

NATIONAL RESEARCH FOUNDATION

PRESS RELEASE

20 April 2007
In Zurich

SINGAPORE SET TO BECOME A CENTRE FOR RESEARCH IN ENVIRONMENTAL SUSTAINABILITY

- *High-level delegation visiting Europe's leading organisations in water and clean energy research, led by National Research Foundation (NRF) Chairman, Dr Tony Tan, affirmed the Republic's aim to become a centre for research in environmental sustainability*
- *This follows the recent decision by the Government to invest substantially in R&D in clean energy in addition to clean water technologies*

Dr Tony Tan, Chairman of the National Research Foundation (NRF), announced that the government plans to develop Singapore as a centre for research in environmental sustainability. His comments were made during a media briefing held at the conclusion of a high-level NRF-led study trip to several top research organisations in Europe with expertise in water and clean energy technologies from 15 to 20 April 2007. With growing concerns about the global environment, Singapore, like other developed nations, needs to have long term sustainable solutions for the supply of water and clean energy. Being a compact city state, Singapore is also an ideal test-bed for new technologies in these areas.

2. The delegation visited three leading water research organisations in the Netherlands - Delft Hydraulics, the Netherlands Organisation for Applied Scientific Research (TNO) and KIWA Water Research. In the area of clean energy, the delegation visited the Energy Research Centre of the Netherlands, SolarWorld, a leading manufacturer of solar energy systems, and the Fraunhofer Institute for Solar Energy Systems (ISE) in Germany. The delegation also visited the zero energy building of the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland, and the *Maasland Kaering*, a large storm water barrier built to protect South Netherlands from North Sea surges. (Please refer to **Annex A** for fact sheets on the organisations and places visited. Details on ETH's zero energy building can be found at <http://www.forumchriesbach.eawag.ch>)

Singapore and the Netherlands are at the forefront of research in water technologies

3. Singapore and the Netherlands are both small nations which face significant challenges in ensuring the supply and security of water. Both nations have invested heavily in research and are collaborating actively to overcome these challenges. For example:

- Singapore's Public Utilities Board (PUB) is working with KIWA Water Research on a new osmotic membrane bioreactor that uses a novel forward osmosis technology to reduce the cost of producing NEWater;
- Singapore's Keppel Seghers is working with TNO to pilot test Memstill®, which makes use of industrial waste heat to distill seawater through membranes; and
- The National University of Singapore, PUB and Delft Hydraulics are partners in the Singapore Delft Water Alliance (SDWA), formed in February 2007 to work on water quality modeling and urban water resource management. Delft Hydraulics is also involved in water quality modeling for the Singapore Marina Reservoir Project.

4. The delegation gained three key insights from discussions with experts in the three Dutch water research organisations. These will guide our efforts to grow Singapore into a global hydrohub by 2015, with value added of S\$1.7 billion and the creation of 11,000 jobs:

- Globally, leadership in water technologies is concentrated in a small number of research organisations which are the principal partners in all major water research programmes. Singapore is acknowledged as one of the leading innovators in this area. Building on our existing strengths, and working with other top research organisations, there is thus good potential for Singapore to be a leader in water technologies in Asia;
- With these traditional public sector markets opening up and increased private sector participation in water treatment and supply, there are immense opportunities and markets worldwide for Singapore companies in the water business. Indeed, several have already made significant inroads into the Middle East and China markets; and
- Water research is becoming an increasingly multi-disciplinary endeavour. For example, knowledge of biology and chemistry are needed in new water treatment methods and water monitoring technologies. NRF's initiatives which support specialised manpower development and inter-disciplinary research platforms will give Singapore a strong competitive advantage in developing new technologies.

Insights from top European clean energy research organisations offer good starting point for Singapore's future work

5. The visits to the three clean energy organisations in the Netherlands and Germany have affirmed the recent decision by the Research, Innovation and Enterprise Council¹ to fund Clean Energy as a new research initiative under the S\$500 million Environmental and Water Technologies (EWT) strategic research programme². The global market for clean and renewable energy is growing very rapidly, driven by concerns about the impact of fossil fuels on the environment as well as the desires of major economies to diversify their energy sources to reduce dependency on oil and gas.

6. Singapore has the necessary competitive advantages to undertake R&D in clean energy, in particular solar energy, and to commercialise the R&D output. For example:

- This industry plays to our existing cluster strengths in electronics, chemicals and process engineering;
- Singapore also possesses manufacturing automation and supply chain management competencies which are important ingredients in the rapid scale-up of the industry; and
- We have begun building up R&D capabilities in our education institutions such as the National University of Singapore (NUS), Nanyang Technological University (NTU) and the University of New South Wales Asia (UNSW Asia), and the attraction of new competence centres from foreign R&D organisations.

7. In the near term, Singapore can play the role of an effective springboard for European companies that wish to serve the fast-growing Asian markets for clean, renewable energy. By attracting these companies to set up test-bedding and manufacturing facilities in Singapore to serve the Asian markets, we will be able to develop this industry while concurrently building up our own R&D capabilities in this field.

8. The following learning points derived from this trip will be of great help in shaping Singapore's developmental blueprint for this industry.

- The trip has affirmed that the industry is a good fit with Singapore due to its high level of knowledge and innovation content. Hence, the push by Singapore to develop R&D capabilities is timely.
- This industry provides skilled, good-paying jobs in R&D and high-value manufacturing activities which are in line with Singapore's drive to develop new economic sectors. Due to the rapid global growth, organizations in this industry are facing shortages in quality manpower for R&D and management. Therefore, Singapore's

¹ The RIEC is chaired by Prime Minister Lee Hsien Loong, comprising several Cabinet Ministers and distinguished local and foreign members from the business, science and technology community. Dr Tony Tan is Deputy Chairman of the RIEC.

² The RIEC had approved the allocation of S\$170 million to develop the Clean Energy research programme.

emphasis on manpower development, especially in Science and Technology, would help us create value for this industry.

- While Europe, Japan and US are the main markets now, clean energy organisations are increasingly turning to Asia as a new growth market as well as a source of talent. Singapore is well-positioned to serve this need, especially in terms of hosting world-scale operations in manufacturing and R&D, as well as providing the springboard to the Asian region, which includes the promising off-grid market.
- By providing financial incentives for generating power from alternative energy sources and feeding in to the national power grid, the German Government has not only been successful in catalysing the growth of its solar energy industry but has helped to diversify the country's energy sources.

Energy conservation is an important part of environmental sustainability

9. The visit to Forum Chriesbach, the zero energy building at ETH has allowed the delegation to appreciate the challenges temperate countries face in building environmentally friendly buildings. Forum Chriesbach was carefully designed to employ all available means to minimise direct energy usage such as using natural lighting, insulating walls, solar energy sources, etc. Direct energy consumption has been successfully reduced to a fraction of that required by similar sized conventional buildings. While the end goal is to minimise energy consumption, the zero energy building seeks to keep heat in, whereas Singapore's challenge is to keep heat out. Besides building up capabilities in clean energy sources, developing knowledge in reducing the energy consumption of a modern, high-density city will add to our efforts to be a centre for environmental sustainability.

10 The NRF has been in active discussion with ETH to establish a significant research presence in Singapore. ETH has proposed the establishment of a research centre to focus on Global Environmental Sustainability. Partnership with top research establishments such as ETH will allow us to tap on ETH's considerable expertise in environmental research (see **Annex B**).

Conclusion

11. Rounding up the trip, Dr Tony Tan said, "Although Singapore is a small, compact island, we have been able to maintain a high standard of living with our limited resources, and turn our constraints into our strengths. We are known to be a garden city, and have been used as a showcase for being clean and green. We have been able to provide potable and industrial water even when our limited land area provides for storage of only 50% of our water needs. Although we have done less in renewable energy research, we do have a competitive advantage in solar cell technology. We will build on our efforts in environmental sustainability to develop knowledge and technologies for addressing global concerns."

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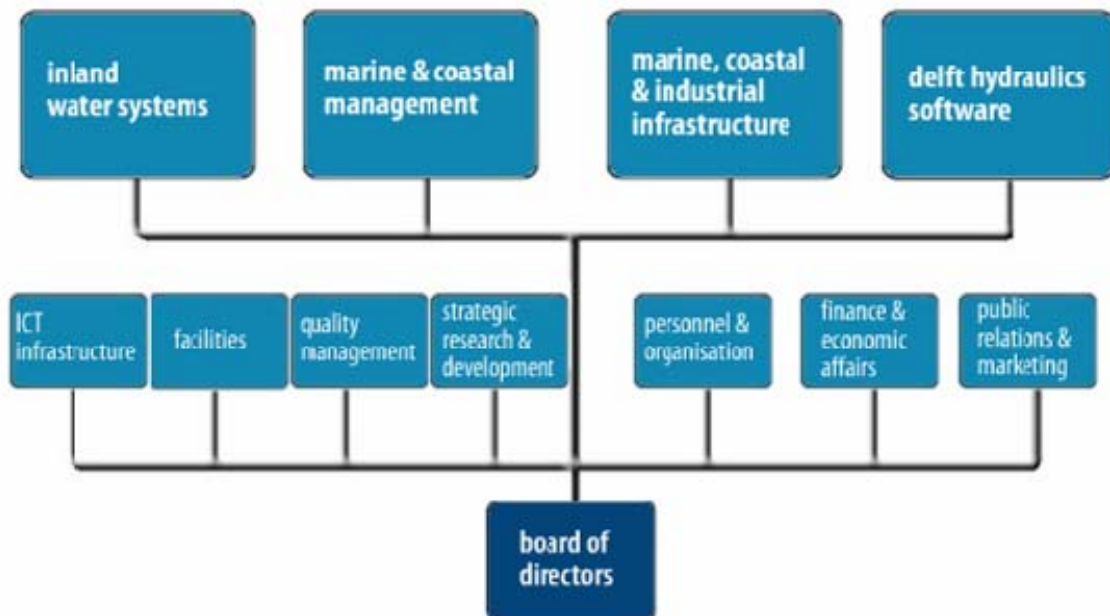
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FACT SHEET ON DELFT HYDRAULICS AND TU DELFT

ORGANISATION PROFILES

Delft Hydraulics

1 Delft Hydraulics is an independent research institute and specialist consultancy located in the Netherlands. The institute has been providing clients, at home and abroad, with expert advice and technical assistance on water-related issues for over 75 years.



N& **managing director** Jan Groen **director science & technology** Huib de Vriend **director specialist consultancy** Rob Klomp

2 With a staff strength of about 350, WL Delft is internationally renowned for their expertise in the fields of hydrology, hydraulics, hydrodynamics, water quality, ecology and hydroinformatics. The research revenue for last year totaled €30m of which 25% came from international clients. WL Delft is well-known for both its experimental facilities and its software, most of which has been developed and validated in-house. Some of their notable projects include the development of flood modelling simulation for Indonesia after the 2004 Tsunami. WL Delft is also one of the consultants to develop a hurricane protection system for New Orleans after Hurricane Katrina.

Delft University of Technology (TU Delft)

3 Founded in 1842, the Delft University of Technology (or TU Delft) is the oldest, largest, and most comprehensive university in the Netherlands for engineering sciences, with over 13,000 students and 2,100 scientists (including 200 professors).

4 TU Delft's research portfolio is clustered around thirteen interdisciplinary technological themes, examples of which are Computational Science and Engineering, Mechatronics and Microsystems, Nanotechnology, Sustainable Industrial Processes and Water: Water Works, Water Management and Water Quality. Research is conducted within the faculties, research institutes and research schools. Due to the nature of their research, TU Delft has very close ties with Delft Hydraulics. NUS also had close working relationships with TU Delft and various Delft institutes since 1997.

RELEVANCE TO SINGAPORE

Delft Hydraulics

5 Delft is one of the top water knowledge institutes in the world especially in the field of hydrodynamics and water quality modeling. They have played an important role by providing specialist consultancy services in many recent developments in Singapore. Delft was involved in the hydraulic model and environment impact studies for PUB's Sungei Serangoon Reservoir Scheme (SSRS) and HDB's land reclamation schemes at Simpang and Sembawang (completed in September 2005). In June 2006, PUB also appointed Delft as the specialist consultants to develop water quality models and operational tools to manage the new Marina Reservoir.

TU Delft

6 The presence of TU Delft in Singapore broadens the fields in which postgraduate training is available. Apart from training PhDs, TU Delft is working with NUS to offer a new two-year Master of Science Programme in Integrated Water Resources Management and Hydraulic Engineering where students spend a year each studying in Singapore and the Netherlands.

CURRENT INITIATIVES WITH SINGAPORE

Consultancy Services for Marina Reservoir

7 PUB awarded a contract to WL Delft in June 2006 to carry out fully dynamic modeling to accurately locate and quantify sources of pollution, predict water quality in Marina Reservoir, assess pollution load reduction and mitigation measures and develop water quality and operational management tools. The project cost is \$4.8m over three years. At the end of the project, WL Delft is expected to develop an adequate mitigation and management

programme including an operational management system/tool to increase the preparedness of PUB to deal with any water quality problems in the future Marina Reservoir and to support management actions.

Singapore-Delft Water Alliance (SDWA)

8 NUS, WL Delft and PUB signed an agreement to form the Singapore Delft Water Alliance (SDWA) on 7 Feb 2007. SDWA is envisaged to be a centre of excellence for water knowledge for the region. The SDWA centre, to be hosted in NUS, will carry out research with the aim to provide solutions to the water problems in the region, and eventually commercialise its technology and findings for specialist consultancy services. In addition, SDWA plans to offer a series of educational initiatives at the Masters and PhD level through a tie up between NUS and TU Delft, as well as enrichment courses for professionals.

9 SDWA is the first manpower receptacle established under EWI's initiative to build world-class research centres in Singapore to produce postgraduate professionals for the water industry. The centre, which is worth \$64million over the next 5 years, will receive an estimated \$24million funding. It will hire up to 70 researchers, and train up to 40 PhDs and 360 Masters degree holders in key water disciplines over the next 7 years.

10 The research activities of SDWA will contribute to better understanding of basic physical, biological and chemical phenomena that affect water, as well as provide an information framework, from data sensing and acquisition to modeling and decision support, to address their integrated nature. SDWA's research focus covers six disciplines, namely hydrodynamics, hydrology, morphodynamics, water quality and ecology, policy analysis and hydroinformatics. To kick-start its operations, SDWA has established four research programmes – integrated water resources management, sustainable marine and inland water construction, integrated maritime forecast and smart sensing of water systems. Research activities will be conducted by some 70 researchers from NUS, Delft University of Technology (TU Delft) and Delft Hydraulics.

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FACT SHEET ON THE NETHERLANDS ORGANISATION FOR APPLIED SCIENTIFIC RESEARCH (TNO)

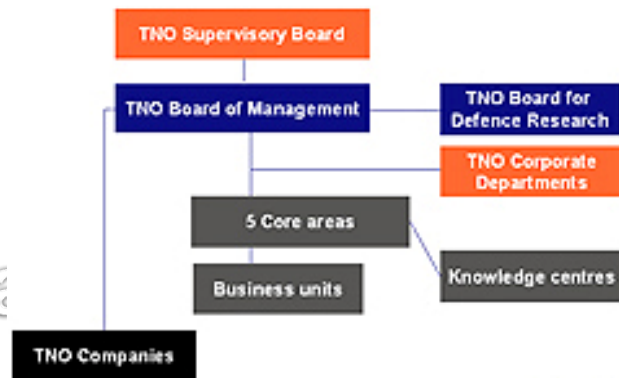
ORGANISATION PROFILE

1 The Netherlands Organisation for Applied Scientific Research (TNO) is a research organisation in Netherlands established by law in 1932 to support companies and government bodies that had no R&D capacity of their own. However, it is independent and has never been part of the national government.

ORGANISATION

- 2 TNO is divided into five core areas of research:
- (a) TNO Quality of Life (Research on Healthcare, food, effects of ageing population etc)
 - (b) TNO Defence, Security and Safety
 - (c) TNO Science and Industry (Industry Processes, New materials, New Design and Development Methods)
 - (d) TNO Built Environment and Geosciences (Construction, Energy Management)
 - (e) TNO Information and Communication Technology

TNO organisation



3 TNO, together with Dutch universities, has established some 30 knowledge centres all over Netherlands to develop knowledge in carefully selected fields. These knowledge centres function as innovation centres which draw participation from both universities as well as the private sector.

4 With over 4,500 employees, TNO provides contract research and specialist consultancy as well as grant licences for patents and specialist software. Its client base includes private companies, government bodies and public organisations. Out of these, about 25% of R&D contracts are from outside the Netherlands. Research Revenue in 2005 was €561.9million (there is no exact breakdown on how much of these is for environmental and water

R&D). Research is carried out at the client's request and the R&D work is customised to meet the client's unique requirements. The costs are borne by the client in full. TNO also receives programme-directed government funding for the development and application of new, strategic technologies.

RELEVANCE TO SINGAPORE

5 TNO Science and Industry has patented the Memstill Technology, which makes use of industrial waste heat to distill seawater through membrane. Keppel Seghers, the EWT arm of Keppel Corporation, is working with TNO on the testing of pilot Memstill plants in the Netherlands and in Singapore. This technology is very promising for industrial users, especially those that produce a lot of waste heat e.g. incinerator/power plants or refineries, since it offers an energy-saving method to produce distilled water from seawater.

CURRENT INITIATIVES WITH SINGAPORE

Memstill

6 Membrane distillation technology (Memstill) is being actively researched as a cheaper alternative to the reverse osmosis desalination process. The Memstill process is driven by minor temperature differences so very little energy is required, hence the attractiveness of this technology is. It could utilise the low grade waste steam/heat of power stations, refuse incineration plants and other heat generating plants to produce near distilled water from seawater through vaporisation and condensation processes with microfiltration-type membranes (instead of RO) providing the barrier for only water vapour to pass through. This is unlike the current conventional RO approach of "pushing" water through the membrane.

7 TNO Science and Industry has patented its version of membrane distillation technology, called "Memstill". Keppel Seghers, the EWT arm of Keppel Corporation, is a partner of TNO in the development of Memstill and has been working with TNO on the testing of a pilot Memstill Plant in the Netherlands.

8 A 20m³/d pilot scale Memstill plant has also been installed at Senoko Refuse Incineration Plant to conduct R&D aimed at optimising Memstill operations and to produce good and reliable drinking water for at least 2000 operating hours (about 90 days). The pilot unit was commissioned in Feb 2006 and the joint testing by Keppel Seghers, TNO, NEA and PUB would take about 18 months to complete.

FACT SHEET ON KIWA WATER RESEARCH

ORGANISATION PROFILE

1 KIWA is an independent organisation in the Netherlands whose concept is similar to PUB's own Centre for Advanced Water Technology (CAWT). With VEWIN (The Netherlands Waterworks Association), KVWN (The Royal Association of Drinking Water Supply in the Netherlands) and individual water companies as its shareholders, it collaborates with and carries out applied R&D work for manufacturing industry, government, water companies and other players in the water chain, with customers in over 40 countries. KIWA is also a member of the Global Water Research Coalition (GWRC) together with PUB.

2 KIWA's main responsibility is the execution of the Research Program (JWRP) that the Netherlands water industry is undertaking jointly. KIWA's day-to-day-operation consists of the programming, management and partly execution of all projects under the umbrella of the JWRP. All Netherlands water utilities invest individually in this program.

3 While the major focus is on drinking water supply, KIWA is also involved in projects addressing the integration of the water chain, including water for domestic use and industrial use. Core tasks of the division include innovative research and transfer of knowledge and know-how. Other divisions of KIWA provide a range of certification and inspection services for water businesses and other sectors of industry.

ORGANISATION

4 KIWA is divided into its three main core activities or business lines:

- KIWA Certification;
- KIWA Research & Technology;
- KIWA Training & Consultancy.

5 In 2005, KIWA's research revenue totalled €71million. R&D funding for KIWA is obtained externally from government grants and clients which include water utilities companies, industries, government agencies and international organisations. These clients decide the scope and content of the research to be carried out by KIWA. R&D is mainly done in-house by KIWA's 140 research scientists and on occasions in partnership with other research institutions, industry or academia depending on the type of R&D.

RELEVANCE TO SINGAPORE

6 KIWA has over 50 years of experience in the technology of water disinfection, water distribution systems and drinking water quality. This know-how is of interest to Singapore and complements our expertise in urban water

management and water reuse (i.e. NEWater). PUB's commercial arm, Singapore Utilities International (SUI) signed a Memorandum of Understanding (MOU) with KIWA in Nov 2005. This partnership enables PUB to exchange knowledge and expertise with KIWA as well as pave the way for more joint collaborations in water research.

CURRENT INITIATIVES WITH SINGAPORE

Development of an Innovative MBR Technique based on Osmotic Nano-Filtration

7 PUB and KIWA have identified joint research and development on the concept of the Osmotic Membrane Bioreactor (oMBR) as an area for collaboration. The joint research project aims to develop a new process, which combines MBR with a conventional Reverse Osmosis (RO) process. The essence of this new combination is an osmotic driving force for the bioreactor membrane process (an osmotic pump). This project will provide for a cheaper purification concept for producing high quality water out of used water, as compared to conventional MBR-RO processes. The goals of the oMBR-RO project focus on the sustainability of the operation, optimisation of overall process and definition of the parameters needed to develop a full scale industrial plant. Pilot-testing of the oMBR plant is currently on-going at the Ulu Pandan Water Reclamation Plant.

Identification of new areas for collaboration with KIWA

8 PUB and KIWA are in the process of identifying new areas for R&D projects and collaboration which include:

(a) Computer modelling and online monitoring of the water distribution network;

(b) Safe-Wat – a joint project involving other partners such as Vitens (one of the Netherlands' water utilities with its own research capabilities), Optisense (a Dutch sensor developer), Sandia National Laboratories (USA) and Mekorot (Israel). The project aims to develop a real-time water quality monitoring and detection system, coupled with decision support systems, to allow decision-makers to determine appropriate courses of action in the event of water contamination.

FACT SHEET ON THE ENERGY RESEARCH CENTRE OF THE NETHERLANDS



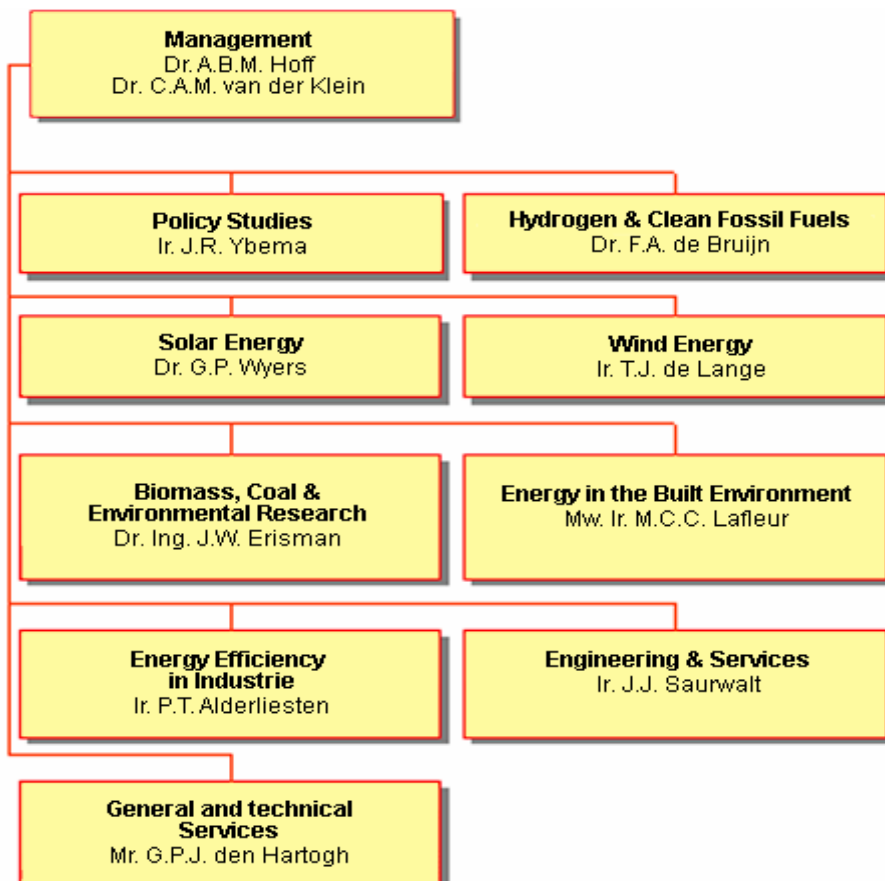
<http://www.ecn.nl/en/>

1. Corporate Profile

1.1 Overview

The Energy Research Centre of the Netherlands (ECN) is the largest research centre in the Netherlands in the field of energy. 900 staff work at the centre, based in Petten, a village in the northern part of Holland. ECN carries out fundamental research in partnership with universities as well as applied research in partnership with industry.

1.2 Organisation Structure



1.3 Key Executives

Executive	Designation
Dr. Ton Hoff	Director
Dr. Kees van der Klein	Deputy Director

1.4 Research Areas

Area	Scope
Solar	<p>Photovoltaic (PV) materials and processing technology, cell and module design in three main areas:</p> <ul style="list-style-type: none"> ▪ Crystalline Silicon <ul style="list-style-type: none"> ○ Inline etching ○ Plasma Enhanced Chemical Vapour Deposition (PECVD) ○ Ribbon-growth-on-Substrate silicon wafer technology³ ▪ Thin-film PV <ul style="list-style-type: none"> ○ Thin-film silicon solar cells ○ Dye-sensitized solar cells ○ Organic Polymer based solar cells ▪ New module manufacturing concepts <ul style="list-style-type: none"> ○ Stress-free interconnection ○ Back-contact cells⁴
Hydrogen & Clean Fossil Fuels	<ul style="list-style-type: none"> ▪ H₂ production (reformation technologies of hydrocarbons) ▪ CO₂ capture ▪ Fuel Cells (cells, stacks and fuel processor reactors)
Wind	<p>Variety of wind-related disciplines from long term fundamental research to industry consultancy such as:</p> <ul style="list-style-type: none"> ▪ Wind turbine aero-elastics and aerodynamic ▪ Condition monitoring and measurement techniques ▪ Wind turbine control ▪ Wind farm aerodynamic ▪ Wind farm operation and maintenance
Biomass, Coal & Environment	<ul style="list-style-type: none"> ▪ Heat and power generation from biomass ▪ Gasification and gas conditioning ▪ Biofuels and refinery processes ▪ Air quality and climate change. ▪ Environmental risk assessment.
Energy in the Built Environment	<p>Studies the possibility and methods of the application of renewable energy in both residential and commercial buildings, focusing on:</p> <ul style="list-style-type: none"> ▪ System integration ▪ Intelligent energy management ▪ Energy storage ▪ Energy and user behaviour

³ This group is involved in R&D with Sunergy, a Dutch solar company.

⁴ This group licensed the back contact cell technology to Solland BV which Sunergy acquired recently.

	<ul style="list-style-type: none"> ▪ Distributed generation
Energy Efficiency in Industry	<ul style="list-style-type: none"> ▪ Heat technology to reduce and recover industrial heat losses ▪ Molecular separation technology to reduce energy required for separation techniques ▪ Process intensification to develop new process designs that reduce energy requirements
Engineering & Services	<p>Technical support and development group of ECN that designs, engineers and realises experimental installations, prototypes and high-tech components, materials research, focusing on:</p> <ul style="list-style-type: none"> ▪ Process system engineering ▪ Software and electrical engineering ▪ Mechanical engineering and realisation ▪ Materials testing and consultancy
Policy Studies	<p>Provides consultancy services to public authorities, companies and individuals regarding energy and environmental issues such as:</p> <ul style="list-style-type: none"> ▪ Energy innovations and transitions ▪ Energy markets & international climate policy ▪ Renewable energy ▪ Energy use and emission reduction

1.5 Key Statistics

	2005	2004
Turnover (€ mil)	107	102
Profit (€ mil)	4.4	2.4
Employment	900 (full time + temp)	573 (full time)

Note: Statistics for 2006 are not released yet

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2. **Major Corporate Developments**

2.1 ECN acquires KEMA's 30% stake in the Nuclear Research and Consultancy Group (NRG), Jan 2007

On 1 December 2006, ECN acquired KEMA's 30% stake in NRG and now has complete ownership of NRG. This reinforces ECN's leading and strategic position in the study into sustainable energy. There is ongoing reorganisation of the control structure of NRG now that NRG is fully owned by ECN.

2.2 Unique PECVD machine delivered to ECN, 3Q 2006

ECN, in collaboration with its German partner Roth & Rau AG developed a roll-to-roll PECVD machine which can provide continuous

deposition of thin-film n-and p-doped silicon layers on steel foil, which can then be made into solar cell modules.

2.3 ECN builds first Dutch hydrogen car, 27Jul 2006

ECN has built the first car to be powered by a Dutch fuel cell system. The key component, the PEM fuel cell stack, has been developed entirely in Petten. The car itself is a modified version of an existing electric service vehicle, the DaimlerChrysler GEM. The standard GEM is powered by a traction battery, the capacity of which restricts the car's operating range and necessitates regular and lengthy recharging from the mains. But the new version developed by ECN and christened the *HydroGEM* has a far greater range and can be refuelled quickly. The fuel cell produces sufficient power to supply electricity to utensils such as electric tools as well. The *HydroGEM* is quiet and extremely clean, making it suitable for use at airports, railway stations, distribution centres and other industrial locations, not to mention on nature reserves and even in hospitals.

2.4 Tempress Systems involved in major R&D project with ECN, 2Q 2006

ECN has signed an R&D partnership agreement with Tempress Systems, Inc., a subsidiary of the NASDAQ-quoted company Amtech Systems, Inc. The aim of the co-operation is to develop a new production process for solar cells and to improve the efficiency of solar cells using the diffusion furnace systems manufactured by Tempress.

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FACT SHEET ON SOLARWORLD



SolarWorld AG

www.solarworld.de

1. Corporate Profile

1.1 Company Background

The SolarWorld AG Group is among the three largest solar companies in the world. The group is exclusively dedicated to solar energy and is involved in all stages of the solar value chain from silicon as the raw material all the way to turn-key solar power plants. The company operates production facilities in Germany, Sweden and the USA⁵. After the IPO in 1999, the company developed within a few years from a solar trading house to an integrated solar technology group. Headquarters is in Bonn, Germany.

1.2 Key Statistics

€million	2006	2005	2004
Sales	515	356	200
EBIT	180	89	33
Employment	1,348	759	616

1.3 Key Executives

Executive	Designation
Frank Asbeck	Founder, Chairman & CEO
Phillip Koecke	Chief Financial Officer
Boris Klebensberger	Chief Operating Officer
Frank Henn	Chief Sales Officer
Prof. Peter Woditsch	CEO, Deutsche Solar

⁵ SolarWorld entered the US market when it acquired all of Shell Solar's silicon (wafer) solar activities in June 2006.

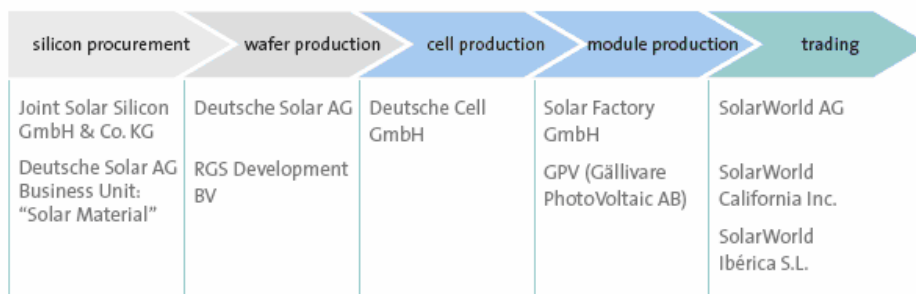
1.4 Share Performance (Frankfurt)

Share price (5 Apr 2007): €60.20, Market Cap: €\$3.36B



2. Business Structure

The SolarWorld Group is a company dedicated to research and development, production and sales of solar power technology products (photovoltaic products). The business operations break down into four business areas reflecting the company's vertical integration.



2.1 The solar value chain starts with the **'Wafer & raw materials'** division managed by the subsidiary Deutsche Solar AG. The company's core activities are the production of solar wafers from solar-grade silicon and the safeguarding of supplies of raw materials. The 'Solar Material' division is responsible for the processing and recycling of raw materials. In addition, Deutsche Solar AG has a shareholding in an innovative production process (RGS Development BV) in parallel to its major research and development centre. Deutsche Solar AG also organizes the Group's entire logistics operations. SolarWorld has a 49% JV with Degussa AG to produce polysilicon from monosilanes, the starting material for ultra-pure silicon ingot and wafer production.

2.2 The **'Cell'**, pooled in the subsidiary Deutsche Cell GmbH, produces solar cells from solar silicon wafers, a basic material. The cells have all the technical properties required in order to produce power from solar energy.

2.3 In the **'Module'** division, solar cells are interconnected into larger units, the modules. They are then framed and sealed in a weather-tight way. The solar power modules are the final solar product, ready to produce power and feed it into the power grid or directly supply it to customers.

The modules are produced by the subsidiaries Solar Factory GmbH in Freiberg and GPV (Gällivare Photovoltaic AB) in Sweden.

- 2.4 The **'Trading'** division operated by SolarWorld AG is responsible for the sale of solar modules and the SolarWorld kits for complete solar power stations. In the case of high-capacity, central solar power stations, SolarWorld AG also offers turn-key constructions for its customers.

3. Major Corporate Developments

3.1 SolarWorld to Build 500-MW Solar Factory in Oregon, 2 Mar 2007

SolarWorld is establishing an integrated solar silicon wafer and solar cell production facility in Hillsboro, Oregon, that will become the largest solar factory in North America once the plant reaches its projected capacity of 500 megawatts (MW) by 2009.

The company will invest an estimated US\$400 million to expand and develop its new facility, which it recently acquired from the Japanese Komatsu Group for US\$40 million. The Japanese Komatsu Group had already invested approximately US\$500 million in the Hillsboro location – but had never gone into production.

3.2 SolarWorld Group signs new wafer deal for more than €180 million, 24 Jan 2007

Deutsche Solar AG, a subsidiary of SolarWorld AG and one of the world's largest manufacturers of silicon wafers for solar applications, has signed another long-term delivery contract. The customer is the Canadian company Canadian Solar Inc. (CSI), an international manufacturer of solar modules, which operates production facilities in China. Frank H. Asbeck, Chairman of the Management Board of SolarWorld AG. 'Our long-term strategic goal is to sell 50 per cent of the wafers made by Deutsche Solar AG to external customers. This additional contract brings the total of long-term orders for our international customers to about €2.5 billion. These are long-term export contracts which safeguard jobs in Germany and underline the leading role that Germany plays in the development of renewables. Our agreements are an example of the fact that the 'green' industry in Germany is well on the way to becoming another export heavyweight, ultimately taking its place alongside the automotive industry.'

3.3 SolarWorld AG completes acquisition of Shell assets, 20 Jun 2006

SolarWorld will complete the acquisition of the solar silicon activities of the Shell Group effective 1 July 2006. As of this date all relevant former Shell assets in the area of crystalline solar silicon technology will legally be part of the SolarWorld Group and operate under the name SolarWorld. After the integration of these solar activities, SolarWorld will be among the world's three largest providers of solar power. With

the acquisition, SolarWorld will be represented in Asia and Africa clearly more substantially than in the past.

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FACT SHEET ON FRAUNHOFER INSTITUTE FOR SOLAR ENERGY SYSTEMS



Institut
Solare Energiesysteme

Fraunhofer ISE

<http://www.ise.fhg.de>

1. Corporate Profile

1.1 Company Background

The Fraunhofer Institute of Solar Energy Systems (ISE) is part of the Fraunhofer Gesellschaft (FhG), one of the world's largest research organizations with 56 Institutes in Germany, 9,000 researchers and an annual research budget of €1.2 billion.

Founded in 1981 in Freiburg, Germany, ISE is widely regarded as one of the world's top solar research institutes and is also the second largest institute in the Fraunhofer Gesellschaft family. ISE develops components, materials and processes in the areas of the thermal use of solar energy, solar building, solar cells, electrical power supplies, chemical energy conversion, energy storage and the rational use of energy.

1.2 Key Statistics

	2006
Budget	€ 33 million <i>37% of which comes from industry</i>
Employment	480 (including 200 researchers)

1.3 Key Executives

Executive	Designation
Eicke Weber	Director
Volker Wittwer	Deputy Director
Prof Peter Woditsch ⁶	Chairman of Scientific Advisory Board

⁶ Prof Woditsch is the CEO of Deutsche Solar, the largest entity of SolarWorld Group.

1.4 Research areas and organisational chart



2. Major Corporate Developments

2.1 German Minister for the Environment, inaugurates the Photovoltaic Technology Evaluation Center PV-TEC – Research Factory for Solar Cells, 21 Mar 2006

The Photovoltaic Technology Evaluation Center, PV-TEC, is a new, unique service center for the photovoltaic industry. With a floor area of 1200m², the Center offers research, development and service at production level standards, thereby accelerating the technology transfer between laboratories and industry. Researchers at Fraunhofer ISE have built up this research facility for solar cells in Freiburg with €11 million financial support from the German Federal Ministry for the Environment (BMU).

UPDATE ON THE SINGAPORE-ETH CENTRE

Background

1. A team of 13 distinguished scientists and academics from ETH Domain visited Singapore from 8 to 13 October 2006 at the invitation of the National Research Foundation (NRF). The visit by the scientists was a follow-up to Chairman NRF, Dr Tony Tan's trip to Switzerland in April 2006, during which ETH's participation in CREATE was broached. CREATE, endorsed by the Research, Innovation and Enterprise Council (RIEC) in July 2006, aims to foster joint research programmes between the world's top research universities and Singapore-based research institutions.
2. A Steering Committee, jointly chaired by Professor Alexander Zehnder, President of the ETH Board, and Mr Teo Ming Kian, Permanent Secretary, National Research and Development, was set up to work out the details for the establishment of the research centre.

Update

3. The Steering Committee has made good progress on the proposed Singapore-ETH Centre (SEC) to be set up in CREATE. At the committee's meeting last month in Zurich, it was agreed that SEC will carry out research on the theme of global environmental sustainability. This was in line with the research focus on Environmental and Water Technologies, one of three strategic research programmes⁷ identified by the NRF in 2006. ETH will present the framework for the SEC to the NRF Board for approval in June 2007.
4. The SEC's focus on global environmental sustainability will unify multidisciplinary research in various science and engineering fields, including life sciences, clean water, clean energy, environmental monitoring and urban design. It will bring together Singapore researchers from the local universities and research institutions with the universities and research organisations in the ETH Domain.
5. Professor Alexander Zehnder, President of the ETH Board, said, "I am pleased that we have made significant progress on the set-up of the SEC. SEC will be ETH's window to Asia. Research on global environmental sustainability will benefit not just ETH and Singapore but also contribute to the global knowledge base of this critically important area."

⁷ The other two strategic programmes are Biomedical Sciences Phase II and Interactive and Digital Media.

6. Chairman of the NRF, Dr Tony Tan said: “ETH is a well respected education and research institution in Europe and I am glad to have ETH establish a strong research presence in CREATE. ETH will present its plans for SEC for approval at the NRF Board meeting in June 2007. The theme for the SEC resonates well with our findings during this study trip to Europe. The SEC will reinforce Singapore’s drive to develop into a knowledge centre for global environmental sustainability.”

National Archives of Singapore