ForWind – Center for Wind Energy Research

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European Academy of Wind Energy and the European Wind Energy Master Program – Study Programs at the University of Oldenburg and in Europe

NAWEA Symposium 2015, Virginia Tech, Blacksburg, VA
June 10, 2015
Agenda

1. ForWind and European Collaborations
2. Local an International Master Programs
3. European Wind Energy Master (Erasmus Mundus)
5. Continuing Education for Professionals
Part 1

FORWIND & EUROPEAN COLLABORATION
1981: University of Oldenburg was the first to establish a „Renewable Energy Lab“ in Germany

Passive house design:
• Electrical System: wind turbine, solar panels, batteries
• Heating system: solar thermal, geo thermal, storage
• Biomass generator for heat and electricity

Research at the Dept. of Physics:
• „physics of renewable energy sources“
• measurements and simulations
• component and system behaviour

→First university research group for Renewable Energy in Germany
Today: Energy Systems Research is at the Forefront of the Energy Transition

Renewable Energy Sources
- Wind Energy, Turbulence
- Energy Meteorology
- Photovoltaics, Solar Cell Materials

Energy Efficiency
- Fuel Cells
- Energy Saving IT

Energy Systems
- Energy Economics, Sustainability
- Storage Technology & Systems
- Energy Management, Smart Grids

Study Programmes, Teacher Training

Turbulent Wind Tunnel operative in 2016:
ForWind Cooperates with Federal Institutions to form the German Research Alliance Wind Energy

- **ForWind**: 30 institutes at 3 universities in Oldenburg, Hannover, Bremen (state)
- **Fraunhofer** Institute for Wind Energy and Energy System Technology (IWES) (federal)
- **German Aerospace Center (DLR)**: 6 institutes (federal)

- 11 locations in 6 German states
- ~ 600 researchers and staff
- Share large research infrastructure
- Industry advisory board

www.forschungsverbund-windenergie.de
Become Visible Among the EU policy bodies: ForWind‘s contributions to strategic R&D&I roadmaps

- IEA Wind
- Strategic Research Agenda
- Market Deployment Strategy
- Long-Term Research Challenges
- Joint Programme Wind Energy RnD Roadmap
- Strategic Research Projects
- Large Research Infrastructures
European Academy of Wind Energy
(http://www.eawe.eu/)

- **Founded in 2004 as network for exchange of PhD students, today EAWE**
  - is a registered body of research institutions and universities engaged in Wind Energy research and education with 39 members from 14 countries
  - formulates and executes joint R&D projects and coordinates high quality scientific research and education on wind energy at a European level.

- **Important activities:**
  - Annual PhD seminar
  - Biennial conference: The Science of Making Torque from Wind
  - EAWE supervises Scientific Track of the EWEA Annual Conference
  - Facilitates exchange of staff, PhD & Master students
  - Push the development of high quality standards in Master education and support cooperation
EAWE’s Selection of Programs in Academic Education

- What you find on the website:

  **Wind Energy Master Programmes**
  - (Erasmus Mundus) European Wind Energy Master (EWEM)
  - DTU Wind Energy Master
  - Master Programme in Wind Power Project Management
  - Offshore und Ocean Technology mit Offshore Renewable Energy
  - Wind Energy Engineering

  **Extra-occupational | Part Time Study Programmes**
  - Continuing Studies Programme Offshore Wind Energy
  - Weiterbildendes Studium Windenergietechnik und -management

- This list not all-inclusive. There is a large number of other programs.

- Programs vary greatly in scope and address different target groups:
  - research \(<=\) application

- Cooperations on master level have begun just recently.

- EWEM is best-practice in research area.

- ForWind is pioneering with continuing education.

- There are other networks like the Association of European Renewable Energy Research Centres (EUREC).
Part 2

WIND ENERGY MASTER EDUCATION AT UNIVERSITY OF OLDENBURG/FORWIND
University of Oldenburg: Over 30 Years of Experience in Teaching Renewable and Wind Energy

1980
Physics
BSc / MSc / PhD

1987
Postgrad. Progr. Renewable Energies (PPRE) MSc

2002
European Master in Renewable Energy by EUREC MSc

1998 / 2011
Engineering Physics BSc / MSc / PhD

2012
EWEM – European Wind Energy Master MSc

since 2011: Wind Physics
Number of credits and students per year

<table>
<thead>
<tr>
<th>Program</th>
<th>ECTS in total / in wind (including master thesis)</th>
<th>Students per year in total / in wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPRE</td>
<td>90 / ~30</td>
<td>≤ 40 / ?</td>
</tr>
<tr>
<td>EUREC</td>
<td>90 / ~60</td>
<td>≤ 20 / ?</td>
</tr>
<tr>
<td>Physics</td>
<td>120 / ?</td>
<td>~ 40 / ?</td>
</tr>
<tr>
<td>Engineering Physics</td>
<td>120 / ~108</td>
<td>~ 140 / 40</td>
</tr>
<tr>
<td>EWEM</td>
<td>120 / 120</td>
<td>35-40 / 35-40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50% Rotor Design, 25% Offshore Engineering</td>
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<tr>
<td></td>
<td></td>
<td>15% Electrical Power Systems</td>
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<tr>
<td></td>
<td></td>
<td>10% Wind Physics</td>
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</tbody>
</table>
Postgraduate Programme Renewable Energy (PPRE)

- Established 1987
- Master of Science
- 3 semester (= 90 ECTS)
- In English
- More than 400 alumni from 79 countries
- Since 2002: core semester provider for the EUREC-Master in RE
- Wind Energy only one of many topics (12 ECTS + thesis)
- Approx. 40 Students per year
European Master in Renewable Energy

International Master organized by the Association of European Renewable Energy Research Centres (EUREC)

3 semesters (90 ECTS):
(1) Core → (2) specialization → (3) Master project

Specializations (30 ECTS)
- Photovoltaics
- Grid Integration
- Wind power
- Hybrid systems
- Solar Thermal
- Ocean Energy

Wind Energy: 30 ECTS + master thesis
Approx. 20 students per year
EUREC-Master Partner Universities

Core providers:

Oldenburg University, Germany (English)
Ecole des Mines de Paris, France (French)
Loughborough University, UK (English)
University of Zaragoza, Spain – (Spanish)
Hanze University of Applied Sciences, The Netherlands (English)

Specialisation Providers:

National Technical University of Athens, Greece - Wind
Kassel University, Germany - Hybrid Systems
University of Northumbria, UK – Photovoltaics
University of Zaragoza, Spain - Grid Integration
University of Perpignan, France - Solar Thermal
Instituto Superior Tecnico, Portugal - Ocean Energy
Engineering Physics

- In cooperation with University of Applied Science, Emden
- Master of Science in English language.
- 4 semesters / 120 ECTS
- Physics, Mathematics, Engineering Sciences
- Specialisations:
  - Renewable Energies → Wind Physics
  - Lasers & Optics
  - Biomedical Physics and Acoustics
- Wind Energy: up to 75 ECTS + thesis
- 140 students per year in program / around 40 in Wind Energy
Part 3

EUROPEAN WIND ENERGY MASTER (EWEM)
European Wind Energy Master (EWEM)

- 4 world-leading Wind Energy universities join forces
- Building on long-standing cooperation in research and local master programs
- 2 year program, 4 tracks, double degree
- Erasmus Mundus Scholarships for students
- Mobility funding for staff and students
- Associated partners: major industry, business & associations involved: guest lectures, summer schools, internships, or MSc thesis
- Aim: 50-60 graduates per year (today around 40)
- Wind Energy: 90 ECTS + thesis (=100%)
# Program Structure

<table>
<thead>
<tr>
<th></th>
<th>First year (60 ects)</th>
<th>Second year (60 ects)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Semester 1</td>
<td>Semester 2</td>
</tr>
<tr>
<td>Wind Physics</td>
<td></td>
<td>UniO1</td>
</tr>
<tr>
<td>Rotor Design</td>
<td>DTU: general introduction to wind energy</td>
<td>TU Delft</td>
</tr>
<tr>
<td>Electric Power Systems</td>
<td></td>
<td>TU Delft</td>
</tr>
<tr>
<td>Offshore Engineering</td>
<td></td>
<td>TU Delft</td>
</tr>
</tbody>
</table>

- TU Delft = Delft University of Technology, DTU = Technical University Denmark, NTNU = Norwegian University of Science and Technology, UniO1 = Carl von Ossietzky University of Oldenburg
- 1 ects = 28 hours of study according to the European Credit Transfer System
# Awarded Degrees

<table>
<thead>
<tr>
<th>Track</th>
<th>Degree 1</th>
<th>Degree 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Physics</td>
<td>MSc Wind Energy Engineering from DTU</td>
<td>MSc Engineering Physics from UniOl</td>
</tr>
<tr>
<td>Rotor Design</td>
<td>MSc Wind Energy Engineering from DTU</td>
<td>MSc Aerospace Engineering from TU Delft</td>
</tr>
<tr>
<td>Electric Power Systems</td>
<td>MSc Electrical Engineering from TU Delft</td>
<td>MSc Technology-Wind Energy from NTNU</td>
</tr>
<tr>
<td>Offshore Engineering</td>
<td>MSc Offshore Engineering and Dredging from TU Delft</td>
<td>MSc Technology-Wind Energy from NTNU</td>
</tr>
</tbody>
</table>
## Required BSc Background

### Wind Physics:
- Mechanical Engineering
- Aerospace Engineering
- Mathematics
- Physics

### Rotor Design:
- Mechanical Engineering
- Aerospace Engineering
- Physics

Similar backgrounds accepted if proven relevant.
Required BSc Background

Electric Power
Systems Electrical Engineering
Physics

Offshore Engineering
Civil Engineering
Structural Engineering
Mechanical Engineering
Physics

Similar backgrounds accepted if proven relevant.
Opportunities for your engagement within EWEM:

• If you are not associated yet, try to change that.

• Host students for internships or master thesis.

• Host visiting scholars for teaching purposes.

• Use scholarship to travel to one of the four European universities for teaching purposes.

• Give guest lectures at the Summer School.

• Promote PhD and Post-Doc positions.
Some key issues for successful cooperation in joint programmes -- lessons learned from EWEM:

- Create added value for students: attractive universities and high quality of the program.
- Resources are (as usually) critical: professors, lecturers, staff, rooms,…
- Key issue: local programmes have to be existing beforehand – and they need to fit together without many new courses to be created.
- Collaboration builds on trust that has been developing over the years in research.
- Consortium partners need to overcome local administrative and legal barriers:
  - Different semester calendars / module structure / different credit systems
  - Business model to divide tuition
- Involve industry to fund scholarships (still ways to go on this…).
- Exchange with associated partners can be intensified.
Part 4

ONLINE CERTIFICATE „ADVANCED WIND ENERGY“ FOR NON-TRADITIONAL STUDENTS
Motivation: Open Universities to Non-Traditional Students

The regular student becomes less regular in Germany:

- 64% of the students have work experience
- 25% have acquired another job qualification before coming to university
- 66% of the students work part-time
- 79% of those over 30 years work part-time

→ Already, the majority of the students works part-time.

In the future: Number of professionals with Bachelor degree is likely to rise. And, they are hardly going back to university full-time!
Online-Certificate Advanced Wind Energy

Bridge Module
- Wind Energy Utilisation 3 ECTS
- Fluid Dynamics I 3 ECTS
- Computational Fluid Dynamics (CFD) 3 ECTS

Track I: Energy Meteorology
- Energy Meteorology and Numerical Methods for Wind Energy 1 3 ECTS
- Energy Meteorology and Numerical Methods for Wind Energy 2 3 ECTS

Track II: Wind Energy Systems
- Design of Wind Energy Systems 3 ECTS
- Aeroelastic Simulations of Wind Turbines 3 ECTS

Extension Module
- Measurements and Validation for Advanced Wind Energy (Lab & Field Project) 8 ECTS

Σ 23 ECTS
# Master online Renewable Energy (MoRE)

90 CP inkl. Brückensemester + 30 CP Master Thesis

<table>
<thead>
<tr>
<th>Grundlagen Modul</th>
<th>Kernmodule</th>
<th>Fachmodule (Wahlpflicht) 21 out of 60</th>
<th>Labormodule</th>
<th>Projektarbeit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>30</strong></td>
<td><strong>21</strong></td>
<td><strong>21</strong></td>
<td><strong>6</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

###Introductory Module (0)
- Introduction to Online Learning
- Introduction to Scientific research and writing

###Propädeutik (30)
- Electricity
- Solid State Physics
- Radiation
- Basic Thermodynamics
- Chemistry
- Biology
- Numerics / Simulation Basics
- Mathematics / Statistics

###Energy Resources & Systems (6)
- Energy Systems & Thermo-dynamics of RE Systems (3)
- ThD od RE Systems

###Modellbildung (3)
- Modellbildung

###Energy Resources & Systems (6)
- Energy Resources & Systems (6)
- Energy Meteorology I
- Resources, Distribution & Systems
- Rural Energy I
- Rural Energy II

###Energy, Society & Ecology (9)
- Renewable Energy & Society
- Sustainability of RE Technology
- Energy Economics
- Wind Energy Meteorology I
- Design of Wind Energy Systems
- Secondary Batteries (Basics)
- Applications for Electrical Storage Systems

###Fachmodule 7 out of all (21 CP)
- Solar Energy Meteorology
- PV Systems I
- Semiconductor I
- Biomass Energy / Resource
- Micro Hydro
- Sol. Thermal Systems I
- Sol. Thermal Systems II

###Labormodul I (3)
- Labs: RE components and Energy Transfer Mech. (3)
- Intro. to Lab Work

###Labormodul II (3)
- Labs: RE Systems (3)
- Datalogger

###Project Work (10)
- Case Study (4)
- Management (2)
- Financing (2)
- Software (2)

###Modul Internship (6)
- Internship (6)

###Wind Energy Meteorology I & Wind Energy Meteorology II
- Wind Energy Meteorology I
- Wind Energy Meteorology II
- Aerodynamic Simulation of Wind Turbines

###Secondary Batteries (Basics) & Grid Integration and Charge Control
- Secondary Batteries (Basics)
- Grid Integration and Charge Control

###IÖB
- mandatory, on-site
- OI: mandatory, online
- elective, online
- elective, free choice

rot: Lehrveranstaltungen ForWind
blau: Next Energy
grün: IÖB
Part 4

CONTINUING EDUCATION FOR PROFESSIONALS IN WIND ENERGY
10 Years of Collaboration with the Wind Energy Industry

Wind Energy Agency WAB
= Industry and business network since 2003

- Energy supplier, grid operator
- Manufacturer
- Project developer
- Finance
- Research
- Service
- Business associations
- Engineering services
- Insurance

© ForWind
Participants and Lecturers built Network of Experts in Realization and Operation of Wind Farms

- **Multi-disciplinary target group:**
  - scientists, engineers, project developpers,
  - economists, managers, law, finance, insurance,…

- **Lecturers** are experts from industry, business, and universities.

- **Aims:**
  - Offer systematic know-how about wind energy projects.
  - Fill individual knowledge gaps.
  - Develop **interdisciplinary competences**.
  - Build **network** of experts.

- **Leadership program.**
Interdisciplinarity and Systems Knowledge

Understand and Master the Complexity of Modern Wind Farm Projects

- Science, Technology
- Law, Policy, Economy
- Planning, Development
- Financing, Insurance
- Manufacturing, Components
- Logistics, Construction
- Technical and Commercial Operation
- Maritime Technologies
Example: Participants of the Continuing Studies Program in Offshore Wind by Areas of Supply Chain

**Planning & Consenting**
- Public Affairs
- Investment Fund, Bank
- Engineering, Consulting

**Project Development**
- WT Manufacturing
- Offshore Substructure
- Technical and Commercial Operation
- Energy Supplier
- Insurance Surveyor / Broker
- O&M Manager

**WT Manufacturing**
- Technical Design
- Procurement
- Service Technician

**Offshore Substructure**
- Technical Design
- Law, Contracting
- TSO
- Substation Engineering
- Electrical Power Systems

**Installation & Commissioning**
- Naval Officer Installation Vessel
- Construction Site Management
- Ship Building
- Harbour Development
- Cable Manufacturing

**Electrical System & Grid**
- Electrical System & Grid
- Energy Supplier
- Project Development
- Ship Building
- Engineering, Consulting

**Construction Site Management**
- TSO
- Substation Engineering
- Electrical Power Systems

**Technical and Commercial Operation**
- Planning & Consenting
- Investment Fund, Bank
- Engineering, Consulting

**Sale**
Structure and Organisation

• Part-time study program for and with professionals
  • Duration: 11 months
  • University certificate on Master level (30 ECTS)
  • Fee: 9.200 EUR
• Mix of methods / „blended learning“:
  • Lecturers from industry, business, universities.
  • Exclusive reading material (3-4 weeks reading period)
  • On-site seminars once a month
  • Project work (wind farm development)
  • Field trips, workshops, …
  • Online learning platform
• Alumni network with more than 220 alumni and 80 lecturers
The Key Learning Experience: Develop a Wind Farm in Interdisciplinary Project Teams

Task: Wind Farm Development
- Interdisciplinary teams form virtual company
- Project meetings during on-site lectures
- Support through online-platform
- Project presentation is main part of final exam

Learning by doing:
- Learn all aspects of wind farm development
- Gain experience in project and team management
- Train communication and negotiation skills
CONCLUDING REMARKS
Conclusion

• There are many good examples for educational activities in Europe. EAWE started as network for PhD students but is now supporting exchange about curricula on Master level.

• EWEM is best-practice model.

• Collaboration among universities is wanted in Europe. There are a lot of organisational and administrative challenges. Personal connections are key!

• Education of non-traditional students is becoming more important: Continuing online and part-time programs offer new chances. Collaboration with industry is important – and in return also helps to extend the network for researchers.

• Future challenges in the energy transition (innovation in systems technologies for grid stabilisation, smart grids, or new market instruments) will lead to changes in the programs.

➔ We are looking forward to collaborating with you!
Thank You! Questions?

Collaboration wanted!

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