

Report

Fossil Fuel to Renewable Energy

Comparator Study of Subsidy Reforms and
Energy Transitions in African and
Indian Ocean Island States

FFRE



United Nations Office for
Sustainable Development

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Foreword

Humanity faces the daunting challenge of pursuing prosperity for all, while maintaining – indeed rebuilding – the integrity of the embattled biosphere that provides our common life support system. Of all economic activities, the production and consumption of energy is among the most central to creating wealth and sustaining livelihoods. Unfortunately, through the burning of fossil fuels as we have done over the past few centuries, energy generation also greatly damages health and ecosystems, notably through greenhouse gases (GHG) emissions, at an ever greater pace. As those externalities are now reaching critical levels, we urgently need to restructure our energy systems in sustainable ways.

In contributing to addressing that challenge, this report explores options and recommends solutions towards a better energy future, focussing on island states and territories in the Indian Ocean basin and the Atlantic coast of Africa. It draws possible roadmaps for the energy transition needed to enable sustainable energy for all, while ending and mending the damages of the old, unsustainable energy paradigm.

The proposed pathways seek to reform the current energy economics by eliminating subsidies to fossil fuels, hence reducing fiscal and trade deficits, while encouraging energy efficiency and generation from renewable sources. This manages both the supply and demand of energy, pushing them towards fiscal, social and environmental sustainability. By now, solutions for needed environmental fiscal reforms are well known and tested, while technological options for energy efficiency and the production and storage of renewable energy is becoming mainstreamed, overcoming issues of both capacity and intermittence.

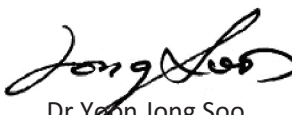
Yet, the proposed transition pathway remains littered with policy and political obstacles, including various interests deeply vested in the current model of energy production and consumption, exerting powerful influence on legislative and regulatory authorities. These interests need being engaged in the reform process, recognising its necessity and finding

opportunities beyond and above the inevitable cost of transition. Besides understanding fiscal and technological options, solutions therefore also need to recognise and address those policy and political dimensions of energy.

With such clear policy objectives in mind, this study was commissioned by the United Nations Office for Sustainable Development (UNOSD), a unit of the UN Department for Economic and Social Affairs (DESA, Division for Sustainable Development) mandated to share knowledge, build capacity and advise governments on sustainability strategies and programming. The study first informed a capacity development workshop organised in partnership with the Mauritius *Maurice Ile Durable* Commission, to which ten island states and territories participated in May 2014. UNOSD, with its own expertise in political economy, also enlisted environmental fiscal reforms specialists with links to prior similar capacity development work by the *Deutsche Gesellschaft für internationale Zusammenarbeit* (GIZ), the organisation Green Budget Europe, and the Global Subsidies Initiative (GSI), a project of the International Institute for Sustainable Development (IISD). The collaboration of country delegates and facilitators, with their collective wealth of contextual knowledge and experience, allowed using the workshop proceedings to complete components of this study and assemble this report.

It is therefore with great pride that UNOSD releases this publication, with the confidence that it will substantially contribute to the energy transition in island countries and territories, enabling our shared vision of sustainable energy for all, there and beyond.




Dr Yoon Jong Soo
Head of UNOSD

Summary

Energy is key to prosperity, and the discovery and use of fossil fuels in the past few centuries has generated tremendous wealth. Yet, this energy paradigm has now become a liability that threatens the very sustainability of all it enabled.

Coal, petroleum and gas not only induce climate instability through emissions of greenhouse gases, but also entail numerous other economic, social and environmental externalities, adding up to a dangerously negative balance sheet.

This report analyses the impacts of fossil fuel energy in the multiple dimensions of sustainability, modelling the relationships, externalities, and opportunities that a transition to a new energy paradigm can offer, based on energy conservation, efficiency and low-carbon renewable sources. It first explores the “sustainability doughnut” as an integrative model, which facilitates the overlaying of policy choices, including energy-related ones, with the economic, social and environmental sustainability impacts they have. This provides a cogent framework for the comparison of the fossil fuel and renewable energy paradigms, highlighting their costs and opportunities.

Based on this modelling and rationale, the bulk of the report then turns to analysing fossil fuel subsidy reforms and renewable energy (RE) transitions in the context of island states, with particular reference to Small Island Developing States (SIDS) in the Indian Ocean and Atlantic African coast. **With policy-relevance as key objective, the report makes a series of general and country-specific recommendations, underlining the most important policy areas of fossil fuel to renewable energy (FFRE) transition** for the islands that participated in a capacity building workshop organised in Mauritius, in May 2014, by UNOSD and the *Maurice Ile Durable* Commission.¹

These recommendations have broader policy relevance for countries wishing to pursue a fossil fuel subsidy reform and renewable energy transition.

Main conclusions

There is increasing focus and innovation in island states on renewable energy, and for energy transitions along the post-2015 development agenda (AIMS SIDS, 2013). Many island states have drafted or adopted national and regional

energy policies and strategies seeking to improve energy efficiency and exploit renewable energy potential, notably to minimise future dependence on imported fossil fuels (UNEP, UNDESA and FAO, 2012). To ensure the success of fossil fuel to renewable energy transitions however, key measures need to be followed-up and implemented with determination, and as soon as possible.

Given that most island states have market economies, prices are crucial for investment and consumption decisions. Influencing prices via taxes and subsidies provide strong leverages for governments to change behaviour and reduce fossil fuel consumption. Moral appeals, information campaigns and awareness-raising may be important, too, but often not as effective as price signals, a key factor in household and industrial decision-making.

The challenge for island states today is to identify how best they can benefit from the falling price of renewable energy, as soon and as much as possible.

Fiscal space and EFR

To create an economic climate which fosters FFRE transitions, island states need to adjust energy pricing to match their national context by means of environmental fiscal reform (EFR). Increased domestic revenue mobilisation – through environmental taxation and subsidy reform – can promote the FFRE agenda by increasing fiscal space and delivering much-needed revenues to meet critical spending needs.

Island states should also consider regionally coordinating and harmonising fiscal policies in the tourism and aviation sectors. This could include a standardised levy per overnight stay or an infrastructure service charge paid on entry or exit. While unilateral measures encounter political resistance among industry stakeholders, coordination between major destinations, such as in the Indian Ocean basin, will partly address concerns, and avoid a race to the bottom in the tax treatment of the two sectors.

Along with such reforms, regular reviews of the fiscal system should be institutionalised to monitor and report on government revenues and expenditures. Impact assessments can then inform adjustments, particularly in protecting the vulnerable. Consistent communication strategies on the rationale and benefits of reforms will also help gain further acceptance.

¹ Details at <http://www.unosd.org/index.php?page=view&type=13&nr=22&menu=229> (accessed 01/07/2014).

Mobilising investment

Creating a stable investment climate is essential to facilitate a FFRE transition. Policy measures should take the multi-faceted nature of energy markets into consideration and provide for:

- Making mobilisation of private investment a political priority
- Support capacity development with institution building (e.g. nurturing relevant trade associations) and training of human resources (e.g. specialised RE skills)
- Ensuring a good return on investment by means of feed-in tariffs (FITs) and appropriate power purchase agreements (PPAs)
- Facilitating access to RE solutions by fostering technology transfer and removing import duties on RE technologies and components
- Consider aggregating FFRE projects to develop new models of ownership between islands, taking advantage of economies of scale in the RE sector and reduce the cost of RE transition in each individual island state
- Reducing investment risk by making contracts clear and transparent, providing infrastructure and loan guarantees to instil investor confidence
- Creating a level-playing field in energy markets through a fossil fuel subsidy reform and green taxation, including varied customs and duties on fossil fuels and RE technologies and components
- Introducing technical and integrated resource planning

Policy mainstreaming and FFRE transition roadmaps

FFRE transition should be mainstreamed within all national policy planning processes, becoming part and parcel of national decision-making. In supporting this integration, planning authorities need to conduct RE resource mapping and feasibility studies, exploration of policy options, and accurate modelling and cost-benefit analysis of FFRE transition impacts.

Beyond this macroeconomic review, a political economy analysis must also be undertaken, **mapping the stakeholders of the energy landscape with their interests, strategies, resources, relations and discourses. Together, such comprehensive groundwork will enable a FFRE transition strategy**

based on realistic and sustainable assumptions, aimed at relevant objectives and guided by a clear roadmap of specific, measurable, achievable, relevant and time-bound (SMART) indicators. It will also ensure that the politics of transition is well understood and planned for, nurturing a collaborative and participatory policy process that increases the chance of success and minimises disruption.

Further to such groundwork, the **role of policy-makers in demonstrating the value of an RE transition is crucial.** “Low-hanging fruits” solution should be identified, such as simple energy efficiency measures and high-return RE pilot projects that will reduce fossil fuel dependence, improve fiscal and trade balances, and **quickly demonstrate the viability of the RE transition.** Acceptance of RE policies and willingness to invest will increase, making subsequent steps easier.

Overcoming barriers to reform

The need for reliable base-load electrical supply has raised doubts on the feasibility of high levels of RE in the energy mix, particularly in small and unconnected island markets. These concerns are largely unfounded. Intermittence can be overcome through enhanced energy efficiency that reduces base-load demand, along with new grid management and storage technologies that buffer both various power sources and peak demand.

Another area of concern has been the recent falling prices of fossil fuels, perceived as a threat to renewable energy value and viability. **Falling fossil fuel prices can favour FFRE transitions in several ways, however. For one, low fuel prices create a political opportunity to reform subsidies, even eliminating them altogether, without public resistance** – as recently seen in e.g. Indonesia. **Low prices also create opportunities for policy-makers to internalise fossil fuel externalities by introducing new taxes** to keep prices stable – similarly, without public resistance.

Such measures increase national fiscal space, while levelling playing fields in energy markets, and incentivising investment in efficiency and renewables. Finally, currently low fossil fuel prices result from overproduction, fracking and sluggish demand. This is not expected to last beyond 2015, and possibly signals an era of widely unstable and unpredictable prices. This, in itself, is good news for investments in FFRE transitions, which offer structurally declining RE prices and predictable stability.

Overcoming other barriers – such as access to grants and climate finance from donors, and technology transfer – require innovative approaches and greater regional coordination. There is great potential for island states to learn from each other's experiences, such as from the public-private funding model applied in Cabo Verde, and to tailor these approaches to their own particular country context.

Working together

Island states should maximise the benefits of new coordinated and regional approaches to partnership and cooperation, including improved mechanisms for research, technology transfer and

new approaches to financing FFRE transitions.

Sharing innovative developments and research findings, as well as collaborating on research and pilot projects, could help all island states to advance their FFRE agendas and to develop island-appropriate technologies for RE generation. Strong networks among island states RE practitioners and policy-makers can enhance and accelerate learning and knowledge exchange, notably of best (and worst) practices, valuable experiences, and the mapping of capital and human resources.

Some initiatives are underway to facilitate such networking, and will greatly contribute to nurture the community of FFRE practitioners among island states in the coming years.

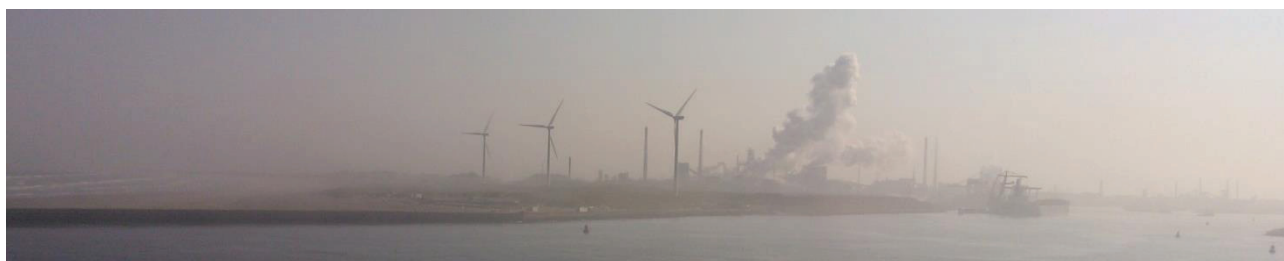


Photo Credit: Jacqueline Cottrell

Why an Energy Transition?

The UNOSD Strategy

Energy is a key component of poverty reduction and prosperity. It also is a precious resource, with limited supply and potentially damaging impacts on people and the environment. The United Nations has recognised this key role and constraints, notably by Secretary General Ban Ki-moon's launching in 2011 the Sustainable Energy for All initiative (UN SE4All, 2012) with 3 goals to reach by 2030:

- Universal access to modern energy services
- Doubling the global rate of improvement in energy efficiency
- Doubling the share of renewable energy in the global energy mix

In this context, the UNOSD has undertaken to assist its clients, UN Member States, with knowledge management and capacity development programmes for transforming their national energy systems, migrating from fossil fuels (FF) dependency towards energy efficiency (EE) and renewable sources. The UNOSD is doing so by organising, in cooperation with Member States and several other institutions working in the field of energy transition, a series of capacity development workshops aimed at removing fossil fuel subsidies and adopting sustainable energy practices and technologies. The *Fossil Fuels to Renewable Energy* (FFRE) workshop series already delivered two events in 2014, with the participation of 25 countries, and has plans for more in the near future.

The UNOSD mostly work with developing country governments. Among them, particularly in Small Island Developing States (SIDS) and Least Developed Countries (LDCs), are some of the least responsible for greenhouse gas emissions, both historically and at current levels of emissions. Why then seek to reduce emissions from countries that contribute little to the problem? Will this make much difference in global emissions, and should those countries not be given the opportunity to develop further before having to constrain their use of fossil fuels? Those are legitimate questions, and responsibilities for climate mitigation have been recognised as *differentiated* by the 166 signatory Member States of the U.N. Framework Convention on Climate Change (UNFCCC) since 1992. Yet, all countries nevertheless have such responsibility to mitigate according to their situation, and many have proven their commitment to do so. Furthermore, as will be discussed below, there are a number of compelling

reasons beyond climate change for all countries, particularly SIDS and LDCs, to leap-frog onto a development path beyond the intensive use of fossil fuels. Lastly, while the emissions of low-income countries are only about 5% of global emissions (Casella, 2010), those have increased quickly since 1990, a trend that urgently needs to be reversed. Reduction of GHG emissions is a battle that must be fought on all fronts. The work of UNOSD with island territories or low-income countries is only one such front, while countless other organisations are simultaneously working to address emissions from middle and high-income countries as well – where half of global emissions are produced by only 10% of global consumers. While successful mitigation in those large and wealthy economies is a condition of climate stabilisation, the energy transition in remaining countries is clearly becoming a condition of their own prosperity in a post-carbon, sustainable world – for the reasons discussed below.

Necessity and Urgency

Fossil fuels, from coal to petroleum and natural gas, have been central to the unfolding of the industrial revolution and the prosperity it brought much of humanity since. By 2012, fossil fuels provided almost 82% of the world's total primary energy, with biofuels and waste another 10%, nuclear fission 5%, hydroelectricity 2.4%, and geothermal, solar, wind, ocean and heat combined, only 1.1% (IEA, 2014).

Yet, there are a number of compelling reasons to now urgently reform our energy systems, in both production and consumption, to use progressively less fossil fuels, and burn none at all as soon as possible. First, the extraction and burning of fossil fuels has become a huge liability, costing ever more in environmental, health and social bills, well beyond the benefits of their concentrated energy output. In this, greenhouse gases-induced climate change is only one of the costs, others being less visible or dramatic, but sometimes as consequential. Second, the peaking of petroleum and natural gas production, despite its postponement by a few years through extreme extraction methods, is inevitable and irreversible. This puts tremendous pressure on a globalised economy so dependent on cheap energy for its growth and stability, and needs to be overcome by managing both energy demand and supply from alternative sources. Finally, the very alternatives to fossil fuels, energy efficiency, frugality and renewables, present inherent benefits that can

greatly contribute to addressing various aspects of social, environmental and economic sustainability, such as in energy access, resilient livelihoods, water management, or food security.

Those reasons for a compelling energy transition will be discussed at some length below, arguing that it should be as deep, wide and quick as possible. Yet, the physics of climate dynamics conspire with the maths of economics to also make very clear that even a global energy transition will not by itself suffice to face the full challenge of sustainability – not, at least, for the massive reduction in greenhouse gas emissions needed within a rapidly closing window of opportunity. A significant slowdown in overall energy-material throughput, especially across wealthy and populous economies, will also be necessary, as amply substantiated elsewhere (Heinberg, 2009; Anderson & Bows, 2011; Anderson & Bows, 2012; Rogelj, et al., 2013). Beyond energy, other sectors of major GHG mitigation potential include agriculture (which generates large amounts of nitrous oxide and methane, totalling 15%, in carbon dioxide-equivalent or CO₂-eq, of all GHG) as well as land use change, responsible for another 12% percent of emissions (World Resources Institute, 2005). Above all however, it is changes in the very nature and scope of what we consume, and how we produce it, that will allow us to reduce our environmental footprint and distribute the wealth we create in a truly sustainable way (Spratt, et al., 2009; Raskin, Paul, et al., 2002).

While this broader discussion of material-energy throughput, economic growth and prosperity is beyond the scope of this report, the magnitude of the mitigation challenge only makes clearer the imperative and urgency of a fossil fuel to renewable

energy transition (FFRE) – a low-hanging fruit among mitigation options, potentially reducing by 60% anthropogenic greenhouse gases emissions. This introduction therefore sets the stage for why a paradigmatic energy transition is both necessary and beneficial. In so doing, it provides the rationale of the comparative policy analysis and recommendations discussed in the remainder of this report.

Modelling Sustainable Energy

To substantiate and illustrate the argument in support of a post-carbon energy transition, it is useful to articulate the objectives of such a reform – economic, social and environmental sustainability – with the evidence against fossil fuels and for energy efficiency and renewables. To this aim, we use the integrative sustainability model introduced in 2012 by Kate Raworth and illustrated in Figure 1 (Raworth, 2012). The model aptly combines co-centric radar charts that show the developmental needs of humanity through 11 goals that constitute a “social foundation”, and 9 planetary boundaries (Rockström, et al., 2009) forming an “environmental ceiling” that should not be exceeded to ensure the stability of the Earth system (detailed in Figure 2, updated in Steffen, et al., 2015, as this report goes to press). For Raworth, the gap above the minimum social foundation and maximum environmental ceiling is where sustainable development (SD) resides, providing a “safe and just space for humanity”.

This model not only schematises the interaction of society and environment (two of the so-called pillars of sustainable development), but also allows to situate the economy – the third of the SD pillars – as the engine of wealth which gives society the goods

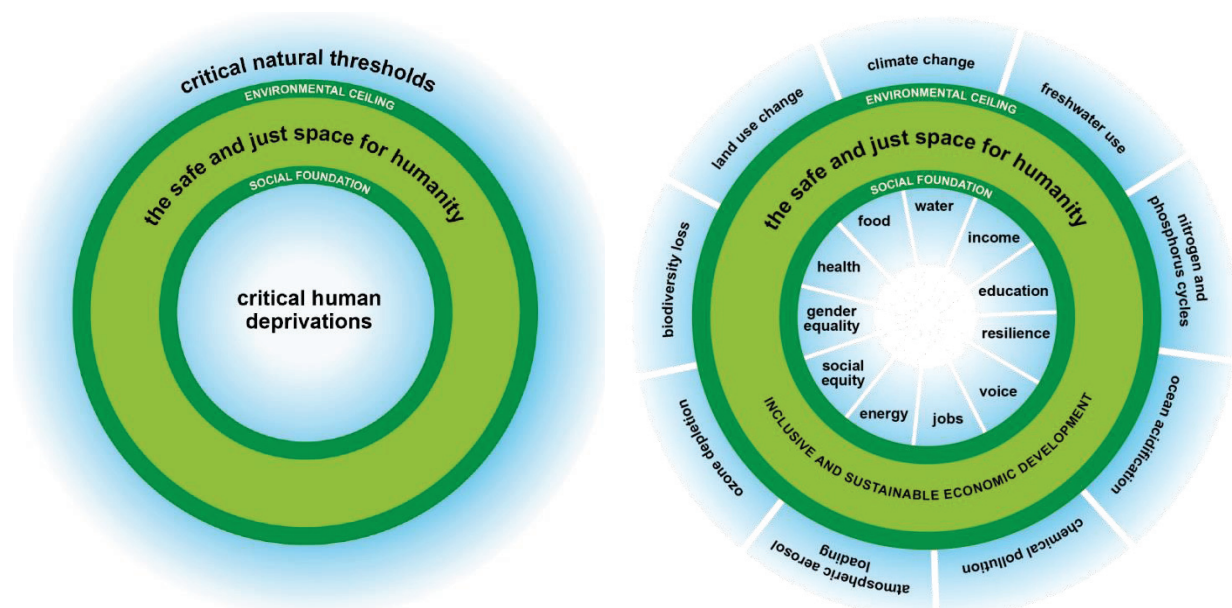


Figure 1. The Doughnut Model of Social Foundation and Planetary Boundaries
Source: Raworth, Kate, 2012, "A Safe and Just Space for Humanity", London, Oxfam.

and services laying its foundation of 11 goals. Furthermore, we add here what too often remains invisible from the sustainable development literature: the political-economic power that defines the relationship of actors within and between the SD spheres, and is exerted through the practice of politics and markets. In Figure 3, the economy and power relations are illustrated by two additional concentric circles, the latter adjusting what is produced, by whom, how wealth is accumulated, distributed and consumed, for what social goals, and with what environmental risk and impact.

The Case for Transition

Three Converging Crises

The model’s broader canvas clearly highlights the nature and interaction of our current predicaments, rooted in the convergence of social, environmental and economic crises. First, and despite the technological advances of the Industrial Revolution and the rapid increases of wealth creation since the Second World War, the 11 indicators of the social foundation remain incomplete, many at alarmingly low levels. More than a failure of production, it is one of distribution (Wilkinson & Pickett, 2010),

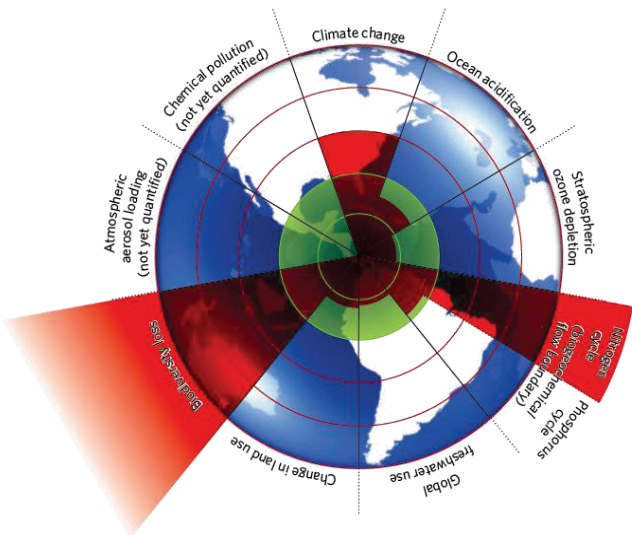


Figure 2. Rockström, Johan et al. 2009, "A Safe Operating Space for Humanity", Nature, vol. 461, p. 472.

keeping nearly one third of humanity in multidimensional poverty (UNDP, 2014, p. 3), which implies a variable combination of food and energy insecurity, little or no access to education and health services, social and gender inequality, as well as human and civil rights abuses.

Second, the concept and chart of planetary boundaries developed by Johan Rockström and his co-authors clearly illustrate the nature and magni-

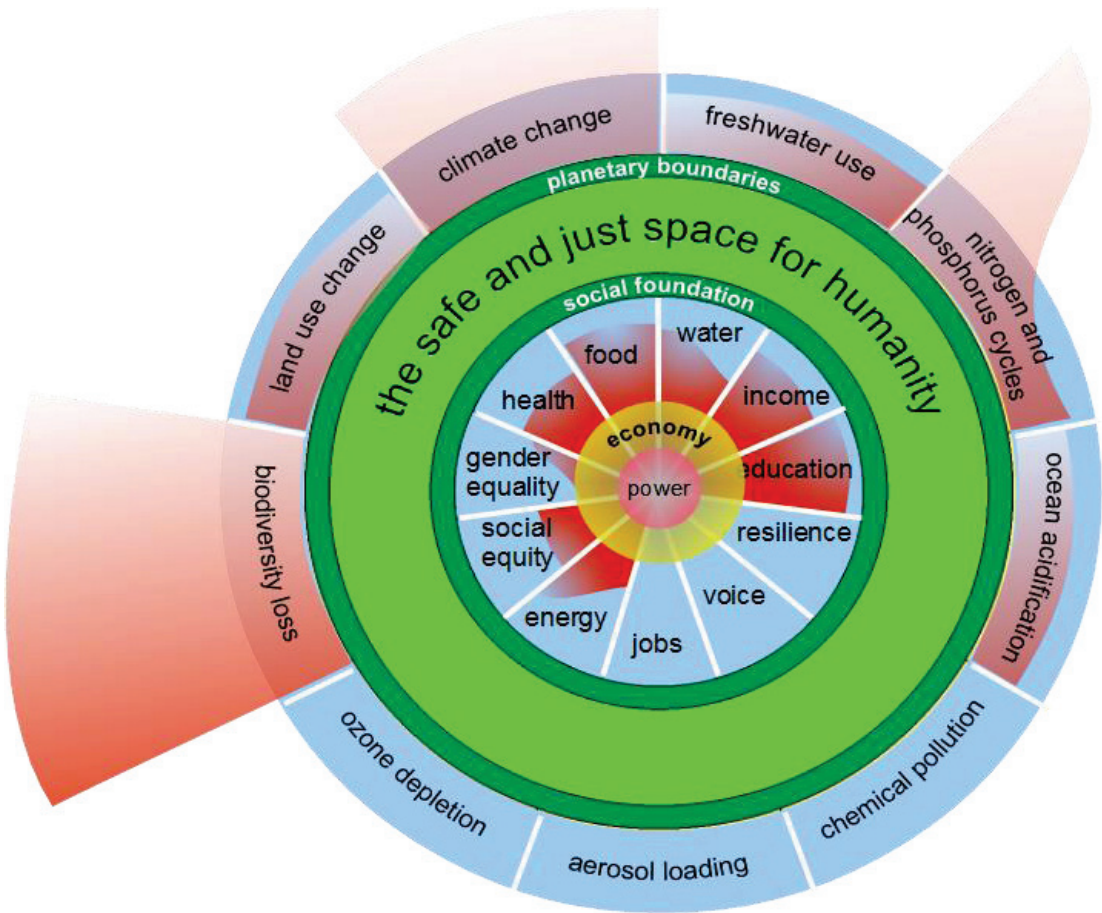


Figure 3. Composite Doughnut Model, with the 3 Sustainable Development Spheres and Power (Political Economy) as control process.

tude of the environmental impacts of human activities, and where this is now destabilising the Earth system's relative Holocene equilibrium. Among those boundaries, biodiversity loss is the worst affected, while the disruption of the nitrogen cycle and climate change are not far behind.

Third, the depletion of petroleum and natural gas and peaking of their production (coal not being depleted anytime soon) is a major challenge to economies globally, as they heavily depend on these relatively inexpensive hydrocarbons for liquid fuels, electrical generation and industrial feedstock. More than anything else, it is such cheap energy that has nurtured a surge in wealth creation and population growth of the last two centuries, notably through mechanisation, mobility and trade, as well as petrochemicals and synthetic fertilisers. Yet, global petroleum production has roughly plateaued since 2005, sustained only by unconventional recovery in tar sands, shale plays (hydraulic fracturing of tight oil) and deep waters (Hallock Jr., et al., 2014; Hughes, 2014; Inman, 2014). This is not expected to last but a few more years however, while demand and prices continue to rise structurally, as they have for over a decade (Bast, et al., 2014) amidst fluctuations from supply management and global economic downturns. Despite recent drops in global oil prices since the middle of 2014, structural price increases are inevitably driven by the ever more expensive exploration and extraction of petroleum and gas. In this regard, "It is also estimated that half of the oil industry needs crude oil prices of \$120 per barrel or more to generate 'free cash flow' under current drilling plans" (Bast, et al., 2014, p. 17), while the United States tight oil industry needs from roughly \$50 to \$75 in order to maintain operation over time (Andrews, 2014; McGlade, 2013; IMF, 2014).

In other words, economic engines, globally, are running dry while hoping to turn ever faster. This, combined with the accumulating tensions of persistent social crises, and the fast emerging planetary boundary crises, is pressuring the current model of socio-economic development from all sides, rendering it less sustainable, and more brittle, than ever before. In the words of the International Energy Agency World Energy Outlook 2008:

The world's energy system is at a crossroads. Current global trends in energy supply and consumption are patently unsustainable — environmentally, economically, socially. But that can —

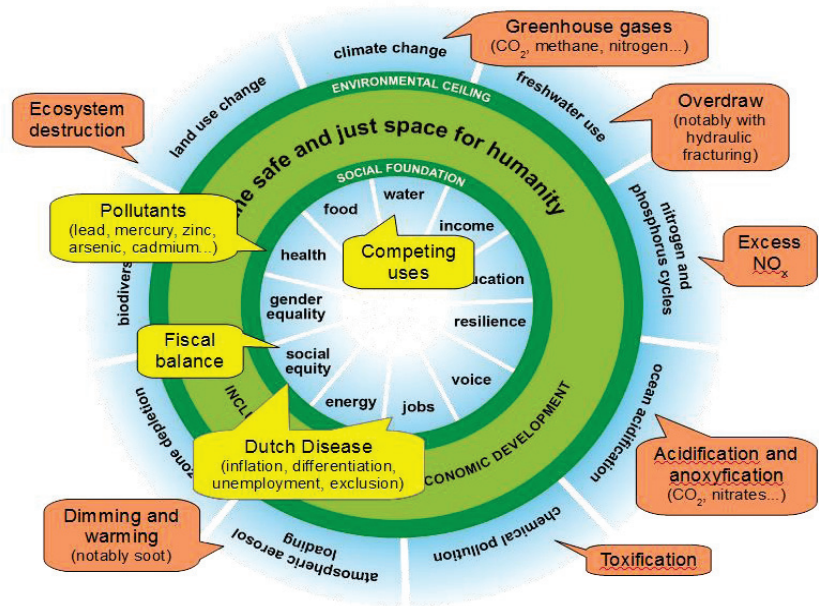


Figure 4. The Broader Costs of Fossil Fuels

and must — be altered; there's still time to change the road we're on. It is not an exaggeration to claim that the future of human prosperity depends on how successfully we tackle the two central energy challenges facing us today: securing the supply of reliable and affordable energy; and effecting a rapid transformation to a low-carbon, efficient and environmentally benign system of energy supply. What is needed is nothing short of an energy revolution. (IEA, 2008, p. 37)

And those crises not only coincide in time, they also systemically interact. The co-centric doughnut model brightly reveals that the fingerprints of fossil fuels are all over this "crime scene" of converging crises. The model makes it easier to map the evidence, drawing our attention past the cheap, concentrated energy of fossil fuels onto their now overwhelming costs and quickly diminishing returns.

This sheds light on the unseen costs, or externalities, of fossil fuels for our social foundation and planetary boundaries, showing their pervasive, cumulative and persistent impacts that result from all stages of their extraction, processing, circulation, combustion and other forms of consumption. Figure 4 graphically summarises those externalities, overlaying them on the doughnut model and linking them to economic and social foundation indicators as well as to planetary boundaries. In this way, the model also illustrates the dynamic relationships between impacts, such as competing fresh water uses between various economic activities and the needs of ecosystems. The following text reviews those categories in some detail.

Economic Costs

Fiscal costs: Countries that are net-importers of fossil energy have long experienced the cost of vulnerability to fluctuating hydrocarbon prices. Their economies are directly exposed, particularly where governments subsidise fuels and must bear fiscal costs that can amount to large proportions of total state revenues, depriving them in equal measure of funds for other purposes, while distorting energy prices that favour inefficient uses and behaviours (World Bank, 2014; Alberici, et al., 2014). This is true for many sectors of the economy, where practices may also be detrimental to livelihoods, as in agriculture with excessive irrigation or fisheries where fossil fuel subsidies encourage stock depletion (Martens, et al., 2014). Furthermore, fossil fuel subsidies generally benefit higher-income groups far more than the poor in most countries: “On average, the top income quintile receives about six times more in subsidies than the bottom quintile. The concentration of subsidy benefits in the hands of the top income groups is even more pronounced in the case of gasoline and LPG, where the top income quintile receives 20 and 14 times that of the bottom quintile, respectively.” (Arze del Granado, et al., 2010, p. 11). Those issues are documented and analysed for the countries of this comparative study in the chapters that follow.

Capital risks: Beyond the fiscal costs of fossil fuel subsidies, there are also longer-term risks associated with fossil fuel capital investments, as extraction and use become more constrained under global greenhouse gas mitigation measures – with major financial institutions now paying attention, such as the World Bank and the Bank of England (Clark, 2014). The risks of such “stranded assets” are most obvious for producing countries, where huge capitalisation goes to exploration, extraction, processing and trading (McGlade & Ekins, 2015). Risks are also increasing for importing countries however, which equally need trading, processing and retailing infrastructures, and may invest in long-term path-dependent technologies (such as coal-fired power plants) that could well become unusable long before generating returns that cover their invested capital and debt.

Macroeconomic imbalances: In addition to fiscal costs and capital risks, fossil fuels bear extensive and long-term hidden structural and opportunity costs for both exporting and importing countries. For the former, this includes the well-documented “Dutch disease”, whereby a currency is over-valued by resource-related foreign investments, resulting in the decline of the competitiveness of other sectors, notably agriculture and industry. This “resource curse” also impacts differentiation and exclusion

within many producing countries, when not resulting, for some of them, in tragic and prolonged civil unrest and international conflicts – from the Chaco War of the 1930s to Angola, the Niger Delta, Sudan and the Middle East for the past half-century. For the United States alone, the monetary cost of preserving its energy security is staggering: “Each day, the United States spends about \$2 billion buying oil and loses another \$4 billion indirectly to the macroeconomic costs of oil dependence, the microeconomic costs of oil price volatility, and the cost of keeping military forces ready for intervention in the Persian Gulf.” (Lovins, 2012). Not counting the war in Iraq since 2003, the U.S. has spent an estimated \$7 trillion dollars maintaining its military presence in the Persian Gulf between 1976 and 2007 (Jones, 2012, p. 218). At nominal dollar value, this is roughly 3% of the country’s GDP for that period. This, of course, adds to unmeasurable human costs and missed development opportunities for all concerned.

Social Foundation Costs

Health: One of the most deleterious externalised costs of fossil fuel energy is on public health, affecting both quality of life and labour productivity. The prevalence, toxicity and human cost of nitrogen oxides, ozone, carbon monoxide, sulphur dioxide, particulate matter, mercury and lead have been extensively documented. While groups directly exposed to fossil fuel contaminants have long suffered the most, such as black lung disease (*pneumoconiosis*) for coal miners, the broader, public health impact of such pollutants “include chronic respiratory diseases, such as chronic bronchitis, emphysema and lung cancer, and cardiovascular diseases, such as myocardial infarctions, congestive heart failure, ischemic heart disease and heart arrhythmias.” (Huscher & Smith, 2013, p. 6). The World Health Organisation (WHO, 2014) now estimates that roughly 7 million people prematurely die each year from both indoor and outdoor air pollution, much of it the direct result of fossil fuel combustion for electrical generation, industry and transport, as well as indoor cooking from coal, kerosene and biomass. Renewable energy, by replacing fossil fuels and providing clean energy sources for off-grid households, can address much of that public health burden.

Studies have recently monetised this impact so that externalities can be economically assessed. In the case of electricity generation in the United States, “the average economic value of health impacts associated with fossil fuel usage is \$0.14–\$0.35/kWh.” (Machol & Rizk, 2013, p. 75; National Academy of Sciences, 2009; Parry, et al., 2014).

While this value is only of 1 or 2 cents per kWh for electricity generated from natural gas, it ranges from 8 to 19 cents, and 19 to 45 cents respectively for oil and coal. This is 1 to 4 times the average price of electricity in the U.S. – eventually paid in health-related costs – and 2.5 to 6% of the country's GDP (Machol & Rizk, 2013). Across the European Union, 18,200 premature death and 4 million lost working days can annually be attributed to coal-fired electrical generation, at a cost of €43 billion (Huscher & Smith, 2013).

Other Social Costs: When monetizing the Social Cost of Carbon (SCC), the most recent assessment of the overall welfare impacts tags the tonne of carbon at \$220, almost 7 times higher than previous US government estimates of \$33 (Moore & Diaz, 2015). The study accounts for cumulative impacts on total factor productivity and economic output. Costs are found to be highest in developing countries due to a wider exposure to climatic extremes and stronger economic sensitivity. Again, such carbon valuation reveals the gap between current (externalised) and actual costs of fossil fuels, and the social welfare magnitude of a post-carbon energy transition.

Planetary Boundary Costs

Greenhouse Gases: The combustion of fossil fuels, in transportation or to generate electricity and heat, released a staggering 30 gigatonnes (Gt) of CO₂ in 2012 (Olivier, 2013, pp. 9-10). This is nearly 60% of all anthropogenic carbon dioxide, in addition to that from land use change, cement calcination and other industrial processes, totalling 37 Gt in 2014 (Global Carbon Project, 2014). Alongside other GHG such as methane and nitrous oxide from agriculture and industry (Olivier, 2013, pp. 8-10), the world reached a total of 50 GtCO₂-eq already in 2010 (UNEP, 2013b, p. 3). At this pace and increasing trends of 2.5 to 3% per year (Olivier, 2013, p. 8; Le Quéré, et al., 2013), the maximum of 1,200 GtCO₂ – the *carbon budget* expected to give a 67% chance of maintaining atmospheric CO₂ concentration below 450 parts per million (ppm) and a rise in global mean temperature below 2°C – would be reached in about 35 years (Friedlingstein, et al., 2013). For an 80% chance, this budget comes down to about 500 GtCO₂, fully spent in the next 14 years at our current emission rate (McKibben, 2012).

Other Pollutants: Beyond CO₂ emissions from combustion, fossil fuel-related activities also put pressure on several other planetary boundaries. Fossil fuels contribute to the imbalance of the

nitrogen cycle, air pollution (forming urban smog and tropospheric ozone, O₃) and acidification (of rains and oceans) by releasing nitrogen oxides (NO_x), carbon monoxide (CO), sulphur dioxide (SO₂), particulate matter and unburnt hydrocarbons, notably methane (CH₄, little from combustion, but of concern as a potent GHG, from coal mining and as yet poorly assessed oil and gas extraction venting and leakages) (Howard, et al., 2011; UCS, c2000; Bell, et al., 2006, p. 432). The fossil fuel industry is also responsible for a large amount of other pollutants that accumulate in various ecosystems, as well as for competing uses of water and land. This includes soil and water contamination from oil and gas drilling and transportation, disposal of coal ashes and petroleum coke from tar sands refining, atmospheric release of mercury from coal burning, as well as discarded combustion heat which particularly affects aquatic ecosystems (UNEP, 2013a; UCS, c2000).

Post-Carbon Opportunities

By mapping the impacts of fossil fuels and revealing their various interactions, the doughnut model also highlights how much addressing the economic challenge raised by the depletion of petroleum and natural gas presents important opportunities to address the social and environmental crises fuelled by fossil energy (see Figure 5).

The obvious economic silver lining of the current energy crisis is a future of cheaper, renewable energy, with much fewer of the social and environmental externalities of fossil fuels. The current amount of power generated from renewables remains marginal, clearly insufficient to replace fossil fuels and bring the benefits of climate mitigation. But prices are falling quickly, and the outputs of the competing energy paradigms are

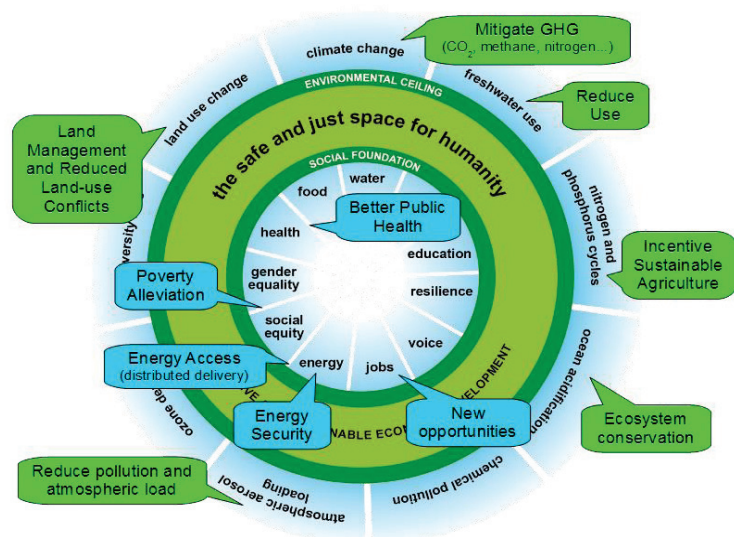


Figure 5. Post-Fossil Fuels Opportunities

poised to cross within one or two decades: “solar power alone (without subsidies) has already reached grid parity in Germany, Italy, Spain, Portugal, Australia and the US southwest, and [...] Japan will reach that point this year, Korea in 2018 and the UK in 2020” (Bast, et al., 2014, p. 18).

Furthermore, grid parity does not do justice to renewable energy sources as an indicator of their full value. By reducing or eliminating many of the negative fossil fuel economic, social and environmental externalities discussed above, renewable sources can bring unquantifiable human development co-benefits and can, in financial terms, save several times the ongoing nominal value of their fossil counterparts. With biases favouring regions with the most potential displacement of fossil fuel (notably coal), Siler-Evans *et al.* (2013) “estimate that the social benefits of wind and solar are more than \$40/MWh in much of the United States and as high as \$100/MWh in the parts of the mid-Atlantic and Midwest. This suggests that appropriately valuing health, environmental, and climate impacts would significantly improve the competitiveness of wind and solar in some regions.” (p. 4). At 4 to 10 USD cents per kWh, these findings are comparable in magnitude to the other studies cited earlier, which would all make wind and solar-generated electricity much more competitive than fossil fuel generation if any range of health, social and environmental externalities were taken into account.

Several renewable energy sources provide new opportunities to increase the energy security of the 1.3 billion people who, around the world, still have no access to modern energy. Since 84% of those are in rural areas, often far from existing electrical grids, decentralised, mini- or off-grid generation and local distribution are of key importance in this endeavour (Bast, et al., 2014, p. 41). Such deployment would improve energy affordability and cost predictability, and through this, enable overall rural and regional development with gender equity, healthier homes and environment, agricultural productivity and livelihood opportunities (UN SE4All, 2012; IRENA, 2013a).

Furthermore, while dismantling the fossil energy industry will eliminate many types of jobs, the renewable energy sector creates countless others. By 2012, nearly 6 million new jobs had directly or indirectly been created by globally RE growth. Most of the manufacturing opportunities have appeared in a handful of countries, namely Brazil, China, India, the European Union and the United States, but RE-related jobs in assembly, sales, installation, operations and maintenance are much more widely

distributed, and are predicted to reach between 10 to 17 million by 2030 (IRENA, 2013a).

The large-scale manufacturing and deployment of RE systems, and the generation, storage and distribution of that energy, also present numerous ecological challenges that cannot be neglected. Renewable energy can have deleterious impacts on land use change, water and landscapes, notably in the case of biofuel production, the deployment of hydro, wind, solar, and marine energy capturing infrastructures, or storage systems such as pump hydro reservoirs (Howard, et al., 2011). Possible impacts on ecosystems and availability of land and water must therefore be kept in sight when planning a renewable energy transition. Nevertheless, those effects pale in comparison to the externalities of fossil fuels. The opportunities for improved environmental and social impacts of energy systems remain colossal, starting with the reduction of carbon emissions, of course, but also by addressing most of the other consequences of fossil fuel uses discussed above.

Policy Implications

The evidence presented above supports the long-argued position that accounting for economic distortions and externalised social and environmental costs of fossil fuel energy would strongly tilt the balance in favour of renewable sources – without the need for additional subsidies to buttress the numerous mature technologies already on the market. In fiscal terms, the simplest policies for internalising those hidden costs are health and environmental taxes, while cap-and-trade mechanisms, such as with sulphur dioxides adopted decades ago to tackle acid rains, may work in specific contexts (Siler-Evans, et al., 2013).

The main obstacles preventing the internalisation of fossil fuel externalities are not technical, or the mere result of ignorance, but stem instead from the politics of energy: who benefits from current flows of wealth creation and accumulation, and who would lose or win from any changes in such flows. This is why understanding the *political economy* of actors, that is their interests, strategies, actions, relationships and discourses, and how those change over time, is key to effective policy making and implementation (for discussions of *political economy analysis*, see Collinson, 2003; Copestake & Williams, 2012; Duncan & Williams, 2012; Hughes & Hutchison, 2012). In this respect, the doughnut model is also helpful in capturing how power relations between actors in wealth creation and distribution do redefine the balance of social foundation goals and

socio-ecological interactions. Shedding light on such political economy drivers behind the impacts illustrated in Figures 4 and 5 not only brings clarity to their causes and pathways, but, most importantly, opens possibilities of powerful policy interventions.

This implies that effective policies for energy transitions must not only rest on the above evidence in favour of renewable energy, but also acknowledge and confront the tremendous power relations inherent to energy systems. It was with such an explicit objective in mind that the FFRE workshop series was conceived, thus including political economy modules that consider such power relations, as well as viable options for addressing them in the context of participating countries. While some stakeholders may initially be taken aback by analyses and policy options that bring them outside of usual technocratic comfort zones (Unsworth, 2009), the results from this process, documented in the remainder of this report, clearly show both the analytical and programmatic value of openly addressing the politics of energy transition as a driver of policy options.

Comparator Study

The majority of island territories covered in this report are Small Island Developing States (SIDS), although some are not considered as such by international practice, notably for not being small in either size or population. For this reason, the broader term “island states” is used here. Nevertheless, as a general rule, the country cases reviewed in this report share many of the characteristics and vulnerabilities specifically referred to by the UN-DESA definition of SIDS, that is:

similar sustainable development challenges, including small population, limited resources, susceptibility to natural disasters, vulnerability to external shocks and excessive dependence on international trade. Their growth and development is often further stymied by high transportation and communication costs, disproportionately expensive public administration and infrastructure due to their small size, and little to no opportunity to create economies of scale (UN DESA, 2007).

Excessive dependence on international trade in island states includes energy dependence on fossil fuel imports, making those countries extremely vulnerable to changes in global energy prices. At the same time, many island states have considerable potential for renewable energy generation, in terms of solar, wind, hydro, ocean, biomass and geothermal power. Thus, many island states are in the position to bring together the related aims of reducing wasteful spending on fossil fuels – in relation to fossil fuel subsidies (FFS) and/or high spending on fossil fuel imports – and increasing the rate of renewable energy technology deployment.

This approach would have several benefits. A gradual shift away from fossil fuels and towards renewable energy could enable island states to achieve energy independence in the medium term, freeing up foreign exchange needlessly wasted on energy imports and government revenues spent or foregone due to fossil fuel subsidies, reducing both budget deficits and balance of payments deficits. In

fiscal and economic terms, RE transition makes sense, particularly in the context of island states.

As reviewed in the previous chapter, FFS reforms and RE transitions also have a number of climate, environmental and social benefits: reduced greenhouse gas emissions; improved local air quality with reduced SO₂, NO_x and particulate matter emissions; improved respiratory health; and net job creation from the RE sector. Subsidy reform can also free up revenues for spending, for example, on education and health activities previously crowded out as a result of high levels of government expenditures to keep the price of fossil fuels low.

Thus, a gradual and carefully planned energy transition offers island states – and others – the chance to reap the benefits of a win-win solution to several of their most pressing economic and fiscal problems.

This comparator study provides an overview of the political economy of energy transition in African and Indian Ocean island states which participated in a UNOSD capacity building workshop on fossil fuel and renewable energy (FFRE) transition, held in Mauritius from 12.-16. May 2014. The report begins with a comparator table of key data for each country that participated in the workshop. A second table contains an analysis of strengths, weaknesses, opportunities and threats to FFRE transition in island states. Following that, the report presents a series of recommendations for FFRE transition policies in island states, and explores ways to overcome perceptions which currently act as barriers to FFRE transition specific to islands, before briefly analysing each of the country cases from the workshop and making a series of recommendations on possible next steps on the way to FFRE transitions.

This report has been produced on the basis of background research on island states and information kindly provided by participants of the UNOSD FFRE workshop. The authors would like to thank all participants for their contributions and comments.

Comparator Matrix: basic data on FFRE transition in island states

Country	GDP mil. USD ²	GDP per capita (growth % 2012)	Energy mix in electricity generation	Tax revenues as % GDP (2012)	Energy-related and green taxation	Cash surplus / deficit (% GDP)	Gini ³	IMF post-tax FFS 2013 (% GDP)	FFS – most notable measures	RE strategy and targets?
Cabo Verde	1,827	3,695 (2.5%)	Oil 79% Solar 2% Wind 19%	17%	Tax on oil Packaging tax <i>No WSS user charges</i>	-9.8%	50.5	2.6% (elec) n/a (petrol prod, gas, coal)	Lack of full cost pricing Tax exemptions e.g. for irrigation pumps VAT exemptions for some islands	25% RE by 2012 (target missed) 100% RE by 2025
Comoros	596	831 (3%)	Biomass 71% FF 27% RE 2% (energy mix - elec n/a)	n/a	Excise on petroleum products	n/a	64.3	n/a (petrol prod, elec, gas, coal)	Diesel tax exemptions for govt. (only 35% of consumption liable for tax)	Yes
Madagascar	9,975	447 (3.1%)	66% FF 34% Hydro Cooking 80% wood-based	10.3% (2010 WB) 20% (2013 est.)	Oil royalties Waste charges National park fees	-2.3% of GDP (2013 est.)	44.1	1.39% (petrol prod & elec) n/a (gas, coal)		54% final energy RE by 2020 75% of elec gen from RE by 2020
Mauritius				19% (2012)	MID levy Plastic bag tax Env. protection fee Excise dut. bottles/ cans Lower tax or exempt. on RE / EE	-0.6%	----	0% (elec) n/a (petrol prod, gas, coal)	Differentiated electricity tariffs Cross-subsidies for LGP	

² GDP data and data on tax revenues are taken from 2012 World Bank: <http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG> (accessed 06/06/2014). Unless noted otherwise, all other data based on information kindly provided by workshop participants. Primary research was not undertaken to verify this data due to time constraints.

³ Data from the Human Development Index, UNDP 2013.

Country	GDP mil. USD ²	GDP per capita (growth % 2012)	Energy mix in electricity generation	Tax revenues as % GDP (2012)	Energy-related and green taxation	Cash surplus / deficit (% GDP)	Gini ³	IMF post-tax FFS 2013 (% GDP)	FFS – most notable measures	RE strategy and targets?
São Tomé and Príncipe	263	1,400 (4%)	91.2% thermal (FF) 8.8% hydro	14%		-12.2%	50.8	0.6% (petrol prod) n/a (elec, gas, coal)		No regulatory framework for SE policy
Seychelles	1,128	12,783 (2.8%)	FF 98% RE 2% (wind) Solar PV installed but not in stats.	29%	n/a	4.8%	65.8	0% (petrol prod) n/a (elec, gas, coal)		5% RE 2020 15% 2030 100% “in the long term”
Sri Lanka	59,423	2,923 (6.3%)	Large hydro 30 % FF 64% New RE 6 %	11.6% (2013)	Energy taxes Vehicle reg. fees Highway tolls Charges for WSS Env. licensing FITs No waste taxes	-5.9%	40.3	2% (petrol prod) 0.75% (elect.) 0% (gas) 0.03% (coal)	Some price regulation of FF Lack of full cost pricing, e.g. no coal tax	Energy policy well developed inc. set amount of RE deployment (but not ambitious) SE strategy is being developed
Zanzibar	893.4	609USD (7.4%) ⁴	Elect. 100% imported: Hydro 57% FF 43% (gas and coal) Cooking biomass	16% (2013)	2.4 mil. USD raised from taxes on petroleum products and transport (>0.25% of GDP)	-7.2% ⁵	n/a	n/a	Elec. supply subsidised Differentiated electricity tariffs for industry, households, services	No

⁴ Growth data for Zanzibar are for Tanzania.

⁵ Data on cash surplus / deficit are for Tanzania.

SWOT Analysis of FFRE Transitions in Island States

<p>Strengths</p> <ul style="list-style-type: none"> • RE potentials generally high in island states • Good potential to increase fiscal space due to current low-tax regimes • Small-scale RE projects in island states demonstrably effective • High spending on imports unsustainable and possible entry point for reforms • Benefits of FFRE – reduced energy costs, enhanced energy security • Environmental improvements from reduced FF use (biodiversity impacts) • Economic gains from sale of Certified Emissions Reductions (CERs) • Social benefits: RE can boost (on and off-grid) electricity access • Job creation in RE and EE industries • Long-term impact reduced energy bills – RE running costs lower than FF 	<p>Weaknesses</p> <ul style="list-style-type: none"> • High up-front costs per unit of RE investment in island states • High debt-to-GDP ratios, causing limited availability of government revenues • Lack of funding for R&D • Few economic incentives to invest in RE, lack of opportunities and small energy market for private sector investors • Lack of capacity and specialist expertise in RE technology and feasibility • Disproportionate costs due to small size – including high energy and living costs • High dependence on international trade and imports of FF, RE technologies • In some cases, lack of appropriate policies, regulations, institutional mechanisms or monitoring for RE transition • FFS dependency and “lock-in”, e.g. for diesel-based electricity generation • Rapidly growing energy demand
<p>Opportunities</p> <ul style="list-style-type: none"> • 2014 UN year of the SIDS raised attention to prioritise FFRE transition • International movement to reform FFS powerful and growing • Cost of RE technologies is falling: onshore wind and hydro at grid parity, solar almost • High rates of investment in RE globally • Creation of opportunities for RE investment will boost FDI in island states • Reduced energy dependency already explicit policy goal of many island states • Improved balance of payments can boost foreign currency reserves • Window of opportunity for EFR created by falling global oil and gas prices • Small territories suitable for electric vehicles constrained by short and mid-ranges. 	<p>Threats</p> <ul style="list-style-type: none"> • Vulnerability to highly volatile and in structurally rising global FF prices – FFS reforms are urgent • International financing mechanisms (FDI, private sector, climate finance) are difficult for island states to access • Disproportionate impact of climate change and sea-level rise • Vulnerability to extreme weather events (cyclones) • Barriers to technology transfer due to small markets and poor economies of scale and hence low attractiveness for foreign investment

General Recommendations for FFRE Transitions in Island States

On the basis of workshop inputs and research, including the baseline study completed for the information of participants prior to the Mauritius FFRE event of May 2014, this section makes a series of recommendations for FFRE policies specifically relevant to the needs of island states.⁶ The issues highlighted in the SWOT analysis above are picked up here and integrated within a broad framework for FFRE transition. Not all recommendations will be relevant to all countries, indeed readers are invited to pick up on those elements most relevant to the specific circumstances of their country, taking into account, for example, existing RE strategies and policies as well as the national developmental and political economic context.

Increase fiscal space by means of EFR

The World Bank defines environmental fiscal reform as “a range of taxation or pricing instruments that can raise revenue, while simultaneously furthering environmental goals. This is achieved by providing economic incentives to correct market failure in the management of natural resources and the control of pollution” (World Bank, 2005, p.1). The European Environment Agency emphasises the importance of subsidy reform: “Environmental Fiscal Reform (EFR) ... focuses not just on shifting taxes and tax burdens, but also on reforming economically motivated subsidies, some of which are harmful to the environment and may have outlived their rationale” (EEA, 2005, p. 84).

Environmental fiscal reform can be used to raise revenues by means of environmental taxation, or reduce government spending by means of reform of harmful subsidies. Thus, implementing EFR can increase fiscal space and free up government revenues for investment in FFRE transition.

In the majority of the island states participating in the workshop, and in the majority of SIDS as a whole, tax revenues were worth less than 20% of GDP, while in OECD countries, tax revenues are as a general rule worth between 30-40% of GDP, sometimes more. This means that SIDS and island state governments have limited budgetary room to provide resources for a desired purpose, such as

fostering energy transition. Budgetary room can be increased in a number of ways. Diversification of revenue sources is one possibility. EFR is another – increasing environmental taxation and reforming fossil fuel subsidies – and has the added advantage that it can give government revenues a much-needed boost and change relative pricing in the energy sector at the same time, thus incentivizing more environmentally friendly behaviour.

Increasing taxes or consumer prices is politically controversial and as a general rule, does not go unchallenged, however. For this reason, policy-makers should be very explicit about the purpose of EFR measures and ensure the revenue expenditures are transparent. Revenues should generally be used for the highest national priority, as this is most likely to ensure sustained and broad political support for such reforms, particularly in critical times. The list below summarises recommended environmentally related taxes applicable to island states:

- Introduce or increase taxes on energy consumption (fossil fuels and electricity), apart from RE.
- Taxes on road transport fuels, domestic flights, domestic shipping, cooking fuels and fossil fuels used for electricity generation should be focus of any tax changes.⁷
- Levy or increase taxes on the import of cars and differentiate them according to CO₂ emissions in g/km, fuel efficiency, engine size, or import price (in this order of preference).
- Introduce or increase annual road taxes, using a similar differentiation.
- Introduce or increase water charges to ensure cost coverage and incentivise efficient water consumption.
- Remove levies on import of RE products and components.
- Levy a tourism tax for the use of infrastructure (e.g. amount per night) or introduce an “ecosystem contribution” for tourists (on arrival or departure).
- Levy an air ticket tax on all departing flights; differentiate according to flight distance, tax first and business class higher than economy class. Include freight transport.

⁶ For a generic review of RE transition in island contexts, see also IRENA, 2013b: *Pacific Lighthouses. Renewable Energy Roadmapping for Islands*, available online at: <http://www.irena.org/DocumentDownloads/Publications/Pacific-Lighthouse-Roadmapping.pdf> (accessed 10/05/2014). Although the focus is on the Pacific region, many of the conclusions apply more widely.

⁷ An electricity tax incentivises energy efficiency, while input taxes on fossil fuels for electricity generation incentivise renewables (as they create a level-playing field in energy markets) and efficient electricity generation technologies.

Box 1: El Hierro – RE transition as an enabling factor for FFS reform*

El Hierro is the smallest of the Canary islands, with a population of just over 10,000 and in the 1990s, was 100% dependent on fossil fuels. In 1997, El Hierro set itself the target of being the first 100% RE-powered island in the world.

In 2012-2013, 12MW of wind and 11MW of pumped hydro power generation for energy storage were installed, alongside solar PV, to replace the current 13 MW generators powered by heavily subsidised diesel. Already in the first year of operation, 70-80% of total electricity came from RE sources. The system uses diesel generators as a back-up only in times where there is no wind or hydro power available.

Key lessons: *RE transition can generate massive savings due to reduced expenditures on fossil fuel subsidies – which amounted to 2.4 million USD in 2013 – as a result of reduced fuel use. It is estimated that revenues from sale of RE will generate a further 5.4 million USD each year.*

** All data included in this case study are taken from IEA-RETD (2012), pp. 64-168.*

Clearly, these measures cannot all be implemented at the same time – and not all measures will be feasible in all countries. Generally, all these changes should be announced well in advance, giving stakeholders time to plan ahead, and implemented gradually in small steps. Policy-makers should prepare an appropriate communication strategy to ensure a broad and shared understanding of the rationale of the measures, to make the benefits of the measures clear, and to inform which sectors and stakeholders are the beneficiaries of increased spending.

Subsidy Reporting and Subsidy Reform

Island countries are highly dependent on imports and spend a great deal of limited foreign exchange on fossil fuels. For this reason, they are extremely vulnerable to fluctuations in global fuel prices. This problem is compounded in those countries which subsidise fossil fuels, as an increase in global prices can result in a substantial – and unexpected – increase in government spending. Because prices of petroleum products in island countries are amongst the highest in the world, these fluctuations can have a particularly severe impact on small FF-dependent economies (UNEP, UNDESA and FAO, 2012). Perhaps in part as a result of this, awareness of the problem of energy dependence seems in general to be higher in island states than in many other countries. In some cases, this awareness might help foster an enabling environment for subsidy reforms and feed into government strategies to garner support and ensure that a reform is sustained in the long-term.

Fossil fuel subsidies are not always visible and easy to identify or quantify. Often, the fiscal or environmental impacts of a particular measure have not been quantified at all. For this reason, regular subsidy reporting can be a useful tool. Subsidy reports should analyse all expenditures and subsidies and all reduced tax rates to evaluate

whether they have, or could potentially have, negative impacts on the environment. Publishing such an analysis on a regular basis can help raise awareness of wasteful spending and the negative impacts of fossil fuel subsidies, and create a political consensus in favour of reform.

In Germany, for example, biannual reporting on general subsidies has taken place since the late 1960s, and was recently supplemented by regular reporting from the Federal Environmental Agency on environmentally harmful subsidies.⁸

If tax revenues are earmarked or ring-fenced, these links should be carefully analysed against environmental and sustainability criteria. These links often reveal environmentally harmful subsidies, for example excise duties on road transport fuels that must be spent on road infrastructure.

In turn, a renewable energy transition can create an enabling framework for FFS reform, as in the case of El Hierro described in Box 1. Single large solar PV or wind farm facilities can account for a large proportion of total electricity consumed in smaller island states, and substantially reduce fossil fuel imports and subsidy expenditures.

Fossil fuel subsidy reforms are politically contentious processes and governments should prepare the ground well in advance. A roadmap for reform should develop a strategy for how, when, and over what timescale to reduce subsidies. It is also essential that governments develop flanking measures to protect the vulnerable from the impact of rising prices.⁹

⁸ <http://www.umweltbundesamt.de/publikationen/umweltbundesamt-entally-harmful-subsidies-in-germany> (acc. 12/06/0214).

⁹ The GSI *Guidebook to Fossil Fuel Subsidy Reform for Policy-makers in South East Asia* provides a useful introduction to

Protecting the vulnerable

EFR will result in increased energy prices. Green taxes or subsidy reforms must be accompanied by flanking measures to ensure that vulnerable groups are protected from the impact of such price increases. This is important even in cases where many people are off-grid and rely mainly on fuel wood for their energy needs, because higher energy prices will have a knock-on effect on the prices of other commodities, including staple foods.

The following compensation measures could be considered:

- Vouchers or green cheques, which can be distributed by local government or post offices
- Cash transfers – e.g. in Iran, compensation payments were paid into accounts set up for almost 80% of the population
- Provision of alternatives – e.g. LPG or solar stoves to replace kerosene
- Lifeline tariffs, i.e. zero or lower rates for first units of consumption, targeting the poorest households

Compensation measures should minimise market distortions. The impact of rising energy prices should be visible and tangible to incentivise more energy-efficient behaviour, while compensation should ensure that the poor are not adversely affected. Programmes should also be temporary, targeted and tailored to minimise costs and prevent subsidy dependence.

Develop a detailed country-specific FFRE strategy with binding RE targets

A clear, overarching FFRE strategy is essential as a basis for the development of effective, relevant, feasible and complementary RE policies. A country-specific strategy should start with an in-depth analysis of current fiscal policies, looking at all expenditures, subsidies and tax policies, particularly reduced tax rates and exemptions, to identify any negative environmental impacts and options to increase revenues. Planners should also undertake an in-depth analysis of the political economy of FFRE transition, identifying key political obstacles to transition and subsidy reforms, understanding key stakeholders, and consider possible solutions.

The setting of renewable energy objectives should be guided by SMART binding targets: Specific, Measurable, Achievable, Relevant and Time-bound.

developing reform frameworks: http://www.iisd.org/gsi/sites/default/files/ffs_guidebook.pdf (acc. 21/08/2014).

The process should include as much of the following as possible:

- RE resource mapping and feasibility studies, clarifying what potentials exist and where
- Explicit R&D investment planning
- Explore and exploit the potential of a range of RE sources
- Improve and strengthen the existing infrastructures (grids, transformer stations, meters), including RE sources as backup (e.g. hydro [pump] power, biogas)
- Mobilise public and private capital for the energy sector, e.g. by providing low-interest loans for investors and/or high-interest funds for bond owners. In some cases, funds can help to finance such investments
- Improved availability of energy services
- Improve on- and off-grid energy access
- Invest in demonstration plants/projects

Box 2: Floreana, Galapagos Islands – gradual RE transition*

Floreana is the smallest island of the Galapagos Archipelago (Republic of Ecuador) in the East Pacific, with a population of 200. The transition to 100% RE electricity (solar PV and biodiesel) from 100% FF generation took place in two stages in 2003 and 2011. In 2003, a multi-user solar hybrid grid was installed alongside a number of demand-side measures to boost energy efficiency. In 2011, the system was updated to allow for bio-diesel (jatropha) generation.

Initially, all users were obliged to pay a flat monthly charge, independent of usage, with electricity usage being capped by a daily allowance with demand-side controls. This ensured cost-coverage for operation and maintenance of the project. Later, prices were reduced and brought into line with national island energy pricing policy, which meant that subsidies for energy provision on the island had to be reintroduced. Subsequent lower prices did not create incentives to constrain demand and contributed to load growth.

Key lessons: *This case exemplifies the need for policy-makers in island states to tailor policies carefully to their specific island context. Policies appropriate in larger national grids may not be appropriate for remote islands. Gradual transition to RE, alongside EE, can foster acceptance.*

* All data taken from IEA-RETD (2012), pp. 151-155.

- Develop a communication and marketing strategy that explains and makes FFRE attractive to as many stakeholders as possible

RE transition is a gradual and incremental process. Policy-makers should look to easy, low-cost solutions to initiate a shift towards RE and reduced energy dependence – e.g. promotion of energy efficiency (EE), or pilot projects to prove viability and foster acceptance of RE transition. Once it has been demonstrated that RE technologies are feasible, acceptance of RE policies and willingness to invest will increase, making next steps easier. Box 2 describes the case of Floreana in the Galapagos Islands, which exemplifies this.

The ultimate objective of RE policy formulation should be to develop a series of collaborative recommendations and strategies for FFRE transition which have been developed with a wide range of stakeholders and meet with broad acceptance within the country. Creating a sense of ownership can go a long way towards ensuring that energy transition policies are a success.

Develop sound transition policy packages

Multi-faceted environmental problems

The complex nature of environmental problems is such that a single policy is not sufficient to effectively address all aspects of the problem. Instead, several policy instruments are required, each addressing one facet of the problem. One example might be a raft of measures to tackle market failures, which may require better information flows, clearer property rights, and internalisation of external costs. In this way, policy instruments can mutually underpin and complement one another (see e.g. OECD, 2007).

As a result, implementation of a complementary – but not overlapping – policy package is necessary to realise energy transition: regulation can create the right conditions for RE deployment, while guaranteed prices and grid access facilitate deployment by offering investors the required security.

Level-playing field in energy markets

An environmental fiscal reform, as described in detail above, is the best means of guaranteeing full-cost pricing within energy markets and reducing distortions from non-internalised costs of fossil fuel combustion.¹⁰ Correcting these market distortions

improves conditions for renewable energy and enables it to compete on energy markets, as it is not burdened by high pollution externalities. Alongside EFR – particularly when technologies are just starting out in the market – other policy measures can support RE technology deployment by fostering a stable investment climate, guaranteeing return on investment (ROI) and reducing the cost of importing RE technologies, as shown in Figure 6.

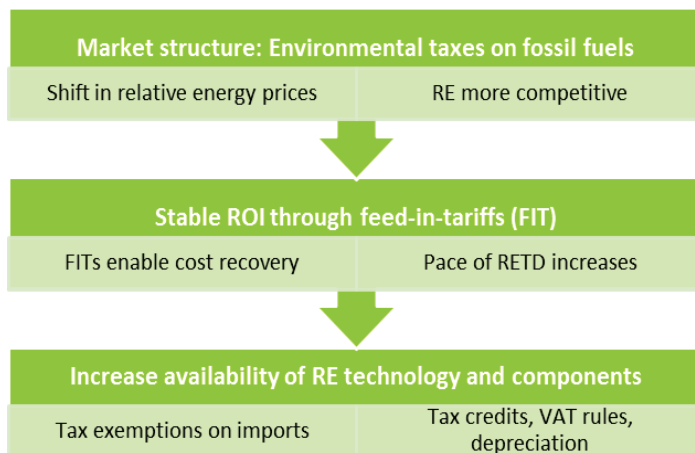


Figure 6. Environmental Fiscal Reform measures to create a level-playing field in energy markets

Instruments to enhance energy efficiency

A natural complement to renewable energy transition is energy efficiency, which curbs demand and reduces the investment required in RE generation. Energy efficiency (EE) gives policy-makers the option to use savings on the deployment of renewables, for which upfront capital costs can be relatively high. Once RE generation facilities are operational, costs are often much lower than with FF-based plants (sometimes close to zero), as for wind, hydro and solar facilities. *This means that the targeted deployment of RE combined with improved energy efficiency can significantly reduce the long-term costs of energy service* (IEA-RETD 2012).

Energy efficiency can be incentivised by environmental fiscal reform, encouraging efficient behaviour through energy prices. Other measures to encourage behavioural change or facilitate technology transfer may include:

- Differentiated import duties
- Efficiency standards
- Green procurement

¹⁰ As discussed in the first chapter of this report, fossil fuel combustion has a range of environmental and social costs – impacts on air and water quality, ecosystems, climate

change, and human health. Subsidy reforms and environmental taxes can internalise these costs in the price of fuels, avoiding that they be borne by those who suffer most from the consequences of pollution.

Box 3: Tunisia – Prosol – innovatively combining EFR and RE transition

The Tunisia Prosol programme uses revenues from green taxes – car registration and import duties on thermal units in air-conditioning systems – to partly fund a scheme to install household solar water heaters (SWH). Grants and additional costs subsidies account for much of the remainder, with households only required to pay 10% of the cost up-front. Monthly loan repayments, at subsidised interest rates, are recovered in energy bills over 5 years. The project has been a great success and has resulted in widespread installation of SWH, reduced air pollution and greenhouse gases emissions estimated at 11,000 tCO₂-eq in 2009.

Key lessons: *The right combination of policy instruments can achieve a raft of policy objectives and exploit synergies between them.*

Source: Trabacchi et al., 2012 and <http://www.unep.org/climatechange/finance/LoanProgrammes/MEDREP/PROSO/LinTunisia/tabid/29559/Default.aspx> (acc. 28/01/2015).

- Incentives to make larger energy-saving purchases (low-cost loans, grants...)
- Feebate schemes – to eliminate or reverse price spread between more and less efficient appliances, in favour of EE
- Clear, compulsory energy efficiency labelling

Instruments to reduce risk

Creating a stable low-risk investment climate for RE is essential to facilitate transition. There is evidence that commitment, stability, reliability and predictability can increase the confidence of market actors and reduce regulatory risk, which can have the knock-on effect of reducing the levelised cost of renewable electricity by 10-30% (de Jaeger and Rathmann, 2008). The policy instruments below are supportive of this aim:

- Stable and enforceable contracts for electricity purchases (preferred grid access for RE)
- Clear long-term policy and objectives
- Institutional support – including technical and training assistance
- Supportive infrastructure
- Streamlined permitting and grid connection procedures
- Credit or loan guarantees, insurance mechanisms to reduce cost of financing

Fostering a stable and reliable climate for private investors

Renewable energy requires significant up-front investments, although facilities are much cheaper to run, with free RE resources, than fossil-fuelled power plants. Nevertheless, private investors are often deterred from island states, due to their small energy markets and the resulting lack of economies of scale. Not surprisingly, the bulk of energy FDI flows to island states have been directed at a very few high- or upper-middle income island states (UNDESA 2013a).

Failure to access up-front finance for RE project can act as a significant barrier to technology deployment. Thus, it is essential that governments foster an attractive and stable investment climate to appeal to private investors. Reducing risk, as discussed above, is an integral part of this process. However, creating an attractive investment climate for RE also requires a multi-aspect approach to FFRE transition policy. The International Renewable Energy Agency has developed a framework for attracting investments to islands, focussed on four priority areas, as shown in Table 1, below (IRENA, 2014).

The case of Cabo Verde, discussed among others later in this report, highlights the benefits of a government commitment to renewable energy, and where a public-private partnership has funded a large RE project.

Explore regional cooperation to fund RE transition

Renewable energy finance has boomed in the last decade, with \$244 billion invested globally in 2012, of which 112 billion in non-OECD countries (UNEP, 2013c). A key question for policymakers in island states is how to exploit these opportunities.

Accessing international finance

It is difficult for island states to access international climate finance for a number of reasons. International donors tend to focus on larger emerging economies and often seem unaware of the special difficulties faced by island states, and of opportunities available to them. As a result, foreign development assistance to island states remains under-funded (Caribbean Development Bank, 2013). Furthermore, a major criterion for accessing climate finance is *per capita* income, rather than structural needs and vulnerabilities, which often puts island countries at a clear disadvantage (UNDESA, 2013a).

Some barriers stem from within island states themselves. Scarce human resources may result in

Table 1: A framework for attracting investment to island states

Attracting investment as political priority	<p>Investors can be sure that RE is a long-term project.</p> <p>Political will to bring about change based on realisation that dependence on fossil fuel imports is costly and unsustainable.</p> <p>Policy-makers to prioritise and legislate accordingly.</p>
Creating market framework for investment	<p>Electricity market open to all kinds of actors – utilities, independent power producers (IPPs), commercial and residential owners.</p> <p>Ensuring that RE investment is low-risk and profitable through suitable legislation, e.g. feed-in tariffs (FITs) regulation.</p>
Technical and integrated resource planning	<p>RE investment is in the economic interest of the island</p> <p>Grid stability analysis – stable electricity supply as RE penetration increases</p> <p>Optimal energy mix, taking environmental, economic and social aspects into account</p>
Capacity building	<p>Skills needed to plan, finance, install, manage, operate and maintain RE systems</p> <p>Power grid is effective, safe and reliable.</p>

lack of institutional capacity to navigate the complex funding access criteria and application procedures. Some island states also lack in-country coordination systems necessary to monitor and enforce climate funds, or to report to donors in compliance with international fiduciary requirements (Caribbean Development Bank, 2013). Finally, lack of fiscal space and high levels of debt may also act as a barrier. The development of institutional capacity by the governments concerned, with assistance and facilitation by donors and international financial organisations, is a key enabling priority.

Aggregating projects to attract investors

Island states should explore ways of cooperating and jointly applying for climate finance, enhancing their visibility with donors and making the most of their

scarce human resources. This could reduce transaction costs and create opportunities to access higher levels of climate finance.

One strategy to attract renewable energy investment to island states would be to aggregate RE projects and develop new models of ownership. This could attract investors seeking larger-scale opportunities and enable island states to access more attractive terms and conditions for investments and in so-doing, reap the benefits of economies of scale. An example of this has been documented in the US state of Massachusetts, which recently aggregated all municipal property to attract a large investor, identifying 10MW of opportunities in solar PV and offering to develop the project at rates considerably below ongoing utility ones (IEA-RETD, 2012).

Box 4: Eigg, UK – cooperative RE projects to foster support, even for capped electricity use

Eigg, a small island off the coast of Scotland (pop. 96), has recently installed a cooperative-funded (developer and community) hybrid RE generation system consisting of 80.5% hydro, 10.5% wind, 2% solar PV and 7% diesel gensets for back-up. Eigg residents also contributed to in-kind support and local expertise to the project.

Eigg has introduced innovative measures to manage demand. Each household has a 5kW cap on electricity consumption, with an alarm warning when nearing the limit. If overstepped the cap, electricity supply is automatically cut off, and \$42 USD are charged for reconnection. The supply system also has an “energy traffic light”, which is green when consuming only RE, but turns amber to warn of impending diesel gensets, and red once the system starts producing from fossil fuel generators.

Key lessons: Even in an industrialised country, capped energy consumption can be met with broad acceptance by residents – as a result of local involvement in power provision and sound, well-communicated energy policy.

New funding strategies

The Seychelles roving Ambassador for Climate Change and SIDS, Ronald Jumeau, has criticised the “traditional donor-based ‘North-South’ partnership model” for not living-up to the expectations of island states. He proposed instead to explore sustainability and energy transition financing from non-traditional sources, including the private sector, philanthropic trusts and foundations.¹¹

There is considerable potential for renewable energy in island states to be partly citizen- or community-owned, and to generate substantial additional economic impacts for local communities. The case of Eigg (Box 4) exemplifies a trend in this direction.

Technology transfer and research

Island states will also benefit from new coordinated and regional approaches to partnership and cooperation, including improved mechanisms for research, technology transfer and new approaches to financing FFRE transitions.

Sharing innovative developments and research findings, as well as collaborating on research and pilot projects, could help all island states to advance their FFRE agendas and to develop RE generation technologies appropriate to their specific contexts.

For example, the German Ministry for the Environment has carried out a feasibility study in Cabo Verde to design a wind electricity plant that would power sea water desalination whenever the wind blows and electricity is generated, thus using this fluctuating resource in a way that does not require grid integration – which can be a challenge, notably in island states. This is just one example of the development of island-appropriate technologies, from which all island could potentially benefit.¹²

Coordination of FFRE policies

Similarly, island states could consider regionally coordinating tax policies targeting the tourism industry. For example, air ticket taxes introduced unilaterally might be considered politically sensitive, particularly given high dependency on tourism in many island states. However, an alliance between African and Indian Ocean island states, along with

other countries in a similar situation, could be formed to coordinate air ticket taxation policies and implementation.

The Maldives will introduce a \$6 per bed tax on tourism from November 2015, with revenues being used to fund waste management on the islands. If other island states were to follow suit, tax competition between countries would be reduced and any leakage of tourism in response to the tax would be minimised.¹³

Two Barriers to RE Technology Deployment in Island States – and How to Overcome Them

Perceptions and preconceptions can act as influential barriers to RE deployment. They certainly do in relation to the two issues discussed in this section of the report – provision of base-load electricity with RE sources and the current trend in falling fossil fuel prices. These issues were raised more than once during the Mauritius FFRE capacity building workshop as significant barriers to FFRE transition. Both these issues are more acutely felt in island states as a result of their special circumstances described in detail in the SWOT analysis introduced earlier in this report.

Dealing with RE supply fluctuations and providing base-load

A commonly-voiced doubt regarding the feasibility of FFRE transition is the concern that RE cannot meet the fluctuating energy demands of a country, and that RE supply is unable to meet RE demand all of the time. RE is not sufficiently flexible, such critics contend, to provide base-load generation or to adjust to fluctuations in electricity demand.

This concern is compounded in the context of island states, because they are generally unable to import electricity from neighbouring countries, or to be connected to a larger grid. Misconceptions regarding the severity of this problem act as a barrier to RE deployment in island states and foster scepticism regarding the feasibility of RE as an alternative to fossil fuel electricity generation.

It should be noted that in many island states, RE penetration is at relatively low levels – as documented in the comparator table above – meaning that meeting base-load energy needs, or energy demand at peak periods, is not a pressing concern. The

¹¹ <http://www.un.org/en/development/desa/newsletter/desa-features/2014/05/index.html> (accessed 05/05/2014).

¹² German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety: *Windbetriebene und regulierbare Meerwasserentsalzung auf Kap Verde* (Wind-powered seawater desalination on Cabo Verde), MARI-VENTO, unpublished feasibility study, Berlin, Aug. 2011.

¹³ http://www.ttgasia.com/article.php?article_id=24482 (accessed 28/01/15).

immediate aim of island states should thus be to increase the proportion of RE within their electricity mix to 20-30%, with a view to achieving a 100% transition in the medium- or long-term. Achieving this first step would reap immediate rewards in terms of reduced fossil fuel dependence – reduced spending on imports, an improved trade balance, savings on scarce foreign currencies and reduced vulnerability to fluctuating fuel prices – and so help address political and perceptual barriers to FFRE transitions.

In anticipation of much higher levels of RE penetration later on, there are a number of steps island states can take to address natural fluctuations in RE supply and the provision of base-load. These include generally adapting demand to supply from an increasing share of RE, i.e. by reducing peak and base-load demand, facilitating storage of energy, investment in smart grids and smart metering, and development of sound energy planning and strategy to guarantee a reliable electricity supply, no matter how high the penetration of RE (IRENA, 2012b).¹⁴ The latter point is discussed as a general recommendation in the relevant section above.

Reducing base and peak load demand

Energy conservation is one of the prerequisites of FFRE transition to meet base and peak load demand. Numerous energy-efficiency solutions exist today to reduce total energy consumption or to facilitate increased RE access. As discussed above, energy efficiency is an essential part of a FFRE transition, as it facilitates increased reliance on renewable energy and can help reduce its associated costs.

Peak load is very costly as it requires supply capacity used for just short periods of demand, sometimes only a few hours or days in a year. For this reason, reducing peak load should be a priority for policy-makers. Energy conservation, storage systems, smart meters and grids can all facilitate reallocation of demand from peak times to times of lower demand. Such measures are described in more detail below, and as a general rule, apply to both base and peak load, as they all provide a means for policy-makers to bring grids, power generation and demand more in line with each other.

Provision of base-load with RE

Electricity grids today tend to require a steady supply of power which does not fluctuate to a great extent – a so-called base-load. This base-load can be

provided by RE sources. Hydro, geothermal, biomass, waste-to-energy and biofuel plants can all be designed for base-load operation and are as reliable and predictable as fossil fuel generation. In Spain, solar energy is used to provide base-load electricity on a commercial scale at the thermo-solar electrical generation plant, Gemasolar, which uses molten salt heat technology to store solar energy that can generate electricity for up to 15 hours without solar input.¹⁵ Two further sites, Valle 1 and Valle 2, use a parabolic trough collector system and molten-salt heat storage system in the same way. This type of generation is known as Concentrated Solar Power (CSP) and is also well suited for base-load generation.

Similarly, electricity generated from biomass contributes to base-load in both the EU and the USA. Biofuels are already used in a number of island states to provide a non-fluctuating energy supply, e.g. sugar cane residues in Mauritius, biofuels produced on Vanuatu and Fiji, and jatropha oil in Floreana, Galapagos Islands (UNEP, UN DESA and FAO 2012; IEA-RETD, 2012).

In addition, many island states have the potential to address problems associated with waste disposal and energy provision by setting up waste-to-energy plants to meet at least a proportion of their base-load energy needs.

Renewable Energy Storage

Provision for energy storage facilitates a higher proportion of renewables in the electricity mix. It can be used to bridge lulls in RE output and ensure base-load, smooth transitions between high and low energy supply, and store energy when prices are low (IEA-RETD, 2012). IRENA has suggested it is likely that small islands will require some mechanisms to stabilise supply at RE penetrations of 20-50% – either storage or other policy tools, such as demand-side measures, usage caps or emergency generators – which could be powered with bio-fuels. The agency points out that islands will almost definitely require some of these measures when variable RE penetrations are over 50% (IRENA, 2012b).

At the time of writing, commercially viable storage technologies for RE included pumped hydro, batteries, compressed air storage and concentrated solar power (CSP). Ongoing research into those and other ways in which RE can be stored will facilitate higher levels of buffering and thus RE penetration in the near future, notably as commercial scale CSP plants are being rolled out more widely (IRENA, 2012b).

¹⁴ The report by IRENA cited here, *Electricity Storage and Renewables for Island Power: A guide for decision-makers*, provides an excellent introduction to large-scale RE storage technologies and deployment in SIDS.

¹⁵ <http://www.torresolenergy.com/TORRESOL/gemasolar-plant/en> (accessed 18/08/2014).

Dispatchable load

Alongside base-load, dispatchable generators designed to vary their output to compensate for fluctuations in other RE sources can be turned on and off as required to boost output at peak times (IEA-RETD 2012). RE-based dispatchable electricity generation includes bio-diesel generators and hydropower using a reservoir (IEA-RETD, 2012).

In some countries, with higher proportions of RE in the electricity mix, flexible electricity sources have grown enough to overcome base-load concerns. In such cases, dispatchable generators or intermittent but numerous and diverse RE sources can always ensure base-load coverage. In Germany, for example, dispatchable energy (in the form of bio- and, for the time-being, natural gas power plants) has already become far more important than base-load.¹⁶

State-of-the-art integration and control strategies can provide stable electricity, even in cases of very high RE penetration. In Ecuador, for example, a solar PV / diesel micro-grid has provided electricity for all but 51 minutes in one year (IEA-RETD, 2012).

Smart grids to smooth energy supply

As RE penetration increases, investment in smart infrastructure is necessary so that grids can cope with variable, supply-driven sources, while keeping voltage and frequency steady to avoid dangerous power surges and meet peak demand (WWF, 2011).

Smart grids reduce wind and solar energy fluctuations by giving electricity consumers information on energy supply and price to help manage demand. They use price signals to influence behaviours, following the same underlying principle as environmental fiscal reform (see *Increase fiscal space by means of EFR* in *General Recommendations* above). Smart grids make it cheaper to use electricity when supply is high, and more expensive when electricity is scarce. Smart meters can be installed to make consumers aware of fluctuating electricity prices and tailor their demand accordingly, while smart appliances can be used to operate automatically when the price of electricity is low.

RE fluctuations not a barrier to high rates of penetration

It is no more than a misconception that fluctuations in RE supply act as an effective barrier to a 100% FFRE transition. However, it does require a shift away from how electricity systems have often been

built in the past. RE sources can provide for base-load, and can be stored to match dispatchable and peak load demand while smoothing-out fluctuations in supply. Commercial techniques using RE for storage are already in operation, such as pumped hydro, molten salt and flywheels. Complemented by energy efficiency measures and smart grid technologies, RE are capable of providing 100% of RE needs in SIDS.

Responding to Variations in Global Energy Prices

Recent trends in fossil fuel prices

Rising energy prices – and energy taxes, as a major cause of rising prices – tend to be a political concern for social and economic reasons. On the other hand, they also tend to have a positive influence on innovations for energy savings and renewable energies (see e.g. EEA, 2011; OECD, 2010).

However, since their last peak in early and mid-2014, the prices of natural gas and crude oil have fallen sharply. In the case of natural gas, this trend seems to have been triggered mainly by new extraction methods, such as hydraulic fracturing (fracking) of shale deposits. In the case of oil, stable oil extraction rates and reduced demand from global economic slowdown have brought prices below 100 USD per barrel since August 2014, in spite of multiple crises in oil-producing regions, such as Ukraine and Iraq.¹⁷ By January 2015, the global benchmark oil price of Brent Crude had fallen even further, to below \$50 a barrel.¹⁸

But how might these trends impact FFRE energy transitions over time? Long-term low fossil fuel prices tend to make RE investments comparatively less attractive. On the other hand, the latest drop in fossil fuel prices is not expected to last for very long, as supply will fall sharply from the too expensive offshore and shale wells in coming months or years. Prices will then likely recover to levels where RE investments are again attractive, and in line with the structural valuation trends of fossil fuels (see Figure 7), shaped by rising demand and increasingly expensive recovery (IEA, 2013).

Perhaps more importantly however, the recent fluctuations of fossil fuel prices may signal a chronic

¹⁶ <http://energytransition.de/2012/10/flexible-power-production-no-more-baseload/> (accessed 15/08/2014).

¹⁷ Spiegel Online <http://www.spiegel.de/wirtschaft/unternehmen/oelpreis-sinkt-trotz-krisen-in-irak-gaza-ukraine-a-987112.html> (accessed 21/08/2014).

¹⁸ <http://www.reuters.com/article/2015/01/28/us-markets-oil-idUSKBNOL107120150128> (accessed 28/01/2015).

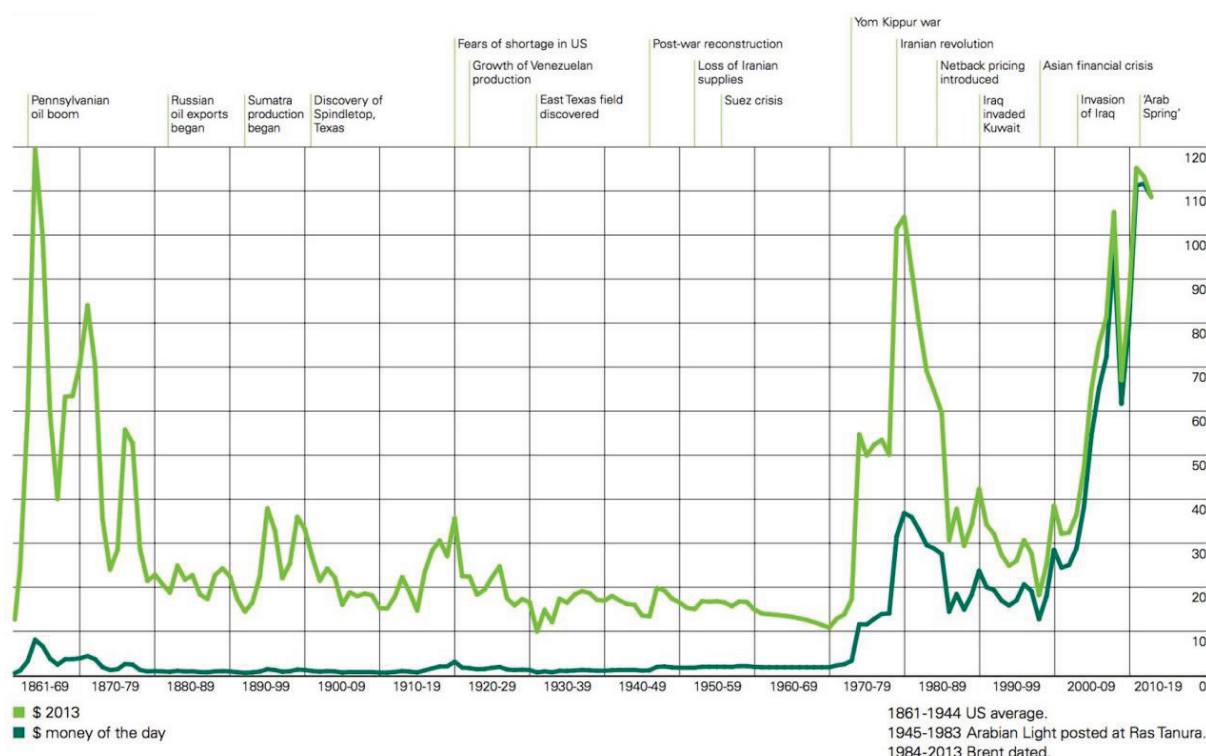


Figure 7. Crude oil prices 1861-2013 in USD per barrel

Source: BP, 2014, Statistical Review of World Energy: <http://www.bp.com/statisticalreview> (acc. 21/08/2014)

instability in fuel prices, as expensive extraction brings supply beyond the means of many users. This instability could constitute a strong incentive, regardless of prices, to shift towards RE sources and their much more predictable prices, supply, and return on investments (Bosman & Loorbach, 2015).

Low FF prices: A window of opportunity

Bearing in mind the long-term trend towards higher global fossil fuel prices and the severe pressure on the economies of island states resulting from imbalances in trade, diminishing foreign exchange and limited national financial resources, it is essential that fossil fuel-dependent countries in particular phase-out subsidies and initiate a shift to domestic RE. What is more, low oil and gas prices provide the window of opportunity for island states to do so. As The Economist wrote in January 2015, this is “a once-in-a-generation opportunity to fix bad energy policies”. The newspaper also called for higher taxes on fossil fuels to “encourage conservation, dampen future price swings and provide a more sensible way for governments to raise money.”¹⁹

Thus, falling global energy prices represent a very real chance to phase-out fossil fuel subsidies and initiate a shift towards full-cost pricing. Step-by-step, governments can take the opportunity afforded by

stable or falling energy prices to phase-out subsidies while consumers are shielded from the impact of reforms due to the temporary lower global fuel prices. Many countries have already started seizing such an opportunity, including Egypt and India, joining others that had started to cut subsidies even at high global prices, such as Indonesia, Jordan, Malaysia, Mexico and Morocco. Those favourable circumstances may greatly help avoid the backlashes experienced with similar policies in Nigeria and Yemen. Subsequently, governments can gradually start to tax energy consumption according to the real environmental and social costs associated with its use – as described earlier (see also IMF, 2014).

At the same time, even if fossil fuel prices are temporarily falling, it remains absolutely crucial for economic decision-making to consider the relative effects of such price changes. In the past, the costs and thus prices of RE have been reduced substantially – a trend which is ongoing, and very likely to continue. Some RE sources, onshore wind and solar PV, have already reached grid parity in several countries. As the cost of RE falls more rapidly than fossil fuel prices, RE continues to widen its relative advantage. If these developments are considered in relation to each other, investors may find, on balance, that the perspectives for RE are better than those for fossil fuels – particularly if governments move to level playing fields in energy markets by reforming subsidies and taxing fossil fuels.

¹⁹ <http://www.economist.com/news/leaders/21639501-fall-price-oil-and-gas-provides-once-generation-opportunity-fix-bad?fsrc=scn/tw/te/pe/ed/siezetheday> (acc. 28/01/2015).

Using taxes on fossil fuels to foster an attractive investment framework

Policy-makers can create a sound investment framework by introducing or increasing fossil fuel taxes that compensate for temporarily falling prices. These taxes will internalise at least some of the externalities associated with fossil fuel combustion and create a more level-playing field in energy markets. This is crucial to preserve the value of current energy efficiency and RE investments, and make future ones more predictable and attractive. Such a move would also preserve trust in long-term government GHG mitigation objectives, and avoid capital destruction resulting from, for example, the under-pricing of carbon units within the EU-emissions trading system.

Preparing the ground for rising FF prices

In the medium term, irrespective of the current hiatus in price increases due to demand fluctuations and the spike in unconventional oil and gas extraction, the supply of those fossil fuels is necessarily bound by limited reserves and increasingly difficult recovery. It is thus just a matter of time before oil and gas prices start rising again, substantially. Countries that will have taken advantage of temporary low prices to cut subsidies and incentivise the RE transition will be spared the fiscal and trade deficit shock of returning high prices, and be the most immune to the volatility reflected in Figure 7 and expected to worsen in coming years. It is therefore essential that countries most vulnerable to volatile fossil fuel prices – such as island states – act now while prices are low to build their economic resilience and work towards energy independence.

Denmark is a shining example in this respect. Hit hard by the global oil crisis of the 1970s, the country started changing its policies substantially and initiated an energy transition, investing a lot in efficiency and renewables. When global energy prices dropped in the 1980s after the first two oil price peaks of 1973 and 1979, Denmark decided to introduce energy taxes in order to keep domestic prices high, protecting their recent investments in efficiency and renewables. This policy was hardly felt by consumers, as the economy had adapted to high energy prices in the 1970s. Denmark is now a world leader in EE and RE, particularly wind generation, and demonstrates how active intervention by ensuring a high or gradually increasing level of energy prices can foster a stable investment framework to support FFRE transition.

More recently, in June 2014, the United States set absolute carbon pollution standards for new fossil

fuel power plants and specific carbon reduction targets for each US state, amounting to a 30% reduction of CO₂ emissions on 2005 levels by 2030.²⁰ This will increase demand for efficiency measures and alternative sources, acting against lower energy prices and contributing to the country's energy transition. A similar signal was sent by China at the UN Climate Summit in September 2014, when Vice-Premier Zhang Gaoli reiterated his country's commitment to climate change mitigation and intention to peak emissions "as early as possible". China had legislation already in place to ensure a reduction in carbon intensity of 40-45% by 2020 from 2005 levels,²¹ and has since agreed with the United States to peak its emissions by 2030.²²

Subsidy reforms and energy taxation: The optimal policy response

An optimal transition path would entail island states acting now to foster FFRE transitions by reforming harmful subsidies and increasing energy taxes. The potential for increasing energy taxes and thus raising government revenues is much higher in the present context, when gas and oil prices are relatively low, than when higher global energy prices will have returned.

The crucial difference between production-driven and tax-driven higher energy prices is that with the former, large sums are being spent on financing fossil fuel imports, while the latter generates national public revenues. A pro-active policy intervention through timely energy taxes can therefore ensure that funds are mainly spent domestically, alleviating other taxes, stimulating employment, or supporting the energy transition with direct financing and a more predictable investment environment.

²⁰ See US Environmental Protection Agency at: <http://www2.epa.gov/carbon-pollution-standards> (accessed 21/08/2014).

²¹ <http://www.iisd.ca/climate/cs/2014/html/crsvol172num18e.html> (accessed 24/10/2014).

²² <http://www.whitehouse.gov/the-press-office/2014/11/11/fact-sheet-us-china-joint-announcement-climate-change-and-clean-energy-c>

Specific Recommendations

The following section of this report makes a series of country-specific FFRE-related recommendations for those island states that participated in the Mauritius workshop. The general elements proposed above for all islands – most notably, protection of vulnerable groups from rising energy prices – are not repeated here, unless specific suggestions or amendments are made. Nonetheless, all general recommendations should be regarded as an integral part of the far more specific recommendations made here.

Cabo Verde

Basic data

Cabo Verde has an area of 4,033 km² and a population of 499,900 spread over 9 inhabited islands. The country consumes 330 GWh of electricity annually. Poverty rates have been declining steadily over the past 20 years, from 49% below the poverty line in 1989 to 29% in 2007. In 2010, yearly per capita emissions were just 0.7 tCO₂-eq. The country has an ambitious RE target of 50% by 2020, and of 100% by 2025.

The economy is service-oriented, with the tertiary sector generating 61% of GDP in 2010. Cabo Verde is heavily dependent on imports, which equal 40% of GDP. The government aims to attract 1 million tourists by 2015 – about 30% of GDP (AfDB and OECD, 2008). To reduce high dependency on imported fuels, Cabo Verde was aiming to produce 25% of its electricity from renewable energy by 2011. However, by early 2014, less than 21% of all electricity was RE-generated – 18.6% from wind and 2.3% from solar. This makes achieving the 50% of total electricity supply from renewables by 2020 a challenging proposition.

Cabo Verde is nevertheless on the right path to RE transition. It has set up an effective and supportive structure for market investments in RE which guarantees power purchase agreements (PPAs) for independent power producers (IPPs) for 15 or 20 years (IRENA, 2014). Nevertheless, the large-scale commercial use of renewable energy resources faces several constraints, including limited technical development, difficulty in freeing-up revenues for investments, and scarcity of local skills.

Recommendations

Increase fiscal space

In 2012, tax revenues in Cabo Verde amounted to just 17% of GDP. This suggests a margin to increase

(environmental) taxation and raise revenues to fund various aspects of RE transition and address the barriers described above.

It is important to phase-out all energy tax reductions and exemptions which favour excessive consumption, such as for irrigation pumps or farmers' road tax. Policies should in fact gradually phase-in and increase energy taxes to reflect full-cost pricing for all natural resources, starting with energy products, notably oil. The apparently obligatory linkage between the oil taxation and the use of its revenues for road maintenance should be phased-out, as this leads to increased supply of road infrastructure, neutralising incentives stemming from higher taxation. Considering water scarcity on Cabo Verde islands, related charges would also seem advisable to incentivise conservation and more efficient use.

Tourism

Although tourism is a leading growth sector of the Cabo Verde economy, the spill-over effects of tourism to local markets are not large, as tourists tend to cluster in large resorts and consume imported rather than local commodities (AfDB and OECD, 2008). Introducing taxes that deliberately target tourists, such as a tax on overnight stay, or an "ecosystem services levy" charged upon airport arrival or departure, could compensate for public expenditure for this industry, such as infrastructure. Incentivising spill-over effects in local markets is more challenging, but could be encouraged through (possibly government-funded) information campaigns on local markets and businesses close to resort areas.

Scale-up innovative approaches to RE financing

Innovative financing approaches have been tested in Cabo Verde. The 2010 European Investment Bank (EIB) and African Development Bank (AfDB) funded project to design, build and operate onshore wind farms on four islands of the Cabo Verde archipelago exemplifies how innovative financing can provide for FFRE transition. The project is a public-private partnership (PPP) held between the Cabo Verde state, a government-owned utility company, Electra, and InfraCo, a publicly-financed privately managed company.²³ Such innovative approach creates new opportunities for private investment in the RE sector and should be scaled-up as soon and as much as possible. Indeed, Cabo Verde's success highlights an approach from which other small island states can learn.

²³ For details see <http://elegtra.com/projects/cabeolica-wind/> (accessed 05/05/2014).

Comoros

Basic data

Comoros has an area of 2,235 km² and a population of 767,000 (July 2014 est.) spread over 3 large and numerous smaller islands.²⁴ The country consumed 40 GWh of electricity in 2010, although supplies are intermittent and negatively effects economic development.²⁵ Greenhouse gases emissions amount to just 0.2 tCO₂-eq per capita. Poverty rates are high and Comoros was ranked 162 of 187 countries in the UNDP Human Development Index. The country is 100 percent dependent on fossil fuel imports.

Comoros adopted energy policies in 2012, and a renewable energy strategy in 2013. Nonetheless, the electricity sector faces numerous problems, with access being relatively low and power outages common. The country relies on aging diesel generators, and capacity in terms of both human resources and RE technology transfer is lacking.

Recommendations

The following country-specific recommendations could help address these obstacles.

Policy coherence

Develop a coherent national strategy for FFRE transition and energy resource use on the basis of the renewable energy strategy and existing energy policies. This should include measures to increase fiscal space, such as a FFS reform and the development of indigenous renewable energy resources.

Reform fossil fuel subsidies

Preferential pricing for diesel fuels mean that 65% of all diesel consumed in Comoros is not subject to taxation. This subsidy should be phased-out as soon as possible.

Improve institutional and legislative frameworks for RE transition and to attract investment

The government should improve institutional and legislative frameworks for the development of renewable energy, and improve policy frameworks to attract related investment (see general recommendations on regulation of energy markets). This and direct incentives may help to mobilise both public and private capital for RE investment and the energy sector.

²⁴ <https://www.cia.gov/library/publications/the-world-factbook/geos/cn.html> (accessed 14/05/2014).

²⁵ <https://www.cia.gov/library/publications/the-world-factbook/geos/cn.html> (accessed 14/05/2014).

Explore possibility of replacing aging diesel generators with geothermal and solar PV

Needed updating of fossil fuel-powered facilities opens a window of opportunity to redirect funds to RE. In the medium term, this will help address the problem of very high electricity tariffs, which exceeded those in Mauritius by 50% and 133% for commercial and residential users respectively.²⁶ The country's large geothermal potential is being considered, and should remain the main focus of new programming.

Increase access and partnerships

Energy and electricity access strategies should also explore small-scale solar PV and solar water heating (SWH), as well as mini-hydro for off-grid or mini-grid connections in remote areas. In turn, increasing the effectiveness of international partnerships could take place within the context of greater regional cooperation (see *General Recommendations* section).

Madagascar

Basic data

The island of Madagascar has a relatively large land area of 581,540 km² and a population of 23,202,000 (July 2014 est.).²⁷ Tourism is an important industry, generating 15% of the GDP. Approximately 80% of the population is employed in agricultural, forestry and fishing, which account for about 25% of the GDP.

Electricity access is very low – about 25% in urban areas, and only 7% in rural areas. Total consumption amounts to 1.13 TWh annually, more than 30% being hydro-electrical. In 2010, annual GHG emissions per capita were just 0.1 tCO₂-eq. Dependence on fossil fuels is high, with oil imports worth \$350 million in 2010. The country has a high RE potential of hydro, wind, solar and ocean sources,²⁸ and a considerable scope to scale up existing pilot RE and energy access projects. However, Madagascar has faced political instability since 2009, with an estimated cumulative cost of \$8 billion, flattening-out growth rates formerly averaging 5% annually, and resulting in a sharp increase in poverty.²⁹

²⁶ <http://www.reegle.info/policy-and-regulatory-overviews/KM> (acc. 14/05/2014).

²⁷ <https://www.cia.gov/library/publications/the-world-factbook/geos/ma.html> (accessed 13/06/2014).

²⁸ <http://www.irena.org/remaps/countryprofiles/africa/madagascar.pdf> (accessed 16/05/2014).

²⁹ <http://www.worldbank.org/en/news/feature/2013/06/05/madagascar-measuring-the-impact-of-the-political-crisis> (accessed 10/05/2014).

Recommendations

Increase fiscal space

Tax revenues amounted to just 10.3% of GDP in 2011, although estimates indicate this may have almost doubled to 20% in 2013.³⁰ A breakdown of tax revenues by source is not available. In any case, 20% is still rather low and suggests that fiscal space remains for increased (environmental) taxation. Because of very high poverty rates in the country, extreme care must be taken to protect the vulnerable from the impact of tax increases.

The section on General Recommendations, on p. 18, lists environmental taxes which could be considered to foster FFRE transitions. Other possible taxes include increasing resource extraction taxes on mining and a levy on tourism – perhaps referred to as a “conservation fee” to increase acceptance (or *willingness to pay*, WTP). This could take the form of an airport landing or departure tax, or a (proportional or flat) tax on the cost of accommodation. Part of the revenues thus generated could be earmarked for investment in energy efficiency and renewable technologies. Reform of import duties to encourage imports of RE technologies and components, and EE appliances, could also be considered.

Scale up programmes to facilitate fuel switching from unsustainable wood fuels

As a result of low electricity access, an estimated 80% of the population largely relies on fuel wood for cooking. Alternatives, such as solar, ethanol or LPG stoves are not widely used (though LPG is a fossil fuel, it is much lower health hazard than using fuel wood). The cost of purchasing such equipment is prohibitive for most households – 92% of Madagascans are estimated to be living on less than USD 2 a day.³¹ This in turn is a major driver of deforestation, estimated at 50,000 hectares per year and an underlying cause of the 0.55% annual rate of natural habitat depletion. The complex mix of causes – poverty, insecure tenure, low awareness, inadequate legal and regulatory frameworks, demographic trends, lack of conservation incentives, and political instability – make tackling this problem a very real policy challenge.

There are already a number of small projects to foster sustainable forestry and encourage fuel

switching, notably by GIZ. The most successful of these should be scaled-up as rapidly as possible. Awareness-raising and capacity building in sustainable farming methods, sustainable charcoal extraction, and agro-forestry is an additional way of addressing current drivers of deforestation. This should take place alongside the introduction of payments for environmental services (PES) for sustainable forestry practices and other measures to encourage afforestation, including allocation of ownership and usage rights for newly forested areas.

Landfill methane and fuel switching

Biogas production pilot projects could be rolled-out to capture methane from landfill and other public utility sites. This could partly be funded by the sale of Certified Emissions Reductions (CERs), and complemented by a wood stove replacement programme with biogas or LPG units – based on the scaling up of existing pilot projects. Biogas could meet at least part of the rural poor cooking fuel needs, while reducing dependence on fossil fuel imports and organic waste fly-tipping (a common occurrence). Pilot projects should be accompanied by a feasibility study of the waste-to-gas potential to meet national cooking needs and to identify necessary additional measures.

New tax measures to foster sustainable forestry

Timber extraction taxes or stump charges could be levied on large timber extractors and foreign companies, on top of licensing fees. A proportion of funds could be used to crack down on illegal logging. Payment for environmental services systems could create incentives for sustainable forestry management, protect existing forests and also improve watershed management (forest cover reduces rates of run-off). In the long-term, differentiated land taxation could create incentives to preserve forested areas and apply sustainable agricultural practices.

Investment in small-scale RE to boost energy and electricity access

Investment in mini-hydro and small scale PV projects could provide sustainable energy access and off-grid rural electrification. This should be supported by introducing measures to create an attractive climate for private investors in RE, as described in the earlier section on generational recommendations. Investment in large-scale hydro projects, particularly in the North of the country, could also be considered.

³⁰ This estimate was kindly provided by the workshop participant from Madagascar

³¹ <http://www.worldbank.org/en/news/feature/2013/06/05/madagascar-measuring-the-impact-of-the-political-crisis> (accessed 10/05/2014).

Maldives

Basic data

The Maldives have a relatively small land area of 300 km² and a population of 351,000 spread over 190 inhabited islands, consuming 428 GWh of electricity annually. No interconnected national grid exists. In 2009, GHG emissions were high in the context of Indian Ocean island states, at 4 tCO₂-eq per capita. As annual GDP growth is relatively high at 6-8%, emissions could double by 2020 under a business as usual scenario.

Tourism is the single most important industry in the Maldives, and also its largest energy consumer. Almost 1 million tourists visit the country each year and generate 29% of its GDP. Total imports have averaged around 61% of GDP over the last 5 years. Petroleum products make up 23% of total imports, amounting to \$470 million in 2012 (about 35% of GDP)³². The only documented source of RE-generated electricity in the Maldives is solar PV, for a mere 0.8% of installed capacity, the remaining 99.2% being produced from inefficient diesel generators.

Recommendations

Seizing window of opportunity for FFRE transition

A new government took office for 2014-2018 and the freshly appointed cabinet may see an opportunity to set the agenda and pursue an ambitious FFRE-reform with concrete implementation steps. This should feed into the development of a National Strategic Action Plan (SAP) for 2014-2018 (replacing the previous 2010-2014 SAP), which should cover the energy sector and establish future goals and strategies for FFRE-transition.³³

Fiscal space

Tax revenues amounted to 16% of the Maldives' GDP in 2011, leaving much fiscal space to increase (environmental) taxation. Almost 64% of total tax revenues are raised from import duties, while a further 28% originate from tourism-related taxes. There are several environmentally-related taxes in place, including fossil fuel import duties and a complex fine system for pollution and other environmental damages based on type, scale, area and duration of damage, as well as non-compliance. Possible environmental taxes to incentivise an energy transition and raise revenues are listed in the earlier general recommendations section.

³² Maldives Customs Service 2012, www.customs.gov.mv.

³³ http://www.unicef.org/about/execboard/files/Maldives_final_approved_CPD_11_Feb_2011.pdf, accessed 16.06.2014.

Fossil fuel subsidy reform – an essential step on the road to fiscal sustainability

Electricity subsidies increased fivefold between 2010 and 2012, when they accounted for the equivalent of 1.6% of GDP. Energy dependency is an obstacle to development in the Maldives. In 2012, fossil fuel imports cost the equivalent of 31% of GDP. Current legislation – the fuel surcharge and fuel surcharge subsidy – ensures that neither producers nor consumers bear the cost of changes in global energy prices. The real value of household energy bills has been falling over time, not supporting energy conservation.

However, pressure to reform electricity subsidies, reduce wasteful spending and diversify the energy sector is increasing while high import costs and a low tax-to-GDP ratio offer policy-makers plenty of room for subsidy reduction. Yet raising the price of fuels can easily become highly politicised – particularly in cases where consumers have been protected from them in the past – so care should be taken to communicate policies clearly and raise awareness of upcoming changes prior to enactment. Policy mechanisms to protect the poorest from the impact of price increases are essential, as those households spend 8.6% of their income on electricity.

Accelerated energy transition and diversification of the energy sector, funded by EFR

The following measures could be considered:

- A feasibility study on RE potential in the Maldives, looking in particular at innovative ways of interconnecting the various islands, or establishing a national grid to allow for least-cost back-up solutions.
- Energy diversification should include solar expansion and efficient LED lighting for streets, harbours, public buildings and households, accompanied by an access programme to facilitate behavioural change.
- A model green island could be selected as a pilot project, with increasingly ambitious targets and the final aim of 100% RE by 2020. From lessons learned with this pilot, the model could be replicated elsewhere in the archipelago.
- Introduce electric vehicles and charging stations in parallel to RE electrical generation. Electric mobility is an ideal technology for smaller island states, as journeys are of comparatively short and predictable distances.

Mauritius

Basic data

Mauritius consists of two larger islands, Mauritius and Rodrigues, and a number of smaller one, with a total land area of 1,965 km² and a population of 1,259,000 (mid-2013). A little less than 10% of the population lived under the relative poverty line in 2012. Amongst the most important industries are sugar, textiles, tourism and clothing.

Total annual electricity consumption was 2,358 GWh in 2010. 99.4% of the population has access to electricity and GHG emissions are 3.2 tCO₂-eq per capita. Fossil fuel dependence is high, but so is RE potential. Mauritius has a relatively ambitious sustainability and energy transition policy strategy and action plan. Renewable energy is expected to account for 20% of all electricity production by 2020 and 35% by 2025. A small-scale distributed generation project has already installed nearly 2 MW on Mauritius, and a further 73 kW on Rodrigues, between 2011 and 2014.

In many ways, Mauritius is a model of innovative approaches to sustainable development and RE deployment, and a pioneer for environmental policy. This experience can inspire even more ambitious FFRE policies – perhaps making Mauritius the first 100% RE island with a population of more than 1 million.

Table 2: Mauritius Policy Strategy and Action Plan for Sustainable Development

Objective	Target	Year
Increase share of sustainable RE sources in electricity production	35%	2025
Reduce energy consumption in non-residential buildings	10%	2020
Reduce energy consumption in public sector buildings	10%	2020
Reduce energy consumption in the transport sector	35%	2025

Mauritius' total tax revenues amount to 19% of GDP. As in most other island states, fiscal space could therefore be increased through new (environmental) taxes and a fossil fuel subsidy reform. It should be noted however that environmental tax revenues amounted to over 11% of total tax revenues in 2008/2009 (Parry, 2011) – a very high proportion for an industrialising country.

Recommendations

Policy recommendations for Mauritius include:

Introduce taxes on fossil fuels-based electricity

The RE transition should be supported by an input tax on fuels used for electricity generation – ideally based on carbon content and other pollutants. This would incentivise fuel switching towards RE, partly internalise the external costs of combustion, and reduce the country's dependence on fossil fuel imports. This is particularly true of coal, used for electrical generation when sugar cane bagasse is in low supply, about six months per year.

Reform of differentiated electricity prices

Electricity tariffs in Mauritius are differentiated by end-user, with residential consumers cross-subsidising industrial ones. This is a market distortion which incentivises inefficient electricity use and constitutes an environmentally harmful subsidy. These tariffs should be reformed, albeit gradually to give industry the time to implement more energy efficient practices and technologies. Some have already anticipated changes and are equipping themselves accordingly.

Focus on energy efficiency

The potential for energy efficiency improvement in Mauritius has been estimated at between 20% and 40%, depending on sectors. Within 3 years, one third of that potential could apparently be tapped with a pay-back of less than 2 years. Energy efficiency investments of USD 500 million over the next 20 years would generate net savings of \$670 million (at current value).³⁴ Furthermore, while electricity demand continues to rise quickly, particularly at peak times, efficiency-enhancing policies can help slow this trend and RE deployment meet needs with little additional pollutants.

MID levy as carbon tax base

The MID levy is an excellent example of EFR and has created a strong basis for the realisation of FFRE-policies. Yet, turning the levy into an explicit carbon tax would have a number of advantages, not least setting an excellent example for other countries (Parry, 2011) and improve collaborative learning, particularly among island states. Increasing revenues raised by the MID levy could also generate additional funds to support the FFRE transition.

Explore fuel switching from coal to biomass

The recent trend in setting-up new coal-fired plants, not least by the sugarcane industry itself, should be

³⁴ <http://www.reegle.info/policy-and-regulatory-overviews/MU> (accessed 16/05/2014).

reconsidered to focus on biomass, notably bagasse. While insufficient biomass is currently available year-round for electricity generation, other biomass options are possible, and promising synergies between biofuels and waste collection could also be further explored.

Landfill tax

The introduction of a landfill tax would incentivise waste prevention, reduction, reuse and material and energetic recycling. Such a tax, for example, has been successful in the United Kingdom since 1996. A landfill tax could have multiple benefits:

- Improve and strengthen the waste collection system as increased recovery and sorting of bio-waste would take place
- Reduce incentives to open another landfill site
- Increase amount of methane captured through improved collection and sorting of waste
- Separately collected bio-waste would allow for more efficient use
- Domestic bio-energy sources could be made available to local industry, thus reducing fossil fuel imports, notably coal

To inform policy-making, an international comparison with other countries of a similar production structure should be carried out to identify best practices and enhance knowledge of efficiency potentials.

Consider mineral fertiliser taxation

Mauritius produces a great deal of sugarcane, which is a rich biomass resource. Yet, the main product, sugar, is facing changing framework conditions, particularly a lowering trend in global prices since 2011, which already brought restructuring in the Mauritius sugarcane industry. In turn, sugarcane processing also provides valuable natural fertilisers, already used sugarcane and other crops. This could be extended and further substitute mineral with natural fertilisers. In order to incentivise this process, from which the local sugarcane industry would benefit, a mineral fertiliser tax should be introduced. Increased domestic demand for sugarcane-based fertiliser would favour Mauritian producers and reduce imports. Tax revenues could fund the training of farmers for shifting fertilisers.

Seychelles

Basic data

The Seychelles have a population of 88,000 (2010 census), 90% of which live on the island of Mahé.

The total land area is 459 km². Total electricity consumed in 2010 amounted to 263 GWh,³⁵ with a household electrification rate of 97%.³⁶ About 98% of electricity is generated from imported fossil fuels (25% of total imports), the remaining 2% being from windmills. Already in 2010, per capita GHG emissions were high, at 7.8 tCO₂-eq. Tourism is one of the most important industries in the Seychelles, and has a significant impact on the country's energy consumption – to the extent that international aviation accounts for 28% of primary energy demand.

The main goal of the country's energy policy is to develop a sustainable energy sector, reduce dependence on oil and increase energy efficiency and RE in the overall energy mix. This reflects the government's concerns over the economic and environmental problems associated with energy dependence and fossil fuels, and its will to reform the current energy regime. Nevertheless, in view of current energy dependence and RE potential from solar, biomass, ocean and wind sources,³⁷ official targets for RE deployment of 5% of total energy use in 2020 and 15% by 2030 (100% "in the long term") are not particularly ambitious.

Recommendations

Explore possibilities to increase fiscal space

Seychelles' total tax revenues amounted to 29% of GDP in 2012, a rather high figure in comparison to other island states. Its potential to increase environmental taxes is therefore limited, and particular care must be taken to protect the vulnerable from the impact of eventual tax hikes.

Reform fossil fuel subsidies

Increasing taxation is not the only way to improve the fiscal space: phasing-out environmentally harmful subsidies will also free up revenues for other uses, including RE investments. Although precise figures are unavailable, prices for petroleum products are regulated in the Seychelles, which should be phased-out and depoliticised. Renewable energy deployment would reduce fossil fuel dependence and facilitate this process. Policy-makers should therefore encourage inter-ministerial cooperation to implement FFRE transition measures based on consensus.

³⁵ <https://www.cia.gov/library/publications/the-world-factbook/geos/se.html> (accessed 15/05/2014).

³⁶ Seychelles National Bureau of Statistics: <http://www.nsb.gov.sc/archives/82>

³⁷ <http://www.irena.org/remaps/countryprofiles/africa/seychelles.pdf> (accessed 14/05/2014).

Develop a RE enabling environment

In the past, efforts to adopt RE technology in the Seychelles have had limited success, in part due to legal, regulatory and policy constraints and a lack of incentives for renewable energy investment.³⁸ Administrative mechanisms to guarantee RE prices and ensure that production can be fed into the national grid, such as feed-in tariffs (FITs) and power purchase agreements (PPAs), should be introduced to create a stable and attractive investment climate. In addition, the establishment of an independent energy regulator, and a legal framework for sustainable energy, would overcome a number of barriers to renewable energy uptake.

São Tomé and Príncipe

Basic data

São Tomé and Príncipe is an archipelago centred on two main islands with a total population of 179,000 spread over a land area of 1,001 km². Electricity consumption in 2010 was estimated at just 28 GWh, supplies being relatively unstable.³⁹ In 2010, GHG emissions per capita were merely 0.6 tCO₂-eq. The country's electricity access rate is also low, at about 60%. Around 85% of the population relies on fuel wood for cooking (UNEP RISØ, 2013). Energy dependence is also high, with fuel imports worth \$18 million in 2010, or 16% of total imports⁴⁰ (IRENA, 2012a). In turn, the RE potential is considerable, notably for solar energy and 14 small-scale hydro-power sites already identified, and one larger dam (UNEP RISØ, 2013; IRENA, 2012a).

Poor governance and lack of political commitment have in the past impeded the development and implementation of a coherent RE transition strategy and policies. There has been frequent political change, including for the Environment Minister, and no information on the development of a national RE strategy was available at the time of writing.

Recommendations

Development of sustainable energy sources

Given ongoing concerns over deforestation, the development of sustainable biomass or other sustainable cooking fuels (such as biogas) should be prioritised.

³⁸ <http://www.reegle.info/policy-and-regulatory-overviews/SC> (accessed 10/06/2014).

³⁹ <https://www.cia.gov/library/publications/the-world-factbook/geos/tp.html> (accessed 10/05/2014).

⁴⁰ A relatively low figure compare to other island states, as the country is also very dependent on food imports.

Improved RE investment climate

São Tomé and Príncipe still lacks the foundations of a renewable energy strategy, and faces a number of financial and institutional barriers to investment. These include a lack of information, a poor investment climate with few economic incentives in favour of RE, lack of legal and institutional frameworks for RE, a shortage of capital for RE investment, and a perception that such investments are high risk with relatively long-term ROI.

Bearing these in mind, the country's RE strategy should include:

- Analysis of how an effective investment framework, such as RE incentives through feed-in tariffs, could be established, leading to a stable and attractive investment climate.
- Development of a contingency plan for energy production
- Training and qualification of staff
- Funding the implementation of these framework conditions
- Financing of upfront investments in efficient (but often expensive) technology
- Providing risk and normal capital for overcoming risk aversion against new technologies
- Proper installations and transportation for field facilities and equipment
- Effective implementation of already approved environmental laws and other environmental policy instruments through evaluation and monitoring

Sri Lanka

Basic Data

Sri Lanka has a total land area of 62,705 km². Of the 20,483,000 million (2013) population, 8.9% lives below the poverty line (2010), and yet 94% has access to energy. The country's sovereign debt, at around 80% of GDP, is among the highest in emerging markets. Total electricity generation amounted to 11,896 GWh in 2012 (including self-generation) and is growing rapidly. Industry consumes 24% of the total, transport 28%, and residential and commercial use 48%. The GDP is USD 2,900 per capita, with an annual growth rate of 6 to 8%. Nonetheless, an energy mix with 35% hydroelectricity has thus far secured very low GHG emissions of 0.6 tCO₂-eq per capita. Biomass is the main source of energy in Sri Lanka, contributing to about 44% of the primary energy supply. RE potentials are high.

The single most important barrier to a FFRE transition in Sri Lanka is the government's current focus on shifting fuel towards coal, as shown in Table 3 below. The rationale underlying this significant shift was to reduce the fiscal burden of oil subsidies, which were historically very high, but removed in December 2011. Nevertheless, there could be avenues to leverage a RE energy transition: the Presidency (at least prior to January 2015) had shown commitment to sustainable development, while local governments have responded positively to renewable energy initiatives in the past.

Table 3: Predicted development of the energy mix in Sri Lanka electricity generation

	Coal	Oil	Existing major hydro	New major hydro	New RE
2015	34%	32%	28%		6%
2020	62%	6%	22%	2%	8%
2032	70%	1%	12%	2%	6%

Recommendations

A much cleaner energy strategy and one which would increase energy independence – rather than shifting dependence from one fossil fuel import to another – would be for Sri Lanka to focus on a combination of renewable energy deployment and energy efficiency. Some suggestions for how this might be done are given below.

Fiscal space

Sri Lanka's 2013 tax revenues were worth less than 12% of GDP. Clearly, there is considerable potential for increased (environmental) taxes and subsidy review and reform to free-up funds for policies that facilitate EE and RE deployment. There are neither excises nor customs duties on fossil fuels, apart from natural gas and heating fuels. On most, there is not even VAT or NBT (Nation Building Tax), or if so (as is the case with the Ports and Airports Development Levy), rates are very low and have almost no price impact. Thus, the fiscal system creates no incentives to change investment and consumption behaviours.

A list of possible environmental tax increases can be found in the *General Recommendations* section on p. 18. These could play a crucial role in facilitating policy reversal in the energy sector. It is recommended to tax coal and all fossil fuels in general, particularly those used for electricity generation. This is very important to facilitate a

transition from current high oil dependency to an efficient and renewable energy future, instead of one locked-in to coal. Otherwise, price signals are being sent to the market that will lead to misallocations of investment capital with severe long-term consequences.

Sri Lanka already has innovative tax elements, such as a progressive electricity tax that cross-subsidises small (usually poorer) consumers. Increasing higher rates of electricity tax would therefore have a minimal impact on the poor. In turn, the monthly fixed charge paid by Sri Lankan electricity consumers, though progressive, is a disincentive against conservation and efficiency: the more energy one saves, the higher the relative share of this fixed charge in overall electricity costs. Conservation could be better incentivised if operational costs were charged in proportion to total power consumed.

Time-based differentiation of tariffs is another innovative measure, which discourages electricity consumption at demand peaks, thus relieving the grid.⁴¹ Such time-dependent tariffs should be further used, and possibly extended through smart metering in the mid- and long-term. This could help demand follow fluctuating RE supply, and so reduce the amount of back-up capacity needed.⁴²

Return focus from coal to RE

In 1986, hydroelectric contributed 99.7% of Sri Lanka's power production. This share dramatically declined to 35% in 2013, due to demand growth being addressed from other sources, notably oil-based generators. This resulted in high electricity costs and a heavy drain on foreign exchange. Now, as shown in Table 4, coal is predicted to become the dominant fuel by 2032. This is a step backward and one that should be reversed as soon as possible. Furthermore, while Sri Lanka does not have fossil fuel resources, recent surveys suggest the presence of exploitable gas reserves. The capital spent on these yet uncertain resources may well lead to costly, path-dependent infrastructures.

There are many sound fiscal, economic, health-related and environmental (including climatic) arguments against a shift towards gas and especially coal, and in favour of a FFRE transition – as discussed

⁴¹ See Sri Lanka Customs "Budget Updates - Excise Duty": <http://www.customs.gov.lk/tariff/ExciseBudget2013.pdf>, <http://www.ceypetco.gov.lk/Marketing.htm> and <http://www.pucsl.gov.lk/english/information-centre/tariff-revision-2013> (accessed 05/05/2014).

⁴² Since innovative consumers will use lower tariffs at off-peak-times to reallocate their consumption, leading to decreasing costs and flatten demand curves over time.

in the first chapter of this report and the SWOT analysis of this section. Sri Lankan energy development efforts would be better vested in RE deployment, providing predictable returns through sustainable options and lower long-term energy costs.

Focus on Energy Efficiency

Energy demand is growing fast in Sri Lanka, alongside relatively high rates of GDP growth. A greater focus on energy efficiency measures can bend this trend and partly decouple energy consumption from growth. Enhanced efficiency is an essential element of a FFRE transition.

Feasibility study on renewable energy sources to meet Sri Lanka's energy needs

To prevent a path-dependent lock-in of coal-powered electricity production, a feasibility study for the whole country is needed to explore possibilities for power generation, and to investigate to what extent these can be covered by renewable energy sources. Strong evidence that RE is a viable alternative to coal will be necessary if current policies are to be reviewed.

Zanzibar

Basic data

Zanzibar is part of the United Republic of Tanzania. Made of two islands off the mainland Tanzanian coast, it has a total land area of 2,654 km², and a population of 1.3 million. Tanzania's GHG emissions are very low, at just 0.2 tCO₂-eq per capita.⁴³ Annual electricity consumption is also low, in part due to low energy access rates, but growing rapidly. Population growth and tourism are expected to drive stronger demand over the next few years. The RE potential is substantial, notably from wind, solar PV and SWH, as well as biomass and biofuels. Total tax revenues were worth about 16% of GDP in 2013, confirming a margin to enhance fiscal space.

Recommendations

Coherent EE and RE technology deployment

The lack of renewable energy planning has undermined progress thus far in Zanzibar, and developing a coherent FFRE strategy is a matter of urgency. Alongside target- and agenda-setting, the strategy should aim to mainstream RE within sector-based policies, such as land use and spatial planning policies, sustainable housing, sustainable livelihoods,

fisheries, agriculture, forestry, transport and tourism. To secure buy-in of industry stakeholders and acceptance on the part of households, a communication strategy should also be developed.

Switching to sustainable cooking fuels

Currently, differentiated electricity tariffs distort energy markets and push domestic consumers towards using biomass. This is environmentally damaging, as wood fuel and charcoal for cooking are major drivers of deforestation, and also severely impact human health. Firewood accounts for 74% of total domestic energy consumption in Zanzibar, while charcoal accounts for a further 11% (CARE, 2011). Thus, an absolute policy priority on the islands must be to promote switching to sustainable cooking fuels – technologies using solar stoves and SWH, biogas and sustainable charcoal should all be researched and developed as appropriate.⁴⁴ These policies should be linked to the Enhancing Community Forest Management Areas (COFMAs) programme and other projects.

Institutional frameworks to foster RE investment

Zanzibar is lacking the financial and planning architecture, and the legislative framework, to enable RE transition. The establishment of an independent energy authority responsible for energy legislation, regulation of energy markets, and management of the power grid is advisable, supported by adequate institutional and human resource capacity development. A renewable energy fund could also be established to provide grants for RE or EE R&D and deployment, including low-cost loans and micro-finance for the installation of on- or off-grid RE equipment. The authority could be responsible for the development of an energy pricing formula variable according to RE source, most importantly a FIT, to guarantee priority access and transmission.

Incentivising solar and wind investments

Zanzibar does not generate its own electricity, and beside small-scale off-grid RE sources, it imports all its power from the mainland. Investments to lay undersea cables which can only transport a specified amount of electricity have been considerable, with more than USD 150 million spent on infrastructure (equivalent to 16% of current Zanzibar GDP). Despite

⁴³ <https://www.cia.gov/library/publications/the-world-factbook/geos/tz.html> (accessed 29/05/2014).

⁴⁴ All fuel switching options must be considered, as under the current baseline scenario, an estimated 200,000 tons of LPG costing over USD 200 million would be required annually to replace all firewood and charcoal.

such investments, power demand is straining existing installed capacity.

While oil and gas reserves are being explored off the Zanzibar coast, the lure of fossil fuel profits should not distract from a sound renewable energy strategy and transition, with solutions already offering competitive power generation with none of the fossil fuel social, economic and environmental costs discussed earlier in this report.

Reforming fossil fuel subsidies

In Zanzibar, energy tariffs vary according to users, and prices for industry are relatively low – even for the service sector, including tourism. This creates detrimental consumption incentives for domestic use of biomass sources, while discouraging industrial energy efficiency. Reform is a matter of relative urgency, and should be aligned with sustainable forestry policies.

Electrifying the transport sector

Growing tourism is pushing up demand and cost of fuels (notably for generators in tourist resorts) as well as vehicle imports, which are expected to increase by 150% between 2014 and 2030.

Islands are ideal locations for electric mobility, where journeys tend to be sufficiently short for electric vehicles (EV) to be a convenient alternative. EV transport should be piloted in Zanzibar, starting with the deployment of charging stations along existing service infrastructures, and supplied from RE electricity.

In the medium term, Zanzibar could consider regulating and limiting the import of fossil fuelled-vehicles. It could also introduce high excise duties on petrol and diesel vehicles, while incentivising fleet replacement with electric vehicles.

Conclusion

There is increasing focus and innovation in island states on renewable energy, and for energy transitions along the post-2015 development agenda (AIMS SIDS, 2013). Many island states have drafted or adopted national and regional energy policies and strategies. They seek to improve energy efficiency and make use of their renewable solar, wind, ocean, geothermal, hydropower, and biomass potential, notably to minimise future dependence on imported fossil fuels (UNEP, UNDESA and FAO, 2012). To ensure the success of fossil fuel to renewable energy (FFRE) transitions however, key measures need to be followed-up and implemented with determination, and as soon as possible.

Given that most island states have market economies, prices are crucial for investment and consumption decisions. Influencing prices via taxes and subsidies provide strong leverages for governments to change behaviour and reduce fossil fuel consumption. Moral appeals, information campaigns and awareness-raising may be important, too, but often not as effective as price signals, a key factor in household and industrial decision-making.

Bearing these factors in mind, the challenge for island states today has shifted to how these countries can benefit from the falling price of renewable energy, as soon and as much as possible.

As always, context is vital and generalisations are only helpful to a limited extent. While the challenges faced by island states are often similar, best responses vary, and policy approaches need to be carefully tailored to the specific socio-economic and environmental conditions within each country. All island states need to identify sectors, actions and priorities in order to achieve their FFRE transition effectively and efficiently. Nonetheless, it is possible to make some general recommendations for island states on how to best undertake such transition.

Policy mainstreaming and FFRE transition roadmaps

One clear and useful generalisation is that governments should mainstream FFRE transitions within all national policy planning processes, becoming part and parcel of national decision-making. In supporting this integration, planning authorities need to conduct RE resource mapping and feasibility studies, exploration of policy options, and accurate modelling and cost-benefit analysis of FFRE transition impacts.

Beyond this macroeconomic review, a political economy analysis must also be undertaken, mapping the stakeholders of the energy landscape with their interests, strategies, resources, relations and discourses. Together, such comprehensive groundwork will enable a FFRE transition strategy based on realistic and sustainable assumptions, aimed at relevant objectives and guided by a clear time-bound roadmap of SMART indicators. It will also ensure that the politics of transition is well understood and planned for, nurturing a collaborative and participatory policy process that increases the chance of success and minimises disruption.

Further to such groundwork, the role of policy-makers in demonstrating the value of an RE transition is crucial. “Low-hanging fruits” solutions should be identified, such as simple energy efficiency measures and high-return RE pilot projects that will reduce fossil fuel dependence, improve fiscal and trade balances, and quickly demonstrate the viability of the RE transition. Acceptance of RE policies and willingness to invest will increase, making subsequent steps easier.

Addressing FFRE Concerns

The need for reliable base-load electrical supply has raised doubts about the feasibility of high levels of RE in the energy mix, particularly in small and unconnected island markets. As argued in this report however, intermittence can be overcome through enhanced energy efficiency that reduces base-load demand, along with new grid management and storage technologies that buffer both various power sources and peak demand.

Another area of concern has been the recent falling prices of fossil fuels, perceived as a threat to renewable energy value and viability. Falling prices can favour FFRE transitions in several ways, however. For one, low fuel prices create a political opportunity to reform subsidies, even eliminating them altogether, without public resistance – as recently seen in several countries, e.g. Indonesia. Low prices also create opportunities for policy-makers to internalise fossil fuel externalities by introducing new taxes and keep prices stable – similarly, with little public resistance. Such measures increase national fiscal space, while levelling playing fields in energy markets, and incentivising investment in efficiency and RE. Finally, currently low fossil fuel prices result from overproduction and sluggish demand. This is not expected to last beyond 2015, and possibly signals

an era of widely unstable and unpredictable prices. This, in itself, is good news for investments in FFRE transitions, which offer structurally declining renewable energy prices and predictable stability.

Overcoming other barriers – such as access to grants and climate finance from donors, and technology transfer – require innovative approaches and greater regional coordination. There is great potential for island states to learn from each other's experiences, such as from the public-private funding model applied in Cabo Verde, and to tailor these approaches to their own particular country context.

Fiscal space and EFR

To create an economic climate which fosters FFRE transitions, island states also need to adjust energy pricing in a way appropriate to their national context by means of environmental fiscal reform (EFR). Increased domestic revenue mobilisation (through environmental taxation and subsidy reform) can thus promote the FFRE agenda by increasing fiscal space and delivering much-needed revenues to meet critical spending needs.

Island states should also consider regionally coordinating and harmonising fiscal policies that leverage the tourism and aviation sectors. This could include a standardised levy per overnight stay, conservation fees, or an infrastructure service charge paid on entry or exit. If taken unilaterally, such measures may encounter political resistance among industry stakeholders. Coordination among major destinations, for example of the Indian Ocean basin, will at least partly address concerns, and avoid a race to the bottom in the tax treatment of the two sectors.

Along those reforms, regular reviews of the fiscal system should be institutionalised to monitor and report on government revenues and expenditures. Impact assessments can then inform adjustments, particularly in protecting the vulnerable. Consistent communication strategies on the rationale and benefits of reforms will also help gain further acceptance.

Mobilising investment

Creating a stable investment climate is essential to facilitate a FFRE transition. Policy measures should take the multi-faceted nature of energy markets into consideration and provide for:

- Making mobilisation of private investment a political priority
- Creating a level-playing field in energy markets through FFS reform and green taxation, including varied customs and duties on FF and RE technologies and components
- Introducing technical and integrated resource planning
- Support capacity development with institution building (e.g. nurturing relevant trade associations) and training of human resources (e.g. specialised RE skills)
- Ensuring a good return on investment by means of FITs and appropriate PPAs
- Facilitating access to RE solutions by fostering technology transfer and removing import duties on RE technologies and components
- Consider aggregating FFRE projects to develop new models of ownership between islands, taking advantage of economies of scale in the RE sector and reduce the cost of RE transition in each individual island state
- Reducing investment risk by making contracts clear and transparent, providing infrastructure and loan guarantees to instil investor confidence

Working together

Finally, island states should maximise the benefits of new coordinated and regional approaches to partnership and cooperation, including improved mechanisms for research, technology transfer and new approaches to financing FFRE transitions. Sharing innovative developments and research findings, as well as collaborating on research and pilot projects, could help all island states to advance their FFRE agendas and to develop island-appropriate technologies for RE generation. Strong networks among island states RE practitioners and policy-makers can enhance and accelerate learning and knowledge exchange, notably of best (and worst) practices, valuable experiences, and the mapping of capital and human resources. Some initiatives are underway to facilitate such networking, and will greatly contribute to nurture the community of FFRE practitioners among island states in the coming years.

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Abbreviations

AfDB	African Development Bank	LPG	Liquefied Petroleum Gas
AIMS	Atlantic, Indian Ocean, Mediterranean and South China Seas	MDG	Millennium Development Goals
AOSIS	Alliance Of Small Island States	MSI	Mauritius Strategy of Implementation (2004)
BPOA	Barbados Programme of Action (1994)	mtoe	million tons of oil equivalent
CER	Certified Emission Reduction	NBT	Nation Building Tax
CFL	Compact fluorescent lamp	PAL	Ports and Airports Development Levy
CO ₂	Carbon Dioxide	ODA	Official Development Assistance
CO ₂ -eq	Carbon Dioxide Equivalent	PES	Payments for Environmental Services
CSP	Concentrated Solar Power	PPA	Power Purchase Agreements
EE	Energy Efficiency	R&D	Research and Development
EFR	Environmental Fiscal Reform	RE	Renewable Energy
EHS	Environmentally Harmful Subsidies	RETD	Renewable Energy Technology Deployment
EIB	European Investment Bank	ROI	Return on Investment
ETR	Environmental Tax Reform	SCC	Social Cost of Carbon
ETS	Emissions Trading System	SE	Sustainable Energy
EUR	Euro	SIDS	Small Island Developing States
EV	Electric Vehicles	SMART	Specific, Measurable, Achievable, Relevant and Time-bound
FAO	Food and Agriculture Organization of the United Nations	SWH	Solar Water Heaters
FF	Fossil Fuel	SWOT	Strength, Weaknesses, Opportunities, Threats
FFS	Fossil Fuel Subsidies	TANESCO	Tanzania Electricity Supply Corporation
FFRE	Fossil Fuel and Renewable Energy	UN	United Nations
FIT	Feed-in Tariff	UNEP	United Nations Environment Programme
GBE	Green Budget Europe	UNDESA	United Nations Department of Economic and Social Affairs
GHG	Greenhouse Gases	UNDP	United Nations Development Programme
GIZ	Gesellschaft für Internationale Zusammenarbeit (German Implementing Agency)	UNOSD	United Nations Office for Sustainable Development
GWh	Gigawatt hours	USD	United States Dollar
FDI	Foreign Direct Investment	VAT	Value Added Tax
HDI	Human Development Index	WSS	Water Supply and Sanitation
IPP	Independent Power Producer		
IRENA	International Renewable Energy Agency		
LED	Light-emitting Diode		
LDCs	Least Developed Countries		