The Cheapest Kilowatt: The Lessons of Energy Efficiency

The Hon. Tom Roper
Climate Institute
Email: troper@nyc.rr.com

The World's 51 Small Island Developing States (SIDS) and Territories are amongst the most vulnerable to the impacts of global warming despite the fact that they contribute almost nothing to the escalating growth of global greenhouse emissions – less than 0.02 per cent.

SIDS are characterized by small populations, limited resources, lack of economies of scale and financial and technical resources, remoteness, susceptibility to natural disasters, high dependence on and vulnerability to international trade. The pressures of climate change, particularly sea level rise and extreme weather events, add to often already stressed social, economic and environmental conditions.

Rapidly escalating petroleum prices threaten national energy security, damage precarious balance of payments and place huge pressure on individual, family, government and business budgets:

> The Small Island States can by promoting a clean energy environment set an example for the rest of the world. Too much of our national budgets are spent on fossil fuels for diesel generation of electricity. This is a drain on our national budgets and does not work towards a solution to the problems of climate change. When the tanker comes in the foreign reserves go out (Slade 1998, 14)

For Kiribati fuel imports are 30 per cent of GDP (Levantis, Groeger and McNamara, 2006).Rates for Island consumers are mostly above 30 cents/kWh, with 50 cents for the Cook Islands.

Electric utilities are major players in Island economies, enabling or damaging industry development, improved lifestyles and living standards. A badly run or ill prepared utility damages the economy, destroys opportunities and penalizes the less well off. In April the Pacific Energy Ministers Meeting said

Current levels of inefficient operation of many power utilities and distribution facilities in the region are unacceptably high. Efficient and transparent utility governance and pricing of energy and energy services are essential given ongoing dependence on fossil fuel, and high power losses (Ministers' Communiqué, April, 2007).

Pacific Island Countries should increase sustainable renewable energy initiatives, provide access to the seventy percent without electricity and improve energy efficiency by reducing energy losses and improving consumer behaviour. Most utilities are very small – the 23 Pacific Power Association members generate less than 940 MW of maximum peak demand – and lack professional, technical and financial skills.

A first step would be to follow the advice of the Rocky Mountains Institute Director, Amory Lovins, that there is no cheaper or cleaner power than that the utility doesn't have to produce. A case study is a 1992 analysis of the remote West Australian town of Broome with a maximum capacity and highest system load similar to many of the smaller SIDS (14MW and 8.3MW respectively). Most of the 25 suggested improvement were cost effective for either the utility or customer or both and reduced the maximum peak demand by nearly 20 per cent (1.7MW). Such action could avoid proposed system expansion, allow older equipment retirement or non use and cut operating costs (Energetics & State Energy Commission of WA, 1993).

The starting point is to examine every activity to reduce generation and transmission losses which are often an unacceptable twenty per cent or more. If they are halved one litre in ten would be saved. Performance needs to be bench marked and best practice highlighted and adopted.

As part of the Global Sustainable Energy Islands Initiative (GSEII) UNIDO commissioned a study of the Caribbean utility, DOMLEC (Beck, 2005). Net losses were 17.1 per cent and 3 suggested efficiency measures would save a third of all losses, produce annual savings of US$600,000, and cut 344,000 gallons of diesel and 3,740 tonnes of CO2. Other suggestions included modernizing the hydro scheme to increase production. DOMLEC charges exceed 30cts/kWh.

Table 1. DOMLEC 2005 Loss Reduction Study

	Net Generation	Net Losses	%	Annual Cost of Losses
2005	78,843,220 kWh	13,482,190 kWh	17.1	1,463,970 USD

Other comparatively small interventions can produce good results. CBM Radiators and the American Samoa Power Authority (ASPA) replaced corroding cooling systems and power required to run the station dropped by a third from 5.4 to 3.5 per cent – saving 300,000 kWh's monthly and $400,000 annually (personal communication).

Utilities should also examine fuel switching. Vanuatu's UNELCO has successfully substituted coconut oil for 10 per cent of diesel in one of its generators and has set a 30 per cent system wide target for 2010 – a real balance of payments boost (SOPAC, 2007). MAN, Watsila and others are developing biofuel capable diesels. Wind energy, solar power and hydro provide other opportunities.

There are a minimum of five energy efficiency principles: requiring energy efficient new buildings and encouraging retrofits; reducing heating, cooling and lighting loads; increasing the efficiency of appliances, heating and cooling equipment and ventilation; improving operations and maintenance; and replacing fossil fuel with "green" power.

Key features of "demand side management" programmes include compact and high efficiency fluorescent lighting; refrigerator, and air conditioner labeling and standards; commercial refrigeration and air conditioner equipment maintenance; energy audits, street lighting; solar hot water; and interruptible and time of use tariffs (SOPAC, July, 2007). Improved utility performance should be combined with working with customers to reduce their consumption.

This is most vital in the poorest countries where unnecessary power plant investments to run inefficient equipment divert scarce capital from basic needs such as access to electricity and clean water. Appliances are also far more likely to be wasteful.

The place to start is new and existing buildings. The Noble Prize winning International Panel on Climate Change (IPCC) said that the buildings sector accounts for 30 to 40 per cent of global energy use – 10 gigatonnes of carbon dioxide equivalent – growing a further 40 per cent by 2030 (IPCC Working Group 111 – Buildings, 2007). The IPCC said that by 2020 there was the potential to reduce projected global emissions from buildings by 29 per cent – the biggest and most immediate reduction available. Harvard's Professor John Holdren claims a third reduction of fossil fuel combustion is feasible through heating, cooling, refrigeration, lights and office equipment improvements.

A badly designed, electricity guzzling building will last for generations. Such is the case with the new Government Office Building in the world's most endangered nation, Tuvalu. Paid for by Taiwan it has been built without regard for tropical temperatures, with almost no shading or natural air flow – full sun on one side in the morning matched on the other side in the afternoon. The Tuvalu utility has had to install a new CO2 producing diesel engine, donated by the Japanese, to make it habitable. In contrast the new technical college and hospital buildings in the Marshalls capital, Majuro, designed by an Australian firm, have passive solar design, shading and air flow.

New building design in the US, UK and Australia can achieve energy and water reductions of up to 50 per cent. The southern hemisphere's largest public building, Parliament House Canberra, has cut electricity and gas usage by half since opening in 1988. The Clinton Initiative is developing a bank and energy efficiency company backed retrofit programme in 40 major cities, providing lessons and demonstration projects world wide. Too frequently the drive for the lowest initial building costs results in wasteful energy and water use for a building's life – purchase price versus operating cost.

Two excellent individual building examples come from a Canadian funded study carried out by Marbek Resource Consultants, Lewis Engineering and the Government of St. Lucia. Seven measures costing $187,000 (E.C.) achieved $90,750 annual savings, and a 2.1 year payback at the Village Inn and Spa. Five at the Victoria Hospital were costed at $143,000 (E.C.) to save $47,108 – a 3.1 year payback (Marbek & Lewis, 2004).

Victoria Hospital, St Lucia

Recommendation	Expected Annual Savings (E.C.)	Cost Estimate (E.C.)	Payback (years)
Lighting replacements	$12,532	$31,000	2.5 years
Replace electric water heaters with solar	$4,200	$12,000	2.9 years
Install solar DHW system for laundry	$13,014	$50,000	3.9 years
Replace air conditioners in high use areas	$17,352	$50,000	2.9 years
	$47,108	**$143,000**	**3.1 years**

MARBEK Resource Consultants Ltd.

Lewis Engineering

Village Inn and Spa, St Lucia

Measure	Cost (E.C.)	Annual Savings (E.C.)	Simple Payback (Yrs)
Lighting Upgrades	$27,400	$26,400	1.1
Solar DHW	$109,000	$23,000	4.7
Roof Insulation	$42,000	$33,600	1.25
Low Flow Showerheads	$3,900	$4,000	1.0
Bypass PRV	$1,000	$550	1.9
Weatherstripping	$3,900	$3,200	1.2
	$187,000	**$90,750**	**2.1**

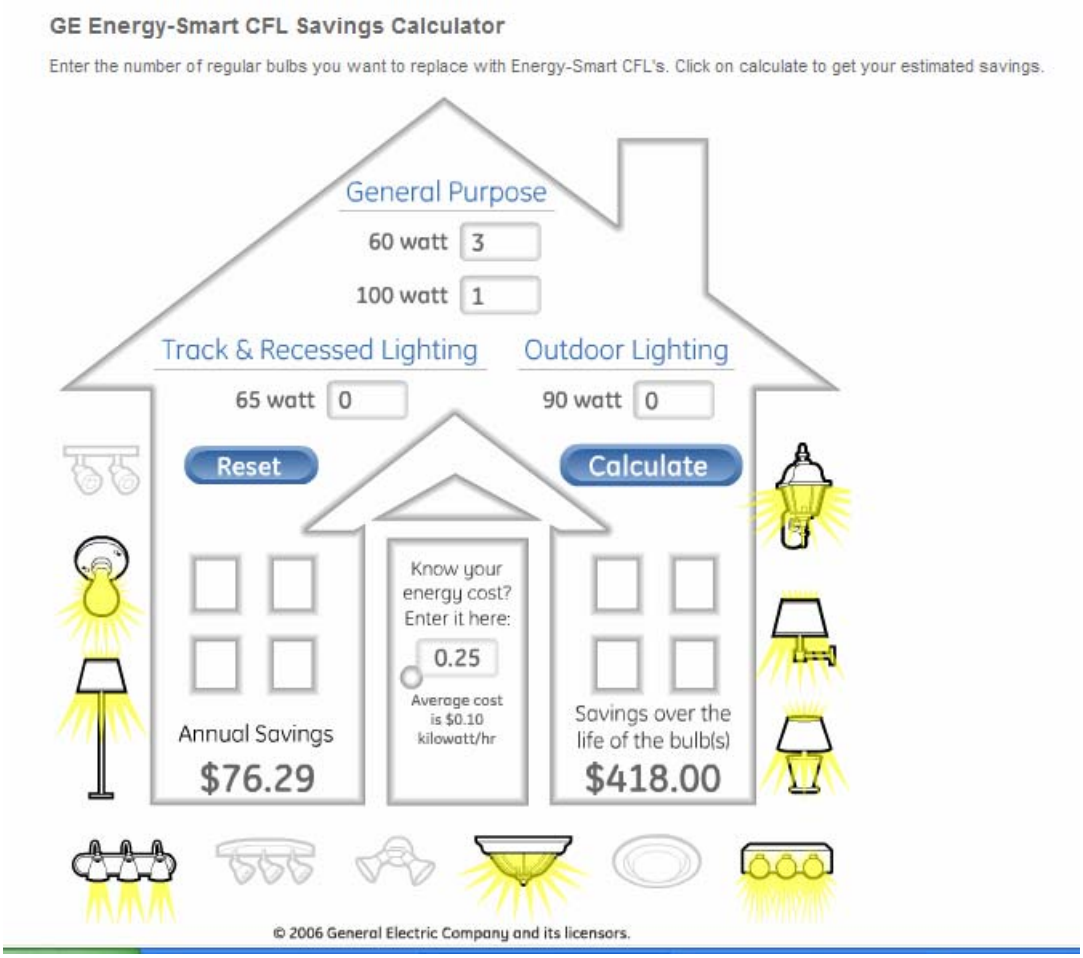
The Coco Palm Resort in the Maldives is implementing sustainable environmental practices which have reduced diesel use by 16,280 litres through key cards for lighting; natural airflow; natural light; lighting sensors; energy saving light bulbs; rainwater harvesting and reuse; and water saving taps (Green Globe 21, May 2004). Green Globe's web site has may other examples and promotes opportunities to exploit a 'green' image.

New and existing buildings will also have to take into account higher temperatures. BRANZ has prepared climate change scenarios for building and social impacts from both temperature change and extreme weather events. Auckland currently has 20 days 25C degrees or above and will see a significant increase by 2070. The range will be from 31 to 81 days (BRANZ, 2006). The cost of adaptation measures, particularly insulation, NZ$2.3b, would be more than offset by energy savings and other benefits.

For success in the SIDS at least nine steps will be essential: a Government and utility commitment to their own efficiency; regulations and import controls; customer examples and case studies; community education; the training of technical staff; setting up energy conservation businesses; budgetary and taxation incentives; private and public loan programmes and the international swapping of best practice examples and lessons learned.

At the UN CSD-15 in May the International Energy Agency's Paul Wade urged attention to life-cycle rather than initial costs: "using efficient products can result in electricity savings of around 40% for street lighting, 33% for home lighting, 35% for appliances and 295 for residential and commercial buildings" (ENB on the side, May 2nd, 2007).

Lighting alone makes up 19 per cent of global energy consumption (IEA Workshop, Paris). Compact Fluorescents face classical barriers of non – economic energy pricing, high up front costs, lack of awareness of lower running costs while producing higher quality lighting and reduced carbon emissions. The GE Energy Smart CFL Savings Calculator savings for a typical Marshall Islands, Majuro house with three 60watt and one 100 watt globes – paying 0.25 cents per kWh - were US$76.29 annually and US$418.00 over the bulbs' life. Nearly a tonne of CO2 was prevented (GE, 2006).



The Marshalls Energy Company in conjunction with Climate Care and the Climate Institute is currently installing 10,000 bulbs, funded by voluntary carbon offset purchases. Each bulb will save a half to three quarters of a barrel of oil, 225,000 litres of diesel, 6000 tonnes of CO2 and halve many individual's bills. The RMI Government has played its part by adopting an energy conservation policy and not charging import duty on the globes.

In East Timor the World Bank distributed 27,000 free CFL's to customers who had acquired pre paid metres reducing monthly bills (from $15 to $11), increasing consumer energy saving awareness and cutting fuel imports. Six hundred thousand CFL's in Uganda reduced peak load by 25MW, a quarter of the supply deficit (World Bank, 2006) Cuba has compulsorily replaced 8 million globes reducing maximum peak demand by 200 MW – a reasonably sized plant. Still most CFL's in the island stores cost $12 or $13 compared with an incandescent at less than $1.00.

The US EPA's website has detailed calculators for all manner of lighting and appliances. Life cycle usage reductions and savings for Energy Star appliances are often a third or more.

Examples include Central AC with savings of $9921 on Energy Star costs of $30,160; fan and lighting $1444 on $3662 costs; and computer and monitor $498 on $1,148. Kilowatt hours and CO2 savings can also be calculated totaling 59,437 kWh and 95,099 lbs of CO2 for the Central Air Conditioner. Savings as a percentage of the retail price were 248 per cent (www.energystar.org).

Appliance shops in most SIDS sell products which would not be allowed under developed country standards. In Fiji some Australian/NZ appliances, subject to mandatory energy labeling at home, are sold and the percentage of refrigerator and freezer energy labeling has increased. However buyers are very purchase price sensitive.

A joint study by the Australian Greenhouse Office and George Wilkenfield and Associates (AGO, 2006). concluded that a mandatory scheme would change the market, reduce electricity use by 8 per cent (9GWh/yr) by 2010 and 20 per cent (35 GWh) by 2020. Over 15 years the benefits of $37m plus, shared by the utility and all users would outweigh the $8m additional cost. Air conditioners and commercial refrigeration labeled elsewhere are also major Fijian users – half of all commercial use.

Many savings relate to installing more efficient motors and chillers, fans and installing insulation – not rocket science. In A Lewis Engineering report for the Organization of Eastern Caribbean States (2000) a new hotel chiller costing $22,980 saved 31% with a 3.3 year payback and ROI of 24%. Retrofitting the AC heat exchanger cost $11,914 with a payback of 0.4 years and return of 241%. Roof insulation returned 52% in 1.7 years. Regular tuning up and maintenance, without additional equipment cost achieves similar results.

Jamaica's power company retrofitted its own office lighting and HVAC at a cost of $630,000 halving its own consumption (OECS, 2000).
In addition to residential and tourism efficiency government and commercial offices need attention. Offices have become energy hungry. A computer and monitor left on for a year generates the same amount of CO2 as a car driven 3,400 kms. Last year the US EPA announced the details of 60 desktop computers, laptops and monitors which cut energy use, reduced toxics (cadmium, lead and mercury) and safely recyclable. In the US alone these EPEAT purchases will save 600,000MWh of energy, enough to power 6 million homes, and 13m pounds of hazardous waste. Printers spend 95% of their time idle; fax machines often left on continuously average an hour a day of use; and screensavers use power unless the monitor is turned off. Home electronics can be on standby between 16 and 22 hours per day and use between 1 and 20 watts on standby.

Changing to solar hot water, easy in most SIDS, was a key element in the 2 St. Lucian examples given earlier. Barbados is the world SWH capital with 32,000 installed in more than 40 per cent of properties including most hotels. Consumers receive full or partial tax deductions and imported material are duty free Apart from starting a local industry which has expanded to other parts of the Caribbean the annual balance of payments savings on imported fuel was $6.5m and individual savings of $16m - this at $25 a barrel not the current $100 (Sustainable Energy News, No. 30, 2000).

Most island utilities generate and transmit high cost diesel electricity (whether efficiently or not) and send out and collect their revenue. Occasionally government price controls forbid full cost recovery or capital upgrades. Boards, managers and staff do not see their possible role as energy savers, reducing their diesel use and cutting consumer consumption – higher sales are seen as a positive. A number of Caribbean utilities have reason to oppose energy efficiency because their profits are based on a 15% return on capital – the driver is to use

expensive diesel and encourage use. A Canadian investor's proposal for a wind farm on St. Lucia, whose utility was then controlled by the UK Government, was rejected by the Board – it could have reduced average production costs.

To move past the individual good practice highlighted in this paper government and utility policy must change, trained personnel be available, energy audit and service companies operate, education and awareness programmes develop and public and private investment harnessed. For instance government procurement repeats what has been purchased before - utility bills are regarded by Treasuries as unavoidable costs.

In Cuba as part of a wholesale change of their worn out system "an essential aim of our energy revolution is to create a new energy savings culture in the Cuban society" (Cuba, Current situation and Perspectives, OAS, Dominica, March, 2006). At all levels teachers offer subjects about the rational use of energy and the environment, "kids" make drawings, narrations, etc, regulations allow only efficient appliance imports which are being distributed and tariffs stimulate saving introduced (off peak).

The St. Lucian Government has run two energy weeks with Ministerial media statements, a newspaper supplement, seminars, an energy exhibition and school project competition.

SIDS lack qualified technicians, installers and trained professionals in design and business practices. Some of the most helpful aid could be the provision of basic and local training. Local distributors aren't aware of more efficient products and processes and have incentives going in the other direction.

A combination of audits recommending cost effective improvements and ESCO's designing, installing, maintaining and potentially financing savings opportunities will give rise to new industries as the SWH scheme has in Barbados.

Political commitment is essential because neither audits nor ESCOs are politically sexy. How much better to fund a solar or wind project which can be officially opened and which if it fails has long since vanished from the Donors view – a solar panel makes a better photo than a kilowatt not generated.

Most aid programmes ignore efficiency – the recent 200m Euro Energy Initiative funded new services in the mere 10 per cent for IDS for 10 new projects. We can only hope that the World Bank Sustainable Energy Finance Project which has the intention to bring cheap and reliable power to Pacific islanders will not only fund new power sources but encourage efficiency as well.

Of the 2000 plus UN sponsored Clean Development Mechanism projects registered less than ten are from SIDS and none have an efficiency thrust or component.

New policy needs to do both. There are numerous technologies to benefit islanders in all oceans ranging from photovoltaic ATM's in the Solomons, solar desalination in the Maldives to wind turbines in Jamaica, New Caledonia and the Galapagos. The giant French supplier, EDF, has developed a balanced policy in Guadeloupe with seven different renewable technologies and 44,000 households with energy efficient lamps.

Targets for the Pacific, and applicable elsewhere should include 25 per cent renewable energy; an improvement of 20 per cent in existing diesel generation and transmission; efficiency targets for motors, A/C, appliances and lighting; a reduction in public offices and buildings of 10 to 15 per cent immediately; reduced oil use for transportation and a doubling of village and outer island access to electricity (Roper, PPA, 2007).

Sustainable energy is not only an environmental necessity it makes economic and social sense.

REFERENCES

AGO & Wilkenfield G (2006).*The Costs and Benefits of Energy Labelling and Minimum Energy Performance Standards for Refrigerators and Freezers in Fiji.*Report, Canberra, AGO.

Beck R W (2005).*DOMLEC Loss Reduction Study,* UNIDO, Vienna.

BRANZ (2006).*Designing Homes for Climate Change.* BRANZ Ltd, NZ.

Cloin Jan (2007) *Liquid Biofuels in Pacific Island Countries.* SOPAC, Fiji.

Green Globe 21. *www.greenglobe.21.com.*

Lewis Engineering (2001). *Energy Audit of Victoria Hospital St. Lucia.* Paper presented to Government of St. Lucia, Castries.

Marbek, Lewis and the Government of Saint Lucia (2004).*Greenhouse Gas Emission Reduction in St. Lucia.* Report presented to Canadian International Decelopment Agency, Ottawa, Canada.

Inforse (2000). *Barbados employs the sun to heat water.* Sustainable Energy News, Issue 30, Copenhagen.

Levantis T, Groeger C, McNamara S (2006) *Are Pacific Countries Coping with Surging Oil Prices.* Pacific Economic Bulletin, Volume 21 No. 3,pp115-119.

Roper T W (2007) *Making Utilities and their Customers More Efficient.* Pacific Power Association, Majuro, Marshall Islands, slides 15, 28.

Slade N (1998). *Small Island States – Leading the Global Energy Revolution.* Climate Institute, Washington DC, pp14-15.

SOPAC, International Institute for Energy Conservation. *Demand Side Management: Best Practices Guidebook,* SOPAC, Fiji.

World Bank (2006) *Improving Lives.* World Bank, Washington DC. Pp20-27.