CONFERENCE HANDBOOK
and
PROGRAMME

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The New Zealand Society for Sustainability Engineering and Science (NZSSES), as hosts to the Inaugural International Conference on Sustainability Engineering and Science, is a new Technical Interest Group that operates under the auspices of IPENZ, The Institution of Professional Engineers of New Zealand.

The AGM of NZSSES will be held at the conclusion of the conference.
NZSSES Membership forms and Nomination forms for the National Committee are included in your blue folders.

Establishment Committee members of NZSSES are:

Dr Carol Boyle, Chair, Deputy Director, ICSER,
Civil and Environmental Engineering,
The University of Auckland. Email:c.boyle@auckland.ac.nz

Ir Ron McDowall, Director, ICSER,
The University of Auckland
Email: r.mcdowall@auckland.ac.nz

Norman Firth, Fraser Thomas Ltd
Email: nfirth@ftl.co.nz

David Kettle, Maunsell Ltd.
Email: david.kettle@maunsell.com

Dr Jane Harman, UNITEC
Email: jharman@unitec.ac.nz

Helen Shaw, URS New Zealand
Email: helen_shaw@urscorp.com

John Gardiner, Deputy CEO, IPENZ
Email: gardiner@ipenz.org.nz

Dr John Peet, Canterbury University
Email: j.peet@canterbury.ac.nz

Distinguished Professor Roland Clift,
University of Surrey, England,
Email: r.clift@surrey.ac.uk

ACKNOWLEDGEMENTS

The NZ Society for Sustainability Engineering and Science wish to thank all keynote speakers, sponsors and delegates for supporting this conference.

The members of the Establishment Committee would like to acknowledge their respective employers for supporting the member's commitment to the Society during the lead up to the Conference.

NZSSES would like to acknowledge the following companies for their assistance with the conference

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GENERAL INFORMATION

If you require assistance with anything during the conference either contact someone on the registration desk when attended *OR*
Visit the "Aucklander" Boardroom (see map) *OR*
Phone Vicky on mobile 025.230.5365

Please advise if you wish us to book shuttle transport to the airport.

The Proceedings of the Conference are on the CD included in the back pocket of this Handbook. Printed Proceedings will not be provided. The CD includes the Parallel Papers. Should you require copies of any keynote speaker speech notes, please complete the form in your blue folders.

Don't forget the Conference feedback report in your blue folders.

Reminder:
Check out at the Sheraton Hotel is 11am on day of departure.
Check out at the Quest Apartments is 10am on day of departure.
There is a luggage store available at the Sheraton Hotel.

MAP OF SHERATON

PROGRAMME

6-9 July 2004
Sheraton Hotel and Towers
Symonds St, Auckland. New Zealand

TUESDAY 6 July 2004		**ARAWA ROOM PRE-FUNCTION AREA**
5.00 pm 6.00-8.00 pm	**REGISTRATIONS OPEN** **OFFICIAL RECEPTION** Powhiri by Haka the Legend	Welcome **Ron McDowall** Director, ICSER, NZ
	Meet and greet international guests and keynote speakers	Guest speaker **Gwen Bull, JP,** Chair, Auckland Regional Council,
WEDNESDAY 7 July 2004 **OPEN PLENARY SESSIONS**		**ARAWA ROOM** **Morning Session**
8.00 am	REGISTRATION DESK OPENS	
8.45 am	**Master of Ceremonies** Welcome	**Dr. Carol Boyle** Chair NZSSES
9.00 am	Official Opening	**Hon Marian Hobbs** Minister for the Environment, NZ
9.30 am	Keynote speaker 1 *A Pragmatic Approach to Sustainability*	**Dr Robin Batterham** Chief Scientist, Australia
10.00 am	Keynote speaker 2 *Engineers As Leaders In The Transition To A Sustainable World*	**Dr Ian Parton** President IPENZ
10.30-11.00 am	Morning Tea Break	

WEDNESDAY – 7 JULY 2004 –continues		
11.00 am	Keynote speaker 3 *The Paradigm Of Sustainable Development And The Changing Role Of The Technical Specialist*	**Distinguished Professor Roland Clift**, OBE. Centre For Environmental Strategy, University of Surrey, UK
11.30 am	Keynote speaker 4 *Building capacity for sustainable development*.	**Professor Dr Ir. J.L.A. Jansen** Commander in the order of Oranje Nassau, Retired (formerly Delft University of Technology)
12 noon	Keynote speaker 5 *Engineering without Frontiers*	**Professor Paul Jowitt**, Scottish Institute of Sustainable Technology.
12.30 -1.30 pm	Lunch	
1.30-3.00 pm	**PARALLEL PAPER SESSION 1**	
Note: *Presentations will be made in alphabetical order of presenter in each session. For co-authors of papers see table at back of the Book of Abstracts*		
GREYS ROOM	**Philosophy/Policy – Session 1** (4 papers) *Green Engineering Education in the United States* *Optimising sustainable use of ground-waters: a challenge for science and water markets* *The roles and responsibilities of engineers towards implementing sustainable development.* *Sustainability – why is it way beyond the Triple Bottom line?*	**Facilitator: Professor Roland Clift** **Professor Dave Allen**, University of Texas, USA **John Brumley** RMIT University, Australia **Heather Cruickshank**, University of Cambridge, England **Richard Donnelly** ICSER, University of Auckland
ARAWA ROOM	**WORKSHOP –** Session 1 Code of Practice – ***Sponsored By Waitakere City Council***	**Facilitator: Dr Carol Boyle**
3.00- 3.30 pm	**Afternoon Tea Break**	

WEDNESDAY 7 July 2004 - continued		
3.30--5.00 pm	**PARALLEL PAPER –SESSION 2**	
GREYS ROOM	**Tools – Session 1** (4 papers) *…Tracking of Environmental Sustainability at Solid Energy* *A Sustainability Action Planning Tool* *Sustainability Assessment of Hydrogen Energy Pathways* *Energy sustainability through representative large-scale simulation: the logical and physical design of 'xoena'*	**Facilitator:** **Professor Jorge Vanegas** **Zoe Burkitt**, MWH Ltd. NZ **David Kettle** Maunsell, NZ **Ben McLellan** University of Queensland, Australia **Robbie Morrison** Technical University of Berlin, Germany
ARAWA ROOM 3.30-5.00 pm	**WORKSHOP-** Session 2 Code of Practice – ***Sponsored By*** ***Waitakere City Council***	**Facilitator:** **Dr Carol Boyle**
ARAWA ROOM 5.00 pm	Keynote speaker 6 *NZ Aluminium Smelter's contribution to sustainable development*	**David Bloor,** Manager - Health, Safety, Environment and Community Relations, NZ Aluminium Smelters ***Sponsored By NZAS***
5.30 pm	Wrap up of day's discussion	**Dr Carol Boyle**
WEDNESDAY 7 July 2004 - Evening		
6.00 – 8.00 pm	**Meet and Greet Session** **Arawa Room Pre-function area**	

THURSDAY 8 July 2004 – Morning Session		**ARAWA ROOM**
9.00 am	Keynote speaker 7 *Road map and principles for built environment sustainability*	**Professor Jorge Vanegas** Georgia Institute of Technology, USA
9.30 am	Keynote speaker 8 *An Industrial Ecology*	**Professor David Allen**, University of Texas, USA
10.00 am	Keynote speaker 9 *Implementing ESD in major infrastructure projects*	**Jo Moss,** Senior Principal, Australia Sinclair Knight Mertz ***Sponsored By NZSSES***
10.30 – 11.00 am	Morning tea break	
11.00 am- 12.30 pm	**PARALLEL PAPER SESSION 3**	
GREYS ROOM	**Philosophy and Policy – Session 2 -** (3 papers) *Achieving Sustainability* *Low-impact Urban Design: Making it mainstream* *Wasting "Eco-efficiency": Sisyphus and the policy maker* *From Grey to Green*	**Facilitator: Professor Quentin (Q) Leiper** **Dr Carol Boyle** ICSER, NZ **Dr. Charles Eason** Landcare Research, NZ **Nigel Jollands, PhD** NZ Centre for Ecological Economics **Dr Maggie Lawton** Landcare Research, NZ
HAURAKI ROOM	**Sustainable Energies Session 1** (4 papers) *Key factors in the introduction of hydrogen as the sustainable fuel of the future.* *Predicting the unpredictable: Is the electrical spot price chaotic* *Scoping technology scenarios for a 100% Renewable Energy Rotorua* *Siting Criteria for Wind Farms*	**Facilitator: Dr John Peet, NZSSES** **John Blakeley** UNITEC, NZ **Cho Ming Bernard Cheng** Auckland University of Technology **Mike Collins**, NZ Forest Research Institute **Jay Coy,** Swinburne University of Technology, Australia.

THURSDAY 8 July 2004 – continued		
TAMAKI ROOM	**Tools - Session 2** (4 papers) *TBL Reporting – A Review of Recent Practice* *Sustainable Engineering applied into the PET plastic supply chain. A policy tool for industry and government.* *Towards the evaluation of the sustainability of a region, taking different sustainability criteria into account* *Sustainable Rural Development through appropriate technology and participation in Northwestern Cambodia*	**Facilitator: Professor Jorge Vanegas** **Kerry Griffiths** URS Ltd, NZ **Dr. Omar Romero-Hernández**, Instituto Tecnologico Autonomo de Mexico (ITAM) Bárbara Sureda**, (presented by Richard Donnelly)** Technical University of Catalonia, Spain (UNESCO Chair of Technology, Sustainable Development, Imbalance and Global Change) **Chris Tolley** Maunsell Ltd, Cambodia/NZ
WESTHAVEN ROOM	**Mixed Session 1 –** (4 papers) **Infrastructure & building (2)** *Timber, a truly sustainable resource, can be used to replace steel and concrete structures in multi-storey building.* *Stock and Flow models of housing* **Sustainable Science (2)** *Remediation of heavy metal impacts in roadside corridors Wet Tropics World Heritage Area, Australia* *Application of Lean Management to Improve Educational Operations*	**Facilitator: Professor Dave Allen** **John Chapman** University of Auckland, NZ **Dr Ivan Johnstone,** University of Auckland, NZ **Chris Pratt**, James Cook University, Cairns, Australia **Dr Mouafak Zaher**, UNITEC, NZ
12.30 – 1.30 pm	Lunch	

THURSDAY 8 July 2004 – continued		
1.30-3.00 pm	**PARALLEL PAPER SESSION 4**	
GREYS ROOM	**Philosophy/Policy – Session 3** (4 papers) *Supply and Demand is not Sustainable* *Sustainability Assessment: The Way Ahead for Corporate Reporting* *Sustainability - The Education Driver* *Networking Young India for Sustainable Development*	**Facilitator: Helen Shaw, NZSSES** **Dr Susan Krumdieck** University of Canterbury, NZ **Richard Lumsden** Dynamic Traffic Services, NZ **Ljubica Mamula-Stojnic** UNITEC, NZ **Arup Misra** Assam Engineering College, India
HAURAKI ROOM	**Sustainability Science –** (4 papers) *Letter from the oasis – helping engineering students to become sustainability cadres* *Applying Sustainability Science* *The Sustainability of Land Uses in the Strezlecki Ranges in Victoria, Australia.* *Evaluating the Ecological Efficacy of Low Impact Urban Design and Development*	**Facilitator: Dr Jane Harman NZSSES** **Patricia Kelly**, Queensland University of Technology **Emeritus Professor Ian Lowe**, Griffith University, Australia **Daniel Mainville** Department of Sustainability and Environment, Victoria, Australia, **Marjorie van Roon** University of Auckland, NZ

THURSDAY 8 July 2004 - continued		
TAMAKI ROOM	**Technologies and Products – Session 1** (4 papers) *A study stream of the bioindicator systematic* *Energy demand analysis for small and medium scale heat users in Rotorua aiming at converting existing heating systems to bioenergy* *The electric powered assisted bicycle; a clean vehicle to reduce car dependence and enhance the mobility of the elderly* *Protecting our waterways –research of novel methods for removal of nutrients from wastewaters*	**Facilitator:** **Dave Kettle, NZSSES** **Ming-Hsien Lee** ChungHua University, Taiwan **Dr Per Nielsen** NZ Forest Research Institute **Alan Parker** Town and Country Planning Association, Victoria, Australia. Steven Pratt, **(presented by David Miller**) Massey University, NZ.
WESTHAVEN ROOM	**Infrastructure and Buildings– Session 2** (4 papers) *Engineering a sustainable house for Solar Decathlon 2002* *Sustainable Laboratory Design: Challenges and Solutions* *Optimum Specification for New Zealand Houses* *Built Environment Solutions That Meet Goals for Sustainability Outcomes*	**Facilitator:** **Professor Leo Jansen** **Donald D. Liou** University of North Carolina, USA **Stephen Mead** Northern Arizona University, USA **Dr Nalanie Mithraratne** University of Auckland, NZ **Dr Mike O'Connell** BRANZ, NZ
3.00 – 3.30 pm	Afternoon tea	

THURSDAY 8 July 2004 – continued		
3.30-4.45 pm	**PARALLEL PAPER SESSION 5**	
GREYS ROOM	**Philosophy/Policy – Session 4** (3 papers) *A Tangata Whenua Perspective on Sustainability using the Mauri Model* *Sustainable Mining* *Establishing disposal siting mechanism towards a sustainable industrial waste management in the Philippines*	**Facilitator: Professor Roland Clift** **Te Kipa Kepa Brian Morgan** University of Auckland, NZ **Dr Gavin Mudd** Monash University, Australia **Reynaldo Perez Ramos** University of Queensland, Australia
HAURAKI ROOM	**Philosophy/Policy –Session 5** (3 papers) *Sustainability Of Coastal And Water Resource Engineering* *Usability and eco-ergonomics: encouraging environmentally effective behaviours in users of products through the industrial design process* *Defining and evaluating "science for sustainability*	**Facilitator: Norman Firth** **John Duder** Tonkin & Taylor, NZ **Edgar Rodriguez** Victoria University, NZ **Paul Weaver** University of Durham, UK
TAMAKI ROOM	**Mixed Session 2** (3 papers) ***Technologies & Products (2)*** *Sustainability.as appropriate use of technology for onsite wastewater/used water systems* *Composting Toilet Technology In Urban Apartments And Agricultural Trials For Beneficial Re-use Of Residues* ***Tools (1)*** *Life cycle assessment of management options for waste farm plastic*	**Facilitator: Professor Paul Jowitt** **Tim Rimmer,** UNITEC, Auckland, NZ **Chris Salmon**, GHD Ltd, Australia/NZ Laurence Dolan, **Presented by Ron McDowall**

THURSDAY 8 July 2004 - continued		
WESTHAVEN ROOM	**Infrastructure and Buildings – Session 2** (3 papers) *Thermal Characteristics of High Thermal Mass Passive Solar Buildings* *The role of bioenergy to meet the renewable energy target for New Zealand* *Sustainability and The Role Of Natural Ventilation In NZ*	**Facilitator:** **Helen Shaw, NZSSES** **Dr Kumar Mithraratne** University of Auckland, NZ **Dr Per Nielsen** NZ Forest Research Institute Dr Regan Potangaroa, **Presented by Dr Bin Su** UNITEC, Auckland, NZ
5.00-5.30 pm ARAWA ROOM	Wrap up of day's events	**Dr Carol Boyle**

CONFERENCE DINNER **ARAWA ROOM** **Sheraton Hotel – 7.00 pm -11.00 pm**	
7.00 pm	Pre-dinner drinks
7.30 pm	Seated at tables - Buffet Dinner No pre-designated seating - make up your own table
9.00 pm	**Guest Speaker:** Emeritus Professor Ian Lowe, Griffith University, Queensland
	Desert and coffee
	Mix & mingle
Music provided by Chris Powley, "THE VOICE"	
11.00 pm Close	

FRIDAY 9 July 2004 – Morning Session		**ARAWA ROOM**
9.00 am	Keynote speaker 10 *Sustainable Steps -walking with industry towards sustainability*	**Bill Bayfield** Ministry for the Environment General Manager Sustainable Industry and Climate Change Group, NZ
9.30 am	Keynote speaker 11 *Driving Sustainability into Business Strategy*	**Professor** **Quentin (Q) Leiper** Director for Engineering and Environment Carillion. UK
10.00 am	Keynote speaker 12 *Sustainability Consulting – Oxymoron or Opportunity?*	**Kerry Griffiths** Senior Sustainability Consultant. URS, NZ ***Sponsored By*** ***URS New Zealand Ltd***
10.30 – 11.00 am	Morning tea break	
11.00 am-12.30 pm	**PARALLEL PAPER SESSION 6**	
GREYS ROOM	**Philosophy/Policy– Session 6** (4 papers) *Greening beyond the firm: improving environmental performance through the supply relationship* *So You Are Thinking Sustainability: Who Is On Your Team?* *From Corporate Governance to Sustainable Governance* *Case studies illustrating the twelve principles of Green Engineering*	**Facilitator:** **Dr Jane Harman** **Dayna Simpson** University of Melbourne, Australia **Caroline Watkins** Maunsell Ltd, Australia **Peter White** Maunsell Ltd, Australia **Dr Julie-Beth Zimmerman** Environmental Protection Agency, USA

FRIDAY 9 July 2004 - continued		
HAURAKI ROOM	**Sustainable energies – Session 2** (4 Papers)	**Facilitator: Professor Q. Leiper**
	Performance of an Industrial Solar Kiln for Drying Timber in Australia	**Dr Nawshad Haque** NZ Forest Research Institute
	Continuity Model for Energy System Sustainability	**Dr Susan Krumdieck** University of Canterbury, NZ
	Tools for the Integrated Assessment of Sustainable Regional Energy Systems	**Ben Maddox** University of Newcastle, Australia
	Geographical analyses of wood chip potentials, costs and markets for sustainable energy production in Denmark	Bernd Moller **(presented by Dr Per Nielsen)** Aalborg University, Denmark
TAMAKI ROOM	**Mixed Session 3** (4 papers)	**Facilitator: Norman Firth, NZSSES**
	Engineering (2) *Feasibility study of harnessing on-shore wave-energy at Waipapa, NZ*	**Muhunthan Ponniah** UNITEC, NZ
	The Effects of Moderate Die Pressure on Maize Cob Briquettes: A Case Study in Phitsanulok, Thailand	**Panote Wilaipon** Naresuan University, Thailand
	Technologies & Products (2)	
	Propositions of Sustainable Methods of Carbon Dioxide Separation and Disposal	**Caleb Stewart** Monash University, Australia
	Dial a House: Used Telephone Directories as Structural wall elements	**Dr Garry Tonks** University of Auckland NZ

FRIDAY 9 July 2004 - continued		
WESTHAVEN ROOM	**Infrastructure & Buildings – Session 3** (4 papers)	**Facilitator: Norman Firth, NZSSES**
	Sustainable Integrated Planning Approach Case Study-NORSGA	**Helen Shaw** URS Ltd, NZ
	Architectural Design of Large Hotel and Energy Use for Internal Space Thermal Control	**Dr Bin Su** UNITEC, Auckland, NZ
	Inter-discipline Integration Implications of Sustained Development of Architectural Education	**Tsung-juang (TJ) Wang** National Taipei University of Technology, Taiwan
	The Congestion Conundrum: sustainable solutions	**Professor Alan Woodside** University of Ulster at Jordonstown, County Antrim, Northern Ireland
12.30 – 1.30 pm	Lunch	
1.30 pm	**PANEL DISCUSSIONS** *Questions and Answers*	Chair: **Dr Carol Boyle** **All keynote speakers**
2.00 pm	Keynote speaker 14 *Technology for Sustainability - Some Facts and Some Fallacies*	**Dr John Peet** University of Canterbury, NZ
2.30 pm	Keynote speaker 15 *Engineers-The key to a sustainable future*	**Gerry Coates** IPENZ President 2003
3.00 – 3.30 pm	Afternoon Tea	

FRIDAY 9 July 2004 continued		
3.30--5.30 pm	**FINAL SESSION**	
3.30 – 4.00 pm Breakout sessions PANEL DISCUSSIONS - To formulate one recommendation from each theme for ongoing discussion, collaboration, and dissemination of research		
Note*: Facilitators and panel for the following breakout sessions will be chosen during the course of the conference and advised at lunchtime Friday*.		
ARAWA ROOM	Tools	Facilitator: Panel (2)
GREYS ROOM	Philosophy and policy	Facilitator: Panel (2)
HAURAKI ROOM	Science and Energies	Facilitator: Panel (2)
TAMAKI ROOM	Infrastructure and Buildings	Facilitator: Panel (2)
WESTHAVEN ROOM	Technology and Products	Facilitator: Panel (2)
4.15 pm	Facilitators Report to Plenary Session	Facilitator **Dr Carol Boyle**
5.00 pm	Wrap up of Conference discussions and final resolutions	**Dr Carol Boyle**
6.00 – 7.00 pm	**ANNUAL GENERAL MEETING**	**NZ Society For Sustainability Engineering and Science**
Membership and Nomination forms are in your blue folders or available from Vicky		

KEYNOTE SPEAKER PROFILES
and SPEECH ABSTRACTS

In Alphabetical order

Professor David T. ALLEN

Department of Chemical Engineering,
Director, Center for Energy and Environmental Resources
University of Texas
Austin, Texas 78712 USA
(512-471-0049; allen@che.utexas.edu)
web site: www.utexas.edu/research/ceer

Dr. David Allen is the Gertz Regents Professor of Chemical Engineering and the Director of the Center for Energy and Environmental Resources at the University of Texas at Austin. His research interests lie in air quality and pollution prevention. He is the author of four books and over 140 papers in these areas. The quality of his research has been recognized by the National Science Foundation (through the Presidential Young Investigator Award), the AT&T Foundation (through an Industrial Ecology Fellowship), the American Institute of Chemical Engineers (through the Cecil Award for contributions to environmental engineering), and the State of Texas (through the Governor's Environmental Excellence Award).

Dr Allen was a lead investigator in one of the largest and most successful air quality studies ever undertaken: the Texas Air Quality Study (www.utexas.edu/research/ceer/texaqs). His current research is focused on using the results from that study to provide a sound scientific basis for air quality management in Texas. In addition, Dr. Allen is actively involved in developing Green Engineering educational materials for the chemical engineering curriculum. His most recent effort is a textbook on design of chemical processes and products, jointly developed with the U.S. EPA.

Dr Allen received his B.S. degree in Chemical Engineering, with distinction, from Cornell University in 1979. His M.S. and Ph.D. degrees in Chemical Engineering were awarded by the California Institute of Technology in 1981 and 1983. He has held visiting faculty appointments at the California Institute of Technology, the University of California, Santa Barbara, and the Department of Energy.

Dr Dave Allen

ABSTRACT:

An Industrial Ecology: Material Flows And Engineering Design

The materials used in industrialized economies average 40-80 tons per person, per year. Whether we express this personal consumption as a ton per week, or a body weight per day, it amounts to staggering quantities of materials, most of which are used once, then discarded. An alternative to designing industrial systems that use materials once is to design industrial ecosystems that mimic the mass conservation properties of natural ecosystems. In industrial ecosystems, the wastes and by-products from one industrial process would be used as the raw materials for another. Are such systems realistic? Do they exist now? How could they be designed?

This presentation will examine the tools that are emerging to design more mass efficient industrial systems, at a variety of scales. Examples of national material flow analyses, material flow analyses in industrial sectors, and the integration of material flows within industrial processes will be presented. The examples will demonstrate that insights provided by material flow analyses can guide environmental and material policies, and can lead to mass and energy efficient process designs. The presentation and case studies will show that, while true zero emission/no mass requirement industrial systems are not yet a reality, the analysis tools for developing such designs are developing rapidly.

Dr Robin J BATTERHAM
BE, PhD, FAA, FTSE, FAusIMM, FIEAust, FAICD, FIChemE, FISS, FAIM, CE, CPE, AMusA
Chief Scientist, Australia
E-mail: Helen.WILSON@Dest.gov.au
Website: www.dest.gov.au/chiefscientist

Dr Robin Batterham is the Chief Scientist, Australian Government and Chief Technologist, Rio Tinto Limited. He has had a distinguished career in research and technology, in the public and private sectors. In this role as Chief Scientist he provides advice to the Australian Government on science and innovation matters. He plays a major role in promoting linkages between science, industry and government and helps to ensure public investment in science and technology is properly focussed on issues of national priority.

After completing his PhD at Melbourne University in 1969, Dr Batterham was awarded a CSIRO post-doctoral fellowship, which he undertook at ICI Central Research Laboratories in the UK. On his return to Australia, he worked with CSIRO as a research scientist, progressing to the position of Chief of the Division of Mineral and Process Engineering in 1985. During this time, he undertook or supervised successful research activities between CSIRO and Australian industry, in areas such as mining, mineral processing, mineral agglomeration processes, and iron making.

From 1988, Dr Batterham has held senior position in technology development with CRA Limited, now Rio Tinto Limited. During this time, he developed a processing route for what is now recognised as the world's largest economic zinc mineralisation. Dr Batterham is credited as having a major role in the HIsmelt process; a $650 million project to develop a novel direct smelting technology for iron making that is adding potential value of the order of $20 billion.

Dr Batterham holds a number of Australian Government appointments including membership on the Commonwealth, States and Terrritories Advisory Council on Innovation, the Australian Research Council, the Cooperative Research Centres Committee and the Victorian Government's Innovation Economy Advisory Board.

Dr Robin Batterham

ABSTRACT:

A Pragmatic Approach to Sustainability

There have been significant gains made in sustainability, its profile, its understanding and its implementation. That said, much remains to be done because the science that underlies sustainability is still far from exact. Metrics play an important role, to ensure what gets measured gets done. Therefore, it is vital to identify the key indicators for sustainability, and perhaps it is time to review current practices in sustainability measurement.

The way forward may be to review thoughts on long-term targets. Why does The Natural Step present such a dilemma? Is it because it is tied to geological timescales and we are already past the point where this can be done?
The pragmatic approach may hold some of the answers. A framework that includes 'rate of change' considerations and how people are handling these changes may be useful to consider.

A pragmatic target of 50% greenhouse gas emission reduction by 2050 may be acceptable, but the question remains - how best to get there from here? What lies at the far end? The possible components thus far are: hot rocks and geothermal; photovoltaics, wind and wave energy; coal, gas and other hydrocarbons, including zero emission technologies; hydrogen/ distributed energy; and increased efficiency by energy users.

How much emphasis should be placed on each component? We need to balance the science/technology challenge with some sustainability metrics, such as balanced scorecard.

Bill BAYFIELD
General Manager,
Sustainable Industry and Climate Change
Ministry for the Environment Manat_ M_ Te Taiao
Email: lisa.riley@mfe.govt.nz
Direct Telephone: 04 916 7678

Bill Bayfield leads the Sustainable Industry and Climate Change Office at the Ministry for the Environment and is responsible for its strategic direction and programme delivery. Bill came to the Ministry from the Taranaki Regional Council where he was Director of Resource Management. He has more than 20 years experience in regional government, including considerable interaction with a wide range of industries.

Bill also acted as the convener of the Regional Council's Resource Managers Group from 1999 to 2002; was the Local Government New Zealand representative on the Biodiversity National Policy Statement Reference Group and the New Zealand Oil Pollution Advisory Committee; he managed the investigations into alleged historic dumping of dioxin wastes in and around New Plymouth; and worked on the proposed Dairying and Clean Streams Accord.

Bill has a Bachelor of Science in Botany and Earth Sciences. He is married to Maggie and has two daughters, Rachel and Alexandra.

ABSTRACT:
Sustainable Steps -*walking with industry towards sustainability*
The Ministry for the Environment is taking practical steps with industry towards sustainability. We've established the Sustainable Industry group to work with New Zealand Industry and give stronger emphasis to action on sustainability.

Essentially we exist to help industry compete and grow sustainably. Achieving this in the real world is challenging. So we focus on helping industry take practical steps, to think, to plan and to operate sustainably.

This includes:

- Providing sustainability tools and services
- Building sustainability into what we and others do
- Managing roadblocks for industry

Through our key projects in 2003 /04 we're learning, with industry, what works well and what doesn't. We will present some of our key projects, their highlights and lessons learnt.

A key lesson we've already learnt is that helping industry compete and grow sustainably requires support from a wide range of agencies and professions. We all need to take steps to build sustainability into what we do from our policy and research activities to designing sustainable technologies, products and services.

If we don't take up the challenge industry struggles to obtain the necessary information and tools it needs to take steps towards sustainability.

Key projects to build sustainability into our operations and with industry that will be presented include:

- *Product design and extended producer responsibility*. Investigating policy and industry options to redesign, recover, reuse or safely dispose of a number of products that are particularly difficult to manage at the disposal or recycling stage. Products we are focusing on include, packaging, used oil, end of life tyres and cars.

- *Govt^3: Towards Sustainable Practice – procurement, impact assessment, reporting*. The project is helping a pilot group of government agencies to take practical steps towards sustainability. Govt^3 will make it easy for government agencies to; explore a range of policy tools and actions to minimize their energy use, materials use, amount of waste sent to landfill and CO_2 emissions, and to buy products that are better for the environment. It includes the work we have done to incorporate sustainability into our new building lease.

- *Eco efficiency*. We are partnering with Fonterra on the design and implementation of an Eco-Efficiency project covering all of Fonterra's factories, warehouses and offices. The project involves working with Fonterra to identify eco efficiency gains for example innovative ways to manage plastic waste

David BLOOR
Manager,
Health, Safety, Environment and Community Relations
NZ Aluminium Smelters

Email contact: Joanna.McKenzie@comalco.riotinto.com.au

David Bloor has over 15 years experience in the aluminium industry in a variety of operational, project and support roles. He has worked in many different countries including the UK, New Zealand, Australia and Canada. His current role focuses on a number of external challenges facing New Zealand Aluminium Smelters both nationally and globally. David's work at NZAS, New Zealand's only primary aluminium smelter, encompasses all aspects of sustainability all aimed at delivering business excellence for a thriving New Zealand export business. David is a Minerals Engineer.

ABSTRACT:

New Zealand Aluminium Smelters (NZAS) produces the highest purity aluminium of any smelter in the world at 99.98% pure, generates $1 billion in exports sales per annum, provides 1000 jobs in Southland and contributes over $800 million in economic benefit to New Zealand.

At NZAS we recognise that competitiveness and future success depends not only on the economic benefit we generate and the quality of our product but also upon our record as good neighbours and partners with the community that sustains us.

Naturally environmental and community expectations grow overtime. Therefore our focus on sustainable development must continue to match and exceed our community's expectations

Distinguished Professor Roland CLIFT
Director, Centre for Environmental Strategy
University of Surrey
GUILDFORD
Surrey GU2 7XH
Email: r.clift@surrey.ac.uk Website:
www.surrey.ac.uk/eng/research/environmental/ces/index.htm

Professor Roland Clift OBE, FREng FIChemE HonFCIWEM FRSA:
Distinguished Professor of Environmental Technology and founding Director of the Centre for Environmental Strategy at the University of Surrey; previously Head of the Department of Chemical and Process Engineering at the University of Surrey. He is a member of the Royal Commission on Environmental Pollution, of the International Expert Group on application of Life Cycle Assessment to waste management and of the Rolls-Royce Environmental Advisory Board, and a past member of the UK Ecolabelling Board. Professor Clift is Visiting Professor in Environmental System Analysis at Chalmers University, Göteborg, Sweden. Professor Clift was recently awarded the Sir Frank Whittle medal.

ABSTRACT:
The Paradigm Of Sustainable Development And The Changing Role Of The Technical Specialist

The concept of sustainability incorporates the recognition that there are constraints on human activities, imposed both by finite resources and by the capacity of the planet to accommodate emissions and wastes. Living within constraints is a relatively new paradigm, to which the economic system and many of the established professions need to adapt. Drawing on experience of the development of policy in the UK in energy and climate change, this contribution will set out the way in which the conventional three aspects of sustainable development – ecological, techno-economic and social – were combined to develop an argument sufficiently compelling to influence political processes and policy. The case study provides an illustration of the new role demanded of professional engineers and scientists – as "honest brokers" in inclusive decision processes

Gerry Te Kapa COATES, Consultant
Managing Director
Wise Analysis Limited
P O Box 10-186
Wellington 6001
Ph: +64-4-472 7621(DDI)
Fax: +64-4-472 2022
Mobile: +64-21-355 099
E-mail: gcoates@xtra.co.nz

Gerry Coates is a consulting professional engineer, and 2003 President of the Institution of Professional Engineers NZ. http://www.ipenz.org.nz/ Gerry has been a consulting electrical engineer since 1970 lately specialising in fire and forensic investigations and expert witness services. Of Ngäi Tahu descent he acted as a consultant to Ngäi Tahu in 1997 in getting their Treaty of Waitangi claim to the point of acceptance and settlement by both the Government and the tribe.

He has been active in IPENZ for many years, and was instrumental in a review of its Code of Ethics into a groundbreaking new format. He also founded the independent group Engineers for Social Responsibility in 1983, which has now become a worldwide movement among professional engineers who care about the direction technology is taking. A particular interest is promoting a move towards sustainability in technology. He has written widely on issues that concern him about technology as a regular columnist in e.NZ and its predecessor NZ Engineering, and in various other newsletters and journals. He is also active in the fields of arbitration, mediation, counselling and conflict resolution.

ABSTRACT:
Engineering a Sustainable Future

Sustainability is about coping with change, to ensure that humanity and its environment can survive in the long term. How we do that depends a lot on how technology can become more efficient and use less resources. This paper looks at the basic principles of sustainability, and what a more ideal world might look like where these principles were applied by engineers in their daily work.

Kerry GRIFFITHS
MA (University of Auckland), MBA (Victoria University), MSc (University of Bath, UK)
Senior Sustainability Consultant
URS New Zealand Limited
Email: kerry_griffiths@urscorp.com

Kerry Griffiths has been active in working with business and public sector agencies on sustainability and corporate social responsibility issues since they began to be more widely embraced by New Zealand business and communities in the mid-1990s. She was a founding member and the first Vice Chair of the Dick Hubbard-led New Zealand Businesses for Social Responsibility. Kerry's postgraduate studies have included an MBA from Victoria University, graduating as the top scholar of her year, and the groundbreaking Master of Science degree in Responsibility and Business Practice from the University of Bath School of Management, England.

Kerry is an experienced organization development consultant who has worked in the Corporate Social Responsibility and Sustainable Business field in New Zealand for the last six years. She was the first Vice Chair of New Zealand Businesses for Social Responsibility. In 1999, she completed a Masters degree at Bath University, School of Management, in Responsibility and Business Practice.

Formerly with Tall Poppies Consulting, Kerry joined URS in November 2003 and is now their Senior Sustainability Consultant, based in Wellington. Kerry will be working in the growing areas of sustainable development, triple bottom line reporting and corporate social responsibility.

Kerry Griffiths

ABSTRACT:

Sustainability Consulting – Oxymoron or Opportunity?

Sustainability is the new black. Not a conference goes by or a newspaper gets published without sustainability appearing somewhere to educate or entice us. And as surely as night follows day the fickle fate of fashion has now landed sustainability at the feet of the consultants. Will they use it or abuse it?

Kerry Griffiths will share the story of how URS New Zealand is making sustainability a reality in the consulting world. She will draw on the experiences of URS here in New Zealand and further a field in Australia and Europe. The presentation will provide practical insights into the successes, the lessons and the challenges of incorporating sustainable development into the day-to-day operations of an engineering and environmental management consultancy.

Professor Dr. Ir. J.L.A. JANSEN
Commander in the order of Oranje Nassau
Retired
Kerkeland 16
6883 HA Velp
email: Jansenleo@hetnet.nl

Leo Jansen was educated at the Delft University of Technology, the Netherlands. He started his industrial career at AKU (nowadays a division of AKZO), where he made researches into synthetic fibres. In September 1967 he was awarded the technical degree at the Delft University of Technology on the thesis ' A comparative study of some polyamides'. From 1967 to 1973 he was staff member and head of management information of the fibres division of AKZO in Western Europe.

From 1973 to 1981 he was a member of parliament. He was a spokesman for finances, economic affairs, energy, social affairs, transport, water management, agriculture, environment and spatial planning. Subsequently he was vice-chairman of the steering committee for the national debate on energy policy until 1984. In this national debate about 40000 citizens and some 200 organisations participated actively. His career in the civil service started in 1984 at the directorate-general for the Environment of the ministry of Housing, Spatial Planning and Environment. Subsequently as a senior project manager, as inspector for public health and the environment, as the managing director for waste management policies and since January 1991 as the managing director for Sustainable Technology at the directorate-general for the Environment. He chaired the Dutch inter-ministerial program: Sustainable Technology Development (1993-1998) and the sequential knowledge dissemination program. He was chairman of the Dutch jury for the Environment award for the Industry.

He was appointed to be professor for the Environmental Technology in the Delft University of Technology in 1990. In 1996 he was appointed to be chairman of the commission later platform on Sustainability of the Delft University of Technology.

1999- Honoured as Commander in the order of Oranje Nassau.
2000- Award 2000 of the Royal Netherlands Academy of Science.
2002- Open University of the Netherlands adjudged him an honorary doctorate.

Professor Leo Jansen

ABSTRACT:

Building capacity for sustainable development.

Sustainable development has to be regarded as a long lasting complex social process. The challenge to achieve a continuous justified level of welfare for the growing world population of future generations requires radical renewal of systems of production and consumption and of governance. This comprises integration of technological, economic, cultural, social and institutional aspects simultaneously and interacting at different levels of society from macro to micro. Essential is the driving force of a shared orientation of all involved on a sustainable future in a long lasting evolutionary process: Transition of society for sustainability. Such process consists of numerous initiatives for renewal throughout society. The capacities to initiate, operate and manage these initiatives are developed in a "learning by doing" manner. In the European AIRP Project[1] some ten sustainability oriented RTD projects were selected and analysed. Recommendations are given on how to set up and how to evaluate (ex ante and ex post) sustainability oriented RTD programs and projects. The experiences of the Dutch program "Sustainable Technology Development" based on a "backcasting" approach fit very well in these recommendations.

Future capacities are also built in education systems. Based on the "backcasting" approach: "Which competences should our engineers have 10 years from now and what should the university look like", the University of Technology of Delft developed a program to embed sustainability in all its research and education programs. So far the university is well under way with three lines in education: All graduates should be aware of the significance of sustainability for technology and its applications, sustainability should be integrated in all regular courses and there should be a possibility for students to incorporate sustainability their disciplinary graduation. In research a number of spearhead programs integrate sustainability. A proposal has been made to integrate the line of practise and the educational line in synergistic model.

[1] AIRP stands for: Adaptive Integration of sustainable Research and Policy for development.

Professor Paul JOWITT
BSc(Eng), PhD, ACGI, DIC, CEng, FICE, FRSA
Executive Director
Scottish Institute of Sustainable Technology
Edinburgh **- Email** ***paul.jowitt@sistech.co.uk***

Paul Jowitt is Professor of Civil Engineering Systems within the School of the Built Environment at HeriotWatt University and Executive Director of the Scottish Institute of Sustainable Technology. He is also a Board Member of Scottish Water, a Member of the East Regional Board of the Scottish Environment Protection Agency.

Major research interests concern the issues of sustainability and risk and the development of systems based solutions within civil engineering and environmental management. Major areas of activity are water resources systems modelling, asset and resource management and the environmental and engineering applications of systems modelling, optimisation, reliability, and risk assessment.

This research has been funded mainly by a combination of EPSRC research grants and water industry research contracts in such areas as water distribution systems, wastewater treatment plant modelling & control, drought management and sustainable water resource management. Research grants are in progress on the time critical modelling of water distribution networks under emergency conditions (EPSRC), fire risk estimation in tunnels (EPSRC), and systemic approach to safety management on the railways (Railway Safety).

Recently completed grants include multi-criteria decision-making for sustainability in the water industry (EPSRC and Water Industry funded) and on construction waste recycling (EU-NPP). Research is also being undertaken on sustainability assessments and triple bottom line reporting for the built environment. Other major areas of expertise are the modelling, assessment and understanding of uncertainty, risk assessment in problems such as contaminated land and other engineering and environmental systems.

Paul Jowitt is a Fellow of the Institution of Civil Engineers (ICE), and is an elected Member of Council, serving on its Environment and Sustainability Board and the Joint Board of Moderators. He is a former Chairman of the Edinburgh and East of Scotland Association of the ICE and the Scottish Hydrological Group.

ABSTRACT:
"Engineering without Frontiers"

In December 2003 the Institution of Civil Engineers established a Presidential Commission – Engineering without Frontiers" - to:

- Identify society's expectations of an engineer in the 21st century; and
- Determine the critical activities that need to be addressed in caring for Earth and meeting the UN Millennium Development Goals.

The remit of the Commission is outward facing and has a strong global dimension, in particular the issues of international development. The work of the Commission to date will be described and the key emerging issues discussed. Major themes emerging from the project to date are:

- The education and professional development of the engineer, including their Awareness and associated competences of development issues.
- The energy and potential of young engineers to contribute and provide leadership in human development and well-being
- Appropriate standards and goals and the promotion of primary engineering
- The scope for industry and the professional institutions to better contribute to more effective progress in international development through appropriate partnerships.

The Commission's future work and its plans for implementing its key outcomes will be outlined.

Professor Quentin LEIPER
Director for Engineering and the Environment, Carillion
Email: QLeiper@carillionplc.com

Quentin Leiper is Director for Engineering and the Environment at Carillion and is responsible for leading Carillion's sustainability programme. He is also involved in teaching design and carrying out research at the University of Edinburgh where he is a Visiting Professor. He is the Honorary Editor of Engineering Sustainability, the Institution of Civil Engineers' new journal. He is keen to help demonstrate that corporate responsibility is not only right at the heart, but that it is also good for business and customers. With others, he has developed the Carillion Sustainability Strategy Model, which has helped to put sustainability and corporate responsibility at the core of Carillion's business strategy. Quentin is a Director of the Construction Industry Research and Information Association (CIRIA). He has recently been elected a Vice President on the Institution of Civil Engineers, succeeding to President in 2006.

Website: See the 2001 Sustainability Report or download the 16 page review at: http://www.carillionplc.com/sustainability

ABSTRACT:
Driving Sustainability into Business Strategy
The presentation will describe how an awareness of environmental issues, followed by a broader understanding of sustainability has led to benefits for business, shareholders and society. Carillion's journey towards sustainability and how this has facilitated greater innovation, enhanced individual and corporate responsibility and improved product delivery, in both construction and maintenance activities will be described. Some of the business drivers for sustainability will also be identified, together with the challenges and opportunities experienced in the implementation of a sustainability strategy. In addition, a sustainability strategy model will be presented, which shows how, by integrating sustainability with business strategy through the use of key performance indicators, benefits that can be gained by businesses and communities. Practical examples will used to illustrate benefits gained by business, communities and clients and advice will be given on how to embed the principles of sustainable development into business strategy to the benefits of all stakeholders.

Jo MOSS
Senior Principal
Sinclair Knight Merz
Email: jmoss@skm.com.au

Profile

Jo is a senior environmental and development consultant with Sinclair Knight Merz. She is responsible for the company's Sustainable Development Advisory Services business.

She has been working in the environmental business for over 30 years with both public and private sector organisations. Jo's expertise is in project management and environmental impact assessment of large multi-disciplinary studies. She has successfully project managed numerous major infrastructure projects, including some of the largest highway studies in NSW.

Jo's interest in and passion for sustainability stems from the two years she spent as Senior Director Environment of the Olympic Coordination Authority. In that role she guided the environmental aspects of the planing, development and construction for the Sydney 2000 Olympic Games venues, facilities and infrastructure. Her work with OCA won OCA the prestigious Gold Banksia Environmental Award in 2000.

Jo has been a Director on the SKM Management Board and was responsible for the Board's initiatives on Corporate Reporting and Good Corporate Citizenship. She has just been elected to the Board of Management of the National Association of Women in Construction.

Jo holds a Science Degree and a Masters Degree in Environmental Planning. She is a Fellow of the Royal Australian Planning Institute, a Member of the Environment Institute of Australia and a Member of the Australian Marine Science Association.

Last month Jo won two merit awards from the National Association of Women in Construction in Australia – for her achievement as a businesswoman and for advancing the interests of women in the construction industry.

Jo Moss

ABSTRACT:

Implementing ESD in major infrastructure projects

Assessment of major infrastructure project in terms of ESD is a requirement of most State Governments in Australia. While the environmental component of the ESD approach has been assessed and evaluated for several decades, the social and economic parameters are less easy to define. Today's emphasis on sustainable development, and the community's demands for it, requires a more focused and robust approach to this issue. This presentation will discuss some of the key issues facing the infrastructure development industry, in terms of interpretation, implementation and evaluation.

Dr Ian PARTON
Maunsell Limited
PO Box 4241, Auckland
Ph: (09) 379-1204 - Fax+64 9 336 0174
Email: ian.parton@maunsell.com

Dr Parton is currently the Development Director and Chairman of Maunsell Limited (formerly Meritec Group) and 2004 President, Institution of Professional Engineers of NZ, IPENZ. His areas of expertise include consulting engineering and expert witness assignments, business management and strategic planning and international business development. He holds a PhD (Engineering) (1972), a Harvard Graduate School of Business OPM Programme, USA (1995) and Distinguished Fellow of Institution of Professional Engineers NZ (2001).

Work Record

2002-present	Development Director, Maunsell ANZAME
1987 - 2002,	Managing Director, Meritec Group Ltd (formerly Worley Consultants)
1981 - 1987,	Director of Geotechnical Engineering, and later Director of Natural Resources Division, Worley Consultants Ltd
1977 - 1981,	Mandeno Chitty & Bell Ltd, Director of Geotechnical Engineering Group
1977	Geotechnical Engineer, Ground Engineering Ltd
1972 - 1976,	Geotechnical Engineer, Ministry of Works & Development

Governance Posts and Professional Memberships

1972-2000	Member, Institution of Professional Engineers of New Zealand
1978-current	Member, Consulting Engineers Association of New Zealand
1984-2000	Trustee, St Cuthbert's Educational College, also Chairman of Building and Strategy Committees

1991-1998 Founding Chairman and Committee Member of Consulting Services Exporters Group of New Zealand

1994-current Fellow of Institute of Directors

1994-1997 Director, Tanlaw Corporation Limited

1995-current Member, Harvard Business School Alumni of New Zealand

1997-2002 Director and Chairman, Bendon Limited (formerly Ceramco Corporation Limited)

2000-2002 Fellow of Institution of Professional Engineers of New Zealand

2000-current Chairman of Department of Civil Engineering Advisory Board, Auckland University School of Engineering

2001-current Director and Deputy Chairman, Watercare Services Limited

2002-current Distinguished Fellow, Institution of Professional Engineers of New Zealand

2004-current President of Institution of Professional Engineers of New Zealand

ABSTRACT:

Engineers As Leaders In The Transition To A Sustainable World.

The Institution of Professional Engineers of New Zealand (IPENZ) has been an active participant in the sustainable future debate. It has contributed through work nationally, and in international fora such as the Committee for Engineering and Environment of the World Federation of Engineering Organisations (WFEO).

Civil engineering has played a critical role in increases in life expectancy over the past 50 years through improved infrastructure and food production. It has enabled us to feed a global population of 6 billion people. But global population is

forecast to grow to more than 9 billion people over the next 50 years. What will the demands of future generations be in 100 or 1000 years time?

Water, energy and resource use, along with transport systems, will change radically over the next 100 years. We will move from a scenario of resource rich - people scarce, to people rich – resource scarce. Technology developments will assist in us making resource productivity improvements of 10 to 50 times that are being called for.

Sustainable development is no more than rational development. While we will see rapid advances in technology over the next 50 years, there are technologies available to us today to adapt to meet the sustainable development challenge. While we must to continue with science-based research into sustainability, the urgency is with the application of engineering-based research. The important short-term breakthroughs will come from the application of existing technology, not blue-sky research.

Dr John PEET
Department of Chemical & Process Engineering
University of Canterbury
Private Bag 4800
Christchurch
Phone: +64 3 384 1281
Fax: +64.3.384 6281
Email: john.peet@canterbury.ac.nz
Web: www.cape.canterbury.ac.nz/people/njp/njp.htm

1996 attended an International Workshop on Indicators of Sustainable Development, Bilthoven, Netherlands. The outcomes of this workshop relate closely to much of the research programme he has been involved in, in recent years.

1997 Study Leave in Europe, including a substantial period in Germany, working with Prof-em Dr-Ing Hartmut Bossel, former Director of the Center for Environmental Systems Analysis at the University of Kassel, Germany. Much of the subsequent research and writing has been in ongoing collaboration with Prof Bossel.

1999 gave the opening Plenary address to the Australia and New Zealand Society for Ecological Economics (ANZSEE) Conference, Brisbane, on the topic of ethics and ecological economics for community.

2000, invited plenary paper to the Baltic21 Workshop on Sustainability, at the Sigtuna Foundation, Sweden.
Paper to the INES2000 conference in Stockholm,
Paper to the ISEE/ANZSEE Conference in Canberra, on freedom and sustainability.

John is a Past President of Engineers for Social Responsibility (ESR) in New Zealand/Aotearoa, and is the ESR contact person for the International Network of Engineers and Scientists for Global Responsibility (INES). Until recently he was a member of the Board of the International Society for Ecological Economics (ISEE). He is currently on the Editorial Boards of the journal Ecological Economics, the International Journal of Sustainable Development (IJSD), and the International Journal of Agricultural Resources, Governance and Ecology (IJARGE).

Dr John Peet

ABSTRACT:

Technology for Sustainability - Some Facts and Some Fallacies

Sustainable Development is seen in most countries as a shorthand term for a process whereby techniques such as eco-efficiency, dematerialisation and decoupling will guarantee economic growth continuing without limit into the indefinite future, so that the wellbeing of people will be continually improved without compromising the quality of the environment. This process, where economic growth takes centre stage, is the policymaking priority in most countries.

This paper challenges that position, pointing out that, firstly there is scant evidence that continued economic growth actually improves people's wellbeing, and secondly that eco-efficiency, dematerialisation and decoupling involve assumptions about the ability of science and technology to deliver both unending growth in goods and services and environmental sustainability, that are at best highly questionable and at worst potentially disastrous, for society and for the ecosystems of Planet Earth.

The problem is addressed by suggesting a number of ways in which scientifically-informed, economically-viable and socially-benign sustainable development policies can be created, that could genuinely satisfy the aim of improving the wellbeing of people and at the same time maintain or improve the health of their total environment over the very long term. The major imperatives of our time are to identify such policies, and initiate a process of re-examining the priorities of economic, social and environmental policymaking.

Professor Jorge VANEGAS
Construction Engineering and Management Program
School of Civil and Environmental Engineering
College of Engineering
Georgia Institute of Technology
Postal Address: 790 Atlantic Dr.; Mason Bldg.
Georgia Institute of Technology
Atlanta, GA 30332-0355
Tel: (404) 894-9881 Fax: (404) 894-5418
Email: jorge.vanegas@ce.gatech.edu
Website http://www.ce.gatech.edu/~jvanegas/

Dr. Vanegas is an Associate Professor and current Group Leader in the Construction Engineering and Management (CEM) Program of the School of Civil and Environmental Engineering (CEE) at the Georgia Institute of Technology (Georgia Tech). In this capacity, he is responsible for teaching undergraduate, graduate, and professional continuing education courses, and also leading and managing an active research program in the following primary domains:

(1) Built Environment Sustainability and Security (facilities and civil infrastructure systems)
(2) Advanced strategies, tools, and methods for integrated capital asset delivery and management
(3) Design/construction integration in the development and rehabilitation of facilities and civil infrastructure systems
(4) Constructability programs and advanced modularization technologies
(5) Advanced strategies, tools, and methods for affordable housing
(6) Undergraduate and graduate curricula development
(7) Continuing education and technology transfer program development

In recognition of his research and teaching accomplishments, Dr. Vanegas has received:

2001 Society of Hispanic Professional Engineers Educator of the Year Award
1999 - The CoE Fred and Teresa Estrada Young Professorship
1998 - Georgia Tech Outstanding Interdisciplinary Activity

Award
1995 - The first Construction Industry Institute (CII)
Outstanding Instructor Award
1992 - A National Science Foundation National Young Investigator Award (NSF/NYI)

Since Fall Semester 1999, Dr. Jorge Vanegas also holds the Fred and Teresa Estrada Professor in the College of Engineering (CoE) at Georgia Tech. [Note: This is a five-year appointment.] In this capacity, he is currently developing a focused, multi-disciplinary, and self-sustaining institutional infrastructure for education, research, and outreach in sustainable affordable housing and related civil infrastructure systems, for the U.S. and the Americas.

Dr. Vanegas is currently an associated researcher in the applied research, technical assistance, and outreach programs of the Sustainable Facilities and Infrastructure (SFI) Branch and of the recently established Center for Sustainable Urban Revitalization (CSUR), within the Safety, Health, & Environmental Technology Division (SHETD), of the Electro-Optics, Environment, & Materials Laboratory (EOEML) at the Georgia Tech Research Institute (GTRI). He also is an associated researcher in the Institute for Sustainable Technology and Development (ISTD) at Georgia Tech, formerly the Center for Sustainable Technology (CST). [Note: from July 1, 1994, to June 30, 1997, Dr. Vanegas served as the Associate Director of Educational Programs of CST.] In this capacity, his primary responsibilities were to manage a four-year multidisciplinary research and development effort for a curriculum in sustainable development and technology to be deployed within the CoE across its different engineering schools. He also provided support to various educational, dissemination and informational exchange initiatives, both within and outside the Institute. This project served as one of the original cornerstones for Georgia Tech's current institutional commitment to sustainability through its education, research, and outreach programs, and also through its campus master plan and physical plant. Finally, Dr. Vanegas held a joint appointment with the Army Environmental Policy Institute (AEPI) of the Department of the U.S. Army, through an Intergovernmental Personnel Act (IPA), where he served as an AEPI policy analyst and advisor in the area of

Army Installations Sustainability - Facilities, Infrastructure, Ranges, and Ecosystems (FIRE). [Note: From August 1, 2000, to July 31, 2001, it was a 20% appointment; From August 1, 2001, to July 31, 2002, it was a 40% appointment; From August 1, 2002, to July 31, 2003, it was a 20% appointment.]

Dr. Vanegas also held a joint appointment is with the College of Architecture (CoA) at Georgia Tech, where he served as Co-Director of the Construction Resource Center (CRC), formerly the Construction Research Center. [Note: from the beginning of the Fall Term, 1997, to the end of the Spring Term, 2001, Dr. Vanegas held a 20% joint appointment.] In this capacity, his primary responsibilities were the development and implementation of an integrated, quality-driven, interdisciplinary, and institute-wide research and education infrastructure to advance the knowledge and practices of the Architectural, Engineering and Construction (A/E/C) industry. This was achieved through strong industry/academic partnerships, focused on more effective and efficient delivery of sustainable, cost-effective facilities and civil infrastructure to individuals, communities, and organizations locally, nationally, and internationally. The CRC is an information and knowledge enterprise that provides research and education capabilities to any organization involved in construction-related activities, to enhance the effectiveness and efficiency of its operations, develop and implement advanced technologies, and be more competitive and profitable. CRC capitalizes on the complete multidisciplinary resource base of Georgia Tech, through a joint collaboration of the Building Construction Program (BC) of the CoA, the CEM Program in CEE of the CoE, and various other academic and research units at Georgia Tech, as needed.

Dr. Vanegas is an active member of the American Society of Civil Engineers (ASCE), especially within the Construction Research Council, for which he served as Chair in 1993. He is currently a member of the Subcommittee on Sustainability of the Technical Activities Council. Dr. Vanegas is also an active member of the American Society for Engineering Education (ASEE), the Urban Land Institute (ULI), the Project Management Institute (PMI), the International Association of Bridge and Structural Engineers (IABSE), and the Society of Hispanic Professional Engineers (SHPE). He has been a regular

contributor to the research and educational deployment efforts of the CII in the following areas: constructability; innovative practices for cost-effective capital projects; and prefabrication, pre-assembly, modularization, and off-site construction. He also has participated actively in programs of various Local User Councils of the Business Roundtable (BRT). Different academic institutions, organizations, and companies within the U.S. and abroad have invited Dr. Vanegas to serve as a technical advisor, and as developer and instructor of continuing education courses for professionals in the A/E/C and other industries. He also serves as a member of External Advisory Boards for several research and education centers. Finally, Dr. Vanegas was a founding partner, in 1989, of LSV, Inc., a construction program and project management firm based in Denver, Colorado. He currently serves as an associated principal and technical advisor to the firm.

Dr. Vanegas was born in Bogotá, Colombia. In 1991, he became a U.S. citizen. He received a B.S. in Architecture degree from the Universidad de los Andes (1979), Bogotá, Colombia. He worked for four years, and moved to the U.S. in 1983. He received a M.S. degree (1985) and a Ph.D. degree (1988) from the Construction Engineering and Management Program of the Department of Civil and Environmental Engineering at Stanford University, Stanford, California. Prior to joining Georgia Tech, Dr. Vanegas held an Assistant Professor appointment for 5 years in the School of Civil Engineering and the Division of Construction Engineering and Management at Purdue University, West Lafayette, Indiana.

ABSTRACT:
A Road Map and Principles for the Implementation of Built Environment Sustainability

The built environment is the fundamental foundation upon which a society exists, develops, and survives. The built environment is composed of a diverse range of facilities (e.g., residential, building, and industrial facilities), and of civil infrastructure systems (e.g., transportation, energy, water supply, waste management, communications). As the main provider and the life cycle custodian of the built environment, the Architecture, Engineering, and

Construction (AEC) industry:

(a) plays a critical role in determining the quality, integrity, and longevity of this foundation; and

(b) has had a major direct and indirect impact on the natural environment in the execution of its provider and custodian roles.

The AEC industry contributes, both directly and indirectly, to natural resource depletion and degradation, waste generation and accumulation, and environmental impact and degradation. These impacts are not unique to the AEC industry, and other industries face similar challenges.

As a result, a wide range of constituencies have been attempting for many years the implementation of the concept of sustainability within what people, communities, organizations, and industries do, how they do it, and with what, as a possible mechanism to slow, reduce, and eliminate these impacts, and even restore conditions to a better state. However, in the pursuit of sustainability, the AEC industry faces challenges posed by the unique attributes and characteristics nature of facilities and civil infrastructure systems, the complexities of the current processes for their delivery and use, and the diverse set of resources required for both their delivery and their use. To be successful, the AEC industry needs to (a) define, plan, and design more sustainable facilities and civil infrastructure systems; (b) procure, construct, commission, operate, and maintain them in more sustainable ways; and (c) supply more sustainable building technologies, systems, products and materials used within them.

Effective implementation and achievement of sustainability in the built environment begin with visions for sustainability at global, industry, and project levels, and continue with an implementation road map at strategic, tactical, and operational levels. A fundamental foundation of this implementation road map is the continuous application of specific sustainability principles within the various processes embedded in the visions and the road map. This paper offers a description of a roadmap and an initial set of principles to implement built environment sustainability, as a starting point for an on-going, industry-wide dialogue and debate.

BOOK OF ABSTRACTS

(see database pages for co-authors)

ABSTRACT NO. 1

Authors: **David T. Allen[a*], David R. Shonnard[b], Nhan Nguyen[c]Sharon Weil Austin[c] and Robert Hesketh[d]**

Presenter: **Dave Allen**

Title: **Green Engineering Education In The United States**

Corresponding Author, email: allen@che.utexas.edu;
Fax 1-512-471-1720; Tel. 1-512-471-0049
[a]*Department of Chemical Engineering,*
The University of Texas at Austin, Austin, Texas 78712
[b]*Department of Chemical Engineering,*
Michigan Technological University, Houghton, Michigan 49931
[c]*Office of Pollution Prevention and Toxics,*
U.S. Environmental Protection Agency, Washington, D.C. 20460
[d]*Department of Chemical Engineering,*
Rowan University,Glassboro, New Jersey 08028

Abstract:
Engineering education at most institutions of higher education is based on a combination of scientific training and engineering problem solving and design. System boundaries for the problems used in typical curricula are narrowly focused and well-defined, such that students will achieve solutions using well-defined scientific principles and mathematical techniques. For example, in chemical engineering education, students are taught at an early stage to draw a "box" around the system to be analyzed in order to, for example, calculate mass and energy flows entering and leaving the system. The box approach is a powerful concept for teaching engineering. Yet there is an increasing need to teach students to consider factors that are "out of the box". Although engineering education requires courses in business, social science, and humanities, there is little opportunity to integrate effectively these issues into the technological component of engineering education. Green engineering can be viewed as an attempt to integrate more completely environmental issues into a technological education. By illustrating techniques for incorporating broader issues into

technological analyses, Green engineering can be an important pedagogical tool.

This paper describes a general framework for incorporating green engineering design principles into engineering curricula, with specific examples for chemical engineering. The components of green engineering, which enlarge the "box" for engineering design, are environmental literacy, environmentally conscious design, and beyond-the-plant boundary considerations. The environmental literacy topics include an introduction to environmental issues, risk assessment, and environmental legislation. The environmentally conscious design topics include design tools for assessing the environmental performance of chemical processes, and tools for improving that performance. Finally, the beyond-the-plant boundary considerations include concepts from life cycle assessment (LCA) and industrial ecology. These topics integrate chemical process design with the entire chemical product supply chain, and introduce concepts and tools for assessing the environmental performance of products from cradle to grave.

The ultimate goal for introducing Green Engineering into engineering education is to provide the next generation of engineers with the knowledge necessary to create greener and safer products and processes. Green Engineering enlarges the scope of engineering design to encompass critical environmental issues; therefore, Green Engineering is an important tool for achieving goals of sustainable development.

ABSTRACT NO 2

Authors: **John P Blakeley,** Research Fellow. BE(Hons), ME, MS(Illinois), FIPENZ, FIEAust, CPEng(Aust), CEng(UK), MICE **and**
Jonathan D Leaver, Chairman,

Presenter: **John Blakeley**

Title: **Key Factors In The Introduction Of Hydrogen As The Sustainable Fuel Of The Future**

Centre for Sustainable Energy Initiatives, School of the Built Environment
UNITEC Institute of Technology, Private Bag 92-025, Auckland.
Telephone (09) 815 4321 extn 8876 or 8568 Fax (09) 8156795
E-Mails; jblakeley@unitec.ac.nz or jleaver@unitec.ac.nz

Abstract:
The future potential of hydrogen fuel for large scale use in New Zealand is examined, especially in fuel cell applications. The most likely uses of hydrogen are as fuel for motor vehicles, as a source of distributed generation in electricity networks and for remote area electricity supplies.

The likely rate of uptake of hydrogen over the next 50 years for these issues is proposed and the likely economic and environmental considerations in the large scale use of hydrogen, bearing in mind hydrogen is an energy carrier and not an energy source. The energy source used to create the hydrogen will be an important economic and environmental factor.

Several key factors need to be considered in the development of a hydrogen economy. These include the future availability and price of oil as a transportation fuel given that New Zealand is becoming increasingly dependent on importing most of its oil, and the potential use of coal as a source of hydrogen with its associated environmental impacts, given the very large reserves of coal in New Zealand.

Large-scale production of hydrogen by electrolysis is also important, with costs and environmental effects dependent on the source of the electricity used. Rates of uptake of hydrogen for widespread use will be significantly affected by provision of the necessary infrastructure

with likely high initial investment cost being required, unless the hydrogen can be produced by cost effective small plants near the point of use.

The rate of uptake fuel cell motor vehicles powered by hydrogen will also be a critical factor in a decision to invest in the necessary infrastructure and that uptake rate will be greatly influenced by the relative capital and running cost of such motor vehicles in comparison with other increasingly fuel efficient motor vehicles currently under development.
The benefits of the widespread use in major cities of motor vehicles whose main emission is water vapour and with negligible other emissions are very attractive from an environmental and human health point of view.

ABSTRACT NO 3

Author: **Dr Carol Boyle**

Presenter: **Dr Carol Boyle**

Title: **Achieving Sustainability**

International Centre for Sustainability Engineering and Research
Department of Civil and Environmental Engineering
University of Auckland
Auckland, New Zealand
Email: c.boyle@auckland.ac.nz

Abstract:
Although sustainability is now a common term, there has been little agreement about how it can be achieved. Most measures, such as triple bottom line reporting, do not measure sustainability at all. This research focuses on the long term nature of human society which, for sustainability, requires that we take a 1000 year perspective of development. For such a perspective, the local geology, hydrology, climate, soil and other physical factors comprise a framework which sets limitations on development that can occur without incurring significant risk to human society, such as water shortages. Once the framework has been identified, the timeframes for management of components of the framework (water, soil, energy, food production, etc.) can then be identified. Risks to sustainability can then be identified, prioritised and managed. Only with long term thinking by local and national governments, scientists, engineers and planners will we be able to achieve sustainability.

Keywords: Sustainability; risk; long term planning

ABSTRACT NO. 4

Authors: **Tamara Boyd[1] & John Brumley[2]**

Presenter: **John Brumley**

Title: **Optimising Sustainable Use Of Groundwater: A Challenge For Science And Water Markets**

[1]PhD Candidate, tamara.boyd@rmit.edu.au, Tel +613 9925 2407
[2]Associate Professor, john.brumley@rmit.edu.au,
Tel +613 9925 2379
School of Civil and Chemical Engineering, RMIT University
GPO Box 2476V, Melbourne VIC 3001, Australia.
Fax: +613 9639 0138

Abstract:
Prior to the 1980s, sustainability principles for groundwater use in Australia were poorly understood and rarely practiced. Disquiet over cases of severe degradation of some aquifer systems raised the level of awareness in the 1980s and aquifer over-development was eventually recognised as a threat to long-term supplies, water quality and dependent ecosystems. By the time Australia committed to Ecologically Sustainable Development in 1992, it was clear that many groundwater practices were unsustainable.

Today, groundwater typifies the difficulties facing sustainable management of natural resources. Aquifers are poorly understood, yet the prompt implementation of appropriate controls and practices could ensure the preservation of those systems that are, as yet, not impacted. This is especially important given that aquifers are more vulnerable to irreversible impacts than are surface water systems. So a window of opportunity now exists for the successful protection of Australia's precious groundwater resources. One water management practice which has the potential to enhance the sustainable management of groundwater is trade in groundwater allocations. This has been made possible within Australia through the Commonwealth of Australian Governments national water reform framework.

Since the reform process commenced, groundwater trading has taken a back seat to surface water trading. This must change or else the gains made from surface water reform will be negated via poor groundwater policy. The characteristically interconnected nature of groundwater and surface water demands integrated management of these resources. Over 30 per cent of Australia's groundwater systems are approaching or beyond sustainable extraction limits. Trading stands to facilitate the allocation of these finite groundwater resources to their highest value use. It can also, if managed correctly, protect against impacts to both the aquifer and all groundwater users (including the environment). Furthermore trading promises to provide dynamic responses to Australia's highly variable water demand and supply needs. Groundwater trading must, however, be administered effectively and with due consideration to the physical, social and environmental constraints shaping sustainable groundwater supply. Implementing these ideals is proving difficult. The fact that each Australian State and Territory has been granted the flexibility to adopt its own approach further compounds the drama. The current evolution of different groundwater trading policies will hinder future trade within aquifers crossing political boundaries.

This paper examines the range of groundwater trading practices and policies taking shape across Australia. Specific attention is paid to the physical requisites for sustainable trade, with guiding hydrogeological principles presented. Such principles could be used in the development of groundwater trading rules, as an aid for those assigned the task of assessing the sustainability of trade proposals, or to assist applicants in their understanding of the limitations to groundwater trade.

ABSTRACT NO. 5

Authors: **Zoë Burkitt,** [1] **and Tim Preston**[2]

Presenter: **Zoe Burkitt**

Title: **Developing A Scoring System To Improve Environmental Sustainability At Solid Energy**

[1]*Environmental Scientist, MWH New Zealand Ltd*
e-mail: zoe.l.burkitt@mwhglobal.com
[2]*Environmental Programme Manager, Solid Energy New Zealand e-mail: tim.preston@solidenergy.co.nz*

Abstract:
Solid Energy is the largest coal producing company in New Zealand, employing 500 people and more than 250 mining contract personnel. The coal produced by Solid Energy plays a significant part in the energy mix for New Zealand being supplied to the coal-fired power station at Huntly. It is also supplied to a wide range of industrial users, NZ Steel, and primary processing.

It is fair to say however that the positive economic and social benefits of coal have been overshadowed by the negative environmental consequences of coal mining. Over the past two years Solid Energy have been actively researching and addressing the impacts that they currently have on the environment and making a significant investment in environmental improvements, rehabilitation projects and environmental research to address historical and ongoing environmental issues. These investments have been driven by the company's commitment to its environmental policy, which states:

"Solid Energy's overall environmental objective is for the cumulative result of all the activities we undertake to have a positive net effect on the New Zealand environment" With such significant investment it is essential that the company is able to target expenditure wisely, i.e. invest where there is greatest environmental gain to be had, and are also able to actively demonstrate to stakeholders the improvements that are achieved.

In order to be able to demonstrate the commitment and the steps that the company is making towards this goal a number of systems have been developed.

- Firstly an environmental management system along the lines of ISO14001 formalising the environmental processes, responsibilities, auditing and management review.
- Secondly as part of the planning element of the EMS an environmental scoreboard has been developed, which is the focus of this paper.
- Thirdly the monitoring and measuring tools have been upgraded with GIS driven relational databases installed for management of consent related information and monitoring results.

The development of the environmental scorecard has drawn on a number of existing systems such as the Hellstrom method and the Australian Institute of Mining and Minerals Code 2000. In addition to adapting the scoring regimes from these methods the Solid Energy Environmental Matrix has been further developed to ensure that it reflects the actual environmental impacts on site, as well as the management and audit systems that are in place to control them at a strategic level.

The development of this matrix has included a number of steps:

- Reviewing the information that stakeholders would be interested in
- Reviewing what was already available
- Development of systems to collect data and benchmark the current operations
- Setting up support systems to ensure that the correct information would be provided for scoring
- Development of a methodology for scoring and weighting
- Internal and external methodology reviews
- Internal training
- Internal scoring of individual sites
- External audit of scoring

This paper describes these steps and the management of the implementation of the scoring methodology.

ABSTRACT NO. 6

Author: **John Chapman**

Presenter: **John Chapman**

Title **Timber, A Truly Sustainable Resource, Can Be Used To Replace Steel And Concrete Structures In Multi-Storey Building**

Lecturer, School of Architecture
University of Auckland

Private Bag 92019
Auckland, New Zealand.
Email: jb.chapman@auckland.ac.nz
Phone: 64 9 3737599 ext 84680
Fax: 64 9 3737694

Abstract:

This paper describes and summarises the recent research at the School of Architecture, University of Auckland, into utilising pinus radiata timber for the main structural elements in commercial and industrial building. This research is in response to the advantages of timber as an environmentally sustainable material. Timber is a reducer of the greenhouse gas, CO_2 and requires low amounts of energy for manufacture. Also, it is an efficient material for structural elements and is cost effective. The initial three studies were concerned with radiata poles as the columns for multi-storey building; comparing various types of timber floors for commercial applications; and poles as industrial truss elements. The fourth and main project, informed by the previous studies, researched the potential of radiata poles as the main structural elements in medium storey apartment building.

ABSTRACT NO. 7

Authors	**David I. Wilson and Cho Ming Bernard Cheng**
Presenter	**Cho Ming Bernard Cheng**
Title	**Predicting The Unpredictable: Is The Electrical Spot Price Chaotic?**

David I. Wilson and Bernard Cho Ming Cheng
Department of Electrotechnology
Auckland University of Technology, New Zealand
email: diwilson@aut.ac.nz

Abstract:
Electricity necessary for our society is extremely inelastic. As a commodity, it is also essentially unstorable, and as the Maui Gas field depletes in the next few years, the supply is vulnerable, let alone sustainable. The deregulation of the electricity supply and generation has shifted the focus of electricity modelling from long term by government agencies concentrating on supply and infrastructure, to the prediction of short term price variations by those participating in the electricity market. However the question whether sensible predictions in the short term, (or even in the long term), are possible is relevant given the marginal success of three decades of electricity modelling both in New Zealand and around the world.

This paper compares the performance of historical models for trends in New Zealand to show both the average prediction error and that model complexity and model performance are uncorrelated. Secondly this paper shows that the spot price, a key output variable for the short-term predictions, exhibits some chaotic characteristics. While chaotic behaviour is technically difficult to unambiguously establish given a discrete time series, the consequence makes one seriously question the advisability of expecting a predictive model to work in this situation. Truly sustainable generating options for electricity are, we believe, not viable for New Zealand in the next decade. However what is needed as energy planners move from the resource depleting options used currently, to a more sustainable and reliable generating options in the future are models, but not models that attempt to predict chaos.

ABSTRACT NO. 8

Authors: **Mike J. Collins and Dr Per S. Nielsen,**

Presenter: **Mike Collins**

Title: **Scoping Technology Scenarios For A 100% Renewable Energy Rotorua**

NZ Forest Research Institute,
Sala Street, Private Bag 3020, Rotorua, New Zealand
Telephone: 07-343-5899, fax 07-343-5332
Email: per.nielsen@forestresearch.co.nz
Category: Sustainable energies

Abstract:
Around the world there is a push towards the use of renewable energy. New Zealand is in the position that already a significant part of its energy supply is from hydro-power, geothermal resources and bioenergy. Of total energy consumption in NZ, renewable energy comprises 28%. For the future, most of the hydropower resources used for electricity generation are being utilised but there is still significant renewable energy resources in geothermal, bioenergy, solar energy and wind energy. Provided that these technologies are economically competitive, there is still significant potential to develop renewable energy sources in New Zealand.

There is a move towards the use of renewable energy in particular in Europe, which has been a strong supporter of the Kyoto Protocol. In the countries, which have been successful, like Denmark and Germany, the increasing use of renewable energy has been through a multi-resource approach. In Denmark the development has happened with an increase in energy efficiency, more use of bioenergy, more use of wind power, more use of solar energy and more use of waste heat from cogeneration of electricity and heat. One project under development in Denmark is a 100% Renewable Island project, where Samsoe is endeavoring to achieve 100 % renewable heat and electricity supply by 2010 supported by funds from the Danish Energy Agency. Another island, Aeroe may follow. By investing in a wind “park”, Samsoe will achieve their goal by the end of 2003.

Rotorua has the potential to be New Zealand's first 100% renewable energy city. Rotorua has around 50,000 inhabitants and of total energy consumption, bioenergy is already estimated to cover around 25%, and by covering the low grade heat demand only, it is possible that bioenergy could supply 65% of Rotorua's total energy demand (ref to Pers paper, 2000). On top of that there is geothermal and solar energy. In the paper is a framework to develop technology scenarios for Rotorua to become a 100% renewable energy city. The main target for all scenarios is for Rotorua to become a 100% renewable energy city by 2008. The methods used to develop the scenarios, will draw on the experiences of other countries such as Denmark.

A number of policies are currently being implemented which encourage decisions to switch to renewable energy in New Zealand. These include the Energy Efficiency and Conservation Strategy, a Renewable Energy Target, the Climate Change Policy, and the New Zealand Waste Minimisation Strategy. To achieve a 100% renewable energy goal, significant improvements should also be made by improving the efficiency with which energy is used, through insulating buildings and increased energy efficiency in households and industries. Different degrees of achieved energy savings and energy efficiency gains will be included in the scenarios.

The aim of the scenario development is to identify the most cost-effective way for Rotorua to become a 100% renewable energy city – and evaluate environmental and socio-economic benefits.

ABSTRACT NO. 9

Authors: **Jay Coy, Nabeel Sadaka, and Mrs Julia Lamborn°**

Presenters: **Jay Coy and Nabeel Sadaka**

Title: **Siting Criteria For Wind Farms**

School of Engineering and Science
Swinburne University of Technology
PO Box 218 Hawthorn 3122, Victoria, Australia
°Phone +61 2 9214 8344, Fax +61 3 9214 8264
email: jlamborn@swin.edu.au

Abstract:
The search for renewable energy sources has led to an increasing interest in the use of wind farms. With such an abundance of open space and wind, Australia seems an ideal place for these farms to boom. Whilst the proposed wind farms have the support of most, the developments must also protect native vegetation, endangered bird life and consider aesthetic issues. The Kyoto Summit highlighted the need for renewable energy sources worldwide. In response to the summit, many governments set targets for renewable energy. Wind farms were seen as an economically viable option to achieve these targets.

The siting of wind farms has caused intense social and political debate worldwide. At present, wind speeds govern site suitability. The disruption of habitat, effects on flora and fauna, and impacts on indigenous land users are of secondary importance.

Some of the technical issues that receive complaints with regard to wind turbines are blade glint, shadow flicker and turbine noise. Blade Glint is caused by sunlight reflected off the spinning blades of a turbine. This causes flickering beams of light, which are potentially hazardous to road users (depending on road alignment and the orientation of turbines) and can sometimes intrude on homes. Shadow Flicker occurs when the blades of the turbine cast rapidly moving shadows across the

ground or nearby structures. Shadow flicker is generally a problem faced in the East and West directions as most shadows are cast during sunrise and sunset. Wind energy generates noise from several parts of a turbine: the generator, the gearbox, and contact between the nacelle and the supporting tower, which together give rise to mechanical noise. Research and modelling can reduce the effects of blade glint and shadow flicker. Restrictions can be placed on the number of decibels allowable within the vicinity of residence.

The one of the environmental issues associated with wind farms is the effect on birds. In the 1980s, wind farms in The United States were erected directly in the path of a bird migration zone. A dramatic impact on migratory bird species in the vicinity of the turbines was observed. However, the greatest hindrance to the development of wind farms is the opinions of the media and the general public. Even though the majority of the objectors are in support of the renewable and environmentally friendly energy resource, their arguments centre on the location and aesthetics.

This paper addresses these issues, analyses their effects and provides advice and guidance regarding the development and design of wind farms. The environmental effects and public opinion issues are also covered. Siting criteria have been developed from an analysis of all these factors.

ABSTRACT NO. 10

Author: **Miss Heather J. Cruickshank** BEng (Hons) BSc CEng MICE MCIWEM

Presenter: **Heather Cruickshank**

Title: **The Roles And Responsibilities Of Engineers Towards Implementing Sustainable Development**

Centre for Sustainable Development,
Department of Engineering, University of Cambridge,
Trumpington Street, Cambridge. CB2 1PZ, UK
Tel: +44 (0)1223 766685 Fax: +44 (0)1223 765625
Email: *hjc34@eng.cam.ac.uk*

Abstract:
This paper looks at what it means to be an engineer in modern society and the role that engineers could take in the implementation of sustainable development ideals into practical engineering. Based on case studies carried out by the author in a selection of developing transitional countries, plus the author's recent experience working as engineering advisor in Afghanistan for a non-governmental organization, this work draws on the experiences of working engineers and examines how decisions are made, by whom, and in what context. It then goes on to look at enabling mechanisms required to allow the concepts of sustainable development to be incorporated in to practical engineering.

Regarding sustainable development as a route towards the ultimate goal of global sustainability, this paper explores some of the perceptions of what development means in different cultures and societies and uses this to try to envisage an appropriate course of action applicable now and in the future. The paper proposes that in order to be able to make viable recommendations regarding the future path of global development it is necessary to have an understanding of the historical route to the current state of affairs, as such it begins with a social anthropological overview of the context in which we now operate.

Following this the paper investigates the scope and limitations of the influence held by engineers both in terms of their own

skills and their role within the wider team. It concludes that engineers today need education and training broader than the traditional technical emphasis of Newtonian mechanics and while recognising that this fundamental basis is evidently vital to engineers the author argues that this needs to be complemented by the communication of additional skills to allow engineers to fully engage in development activities and take full responsibility for the consequences of the decisions that they take in the course of their work.

The author advocates the broadening of engineering and technical education to encompass trans-disciplinary studies that better reflect the working environment in which such professions operate. Support for this approach is taken from teaching carried out at University of Cambridge, UK, over the past four years. This paper argues that a sub-set of the engineering community could be encouraged to use their range of skills to allow them to take a more strategic role in organisations in order to enhance the application of sustainable development for the benefit of all. It also stresses the need for engineers to participate in the formation of policy as well as the implementation of development work.

The paper finishes with an outline of further work that could enhance our understanding of the role of engineering in future global development including further social anthropological study of the work of current engineers and the environments in which they operate. It also proposes a period of action research into the changes proposed by this and earlier work.

Heather Cruickshank worked as a civil engineer for ten years before joining the University of Cambridge Department of Engineering as a Research Assistant. She is one of the founding members of the department's Centre for Sustainable Development and is involved in preparation of teaching material for a number of undergraduate and graduate engineering courses. She is also carrying out research towards a PhD in "Embedding the Concepts of Sustainable Development into Practical Civil Engineering" and hopes to submit her thesis in the coming months.

ABSTRACT NO. 11

Author: **Laurence Dolan**

Presenter: **Ron McDowall**

Title: **Life Cycle Assessment Of Management Options For Waste Farm Plastics**

URS New Zealand Limited
Engineering and Environmental Management
Bank Direct Centre, 13-15 College Hill,
P.O. Box 821, Auckland, New Zealand
e-mail: laurence@laurencedolan.com

Abstract:
This study, commissioned by the New Zealand Agrichemical Education Trust and funded by the Sustainable Management Fund and others, is a Life Cycle Assessment of five options for the management of the two predominant types of waste farm plastics (HDPE chemical containers and LDPE film) compared with the status quo. The waste management options are:

- on-farm burial;
- on-farm burning;
- drop-off at collection facility for recycling;
- drop of at transfer station for landfilling;
- drop off at transfer station for incineration and energy recovery.

Two regions (Hawkes Bay and Canterbury) were used as case study areas. For these areas farm and horticultural unit numbers, plastic quantities, transport distances and transfer and disposal facilities were determined. Published data was used to obtain quantitative information for on-farm scenarios. The WISARD Life Cycle Assessment for Waste Management software tool was used to model the off-farm management scenarios. In addition, the practicalities of the different management options and risks associated with people's behaviour (for example inadequate rinsing of chemical containers) were addressed in a qualitative manner. The life cycle assessment indicated that recycling of waste farm plastics (into products as a replacement for virgin plastic) has environmental benefits when compared to other options, and the mix of options currently used by farmers in New Zealand. The benefits are principally due to avoided environmental burdens that result from the use of recycled plastic rather than virgin plastic.

ABSTRACT NO. 12

Authors **Richard Donnelly, and Dr Carol Boyle**

Presenter **Richard Donnelly**

Title: **Sustainability – Why Is It Way Beyond The Triple Bottom Line?**

International Centre for Sustainability Engineering & Research (ICSER)
University of Auckland, Faculty of Engineering
Private Bag 92019, Auckland, New Zealand
Ph: *+64 9 373 7599 ext 88210*
Fax: *+64 9 373 7462*
Email: *rdon@ihug.co.nz (presenter)*
Email: *c.boyle@auckland.ac.nz*

Category: Philosophy, policy and practice

Abstract
Research into improving the sustainability of urban water management systems at the site level within an engineering context has revealed that this is impossible without regional level guidance on site level outcomes necessary to address specific threats and risks to the sustainability of water supply, wastewater and stormwater services within the city as a whole. Without such guidance, actions at the site level can only be directed to reducing contributions to the Tragedy of the Commons by improving hydrological efficiency and environmental performance. The sustainability of critical infrastructure systems and processes cannot be addressed through the application of generic sustainability principles and/or the consideration of Triple Bottom Line impacts at the site or project level. Extensive, coordinated, integrated, multi-disciplinary and context specific planning approaches are required at the regional level to identify threats and risks to the sustainability of critical systems and processes, and paths of action to address them. These findings support the philosophy behind current research into the long term planning for the sustainability of human cities.

ABSTRACT NO. 13

Authors: **Richard Reinen-Hamill**[1] ME MIPENZ**, and John Duder**[2] BE FIPENZ MICE

Presenter: **John Duder**

Title: **Sustainability Of Coastal And Water Resource Engineering**

[1]*Director*
[1]*Consulting Engineer*
Tonkin & Taylor Ltd, Auckland
Email: rreinen-hamill@tonkin.co.nz,

Abstract:

To follow both the precepts of the Resource Management Act, and the burgeoning exhortations of "sustainers", requires more than just environmental adequacy. This paper examines the sustainable aspects of both coastal and water resource projects and includes a range of projects, some of which have been recognised for environmental excellence, and others that have won recognition for the quality of their engineering. Consideration of sustainability introduces the role of kaitiakitanga or stewardship and the integration of a range of options considering time as well as resource use.

ABSTRACT NO. 14

Authors: **Charles Eason[1], Surya Pandey [1]Clare Feeney[2], Marjorie van Roon[3] and Jenny Dixon[3]**

Presenter: **Charles Eason**

Title: **Low-Impact Urban Design: Making It Mainstream**

[1] Landcare Research, Private Bag 92170, Auckland, NZ
[2] Environment Business Group, P.O. Box 68440, Auckland, NZ
[3] Department of Planning, University of Auckland, Private Bag 92019, Auckland, New Zealand

Abstract:
Our multidisciplinary research team of planners, environmental scientists, and economists has initiated a programme of research to facilitate, stimulate, and encourage urban developers to strive for more sustainable urban housing development that has minimal adverse off-site environmental effects and focuses on people's needs for quality of life and quality environment. This paper presents preliminary findings from working with four key stakeholder groups: community, developers and engineers, regional and city councils. The major research question addressed by the programme is 'how to overcome obstacles and make broad-scale implementation of low impact urban design and development (LIUDD) happen. As yet effective LIUDD is not sufficiently mainstream in day-to-day practice in terms of planning requirements (district plans, etc.) and implementation (e.g. design techniques, subdivision codes of practice). Where LIUDD is practiced, site-specific improvements have occurred, but the current piecemeal application of LIUDD is failing to reverse the trends of urban deterioration at a district or catchment scale. This paper presents the preliminary findings of several related studies that look at multiple assessment criteria and indicators of sustainable urban developments, existing compliance codes, and alternative codes that could promote LIUDD. By working closely with developers we have identified various incentives for LIUDD that can be practically applied. We are also ensuring that such work is closely aligned with key government-level strategies, such as sustainable development, urban sustainability, skills/ innovation/knowledge and several others related to broader areas of resource efficiency, health, transport and so on.

ABSTRACT NO. 15

Author: **Kerry Griffiths,** MA (University of Auckland), MBA (Victoria University), MSc (University of Bath, UK)

Presenter: **Kerry Griffiths**

Title: **TBL Reporting – A Review Of Recent Practice**

Senior Sustainability Consultant
URS New Zealand Limited
Email: kerry_griffiths@urscorp.com

Abstract:
A growing number of private sector organizations – both internationally and locally - are reporting publicly on their 'Triple Bottom Line' performance. This paper presents the findings of a study carried out by CSR Europe and AccountAbility UK on the impacts of such reporting as experienced by eleven companies including Unilever, BT, Volkswagen, Nike. The questions explored are:

- What are companies reporting on? Where are the challenges and the opportunities?
- How does reporting develop over time?
- What value is TBL Reporting adding to the reporting organizations?
- What impact does reporting have on stakeholder relationships?
- What differentiates good reporters from the rest?
- How effective is TBL Reporting as a tool for moving an organization towards more sustainable practices?

In addition to the international research, an update will be provided on the development of TBL Reporting in New Zealand including a number of local case studies. Kerry Griffiths has been involved in the development of Triple Bottom Line Reporting in both private and public sector organizations and has provided extensive training in this area. She is able to draw on the wide range of experience provided by URS New Zealand Limited as a verifier of TBL / Sustainability Reporting. Kerry is the Senior Sustainability Consultant at URS New Zealand Ltd, an active member of the New Zealand Business Council for Sustainable Development.

Kerry Griffiths is an experienced organization development consultant who has worked in the Corporate Social Responsibility and Sustainable Business field in New Zealand for the last six years. In 1999, she completed a Masters degree at Bath University, School of Management, in Responsibility and Business Practice. She was the first Vice Chair of New Zealand Businesses for Social Responsibility and is an active participant in the Sustainable Development Forum. Kerry is the Senior Sustainability Consultant at URS New Zealand Ltd, an active member of the New Zealand Business Council for Sustainable Development.

ABSTRACT NO. 16

Authors: **M. N. Haque[1*] and T.A.G. Langrish[2]**

Presenter: **Dr Nawshad Haque**

Title: **Performance Of An Industrial Solar Kiln For Drying Timber In Australia**

[1]Scientist, Wood Drying Technologies
Forest Research, Private Bag 3020, Rotorua, New Zealand
[*]Corresponding author's Email:
Nawshad.Haque@forestresearch.co.nz
[2]Associate Professor, Department of Chemical Engineering, University of Sydney, NSW 2006, Australia
Email: timl@chem.eng.usyd.edu.au

Abstract:
The Australian timber industry is showing an increasing interest in the use of solar kilns to accelerate the pre-drying stages for hardwoods. Research studies around the world have claimed that the advantages of solar kilns are shorter drying time, better product quality and low operating costs compared to open-air drying and lower energy cost compared with conventional kiln drying. This study assessed the actual performance of an instrumented industrial solar kiln and developed a simulation model. Solar energy, wind velocity, ambient temperature and humidity, kiln temperature and humidity and wood moisture contents were recorded on site (at Boral Timber's solar kiln at Heron's Creek, NSW) using sensors and an electronic data acquisition and logging system. The average increases in air temperatures in the kiln (compared with ambient conditions) were 17.3°C (May-June), 13.8°C (July-August), 10°C (September-October), 8.2°C (November-March) and 7.5°C (March-May) for five runs monitored, respectively. Drying times were three to four months from an initial (43 to 62% dry-basis) to a final moisture content (12 to 22% dry-basis). Overall the solar kiln has been considered as an acceptable alternative to air-drying method for pre-drying of hardwoods.

Keywords: solar kiln; renewable energy; wood drying; timber processing; hardwood; pre-drying.

ABSTRACT NO. 17

Authors: **Dr Ivan M Johnstone**

Presenter: **Dr Ivan Johnstone**

Title: **Stock And Flow Models Of Housing**

Department of Property, The University of Auckland
Level 5, Architecture Building 26 Symonds Street, Auckland
Phone: (09) 3737 599 extension 86289,
Email: i.johnstone@auckland.ac.nz

Abstract:
The factor that most influences the sustainability of a housing stock is the service life of the dwellings within the stock. Although research on the physical degradation of building materials and components is essential and the development of innovative and appropriate materials and components is desirable, it should not be overlooked that the demolition and replacement of dwellings is not physically determined, but is instead the end result of an economic process. This is because dwellings in themselves are but are a means to an end and we are ultimately concerned with the services that dwellings provide. Appropriate and internally consistent government policies and regulations that influence and direct the sustainability of housing should therefore be based on both the benefits provided by housing and the costs that sustain those services. Furthermore, performance measurements of the sustainability of housing require a stock and flow approach due to the dynamic relationships between benefits and costs over time.

Over the past 10 years the author has developed a number of stock and flow models of the New Zealand housing stock. This paper describes a selection of these models and their results. The models include a mortality model that estimate the average service life of New Zealand housing stock and an actuarial model that estimates the maximum expenditure that can be justified on undertaking full refurbishment as opposed to investing in new housing. Later models include those that estimate the optimum timing of full refurbishment, the impact of periodic refurbishment on the national costs to sustain housing stock, the potential for further reductions in national costs due to

refurbishment, and the energy and mass flows of the housing stock.

Issues which affect the sustainability of housing are addressed. One issue is the major impact on the national costs to sustain housing should there be widespread use of innovative but short-life structural systems that satisfy only the minimum service life of 50 years required by the New Zealand Building Code. Another issue which affects buildings in general is the depreciation allowance. Although depreciation allowances for buildings have a substantial influence on the timing of land use succession, depreciation rates are commonly arbitrary.

Future research includes the need for a follow up study of the New Zealand housing stock that was carried out by the National Housing Commission in the early 1980s and quantification of the dynamics of obsolescence over the full service life of dwellings. A study of the standard land use succession criterion used by property professionals is also needed. This standard criterion is anomalous under conditions of zero increases in land values and the issue of the extent that increases in land values should be allowed to influence the timing of land use succession needs to be examined.

ABSTRACT NO. 18

Author: **Nigel Jollands, PhD**

Presenter: **Nigel Jollands**

Title: **Wasting 'Eco-Efficiency': Sisyphus And The Policy Maker**

NZ Centre for Ecological Economics
Massey University,
PO Box 11222, Palmerston North, NZ
Tel: +64 6 456 7154: FAX: +64 6 355 9230
Email: jollandsn@landcareresearch.co.nz

Abstract:
Eco-efficiency plays an important role in policy, planning and business approaches to sustainable development. But what do we mean by eco-efficiency? Despite the potential richness of the eco-efficiency concept, in practice, it is often narrowly conceived within narrow disciplinary boundaries. This appears to be the case even in ecological economics which purports to be 'transdisciplinary' and pluralistic. Such narrow disciplinary perspectives essentially waste the richness of the eco-efficiency concept. This wasting of eco-efficiency concepts could mean policy makers are destined to Sisyphean[2] toil in the pursuit of ecologically sustainable development.

This paper explores the origins of the eco-efficiency concept and the potential insights into the concept from several core disciplines: thermodynamics, ecology and economics. The discussion then presents an interdisciplinary, pluralistic framework within which a truly ecological economic approach to eco-efficiency can emerge. Armed with this framework it is hoped that policy makers will be less likely to follow Sisyphus in pushing the proverbial uphill and be better placed to make decisions that lead to an ecologically sustainable society.

[2] In Greek mythology, Sisyphus was a cruel King of Corinth condemned forever to roll a huge stone up a hill in Hades only to have it roll down again on nearing the top. The gods thought with some reason that there is no more dreadful punishment than futile and hopeless labour.

ABSTRACT NO. 19

Author **Ms Patricia Kelly,** BA Dip Ed B ED Grad Dip Media MA FSEDA

Presenter: **Pat Kelly**

Title: **Letter From The Oasis - Helping Engineering Students To Become Sustainability Cadres**

Adjunct Lecturer Uni of the Sunshine Coast
PhD Candidate, QUT
Ph (617) 33455669
Email: p2.kelly@student.qut.edu.au

Abstract:
Sustainability scientists Raskin et al call for education that produces "sustainability cadres", professionals who understand the need for sustainability and can work towards it. However students often have very different ideas, usually based on an expectation of continued unlimited growth.

This paper, based on research with large diverse first year engineering cohorts, shows how a reflective process and on-line support can create a learning oasis - an environment that encourages students to leave their cultural and intellectual comfort zones. In these circumstances, most students will engage with the personal and professional challenges of what it means to be Globo sapiens, a global sustainability professional for an increasingly complex century. The lessons learned from this work are relevant to others engaged in this urgent international task.

ABSTRACT NO. 20

Author **David Kettle**

Presenter: **David Kettle**

Title: **A Sustainability Action Planning Tool**

PhD student, University of Auckland, New Zealand
295 Wainui Road, Silverdale, OREWA, New Zealand
Phone 09 426 4909 (home), 09 379 1200 (work), fax 09 336 0121
david.kettle@maunsell.com

Abstract:
The traditional trilogy of social, economic and environmental has been widely accepted as representing the three different areas "making up" sustainability. However, the traditional trilogy has been found to be lacking as it ignores the complexity that exists with the additional cultural and institutional components of sustainability.

This paper presents a proposed redefinition of the sustainability trilogy into more fundamental generic terms that allows the inclusion of cultural, institutional and other factors while still maintaining an underlying trilogy. The need for a framework to manage the urbanisation process (in this case, sustainable development) is not new. For instance, Le Play in the 1800's and Geddes in the 1900's had trilogy frameworks that are very similar to the social, economic and environmental trilogy of today. In 2000, the Dutch have used the trilogy of Profit, People, Planet (see table below):

Le Play (1800's)	**Geddes (1915)**	**Dutch Social-Economic Planning Council (2000)**	**Traditional Sustainability Trilogy**
Family	Folk	People	Social
Work Patterns	Work	Profit	Economic
Environment	Place	Planet	Environmental

It is not the trilogy words themselves that are important but the underlying concept behind the words that is more important to understand. To portray the underlying trilogy concepts the author suggests richer and more inclusive phrases of people, processes and places.

Traditional Sustainability Trilogy	**Authors Preferred Terminology**	**Explanation**
Social	People	*People* combines both the social and cultural aspects
Economic	Processes	Includes both the economic and institutional aspects, which are the vital *processes* by which the *people* interact and link with the *places*, or environment.
Environmental	Places	*Places* includes both the natural (ecological) and built (buildings and infrastructure) environment

The proposed definitions of people, processes and places form the basis of a proposed "sustainability matrix framework" as shown on Attachment 1. The paper presents the derivation of this new framework along with a practical case study example for an urban 3-waters (stormwater, wastewater and water supply) infrastructure system sustainability options analysis. The proposed multi-level matrix emphasises that sustainability is a journey, and not merely an endpoint. That is, for true sustainability, sustainability principles have to be implemented at all stages of the project, from the initial vision or concept, through the design and construction stages, and finally to the monitoring or measuring of the final outcomes.

Acknowledgements:
PhD Supervisors at the Faculty of Architecture, Property, Planning & Fine Arts, University of Auckland, NZ;

- Dr Robert Vale, Principal Supervisor
- Assoc. Prof. Tom Fookes, Associate Supervisor

ABSTRACT NO. 21

Authors: **Tony Burton and Susan Krumdieck**

Presenter: **Dr Susan Krumdieck**

Title: **Continuity Model For Energy System Sustainability**

Dr Susan Krumdieck
Department of Mechanical Engineering, University of Canterbury
Email: s.krumdieck@mech.canterbury.ac.nz

Mr Tony Burton
Email: t.burton@mech.canterbury.ac.nz

Abstract:
What is a sustainable technology? Can something be 10% *more* sustainable? What is sustainable growth? By *sustainable*, do we really mean, *we don't want to change?* If we were to define sustainability as an engineering *design criteria* or a *performance parameter*, what would the numbers mean? This paper explores the first steps to functional deployment of the criteria of sustainability for a regional energy system using a novel continuity model.

At the University of Canterbury, the Advanced Energy and Material Systems Group (AEMS) is dedicated to research into the planning and development processes for development of the next generation energy system. The standard engineering systems design approach, together with advanced modelling techniques are employed in a revolutionary methodology to determine an "energy architecture" that could meet society's needs within the limits of available sustainable resources. This field of study is called Strategic Analysis of Complex Energy and Environmental Systems (SACEES). The SACEES approach has been developed from original research describing human activity, energy consumption, and the environmental impacts as a feedback control system, which operates within a geographical, cultural, and economic context. In this paper, the theory is described, and used to demonstrate that the first step toward a sustainable energy system is to design a system that meets the given requirements of the regional society within the

constraints of geography and environment. The theory of energy continuity is several hundred years old (the First Law of Thermodynamics). However, the continuity model developed for the SACEES programme requires that:

1. at least one possible manifestation of a fully sustainable energy system for a specific region must be defined;
2. the nature and functionality of the resource-constrained, sustainable energy system must be communicated to the community in non-technical terms; and
3. feedback of service availability and environmental impacts must be related directly to immediate, daily activities of individuals and businesses.

A SACEES study must be done for a specific region, and for a specific community requirement. The study requires compilation of renewable energy availability data and energy conversion technology characterization, together with cultural requirements of the society for a high quality of life. In this paper we will present the example of a SACEES study done for the city of Christchurch, concerning the winter home heating problem. The continuity model of a sustainable system was developed, specifying that wood energy in the form of forced-air pellet stoves could provide the service required to all residents of the city within the waste wood supply limits for the area. Direct feedback mechanisms were also proposed which would drive the change to the sustainable system.

ABSTRACT NO. 22

Authors: **Dr. Susan Krumdieck, Dr. Andre Dantas, Mr. Tony Burton**

Presenter: **Dr Susan Krumdieck**

Title: **Supply And Demand Is Not Sustainable**

Dr Susan Krumdieck
Department of Mechanical Engineering, University of Canterbury
Private Bag 4800, Christchurch 8020
Ph: 03 364 2987 ext 7249
Fax: 03 364 2078
Email: s.krumdieck@mech.canterbury.ac.nz

Mr Tony Burton
Department of Mechanical Engineering, University of Canterbury
Ph: 03 364 2987 ext 7092
Fax: 03 364 2078
Email: t.burton@mech.canterbury.ac.nz

Abstract:
What does a sustainable society look like? Prior to the industrial revolution, local societies developed and organized their resource utilisation with regard to living within the environmental constraints of their geographical area. Whether past cultures found ways to live in relative sustainability through conscious design or through limited technology may be a source of debate. The fact of resource limits has been patently obvious to people for thousands of years. However, over the past two centuries or so, engineered environments have increasingly defined the living experiences of people in the developed world, where the only constraint is the consumer's ability and willingness to pay the going price. Because we *believe* in supply-and-demand and endless growth, we have collectively lost sight of the *fact* of energy and resource constraints. The challenge for our time is to apply the same powerful intellectual and technological tools that have created the illusion of perpetual growth and use them to find our limits.

At the University of Canterbury, the Advanced Energy and Material Systems Group (AEMS) is dedicated to investigating the role that new technology and modelling can play in deploying the next generation energy system. The standard engineering systems design approach, together with advanced modelling techniques are employed in a revolutionary methodology to determine an "energy architecture" that could meet society's needs within the limits of available sustainable resources. This field of study is called Strategic Analysis of Complex Energy and Environmental Systems (SACEES).

The SACEES approach has been developed from original research describing human activity, energy consumption, and the environmental impacts as a feedback control system, which operates within a geographical, cultural, and economic context. In this paper, the theory is described, and used to demonstrate why pricing signals through increased *cost* for fossil energy will not lead to sustainability. The feedback signals as described by the theory are discussed, showing why environmental *impacts* have also not been effective drivers for change. The role of the market is explored, and the theory explains why *supply and demand* economics will never produce a sustainable society. Examples of historical events are given, and the conclusion is made that *availability* and *service* are the clear factors in stabilising the energy system and driving it toward sustainability.

ABSTRACT NO. 23

Author **Dr Margaret Lawton**

Presenter **Dr Maggie Lawton**

Title **From Grey To Green**

Lawton, Dr, Maggie
Landcare Research, Private Bag 92170, Auckland
Mobile: 021377711 Phone: 095744132
Lawtonm@landcareresearch.co.nz

Abstract:
The Country quivers under the threat of a potential power crisis and Auckland may need to spend $11billion over 20 years to clean up its stormwater management systems. Rather than continue to meet the demand through increasingly difficult and expensive means, its time to reduce the demand and consider a new approach to life, one based on far less use of resources and better management of waste.

As a research organisation dedicated to the health of New Zealand's environment and hence, we believe it's economy, we have recently completed a new building for our staff in Auckland. The building was an opportunity to put our money where our mouth is by making it as sustainable for the long-term as is currently practical within the normal fiscal envelope for a similar building. We wanted to ensure that cost would not be a deterrent to others who wanted to follow suit. The building demonstrates a number of novel features, advanced in the management of energy, water and waste. It includes on two floors the first use of composting toilets in a commercial building of this size, recovered rainwater for glasshouse and ground floor toilet use, pervious carparks which will lead to rain gardens (yet to be completed) for the removal of organic chemicals and heavy metals. The target energy consumption is about a third of a normal equivalent building. This is achieved through good design and insulation to achieve an R4 rating and clever engineering using a range of approaches to achieve the required conditions, either within a comfort range or to meet the more stringent containment requirements of some laboratories. Meeting the target will also require sensible use of the building

and a heightened awareness by users for the need to minimise resource use.

Achieving the above was not easy. The infrastructure to buy sustainable buildings off the shelf is not there as yet and that is what is needed to make such buildings mainstream. We will continue to assist that process by taking the opportunity to measure and monitor our performance and help improve the sustainable design of features, in and around our building.

ABSTRACT NO. 24 (unedited as received)

Authors **Tang, Hsien-Po[1], Lee, Ming-Hsien[2], Lu, Wei-chi[3]**

Presenter: **Lee, Ming-Hsien**

Title: **A Study Stream Of The Bioindicator Systematic To Establish -For Example Zhong-Gang Stream In Taiwan.**

**. Corresponding author. Tel: +886-3-5186672, Fax: +886-3-5186670, E-mail: tang@chu.edu.tw and mhlee927@yahoo.com.tw*

[1] Associate Professor,
Department of Landscape Architecture, ChungHua University.
30 TungShiang, HsinChu, Taiwan, 300 R.O.C.
[2] Graduated Student,
Department of Civil engineering, ChungHua University.
30 TungShiang, HsinChu, Taiwan, 300 R.O.C.
[2] Graduated Student,
Department of Civil engineering, ChungHua University.
30 TungShiang, HsinChu, Taiwan, 300 R.O.C.

Abstract:
Due to the more environmental discredits and concerns of ecological conservation, ecological engineering must be developed in order to meet the environmental requirement. The environment impact assessment surveys and investigations must be taken care of in any large land use projects and adopted by nature conservations and restoration methods whenever possible. At present, studying about bio-indicator has less support, and monitoring the environment, as bio-indicator existence, population composition and a particular community.

The objective of this study is to investigate the species composition and distribution of the aquatic insects, to monitor the change of community structure of aquatic insects in one-year study, and in the Zhong-kang River. Twelve sampling areas were selected from upstream to downstream. Monthly sampling of aquatic insects was classified in the laboratory. Water quality monitoring was collected monthly. Water quality

parameters such as temperature, pH, conductivity, Dissolved Oxygen (D.O), suspended solid, ammonia, nitrate, and phosphate were analyzed.

The results indicated that 20 species of aquatic insects including 6 orders, and 12 families were classified in Zhong-kang River. The larvae of Trichopteran are the dominant species. The monthly change of the insect number suggested that the number increased in spring and fall, and declined in summer and winter. The assessment (fig2-7) illustrated that upper upstream contains the best water quality. However, water quality of downstream was the worst along the river.

For applying the aquatic insect species as bio-indicators, only species, ecological diversity, community similarity and seasonal succession change were studied. In addition, the aquatic insects communities grown on different artificially attached substance on riverbed were also studied. The primary result showed the restoration rate of insect species had great potential in further utility of Ecological Engineering.

Key Words:
Bioindicator ,Ecological engineering, Environment Restoration

ABSTRACT NO. 25

Author: **Donald D. Liou**[1] ASCE **And Kanya Mukoko**[2]

Presenter: **Donald Liou**

Title: **Engineering A Sustainable House For Solar Decathlon 2002**

[1] *Associate Prof., Depart. of Engineering. Technology, the Williams States Lee Col. of Engineering., Uni. of North Carolina at Charlotte, 9201 University City Blvd., Charlotte, NC 28223-0001.*
[2] *Undergraduate student, Civil Engineering. Technology, Department. of Engineering. Technology, University. of North Carolina at Charlotte*

Abstract:
In 2002, a team of students from the University of North Carolina at Charlotte (UNC Charlotte), USA constructed a green building. The student-designed and student-constructed house has 500 square-feet of conditioned floor-area, and is powered by the sun's energy alone. It was one of the fourteen entries in the 2002 Solar Decathlon Competition, the first intra-university solar-house competition sponsored by the U.S. Department of Energy. That competition was held in Washington, D. C. mall for a 2-week period starting from the last week of September, 2002.

This solar house was a joint-venture endeavor between the College of Engineering and the College of Architecture of UNC Charlotte. Nine professors from the two colleges volunteered for advising this endeavor. The advisors helped organize student teams, plan and coordinate activities. Each of them was responsible for guiding students in one or more aspects of the solar house project. Within the already scheduled and published courses, the professors re-structured the contents of regular course works to incorporate studies, researches, and designs that were necessary to make this house a reality. The time and efforts they contributed led to the success of the solar house project. More than 50 students participated in the project. Architectural students conceived several conceptual designs, from which two were chosen. Engineering students were grouped into different teams, with each of these teams focused

on one or two technical tasks. Design information and data were freely exchanged between students of the two colleges. From the start to the end of the project, student teams solicited funding, designed, engineered, and built the solar house, and operated the house while it was in competition.

The house was engineered to address the following goals and issues:

To build a house that can be taken apart easily, transport to another location easily, and assemble for use in a new location easily.

To build a house that uses only the sun's energy, and yet has enough energy to support normal living activities, such as washing, cooking, office work, entertaining, and transportation.

To build a house that not only needs no ground digging (for conventional form of foundation), but also has enough strength to balance loads from nature and capability to provide stability to itself.

To design an energy-efficient house that not only has adequate insulation and moisture barrier, but also has enough lighting and other nice features of liveability.

Because the solar house was actually built and competed in Washington, rather than stopping at the design stage, all UNCC students and faculty advisors who participated in the event seem to have benefited from the participation. This paper documents some of the challenges that the participated engineering faculty and students have overcome in the process of achieving the goal of building the sustainable house. It presents the knowledge and experience gained from involving in the solar house competition. Steps taken to address these engineering issues could be useful in the general practice of sustainable engineering. They also may indirectly address some of the political, social, economic, environmental issues that are related to the housing problem of the world.

Key Words:
Solar Decathlon, solar panel, solar house, livability, manufactured house, the U.S. Department of Energy, building envelop, vapor barrier, green building, sustainable engineering

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ABSTRACT NO. 26

Author: **Emeritus Professor Ian Lowe**

Presenter: **Ian Lowe**

Title: **Applying Sustainability Science**

School of Science, Griffith University,
Nathan 4111, Australia
phone 61 7 38757610, fax 61 7 48757656,
e-mail i.lowe@griffith.edu.au

Abstract:
Many of our most serious environmental problems are the direct or indirect result of applying narrow technical expertise to complex natural systems. Local and international examples demonstrate the need for a radically different approach. Scientists who recognised the problem have produced the move toward sustainability science. As well as explictly recognising the complexity of natural systems, sustainability science involves researchers working with the wider community to specify the problem, collect and evaluate data, develop and refine theories, and propose new responses. Sustainability science also requires new approaches, such as working back from identified unacceptable outcomes to determine better trajectories of development. Some examples of the approach will be given, ranging from protection of the Great Barrier Reef and maintenance of coastal ecosystems to setting greenhouse gas emission targets for the city of Brisbane. Sustainability scie nce offers a practical way of moving toward the only type of development which is morally defensible, a path that explicitly aims to sustain the natural systems on which we depend.

ABSTRACT NO. 27

Author: **Richard Lumsden**

Presenter: **Richard Lumsden**

Title: **Sustainability Assessment: The Way Ahead For Corporate Reporting**

PhD student, ICSER
University of Auckland
e-mail: Lumsden.f@xtra.co.nz

Abstract:
The traditional single line corporate financial report does not evaluate the sustainability of a company. Triple Bottom Line (TBL) reporting has been developed so that companies can report on their impact on the three pillars of sustainability i.e: social, economic and environment. The limitations of TBL is that it is focussed on the past and the short term whereas the impacts of sustainability can manifest themselves in the medium and long term, i.e: 50 to1000 years. Sustainability assessment provides a medium and long term tool that analyses not only the processes but the risk that negative impacts will occur over time. This enables a company to mitigate these risks. As business success is reliant on the effective management of risk, sustainability assessments will therefore be a useful tool that will enhance long term business sustainability to the benefit of shareholder and stakeholders of the enterprise.

ABSTRACT NO. 28

Authors: **Mr Ben Maddox, Professor Geoffrey Evans, Dr Peter Scaife**

Presenter: **Ben Maddox**

Title: **Tools For The Integrated Assessment Of Sustainable Regional Energy Systems**

Department of Chemical Engineering, University of Newcastle, Callaghan, NSW, 2308 Australia
e-mail: *ben.maddox@newcastle.edu.au*
Phone: *61 02 49 217838*
Fax: *61 02 49 216893*

Abstract:
This project focuses on the development of a modelling framework for the integration of Life Cycle Analysis (LCA), externality costing and economic input – output analysis, with the aim of helping decision-makers assess the sustainability of regional development options. The framework is based on normalising, in monetary terms, economic, social and ecological costs and benefits, so that all impacts can be considered on the same basis, and trade - offs analysed. The New South Wales Hunter Valley, a centre for coal based extraction, export and electricity generation is the study region for which the framework is being developed. The initial focus on energy - related costs and benefits is due to their global importance, and because it is highly likely that ongoing changes to the Hunter Valley's energy industry will have significant socio-economic effects as it moves, as all regions of the world must move, toward more sustainable energy systems.

There is a growing awareness that decision-making related to fuel and technology choice for power generation should take into account externalised costs and benefits. However, energy is only the starting point for the integrated assessment. The ExternE (Externalities of Energy) methodology developed by the European Commissions has been modified for Australian conditions with; for example, water impacts receiving more attention than in European and North American applications. Model development is based at the University of Newcastle and will be ongoing. The model is accessed through a geographic

information system (GIS), which is open to addition by other researchers who may focus on areas other than energy. The aim is to produce a transferable regional assessment model facilitating continual updating, trend analysis and knowledge expansion in regard to regionally specific impacts. This will provide a valuable tool for the analysis of tradeoffs inherent in decision making for the transition to regional sustainability.

In addition, it is acknowledged that assessments of regional sustainability requires more than the evaluation of developmental trade - offs described above. Sustainability is dependent upon maintaining or enhancing the resilience and adaptability of ecological, social and economic systems in response to short and long-term change. The project extends the trade - off analysis to incorporate these principles. A region may create a number of strategies that enhance this adaptability through experimentation and investment in technology and social systems that create a diversity of options capable of maintaining a desirable level of economic, social and ecological function in response to a wide range of possible changes. The modelling framework developed here provides a means of carrying out a cost - benefit analysis of any options identified, so that the sustainability credentials of investments in technology, skills and social structures can be tracked and evaluated.

Finally, while it is widely recognised that all impacts on society, ecology and economy cannot be put into monetary terms without uncertainties involved. When applied consistently, it can provide a comparison of the sustainability of proposed development options expressed in terms relevant to most stakeholders i.e. economics. For this reason, the ExternE approach has been used as a basis for the analysis.

ABSTRACT NO. 29

Authors: **Mr Daniel M.Mainville**[1] MIEAust, P.Eng **and Associate Professor John C.Brumley**[2]

Presenter: **Daniel Mainville**

Title: **The Sustainability Of Land Uses In The Strzelecki Ranges In Victoria, Australia**

[1]*Department of Sustainability and Environment*
Crown Land Management
71 Hotham Street, Traralgon Victoria 3840, Australia
Tel: +613 5172 2110 // Fax: +613 5172 2100
Email: daniel.mainville@dse.vic.gov.au

[2]*School of Civil and Chemical Engineering*
RMIT University, GPO Box 2476V
Melbourne Victoria 3001 Australia
Tel: +613 9925 2379 // Fax: +613 9639 0138
Email: john.brumley@rmit.edu.au

Abstract:
The intensive nature of land uses in catchments of the Gippsland Lakes has created significant environmental impacts. To protect the values of the lakes, pollutant sources need to be identified and appropriate mitigation measures implemented. The definition of sources and assessment of land management practices requires accurate estimates of pollutant loads levels. The suspended sediment load in streams is strongly dependent on supply factors and is rarely transport limited.

The analysis of water quality within a stream, over a period of time, may be helpful in isolating possible water quality trends in the catchment; thereby, identifying how land use change may impact the catchment. Erosion is a natural process; however, it is more frequent and potentially more damaging in landscapes with high rainfall intensity combined with steep slopes such as the Strzelecki Ranges. When the protective vegetation cover is removed or degraded, the risks of erosion can be substantially increased. After land use change, increased stream turbidity may also be related to changes in catchment hydrology that cause increased channel erosion. The Strzelecki Ranges are an

elevated and strongly dissected landscape, characterised by steep slopes and rounded ridges. The slopes are prone to erosion and landslips which are aggravated by large-scale clearing and of vegetation and cases of inappropriate land management. The key geological features are an uplifted block of Lower Cretaceous sediments partially capped with Tertiary sediments and/or volcanics. All geological units are deeply weathered.

Prior to European settlement, the Strzeleckis were densely vegetated by wet sclerophyll and temperate rainforest-type vegetation. From 1870 to 1900, farmers settling the ranges largely destroyed the stands of high quality mountain ash (*Eucalyptus regnans*). Present land uses in the Strzeleckis include agriculture primarily grazing and dairying, forest plantations, reserved forests and small communities. Sustained growth of plantation forestry combined with unregulated agricultural practices continues to raise the risk of persistent and magnified environmental impacts.

This paper describes research based on a paired catchment approach. Three catchments were selected representing a forested catchment as a control, a forested catchment where timber harvesting was occurring, and an agricultural catchment. Turbidity and water levels were continuously monitored using a data logger equipped with a turbidity probe and pressure sensor. This data was supplemented with weekly manual turbidity, flow, temperature, and electrical conductivity readings.

These water quality indicators were demonstrated to be good indicators of land use impacts in the catchments. The differences found between forestry, agriculture, and the control catchment highlighted the degradation of water quality with increasing land use change. Agriculture is generating the greatest impact on the local water quality. Establishing healthy riparian zones and controlling cattle access to streams would help to ensure catchment health. Forestry also created water quality impacts. These impacts were more of an indirect nature resulting from increased streamflows and concentration of fauna along the soak areas; the result being extensive bearing of soils through bioturbation. Bioturbation substantially increased the potential for suspended sediment generation. These enhanced natural processes were not observed in the control catchment.

ABSTRACT NO. 30

Authors: **Mary Panko and Ljubica Mamula-Stojnic**

Presenter: **Ljubica Mamula-Stojnic**

Title: **Sustainability - The Education Driver**

UNITEC Applied Technology Institute
Carrington Road,
Private Bag 92025, Auckland
Phone: (09) 815 4321 ext 8552 or ext 7157
Email: mpanko@unitec.ac.nz, lstojnic@unitec.ac.nz
Fax: (09) 815 4310

Abstract:
This paper draws on the practices of sustainable technologies and shows how education is an integral driver in this evolving process.

We argue that the increasing profile given to sustainable practices and products gives rise to new societal demands, that can only be satisfied if both the private and public sectors of industry have a supply of new entrants versed in this aspect of technology. This means that educational organisations have a significant role to play in developing the necessary skills and values within their graduates who have targeted sustainable technology businesses.

Proof of the increasing awareness of this education role has become apparent on a global basis as evidenced by the creation of the Centre for Global Sustainability at RMIT in Australia, and the development in Auckland of sustainable environmental practices in UNITEC's School of Landscape and Plant Sciences. This is now being advanced into the area of sustainable technology within the UNITEC Applied Technology Institute (UATI).

This enables the Triple Bottom Line, comprising environmental, socio-cultural and economic practices to be examined in combination with the +1 factor of governance (using the RMIT model) both practically and with regard to its underpinning theories.

In UATI this theme is emphasised throughout the three years of the new Bachelor of Applied Technology degree in all of its disciplines ranging from Plumbing and Electrotechnology to Building, Maine and Automotive Transport. The rationale of sustainable technology and its characteristics are examined within industry initiatives locally and globally, and students are required to design creative solutions for sustainable practices in individual, community or workplace settings.

The case studies used by students are real, developed with the cooperation of New Zealand businesses that are part of the wider sustainability community and the findings that students discover will be fed back into those industries. In addition, learning will be student-centred, integrated with their developing understanding of technological processes but wherever suitable will incorporate collaborative work.

These studies are also backed up by a versatile range of practical research currently being undertaken by the lecturers in UATI who are working on topics as wide ranging as:

- Wall boards, incorporating the use of flax fibres,
- The use of Bio-diesel and alternative fuels,
- Magnetic Maximisers for increased fuel efficiency,
- Renewable Energy Converter power modules and fuel cells,
- Multi-component vane compressor pumps and the development of wind turbines for domestic use, and,
- The utilisation of non-toxic marine paints.

This paper explains how these projects and others like them relate to issues of sustainability and how knowledge gained is then reflected back into the teaching environment. At this point students are encouraged to develop capabilities in a positive way to enhance their future employment prospects or ideally start their own businesses.

Summarising, the educational driver encourages the growing of ideas and the growing of people. Small positive steps will produce the next generation of practical specialists at a time when the wider community has most need of them.

ABSTRACT NO. 31

Authors: **Ben McLellan, Dr Andrew Dicks and Dr Joao C. Diniz da Costa**

Presenter: **Ben McLellan**

Title: **Sustainability Assessment Of Hydrogen Energy Pathways**

The University of Queensland,
Nanomaterials Centre and Environmental Energy Group
Chemical Engineering Division,
The University of Queensland,
St Lucia. QLD 4072, Australia
(W) +61 7 334 61407
(F) +61 7 336 54199
(M) 0412 426 605
E-mail: b.mclellan@uq.edu.au

Abstract:
Hydrogen is widely seen as the solution to the current problems of Global Warming and poor urban air quality. Much research and funding is being invested in the development of a "Hydrogen Economy", using hydrogen as an energy carrier for vehicles and stationary electricity production. There are a wide variety of sources for hydrogen – ranging from fossil fuels to solar electrolysis – and various options for transport and utilisation. However, the most appropriate pathway to producing and utilising hydrogen is yet to be determined, and the number of variables and uncertainty involved makes prediction difficult. This paper outlines the methodology for, and some preliminary findings of, the Life Cycle sustainability assessment of Hydrogen Energy Pathways, specifically in the Australian context. In particular, it focuses on the sustainability metrics of various hydrogen production pathways, by taking into consideration the environmental burden of pollution upon the receiving environment. This study provides an insight into the potential effects, and hydrogen production technologies that may eventually lead to a more sustainable energy pathway.

ABSTRACT NO. 32

Authors: **Stephen P. Mead Ph.D.**

Presenter: **Stephen Mead**

Title: **Sustainable Laboratory Design: Challenges And Solutions**

Associate Professor
Department of Construction Management
College of Engineering
Northern Arizona University
P.O. Box 15600
Flagstaff, Arizona 86011
stephen.mead@nau.edu
928-523-5650 Work
928-523-2300 Fax

Abstract:
This paper will provide a case study analysis of a bio hazard laboratory that is currently being designed at our University. The lab will be located in a high performance sustainable building that conforms with the United States Green Building Council's LEED program. LEED (Leadership in in energy and environmental design) is the fastest growing sustainable building initiative in the United States, and it is currently being applied to over 10% of new building construction in our country. The paper will summarize the challenges that are inherent in the design of a sustainable laboratories including planning and programming, engineering challenges, bio hazard isolation, and low energy design. In addition the paper will summarize the "best practices" developed from the United States government's "Labs for the 21st Century" program.

ABSTRACT NO. 33

Author **Arup Kumar Misra**

Presenter: **Arup Misra**

Title: **Networking Young India For Sustainable Development**

Assistant Professor of Chemical Engineering
Assam Engineering College
Guwahati-781014, Assam, India.
Telephone: 00-91-361-2571213®, 00-91-361-2674128(O)
Fax: 00-91-361-2572215/ 2668475
e-mail: misak62@hotmail.com

Abstract:
Sustainable Development implies resource management and enhancement, coupled with efficient and equitable use of the existing resources. It is easier said than done to implement such concepts in the field in the context of the developing countries of Asia and Africa. While these regions are yet to develop requisite awareness on "sustainability" as perceived today, ecological awareness and environmental activism have reached a very high degree even in these countries. The issues are well known but complex. India, the largest democracy in the World and a major player in the South East Asian Region, is facing rapid and unbalanced population growth, overloading on capacities of natural systems, unchecked urbanization, increased pollution leading to more poverty.

The core of this paper is based upon the tools developed to create mass awareness and scientific temperament among the children & youth of India through multi-faceted intra-mural and extra-mural activities. All development agencies of the UN and the Government of India with all its arterial organizations have strongly felt the necessity of training and education for "sustainability" as one of the paths to recovery from the impasse. The author of the paper is the Founder-Coordinator of a Network of Science & Eco-Clubs in India, the largest in the sub-continent, which addresses to the relevant sectors and associated problems of Sustainable Development, as defined in the Rio Summit in 1992.

A very large group of students, teachers, facilitators and non-governmental organizations are involved in India in various activities on environment & development. The major issues where some breakthrough have been made are population growth abatement, urbanization and rural-urban interface, poverty alleviation, energy consumption with special emphasis on renewable resources, food production, conservation of forest & genetic resources, restoration of land, reduction in greenhouse gases, use of appropriate technologies for control of pollution, etc. As an additional outcome, these groups are producing huge volumes of documents on local natural resources and their traditional uses. Adequate case studies have been highlighted in the Paper to elucidate the indigenous technologies for the benefit of the participants. These initiatives are not just eco-friendly for the developing countries, they also hold promise for the developed world in the fast changing international scenarios. Our efforts are based on greater emphasis on the mix of new & time-tested technologies and tools are designed to put the environmental planning at the apex of the process. This Network, known as VIPNET (VIgyan Prasar Network, meaning Science Communication Network in English) has gained excellent popularity in India, besides attracting wide spread recognition in many other countries. It could be a model of activities in formal & non-formal academic systems to teach "sustainability" without compromising on one's own culture, heritage and social dynamics. The Indian philosophy of sustainable development, with the help of the art & science of the prevalent practices, and building up of a conscious population through effective intervention, has been reasonably highlighted in the Paper.

ABSTRACT NO. 34

Author: **Dr Kumar Mithraratne and Professor Brenda Vale**

Presenter: **Kumar Mithraratne**

Title: **Thermal Characteristics Of High Thermal Mass Passive Solar Buildings**

School of Architecture
The University of Auckland
Private Bag 92019, Auckland 1020, New Zealand
e-mail : b.vale@auckland.ac.nz

Abstract:
Thermal mass is incorporated in buildings in order to damp out excessive diurnal temperature fluctuations in the inside air. During the summer, higher inside air temperatures cause heat to flow from the air to the thermal mass. This results in reducing the daytime peak temperatures of the inside air. The heat thus stored is released later at night bringing the air temperatures up. Storing of the excess heat energy in the thermal mass reduces mechanical ventilation requirements during the daytime in summer. However, in the winter, poorly insulated thermal mass may be disadvantageous, as the mass itself demands additional heat in order to maintain the required inside air temperature levels. If the building has been designed to utilise solar energy for space heating, the thermal mass can be used in an effective manner to absorb and store the transmitted solar radiation through the building fenestration.

Thermal characteristics of a high thermal mass residential building located in Hockerton, U.K was simulated using SUNREL and EnergyPlus building energy simulation software. The building was designed to operate with no conventional space heating during the winter. A south-facing conservatory runs the full width of the dwelling allowing maximum winter solar gain. Measured air temperatures of the inside rooms of the building show a steady value throughout the year with minimal diurnal temperature swings. Simulation runs from both software revealed that the distribution of net transmitted solar radiations over the thermal components of the thermal zones plays a vital

role on the accuracy of the predicted zone air temperatures. SUNREL has two relatively simple schemes to distribute the net transmitted solar into the zone. The first scheme allows the user to input fractions absorbed by each mass wall, transferred to other zones and losses. In the second method, the balance amount of solar transmitted after losses and transfers, is uniformly distributed over all the mass wall surfaces based on the area. Further, it uses the isotropic model to estimate the sky diffuse radiation transmitted through the fenestration. EnergyPlus, on the other hand, uses a detailed distribution scheme with minimum user defined parameters. The model treats the beam solar component separately from the sky diffuse and ground-reflected solar components. The absorption of the solar radiation into each mass wall depends on the area and the solar absorptance of the wall. The sky radiations model implemented in EnergyPlus is based on the Perez et. al anisotropic model.

In this study, various zone solar distribution scenarios together with the impact of air-to-surface coefficients on the accuracy of the predicted zone air temperatures were investigated. The results obtained from both models are compared with the measured data and important conclusions that lead to setting up some guidelines on modelling thermally massive passive solar houses are discussed

Key Words:
Passive Solar Buildings, Thermal Mass, Thermal Simulation
.

ABSTRACT NO. 35

Authors: **Dr Nalanie Mithraratne and Professor Brenda Vale**

Presenter: **Nalanie Mithraratne**

Title: **Optimum Specification For New Zealand Houses**

School of Architecture, University of Auckland,
Private Bag 92019, Auckland, NEW ZEALAND
E-mail: n.mithraratne@auckland.ac.nz, b.vale@auckland.ac.nz

Abstract
At present New Zealand is divided into three climate zones in terms of the Energy Efficiency Building Code requirements. Light timber framed construction type and the 'mass construction type' commonly used in the Auckland region do not satisfy the requirements for the colder climate region. In order to determine the impact a particular building makes on the environment, operating as well as construction requirements over the total useful life of such buildings should be considered. However, since buildings last for a long period compared to building materials and equipment – around 100 years – the data required for an analysis of life cycle energy and cost is numerous and analysis would be tedious and time consuming and often not practical in a office of a practicing architect. This paper describes a method that has been developed at the University of Auckland for a detailed life cycle analysis of an individual house based on the embodied and operating energy requirements and life cycle cost over the useful life of the building with funding from the Public Good Science Fund of the Foundation for Research, Science and Technology of New Zealand for such an analysis of residential buildings. This design tool allows a building to be assessed at the design stage, so that various design options and strategies can be compared with one another and also to quantify the environmental impact of New Zealand house designs over their useful lifetime. Although the model is based on the generic construction types that are currently being used, it has been designed as an expert system so that updating the model database can be done with relative ease. The paper also discusses the use of this tool to explore the optimum specification for house construction for the different climate regions of New Zealand in terms of life cycle energy and cost.

ABSTRACT NO. 36

Author: **Te Kipa Kepa Brian Morgan** BE(Civil) MBA MIPENZ Ngati Pikiao, Te Arawa, Ngati Kahungunu, Kai Tahu

Presenter: **Kepa Morgan**

Title: **A Tangata Whenua Perspective On Sustainability Using The Mauri Model**

Senior Lecturer Civil and Environmental Engineering
Faculty of Engineering, University of Auckland
Email: Te Kipa Kepa Brian Morgan
<k.morgan@auckland.ac.nz

Abstract:
The central contribution provided in this paper is a new model to assist resource management decision-making. The Mauri Model has been endorsed by Tangata Whenua and is providing the basis for a new decision making paradigm that has evolved out of the current planning and environmental crises faced by Regional government in New Zealand. The anticipated outcome for this presentation is an enhanced understanding of indigenous values as they relate to resource management and the Tangata Whenua.

Two case studies will be investigated to discuss the application of the Mauri Model and the resulting impact on decision-making. These results will be contrasted with the legacy of inappropriate management of water catchments and hydrology. The paper concludes by discussing what contribution Tangata Whenua can make towards this aspect of sustainability, whether this contribution could have been made earlier, whether it would have made a difference, and how this potential contribution can be harnessed for maximum benefit in the future. In this paper I will identify what are considered to be the primary contributors to the current state of poor environmental health of several lakes and harbours in the central North Island. The enablers of those processes and the drivers that have led to the deterioration in water quality will be discussed including how these may have been different under an alternative paradigm

ABSTRACT NO. 37

Authors: **Robbie Morrison[12] Tobias Wittmann, Dipl-Ing[1] and Dr Thomas Bruckner[1]**

Presenter: **Robbie Morrison**

Title: **Energy Sustainability Through Representative Large-Scale Simulation: The Logical And Physical Design Of *'Xeona'***

[1]*Institute for Energy Engineering, Technical University of Berlin*
[1]*School of Mathematical and Computing Sciences, Victoria University of Wellington*
email robbie@actrix.co.nz

Abstract:

x e o n a (e*x* tensible *e*ntity-oriented *o*ptimization-based *n*etwork-mediated *a*nalysis) is a new user-extensible, entity-oriented modeling environment (the software itself remains under development) whose principal role is to facilitate robust sustainability policy under conditions of uncertainty. More specifically, *xeona* is designed to study interconnected resource transformative systems and industries, at appropriate resolution, in terms of their public interest performance. The method is particularly suited to systems, which are decentralized, capacity-constrained, and volatile *and* whose primary purpose is to provide physical services as opposed to tangible commodities. Energy systems typically exhibit such characteristics and the current development effort is directed toward this problem domain. The paper describes the *logical* and *physical* design of *xeona* and uses UML (unified modeling language) and C++ pseudo-code to articulate key ideas. Logical design deals with the conceptual model, whereas physical design focuses on implementation issues relative to the deployment environment. The logical design of *xeona* is fully object-oriented and combines high-resolution system optimization modeling with multi-agent simulation. *xeona* derives a number of features from the established energy system optimization modeling environment *deeco* (*d*ynamic *e*nergy, *e*missions, and *c*ost *o*ptimization). Intangible entities are central

to the method and *xeona* is generally able to mimic technical control practices, unit commitment protocols, electricity price and dispatch algorithms, primary commodity and carbon markets, and simple contract negotiations. Public policy-oriented investigations also require that policy interventions be explicitly captured and currently supported policy instruments include tax exemptions and accelerated write-downs, explicit subsidies, resource and energy taxes, permit regimes, environmental impact entitlements, and incentives to promote modified technical management and/or investment. System performance under normal and extreme external events, including worst-case weather patterns, can be readily tested. Resource entities are classified using exergy analysis to ensure extensibility. Agent entities are limited to synchronous (scheduled) interactions for reasons of simplicity. The logical design enables third-party software and/or external players to be invoked for further analytical and/or decision support. The data model is hierarchical, rather than relational, and data interchange and persistent storage utilize XML (extensible markup language). Model design and construction comprise only part of the modeling task. The way in which a particular model is applied and interpreted is of equal importance and pointers to relevant literature are given. Stakeholder acceptance is often pivotal for model-supported policy development and open-source (published) software should help reduce public mistrust as well as furnish added safeguards on code and model quality.

ABSTRACT NO. 38

Author: **Dr Gavin M Mudd**

Presenter: **Gavin Mudd**

Title: **Sustainable Mining: A 50-Year Evaluation Of Changing Ore Grades And Waste Volumes**

Dept. of Civil Engineering, Monash University,
Clayton, VIC 3800 Australia
Ph +61-3-9905-1352 / Fax +61-3-9905-4944
Email Gavin.Mudd@eng.monash.edu.au

Abstract
The mining industry, to varying degrees, has been an important contributor to the economic wealth of nations all over the world. The first academic treatise to address the broader mining debate in society was 'De Re Metallica' by German philosopher Georgius Agricola in 1556, a text which remains as relevant today. The advances in technology over more recent centuries has enabled larger and lower grade orebodies to be mined compared to the previous century, a trend which has greatly accelerated over the last fifty years or so. The debate about the rate of extraction versus known resources remains a pivotal issue in moving modern industrial society towards sustainable development. The global mining industry, as a contribution to the 2002 Earth Summit, recently published the landmark 'Minerals Mining & Sustainable Development' (MMSD) reports to argue the case for 'sustainable mining'. The MMSD reports cover a wide range of issues, including social impacts, abandoned mine sites and facilities, economics, conservation, economics, land use, technology and corporate governance, as well as the need to move towards a greater degree of recycling in many basic mineral commodities and metals. In general, most commodities have increased production over time, some dramatically. Given that, in general, the grades of the ore from which the minerals or metals are extracted are decreasing over time, with some metals more rapidly than others, this means that the quantities of wastes over time must be increasing considerably over time as production continues to intensify. The MMSD reports, however, do not present any data or systematic analysis on the changing ore grades of the major mineral

commodities and metals produced in modern times or their associated waste volumes (principally tailings and waste rock or overburden). The balance between ore sourced from open cut versus underground mines is also important since open cut mines involve the excavation of a greater quantity of waste rock to access the ore of interest. This paper will analyse the principal mineral commodities produced in Australia, namely coal (black and brown), gold, iron ore, mineral sands, lead-zinc, diamonds, aluminium and nickel. The production data for these commodities over the last fifty years in Australia will be presented, combined with the available ore grades and estimates of waste quantities produced and followed by a discussion of the apparent trends in the various commodities and the implications for the concept of 'sustainable mining'.

ABSTRACT NO. 39

Authors: **Mr George Estcourt, Dr Per S. Nielsen, and M. Shepherd**

Presenter: **Dr Per Nielsen**

Title: **Energy Demand Analysis For Small And Medium Scale Heat Users In Rotorua Aiming At Converting Existing Heating Systems To Bioenergy.**

NZ Forest Research Institute Private Bag 3020,
Rotorua, New Zealand,
Phone +64-7-343 5657 fax +64-7-343 5332,
Email george.estcourt@forestresearch.co.nz
Email Per.Nielsen@forestresearch.co.nz (for correspondence)

Abstract
The climate in New Zealand is in general warmer than in the northern European and Scandinavian countries. In particular the solar influx in higher. Despite that, there is a heat demand for both space heating and hot water heating. With increasing fossil fuel prices and increasing electricity prices this is becoming obvious and therefore identification of the specific heat demand is becoming an issues in national energy planning in New Zealand.

In the paper energy demands have been evaluated in 5 primary schools, 5 high school and 5 hotels all in Rotorua, New Zealand. Daily, weekly and annual heart profiles have been developed. In the primary schools the heat demand is in the morning where it is necessary to heat the building. Typically the solar influx from around 10 am is sufficient to meet the heat demand for the rest of the day. The energy demand at high schools has the same pattern, but due to the larger scale of the schools the total heat demand is bigger.

Looking at the energy system in the school, around two third uses a centralised hot water heating system in their old buildings (more than 20 years old). Any building newer than that is mainly heated with electricity. It means that in general the present centralised heating system covers less than half for the energy demand.

The energy demand profiles have been used as inputs for simulation in the Danish EnergyPro CHP Design model. By developing heat duration curves for the schools, it is shown that the boilers typically are designed to deliver the heat within the four hours from 6 to 10 am. It means that boilers are typically 4-5 times too big, compared to a centralised heating system with constant heat production and use of a heat storage.

The energy demand analysis at the hotels has a different picture, because the hot water demand is relatively high during the year, including not water demand for spa baths, swimming pool, and hot water for the laundry department. The heat duration curve therefore has a "normal shape" where the boiler delivers heat throughout the year.

From a bioenergy perspective, it is possible to promote bioenergy based boilers, in particular using wood pellets, in delivering a convenient fuel. Implementing centralised heating systems, which should cover the whole energy demand at the schools and using a heat storage, should make bioenergy systems an optimal solution for the schools. For the hotels, convenient bioenergy solutions, which can compete in convenience with the natural gas systems in particular, are applicable.

ABSTRACT NO. 40

Author: **Assistant Professor Bernd Möller, Ph.D and Dr Per Nielsen**

Presenter: **Dr Per Nielsen**

Title: **Geographical Analyses Of Wood Chip Potentials, Costs And Supply For Sustainable Energy Production In Denmark**

Department of Development and Planning, Aalborg University
Mail: Fibigerstraede 13, 9220 Aalborg, Denmark
E-mail: berndm@plan.auc.dk
Fax: +45 - 98 15 37 88
Phone: + 45 - 96 35 84 07

Abstract:
Biomass resources for sustainable energy production are geographically distributed. Supply and demand varies by energy plant location and size. This results in a significant need for transportation, which has impact on the way bioenergy markets operate, and how the targets of sustainable development are met. The presented study uses a practical application of raster-based geographical information systems (GIS) to perform cost-supply analysis of wood chip resources for energy production. Recoverable potentials are mapped using forest statistics, empirical methods and land use data. For bioenergy-plant sites in Denmark the transportation costs for wood chips from forestry are analysed using cost distance analysis. A modelling methodology has been developed, which facilitates the production of cost-supply curves. These curves constitute an effective way to assess the costs of delivered biomass dependent on amount and location, and to analyse discrepances in the way biomass markets operate. Results show that plants in areas with sparse forest cultivation and plants with a large consumption of biomass fuels have higher fuel costs. Therefore the results of this study may be used to select fuels by regional availability, and to assess the economic advantages of decentralised energy production. Cost-supply curves could also be used for sensitivity analyses at specific sites for managing economic risk of bioenergy plants.

ABSTRACT NO. 41

Author: **Dr Per S. Nielsen**

Presenter: **Dr Per Nielsen**

Title: **The Role Of Bioenergy To Meet The Renewable Energy Target For New Zealand**

NZ Forest Research Institute, Sala Street, Rotorua
Private Bag 3020, Rotorua, New Zealand,
Phone +64-7-343 5657 fax +64-7-343 5332,
per.nielsen@forestresearch.co.nz

Abstract:
There is around the world a push towards using of sustainable energy and in particular bioenergy. Environmentally this is desirable because biomass can substitute fossil fuels for heat and electricity production and thus reduce emission of greenhouse gases. As important or maybe even more important biomass produced methane, which is also a greenhouse gas, when it is disposed of at landfills. So wood waste and other organic waste streams are not desirable to be disposed at landfills. Biomass covers around 25% of heat and electricity consumption in Rotorua. Biomass in form of wood waste is used in the wood processing industry for process heat and in some cases for electricity generation. In the residential sector biomass is used in the form of firewood for room heating and for heating water.
For the individual user, whether a wood processing industry or a property owner, the choice to use biomass for energy is general based upon cost. There are a lot of barriers and at the same time no incentive. Therefore bioenergy still has to be competitive on price. It does not always give the society the most energy efficient solution to prevent problems for electricity supply. New fuels like wood pellets could carry some of the answer to electricity shortage in New Zealand. Traditional log burners do in principle have the same answer, but very few wood burners do meet high environmental standards and they are not competitive in convenient with electric heaters. The wood pellet market is an emerging fuel and wood pellet based energy systems emerging technologies. The paper will describe how wood pellets can be the answer to electricity shortage in New Zealand in dry years.

ABSTRACT NO. 42

Author: **Dr Mike (Michael) O'Connell and Mr Chris Kane**

Presenter: **Mike O'Connell**

Title: **Built Environment Solutions That Meet Goals For Sustainability Outcomes**

BRANZ Ltd, Private Bag 50908, Porirua City
T 04 237 1170 // F 04 237 1171
Email: MikeOConnell@branz.co.nz

Abstract:
New Zealand's residential dwellings account for about one-third of all electricity consumed, and are a source of 20% of the country's carbon dioxide emissions. Despite a recent surfeit of policies and strategies associated with or linked to housing, New Zealand, as a nation, is failing to meet its goals and is well below international standards for energy efficiency, health and sustainability. Meeting the requirements of the 1st commitment period of the Kyoto Protocol and beyond also presents both large challenges for New Zealand's construction and energy supply industries.

To this end, opportunities exist for the implementation of building solutions with low energy requirements and low carbon emissions, which would enable New Zealand to meet national goals for triple bottom line outcomes required of energy, health and sustainable development strategies. However, to embrace the government's drive towards sustainable development, attitudes need to change both in industry and the community to enable the successful transition of 'green' building from the fringe to the mainstream. The path to a sustainable built environment is underway. A grouping of cross-sector consortium shareholders are developing a housing 'vision' which will result in the construction of new domestic dwellings and retrofitting of existing building stock to a high standard of sustainable design and thermal comfort, which will enable New Zealand to meet national and international goals, and achieve equitable social, environmental and economic outcomes.
This paper examines the progress this initiative is making in order to deliver sustainable housing to current and future generations and communities.

ABSTRACT NO. 43

Author: **Alan A Parker, Australia (retired)**

Presenter: **Alan Parker**

Title: **The Electric Powered Assisted Bicycle; A Clean Vehicle To Reduce Oil Dependence And Enhance The Mobility Of The Elderly,**

50 Stirling Street
Footscray
Vic 3001.
alanpar@labyrinth.net.au

Abstract:
The electric power assisted bicycle (E-PAB) and fully powered electric-bicycles (E-Bike) weigh only a few kilograms more than a bicycle.The E-PAB as its name suggests, gives only power assistance. Some E-PABs are powered by small and dirty two stroke petrol engines; some have clean electric motors powered by on-board rechargeable batteries. The most advanced E-PAB has electronically controlled power assistance via sensors in the cranks linked to a computer chip, with automatic speed control to enable them to be safely used on shared footways. The E-Bike is fully powered for riding on level roads and only needs to be pedalled on hills and against strong head and crosswinds. There over 300 models of E-PABs and E-Bikes sold throughout the world today and most are legally classified as bicycles and 3 million of them will be produced in China in 2003; however, their sale and use in New Zealand is constrained by poor legislation. which classifies them as mopeds. This paper describes the past, present and possible future development of the E-PABs and E-Bikes to enhance the mobility of the elderly, the lame, the disabled and for the able bodied as a practical substitute for many urban car trips of less than 10 km :-

1. Product development since 1950; from the early petrol powered models to “state of the art” electric models.
2. Existing markets in Japan and China; their planned use to reduce air pollution in China.
3. How power assistance that reduces physical effort by 50% makes is easier to cycle in hilly cities, to carry loads and enables the elderly, the lame and some partially disabled to

continue cycling. or to generally improve their mobility and access to community resources.

4. The development of E-PABs coupled with roof mounted solar PV panels for recharging, has been proven to be practical in Japan.
5. Suggest that there is an opportunity to sell imported or assembled E-PABs in New Zealand using batteries recharged from roof mounted solar cells.

It is concluded that when E-PABs and E-Bikes are classified as bicycles in New Zealand a start can be made on realising their potential for reducing greenhouse gas emissions, air pollution, petrol consumption and traffic congestion in cities. E-Bikes of less than 500 watt power output should be legally recognized as bicycles to enhance the mobility of the elderly and the disabled.

ABSTRACT NO. 44

Author: **M. Ponniah[1], B.Mahmood[2]**

Presenter: **Muhunthan Ponniah**

Title **Feasibility Study Of Harnessing On-Shore Wave Energy At Waipapa, New Zealand: A Case Study**

[1] Student, School of Engineering, UNITEC Institute of Technology, Auckland.
Email: mookseyp@wdc.govt.nz,
[2] Senior ASM / Programme Leader, School of Engineering, UUNITEC Institute of Technology, Auckland. Tel: +64-9-8154321, Fax: +64-9-8156795,
Email: bmahmood@unitec.ac.nz

Abstract:
The need for renewable energy is becoming more essential in today's energy world market. This is because the world needs a source of energy that will last longer than our limited supply of fossil fuels. Pollution is also an issue; many environmentalist groups are pushing towards more "Earth friendly" sources of energy. The world will have to come up with new ideas and methods for creating energy or civilization will come to a screeching halt around the year 2040.There are three main solutions to the energy crisis by renewable energies such as solar power, wind power, and water power. The Greeks first mentioned waterpower, around 4000 B.C. It has developed over the years and now has great potential (Hammond, 1999). Climate change and fuel security are two key issues that are beginning to drive the current energy sector. Wave energy is emerging as a key technology with the potential to make a large contribution, with minimal environmental impact. Oceans cover three quarters of the earth's surface and represent a vast natural energy resource in the form of waves. It has been estimated by the Marine Foresight Panel that if less than 0.1 % of the renewable energy available within the oceans could be converted into electricity it would satisfy the present world demand for energy more than five times over. The main aim of this project was to determine whether Waipapa (New Zealand) has a high potential to harness energy from the onshore sea wave method and also to determine the amount of power that

can be generated from the Waipapa onshore wave energy model. More research in this area can cut down the cost/kWh produced. During 1996 researchers predicted that the cost involved in producing energy from sea waves prototype was 50cents/kWh (EECA, 1996) but since then many developments in these prototypes have brought the cost down to 15 cents/kWh (Deniss, 1998). Waipapa is located along the South Island South Coast of New Zealand, which is very close to Stuart Island and near Invercargill. It has favourable conditions to harness energy from sea waves along the coast. This study reviews the principles currently used to harness onshore sea wave energy and summarises the potential of harnessing onshore wave energy at Waipapa, New Zealand. Current principles and methods of harnessing wave energy on shore were reviewed. The data relevant to wave height and wave period at Waipapa and other New Zealand coastlines was collected from NIWA (National Institute of Water and Atmosphere). The amount power that can be harnessed from an onshore sea wave energy model at Waipapa was determined using the wave power equation. The study shows that if the current existing Wavegen Company's onshore wave technology is installed at Waipapa, then 3,693.4 megawatts (MW) of power can be generated annually. Hence the Waipapa onshore wave plant could supply power for 369 houses.

ABSTRACT NO. 45

Author: **Dr Regan Potangaroa**

Presenter: **Dr Bin Su**

Title: **Sustainability And The Role Of Natural Ventilation In New Zealand.**

School of Architecture
Faculty of Architecture and Design
UNITEC, Auckland, New Zealand.
Ph +64-9-815 4321 ext 7261
Fax +64-9-846 7369
rpotangaroa@unitec.ac.nz

Abstract:
"…it is sometimes said of those who try to persuade man of his environmental predicament that they paint a picture so gloomy and irreversible that the average citizen's response is to go out and buy a can of beer. If nothing can be done to escape the onward rush of some irreversible eco doom, then why take the trouble even to return the can? But indeed over a vast range of environmental problems, action is possible, polices are available, reversals can take place, water can run clean, the sun shine over clear cities, the oceans cleanse our human shores and harvest ripen in uncontaminated fields." *(Ward et al, 1972).*

The concept of sustainability lacks a vision of what life could or would be. Stories of impending gloom as Ward suggests above create a sense of apathy rather than action. A sense that appears to still exists today as it was back in 1972.

The search for an economic solution has also not been completely successful. Lovins comments "…that these kinds of creative "eco-capitalism" lead to a "livable world" but they would not necessarily give us a world we would want to live in. It also takes ethics, religion and politics to do the things. Markets can not tell us how much is enough?" *(Lovins, 1994).*

A similar situation exists in the transport area where Flavin et al reports that "…No matter how much less polluting automobiles become in the future, one thing is clear: they will not be a panacea for the world's transportation problems.

Although the new technologies could greatly reduce many of the energy related problems caused by cars, they could exacerbate others, including the suburban sprawl, congestion and destruction of neighbourhoods that is rampant in so many parts of the world. This suggests that the redesign of the automobile must be accompanied by efforts to spur an array of new transport options and to change regional development patterns so as to reduce the need for travel and create more livable communities" *(Flavin et al, 1994).*

Where then is this vision of a sustainable tomorrow come from? Rowe suggests the following "…it would therefore seem that the time has come for a radical rethinking of design concepts for commercial buildings so that they are centred on the needs and satisfaction of individuals. Designers will recognise that occupants have needs that differ between one another and within the individual from time to time. They will therefore design control systems that permit intelligent beings to operate responsive control systems when change is perceived as necessary; and above all that allow the choice of a gentle movement of air through an open window to stir the curtains and the spirits on a fine spring day" *(Rowe, 1994).*

Graeme Robertson is more specific "Although the 20% reduction of CO_2 emissions by 2000 as agreed by New Zealand is a good start, to achieve true sustainability we may have to reduce our per capita emissions by over 70%. This of course requires greater changes than merely improving the efficiency of buildings; it starts to seriously question the very nature of our cities.
But the first step is clear – reduce energy consumption. We must locate, orientate, insulate, naturally ventilate and daylight our buildings better." *(Robertson, 1991).*

Both authors suggested (over 10 years ago) that building designers must become more active. To date building designers have been slow to respond to this situation, in part due to the lack of suitable tools (particularly quantitative tools). This paper applies recently developed natural ventilation tools to the climates of four large urban centres in New Zealand to ascertain the potential for natural ventilation. (these tools were developed using data from boundary layer wind tunnel tests,

computation fluid dynamic studies coupled with thermal comfort models. The tools only require input of the site climate data. The paper will also present research into the unique and innovative potential for natural ventilation using a double facade where the façade is sealed at the base, open at the top and with air flow throughout. Such an arrangement creates a large even negative suction pressure over the face of the building regardless of the wind direction and is not presently reflected in the literature.

This is still short of the vision sought but is a move towards one.

ABSTRACT NO. 46

Author: **Chris Pratt**

Presenter: **Chris Pratt**

Title: **Remediation Of Heavy Metal Impacts In Roadside Corridors, Wet Tropics World Heritage Area, Australia**

PhD candidate, School of Earth Sciences, James Cook University, Cairns
McGregor Road, Smithfield, Cairns, Queensland 4870
Phone: (07) 4042 1209
Email: chris.pratt@jcu.edu.au

Abstract:
Elevated heavy metal concentrations have been detected in road sediments and runoff waters throughout the world. Significant concentrations of these metals are derived from vehicle degradation and emissions. The availability of these metals to plants and lower food-chain organisms in roadside corridors is a potential concern.

This paper examines heavy metal impact along the Kuranda Range Road in Cairns, northern Australia. The Kuranda Range Road passes through a section of Wet Tropics World Heritage Area (WTWHA) listed rainforest.

The study investigated: a) Cd, Cu, Pb, Ni and Zn concentrations in road sediments along the Kuranda Range Road; b) Cd, Cu, Pb, Ni and Zn levels in runoff waters along the Kuranda Range Road, following an extended dry spell in the region; and c) the potential of zeolites to adsorb these metals from solution and reduce their dispersal into roadside rainforest streams and over soils.

Elevated concentrations of Cu, Pb, Ni and Zn were detected in road sediment samples collected from gutters on the Kuranda Range Road between October 2002 and November 2003. In some of these samples these metal concentrations were above ANZECC Draft Guidelines (2000).

Rainwater runoff samples collected in January 2003 and February 2003 contained dissolved Cu and Zn concentrations that exceeded ANZECC Draft Guidelines (2000).

The dispersal of Cd, Cu, Ni and Zn from roadside runoff waters into surrounding environments may be controlled by filter traps that incorporate zeolites. In a laboratory experiment zeolites proved extremely effective in reducing dissolved Zn loads in contaminated waters over a period of five minutes to 24 hours. However, other results from the adsorption experiment showed that zeolites were much less effective in reducing Cd, Cu, Pb and Ni concentrations in solution.

The capacity of zeolites to adsorb Cd, Cu, Pb and Ni requires further research to validate their incorporation into filtration traps in gutters to reduce the levels of these metals in runoff waters. This research will most likely involve methods such as active stirring or some kind of agitation of solution treated with zeolites.

Ideally, zeolites may be incorporated into low-cost and low-maintenance remediation traps that can be installed in drainage points along the Kuranda Range Road to reduce the aqueous dispersal of heavy metals into sensitive roadside environments. These traps may be integrated into existing or proposed road structures that pass through environmentally sensitive landscapes.

ABSTRACT NO. 47

Authors: **Steven Pratt*, David Rei Miller, Sumit Banker and Andy Shilton**

Presenter: **David Rei Miller**

Title: **Protecting Our Waterways – Research Of Novel Methods For Removal Of Nutrients *From Wastewaters***

Centre for Environmental Technology and Engineering (CETE)
Institute of Technology and Engineering, Massey University
Private Bag 11 222, Palmerston North, New Zealand
** s.pratt@massey.ac.nz, ph: 64 6 350 5799 (ext 7427), fax: 64 6 350 5604*

Extended Abstract:
Disposal of nutrient rich wastewaters, both directly and indirectly, into rivers and lakes is common in New Zealand. These nutrients (nitrogen and phosphorus) are often limiting for the growth of algae and bacteria so their discharge can stimulate unsightly and potentially harmful algal and bacterial blooms. The consequences are now being realised in many parts of the country.

There is an urgent need to find effective and at the same time economically attractive solutions. In this paper, a review of the state-of-the-art technologies for the removal of nitrogen and phosphorus is presented. The focus of the paper is on nutrient removal from low volume domestic wastewaters.

For nitrogen removal from household systems, the installation of a novel biofilter system is discussed. The biofilter system facilitates the necessary nitrification and denitrification reactions by ensuring the presence of both aerobic and anoxic zones. However, the US EPA (2002) reports that such systems are yet to achieve an effluent with a suitably low nitrogen concentration and concludes that more research is required in order to refine performance consistency and improve understanding of operational processes and mechanisms. In this work, the key factors limiting process performance are discussed, namely the availability of oxygen for nitrification and

carbon for denitrification. Results from a pilot plant study are used to highlight the influence of these factors of process performance.

For phosphorus removal from domestic wastewaters the use of rock filter media is proposed. Rock filters are a low-cost and low-maintenance technology, and they may be particularly applicable for low-flow wastewaters. Various filter media have been tested and the use of iron or steel slag appears to be an attractive option (Mann, 1997; Drizo et al., 2002). Results from a field study conducted by the Centre for Environmental Technology and Engineering confirm that significant phosphorus removal can be achieved using these types of filters. However, their performance needs to be optimised in order to achieve a treated effluent with a suitably low phosphorus concentration. And in order to optimise this technology, improved understanding of the removal mechanisms is required. It is suspected that the mechanisms involved are adsorption, ion exchange and, in particular, precipitation (Drizo et al., 2002). In this work, the factors that affect these mechanisms, and consequently the performance of the filters, are discussed.

Also, it is noted that iron and steel slags have been earmarked for regulation under various waste classifications (US Geological Survey, 1997). So their use in a wastewater treatment process could defer the problems that will be associated with their disposal. Nonetheless, it is acknowledged that the capacity of the media is limited so final disposal must be considered. The predicted lifespan of these filters is presented.

The paper concludes with consideration of the requirements for a complete nutrient removal facility, based on the potential for appending the rock filter technology to a nitrogen removal system. A configuration for the integrated system is presented.

ABSTRACT NO. 48

Authors: **Reynaldo Perez Ramos**

Presenter: **Reynaldo Ramos**

Title: **Establishing Disposal Siting Mechanism Towards A Sustainable Industrial Waste Management In The Philippines**

School of Geography, Planning and Architecture,
University of Queensland Brisbane 4072, Australia
Home address – 4/12 Bryce St, St Lucia, Qld Australia 4067
Mobile No: 0412 115 445
Emails: thwdisposalsiting@yahoo.com, reynaldoramos_98@yahoo.com or s4015642@student.uq.edu.au

Abstract:
Managing industrial waste particularly toxic and hazardous waste (THW) in developing countries like the Philippines is a major concern towards a healthy living environment. With the present pace of urbanization and industrialization of the country, proper planning and management of THW need immediate and utmost attention.

This paper examines the current practices in managing of THW as guided by existing government environmental laws and regulations particularly in the major urban and industrial centers in the country. Moreover, how these legalities put more burdens to the THW generators, aside from not having a centralized surface disposal infrastructure facility in the country, which forces them to throw their generated THW to waterways, or to environmentally sensitive areas, and even to the municipal sanitary landfills.

In addition, this paper will recommend a workable framework or procedure in THW disposal siting and how this framework could be implemented utilizing a computer-based spatial support system (i.e. Geographic Information System) towards improvement of THW disposal siting practices in the Philippines. A three-level surface disposal siting/screening criteria mechanism was proposed for the initial selection process of identifying potential sites/areas to be developed into a landfill

dedicated for THW. The siting criteria were based from the existing literatures, and these were identified and ranked in the study by three major groups of respondents namely: (a) primary-generator group, (b) secondary-generator group, and (c) non-generator group thru a structured survey questionnaire.

Author's Profile: Reynaldo is currently pursuing his Masters by Research or MPhil degree in Environmental Management. He is a registered Civil Engineer in the Philippines, with a first postgraduate degree (MSc) in Urban Planning at the Asian Institute of Technology, Thailand. Mr. Ramos is also an Environmental Institute Australia (EIA) student member and a former officer of the Air and Waste Management Association-Philippine Section (AWMA).

ABSTRACT NO. 49

Author: **Tim Rimmer**

Presenter: **Tim Rimmer**

Title: **Sustainability As Appropriate Use Of Technology For Onsite Wastewater/Used Water Systems – Examples From Waiheke Island, New Zealand.**

Lecturer, School of Civil and Environmental Engineering,
Unitec Institute of Technology, Carrington Road, Mt Albert,
Auckland, New Zealand.
Phone 8154321 x 8443, email: trimmer@unitec.ac.nz
Or PO Box 257, Ostend Waiheke Island,
home phone/fax 093729336 email: timrim@ihug.co.nz

Abstract:
On Waiheke Island failure of septic tank and disposal systems create environmental impact problems, particularly as the Island rapidly develops. The Regional Council is responding to such problems by tightening the criteria for permitted activities for onsite wastewater disposal. At the time of writing, this is largely taking the form of a 'one type fits all' solution based around technology that achieves excellent water quality outcomes. However, such technology can be viewed as being both resource and energy hungry and with its own wider environmental impacts. This paper suggests that such approaches are not necessarily the most sustainable option for onsite waste and used water disposal. Inherent in sustainability are notions that wider social, economic and environmental effects need consideration, as such it is important that technology is used appropriately. The paper presents information from the monitoring of four alternative onsite systems on Waiheke Island. These comprise i) composting/ greywater, ii)composting/ greywater/ reedbed, iii) split septic tank/ greywater systems
and iv) one involving full botanical treatment of both black and greywater.

I suggest such systems are examples of sustainable technologies that achieve very good to excellent water quality outcomes, and are appropriate for both the site and in addressing wider social/environmental issues.

ABSTRACT NO. 50

Author **Rodriguez Ramirez, Edgar (Mexico)**

Presenter **Edgar Rodriguez**

Title **User Research And Eco-Ergonomics: Encouraging Environmentally Effective Behaviours In Users Of Products Through The Industrial Design Process**

Victoria University of Wellington
School of Design, 139 Vivian St. Wellington
Phone: 04 463 6245; 021422563
Fax: 04 463 6204
edgar.rodriguez@vuw.ac.nz

Abstract
Sustainable development seeks to achieve economic growth, preservation of the environment and improvement of social conditions. The dominant economic model at present degrades the environment, gives little importance to cultural diversity and encourages an unsustainable way of life in the process of globalisation (Galano, 2002).

Many disciplines are taking action working towards a sustainable development. The solutions may be political or engineering changes, but creativity can be a powerful weapon to allow companies to offer more, satisfaction of needs, with less resources, energy, etc. (Khazazian, 2003). The design community has published a manifesto in which it is encouraged to seek a sustainable development (ICSID, 2001).

Design firms such as Philips or IDEO, show a particular concern for the environment when developing their own design principles (Philips, 2002). Efforts have been made to develop a documented compendium, such as the *Eco-design handbook* by Fuad-Luke (2002). On the other hand, there are many strategies that have yet to be assessed to prove their practical efficiency: to intensify the use of products, dematerialise the consumption by passing from products to services, etc. (Khazazian, 2003).

One strategy to address sustainable issues is to analyse products' usability, given that some commodities have a larger environmental impact during their use than during their production (Fuad-Luke, 2002). Some products, such as packaging, need a thorough study of how people interact with them and what people do with them after their very short usable life span.

Products can be developed to encourage environmentally friendly and/or socially conscious behaviours in users. This can be achieved using usability principles and the concept of eco-ergonomics (Rodriguez, 2002). Product usability is defined by product attributes that address the physical, cognitive and emotional needs of intended users (Babbar et al., 2002). We live in an artificial world that keeps growing in complexity. The environment in which we live has been developed following design decisions that affect our everyday lives and some times saturate the space in which we live. Research suggests that there are around 30,000 products in today's world (Norman, 2002). Many of them are confusing and difficult to use and lead to user frustration (Nussbaum and Neff, 1991). Product usability is now an important matter to consider in the design process and recognised as a critical dimension of product quality (Babbar et al., 2002).

The concept of eco-ergonomics suggests that ergonomic methodology can be used to reduce pollution, fuel consumption, crime, the size of big cities and so on. This approach would study systems at the level of individuals to understand how their behaviour can be structured towards desired goals (Salvendy, 1997).

This paper discusses the following questions:
What roles can industrial designers take to seek a sustainable society?
Can usability principles be defined and used to encourage environmentally friendly or socially conscious behaviours in users, through the design process, hence reducing the environmental impact of product use?

Keywords:
Industrial design, usability, eco-ergonomics, sustainability

ABSTRACT NO. 51

Authors: **Professors Omar Romero-Hernández*, Professor Sergio Romero-Hernández and Professor David Muñoz**

Presenter: **Dr Omar Romero**

Title: **Sustainability Engineering Applied Into The Pet Plastic Supply Chain. A Policy Tool For Industry And Government.**

Instituto Tecnológico Autónomo de México
Industrial Engineering Department
Río Hondo No. 1, Col. Tizapán San Angel, México City, C.P. 01000; MÉXICO
Tel.: +52 55 56284000 x3682; Fax: +52 55 5490 4663; E-mail: oromero@itam.mx

Abstract:
This paper presents a practical application of sustainability engineering in industry and government. The work presented is part of a project sponsored by a consortium of industries who participate in the Polyethylene Tereftalate (PET) market as resin producers, bottle manufacturers, soft drinks producers, distributors and plastic recyclers in Mexico.

PET market in Mexico has increased substantially in the previous years to account for more than 300,000 tonnes. There is a public concern about the implications of PET use to the environment and also on the need for the Mexican government to be provided with analytical tools and results that describe the economic and environmental effects of PET due to environmental policy and market forces.

The research objectives were:

(i) to describe with a robust dynamic simulation model the behaviour of PET consumption as a function of: imports, exports, production capacity, demand, distribution costs/capacities, recycling technologies cost/capacities, landfill cost/capacities and environmental impact.

(ii) to perform a LCA of the PET from raw materials extraction to mechanical/chemical/thermic recycling.
(iii) to integrate the results of the dynamic simulation into the LCA and analyse the economic and environmental effect of various degrees of PET recycling.
(iv) to identify the optimal degree of PET recycling at which environmental impacts are minimum.
(v) to provide suggestions for analytical sound environmental policy.

Several interviews have been conducted to various industry makers and public servants, which combined with the economic data previously gathered has allowed to develop the first version of the simulation model. The simulation was conducted by using a computer software (Arena) which allows the inclusion of not only average values but also distribution function. The result is a model that predicts steady-state conditions for the market.

These market steady-state results were then incorporated into the LCA study in order to evaluate the emissions and environmental impacts related to different market and recycling conditions. The inventory of emissions contains considerable original data that has been gathered at various visits, inspections and interviews.

As such, this paper presents the effective use of various sustainability engineering tools that provide basis for decision making in industries and the Mexican federal government.

ABSTRACT NO. 52

Authors: **Sarah Oliver, Clair Millar, Jonathan Crockett, Chris Salmon**

Presenter: **Chris Salmon**

Title: **Composting Toilet Technology In Urban Apartments And Agricultural Trials For Beneficial Reuse Of Residues.**

GHD Pty Ltd, 380 Lonsdale Street, Melbourne,
VIC 3000 AUSTRALIA
T. +61 3 9278 2372
F. +61 3 9600 1300
E. sarah_oliver@ghd.com.au

ABSTRACT:

Introduction

The authors (and other team members as noted in the acknowledgements) have conducted a feasibility study as the first stage of a proposed 5-year project to design, build, demonstrate and assess dry composting toilet (DCT) technology in urban areas (inner city apartments). The project includes urine separation, waste removal and agricultural trials for beneficial reuse of nutrients and compost and liquid.

This paper presents the proposed project and key findings of the feasibility study. Funding for the study was provided jointly by the Victorian Smart Water Fund and the project team. The investigations reported were carried out between July and November 2003 and build on earlier work by J. Crockett (Crockett, 2000).

The Project

While composting toilets are not at all new, application in inner city (medium to high density) residential apartments in Australia is new. A development in inner Melbourne is proposed consisting 12 new premium quality apartments with a strong sustainability slant. The apartments will face onto a parkland area in a two-story single row layout. Each will have two toilets serviced by one rotary dry composting unit. Urine and compost leachate will be collected in two separate centralised storage tanks and all waste will be periodically removed and taken to an

agricultural reuse site. An agricultural reuse trial is aimed at assessing the health risks and effectiveness of compost, urine and leachate for replacing fertilizer dry-land grain and oil seed crops.

The Challenges

One fundamental challenge for composting toilet technology in urban areas is lack of adequate space for reuse of compost and urine products. On site disposal is not sustainable due to high nutrient levels in human waste and potential risk of contamination to stormwater and groundwater, particularly during wet periods.

Further challenges include

- legislation, planning, approvals and design requirements (where they exist)
- ventilation to prevent odour
- insect and pest prevention
- transportation & System Maintenance (including ventilation, composter bin rotation, liquid pipe work)
- user acceptance (including for selling the apartments)
- alteration of user habits, including toilet cleaning process
- beneficial reuse of by-products (including design and operation of the agricultural reuse trial to capture useful data as part of the demonstration project)

Technology for modern composting toilet systems, including urine separating pedestal designs have advanced sufficiently to combat many of the drawbacks of the earlier models, including aesthetics, smell and men having to sit to urinate.

The Benefits

Composting toilets have become the technology of choice for permanent public toilet facilities in national parks and for many isolated roadside rest areas and houses. However, the technology has wider application for unsewered towns and for suburbs within established sewered cities and is already being adopted more broadly in other countries. DCTs are compatible with other water saving technologies such as grey water recycling, waterless urinals and rainwater capture.

The advantages of composting toilets over conventional water-flush toilets include

- 15% to 25% savings in household indoor water use
- over 80% reduction in nutrient loads to sewer
- 25% reduction in BOD to sewer
- 50% reduction in salt load to sewer
- recovery of safe to handle nutrient rich fertilizer replacement (enhanced by urine separation)
- increasing longevity of current sewer systems (by reducing loads and rates of increases)
- reduction in overall lifecycle and economic cost of new centralized sewer systems
- provision of sustainable solution for eco-conscious residents

Conclusions

Key conclusions of the study include

- a demonstration project for composting toilet technology in a high-density urban development is economically and environmentally justified and there is growing market demand for such technology.
- composting toilets with urine separation offer potential economical and environmental advantages compared to conventional sewerage systems or grey water reuse for toilet flushing.
- composting toilets have potential to extend the life of existing sewerage systems by reducing loads and flows
- water price increases in future will amplify the cost advantage of composting toilet systems
- grey water sewerage provision in dense urban developments is still required
- if funding is received, the project will provide extensive independent and reliable data on water, nutrient and BOD load to sewer reductions that can be achieved and will provide a practical demonstration of user-acceptability.
- There is a need to investigate the potential of compost and liquid residues as fertilizer and as such to run an agricultural trial. The agricultural trial will provide useful data on health risks, agricultural benefits and potential savings in chemical fertiliser.

ACKNOWLEDGEMENTS

The following were part of the demonstration project team and have provided valuable contribution to the project study report of which some is reproduced in this paper with permission. Their contribution is gratefully acknowledged.

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Michael JEFFRESON, Demaine Partnership Pty Ltd;
Buzzby BURROWS, Environment Equipment Pty Ltd;
Elias JREISSATI, Kim JAQUES, Bensons Property Group

ABSTRACT NO. 53

Authors: **Helen Shaw[1], Sioban Hartwell[1], Darren Utting[2], Tilaka Diyagama[3], David Kettle[3], Alan McPike[4], Tony Miguel[4]**

Presenter: **Helen Shaw**

Title: **Sustainable Integrated Planning Approach Case Study-Norsga**

[1]URS New Zealand, [2]Synergine Strategic Ltd, [3]Maunsell Ltd, [4]EcoWater Solutions (Waitakere City Council)
(Primary contact Helen Shaw) at Helen_shaw@URSCorp.com,
phone 09 355 1300, fax 09 355 1333
Address PO Box 821, Auckland, New Zealand)

Abstract:
The Northern Strategic Growth Area (NORSGA) is one of the largest remaining greenfield areas for development within Waitakere City Council, Auckland, New Zealand. NORSGA is approximately 2,700 hectares of undulating rural land surrounded by an inner harbour environment on two sides. The strategic planning timeframe is to the year 2050. Waitakere City Council is New Zealand's largest "Eco-City".

Traditionally, land use and infrastructure planning have occurred as separate processes. Under the traditional model infrastructure decisions are made based on a pre-determined land use (i.e. zonings in a district plan). However, with sustainability being a key goal it becomes essential that land use and water cycle management planning are closely linked.

Sustainable management of Waitakere City's 3-waters (water supply, wastewater and stormwater) has been a major focus of the city since proclaiming it an Eco-City in the early 1990s.

This paper presents the process and preliminary outcomes for the planning of appropriate water cycle management infrastructure solutions (for water supply, wastewater and stormwater) for the 2,700 hectares of greenfield development The "Local water Agenda" project is only one of the many issues being considered in the overall strategic direction for this greenfield area.

The project itself is unusual in that the technical team comprises a consortium of consultants and research bodies working closely with key stakeholders.

The planning process to date has comprised:

- Establishing of baseline information including existing District Plan provisions, environmentally sensitive areas and existing infrastructure services.
- Definition of 4 different land use scenarios (varying in land use densities and 50 year population growths of 10,000 to 40,000)
- Developing of water cycle models for both water quality and quantity
- Development of a quadruple bottom line matrix including cultural, social, economic and environmental criteria for options comparison;
- Water cycle options identification; and
- Development of life cycle costing analyses and financial contributions

Preliminary outcomes, issues and next steps for the project are presented.

ABSTRACT NO. 54

Author: **Ms Dayna Simpson**

Presenter: **Dayna Simpson**

Title: **Greening Beyond The Firm: Improving Environmental Performance Through The Supply Relationship**

Department of Management, University of Melbourne,
Parkville, VIC, 3010, Australia
Email: d.simpson@pgrad.unimelb.edu.au
Phone: 61 3 8344 4481, Fax: 61 3 9349 4293

Abstract
Supply chains are a significant contributor to the generation of waste in all its forms (both toxic and non-toxic). Supply relationships are a key way for business to influence the sustainability of their products and services through better manufacturing. Addressing the issue of the environmental performance of suppliers may however prove a costly endeavour for the supply chain. Management of cross-boundary environmental performance raises major issues of efficacy of the approach and costs of the transaction.

Previous research has found high levels of advanced pollution prevention amongst firms adopting lean manufacturing strategies. This antecedent work has found that reducing waste through product design and better process efficiency can have a positive effect on both manufacturing performance AND environmental performance. At the firm level, the manufacturing system is a major contributor to generation of waste. At the manufacturing system level, day-to-day practices become important in generation of waste. Developing suppliers in the principle elements of lean manufacturing should support improvements in environmental performance.

The research paper presents a model for improvement of a supplier's environmental performance via the existing business-to-business relationship which is required to maintain a lean manufacturing system. The model presents one of the first attempts to understand the transaction environment within which a firm may expect to approach to green-supply-chain.

Pre-testing of the research model in the Victorian automotive sector has occurred in the latter part of 2003 and early 2004. Testing should offer clarity in how to measure the three major constructs of the model – supply relationship, environmental performance and lean manufacturing.

Implications of a major literature review and subsequent model revealed that management of a supplier's environmental performance raises critical issues of transaction costs and efficacy of approach for any buyer-driven program of supplier development. The nature of the research model and findings of the pre-testing work will be reported in this paper.

ABSTRACT NO. 55

Authors **Mr Caleb Stewart and Dr Mir-Akbar Hessami**

Presenters: **Caleb Stewart**

Title **Propositions Of Sustainable Methods Of Carbon Dioxide Separion And Disposal**

Department of Mechanical Engineering, Monash University, Clayton, Victoria, Australia, 3800
Phone: (03) 9905-3562 *Fax: (03) 9905-1825*
Email: akbar.hessami@eng.monash.edu.au

Abstract:
The world is faced with an intrinsic environmental responsibility, i.e. the minimisation of greenhouse gases to sustainable levels. This paper seeks to explain methods of carbon dioxide capture and sequestration and discusses a line of research that may in the future help to reduce carbon emissions. The production of carbon dioxide as a by-product of fossil fuel based electrical generators can be achieved by amine scrubbing of flue gases. This process is costly and may in the future be replaced by options such as membrane separation, molecular sieves or through desiccant adsorption. Short term options of sequestration by direct injection into geologic or oceanic sinks are recognised as methods to reduce carbon dioxide levels but do not address issues of sustainability. For this purpose, the topic of photosynthetic reaction which has long been known as a natural process that can produce useful by-products of biomass, oxygen and hydrogen and can fix carbon dioxide, has been studied.

In a controlled environment such as a bio-reactor, micro-organisms capable of photosynthetic reactions may hold the key to reducing emissions in both an economically and environmentally sustainable manner. The design of laboratory scale apparatus' may help researchers to implement a larger scale economically sustainable system capable of sequestering significant quantities of carbon dioxide.

This paper will assist researchers and decision makers to succinctly cover a broad range of options in this area.

ABSTRACT NO. 56

Authors: **Dr Bin Su**

Presenter: **Dr Bin Su**

Title: **Architectural Design Of Large Hotel And Energy Use For Internal Space Thermal Control**

Senior Lecturer
School of Architecture
Faulty of Architecture and Design
UNITEC, Auckland, New Zealand
Phone 0064-9-8154321 ext 7847
Fax 0064-9-8154343
Email: bsu@unitec.ac.nz

Abstract:
Studies both in New Zealand and international have suggested that the best place to consider building energy efficiency, is during design of the building, not once the building has been completed and is in operation.

Larger energy use per guest night or per guest room does not necessarily result from poor energy management. It may be due to the factors such as architecture design, location or climate etc. The historic surveys showed that the energy use per bedroom per year for New Zealand large hotels (>100 rooms) vary greatly, from very high (50678 kWh/bedroom) to very low values (2075 kWh/bedroom). The feeling of that the widest range of energy use could be related to hotel design factors such as building site, architectural features, building component features and indoor space arrangement (refer *Hotel Design Factors and Energy Consumption Data*).

The research investigates the relationship between the hotel design factors and the energy use for internal thermal control by central heating and cooling in large hotels based on the analysis of the energy consumption data of a number of 4-5 Star (>100 guest rooms) hotels in Auckland. The overall conclusion is that Architects should also take greater responsibility and leadership for hotel energy efficiency.

ABSTRACT NO. 57

Authors: **Bárbara Sureda, J.J. de Felipe, Josep Xercavins**

Presenters: **Richard Donnelly**

Title: **Towards the Evaluation of the Sustainability of a Region, Taking Different Sustainability Criteria into Account.**

Technical University of Catalonia, Spain.
(UNESCO Chair of Technology, Sustainable Development, Imbalance and Global Change),
Bárbara Sureda. C/ Colom, 1. UNESCO Chair. EUETIT. 08222. Terrassa. Barcelona. Spain.
Telephone: 00 34 93 7398050
Fax: 00 34 93 7398032
E-Mail: barbara.sureda@upc.es

Abstract:
This study was carried out by the UNESCO Chair of the Technical University of Catalonia (Spain). The Chair is a pioneer in the support and establishment of Agendas 21 in Catalonia. It has experience in the definition of indicators of sustainability based on the monitoring of variables that affect sustainable development in the municipal area.

There is currently a great interest throughout the world for ways of measuring sustainable development. This is due to the fact that its measurement entails great difficulty, and that there are widely differing criteria of interpretation for this concept (strong and weak sustainability, etc.). One needs only to look at the disparity in the results of existing sustainability indexes such as the Environmental Sustainability Index-ESI (Samuel-Johnson, 2001) versus the ESI corrected by The Ecologist-Friends of the Earth in 2001. We have therefore developed a sustainability index with variables based on the definition of load capacity and on the human development indexes of the PNUD. This index is integral and takes environmental, social and economic factors into account. All the variables included in the index are weighed as a function of an independent variable which can take different values according to the existing criteria of interpretation of sustainability. This means the index can be

used to draft future scenarios, taking the different points of view on sustainability into account.

The computer tool used for the creation of the index itself and the future scenarios is called Globesight. It was developed by Dr. Mihajlo D. Mesarovic (author of the second report for the *Club de Roma*, "Mankind at the Turning Point", 1974) of the Case Western Reserve University in Cleveland, Ohio, USA. This interface allows us to understand the past, evaluate the present and carry out projections of possible future scenarios according to the policies applied, the variables used and the criteria established.

The advantage of the suggested index is the evaluation of a specific future scenario created according to specific policies, under different points of view on sustainability, while allowing the future integration of other variables and new factors.

ABSTRACT NO. 58

Authors: **Philip Warren[1], Dara Johnston[2], Dr John McKinnon[3], and Chris Tolley[4]**

Presenter: **Chris Tolley**

Title: **Sustainable Rural Development Through Appropriate Technology And Participation In Northwestern Cambodia**

[1]Project Team Leader & Project Management Specialist – Maunsell Ltd
[2] Rural Infrastructure Engineer, Fraser Thomas Limited.
[3] Community Development Specialist - Kinsa Associates
[4] Project Director - Maunsell Ltd.

Maunsell Ltd
47 George St, Newmarket, Auckland
Ph +64 9 379 1229
Email: chris.tolley@maunsell.com

Abstract:
The Cambodian Ministry of Rural Development's Northwestern Rural Development Project, on which Maunsell Ltd. of New Zealand is currently working, is an integrated project whose principal focus is accelerating rural development through increased accessibility to public utilities and services. The project, funded under a loan from the Asian Development Bank[3], is building the capacity of local contractors and the rural population to construct, manage and maintain rural infrastructure. The range of infrastructure being constructed under the project goes from the larger scale public utilities, including rural roads under the responsibility of the local authorities; to small scale sub-projects comprising wells, rice drying platforms and other village infrastructure, built at the request of villagers, and vested in the care of indigenous community based organisations. The greatest challenge is to introduce a qualitative change in which funding from an international lending agency is used to optimise the integrity of built structures and set up the skills base, management systems and community ownership that will ensure sustainability.

[3] ADB Loan No. 1862-CAM(SF)

Project documentation identifies the challenge of developing a sociologically informed approach to, on one hand, build the capacity of local contractors and administrators, and on the other, of promoting village initiated placement, and maintenance of infrastructure. The overall development intervention advocates use of a gender sensitive, participatory approach that will directly address the needs of the poor. Technological innovations include optimising the use of local resources in infrastructure construction and maintenance and enhancing the capabilities of local construction companies. The principal administrative innovation is the out-sourcing of community development work to Non Government Organisations (NGOs). To achieve sustainability the project emphasises the cultivation of local skills and capabilities and a change in cultural orientation of the NGO's to one of longer term continued development.

This paper discusses work undertaken to build sustainability in three areas of project activity: the construction , management and maintenance of rural infrastructure maximising the use of local resources; enhancing participatory development approaches with project benefit monitoring and evaluation through outsourced NGO contracted services; and enabling sustainable pro poor rural development through appropriate capacity building and institutional development of government and community based organisations.

Linked capacity building of local government and community based organizations, to manage rural infrastructure is the key to sustainable rural development in Cambodia. Development of the private sectors capacity goes hand-in-hand with this approach. Maximizing the use of local resources to benefit the local economy, not deplete the countries foreign exchange resources; the development of appropriate contracting systems and specifications for quality control; and a sustained national commitment to decentralization and local empowerment, are essential ingredients for this approach to succeed.

ABSTRACT NO. 59

Authors **G M Tonks,** B Arch(hons) Ph.D ANZIA **and Li Sheng** Masters Student

Presenter: **Garry Tonks**

Title: **Dial A House: The Construction Of Residential Buildings From Used Telephone Directories.**

Dr G M Tonks
Senior Lecturer
School of Architecture
University of Auckland
Private Bag 92 019
Auckland New Zealand

Phn +64 9 3737 599 ex 88213
g.tonks@auckland.ac.nz

Abstract.
Despite the expanding use of computers for the storage of information, the telephone directory continues as the major communication index. In Auckland there are in excess of 300,000 sets of three volumes discarded each year. If all were suitable, the resulting wall would be 2.4 m high and 5 km long. Many recycled products require additional energy/materials to enable effective re-use.

This paper reports on the work carried out to explore the use of this waste paper, utilizing it for wall elements with the minimum of re-working. Issued addressed are erection sequence, water and insect resistance, thermal, acoustic and fire resistance. Comparisons are drawn between buildings constructed from telephone directories, and those constructed from earth and straw bale. The progress of a house on Waiheke Island is discussed, with particular emphasis on regulatory requirements.

ABSTRACT NO. 60

Author: **Marjorie van Roon and Stephen Moore**

Presenter: **Marjorie van Roon**

Title: **Evaluating The Ecological Efficacy Of Low Impact Urban Design And Development**

Centre for Urban Ecosystem Sustainability,
University of Auckland, Private Bag 92019, Auckland, New Zealand
Phone 3737599 Ex 88594 Fax 3737652
email: m.vanroon@auckland.ac.nz

Abstract:
It is anticipated that implementation of low impact urban design and development (LIUDD) on a catchment scale will lead to a quantum leap in ecological improvement in both terrestrial and aquatic environments. One of the primary objectives in LIUDD is the achievement of hydrological neutrality, that is a nil or at worst negligible change in the hydrologic regime. This might be measured using indicators of water body functionality and sustainability. One of the anticipated outcomes of such hydrological stability throughout and after the development process is the retention of aquatic ecosystem health and biodiversity. This should be true for all streams, wetlands, lakes and estuaries within the catchment.

In addition, the achievement of hydrological neutrality demands much higher catchment coverage with vegetation of high biomass, ensuring high evapotranspiration rates. This is particularly necessary in locations where soils have limited infiltration capacity. Much of this vegetation is likely to be within riparian margins where it can contribute to both terrestrial and aquatic biodiversity enhancement and improve water quality.

This paper explores the type of research framework that might be developed to measure these ecological gains. Such a framework would include the monitoring of sites in both Greenfield and Brownfield low impact developments to determine gains in physicochemical condition and biotic integrity relative to that in conventionally developed urban catchments.

ABSTRACT NO. 61 (unedited as received)

Author: **Tsung-juang (TJ) Wang**

Presenter: **TJ Wang**

Title: **Inter-Discipline Integration Implications Of Sustained Development Of Architectural Education**

Associate Professor, Architecture
National Taipei University of Technology
1, Sect 3, Chunghsiao E. Rd. Taipei, Taiwan
(phone)+886-2-27712171ext2926
(fax)+886-2-27510843
(email) tjwang@ntut.edu.tw

Abstract:
Both of the city and the architecture are products from the social civilization and economic development of the mankind, also the primary source of environmental topics. The sustained development of the city and the architecture are the vital objectives in promoting the sustained development of the 21st Century. Therefore, conclusions are drawn from the discussion given above by exploring into the sustained education of architecture:

1. Environmental topics including intensive population, energy source, disposal of the refuses, sewage, and carbon dioxide as well as the reduction of the use of non-recyclable energy source resulted from the development of the city and the architecture certainly cannot be solved by a single oriented filed. It involves the overall thinking process of cross and comprehensive engineering of multiple sciences, disciplines and works.

2. Within the framework of the contexts of the sustained city and architecture, it contains:

(1). The integrated design of ecological system: refers to the application of technique and knowledge related to environmental architecture and natural ecology to reduce the impacts upon the environment by constructional behavior and maintain the operation of the

ecological system as a whole in the course of the human development.

(2). Industrial coupling and technology innovation: the industrial system becoming the architectural substances in the life cycle of the architecture shall be added into the entire cycle of the system of social and economic industries to couple to other industries, and develop ecological materials, innovation technique and energy sources to reduce pollution to the environment based on the knowledge and technical of the natural ecology designed by the integrated ecological system.

(3). Creation of assessment indices: the created indices may serve the basis of the fundamental standard governing the circulation of the energy from the ecological environment in pursuing a sustained society for the mankind.

3. The sustained education is the very root of keeping the sustained development to move on. In future the architectural education shall cover the contents of the sustained education and those of the sustained development of the city and the architecture. Therefore, the purpose of the sustained education for the architecture is to come up with the best green architecture settler and those who are capable of carrying out the sustained development of the city and the architecture. Objectives inferred by this paper for the sustained education development of the future architecture thus can be referred in the planning the curriculum of the sustained education of the architecture.

ABSTRACT NO. 62

Authors: **Caroline Watkins**

Presenter: **Caroline Watkins**

Title **So You Are Thinking Sustainability: Who Is On Your Team?**

Environment and Sustainability Consultant
Maunsell Australia Pty Ltd
629 Newcastle Street, Leederville, Western Australia,6902
Telephone: +61 8 9281 6224
Fax: +61 8 9281 6297
e-mail: caroline.Watkins@maunsell.com

Abstract
The concept of sustainability is posing many new questions in engineering today and often members of a project team have differing ideas on how to address the issue and which tools to use. In many cases traditional engineering teams are no longer effective and projects are encountering environmental and social complications that impact the project reputation, budget and timeframe.

This paper will explore the key features important to an engineering team working within a sustainability framework. Some issues to be addressed will include the balance between:

- Internal (in-house) and external (consultants) members of a team.
- Combining the old and young. Often senior roles are only involved in the decision making process and the innovative ideas of younger team members excluded
- Varying professions. Experts from the social and environmental fields need substantive inclusion in engineering processes. The traditional " let the environmental person know as little as possible to reduce project complications" is no longer working as improved community awareness and regulatory authority standards mean these problems often resurface at a later date.
- Technical and "people" skills. With increasing community consultation and the need to be able

understand the complexity of community concerns, human qualities such as facilitation, empathy and compassion are becoming requirements for engineering projects.

- Genders. To address the broad range of issues raised by any sustainability framework all human qualities are required and can only be done by including both sexes in a project team.

The people employed in an engineering project will greatly impact the issues raised, how they are dealt with and project outcomes. By choosing a balanced team on project onset we can greatly improve the sustainability performance.

ABSTRACT NO. 63

Authors **Dr Paul M. Weaver and Professor Leo Jansen**

Presenter **Paul M. Weaver**

Title **Defining And Evaluating "Science For Sustainability"**

University of Durham, UK
Email: pweaver@noos.fr

Abstract:
If science and engineering efforts in support of sustainable development are to be made more effective we need to be able to evaluate the effectiveness of innovative research programmes and the transferability of good practice. In turn, this depends on establishing an externally-specified reference standard by which to evaluate performance. This paper sets out to define the challenge that sustainability poses to science and engineering by drawing out key differences from usual scientific practice. These differences are used as a basis for developing a preliminary methodology for evaluating science and engineering efforts in support of sustainable development. Our initial hypotheses are that: the contribution that a research project makes to sustainable development is related to a set of generic product- and process- related research outcomes, which can be evaluated on the basis of normative (externally-specified) sustainability criteria; research management procedures, research designs and research processes that conform strongly with the principles of sustainable development are likely to contribute to strong research outcomes; and, both research designs and research outcomes are likely to be influenced by the external research context, especially by the existing status of scientific and social capital and capacities and by how well these are aligned to meet the challenges to science and society posed by sustainable development. A fourth hypothesis is that contextual conditions, research designs and research outcomes are dynamically interconnected through a feedback loop. The paper describes the AIRP-SD study of the EC STRATA programme that tested these hypotheses. It draws lessons from the study about the nature of successful science and engineering efforts in support of sustainable development and suggests that well-designed programmes could leverage the effectiveness of future research activities by improving the quality of research contexts.

ABSTRACT NO. 64

Author: **Peter White**

Presenter: **Peter White**

Title: **From Corporate Governance To Sustainable Governance**

Principal Professional - Environmental Sustainability
Maunsell Australia
ABN 20 093 846 925
PO Box 1823 Milton Australia 4064
12 Cribb Street, Milton QLD 4064 Australia
Telephone: +61 7 3858 6700 Office
Telephone: +61 7 3858 6862 Direct
Mobile: 0423 029 150 All Hours
Fax: +61 7 3858 6705
Email: Peter.White@maunsell.com.au

Abstract:
The subdued business environment is not fertile ground for experimenting on anything beyond core business functions. The core function of business is sound corporate governance, yet in recent years, the experience nationally and internationally is of the failure of current standards of corporate governance.

This has led to a revised agenda for corporate governance globally. Amongst the more progressive reviews are those that incorporate the notion of sustainable development. Yet for many, no mater how important environmental and social considerations are, the business world understands money better than anything else. The financial implications of any strategy are therefore critical. Without the confidence of shareholders and financial investors, a business cannot progress an agenda with broader environmental and social objectives.

A business that realises that risks that are not managed will have an economic impact with time have commenced this transition. A business financial performance can be enhanced or undermined by its reputation, brand equity, risk profile, innovation, productivity, efficiency, access to capital, licence to operate and ability to attract and retain talent.

Sustainable development and improved corporate governance will be the hallmarks of successful business in the 21st century. The term sustainable governance is emerging.

As an ultimate objective, the concept of sustainable governance is immensely valuable. However, strategies are required to translate conceptual theories into practical reality. It is when sustainability principles are incorporated into the corporate governance agenda of a business that long-term shareholder value and success can be achieved and maintained.

In this paper, the application of sustainable governance in the Australian context is examined by the integration of the National Strategy for Ecologically Sustainable Development with the Australian Stock Exchange Principles for Corporate Governance. The resulting framework provides direction to those seeking progress towards an effective corporate sustainability agenda.

ABSTRACT NO. 65

Authors: **Panote Wilaipon**

Presenter: **Panote Wilaipon**

Title: **The Effects Of Moderate Die Pressure On Maize Cob Briquettes: A Case Study In Phitsanulok, Thailand**

[1]*Mechanical Engineering Department, Engineering Faculty*
Naresuan University, Muang, Phitsanulok, Thailand 65000
Tel: +66 55 261000 ext. 4261, Fax: +66 55 261062, Email: panotew@yahoo.com

Abstract
With regard to energy shortage and environmental issues, it is widely accepted that renewable energy will play a major role in the foreseeing year. One of the most important energy resources, particularly for developing countries, is biomass. Generally, it can be divided into three main categories viz. biomass plantation, forest residues, and agricultural residues.

Out of these, agricultural residues account for the largest amount available worldwide. Concerning with developing and agricultural-based countries, the utilization of the residues from agricultural sectors as primary or secondary sources of energy is considerably attractive. The residues are available as a free, indigenous and environmentally friendly energy resource. Nonetheless, one of the drawbacks of the utilization of the materials is that they are dispersed over large areas. Besides, their bulky density and low energy density may result in higher transportation and storage costs.

The amount of agricultural residues available related to the crop productivity. By utilizing the residue-to-product ratio and the amount of agricultural product, it is possible to estimate the quantity of the residue available.

Nine sub-districts altogether constitute Phitsanulok, a province located in Northern Thailand. Large areas in the province are devoted for plantations. Rice, sugar cane and maize are examples of the agricultural products at Phitsanulok. From the previous data, the annual planted-area for maize was over 384

km^2. Consequently, a large amount of the product was available in this location. The annual value of maize productivity exceed 138 ktons was reported for the case of Phitsanulok.

In general, for maize industries in Phitsanulok, maize cobs will be left and disposed after industrial processes. There is a possibility for utilizing this kind of waste as an energy resource. However, the efficiency of combustion of maize cob is limited by its properties. As a result of this, a suitable and non-complicated technology should be chosen for enhancing its fuel characteristics. One of the promising technologies, particularly for Thailand, is briquetting process, simply defined as the densification process for improving the biomass characteristics.

In this paper, the amount of maize cobs available in this province, Phitsanulok, was presented. It was computed based on the maize productivity and the residue-to-product ratio. The effects of moderate die pressures on maize-cob briquettes were also depicted. Also, the relaxation in length of the briquettes was periodically investigated. Finally, the influence of dwell time of the briquettes in the die was also included in the paper.

ABSTRACT NO. 66

Authors: **Professor Alan R. Woodside, Dr Banihan Gunay & Mr Jonathan R. Seymour**

Presenter: **Professor Alan R. Woodside**

Title: **The Congestion Conundrum: Sustainable Solutions**

Transport & Road Assessment Centre,
University of Ulster at Jordanstown,
Shore Road, Newtownabbey,
Co Antrim, UK
(T) +44 2890 366376 (F) +44 2890 366826,
Email: jr.seymour@ulster.ac.uk

Abstract:
This paper examines modern day travel habits and how people in the UK and Northern Ireland travel and shows that levels of car use is higher in NI, how this exacerbates congestion, why we use the various modes and what alternative sustainable transport modes are available that could be encouraged and developed.

The paper shows that as the cost of motoring has declined the average cost of public transport use has increased by over 1/3. The downside to this car dependence is more air pollution and road traffic collisions, amongst other things. The paper then goes on to discuss the 3 approaches to making the whole transportation sphere more sustainable. The measures are categorised into (1) 'Pathway', (2) 'Propulsion' and (3) 'People'

There are a number of technical innovations that can be used to reduce the waste of resources in the construction of the transportation pathways. These range from the use of recycled 'mixed' materials (involving the integration of Asphalt Planings, Roofing Felt, Gully Waste, Glass, Plastic Composites, et al into bituminous mixes) to assist in the provision of surfaces with decreased rolling resistance and fuel saving.

The vehicles that people use can be more sustainable and environmentally friendly. The initiatives range from recycling body parts to energy efficient and zero emission vehicles. The

success or failure of sustainable transport rests with 'people'. Persuading people to use sustainable transport is the ultimate aim, this will involve changing negative and misinformed perceptions of many of the travelling public.

The paper concludes by suggesting 'Carrot & Stick' measures, which could be implemented. The ultimate aim of these would be to reduce the number of cars on the road and in so doing to reduce levels of congestion, pollution and accidents. For the UK, the most effective way of achieving this goal is probably through GPS Tracking by charging, but unfortunately this may not have the desired result in NI.

Finally however, the greatest irony is that in the long term oil and gas reserves are only predicted to last for another 40-60 years and as a result we may lose the standard of lifestyle that we are currently accustomed to, if we don't become a more sustainable society.

ABSTRACT NO. 67

Authors: **Bill Woods and Dr Mouafak Zaher**

Presenter: **Moufak Zaher**

Title: **Application Of Lean Management To Improve Educational Operations**

Unitec Applied Technology Institute
Carrington Road, Mt-Albert
Private Bag 92025, Auckland
New Zealand
Telephone: (649)8154321 Ext 8386
Fax: (649)8152907
E-Mail: mzaher@unitec.ac.nz

Abstract
Public awareness of global environmental problems such as global warming and ozone depletion has increased, to become one of the biggest issues for the new millennium, since the concept of sustainable development has attracted public attention as the greatest concern of the late twentieth century. According to this concern, some action and counter planning to solve the regional and global environmental problems have occurred. As part of these efforts, several international environmental conventions have been conducted, and their final goals are focused on the reduction of fossil energy consumption and development of alternative energy.

It is viewed, therefore, that sooner or later every country in the world should take part in the international agreements voluntarily because they are essential in dealing with the global environmental problems, even through the socioeconomic situation of each country is different. It is not sufficient for a business to merely complete a task in order to survive in today's competitive environment. The business must complete the task better than its competitors.

Successful industries must show that it provides unique capabilities, or core competencies, if it is to maintain its current mission and function. There should be a quantitative comparative assessment that enables an orgnisation to track its internal performance over time and compare it with that of the best performing organisations.

Paper shall introduce Lean Management as a total business approach designed to identify and eliminate forms of waste in the process of producing goods, services, or combination of both. Typical forms of waste include defects, rework, transportation, overproducing, waiting, unnecessary processing, unnecessary movement, inventory, and behaviour (Emiliani 1998). The elimination of waste will enable business to improve quality, lower costs, and sustain market competitiveness while at the same time adding customer value and responsiveness, increasing employee morale, and improving customer satisfaction.. The implementation of lean management principles in service business may increase efficiency and reduce project costs but may consequently reduce revenues (due to reduced billability) unless the firm is able to capitalize on its newly available resources and attract additional work.

The paper will relay on five established fundamentals of lean management:

(1) specify value; (2) identify the value stream; (3) flow; (4) pull; and (5) perfection (Womack and Jones 1996). Initially, customers must provide the definition of *value*, which is how the customer determines whether or not the service provided satisfies their needs. Once the value desired by the customer has been appropriately specified, the *value stream,* consisting of all actions (encompassing the problem-solving, information management, and physical transformation tasks) required to produce value, must be accurately identified. It is at this step that operational modifications will be made to identify and eliminate all actions that may not create value to the customer. The concept of *flow* is then applied to the new value stream to enhance the efficient addition of value through the operational stages and ultimately to the customer. The newly created value stream can then be used to shift from "*push*", when production and delivery instructions originate from upstream supplier locations regardless of downstream customer conditions, to *pull,* where cascading production and delivery instructions are implemented at upstream supplier locations only when signaled by downstream customer (Womack and Jones 1996). In other words, the system will accommodate the production of the good or service in response to the customer demand as opposed to the traditional production system, where production takes place in anticipation of demand. The final fundamental concept in lean

> management is the continual striving to achieve *perfection* through radical and continuous improvement orts in the generation and delivery of the product or service to the customer.

Although lean management systems are appropriate to manufacturing industries, it can also be applied service industries such as education (Cromm 1999)

This paper will explore the applicability of lean management principles to improve educational operations. It will also present the five fundamental concepts of lean management so that educational and training sectors can use them to reduce waste and enhance their business operations.

ABSTRACT NO. 68

Authors: **Julie B. Zimmerman, Ph.D. and Paul T. Anastas, Ph.D**

Presenter: **Julie Zimmerman**

Title: **Case Studies Illustrating The Twelve Principles Of Green Engineering**

Julie Beth Zimmerman, PhD
United States Environmental Protection Agency
Office of Research and Development
National Center for Environmental Research
1200 Pennsylvania Avenue, NW (8722R)
Washington, DC 20460
+1-202-564-1589
zimmerman.julie@epa.gov

and

Paul T. Anastas, PhD
White House Office of Science and Technology Policy
Executive Office of the President
Washington, DC 20520
+1-202-456-6105
panastas@ostp.eop.gov

Abstract:
Recently, there has been increased attention on ways of using the classical traditions of engineering expertise in ways that further the goals of environmental protection and sustainability. Approaches to green engineering have been noted in recent years and have been demonstrated in a variety of ways in particular industry and service sectors. These approaches, while important advances have not been implemented comprehensively or systematically either in the industrial sectors or by the engineering disciplines. In order to further the implementation of green engineering, a set of Green Engineering Principles was proposed in 2003 (1) as a framework for how engineers could move toward sustainability in their designs.

The Twelve Principles of Green Engineering allow designers to consider fundamental factors at the earliest stages as they are designing a product, process or a system. The principles should be understood as a collection of parameters in a complex system that needs to be optimized, including taking advantage of synergies and recognizing trade-offs. The application and emphasis of individual principles will be largely contextual dependant on the specific conditions and circumstances of the product, process or system being designed.

- PRINCIPLE 1 - Designers need to strive to ensure that all material and energy inputs and outputs are as inherently non-hazardous as possible.
- PRINCIPLE 2 - It is better to prevent waste than to treat or clean up waste after it is formed.
- PRINCIPLE 3 -Separation and purification operations should be a component of the design framework.
- PRINCIPLE 4 - System components should be designed to maximize mass, energy and temporal efficiency.
- PRINCIPLE 5 - System components should be output pulled rather than input pushed through the use of energy and materials.
- PRINCIPLE 6 - Embedded entropy and complexity must be viewed as an investment when making design choices on recycle, reuse or beneficial disposition.
- PRINCIPLE 7 - Targeted durability, not immortality, should be a design goal.
- PRINCIPLE 8 - Design for unnecessary capacity or capability should be considered a design flaw. This includes engineering “one size fits all” solutions.
- PRINCIPLE 9 - Multi-component products should strive for material unification to promote disassembly and value retention. (minimize material diversity)
- PRINCIPLE 10 - Design of processes and systems must include integration of interconnectivity with available energy and materials flows.
- PRINCIPLE 11 - Performance metrics include designing for performance in commercial “after-life”.
- PRINCIPLE 12 - Design should be based on renewable and readily available inputs throughout the life-cycle.

To illustrate how the Twelve Principles can be applied both across scales and across engineering disciplines, this paper seeks to provide case studies from a variety of industrial sectors. Through these case studies, it will become apparent to the audience that while there are differences in terminology and jargon between those who design molecules versus those who design cars, versus those who design agricultural systems, the fundamental approaches and guidelines in moving toward sustainability are common among designers. By clearly illustrating how the framework of principles has worked in the past, it can also provide a blueprint for how these guidelines can be used in future designs of products, processes, and systems.

(1) Anastas, P. and J. Zimmerman (2003). Environmental Science and Technology, **37**(5): 94A-101A