Teaching wind energy in 18 hours?

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Abstract

Today various universities are offering courses that vary in duration.
The **I**nternational **H**ellenic **U**niversity has asked for an **18-hour** course about wind energy for postgraduate students pursuing the MSc in Energy Systems degree in Greece.
The course is offered in English to local and international students.
So the challenge was to combine time limitations with quality knowledge taking into account the students' diverse background in sciences.
The poster highlights the key subjects that a postgraduate needs to know about wind engineering.
It presents the accredited sources from where material was taken or proposed for further reading, the major internet sources and online tools freely available today, as well as video and animation presentations.
Last but not least the 31-year experience in the field proved to be a teaching advantage.

On the drawing board!

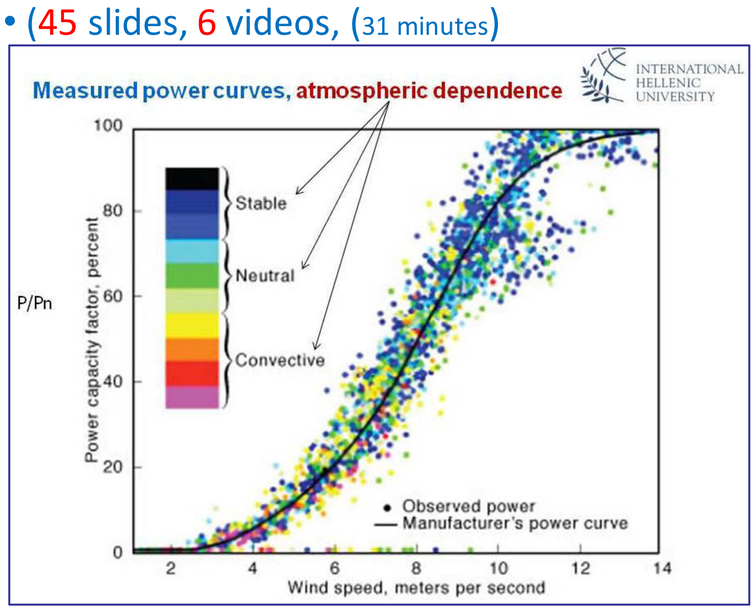
In collaboration with the course organizers CVs of the postgraduate students were studied. The class of 2016 had a mixture of **environmental specialists**, **electrical engineers**, **geologists**, **mathematicians** and **chemical engineers**. A very diverse group of sciences. This fact was taken into account in the mathematical content of the lecture notes, the physics behind the engineering to be presented and the **extra material** to be **suggested** for **further reading** in order to **satisfy a student** that needed **to go** the **extra mile.**

The lectures took place on Friday evenings and Saturday mornings in order to accommodate working students. They lasted for 3 hours each time. The course was completed after 6 days. An exam followed in June 2016. **All** the lecture material was uploaded in a university portal **prior** to the lectures.

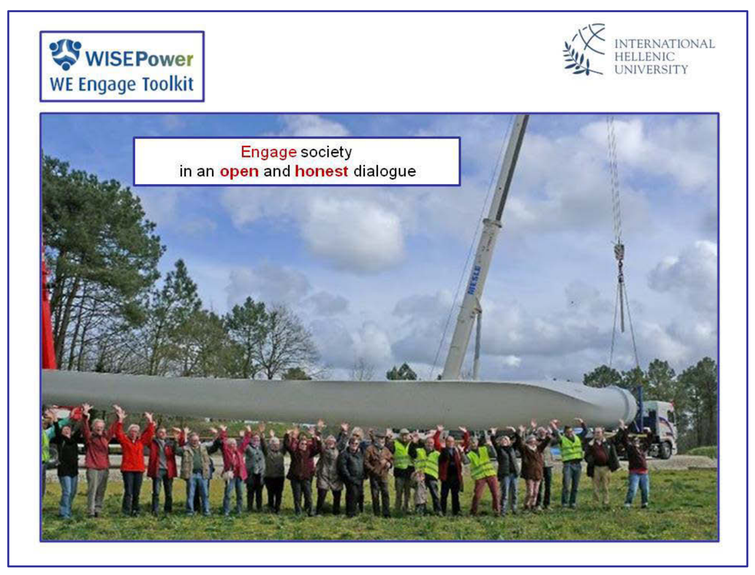
For each day additional material was uploaded well in advance. This included reports from **EWEA** (WindEurope), **GWEA**, **IEA**, **W**orld **B**ank, **IMF**, books and papers. References were made to these during the lectures. **Links** to international research centers such as **DTU** (RISO), **NREL**, MEASNET were presented with commentary about their usefulness. **A careful selection of videos and animations related to wind were presented**.

Course curriculum

• **W**ind **t**urbine **technology** today and future trends onshore & offshore, **wt** certification, **IEC 61400** standard
• (45 slides, 6 videos, (31 minutes)



• Wind **resource evaluation** (instruments-measurements-modeling), meteorological parameters
(121 slides, 2 videos (6 minutes)
• **A**tmospheric **B**oundary **L**ayer, wind speed profiles, analysis of **measurements**, wind **atlases** onshore & offshore
(54 slides)
• **Selection** methodology of most suitable locations, **site** surveys
(58 slides, 1 video (2 minutes)
• **Energy yield** (measurements-modeling-state of the art tools), wake losses, CFD codes
(76 slides)
• **Environmental constrains & social acceptability**
(79 slides, 3 videos (6 minutes)



• Detailed methodology on how to **design wind farms** in areas of **complex terrain**, plains or the sea
(45 slides + working example with students)
• A full example of a **technical** and **economic evaluation** of a big wind farm
(22 slides)

In total 500 slides and 45 minutes of videos comprised the total material presented in 18 hours.

Why was the curriculum presented in that order?

WIND TURBINES: Familiarization of the students with terminology and features of the geared and direct drive wts. Wt certification and choice depending upon extreme conditions. Videos showing the basic aerodynamic principles, transportation and construction of large wind farms onshore and offshore globally.
WIND RESOURCE: This fundamental part of wind energy took 24 % of the slide content. Instrumentation and state-of-the art LIDAR and SODAR technologies were introduced. Examples of the MCP methodology were discussed.
SITING IS EXITING: Developing a new site can and should be creative and fun. The documentation needed (maps, satellite photos), preliminary road surveys, foreseeing environmental and other technical constrains, are all crucial parts equally important to wind resource evaluation.
ANNUAL ENERGY PRODUCTION: For the 20-year operational life time of a project is the margin of error should be as low as possible. Farms designed on complex terrain sites need a CFD approach. Examples documented the usefulness of the numerical codes.
SOCIAL ACCEPTABILITY AND ENVIRONMENT: **Strong evidence** in support of wind technology were presented **against** the NIMBY syndrome .
LAB, wind farm design in complex terrain: The students were engaged in a lab were the objective was to design a wind farm along a hill top with varied orientation. Wts from 300 kW to 3.45 MW were chosen with diameters from 30 to 112 m.
A TECHNO-ECONOMIC ANALYSIS: A feasibility study was presented for a big wind farm in Crete. Experimental evaluation of the wind recourse plus CFD for estimating the wind potential at a 5 km by 5 km site. WTs ranging from 1.8 to 3 MW. Taking into account real CAPEX and OPEX values plus financial parameters, the IRR and Pay Back times were calculated using the free **RETScreen** Energy Model.

Conclusion

Yes it can be done, as long as you chose lecture material that can be understood by the majority, **anticipate individual needs** and provide **additional** resources. The **content** can be **modulated** according to the students' background. **Teaching** about this marvelous renewable resource **is** only **FUN**.