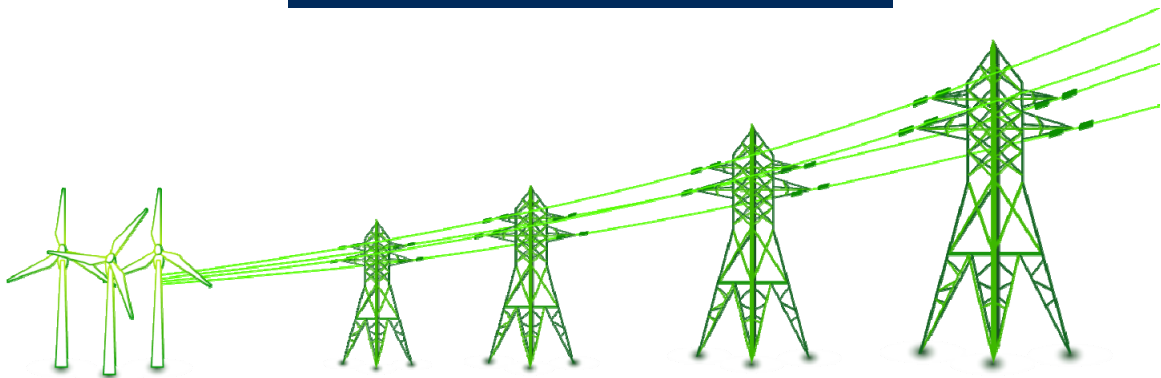


Scaling Up Renewables

Developing Renewable
Energy Capacity – Addressing
Regulatory and
Infrastructure Challenges
in Emerging Markets
April 2011



This document was prepared by the World Economic Forum Scaling Up Renewables Initiative in collaboration with PwC, Project Adviser to the World Economic Forum on the Scaling Up Renewables Initiative.

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Foreword

The World Economic Forum in collaboration with PwC is pleased to release *Developing Renewable Energy Capacity – Addressing Regulatory and Infrastructure Challenges in Emerging Markets*. The renewable energy industry still faces obstacles to continued growth – particularly in new and emerging markets – despite a significant increase in global investment in the sector in recent years, mobilization of a stream of clean stimulus funding, and initialization of a number of multilateral initiatives to realize the potential of renewables.

Scaling up renewables is not centred on financial incentives alone. Non-financial challenges such as the regulatory framework, time required to complete administrative processes and grid access are equally important in enabling conditions to reach scale. This report seeks to understand the key regulatory and grid infrastructures challenges that currently affect the development of renewable energy and highlights actions required by governments, utilities and developers for successful large-scale deployment. The challenges identified include, but are not limited to, the need for strategic renewable energy long-term planning, coordination between relevant authorities, experience among decision-makers, electricity market structure and grid capacity and coverage. These are all integral to reducing risks and increasing investors' confidence to commit capital.

To provide key learning and understand regulatory and infrastructure issues in emerging markets, five reference group countries (Indonesia, Jordan, Mexico, Morocco and South Africa) were chosen for investigation. They possess abundant renewable resources that could support a considerable share of national electricity demand. Although the reference group countries have been studied in detail for our analysis, by design this report is not an in-depth country assessment. These countries were selected because they have begun to lay essential foundations to shift to a renewables future despite the great challenges ahead. The report is a collection of learning and insights gained from their experience in establishing renewables markets, seen through the eyes of public and private sector contributors, which we believe will be valuable to other emerging countries that are going through a similar transition.

In this report, we propose six recommendations, which we trust will provide decision-makers with valuable ingredients as they determine regulatory and infrastructure frameworks to enable and accelerate the renewable energy sector to reach scale. In addition, we hope that these recommendations will also encourage partnership among stakeholders to establish a clean energy future.

On behalf of the World Economic Forum, we are grateful to the Advisory Board members who have provided valuable input and guidance on this report. We also would like to thank the many individuals who participated in various interviews and discussions. Particular thanks are due to Henrik Breum, Senior Specialist, GR Intelligence/Group Government Relations, Vestas Wind Systems; Manfred Hafner, Research Fellow, FEEM; Harish Hande, Managing Director, SELCO; Herman Darnel Ibrahim, Member of the National Energy Council of Indonesia; Sunil Paramesh Krishna, Economist, Suzlon Energy; Dennis Kumetat, London School of Economics (LSE) Kuwait Programme PhD Scholar; Professor Toufic Mezher, Masdar Institute of Science and Technology; Camila Ramos, Marketing Manager, Energias Renováveis do Brasil; Ennis Rimawi, Managing Partner, Catalyst Private Equity; Ashish Sethia, Head of Research, India, Bloomberg New Energy Finance; and Mustapha Taoumi, Project Officer MENA Region, IRENA, for their time, energy and insights.

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Executive Summary

Of the many problems facing the world in the 21st century, climate change and the dwindling supply of low-cost energy are two of the largest. Renewable energy has the potential to solve both. Given appropriate scale, renewable energy could also become genuinely competitive and a self-sustaining investment proposition. Despite impressive growth over the past two decades, the renewable energy industry continues to face obstacles and will require more than just public and private finance to operate at scale. Studies suggest that further market development is highly sensitive to administrative barriers, grid access and the risk of policy change.¹

Institutional and regulatory frameworks must facilitate private renewable energy activity. Yet they often hinder it – particularly in emerging markets. The grid infrastructure needs appropriate capacity and resilience to cope with the intermittent nature of renewable energy sources. This paper aims to move the debate forward in these areas by identifying the key regulatory and infrastructure challenges to scaling up renewables. It focuses on the experiences of five countries, (Indonesia, Jordan, Mexico, Morocco and South Africa) and suggests approaches to overcoming the challenges.

The World Economic Forum and its adviser, PwC, make a number of recommendations, partly based on desk-based research, but mostly following broad engagement with business, government, financial and academic stakeholders in each of the five countries.

A number of factors often hamper deployment of renewables in emerging markets:

- The absence of long-term planning, with specific implementation plans for renewable energy capacity targets, creates uncertainty and undermines government credibility.
- Government and regulatory bodies do not always communicate effectively with each other, causing confusion among developers and delays in project approval.
- Many government bodies and regulators face shortages of experienced staff familiar with the renewable energy industry. This has led to a high level of risk aversion and slow processing of permit applications. It has also been exacerbated by a lack of common or consistent contracting arrangements for renewable energy developers.
- The structure of electricity markets, with one dominant player preventing private developers from conducting business on a level playing field.
- Limited grid infrastructure, in the areas where renewable resources are most abundant, presents a current and future barrier to increased generation.
- A common feature is that all these factors impact the early phases of the project life cycle – i.e. before construction even starts.

¹ Lüthi (2011) Effective Renewable Energy Policy – Empirical Insights from Choice Experiments With Project Developer – University of St. Gallen, Graduate School of Business Administration Economics, Law and Social Sciences

The findings of this paper show that, despite encouraging steps in the right direction by most of the five countries, more work remains to be done to support the continued expansion of renewable capacities. In particular, opportunities exist for countries to work independently and together to:

1. Build comprehensive energy strategies and policies, with generation targets for particular technologies; longer-term success could then be ensured by combining these with implementation review and enforcement plans
2. Comprehensively assess and periodically review the renewable resource potential; this can also be linked to reviews of the country-level strategic plan
3. Consider appropriate options and undertake regulatory reform; for governments, this should include steps to improve decision-making times, interagency coordination and transparency of the entire process; it could also include development of “one-stop shops” or regulatory focal points for private developers who, in turn, could align with regulators through the formation of renewable energy associations
4. Create more certainty and clarity through the appointment of an independent regulator to oversee the electricity market
5. Commission work to actively identify weaknesses in current grid infrastructure and consider the attributes of renewable energy in future infrastructure developments
6. Review existing and undertake new focused capacity-building programmes within government and regulatory organizations; this would support all of the above points and could be linked to programmes to raise public awareness

1 Introduction

Infrastructure and regulatory challenges are found within the early stages of the renewable energy life cycle. Analysing these with the help of a life cycle model allows appropriate stakeholder engagement and timely completion of supporting activities to create a growing and self-sustaining market.

Installed renewable power capacity has grown rapidly over the past decade around the world. Driven by economic development and associated increasing demand for energy, 2009 saw over US\$ 150 billion invested in renewables.² This increased to over US\$ 240 billion in 2010³ with the US and Europe adding more renewable than conventional power capacity. What is also encouraging is that this growth is not limited to developed countries.

As of 2009, China had the world's largest renewable capacity installation, contributing 37GW to the global total of nearly 80GW added renewable capacity that year. Turkey, Brazil, India and Argentina were also in the top five global producers of wind energy, solar hot water/heat capacity additions or biodiesel⁴ production. This has helped countries in their attempts to address both climate change and domestic energy security and supply issues, as well as create new jobs in a period of high unemployment.

However, as these growth rates have been from a small base, sustaining them will be no easy task. To transform renewable energy from a niche player in a country into one that can dominate the mainstream market will require that governments and industry work closely together to lay the right foundations. For both developed and emerging countries, this means that a set of enabling conditions needs to be in place.

Finance is one of these enablers. Investment needs to remain high and there must be constant innovation to support it. Such innovation will have to come from national and regional governments, the financial sector and multilateral development banks, often working hand in hand. To attract finance, three preconditions are necessary:

1. Investors must receive a return on renewable energy infrastructure sufficient to make these investments attractive. Fundamentally, the project economics must work.
2. Businesses and national governments need to work together to reduce investment risks and the cost of residual risk.
3. Governments need to provide long-term signals to stimulate long-term investment in supply chains. Feed-in tariffs have so far proved to be the single most important stimulus for new investment in many countries. However, finance is necessary but not sufficient on its own.

Other enabling conditions are associated with perceived sources of risk in new technologies or markets. These can include a variety of non-financial challenges such as regulatory red tape, unpredictable bureaucracies, and weak physical and social infrastructure. These risks are tangible: Standard & Poor's for example, include in their credit and risk analysis of renewable energy projects – among other factors – contractual foundations, construction arrangements, resource availability and competitive-market exposure.

The Scaling Up Renewables (SUR) initiative was conceived to examine a part of the non-financial landscape in more detail. It aims to understand the impact of regulatory and infrastructure (grid) challenges on the possible scaling up of renewables.

² REN21 Renewables 2010 Global Status Report

³ Bloomberg New Energy Finance 2011

⁴ REN21 Renewables Status Update

Regulatory challenges are diverse. Some affect the energy industry generally, others more specifically the renewable energy industry, and some just emerging economies. In all cases, regulators need to avoid creating an environment of heightened investor risk, which can lead to reluctance to commit capital. Key examples of regulatory challenges include:

- Absence of long-term planning
- Large number of relevant authorities
- Need for better coordination between relevant authorities
- Electricity market structures
- Insufficient consideration of renewable energy in spatial planning
- Complex permitting procedures and legal appeal process
- Lack of stakeholder involvement in decision-making
- Lack of experience among decision-makers
- Complex grid connection procedures

Infrastructure challenges are equally diverse and also present a major concern for energy project development. They are particularly acute for renewable energy deployment, often increasing the risk associated with renewable investments and, in extreme cases, preventing a prospective project from being taken forward. Key examples of infrastructure challenges include:

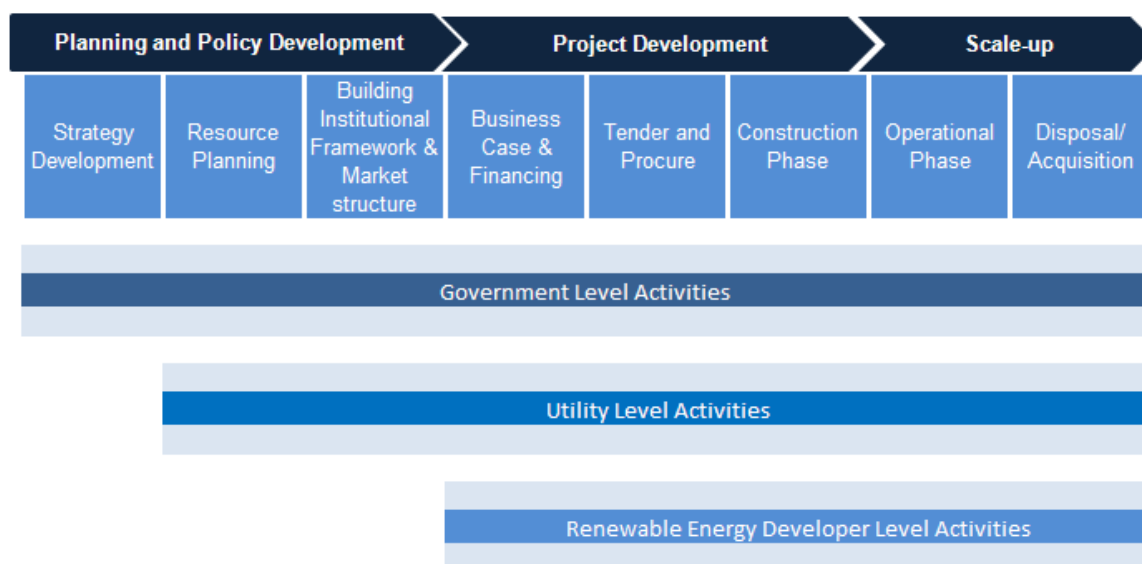
- System constraints
- Lack of grid access
- High grid connection costs
- Limited grid capacity and coverage
- Lack of technical standards and certification
- Lack of operation and maintenance facilities

The existence of these challenges has been noted before.⁵ This project aims to provide a new way of considering the impact of these non-financial challenges by mapping the point at which they are most likely to impact project development and their interaction. This provides new insight and knowledge that will not only allow actions to be prioritized, but will also help identify other dependencies and appropriate stakeholders to be engaged. Ultimately, this may help to ensure that the challenges can be overcome on a timely basis, supporting rather than holding back renewable energy project development.

The Renewable Energy Life Cycle Model shown below is used by as the basis for analysis in this paper. It proposes that, at a high level, the development of renewable energy capacity in countries can be broken down into three key stages, as shown in Figure 1.

⁵ Olz and Beerepoot (2010)

Figure 1: Renewable Energy Life Cycle Model Overview



These three stages are:

1. **Planning and Policy Development:** Governments seek to create the right enabling conditions to encourage the development of renewable energy projects.
2. **Project/Programme Development:** With a more supportive business environment in place as a result of a wider government programme, the private sector begins to explore the development of projects, aided by government and national utility activities.
3. **Scaling-up:** Appropriate enabling conditions are in place at a country level. Government level programmes are established and projects have been successfully developed and are at a point where they can be commissioned and connected to the electricity grid to supply electricity.

The model also proposes three broad categories of stakeholder that are key along this life cycle. In practice, there will be a diverse set of other stakeholders and organizations that are involved. However, these are normally reliant in different ways on these three primary stakeholders.

1. Country governments (including the relevant ministries, agencies, etc. responsible for aspects of renewable energy)
2. National utility (responsible for the grid infrastructure)
3. Renewable energy project developers (usually private sector)

To provide the necessary focus for this initiative and allow for in-depth analysis, five reference countries were chosen by the initiative’s steering committee and project team for detailed investigation: Indonesia, Jordan, Mexico, Morocco and South Africa. One reason for their selection was that these countries (“the reference group”) were seen as potential early adopters⁶ of renewable energy technologies, with the ability to play an important role in their wider regional uptake.

⁶ See Section 5.2 for details of the energy situation in these countries. The reference set of countries were chosen for their early progress with renewable energy only, and not for any social or economic reason.

These countries all contain abundant wind, solar, geothermal or biomass⁷ resources that could support a significant portion of national electricity requirements. Given their dominance, these national resources determined the main areas of technology focus for this work. Infrastructure was largely defined in terms of national electricity grids.

Working with its project adviser, PwC, and an advisory board and task force that included experts drawn from the Forum's industry and Strategic Partners, the Forum's SUR project aimed to:

- Assess from a business perspective the key regulatory and energy infrastructure challenges that currently affect the development of renewable energy in the five key countries
- Identify gaps in the existing infrastructure and assess the opportunities for new infrastructure to help meet national targets for renewable development
- Develop a set of business recommendations on the regulatory and infrastructure changes required to support further growth in renewables.

The work was completed in three stages. Stage 1 involved the development of a working paper in 2010 based on desktop research and initial discussions with stakeholders. This began to identify the regulatory and infrastructure challenges in the five selected countries and consider how these occur over the life cycle of renewable energy projects.

Stage 2 involved broad engagements during 2010 and 2011 with a range of business, government, financial and academic stakeholders to understand current, issues with regulatory and infrastructure challenges, and begin the analysis and co-development of possible solutions.

Stage 3 focused on the development of a white paper (this paper) consolidating the findings of Phases 1 and 2 to deliver business recommendations on how best to meet challenges for key stakeholders active in renewables development.

The remainder of this paper is structured in the following way:

- Chapter 2 presents key challenges from stakeholder consultation, highlighting particular country experiences and solutions, and places priority challenges within the renewable energy life cycle model.
- Chapter 3 presents suggested recommendations to the identified issues, highlighting the necessary actions by stakeholder groups to move these forward.
- Chapter 4 presents the conclusions from this work, including proposed next steps and actions.

⁷ This does not include biofuels.

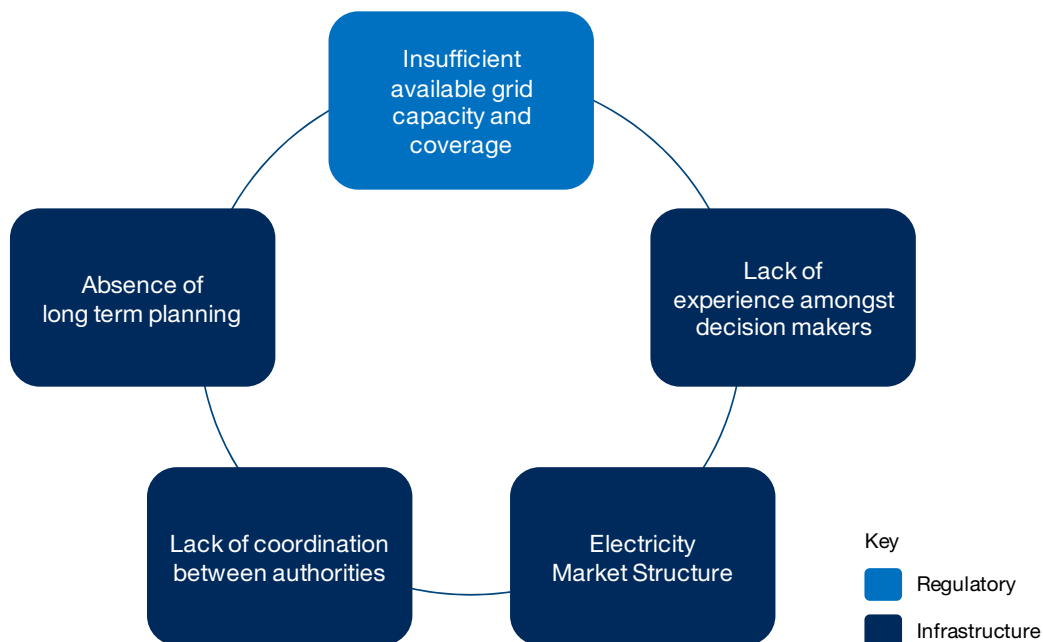
2 Key challenges

Infrastructure and regulatory challenges are concentrated in the planning and policy stage and, unless effectively addressed, can prevent markets from developing further.

This section categorizes the key infrastructure and regulatory challenges identified in each of the five reference countries as a result of the desktop research and the structured interviews with key stakeholders. A renewable energy deployment model has been used to illustrate at what point in time each of these are likely to impact renewable energy project development (see Figures 1 and 3).

The results of the desktop research and stakeholder consultation showed that five challenges dominated discussion for all five reference countries. These were: absence of long-term planning; lack of coordination between relevant authorities; lack of experience among decision-makers; electricity market structure; and limited grid capacity and coverage.

Figure 2: The Most Significant Non-financial Challenges to Scaling Up Renewables Identified by Stakeholder Consultation



These challenges are each examined in more detail, followed by a brief discussion of other secondary challenges.

Figure 3: Regulatory and Infrastructure Challenges to Scaling Up Renewables, within the Renewable Energy Life Cycle Model

		Planning and Policy Development			Project Development		Scale-up		
		Strategy Development	Resource Planning	Building Institutional Framework & Market structure	Business Case & Financing	Tender and Procure	Construction Phase	Operational Phase	Disposal/ Acquisition
Government Regulatory/ Infrastructure		<p>Absence of long term planning</p> <p>-Renewable resource data</p> <p>-Electricity pricing data</p> <p>-Standardisation of PPA</p> <p>-Consistency</p>	<p>Renewable Energy insufficiently considered in spatial planning</p> <p>Lack of stakeholder involvement in decision making</p> <p>Limited grid capacity and coverage</p>	<p>Electricity market structure</p> <p>Large number of relevant authorities</p> <p>Insufficient coordination between relevant authorities</p> <p>Lack of experience amongst decision makers</p> <p>Complex permitting and legal appeal procedures</p>	<p>Complex permitting procedures and legal appeal process</p> <p>Achieving financial closure</p>				
	Utilities		<p>Limited grid capacity and coverage</p>	<p>Complex grid connection authorisation</p> <p>Lack of technical standards and certification</p>	<p>High grid connection costs</p>			<p>System constraints</p> <p>Lack of grid access</p>	<p>Lack of operation and maintenance facilities</p>

Notes to Figure 3:

1. The scope of this initiative is to look in detail at infrastructure and regulatory challenges to scaling up renewables. These do not typically occur at the developer level, although they are often part of the solution. This level has therefore been omitted from the life cycle model that will be used as the basis for the analysis in this section. In addition, when considering these challenges, it is clear that utilities also have a key role to play in the planning phase.
2. It can be seen that most of the infrastructure and regulatory challenges occur at the planning stage. One key reason for this is that the set of countries chosen are all early adopters of renewable energy technology (RET).
3. The issues that have been identified using this model are summarized below. They have been presented in this manner as, in many cases, they apply to the majority of the countries in the reference group. In some cases, they only apply to a few countries and where appropriate specific examples have then been included to highlight specific issues.

2.1 Long-term Planning

The first key challenge identified by the renewable energy deployment model relates to long-term planning. Ambitious targets for renewable electricity generation have been set across all the reference countries and these are important to provide the business community with certainty and a guaranteed market. However, there is a risk that the credibility of these targets will be undermined without meaningful mechanisms for delivery as part of an overall strategic framework. Although ministries might pave the way for individual or flagship projects, this does not necessarily lead to programmes of work or the development of a wider market.

Long-term planning also needs to be supported by a number of other aspects to be credible. The research highlighted the following areas:

1. **Renewable resource data:** Updated and consolidated public resource maps need to be accessible as part of a national strategy. The research showed that data were not always available to private investors trying to optimally site projects in particular for foreign developers with less local knowledge. This had a further impact on local market development, as discouraging these players reduced the potential for knowledge transfer, capacity-building expertise and overseas finance. In some cases data do exist, but may not be integrated into a publicly available framework. For example, Indonesia has carefully mapped its geothermal resources, but a next step is to integrate these into long-term plans that would encourage investments in the identified sites.⁸ For many countries, detailed data assessments remain to be completed.
2. **Transparency of electricity pricing data:** Renewables have the potential to provide a surge of power at peak time, and so may be profitable under differentiated pricing. Peak price information could be made available to support the development of business cases. The research identified that solar power in the Middle East, for example, could be further developed to satisfy daily air-conditioning induced peak demand if this information were made available.
3. **Standardization of power purchase agreements (PPA):** The desktop research and stakeholder consultations highlighted that inconsistent contracts for project development are not conducive to the creation of a true market for renewables. This situation can be compounded if regulators are new to their role and not yet familiar with many of the renewable market intricacies. It was suggested that standard contracts should be developed in conjunction with the private sector so the terms of business would be acceptable to both sides. In the interim, an alternative is to make greater use of resources such as World Bank template contracts for wind power.
4. **Consistency:** There is an ever-present risk of publicly made promises not being kept, with frequent changes to legislation or where the policy horizon matches the election cycle. Constant amendments to legislation create confusion for projects in transition and require regulatory steps to be repeated to obtain new permissions. This can add years of expenses for developers with extension of their project development time frame. In other cases, new legislation may be introduced that amends or overturns prior regulation. In all cases, this creates risk and concern for both investors and developers and needs to be kept to a minimum.

For governments looking to address these concerns, it is important to consider the following:

- Trust over future policy consistency cannot be earned overnight. In the short term, to make current policy announcements credible, appropriate legal arrangements may be needed. For example, the PPA

⁸ Indonesia is currently working on a clean energy plan under the auspices of the Directorate of New & Renewable Energy and Energy Conservation.

model in Morocco dictates that the National Office for Electricity (ONE) or the Agency for Solar Energy (MASEN) assume risk from changes to feed-in tariffs (FiT). This reassures the wider investor community by making it unlikely the government would change FiT levels.

- The involvement of the private sector from the start is also key. In South Africa, businesses have organized themselves into the National Energy Association and Alternative Energy Association, conducting workshops and working closely with the government and stakeholder consultation to support the design and development of the REFIT programme.

Good policy requires proper enforcement. The UN Industrial Development Organization recently noted that “Where suitable policies for promoting renewable energy do exist, their impact is weakened by a lack of enforcement mechanisms.” The research has shown that, in many cases, there is little or no enforcement of the relevant legislation in many countries. Private sector developers quickly look elsewhere for improved chances of success if there is no certainty of enforcement or if government targets are endlessly postponed.

2.2 Coordination between Relevant Authorities

While the large number of relevant authorities was identified as a challenge during the research, one commentator observed, “It is not so much the number of authorities that is the problem, as the lack of coordination between them.” In some cases, multiple government departments are responsible for the same decision.

The research indicates that more clearly defining the roles of relevant authorities would help remedy this challenge. Sequential sign-off and greater political backing would also ease the problem. Sequential sign-off on regulatory areas could allow hold-ups to be negotiated one at a time, rather than being passed around departments.⁹ Increased political support at the highest levels of government is also constructive. For example, in Morocco, monarchical backing appears to be catalysing the reform process.

Higher authorities may want to consider increased delegation and encouraging independence of lower tiers of government. If regulators could sign-off minor decisions without deferring to higher authorities, the regulatory process would be greatly expedited. Also, direct lines of communication between regulators and utilities should always be open. Certain countries that have made laudable legislative reforms may want to consider whether the actual actions of utilities are reinforcing or undermining these reforms.

2.3 Experience among Decision-makers

Across the reference group, regulators responsible for approving renewable development projects do not have staff sufficiently familiar with the industry to process applications efficiently. This inexperience poses a number of problems.

Highly devolved decision-making can lead to committees that are unfamiliar with the details of the bidding process, particularly financial and investment appraisal analysis. The research suggests that this leads to risk aversion, with regulators preferring more manageable projects and thus less-than-optimal project sizes.

⁹ Although it could theoretically increase the power of any one authority to delay developments, which may encourage corruption in some countries.

Unless staff have a strong technical background in renewable energy, having the regulator form a layer between state-owned utilities and private developers is also a problem.¹⁰

A number of companies highlighted the progress that several regulators have made to address these issues. South Africa's municipalities have become more capable following live project experience, and Morocco's National Office for Electricity (ONE) is now taking on responsibility for multiple wind projects. Overall, it was conceded that much learning takes place with experience of live projects and businesses earning the trust of regulators. A Moroccan operator emphasized the "local touch": extensive and sensitive consultation.

However, a number of suggestions were made to catalyse this process:

1. Skills already learned must be codified in knowledge systems, and capable staff retained.
2. A portfolio approach where the regulator takes on multiple small projects (less than 10MW) – rather than a few large ones – may be the best way to identify and rectify common obstacles quickly with limited financial resources.
3. Private developers should be allowed to interface and contract directly with the off-taker.
4. Increased private sector engagement is necessary to provide constructive feedback to regulators and build collaborative solutions. The potential impact of this cannot be understated. In South Africa for example, the private sector in some cases has provided free legal counsel to municipalities, which catalysed project approval and improved the long-term capability of the regulator. Developers also redesigned their projects as build-own-operate projects, avoiding the need for financial outlay from the municipality. In Indonesia, patient operators argued that advising government on key challenges has resulted in progress after more than a decade.
5. Where the tender process is highly devolved, central government should provide institutional support.
6. Industry displayed a willingness to pay for training and other measures to improve regulatory expertise; this was expected to be a profitable investment given anticipated increases in project approval rates.

2.4 Electricity Market Structure

In some countries, the structure of the electricity market does not provide the reliable and long-term price signals needed to encourage private investment in renewables. Many countries, particularly in less developed economies, have a vertically integrated national electricity company. Without separation of these incumbent players, it is often difficult for developers to obtain clear signals of demand for the power from their projects and of the price that the power is likely to receive. There is clear potential for more private sector participation in a transparent wholesale market.

The research suggested there is scope for provision of explicit incentives for state-owned utilities to engage with the private sector, even without more extensive market reform. With the continued dominance of a national electricity company the role of an independent regulatory will be especially important to monitor fair access to market for independent generators.

¹⁰ One developer stated that, in their personal experience, wherever there has been a layer between developer and off-taker (around the world), the renewable energy industry has faced challenges.

Notwithstanding these concerns, many impressive reforms have been enacted within the reference group. The research revealed that the increasing attractiveness of renewable energy as a market proposition was directly linked to these reforms. For example, Jordan has introduced an electricity law that forces its state-owned utility, National Electric Power Company (NEPCO), to purchase electricity from independent power producers (IPPs) at full retail price. Jordan's move can be considered a movement towards a single buyer model (where generation is separated from transmission and distribution, a single transmitting agency buys from multiple generating sources, and tariffs are regulated).

Indonesia has also taken a step to provide a clear demand signal, announcing that its national utility, Perusahaan Listrik Negara (PLN), will be obliged to purchase electricity from all new geothermal projects at the bid-price.¹¹

Suggestions for achieving structural and regulatory transformation of electricity markets are further discussed in section 3.5.

2.5 Grid Capacity and Coverage

All countries were to some extent perceived to have inadequate transmission connections to link renewable energy projects to main grids. Some also have inefficient electricity distribution networks. Not every country can currently handle the intermittent nature of renewable energy on a larger scale. It is essential that grids are not only well connected, but also that they are stable and can accommodate fluctuations on both the supply and demand side.

In Morocco, the review highlighted that grid capacity could present a future barrier to scaling up renewable generation efforts, and that improved dispatching systems could facilitate large amounts of wind making it onto the grid. A possible solution was suggested in the interim: to reinforce substations.

The research identified similar bottlenecks in grid capacity and coverage in Indonesia, although government money is being directed at the issue in central regions. In South Africa, there was a consensus that further investment would be important if national infrastructure were to be able to cope with the addition of multiple larger projects (of more than 100MW).

Over the long term, efforts to improve national grids need to be supported by interconnection across national borders, particular in the Maghreb and between MENA and the EU. It was argued one cannot separate the Middle East from the EU when talking about long-term energy development.

However, there are still regulatory and infrastructure issues in developed markets that slow such plans.

On the regulatory side, the absence of a guaranteed EU electricity market (the regulatory framework is still evolving) means renewable operators will not book and pay for potentially unnecessary capacity. Likewise, the transmission developer is unlikely to build and reserve capacity for an uncertain return. The chicken-and-egg problem thus develops in the absence of public-sector guarantees.¹²

On the infrastructure side, the France-Spain bottleneck has knock-on implications for the Moroccan market, whose export market is essentially limited to the Iberian Peninsula. It is clear that some degree of reform outside the reference group of countries will help reform within them.

¹¹ MEMR Reg 2/2011, subject to a cap of 9.7c/kWh

¹² CSP-MAN Investment Plan

Grid problems tend to be worse in more remote regions. This is a major problem, given that the best renewable resources are often located in such regions. For example, in Mexico, “wind’s expansion has been hampered by lack of transmission capacity to the isthmus region,”¹³ which the National Renewable Energy Laboratory found to contain 33,000MW of wind potential.¹⁴

Clearly, this represents a huge opportunity for Mexico, as do South Africa’s and Indonesia’s large areas of non-electrified land. To some extent, Indonesia’s natural landscape presents an inherent barrier to scaling up renewables conventionally. Here, an off-grid approach may be appropriate to scale up renewable generation. In Jordan, an opportunity to expand solar capacity near phosphate mines in the desert was identified; strong demand from these mines already causes grid imbalances that NEPCO is trying to address.

2.6 Other Current Challenges

These non-financial regulatory and infrastructure challenges have not featured heavily in our stakeholder consultations but, for completeness, we have briefly mentioned some of these below.

- Difficulties associated with the unpredictability of the stakeholder consultation process were underlined in the MENA region. It was stated that private developers might be informed very late in the process that they need to consult with a range of groups, and that the composition of the groups changed with each project. Clearer stakeholder mapping from the authorities would be welcome.
- Generally, respondents did not find **grid authorization or lack of technical standards and certification** to be a problem. Where national grid connection codes, standards and protocols are to international specifications, it was found little additional effort is required for compliance (South Africa, Indonesia). In Morocco, grid access information was available from ONE but could be easier to source. Electricity Regulatory Commission (ERC) in Jordan provides a model website, which clearly displays relevant documentation.
- Despite being a major obstacle to renewables development in many developed countries (“not in my back yard”), **spatial planning** and a **lack of stakeholder consultation** were not found to be serious challenges to renewables development in the reference group. Having said this, Indonesia may need to remain aware of conflicts between its conservation and energy objectives; this conflict can show through in difficulties in acquiring land clearance permits.
- **Grid connection costs** varied across the reference group, killing the case for small-scale projects such as micro-hydro in some countries,¹⁵ but were less of a concern in others, such as Jordan.¹⁶
- In Mexico, there is some uncertainty over grid connection costs, particularly concerning substation to grid costs. Requiring the off-taker to pay connection costs as in Jordan could reduce uncertainty for private developers.
- Respondents did not highlight a lack of **operation and maintenance facilities** as a major concern. It was pointed out that existing oil and gas infrastructure in Indonesia could be used to support the development of renewables for most purposes. A sensible suggestion arising from this observation

¹³ Pew Charitable Trusts “Global Clean Power: A \$2.3 trillion opportunity”

¹⁴ National Renewable Energy Laboratory “Advancing Clean Energy Use in Mexico”

¹⁵ In Indonesia, the developer has to finance the transmission line and hand over to PLN.

¹⁶ They are borne by the off-taker in Jordan.

would be greater cooperation of infrastructure planning between conventional energy and new energy groups.

- **Permit procedures** were considered an important obstacle, both in themselves and as a method of state monopolies entrenching themselves. In some countries, acquiring a permit to develop a renewable project requires inter alia building permits and manpower permits, which require approval even on such details as salary structures. In general, the more complicated the permit process, the more opportunities exist for rent seeking from public officials.
- **Consistent feedstock supply for biomass-based power projects is considered to be a major risk.** The supply chain includes stakeholders spanning different sectors, such as agriculture, forestry, transport and energy utilities. Availability of agro-residues also depends on production efficiency of the parent crop and other climatic externalities. Further, as the agriculture and forestry sector remains uncoordinated in developing countries, presence of market intermediaries increases fuel price. Dependence on solely seasonal flux in fuel produce, such as bagasse, can lead to temporary closure of power plants, thus reducing ability to support constant demand on-grid.

2.7 Other Future Challenges

As the renewable energy industry matures in these emerging markets, it is likely that a new set of challenges will appear. Stakeholder consultation has identified the following as likely future challenges:

- **Capacity attrition:** Government departments and regulators will, over time, build strong capacity that is capable of dealing with the requirements of developing renewable energy projects. Unless actively maintained, this capacity will dissipate over time. This can be partly due to a failure to retain trained and experienced regulatory staff and/or to keep skilled private sector staff in place. Without appropriate succession plans and ongoing programmes of training and development, the capability of government departments can be quickly reversed, creating a recurring barrier for new projects.
- **Reluctance of local electricity distributors to accept large renewable input:** Due to risk diversification, and sometimes a distrust of new technologies, local electricity distributors may refuse to accept more than, say, 10% of generation input from one source, despite national targets saying otherwise. Such behaviour creates an artificial barrier to the connection of further renewable projects.
- **Grid issues:** The issues identified above will become more and more pressing over time: as the proportion of energy derived from renewables increases, the problems of intermittency will become more potent. Extremely comprehensive and wide-ranging grid upgrades must be planned and completed over the short to medium term to enable systems to cope with ever-larger amounts of electricity from renewables.
- **Trade barriers:** Policies designed to create local jobs may, in fact, inhibit renewable energy growth. To make renewables competitive with conventional sources of energy, markets must be sufficiently large to benefit from economies of scale. Fragmenting markets along national boundaries undermines this process. The research highlighted the risk of a “rising tide of such trade barriers” in the long term.

3 Recommendations

Delivering on strategic decisions involves multistakeholder participation, the use of accurate information and capacity development in the areas of human resources, technology, infrastructure and social acceptance.

Our findings make the case for action across several key areas. These changes require that specific actions be undertaken by several different stakeholder groups. In this section, we recommend changes to overcome the key regulatory and infrastructure challenges identified, and specify the roles to be played by renewable energy developers, utilities and government.

Summary of Key Challenges and Recommendations

Significant Challenges	Key Recommendations	Type
<ul style="list-style-type: none"> Absence of long-term planning Lack of coordination between relevant authorities Lack of experience among decision-makers Electricity market structure 	<ul style="list-style-type: none"> Development of holistic regulatory and infrastructure strategy Resource assessment and mapping Single window system for government and business Electricity market assessment and restructuring 	Regulatory
<ul style="list-style-type: none"> Limited grid capacity and coverage 	<ul style="list-style-type: none"> Development of holistic regulatory and infrastructure strategy Enhancement of grid infrastructure 	Infrastructure
	<ul style="list-style-type: none"> Capacity building 	Other

3.1 Development of Holistic Regulatory and Infrastructure Strategy

Our findings demonstrate that the absence of long-term planning is holding back progress in many areas. The development of a clear strategy should be a key priority for governments looking to scale up renewable generation efforts. This should include a coherent framework that encompasses credible short-, medium- and long-term targets for generation and specifies which technologies will be broadly responsible for this generation. It should also identify infrastructure upgrades necessary to accommodate additional generation capacity, and the potential for power storage mechanisms.

It is critical that an appropriate balance be struck between consistency and flexibility. The roadmap that implements the strategy must be flexible enough to accommodate ongoing developments in the sector at a national and global level. For example, rapid cost reductions in solar technology would mitigate in favour of adjusting the roadmap. Unexpected withdrawals of government support for individual renewable energy technologies (RETs) should be avoided as they undermine the credibility of future support schemes. This is an admittedly difficult balancing act. Postponing the implementation of overall generation targets is also unacceptable and therefore strict renewable portfolio standards are necessary.

There is another element to consistency. Any renewable energy strategy must be congruous with national economic or industrial development plans and energy master plans. Having explicit or implicit policy conflicts across departments can be as bad as having no policy. Business must take part in the sculpting of such a strategy. National dialogues between governments and business (both domestic and foreign) will help to foster understanding of weaknesses in current arrangements, optimal institutional structures going

forward and useful policy targets that could be set. This could include detailed consideration of how governments can support developers to tap international sources of finance, such as voluntary offset markets and Clean Development Mechanism credits.

Lastly, a policy framework must address the fundamental question, “why do we as a nation want renewable energy?” This may seem obvious in OECD nations, where climate change is a primary driver of renewable energy policy. However, climate change is only one of many relevant factors in developing countries. The provision of baseload power to meet rapidly increasing demand, the earning of foreign currency from electricity exports, and even the prospect of international development assistance may be equally important in driving the renewable agenda.

Suggested Stakeholder Actions

Governments	Utilities	Developers
<ul style="list-style-type: none"> • Lead development of renewable energy strategy that is aligned and consistent with national planning • Be more aggressive in prioritizing renewable energy and set concrete and actionable targets • Develop roadmap with key milestones and actions • Lead open dialogues with business through workshops and consultation • Articulate vision and rationale for renewable energy 	<ul style="list-style-type: none"> • Input overview of policy, regulatory and grid infrastructure 	<ul style="list-style-type: none"> • Input overview of policy and regulatory measures

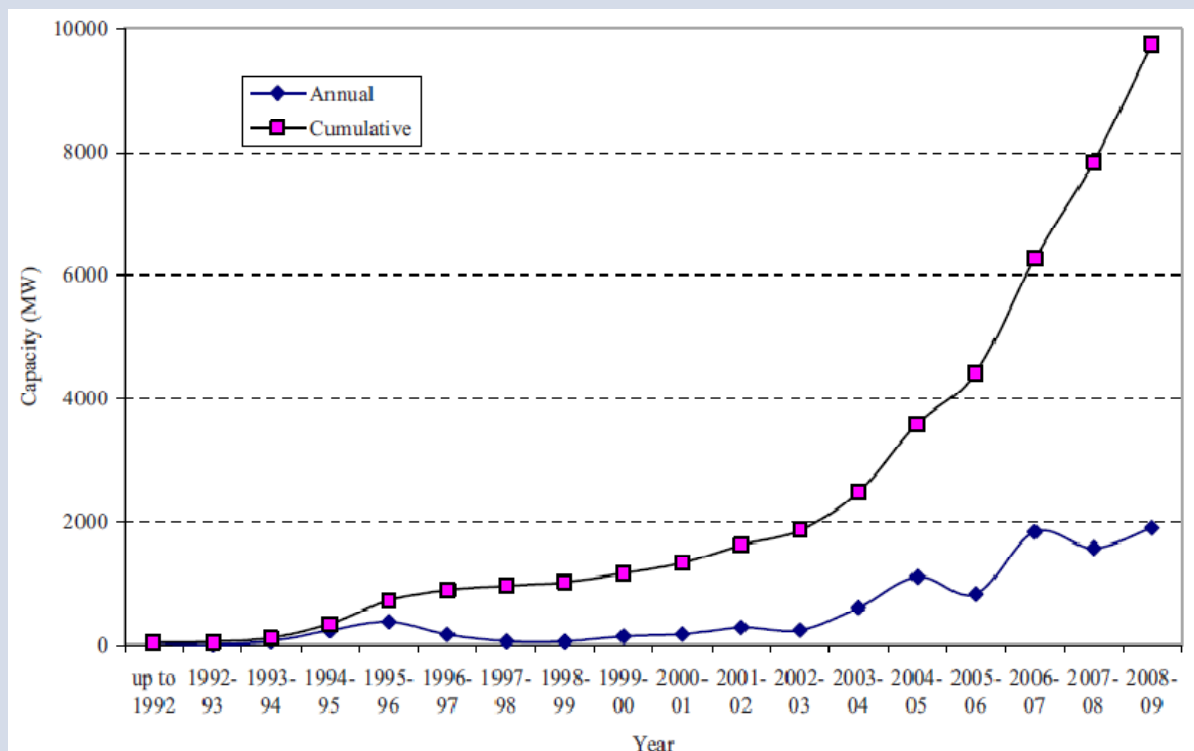
India – Wind Energy, a Complete Example

The Indian wind power market took off during early 1990s. This began as a result of the government introducing a full-fledged independent ministry called the Ministry of Non-Conventional Energy Sources (MNES) – later renamed the Ministry of New and Renewable Energy (MNRE) in 2006 – in 1992. Its purpose is to develop and deploy new and renewable energy to supplement Indian energy requirements.

A broad-based national programme was set up in 1995. This included wind resource assessment; implementation of demonstration projects to create awareness; encouraging involvement of utilities and industry; development of infrastructure capability and capacity for manufacture, installation, operation and maintenance of wind power plants; and policy support. A feed-in tariff structure was announced that considered technology and site-specific details as crucial elements. An autonomous R&D centre was developed for dissemination of information on potential sites and to develop standards and codes for RET.

By 2003, with amendments to the existing Electricity Act, options for wheeling and third-party sale at retail markets became more plausible. Guaranteed grid access, together with financial incentives like tax holidays, accelerated depreciation and generation-based credits, led to massive investment of private equity into the sector. To date, about 96% of investments come from the private business community. The figure below illustrates the growth in wind capacity that has resulted from this planned approach to

developing a renewable energy market.



Source: MNRE

3.2 Resource Assessment and Mapping

As part of an integrated approach to scaling up renewables, we recommend conducting a comprehensive technical assessment of renewable energy potential. Particular attention needs to be paid to accurate short-term forecasting of wind and solar power resources, and biomass production potential. The resource assessments need to be highly granular and updated on a regular basis to be useful.

The cost burden may be problematic in implementing this recommendation. We envisage that the government and private sector will share the burden of gathering resource data, with the private sector identifying priority sites for assessment. Business associations can coordinate such “public good” activity and share the private-sector portion of the cost among their members. Associations can also take a leadership role in actually conducting the assessments. Government funds can be combined with members’ dues to undertake the engineering and mapping processes.

MAPA EÓLICO DE ESPAÑA
Velocidad Media Anual a 80 m de altura



Figure 4: Example Resource Assessment Map (Wind Speeds in Spain)

Source: <http://atlaseolico.idae.es/>

Suggested Stakeholder Actions

Governments

- Financially support the gathering of resource data and approach multilateral development agencies for additional funding
- Liaise with the private sector to identify promising sites early on

Utilities

- Make available data sets that utilities have developed on grid infrastructure, including capacity, coverage and possibility of revamping/expansion

Developers

- Prioritize areas for resource data gathering
- Agree a cost-sharing scheme, and plan implementation steps with government

3.3 Single Window System

We recommend regulatory reform in all five countries. This will involve both organizing private sector interaction through a single “window” and more fundamental regulatory reform. The creation of a “one-stop shop” would allow the private sector to submit all its paperwork to, clarify queries and liaise with one agency. This brings obvious benefits in terms of reducing wasted time and transaction costs.

Combining points-of-contact into a single service window is necessary but not sufficient to create a regulatory process conducive to the development of a real market for renewable energy. Regulatory and institutional structures must be designed to serve the development of a renewable energy market, not reflect historical idiosyncrasies. Back-office structures must be aligned towards rapid application processing and minimizing departmental overlap. This requires a top-down approach where national governments clearly define roles and respond to private sector concerns over poor coordination.

This must include defining decision-making time frames and removing regulatory discretion where possible (legislating that if renewables developers meet all the criteria for a project they must be granted approval). This process should be transparent and regular status updates are still necessary to aid planning. Finally, a well-established appeal process is necessary to support these objectives. In this manner, the burden of regulatory clearance can be fundamentally shifted to the public sector; issues would have to be solved between departments rather than being passed around endlessly. We recommend that pre-qualification criteria be introduced with these other reforms. Experience has shown that successful reforms encourage a flood of applications and a filtering process will be necessary to avoid overburdening the regulator.

The private sector must clearly communicate its needs as well. Governments need a single voice providing them with recommendations and feedback if they are to act effectively. We recommend that businesses work together, perhaps via associations for each renewable energy technology that would then become the main liaison point for ministries. This also involves businesses coordinating with utilities so that all relevant players are at the table with the regulator.

Suggested Stakeholder Actions

Governments	Utilities	Developers
<ul style="list-style-type: none"> Assign private-sector interaction responsibility to one agency Remove discretion from the project approval process and enforcement of timelines response Ensure utility meets obligations 	<ul style="list-style-type: none"> Liaise with governments and regulators to provide a consistent feedback to developers 	<ul style="list-style-type: none"> Form industry association to provide coherent recommendations and feedback to government

Moroccan One-stop-shop Solution

While considering how to promote the development of renewable energy, the Moroccan government was challenged by how to promote and support research, training and industry development. In response, a company called the Moroccan Agency for Solar Energy (MASEN) was set up with a board of trustees and a supervisory board. It included representation from various ministries such as energy, finance, trade and industry, education, utility companies and developers.

The main objective is to support the development of solar industry and related activities that contribute to

meeting country's 2020 target of 2000MW. MASEN acts a single-window trade facilitator for the business community and provides project management support for execution. It provides the necessary inputs on industry progress and barrier, conducts studies to identify potential sites and technology, informs the government on areas that need to be addressed to further develop sites for project implementation, and designs training curricula in association with educational and vocational institutes for manpower and skills development.

The UNEP Solar and Wind Energy Resource Assessment (SWERA) Programme

Sponsored by the Global Environment Facility (GEF) under the UN Environment Programme (UNEP), the SWERA project provides easy access to high-quality renewable energy resource information and data to users around the world. Its goal is to facilitate renewable energy policy and investment by making high-quality information freely available to key user groups. SWERA products include geographic information systems (GIS) and time series data, along with links to energy optimization tools needed to apply these data. Results were integrated into a user-friendly computer-based geo-referenced information system containing relevant infrastructure data, such as roads and transmission lines, and could be easily imported into common GIS software packages.

The project started in 2001 with a five-year effort that aimed at developing information tools to stimulate renewable energy development. It covered major areas of 13 developing countries in Latin America, the Caribbean, Africa and Asia. The goal was to focus on a selection of countries and provide them with a comprehensive package of services to support expanded renewable energy technology deployment. The goal since 2006 has been to increase the global coverage of renewable resource data.

First-time countries lacking funds for investment in renewables can apply to this programme for support. According to SWERA, mapping two adjacent countries of roughly the same size at once costs much less than doing each separately. Hence, there is some logic in doing regional or sub-regional assessments and assembling groups of countries into a common effort.

Developed countries such as Spain, Germany and Denmark, provide information free of cost; however, developing countries can choose to share the cost of the data with the user. SWERA also advocates collaboration with developers and utilities as they are often the custodian of up-to-date spatial and infrastructure data and can help validate the final SWERA product by using and approving it through live projects.

3.4 Electricity Market Restructuring

General regulatory reform tends to go hand-in-hand with restructuring of electricity markets. The final objective of the restructuring process must be to create a clear route to market, in addition to other national objectives such as expanding rural coverage. This requires a transparent and long-term price signal coming from identified buyers.

However, it is widely recognized that electricity market reform is subject of substantial debate. Risks inherently exist in regulated and deregulated electricity markets; the decision to restructure and the readiness of the country to transition from one structure to another will have to be carefully assessed.

Restructuring should be seen as means to this end of market transparency, to create confidence in future cash flows and thus encourage investment in renewable energy. Privatization and liberalization are not necessarily goals in themselves, and may or may not help to achieve this aim depending on context. Over-reliance on competition may be as ineffective as allowing over-dominance on any one entity. The balance of competition, integration and regulation is a difficult one and optimal regulatory solutions are often unique to each country.

Some broad recommendations may help bring about transparency in electricity markets in the reference group, highlighted respondents. For example, depending on the development of the country's electricity market, some separation of the vertically integrated national electricity companies may be necessary. This may be limited to accounting separation or may extend to full legal unbundling, particularly of system operators.

Separation of the generation, transmission, distribution and retail portions of the business is likely to be helpful in increasing the transparency of price signals to independent developers. It is also desirable that IPPs are given a price for their power at least equal to their state-owned competitors. The mitigation of risk through appropriate PPA contracting arrangements is another generally desirable outcome (see section 2.1) and the PPA and subsidy regime put in place in each country needs to be consistent and compatible with the overall market structure. Lastly, an independent regulator free from political interference is needed to enforce the rules of the market.

If, despite the implementation of previous steps, governments do not believe their current market structures are functioning in terms of reassuring investors that a long-term buyer of power at an acceptable price exists, then further reforms may be required. For example, the legal separation of vertically integrated state-owned utilities into separate entities (in particular, the creation of an independent system operator) may be necessary where accounting separation is not strong enough to eliminate unfair bias in purchasing decisions. This is likely to involve greater liberalization, and possibly privatization, but does not necessarily preclude a continuing heavy state role. Financial incentives, such as levying of penalties for anti-competitive behaviour and payment of subsidies for engaging with the private sector, can be used effectively where a state-owned utility remains dominant.

Decisions must be taken as to the degree of liberalization of prices. On the positive side, freely floating prices allow the exploitation of correlations between supply and demand for power (e.g. solar generation and air conditioning, discussed in section 2.1), and may be driven lower by competitive pressure. However, volatility in prices may undermine the price signal that improved regulation seeks to provide. In addition, where one entity is dominant in the market, regulated prices may provide this signal more efficiently. In this case, mandatory pools, where all electricity generated and sold in the market for a given period passes through the pool and achieves the same price, may be appropriate.

Suggested Stakeholder Actions

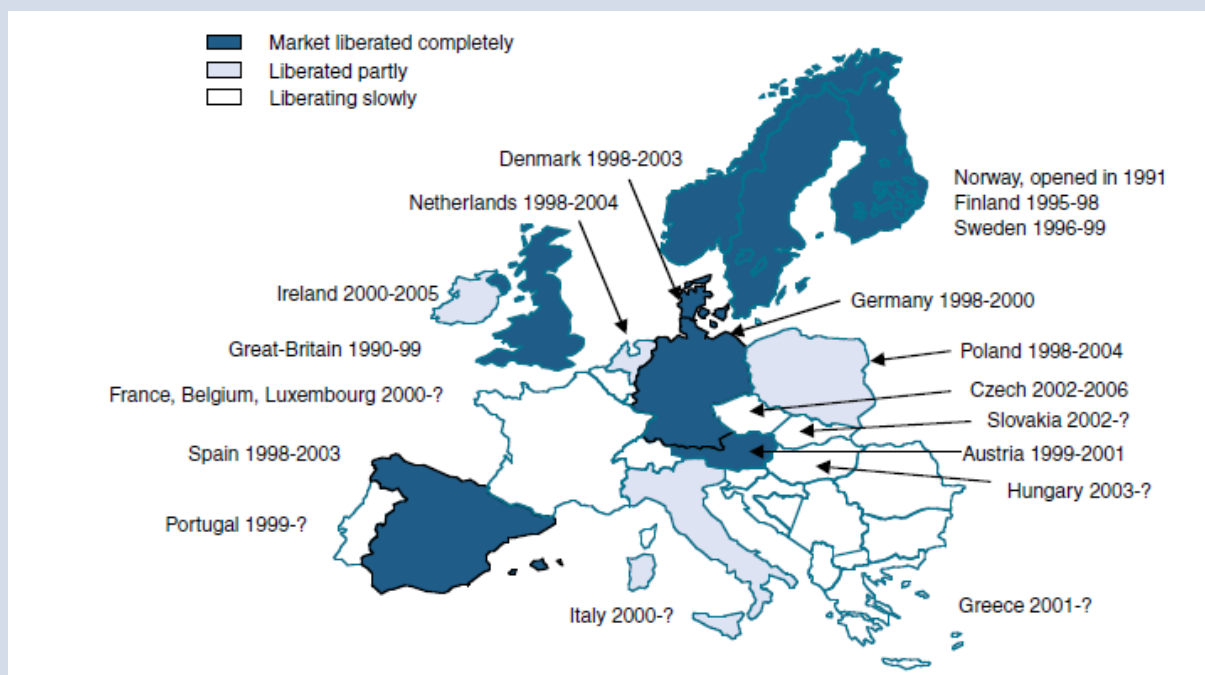
Governments	Utilities	Developers
<ul style="list-style-type: none"> Assess electricity market structure to ensure transparency and that risks are well mitigated Minimize barriers to entry at the generation level Create independent regulator overseeing electricity market if possible 	<ul style="list-style-type: none"> Assist governments in electricity market assessment and restructuring process 	<ul style="list-style-type: none"> Assist government and utilities in electricity market assessment and restructuring process Identify and report breaches of competition law (in the case of a deregulated market)

European Electricity Market Reforms

During the past two decades, the European electricity industry has made substantial progress in electricity reform. The reform was pursued at two parallel levels: liberalization of the national markets of the member states by splitting the vertically integrated utilities into generation, transmission and distribution; and by promoting efforts to improve the interfaces between national markets, establishing cross-border trading rules and expanding cross-border transmission links.

The underlying aims of the two directives (1996, 2003) were to unbundle the transmission system and distribution system from the rest of the industry, allow free entry to generation for IPPs, monitor and regulate wholesale competition, promote renewable sources and ensure a self-sustaining single energy market. This also led to standardization of the transmission and distribution system, avoiding losses and establishment of a common code for trading.

This centralized approach to market reform provides industry and households the right to be supplied with electricity of a specified quality at transparent prices, and the private sector the opportunity to participate in the more competitive market. However, while a number of countries have made significant reform progress, the goal of a single European electricity market remains very much a work in progress and “a long way off.” (Jamasb and Pollitt, 2005)



Reform of European electricity markets. The first year refers to the year when market liberalization was launched and the second year to the year when the market was fully open.

Sources: European Commission and UCTE (2003)

3.5 Enhancing Grid Infrastructure

Equipping grids to handle renewable energy is a long process and it is important that this be started as soon as possible. The transmission and distribution owners, normally the state-owned utility, would ideally fund this assessment. Once key weaknesses and technical issues have been identified, utilities and government should work together to create a suitable investment plan.

This should include large-scale themes such as rural or desert electrification, as well as the minutiae such as voltage codes and standards. The resulting plan will need to be integrated with the renewable energy strategy plan, so generation and capacity issues are solved side by side. To avoid over- or under-capacity, the infrastructure roadmap should explicitly and quantitatively link recommended capacity expansions with generation expansions.

The unique nature of renewable energy, which typically provides intermittent streams of power, makes the pooling of infrastructure capabilities critical. Greater regional connection is essential to reduce disruption from varying weather patterns and smooth demand shocks across geographies. Regional interconnection is not straightforward. For example, for Jordan to benefit from links between the EU and North Africa coasts, the links between Libya and Egypt and between Libya and Tunisia would have to be upgraded first.

We recommend extending multilateral initiatives, such as studies on learning from the MENA region to other continents, and providing a set of recommended regional interconnection projects. Consideration of differences in national grid codes and standards will be important to achieving this in the medium term. In MENA itself, next steps must include the EU. Countries should have the option to become islands off the European grid, thereby providing the opportunity to scale up capacity now while domestic infrastructure challenges are still being addressed.

To cope with further fluctuations on the supply side, a recommendation is that emerging markets take steps to establish smart grids. This would involve the gradual installation of smart meters (new construction through housing regulations) and better information on real-time pricing already discussed.¹⁷

Suggested Stakeholder Actions

Government	Utilities	Developers
<ul style="list-style-type: none"> • Undertake detailed domestic infrastructure assessments • Fund (or seek international funding for) feasibility assessments of cross-border grid integration 	<ul style="list-style-type: none"> • Support government in assessing grid capacity and coverage and ensure that adequate infrastructure is developed to absorb increased generation 	<ul style="list-style-type: none"> • Input key barriers to entry in electricity generation • Actively participate in dialogue with government and utilities to identify areas of collaboration

¹⁷ More information on smart grid can be found in the World Economic Forum reports on Accelerating Smart Grid Investment and Accelerating Successful Smart Grid Pilots (<http://www.weforum.org/s?s=smartgrid>)

Portugal's Renewable Energy Experience

In just five years, Portugal has cut its dependence on fossil fuels dramatically, with nearly 45% of its grid electricity coming from renewable sources this year, up from 17% in 2005. Ten years ago, Portugal's transmission lines were owned by private power companies that had no interest in investing in renewables because using renewable technology would have meant radical changes in the grid infrastructure, leading to cost liability to the industry. To get around this, the government started working with the private sector in planning the grid infrastructure, and began adapting the grid, including more flexibility and better connections in remote areas to allow the production and distribution of electricity from small generators, such as domestic solar panels. There was also a combination of incentives to encourage developments, including the introduction of feed-in tariffs. Portugal's next target is 60% renewable energy by 2020.

Rural Electrification and Off-grid Solutions through Renewable Energy

Renewable energy projects have been used to create individual or mini-grid off-grid systems. In 2005, Sri Lanka electrified 900 off-grid households with small hydro and 20,000 with solar PV. In 2006, India's Integrated Rural Energy Programme, using a variety of renewable sources, electrified 2200 villages. India has also encouraged the development of 70MW of small-scale biomass gasification systems for rural (off-grid) power generation.

Experts point out that, once off-grid systems are in place and profitable, a share of profits could be spent on connections to the main grid. The China Township and Village electrification programme is a good example. In 2005, China announced a scheme to provide renewable electricity to 3.5 million households in 10,000 villages by 2010. This is being followed by full rural electrification using renewable energy by 2015.

The government decided to determine the price at which the electricity would be sold to the villagers and the initial capital that would be required by the villagers to set up the projects. Recognizing that every village has its own unique set up and different renewable energy potential, the first step was to collect information on the amount of renewable resources and the individual configuration of each of the villages. A tool was then created to calculate the initial government grant required to set up the project and the subsidy required to sustain it in the long term.

It was found that systems were up to 26% cheaper if a mix of PV and mini wind turbines were used rather than just PV and, for a mini-grid to be effective, it needed to include at least 100 houses. Villages were encouraged to participate and, if accepted, were provided with generators, batteries and an inverter/rectifier. If it was a mini-grid system, the government also provided support with distribution lines and a central control system. Different-sized wind turbines were used depending on the load being served. For mini-grids that served around 100 homes, the levelised cost was between US\$ 0.87 and US\$ 1.09 per KWh.

3.6 Capacity Building

Underlying many of the challenges are fundamental problems with capacity in terms of skills, knowledge and technology. Overcoming these challenges requires addressing issues beyond the traditional remit of the energy regulator.

- Additional technical courses should be offered at university level to improve the level of labour force skills. These should cover construction, installation and maintenance of RETs, grid management skills such as grid operation and demand forecasting.
- Additional mid-level management and business development skills will be essential in the short to medium term. Expatriates from the generating country may prove the most useful resource to draw upon in the short term.
- Regulators will need to have a minimum technical and legal training to operate effectively.
- Multinational companies can bring powerful benefits in these arenas. Incentives should be provided for them to invest locally and enhance local skills rather than rely on foreign workers.

Business can play a key role in defining their needs for such vocational courses and guaranteeing employment of graduates. Foreign operators can bring particular benefits to this area in terms of skills building and knowledge transfer. Governments must provide a legal regime that protects intellectual property rights if knowledge transfer and expertise sharing is to be effected to maximum benefit. Over time, as the size of the renewable energy market in a country develops, further manufacturing and technology development opportunities may also arise.

Multilateral institutions may be willing to provide finance to aid such capacity building; training adequate numbers of engineers, developing initial manufacturing capacity, etc. may have high up-front costs. For example, the Facility for Euro-Mediterranean Investment and Partnership (FEMIP) trust fund and the Neighbourhood Investment Facility (NIF) aim to provide technical and financial assistance for capacity building and the design of institutional measures. This type of funding could be applied for by national governments with credible reform plans. International donors should also ensure that their grants aim to create a longer-term market for renewables in the country and support longer-term after-care for technologies and projects. As planning procedures and institutional structures change over time, governments will increasingly need to educate and consult local communities, especially in remote areas. Dedicated research institutions may also be needed in the long run, as home-grown and locally tailored R&D is likely to be superior to imported innovation.

We recommend that underlying this capacity-building programme is a campaign to bolster public support. Through public information provision, commercial advertising and secondary and university education programmes, governments can explain the benefits of renewable energy to their citizens. This, in the long term, will feed through to public acceptance of market and regulatory reforms. It will also encourage entrepreneurs to enter the market and financial institutions to support such ventures. International grants may be used where available to fund such national-level programmes.

Suggested Stakeholder Actions

Government	Utilities	Developers
<ul style="list-style-type: none"> • Create a comprehensive capacity-building plan to invest in skills and higher education • Encourage knowledge sharing and domestic renewables research 	<ul style="list-style-type: none"> • Actively take part in the capacity building programme to improve technical skills for grid operation and management 	<ul style="list-style-type: none"> • Enhance local skills through training across the value chain from senior management, experts, analysts and entry-level employees • Hire locals in preference to expatriates

4 Conclusions

Unless governments address early-stage challenges, there is the risk that market development will remain uncoordinated and small scale, and thus fundamentally constrained.

This paper supports the notion that renewable energy is well-positioned to scale up significantly in the reference group of countries and beyond. A range of financial and non-financial challenges obstructs the realization of this opportunity. This paper investigates the most prominent non-financial challenges through comprehensive stakeholder engagement with the private sector in Mexico, Indonesia, South Africa, Morocco and Jordan. The issues are:

- **Absence of long-term planning**, which results in a lack of policy clarity and consistency over the long term, hampering investment in and development of renewable energy
- **Lack of coordination between relevant authorities** can result in long lead times and cause delays in project approval, affecting the financial viability of the project
- **Lack of experience among decision-makers**. Many decision-makers in the renewable energy industry are not fully aware of the characteristics, intricacies and benefits of renewable energy; this can lead to significant delays in the development and expansion of renewable projects
- **Electricity market structure** with one dominant player can disadvantage new entrants in competing fairly in the market
- **Insufficient grid infrastructure** presents a current and future barrier to increased generation, particularly in the areas where renewable resources are most abundant

Placing these challenges within the Renewable Energy Life Cycle Model has shown that non-financial challenges mostly occur in the planning stage of the renewable life cycle. This suggests that simply spending more government and multilateral money will not transform renewable energy from a niche player to a dominant market technology in a particular country unless these early non-financial challenges are addressed first. The five countries studied have all made progress towards lowering the primary non-financial challenges. However, much remains to be done.

No one stakeholder group will accelerate the renewable capacity. What is clear is that each stakeholder group has a critical role to play and the scale of challenge will require significant engagement by government, state-owned utilities and the renewable energy community and collaboration across the board.

As the primary stakeholder and ultimate custodian of the country's renewable energy potential, governments must take the lead to set the direction and address these challenges. If they do not, there is the risk that market development will remain uncoordinated, smaller-scale and fundamentally constrained. The five countries currently have unprecedented financial and political opportunities presented by international interest in the "green economy", and renewable resource abundance.

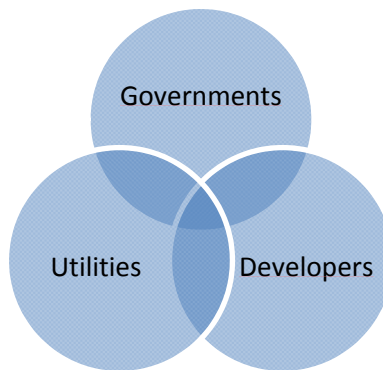
Suggested Stakeholder Actions

Lead and Set the Direction

- Develop holistic and consistent renewable energy plan and strategy that is aligned with national planning with clear targets, milestones and actions
- Conduct comprehensive resource assessment and mapping
- Establish a single window system to interact with business
- Assess electricity market structure and ensure transparency in pricing
- Conduct detailed infrastructure assessment
- Invest in skills and capacity building

Support in Actions

- Provide input overview of policy, regulatory and grid infrastructure
- Make available data sets on grid capacity, coverage and revamping and expansion
- Coordinate with government to provide consistent feedback to private developer
- Provide capacity building in grid operation and management



Engage in Partnership

- Step engagement with policy-makers and utilities through dialogues, consultation and partnership
- Actively provide input overview of policy regulatory measures
- Partner with and assist governments in data gathering and resource mapping
- Provide unified and coherent recommendations
- Partner with government to provide capacity building and training to local employees and community

Business will benefit from engaging in partnerships with government when it is looking to develop its policy and regulatory reforms. By better understanding actions that state-owned utilities need to take to support this, they too can contribute. Utilities also need to take part to ensure that adequate grid infrastructure is developed to capably absorb future planned renewable generation. It is ultimately through partnerships and co-development of fit-for-purpose solutions at a country level that the long-lasting conditions to support a significant scaling up of renewables can be created.

5 Annex

5.1 Renewable Energy Country Outline

A Indonesia

Area	Details Source: <i>Pew (2010); GBI (2010a); Jakarta Updates (2010)</i>
Market Context	<ul style="list-style-type: none"> Total installed power capacity (all sources as of 2010): 37.9 GWe Estimated growth in electricity generation in period 2010-2020: 7.6% p.a. Current power capacity met by new renewables (as of 2010): 5.8% Price paid by households for electricity (as of 2006): US\$ 0.065 per kWh
	<ul style="list-style-type: none"> Total installed renewable energy capacity (including hydro) in 2010: 2194MW Renewable capacity growth rate 2004-2009: 7.9% Key renewable sectors (aggregate installed capacity in 2010): Geothermal 1189MW
Incentives and Investment Flows	<ul style="list-style-type: none"> Key incentives in place: Feed-in tariffs, tax exemptions Clean energy investment in 2009: US\$ 354 million Clean energy investment growth rate 2004-2009: 94.5%
Policy and Targets	<ul style="list-style-type: none"> Key government policies in place: Green Energy Policy, National Energy Policy, Energy Law, Crash Program 2 Key targets by 2025 (aggregate installed capacity): Geothermal: 5,000MW, Solar 500MW, 15% of all electricity to be sourced from clean energy

B Jordan

Area	Details Source: <i>GBI Research (2010b); MEDA electricity tariffs (2008); IEA (2010)</i>
Market Context	<ul style="list-style-type: none"> Total installed power capacity (all sources as of 2009): 2.6GWe Estimated growth in electricity generation in period 2010-2020: 5.6% p.a. Current power capacity met by new renewables (as of 2009): 0.7% Price paid by households for electricity (as of 2008): US\$ 0.046-0.16 per kWh
	<ul style="list-style-type: none"> Total installed renewable energy capacity in 2009: 17.4MW Renewable capacity growth rate 2004-2009: Not available Key renewable sectors (aggregate installed capacity - 2009): Biofuel – 4MW
Incentives and Investment Flows	<ul style="list-style-type: none"> Key incentives in place: Net metering, public investment, tax reductions Clean energy investment in 2009: Not available Clean energy investment growth rate 2004-2009: Not available
Policy and Targets	<ul style="list-style-type: none"> Key government policies in place: Renewable Energy Law Key targets: 7% of the energy mix to come from renewable energy sources by 2015 (translates into 600MW of wind power) and 10% by 2020 (will include 300MW to 600MW of PV and CSP)

C Mexico

Area	Details Source: <i>Pew (2010); EIA (2010a), SENER (2010)</i>
Market Context	<ul style="list-style-type: none"> Total installed power capacity (all sources as of 2010): 53 GWe Estimated growth in electricity generation in period 2010-2014: 2.4% p.a. Current power capacity met by new renewables (as of 2009): 3.3% Price paid by households for electricity (as of 2010): US\$ 0.0733 per kWh
	<ul style="list-style-type: none"> Total installed renewable energy capacity in 2010: 1.548GW (excluding hydro) Renewable capacity growth rate 2004-2009: 10.1% Key renewable sectors (aggregate installed capacity - 2010): Geothermal: 965 MW, Biomass 498MW, Wind 85MW
Incentives and Investment Flows	<ul style="list-style-type: none"> Key incentives in place: Concession tendering, net metering, public investment, tax credits Clean energy investment in 2009: US\$ 2.1 billion Clean energy investment growth rate 2004-2009: 91.9%
Policy and Targets	<ul style="list-style-type: none"> Key government policies in place: Energy Reform Bill, Law for the Promotion and Development of Bioenergy, Renewable Interconnection Regulation, Tax Exemptions Key targets by 2012 (Aggregate Installed Capacity): 4.8GW in cumulative capacity - Wind: 2,726MW, Geothermal:1,036MW, Ethanol: 25% of total gasoline consumption

D Morocco

Area	Details Source: <i>EIA (2010c); IEA (2010); REN21 (2010); Enzili (2008), RCREEE (2008)</i>
Market Context	<ul style="list-style-type: none"> Total installed power capacity (all sources as of 2008): 5.3 GWe Recent % growth in electricity demand up to 2010: 6-8% p.a. Current power capacity met by new renewables (as of 2008): 1.8% Price paid by households for electricity (as of 2008): US\$ 0.11- 0.17 per kWh
	<ul style="list-style-type: none"> Total installed renewable energy capacity in 2009: 286MW Wind Renewable capacity growth rate 2004-2009: Not available Key renewable sectors (aggregate installed capacity - 2009): 286MW Wind
Incentives and Investment Flows	<ul style="list-style-type: none"> Key incentives in place: Public investment, tax credits Clean energy investment in 2009: Not available Clean energy investment growth rate 2004-2009: Not available
Policy and Targets	<ul style="list-style-type: none"> Key government policies in place: Renewable Energy Law, National Integrated Project for Solar Electricity Production and National Agency for Solar Energy Key targets by 2012: 10% of the national energy balance renewables, with a 20% renewable share of total electricity demand

E South Africa

Area	Details Source: <i>EIA (2010b); Pew (2010); IEA (2010); South Africa web (2010)</i>
Market Context	<ul style="list-style-type: none"> Total installed power capacity (all sources as of 2010): 42.43 GWe Estimated growth in installed electric capacity in period 2010-2020: 3.5% p.a. Current power generated by new renewables (as of 2008): 0.2% Price paid by households for electricity (as of 2009): US\$ 0.1015 per kWh
	<ul style="list-style-type: none"> Total installed renewable energy capacity in 2009: 0.4GW Renewable capacity growth rate 2009-2015: 10% for off grid solar power market Key renewable sectors (aggregate installed capacity - 2009): 0.3GW Solar
Incentives and Investment Flows	<ul style="list-style-type: none"> Key incentives in place: Feed-in tariffs Clean energy investment in 2009: US\$ 125 million Clean energy investment growth rate 2004-2009: Not available
Policy and Targets	<ul style="list-style-type: none"> Key government policies in place: SA's Vision, Strategic Direction and Framework for Climate Policy Key targets by 2013: 1,667MW aggregate installed renewable capacity, biofuels being 2% of national liquid fuel by 2012

5.2 Scaling Up Renewables: Evaluation Template

A Purpose

This template has been designed to help interested stakeholders identify, clarify and resolve the regulatory and infrastructure challenges that are currently influencing the development of renewable energy projects in a particular geography (from national country level down to local municipal level). It builds on the development model proposed in this paper and encourages input from multiple stakeholder groups, lessons learned to date to be captured and allows participants to contribute suggestions on how current challenges could be met, identifying responsibilities by stakeholder group. The format also allows the group to assess and identify possible future challenges and ways in which these might be met.

B When and How to Use

It is recommended that this template be used in small group discussions led by a facilitator. These discussions can run for 1.5–3 hours (with breaks). Those facilitating and completing the template must have sufficient personal understanding and experience of developing renewable energy projects to be able to challenge and support the group discussion. Likewise, participants should have personal experience of developing renewable energy projects to be able to contribute practical details. Broad stakeholder representation in the groups will allow for richer discussions and outputs that are more meaningful. The suggested process to follow when using this template is as follows:

1. Brief respondents on purpose and process for discussions; explain confidentiality approach
2. Check understanding of the proposed challenges for discussion, explain proposed development model
3. Start discussions within groups, collect and aggregate data on historical challenges and experiences, map these to the appropriate development stage, and then use the group to develop solutions and approaches to overcome the issues identified
4. Use the group to identify possible future challenges and solutions
5. Close the discussion, explain next steps and proposed involvement of participants

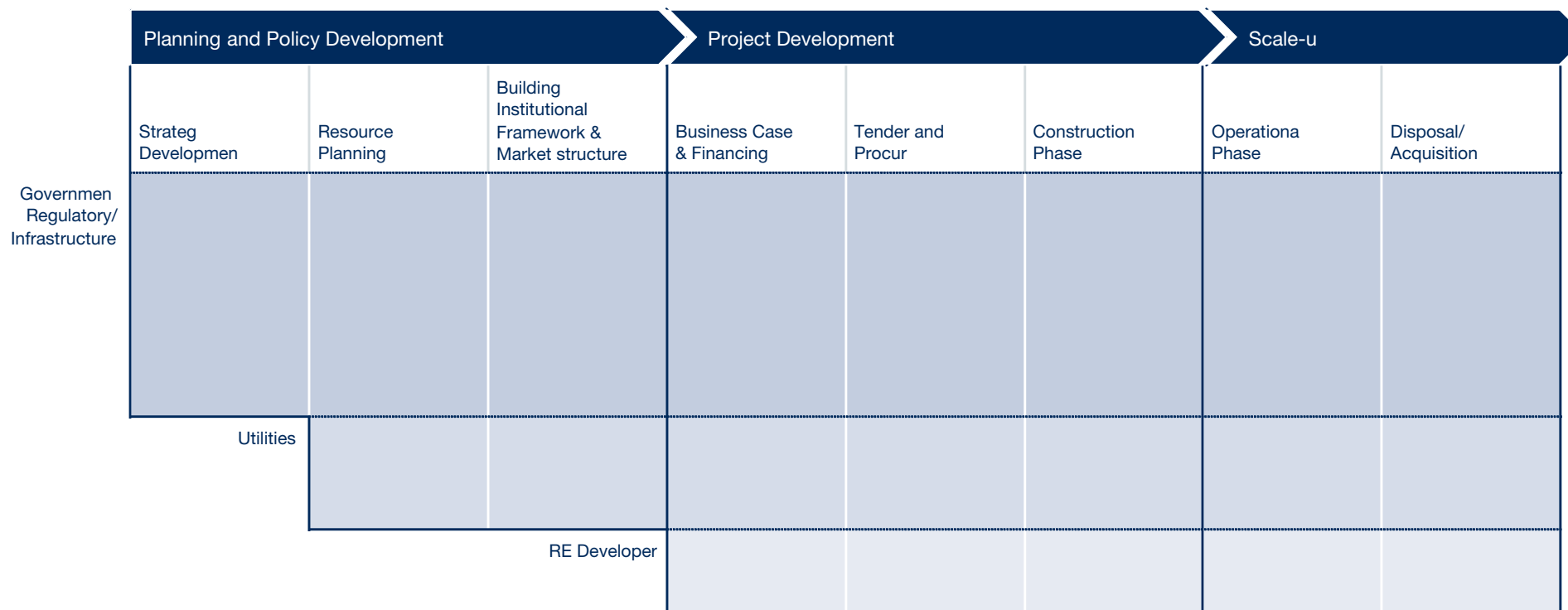
C Challenges for Discussion

The challenges listed below can be used as a basis for the discussions; however, the identification of additional challenges applicable locally should also be encouraged.

Example Regulatory Challenges		Example Infrastructure Challenges	
<ul style="list-style-type: none"> • Electricity market structure • Large number of relevant authorities • Poor coordination between relevant authorities • Absence of long-term planning • Lack of experience among decision-makers 	<ul style="list-style-type: none"> • Renewable energy is insufficiently considered in spatial planning • Lack of stakeholder involvement in decision-making • Complex permit procedures and legal appeal process • Complex grid connection authorization 	<ul style="list-style-type: none"> • Insufficient grid capacity and coverage • System constraints • Lack of grid access • High grid connection costs 	<ul style="list-style-type: none"> • Complex grid connection authorization • Lack of technical standards and certification • Lack of operation and maintenance facilities

D Renewable Energy Life Cycle Model Overview

This diagram can be reproduced to introduce participants in the working groups to the stages of development life cycle and allow challenges to be mapped to specific stages and stakeholders.



E Evaluation Template

This template should be adapted as needed to support the group discussions. It is recommended that a separate page be provided to participants for each sub-stage (in A3 or larger size). This will allow all the stages in the development life cycle to be considered. Where appropriate, this can be repeated to consider national, regional and local issues. The template can be part populated or left blank depending on the time available, etc.

Regulatory and Infrastructure Barrier Evaluation Template v1.0		ABC Meeting Location	Date: Facilitator:				
Life Cycle Stage	<i>Enter the life cycle stage e.g. Planning Stage</i>						
Sub Stage	<i>Enter the sub stage e.g. Strategy Development</i>						
A Current Challenges	Description	Cause	Effect	Possible Resolution	Stakeholder Responsibility	Linkages to Other Barriers	Comments
1 Barrier #1	<i>Enter a full description of the barrier, details of the impact by stakeholder group and technology, if possible financial consequences</i>	<i>Explain the underlying cause of the barrier, including history, evolution of the barrier to date</i>	<i>Explain the effect that it has on all impacted stakeholder levels and the issues that it creates based on practical experiences of participants</i>	<i>Identify possible ways that the barrier could be addressed, set out steps that need to be completed and in what order</i>	<i>Identify government, utility or private sector responsibilities associated with the resolution steps proposed, including timing and order</i>	<i>Identify linkages to other current or future barriers – possibility for the proposed resolution to the barrier to be combined, etc.</i>	<i>Other comments on the barrier e.g. timing of impact, the priority order or time frames within which it should be addressed, etc.</i>
2 Barrier #2 etc.							
B Future Challenges	Description	Cause	Effect	Possible Resolution	Stakeholder Responsibility	Linkages to Other Barriers	Comments
1 Barrier #1							
2 Barrier #2 etc.							

5.3 Acronyms

	Acronyms	Explanation
1	CFE	Federal Electricity Commission [Mexico's national utility]
2	CSP	Concentrated Solar Power technology
3	EU	European Union
4	FiT	Feed-in tariffs
5	GEF	Global Environment Facility
6	GIS	Geographic information systems
7	GW	Gigawatt
8	GWh	Gigawatt hour
9	IPP	Independent power producer
10	IPP	Independent power purchaser
11	MASEN	Moroccan Agency for Solar Energy
12	MENA	Middle East and North Africa
13	MNCs	Multinational corporations
14	MNES	Ministry of Non-Conventional Energy Sources [India]
15	MNRE	Ministry of New and Renewable Energy [India]
16	MW	Megawatt
17	MWh	Megawatt hour
18	NEPCO	National Electric Power Company [Jordan's national utility]
19	NIF	Neighbourhood investment facility
20	OECD	Organisation for Economic Co-operation and Development
21	ONE	National Office for Electricity [Morocco]
22	PLN	Perusahaan Listrik Negara [Indonesia's national utility]
23	PPA	Power purchasing agreement
24	PV	Photovoltaic technology
25	R&D	Research and development
26	RE	Renewable energy
27	SLU	Sustainable land use
28	SUR	Scaling Up Renewables
29	SWERA	Solar and Wind Energy Resource Assessment
30	TWh	Terrawatt hour
31	UN	United Nations
32	UNEP	United Nations Environment Programme
33	"New" Renewables	Renewable energy technology that adheres to the above definition but excluding large hydroelectric and traditional biomass
34	Renewable Energy Technology	The term renewable energy technology refers to a technology that harnesses environmental resources to produce usable energy. These resources must be capable of replenishment in human life and commercial timescales as without this caveat even fossil fuels like oil are "replenishable" if they are considered over millions of years (ASE, 2005).

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