Technical University of Denmark
Department of Environmental Engineering
DTU Environment

Web: env.dtu.dk

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Head, International Research Relations

DTU Environment
Department of Environmental Engineering
DTU Mission

To develop and create value using the natural sciences and the technical sciences to benefit society.

HC Ørsted 1829

Education
Innovation
Research-based consultancy
Research
DTU Vision

DTU is recognized as an elite technical university, assessed according to the highest international standards, with the traditions of Danish engineering as the foundation for its activities.

DTU is known for active and close interaction between the technical sciences, the natural sciences and adjacent scientific disciplines; between practice, theoretical and empirical research; between researchers and students, and between the University and society in general.

As an elite technical university, and through its collaboration with private and public sector stakeholders, DTU is to act as a driving force for welfare and sustainable value creation in Danish society, and should consistently take on the same role in an international context.
## Facts & figures (2013)

### Education

<table>
<thead>
<tr>
<th>Programme</th>
<th>Students</th>
<th>Programmes</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEng</td>
<td>4,028</td>
<td>17</td>
</tr>
<tr>
<td>BSc</td>
<td>2,775</td>
<td>16</td>
</tr>
<tr>
<td>MSc</td>
<td>3,187</td>
<td>28</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9,990</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Out of total number of MSc*

**Exchange students** 961

### Employees

<table>
<thead>
<tr>
<th>Category</th>
<th>FTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty and researchers</td>
<td>2,003</td>
</tr>
<tr>
<td>PhDs</td>
<td>1,200</td>
</tr>
<tr>
<td>Technical and administrative staff</td>
<td>2,518</td>
</tr>
<tr>
<td><strong>DTU total</strong></td>
<td>5,721</td>
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</table>

### Research

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
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</thead>
<tbody>
<tr>
<td>Research publications</td>
<td>4,098</td>
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<tr>
<td>ISI publications</td>
<td>2,595</td>
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<tr>
<td>ISI citation impact</td>
<td>10.5</td>
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</table>

### Finances

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount (mio. €)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenues</td>
<td>627</td>
</tr>
<tr>
<td>Hereof:</td>
<td></td>
</tr>
<tr>
<td>... education</td>
<td>97</td>
</tr>
<tr>
<td>... research</td>
<td>209</td>
</tr>
<tr>
<td>... external research funding</td>
<td>202</td>
</tr>
<tr>
<td>... public sector services</td>
<td>47</td>
</tr>
<tr>
<td>... commercial and other revenues</td>
<td>72</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of revenues</th>
<th>Amount (mio. €)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... education</td>
<td>97</td>
</tr>
<tr>
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<td>72</td>
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</tbody>
</table>

### Innovation

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovations notified</td>
<td>169</td>
</tr>
<tr>
<td>Patent applications filed</td>
<td>114</td>
</tr>
<tr>
<td>New companies</td>
<td>19</td>
</tr>
<tr>
<td>Industry agreements</td>
<td>1,146</td>
</tr>
</tbody>
</table>

DTU Environment
Department of Environmental Engineering
A nationwide university

DTU Environmental Engineering

3 university campuses
Lyngby, Copenhagen
Risø, Roskilde
Ballerup, Copenhagen

8 research stations

2 science parks

1 research vessel

1 Arctic educational centre
Alliances and strategic partners

Partnerships

> 200 exchange partners
Department of Environmental Engineering: Mission and Vision

The *mission* is to carry out research, disseminate knowledge and teach within the science and technology of environmental engineering at a high international level within:

- sustainable management and engineering of *water* in natural, urban and industrial contexts
- processing and recovery of *residual resources*
- environmental risk assessment and risk reduction wrt. *chemicals*
- technology transfer, development and innovation
- research-based BSc, MSc, PhD and continuing education

The *vision* is to be at the **leading edge** scientifically and technologically. Specifically DTU ENVIRONMENT shall be:

- among the top 5 university departments in Europe within selected fields of engineering measured by commonly accepted indices
- identified as a preferred provider of knowledge and knowledge-based solutions in environmental technology in Denmark and Europe
- recognized by peers, public authorities, industry and society as a highly qualified, independent, reliable and effective partner
Department of Environmental Engineering: Staff

Permanent Scientific Staff
- 26 Faculty
- 5 Senior Researchers

Research
- 70 PhD students
- 35 Postdocs and researchers
- 17 Technicians

Services
- 5 Project and HR management
- 3 Graphics and communication
- 2 Education management
- 3 IT

32 nationalities
English is the working language
Department of Environmental Engineering: Teaching deliveries

Courses:
- BEng: 3
- BSc: 11
- MSc: 28
- PhD: 4-7

Students:
- BSc: ~150
- MSc: ~100 + guest students ~ 100, ERASMUS etc

Graduates per year:
- BEng: 0-2
- BSc: 10-16
- MSc: 30-40
- PhD: 15-20
Department of Environmental Engineering: International alliances

Sino-Danish Center, Beijing, China:
- Teaching in China
- PhD students

EuroTech: TUM, EPFL, Eindhoven:
- Joint MSc program
- PhD students

Nordic5Tech: NTNH, Chalmers, KTH, Alto
- Joint MSc program
- PhD students

KAIST: Korea Advanced Institute of Science and Technology
- Research projects
- Staff exchange

Tsinghua University, Beijing, China:
- Research projects
- Teaching

Tongji University, Shanghai, China:
- PhD student exchange
DTU Environment - Sections
Department of Environmental Engineering: R&D in four sections

**Water Resources Engineering:** Poul L Bjerg (H), Philip Binning, Peter Bauer-Gottwein, Mette Broholm, Massimo Rolle, Monica Garcia, Ursula McKnight, Gitte Lemming & Dan Rosbjerg:

**Urban Water Engineering:** Hans-Jørgen Albrechtsen (H), Peter Steen Mikkelsen, Barth F Smets, Benedek Plósz, Martin Rygaard, Karsten Arnbjerg-Nielsen, Claus Helix-Nielsen, Morten Borup, Henrik R Andersen, Luca Vezzaro Hjalte Danielsen & Arnaud Dechesne:

**Residual Resource Engineering:** Thomas Astrup (H), Charlotte Scheutz, Peter Kjeldsen, Irini Angelidaki, Thomas Astrup, Anders Damgaard, Dimitar Karakashev & Alessio Boldrin:

**Environmental Chemistry:** Anders Baun (H), Stefan Trap, Philipp Mayer, Eva Eriksson, Steffen F Hansen & Hans-Christian Lützhøft:
Urban Water Engineering focusses on sustainable management of the urban water cycle with respect to its quantity and quality dealing with processes and technologies across the continuum from raw water, to potable water, to wastewater, to storm water. In all cases, collection, treatment, use, and reuse are considered. Both computational and experimental studies are conducted and research is done at the lab, pilot, full, or city scale, and in collaboration with other research institutes, stake holders, or end users.

Scientific topics in focus:
- Water supply
- Storm water management
- Climate change impact and adaptation
- Wastewater treatment
- Microbial ecology
Systems analysis of urban water systems
Management of multiple water qualities in complex water systems requires development and application of tools to assess climate change mitigation and adaptation, energy efficiency, cost efficiency, health and risk.

Treatment technologies in water supply
Understanding and optimization of treatment processes to ensure good water quality. This includes biological rapid sand filters removing e.g. ammonium and pesticides, sensors, monitoring and foodwebs with bacteria and small animals.

Membranes
Understanding membrane processes for water treatment including the use of hydraulic, osmotic or electro-chemical gradients across semipermeable membranes. Particular focus is on new membrane designs, materials and operations.

Water treatment from a chemical approach
Selection and optimization of treatment for chemical impurities from industrial pure water to wastewater and municipal drinking water to sewage. Dependence of matrix for process selection, efficiency and products and by-products.
Past, present and future rainfall extremes
Rainfall observations from gauges and weather radar, scaling from point rainfall to high-resolution weather models used in climate change predictions, non-stationary point process models, climate change factors for design, Tools to guide design and analysis.

Climate change impacts and adaptation
Cities of the future, impacts from rainfall and storm surges, risk-based design of urban water infrastructure, hydrological modelling of novel urban drainage systems, multifunctional solutions, decision making under uncertainty, innovation on climate adaptation.

Real time modelling for warning and control
Rainfall forecasts, in-situ probes and software sensors, on-line data assimilation and deterministic-stochastic modelling. Flood warning and risk-based, dynamically optimized control of sewer systems and wastewater treatment plants.

Chemical constituents in stormwater runoff
Conventional sampling methods and passive sampling techniques are combined with chemical analysis, dynamic process modelling and uncertainty quantification to assess fluxes and control options for priority pollutants at the treatment unit and catchment scale.
Wastewater systems modeling
Xenobiotic trace organics in wastewater (ASM-X); Green microalgal growth kinetics (ASM-A); Statistically interpreted computational fluid dynamics (iCFD);

Usedwater resource recovery & reuse
Enhanced biological phosphorus recovery and removal (EBP2R); Photobioreactor process (TRENS); LCA-aided technology development (reuse: fertigation, high-value products); Innovative N- & trace organics removal processes.

Wastewater systems analysis
Use our modelling frameworks and experimental design to understand (i) the xenobiotic chemical risk and urban drug abuse (sewage epidemiology); (ii) bioreactor hydraulics under climate-related shock-loading conditions

Greenhouse gas emission and mitigation
Measurement of N₂O and CH₄ emissions from wastewater treatment plant units using liquid, off-gas, and plume-based methods, experimental verification of mitigation scenarios, CO₂ footprint calculations
Managing the engineered N cycle
Combining biogeochemical, molecular and mathematical modeling skills, the controls of biogenic N$_2$O emission, new N pathways, and innovative solutions for low-cost N removal are investigated, at lab- and full-scale.

Gene flow in microbial communities
Horizontal transfer of ARGs in mixed microbial communities, effect of environmental stress, high-throughput identification of bacteria involved in transfer and mobilization of MGEs.

Biofilms and bioaggregates
Innovative biofilm reactor technology, agent-based and continuum biofilm modelling, advanced analytical techniques including CSLM and microelectrode inspection to assess and control biofilm architectures.

Characterization of microbial communities
Understanding the structure and function of engineered microbial communities using a combination of physiological studies, molecular tools and ‘omics approaches to improve management of engineered microbial communities.
Water Resources Engineering covers management, protection and remediation of freshwater in natural settings (rivers, lakes) and groundwater in shallow and deep aquifers

Scientific topics in focus:

- Reactive solute transport in the subsurface
- Risk assessment of contaminated sites
- Sustainable remediation
- Multiple stressors and decision support tools
- Hydrogeophysics and data assimilation
- Hydroeconomics
- Land atmosphere interaction
Reactive solute transport in the subsurface
The physical, chemical, biological and geochemical processes that control release, transport and fate of contaminants in the subsurface need to be understood to facilitate the development of characterization tools, risk assessment and remediation.

Risk assessment of contaminated sites
Contaminated sites pose a significant threat to groundwater resources. Tools and methods to identify the sites posing the largest risk to drinking water resources and groundwater-dependent ecosystems are developed.

Sustainable remediation
Development and enhancement of innovative in situ remediation technologies are crucial. Research combines lab experiments, field studies, modeling and life cycle assessment.

Multiple stressors and decision support
Groundwater and surface water resources are under increasing pressure from multiple stressors. A holistic view of water resources, highlighting the linkages between ground- and surface water, and decision support tools for water resources management are needed.
Hydrogeophysics and data assimilation

Hydrological modelling by informing models with space-borne and ground-based geophysical data are a main focus. These new data sources pose a great challenge to modelling. Areas such as real-time management and data assimilation are inherent parts of the efforts.

Hydroeconomics

Determination of the spatial, inter-temporal and inter-sectoral trade-offs in water resources allocation in a stochastic and possibly non-stationary environment (climate change). Water resources management decision support tools must interface with state-of-the-art energy models to assess the trade-offs between the energy sector and other water use sectors.

Land atmosphere interaction

Methodologies and models as well as spatial databases of hydro-meteorological variables relevant for water resources management, drought risk mitigation, climate models, or valuation of ecosystem services are developed.
Residual Resource Engineering deals with characterization of waste and resources, treatment technologies to extract materials and energy, disposal methods for rejects, and assessment of overall environmental performance. Special focus is on generation of energy by anaerobic microbial processes (bioethanol, biohydrogen and biogas). Focus is on municipal waste, industrial waste and agricultural waste.

Scientific topics in focus:
- Solid characterization
- Gaseous emissions
- Life cycle assessment
- Resource management
- Biogas technology
- Algae biomass utilization
- Biorefinery
- Microbial electrochemistry
Solid characterization
Characterization of physical and chemical properties of waste, biomass and secondary materials essential for their quality as a resource, as well as for the environmental impacts associated with their recycling and utilization.

Gaseous emissions
Quantification and control of fugitive greenhouse gas emissions from waste and biomass technologies require specific full-scale measurement techniques and mitigation systems (biocovers).

Life cycle assessment
Life-cycle-assessment modelling is the key in finding sustainable environmental solutions. The dedicated LCA model EASETECH is applicable to waste management, biorefineries and renewable energy technologies.

Resource management
Material flow analysis and approaches to characterize the resource quality in waste and biomass streams are fundamental to developing resource effective systems and to ensure high recycling of quality materials.
Biogas technology
Technology development of anaerobic digestion of waste and biomass involves process configuration, monitoring and control. The aim is to produce energy-rich biogas and allow recycling of nutrients to land by application of digestate.

Algae biomass utilization
Algae (micro, macro) are used for capturing nutrients and pollutants from aquatic environments while simultaneously producing biomass that can be utilized in biorefineries.

Biorefinery
Biorefineries are integrated environmental biotechnologies for optimal utilization of a range of wastes and biomasses by producing biofuels (ethanol, biogas), high-value biochemical products (organic acids), and nutrients for recycling.

Microbial electrochemistry
Microbial electrochemical processes are investigated with the purpose of developing new approaches and technologies for biofuel production and for development of biosensors.
Environmental Chemistry is dedicated to basic and applied research in environmental toxicology and chemistry. The overall aim is to gain scientific knowledge that can strongly contribute to the identification, quantification, and decision-making in relation to environmental problems caused by emissions of existing and emerging chemical contaminants from the technosphere to the environment.

Scientific topics in focus:
- Contaminant source tracking
- Chemical fate modelling
- Ecotoxicity of chemicals and nanomaterials
- Regulatory engineering
- Nanomaterials in the environment
- Partitioning-based approaches
Contaminant source tracking
Chemical contaminants’ sources, flows and accumulation in the technosphere sinks are identified and tracked though a combination of “dry” and “wet” methods. Source identification such as database mining and review; substance flow analysis; and chemical fingerprinting are the frequently applied tools.

Chemical fate modelling
Prediction of the fate and behavior of chemicals in the environment is feasible with mathematical models that integrate physical, chemical and biological process. Our focus is on plant uptake and bioaccumulation.

Ecotoxicity of chemicals and nanomaterials
Development of new test principles and methods for providing information on ecotoxicity which is one of the cornerstones in environmental risk assessment. We are specialized in algal, crustacean and plant tests, and in testing of poorly soluble chemicals and other difficult to test chemicals.
Regulatory engineering
Regulation involves complex environmental, social and ethical considerations. Regulatory engineering focuses on the development of decision-support frameworks and principles making better use of engineering in regulatory settings. Focus is on regulation of chemicals and nanomaterials.

Nanomaterials in the environment
The increasing use of nanomaterials in society makes it crucial to understand their environmental behavior and effects. Advanced physical-chemical characterization, models and laboratory experiments provide a base for increase scientific insight and regulatory decision-support.

Partitioning-based approaches
Partitioning based approaches are applied in research on processes, exposure and effects of organic chemicals in the environment. Partitioning into polymers is used for enrichment and measurements at ultra-trace levels. The section is internationally leading the development of passive dosing.
To develop and create value using the natural sciences and the technical sciences to benefit society.

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To attain this vision, DTU is committed to the triple-helix in its activity (strong collaboration between university, industry and public owned utilities, government funding bodies)