exemplaryenergypartners

Divisions of Exemplary Investments Pty Ltd
ABN 83 111 635 931

SUMMARY

STATEMENT OF CAPABILITIES

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energy · economics · buildings · environment

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FIELDS OF EXPERTISE

Energy Partners is a multi-disciplinary consulting practice, established in 1989. The company has expertise in four distinct but related fields.

1. Climate and Weather Data

This includes production of the "Australian Solar Radiation Data Handbook" (ASRDH) and the "Australian Climate Data Bank" (ACDB) as well as customised climate data sets for renewable energy and building energy efficiency applications including ersatz future climate data prepared in collaboration with the Centre for Australian Weather and Climate Research [a partnership between CSIRO (Marine and Atmospheric Research) and the Bureau of Meteorology].

2. Energy, Environmental and Industry Economics and Policy

This includes review and analysis of economic and policy issues relating to energy and the environment, efficient supply and use of energy, electricity economics, foreign aid for energy projects, national energy policy, energy R&D policy, and policies for renewable energy supply industries.

3. Design and Design Evaluation of Low Energy Buildings

This includes all aspects of building design and siting and computer simulation of thermal performance and lighting performance including their interaction; thermal interaction of the building with the ground; natural ventilation systems including nocturnal pre-cooling; advanced glazing systems providing low thermal transmission and/or daylight redirection; setting achievable and economically attainable targets for energy consumption; small-scale cogeneration systems and renewable energy systems.

Energy Partners' staff and associates have expertise in the use of numerous building modelling software packages for energy system and non-residential projects such as Bunyip[i], Camel[ii], DOE2, E-Quest, ESPII, DesignBuilder[iii] with EnergyPlus[iv] and TRNSYS[v]; as well as AccuRate[vi], BASIX[vii] and BERS Pro[viii] for residential projects.

4. Monitoring, Energy Auditing and Remedial Measures for Existing Buildings

This includes monitoring and analysis of lighting, ventilation, heating, cooling, refrigeration, pumps, fans, water heating and internal transport systems as well as process heating, compressed air reticulation, large scale refrigeration, furnaces and calorifiers; design and documentation of remedial measures; cost estimation of remedial measures and their annual savings, financial evaluation of proposed remedial measures. Historically, this included many energy audits conforming with the Commonwealth's Enterprise Energy Audit Program (EEAP) to qualify clients for the 50% subsidy on audit costs (scheme now closed).

PRINCIPAL

Mr Trevor Lee, B Arch (Hons), ARAIA

Trevor Lee is an architect specialising in low energy and passive solar buildings in both design and post-occupancy evaluation terms with experience across the full gamut of Australian climates.

From 1985 to 1989 Mr Lee served as the Senior Architect for Energy Management with Australian Construction Services, representing ACS on relevant Standards Australia committees. He provided consulting and training in-house on low energy design and energy targeting from feasibility study and financial evaluation through to complete and commissioned buildings and also on refit and refurbishment projects.

He has subsequently been involved in research at the Australian National University in the application of heat storage in phase change materials for solar and off peak electric applications in building services and in the correlative relationships between ambient air temperatures and building energy consumption on a real-time basis. He is also the lead author of the 4th edition of the Australian Solar Radiation Data Handbook published in 2006. After previously establishing the gross errors embodied in the 1st edition as a result of an erroneous algorithm for solar position being applied to the Bureau of Meteorology's horizontal irradiation measurement records he was the project leader and co-author of the 3rd edition in 1995 and project leader for its companion software AUSOLRAD.

He is the author of numerous published papers on the subjects of low energy design, renewable energy use in buildings and financial evaluation of energy saving or generating investments. He was the editor of the quarterly journal *"Solar Progress"* for the Australian & New Zealand Solar Energy Society from December 1989 until early 1995 and edited the proceedings of the Society's Annual Australasian Conference in 1987 and 1997. He has served as its Secretary from 1986 to 1989, Vice Chairman from 1995 to 1996 and Chairman from 1996 to 1998. From 1997 he served as a foundation director of the Sustainable Energy Industry Association until the end of 2001, fulfilling the role of Vice President in his final year. Through subsequent mergers, that organisation became the Business Council for Sustainable Energy (BCSE) and in 2008 the Clean Energy Council (CEC).

Trevor Lee was approved under the Enterprise Energy Audit Program to certify that energy audits undertaken by Energy Partners have been properly conducted and is an accredited assessor under the ACT House Energy Rating Scheme, being competent in both the ACTHERS, FirstRate and NatHERS/AccuRate software packages. He also trained the Accredited Assessors under the ACT House Energy Rating Scheme (ACTHERS) and, for its first four years, provided detailed technical advice to the ACT Division of Planning and Land Management on its implementation for both proposed new homes and for existing homes at the time of sale. He also held a Builder's Licence (Class B) in the ACT.

From mid-1991 until November 2004, Trevor has also served as a director of Australian Ethical Investment Ltd and as a member of its Investment Committee directing specialist expertise to their energy conservation, renewable energy and property investments until August 1999. In 1996 he edited the book *"Ethical Investment in Australasia - a Handbook for the Concerned Investor"* (ISBN 0 646 27463 5) and was a major contributor to its successor, the Choice Book *"Ethical Investment"* (ISBN 0 947277 37 4) edited by Ross Knowles and published in 1997 and again, fully revised, in May 2000.

PROFESSIONAL STAFF AND ASSOCIATES

Mr Denis Wylks, A.P.T.C. (Arch.), F.R.A.I.A.

Denis is an Architect with some forty-five years' experience working in Architects' offices in Perth, Sydney, Cambridge, Edinburgh and Canberra. He is the director of LBW Architects Pty. Ltd., specialising in providing a personalised services to Clients seeking advice regarding smaller Architectural projects and energy efficiency. He has practised in Canberra for thirty-seven years.

Denis has been an energy rating assessor in A.C.T. and N.S.W. since the early days of operation of house energy rating schemes in both states, using FirstRate, NatHERS, AccuRate and BERS Pro programmes. He has attended specialised training and conferences, most recent being the ABSA Short Course in Building Thermal Performance (Residential) based on second generation NatHERS software and the Residential Sustainability Assessment course run by Archicentre (an enterprise of the Australian Institute of Architects).

Denis has completed hundreds of energy ratings in A.C.T. and N.S.W. for multi-unit and single residential projects, including advice regarding the most cost efficient means of achieving the required rating and is able to offer a quick turnaround for projects of any size.

Mr Nigel Coates, B.A. (Architecture)

Nigel has been building to his own designs and those of selected architects for over 35 years whilst studying architecture at UNSW, Sydney University and the University of Canberra.

He controlled a successful construction business on the northern beaches of Sydney for twenty years before moving to the southern Monaro region 15 years ago. He now lives in Canberra and works collaboratively with his clients to make their home building experience part of the solution to climate change.

He is an experienced project manager, builder, shipwright, cabinetmaker and architectural draughtsman and has led tours of sustainable housing in Canberra, Wagga Wagga and Jindabyne.

In late 2005 Nigel collaborated with Energy Partners to design and build a sustainable residence in Wagga Wagga. Their clients entertained the largest contingent of visitors for rural NSW on Sustainable House Day in 2008 and have had over 500 visitors by appointment since.

His current project is the design and construction of an autonomous, energy efficient residence in a bushfire prone area south of Yass, NSW using AutoCAD and AutoCAD Revit 2009 Building Information Modelling to document and communicate the design.

Past projects include residential, commercial and heritage building projects, client side project management, remote, inaccessible and geotechnically challenging sites, demolition and retrieval of building materials, use of unique construction systems, building surfboards and sailboards, a 40' yacht, product display, commercial fit out, kitchens, furniture, and school playgrounds.

Nigel's building designs incorporate both traditional and alternative building techniques including stabilised rammed earth, natural stone, straw bale, modified blockwork like Timbercrete and Benex, reverse brick veneer and foam composites. The buildings are serviced by solar power and rain water. Active heating and cooling systems are generally avoided. Evacuated tube solar

collectors heat water in a reticulated hot water service with solar electric or instantaneous gas backup. Household waste management includes biolytic conversion and grey water diversion to fertilise and water both native and permaculture household gardens.

The core design is always arranged to exploit earth coupling, passive solar heating and convection cooling. Recent buildings have used no active heating or cooling systems to great effect. Thermal efficiency is achieved through effective siting and orientation, fenestration, draught exclusion, the exploitation of materials for thermal inertia and insulation plus strategic planting and screening.

His sustainable design practice also specifies plantation and recycled timber, recycled masonry and concrete, materials with low embodied energy over service life, building waste minimisation and recycling, water efficient fittings, high performance, energy efficient whitegoods and lighting, natural paints and oils and a preference for local materials and labour.

Mr William Logie, B. Eng. (Hons)

William (Will) brings to Energy Partners a keen interest in sustainable energy. Graduating from the Australian National University's Bachelor program at the end of 2003 with an Interdisciplinary Systems Engineering degree his thesis project involved the design, construction and flight testing of a solar powered aircraft.

Well on his way to post-university social integration, Will still sought overseas exploration and experience and left Australia in early 2004 on a wander through the South Americas and on to Europe, where he now resides in Zurich and telecommutes for building simulation and energy rating projects as required. He maintains a career objective: although he was educated to be an engineer, he is actually an environmental physicist in the making and pursues knowledge and experience to this end.

Having sufficiently developed his German language skills by September 2005, he joined forces with a small office of Engineers with skills descended from the Technical Inspection Group Rheinland (Technischeüberwachungsverein - TÜV) specialising in energy auditing and for whom rising oil prices and the European Performance in Buildings Directive (EPBD) provided an opportunity to expand operations. Will has assisted in developing automation software towards calculations and report writing for the auditing of clients in the private, commercial and industrial (process) sectors; for which the internal rate of return (IRR) on recommended investment measures must be specified. In this time he has performed audits on housing, schools, council/public buildings, swimming pools, office blocks and a metal-casting factory. His current focus is on solar thermal systems simulation and testing through the SPF (Institute for Solar Technologies) near Zurich in Switzerland.

Will has been an accredited assessor under the ACT House Energy Rating Scheme and is a skilled user of AccuRate (CSIRO's 2nd generation replacement for NatHERS). His computing skills encompass the Windows and UNIX environment, offers programming within Excel/VBA and C++ and client accessible (PHP - SQL) internet databanking.

Will has recently commenced doctoral studies with the ANU's Centre for Sustainable Energy Systems in the field of high temperature concentrated solar receiver systems.

Mr David Hodgkin, Ass Dip Wood CSA ANU;
Dip Wood Tech, Ithaca TAFE Qld; current MA REM ANU

Until joining Energy Partners, David was an independent consultant working on a range of environmental and building issues. These have included, setting up the ACT Energy Advisory Service with the Master Builders Association, Managing Revolve ACT (a salvage and recycling company operating out of the main Canberra tip), training apprentices in the building industry and providing technical building advice to the general public through the ACT Building Information Centre operated by the Master Builders Association of the ACT.

David has been involved in a number of Humanitarian projects including a year with the UN and AusAID in East Timor as a consultant on the School Rehabilitation Project, training East Timorese Carpenters in business management and furniture manufacture. He has worked in the Tanami Desert on a number of occasions managing the Yuendumu Petrol Sniffing Detox program. Since the tsunami and volcanic eruption in Indonesia he has been engaged in the reconstruction planning and delivery in those disaster areas from his current base in Jogjakarta.

As well as running a Canberra based Design–Build Company for 5 years, David presented the talk-back building advice segment on ABC radio 2CN, along with many interviews on television, radio and for newspapers.

David has 10 years experience of business related computing. He is an advanced user of Microsoft Office and has worked in presentations using PageMaker, Illustrator, PhotoShop, Draw and AutoCAD and in small business bookkeeping using MYOB. He also has 10 years of internet experience using Usenet, FTP, WWW, HTML, etc. for site design and development.

David has been an accredited assessor for the ACT House Energy Rating Scheme (ACTHERS) and holds a current ACT Class B Builder's License. David's study and disaster relief activities suggest he will have limited availability for Energy Partners projects in the near future.

Mr Greg Burghardt Dip Arch, Dip Teaching (Technical)
Building Supervision, (Clerk of Works), NSW Licensed Builder 3605C.

Greg has worked in the building and design professions for the past twenty five years in various roles including building, design and teaching. In 1998 he established one of the first building consultancies in NSW (Envirohome) specifically focused on issues of building sustainability. The core function of this business is to provide consultancy services throughout Australia related to building energy efficiency in compliance with the various codes and regulations. He is an accredited energy rating assessor in NSW, the ACT and Victoria.

Greg was contracted to the ACT Planning and Land Authority (ACTPLA) for the first six months of 2008 as the Senior Officer for Building Sustainability. His role was to implement changes to ACT House Energy Rating Scheme (ACTHERS) including the proposed licensing of energy rating assessors, changes to the Sale of Property Act and the establishment of an auditing system. Before moving to Canberra at the beginning of 2008, Greg was the Head Teacher of the Building and Construction Faculty at Wollongong TAFE.

In 2005, the NSW Office of Fair Trading contracted Greg to develop a text, "Building on Your Foundations" for the Continuing Professional Development (CPD) Scheme for NSW Licensed Builders.

Greg was an elected board member of Futureworld; Institute for Sustainable Futures Wollongong in 2006 and in 2007 was an elected director of the Association of Building Sustainability Assessors (ABSA).

His fields of expertise include:

- In depth knowledge of 2nd generation residential building thermal performance software including AccuRate, BERS-Pro and FirstRate 5
- Training in 2nd generation software
- Use of computer modelling software including Revit and Ecotect
- BASIX assessments
- BCA including Section J consultancy services
- Sustainable design services

Greg is currently engaged with consultancies with the Australian Building Codes Board and ABSA. In 2009 Greg undertook training in DesignBuilder with EnergyPlus software and aims to gain NFRC accreditation and assist the Land Development Authority (ACT) with the implementation of their sustainability measures in the residential areas of the Molonglo development area.

Ms Trish Campbell NatHERS Assessor
As a first year Psychology student at Armidale University and mother of four, Trish began a small business in 2005 labelling an environmentally friendly chemical range of household cleaners. After publishing a paper on the potential hazards of standard cleaning products, Trish was offered the role of National Sales and Marketing Manager for Charmnote Industries in 2007. Trish had extensive experience during this time with sales, marketing, training and customer relations to high level stakeholders and business plan modelling for export markets. In 2008, Trish took on a more active role with product development that included bio-remediation efficacy testing, MSDS hazard identification and company representation to international trade health organisations.

Trish resigned from Charmnote in 2009 to establish ACT Sustainable Systems and pursue a career in the built environment and sustainability sector. She trained as a NABERS Assessor, Home Sustainability Assessor and Accredited Thermal Performance Assessor in both First Rate 5 and BERS Pro. Trish delivered over 270 home sustainability assessments under the Green Loans Program between 2009 and 2010 and over 70 home energy audits for the Home Energy Advice Team. As an Energy Auditor for the Sustainability Advice Team, Trish was Lead Auditor for over 15% of ACT public schools in 2010 delivering Energy Audits for the Department of Environment and Training.

Trish provided training for the Master Builders Association in October 2010 in Financial and Business Management for their Builder's Licence Course and took on the role of ACT Government Energy and Water Assessor in 2012.

She is a current ABSA accredited assessor and ACT Licenced Class B Building Assessor (Energy Efficiency) familiar with both NatHERS and BASIX schemes.

Dr Peter Lyons, PhD, M.ASHRAE

Peter Lyons is a building physicist with extensive experience in a range of fields and employment sectors. Peter applies this experience to a wide range of unusual and challenging projects, among existing clients and new clients – both local and overseas. Peter's expertise has been acquired locally and internationally and is applied individually and in a team setting across façade engineering and sustainable building design. He specialises in energy performance modelling of all types of fenestration systems and of whole buildings, both residential and commercial. He has continuing research interests in the impact of glazings on human comfort in buildings.

During 1998–99 Peter was a visiting researcher at Lawrence Berkeley National Laboratory (LBNL) at the University of California, where he continues applied research into the energy modeling and rating of windows and skylights. He has published over 50 research papers and reports. Together with colleagues from Team Catalyst, Peter also trains engineers and architects in the application of DesignBuilder with EnergyPlus software to building energy simulation.

Relevant Projects and Activities:
Professional Bodies, Codes, Standards and Technical Committees

- Australian Building Codes Board (Commercial Glazing Working Group, WGC7), ongoing.
- National Fenestration Rating Council (USA), ongoing.
- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) – TC 4.5, Fenestration, ongoing.
- Nationwide House Energy Rating Scheme (NatHERS) - Technical Advisory Committee, ongoing.
- International Energy Agency project 'Task 18': Research & consulting on energy performance of windows, 1992 – 97.
- Window Energy Rating Scheme (WERS): co-principal developer of the Window Energy Rating Scheme (WERS) under contract to the Australasian Window Council, 1995.
- Energy Ratings for Blinds and Shading Systems: consultant to Blind Manufacturers Association of Australia, 2004, and beta tester of Window 6 beta (with Lawrence Berkeley National Laboratory).

Mr Martin Leadbeater, B. App. Sc. (Computer Studies)

Martin is a software developer with experience in the entire software lifecycle, including requirements gathering, project management and application maintenance. Since obtaining his computing degree from the South Australian Institute of Technology (now the University of South Australia) during 1986, Martin has held two jobs; one at the Computer Centre of the University for nine years and the other as Managing Director Tellurian Pty Ltd, a small software house, for 15 years. Since July 2010 Martin has been operating a small business called 'Vale Park Software Development'.

While working at the University, Martin used the TeX typesetting system to generate pages of the first edition (1988) of the Australian Solar Radiation Data Handbook and remains fascinated by the power of a suite of software that has been under constant open development for more than thirty years. Since the mid-1990s, Martin has been using C, C++ and Java for most applications, often using the Literate Programming style, invented by Donald Knuth, but normally sticking to the more conventional Object Oriented or Structured programming styles.

During the last fifteen years, Martin has written a version of MFC for the Macintosh (OS 9), developed machine control software for wool bale sorting machinery, built a desktop nurse-call monitoring system, a flow-based simulation system and has developed a love of finite state machines. For fun, while relaxing from software development, Martin has built a prototype first person shooter in Java and a proof of concept role playing game in a combination of C++ and Lua, published an iPhone game and developed several small algorithms and a couple of small programming languages.

Philosophically, Martin is a proponent of open source and has benefitted by Open Source Software so much that he is now trying to find a way to pay back and make a useful contribution of his own. Recently, with this in mind, he has developed the fairly modest system monitoring language, 'monstate' and intends to publish this as Open Source. At present, in addition to his work in climate data applications, Martin is also working on a browser-based application for a web solutions vendor, some new control software for a local machine manufacturer and, in his spare time, he likes to do a bit of casual iPhone and game programming.

Mr Zhongran Deng, B. Comp. Sc., M. Comp.

Zhongran (Talent) completed his Bachelor degree at the University of Adelaide in 2010 in the field of computer science, during which time he participated in the project of network-on-chip research aiming to find an acceptable solution of network distribution and power consumption of the multi-cores on chip problem.

In July 2011, Zhongran was awarded a Master of Computing specialized in Software Engineering from the Australian National University. His final semester project was the design and implementation of a safety model within the Android framework which was conducted within National Information and Communications Technology Australia Ltd (NICTA) Canberra.

For around 3 years working in Exemplary Energy Partners, Zhongran is now a full time software engineer undertaking the following roles:

- Developing and maintaining software to process and supply quality assured solar and weather or climate data for use in Australian buildings and for the solar industry - in association with CSIRO and Macquarie University and the CSIRO/BOM[ix] Centre for Australian Weather and Climate Research for projected future climates.
- Develop applications in solar energy and weather / climate field (such as PV_OptiMizer App for both Android and IOS systems and AUSOLRAD version 3 for Windows system).
- Development of Rating_Optimizer which enables batch energy ratings of NatHERS-compliant energy rating software by controlling the corresponding scratch files.
- QA of existing weather and climate data either from BOM or any other sources.
- Maintaining and updating the company’s web in WAMP environment.

He is experienced at Java, Android, IOS and VB.net development and is capable of working under the Windows, Mac OS X and Linux environments. His programming skills include objective-C, C++, Java and VB.net.

Mr Chun Yin Wu, B. Eng. (Mech.)

Chun Yin speaks fluent Cantonese and working Mandarin and completed his Bachelor of Engineering at the Australian National University in 2009, majoring in 'Manufacturing and Management Systems' and 'Material and Mechanical Systems'. Chun Yin gained extensive knowledge in Solidworks engineering programs during the design of a transferable vehicle hand control system for the disabled for his honours year project.

Chun Yin has gained experience in building energy simulation through a three-month internship at Beca Carter Hollings & Ferner (SE Asia) Pte Ltd in Singapore in 2008 where he was exposed to the field of sustainable and building engineering. He learned to use the energy modelling software – IES Virtual Environment and developed an understanding of a different Engineering Standard through the completion of engineering calculation and preparation of documents for building assessment.

Since joining Exemplary Energy Partners in 2011 he has broadened those skills to include energy modelling using DesignBuilder and EnergyPlus for commercial buildings and energy efficient products, and residential dwellings energy simulation using the primary NatHERS-compliant energy rating software AccuRate. He also uses THERM^{x} for modelling and imaging heat flow of fenestration systems and other building-related products/systems like insulated slab edges. He is licensed to use BERS Pro and FirstRate5 for House Energy Rating regulatory purposes with an ACT assessor license for proposed dwellings.

ADMINISTRATIVE AND TECHNICAL PERSONNEL

Fran Monahan BEd

Fran has a Bachelor of Education degree from the University of Canberra and a Certificate in Computerised Bookkeeping from the Canberra Institute of Technology. She is also currently completing a Masters degree in Professional Accounting.

Prior to joining Energy Strategies in 2001, Fran worked as a primary school teacher, and prepared and taught lessons to children ranging from Years 1 to 12 at a local education centre. She has also balanced the accounts for a local restaurant, and worked as a receptionist in various clerical / administrative positions. Ensuring the smooth operation of our company Fran is responsible for managing the office including bookkeeping and administration.

Fran’s current duties, with Energy Partners from 2009, include bookkeeping and human resources records and remuneration management.

ENGINEERING AND SCIENCE INTERNS

Exemplary Energy Partners has a proud tradition of engaging with engineering interns over many years in liaison with staff and management at: Australian National University, Australian Solar Energy Society, CSIRO, Ecoles des Mines in both Nantes and Rouen (France) and Macquarie University.

Mr Fangwei Ding

Fangwei is currently a 4th year engineering student in the Australian National University. He is majoring in Mechanical and Material Systems and Sustainable Systems. While studying at ANU, Fangwei familiarised himself with a range of different applications across different field such as Solidworks and ANSYS for mechanical engineering; Matlab, Python and C Language for computer programming; ArcGIS for environmental analysis.

During his studies, Fangwei has collaborated and worked with a number of different stakeholders including the ACT Architects Boards for building structure analysis and solving dwelling upgrade difficulties; ACT Macarthur House for construction supervision and sewage and stormwater management. He was involved in Green Star building design for Community@work in Canberra in the area of energy efficiency and waste management. Fangwei was also an event officer for the ANU International Student Department and had two part-time jobs during this period.

Fangwei recently joined Exemplary as an intern and has been trained in using EnergyPlus to analyse and understand the energy efficiency of different buildings. In collaboration with the CSIRO Oceans and Energy Flagship, he is also manipulating and analysing solar data from satellite observations and ground station measurements for comparative purposes. He is looking forward to obtain more useful skills from Exemplary and prepared for the challenging and exciting projects ahead of him.

Ms Maria Salazar

Maria is in her penultimate year of a Bachelor of Engineering/Bachelor of Arts degree at the Australian National University, majoring in Renewable Energy, Sustainable Systems, and Environmental Studies. Throughout her studies, she has been involved in volunteer work for Engineers Without Borders (ACT Chapter) to raise awareness about humanitarian engineering, and RoboGals, through workshops to encourage young women to enter STEM fields.

Maria has engaged with various stakeholders such as A T Adams Consulting, where she applied technical engineering knowledge and research skills to produce the West Belconnen Ground Source Heat Pump Report 2014; and was awarded a Highly Commendable Certificate of Recognition from the Commissioner for Sustainability and the Environment, for assessment of, and alternatives for, intergenerational equity implementation in the ACT.

Maria started working at Exemplary Energy Partners as an intern in October 2015, and is currently working on the normalisation and analysis of climatic data for NSW, and using EnergyPlus and ASOLRAD to develop climate data sets. She is enthusiastic about future projects and learning more practical skills from Exemplary Energy Partners.

Mr Miao Wang, B. Infor. Tech.

Miao (Chris) Wang is a final year student at the University of Canberra completing a Master of Information Technology degree. He recently joined Exemplary as an intern and has been trained in using software for weather file analysis for the production of climate and weather data. He will focus on rebuilding Exemplary's website and its SEO (Search Engine Optimization). In the future, he will build up and add more functions (applications) in the website to provide more convenience and assistance to our clients. If you have any suggestions or requests, please let us know.

His programming skills include C#, Java, VB.net. He also took the role of maintaining and updating the company's web using PHP and JavaScript.

Mr Otto Lam Hello (2013)

Otto Hello has just finished his 3rd year of a Bachelor of Engineering at the Australian National University. He is majoring in Renewable Energy Systems and Sustainable Systems; both of which he has utilized in his role as a mentor in the AYCC (Australian Youth Climate Coalition) SOS (Switched on Schools) program. He has also been actively affiliated with KTK (Kids Teaching Kids) week as well as the international KTK conferences.

Otto is currently working at Exemplary as an intern and has since been trained in using climate software such as ClimateCypher to develop solar and other weather data for the full range of Australian regions including Quality Assurance checks on the resultant outputs. Otto started his internship by analysing trends in residential sales and rental data within the ACT; observing the relationship between Energy Efficiency Ratings (EER) and asking price within sales and rental offerings and the number of recorded EERs for rental listings. He was also responsible for designing the logo, brochure and promotional video for the new PV OptiMizer Android application and participated in its final stage beta testing and subsequent marketing.

Mr Colin Lemutricy (2012)

Colin was studying for a master's degree at the French engineering school "Ecole des Mines" in Nantes. He was majoring in "Energy Systems Engineering" which includes renewable energies, fluid mechanics and energy efficiency.

Colin was working at Energy Partners and in collaboration with the CSIRO's Weather and Energy Research Unit (WERU) as an intern for three months. His project aimed at optimising the use of the energy produced by photovoltaic solar panels to supply a cooling system in a house. For this purpose he used the "R" language to interpolate half-hourly weather data from measurements at three CSIRO sites in Canberra and employed simulation software packages DesignBuilder and EnergyPlus to simulate the house.

With still one year of study to go, Colin planned to work on the improvement of energy efficiency of buildings, especially for existing buildings.

Mr Daniel Barrett, B. Eng., B. Sc. (2011-12)

Daniel was completing his final year of a double degree in engineering and science at the Australian National University. He was majoring in "Renewable Energy Systems", "Sustainable Systems" and "Global Change Science". During his studies at the ANU, Daniel has gained

experience in working with multidisciplinary groups and developed his knowledge base of renewable energy sources and technology.

Daniel wrote a thesis in 2012 investigating the feasibility of the use of micro-inverters on solar photovoltaic panels with the aim of increasing their efficiency and decreasing the payback period, with the overall aim of increasing their implementation into society.

Daniel has a goal of contributing towards the increased expansion of the renewable energy network within Australia and his work at Energy Partners will provide him an insight into the renewable energy industry.

Mr Ananth Naidu B. Eng. (Mech.) (2010-11)

Ananth (Ant) graduated as Bachelor of Engineering at the Australian National University in 2010 with majors in 'Sustainable Energy Systems' and 'Material and Mechanical Systems'. Then Ananth intends to pursue postgraduate studies in Civil and Environmental Engineering. During his time at ANU, Ananth has gained extensive knowledge in PsPice, Matlab, Solidworks and Strand7 engineering programs with a thesis on the design and optimization of a high efficiency Bunsen burner powered Stirling engine.

During Ananth's time at Energy Partners he has gained experience in using energy analysis software such as DesignBuilder and AccuRate. He has also developed a technical understanding of the Australian Climate Data Bank by performing analytical calculations on these records. He has been engaged in the marketing and distribution aspects of the Australian Solar Radiation Software and Handbook and expects to participate in updates and revisions.

Mr Edwin Thanavelil B. Eng. (Mech.) (2010-11)

Edwin (Eddie) was completing his final year of university studying Bachelor of Engineering at the Australian National University with majors in 'Material and Mechanical Systems' and 'Sustainable Energy Systems'. During his studies at ANU, Eddie has gained extensive knowledge in Solidworks, and PsPice engineering programs along with his study in solar technologies. Eddie was also completing a thesis with Birrigai Outdoor School to design and build passive solar cubby houses for primary school students.

Eddie has also conducted a sustainability outreach program for ANU Students Association building during his internship with ANU Green, reporting on the energy consumption trends and enhancements for the association's building. During his employment with Energy Partners, Eddie has gained experience in using software such as DesignBuilder and EnergyPlus for building energy simulations. He has also developed a concrete understanding of the Australian Climate Data Bank by performing analytical calculations on these records and researching and comparing historical data sets prepared with a range of techniques being developed by Energy Partners.

Mr Yuelin Wang B. Eng. (Mech.) (2010)

Yuelin was completing his fourth year of university, studying a combined degree of a Bachelor of Engineering/Bachelor of Commerce at the ANU. He has developed a strong interest in energy efficiency and environmental sustainability as well as completing majors in sustainable energy systems, manufacturing and management systems, materials and mechanical systems and in Finance. During his studies at ANU Yuelin has gained experience with several professional engineering design and analysis programs including carrying out a FirstRate energy rating on his home and computer modelling of solar cell operation using the program PC1D.

During his employment with Energy Partners he gained experience with researching, handling large data sets and capable of running simulations in the house energy rating software package AccuRate (beta and commercial versions, manual and batch) as well as the analysis of climate data and its relationship with house energy performance. He also undertook training in DesignBuilder with EnergyPlus software for building energy simulation.

Mr Hai Le B. Eng. (Mech.) (2010)

Hai graduated from the Australian National University with Bachelor of Engineering Degree. During his time at anu Hai has actively participated in many engineering activities and as such he has become a member of the Engineering Students Association. His time at ANU has allowed hai to gain a significant understanding of technical and practical aspect of engineering. Hai's proficiency in engineering is demonstrated through his excellent knowledge of most demanded engineering software applications such as Strand7, PsPice, SolidWorks and Matlab. Hai has demonstrated particular in the field of solar energy and has participated in the 2009 World Solar Challenge with ANU's flare solar car.

During his time at Energy Partners Hai applied his engineering knowledge effectively to accurately understand and analyse Energy Plus and Accurate energy software. He is also proficient at handling large quantities of climate data to run multiple simulations for analysis.

Ms Orianne Budai (2010)

Orianne was a final year engineering student at the Ecole des Mines in Rouen. She worked jointly with the Australian Solar Energy Society and Energy Partners and also spent a two week secondment at the Centre for Appropriate Technology - Bushlight in Alice Springs NT.

Mr Paul O'Brien (2009)

Paul graduated from the Australian National University with a combined Bachelor of Engineering/Bachelor of Science degree. He completed two majors within the engineering degree, Material and Mechanical Systems and Mechatronic systems and a major in chemistry within the science degree. During his time at university, Paul has developed a strong interest in renewable energy technologies, energy efficiency and environmental sustainability. In 2009, Paul will completed his final year project based upon an exergetic analysis of a compressed water steam flashing storage system for implementation into a solar thermal power plant.

Since joining Energy Partners, he has gained experience with researching, handling large quantities of data and capable of running simulations in the house energy rating software package AccuRate (beta and commercial versions, manual and batch) as well as the analysis of climate data and its relationship with house energy performance. He has also conducted analysis and verification of clear sky radiation models.

Ms Miranda Bone (2009)

Miranda was completing her third year of a bachelor of Human Nutrition at the University of Canberra. She has a keen interest in energy efficiency and environmental sustainability, having been an office bearer in the Environmental Society of the UC for her last year, as well as running tutorial sessions in Biology. While working with Energy Partners, Miranda gained experience in analysing house price data to compare it with energy efficiency ratings of the houses. She also

worked with the Australian Climate Data Bank forty year weather records, as part of the Quality Assurance process.

Mr Thomas Ratcliff (2009)

Thomas was completing his final year of a Bachelor of Engineering degree at the Australian National University. He was completing two majors within this degree, Sustainable Energy Systems and Material and Mechanical Systems. During his time at university, Thomas developed a strong interest in renewable energy technologies, energy efficiency and environmental sustainability. In 2009, Thomas completed his final year project based on characterising the performance of 'Sliver' solar cells at extremely low temperatures.

While with Energy Partners, Thomas gained experience in the use of house energy rating software First Rate and AccuRate and participated in the validation for future versions of AccuRate, applying them to evaluation projects relating to high performance fenestration as well as to conventional design and constructions. He also gained experience performing calculations and analysing large amounts of data from the Australian Climate Data Bank forty year weather records. Also, he was engaged in commercial energy audits in which the potential for cost and energy savings are measured against historical energy consumption and commercially accepted benchmarks. He also undertook training in DesignBuilder with EnergyPlus software for building energy simulation.

RECENT PROJECTS OF EXEMPLARY ENERGY AND ENERGY PARTNERS

Exemplary Energy and Energy Partners are trading divisions of Exemplary Investments Pty Ltd. Founded in 1989, Energy Partners merged with Energy Strategies and Chalkley Consulting in 1999 to serve as a division of Energy Strategies Pty Ltd until early 2009. Significant projects carried out by the Energy Partners and Exemplary Energy teams include:

- In association with the Association for Computer Aided Design – Building Services Group (ACADS-BSG) provide weather, climate and energy data services to the construction design industry including Real Time Year (RTY) weather data services for advanced simulation and Ersatz Future Meteorological Years (EFMYs) for a range of worldwide greenhouse gas emission scenarios for 2030 and 2050. (2015 and ongoing)

- In association with the CSIRO's Oceans and Atmosphere Flagship, analysed the reliability of the hourly solar radiation data published by the Bureau of Meteorology in gridded data sets by comparing them in detail with coincident ground based measurements carried out by both the Bureau and the CSIRO. (2015)

- Enhanced the output of the Home Energy Rating_OptiMizer (HERO) to assist in applying it to optimisation problems and expanded its utility for the popular BERS Pro and FirstRate5 software packages. (2015)

- Produced and published an iOS version of the PV_OptiMizer and applied the results to enhancing the functionality of both versions. (2015)

- Developed in house software for batch file handling of NatHERS accredited home energy rating software packages. Called the Home Energy Rating_OptiMizer (HERO), the software is available as a bureau service. (2014)

- For Sustainability Victoria and in collaboration with Sustainable Energy Transformation and the University of Tasmania, provided an analysis and evaluation of the impacts on energy, cost, health and comfort benefits when 11 selected energy efficiency measures, which are of superior level than the National Construction Code (NCC) minimum requirements, are applied to typical house renovation projects in Victoria. Also the benefits from upgrading the heating/cooling appliances, solar hot water and solar PV systems are evaluated. The NatHERS accredited software AccuRate is used in this project for evaluating improvements to the construction of the houses. The work has been incorporated in Sustainability Victoria's Smarter Renovations website[xi]. (2013-14)

- For Ventis and Australian Urethane and Styrene (Cupolex), carried out detailed simulations for the SubFlow concept: linking ceiling heat extraction fans (Ventis) with formed voids under a concrete slab floor (Cupolex) to form a low energy heating and cooling system. Simulations were done for the five markets (Melbourne, Sydney, Canberra, Brisbane and Townsville) and were carried out to compare the heating and cooling consumptions, and the first and last Cupolex pod temperature of the house model using the following three different modes to cool the Cupolex slab (for heating,

roof air is the only air source in all three modes): Roof air only; Roof and outdoor air; and Outdoor air only (2013)

- The thermal performance of the Smartslab suspended floor slab systems were evaluated by comparing the simulation results of an identical house model with identical house design superstructures. These were used for all comparisons with three commonly used floor slab systems CSOG, Waffle Pod R1.0 and Waffle Pod R0.5. (2013)

- Produced and published the PV_OptiMizer[xii] smart-phone application for lay and professional use, applying the device's compass and tiltometer to calculate solar PV output on existing or selected roofs. Calculations are in accordance with the CEC published Guidelines so the tool is capable of professional use once the in-app payment is made to allow editing of system characteristics. (2013)

- Initiated a Real Time Year (RTY) weather data service for advanced simulation and building energy system maintenance applications in June 2013. (ongoing)

- Carried out a wide range of Energy Efficiency reviews for BCA Section J compliance purposes including advanced simulation techniques under verification method 3 methodology (JV3) using DesignBuilder and EnergyPlus software packages to allow cost effective solutions as a client saving relative to the costs associated with the blunt Deemed To Satisfy (DTS) methodology. (ongoing)

- Provided tailored climate data sets for private clients including real time weather data for ongoing system performance checking, forecast future climate data and extreme weather sets for concept testing at the design stage. (ongoing).

- Provided a domestic scale design and documentation service for new and existing dwellings with a theme of passive solar attributes and energy efficiency using low environmental impact materials and techniques (ongoing from 2001).

- Produced a revised and expanded edition of the Australian Solar Radiation Data Handbook (ASRDH) and its associated software AUSOLRAD to incorporate 80 locations, updated climate data and tables for clear sky conditions. (in process).

- Produced ersatz future climate data files for use in the design of buildings and assessment of their energy consumptions for 80 locations across Australia. Future climates for 2030 and 2050 were based upon climate model predictions supplied by CSIRO for a range of GHG emission scenarios (2013).

- Using advanced thermal simulation techniques, evaluated the household heating energy savings of specialised Luxaflex insulating window furnishings for Hunter Douglas (2013).

- Using advanced thermal simulation techniques including detailed 2-D modelling of heat flux and temperature gradients for edge effects, evaluated the performance of several novel floor constructions and fan-assisted heat distribution techniques for innovative clients in the building industry (2012 and 2013).

- Provided detailed solar radiation data for 100 locations to the Clean Energy Council (CEC) for application by its members in PV system sizing in accordance with the CEC's Guidelines: *"Grid-connected solar PV systems (no battery storage) Design guidelines for accredited installers"* (2012).

- In association with Pitt and Sherry, Davis Langdon, Engineering Solutions Tasmania and Energy Efficient Strategies, prepared the benefit cost analysis of increasing the energy efficiency of new buildings in a project for the Department of Climate Change and Energy Efficiency (DCCEE) called *Pathway to 2020 for Increased Stringency in New Building Energy Efficiency Standards.* In that project Energy Partners simulated the performance of an archetypical three-storey office and a supermarket at current (BCA 2010) standards, a 40% improvement, a 70% improvement and a nett zero energy version incorporating on site renewable energy generation. This analysis covered all 8 capital cities and included the sizing and cost of peak load effects as well as the reductions in annual energy consumption. (2011)

- In association with Centre for International Economics (CIE) and Pitt and Sherry, contributed to the report for Master Builders Australia *"Energy-efficiency: building code star-ratings - What's optimal, what's not"*. This work included the costing of enhancements to the construction of houses and simulating their impacts using AccuRate and including those associated with improved heaters, coolers and ductwork which are not included in the NatHERS software or rating scheme. (2010)

- Produced ersatz future weather files for use in the design of buildings and assessment of their energy consumptions across a selection of locations around Australia for the Department of the Environment, Water, Heritage and the Arts (DEWHA). Future climates for 2030 and 2050 were based upon climate model predictions supplied by CSIRO for a range of GHG emission scenarios and the impacts on buildings estimated by simulations using EnergyPlus for offices and AccuRate for housing. (2010)

- In association with Pitt and Sherry, carried out assessment of the effects of an updated set of weather files on house energy star rating bands for 12 new climate zones across Australia using AccuRate for the Department of the Environment, Water, Heritage and the Arts (DEWHA). (2010)

- In association with Viridis E3, undertook performance analyses of archetypical office buildings in 12 locations covering all 8 BCA climates to establish any regulation-useful alignment of the Building Code of Australia (Section J) and NABERS Energy (4-stars commitment agreement) for the Department of the Environment, Water, Heritage and the Arts. (2009).

- Using advanced thermal simulation techniques, evaluated the energy savings of specialised Luxaflex insulating window furnishings for Hunter Douglas (2009).

- In association with Fenestralia, undertook performance analyses of a wide range of window systems and house designs in 17 archetypical climates in both standard and "worst case" (no eaves or window furnishings) formats. From the results of those simulations, developed algorithms for describing the effective performance of those window systems. (2009).

- Participated as a team member on the project for the Australian Department of Environment, Water, Heritage and the Arts (DEWHA) and the New Zealand Energy Efficiency and Conservation Authority (EECA) to develop house sustainability rating tools based on the house energy rating tool AccuRate. (2009)

- Undertook an energy audit and benchmark analysis on a resort heated and enclosed swimming pool in Jindabyne, NSW, altitude 900 m. (2009)

- Under the overall project to prepare an ANZHERS based on the Australian house energy rating software AccuRate, validated the new NFRC version of the software and provided a sample of performance results for the team to set the star bands (2009).

- Updated and enhanced the Australian Climatic Data Bank (ACDB) for the Australian Department of Environment, Water, Heritage and the Arts (DEWHA) to specifications set by CSIRO and the Bureau of Meteorology expanding the set to 80 locations and preparing the MakeACDB software and map for ongoing use (2008)

- In association with Collins Caddaye Architects, prepared a review of the potential to enhance the sustainability of a large heritage-listed house in Canberra (2008).

- Carried out bulk simulations (energy efficiency ratings) for new homes in Adelaide for a project home builder wanting to optimise the energy efficiency of the design set offered (2008).

- Carried out a 5 Star Evaluation study for Sustainability Victoria where a range of builders' 4 star designs were optimally upgraded to 5 star standard using FirstRate4 to maximise their cost effectiveness in light of actual market constraints of client acceptability and cost (2008)

- Peer reviewed the climate data sets prepared by others for use in New Zealand for the Australian and New Zealand House Energy Rating Scheme (ANZHERS). Team members included Brett Stokes (Adelaide Applied Algebra), Dr Mike Donn (Victoria University of Wellington, NZ) and Drury Crawley (Department of Energy, USA) (2008).

- Scoped the potential of the existing buildings and grounds and developed a brief to prepare a renewable energy plan for the Wollongong and Innovation Campuses of the University of Wollongong (2008).

- Advised ActewAGL on projected electricity costs to 2050 comparing a range of scenarios for the cost of carbon emissions and mandatory renewable energy target fractions as they might impact the costs and infrastructure selections for new water supply options for Canberra, some of which have large pumping energy implications (2007).

- Prepared a detailed analysis for the Environmental Defender's Office of the embodied and operational energy use, greenhouse gas emissions and water consumptions of a high-rise mixed use development proposed for inner Sydney. That report was presented as evidence in the NSW Land and Environment Court (Proceedings No 40186 of 2007) in July 2007.

- Using the Deemed to Satisfy and alternative verification methods, established the compliance of novel commercial and residential buildings with the energy efficiency provisions (Section J) of the BCA for clients in Canberra including Rolfe BMW, Rolfe Audi, Rolfe Honda, Oasis Leisure Centre, Manny Landmark Centre and Mirinjani Nursing Home (ongoing).

- Prepared a regulatory impact statement for the NT Department of Planning and Infrastructure, for the possible application of the energy provisions of the BCA in the NT. This work was done in association with Artcraft Research (householder surveys), QS Services (cost advice), and BRANZ (economic analysis) and covered provisions for housing and commercial/institutional buildings in BCA climate zones 1 (Darwin) and 3 (Alice Springs). (2007)

- For the Commonwealth's Office of the Renewable Energy Regulator, in association with the ANU's Centre for Sustainable Energy Systems, analysed and reported on the impact of sun-tracking and radiation concentrating systems on the outputs (and hence the deemed RECs) of small photovoltaic systems (2007).

- For the Forest and Wood Products Research and Development Corporation, analysed sets of timber floored dwellings to generate rules-of-thumb for improving existing designs with a 4-star energy rating to enable them to meet the new 5-star requirements of the BCA in all 8 BCA climate zones and all Australian capital cities (2006). The report was published at www.fwprdc.org.au in November 2006.

- Updated and enhanced the Australian Climatic Data Bank (ACDB) for the Australian Greenhouse Office to specifications set by CSIRO and the Bureau of Meteorology for use in building and engineering energy simulation software through the creation of Typical Meteorological Years (TMY) for 69 locations within Australia (2005). Mapped those 69 "climate zones" for application in house energy rating software (2007).

- Enhanced the Australian Solar Radiation Data Handbook (ASRDH) and its associated software AUSOLRAD by expanding its electronic data handling potential and adopting the more reliable data collected since 1986 (2005). Subsequently, prepared the resultant report and tables for publication and distributed these under contract with the publisher, ANZSES (2006) – www.anzses.org.

- In an integrated trial and validation process for the Australian Greenhouse Office and in liaison with the CSIRO, tested the 2nd Generation NatHERS software (AccuRate) by generating comparison file "triplets" in FirstRate, NatHERS and AccuRate of over 150 dwellings and analysed their "ratings" in all 28 NatHERS climate zones. For each of those homes, uninsulated and thermally enhanced versions were created to extend the range of house types to ensure validation for use in rating poorly performing old stock and high performing new stock. In all, nine software versions of each dwelling were simulated in 28 climates making almost 40,000 simulations run and analysed (2003-6).

- As a special project in the validation of AccuRate, surveyed in detail 15 homes in the Canberra climate and simulated their households' heating and cooling energy

consumptions using real-time weather data pre-processed to the ACDB format for use in the software (2006).

- In association with Syneca Pty Ltd, provided detailed simulation and advice services to the Australian Building Codes Board for the revising of the Regulatory Impact Statement for the proposed tightening of the energy provisions for housing (Class 1 buildings) in the BCA to take effect in May 2006.

- For the Australian Greenhouse Office, provided a detailed analysis of the cost effectiveness and GHG emissions of the full range of water heating systems currently significant in the housing stock and/or in the sales of new appliances (2005).

- In association with Arup Façade Engineering, applied the current version of the 2nd Generation NatHERS software and the sample set of 471 dwellings to establish Heating and Cooling Caps for application in the BASIX residential approval website in NSW to restrict approval to those designs that are not heavily skewed in their energy efficiency to either the heating or cooling seasons (2005).

- Carried out an audit for the ACT Planning and Land Authority of all the FirstRate ratings undertaken in the ACT in calendar 2003 including statistical analysis of all ratings submitted for audit using the batch processing functionality of FirstRate and a detailed audit (with quality assurance) of a randomised sample of those ratings (2005).

- Provided full service Energy Efficiency Ratings using the ACTHERS (initially), FirstRate and NatHERS software packages for home sellers under the Energy Efficiency Ratings (Sale of Premises) Act 1997 until July 2004 and under the Civil Law (Sale of Residential Property) Act 2003 from that time and for home designers from 1996 under the ACT House Energy Rating Scheme and continues to provide FirstRate ratings for new homes and apartment complexes in the ACT and NatHERS ratings for new residential buildings in south-east NSW.(ongoing)

- For the Australian Greenhouse Office, in association with BRANZ, Artcraft Research, ANU-NCEPH and CSIRO, produced and applied ersatz climate data sets for key cites as forecast by CSIRO for 2030 and 2070 for simulation and analysis of the likely impact of climate change on the performance, energy demand and peak loads (or outputs) of buildings and energy systems like solar water heaters and photovoltaic (PV) panels (2005). Published in 2007 at
http://www.greenhouse.gov.au/impacts/publications/buildings.html

- For the Australian Greenhouse Office, conducted computer simulation of the eleven main types of water heaters and collated data on their distribution geographically, climatically and socio-economically to analyse the trends and stock of water heaters to estimate their collective greenhouse gas emissions and scope for reductions in the near term (2005).

- For the Association of Building Sustainability Assessors (ABSA), conducted scoping studies of BASIX for houses, comparing the proposed simplistic DIY version with the more rigorous Thermal Comfort assessment using 2nd Generation NatHERS software (AccuRate being used for these comparisons) for presentation to the NSW Department of Planning (2005).

- Provided a Level 2 Energy Audit of the ACT Therapy Complex in the suburb of Holder in accordance with Australian Standard AS/NZS 3598:2000 and provided design development input to the multi-disciplined team for the energy efficient major refit of this building (2005).

- Provided a Level 1 energy audit of the ACT Aboriginal Cultural Centre, Yarramundi (previously the interim National Museum of Australia) in accordance with AS3598:2000 (2004). Provided a Level 2 energy audit of the same premises over the period February to May 2005 to measure the building performance in hot and cold weather conditions (2005).

- Provided an Environmental Audit in accordance with AS/NZS ISO 19011:2003 of the design development by Daryl Jackson Alastair Swayn for a new laboratory building and the extensive refit of its existing neighbouring laboratory and office buildings for CSIRO Entomology Division within its Black Mountain complex in the ACT (2005).

- Provided detailed thermal simulation and energy efficiency advice to the architects (Interiors Australia) on the alterations and additions to the St Peter Chanel School in Yarralumla ACT as part of its conversion to an environmentally benign conference centre (2004).

- Provided as a sub-consultant to Exergy Pty Ltd, an Australian Building Greenhouse Rating (ABGR) of eight NSW Government country offices: Albury, Condobolin, Cootamundra, Eden, Griffith, Narrandera, Wagga Wagga, Young (2002).

- Provided an Australian Building Greenhouse Rating (ABGR) of Lovett House (Woden, 22 storeys) and IBM House (Barton, 3 storeys), retaining the services of accredited ABGR assessor and mechanical engineer, Michael Pines (2003).

- Provided a comparison of NatHERS and FirstRate for the Australian Greenhouse Office (AGO) to inform the current debate about the energy efficiency provisions in the BCA. It did not seek to compare the accuracy of the programs but rather the algorithms and assumptions both within the programs and within the conventions employed by trained users of the respective software packages (2002).

- Provided a comparison of NatHERS, AccuRate and FirstRate for the Australian Greenhouse Office (AGO). In particular, provided a test routine for the AccuRate software (the then proposed replacement for NatHERS) including its advanced ventilation algorithms by dual ‘rating’ over 200 houses of varying size and design concept from all over Australia (2001-6).

- Undertook an audit for the ACT Planning and Land Authority of all the residential energy ratings (at time of sale for existing homes and at development approval stage for new homes) performed in the ACT in calendar 2003 (2004).

- Carried out thermal simulations for the new wing of the Bruce Hall student residence, at the Australian National University (ANU). Subsequently energy rated each residence based on the final sketch plans provided by Cox Humphries Moss architects (2002).

- Through advanced simulation techniques, advised Environment ACT of the likely greenhouse impact of the widespread adoption of solar water heating, low flow shower heads and retrofit wall insulation (2002).

- For the Fibreglass and Rockwool Insulation Manufacturers' Association (FARIMA) carried out detailed performance and cost studies on the levels of insulation recommended for adoption in the BCA (2002).

- Provided energy efficiency advice and simulation input to the design of major extensions to the Coombs Building, ANU (2003).

- Installed a monitoring system in 2002 for two years to evaluate the performance of the solar heating water heating and evaporative cooling system in the Tidbinbilla Visitor Centre including a program of measurement and interpretation of temperatures, irradiation (both global and as incident on the system's collectors), humidity and gas and hot water consumption (2005).

- Evaluated the thermal effectiveness and economic attractiveness of a range of window glazings and treatments for ACT Housing (2002).

- Energy audit and renewable energy business plan for the Biosphere 2 installation of Columbia University near Tucson, Arizona, USA (2001).

- Measured, simulated and recommended solutions for non-air-conditioning solutions to overheating problems in the three wings of the Law Building, ANU, and the Woolley and Duffield Buildings on the ANU's Mt Stromlo Campus (2001).

- Feasibility study environmentally exemplary master plan for the Narrabundah and Downer complexes of CREEDA, the Capital Region Enterprise and Employment Development Association, including adjoining sites.

- Simulated the performance of high performance single glazing technologies in the Perth climate for Pilkington and reported on their energy and environmental impacts (2001).

- Analysed the key thermal criteria (roof/ceiling, wall and floor insulation and window size) for establishing draft energy regulations for the housing provisions of the Building Code of Australia, completed in association with BRANZ (2001).

- Cost Benefit Study of possible mandatory energy efficiency provisions for Class 1 buildings (houses and townhouses) in the Building Code of Australia (BCA) for the Australian Greenhouse Office (AGO) and the Australian Building Codes Board (ABCB), in consortium with BRANZ and Northcroft (2001).

- Thermal simulation of shading alternatives for key areas of the CS Christian office/laboratory building for the CSIRO, to reduce peak temperatures without the installation of air conditioning, in association with TT Architecture (2000).

- Energy audit of the Canberra Club building, Canberra (2000).

- Thermal simulation of shading alternatives for key areas of the John Dedman office building for the ANU, to reduce peak temperatures without the installation of air conditioning, in association with Bunning and Madden Architects (2000).

- Provided detailed assessment of embodied energy, energy efficiency and environmental impacts and thermal performance simulation of the award-winning Tidbinbilla Visitor Centre in collaboration with the design architects, TT Architecture, for Environment ACT. The work included the design of a novel integrated solar space and water heating system as well as a full elemental analysis of the embodied energy of the proposed building (2000).

- Consulting building scientists to the design team for the proposed new Canberra headquarters for the Australian Geological Survey Organisation - an office laboratory complex of 35,000 m^2. Contributed to the simulations and design of daylighting and low energy climate control systems, building siting and co-generation. The design process required detailed simulations being conducted using BUNYIP, CHEETAH, SHADING, SUPERLITE, TEMPAL, TEMPER, tsbi 3 and WINDOW. These were supplemented by purpose made programs written in EXCEL specifically for the project.

- Conducted a stringency analysis for the ACT Government of the relative ratings of dwellings using the ACTHERS software and the FirstRate software (emulating NatHERS version 2.31). This was done using both mass re-rating of nearly 1000 homes using the FirstRate in batch mode and the selective manual re-rating of 30 dwellings chosen to score just over 10 points (the current “pass” mark) in the soon to be superseded ACTHERS software (completed 2001).

- In consortium with George Wilkenfeld and Associates and Artcraft Research, evaluated the effectiveness of mandatory house energy rating and mandatory disclosure of that rating at the time of sale in generating energy and greenhouse gas emissions reductions (completed in 2001).

- Evaluated the market and energy/greenhouse gas emission impact of the second phase of the Window Energy Rating Scheme (WERS) for the Australasian Window Council and the Australian Greenhouse Office (completed in 2001).

- In consortium with Energy Efficient Strategies, evaluated the energy and greenhouse gas emission impact of the Victorian regulations mandating basic insulation of new housing construction (completed in 2000).

- Energy audits to the exacting standards of the Commonwealth's Enterprise Energy Audit Program (qualifying for the Government subsidy, usually 50%) have been completed on:

    - Burton and Garran Hall, ANU
    - Bruce Hall, ANU
    - RSL Club, Deniliquin, NSW
    - John XXIII College, ANU
    - AIDAB tenancy, AIDAB House, Canberra (now called AusAID)

- Australian Bureau of Statistics tenancy, Cameron Offices, Canberra
- ACT Health Facilities at Rivett, Holder, Phillip, Kippax and Tuggeranong
- Australian Automobile Association headquarters building, Canberra
- Energy Research and Development Corporation tenancy, Baillieu House, Canberra
- HMAS Harman, Symonston facilities, Canberra

- Detailed monitoring of the energy and thermal performance of advanced solar design houses as a scientific study and for evaluation purposes for the ACT Housing Trust including a trial of the Short Term Energy Performance (STEP) technique or "bake-out". Analysis of 30 months of detailed monitoring data commenced in June 1995.

- Computer simulation of the energy and thermal performance of houses for the ACT Housing Trust including the detailed interpretation of a pair of dual occupancy houses in Hughes which are identical except for specific energy saving modifications to construction elements carried out in one of them only. Subsequently, carried out a detailed analysis of the short term winter monitoring results obtained by staff of the ACT Department of Urban Services before the houses were occupied and reported on their conclusions.

- Design and installation oversight of replacements for the original convector heating units in Bruce Hall, ANU.

- Design and implementation oversight of upgrade of hot water service and heating systems and controls for more effective and efficient operation in Burton and Garran Hall, ANU.

- Editing and technical management of the fully revised third edition of the "Australian Solar Radiation Data Handbook" for the Australian and New Zealand Solar Energy Society and the Energy Research and Development Corporation. The Handbook, including a full set of tab delimited data files on disk, was published by ERDC in April 1995.

- Brief preparation for consultants to provide a public consultation document on *"Electricity Futures"* for the ACT Electricity and Water Authority.

- Preparing simulated performance data on the energy upgrading of detached houses and presentation materials based on those results for a series of seminars run by the Australian and New Zealand Solar Energy Society with Commonwealth funding through its Local Energy Efficiency Program (LEEP).

- Reviewing the energy consumption and expenditure reporting for Commonwealth-occupied buildings managed by Australian Estate Management in Canberra and devising and implementing a common reporting system to allow AEM to demonstrate its efficiency improvements for inclusion in their Annual Reports.

- Consultancy to ACT Electricity & Water (now ActewAGL) in design and layout of sensor network for monitoring the energy and comfort performance of demonstration Resource Efficient Housing in the Canberra suburb of Nichols.

- Researched and reported on dwelling occupancy patterns and heater/cooler use in the ACT for input to simulation studies toward the National House Energy Rating Scheme (NatHERS).

- Integrally with the energy audit of the Energy Research and Development Corporation (ERDC) tenancy in Baillieu House, Canberra, using the program DOE-2, dynamically simulated the interaction of daylight controlled electric lighting with the HVAC system to establish the net energy impact of the strategy, fully accounting for the resultant decrease in cooling energy and increase in heating energy that the daylight system provides.

- In association with Cox Architects and Planners, provided expert thermal and lighting services advice to the planning stage of the New Graduate House project for the Australian National University and provided detailed thermal simulation of construction and fenestration alternatives during design development.

- Provided industry sector advice to CADDET Australia on renewable energy and energy conservation in the built environment over 1997-9. CADDET is the International Energy Agency's Centre for the Analysis and Dissemination of Demonstrated Energy Technologies.

- Provided executive services to the Sustainable Energy Industries Council of Australia for the last quarter of 1997.

- Trained Accredited Assessors and non-accredited users of the ACTHERS tabular and software-based rating systems for the mandatory House Energy Rating Scheme in the ACT.

- Carried out the role of Technical Advisor to the ACT Planning Authority and later for the division of Planning And Land Management of the Department of Urban Services to handle technical enquiries and difficulties in the first few years of the mandatory House Energy Rating Scheme (ACTHERS).

- Generation of window energy ratings for residential applications, as an Accredited Simulation Assessor, under the Australasian Window Council's Window Energy Rating Scheme (WERS) formally launched in September 1996.

- In consortium, carried out a field audit of the ACTHERS for the Building, Electrical and Plumbing Control (BEPCON) division of the ACT Department of Urban Services over the period July to September 1998.

- In consortium, carried out a public and stakeholder consultation on behalf of PALM for the introduction of the Energy Efficiency Ratings (Sale of Premises) Act 1997 which requires the energy rating and advertising of the rating of all houses offered for sale in the ACT, originally from the end of 1998 but later deferred to start at the end of March 1999.

- In consortium, carried out on behalf of PALM a full review of the ACT House Energy Rating Scheme including its application and relationship with similar schemes

elsewhere in Australia, reporting to the ACTHERS Review Steering Committee established by PALM to represent all stakeholder interests.

- In 1998, in consortium with Energy Efficient Strategies, analysed the 28 NatHERS climate zones into 5 climate groups and then performed the parametric simulation in each of the five groups of an archetypal detached and attached house plan to develop a baseline for greenhouse gas emissions for the residential sector to 2010 related to the postcodes in the climate groups and the number of households (Australia Post residential delivery points) within each group. This work was published as *"Australian Residential Building Sector Greenhouse Gas Emissions 1990-2010"*, Australian Greenhouse Office, Canberra, 1999.

- Incorporating the then current version of the NatHERS software (version 2.12), assisted in developing the second version of the national Window Energy Rating Scheme (WERS) for the Australasian Window Council in 1999.

- For the Australian Greenhouse Office, conducted computer simulation of small electric water heaters to analyse the means by which their standing losses could be reduced by 30% - as had been done for the larger models for the introduction of a Minimum Energy Performance Standard (MEPS) in October 1999.

- From April 1999 to November 2002, conducted inspections and energy rating of houses for sale in the ACT using the ACTHERS software as required under the Energy Efficiency Ratings (Sale of Premises) Act - 1997 which came into effect in the ACT in April 1999. Since July 2001, the FirstRate software package superseded ACTHERS and has been used for such ratings.

- Energy rated over 100 houses for the Defence Housing Authority (and their suppliers) in the early implementation phase of the requirement to ensure that all new acquisitions from January 1999 were rated 4 star or better using the NatHERS rating software.

GLOSSARY of SOURCES

[i] http://members.ozemail.com.au/~acadsbsg/versions_files/PUAN_BEAVER.pdf
[ii] http://members.ozemail.com.au/~acadsbsg/versions_files/PUAN_CAMEL.pdf
[iii] www.designbuilder.com.au
[iv] http://apps1.eere.energy.gov/buildings/energyplus/
[v] http://www.trnsys.com/
[vi] http://nathers.gov.au/software/
[vii] https://www.basix.nsw.gov.au/basixcms/
[viii] http://www.solarlogic.com.au/bers-pro/details
[ix] Bureau of Meteorology
[x] http://windows.lbl.gov/software/therm/therm.html
[xi] www.sustainability.vic.gov.au/smarter-renovations
[xii] https://play.google.com/store/apps/details?id=com.ep_android2