General laws are applicable for noise and vibration.

Besides safety aspects,
→
attention for local requirements on SWT



Certification |

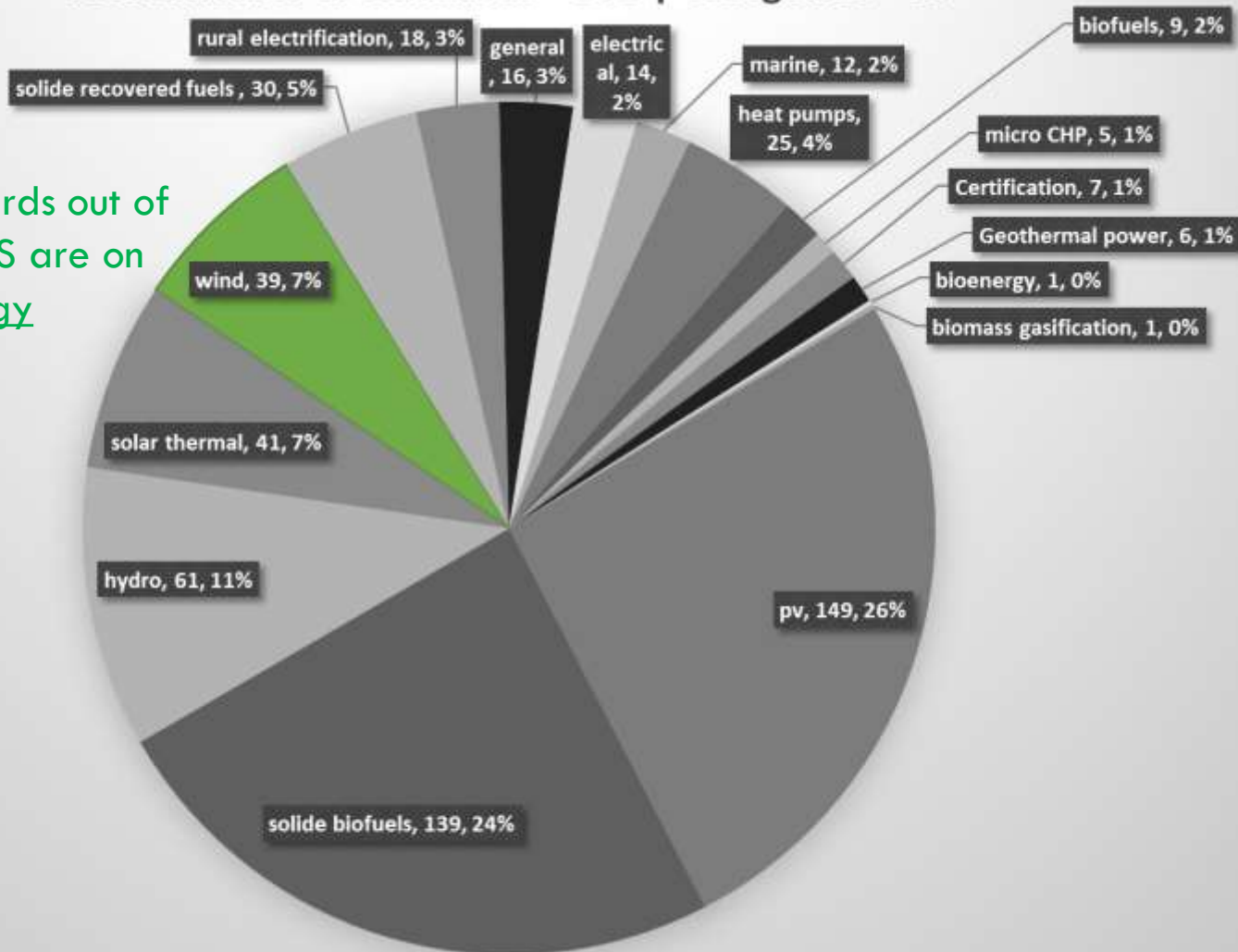


Certification | Overview of RES standards

■ Standards on renewable energy and its connection to SWT

39 Standards out of 573 on RES are on wind energy

Total number of standards = 573 | Categories = 17



Certification |

IEC 61400 Series of standards on Wind energy (I/II)

IEC 61400-1 Design requirements

IEC 61400-2 Small wind turbines

IEC 61400-3 Design requirements for offshore wind turbines

IEC 61400-3-2 Design requirements for floating offshore wind turbines

IEC 61400-4 Design requirements for wind turbine gear

IEC 61400-5 Wind turbine rotor blades

IEC 61400-11 Acoustic noise measurement techniques

IEC 61400-12 Wind turbine power performance testing

IEC 61400-13 Measurement of mechanical loads

IEC 61400-14 Declaration of apparent sound power level

IEC 61400-21 Measurement and assessment of power

IEC 61400-22 Conformity testing and certification

IEC 61400-23 Full-scale structural testing of rotor blades

IEC 61400-24 Lightning protection

IEC 61400-25 Communication protocol

IEC 61400-26 Time based availability for wind turbine

IEC 61400-27 Electrical simulation models for wind power

+ other normative References IEC 61400-2 (SWT)

IEC 60204-1:2005, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 60721-2-1, *Classification of environmental conditions – Part 2-1: Environmental conditions appearing in nature – Temperature and humidity*

IEC 60364-5-54, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*

IEC 61643-11:2011, *Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power distribution systems – Requirements and test methods*

IEC 60038:2009, *IEC standard voltages*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

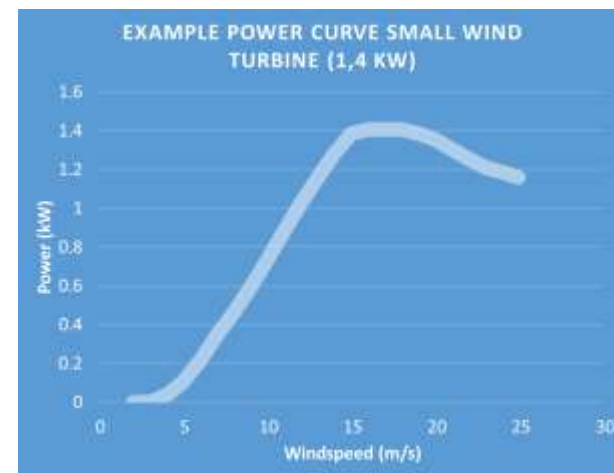
ISO 2394:1998, *General principles on reliability for structures*

Certification |

IEC 61400 Series of standards on Wind energy (II/II)

Compliance verification

- Certification is needed for assuring safe and reliable operational systems in SWT.
- However, compliance verification for SWT is costly (50-100 kEUR)
- Guidance template for engineers on IEC 61400-2
- The SWT sector also would benefit from powercurve certification requirements, easy to apply for SWT.
 - Avoiding unexpected lower energy production
 - Building more trust in the market for SWTs





Certification | IEC 61400-2 (SWT) - overview

1 Scope

2 Normative references

3 Terms and definitions

4 Symbols and abbreviated terms

5 Principal elements

6 External conditions

7 Structural design

8 Protection and shutdown system

9 Electrical system

10 Support structure

11 Documentation requirements

12 Wind turbine markings

13 Testing

Annex A (informative) Variants of small wind turbine systems

Annex B (normative) Design parameters for describing SWT class S

Annex C (informative) Stochastic turbulence models

Annex D (informative) Deterministic turbulence description

Annex E (informative) Partial safety factors for materials

Annex F (informative) Development of the simplified loads methodology

Annex G (informative) Example of test reporting formats

Annex H (informative) EMC measurements

Annex I (normative) Natural frequency analysis

Annex J (informative) Extreme environmental conditions

Annex K (informative) Extreme wind conditions of tropical cyclones

Annex L (informative) Other wind conditions

Annex M (informative) Consumer label



Certification | IEC 61400-2 (SWT) - scope

Safety, quality & engineering

Design, installation, maintenance & operation

Includes all subsystems for SWT

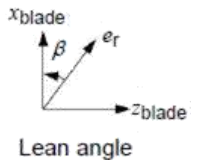
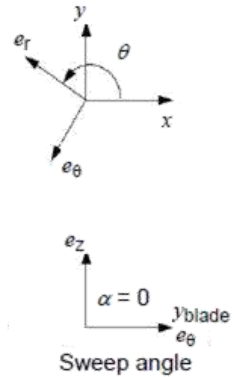
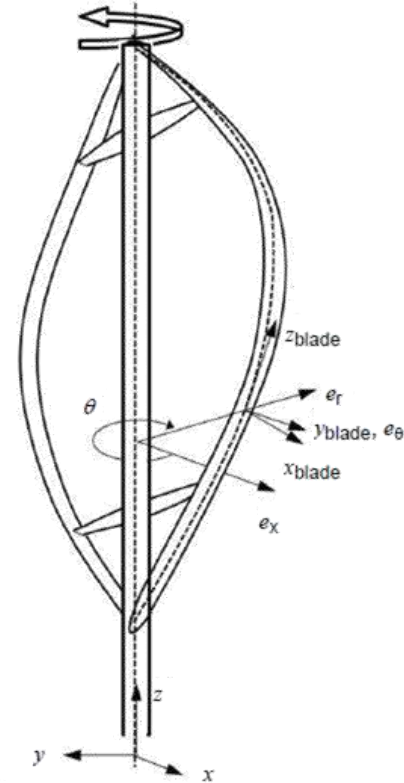
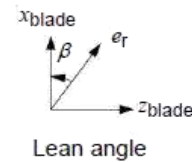
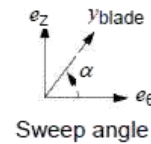
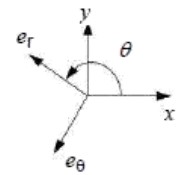
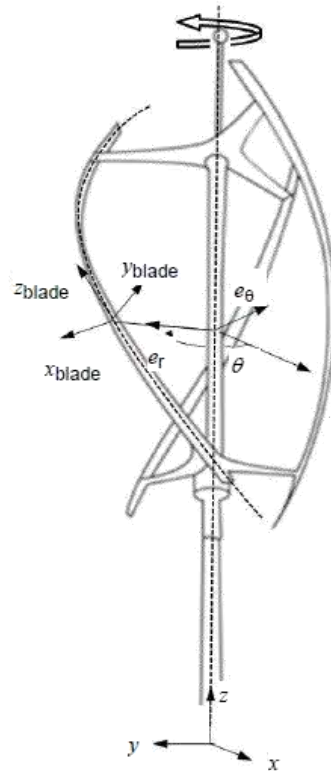
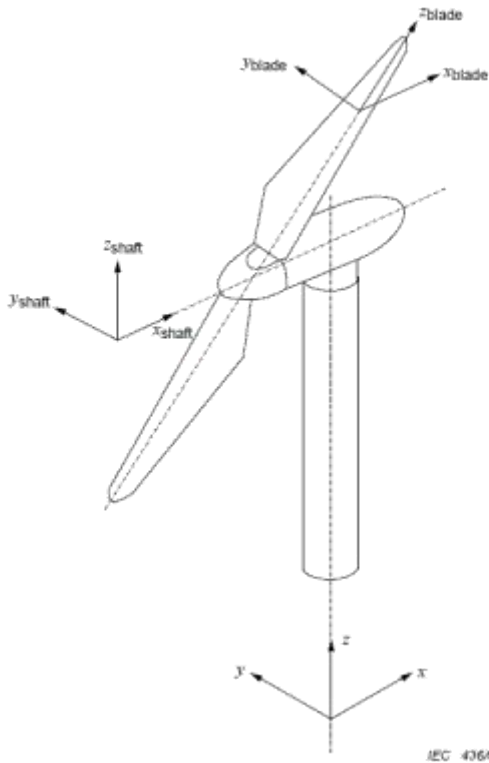
- Protection mechanisms
- Electrical systems
- Mechanical systems
- Support structures
- Foundations
- Grid connection

SWT

- the turbine controller,
- the charge controller / inverter (if required),
- wiring and disconnects,
- the installation
- operation manual(s) and other documentation

Certification |

IEC 61400-2 (SWT) - includes V and H turbines



IEC 2896/13



Certification | Compliance certification SWTs (I/II)

Compliance

Compliance with
IEC 61400-2
and its
normative
references

(Template for
compliance
check would be
usefull for
engineers)

Safety

Unauthorized
people do not
approach the
area of an SWT
within a radius
of 3m

Noise

Noise
measurements
according to IEC
61400-11

Maximum noise
level of 37 dB
at 6 m/s and 39
dB at 8 m/s
(used in
Denmark)

Vibration

In the case of
the placement of
an SWT on a
building, add a
structure which
prevents the
vibrations from
passing from
SWT to building

Certification | Compliance certification SWTs (I/II)

Flickering

Flickering should not influence people in surrounding buildings

Icing

Compliance with formulas for safety radius r :
 $1.5(D + H)$ (rotating)
 $v(0.5D + H/15)$ (non-rotating)

Or take measures to prevent icing

Or shut down SWT when temperature $< 0^{\circ}\text{C}$ and it only operate again when ice is gone

Electrical components

Compliance with IEC 61400-2, 60204-1, 60364-5-54, 62305-3 and 61400-24

IEC 60204-1: requirements to guarantee the equipment electrical safety

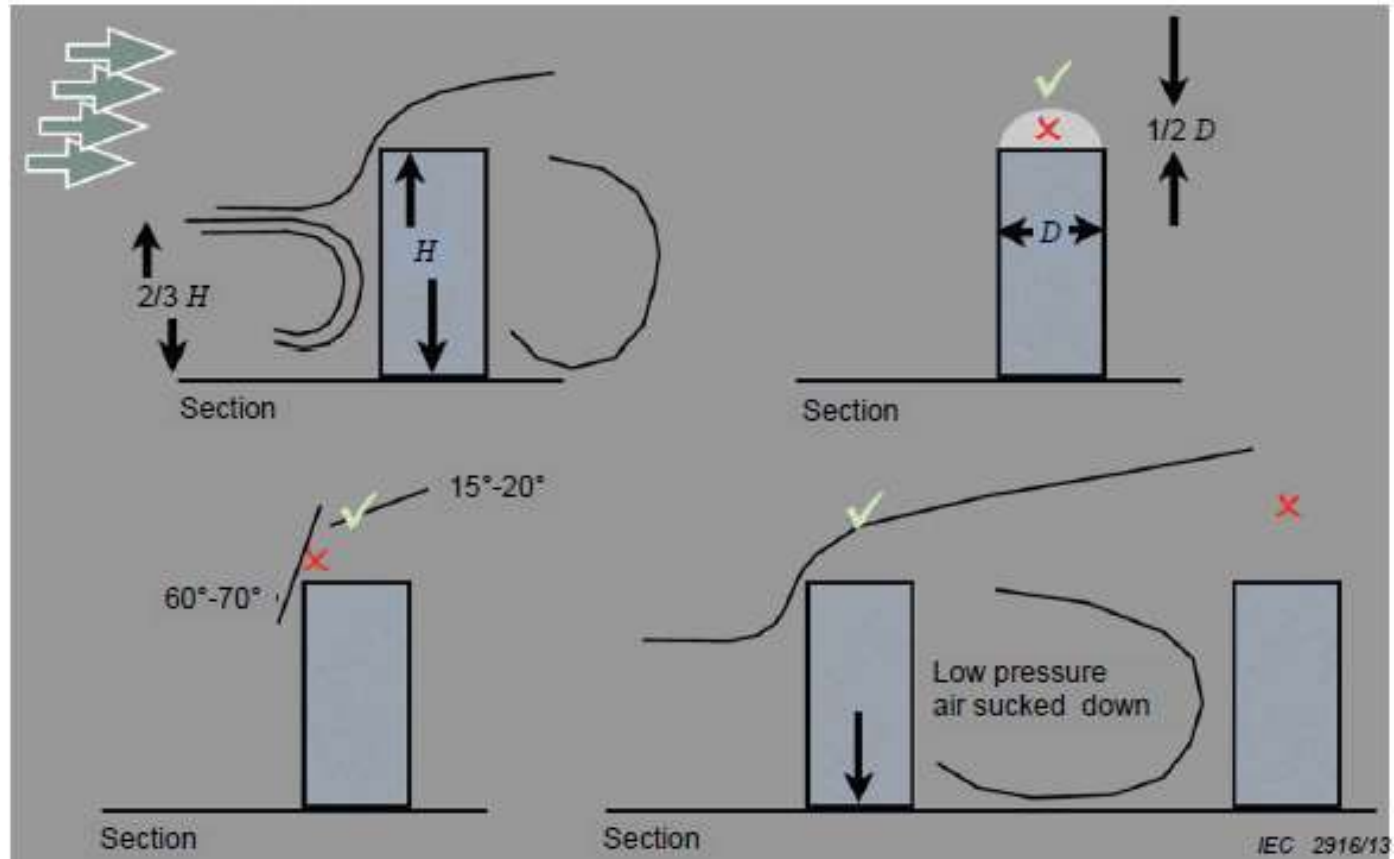
IEC 60364-5-54: requirements on earthing

IEC 62305-3 and 61400-24: protection against lightning

Site-specific wind conditions

Consult Annex L of IEC 61400-2 and examine each specific location thoroughly

Certification | Site specific wind conditions



Annex L in standard IEC 61400-2



Key messages |





Key messages

Regulatory aspects

- There are hardly any examples of *energy planning* taking into account SWT's in cities.
 - SWTs are dependent on the 'micro conditions' around the turbine and are location specific (airflows, architectural and structural conditions of the building and the environment).
- Urban planning needs to identify areas with favourable wind conditions, and needs to address architectural issues of incorporating installations while taking into account parameters of noise, vibration and public safety.
- Besides safety aspects, take into account local or regional regulations for design/installation of SWTs

Certification

- While large scale wind turbines gather momentum, the installation of smaller ones in Europe is progressing very slowly.
- One of the major problems is the lack of certified machines, turbine producers are put off by the high costs of the certification procedures
- Certification for SWT is needed to assure safe and reliable wind turbines.
- Guidance template document would help engineers on compliance
- Powercurve measurements for SWT are important to assure market acceptance of turbines

More and more applications of SWT's, it is a Developing technology; RES and LCA are drivers: e.g. for charging points of vehicles and electric bicycles; city buses, street lighting etc.

The conclusion is therefore that SWTs need to be put on the agenda of policy makers.