TUM DeSal Challenge

A Novel Educational Campaign for and with Students to Face Water Scarcity

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Meeting the worldwide demand for energy and water is the biggest challenge of this century. Technische Universität München is strongly committed to research on technologies providing sustainable solutions. The Institute of Thermodynamics contributes to this research in the areas of Combustion, Thermo Acoustics, Transport Phenomena and Energy as well as Environmental Technologies.
To provide the educational basis required for research in the energy and water sector, we offer lectures including Thermodynamics, Heat- and Mass-Transfer, Multi-Phase-Flow as well as Solar Engineering and Desalination. Among our research projects, we are active in desalination, both thermal and membrane based, also being supported with renewable energy.

The **TUM DeSal Challenge** to date has been a unique competition that was created for drawing attention to the challenge of the worldwide water shortage. This event took place for the first time in 2009. As the competition was very well received by high school students, university students and others, we decided to repeat the Challenge every two to three years.

10 to 20 teams from schools and universities are nominated to challenge the global drinking water problem and to develop and build each a small, self-powered plant for seawater desalination.
The competition is accompanied by the **TUM DeSal Conference** in the area of desalination and water treatment focusing on strategies and technologies with low impact on the environment."
This new educational approach is focusing on young people to integrate them in the process of solving the problem of water scarcity, which is mainly promoted by research and industry. We want to provide a valuable platform for high schools, universities and industry.
In hosting the **TUM DeSal Challenge**, we look forward to fostering partnerships and networks within the desalination community.

TUM DeSal Challenge

Mission

There are five main objectives of **TUM DeSal Challenge**. First of all, the main goal of the competition is to inform young people in schools and universities worldwide about the danger of the drinking water scarcity and to motivate them to contribute to the question of how to tackle the task.
Special attention is drawn to a responsible and economical use of natural resources in combination with the technology of seawater desalination, which results in the development of systems powered by regenerative forms of energy for the decentralized operation in economically weak regions.
By putting emphasis on training the team participants, latest results of research feed into the contest entries and create new, innovative approaches. Eventually, the plan is to develop new ideas. These are going to be expanded to research projects in cooperation with the participants from the competition and ultimately to be commercialized. Young people, especially the participants from high schools, get in touch with science and engineering in a very early stage. For engineering students, cost calculations and business plan workshops make them aware of the importance of business management skills.
Last but not least, attention of the general public has to be drawn to the growing issues of drinking water scarcity in the world. Participants as well as visitors create great publicity which carries idea of the challenge into the wide world.

Milestones for TUM DeSal Challenge 2016

Since 2009, around 10 to 20 student teams per competition provide their own, novel solution for sustainable seawater desalination exclusively by means of renewable energies. They develop extremely creative, innovative concepts for the construction of energy-self-sufficient desalination plants.
When the Call for Applications opens, student teams send their ideas to the **TUM DeSal Challenge** where an independent jury of specialists, consisting of top-flight personalities from the areas of scientific research and industries, selects the best ideas. During the application period, the challenge is planned to be accompanied by Webinars which provide students with the necessary fundamentals on desalination. Depending on the available funding and the originality of the concepts handed in, 10 to 20 teams are selected for the competition's final. Those teams finally realize their theoretical concepts. Each team is funded with a starting capital of 1,000 EUR to build their plants – money acquired by the **TUM DeSal Challenge** organization beforehand. A kick-off meeting with the participating teams during the World Water Day brings the competitors together to enhance team spirit as well as the opportunity to exchange experiences and ideas.
On the two-days-final, the competition is accompanied by a scientific conference on desalination, the **TUM DeSal Conference**. The conference deadlines are synchronized with the ones of the challenge. The scientific program focuses on discussion about "Desalination Systems with Transient Power Supply", the conference topic of 2011, or, more generally, about "Desalination and Water Treatment" in 2013. Accompanied by an exhibition area for sponsors' booths, this provides a platform for both, industry and research. In the **TUM DeSal Exhibition**, sponsors have the opportunity to present their business as well as their products. Additionally, in 2011, the **TUM DeSal Kids Program**, was held the first time, where even kindergarten kids explored over several months the secrets of water and worked with solar stills discovering desalination science.
Over 250 students from Germany, Austria, Switzerland and Spain joined the **TUM DeSal Challenges** in 2009 to 2013. In 2013, the range of countries of origin extended even further to Serbia, Morocco, Spain and Australia. In 2016, the contest is aimed to expand even more.

Preliminary Program for 2-Days-Final of TUM DeSal Challenge and TUM DeSal Conference

Day before Event	
18:00	Dinner with TUM DeSal Challenge jury members and conference speakers

Day 1	TUM DeSal Challenge	TUM DeSal Conference
7:00 – 10:30	**Start-Up**	
	Building up of desalination plants by TUM DeSal Challenge teams.	Registration of TUM DeSal Conference participants and building up of exhibition booths by DeSal sponsors.
10:30 - 11:15	**Opening Ceremony and Welcome Address**	
11:15 - 16:00	TUM DeSal Challenge (Part I)	Visiting DeSal Challenge and DeSal Exhibition.
	Fresh water production by DeSal plants; evaluation of different contributions by the jury.	Visiting the DeSal Challenge plants during operation and DeSal Sponsors' booths at Exhibition
16:00 - 17:00	**Team Presentations at Conference**	
	Oral Presentations of TUM DeSal Challenge teams: innovative DeSal concepts are presented by the student teams.	
	Conference Session 1: Scientific Topic 1	
17.00 - 17.20	Visiting the TUM DeSal Conference and Exhibition.	Presentation 1
17:20 - 17:40		Presentation 2
17:40 - 18:00		Presentation 3
	Conference Session 2: Scientific Topic 2	
17.00 - 17.20	Visiting the TUM DeSal Conference and Exhibition.	Presentation 4
17:30 - 18:00		Presentation 5
18:00 - 18:30		Presentation 6
19:00	**DeSal Summer Festival with Barbecue and Band**	

Day 2	TUM DeSal Challenge	TUM DeSal Conference
8:00 - 10:00	**Breakfast**	
	TUM DeSal Challenge (Part II)	**Conference Session 3: Company and Sponsor Presentations**
10:00 - 10:20	Fresh water production by DeSal plants; evaluation of different contributions by the jury.	Company 1
10:20 - 10:40		Company 2
10:40 - 11:00		Company 3
11:00 - 11:20		Company 4
11:20 - 11:40		Company 5
11:40 - 12:00		Company 6
12:00 - 13:00		Visiting DeSal Challenge and Exhibition.
13:00 – 14:00	**Lunch Break**	
	Conference Session 4: Scientific Topic 3	
14:00 - 14:30	Visiting the TUM DeSal Conference and Exhibition.	Presentation 7
14:30 - 15:00		Presentation 8
15:00 - 15:30		Presentation 9
15.30 - 16.30	**Award Ceremony TUM DeSal Challenge and DeSal Conference Best Paper Award**	

Milestones 2016

17th/18th June 2016 — **TUM DeSal Challenge 2016**
TUM DeSal Conference 2016
TUM DeSal Exhibition 2016
(2 Days Final)

22nd March 2016 — ▲ Building of DeSal Plants by Students

15th February 2016 — **Kick-Off Team Meeting on World Water Day**

Nomination of Challenge Participants and Conference Presenters
(Press Conference)

▲ Evaluation by DeSal Jury

1st December 2015 — **Deadline for Applications and Abstracts**
(info@desalchallenge.com)

▲ Webinars on Desalination

1st September 2015 — **Call for Applications and Abstracts**
(www.desalchallenge.com)

Disciplines

The **TUM DeSal Challenge** ends up with a great 2-days-final in Munich when the nominated teams run their self-developed and self-constructed desalination plants competing in six categories against each other:

1. Drinking Water Capacity and Quality
2. Cost Planning
3. Maintenance Effort, Ease of Use and Installation
4. Degree of Innovation
5. Design and Engineering
6. Communication

Exclusion criteria are the water quality (salinity level < 1,000 ppm) as well as an energy independent operation driven only by renewable energy sources. In order to guarantee the feasibility of the concept in developing countries and to assure a largely fair competition, it is not allowed to exceed the costs of 2,000 EUR. Each team is funded with a starting capital of 1,000 EUR for building their plants.

Jury Members 2009 to 2013

Claus Mertes

Deutsche Meerwasser-Entsalzung GmbH

Prof. Dr. Oliver Mayer

General Electric Global Research

Dr. Bruno Schiebelsberger

Solarenergieförderverein Bayern e.V.

Dr. Paul Schausberger

UNIHA Wasser Technologie GmbH

Dr. Christian Weidl

BASF SE Ludwigshafen

Dr. Joachim Koschikowski

Fraunhofer-Institute for Solar Energy Systems

Prof. Matthias Rommel

HRS Hochschule für Technik, Rapperswil

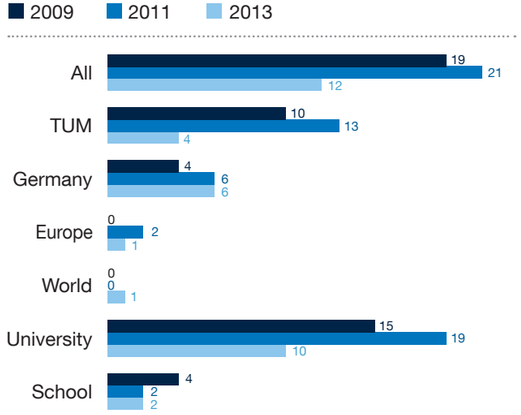
Dr. Markus Forstmeier

SGL Carbon

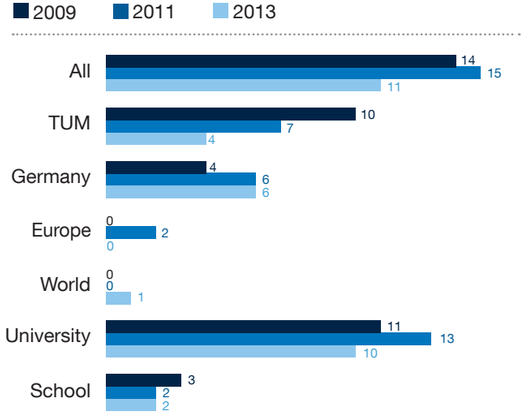
TUM DeSal Challenges in Numbers

The idea of the **TUM DeSal Challenge** was born in January 2009. It resulted in the first final in July 2009 and has been further developed to a great extent. While the host of this competition is Lehrstuhl für Thermodynamik of Technische Universität München (TUM), the main part is organized on a voluntary basis by averagely ten TUM students.

Numbers of Applications

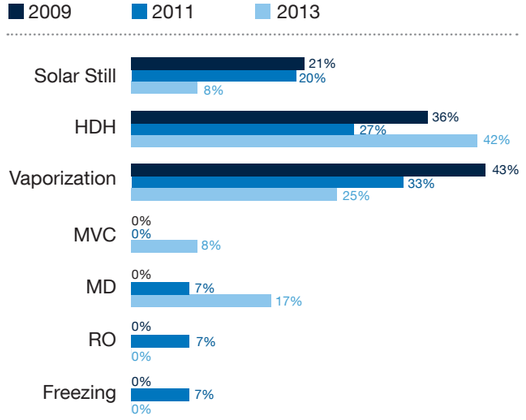


Numbers of Accepted Applications

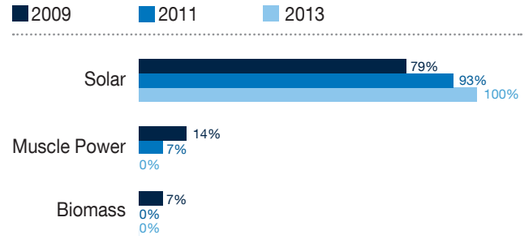


Having a look at the received and accepted applications to the **TUM DeSal Challenge**, a nice trend to international diversity of the participating teams can be seen. Whereas the event was a quite regional phenomenon in 2009 (half of the applications by TUM students), in 2013 it was possible to reach one of the main goals, which was to excite many young people in different regions of the world, starting with Switzerland, Austria and Spain in 2011. In 2013, the geographic range was even extended to Morocco and Serbia. Every team consists up to 7 team members. In total, around 100 students are involved each competition.

Range of DeSal Technologies



Range of Power Supply



The great variety of competing teams and their technical concepts represent the full range of desalination methods: membrane systems such as reverse osmosis plants, even membrane distillation, but also a large number of thermal systems, from the more classical “Improved Solar Still” to the humid air distillation up to exotics like the freezing method are being developed. This does not only show how detailed and technically adept nowadays young people deal with the solutions for providing drinking water, but also that they are ready to strike new paths.

Due to the rule that the desalination systems have to be powered by renewable energy supply, many teams focus on solar energy, both photovoltaics and solar thermal. Biomass, e.g. burning of wood, or muscle power, e.g. pumping by hand, are also applied. The jury had to smile when evaluating a team powering their plant by riding a bicycle (but drinking more water than producing).

Benefits

- **TUM DeSal Challenge** has developed to a great platform for around 100 students per competition to experiment with different ideas.
- The **TUM DeSal Conference** as scientific conference accompanied by the competition guarantees the exchange and networking spirit between young and innovative students and experienced professionals.
- For research institutes and industries, this event is the ideal platform to get in touch with highly committed and creative students and young professionals.
- Every competition, at least one team handed in a patent to maintain long-term benefit of their innovative ideas.
- The great final of the **TUM DeSal Challenge** multiplies the project's idea and rises awareness and public interest to water shortages and desalination not just of participants, but also visitors, jury members, sponsors and press.
- The awards for innovation and market relevance emphasize the focus on new ideas with a high potential to be further developed and commercialized.
- Young people get in touch with science and business issues in this international and interdisciplinary competition already during school time.

According to Participants and Friends

»During my studies, the competition aroused my fascination for seawater desalination. I was given the chance to develop new ideas in a team and to gather valuable practical project experiences. Now, I am working in the desalination business.«

(Markus Wenzel, Leader of the Team Zyklon in 2011 and Team CIS in 2009)

»It was a great experience, both with my friends in the team and the actual flair on the competition. I learned a lot technologically but even more about myself, team leading, team characters, industry relations and the process of innovation and development.«
»I would recommend projects like this not only for the desalination challenge but as a fixed part of our studies - for example instead of a semester thesis.«

(Daniel Wiegand, Leader of Team Wasserbrennerei in 2013, Winner of the Award for Market Relevance)

»The TUM DeSal Challenge was a great opportunity to get in contact with other people who share the same interests in causing a positive progress in the worldwide problem of water shortage. It was interesting to see various desalination machines. Especially how each team solved the challenges of designing such a machine was really interesting. Our desalination machine is exhibited at our University in Heidenheim. Unfortunately, we aren't able to improve our machine because we finished our studies short time after the competition and now each team member is studying/working in a different part of Germany. But the project is still developed further by other students in Heidenheim in student research projects.«

(Florian Frühsammer, Leader of the Team Drink of Water in 2013)

Public Relations

The **TUM DeSal Challenge** addresses various channels of public releations – email, homepage, newsletter, student online platforms, social media e.g. facebook, xing, press conferences, press reports, printing materials, TV reports and further more. It is accompanied by scientific publications and conference oral presentations, latest at the IDA World Congress in China 2013.
Very important for the success of this educational campaign is the spreading of its idea and thus the interest of national and international press. While regional newspapers report mostly about the teams and their performance at the competition, associations like the Deutsche MeerwasserEntsalzung e.V. transport the idea of the competition to the national and international desalination community. ChemistryViews, for example, documents the contribution of the different teams by video, beginning in 2011, and reports about the competition in the web. Television like Aljazeera TV and Pro7 (Galileo) come to the final event and report about the great innovations discovered by the students within this campaign. In 2013, even the heute.de journal (German national news) reported about the competition.

More impressions as well as references from press can be found on our website **www.desalchallenge.com.**

»We already started with three teams and it's always a great honour and pleasure for us to be a part of the „Mehrwasser" idea. The students are very motivated, they learn a lot and have fun. It's the best competition I know. See you 2016!«

(Christian Zillenbiller, Teacher and Leader of the High School Teams Konzentrix and Nebelhorn, in 2009, and Team FROG, in 2011)

»The TUM DeSal Challenge was a great opportunity to get involved in an interesting hands-on project and to intensify the curriculum. Skills you won't find in a textbook and therefore an experience that made a difference. We handed in the patent DE102009035858A1.«

(Maximilian Strauß, Leader of the Team Solarkocher in 2009)

»I have great faith in the TUM Challenge as means of drawing youth into a better understanding of both the importance of desalination and the many challenges in its successful implementation. I believe that the involvement of the IDA Young Leaders Program will help ensure the geographical diversity of the participants as well as provide energy necessary for successful execution of the Challenge.«

(Dr. Jim Birkett, first elected president of the International Desalination Association)

»As a participant of the „TUM DeSal Challenge" I had the chance to understand how the different desalination technologies work, especially the one my plant is based on. It's a sophisticated task to design, construct and run a renewable energy based desalination plant. The „TUM DeSal Challenge" is a great chance to implement your interpretation of an energy efficient and modular plant. The 1. price at the „TUM DeSal Challenge" promoted my design of a modular thermal membrane distillation plant immensely. Today we are working in three teams on the development of the plant. It is our goal to optimize the geometry as well as the membrane and after that to erect a pilot plant.«

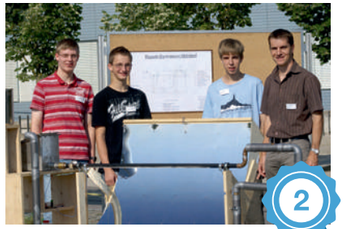
(Raphael Tarek Wagensonner, Leader of the Team NanoSystems in 2013, 1st Winner of the Competition)

Winner Teams 2009 to 2013

The Teams from 2009, 2011 and 2013

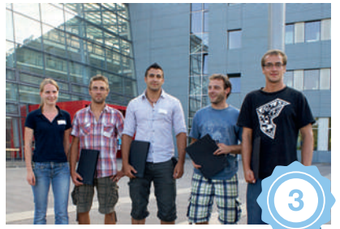
Team »Konzentrix«

Humidification-Dehumidification Powered by Concentrated Solar Thermal Power



Team »Turbine«

Humidification-Dehumidification Powered by Concentrated Solar Thermal Power



Team »Nebelhorn«

Distillation („Passarell Process“) Powered by Solar Thermal Power

Team »Steam«

Vaporization Powered by Concentrated Solar Thermal Power

Team »Solar Well«

Vacuum Vaporization Powered by Photovoltaic Solar Power

Team »Radl 2.0«

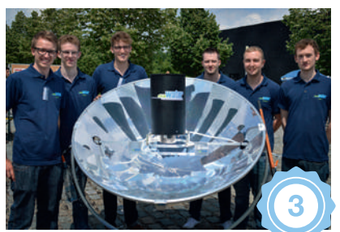
Membrandestillation Powered by Photovoltaic and Solar Thermal Power

Team »NanoSystem«

Membrandestillation Powered by Temperature Gradient in the Sea

Team »Wasserbrennerei«

Mechanical Vapor Compression Powered by Photovoltaic Solar Power



Team »Drink of Water«

Improved Solar Cooker Powered by Concentrated Solar Thermal Power

Prize for Innovation

Team »Solar Tower«

Solar Chimney with Integrated Humidification-Dehumidification Stage

Team »KJ5«

Integrated Desalination and Greenhouse System

Team »Super Sonic«

Super Sonic Supported Humidification-Dehumidification

Prize for Market Relevance

Team »Solarkocher«

Improved Solar Cooker Powered by Concentrated Solar Thermal Power

Team »Zyklon«

Humidification-Dehumidification with Forced Convection Powered by Solar Thermal Power

Team »Wasserbrennerei«

Mechanical Vapor Compression Powered by Photovoltaic Solar Power

TUM DeSal Challenge 2009 was very successful for high school teams - position one to three of the final ranking went to them. In 2011, the performance of the university teams became better and dominated the competition. In the latest event in 2013, universities of applied science were in the front.

Organizers

Organisation TUM DeSal Challenge | Conference | Exhibition
Technische Universität München
Lehrstuhl für Thermodynamik

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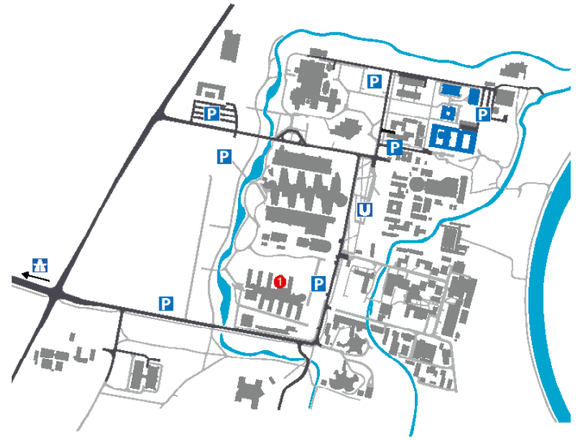

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Providing Water for the World

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