

**INTERNATIONAL CONFERENCE ON
RENEWABLE ENERGY AND CLIMATE CHANGE -
FOCUS ON THE PACIFIC**

BOOK OF ABSTRACTS

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Table of Contents

| | |
|--|-------|
| 1. Welcome | 3 |
| 2. Programme of Events | 4 - 9 |
| 3. General Information about the Conference | 10 |
| 4. Conference Abstracts | |
| Key Note Address | 12 |
| Session 1: Renewable Energy and Climate Change Assessment..... | 13-18 |
| Session 2: Renewable Energy Technologies and Applications..... | 19-23 |
| Session 3: Renewable Energy Economics..... | 24-28 |
| Session 4: Policy Strategy and Framework..... | 29-33 |
| Session 5: Technology Transfer and Capacity Building..... | 34-40 |
| Session 6: Environment Sustainability and Socio Economics..... | 41-44 |
| Session 7: Renewable Energy in Developing Countries..... | 45-50 |
| Session 8: Renewable Energy and Climate Change Mitigation..... | 51-60 |
| Session 9: Miscellaneous..... | 61-67 |
| 5. List of Abstracts..... | 68-74 |



THE INTERNATIONAL CONFERENCE ON RENEWABLE ENERGY AND CLIMATE CHANGE: FOCUS ON THE PACIFIC

**AusAid Lecture Theatre
University of the South Pacific
06th-08th December 2010**

Dear Participants

Bula Vinaka and welcome to the University of the South Pacific, Fiji Islands. As hosts we would like to extend a warm welcome to all participants to the International Conference on Renewable Energy and Climate Change: Focus on the Pacific.

As we know, the people of the Pacific nations face many common challenges, including lack of indigenous fossil fuel supply, their remoteness and the low-lying nature of their island homes. This makes them susceptible to economic challenges such as fuel price shocks well as extreme weather events, sea level rise, storm surges and ground water pollution caused by climate change.

A primary aim of this conference is to provide a common venue for the people of the Pacific to meet and mingle with their counterparts from the ACP and well as their development partners and perhaps work out their own strategies for solving their common problems. The ICRECC2010 could also be used as an excellent opportunity for team building and informal forward planning. The wealth of knowledge and experience available at the Conference will be enormous considering the number of participants who have agreed to attend.

We hope you will use this as an opportunity to establish both personal and professional links that are lasting and productive to you all. We are looking forward to meeting you and working with you for the success of this event.

Once again, a warm welcome!

Conference Organizing Committee

INTERNATIONAL CONFERENCE ON RENEWABLE ENERGY AND CLIMATE CHANGE

FOCUS ON THE PACIFIC

USP, Suva, Fiji
6 - 8th December, 2010

Conference Programme

| DATE | TIME | SESSIONS | CHAIR [FACILITATOR] |
|---|---------------|---|--|
| MONDAY 6TH DECEMBER DAY 1 – ICRECC 2010 | 8:30-9:00am | REGISTRATION | USP |
| | 9:00-10:15 | Opening Session <ul style="list-style-type: none"> ❖ Welcome ❖ Opening Address (Professor Rajesh Chandra, Vice Chancellor of USP) ❖ Keynote Address (Dr. Tony Weir, USP PACE-SD) ❖ Official Photography | Dr. Anirudh Singh |
| | 10:15-10:30 | MORNING TEA | |
| | 10:30-11:00 | Session 1: Renewable Energy and Climate Change Assessment 1.1 Invited Speaker: Dr. Lalit Kumar <i>Topic: Remote Sensing and Geographic Information Systems for Resource Assessment – Scope and Capabilities for the Pacific</i> | Peceli Nakavulevu (Dept. of Energy) |
| | 11:00-11:15 | 1.2 Ajal Kumar and Krishnam <i>Topic: Wind characteristics and energy potential of Wainiyaku, Taveuni, Fiji</i> | |
| | 11:15-11:30 | 1.3 Paras Nath <i>Topic: Consequences of Climate Change on Agriculture and Farmers Adaptation</i> | |
| | 11:30-11:45 | 1.4 Jagjit Khurma , A. Singh and P. Singh <i>Topic: The potential of using coconut oil-based microemulsions as fuel for diesel engines</i> | |
| | 11:45-12:00pm | 1.5 Shivneel Prasad and A. Kumar <i>Topic: Software design of Solar-Wind Hybrid Systems</i> | |
| | 12:00-12:15 | 1.6 Pritika , A. Singh and J. Khurma <i>Topic: Investigation of ethanol producing potential of local varieties of cassava in Fiji</i> | |

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| 12:15-12:30 | 1.7 Mathew Dornan Topic: <i>Assessing the contribution of renewable technologies to energy security: the electricity sector of Fiji</i> | |
| 12:30-1:30 | LUNCH | |
| 1:30-2:00 | Session 2: Renewable Energy Technologies and Applications 2.1 Invited Speaker: Surendra Prasad Topic: <i>A Review of the Technologies for Electricity Generation from Solar and Wind Energy Resources</i> | Dr. Tony Weir (USP) |
| 2:00-2:15 | 2.2 Dr. Atul Raturi Topic: <i>A Grid-connected PV system for the USP Lower Campus: Design and Economics</i> | |
| 2:15-2:30 | 2.3 Monishka Narayan and A. Raturi Topic: <i>Fabrication and Characterization of Bougainvillea spectabilis based Dye Sensitized Solar Cell</i> | |
| 2:30-2:45 | 2.4 Naveendra Reddy and A. Singh Topic: <i>A study of the properties of traditional fuel wood and industrial biomass residues in Fiji</i> | |
| 2:45-3:00 | 2.5 Tim Daniel Topic: <i>Geothermal Energy: Electricity for the Future</i> | |
| 3:00-3:20 | AFTERNOON TEA | |
| 3:20-3:50 | Session 3: Renewable Energy Economics 3.1 Invited Speaker: David Smith and Jessica Gardner Topic: <i>Greening the economy – shifting the growth paradigm to be more inclusive and sustainable</i> | Surendra Prasad (FNU) |
| 3:50-4:05 | 3.2 Gyneshwar Rao Topic: <i>Energy Policies and Renewable Energy: An Overview and Options for Pacific Island Economies</i> | |
| 4:05-4:20 | 3.3 Hong Chen and Sunil Kumar Topic: <i>Do Fossil Fuel Prices Hamper Exports from Small, Energy-Dependent Countries of the Pacific?</i> | |
| 4:20-4:35 | 3.4 Scott Hook Topic: <i>Managing Energy Resources to Strengthen the Pacific Economic Base</i> | |
| 4:35-4:50 | 3.5 Gyaneshwar Rao Topic: <i>Ethanol production in Fiji</i> | |

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|---|-------------|---|-----------------------|
| | 6:00-8:00 | COCKTAIL @ USP Gym | |
| TUESDAY 7TH DECEMBER DAY 2 – ICRECC | 8:30-9:00 | <p align="center">Session 4: Policy Strategy and Framework</p> <p>4.1 Invited Speaker: Solomone Fifita Topic: <i>The Framework for Action on Energy Security in the Pacific</i></p> | Sunil Kumar (USP) |
| | 9:00-9:15 | 4.2 Julian Prior Topic: <i>Developing a national and regional climate change policy</i> | |
| | 9:15-9:30 | 4.3 Dinesh Surroop et al Topic: <i>An overview of the renewable energy political and institutional frameworks in the ACP countries</i> | |
| | 9:30-9:45 | 4.4 O.S. Iyare and L.L. Moseley Topic: <i>Caribbean renewable energy: policies, competition and regulation</i> | |
| | 9:45-10:00 | 4.5 Daphne Barbotte Topic: <i>The Tonga energy roadmap</i> | |
| | 10:00-10:15 | 4.6 Anirudh Singh Topic: <i>Renewable energy in the PICs – resources, policies and issues</i> | |
| | 10:15-10:35 | MORNING TEA | |
| | 10:35-11:05 | <p align="center">Session 5: Technology Transfer and Capacity Building</p> <p>5.1 Invited Speaker: Julia Gottwald Topic: <i>The role of universities in technology transfer in the renewable energy sector in Bolivia – findings from a labour market survey and experiences from a rural electrification pilot project</i></p> | Solomone Fifita (SPC) |
| | 11:05-11:20 | 5.2 Katerina Syngellakis Topic: <i>Outcomes and Impacts of the European Union’s Renewable Energy and Energy Efficiency Programme (REP-5)</i> | |
| | 11:20-11:35 | 5.3 Pranil Singh Topic: <i>Biofuel developments in the Fiji Islands</i> | |
| | 11:35-11:50 | 5.4 Shalendra Prasad, R. Chandra and A. Singh Topic: <i>‘Waste’ to ‘Energy’ – process and possibilities for Fiji</i> | |
| | 11:50-12:05 | 5.5 Frank Vukikomoala Topic: <i>SPC-CATD Small coconut oil processing project</i> | |
| | 12:05-12:15 | 5.6 Dellena Gloria-Alagcan Topic: <i>Application of ARTI based</i> | |

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|-------------|--|--|----------------------------------|
| | | <i>Compact Biogas Plants for mitigating Climate Change in Fiji</i> | |
| 12:15-12:30 | 5.7 | Denise Chand and A. Kumar Topic: <i>Status of Wind Power in Fiji</i> | |
| 12:30-1:30 | LUNCH | | |
| 1:30-1:45 | Session 6: Environment Sustainability and Socio-Economics | | Walter Leal (Hamburg) |
| | 6.1 | Invited Speaker: Bernard O’Callaghan Topic: <i>Clean doesn’t always mean green – understanding the impacts of energy options</i> | |
| 1:45-2:00 | 6.2 | William Rhier Topic: <i>Marshall Islands streetlights retrofitting project</i> | |
| 2:00-2:15 | 6.3 | Ms. Clarinda Ziegler Topic: <i>Palau Energy Efficiency subsidy programme</i> | |
| 2:15-2:30 | 6.4 | Daphne Barbotte Topic: <i>Gender and energy in the Pacific</i> | |
| 2:30-3:00 | AFTERNOON TEA | | |
| 3:00-3:30 | Session 7: Renewable Energy in Developing Countries | | Bernard O’Callaghan (IUCN) |
| | 7.1 | Invited Speaker: Thomas Rogers and L.L. Moseley Topic: <i>The potential of PV installations in SIDS – an example in the island of Barbados</i> | |
| 3:30-3:45 | 7.2 | Surendra B. Prasad Topic: <i>Emerging Technologies for the Efficient Generation of Heat and Electricity from Biomass Waste in developing countries</i> | |
| 3:45-4:00 | 7.3 | Prasanna Waichal and E. Kama Topic: <i>Rural electrification needs in the Pacific Islands – a case study of a village in Kadavu</i> | |
| 4:00-4:15 | 7.4 | Rupantri Raju and W. Aalbersberg Topic: <i>Effectiveness of Solar Drying on Local Fruits</i> | |
| 4:15-4:30 | 7.5 | Romeela Mohee and D. Surroop Topic: <i>Energy Generation from Municipal Solid Waste in Small Island Developing States</i> | |
| 4:30-4:45 | 7.6 | Sarah Hemstock Topic: <i>Small is Beautiful: An analysis of the NGO Alofa Tuvalu’s 10 year renewable energy project in Tuvalu</i> | |

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| WEDNESDAY 8TH DECEMBER DAY 3 – ICRECC 2010 | 7:00-9:00PM | CONFERENCE DINNER | |
| | 8:30-9:00 | Session 8a: Renewable Energy and Climate Change Mitigation 8a.1 Invited Speaker: Walter Leal Topic: <i>The role of renewable energy in addressing the challenge of climate change in the Pacific Region</i> | Lalit Kumar (UNE) |
| | 9:00-9:15 | 8a.2 Leone Limalevu, W. Aalbersberg, P. Dumaru and T. Weir Topic: <i>Fiji rural climate change adaptation project</i> | |
| | 9:15-9:30 | 8a.3 Shalini Lata and P. Nunn Topic: <i>Climate Change and the habitability of tropical Pacific islands river deltas</i> | |
| | 9:30-9:45 | 8a.4 Julia Gottwald Topic: <i>Analysis of community-based climate change adaptation initiatives from Africa, Europe, Asia and America: What lessons can Pacific Island States learn from them?</i> | |
| | 9:45-10:00 | 8a.5 Ming Jiang et al Topic: <i>Climate Change Adaptation for Tourism in the Pacific: Analysing the Policy Environment in Fiji</i> | |
| | 10:00-10:15 | 8a.6 Elsah Mumu et al Topic: <i>PNG's emissions path under the PNG Development Strategic Plan 2010-2030</i> | |
| | 10:15-10:35 | MORNING TEA | |
| | 10:35-11:05 | Session 8b: Renewable Energy and Climate Change Mitigation Cont'd 8b.1 Invited Speaker: Julian Prior Topic: <i>Building social capital to facilitate adaptation to climate change</i> | |
| | 11:05-11:35 | 8b.2 Invited Speaker: Atul Raturi and Katerina Syngellakis Topic: <i>Renewable Energy Development and Carbon Trading: Options for the PICs</i> | |
| | 11:35-11:50 | 8b.3 Mattias Goldmann Topic: <i>Carbon financing opportunities</i> | |
| | 11:50-12:05 | 8b.4 Unaisi Narawa-Daurewa Topic: <i>The Human Rights Dimension of Climate Change: An Indigenous Face</i> | |

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| 12:05-12:20 | 8b.5 Manoranjan Mohanty Topic: <i>New Renewable Energy Sources, Green Energy Development and Environment/Climate Change: Implications to Pacific Island countries</i> | |
| 12:20-12:35 | 8b.6 Filipo Tokalau Topic: <i>Is ecotourism climate-friendly? Revisiting the Namuamua island tour in Namosi, 1990-7</i> | |
| 12:35-1:35 | LUNCH | |
| 1:35-2:05 | Session 9: Miscellaneous | |
| | 9.1 Invited Speaker: Uzumma Erume Topic: <i>Pacific Island Countries and Fuel Price Volatility: Smoothing the path to greater energy security</i> | Dr. Anirudh Singh (USP) |
| 2:05-2:20 | 9.2 Shakil Kumar Topic: <i>Pacific Island Countries' Petroleum Supply and benefits of Bulk Procurement Initiatives</i> | |
| 2:20-2:35 | 9.3 Niko Kunavue Topic: <i>Effect of groundwater salinization and other climate related indices on sugarcane productivity</i> | |
| 2:35-2:50 | 9.4 Romeela Mohee and Dinesh Surroop Topic: <i>Power Generation from Bagasse in Mauritius</i> | |
| 2:50-3:05 | 9.5 Nilesh Billimoria Topic: <i>The Three (3) Pillars of Sustainable Development implies Continuity – are decision makers successful in giving practical legal effect?</i> | |
| 3:05-3:20 | 9.6 Sushil Kumar Topic: <i>A brief review of the long-term effect of climate change on the upper atmosphere and ionosphere – Space Weather Contribution</i> | |
| 3:20-3:50 | AFTERNOON TEA | |
| 3:50 | Closing Remarks | Dr. Anirudh Singh |
| 4:00 | Vote of thanks and Close of Conference | |



Background Information on ICRECC 2010

www.usp.ac.fj/icrecc2010

In December 2009, the University of the South Pacific in collaboration with partner regional organisations conducted the Sustainable Energy Resources Workshop. It was from this workshop that partners decided the need to organise a full scale conference.

This decision to have a full scale conference was timely as the Vice Chancellor and President of the university later announced his vision to have USP engage more on conducting Multi-disciplinary International Conferences with some financial support from his office.

As a result of this decision, a committee (comprising of regional partners) was established to organise the upcoming conference. With much discussion, it was decided that the Renewable Energy conference be held in December 2010 to be hosted by USP.

The theme of the International Conference on Renewable Energy and Climate Change: Focus on the Pacific is in line with the university's Strategic Plan on Quality, Relevance and Sustainability.

This conference aims to provide a common venue for the people of the Pacific to meet and mingle with their counterparts from the ACP and well as their development partners and perhaps work out their own strategies for solving their common problems. The ICRECC2010 will be an excellent opportunity for team building and informal forward planning. The wealth of knowledge and experience available at the Conference will be enormous considering the number of participants who have agreed to attend.

CONFERENCE ABSTRACTS

The role of Renewable Energy in mitigating global climate change

Dr Tony Weir

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Abstract

The IPCC Fourth Assessment Report of 2007 showed that climate change due to human activity (emissions of greenhouse gases especially carbon dioxide from the use of fossil fuels) is accelerating and that global warming in this century may be significantly greater and the consequences more severe than previously realized. To avoid the most dangerous climate change it will be necessary to hold temperature rises to less than about 2°C above pre-industrial values. To achieve this goal will require global greenhouse gas emissions to be 50% to 80% lower in 2050 than in 2000, and to begin declining by 2015.

Renewable energy (RE) in combination with major changes in the end use of energy, including increasing efficiency and changing consumption patterns, is one of the solutions that enable reducing CO₂ output while maintaining energy services and economic growth.

A forthcoming IPCC report on RE indicates that with a combination of high market development for RE and a successfully implemented strategy for delivering energy services with higher efficiency, CO₂ could eventually be stabilized at 450 ppm by 2100. To be on this trajectory, RE would need to approximately double its current (2007) amount of primary energy, increasing from 64 EJ to about 133 EJ by 2030, and total primary energy would need to rise only slightly from 441 EJ in 2007 to 472 EJ.

Already RE is growing rapidly and in 2007 contributed about 18% of global energy use. For example, in 2008 the investment in new installations of RE systems by the electric power sector globally and in both the EU and the USA exceeded their investment in new coal and gas energy systems, which is a promising start. But to achieve a much more substantial energy supply from RE requires a shift in development strategy in both developed and developing countries by systematically implementing policies on a wide scale that can overcome the economic, technical, institutional, and social barriers, which have limited the adoption of RE to date.

**Session 1: RENEWABLE
ENERGY AND CLIMATE
CHANGE ASSESSMENT**

Remote Sensing and Geographic Information Systems for Resource Assessment – Scope and Capabilities for the Pacific

Dr Lalit Kumar

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Abstract

Timely data at appropriate scales is critical for the management of natural resources. Remote Sensing provides the means to collect data at broad scales and at variable resolutions for input into GIS based models so that the satellite data can be integrated with other ancillary data for modelling purposes.

A thorough knowledge of the spatial distribution and quantity of resources is critical to any decision making process. In regions with limited resources, there is always competition between interested groups for the utilisation of such resources. In the Pacific Islands there is the added problem of the geographic spread of such resources and accessibility is a major issue in deciding what is where and how much is on the ground.

Remote Sensing is a technology that has made great strides in the last 20 years in terms of resolution and repeatability. There are many more satellites from which data can be obtained, and the spatial resolutions are much better than when the first environmental satellites were launched. The repeat cycles have also improved greatly. This presentation will highlight some key satellite and air-borne platforms that can be used for data acquisition in the Pacific and the issues each one poses. It will also show how satellite data can be integrated with GIS data layers for improved resource assessment and how these data products can add to the renewable energy and climate change decision support systems.

Keywords: Remote Sensing, Geographic Information Systems, Resource assessment, Biomass, LiDAR

Wind Characteristics and Energy Potential of Wainiyaku, Taveuni, Fiji

Ajal Kumar and K. Nair

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Abstract

Wind characteristics and the Energy Potential of Wainiyaku Taveuni (16° 49'South and 179° 58'East) is investigated using the Wind Atlas Analysis and Application Program (WASP). The wind assessment is based on the data provided by the Department of Energy (Fiji). Digitized map of Wainiyaku with appropriate area

roughness and other parameters were chosen for accurate estimation of power potential using WASP. The report suggests that Wainiyaku Taveuni is a good site for wind power generation based on mean wind speed at 25 m a.g.l. A resource grid for mean wind speed and power density around Wainiyaku is predicted by the software. An economic analysis for a prospective wind power generation using Vergnet 275 kW is carried out.

Key words: energy potential, WASP, roughness, resource grid, Verged 275kW

Consequences of Climate Change on Agriculture and Farmers adaptation

Dr. Paras Nath

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Abstract

Will climate change facilitate or hamper our efforts to maintain ample food supply for the increasing world population or not? Which parts are likely to profit and which are likely to go through food shortages and socioeconomic problems? Could the beneficial effects of the CO₂ fertilization neutralize some of the negative effects of climate change on plants? What types of farmers' adaptations will be required to derive benefit out of the available opportunities and lessen the harmful impacts of climate change on agriculture? How much will be the cost of these adaptations? Will it be possible for the farmers of the developing and under developed nations to cope up the adaptations?

To answer these questions scientists from various disciplines and countries have made studies using simulated models. These models give some indications of the impact of climate change which may fluctuate in diverse geographical regions and climatic zones. This paper presents some fundamental aspects studied in India and some other parts of the world about how crop plants respond to changed temperature and increases in atmospheric CO₂ and how farmers may respond to derive benefit or to cope up the problems created by the climate change. The farmers of developing and under developed nations will find difficulty to adapt to climate change due to relatively weak agricultural research base, poor availability of inputs and inadequate capital for making adjustments at both the farm and national levels. But the farmers of developed countries having a strong research base and availability of capital to pay for adaptations will be able to minimize negative effects associated with climate change.

Keywords: Climate change, agriculture, CO₂ fertilization, temperature, adaptation.

The Potential of Using Coconut Oil Based Microemulsions as Fuel for Diesel Engines

Jagjit Khurma, Anirudh Singh, Pranil Singh

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Abstract

Direct use of vegetable oils in the diesel engines is very attractive but long term operation of engine on vegetable oils is unsatisfactory as it results in a number of problems. High viscosity of vegetable oils interferes with the injection process and leads to poor fuel atomization. Incomplete combustion of oils can cause deposit formation on injector tips, ring sticking, etc. A number of techniques are currently used to overcome these difficulties which include blending of vegetable oils with diesel, increasing the fuel temperature, pyrolysis, transesterification to produce biodiesel and dilution of oils with low viscosity liquids such as ethanol. Ethanol and coconut oil are mutually insoluble liquids but can be converted into an optically transparent thermodynamically stable and low viscous system known as microemulsion by adding an appropriate surfactant or a mixture of surfactants. In microemulsions, an interphase separates the microscopic alcohol droplets in the discontinuous phase from the vegetable oil in the continuous phase. The diameter of the dispersed-phase particles is less than one-fourth the wavelength of the visible light. Preparation of microemulsions is fast as well as inexpensive and when used as a fuel in diesel engines, there is a reduction in the exhaust emissions compared to diesel.

This presentation is related to the studies on microemulsion fuels consisting of coconut oil and ethanol. The microemulsions were prepared by using butanol and octan-1-ol as surfactants and ternary phase diagrams coconut oil, ethanol and surfactant systems were constructed. Density, viscosity and gross calorific values of selected microemulsions fuels were determined. The performance of a single cylinder, air-cooled, direct injection diesel engine was studied using these microemulsions and exhaust emissions were investigated. The results indicate that the engine efficiency of these fuels is comparable to that of diesel. The exhaust emissions were lower than those from diesel. The studies show clearly that these microemulsions can be used as fuel in diesel engines without any modifications.

Software design of Solar-Wind Hybrid Systems

Shivneel Prasad and Ajal Kumar

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Abstract

Pacific Island Countries (PIC's) have a huge potential renewable energy to cater for their energy needs. This vast amount of energy can be captured directly as solar radiation or indirectly from wind or by hybridising the two. It is important that research be carried out in

PIC's to study solar and wind resources to design and implement efficient and economical renewable systems.

This project was carried out at the University of the South Pacific Campus, Suva to study solar and wind resources in order to design and implement a solar-wind hybrid system to light up dark areas around the student recreational area.

The project was carried out in 3 stages. Firstly, the load analysis for the area was done, after which 3 different software were used to carry out simulation and system modelling. The 3 softwares used were HOMER, WASP and Rescreen. HOMER was used to carry out the hybrid system design and optimization whereas WASP and Rescreen were used to model wind and PV systems respectively.

Lastly an optimised system was decided on the taking the capital cost into account as well the cost of energy and lifetime of the system. Four days of no sun and wind days were catered for in the system. Manual modelling was also carried out and compared with modelling from the softwares and thus the 3rd stage of the project was implemented. I.e. the system was constructed onsite and set in operation after which it was monitored.

Resource analysis showed that on average the site received $3.8 \text{ kWh m}^{-2} \text{ day}^{-1}$ of solar energy with 1387 full sun hours annually. Monthly average wind speeds of 3.88 m s^{-1} 10 m above ground level was obtained which when extrapolated to 15 m (the hub height of the wind turbine) showed average wind speed was 4 m s^{-1} with power density of 70 W m^{-2} . With this wind resource, a Whisper 100 wind turbine would be in operation for approximately 50% of the time in the year. The complementary nature of solar and wind resources showed good potential for a solar-wind hybrid system. WASP's analysis and prediction of the annual energy production (AEP) from the wind turbine showed that the site had an AEP of 556 kWh using a *Whisper 100* with the most prominent wind direction being from the south east. Rescreen software indicated that approximately 90 kWh of renewable energy could be harnessed using a single *Sharp 120 W_p* PV module.

Ethanol producing potential of local varieties of cassava in Fiji

Pritika, A. Singh and J Khurma

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Abstract

Ethanol production from renewable resources has received attention due to increasing petroleum shortage. One such renewable resource that has been identified is cassava starch. Cassava starch is extracted from the root crop, cassava (*Manihot esculenta* (Crantz)) which is readily available in Fiji. There are different varieties of cassava so it becomes important to identify the most suitable variety.

The current paper looks at the extraction of starch from the roots of ten different cassava varieties available at two different research stations in Fiji. The sedimentation technique was

used to extract starch from cassava roots and some properties of the extracted starch were also determined. Results of starch yield extracted from different varieties from two government research stations (Koronivia Research Station and Dombuilevu Research Station) are reported.

The extracted starch was also characterised for ash content, pH and moisture content. The results reveal interesting differences in the varieties from the two stations. Starch yields of up to 23% were obtained. The moisture content for the starch of cassava varieties were typically below 15 %. Dry matter content of the cassava roots showed values as high as 41% for some varieties. .

Simultaneous Saccharification and Fermentation (SSF) technique was employed to determine the highest ethanol yield from cassava starch obtained from different cassava varieties. Ethanol yields of 0.400 L ethanol/kg substrate were obtained for some varieties.

This paper presents the results of these investigations in detail, and assesses the viability of the production of ethanol from these Fijian cassava varieties by comparing these results with investigations of varieties from other tropical countries.

Keywords: Cassava, Starch, ethanol, simultaneous saccharification and fermentation

Assessing the contribution of renewable technologies to energy security: the electricity sector of Fiji

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Abstract

In recent years, renewable energy technologies have been advocated in Fiji on the basis that they improve energy security and serve as a risk-mitigation measure against oil price volatility. Despite this, there have been few attempts to measure the impact of renewable technologies on energy security. That analysis is important if the benefits of renewable energy technologies in Fiji are to be adequately evaluated. This paper develops and applies a method for assessing the potential contribution of renewable technologies to the security of electricity supply in Fiji. The method is based on an application of portfolio theory, traditionally used in financial markets, to the electricity generation mix in Fiji. The results demonstrate the impact of different renewable technologies on both portfolio generation cost and risk for Fijian electricity grids.

**Session 2: RENEWABLE
ENERGY
TECHNOLOGIES AND
APPLICATIONS**

A Review of the Technologies for Electricity Generation from Solar and Wind Energy Resources

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Abstract

There is considerable potential for generating electricity (as well as thermal energy) from solar and wind resources in Fiji. Apart from the 10 MW wind farm at Butoni, no large power generation systems exist in Fiji. While there is good to excellent potential in various sites, there are also barriers to be overcome for the economic power generation from these resources.

The paper will consider these barriers, ways and means of overcoming them and then focus on the technical and economic viability of installing large (>1 MW_e) systems to meet rising electricity demand, mainly from rural and small island locations. The current policy framework on utilisation of RE resources will also be addressed. Key aspects of the environmental impact of such technologies will also be addressed.

Keywords: RE technologies, solar photovoltaic systems, wind turbines, barriers to RE use, environmental aspects

A Grid –connected PV system for the USP lower Campus: Design and Economics

Atul Raturi and Hamendra Reddy

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Abstract

Grid-tied Photovoltaic systems are increasingly becoming attractive in the Pacific Island Countries. There are a number of systems already in operation and more are being planned. The economic implications of renewable energy systems on heavily imported diesel dependent PICs are subject of many studies. Moreover, long term sustainability of any RE system strongly depends on the trained manpower available locally.

A 54 kW grid-connected system is being proposed for the USP lower campus. This project is supported by KOICA as a part of Renewable Energy Capacity Building programme at the USP. This paper reports a techno-economic analysis of the PV system including the system design considerations, expected electricity output and economics of net metering. A part of

this system will exclusively be used for training purposes. Considering USP's regional reach, this project can be developed into a regional Grid-connected PV training platform

Key words: Grid-connected PV systems, Grid-interaction, Net -metering, Capacity Building

Fabrication and Characterization of *Bougainvillea spectabilis* based Dye Sensitized Solar Cell

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Abstract

Dye sensitized solar cell (DSSC) is a third generation solar cell that mimics the process of photosynthesis. Natural dye based DSSC does not require ultra-pure materials, permits flexibility in the preference of materials and utilizes low-cost processes and substances. Furthermore, it achieves reasonable performance and allows alteration and optimization of its properties for applications. This paper illustrates the fabrication of DSSCs using a local flower, *Bougainvillea spectabilis* as the sensitizer. The main components of DSSC comprise of a photoanode, redox electrolyte and a counter electrode. The dye was coated onto nanocrystalline titanium dioxide (TiO₂) films prepared by electrophoretic deposition (EPD). The conditions for constant voltage EPD were based on electrophoretic voltage applied at 5 V, deposition duration maintained at 30 s and annealing temperature fixed at 250 °C.

The main anthocyanin pigment present in *Bougainvillea spectabilis* is betanin. Methanol was used as the extracting agent. The UV-visible spectra of the dyes before and after adsorption were analyzed for their photoactivity. Upon adsorption of the dye extract from the TiO₂ films, the visible absorption band shifted to higher energy. DSSC converted visible light into electricity based on the sensitization of wide bandgap of TiO₂.

The typical photoelectrochemical parameters of *Bougainvillea spectabilis* were determined from the current-voltage plot. Platinum was used as the counter electrode and sealant was applied during assembly of DSSC. The bougainvillea based DSSC produced an open circuit voltage (V_{oc}) of 0.359 V, a short circuit current density (J_{sc}) of 0.898 mA cm⁻² and a fill factor (ff) of 0.52. The efficiency (η) of bougainvillea based DSSC was calculated to be 0.38 %. The photoaction spectrum of the DSSC was also determined using filters of various wavelengths.

Keywords: Dye sensitized solar cell, *Bougainvillea spectabilis*, Betanin, Electrophoretic deposition.

Properties of Traditional Fuelwood and Industrial Biomass Residues in Fiji

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Abstract

Wood energy is an attractive idea since our current dependence on petroleum worries all of us for a number of reasons like its costs. In developing countries the predominant traditional sources of energy are fuel wood and charcoal, which are used primarily for cooking and heating homes. There are various ways in which wood might be used for energy purpose. Direct burning of wood is a simple and efficient, and is the way in which almost all energy from wood is produced now.

This paper looks at the properties of some of the common traditional fuel woods and timber-milling residues in Fiji. The dependence of the Calorific Values (CV) with the Moisture Content (MC) of fuel woods used traditionally (Black Mangrove, Guava, Mango, Tamarind, etc) and industrial biomass residues (Bagasse, Mahogany and Pine) used by the industries for power generation are studied. A Bomb Calorimeter was used to determine the CV and the Oven-dry method was used to determine the MC. The MC of each species decreased with sun drying whereas the CV increased. Comparison of the results shows that the CV of softwoods is slightly higher at higher MC but at lower MC (below 15 %) the hardwoods tend to have higher calorific values. Similar trends were seen with Pine and Mahogany sawdust residues produced by the timber-milling industry.

Fresh bagasse samples were found to have higher calorific values as compared with 2 months old sample and 1 year old sample in the higher moisture content regime, but as the moisture content decreases below 30 % the calorific value increases towards the 20 MJ/kg value.

Keywords: Fuel Wood, Calorific Value, Moisture Content

Geothermal Energy: Electricity for the Future

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Abstract

Geothermal energy is an environmentally sustainable form of energy and is virtually free of pollutants produced by fossils or nuclear fuels. Its benefits in reducing greenhouse emissions are considerable. Much greater economic benefits will be derived from savings in foreign exchange as currently a substantial portion of payments generated from imports of fossil fuel leaves the country and thus has a negative impact on the economy.

Fiji is among the Pacific Islands that are most vulnerable in the face of energy uncertainty. The solution to our fossil fuel woes is in renewable energy and in particular geothermal power. We have the potential to generate geothermal energy for the nation that could drastically change the balance of our economy towards a more healthier and vibrant one with the significant change in the foreign exchange equation. Geothermal Energy is one of the emerging and most reliable renewable energy sources for the future. This paper will outline the efforts of the Geothermal Electric Ltd towards the utilization of such resources.

Keywords: geothermal energy, fossil fuels, Fiji's energy situation, environmental impact

Session 3: RENEWABLE ENERGY ECONOMICS

Greening the economy: Shifting the growth paradigm to be more inclusive and sustainable

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Abstract

Pacific small islands developing States (SIDS), together with other members of the ESCAP Asia-Pacific region, adopted **Green Growth** as a key economic policy in 2005. Although, there are a number of initiatives in the Pacific that could be considered examples of Green Growth, an ability to capture the full potential of this approach is still lacking.

The path to Green Growth includes:

- Green Tax and Budget Reform (GTBR)
- Sustainable consumption and production
- Greening business
- Sustainable infrastructure
- Investment in natural capital
- Eco-efficiency indicators

The Green Growth approach is considered a viable strategy for achieving sustainable development in the region. It is particularly relevant for Pacific SIDS as it involves creating economic wealth and social inclusion from activities that benefit the environment, our most precious resource. But, do our region's economists and financial decision-makers know about Green Growth? Are they tapping into the foreign investment being directed to such projects?

This paper will inform strategies for addressing climate change and demands for renewable energies by educating participants in the Green Growth approach. As the situation in the region illustrates, it is now an urgent challenge to find ways to ensure that the old paradigm "grow first, clean up later" is replaced by an integrated approach that enables economic growth to support and reinforce sustainability, rather than undermine it.

The paper will draw on existing examples of Green Growth in the Pacific and stimulate debate about how to fully capitalize on the opportunities ahead.

Energy Policies and Renewable Energy: An Overview and Options for Pacific Island Economies

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Abstract

This paper provides an overview of energy policies that have been used to encourage investment in renewable energy technology and related issues both developed and developing countries. An assessment is made for appropriate renewable energy policy options for the Pacific Island Economies.

Do Fossil Fuel Prices Hamper Exports from Small, Energy-Dependent Countries of the Pacific?

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Abstract

Small Pacific Island countries are energy dependent and have a disproportionately large energy import bills. The anecdotal evidence suggests that the energy bill increases as the price of fossil fuel increases in the world market. Given this near one-to-one relationship between fuel prices and the import bills, it is expected that production cost and thus the per-unit price of the exportable commodities would also increase by a proportion. Since the transport cost component of commodity prices from the PICs is quite high mainly due to the distance factor, the prices of commodities produced in the PICs are likely to be much higher and less competitive than those from other countries in the global markets place. This disproportionate change in prices of exportable commodities from the PICs attributable to distance from source to the global market is likely to affect trade negatively. This paper estimates the elasticity of trade to price fluctuations of fossil fuel and provides the findings as a basis for the small Pacific Island countries to consider alternative sources of fuel as a mitigating option for minimising economic losses from reduced exports.

Managing Energy Resources to Strengthen the Pacific Economic Base

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Abstract

Pacific island countries (PICs) are heavily dependent on oil for energy. The fall in the price of oil since mid 2008 has provided some relief to PICs but there remain serious concerns about the preparedness of the region to cope with future rises in oil prices or to be able to grow with significantly reduced supplies of oil based energy. The accelerated price rise in late 2007 and early 2008 highlighted the risks posed to the Pacific. There are possible alternatives through renewable energy but these remain often higher cost and experimental at providing grid based electricity. There is a need to provide clear economic incentives to improve current and future investment decisions in stationary energy and transport.

From a regional perspective there is limited access to affordable, reliable and environmentally sound renewable energy that can replace a significant proportion of energy supplied by oil. Despite this, Pacific nations are motivated to look for alternatives as the recently released *Pacific Energy Policy Framework: Towards an energy secure Pacific* noted the long-term problem of oil dependence and discussed alternatives, including improved energy efficiency and more production from renewable energy resources. This supports previous statements and reports on renewable energy to Pacific Island Energy Ministers (in June 2010 in Brisbane, in April 2009 in Tonga and April 2007 in the Cook Islands). However, caution is needed before making commitments about energy directions, in particular, consistent and up-to-date data are required to enable the sound analysis and appropriate policies and strategies can be developed to allow the adoption of proven alternatives that match local needs. This is especially important as the stated national objectives for renewable energy usage in the region are ambitious with Tonga and Nauru planning for large increases in the amount of electricity being supplied by renewable energy.¹

This proposed paper brings together some of the practical and theoretical issues associated with the incentives and sanctions underlying particular types of energy usage and energy policy development in the Pacific.

Keywords: Energy economic, cost-benefit analysis and Pacific island economies.

¹ Nauru is committed to 50% of energy needs being met by renewables by 2015. Samoa has set a 20% target by 2030. Tonga has an ambitious target to reach 40 to 50% within 2 years. Niue has set a target of 100% without setting a date. The Fiji Electricity Authority has plans to be a 100% renewable power utility by 2011.

Ethanol Production in Fiji

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Abstract

Worldwide interest in reducing reliance on petroleum based fuels and the renewed interest in sustainable development including reductions in carbon emissions has led to increased interest to renewable alternative non-petroleum based fuels. The drivers behind this interest worldwide are to lessen dependence on foreign sources of fuel supply, possible scarcity of fossil fuel in future, environmental protection and the profitability of non-renewable fuel options with the higher prices of fossil based fuels

The purpose of this research is to investigate the economic feasibility of producing ethanol from sugar and sugar related feed-stocks in Fiji Islands. We present arguments that ethanol production is feasible given the current on-going reforms in the sugar industry. We discuss a number of options of producing ethanol from sugar cane feedstock.

Our research shows that the world price of oil will be positively correlated with sugar prices and the ethanol prices. Considering several options for ethanol production analysis shows that perhaps molasses feedstock is the best option for producing ethanol in Fiji.

Session 4: POLICY STRATEGY AND FRAMEWORK

The Framework for Action on Energy Security in the Pacific Islands – what is it and what is in there for the Pacific Islands

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Abstract

The Framework for Action on Energy Security (FAESP) signals a new chapter in the development of the Energy Sector of the Pacific Islands. The FAESP defines Energy Security to exist when all people at all times have access to sufficient sustainable sources of clean and affordable energy and services to enhance their social and economic well-being. It is therefore a new chapter based on closer collaboration at both the delivery and the recipient ends. That close collaboration is based on the premise of Many Partners One Team One Plan where energy issues are considered and addressed through a whole-of-sector approach. The whole-of-sector approach is characterized by a balancing of Access, Affordability, Productivity and Environmental Quality. It is a fine balancing act based on the priority needs of the Pacific Islands, as seen by the eyes of the Pacific Islands rather than being donor and technology driven.

The FAESP will only be successful if all the Partners are genuine about working together under one common plan, outcomes and strategies. Leadership at the national level is of paramount importance as regional and multilateral supports are only to complement national effort.

A stock take of what the many partners are doing in each island country is essential in order to identify opportunities for joint activities, duplication of effort and priority areas that are neglected.

This presentation will present the FAESP and will provide an update on the status of the FAESP and its Implementation Plan.

Keywords: FAESP, Energy Security, whole-of-sector approach

How Can We Achieve ‘Good’ Governance for Climate Change Adaptation? Lessons Learnt of Relevance to the Pacific.

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Abstract

The ability of countries to adapt rapidly to climate change will determine the longer term environmental, social and economic health of Pacific Island communities. Climate change adaptation must occur at multiple levels. Households, communities, industries, institutions and governments must all adapt. What makes this adaptation process more complex, is the need for clear linkages and coordination between these different levels of adaptation. To achieve this will also require effective governance at multiple levels. Without effective governance, even good policy and strategy will fail.

This paper highlights lessons learnt from the natural resource governance experience in other areas, which will be relevant to enabling Pacific Island government and non-government institutions, and communities, to adapt effectively. What constitutes ‘good’ governance will, in part, be culturally and contextually defined. However, there are some broad principles that will have general application to most contexts.

The paper identifies five desirable conditions and strategies for effective climate change adaptation governance, relevant to both government and non-government institutions.

1. The presence of ‘political champions’ with a strong philosophical commitment to provide the necessary policy mandate and political will to stimulate and maintain institutional adaptation.
2. Identification of clear governance performance criteria, against which institutions will be assessed. This paper suggests several performance criteria that may be relevant.
3. The production of regular governance ‘report cards’, based on the governance performance criteria and performance targets, and developed through a governance monitoring and reporting system that includes assessments by key stakeholders and constituents.
4. Incentive systems for managers and front-line staff to satisfy governance performance criteria.
5. The use of evidence-based policy, where the policy is formulated based on relevant scientific, economic and social/human evidence; and where policy appropriateness, effectiveness and impacts are monitored, and adjusted accordingly.

Keywords: Climate adaptation, policy, governance

Caribbean Renewable Energy: Policies, Competition and regulations

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Abstract

There are many barriers to the implementation of RE programmes in SIDS. These include education, identification of appropriate technologies, research and development in the indigenous environments and, perhaps most importantly, public policy. In this paper we discuss these barriers and suggest ways in which they might be overcome. Emphasis is placed on those factors which are common to all SIDS and which therefore, may be applicable to the Pacific islands as well as those in the Caribbean.

The Tonga Energy Road Map

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Abstract

The Tonga Energy Road Map outlines a pathway for Tonga to become 50% less reliant on imported fossil fuels by 2020 and revolutionise the way that clean energy is developed in many parts of the world. The road map process has been successful in bringing together governments, development partners and regional energy organisations to plan the next 10 years of the country's energy future - under a strong leadership of the Prime Minister's office of the Government of Tonga.

To what extent could the establishment of such a roadmap be undertaken in other PICs? Given the diversity of energy situations across the region, how can this model be replicated in other countries? Is it now part of Tonga's role to help foster these changes across the region and other parts of the world?

Keywords: Tonga energy roadmap, whole-of-sector approach

Renewable Energy in the Pacific Island Countries – Resources, Policies and Issues

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Abstract

The development of a viable renewable energy sector in the Pacific Island Countries (PICs) is dependent on several enabling factors and circumstances in additions to the availability of the appropriate renewable energy resources. These factors include policy frameworks, human resources and the institutional mechanisms to develop these, as well as the availability of market-ready technology. All this must be supported by an economic infrastructure, a science base and a political atmosphere conducive to development.

The choice of appropriate RE technology is crucial, and decision-makers must not only ascertain whether resources are available for the development of a particular RE sector, but also whether mature and commercially-available technologies exist.

To gauge the likely success of any RE development programme, it is instructive to consider examples of countries where such development has been successful. What do they have that many developing countries lack? Countries that supply such examples include our next-door developed neighbours, Brazil, and Europe.

When such comparisons are made, one very obvious deficiency in the PICs turns out to be research policies, and the science and technology-related institutional frameworks to formulate and support such policies. Indeed, PICs seem to be lagging behind their ACP counterparts in this. There is an urgent need to address this issue.

This presentation will consider the RE resources available in the PICs, and briefly overview their energy policy frameworks. It will attempt to provide a league table of the relative merits of the commercially available technologies in a bid to understand their limitations and merits. It will then consider the development of the RE sector in countries where this has been successful, and go on to point out the deficiencies in the science and research infrastructure of the PICs that are evident.

Keywords: renewable energy resources, renewable energy policies, Pacific Island Countries, renewable energy institutional frameworks

Session 5: TECHNOLOGY TRANSFER AND CAPACITY BUILDING

The role of universities in technology transfer in the renewable energy sector in Bolivia - findings from a labour market survey and experiences from a rural electrification pilot project

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Abstract

Renewable energy is of major importance for sustainable socio-economic development in Bolivia for three main reasons. Firstly, due to the obvious environmental benefits in respect of the use of reduced or no CO₂ emissions; secondly, because it offers local job opportunities and increases the export potential of locally available fossil fuels; and finally renewable energy could play an important role for rural electrification. Renewable energy goals are on the political agenda of Bolivia as well as many other Latin American countries. However, the current potential is not used despite the high availability of natural resources. One of the main problems is the lack of policies combined with logistic barriers, such as the lack of local expertise available to plan, design, implement and maintain renewable energy technologies. Due to the innovative nature of this field, institutions of higher education are very important actors in this sector, especially in terms of research as well as educating future employees.

This paper presents the key findings of a set of surveys which have been carried out in Bolivia as part of the EU funded project JELARE. The objectives of these surveys were to identify the needs of the local labour market regarding education and research in the renewable energy sector, to identify training needs of university staff in the renewable energy sector and to benchmark renewable energy activities among higher education institutions. In addition, this paper showcases a German – Bolivian pilot project on technology transfer on renewable rural electrification as an example for local and international university technology transfer. Finally, it will conclude with some suggestions for fostering research and innovation in the renewable energy sector in developing countries and in the Pacific region in particular.

Keywords: renewable energy, technology transfer, rural electrification, Bolivia

Outcomes and Impacts of the European Union's Renewable Energy and Energy Efficiency Programme (REP-5 Programme)

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Abstract

The REP-5 programme was a regional initiative implemented by the Pacific Islands Forum Secretariat (PIFS) supported with funding from the 9th European Development Fund (EDF9). The REP-5 programme focused on renewable energy and demand-side energy efficiency in five countries in the Federated States of Micronesia (FSM), Nauru, Niue, Palau and the Republic of the Marshall Islands (RMI). Within the FSM, all four States of Yap, Chuuk, Pohnpei and Kosrae participated. The REP-5 programme began in January 2006 and is now scheduled to end in December 2010.

The specific objectives of the programme were:

- In FSM and RMI the programme objective is to increase access of the outer islands population to adequate, affordable and environmentally sound electricity.
- While for Nauru, Niue and Palau the objective is to improve the overall efficiency of the energy sector and, where justified, increase the production through renewable energy sources

In FSM and RMI, the project has carried out off-grid solar installation projects on 18 atolls and islands. In summary:

- Over 260 kWp Off-grid solar PV installed;
- 3 islands (471 households) entirely electrified;
- 16 schools; 7 dispensaries; 4 municipal buildings; and 3 community halls electrified.

Energy efficiency awareness campaigns were carried out in FSM, Nauru, Niue and Palau. Along with activities such as CFL distribution campaigns, the awareness campaigns have: made people aware of and willing to use more energy efficient appliances; enabled people to apply energy efficiency principles in the home; and encouraged the private sector to stock more energy efficient lights and appliances. The REP-5 Programme also installed over 1,800 prepayment meters in Nauru as part of the Government's strategy to improve demand side energy efficiency and cost recovery on electricity generation, enabling Nauru to restore 24 hour power to the whole island in 2009.

The first grid-connected PV systems were installed for Nauru, Niue and Kosrae and one of the largest arrays in the Pacific was installed in Palau. In summary:

- 100 kWp at the Capitol Building in Palau;
- 52.5 kWp installed in Kosrae;
- 46.0 kWp installed on roof of Nauru College; and
- 52.7 kWp installed at the NPC office, the high school and the hospital in Niue.

In total 250 kWp of grid-connected PV was installed, which is producing approximately 25,000 kWh per month of renewable electricity. The REP-5 project also strengthened policy and planning frameworks and implementing capacity through capacity building and training to Government, utilities and the private sector.

Keywords: Renewable Energy, Energy Efficiency, Pacific Islands

Biofuel Developments in the Fiji Islands

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Abstract

The Government of Fiji is considering biofuel industry as an alternative and cheaper source of fuel in light of the decline in EU's preferential prices for sugar, increasing fuel prices and the consecutive increase in demand for energy. Development of the biofuel industry has been assessed to be economic and socially it will provide secure employment in the agriculture sector. In addition, sustainable use of land resources and massive reduction in harmful greenhouse gases by the country is the environmental rationale of the project. An Oil Price Vulnerability Index (OPVI) measures the vulnerability of countries to increasing oil prices. Out of 24 Asia-Pacific countries studied, 13 countries are classified as 'most vulnerable', and four Pacific Island Countries (PICs) including Fiji are among the seven most vulnerable countries. For the last three years, annual imports of petroleum products have been hovering around the one billion Fiji Dollar mark. For a small economy like Fiji, the effects of such expenditures can be devastating and also means reduced budgets for critical social concerns such as infrastructure, education and health.

The Department of Energy is the organization in charge of developing a sustainable economy through the implementation of renewable energy technologies. The Biofuels Development Unit at the department is tasked with decreasing our dependence on fossil fuels through implementation of biofuel programs throughout Fiji. This paper gives an overview of the roles of the Biofuel Development Unit, the progress made in terms of government and private funded biofuel programs and other critical developments in the Fiji biofuel industry.

Keywords: Fiji Department of Energy, coconut oil, pongamia, biodiesel standards, biofuel laboratory.

Waste' to `Energy' – process and possibilities for Fiji

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Abstract

It is well known that conventional sources of energy (in particular fossil fuel, such as coal and oil) are limited in availability and will run out someday. With continued economic growth and rapid industrialization on a global scale, the demand for energy is only expected to increase further. Energy generated from renewable sources appears to be the only viable answer for the future.

Energy extraction from waste is one of the renewable ways to generate power. Energy from Municipal Solid Waste can be used to generate electricity. Several technologies have been tried out in this field and with varying degrees of success. Waste pyrolysis and gasification technique aims to produce liquid and gaseous fuels by heating the waste under strictly controlled pressure, atmospheric and moisture conditions that prevent combustion from occurring.. The paper provides a general overview of the various WTE technologies that are in operation or can be operated here in Fiji and their relative performance. It reviews the processes and possibilities of WTE available in Fiji and tries to establish possible projects for the future.

Keywords: waste-to-energy, WTE, municipal solid waste, energy generation

SPC-CATD Small Scale Coconut Oil Processing Project

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Abstract

Fossil-based energy imposes huge costs to the domestic economy. These include, risk from volatility of oil prices, trade deficits due to high energy imports, and GHG emissions contributing to global warming. Rural Electrification projects in most PICs have been predominantly diesel-based which also faces a great deal of challenges due to high transportation costs, remoteness and lack of income generating opportunities. Coconut as a feedstock for bio-fuel to meet the energy needs of rural communities is one area of interest in PICs, however there have not been many practical experience and knowledge of existing units operating successfully in the region. SOPAC and CTA [The Technical Centre for Agricultural and Rural Cooperation, based in the Netherlands] in 2008, jointly funded an action research project on small scale coconut oil processing. Utilizing the local copra supply as biofuel for rural electrification together with producing valued added products such as coconut soap and lotion for diversifying of income base is perceived as a viable and sustainable option for rural communities in the PICs. The action research project has documented practical experience and relevant knowledge to operate and manage a small scale coconut oil processing mill, produce quality value added products such as coconut soap and body lotion and undertake proper product labeling and marketing. In July 2009, the project successfully installed and commissioned a small scale coconut processing mill at the Centre for Appropriate Technology and Development (CATD) in the Fiji Islands. The small scale coconut processing mill comes as a full package consisting of a mini oil mill, settling tanks, filtration unit, accessories to blend the coconut oil with diesel, and an 18 kVa indirect injection diesel engine.

The paper will discuss the technical specification, and experience on the operation and performance of the small scale coconut oil processing mill at CATD.

Keywords: coconut, bio-fuel, & rural communities.

Application of ARTI based Compact Biogas Plants for mitigating Climate Change in Fiji

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Abstract

Fiji, being an island nation is highly susceptible to the effects of climate change. Rising sea levels and effect on agricultural crops could have a long term impact on the economic development of this nation. This paper will look at how a rural based appropriate technology can help in mitigating climate change in Fiji islands.

The Appropriate Rural Technology Institute of India (ARTI), in 2003 developed a compact biogas plant (CBP). It affirmed that high value calorific food could be used to produce methane from 2 kg sugary or starchy based food sources and yielded about 500 g of methane per day. It was found out by ARTI that the Compact Biogas Plant could theoretically replace 250 L of kerosene per year, 100 kg of LPG & reduce Carbon dioxide emissions from 300 - 600 kg per year. In a rural setting, CBP could replace 3000 kg of firewood, hence reducing deforestation and 5000 kg of carbon dioxide if burnt.

Wide spread utilization can be used as a mitigating tool for climate change in Fiji and the emission reductions achieved by using CBP could be used for carbon credits, which in turn can be used as a economic tool to fund mitigation of effects of climate change, in Fiji. Thus, during the last quarter of 2009, the department of Agricultural Engineering, School of Mechanical Engineering, in collaboration with the Department of Energy, conducted verification trials to assess the applicability of ARTI based compact biogas plants to Fiji's situation. Trials were conducted in 100 L digesters and it was found that gas yields were in the range of 15 – 20 % compared to ARTI's results. 2000 L trials will be conducted in future. This presentation will focus on explaining climate change, evidence of climate, effects of climate change and how mitigation and adaptation strategies can combat climate change. The usage of CBP in reducing methane emissions and replacing wood as a source of fuel will also be discussed. Clean development mechanism and how carbon credits are generated will also be discussed.

Keywords: Compact biogas digesters, Appropriate Rural Technology Institute, climate change, mitigation, carbon credits, clean development mechanism.

Status of Wind Power in Fiji

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Abstract

Increasing environmental concerns and decreasing stocks of fossil fuels encouraged wind power generation worldwide. Fiji, to be consistent with the worldwide growth, wind power is growing at an impressive rate as a potential energy source.

This paper investigates the status and prospects of wind power development in Fiji. Currently, Fiji has an installed wind power capacity of 10 MW and the target is to construct more wind farms to meet the Fiji Government's commitment to meet the demand of escalating oil price and reduce green house gases. The government is also encouraging the application of wind power by implementing policies and programs. This paper outlines a few key issues which the country has to overcome in order to utilize the significant untapped wind energy and the emerging policies for RE installations.

Keywords: wind energy; renewable energy; wind turbines; renewable energy policy.

Session 6: ENVIRONMENT SUSTAINABILITY AND SOCIO ECONOMICS

Clean doesn't always mean green – understanding the impacts of energy options

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Abstract

A variety of factors are fuelling the push to energy self-sufficiency. This includes recognition of the impacts of increasing greenhouse gasses in our atmosphere, but also in the Pacific Region, a reduction in the reliance of imported fossil fuels resulting in loss of foreign exchange revenue.

In the rush to increase renewable energy options, there is a danger that the self-sufficiency goal is driving energy development that is inefficient and exacerbates social and environmental impacts. IUCN is concerned about these impacts, particularly as the flow-on effects often impact upon biodiversity.

As part of efforts to move towards a low-carbon economy, societies around the world are looking towards renewable energy options such as hydro, geothermal, solar, wind, wave and tidal power. It is not possible to supply all of the world's energy needs from just one source.

All energy options can have negative effects on both the environment and people. Biofuel proponents often underestimate the environmental and social consequences of unsustainable biofuel crops and processing methods. Current biofuels policies and practices run the risk of undermining food security while degrading ecosystems through deforestation, agrochemical pollution, the introduction of invasive species and the use of genetically-modified crops.

The best options are those that are socially, economically and environmentally sustainable. Decisions on which option to choose—whether it is biofuel, local hydropower, solar power or wind—should be based on an understanding of the potential impacts on biodiversity.

One option that has only positive effects for the environment and people (and even our bank accounts) is increasing energy efficiency and reducing our energy use. Energy security depends on healthy ecosystems. But these ecosystem services are not being properly valued or factored into decision making about energy investments and they are all declining.

Climate change increases the risk of disruption to energy generation as well as reduced output. Changes in rainfall patterns affect growth rates of crops used for biofuels and cause fluctuations in hydropower. The efficiency of hydropower generation can also be reduced through dam siltation caused by increased run-off from deforested land, and other unsustainable land use practices.

Keywords: renewable energy, environment, low carbon, invasive species, biodiversity

Marshall Islands streetlights retrofitting project

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Abstract

The project focuses on energy efficient lighting with the aim to retrofit the current sets of inefficient Mercury and Vapour street lights with more efficient LED and HID lights and also the installation of some solar street lights. Maintenance for the street lights in Majuro and Ebeye are costing the power utility approximately USD500K annually. This retrofitting exercise is projected to save the utility USD300K per annum.

Keywords: retrofit, energy efficiency, LED lights, solar street lighting

Palau energy efficiency subsidy programme

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Abstract

The project focuses on the promotion of energy efficiency and investment in energy efficient homes. The project titled Energy Efficiency Subsidy Programme (EESP) is managed by the National Development Bank of Palau with the support of the established National Task Force (NTF) and Technical Team. The programme expects a 15% reduction in the electricity consumption in new homes and has spent extensive efforts in raising awareness of the programme to the people of Palau. The programme has gained much popularity in Palau, and the EESP Steering Committee has received queries and interest from the Palau Housing Authority (PHA) for collaboration. A Memorandum of Understanding between NDBP and PHA is currently being drafted.

Keywords: energy efficiency, subsidy, investment, electricity consumption and awareness

Gender and energy in the Pacific

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Abstract

Pacific Island countries rely on large oil imports, which leave them highly sensitive to oil price shocks and limit the population's access to electricity. Now, access to energy can dramatically improve people's lives. Without energy access nor affordable electricity, poverty won't disappear. In the Pacific, women have an important role related to energy through activities such as cooking and firewood collection. Because of this significant role played by women in energy provision, they are also confronted with many health issues, such as indoor air pollution and heavy physical burdens. In the end, all these activities make women lose many productive and income-generating hours. Furthermore, since women in developing countries are highly dependent on their natural environment, climate change increases their burden. Expanding the use of renewable energy in the Pacific will bring improvements to women's daily lives. And behind the improvement of women's lives lies the improvement of the entire community's livelihood.

Session 7: RENEWABLE ENERGY IN DEVELOPING COUNTRIES

The potential of PV installations in SIDS – an example in the island of Barbados

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Abstract

As with many Small Island Developing States (SIDS) the island of Barbados is heavily reliant upon fossil fuels to meet their electricity generation needs (currently 98% of total electricity generation). In 2010, the installed capacity of photovoltaic solar systems on Barbados was estimated to be around 200 kWp (0.12% of the peak demand). With an average daily solar radiation of 5.7 kWh/m², the potential of the resource is clear to see. This paper examines the future potential of photovoltaics on the island including their experiences to date and discusses the application to other SIDS.

Keywords: SIDS, PV, Barbados

Emerging Technologies for the Efficient Generation of Heat and Electricity from Biomass Waste

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Abstract

Energy from biomass is used extensively throughout the developing world for cooking, water and space heating, electricity generation, producing steam and hot water for industries and for a host of other uses such as for crop drying and preservation. Many developed countries also use biomass for relatively large scale steam and electricity generation. For most of the developing countries, including many island nations of the Pacific region, energy from biomass forms accounts for over 50 % of their total energy consumption. Forms of biomass in our region includes firewood, coconut husks and shells, paper and cardboard, crop waste, and biofuels derived from biomass.

This paper deals with the use of biomass waste products for large scale steam and power generation using new and emerging technologies, such as gasification, pyrolysis and digestion. It is argued that the use of more efficient processes for the conversion of waste biomass (such as bagasse and sawmill waste) can result in higher conversion efficiencies and thus are better suited to the need to use the biomass in such a manner as to reduce the emission of greenhouse gases and thus to give rise to a cleaner environment.

Keywords: biomass energy, waste biomass, emerging technologies, gasification, pyrolysis, digestion, clean energy use, environmental pollution

Rural Electrification Needs in Pacific Islands – A Case Study of a Village in Kadavu Islands in Fiji

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Abstract

Besides having two larger islands, where most of the population dwells, Fiji has smaller islands scattered and isolated far away from the two main islands. Providing grid powered electricity is therefore not a practical solution for the electrification. Therefore these areas are largely affected due to limited progress. Education in schools, small business economy and health services are the areas of prime focus.

In our research work, we focus on understanding the energy requirements of the village Solodamu in the southern island of Kadavu in Fiji as a case study. Although the government is operating a diesel generator to provide electricity, it is run during the evening hours only. The cost of this electricity is not affordable to every rural family. Thus, the villagers use traditional fuels like kerosene and benzene for home lighting. Very few families have renewable energy like solar power for the domestic use.

In the present work we carry out the study of the electricity requirements of this village and evaluate possible solutions like community solar photo voltaic systems, bio-fuels, etc.

Key words: Renewable Energy, Rural Electrification, Solar Photovoltaic (SPV) Systems, Bio-fuel

Effectiveness of Solar Drying on Local Fruits

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Abstract

Postharvest losses of surplus seasonal fruits are a major problem in Fiji and other Pacific Islands. Drying is one of the cheapest and most efficient methods to preserve these surpluses, but there are losses with open sun drying due to contamination by pests and dust. Therefore, there is a need to develop a low cost drying system, such as solar drying to effectively dry fruits, reduce postharvest losses and minimize use of electricity.

Three different types of solar dryers were selected to dry (60kg each) papaya (*Carica papaya*) and pineapple (*Ananas cosmusas*). These dryers were: indirect dryer with natural convection, direct cabinet dryer and direct dryer with natural convection. Firm and half ripe Hawaiian

papaya (Solo and Waimanalo) and pineapple (Smooth Cayenne and Ripley Queen) were selected for drying.

Micrometeorological conditions were measured, together with moisture and microbial analysis of the dried fruits to determine the effectiveness of solar drying. Hazard Analysis and Critical Control Points were established as guidelines to ensure quality. Changes in the total sugar content of the dried fruits were determined by High Performance Liquid Chromatography.

The direct cabinet dryer was the most effective, with a drying rate of 20-25% per hour at 65°C with a relative humidity of 4.12%. The three types of solar dryers were effective in reducing the moisture content of the fruits to 20%. Sucrose content was high in dried pineapple composites (35%) but low in dried papaya composites (0.1%). The microbial analysis showed that the solar dried fruits are safe to consume having an Escherichia coli count in the dried fruits was <3 MPN/g.

Solar drying can be applied to vegetables, seafood and root crops, which are abundant in the Pacific. The conditions in the Pacific make the use of solar energy for drying food economical and environmentally sustainable as it uses a renewable energy source.

Keywords: Solar, Drying, Postharvest, Pineapple, Papaya

Energy Generation from Municipal Solid Waste in Small Island Developing States

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Abstract

Small Island Developing States (SIDS) are characterized by inescapable limitations namely small domestic markets, isolation, narrow resource base and dependence on external trade. Limited or scarce indigenous commercial energy resources and difficulties in securing energy supplies increase the many constraints in economic and social development of SIDS. The cost, source and usage of energy have become major concern for SIDS and warrants careful energy planning.

Energy generation for municipal solid waste which is commonly known as waste to energy can be a solution for sustainable energy generation in SIDS. Waste to Energy (WTE) is a term describing the technologies used to recover energy in a carefully controlled and highly regulated combustion environment. These technologies can take widely different forms, ranging from systems that receive waste on a moving grate, to systems that receive waste in a circulating bed of hot sand. All WTE plants have a boiler to capture and convert the released heat, and an extensive air pollution control system that cleans the combustion gases to comply with regulatory emission limits before they are released to atmosphere through the stack.

The recovered electricity can be fed into the national grid and recovered steam can be exported to adjacent industrial premises. The development of WTE will also play a vital role in helping many countries not only to meet their energy supplies but also to meet their international obligations to reduce the emission of greenhouse gases, in particular carbon dioxide, by replacing fossil fuels as a source of energy. MSW has a very good calorific value

which makes it a good source of energy. MSW power plants are designed to dispose of MSW and to produce electricity.

Keywords: SIDS, municipal solid waste, Energy

Small is Beautiful: An analysis of the NGO Alofa Tuvalu's 10 year renewable energy project in Tuvalu.

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Abstract

Tuvalu is a small island developing state (SID) with least developed country (LDC) status. For Tuvalu, the lack of access to adequate, affordable, reliable, safe and environmentally benign energy is a severe development constraint. Currently, Tuvalu is close to being a totally oil dependent economy, whose energy security is dependent upon foreign aid to ensure its ability to pay international oil companies. Costs of all imported goods are exacerbated by its geographical isolation.

The renewable energy component of the Small is Beautiful (SiB) project is aimed at ensuring provision of & access to a matrix of secure, affordable, appropriate & sustainable energy sources throughout Tuvalu – particularly for the isolated outer-islands – and will be achieved by using Tuvalu's own resources (biomass, solar, wind). The overall objective of this project is to improve access to energy services for the rural poor and thereby improve economic, social and environmental conditions for all isolated communities throughout the 9 atolls of Tuvalu.

SiB's specific objectives were drawn up in response to community identified needs and include:

- Access to an affordable modern energy carrier.
- Improved efficiency of energy service delivery, provision and use in order to effectively decrease the cost of energy production and the cost to the service user within 3 key energy sectors: electricity generation & consumption; transportation; and thermal use.
- Promotion of community ownership.
- Reducing the growth rate of greenhouse gas emissions from fossil fuel use. To increase the renewable energy contribution to a minimum of 40% of Tuvalu's current primary energy consumption (4574toe) and to reduce traditional biomass use.
- Reducing poverty by increasing household incomes for small-scale copra producers.
- Supporting women's groups in the outer-islands to improve livelihoods.
- Improving autonomy, security & sustainability of energy service delivery by building capacity for technical and engineering support. To deliver ongoing education and training

programmes which will allow the isolated communities of the outer-islands to carryout basic maintenance and repair of RET equipment.

- Delivery of environmental benefits for human health and the surrounding ecosystems.

This paper will analyse SiB's objectives against project outcomes so far and comment on the Tuvalu Government's commitment to 100% renewable energy – “being carbon neutral” - by 2020.

Session 8: RENWEABLE ENERGY AND CLIMATE CHANGE MITIGATION

The Role of Renewable Energy in Addressing the Challenge of Climate Change in the Pacific Region

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Abstract

This paper discusses the contribution which can be provided by renewable energy as a tool in addressing the challenge of climate change on a global level. It shows the extent to which renewable energy systems are being used in order to satisfy current energy demands and which positive effects have been achieved with these measures. The paper also discusses some of the empirical evidence available and outlines some of the actions currently being taken in Europe, as an example of a region committed towards meeting the targets set at the Kyoto Protocol and beyond. Finally, it summarises some of the lessons learned from Europe and lists some of the challenges and measures that need to be implemented, in order to achieve better integration between the use of renewable energy and climate change goals in the Pacific region.

Keywords: Renewable Energy – Europe- Climate Change – Pacific Region

Fiji rural climate change adaptation project - Lessons learnt

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Abstract

The University of the South Pacific has facilitated community-based adaptation projects in six Fijian villages from 2006 to early 2010, with financial support from AusAID. Three of these villages suffer from coastal erosion and three from low and poor water supply systems; with the problems exacerbated during the dry season. Our experience with these projects suggests many lessons for community-based adaptation projects more generally, which can be summarized as: (i) project management system and coordination set-up is essential (ii) proper community-based awareness, information and training programme is essential, (iii) community leadership or management system play an important role in project implementation and uptake (iv) community involvement is essential (v) support from outside groups, both in terms of policies and technology inputs, is important (vi) information about climate change and adaptation needs to be disseminated and shared to ensure uptake of best practices, (vii) long-term monitoring, maintenance and evaluation is needed (5-10 years).

Several of these lessons confirm our earlier and ongoing experience with locally managed marine areas.

Keywords: climate change, community-based adaptation, project management, community leadership

Climate Change and the Habitability of Tropical Pacific Island River Deltas

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Abstract

Small island developing states of the world are at the forefront of threats emanating from changing climates. Sea-level rise not only threatens the sovereignty of low lying Pacific islands but is already altering coastal and deltaic landscapes on high volcanic islands. In most parts of the Pacific, coastal communities are already witnessing climate change impacts that are eroding shorelines and inundating agricultural and habitable land area in deltas.

Studies of the interactions – present and future – between climate change and deltas have focused on mega deltas and very little research has been done in the area of Pacific Island deltas, even though these have comparable population densities. As part of a wider interest in the effects on island river deltas of current and future climate change, this paper examines the contemporary and future nature of sea-level rise stresses on the Rewa River delta in the south west Pacific. The Rewa Delta in Fiji Islands is the largest fluvial system in the South Pacific and sustains a population of almost 70,000. Sea-level rise will cause significant landward movement of the shoreline threatening the livelihoods and traditional homes of the delta's inhabitants.

Developing effective adaptation responses for reducing the impacts of climate change on such deltas is crucial. Yet most Pacific Island governments have failed to implement environment and sustainable management policies that would assist adaptation. The result is that the adaptive capacity of Pacific Island communities has been compromised as a result of the difficulties of mainstreaming climate change adaptation among such communities. In order to minimize the effects of future sea-level rise on deltaic communities in the Pacific Islands, adaptation options (including phased re-location) need to be implemented soon.

Keywords: climate change, deltas, sea-level rise, adaptation

Analysis of community-based climate change adaptation initiatives from Africa, Europe, Asia and America: What lessons can Pacific Island States learn from them?

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Abstract

Due to their economic and social conditions rural communities in developing countries have not been recognised as contributing to global climate change, nevertheless they are often the ones affected most severely by its impacts. In addition, financial resources, technical capacity and knowledge for designing and implementing adaptation measure are often scarcely available, which makes them depend on support from developed countries.

Despite this trend, many rural and indigenous communities worldwide are carrying out initiatives to adapt to climate change. However, many of these communities are not being identified, nor are they sharing the lessons they are learning. On behalf of the Arkleton Trust (UK) a global mapping exercise of these communities and their projects has been carried out. This paper analyses the results of this mapping exercise and presents a set of climate change adaptation initiatives and approaches that are relevant to the Pacific context. It highlights specific themes that seem to be among the most relevant for the context of communities in other regions of the world and suggests some lessons learnt that might also be relevant for implementing climate change initiatives in rural communities in the Pacific. Finally, the paper showcases some best-practice and presents case studies of initiatives and communities that have developed solutions to problems caused by climate change that also prevail in the Pacific region.

Keywords: climate change, community-based adaptation

Climate Change Adaptation for Tourism in the Pacific: Analysing the Policy Environment in Fiji

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Abstract

Tourism is the largest export sector and a major employer for most Pacific Island countries including Fiji. Pacific tourism is particularly vulnerable to climate change impacts due to the climate sensitivity of the natural environmental assets upon which the industry is based, the vulnerability of coastal infrastructure, the industry’s reliance on a long haul travel market

threatened by global climate change policy and changing consumer demands. Fiji and its neighbouring small island countries in the Pacific experience a high vulnerability to climate change impacts including sea level rise leading to coastal erosion and coastal inundation, warming sea surface temperatures leading to coral bleaching, increase in frequency and/or intensity of cyclones etc.

This study examines the policy environment in Fiji for its conduciveness to climate change adaptation for the tourism sector. It identifies the types of adaptation processes (explicit or implicit) and types of adaptation measures (technical, business management, behavioural, policy, and research & education) and critically analyses the current policies related to climate change, tourism, environmental and disaster management for their effectiveness in assisting the tourism sector addressing climate change. It was found that the Fiji government has shown an intention to develop adaptation policies through an explicit process but more policies identified tend to implicitly address tourism adaptation to climate change and mainly through the use of policy and research & education measures. The authors argue that in order to strengthen the resilience of the tourism sector, Fiji needs to further develop and implement explicit tourism adaptation policies that incorporate other types of adaptation and in particular, technical, business management, and behavioural measures.

Keywords: tourism, climate change, adaptation, Fiji

PNG's emission path under the PNG Development Strategic Plan 2010-2030

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Abstract

Although a small developing country, Papua New Guinea is nonetheless conscious of its carbon footprint. In vision 2050, for example, the Government's visionary statement for Papua New Guinea, Papua New Guinea proposes an ambitious aspiration of reducing carbon emissions to 90 per cent of 1990 levels. The Papua New Guinea Development Strategic Plan 2010-2030 (PNGDSP) is the Government's strategic policy plan for implementing Vision 2050. The PNGDSP proposes a path of development that combines economic progress with low growth in emissions. Key aspects of the PNGDSP include an increased reliance on renewable energy in place of diesel in electricity generation, the potential for biofuel as a fuel for transport and more effective enforcement of emissions standards in the transport and industrial sectors.

However, how well does the PNGDSP contribute to Vision 2050's aspirational target of reducing emissions to 90% of 1990 levels by 2050? To consider this question, the authors introduce an emissions module into PNGGEM, a computable general equilibrium model of the PNG economy. The model is then used to examine the emissions path of PNG under the PNGDSP, compared with a scenario in which PNGDSP policy measures are not implemented. It finds that while PNGDSP does make substantial progress in reducing PNG's emissions intensity, much more is needed to deliver the emission target proposed by Vision 2050.

You Don't Know What You've Got 'Til It's Gone – Protecting and Building Social Capital for Community Adaptation to Climate Change

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Abstract

A primary focus of adaptation to climate change will be at the community level. Research has demonstrated that the level of social capital within communities has a strong influence on the ability of communities to adapt. Social capital refers to the features of social organisation such as networks, behavioural norms, and trust, which increase a society's productive potential. Social capital is generally considered an attribute of communities, whereas human capital is considered an attribute of individuals. It is now broadly accepted that improvements to social capital contribute to poverty alleviation and sustainable development, and to general community well-being.

Many traditional societies inherently have high levels of social capital, while the westernisation of these societies can potentially reduce these inherent levels. Public policy and targeted investments can both diminish social capital, or build it. The international and Australian Landcare experience over the last 20 years has demonstrated how the influence of a variety public policy investments in natural resource management has achieved the extremes of both building, and diminishing social capital.

Communities themselves must accept responsibility for assessing, enhancing and monitoring their own levels of social capital, and they must be provided with the means to be able to do this. Concurrently, government and non-government organisations must ensure that their climate adaptation activities and investments are framed, and targeted, in a manner that builds social capital, rather than destroying it.

This paper outlines social capital-building strategies that have been used to achieve sustainable natural resource management in international Landcare and elsewhere. It describes how community-based climate adaptation programs in the Pacific might use these strategies to build social capital for adaptation in vulnerable communities.

Keywords: Climate adaptation, social capital, Landcare

Renewable Energy Development and Carbon Trading: Options for the PICs

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Abstract

The Clean Development Mechanism (CDM) under the Kyoto Protocol was envisaged to help develop renewable energy projects leading to sustainable development in non-Annex 1 countries. PICs have however remained almost untouched by this initiative owing to a number of barriers. There is a renewed interest in developing carbon-trading projects in the region despite the post-2012 uncertainty of the CDM process. Programmatic CDM (p-CDM) projects spanning across countries can be developed to make renewable energy based electricity available to hitherto unserved population.

It is important to strengthen the technical, regulatory, and institutional framework within the region for this to succeed. This paper discusses the opportunities for RE and EE p-CDM projects in the PICs.

Keywords: Programmatic CDM , RETs, Kyoto Protocol

Carbon financing opportunities

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Abstract

The United Nations Kyoto Protocol includes the Clean Development Mechanism (CDM), entering into force early 2005. CDM allows projects in developing countries that reduce emissions to earn certified emission reduction credits (CERs), each equivalent to one tonne of CO₂. CERs are sold to industrialized countries to meet a part of their Kyoto Protocol targets, and to voluntary buyers who wish to reduce their carbon footprint.

To get a CDM project approved, the developing host country must agree that it contributes to sustainable development. The applicant must prove that the project would not happen otherwise (*additionality*), establish a *baseline* for future emissions in absence of the project, and determine the *leakage* of emissions moving to other areas or sectors due to the project. The project is validated by a third party agency, to ensure the emission reductions are real, measurable and long-term. Once the project is implemented and registered, the EB issues CERs. CERs trade as a commodity, with price historically ranging from € 7 to € 23, currently at around € 13. CERs that comply with the voluntary Gold Standard-scheme trade at a slightly higher price.

For smaller projects the process is simplified, using *small-scale methodologies*. To reduce transaction costs, projects can also be bundled for registration, validation and verification.

For projects that do not comply with CDM, or where the volume is too small to warrant the expensive procedure, the less stringent Voluntary Carbon Market (VCM) can be used, with lower costs, better prospects of approval but lower income. Voluntary offset retailers have developed the Verified Emission Reductions standards (VERs). Non-VER projects can still be sold, but cannot rely on established markets to find customers.

Keywords: cdm, carbon financing, CER, VER

The Human Rights Dimension of Climate Change: An Indigenous Face

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Abstract

Principle 1 of the Stockholm Declaration provides:

“Man has the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being and he bears a solemn responsibility to protect and improve the environment for present and future generations...”

Although this provision does not declare a right to environment it does show a link between human rights and environmental protection. It appears to view human rights as a fundamental goal and environmental protection as an essential means to achieve the “adequate conditions” for a “life of dignity and well-being” that is guaranteed.² When trying to understand the link between human rights and the environment it may be beneficial to think of it as deriving from the fact that human health and existence, legally protected as the right to health and the right to life, are dependent upon environmental conditions.

The discussion across the globe has been centered mainly on the effects that climate change will have on coastal resources, water resources, agriculture and health. This paper seeks to put a human face to the discussion by highlighting that climate change affects our basic human rights as global citizens. The right of many Pacific Islanders to live as indigenous people is slowly slipping from their grasp.

The objectives of this paper are to evaluate the link between human rights violations and climate change, to provide case studies illustrating the link and finally to consider whether it is the State or the international community that is responsible for addressing the issues of climate change and its impact on human rights.

² Kiss A C and Shelton D, 1997. Manual of European Environmental Law. Cambridge University Press. Pg 85.

New Renewable Energy Sources, Green Energy Development and Environment/Climate Change: Implications to Pacific Island countries

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Abstract

Energy use, green house gases (GHGs), global warming and climate change concerns, and the global fuel crisis are the critical energy sector challenges today. There is a greater need for changing the patterns of energy production and consumption. The global emphasis has been changing from an 'old' to a 'new' renewable energy sources and to a 'green energy' development in the face of climate change. More focus is on the use of 'biomass', 'bio-fuels', solar, wind and other non-traditional renewable energy sources. A 'green energy' development with a 'low carbon' and less harmful by-products has emerged as an alternative energy development strategy and a process of climate change mitigation. There have been persistent efforts in increasing energy efficiency primarily through 'new' renewable technologies in order to enhance the eco-efficiency of economy and in achieving a 'low carbon' development and environmental sustainability. A holistic and multi-disciplinary approach is however needed to understand the complex linkages between energy, environment and climate change.

The small Pacific Islands countries (PICs) are urbanizing faster and are heavily dependent on imported petroleum and the by-products and affected by the global fuel crisis. The PICs have potential for 'new' renewable energy sources and green energy development which will not only have impact on reducing dependency on petroleum and the by-products and mitigate the fuel crisis but also help lowering carbon emissions and improve the environmental quality.

The paper examines the 'old' vs. 'new' renewable energy resources for enhancing a green energy development in the face of climate change and explores the prospects of 'new' renewable energy sources and green energy development in the Pacific countries.

Keywords: Climate change, 'green energy', 'green growth', low-carbon development, new renewable energy source.

Is ecotourism climate-friendly? Revisiting the Namuamua Inland Tour in Namosi, 1990-7.

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Abstract

Anecdotal evidence indicated that from 1990-7, the Namuamua Inland Tour (NIT) ecotourism project was fulfilling its role as a mechanism for economic development in the inland regions of Namosi. It raised rural income levels, increased households' consumption expenditures and local entrepreneurship and improved family health and educational conditions.

Time management skills improved which resulted in some increases in labour productivity. This boosted an improvement in a community where labour is always in overabundant supply. Similarly, NIT was fittingly regarded as an engine for social and environmental development in a peripheral region in Fiji.

This paper revisits the NIT project. Using a literature method supplemented with a simple foot-print analysis of NIT clients, the paper argues that project is not climate-friendly as the finding shows that the average emission of CO₂ per dollar of NIT visitors is higher than higher-paid tourists in Nadi or Coral Coasts. This poses a dilemma for small islands that depend on ecotourism for sustainable tourism development and for decision-makers within these countries.

A large scale study with correct robust quantitative techniques would provide more information on the issues and may provide some durable means to addressing the dilemma in ecotourism and climate change.

Key words: ecotourism, peripheral, foot-prints, CO₂ emission, climate change, dilemma.

Session 9:
MISCELLANEOUS

Pacific Island Countries and Fuel Price Volatility: Smoothing the path to greater energy security

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Abstract

The energy sector is widely recognised as playing a fundamental role in achieving sustainable development in Less Developed Countries through facilitating economic development and improving access to basic social development needs for those living in poverty. For Pacific Island countries (PICs), fossil fuel based systems are the foundation of energy generation and although much has been done to develop and adopt renewable energy technologies, PICs still remain heavily dependent on fossil fuels and will be for some time. PICs have also been identified amongst those countries most vulnerable to fuel price volatility. The recent financial crisis and ensuing volatility in commodity prices has further raised the profile of fuel costs and security in the Pacific, particularly due to the impact on national budgets and economic development. In a regional response to these growing challenges, the Pacific Islands Leaders have committed their governments to the implementation of a bulk procurement of petroleum initiative which aims to improve the efficiency of purchasing petroleum in the Pacific. This regional initiative may bring about benefits to the Signatories but should be complemented by further policy changes to address the impact of fuel price volatility on their economies and consequently, sustained economic growth.

This paper will provide a review of the macroeconomic impact of high and volatile fuel prices and recommend that alongside participating in the bulk procurement project, governments should also focus their efforts on exploring policy solutions that will better address the issue of high, volatile fuel prices and its impact on the poor. It will also recommend that PICs consider the provision of incentives to curb fuel demand in non-key growth sectors and encourage energy diversification in order to reduce their dependency on fossil-fuels. The paper will conclude with a summary of how the *Framework for Action on Energy Security in the Pacific* could assist PICTs with this work.

Keywords: fuel, dependency, energy framework & price volatility

Pacific Island Countries' Petroleum Supply and benefits of Bulk Procurement Initiatives

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Abstract

Energy cost and security is one of the Pacific region's key priorities. The Pacific island countries (PICs) remain heavily dependent on fossil fuel based systems of energy generation. Petroleum imports account for well over 90% of those requirements overall where these are often environmentally and economically unsustainable and are not equitably available to remote populations. This dependency makes the PICs vulnerable to increasing and fluctuating global costs, along with the uncertainty of and security of supply which impacts on economic development. It is estimated that the total energy supply for PICs is growing at a rate of 3.8% per year and with the cost of petroleum imports, particularly when prices increase rapidly on international markets, places particular pressure on national budgets. In an effort to improve both security and the cost of petroleum supply to the region, Pacific Island Leaders have committed their governments to the implementation of a bulk procurement of petroleum initiative. This Pacific Petroleum Project (PPP) initiative is being run through the Pacific Islands Forum Secretariat (PIFS) with technical assistance from, Secretariat of Pacific Community (SPC). Hale & Twomey Limited has been appointed as the consultant to carry out Phase 1 of the Project. The current signatories to the Project (Signatories) are Cook Islands, Nauru, Niue, Republic of the Marshall Islands and Tuvalu although it is recognised that more countries may sign up to the initiative during the course of the project.

This paper provides background information on recent developments in regional petroleum markets. It will also highlight the current progress of the PPP project and the challenges of the signatories to enter into bulk procurement. It will conclude with a forward plan and a tendering toolkit to achieve the best outcome for the whole of a country's demand rather than only part of it, along with the opportunity to obtain synergies between countries.

Keywords: fossil fuel, bulk procurement & fuel price.

Effect of groundwater salinization and other climate related indices on sugarcane productivity

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Abstract

The disconcerting trend in the changes of temperature, sea level and rainfall trend reported by the IPCC (2007) is that the rate at which these changes are occurring is more rapid than in the past thousand years especially for Pacific Island Countries. IPCC (2007) projected that sea level may rise by between 18cm and 59cm by 2100 however, recent study have projected a sea-level rise of 1.9 m by 2100. The increase in the rate of ice meltdown will definitely lead to sea-level rise thus inundate coasts, cause shoreline erosion and groundwater salinization of low lying areas. In Tuvalu, groundwater salinization as a result of sea-level rise is destroying the swamp taro pit gardens (Webb, 2006) and raises concern on the safety of drinking water (Tekiene, 2000). A decline in rainfall or reduced irrigation water availability could put a serious limitation on crop productivity in a region (Lal et al. 1998).

The Sugarcane industry in Fiji is not exempted from the threat of climate change. The major concern of sugar production in Fiji relative to climate change is the sporadic sucrose content in the yield which could be affected with increase in temperature, groundwater salinization and fluctuating soil moisture content. This is an existing problem that has not been thoroughly researched and the lack of understanding on the link between climate variability and crop productivity together with global warming and its likely impact could seriously endanger sustained production in the future. Sugarcane totally depends on rainfall for water; climate variability has a major impact on the production and to a more extent the Fiji economy.

Given the present and anticipated impacts of climate variability on sugarcane, increased capacity for utilizing climate predictions in management decisions would be beneficial to the sugar industry. In light of the current trend and future projections of climate change this study is essential to explore the effect of temperature changes, groundwater salinization and rainfall on the future potential of sugarcane productivity in Fiji.

Keywords: Climate change, temperature, sea-level rise, sugarcane, rainfall

Power Generation from Bagasse in Mauritius

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Abstract

Sugarcane is crushed during the crop season in the sugar factory and the bagasse is sent to the power plant. The cane processed at the mills has a bagasse percent of about 35 % and the bagasse has a moisture content of 50% which is fed in the furnace. All the furnaces used in Mauritius are moving grate furnace. The grate moves from right to left. The temperature on the grate varies from 100°C to about 1300°C. The combustion of bagasse in the furnace converts the water in the boiler into a superheated steam. Steam leaves the boiler at a temperature of 525°C and a pressure of 82 bars. The superheated steam is fed to the turbine. The turbine is an impulse type extraction condensing one designed to rotate at 4600 rpm. It converts the thermal energy of the steam into mechanical energy. The rotor consists of 9 stages in which 7 are high pressure ones and the remaining two are low pressure stages.

Steam is extracted from the turbine at a pressure of 2.7 bar and temperature of 175°C during the crop season. The steam is sent to the sugar factory, feed water tank and steam Coil Air Heater. A second extraction is done at a pressure of 0.96 bar and 99°C. This is supplied to the low pressure (LP) heater which acts as a heat exchanger. The exhaust steam at 0.1 bar and 45°C is sent to the condenser.

On average, 1800 kg of bagasse is burnt to produce 1 MW of power. Around 20% of the power produced in the country is produced from bagasse.

During the intercrop season power is produced by burning coal instead of bagasse in the same facility. All the processes are the same except there is no extraction of steam for sugar factory consumption.

Keywords: Bagasse, combined heat and power

The Three (3) Pillars of Sustainable Development implies Continuity – are decision makers successful in giving practical legal effect?

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Abstract

This paper investigates the concept of *sustainable development* (SD), its emergence and definition. It then identifies some of the principles of *SD*, which integrates with the economic, social and environmental dimensions.

In identifying whether decision makers have been successful in giving practical legal effect to the three pillars, references are made to decisions of Courts and the domestic legislative framework from the Africa's, Europe and the Pacific Region.

What steps if any, have been taken and made by decision-makers to embrace the three pillars for Small Island Developing States, this paper attempts to also address.

Keywords: Principles of Sustainable Development; Agenda 21; Stockholm Declaration; Rio Declaration; FRASA; Barbados Programme of Action

A brief Review of the long term effect of Climate Change on the upper atmosphere and ionosphere – Space Weather Contribution

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Abstract

About 20 years ago, Roble and Dickinson [1989] reported that the global warming of lower atmosphere due to green house gases (GHGs) would result in the cooling of the upper atmosphere starting from 70km due infrared radiative cooling mainly by CO₂.

Carbon dioxide and other GHGs are optically thin for outgoing infrared radiation emitted by the Earth. Thus, the increasing concentration of CO₂ results in the cooling of the atmosphere above 70km (called ionosphere), and this effect is termed as “greenhouse cooling”.

Many communication systems utilize the ionosphere to reflect radio signals over long distances. The ionosphere acts as an efficient reflector with frequencies below about 30 MHz, allowing high frequency (HF) radio communication to the distances of many thousand kilometers.

The important factor for HF communication is that the characteristics of the F2 region ionosphere must be accurately predicted. The thermal cooling of the ionosphere would result in its contraction and result in an increase in the electron concentration at different heights. The strong Space weather events (Geomagnetic storms) contribute to the huge amount of energy deposition at the auroral latitudes which than propagates to the lower latitudes.

This paper will briefly review the long term changes in the upper atmosphere and ionosphere due to global warming arising from GHGs and space weather.

Keywords: greenhouse cooling, upper atmosphere, ionosphere, space weather

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| NAME/NAMES | SESSION (S) # | ORGANISATION | COUNTRY | ABSTRACT TITLE(S) | EMAIL |
|--|---------------|--|-----------|---|--|
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