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RENEWABLE AND SUSTAINABLE ENERGY TECHNOLOGY

Pilar de la Torre
Victorian Government (TAFE)/ISS Institute Fellowship

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Department of Innovation,
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Executive Summary

This report has been compiled in response to the growing need to transition to 100% sustainable way of life. Achieving such an outcome involves a new way of thinking, conducting business and selecting sustainable technologies which are required in the face of a growing 'climate emergency' and the globe's need to move towards being 'fossil fuel free' as a matter of urgency even under the current global financial crisis.

There are increasingly insistent voices from the scientific community asking all decision makers in government and business to recognise that humankind faces a 'climate emergency', a code red situation and that we must act decisively and intelligently regarding sustainable solutions.[1]

It is not difficult to see that there are other equally, if not more pressing and urgent challenges regarding *'peak oil', 'peak gas'* and *'peak coal'* and 'nil net energy' from fossil fuels, all converging with the *climate emergency*. In considering this point, Professor Charles Hall of New York State University and others, have demonstrated that currently net energy from oil and gas is on a steep decline towards zero in about ten years. They also state that coal supplies will peak globally by about 2020 and that net energy from all fossil fuels are expected to be about nil well before 2030.[2]

Given the current predicted future status of supplies it is essential to pursue sustainable technologies to ensure future wellbeing within a global context. Supporting the exploration and development of solar, wind, geothermal and other emerging technologies is paramount to our future sustainability.

Considering that all technologies are made up of discrete components and these components need to be manufactured and distributed, and all of this activity takes energy and oil, while oil supplies are getting severely constrained, net energy and oil is what the world is quickly running out of.

All technologies renewable, or otherwise, embody energy. The components were created using energy in the first place, so if we are looking to discover a point when they create 'clean, green energy', the energy payback is near enough to the equipment's complete life cycle. In other words, it costs energy to make energy and this must be considered when assessing our future and technologies.

Substantial quantities of oil are consumed in transporting these components to Australia as the majority of these renewable technology components are manufactured overseas, in Europe, the USA, China and Japan. With the current considerations for a carbon emissions trading scheme planned for implementation in Australia within the next few years, who will carry the costs of carbon emissions on these components, the manufacturer or the importer?

An immediate response strictly focused on a 10-year time frame is vital. The technologies to be used in this response must be carefully selected and lead to high net energy solution. Australia needs an inspiring vision, one which remains firm through successive governments, regardless of which party is in power for any given term.

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[1] Climate Code Red, David Spratt and Philip Sutton, 2008

[2] Peak Oil, EROI, Investments and the Economy in an Uncertain Future by Charles A. S. Hall, Robert Powers and William Schoenberg

Executive Summary

There are a number of outstanding examples where European cities, despite the government of the day, put into action visions that have now made them leading sustainable cities.

One such city is Växjö, in Sweden, where the vision is to be a 'fossil fuel free' city. This vision has focused Växjö's citizens' thinking and innovation into achieving the goals that will make theirs a 'fossil fuel free' city. Another city is Freiburg. Known as the 'eco city' of Germany, it is a city that in 1975 fought against Nuclear Power plans. A vision was created that inspired them to be a 'solar city'. This vision has literally put them on the map, as many visitors and tourists from around the world have visited Freiburg in the hope of replicating some of the ideas and innovations back in their own countries as the race towards 20% by 2020 takes hold.

Australia is a unique country. Geographically we are located far from the rest of the older industrialised countries such as Europe and USA, or emerging industrialised countries like Brazil, India and China. Manufacturing in this country has not been sufficiently fostered nor encouraged, and as such we find ourselves importing much of our consumable goods.

De la Torre believes this past legacy must not continue as the status quo if we are to ensure our future. Australia needs to re-engineer, re-establish and re-invent our manufacturing capacity if we are to meet our climate change target of 20% by 2020. We may be playing a 20-year catch up game, therefore we need to take a different approach and implement a unique solution.

There have been past attempts to re-establish some manufacturing and assembly of wind components within Australia. Vestas Australia established two plants, one in Wynyard, Tasmania, a nacelle assembly plant and another in Portland, Victoria, manufacturing blades. These two plants employed and trained local people in the manufacturing and assembly processes. Unfortunately both plants closed their doors by late 2007.

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This was a great blow for the development of wind power in Australia, and de la Torre believes we have not yet recognised the significance of this loss to the nation. This belief is supported in this report. At the European Wind Energy Conference 2008, it was reported that there is a major Supply Chain issue for wind components. In other words, there is more demand than supply for wind energy technology, mainly due to two factors:

Executive Summary

1. The incredibly ambitious and inspiring plans by the European Union to increase the capacity of energy generated by wind from 56GW in 2007 to 180GW in 2020 for 'onshore wind', whilst simultaneously increasing the 'offshore wind' capacity from 1.08GW in 2007 to 35GW in 2020.[3]

2. The European Union is a mature wind energy region and some of its earliest installations are close to twenty years old. These installations are nearing the end of their life cycle and are due to be 're-powered'. This means dismantling, discarding and replacing most of these existing systems.

Out of all the current renewable energy technologies, wind has offered the best option from a cost/watt perspective for production of so called 'clean energy', so long as we do not account for the embodied energies. However, if there is a global demand for these components, what does this mean for countries that do not manufacture wind components?

It is common that the rest of the globe considers Australia to be a sun-burnt and sun-filled country. Solar PV and thermal technologies were developed, trialled and tested here, but we have lost most of the manufacturing and commercialisation technology to Europe, USA, China and Japan. On many occasions during the Fellowship de la Torre was questioned as to why Australia was not the leader in this field. The answers can be wide and varied, but the fact still remains that we have lost the vision to manufacture and commercialise here in Australia.

An example of this loss of vision is that the only operational PV module assembly plant in Australia (BP Solar) was closed down and moved to China in late 2008.

This report highlights the achievements Spain has made in a relatively short period of time. In the past 10 years, and more specifically in the last few years, Spain has been visionary in both the implementation and manufacturing of wind, solar PV and solar thermal. The Spanish people were inspired by the level of government policy, financial and research and development commitments in order to build up their renewable energy capacity. Spain now leads Europe in both these technologies and are in the process of developing some of the largest scale solar thermal farms. The main incentive mechanism was the commitment to the introduction of the 'Gross Feed-in Tariff' by the Spanish Government.

Courtesy: Solucar Energia SA

Geothermal in Europe, takes two paths; that of district water and space heating, and also production of electrical power

[3] EWEA – Annual Report 2007

Executive Summary

Once a geothermal plant is established and producing heating and/or electricity, it has a long life expectancy, such as can be seen with Larderello Geothermal plant in Italy. But the challenges are the enormous risks, costs of exploration, establishment costs and embodied energy required. In addition, the unknown side effects such as test boreholes have been known to cause harmless, but nevertheless noticeable earth tremors - as recently occurred on the boarder of Germany and Switzerland and suspected due to geothermal explorations.[4]

The European countries included in this report have successfully created a strong renewable industry mainly driven by strong long-term visionary government policy. The most effective policy being the 'gross feed-in tariff' policy guaranteed over at least 20 years for all renewable systems without limitation to system sizing. The success of this policy alone is documented and proven.[5] The formula exists to achieve energy security from renewable resources without disadvantaging any business or citizens, regardless of income status.

Other considerations for Australia include the implementation of strict national energy efficiency measures. The underlying philosophy is "If we can save energy then there is less that has to be produced". Energy efficiency is the first step to the implementation of renewable energy technologies and by far the most cost effective.

This report provides a comprehensive overview of the steps taken by some of the world's leading energy efficient cities, from new solar designed and meticulously constructed buildings, to retro-fitting and refurbishing of existing building stock.

The Victorian Energy Efficiency Target (VEET) was introduced in Victoria in 2009. The exemplary visionary city of Freiburg not only exceeded the German Energy Efficiency Targets, but created and implemented three levels of energy efficiency higher than that which was set by the country. This initiative has set a new standard in energy efficiency for the city, Germany and the rest of the world.

In this Fellowship report, de la Torre has documented the formulated and innovative examples of the outstanding results in the area of renewable, sustainable and energy efficiency achieved by many countries in Europe over the past 10 to 25 years. This knowledge and experience is important to ensure Australia can more easily fast track beyond many years of trial and error to achieve and exceed these results, and get to a position where we can be 100% sustainable within a much shorter time frame.

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[4] www.dw-world.de/dw/article/0,,2312857,00.html and www.iran-daily.com/1385/2764/pdf/i8.pdf. Also see Attachment A

[5] Federal Ministry of the Environment, Nature Conservation and Nuclear Safety, (2007) EEG – The Renewable Energy Sources Act, The success story of sustainable policies for Germany.

Table of Contents

Table of Contents

Abbreviations and Acronyms

ATA	Alternative Technology Association
BIPV	Building Integrated Photo Voltaic
CHP	Combined Heat and Power
CSP	Concentrating Solar Power
DIOC	Deft Interfaculty Research Centres
DUwind	Delft University Wind Energy Research Institute
EQP	European Qualification Profile
EU	European Union
EWEA	European Wind Energy Association
EWEC	European Wind Energy Conference
FraMe	Fractal Mesh Network
GBF	Gravity Base Foundations
HVDC	High Voltage Direct Current
ICET	Information, Communications, Energy and Transport
IEA	International Energy Agency
ISS Institute	International Specialised Skills Institute
MDI	Motor Development International
MENA	Middle East and North Africa
PV	Photovoltaic
SETN	Specialist Energy Training Network
SWH	Solar Water Heating
TREC	Trans-Mediterranean Renewable Energy Cooperation
VEET	Victorian Energy Efficiency Targets

Definitions

Innovation	Creating and meeting new needs with new technical and design styles (new realities of lifestyle). *Reference: 'Sustainable Policies for a Dynamic Future', ISS Institute 2007.*
Skills deficiency	A skill deficiency is where a demand for labour has not been recognised and where accredited courses are not available through Australian higher education institutions. This demand is met where skills and knowledge are acquired on-the-job, gleaned from published material, or from working and/or study overseas. There may be individuals or individual firms that have these capabilities. However, individuals in the main do not share their capabilities, but rather keep the IP to themselves; and over time they retire and pass way. Firms likewise come and go. *Reference: 'Directory of Opportunities. Specialised Courses with Italy. Part 1: Veneto Region', ISS Institute, 1991.*
Sustainability	The ISS Institute follows the United Nations NGO on Sustainability, *"Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* *Reference: http://www.unngosustainability.org/CSD_Definitions%20SD.*htm

Acknowledgments

Pilar de la Torre would like to thank the following individuals and organisations who gave generously of their time and their expertise to assist, advise and guide her throughout the Fellowship program.

Awarding Body - International Specialised Skills Institute (ISS Institute)

We know that Australia's economic future is reliant upon high level skills and knowledge, underpinned by design and innovation.

The International Specialised Skills Institute Inc (ISS Institute) is an independent, national organisation, which has a record of nearly twenty years of working with Australian industry and commerce to gain best-in-the-world skills and experience in traditional and leading-edge technology, design, innovation and management. The Institute has worked extensively with Government and non-Government organisations, firms, industry bodies, professional associations and education and training institutions.

The Patron in Chief is Sir James Gobbo AC, CVO. The ISS Institute Board of Management is Chaired by Noel Waite AO. The Board comprises Franco Fiorentini, John Iacovangelo, Lady Primrose Potter AC and David Wittner.

Through its CEO, Carolynne Bourne AM, the ISS Institute identifies and researches skill deficiencies and then meets the deficiency needs through its *Overseas Skill Acquisition Plan (Fellowship Program),* its education and training activities, professional development events and consultancy services.

Under the Overseas Skill Acquisition Plan (Fellowship Program) Australians travel overseas or international experts travel to Australia. Participants then pass on what they have learnt through reports, education and training activities such as workshops, conferences, lectures, forums, seminars and events, therein ensuring that for each Fellowship undertaken many benefit.

As an outcome of its work, ISS Institute has gained a deep understanding of the nature and scope of a number of issues. Four clearly defined economic forces have emerged out of our nearly twenty years of research. The drivers have arisen out of research that has been induced rather than deduced and innovative, practical solutions created - it is about thinking and working differently.

A Global Perspective. 'Skills Deficiencies' + 'Skills Shortages'

Skill deficiencies address future needs. Skill shortages replicate the past and are focused on immediate needs.

Skill deficiency is where a demand for labour has not been recognised and where accredited courses are not available through Australian higher education institutions. This demand is met where skills and knowledge are acquired on-the-job, gleaned from published material, or from working and/or study overseas. This is the focus of the work of ISS Institute.

There may be individuals or firms that have these capabilities. However, individuals in the main do not share their capabilities, but rather keep the IP to themselves; and over time they retire and pass way. Firms likewise come and go. If Australia is to create, build and sustain Industries, knowledge/skills/understandings must be accessible trans-generationally through nationally accredited courses and not be reliant on individuals.

Our international competitors have these capabilities as well as the education and training infrastructure to underpin them.

Addressing skill shortages, however, is merely delivering more of what we already know and can do to meet current market demands. Australia needs to address the ***dual*** challenge – skill deficiencies and skill shortages.

Acknowledgments

Identifying and closing skills deficiencies is vital to long-term economic prospects in order to sustain sectors that are at risk of disappearing, not being developed or leaving our shores to be taken up by our competitors. The only prudent option is to achieve a high skill, high value-added economy in order to build a significant future in the local and international marketplace.

The Trades

The ISS Institute views the trades as the backbone of our economy. Yet, they are often unseen and, in the main, have no direct voice as to issues which are in their domain of expertise. The trades are equal, but different to professions.

The ISS Institute has the way forward through its 'Master Artisan Framework for Excellence. A New Model for Skilling the Trades', December 2004. The Federal Government, DEEWR commissioned ISS Institute to write an Australian Master Artisan School, Feasibility Plan.

In 2006, ISS Institute Inc. set up a new ISS advisory body, the **Trades Advisory Council.** Members are Ivan Deveson AO; Martin Ferguson AM, MP, Federal Labor Member for Batman; Geoff Masters, CEO, Australian Council of Educational Research; Simon McKeon, Executive Chairman, Macquarie Bank, Melbourne Office; Richard Pratt, Chairman, Visy Industries and Julius Roe, National President Australian Manufacturing Workers' Union.

Think and Work in an Holistic Approach along the Supply Chain - Collaboration and Communication

Our experience has shown that most perceive that lack of skills is the principal factor related to quality and productivity. We believe that attitudes are often the constraint to turning ideas into product and a successful business; the ability to think laterally, to work and communicate across disciplines and industry sectors, to be able to take risks and think outside the familiar, to share – to turn competitors into partners.

Australia needs to change to thinking and working holistically along the entire Supply Chain; to collaborate and communicate across industries and occupations - designers with master artisans, trades men and women, Government agencies, manufacturers, engineers, farmers, retailers, suppliers to name a few in the Chain.

'Design' has to be seen as more than 'Art' discipline – it is a fundamental economic and business tool for the 21st Century

Design is crucial to the economic future of our nation. Australia needs to understand and learn the value of design, the benefits of good design and for it to become part of everyday language, decision making and choice.

Design is as important to the child exploring the possibilities of the world, as it is to the architect developing new concepts, and as it is to the electrician placing power points or the furniture designer working with a cabinet-maker and manufacturer. As such, design is vested in every member of our community and touches every aspect of our lives.

Our holistic approach takes us to working across occupations and industry sectors and building bridges along the way. The result has been highly effective in the creation of new business, the development of existing business and the return of lost skills and knowledge to our workforce, thus creating jobs - whereby individuals gain; industry and business gain; the Australian community gains economically, educationally and culturally.

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Fellowship Sponsor

The Victorian Government, Skills Victoria is responsible for the administration and coordination of programs for the provision of training and further education, adult community education and employment services in Victoria and is a valued sponsor of the ISS Institute. De la Torre takes this opportunity to acknowledge and thank Skills Victoria, Victorian Government, for providing funding for this Fellowship.

Supporters

De la Torre would sincerely like to thank Holmesglen TAFE for their support and for the time granted to complete the Fellowship journey.

In addition, she offers many thanks to RMIT University for encouraging and supporting her application for the Fellowship.

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- Paddy Walton, RMIT University
- Tony Robbins, RMIT University
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- Vladimir Damjanovski, Geothermal, Italy

De la Torre would also like to offer a special thanks to her partner Andrew Barrett, her son Matthew Stewart and her family for their constant support and encouragement throughout the Fellowship journey.

About the Fellow

Name: Pilar de la Torre

Current Positions

- Electrotechnology and Renewable Energy Teacher, Holmesglen Institute of TAFE
- Renewable and Sustainable Technology Consultant, SustainablePlanet.com.au

Qualifications

- 'A' Grade Electrician, State Rail NSW, 1986
- Electrical Engineering Certificate, TAFE NSW, 1989
- Certificate IV Training and Assessor, Scientific Management Associates, 2004
- Energy Smart Electrician (Energy Efficiency Consultant), RMIT University, 2005
- Grid connect Accredited Installer (Photovoltaic), Chisholm TAFE, 2007
- Perma-culture Designer, Permaculture Research Institute, 2008
- Advanced Diploma in Renewable Energy, TAFE NSW, 2009
- Global Green Electrician Training, Electrical Trades Union, 2009
- Green Loans Energy Assessor, Sustainable Footprint, 2009

Memberships

- Member of Business Council of Sustainable Energy (BCSE or Clean Energy Council)
- Member of the Alternative Technology Association

Awards

- '07 Victorian Government (TAFE)/ISS Institute Fellowship, Sponsored by Skills Victoria (OTTE, Victorian Government)
- Julian Ashton Art School Scholarship – Fine Arts
- Various trade awards
- State Rail Authority Apprentice of the Year 1986

De la Torre values and actively participates in the process of life-long learning. This Fellowship experience has given her the opportunity to expand her knowledge and expertise in the areas of sustainable technologies and critical thinking about sustainable existence on this planet. She is committed to sharing this knowledge and is incorporating her experience into practical and applicable training for colleagues, students, industry and anyone who wishes to listen, learn and most importantly take action regarding living in harmony with our environment.

De la Torre has naturally gravitated to teaching and training as her personal mantra is to 'make a difference' in all aspects of her life.

A person with diverse interests, de la Torre works 'dual careers', both as a qualified electrician/electrical engineer, teacher and renewable energy consultant, as well as a visual artist. As a visual artist, she is very connected with the environment and has always had great regard for the amazing planet that we are privileged to inhabit. Understanding that burning coal to create electricity has a direct and negative impact on the environment; de la Torre has worked hard to raise awareness in the electrical trade area regarding more sustainable ways of generating and conserving energy.

Aims of Fellowship Program

It is undeniable that we have a major global issue with regard to the depletion of the fossil based fuels across the planet, and to 'Global Climate Change' (incorrectly referred to as 'Global Warming'). It is generally accepted that due to the way we have managed our lifestyle, particularly the ever-increasing hunger for energy and subsequent production that come from non-renewable resources; we need to produce electricity from more sustainable resources. In addition, the recognition of a skills deficiency in this area and an aging workforce also poses a unique challenge for Australia.

The aim of this Fellowship is to investigate training programs offered by those countries that have successfully implemented renewable energy systems and then apply these best practice examples within the Australian context.

Australia does not have the luxury to delay nor to reinvent the wheel. We need to learn from countries that have taken the lead in implementing and progressing renewable and sustainable energy technologies and deliver world's best practice including the training of our workforce for the future.

Benefits for Australia include:

- The development of models for world's best practice in renewable energy training. The industry in Australia is in its infancy and very much 'home grown'.
- A more accurate understanding of which trades are best positioned to be developed in this industry.
- The implementation of strategies for managing the large scale implementation of training, with appropriate skills sets.
- A more accurate understanding as to what other semi-skilled trades could be up-skilled and what qualifications would be required to undertake tasks. Such action would address dual areas of skills shortage and deficiencies.
- Identifying cutting edge technology for its dissemination through training to raise more interest and awareness and encourage people to enter the industry.

The Australian Context

The Renewable and Sustainable Energy Industry

The renewable and sustainable energy industry is set to embark on an exponential growth curve. The acknowledgement of climate change by the community, business and governments worldwide, will set the agenda for how quickly the curve rises.

The signing of the Kyoto Protocol by the Labour Government in 2008 and the setting of the 20% Renewable Energy Target by 2020 places significant urgency on training in the trades areas to meet the impending demands, despite the on-going debate and apparent Government mixed reaction regarding acting upon these targets.

Training in the areas of energy efficiency is vital to the implementation of any other renewable energy technology. Trades such as the electrical trades need to be skilled in these areas as a matter of urgency, followed by training in the installation of solar, wind and other sustainable energy systems.

On a larger scale there is the construction and maintenance of onshore and offshore wind farms and solar farms. In Australia, we are yet to see the first of the large scale solar concentrated farms to come on-line to the national grid, and now the future of this looks very dime, as the largest solar farm project in Australia, has recently gone into receivership.[6] At the same time we are yet to see offshore wind farms.

This Fellowship identifies the skills deficiency and endeavors to determine strategies to fill the skills and knowledge deficiencies, in order to assist with the training of highly skilled trade personnel for the implementation of renewable energy systems.

Courtesy: Solar Systems

A Vision for Australia

The vision that de la Torre holds for Australia, is one of a country that is sustainable and self reliant; a country that has supporting government policy that promotes, implements and encourages sustainable technologies to be manufactured in Australia. Such policy would encourage the Australian community to transition to 100% sustainable living and business practices which are in total harmony with our environment.

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[6] http://www.theage.com.au/national/solar-project-on-the-skids-20090907-fedb.html

The Australian Context

At both a micro and macro level, we need to rethink and acknowledge that 'the environment is number one' and that the economy is based on having a planet to do business on. The Electrical Trade Union is aware of this and their slogan "No jobs on a dead planet" reflects this point.

We need to re-generate and inspire a society that is well informed, educated and focused on local sustainable living and actively encouraged to participate in the decision making processes so that they are a part of the solution.

There are a number of examples throughout this report of other countries that aspire to parts of the vision that de la Torre holds for Australia, but there is not one example of an entire country working together to meet the all the challenges that we all face.

In order to achieve the above, Australia needs to strongly support and develop existing renewable technologies as well as exploring our own unique opportunities. Within this report de la Torre describes one such unique solution that needs to be explored, and this is the suite of solutions from IT MDI-Energy. More importantly, IT MDI-Energy solutions can be fully implemented within 10 years. De la Torre now believes that this must start without delay, as there is a critical 10-year window of opportunity to transition to 100% sustainable ways of life and business

Each year the earth receives from the sun huge amounts of energy, many times more than humankind will ever possibly require. As an example of what can actually be achieved, IT MDI-Energy in Victoria has forged sustainable ways to harness the sun's energy by emulating what nature does naturally. It is perfectly feasible to safely and rapidly achieve a global transition to 100% sustainable ways of living.

IT MDI-Energy is also showing that this can be done in ways that cost significantly less than what we currently pay for energy, transport, communications, housing and food. Furthermore this can be done without placing a strain on government funding, particularly in these difficult financial times.

Imagine, over abundant solar energy combined with emerging, highly competitive, low embodied energy technology and knowledge that can rapidly lead to sustainable global prosperity.

Based on knowledge and skills acquired as a result of this Fellowship, de la Torre believes that Australia has a unique solution for dealing with issues such as climate change, the availability of peak oil, peak coal and other resources.

SWOT Analysis – Renewable and Sustainable Energy Technology

A Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis provides a useful avenue for summarising the current situation and the implications of addressing, or not addressing, the need for training programs specific to ensuring the optimisation of renewable and sustainable technologies.

Strengths

- R&S technology industry in embryonic stage, therefore it can be shaped and modelled
- R&S technology more visible in the new AQTF training package
- Huge growth potential
- World wide demand for skills and knowledge

The Australian Context

- High awareness due to Climate Change impact
- Self promoting to the general public due to Climate Change
- High demand for trained and qualified people in Australia
- High demand for trained and experienced R&S technology teachers
- High demand for quality training courses and materials in R&S technology

Weaknesses

- Lack of financial support of the development of training
- Not given the required level of priority for immediate development
- Urgency and timeliness not recognised nor addressed
- Implementation too haphazard at present
- Not enough Government policy support nor financial support incentives or investments
- TAFE institutes work in competition with each other rather than collaboration
- Lack of manufacturing capacity in Australia regarding R&S technology components

Opportunities

- R&S technology set to become a huge growth industry (similar to the initial computer technology boom)
- Potential for financial investors from Australia and Internationally
- Potential for more Government investment in training and development
- Potential for new 'green' jobs and transition to 'green' jobs
- Potential for Australian and Overseas investors for manufacturing in Australia
- Potential for all TAFEs to work collaboratively on R&S technology projects
- Skills and knowledge is required NOW in Australia and Internationally
- Need to learn from countries leading the renewable and sustainable drive, how to proceed with more speed , efficiency and effectiveness

Threats

- Massive effort is required at all levels of government and industry in order to slow down climate change
- Australia is at least 20 years behind many European countries in many elements of the use of renewable and sustainable technologies
- TAFEs working in isolation on training and development rather than collaboratively
- The global financial crisis is being used as an excuse not to proceed
- Lack of R&S technology training facilities and supporting resources
- Impact on industry of not having appropriately qualified training and development people
- Slow and haphazard implementation of R&S technology systems
- Lack of manufacturing capacity in Australia for R&S technologies due to current lack of vision

Skills Deficiencies

Definition of Skills Deficiencies

As already established, skill deficiencies address future needs. Skill shortages replicate the past and are focused on immediate needs.

Skill deficiency is where a demand for labour has not been recognised and where accredited courses are not available through Australian higher education institutions. This demand is met where skills and knowledge are acquired on-the-job, gleaned from published material, or from working and/or study overseas. This is the focus of the work of ISS Institute.

There may be individuals or firms that have these capabilities. However, individuals in the main do not share their capabilities, but rather keep the IP to themselves; and over time they retire or pass away. Firms likewise come and go. If Australia is to create, build and sustain industries, knowledge/skills/understandings must be accessible trans-generally through nationally accredited courses and not be reliant on individuals.

Domestic and Commercial PV

Germany is an example of a country which has taken the lead in development and constant improvement of efficient Solar PV power for the domestic / commercial market. They have implemented large scale projects installing solar electricity on available large roof space for investment purposes.

In Australia, and particularly in Victoria, we are currently experiencing an increased demand for the design, installation and ongoing maintenance of domestic solar electricity. Currently, it is apparent that we are not prepared to meet the anticipated demand. Until now, we have not investigated who is best positioned to do this work! Do they have the appropriate training and qualification for a successful implementation? What is the skills base? Do the TAFEs and Universities have adequate trainers and facilities? Do we have a skilled workforce in the trades and other professions?

Germany's success in developing, implementing and training their workforce allows us to move forward with confidence with the knowledge that it is possible to ensure successful implementation. Australia needs to learn lessons from the success that Germany has achieved and to continue to improve upon it. In order to do this, we need to develop a comprehensive understanding of advancements in renewable and sustainable technology. Europe hosts the most significant Expo with regards to the industry and it is essential that Australia is represented to ensure that we have access to the latest developments.

Another important development for this industry is the Renewable Energy Incentives that countries such as Germany have instigated and the "gross feed-in" which encourages the uptake of renewable and sustainable technologies. Australia needs to have an understanding of how other countries have managed these issues.

Training, skills and qualifications required by vocation is another area of investigation. Are we training the most appropriate trades, for the implementation of Renewable Energy Systems? Is there a different cohort of students required than those currently being trained? How have Germany and other European countries managed skills deficiencies? What are the skills required by a traditional electrician working in the Renewable Energy Industry? What training systems are in place for training in this area? Is this really a new industry all together or is it an evolution of the existing Electrical Industry?

The same approach is required to investigate the implementation and training for large scale solar farms. It is essential that we identify the major differences in training a workforce for domestic installations and maintenance as opposed to large scale solar projects.

Wind – Offshore Wind Farms

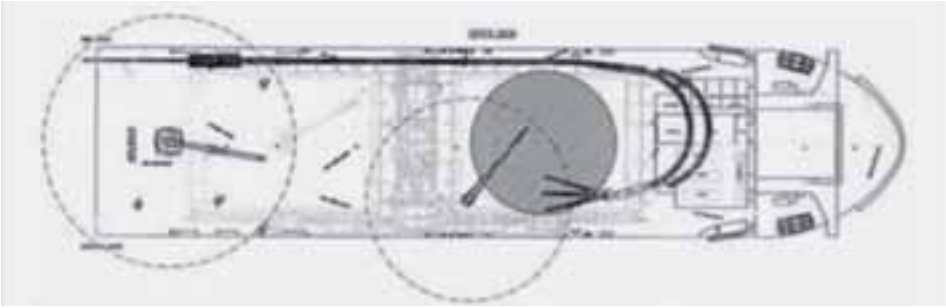
What are the skills, knowledge and qualifications required for the successful training of the appropriate personnel for the construction and maintenance of large-scale offshore wind projects? According to Wendy Miller, Senior Research Fellow in Sustainable Energy for Queensland University of Technology, "there is a world wide shortage for people with the required skills, knowledge and experience in the area of wind".[7]

Germany and the Scandinavian countries are world leaders in this renewable technology. These countries are currently not only refining their on land based wind farm technologies, but also developing offshore wind farms. This includes the development of physically larger machines such as the 5Mwatt wind turbine to be placed out at sea.

> The world's largest wind turbine, a 120-meter (394-feet) behemoth capable of generating 5 MW at full output, has just been officially inaugurated and connected to the German electrical grid. *"We're proud of the way our engineers and installers have successfully realised these new dimensions",* stated Chairman of REpower Fritz Vahrenholt. The "5M" turbine, designed and built by Germany's REpower, was officially inaugurated at a dedication event in Germany this week with over 600 guests from business and politics. In a symbolic gesture, the turbine was activated by the German Federal Minister for the Environment, Jurgen Trittin.
>
> Germany has one of the strongest wind power markets in world. In bare figures, wind power already meets more than 30 percent of the electricity demand in the German states Schleswig-Holstein and Mecklenburg-Western Pomerania.
>
> *Reference: http://www.renewableenergyaccess.com*

It is essential that Australia engage with research that investigates and determines the difference of working onshore as opposed to offshore. Key questions to be explored are:

- "What are the safety and training issues for offshore workers?"
- "Do offshore workers need to be more multi-skilled and cross-trade skilled people to be involved in such projects because of the nature and environment of the work?"



Courtesy: www.c-power.be

[7] Renewable Energy: Development of policy, technology and education knowledge and skills by Wendy Miller, School of Engineering Systems Faculty of Built Environment and Engineering Queensland University of Technology

Courtesy: www.c-power.be

Geothermal

Geothermal power plants are at the demonstration phase in South Australia, as a renewable energy technology able to deliver sustainable energy in the future. De la Torre believes that commercialisation of geothermal electricity may still be a few years away for Australia.

Courtesy: Geo Dynamics

© SustainablePlanet.com.au

The outcome of visiting a well established geothermal plant in Europe was to enable an understanding of the training requirements for the construction, maintenance and operational phases of this technology.

A visit to Larderello, in Italy, in the Tuscan hills just out of Florence was undertaken to visit a well established plant and educational museum which was visited to add a contextual understanding to current practices.

The International Experience

The Global Outlook

De la Torre believes that the world's current economic crisis will be closely followed by an energy and climate crisis. We need to rethink our global future with regards to the following challenges:

- Effects of Climate change
- Global energy dependency (Fossil Fuel based)
- Rising global energy cost and production methods
- Embodied energy (Nil Net Energy)
- Global Economic Crisis

There are many countries around the globe at a virtual energy crisis crossroad already. The two specifically experiencing major problems at this moment are Chile and Brazil,[8] and de la Torre asserts that there will be many that may follow

Globally, the energy sector emits 26 billion tonnes of CO_2 each year and electricity production alone is accountable for 41% of emissions. The International Energy Agency (IEA) expects CO_2 emissions in 2030 to have increased by 55% to reach more than 40 billion tonnes of CO_2. The share of emissions coming from electricity production will increase to 44% in 2030, reaching 18 billion tones of CO_2.[9]

Europe has been investing in new capacity to replace the ageing power plants and meet future demand. Satisfying the energy needs over the coming decades will be the big challenge.

This reality could be a great challenge to Australia. Developed countries around the world are bidding for the same resources and technologies to meet their own share of the 20% by 2020 targets. Europe has been experiencing a supply bottleneck for wind components.

Australia is dependent on the wind components being imported from China, Europe and the USA, as we do not manufacture these components ourselves. This dependency could be detrimental to us achieving our stated goal of 20% by 2020 (if we identify wind as our main renewable solution). There are a number of factors impacting on this situation; our country's physical location in the world and our relatively small economy compared to the rest of the world.

From another perspective, if we are to really consider reduction of carbon dioxide, we must also consider the full life-cycle and embodied energy of all technologies that are manufactured and imported. In order to produce truly 'clean energy', we need to take these issues into account. It is, therefore, vital to encourage local manufacturing in order to minimise carbon dioxide emissions and reduce the total carbon footprint of the technologies we choose to implement.

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[8] Presentation by Abengoa/Inabensa at EWEC 2008 conference

[9] The International Energy Agency (IEA) - Global Energy Industry Outlook 2008

Netherlands – Delft

The wind energy industry has enjoyed very successful development for decades across Europe. This is primarily due to the following factors:

- Improvements in the technology
- Reductions in costs
- A large increase in the size of the industry.

Delft University – Offshore Wind Course

DUwind is the Delft University Wind Energy Research Institute. In August 1999 DUwind was formed, a new interfaculty research organisation, specifically for wind energy. Research into wind energy began 25 years ago through an aerodynamic project at Aerospace Engineering.

Research programs cover almost all aspects of modern wind turbine technology, and are undertaken across four faculties. Each of the research groups at these faculties has its own specific expertise, but an increasing number of research problems require a multi-disciplinary approach.

Another Delft Interfaculty Research Program, known as the Deft Interfaculty Research Centre (DIOC in Dutch), is dedicated to renewable energy research in general. DUwind participates in this DIOC Renewable Energy program.

The focus of DUwind's programs is on the development of turbine and wind farm technology. This ranges from fundamental research through to design and support for the industry. An important role for DUwind is the provision of industry specific courses for students and for professionals in the wind energy industry.

DUwind is not a stand-alone organisation, as it co-operates closely with the wind energy group of the Netherlands Energy Research Foundation ECN. Many projects are performed jointly, and mutual use is made of the research facilities.

Technology of Offshore Wind Energy

Courtesy: DUwind

The International Experience

The intensive course on 'Offshore Wind Energy' attended by de la Torre was focused on the technical aspects of:

- Design
- Implementation and
- Maintenance and operation.

The Offshore wind energy course spans across the following issues:

- Technical – Wind turbine - Electrical - Offshore engineering aspects
- Non-technical aspects – Environmental impact assessment - Regulations

Broad Course Outline - Technology of Offshore Wind[10]

- Introduction to course and to current wind turbine design
- Offshore wind climate and loading
- Offshore wave and current climate & loading
- Long-term loading situation
- Offshore soil conditions and foundations
- Offshore support structure
- Dynamics of an offshore wind turbine
- Operation and maintenance
- Electrical systems
- Integrated wind farm design
- Round-up of the course.

Course Review – Technology of Offshore Wind

The course was well designed and each section was delivered by specialists in that specific area. The professors discussed both theory and case studies based on current projects that were happening around Europe.

From a personal perspective, supported by an electrical engineering background, the course provided awareness of the complexities in design, construction, logistics, environmental impact, maintenance, servicing and training for offshore wind farms.

Going 'offshore' may look to be an easier option from the 'community acceptance' perspective, but proves to be a colossal task from an environmental, engineering, on-going maintenance and training perspective. For the European Union, the task is made more difficult by the fact that most projects cross marine borders to other countries and, therefore, become cross-country projects. When considering such projects in Europe it was important to recognise that any language barriers needed to be addressed – the absence of this problem should prove to be an advantage for Australia.

Part of the training programs for the European projects include a 'Technical English' component, so that there is some common understanding. However, it seems that by majority, English is the adopted business language, so most people can communicate.

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[10] More details on the course can be found in Attachment B.

The training programs associated with onshore and offshore wind have some commonality and some divergence due to the operational environment. For this reason, the European Commission has funded projects that allow the emerging offshore wind energy industry to set up formal and transferable qualifications. The project known as the 'Windskill' is part of the Intelligent Energy Europe program.

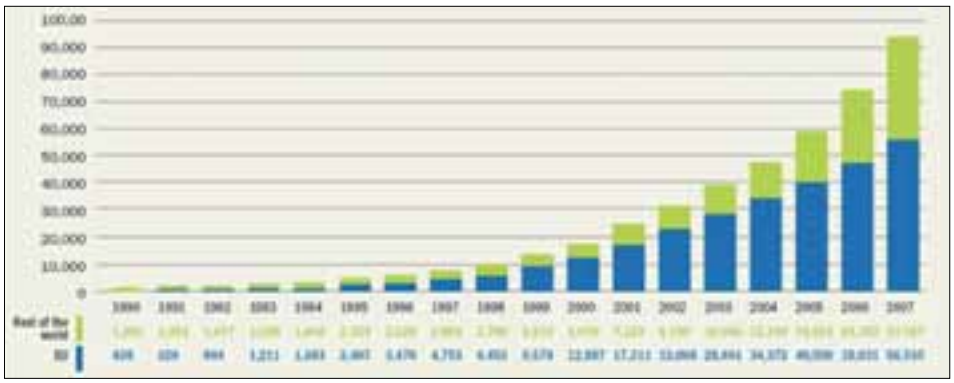
Key areas to be addressed include operations and maintenance skills for both the onshore and offshore sectors. Divergence occurs at this point with operations and maintenance of the onshore and offshore wind farms being dictated by the physical working environment. Therefore, one of the key training components is in the area of working at heights, sea safety and rescue procedures. Special training facilities are required for this training, a pool that simulates differing weather conditions, etc.

This 'Windskill' project is described in more detail later in this report and web access is available for further research and contact with the network.

Belgium – Brussels

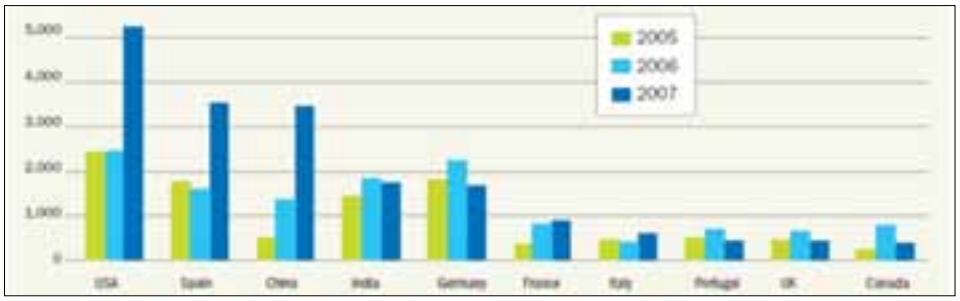
European Wind Energy Conference (EWEC) – Current Global Wind Market

20,073 MW of wind power capacity was installed globally during 2007. By the end of the year a global total of 94,122 MW capacity was reached. The global market for the demand for wind turbines and other components was increased by 31% in 2007. The graph below shows the global cumulative wind power installed capacity 1990 to 2007 in MW.



Courtesy: EWEA/GWEC

The graph below shows the top ten markets worldwide and the wind energy capacity installed annually in 2005, 2006 and 2007, in descending order of the wind capacity installed in 2007 in each country.

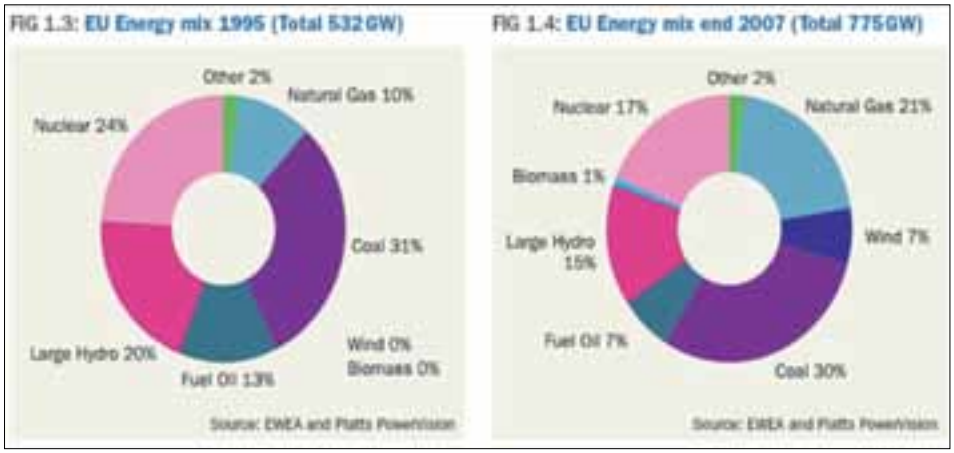


Courtesy: EWEA/GWEC

The majority of the above countries have component manufacturing facilities and therefore can more readily plan and implement their wind energy projects. Supply Chain issues still exist due to the growth and uptake of wind energy in these countries. The question has to be asked as to where Australia sits within this sector and importantly, will our projects and future plans for the installation of wind meet the same Supply Chain deadlock?

European Union Energy Mix

In 2007, wind energy increased its share of total capacity in the EU to 7% and has a significant share of new generation capacity. 30% of all power capacity installed since 2000 has been wind power, making it the second largest contributor to installation of EU capacity over the last eight years after natural gas (55%).



Courtesy: EWEA

Wind energy today meets 3.7% of EU electricity demand; the technology is already the second largest contributor to economic activity and employment in power plant manufacturing.

Spain (3,522 MW) is by far the largest market for wind turbines, followed by Germany (1,667 MW), France (888 MW) and Italy (603 MW). Eight countries including Germany, Spain, Denmark, Italy, France, the UK, Portugal, and the Netherlands – now have more than 1,000 MW installed.

Within Europe, Germany, Spain and Denmark are the three pioneering countries of wind power and are home to 72% of the EU's installed wind power capacity. That share is expected to decrease to 62% of installed capacity in 2010. Spain now obtains 10% of its electricity from wind power, Germany 7.2%. These leaders are being followed by a second wave of other European countries investing in wind power. Countries such as Italy, the United Kingdom, Portugal, France, the Netherlands, Austria and Greece are now increasing wind power capacity.

The time to act to meet such goals and to tackle climate change is short, stressed Paul Magnette, Federal Minister for Energy and Climate in Belgium, who emphasised that "the window of opportunity to act is closing". One key step for increasing and improving wind energy's share of the power mix, he said, would be to focus on increasing research efforts.

Reference: EWEA press release, May 2008

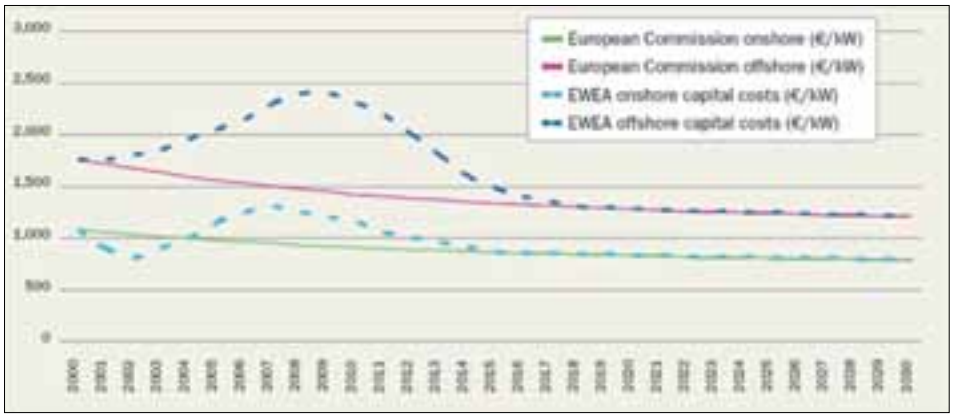
Based on current estimates, EWEA predicts that 80,000 MW (80 GW) will be installed in the EU by the end of 2010. The United Kingdom, France, Portugal and Italy are expecting annual average growth rates of over 20% between now and 2010.

Wind Technology in Demand

In Europe, the wind energy industry has created benefits in terms of employment, investment, research and economic activity in the electricity sector. Today, Europe leads the world in terms of the manufacturing and development of wind energy components and technology.

Eight of the top ten turbine manufacturing companies are European. In 2007, the European market was estimated to be worth approximately □25 billion, with European manufacturers having a 75% share of the global market for wind turbines.

As a rule of thumb installed wind power capacity costs are approx. □1,000/kW. In the period 2001 to 2004, the global market for wind power capacity grew less than expected and created a surplus in wind turbine production capacity. Consequently, the price of wind power capacity went down dramatically and for some projects as low as □700-800/kW. In the past three years from 2005 to 2007, the global market for wind energy has increased by 30-40% annually, and demand for wind turbines has surged, leading to increases in prices.



Courtesy: EWEA

The graph above shows the European Commission's assumptions on the development of onshore and offshore wind power capacity costs up to 2030. In addition, there are two curves that reflect the effect of the demand/supply on wind turbine prices in recent years. EWEA assumes onshore wind energy prices of □1,300/kW in 2007 and offshore prices of €2,300/kW. The steep increase in offshore cost reflects the limited number of manufacturers in the offshore market, the current absence of economies of scale due to low market deployment and bottlenecks in the Supply Chain.

Totals (oil $120; CO_2 €40)	2008-2010	2011-2020	2021-2030	2008-2020	2008-2030
Investment	31,062	120,529	187,308	151,591	338,899
Avoided CO_2 cost	33,623	182,223	299,011	215,846	514,857
Avoided fuel cost	67,002	363,126	595,856	430,128	1,025,984

Courtesy: EWEA

The International Experience

The table above shows the savings made based on the price of oil (per barrel) at US$120 and CO_2 (per tonne) at □40. This should be looked at in light of current pricing.

European Renewable Energy Targets of 20% by 2020

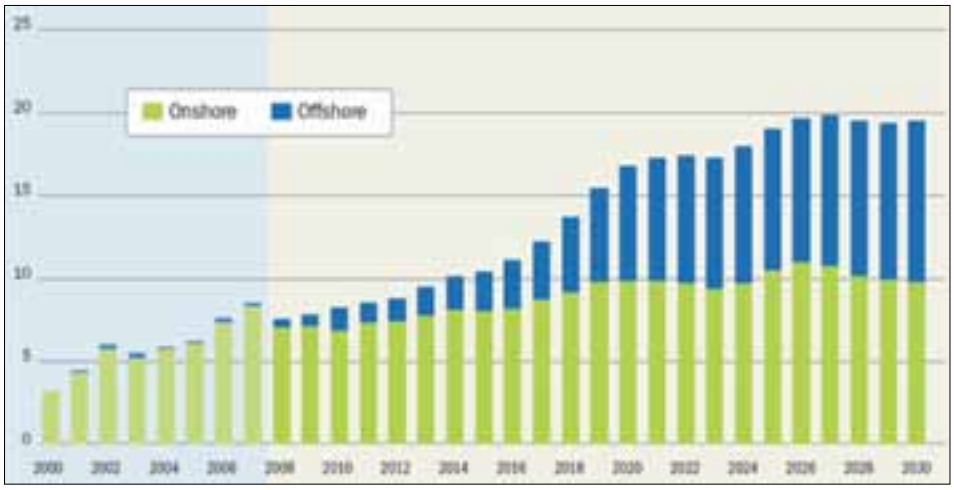
The European Parliament has mandated a 20% by 2020 binding renewable energy target for all member states. Interim targets have been set for the implementation of wind, starting with a measured starting point at 2007.

Wind Industry Targets for 2007, 2010, 2020 and 2030

2007	2010	2020	2030
56 GW installed capacity including 1.08GW offshore	80 GW installed capacity including 3.5GW offshore	180 GW installed capacity including 35GW offshore	300 GW installed capacity including 120GW offshore
8.5 GW annual including 0.2GW offshore	8.2 GW annual including 1.3 GW offshore	16.8 GW annual including 6.8 GW offshore	19.5 GW annual including 9.6 GW offshore
119 TWh production including 4 TWh offshore	177 TWh production including 13 TWh offshore	477 TWh production including 133 TWh offshore	935 TWh production including 469 TWh offshore
Meeting 3.7% of total EU demand	Meeting 5.2% of total EU demand	Meeting 14.3% of total EU demand	Meeting 28.2% of total EU demand
Avoiding 91Mt of CO_2	Avoiding 133Mt of CO_2	Avoiding 328Mt of CO_2	Avoiding 575Mt of CO_2

Courtesy: EWEA/GWEC

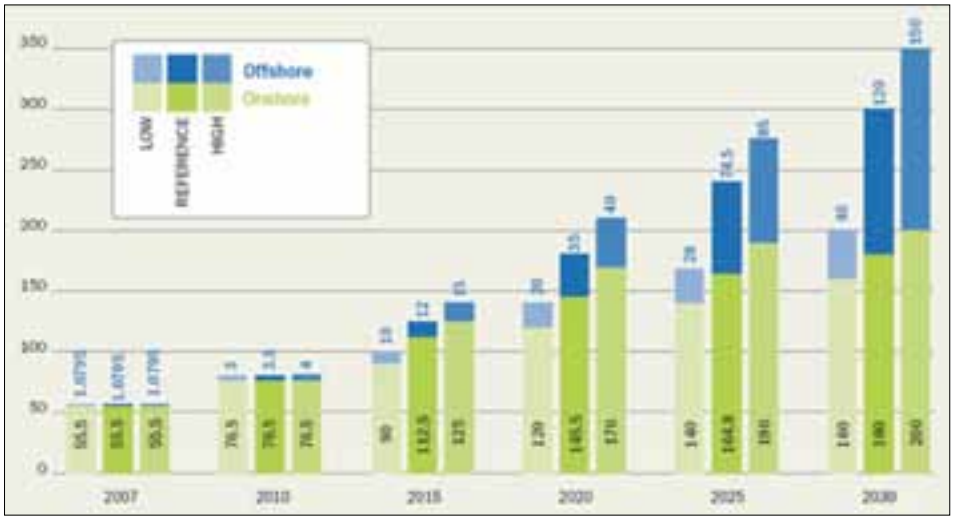
The graph below gives a clear visual of the proportion of onshore and offshore wind implementation. Offshore is by far the most attractive strategy as each wind turbine will yield so much more clean power. The output capacity of offshore wind turbines is the major focus of most wind turbine manufacturers. The current designs for wind turbines are now reaching capacities of 5 to 7 MW per unit.



Courtesy: EWEA/GWEC

The International Experience

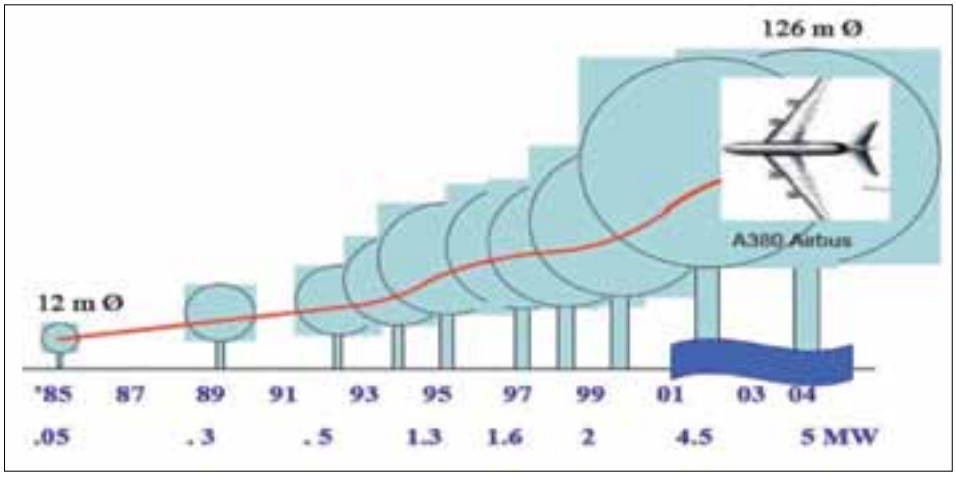
Offshore: The New Frontier of Wind Power



Courtesy: EWEA/GWEC

The challenge of offshore is that the project risks are high. Implementation of projects are expensive, time consuming, require specialist sea vessels and the training of staff from construction to maintenance is extensive. However, the biggest challenge is that there are a limited number of manufacturers in the market as it is a relatively new sector. The lack of 'economies of scale' have created bottlenecks in the Supply Chain.

On the positive side, there is more community acceptance, and it could be due to the basic principle of "out of sight, out of mind".



Courtesy: DUwind

Growth in size of wind turbines over past 20 years as the industry tools up for 7MW turbines for offshore wind farms.

European Wind Energy Conference (EWEC) – Key Observations

Europe predicts a massive increase in employment in the wind industry, to meet the scheduled implementation plans below.

Snapshot of the wind installation capacity plan:

2007	2010	2020	2030
56 GW installed capacity including 1.08GW offshore	80 GW installed capacity including 3.5GW offshore	180 GW installed capacity including 35GW offshore	300 GW installed capacity including 120GW offshore

Courtesy: EWEA/GWEC

The European wind implementation plan indicates a number of challenges for Europe. Australia needs to be aware of such issues in order to prepare against these challenges, as we will be impacted by the European plan.

The following issues need to be considered:

- Supply chain issues
- Re-powering
- Community acceptance issues
- Grid integration and access issues
- Administrative issues
- Offshore - Shipping vessels availability issues
- Cross discipline and training issues

Supply Chain and Re-Powering Issues

The Supply Chain issue is one of great concern in Europe and this was stated on numerous occasions at the 2008 EWEC. This issue was highlighted by project managers, components manufacturers and suppliers alike. The main concern is that most countries around the globe can see that the quickest way to increase the market share of 'green energy' from renewable resources is by the installation of wind. This places great demands on wind components and their availability. As such a world wide supply and demand situation is created whereby there is far more demand and not enough supply.

It was also acknowledged that China, will be manufacturing wind components mainly for the Chinese market.

What will this mean for Australian projects given that we are isolated from other international manufacturers? We have only one wind tower manufacturing firm in Australia and do not manufacture any other vital wind components?

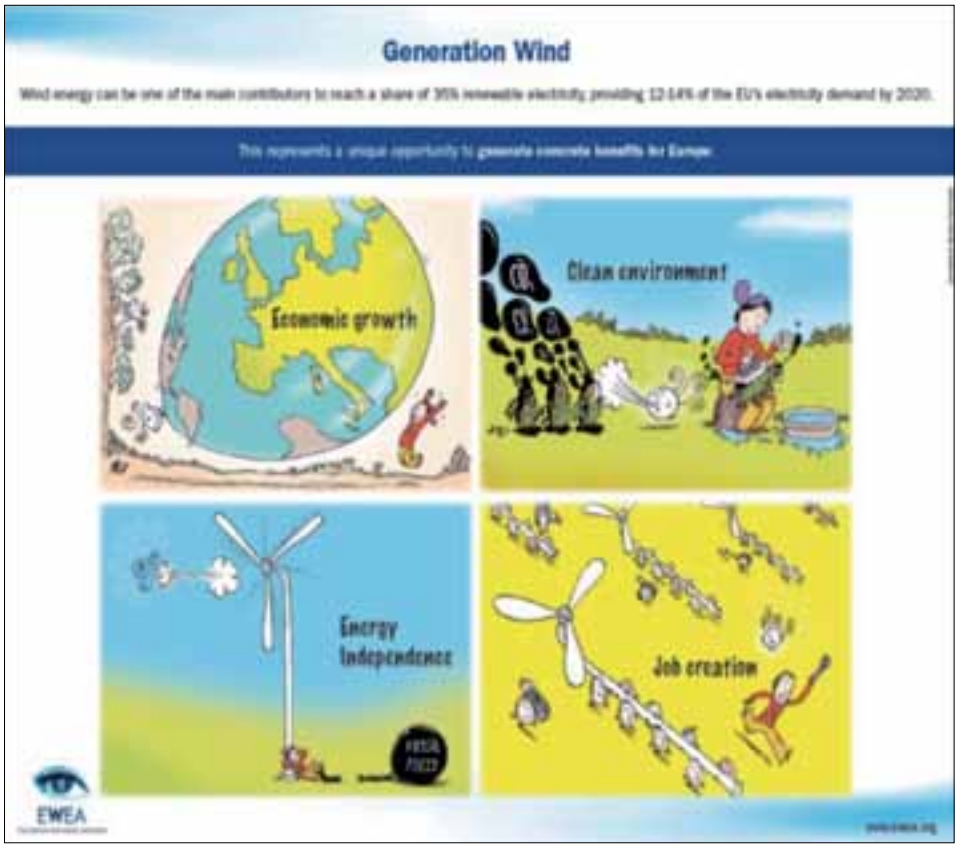
Furthermore, there are many countries in Europe, particularly Germany and some of the Scandinavian countries that have wind systems that are nearing the end of their designed life and need to be re-powered. This adds more pressure to the Supply Chain issue, with entire wind systems needing to be replaced and disposed of. This includes all parts of the system such as the towers, nacelles, blades and control systems.

Administrative issues

Streamlining administrative barriers for connecting wind energy into the grid was raised as another issue that needs to be addressed. By doing so, this will allow wind energy projects to be fast tracked and lower overall project costs.

Community Acceptance Issues

Community acceptance of wind farms is a battle that has been won throughout Europe. The public support the construction of wind farms as there has been a huge effort to communicate the vision to the general populous. Television education and communications campaigns have been implemented to educate and address public misconception (for example, the one commissioned by EWEA).



Courtesy: EWEA

This campaign is one of raising awareness of how wind has the capacity to tackle issues such as economic growth, the environment, energy independence and job creation. It is an attempt to engage public thinking to consider wind as a total solution.

European Wind Day 2008

In 2007, the European Wind Day campaign was launched by Commissioner for Energy, Andris Piebalgs, who inaugurated the installation of a real size wind turbine on the Schuman roundabout, between the European Commission and Council buildings in Brussels.

Commissioner Piebalgs reinforced the message of the European Wind Day when he said that *"It is important that each citizen understands why we are doing this [developing wind energy] and why it is necessary."*

The main objectives of the 2007 Wind Day were to promote the power of wind across Europe as a clean and effective energy source:

- Explaining why wind energy is a key solution to the current energy and climate crisis
- Clarifying how wind energy can be the main contrib¬utor to the 20% binding target for renewable energy
- Encouraging Europeans to sign up for green electricity.

The event in 2008 was even bigger and more successful both in terms of the number of activities organised and of the level of participation. The new catch line, 'discover unlimited power', matches with the shift of the campaign's focus from a day of celebration to a day of information, enabling citizens to find out more about wind energy.

> The European Wind Day is designed to raise awareness of the huge benefits that come from harnessing this unlimited energy source and highlight its popularity amongst the general public.
>
> *Christian Kjaer, EWEA's Chief Executive.*

Eighteen countries participated in this year's 'Wind Day' and more than 150 events were organised, such as wind farm inaugurations and open days, concerts, conferences, information days with schools, debates, races, contests and much more.

Courtesy: Wind Day

Grid Integration and Access issues

A number of issues have emerged as wind power has expanded quickly across Europe. Two key issues are of particular significance:

- The need for new power lines to connect up turbines - both in areas of weak grid capacity and for large offshore parks
- The other is for 'smart' solutions to the way in which wind farms integrate with the network.

Up until now wind farms have just been connected to the grid rather than integrated into the grid. To this end controlling the power flow has been impossible. Power electronics or sophisticated communications systems could be used to create 'intelligent grids'.[11]

The need for infrastructure investments is not based only on wind energy; grid extensions, grid reinforcement and increased backup capacity benefit all system users. An integrated approach to future decisions is needed in Europe, as in Australia, regarding the grid.

Future Electricity Grids

The vision for grids:

- Renewable Energy Sources and Distributed Generation will be fully integrated in the electricity system.
- Users will become both producers and consumers.
- The power grid will look like the internet.
- Distributed decision making, self-healing, bi-directional flows at all levels, etc.
- Loads will become more flexible
- Real-time prices for most users, smart appliances and other loads reactive to network conditions and price variations.
- Smart electronic meters will bring new services.
- All this is to be achieved while maintaining high quality and reliability.

Wind farms and all other renewable energy producers must be integrated with the network, not just connected to it.[12]

wwww.smartgrids.eu

wwww.smartgrids.eu

[11] www.smartgrids.eu

[12] EWEA large scale integration of wind energy in the European power supply

The International Experience

Summary of Wind Energy Plan to 2030

	Cumulative capacity onshore (GW)	Cumulative capacity offshore (GW)	Annual decommissioning (GW)	Total cumulative capacity	Wind energy production (TWh)	Wind Energy's share of electricity demand (BAU)	Wind Energy's share of electricity demand (High RE&Efficiency)	Mt CO_2 avoided	Annual wind power investments (€ mio)	Annual avoided fuel cost – € billions (assuming $90 oil price)	Annual avoided CO_2 cost – € billions (assuming €25/t CO_2)
2007	55.5	1.1	0.1	56.5	119	3.7%	3.7%	91	11,330	5.018	2,283
2008	62.5	1.6	0.0	64.1	137	4.1%	4.2%	105	10,017		2,619
2009	69.7	2.2	0.0	71.8	156	4.5%	4.7%	119	10,079		2,963
2010	76.5	3.5	0.0	80.0	177	5.0%	5.2%	133	10,966	8.328	3,336
2011	83.8	4.7	0.0	88.5	200	5.5%	5.9%	149	10,341		3,730
2012	91.1	6.0	0.2	97.1	223	6.1%	6.6%	165	10,082		4,124
2013	98.3	7.7	0.6	106.0	247	6.6%	7.3%	182	10,476		4,541
2014	105.4	9.7	1.0	115.1	273	7.2%	8.1%	199	10,590		4,972
2015	112.5	12.0	1.0	124.5	299	7.7%	8.9%	217	10,338	13.770	5,414
2016	119.5	14.8	1.3	134.3	329	8.3%	9.8%	235	10,970		5,886
2017	126.4	18.2	1.9	144.6	360	9.0%	10.7%	256	12,042		6,388
2018	133.0	22.6	2.6	155.6	395	9.8%	11.8%	278	13,439		6,939
2019	139.3	28.2	3.5	167.5	435	10.7%	13.0%	302	15,364		7,552
2020	145.0	35.0	4.3	180.0	477	11.6%	14.3%	328	16,887	20.512	8,205
2021	149.9	42.3	5.1	192.2	522	12.5%	15.6%	355	17,441		8,880
2022	154.1	49.9	5.6	204.0	567	13.4%	17.0%	381	17,567		9,532
2023	157.9	57.8	5.6	215.7	611	14.3%	18.3%	407	17,583		10,164
2024	161.4	66.0	6.3	227.4	655	15.1%	19.6%	432	18,161		10,792
2025	164.8	74.5	7.1	239.3	701	16.0%	21.0%	457	19,034	27.501	11,416
2026	168.1	83.2	7.7	251.3	747	16.9%	22.4%	481	19,597		12,037
2027	171.3	92.1	7.8	263.4	794	17.9%	23.9%	506	19,756		12,651
2028	174.4	101.2	7.3	275.6	842	18.9%	25.3%	530	19,504		13,251
2029	177.3	110.5	7.2	287.8	889	19.8%	26.7%	553	19,312		13,834
2030	180.0	120.0	7.3	300.0	935	20.8%	28.2%	576	19,353	34.566	14.389

Courtesy: EWEA

The table above provides a 'bird's eye view' of the plan proposed by the European Wind Energy Association and supported by the European Commission.

It also offers a good indicator as to the manufacturing capacity required to implement and achieve such a plan. The financial investments have been discussed and other barriers identified.

To take the offshore capacity from 1.08MW in 2007 to 120MW in 2030 will be a colossal task, given the environment in which these plants operate - the cost, the engineering and manpower required, as is shown in the 'Oostende Offshore Wind Farm' (that was visited as part of this Fellowship).

The International Experience

In order to manage the need for uniform qualifications and cross discipline training in the offshore wind sector, the industry together with training specialist and the European Commission, have set up the 'Windskill' project.

This project is part of the Intelligent Energy Europe program. It is focused on the development and implementation of uniform qualification standards for Europe's wind energy industry. The key areas are in operations and maintenance skills for both the onshore and offshore sectors.

This industry initiative is designed to resolve national qualification disputes, accelerate the realisation of wind farm projects and provide the blueprint for skills development activities throughout the EU.

European Qualification Profile

The European Qualification Profile (EQP) represents an initiative of the European wind energy sector to specify uniform transnational qualification standards for the Industry.

Individual job profiles are structured in accordance with the European Qualification Framework for Lifelong Learning to ensure applicability and transfer to all European educational frameworks.

The Windskill profiles provide an overview of each key process stage. In addition, detailed job profiles have been developed for the following process stages:

- Installation
- Onshore maintenance and
- Offshore maintenance

The EQP profiles will be extended and reviewed on the basis of the experience in the development of appropriate training concepts and extensive stakeholder consultations. The finalised profiles will be issued as the Windskill Standard in June 2009.

The key feature of what is being developed in this project is that identified skills sets are specific to job tasks. This allows the base trade qualified personnel to be fast tracked trained in order to enable jobs to be filled quickly.

A website has been set up to ensure that the information is readily available to anyone in the industry: http://www.windskill.eu/

Courtesy: WindSkill – European Wind Energy Skills Network

The International Experience

The following information is a sample of information available on the 'Windskill' website regarding job profiling. This information has been complied by the European Wind Energy Skills network.

Courtesy: WindSkill – European Wind Energy Skills Network

Courtesy: WindSkill – European Wind Energy Skills Network

Courtesy: WindSkill – European Wind Energy Skills Network

Membership of this network is available to interested parties. Encouraging Australian members to this network would be a great asset to the future wind industry and provide Australia with access to resources that are already well researched and developed, rather than reinventing the wheel.

C-Power's Offshore Wind Farm in Oostende

A visit to the foundation work yard of the worlds' largest offshore wind farm under construction, at Oostende off the coast in Belgium was undertaken.

The project is situated about 30km off the Belgian coast in water depths ranging from 15 to 30m. and has a total installed capacity of 300 MW, using 60 RE power 5 MW turbines. The wind farm will produce about 1000 GWh/year, sufficient to provide 600,000 inhabitants with renewable electricity.

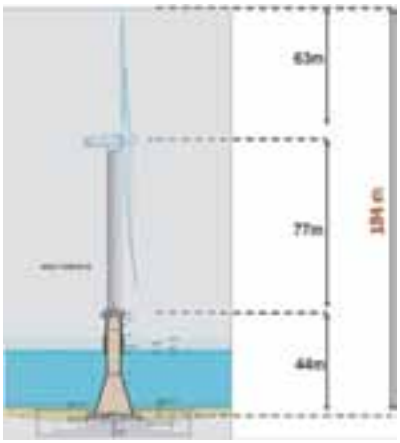
The project began in the summer of 2007 and the first phase, which includes the construction, erection and commissioning of 6 turbines, is due to feed the grid the end of September 2008. The project is managed by C-Power and the first phase investment is about 150 Million EUR.

During the visit to the construction site, on view were the impressive gravity-based foundations. They were floated and installed offshore in May 2008.

The International Experience

Courtesy: www.c-power.be

The above photograph shows the Gravity Base Foundations (GBF) at different stages of construction. Once completed on the drydock, they were taken by a specially constructed transport vessel to their positions out at sea and sunk into the seabed. Prior to this there was extensive preparatory work of the seabed by specially designed and fitted sea vessels. Once in place the GBFs were then filled with sand to add stability and weight. The wind tower, turbine and blades were assembled on the drydock and once again transported to the foundation structures out at sea and positioned in place on the GBF.



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For updated information on project progress, log on to: www.c-power.be.

Denmark – Copenhagen

Denmark is the world leader in wind power technology and has been one of the driving forces in developing the wind power industry - from single wind turbines on land to large scale wind farms at sea.

Denmark is also focused on solar thermal and PV energy and is investing in all these technologies.

Whilst in Denmark the following locations were visited: Solar City Copenhagen headquarters, Tecknologick Institute and a small business called Gaia Solar.

Solar City Copenhagen

The primary objective of the organisation Solar City Copenhagen is to establish Copenhagen as a demonstration and development centre for solar energy systems and energy optimization.

The main purpose is to contribute to sustainable and CO_2 neutral energy supply.

This is achieved in the following ways:

- Promoting the establishment and development of solar PV and solar thermal.
- Ensuring public awareness through information and involvement.
- Encouraging cooperation within the field of solar energy regionally and internationally.

These objectives are achieved through intensified cooperation between those that are willing to support such a development. They include the general public, municipal institutions, private companies, owner builders, investors, banks, credit institutions, housing societies and residents etc.

How the Danish are Promoting the Use of Solar PV

Solar City Copenhagen has changed the perception of solar in the minds of their citizens by placing solar in many prominent places around the city.

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A further activity promoted by Solar City Copenhagen is the annual Solar Award. This award has been given each year since 2005. Its aim is to encourage engagement of the use of solar to produce renewable energy, to promote creativity and incorporate solar in architectural design.

In 2007, the Solar Award was shared by two projects. One was the visionary district project on the Carlsberg site, the other was awarded to an artist that not only created a work that changes the facade of a building which faces the railway lines, but at the same time raises awareness of solar functionality to the general public. The artwork will be seen on a daily basis by 400,000 commuters going to and from Copenhagen Central Station.

Courtesy: SolarCityCopenhagen

Courtesy: SolarCityCopenhagen

The pictures above represent the Carlsberg site redevelopment and the Valby solar façade, winners of the Solar Award 2007, at Copenhagen.

The International Experience

A special award was given to the company “Out-sider A/S”, for their development of PV LED-light in urban space fixtures.

The product series “Photovoltaic LED-light in urban space fixtures” was focused on quality and the development of an integrated energy design. The project is based on a combination of PV technology and urban space furniture and equipment, and is a great example of the introduction of PV into urban spaces.

The most notable point about these products is the use of PV in an unconventional manner; a creative promotion of solar energy to users and passers-by in the urban space.

Courtesy: SolarCityCopenhagen

Courtesy: SolarCityCopenhagen

The Carlberg Site

Over the next few years and after beer production has stopped in the area, the Carlsberg site is to be converted into a dense, vibrant, pulsating city district within a framework of historical buildings and new facilities.

The vision is to create a lively city district that offers a wealth of experiences, surprises and stories. The requirements are that *“it should be a city district in constant development, so that the spirit of the place will be revitalised and reinforced on an ongoing basis.”*

Courtesy: SolarCityCopenhagen

A competition was held to engage innovation. The basic vision was to respond to five key points. These points were to reflect important aspect of city life and the overall goal:

1. Identity
2. City life
3. Urban form
4. Sustainability and
5. Realisation

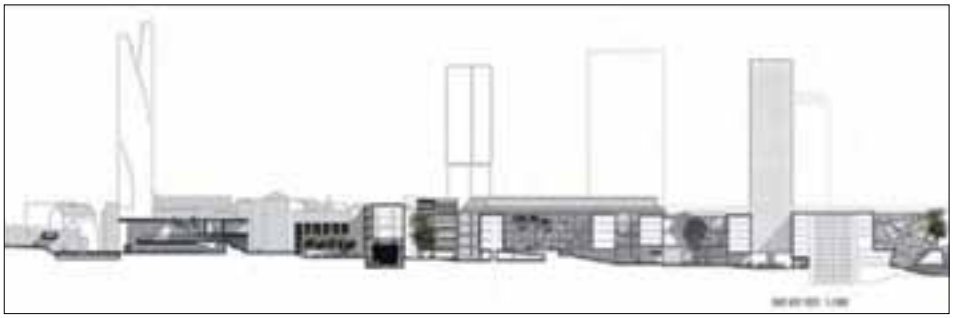
More specifically, entrants were requested to submit the following:

- A proposal for the overall identity of the new Carlsberg city district
- A proposal for an urban life concept, suggesting how a good framework for dynamic, sustainable and innovative city life can be created
- A plan of urban spaces illustrating the main structures that will ensure coherence and facilitate variation in the ongoing development of the area.

The plan was to create focal points and ensure connection, closeness, density and coherence.

- A concept for the social, environmental and economic sustainability of the proposed scheme
- A concept for the realisation of the new Carlsberg city district.

The competition brief was very broad, and imposed as few requirements and restrictions as possible. This allowed for creativity, innovation and freedom from restrictions such as height, depth or density of the buildings.



The winner was 'Vores Rum'– Entasis Arkitekter, Copenhagen

For the last 20 years the company has specialised in energy and environmental friendly building design and participates in national and international research and development projects primarily concerning renewable energy, daylight, natural ventilation and indoor climate.

The inspiring use of space and innovative ways of integrating and revitalizing the old, whilst creating sustainable solutions won this architect the prize.

Courtesy: VoresRum

Courtesy: VoresRum

Courtesy: VoresRum

Courtesy: VoresRum

Courtesy: VoresRum

Other Ways of Using Solar in Copenhagen

Integrated building solutions for solar PV can been seen all around the city of Copenhagen. From decorative solar pieces to more traditional applications; all are functional in their use.

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On façade walls and as window shading, PV has been used.

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The International Experience

The use of PV Solar at the Copenhagen Energy headquarters is impressive, with the entire south facing façade covered with Solar PV louvers, acting to collect electricity, heat and provide shade.

School for Architects in Copenhagen

The school for Architects has an impressive example of integrated Solar PV and Solar Thermal on the canteen roof building. Students and teachers alike have a living example of how design, function, aesthetics and sustainability can be effectively married together.

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Close view of the Solar PV and Solar Water heating using vacuum tube technology.

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The International Experience

Danish Broadcasting Building

The Danish Broadcasting building offers intelligent ECO-solutions for others to emulate. In Copenhagen, this building is looked upon as a project that will contribute significantly to the further adoption of these types of sustainable solutions in office buildings. A positive demonstration which leads the way for 80% savings in CO_2 emissions for cooling and 50% for heating in offices.

Courtesy: Danish Broadcasting

In order to demonstrate leading edge technology in sustainable building, the project focused on three main technologies:

- The use of an innovative hybrid cooling system with natural cooling and an underground seasonal cold storage system.
- Different types of double-envelope glass facades and atria will interact with climate control systems
- A PV plant of up to 1200m^2 will be integrated in the buildings.

Courtesy: Danish Broadcasting

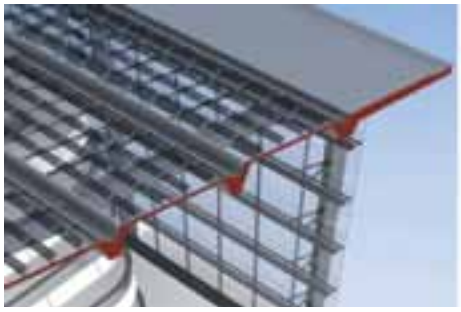
The hybrid cooling system was the first of its kind in Denmark. The utilisation of groundwater and external air for cooling the building makes this system sustainable compared with regular compression cooling.

The glass façade allows intelligent regulation of ventilation, heating, cooling and acoustics.

The International Experience

Courtesy: Danish Broadcasting

The PV-plant is a 120 kW system. Ecofys International BV is the company responsible for advising, designing, testing, commissioning and monitoring the PV-system.



Courtesy: Danish Broadcasting

Courtesy: Danish Broadcasting

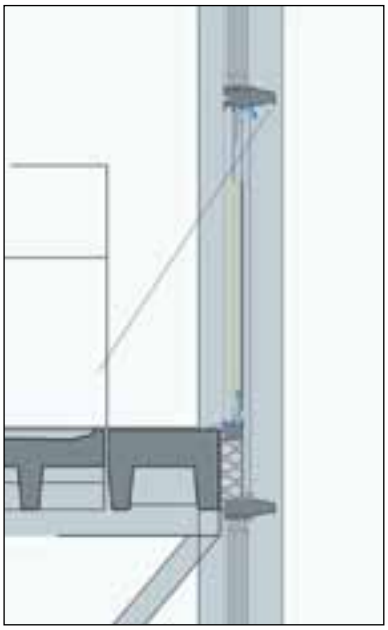
Courtesy: Danish Broadcasting

Retrofit Building Projects

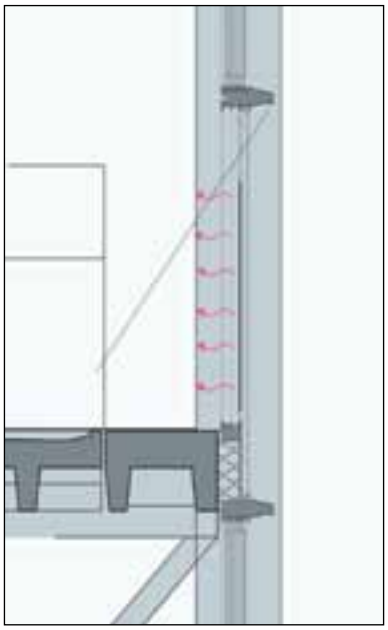
There is much in the way of building renovations occurring in Copenhagen, all with the view to reduce energy and implement solar technology in all forms of creative ways.

This multi-storey housing block for tenants with disabilities had a Facade renovation. The building comprises 224 flats and the renovation involved enclosing the open balconies which thereby made the building more thermally comfortable. Implementing a completely new design, the glazed balconies have integrated PV modules for the production of electricity. The total peak power is approximately 12 KWp, with an annual production of approximately 10 MWh per year.

The front glass of the parapet is a normal glazed balcony glazing, ensuring water tightness and sound protection from the main road in front of the building. Behind this glazing the PV-modules are placed and in this zone also a flexible sliding back-plate system is integrated. This gives the users of each dwelling the ability to utilise the solar heating building up on the PV panel or to dispel it.



Courtesy: SolarCityCopenhagen



Courtesy: SolarCityCopenhagen

In the summer, the users will vent the heat from the PV panels to the outside environment. Sliding the moveable back-panel in a position just behind the PV-panel does this. Hereby the heat will be forced to leave the parapet-zone through the ventilation openings at the top and bottom of the facade-profiles around the PV-panel. In case the user wants to have the heat to enter the glazed balcony, the back plate is moved to the side. Therefore the PV-panel will heat the air directly on the balcony and radiate the heat to the balcony, all the while, it will be producing electricity.

The PV Connections

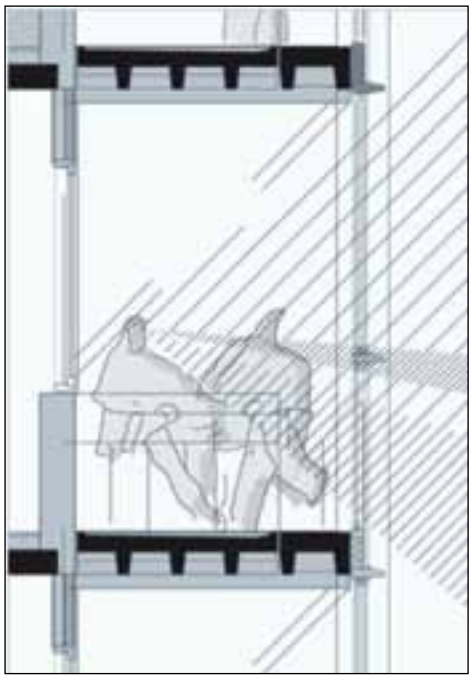
The PV system is designed to be flexible for future expansion. The string wiring is established in vertical zones fully integrated in the façade construction collecting the power from each panel. All electrical connections are based on the Multi-contact PV-cables, which allow the connectors to be accessed directly at each balcony without any risk of electrical shock.

The sliding system of panels is designed to have more panels added in the future at each balcony and directly connected to the string-wiring, allowing for a flexible expansion of the system.

Courtesy: SolarCityCopenhagen

The PV-system is said to be achieving an electrical yield of approximately 85kWh/m^2. Due to net metering in Denmark, the value of the power produced will be equal to the amount the tenants would have paid for the electricity including GST and an environmental levy. As such the selling price for the electricity produced by the system has the same value as electricity purchased by the tenants, and principally the electricity grid serves as short and long term storage of the power produced.

The costs of the system has been approximated at □11,2 watt peak. This must be seen in connection with the high degree of flexibility and large potential of replication for other archaic buildings that are in desperate need of sustainable refurbishment.



Courtesy: SolarCityCopenhagen

Danish 'Tecknologick' Institute

The Danish Technological Institute occupies a crucial position at the point where research, business, and the community converge.

The objective of the institute is to generate value for its target groups by making the best possible use of knowledge available anywhere in the world. The Institute was founded as an independent institution in 1906 and is one of the oldest of its type in the world. The Institute now has 850 employees, making it one of the world's largest private institutes to supply approved technological services such as consultancy, tests, certification and training for companies and public sector organisations.

The Institute is located at six premises throughout Denmark and employs experts in hundreds of different fields at 34 centres organised under the auspices of the five organisational units that define the main parameters for their work which fall into the following categories:

- Building Technology
- Industry and Energy
- Business Development
- Materials standards
- Productivity and Logistics

A visit to the Technologic Institute on the outskirts of Copenhagen led to the Building Technology/Industry and Energy Campus. The purpose of this campus is to provide testing, standards, development of training materials and demonstration of sustainable building methods.

Cornerstone to the Danish Technological Institute

Knowledge Development

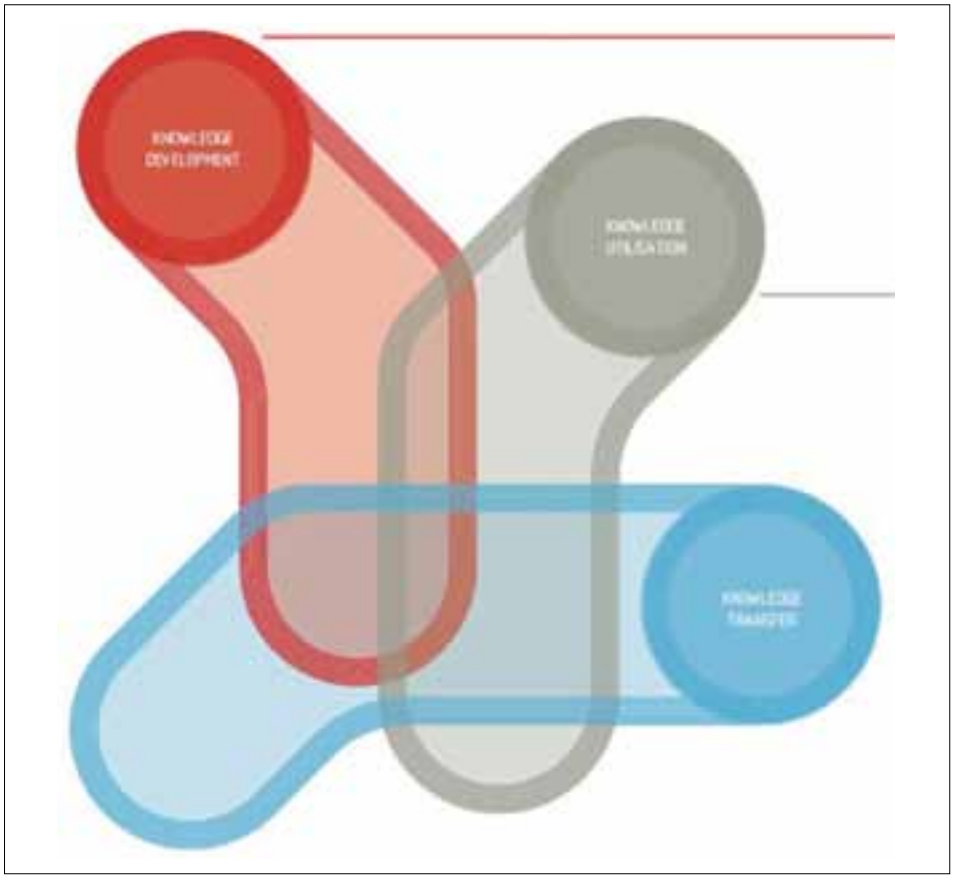
The Institute develops new knowledge through research and development projects. This is done in close co-operation with both Danish and foreign research institutions. New knowledge is fundamental for all the Institute's other services. Research results are passed on to companies, thereby giving the Institute the role of bridge-builder between research and business.

Knowledge Utilisation

The new knowledge and research results provide the basis to enable the Institute to continuously develop general technological services, like for example standards for laboratory testing, calibration and certification. These services form a solid 'technological infrastructure' which matches customers needs.

Knowledge Transfer

Knowledge is a prerequisite for growth and development, and one of the Institute's most important tasks is creating effective knowledge transfer. Through interaction with private companies, large, small and medium-sized organisations and public institutions, knowledge is transferred through consultancy, training and networking activities.



Courtesy: Danish Technological Institute

Testing, Standards And Training

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On this campus the following activities are evaluated, documented and demonstrated:

- Solar Water Heating
  - Demonstration of Solar Water Heating (SWH)
  - Centralised development of training material for SWH
  - Testing of SWH units
  - Standards, calibration and certification of SWH
- Solar PV
  - Demonstration of Photo voltaic (PV)
  - Centralised development of training material for PV
  - Testing of PV modules
  - Standards, calibration and certification of PV
- Solar House
  - Demonstration sustainable house
  - Building materials
  - Solar technologies
  - Passive solar building design
  - Energy efficiency measures

Sustainable Passive Solar Demonstration Building

The 'Energy in Buildings Centre' of the Danish Technological Institute provides consulting and development services in connection with the utilisation of passive solar energy. Some of the most important services include consulting on the correct design of buildings and climate shading, and the utilisation of natural ventilation, building-integrated heat storage, etc. This includes advanced simulation of the interplay between climate shading and buildings. Measurements are recorded, analysed and documented.

The project below was a demonstration sustainable house designed and built on campus, for the purpose of evaluating the design, materials, theories and technologies.

The International Experience

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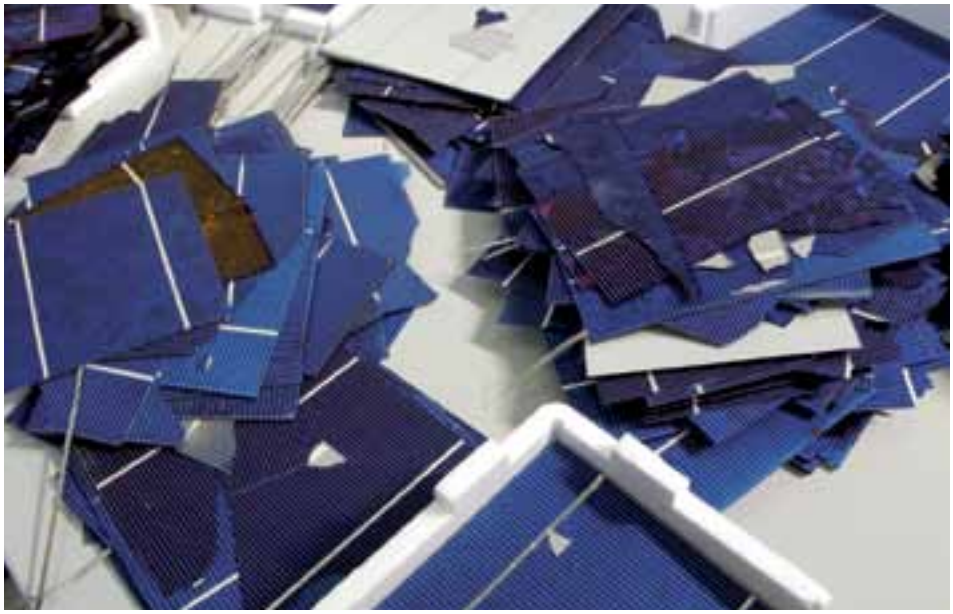
© Danish Technology Institute

Solar Business – Gaia Solar A/S

Gaia Solar was founded in 1996 and has established a position as the leading supplier of complete turnkey solar systems in Denmark. Gaia Solar develops, produces and markets solar cell modules custom designed for their clients need. Gaia Solar manufactures high quality solar cell modules based on solar cells from the leading European manufacturers.



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The International Experience

Gaia Solar's niche market is re-cycling discarded cells to create custom made solutions for both the usual grid connected systems and architectural projects. They specialise in creative, innovative solutions that are both functional and visually artistic. They are mainly focused on the Scandinavian market, but do have international offices.

With architectural projects, Gaia Solar is particularly involved in the rapid growing market for building integrated PV (BIPV). This is where the solar modules are part of the construction of the facade and/or roofing material, in both new constructions as well as retrofitting existing buildings. In order to excel in this type of installation there needs to be an understanding of the building structure, and Gaia Solar has developed close associations with builders, architects and consultants.

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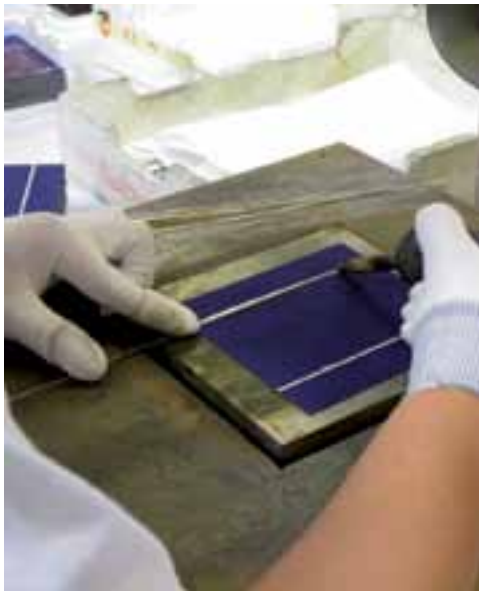
During the past years, more international focus has been on moving production to smaller local units. Gaia Solar is leading the way in this area. Its small footprint factory employs locally and distributes locally. It is home growing its base skills and knowledge and transferring this knowledge to its staff and team. This ensures manufacturing of local products which include the assembly of units, such as laminate solar modules, installation and maintenance.



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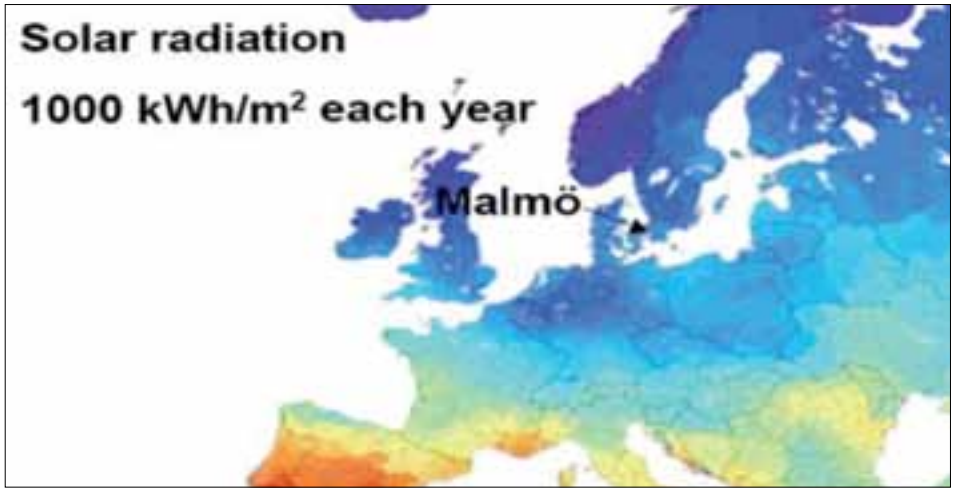
Sweden – Solar City Malmö

The Swedish city of Malmö is a municipality of 280,000 inhabitants located in Southern Sweden. It is the third largest city in Sweden and it participates in the International Solar City's Project.[13] Solar City Malmö is a non-profit association working hard to increase awareness of solar energy and to increase the use of distributed generated solar power. The aim is to make Malmö the leading solar energy centre in the country and to assume an international role as a model city for solar energy.

The key role of Solar City Malmö is to support and develop the solar energy industry in southern Sweden. Primary activities include the demonstration and promotion of solar PV and solar thermal systems.

Solar City Malmö are also involved in an advocacy role for which they are lobbying for the implementation of a feed-in tariffs system in Sweden. At the moment there are no feed-in policies in Sweden. The only incentive mechanism for the uptake of PV Solar is government funding of 70% of the cost of PV installations on public buildings. To date approximately □15 million has been spent on solar between 2005 and 2008.

Solar City Malmö also organises training sessions, seminars, exhibitions, study visits, theme days, conferences, technology competitions, information meetings for businesses, installers and councils, education for students, and advisory and dissemination services.



Malmö has set a high target for reduction of CO_2 emissions by an average of 25% over the period 2008 - 2012, compared to 1990 levels. This exceeds targets set by other nations. To achieve this goal, a number of significant measures have been taken in the energy, transport and building sectors over the past few years.

Solar PV and Solar Thermal

Solar energy can be primarily harnessed in two ways, by solar collectors that produce hot water (thermal), and by Solar PV that produce electricity. There are more than 4000m^2 of solar thermal collectors and 2500m^2 of PV have been installed so far in schools, museum, hospitals, industrial buildings etc.

[13] http://www.solarcity.org/industry.htm

The International Experience

The map above shows the current distribution of solar thermal collectors and PV plants around the Malmo area.

Solar Collectors

Solar collectors transform the sun's energy to heat that can be used for heating water and heating buildings. The solar collector is essentially an insulated box with a pane of glass on the top, a blackened copper plate inside that absorbs heat from the sun and a pipe system in which water circulates. The hot water is led into a heating system where the heat is used. Systems often include a storage facility for storing hot water (accumulator tank). Solar collectors are currently mostly used in hot water systems where they are backed up by a hot water boiler. 1m^2 of solar collectors generates approximately 400kWh/year.

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Solar Photovoltaic (PV)

Solar cells transform the sun's energy to electricity without any moving parts. A solar cell consists of a thin slice of silicone with contacts on the front and back. When the solar cell is exposed to light, it produces a direct current that, with the help of an inverter, can be fed into the electricity system in a building. 1m^2 of solar cells produces approximately 1000kWh/year.

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Other interesting features are apparent in the above photo. The roof of the Malmö City Council premises is not only covered with solar thermal collectors and PVs, but also with moss. This is a demonstration site for the 'greening roofs project'. The moss on the roof acts as a natural insulator as well as a natural cooling system in summer.

The use of PV solar modules for both collecting electricity and as a shading device is widely used in Malmö city.

Other locations of PV modules used as shading devices include schools, university accommodation and business premises. It is a functional and aesthetically pleasing solution.

Mellanheds Primary School

At Mellanheds Primary School, problems with overheating have been solved by installing solar modules as solar shading. Electricity can be generated at a competitive price by integrating the PV panels into the façade. The plant has a peak power of 34 KW.

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Solar shading has also been used at the Student Union House in Malmö. The surface of PV is 180m^2 and the peak power is 25 kW.

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The Museum of Science and Technology

The PV plant on the Museum of Science and Technology was installed in September 2006. An area of 335m^2 of PV is installed on the flat roof, and 180m^2 on the façade. The total peak power is 67 kW. The plant was awarded the Solar Plant of the Year by the Swedish Solar Electricity Program 2006, for its architectural integration into the building. A public display provides up to date information on the amount of electricity produced.

© SolarCityMalmo

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Malmö city also uses solar PV for street lighting and for parking metres.

Sege Park Area

The largest and most spectacular PV plant in Sweden was completed in July 2007 in the City of Malmö in the old hospital area of Sege Park. The plant has a total area of 1250m^2 across two buildings, and generates a maximum power of 166 kW.

© SolarCityMalmo

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The plant has a unique architectural and technical solution and it rests on a 20-metre high steel frame.

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The entire area of Sege Park is going through major restorations. There are plans for expansion and integration of solar into the new buildings, for example student apartments. The area will be self sufficient in energy from renewable energy sources such as PV, solar thermal plants, biofuels and wind energy.

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The District of Western Harbour

The creation of the district of Western Harbour was fundamentally based on an ecological approach to planning, building and construction. The aim was for the district to be an internationally leading example of environmental adaptation of a densely built urban environment.

The International Experience

© SolarCityMalmo

This area is now a driving force in the development of Malmö's environmental sustainability. The district is exclusively provided with energy from locally produced renewable sources. Sun, wind and water form the basis for energy production, together with biogas produced from organic waste from the district in biogas digesters.

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Buildings are designed to have a low energy demand and the area is planned to minimise future transport needs and car dependency. Cycle traffic is the most important element in the area's transport system. The district was built with the aim of containing a diverse range of natural life using plant beds, foliage on walls, green roofs, water surfaces in ponds and large trees and bushes.

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Solar thermal is achieved by the use of evacuated vacuum tubes as can be seen in the previous photo.

PV modules provide both shading and electricity on this energy efficient apartment.

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The Solar City Malmö Office

Solar City Malmö are building up a network and knowledge centre for solar energy. On the roof of their office, there are all types of solar PV modules and solar thermal demonstration units on display and in use.

The International Experience

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Sweden – Växjö

Växjö is proudly known as the "Greenest city in Europe". Its main aim is to be "Fossil Fuel Free Växjö" by 2050. The city of Växjö has 78,000 inhabitants and is situated in the southern part of Sweden

A unanimous decision by the City Council in 1996 to achieve a "Fossil Fuel Free Växjö" became the vision, which is now well on its way to being achieved. The overall fossil CO_2 emissions per inhabitant had been reduced by 30 % in 2006, compared to 1993 emissions levels. At the same time a strong economic growth occurred where it is easy and profitable to live a good life without fossil fuels.

The key to their success is the vision that was set down and the ongoing implementation regardless to change of government. The following extract is an indicator of the Environmental Policy and vision which has led this city to be a world leader and an example to be replicated.

Environmental Policy for Växjö Municipal Organization

We will continue to be a leading environmental municipality. All areas of our operations will be run and developed taking great account of conditions that the environment and local and global natural resources allow. All this to ensure current and future generations a healthy and good environment.

We will achieve this by:

- Our elected representatives and employees continually acquiring the necessary knowledge, taking into account the type of operations that we run.
- Our social structure being based on land, water and physical environments being used non-wastefully, in terms of resources and in an ecologically sustainable way.
- Being good examples, and when decisions need to be made where a conflict of interest can occur, to act in a long-term sustainable manner by taking particular account of questions relating to the environmental and natural resources.
- Our position within society being used to affect and facilitate authorities, companies, organisations, and the inhabitants of the municipality to reduce their negative effect on the environment.
- Involving authorities, companies, organisations and inhabitants of the municipality in the development towards a sustainable society by means of information and consultation.

Courtesy: Environmental Växjö Policy

Växjö City's Reputation

Two of Australia's national newspapers have reported on the success that Växjö has achieved due to the vision and long-term commitment of the City Council.

THE AGE

Emission possible

Vaxjo is a city in southern Sweden with a population of 85,500. Near a series of lakes, the university town is the commercial, cultural and educational centre of a region of 1.2 million people. Earlier in the year, the City of Vaxjo received the Sustainable Energy Europe Award during the European Sustainable Energy Week.

The Sydney Morning Herald

Going green

Despite forecasts of doom, Sweden's economy is thriving thanks to alternative energy sources and lowered carbon emissions, Louise Williams reports.

In the cool forest region of southern Sweden, the city of Vaxjo has turned off the heating oil, even on the darkest, snowbound days of winter. Coal, too, is gone and next on the fossil fuel hit list is petrol. In the underground car park of the local government offices there are no private vehicles, just a communal car fleet.

© Växjö municipal organization

The Plan for a Fossil Fuel Free Växjö

In 2006, a new environmental program for the city, consisting of three profile areas, was adopted. Fossil Fuel Free Växjö is one of these profile areas. Below, the goals for Fossil Fuel Free Växjö are described.

The specific and expanded vision:

- The City of Växjö strives to use energy from renewable sources
- The City of Växjö strives to use energy efficiently
- The City of Växjö strives to go over to a fossil fuel free transport system

Goals to be achieved are:

- To reduce fossil carbon dioxide emissions per inhabitant by at least 50% by the year 2010 and by at least 70% by the year 2025 compared to 1993
- To reduce the consumption of electrical energy by at least 20% per inhabitant by the year 2015 compared to 1993
- To increase cycle traffic in the City of Växjö by at least 20% by the year 2015 compared to 2004
- To increase the use of public city transport by at least 20% and public regional transport by at least 12% compared to 2002
- To stop the municipality's use of oil for heating, other than for complementary use by 2010
- To reduce fossil carbon dioxide emissions from the municipality's transport and services by at least 30% by the year 2015 compared to 1999, and in the long-term cease to emit fossil carbon dioxide.

A major component of the plan includes information transfer to the consumers. This has been achieved in many ways as there has been on going campaigns on the city goals, training and information sessions and specific publications of the Växjö's strategy for a change to a fossil fuel free society.

The main communication to the consumer focuses upon a combination of changed behavior, energy efficiency and transition to renewable energies both in the heating and the transport sector.

The biggest challenge is to change people's behavior. In order to make the transition easier and achievable the following strategy has been adopted:

- Cheap and convenient district heating
- Attractive public transport
- Good walking and cycling paths,

As well as continuing ongoing information communication campaigns.

Energy Efficiency

The most effective way to reduce dependency on fossil fuels is to increase energy efficiency. Studies and actions have shown that a 20% reduction of energy consumption is possible. This potential is huge not only for large business, and the public sector, but also for the domestic market.

One area where this knowledge has been applied in Växjö is in the public and private housing sector. Current housing projects meet strict, high levels of energy efficient building codes as well as using local materials.

A visit was undertaken to a building site of a six level apartment block under construction. The main building materials are locally sourced such as the timber used in the building. The other main feature being that it was highly insulated and designed to not only take in views of the beautiful lake, but to be a passive solar building.

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Until the building is complete, it is literally under wraps. Due to the timber walls etc, the entire building needs to be protected from the elements. Eventually a weatherproof coating will be applied to the external walls.

Key to the construction is the insulation of the entire building; this includes the installation of double or triple glazed windows and doors, inbuilt floor hydronic heating and correct orientation of the building to enable passive solar principles to operate the apartments. The other important feature is effective ventilating systems, to allow fresh air to enter the apartments.

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Insulation and ventilation ducts. Hydronic heating inlaid into the floor boards.

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Heating Space and Water

The biggest cuts in CO_2 emissions have been made in the heating of water and in space heating. This has been possible as Växjö's heating is mainly based on forest products. The replacement heating with oil and electricity by biofuels where possible or by small-scale heating with pellets or wood have been the best alternatives for the city.

They also believe that there is potential of increased use of solar heating in conjunction with their biomass heating systems.

There is one main difference between Australia and European countries, and that is that they have district heating systems in place. Heating of water is centralised. In Australia however, we have distributed heating and cooling systems that are often inefficient due to our inefficient building developments, construction methods and lack of passive solar principles.

The Sandviksverken bio-energy plant was visited to observe operations. A combined heat and power (CHP) plant, which uses only biomass as fuel, was built by the Swedish energy company Växjö Energi AB to expand its Sandvik plant in Växjö. The plant called Sandvik II, has an output of 38 MWe and 66 MWth. Sandvik caters for the entire district heating needs of the Växjö district and 30-40 % of its electrical needs. Residual wood ash from the plant is returned to the forest to complete the life cycle.

The plant is also prepared for the use of gasified biomass in the future, which could add 15-25MW equivalent to its output.

Under normal conditions the plant's annual energy production is about 350GWh of district heating and 175GWh of electricity for the grid.

From an environmental perspective, Sandvik II´s particle collection equipment comprises the following components:

- An electrostatic precipitator that separates dust from
- the flue gases with an efficiency of 99.5%
- An induced draft fan
- A flue gas condenser to recover the energy content in the flue gas
- and a dust transportation and storage system.

The flue gas condenser provides between 10MW and 20MW of district heating.

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The International Experience

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This 40,000 cubic metre of capacity storage tank avove stores the water for district heating after steam has been used for the production of electricity.

These large motors below left are used to power the pumps circulating hot water through the district heating network.

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The York absorption-cooling unit above right was recently added to the VEAB plant to convert heat into chilled water for summertime cooling. The company is experimenting with chilled water production; so far it is only used for cooling offices at the plant, but as cooling demands grows in Växjö, district cooling may become a new product offering.

Sandvik II is fully computerised. The control room is highly organised, efficient, and attractive. Monitors for operation and supervision, are located here and complement the operating terminal in the central control room of the main Sandvik plant. Communication between the systems is maintained by fibre optics, but important functions are duplicated for security.

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Transport

It has been accepted that the emissions from the transport sector are more difficult to deal with. While the measures for energy efficiency and district heating can be controlled to some extent by the municipality, this is not the case for the majority of transport. The strategy is to make transport easier for those who prefer a more environmentally friendly way of moving themselves.

The City of Växjö is assisting this change, by making traffic more efficient and also increasing the replacement of fossil fuels with renewable ones, achieved mainly by introducing different kinds of renewable fuels such as Ethanol, DME and Biogas.

The City of Växjö has continued to establish cycle paths and increase communication with the general public regarding more healthy and fun options for transport, such as riding their bikes.

© Växjö municipal organization

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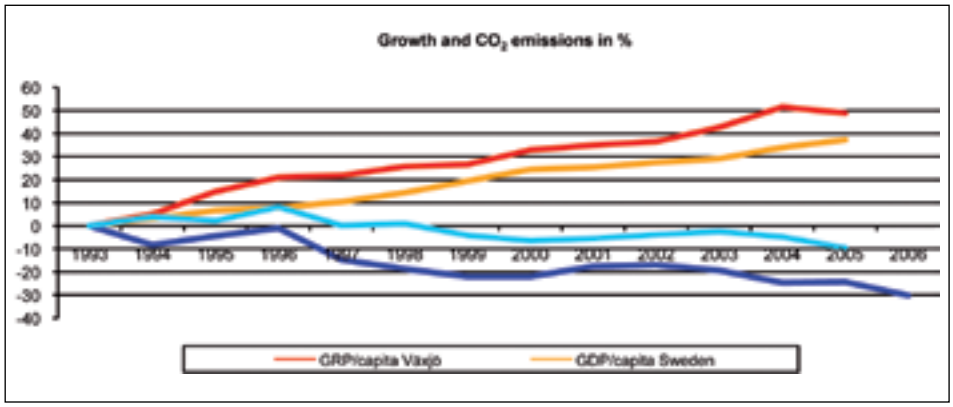
Striving for World Best Practice

The possibility of creating a fossil fuel free society, where the energy consumption is based on renewable and sustainable energy sources is an aspiration. Växjö is demonstrating that such an aspiration possible, profitable and achievable. Statistics demonstrate that in 2005, 51% of the energy consumption came from renewable energy sources and that CO_2 emissions per inhabitant had been reduced dramatically:



© Växjö municipal organization

France – Paris

In the city of love and art, there was much activity with the refurbishment of existing city buildings. Whilst modernising these tired looking concrete blocks, there is a program of installing insulation on the walls prior to facing off the façade of the buildings. Insulation is the fastest method of implementing Energy Efficiency measures, as it:

- Reduces the need for mechanical heating and cooling and
- Retains the heat or coolness in the building if mechanical heating and cooling is used

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Sustainable Transport Solution for Inner City Commuting

© Velib

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The International Experience

In July 2007, Paris began a public bike rental program ('Velib') that made cruiser bikes available to anyone wanting to ride. Today there are more than 20,000 bikes and 1,500 self-service stations are spread across the city.

Advertising giant JC Deco negotiated the exclusive rights to 1,600 billboards across the city and in exchange sponsored the cost of the bikes at a cost of $2,000 per bike.

Rental is easy and if you return your bike within the first 30 minutes, there's no charge!! All that needs to be arranged is a subscription, which provides an unlimited number of rentals. This may be purchased for a day, a week, or a year and subscription costs are 1, 5, or 29 Euros, respectively. A valid credit card is required for the subscription and subsequent billing, if any.

After the first 30 minutes, costs are as follows:

- 1 hour = 1 Euro
- 1.5 hours = 3 Euro
- 2 hours = 7 Euro
- 5 hours = 31 Euro
- 10 hourrs = 71 Euro
- 20 hours = 151 Euro

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This is not just a novel idea for the tourist in town, the locals are also using it, as they become increasingly aware of the many benefits to the scheme.

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The city of Paris has realised the following benefits:

- Raised its image
- As the mayor of the city proclaimed:
  - *"It has changed Paris's image -- made it quieter, less polluted, with a nicer atmosphere, a better way of life."*
  - *"It has inspired some US cities to leave their cars at home".*

Spain – Valencia

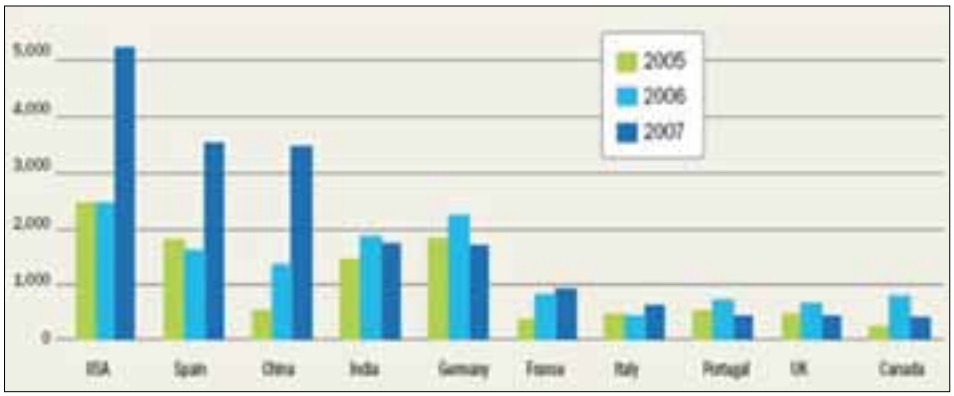
All statistics validate that Spain has been the market leader in Europe for the implementation of both onshore wind installation and solar PV and thermal energies.[14] While Spain spans across all markets, their primary focus has been on large scale solar plants.

Wind Power Status

At the end of 2004 the installed wind power in Spain was 8.26GW (EWEA 05). This was 12.0% of the net generation capacity in the country.

The recently revised target for 2011 is now set at 20GW, although the industry association AEE believes it can be even 23GW, which will then cover 16% of electricity demand.

In recent years Spain has become an international reference with its rapid growth of wind power. The recent growth is foremost in Castilla-la-Mancha, followed by Castilla y Leon, Galicia, Aragon and Andalucia.



Courtesy: EWEA/GWEC

Spain is the market leader in Wind as published by the European Wind Energy Association in "Delivering Energy and Climate Solutions - EWEA 2007"

The Spanish record: *"In 2007, the most impressive performance came from Spain. A record 3,522 MW of wind turbines were installed – the largest figure ever – representing 40% of the European total. The Spanish success story has resulted from a clear national incentive framework for renewable energy, as well as strong regional targets."*

As can be seen from the graph above, in 2007, Spain (3,522MW) was by far the largest market in Europe for wind turbines, followed by Germany (1,667MW), France (888MW) and Italy (603MW).

Eight countries – Spain, Germany, Denmark, Italy, France, the UK, Portugal, and the Netherlands – now have more than 1,000MW of wind capacity installed. Spain, Germany and Denmark are the three pioneering countries of wind power and have a total installed capacity of 72%. This share is expected to decrease to 62% of installed capacity in 2010 as other nations increase their own capacity.

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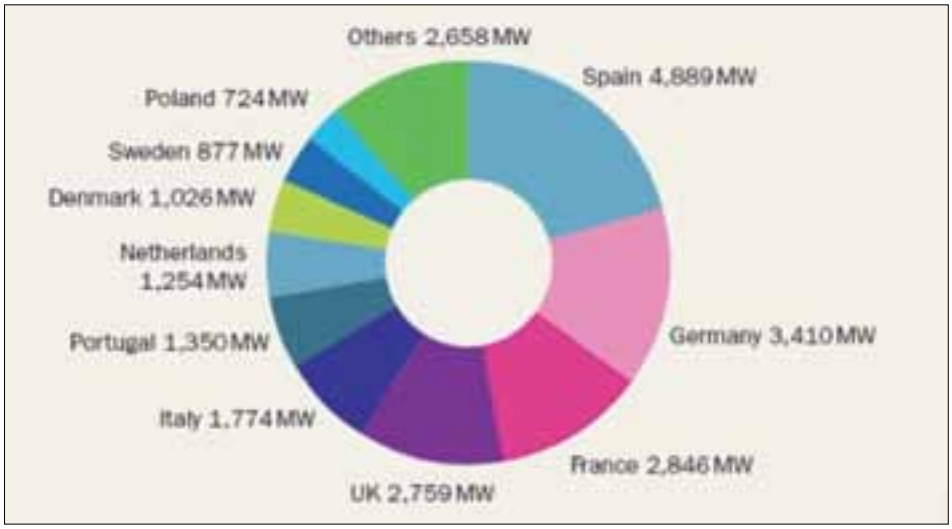
[14] Solar Power for a Sustainable World by presentation by Dr. Michael Geyer, Director International Project Development and Pure Power – Wind Energy Scenarios up to 2030, EWEA

Courtesy: EWEA Annual Report 2007

The above diagram indicates the distribution of wind installations within the European Union. Spain is nudging closer to Germany, who has been traditionally the market leader for many years. It is predicted that Spain will take the role of leader in this industry leading up to 2010, as shown below.



Courtesy: EWEA/GWEC

Solar Power Status

Spain has forged ahead with plans to build concentrating solar power plants, establishing the country and Spanish companies as world leaders in this emerging field. Simultaneously the number of installed PV systems is growing exponentially, as researchers continue to explore new ways to promote and improve solar power.

The International Experience

Spain has developed and invested in all possibilities of solar technology. It has Solar PV as well as Solar Thermal in the form of concentrated tower and parabolic dish technology.

The climatic conditions in the south of Spain are very similar to central Australia. The irradiance received in Spain is very comparable to that of Australia, and this is one of the reasons for the huge developments in the investment of time, money and research and development into solar power in this area.

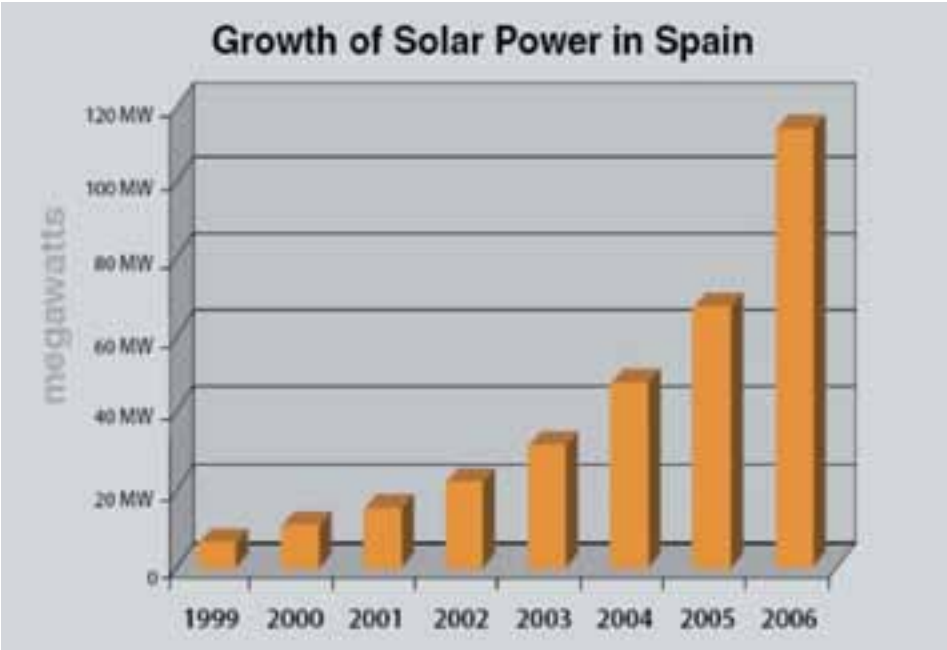
As one drives along the road just outside of Seville, an interesting phenomenon can be observed, and that is the glowing white rays emanating from a tower, piercing the dry air, and alighting upon the upturned faces of the tilted mirror panels below. Appearances, though, are deceiving: those upturned mirrors are actually tracking the sun and radiating its energy onto a blindingly white square at the top of the tower, creating the equivalent of the power of 600 suns. That power is used to vaporise water into steam to power a turbine that generates electricity using this renewable and sustainable resource.

This tower plant uses concentrating solar technology with a central receiver. It is the first commercial central-receiver system in the world, and the Solúcar an Abengoa company intends to protect its propriety intellectual property.

Courtesy: www.solarmillennium.de

Spanish companies and research centres such as, the Solar Platform of Almería, a research, development and testing center, are taking the lead in the development of Concentrated Solar Power (CSP), a type of solar thermal power. At the same time Spanish companies are investing in huge PV fields. The production of PV panels has dramatically increased due to the unprecedented increase in demand. Research and development is now more vital than ever in the endeavour to improve and create the next generation of this technology.

Spain already generates more than 120 MW in about 8,300 installations and is the fourth in the world in its use of solar power, and second in Europe. This has occurred in only the past 10 years and the number of companies working in solar energy has increased from about 10 MW to over 120 MW.



Courtesy: www.solarmillennium.de

The main driver for the intense solar industry in Spain has been assisted by Royal Decree 436, which was implemented in March 2004. This described a guaranteed price and approved a "gross feed-in tariff" for solar thermal power. The gross feed-in tariff made building this type of power plant economically viable. The government also recognised that support is necessary at the beginning to enable the creation of renewable and sustainable technology power plants.

Solar Technologies in Spain

Parabolic Trough Technology

Andalusia in the province of Granada, Spain has installed Europe's first parabolic trough power plant. This site was selected due to its high number of sunny days, offering an annual direct insolation of 2,200kW/m /yr. The Andasol 1 CSP plant is due for completion in mid-2008 and will produce 50MW of electricity at start-up.

The Andasol 1 project is the first of a three-stage process that will see a further 100MW added to the power plant in 50MW lots. The second stage known as Andasol 2 will be scheduled to finish in March 2009 and the third Andasol 3 has a planned build start date during the first quarter of 2008. With each phase taking around two years to complete, the estimated end-date for the entire project is 2010.

The parabolic trough solar field is made up of over 1,000 Trough collectors arranged in 168 parallel loops. The plant will be capable of generating 182 million kWh per year, whilst covering an area of 549,300m², equal to 70 soccer fields. Andasol 1 will supply electricity for around 50,000 homes mitigating 172,000 tonnes of carbon dioxide emissions per year.

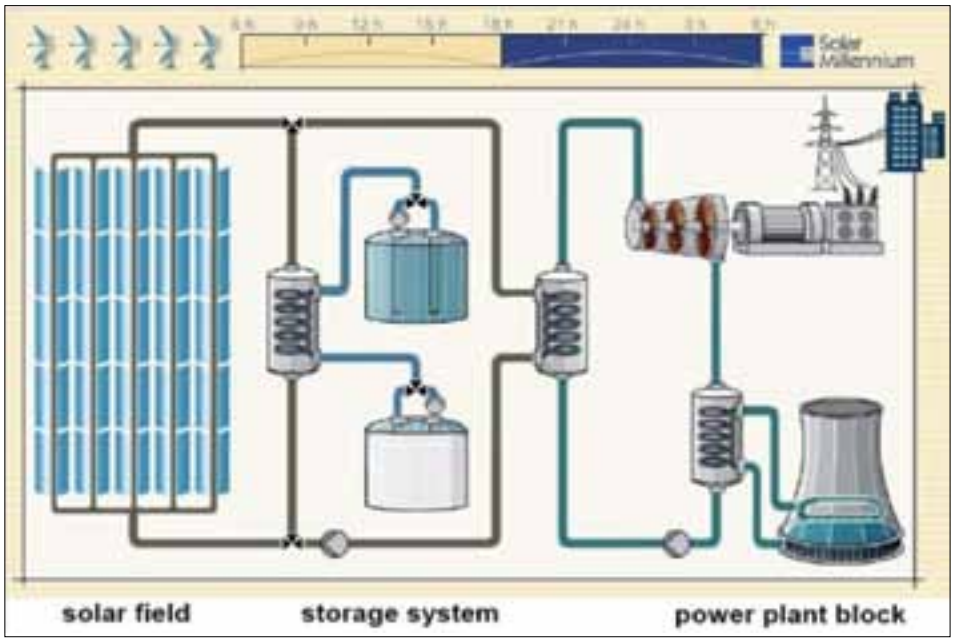
The biggest challenge for solar is that it currently is not considered capable of providing 'base load' electricity, because when the sun goes down production stops. The company behind the design of the Andasol plants, Flagsol GmbH, has developed a process that uses a two-tank molten salt storage system that is cable of providing 7.5 hours of electricity at full load. The heat reservoirs each comprise of two tanks measuring 14 metres in height and 36 metres in diameter and contain liquid salt. Each provides 28,500 tons of storage medium.

Courtesy: www.solarmillennium.de

Courtesy: www.solarmillennium.de

This parabolic trough technology utilised at Andasol 1 is one of the most common large-scale solar technologies 1. It employs 1000 huge curved mirrors of about 5.5 metres wide that collect the sun's energy and focus it on a receiver pipe in the middle. These mirrors slowly track the sun from east to west during daytime hours, and the oil which streams through the pipe along a long loop of troughs, reaches about 400ºC.

The heat transfer fluid then travels to a steam generator, where the heat is transferred to water, immediately turning the water into steam. That steam powers turbines that turn the generators that produce electricity as normal.



Courtesy: www.solarmillennium.de

The steam is then condensed and reused as the cycle begins again. After the electricity leaves the generator, it goes to a transformer so that the voltage can be increased, allowing the power to be transmitted long distances via the transmission system.

On cloudy days, the plant has a supplementary natural gas boiler. The plant can burn natural gas to heat the water, creating steam to generate electricity.

The Andasol 1 Project

At a Glance – the Data Sheet of an Andasol Power Plant

Electrical Capacity	*50 Megawatt (MW)*
Capital expenditure	*~ 300 million Euro*
Gross electricity output	*~ 180 gigawatt hours per year (GWh/year)*
Power plant dimension	*2 square kilometres*
Surface area of the collectors	*> 510.000 square meters*
Thermal storage system	*28.500 tons of salt, sufficient for 7,5 hours at 50 MW power output*
Solar power	*to supply up to 200.000 people*
Construction period	*2 – 2,5 years*
Number of employees during construction	*up to 500*
Number of employees when in service	*about 40*

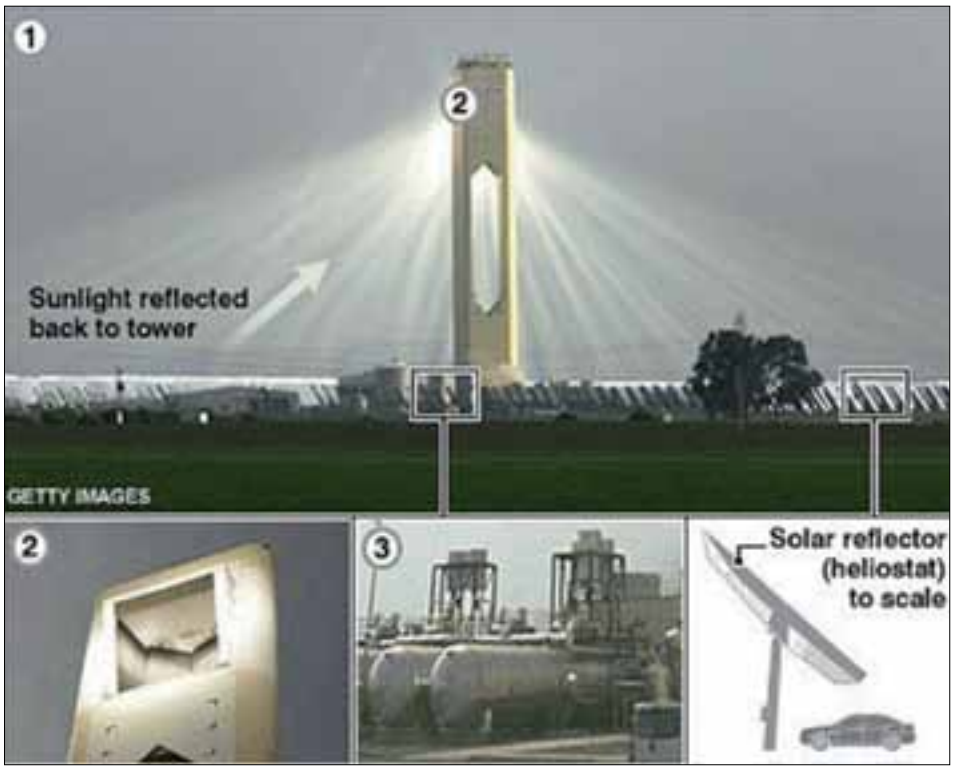
Courtesy: www.solarmillennium.de

Courtesy: www.solarmillennium.de

Solar Thermal/CSP (Concentrated Solar Power) Tower

Rising high above the flat Andalusian countryside like a gigantic obelisk, a concrete tower measuring 120 metres tall and surrounded by a fields of 624 steel worshiping solar reflectors known as heliostats. This is the first stage of Europe's first commercial solar tower power station, and is known as PS10.

The PS10 solar tower project in Sanlúcar la Mayor, Seville, is designed to generate around 24.3 GWh/yr, producing enough energy to power 60,000 homes.



Courtesy: Solucar Energia SA

The solar field has 624, two-axis tracking heliostats that track the sun throughout the year and concentrate solar radiation on a receiver placed on top of a 120m tower. The solar energy is transferred to the working fluid, generating steam that is sent to a steam turbine. The steam is stored in tanks and pressurised at 250o, and is used to turn turbines that are connected to generators that create electricity.

This solar tower technology is part of a series of projects whose final aim is to provide enough green energy for 180,000 homes, or most of the population of Seville. The completed project will be able to produce over 300MW and will include a series of towers, two more of which are being built, and standard PV power plants, as well as a mixture of newer parabolic solar collectors, which will be installed at a later stage. The entire power plant will be operational by 2013.

The most impressive result of this technology is that the entire development, once operational, will generate zero greenhouse gas emissions.

Courtesy: Solucar Energia SA

Courtesy: Solucar Energia SA

Another estimate from Sandia Labs estimates solar thermal costs (for solar towers) could fall to around 4 cents per kWh by 2030.

Solar PV

Spain has been one of the top world producers of solar cells for the past decade with the two main companies producing those cells being 'Isofotón', and 'BP Solar' which has been in Spain for more than 20 years. 'Isofotón' are now planning a major production expansion. Another Spanish company known as 'Atersa' builds solar panels and provides full solar-power installations. The company has grown to 14 MW of annual capacity. There is a new factory in Valencia, and they will be expanding to 30 MW.

'Siliken' is a young solar panel company who is experiencing rapid growth. Their plans are to develop a silicon plant to ensure a steady supply of raw materials, for which there is a world wide shortage.

Highly purified silicon necessary both for microelectronics and the solar industry have been in short supply. "Isofotón" made a business decision and set up a silicon refining operation in Cadiz, which should begin production in 2008.

Courtesy: Acciona

In only the last two years, nearly 100 MW of PV power have been added to solar generation in Spain. Traditionally, Spanish companies have exported about 80 percent of the cells they produced, but with this renewed interest in PV within Spain, those numbers are changing. 'Isofotón' now expects to sell about 60 percent of its panels within Spain, despite the fact that they export to Europe, North and South America, and Asia.

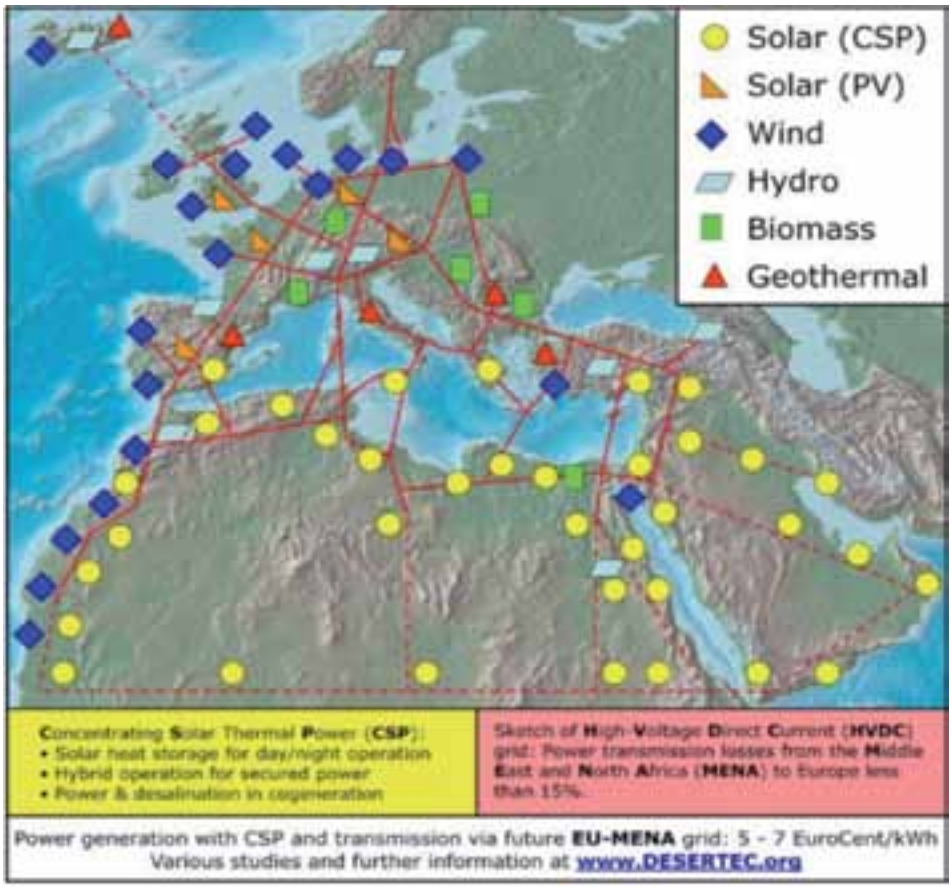
'Isofotón' is also focused on research and development concentrating on PV cells. Its objectives are to reduce production costs and increase efficiency.

Concentrated Thermal Solar Power (CSP) Project: Trans-Mediterranean Renewable Energy Cooperation

The Trans-Mediterranean Renewable Energy Cooperation (TREC) is an initiative of the Club of Rome, the Hamburg Climate Protection Foundation and the National Energy Research Center of Jordan. Founded in 2003 and together with the German Aerospace Center (DLR) have developed the concept of DESERTEC.

The DESERTEC concept is to marry the deserts of the world with technology to service our ever hungry energy needs with renewable clean energy and process seawater to replace ever diminishing storage of drinkable rainwater. Good locations in Africa, America, China, India, Australia or Middle East and North Africa (MENA) are being targeted for this implementation.

To this end there are plans for Europe, the Middle East and North Africa (EU-MENA) to begin to cooperate in the production of electricity and desalinated water using concentrating solar thermal power and wind turbines in the MENA deserts.



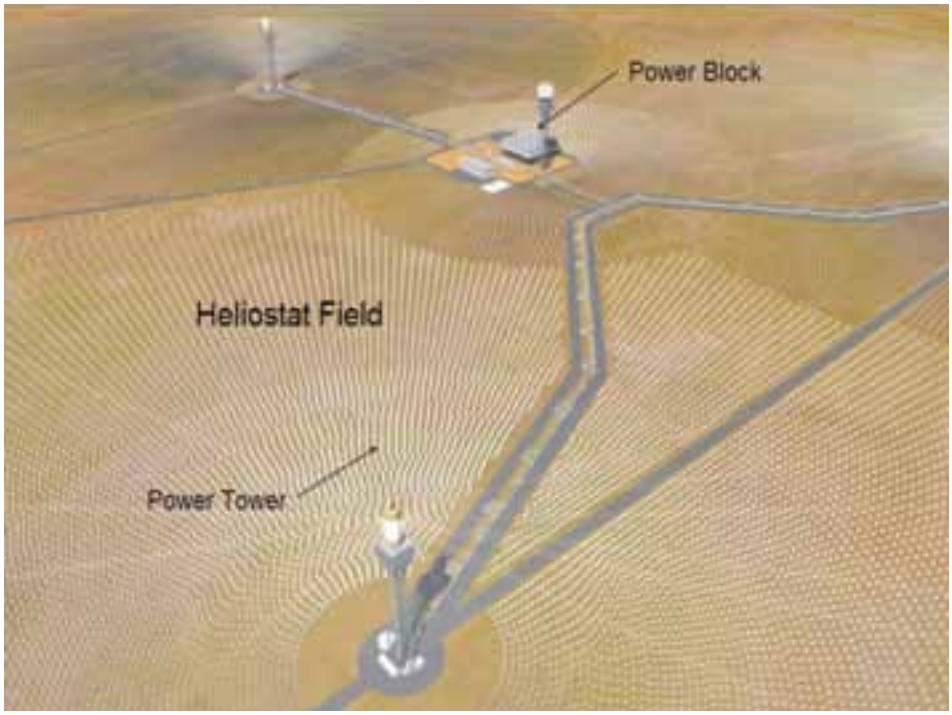
Courtesy: DESERTEC Project

The technology that will be used is Solar Thermal/Concentrated Solar Power (CSP) coupled with High Voltage Direct Current (HVDC) transmission lines. Projects in the North American deserts at Kramer Junction in California and in Spain, such as the PS10 Solar Tower Project in Sanlúcar la Mayor, Seville, previously described, have proven the technology. New solar thermal power plants with a total capacity of more than 2000MW are at the planning stage, under construction, or already in operation.

The Spanish Government guaranteed a “gross feed-in tariff” of about 26 Eurocent/kWh for 25 years, thereby establishing favorable business conditions for investing in Concentrated Solar Power (CSP) in Spain.

The developments in energy provision and the climate situation gives added urgency to implementing concepts such as this. All that is required is the political will and the right framework of incentives.

It is calculated that, if solar thermal power plants were to be constructed in large numbers in the coming decades, the estimated cost would come down to about 4-5 Eurocents/ kWh.



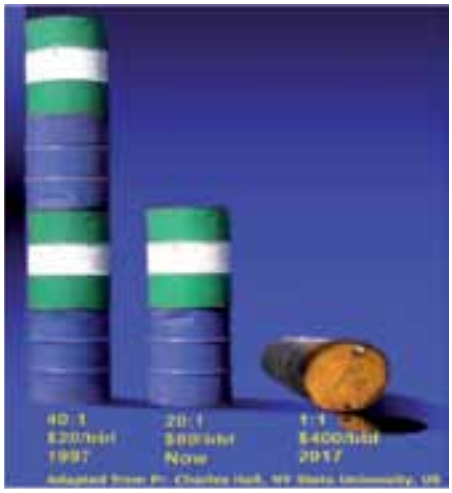
Courtesy: BrightSourceEnergy

It is noted that the costs for raw materials for solar thermal power stations are rising more slowly than the price of fossil fuels therefore CSP may become competitive earlier than previously expected. However, at the moment, production bottlenecks and strong demand are keeping prices high.

France – Nice

A meeting with Dr Louis Arnoux, Director, IndraNet Group, provided an insightful opportunity to discuss the present rapid trend towards 'nil net energy' from fossil fuels raised a new awareness on the issue of sustainability. A tangible threat which this situation presents not only to Australia but globally is nil net energy. Discussions were based on technology that is now available to address the problem and that is ready for commercialisation within Australasia (Australia, New Zealand and the Pacific Islands).

The trip to this point had been amazing, interesting, revealing, and at the same time confronting. Australia, more than any other country needs to consider following in the footsteps of countries like Spain. *The Australian Energy Industry needs to be revived, re-engineered and manufacturing re-established in ways that are fully sustainable and urgently address the global challenge of Climate Change and Nil Net Energy from fossil fuels.*



Courtesy: IT MDI-Energy

This initiative would have a flow-on effect of many positive outcomes. Job creation, job retention, self reliance, reduced dependence on imported components, more insulation from the soaring fuel and transport costs are but a handful of benefits. The key benefit for re-engineering Australia is certainly that we will have the components, equipment, supplies, Intellectual Property (IP) and trained expert personnel to implement a reduction in CO_2 emissions and reduce our carbon footprint as a self-reliant nation.

The above conversation provided a backdrop to de la Torre's introduction to MDI technologies and its potential implementation by IT MDI-Energy within Australasia.

Motor Development International (MDI)

The visit to the MDI factory was a most rewarding and insightful experience.

MDI develops and commercialises an entirely new class of high efficiency engines based on compressed air as the energy storage and energy carrier medium. These engines have an extremely large field of applications ranging from highly distributed power generation through to personal transport, to trucks, buses, marine and aircraft applications. The MDI technology is being implemented in a series of steps all the way to 100% solar based operation at capital, operating and maintenance costs that are substantially below most known alternative technologies.

One of the most striking features of the MDI technology is its advanced manufacturing process. The philosophy of MDI is to create many small distributed manufacturing plants rather than one large centralised factory. In comparison while the main factory of one of the largest car manufacturers requires a land surface area of 2, 370,000m^2, one MDI factory occupies a land surface area of just 15,000m^2 and to achieve the same output, 50 MDI plants would require only 750,000m^2. More to the point, the MDI process requires 80% less capital expenditure. It offers prospects of 30% more employment and gross profit margins above 30% instead of the 2% currently prevailing in the global car manufacturing industry.

This concept sets the scene for a sustainable low carbon footprint distributed manufacturing. The plants are also designed to ensure an efficient work flow. Raw materials enter from one side and the completed products flow out the other side, with minimal wastage. It was a clean and impressive layout and setup. The key to this design is that it is replicable anywhere.

In this manufacturing facility, which has a plant surface area of 4350m^2, key components are manufactured. It also is the point-of-sale, display and servicing centre. The cost for the fully outfitted manufacturing plant, turn key, is 12 Million Euros. For 50 plants producing the same number of cars as a current legacy facility this compares at 600 Million Euros for the MDI system versus 3,000 Million Euros for the legacy approach.

Courtesy: IT MDI-Energy

The Inventor – Guy Nègre *(Photo courtesy of IT MDI-Energy)*

Guy Nègre is the Founder and Managing Director of Moteur Development International S.A. (MDI) and the inventor of the MDI technology.

Meeting the inventor Guy Nègre, an engineer who holds over 100 engine patents to his name including 3 patents co-owned with the French oil company ELF and 2 jointly with "Institute Français du Pétrole" (French Petroleum Institute) gave de la Torre an insight to his passion for cutting edge design.

He has designed over 100 engines, from Formula 1 and light aircraft engines to the present family of advanced compressed air engines. He is now world renowned for his compressed air engine and the new thermodynamic cycle he invented.

The initial pioneering work led to the first trials in 1992 of cars running on compressed air. Since then he has produced a series of compressed air engine models to arrive at the present designs that are being readied for commercial release soon.

Nègre is also the inventor and developer of the MDI distributed manufacturing process for all applications of the MDI Technology that enables reducing vehicle manufacturing costs by 75%.

In late 2008, MDI launched the 'Air Pod'. Pictured here is Guy Nègre and Mr Christian Estrosi, Major of Nice, MP of the French Parliament. There is now an agreement to supply a fleet of Air Pods to the City of Nice and eventually to supply Paris similar to the 'Velib' bike sharing program.

Courtesy: IT MDI-Energy

The MDI Technology

The MDI engines are powered by compressed air. In order to create the compressed air there is a wide variety of fuels that can be combusted, including the usual fossil fuels such as petrol, diesel, natural gas and LPG. A wide range of biofuels can also be used such as gasified biomass, wood waste, ethanol, coconut oil, tallow, rapeseed oil, etc. In the very near future direct and indirect thermal solar energy is possible. These fuels can be used without changing the engine or its specifications as the combustion and/or heating used to produce the compressed air takes place outside the MDI engines.

One of the key differences between the MDI engine and a normal internal combustion engine is that combustion occurs outside the engine in an extremely efficient and clean way. Another important difference is what MDI calls the 'active chamber' that enables two piston down strokes for a given volume of compressed gas instead of only one in a traditional internal combustion engine.

In the case of biofuels there is no need for costly transformation into bio-diesel or cumbersome blending. This considerably reduces cost and makes for ease and speed of deployment.

The design of this engine is such that it is totally scalable and replicable, as is the model for the manufacturing plant. This allows for a wide scope of applications. Two specific applications for the MDI engine that are viable and available are the compressed air electrical power generators and the compressed vehicles.

Bolt-Ons – Electricity Generator

Courtesy: IT MDI-Energy

The compressed air generator is an MDI engine driving a bolt-on generator to create electricity. Due to the properties of the engine design, this system offers more possibilities than any other for co-generation. When integrated with technology that enables the re-use of so-called waste energy from a power generation system, it will be possible to generate power at the point of use while simultaneously providing air conditioning (heating or cooling as required) hot water and recycling grey water to spring water quality levels.

This creates the possibility of providing a sustainable environmentally sound solution to climate change and related fossil fuel issues.

These compressed air generators are not just electricity generators, instead they form the basis for a total processing system with bolt-on features. Therefore, when fully integrated in a home environment the overall energy efficiency of the system can be over 90% from primary source to end-use.

The MDI engine alone is estimated to have overall energy efficiencies that range from 45% to over 70% depending on the versions and models.

The commercial units are planned to range in capacity from six-kilowatt units increasing to megawatt units. The small units for domestic use will be about the size of an air conditioning unit, 500x 600x 800mm. These units can be used as stand-alone systems, or as an emergency back up in an office building, or integrated into the grid just like solar PV and wind systems.

Sustainable Transport Options

As can be seen in this report, there are some European cities that could be totally 'fossil free' if only they had sustainable transport systems in place. For most European cities, the city centres are busy with high density living, business and tourism. Private transport is limited or massively reduced, for the health of people and for the health of the historic buildings that keep the tourist economy alive.

The same MDI engines provide the core to a new class of Compressed Air Transport that addresses the above requirements. The initial release of vehicles will be small car, three to five seat vehicles, estimated at a value of about eight thousand dollars Australian or less.

Other larger vehicles are planned and being designed for urban driving and for family driving, country cruising and so on, leading to trucks, buses, industry specific vehicles such as forklifts, farm, marine and light aircraft applications.

Courtesy: IT MDI-Energy

Not only are these vehicles very low to near zero carbon emitters, they also are incredibly fuel efficient, and can use any number of fuels as described above.

Currently the vehicles achieve about two litres per one hundred kilometres. No other known manufacturer can presently achieve that level of efficiency with normal driving performances. The goal for the future is to achieve around one litre of fuel equivalent per one hundred kilometres. Similar performances are achievable proportionally to the size of the engine and such gains also apply to trucks and buses.

Courtesy: IT MDI-Energy

These vehicles are also significantly cheaper to manufacture and to acquire. The technology is not only green and clean, but also very competitive.

The other clear advantage of this vehicle is its embodied energy. Being cast and machined essentially from aluminum, at the end of their life they are totally recyclable. This contrasts with other alternative designs based on electric batteries, hydrogen, fuel cells, and so on that at the end of their life result in a substantial amount of non recyclable waste and landfill.

Louis Arnoux – Director IT MDI-Energy

Dr Arnoux is the inventor of the 'IndraNet' communication infrastructure technology and its applications to communications, energy & transport infrastructures. The objective of Dr Arnoux is the business initiative, undertaken jointly with MDI & others, aimed at a coherent, accelerated transition to the necessary, sustainable, non-hierarchical, distributed, communication, energy and transport infrastructures that the world now urgently requires.

The Missing Link – Broadband Communication

Courtesy: IT MDI-Energy

Our current communications and electrical grid are largely centralised and hierarchical systems. They are inefficient infrastructures, high energy wasters with high costs to establish and maintain. It has been estimated that *"the average Internet user apparently burns over 150 kg of coal per week, ie close to 8 tonnes of coal or coal equivalent per year."* [15]

IndraNet has developed an advanced mesh network system called it 'FraMe' which stands for 'Fractal Mesh'. This mesh network uses communication devices, called minders, located at each customer's premises.

What IndraNet has designed is a new class of infrastructure capable of delivering real high speed broadband at very low cost and in a resilient way. It is expected to deliver very affordable, guaranteed end-user bandwidth well above 1Mbps, low latency, scaleable, with no limit practically to the number of supply points in a network, no shared bandwidth, highly secure, no data transfer cap, no extra payments, no limit to monthly use.

With its 'FraMe' networks, IndraNet is proposing an infrastructure that has high capacity and very light capital expenditure foot-print, that is easy to deploy and maintain and that has a very broad range of applications to communications as well as intelligent energy and transport networks.

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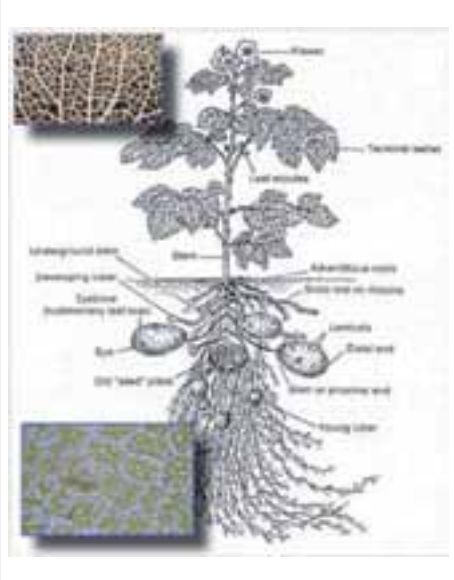
[15] *The Internet Begins With Coal: A Preliminary Exploration of the Impact of the Internet on Electricity Consumption*, a 1999 study by Mark Mills for the Greening Earth Society

IT MDI-Energy is the convergence of technologies that work synergistically to create a holistic workable solution for tackling not only Climate Change but more importantly 'Peak Oil' and rapidly declining net energy from fossil fuels. The impacts of the latter on our day to day existence on this amazing planet are said to be closer than we all care to acknowledge, let alone contemplate.

The partnership between Motor Development International (MDI) and its compressed air engines on the one hand and IndraNet's with its 'FraMe' technology, (Fractal Mesh Network) have resulted in the development of the IT MDI-Energy 'ICET package', (Information, Communications, Energy and Transport Technology Package). IT MDI-Energy plans to implement this package here in Melbourne, Australia as a world first.

The development of the 'Fractal Mesh Network' comes from Dr Louis Arnoux's observation of how nature works. The humble potato plant has the capacity to show us the way of sustainability.



Extract from ***Climate Change Peak Oil, and All That Jazz***

Consider a humble potato plant and zoom in on a leaf (figure left of page).

Mesh networks of tubular cells appear (see the leaf's intricate veins in the top left picture) that link all the cells in the leaf so that they can share in the flows of nutrients from the networks of roots and in the flows of sugars each cell contribute through photosynthesis.

This is an example of a fractal mesh network of networks. Zoom in further to look at single cells. You now see myriad chloroplasts within the cell engaged in the photosynthesis process (bottom left picture). They too form and are part of biochemical networks of networks busily communicating information to self-regulate the overall system while also exchanging and storing energy through various molecular systems (such as ATP, sugars, starches, etc.).

Figure: Learning from the humble potato and other plants (courtesy of Alberta, Food and Rural Development and Wikipedia)

Zoom back out and you can observe the flows of nutrients from the roots to the leaves and of sugars from the leaves towards the roots. Zoom in on the roots and there some cells are busy linking sugar molecules into starches and fast multiplying to form potato tubers. What we observe at work in our potato plant is (1) local harvesting at the point of use within each cell of more solar energy than each cell requires, (2) local use of part of that harvested energy within each cell, (3) sharing of the surplus energy through the mesh network of tubular cells, (4) intense many ways and many to- many communications between all points of the networks of networks involved in the overall system in ways that make it self-managing and self-regulating without any central command, and (5) huge concentration and storage of energy (in the tubers) to provide a buffer against future requirements through seasonal cycles.

Courtesy: http://www.itmdi-energy.com

Germany – Freiburg

Freiburg is a city in Breisgau, Germany, on the western edge of the Black Forest. Popular opinion has it that Freiburg is the warmest city in Germany.

Freiburg was founded in the 12th century (1120) by Duke Konrad of Zahringen as a free market town; hence its name, which translates to 'free (or independent) town'. The town was strategically located at a junction of trade routes between the Mediterranean and North seas, and the Rhine and the Danube Rivers.

Politically the Greens Party has a stronghold in Freiburg and that is one of the reasons that this German city has attracted many renewable industries. The solar industry is particularly invested in this part of Germany. Important international organizations are located here in Freiburg such as the Fraunhofer Institute for Solar Energy Systems (ISE), the International Solar Energy Society and the ICLEI, Local Governments for Sustainability.

Freiburg has been known as an 'eco-city' for many years.

Sustainability is the key issue here. It is not in isolation from the renewable technologies such as solar, wind and geothermal, as these technologies are just a part of the solution. Sustainability is a holistic point of stance and therefore the solution must address the entire challenge, from the beginning to the end of its life cycle.

With this holistic point of view, the projects that Freiburg has implemented are very organised and well coordinated. The city has had a 30 year vision towards sustainability and now reaps the rewards with a large number of tourist and international visitors arriving daily at the city to see what they have achieved. Specific Eco Tours are conducted daily. These popular tours cater to peoples need and curiosity and allow them to take home ideas and solutions that are tried and proven. The city also promotes self guided tours of the main and important sustainable sites.

Freiburg has built neighborhoods, such as Vauban and Rieselfeld which not only reflect the philosophy of sustainability but in which people live a sustainable existence from day to day. There have been some very positive and replicable results.

In June 1992, the Freiburg city council adopted a resolution that it would only permit construction of 'low energy buildings' on municipal land, and all new buildings must comply with certain "low energy" specifications. Low energy housing uses solar power passively as well as actively. In addition to solar panels and collectors on the roof, providing electricity and hot water, many passive features use the sun's energy to regulate the temperature of the rooms.

Citizen Participation and Engagement

One of the primary success factors is attributed to a high level of citizen involvement through:

- Environmental awareness
- Political priorities
- Targeted economic development.

The recognition of solar energy as a solution in terms of seven social domains:

- Work and employment
- Citizen participation (People power)
- Tourism
- Building and housing
- Research & development
- Financing and marketing
- Education and training.

Citizen Participation

Energy policies were moulded by the citizens and the political party of the time had to respond. Controversy over nuclear energy led to a high level of awareness within the population. The unique and successful struggle by citizens and citizens' initiatives against nuclear power plants 30 years ago forged strong cross-border cooperation on all energy related and environmental issues.

"They didn't want nuclear power in their backyards and fields," said Thomas Dresel of the city's Environmental Protection Agency, noting that not only students but farmers demonstrated.

Residents boast that Freiburg's solar power roots go back to a protest in 1975 against plans for a nuclear plant and the people power that created what they enjoy today.

Courtesy: SolarCityFreiburg

Courtesy: SolarCityFreiburg

A Definition for Freiburg

Freiburg can be described as a sustainable city that has driven down CO_2 emissions by implementing regulations, incentives, design, long-term commitment and policy reform to ensure success.

The other important part of the success formula for Freiburg is that policy reform was driven from the grassroots up.

Recognition for its Commitment to Sustainability

This pioneering action has acclaimed the city to countless awards and high visitor numbers from all around the globe. Key initiatives include:

- World's first energy self sustaining solar building,
- 'Solarsiedlung am Schlierberg', the solar village and the,
- 'Heliotrope', the solar village created by Rolf Disch,
- Zero-energy houses of the Vauban neighborhood,
- Local football stadium has become is the first stadium in the world to have its own solar plant.

Even private business owners are engaged in the challenge of sustainability and not only reap the benefits but have world recognition as well. Such a place is the Hotel Victoria, Freiburg. The Hotel was awarded recognition for "The most environmentally friendly private-hotel in the world".

They operate under the ethos of: **Ecology = long term economy.**

The city actively promotes its success and continues to strive to lead the rest of the world.

Courtesy: SolarCityFreiburg

Innovation Academy

Freiburg is one of the most renowned cities in Germany, when it comes to solar energy. A large number of solar, biomass, wind as well as hydro power stations provide their share of power supply to the city and thus characterise it as a standard model for other cities.

Organisations such as the Innovations Academy have built a business delivering educational services to visitors and tourists to Freiburg that have interest in sustainability. Hans-Jörg Schwander is the Managing Director of Innovation Academy and knows all to well the demand that has created a very lucrative and successful business.

Tours and seminars cover the following:

- Freiburg Solar Tour
- Freiburg Architectural Tour
- Refurbishment and buildings
- Sustainable urban district planning
- Power communities

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Richard Fehrenbach Gewerbeschule – Vocational Training

The school is located about 200 metres north of the main railway station on the corner of Friedrichstrasse and Stefan Meier Street. The first impression is of the school is an impressive solar demonstration building with different types of solar PV panels as well as solar water heating systems. It is known as the 'Solarturm Gewerbeschule'.

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The school caters for vocational students ranging from secondary students, similar to the VET in schools programs that we have here in Victoria, to apprentices and post trade training. Apprenticeships offered include electrical, with renewable subjects, plumbing with solar water heating and other engineering trades. A similar apprenticeship system exists here in Freiburg as in Australia.

The school not only teaches these subjects, but practices what it teaches. As is evident when one visits the school, not only is one greeted by this impressive solar building, but as one looks around there are functional solutions that have been embedded into the fabric of the school. Initiatives include a demonstration water pumping station, solar lights, electric solar station, PV solar window shading and solar water heating units. All these are visible, so the student not only learns the theory and workshop practices, but can observe and gain first hand experiences of the examples of application.

The International Experience

The practical training rigs are an integral part of active learning. These indoor installations are realistic and offer a range of solutions all in one area.

Solar Stadium

An initiative that combines solar technology and sport in Freiburg is the Freiburg Stadium. This is the world's first football stadium with solar panels. Installed is a large solar PV array generating a total of 290kW with a total surface area of 2,300m . There is also some 60m^2 of thermal collectors for heating water for showers for the players.

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It is common knowledge that Freiburg's city soccer team shower after each game with water heated by solar on the stadium roof. This has been a very positive marketing exercise for Badenova the regional power company.

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The Solar Stadium was financed by a partnership between the local team SC Freiburg and Badenova, which offered public shares in the project. They also continue their awareness and/or marketing campaign by offering investors in the project season tickets. It is a similar scheme for investors of the PV system with the added bonus that these panels feed the grid and earn excellent income by doing so, particularly since the feed-in is the highest paying and paid on gross production.

Badenova is jointly owned by a number of regional municipalities and a natural gas company, created an opportunity for citizens that wanted to install Solar PV and either had no roof space or lived in apartment style accommodation. There are opportunities offered for investment subsidy of about □300 for customers who want to install PV panels.

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The program is financed from electricity sold under the brand label 'Regiostrom' which is an alternative to the standard electricity (equivalent to our 'green power' option). Customers can chose between two tariffs, normal and a green tariff, which is □1.5 cents more expensive, but guarantees to support renewable energy projects, such as PV, biomass and small hydropower.

Statistics have shown that there has been a voluntary 10% take-up by Badenova's customers, who have chosen electricity from regional and renewable energy sources. This has led to a steady increase in the generation of clean electricity.

Solar has become more economically competitive. The yearly volume of the 'Regiostrom' fund is some □500,000. Assuming that the subsidies cover less than 10% of the actual investments, this equals a total investment of more than □5,000,000 a year in Freiburg – the majority of this goes to providing the □300 rebate.

Australia could consider implementing a similar model based on incentives such as a national gross feed in tariff rather than government rebates. A single policy direction can change the debate and instantly stimulate investment, jobs and manufacturing in Australia.[16]

'Sonnenschiff'

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[16] Job creation – the case for a gross solar feed-in tariff – ETU 2009 and Access Economics

This building both in concept and design was constructed to demonstrate that it was both financially and aesthetically viable to blend residential and commercial within a building that is energy efficient.

The building known as the 'Sonnenschiff' which translated to 'Solar Ship' runs along Merzhauser Straße, a main thorough fare, and very visible to all who travel by road and tram; stretching for 125m. It also provides the much needed traffic noise and visual barrier to the solar residence directly behind the 'Sonnenschiff' known as the 'Solarsiedlung am Schlierberg'. The cost of the development was estimated at 40 Million Euros (not including land).

© Rolf Disch

The Design, Function, Aesthetics

© Rolf Disch

As can be seen in the above picture, there are very strong vertical towers meeting horizontal breaks. The roof comprises structures with a slightly suspended solar roof. The vertical towers are designed to house the elevators and light filled, glass covered stairwells.

The ground floor is dedicated for commercial activities, which includes an organic and health food supermarket to service the residence behind. The next two levels are office and business premises. The top level has a 3m high glass wall protecting the open roof space and roof top garden. It acts to create a protective sound and wind barrier.

There are eight penthouse apartments built on the top level to a 'Plusenergie®' standard. This building and the residential area behind is said to have been built to a higher level of building standard sets the benchmark with the PV roof creating surplus energy that is feed back into the grid. That is why the concept of this development has the registered trademarked stamp of 'Plusenergie®'.

As can be seen in the pictures, there are substantial glazed areas on the façade of the building. This allows for the building to be filled with natural light, doing away with energy consuming lights during the day and the overall atmosphere inside the commercial and office space is light and elegant. These windows and the glass barrier are triple glazed; creating a barrier for sound and protecting against summer and winter solar gain.

The building also has an integrated ventilation system for heat recovery in the winter and to cool the building units at nighttime in the summer, as well as shading devices for keeping out the summer sun. These are easy to operate systems that are controlled by the tenants.

Brightly coloured composite panel screens with side grilles project some 400mm from the main building. Behind them are 'doors' that can be opened at night to allow cool air to enter the building through the side grilles, without fear of burglary. A Berlin artist named Erich Wiesner designed the panel colour. This harmonious colour design, give the building its interesting characteristics that are then reflected in the colour scheme of the residential estate behind the 'Sonnenschiff'.

Construction

The skeleton of the structure is reinforced steel. The staircases are fundamental to the structural bracing and cross bracing of the building. Materials used in the construction and finishing of this building included lightweight single plank walls, prefabricated, highly heat insulated timber, that is, timber-metal components, or vacuum sandwich composites. The latter are 40mm deep, but achieve the same R-value as a 400mm thickness of insulation. It is largely ecological, healthy and recyclable building materials that are being used for the interior.

The glass façades, glazed windows and doors are created of 3-pane heat insulation 'thermopane' glazing and also meet the required soundproofing standards. 400mm insulation is used in the walls and 450mm insulation in ceiling space is used to prevent heat loss or gain.

Energy Efficiency

The 'Sonnenschiff', is built to ensure that it meets the Plusenergie®-house standard, which was also used for the residential development that is described below. The high standard of building is the solution in achieving energy efficiency. For example the largest consumption of energy in a building is due to the heating and cooling requirements of a building. This is effectively kept to a minimum due to the highly heat insulated outer casing, the decentralised ventilation system with a highly efficient heat recovery, 3-pane heat insulation 'thermopane' glazing and the passive-solar design.

The next other major energy consumer is the heating of water. For the 'Sonnenschiff' the heating of water comes from combined heat and power plant (CHP) that uses local wood chip, which is backed up by gas. These district heating systems use some form of solid fuel such as wood chips and/or pellets and are considered to be sustainable as the fuel source is local and renewable.

To further reduce energy usage for heating in winter and cooling in summer, pipes buried in the earth preheat or cool the air to between 8 and 12°C before it enters the building. Therefore, the 'Sonnenschiff', is considered to exceed the standard energy savings regulations by even more than the factor 10.

A total area of 1,000m^2 that equates to the entire available roof space of the 'Sonnenschiff', creates a solar array with an output of 135kWp. All of this power is fed back into the electricity grid, based on a gross feed-in, which creates a great financial model for investors. The owners of the apartments are given the opportunity to purchase the PV solar on their roof and if they do not take up the offer, it is sold to other investors.

The idea of every person owning a car is very much "old mentality". Instead replace the thought with car-sharing, or riding a bike and using the public transport system. There is a tramway just in front of the 'Sonnenschiff' that is hard to spot, as the tramlines are among a well tendered grassy medium strip. The grass surrounding the tram tracks has both an aesthetic positive influence as well as acting to absorb the sound made by metal on metal of tramway systems.

Energy Standards

Like all homes built in Freiburg, the 'Sonnenschiff' and 'Solarsiedlung am Schlierberg' have been built to one of the following standards set by the Freiburg Local Council. The council standards are higher than those set nationally in Germany. These standards are also crucially, endorsed by the local community in a willingness to pay a premium of up to 15% more for a sustainable home.

Holistic Standard

- Energy use of 65 kWh/m^2/year
- 250mm insulation in walls
- 350mm insulation in roofs
- High-performance double-glazing

Passive House Standard

- Energy use of 15 kWh/m^2/year
- 400mm insulation in walls
- 450mm insulation in roofs
- High-performance triple-glazing
- Use of solar gain

Energy Plus Standard - Plusenergie®

- Passive House standard or better for house fabric
- PV array producing surplus electricity

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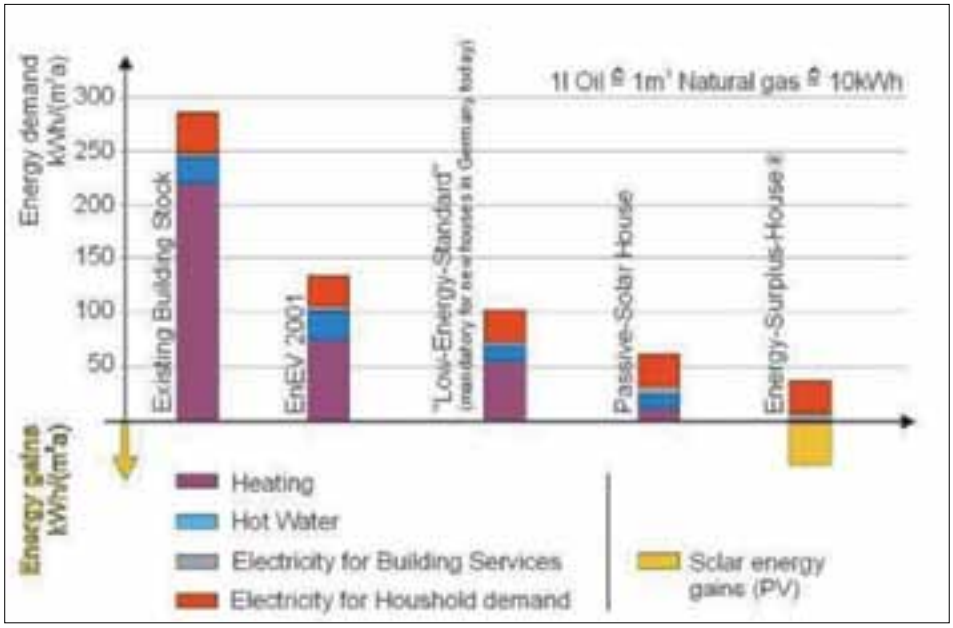

© Rolf Disch

'Solarsiedlung am Schlierberg'

In the residential development behind the 'Sonnenschiff' there are 58 'Plusenergiehäuser®' (translated 'Energy Plus Houses'). The 'Solarsiedlung am Schlierberg' (translating to Solar Community), is reputed to be the most modern solar housing project in Europe. This development had its trials and tribulations, but eventually proved to be not only a development that produces more energy than it uses, but also a multi awarded development. It has received awards for innovation, environmental and nature protection and for creative use of timber. Furthermore, it was the head project for solar housing at the 'World Exhibition 2000'.

Built as passive solar homes with their PV arrays producing surplus electricity, a community environment has been established that is enviable. Open spaces for children to safely play without the risk of been hurt are available as there are few cars in the area. This development demonstrates the possibility of living an enjoyable, safe and comfortable low carbon footprint life.

The homes have incorporated vibrant colour schemes that reinforce a happy, relaxed and stress free atmosphere.

With a focus on the sun, the development faces south. All living areas are at the front of the terraced houses but more importantly the distance between the rows of houses are designed to guarantee insulation over the winter. This means that the building in front or shading the PV arrays on the roof does not obstruct access to the winter sun.

© Rolf Disch

© Rolf Disch

The houses are two and three storey high, with the 'Sonnenschiff' being four to five stories high, it creates a sound and visual barrier for the solar community from traffic on "Merzhauser Straße" (a major road) and the tramway.

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Solar PV systems on the roof totaling 445kWp and generating approximately 420MWh/ annually, are fed back into the grid as with the 'Sonnenschiff', and this signifies a profit of at least □0,42 /KWh over 20 years.

© Rolf Disch

© Rolf Disch

Rolf Disch – Award Wining Solar Architect

'Sonnenschiff', the 'Solarsiedlung am Schlierberg' and other buildings in the city of Freiburg are designed by German Solar Architect Rolf Disch. Rolf, who not only designs sustainable buildings and developments, but also affirms his commitment and lives in the Helitrop; a building which he designed and built.

© Rolf Disch

© Rolf Disch

The 'Heliotrop' from the Greek words for 'sun' and 'turn', is the city's impressive green icon. The 'Heliotrop' turns towards the sun to enhance its energy production due to the 54m^2 rooftop mounted PV array, which produces roughly five times more energy than it uses.

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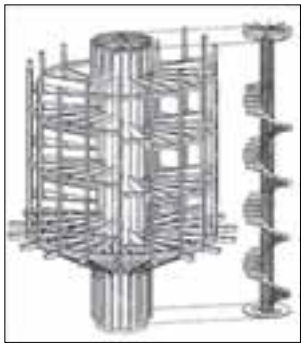
Construction and Engineering

The 'Heliotrop' was designed to be a prefabricated, modular construction and this ensured that fabrication was of the highest precision and quickly achievable. The skeleton of the construction was laminated timber. There is a central column of 14metres that supports the carrying of electrical wiring. Winding around a supporting central column are spiral stairs that create the floors for each level.

The most important building material of a solar house is timber, as it comes from a local and sustainable source.

The idea is one that is very similar to that of the human body. The central column of the 'Heliotrop' mimics the spinal cord and it functions in a similar manner by carrying the vital communications systems through the spine of the building.

The helical conception with 18 angles around it creates three floors plus the terrace where it's viewing deck and solar array is erected.



© Rolf Disch

© Rolf Disch

There are exit and entry points on these levels of the building as the stairs wind around the central staircase. The integration of the third dimension into the layout and interior design of the rooms must produce a fascinating living experience.

Technology and Energy

The column of the 'Heliotrop' stands on a ring gear with a swinging element that is run by an electric motor that makes the entire building turn. However, the solar array, at the top moves independently to the rest of the building.

By having the building rotate, it makes it possible to face the building to the sun in winter and turn it away from the sun in the summer.

The 'Heliotrop', is glazed on 9 sides by triple heat-absorbing glazing with a U-value of 0.5 and high heat insulation on the other 9 side with a U-value of 0.12.

The 'Heliotrop' is located just behind the 'Sonnenschiff' and the 'Solarsiedlung am Schlierberg' and has a peaceful rural outlook.

© Rolf Disch

© Rolf Disch

An added advantage to this style of building is that it must be interesting to live in this home as the rotating of the house changes the panoramic view in each room as each hour passes.

The vacuum tube solar collectors on the veranda heat the hot water and these appear to double up as railings. Heating is provided through several different strategies including radiant ceiling heat using copper segments. The copper units can also be used for radiant cooling in summer months. An earth-to-air heat exchanger is used for thermal storage and can provide both heating and cooling for the home.

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In order to obtain 'Plusenergiehaus®' energy standard, the building must reach or surpass:

- Passive House standard or better for house fabric
- PV array producing surplus electricity.

The 'Heliotrop' has a biaxial tracking 6.6kW PV array that generates five to six times more energy than is consumed in the building. It is installed on a central column above the roof terrace and serves the purpose of sun and rain protection. As this structure is highly exposed to wind the installation uses a quintuple security system for a high degree of wind loading.

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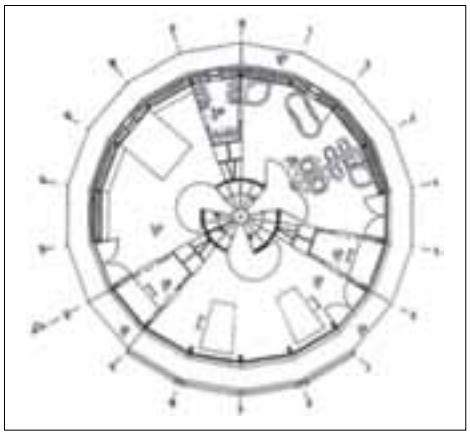

© Rolf Disch

From a completely holistic perspective, the building collects rainwater to wash and clean, dishes, clothes, etc. Other waste is decomposed in a dry-compost installation without smell or the need for chemicals. The building has a compost toilet and also purifies sewage in a cascade pool with plants.

The philosophy that the 'Heliotrop' stands for is the possibility that we can live with the environment in harmony and be sustainable.

Prizes and Awards

- 1996 – Special Award - Freiburg Innovation Award
- 1996 – Special Award - "Das goldene Haus" (The Golden House)
- 1995 – German Architectural Award

Modernization and Retrofitting of Buildings

The potential in renovating old buildings is substantial. Not only do old buildings in Germany use three times more energy than new buildings, it is also well documented that 87% of the total energy requirements for private households are used for space heating and hot water. Of this, up to 80% could be saved by competent retrofitting. This modernisation process would lessen dependence on fossil energy sources while at the same time giving a new stimulus to the job market.

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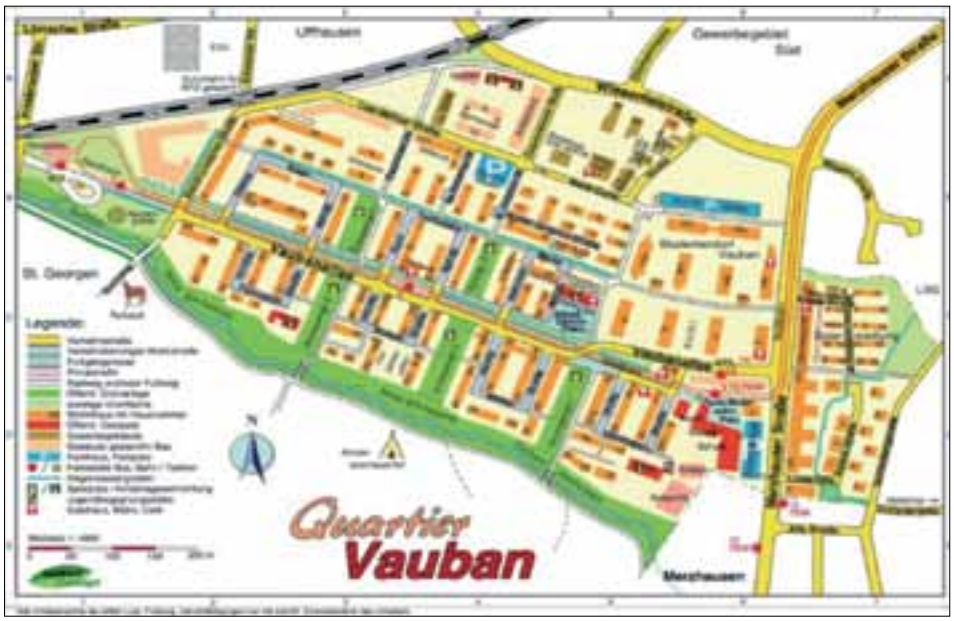
The apartment block above left was a grey, uninspired open veranda style 1970's building. It was modernised, retrofitted and has proven the potential for saving energy, creating electricity and at the same time give it a fresh lease of life. The façade of this, which building was made over by installing the PV panels and enclosing the verandas conserves heating energy, as well as trapping the sun's energy in the winter. The building has a solar water heating system installed on the roof. It also promotes the nurturing of winter gardens.

Above right is another example where function, retrofitting to increase energy efficiency, generation of energy and substantial improvement in the aesthetics and revitalization of the city buildings are presented.

These buildings are very prominent, ensuring the promotion of solar energy and creating public interest and awareness.

Vauban – Model Urban Development

The Vauban Quarter was created on an area of 38 hectares located close to the city centre, on the terrain where the barracks of the French military forces once stood. It is an attractive, family-friendly neighbourhood of 5,000 people, in which civic commitment, collective building, and living with ecological awareness has great importance.



Low-energy building is obligatory in this district; zero-energy and energy-plus building and the application of solar technology are standard for most.

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The green spaces between the housing rows account for good climatic conditions and provide play areas for children. The rows of old trees were preserved as much as possible. Parallel to private development, infrastructure was created that encompassed schools, kindergartens, youth facilities, civic meeting places, a market place, as well as spaces for recreation and play.

Vegetation-covered flat roofs store rainwater, which is collected and re-used.

The neighbourhood area is traffic-calmed, with the majority of households not owning a car. Private motor vehicles are parked in either of the two garages of the Quarter. Since 2006, the residential area has been linked to the city tram system, enabling many people to do without a car, using local public transport or riding their bikes instead.

Planning the Development

The planning of this development involved many parties including the people that were going to eventually reside in Vauban. There were three main working parties involved in the process:

- 'Project Group Vauban' (the administrative coordination of local authorities dealing with the Vauban project)
- 'City Council Vauban Committee' (the main platform for information exchange, discussion, and decision preparation; decisions are ultimately made by the City Council)
- 'Forum Vauban' (the local citizens' Association; being the legal body of the participation process, as well as responsible for social work within the district).

Forum Vauban started with a handful of volunteers, mainly students and people from the environmental movement. It received some funding which created a few moderately paid jobs for young graduates. The combination of idealism, knowledge, and economical structures led to a breakthrough for the Forum's work.

A publicity campaign was launched and this moved interested parties into the participation process and this enticed the first future inhabitants of Vauban to meet, contribute their ideas, form co-building groups, and from there become active 'Vauban-citizens'.

Forum Vauban brought together citizens, architects, engineers, financial experts, experienced managers of co-building projects, and other partners. Various tools were, and are still, used such as project workshops, all kinds of working groups, residential meetings, 'on-site' meetings, 'planning for real' social events such as district festivals, 'culture café', etc. About 40 major workshops and excursions were organised by Forum Vauban to spread information about ecological building corresponding to the current needs of builders and Baugruppen.

There was strong support for joint building processes such as Baugruppen and co-operative building. New inhabitants influenced their future living conditions and directly receive economical benefits, because building takes place on a larger scale without the engagement of private investors (cost savings up to 25%),

Besides the low-energy standard and the 'parking-free' area, the marketing concept and the development plan include some more regulations with regards to ecological building; greening of roofs, the conservation and planting of trees, rainwater infiltration, etc. More progressive standards were self-imposed and implemented by many of the Baugruppen and co-operative building projects. Initiatives included using ecological building materials such as wood, clay, and other locally produced energy-extensive building material.

Applying New Energy Standards

As discussed previously, there is a compulsory low energy standard that applies to all new building developments. The minimum standard is at least 65 kWh/m^2 annually. This standard is imposed by the city council, in contrast the average energy standard in Germany for newly built houses between 1995 and 2000 was about 100kWh/m^2/year, and the standard of older houses is about 290kWh/m^{2}year.

The next standard is for passive houses, of which there were 42 units of 15kWh/m^2/year in stage 1 of the development. In stage two, an additional 50 units were built to this standard. Therefore these units need no active mechanical heating in winter as this is taken care of by the sun.

The next standard is known as 'Plus Energy Houses' There were 10 units built to this standard, by an investor. There are hopes for building more of these standard buildings.

Like most cities in Europe, Vauban is part of the district heating grid. In order to cater for the extra demand that the development would require, it was decided to build a highly efficient combined heat and power plant (CHP) that would be fueled by local and sustainable wood chips, 80% and gas 20%.

There are more than 2500m of PV panels and 500m of solar collectors for hot water. It is estimated that sixty-five percent of the electricity needed in Vauban is produced on site through CHP and PV. Vauban is estimated to be one of the largest solar districts in Europe.

The estimated CO_2-savings through good insulation and efficient heat supply is 80-90%.

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Water management is one of the major challenges facing Australia. Despite the fact that most of our streets look tidy and orderly with sealed roads and storm water drains, we have created problems that are now a challenge to reverse.

In the Vauban development they address these issues, with the car being subservient to the needs of the inhabitants and the environment. Therefore, the streetscape is designed to cater for people, and their social and psychological needs. The environment supports this approach.

To this effect infiltration of rainwater into the ground is part of the design. The system covers 80% of the residential area. The infiltration of rainwater is an innovative concept and this has now been implemented in other new district.

There was a new ecological sewage system trialled within one pilot project. Waste is transported into a biogas plant through vacuum pipes. It then ferments anaerobically together with organic household waste generating biogas, which is used for cooking. Remaining waste water (grey-water) is cleaned through bio film plants and returned to the water cycle.

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Mobility Concept and Implementation

Since the focus in this community is the inhabitants and the environment that supports them, the car plays a minor role. In particular, car ownership is a long forgotten concept.

The goal of the traffic concept is not a small, car-free enclave, but rather reducing the use of cars in the entire district for everybody's benefit. The result is the combination of two forms of living that are often not integrated into one concept, that is, 'parking-free' and 'car-free' living.

The development did not ban people from owning their own car. If you need to own a private vehicle then you must park it in one of the two community car parks, which are located at the periphery of the residential area. The only driving up to your home and parking, is for pick up and drop off. The speed limit on the district's main road is 30km/h, and in the residential area cars should not drive faster than 'walking speed' (5km/h). This achieves the 'parking-free' living concept.

Residents who have chosen to live without their own car are exempted from participating in the community car park. This accounts for about 45% of residents who are 'car-free households' and therefore save substantially in packing costs. The same is true for development companies who put up car-free apartments for rent. The community car park is, therefore, not subsidised by the 'car-free' households, it is a user pay system. Car owners have to accept walking a short distance to reach of their cars. This soft break with the omnipresence of private cars is offset by a higher quality of living that is valued, especially by the car-free households. From de la Torre's observation this concept of 'car free' living had many benefits. These include a healthy, unpolluted and safe environment for all residents and especially for children. The car did not dominate the roadways and created much needed 'green space' and a connected community.

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Car-Sharing in Südbaden und Freiburg

Implementation of the 'car free' living concept was not just a vision; it required a legal framework to make the concept possible. An association for car-free living in Vauban (Verein für autofreies Wohnen) was founded as a legal body for the implementation of the concept. More details see the website www.forum-vauban.de

Vauban is one of the biggest projects of 'car-free' living in Germany. There were more than 140 households within the first development section alone. This has now grown to include a larger percentage of the residents.

The key with a development such as this is that as much as possible is kept local and within walking and cycling distance. Facilities such as schools, kindergartens, farmers' market, businesses, shopping centre, a food co-operatives, recreational areas, and work are all kept in a centralised local area.

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Public transport for traveling into the city and further afield needs to be reliable, regular and easily accessible. There are two bus lines connecting Vauban with the city center, the main railway station and the recreation area "Hexental". A tram-line and a suburban train line also service the area.

A car sharing concept is also part of the mobility solution. The car sharing company 'Freiburger Auto Gemeinschaft' offers five cars and one van especially for people living in Vauban. They are parked in the community car park. An innovative way to transition into the concept of car sharing was to offer those residents who joined the car sharing organisation, not only have access to the shared cars, but also received a one-year free pass for all public transportation within Freiburg as well as a one-year 50% reduction on every train ticket in form of the 'Bahncard' (bank card).

Civil Participation, Social Interaction and Public Space

Between 1996 and the end of 2000, Forum Vauban as a legal body representing the participation process, organised:

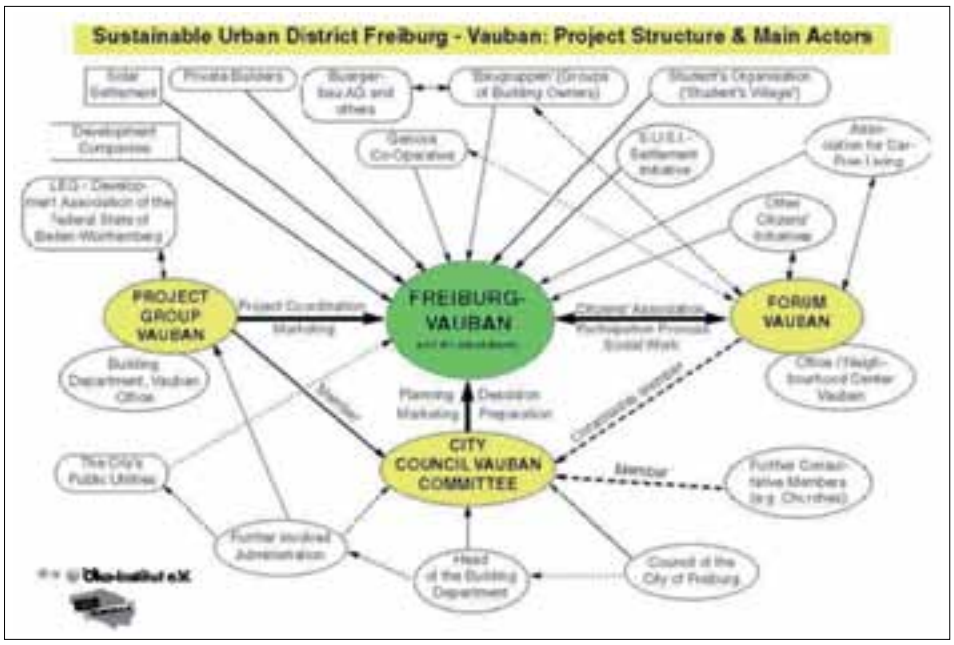
- 40 major workshops and excursions
- Three district's festivals
- An International conference 'UrbanVisions'.

'UrbanVisions' was a pre-event of the United Nations, 'Urban 21' Conference 2000, in Berlin (10 events were co-organised with the City of Freiburg).

The workshops mainly addressed future housing owners, architects, craftsmen, the building industry and financial institutions.

For example, there were workshops focusing on:

- Ecological building, energy saving technologies and solar energy
- Greening roofs and the use of rainwater
- Greening facades and the ecological design of green spaces
- Basic information for future building owners, Baugruppen/co-housing groups (concepts, legal and financial aspects), exchanging information between Baugruppen of the first and the second development section of Vauban
- Building with local wood
- Financing of building projects
- Design of district's public areas (streets, public green spaces)
- Design of the neighbourhood center (using the concept "planning for real"), and many other aspects.



Courtesy: ForumVauban

Freiburg-Vauban was presented as 'German Best Practice' at the United Nations Habitat II Conference 1996 in Istanbul because of the cooperative planning process.

It was evident that the community was involved in creating their own neighbourhood and semi-public and public space. In years to come, generations will be able to reconnect to the input that they had in creating a vision that people from all corners of the world come to study and hope to replicate back in their own communities. This community development was impressive, as there was pride and care for the neighbourhood, the residents and the environment supports a beautiful life.

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Hotel Victoria

The Hotel Victoria in Freiburg was named *"The most environmentally friendly private-hotel in the world",* and has won awards that acknowledge this fact. It is a privately owned and operated hotel, where part of their service to the visitor to the hotel is education and demonstration.

The owners and managers are a husband and wife team "Bertram and Astrid Späth". The award that they won in 2004 was for the chain-affiliated category, Environmental Best Practice by IH&RA.

They believe that the foundations for our common future are built on the preservation and nurture of our common environment. Therefore, their business motto is 'Ecology = long term economy'. This belief has been behind every decision that they have made regarding

the renovation and capital investments that they have made directly into the hotel, but also an on flow decision to go the complete zero carbon footprint by investing in a wind farm. This wind farm is used as a positive carbon offset and they can see that their investment not only benefits them directly but also supports the greater global community.

Their focus regarding sustainability has been in the following areas:

- Sustainable operations
- Energy demand
- Heat generation
- Reducing heat loss
- Cooling
- Power generation
- Water conservation
- Public transport
- Local supplies / minimal waste
- Staff / Team

Vision – Sustainable Operation

The Hotel Victoria has guiding principles that create an environmentally friendly, modern and sustainable management business and they are well known for this. They actively engage their staff and their guests to achieve their goal of protecting and preserving the environment. They are focused on exploring new ways of engaging everyone (other hotels, suppliers, guests, partners, neighbours and companies who take their commitment to the future as seriously as they are) in the challenge 'doing as they do'.

Energy Demand

The Hotel Victoria has an annual consumption of 210,000 kilowatt-hours of electricity and 450,000 kilowatt-hours for heating water and space. It has been estimated that each guest consumes about 30 kilowatt-hours of energy per overnight stay and that is significant.

It is evident that they have implemented certain energy efficient measures in order to reduce demand as the hardest task is to change people's behavior and only through awareness and education can that occur.

The strategy that they have is to minimise energy demand, generate all their energy from renewable resources such as the sun, wind, water and local timber. Thus, the Victoria supplies itself with emission-free power and is therefore considered a zero emission hotel.

Heat Generation

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The heating of water and space heating is achieved by a solid fuel heating system, a 300 kilowatt unit burning wood-pellets this replaces the oil heating system. It is a sustainable solution for them as the fuel source is local and renewable for them in that area of Germany. Some 100 tonnes of wood pellets per year will cover their requirements.

By choosing pellets as fuel they save 50,000 litres of heating oil per annum, minimizing air pollutants such as sulphur dioxide. Pellet fuel is made of dried compressed sawdust resulting from timber production this fuel source is stored in an underground hopper and fed automatically to the boiler.

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The system is an extremely efficient in its operation with the only remains from it being some soot that is then returned back into the soils of the Black Forest which guarantees a closed CO_2 cycle.

The roof of the Hotel Victoria is the home for a number of renewable energy technologies, including solar water heating system. This water heating plant has approximately a collector area of $30m^2$. In the summer, this system is capable of delivering all the hotels hot water requirements to cover showers and washing.

Reducing Heat Loss

The energy efficient measures that have been adopted include the reduction of heat loss through windows. Since the building is heritage listed, the solution needs to achieve the outcome without breaking building heritage requirements. All windows have been fitted with thermal protection insulation glass.

Simple actions such as the replacement of all showers with economic low-flow showerheads reduced the demand for heating water and conserves water. In addition, the replacement of old style bathtubs with ergonomically shaped tubs cuts water usage by 30% in volume and guests still enjoying the luxury of a bath.

Cooling

In 2007, the Hotel Victoria invested in an eco-friendly air conditioning system. The principle of operation is to circulate cool water that comes from the depths below Freiburg, through the system. The water temperature varies between 10 to 13° C and is pumped from a 16 to 24m deep suction well installed in the hotel yard. This feeds a 'filigree' heat exchanger system and together with special ventilators and pipe work installed to all rooms creates a closed looped system. The cool water is pumped and circulated throughout the building distributing cool air and returning at a maximum temperature of 16° C which is then discharged back to earth via an injection well, where it cools down.

Power Reduction

In order to support and make the investment in renewable energy technology logical, the first and foremost action needs to be 'energy reduction measures'.

The Hotel Victoria cannot compromise the comfort of their guests, but they can, and have, introduced energy efficient appliances, changed light globes, made certain systems automatic etc.

All the rooms have been equipped with state-of-the-art 'fuzzy logic' refrigerators that utilise 30% less energy than conventional mini-bar fridges. Wherever possible, compact fluorescent lamps have been installed. These lamps reduce electricity consumption by 80% compared to the incandescent lamps. Certain areas also use movement sensors and dimmers to better manage energy consumption and control energy waste.

Wasteful standby energy is also considered and all room service staff are trained to switch off all devices with standby energy, such as televisions, and all other unnecessary energy consuming devices. The hotel also employs a computer-based energy management system to monitor consumption and cost.

Power Production

The solar array on the roof of the Hotel Victoria is a 7.6kWp system and generates approximately 7,000 kilowatt-hours of solar power per year. This is enough to supply a quarter of the hotel's rooms. A display panel prominently positioned at reception displays the daily/yearly solar energy production. This provides vital educational services to staff, visitors and guests alike.

Courtesy: Hotel Victoria

Since solar alone cannot provide the total energy demand, the rest is offset by the owners' direct investment in a wind farm at Ettenheim. They have a share of approximately 70,000 kilowatt-hours per annum which comes from the 1.3 Megawatt plant.

The deficit of electricity demand is met by paying a small surcharge to their energy distributor to buy 'green power'. By doing so, this surcharge supports the installation of additional renewable power generators in the region.

Water Conservation

Water conservation without compromising the comfort of guests is achieved by fitting AAA showers heads and other flow controls devices for basins. All the WC cisterns have all been refitted with stop buttons to reduce their capacity from nine to six litres, while many of the bath tubs have been replaced with ergonomically shaped tubs requiring 30% less water.

All cleaning and washing activities use enough water without waste. Towels are only changed on request in order to avoid unnecessary laundering. All cleaning agents used are environmentally friendly and do not interfere with the water hardness and composition of Freiburg's water.

Rainwater seeps through the paved, unsealed hotel courtyard avoiding any unnecessary load on the rainwater drainage system.

Public Transport

The Hotel Victoria is centrally located between the main station and the city centre and is easily reached by foot. Freiburg is known for its exemplary public transport system of extensive tramlines and cycle paths. Hotel guests are given a free public transport pass for the duration of their stay; the hotel also hires out bikes to their guest.

All staff are issued with a general season ticket providing them with unlimited free public transport. The hotel has three bicycles and a solar powered vehicle for inner-city tasks. The solar vehicle is parked in front of the entrance to the hotel and also serves to educate and raise public/tourist awareness.

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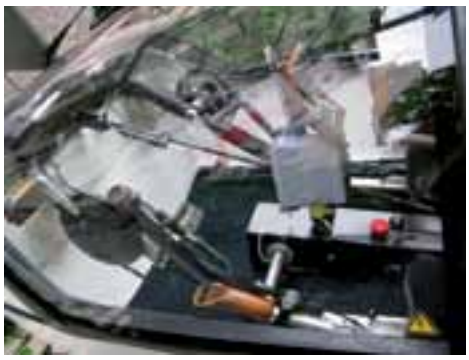

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Local Supplies/Minimal Waste

Operating in a sustainable manner means considering how every part of an operation impacts on the environment. Therefore, the Hotel Victoria uses local suppliers. This not only minimises the need for transporting goods long distances, using more fossil fuels and creating unnecessary carbon emissions, but also ensures a co-operative and thriving local economy.

Other operating principles include minimization of waste and avoidance of plastic wherever possible and last but not least, recycling. All consumables are selected as long as they are made from recycled materials, are refillable or are recyclable at the end of their usefulness. All packaging material is returned to the supplier and electronic scrap, along with metal, paint and other special wastes are taken to the Freiburg city recycling point

When renovations occur, the selected materials are sustainable and high quality. This reduces the need for frequent renovation and the resulting creation of unnecessary waste.

Staff/Team

All hotel staff participate actively in environmental protection activities within the operation of the hotel and their own personal lives. Goals are set annually in collaboration with all staff and management. The team outlines written targets in the area of environmental management as well as drawing up timetables assigning responsibilities and planning implementation. These goals are monitored in monthly meetings.

Courtesy: Hotel Victoria

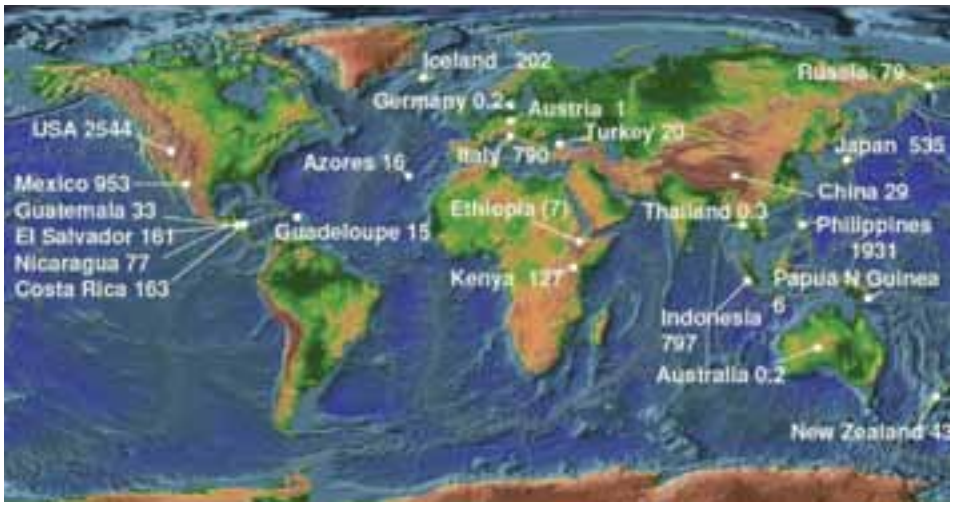
New members of staff are inducted into the Hotel Victoria's environmental program as soon as they are employed.

Achievements are awarded and celebrated together, and staff outings are regularly organised to visit environmental projects. There is a suggestion scheme in place that encourages staff to make suggestions for improvement. If the improvements are adopted, the staff member is rewarded on a monetary basis.

4th Geothermal International Conference

The 4th Geothermal International Conference was hosted by Freiburg. The event provided information about technology, financing and insurance of geothermal projects to an international audience. The major challenge was that the conference was mainly in German with some English translation.

There was acknowledgment that back in 2004, at the first Geothermal International Conference, the main challenge was that geothermal projects suffered from a lack of financing and insurance support. In 2008, partially due to the acknowledgment of Climate Change and the search for viable alternatives to non-renewable energy sources, there is increasing financial support. However, insurance companies are still very cautious.



Courtesy: FlovenzReport

This conference enabled projects from around the world to be reported and information disseminated. One interesting report addressed the state of Geothermal in the USA. It was presented by a member of the Geothermal Energy Association, leading to much consideration for the implementation of Geothermal Technology.

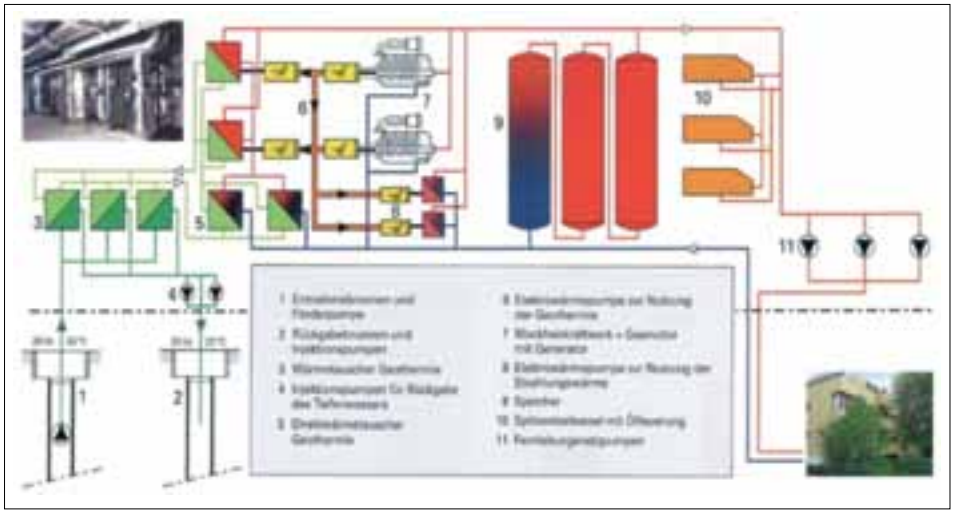
Main areas of use for geothermal applications are:

- Geothermal Heat Pumps – Domestic/commercial buildings
  - 50,000 units installed annually
  - 3 million homes are provided with heating and cooling
- Geothermal Direct Use – Pool, space, district, snow melting and industrial heating.
  - 650MW of direct geothermal energy
  - Equivalent of 2,640Giga watt hours of electricity
- Geothermal Power Production – Electricity Production
  - 16 Giga watts total installed till 2005
  - there are 83 projects with an extra 3.4 Giga watts

This presentation showed the commitment by the USA regarding geothermal energy implementation.

Field Trip to Riehen

The geothermal field trip to Riehen, which is located next to Basle, Switzerland was of great interest as this plant has been operating since 1994. This particular plant uses geothermal energy to heat water. The 65º C hot thermal water is delivered from 1,547 metres of depth via a submerged pump.



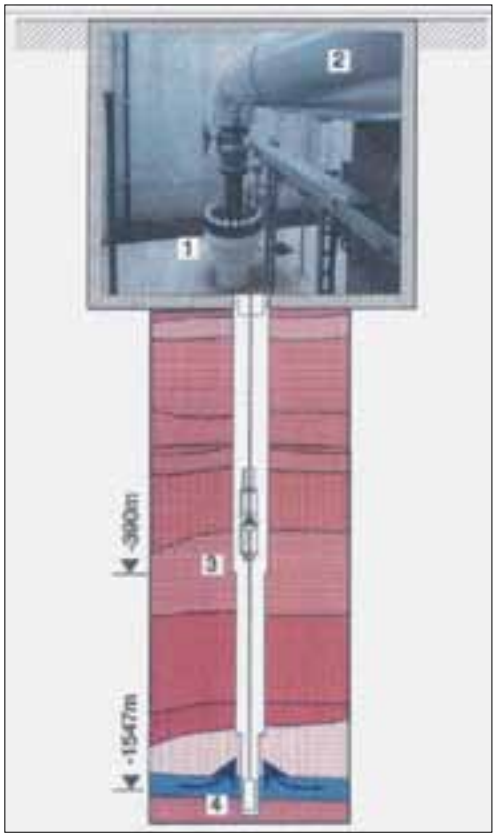
Courtesy: Gruneko AG, Basel

The geothermal heat is the basis of two co-generation plants (CHP), which raise the heat level in the district heat station. A district heating grid of 21 km delivers the heat to more than 200 customers. In the measuring period of 1996/97, the annual heat production of the Geothermal-cycle constituted 22,8GWh.

The International Experience

Courtesy: Gruneko AG, Basel

One characteristic of the Riehen-project is the transnational heat supply of one district of the City Lörrach (Germany) in cooperation with the energy trading company Badenova. Since 1995, the transnational heat supply has been contractually regulated. After Lörrach`s district 'Stetten-Süd' was largely provided with their energy needs, a 600 metre connecting pipeline between Riehen and Lörrach-Stetten was built and started up. The heat supply covers the requirements in summertime, or up to an outside temperature of 3° C. Otherwise, the heat supply is secured by condensing boilers burning natural gas. Among the advantages are, substantial decrease of noxious emissions, the savings associated with having one's own heating system as well as attractive heating costs.



Courtesy: Gruneko AG, Basel

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As a result of chemical corrosion damage, the plant had to be shut down temporarily in March 2008. The plant was operational when visited in April, 2008.

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Highly insulated pipe lines deliver hot water around the district.

Italy – Larderello

Hidden in the beautiful hills of Tuscany, just 120km out from Florence, is one of the longest producing geothermal power producing areas.

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Historically, the natural manifestations held people of that time in wonderment and fear of the 'fumaroles', or steam jets, hot water springs and lagoons. The sense of 'supernatural phenomenons' of the hot springs, which held therapeutic properties were well known to the people of these areas.

In the first half of 17th Century, Pietro Leopoldo, the Grand Duke of Tuscany, ordered that an inventory of natural resources be drawn. Specialists were sent to inspect areas, take samples and analysis of the available natural resources. This area at the time was active with the industries in glass, alum mines and thermal baths, but due to the recession at the time activity had ceased. Tuscany was in an economic crisis after the Renaissance.

The International Experience

A discovery of boric acid in the lagoon in 'Monterotondo' and 'Castelnuovo' was made by the director of the Grand Duchy's pharmacies in 1777. In 1799, Paolo 'Mascagni' patented the use of natural heat in the extraction of boric acid which was used for:

- Pharmaceutical products
- Ceramic glazing and welding

Despite the economic interest in this discovery, it still took until 1812 for the first company to be founded to 'exploit the natural manifestations' which were found.

Attempts to put 'Mascagni's method' into action failed and soon they were using wood to create heat to evaporate the water's of the lagoons to extract boric acid.

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In 1818 the 'Societa Chemin, Prat, La Motte' Larderel was established by the Managing Director Francesco Del Larderel. In this time there was about 50 tons of boric acid being produced annually. As time went on, the increase of a non renewable resource (namely wood) began to diminish with production and profits following suit. The company was in decline and Francesco Del Larderel bought out the other share holders and became sole owner.

Del Larderel decided to experiment with the use of natural steam for the evaporation process and constructed a cover over the lagoon, to maintain the heat. This with other new innovations, increased the total production of boric acid to 125 tons annually in 1829.

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His focus was then to increase the production of steam and, therefore, he adopted new drilling technology that was in use in other parts of Italy. The technology was not as successful mainly due to the original design being for a different purpose.

In 1841 an engineer by the name of 'Vincenzo Manteri', applying theories of 'Professor G. Gazzeri', drilled a well with a dimension of 4 inches diameter and a depth of 10 metres. Developments continued with the improvement of drilling techniques and the construction of the first purpose built drilling rigs.

The Production of Electricity

The production of electricity occurred as a by-product of all the other activities. On the 4th July 1904, 'Prince Piero Ginori Conti', Francesco De Larderel's son-in-law, conducted a series of experiments and succeeded in lighting up five light bulbs that were fed by a geothermal steam driven generator.

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In 1913, the first geothermal Power Plant began operations with a 250kW turbine manufactured by Tosi. Other plants were built over the entire area and the output capacity grew to 12.15MW by 1930.

By 1939 the first large scale geothermal power plant was completed, known as Larderello 2 which had a capacity of 60MW (6 x 10MW) of electrical power from 'natural manifestations' otherwise known as geothermal power.

From that point on there was a rapid build up of capacity as others built more power plants in the area and raised total production to 132MW by the year 1943.

Post-war there was yet another growth spurt in the geothermal industry, which included a reconstruction of 6 plants in the 1950s which increased capacity to 211MW and further to 311MW in 1962. Today there a total of 34 geothermal power plants in Italy, producing a total of 862MW annually.

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Thousands of people travel to Larderello each year and visit the extensive museum which was set up for the education and awareness of how the natural resources of the area have served the community in the production of 'clean electricity' for the past 96 years and which continue to do so today.

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Museum and Models

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There are charts, photos and models to illustrate the history, development and exploration of geothermal energy. The models are scaled and accurate and provide a realistic perspective to the visitor of the scale of the operation.

Knowledge Transfer: Applying the Outcomes

De la Torre will use this report to share knowledge and experience gained as a result of the study tour, and believes that it is essential to disseminate the information to a wide range of interested parties.

The diagram shown in Attachment E provides an overview of activities that de la Torre is both currently engaged in and future planning with regard to knowledge transfer within the industry and training sector.

Publishing

Following the publication of this report, which will be available from ISS Institute, a 'Sustainability Resource Manual' will be available for access by students, teachers and the broader community seeking information, guidance and inspiration on issues such as renewable and sustainable technologies, energy efficiency, building technology, sustainable transport and water management.

Articles to be submitted to ReNew, Eco Generation and relevant publications regarding the Fellowship findings for publishing in their magazines, this will facilitate the sharing of information with a broad audience. There are a range of industry bodies with an interest in the findings and information contained in the Fellowship report, with one such body being the Electrical Trade Union.

Information will also be disseminated initially through TAFE news and the websites of Holmesglen TAFE and RMIT.

Workshops and Conferences

Industry and TAFE trainers are involved in the annual Clean Energy Council, ATRAA conference held each year. An integral part of this conference was the 'National Renewable Energy Teachers - Train the Trainer' program. This event brings together Renewable Energy Trainers from around the nation for 3 days of training and networking opportunities and de la Torre presented a session as part of the dissemination process in 2008 and the 2009 conference.

De la Torre has developed and arranged future workshops and training sessions for TAFE teaching staff, commencing with the electrotechnology teachers, followed by other trade teachers within Holmesglen TAFE. A session for RMIT teachers and management is also planned for 2009.

De la Torre is currently managing 'Live Projects' at Holmesglen TAFE as part of the 'Living, Learning and Putting into Action' program. This project has been inspired as a result of the Fellowship. It is anticipated that an industry workshop will be hosted at Holmesglen TAFE which furthers the aims and objectives of the Program.

Live Projects

Holmesglen TAFE has embarked on a project called 'Future Sustainability in Action', it is one of the 'Living, Learning and Putting into Action' programs. It aims to demonstrate the need for, and viability of, sustainable living. De la Torre is a Perma Culture designer and together with the knowledge and experience gained through this Fellowship, she will project manage, design, develop and implement this project.

The aim is to demonstrate sustainability in all aspects of the development of an urban site. The site will incubate a dual occupancy 'reactive house' (passive solar design), incubate cutting edge technology that produces electricity, manages grey water and black water processing.

The site will collect and store rainwater as well as grow and harvest food for the households. The project also aims to be affordable and replicable. The Program offers an exciting opportunity to apply the 'Living, Learning and Putting into Action' Programs to train apprentices and master trades.

The importance of the 'Future Sustainability in Action' demonstration site is that it is not only available to students, but will also provide access to the community in order to disseminate the concept that 'Sustainable Living' is an achievable objective for all.

Teaching

The entire Fellowship experience has greatly influenced and inspired de la Torre and she is already embedding the skills and knowledge in programs delivered to current students of renewable energy studies such as 'PV Grid Connect'. Renewable and sustainable energy training of pre vocational students have also been introduced into the training programs offered by Holmesglen TAFE in 2009 (RE Cert II).

In 2010, Cert III electrical apprentices will be offered PV Grid connect as an elective. It is planned to deliver the Renewable Energy Cert IV Solar and Electrical pathways. Further to the above training, it is envisaged that the 'Future Sustainability in Action', live project could serve as an opportunity to engage all trades in sustainability learning experience.

One urgent and important program that de la Torre will pursue is the introduction of a mandatory 'sustainability' introduction to all enrolled students at the commencement of their studies. It is de la Torre's belief that sustainability needs to be profiled as prominently as occupational health and safety matters. De la Torre believes that this will be in place at Holmesglen TAFE during 2010. Such an initiative could then be extended to the wider community.

As manufacturing of the IT MDI-Energy technology begins in 2009 and the first installations begin in first quarter of 2010, training will need to be developed, trialled and implemented in order to support the technology.

As part of the requirements of this project and new sustainability requirements, the development of appropriate teaching staff is being managed. De la Torre is working with industry and Holmesglen Institute of TAFE to identify, mentor and prepare future industry based trainers for this task.

Other trades that have expressed interest regarding sustainability training are the building, plumbing and other trade. This is due to a project that de la Torre is managing named 'Future Sustainability in Action'. This project will be described later in the section.

Since returning from the Fellowship travel, de la Torre has been managing the development of a sustainable training house known as the 'Solar Training House' at Holmesglen Institute of TAFE, Moorabbin Campus. This facility has been designed to not only trial the fundamental principles of passive solar design, but to function as a 'Living, Learning and Putting into Action' building from which de la Torre is delivering training to electricians and pre vocational students.

Enhancing the Trades Program

Enhancing the Trades Program is an important aspect of all the activities that de la Torre has planned. Working together with industry, the Electrical Trade Union and through Holmesglen Institute of TAFE, de la Torre plans to raise the status and standards of trades and trades training.

Knowledge Transfer: Applying the Outcomes

Re-skilling and up-skilling of essential trades in the areas of sustainable work practices, energy assessment, energy management, waste management, new technology implementation and maintenance are some areas that de la Torre believes need to be urgently addressed. All this will ensure that electrical personnel are trained and ready to transition to green job opportunities.

As such, de la Torre is working with key industry stakeholders to develop and implement training in these areas. The first of these industry driven 'green training programs' is the ETU program known as 'Global Green Electrician'.[17] This program aims to build skills and knowledge in the areas of energy efficiency, sustainability and renewables for electrical trade workers. This program was first delivered April, 2009 and thus far proven to be a success. The program engages industry, training and union to create an important model for success in moving forward towards 100% sustainable way of life. It is vital for government to support this important initiative.

Industry

Work continues with industry on 'Live projects' and training development.

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The Solar training house, which is part of the 'Living, Learning and Putting into Action' Program, commissioned and put into action in November 2008. In 2009, delivery of training programs in the areas of energy efficiency, PV grid connect and training of electrical apprentices and new renewable energy certificate II programs are all delivered at the Solar Training House, Holmesglen Institute of TAFE, Moorabbin Campus.

[17] http://www.etu.asn.au/training/courses/global-green-electricians/about-the-training

Key Findings and Recommendations

Recommendations – General

Australia has the opportunity to create its own unique solution by building upon the advances made in other countries. We need to re-engineer Australia and stimulate our manufacturing capacity once again. This will allow for the creation of jobs as well as the transitioning from non-sustainable jobs to rewarding new 'green jobs' for Australians. The other main advantage of this position is for Australia to be self reliant and insulated from the current global demand for other renewable technologies.

Government

Australia to continue and strengthen its commitment to supporting the current known renewable technologies such as Solar, Wind, and Geothermal.

Recommendation: For example, this could be done through appropriate and visionary policy making that replicates the German success, such as 'Gross Feed-in tariff' for all renewable and sustainable technologies.

Recommendation: Fund programs that pursue unique solutions such as the IT MDI-Energy technology that creates the opportunities for re-establishing manufacturing, creating jobs and enabling a cost effective transition to allow us to meet and exceed the anticipated 20% by 2020 target for Australia, as well as being 100% Sustainable.

Government, Industry, Education and ISS Institute

Recommendation: In line with ISS Institute's view that the existing status of trades needs to be realigned as detailed in the proposal to the Federal Government, DEST, *New Model for Skilling the Trades. Master Artisan Framework for Excellence*, ISS Institute, December 2004. These vital vocations need to be given appropriate recognition and appropriate credentialing pathways. Supported by government, training institutions need to promote this reality. Setting programs into schools to promote the importance of trade people and change the perception that *"if you are not good enough to go to university, then get a trade"* is essential. The same status required for university training needs to be realigned for high level vocational skills.

> China, the United States, the European Union, Japan—the big economies—may find ways partially and expensively to protect their own industries in a mad scramble for preferment in a world of deep and differentiated government intervention over the dreadful problem. Middle-sized countries like Australia will find it more difficult. But if we get it right, then we can help other countries to get it right. Getting it right means we have to shift the mindset that is currently dictating the policy debate in Australia.
>
> *Garnaut Climate Change Review Supplementary Draft Report, September 2008*

Recommendations for addressing the skills deficiencies identified by de la Torre, and specific achievable solutions for each of the renewable energy technologies investigated as part of this Fellowship follows.

Key Findings for Solar – PV Domestic/Commercial

Solar PV systems have played an important part of transitioning the European cities described in this report from fossil fuel dependence to more renewable and sustainable resources for the production renewable electricity and heating of water. The Fellowship analysis identified that it was a 'mindset change' often referred to as a 'paradigm shift', that re-focused thinking in order to transition to new and sustainable technology.

Solar PV has also been used as an educational tool for citizens and political leaders alike. This has been a valuable method of engaging and helping the lay person to understand 'electricity and where it comes from'. Without this knowledge the lay person finds the connection from fossil fuel based production of electricity and hot water to carbon emission difficult to understand. Therefore, people do not engage in energy reduction measures and do not voluntarily invest in solar power.

Another important point in favour of solar PV at a domestic/ commercial level is that it engages the community. It enables people in the community to be a part of the climate change solution. The 'Vauban' urban development in Freiburg where 'people participation' and engagement was most successful is a perfect example of this process at work. People participation was by far the most important part of the change management and engagement process.

It is apparent that in today's societies around the world there is a predominant feeling *"that there is nothing I can do, to make a difference"*. The people of Freiburg feel differently; they feel a sense of pride and they know that *"they are the difference"*. They stood firmly against nuclear power and they used solar power as part of their solution a long time before climate change was publicly acknowledged. Now Freiburg is a leading tourist city in Europe due to its visionary renewable energy implementation, energy efficiency standards and visionary policies and encourages citizens to live in harmony with their environment.

It is also important to note that secure and supportive government policy such as the 'gross feed-in tariff', encouraged people to take active participation by investing in solar PV for their homes and businesses. The right policy has made it a viable possibility for the individual to invest even if they have no roof space, as many people live in apartments, they were able to buy a share of a commercial installation and enjoy the benefits. All of these options help to increase the solar capacity for generating 'cleaner and greener' energy.

Appropriate policy in this area has had the effect of increasing jobs, creating manufacturing and growing the industry. World wide the solar industry to date has grown at a rate of 30%.[18] This is a result of investor confidence and a future and encouraging return on investment.

Just as Australia is experiencing skill shortages compounded by an aging population, Europe faces the same challenges. Solutions to overcome these challenges are to multi-skill and cross-train trades where appropriate. The training of base trades such as electrical, mechanical, plumbing, carpenter, building trades is vital. There are training programs similar to what we have in Australia for VET in schools, pre-apprenticeship and apprenticeships which are part of their skills training plan. The main difference being that more specialised trade focused schools such as the 'Richard Fehrenbach Gewerbeschule' Vocational Training School, delivering the base trade training as well as more specialised skills training such as solar PV installation for electricians.

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[18] World Future Council, Hamburg – Submission 30, to the 2008 Senate inquiry into the Renewable Energy (Electricity) Amendment (Feed-in-Tariff) Bill 2008

A constant concern for Australia was, and is, the lack of completion of apprenticeships in these base trades. A key observation was that there was a distinct difference between being a qualified tradesperson here in Australia and, for exmple Germany, and that was that a qualified tradesperson in Germany is amongst the best paid and held in high regard. The trades have a much higher profile and, therefore, attract a different caliber of person who has accredited training pathways to gaining higher level skills and knowledge.

Recommendation for Solar – PV Domestic/Commercial

Government

Appropriate and visionary Government policy plays an enormous part in the uptake of PV systems. Within this context, 'visionary' relates to policy created today being appropriate for our current situation and made with a long term focus, that is, it is bipartisan and beyond the three-year election cycle. This alone will give industry security, investor security and society the ability to know that they are making a financial and ethical investment that affects their own future and knowledge that they are positively supported by government policy.

Government policy needs to remove perceived and, or actual obstacles, if it is to encourage solar PV at a domestic/commercial level. For example to set an incentive such as the 'gross feed in tariff', for a set period of time, without limiting the size of the installations, rather than handing out rebates or subsidies. As long as investors can see a return on their investment and a profit in the near future and it is set for a period of time, they will invest.

Government support required for public private partnerships (PPP) within the context of training, (such as the Global Green Electrician Program[19]) so that 'green skills training' is fast tracked and up skilling of the trades can be greatly accelerated to meet the 20% by 2020 in Renewable Energy Target.

Industry

In addressing the issues of skills shortage and the aging population, it is suggested that there exists the opportunity to structure programs where retired tradespeople be trained to coach small groups of apprentices, thereby retaining their vast knowledge and creating a support system for apprentices. The transfer of important skills and knowledge from someone that has left, or is about to leave the workforce to almost one-on-one mentoring situation is invaluable. In this scenario, Victoria's knowledge and skills base is cross-generational and the accumulated wisdom and understandings leveraged into young people (apprentices) at the beginning of the lifelong learning pathway could increase the completion and retention of young people in these trade areas. This also allows for participation of 'master trades people' to not only mentor apprentices, but allows for those people to also be trained and involved in new and sustainable technologies.

Education and Training

Solar PV can no longer be considered as an alternative technology. It has come of age and needs to be thought of as proven renewable technology. All training programs need to reflect this paradigm shift. Trade training especially needs to be now focused on sustainability. Sustainability needs to be embedded throughout the training, just as firmly as Occupational Health and Safety.

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[19] http://www.ggelectricians.com/

An important point to note about Solar PV is that it is a part of the currently available solutions for production of 'clean electricity'. Currently, there is a shortage of base silicon material and the entire PV system embodies a high amount of energy and this may lead to a shortage or an increased cost of components. Australia plays a lead role in the ongoing development of solar related technologies and this vision needs to be fully supported.

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Key Findings for Solar – Large Scale Solar

It is increasingly obvious that solar thermal technology such as large scale concentrated solar power (parabolic dish) and solar tower technologies along with energy storage systems are solutions that have the possibility of offering base load secure energy. They can provide both electricity and hot water.

This report covers a number of large-scale solar thermal projects undertaken particularly in the south of Spain. The successes of these projects have mainly been driven by government policy. Particularly in Spain, investors have seen a need and an opportunity backed by government policy. These projects are high capital input and there are current reports on supply bottlenecks regarding base materials, but nevertheless, these projects are leading the rest of the industrialised economies.

The Trans-Mediterranean Renewable Energy Cooperation and its project 'DESERTEC' are interesting with plans to link the Middle East and North of Africa, (MENA) to Europe via high voltage direct current (HVDC) transmission lines to provide those areas and Europe with 'green electricity' created by solar thermal. This is an option that Australia could explore with regard to utilising desert areas for the same purpose.

Recommendations for Solar – Large Scale Solar

Government

Currently in Australia, there is a Melbourne based company 'Solar Systems' who are developing, demonstrating and manufacturing solar concentrated technology for implementation in Australian projects. Companies such as Solar Systems need to be supported, nurtured and assisted in every possible manner. This is essential to ensuring that this company, and its intellectual property, is not enticed to other parts of the world as many have gone before them.

Industry

Australia needs to re-engineer its manufacturing capacity, by supporting those companies that have been loyal to Australia. This will lead to be the unique solution that we so desperately need.

It is also important to ensure that we do not encounter an increasing scarcity of resources as demand increases within the context of reaching the 20% target by 2020. In order to avoid this situation it is imperative to support all technologies rather than putting all our eggs in one basket and then having the technologies all competing for the same resources.

Courtesy: Solar Systems

Key Findings for Wind – Offshore Wind

The European Parliament has mandated a 20% by 2020 binding renewable energy target for all Member States.

2007	2010	2020	2030
56 GW installed capacity including 1.08GW offshore	80 GW installed capacity including 3.5GW offshore	180 GW installed capacity including 35GW offshore	300 GW installed capacity including 120GW offshore

As can be seen from the table above, interim targets have been set and onshore wind capacity is scheduled to grow by 3 times the 2007 installed capacity by 2020. The offshore wind sector, predicted to increase by approximately 32 times the 2007 installed capacity by 2020, then a further major increase by 2030.

Another major concern is that much of the current installed capacity, is coming to the end of its life cycle and over the next few years, these systems will need to be re-powered. That is wind turbines, their structures and associated components will need to be replaced and disposed.

The biggest barrier within the European market is access to wind components from manufactures. There is a reported 'bottle neck' in the manufacturing and supply of wind components. The same scenario exists within the USA and Canada. The world is looking towards China, but China is mainly manufacturing for China, as reported at the EWEC, European Wind Energy Conference.

A note of interest is that currently about 80% of all global manufacturing of wind components occurs in Europe and they still can not meet their own demand.

What Does That Mean for Australia?

Are Australia's needs for wind components considered and accounted for by the rest of the world? The Europeans perceive Australia's global position as 'far away', our economy as 'relatively small', our past obstinacy to ratify the 'Kyoto Protocol' as uninterested, and thereby may have we been locked out of the market?

Our challenge is that we need those wind components for implementation of projects in Australia to meet our 20% by 2020 target, yet we may not have the required level of access as others around the world, unless we can manufacture them for ourselves. Unfortunately, we are a country where a significant manufacturing capability has gone 'offshore'; therefore we could find ourselves 'out on a limb' with regards to implementing changes as quickly as needed.

It is correct to acknowledge that out of all the current renewable technologies available, wind can deliver the highest renewable energy capacity per turbine, but we have to have satisfactory access to the components and/or be able to manufacture them in Australia.

Another issue, which plagues most projects around the globe, is community acceptance of these large (majestic) machines. So is the answer 'going offshore'? Offshore wind farms are set to take the stage in Europe from now until at least 2030 according to EWEA, European Wind Energy Association. A well structured and mandatory plan is in place for the implementation of 111GWatts of Offshore Wind by 2030, from 1.08GW in 2007 to 120GW of new offshore capacity.

The implementation of offshore wind is enormous. It has challenges at all stages of planning, implementation and on going maintenance mainly due to the environmental conditions of operation. It was reported at the European Wind Energy Conference (EWEC) that there are at least four offshore wind projects in the planning stage for Australia.

Training of personnel for these projects is just as challenging and specialised as the projects themselves. It is perceived that oil rig personnel maybe re-trained to work on offshore wind projects as they are use to working in these environments.

Offshore wind projects require personnel numbers to be kept to a minimum for financial and safety reasons. Therefore, personnel need to be multi-trade skilled. For example an electrician would need to have electrical, mechanical, electronics, high voltage skills as well as working at heights, safety, survival at sea and life saving training.

In order to ensure the success of offshore wind projects, the European Commission under the Intelligent Energy Europe program, has set up the European Wind Energy Skills Network. This network is tasked with defining and documenting the competencies required for training offshore wind personnel and creating a standardised, recognisable and transferable European qualifications.

Once Australia is ready to train personnel for offshore wind projects there is an opportunity to join the group and share in what they have developed.

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Recommendations for Wind – Offshore Wind

Government

It is vital for Australia when planning and setting Renewable Energy Targets by technology to ensure and be certain that we will have access to the technology components. In the case of wind, we may find that we are caught in the 'supply bottleneck' which may delay our project implementations and targets being achieved.

Australia can ill afford to place all its eggs in one basket, therefore, it is important to support the PV Industry and other sustainable solutions as added certainty to our plan towards 20% by 2020.

Education and Training

If there is a foreseeable future in Offshore Wind farms here in Australia, training of personnel for the construction and implementation needs to be identified. A training network such as the Specialist Energy Training Network could make connections with the European Wind Energy Skills Network and participate in these developments.

Industry

Ideally, Australia needs to re-enter the manufacturing arena, particularly if we are to ensure our own future. In particular we need to consider other sustainable technologies that can manufacture, deploy and maintain systems that take less energy to manufacture and at the end of their life cycle can be by majority, recycled.

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Key Findings for Geothermal

Geothermal will play a part in the renewable energy suite of established technologies as it is capable of supplying secure load base energy. The main uses for geothermal technologies in Europe were in the areas of district heating, water, space heating and electricity.

In parts of northern Europe, other highly efficient and sustainable technologies were used for thermal uses; by combusting pellets and woodchips.

In the south of Europe, at Larderello, south of Florence in Italy the oldest geothermal power station is still producing electricity, but only enough to meet a small proportion of the current consumer demand.

It was apparent at the 3rd Geothermal Conference in Freiburg, that this type of renewable resource carries high risks, particularly in the initial stages of establishing a power station to deliver reliable electricity. Financing of projects seemed to be problematic due to these associated risks.

It is noted that there is one well established project in Australia, managed by Geo Dynamics that is closer to exporting electricity to the grid, and they may still be a few years away.

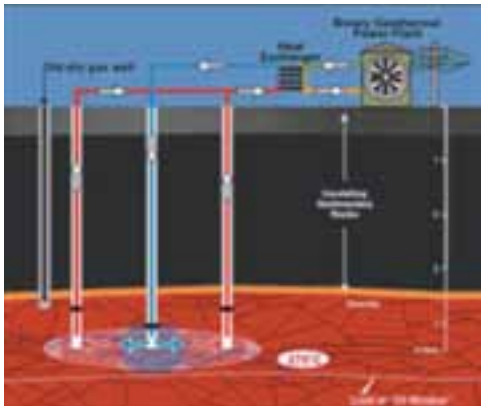
Training of personnel is very specific and mainly 'on the job'. Experienced oil rig workers, are best positioned for the construction phase of the project. Once the plant is operating, power station operators would be suitable to maintain operations.

Recommendations for Geothermal

Government

Every effort should be made to support current projects such as Geo Dynamics as this plant should soon deliver the base load power that we need to move away from coal burning power stations. It is apparent that these projects carry high risks that need to be considered. Two vital considerations are time and cost. Given the climate change timeline, we can ill afford the delay in implementing clean energy technologies.

Courtesy: GeoDynamics



Courtesy: GeoDynamics

Key Findings for Other Measures – Energy Efficiency

> The International Energy Agency (IEA) forecasts that energy demand between now and 2030 will increase by a half, an annual average increase of 1.6%. Two-thirds of the new demand will come from developing nations, with China accounting for 30%.
>
> What is new is the focus on the environmental impact of consuming as much energy as we do in the way that we do. And that is what provides the hope that the world can modify its demand for energy, or at least its fossil-fuel energy demand, through efficiency and conservation.
>
> *GlobalEnergyIndustryOutlook2008*

It is essential that we reduce our demand through energy efficiency and in taking energy conservation measures otherwise we will find ourselves in a 'catch 22' situation. As we build capacity with renewable energy technologies for the production of 'clean, green electricity', we can not afford to increase demand or waste electricity as this acts in opposition to what we are trying to achieve.

It is evident in cities that have made energy efficiency a priority that renewable energy technologies are a viable and profitable solution. Another key point is that the communities appear more aware, responsible and proactive regarding energy conservation and environmental issues.

Integral to this development are communications resulting in awareness raising, and education by an actively involved community. Without this process, it is problematic to move people's thinking as well as engage them in the process of being a part of the solution.

Recommendations for Energy Efficiency

Government

Legislate national mandatory energy efficiency targets. Communicate a mass media campaign on the benefits of energy reduction and conservation for the individual, the community, Australia and for the global dilemma that we are in.

Education and Training

Encourage Schools, TAFEs, and Universities, as well as other interested organisations to deliver workshops, education and training regarding energy efficiency at all levels.

Create appropriate training for 'Energy Assessors' and train those with base trades such as electricians, plumbers and builders to implement rapidly and effective assessments and appropriate reduction measures.

Industry

Create 'Energy Advisory Centers' for the dissemination of information as well as providing training and product purchase of energy efficient retrofitting items.

Summary of the Current Renewable Energy Technologies Status

The biggest challenge that all the current technologies face is an aging electricity grid, and this is a global problem.

Key Findings and Recommendations

In 2008, Melbourne experienced a number of mild storms, resulting in electricity blackouts that lasted from a couple of hours up to a number of days in some areas. These events have confirmed that our electricity grid is very fragile and the future for delivering electrical energy may become uncertain.

A decision needs to be made as to renewing the grid, or upgrading and maintaining the existing infrastructure, all of which comes at a huge financial cost, or to re-invent the way that the grid is utilised.

The reality is that we can produce as much renewable energy as is possible, but without a grid that supports the transportation of electrons to the consumer, we are wasting our energy and efforts. We need a plan to embrace other possible solutions to the problem.

Key Findings for IT MDI-Energy

IT MDI-Energy Ltd is a company that has commenced operating here in Australia and plans to commence manufacturing in Melbourne during 2009. (see Attachment D for full details regarding the potential of this technology for reengineering Australia). It will implement the Information, Communications, Energy and Transport Technology (ICET) package. This package includes electricity generators and vehicles powered by the MDI compressed air engine technology. They have also been working on other retrofit solutions for our existing transport fleet.

The solutions are available to Australia, covering three important categories essential for implementation of an effective, efficient and sustainable 'alternative' to current systems:

- Distributed solar-based point-of-use electrical power generation,
- Networked transport of goods and people, and
- Advanced affordable broadband communications.

As a complete system the ICET package from IT MDI-Energy seems able to facilitate transformation of our ageing electricity grids into 'intelligent grids'. An intelligent electricity grid network will enable utilisation of the ageing electricity grid without overstressing it and without the enormous expense of renewing the grid infrastructure.

This is impossible without low cost, high speed data transfer as this allows generation capacity across the entire network to be micromanaged. If this can be achieved it is then possible to envisage the reduction and eventual elimination of centralised fossil fuel based electricity generation without the fear of job losses, but with the vision of transitioning personnel to 'green, sustainable jobs'.

Australia has been falling further behind the rest of the world in relation to its data networks and broadband services and if this important infrastructure is not brought up to current world standards it will inhibit and effectively neutralise efforts to feed distributed electricity from any source back into the grid.

Recommendations for IT MDI-Energy

Industry

Australia is uniquely placed in the world and we need to find our own 100% Sustainable Solution. De la Torre believes that IT MDI-Energy offers a unique solution that needs to be seriously considered in the light of the Fellowship findings.

Key Findings and Recommendations

By implementing the ICET package, Australia can look forward to not only highly efficient distributed electricity from IT MDI-Energy generators, but also to high speed communications and sustainable transport systems.

Another interesting aspect about IT MDI-Energy, is their unique business model through which the ICET package is made available to end users. This package business model has more in common with mobile phone contracts rather than other possible energy solutions. It is apparent that there are three important barriers that must be addressed by any solution adopted by Australia:

1. Low or nil up front cost to end users and government
2. Substantially reduced ongoing costs to end users and government
3. Absolutely no hassle or impact on the lifestyles of end users.

IT MDI-Energy's solution addresses each of these issues for both the vehicles and electricity generators for Australian users with positive benefits.

Government, Industry and the Community

The key however lies in addressing 100% *sustainable living*. This includes manufacturing in Australia, transitioning from fossil fuel dependency to 100% renewable energy and ensuring that the technology is totally sustainable in its entire life cycle.

Looking at this technology from a sustainability perspective, the first IT MDI-Energy generators to be deployed in Victoria have been modelled by a reputable multinational ESD consultant with offices in Australia and found to achieve a minimum 46% reduction of CO_2 emissions compared to drawing electricity from the grid in Victoria. Future IT MDI-Energy engine models are planned to be even more efficient and eventually will scavenge solar energy directly from ambient air meaning that relative CO_2 comparisons will improve dramatically as the IT MDI-Energy ICET package evolves.

It is commonly accepted that 'green' means more expensive but in this instance de la Torre firmly believes that cleaner and greener can be less expensive and 100% sustainable.

References

Websites

Windskills
http://www.windskill.eu/

Intelligent grids Australia
http://www.csiro.au/science/IntelligentGrid.html

Smart grids Europe
http://www.smartgrids.eu/

Building refurbishing
http://www.bestfacade.com/

Solarsiedlung
http://www.solarsiedlung.de

Models for 'car free' living
www.commondreams.org

Sustainable Urban District Freiburg-Vauban – Habitat International Coalition
http://www.hic-net.org

Stadtteil Vauban, Freiburg
www.vauban.de

Freiburg Car-sharing
www.car-sharing-suedbaden.de

Vauban (City of Freiburg)
www.quartier-vauban.de

International Council for Environmental Initiatives
www.iclei.org

A multi-family passive house
www.passivhaus-vauban.de

Wind Day Campaign
www.windday.eu

TP Wind
www.windplatform.eu

Fraunhofer Institute for Solar Energy Systems
http://www.ise.fhg.de

Attachments

Attachment A – Geothermal Exploration – DW-WORLD.DE

Geothermal Exploration Makes Neighbors Tremble | Europe | Deutsche Welle | 17.01.2007

http://www.dw-world.de/dw/article/0,2112857,00.html

DW-WORLD.DE
DEUTSCHE WELLE

ENERGY

Geothermal Exploration Makes Neighbors Tremble

Using the earth's natural heat as an energy resource is a fine idea. But not necessarily for those who live near drilling sites, as people along the border between Germany, Switzerland and France are finding out.

Emergency services in and around the northern Swiss city of Basel were flooded with calls on Tuesday, as tremors measuring 3.2 in the Richter scale shook the region. It was the latest in series of small earthquakes over the past month caused by the Swiss Deep Heat Mining project.

The geothermal project, which was launched in 1996 under the auspices of the Swiss Federal Office of Energy, involves drilling the country's first exploratory borehole and injecting pressurized water more than 5000 meters (16,400 feet) underground.

But that has caused the earth to move in what is normally an area of geological calm.

"The first time around, I was really scared," said Catherine Wiest, a shopkeeper in Basel. "It was like a rock fall and glasses were tinkling in the cupboard. I didn't know what was happening."

Man-Made Quakes

Jean Ueberschlag, the mayor of nearby Saint Louis in France, has written to Swiss authorities recently demanding that the project be halted.

"You don't have the right to play around with the safety of our populations," he said.

Geopower, the company heading the project, suspended drilling in December but the tremors continue. Local authorities in Basel are set to meet at the end of January to debate the project, which was supposed to provide heat and energy for thousands of homes in Basel.

"We're a bit nervous of course because the experts can't tell us how many tremors we're in for," said Marc Keller, a spokesman for Basel's public works department.

DW staff (jc)

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Attachment B – Delft University Offshore Wind Course

Introduction to course and to current wind turbine design

- Summary of the principles of wind energy conversion
- Some design recommendations
- Overview of :
  - basic aerodynamic theory
  - control strategies and systems
  - rotor dynamics and energy yield
- Introduction to the subject "offshore wind energy"

Offshore wind climate and loading

- No wind energy, without wind.
- Wind properties of the at offshore locations and how do they effect a the wind turbine?
- Wind:
  - origin and character
  - specific properties for the offshore environment
  - analysis of measurement data
- The relation of the offshore wind with energy yield and loading phenomena were explained

Offshore wave and current climate & loading

- Discussed the importance of wave and current climate
- Discussed waves:
  - generation
  - development
  - nature and mathematics of waves and sea states
- Different models for the water particle kinematics
- Structural loading calculation based on the wave kinematics
- Discussed currents and their effects

Long-term loading situation

- Having discussed wind, waves and current as separate phenomenon.
- Long-term loading of the above correlated forced in magnitude and direction
- Calculations of the correlation can be determined and how it can practically be presented.
- Several examples illustrate the long-term correlation between some environmental parameters.
- Discussion of required knowledge of long-term environmental conditions to predict load and performance analysis.

Offshore soil conditions and foundations

- Discussion of offshore ground condition
  - Soil preparation
- Discussion of the difference between offshore and onshore foundations
- Discussion of different foundation type
  - pile foundations
  - gravity based foundations
- Foundation construction methods:
  - axial and lateral loading.

Offshore support structure

- Offshore support structures are very site specific, resulting in a large variety of structures for the oil and gas industry.
- The experience obtained with these structures translated to lessons for offshore wind energy.
- Discussed concepts and a design approach for support structures for wind turbines.

Dynamics of an offshore wind turbine

- The structural dynamics of an offshore wind turbine are important, as well as complicated.

- To facilitate the understanding of the dynamics of the entire system an introduction of dynamics presents the relevant issue of mechanics.
- Following the analysis of the differences with other offshore structures and onshore wind turbines, the importance of structural dynamics of offshore wind turbines is explained.
- An overview is given of typical offshore aspects of the dynamic behaviour and of various analysis methods.
- Special attention is paid to the subject of fatigue loading, which is often a design driver for the support structure.

Operation and maintenance

- Operation and maintenance is one of the less 'hard core technology' aspects of this course.
- Discussed a systematic approach toward:
  - analysis
  - planning of operation and maintenance activities
- Discussion of system reliability, access methods, lifting equipment and maintenance strategies.
- Training of maintenance staff

Electrical systems

- Discussion in three part:
  - the electrical system of the turbine
  - the electrical system of a wind farm
  - aspects of grid integration.
- conversion of mechanical power into electrical power
  - the principles
  - characteristics
  - types of generators
  - and power electronics
- Functionality of the electrical infrastructure:
  - Transmission
  - capacity of cables and transmission by AC and DC
- Several configurations and types of clustering and provides examples of their costs and efficiency.
- The integration of wind power into the grid
  - functions and operation of the power grid is reviewed.
  - The effect of injection of wind power is considered with respect to voltage stability, faults, islanding and power quality

Integrated wind farm design

- This lecture gives a schematic representation of several design approaches. The abstract ideas are illustrated with examples from existing projects.
- The integrated design approach is identified as the most promising approach and discussed in more detail, emphasizing on the conceptual design phase.
- The lecture then focuses on key aspects of the integrated approach such as availability and levelled production costs.
- Some technical issues are singled out to demonstrate the importance of interactions between sub-systems.

Round-up of the course

- Discussion of experience gained with design and implementation of current offshore wind farms
- Discussion of development of offshore wind farms in the medium and long term future
- Discussion of implementation of offshore to meet European Renewable Energy target by 2020

Attachment C – Questions/Discussion with Overseas Individuals and Organisations

1. Solar Electricity - PV Domestic

- Design, installation and maintenance of domestic PV systems to meet worlds best practice.
- What are the cutting edge technologies in solar cell technology?
  - How is thin film technology affecting the industry and how is it being applied?
  - How is Building Integrated Photovoltaic (BIPV) changing the design of architecture?
- What are the cutting edge technologies in other associated components?
- How and who manages installations?
  - Small and large scale.
- How do government policies affect the uptake of solar PV?
  - What are the incentives?
  - What are the legislative mandates?
- What are the trade skills levels required for these projects?
- What are the maintenance programs in place for the ongoing management of these systems?

2. Solar Electricity – PV Farms

- Design, installation and maintenance of PV farm systems to meet world's best practice.
- What are the cutting edge technologies in large scale solar technology?
  - How are solar towers farms being implemented?
  - How are parabolic dish farms being implemented?
  - What training is required for installers and maintainers of these farms?
- How and who manages installations?
- How do government policies affect the investment in solar farms?
  - What are the incentives?
  - What are the legislative mandates?
- What are the trade skills levels required for these projects?
- What are the maintenance programs in place for the ongoing management of these systems?

3. Wind – Wind farms offshore

- Design, installation and maintenance of offshore wind systems to meet worlds best practice.
- What are the cutting edge technologies in wind technology?
- What are the limitations in size of one single wind turbine?
  - 5Mwatt turbine
  - 7Mwatt turbine
  - Noise and bird dangers?
- How and who manages installations?
- How do government policies affect the investments in wind farms?
  - What are the incentives?
  - What are the legislative mandates?
- What are the trade skills levels required for these projects?
- What are the maintenance programs in place for the ongoing management of these systems?

4. Geothermal

- Geothermal options for Australia

5. Energy Efficiency

- What is Europe doing in the area of energy efficiency measures?
  - Energy efficient new building constructions
  - Existing building stock
- Who needs to be trained for energy efficiency jobs?
- What are the legislative mandated targets for energy efficiency?
- What else are European cities doing regarding conserving energy?

6. Sustainability

- What sustainability measures are there in European cities?
- What sustainable technologies are available?
- What sustainable transport methods are employed?
- What do sustainable buildings look like?
- Who needs to be trained regarding sustainability issues?

Attachment D – Case Study. IT MDI-Energy Technology Solutions

An Opportunity to Re-Engineer Australian Energy Supply

An opportunity exists for Australia to transition to a 100% solar and sustainable initiative by considering the technology that IT MDI-Energy has developed, such as:

- Use of advanced broadband communications
  - (replace the transport of people with that of data, voice and visuals)
- Deployment of high efficiency, de-centralised energy networks
- Deployment of novel forms of high efficiency transport for people and goods
- Basing all of the above on solar energy

The 100% solar and sustainable IT MDI-Energy Initiative is a $1.8 billion investment and implementation program that aims to create a smooth transition to 100% solar based and fully sustainable infrastructures for power generation, transport and communications for the whole of Australasia (Australia, New Zealand and the Pacific Islands).

This initiative is entirely demand driven and based on competitively priced consumer products and services. It is designed to address squarely and fully commercially the pressing challenges of 'Peak Oil', the subsequent challenges of the eventual global peaking of natural gas, coal and uranium supplies, and the related challenges of 'Climate Change'.

This initiative is based on a cost-effective technology package. We, as a society, are used to thinking of 'green' alternatives as being more expensive, cumbersome and a loss of comfort. With the converged IT MDI-Energy Information, Communications, Energy and Transport Technology package (ICET), 'green' costs less to deploy, operate and maintain and is easy for consumers to use.

The 100% solar and sustainable IT MDI-Energy Initiative is growth oriented. During the next five years, it aims to create over 9,000 new, environmentally sound, jobs directly and over 26,000 indirect jobs, all distributed close to where people live, thus considerably reducing commuting requirements.

The most important aspect of this technology opportunity is about job creation and transitioning people from failing industries into rewarding green jobs.

By utilising this technology the benefits from an environmental perspective are considerable. These include reduced car emissions in Australasia by 20% and emissions from power generation by 80% over the first ten years of implementation. Over the full 20 years of its implementation program, this initiative aims to achieve 100% sustainable infrastructures for power generation, transport and communications, that will ensure a neutral carbon footprint for Australia.

As a clear vision for Australia, the technology that IT MDI- Energy brings to Australia is an opportunity to re-engineer Australia by reviving manufacturing and enabling a real 'Clean Green' holistic solution whilst allowing us to meet our expected emissions reduction target 20% by 2020.

Training of Personnel

Training for this deployment will be delivered at Holmesglen Institute of TAFE in partnership with IT MDI-Energy. Qualifications based on the Australian Training package, the training developed will be competency based targeting in the first instance the trades, electricians, plumbers, IT personnel, engineering machining, apprentices and trainees. This allows for trained and competent people to be ready for fast deployment of the ICET package.

Courtesy: Holmesglen TAFE

Main areas of training will be in:

- Manufacturing, assembling, testing, standards and quality control
- Installing, testing, commissioning and
- Maintenance, repairing and replacement
- Point of sale, customer service and general communication.

Holmesglen Institute of TAFE currently provides engineering and manufacturing training programs and is equipped with engineering equipment and machinery that were in the MDI plant in Carros, Nice, France. The vision for job transitioning and job creation means that training will also need to be developed for the wider community. Once the above training is developed and tested, the strategy will be to roll out training throughout Australia and then internationally.

Australia's Manufacturing Opportunity

IT MDI-Energy's "Green Victoria" will be the first manufacturing facility of its kind in Australia. It will resemble the Carros plant in Nice, France.

Courtesy: IT MDI-Energy

Courtesy: SustainablePlanet.com.au & IT MDI-Energy

The fit out of the Australian manufacturing plant is easily replicable as per the set up inside the Nice plant. In the mean time, strategic partnerships are in place to commence production with Yella Terra Australia in Moorabbin and training programs with Holmesglen Institute of TAFE.

Pictured above right is the Yella Terra Australia facility in Moorabbin, Melbourne.

Attachment E – An overview of activities that de la Torre is both currently engaged in and future planning