

# Independent Completion Report

## *Lighting Vanuatu*



Version: 3.0 Final

Date: August 2014

© DFAT Australian Aid 2014

This document is the property of DFAT Australian Aid.

It is permissible to copy and use any of the material in this report provided that the source is appropriately acknowledged. Further information is available from:

**Angeline K. Fatiaki**

Assistant Program Manager

Australia-Vanuatu Governance for Growth Program

DFAT Australian Aid

Vanuatu

Email: [angeline.fatiaki@dfat.gov.au](mailto:angeline.fatiaki@dfat.gov.au)

[www.vanuatu.embassy.gov.au](http://www.vanuatu.embassy.gov.au)

The views expressed in the evaluation are those of the evaluation team, and do not necessarily represent the views of the Government of Vanuatu or the Government of Australia.

## Acknowledgements

This Independent Completion Review would not have been possible without the dedicated efforts of the Vanuatu Energy Department and Australian Aid's Governance for Growth Program in Vanuatu. Sincere appreciation is also due to the Provincial Governments of Tafea, Malampa, Torba, Shefa, and Sanma for their assistance in facilitating field visits and community introductions.

The candour and constructive stance of all stakeholders (Government of Vanuatu officials, donor representatives, NGO representatives, and the private sector) were very much appreciated, as was the generous contribution of their time for interviews.

Lastly, the review must give credit to the communities on Tanna, Efate, Malekula, Epi, Santo and Mota Lava for their patience, generosity and hospitality to the team during field visits.

## Authors Details

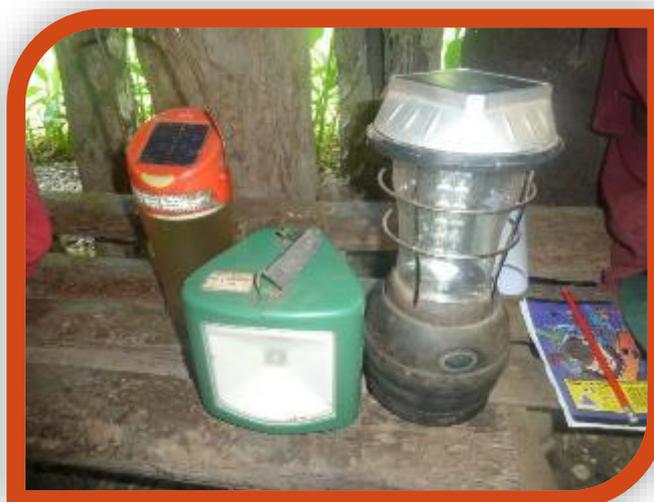
Authors contributing to this report include:

1. David Swete Kelly, Team Leader [david@rdsiconsulting.co.nz](mailto:david@rdsiconsulting.co.nz)
2. The Energy Cultures Group of the University of Otago: The Energy Cultures Team not only contributed to the ICR process itself but, over the longer term, will use the data for further research focused on understanding the interactions between energy supply, energy use, human behaviour, social processes, economic forces and environmental impact. While this work is beyond the scope of this ICR, DFAT appreciates the benefits of embedding the data with appropriate development research institutions. The Energy Cultures Team included (alphabetically):
  - a. Dr Adam Doering (Research Fellow) [adam.doering@otago.ac.nz](mailto:adam.doering@otago.ac.nz)
  - b. Dr Rebecca Ford (Socio-technical impacts) [rebecca.ford@ecs.vuw.ac.nz](mailto:rebecca.ford@ecs.vuw.ac.nz)
  - c. Cle-Anne Gabriel (Doctoral studies) [cleanne.gabriel@otago.ac.nz](mailto:cleanne.gabriel@otago.ac.nz)
  - d. Dr Sara Walton (Value Chain and business processes) [sara.walton@otago.ac.nz](mailto:sara.walton@otago.ac.nz)



## Executive Summary

*Lighting Vanuatu* commenced on 1 May 2010 as a two year project. It sought to address Vanuatu's "energy poverty" by increasing access by rural householders to handheld solar lanterns, thereby reducing household dependency on the use of kerosene for lighting. *Lighting Vanuatu* aimed to deliver at least 24,000 solar lanterns through the use of a supply-side subsidy. This subsidy aimed to:



- Improve upstream finance;
- Make solar lanterns more affordable;
- Reduce the geographic challenges posed by remoteness;
- Increase consumer awareness; and
- Improve product quality.

*Lighting Vanuatu* received Vt38.0m in grant funds. Funds were managed by the Energy Unit (now the Energy Department), and implemented by two Vanuatu NGOs already actively promoting and delivering pico-solar products throughout Vanuatu, albeit on a limited scale:

1. ACTIV (Alternative Communities Trade in Vanuatu); and
2. VANREPA (Vanuatu Renewable Energy and Power Association).

This ICR was tasked to look at the efficacy, efficiency and sustainability of the project, and involved extensive engagement with project stakeholders and beneficiaries through:

1. A survey of beneficiary households from 193 villages across 19 islands of Vanuatu; and
2. An in-country mission (10 to 23 November 2013) to further assess adoption patterns and the impact that small solar lanterns have had on rural family life.

Rural electrification and electricity needs are changing rapidly in Vanuatu. The advent of solar lanterns has occurred in parallel with a dramatic increase in the use of cheap electric generators, improved battery powered lanterns, and the rapid influx of larger photo-voltaic systems. All of these technologies have impacted on rural lighting and the sector is changing rapidly. However over its term *Lighting Vanuatu* has delivered:

1. **Solar lantern sales:** *Lighting Vanuatu* seems to have delivered twice its expected sales of solar lanterns. Frustratingly, more definitive claims are undermined by poor monitoring data.
2. **Adoption of Solar Lanterns:** More than 50% of households across the country now use solar lanterns. This massive change has occurred concurrently with a substantial reduction in the use of kerosene for lighting over the 2009 to 2013 period.

3. **Solar Lantern Distribution:** *Lighting Vanuatu* products now account for more than 90% of solar lanterns used by rural households; a finding that is remarkably consistent across the country, whether households are accessible or remote. The driving force behind these high levels of adoption has been the NGOs' capacity to tap into existing formal, semi-formal or informal networks already established across the islands. These partnerships are, however, very fluid – a situation that is likely to jeopardise ongoing access for those living in remote areas.
4. **Household Benefits:** Despite a wealth of more traditional outcomes associated with gender equality, improved education, financial savings, and community building, people see the greatest benefit of the portable solar lanterns as “*Isi nomo*” or “they’re just easy.” Household members, particularly women, greatly valued the various aspects of ease (convenience, safety, cleanliness, autonomy, affordability, simplicity, durability, brightness and mobility).
5. **Economic Benefits:** Solar lanterns have reduced ongoing monetary outlay for kerosene with annual savings estimates between Vt10,000 - Vt15,000 per household. Overall *Lighting Vanuatu* represents a six fold return on Australia’s investment.
6. **Social Benefits:** Women, children and the elderly are now more empowered in the management of energy use in the home. Most villagers found that there is now more opportunity to socialise, and, even though night time work has increased, most women talked about this in a positive, social sense – small groups of relatives or friends coming together to work on weaving, sewing or handicrafts in the evenings.
7. **Education Benefits:** Families regularly mentioned that children now undertake educational pursuits in the evening and boarding schools are now open to much more lenient student use of solar lanterns as the fear of fires is eliminated.

Overall, the introduction of solar lanterns has shifted the norms and aspirations of many rural Ni-Vanuatu communities. There is now an aversion to kerosene, with most people aspiring to further improve their solar household lighting - firstly with fixed lighting and phone charging, and then with systems capable of powering small appliances. In parallel with these aspirations, households see the ongoing need for access to bright portable solar lanterns.

Over the term of *Lighting Vanuatu*, consumer experience has also led to a better appreciation of product capabilities. One result of this has been a clear differentiation of the functions in the home that small solar lights are capable of filling. People now talk about different products for:

- Standby/emergency light;
- Mobile solar lights;
- Solar phone charging;
- Solar fixed light; and
- Fixed light and power.

Particularly for the small lanterns, people’s prime concerns focus on ongoing access and product information, rather than cost.

Clearly, *Lighting Vanuatu* was the ideal catalyst for the introduction of solar lanterns. However, its success, while planned, has also been serendipitous – it was the right assistance supplied over a



short enough period to catalyse and guide development. A little earlier or a little later and the outcomes would probably have been less relevant and therefore less justifiable.

While little further donor support to solar lanterns is needed per se, consideration could nevertheless be given to:

- Government or industry support to better information for consumers on product quality;
- Sustained support to improve access in remote areas; and
- Other ways of supporting household lighting in Vanuatu, particularly support for the proposed Vanuatu Rural Electrification Program (VREP).

However, any support should be based on a programmatic approach, and reviewed on an annual rolling basis. Timeliness, flexibility and close partnerships with both utility authorities and the energy private sector, will be essential.

The following quality ratings have been agreed for the *Lighting Vanuatu* Project.

Evaluation Criteria	Rating (1-6)
Relevance	5
Effectiveness	5
Efficiency	3
Monitoring and Evaluation	2
Sustainability	3
Gender Equality	4

## Consolidated Lessons Learned and Recommendations

Lesson	Description	Page	Follow up required
Lesson 1	<i>Lighting Vanuatu</i> has significantly exceeded its target of distributing 24,000 solar lanterns. The ICR estimates that in excess of 55,000 solar lanterns were distributed between 2010 and 2013.	6	Nil
Lesson 2	<i>Lighting Vanuatu</i> appears to have been the right catalyst applied at the right time, and has thus been a key driver in the rapid and widespread adoption of solar lanterns across Vanuatu (now >50% in rural areas). This has occurred in parallel with a significant reduction in the use of kerosene for lighting.	9	The Energy Department and Aid community should monitor ongoing and rapid developments. In particular the need for some form of ongoing support to sustain access in remote communities.
Lesson 3	ACTIV and VANREPA are by far the dominant suppliers in the solar lantern market, accounting for 90% of market penetration.	12	
Lesson 4	Alternative traders, while also supplying increasing numbers of lights, have networks that are largely concentrated in and around the major population centres.	12	
Lesson 5	The distribution partnerships established by <i>Lighting Vanuatu</i> (based on existing formal and informal networks) have been the driving force behind widespread adoption.	12	

Lesson	Description	Page	Follow up required
Lesson 6	Government and donor agencies must consider including geographical incentives in future projects that involve private sector and NGO partners in the distribution of solar products.	14	
Lesson 7	'Ease' was clearly a key driver in the rapid and widespread adoption of solar lanterns. Household members, particularly women, greatly valued the various aspects of ease (convenience, safety, cleanliness, autonomy, affordability, simplicity, durability, brightness and mobility). As such, it is suggested that "making people's lives a bit easier" should be considered a worthy development impact in its own right.	14	Where Australian Aid is supporting technological assistance "making life easier" (as broadly defined) should be an outcome as important as others (e.g. income)
Lesson 8	The benefits of small solar lanterns, while quite ubiquitous, were most apparent for women, the elderly and children who are now more empowered and independent in their use of lighting.	15	
Lesson 9	Conservative estimates of the economic impact of solar lantern adoption show savings alone are almost \$A3m per year nationally (or a six fold return on investment).	17	Nil
Lesson 10	Most women talked about the additional work they now undertake in a positive, social sense – small groups of relatives or friends coming together to work on weaving, sewing or handicrafts in the evenings.	18	The Energy Department and Aid community should monitor these impacts to ensure women's roles are not further burdened.
Lesson 11	The majority of broken or old solar lanterns currently remain in the home. Recycling and safe disposal information is not available. However, it seems likely that the availability of simple vocational electrical skills in remote communities would see many of these lights usefully repaired.	19	As renewable energy devices, and especially battery technologies, become more prevalent in rural communities, the Energy Department and local business sector should consider recycling incentives, as well as potential training / upskilling programmes for persons with basic electrical skills.
Lesson 12	All people interviewed aspire to further improvements in their household lighting – firstly with fixed lighting and phone charging, and then with systems possessing the power to operate small appliances.	20	Key donors focused on VREP (World Bank, NZAID and Australian Aid) should review the VREP design to ensure it embodies the flexibility and responsiveness needed
Lesson 13	With the increasing prevalence of solar lighting, the availability of different types of solar lights, and increased experience with the products and the	20	

Lesson	Description	Page	Follow up required
	opportunities created, households are differentiating their needs more clearly.		to be effective in a rapidly changing sector.
Lesson 14	While cost, access and knowledge are all important, those interviewed consistently mentioned that access and knowledge were the most difficult of the three, while de-emphasising the cost, particularly for the smaller or lower cost systems.	21	
Lesson 15	Any future assistance for rural electrification should be based on a programmatic approach and reviewed on an annual rolling basis to ensure its responsiveness and relevance in Vanuatu's rapidly changing environment. Timeliness, flexibility and close partnerships with both utility authorities and the energy private sector, will be essential.	22	
Lesson 16	No further general donor support for the small solar lantern market is considered necessary.	24	Nil

## **Contents**

<b>Introduction</b> .....	1
<b>Limitations Encountered</b> .....	4
<b>Relevance</b> .....	5
<b>Effectiveness</b> .....	6
Solar lantern sales.....	6
National Adoption of Solar Lanterns .....	7
Solar Lantern Distribution.....	10
Household Benefits.....	14
Economic Benefits .....	17
Social Benefits.....	18
Education Benefits.....	18
Environmental Impact .....	19
Changing Norms and Aspirations.....	19
<b>Efficiency</b> .....	21
Implementation Arrangements .....	22
<b>Sustainability</b> .....	23
Sustainability of the solar lantern business models .....	23
<b>Conclusions</b> .....	24
Evaluation Criteria Ratings.....	24
<b>Annex 1: Terms of Reference</b> .....	26
<b>Annex 2: Evaluation Plan</b> .....	33
<b>Annex 3: Person’s Met</b> .....	55
<b>Annex4: Ethics Approval</b> .....	62
<b>Annex 5: Aide Memoire</b> .....	77
<b>Annex 6: Case Study</b> .....	82
<b>Annex 7: Energy Transitions</b> .....	105
<b>Annex 8: Beneficiary Survey</b> .....	124

## List of Acronyms

<b>Acronym</b>	<b>Meaning</b>
<b>ACTIV</b>	Alternative Communities Trade in Vanuatu
<b>EU</b>	European Union
<b>GfG</b>	Governance for Growth
<b>GoA</b>	Government of Australia
<b>GoV</b>	Government of Vanuatu
<b>HH</b>	Household
<b>HIES</b>	Household Income and Expenditure Survey
<b>ICT</b>	Information Communication Technology
<b>M&amp;E</b>	Monitoring and Evaluation
<b>MC</b>	Managing Contractor
<b>MDG</b>	Millennium Development Goal
<b>MIPU</b>	Ministry of Infrastructure and Public Utilities
<b>MoE</b>	Ministry of Education
<b>MFEM</b>	Ministry of Finance and Economic Management
<b>MoH</b>	Ministry of Health
<b>MoL&amp;NR</b>	Ministry of Lands, Environment, Water Supply, Energy, Geology, Mines and Mineral Resources
<b>NSO</b>	National Statistics Office
<b>PAA</b>	Priorities and Action Agenda
<b>PIPP</b>	Pacific Institute of Public Policy
<b>REP</b>	Renewable Energy Provider
<b>SOPAC</b>	Pacific Islands Applied Geosciences Commission
<b>TNA</b>	Training Needs Assessment
<b>ToR</b>	Terms of Reference
<b>TVET</b>	Technical Vocational Education and Training
<b>URA</b>	Utilities Regulatory Authority
<b>VANREPA</b>	Vanuatu Renewable Energy and Power Association
<b>VERD</b>	Vanuatu Electricity for Rural Development
<b>VIT</b>	Vanuatu Institute of Technology
<b>VRDTCA</b>	Vanuatu Rural Development Training Centre Association
<b>Vt</b>	Vatu

## Introduction

According to the International Energy Agency, access to energy services is one of the keys to alleviating poverty, and as such is an "indispensable element of sustainable human development"<sup>2</sup>. Energy poverty, especially in rural areas is considered to be a significant constraint to achieving the Millennium Development Goals. The *Lighting Vanuatu Project* sought to address the foundation of such "energy poverty" in Vanuatu by increasing the access of rural households<sup>3</sup> to handheld solar lanterns (typically < 1.5 watts), thereby reducing household dependency on the use of kerosene for lighting. *Lighting Vanuatu* commenced on 1 May 2010 as a two year project<sup>4</sup>. Quality solar lanterns, which had become increasingly available by 2010, offered a relatively low cost and viable alternative to kerosene lighting. The *Lighting Vanuatu Project* was designed and funded by Australian Aid's Governance for Growth (GfG) Program based in Port Vila.



*Lighting Vanuatu* aimed to deliver at least 24,000 solar lanterns through the use of a supply-side subsidy. This subsidy aimed to improve the bulk purchasing power of suppliers, and thus reduce the cost of imported lanterns. Indirectly, the subsidy also sought to overcome:

- other barriers such as lack of upstream access to finance;
- the challenges posed by the difficulties of distribution in a nation of widely scattered and often remote islands;
- lack of consumer awareness; and
- poor product quality<sup>5</sup>.

All of these issues are common to similar development projects world-wide (e.g. *Lighting Africa*<sup>6</sup>).

**Table 1: Aid Activity Summary**

<b>Aid Activity Name</b>	<i>Lighting Vanuatu</i>		
<b>AidWorks initiative number</b>	INH523		
<b>Commencement date</b>	17 May 2010	<b>Completion date</b>	30 June 2014

<sup>2</sup> International Energy Agency (2013). *World Energy Outlook 2013*. OECD, EA

<sup>3</sup> The design called for 70% of lanterns to be distributed in the more remote areas outside of Efate Island and Luganville.

<sup>4</sup> Subsequently the project has received a number of no-cost extensions, and is currently scheduled to close on 30 June 2014.

<sup>5</sup> This results in consumer dissatisfaction and "market spoilage".

<sup>6</sup> *Lighting Africa*. (2013). *Lighting Africa Market Trends Report 2012*. Overview of the off-grid lighting market in Africa (<http://lightingafrica.org/lighting-africa-market-trend-report-2012-overview-of-the-off-grid-lighting-market-in-africa>).

<b>Total Australian \$</b>	Vt38,000,000 (approximately \$425K)
<b>Total other \$</b>	Vt1,744,354 <sup>7</sup>
<b>Delivery organisation(s)</b>	ACTIV and VANREPA
<b>Implementing Partner(s)</b>	Energy Department, Government of Vanuatu
<b>Country/Region</b>	Pacific
<b>Primary Sector</b>	Renewable Energy

*Lighting Vanuatu* has been managed by the Energy Unit (now the Energy Department) of the Government of Vanuatu, and implemented by two Vanuatu NGOs:

1. ACTIV (Alternative Communities Trade in Vanuatu); and
2. VANREPA (Vanuatu Renewable Energy and Power Association).

In 2010, both ACTIV and VANREPA were already actively promoting and delivering pico-solar products throughout Vanuatu, albeit on a limited scale. At the time these were the only active Vanuatu players in what is, in reality, a limited segment of the renewable energy technology market. Given their established presence and their willingness to source, promote and distribute solar lanterns, they were the logical partners for the *Lighting Vanuatu* project. *Lighting Vanuatu* hoped to further strengthen their capacity, and thereby make them long term sustainable players in the renewable energy marketplace.

Project funding was quite small at Vt38.0m<sup>8</sup>. Vt6.0m of this was managed by the Energy Unit for monitoring, evaluation and oversight purposes. The remaining Vt32.0m formed the subsidies to ACTIV and VANREPA.

Australia commissioned an Independent Completion Review (ICR) of *Lighting Vanuatu* as part of its standard quality processes. Full *Terms of Reference* for the ICR are outlined in Annex 1. In summary, the ICR aimed to determine:

- The degree of adoption of pico-solar products, and the specific contribution made by *Lighting Vanuatu* in facilitating this adoption;
- Any geographic, social or cultural trends evident in these adoption patterns;
- Any economic or social benefits – both overall, but especially for women and youth;
- Specific changes in the lighting technology used by households;
- Changes in household practices associated with any shift in technology;
- Any changes in householders' perceptions of solar lighting, and the use of lights more generally;
- Changes in householders' perceived needs and aspirations with regard to lighting, and electricity more generally; and
- The effectiveness and sustainability of pico-lighting products and the pico-lighting marketing/distribution chain.

---

<sup>7</sup> Vt2,911,840 in supplemental funding was provided to the NGO, Youth Challenge Vanuatu, to help them distribute solar lanterns in partnership with VANREPA. The original intention was to distribute 6,000 units, however VANREPA failed to supply sufficient stock. As such, YCV distributed 4,121 units and returned Vt1,167,486 in unused funds to GfG.

<sup>8</sup> Approximately A\$0.426m

A detailed Evaluation Plan was prepared and then used in the delivery of each element of the ICR (see Annex 2). The ICR included two key processes:

1. A survey of 1,436 beneficiary households from 193 villages across 19 islands of Vanuatu. The survey aimed to identify foundational data on household use, challenges and aspirations related to solar lanterns. It was also intended to help with targeting and questioning during the in-country mission (results of the survey are presented in Annex 8); and
2. An in-country mission (10 to 23 November 2013) to further assess adoption patterns and the impact that small solar lanterns have had on rural family life. Preliminary findings have been summarised in a post-mission Aide Memoire (Annex 5). In addition, the results of the mission are presented as a Case Study (Annex 6), as well as a deeper analysis of the changes observed from an “Energy Cultures” perspective (Annex 7)<sup>9</sup>.

During this mission the key informants included three main groups (see Annex 3 for a full list of informants):

1. the **Market/Distribution Chain**: Key informant interviews were undertaken with all stakeholders involved in the marketing of pico solar lanterns including:
  - a. VANREPA;
  - b. ACTIV;
  - c. Youth Challenge;
  - d. Vanuatu Women's Development Scheme (VANWODS Microfinance);
  - e. Telecom Vanuatu Ltd (TVL); and
  - f. Relevant others in the local private sector, including local renewable energy entrepreneurs; general traders, and local agricultural supplies stores.
2. the **Project Owners and other donors**: Key informant interviews were undertaken and data needs discussed with:
  - a. the Energy Department;
  - b. Vanuatu National Statistics Office;
  - c. Australian Aid;
  - d. the World Bank;
  - e. New Zealand Aid (NZ Aid); and
  - f. the Asian Development Bank (ADB).
3. **Beneficiary Communities**: Two main tools were used for community interviews:
  - a. Ethnographic enquiry, which included participant observation as well as household and key informant interviews in numerous villages across six islands (Tanna, Efate, Malekula, Epi, Espiritu Santo and Mota Lava). These islands were chosen based on a remoteness ranking that took into account both flight and shipping schedules to each island (see Table 8, Annex 2). One island from each “remoteness” class was

---

<sup>9</sup> The Energy Cultures Framework was developed by the University of Otago as a tool to help identify the key factors involved in human behaviour and changes in that behaviour. The framework outlines energy behaviour as a result of the interactions between material culture (i.e. energy related technologies, physical infrastructure, etc.), energy practices (i.e. how people, groups and communities interact with their material culture), and norms and aspirations (i.e. the beliefs and understandings that underpin material culture and energy practices).

chosen. Villages on each island were initially selected based on the number of survey respondents. Final village selection was, however, often influenced by logistical and Provincial preferences.

- b. Detailed focus group discussions with men, women and youth in each of the selected villages across the six islands.

The mission team included representatives from Vanuatu's Energy Department, Australian Aid's Governance for Growth Program, and the University of Otago, along with an independently contracted Team Leader. Four local enumerators were employed to act as cultural and language intermediaries between the ICR team and the respondents in the beneficiary communities.

All focus groups, as well as the interviews with the three proponents (i.e. VANREPA, ACTIV and Youth Challenge), were recorded and transcribed. For all other interviews, notes were taken and daily journals kept by each of the five members of the research team. In addition, a stakeholder workshop at the end of the second week presented preliminary findings. This was likewise recorded and transcribed in order for the feedback to be captured, and hence incorporated into the subsequent analysis and reporting. Ethics approval for the tools used in the ICR was provided by the University of Otago (see Annex 4).

## Limitations Encountered

The ICR process operated within the usual constraints of time and resources. Although no major problems were encountered, it has been necessary for the review to take into account the following limitations:

**Uncertain veracity of Beneficiary Questionnaire Survey Data:** As mentioned, the Survey Questionnaire undertaken by Australian Aid was returned by over 1,400 respondents from across Vanuatu. Analysis of the data showed, however, that variations in the way the survey was administered resulted in the sometimes unfortunate misinterpretation of some questions<sup>10</sup>. This misinterpretation has made some of the data unusable. However, the responses to the majority of questions are nonetheless quite robust. Also, the data was still useful for identifying initial trends, as well as for refining the targeting and questioning for the subsequent mission. In all areas of uncertainty, triangulation with field interviews was used for clarification.

**Limited Project Documentation and Reporting:** The design document for *Lighting Vanuatu* is brief – it includes little analysis of the problem, or of the preferred response. Moreover, the implementation of *Lighting Vanuatu* appears to have been quite dynamic and responsive – agreements, new proponents, and delivery have all evolved as the project has progressed. Hence, while Australian Aid has supplied all relevant documents, much of the evolutionary decision-making has been lost, particularly due to staff changes. In addition, the quality of record keeping and reporting of the three NGO proponents who received funding under *Lighting Vanuatu* varied considerably. Both ACTIV and Youth Challenge appear to have solid records, and thoughtful reports.

---

<sup>10</sup> The enumerators initially trained were engaged from the USAID Peace Corp. However, this team only generated about 100 completed surveys. In order to increase the number of respondents, GfG subsequently engaged largely church-based groups to administer the survey.

However, VANREPA has failed to meet the requirements for either its record keeping or its reporting. This limited the Evaluation's capacity to fully verify the data related to the supply chain and to the geographic distribution of pico-lights supplied through Australian support. However, it did not compromise the assessment of beneficiary household impact.

**Village selection:** Islands chosen for the field mission were selected on the basis of the 'remoteness ranking' reported earlier. On each island a number of villages were proposed, primarily based on the number of respondents to the initial beneficiary survey. However, given the limitations of time and transport, Provincial officials sometimes sought agreement for a different set of villages. Of the ten villages visited, no apparent selection bias has been detected.

## Relevance

In 2010 only 42% of Vanuatu's 47,000 households had any access to electricity, nearly all of these in urban areas where they were connected to the Government regulated grid<sup>11</sup>. Yet 75% of Vanuatu's households were living in rural areas, where only one in three rural homes, under half of the schools (42%), and one in four health facilities had some self-generated electricity. Hence Vanuatu - at 30% - had about the same level of rural electrification as Africa (29%). Moreover, when this is compared to the 2011 average reported for developing countries as a whole - 69%<sup>12</sup> - it is obvious that Vanuatu (along with many of its Pacific neighbours) has had a significant problem with "energy poverty" in rural areas. Projects such as *Lighting Vanuatu* were therefore hugely relevant as they addressed the need for rural people to have reliable access to efficient and safe lighting.

GfG's original vision for *Lighting Vanuatu* was for a small interim engagement to be implemented in parallel with the design of a more significant, longer term programmatic approach to renewable energy usage in rural Vanuatu<sup>13</sup> - the two engagements together were meant to form an integral part of Vanuatu's Energy Roadmap<sup>14</sup>. However, donor deliberations on the form of the larger program of support have not, as yet, been finalised, leaving *Lighting Vanuatu* to be more of a stand-alone engagement than originally envisaged. Nonetheless, the outcomes and lessons learnt will be of direct relevance to ongoing planning.

That said, rural electrification demand and technologies are changing rapidly in Vanuatu. As we will see in this ICR, the advent of efficient and affordable solar lanterns can be linked to a rapid decline in kerosene use for lighting. This, however, has not happened in isolation – the advent of solar lanterns has been paralleled by dramatic increases in the availability and use of cheap electric generators and larger photo-voltaic systems, as well as by improved battery-powered lanterns. All

---

<sup>11</sup> These are figures from the Household Income and Expenditure Survey (2010) of the Gov of Vanuatu's National Statistics Office. The main urban centres of Port Vila on Efate, Luganville on Espiritu Santo, and Lenakel on Tanna have electricity grids. Some other areas have mains electricity of sorts, such as the provincial centres in the provinces of Torba, Penama and Malampa. This is provided either by the provincial government or by community-operated electricity generators.

<sup>12</sup> <http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/#d.en.8609>

<sup>13</sup> Australia designed the Vanuatu Electricity for Rural Development (VERD) Program in 2012. Changes to Australia's funding priorities have meant that final donor arrangements for VERD are still under discussion.

<sup>14</sup> Vanuatu Energy Roadmap 2013-2020, Final Version, released Mar 2013.

of these technologies have impacted on rural lighting, while further changes can only be expected - the sector is still in a state of flux.

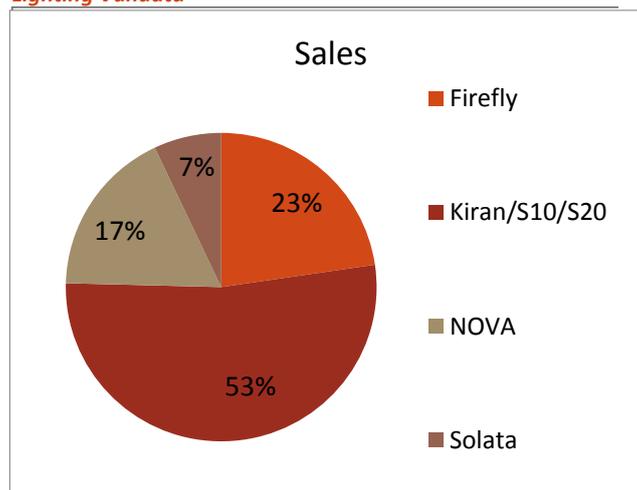
## Effectiveness

### Solar lantern sales

*Lighting Vanuatu* required ACTIV and VANREPA to obtain Energy Department approval for the specific products they distributed under the project. The approved products have included the following:

1. ACTIV distributed the Firefly lantern produced by BareFoot Power. This accounted for about 23% of products sold (12,908 units); and
2. VANREPA distributed three d.light products including:
  - a. The various iterations of the Kiran/S10/S20 (dominating the sales at 53% or about 30,000 units);
  - b. The Nova (accounting for 17% of sales or 10,000 units); and
  - c. The Solata (accounting for 7% of sales or 4,000 units).

**Figure 1: Relative sales of solar lanterns sponsored by Lighting Vanuatu**



As can be seen;

***Lesson 1. Lighting Vanuatu has significantly exceeded its target of distributing 24,000 solar lanterns. The ICR estimates that in excess of 55,000 solar lanterns were distributed between 2010 and 2013.***

Greater accuracy and certainty is not possible, given the poor record keeping by VANREPA.

ACTIV has audited sales for 12,908 units – about 40% (5,067) were sold directly, while almost 60% (7,476 units) were sold through a distribution partnership with Telecom Vanuatu Limited (TVL).

By contrast, it has been impossible to acquire accurate figures for VANREPA's sales. This is especially unfortunate given that VANREPA were apparently responsible for selling more than three quarters of the solar lanterns. Audit reports in April 2011 indicate that:

- VANREPA failed to distinguish between “*Lighting Vanuatu*” products and other solar lantern sales;
- reporting included sales made in the months prior to the commencement of *Lighting Vanuatu*;
- reporting failed to distinguish between the sales made by VANREPA (as an NGO) and the sales made by its trading arm “Green Power”; and
- VANREPA failed to keep inventory lists, sales receipts or effective accounts.

Such fundamental management shortfalls, seem to have contributed to the failure of VANREPA, which ceased to operate in 2013, and has since consolidated its now diminished resources under its “Green Power” operation. That said, the general feeling is that VANREPA was not trying to purposefully deceive; that the fault lay with its poor management skills. Even in its final report, VANREPA was still failing to grasp the importance of delineating its sales. They state:

*Since 2009, we have imported and distributed more than 40,000 solar lighting products. However, not all of these sales are within the scope of the AusAID funded project.*

At the time of the ICR (approximately 10 months after VANREPA’s final report was submitted) VANREPA’s manager indicated that 44,000 units had by then been distributed. However, the only verifiable sales were those made through Youth Challenge – this resulted in audited sales of 4,121 units. VANREPA, however, distributed many units directly. It also had a long relationship with the micro-finance group, VANWOODS. Yet the number of these latter sales is unclear.

Despite VANREPA’s extremely poor record keeping, there is strong support for VANREPA’s claims of a wide distribution, both from the Beneficiary Survey and all ten of the villages visited – 77% of survey respondents (n=1,077) indicated that they had a d.light product, all of which were imported by VANREPA. Field observations also confirmed the dominance of the d.light lanterns across all ten of the villages visited. As for the differentiation between solar lanterns that were part of *Lighting Vanuatu* and those that were not, it can now be considered an almost redundant point. The fact is the *Lighting Vanuatu* subsidy was essential to the solar lantern businesses of both ACTIV and VANREPA - all activities of these partners since mid-2010 have been strongly impacted by the initial subsidy and subsequent grant capitalisation. As such, the solar lantern businesses of both NGOs are heavily attributable to the *Lighting Vanuatu* partnership.

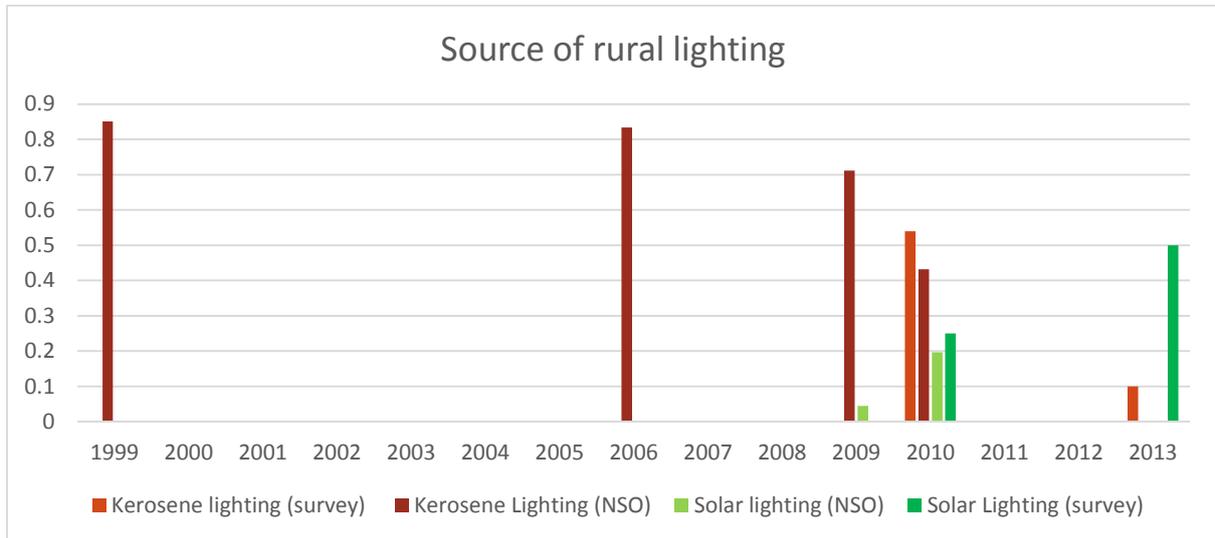
It must be stressed, however, that not all of the solar lanterns were available at the same time. At the start of *Lighting Vanuatu*, ACTIV quickly scaled up distribution of the Firefly through its Fair Trade network, selling substantial quantities in 2010/11. This earlier version of the Firefly, however, had a Ni-Cad battery and only lasted between one and two years. The Kiran lights, on the other hand, had a Lithium-ion Battery (LIB) with greater longevity (two to four years). Thus by the time of the mission, very few of the early Firefly products remained. In fact, the Beneficiary Survey showed that by 2012 the Firefly accounted for only 14.6% of the solar lanterns across Vanuatu. Clearly, at 77%, the Kiran and its d.light successors – the S10 and the S20 - have come to dominate the solar lantern market.

### **National Adoption of Solar Lanterns**

Whereas sales figures give some indication of adoption, the ICR also studied national adoption figures, as well as any apparent regional variations. Overall adoption figures for solar lanterns across

Vanuatu are derived from three sources: the National Statistics Office (NSO), the Beneficiary Survey, and field observations. Two sets of NSO figures help define the level of adoption: firstly, the NSO has been tracking the reduction in the use of kerosene for lighting since 1996<sup>15</sup>. Secondly, the NSO has, since 2009, been collecting specific data on the incidence of solar lighting products<sup>16</sup>. This data is summarised in Figure 2<sup>17</sup>.

**Figure 2: Changes in kerosene and solar use for rural household lighting**



As can be seen, increased use of solar lanterns has occurred concurrently with a massive reduction in the use of kerosene for lighting over the 2009 to 2013 period<sup>18</sup>. In 2006, 83% of rural households used kerosene for lighting. By 2010 about 50% of rural households used kerosene for lighting<sup>19</sup>. By 2013, both ICR field observations and stakeholder interviews indicate that less than 10% of households were still using kerosene (ranging from zero to about 20%). The reduction in kerosene use in **rural** areas is relatively uniform across the country, showing little significant regional variation.

Solar lighting, on the other hand, rose from about 4% in 2009 to over 25% in 2010 and has continued to rise ever since. The rapid increase in solar lantern use in 2010<sup>20</sup> coincides with the

<sup>15</sup> Falling kerosene use, particularly in rural areas, is strongly correlated with the increasing incidence of solar lights and domestic generators.

<sup>16</sup> Figures include both solar lanterns and photovoltaic systems. The use of the more substantial PV systems is, however, a small percentage of the figures.

<sup>17</sup> NSO data includes the 1999 Census; the 2006 Household Income and Expenditure Survey (HIES); the 2009 Census; and the 2010 HIES. Hence the final figures given for 2013 are estimates determined via the ICR Beneficiary Survey and the Village interviews.

<sup>18</sup> While these figures arise from different sources and different methodologies, the general trends are very consistent.

<sup>19</sup> Estimates range from 42% (HIES) to 54% (Survey). This latter figure is, however, probably the less accurate, as it required respondents to recall their use in 2010.

<sup>20</sup> The HIES was conducted between late November 2010 and January 2011.

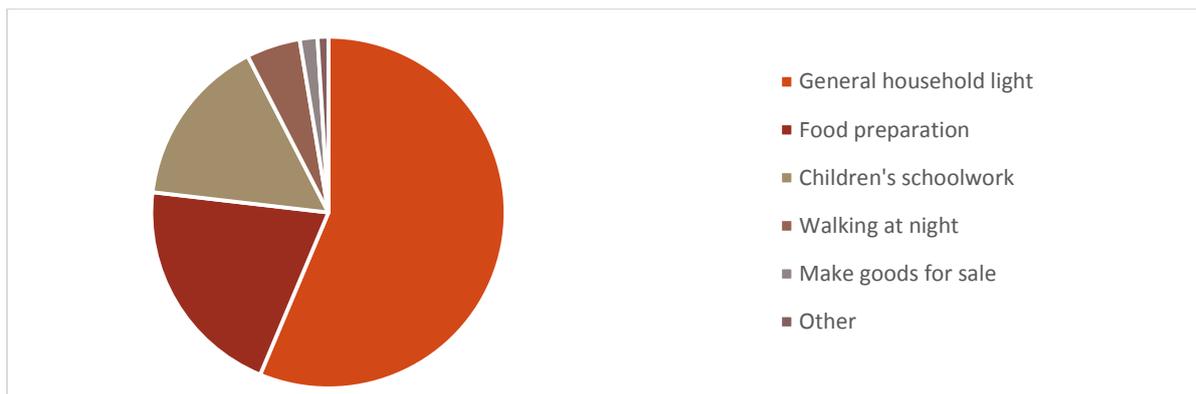
commencement and early sales of *Lighting Vanuatu*<sup>21</sup>. The ICR team conservatively estimates that well over half of all rural households now use solar lanterns.

***Lesson 2. Lighting Vanuatu appears to have been the right catalyst applied at the right time, and has thus been a key driver in the rapid and widespread adoption of solar lanterns across Vanuatu (now >50% in rural areas). This has occurred in parallel with a significant reduction in the use of kerosene for lighting.***

At the time of the Beneficiary Survey in 2012, the majority (85%) of homes with solar lanterns were still using their first unit. Most households had one lantern, although (unsurprisingly) wealthier families<sup>22</sup> tended to have two or more.

56.5% of survey participants use their lantern for general lighting purposes; 20.5% predominantly for food preparation; and 4.9% for walking at night. 15.6% of householders responded that its main use is for children's schoolwork. However, 54% indicate that the main user is 'all the family', with only 15% saying that the main user is a child.

**Figure 3: Main use of solar light**



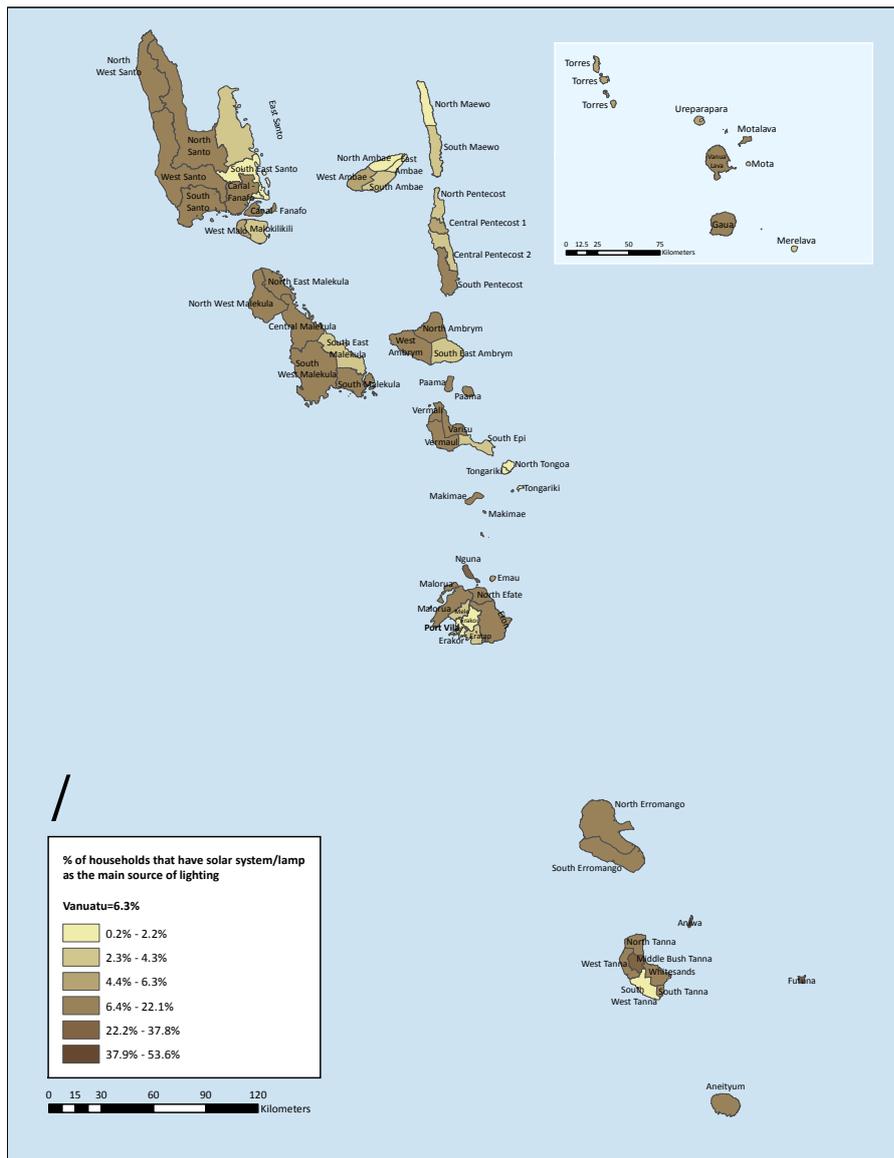
Interestingly, there seems to be no significant regional variations in the overall adoption patterns. Even in 2009, the Vanuatu Socioeconomic Atlas<sup>23</sup> shows relatively uniform adoption patterns for solar lighting (albeit at very low levels) - Figure 4.

<sup>21</sup> ACTIV sold 4,757 units between Jun and Oct 2010; verified data from VANREPA is not available, but they claim to have sold in excess of 10,000 units over the same period.

<sup>22</sup> As indicated either by metal roofing or a greater number of rooms in the house.

<sup>23</sup> To be released in 2014

Figure 4: Percentage of households that had solar lighting in 2010 (National average 6.3%)



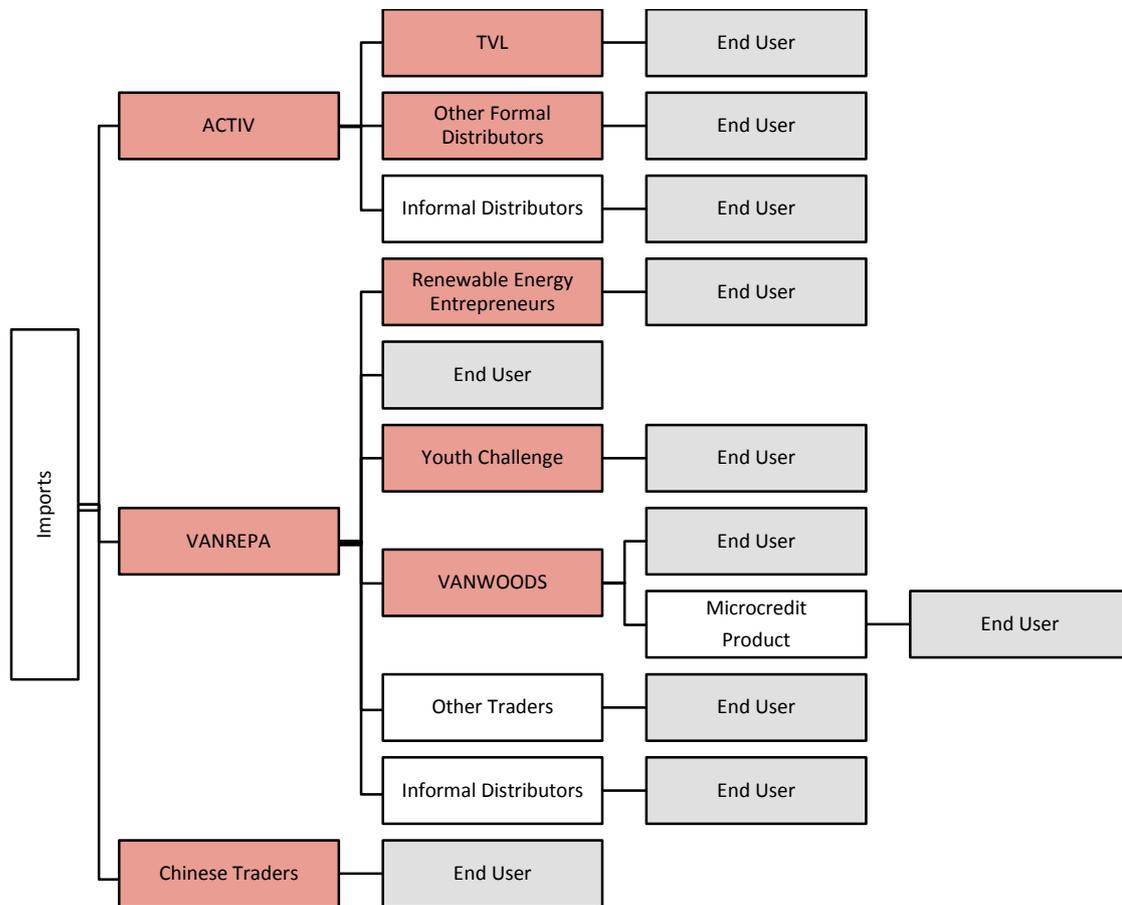
By 2013, the Beneficiary Survey revealed much higher, but still relatively uniform adoption levels across the country. These findings are corroborated by the HIES data in 2010, and the field visits in 2013.

### Solar Lantern Distribution

One of the key outcomes of the Lighting Vanuatu project was the distribution of the lights throughout the country in considerable numbers in a short time. The uptake of the technology was rapid and extensive. It would seem that a vital part of the transition process were the informal networks already existing within Vanuatu that we suggest maintain a sense of community throughout the country. The circulation of knowledge and people through the many islands enabled the lights to be talked about and distributed widely. Using known NGOs with already established networks in a country where networks of people are key communication channels was a major key to the success of this project.

ACTIV and VANREPA used different distribution chains (see Figure 5), although the two chains inevitably involved significant local partnerships.

Figure 5: Lighting Vanuatu distribution chains



1. For ACTIV this included the use of their already-established Fair Trade wholesaler network, although they also benefitted greatly from their partnership with Telecom Vanuatu Ltd (TVL). TVL was particularly interested in the Firefly because of its capacity to charge mobile phones, and its relatively cheap price (when compared with the commensurate d.light product, the NOVA).
2. For VANREPA, distribution included very effective partnerships with VANWOODS (a micro finance group) and Youth Challenge Vanuatu<sup>24</sup>, these being partners able to tap into their existing distribution channels within the country. These groups were responsible for the significant expansion of VANREPA's distribution network, especially to the outer islands. However, VANREPA also distributed units through direct, point-of-sale contact via its trading arm, Green Power. This included wholesale distribution to other retailers (e.g. Greentech), both locally and more remotely.

The differing strengths of ACTIV's and VANREPA's distribution networks resulted in differences in product prevalence across the different islands (Figure 6). As seen from this 2012 Beneficiary Survey

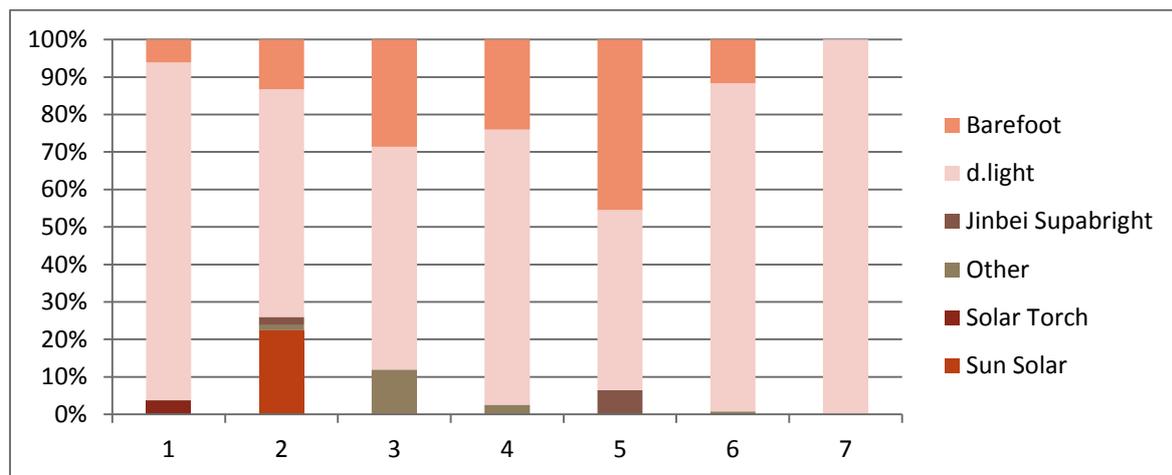
<sup>24</sup> Youth Challenge's engagement with the project was separately supported by Australian Aid.

data, the VANREPA units are more common than ACTIV products, even more so in the remotest areas.

***Lesson 3. ACTIV and VANREPA are by far the dominant suppliers in the solar lantern market, accounting for 90% of market penetration.***

***Lesson 4. Alternative traders, while also supplying increasing numbers of lights, have networks that are largely concentrated in and around the major population centres.***

**Figure 6: Prevalence of solar light brands across Vanuatu (1= less remote; 7 = very remote)**



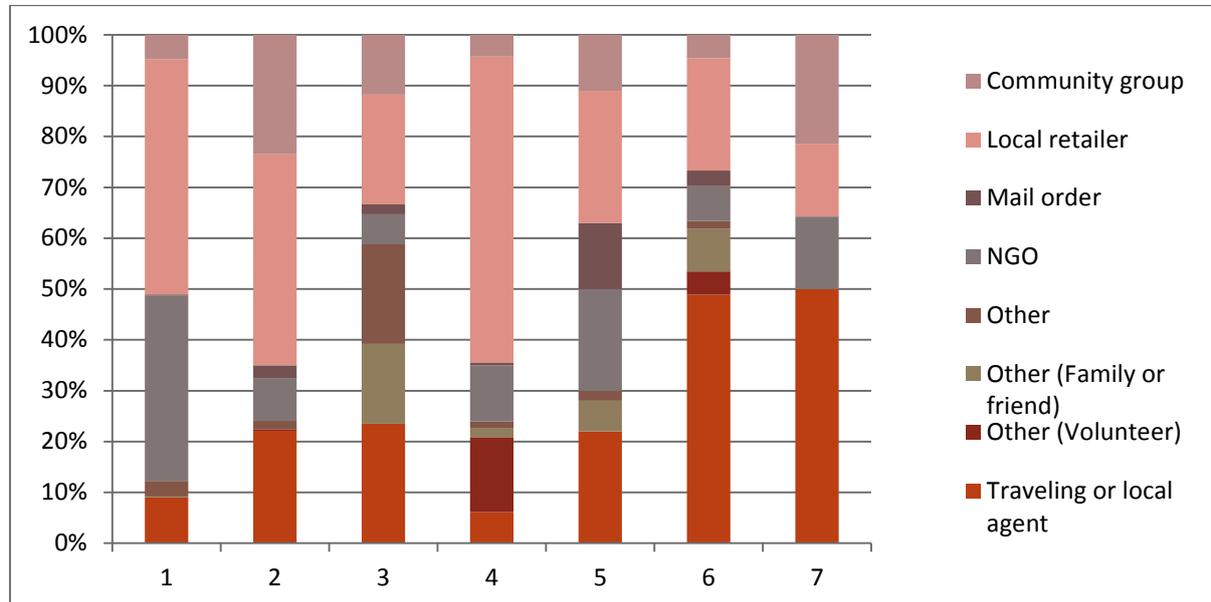
One of the key lessons is that the more effective distribution models arose from fitting into the cultural norms and thus tapping into networks already established across the islands, whether these were formal, semi-formal or informal. Another is that tapping into informal and semi-formal networks proved essential, especially for the more remote areas which often lacked formal distribution networks – the less formal networks exist and evolve because of social, information, trade and exchange benefits. Hence it is largely within these networks that knowledge and people are circulated through the islands, enabling the lights to be talked about and widely distributed. It is quite clear then that establishing a parallel distribution network would have been both cumbersome and risky. Conversely, using known NGOs with already established networks, in a country where networks of people are key communication channels, has been a major key to the success of the project.

***Lesson 5. The distribution partnerships established by Lighting Vanuatu (based on existing formal and informal networks) have been the driving force behind widespread adoption.***

As seen in Figure 7, households in remote areas (remoteness ranking of 6 or 7) depended less on local retailers and more on informal networks - particularly travelling or 'local' agents - to distribute lights. As seen in the survey, when people made decisions to purchase solar lights, they tended to turn to family and neighbours for information (68.9%). Agents and shops were also used as a source of information, but very few participants turned to the TV (1.6%), the radio (1.9%), the newspaper (3%) or fliers (0.7%) for advice.

Both ACTIV and VANREPA used *Lighting Vanuatu* grants to fund travel to remote areas to either distribute lights directly<sup>25</sup>, or establish links with locals who could act as these 'local agents'. This was clearly essential if access was to be gained to the more isolated areas.

**Figure 7: Sourcing of solar lights based on remoteness (1= less remote; 7 = very remote)**



All of the formal partnerships (see pink boxes in Column 3 of Figure 5) have been of limited duration, none being still active at the time of the ICR. In the case of VANREPA, poor management, supply inconsistencies, and struggling finances were the causes of both Youth Challenge and VANWOODS losing confidence in sustaining the partnership. For ACTIV, difficulties in accessing the latest Barefoot models at competitive prices caused the partnership to sag because of supply delays. All the same, ACTIV is currently assessing other products that might rejuvenate its business. Notably, ACTIV and TVL remain in discussions.

Such difficulties are, however, somewhat balanced by a developing private sector response to increased demand. Since their connections to *Lighting Vanuatu* ceased, ACTIV and Green Power have both established a number of new distribution partnerships including:

- other renewable energy suppliers;
- local and national traders and agricultural input suppliers; and
- telecommunications groups.

It is unfortunate, however, that there is no longer an economic incentive for suppliers to distribute to the more remote communities. A constant complaint from these communities during the ICR was that they can no longer access lights now that *Lighting Vanuatu* support for the remote travel of agents has ceased. Even those who have acted as 'local agents' are finding it increasingly difficult to maintain their connections.

<sup>25</sup> VANREPA pointed out that travel costs to the very remote areas were insufficiently resourced. Without ongoing support distribution in remote areas will dwindle.

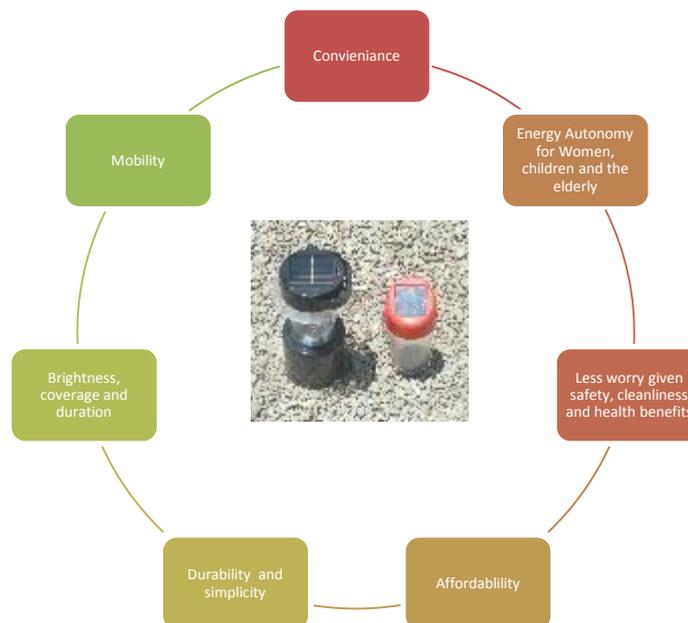
**Lesson 6. Government and donor agencies must consider including geographical incentives in future projects that involve private sector and NGO partners in the distribution of solar products.**

### Household Benefits

During interviews and as seen in the survey results, it quickly became apparent that one of the primary benefits of small solar lanterns is that they make life just that little bit easier. Despite a wealth of more traditional outcomes associated with gender equality, improved education, financial savings, and community building, many of the beneficiaries of *Lighting Vanuatu* saw the greatest benefit of the portable solar lanterns as “*Isi nomo*” or “they’re just easy.” On the other hand, the word ‘easy’ was never associated with solar panels, and indeed observational evidence suggests that the level of involvement required by solar panels is anything but ‘easy’.

**Lesson 7. ‘Ease’ was clearly a key driver in the rapid and widespread adoption of solar lanterns. Household members, particularly women, greatly valued the various aspects of ease (convenience, safety, cleanliness, autonomy, affordability, simplicity, durability, brightness and mobility). As such, it is suggested that “making people’s lives a bit easier” should be considered a worthy development impact in its own right.**

Figure 8: Key benefits of solar lanterns identified by households



As Elizabeth Shove<sup>26</sup> describes it, a technology's convenience, comfort and cleanliness have been key aspirations that have produced "the locking in of technologies and practices as [people] move along a path dependant trajectory of socio-technological change."

The diagram below reflects the primary features that Vanuatu communities consistently mentioned when discussing the 'ease' and other benefits associated with solar lanterns (especially in comparison with kerosene lanterns).

### Convenience

By far the most commonly mentioned reason for solar lanterns being 'easy' is their convenience. This is especially so when the lanterns are compared with kerosene lighting, for which time and effort is needed to fill, light, trim and protect the flame. Lighting for any night-time activity (cooking, fetching water, cleaning, reading, baby care, toileting, tending the sick, etc) is now a simple operation involving the press of a button. Convenience, then, seems to be the major driver for solar adoption, and the rapid substitution of kerosene lamps.

### Energy Autonomy for Women, the Elderly & Children

Within the communities visited, the benefits of small solar lanterns, while quite ubiquitous, were most apparent for women, the elderly and children. Inevitably perhaps, it was women who were most impassioned about the benefits of such lights in the home – clearly, it is largely women who instigate the purchase of solar lanterns and take responsibility for the lights, ensuring they are placed in the sun for charging, and protected from the elements. This means that women are now playing a greater role in the management of a household's energy and lighting than they generally have in the past. Previously, they were often forced to wait for their husbands to return from the store with fuel in order to start the generator or light the kerosene lamp. Furthermore, the worry associated with children, the elderly, or other vulnerable people handling kerosene lamps has now been eliminated. This allows for their much greater independence, which is a benefit for all.

***Lesson 8. The benefits of small solar lanterns, while quite ubiquitous, were most apparent for women, the elderly and children who are now more empowered and independent in their use of lighting.***

---

### Safety, cleanliness and health

Overall, there is great "peace of mind" associated with solar lanterns. They are safer, cleaner, and altogether healthier than kerosene lamps. Solar lanterns completely eliminate the fear of kerosene lights falling down, causing fires, or blowing out during wind, storms, or because of general household activity. As mentioned, children, the handicapped and the aged are all able to use solar lanterns without concern. Solar lanterns have also had broader community benefits – an example is the midwife in Mota Lava who can now attend reasonably well-lit night-time deliveries, rather than relying on kerosene or the feeble light of a cell-phone torch.

The elimination of kerosene in the home has had many safety benefits. Data on house fires is limited, but anecdotal comments consistently referred to a reduction in household fires (and a

---

<sup>26</sup> Shove, E. (2003). Converging conventions of comfort, cleanliness and convenience. *Journal of Consumer Policy*, 26(4), 395-418.

concomitant reduction in property loss and personal injury). Many households also reported that the shift to solar removed the “unpleasant smell of kerosene” – the use of solar eliminates the indoor air pollution associated with the burning of fossil fuels for light.

### **Affordability**

There are usually no further costs associated with a solar light once its upfront cost is dealt with, unlike the consistent financial outlay, and the significant time commitment needed to source kerosene/fuel. Solar lanterns are therefore considered affordable by most households, and payback periods are relatively short (1-2 months). It is only the very underprivileged who cannot self-fund the purchase price.

Many families also commented on the elimination of the stress associated with the regular purchase of kerosene. Kerosene required continuous engagement with the marketplace through constant monitoring of its supply and price, as well as regular trips to the fuelling stations. This was especially so in remote rural communities - a lighting source comprising a one-time capital expense was seen as preferable to dealing with the on-going variable cost and supply of kerosene fuel.

### **Durability and simplicity**

Again, when compared with kerosene lanterns, the durability of the better quality solar lanterns is seen as a key benefit. Dropping or tipping a kerosene lantern results in almost inevitable damage, while good quality solar lanterns survive everyday household handling with relative ease.

Furthermore, many households now easily distinguish between the products endorsed by the *Lighting Vanuatu* project, and the more fragile products imported from China. In addition, there is a growing appreciation of the durability of improved battery technology (LIB) that is now universally found in the *Lighting Vanuatu*-endorsed solar lanterns.

The issue of durability also reflects consumer preference for products with no removable parts. The Kiran/S10/S20 are particularly well liked because there are no parts to get lost; they are an all-inclusive unit. On the other hand, it was commonly commented that the Firefly – with its separate panel, cables and connectors – was not so appropriate to the chaos of family life.

### **Brightness, coverage and duration**

There is a growing consumer appreciation of product specifications such as brightness, coverage and duration. The brighter the better for most household night-time tasks. Yet while almost any solar lantern is appreciably brighter than a kerosene lamp, there is a considerable differentiation between the brightness of competing products. For example, the newly introduced d.light S2 is in high demand, not only because of its compact size and competitive price, but also because it has a brighter light that can fill a room more effectively than the S20. Complementing the issue of brightness is the coverage of certain lights.

The duration of the light is - surprisingly - not as important an issue as it might be considered in theory. Provided a light exceeds three to four hours on a single charge, then it is considered functional for most purposes. Also, people tend to use the solar lanterns more freely than they would candles or kerosene, as it costs nothing to run them. People feel free to use them not only when they are needed, but anytime they want to.

### Mobility

Lastly, the mobility of solar lanterns is also a key benefit. Their capacity to be easily and safely moved, both inside and outside the home, opens up a wealth of opportunities for all members of the family. So much so, in fact, that in many households an easily mobile solar lantern continues to be used and valued even after the installation of an upgraded fixed PV lighting system. For example, one Provincial official noted that even though his village has since become connected to the grid, he still has a solar light to go fishing at night, looking for shellfish, or digging for kava. Another informant reported how the solar lanterns were being used during inter-village events for food preparation, as well as for walking home in the dark.

Many communities also noted that this ease of mobility is linked to improved resilience – a safe, relatively long-lasting, and durable lighting source is now available in times of emergency, such as cyclones, floods and earthquakes.

### Problems

While the majority of the comments were positive, some were not. Most negative comments concerned how the lights stop working. As seen in the survey, 17.9% of respondents had had to get their solar light repaired; 38.5% of respondents who had their lights repaired did it themselves, whilst the rest mainly employed local tradesmen (29.7%), or took it back to the place of purchase (20.3%). There was also considerable awareness that getting the lights wet was the main cause of failure. One village in Tanna showed how they wrapped the lights when charging to stop condensation. Others reported the need to find dry places to charge the lights on wet days. Yet despite the limitations of the technology, ways of dealing with such issues are being both found and variously adapted into everyday practices and routines.

### Economic Benefits

The transition to solar lamps has had two economic household benefits. Firstly, there is the obvious reduction in ongoing monetary outlay associated with the transition to the solar lanterns. Kerosene costs for lighting typically averaged around Vt50 per day, or Vt18,200 per year (although some respondents reported up to twice this i.e. Vt100 per day). As portable solar lanterns retail in Vanuatu for between Vt1300 and Vt5000, and last for up to 4 years depending on brand and model, it is clear that significant savings are possible (annual estimates typically ranged between Vt10,000 and Vt15,000<sup>27</sup>). Conservatively, if solar lantern adoption is estimated at 50% of households in rural areas, then fuel savings alone would be almost \$A3m per year nationally (or a six fold return on investment). This, however, should not be interpreted as “savings” transferrable to other costs – for many rural households in Vanuatu the mobilisation of cash occurs on an as-needed basis.

***Lesson 9. Conservative estimates of the economic impact of solar lantern adoption show savings alone are almost \$A3m per year nationally (or a six fold return on investment).***

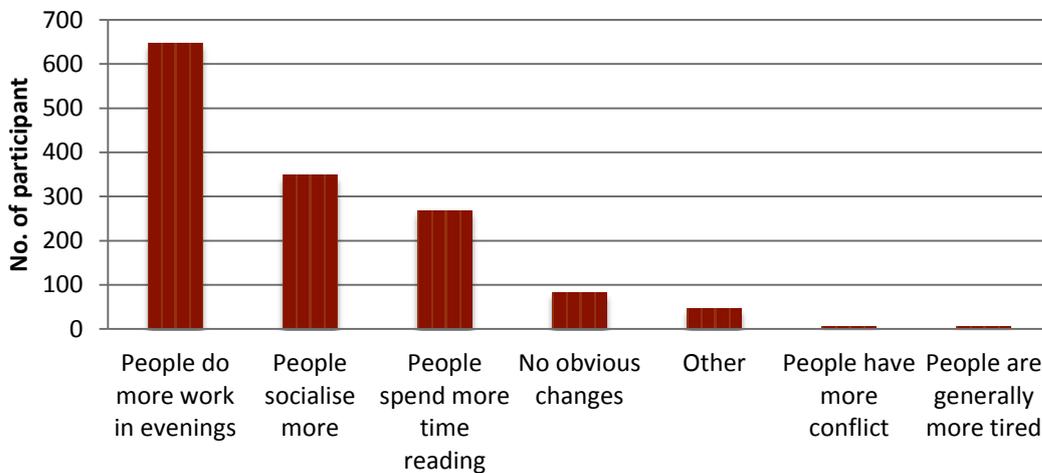
---

Secondly, there were many examples given of the increased opportunity for evening work enabled by solar lanterns (including: sewing, weaving, kava preparation, and night fishing), many of which

<sup>27</sup> \$A120-\$A180 per year

appeared to be opportunities for women, although quantification of this was not possible. This, however, raises some concern (also lacking quantification) that women are now working longer hours.

Figure 9: Main change since using the solar light



### Social Benefits

Changes in financial dynamics through the transition to solar have shifted the gender dynamics of household energy use. Although gender roles have not radically altered since the introduction of portable solar lanterns, the majority of respondents did note that men were no longer in sole charge of one of the main household expenditures: energy. With kerosene fuel no longer needing daily monitoring, most respondents reported an associated decline in marital confrontations related to money issues.

**Lesson 10. Most women talked about the additional work they now undertake in a positive, social sense – small groups of relatives or friends coming together to work on weaving, sewing or handicrafts in the evenings.**

More generally, most villagers found that there is now more opportunity to socialise. People regularly mentioned the use of solar lanterns for village and inter-village functions.

While lighting also brings with it opportunity for some anti-social outcomes, it is surprising that none were mentioned during the extensive survey and interview processes – although it may take time for communities to fully appreciate both the upside and downside of improved and mobile lighting.

### Education Benefits

There were regular comments regarding the capacity for children to now undertake educational pursuits in the evening. It was hard to confirm the veracity of this (or whether it was more parental aspiration), yet most parents mentioned the opportunity solar lanterns give for school age children to study independently (and safely) in the evenings. A more substantiated outcome was reported by boarding schools and colleges, where the fear of fire has, in the past, resulted in a ban on kerosene lamps and candles. Solar lanterns thus provide students with the opportunity to continue their

study, both individually and in groups, after the general lights-out (which in many boarding schools occurs quite early).

### Environmental Impact

There has been considerable concern about the environmental impact of solar lanterns. An assumption of the *Lighting Vanuatu* design was that proponents would establish systems for return, repair or recycling. From the survey, only 6% of respondents had had to replace the battery for the light, and of these they predominantly kept the old battery in the house (58%). Others sent it back to the supplier (20.3%), buried it (11.6%), or burned it (4.3%). The original supplier supplied the new batteries approximately half the time, the other half they were supplied by a different supplier. It also became apparent during the mission that any long term solution to battery recycling was going to be difficult. The efforts of VANREPA and ACTIV in this regard have been largely unsuccessful, especially in the remoter islands. Almost all broken lights have remained within the communities. Some have been dumped, but most are still in the homes, having been re-engineered for parts, and then used in any and every way they could possibly be made useful again.

***Lesson 11. The majority of broken or old solar lanterns currently remain in the home. Recycling and safe disposal information is not available. However, it seems likely that the availability of simple vocational electrical skills in remote communities would see many of these lights usefully repaired<sup>28</sup>.***

---

### Changing Norms and Aspirations

There is clear evidence that solar technology has significantly changed people's norms and aspirations. There is now an almost complete aversion to kerosene, and consumers are universally unwilling to now forgo the convenience of solar lanterns and the opportunity they present for multiple night-time activities. For instance, during a household interview in Nerenigman village on Mota Lava (November 21, 2013), one respondent expressed this sense of progression by stating, "If we had to go back to kerosene we would be embarrassed." The perception being here that anything other than solar would be like falling backwards, even to the point of stigmatisation for those who still used it, as another respondent from a focus group on Mota Lava (November 21, 2013) recounted, "If we see someone using kerosene we laugh, it's like they're stuck in the past." Solar energy was closely associated with progress to the degree that in the vast majority of interviews alternative energy options were rarely discussed.

In fact, one of the primary outcomes of the Lighting Vanuatu project was that it helped raise awareness and exposure to the option of solar power. As the vast majority of villages indicated and demonstrated through their purchases of larger solar panels (often purchased in New Zealand during the participation in the Recognised Seasonal Employer (RSE) scheme), the aspirations and expectations of the achieving a solar powered future was not limited to portable solar lighting. As awareness of solar

---

<sup>28</sup> There is also the opportunity for social benefit: training / upskilling electricians, etc with basic skills to enable them to not only safely repair broken lanterns, but also to be a source of information about solar in their respective villages. This could also have the additional effect of better preparing people for larger systems and VREP as, presumably, more knowledge of solar / more sustainable electricity will lead to greater acceptance and faster adoption.

powered lighting had exploded since the start of the Lighting Vanuatu project the expectation from many of the villages visited that the future will be increasingly solar, which would include the larger housing systems as well as the convenient and mobile portable solar lights. This is expressed by a young father from Laukatai who when asked how he disposed of an earlier broken solar lamp stated, “I want to keep it as a memory [the solar lamp]. When my kids get older I want to show them what we used to use for light.”

***Lesson 12. All people interviewed aspire to further improvements in their household lighting – firstly with fixed lighting and phone charging, and then with systems possessing the power to operate small appliances.***

---

Indeed, the ICR heard multiple stories of people returning from the seasonal workers programs in New Zealand with solar lights and/or solar panels for themselves or others in their village. Such enthusiasm is exciting from an energy transition perspective, although it will inevitably be limited in its results by contextual constraints such as physicality (Vanuatu is a small group of islands with a small population), finances, and village life – the same constraints, in fact, that were initially overcome through the supply-side subsidy with the pico-lights.

### **Product differentiation**

Over the term of *Lighting Vanuatu*, consumer experience, needs and aspirations have led to a clearer appreciation of product capabilities. One result of this has been a clear differentiation of the functions that small domestic solar lights are capable of filling.

The various lights distributed under the *Lighting Vanuatu* program differ with respect to their ‘benefits’ as listed above. Whilst many households indicated a clear preference for the Kiran/S10/S20, particularly for general and mobile use, other households (especially those with access to more than one type of light) talked about the benefits of different lights for different purposes. The Nova is preferred by some households, as it provides a bigger lighting system with multiple brightness settings and an opportunity to charge their phones. Other households prefer the Firefly and Solata models, as these are more focussed light sources that are perceived to be better for study.

***Lesson 13. With the increasing prevalence of solar lighting, the availability of different types of solar lights, and increased experience with the products and the opportunities created, households are differentiating their needs more clearly.***

---

As a result, people are not using all the products equally - an important point when considering future distribution and uptake of solar products. The simplistic notion that a light is a light, is now being challenged as families identify the concurrent need for the following:

1. Standby/emergency light: Most families have a torch for urgent use, with a clear preference for the battery-powered LED lanterns – these are especially necessary for when solar lanterns fail due to insufficient charging.

2. Solar mobile light: The need for a simple and mobile all-in-one unit for indoor and outdoor activities – the Kiran/S10/S20 and new S2 units suit this market well. This is a huge market seeking more affordable, durable and brighter lights.
3. Solar phone charging: The majority of solar lanterns sold through *Lighting Vanuatu* did not have this capacity. However, the Firefly and the Nova were valued for this function. Many of the current, higher priced solar lanterns (e.g. the new 1.5W Firefly with the LIB, as well as an increasing range of 5W to 20W systems) may well bring phone charging capacity into the home. However, the general trend is still to get your phone charged at the nearby home or business of someone with access to a generator, or a larger PV system (the cost ranges between Vt25 and Vt100 per charge). The scope for central charging stations therefore seems significant.
4. Solar fixed light: Fixed lighting is needed for:
  - a. space lighting;
  - b. security lighting; and
  - c. the brighter, more focussed lighting needed for more detailed endeavours (reading, writing, weaving etc).

More and more families are now upgrading to larger, PV panel-based, fixed, multiple lighting systems to meet these needs.
5. Fixed light and power: Finally, most families aspire to a PV system that can provide both light and power (the latter being primarily for entertainment). There has been a significant reduction in the cost of these systems, leading to increased availability and adoption. In particular, those families who have joined the New Zealand seasonal work program seem to have targeted the purchase of these larger PV Power Systems for these reasons.

The key factors that households consider when making a decision about lighting (or power more generally) are:

- cost,
- access (Where can we get it? Can we easily get it serviced?), and
- knowledge (What is the best for my need? Which products are quality assured? ).

***Lesson 14. While cost, access and knowledge are all important, those interviewed consistently mentioned that access and knowledge were the most difficult of the three, while de-emphasising the cost, particularly for the smaller or lower cost systems.***

---

Many families are able to visualise ways to meet the cash requirement. Instead, they have limited knowledge and poor access.

## Efficiency

The injection of a supply-side subsidy that facilitated the NGOs' access to manufacturers, rather than a demand-side subsidy that would have lowered the price for end-users, contributed to the end-users' acceptance of market-based prices for the products. The ICR endorses the use of this mechanism as an efficient and sustainable tool for project delivery.

In addition, the ICR findings confirm that a 'short, sharp' injection of funds was the ideal catalyst for the initiation of a commercially-viable market. The rapid changes in the energy environment evident in *Lighting Vanuatu* are exciting. Yet they also underscore the significant challenges faced by

development projects wanting to work in this sector. *Lighting Vanuatu's* success, while planned, has also been serendipitous – it was the right assistance supplied over a short enough period to catalyse and guide development. A little earlier or a little later and the outcomes would have probably been less relevant and therefore less justifiable.

While little further support to solar lanterns is needed per se, consideration could nevertheless be given to other ways of supporting household lighting in Vanuatu, e.g. small PV units capable of providing households with both fixed lighting and some extra power (primarily for phone charging, communication and entertainment). Consideration by the World Bank, NZAID and Australian Aid of opportunities for the provision of these under the proposed Vanuatu Rural Electrification Program (VREP) is therefore endorsed.

***Lesson 15. Any future assistance for rural electrification should be based on a programmatic approach and reviewed on an annual rolling basis to ensure its responsiveness and relevance in Vanuatu's rapidly changing environment. Timeliness, flexibility and close partnerships with both utility authorities and the energy private sector, will be essential.***

---

### Implementation Arrangements

The Energy Unit managed implementation of the project. This group had sufficient funding but limited skilled staff, staff turnover and an uncertain structure that failed to provide sufficient staff for the roles required. In addition, the staff provided were insufficiently skilled in their management and monitoring roles, and the oligarchic approach to overall management led to inefficiencies. Finally, frequent staff changes coupled with limited briefings for the newcomers, resulted in the loss of much of the institutional knowledge associated with the project. The information on implementation that was provided to the ICR was limited, often dispersed, and lacked quality control.

The Government of Vanuatu has recognised many of these challenges. The new Energy Department has confirmed staff positions and a focus on improved oversight, with a resulting clear improvement in morale, vision and staff capacity to support its programs.

A number of constraints caused inefficient implementation, two of which merit a brief description:

1. The project attempted to ensure accountability and assess the distribution patterns of solar lanterns through the collection of consumer receipts. This, however, put a huge pressure on the distributors to ensure the return of receipts from users, often at the end of very long supply chains - a monumental, but largely unachievable task. In retrospect, both the accountability and learning aspects could have been dealt with by other, more efficient methods; and
2. The Energy Unit was responsible for "approving" *Lighting Vanuatu* products for distribution. This caused significant frustration, time delays and confusion, as the criteria and processes for approval were never clarified. Nor did the Energy Unit's staff have the skills or equipment necessary to effectively test the units. For such a small engagement, then, such a formal process was both ineffectual and unnecessary. It

would have been better if the project had simply accepted units that had already been endorsed by other, much larger, global solar lantern projects e.g. *Lighting Africa*.

3. Lastly, the Energy Unit and Australian Aid had limited involvement in the structure and negotiation of supply contracts by the NGOs. This had important implications. Not only did the NGOs use the donor funds to improve their negotiating position on price and supply (as was expected), but they also used their improved negotiating position to “lock in” sole distribution rights to the products of a particular manufacturer. While this is common business practice, the implication has been that other, more sophisticated, and newer solar businesses in Vanuatu have been unable to source these products and support the significant gaps in the supply chain. In the case of the D Lights, VANREPA has not met consumer demand, and other suppliers have been restricted from sourcing the product. If future subsidies are considered for consumer energy products, the Energy Unit and Australian Aid should consider being more engaged in the detail of supply contracts.

## Sustainability

### Sustainability of the solar lantern business models

The *Lighting Vanuatu* project has been successful in enabling the rapid and widespread uptake and awareness of portable solar lighting products. In cities, portable solar lamps now hold a ubiquitous and prominent space in the window displays of many retail shops. A visual stocktake of shops in Port Vila and Luganville confirm that nearly every general merchandise shop, and most daily goods stores, now prominently display portable solar lighting products, highlighting the popularity and demand for the units. When framed at this descriptive level, the project certainly presents a good news story for renewable energy. However, it is worth considering the sustainability of the business models established.

While ACTIV and VANREPA were already involved in the distribution of pico-solar lights before the commencement of *Lighting Vanuatu*, both NGOs were struggling at the time to purchase sufficient quantities from their suppliers to qualify for bulk purchase discounts. *Lighting Vanuatu* therefore aimed to assist these NGOs through a direct grant, allowing them to purchase by the container load, and thus pass the savings on to the consumer. As the units were subsequently sold, the grant capital could then be reused by the NGOs to support ongoing purchases, in the process establishing a sustainable business model. Yet while these assumptions certainly held true for the initial container purchases - units were made available to consumers at prices between Vt1,000 and Vt1,500 cheaper than previously - a number of rapid changes in the global energy sector impacted on the viability of the model as initially conceived:

1. Worldwide demand for pico-solar lanterns sky-rocketed between 2010 and 2013. Manufacturing capacity was swamped, and supply preference was given to the largest markets in Asia and Africa – the Pacific was not a priority, and significant supply delays were therefore encountered;
2. The resulting increased demand and production volumes meant that a single container load no longer attracted bulk purchase discounts – this, however, was largely balanced by a rapid reduction in overall price; and

3. Rapid improvements in battery and LED technology resulted in much better quality units becoming available at comparable or even cheaper prices.

Hence while the subsidy efficiently kick-started a more active phase of ACTIV and VANREPA's businesses, any subsequent capitalisation of the grant has not resulted in the businesses continuing with the same business model. ACTIV has largely withdrawn from the solar lantern market, seeing they can no longer obtain sufficient discounts on their purchase of the Firefly. Instead, they have chosen to focus on the more advanced (and expensive) fixed lighting systems that provide multiple lights for the home (5-25w systems). They feel that this market is the next logical step, and that demand is increasing. They are thus currently reviewing suppliers to find the best quality affordable packages. VANREPA, on the other hand, has collapsed as an effective trading entity. However, its affiliated trading arm Green Power continues its relationship with d.light, and is strongly focused on supplying quality solar lanterns in the Vt1,000 to Vt2,000 range (e.g. the d.light S2).

A primary concern of the ICR is that while demand and awareness have been effectively established, sustainable and consistent supply chains have not. There is a risk, then, that the current demand vacuum will be filled with poor quality lanterns, and that this may lead to considerable "market spoilage". On the other hand, the enduring issue of competition with low quality products may be viewed as an effective means of preventing the "market spoilage" experienced by similar projects such as *Lighting Africa*.

Consideration should be given to:

- Supporting the very underprivileged to access solar lanterns;
- Monitoring the capacity of the private sector to maintain supply chains to the remote islands; and
- Improving public access to impartial consumer information on product quality.

Australia's short, sharp subsidy through *Lighting Vanuatu* has not only been a significant catalyst in the adoption of solar lanterns, but it has also raised the awareness of solar power technology across Vanuatu.

***Lesson 16. No further general donor support for the small solar lantern market is considered necessary.***

---

## Conclusions

### Evaluation Criteria Ratings

This ICR was asked to focus on three criteria: effectiveness, efficiency and sustainability (see Annex 1). This is a subset of the standard six ICR criteria and thus, wherever relevant, comments have also been included on relevance, gender equality and monitoring and evaluation.

In accordance with ICR requirements, the following quality ratings have been agreed for the *Lighting Vanuatu* Project. The criteria ratings are the opinions of the review team solely and are not reflective of any external perceptions or guidance.

Evaluation Criteria	Rating (1-6)
---------------------	--------------

<b>Relevance</b>	5
<b>Effectiveness</b>	5
<b>Efficiency</b>	3
<b>Monitoring and Evaluation</b>	2
<b>Sustainability</b>	3
<b>Gender Equality</b>	4

**Rating Scale:**

Satisfactory		Less than satisfactory	
6	Very high quality	3	Less than adequate quality
5	Good quality	2	Poor quality
4	Adequate quality	1	Very poor quality

## Conclusion

*Lighting Vanuatu* has been a small but highly successful Australian project. It has, however, not been without its faults - project documentation, monitoring, ongoing evaluation, oversight and management could all have been improved. Yet despite these failings, *Lighting Vanuatu* has still managed to achieve significant outcomes.

*Lighting Vanuatu* is typical of many of the smaller entrepreneurial endeavours that have been reviewed around the world. Such projects are driven by locally-based NGOs or small businesses, and thus managed by committed individuals who are passionate about their work. Both ACTIV and VANREPA used the Australian funding to do much more than was envisaged in the design. These emergent outcomes are extremely pleasing to see, but were not planned for. It is, in fact, the perception of the ICR team that the outcomes may have been more constrained if there had been tighter fiscal, transparency, oversight and reporting obligations, in line with the ever-developing models of the good management of development endeavours.

ACTIV used the funds to meet all their targets, and their reporting has been exemplary. In addition they have continued to evolve their renewable lighting business in response to the changing environment – new supply chains, new products, changing consumer demand, and changing consumer capacity to pay. Every indication is that the capitalised funds will ensure that ACTIV maintains itself as a key player into the future. In the case of VANREPA, its driving ambition was the need to get lights out to the communities that needed them. Clearly, management acumen was limited. Yet also clearly, VANREPA used the subsidy and the subsequently capitalised funds to ramp up rapid delivery well in excess of contractual requirements or expectations. Almost inevitably, this model was not sustainable and the institution collapsed. However, the passion still remains, and the concentration of efforts into Green Power will sustain many of the benefits, albeit with a legacy of wisdom regarding the need for better fiscal and management processes.

The over-riding lesson from *Lighting Vanuatu* is, therefore, that it is sometimes good for the Aid program to take risks – local entrepreneurs in emerging economies cannot easily be supported under the often strict aid bureaucracy aimed at ensuring transparency. GfG must be commended for taking such a risk – it has not been easy and *Lighting Vanuatu* will be remembered within GfG as much for its management problems as for its outcomes. However, the ICR team would recommend that Australian Aid consider models that clearly balance risk-taking with responsibility, as these can have clear successes.

# Annex 1: Terms of Reference for the Independent Completion Report of *Lighting Vanuatu*

---

## Background and Orientation to the Evaluation

### Orientation to *Lighting Vanuatu*

Vanuatu's population is estimated to be about 230,000 of which 10,000 households are in urban areas and 34,000 households are in rural areas. Estimated overall electrification rate for is about 27% with approximately 30,000 households relying on kerosene and/or wood for lighting needs. Studies have revealed that access to safe, clean lighting is an urgent priority for households which do not have access to electricity. Households relying on kerosene lighting typically spend between \$5 and \$30 on kerosene monthly.

A new variety of low-cost LED (light emitting diodes) lighting products, known as pico-solar products, are now available in the market. The advantage of the new LED based lighting products is that they are much more efficient, requiring only a solar module in the 1 – 2Wp range, thereby reducing system cost, and have a much longer life than conventional compact fluorescent light source (about three years). Compared to conventional 'solar home system', these products are much cheaper, are portable, require no expert installation and almost no maintenance. Additionally, some pico-solar products are also able to charge mobile phones, which a highly desirable feature given the high rate of mobile use penetration in Vanuatu.

These pico-solar products have the potential to rapidly and radically transform the off-grid household lighting market. With these low-cost products, basic electric lighting is now within the affordability envelope of an average household with an expected payback period of just 2 – 6 months (depending on product chosen) based on monthly kerosene expenditure. These products are already being sold in Vanuatu by two non-government organisations (NGOs), Alternative Communities Trade in Vanuatu (ACTIV) and Vanuatu Renewable Energy and Power Association (VANREPA) and experience to date confirms that there is genuine demand in Vanuatu for these products. ACTIV and VANREPA have not been able to bring in sufficient product quantities to meet the demand from Vanuatu consumers.

Barriers to accelerated market uptake of pico-solar products in Vanuatu include:

- Geographically dispersed markets
- Low quality products
- Limited awareness
- Financial constraints
- Commercial risks of scale-up

To address these barriers and support ni-Vanuatu households without access to electricity, Australian Aid supported ACTIV, VANREPA and Youth Challenge to achieve wide-scale distribution of pico-solar products, particularly in the rural areas of Vanuatu. The design of the project focused on

overcoming the identified barriers to the accelerated uptake of the pico-solar products across Vanuatu. Implemented between July 2010 and June 2012, Australian Aid invested the equivalent of Vt38.0 million – of which Vt32.0 million was shared between ACTIV, VANREPA and Youth Challenge while Vt6.0 million was allocated to the Government of Vanuatu Energy Unit for purpose of undertaking project monitoring and verification activities, particularly verification of product sales prior to release of milestone payments.

The purpose of the *Lighting Vanuatu* program was to achieve wide scale distribution of pico-solar products, particularly in the rural areas of Vanuatu. The program also mobilised the funds and resources of ACTIV and VANREPA to complement the Australian Aid funding, as well as to hold both organisations accountable for reaching the distribution target of 24,000 products.

The overall objective of the program is adoption of LED lighting in rural Vanuatu through the removal of the barriers for a rapid transition from kerosene based lighting to solar charged LED lighting. The program objective is linked directly to the aim of the Australian Aid Governance for Growth (GfG) program’s power component of achieving expansion of access to safe and reliable power for men and women across Vanuatu.

Program targets for outputs and outcomes over the two year program life included:

- Distribution of a minimum of 24,000 pico-solar products to households in Vanuatu. Particular attention was to be made to distribute these products to rural households without access to electricity. More than 70% of sales of these products under the project were to be made outside of Efate Island and the Luganville area (on the island of Santo).
- Raised awareness of pico-solar products by households in Vanuatu.
- Establishment and expansion of a network of distribution/sale channels to enable the sustainable distribution and sale of products across Vanuatu’s rural communities.
- Building a domestic “pico-solar” industry which is commercially viable and sustainable.

Some of the key benefits which the program was anticipated to deliver included:

- Financial savings for households from not having to spend money on purchase of kerosene. These savings in turn can be used to improve a household’s household assets and help build their readiness for the purchase and/or use of larger electricity systems.
- A clean and safe source of lighting that increases household and personal health through the removal of kerosene lighting from ‘bush’ houses.
- Reduction in carbon dioxide emissions.
- Increase in productive working and learning hours in the evening which can contribute to poverty reduction goals.

### **Purpose of the evaluation**

Australian Aid wishes to commission an Independent Completion Report of the *Lighting Vanuatu* Program, that builds on recent Australian Aid monitoring studies that demonstrated that there is significant uptake of pico-solar lamps, by answering causal questions to help understand why people adopt and commit to the new technology as well as the way in which households engage with the new technology.

The purpose of the evaluation is to gain an understanding of how the new lighting technology impacts women, men, youth and the aged in terms of:

- degree of adoption,
- geographical, social or cultural trends in adoption,
- economic benefits – especially for women and youth,
- changes in technology used in households,
- changes in practices surrounding this technology shifts, and
- changes in perceptions of solar lighting and use of lights.

In particular Australian Aid would like the evaluation to draw out the gender dimensions associated with each of these assessments. This evaluation should seek to provide local insights which could be used to guide future program investment by Australian Aid in this area.

### Key management decisions to be informed by the evaluation

Australian Aid and the Government of Vanuatu will use information from the evaluation to support discussions about future investments in energy and technology support for households outside the Vanuatu electricity grid to contribute to equality of opportunities and equal access to resources for women, men, youth and the aged in more remote parts of Vanuatu.

### Key Issues

Key issues that lead to the primary evaluation questions include:

- increasing disparity between rural, isolated and urban households in Vanuatu, particularly in terms of access to services and equality of opportunities;
- increasing disengagement of youth, particularly young men, from the formal economy as a result of poor education and lack of opportunities for employment with an increasing proportion of people in correctional facilities such as prisons coming from this demographic group in Vanuatu;
- technological innovations that provide sustainable and cost-effective alternatives to traditional sources of power and light in remote areas of Vanuatu; and
- high demand for local economic development opportunities in rural areas of Vanuatu.

### Evaluation Questions and Scope

#### Priority evaluation questions

The evaluation will focus on three criteria: effectiveness, efficiency and sustainability. This focus recognises that a key aspect of evaluating the uptake of pico-solar lighting in Vanuatu is the ability to understand what is involved in a change in energy consumption behaviour. Priority questions to be addressed by the evaluation under each of these criteria are:

#### Effectiveness:

1. To what extent has *Lighting Vanuatu* delivered on anticipated adoption rates, outputs, outcomes and benefits?
2. How do women, men, youth and the aged in rural and remote areas of Vanuatu benefit from *Lighting Vanuatu* – economically, socially and environmentally?
3. What are the geographical, social and cultural trends in adoption?
4. How has the technology used in adopting households changed compared to non-adopting households?
5. How have energy-use practices changed in adopting households compared to non-adopting households?
6. How do women, men, youth and the aged in rural and remote areas of Vanuatu perceive solar lighting and use of solar lights?

7. To what extent did monitoring of *Lighting Vanuatu* provide relevant information to support program management and identify program results?

#### Efficiency:

1. How could the implementation partners (ACTIV, VANREPA, Youth Challenge and Government of Vanuatu) have delivered more outputs with the same inputs?
2. Could the implementation partners (ACTIV, VANREPA, Youth Challenge and Government of Vanuatu) have delivered the same outputs with less inputs? If so, how?

#### Sustainability:

1. What evidence is there that barriers to accelerated market uptake of pico-solar products in Vanuatu have been addressed?
2. How have social norms of women, men, youth and the aged changed towards the use of pico-solar products?
3. To what extent has a domestic pico-solar industry which is commercially viable and sustainable been initiated?
4. What additional investment is being made by the private sector, other civil society organisations and the government to support wide-spread adoption of pico-solar lighting in remote and rural areas of Vanuatu?

#### Scope

The evaluation will be conducted over an elapsed period of 6 months (February 2012 – July 2013 inclusive) and include time to prepare an evaluation plan and related methodologies and instruments; time to conduct document review of existing data and to conduct field work to collect new data; time to analyse and interpret data; and time to prepare and communicate information found from the work and related conclusions in an evaluation report.

#### Evaluation Process

In conducting the evaluation, the team shall undertake the following activities, with timelines according to 3.2:

1. **Preliminary Briefing:** Prior to start of desk review and preparation of the evaluation plan, the evaluation team shall attend a briefing (by telephone if not in-country) with the Australian Aid GfG Team to discuss further objective, plans and expectations for the evaluation.
2. **Document Review:** Review of key program documents, related studies and research from other countries and related contextual information to establish understanding of the program, develop the methodology and plan for the evaluation, and information gaps which need to be collected during field visits. A list of key documents will be provided to the team by Australian Aid 10 days prior to the in-country visit.
3. **Evaluation Plan:** The Team Leader shall develop an Evaluation Plan in accordance with the Australian Aid Standard 5 for preparation of Evaluation Plans (2012 version). A draft will be submitted to Australian Aid for review and resulting comments will be addressed in the final plan.. The evaluation plan will ensure that all work on the evaluation is conducted to the ethical standards expected by the Australasian Evaluation Society Guidelines for Ethical Conduct of Evaluations. These can be found at: [www.ode.AustralianAid.gov.au/publications/pdf/guidelines\\_for\\_the\\_ethical\\_conduct\\_of\\_evaluations.pdf](http://www.ode.AustralianAid.gov.au/publications/pdf/guidelines_for_the_ethical_conduct_of_evaluations.pdf)
4. **Pre-mission Briefing:** The evaluation team shall participate in a preliminary briefing session in Port Vila with Australian Aid. 1 day including travel. Australian Aid GfG will

conduct a verbal briefing with the contracted evaluation team in person at the commencement of field work. The verbal briefing will ensure consensus understanding of the information sought by Australian Aid, the methods to be used to collect data and the timing for analysis, interpretation and reporting of information from meta-data and new field data.

5. **In-country field work:** The evaluation team shall have preliminary meetings with key stakeholders in Port Vila and then conduct field work in a purposeful sample of locations proposed in the evaluation plan using methods and instruments proposed in the evaluation plan.
6. **Initial Findings:** Before leaving Vanuatu on completion of the field work, the team will prepare an Aide Memoire setting out initial findings and present those initial findings to Australian Aid and other partners in Port Vila. A brief synopsis of these findings will be provided as feedback in Bislama to participating communities and other stakeholders in the evaluation.
7. **Reporting:** The team shall prepare and submit a Draft Report in electronic format three weeks after presentation of the Aide Memoire. This period includes inputs for data processing by the team, analysis and interpretation for report writing and submission of the draft report. Australian Aid will then have 3 weeks to consolidate comments on the report. A Final Report, incorporating responses to comments from Australian Aid, shall be submitted 10 days after receiving comments on the draft report from Australian Aid.

## Evaluation plan

The Team Leader will be responsible for the development of an evaluation plan, to be submitted to Australian Aid for approval. The evaluation plan will include secondary questions to be asked under each of the primary questions set out in these TOR, the methods and approach proposed for the evaluation and the report structure. The evaluation will be implemented according to the approved plan. The plan will be prepared in accordance with the Australian Aid Standard 5 for preparation of Evaluation Plans (2012 version) and be generally consistent with quality standards such as those produced by the Joint Committee on Standards for Educational Evaluation – Program Evaluation Standards (<http://www.jcsee.org/program-evaluation-standards>). Ethical standards adopted in the plan will be consistent with those used by the Australasian Evaluation Society ([http://www.ode.AustralianAid.gov.au/publications/pdf/guidelines\\_for\\_the\\_ethical\\_conduct\\_of\\_evaluations.pdf](http://www.ode.AustralianAid.gov.au/publications/pdf/guidelines_for_the_ethical_conduct_of_evaluations.pdf)).

## Schedule

The schedule proposed below allows for adequate document review, data collection and analysis and processing of data to answer the key evaluation questions set out in these TOR. The review will commence in February 2013 and be completed by end of July 2013. The total timing and scope of services is up to 84 input days as outlined below (final dates and timing will be negotiated with team members and stated in contracts).

TASK	LOCATION		INPUT (days)	
			Technology Adoption Researchers	
Survey data analysis	Home Office	3.64	2	2
Document review	Home office	1	2	2
Draft evaluation plan	Home office	2	1	1
Revise evaluation plan and incorporate feedback	Home Office	.36	1	1

TASK	LOCATION	INPUT (days)		
			Technology Adoption Researchers	
<b>Mission, including: Travel to Vanuatu and Australian Aid briefing Field work (incl. travel home) Preparation and presentation of aide memoire</b>	Vanuatu	14	7	<b>28</b>
<b>Draft evaluation report</b>	Home Office	8	2	<b>6</b>
<b>Peer review assessment</b>	Australian Aid	1	1	<b>1</b>
<b>Revise and submit final report</b>	Home Office	1	1	<b>1</b>
<b>TOTAL</b>		<b>31</b>	<b>17</b>	<b>42</b>

### Reporting and feedback

The draft report will be prepared in accordance with the Australian Aid Standard 6 for preparation of Evaluation Reports (2012 version) and be generally consistent with quality and ethical standards identified above.

All documents produced by the team will be provided in accordance with the specification under Standard Conditions clause headed Reports; be accurate and not misleading in any respect; be prepared as directed by Australian Aid and the Government of Vanuatu; be provided in the format and on the media approved or requested by Australian Aid; not incorporate either the Australian Aid, Government of Vanuatu or the Contractor's logo; be provided at the time specified in these Terms of Reference; and incorporate sufficient information to meet the agreed needs of Australian Aid.

A peer review will examine and contest the findings of the evaluation report to ensure the findings are consistent with these TOR and the required standards, that the information and conclusions are relevant and applicable to the Australian Aid operating environment. The peer review will be organised by Australian Aid.

### Review team and expected skills

The evaluation team will consist of:

1. **Team Leader:** independently contracted by DFAT and responsible for preparing the evaluation plan, contributing to development of field work tools and instruments, conducting the document review, contributing to collation of relevant meta-data, leading field work and finalising the written report. The Team Leader will demonstrate skills and relevant experience in evaluation, field research and review, experience in the Pacific region and a thorough understanding of Australia's aid program.
2. **Technology Adoption Researchers:** contracted through the University of Otago and responsible for contributing to the evaluation plan, developing field work tools and instruments, contributing to the document review, collating relevant meta-data, contributing to field work, leading data analysis and contributing to the written report. The Technology Adoption Researcher will demonstrate skills and relevant experience in social change research, technology adoption research, field research in Melanesia and a thorough understanding of the Pacific context for adoption of energy technology.
3. **Research Assistants:** contracted through the University of Otago and preferably including a ni-Vanuatu graduate and if not possible, a graduate with the capacity to

facilitate team engagement with ni-Vanuatu stakeholders, use research instruments with ni-Vanuatu participants in the evaluation, work with other team members in the field to collect and collate new data and contribute to the reporting and feedback activities.

All team members are expected to have:

1. relevant tertiary qualifications and evaluation/research experience in a Melanesian context;
2. knowledge of development issues and the role of technology and social change in development;
3. expertise in energy technology and its adoption in the Pacific;
4. a background understanding of the Australian aid program in Vanuatu;
5. excellent interpersonal and communication skills, including a proven ability to liaise and communicate effectively with Pacific Island nationals; and
6. ability to provide timely delivery of high-quality written reports in English.

### Documents for review

The Australian Aid GfG team will provide the evaluation team with the following documents for review:

1. *Lighting Vanuatu* Proposal
2. Vanuatu Electricity for Rural Development (VERD) Program
3. Progress and Final Reports from ACTIV, VANREPA and Youth Challenge Vanuatu

# Annex 2: *Lighting Vanuatu* - ICR Evaluation Plan

*Lighting Vanuatu* is a project funded by Australian Aid within the Vanuatu Governance for Growth (GfG) Program. It commenced in June 2010 with the objective of accelerating the conversion of rural Vanuatu households from kerosene-based lighting to affordable, safe, and reliable solar-charged LED lighting. The project aimed to distribute a minimum of 24,000 pico-solar products, with particular focus on those households with no access to electricity, and particularly those located outside the major population centres of Port Vila on Efate, and the Luganville area on the island of Espiritu Santo.

## 1 Collaboration in developing the Evaluation Work Plan

This Evaluation Work Plan outlines the work required to undertake the Independent Completion Review (ICR) of Australian Aid’s *Lighting Vanuatu Project*. The Plan has been developed in accordance with Australian Aid Monitoring and Evaluation Standards<sup>29</sup>, and builds off the Terms of Reference, as well as a review of key documents relating to the *Vanuatu Lighting Project* and the *Vanuatu Electricity for Rural Development* program.

In preparing the Evaluation Work Plan the following consultations have taken place and are proposed:

**Table 2: Proposed Work Plan Consultations**

Date	Activity	Comments/Status
<b>Early Aug 2013</b>	Contracts finalised with: <ul style="list-style-type: none"> <li>• Team Leader.</li> <li>• Otago University.</li> </ul>	<ul style="list-style-type: none"> <li>• Completed.</li> <li>• Terms agreed and final signatures required.</li> </ul>
<b>Friday 2 Aug 2013</b>	Team Planning meeting.	Team meeting to discuss roles responsibilities, timing, Survey analysis, Work Plan and logistics. Preliminary agenda submitted to Australian Aid on Monday 5 August 2013.
<b>Wednesday 7 Aug 2013</b>	Initial planning discussions with Australian Aid’s GfG Program.	Discussed contracts, Work Plan, mission timing, support requirements, logistics and timeline.
<b>Monday 12 Aug 2013</b>	Draft Work Plan submitted to Australian Aid (GfG Program).	Includes a revision of planned village meetings based on an assessment of logistical feasibility.
<b>Week of the 12 Aug 2013</b>	Australian Aid appraises the draft Work Plan, and provides comments to the Team. The Team and Australian Aid conduct phone and email consultations with key stakeholders.	See Section 2 for discussion of Stakeholders

<sup>29</sup> No 246 Version 1.0 (June 2013-June 2014)

Date	Activity	Comments/Status
Tuesday 13 Aug 2013	Team Planning Meeting. Phone link with Australian Aid Vanuatu. Discussion of Survey Data Analysis.	
<b>The original timeline was delayed due to contracting restrictions during the Federal Election period.</b>		
Week of the 14 October 2013	Final Work Plan submitted. The Team and Australian Aid: <ul style="list-style-type: none"> <li>Engages with <i>Lighting Vanuatu</i> NGOs to facilitate Village meetings.</li> <li>Facilitates meetings with other stakeholders outlined in the agreed Mission agenda.</li> </ul>	
Sunday 10 October 2013 to Saturday 23 October 2013	<i>Lighting Vanuatu</i> In-country Mission.	

The Work Plan is intended to be a 'living document' that responds flexibly to implementation constraints and opportunities. However, all revisions and updates will be discussed with, and approved by Australian Aid.

## 2 Stakeholders:

The primary intended 'users' of the ICR when completed are shown in Table 3.

Table 3: Primary Evaluation Users

Primary Evaluation User	Contact	Need
Australian Aid's Governance for Growth Program	Mathew Harding, Director GfG	<ul style="list-style-type: none"> <li>To understand impact/ other issues related to the LV project.</li> <li>To integrate lessons into any future Australian Aid assistance to the Energy Sector (Possible collaboration with NZAID and the WB).</li> <li>To share lessons with Government and other donors.</li> </ul>
	Susan Kaltovei, Assistant Program Manager, GfG.	<ul style="list-style-type: none"> <li>To complete Quality assessments and incorporate findings into the QAC report.</li> <li>To update AidWorks and the Australian Aid website.</li> <li>To integrate impacts into reporting for the Country PAF and CAPF.</li> </ul>
	Australian Aid Regional, Post and Desk	<ul style="list-style-type: none"> <li>As above</li> <li>To integrate lessons into any future Australian Aid assistance enabling energy self-sufficiency in remote communities in other developing countries.</li> </ul>
Government of Vanuatu	Leo Moli, Act'g Director, GoV Energy Unit	<ul style="list-style-type: none"> <li>To understand impact /other issues related to the LV project.</li> </ul>

Primary Evaluation User	Contact	Need
	Department of Energy Mines and Mineral Resources (+678) 25201 lmoli@vanuatu.com.vu	<ul style="list-style-type: none"> <li>To integrate lessons into future GoV assistance to the Energy Sector.</li> <li>To report on impact as part of the GoV Energy Roadmap.</li> </ul>
	Ms Lizzie Taura Manager Regulation, Utilities Regulatory Authority +678) 23521 ltaura@ura.gov.vu/	<ul style="list-style-type: none"> <li>To understand impact /other issues related to the LV project.</li> <li>To integrate lessons into future GoV assistance to the Energy Sector, particularly the <i>Vanuatu Energy Sector Development Project</i></li> </ul>
<b>Donors</b>	Kamlesh Khelawan Senior Energy Specialist, World Bank +61 2 9235 6573 kkhelawan@worldbank.org	<ul style="list-style-type: none"> <li>To understand impact /other issues related to the LV project.</li> <li>To integrate lessons into future WB assistance to the Energy Sector, in particular the possible implementation of the <i>Vanuatu Electricity for Rural Development (VERD) Program</i>, as well as the <i>Vanuatu Energy Sector Development Project</i>.</li> </ul>
	Barbara Williams, Director - Pacific Bilateral Division Barbara.williams@mfat.govt.nz	<ul style="list-style-type: none"> <li>To understand impact /other issues related to the LV project.</li> <li>To integrate lessons into future NZAID assistance to the Energy Sector, in particular future support to the <i>Vanuatu Electricity for Rural Development (VERD) Program</i></li> </ul>
<b>Local Stakeholders</b>	Vanuatu NGOs Vanuatu Renewable Energy private sector	

The broader 'audience' for the evaluation also includes

- The *Lighting Vanuatu* NGO Proponents - ACTIV, VANREPA and Youth Challenge;
- Other Vanuatu NGOs;
- Local Renewable Energy suppliers;
- Local traders;
- Other pico lighting distributors (commercial and civil); and
- The target villages, village organisations, and households.

These groups have both a general interest in the success and challenges faced by the project, as well as a particular interest in any implications for their own organisations/ communities.

### 3 Purpose of the Evaluation

This Evaluation Plan proposes methods to gather the necessary data for *Lighting Vanuatu's* Independent Completion Report. In particular, the Evaluation will investigate causal questions that enable an understanding of why people have adopted/ committed to the new technology, as well as the ways in which rural households have engaged with the new technology. The ICR Evaluation builds on recent informal Australian Aid monitoring studies that have reported significant uptake of pico-solar lamps across rural Vanuatu.

More specifically, the purpose of the Evaluation is to gain an understanding of how the new lighting technology impacts women, men, youth and the aged in terms of:

- The degree of adoption, and the specific contribution of *Lighting Vanuatu* in facilitating this adoption,
- Any geographic, social or cultural trends evident in adoption patterns,
- Any economic or social benefits – overall but especially for women and youth,
- Specific changes in the lighting technology used by households,
- Changes in household practices associated with any shift in technology,
- Any changes in householders’ perceptions of solar lighting, and the use of lights more generally,
- Changes in householders’ perceived needs and aspirations toward lighting and electricity more generally, and
- The effectiveness and sustainability of the pico-lighting marketing/distribution chain and products.

In particular, Australian Aid would like the Evaluation to draw out the gender dimensions associated with each of these assessments. The Evaluation should also seek to provide local insights which can guide future program investment by Australian Aid in this particular arena.

#### 4 Background Orientation

The Evaluation of the *Lighting Vanuatu* Project will explore the contribution that the Project has made to the adoption, impact and sustainability of pico-lighting in Vanuatu. One key aspect will be to understand the factors that underlie any perceived changes in energy consumption behaviour. The University of Otago *Energy Cultures Group* will use the Energy Cultures conceptual framework<sup>30</sup> to both assist in the development of this understanding, and to help identify what more may be needed to accelerate adoption of new energy technologies and practices.

To apply the Energy Cultures conceptual framework the evaluation will draw on three significant investigations:

1. In 2011/12 Australian Aid conducted a questionnaire survey of communities who received pico-lighting under *Lighting Vanuatu*. Originally planned as an enumerator-administered questionnaire, the initial coverage was low (<100 respondents). In response, Australian Aid sought the help of local (predominantly church) groups to deliver the survey. While this resulted in a flood of responses (>1,400), there was also worrying evidence of compromised data quality. Hence, this ICR Evaluation will assess the veracity of the survey data collected. In particular, it will aim to ‘clean’ the data set of erroneous entries and undertake statistical analysis of the data. If successful this will help to identify or triangulate findings, and refine the demographic questions and geographic coverage for the main Mission.
2. *Household Income and Expenditure Surveys* were undertaken by The Vanuatu National Statistics Office in 2006 and 2010. This data included key questions on household lighting,

---

<sup>30</sup> Stephenson, J., Barton, B., Carrington, G., Gnoth, D., Lawson, R., & Thorsnes, P. (2010). Energy cultures: A framework for understanding energy behaviours. *Energy Policy*, 38(10), 6120-6129.

sources and fuel, and may therefore provide baseline levels of solar light adoption, and possibly some longitudinal data for early stage trend analysis. However, it is still unclear if the 2010 data is readily accessible.

3. The ICR In-country Evaluation Mission, which aims to:
  - a. generate solid quantitative information on the numbers of lights sold, as well as their geographic distribution (based on NGO statistics);
  - a. collect qualitative information through in-depth household case study interviews, key informant interviews and beneficiary Focus Group Discussions. This will help determine perceptions, norms and aspirations, and practices relating to solar lighting across the target demographic; and
  - b. develop a deeper understanding of the pico-lighting marketing/distribution chain, in particular how the LV intervention has affected product selection, delivery and the sustainability of business models.

## 5 Constraints for the evaluation

The Work Plan has been developed to work within or address the following limitations:

***The time available for the in-country mission is limited to 2 weeks:*** The Evaluation includes the inputs of a Team Leader, as well as a Research Team from the Energy Cultures Group at the University of Otago. Australian Aid understands that a standard ICR under its Quality Management processes will capture the major development findings and lessons. As such, the two week time frame for the in-country mission will be tight, but nevertheless in keeping with other Australian Aid ICR investments for similar programs.

Australian Aid has chosen to engage the Energy Cultures Group in the ICR process as earlier findings have indicated both rapid adoption and rapid behaviour change - if adoption has really been as rapid as reported, there is significant opportunity for the data to be further analysed, resulting in a deepened development understanding. Over the longer term, the Energy Cultures Group will therefore use the data for further research. Already the Energy Cultures Group has secured an Otago Energy Research Centre Grant (\$NZ2500) for additional research focused on understanding the interactions between energy supply, energy use, human behaviour, social processes, economic forces and environmental impact. While this supplementary work is beyond the Contractual scope of this ICR, Australian Aid appreciates the benefits of embedding the data with appropriate development research institutions.

***Uncertain veracity of Questionnaire Survey Data:*** As mentioned, the Survey Questionnaire undertaken by Australian Aid was returned by over 1,400 respondents from across Vanuatu (see Table 4). A preliminary assessment of the data conducted in January 2013 showed that changes in the way the survey was administered resulted in some unfortunate misinterpretation of questions<sup>31</sup>. As such, some of the data will not be useable. However, a more solid review of the data, revealed that responses to the majority of questions are nevertheless quite robust. As also mentioned, prior

---

<sup>31</sup> Initially trained enumerators were engaged from the USAID Peace Corp. However, in order to increase the number of respondents, Australian Aid subsequently engaged largely church-based groups to administer the survey.

to the field mission, the Evaluation Team will undertake further analysis of the cleaned data set. If sufficiently robust, this analysis will then be used to identify initial trends, and to help refine both mission targeting and the questions to be used.

**Table 4: Lighting Vanuatu survey respondents**

Island	Survey Respondents
Efate	174
Santo	375
Malakula	32
Tanna	359
Ambrym	12
Epi	19
Pentecost Island	21
Aore	26
Maewo	13
Malo	53
Nguna	42
Paama	20
Pele	10
Makira	14
Vanualava	89
Buninga	10
Motalava	130
Aniwa	14
Mota	1
x) Mis	22
<b>Total</b>	<b>1436</b>

**Limited Project Documentation and Reporting:** The *Lighting Vanuatu* Project was originally designed as a small interim engagement undertaken by the GfG Program to meet a specific need, while Australian Aid was in the process of designing a more significant, longer term engagement to promote rural renewable energy usage in Vanuatu. In consequence, the design documents for *Lighting Vanuatu* are unusually brief - they include little analysis of the problem, or of the preferred response. Moreover, the implementation of Vanuatu Lighting appears to have been quite dynamic and responsive – agreements, new proponents, and delivery have all significantly evolved as the project progressed. Hence, while Australian Aid has supplied all relevant documents, much of the evolutionary decision-making is not embedded in these, rather in institutional memory, only some of which may prove available – in particular, some key informants have left their former positions (e.g. the Project Manager and the GfG Director). In addition, the quality of record keeping and reporting of the three NGO proponents who received funding under *Lighting Vanuatu* varied considerably. Both ACTIV and Youth Challenge appear to have solid records, and thoughtful reports. However, VANREPA has failed to meet either its record keeping or its reporting requirements. This will limit the Evaluation’s capacity to fully appreciate the issues related to the supply chain, geographic distribution, and adoption of pico-lights supplied through Australian Aid support. However, it should not compromise the assessment of beneficiary household impact.

**Direct Support from the Australian Aid GfG Program:** Given the limited resources of the NGOs implementing *Lighting Vanuatu*, the Australian Aid GfG Program has agreed to provide the in-country logistical, facilitation and organisational support needed by the Evaluation Team. This is essential for implementation to proceed and is hugely appreciated. However, the Evaluation Team

will need to maintain regular contact with Australian Aid throughout the planning process to ensure that its expectations do not exceed the limited resources.

## 6 Key Evaluation Questions

The evaluation will focus on three criteria: effectiveness, efficiency and sustainability. Priority questions to be addressed by the evaluation under each of these criteria are:

### 6.1 Effectiveness:

1. To what extent has *Lighting Vanuatu* delivered on anticipated adoption rates, outputs, outcomes and benefits?
2. How do women, men, youth and the aged in rural and remote areas of Vanuatu benefit from *Lighting Vanuatu* – economically, socially and environmentally?
3. What are the geographical, social and cultural trends in adoption?
4. How has the technology used in adopting households changed compared to non-adopting households?
5. How have energy-use practices changed in adopting households compared to non-adopting households?
6. How do women, men, youth and the aged in rural and remote areas of Vanuatu perceive solar lighting and use of solar lights?
7. To what extent did monitoring of *Lighting Vanuatu* provide relevant information to support program management and identify program results?

### 6.2 Efficiency:

1. How could the implementation partners (ACTIV, VANREPA, Youth Challenge and Government of Vanuatu) have delivered more outputs with the same inputs?
2. Could the implementation partners (ACTIV, VANREPA, Youth Challenge and Government of Vanuatu) have delivered the same outputs with less inputs? If so, how?

### 6.3 Sustainability:

1. What evidence is there that barriers to accelerated market uptake of pico-solar products in Vanuatu have been addressed?
2. How have social norms of women, men, youth and the aged changed towards the use of pico-solar products?
3. To what extent has a domestic pico-solar industry which is commercially viable and sustainable been initiated?
4. What additional investment is being made by the private sector, other civil society organisations and the government to support wide-spread adoption of pico-solar lighting in remote and rural areas of Vanuatu?

To provide sufficient understanding to answer these questions the Evaluation will target key informants from three main groups:

- *The beneficiary households* – men, women and youth – as well as their associated community groups, activities and structures;
- *The marketing and distribution chain* associated with sourcing, promotion, pricing and distribution of the pico-solar lights. For *Lighting Vanuatu* this will include the three

proponent NGOs, the local renewable energy private sector, and the traders/ suppliers of consumer products more generally; and

- *The Project owners*, namely Australian Aid and the Energy Unit of the Government of Vanuatu.

In Annex 1 & 2, the team has presented the range of issues needing to be explored with each informant group, if the key questions listed above are to be answered. Based on these, the detailed questions expected of **Beneficiaries** include:

**Table 5: Detail of Community/Beneficiary questions (including key questions) and methods to be applied.**

Issue <sup>32</sup>	Evaluation Method				Comments
	Survey	HIES	Interview or Focus Group	Docs and reports	
<b>Stratifying Variables</b>					
How many house/ holds, people in the village (men, women, age)?			◆	◆	This is to try and gain an understanding of the participant and their patterns of everyday life, which is likely to be different to the researchers’.
*General demographic of beneficiary - age, gender, location			◆	◆	
*What is the total number, age and gender of people normally living in the house where the light is used?	◆		◆		
*What is the main source of lighting used in the home? Has this changed in the last three years?	◆	◆	◆		
I want to start by getting a picture of your everyday life. Can you describe a typical day to me?			◆		
<b>Solar lighting</b>					
*How many households in the village use solar pico lights? What other forms of lighting are used? How has this changed over the last three years?			◆		These questions are designed to get an insight into the lighting technology owned and used by the household. We are also trying to understand the factors surrounding the participant’s decision to purchase, or not to purchase, solar lights. This includes things like where they found information about the lights, whether or not they knew anyone else who was using them, and how the upfront and running costs varies.
How did you come to hear about solar lighting? Who in the family instigated the purchase?	◆		◆		
Did you know anyone else who was using solar lights? What was their experience?			◆		
*What did you like/not like about the lighting you used previously?	◆		◆		

<sup>32</sup> The priority questions (those that must be asked if time is restricted) are noted with an asterisk (\*)

Issue <sup>32</sup>	Evaluation Method				Comments
	Survey	HIES	Interview or Focus Group	Docs and reports	
How much did you spend on kerosene? How much do you spend now?	◆		◆		
*How many solar lights are currently owned by this household? How many solar lights have you purchased in the past year?	◆		◆		
*Where did you buy the lights? How much did they cost? How did you pay for them (loan/credit/cash etc)?	◆		◆	◆	
<b>Light Usage</b>					
For each of these questions I'd like you to think about what you do now/what you did before you used solar lights.					
Where do you use the lights?	◆		◆		These questions aim to elicit a fuller understanding of the participant's energy practices in the home. We want to understand when and where the lights are being used, and how this might have changed due to switching from kerosene lamps to solar lamps. We are also hoping to find out how participants re-charge the lights, as this is something they would not have had to do with older technologies. It is hoped that these questions will give us a better picture of how the shift in technology has impacted on family practices and daily life.
*What are the lights used for?	◆		◆		
When do you turn the lights on and off?			◆		
Who is in charge of the lights?			◆		
*Who in your family uses the lights?	◆		◆		
*How long does it take for the lights to run out of battery?			◆		
Where do you charge the lights?			◆		
How long do you charge the lights for?			◆		
Has this changed your daily habits in any way?			◆		
<b>Supply Chain</b>					
*From whom did you obtain your solar light(s)?	◆		◆	◆	
Were you satisfied with the information you received about your light from the above source?	◆		◆		
*Have you ever had to buy a replacement battery? How long did the battery last?	◆		◆	◆	
*Where did you get the battery? What happened to the old battery?	◆		◆		
<b>Moving Forward</b>					
Would you want to have more solar lights?			◆		The objective of these questions is to find out how participants might want to use the solar technology in the future. We want to know about the appetite for more of the same or
*What do you like/dislike about the solar lights?	◆		◆		

Issue <sup>32</sup>	Evaluation Method				Comments
	Survey	HIES	Interview or Focus Group	Docs and reports	
What do you tell your friends and family about the solar lights? Do you recommend them?			◆		similar solar lamps, as well as for more sophisticated systems. We also want to understand how participants would react to failing technology, particularly given that this is a new type of technology for participants.
Have you ever had your solar light repaired? Who repaired the light? How long do they last before breaking?	◆		◆		
*How would you feel about going back to using kerosene lamps again?			◆		
*How much money would you pay for a system that could light your whole home?			◆		
<b>Anything else?</b>					
Is there anything else that you think I have missed or that you would like to add?			◆		
Is there anyone else that you would recommend that I talk to?			◆		
In terms of me getting a complete picture, would you be happy for me to take a few pictures that show how/where you use the solar lights and how/where you recharge the batteries?			◆		

The detailed questions expected of the **Marketing/Distribution Chain** proponents include:

**Table 6: Detail of Marketing/Distribution Chain questions (including key questions) and methods to be applied.**

Issue <sup>33</sup>	Evaluation Method				Comments
	Survey	HIES	Interview or Focus Group	Docs and Reports	
<b>Stratifying Variables</b>					
*Date; Respondent name and position; Organisation name; Organisation type; time/experience in solar energy; time experience in marketing and distribution?			◆	◆	Stratify the roles of the primary NGO proponents and the emerging/competitive roles of the renewable energy private sector and traders.
<b>Product/Services</b>					
*Which products have you been marketing?			◆	◆	Identify product life cycles, quality and service issues. Particularly changes in product due to

<sup>33</sup> The priority questions (those that must be asked if time is restricted) are noted with an asterisk (\*)

Issue <sup>33</sup>	Evaluation Method				Comments
	Survey	HIES	Interview or Focus Group	Docs and Reports	
*How have these products performed? Have you changed your product mix? Why?			◆		performance issues and the capability of the market chain to handle warranty, service and battery replacement needs.
*How many pico-lights have you acquired? How many have you sold?			◆	◆	
*What are your sourcing arrangements? Has this worked well? How has it changed over time? (Is it sustainable for you from a business perspective once LV support ends?)			◆	◆	
*Do you provide warranty, service or battery exchange facilities? How do these work? What demand has there been for these services?			◆	◆	
<b>Price</b>					
*What is the unit cost landed in Vanuatu?			◆	◆	Identify key price points for demand across customer groups and some indication of the sustainability of the operations based on margins obtained.
*What price do you sell the units for? How have you developed this pricing structure and do you think it will remain stable?			◆	◆	
<b>Place</b>					
*What are your distribution arrangements? What distribution channels and outlets do you supply (shop, market, mobile seller, phone sales etc)? What is your business relationship with others in this marketing chain?			◆		Clarify if pico-lighting distribution has met the objectives of broad rural distribution or been more concentrated. Identify any innovations that have assisted in improving access for remote communities.
Who generally buys the lights? Retailer/agent/onseller/community group/individual/household			◆	◆	
*Where have the lights been sold?			◆	◆	
*How does this distribution network change for more remote markets?			◆		
*How sustainable are these market chain relationships?			◆		
<b>Promotion</b>					
*How do people find out about the lights?			◆		Identify if promotion has been used to adjust anomalies in demand. Also

Issue <sup>33</sup>	Evaluation Method				Comments
	Survey	HIES	Interview or Focus Group	Docs and Reports	
Do you do any active promotion? Has promotion been done for particular target groups (location/gender/age)? What has this cost? What has been the response?			◆	◆	gauge the level of latent demand across the country.

## 7 Implementation of the Evaluation

The Evaluation Plan incorporates a range of methods to improve the quality of the analysis through confirmation and triangulation. The methods to be employed include:

1. Review of project documents;
2. Analysis of the *Lighting Vanuatu* Beneficiary Survey data;
3. Analysis of HIES data; and
4. In-country mission Interviews including:
  - a. In-depth interviews: key informants
  - b. In-depth interviews: beneficiary households
  - a. Focus Group Discussions: beneficiary communities

The preceding tables indicate which data collection method is applicable to which question, with two or more methods proposed for some questions in order to strengthen confidence in the findings.

Throughout the Evaluation the Team Leader will regularly consult with the Australian Aid Activity Manager and the University of Otago lead researcher to respond to emerging issues and flexibly adjust the Evaluation process to ensure it remains relevant to the issues, challenges and opportunities as they arise.

### 7.1 Review of project documents

Australian Aid has been requested to supply all documentation and reporting related to the Vanuatu Lighting Project including:

- The original Vanuatu Lighting Design and its approval;
- The contractual agreements with ACTIV, VANREPA and Youth Challenge;
- All Australian Aid internal QAI and reporting;
- All Progress and Final Reports from ACTIV, VANREPA and Youth Challenge;
- Any other information related to project delivery and compliance;
- Documentation related to the Vanuatu Electricity for Rural Development (VERD) Program.

The limitations of the available documentation – as relating to the evolutionary nature of the project, its time frame and its deliverables - have already been noted as a constraint (Section 5). It is however hoped that in-depth interviews with current Project management staff and proponents can

still deliver a solid understanding of major issues. If thought necessary, interviews will also be sought with previous Australian Aid staff associated with the project (in particular Leith Verimaito – currently studying in Australia under an Australia Awards Scholarship).

## 7.2 Analysis of the *Lighting Vanuatu* Beneficiary Survey data

The beneficiary survey has already been reviewed and the data set cleaned. An initial review using Excel pivot tables has revealed first order relationships associated with geographic location. As mentioned, it appears that while some of the quantitative data related to demography and adoption can only be used with care. However, much of the data related to usage, perception and aspiration seems sound. The University of Otago will undertake a more detailed analysis of the cleaned data set, in order to identify other significant trends and relationships in the data. This assessment, to be completed by the end of August 2013, will be used to refine the questions used during the in-country Mission, as well as the final selection of target islands and villages.

## 7.3 Analysis of HIES Data

The HIES data from 2006 is widely available and includes important baseline information of the energy practices and consumption habits of rural communities. This will help establish baseline usage patterns for kerosene, generator and solar lighting. If subsequent 2010 data is available, this would indicate some trends, including adoption levels very early in the implementation of *Lighting Vanuatu* - data that would not only be very useful in assessing uptake, but valuable in the triangulation of on-the-ground observations of village practices.

## 7.4 Mission Interviews

The Mission itself will be the major source of qualitative information collection and assimilation for the Evaluation. The following matrix identifies the interview tools that will be applied for each of the three informant groups.

**Table 7: Interview tools to be used with each informant group during the In-country Mission**

Informant Group	Evaluation Tool		
	Key Informant Interviews	Household Interviews	Focus Group Discussions
<b>Beneficiary Households/Communities</b>	Interviews with community leaders (male and female) in each target community. Responsibility: Team Leader	Household Interviews that ensure gender and age stratification is clear Responsibility: Otago University	FGDs with either men or women in each target community Responsibility: Team Leader
<b>Marketing/Distribution Chain</b>	Interviews with the “Principal” of each NGO proponent or business Responsibility: Otago University	NA	NA
<b>Project Owners</b>	Interviews with each of the Primary Evaluation Users Responsibility: Team Leader	NA	NA

### 7.4.1 Beneficiary Households and Communities

Beneficiary Households and Communities include: men, women and youth, along with their community groups, activities and structures. The communities/villages to be surveyed will be chosen from those who participated in the Beneficiary Survey. As seen in Table 8, respondents to the Beneficiary Survey came from 193 villages spread across 19 islands throughout Vanuatu. To help provide a short list of prospective villages the team has:

- Listed in Table 7 the villages which had the largest number of respondents to the Beneficiary Survey (generally where  $n > 10$ ); and
- Developed and applied a Remoteness Ranking<sup>34</sup> to help cluster these islands.

**Table 8: Villages covered in the *Lighting Vanuatu* Beneficiary Survey**

Island	Remoteness Ranking	Census Population	No of Surveys	No of Villages	Major surveyed villages (generally $n > 10$ survey respondents)
Efate	1	65829	174	11	Saama, Natapau, Magaliliu, Tanoliu, Eratap, Eton, Takara
Santo	1	39606	375	35	Arantoa, Banbab, Beleru, Hog Harbour, Kolei, Malao, Mavunlep, Naone, Natawa, Pepsi, Sara, Winsao
Malakula	2	22934	32	2	Dravail, Lamap
Tanna	2	28799	359	65	Epakel, Iarkei, Lahtapu, Lemakaun, Lapangtawa, Laweane, Learfi, Lenakel. Lounu, Port Resolution
Ambrym	3	7275	12	1	Toak
Epi	3	5207	19	3	Alack
Pentecost Island	3	16843	21	7	Nafaranguit, Vanmelang
Aore	4	556	26	7	Siro, Nawaswas, Port Latoir
Maewo	4	3569	13	1	Naviso
Malo	4	4273	53	9	Tanmeal, Nanuk
Nguna	4	1255	42	14	Malaliu, Taloa
Paama	4	1627	20	1	Tahi
Pele	4	321	10	5	Piliura
Makira	5	106	14	1	Malakoto
Vanualava	5	1933	89	14	Mosina, Sola, Vatop, Vureas,
Buninga	6	144	10	6	No major village
Motalava	6	1451	130	9	Avar, Demsas, Nerenigman, Qeremande, Rah, Toutoulau,
Aniwa	7	341	14	1	Ikaukau
Mota	7	683	1	1	No major village
x) Mis			22		
<b>Total</b>		<b>202752</b>	<b>1436</b>	<b>193</b>	

The mission will aim to visit villages from across this Remoteness Ranking spectrum. Given the logistical challenges of travelling in Vanuatu, and the shortness of the Mission, it is proposed that a maximum of eight villages can be surveyed as outlined in Table 9.

<sup>34</sup> The remoteness ranking takes into account both flight and shipping schedules to each island – Efate and Espiritu Santo are ranked at 1; those with regular (daily or more) contact with either Port Vila or Luganville are ranked at 2; a Ranking of 3-4 reflects services 2 or more times per week; while a Ranking of 6 and 7 reflects services of once per week or less.

Table 9: Proposed Schedule of Village visits

Time	Team A	Team B
Week 1 (Thurs/Fri)	1 village on Malekula (Ranking 2)	1 village on Tanna (Ranking 2)
Saturday	2 Villages on Efate (Ranking 1)	
Week 2 (Mon/Tues)	2 Villages on a very remote Island (e.g. Motalava) (Ranking 6-7)	1 Villages on Medium Remoteness Island 1 (Ranking 3-5)
Week 2 (Wed/Thurs)		1 Villages on Medium Remoteness Island 2 (Ranking 3-5)
Total	Eight Villages	

It is appreciated that on some islands the villages are less accessible than on others. As such, final village selection will be a necessarily subjective affair, decided in consultation with local informants. As a general rule, however, the aim will be to choose the village from Table 8 that is most representative of the **rural population** on that island.

On entry to each village there will be

- Introductions, explanations and agreements to participate;
- A tour of the village;
- Key informant discussions – both male and female from the church/ village leadership;
- One or two Focus Groups (Men and/or Women - alternating)
- Three or four Household Interviews (covering the gender and age demographic)

**Key informant interviews** will take place with the male and female leadership of the village (generally two interviews). These will explore the broad demographic of the village, along with the specific changes to village life engendered by the introduction of pico lighting.

**The Focus Group Discussion(s)** will alternate across villages between men and women participants. Selection for the FGD will include between seven and ten men/women from those homes using pico lights. The FGD will explore less “sensitive” issues, and will thus cover questions related to perceptions of the technology (its strengths and weaknesses), affordability, challenges of access to the product and its associated services; and broad perceptions of energy change over time, including any aspirations for the future. To help facilitate Focus Group Discussions each team will have a kit including samples of kerosene and pico lamps. Wherever possible the team will not make leading statements or communicate any value judgements related to any of the technologies used by villagers.

**Household interviews** will occur in parallel with the key informant interviews and the FGDs. Only three or four households are to be selected in each village. Sampling will purposefully focus on “typical” village households. Household interviews will be with the whole family whenever possible. Households will be selected on the basis of: their willingness to participate; the availability of both male and female household heads; the availability of school age youth. Questioning will specifically draw out gender and age-related differences. Questioning will also explore the full range of issues related to: purchasing decisions, product performance and usage; access to suppliers and services; and future aspirations for lighting in the home.

These interviews will follow a semi-structured set of questions, a translator will facilitate dialogue, and the conversation will be recorded to ensure accurate transcription. The data will be transcribed on return to New Zealand, and securely stored so that only the research team can access it. The information will be analysed by the research team in order to answer the research questions outlined in Table 4 (above), but every attempt will be made to preserve the respondents' anonymity. The data we collect during this research will be kept for at least 5 years in secure storage. The personal information we collect may be destroyed at the completion of the research, but the data derived from the research will, in most cases, be kept for much longer or possibly indefinitely.

#### **7.4.2 Marketing/Distribution Chain**

The Marketing/Distribution Chain includes the three proponent NGOs and their distribution/service partners, but may also involve the local renewable energy private sector, as well as the traders / suppliers of other consumer products. Interviews, based on the questions outlined in Table 6, are planned with:

- ACTIV
- VANREPA
- Youth Challenge
- Two major private businesses in the renewable energy sector (e.g Energy 4 All, Green Tech etc)
- Two major traders supplying consumer goods (including pico-solar lights across Vanuatu)

These interviews will all occur in Port Vila and are scheduled for Tuesday and Wednesday of Week 1.

#### **7.4.3 The Project Owners**

The Project Owners include Australian Aid and the Energy Unit of the Government of Vanuatu. Meetings scheduled with all the primary evaluation users are outlined in Table 3.

#### **7.4.4 Mission Interview Analysis**

The data generated during the mission will be a mixture of transcribed interviews (more formal), written observations (in the form of field notes) and written notes from the more informal interviews conducted in the villages. It is anticipated that the business model interviews will be those that are transcribed plus a smaller amount of observational field-notes. These will be analysed to produce a diagram of the value chain that can be examined to understand ways in which it works effectively and also for areas where it could be improved. The analysis of the household level interviews is highly likely to be carried out using a thematic method that will be extended by using the Energy Cultures framework to examine energy behaviour changes.

## **8 Scheduling**

A draft Mission Schedule, to be used as the basis for further planning, is attached as Annex 3. Roles and responsibilities (including reporting) have been agreed and allocated.

In general, the Team Leader will:

1. Prepare, consult and finalise the Evaluation Plan and Mission Schedule;
2. Take lead responsibility for village-based key informant interviews;
3. Take lead responsibility for village based FGDs;

4. Take lead responsibility for key informant interviews with Primary Users;
5. Take the lead responsibility for preparation and presentation of the Aide Memoire
6. Take the lead responsibility for preparing the draft and final ICR document.

In general, the Energy Cultures Group will:

1. Take lead responsibility for SPSS analysis of the Beneficiary Survey;
2. Take lead responsibility for household interviews;
3. Take lead responsibility for Market/Distribution Chain interviews;
4. Contribute to the ICR.

Throughout the mission and during the preparation of results there will be many situations where judgement and decision making is required. Responsibility for these judgements will sit with the Team Member responsible as outlined in Annex 3. However where possible judgements will be made collaboratively and discussed in team meetings or through email. Whenever flexibility in scheduling is required this will be agreed between the team leader and the Australian Aid Activity Manager.

## 9 Ethical issues

The Energy Cultures Group of the University of Otago has received ethics clearance to conduct the Evaluation. The full ethics application, along with correspondence granting approval, is provided in Annex 4. This covers issues relating to:

- participant selection and recruitment,
- methods and procedures with which fieldwork is conducted,
- Pacific Island research protocol principles,
- privacy and confidentiality issues,
- data storage and reporting,
- assurances of anonymity - no documents provided by the Evaluation Team will include any personal identification without the written permission of the individual,
- processes for reporting serious issues if these should be identified during data collection,
- photography, which must receive the permission of the communities/individuals concerned, and must also comply with Australian Aid Child Protection policies.

These practices are in line with internationally accepted guiding principles of good practice evaluation<sup>35</sup> and the Australian evaluation code of ethics<sup>36</sup>. Locally engaged enumerators, along with the Evaluation Team, the Australian Aid Activity Manager and local logistics support personnel, will undertake a training workshop at the commencement of the mission to ensure they are fully aware of these principles and their obligations.

---

<sup>35</sup> <http://www.eval.org/p/cm/ld/fid=51>

<sup>36</sup> [http://www.aes.asn.au/images/stories/files/About/Documents%20-%20ongoing/code\\_of\\_ethics.pdf](http://www.aes.asn.au/images/stories/files/About/Documents%20-%20ongoing/code_of_ethics.pdf)

## 10 Reporting and Communication of Findings

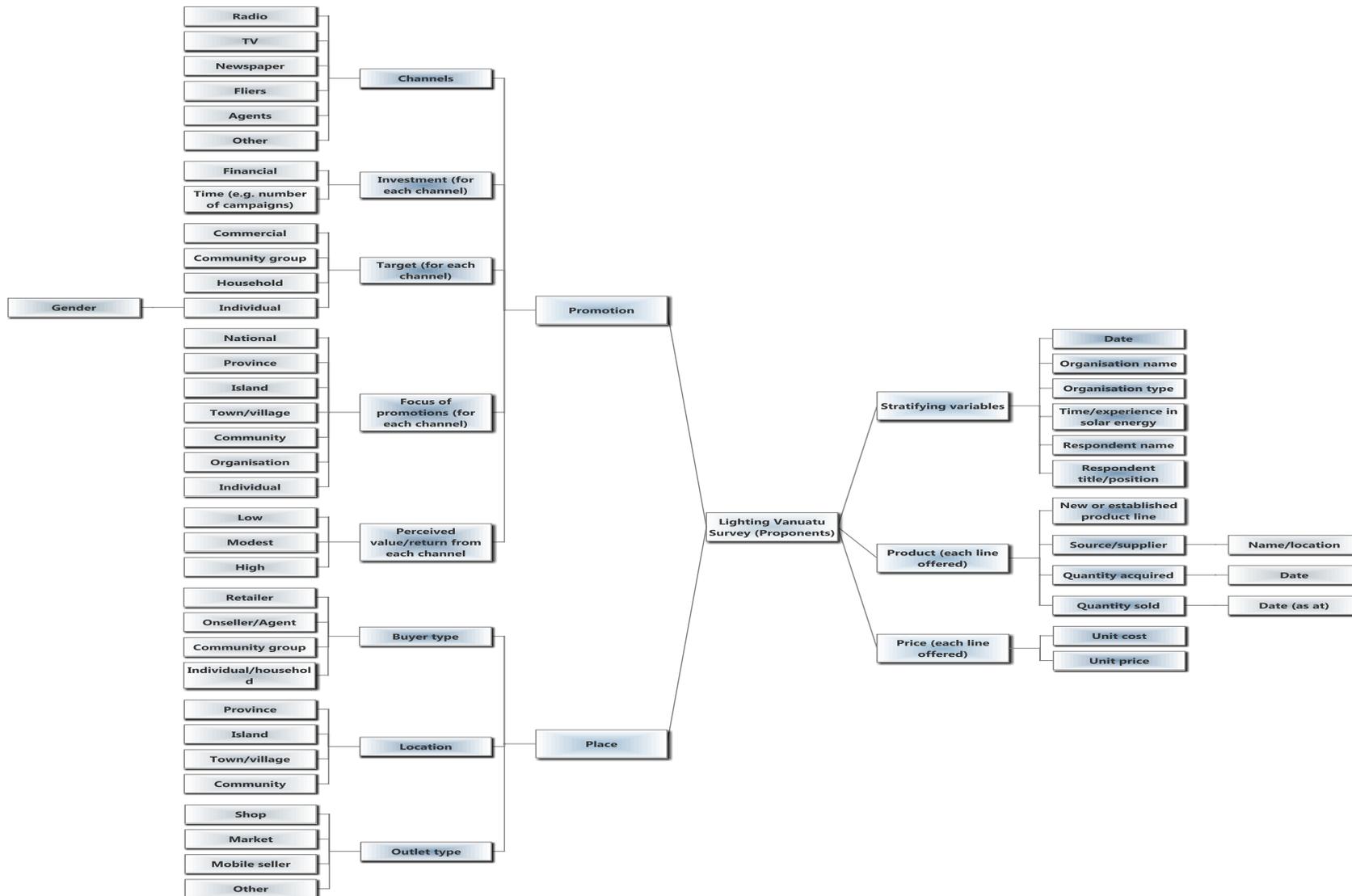
It is particularly important that the results of the evaluation are made available and used by key stakeholders. To this end the evaluation team will undertake the following reporting and communication:

1. The Evaluation Team will present a briefing for rural lighting “boundary partners” at the end of the mission that discusses initial outcomes and impressions, test some of the initial thinking, and discuss any concerns. Key participants will include:
  - a. Partner NGOs;
  - b. Renewable lighting private sector; and the
  - c. Representatives of the Malvatumari;
2. In addition, the Team will present an Aide Memoire to Australian Aid (including the Governance for Growth Program), the GoV Energy Unit, the utilities Regulation Authority and the World Bank (if available) that will discuss the outcomes and implications of *Lighting Vanuatu*. In particular the implications for the Energy Roadmap, future rural lighting engagements and especially the proposed Vanuatu Electrification for Rural Development program will be discussed.
3. The Evaluation Team will develop and prepare an Implementation Completion Report in the standard Australian Aid format. This Report will contain all available facts, along with the professional judgement of the Evaluators on issues such as lessons learnt, recommendations and future directions. All recommendations will be provided in draft form for consultation with Australian Aid and other primary evaluation users (as agreed by Australian Aid), prior to the preparation of the final document. This will ensure that recommendations are both feasible and appropriate. However, it is understood that neither Australian Aid nor its partners are obligated to act on any of the evaluation findings.

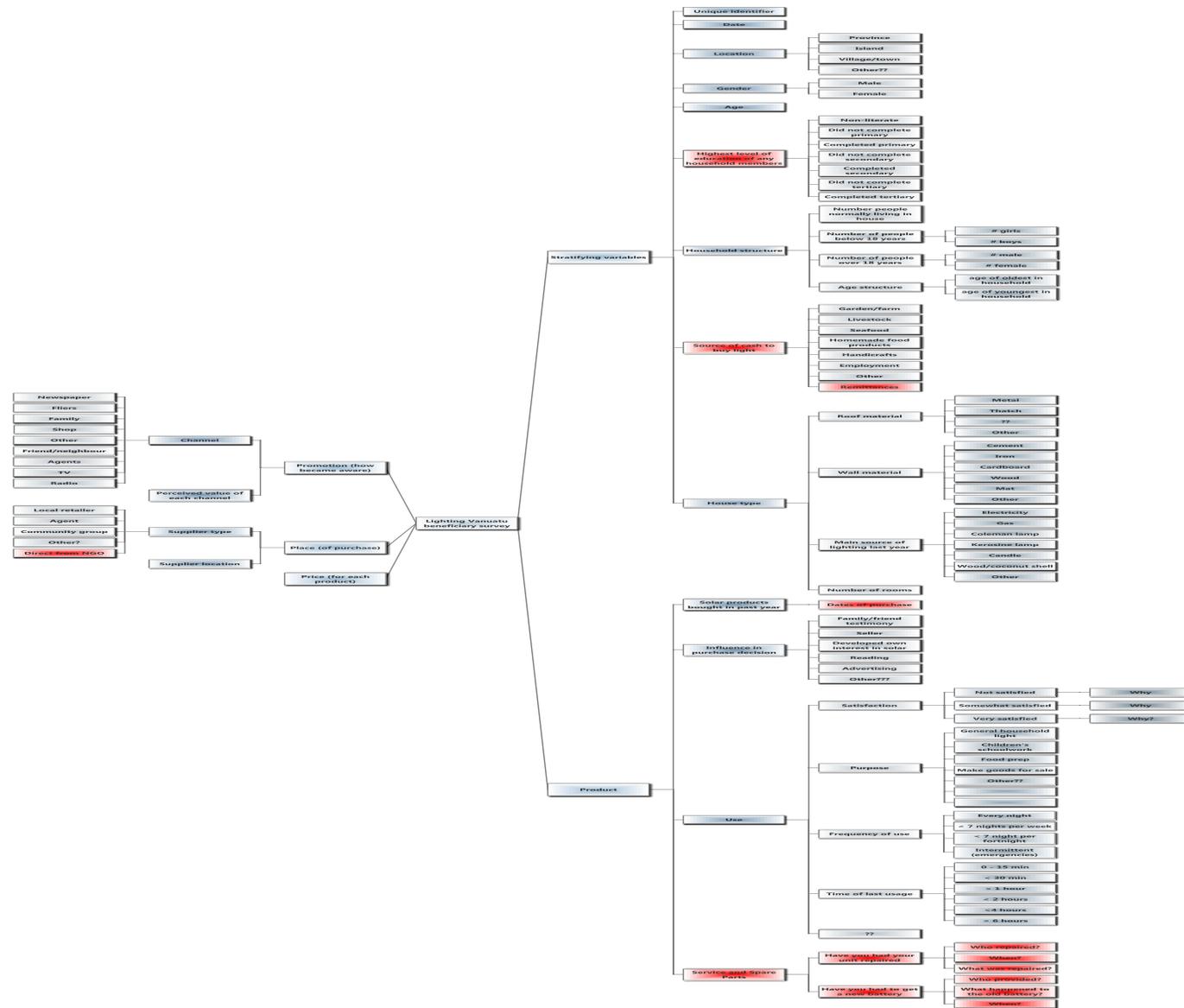
The Team will include a brief Executive Summary of major Evaluation outcomes in a format that is suitable for both key informants, and broader public circulation. However, no commitment is to be made to any stakeholder to provide further information beyond this. It will be Australian Aid’s decision to circulate or release more detailed findings.

4. The University of Otago will use the data generated by the review within its Energy Cultures Research Program. This will likely lead to broader communication of findings within the formal literature over time.

## Appendix 1: Mind map of beneficiary questions



## Appendix 2: Mind map of marketing/distribution questions



## Annex 3: List of People Met

Date	Day	Start	Finish	Duration	Evaluation Team Members	Location		Activity	Primary Responsibility
						Team A	Team B		
<b>Sunday, 10 November 2013</b>	1	10:30 a.m.	12:30 p.m.	2:00	Sara/ David/ Adam and Cle-Anne	Bauerfield Airport		Team arrives NZ788; taxi to Chantillys; check-in.	David SK/Sara W
		12:30 p.m.	1:30 p.m.	1:00	Sara/ David/ Adam and Cle-Anne	Chantillys		Lunch	David SK
		2:30 a.m.	4:30 a.m.	2:00	Sara/ David/ Adam and Cle-Anne	Chantillys		Review of tasks roles and responsibilities	
		Evening			Sara/ David/ Adam and Cle-Anne	o/n Chantillys			Susan K
<b>Monday, 11 November 2013</b>	2	8:30 a.m.	9:30 a.m.	1:00	Sara/ David/ Adam and Cle-Anne	GfG Office		Introduction and briefing by GfG Director (Mat Harding) and <i>Lighting Vanuatu</i> Activity Manager (Susan Kaltovei)	Susan K
		10:00 a.m.	12:30 p.m.	2:30	Sara, David, Adam, Cle-Anne, local enumerators (4), Susan	TBA		Evaluation Team Workshop – Introduction, activities, logistics, roles, responsibilities, methodology and procedures.	David SK; Sara W
		12:30 p.m.	1:30 p.m.	1:00	Sara, David, Adam, Cle-Anne, local enumerators (4), Susan	TBA		Lunch	
		1:30 p.m.	2:00 p.m.	0:30	Sara, David, Adam, Cle-	TBA		Evaluation Team Workshop - Overview of	David SK; Susan K.

Date	Day	Start	Finish	Duration	Evaluation Team Members	Location		Activity	Primary Responsibility
						Team A	Team B		
					Anne, local enumerators (4), Susan			the LV program; share data; design; reports; outcomes etc	
		2:00 p.m.	3:00 p.m.	1:00	Sara, David, Adam, Cle-Anne, Susan	Energy Unit		Energy Unit - Introductions; GoV Energy Roadmap; data; reports	Susan K; LeoM
		3:00 p.m.	5:00 p.m.	2:00	Sara, David, Adam, Cle-Anne, Susan	Port Vila		World Bank and other donors - feel for their activities and overlap with LV. Meet with HLES to get data.	Susan K - parallel meetings if required
		Evening			Sara, David, Adam, Cle-Anne, Susan	o/n Chantillys			Susan K
<b>Tuesday, 12 November 2013</b>	3	9:00 a.m.	12:30 p.m.	3:30	Sara, David, Adam, Cle-Anne, Susan	Port Vila		Major meeting and taped interviews with NGO proponents - ACTIV	Sara W; David SK
		12:30 p.m.	1:30 p.m.	1:00	Sara, David, Adam, Cle-Anne, Susan	Port Vila		Lunch	
		1:30 p.m.	5:00 p.m.	3:30	Sara, David, Adam, Cle-Anne, Susan	Port Vila		Major meeting and taped interviews with NGO proponents - VANREPA	Susan K to schedule Sara W; David SK
<b>Wednesday, 13 November 2013</b>	4	9:00 a.m.	12:30 p.m.	3:30	Sara, David, Adam, Cle-Anne, Susan	Port Vila		Major meeting and taped interviews with NGO proponents - Youth Challenge	Susan K to schedule Sara W; David SK
		12:30 p.m.	1:30 p.m.	1:00	Sara, David, Adam, Cle-Anne, Susan	Port Vila		Lunch	

Date	Day	Start	Finish	Duration	Evaluation Team Members	Location		Activity	Primary Responsibility
						Team A	Team B		
		1:30 p.m.	5:00 p.m.	3:30	Sara, David, Adam, Cle-Anne, Susan	Port Vila		Meeting with local Reneable Energy private sector (two) and local trader selling pico lights (Chinese or other) - Two teams (Sara/Adam and David/Cle-Anne) if necessary	Susan K to schedule Sara W; David SK
		Evening			Sara, David, Adam, Cle-Anne, Susan	o/n Chantillys			Susan K
<b>Thursday, 14 November 2013</b>	5	Early			Sara, David, Adam, Cle-Anne, Susan, local enumerators (4)	Tanna (David and Cle-Anne and two enumerators)	Malekula (Sara and Adam and two enumerators)	Fly to Islands	Susan K
		All Day			Team A: David, Cle-Anne and two enumerators Team B: Sara, Adam and two enumerators	Tanna – Village 1 selected from: • Lowmalu • Lapayu • Lounatem • Lounasunan • Lemanaplepi • Loukatai • Lamakaun • Epikakien • Lepad • Epakel	Malekula – Village 1 selected from: • Lamap • Daravail	Focus groups Interviews Key informant interviews Household Interviews (Interviews structured to gather perspectives segregated by Gender, Age and Remoteness)	Susan K to schedule Team A: David SK Team B: Sara W
		Evening			Sara, David, Adam, Cle-Anne, Susan, local enumerators (4)	Local Accommodation		Teams to sleep locally	Susan K

Date	Day	Start	Finish	Duration	Evaluation Team Members	Location		Activity	Primary Responsibility
						Team A	Team B		
<b>Friday, 15 November 2013</b>	6	Morning			Team A: David, Cle-Anne and two enumerators Team B: Sara, Adam and two enumerators	Tanna: Village 2 selected from above (dependant on flight times)	Malekula – Village 2 selected from: • Lamap • Daravail (dependent on flight times)	Focus groups Interviews Key informant interviews Household Interviews (Interviews structured to gather perspectives segregated by Gender, Age and Remoteness)	Susan K to schedule Team A: David SK Team B: Sara
		Afternoon			Sara, David, Adam, Cle-Anne, Susan, local enumerators (4)	Flights		Return to Efate PM	Susan K
		Evening			Sara, David, Adam, Cle-Anne, Susan	Chantillys		Team Discussions	David SK
		Evening			Sara, David, Adam, Cle-Anne, Susan	o/n Chantillys			Susan K
<b>Saturday, 16 November 2013</b>	7	All Day			Team A: David, Adam and two enumerators Team B: Sara, Cle-Anne and two enumerators	Rural Efate – Village 1: Selected from various villages (see Table 7)	Rural Efate – Village 2: Selected from various villages (see Table 7)	Focus groups Interviews Key informant interviews Household Interviews (Interviews structured to gather perspectives segregated by Gender, Age and Remoteness)	Susan to Schedule Team A: David SK Team B: Sara W
		Late afternoon			Sara and Cle Anne	Afternoon		Follow up conversations with Value Chain if required	Sara W
		Late afternoon			Rebecca F Arrives	Bauerfield Airport		Rebecca arrives XXXX; taxi to Chantillys; check-in.	Rebecca F
		Evening			Sara, David, Rebecca, Adam, Cle-Anne, Susan	Chantillys		Team Discussions	David SK

Date	Day	Start	Finish	Duration	Evaluation Team Members	Location		Activity	Primary Responsibility
						Team A	Team B		
<b>Sunday, 17 November 2013</b>	8	Morning			Sara and Cle-Anne	Bauerfield Airport		Sara and Cle-Anne depart for New Zealand	Sara W
		Morning			David, Rebecca, Adam	Chantillys		Team Workshop and update of notes	David SK
		Afternoon			David, Rebecca, Adam, Enumerators (4), Susan	Bauerfield Airport		Teams fly to outer islands: Team A: David, Susan, 2 enumerators to Very Remote island (6-7) Team B: Rebecca, Adam, 2 enumerators to Remote Islands (3-5)	Susan K
		Evening			David, Rebecca, Adam, Enumerators (4), Susan	Very remote C 6-7 e.g. Motalava, Aniwa or Buninga	Remote A 3-5 e.g. Maewo, Nguna, Pentecost, Makira, Ambrym, Epi, Malo, Pele, Paama	o/n accommodation TBA	Susan K
<b>Monday, 18 November 2013</b>	9	Morning and early afternoon			Team A: David, Susan, 2 enumerators to Very Remote island (6-7) Team B: Rebecca, Adam, 2 enumerators to Remote Islands (3-5)	Village 1: Very remote C 6-7 e.g. Motalava, Aniwa or Buninga	Village 1 on first island: Remote A 3-5 e.g. Maewo, Nguna, Pentecost, Makira, Ambrym, Epi, Malo, Pele, Paama	Focus groups Interviews Key informant interviews Household Interviews (Interviews structured to gather perspectives segregated by Gender, Age and Remoteness)	Team A: David SK Team B: Rebecca F
		Late afternoon				Travel to Village 2: Very remote C 6-7 e.g. Motalava, Aniwa or Buninga	Travel to Village 2 on second island: Remote A 3-5 e.g. Maewo, Nguna, Pentecost, Makira, Ambrym, Epi, Malo, Pele, Paama	Travel to next village	
		Evening			David, Rebecca, Adam, Susan,	Local Accommodation		Teams to sleep locally	Susan K

Date	Day	Start	Finish	Duration	Evaluation Team Members	Location		Activity	Primary Responsibility
						Team A	Team B		
					local enumerators (4)				
<b>Tuesday, 19 November 2013</b>	10	Travel Buffer			Team A: David, Susan, 2 enumerators to Very Remote island (6-7) Team B: Rebecca, Adam, 2 enumerators to Remote Islands (3-5)	Travel to Village 2: Very remote C 6-7 e.g. Motalava, Aniwa or Buninga	Travel to Village 2 on second island: Remote A 3-5 e.g. Maewo, Nguna, Pentecost, Makira, Ambrym, Epi, Malo, Pele, Paama	Travel Buffer	Susan K
		Afternoon			David Rebecca, Adam, Susan, local enumerators (4)	Village 2: Very remote C 6-7 e.g. Motalava, Aniwa or Buninga	Village 2 on second island: Remote A 3-5 e.g. Maewo, Nguna, Pentecost, Makira, Ambrym, Epi, Malo, Pele, Paama	Focus groups Interviews Key informant interviews Household Interviews (Interviews structured to gather perspectives segregated by Gender, Age and Remoteness)	Team A: David SK Team B: Rebecca F
		Evening			David Rebecca, Adam, Susan, local enumerators (4)	Local Accommodation			Teams to sleep locally
<b>Wednesday, 20 November 2013</b>	11	Morning and early afternoon			Team A: David, Susan, 2 enumerators to Very Remote island (6-7) Team B: Rebecca, Adam, 2 enumerators to Remote Islands (3-5)	Village 2: Very remote C 6-7 e.g. Motalava, Aniwa or Buninga	Village 2 on first island: Remote A 3-5 e.g. Maewo, Nguna, Pentecost, Makira, Ambrym, Epi, Malo, Pele, Paama	Focus groups Interviews Key informant interviews Household Interviews (Interviews structured to gather perspectives segregated by Gender, Age and Remoteness)	Team A: David SK Team B: Rebecca F
		Late afternoon			David, Rebecca, Adam	Return to Efate	Return to Efate	Travel to Efate	Susan K
		Evening			David, Rebecca, Adam	Local Accommodation			Teams to sleep locally
	12	Buffer Day			David, Rebecca, Adam	Efate	Efate	As required - finalisation of Village interviews,	David SK, Susan K

Date	Day	Start	Finish	Duration	Evaluation Team Members	Location		Activity	Primary Responsibility
						Team A	Team B		
<b>Thursday, 21 November 2013</b>								travel or Efate, follow-up interviews, field note preparation, team workshop, Aide Memoire presentation. NB: Rebecca F would like interviews with: * Statutory Authorities (Grid) * World Bank - grid extension	
		Evening			David, Rebecca, Adam		o/n Chantillys	Team Discussions	David SK
<b>Friday, 22 November 2013</b>	13	All Day			David, Rebecca, Adam	Efate	Efate	Workshop with NGOs, Private Sector and Malvatumari to present and discuss initial findings Australian Aid/Energy Unit/others - Aide Memoire Team Discussion	David SK, Susan K
		Evening			David, Rebecca, Adam		o/n Chantillys	Nil	
<b>Saturday, 23 November 2013</b>	14	All Day			David, Rebecca, Adam fly out	Bauerfield Airport		Travel	

# Annex 4: University of Otago Ethics Application and Approval

---



## HUMAN ETHICS APPLICATION: CATEGORY A

**1. University of Otago staff member responsible for project:**

Dr Rebecca Ford

**2. Department:**

Marketing

**3. Contact details of staff member responsible:**

rebecca.ford@otago.ac.nz

Ph 470 3577

**4. Title of project:**

*Lighting Vanuatu Through the Energy Cultures Lens*

**5. Indicate type of project and names of other investigators and students:**

**Staff Research**

 es

Dr Sara Walton  
Dr Janet Stephenson  
Seth Gorrie

**Student Research**

 Names

*Level of Study (e.g. PhD, Masters, Hons)*

**External Research/**

 Y Names

David Swete Kelly

**Collaboration**

*Institute/Company*

RDSM Consulting NZ

**6. Is this a repeated class teaching activity?**

NO

**7. Fast-Track procedure**

Do you request fast-track consideration?

NO

**8. When will recruitment and data collection commence?**

September 2012

**When will data collection be completed?**

November 2012

**9. Funding of project.**

Is the project to be funded by an external grant? YES (partially)

If YES, please specify who is funding the project: Australian Aid

If commercial use will be made of the data, will potential participants be made aware of this before they agree to participate? If not, please explain:

No commercial use will be made of the data.

**10. Brief description in lay terms of the purpose of the project** (approx. 75 words):

Australian Aid has recently engaged in funding agreements with 3 NGOs in Vanuatu, in an initiative referred to as "*Lighting Vanuatu*", with the purpose of providing pico-solar lighting solutions to communities in rural areas. An analysis of sales indicates that the project has been successful in enabling the uptake of solar lighting products. However, little is known about the specifics of uptake, the penetration in different rural areas across Vanuatu, and the way in which households engage with these new technologies. The purpose of this project is to undertake an independent evaluation to provide a more in-depth understanding of how the availability of pico-solar light has impacted members of the rural communities in terms of changes in technologies, practices, and social norms.

The data will be further used as part of a triple bottom line examination of the use of the lamps to investigate the social, economic and environmental value created.

**11. Aim of project, including the research questions the project is intended to answer:**

The aim of this project is to enhance our understanding of the factors surrounding energy related behaviour changes following the introduction of pico-solar lighting solutions to communities in rural Vanuatu in Australian Aid's "*Lighting Vanuatu*" initiative.

A key aspect of evaluating the factors surrounding energy related behaviour change is the use of the Energy Cultures conceptual framework (Stephenson et al., 2011), developed at the University of Otago, to assist with this understanding and to help identify further opportunities for achieving adoptions of new energy technologies and practices. The Energy Cultures framework takes a cultures-based approach to modelling behaviour, and also draws on systems thinking. It provides a simple structure to help identify the key factors that are involved in human behaviour (and behaviour change). The framework shows that energy-related behaviours are the result of the dynamic interactions of people's technologies (in this instance their

lighting), energy practices (i.e. how those technologies are used), and cognitive norms (i.e. what is considered the ‘right thing to do’). The framework also takes into account the “contextual soup” influencing these three key factors, which includes social and cultural values, availability of technologies, pricing, market conditions, regulatory and policy environments, incentives and disincentives, and so on.

The three elements of the Energy Cultures framework strongly influence each other – for example, having a kerosene lamp (technology) will ‘force’ a certain set of energy practices (buying kerosene, lighting lamps at a certain time) and around this will be a certain set of cultural norms (expectations of ‘how we do things around here’). This creates habit. To achieve a shift in energy behaviour requires a change in the technology owned, or the way in which technologies are used, or the cognitive norms. For the “*Lighting Vanuatu*” project, the change in the technology side (solar lighting) will also result in changes in the way lighting is used in households, and in the norms and expectations of households and communities.

Arising from this approach to understanding behaviour change, the key research questions are:

1. Has the introduction of solar technology brought about changes in practices and norms?
2. To what extent do the changes in practice involved with pico-lighting have either a good or poor fit with existing norms around lighting?
3. At what point might any shift in household norms become a tipping point for more widespread adoption of solar lighting solutions?
4. What is the consumer life cycle of the pico-lighting? (How long are the lights lasting? What happens to the lights when they have stopped working? What are consumers doing to ensure the lights last as long as possible?)
5. How have the lights enabled, or not, paid work opportunities?

## 12. **Researcher or instructor experience and qualifications in this research area:**

Dr. Rebecca Ford is part of the Energy Cultures research team at the University of Otago, and has been using the Energy Cultures framework to structure her research over the past year. She has a background in investigating household energy consumption and behaviour change using quantitative research methodologies, and has more recently been involved in a piece of work developing a framework for evaluating energy efficiency interventions.

Dr. Sara Walton completed her PhD using qualitative research methodologies and is experienced in the area of semi-structured interviewing techniques. Dr Walton also used ethnographic approaches for case studies on the West Coast. She has also been researching environmental entrepreneurs through both qualitative and quantitative methods for a number of years.

Seth Gorrie is a New Zealand born Samoan postgraduate who has recently completed his Geography Master’s thesis doing research on responses to new energy technologies in Samoa. His thesis has been examined and he is due to graduate shortly. Seth used semi-structured interviews and qualitative analysis in his research.

David Swete Kelly has a longstanding history of working with Australian Aid and with people from the Pacific Islands in a variety of projects. His areas of expertise are in project design/development and program evaluation using, in particular, soft system methodologies. He has conducted over 120 trips to (amongst other places) Vanuatu, Philippines, Papua New Guinea, East Timor, Hawaii, Vietnam and Fiji, working in areas of Sustainable Development.

### 13. Participants

#### 13(a) Population from which participants are drawn:

The population covers the rural area in Vanuatu in which three NGOs have been providing access to pico-solar lighting solutions. Participants will be selected from those communities who have been exposed to the new technology.

#### 13(b) Specify inclusion and exclusion criteria:

Participants will be over 18 years of age, and able to communicate using either English or Bislama.

#### 13(c) Estimated number of participants:

20-40

#### 13(d) Age range of participants:

18 +

#### 13(e) Method of recruitment:

Recruitment will be mainly via word of mouth through Australian Aid employees and NGOs involved in the roll-out of the pico-lighting, to identify families that have taken up the new lighting. David Swete Kelly has existing working relationships with those people involved in Australian Aid's "*Lighting Vanuatu*" program, who will help to facilitate access to rural communities. There is also an Australian Aid employee, based in Vanuatu, who will form part of the "in country" team collecting data. Whilst he will not be involved with the interviews conducted by the University of Otago staff, he will be running focus groups for Australian Aid's own research in the same communities. Recruitment requests will be face-to-face as that is the norm in the Pacific.

#### 13(f) Please specify any payment or reward to be offered:

No payments or rewards will be offered.

### 14. Methods and Procedures:

The fieldwork will consist of a mixture of observational data collection and interviews. As the study population exists in a culture different from the researchers it is important to acknowledge that there will be significant cultural learning and this will most likely occur through observational research.

Semi-structured interviews (see Appendix A) will be conducted and these will be the primary form of data generation. The researchers will conduct interviews with the help of a local translator (if needed), and these interviews will be recorded and will involve the use of consent forms and information sheets (translated if needed). The interviews will be with members of the rural communities in which the three NGOs involved with

Australian Aid's "*Lighting Vanuatu*" project have been selling pico-solar lighting products.

The interviews will involve topics centred on the use of the lighting in people's homes. This will include an exploration of the lighting technology in the home (i.e. are they using solar lamps or the more traditional kerosene ones), what it was that made this technology seem like the best (or only) choice, how they are using the lamps in terms of time of day and which family members, and what their expectations of the technology are. We will also ask participants to take photos to illustrate how they typically use the solar lamps. We will provide a digital camera to do this.

Timetable:

At present we have one trip planned for October 2012 for Dr Rebecca Ford, Seth Gorrie and David Swete Kelly to travel to Vanuatu. The trip will begin in Port Vila where accommodation will be in a hotel organised by Australian Aid. From here they will travel to the rural communities where the NGOs have been delivering pico-solar lighting. Here the accommodation will be in guesthouses, also organised by Australian Aid. It is not expected that they will stay in the villages where they will be collecting data, but if this does occur it will be in a guest bungalow.

We acknowledge the Pacific Island Research Protocol as a useful tool in conceptualising and operationalizing important aspects of the research. Please see below for how we see these principles being used in our research.

University of Otago Pacific Island Research Protocol Principles	<i>Lighting Vanuatu Through The Energy Cultures Lens</i>
Maximising benefits to humans	Our aim is to generate knowledge that helps communities and in particular the delivery of residential lighting solutions in Vanuatu. We will work with Australian Aid and the local NGOs to assist them with things that they want to know.
Relationships	Building relationships is at the heart of this research. We aim to create collaborative relationships with all the groups we are involved with. If possible we will also engage with staff at the Uni of South Pacific in Port Vila.
Respect	We are humbled to be able to conduct this research around Australian Aid's " <i>Lighting Vanuatu</i> " project, and that they, and local community groups and NGOs, are willing to be involved in our research.
Cultural competency	We are aware of the majority of our team being pakeha (white European) researchers entering into the field with a different culture that we need to understand and respect. David Swete Kelly, with his rich background of work in Pacific Countries, and Leith Veremaito, who is an Australian Aid employee based on Vanuatu are helping us improve our cultural competency. Understanding aspects of Pacific culture has helped us back at Otago with PI students and made us appreciative of the culture (and temperature) shock they face when studying here.
Meaningful engagement	We understand that face-to-face communication is important in the Pacific and are prepared to spend time building meaningful relationships.

Reciprocity	Part of our relationship building is to offer to help with our research partners where possible. It is anticipated that while in Vanuatu opportunities will arise where we can give something back to the communities we are working with. Furthermore, it is our aim that the research will be of use to Australian Aid, to local communities, and also to other groups in the Pacific.
Utility	The aim of our research is to understand the impact of pico-lighting solution in rural communities in Vanuatu. Specifically the research is novel in that it aims to investigate the behavioural impact through a holistic lens, capturing not only the technology changes occurring, but also the practice changes and norm changes surrounding this. We understand that this level research has not been completed but would add value to existing research. We will be disseminating our results widely.
Rights	We will explain the research to all participants, provide them with the information sheet and ask them to sign a consent form. All participants will be treated with the utmost respect that we afford all our participants that we have dealt with.
Balance	Reflexivity is important in research – that is acknowledging the researchers’ role in the process. With such an approach knowledge is considered a co-creation between the participant and the researcher. As we are pakeha researchers part of our learning will be in understanding Vanuatu culture.
Protection	We will endeavour to protect any indigenous knowledge that we collect and safeguard it and know that it is not ours but acknowledge our participants in our study.
Capacity building	Working with people in Vanuatu and sharing our skills and knowledge is an important part of this trip. We will be working with local groups whilst in Vanuatu, and we will be offering to provide assistance to the NGOs in developing their own evaluation methods.
Participation	It is hoped that during our time in Vanuatu collaborations can be formed with local researchers in this area. We consider our relationship with Australian Aid and RDSM consulting as collaborative as they are involved in all stages of this research project.

**15. Compliance with The Privacy Act 1993 and the Health Information Privacy Code 1994 imposes strict requirements concerning the collection, use and disclosure of personal information. These questions allow the Committee to assess compliance.**

**15(a) Are you collecting and storing personal information directly from the individual concerned that could identify the individual?**

Yes. We will be recording the interviews with participants so information collected during this interview may enable individuals to be identified.

**15(b) Are you collecting information about individuals from another source? Please explain:**

No.

**15(c) Collecting Personal Information:**

- Will you be collecting personal information?

Yes.

- Will you be informing participants of the purpose for which you are collecting the information and the uses you propose to make of it?

Yes

- Will you be informing participants who will receive the information?

Yes

- Will you inform participants of the consequences, if any, of not supplying the information?

There are no consequences

- Will you inform the participants of their rights of access to and correction of personal information?

Yes

**If you are NOT informing them of the points above, please explain why:**

**15(d) Please outline your data storage and security procedures.**

All data will be confidential and anonymous. Only the named researchers will have access to the raw data. Data will be kept on Dr Rebecca Ford's laptop which is password protected. It will also be stored on a secure, password protected server.

**15(e) Who will have access to personal information, under what conditions, and subject to what safeguards?**

Only named researchers will have access to personal information collected.

**Will participants have access to the information they have provided?**

Participants may have access to their data if they request.

**15(f) Do you intend to publish any personal information they have provided?**

NO

**If YES, please specify in what form you intend to do this?**

**15(g) Do you propose to collect demographic information to describe your sample? For example: gender, age, ethnicity, education level, etc.**

YES

**15 (h) Have you, or do you propose to undertake Māori consultation? Please choose one of the options below, and delete the options that do not apply:**

(Please see <http://www.otago.ac.nz/research/maoriconsultation/index.html>).

YES We will be undertaking Maori consultation through the Otago University online tool.

**16. Does the research or teaching project involve any form of deception?**

NO

- 17. Please disclose and discuss any potential problems:** (For example: medical/legal problems, issues with disclosure, conflict of interest, etc.)

We do not foresee any potential problems. The team members will carry out a Health and Safety assessment prior to the fieldwork.

**18. Applicant's Signature:** ....  ..... (REBECCA FORD)

**Date:** .....31 July 2012.....

- 19. Departmental approval:** *I have read this application and believe it to be scientifically and ethically sound. I approve the research design. The Research proposed in this application is compatible with the University of Otago policies and I give my consent for the application to be forwarded to the University of Otago Human Ethics Committee with my recommendation that it be approved.*

**Signature of \*Head of Department:** .....

**Name of Signatory (please print):** .....

**Date:** .....

[Reference Number *as allocated upon approval by the Ethics Committee*]  
 [Date]



## **Appendix A: *Lighting Vanuatu* through the Energy Cultures Lens**

### **INFORMATION SHEET FOR PARTICIPANTS**

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

#### **What is the Aim of the Project?**

The aim of this project is to find out how the purchase and use of pico-solar lighting has affected other aspects of the way that you and your household use energy at home. We are interested in whether they way that you use lights has changed since you started using solar lamps, and whether your have noticed changes in other areas of your life that you can attribute to the use of the solar lamps.

#### **What Type of Participants are being sought?**

We are looking for participants from all areas of rural Vanuatu, who have either heard about, purchased or been given pico-solar lighting products. You must be over 18 years old and speak either English or Bislama.

#### **What will Participants be Asked to Do?**

If you agree to take part in this project, you will be asked to take part in an interview that may last 30-60 minutes. The interview will be focused on the way that you use solar lamps in your home, and we will also ask questions about whether or not you like using the lamps, and why you feel the way you do about them.

Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind.

#### **What Data or Information will be Collected and What Use will be Made of it?**

We will be collecting data in two ways. We will be making observations of how you are using solar lighting, and we may also ask to take some photos to illustrate where you are using the

lamps and where you are charging the batteries. We will also be collecting data through what you say in the interview.

The interviews will be recorded, so data will be collected on your responses to the questions we ask about solar lamps. We may also ask some personal data about your household, including ages of family members, and whether or not they go to work or school. We will ask this to get a fuller picture of the way in which your household uses lamps. The audio recordings will be translated and transcribed, but the information will only be shared with the research team.

The data collected will be securely stored in such a way that only the members of the research team (listed below) will be able to gain access to it. The data we collect during this research will be kept for **at least 5 years** in secure storage. The personal information we collect about your household may be destroyed at the completion of the research, but the data derived from the research will, in most cases, be kept for much longer or possibly indefinitely.

The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve your anonymity.

This project involves some amount of open-questioning technique. The general line of questioning will be about the lamps you use in your home. The precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops. Consequently, although the University of Otago Human Ethics Committee is aware of the general areas to be explored in the interview, the Committee has not been able to review the precise questions to be used.

In the event that the line of questioning develops in such a way that you feel hesitant or uncomfortable you are reminded of your right to decline to answer any particular question(s) and also that you may withdraw from the project at any stage without any disadvantage to yourself of any kind.

Results of the project will be made available to all participants at the conclusions of the study and at points along the way. At any time you are welcome to get in contact to ascertain the results of the study.

### **Can Participants Change their Mind and Withdraw from the Project?**

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

### **What if Participants have any Questions?**

If you have any questions about our project, either now or in the future, please feel free to contact:-

Dr Rebecca Ford

Centre for Sustainability, University of Otago

University Telephone Number:- +64 3 470 3577

Email Address [rebecca.ford@otago.ac.nz](mailto:rebecca.ford@otago.ac.nz)

NOTE: Between the 1<sup>st</sup> and 14<sup>th</sup> of October contact for Dr. Rebecca Ford should be directed through Leith Veremaito at Australian Aid's Governance for Growth Office in Port Vila. The contact telephone number is +678 27752.

This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

## Appendix B: Consent Form for Participants

[Reference Number as allocated upon approval by the Ethics Committee]  
[Date]

### *Lighting Vanuatu through the Energy Cultures Lens*

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:-

1. My participation in the project is entirely voluntary;
2. I am free to withdraw from the project at any time without any disadvantage;
3. Personal identifying information [audio files] will be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for at least five years;
4. This project involves an open-questioning technique. The general line of questioning will be about the way that my household uses lamps for lighting. The precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops and that in the event that the line of questioning develops in such a way that I feel hesitant or uncomfortable I may decline to answer any particular question(s) and/or may withdraw from the project without any disadvantage of any kind.
5. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand).

I agree to take part in this project.

..... (Signature of participant) ..... (Date) .....

This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

## APPENDIX C

Topic	Potential Questions	Reasoning
A. Contextual information	<i>I want to start by getting a picture of your everyday life. Can you describe a typical day to me...</i>	This is to try and gain an understanding of the participant and their patterns of everyday life, which is likely to be different to the researchers'.
B. Story of the lighting decision	<p>B1 Where did you hear about solar lighting?</p> <p>B2 Did you know anyone else who was using solar lights? What was their experience?</p> <p>B3 What did you like/not like about the lighting you used previously?</p> <p>B4 How much did you spend on kerosene? How much do you spend now?</p> <p>B5 Where did you buy the lights? How much did they cost? Did you have to pay upfront?</p> <p>B6 How many lights do you have?</p>	<p>These questions are designed to get an insight into the lighting technology owned and used by the household.</p> <p>We are also trying to understand the factors surrounding the participant's decision to purchase, or not to purchase, solar lights. This includes things like where they found information about the lights, whether or not they knew anyone else who was using them, and how the upfront and running costs varies.</p>
C. Daily use of lighting	<p><i>For each of these questions I'd like you to think about what you do now/what you did before you used solar lights.</i></p> <p>C1 Where do you use the lights?</p> <p>C2 When (in the day) do you turn the lights on and off?</p> <p>C3 Who is in charge of the lights?</p> <p>C4 Who in your family uses the lights?</p> <p>C5 What are the lights used for?</p> <p>C6 Do the lights run out of battery?</p> <p>C7 Where do you charge the lights?</p> <p>C8 How long do you charge the lights for?</p> <p>C9 Has this changed your daily habits in any way?</p>	<p>These questions aim to elicit a fuller understanding of the participant's energy practices in the home. We want to understand when and where the lights are being used, and how this might have changed due to switching from kerosene lamps to solar lamps.</p> <p>We are also hoping to find out how participants re-charge the lights, as this is something they would not have had to do with older technologies.</p> <p>It is hoped that these questions will give us a better picture of how the shift in technology has impacted on family practices and daily life.</p>
D. Moving forward	<p>D1 Would you want to have more solar lights?</p> <p>D2 What do you like/dislike about the solar lights?</p> <p>D3 What do you tell your friends and family about the solar lights? Do you recommend them?</p> <p>D4 How long do you think they will last before breaking?</p> <p>D5 What would you do if the solar light broke?</p> <p>D6 How would you feel about going back to using kerosene lamps again?</p>	<p>The objective of these questions is to find out how participants might want to use the solar technology in the future. We want to know about the appetite for more of the same or similar solar lamps, as well as for more sophisticated systems.</p> <p>We also want to understand how participants would react to failing technology, particularly given that this is a new type of technology for participants.</p>

Topic	Potential Questions	Reasoning
	<p>D7 What would you do if the kerosene lamp broke?</p> <p>D8 How much money would you pay for a system that could light your whole home?</p>	
E. Anything else?	<p><i>Is there anything else that you think I have missed or that you would like to add?</i></p> <p><i>Is there anyone else that you would recommend that I talk to?</i></p> <p><i>In terms of me getting a complete picture, would you be happy for me to take a few pictures that show how/where you use the solar lights and how/where you recharge the batteries?</i></p>	



12/208

Academic Services  
 Manager, Academic Committees, Mr Gary Witte

28 August 2012

Dr R Ford  
 Department of Marketing  
 Division of Commerce  
 School of Business

Dear Dr Ford,

I am again writing to you concerning your proposal entitled "**Lighting Vanuatu Through the Energy Cultures Lens**", Ethics Committee reference number **12/208**.

Thank you for your letter of 24 August 2012, responding to the Committee and providing your amended application, Information Sheet and Consent Form.

We would be grateful to receive a copy of your Research Permit for Vanuatu once it comes through.

On the basis of this response, I am pleased to confirm that the proposal now has full ethical approval to proceed.

Approval is for up to three years from the date of this letter. If this project has not been completed within three years from the date of this letter, re-approval must be requested. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing.

Yours sincerely,

Mr Gary Witte  
**Manager, Academic Committees**  
 Tel: 479 8256  
 Email: gary.witte@otago.ac.nz

c.c. Assoc. Prof. K R Deans Head Department of Marketing

# Annex 5: Aide Memoire

## Independent Completion Review Mission

### *Lighting Vanuatu*

10 – 23 November 2013

---

## Background

*Lighting Vanuatu* commenced in 2010 as a small two year project funded by Australian Aid. It aimed to increase access to small handheld solar lanterns for mainly rural households and thus reduce household dependency on the use of kerosene for lighting. Quality solar lanterns had become increasingly available by 2010, and offered a relatively low cost and viable alternative to kerosene lighting. The project was managed by the Energy Unit (now the Energy Department) of the Government of Vanuatu and implemented by two Vanuatu NGOs (ACTIV and VANREPA).

The project's intent was to deliver at least 24,000 solar lanterns to mainly rural Vanuatu through the use of a supply-side subsidy. This subsidy aimed to improve bulk purchasing power, and thus reduce the cost of imported lanterns.

Project funding was Vt38.0m<sup>37</sup>, of which Vt6.0m was managed by the Energy Unit for monitoring, evaluation and oversight purposes, while the remaining Vt32.0m formed the subsidy to ACTIV and VANREPA.

## Description of Activities

Australia has commissioned an Independent Completion Review (ICR) of *Lighting Vanuatu* as part of its standard quality processes. The ICR aimed to determine:

- The degree of adoption, and the specific contribution made by *Lighting Vanuatu* in facilitating this adoption,
- Any geographic, social or cultural trends evident in adoption patterns,
- Any economic or social benefits – both overall, but especially for women and youth,
- Specific changes in the lighting technology used by households,
- Changes in household practices associated with any shift in technology,
- Any changes in householders' perceptions of solar lighting, and the use of lights more generally,
- Changes in householders' perceived needs and aspirations with regard to lighting, and electricity more generally, and
- The effectiveness and sustainability of pico-lighting products and the pico-lighting marketing/distribution chain.

The Review included two key processes:

1. A survey of 1,450 beneficiary households across Vanuatu; and

---

<sup>37</sup> Approximately AUD0.426m

2. An in-country mission (10 to 23 November 2013) to further assess adoption patterns and the impact that small solar lanterns have had on rural family life. Tools used during the mission comprised:
  - a. Key informant interviews with all major stakeholders including:
    - i. the market/distribution Chain (VANREPA; ACTIV; Youth Challenge; VANWODS Microfinance; TVL; and others in the local private sector); as well as
    - ii. the project owners and other donors (the Energy Department; Australian Aid; the World Bank; NZAID; the ADB).
  - b. Focus group discussions with men, women and youth on six islands (Tanna, Efate, Malekula, Epi, Espiritu Santo and Mota Lava); and
  - c. Ethnographic enquiry and participant observation, as well as household and key informant interviews in numerous villages across the same six islands.

The mission team included representatives from the Energy Department, Australian Aid's Governance for Growth Program, and the University of Otago, along with an independent consultant, and local enumerators. Full Terms of Reference for the mission are outlined in Annex 1.

## Initial Findings and Recommendations

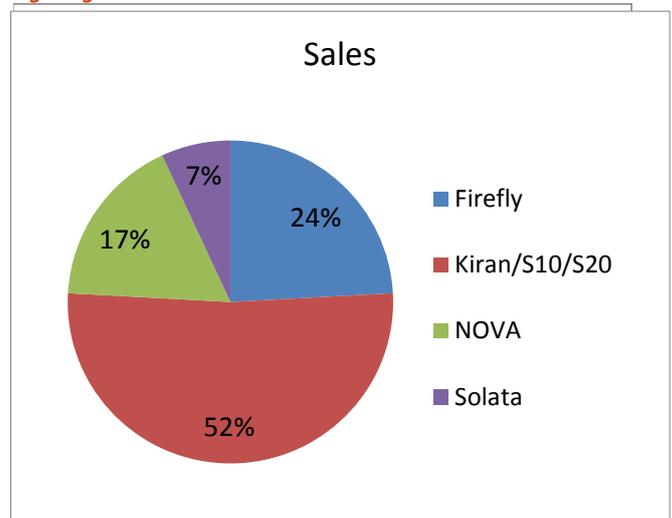
### Solar lantern sales

*Lighting Vanuatu* has significantly exceeded its target - between 55,000 and 60,000 solar lanterns have been distributed. The various products distributed by *Lighting Vanuatu* include the following:

3. ACTIV distributed the Firefly lantern produced by BareFoot Power. This accounted for about 24% of products sold; and
4. VANREPA distributed three *D.light* products including:
  - a. The various iterations of the Kiran/S10/S20 (dominating the sales at 52%);
  - b. The Nova (accounting for 17% of sales); and
  - c. The Solata (which accounted for 7% of sales).

It must be stressed, however, that not all of these products were available at the same time. At the start of *Lighting Vanuatu*, ACTIV quickly scaled up its already-established distribution of the Firefly, and thus sold substantial quantities in 2010/11. This earlier version of the product, however, had a Ni-Cad battery and lasted between 1-2 years. The Kiran lights, on the other hand, have a Lithium-ion Battery (LIB) with greater longevity (2 to 4 years). Thus by the time of the mission, very few of the early Firefly products remained, while the Kiran and its successors – the S10 and the S20 - have come to dominate the solar lantern market. Hence it is quite clear that since 2010 many households have successively bought and experienced several lights, and that in doing so they have grown to appreciate the features and capabilities of the various products.

Figure 10: Relative sales of solar lanterns sponsored by *Lighting Vanuatu*

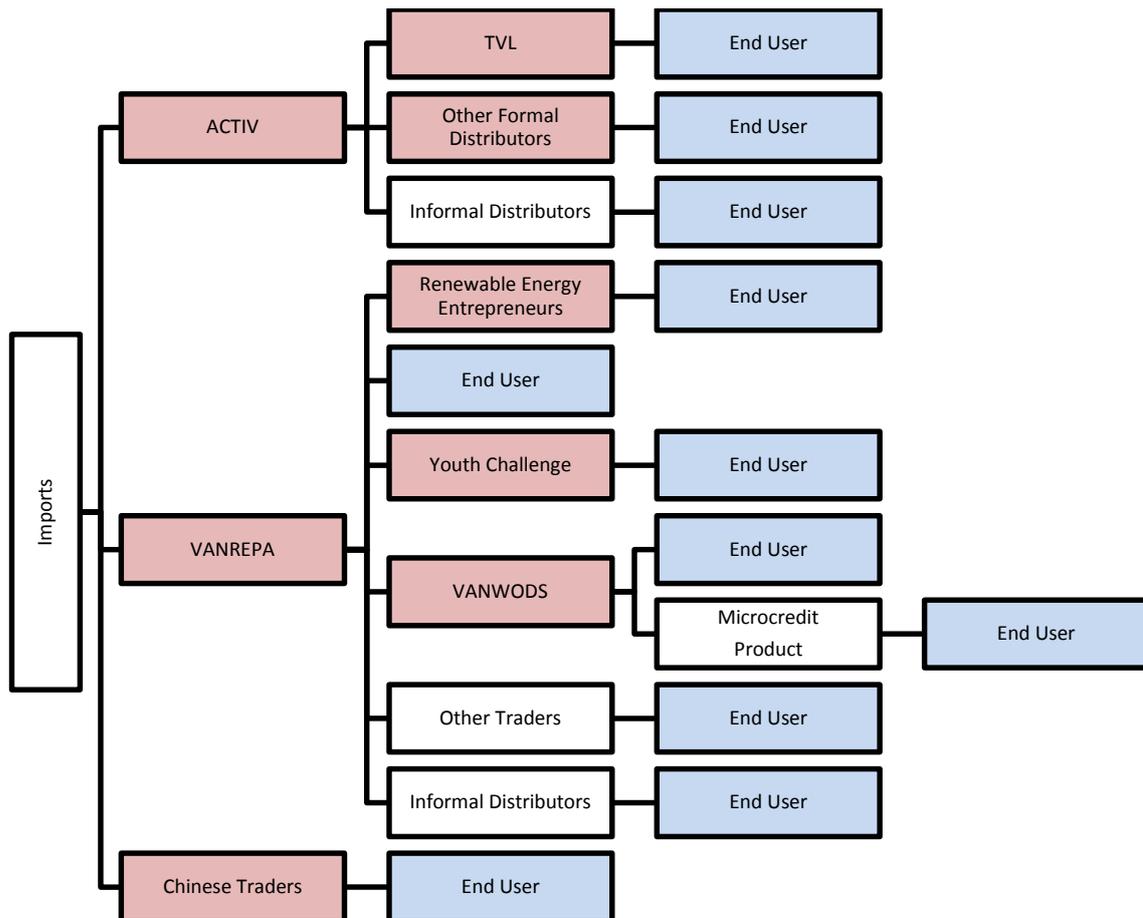


## Solar lantern distribution

The primary distributors of solar lanterns under *Lighting Vanuatu* have been ACTIV and VANREPA. During the mission the only other products seen were a limited range of low quality lanterns distributed by mainly Chinese traders. This confirms the importance of *Lighting Vanuatu* as a vehicle to establish the distribution of quality products.

ACTIV and VANREPA used different value chains (see Figure 11), however both chains inevitably involved significant local partnerships.

Figure 11: *Lighting Vanuatu* supply chains



1. For ACTIV this included the use of their already-established Fair Trade market networks. However, they also benefitted greatly from a partnership with Telecom Vanuatu Ltd (TVL). TVL was particularly interested in the Firefly because of its capacity to charge mobile phones and its relatively cheap price (cf the only comparable *D.light* product, the NOVA).
2. For VANREPA, distribution included very effective partnerships with VANWODS (a micro finance group) and Youth Challenge Vanuatu<sup>38</sup>. These groups were responsible for the significant expansion of VANREPA's distribution network, especially to the outer islands.

<sup>38</sup> Youth Challenge's engagement with the project was separately supported by Australian Aid

These channels resulted in differences in product distribution between the different islands (e.g. there were a higher proportion of Nova lamps in villages on Epi, while nearly all the Firefly lanterns seen during the mission were on Moto Lava), this being indicative of the differing strengths of ACTIV's and VANREPA's distribution networks. In contrast, the Chinese traders, while supplying increasing numbers of lights, have a network that is largely concentrated around the major population centres.

Unfortunately, with the completion of *Lighting Vanuatu*, a variety of circumstances have led both VANWOODS and Youth Challenge to withdraw from product merchandising, with the result that many communities are now uncertain as to where to buy (or replace) their current lights. This is likely to affect the long term distribution of solar lighting products, especially to the outer islands.

However, this trend is somewhat balanced by a developing private sector response to increased demand. Already VANREPA and ACTIV have established a number of new distribution partnerships including:

- other renewable energy suppliers;
- local and national traders and agricultural input suppliers; and
- the evolving interest of telecommunications groups.

Finally, the many varied and complex informal networks across Vanuatu should not be underestimated as a vehicle for technology distribution. Such networks are particularly hard to quantify, but the anecdotal evidence is clear – many households have sourced their lights through family, tribal and friendship networks across the country, as well as informal “agents” that had been established to place orders from the NGO suppliers on behalf of their respective communities<sup>39</sup>.

### Household Benefits

The diagram below reflects the primary features that Vanuatu communities consistently mentioned when discussing the advantages of solar lanterns (especially when compared with kerosene lanterns).

#### Ease of Use

By far the most commonly mentioned benefit was that solar lights are easy to use – especially when compared with kerosene lighting, where time and effort is needed to fill, light, trim and protect the flame. Lighting for any night-time activity (cooking, fetching water, cleaning, reading, baby care, toileting, sickness, etc) is now a simple operation involving the press of a button. Ease of use, then, seems to be the major driver for solar adoption and the substitution of kerosene lamps.

#### Safety, cleanliness and health

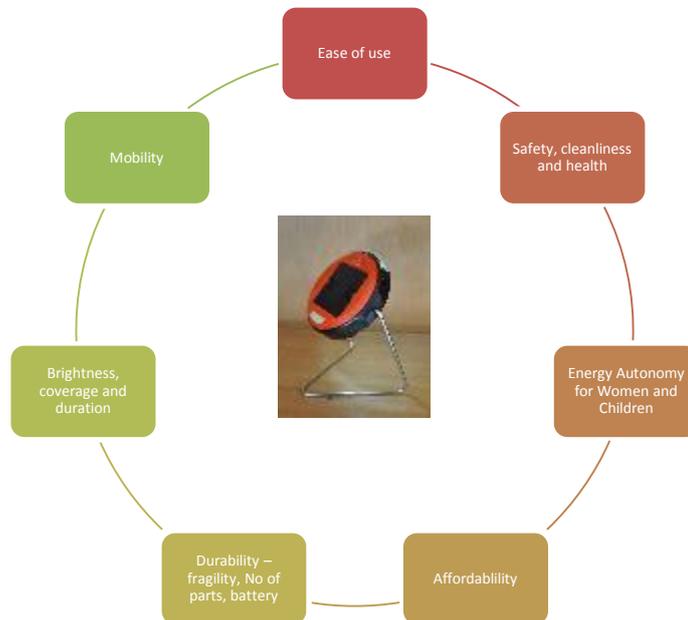
Safety is also an important issue. Solar lights completely eliminate the fear of kerosene lights falling down, causing fires, or blowing out during wind, storms, or because of general household activity. Children, the handicapped and the aged are all able to use solar lights without concern. This has also had broader community benefits – for example the mid-wife in Mota Lava can now

---

<sup>39</sup> For example, VANREPA also established ‘informal’ agents for the solar lights in Mota Lava and Epi, where the local agent would place orders directly with VANREPA on behalf of the community members.

attend reasonably well-lit evening deliveries, rather than relying on kerosene or the feeble light of a cell-phone torch.

Figure 12: Key benefits of solar lights identified by households



Solar lighting also avoids the need to handle and store kerosene in the home. Data on house fires is limited, but anecdotal comments consistently referred to a reduction in household fires (and a concomitant reduction in property loss and personal injury). Many households also reported that the shift to solar removed the “unpleasant smell of kerosene” – the use of solar eliminates the indoor air pollution associated with the burning of fossil fuels for light.

### Affordability

After the upfront cost of a solar light there should be no further associated costs, unlike the consistent financial outlay, and the significant time commitment, needed to source kerosene/fuel. Solar lanterns are therefore considered affordable by most households, and payback periods are relatively short (1-2 months). It is only the very under-privileged who cannot self-fund the purchase price.

### Durability

Again compared with kerosene lanterns, the durability of the better quality solar lights is seen as a key benefit. Dropping or tipping a kerosene lantern results in almost inevitable damage, while good quality solar lanterns survive everyday household handling with relative ease.

Furthermore, many households now easily distinguish between the products endorsed by the *Lighting Vanuatu* project, and the more fragile products sold by the Chinese traders. In addition, there is a growing appreciation of the durability of improved battery technology (LIB) that is now universally found in the *Lighting Vanuatu*-endorsed solar lanterns.

The issue of durability also reflects consumer preference for products with no removable parts. The Kiran/S10/S20 are well liked because there are no parts that can get lost; they are an all-

inclusive unit. On the other hand, it was commonly commented that the Firefly – with its separate panel, cables and connectors – was not so appropriate to the chaos of family life.

### Brightness, coverage and duration

There is a growing consumer appreciation of product specifications such as brightness, coverage and duration. The brighter the better for most household night-time tasks. Yet while almost any solar lantern is appreciably brighter than a kerosene lamp, there is a considerable differentiation between the brightness of competing products. For example, the newly introduced *D.light* S2 is in high demand not only because of its compact size and competitive price, but also because it has a brighter light that fills a room more effectively than the S20. Complementing brightness is the coverage of certain lights.

The duration of the light is - surprisingly - not as important an issue as it was initially thought. It appears that provided a light exceeds three to four hours on a single charge, then it is considered functional for most purposes.

### Mobility

Lastly, the mobility of solar lanterns is seen as a key benefit. Their capacity to be easily and safely moved, both inside and outside the home, opens up a wealth of opportunities for all members of the family. So much so, in fact, that in many households an easily mobile solar lantern continues to be used and valued even after an upgraded fixed PV lighting system has been installed. In terms of safety, many communities also noted that this ease of mobility was linked to resilience - they could easily transport to wherever was needed a long-lasting and durable lighting source in times of emergencies such as cyclones, flooding and earthquakes.

### Impact

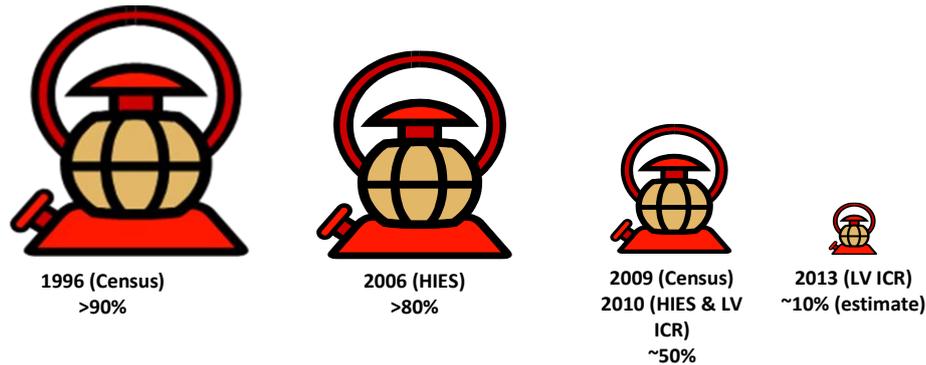
#### Kerosene use

*Lighting Vanuatu* seems to have been the right catalyst applied at the right time, and has thus been a key driver in the rapid and widespread adoption of solar lanterns across Vanuatu. Increased use of solar has also occurred concurrently with a massive reduction in the use of kerosene for lighting. As seen below, the number of households using kerosene or candles for lighting has been falling since 1996<sup>40</sup>, a trend that has been significantly accentuated in the last five years by the rapid adoption of solar lighting. Across the surveyed villages, the average use of kerosene for lighting is now estimated to be less than 10% (ranging from zero to about 20%).

---

<sup>40</sup> While these figures arise from different sources and different methodologies - the general trends are very consistent.

Figure 13: Reduction in kerosene use for household lighting



### Economic Impact

The key economic benefit associated with the use of solar lanterns is the net benefit derived from not having to outlay regular funds for the purchase of kerosene. This, however, should not be interpreted as “savings” - the mobilisation of cash occurs on an as-needed basis in Vanuatu.

There were many examples given of the increased opportunity for evening work enabled by solar lanterns, including: sewing, weaving, kava preparation, and night fishing. The majority of these reflected opportunities for women, although quantification of this was not possible. There is some concern that women are now working longer. However, most women talked about this in a positive, social sense – small groups of relatives or friends coming together to work on weaving, sewing or handicrafts.

### Social Impact

The primary social benefit is associated with the “convenience” of solar lights. The characteristics outlined in Figure 3 epitomise the various aspects of “convenience” valued by householders.

Other socially relevant impacts include:

1. **Energy Autonomy for Women & Children:** Within the communities visited, the benefits of small solar lanterns, while quite ubiquitous, were most apparent for the women. Inevitably, it was the women who were most impassioned about the benefits of light in the home - it was seen to be largely women who instigate the purchase of solar lanterns, take responsibility for the lights, and ensure they are placed in the sun for charging, and protected from the elements. This means that women are now playing a greater role in the management of the household’s energy and lighting than they generally have in the past, when they often had to wait for the husband to return from the store in order to start the generator or light the kerosene lamp. Furthermore, the worry associated with children handling kerosene lamps has been eliminated. A child’s access to light is now much more liberal and independent.
2. **Increased opportunity for social interaction:** People regularly mentioned the use of solar lanterns for village and inter-village functions. While lighting also brings with it opportunity for some anti-social outcomes, none were mentioned during the extensive survey and interview process – although it may take time for communities to fully appreciate both the upside and downside of improved and mobile lighting.
3. **Education Benefits:** There were regular comments regarding the capacity for children to now undertake educational pursuits in the evening. It was hard to confirm the veracity of this (or whether it was more parental aspiration), yet most parents mentioned the opportunity for school age children to study independently (and safely) in the evenings. A more

substantiated outcome was found in boarding schools and colleges where the fear of fire has, in the past, resulted in a ban on kerosene lamps and candles. However, students are now able to continue their study, both individually and in groups, after the general lights-out (which in many boarding schools occurs quite early).

4. **Norms and aspirations:** Finally, there is clear evidence that solar technology has significantly changed people's norms and aspirations. There is now an almost complete aversion to kerosene, with the thought of ever going back to it an anathema. The lights have changed the convenience and opportunity for multiple night-time activities, and in fact all people interviewed aspire to further improvements in their household lighting - firstly with fixed lighting, and then for the power to operate small appliances.

### Environmental Impact

There has been considerable concern about the environmental impact of solar lanterns. There was an assumption within the *Lighting Vanuatu* design that proponents could establish systems for return, repair or recycling functions. However, it became apparent during the mission that efforts by VANREPA and ACTIV have been largely unsuccessful, especially in the more distant islands. It was clear that almost all broken lights remained in the community. Some were dumped, most were still in the home, and many were re-engineered for parts and used in any and every way they could to be made useful again. It was apparent, however, that the availability of simple vocational electrical skills in remote communities would see many more of these lights usefully repaired.

### Future Trends

#### Product differentiation

Over the term of *Lighting Vanuatu*, consumer experience, needs and aspirations have led to a clearer appreciation of product capabilities. One result of this has been a clear differentiation of the functions that small solar lights in the home are capable of filling.

The various lights distributed under the *Lighting Vanuatu* program differ with respect to their 'benefits' as listed above. Whilst many households indicated a preference for the Kiran/S10/S20, particularly for general and mobile use, other households (especially those with access to more than one type of light) talk about the benefits of the different lights for various purposes. The Nova is preferred by some households, as it provides them with a bigger lighting system with multiple brightness settings and an opportunity to charge their phones. Other households prefer the Firefly and Solata models, as these are more focussed light sources that are perceived to be better for study.

With the increasing prevalence of solar lighting, and the availability of different types of solar lights, households are clearly not using all the products equally, and this is important when considering future distribution and uptake of solar products. The simplistic notion that a light is a light, is now being challenged as families identify the concurrent need for the following:

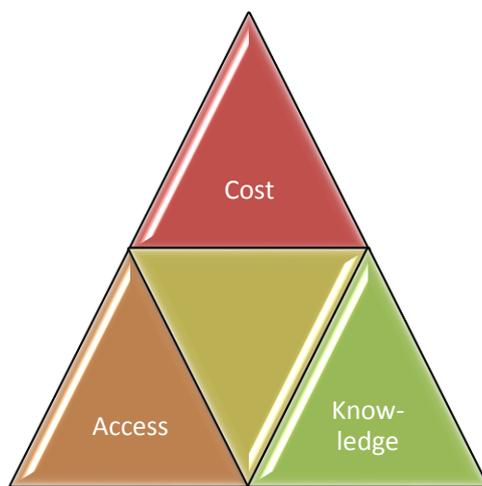
4. Standby/emergency light: Most families have a torch for urgent use, with a clear preference for the battery-powered LED lanterns – these are especially necessary for when solar lights fail due to insufficient charging.
5. Solar mobile light: The need for a simple and mobile all-in-one unit for indoor and outdoor activities – the Kiran/S10/S20 and new S2 units suit this market well. This is a huge market seeking more affordable, durable and brighter lights.

6. Solar phone charging: The majority of solar lanterns sold through *Lighting Vanuatu* did not have this capacity. However, the Firefly and the Nova were valued for this function. Many of the current, higher priced solar lanterns (e.g. the new 1.5W Firefly with the LIB as well as an increasing range of 5 to 20W systems) may well bring phone charging capacity into the home. However, the general trend is still to get your phone charged at the nearby home or business of someone with access to a generator or larger PV system, at a cost ranging between Vt25 and Vt100 per charge. The scope for central charging stations therefore seems significant.
7. Solar fixed light: Fixed lighting is needed for:
  - a. space lighting;
  - b. security lighting; and
  - c. the brighter, more concentrated illumination of detailed endeavours (reading, writing, weaving etc).

More and more families are now upgrading to larger multiple light, PV panel-based, fixed lighting systems to meet these needs.
8. Fixed light and power: Finally, most families aspire to a system that can provide both light and power (primarily for entertainment). There has been a significant reduction in the cost of these systems, leading to increased availability and adoption. In particular, those families who have joined the New Zealand seasonal work program seem to have targeted the purchase of these larger PV Power Systems.

### Supporting future demand

The key factors that households consider when making a decision about lighting (or power more generally) are:



- cost,
- access (Where can we get it? Can we get it serviced?), and
- knowledge (What is the best for my need? Which products are quality assured? ).

It is clear that all three are important, however those interviewed consistently mentioned that knowledge and access were the most difficult of the three, while de-emphasising the costs, particularly for the smaller or lower cost systems.

Many families are able to visualise ways to meet the cash requirement. Instead, they have limited knowledge and poor access.

### Implementation Arrangements

The project attempted to ensure accountability and assess the distribution patterns of solar lanterns through the collection of consumer receipts. This put a huge pressure on the distributors to ensure the return of receipts from users, often at the end of very long supply chains. In reality this became a monumental, but largely unachievable task. In retrospect, both the accountability and learning aspects could have been covered by other, more efficient methods.

## Next Steps

Over the term of *Lighting Vanuatu* there have been ongoing developments in the solar lighting market. Not only have better and cheaper lanterns become available, but the price of small PV systems has dropped significantly. Australia's short, sharp subsidy through *Lighting Vanuatu* has not only been a significant catalyst in the adoption of solar lanterns, but it has also raised the awareness of solar power technology across Vanuatu. No further general donor support for the small solar lantern market is therefore considered necessary.

That said, however, consideration may be given to:

- Supporting the very underprivileged to access lanterns;
- Monitoring the capacity of the private sector to maintain supply chains to remote islands; and
- Improving public access to impartial consumer information on product quality.

While little further support to solar lanterns is needed per se, consideration could nevertheless be given to other ways of supporting household lighting in Vanuatu, e.g. small PV units capable of providing households with both fixed lighting and some extra power (primarily for phone charging, communication and entertainment). Consideration by the World Bank, NZAID and Australian Aid of opportunities for the provision of these under the proposed Vanuatu Rural Electrification Program (VREP) is therefore endorsed.

# Annex 6: *Lighting Vanuatu* - A Case Study

Cle-Anne Gabriel, Dr Sara Walton, Dr Rebecca Ford, Dr Adam Doering, David Swete-Kelly

16 January 2014

---

## Introduction

Vanuatu has an estimated population of 230,000 and an estimated electrification rate of only 27% - approximately 30,000 households still rely on kerosene and/or wood for lighting. Particularly for the 34,000 households living in Vanuatu's rural areas, access to clean, safe and affordable lighting has been identified as a development priority by the government and other stakeholders, as traditional fuel dependence is estimated at 79% (UNDP, 2013). Two NGOs in particular, the Vanuatu Renewable Energy and Power Association (VANREPA) and Alternative Communities Trade in Vanuatu (ACTIV), saw the need for portable pico-solar lighting products to replace kerosene as the source of lighting for households. However, having realised that they were unable to maintain a large enough supply to meet the growing demand for the solar lighting products, both NGOs sought the assistance of Australian Aid to provide a supply-side subsidy that would enable them to scale-up their supply of the products.

As a result, *Lighting Vanuatu* started on June 1st 2010, as a two-year project with the aim of improving access to pico-solar lighting products for households. Specifically, the project had a targeted distribution of 24,000 lanterns, with more than 70% to be distributed in the more remote areas outside Efate Island and Luganville. The *Lighting Vanuatu* project included a Vt38.0 million subsidy, of which Vt6.0 million went to the Government of Vanuatu's Energy Department for project administration, and the remaining Vt32.0 million was a direct subsidy to VANREPA and ACTIV, to enable the purchase of products in bulk, thereby reducing the importation costs of the solar lanterns. In their "Proposal for assistance to achieve wide-scale distribution of pico-solar products in Vanuatu", ACTIV and VANREPA mention that pico-solar products can facilitate the end of kerosene dependence, if barriers such as geographically dispersed markets, low quality products, limited awareness, financial constraints and the commercial risks of scale-up could be overcome. From the research we conducted it would seem that The *Lighting Vanuatu* subsidy has helped to remove some of these barriers.

This case study addresses and extends the discussion on a number of the research aims that have been set out in the ICR. In particular, this case aims to contribute to understanding the implementation efficiency of the *Lighting Vanuatu* project partners, as well as the project's impact on the sustainability of the Vanuatu market for solar lights:

1. **Efficiency:** To what extent have the project partners (ACTIV, VANREPA) implemented the project efficiently, i.e. with the production of equal or greater outputs than inputs? How could this efficiency have been improved?
2. **Sustainability:** What evidence is there that barriers to accelerated market uptake of pico-solar products in Vanuatu have been addressed? And to what extent has a domestic pico-solar industry which is commercially viable and sustainable been initiated?

## Background

The International Energy Agency's (IEA) 2012 World Energy Outlook (WEO) projects that by 2035, not only will non-OECD countries' share of global energy demand be about 64% (meaning that energy markets will be increasingly determined by developing economies), but also that the aim of providing universal energy access to the world's poor will remain elusive, and an inescapable characteristic of the world's energy situation (IEA, 2012). Currently about 20% of the world's population lacks access to electricity. 95% of these people are in sub-Saharan Africa or developing Asia (IEA, 2012, 2013). The IEA insists that neither business-as-usual nor the full implementation of proposed policies and commitments will solve this problem universally (IEA, 2012, p. 51). Thus, the energy issue is and will for the foreseeable future continue to be both pertinent and contentious (Worldbank, 2008). Additionally, the discussion of the ecological impacts of fossil fuels has also been a crucial part of the energy debate as the IEA projects a rise in energy-related CO<sub>2</sub> emissions that will correspond to an average global temperature increase of 3.6°C by 2035 (IEA, 2012). Renewable energies have therefore been touted as one of the solutions to some of these issues as they offer an ecologically cleaner and more socially acceptable means of meeting some of the projected increases in demand, as well as a more sustainable means of reaching rural, off-grid energy users in the developing world (Kolk & Buuse, 2012; Martinot, Chaurey, Lew, Moreira, & Wamukonya, 2002).

In the case of developing countries, a major research theme is the supply of renewable energies to rural areas (Worldbank, 2008), as they offer a particularly interesting opportunity for the development and use of decentralised/offgrid renewable energy infrastructure and technologies (Barnes, 2011; Reddy & Painuly, 2004). The suggestion is that renewable energy investment ought to concentrate on and be adapted to the "characteristics of decentralised systems of energy production" (Monroy and Hernández (2008) in developing countries (Glemarec, 2012; Rady, 1992) ENREF 6. Decentralised off-grid solutions have therefore been identified as arguably the best means of advancing the uptake of renewable energies in developing countries (Barnes, 2011; Glemarec, 2012; Rady, 1992), especially for increasing rural electrification and thus reducing energy poverty in remote rural areas (Sovacool, 2012; Worldbank, 2008).

The IEA defines energy poverty as the lack of access to modern energy services, defined as household access to electricity and clean cooking facilities, and views this issue as pivotal to attaining many socio-economic development goals in developing regions. Its 2013 analysis of energy access reveals that there has been little change in access to modern energy services globally, particularly in rural areas (IEA, 2013). In fact, much of the growth in electricity access has occurred in urban areas, causing energy poverty incidence to cluster around rural regions (IEA, 2013). Therefore, in response to the energy poverty challenge, a number of initiatives and programs have emerged, which offer various strategies for using the eradication of energy poverty as a means to many socioeconomic ends.

Recognising that the eight Millennium Development Goals (MDGs) designed to eradicate extreme poverty by 2015 did not include goals specific to facilitating universal access to energy (IEA, UNDP, & UNIDO, 2010), there has been a call for energy poverty to be included in the Post-2015 Development Agenda (UN, 2013). Thus, Post-2015 Development Agenda stakeholders have called for sustainable development to be placed at the core of all future development efforts (UN, 2013). In support of the United Nations General Assembly's declaration of 2014-2024 as a Decade of Sustainable Energy for All, the Sustainable Energy for All (SE4All) initiative continues to work towards three main goals:

ensuring universal access to modern energy services, doubling the global rate of improvement in energy efficiency, and doubling the share of renewable energy in the global energy mix ([UNDP, 2013](#)). SE4All's Global Tracking Framework has piloted a framework for tracking progress toward the goal of sustainable energy for all ([SE4All, 2013](#)).

Towards the goals of rural electrification and eradicating energy poverty, access to off-grid lighting has been seen as a major first step ([Barnes, 2011](#); [Chaurey, Krithika, Palit, Rakesh, & Sovacool, 2012](#); [Woodruff, 2007](#)). The increasing focus on decentralisation and the current increase in available solar lighting products is seen as precursor to up-scaling to either more centralised lighting and electrification, or larger, fixed decentralised systems. The *Lighting Vanuatu* project may be compared to the Global Lighting and Energy Access Partnership (Global LEAP)'s *Lighting Africa* Initiative, whose aim was the distribution of "pico-powered lighting systems" (PLSs) to low-income households in Africa, of which solar LEDs are a subset ([LightingAfrica, 2013](#)). Though implemented on a much larger scale than *Lighting Vanuatu*, the high-rated challenges identified by *Lighting Africa* stakeholders are similar to those identified by ACTIV and VANREPA: lack of upstream access to finance, distribution challenges, lack of consumer awareness, and poor product quality/market spoilage ([LightingAfrica, 2013](#)). Regarding the use of solar power in the Pacific region in general, the Pacific Islands Applied Geoscience Commission (SOPAC) reported in 2007 that "early trials failed to live up to expectations due to short battery life, poor maintenance, lack of financial sustainability and inappropriate institutional structures" ([Woodruff, 2007](#)).

In many parts of the Pacific, these challenges persist. However, growing interest in rural electrification by international funding agencies contributes to the removal of institutional barriers, particularly financial barriers. However, the *Lighting Vanuatu* subsidy was also aimed at removing some market barriers that were peculiar to the Vanuatu situation. To some extent, the effectiveness and sustainability of pico-lighting products and the pico-lighting marketing/distribution chain, is influenced by whether and to what extent the barriers identified by VANREPA and ACTIV have been overcome, as well as the magnitude of the challenges that persist. Understanding the dynamics and evolution of the Vanuatu market will therefore inform our understanding of how the *Lighting Vanuatu* project contributed to overcoming the market barriers faced and stimulating the development of the Vanuatu market for pico-solar lighting and other renewable energy products.

## Method

The research was carried out over a two-week period, through an in-country mission led by a team of four researchers. Four local enumerators were employed to act as cultural and language intermediaries between the research team and respondents in the beneficiary communities. Where possible, the team was also accompanied by a representative of the Government of Vanuatu's Energy Department, or Australian Aid's Governance for Growth program.

## Research approach

A case study has been developed from the fieldwork utilising data on both the phenomena being studied (i.e. the adoption dynamic and the marketing/distribution chain for pico-solar lighting products through the *Lighting Vanuatu* project), and the context of that phenomena (i.e. Vanuatu, particularly rural Vanuatu). According to [Yin \(2009\)](#), the case study does just that; a case study may be defined as an "empirical inquiry that investigates a contemporary phenomenon in-depth and

within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident” (Yin, 2009, p. 18). This ability to simultaneously study phenomena within their contexts is a strength of a case study approach (Yin, 2009) and a key reason why this approach has been adopted here.

### Field work

Six Vanuatu islands were chosen for field work (Efate, Epi, Malakula, Motalava, Santo and Tanna) based on:

1. The results of a preliminary beneficiary survey conducted as part of a preliminary Implementation Completion Review (ICR) investigation. There were 1436 respondents in total, from 193 villages across 19 islands. See Annex 8 for a full description of the Beneficiary Survey.
2. The second step involved conducting field work in at least one island from each of the remoteness rank groupings<sup>41</sup>. The purpose of this second step was to ensure that data from even very remote areas would be included in our investigation. This is particularly important as one of the *Lighting Vanuatu* aims specifically concerns improving distribution and access in the rural / outer island parts of Vanuatu. Overall 10 villages were visited.

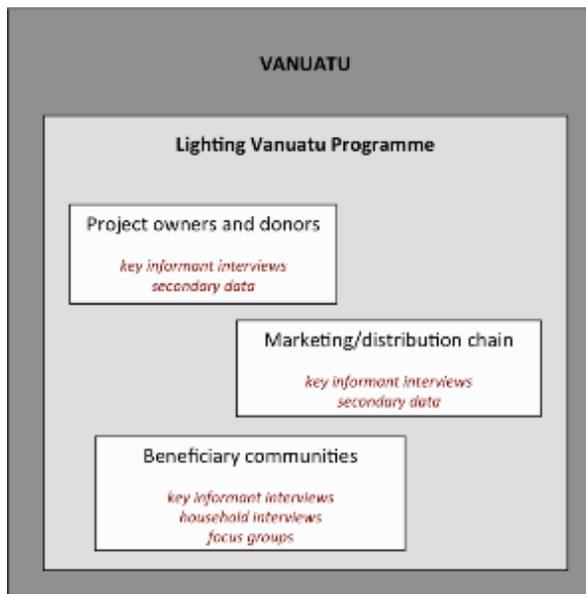
### Data generated

The data was collected using mainly key informant interviews and, where possible, interviews were combined with secondary data. This mixed method approach helped to provide a degree of triangulation, which improved the validity of the research findings, as the weaknesses of either data collection method are compensated by the strengths of another. Our data collection strategy is illustrated in Figure 14.

---

<sup>41</sup> The remoteness ranking took into account both flight and shipping schedules to each island – Efate and Espiritu Santo are ranked at 1; those with regular (daily or more) contact with either Port Vila or Luganville are ranked at 2; a Ranking of 3-4 reflects services 2 or more times per week; while a Ranking of 6 and 7 reflects services of once per week or less.

Figure 14 A single case embedded design for the *Lighting Vanuatu* case study, including the data collection methods used



Data was collected from the main stakeholders of the *Lighting Vanuatu* project, as follows:

1. **Marketing/Distribution Chain:** The key stakeholders identified within the marketing/distribution chain for the *Lighting Vanuatu* pico-solar products are VANREPA, ACTIV, Youth Challenge, Vanuatu Women's Development Scheme (VANWODS Microfinance), Telecom Vanuatu Ltd (TVL), as well as other members of the local private sector including local renewable energy entrepreneurs and other traders identified during the mission, such as a large number of Chinese traders, and stores such as the local agricultural supplies store. The primary methods of data collection for these groups were interviews and any secondary data collected (refer to Figure 14). In addition to visiting their shops, wherever possible the renewable energy entrepreneurs and traders were interviewed. For the traders, we were particularly interested in the types and variety of lighting products offered, and the quantity and frequency sold.
2. **Project Owners and Donors:** The key stakeholders identified as project owners and donors were the Government of Vanuatu's Energy Department, Australian Aid, the World Bank, New Zealand Aid (NZAID), and the Asian Development Bank (ADB). These stakeholders were interviewed and, where relevant, were also asked to supply supplemental secondary data to help deepen our understanding of not only their position within the *Lighting Vanuatu* project, but also their expectations in terms of the high level impacts and outcomes of the project.
3. **Beneficiary Communities:** The beneficiary communities selected on the islands of Tanna, Efate, Malekula, Epi, Santo, and Mota Lava were all visited by members of the team and, in each community, data was collected using interviews and focus groups, as follows:
  - a. **Key Informant Interviews:** These interviews were conducted with community leaders and elders, as well as any other individuals within each community identified as either playing a key role in the local distribution of the pico-solar products, or having an overview of the uptake of the products within the community. This group

invariably included the chief of each village, but also included school principals, shop owners and heads of other community groups for example.

- b. Household Interviews: These interviews were conducted with individual households within each of the villages visited. Wherever possible, the entire family, including both parents, children and all other extended family living in the same house, were gathered together and interviewed about their use of and daily interactions with their lighting products.
- c. Focus Groups: Wherever possible, at least two focus groups were held in each village, one each for men and women, in groups of 5 to 10. Additional mixed gender focus groups were also carried out, depending on the availability of time and other resources at the time of the visit to the village.

All focus groups, as well as the interviews with key retailers of *Lighting Vanuatu* products (i.e. VANREPA, ACTIV and Youth Challenge), were recorded and transcribed. For all other interviews, the daily journals and notes taken by each of the five members of the research team were the record-keeping methods used. The briefing carried out at the end of week two of the research mission was also recorded and transcribed, so as to capture the feedback and ideas offered by the stakeholders present, and incorporate it into the subsequent analysis and reporting.

## Findings and Discussion

This section outlines the findings from a business model – case study perspective. It looks at the value added through the supply/distribution chain and then uses these findings to discuss the efficiency and sustainability of the *Lighting Vanuatu* project.

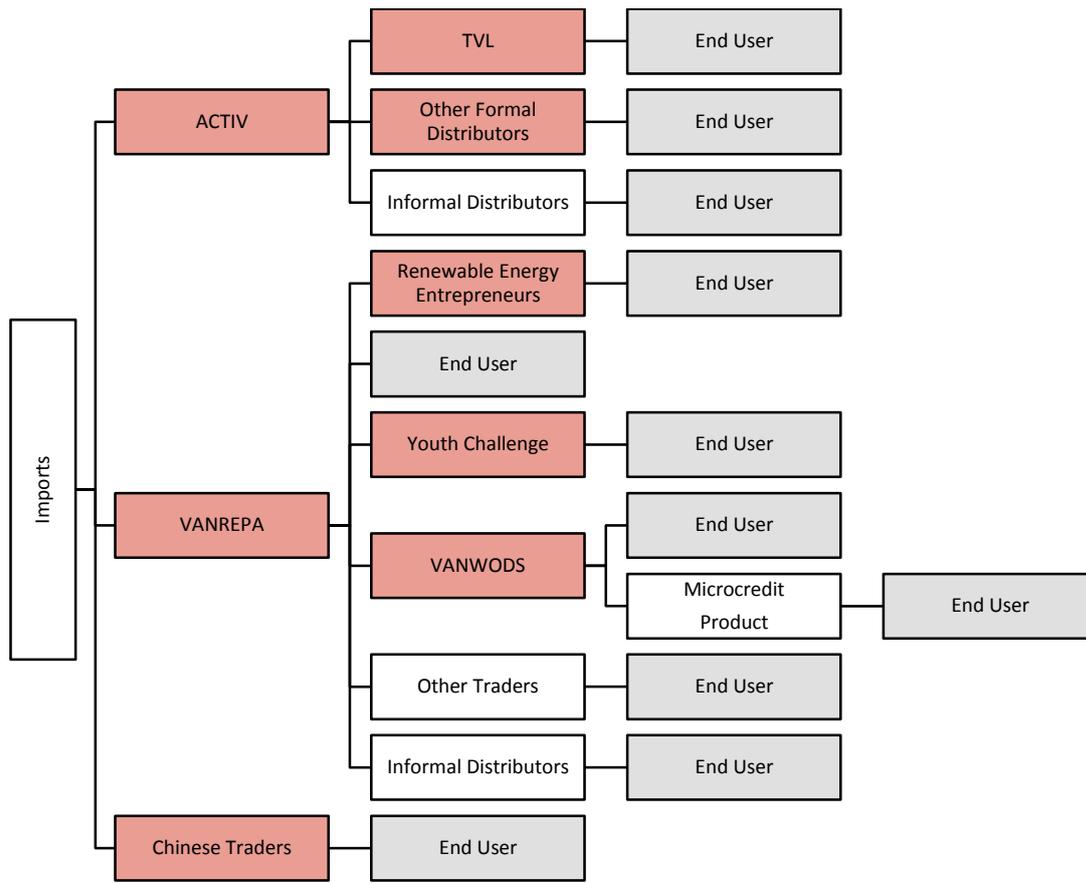
### Findings

Our interviews with the project's supply/distribution chain partners focused on the customer-oriented aspects of the NGOs' business models, such as the end-users' perceptions of the product and its price, and how key industry and strategic partnerships were leveraged to ensure customer outreach and satisfaction. One of the themes that resonated throughout our interviews with actors within the pico-solar lighting supply/distribution chain was sales and distribution. Vanuatu comprises about 60 islands, many of which are very remote (ACTIV & VANREPA, 2010). The *Lighting Vanuatu* NGOs discussed the challenge in accessing these markets. In particular, the NGOs mentioned leveraging already-existing ties with informal networks in the islands, in order to distribute the lights. As our informant at ACTIV explained,

*"...if we were selling directly, no problem – but selling directly, people have to come to [Port] Vila (the capital city) you know" (Key Informant, ACTIV).*

The challenge of geographically dispersed markets has been explained in the NGOs' "Proposal for assistance to achieve wide-scale distribution of pico-solar products in Vanuatu", and discussed in more detail in our discussion of the findings. Our analysis of the entire value chain, based on our interviews with key stakeholders and beneficiaries, has revealed the direct and indirect ways by which pico-solar products are reaching end-users in Vanuatu. These findings are summarised in Figure 15.

Figure 15: The supply/distribution chain for pico-solar products in Vanuatu



Findings from our fieldwork suggest that ACTIV, VANREPA and the Chinese Traders were the three main importers of pico-solar lighting products. While private renewable energy entrepreneurs imported a variety of other solar lighting products and solar home systems, the main sources of pico-solar product were these three institutions. For the Chinese traders, distribution seems to involve direct, point-of-sale contact with end-users. ACTIV leveraged its relationship with a number of mostly formal intermediaries, including its own fair-trade retail store, in order to get the lights to end-users. For VANREPA, we find that a variety of channels were used in distributing the lights to end-users. In addition to some direct, point-of-sale contact through its trading arm, Green Power, VANREPA's products were sold wholesale to other retailers and traders. VANREPA also engaged with Youth Challenge and VANWODS Microfinance, using their established networks to facilitate further, indirect distribution of the lights. Our informant at VANREPA explained that this is consistent with how goods and information are generally distributed in Vanuatu - "through informal distribution channels" (Key Informant, VANREPA).

### Business model analysis

There are three key aspects of the *Lighting Vanuatu* business model. The first is the use of NGOs who were able to tap into existing distribution channels within the country – this greatly affected the distribution and sales models used by the *Lighting Vanuatu* NGOs and their partners and intermediaries.

Second, a central and original aspect of the model is the relationship between public entities (aid donor organisation, Australian AID, and the Government of Vanuatu's Energy Department) and

NGOs. This relationship was nurtured and formally constructed as part of the project with the intention that *Lighting Vanuatu* would also help support the NGOs' own programs and intentions, particularly as they relate to energy access. A deeper look at this relationship revealed that an important catalyst of this relationship is the injection of the supply-side subsidy. This was integral to the *Lighting Vanuatu* project and the NGOs' ability to purchase the lights at a price that would enable rapid uptake. Additionally, the subsidy enabled the NGOs to address their need to match and surpass the increasing supply of low-quality solar lighting products on the Vanuatu market. Our investigation has since identified these low-quality products as "Chinese solar" (as they were referred to in our beneficiary interviews) products, sold by the many Chinese traders operating in Vanuatu.

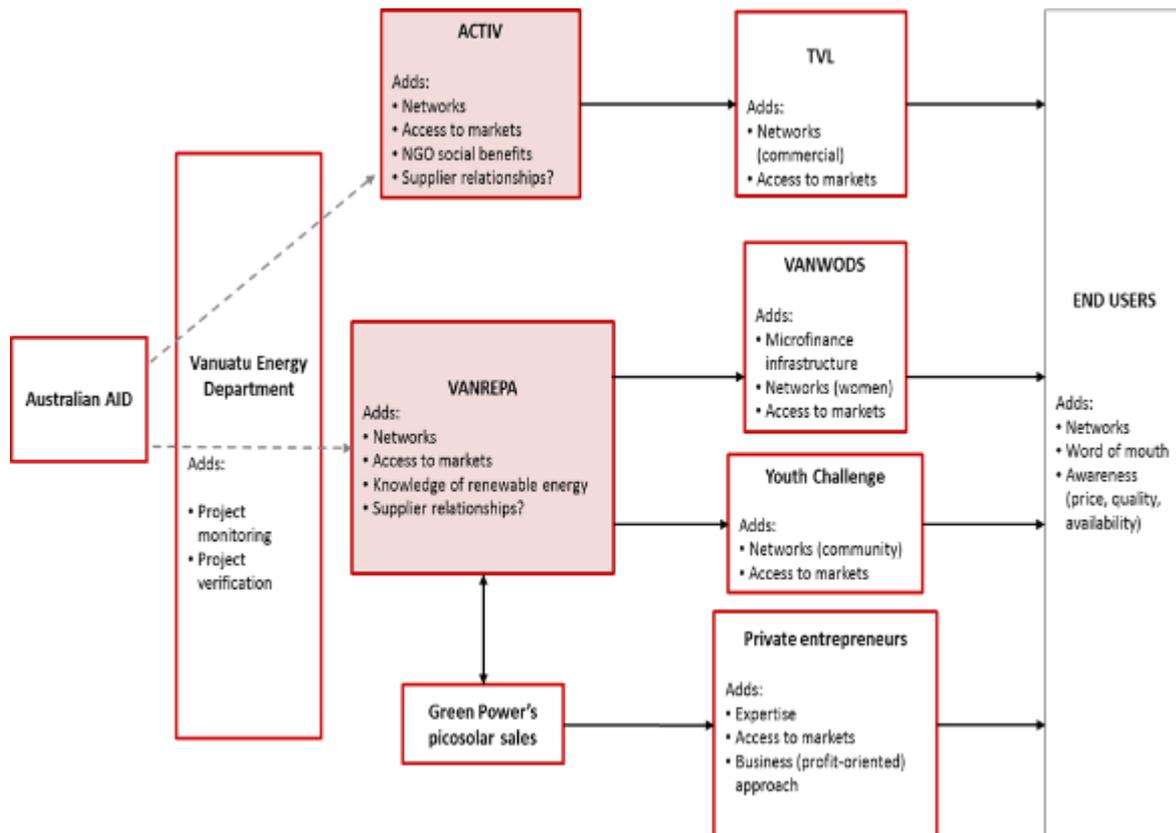
The third key aspect of the model is that consumers are paying a market-based, rather than a subsidised price for the lights. This aspect of the overall *Lighting Vanuatu* model seems to have been crucial to the sustainability of not only the pico-solar lighting market, but also the broader solar product market in Vanuatu, as end-users had generally realistic price expectations.

### 1. Distribution model – using NGO channels

Each of the NGOs developed their own way of engaging distribution channels. For example, as Figure 15 illustrates, ACTIV joined with Telecom Vanuatu Limited (TVL) to sell the lights as part of their mobile phone packages, while VANREPA sold its products to private businesses, individuals and informal channels that included community and family groups and representatives. The use of these distribution channels was one of the key sources of added value, as it contributed to the distribution of the lights throughout the islands of Vanuatu, even in the most remote island visited during our research visit, Mota Lava. In addition to facilitating distribution, the NGOs' ability to tap into these channels also increased awareness of product availability and quality throughout the country. Our informant at ACTIV identified access to distribution intermediaries as an important feature of *Lighting Vanuatu*:

*"actually the strength of this project, and the way we did it, is because we have this wholesaler, our groups on the Island, so that's why we could penetrate so quickly in the islands otherwise it will not be very quickly, or expensive for me to go down to an island"* (Key Informant, ACTIV)

**Error! Reference source not found.** below is a value chain analysis that highlights the value added at each stage of the pico-solar supply/distribution chain. The figure shows only the *Lighting Vanuatu*-influenced aspects of the pico-solar supply/distribution chain, thereby excluding the value chain for pico-solar products distributed by the Chinese traders and other private businesses who did not report receiving products from ACTIV or VANREPA, or one of their intermediaries. Intermediaries such as TVL, VANWODS and Youth Challenge introduced the added value of a greatly expanded network for distribution of the pico-solar products. In particular, the ability of TVL and VANWODS to incorporate the products into the existing product and service offerings demonstrates the market viability of the products, and indicates the potential sustainability of a future non-NGO driven supply base. Additionally, the distribution models adopted by ACTIV and VANREPA enabled them to capitalise on the specific knowledge bases of a wide variety of entities. Their engagement with private entrepreneurs enabled them to tap into their knowledge of renewable energy in general, while the inclusion of VANWODS added microfinance knowledge and capability, as well as access to highly marginalised end-users who may not have been reached otherwise.

Figure 16: Value added at each stage of the *Lighting Vanuatu* supply/distribution chain

The building up of extensive networking capacity for pico-solar-related information and goods seems to have been the major value added by the distribution models used by ACTIV and VANREPA. Not only did the engaged intermediaries enable the NGOs to improve their access to the market, but the intermediaries themselves benefitted from the supply capabilities of the NGOs. As our informant at Youth Challenge elaborated,

*“I mean VANREPA has been involved in this project...and especially the complication around the logistics of getting these here where they’ve got a knowledge and experience...we were willing to distribute the lights but we, we don’t necessarily, we don’t have a [capacity] to get those lights directly from the factory. So that’s why we used VANREPA” [Key Informant, Youth Challenge].*

The *Lighting Vanuatu* NGOs’ direct links to manufacturers enabled them to supply the products to their intermediary distributors such as Youth Challenge, who were previously unable to access manufacturers directly. Our findings suggest that this added value in particular was a direct result of the supply-side subsidy given to the NGOs through a public-NGO partnership, which allowed them to meet the costs of scaling-up their importation and supply of pico-solar products. However, this exclusivity involved with the manufacturers was not always beneficial to the sustainability of the project as the dependence on the NGOs to maintain the supply chain of solar lights did not always work out.

## 2. Public-NGO partnership and the supply-side subsidy

The *Lighting Vanuatu* business model was based primarily upon a relationship between the aid donor (Australian Aid) and NGOs. Public-NGO partnerships, particularly where the public entity is an aid donor, are a common feature of many energy access programs in the developing world (Kolk &

[Buuse, 2012](#); [LightingAfrica, 2013](#); [Sovacool, 2012](#)), as it is difficult to find business models or approaches operating without subsidy ([Kolk & Buuse, 2012](#)). However, the *Lighting Vanuatu* case may be unique, as our analysis of several secondary sources of data, including the “Proposal for assistance to achieve wide-scale distribution of pico-solar products in Vanuatu”, suggests that ACTIV and VANREPA were already involved in the distribution of pico-solar lights in Vanuatu. Both NGOs already had some experience regarding the need for better quality and awareness of solar lighting products on the market, and were in need of an injection of funds in order to scale-up their supply of pico-solar products. This therefore suggests that, though some supply of the products may have continued, without partnering with Australian Aid the NGOs may not have been able to achieve the same results. This partnership and the associated supply-side subsidy were therefore important catalysts for increased distribution and awareness and, consequently, are central features of the overall *Lighting Vanuatu* business model.

Also, during the field visit, we noticed that the incidence of Chinese traders, and ‘Chinese solar’ products, diminished significantly as we got to the more remote islands. As the ‘Chinese solar’ products have been identified as the lower quality products, this observation suggests an increased potential for uptake of higher quality products in these areas. The supply-side subsidy therefore seems to have not only facilitated a potential future NGO-manufacturer relationship, but may also have enabled the *Lighting Vanuatu* NGOs to either unseat or preempt the supply of ‘Chinese solar’ products in the more remote parts of Vanuatu. Additionally, the injection of a supply-side subsidy that facilitates the NGOs’ access to manufacturers, rather than a demand-side subsidy that would lower the price for end-users, also contributed to the end-users’ acceptance of market-based prices for the products.

### **3. Paying a market-based price**

This feature of the *Lighting Vanuatu* model is essential to overcoming what [Sovacool \(2012\)](#) refers to as a system of ‘givers’ and ‘takers’, where the utility gives electricity or donors give technology, and the consumers take it ([Sovacool, 2012](#)). *Lighting Vanuatu* seems to have this feature in common with a number of other access projects worldwide. These particular models work by ensuring that the selling price of the product is market-based because it allows private businesses in the same industry to not only purchase lights from the NGOs and distribute them, but also to have a fair chance of competing with them on the market. As a result, increased competition through the participation of private businesses on the pico-solar market facilitates greater price control, which further improves the affordability of the product for the end-user.

One price-related feature of the *Lighting Vanuatu* project is the inclusion of microcredit facilities for end-users at the Base of the Pyramid who are unable to afford even the market-based price. This was attempted by VANWODS Microfinance. However, rather than developing a microfinance product specifically for pico-solar lights, VANWODS simply opened up its regular microcredit facilities to include the purchase of products to meet some of the basic needs of its members, one of which was lighting. Our informant at VANWODS has indicated that this method of facilitating access to the lights worked very well for the institution, and would perhaps have continued were it not for an interruption in their supply from VANREPA. However, one interview with an informant at the World Bank’s Vanuatu office revealed that microfinance (on a large scale) has been approached with considerable caution to date, as it is relatively new to Vanuatu, and the potential effects of microfinance on the sociocultural and economic norms of the society are therefore unknown.

Going forward, particularly as the need for larger solar home systems has been indicated by the end-users (the increased expectations and aspirations of the villagers was striking – refer to Annex 7), and project partners alike (“that’s why we have also a big drop in the sale of the firefly, because now for the same guy, the firefly is not enough” (Key Informant, ACTIV)), the extent to which market-based pricing of solar products will continue is likely to be a key consideration.

## Discussion

Our discussion of the above findings focuses on the implementation efficiency of the *Lighting Vanuatu* project partners, as well as the project’s impact on the sustainability of the Vanuatu market for solar lights, as highlighted in the ICR.

## Efficiency

In order to assess the efficiency with which the project partners implemented the project, we focus on whether ACTIV and VANREPA produced equal or greater amounts of outputs (units sold – quantity and quality – and value added) than inputs (resources spent). Table 10 below summarises our findings in this regard. In terms of the choice of product where cost is a determining factor, solar LEDs appear to have been the ideal choice, as a comparison of the cost of illumination services reveals that, while a 0.74W battery flashlight, candles and a simple kerosene lamp (wick) cost approximately 60, 29 and 6 USD per 1000 Lux hours respectively, the 1W solar LED costs anywhere between 0.01 and 0.18 USD per 1000 Lux hours (UNDP, 2013). However, with the same funding, ACTIV appears to have used considerably less time to distribute its products, but sold fewer and lower-quality products than VANREPA. However it is worth mentioning at this point that as VANREPA continues to sell considerable amounts of *Lighting Vanuatu*-endorsed products to date (through its trading arm, Green Power), and in the absence of comprehensive records, we are unable to determine at which point VANREPA sold its share (12,000) of *Lighting Vanuatu* products. Therefore, it is difficult to establish a timeline for the completion of *Lighting Vanuatu* sales. Nevertheless, as ACTIV took 1 year to sell 15,000 units and to date, 3 years later, VANREPA has sold 40,000 units, we highlight the possibility that during the first year of the project both NGOs were distributing their products at roughly the same rate.

**Table 10 A brief assessment of the inputs and outputs of the *Lighting Vanuatu* NGOs during the project implementation period**

	INPUTS		OUTPUTS		
	Subsidy	Est. time to sales completion	UNITS SOLD: Quantity	UNITS SOLD: Quality	Value Added
<b>ACTIV</b>	Vt16.0 million	1 year	Approx. 15,000	<ul style="list-style-type: none"> <li><b>Battery life:</b> Too short</li> <li><b>Durability</b> (as reported by beneficiaries): Good, but “neck” breaks easily</li> <li><b>Light:</b> Good</li> </ul>	<ul style="list-style-type: none"> <li><b>Geographic dispersal &amp; awareness:</b> nearly all the Firefly lanterns seen during field visit were on Moto Lava</li> <li><b>Partnerships:</b> TVL interested in continuing to sell solar lights to charge phones; informal networks</li> </ul>
<b>VANREPA</b>	Vt16.0 million	Unknown	Approx. 40,000	<ul style="list-style-type: none"> <li><b>Battery life:</b> Good</li> <li><b>Durability</b> (as reported by beneficiaries): Very good</li> <li><b>Light:</b> new generation is better</li> </ul>	<ul style="list-style-type: none"> <li><b>Geographic dispersal &amp; awareness:</b> <i>d.lights</i> were found in every village visited</li> <li><b>Partnerships:</b> VANWODS helped BoP gain access; Youth Challenge for distribution; informal networks</li> </ul>

It is difficult to provide an accurate picture of the efficiency of implementation without comprehensive and reliable sales and distribution data from all partners involved. One approach would be to compare the inputs and outputs of *Lighting Vanuatu* to that of *Lighting Africa* but, given the immense differences in scales of the two projects, this is also not feasible. However, based on the secondary information collected on *Lighting Africa* so far, it appears that the approximately USD 160,000 subsidy received by each of the *Lighting Vanuatu* NGOs is considerably higher than the grants received in 2009/2010 by similar individual NGOs and distribution partners through *Lighting Africa* ([LightingAfrica, 2013](#)). All things considered therefore, though we are unable to determine definitively whether better could have been done with the resources provided, we may however speculate that at least the same may have been possible with less monetary input.

Still, we suggest that the efficiency of the distribution achieved by both NGOs may also be assessed by considering other factors, such as the quality of the products sold and the value added by their distribution, that are not easily measured. For instance, despite the limited numbers of ACTIV's Firefly products seen during our investigation (caused by short battery life and problems with durability), the ACTIV-TVL partnership may prove invaluable, as mobile phones and solar lights with phone charging capabilities are complementary products that will continue to be in demand, particularly in remote areas, in the short- to medium-term. Additionally, increased awareness and interest in pico-solar products in the rural areas is yet another value-added output to be considered.

There are however some ways by which the efficiency of the NGOs' implementation of the project may have been improved. First, our informant at ACTIV suggests that acquiring fewer of the same model would have been a better approach than acquiring large quantities of the same. This would better allow the NGOs to match the changing needs of the end-users and compete with new models, and other changing market trends. As the informant explains, "if today we have to start *Lighting Vanuatu* again, firefly would not be operated at all..." [Key Informant, ACTIV]. This situation has therefore affected ACTIV's market responsiveness. One suggestion therefore would be to allow for greater flexibility in terms of the kinds of products that can be imported under a subsidised scheme. However, this should only be done as far as quality concerns would allow. The products used by the *Lighting Vanuatu* NGOs appear to be consistent with those approved through the *Lighting Africa* initiative. Also, the point of the subsidy was to bring in significant numbers of the lights – in numbers that would be meaningful globally. In comparison with the numbers of lights going to Africa, Vanuatu is relatively small. Thus to help the NGOs develop supply channels and relationships, the larger numbers of lights purchased at one time was considered important to create and develop supply contracts for the lights. This leaves somewhat of a catch22 situation – larger numbers are needed to create supply contracts, yet bringing in large numbers of the same product is a risk from a sales point of view. The subsidy aimed to reduce the risk, but perhaps in future creativity with the type and amount of subsidy could be considered.

Another suggestion is the more hands-on involvement of the Vanuatu Energy Department in the supply side of the project. Due to issues with the supply of some of the lights from VANREPA to its network partners we observed the way in which the NGOs became crucial in the sustainability of supply. While the network partners (e.g. Youth Challenge and VANWODS) had demand for the lights at times they were unable to source the lights from VANREPA to on sell. As such, VANREPA became somewhat a bottleneck in the process of the distribution of lights. To reduce the risk of this occurring the Energy Department could become involved in the supply relationships so that there is

more than one party involved if something occurs in the relationship. Now that the Energy Department are expanding and developing roles this may be a more appropriate suggestion. The involvement of government not only ensures the longevity of the project's outcomes and impacts but, had the government played a more involved role, some of the distribution challenges observed, such as the cut-off of supply between VANREPA and Youth Challenge may have been avoided.

### **Sustainability**

In terms of the sustainability of the supply/distribution chain, the concerns are with the extent to which the barriers to accelerated market uptake have been addressed, as well as the extent to which a commercially viable industry has been initiated locally. Regarding the barriers to accelerated market uptake and considering our findings on the key features of the *Lighting Vanuatu* business model, Table 11 provides an analysis of the extent to which the barriers identified by *Lighting Vanuatu* NGOs have been addressed by the project itself.

Table 11 An analysis of the extent to which the barriers identified by *Lighting Vanuatu* NGOs have been addressed

Challenges	Description <sup>42</sup>	Challenge Overcome?	Comments
<b>Geographically dispersed markets</b>	As Vanuatu's population is dispersed across approximately 60 islands, a key challenge is that of making the products available for purchase to households living in more remote communities.	Yes	Informal distribution networks have been important for overcoming this challenge: village reps and family members have been able to get the products to some of the more remote islands. Additionally, the observed decreasing occurrence of low quality product in the more remote areas suggests considerable <i>Lighting Vanuatu</i> product (Barefoot Power Fireflies, <i>d.light</i> ) distribution to these areas.
<b>Low quality imports</b>	It is important to facilitate the wide distribution of high quality products, before low quality products enter the market in a more substantial way and 'ruin' the market for pico-solar products. Customers need to be made aware of the availability of high quality products to facilitate a positive, reliable experience with pico-solar use.	Somewhat	More high quality products are now available on the market, but our observations revealed that there is also a large quantity of low quality product available, at least in the urban areas of Efate, Tanna and Santo. However, without being able to stop other traders from importing low-quality products entirely, the challenge has been overcome somewhat, as villagers are generally able to discern the high-quality <i>Lighting Vanuatu</i> lights from lower quality products.
<b>Limited awareness</b>	As these products are relatively new, many consumers even within urban areas such as Vila and Luganville are not aware of them.	Yes	" <i>Lighting Vanuatu</i> was an extremely good investment in terms of improving access" (Key Informant, VANREPA). Our informants in ACTIV, Youth Challenge and World Bank agree.
<b>Financial constraints</b>	Experience suggests that there is a significant percentage of the rural population which have sufficient cash on hand to pay for these products up front. However, there are households and communities who may not be able to afford the upfront purchase of these products without some form of assistance.	Yes	The majority of the beneficiaries we interviewed appeared to be able to afford the lights. However, the fact that VANWODS found a fit between their product (microcredit) and the pico-solar product suggests that there is a segment of the market (albeit small) that is still unable to purchase in cash. But, do the end-users' signs of wanting more, and bigger systems point to their increasing ability to afford larger systems?
<b>Commercial risks of scale-up</b>	Small-scale entrepreneurs or NGOs in Vanuatu do not have sufficient incentive or the ability to raise the capital necessary to risk scaling up operations to facilitate wider distribution, even though such an approach is needed to create the 'critical mass' for growth.	Somewhat	The challenge of scaling up has been overcome by providing the grant, but now the NGOs and businesses are faced with "real" market challenges, such as competition and the seemingly large number of knock-offs/cheap product available in retail shops. However, this may be seen as a sign of the development of a "healthy" market. We should be concerned though if, in 2 years, there are no more good quality solar lights available on the market. Overall, it may be too soon to tell.

<sup>42</sup> Full challenge descriptions are provided in the "proposal for assistance to achieve wide-scale distribution of pico-solar products in Vanuatu" prepared by the *Lighting Vanuatu* NGOs.

We suggest that three of the five challenges have been largely overcome – geographically dispersed markets, limited awareness and financial constraints. Though the research team was unable to visit all remote islands in Vanuatu, in terms of the challenge of geographically dispersed markets we base our deductions on our observations of household pico-solar usage in communities across the different remoteness rankings. Also, our findings suggest that both product and price awareness have improved considerably – most of the households interviewed indicated that returning to kerosene and other traditional forms of lighting was not an option, and discussions of the cost savings incurred by investing their money in the pico-solar products suggest some understanding of the value of the product. In terms of the challenge of financial constraints, we cautiously suggest that the issue has been addressed as, in the absence of detailed financial data for each household, we are unable to determine if overall financial hardship within the households has been addressed. We therefore base our suggestion on the observation that most of the end-users interviewed paid market-based prices for their products and were willing to pay for them again. Therefore, we suggest that, because of the supply-side subsidy that enabled the products to be provided more affordably, most end-users in Vanuatu are able to afford pico-solar lighting. Regarding the challenge of low quality imports on the market, considerable amounts of low quality product are still available, but we find no evidence that these have overshadowed the presence of higher quality, *Lighting Vanuatu*-sponsored products on the market. We suggest instead that perhaps this is an indication of the development of a sustainable market for the products.

A market for solar lighting and other forms of renewable power did certainly exist prior to the initiation of the *Lighting Vanuatu* project as, in addition to the NGOs, private businesses and the Chinese trader shops made various forms of solar lighting products available to consumers. However, our observations suggest that the *Lighting Vanuatu* subsidy was a catalyst for the improvement and revitalisation of the market in many ways. Figure 17 maps the aforementioned five challenges faced by the *Lighting Vanuatu* project partners prior to implementation, as well as the ways these problems have been addressed by the project. In terms of the sustainability of the market, we observed both positive and negative effects of the project. Positive effects observed include the availability of better quality products on the market, increased awareness and uptake, the ability of the NGOs to scale-up their supply and reinvest their earnings into their operations, and the fact that end-users now have more choice than before and have started requesting larger systems.

The negative effects observed are increased competition from other products on the market that are not necessarily good quality, and the fact that keeping too much inventory of a single model makes it difficult for the NGOs to respond to market changes such as the introduction of newer models. However, though these issues have a negative effect on the competitive edge of the *Lighting Vanuatu* NGOs, they may be considered as indicative of the development of a “real” and potentially more sustainable market. Additionally, exposure to products of different levels of quality may also be an effective way to ensure that consumers understand the value of investing in higher quality products. Thus, limited competition in a market now fully exposed to better quality products may be an effective means of preventing the “market spoilage” experienced by stakeholders of the *Lighting Africa* project.

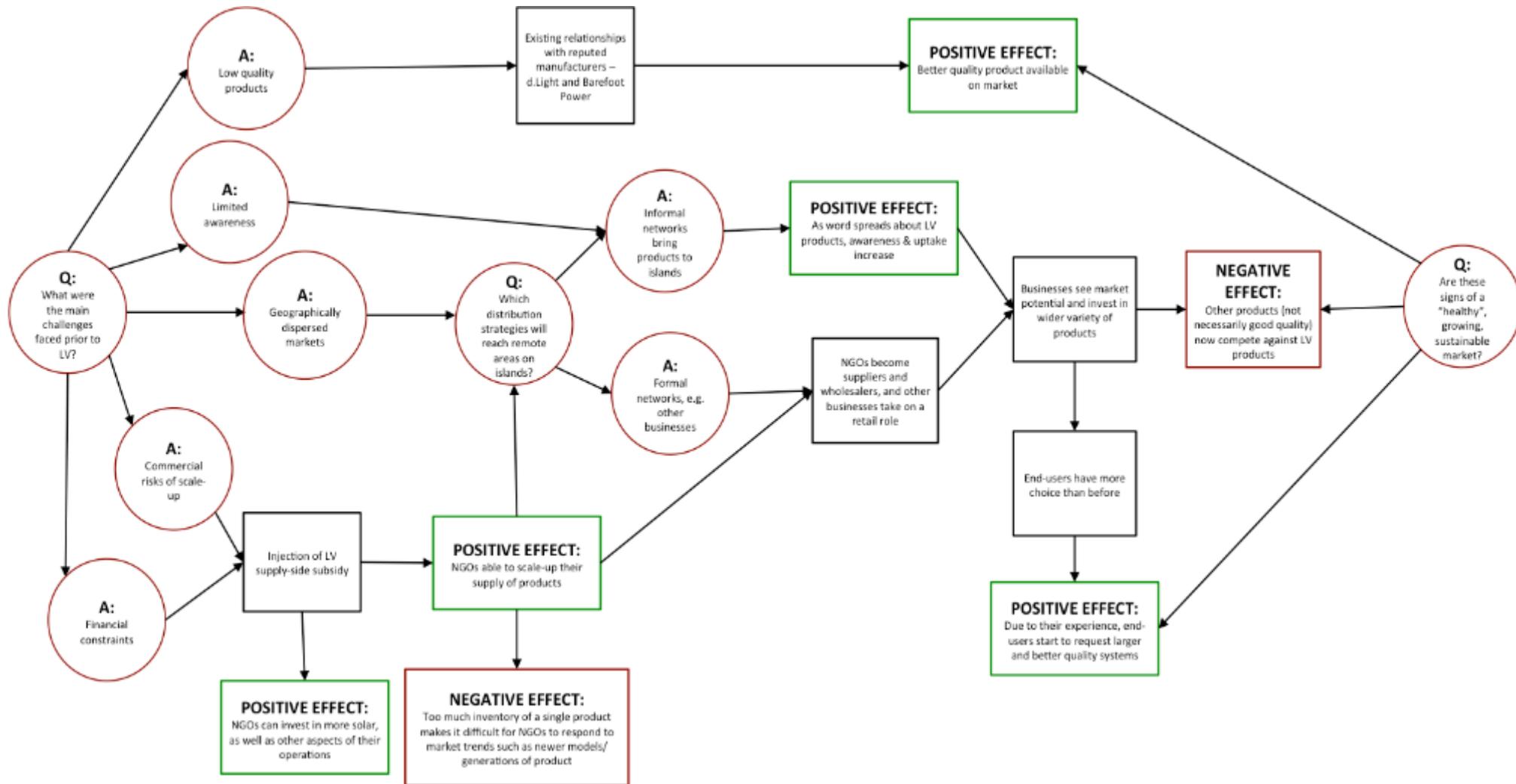


Figure 17 Lighting Vanuatu NGO Problem Map

Likewise, our informant at ACTIV discussed an important side effect of a subsidy and business approach that supports only one type of product. As the Firefly was the only product they were able to sell under the *Lighting Vanuatu* project, ACTIV was unable to respond to crucial market shifts such as consumer's demands for newer models, particularly those with longer battery life. However, this process of market learning and adaptation, particularly as VANREPA has since broadened its product line, appears to have been another key ingredient in the development of a sustainable pico-solar lighting market.

### Concluding Statement

Based on our two-week investigation of the *Lighting Vanuatu* market for pico-solar lighting products, we find that, in general, the challenges previously faced by ACTIV and VANREPA have been overcome. Indeed the issues that persist can be found in many "real" or unsubsidised markets, but this observation raises the question of whether subsidies for renewable energy technologies ought to continue indefinitely. Our findings suggest that a 'short, sharp' injection of funds may instead be the ideal catalyst for the initiation of a sustainable and commercially-viable market. Additionally, the enduring issue of competition with low quality products may be viewed as an effective means of preventing the "market spoilage" experienced by stakeholders of the *Lighting Africa* project.

We suggest that it is yet too soon to make an accurate determination of whether a sustainable market has been initiated. Certainly, we observed that many barriers have been removed, and have observed the emergence of competition, distribution networks, key partnerships and alliances for facilitating access (e.g. with TVL and VANWODS). However, another investigation may be required in about three years to determine whether and in what ways *Lighting Vanuatu* had a lasting impact on the market. Due to its small size and relatively remote, island nature, Vanuatu is perhaps an ideal system for observing such impacts.

- ACTIV, A. C. T. i. V., & VANREPA, V. R. E. a. P. A. (2010). Proposal for assistance to achieve wide-scale distribution of pico-solar products in Vanuatu.
- Barnes, D. F. (2011). Effective solutions for rural electrification in developing countries: Lessons from successful programs. *Current Opinion in Environmental Sustainability*, 3(4), 260-264.
- Chaurey, A., Krithika, P. R., Palit, D., Rakesh, S., & Sovacool, B. K. (2012). New partnerships and business models for facilitating energy access. *Energy Policy*, 47(Journal Article), 48-55. doi: 10.1016/j.enpol.2012.03.031
- Glemarec, Y. (2012). Financing off-grid sustainable energy access for the poor. *Energy Policy*, 47, Supplement 1(0), 87-93.
- IEA, I. E. A. (2012). *World Energy Outlook 2012*
- IEA, I. E. A. (2013). *World Energy Outlook 2013. Energy for All.*
- IEA, I. E. A., UNDP, U. N. D. P., & UNIDO, U. N. I. D. O. (2010). Energy Poverty - How to make modern energy access universal? Special early excerpt of the World Energy Outlook 2010 for the UN General Assembly on the Millennium Development Goals.
- Kolk, A., & Buuse, D. v. d. (2012). In search of viable business models for development: sustainable energy in developing countries. *Corporate Governance*, 12(4), 551-567. doi: 10.1108/14720701211267865
- LightingAfrica. (2013). *Lighting Africa Market Trends Report 2012. Overview of the offgrid lighting market in Africa.* In I. F. C. IFC (Ed.).
- Martinot, E., Chaurey, A., Lew, D., Moreira, J. R., & Wamukonya, N. (2002). Renewable energy markets in developing countries. *Annual Review of Energy and the Environment*, 27, 309-348.
- Monroy, C. R., & Hernández, A. S. S. (2008). Strengthening financial innovation in energy supply projects for rural communities in developing countries. *International Journal of Sustainable Development and World Ecology*, 15(5), 471-483.
- Rady, H. M. (1992). Renewable Energy in Rural Areas of Developing Countries: Some Recommendations for a Sustainable Strategy. *Energy Policy*, 20(6), 581-581.
- Reddy, S., & Painuly, J. P. (2004). Diffusion of renewable energy technologies - barriers and stakeholders' perspectives. *Renewable Energy*, 29(9), 1431-1447. doi: 10.1016/j.renene.2003.12.003
- SE4All, S. E. f. A. (2013). *Global Tracking Framework.*
- Sovacool, B. K. (2012). Deploying Off-Grid Technology to Eradicate Energy Poverty. *Science*, 338(6103), 47-48.
- UN, U. N. (2013). *A New Global Partnership: Eradicate Poverty and Transform Economies through Sustainable Development.*
- UNDP, U. N. D. P. A.-P. R. C. (2013). *Achieving Sustainable Energy for All in the Asia-Pacific. .*
- Woodruff, A. (2007). *An Economic Assessment of Renewable Energy Options for Rural Electrification in Pacific Island Countries. .* In P. I. A. G. C. (SOPAC) (Ed.), *SOPAC Technical Report 397.* Suva.
- Worldbank. (2008). *Designing Sustainable Off-Grid Rural Electrification Projects: Principles and Practices Operational Guidance for World Bank Group Staff.* Washington DC, USA: The World Bank.
- Yin, R. K. (2009). *Case Study Research - Design and Methods* (4th ed.). Thousand Oaks: SAGE Publications.

# Annex 7: Energy Transitions

Lighting in Vanuatu

Dr Sara Walton, Dr Adam Doering, Cle-Anne Gabriel & Dr Rebecca Ford

---

## Introduction

*Lighting Vanuatu* began in 2010 as a two-year project funded through The Australian Aid - Governance for Growth Program. The primary objective of the project was to increase access of portable solar lanterns for rural Vanuatu communities in an effort to reduce their dependency on kerosene as the primary source of household lighting. To achieve this goal the project offered a supply-side subsidy for two Vanuatu NGOs (ACTIV and VANREPA) to support the distribution of 24,000 solar lamps mainly to rural areas. The subsidy was aimed at improving bulk purchasing power by the NGO's in an effort to reduce the price of the imported solar lights at the household level.

The analysis of the Independent Completion Review (ICR), Business Case Study (Annex 6), and the Survey Data Overview (Annex 8) indicate that the *Lighting Vanuatu* project has been successful in enabling the uptake and awareness of portable solar lighting products. These reports highlight that the transition from kerosene lamps to solar throughout the islands of Vanuatu was both clear and ubiquitous. When framed at this descriptive level, the project certainly presents a good news story for renewable energy.

The rapid transformation from a non-renewable to a renewable source of lighting within a 2 to 3 year period runs counter to many of the discussions in developed countries who struggle to disrupt the locked-in energy systems that sustain and maintain a reliance on fossil fuels. Considered alongside the slow and politically infused renewable energy debates in the developed country context, Vanuatu's rapid adoption of portable solar lighting is precisely the kind of transitional story that many communities could only dream of achieving. However, the successful or unsuccessful acquisition and diffusion of a particular piece of technology – portable solar lamps – is only part of the story.

The initial aim of the Independent Completion Review (ICR) was to identify the degree of adoption and contribution made by *Lighting Vanuatu*, any geographic, social or cultural trends evident in adoption patterns, any economic or social benefits, specific changes in the lighting technology used by households, changes in household practices associated with any shift in technology, and changes in householders' perceived needs and aspirations with regard to lighting. While this descriptive analysis is essential for evaluating the success of the project within its own terms (i.e. the ICR), the broader cultural, economic and political implications of this technological diffusion have yet to be addressed. The purpose of Annex 2, therefore, is to develop the *Lighting Vanuatu* story further by offering a more nuanced interpretation of the transition from kerosene to portable solar lights in rural Vanuatu communities; our emphasis and focus is different to that of the ICR, but complements and enhances the understanding of *Lighting Vanuatu* as an aid project.

We begin by outlining the methodology used to gather and interpret the information that informs this report. We then draw on the Energy Cultures Framework (Stephenson et al., 2010) as an organising structure for describing Vanuatu's prevailing energy culture. Next, we address four key

debates to emerge from the fieldwork with the hope of encouraging a reflection on the shifting social norms and practices (economic and political) that are also 'diffused' with the introduction of a new piece of material culture like the portable solar lamps. The annex concludes with a comment on the implications of this analysis for future energy-related development projects in Vanuatu.

## Methodology

The overall approach to this research is qualitative in nature as we wanted to explore the meanings that people attributed to the lights and the impacts that they had on everyday life. Interviews were conducted during a two-week period in Vanuatu with a variety of stakeholders in the *Lighting Vanuatu* project. The analysis was largely interpretative, beginning by using the Energy Cultures framework to make sense of the technology transition and then developing and discussing a number of the key findings from the initial analysis using some thinking from poststructural theory.

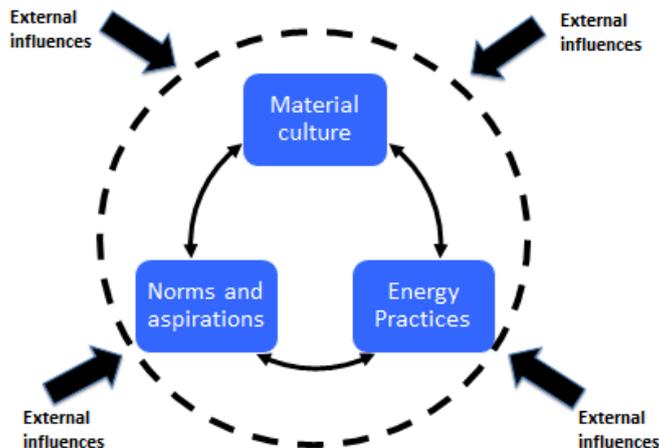
### Energy Cultures as a framework for understanding energy transitions

Transitions in energy cultures are a complex processes, combining a multitude of factors that coalesce to shape individual, group, and community energy practices. Such transitions have been studied from a number of perspectives, including (but not limited to) microeconomics, behavioural economics, technology adoption, social and environmental psychology, and sociology. However, each of these perspectives offers only a partial insight into the complex landscape of energy transitioning. The Energy Cultures Framework (see Stephenson et al., 2010 for more information) provides a broad model that is "inclusive of the many perspectives of ... transitions" and enables "greater exploration and debate of this complexity" (Stephenson et al., 2014).

At its core the Energy Cultures Framework is deceptively simple, providing a structure to help identify the key factors involved in human behaviour and behaviour change; the framework outlines energy behaviour as a result of the interactions between material culture (i.e. energy related technologies, physical infrastructure, etc.), energy practices (i.e. how people, groups and communities interact with their material culture), and norms and aspirations (i.e. the beliefs and understandings that may underpin material culture and energy practices). For example, having a kerosene lamp (material culture) will "force" a particular set of energy practices (e.g., regular purchase of kerosene, lighting lamps at a certain time, etc.) and around these will sit a set of norms (i.e. expectations of "how we do things round here").

Additionally, as shown in Figure 18, these three elements exist and interact within a particular context, comprising a complex mix of external influences, which may impact and affect each of these aspects. This includes factors such as the availability of different lighting technologies, the pricing of kerosene, the amount of disposable income available to households, and so on. Each of these may impact on the elements of the Energy Cultures framework, for example, the availability of different lighting technologies will affect the context in which purchase decisions are made, and may therefore impact upon the material culture of the households within a community (i.e. the mix of lighting technologies owned and used by that community).

Figure 18: Energy Cultures Framework



As well as offering an insight into the complexity of energy transitions over different scales (individual, group, community, etc.) and accounting for context and heterogeneity, the Energy Cultures framework can act as an organising framework for research, assisting researchers to take a holistic perspective of research space when designing methodologies or structuring analyses. Integrating the Energy Cultures Framework into this work thus ensures that the design of research questions and subsequent evaluation of data accounts for each integrated element of energy behaviour and energy transitions.

## Methods

To evaluate the effectiveness, efficiency and community implications of the *Lighting Vanuatu* project, the research combined interviews with stakeholders in the distribution chain, survey data from beneficiary households in multiple communities distributed across Vanuatu, and semi-structured interviews and observational field-notes with a subset of beneficiary households and communities.

The design, implementation, and initial evaluation of the survey is described in more detail in Annex 3. Insights from this work was used alongside the Energy Cultures framework to help design the interview questions and provide a structure to help identify the key factors involved in the adoption and use of pico-solar lighting, and the subsequent shifts in energy related behaviours. This resulted in the interviews with beneficiary households and communities following a four-staged approach:

1. Contextual information was sought to gain an understanding of the participants and their general patterns of everyday life.
2. Questions were asked to get an insight into the material culture around lighting technologies owned and used by the households, and the extent to which a technological shift in lighting solutions has been cultivated. These included issues surrounding the decision to purchase (or not) solar lights, such as where they heard about the lights, knew anyone else using solar, and what the key economic differences were found to be.
3. These questions aimed to elicit a fuller understanding of how any shift in technology has impacted family practices and daily life, especially around energy related practices in the home; where and when are the lights used, how has this varied between the old lighting technology and the new, how are the lights recharged.

4. Questions aiming to probe shifts in norms and aspirations around lighting and other solar technologies (e.g. photovoltaic panels) were asked to understand how communities may want to use solar technologies in the future. Has their experience to date affected their appetite for more solar lamps, or for bigger systems capable of delivering power?

The household interviews were carried out in Bislama (the local language) with translators or enumerators initially dealing directly with villagers and noting responses to the questions pre-developed. However, after only a handful of interviews and listening intently we were able to pick up the language and work with the enumerators to conduct the interviews in a more semi-structured manner. This was not the case for every interview but for the vast majority we were able to have a role in the generation of the data.

Distribution chain interviews were held with the NGOs involved in the project and other private renewable energy businesses. The interviews were tape recorded and transcribed word for word. Observational field-notes were generated from visiting trader stores and any other businesses/shops selling solar lights. Further to these interviews other stakeholders were interviewed as part of the process to understand the implications of the project. For example, interviews were held with representatives from the World Bank, NZ Aid and Telecom Vanuatu Ltd. These interviews, while not directly used in the generation of themes and discussion in this annex are nevertheless part of the research that all contributed to the arguments constructed.

A significant part of the research in the field was what could be termed ‘ethnographic’ meaning that it involved immersion by observation and participation in the cultural field of investigation (Fetterman, 1989; Geertz, 1973). We use the term ethnography to depict a method that Geertz, borrowed from Ryle, has famously termed “thick description” (Geertz, 1973: 6) meaning that data in ethnographic method involves descriptions of complex human interactions in complex contexts and these are examined as part of the field research. It is ‘thick’ in terms of being densely rich data. While we use an ethnographic method we have not adopted a traditional ethnographic realist position in this research, i.e. a search for an objective reality or a “passive contemplation of existence” (Rabinow & Sullivan, 1979: 20). Rather, we adopted an approach of acknowledging multiple subjectivities and meanings (Kondo, 1990). Our research journey included key aspects described by Fetterman (1989) as culture, holistic perspective, contextualisation, multiple realities, non-judgemental orientation, symbol & ritual.

Field notes were made at the time of immersion. Each researcher made notes during interviews and focus groups then after each village and each evening. In addition we all kept individual diaries that capture our individual thoughts, feelings and experiences. All the data was shared at the conclusion of the field work. Field notes consisted of “accounts describing experiences and observations the researcher has made while participating in an intense and involved manner” (Emerson, Fretz & Shaw, 1995: 5) and are an important part of the ethnographic research journey. The notes aimed to be reflective on participant voice, physical environs, behaviours and our own thoughts, which were sometimes challenged through the experiences we had.

### Analysis

A thematic analysis was applied to the information collected from the beneficiary household and community interviews to draw out the significant themes and codes from the data. The

interpretation of these themes, and the fieldwork in general, were sensitised by the Energy Cultures framework. This provided a holistic perspective into our investigation of energy behaviour and energy transitions, incorporating the integrated elements of material culture, energy practices, norms and aspirations, and contextual information. The analysis was designed to provide a rich description of the changes in household and community practices associated with the new lighting technology.

Additionally, a contextual analysis of the data examining not only what participants said but also what enabled them to make particular statements in particular ways (i.e. why some statements were constructed in a certain way and understood in a common-sense manner) enabled further exploration of the energy transition (Foucault, 2002 [1972]). Although this approach may seem to be just about words and language, it allowed us to explore meanings that may otherwise be taken for granted (see for example Laclau & Mouffe, 2001). The use of poststructural theory to make sense of certain phenomena disrupts an acceptance of meaning as common sense, and is the approach we have drawn upon in this research.

### Vanuatu's Prevailing Energy Culture

Before evaluating the impact of the *Lighting Vanuatu* project in terms of the cultural, economic and political implications, it is first necessary to understand the prevailing energy culture, particularly with regard to lighting, within communities in Vanuatu. This section is intended to help set the scene and situate our findings.

Vanuatu is comprised of 83 islands supporting a population of approximately 250,000 people, of which fewer than 30% are connected to an electrical power grid. This infrastructure is limited to areas of Port Vila and Luganville, and whilst some rural communities do have access to generators they are generally found to be expensive to run and are not used frequently.

The lifestyle in rural Vanuatu tends to be an outdoors one; many people live in homes that have 2 or 3 rooms, as well as separate area for food preparation and another for washing that is often not connected to the main building. There are also toilets that may be shared with other families and are separated a short walk from the main buildings. In addition, there is a social element within most rural communities, with each village having a traditional meeting place used for community gatherings and ceremonies. Many also have nakamal, where men (and sometimes women) can congregate for the preparation and drinking of kava. As the sun sets relatively early throughout the year (5:20pm in winter and 6:20pm in summer) this means that people are frequently eating dinner, engaged in social activities, or moving around between different parts of their home or between their homes and other buildings in the village, after dark.

### Material Culture

As a consequence of the lack of electricity access in rural Vanuatu, combined with the early hour of sunset through the year, portable lighting has played a role within these communities for some time. In an 18-month ethnography conducted nearly 15 years ago, New Zealand Anthropologist James Patrick Taylor (2008) describes the use of portable lamps:

*Houses with corrugated iron mixed with those of more familiar concrete blocks, some emitting the glow of an electric light or more softly-toned hurricane lamps. People were out walking, on their way*

home from work or off to drink kava at one of the many nakamal (kava bars) whose proprietors had hung out kerosene lamps, signalling that their kava was ready (p. 21, emphasis added).

As indicated by Taylor, the prevailing lighting technology used in rural Vanuatu has been kerosene lamps; in 1996 over 90% of the population used kerosene as their main form of lighting, and even as recently as 2010, one year into the *Lighting Vanuatu* program, approximately 50% of the population still relied on this fuel source.

However, since Taylor's observations Vanuatu's energy culture has observably changed. Although electricity remains the dominant source of lighting in Port Vila, the visual presence of solar lights has replaced the softly-toned kerosene lamps. In cities, portable solar lamps hold a ubiquitous and prominent space in the window displays of many retail shops. A visual stocktake of shops in Port Vila and Luganville confirm that nearly every Chinese shop and most daily good stores prominently display portable solar lighting products, highlighting their popularity and demand in the retail space. Portable solar lamps are even more prominent in rural villages where they are readily visible, found either hanging on their houses or placed on grassy clearings to gather the sun's rays. And often the lights that now beckon customers to the kava bars are solar, not kerosene (Figure 20). In fact, where kerosene lamps were found, they were often abandoned and broken (Figure 19).

### Energy Practices

There have been some shifts in energy practices that have gone hand in hand with the change of technology. Solar lamps are better suited than the kerosene lamps for mobile or outdoors use; they are brighter, they do not have a flame that could blow out, there is no danger of causing fire, they do not generate heat, and they are safer to carry around. This has had an impact on the purposes for which the lights are used, levels of social interaction, and on which members of the household are able to use the lights.

As outlined in the ICR, with the change in lighting technology there has also been increased opportunity for social interactions with the lights being used for village and inter-village functions. Women are also taking

Figure 19: 'Antique' kerosene lamps



Figure 20: Solar lamp signalling customers outside a nakamal, Efate



advantage of the new technology, and using the solar lights to facilitate social working groups (e.g., mat weaving) in the evenings. The light are also able to be used more in outdoor and mobile settings; people can use them when walking and travelling between community spaces and their homes, or when they visit the bathroom or toilet after dark.

In addition, children are able to comfortably use solar lights, whereas they were not able to use kerosene lights in this way due to the potential dangers of a naked flame, thus changing generational practices and influencing norms around energy use.

### Norms and Aspirations

There is no doubt that the technological shift to solar has resulted in shifting norms and aspirations around both lighting use and solar more generally. When travelling around villages in rural Vanuatu there is much evidence of the presence of solar lamps, particularly as they are left charging outside homes during the day clearly visible for all to see.

**Figure 21: Lamps being charged in villages and clearly visible from public space**



Almost everyone consulted during the ICR spoke of the desire to have more solar lamps, and the aversion to the use of kerosene. Despite the prevalence of kerosene just 3 years ago, the displeasure expressed at the thought of returning to this technology indicates the clear changes in norms and aspirations bubbling away.

Whilst this overview of the prevailing Energy Culture in Vanuatu helps to set the scene and situate some of the initial findings, it also raises further questions around the factors governing this rapid uptake and the social, cultural and political implications of this new technology.

## Vanuatu's Transitional Energy Cultures: Key debates

Sensitised by the Energy Cultures framework (Stephenson et al, 2010), the aim of this section is to begin (re)considering 'technology' paying particular attention to the relationships between material culture, energy practices, and social norms. This broader understanding of 'technology' involves an intentional play on words in order to reinforce the idea that any shift in material culture is always accompanied by a transformation of social norms as well practices. Inspired by philosopher Michel Foucault, we consider 'technology',

*to refer not to tools, machines, or the application of science to industrial production, but rather to methods and procedures for governing human beings... It refers to the ways in which modern social and political systems control, supervise, and manipulate populations as well as individuals (Behrent 2013: 55).*

The excerpt above highlights one the underpinning assumptions of the Energy Cultures Framework, namely, technological solutions alone cannot inspire the kind of transformation of social relations needed for wide reaching sustainable transitions to occur. 'Sustainability' – be it social, environmental, or economic or a combination of all - is tied to whole systems of which technological consumer products are a part. More than just material culture, 'technology' is therefore employed here to refer not only to the acquisition of new things, but more radically incorporates how material goods are deployed in practice and normalised in everyday lives at a range of scales (communities, national governments, NGOs and individuals).

This section strives to open a debate on the shifting social norms and practices (economic and political) that are also 'diffused' with the introduction of portable solar lamps through the *Lighting Vanuatu* project. In doing so, we seek to help redefine 'technology' within the international development context. No longer will 'technology' only refer to the diffusion or acquisition of material culture, but the 'technology' of the entire energy culture (material culture, norms and practices). As such, sustainability and social equality are only ever possible if all the 'technical' elements of an energy culture are inclined that way.

With this theoretical position in mind, the discussion below seeks to extend the initial ICR by asking:

1. How has the technological shift from *Lighting Vanuatu* project been enabled? What are the (socio-political) conditions that have made the shift possible?
2. How can the Energy Cultures framework help to make sense of the impacts arising from the shift in lighting technology?

These questions are addressed through a discussion of four key debates that emerged from this research: (1) 'easy' as an outcome? (2) solar expectations and aspirations, (3) negotiating cash, subsistence and political economies, and (4) circulating practices of Ni-Vanuatu communities.

### 1. *Isi nomo*: 'Easy' as an outcome?

It quickly became apparent that one of the primary themes of the *Lighting Vanuatu* project was that having a portable solar lamp simply made life a little easier. In meetings during the mission it became apparent that despite outcomes of gender equality, improved education, financial savings, and community building, many participants in the *Lighting Vanuatu* review kept reiterating the same general benefit of the portable solar lights: "*Isi nomo*" or "They're just easy." From an energy

transition point of view this is a useful finding – it shows that if the technology is easy to use and makes life easier then a rapid uptake can be enabled. However, this raises several questions when looking at this theme from the position as a development/aid project. Namely, does supporting and promoting an ‘easy’ life through the consumer purchase of a new technology amount to an appropriate developmental goal? Is it enough to strive to make life a little bit easier or what else is expected now that this part of life is easier?

The idea that the solar lights simply made everyday life a little bit “easier” was heard consistently across all the villages visited. The following sub-themes (re)present the ways in which villagers discussed the convenience of the lights and the ways in which they made their lives ‘easy.’

### ‘Easy’ in the everyday

The most prominent discussion across the interviews and focus groups was how the solar lights made everyday life easier. The patterns of use and stories told varied little between villages, and examples discussed by participants include:

- Mothers getting up during the night for babies or sick children find it much easier to turn on the solar light than light a candle.
- Some of the older members of the community mentioned that it made it easier to go to the toilet at night.
- Other tasks such as fetching water, kava preparation, weaving mats, sewing dresses, doing homework, conducting meetings (often there would be a number of lights at a meeting), fishing at night, and going to church at night were also made easier.
- In a focus group in Laukatai it was mentioned that there was no more collecting firewood, no lighter required, and no kerosene needed, which made the everyday lighting of the household easier.

### Easy because the lights are not complicated technology

Solar lamps required little education to use; as one participant mentioned, “Just press the button!” The word ‘easy’ was never associated with solar panels and observational evidence suggests that the level of involvement here was anything but easy. However, the concept of easy was associated with

Figure 22: Telecom Vanuatu Limited’s (TVL) “Making mobile easy” campaign, Port Vila Bauerfield domestic Airport



other technology such as mobile phones as the following illustrates:

This campaign attempts to demystify the concept of a mobile phone to encourage uptake of this technology. For many people (Ni Vanuatu and globally too) mobile phones themselves and the wider technologies with the phone i.e. the call plans, top ups, texting etc. may be off-putting for purchase. Therefore the technologies (methods around

the technology) and the piece of technology itself (material culture) have to be easy to adopt for uptake to occur. The same happened with the solar lights – participants told stories of seeing other villagers with the lights and seeing how easy they were to operate and then realising that the lights would benefit them as well and be easy to operate and use in everyday life.

### **Easy because they are mobile**

Numerous comments were made describing the ways in which the mobility of the lights made everyday life easier too. For example, former Provincial Council President Mr Yatasaimaka at the nakamal also noted that even though his village was connected to the grid, electricity is fixed, the solar lights are mobile. Linked to his examples of how he uses them: to go fishing at night, digging kava, looking for shellfish. Another example given from Tanna was of the lights being used when inter-village events are being held. The lights are taken with them to other villages and used there in the preparation of food and then are also useful for the walk home in the dark. These examples provided by participants illustrate the ways in which the mobility of the solar lights help to make their current lifestyle easier.

### **Easy because they are safer**

Included in the theme of ‘easy’ are a number of comments for participants that discuss the solar lights being safer. One village (Middle Bush, Tanna) talked about how much easier and safer they were during cyclone time. Wind was mentioned a few times in terms of how much safer the solar lights are when there is wind. There were also comments made about the burning of houses and how the solar lights were much safer. Another example of participants mentioning the lights being safe was a conversation with Brian and Charlie again on the Island of Tanna, two young males, and very keen on solar energy despite being in a grid connected village emphasised safety as a key feature of solar, this was for two reasons: (1) Older members of the community were noted as often being “afraid of electricity” and did not feel that electricity was a safe source of energy and often avoided using it. (2) Children can carry it around without any concern of setting the house on fire.

### **Easy because the lights last longer:**

People in the villages also mentioned the length of time that the solar lights lasted for. Typically they could last all night if they had been charged during the day. As they were cheaper (free) to run the length of time they were on from was not monitored in the same way that a candle or kerosene lamp had been. Comments indicated that this gave a sense of freedom in terms of being able to just use them when they were needed and wanted.

### **Sometimes...not easy**

While the majority of the comments were positive regarding the lights themselves and the use of them, there were some stories that told of the lights not always being a successful experience. For example:

- sometimes they get cracked and then get water inside them
- condensation can get inside (from the sun when being charged)
- ash from the volcano on Tanna can affect the charging
- can get dimmer after some use
- issues with charging during the wet season – when they experience many days of rain

Mostly there was concern about the lights getting wet (during the wet season) and then not working anymore – there were sometimes stories from participants about this happening to someone who they knew and then they would show concern (often this was during focus group discussions). One village visited in Tanna showed how they wrapped the lights when charging them to stop the condensation – they were finding ways of adapting the technology to the physical environs. Others found places to hang the lights for charging during wet days where the lights themselves would not get wet. Another story was told of sending children back to the village from the garden to rescue a light when it had started raining. Hence, while there were some limitations of the technology ways of dealing with the issues were being founded and adapted into everyday practices and routines.

The discussion above highlights that reworking social norms of what constitutes ‘the easy life’ in Vanuatu was a major outcome of the *Lighting Vanuatu* project. This is, however, not surprising given that many authors have argued there has been no other ‘goal’ in international development than to make life easier, that is, to bring forth and promote new ideas of ‘the good life’ in order to establish a comfortable, less unpredictable, more productive working-class in developing countries.

## 2. Solar expectations: Mobilising aspiration through *Lighting Vanuatu*

What comes with technological convenience? Reflecting on the many different conversations of convenience and comfort today, one hears a wide range of concerns associated with the notion that technology is ‘good’ simply because it makes our lives a little easier, safer, or comfortable. From the convenience of the car, expectations of cleanliness linked to the towards daily bathing and showering, to the shifting norms of what constitutes a ‘comfortable’ and healthy heated home, each technological advancement simultaneously holds the potential to make peoples’ lives a little easier while also potentially embedding societies into often environmentally problematic systems (Shove, 2003). In other words, material culture shifts alter our expectations of what constitutes ‘the good life’, and vice versa, in ways that are both liberating and problematic. We examine the aspirations and expectations around solar that we encountered.

The large majority of household interviews expressed the expectation that there was no going back to kerosene or gas. For instance, during a household interview in Nerenigman village on Mota Lava (November 21, 2013), one respondent expressed this sense of progression by stating, “If we had to go back to kerosene we would be embarrassed.” The perception being here that anything other than solar would be like falling backwards, even to the point of stigmatisation for those who still used it, as another respondent from a focus group on Mota Lava (November 21, 2013) recounted, “If we see someone using kerosene we laugh, it’s like they’re stuck in the past.” Solar energy was closely associated with progress to the degree that in the vast majority of interviews alternative energy options were rarely discussed. Alternative energy sources, were seen as a ‘backwards’, or in some instances just plain ‘bad’, even if the participants themselves had for example gone to torches when the solar had broken. As another respondent from Emua village on Efate (November 17, 2013) exclaimed, “What else but solar!” The future trajectory of energy and lighting in Vanuatu would seem to be solar. Therefore, not only have solar lights become normalised in the everyday (see theme one), there are also high expectations that solar powered energy will light the way towards a better future in rural Vanuatu.

This confirms the statements made by the participating NGOs that one of the primary outcomes of the *Lighting Vanuatu* project was that it helped raise awareness and exposure to the option of solar

power. As the vast majority of villages indicated and demonstrated through their purchases of larger solar panels (often purchased in New Zealand during the participation in the Recognised Seasonal Employer (RSE) scheme), the aspirations and expectations of the achieving a solar powered future was not limited to portable solar lighting. As awareness of solar powered lighting had exploded since the start of the *Lighting Vanuatu* project the expectation from many of the villages visited that the future will be increasingly solar, which would include the larger housing systems as well as the convenient and mobile portable solar lights. This is expressed by a young father from Laukatai who when asked how he disposed of an earlier broken solar lamp stated, "I want to keep it as a memory [the solar lamp]. When my kids get older I want to show them what we used to use for light."

Establishing and normalising high expectations have the potential to be both a positive and negative endeavour. From the perspective of the villages interviewed the energy future of rural Vanuatu has clearly been demarcated as solar. As Shove (2003: 400) describes it, technologies of convenience, comfort and cleanliness have been the key aspirations that have produced "the locking in of technologies and practices as they move along a path dependant trajectory of socio-technological change." This raises the questions, who gains financially, politically and socially from advancing this particular vision of 'normality'? Are there any unsustainable practices associated with the introduction of 'sustainable' technologies? As we will explore in the next section, this transition simultaneously opens new pathways of energy autonomy for communities and creates other paths that may also lead to unwelcome or undesirable economic and political dependencies.

### 3. Vanuatu's transitional economies: Negotiating the cash & subsistence landscape

Energy, renewable or otherwise, has played an influential role in normalising the cash economy in rural Vanuatu (and across the Pacific). Today's subsistence affluence in Vanuatu has not extended to the energy used to light houses and to fuel the transport needed to move people and materials around. As a result, kerosene used for lighting the home has been one of the prominent market mechanisms used to sustain and maintain a household level engagement in the cash economy. As indicated in a recent report by the Australian Agency for International Development (Cox et al. 2007), the tension between subsistence and market economic dynamics is increasingly becoming a source of anxiety for rural Vanuatu:

*Local communities are under increasing stress. The penetration of cash into the rural areas is one of the main pressures. Cash is increasingly becoming necessary to maintain a basic standard of living. In addition to primary school fees (up to Vt3,000 (A\$40) per term in rural areas), households need cash for necessities (salt; sugar; soap; clothing; kerosene). These may be twice as expensive in rural areas, owing to the costs of transport (p. 12).*

It is not surprising then that primary benefit of the portable solar lamps identified by the nearly every respondent was its cost savings. For remote rural communities a lighting source comprising a one-time capital expense was seen as preferable to the on-going variable cost of kerosene fuel. Kerosene required continuous engagement with the marketplace through constant monitoring of its supply and price, as well as regular trips to the fuelling stations.

The recent transition to solar lamps had two interrelated outcomes in terms of cost and stress reduction. Firstly, there was obvious savings associated with the transition to the solar lights. Kerosene costs typically averaged around Vt50 per day, or Vt18,200 per year (although some

respondents reported up to Vt100 per day). As portable solar lights retail in Vanuatu for between Vt2000 and Vt5000 and last up to 4 years in some instances, depending on the particulate brand and model, it is clear that significant savings are possible (annual estimates typically ranged between Vt10,000 - Vt15,000 per year), though not necessarily realised due to the subsistence economy that exists within rural Vanuatu. The one-time capital expense of solar lamps meant that the daily financial and emotional investment in kerosene fuel, discussed frequently in a negative light by participants, was a thing of the past. In addition, it was reported that women were able to work longer hours, congregating with others to weave in the evening, resulting in more money for the family.

These changes in financial dynamics through the transition to solar have spurred a second gender related outcome. As one male focus group in Mota Lava (November 21, 2013) summarised, this shift in purchasing practice has resulted in shifting the gender dynamics of household energy use; although gender roles have not radically altered with the introduction of the portable solar lights, the majority of respondents did note the fact that men were no longer in sole charge of one of the main household expenditures: energy. Once purchased there was no need for daily monitoring of the kerosene fuel, resulting in less daily marital confrontation about money issues.

Despite these financially driven benefits of solar in the mid- and long-term, the upfront cost is still significantly more than the regular kerosene payments, but the prevailing attitude across NGOs, small businesses and even within the communities themselves is one of individual responsibility through purchasing power. Two separate entrepreneurs suggested that, “if they want a better life they’ll have to pay for it”, and at the beginning of one focus groups in Tanna, one of the interviewees exclaimed, “we have money, just bring stuff and we’ll pay for it”. So while it is true that the portable solar lights distributed as part of the *Lighting Vanuatu* program have helped establish renewable-energy autonomy, it has also encouraged a social norm where people are taking responsibilities for their own energy future. On the one hand this has the potential to lead to “the self-fulfilling dynamic of the endless pursuit of convenience” (Shove 2003: 397), but on the other it may drive a continuing renewable energy development in Vanuatu that goes well beyond solar lighting.

#### **4. Ni-Van techniques in *Lighting Vanuatu*: Circulation, communication & community**

One of the key outcomes of the *Lighting Vanuatu* project was the distribution of the lights throughout the country in considerable numbers in a short time. The uptake of the technology was rapid and extensive. It was of interest then to find out what had made possible this rapid and extensive transition to a new technology. It would seem that a vital part of the transition process were the informal networks already existing within Vanuatu that we suggest maintain a sense of community throughout the country. The circulation of knowledge and people through the many islands enabled the lights to be talked about and distributed widely. Using known NGOs with already established networks in a country where networks of people are key communication channels was a major key to the success of this project.

The following are three examples of circulation from the data generated that illustrate how the distribution of the lights tapped into existing channels and by default also helped to maintain these channels through just being a topic of the conversation and medium of mobilisation.

1. In an interview with VANREPA's David Stein he stated that distribution channels didn't need to be made; they already existed through family networks and inter-island connections. He went on to say that the NGOs were encouraged to create distribution channels but that didn't make sense to him because they were already there. It would seem that the distribution channels have existed for some time and are part of the way of life in Vanuatu. Taylor (2008:137) discusses the importance of hala in linking people across the land and its role in maintaining social vitality in the village. During the two weeks in Vanuatu whilst conducting the ICR, we witnessed a number of seemingly random events whereby people just happened to bump into others when travelling, and then would ask them to take something back to the island to which they were going. Indeed many of the lights were distributed through people from Port Vila sending them to friends or relatives in the outer islands or when someone from the village was in town they would stock up on supplies of the lights to take back with them. It seemed that people would travel between the islands and as they did so take things for others as they went.
2. In an interview with the NGO Youth Challenge, Morresen Timatua discussed one channel they used to facilitate the distribution of the lights. They gave 50 units away to leaders in the communities (Chiefs, Parliament etc.). The free promotion worked very well as these influential players ended up buying hundreds for their respective communities, which were then distributed freely to households. Ironically this contradicts what the Western entrepreneurs were saying about changing the expectations to "purchase" a better life, bringing us to the third type of distribution channel we witnessed.
3. We also interviewed some private distributors of solar lights – who were purchasing from VANREPA or ACTIV. One private business owner had his own unique distribution network, which was a two-fold approach. First, he sent individual staff to travel to the communities directly. Some of these would set up a shop on the islands (he had two outposts at the time of the interview on the more populated islands). Second, he promoted his campaign for solar energy on National Radio to encourage those on the islands to get in contact with their family in Port Vila and send/bring back to the villages. Both these approaches were purported to have yielded successful results for his business. Further, both of these approaches tapped into ways of circulating knowledge and materials within the islands of Vanuatu.

The ideas around circulation, communication and community are positive and offer a counter narrative to the humanist view that modern technology is the source of individual alienation in modern society. The solar lights do not appear to have alienated people; rather they have extended and amplified communities. The technologies of society<sup>43</sup> that make up the socio-political system of the material good were not changed through the introduction of the solar lights. Traditions and customs remained largely unchanged; rather the lights mobilised those traditions and operationalized the Ni-Van sense of community to become circulated through the Vanuatu society.

---

<sup>43</sup> Here we use the Foucaultian sense of technique to refer to a specific practice, ritual or device within a technology.

## Conclusions

In summary, this annex has emphasised the idea that any shift in material culture (e.g. from kerosene to pico-solar lamps) may be accompanied by shifting social norms (e.g. expectations and aspirations around 'easy' technologies) and energy practices (e.g. engaging in the cash economy in a global market place). From an Energy Cultures perspective, environmental and social equality issues cannot be solved with a quick technological fix leaving unsustainable and inequitable social norms and practices intact. In this work the Energy Cultures framework has been used to help explore some of the key themes from our fieldwork and research into the *Lighting Vanuatu* program.

Using the framework as a sensitizing tool we looked deeper at the qualitative, quantitative, and ethnographic data to question and raise issues with what we saw occurring as a result of *Lighting Vanuatu*. This has been done from an academic perspective; as academic researchers we are outsiders to the aid industry and analysing aid projects is not part of our previous expertise. Instead, we bring to this review an interest and expertise in energy transitions and the analysis of their underlying determinants, whether occurring in foreign countries or the communities in which we live. From our position as academics we came to the research project with a different perspective, and we hope that this has added value and insight as a result.

Returning to our guiding research questions provides a point from which to conclude these discussions. These were:

1. How has the technological shift from *Lighting Vanuatu* project been enabled? What are the (socio-political) conditions that have made the shift possible?
2. How can the Energy Cultures framework help to make sense of the impacts arising from the shift in lighting technology?

## Enabling Technological Shifts

The first question aimed to broaden the scope of this research to consider the wider context that enabled the technological shift from kerosene to solar. We examined the data from a position whereby nothing was taken for granted and questions were posed from a variety of different angles. In doing so we developed 4 themes, which have been discussed in-depth in this annex. These themes, which encompass the key elements that made such a rapid transition to pico-solar lighting possible, are discussed in terms of how they influenced the technological shift and the underlying assumptions involved.

The first theme focussed on how the solar lighting technology was easy to use, and how it made existing household practices easier. While it was interesting to see potential correlations between easiness and uptake, we questioned whether 'easy' is a significant enough outcome of the project. Crucially we asked that if something is made easier then what is expected to take the place of the hardship that has gone? Thinking of our own lives we know how technology has made housework 'easy', but having more time for paid employment is not always so. We drew upon Shove's work (2003) in this section to explore technologies of convenience to raise questions of whether 'easy' is fundamentally a way of normalising paying for convenience.

The next theme incorporated ideas of expectations and aspirations, which is one of the key aspects of the energy cultures framing that helps understand technology transitions. We found that people

discussed a future with bigger and brighter solar; they did not want to return to kerosene and instead wanted more solar technology. Indeed, we heard stories of people returning from the seasonal workers programs in New Zealand with solar lights and solar panels for themselves and others in their village. Again, this is exciting from an energy transition perspective as the solar transition is represented in their aspirations for the future, though we also discussed the notion of being locked in to a technological trajectory and dependencies that could occur as a result. While this may be a possibility, the technological changes in Vanuatu will be limited by contextual aspects such as physicality (being a group of small islands with a small population), financial constraints and village life – the same constraints that were overcome through the supply-side subsidy with the pico-lights.

This leads to the third theme, which considers the role of the cash economy in the project and the project's role in the cash economy in Vanuatu. That is, how the economy was strengthened in some ways through the *Lighting Vanuatu* project, yet at the same time it created a temporary departure with regards to fuel purchases for lighting (i.e. not having to continuously pay for kerosene). We discussed some of the implications of normalising paying for energy that has occurred in Vanuatu.

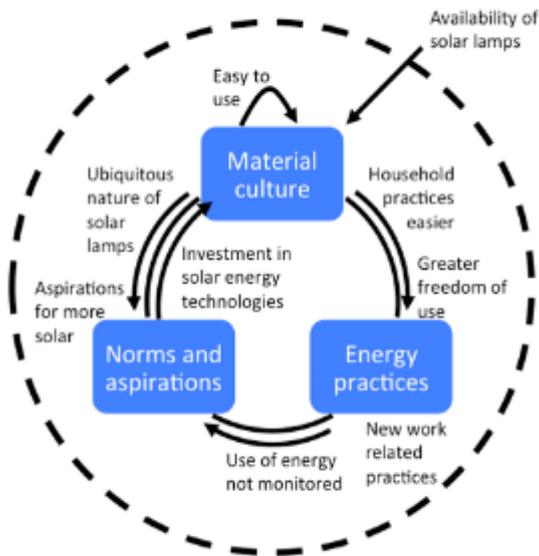
Finally, we consider the role of circulation and communication and the informal networks that facilitated the distribution of the lights throughout most of Vanuatu. Again from a transitory perspective, the networks that enabled this technology to literally go far and wide was significant in the success of the project. We learnt that the networks already existed and the NGOs cleverly drew upon these networks to bring about this transition. Networks and the community are a part of Ni Vanuatu culture (Taylor, 2008) and we discuss this as being the 'good news story.' This technology became part of the existing networks; it did not alienate, but rather facilitated the circulation and community that already existed, and from stories we heard of village life are also used frequently in communal village activities – perhaps because they just make it easy!

### Using the Energy Cultures Framework

The Energy Cultures framework enables a holistic perspective into the complexity of energy transitions and energy behaviours, accounting for interconnected elements of material culture, energy practices, and norms and aspirations, situated within a particular context. In this study we have witnessed how the mass introduction of pico-solar lights during the *Lighting Vanuatu* program has shifted the context in which lighting decisions were made. The existence of informal networks and communications channels as part of the Ni Vanuatu culture, combined with the successful use of these networks by the NGOs involved in the project, resulted in a large influx of new technology to a wide ranging marketplace across much of Vanuatu, illustrating how external influences (i.e. availability) can drive a shift in material culture (i.e. solar lighting technology).

The shift in lighting technology from kerosene to solar is also very closely tied to energy practices. It appears that for the most part household practices remain unchanged; largely existing practices are just made 'easier' and the mobility of solar lamps seems to be better suited to the mobile lifestyle in rural Vanuatu. However, there has been the introduction of some new practices: women are now weaving more at night, and school children, who would not previously have used kerosene lights due to the associated fire risks, are able to do school-work after dark. Additionally, the shift in lighting technology has gone hand-in-hand with a shift in financial obligations around the regular purchase of

Figure 23: Transitional Energy Culture key debates



lighting fuel (i.e. the sun is free). This has resulted in greater freedom of use of lights and as such families no longer feel the need to monitor their use so much.

The shifts in technologies and practices have cultivated a corresponding shift in norms and aspirations. The ubiquitous nature of the solar lamps has increased the general awareness of solar technologies and perceptions about what a 'good' technology is. Solar is seen as a big step forward from kerosene, and there is a strong resistance against reverting to the use of what are seen as 'bad' energy technologies. Combined with the connected nature of communities in Vanuatu, and the access to solar panels through the RSE scheme in New

Zealand, aspirations for larger solar lighting systems and systems capable of delivering solar power are starting to emerge.

The nature of the *Lighting Vanuatu* program also meant that households and communities had to make financial investments in the solar lighting technologies; the subsidies were provided for the NGOs and not the end users of the lights. This financial investment serves to solidify personal investments and the positive perceptions of solar power, and this may also drive the establishment of community level renewable energy autonomy.

### Implications for the future

Finally, as communities in Vanuatu look to further develop their renewable energy technologies, it is vitally important to consider a holistic approach to understand the various impacts that can occur. Using a framework like the energy cultures to explore possibilities and make sense of transitional impacts is useful for future planning and understanding. In concluding we finish with two points that sum up the value of this approach in making sense and 'learning lessons' from *Lighting Vanuatu*.

1. This was a rapid energy transition brought about by a number of factors not least the ability to draw upon informal cultural networks to disseminate knowledge of the lights and the material good themselves. Using the EC has enabled an understanding of the factors and the interactions of the factors in this transition. Plus delving further into some of the socio-political and economic contexts further enabled an examination of the factors in considerable depth.
2. In addition to the depth of analysis using the Energy Cultures approach has enabled a breadth of analysis. There are a variety of factors that have been considered and explored in the process of understanding the transition. Examining from this holistic perspective develops big picture type thinking and means that the unintended consequences can be considered as part of the framing. The result then builds a picture of the systems (social, economic etc.) around the transitions and helps make sense of the interactions of the various elements creating a rich understanding of the dynamics of a complex process.

## References

- Behrent, M. C. (2013). Foucault and Technology. *History and Technology: An International Journal*, 29(1), 1-51.
- Cox, M., Alatoa, H., Kenni, L., Naupa, A., Rawlings, G., Soni, N. Bulekone, V. (2007). *The unfinished state: drivers of change in Vanuatu*. Port Vila: Australian Agency for International Development.
- Cummings, M. (2013). Imagining transnational futures in Vanuatu. In A. Quayson & G. Daswani (Eds.), *A Companion to Diaspora and Transnationalism* (pp. 381-396). Sussex: Blackwell Publishing.
- EIU [Economic Intelligence Unit] (2003). *Country Profiles: Pacific Islands 2003*. New York: Economic Intelligence Unit, 96-112.
- Emerson, R. M., Fretz, R. I., & Shaw, L. L. (1995). *Writing ethnographic field notes*. Chicago: University of Chicago Press.
- Ferguson, J. (1990). *The anti-politics machine: development, de-politicization, and bureaucratic power in Lesotho*. Cambridge: Cambridge University Press.
- Fetterman, D. M. (1989). *Ethnography: Step-by-step*. Thousand Oaks: Sage.
- Foucault, M. (1972). *The Archaeology of Knowledge* (A. M. S. Smith, Trans.). London: Routledge.
- Foucault, M. (1979). *Discipline and punish: The birth of the prison*. London: Penguin.
- Geertz, C. (1973). *The interpretation of cultures: Selected essays* (Vol. 5019). New York: Basic books.
- Kondo, D. K. (1990). *Crafting selves: Power, gender, and discourses of identity in a Japanese workplace*. Chicago: University of Chicago Press.
- Laclau, E., & Mouffe, C. (2001). *Hegemony and socialist strategy: Towards a radical democratic politics* (2 ed.). London: Verso.
- Rabinow, P., & Sullivan, W. M. (1979). The interpretive turn: Emergence of an approach. In P. Rabinow & W. M. Sullivan (Eds.), *Interpretive social science: A reader* (pp. 1-21). Berkeley: University of California Press.
- Shove, E. (2003). Converging conventions of comfort, cleanliness and convenience. *Journal of Consumer Policy*, 26(4), 395-418.
- Stephenson, J., Barton, B., Carrington, G., Gnoth, D., Lawson, R., & Thorsnes, P. (2010). Energy cultures: A framework for understanding energy behaviours. *Energy Policy*, 38(10), 6120-6129.
- Stephenson, J., Hopkins, D. & Doering, A (forthcoming, 2014). Conceptualising transport transitions: Energy Cultures as an organising framework. *WIRES: Energy and Environment*.
- Taylor, J. P. (2008). *The other side: ways of being and place in Vanuatu*. Honolulu: University of Hawaii Press.
- Telecom Vanuatu Limited (TVL), 2013. [Online] Available at <http://www.tvl.vu/bislama/index1.html>.

UNDP. (2010). *Millennium Development Goals 2010 Report for Vanuatu*. Vanuatu: UNDP. [Online] Available at [http://www.undp.org.fj/pdf/MDG%20Report/Vanuatu\\_MDG.pdf](http://www.undp.org.fj/pdf/MDG%20Report/Vanuatu_MDG.pdf) .

Urry, J. (2004). The 'System' of Automobility. *Theory, Culture & Society*, 21(4-5), 25-39.

# Annex 8: Lighting Vanuatu Beneficiary Survey: Uptake, Use, and Future Directions

Dr Rebecca Ford

---

## Introduction

Following the completion of the *Lighting Vanuatu* project in 2012, a paper based survey was developed and rolled out to assess the impact of this program on the households that had purchased pico solar lights. The purpose of this survey was threefold: (1) to generate baseline knowledge about the uptake and usage patterns of the lamps across Vanuatu's 83 islands, (2) to inform the development set of more detailed interview questions posed during the in country Independent Completion Review, and to assist the more detailed planning for the Vanuatu Energy for Rural Development (VERD) program.

This document describes the implementation of the paper-based survey, and outlines initial findings from the survey, including an overview of remoteness and access to electricity, changes in lighting technology and factors influencing purchase decisions, the actual usage of pico-solar in the home, on-going maintenance issues, and the desire for further electrification. These findings are drawn together in a discussion section, where tentative conclusions are drawn and further questions arising from these findings are highlighted.

## Implementation

The survey was conducted throughout 2012 using an enumerator-administered questionnaire (see Appendix 1). This was initially distributed by US Pearce Corps volunteers (<http://vanuatu.peacecorps.gov/>) during the first half of 2012, though to facilitate a greater responses rate, Youth Challenge Vanuatu volunteers, local churches and the Australian Youth Ambassadors were also engaged from July onward.

In recording the data the following key points were required to ensure data consistency across the various enumerators used to administer the survey:

- Enumerators followed normal courtesies (greeting, thanking, farewells).
- After establishing if there is a solar light in the home, enumerators:
  - Outlined the purpose of the survey
  - Explained that responses will be confidential
  - Politely requested participation
  - Advised respondents that they are free to decline participation without consequences.
- For each questionnaire, a 'Respondent Unique ID' was recorded on the top right-hand corner of the form.

- When written responses were required, enumerators wrote in the square provided using block letters/numbers.
- For responses that required elaboration, enumerators provided the explanation in the space immediately below the question on the left-hand side of the response task.

Once all the survey responses had been collected from the enumerators, the questionnaires were scanned (as opposed to manual entry) to save time and ensure accuracy, and data was captured in a database. This database was exported to SPSS to enable statistical analysis of responses. Survey data will remain the property of Australian Aid and will be provided in digital format to Australian Aid along with the full report.

## Participants

Respondent households were selected through a three-stage cluster sampling process. The ‘survey universe’ (N) was defined as the population of Vanuatu—or more specifically the number of rural households (outside of Port Vila and Luganville), which is estimated to be 167,357<sup>44</sup> people, or 34,866 households<sup>45</sup>. The survey sample (n) needed to be greater than 300 households (i.e. more than approximately 1%). This minimum was necessary to enable sufficient confidence (95% level of significance) and power (80%).

### Stage 1: Island Selection

There are 83 islands in the Vanuatu archipelago, organised into six provinces; islands chosen were purposively sampled from each. Furthermore islands were chosen based on a remoteness ranking (Table 12). The remoteness ranking took into account both flight and shipping schedules to each island – Efate and Espiritu Santo are ranked at 1; those with regular (daily or more) contact with either Port Vila or Luganville are ranked at 2; a Ranking of 3-4 reflects services 2 or more times per week; while a Ranking of 6 and 7 reflects services of once per week or less.

**Table 12: Villages covered in the *Lighting Vanuatu* Beneficiary Survey**

Island	Remoteness Ranking	Census Population	No of Surveys	No of Villages	Major surveyed villages (generally n > 10 survey respondents)
<b>Efate</b>	1	65829	174	11	Saama, Natapau, Magaliliu, Tanoliu, Eratap, Eton, Takara
<b>Santo</b>	1	39606	375	35	Arantoa, Banbab, Beleru, Hog Harbour, Kolei, Malao, Mavunlep, Naone, Natawa, Pepsi, Sara, Winsao
<b>Malakula</b>	2	22934	32	2	Dravail, Lamap
<b>Tanna</b>	2	28799	359	65	Epakel, Iarkei, Lahtapu, Lemakaun, Lapangtawa, Laweane, Learfi, Lenakel, Lounu, Port Resolution
<b>Ambrym</b>	3	7275	12	1	Toak
<b>Epi</b>	3	5207	19	3	Alack
<b>Pentecost Island</b>	3	16843	21	7	Nafaranguit, Vanmelang

<sup>44</sup> National population (2011) is 224,564, less population of Port Vila (44,040) and Luganville (13,167).

<http://www.state.gov/r/pa/ei/bgn/2815.htm>

<sup>45</sup> The 2009 census estimated average household size to be 4.8 persons.

Island	Remoteness Ranking	Census Population	No of Surveys	No of Villages	Major surveyed villages (generally n > 10 survey respondents)
Aobe	4	556	26	7	Siro, Nawaswas, Port Latoir
Maewo	4	3569	13	1	Naviso
Malo	4	4273	53	9	Tanmeal, Nanuk
Nguna	4	1255	42	14	Malaliu, Taloa
Paama	4	1627	20	1	Tahi
Pele	4	321	10	5	Piliura
Makira	5	106	14	1	Malakoto
Vanualava	5	1933	89	14	Mosina, Sola, Vatop, Vureas,
Buninga	6	144	10	6	No major village
Motalava	6	1451	130	9	Avar, Demsas, Nerenigman, Qeremande, Rah, Toutoulau,
Aniwa	7	341	14	1	Ikaukau
Mota	7	683	1	1	No major village
x) Mis			22		
<b>Total</b>		<b>202752</b>	<b>1436</b>	<b>193</b>	

## Stage 2: Community/Village Selection

Enumerators were responsible for selecting communities/villages from comprehensive lists of village names for each of the sampled islands, in line with logistical considerations such that the villages could be visited within the required timeframe.

## Stage 3: Household Selection

The unit of analysis for this survey was a 'rural household'. For the purposes of this study a household is defined as the group of people that 'eat from the same pot'. The survey is only administered in households that currently own or use a solar powered light.

The required number of households from each of the sampled islands was determined on a proportional basis. The required and actual surveys are shown in Table 13.

Table 13: Minimum number of surveys, and actual surveys conducted in each province

Province	Sampled Island	Population	%	Survey Sample	Actual Surveyed
Malampa	Malakula; Ambrym; Paama	36727	0.16	48	64
Pénama	Aoba/Ambae; Pentecost; Maewo	30819	0.13	39	60
Sanma	Santo; Malo	45855	0.20	60	428
Shéfa	Efate; Epi; Makura; Pele; Buninga	78723	0.33	99	269
Taféa	Tanna; Aniwa	32540	0.14	42	373
Torba	Mota; Mota Lava; Vuanalava	9359	0.04	12	220

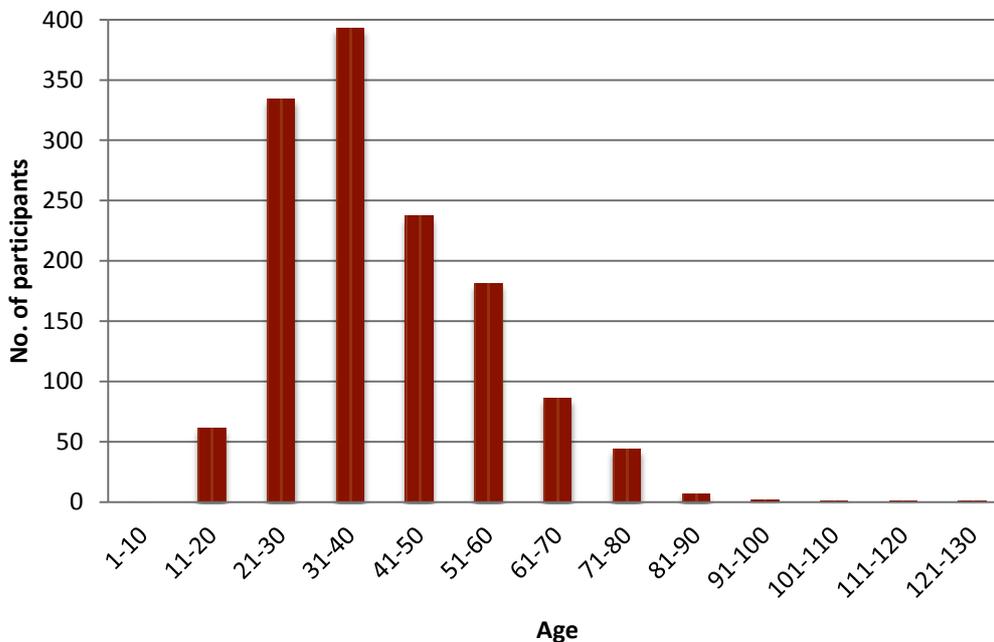
## Findings

In total 1436 survey responses were collected, however, 9 had to be excluded due to incomplete responses. Of the 1427 surveys included for analysis purposes, 1340 had an administration year of 2012. However, 67 surveys have an administration year of 2000 (01/01/2000), 4 are completed in 2002, 12 in 2008, 1 in 2009, 1 in 2010, and 2 in 2011. It is suspected that these are erroneous entries; the 67 from 2000 were likely missing data that was subsequently coded as 01/01/2000. The 20 surveys with dates from 2002 to 2011 inclusive may have been incorrectly interpreted; either by the survey administrator during data capture, or during data entry.

## Demographics

The gender of people answering the survey is fairly balanced (52.7% male). The median age of survey respondents was 37 and age ranged from 11 years to 130 years; 13 respondents claimed to be 16 or under, and 3 are 110 or older; the distribution of ages is shown in Figure 24.

Figure 24: Age range of survey respondents



Some participants were non-literate (11.2%) or had not completed primary (16.2%), but most had completed primary schooling. Additionally, there were often other household members with higher literacy than the respondent, as shown in Figure 25.

Figure 25: Education level of survey participants and household members

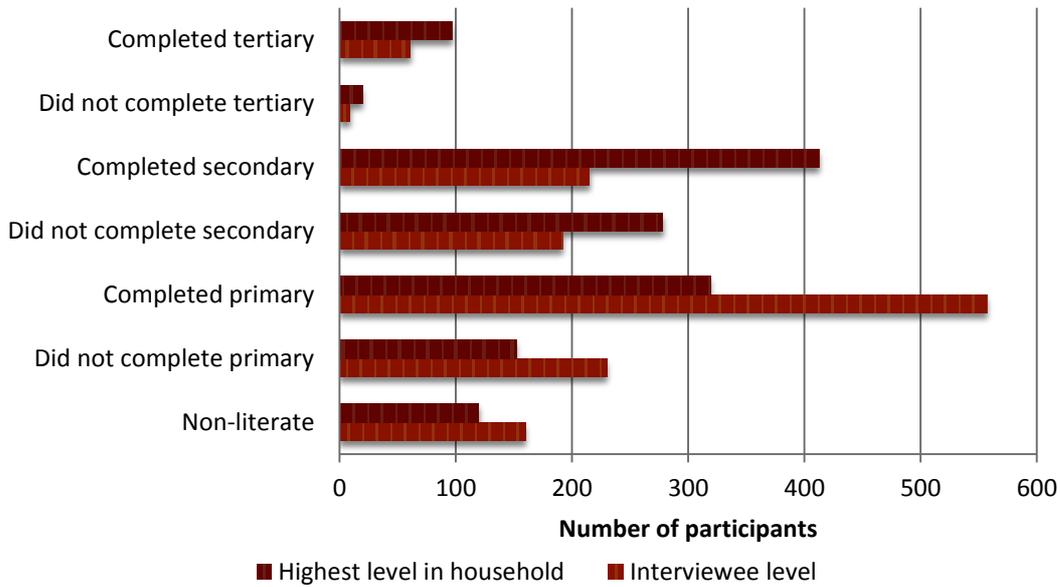
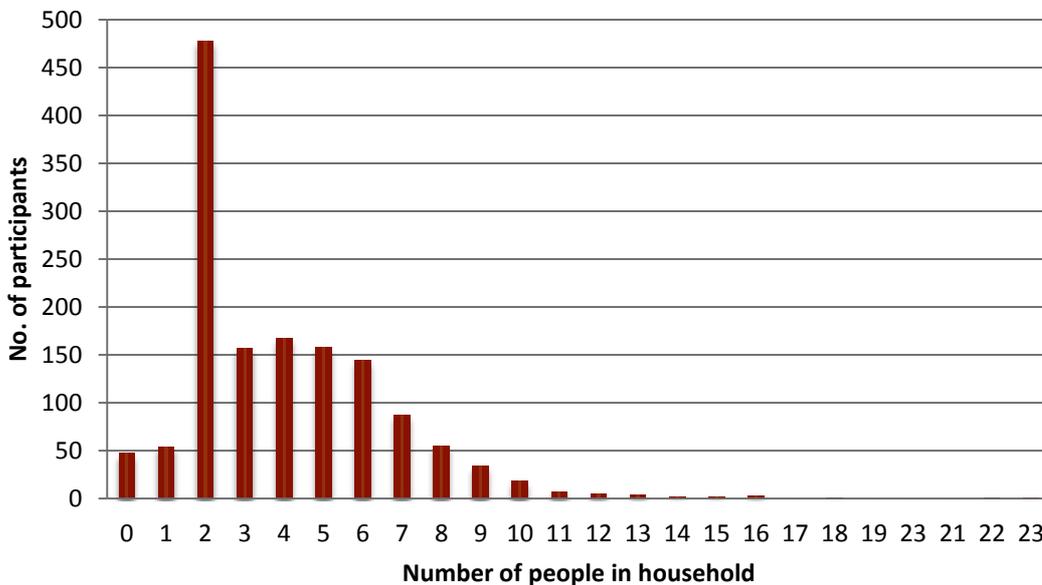


Figure 26 below shows how many people belong to each survey respondents’ household. The median number of children (under 18) is 2, and 10% of households have more than 5 children.

However, the integrity of this data is questionable, as 23% of respondents claimed that there were more children in the household than the total number of people.

Figure 26: Overview of the number of people living in each household



Houses ranged in size from 1 room to 12 rooms, with a mean of 2.78 ( $\sigma= 1.28$ ), and the predominant source of income among survey participants was from gardens/farms (64.3%), followed by general employment (14.5%), income from handicrafts (7.1%), and from homemade food products (5.8%).

## Electricity Access

All survey respondent households will have had solar lanterns. Of these 43% (n=606) also had access to electricity. Of these, 7% were connected to an electricity grid and were thus non-rural households, 28% had access to electricity from solar (clearly some respondents have included their solar lantern as solar power), 9% from generators and 57% had no access to general electricity.

Of those that were connected to on-grid electricity, 32 were on Efate (18.9% of Efate respondents), 13 were on Santo (3.5% of Santo respondents), and 41 on Tanna (11.8% of Tanna respondents). Additionally, 86 of the 94 respondents with access on-grid electricity were located on an island ascribed a remoteness index of 1 or 2, as shown in Table 14. This represents 8.3% of respondents from areas of remoteness index 1, and 10.9% of respondents from areas of remoteness index 2. Comparatively, only 0.0%, 0.6%, 3.9%, 1.4% and 0.0% of respondents from areas of remoteness index 3, 4, 5, 6, and 7 respectively had access to on-grid electricity.

**Table 14: Distribution of electricity access according to remoteness index**

Remoteness index	No power	Solar power	Generator	On-grid	Total (n)
-	6	8	6	1	21
1	200	249	46	45	540
2	258	57	22	41	378
3	49	0	3	0	52
4	100	50	13	1	164
5	66	7	26	4	103
6	114	19	4	2	139
7	7	0	2	0	9
Total	800	390	122	94	1406

## Solar Lighting

In 2010, the main form of lighting used by the respondents was kerosene (53.8%), followed by solar (25.1%). The remainder used candles (3.8%), coconut oil (1.7%), wood and coconut shells (6.3%), generators (5.5%), and flashlights (2.9%).

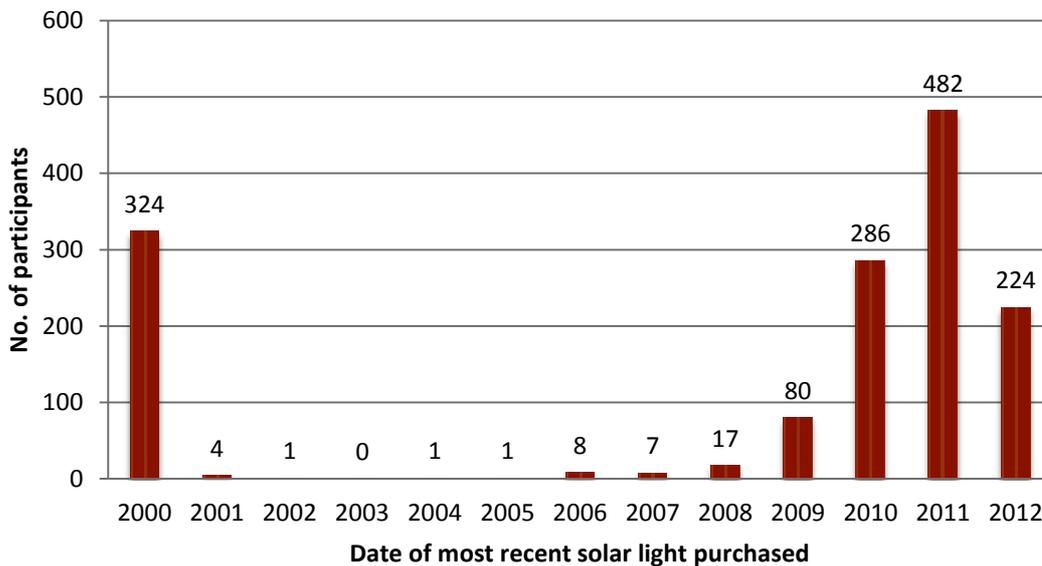
In the Shefa and Tafea provinces there was a slight underrepresentation of solar lighting in 2010; only 49 out of 262 in Shefa, and 62 out of 366 in Tafea claimed solar as their main form of lighting, despite expected counts of 67 and 93 respectively. However, in Torba there was an overrepresentation with 70 of 219 respondents using solar in 2010, though the expected count was only 56. These distributions are significantly different to Malampa, Penama and Sanma, which are more similar to the overall sample distribution.

All survey households were chosen on the basis that they had a solar lamp. 90% of households own 2 or fewer solar lamps, and 99% own 4 or fewer. However, three homes claimed to own 7 lamps, one to own 8, and one to own 12 lamps.

79.6% of respondents had purchased 1 or 2 solar lamps this year, and only 12.8% said they did not purchase a solar light in the last year. Figure 27 shows the date that the households' most recent

solar lamp had been purchased. A large number (n=324) of lamps were apparently purchased on 01/01/2000, indicating an error in data entry for these responses.

Figure 27: Date of most recent solar lamp purchase



However, for those people that said they purchased 1 or more solar lamps this year, a validity check was performed against the response given when asked for the date of their most recent solar lamp purchase. These dates matched up for only 607 of the survey respondents, indicating a relatively robust response to this question.

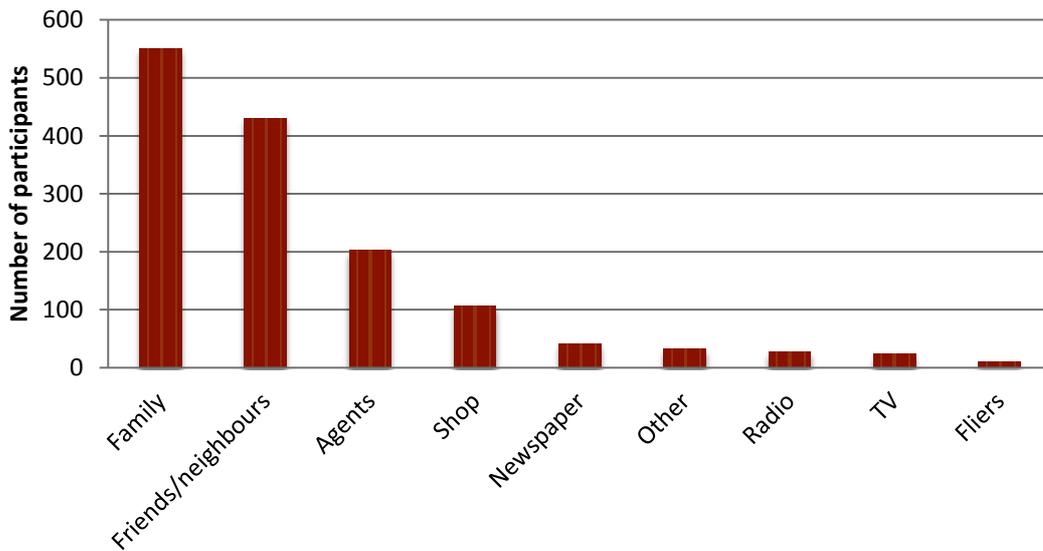
When asked about the cost of the lamp, 50% of people said that theirs had cost less than Vt2,000. Another 35% paid between Vt2,000 and Vt5,000, and some claimed to pay up to Vt500,000. In general this matches the suggested RRP for solar lanterns; the cheaper *d.light* lamps cost upward of Vt1300, while the more expensive *d.light* and Barefoot units retail at Vt5,000-Vt6,000. It is suspected that values upward of Vt100,000 are for full solar photovoltaic systems.

The amount paid for the solar lights does not vary significantly with either province or remoteness index.

### Purchase Decisions

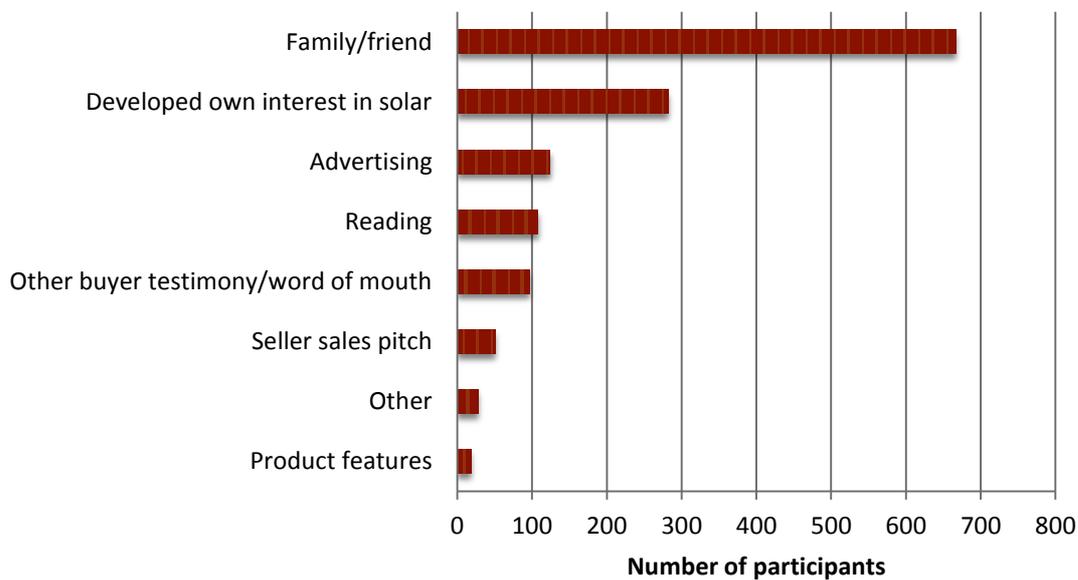
When people made decisions to purchase solar lights, they tended to turn to family and neighbours for information (68.9%). Agents and shops were also used as a source of information, but very few participants turned to the TV (1.6%), the radio (1.9%), the newspaper (3%) or fliers (0.7%) for advice (see Figure 28).

Figure 28: Source of information used when deciding whether or not to purchase solar lights



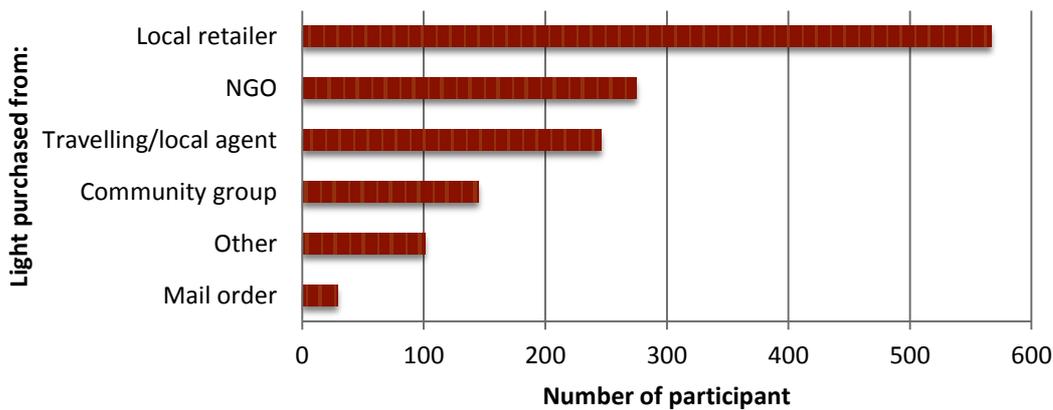
Most people were satisfied (85.4%) or somewhat satisfied (13.4%) with this information. For 84.4% of the survey respondents, this was their first time buying a solar lamp, and the greatest influence on their purchase decision was from family and friends (see Figure 29).

Figure 29: Greatest influence on purchase decision



The solar lights were purchased from a mixture of agents, as shown in Figure 30.

Figure 30: Agents from whom solar lights were purchased



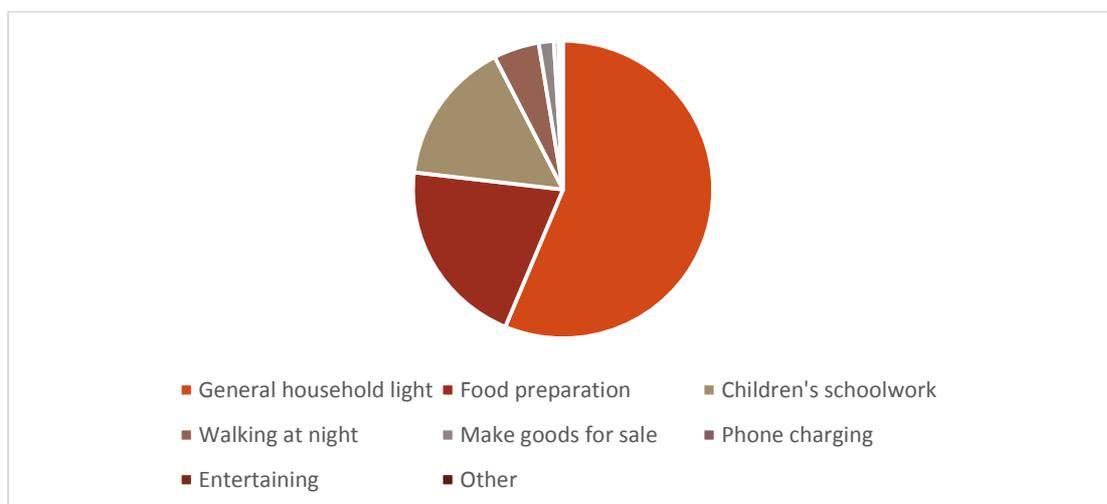
Of the “others”, most (47.7%) were gifted the light by a family member or friend, 14.8% bought them from a peace corps volunteer, and 15.9% bought them from other volunteers. 11.4% were purchased overseas in NZ or in Port Vila, and 9.1% came from MPs, local schools and pastors. Those households in areas with a remoteness ranking of 6-7 (remote and very remote) depended more on travelling and local agents for their purchases and less on local retailers.

At the time of this survey, 83.3% of respondents still have the solar light they bought/were gifted, and of the 16.7% of those that don’t 81.4% explain that it’s broken, 7.2% lost it, 5.5% gifted it to someone else, 4.6% say it was stolen, and 1.3% have loaned their light to someone else.

### Use of Solar Lighting

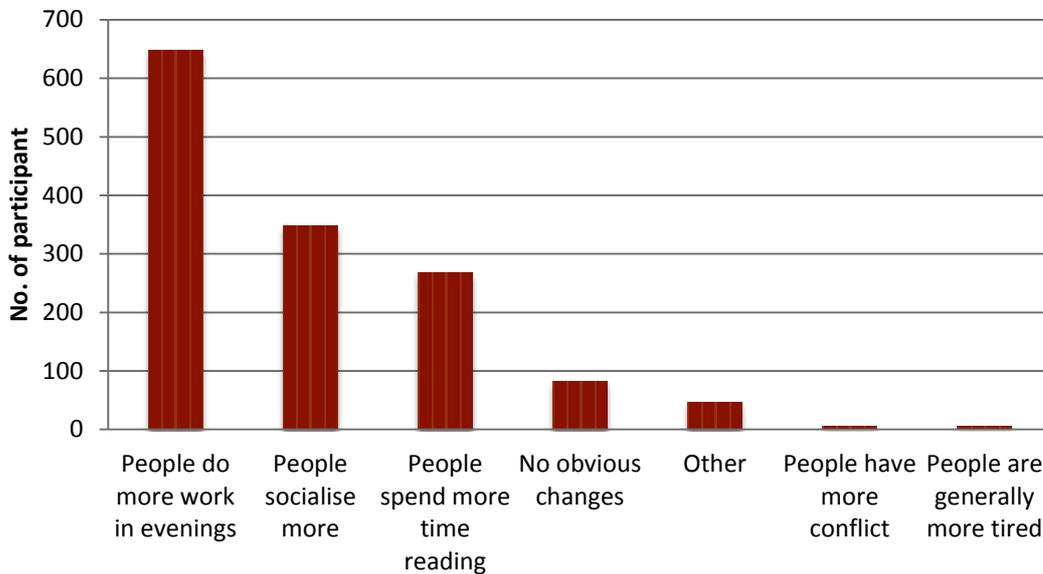
As Figure 31 shows, 56.5% say that the light is used as a general household light, 20.5% use it predominantly for food preparation, and 4.9% for walking at night. 15.6% say its main use is for children’s schoolwork, however, 54% says that the main user is all the family and only 15% say that the main user is a child.

Figure 31: Main use of solar light



The main change that has happened since using the light is that people say they do more work in the evenings (46.2%), they socialise more (24.8%), and spend more time reading (19.1%), as shown in Figure 32.

Figure 32: Main change since using the solar light

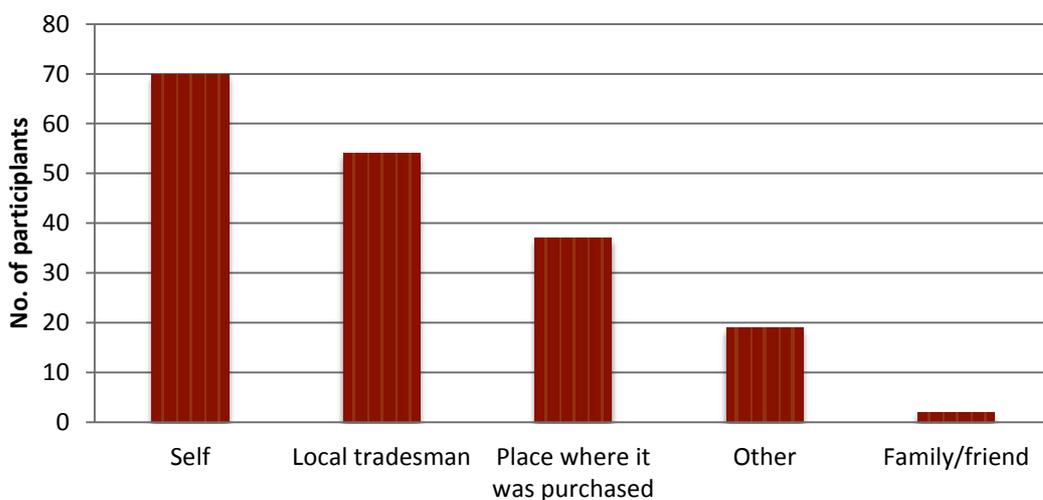


Most households (80.8%) use the lamp every night, and a further 8.1% use it 4-6 nights a week. Most homes tend to use their lamp for between 4 and 6 hours, and 82.1% use their light for more than 2 hours at a time.

### Maintenance

17.9% of respondents had had to get their solar light repaired; 38.5% of respondents who had their lights repaired did it themselves, whilst the rest mainly employed local tradesmen (29.7%), or took it back to the place of purchase (20.3%), as shown in Figure 33.

Figure 33: Method of repair of solar light



Only 6% of respondents had had to replace the battery for the light, and of these they predominantly kept the old battery in the house (58%). Others sent it back to the supplier (20.3%), buried it (11.6%), or burned it (4.3%). The original supplier supplied the new batteries approximately half the time, the other half they were supplied by a different supplier.

### Solar lighting characteristics

When asked what they like most about the light, 78.6% of respondents said the brightness. When asked what they like least, 40.3% say battery life, 28.1% say brightness, and 17.4% say size and weight: in fact 318 (23.4%) people give the same response for the thing they like the most and least about the light (brightness). Clearly the lights are brighter than previous options but there is still an aspiration for greater brightness.

90.9% of respondents also thought that a bigger system would be more useful, mainly because it would last longer (39.4%), be brighter (25.2%), or be more impressive (9.4%). 5.5% said they thought it would be more useful for other reasons, and an analysis of these open ended responses revealed 3 main arguments: lighting greater areas (2.9%), used for power as well as light (1.7%), and because it would be more permanent and better quality (0.3%).

### Discussion

This survey provides some interesting findings about the uptake and use of solar lighting in Vanuatu, and provides baseline data from which further analysis can be undertaken. There was little geographic difference noted into the majority of questions, apart from the source of light.

The findings outlined here give rise to further questions, including more detailed information about the nature of the supply chain (i.e. how are people on more remote islands getting continued access to solar lamps?), the nature of use (many people say that practices have not changed much but that mainly more work is facilitated in the evening, and it would be interesting to investigate this further), and any shifts in social norms or aspirations that have occurred as a result of the increased number of solar lights in the communities.

It is anticipated that these questions, along with others, will be answered following the ICR during which detailed interviews and focus groups will be conducted on a select number of islands.

## Appendix1: Lighting Vanuatu Survey Questionnaire

Date: Province:

Island: Town/Village:

A Interviewee profile					
1	Gender of interviewee	Male	<input type="radio"/>	Female	<input type="radio"/>
2	Age of interviewee (years)				
3	Highest level of education achieved by interviewee (choose one)	<input type="radio"/>	Non-literate		
		<input type="radio"/>	Did not complete primary		
		<input type="radio"/>	Completed primary		
		<input type="radio"/>	Did not complete secondary		
		<input type="radio"/>	Completed secondary		
		<input type="radio"/>	Did not complete tertiary		
		<input type="radio"/>	Completed tertiary		
B Household profile					
4	Highest level of education of any household member where the light is used (choose one)	<input type="radio"/>	Non-literate		
		<input type="radio"/>	Did not complete primary		
		<input type="radio"/>	Completed primary		
		<input type="radio"/>	Did not complete secondary		
		<input type="radio"/>	Completed secondary		
		<input type="radio"/>	Did not complete tertiary		
		<input type="radio"/>	Completed tertiary		
5	Total number of people normally living in the house where the light is used (number for each gender)	Male		Female	
6	Number of people below 18 years living in the house where the light is used (number for each gender)	Boys		Girls	
7	Main source of household cash (choose one)	<input type="radio"/>	Garden/farm		
		<input type="radio"/>	Livestock		
		<input type="radio"/>	Seafood		
		<input type="radio"/>	Homemade food products		
		<input type="radio"/>	Handicrafts		
		<input type="radio"/>	Employment		
		<input type="radio"/>	Remittances		
		<input type="radio"/>	Other (specify in space at left)		
C House profile					
8	Does the house where the light is used have access to electrical power? (choose one)	<input type="radio"/>	Yes, on grid		
		<input type="radio"/>	Yes, generator		
		<input type="radio"/>	Yes, solar power		
		<input type="radio"/>	No		
9	Main source of lighting in 2010 (choose one)	<input type="radio"/>	Generator		
		<input type="radio"/>	Gas		
		<input type="radio"/>	Coleman lamp		
		<input type="radio"/>	Kerosene lamp		
		<input type="radio"/>	Candle		
		<input type="radio"/>	Wood/coconut shell		
		<input type="radio"/>	Solar		
		<input type="radio"/>	Other (specify in space at left)		
		<input type="radio"/>	Decreased a lot (specify at left)		
<input type="radio"/>	Increased a little (specify at left)				

		<input type="radio"/>	Increased a lot ( <i>specify at left</i> )
		<input type="radio"/>	Don't know
10	Number of rooms in house ( <i>number</i> )		
11	Roof material on house ( <i>choose one</i> )	<input type="radio"/>	Metal
		<input type="radio"/>	Thatch
		<input type="radio"/>	Other ( <i>specify in space at left</i> )
<b>D</b>	<b>Solar lighting</b>		
12	How many solar lights are currently owned by this household? ( <i>number</i> )		
13	Financial impact of buying a solar light on <b>monthly</b> household expenditure ( <i>estimate increase/decrease in monthly expenditure in Vatu below</i> )	<input type="radio"/>	Decreased a little ( <i>specify at left</i> )
		<input type="radio"/>	Decreased a lot ( <i>specify at left</i> )
		<input type="radio"/>	Increased a little ( <i>specify at left</i> )
		<input type="radio"/>	Increased a lot ( <i>specify at left</i> )
		<input type="radio"/>	Don't know
14	How many solar lights have you purchased in the past year? ( <i>number</i> )		
15	How did you <b>first</b> come to know about the solar light that you most recently purchased? ( <i>choose one</i> )	<input type="radio"/>	Newspaper
		<input type="radio"/>	Fliers
		<input type="radio"/>	Family
		<input type="radio"/>	Shop
		<input type="radio"/>	Friend/neighbour
		<input type="radio"/>	Agents
		<input type="radio"/>	TV
		<input type="radio"/>	Radio
		<input type="radio"/>	Other ( <i>specify in space at left</i> )
16	Were you satisfied with the information you received about your light from the above source? ( <i>choose one</i> )	<input type="radio"/>	Yes
		<input type="radio"/>	Somewhat
		<input type="radio"/>	No ( <i>Why? Specify in space at left</i> )
17	From whom did you obtain your most recently purchased solar light? ( <i>choose one</i> )	<input type="radio"/>	Local retailer
		<input type="radio"/>	Traveling agent
		<input type="radio"/>	Community group
		<input type="radio"/>	NGO
		<input type="radio"/>	Mail order
		<input type="radio"/>	Other ( <i>specify in space at left</i> )
18	Location of above supplier	Province	
		Island	
		Town/vill.	
19	Date of purchase ( <i>dd/mm/yy</i> )		/ /
20	Name of product	Make	
		Model	
21	Was this the first time you bought a solar light?	Yes	<input type="radio"/> No <input type="radio"/>
22	How much did it cost? ( <i>Vatu</i> )		
23	What had the <b>greatest</b> influence on your purchase decision? ( <i>choose one</i> )	<input type="radio"/>	Family/friend
		<input type="radio"/>	Seller sales pitch
		<input type="radio"/>	Developed own interest in solar

		<input type="radio"/>	Reading
		<input type="radio"/>	Advertising
		<input type="radio"/>	Product features
		<input type="radio"/>	Other buyer testimony/word of mouth
		<input type="radio"/>	Other ( <i>specify in space at left</i> )
24	Do you still have this light?	<input type="radio"/>	Yes
		<input type="radio"/>	No, broken
		<input type="radio"/>	No, stolen
		<input type="radio"/>	No, lost
		<input type="radio"/>	No, loaned ( <i>specify Island you sent to</i> )
		<input type="radio"/>	No, gifted ( <i>specify Island you sent to</i> )
25	What is the <b>main</b> thing that the light is used for? ( <i>choose one</i> )	<input type="radio"/>	General household light
		<input type="radio"/>	Children's schoolwork
		<input type="radio"/>	Food preparation
		<input type="radio"/>	Make goods for sale
		<input type="radio"/>	Entertaining
		<input type="radio"/>	Walking at night
		<input type="radio"/>	Phone charging
		<input type="radio"/>	Other ( <i>specify in space at left</i> )
26	Who in the household <b>mainly</b> uses the light? ( <i>choose one</i> )	<input type="radio"/>	Adult male(s)
		<input type="radio"/>	Adult female(s)
		<input type="radio"/>	Child male(s)
		<input type="radio"/>	Child female(s)
		<input type="radio"/>	All
27	How often is the light <b>normally</b> used? ( <i>choose one</i> )	<input type="radio"/>	Every night
		<input type="radio"/>	4 - 6 nights per week
		<input type="radio"/>	1 - 3 nights per week
		<input type="radio"/>	Intermittently
		<input type="radio"/>	Only in emergencies
28	Time of last usage? ( <i>choose one</i> )	<input type="radio"/>	0 - 15 min
		<input type="radio"/>	15 - 30 min
		<input type="radio"/>	30 min - 1 hour
		<input type="radio"/>	1 - 2 hours
		<input type="radio"/>	2 - 4 hours
		<input type="radio"/>	4 - 6 hours
29	What do you like <b>most</b> about the light? ( <i>choose one</i> )	<input type="radio"/>	Size/weight
		<input type="radio"/>	Brightness
		<input type="radio"/>	Battery life
		<input type="radio"/>	Colour
		<input type="radio"/>	Other ( <i>specify in space at left</i> )
30	What do you like <b>least</b> about the light? ( <i>choose one</i> )	<input type="radio"/>	Size/weight
		<input type="radio"/>	Brightness
		<input type="radio"/>	Battery life
		<input type="radio"/>	Colour
		<input type="radio"/>	Other ( <i>specify in space at left</i> )
31	What is the <b>main</b> change you have noticed since you obtained the light? ( <i>choose one</i> )	<input type="radio"/>	People spend more time reading

		<input type="radio"/>	People do more work in evenings
		<input type="radio"/>	People socialise more
		<input type="radio"/>	People are generally more tired
		<input type="radio"/>	People have more conflict
		<input type="radio"/>	Other ( <i>specify in space at left</i> )
		<input type="radio"/>	No obvious changes
32	Would a larger solar system be more useful?	<input type="radio"/>	Yes
		<input type="radio"/>	No ( <b>Go to 34</b> )
		<input type="radio"/>	Unsure ( <b>Go to 34</b> )
33	Why would a larger solar system be better? ( <i>choose one</i> )	<input type="radio"/>	Brighter
		<input type="radio"/>	Last longer
		<input type="radio"/>	More impressive
		<input type="radio"/>	Other ( <i>specify in space at left</i> )
		<input type="radio"/>	Unsure
34	Have you ever had your solar light repaired?	Yes	<input type="radio"/> No <input type="radio"/> <b>Go to 35</b>
	Who repaired the light? ( <i>choose one</i> )	<input type="radio"/>	Local tradesman
		<input type="radio"/>	Place where purchased
		<input type="radio"/>	Self
		<input type="radio"/>	Other ( <i>specify in space at left</i> )
35	Have you ever had to buy a replacement battery?	Yes	<input type="radio"/> No <input type="radio"/> <b>End</b>
36	What date was the replacement battery purchased? ( <i>dd/mm/yy</i> )		/ /
	What happened to the old battery? ( <i>choose one</i> )	<input type="radio"/>	Still in house
		<input type="radio"/>	Sent back to supplier
		<input type="radio"/>	Buried
		<input type="radio"/>	Threw in sea
		<input type="radio"/>	Burned
		<input type="radio"/>	Other ( <i>specify in space at left</i> )
37	Who supplied the new battery? ( <i>choose one</i> )	<input type="radio"/>	Original supplier
		<input type="radio"/>	Different supplier