Energy policy, aid, and the development of renewable energy resources in Small Island Developing States

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Abstract

Small Island Developing States (SIDS) have established ambitious renewable energy targets. The promotion of renewable energy has been motivated by several factors: a desire to lessen dependence on fossil fuels, to attract development assistance in the energy sector, and to strengthen the position of SIDS in climate change negotiations. Here we explore the interplay between the role of aid and energy policy on the development of renewable energy resources in SIDS. We find that the importance of development assistance has implications for the sustainability of renewable energy development, given that funding is not always accompanied by necessary energy policy reforms. We also identify energy efficiency and access to modern energy services as having received insufficient attention in the establishment and structure of renewable energy targets in SIDS, and argue that this is problematic due to the strong economic case for such investments.

Key words: Small Island Developing States (SIDS), Pacific islands, Caribbean islands, energy policy, renewable energy, aid

1. Introduction

Small Island Developing States (SIDS) have established some of the most ambitious renewable energy targets in the world. Their promotion of renewable energy has been motivated by several objectives. Foremost is the desire to lessen dependence on fossil fuels, given high levels of reliance on imported fossil fuel products which make SIDS vulnerable to oil price rises. To meet such targets, SIDS must attract, and even compete for, development assistance to the energy sector, given barriers to financing renewable energy investment in other ways. All ten countries in the world that are most dependent on aid (defined as ODA as a proportion of GNI) are SIDS (OECD various years). Aid is especially important in the development of infrastructure in these countries, with much capital expenditure in the energy sector being funded by development partners. Apart from the energy insecurity challenge, SIDS now find themselves at the forefront to climate change impacts including more extreme weather events, sea level rise and coastal inundation (Rhiney 2015; Shah, et al. 2014). For this reason, SIDS have a prominent international platform in climate change negotiations and while their greenhouse gas emissions share is negligible, by setting ambitious renewable energy targets, they champion the urgency for action. This is acknowledged in their special treatment by successive IPCC reports and the establishment of special funding streams dedicated to SIDS such as that of the Green Climate Fund.

This paper explores the role of aid and energy policy in the development of renewable energy resources in SIDS from a public policy perspective. Although these subjects are related, the academic literature has mostly developed each in isolation. We contribute to the literature by bringing these strands together to show how energy policy and the provision of aid in the energy sector are important determinants of renewable energy development in SIDS. We also contribute through coverage of all SIDS groupings: the Caribbean; the Pacific; and the Atlantic, Indian Ocean, Mediterranean, and South China Sea (AIMS), since the majority of the literature on renewable energy development in SIDS is concerned with countries in one of these groups (especially in the case of the Caribbean and the Pacific) (Dornan 2015b; Niles & Lloyd 2013; Yu, et al. 1996), or with SIDS country case studies (Dornan 2011; Mala, et al. 2008; Urmee & Harries 2012). Very few papers have explored renewable energy

development across SIDS (Niles & Lloyd 2013 explore developments in the Caribbean and Pacific SIDS; Stuart 2006; Weisser 2004a; Weisser 2004b are other exceptions).

2. Background

2.1. The Energy Sector in SIDS

By definition a common attribute of SIDS is that they are geographically small. This has economic and policy implications for renewable energy development. Small consumer markets constrain the ability of energy suppliers to benefit from economies of scale in power generation, and limit the extent to which it is possible to have multiple competing generation and retail companies supplying electricity (Weisser 2004b). This has implications for the structure and regulation of the power sector. Smallness limits the ability to establish independent regulatory agencies in extremely small SIDS, given the fixed costs associated with those agencies (Dornan 2014a). National markets spread over island archipelagos also make electrification efforts more difficult in the case of several SIDS (Dornan 2014a; Dornan 2015a). Logistically many SIDS, particularly those of the Pacific, must also rely on oil-fired generators, as can be seen in table 1. Technologies that can provide electricity at scale and at low financial cost (although high environmental costs), such as coal-fired generation, are generally inappropriate in SIDS given limited demand for power.

Presently, renewable energy is a major source of electricity supply in few SIDS, despite ongoing efforts to ramp up development and production. The reliance on fossil fuels to meet energy needs makes SIDS vulnerable to movements in the international price of oil. The oil price spike that occurred prior to the global financial crisis caused price inflation and led to major declines in the terms of trade of SIDS (ADB 2008; ADB 2009; Dornan 2009; IMF 2011; Levantis 2008; Levantis, et al. 2006; Sugden 2009; UNDP 2007b). Risk mitigation and economic objectives form a major objective of efforts to promote renewable energy development in SIDS as a result (Dornan & Jotzo 2015). In this context, aid for energy development is important for SIDS, especially in the financing of large-scale energy

infrastructure projects (Bertram & Watters 1985; Easterly & Kraay 2000; Pacific Region Infrastructure Facility 2013). The energy sector has historically been a beneficiary of such assistance, attracting limited government funding (and attention) (Niles & Lloyd 2013; Stuart 2006). Private sector investment in energy infrastructure has similarly been limited in most SIDS, given the small scale of markets, as well as various regulatory challenges (outlined below).

[Insert Table 1 here]

Despite common features, there are important differences in the energy sectors of SIDS. One is access to modern energy services. Many SIDS enjoy high levels of access to modern energy services, but this is not universal. The Melanesian states of Papua New Guinea, Solomon Islands, and Vanuatu in the Western Pacific have very low rates of electricity access, comparable to those in Sub-Saharan African countries. The availability of renewable energy resources also varies considerably in SIDS. Atoll states must rely on solar power, and small-scale biofuel or waste-to-power schemes for their renewable energy supplies. Larger countries such as Jamaica, Papua New Guinea, and Fiji have ample supplies of renewable energy resources that can be used for large-scale electricity production: hydro-power, geothermal, wind-power, are some examples. A third difference among SIDS are the institutional arrangements in the energy sector. As in most of the world, the power sector of most SIDS developed as vertically integrated state-owned monopolies. However, in some SIDS, power sector reforms have led to the privatisation of utilities or their separation into generation, distribution/transmission and retail components in a bid to facilitate competition.

Such differences have a bearing on renewable energy development in SIDS. The availability of renewable energy resources, for instance, is an important determinant of the economics of renewable energy investment. Countries with ample renewable energy resources that are suitable for low-cost energy supply are better placed to utilise these resources. The same can be said of development assistance, the significance of which does vary between nations. Access to modern energy services

also influences priorities. In cases where access to modern energy services is limited, renewable energy development may compete for aid funding with rural electrification projects. Institutional arrangements in the energy sector are also important. Regulatory structures determine the incentives of, and financial resources available to, power utilities, and the private sector in investing in renewable energy. These linkages between energy policy, aid, and renewable energy development are further discussed below.

2.2. Method and Literature Review

This paper surveys grey and academic literature relevant to energy policy, aid, and the development of renewable energy resources in SIDS in order to explore both the rationale for ambitious renewable energy targets, and the interplay between aid and energy policy in renewable energy development. Its contribution is in bringing together various strands of literature that have developed in isolation – literature on energy policy, aid, and renewable energy development – together with data procured from disparate international databases. Literature surveyed includes national energy planning documents, project documentation from donors, and academic work on aid, renewable energy development, and energy policy. The paper synthesizes research from across a number of bodies of literature and from the various SIDS regions, drawing on the extensive work of the authors in the energy sectors of both Pacific and Caribbean SIDS. Semi-structured interviews with energy officials in Pacific and Caribbean SIDS, conducted over a period of many years, also inform the conclusions reached in this paper.

Much of the academic literature on renewable energy development in SIDS is concerned with the availability of renewable energy resources and the institutional policies necessary for their development (Dornan 2015b; Jafar 2000; Singh 2009; Stuart 2006; Weisser 2004a; Wright 2001; Yu, et al. 1996; Yu & Taplin 1997a; Yu, et al. 1997). Apart from the academic literature, there is a large and increasingly important grey literature on institutional policies and financial resources required for

development (Johnston et al., 2005; Liebenthal et al., 1994) as well as numerous project studies on installation experiences (Prasad 2003; Singh 2009; Waddell & Bryce 1999). Some studies also consider institutional arrangements for aid-funded programs (Dornan 2011; Mala, et al. 2008; Urmee & Harries 2012).

Researchers have pointed out that reforms advocated in other parts of the world are generally inappropriate due to the small scale of energy markets (Dornan 2014b; Dornan 2015a; Weisser 2004b). Regional studies of access to modern energy services are primarily focus on SIDS in the Pacific, given the low rates of access in that region (Dornan 2014a; Dornan 2015a). These papers draw on the broader energy poverty literature, of which sub-Saharan Africa has been a key focus (Martinot, et al. 2001; Martinot, et al. 2002). There is grey literature on the same issues, most of which comprises project documents produced by development partners (see for example ADB 1998). Broader studies produced by development partners have focused on the impact of high oil prices on SIDS in particular regions (ADB 2009; UNDP 2007b), and on energy poverty and access to modern energy services (UNDP 2007a). Relatively little has been written about aid for renewable energy development (Yu & Taplin 1997b is an exception), although a number of studies discuss its impact (Dornan 2014a; Dornan 2014b; Niles & Lloyd 2013).

Some of the broader literature on development aid in SIDS is generally applicable to the case of energy development. Bowman and Chand (2008) argue that high levels of aid are correlated with low institutional quality in small states, however, their results are contradicted by Gani's (2009) study of aid and governance in Pacific SIDS. The foreign nature of formal institutions established or supported by development partners has been a focus of other social science disciplines. A number of authors conclude that the failure to adequately reflect local power relations has undermined the functions of aid-supported formal institutions in SIDS of the Pacific (Brigg 2009; Fukuyama 2008; Larmour 2000; Larmour 2005; Murray & Overton 2011; Slatter 2006). These findings mirror international work on the institutional impact of aid (Gibson, et al. 2005; Ostrom, et al. 2001), and have parallels with the results

of academic studies of aid to the energy sector of SIDS (Dornan 2014b; Ilskog & Kjellström 2008; Niles & Lloyd 2013).

3. Key developments and issues

3.1. A new ambition? Development of renewable energy resources in SIDS

Over the last decade the energy sectors of SIDS have experienced significant changes and reform, much of it driven by the adoption of ambitious renewable energy targets. Renewable energy investments are not new in most SIDS, with a variety of renewable energy technologies advocated for rural electrification since the 1970s (Liebenthal, et al. 1994). The scale of recent reform to develop renewable energy, however, is unprecedented.

It is only in the last decade that SIDS have aimed to substitute consumption of fossil fuels with renewable energy. Most SIDS have established renewable energy targets. Many of these targets are focused on investments in the electricity sector, recognising the considerable potential that exists in SIDS for replacing oil-based power generation with electricity produced by renewable energy technologies. In some cases, targets extend beyond the electricity sector, often with a view to the production of biofuels from domestic crops (coconut trees, for example). In countries where access to modern energy services is limited, targets are sometimes complemented with rural electrification objectives.

Renewable energy targets are closely related to the Intended Nationally Determined Commitments (INDCs) put forward by SIDS in preparation for the UNFCCC climate change negotiations in Paris. There is some variation, in part due to legal form. The majority of targets established renewable energy targets nationally by SIDS are not legally binding (IRENA 2015). This is also the case for Intended Nationally Determined Commitments (there is some prospect that the latter could become legally binding), however there is greater international pressure to comply with such commitments. There is also significant variation in the way in which renewable energy targets have been established, with

some targets applying to the electricity sector, others to energy consumption more broadly, and some differentiating between rural and urban areas. Targets to reduce greenhouse gas emissions through the UNFCCC process are likely to be more standardised. A list of renewable energy targets adopted by SIDS is provided in table 2.

[Insert table 2 here]

Although SIDS are not unique in the establishment of renewable energy targets, what is unique is the scale of the targets SIDS have established. A recent IRENA report (2015) noted that the number of countries with renewable energy targets in place has climbed dramatically in recent years, from 43 in 2005 to 164 in 2015. Although comparisons are difficult due to the different formats of targets, the majority of countries have established renewable energy targets that aim to generate between 10 to 40 percent of electricity using renewable energy technologies (IRENA 2015). In contrast, more than half of SIDS have established targets that are higher than 40 percent (this includes 14 of 15 Pacific SIDS; 15 Caribbean SIDS through the regional target established by the Caribbean Community, which was agreed by national leaders; and one AIMS SIDS). Indeed, IRENA (2015) notes that the: "few countries aiming for shares of renewable energy generation larger than 50% tend to apply to either hydro-based electricity systems or to relatively smaller electricity systems."

A second reason for the establishment of ambitious renewable energy targets is the objective of attracting development assistance. This objective has been understudied in the literature on renewable energy development in SIDS (Dornan 2015b details the argument). It is most relevant in microstates where development funding is significant, and is not applicable across all SIDS. The incentives faced by leaders in such microstates in attracting development funds are nevertheless clear, and the argument is consistent with broader theory on aid and incentives in developing countries (Gibson, et al. 2005; Ostrom, et al. 2001). Considerable development assistance funds are available for renewable energy development (New Zealand and European Union renewable energy initiatives

in Pacific SIDS provide good examples). Funding for ongoing fossil fuel costs, on the other hand, is limited (Taiwan and Japan both provide balance of payments support in some smaller SIDS for imports of fuel, but the amounts are limited). According to this argument, one reason that SIDS stand to gain financially from renewable energy investments is that most of the (upfront) capital costs associated with these investments is paid for by development funding that would otherwise not be available. In effect, renewable energy investments in these microstates are subsidised to a greater extent than investments in non-renewable energy technologies; something that is unique, given the heavy subsidisation of fossil fuels in other parts of the world (IEA 2014).

Supporting this argument is the fact that many small SIDS that have established ambitious renewable energy targets emphasise that these cannot met without external assistance. The small atoll nation of Tuvalu, population 10,000, is an example. Tuvalu aims to generate 100% of its electricity using renewable energy by 2020. When Tuvalu established this target, it had no significant renewable energy generation in place (it now generates approximately 5 percent of its power using solar photovoltaic technology). Tuvalu has no obvious low-cost renewable energy resources for power generation (wind speeds are not high). A solar energy resource appropriate for photovoltaic technologies is available and significant, but cost-effective storage of electricity is a problem at high penetration levels in the electricity grid. Tuvalu has per capita income of less than US$4,000, and is dependent on aid funding for over 30 percent of its government expenditure. This limits the financial resources that are available for renewable energy investment. Such challenges are acknowledged in the Tuvalu Government's Master Plan for Renewable Electricity and Energy Efficiency, *Enetise Tutumau 2012-2020*. The document notes that investments required to meet the renewable energy target have: "a rate of return is less than that would normally be considered attractive by a private sector investor", and that as a result, "Tuvalu is seeking a steady funding stream and a long-term commitment by donors for the investment plan" (Government of Tuvalu 2013).

The vulnerability of SIDS to climate change underscores a third reason for the establishment of ambitious renewable energy targets. Ambitious targets serve a useful political purpose of enabling SIDS to argue that other countries should take more ambitious action to reduce greenhouse gas emissions. SIDS have been vocal in their support for the adoption of a 1.5 degrees Celsius target – a more ambitious target than the 2 degrees Celsius target agreed through the UNFCCC – through groupings like AOSIS. Many of the most ambitious renewable energy targets established in SIDS, therefore, can be argued to be the result of the (understandable) focus of political leaders on the international climate change negotiations.

3.2. Aid for energy

Development funds and assistance are needed in the majority of SIDS to achieve renewable energy targets. There has been a clear shift this century in the provision of development assistance, away from project-style interventions and toward program-based assistance. The same is true of assistance for renewable energy development in SIDS. Whereas in the past *ad hoc* rural electrification or grid extension projects were the norm, these days considerable assistance for renewable energy is provided as a package, which includes policy advice and reform, various renewable energy investments, network strengthening, and in some countries, funding for rural electrification. Assistance is also better coordinated than in the past, although there is room for improvement.

Development assistance (or aid) directed toward the energy sector is significant in SIDS. Its importance has increased in the last decade, with a scale up in development funding directed toward renewable energy resources. The bulk of development funding for the energy sector is directed toward renewable energy development, which comprises over 50 percent of assistance to the energy sector. The significance of this funding is illustrated in figure 1. Development funding for renewable energy development as a proportion of economic activity is higher in SIDS than in other developing countries. It is higher still in SIDS situated in the Pacific and AIMS (Atlantic, Indian Ocean, Mediterranean, and

South China Sea) groupings, measuring 0.41 and 0.92 percent of GDP respectively. Indeed, the OECD Creditor Reporting System data on which figure 1 is based is likely to understate funding directed toward renewable energy development in SIDS, given the poor quality of data for smaller countries (non-entries are common) and the way in which the data is coded.[1]

[Insert figure 1 here]

The importance of development assistance for the energy sector can have a number of impacts. Development assistance can be beneficial for energy sector planning to the extent that it facilitates the use of external technical expertise. However, if such assistance is not coordinated, it can also be detrimental to the establishment of a coherent set of energy investments and policies (Shah, et al. 2012). Limited coordination among development partners has been a problem in many SIDS. At the launch of the Caribbean Energy Security in 2014 at the behest of the Obama led US administration, Caribbean governments, multilateral banks and the international donor community all agreed that a key step forward had to be donor coordination, especially in key areas such as: improving governance of renewable resources, technical studies including island interconnections; integration of renewables

[1] Aid funds must be coded according to their primary purpose in the OECD Creditor Reporting System. However, because aid is provided with several objectives, or with an immediate and an end objective, this can result in the under-estimate of aid provided for a specific purpose. A good example is that of aid provided for "23010: energy policy and administrative management". This purpose code comprises 19 percent of total energy sector assistance to Pacific SIDS, which is not included in figure 1. Funding provided under this code to SIDS, however, generally complements assistance for the development of renewable power generation, which is provided as part of a broader program including energy policy reform. If assistance for "energy policy and administrative management" were to be included in figure 1, aid for renewable energy development in SIDS would measure 0.17 percent of GDP (including 0.63 percent in Pacific SIDS and 0.96 percent in AIMS SIDS).

into energy grids, and establishing preconditions for clean energy development. A report by the United Nations Development Programme (2007a) argued that in Pacific SIDS:

> "Due to the limited capacity available in Pacific island countries, energy system designs are often carried out by donor-selected consultants. There is usually little coordination between donors or even technical continuity between energy projects from the same donor. As a result, one country may have many types of rural energy systems operating at the same time, making maintenance and technical support difficult and expensive."

A reliance on development assistance has also led to the provision of outdated or inappropriate infrastructure in SIDS (see for example Government of Tuvalu 2013; Wade 2005). In general, there has been a bias toward centralised power supply in the provision of aid in the energy sector of SIDS, even in countries where the population is distributed across many islands in small communities (Niles & Lloyd 2013). Rural electrification has received low priority in most SIDS. That which has occurred has often taken place in the form of *ad hoc* projects funded by different development partners using different technologies and institutional frameworks for ongoing maintenance an cost recovery (Dornan 2011; Dornan 2014a). The same UNDP report quoted above noted that:

> "Some energy initiatives in the past were based on specific technologies seeking an application … some initiatives have promoted renewable technologies not tested elsewhere or in some cases completely unsuitable for the problems they were meant to address." (UNDP 2007a)

Some of these issues are being addressed with the move toward programmatic approaches in the delivery of development assistance. Coordination has improved. The establishment of the Pacific Region Infrastructure Facility (PRIF) in 2008, for example, was designed to ensure that assistance to Pacific SIDS from a variety of development partners was coordinated (PRIF comprises the Asian Development Bank, Australia, European Union, European Investment Bank, Japan, New Zealand, and the World Bank). Similarly, the CARICOM countries of the Caribbean have set up special fund coordination facilities jointly with the Caribbean Development Bank to promote a Caribbean Regional

Energy Policy which has as one of its objectives to umbrella various foreign originated funds and loans for regional projects. In early 2015, The Clinton Climate Initiative (CCI), Rocky Mountain Institute and the Carbon War Room announced a strategic partnership to coordinate their funding to accelerating clean energy and energy efficiency in the Caribbean (CARICOM 2015).

However, problems persist. Development assistance from some partners (such as Japan) continues to be tied to suppliers from the donor, undermining value for money. *Ad hoc* project interventions also continue (renewable energy installations in SIDS are funded by a variety of development partners not otherwise engaged in the sector, such as the United Arab Emirates). Such projects prioritise the development of large-scale infrastructure, generally for power generation. The bulk of assistance in the energy sector is also directed toward existing electricity networks, rather than off-grid communities. This continues the historical bias toward centralised power supply evident historically in SIDS (Dornan 2014a; Niles & Lloyd 2013). Importantly, although institutional structures in the energy sector have improved, these are generally reliant on funding from external development partners. In Vanuatu, for example, the power utilities regulator receives funding support from the World Bank. Even in SIDS with more developed energy sectors, such as Jamaica and Trinidad and Tobago, independent utilities regulators were initially instituted based on the urging and incentives of multilateral banks, including the World Bank and Inter-American Development Bank. This has implications for the sustainable development of renewable energy resources in SIDS.

3.3. Energy policy

Energy policy reform has been an important focus of development partners interested in renewable energy development. Many of the reforms that have been advocated, or are being implemented, are based on experience in other parts of the world. Globally, power sector reform that commenced in the 1980s involved the introduction of competition and private sector investment into a sector that had traditionally been dominated by state owned companies that were vertically integrated across

generation, distribution and retailing functions. Reform advocates argued that private sector involvement and competition could help address poor performance and service, as could reforms designed to ensure adequate pricing of electricity. Proponents of reform sometimes also argued that private sector funding could expand access to power through both network expansion and new investment in generation capacity (Gratwick & Eberhard 2008; Rosenzweig, et al. 2004).

Similar arguments were made in many SIDS, although significant reform was limited to a handful of countries, with the small scale of electricity networks a key barrier (Dornan 2014b; Stuart 2006; Weisser 2004a; Weisser 2004b). Indeed, reform in most developing countries has not been comprehensive. Gratwick and Eberhard conclude that:

> "What we find in the power sector of most developing countries is a confused and contested policy and institutional space that arises from the fact that the incumbent state-owned utility remains intact and dominant, but where independent power producers (IPPs) are also invited into the market, often with less than enthusiastic support from the incumbent" (Gratwick & Eberhard 2008: 3958)

In the majority of SIDS, electricity provision remains the responsibility of the state. Some power utilities have been corporatised, with electricity prices set by an independent board or regulator. In the Pacific for instance, since 2000 at least seven independent regulatory bodies have been created with the assistance of development partners. However, in most cases power utilities continue to operate as government-owned monopolies with numerous objectives related to the quality of service and operating within budget. Electricity prices set by government are also often low, preventing investment in new generation capacity or network expansion. This is a significant barrier to the development of renewable energy resources (Blechinger & Shah 2011).

Governments in many SIDS have sought investment by independent power producers in recent years. Dominica, for instance, has sought private sector investment to develop its substantial geothermal energy potential (it has received assistance from the Clinton Climate Initiative in this endeavour)

(CARICOM 2015). Fiji has done the same in order to develop both its geothermal and biomass resources (Dornan & Jotzo 2015). Results have been mixed, with most SIDS struggling to attract the private sector investment sought for renewable energy development (whether as public-private partnerships, known as PPPs, or as stand-alone investments). There are a number of reasons for this (Dornan 2015b). One is the small size of electricity markets in SIDS, which limits the commercial value of such ventures for the private sector, especially in the case of foreign companies that have the requisite technological knowledge to develop renewable energy resources. Poor credit markets are a compounding factor. Another barrier is the limited regulatory capacity and experience in SIDS, which often results in inappropriate regulatory frameworks and settings that form a disincentive to private sector investment. Fiji provides an example. Government efforts to attract private investment in biomass-fired electricity production led to concessions being granted to foreign energy companies, but without any requirement that those companies invest within a certain period of time. When those companies did not invest – most were small companies without the requisite capital on hand – this prevented investment by other energy companies in those areas.

Energy policy in SIDS is the ongoing subject of contestation and change. SIDS have sought to attract private sector investment in renewable-based power generation, but regulatory frameworks have been slow to catch up, and existing power utilities have sometimes resisted new entrants. Efforts to attract private sector investment have had limited success. The result has been an electricity sector dominated by state-owned power utilities, but with some investment by smaller privately owned independent power producers that seek to feed electricity produced by renewable energy technologies into the grid. This situation explains much of the development assistance provided to the energy sector that takes the form of energy policy advice and technical assistance. It also explains why development assistance is so important in the development of renewable energy resources in SIDS.

Transport policy, by comparison, has received relatively little attention. This is partly because the link between renewable energy development and the transport sector has not been made as explicit as

with the power sector. Low-cost ways of reducing greenhouse gas emissions, such as through minimum performance standards for vehicles, have not been a priority (and where they have the emphasis has been on local air pollution). The use of biofuels in vehicles has only occurred in a number of SIDS (Shah, et al. 2012).

One issue that has received minimal attention in SIDS is access to modern energy services. Access to modern energy services varies enormously between SIDS, although in general, access is slightly lower in SIDS than in countries with comparable GDP (see figures 2 and 3). This finding is to be expected given the geographical constraints to electricity provision faced by SIDS, such as small size, outlined earlier.

[Insert figure 2 here]

[Insert figure 3 here]

The limited focus on access to modern energy services is understandable in SIDS with high rates of access to electricity. But the observation also holds in SIDS where that is not the case, such as in Solomon Islands, which is the subject of significant grid-based renewable energy investments. The limited attention afforded access to modern energy services is notable in such countries given the strong economic case for expanding access to electricity and modern cooking technologies (Bernard 2012; Cook 2011; IEA 2014; World Bank 2008). It is relevant to this paper because grid-based renewable energy investments have attracted more funding (from development partners and government) than rural electrification (Dornan 2014a).

4. Discussion

The energy sector in SIDS is changing rapidly as a result of ambitious renewable energy targets. Within the energy sector, it is electricity generation that has been most affected. Energy policy and aid have

influenced the way in which renewable energy resources are developed, including the scale of private sector investment. In turn, both have been affected by the desire to develop those resources (reflected in the ambitious renewable energy targets established in SIDS) and by the special challenges those countries face in attracting investment. An understanding of the drivers of energy policy and development assistance in SIDS is therefore important if we are to understand how renewable energy resources in SIDS are being developed.

Ambitious renewable energy targets established by SIDS require development funds in order to be met. For most countries, the historical record indicates that private sector investment is unlikely, on its own, to facilitate accomplishment of such targets. The causality runs both ways. Not only is development assistance important for the achievement of renewable energy targets of SIDS, but such targets have been established in part with the objective of attracting development assistance. This argument, although not valid in the case of all SIDS, has strong support in the case of SIDS with few renewable energy resources that have established ambitious renewable energy targets. It is consistent with the broader literature on aid and incentives, which posits that changes in policy in aid-dependent countries can be driven by efforts to attract development funds (Gibson, et al. 2005; Ostrom, et al. 2001; Ostrom, et al. 1993).

Energy policy is also closely linked to the development of renewable energy resources. This is especially true in the power sector, where most renewable energy development in SIDS has occurred (the transport sector, in contrast, has to date not been so strongly influenced by efforts to develop renewable energy resources). In the power sector, regulatory reform is key to attracting private sector investment, which can complement aid in the development of renewable energy resources. To date, reform has been limited in most SIDS, but there are signs that it is accelerating due to the desire to develop renewable energy resources. This is most notable in the establishment of independent regulation, feed-in tariff legislation and regulations, and the general de-politicisation of power sector management in SIDS (Dornan 2015b; Shah, et al. 2012). Such measures are primarily aimed at

attracting new investment in renewable energy resource development. Cost recovery in the tariff setting process is an important step toward this objective.

Most recent investment in the energy sector in SIDS has been for power generation using renewable energy technologies. This is despite low levels of energy efficiency in the electricity sectors of many SIDS, which make energy efficiency measures a more cost effective investment (ADB 2011; GWA 2011). The case of Fiji provides a good example. A number of studies focused on Fiji have suggested that energy efficiency measures would be subject to a substantially greater economic return than renewable energy investment. The government, however, has still to put in place such measures despite facilitating investments in wind-power, biomass, and hydro-power development.[2] Many Caribbean countries including Jamaica, St. Lucia and Barbados have documented greater economic returns in the hotel and hospitality sector through energy efficiency retrofits and transition to solar resources, but surges in such initiatives have mainly been financially supported through development funds rather than government investments.

The focus on the quantity of electricity produced using renewable energy technologies network has also sidelined initiatives to expand access to modern energy services (a point most relevant in a handful of SIDS in the Pacific region). There is good anecdotal evidence to support this claim[3]. Analysis of government budget allocations to rural electrification in SIDS with low rates of access to modern energy services shows that spending is minimal (in the case of Solomon Islands, budget documents

[2] Dornan and Jotzo (Dornan & Jotzo 2015), for example, found that energy efficiency measures associated with Minimum Energy Performance Standards and Energy Labelling schemes would have an average avoided cost of generation of 4 Fijian cents per kilowatt hour, relative to generation costs of 46 Fijian cents per kilowatt hour for existing oil-fired generation. The most promising renewable energy investment was the installation of co-generation facilities at existing sugar processing mills, which had an average cost of generation of 16 Fijian cents per kilowatt hour.

[3] Unfortunately there is no good data on rural electrification spending in SIDS, and development assistance codes designated by the OECD Creditor Reporting System do not include rural electrification.

show that nothing was spent by government agencies on rural electrification in 2012, despite only 22 percent of the Solomon Islanders having access to electricity). Similarly, the bulk of funding from development partners for renewable energy development has targeted the supply of power to existing electricity networks – a global phenomenon, according to the IEA (IEA 2014).[4]

Renewable energy targets that focus on the proportion of power produced are therefore inherently biased toward centralised power supply. This is a problem for a number of reasons. The strong economic case for rural electrification would suggest that a focus on centralised power supply means that financial resources are not being allocated where most effective. A focus on centralised power supply can also be argued to be problematic from a poverty alleviation perspective, given that rural areas in developing countries (and SIDS more broadly) tend to be poorer than urban areas. There are clear political risks to the sustainability of renewable energy development where the distribution of benefits is unequal.

Energy policy and development assistance have also influenced the implementation and achievement of renewable energy targets. Achievement of renewable energy targets in SIDS is a challenge in many cases given ownership and regulatory structures that do not incentivise investment. This issue is especially pertinent in SIDS given small market size and the limited availability of credit. In many cases, state-owned utilities that have previously operated as monopolies oppose private sector investment as well. As a result, ambitious renewable energy targets have sometimes been delayed – something that is made possible by the fact that renewable energy targets established by SIDS are rarely legally binding (Dominica and Antigua and Barbuda having set ambitious 2020 targets are now debating shifting those targets to a 2030 goal; and Fiji has extended and changed its renewable energy target a

[4] At the Pacific Energy Summit, an important gathering of development partners and Pacific SIDS governments in 2012, a document listing current and proposed projects in the energy sector was prepared. Projects focused on improving access to modern energy services accounted for just 4 percent of funding, in a region where 70 percent of the population does not have access to an electricity supply (Dornan 2014a).

number of times when it became clear it would not be achieved (Dornan 2014b)). Power sector reform to address such challenges has progressed in some SIDS, but in most SIDS it has been limited. This includes many of the SIDS with very high (>80%) renewable energy targets.

The difficulty of attracting investment has increased the importance of development funds. Reliance on development funds brings with it risks in terms of the sustainability of renewable energy development. *Ad hoc* renewable energy installations funded by development partners may suffer from poor management if not accompanied by corresponding institutional reform. The fact that poor management has been a problem in the past in SIDS serves to highlight this risk – in many countries, the absence of pricing structures that facilitated cost recovery in the power sector led to financial strain among power utilities, which could not fund appropriate maintenance as a result (Pacific Region Infrastructure Facility 2013). Where power sector reform has taken place, but depends on ongoing development funding, sustainability is similarly not assured.

These risks emphasise the importance of broad-based political support for renewable energy development. That support must be comprehensive, and include support for necessary reform of institutional frameworks in the energy sector. Support for national renewable energy targets is important, and useful insofar as it can guide public policy (including regulatory arrangements) and indicate where potential investment opportunities lie for the private sector (Shah, et al. 2012). But targets established without a view to necessary reforms are often not robust. More than just high level targets established with political objectives are needed for the sustainable development of renewable energy in SIDS, as noted by IRENA (2015):

> "Renewable energy targets can be established through top-down or participatory processes, or a combination of both. In some cases, top-down targets established at the political level by the highest authority are essential to tackling the inertia of energy systems and opening space for new entrants in the renewable energy sector. However, renewable energy targets deriving only from political objectives tend to be fragile."

5. Conclusion

We explore the public policy implications of developing renewable energy resources in SIDS, drawing on the broader literature related to aid and energy policy in SIDS. The development of renewable energy resources in SIDS has been shown to be shaped by both the energy policies of SIDS and by the aid (development funds) that SIDS receive. One reason that targets in SIDS are among the most ambitious in the world is that they have been used in order to attract development assistance. Renewable energy targets have also been established in SIDS with other objectives, including a desire to lessen dependence on fossil fuels (given the vulnerability of SIDS to oil price rises), and in a bid to strengthen the position of SIDS in climate change negotiations. The context within which these targets have been established is also important. In most SIDS, cash-strapped state-owned electricity utilities are not able to fund significant new capital investment, and private sector investment in the energy sector is limited.

The implementation and achievement of renewable energy targets has been (and will continue to be) a challenge in many SIDS given ownership and regulatory structures in the power sector that do not provide appropriate incentives or resources for investment. Development funding will continue to be important as a result, especially in countries where commercial prospects for renewable energy investment are limited. We note that where funding is not accompanied by necessary reforms, this has implications for the sustainability of renewable energy development given the frequent absence of effective management arrangements (including appropriate pricing and other regulatory structures). In larger SIDS, where there is no prospect of development assistance funding all investments necessary to meet renewable energy targets, the failure to attract private sector investment is likely to undermine achievement of those targets.

We also identify two issues that have received insufficient attention in the establishment and structure of renewable energy targets, and in subsequent development of renewable energy resources in SIDS. Investments in energy efficiency and the expansion of access to modern energy

services have strong positive economic impacts. Renewable energy targets focused on the share of power produced by renewable technologies have not adequately incorporated these important objectives into energy planning. This should be particularly concerning for development assistance providers that operate in SIDS, given poverty alleviation concerns.

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