SOLAR MAGAZINE

September 2010
PV SEC Valencia

Dutch Solar Industry: from innovation to practice

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Dutch Solar Industry: from innovation to practice

Dutch companies, knowledge institutes and government authorities are working flat out on new technologies and countless innovations in the field of solar power. They are deeds and answers appropriate for the global push for power transition. They are deeds that will not just shape the future of the Netherlands, but the future of the entire world.

A future in which the Netherlands will hopefully lead with innovations. In which dependency on fossil fuels will decrease. A future in which the Netherlands will globally play a role of crucial importance. The potential is there. The Netherlands does not just have a knowledge institute in the Energieonderzoek Centrum Nederland that enjoys global status, it also has companies like OTB Solar, Tempress Systems, Smit Ovens, Scheuten Solar, Rimas, Solland Solar, DHV and many others that score high internationally. And that is without even mentioning the promising start-ups like Levitech, SoLayTec, Helianthos, RGS Development and RUV Systems. You can read more about them in this special English edition of the only Dutch magazine for the solar industry. The sound journalism and editorial approach of this magazine sketches the full spectrum of the Dutch solar industry.

Solliance

For many years, the Photovoltaic Solar Energy Conference and Exhibition (PV SEC) has been the platform for presenting innovations. This is the reason why we have chosen the title 'From innovation to practice' for this magazine. Indeed, it is up to the Dutch solar industry to put into practice the many new technologies and corresponding opportunities. After all, there can only really be talk of innovation once the new technical opportunities have led to market opportunities and sales. The Dutch solar industry – present in great numbers during the PV SEC – will demonstrate during this event that they are able to transform opportunities into business. There is a lot of positive news to report on regarding knowledge, abilities and sales. Like the establishment of Solliance, which you can read all about in this magazine. A large number of Dutch knowledge institutes have joined hands within Solliance, which facilitates the solar industry in the Netherlands. Within the world of thin film technology, Solliance is involved in the development, scaling-up and demonstration of manufacturing technologies.

Demonstration

There is also a part for the Dutch government to play in the marketing of new technologies through the creation of an industry-friendly home market and the stimulation of innovation. The Dutch government increasingly supports test and demonstration projects within the field of solar power. A step that hopefully the Dutch authorities will take in the foreseeable future will be the step towards a sound grants scheme that will stimulate people to purchase a solar panel. It can facilitate the acceleration of new technologies that make a sustainable future possible all the sooner. Providing we all continue to innovate and providing we manage to continue to raise the level of the development of knowledge. At any rate, the Dutch solar industry is well on its way.

Now all that remains for me to do is to wish you, on behalf of the entire team behind the Solar Magazine, an enjoyable read of this special PV SEC edition of our magazine and every success at the PV SEC 2010. Hopefully, when you reflect on this week, you will remember the Netherlands when you are looking for an innovative partner for your business in the solar industry!

Edwin Gelissen-Van Gastel
Solar Magazine, editor in chief and publisher

BRAINPORT
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With the Eindhoven region as its core, Brainport is the hub of a network stretching out across the Southeast Netherlands and the Dutch borders. Along with Rotterdam (seaport) and Amsterdam (airport), Brainport is a cornerstone of the Dutch economy.

Top technology region Brainport is a breeding ground for innovation and the home base of world class businesses, knowledge institutes and research institutions. Together they design and manufacture the technology of the future to ensure a safe, green and caring society and a sustainable economic development of the Netherlands.

Solar industry champions located in Brainport
The Brainport region is a top location for manufacturers of photovoltaic equipment. World-class knowledge institutes with an enviable reputation in renewable energy, like ECN, TU/e and TNO, form a strong cluster of R&D activities. Moreover, Brainport's competitive supply chain of production equipment and parts includes major players such as OTB Solar and VDL ETG as well as several dynamic young companies developing thin film and establishing production lines for silicon and solar cells.

The prospects for growth of the solar industry is boosted and accelerated by the presence of other related industrial sectors such as coatings, semi-conductors, mechatronics, materials, displays and optical storage. Brainport can consider itself very well represented by leading international companies in these sectors, including DSM, Fuji Film, Assembléon, Océ and NXP.

With all these knowledge institutes, established and new companies, Brainport is a highly attractive place for the development and production of future photovoltaic systems, crystalline silicon solar cell technology and thin film.

By allocating national and international R&D and by strengthening the solar industry's competitiveness, Brainport wants to make solar one of our industries of the future.

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CREATING THE INDUSTRIES OF THE FUTURE

Brainport
Eindhoven

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Solar Magazine is an independent Dutch trade journal and appears four times a year with a circulation of 5,000 copies. This English edition of 3,000 copies has been published for the PV SEC.

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High Tech Campus Eindhoven positions itself as a solar hotspot

High Tech Campus Eindhoven is making great efforts to position itself as a solar hotspot. The Campus is amongst the seventeen percent largest science parks in the world (resident population) and is characterised by an R&D eco system where more than ninety companies and knowledge institutes with over eight thousand researchers, developers and entrepreneurs work on the technologies and products of tomorrow. The Campus initiator was Philips. At the end of the nineteen nineties, the company's R&D activities were spread across Eindhoven and Philips wanted to create a single Campus location for all the national R&D activities. The open atmosphere and the concentration of high-level knowledge resulted in considerable interaction between the researchers from the different technological disciplines. To speed up this process even more, Philips decided to open the Campus to other technology companies in 2003.

The Campus is characterised by Open Innovation. The companies and knowledge institutes here share R&D facilities in order to achieve faster, better and more customer-oriented innovation. Together, they create innovations in the areas of Health, Experience and Energy. A new Campus pillar is the solar cluster, from solar generation with cells, modules and systems to solar storage with materials and applications. Companises from the solar industry that stand out include MiPlaza, Philips Applied Technologies, SunCycle and ECN.

Solland Solar creates consortium for 'Emitter Wrap Through'

Mid April, Solland Solar announced the formation of a consortium with Sunergy, Levitech and ECN for the development of the 'Emitter Wrap Through' (EWT) solar cell. In a three-year project, high efficiency back-contact solar cells will be developed on the basis of the EWT solar cell principle. The consortium, which operates under the project banner New EWT Of the Netherlands (Newton), will be financed by the Ministry of Economic Affairs EOS-KTO programme. The revolutionary EWT principle was discovered by the energy research institute ECN and follows on from the natural evolution of the 'Sunweb' Metal Wrap Through solar cell that Solland Solar is currently marketing.

Research project Silicon-Light for solar cells on foil

Under the auspices of the energy research institute ECN, seven European parties and one Chinese organisation are working on a new solar cell research project with the name Silicon-Light. The project got started at the beginning of January and will run for three years. The objective is to make better and cheaper thin film silicon cells on foil. These solar foils are ideally suited for architecturally integrated PV applications. In Silicon-Light, methods are explored and improved for applying thin layers of typically 1/1000 millimetres in thickness in a gas phase to a foil using Plasma Enhanced Chemical Vapour Deposition (PECVD). The project is subsidised by the European Commission within the scope of the thematic programme Energy in FP7.

M2i research into sustainable solar energy

The Materials Innovation Institute (M2i) is a European Centre of Excellence focusing on the development and application of structural and functional materials. Its mission is to introduce sustainable innovation to Dutch industry and society. To achieve this, M2i employs over 200 full-time research staff and has an annual turnover of EUR 25 million. Dutch industry plays an active and innovative role in the fields of Sustainable Energy and Lighting, two key and closely linked industrial sectors. M2i intends to expand its research programme in this area.

TU/e researches cells 65 percent efficiency

Three researchers at Eindhoven University of Technology (TU/e) want to develop solar cells employing nanotechnology with more than 65 percent efficiency. The Ministry of Economic Affairs has made 1.2 million euro available for this research into nano-wire solar cells. According to the researchers, nano technology, in combination with the use of concentrated sunlight through mirror systems, has the potential to lead to the world's most efficient solar cell system. The TU/e researchers are working with Philips MiPlaza and expect to achieve more than 65 percent efficiency with their nano-structured solar cells.

Solterra enters Dutch chemistry consortium for validation of high volume production

Solterra Renewable Technologies has entered into a process development agreement with a consortium of advanced chemistry companies in the Netherlands, to validate high volume production methods for its proprietary tetrapod quantum dots. The agreement follows the MOU that Solterra, FutureChemistry and Flowid signed earlier. FutureChemistry and Flowid will provide the expertise necessary to find optimal process conditions and scale the synthesis of the quantum dots to necessary levels. With larger quantities of quantum dots, Solterra will be enabled to pursue its goal of reaching 1GW of solar cell production. Pieter Nieuwland, research director of FutureChemistry: 'Testing new chemical reactions is often performed in a traditional way: step by step. With the technology of FutureChemistry and Flowid, these reactions become full-continuous processes that we can optimize with our software and translate to much larger reactors. This project will will prove that the technology is reaching maturity.'

Four new solar projects under the 'Pieken in de Delta' banner

'Pieken in de Delta' (Peaks in the Delta) is a Dutch government grant scheme. The main starting point for the grant scheme is the stimulation of area-specific economic strengths in six Dutch areas: expanding and reinforcing clusters that are important for making the Netherlands a competitive and dynamic economy against the backdrop of a strong and innovative Europe. At the beginning of July, it was announced that four new solar projects were to be awarded a grant under the scheme:

CIGSelf
The CIGSelf project involves research and development of new industrial level manufacturing processes for CIGS solar cells. The collaboration comprises the secretary Smit Ovens, Dutch Space, ECN, Holland Innovative, OTB Solar, Philips Applied Technologies, Scheuten Solar, TNO and TU/e. A prerequisite for raising CIGS to an industrial level is a good laboratory process that can achieve the requested high efficiency of more than twelve percent so that cross-matching at laboratory and industrial levels is possible.

Solar Focus Zuidoost
The basis for the Solar Focus Zuidoost (South-east) project is SunCycle's Concentrated PV (CPV) principle. The SunCycle solar panel focuses sunlight onto a small solar cell. To facilitate mass production, a manufacturing process needs to be developed for all the panel components that is suitable for mass production and a set-up for computerised assembly. In addition to SunCycle, other parties are participating, being KMWE Precisie Eindhoven, Neways Technologies, TNO Industry & Technology and the Radboud University Nijmegen. Following the execution of the project, a production line can be rolled out that manufactures solar panels that deliver sustainable electricity for € 0.11 per kWh in the Netherlands and € 0.06 per kWh in Southern-Europe, lower than the price of grey energy.

FAST ALD
In the project FAST ALD, the TNO spin-off SoLayTec is to focus on adding an extremely thin layer of aluminium oxide to the rear of a solar cell using Atomic Layer Deposition technology. The project focuses on the acceleration of the ALD process by a factor of one hundred, so that the production of solar cells becomes economically feasible.

Zonnedag
The project Zonnedag will test and apply new materials with which the performance of solar panels can be considerably improved. Above all, this will explore the improvement of measurement and control systems – the so-called junction box – and the connection between the junction box and the solar panel.

'Old' projects
Previously, at the end of 2009, three Pieken in de Delta projects commenced in the field of solar energy. In the project 'GEZOND', Philips is working on a joint PV test and analysis centre. The main objective is the measurement of the degradation and lifecycle of various types of solar cells. In the project 'Zon op het zuiden', a roadmap is plotted for various types of solar cells. The roadmap is expressed in a collaborative strategy and tangible project plans. Finally, the Project ZONPROM headed by OTB Solar, focuses on the development of new or improved measurement techniques for qualifying both the products and the manufacturing process in the PV industry. It lays the basis for the necessary measurement techniques to achieve higher production volumes with more stable and better efficiency.

HIFLEX for new low-cost scalable organic photovoltaics applications

The European research project HIFLEX was launched at the start of 2010. Over the next three years a European consortium comprising five research institutes and two industrial companies aims to jointly develop a technology for highly flexible Organic Photovoltaics (OPV) modules, which will allow the cost-effective production of large-area OPV modules with commercially viable Roll-to-Roll compatible printing and coating techniques. HIFLEX will be coordinated by Energy research Centre of the Netherlands (ECN). Organic Photovoltaics (OPV) is considered as one of the important emerging photovoltaic technologies which carry large hope for substantial cost reductions for PV in the future. The potential for cost reduction is based on the compatibility with high throughput processing and the use of low cost materials. The research in HIFLEX aims at developing the OPV technology to match the particular requirements of mobile and remote ICT applications, delivering the required efficiency under different light conditions, sufficient lifetime for practical use, acceptable cost structure, appropriate power-to-weight ratio and fit-to-purpose mechanical flexibility. HIFLEX intends to accelerate the exploitation of this OPV technology for a wide variety of ICT products in the mobile electronics market.

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Frost & Sullivan Award for Scheuten Solar

Scheuten Solar won the 2009 Global Frost & Sullivan Industry Innovation and Advancement of the Year Award. The Venlo company earned this prestigious honor building integrated PV projects. ´Prestigious building-integrated projects – the Nippon Industrial College in Tokyo, the Hauptbahnhof Berlin Central Station, which is the largest railway station in Europe at present, and the major turnkey solar power plants in Spain, Italy, and Greece – combined with an efficient network of sales staff across the global markets and years of knowledge from its solar divisions make Scheuten a reliable partner in this rapidly-upcoming market´, says Frost & Sullivan Research Analyst Suchismita Das. ´The company's products combine robust features with aesthetic design, durability, flexibility, and return on investment, thus helping it effectively maintain the leading position in the market. Apart from having a keen pulse on the consumer needs, the company has developed a significant technological innovation capability and strong R&D expertise that have been successful in advancing the state of the industry forward. factors make Scheuten the worthy recipient of the 2009 Frost & Sullivan Industry Innovation and Advancement of the Year Award in the global solar PV modules market.'

New IBC Handler from ECPHolland improves safety in solar factories

Safe processing, storage and pumping of hazardous chemicals. Operators who can perform their work without having to wear protective suits. Absolutely no contact with chemicals throughout the process of bringing chemicals to the production line. The new IBC Handler from ECPHolland provides these options.

ECPHolland – specialised in the development, engineering, construction, installation and maintenance of advanced production machines and processing equipment – recently launched its innovative IBC Handler. The Intermediate Bulk Container (IBC) Handler has been especially developed to allow operators and maintenance engineers to work safely with the hazardous chemicals necessary for the manufacture of solar cells. Development partner Solland Solar has been employing this new solution for several years. 'We're currently involved in the installation of a number of IBC Handlers in the new Photovoltech factory in Tienen', says Paul Raeven, managing director of ECPHolland. 'We developed the IBC Handler because we saw that the processes employing hazardous chemicals in the solar industry could be better, faster and safer', continues Raeven. 'Following a number of meetings with Solland Solar, it quickly became clear that personal protection from the aggressive chemicals at all times, would be a highly desirable solution. We decided to house the IBC in a kind of giant incubator, so that the operators who work with it could never come into contact with the chemicals. They don't even need to wear protective suits anymore.'

The development of the IBC Handler has taken almost two years. ECPHolland has applied for a patent for this solution. Despite the strengths of the innovation, Raeven expects that it could take a while before the IBC Handlers find global popularity. 'Some companies in the solar industry still underestimate the danger of working with chemicals', explains the ECPHolland managing director. 'Only once an accident has taken place, as was the case for one of our customers, the decision to purchase an IBC Handler is accelerated. More and more customers are proactively adapting to this new standard and are noticing the importance of employing safe chemical handling.'

NEW PRODUCTS

DataLyzer International launches SPC for the solar industry
DataLyzer International is to enter the market with the process-monitoring package SPC. DataLyzer Spectrum has a proven track record of 20 years in the semiconductor industry and is employed in both cell and module manufacturing. DataLyzer Spectrum can be used stand-alone or in combination with company-wide MES systems, for process control, production support and at management level.

JA Solar opts for ECN technology
The German JA Solar is to utilise Metal Wrap Through (MWT) solar cells. The MWT technology ensures a greater light-capturing surface and greater mechanical stability, through which thinner solar cells suffice. In 2009, ECN achieved an efficiency of 17 percent using MWT at module level. ECN had already caught the interest of Solland Solar and the Canadian company Solar.

Switch2Solar launches 'greenhouse solar panelsc
The large-scale use of solar energy in horticulture has come a step closer. Switch2Solar has developed a new technology with which greenhouse glazing could be replaced with transparant solar panels. The light orange panels allow twenty percent of the light to pass through and have a capacity of eighty-five watts.

SolarNow wins EU Sustainable Energy Award
The EU Sustainable Energy Award 2010 has been won by SolarNow. The SolarNow programme assists local entrepreneurs with the sale, installation and maintenance of solar panels. In the last three years, the Rural Energy Foundation in Nijmegen has, through the SolarNow programme, provided 330,000 Africans with access to solar energy. The costs: four euro per resident.

WhisperPower introduces solar hybrid system
WhisperPower in the Netherlands introduced a combined diesel generator/ inverter system, specially designed for off-grid power systems. The Genverter has been developed in close cooperation with power systems specialists and a number of leading European universities. It is available in three versions: Basic, fully hybrid and DC-only. The basic principle of the Genverter is that a variable speed diesel generator, consisting of a High Yield Permanent Magnet Fly Wheel Alternator and a one-cylinder diesel engine, generates 230 VAC power to charge the battery during low irradiation periods.

The evolution of the Netherlands solar landscape

In the last twenty-five years, the Netherlands has acquired an excellent position in the field of research, manufacture and application of photovoltaic technology (PV). The Netherlands is a country where pioneering work is performed in the field of research & development in solar power. That the solar landscape in the Netherlands is evolving is evident from start-ups like Levitech, SoLayTec, Helianthos and RGS Development, as well as from international renowned players like OTB Solar, Scheuten Solar, Solland Solar and Tempress Systems.

From significant innovations regarding high performance, commercial crystalline silicon technology to development of entirely new options such as thin films and polymer solar cells, the Dutch solar landscape covers a broad spectrum including materials and processes, devices and systems. R&D is conducted at universities of technology like the Universities of Eindhoven, Delft and Twente, as well as at the leading international energy research institutes ECN, TNO and the Holst Centre. Also, large companies such as OTB Solar, Scheuten Solar, Solland Solar and Tempress Systems have extensive research programmes. The collaboration between these research institutes and private companies is strong and has led to numerous technology spin-offs, such as SoLayTec and Helianthos.

Economic miracle

Increasing interaction and synergy in PV development between the Netherlands and its two neighbouring countries, Belgium and Germany, in both R&D and trade is a tremendous boost for the Dutch solar industry. In the last decade, a sustainable economic miracle even took place at our neighbours to the east, in Germany. The German government supported its industry through giving each German citizen who had a solar panel or wind turbine installed a grant for the electricity that they would supply the grid with. Partly thanks to this measure, a sustainable multimillion industry was created and almost twenty percent of the German electricity is now produced by wind turbines, solar panels and other sustainable resources. Although such a scheme has not been forthcoming in the Netherlands, the Dutch solar industry has benefited significantly from the German economic miracle. Partly through being active on the German market, the Netherlands solar industry has experienced considerable growth. The systems developed and built in the Netherlands are today amongst some of the lowest priced systems and also, in many aspects, the most advanced in the world.

Peaks in the Delta

The Dutch government recognizes the importance of solar energy for the creation of a sustainable society and supports and encourages the use of solar energy by making

it an integral part of its long-term energy policy. Under the banner of the nationally initiated, but regionally oriented investment programme Peaks in the Delta (Pieken in de Delta = PiD), development and innovation is being worked on in multiple projects in the Dutch solar industry.
Philips, Solland Solar and ECN are collaborating in the PiD project geZONd on a joint facility for solar panel analysis and sustainability testing. Within the PiD project ZONPROM, Rimas, OTB Solar, ECN and TNO are working on reliable measurement products to be able to approve semi-finished products in the manufacturing process. In four new PiD projects that are to commence in the autumn, manufacturing processes for CIGS solar panels will be researched and developed at industrial level, a manufacturing process will be set up for a new concentrated PV (CPV) idea, new materials will be explored and applied ensuring that the performance of the solar panels is improved dramatically and the acceleration of Atomic Layer Deposition process by a factor of one hundred will be investigated. In addition, the Dutch solar industry is currently working intensively on the roadmap 'Zon op het Zuiden' (Southerly Sun). The intention is that this will strengthen and expand the Dutch eco system for solar power; essentially an ecosystem with sufficient strength to play a significant international role. The main objective of the roadmap project is to acquire immediately applicable knowledge, competencies, networks and improvement options in the field of solar technology and corresponding business strategies, resulting in various subsequent projects to actually make tangible progress.

The business strategies to be developed in the project must lead to strong high-tech SME companies that think and act proactively, supply robust process and product quality and that operate flexibly in the global market with distinctive capacities in the field of productivity, cost price reduction and innovation in the solar cell market. In brief, the continued evolution of the Dutch solar landscape.

Short overview Dutch solar landscape

The technology infrastructure includes:

Research Institutes:

- Energy Research Centre of the Netherlands (ECN)
- Advanced Dutch Energy Materials Innovation Lab (ADEM)
- Foundation for Fundamental Research on Matter (FOM)
- The Netherlands Organization for Applied Scientific Research (TNO)
- Holst Centre
- Dutch Polymer Institute & M2i

Universities

- Delft, Eindhoven, Utrecht, Nijmegen, Groningen, Wageningen and Amsterdam

The physical infrastructure includes:

- Avantis European Science and Business Park, Heerlen
- High Tech Campus Eindhoven
- Energy Valley in the North of the Netherlands
- Solar Valley in the South of the Netherlands
- Kennispark Twente
- Technolpolis Innovation Park
- Application Centre for Renewable RESources (ACRRES)

Dutch solar industry leading companies :

- Eurotron, Mastervolt, Helianthos, Oskomera, OTB Solar, Solland Solar, Ubbink Solar, Scheuten Solar, Tempress Systems, Sunergy, RGS Development, Smit Ovens, Philips and OM&T

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Dutch solar power demonstration projects in perspective

The major industrial countries are investing more and more in power-saving technologies and alternatives for fossil fuels. Solar power – and especially PV systems – are being embraced by the industrial super powers as one of the most significant solutions and as promising technology. The Netherlands wants to play the leading role in Europe in these developments. With the Stad van de Zon (City of the Sun) and the Power Matching City, the Netherlands has two practical examples to hand that demonstrate the potential of the technologies and products developed by Dutch industries.

It might not be possible for the Netherlands to solve all the climate issues in its tiny backyard, but with regard to knowledge and ability it can stimulate the global approach to climate problems through the development and marketing of new sustainable technologies and products. The Netherlands has put its best foot forward in following up the advice from the International Energy Agency (IEA). In several reports, this agency has argued for 'a green revolution' in the field of energy during the last few years. Governments, knowledge institutes and industry in the Netherlands join hands to give promising technologies an opportunity and to initiate demonstration projects. Two of these, City of the Sun and the Power Matching City, are currently in full swing.

City of the Sun

On the south side of Heerhugowaard, bordering on the municipalities of Alkmaar and Langedijk, a new urban area is being created: City of the Sun. The municipality of Heerhugowaard has been working on this, the world's largest emission neutral suburb, since 1992. Which means that it produces as much sustainable energy as is consumed. The construction began in 2004. It is expected that the last parts will be completed in 2012.

In the autumn of 2009, the City of the Sun was officially opened by the Prince Royal of the Netherlands Willem-Alexander.

The spiritual father of the City of the Sun is Ashok Bhalotra from the urban development agency KuiperCompagnons. The source of inspiration in both the land division and the architecture for the energy-neutral housing is the sun. Eighty percent of the City of the Sun is southerly oriented and all the homes have solar panels. Three wind turbines have also been located in the neighbourhood. The active solar power is delivered through the use of 2.45 Megawatts photovoltaic solar panels on the roofs of the homes and the various facilities. The entire City of the Sun project – which also includes Alkmaar and Langedijk as well as homes with solar panels in Heerhugowaard – is good for about 5 Megawatts.

New Deltaplan

The City of the Sun project has already received international recognition as the new Dutch Deltaplan because of the major role that water plays – just like the sun and wind – in the project. Japanese, Korean, New-Zealand, South-African, Danish and Polish urban developers have come to take a look at Ashok Bhalotra's brain child.

'It's being called the new Deltaplan', says American David Waggoner, who is working on dike reinforcement in New Orleans. 'It's the following phase in which the Netherlands does not just protect itself from water, but actually incorporates the line of defence as an integral part of the neighbourhood.'

The project City of the Sun has won many prizes. The developer Vos won the Alkmaar Sustainablity prize and the Dak-Award 2004 for the development of the low energy consumption ISO++ home with a roof construction especially designed for solar photovoltaic applications. Above all, Heerhugowaard won an Energy Award in the newbuild category because of the innovative character of the project and its example function for other municipalities.

PowerMatchingCity

At the same time, in the neighbourhood Hoogkerk in Groningen, the first European smart grid was installed. Combining the best of solar and wind power, heat pumps and micro-cogenerators. Energy consultancy and testing company Kema initiated the project 'PowerMatchingCity' together with the Energy Research Centre of the Netherlands (ECN), Essent and software developers Humiq.

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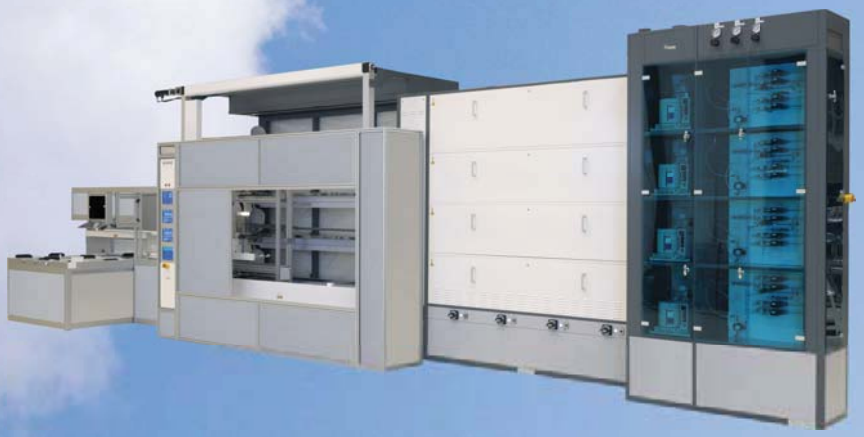

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Not to reduce power consumption, but primarily to harmonise all the new sources of power. The PowerMatchingCity is founded on intelligent software that couples supply and demand of power. The network that is created, the smart grid, is the basis for the sustainable operation of all domestic equipment. The most appealing example is the washing machine that can be switched on from a remote location as soon as sufficient power is available. The washing machine is loaded with washing and the washing detergent and the user enters by what time the washing must have been done. Within ten hours, inside a day or two days. The intelligent grid decides on the best time and lowest rate.

Dovetailed

Smart grids form an essential part of the Dutch and global energy transition. These intelligent networks match supply and demand. This does not just prevent overburdening, but it is also the solution to the fact that the sun does not always shine and the wind is not always equally strong. Within the project, PowerMatcher is the name of the smart power agent that is under development. The majority of the 350m^2 of solar panels that the project uses cover the roof of the Kema building in Groningen. A later phase of the project will focus on the quality of the solar panels and the space for testing the cells on the basis of new technologies. For the time being, the emphasis lies on the successful development of the PowerMatcher.

PowerMatchingCity will come to a conclusion in just over a year's time. The project partners hope to have created an industrial reference standard by this time with which it will no longer matter if it is a smart freezer, washing machine, heat pump or electric car that is connected to the smart grid. The PowerMatcher will immediately calculate, using an algorithm in a computer program, which source of power at a random moment is in bountiful supply and can be supplied the cheapest. On the basis of the 24-hour forecast from Meteo Consult (the MET office), it will be possible to plan for the day ahead in a year's time. It is expected that by 2040 forty percent of the power will no longer be generated in massive power plants. This is why, in the coming years, the PowerMatcher is one of the first solutions that will be offered to match power consumption to what is on offer.

City of the Sun specifics

PV power total community:
5 Megawatts
Number of houses/buildings:
over 3,500 dwellings (in whole location)
PV power per unit:
1.45 kW/house
Energy yield per year:
3,750,000 kWh/year (calculated)
Main PV system type:
Grid-connected – demand side
Main PV application type:
Inclined roof – integrated & flat roof

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SMIT OVENS
THERMAL SOLUTIONS

Tempress Systems consolidates its market leadership

Tempress Systems was one of the first Dutch companies to build manufacturing equipment for the semiconductor industry. Just as with the semiconductor industry, Tempress was active in the solar industry from early on. Today, the company is a worldwide market leader in solar diffusion manufacturing equipment. Four diffusion furnaces leave its factory in Vaassen every week. 'To be successful, it is essential to fine-tune the research into new technologies to the demands from the solar industry and to keep in step', states managing director Fokko Pentinga.

Through the years, Tempress Systems, established in 1967 and a subsidiary of the NASDAQ-listed Amtech Systems, has worked with the Energy Research Centre of the Netherlands (ECN). The most recent achievement from this cooperation is the refinement and taking into production of the N-type solar cell for the Chinese solar giant Yingli. The cell design came from ECN, Tempress supplied the technology for the diffusion and etching process and Yingli dealt with the process technology.

Concentrated effort

'We work extremely closely with ECN, because they are not a bunch of windbags and wishful thinkers', explains Pentinga. 'Together with ECN, we've got to where we are under our own steam. We managed to do this through focusing on research and the application of technologies that are close to the solar industry and not on technologies that might be successful in ten years' time. It is essential to keep research in step with the industry, otherwise you'll overshoot the market.'

This – as Pentinga calls it – concentrated effort will remain the central theme on the Tempress roadmap for the coming years. 'It's essential to maintain the connection with the market, which is why we invest heavily in our R&D. In the short term, we're concentrating on the completion of the successful launch of the N-type solar cell manufacture at Yingli. This also creates opportunities for introducing other companies to these diffusion and etching processes. In the period following this – the medium term – we will introduce, together with ECN, technologies such as PECVD to the market and allow the solar industry to exploit them. Finally, for the long term, we are realistic that, together with ECN, we will be plunging into completely new areas such as heterojunction solar cells.'

Extra jobs

Pentinga praises the way in which ECN operates and wants to intensify the cooperation with the energy research institute. Pentinga considers the occasional criticism from elsewhere in the Netherlands regarding the sale of technologies by ECN to foreign companies unfounded. 'Two years ago, only Yingli dared to participate in the development of the N-type solar cell. The European companies stood back and watched. Surely, it is logical that ECN should opt for Yingli. The result? We have, together with Yingli and ECN, developed the technology with corresponding manufacturing plant. It was essential for the project that we as a Dutch company participated. It resulted in a hundred extra jobs within our company. Above all, our suppliers are not as strongly allied to the semi-conductor industry as they were in the past. On top of this is the fact that, through the success of the project, we now have additional means available for follow-up research.'

'These investments in innovations are also necessary to remain at the top internationally', continues Pentinga. 'We managed to get to the top because we don't just supply a good machine, but also because we were in the right place at the right time. Our installed base in Asia for the semiconductor industry was of crucial importance here. Even more essential is, however, the support of the customer's manufacturing process. Only through demonstrating in the field that your machines can achieve good results can you score in this industry. In the case of Yingli, the support of the customer is so far-reaching that it can be regarded as a technology handover.'

Key competences Tempress Systems

- development and manufacturing of vertical and horizontal Diffusion & LPCVD furnaces
- the product range runs from R&D and pilot to fully automated production furnace systems for processing up to 300 mm wafers

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SoLayTec: Launches Ultra-Fast ALD Process Development Tool

In the coming years, high-speed spatial ALD is expected to make its mark in the solar industry. This is just one of the technologies that the Eindhoven company SoLayTec is specialised in. SoLayTec is to deliver its first product this year: the Process Development Tool. In addition, the company is heavily committed to the development of a high-volume product that will be ready by the end of 2011.

If the economy had developed differently in the last two years, it is likely that the Eindhoven company SoLayTec would never have seen the light of day. The company, a TNO spin-off, originated from the development of a new technology that TNO developed in 2008. As a consequence of the credit crisis, TNO did not manage to sell the technology to the solar industry. The result? TNO decided to spin-off the promising spatial ALD (Atomic Layer Deposition) technology into a new company.

Proof of principle

The first proof of principle that led to the company being formed is still fresh in the memory of SoLayTec's sales director Roger Görtzen. 'In this test, we demonstrated that with high-speed spatial ALD a deposition rate of 1 nm/second could be achieved. This had never been accomplished before with this technology. Using ALD, a uniform layer is built up in a layer-by-layer mechanism until the desired thickness has been reached. The only disadvantage until now for commercial manufacturing processes, was the relative slowness of the process of 0.1 nm/second. We have achieved a breakthrough with regards to deposition rate.'

'The first application that we are focusing on with ultrafast ALD is the application of a passivation layer of aluminium oxide on silicon solar cells with a speed of more than 1.2 nm/second', continues Görtzen. 'The speed facilitates the set-up of cost-effective manufacturing of large volumes for industrial applications. Our target is achieving a manufacturing throughput of 3,000 wafers per hour.'

Milestone

Görtzen expects that the ALD machine will ultimately have a length of 2,5 metres. According to Görtzen, not only is the limited size of the machine an advantage, but also the high degree of flexibility, the fact that a vacuum process and wafer carriers are unnecessary and the reduced use of materials result in considerable savings for the solar industry. 'In the coming months, we are going to demonstrate with a small machine, the so-called Process Development Tool, that this technology works', explains Görtzen . 'The market is crying out for it. The industry will not be ready for high production volumes tomorrow, but they do have a real need for a machine for doing research / process development. Following this development phase, the machine will be redesigned and we plan to deliver the first High Volume Tool at the end of 2011. It is just a question of time, the most important milestone was the technology. We have managed to demonstrate that spatial ALD works and that square wafers can be transported using air bearing.'

'Hopefully, the development of this machine will deliver a major contribution towards the improvement of the export position for Dutch industry', concludes Görtzen. Note, that we will not be the only ones to benefit from the successful launch of the high-speed spatial ALD machine, but also the other companies in our consortium. In brief, this is a truly Dutch product.'

Key competences SoLayTec

High-speed spatial Atomic Layer Deposition, benefits:

- Superior layer quality for Al2O3
- Efficient precursor usage, < € 0.02 / layer
- Deposition rate of > 1.2 nm/sec
- No chamber contamination, low maintenance
- Atmospheric pressure
- Movement using double-floating of wafers, no carriers
- Modular concept, easy ramp-up to high volume

The Netherlands: a solar future

As a consequence of climate change and the pending shortage of fossil fuels in the future, there is global interest in sustainable energy generation. A major innovation role is set aside for solar power (PV) and this will undoubtedly gain pace as an economic motive around the world. Although the Netherlands is not the first country to exploit PV, its solar ecosystem plays a major role. The Dutch Solar Technology Cluster is relatively small, but it is very strong, comprehensive and competitive. The Dutch ecosystem is a hotspot of international excellence in business and technology, unique in Europe.

Where other countries are known for manufacturing products, the Netherlands is famous for its machines. The south of the country is home to a high concentration of companies and knowledge institutes active in PV. This so-called ecosystem is closely knit and it collaborates in the development of new materials and machine concepts to improve reliability and yield. This ecosystem runs throughout the value chain, from research and development to complete solar modules. Originating in the high-tech industry, where companies like Philips, ASML, Océ, DSM, Fuji, FEI Company and OTB play a dominant role in the world market for high-end equipment. The Dutch Solar industry owes its competitive edge to the intense cooperation between manufacturers and research institutes. Through joining forces and sharing knowledge and networks, they create a wider base for succeeding internationally. The next challenge is to expand this technology from the conventional Si-based technology to innovative technology, e.g. printed electronics on flexible substrates. The PV-manufacturing technology market can be divided into manufacturing equipment for silicon and wafers, for wafer-based solar cells and modules and manufacturing equipment for thin films. Most process development and manufacturing technology companies are located in a limited number of countries, for whom this equipment is an important export product to countries where the manufacturing takes place. This is because the manufacturing methods are closely related to manufacturing methods employed in other related industries, such as the semi-conductor industry and the flat panel display industry. Countries that have been traditionally involved in these industries are also strongly represented in the PV manufacturing technology sector. The Netherlands is one of these countries.
Manufacturing technology, demonstration and development regarding the activities that are necessary for large enough scale manufacture with new technologies. This concerns a number of technical areas such as laser technology, wet chemical processes, deposition technology, metalizing, wafer handling, inkjet technology and roll-to-roll processing. The most significant challenges in this technical field are in low-cost scaling up. It is all about the integration of processing and materials in new machine concepts.

The Dutch solar industry is in flux and there are countless new initiatives. ECN, for example, is working on a new facility in Heerlen-Aachen. The intended factory and personnel are to run a flexible pilot line. With the objective of project-based industrialisation of crystalline silicon solar system technologies, rapid scaling up and demonstration of ECN technology.
Another Solliance initiative is the cooperation with R&D organisations in the field of solar PV and it has putting the ELAt region on the map as a world player in its sights. The knowledge institutes involved are: ECN, TU/e, TNO and Holst Centre. The spearheads are process development and manufacturing technology for roll-to-roll manufacture of thin film solar cells; development, scaling up and demonstration of manufacturing technologies for PV; and architecturally integrated solar PV for smart buildings and embedded in smart grids. A new knowledge institute is the Eindhoven Energy Institute (EEI) that gathers together about 150 researchers from 27 research groups from the TU/e. The institute aims to focus, reinforce and improve the visibility of energy research. The EEI will have four lines of research, aimed primarily at sources of energy for the future, such as solar cells, 'new fuels' and nuclear fusion. The start of the EEI underpins the growing role of the TU/e in the Dutch and international search for sustainable energy, prompting the fusion institute FOM Rijnhuizen to move to the university campus Eindhoven this spring. The TU/e is also participating in a large European cooperative that has received more than twenty million from the EU for energy research: the Knowledge and Innovation Community (KIC) InnoEnergy. The Dutch roadmap for solar energy is currently being developed as an umbrella – in a project stimulated by government, Peaks in the Deltra – and this will be published before the end of 2010. All the Dutch stakeholders have been involved in this project. The roadmap is an important step for the further positioning for the region and the Dutch solar cluster. In brief, the Netherlands is working on its solar future!

John Blankendaal
N.V. Noord-Brabant Development Agency

DHV consultancy and engineering wants to expand global top-three position

DHV consultancy and engineering is amongst the top three worldwide with regard to process and construction related utilities, the corresponding architecture and construction supervision for solar manufacturing facilities. The firm has a long history. The company was originally a spin-off of the electronics giant Philips. In 1998, DHV was involved in the establishment of the first Shell Solar Factory in the Brabant town of Helmond. 'We also completed a factory for Shell in the German town of Gelsenkirchen in 2002', explains Ad Schrijvers, business development manager at DHV. 'The realisation that 'solar was going to become big business' really broke through in that year.'

'Today, our company is very internationally oriented', continues Schrijvers. 'The Canadian ARISE selected us for the complete design, installation and constructional supervision of its first solar cell factory in the German town of Bischofswerda. We realised the first trans-border manufacturing facility for Solland Solar (the Netherlands and Germany) and this year a major project in the Belgian town of Tienen was completed, where a new manufacturing facility for Photovoltech was taken into service.'

Floors

According to Schrijvers, it is the way in which the solar manufacturing facilities are designed that makes DHV's strategy so exceptional. Where most competitors opt for a factory design with a single floor, DHV employs two or more floors. The advantages? Personal safety in the case of emergencies is better safeguarded (gravitational conveyance), logistics are simpler to organise as all the machines can be connected from underneath and, above all, less building land is required.
'A fourth advantage is the greater flexibility that is created through building multiple floors. The ARISE factory for example was originally to contain three production lines. In the end, four lines were set up. Due to the fact that there were multiple floors, this was no trouble to organise. In this specific project, our most significant skill became apparent: the design and supply of the necessary utilities that the solar cell production lines employ. We design these utilities in 3D from the outset, ensuring optimum space management and preventing collisions during implementation.'

Ambition

Schrijvers does not mince his words; DHV has serious ambitions. More and more often, the company goes head to head with its two main competitors: M+W Zander and ib vogt. 'We want to reach the size of M+W Zander in the coming years. While making clear that we never plan to execute the construction of manufacturing facilities in the way that M+W Zander does. Even so, we are continually expanding our portfolio. So we no longer exclusively build factories for the manufacturers of silicon solar cells, but also for all other pv-technologies. Partly through cooperation with other companies within the Netherlands that develop and manufacture technologies like CIGS, CdTe and organic, we can understand the processes. Through this, we know what transpires during the manufacturing processes and which systems and utilities are required. More and more attention is being focused on the sustainability of the manufacturing processes. Together with a partner specialised in water treatment we have realised a set-up for a factory in India, which allows for ninety-five percent of the water to be recycled. In the coming five years, the importance of green factories like this one will only increase, as well as the management of the total cost of ownership.'

Key competences DHV

- Design of process systems and supply of utilities
- Management of construction and environmental licences
- Management of the architecture
- Supervision of the construction of the manufacturing facilities
- Feasibility studies

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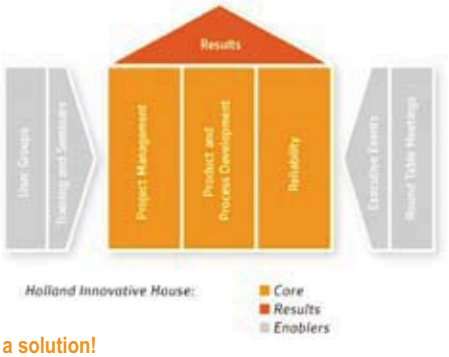

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Scheuten Solar forges ahead the advancement of international solar industry

Scheuten Solar has plans to expand its activities abroad in the coming years. The international prominent player is already active in more than ten countries and will increase this number in the upcoming years. 'Under the motto think global, act local, we spread our risks and continually strengthen our leading international position', explains Scheuten Solar CEO Frans van den Heuvel.

That Scheuten Solar has potential for growth was already shown over the last years. The manufacturing capacity in the German town of Gelsenkirchen was increased with sixty Megawatts to a total volume of two hundred Megawatts. Above all, Scheuten Solar was in the global spotlights just before the summer recess because the company was awarded the '2009 Global Industry Innovation & Advancement of the Year Award' in the solar power market. Frost & Sullivan present this prestigious prize to a leading company that has been the driving force in the successful development of an industry each year. 'According to the jury report, we were awarded the prize because we realised innovative solutions in the rapidly expanding solar market and have focused se-riously on R&D. This includes our integrated BIPV projects such as the central station in Berlin, the turnkey solar power stations in Southern Europe, but also the development of our thin film cell technology', explains Van Den Heuvel.

Strategy

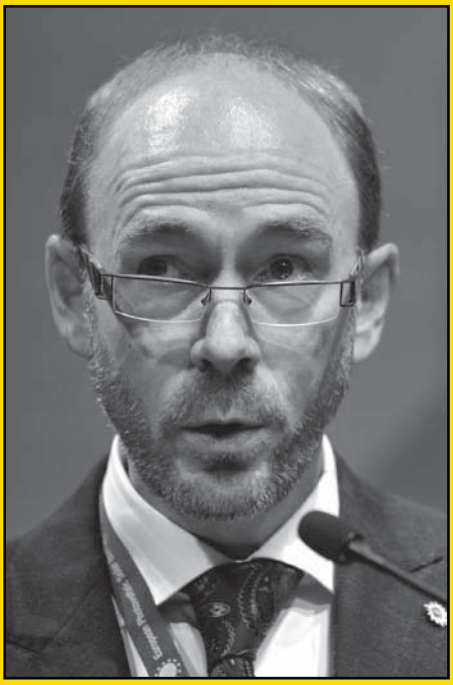
Scheuten Solar is part of Scheuten, a prominent player and manufacturer of total solutions in glass and solar energy systems. Scheuten Solar, in turn, is active in the field of design, manufacture, distribution and installation of photovoltaic solar modules. 'We do not need to be or become the biggest', explains Van den Heuvel. After all, such a strategy leads to a dead end. You would then be going head to head with the Far East and try to distinguish yourself based on volume and price. Instead we focus on creating surplus value for our customers via our value added distribution concept and our plenary activities in the project business and our high-quality products. We develop this independently or with our partners. It is important to make the right decision at the right time in this industry. For example, when you need to initiate or halt a new activity. We did this in the past with the manufacture of cells. The market was flooded and this is why, at the time, we decided not to continue with this.'

'Which is why we have operated a pro-active policy to reduce risks in recent years', explains Van den Heuvel. 'In the last few years, many companies have become dependent on the German market. As Scheuten Solar would rather be active in twenty countries with a few percent of the market share than to acquire a large share of the market in a single country. This is perhaps a little more difficult with regards to manufacturing and logistics, but the risks are considerably lower. Through gearing up a good central organisation with strong local positions – under the motto 'think global, act local' – a company is created with a considerable potential for growth. We strengthen local dealers through offering them added value through market pull and technology push.'

Key competences Scheuten Solar

- Developing, manufacturing, distributing and designing PV solar modules & solutions
- PV system integration
- Development and realization of turnkey PV systems

'If we are in the coming years able to further expand our position by applying existing and new technologies – including crystalline silicon and CIGS – in final products and solutions that are appreciated by our customers, we will be more than satisfied', concludes Van den Heuvel. 'Thanks to sound governmental policy, the Netherlands has been able to command a top position in research and development and has demonstrated the potential of the developed knowledge and skills in various demonstration projects around the country. It would be a shame and a disappointment if we were not able to convey the investment and efforts to industry. This is where the challenges lie for the industry in conjunction with government and knowledge institutes in the Netherlands.'



Mainstreaming of solar electricity

Until recently you needed a magnifying glass to see the contribution of solar electricity in major energy scenarios. This was (obviously) true for the current share, but often also for future contributions. Solar electricity, and especially photovoltaics (PV), was seen an elegant technology for relatively small markets. Cute, but harmless.

A technology with a very modest impact in terms of reduction of greenhouse gas emissions and dependency on fossil fuels. If people in the solar energy field wanted to underline the importance of their work, they had to refer to scenarios from 'biased' sources, like the European Renewable Energy Council (EREC), Greenpeace, and the European Photovoltaic Industry Association (EPIA). Or, only slightly better, the German Advisory Council on Global Change (WBGU). But this is now changing. Although the current share of PV to the global electricity consumption is still less than 0,2 percent, in Germany it is already more than 2 percent, and growing. Other countries have not yet reached the level of Germany, but with double digit market growth that will not take decades. In other words, PV is gradually entering the world of mainstream electricity generation.

As the role of PV becomes significant, the vested interests of stakeholders in the energy sector start to play a role. Also, the properties of the current grid infrastructure need to be considered. This has important consequences for the growth model of PV. On the one hand, the PV sector needs to team up with the existing energy sector. This is essential for PV to gain a strong position and to get the credits it deserves as brilliant new kid on the block in the total technology portfolio. We cannot do without supporters in the energy sector. It is also crucial because the grid infrastructure gradually needs to be made more flexible to allow PV to feed into the grid at high degrees of penetration. On the other hand it is necessary for PV to maintain at least part of its independence to ensure rapid further growth. The major players in the energy sector may not (automatically/spontaneously) support the ambitious growth of PV necessary to reach competitiveness in many electricity markets soon.

I am not a believer in conspiracy theories and I don't want to blame individual companies for their policy and strategy. Keeping some distance is simply a matter of realism. After all, shareholders, governments and society as a whole should give the robust triggers for change and as we all know this is the mother of slow processes. In this context, I consider it a major milestone that the International Energy Agency (IEA) has recently published an ambitious PV Roadmap (see, for instance, www.iea-pvps.org). The IEA is very influential and does not suffer from an image of being biased towards renewables.

The PV Roadmap is one of the first energy technology roadmaps developed in response to a deeply felt need for a rapid energy transition. It shows the vitality and huge potential of PV in a very convincing way. Drastic further reduction of generation costs will enable PV to first compete with retail electricity prices, then with wholesale prices and, ultimately, with almost all forms of electricity generation, in almost all markets. Moreover, this will not take 'forever', as sometimes suggested. Already in the next two decades PV will reach competitiveness in major parts of the global electricity markets. According to the IEA Roadmap, the share of PV to the total global electricity consumption may be more than 10 percent by 2050. Apart from the fact that the global consumption is expected to have doubled by 2050, it is also emphasized that this 10 percent does not represent a physical limit or the result of an accurate calculation. The potential of PV is even much bigger and it is up to all of us to show what is possible.

Wim Sinke
ECN Solar Energy

Key competences Smit Ovens

- Thermal process solutions for high-volume manufacturing
- Thin film solar solutions:
  - Crystallization for CIGS
  - Selenium deposition for CIGS
  - Activation for CdTe
  - Contact firing
- Glass for solar:
  - TCO for CdTe and thin film silicon
  - Strengthening and toughening

Smit Ovens: 'Nurturing innovation through cooperation with market leaders'

Smit Ovens gained fame in the previous century with the development and manufacture of industrial ovens. In recent years, the company has utilized all the skills and knowledge it acquired here to specialise in the solar industry. Smit Ovens designs and manufactures thermal process solutions for three solar thin film technologies: TCO, CIGS and CdTe. 'We nurture our innovation processes through cooperation with international market leaders', explains CEO Wiro Zijlmans.

TCO is a technology with which the deposition of Transparent Conductive Oxide (TCO) takes places for thin film applications. With this technology, the lion's share of the visible sunlight passes through glass with only limited losses. A second technology that Smit Ovens applies is that of Copper Indium Gallium Selenide (CIGS), in which a crystallisation process is brought about in the ovens. 'The crystallisation is a crucial step in the process in the heart of the solar panel', relates Zijlmans. 'This is the place where the increase in the efficiency of the solar cell can be achieved. We develop all sorts of new variations to this end, including equipment for the production of roll-to-roll applications. The third technology we are involved in is Cadmium Telluride (CdTe). This concerns various applications, including equipment that is suitable for deposition of an active layer and thermal curing.'

Lion's share

When asked which of the three technology domains that Smit Ovens is concentrating on he considers to have the most chance of success, Zijlmans says he believes this is CIGS. 'Tremendous developments are taking place here and the technology is very promising. The lion's share of our research activities takes place within the sphere of this technology. It is not for nothing that the Dutch government recently awarded a grant for a large innovation project concerning CIGS. A large consortium within the Netherlands is collaborating in this project for this new technology. Taking this path, we will - as a country and industry - make a substantial contribution to the technological development of the international solar industry.''In the coming two years, 2011 and 2012, we can claim a success from an innovation perspective the moment that CIGS gets off the ground and we can prove that the technology works through a demonstration and test line', continues Zijlmans. 'We want to explore the possibility of combining material. An example is Copper Zinc Tin Sulphide (CZTS). Above all, we can look at roll-to-roll applications. It is true to say that the basic technology has been perfected for TCO. Smit Ovens is one of the few players that can supply offline equipment with which individual sheets of glass can be treated with a TCO coating. With the third technology, CdTe, grid parity will be achieved first. This is why it is so important to look at architecturally integrated solutions. There are lots of wins to be made here and new applications to develop.''There where crystalline silicon has been standardised, you see far more variations in technologies and final products in the area of thin film', continues Zijlmans. 'Many solar companies consequently invest in research and development, looking for more thin film technologies. After all, you are better off boarding a few extra boats, if it means that you don't miss the winning boat. As an equipment supplier, we have the advantage that we get openly around the table with larger companies and, in doing so, can create bonds. Our business model is based on working with the market leaders. This is the only way for us to be able to nurture our innovation processes.'

M2i Materials innovation institute

M2i is an international innovation program based on a partnership between industry, academia and Dutch government. M2i is organising research to develop and apply new and improved materials. By putting emphasis on valorisation M2i ensures that the results are being applied in practice. The aim is both to enable the realisation of societal themes and to help industries to increase the turnover in various market segmets.

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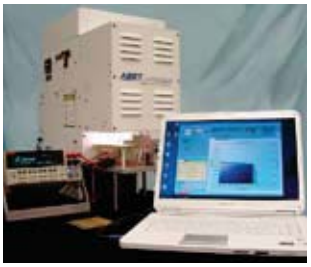

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OTB Solar – Roth & Rau continues to invest in R&D and new technologies

The most important elements of OTB Solar – Roth & Rau's strategy are continuous development of new technologies, extensive specialisation, and seeking joint ventures along the value chain. 'You can only maintain an international top position by focussing on continuous innovation', states OTB Solar – Roth & Rau CEO Paul Breddels.

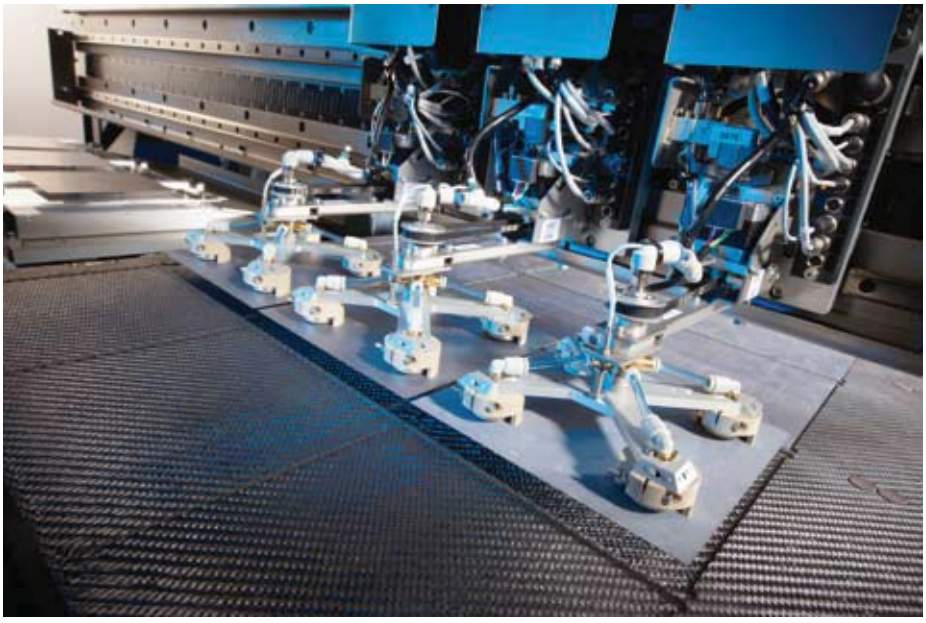
OTB Solar – Roth & Rau's core competence is the development and production of equipment for the manufacturing of solar cells. Last spring it became again apparent that OTB Solar – Roth & Rau has an international reputation in the equipment industry when in February 2010 the – larger – German equipment manufacturer Roth & Rau purchased industry partner OTB Solar. This is one of the first indications of a consolidation in the world-wide and growing solar PV market. 'I am convinced that we will not only grow within with Roth & Rau, but that we will also significantly accelerate our R&D activities', says Breddels.

Retrofit

'We are ready to launch the first of several new technologies that will increase the efficiency of solar cells', continues Breddels. 'Currently we are working on a number of ideas which will improve the process without the need to change the entire production line. We will replace only the key processes. These upgrades can be carried out as a "retrofit" in nearly all existing production lines. In terms of materials we are currently working on silicon oxide, aluminium oxide and amorphous silicon.' According to Breddels OTB Solar – Roth & Rau will put even more focus on the positioning of the DEPx technology in the next two years. 'We use plasma enhanced chemical vapour deposition (PECVD) to produce solar cells with high efficiencies.Using our DEPx product we can deposit silicon nitride at a very high rate. PECVD technology is an area in which synergies between OTB Solar and Roth & Rau have - in the past six months - already shown an increased success rate for the company. More importantly, this technology is one of the segments for which we expect substantial growth in the future.'

Inkjet printing

Another technology which Breddels expects to grow considerably is inkjet printing. 'Applying this technology in the solar industry, we are able to locally vary the concentration of the doping material', Breddels explains. 'By lowering the resistance of the silicon wafer below the metal contacts of the solar cell, the electricity can be more efficiently drawn from the solar cell. Again, we are benefitting from the take-over by Roth & Rau, since we now have access to a pilot production line – located in Germany at Roth & Rau's Hohenstein facility - in which we can test inkjet printing under realistic production conditions.'



'Therefore, we continue developing new technologies in order to stay competitive in the international equipment industry and to remain known as a technology provider', concludes Breddels. 'We are specializing more than ever on our core competences in high tech process automation and we believe it is very important to have a strong representation of the Dutch high tech industry. We are promoting regional collaborations and have already succeeded in aligning the agendas of institutes, universities, and industry. Solliance is an example of such a collaboration and one from which OTB Solar – Roth & Rau as well as all other participating partners, will certainly benefit in the future.'

Core competences OTB Solar – Roth & Rau

- Thin film deposition
- Process integration
- Vacuum technology
- Manufacturing automation
- Providing equipment solutions for automatic solar cell manufacturing
  - DEP_x - product family of Silicon Nitride Deposition Equipment with highest deposition rate;
  - PiXDRO - the future for inkjet printing from product development to pilot and mass production;
  - $LiNE_x$ - from raw wafer to sorted cells. Turn-key solar cell production lines with the very highest level of automation;]
  - MET_x - screen printer metallization system. It is easy to operate and has a small footprint.

Air Liquide subsidiary opens new cleanroom:

Lamers High Tech Systems wants to facilitate innovation processes for the solar industry

Although Lamers High Tech Systems (Lamers HTS) was involved in heating and air treatment for the first eighty years of its existence, the company quickly shifted gear from 1984 and got to work for Philips Semiconductors. For the last twenty-five years, with Philips and ASML amongst its major customers, the company specialised in the design, manufacture and qualification of systems and control systems for ultrapure gasses and chemicals. Since 1999, Lamers has been a subsidiary of the international Air Liquide group. 'We're active in the markets with very high demands on purity of gasses and the purity and leak tightness of the connections in the systems', explains managing director Nico Nieuwland. 'These include the semiconductor industry, space and aviation, food and pharma and, of course, the solar industry.'

Lamers HTS opened a new cleanroom in its Nijmegen location in mid April, giving the company three cleanrooms with a total surface area of over eleven hundred square metres in the province of Gelderland. 'This cleanroom is an expression of our growth during the last few years and a precondition for further expansion. The investment was in fact postponed by six months as a result of the economic downturn. However, the cleanroom was completed at exactly the right moment, because 2010 is expected to be the best year in the history of Lamers HTS with a turnover of seventy to eighty million euro. Above all, this investment will allow us to organise our manufacturing process more flexibly and efficiently.'

Nieuwland envisages that a major share of the growth in the coming years will be from the solar industry. The director is planning three product ranges. 'In the first place, we can provide OEMs with parts for machine construction but we can also install the necessary gas and chemical systems in the factories that will use the machines. Finally, we can supply the dispensing and evaporation equipment. This is of course dependent on the success of the solar industry itself. We grow with them as we deliver the goods in our role as partner. We have turned rapid adaptation into an art form.'

'A good dose of realism is appropriate', continues Nieuwland. 'We have no ambition to play a leading role in the development processes, but we are a facilitator. So Lamers HTS is able to develop and build the latest dispensing and control equipment for the innovation processes within the solar industry. In brief, the scientists have an idea and we transform this into the necessary hardware to achieve the idea and we can even supply the prototypes and make the step to mass production.'

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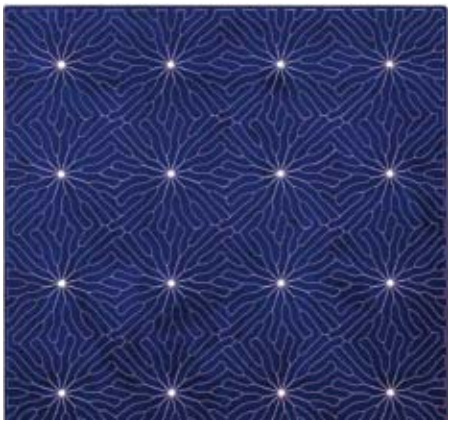

Solland Solar presents new business model with partnerships for Sunweb modules introduction

Solland Solar no longer just manufactures solar cells, but modules too. The company is to market these Sunweb® modules with a number of partners. Under the motto 'if you can't beat them, join them', Solland Solar has not only closed a partnership with the German Schott Solar, but in the near future it will also enter partnerships with companies from – with regards to production – attractive Asian countries.

Solland Solar is the Netherlands' biggest solar cell manufacturer. The company, situated on the German-Dutch European Science & Business Park Avantis, saw the light of day in 2003. Now, seven years on, the company has announced it wants to alter its strategy. A recent development has meant that Solland Solar is no longer exclusively a manufacturer of cells, but of modules too. 'We're taking the step from a manufacturer of multi-crystalline solar cells to supplier of Sunweb modules', explains Henk Roelofs, managing director of Solland Solar. 'Our strategy also has two other pillars. The first concerns the technological perfection of the back-contact solar cells and modules we make. The cells are now based on metal wrap through, characterized by the fact that all contacts are located at the back. We're going to develop this so called back-contact solar technology to a high yield. Also we developed a back-contact module technology. The other pillar is the closing of contracts with original equipment manufacturers (OEMs) for manufacturing objectives.'

Sunweb Inside

The change in Solland Solar's strategy originates from the fact that the monoculture of cell manufacturing did not appear to be resistant to the 'solar winter', as Roelofs names the drop in price and demand in 2009. A specific module concept is required for the Sunweb cell that Solland makes and the company is currently setting this up. Part of the manufacture of the modules will take place in a new location in the southern Netherlands and then we will set up a production, possibly with partners. 'We're going to market the modules on a grand scale, a scale bigger than Solland', continues Roelofs. 'This is why we have entered partnerships with commercial parties who're going to operate under licence using the slogan 'Sunweb Inside'. Advantages of manufacturing modules are that the cost reductions at cell level can be taken in the modules, the increased efficiency at module level and it offers opportunities on our technologic roadmap. For example, bigger and thinner wafers and adding extra features to modules.'

Roelofs hopes to be able to enjoy the benefits of the new joint ventures that Solland Solar has entered within a few months. 'With our partners – commercial, development as well as manufacturing partners – we think we'll be able to market and initiate the selling of the modules in the second quarter of 2011. Through the cooperation, we believe we'll be able to achieve a greater impact on the market and fast-track technological developments. Our roadmap provides for many new generations of solar cells with which even higher efficiency can be achieved. The Sunweb modules that we're now going to market are perfectly suitable for roof construction and we're also especially interested in Building Integrated PV (BIPV) applications.'

'We'll be very satisfied if the company grows profitably in the coming five years', continues Roelofs. 'And if we've managed - with our partners - to position Sunweb solidly in the market as technology. With regards to volume, I'm thinking of the installation of more than a Gigawatt. With regards to technology, three matters are of vital importance: continuing to follow our roadmap to achieve further cost reductions, the introduction of new specific applications such as BIPV and finally the incorporation of extra features in modules. Time-to-market is crucial for the last three; it is the key success factor.'

Key competences Solland Solar

- Development of innovative solar technology
- Marketing of the Sunweb module, benefits to partners:
  - 10% higher output / m2
  - Higher product quality
  - Striking appearance
  - Following a roadmap for continued efficiency improvements and lower product cost

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Solar fits in with robust and innovative Brainport region

The Brainport region, with high-tech Eindhoven at its hub, forms part of the technological backbone of Europe. In fact the entire region, and Brainport Eindhoven in particular, plays a major role in generating the innovative and economic power of the Netherlands as a whole.

The innovative character of our region is supported by the facts. Businesses based in Brainport Eindhoven are awarded 4 to 5 patents per day; this is more than half (55%) of the total number of patents registered throughout the country. Nowhere else in the Netherlands sees as much private investment in R&D as this region. The export figures for businesses in the region exceed 75 billion euros. This is 35% of the total Dutch export figure and way above the figure for the Rotterdam region with its Seaport, and the Amsterdam region with Mainport Schiphol.

I would also like to dispense with a common misunderstanding. There is a widely-held view that Eindhoven is all about Philips, or the other major companies operating from Eindhoven such as ASML (world's leading provider of lithography systems for the semiconductor industry), DAF Trucks (a top 3 truck producer in Europe) or NXP (a leading semiconductor company). Although these companies generate an annual turnover of more than 4 billion euros, there is much more to Eindhoven than this. Brainport Eindhoven is the base for numerous successful, smaller and less well-known businesses. The eco-system has a deep and far-reaching basis in electronics, IT, materials, manufacturing and intelligent and creative design. Furthermore: the number of start-up companies is rising rapidly, which gives a good indication of the solidity of the Brainport economy.

Whatever else, innovation is the driving force behind the basis of industry in this region. Industry in the Eindhoven region earns 32% of its turnover from innovation. This means that 32% of the total turnover of these companies is actually generated from new products. Products that did not even exist two years previously. The figure for the whole of Dutch industry is just 13%. So Brainport Eindhoven lives from robust innovation.

Collaboration between businesses, universities and other knowledge institutes is crucial to innovation. When it comes to collaboration with industry, Eindhoven University of Technology (an essential link for Brainport) is no. 1 in the world, even beating the major Japanese universities. This position is proof of the unique, close R&D collaboration between knowledge institutes and high-tech industry. In addition, the High Tech Campus Eindhoven provides an ideal environment in which innovative companies can swiftly transform knowledge into innovative products and service.

Brainport Eindhoven gives full support to start-up businesses and encourages growth among existing companies. Specific programmes and accommodation opportunities are in place for starters and newcomers. Special attention has been focused on the Solar industry. The Solar industry fits in well with the powerful economic and technological base of this region. In terms of knowledge organisations, a number of research institutes from around the Netherlands, such as FOM and ECN, are choosing to move their operations to Eindhoven. They recognise the added value of this concentration of activities and are keen to be part of the international success of Brainport. Moreover, the European Institute of Innovation and Technology (EIT) has chosen Eindhoven as a co-location centre within the InnoEnergy programme. And Eindhoven has also been assigned as a co-location centre in the ICT Labs programme.

In short, if you want to start a company or take advantage of rapid growth opportunities in the solar industry (a real boom!) and other related sectors such as the battery technology sector, then Brainport Eindhoven is the place to be. It is a solid and innovative environment for R&D and high-tech manufacturing. There is a high degree of confidence that Brainport will be able to continue to generate innovation and successful businesses well into the future. Brainport is certainly living up to its slogan: Creating the industries of the future.

Rob van Gijzel
Mayor of Eindhoven

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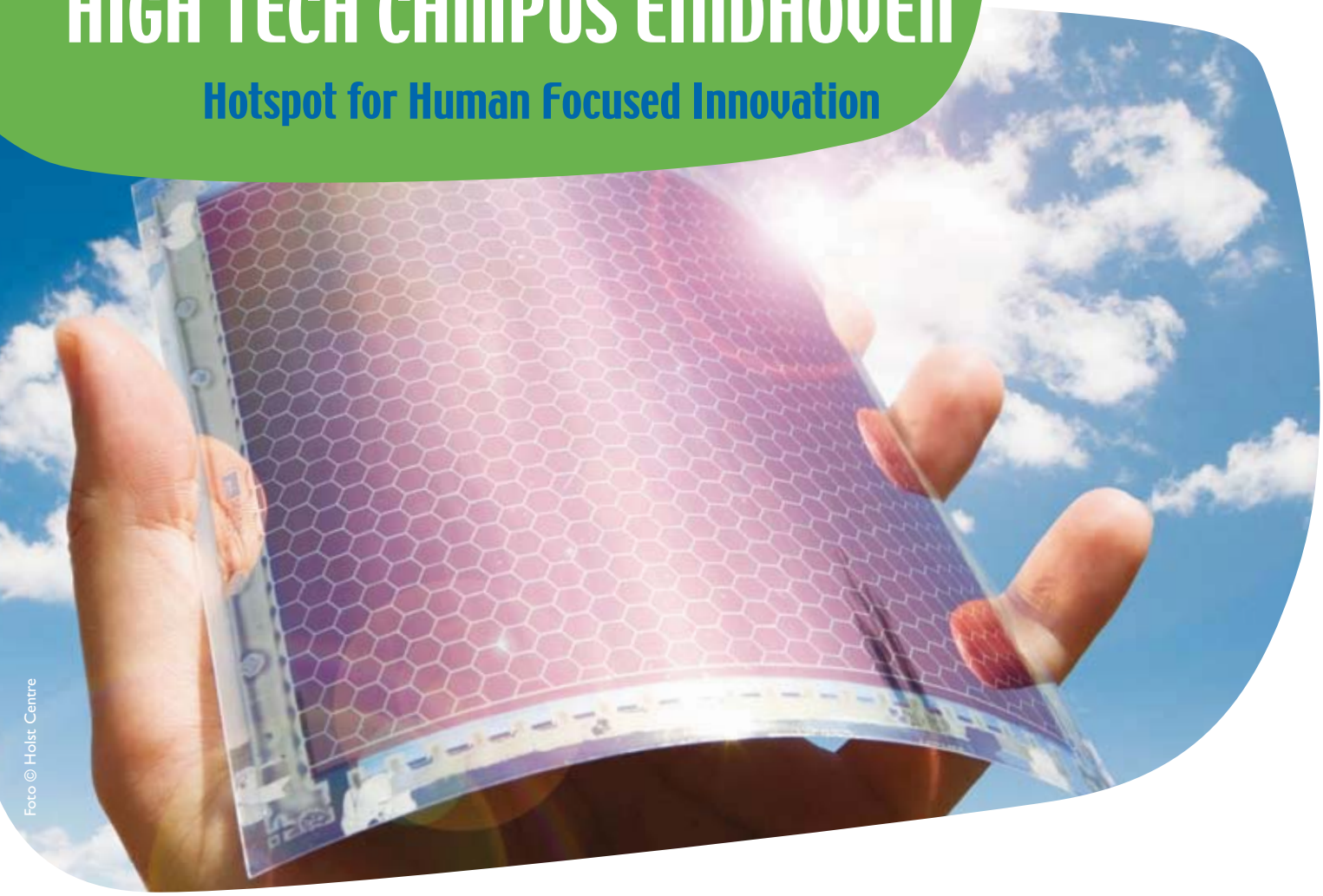

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High Tech Campus Eindhoven is an R&D ecosystem of more than 90 companies and institutes, and over 8,000 researchers, developers and entrepreneurs, who together are working on developing the technologies and products of tomorrow. The preferred work approach at the Campus is Open Innovation. This means that Campus companies share knowledge, skills and R&D facilities in order to achieve faster, better and more customer-oriented innovation.

The companies on the Campus focus on such fields of technology as High Tech Systems, Microsystems, Embedded Systems, Life Sciences and Infotainment. Taking these domains as their starting point, they create global innovations, most notably in the application fields Health, Experience and Energy. The international community of the Campus shares a common drive for creating innovative solutions that make human life healthier, more pleasant, easier, more interesting and which contribute to a sustainable world. This makes the Campus a place where entrepreneurial spirit, high-end research and creativity can flourish and lead to successful new products for global business.

Solar energy

Traditionally, systems and technology involving semiconductors on thin film have been strong fields on the Campus. This knowledge and expertise are extremely valuable assets for the development of solar energy systems, because they offer crucial research answers. Several players in the solar energy business such as ECN, Solland Solar, Suncycle and Free Energy Consulting already enjoy the advantages of being located at the Campus. With knowledge providers such as Philips Applied Technologies and Holst Centre, the expertise is enriched. Finally, the MiPlaza facilities complete the high tech ecosystem in the field of solar.

For more information: www.hightechcampus.nl

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NTS Group enters the solar industry with Jonas & Redmann

The Eindhoven NTS Group has been active in the German solar industry since the beginning of this year. The German Jonas & Redmann – supplier of practically all large solar cell manufacturers – commissioned the company to produce wafer-handling modules. In the coming years, the NTS Group wants to spread its wings in the world of solar energy.

At the start of this year, Eric Hezemans was appointed as managing director of the new company NTS Motion Systems, part of the Application Systems division of the NTS Group. This division focuses on the development of opto-mechatronic systems. 'These are modules that do not generally belong to the OEMs' core competencies', says Hezemans. 'Increasingly often, OEMs subcontract not only the manufacture but also the development of these modules.'

Cyclical markets

In the past decades, with customers such as Philips, ASML and FEI Company, the NTS Group has developed a lot of specialist knowledge in the flexible manufacture of mechatronic systems. Increasingly often, this was also supplemented with development. Hezemans: 'We want to make this knowledge available to OEMs that offer mechatronic systems across the world and in various market segments, such as the semiconductor and the solar industry.'

'With our division NTS Mechatronics, we are now active in the solar industry', adds Frank Theuws, managing director of NTS Mechatronics. 'The German Jonas & Redmann has subcontracted the building of a number of modules and we have committed ourselves to the continuous improvement of these modules.'

The German Jonas & Redmann, originally an engineering firm, grew alongside solar manufacturers such as Q-Cells during the last decade. Today, it counts about seven hundred employees. 'It's a great adventure for us as well as for them', says Theuws. 'For NTS, the German solar industry was new. Jonas & Redmann had never before outsourced production.' 'To Jonas & Redmann it was important to know that we are and will remain a system supplier', says Hezemans. 'We excel in cyclical markets, such as the semiconductor industry, and, as has now become apparent, also in the cyclical solar industry. The Dutch export product here is the organisation of a flexible manufacturing process. The Dutch semiconductor background enables us to deal with extreme volume fluctuations. Within Europe, our region distinguishes itself through its ability to organise a manufacturing process in which ten machines are produced one month and one or none the next. In brief, as a Dutch business cluster, we are able to manage high complexity, low volume and high flexibility.'

Set of competencies

'Only through operating on the basis of trust is it possible to organise such manufacturing processes', Hezemans continues. 'In the case of Jonas & Redmann, we have ma-naged to build up a basis for trust. Important here is that we aren't smarter, but better trained. It is easier for us to do, because we do it more often - or in other words - manufacturing is our forte.'

Now that NTS has entered the solar industry, the company wants to spread its wings in the coming years. 'The organisation of a flexible manufacturing process is an export product in its own right. We are convinced that this set of competencies will enable us to grow in the solar industry', says Theuws. Hezemans concludes: 'It is a matter of extrapolation; the solar business is similar to the semiconductor industry. There are many analogies. We expect the solar industry to undergo a similar development to the semiconductor industry. A chain infrastructure will be formed, but far more rapidly. The lessons learned previously will be invaluable.'

Lutz Redmann, managing director/ owner of Jonas&Redmann GmbH: 'We have found a solid partner in NTS who provides the flexibility in manufacture that the market requires from us. NTS has also realised actual cost reductions. Together with NTS, we are working on the further optimisation of our machine design and NTS is assisting us in setting up a local facility in China. In reflection, the step to outsourcing has been a big one, but also a very successful one.'

Key competences NTS Group

- Supply of modules and complete machines
- Development and manufacture of mechatronics
- Motion and positioning in mechatronic systems

Test machine for 'RGS' solar silicon wafers reaches important milestone

At Broek op Langedijk near Alkmaar in the Netherlands., great progress has been achieved with the development of Ribbon-Growth-on-Substrate silicon wafer technology. Last spring, a wafer of 156 millimetres square was successfully produced and within 3 years RGS Development BV expects to see the first commercial factory line operational, employing this new technology.

'We're in the segment where silicon wafers are manufactured within the solar panel manufacturing chain', explains Axel Schönecker, managing director of RGS Development. 'Up until now, this part of the chain has been plagued with large quantities of material that are lost when silicon blocks are sawn into wafers. With the Ribbon-Growth-on-Substrate (RGS) technology – in which silicon is casted into thin wafers directly from its liquid state – we are able to prevent this type of material loss. With the added advantage that we are not just able to produce twice as many wafers with the same quantity of raw materials, but - thanks to a far more efficient manufacturing process – we are able to halve the cost of manufacturing these wafers. Finally the energy efficiency of the whole production process has improved by more than 50 percent.'

Cluster

Wafers for manufacturing solar cells are normally sawn into thin slices from larger blocks. A lot of silicon is lost in sawing. RGS technology involves the silicon being heated to a temperature of 1410 degrees Celsius. Subsequently, in this molten state, it is casted into a form in which the silicon solidifies into a thin wafer. This avoids the sawing and corresponding material wastage. The manufacturing method and various parts of the machine have already been patented.

The energy research insitute ECN, Deutsche Solar AG and Sunergy Investco BV, which is part of the Dutch power company Delta, are responsible for RGS development. These parties established RGS Development in 2005. After forming a cluster of partners and suppliers, casting the first wafers and the development of a test machine, an important milestone was reached in May 2010. 'This is when we first succeeded in casting an industrial-size wafer of 156 millimetres square', explains Schönecker. 'In doing so, we have demonstrated that we've mastered the technology and have the ability to manufacture wafers. The challenge is now to run this process continuously. The experience we acquire in this development will be shared with Sunergy in order to realize the industrial phase. We expect Sunergy will be able to commercialize the first line in 2013.'

Market share

The test machine will be able to process about fifty kilograms of silicon per hour, creating three thousand wafers. 'We're then talking about a nominal capacity of fifty Megawatts per machine', explains Schönecker. 'We hope to have five percent of the market share of a total market of fifty billion euro in 2017.'

'Moast hurdles that were encountered in the development of the machine have been overcome', continues Schönecker. 'This does not mean we do not have challenges. However, we are convinced that we'll manage to bring the first pilot production line into service with Sunergy Investco by 2013.

Key competences RGS Development

- Ribbon-Growth-on-Substrate (RGS), benefits are:
  - 20 times higher manufacturing capacity for each line in comparison with conventional technology
  - 200 percent more wafers from the same amount of silicon
  - Fifty percent less power consumption for each wafer
  - Twenty percent lower investment for each wafer capacity

It takes twelve months to build a machine. In the period after 2015, we believe that a dozen new machines can be absorbed by the market. RGS Development will have to structure or partner with a very efficient machine-building organisation to be able to supply more machines in a shorter period of time. We see the future as an exciting and challenging period and are convinced that our team is capable of fulfilling this big promise for cheaper solar energy.'

Philips helps innovators from lab to fab

Philips as a supplier of energy-efficient solutions, as a facilitator for pioneering technologies, an integrator and a driving force for innovation. This, in a nutshell, is how Philips Research MiPlaza (MiPlaza) and Philips Applied Technologies envisage the future. They are increasingly focusing on the solar industry.

'We are not a research institute, but an organisation that facilitates research with infrastructure, knowledge and product development. From an idea to mass production', Gerjan van de Walle and Arjan van der Pol open the conversation. They are respectively MiPlaza's business development manager and Philips Applied Technologies' application domain leader. 'With a long and respected track-record in the lighting industry, the next step to the solar industry was a logical one', Van der Pol continues. 'From creating light with lamps, we're now taking the step to capturing light and transforming it into new energy. We do this based on the open innovation approach that characterises our company today.'

Helping hand

Philips Applied Technologies and MiPlaza have been residents of the High Tech Campus Eindhoven from the beginning. On the industrial estate, which is characterized by open innovation and cooperation between companies that are established on the site initiated by Philips, Van de Walle and Van der Pol have seen an increasing number of players in the solar industry appear in the last two years. Philips Applied Technologies and MiPlaza themselves are actively involved in the solar energy sector. Van de Walle: 'We've seen many innovations fail before they have even got to the market. Ideas and money are often in abundant supply, but leaving the laboratory is often a problem. We think we can offer a helping hand. With our experience and competencies, we help shorten our customers' innovation cycle. We can support high-tech innovators in taking the step from a brilliant idea to a successful product introduction.' One of the niches within the solar industry that Philips is working hard on is Concentrated PhotoVoltaïc (CPV) technology. 'Until recently, everyone focused on crystalline silicon and thin film', says Van der Pol. 'CPV was only considered an application for desert-like areas. An industrialisation trend for CPV is now underway, and we are doing our bit. Other new technologies also have our attention. We help innovative companies with these technologies take the step from lab to fab. For those companies, time-to-market is crucial and this is especially true in the solar industry. '

Out-of-the-box

'There are more examples', Van der Walle continues. 'We're working on nano wire PV, for example. With Substrate Conformal Imprint Lithography (SCIL), nano patterning can be made for nano wires. The race for grid parity creates space for new technologies alongside the traditional thin film and crystalline silicon applications. The technology exists; it is now a matter of thinking out-of-the-box when looking for efficiency improvements. I'm convinced that we can contribute considerably to a number of new technologies in the coming years.'

According to Van de Walle and Van der Pol, the knowledge region of the south-east Netherlands must profile itself better internationally. 'We have to be recognised and acknowledged as a whole. This region is not just capable of innovating, but also marketing. Within five years, this industry with related business – from IP creation to engineering– must grow to many times the size it is today.'

Key competences MiPlaza and Applied Technologies

- Product & process development
  - Thin film process development
  - Device encapsulation
  - Large area optical micro-structuring
  - Nano patterning
  - III-V semiconductor technology
  - Materials&process characterization
  - Reliability testing
  - Failure detection and analysis
- Consultancy, industrialization support and technology competencies
  - Energy generation, e.g. solar panel design, fuel cell development
  - Energy storage, e.g. battery management
  - Energy utilization, e.g. smart metering

New manufacturing methods key for acceptance

For many years, the PV-solar market has laboured under a dilemma. On the one hand, there is tremendous enthusiasm for the use of PV-solar systems, especially in areas with copious sun shine. On the other hand, the necessary investment is fuelling the debate about the higher costs per kWh in comparison to electricity generated with fossil fuels or even nuclear power.

With a potential of 2,000 times the current annual global energy requirement, there is no discussion that solar energy is the most important source of power for the future. Fossil fuels, but also uranium stocks, are limited. Oil is really too valuable to burn. And if we continue to drill for oil (and that will remain so for a while), it is far better that it is used for materials with a longer life cycle, such as plastics.

The challenge is in accelerating the transition to the supply of sustainable power. The sun shines every day; let's make optimum use of this for our energy supply as quickly as possible.

The Netherlands has been researching materials and manufacturing processes to facilitate the reliable and cheap manufacture of PV-solar products for a long time. For many years, the Netherlands has fulfilled a pioneering role in the semiconductor market with a company like ASML, but more especially with the entire chain of companies, universities and knowledge institutes around them. The semiconductor market is an industry in which speed, innovation and cost price are important factors.

It is exactly this link that has ensured that the knowledge acquired in this market more than 15 years ago began to find its way into applications for the PV-solar market. Solutions for reliable large-scale manufacture, knowledge of high-end processes and a very elaborate, but geographically compact, network of specialists and researchers have ensured state-of-the-art manufacturing solutions for PV-solar. Whether this concerns cell-manufacture, panel manufacture, manufacture and building of integrated solutions, manufacturing equipment and machine construction, all this knowledge is to hand in a radius of ten to twenty kilometres. The years of experience in an open innovation culture have ensured that the lines between companies and institutes are short and candid.

The open innovation culture has resulted in extremely advanced manufacturing systems, new materials and, with this, lower manufacturing costs (and consequently lower unit costs). Why wait until tomorrow? The step forward can be taken today, thanks to innovative Dutch technology, with the preservation of our energy supply.

In brief, drop in at the 'Holland Solar House' stand during the Photovoltaic Solar Energy Exhibition in Valencia from the 6th to the 9th of September 2010, Hall 4, level 2, stand numbers D35 – D42. After all, seeing is always better than a story of a 1,000 words.

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Helianthos takes major steps towards market launch of solar cell foil

From a brand new factory in Arnhem, Nuon Helianthos plays a prominent role in the international field in the development and marketing of solar cell foil. 'With regards to product development and our test factory, we can already set down 2010 as a year in which we have taken major steps forwards', explains Gert Jan Jongerden, managing director of Nuon Helianthos.

The core of the Nuon Helianthos solar cell foil is formed by the ultra thin active layers – 30 to 50 times thinner than a human hair – that transform light into electricity. Together, they form flexible thin film amorphous single and amorphous/microcrystalline tandem silicon solar cells on long lengths of foil manufactured in a number of 'roll-to-roll' steps. The 'progress' that Jongerden refers to is important for the future of solar cell foil. This year has not only witnessed that the product is ready for certification along the international IEC standards, also the feasibility of a high yield has been demonstrated in the test factory. Further ,Helianthos manufactured flexible tandem cell modules with over 9 percent stabilised efficiency. 'Our test factory opened in June 2009', explains Jongerden. 'This small manufacturing unitenables us to manufacture flexible solar cell laminateson the roll and demonstrate the advantages of Helianthos' product. Tremendous progress has been achieved on many fronts. The solar cell foil's light weight is a real advantage for applications on large light-weight roof constructions. The excellentproduct stability, the efficiency and the simple installation of the system are important pluses that together will lead to very competitive solar electricity costs.'

Big business

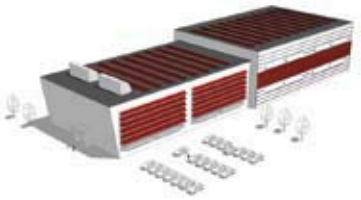
Another important step for Nuon Helianthos is attracting partners to invest in a volume production plant toensure that the product reaches the market successfully. Preferably, this will be a complementary partnerto bring Helianthos to the manufacturing phase. Jongerden cannot say too much about the progress of the search. 'Except that all the wheels are in motion, and in the meantime the development continues.' Market developer Pascal Weijers adds: 'In the coming years, we aim to reach a manufacturing capacity of about one hundred Megawatts to allow both the market and product to grow. It really needs to start to happen now.'

'There were sceptical reactions at the start of Helianthos when we said we wanted to make solar cell foil on the roll for competitive solar electricity', continues Jongerden. 'Now, it is generally accepted in the international solar industry as an elegant solution with a promising market potential. Solar cell foil is the product that is going to introduce solar power to the building industry and become big business.'

Easy to handle

One of the matters of great importance in the minds of Weijers and Jongerden in the roll-out of the product is that it is easy to handle. 'Naturally, it is also important that the product does not contain any rare or toxic materials, but certainly just as important is that the product is easy to handle. Everyone can lay it on their roof. Not just because of the dimensions – a compact thirty centimetre wide roll of solar cell foil six metres in length – but also thanks to its light weight, application on almost every roof is permitted. Something that is certainly not always the case for heavy, glass solar panels.'

'The basis for the success has of course really got to be the technology', continues Jongerden. 'With an efficiency of 9.1 percent, we also think we have scored a world record for a flexible amorphous-micro crystalline



silicon tandem module. It is our aim to raise the efficiency still further in the coming years through intensive collaboration with Dutch and foreign parties. Detailed models from Delft University indicate that a cell efficiency of 15 percent is feasible. This goes to show there is still room for improvement. We see a sunny future ahead.'

Key features Helianthos

- Development of process for the manufacture of flexible solar cells, main benefits:
  - Light weight: the laminate weighs only 600 grams per square metre;
  - Flexible: flexible and unbreakable, easy to handle, transport and install;
  - Ideal for BIPV: easy to integrate into building materials for roofing and facades;
  - Durable: weather-resistant and anti-soiling encapsulation;
  - Performance: generates more kWh in real world conditions.

Levitech ready for introduction of Al_2O_3 atomic layer deposition system

For a long time, the solar industry did not dare dream of atomic layer deposition (ALD). Considering the relative slowness of the process, the sector was very reserved. Even so, last year, the Dutch company Levitech accepted the challenge of developing a suitable atom deposition layer system for the solar industry. And with success; the creation of the 'Levitrack', which can process four thousand wafers an hour, will be ready for operation in the coming months.

In October 2009, the Semiconductor Equipment company ASMI separated itself from the Levitor product line. The Levitor – a Rapid Thermal Processing system (RTP system) – gives Semiconductor wafers an ultra-fast heat treatment. The heating is based on conduction of heat through very thin gas layers present between the (floating) wafer and two massive heat blocks. 'The separation of the product line marked the official establishment of Levitech', explains Jaap Beijersbergen, Levitech's CEO. 'From that moment, we started the development of a new product: Levitrack. This is an atom layer deposition system for the manufacture of solar cells based on the same floating wafer system that is used in the Levitor. Our experience in the semiconductor industry and, as a result, the knowledge and ability we have accrued have enabled us to push the high-speed development of the Levitrack.

Overview of Levitrack prototyping system, the platform is identical to the production system that's under construction

Levitrack

'With the Levitrack, we have tackled two of the three major technological obstacles that the solar industry still has to wrestle with', adds Levitech CTO Ernst Granneman. 'Firstly is the required reduction in the consumption of the (expensive) raw material silicon for the manufacture of wafers; in the coming years, the wafer thickness will be reduced from 0.2 to 0.1 mm. Secondly, we will reduce the losses of charge carriers, the so-called surface recombination losses. In p-type silicon, these are electrons. As the wafers become thinner, this last issue becomes more critical.'

The solution that has been developed by Levitech is based on the deposition of aluminium oxide on the rear side of the solar cell. The system, the Levitrack, creates an uninterrupted process in which the machine guides wafers through a repeating series of gas zones each containing two different gaseous reactants that are strictly separated in space. A self-limiting reaction takes place on the surface in each zone and an atomic layer is deposited. 'We focused our efforts – in contrast to what most other people were doing – on making a high-volume manufacturing tool that can process four thousand wafers an hour', explains Beijersbergen. 'We subsequently derive the R&D tool from the high-volume tool. As a result, it is always possible to scale up rapidly to high volumes from R&D.'

Engineering

'As far as the technology is concerned, we are ready to market the first machine', continues Granneman. 'The present machine produces the correct film thickness, uniformity, and carrier (electron) life times. Wafers with thicknesses varying from 0.12-0.20 mm have been deposited with aluminium oxide layers with thicknesses, as desired, of 5-20 nm. The passivising characteristics of these films have appeared to be so good that surface recombination has been reduced to a negligible level. Now all that remains is an engineering job for us to make the production machine more reliable. The two most important demands that potential customers had – with regard to the deposition of aluminium oxide and the high-throughput transport of wafers – have been successfully answered. The loading and transport of the wafers has been designed such – with the help of an air valve – that no moving parts are present and that correspondingly considerably less maintenance is required.' In the coming quarters, Levitech plans to install a number of R&D versions of the Levitrack at recognised knowledge institutes and renowned companies. With the help of these pilot lines, the company intends to perfect the Levitrack. 'This is where the ambition originates to make this technology the most important in the solar industry', explains Beijersbergen. 'From 2011, we want our atom layer deposition systems to be in use in one in three of all new solar factories.' Granneman concludes: 'We expect that the global market for these systems will grow to a production volume of at least 140 systems a year in 2020. We target a minimum of one third of these systems. In brief, the Netherlands has yet another golden export product.'

Key competences Levitech

Levitech provides unique production solutions for the most advanced processing challenges. Levitech provides this for the following technologies:

- Rapid Thermal Processing for Integrated Circuits
- Atomic Layer Deposition for solar cells

Rimas: pioneering work in the middle segment for turn-key solutions

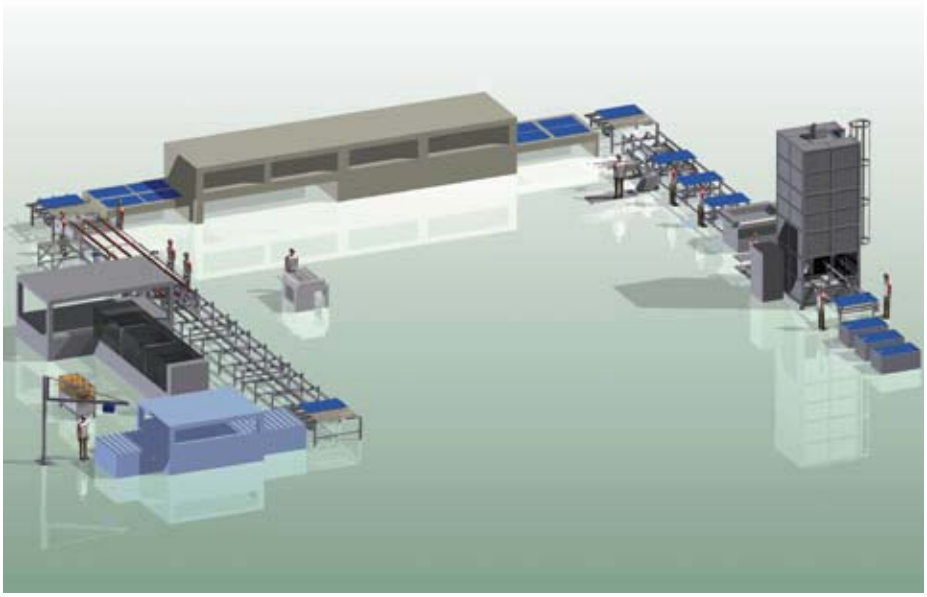
The Dutch Rimas Group is attracting a lot of attention from the international solar industry. The business units Rimas Solar Production Systems and RUV Systems are pioneering turn-key solutions and solar module equipment for the middle segment. International organisations, from Africa to Asia and from Europe to North-America, have meanwhile found the company from Beringe in Limburg.

Until 2005, Rimas was a part of Manders Industries. The management is currently in the hands of Mark Verstraten. He took over Rimas from the former owner and decided to focus more on the solar market with the business unit Rimas Solar Production Systems and the joint venture RUV Systems. Rimas started out as a technical trading enterprise – with the lion's share of products from Bosch Rexroth – focused on machine construction, workshop fitting and transfer systems. The main customers were independent machinery factories, the auto industry and the packaging industry. 'The market in which we're currently growing the most rapidly is the solar power market', relates Verstraten. 'From just a trading company, we've evolved step by step. First to a trading company that also assembled, subsequently supplemented by engineering and then machine construction, followed by specialised knowledge in the field of solar panel manufacture.'

Portfolio

Rimas received its first order from the solar industry a decade ago. The company completed the first production line for Shell Solar in Helmond. Shell was followed by Scheuten Solar, but also by many companies from Southern-Europe, China and even Africa. 'This is how we ended up the global supplier for BP Solar', Verstraten continues. 'Our core business is the supply of machines and turn-key solutions for PV-module manufacture of between five and fifty Megawatts. This is the middle segment where there is great demand for lean manufacturing facilities, which basically means a smart combination of automation and manual work.'

Just as Rimas grew from a trading company into a machine builder, a similar development is visible in the company's solar activities. 'In the first instance, we focused on supplying the back-end of solar production lines', Verstraten explains. 'We grew very rapidly to become an integrator and now we supply turn-key solutions, including stringers, laminators and sun simulators.' Now that the Rimas portfolio and sales are growing, Verstraten expects the personnel head count to triple in the coming years. 'To achieve this growth, we're going to expand physically too. Our added value is in the supply of complete solutions. Our customers often have a building and capital, we ensure that solar panels flood out of their factory.'

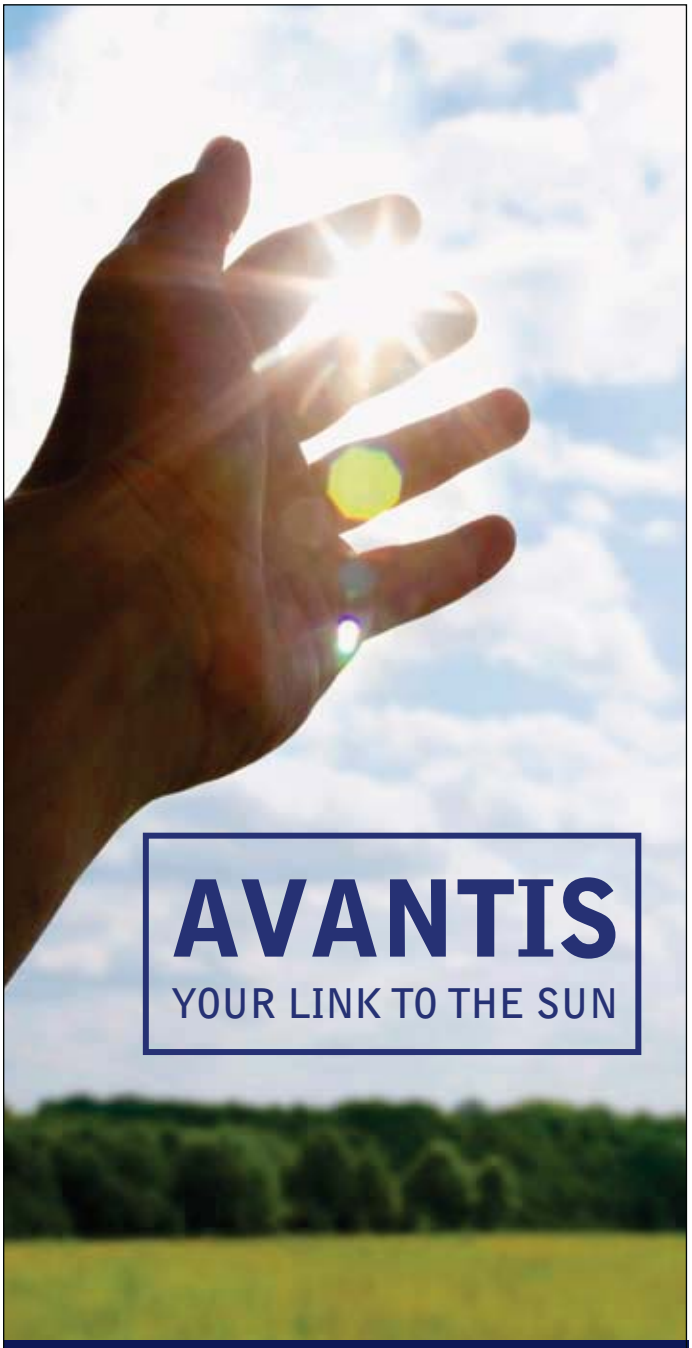


A special Rimas business unit that is also involved in the solar market, is the joint venture RUV Systems for the development of RUV technology. 'This stands for Resonance Ultrasonic Vibration technology, which employs ultrasonic sound to test the quality of the wafers and cells', explains RUV managing director Michel van Dooren. 'This technology checks the quality of the wafers entering the production lines to be processed into solar cells and panels. RUV can detect cracks in the solar cells and wafers. It is an alternative for the traditional optical tests. Using RUV, hairline cracks can be found early on in the manufacturing process. Logically, this improves the process of solar cell manufacture and delivers considerable cost reductions. This addresses and largely solves the biggest quality problem faced during manufacturing: fractures.'

Key competences Rimas

Rimas Group is divided in three companies:

- Rimas Assembly Technology for production automation and high-tech solutions;
- Rimas Solar Production Systems for smart turn-key lines and post-lamination equipment;
- RUV Systems for crack detection with Resonance Ultrasonic Vibrations technology.



Avantis: the best of both worlds in the Netherlands and Germany. This cross-border science & business park offers unparalleled opportunities. The proof of the pudding is the eating, something that Solland Solar Energy is taking full advantage of by basing its operations on the Dutch-German border. Would you like to know what advantages Avantis can offer you?

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A new branch for the ECN in Science & Business Park Avantis

Energieonderzoek Centrum Nederland (ECN) is to open a new branch in the southern Dutch province of Limburg under the name ECN Heerlen-Aachen. The new research centre will be accommodated on the cross-border science and business park Avantis and will facilitate the industrial development of manufacturing processes for crystalline silicon.

'The ECN branch in the Heerlen-Aachen region focuses on scaling up technology for making solar cells based on silicon wafers', says ECN project leader Jan Bultman. 'With ECN Heerlen-Aachen, we want to demonstrate that our partners' and our own innovations will work on an industrial scale. In brief, we facilitate industrial developments of manufacturing processes for crystalline silicon. The primary objective is the accelerated implementation of innovation in the factory, aimed at closing the innovation gap. Something may work in a laboratory, but a lot has to be done before it can work in a factory. ECN Heerlen-Aachen will become the link between these two.'

International fame

At the moment, Heerlen municipality and its partners are working hard on the final preparations for the arrival of ECN Heerlen-Aachen. In the meantime, the solar cluster on the European Science & Business Park Avantis continues to grow. At the beginning of this year, the arrival of Solar Modules Nederland was finalised with the award of a grant for the realisation of a solar panel factory. The start-ups Pro4Sol and Mate4Sun will also establish a branch in the business park this year. 'And once ECN Heerlen-Aachen is up and running, it will have enormous pulling power, attracting other companies to also establish facilities here', says Heerlen councillor Riet de Wit. 'The role of energy supplier is in our genes, here in the Heerlen region', the councillor continues. 'We used to enjoy international fame with the coal from our mines and, several years ago, with the Mine Water Project. Energy was extracted from water in old mine galleries. The result was the opening of the first mine water energy plant in the world in 2008. We now want to secure international fame with the solar cluster. The set-up of Solland Solar represented a flying start. For the municipality, it was the starting point for the creation of a solar cluster as an economic spearhead. The municipality, together with the Arcuscollege and Hogeschool Zuyd, has taken the initiative to train staff for Solland Solar, but also for future companies that will establish themselves in the region.'

Innovation gap

However well the development of the solar cluster on the European Science & Business Park Avantis goes, the Netherlands is not there yet, warns De Wit. 'Abroad, the solar industry is many times bigger. We extend our focus beyond the borders and collaborate with international partners. If the Netherlands does not accelerate, it will only lose more ground and it will miss the boat. This has been the underlying thought in approaching Energieonderzoek Centrum Nederland (ECN) and in exploring the opportunity for this new knowledge institute. This has eventually led to ECN Heerlen-Aachen. This ECN branch is not to perform fundamental, but instead, applied research for the business community.' Bultman concludes: 'We can justifiably talk about a win-win-win situation. The business world is given high-end support and access to research and development facilities, the country emanates international ambition thanks to the accommodation of a top-class institute and ECN enjoys the scaling-up of research facilities and shorter lines to industrial customers.'

About Avantis

Avantis is the first cross-border German-Dutch science and business park. Situated in the EU region Meuse-Rhine, the European Science & Business Park Avantis wants to provide opportunities for new technologies and facilitate the synergy between research, development and international management. The total surface area of the business estate is about a hundred hectares. The centre of the European Science & Business Park Avantis is the forum. In future, a hotel of up to eight stories will be realised here. It will house catering facilities, a swimming pool and meeting facilities. In the past few years, a total of twenty-five companies, representing about seven hundred jobs, have established themselves on the European Science & Business Park Avantis. Big names in the last year included The Solar Cell Company (TSCC), which announced its intention to move to the business park, as well as the Dutch Solar Academy.

Solliance creates an unique strong region for solar innovations

The Energy research Centre of the Netherlands (ECN), Eindhoven University of Technology (TU/e), TNO and Holst Centre have joined forces in Solliance. The R&D organisations' joint venture in the field of photovoltaic solar power (solar PV) concentrates on the geographical triangle of Eindhoven-Leuven-Aachen. 'Solliance is going to put the region on the international map as a world player in solar PV', claim Hein Willems and Richard van de Sanden who are involved in Solliance on behalf of the ECN and TU/e.

Ten years ago, the region Eindhoven-Leuven-Aachen (ELAT) was in the worldwide top three in the field of solar cell manufacture and applications. In terms of manufacturing levels, the region has dropped in order of ranking, but the Netherlands is still amongst the leaders with regards to levels of knowledge. Solliance wants to expand and exploit this knowledge position to ensure that the regional strengths in high-end manufacturing technology match the explosive growth in the solar power market faster and more effectively. 2010 marks the year of the 'inception' of Solliance: the making of plans, the gathering of participants and the establishment of structures, with the objective of being fully operational by the end of 2010. This includes the relocation of the PV activities thin film from ECN to a yet-to-be-established ECN location in Eindhoven, most likely on HighTech Campus Eindhoven. For this knowledge-intensive R&D ecosystem, its arrival would further strengthen the solar cluster already here.

Five business cases

The research programmes that Solliance is to employ are at the start focused on five business cases within the domain 'thin film'. In succession, it is all about thin film silicon solar cells; thin film CIGS solar cells; thin film organic solar cells; testing, analysis and characterisation and, finally, manufacturing technology. 'We will only become an international leading player if we make decisions. With the five business cases, we demonstrate that we dare to take decisions', explains Hein Willems, who is involved in Solliance on behalf of the ECN. 'Solliance wants to effect a bundling of strengths for the R&D sector in the Netherlands, Flanders and North Rhine Westphalia. As soon as the initiative gets off the ground, we want to invite other regional knowledge institutes such as Imec to enter the collaborative venture. To be able to completely involve indu-stry in all the activities, an advisory board will be established. The choices that are made will, in consultation, have to be transformed into research agendas, demonstrations and commercialisation. Bearing in mind that, for the time being at least, no 'silver bullet' technology exists and this is why, for the coming period, various technologies will be applied in parallel.'

Cohesion

'We have clocked up many years in which a lot of sound research took place and knowledge was developed. However, this was not adequately harmonised in the past, which was an obstacle to creating a greater impact', explains Richard van der Sanden, professor of Plasma & Materials Processing at the Eindhoven University of Technology. 'Now we are going to achieve this harmonisation through a number of business cases. Above all, Solliance guaranteed the arrival of ECN in the South of the Netherlands, a tremendous stimulus for the region. A lot of good can come from positioning Eindhoven as the city of energy and through laying the link with the high-tech equipment industry. It will not lead to a large-scale manufacture of solar cells in the region, but it will give the high-tech industry a considerable boost.' The harmonisation that Van der Sanden mentions is the first objective that Solliance has in its sights. Cohesion and cooperation in research and development agendas will lead to optimum harmonisation of existing and future programmes, focused on social challenges and requirements from the industry. Willems concludes: 'Existing and new research infrastructure will be harmonised and made available for all parties.'

SOLAR INDUSTRY REGISTER

September 2010,
PV SEC Valencia

The following pages give an overview of organisations and companies active in the PV-solar value chain. In view of fast developments in the PV-solar industry, it was impossible to make a suitable specific model in which all possible PV-solar technologies are mentioned. For this reason a three-step model has been chosen, with each step coupled to equipment and knowledge center. An indication is given per company in which part of the value chain they are active.

THE HEART OF EUROPE

New Solar Business Development

The Brabant Development Agency (BOM) joins relevant parties in the solar value chain to develop initiatives and projects to build a strong international PV cluster. Partners include companies such as Fujifilm, Philips, NTS Group and academia such as Imec and Eindhoven University of Technology.

Foreign Investments

BOM has helped hundreds of foreign companies initiate or expand operations in Brabant. We provide high quality services to any organisation interested in establishing solar activities in Brabant. Please feel free to contact us.

Contact

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Avantis European Science & Business Park

Avantis Science and Business Park is the first cross-border German-Dutch business park. Its location, in the Meuse-Rhine Euroregion between the cities of Aachen and Heerlen, offers businesses and investors excellent market opportunities.

The purpose of Avantis – which has a special focus on the photovoltaic industry – is to give new technologies the space they need to develop and to facilitate synergies between research, development and international management. At the Avantis business park, you can take advantage of the benefits offered by the labour markets in either Germany or the Netherlands.

AVANTIS
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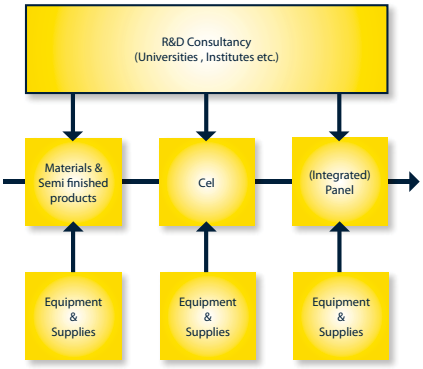
New Solar Business Development The Netherlands



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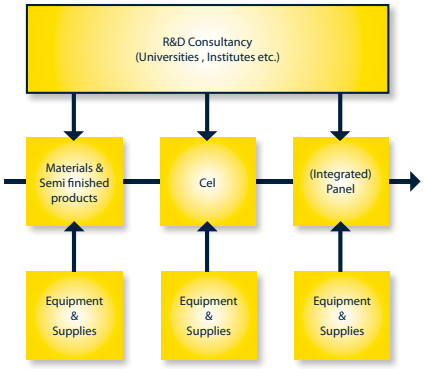

Brainport Development is a new-style development company, working with representatives from industry, knowledge institutions and government to strengthen top technology region Brainport. Along with Rotterdam (seaport) and Amsterdam (airport), Brainport is a cornerstone of the Dutch economy. The five focal sectors are High Tech Systems & Materials, Food, Automotive, Lifetec and Design. Brainport Development encourages and develops regional and (inter)national projects and programmes, promotes Brainport at home and abroad, and facilitates regional industry through business advice and funding, incubator facilities, business premises and business centres. Brainport is a top location for the development and production of photovoltaic systems, crystalline silicon solar cell technology and thin film (see page 4).

Brainport
Eindhoven

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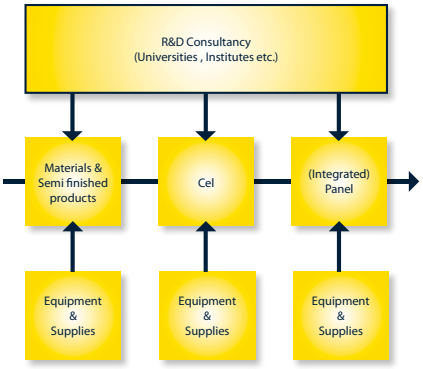
www.brainportdevelopment.nl

Cleantech Holland



Cleantech Holland is the export organization and platform for Dutch cleantech companies. Holland has an outstanding reputation in the field of energy efficiency and renewable energy. Dutch companies are known for their high-quality energy efficient solutions in the build environment, industry and greenhouse sector. When it comes to renewables the Dutch are particularly strong in solar, offshore wind, biomass and waste to energy. Cleantech Holland is an initiative of Association FME-CWM, the Dutch Ministry of Economic Affairs and the Dutch Ministry of the Environment.

cleantech holland
sustainable partners

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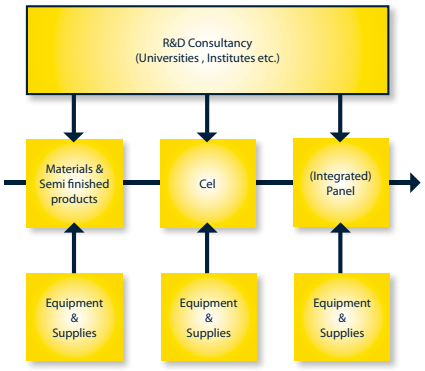
ECN Solar Energy



ECN Solar Energy, with an international staff of 85 employees, offers a wide range of R&D activities on PV materials, solar cells and modules. Our mission is to contribute to the world-wide implementation of solar energy. We develop cutting edge processes & technologies that will drastically reduce manufacturing costs of photovoltaics and improve its environmental profile. Our expertise and facilities optimally fit current and future needs from the industry and the research community. We have a proven track record in co-development and technology transfer to the PV industry. ECN is an independent R&D organization and can work on a non-disclosure and exclusivity basis worldwide.

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High Tech Campus Eindhoven | Hotspot for Human Focused Innovation

High Tech Campus Eindhoven belongs to the 17 percent largest science parks worldwide and has been considered by the Ministry of Economic Affairs as 'campus of national significance'. High Tech Campus Eindhoven is an R&D ecosystem of more than 90 companies and institutes, and over 8,000 researchers, developers and entrepreneurs, who together are working on developing the technologies and products of tomorrow. The preferred work approach at the Campus is Open Innovation. This means that Campus companies share knowledge, skills and R&D facilities, creating innovative solutions that make human life healthier, more pleasant, easier, more interesting and which contribute to a sustainable world.

High Tech Campus Eindhoven
Cees Admiraal

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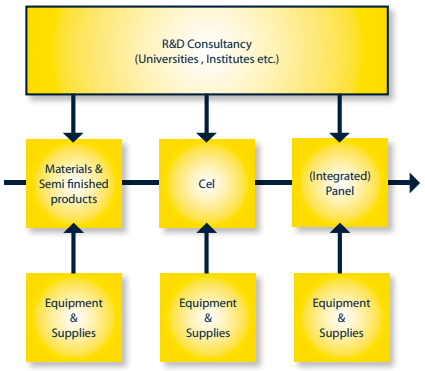
Holland Solar



Holland Solar is the association for the solar energy industry in the Netherlands. It aims at stimulating the use of solar thermal and photovoltaic energy in the Netherlands. In addition, Holland Solar represents the Dutch solar industry on regulatory matters with local and national governments. The association has over 65 members, including manufacturers, suppliers, installers, consultants, architects, and research organizations. Holland Solar is a partner of the Dutch sustainable energy association (DE Koepel) and the Cleantech Holland platform. Internationally, it is a member of the European industry associations ESTIF and EPIA.

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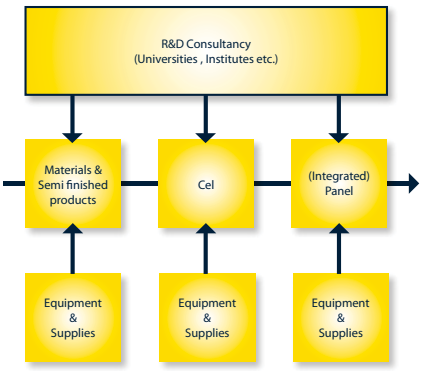
TNO: Innovation partner for the solar industry



As independent technology and knowledge provider, TNO's renowned Solar Group supports the solar industry with the optimization of their production and to innovate their products. By combining customer's requirements with state-of-the-art technology, software tools and expertise, we work on the strengthening of our customer's solar businesses. By means of contract research, industrial consultancy and pilot production facilities, TNO provides solutions for: ; production efficiency; product quality improvements; light management ; industrial equipment design; product development; production technology innovations . TNO - Innovation for life!

TNO
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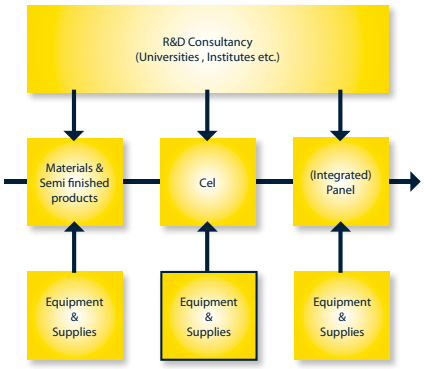
Bronkhorst High-Tech BV



Bronkhorst High-Tech BV has almost 30 years experience in designing and manufacturing precise and reliable mass flow and pressure meters and controllers. In solar cell fabrication Bronkhorst mass flow controllers are applied for highly accurate, repeatable and fast control of process gases and liquids. Our 'CEM'-System (Controlled-Evaporation-Mixing) is an accurate and efficient vapor flow control system that can be applied for atmospheric or vacuum processes, e.g. for coating on polymer films or thin metal foils for flexible PV cells or depositing silicon nitride passivation layers for multi crystalline solar cells.

Bronkhorst®
HIGH-TECH

Bronkhorst High-Tech BV
Wout van 't Wel

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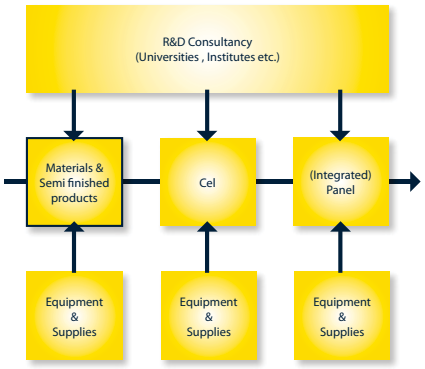
Ceratec Technical Ceramics BV



Ceratec has specialised in industrial components constructed from technical ceramics since 1983. Ceratec's strength lies in the total formula of problem analysis, development, prototyping and production.

ceratec®
Technical Ceramics BV

Ceratec Technical Ceramics BV
Kees Visser

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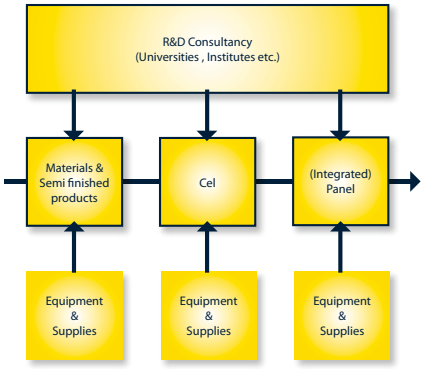
DataLyzer International



Statistical Process Control (SPC) is a well known technique in industry to improve quality and productivity. For example in semiconductor industry SPC is mandatory to achieve the required efficiency. DataLyzer Spectrum has a proven track record of 20 years in semi conductor industry and is implemented in both cell and module manufacturing. DataLyzer Spectrum can be used in combination with MES systems but is also used both in cell (> 150 MW) and module manufacturing as stand-alone MES system. Available in 14 languages including Chinese. Visit us at stand L2/H3/A39.

DATALYZER
International

DataLyzer International bv
Marc Schaeffers

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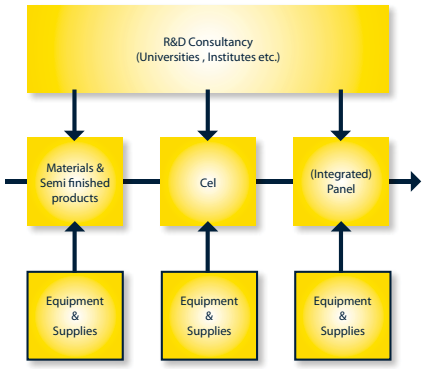
ECP Holland



ECP Holland is a contractor for all utility and process piping. Through many years of experience and working closely with our customers in the industry, ECP Holland has developed a number of features in this area. Our strength is complete project management of utility and process piping, from design, manufacturing, installation till commissioning and training. ECP Holland has also developed a whole new concept of handling the dangerous chemicals of the PV industry, resulting in a patented system for handling IBC bulk containers, which is environmental law, BImSchG certified. Further reclaiming and re-using process water and chemicals are innovations of ECP Holland.

ECP HOLLAND
Equipment for Chemical Cleaning Cleanroom Processes

ECP Holland
Paul Raeven and Nicole Ermans

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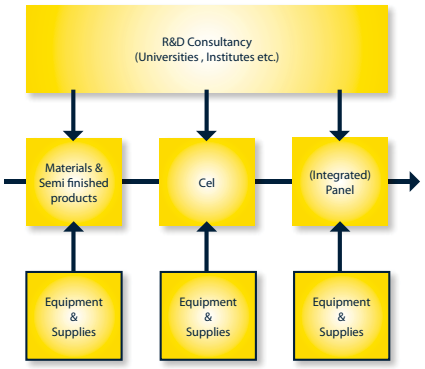
Frencken Europe B.V.



For well over 60 years, Frencken has been serving an international client base in the medical, semiconductor, analytical and industrial automation markets. We enable our customers to speed up their innovation, simplify their processes and focus on their core activities, by offering design, development, and complete production of complex and advanced modules and products, based on precision mechanics, electronics and software. Many high-precision machined parts are being manufactured in house. Frencken has production sites in Europe and Asia, and sales offices in Europe, Asia and the USA as well as a global supplier base for best cost and flexibility.

Frencken Europe B.V.
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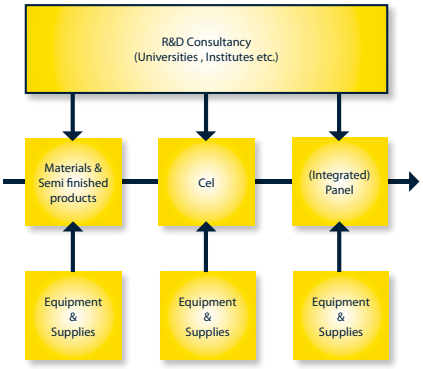
Holland Innovative BV



Holland Innovative is market leader in supporting organizations in product, process en project management. In Solar we actively participate in and reinforce project teams in process development as well as running-in of solar production facilities on a global scale. A multidisciplinary team of experienced professionals develops and implements adequate and sustainable solutions. According the ‹voice of the customer› and the ‹voice of the business›, with clear targets and results.

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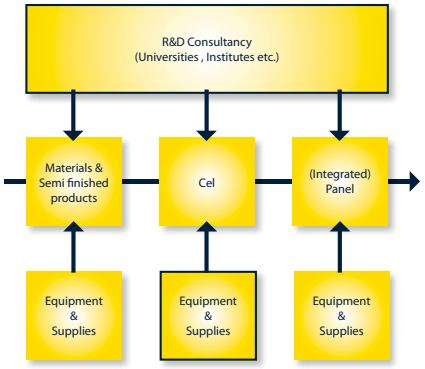
InnoPhysics B.V.



InnoPhysics B.V. is a young company specialized in development and fabrication of plasma equipment for surface treatments. The people behind InnoPhysics actively develop solutions in the field of industrial printing. Its PhD and MSc level researchers are experts in the fields of plasma physics, high voltage technology, materials technology, elipsometry and digital printing. InnoPhysics provides equipment solutions, proprietary to InnoPhysics, and R&D services. *Solutions:* PlasmaPrint on Demand; Wide format UV inkjet printing on alternative media through integration of pretreatment module. *Services:* R&D contract research (feasibility, media & materials testing); Design and engineering of customized equipment, process or application solutions.

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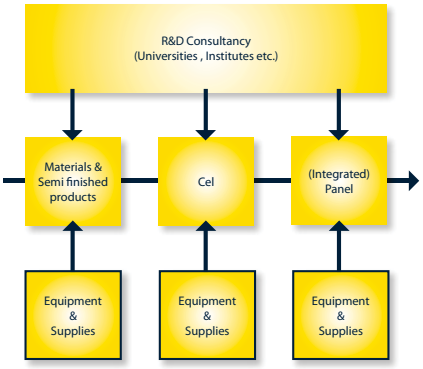
Lamers High Tech Systems



Lamers High Tech Systems is a leading supplier to technology driven markets for over 25 years. Main activities in the solar market are: *Turn key installation consisting of:* Gas & chemical infrastructures (SS or Plastics; Gascabinets and Bulk Chemical systems; Hook up of production equipment incl. vacuum; Hot commissioning, qualification & validation. *Subassemblies for OEM's:* R&D&E of custom & standard products and assemblies; Purification and assembly under clean room conditions (>1000 m2); Bulk Chemical systems for POCL3/BBr3; Stand alone Evaporator Systems for DEZ, TMA, TTC; High Purity vacuum & process piping; Contamination (RGA,TOC,etc), particle and moisture analysis.

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Age Leijenaar

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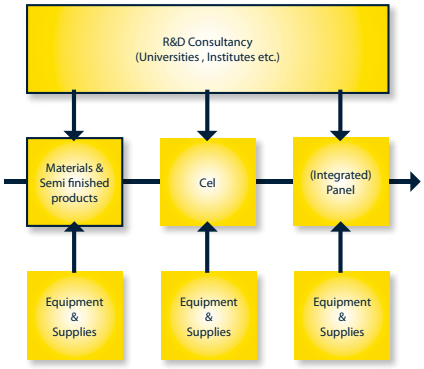
I. www.lamershightechsystems.nl

Materials innovation institute (M2i)



The Materials innovation institute (M2i) is a Public Private Partnership (PPP) between the Dutch government, knowledge institutes and industry. Its mission is to innovate Dutch industry and society in a durable way. To realise this M2i has developed into a European Centre of Excellence focusing on the development and application of structural and functional materials. The goals are to contribute to economic growth and sustainable development, and to increase the pool of talented technical personnel for the benefit of the Dutch industry. M2i employs over 200 fte research staff and has an annual turnover of Euro 25 million.

Materials innovation institute (M2i)
Bert van Haastrecht

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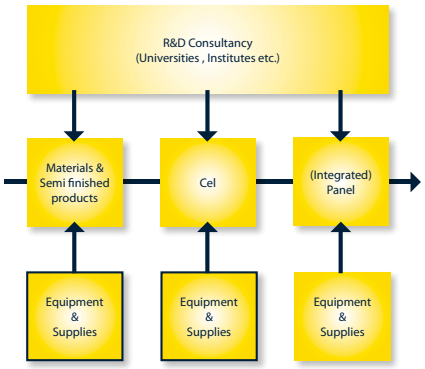
Mogema BV



Mogema is a supplier of mechatronical systems, with over 50 years of experience. With over 130 employees, an advanced machine shop, specific know-how in accurate machine operations , welding and (cleanroom) assembly. Herewith Mogema is the right partner for development and production of high level components, accurate machine frames and integrated modules like vacuum systems. Mogema is a division of Aalberts Industries NV, a Dutch stock listed company. Within Aalberts Industries Mogema has a large network of specialists for production- and surface treatment. Herewith Mogema always has the right partners to manage you complex projects.

Mogema BV
Elgar van der Bij

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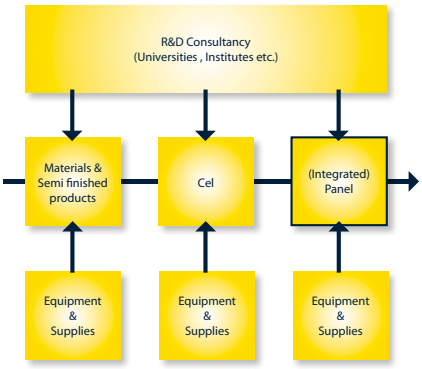
Nedap N.V.



Nedap N.V. is a global leader in developing and manufacturing electronic hardware, software, and product services that provide customers with advanced electronic solutions. Nedap's innovative and entrepreneurial business practices are built on more than 80 years of experience and a stock listing that dates back to 1947. Nedap's multifunction inverter ´the PowerRouter´ converts and directs power from various renewable energy sources to the grid, loads, and/or sto-rage units for on-grid and off-grid applications. The PowerRouter gives industrial and residential users the ability to control energy flow, choose optimal electrical configurations, and expand into a future smart grid.

Nedap Energy Systems
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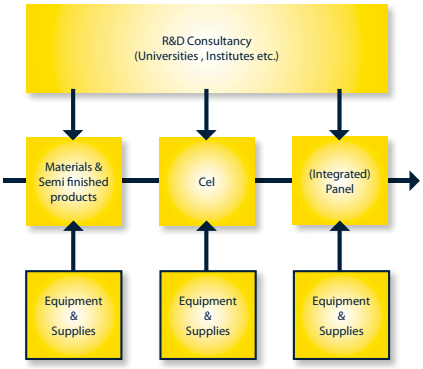
NTS-Group



The NTS-Group develops, manufactures and optimises mechatronic systems and modules for internationally operating original equipment manufacturers (OEMs) in different market segments, o.a. the Solar Industry. The NTS-Group supports these OEMs as a system supplier to ensure they can deliver to their market successful equipment of a high quality in short turnaround times for competitive prices. The NTS-Group intensively searches for realistic and effective methods to produce and optimise products. The NTS-Group comprises a chain of specialised companies, together with a network of strategic partners and suppliers, the NTS-Group can offer its customers a total solution for every step of the lifecycle of a product.

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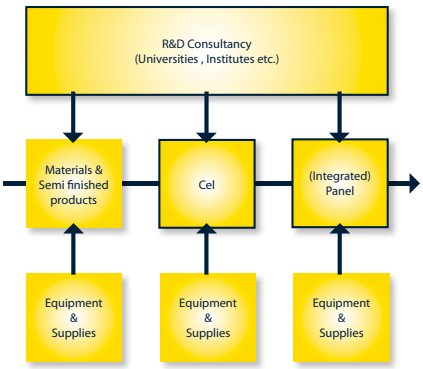
OM&T



OM&T - a 100% subsidiary of Moser Baer India Ltd. - is a leading development center for high-technology products and production processes. In the optical-disc market, OM&T is a respected supplier of recordable/ rewritable optical discs. In recent years, building on its existing competencies and infrastructure, OM&T has successfully extended its development roadmap into the area of photovoltaics In its solar R&D program, the company is cooperating with leading partners in Europe on new concepts for more efficient and cost-effective thin-film solar modules. With the modern and efficient production facilities at its mother company Moser Baer in India, OM&T has a strong position in bringing the new solar module concepts successfully into mass production.

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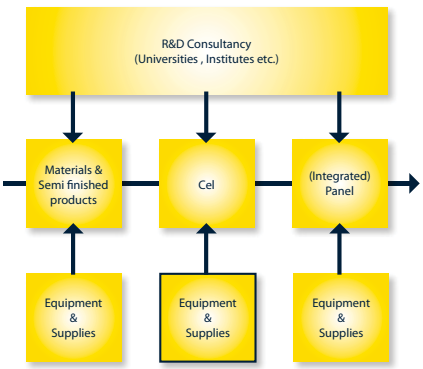
OTB Solar – Member of the Roth & Rau Group



Roth & Rau AG has been one of the world's leading suppliers of production equipment and innovative production technologies for the pv industry for more than 10 years. In its photovoltaics segment, Roth & Rau focuses on providing production systems for crystalline silicon solar cells as well as thin film solar modules. OTB Solar – Roth & Rau, a subsidiary of Roth & Rau AG, is a leading manufacturer of integrated process modules and fully automated inline solar cell production systems. With headquarters in Eindhoven, The Netherlands, and a worldwide sales and service network OTB SOLAR – Roth & Rau provides local, fast, and reliable support for customers' production sites.

OTB Solar – Roth & Rau
Paul Breddels

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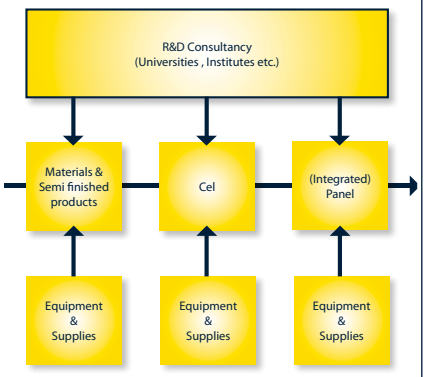
Philips - Accelerate your solar developments



Philips helps companies and knowledge institutes to accelerate innovations in solar, from idea to first-of-a-kind development, from prototyping to production. We offer a range of practical innovation services, expertise and facilities. You can draw on our breath of competences, practical experience gained in many customer projects and an outside perspective for measurable results. Our expertise and consultancy support will help you shape your Ideas into a unique concept, prototype or finished product, fast and efficiently. Our PV-solar expertise includes process development, device realization & encapsulation, reliability testing and failure analysis, PV cell/module characterization, modeling and mass-manufacturing.

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Carlo van Pelt

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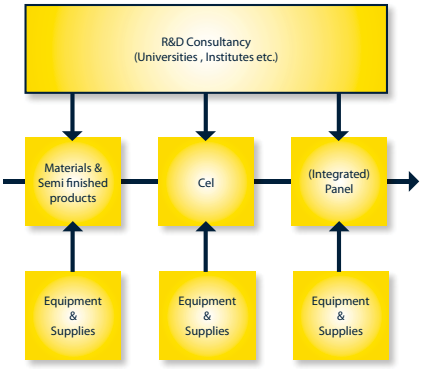
ReRa Systems, PV Measurement Systems



ReRa offers consultancy, software and measurement equipment design for the PV industry. This unique combination results in excellent measurement systems which will facilitate the further research on solar cells. The knowledge of solar cell measurement interpretation is what makes ReRa unique.

ReRa bv
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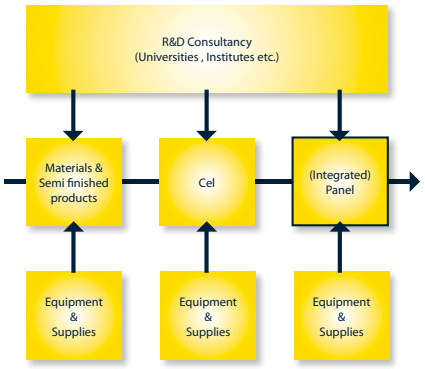
Scheuten Solar



Scheuten Solar is a global player in designing, manufacturing, distributing and applying photovoltaic solar modules. Since Scheuten Solar was set up in 2000 it has evolved into a fully-grown organization boasting specialists in the fields of solar technology, manufacturing, project development and project realization. By managing every stage of the solar value chain Scheuten Solar guarantees the quality and performance of all products. Scheuten is a leading and fast growing international high volume manufacturer of total solutions in glass and solar energy systems. Scheuten employs a staff of over 2000 and achieved a turnover of 407 million euro in 2009.

Scheuten Solar
Lilian Geurtjens (Marketing & Communication Manager)

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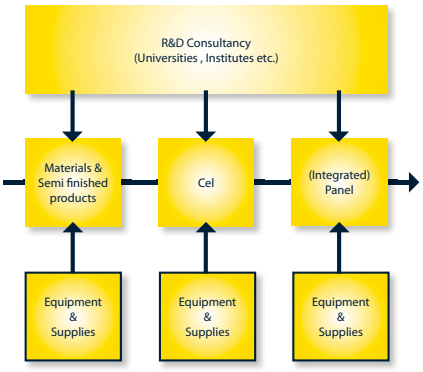
SMC Worldwide leading experts in automation



With more than 26 percent market share SMC is providing the global automation industry pneumatics and related products, keeping them at the leading edge of technology. A global supply of 11,000 standard products in 630,000 variations cover most thin-film and c-Si Solar-Cell manufacturing processes. We understand important issues such as the fast and safe handling of cells, the need for a uniform deposition layer and other technical requirements unique to the Photovoltaic Industry. Our competence includes non-contact handling, transfer, high-vacuum, temperature control, high-purity products and static control. SMC is your reliable partner for developing customized solutions.

SMC Pneumatics B.V.

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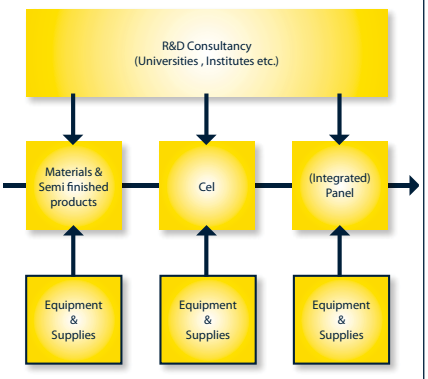
Smit Ovens



Cost-effective thermal processes for thin-film photovoltaic production. Smit Ovens is a leader in thermal processes for high-volume thin-film solar cell production. We deliver innovative, high throughput solutions based on smart designs and processes. These cover: **CIGS:** Deposition of elemental selenium; selenization; crystallization; RTP (Rapid thermal processing); activation; conditioning. **CdTe:** Deposition; activation; conditioning. **a-Si/µ-Si** : Conditioning; Pre-heating. **TCO:** FTO - atmospheric pressure CVD; ZnO - atmospheric pressure CVD.

Smit Ovens BV
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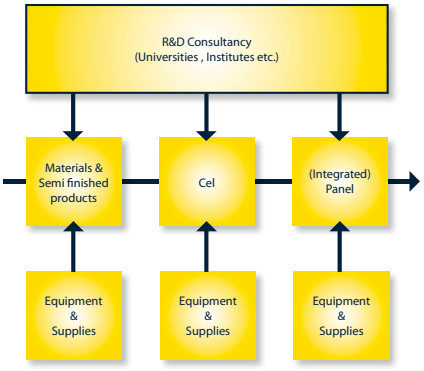
Solar Academy



The Solar Academy is a subsidiary of ECN that provides high level training on photovoltaic cell processing and system design for R&D staff, process engineers, project managers, system designers and others.

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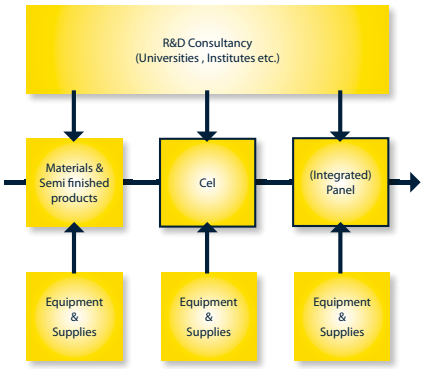
Solland Solar



Sunweb®: the world's most beautiful solar technology. Solland Solar is a worldwide leading technology company in the solar photovoltaic industry. Solland is the inventor of Sunweb®: the ase module technology to fully utilize the advantages of back-contact (Sunweb®) cells making use of Solland's patented In-Laminated Soldering technology (ILS). The Sunweb® cell is ase don 'Metal Wrap Through' (MWT) concept and has a unique metallization pattern on the front side. The advantages of Sunweb® technology result in a stunning 10 percent higher power output per m2 on module level. With Sunweb® inside you will always be one step ahead!

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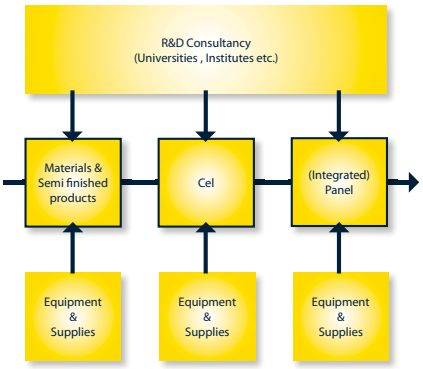

Sunergy invests in a portfolio of technological breakthroughs for the Solar PV market. Sunergy's objective is to significantly reduce the cost of PV modules.

Sunergy cooperates as an active partner in RGS development BV and Fesil Sunergy AS and clusters a team of people, institutes and companies to industrialize these new processes. Furthermore Sunergy develops alternative cell and modules processes for RGS application in cooperation with Solland.

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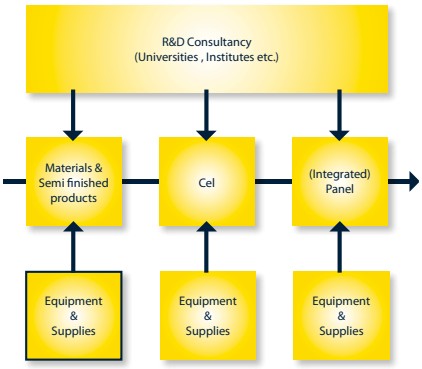
Technobis Mechatronics BV



Technobis Mechatronics is specialized in carrying out complete development trajectories to come from an idea to a successful turnkey special product, prototype or series product. Technobis Mechatronics successfully operates in the solar market for several years now. Technobis Mechatronics is a supplier of handling systems for silicon solar cells and is specialized in handling silicon solar cell wafers at high speeds (one wafer per second) in harsh environments as high temperature (1000 °C) and vacuum environments. Also systems used to handle peripherals for the manufacturing of silicon wafers at high temperatures have been developed and delivered by Technobis Mechatronics.

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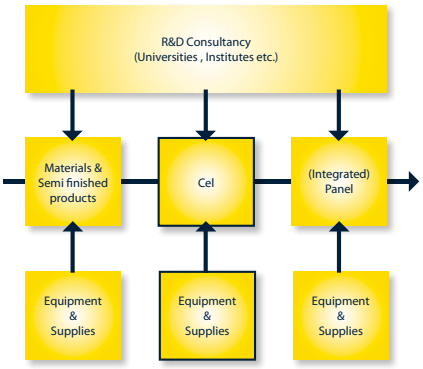
Tempress Systems



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