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World Energy Trilemma

Time to get real – the myths and realities of financing energy systems

Project Partner OLIVER WYMAN

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Foreword by Marie-José Nadeau

It is with great pride that I introduce the latest edition of the World Energy Trilemma report. This new edition focuses on the financing of energy investments, and comes at a time when the global energy sector is facing the need for unprecedented levels of investment in response to rising demand, the need to decarbonise energy and the replacement of ageing plants and equipment. The report provides an excellent tool for governments, industry and the financial community to identify measures to help unlock the investment needed to transform the world's energy system.

In the face of mounting challenges, business as usual in the energy industry is not an option. An increasing number of countries now recognise it is essential to transform their energy sectors. They believe there is a growing need for governments, industry, the finance sector and consumers to align their thinking in order to develop energy systems that are based on equitable energy access, security of supply and have a minimal impact on the environment.

Measures to improve access to modern energy services and to upgrade and replenish ageing infrastructure can be planned, but external events cannot be controlled in an increasingly interconnected world.

For example, the unconventional oil and gas revolution in North America has not only had an impact on the region, but also on regions across the globe. As a result Canada has been forced to re-think its energy export strategy and embark on plans for investments in an East-West export axis to position itself as an exporter to Europe and Asia. While the United States (US) has opened up Liquefied Natural Gas (LNG) exports by allowing recently-built LNG import terminals to convert to liquefied natural gas for export to global markets. Crude oil from West and North Africa is being redirected to the Far East, and at the same time Middle East oil producers are taking exceptional measures to protect their market share that includes setting up their own oil storage hubs in Asia. Other countries see the opportunities that shale gas present. For example, China and South Africa are committed to developing their indigenous shale gas resources. They plan to use shale to replace coal with natural gas for electricity generation, and to decrease their environmental footprint.

The accident at the Fukushima Daiichi nuclear power plant in Japan has reinvigorated the debate about how to meet the world's growing demand for energy and the contribution of nuclear power can make to the mix. For example, Germany's decision to phase-out nuclear power completely by 2022 is a challenge to the country's energy mix. This will have a long-term financial impact on the country's energy and industrial sectors and the population. Although many other countries continue their national programmes, they are paying greater attention to safety, operational, technological improvements and regulation, which includes both infrastructure and education.

Geopolitical tension in Europe over the past few months underlines Europe's vulnerability in relation to energy security. It emphasises the need to improve energy interconnectivity, to increase energy security by adding storage capacity and LNG terminals and to diversify its supply sources, not least through renewables. It also

highlights that Russia may need to secure further customers in the Far East and invest in additional export routes.

Issues such as these can provide opportunities, but can also represent major challenges for policymakers. Perhaps the biggest challenge facing the energy sector worldwide is the one posed by climate change. The need to adapt to climate change, and to mitigate the environmental impact of the energy sector by decarbonising the way energy is produced and consumed, only adds to the already massive bill for future investment needs. The additional investment required in the energy system to keep to a pre-industrial temperature increase of below 2°C has been estimated to cost US$190–900bn per year on the supply-side alone. Recent reports from the Intergovernmental Panel on Climate Change (IPCC) have made it clear that unless there is a fundamental transformation in the energy sector, the globally agreed 2°C target will not be met.

Each country and region faces its own unique set of challenges, and clearly there is no single solution. Furthermore, it is difficult to draw parallels between mature energy markets in the developed world that want to expand capacity of low- and zero-carbon emission technologies, and energy markets in less developed countries that are looking at how to provide for their basic energy needs.

However, there is increasing evidence that in many countries, whether developed, emerging or developing, the political forces that drive energy policies are focused on short-term concerns rather than long-term imperatives. I see energy policies introduced with the aim of a political quick-win at the expense of long-term policies aimed at delivering reliable, affordable and sustainable energy supplies.

The average political term is four to five years, while the typical energy project from conception to commissioning ranges from six to 10 years. This is sometimes longer for nuclear, large hydro or high-voltage transmission schemes. It is no coincidence that this short-term perspective is viewed as one of the biggest risks to preventing investment in energy infrastructure.

The World Energy Council wants to build on the 2013 Agenda for Change report, and give the financial community the opportunity to engage in a dialogue with both public and private decision-makers about how to break the logjam of investment in the energy sector. The contributions made in this report not only provide some insight, but also pragmatic suggestions on how to move forward.

I wish you an insightful dive into this third part of our dialogue and I can only encourage you to act on the recommendations!

Marie-José Nadeau
Chair, World Energy Council

Foreword by Joan MacNaughton

Last year our report World Energy Trilemma 2013: Time to get real – the agenda for change identified 10 areas which policy and business energy leaders saw as a priority for attention if countries are to be able to meet the challenges of the energy trilemma more effectively. They included the need for transparent, flexible and dynamic pricing frameworks, and to enhance engagement with the financial community, in order to facilitate the uplift in investment necessary to deliver secure, sustainable and affordable energy for all.

This report has focused on these issues: through an extensive programme of research; interviews with leading financiers, but also industrialists and policymakers; and analysis of the data underpinning the Energy Trilemma Index. The lessons we have drawn from this work are presented to help the various actors raise their game – in improving the relevant policy frameworks, in making difficult investment decisions, in increasing the scale and velocity of project development, and consequently to scale up what is already an ambitious investment agenda. From a current US$1.7 trillion year, annual investment needs to grow by at least half, to US$2.5 trillion or more in 2035 if the world's energy expectations are to be met.

What does the report tell us? We find that there is capital available in the private sector on the required scale, but that patterns of investment will need to change radically in terms of type of energy source, technology, and infrastructure. And it will need to take place across different regions from those to date. Investors and developers will accordingly have to invest way beyond their comfort zones. They will need help to do so – notably from governments, regulators and international financial institutions. Emerging financing mechanisms must evolve quickly in terms of both scale and accessibility. Policy frameworks and regulatory processes will need to evolve to match the new technical and other realities. In doing so policymakers have to strike a difficult balance between providing predictability for investors, and being able to adapt to what the fast evolving market requires. Getting this balance right will not only be crucial to sustaining and growing investment, it will also determine the cost of capital, and hence the viability and end pricing of energy provision.

We offer some practical suggestions for how policymakers, energy business leaders and the financial community can work together to achieve the right sort of outcomes. In particular, they need to arrive at a common understanding of how to align investors' risk–reward expectations with the need for private sector energy investment, and of how emerging technologies can support national and international energy goals. Policymakers must carefully consider the impact of interventions on investor perceptions and on the allocation of risk. To the extent possible, they should aim to decrease the short-term focus and politicisation of energy policy. The financial community should help policymakers and the energy sector to understand better: the role different investors can play, using various financial instruments, during the life cycle of projects; the role of new funding entities; and how to work to embed best practice and build human capacity in developing and emerging economies. As to the energy sector, they, too, can do more to identify and share practices which will augment the pipeline and increase the velocity of projects. They also need to engage

more with development banks on capacity building and policymakers on the design of new policy models to take account of technological and other changes.

I am struck by the resonance of the themes in this report – themes around engagement, around the significance of getting the right policy approaches, around the dynamism of technology and around business models in the energy sector – with the findings in our 2012 and 2013 reports. The common thinking which we have uncovered among energy business leaders, policymakers and now the financial community gives us hope that we can secure alignment of business, policy and financial approaches. We are convinced that this report will contribute to securing that alignment, and scaling up the flow of investment, as is so desperately needed.

Joan MacNaughton
Executive Chair, WEC World Energy Trilemma

“

We have vast amounts of money – it’s a question of the risk-adjusted cost of capital

”

Executive summary

In 2013 the World Energy Council (WEC) exposed a number of myths that influence the understanding of important aspects of the global energy landscape. It pointed out that, if not challenged, these misconceptions may lead us down a path of complacency and missed opportunities as current pathways may fall short of delivering on the global aspirations of energy access, energy security, and environmental sustainability – the three dimensions that must be balanced in the energy trilemma.

As energy markets become more complex, driven by accelerated change in energy policy, technological innovation, and consumer expectations, current market designs and business models in some countries may be unable to cope. The pressures of meeting increasing demand and the need to transition and replace existing infrastructure must be met with robust policy and regulatory frameworks that include the right investment conditions for the energy and financial sectors.

The WEC's 2014 Energy Trilemma Index highlights those countries that are able to balance energy demands to deliver more sustainable energy systems for their people and help secure long-term competitive economies. Switzerland, Sweden and Norway take top honours in the 2014 Index overall. The highest ranking country for energy security is once again Canada, with the United States (US) maintaining its position as the most equitable energy system, and Switzerland leading the way on environmental sustainability.

As the world economy and population grows, global energy demand is predicted to increase and even double by 2050. To keep pace with this demand, cumulative investment requirements in electricity generation alone will be between US$19.3trn[1] and US$25.7trn between now and 2050.[2] Looking at the broader energy infrastructure, an estimated cumulative investment of US$40.2trn is required across the energy infrastructure supply chain over the period 2014 to 2035 with an additional US$8trn investment needed in energy efficiency. This is equal to an annual investment need of US$1.7trn (rising to US$2.5trn by 2035) in energy supply infrastructure and to improve energy efficiency. To put this into perspective, this equates to an investment of around US$240 per capita per year today to US$285 per capita per year in 2035, considering the current and future world population. A significant figure even for people living in developed countries, and especially high for those in developing and emerging economies. These investment requirements rise by a further 10% to a total of US$53trn in cumulative investment by 2035 if the goal is set

[1] This publication uses the short scale version of a trillion, i.e. one trillion means one thousand billion.
[2] World Energy Council (WEC), 2013: World Energy Scenarios: Composing energy futures to 2050; The lower number refers to the WEC's 'Symphony' scenario, which focuses on achieving environmental sustainability through internationally coordinated policies and practices, while the higher number reflects WEC's 'Jazz' scenario, which focuses on energy equity with priority given to achieving individual access and affordability of energy through economic growth.

to a 2°C emissions path (a target to limit the average global temperature increases and the resulting climate change).[3]

The investment needs offer a significant market opportunity if robust and equitable pathways are provided for the investment community. However, capital is extremely sensitive to perceived political and regulatory risks. Moreover, due to the growing pressures on public finances in most countries, there is a limited availability of public funds to substitute or augment the private financing of energy infrastructure. Increasing private sector investment in the energy sectors enables governments to direct their resources to other economic and social needs that may not otherwise be met. It is therefore critical to improve the understanding of the nature of risk and the way to price it. In the absence of such understanding, investment will not flow.

Building on the findings of the recent work with ministers, policymakers and industry leaders, the WEC and global management consultancy, Oliver Wyman, along with the Global Risk Center of its parent Marsh & McLennan Companies, engaged directly with the finance community to explore if it is possible to meet these investment needs, or if the challenge is too great. The interviews provided a clear understanding of the barriers to investment and identified pathways to deliver competitive and sustainable energy systems.

In addressing the investment challenges, three key questions need to be at the centre of attention:

- Is there enough available capital at the right cost?
- Will the existing funding instruments be able to channel capital from the investor community to the energy sector?
- Can the energy sector attract and absorb capital on this scale?

The report found that there is enough money available from the private sector if the right conditions are provided. Policymakers and regulators must clearly signal their future energy strategies, recognising the need for appropriate risk-reward structures, and to put in place lasting policy and regulatory frameworks, free from populist political interference. Alongside this, it is increasingly clear that there needs to be a focus on the development of technical, financial and management skill sets to support energy projects around the world and enable the energy sector to absorb capital.

There is an emerging risk that, under regulatory pressure of Basel III (the global, voluntary regulatory standard on bank capital adequacy), banks may reduce their infrastructure loans. This will put added pressure on other forms of funding which are not yet prepared or incentivised to meet the challenge.

To ensure a robust pipeline of projects that meets the emerging demand dynamics, the energy sector will need to ‘get real’ about the way it engages with the financial sector, and policymakers will be called on to make some hard choices. The money to catalyse the transition exists – as an example, the International Monetary Fund (IMF) estimates annual global cost of government subsidies for fossil fuels in 2012 was almost US$2trn (factoring lost tax revenues).[4] It is therefore clear that there is scope to deliver a sustainable energy system that meets the triple challenge of the energy trilemma (to balance energy access, energy security, and environmental

[3] International Energy Agency (IEA), 2014: World Energy Investment Outlook; The 2°C scenario would require double the investments in low-carbon technologies and energy efficiency.
[4] International Monetary Fund (IMF), 2013: Energy Subsidy Reform: Lessons and implications

sustainability) but, as this report sets out, energy leaders will need to act quickly and adapt the way they engage with the finance community.

Financial sector recommendations

Countries exhibit a wide diversity of energy policies and strategies but nearly all share a common goal: increasing private sector investment as well as developing skills and expertise. Achieving the necessary investment levels will require that capital can be accessed at the right cost, that there are effective financial instruments to support a flow of investments across the energy sector, and that there is a strong pipeline of energy projects available for investments. Policymakers, the financial sector and the energy sector each have a role to play and must work together to devise and implement approaches that will drive investments.

Research and interviews with financial sector stakeholders have identified three action areas that must be attained to attract greater investment in energy. Unlike complex macroeconomic forces, all of these conditions, while challenging, are still well within the control of governments, investors and energy companies.

Action area 1

Policymakers must focus on implementing the regulatory and policy frameworks to encourage investment and reduce political and regulatory risks.

For many developing and emerging economies, this will include a focus on creating the prerequisite strong legal, regulatory and financial frameworks that provide investors in any sector of the economy with confidence that rules will be followed and investments can be recouped. Policymakers and regulators must clearly signal their future energy strategies and put in place lasting policy and regulatory frameworks. Coherent, long-term, accessible, predictable, and transparent energy policies, underpinned by well-implemented regulations and independent regulatory bodies, can significantly increase investors' confidence.

Along with this, policymakers must strive to keep politics out of energy policy and reduce concerns that investing in energy results in unrewarded exposure to political and regulatory risk. The energy sector has been particularly vulnerable to policy intervention and changes, driven in part by the mismatch between political cycles (five years or less) and asset lifetimes (often spanning decades). This results in a risk premium – and higher cost of capital – being applied on a country-by-country basis to investment in the sector and, in some cases, discouraging investment altogether.

Politicking around energy investments has been compounded by the uncertainty created by ongoing climate framework negotiations, as well as technological changes in energy supply, including the expansion of renewables and unconventional oil and gas. As new technologies come to the fore, policymakers face real challenges in developing policies that will drive necessary changes to decarbonise energy and ensure a secure energy supply that is accessible and affordable, while minimising the impact of energy production and use on the environment in order to combat climate change as well as local air and water pollution. It is more important than ever that policymakers maintain a robust engagement with the energy and financial sector on emerging technologies, accompanying financial opportunities, and effective regulatory

frameworks to meet energy goals. This will enable policymakers to shape thriving energy markets and establish competitive risk–return frameworks for investors, while ensuring the needs of their citizens and economies are met.

Action area 2

The financial infrastructure must exist for capital to flow easily to the energy sector.

Many of the potential financing sources for energy infrastructure are expected to evolve over the coming decades in many countries. Under regulatory pressure of Basel III, banks are expected to reduce their infrastructure loans. At the same time, the regulation opens the space for insurance companies to increase their infrastructure loans. Other investors, for example, pension funds and other long-term investors around the world are also looking to increase their allocations to infrastructure. Over time, more experienced funds may increasingly invest directly and others may invest through dedicated infrastructure funds to bring substantial increases in investments.

Additional developments include the maturing of financial markets in emerging economies, or allowing expanded use of financial mechanisms such as project, infrastructure and green bonds.

As the financial structures evolve, the sector must overcome bias toward conventional energy projects. Currently, approximately 70% of energy investments (not including investments for energy efficiency) are directed to fossil-fuel related projects. Indeed, through to 2035 it is expected that fossil fuels will require 65% of total investments.[5] Nonetheless, increasing the level of comfort and confidence of investors to fund low- and zero-carbon technology projects will be key – especially if a meaningful post-2015 climate change agreement is to be achieved and more investments are to flow in emerging technologies and economies. This will require regulatory stability and new approaches to assess opportunities, aggregate smaller-scale projects, and a greater use of targeted financing mechanisms.

Action area 3

The energy sector must bring clearly bankable projects to the market.

One of the biggest barriers to increased energy investments, especially in non-OECD countries, is the limited number of projects that can secure financing. A bankable project is one that has all the necessary components aligned, so that investors have confidence in the project success.

In some countries, the lack of bankable projects, or the lack of a steady project pipeline, is resulting in a ‘crowding-out’ of private investors, which compete with public funding institutions such as multilateral development banks to invest in effectively scoped energy projects.

[5] IEA, 2014: World Energy Investment Outlook

Many factors can limit the availability of bankable projects. In some instances, there are constraints on investments due to restrictions on foreign direct investments. In many other cases, the lack of human capital is a real impediment. Focusing on the development of necessary technical, financial and management skill sets is crucial to support energy projects around the world.

Preparing a project and arranging for funding can account for between 5% and 10% of a project's costs and add several years to the project's development. It is critical to increase the number and the velocity at which projects are developed. The energy sector can establish standard procedures and best practices on the type of information – for example, technical assessments for wind power projects – as well as financial information required to allow investors to effectively and efficiently assess projects. Common practices, such as the EU infrastructure procurement procedures have facilitated investments in Eastern Europe. Emerging economies could look to adapt these best practice models as a means to efficiently build a pipeline of projects and the associated human capital to attract investments.

Benchmarking the sustainability of national energy systems

A second common energy goal for countries is to balance the three dimensions of the energy trilemma. The evolving challenges facing countries are vividly illustrated by the WEC's 2014 World Energy Trilemma Index. The Index is increasingly being seen as a benchmark for assessing good energy policy at a country level. It points to key areas that countries must give extra attention to in order to further develop a balanced energy profile and minimise the risk and uncertainties investors face due to an unbalanced approach. Comparative rankings highlight how a country is addressing the energy trilemma overall, as well as each of the three dimensions. The balance score provides a snapshot of how well a country manages the trade-offs between the three dimensions (see Figure 1 and Figure 2).[6]

Box 1: Energy trilemma dimensions

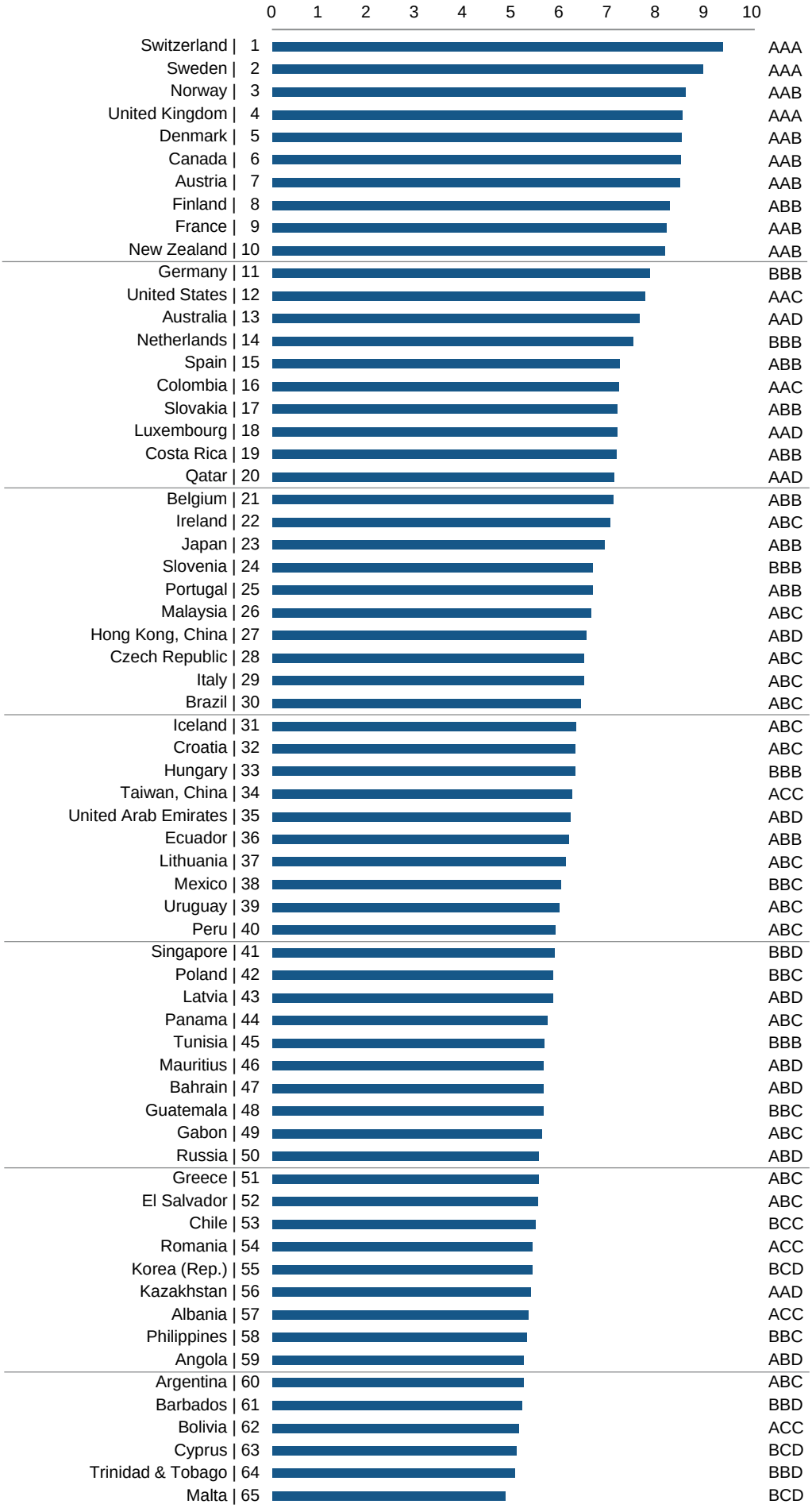
- Energy security: The effective management of primary energy supply from domestic and external sources, the reliability of energy infrastructure, and the ability of energy providers to meet current and future demand.
- Energy equity: The accessibility and affordability of energy supply across the population.
- Environmental sustainability: The achievement of supply- and demand-side energy efficiencies and the development of energy supply from renewable and other low-carbon sources.

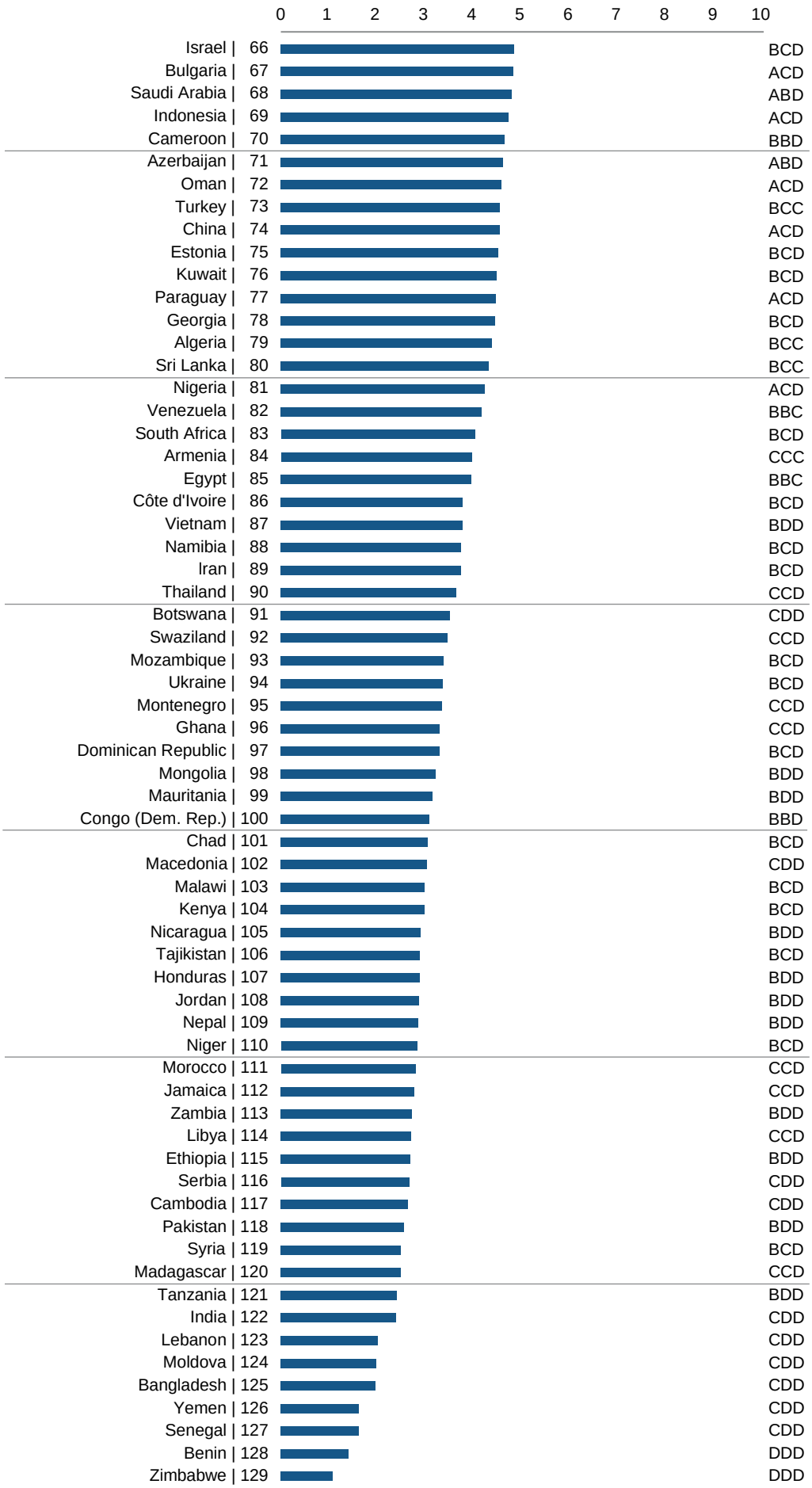
[6] Note, the sequence of the letters in the balance score does not correspond to a specific dimension but rather presents the letter scores in descending alphabetical order.

Figure 1

2014 Energy Trilemma Index rankings and balance scores

Source: WEC/Oliver Wyman, 2014




0 1 2 3 4 5 6 7 8 9 10
Israel | 66 BCD
Bulgaria | 67 ACD
Saudi Arabia | 68 ABD
Indonesia | 69 ACD
Cameroon | 70 BBD
Azerbaijan | 71 ABD
Oman | 72 ACD
Turkey | 73 BCC
China | 74 ACD
Estonia | 75 BCD
Kuwait | 76 BCD
Paraguay | 77 ACD
Georgia | 78 BCD
Algeria | 79 BCC
Sri Lanka | 80 BCC
Nigeria | 81 ACD
Venezuela | 82 BBC
South Africa | 83 BCD
Armenia | 84 CCC
Egypt | 85 BBC
Côte d'Ivoire | 86 BCD
Vietnam | 87 BDD
Namibia | 88 BCD
Iran | 89 BCD
Thailand | 90 CCD
Botswana | 91 CDD
Swaziland | 92 CCD
Mozambique | 93 BCD
Ukraine | 94 BCD
Montenegro | 95 CCD
Ghana | 96 CCD
Dominican Republic | 97 BCD
Mongolia | 98 BDD
Mauritania | 99 BDD
Congo (Dem. Rep.) | 100 BBD
Chad | 101 BCD
Macedonia | 102 CDD
Malawi | 103 BCD
Kenya | 104 BCD
Nicaragua | 105 BDD
Tajikistan | 106 BCD
Honduras | 107 BDD
Jordan | 108 BDD
Nepal | 109 BDD
Niger | 110 BCD
Morocco | 111 CCD
Jamaica | 112 CCD
Zambia | 113 BDD
Libya | 114 CCD
Ethiopia | 115 BDD
Serbia | 116 CDD
Cambodia | 117 CDD
Pakistan | 118 BDD
Syria | 119 BCD
Madagascar | 120 CCD
Tanzania | 121 BDD
India | 122 CDD
Lebanon | 123 CDD
Moldova | 124 CDD
Bangladesh | 125 CDD
Yemen | 126 CDD
Senegal | 127 CDD
Benin | 128 DDD
Zimbabwe | 129 DDD

The results of the 2014 Energy Trilemma Index show that the top 10 countries are developed countries with higher shares of energy coming from low- or zero-carbon energy sources, supported by well-established energy-efficiency programmes. Beyond these commonalities, there are differences in energy resources and supply, such as large discrepancies in the use of nuclear energy. The differences reinforce the conclusion that there is no single solution, but that countries need to take full advantage of available indigenous resources where appropriate and develop policy frameworks that support energy sustainability through the value chain to the end user.

Figure 2

Top 10 Energy Trilemma Index performers overall and per dimension

Source: WEC/Oliver Wyman, 2014

The 2014 Index rankings and balance scores also show changes for a number of countries – including high performers. Both Germany and Spain are showing downward trends since 2012 and have moved out of the top 10 overall ranking. Germany's changes are driven by rising prices for both gasoline and electricity and their impact on energy equity as the country works to transform its energy system. Germany's bold energy transition plans, which include the goals of increasing power generation from renewable sources, a reduction of primary energy usage and CO_2 emissions, and a phase-out of nuclear energy by 2022, require significant and costly changes to Germany's incumbent energy system. It is estimated that close to US$470bn of investments are needed by 2033. Of this amount, about US$280bn will be needed as soon as 2023. Renewable power generation will be the highest cost item, followed by investments in expanding distribution and transmission networks, including the introduction of smart meters. This alone will likely require around US$110bn. Conventional power generation (including gas and new coal-fired power stations) and storage will require investments in the order of US$60bn in order to secure supply given the intermittency of renewable power generation.[7]

[7] Oliver Wyman, 2014: Financing Germany's Energy Transition, (Oliver Wyman Energy Journal)

Germany's challenges are symbolic of issues facing mature developed economies working to craft and finance a successful transition from an ageing energy system (largely built 50 years ago) to one that serves the needs of economies and societies for the next 50 years and beyond. It must also do so within sharply defined political constraints and changing business models. As further changes in rankings and balance scores may occur during the transitional period, Germany has been included in WEC's watch list. Additional countries on the watch list are the United Kingdom (UK), Japan, Italy, Mexico and the United Arab Emirates (UAE). Here, recent changes or unscheduled events that are not yet reflected in the data may lead to a change in Index performance, both positively in the case of Mexico and the UAE and negatively in the case of the UK, Japan and Italy.

By contrast, other countries have moved up the Index rankings with improvements in different dimensions. For example, the Philippines have continued their upward trend with constant improvements on all dimensions, including an increased diversity of electricity fuel mix. Yet the country continues to struggle with energy equity, as energy prices remain expensive and 17% of Filipinos continue to live without access to modern electricity services.[8] In Latin America, Colombia strengthens its overall Index position and continues to benefit from the energy security and sustainability impacts of hydropower, but its performance is still somewhat unbalanced with a relatively lower performance on energy equity. Overall, however, as an active member of the Rio+20 Summit (the United Nations Conference on Sustainable Development), the country is seeing the benefits of a sustained policy focus on how to address its energy trilemma.

Over the next five years we can expect to see more changes in Index performance as recent investments and policy decisions begin to take effect. These include the effects of industrialised emerging economies' efforts to manage energy demand growth and enhance environmental sustainability, the continued rapid growth in renewable energy in developed and developing countries, the United Nations (UN) Sustainable Energy for All initiative beginning to make inroads, and the tapping of other energy resources. For example, one key area is in Africa, where huge resources remain untapped: it is estimated that only 7% of the continent's hydropower potential and less than 0.7% of its wind potential has been used.[9] Using even a small proportion of these resources could have a transformational impact on the quality of life in Africa, as African countries economically progress and also on its contribution to the global economy.

[8] Sustainable Energy for All (SE4ALL), 2013: Global Tracking Framework
[9] The Economist, 2013: Lighting up Africa, 18 November, 2013

How to unlock US$48trn investment in energy infrastructure

OBSTACLES AND BARRIERS

Unlocking capital sources

Roughly US$48 trillion investment in energy infrastructure is required over the next 20 years to replace ageing assets, build new energy infrastructure, meet climate change targets, and provide access to the 1.2 billion people without energy.

Managing trade-offs

Balancing the three dimensions of the energy trilemma is hard. And, as time elapses, it will get even harder and more expensive.

Reducing uncertainty

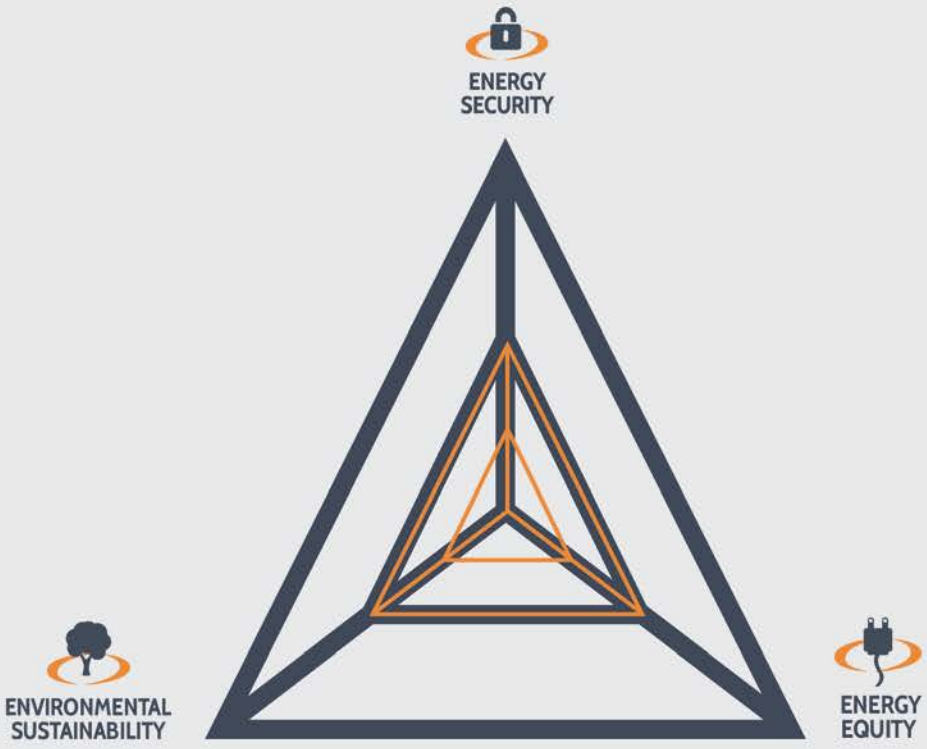
Political and regulatory uncertainty driven by national policy and regulatory changes, lack of an international climate framework, and the speed of technology development drives up the cost of capital and deters investment.

RECIPE FOR SUCCESS

The World Energy Trilemma report helps governments rise to the challenge the World Energy Council has defined as the energy trilemma.

Balancing the three core dimensions of the energy trilemma – energy security, universal access to affordable energy services, and environmentally-sensitive production and use of energy – is the basis for prosperity and competitiveness of individual countries.

Sustainable energy is not only an opportunity to transform societies and grow economies, but also a necessity – a prerequisite to meet growing energy demand and reduce the carbon footprint.



WHAT IS AT RISK?

Meeting energy demands

Secure energy is critical to maintaining and driving economic growth. Meeting rising demands for energy enables the expansion of all sectors of the economy including agriculture, transport, manufacturing, construction, health, and social services.

Delivering social benefits

Energy must be accessible and affordable at all levels of society. The shift from primary energy to electricity is a key feature of modern society and increased energy access is strongly correlated to growth in education, life expectation, and economic development.

Minimising environmental impacts

The impact of energy production and energy use on the environment must be minimised in order to combat climate change as well as the implications of local air and water pollution.

TIME TO GET REAL

Governments and policymakers

Policymakers must focus on reducing political and regulatory risks

- Have a clear vision for sustainable energy and a master plan with clearly defined energy sustainability goals
- Define coherent, long-term, and predictable energy policies, underpinned by well-implemented regulations
- Recognise that investors are not going to provide capital without an attractive profit

Financing community

The financial infrastructure must exist for capital to flow easily to the energy sector

- Help policymakers and energy sector understand the role of different financial investors and instruments
- Support efforts for the standardisation of instruments
- Review existing rating models and develop new approaches to bundle smaller-scale projects

Energy industry

The energy sector must bring clearly bankable projects to the market

- Be more proactive in the dialogues around energy policies
- Establish standard procedures and best practices for data and disclosure
- Create new pricing models that meet the reality of changing business models and encourage demand side response

Collaborative action is required

Provide leadership to build consensus – nationally and globally – as the core platform on which to craft predictable and durable energy policy

Create joint dialogue platforms for information exchange and to increase understanding that encompasses the energy system as a whole

Form research coalitions and encourage joint pre-commercial industry initiatives

Develop a process that ensures a strong and common understanding of emerging technologies and how they can support national and international energy and climate goals

Build capacity in developing and emerging economies to support the development of a robust project pipeline

Identify how investors' risk-reward equations can be aligned with the need to provide accessible and affordable energy

Stimulate the financial sector by ensuring public policy is attractive and business friendly enough for money to flow

WHAT GETS MEASURED, GETS DONE

The Energy Trilemma Index provides the world's most comparative assessment of how countries perform in delivering sustainable energy systems. The Index enables countries to visualise their energy system and identify areas for action. Further information can be found online at **www.worldenergy.org/data/sustainability-index**

2014 Energy Trilemma Index – Top 20 countries

01	Switzerland	AAA
02	Sweden	AAA
03	Norway	AAB
04	United Kingdom	AAA
05	Denmark	AAB
06	Canada	AAB
07	Austria	AAB
08	Finland	ABB
09	France	AAB
10	New Zealand	AAB
11	Germany	BBB
12	United States	AAC
13	Australia	AAD
14	Netherlands	BBB
15	Spain	ABB
16	Colombia	AAC
17	Slovakia	ABB
18	Luxembourg	AAD
19	Costa Rica	ABB
20	Qatar	AAD

Conclusion

There are significant challenges for governments, the energy sector and the financial community over the next 20 years and beyond to meet the projected investment needs to expand energy access, develop new energy technologies, replenish ageing infrastructure assets and associated supply chains, and make energy infrastructure more resilient. Greater engagement is needed from all stakeholder groups to build understanding and trust among policymakers, investors and the energy sector.

Leadership is needed from governments to set targets, develop strategies and create policies and regulations that give the energy and financial sectors certainty that their investments can be recouped and profits made, while meeting the needs of citizens and the economy as a whole.

It is important for the energy sector to ensure that public policy is attractive and business-friendly by engaging in the policymaking process and sharing knowledge and feedback to overcome the information asymmetry. Together, energy leaders from the public and private sectors must actively engage the financial community, highlight the significant opportunities presented by energy sector investments, and find solutions to operate within the challenges.

As the energy system looks to be more market orientated, market dynamics become more important and, with competing demands for capital, external economics will play a more influential role in the success or failure of energy policy goals. The findings and recommendations in this report and the benchmarking the Energy Trilemma Index provides, can help to ensure that countries deliver the conditions to provide for sustainable energy systems.

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If you get the price right,
the private sector
will pile in

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Introduction

Sustainable energy is not only an opportunity to transform societies and grow economies, but also a necessity – a prerequisite to meet growing energy demand and reduce the carbon footprint. That is why it is so important to balance what the WEC defines as the energy trilemma. Balancing the three core dimensions of the energy trilemma is a strong basis for prosperity and competitiveness of individual countries. Secure energy is critical to fuelling economic growth. Energy must be accessible and affordable at all levels of society to ensure social stability. The impact of energy production and energy use on the environment needs to be minimised to combat climate change as well as local air and water pollution.

This sixth annual report builds on the previously developed dialogue among global energy leaders – chief executive officers, senior executives, ministers for energy and the environment, senior policymakers, and regulators, as well as high-level representatives from inter-governmental organisations – discussing what is needed to succeed in providing environmentally-sensitive, affordable, accessible, and secure energy. It adds to the recommendations made in 2013 in World Energy Trilemma: Time to get real – the agenda for change and brings forward the perspectives of the financial sector.

The goal of this report is to continue supporting the global dialogue between energy leaders from the public and private sector and to highlight areas where progress and change may help unlock the investment that is needed along the energy value chain.[10]

Global energy demand is predicted to increase by 1.5% per year through to 2035. To meet this demand, an estimated cumulative investment of US$40.2trn is required across the energy infrastructure supply chain over the period 2014 to 2035, with an additional US$8trn investment needed in energy efficiency measures and more energy-efficient technologies. These investment requirements rise by a further 10% to a total of US$53trn in cumulative investment to 2035 if the target is set to a 2°C emissions path, as the speed at which the decarbonisation of the energy sector takes place would need to be increased substantially. This scenario would see a shift away from fossil fuels and double the investments in energy efficiency and low-carbon technologies such as renewables and nuclear power.[11] However, the effect that extreme weather events and climate change may have on existing energy infrastructure assets is not included in this estimate. For example, changing rainfall patterns may have an impact on water supply needed for electricity generation from fossil fuel, nuclear, and hydropower and will require further adaptation and investment.

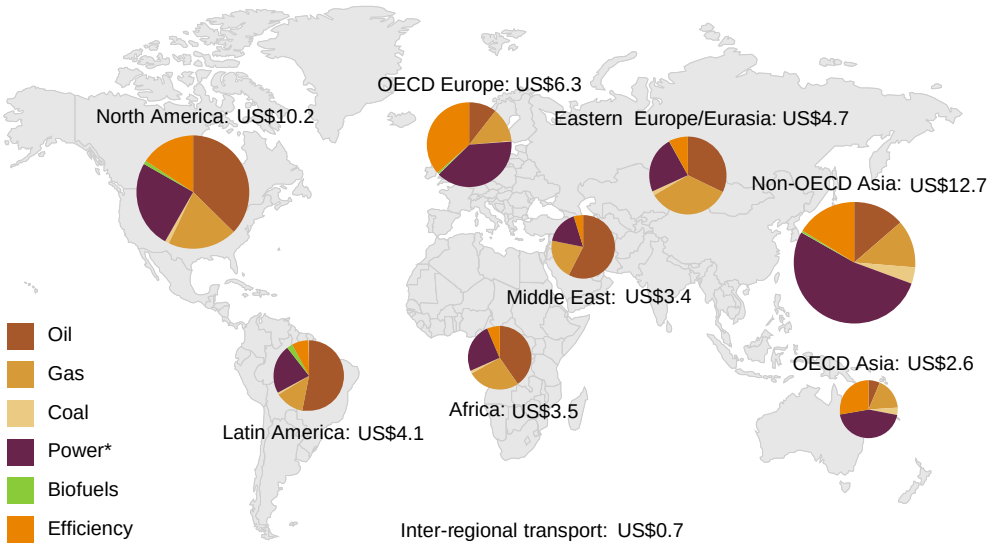
[10] The energy value chain is a sequence of productive activities, which start with exploration and production of the primary energy for subsequent processing, transportation, distribution and use.
[11] IEA, 2014: World Energy Investment Outlook

The needed investments are huge, but the costs caused by insufficient modern energy systems are far greater. The shift from primary energy to electricity is a key feature of modern society and increased energy access is strongly correlated to growth in education, life expectancy and economic development. For example, the lack of electricity stunts the development and growth of businesses and services, as demonstrated in a survey of sub-Saharan African countries where one-third of respondents cited poor access to electricity as the top constraint on enterprise growth; in Pakistan, electricity shortages are estimated to have cost the country 6% of annual gross domestic product, and caused the loss of approximately 500,000 jobs in recent years;[12] and it is estimated that 4.3 million deaths globally can be linked to indoor air pollution in 2012 due to the use of solid fuel wood stoves and heating.[13] The impact energy has on people's life remains unchanged and its central role on economic and social development needs to be recognised by including it as a distinctive and stand-alone element of the post-2015 Development Agenda.

Figure 3

Energy infrastructure investment needed by region 2014–2035 (based on IEA's New Policies Scenario,[14] in US$ trillion)

Source: International Energy Agency (IEA), 2014: World Energy Investment Outlook



* Power includes generation, transmission and distribution

Historically, governments have retained ownership of more than 70% of global oil and gas reserves and control of nearly half of the world's power generation capacity via state-owned companies.[15] However, in many countries, governments have limited capacity to fund the infrastructure necessary to expand energy access, replace legacy assets, and shift to a low-carbon energy system. To fill the gap, more private sector capital is needed. This, in turn, will release government's resources to address other critical social and economic challenges.

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[12] Wall Street Journal, 2013: Power Outages Hobble Pakistan's Biggest Exporters, 29 November, 2013
[13] World Health Organization (WHO), 2014: Burden of Disease from Household Air Pollution for 2012: Summary of results
[14] Takes account of broad policy commitments and plans that have been announced by countries, including national pledges to reduce greenhouse-gas emissions and plans to phase out fossil-energy subsidies, even if the measures to implement these commitments have yet to be identified or announced.
[15] IEA, 2014: World Energy Investment Outlook

This report's findings are based on qualitative and quantitative analyses. In qualitative terms, the report presents the perspectives of the financial community on how to attract investments to the sector, gathered through almost 50 interviews with executives from leading commercial banks, multilateral development banks, pension funds, and institutional investors covering all geographic regions (see Appendix A). Throughout this report, statements in quotation marks are the direct insights and comments of the interviewees.

In quantitative terms, the report presents the annual Energy Trilemma Index rankings which draw on 60 data sets to develop 23 indicators. It sets out a comparative assessment of the effectiveness of 129 countries' policies in balancing the energy trilemma. Energy trilemma rankings and challenges are also discussed in the context of key issues relating to energy investments. The findings of the Index analysis are complemented with 93 individual country profiles – of WEC member countries only – captured in the companion report, 2014 Energy Trilemma Index: Benchmarking the sustainability of national energy systems.

Box 2: Index methodology

The Energy Trilemma Index provides a comparative assessment tool for public and private stakeholders to evaluate where the country of their interest is positioned against others. As countries have unique resource endowments, policy goals and challenges, the overall rank of a country may be less meaningful than its relative performance versus its peers or individual performance over time. Trends and balance within the three dimensions provide valuable information in helping countries address their energy trilemma. Rankings from three consecutive years are covered in the Index and are broken down by dimension. Hence, a country can track the results of energy policies not only on a macro level, but on each dimension as well.

The Energy Trilemma Index comparatively ranks countries on three dimensions: energy security, energy equity, and environmental sustainability. The rank measures overall performance on the Index and the balance score highlights the trade-offs that exist with the energy trilemma and points to key areas that countries must focus on to further develop a balanced energy profile and minimise the uncertainties and risks associated with an unbalanced approach.

The rankings are based on a range of data points that capture both energy performance and the context of that energy performance. Energy performance indicators consider supply and demand, the affordability of, and access to, energy, and the environmental impact of a country's energy production and use. The contextual indicators consider the broader circumstances of energy performance, including that country's political, societal, and economic strength and stability. Indicators were selected based on their high degree of relevance to the research goals. Each is distinct, can be derived from reputable sources and is captured for most countries.

Further information on Index methodology, previous rankings, and the score system can be found in Appendix C.

Each country will balance the energy trilemma in its own way, according to its developmental stage, resource endowment, policies and regulations, as well as its economic and societal goals and needs. Yet patterns exist and grouping countries with similar energy trilemma profiles can help policymakers identify existing or emerging successful solutions to common problems. The challenges are illustrated by five distinct profile groups identified from the Index analysis – with countries in each group sharing energy trilemma characteristics and challenges. While simplified and not comprehensive, these profiles serve as benchmark guides to other countries with similar conditions.

These five Index profiles were initially presented in the 2013 Energy Trilemma Index and are based on their performance in the three dimensions of the energy trilemma: energy security, energy equity, and environmental sustainability. With the exception of the 'Pack leaders', the groupings are not based on a country's absolute performance, but rather on its relative and comparable performance on the three dimensions (see Appendix C). Furthermore, each group contains some countries that are further along the path of economic and social development than others, but still face (or once faced) comparable energy challenges.

Table 1

Five profiles of energy investment challenges

Source: WEC/Oliver Wyman, 2014

	Illustrative members	Key energy trilemma strengths	Core energy investment needs and challenges
Pack leaders	Switzerland, Sweden, United Kingdom	Overall, high performance and balance due to legacy of incumbent system and economic strength: benefit from investment decisions taken decades ago.	Transforming incumbent systems and maintenance of high-performing utility sector; managing energy demand and continuing to drive energy efficiency.
Fossil-fuelled	United Arab Emirates, Malaysia, Saudi Arabia	Affordability and security of energy due to the availability of exploitable fossil fuels.	Stimulating a sustained transition to less intense energy use; managing rising exploration costs and risks for oil and gas; and responding to changing energy markets.
Highly-Industrialised	China, Mexico, Russia	Energy security and strong GDP growth.	Development of financial markets and a secure investment profile; managing energy demand and increasing energy efficiency; increase investment in energy system to support economic growth.
Hydro-powered	Brazil, Colombia, Ethiopia	Strong use of renewables leads to low emissions and higher electrification rates.	Development of financial markets and a secure investment profile; developing bankable projects and increasing investors' comfort with new renewables to strengthen the resilience of energy systems.
Back of the pack	Senegal, Nicaragua	Countries are not locked into a fossil fuel heavy development path.	Country risk ratings may hinder potential investments; developing bankable projects, local financial market capacity and human capacity.

Key strengths and challenges are similar for these illustrative countries. Parallels can also be drawn in how to attract investments into the energy sector. ‘Pack leaders’ perform well on the Index and have a balanced trilemma profile and many of these countries are front-runners at re-designing policies and regulation and adapting them to meet future requirements. This often leads to unintended consequences, in particular when it comes to attracting investments. ‘Fossil-fuelled’ countries need to find the means to finance the increasing cost of exploration and production as reserves become more difficult to exploit, while at the same time reducing the costs of fuel subsidies and mitigating the environmental impact of their endeavours. ‘Highly-industrialised’ countries aim to increase investments into their energy systems to support economic growth. ‘Hydro-powered’ countries are targeting an expansion of ‘new renewable’ energy generation sources to strengthen the resilience of their energy systems and must build up investor comfort and confidence in investing in these projects. Both ‘Highly-industrialised’ and ‘Hydro-powered’ countries face the challenge of developing capital markets that allow the level of debt financing (selling bonds or currency) necessary to finance their projects. Lastly, ‘Back of the pack’ countries must focus on developing the prerequisite governance, legal and regulatory frameworks to support investments, as well as building the local capacity to bring forward a strong pipeline of bankable projects and domestic financial markets.

The WEC conducted the overall project in partnership with the global management consulting firm, Oliver Wyman, a subsidiary of Marsh & McLennan Companies. Senior representatives from WEC member committees served on a study group that guided the analysis and shaped the report’s contents. Further details on the project’s participants and the supporting analyses can be found in the appendices.

Box 3: Iconography

Graphics displaying results of the Energy Trilemma Index analysis make use of the following iconography.

Energy performance dimensions:


Energy security


Energy equity


Environmental sustainability

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The policy uncertainty for energy infrastructure projects is truly numbing

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1. Setting the framework to attract energy investments

The policy and market fundamentals for attractive energy investment conditions are common with other large-scale and long-term infrastructure investments. However, there are a number of factors that create unique, accumulating and complex risks for energy investments. Many countries, in both OECD and non-OECD member countries, have some form of restrictions on foreign direct investments in energy in an effort to maintain control over natural resources and support energy security. Also, energy is typically highly regulated given its contribution to economic and social development. Thus, a country's energy policy and regulatory framework are key factors affecting investment in the energy sector. Yet energy policy is political and subject to policy and regulatory changes as countries struggle to ensure energy security and affordability and respond to national and international approaches to managing the impact of energy production and use on the environment. Moreover, energy projects are hugely capital intensive, often US$5bn or more with long bidding, development and construction periods, and relatively long pay-back periods. Finally, compared to social infrastructure (housing, schools, and health), economic infrastructure projects, including energy, are much more exposed to price, volume, demand, and commodity price risks. The sector also continues to undergo technological developments. These investment risks vary across the energy sectors:

- Within the power sector, the interrelated risks include: fuel cost risks (conventional thermal power generation); technology risk as the generation and transmission sub-sectors undergo changes driven by renewables, distributed generation and smart-grids; and demand risk correlated with economic growth. These risks are embedded within a changing and uncertain regulatory framework which can include, in many countries, price regulations.
- Fossil fuels, including oil, gas and coal, are also facing rising regulatory and political uncertainties driven by the lack of a global climate change framework, and varying national level carbon targets and/or carbon prices. Projects can also be subject to variations in the taxation regime after the initial investment decision. In addition, there are geological risks, production, and technological change risks as exploration costs and complexity increase. There are also many questions over the environmental impact.
- Renewable energy projects face technical challenges as countries work to maintain grid stability to accommodate the intermittency of renewables. At the same time, geographical constraints need to be addressed as renewable energy is often generated in areas that are not connected to the existing grid. Renewable energy projects are also particularly affected by regulatory regimes that may have an impact on revenue flow and profitability once projects are operational. The

majority of the capital costs are upfront during construction and return on investment is dependent on the revenue streams once operating.

From a financial viewpoint, many of the above variables can be priced, provided there is access to adequate information (see Chapter 3). However, for some risks such as political/regulatory risks, there is only so much that can be accurately predicted by financial modelling. Ultimately, investors will attach a premium to the cost of financing to take account of uncertainty. This, in turn, feeds through to the cost of capital. Where a significant risk premium is applied (that is, where there may be significant uncertainty around future policies and regulation, technology or other key drivers of a project's returns), this may significantly impact on financing costs and ultimately may have a direct (and adverse) impact on a project's viability. As one interviewee pointed out, "The greatest expense by far is the cost of the capital used to finance the project".

The financial sector's perspectives on how policy and regulatory regimes affect their assessment of investments in the energy sector are presented in the following chapter and are also illustrated by the 'Pack leaders' countries in the 2014 Energy Trilemma Index.

Lack of an overarching global climate framework

At an international level, the continued lack of an overarching international climate framework creates uncertainty around the future country-level greenhouse gas (GHG) emission policy frameworks and the market outlook for energy sub-sectors. At the United Nations Framework Convention on Climate Change (UNFCCC) in Cancun, Mexico in 2010 (the 16th session of the Conference of the Parties, or COP-16), governments agreed that the average global temperature increase must be held below 2°C, and GHG emissions must be reduced. At COP-18 in Doha, Qatar, in 2012, governments set a target to adopt a protocol, another legal instrument, or an agreed outcome with legal force under the Convention applicable to all parties at COP-21 in December 2015, and that this would come into effect and be implemented from 2020.

The parameters of a future climate framework remain uncertain but it is clear that the financial implications of stronger climate policies will have differing impacts across the energy industry. For example, under a 2°C trajectory, net revenues for existing nuclear and renewables-based power generation plants would be boosted by US$1.8trn through to 2035, while the revenues from existing coal-fired plants would decline by a similar level. Of new fossil-fuelled plants, 8% would be retired before their investment is fully recovered. Looking to oil and gas, it is estimated that no oil or gas field currently in production would need to shut down prematurely. However, some fields will not be able to be developed before 2035, and 5–6% of proven oil and gas reserves do not start to recover their exploration costs in this timeframe.[16] In the future, research has estimated that between 60–80% of coal, oil and gas reserves of publicly listed companies are 'unburnable' if a global warming temperature of 2°C is to be avoided.[17] The high degree of uncertainty among energy leaders caused by the lack of an international climate framework is highlighted in the WEC's annual World Energy Issues Monitor (see Figure 4).

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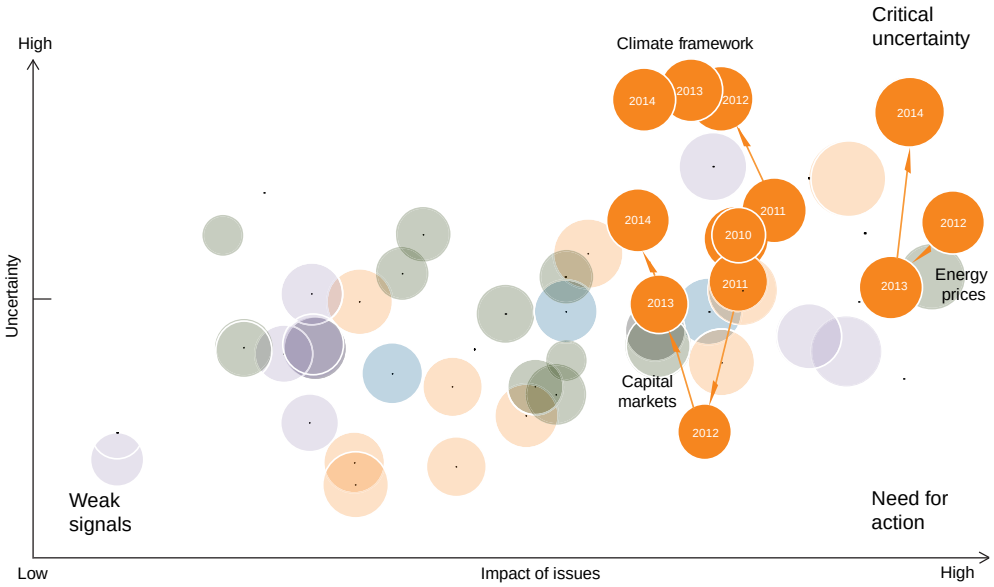
[16] IEA, 2013: Re-drawing the Climate Energy Map

[17] Carbon Tracker, 2013: Unburnable Carbon 2013: Wasted capital and stranded assets. In response to the debate, Shell recently stated that its reserves were not in danger of being stranded by future climate/carbon legislation as has ExxonMobil.

Figure 4

The lack of a global climate framework, the development of energy prices and capital markets are among the greatest uncertainties for energy leaders[18]

Source: WEC, 2014: World Energy Issues Monitor



At a regional or country level, attempts have been made to set climate frameworks and price carbon, such as the European emissions trading scheme. However, this high-profile scheme suffered from a number of implementation challenges, including an overestimation of demand due to the economic downturn and the unintended impact of other policy requirements, such as binding targets for renewables. Subsequently, it resulted in an excess of capacity and a carbon price that is below the level that effectively drives changes in CO_2 output. It was also hampered by a lack of consistency across geographies. For example, in some countries the government imposes financial costs, such as a selective carbon tax in addition to the EU scheme. In other instances, countries have repealed carbon taxes, as witnessed in Australia. There, instead of decreasing pollution through a carbon tax that charges polluters based on their GHG emissions, the government plans to spend money on an Emissions Reduction Fund, an attempt to reduce pollution by paying industries to curb emissions as well as use clean energy sources. Whether this approach will help the country deliver on its goal to cut GHG emissions by 5% below 2000 levels by the year 2020 remains to be seen. These and other similar actions by governments continue to distort the global energy market and feed uncertainty in terms of how future policies will be applied.

Country-level environmental policies to curb GHG emissions or other pollutants can also have significant impacts on future investments. For example, there are views that stricter regulations proposed by the US Environmental Protection Agency's (EPA) Clean Power Plan will make the building of new coal-fired generation increasingly difficult. Some are warning that "in the US, coal-fired power generation is being

[18] The WEC's annual issues monitor gathers the views of the WEC's energy leadership community from over 90 countries, to assess the evolution of the global energy agenda in a high-level overview. The maps provide an insight into the critical uncertainties affecting the energy sector, identifying key trends while highlighting the areas where action is needed to ensure the sustainable supply and use of energy for the greatest benefit of all.

The 'Pack leaders' are top performers in terms of both dimensional balance and overall ranking on the Energy Trilemma Index. The majority of the best performing countries rank in the top one-third of all countries in all three dimensions.

Pack leaders

Figure 5

Trilemma profile and illustrative countries: Pack leaders

Source: WEC/Oliver Wyman, 2014

Countries	Index rank	Balance score
Switzerland	1	AAA
Sweden	2	AAA
United Kingdom	4	AAA
Denmark	5	AAB
Austria	7	AAB
France	9	AAB
New Zealand	10	AAB
Germany	11	BBB
Netherlands	14	BBB
Spain	17	ABB

Pack leaders are all high gross domestic product (GDP) per-capita, OECD member countries with mature and strong political, societal and economic frameworks. However, few countries are able to maintain a balance on the trade-offs within the energy trilemma comparatively well, and even these leading countries face significant energy issues.

Today, Pack leaders still benefit from investment decisions taken decades ago, but one of the greatest challenges they face is the need to drive and finance changes in their ageing and incumbent energy systems. In particular, these countries are focused on switching to lower-carbon fuels, improving energy efficiency in transmission and distribution, increasing the use of low-carbon technologies, and reducing final energy demand. Even without the need to decarbonise the energy system, Pack leaders would have to update ageing assets that are coming to the end of their life cycle. For example, in Germany, Switzerland, the UK, and New Zealand, 38% of power plants are on average over 33 years old, including nuclear power plants.[19] Transmission and distribution lines will also need to be replaced over the next 20 years.

This situation creates a number of closely related challenges and opportunities. For example, while legacy assets will continue to operate and be essential to energy security, ageing conventional power plants will be replaced with low- and zero-carbon technologies (for which costs are decreasing). Encouraging more distributed generation systems is an opportunity to decarbonise the energy system. However, this same opportunity is a major challenge as existing transmission and distribution systems are often not able to balance the intermittency and disruptiveness of these newer technologies. Policymakers must craft the right market structures, policy frameworks and regulations to attract the needed investments by 2035 to ensure energy security, preserve affordability of energy services and competitiveness of economies, and meet decarbonisation goals. The power to promote investment in the energy sector will remain with public policymakers, and policy and regulatory approaches will need to reflect the dynamics and changes of the energy sector.

[19] Germany's Federal Network Agency, Bundesnetzagentur; New Zealand Electricity Authority; Swiss Federal Office of Energy; UK's Department of Energy & Climate Change.

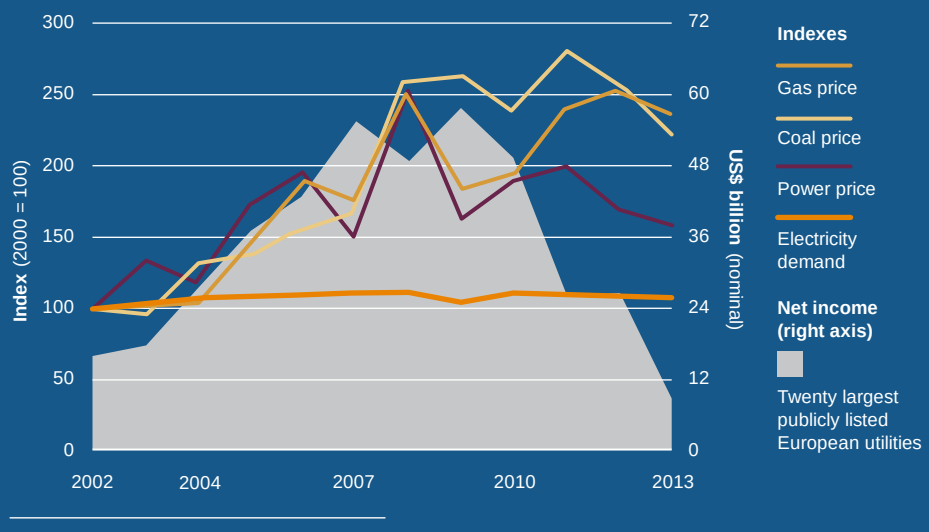
The outlook for this investment is uncertain. In Europe, under current market rules, wholesale electricity prices are approximately 20% below cost-recovery levels.[20] Higher wholesale prices could increase end-user bills, and raise concerns about the global competitiveness of the EU industry. Pack leaders have comparatively high prices for both electricity and gasoline already, but because of fairly high GDP per capita, energy services remain affordable to the majority of the population. Nevertheless, rising energy prices are putting growing pressure on households. For example, in the UK, the average prices of gas and electricity paid by UK households between 2010 and 2012 rose by around 18% and 9% (in real terms), respectively, and between 2007 and 2012 by around 41% and 20% (in real terms), respectively;[21] in Germany electricity prices for households increased by more than 10% from 2012 to 2013.[22] These figures put pressure on politicians to respond to consumer anger over energy companies' profits and renewable targets. At the same time, energy companies need to fund the critical updating of the transmission and distribution system as well as the generation systems. Heavy (non-market based) subsidies to primarily intermittent power have created what some interviewees refer to as a "lose-lose situation" for energy companies and customers, as energy prices go up and energy company profits are eroded (see Figure 6).

In the face of these broad trends, the scope of the changes facing utilities is so large that some commentators say that the traditional, franchised, regulated energy distribution utility model is broken and may be entering a 'death spiral'.[23] Currently, the pace of change and the final utility model is unclear. Over the next 20 years, the electricity transmission and distribution network in many mature economies will likely become a hybrid consisting of the traditional model with centralised grids and the emerging model that included distributed off-grid generation, storage and micro-grids. For example, it is estimated that the size of the European decentralised market could grow to around one-third of the total utility market within the next two decades, causing the addressable market for traditional utilities to shrink by half.[24] Utilities must respond to the trends that are affecting revenue streams and develop new products and services to create new sources of revenue serving as an energy solutions provider for their customers as they face increased competition from those that design, manufacture, install, and maintain distributed technology infrastructure.

Figure 6

Evolution of energy prices, electricity demand and net income for Europe's top 20 publicly listed utilities

Source: IEA, 2014: World Energy Investment Outlook



[20] IEA, 2014: World Energy Investment Outlook
[21] Estimated impacts of energy and climate change policies on energy prices and bills 2012, Department of Energy and Climate Change, UK, March 2013
[22] IEA, 2014: Energy Prices and Taxes. Quarterly statistics (First quarter 2014)
[23] Brookings, 2014: No Imminent Renewables "Death Spiral" for India's Utility Companies, but Other Challenges are Looming,10 June 2014; Ecologist, 2014: Barclays: Solar power threatens US utilities, 13 June 2014; Business Inside, 2014: Barclays Has The Best Explanation Yet Of How Solar Will Destroy America's Electric Utilities, 28 May 2014
[24] Oliver Wyman, 2014: The New Utility Business Model

regulated out of existence". The growing interest in the potential implications of carbon agreements are leading to an active debate around whether fossil fuels could become 'stranded assets'. In other instances, concerns about the impacts of climate change are leading some investors to consider divesting in fossil fuel companies as part of an overall effort to increase the sustainability of investment portfolios or to respond to concerns for socially and environmentally conscious investing.

Overall, it can be hard to define and assess the extent to which investments (current or planned) in the energy sector may be deterred or delayed due to the lack of an international climate framework. However, as policymakers focus on developing a meaningful international climate framework, it is important that they remain in close dialogue with the energy and the financial sector to ensure the framework can be implemented to achieve its goals and maintain necessary investments in energy. Furthermore, policymakers must focus on ensuring synchronisation between multinational and national frameworks – for example, ensuring the January 2014, European Commission (EC) proposal for 2030 climate and energy goals for a competitive, secure and low-carbon EU economy can be aligned with international frameworks.

The need for transparent, long-term, and coherent policy

Leaders from both the public and private sectors set out their perspectives on the necessary policy and regulatory conditions to attract energy investments in the 2012 and 2013 World Energy Trilemma reports. Reassuringly, there was a high degree of agreement between them. Overall, they agreed that the essential foundation for an attractive energy investment environment is a clear vision and 'master plan' that leverages all energy sources and technologies. As illustrated in Figure 7, governments must set the framework and the boundaries to help overcome the hurdles surrounding regulations, markets, technologies, and customer preferences by setting a clear agenda in three key, interconnected policy areas:

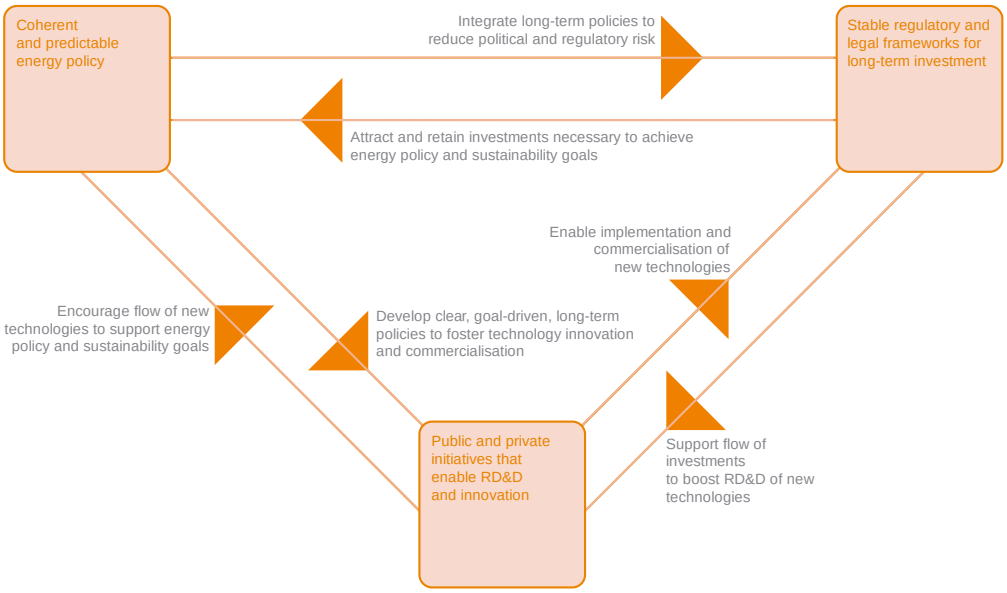
- Define a coherent and predictable energy policy.
- Enable market conditions that attract long-term investments.
- Encourage public and private initiatives that foster research, development and deployment in all areas of energy technology.

The financial sector concurred with these views and again stressed the importance of coherent, long-term, predictable, and transparent energy policies, regulation and adjacent policy areas to attract the necessary investment. As one financial executive noted, "It is a global competition where large companies specialising in energy are more attracted to countries where there is a history of transparent, consistent and attractive regulation".

Figure 7

Three key interconnected policy areas are necessary to create an attractive foundation for energy investments

Source: WEC, 2012: World Energy Trilemma: Time to get real – the case for sustainable energy policy



A sound energy policy must be embedded within an overall business environment that has a stable legal and institutional framework for investments. Investments will be constrained where there are concerns around expropriation or sovereign risk, poor governance or conflict around expropriation. World Bank studies suggest that political economy concerns can increase borrowing costs between 2% and 6% depending on the country and region.[25] As one interviewee noted, “Sometimes it is not clear if it is an endogenous or exogenous problem since many countries that lack a sound investment climate for the energy sector actually lack an investment environment in general”.

Politics and the impact on energy investments

National energy policies are particularly susceptible to political intervention. As one interviewee commented, “Energy has always been very political and always will be”. Energy politics have become more fractious in many countries, given growing concerns about energy security driven by geopolitical changes and also a range of views on climate change. While in many countries there is agreement that changes in energy infrastructure (and therefore investment) need to happen, there is much less agreement about the future structure or how to pay for the shift. Rising energy bills for industry and consumers are becoming particularly contentious in many European countries such as the UK, Germany or France, and leading to debates on how to maintain economic competitiveness. For example, in February 2014, the chief executives of more than 100 energy-intensive companies with large operations in Europe called on European policymakers to ease carbon-cutting mandates to reduce European energy prices and improve competitive positioning against the US.

[25] Multilateral Investment Guarantee Agency (MIGA), 2007: Project Finance Yearbook 2006/2007

In many developing countries, the price of energy is also a major concern. Many governments use energy subsidies to make energy services affordable to a wider population, despite evidence that consumer energy subsidies favour the rich (who use more energy) over the poor and can act as a break on economic development as they can encourage inefficient energy use and impose substantial fiscal and economic costs. Indeed, the International Monetary Fund (IMF) estimates that the annual global cost of government subsidies for fossil fuels in 2012 was almost US$2trn (factoring lost tax revenues) – a figure that is equal to the estimated global annual energy infrastructure requirements through to 2035.[26] But reforms to subsidy programmes are very challenging. For example, in the least-developed countries, governments also have to consider that higher energy tariffs could push people to increase their use of traditional energy sources which can have negative impacts on the environment and health, but also affect future demand. Effective subsidy reforms require a range of sophisticated measures and their consequent implementation, including strong public education and communication programmes to reduce public backlash.[27]

A number of governments have tried to tackle subsidies with varying success. While countries such as Turkey, Brazil, the Philippines, or Kenya have been successful in removing or strongly reducing fossil fuel or electricity subsidies, other countries such as Indonesia, Iran, Peru, or Ghana have struggled in their efforts.[28] For example, in 2013 Indonesia reduced fossil fuel subsidies and increased prices by more than one-third with the goal of reducing the US$20bn annual fuel subsidy bill. It was hoped that the funds could be redirected in part to infrastructure investments to support continued economic growth. However, the government faced a significant amount of public protest and it remains to be seen if the cut in subsidies can be maintained by the new incoming government in 2014.[29] Ghana's attempt to reduce fuel subsidies over the past almost 10 years has been a back and forth effort met with major public opposition. For example, fuel subsidies were completely removed in May 2013,[30] but re-introduced in April 2014 to meet broad popular expectations that citizens should share the benefits of large volumes of oil exports. Only three months later, in July 2014, and after increasing pressure from the IMF and rating agencies to cut spending and restore fiscal stability, legislation was passed to partially remove fuel subsidies for certain products.[31]

[26] IMF, 2013: Energy Subsidy Reform: Lessons and implications
[27] International Institute for Sustainable Development (IISD), 2014: Lessons Learned: Malaysia's 2013 Fuel Subsidy Reform
[28] IMF, 2013: Energy Subsidy Reform: Lessons and implications
[29] The Economist, 2014: Fuelling Controversy, 11 January 2014
[30] Reuters, 2013: Ghana Scraps Fuel Subsidy to Reduce Budget Deficit, 31 May, 2013
[31] Reuters, 2014: Ghana Cuts Fuel Subsidy in Policy U-turn to Reduce Spending, 14 July, 2014

Box 4: Energy and politics

Energy policy is heavily subjected to political manoeuvrings which often result in distortions within energy markets and, in some instances, can undermine independent regulators. In September 2013, the leader of the UK's Labour party, Ed Miliband, pledged to freeze energy prices for 20 months if the Labour party won the 2015 general election. The impact of these proposed regulatory changes and suggested interference in the process of the existing regulatory body was immediately felt in the energy markets. Nearly £1bn was wiped off the value of energy firm Centrica plc within 24 hours of the pledge; and SSE plc, formerly Scottish and Southern Energy, saw a share price drop of 5.3%.[32] The British Chambers of Commerce warned that the proposed freeze would damage long-term attractiveness of energy investments and threaten the government's attempts to attract £110bn new investment in power plants in this decade.

Concerns over energy security and economic competitiveness can drive government involvement in the energy sector, but the fundamental challenge remains that political cycles are short (five years or less) when compared with the life cycle of many energy assets. One of the impacts of these politically driven decisions is to create uncertainty for investors for long-term assets. As one banker noted, "It's a relentless battle of a short-term political environment and a long-term investment environment".

The contentious nature of energy policy is exacerbated by the interplay with social and environmental concern and an increase in the "judicialisation of projects" as they are subject to popular protests and court cases. Because of their scale, energy projects often require a 'social licence', meaning wider public support. However, responses such as NIMBY (not in my back yard), BANANA (build absolutely nothing anywhere near anyone) and NOPE (not on planet Earth) are all too common. Even when projects have legal approval, these responses can discourage companies from making the investment, push out timelines or impact on viability.

Box 5: Keystone XL becomes a political battleground

The Keystone XL proposed US oil pipeline from Alberta to Nebraska shows how environmental and social concerns can heavily impact on the viability of project fruition. The project has been described as "so controversial it has inspired the largest expression of civil disobedience since the Civil Rights Movement".[33] The project, a fourth extension of the original Keystone pipeline which connects Canadian and American energy transits through three corridors, was originally proposed in 2008, but still has yet to receive the American federal licensing needing to begin construction. The project was

[32] London Evening Standard, 2013: Power Shares Dive £1bn after Ed Miliband Price Freeze Pledge, 25 September, 2013
[33] Avery, S, 2013: The Pipeline and the Paradigm

expected to cost US$7bn and, when completed, would increase the existing daily capacity of 590,000 barrels to approximately 1.1 million barrels a day, resulting in a total capital investment of approximately US$12.2bn. The start date of 2010 has been pushed back several times.

The original application for the extension was filed in September 2008 and was approved shortly thereafter by Canada's National Energy Board. In 2010 the South Dakota Public Utilities Commission in the US granted a permit to begin construction; however, the US Environmental Protection Agency (EPA) delayed the project decision over concerns about the scope of the environmental impact assessment. The EPA revisited the assessment and finally released their version in 2011. By then, the pipeline had become the focus of a battle between government officials and party politics as well as a focal point for deep debates on how to resolve goals for energy security, environmental protection and economic benefits and job growth. The project has resulted in the filing of several lawsuits, and has induced protests from both environmental groups and pro-pipeline advocates.

Although the pipeline has been described as routine, the project remains delayed, and only gains further attention and scrutiny due to the increasingly partisan division on the project proposal. Today, green groups, civil groups, and even President Obama have joined in the discussion of the effects of the pipeline. It has become a hotly debated item on the political agenda and is expected to play a key role in the next American presidential election in 2016. However, it is possible that the next president could delay decision on the pipeline even further by requiring further evaluation on the implementation of the project.

The need to build trust to increase investments

Financial sector interviewees also stressed "the decision to invest forms on the credibility of the implementation of the policy strategy, as well as on the policy itself." The issue is particularly acute where there are concerns around the independence of the regulatory regime and political interference. As one interviewee noted: "There are many technical instruments to achieve the trilemma balance and it is not about which instrument is better but rather about how clear and transparent they are, and the reputation of a single country in keeping to their terms and conditions".

An independent regulator is crucial in this regard. Indeed, the importance of this role was recognised by the G20 with a 2013 statement in which they noted: "It is fundamental that National Regulatory Agencies are independent of political and industry pressure in order to provide both operators and consumers with a transparent, stable and predictable set of rules that promotes confidence in the functioning of market mechanisms."[34]

[34] G20 Outreach Energy Regulators Roundtable, 2013: Energy Regulators Statement on Sound Regulation and Promoting Investments in Energy Infrastructure, 3 June, 2013.

Policy reversals, or poorly implemented policy can greatly erode trust and investment flow into that country. “It’s important for regulators and politicians to understand that, while they are regulating and politicking in a local environment, it’s seen in a global context by the investor.”

Where trust has been eroded, the impact can stretch beyond any single border through fears of a “policy contagion effect” that creates an increased perception of risk in an overall sector. For example, in Europe, investors are overcoming a “bad hangover” driven by a handful of sharp policy reversals in countries such as Bulgaria, Romania and Spain regarding renewable energy technologies. In contrast, in Colombia, a degree of stability was established in 1994 when the Public Services Law and Electricity Law were introduced, setting the rules and principles of economic competition for regulated services. For the electricity sector, the laws allowed the participation of private companies, which led to a reduction of costs, improvements in the sector’s efficiency and reliability of services, and an increased competitiveness of companies in national and international markets.

Part of the trust challenge emerges from the asymmetry of roles, priorities and expectations between the government and private sector. There are also the challenges of different approaches, terminology, and knowledge bases between the policy and financial community. Distrust can also be driven by cultural and business practice differences, for example, between international standard of practice and local business behaviour. Several interviewees noted that European or American investors cannot assume business is conducted in the same way in all regions of the globe.

Governments can build trust through participatory policy development and ongoing discussions with the energy and financial sectors. Sharing of information and viewpoints is import in building relationships, even in those markets where the state primarily owns and operates energy assets. Such dialogues can help build the credibility in long-term policy consistency, giving investors a clear signal and reducing the risk in their investment decision making. “Reputation plays a big role. The first move should be done by the public sector.”

Political risk perception and the risk–reward calculation

The risk–reward equation is at the heart of investment decision making by the financial community. Interviewees noted that, “There remains a fundamental disconnect between the private sector investor and the government over the perception of risk and the fundamental issue for lack of investment is the misconception at the political level of the risk–return equation”. Another executive noted that finance ministries in particular are ignorant about the needs of investors. Overall, interviewees expressed frustration on the level of awareness of how certain regulations regarding competitiveness, carbon pricing, or GHG emissions can affect considerations of investment in the energy sector. One interviewee noted that “[politicians] can have an abstract theory of perfect markets and try to apply it to a market that’s clearly imperfect”.

At the same time, it was acknowledged that policymakers can receive inconsistent messages from investors and the energy industry. Representatives from the financial community noted they are typically not compensated for taking undue risk and may have limited capacity or no mandate to lobby for a particular energy agenda or a

"green agenda". However, it should be recognised that many leading financial organisations are already deeply involved in the development of financial instruments for sustainable energy. Nevertheless, some interviewees noted: "Financiers get zero reward for taking any kind of additional risk, so why do we expect someone to do good for the industry, when that is not in his mandate?" Another noted that the "financial sector is not interested in changing how investors think. Financial investors who fund energy projects can also invest in other sectors". Another highlighted that "the financial sector will invest in markets where the return is commensurate with the risk".

Risk and the perception of risk will affect who will invest in what sector of the energy market, as discussed further in Chapter 2.

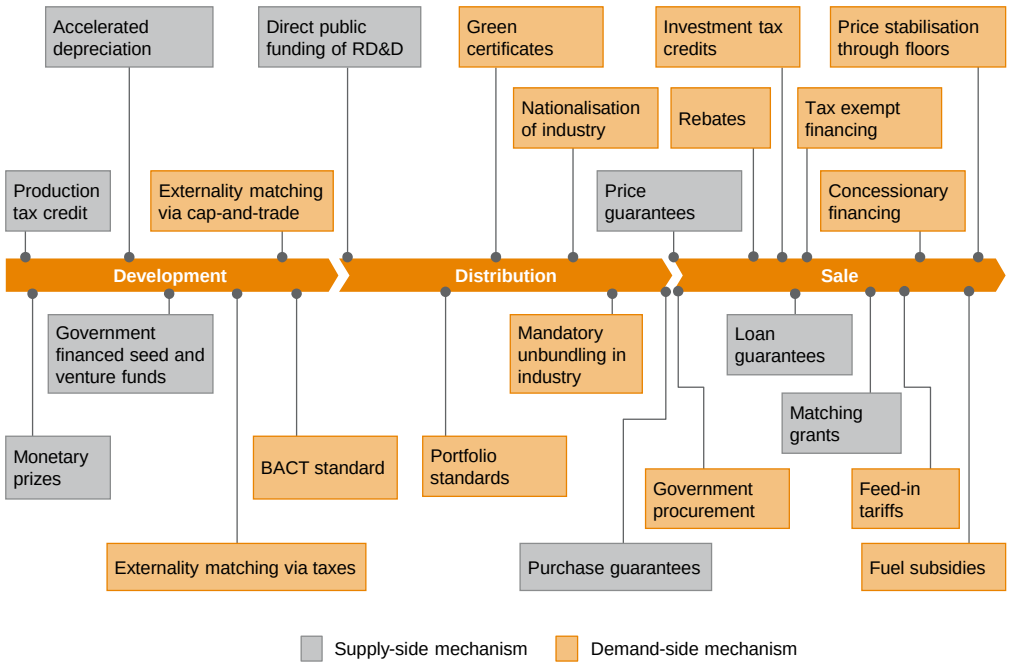
Regulatory regimes, market structure and pricing

In most countries, whether regulated or liberalised, the energy sector is shaped by a range of energy policies, market designs, and regulations. These are implemented to reach policy targets and stimulate investment in energy supply, distribution and demand (see Figure 8). The ultimate goal of these interventions is to progress on the three dimensions of the energy trilemma by increasing energy security, making energy services accessible and affordable while limiting the environmental impact of the way energy is produced and consumed.

Figure 8

Illustrative policy and regulatory mechanisms affecting energy pricing, investment, and return on investments

Source: WEC/Oliver Wyman, 2014



Interventions, such as regulated rates of return or pricing, mandates geared to address market failures or stimulate new markets, but also subsidies, (including grants and tax breaks), have a significant impact on energy prices and returns on investments in the energy sector in general – particularly the power sector (electricity generation). For example, in India, price caps on end-user tariffs that are out of step with fuel prices and availability have led to continuous underinvestment in generation capacity as well as the transmission and distribution network. As a result, the country has suffered from repeated power blackouts, most recently experienced in June 2014.

Investors noted "If you get the price right, the private sector will pile in," and called on policymakers to consider the impact of pricing interventions on the risk–reward calculation for investors. It was recommended that the right pricing regime should be: consistent, profit related, recognising risk investment upfront or reducing the risk on investment (risk adjusted returns), and taxing the profit accordingly.

Within the broad parameters of having a stable framework, there are a range of views regarding the merits of a regulated or deregulated, liberalised energy sector and which was more attractive to investment. The consensus was summed up as "It does not matter whether it's regulated or deregulated as long as we can factor in the risks".

Box 6: Liberalisation of the electricity market in New Zealand

As a small, trade-dependent economy with a population of only about 4.5 million people, New Zealand relies on sound institutions, open markets, world-leading ability to produce primary products and a rich endowment of natural resources such as minerals, petroleum, water and a moderate climate to underpin its international competitiveness and prosperity. The country has a top 10 ranking in the 2014 Index and is a top performer for its gross domestic product (GDP) grouping. (For additional details, see 2014 Energy Trilemma Index: Benchmarking the sustainability of national energy systems.)

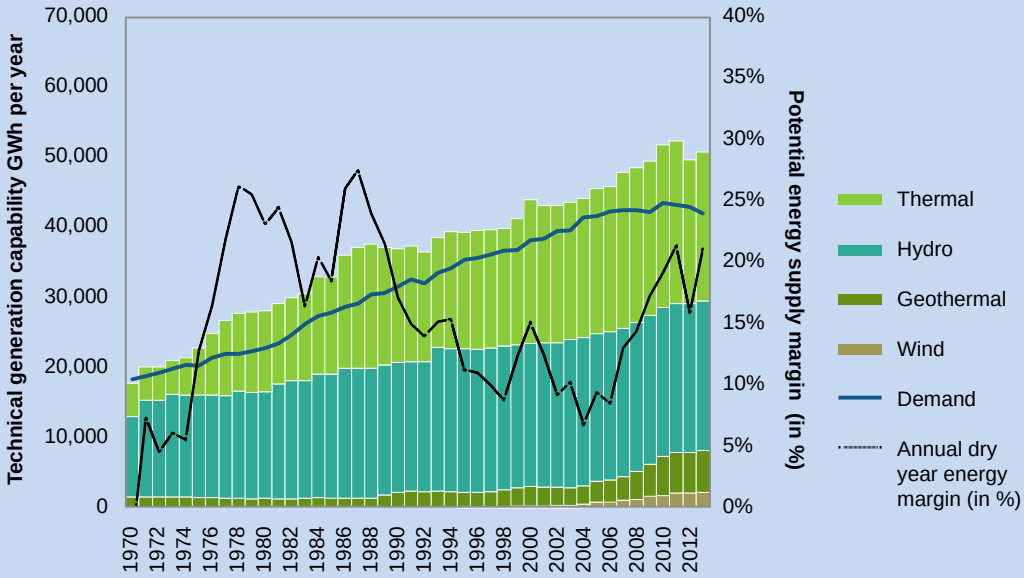
A key element to its international competitive advantage was the liberalisation of its electricity sector between 1996 and 1999. The dominant state-owned generator was split into separate companies to establish wholesale competition. Generation and retail were separated from lines and transmission, and full retail competition commenced in 1999. Prior to the reforms, the quality of investment decisions was patchy, cost over-runs were funded by taxpayers, and there were marked swings in the margin between generation capacity and demand.

A stable market and regulatory framework, with generators competing vigorously over an independent transmission system, has resulted in a number of positive outcomes. Post-liberalisation, security margins tightened as pre-liberalisation over-capacity diminished. But since the early 2000s, the security margin has risen to now comfortably sit at around 20% despite being a hydro-dominated system (see Figure 9).

Liberalisation has not hindered development of New Zealand's electricity market

nor its access to capital. Few other countries have electricity systems that have so easily accommodated the range and expansion of generation types (77% renewable, wind, geothermal, hydro[35]), sizes, and variety of market participants. This has been achieved in the absence of subsidies, and with the introduction of a carbon price through an emissions trading scheme (with no free allocation of units) in 2010.

Figure 9
Generation investment adequacy in a liberalised market
Source: Ministry of Business, Innovation and Employment, New Zealand, 2009: Ministerial Review, (Updated)



New Zealand's market is now characterised by generators being subject to capital and product market disciplines, costs being set by the market (conditioned by the entry cost of new plant), financial risks being borne by shareholders and a pipeline of new, predominantly renewable development projects. As one of the liberalised energy markets in the world, 'Pack leader' New Zealand offers a number of lessons for policymakers.

Interviewees also had mixed views on the impacts of market interventions on pricing regimes and "what works and what doesn't work". In general, as has been noted in the 2012 and 2013 World Energy Trilemma reports, energy subsidies can have detrimental impacts on the overall levels of investment over the mid- and long-term as it creates concerns about whether investments cannot be fully recouped.

There are also concerns about the predictability of returns in the presence of unsustainable or changeable subsidies, including feed-in tariffs: "*S*ince the rules are subject to change you can end up deterring investors from investing in the future". For example, it is estimated that there are 3,000 feed-in tariffs in place across Europe; that

[35] US Energy Information Administration (EIA), 2012: International Energy Statistics

huge number alone creates challenges for investors. However, there are also concerns around the sustainability of these schemes (for example, can governments continue to afford them) and whether these policies will continue to be the main instrument to support the expansion of renewables in the energy supply.

Despite general concerns about subsidies, it was acknowledged that interventions can be necessary to stimulate private sector investment. The effective form of the overall energy policy and any intervention depends on policymakers' goals. For example, growth of the system, expanding energy access, increasing the efficiency of system, switching fuel to lower carbon or maximising the growth of renewables or, in the case of countries with fossil resources, maximising their production or the return obtained from them.

In the power generation sector, governments in many countries have utilised a range of mechanisms, including feed-in tariffs, carbon-trading markets and renewable obligations to stimulate investments in renewables and the transition to a lower-carbon energy sector. Investors recognised that these mechanisms have been necessary in the absence of an overarching climate agreement that would capture externalities in energy pricing. But there are questions as to whether subsidised power can be viewed as a commodity that can be managed within a market-based system. For example, in the EU, renewables are remunerated outside of the competitive markets and this is one factor driving increased power capacity even though wholesale prices have declined. This creates incongruences: "There is no more value inherently in a MW of electricity produced from a wind or solar farm compared to a MW of electricity produced from a coal-fired plant. It is only because politicians say that it is worth more. The idea of a market for that and the ability to interfere in a market is just fundamentally wrong".

Box 7: Investment in renewables for power generation in Germany

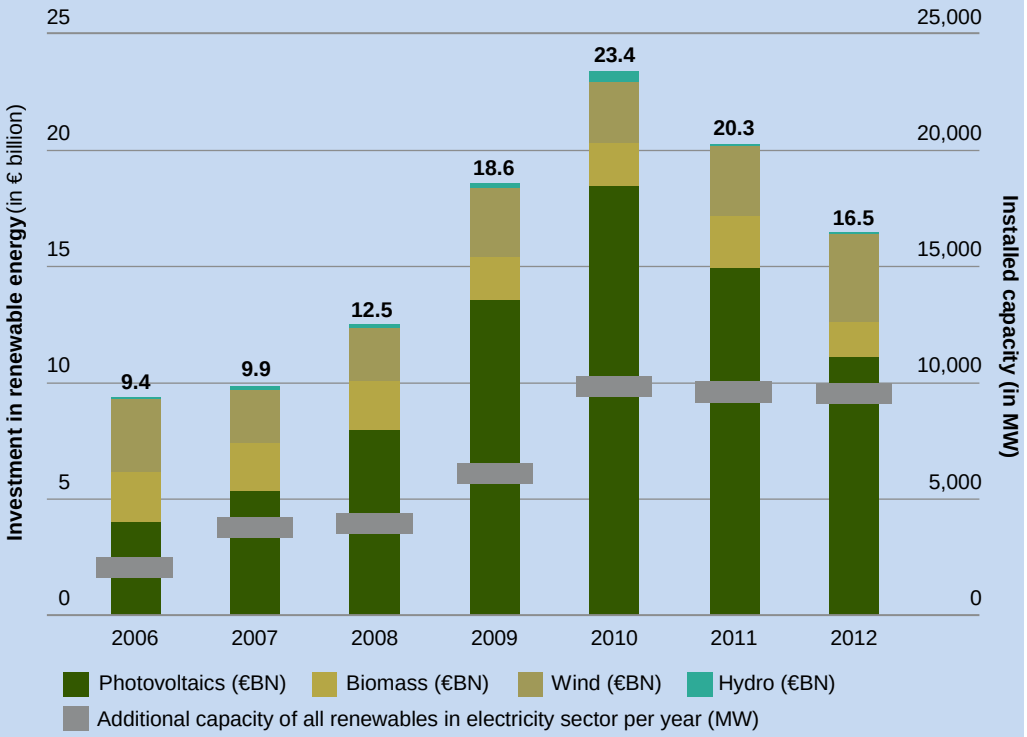
While it is difficult to reliably show a causal link between a specific policy or regulation and subsequent investments in the energy sector, some correlation exists. Germany's programme to stimulate the renewable electricity sector, for example, is among the most innovative and successful worldwide and appears to have flourished only after the introduction of the Renewable Energy Act in 2000, and a wide political consensus among almost all parties on renewable energy targets. The German feed-in tariffs, not necessarily written as a subsidy but to attract long-term debt capital, incentivised the use of new renewable energy technologies such as wind power, biomass, small-scale hydropower, geothermal power and solar photovoltaics by providing a fixed fee (tariff) above the retail rate of electricity. While the conditions of the feed-in tariff in Germany were maintained, attracting investors and driving up the scale of a new, green industry in the country, some stakeholders noted that "the German's have overpaid" not only financially but also with regards to energy security and system reliability.

From a mere investment perspective, while absolute investment in renewable energy generation has decreased in recent years, the actual added installed capacity remains mostly the same since 2010, driven by technological advancements and a drop in costs of photovoltaics (see Figure 10).

Figure 10

Investments in renewable energy in the German electricity sector, 2006–2012

Source: Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW), Germany, 2013; BDEW Bundesverband der Energie- und Wasserwirtschaft e.V. analysis



There are also mixed views on the relative effectiveness of mechanisms to stimulate renewables. Some argue that a "feed-in tariff has been the most successful pricing mechanism" to date and suggest that long-term stable feed-in tariffs attract the lowest cost of capital. Other investors disagree and point to the regulatory risks and uncertainty associated with feed-in tariffs along with all subsidies. Other challenges include the need to get the pricing feedback mechanisms right to minimise the risk of over- or under-paying with a negative impact on the sustainability of renewables sector development, and the fact that feed-in tariffs do not allow for volume monitoring of renewable energy capacity. The European Commission, in its guidelines, targets a substitution of feed-in tariffs by more market-compatible mechanisms, such as competitive bidding processes, auctions or premia payments as implemented in other countries (see Box 13 in Chapter 3 on South Africa's competitive bidding process).

Fiscal incentives and pricing mechanisms are not always the most effective tools to stimulate markets. Investors pointed to the benefits of preferred renewable portfolio standards and competitive procurement. For example, in some instances, a combination of regulation, planning and procurement, driven largely by a powerful state entity, can stimulate the desired energy market structure. Carbon policies and emissions trading can also be very effective in driving changes. The carbon market in the Canadian province of British Columbia is one such example. Implemented in

2008, it sets a tax on emissions from fossil fuels – paid at the pump and in energy bills – but including cuts to business taxes and personal taxes and a low-income tax credit to protect the poor.[36] However, as neighbouring provinces have no such scheme, the unharmonised approach may reduce the overall effectiveness of the mechanism and support regulatory arbitrage.

Overall, it was noted that the most effective regulations must support a flow of capital, rather than generic solutions.

Box 8: The use of white certificates in Italy

White certificates are tradable instruments giving proof of the achievement of end-use energy savings through energy-efficiency improvement initiatives and projects. The mechanism is based on the obligation, placed on electricity and natural gas distributors with more than 50,000 customers, to achieve a quantified target of energy savings yearly. White certificates in Italy were introduced in 2004 to help reduce energy consumption in the context of the EC's 2020 climate and energy package and Italy's National Energy Strategy, which goes further and aims at achieving and exceeding all European environmental targets for 2020.

In 2013, there were 63 obliged companies (13 electricity and 50 natural gas distributors) for an annual target of 5.51 million white certificates. Whoever carries out energy-efficiency projects in order to receive white certificates can sell them on a specific exchange market or through bilateral contracts. So far the mechanism has generated a good availability of white certificates at market prices, allowing participating companies to recover cost and to promote energy-efficiency structured projects in general. The mechanism provides stimulation of investments at short payback periods, energy savings from projects beyond 'business as usual', and the development of an Italian industrial value chain for energy efficiency.

While, in the early years, the beneficiaries were mostly from the residential sector – with more than 50% of the white certificates used for compact fluorescent lighting – in more recent years the industrial sector is at the centre, with 4.7 million out of the 5.9 million white certificates issued in 2013 used for industrial energy-efficiency improvements.

In compliance with the EU State Aid legislation, the actual investments related to the issued certificates will be introduced in 2015. In the meantime, stakeholders indicate that the white certificates have an impact on amounts up to 30% of the overall investment. With 6 million certificates issued per year at approximately €100 each, Italy is mobilising resources of €600m per year.[37]

[36] Ministry of Finance, British Columbia, Canada, 2014
[37] Gestore dei Servizi Energetici (GSE) 2013: GSE Annual Report 2013

Technological changes requiring new policy approaches

The last two decades have seen rapid changes in energy technology. There is an opportunity to leverage these developments to transform energy infrastructure by replacing ageing assets in the world's developed economies and build new infrastructure in the developing world. Policymakers are therefore faced with the challenge of setting frameworks that encourage investment but letting the market pick the winners among new technologies. This requires a deeper understanding of the evolving technologies and a partnership with both the energy sector and the financial community to stimulate effective technologies to be commercialised.

Smart grids, energy storage and carbon capture are some examples of essential but still developing technologies that need combined and coordinated efforts. All are essential to facilitate the transformation of transmission and distribution systems and meet challenges posed by the intermittency and decentralised aspects of renewables sources. Smart grids will support the optimisation of existing infrastructure by helping to regulate power flows and meet peak demand, and improving energy efficiency by managing the consumption patterns of new and existing users connected to the grid. Regulatory barriers and other hurdles must be addressed if smart grids and storage solutions are to be fully implemented, including standardisation and certification, system testing, consumer participation, and accelerated research and development.[38] In terms of energy storage, a few mature technologies exist and additional solutions are under development, but costs in general are still too high and scalability is too low at present.[39]

Considering the continued use of fossil fuels in electricity and heat generation as well as transportation over the next decades, it is urgent that an approach to stimulate the deployment of carbon capture, utilisation and storage (CCUS) technology is found. Without a formal price signal or regulatory requirements to avoid CO_2 emissions, CCUS is at risk of being seen as only adding cost and reducing energy efficiency. However, without this technology, climate objectives may not be reached at all.

The challenges of regulating emerging technologies are considerable, as one interviewee observed: "Policymakers are trying to build the bridge while they cross it". The net result for investors can be an interaction of technology and regulatory risk that creates a significant degree of uncertainty in risk–reward equations. As one interviewee noted: "There can be a perception that investing in the energy sector is unnecessarily exposing yourself to a lot of regulatory risk".[40]

The technology and regulatory risk factors and the ensuing impacts on the economics of energy projects vary depending on the energy sector ('traditional' or 'new renewable' technology) and also the phase of the project ('greenfield' meaning new construction or the development of new infrastructure, or 'brownfield' meaning existing infrastructure assets that have been operating and frequently have a demand history). The financial sector called on policymakers to find ways to develop a strong and common understanding of emerging technologies, as well as new market models, and to overcome the lack of knowledge about the effect on the risk-reward evaluation for

[38] WEC, 2012: World Energy Perspective: Smart Grid – Best practice fundamentals for a modern energy system
[39] WEC, 2013: World Energy Scenarios: Composing energy futures to 2050
[40] WEC, 2013: World Energy Scenarios: Composing energy futures to 2050

investors – particularly on the levelised cost of electricity.[41] For example, how do costs of capital and operation vary for new versus traditional energy technology projects? "They do not know the technology and new market models that would need new regulation." Others noted, "It would be useful if the policymakers understand what the state-of-the-art is and there needs to be some mechanism in place for them to become more educated".

Summary and action items

Countries are in competition for the private sector investments needed to develop, expand and drive evolutions in the energy sector. The overriding message for policymakers and regulators from the financial sector is that a reduction in uncertainty is a prerequisite for increasing investment in the energy sector and decreasing the cost of capital. They also recognised that the opposite was true, that countries with a reputation for clear policy signals benefitted from improved, lower cost investment.

Policymakers must clearly communicate the goals and rules for the energy sector, understand the necessary investments and map out the approach to secure those investments. There are a number of key recommendations for governments and policymakers to help attract investment in the sector. These recommendations add to the strong call to action captured in the 2013 World Energy Trilemma 2013: Time to get real – the agenda for change, in particular to minimise policy and regulatory risk and ensure optimal risk allocation:

- Clearly signpost the future energy strategy and set coherent, predictable, long-term, and transparent regulatory and policy frameworks that are business-friendly, conducive to local conditions, and that recognise the long-term nature of investments in energy infrastructure projects.
- Ensure alignment between multinational regulations and national regimes.
- Aim to decrease the politicisation and 'short-termism' of energy policy and focus on building a national consensus on energy goals and how private sector investments can be stimulated.
- Work with the financial and energy sector to identify how investors' risk–reward equations can be aligned with the need to provide accessible and affordable energy services to citizens and industry.
- Work with the financial and energy sectors to develop a process that ensures a strong and common understanding of emerging technologies as well as new market models and how these can support national and international energy and climate goals.
- Carefully consider the impact of interventions to stimulate investments in energy infrastructure may have, including how subsidies or other mechanisms – such as renewable portfolio standards or procurement policies – can most cost-effectively achieve goals and share risks.

[41] The price at which electricity must be generated from a specific source to break even over the lifetime of the project.

“

It’s important to develop a toolkit that is framed around making sure capital flows rather than generic solutions

”

2. The financial sector and the evolution of potential capital sources

The estimates for the annual investment required to supply the world's energy needs and improve energy efficiency stands at an annual US$1.7trn in 2013 rising to US$2.5trn by 2035. In addition, an estimated US$200bn, rising to more than US$500bn annually, is needed for necessary investments in improving energy efficiency in buildings, the transport sector and also industrial processes.[42]

With more than 70% of all oil and gas reserves in the hands of national oil companies (NOCs) and almost 50% of all power plants owned by the state, much of historic investment has been made directly or indirectly by governments across the world.[43] Driven by the continuing financial, economic and debt crisis and accompanying austerity measures, as well as competing economic and social spending, governments are increasingly unable to fund the acute need for new or modernised energy infrastructure. In developing Asia, the situation is different: government spending on infrastructure is much higher, but economic growth is expected to decrease[44] and with it government allocation to infrastructure. A similar trend can be observed elsewhere in the world. Hence, private sector investment is becoming more critical than ever to meet the energy sector's future investments needs. This raises three questions:

- Is there enough available capital at the right cost?
- Will the existing funding instruments be able to channel capital from the investor community to the energy sector?
- Can the energy sector attract and absorb capital on this scale?

Overall, financial sector interviewees believe that there is enough private sector capital to meet current and future capital needs, be it through equity, loans, bonds, project finance, derivatives, leases, private or public capital or other mechanisms. "We have vast amounts of money. The question is what the risk-adjusted cost of capital is?" Another interviewee added, "There is money for good projects with low risk or that are 'de-risked' – I don't think there is a shortage of money". Indeed, the investments in the sector have more than doubled in real terms since 2000, driven by growing energy

[42] IEA, 2014: World Energy Investment Outlook
[43] IEA, 2014: World Energy Investment Outlook
[44] WEC, 2013: World Energy Scenarios: Composing energy futures to 2050

demand, investment in relatively more expensive renewable energy technology, and rising costs of oil and gas exploration and production.

Interviewees noted that the relative contributions of potential financing sources for energy infrastructure and the financial instruments are expected to evolve over the coming decades in many countries. Some of these changes may occur 'naturally' due to an increased familiarity and level of comfort to invest in the asset class in general. For example, pension funds that, in the past, only invested if there was a guarantee on the transaction, or indirectly through a dedicated infrastructure fund, may start investing directly. Other changes affecting the flow of investments may be driven by financial regulations, the availability of new financial mechanisms such as project, infrastructure and green bonds, new equity vehicles, or the development and maturing of financial markets in emerging economies. Overall, interviewees expect that the continuous evolution of the sector has the potential to reduce the blockage on investment.

Whether capital will flow to energy infrastructure projects depends on the right regulatory and policy framework. It also depends on the energy sector itself and its ability to attract and absorb the funds that are available. As one interviewee noted, "Financing doesn't create the demand, the financing has to follow the demand". One key concern of interviewees in that context is the lack of steady pipeline of bankable energy projects and consequently the 'crowding-out' of private investors which compete with public funding institutions, for example, multilateral development banks, to invest in effectively scoped energy projects. Furthermore, the lack of a robust pipeline of bankable projects often leads to private investors' unwillingness to build out their required expertise to invest in energy infrastructure. The issues around bankable projects are further examined in Chapter 3.

Increasing the level of comfort for investors to provide funding for projects in new markets or using emerging energy technologies will be very important. To overcome these concerns some institutional support may be needed to enable banks, institutional investors and others, in developing the necessary capabilities to assess and invest in energy projects. As one multinational development bank recalled, "We had a client who was very keen on providing money to the private sector to undertake energy-efficiency projects. But after we provided money to them they were sitting on the money. So we had to go in and do capacity building for the bank for more than one year, after which they were able to understand and evaluate the different kinds of projects". A 'learning by doing' effect can be key in building investor confidence with new markets and technologies.

Lastly, interviewees noted that it is important to "understand the role of different financial investors at various stages of a project life cycle to attract the right kind of funding for that phase of the project. Everybody needs to understand their role in the game". It is important to understand the risk appetites of the various investors at each stage of the infrastructure asset life cycle. For example, pension funds that are usually very risk averse look for stable investments at a lower rate of return – 15% or lower – while a venture capital fund with a higher risk appetite may expect a certain percentage of the investment to fail and will look for a very high – 50% or higher – rate of return (see Figure 11).[45] As illustrated, there is a decreasing relative level of risk

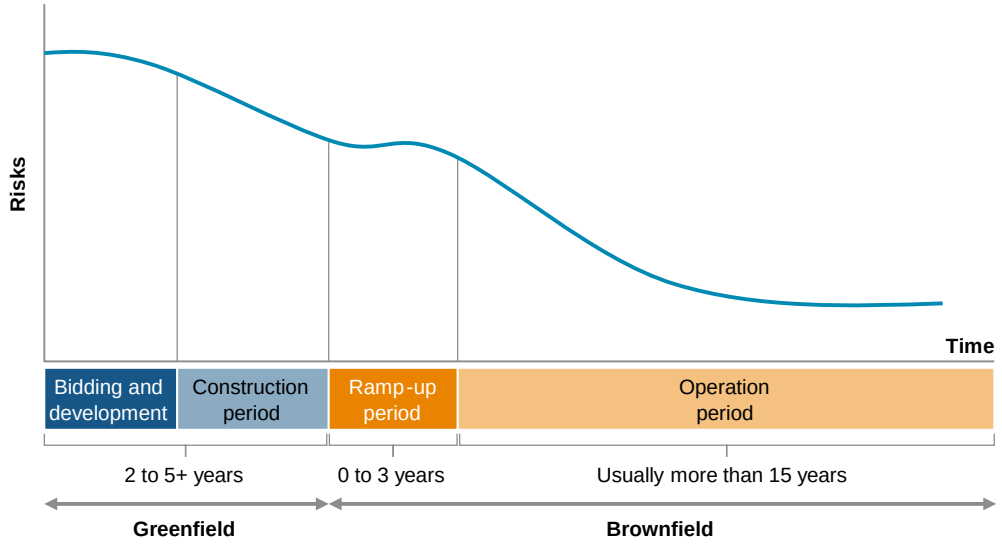
[45] United Nations Environment Programme (UNEP), Sustainable Energy Finance Initiative (SEFI), Bloomberg New Energy Finance, Chatham House, 2009: Private Financing of Renewable Energy: A guide for policymakers

between the greenfield (bidding, development and construction period) and brownfield stages (ramp-up and operation) of a project, assuming a stable regulatory and political environment. For example, an interesting partnership model to explore could involve a utility developing a project until it reaches the operational stage and then selling equity shares to financial investors, with the utility remaining the operator. Political and regulatory risks can change the dynamics and lead to a higher relative risk level than shown, especially in the brownfield stage. Moreover, the risk profile of any infrastructure asset is always dependent on the market it is being developed in. A greenfield electricity generation plant in a developed market is likely to have a lower risk profile than a similar project in a developing market where demand is untested, and construction and technology risks are higher.

Figure 11

Risk profile development of an infrastructure asset

Source: World Economic Forum, 2014: Infrastructure Investment Policy Blueprint



Capital markets

Capital markets have traditionally been a key source of financing for energy projects and companies, both public and private, around the world. While in most developed countries, capital markets offer a variety of long-term financing options for debt and equity, in less-developed countries the market enforcement and supervision required, for example, for a thriving corporate debt market, are often weak. Stimulating the development of capital markets will support an overall increase in private sector investment and the expansion of mechanisms to support energy infrastructure investments.

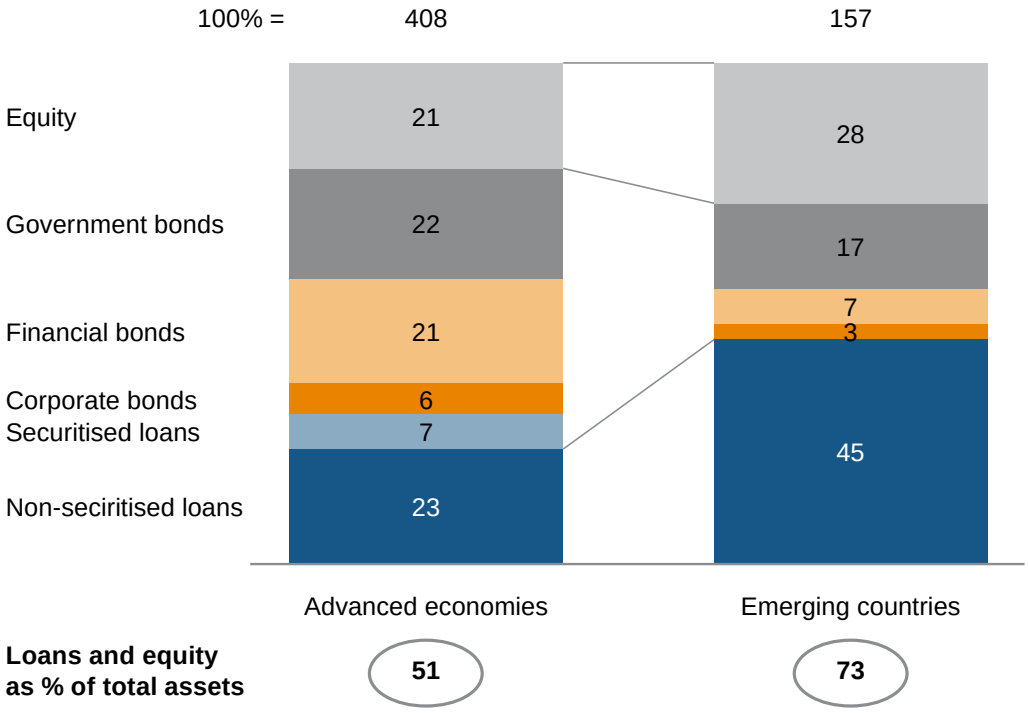
The bulk of the required investment over the next 20 years is needed in non-OECD countries (see also Figure 3), where countries have less money available to spend on basic infrastructure including water, sanitation, energy, housing, and transport. For example, if the Indian government allocates 9% of its GDP to the development of basic infrastructure to support economic and social development, that is still less in absolute terms than what the US or other developed economies spend to meet the needs of their much smaller populations. The need to attract private investment in emerging and developing countries is great, but capital markets are often still

immature, risks are generally higher, the lower saving rates of young populations limit the supply of capital available for long-term investment, and demand for debt is high as there are many competing needs for capital. Also, in many instances, the requirements for capital markets to develop are not in place, including macroeconomic stability, sound banking system, solid institutional frameworks, adequate regulation and supervision, but also the ability to issue internationally recognised safe assets that maintain liquidity in bad times. Also key to securing confidence is an adequate group of qualified professionals who act based on best practices, ethical and professional standards, and who are continually updating their training.[46]

Figure 12

Financial assets in emerging markets are heavily concentrated in equity and loans while advanced economies contain more debt securities

Source: McKinsey, 2013: Global Capital Markets 2013



A number of emerging economies and developing countries have addressed the importance of market perception, the impact of persistent corruption, weak institutions and the need for better macro-fiscal discipline, as well as the country-specific knowledge and expertise needed to make informed decisions. As a consequence, capital markets have started to grow. As illustrated by the 'Highly-industrialised' countries, building capital markets will be a key element to increasing energy sector investments. For example, in Malaysia, improving transparency, promoting higher standards of disclosure and benchmarking against best international practices have been key in transforming the domestic capital markets as an efficient source for raising longer-term funds to finance economic activity. The country's capital markets, which in 2000 were valued at US$240bn, at the end of 2012 amounted to US$816bn.

[46] Rojas-Suarez, L, 2014: Towards Strong and Stable Capital Markets in Emerging Market Economies, Center for Global Development, Policy Paper 042, May 2014

Malaysia also hosted Asia's third-largest bond market relative to GDP worth US$314bn.[47]

Elsewhere in Asia, capital markets in Thailand and the Philippines have seen comparable positive developments. In Latin America, capital markets in Chile, Mexico, Peru, Costa Rica, Colombia, and most noticeably in Brazil, have been growing rapidly over the past decade.

In sub-Saharan African countries capital markets have been growing more slowly than in other regions.[48] The most activity and strongest capital market of the region is in South Africa[49] followed by Nigeria with close to 200 companies listed.[50] Domestic debt markets, however, remain rather shallow. As capital markets develop and more money becomes available to invest in basic infrastructure, economic and social development thrives. In many of the above-mentioned countries, GDP almost doubled during the past decade, and performance on the United Nations (UN) Human Development Index continues to improve as societies evolve.

Bonds

Bonds are a debt security issued by a corporation, government or municipality and sold to investors. In total, global financial assets – equity, loans and bonds – have grown from close to US$60trn in 1990 to US$225trn in 2012.[51]

An important prerequisite for accessing capital through bond markets is securing a credit rating from an agency such as Standard & Poor's or Moody's. In that context, the higher a company's perceived credit quality, the easier it becomes to issue higher amounts of debt at low rates. However, in many instances, the economics and attractiveness of energy projects in developing countries are negatively skewed by a reliance on the sovereign credit rating in assessing the investment. As one interviewee noted, "In the developing world a lot of countries have nationalised power companies, which cannot have different credit ratings than the owner and it will take investors some time to get comfortable with this credit risk". In such cases, power companies or energy infrastructure projects with very attractive underlying economics cannot secure capital at the right price, even in circumstances where the regulatory processes to build and operate a power plant seem similar to those in OECD countries. In that context, one interviewee suggested, "The energy industry can play a role in making investors aware of the differentiation between the sovereign credit of a country and the credit of the energy sector".

Bonds are a widely used financing instrument for long-term funding of public and private expenditures in North America, Western Europe as well as North-East Asia. However, in emerging markets, including the Middle East, emerging Asia, Africa, Latin America and in Commonwealth of Independent States (CIS) countries,[52] domestic bond markets remain small and are dominated by government-issued bonds, a legacy of such countries' reliance on heavy state borrowing. Moreover, in these markets, corporate debt securities are often not traded for extended periods, preventing large institutional investors from holding such securities. As a result, and despite the foreign

[47] PricewaterhouseCoopers (PwC), 2011: Deepening the Capital Market
[48] Milken Institute, 2014: Capital Markets in Developing Countries
[49] South African Reserve Bank, 2013: South African Capital Markets: An overview
[50] World Bank, 2013: World Development Indicators
[51] McKinsey, 2013: Global Capital Markets 2013
[52] CIS countries include the 15 independent states that emerged from the Soviet Union in its dissolution in December 1991.

Here we are referring to countries with emerging economies and large manufacturing sectors. Countries that illustrate the 'Highly-industrialised' profile have an energy trilemma balance that is tilted heavily towards energy security, with progress needed to ensure energy equity and environmental sustainability.

Highly-industrialised

Figure 13

Trilemma profile and illustrative countries: Highly-industrialise

Source: WEC/Oliver Wyman, 2014

Countries	Index rank	Balance score
Mexico	38	BBC
Tunisia	46	BBB
Russia	51	ABD
Philippines	59	BBC
Bolivia	63	ACC
Indonesia	69	ACD
China	74	ACD
Turkey	73	BCC
South Africa	83	BCD
Vietnam	87	BDD
Thailand	90	CCD
India	122	CDD

Countries included are examples of the rapidly-growing emerging economies that will drive 95% of the growth in energy consumption through to 2035. In the near to medium-term future the industrial sector will be the main source of increase in primary energy consumption (directly or indirectly in the form of electricity) in emerging economies and will account for more than half of the growth of energy consumption 2012–35.[53] In addition, countries of the Highly-industrialised profile must meet growing energy demands of a rapidly growing middle-class population.

The investment challenge for these countries is to meet growing energy demands while maintaining environmental sustainability, improving electrification rates, and keeping energy affordable for all. To meet energy security and environmental sustainability goals, some members of the group are making significant investments in renewable energy sources, such as China, which has nearly tripled its renewable energy production from 2001 to 2011.[54] Similarly, in South Africa, the Renewable Energy Independent Power Producer Programme (REIPPP) has helped to attract investment in renewable technologies and achieve significant price reduction for competing technologies in each successive bidding round (see Box 13 in Chapter 3). Other members of this profile have mechanisms such as feed-in tariffs, or renewable portfolio standards in place to incentivise the development of, and investment in, renewable energy technologies. Increasing the share of renewable energy sources in the energy mix will not only help improve the countries' environmental footprint, but also help enhance energy security and lower dependency on imported energy sources. At the same time, many of these countries have significant nuclear development programmes underway, or in preparation, as important elements of their national energy strategy.

[53] BP, 2014: BP Energy Outlook 2035
[54] US Energy Information Administration (EIA), 2012: International Energy Statistics

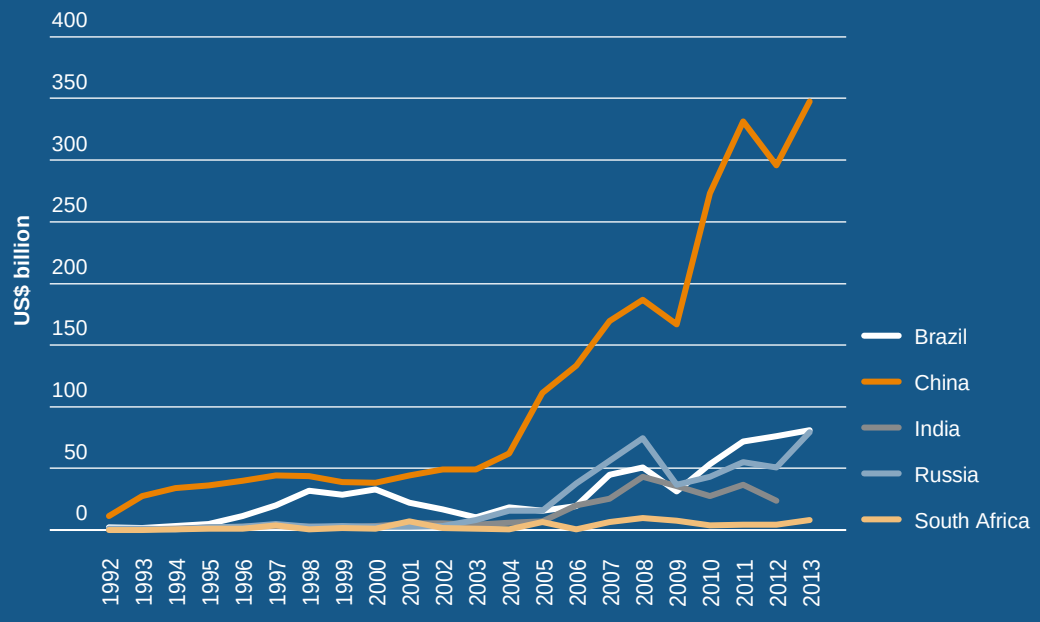
While some of the countries in this group have achieved close to 100% access to electricity already – including China, Mexico, Russia, Thailand, Tunisia, and Turkey – others struggle. Nevertheless, increasing generation capacity, securing energy resources, and upgrading existing transmission and distribution lines to provide more reliable energy services remains a challenge for all of them. Other countries in this profile need to significantly increase electrification rates. For example, in India, electrification rates remain low at 75% and more than 300 million people are without access to electricity.[55] Investments must be made and the country has revised policies to support this, for example, in 2013, India's restrictions on the amount of foreign direct investment to the power sector were lifted, expanding potential access to the market for private sector funds. Yet attracting the financing to upgrade and expand energy infrastructure will remain difficult, especially since end-user tariffs are capped and possibly out of sync with fuel pricing and availability. Also, there are large non-technical losses such as energy theft, which typically occurs through illegal connections to the grid, and corruption remains high.

Ensuring the sector is viable for investment is critical for countries like India. Until 2035, more than US$15trn of investment is needed in the energy supply and energy efficiency measures in BRICS countries alone, that is, close to one-third of global investment needed over the same time period.[56] In that context, the recently established New Development Bank, founded, operated and funded by the five BRICS countries as an alternative to the World Bank and International Monetary Fund, could be one source of capital for emerging and developing nations for the development of energy infrastructure projects, provided the investment environment is attractive. While the New Development Bank is a great opportunity for these nations to spur economic growth and social development, attracting private sector finance will still be crucial. For private sector finance to flow, political and regulatory frameworks need to be coherent, transparent and predictable, corruption has to be minimised and a pipeline of bankable projects needs to be developed.

Figure 14

Development of foreign direct investment in BRICS countries (in US$ billion)

Source: World Bank Indicators, 2014



[55] SE4ALL, 2013: Global Tracking Framework
[56] IEA, 2014: World Energy Investment Outlook

exchange risk, many companies raise money in the US debt market, which offers a combination of low borrowing costs, a diversified pool of long-term investors and liquidity. By issuing debt in the US market, companies also gain access to European and Asian investors. For example, state-controlled Petrobras in Brazil sold US$11bn of bonds in May 2014, which is thought to be the largest corporate debt sale from an emerging market.[57] In emerging East Asia, local currency bond markets are growing steadily, with the region's government bond market growing 8% and the corporate bond market 11.7% from 2013 to 2014. The size of the total emerging East Asian bond market reached US$7.6trn at the end of March 2014, an increase of 9.5% compared to 2013.[58]

While 'traditional' bond markets in emerging economies and developing countries still need to mature, in recent years new types of bonds have been developed and increasingly gain momentum. Green bonds, which specifically target clean energy investment, and project bonds, fill the void left by traditional financial instruments and sources, such as bank loans or public sector investment. They also serve to bring together long-term investors who expect moderate returns and easily calculable risks. As one interviewee noted optimistically, "In the short-term, we can use the bond markets to deploy capital".

Project bonds

While corporate bonds provide an opportunity to invest in corporations, project bonds allow investors to participate in legally and economically self-contained infrastructure projects through listed, tradable securities that can offer superior risk-adjusted returns.

The significant opportunities for institutional investors and their allocations to infrastructure will likely foster growth in capital markets assets, specifically project bonds. Globally, project finance volumes increased by 3% in 2013 to more than US$400bn, and the global project finance bonds more than doubled in 2013 to close to US$50bn. For example, in Latin America, the need for infrastructure spending has stimulated regulations that have fostered an infrastructure project bond market, allowing pension funds and other institutional investors to participate. By contrast, in Asia-Pacific, project finance bonds remain relatively unpopular and have a very limited presence compared with loans, but it is expected that project bonds will become more popular over time, as non-loan instruments become more prominent.[59]

Standardising financial instruments and developing a sizeable project bond market is crucial to increasing infrastructure funding in general with associated increases in energy infrastructure. A number of supporting factors can help stimulate a thriving project bond market. These include a robust project pipeline and standard transaction structures, greater transparency in reporting on project performance, a regulatory regime that encourages insurers to invest, supportive credit enhancement structures, and risk mitigation tools for investment in pre-completion projects.[60]

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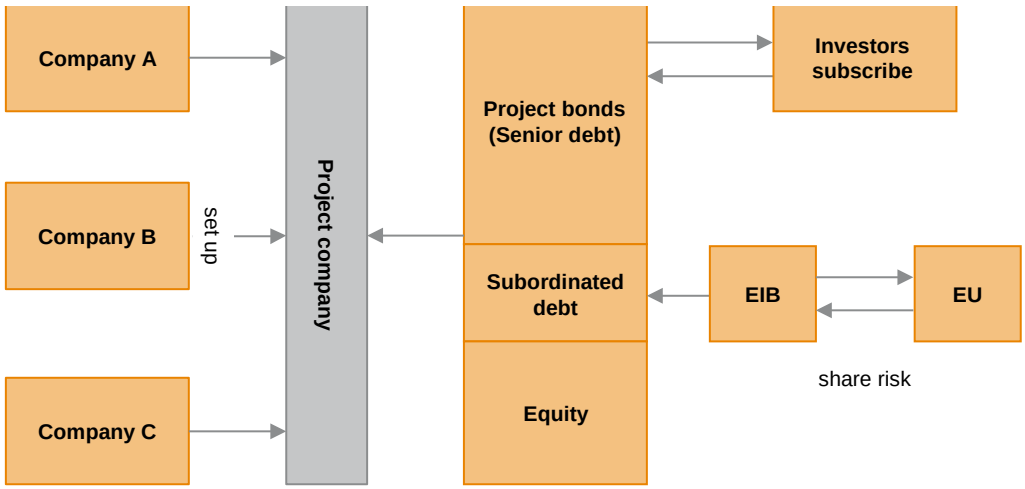
[57] Rodrigues, V, 2014: Latin America corporate bond trade requires time to mature (Financial Times, 17 November 2014)
[58] Asian Development Bank, 2014: Asia Bond Monitor
[59] Standard & Poor's, 2014: Global Infrastructure: How to fill a $500 billion hole
[60] Standard & Poor's, 2013: How To Unlock Long-Term Investment In EMEA Infrastructure

Box 9: Europe 2020 Project Bond Initiative

The Europe 2020 Project Bond Initiative is a joint venture between the European Commission (EC) and European Investment Bank (EIB). The initiative is a financial instrument that was launched to address the blockage between infrastructure demands and stagnant infrastructure investment after the financial crisis in 2008. This instrument works to persuade private sector institutional investors to fund infrastructure projects by providing a "subordinated debt portion of the project financing" through the EIB. This boosts the credit rating of the project bonds so that institutional investors can invest in commercially feasible projects. As one interviewee noted, "The European Investment Bank's Project Bonds Initiative may be very small at the moment, but it is very important. It can show the sorts of things you can do when efficiently allocating money".

The Europe 2020 Project Bond Initiative works by setting up a project company that completes the planning, construction, operation, and financing of an infrastructure project. This company is endowed by the project initiator with capital that covers a fixed percentage of the project costs. The rest of the costs are debt financed, and divided into senior tranche and subordinated tranche. The senior tranche is provided by private institutional investors, and the subordinated tranche comes from the EIB in the form of Project Bonds Credit Enhancement. The EIB can provide the loan at the beginning of the project, which requires less debt capital from private investors, or the EIB may provide a contingent credit line for a fully financed project in the instance that further funding is needed. In either case, the EIB helps to replace the role of the bond insurers to help further the investments behind infrastructure.[61]

Figure 15
Europe 2020 Project Bond Initiative framework
Source: Deutsche Bank Research, 2013: Project Bond Initiative (EU Monitor, 25 September 2013)



[61] Deutsche Bank Research, 2013: Project Bond Initiative (EU Monitor, 25 September 2013)

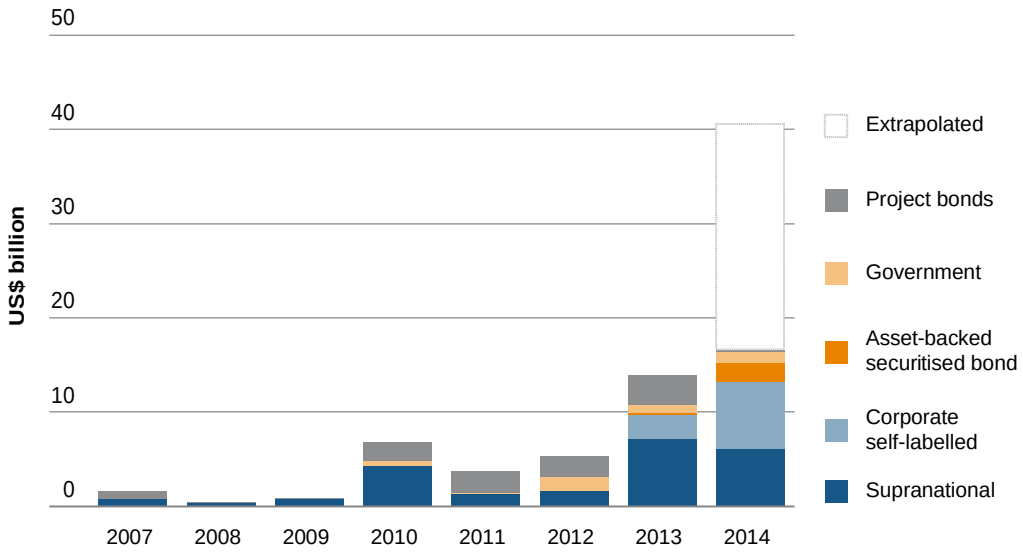
Green bonds

Green bonds are instruments that tie the proceeds of a bond issue to environmentally-friendly investments, including renewable energy infrastructure. There has been a surge in green bonds through 2013 and 2014. For example, in 2012, US$3bn worth of green bonds were sold and, in the first six months of 2014, close to US$20bn green bolds were issued. It is estimated that the cumulative value of all green bonds will be around US$50bn by the end of 2014.[62] Part of the significant growth of the market is a result of the increasing amount of historic data available and a growing familiarity with the bonds. “The more we can find ways of directly educating investors and making it look like any infrastructure bond, the more likely you are to make conservative investors feel comfortable with this space.” Moreover, the issuing of use-of-proceed green bonds (also called asset-linked or self-labelled green bonds as the issuer explicitly labels the bond as green), can help increase familiarity and confidence. “We have started to tackle the world with the plain vanilla, ‘use of proceeds’ green bonds. When you boil those down, they really are simply an investment-grade bond that you can put into your investment-grade portfolio, you have no exposure to the projects themselves, and you leave that risk with the corporate issuer.” As the use of proceeds green bond investor pool expands, there is the potential for bond-issuing companies to target investment specifically towards renewable energy and energy-efficiency projects in OECD and emerging markets to attract a new investor base.

Figure 16

Historical green bond issuance by type (in US$ billion)

Source: Bloomberg New Energy Finance (BNEF), 2014: Green Bonds Market Outlook 2014



Even though the issuing of green bonds has increased noticeably, especially over the past 12 months, the share remains very small at less than 1% of overall issued bonds. The implementation of the recently developed Green Bond Principles, aimed at establishing voluntary guidelines that focus on transparency and disclosure to ensure market integrity, is crucial to continue the scaling up of the green bonds market.[63] This area has benefitted from joint efforts in the financial sector, as noted: “In the area of green bonds you have seen a lot of collaboration amongst banks to try to figure out how do we get the word out about green bonds, how do we take it to the next level,

[62] The Economist, 2014: Green Grow the Markets, 5 July 5, 2014
[63] International Capital Market Association, 2014: Green Bond Principles Governance

how do we open up the market?" Furthermore, a standardised process or creation of a body that would help get more projects rated (and, in that context, evaluate what the risks and tools are that need to be put in place on these projects) may increase the flow of investments.

Venture capital

Venture capital is a very risky, high-reward business and the most expensive form of capital, more costly than public equity, later-stage private equity, bonds, or loans. It is a critical source of financing for the energy sector, in particular for a range of early-stage, high-potential, growth start-up companies. Their often unproven, novel energy technologies or new business models depend greatly on venture capital for commercialisation.

While the number of venture capital firms interested in the energy sector in general has grown over the past years, new investment in renewable energy technologies via venture capital has seen a major decline. Much of this decline has been driven by insolvencies in solar energy caused by the continuous global overcapacity, but also by the lack of predictability of policies and exposure to regulatory risk in the short and medium terms, and a lack of investor confidence overall.[64] As one interviewee noted, "Predictability is probably the single most important factor, especially in a venture situation, where you are focused on the next five years". Another one added, "Venture capital firms may still be convinced, but their investors are not".

The level of venture capital in investment varies greatly from country to country and region to region, and largely depends on the creation of an attractive 'ecosystem'. This ecosystem plays an integral part of the value creation in a technology-based enterprise and is the basis for investors to place their resources at risk. A good 'ecosystem' for energy venture capital to thrive needs the following: intellectual property rights need to be protected sufficiently, entrepreneurship and start-ups need to be encouraged adequately, and substantial policy and market demands need to be in place. While the US and Europe are the biggest markets for venture capital investment in renewable energy sources, energy efficiency and grid technologies, in other regions and countries, early-stage ventures are not as common yet and the industry is only in an early stage of development. This can be observed in many Asian, but also Middle Eastern and North African countries, or in South Africa. In many cases the necessary ecosystem is not yet in place.

Banks

Commercial and investment banks have been a key source of capital for the energy sector, providing short- and long-term loans to support company operations and capital expenditures, underwriting bonds or providing lines of credit. The dynamics of the banking sector, driven by the financial crisis and changing regulations, such as Basel III – the voluntary regulatory standard on bank capital adequacy, stress testing and market liquidity risk – which will eventually supersede Basel II, might have a big impact on infrastructure finance in general, and energy infrastructure finance in particular, as banks become less ready to provide long-term, non-recourse project finance loans (see Box 10).

[64] Bloomberg New Energy Finance (BNEF), 2014: Global Trends in Renewable Energy Investment 2014

Box 10: Basel III

Basel III is a set of international banking regulations developed by the Basel Committee on Banking Supervision with the purpose of promoting stability in the international financial sector by reducing the ability of banks to damage the economy by taking on too much risk. The impending Basel III regulatory standards require banks to hold more capital against their assets, and with that, decreasing their balance sheets and ability to leverage themselves. "The whole intention of Basel III is to make banks less aggressive, and loans to emerging countries are defined as riskier assets so there is less supply of capital for infrastructure projects." While banking regulations such as Basel III may help reduce the risk of a future financial crisis, it may also hinder future economic growth as bank lending and the availability of credit are primary drivers of economic activity.

The new Basel III regulations may not only have a limiting effect on the availability of credit, but are likely to make long-term financing more expensive. This in turn, will affect the financing of capital-intensive conventional and renewable energy technologies, because they typically rely on long-term financing. Together, these are threats to the development of energy projects and, in particular, renewable energy projects as the limited availability of capital may prevent the financing of some projects. Also, more expensive loans are likely to make a number of projects financially unattractive.

While the impact on project finance markets may be severe, with large banks pulling out of the renewable energy sector, there is an opportunity for the capital markets to fill the void – for example, through an increased issuance of bonds, in particular, green project bonds.

These changes have led to a scaling back of infrastructure and project finance loans, rising lending rates, and a shift to shorter maturities. Bank lending has slowed considerably over the past few years. Globally, project finance loans are estimated to have fallen by between 10% and 30% in 2012, compared with 2011.[65] However, the share of loans in global financial assets has remained stable throughout the past decade and continues to play an important role in emerging markets.[66]

Even though bank lending, especially in advanced economies, may continue to slow, banks are still expected to provide the majority of infrastructure debt finance in the near to medium term and are likely to step in as arrangers and facilitators, or to provide bridge financing.[67] But it is clear that supplementary sources need to be cultivated, particularly from those with the capability to provide long-dated financing.

[65] World Economic Forum, 2014: Infrastructure Investment Policy Blueprint
[66] McKinsey, 2013: Global Capital Markets 2013
[67] Standard & Poor's, 2014: Global Infrastructure: How to fill A $500 billion hole

Green banks

Over the past few years, a number of green banks have been founded around the globe, mostly in developed economies. Dedicated to overcoming obstacles in clean energy financing and increasing overall capital availability through various forms of financial support, such as credit enhancement, project aggregation, and securitisation, green banks are mostly state-sponsored. For example, founded in 2012, the UK's Green Investment Bank was provided with an initial £3.8bn by the UK government to back green infrastructure projects across the country and mobilise other private sector capital.

Green banks are looking to spur economic development and jobs in the clean energy sector by:

- providing a bridge to self-sustaining, efficient financing markets for smaller-scale clean energy and energy-efficiency projects that are often too small for a large financial institution to be interested
- crowding in other private sector investors and increasing the amount of clean energy deployed for every pound, euro or dollar of government money spent or invested in the clean energy sector in forms of loans or by providing credit enhancement
- animating capital markets for the clean energy sector to reduce the cost of capital and the need for government support.

In addition to the existing mandates, some interviewees noted that it would be of value if green banks could help private sector investors understand which projects are financially viable and which ones are not. As one interviewee noted: "What we could really use is somebody who is able to help more projects get rated, apply the risks and tools to bring them investment-grade ratings, so that you can crowd pension fund investors into that area".

With many smaller-scale renewable energy projects, a number of interviewees also pointed to the importance of creating aggregation or bundling platforms, a tool which a development or green bank could back or host. "A pension fund is not going to buy a £5m wind farm. There is a role for an aggregator with sufficient volume and structure to help securitise a number of projects." While this was recognised as an opportunity, it was also noted that the development of such a tool would not be easy due to the difficulties related to bundling projects of similar technical nature in countries with very different political and regulatory risk profiles.

Institutional investors

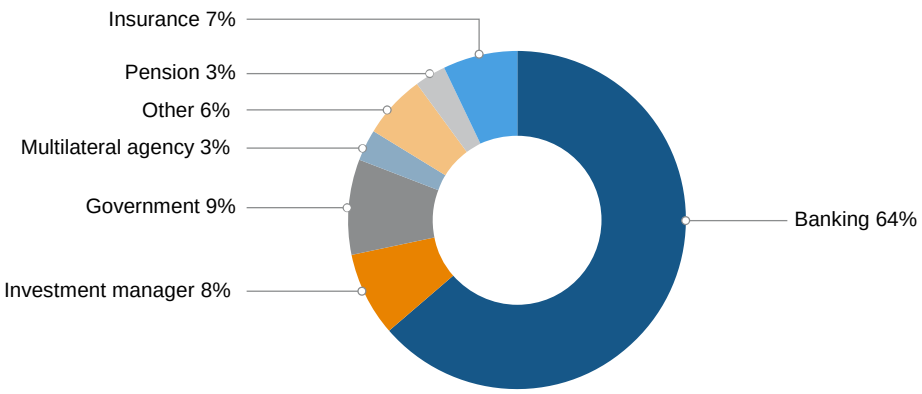
As long-term bank debt is harder to come by, and the associated refinancing risk leads to greater caution from equity investors and governments, infrastructure projects worldwide increasingly look at the 'shadow banking' sector. The shadow banking sector includes pension funds, insurers, sovereign wealth funds, and export credit agencies, alongside finance companies, private investment funds, business development corporations, asset managers, hedge funds, and sponsored intermediaries, such as money-market funds.[68]

[68] Standard & Poor's, 2013: Out of the Shadows: The rise of alternative financing in infrastructure

Figure 17

Global project finance volume by funding institution, January 2012 to January 2013

Source: Standard & Poor's, 2013: Out of the Shadows: The rise of alternative financing in infrastructure



Institutional investors are considered a huge potential source of investment and there are indications of current and potential increases in overall infrastructure investments. Entrusted with the money of others, they tend to look for long-term, low-risk, low-volatility investments that generate inflation-linked, predictable returns.[69] Collectively, these investors in 2011 held assets with a total value of close to US$85trn dollars, of which roughly 40% was held in public equity.[70] Investment funds, insurance companies and pension funds represent by far the largest share, and have more than doubled their total assets over the past decade. Today, 85% of the total assets under management are held by institutional investors.

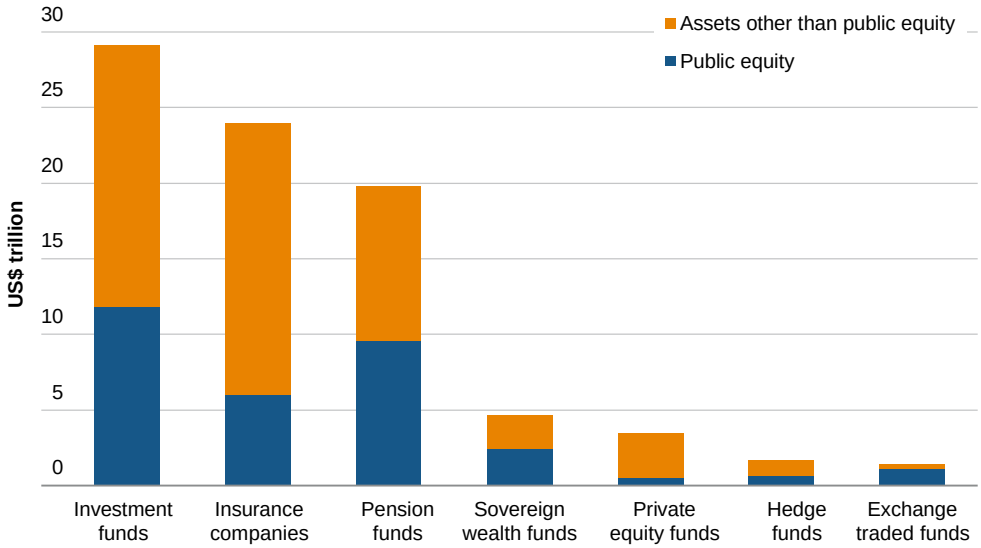
Based on figures from the OECD and other infrastructure data, it is estimated that institutional investors are targeting an increased allocation of assets to infrastructure over the next five years. This could equate to as much as $200bn per year – or $3.2trn by 2030 – for all infrastructure financing, including energy. However, there are a number of barriers to be overcome for institutional investors to increase their investment levels and it is unclear how much of the overall infrastructure investing would be directed to the energy sector. "There is an idea that tens or hundreds of billions of dollars of institutional money will suddenly be unleashed to resolve the energy trilemma if only we could make a few minor nips and tucks to regulation. But energy is not the only competing source for this capital and institutional investors tend to spread their risks and what they like is liquid investments, bonds or stocks."

[69] Standard & Poor's, 2014: Global Infrastructure: How to fill a $500 billion hole
[70] OECD, 2013: Institutional Investors as Owners

Figure 18

Total assets under management by different types of institutional investors (in trillion US$, 2011)

Source: OECD, 2013: Institutional Investors as Owners



Note: Investment funds, insurance companies and pension funds data do not cover non-OECD economies. Since institutional investors also invest in other institutional investments, for instance pensionfunds' investments in mutual funds and private equity, the comparability of different data cannot be verified.

Institutional investors can be wary of taking long-term risks on energy projects, such as uncertainty around policy and regulatory changes; lack of historic data, especially for renewable energy projects; construction and completion risks; technical and design failures; poor operational performance; or commodity prices. However, risk management strategies exist and "done right, investments in infrastructure, of which energy is a subset, are long-term stable cash-yielding assets, which are uncorrelated with the capital market and therefore fit incredibly well with pension funds investment appetite".

Institutional investors have the potential to help bridge the emerging infrastructure financing gap, if the right preconditions are set.

Pension funds

The evolution of pension fund investment in infrastructure is at different stages around the world, but the allocation of assets to alternative asset classes, such as energy infrastructure, are slowly increasing and the approaches to investing vary. In some countries, for example in Canada, the public and private pension fund sector is already one of the largest funders of infrastructure, including energy infrastructure. While the average current allocation to infrastructure by public pension funds globally currently stands at 2.9%,[71] the current allocation of assets under management by the three largest public Canadian pension funds ranges from 5.8% to 24% equalling more than US$33bn.[72] The Canadian model is often referenced as one that public and private pension funds around the world could emulate. Denmark is also cited as a leader. Here, PensionDanmark, a comparatively small pension fund with roughly US$26bn worth of assets under management at the end of 2013, invested US$2.4bn

[71] Preqin, 2014: Infrastructure Spotlight, Volume 6, June 2014
[72] Standard and Poor's, 2014: Global Infrastructure: How to fill a $500 billion hole

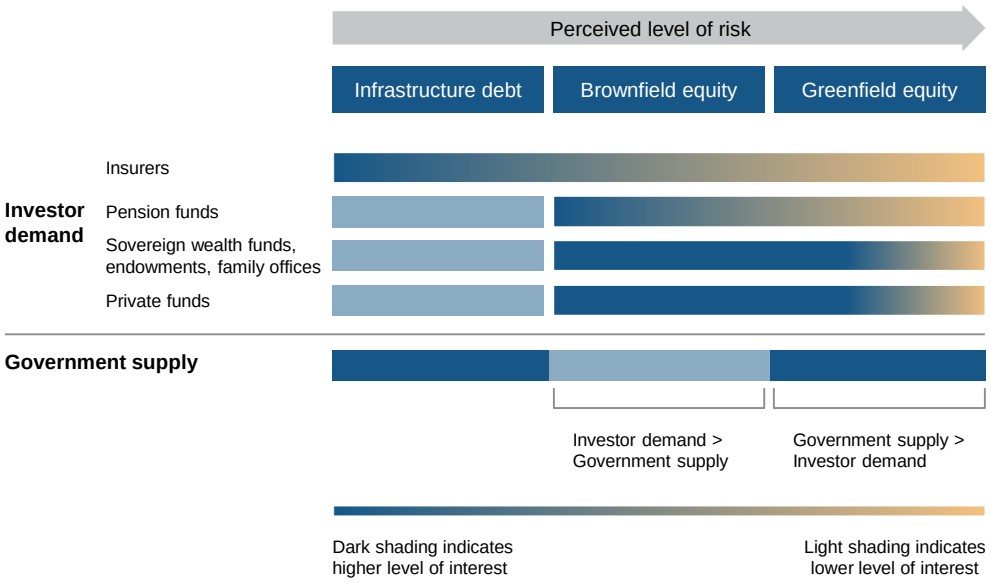
in infrastructure, mainly in renewable energy. PensionDanmark aims to increase investments in infrastructure, mostly energy-related, to 10% of total assets under management.[73]

While investments in projects using low- and zero-carbon technology see an increasing interest, most pension funds do not yet have a target allocation. For many, renewable energy infrastructure is, as discussed earlier, perceived to have a higher risk profile than the incumbent technologies (see Figure 19). “A lot of pension funds are run by advisers: if you tell them you want to do energy infrastructure they have zero incentive to find anything that is innovative, because it will have higher risk in their view than the incumbent technologies.” This can be exacerbated by the difficulties facing rating agencies to apply sufficient investment-grade ratings to projects using new technologies. Lastly, project deals are often still too small-scale – lacking aggregation mechanisms or suitable investment vehicles, such as green project bonds, green asset-backed bonds or funds – to provide the liquidity and risk-return profile that institutional investors need.[74]

Figure 19

Risk profile and investment opportunities by investor type

Source: World Economic Forum, 2014: Infrastructure Investment Policy Blueprint



However, not all pension funds will be able to increase overall investments in infrastructure and energy infrastructure in particular. The approach by which pension funds invest in infrastructure depends on different factors, such as specific regulation, maturity of infrastructure sector, pension fund system, and experience in the sector. For example, there are a number of pension funds that are restricted from embarking on relatively illiquid, long-term debt investment such as infrastructure, or that require monoline insurance before taking stakes in infrastructure projects. Monoline insurance, a type of insurance for securities and bonds, gives investors and issuers the confidence to participate in the market by providing liquidity and financial protection. However, the availability of monoline insurance has been decreasing over the past few years, largely driven by the business suffering losses during the US real

[73] PensionDanmark, www.pension.dk
[74] OECD, 2014: Pooling of Institutional Investors Capital – Selected Case Studies In Unlisted Equity Infrastructure

estate market crisis. “A number of pension funds will be limited in what energy sector projects they can invest in, primarily due to solvency requirements.” For example, in Latin and Central American, there are limits on pension funds’ quantitative investment in unlisted equity, and limitations on bonds issued by new companies and projects. Monoline insurance as used in Chile, structured products as used in Mexico, or collective trust structures as used in Peru, help pension funds to invest in the infrastructure sector.

Only the largest pension funds, or funds with large allocations to infrastructure that have the capability and experience, have started to invest directly in infrastructure projects. Often this is alongside infrastructure funds, but some also take leading roles in consortia. As one interviewee described, “Initially they invested only when the export agency guaranteed the transaction. But over time they started to realise that they understood the transactions well enough and they started to directly invest themselves and didn’t need an infrastructure fund to do the investing for them”.

A number of interviewees confirmed that kind of change and said that one should not underestimate the ‘positive contagion’ effect, which shared experiences and information exchange can have to build confidence and comfort with energy infrastructure investing, especially in renewables. One interviewee suggested that, too often, infrastructure or green bonds can be presented as “ground breaking” and “innovative” to the detriment of attracting investment since it implies a high degree of complexity. “It would makes sense to convene a meeting of pension portfolio managers and decision makers and discuss what got other pension portfolio managers comfortable to invest in long-term infrastructure projects. The other pensions might want to listen to what got select pensions comfortable.”

A number of pension funds have also combined resources to create co-investment vehicles that allow investment in infrastructure assets without the challenge of having detailed in-house expertise. Examples include the UK’s Pensions Infrastructure Platform (PIP), Canada-based Global Strategic Investment Alliance (GSIA) and Canada Pension Plan Investment Board (CPPIB).

Insurance

As impending Basel III liquidity rules affect the availability of debt and equity capital for infrastructure projects, these changes in the banking system’s role may give insurers an opportunity to expand their role in the provision of credit to infrastructure projects.[75] The benefits of this growing role would be twofold. For example, it is estimated that if European insurers developed the skills and capabilities to increase long-term credit, they could increase their aggregate market value by about €200bn, or 50%. At the same time, the value to the economy and society would be significant in terms of loans.[76]

However, to increase their long-term loans or invest in illiquid debt instruments, insurers must extend their sales and risk-assessment skills. Furthermore, in Europe, for example, there is some concern that risk capital charges proposed for insurance companies under the Solvency II Directive[77], scheduled to take effect in 2016, will discourage insurers from providing long-term financing, as it may penalise insurers for

[75] Cooper, S and Whitworth, J, 2012: Sobering Up to Scarce Liquidity, Oliver Wyman Risk Journal, Volume 2, Prospering in a Cash-constrained World
[76] Whitworth, J and Byron, E, 2012: The €200 Billion Opportunity: Why insurers should lend more, Oliver Wyman
[77] Solvency II is an EU Directive that introduces a new, harmonised, EU-wide insurance regulatory regime.

holding long-dated, low- to-mid-investment-grade project debt (that is, debt in the 'BBB' and 'A' categories).[78] Uncertainty over possible implications remains high given the early stage of regulatory reforms, as tighter bank regulation could be a potential impediment to institutional investors' ability to commit long-term capital.[79]

International financial institutions

International financial institutions have been established to provide financing and professional advice – technical assistance and assessment needed in developing the information for projects – to developing countries. Even though the volume handled by multilateral and regional development banks may be considered small compared with the volume handled by commercial banks, they fulfil an important purpose and can unlock markets in the long-term that private sector investors still find too high-risk to enter. For example, one interviewee pointed to the frequent imbalance of investor expectations*:* "Investors are typically European or American and often have the perception that you can conduct business in, for example, Brazil as in Texas. That is not the case and multilateral development banks can help facilitate conversations".

In most developing countries, domestic financial sectors – banking and capital markets – remain underdeveloped, and the necessary demand that attracts investors to the country does not exist and has to be created. In many instances, project pipelines either don't exist or are not well-maintained, projects. Renewable energy projects are often too small to attract funding, and a lack of experience and know-how persists. Development banks play an important role in overcoming these obstacles and "multilateral and regional development banks are key to unlocking domestic markets deal by deal, country by country".

While some development banks provide loans, a variety of guarantees (credit enhancement), or equity directly to project developing entities, others go through the domestic financial sector to entice their interest in different sized (energy) projects while at the same time building capacity of domestic institutions to work with domestic governments. In many cases, credit enhancement products such as credit guarantees, political risk insurance, risk guarantees, or seed capital provided by a multilateral development bank, have helped direct private sector investment in energy. They have also helped attract private sector participation in public-private partnerships, and enabled governments access to international capital markets on more favourable terms. Similarly, development banks can help to 'crowd in' investors by acting as a bridge lender to sovereigns who have a direct equity interest. As one interviewee noted, "As a development bank, we can use our limited public resources for risk mitigation for the private sector and lower the cost of capital. The impacts of defaulting on the development bank are far more severe than a default on an individual company. That has quite a high leverage effect in bringing in private capital".

[78] Standard and Poor's, 2014: Global Infrastructure: How to fill a $500 billion hole
[79] Cooper, S and Whitworth, J, 2012: Sobering Up to Scarce Liquidity, Oliver Wyman Risk Journal, Volume 2, Prospering in a Cash-constrained World; Whitworth, J and Byron, E, 2012: The €200 Billion Opportunity: Why insurers should lend more, Oliver Wyman

Box 11: Lake Turkana Wind Power project in Kenya

In 2013 the African Development Bank (AfDB) took a lead role in developing what will be the largest wind power project in Africa. The Lake Turkana Wind Power project in Kenya will include the construction and operation of a 300 MW wind farm and help diversify the country's electricity generation mix as well as provide more people with access to energy. Important to the project and investment is the fact that the government of Kenya will construct the over 400 km long transmission line required to evacuate power from the project site to the national grid. To this end, the government of Kenya has secured financing from the Spanish government.[80] The project itself is led by a private sector consortium. The AfDB is the lead arranger of the debt financing with South Africa's Standard Bank and Nedbank Capital as co-arrangers. The approval of a loan of close to US$150m by the AfDB in May 2013 and the approval of the first partial risk guarantees of US$27m in October 2013,[81] covering private lenders and investors against the risk of a possible government failure to meet contractual obligations helped bring in other investors. The financing documents were signed in March 2014.

The wind farm is planned to be completed and fully operational by 2016.[82]

Development bank finance, for example, has the potential to play an even more important role for clean energy projects provided the right risk mitigation instruments are available. Currently, more than US$100bn annually goes into projects in clean energy, power generation, transmission and distribution across the globe. By introducing a securitisation facility that packages loans into high-rated bonds and brings in new investors, that are currently not engaged in climate-related investments – a mechanism referred to as the 'big green bucket' – development banks would be able to 'recycle' their money more quickly into new loans.[83]

New source of capital

New investment sources such as municipalities, small businesses, and households, as well as new financial instruments and mechanisms are emerging for the energy sector. Much of the dynamics in energy markets is coming from smaller market players or new entrants. For example, the expansion of distributed renewable energy capacities and energy-efficiency initiatives is turning more small businesses and households into energy investors. Larger-scale adoption of energy-efficiency initiatives or technologies – especially by households – will require innovative models for investment and for financing.

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[80] www.megaprojects.co.ke/articles/187/afdb-approval-of-usd-1495-million-loan-to-turkana-wind-power-project-in-kenya/
[81] Energy Business Review, 2013: AfDB Approves ADF Partial Risk Guarantee for Lake Turkana Wind Power Project in Kenya, 4 October, 2013
[82] Lake Turkana Wind Power website (http://ltwp.co.ke)
[83] BNEF, 2014: Big Green Bucket for Climate-related Lending

These emerging economies have an average of 67.4% [84] of electricity generation from hydropower, the highest share of any profile group. The energy trilemma profile of the 'Hydro-powered' group of countries is tilted towards the environmental sustainability dimension, although these countries also perform reasonably well on the energy security dimension.

Hydro-powered

Figure 20
Trilemma profile and illustrative countries: Hydro-powered
Source: WEC/Oliver Wyman, 2014

Countries	Index rank	Balance score
Costa Rica	20	ABB
Colombia	15	AAC
Brazil	30	ABC
Ecuador	36	ABB
Uruguay	39	ABC
Peru	41	ABC
Panama	44	ABC
Cameroon	71	BBD
Paraguay	76	ACD
Sri Lanka	80	BCC
Ethiopia	115	BDD

The Hydro-powered countries are predominantly in Latin America, due to the region being endowed with numerous powerful rivers and the ability to successfully exploit this resource. Other members of the group include countries from the East African River Basin and South-East Asia. Some countries have been impacted by droughts and the resulting energy shortfalls highlight concerns about energy security. To maintain affordable and secure energy, reduce the risks associated with hydroelectric power generation, and circumvent fossil fuel generation growth, many countries in this group are looking to increase the share of non-hydropower renewable energy generation. They must also consider necessary investments for grid enhancements to support high proportions of intermittency in the grid or to better use hydropower to play a valuable role in keeping the system balanced.

For example, recurring droughts in Brazil have led the country to protect against weather variability and increase energy security by increasing the share of dispatchable sources of electricity generation, such as thermal power plants. At the same time, Brazil has set a target of 16% of electricity generation from renewables (excluding large hydro) by 2020[85] to increase energy security. The dispatchability of thermal power plants will become even more important in the presence of intermittent renewable resources and more run-of-the-river hydropower plants that lack storage capacity. Other countries are also looking to diversify their electricity generation portfolio to supplement hydroelectricity. For example, Colombia is targeting 6.5% of electricity generation to the grid and 30% of off-grid electricity generation from renewables (excluding large hydro) by 2020.[86]

[84] EIA, 2012: International Energy Statistics
[85] International Renewable Energy Agency (IRENA), 2014: Renewable Energy Country Profile: Brazil
[86] IRENA, 2014: Renewable Energy Country Profile: Colombia

Countries of the East African River Basin face similar problems. Ethiopia is looking to increase the number of hydro-electric power stations, despite the seasonality of hydropower created by the dry season, growing environmental and social concerns and the accelerating competition between energy, water and food. At the same time, the country is taking steps to diversify the electricity mix as it aims to become a leading regional power supplier. For example, in 2013, Ethiopia opened Africa's largest wind farm. The wind farm was built by French firm Vergnet SA with concessional loans from BNP Paribas and the French Development Agency. The Ethiopian government covered 9% of the cost.[87] In addition, Ethiopia and Kenya are looking at tapping some of the potential for geothermal electricity production to counter some of the seasonality of hydropower. The cost of development and extraction of geothermal sites is expensive and technologically difficult.[88] To address costs, an initial agreement was signed with a US-Icelandic firm in 2013 for a US$4bn private sector investment intended to tap Ethiopia's vast geothermal power resources and produce 1,000 MW from steam.

Renewable energy has undergone impressive growth in both developed and emerging markets. In recent years, developing countries have continued to close the gap in new investment in renewable energy. While in 2003 investment in renewable energy was US$8bn in developing countries and US$32bn in developed countries, in 2013 investment in developing economies reached US$93bn and US$122bn in developed nations.[89]

To reach national diversification targets, hydro-powered countries are adopting a number of strategies. Firstly, they are building the policy and regulatory frameworks to stimulate new renewables. For example, Peru passed Legislative Decree 1002 in 2008 to promote the inclusion of renewable energy in the nation's energy matrix and fixed goals for its development, including 7% non-hydroelectric renewable generation by 2017, and setting the grounds for greater investment in the industry.[90] This is a strong signal to investors that Peru is willing to take on risk-sharing through financial commitments and assist in developing these renewables. Along with policy and regulatory frameworks, it is important for policymakers to work with the financial sector, including institutional investors and local pension funds, to ensure renewable projects can secure credit ratings and increase investor confidence.

Secondly, they are increasing project viability to attract more private sector investment. Financial institutions can be wary of investing in projects that lack a guaranteed cash flow, such as a power purchase agreement (PPA). If governments can offer rate guarantees or offtake agreements before additional capacity is developed, investments will become more appealing. It is critical that governments abide by these commitments to ensure they remain trustworthy and avoid the experiences of countries such as Spain where reneged rate guarantees led to a 90% decrease in investment in Spain's solar industry from 2011–2013.[91] Following the 2008 financial crisis, the Spanish government – given its overall financial situation – drastically cut its subsidies for solar power and capped future increases. In 2012, it went further, placing a temporary ban on renewable energy subsidies with the aim of saving several billion Euros owed under the policy.

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[87] Reuters, 2013: Ethiopia Opens Africa's Largest Wind Farm To Boost Power Production, 26 October, 2013
[88] Reuters, 2013: Ethiopia: Geothermal Energy Remains in the Shadow of Hydropower in Ethiopia, 23 September, 2013
[89] United Nations Environment Programme (UNEP), Bloomberg New Energy Finance (BNEF), 2014: Global Trends In Renewable Energy Investment 2014
[90] US Department of Commerce, 2012: Peru: Renewable Energy Industry
[91] Financial Post, 2014: Governments Rip Up Renewable Contracts, 18 March, 2014

Especially when it comes to financing demand-side energy efficiency, new financing and risk mitigation mechanisms are required to incentivise investment in new energy-efficient technology. As one interviewee noted, “Sometimes putting in place a soft loan, which is already very cheap, is just not enough as the perceived technology and performance risk is too high”. In Colombia for example, an energy-efficiency initiative targeted the hospital and hotel sector. It put in place soft loans supported by four different non-financial mitigation instruments to increase investor comfort. “You have to remember that these are unusual investments, people are not used to investing in savings, normally they invest in growth, so energy efficiency can be quite challenging.” The non-financial mitigation that helped create confidence included an external entity responsible for the project evaluation process, an independent third-party available for disagreements, local energy-saving insurance and, most importantly, suppliers taking on some of the technology and performance risk.

Another interesting development was highlighted in a recent report from the Solar Energy Industries Association, which found that 25 of America's largest companies had cumulatively deployed 3,380 MW of on-site solar projects. From 2012 to 2013, corporate projects expanded by more than 40%. Furthermore, nearly one-quarter of the companies on the Fortune 100 list have set targets for greenhouse gas (GHG) reduction or renewable energy procurement, with a large number signing power purchase agreements to ensure additional renewable energy generation is built, or investing directly on-site to improve fuel diversity and visibly demonstrate their corporate commitment. One of the companies at the front end of this trend is Google which has been accumulating one of the most impressive clean energy portfolios. Since 2006, when the company started building the largest corporate solar photovoltaic (PV) project on its Mountain View campus, it has agreed to invest more than US$1.5bn in clean renewable energy projects. Another example is Warren Buffett, Chairman and Chief Executive Officer of Berkshire Hathaway, widely considered the most successful investor of the 21st century, who has signalled his intention to increase renewable energy investments. MidAmerican Solar, a subsidiary of Berkshire Hathaway purchased the 579 MW Solar Star projects in January 2013. Combined, the two co-located projects in Southern California will have over 1.7 million solar modules and will sell power under long-term agreements to Southern California Edison, a unit of Edison International. Together, the projects will help both Southern California Edison and the State of California meet its renewable electricity goals.[92] At the Edison Electric Institute June 2014 convention, Buffet remarked, “There’s another US$15bn ready to go, as far as I am concerned”.[93]

[92] Mid American Solar, 2013: Solar Star Projects, (www.midamericanrenewablesllc.com/solarstar_solar.aspx)
[93] Bloomberg, 2014: Buffett Ready to Double $15 Billion Solar, Wind Bet, 10 June, 2014

Summary and action items

While there are strong indicators that there is sufficient private sector capital available to invest in the maintenance and development of energy infrastructure, unlocking it will depend in part on evolutions in the financial sector, and its collaboration and exchange of information within and outside of the financial sector, especially, with public and private energy sector stakeholders. This mirrors the strong call to action captured in the 2013 World Energy Trilemma 2013: Time to get real – the agenda for change. In particular, financial sector representatives highlighted the importance of:

- helping policymakers and the energy sector understand the role different financial investors and instruments can play in funding energy infrastructure projects at various stages of a project life cycle to attract the right kind of funding
- considering the role of new players and initiatives in the financing sector, for example, green banks, BRICS[94] new development bank, or project bonds initiative, to fill the 'right' gap and avoid the 'crowding-out' of other investors
- engaging with regulators on the development of financial regulations to avoid over-regulation and economic slow-down
- supporting efforts which create standardisation of financial instruments (for example, definitions of green bonds) to facilitate investor comfort and confidence in the mechanisms
- jointly working on the development of aggregation platforms for bundling of smaller-scale energy projects, standardised processes to rate energy and other infrastructure projects or similar investments that may help overcome barriers
- reviewing existing rating models and the extent to which project ratings can be disconnected from sovereign credit ratings
- increasing communication within the financing sector to benefit from best practice examples and increase the level of comfort to invest in energy projects and support mechanisms that enable sharing of expertise and knowledge
- investing in the development of human capacity in domestic financial sectors, including capital markets in developing and emerging economies.

[94] The five major emerging national economies: Brazil, Russia, India, China and South Africa.

“

It is not the lack of finance, but the lack of financeable deals

”

3. Improving the capacity of the energy sector to absorb capital

The energy sector is undergoing significant changes, driven by technological developments as well as regulations and policies geared to reduce greenhouse gas (GHG) emissions. Taken together, these developments are shifting the risk profile of investments in energy sub-sectors. For example, the investment needed in conventional fossil fuel infrastructure will not decline as, through to 2050, fossil fuels will continue to represent the dominant share of the world's primary energy mix (see Figure 23). Within the oil and gas sector, the costs and complexities associated with new oil and gas reserves are increasing, as illustrated by the 'Fossil-fuelled' countries in the 2014 Energy Trilemma Index. The utilities sector in many developed countries must fund the transition of ageing infrastructure and adapt to the interruptions to business models driven by climate policies, renewable technologies and distributed generation. The WEC estimates that total investment in electricity generation alone will range from US$19trn ('Jazz scenario') to US$26trn ('Symphony scenario') between now and 2050. Depending on which WEC scenario one considers, a share of 46% to almost 70% of this is to be invested in renewable electricity generation, including solar photovoltaic (PV), hydro and wind.[95] This additional capacity will entail investments in the transmission and distribution networks, supplementing conventional energy generation facilities and the development of energy storage to accommodate and balance the intermittency of renewable energy sources. Renewables are still struggling under the 'policy hangover' caused by sharp reversals on subsidy schemes and also remain outside of the comfort zone of many investors. Finally, nuclear power faces social licence (public approval) issues in some countries; in others, the questions of who is going to bear the cost of dismantling retired reactors, and the location of geological storage facilities, are still not answered (see Table 2).

The requirements are huge and energy sector projects are very capital intensive. This puts a significant focus on the cost of capital and factors that can affect it. As noted by one interviewee, "The capital intensity of the energy business is mind blowing, so cost of capital is critical". The energy sector will need to take a number of steps to secure the necessary capital to ensure the transformation and extension of energy systems.

[95] WEC, 2013: World Energy Scenarios: Composing energy futures to 2050

'Fossil-fuelled' countries tend to rely heavily on their large fossil fuel resources for electricity generation, resulting in comparatively high CO_2 emissions per kWh generated. Countries that illustrate the Fossil-fuelled profile typically show an energy trilemma imbalance that tilts towards energy security and energy equity, while they struggle to minimise their environmental impact.

Fossil-fuelled

Figure 21

Trilemma profile and illustrative countries: Fossil-fuelled

Source: WEC/Oliver Wyman, 2014

Countries	Index rank	Balance score
United States	12	AAC
Australia	13	AAD
Qatar	19	AAD
Malaysia	26	ABC
United Arab Emirates	35	ABD
Kazakhstan	57	AAD
Saudi Arabia	68	ABD
Oman	72	ACD
Kuwait	77	BCD
Egypt	85	BBC

The group is generally made up of net energy exporters, notably Saudi Arabia, the United Arab Emirates as well as the US, which is on course to becoming a net energy exporter of oil and gas. Although fossil fuels are predicted to remain globally dominant in the primary energy mix up to 2050[96], there are challenges on the horizon for these economies. These include: the potential impact of a meaningful post-2015 climate change agreement on global energy demands; the need to diversify energy sources and decarbonise electricity generation; managing demand; and ensuring necessary levels of investments in energy to support economic growth. However, there are also opportunities. A concerted effort on the development of carbon capture, utilisation and storage (CCUS) technologies would allow the mitigation of GHG emissions from large-scale fossil fuel usage in power generation, fuel transformation, and also industry. While all of the components of an integrated CCUS system exist already, it has not yet been applied on a large scale, commercial fossil fuel fired power plant. A breakthrough would have a 'game-changing' impact on these countries' trilemma performance and would enable the long-term, sustainable utilisation of fossil fuels under a post-2015 climate change agreement.

In the meantime, the key for some of the countries in this group is to diversify their resource-based economies, for example, on average, 41% of the gross domestic product (GDP) is linked to oil and gas exports for Organization of the Petroleum Exporting Countries (OPEC) countries.[97] To prevent future economic shortfalls, countries are looking to leverage their fossil fuel wealth to diversify their domestic energy usage and their economies overall, with investments into emerging industries or technologies.

[96] World Energy Council (WEC), 2013: World Energy Scenarios
[97] World Bank, 2014: World Development Indicator database; International Monetary Fund (IMF), 2014: World Economic Outlook Databases

As an investment opportunity, fossil fuels continue to benefit from a long history with investors; this creates a level of comfort and degree of predictability for investors. As one interviewee noted, "We've got 20 years or 30 years or 100 years of credit ratings and credit history for coal plants, oil investments and gas plants. It's relatively easy to project what's going to happen." However, investors can expect to see changes in the nature of oil and gas projects and also the location of projects.

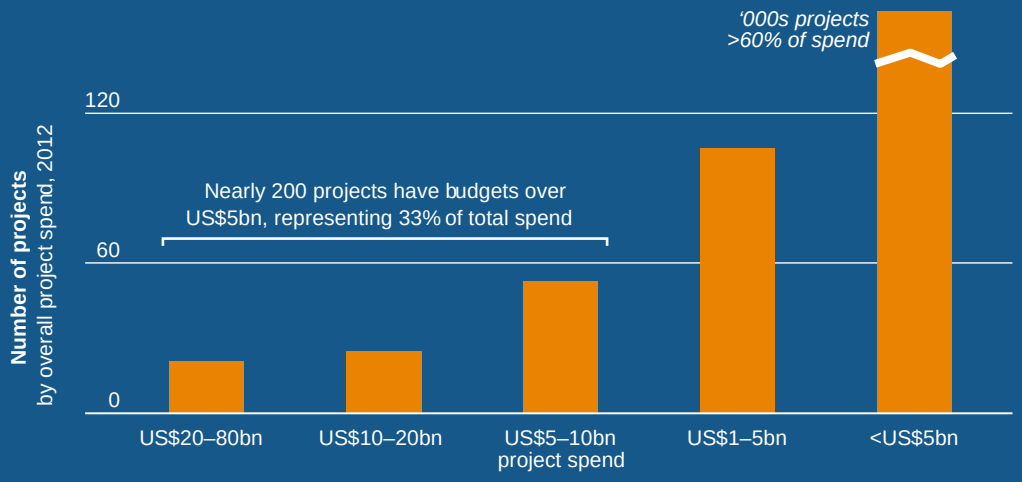
In some oil- and gas-producing countries conventional resources are plentiful, but production is constrained by quotas. In other countries hydrocarbon development is more challenging and costly because of the increasing risks, scale, technical complexity, and need for expertise. In 2012, nearly 200 oil and gas projects already had an overall project spend of US$5bn or more, representing 33% of total spend. Throughout the next decade, more than 70% of the industry's hydrocarbon developments are forecasted to come from complex, unconventional resources in hard-to-access, remote locations such as deep water shelves, tight oil reservoirs, biofuels, oil sands, and potentially the Arctic.[98] With costs rising, the price of oil will have a notable impact on if and when projects are developed or postponed. For example, the history of the Canadian oil sands or Venezuela's extra heavy oil deposits show that more difficult-to-extract resources are generally developed during extended periods of higher prices. Deposits in both countries have only recently been considered as proven oil reserves, closely linked to rising oil prices since 2003 and decreasing extraction costs.

The market for hydrocarbons is also shifting. With growing demand for energy in Asia, energy exporters in the Middle East will be racing against North American natural gas and oil exports through the Canadian Northern Gateway pipeline or export terminals in Texas, to tap a new customer base. In response to market changes, national oil companies have sought and signed joint ventures with international oil companies to maintain their competitive advantage and are also investing in new upstream and downstream assets outside their domestic markets. To succeed in the future, these internationally focused companies need to be globally integrated, decentralised, and need to adapt to local challenges and demands, with a mixed asset portfolio strategy in order to hedge the increasing risks.

Figure 22

The majority of growth in hydrocarbon supply is shifting to complex resources

Source: Oliver Wyman, 2014: Reinventing National Oil Companies – Back to the Future



[98] Oliver Wyman, 2014: Reinventing National Oil Companies – Back to the Future

Table 2

Critical trends in the energy sector affecting investment profile

Source: WEC/Oliver Wyman, 2014

Sector	Political & regulatory	Technology	Economic	Market
Oil	• Policy pressures to reduce GHG emissions and environmental impact. • Evolving and uncertain regulatory frameworks. • Exploration in countries with weaker regulatory frameworks. • Risk of stranded assets under international carbon frameworks.	• End of 'Easy Oil' with increased technical complexity and growing scale of projects (for example, deepwater, Arctic or remote unconventionals). • Declining production from existing oil fields. • Challenges in finding new conventional oil reserves worldwide.	• Investments have become more risky and projects are costlier (US$5bn and more). • Cost of capital is rising, for example, costs of capital for US oil and gas companies, are 33% higher in 2013 compared to 2003. • National Oil Companies (NOC) investment in new upstream and downstream assets to attain size, industrial scope, and technical expertise to manage rising risks. • Some institutional investors divesting from fossil fuels.	• Oil price fluctuations. • CO_2 price fluctuations. • NOC expansion into international markets due to depletion of local resources.
Gas	• Policy pressures to reduce GHG emissions and environmental impact. • Public concerns regarding unconventional gas exploration. • Pressures to increase gas exploration to improve economic security. • Policy discussion around accelerating energy-water-food nexus. • In many countries, existing regulatory frameworks do not yet address unconventional gas development in sufficient detail and slow development.	• Uncertainty around use of new technologies (for example, use of chemicals in hydraulic fracking, assessment and evaluation of fractures, liquefaction and handling etc.).	• Producers may face depletion effects with rising costs. • A large number of major LNG projects in the pipeline may create over-supply in some gas markets and depress prices. • High capital cost of LNG infrastructure.	• Project economics might alter over the next 10-15 years based on likely changes in global supply and demand for gas, and technological advances in drilling. • Shale gas discoveries push down the price of gas. • Market integration (integration with LNG, pipeline transport, gas balancing etc.).
Coal	• Policy pressures to reduce GHG emissions and environmental footprint may have significant impacts on longer-term prospects. • Environmental regulation drive retirement of coal generation capacity (e.g. 60GW reduction of coal generation capacity by 2020 in US). • Without carbon capture, utilisation and storage (CCUS) risk of stranded assets under international carbon frameworks.	• The expedited development and large-scale deployment of clean coal power generation technologies, in particular CCUS, may be necessary under a meaningful post-2015 climate agreement.	• Producers may face depletion effects with rising costs. • Proposed legislation by the US to reduce GHG emissions from coal plants may affect the financing and construction of coal-fired plants in developing countries through multi-lateral development banks. • CCUS will be an added cost and will require investments in major pipeline and other infrastructure.	• Demand for coal will continue to grow in booming Asian countries up to 2050 (for example, China and India). • Coal is a cheaper option than gas for generating electricity in many regions. • Shale gas development in the US has dislocated coal into other markets, for example, Europe. • Increased competition from renewables due to policy priority on grid in some countries.

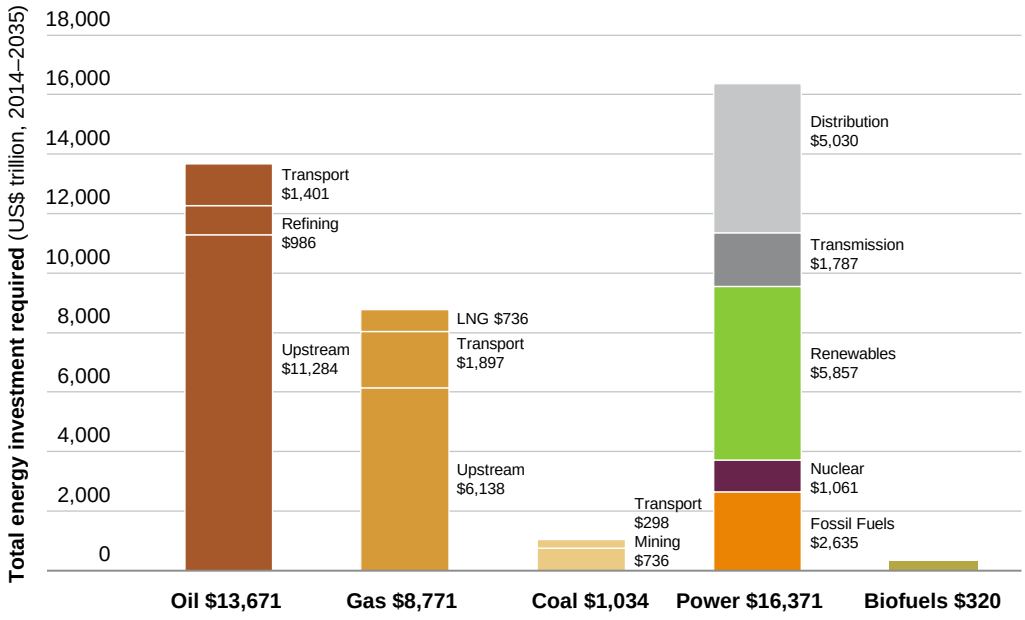
Note: The world's water, energy and food systems are interdependent and tightly linked. In the coming decades, this relationship will come under great pressure.

Sector	Political & regulatory	Technology	Economic	Market
Nuclear	• Social acceptability challenges and several countries are exiting nuclear. • Limited view of future growth. • Uncertainty in license extensions (33 US reactors have licenses expiring by end of 2030). • Added compliance post Fukushima. • Uncertainty of carbon credit schemes structure which could benefit nuclear power.	• High growth locations for nuclear energy lack expertise. • Health and safety, reliability and environmental considerations. • High costs of decommissioning. • Low operational flexibility.	• Ageing fleet of nuclear reactors with higher costs for maintenance and operation. • Capital intensity and cost greater than conventional plants. • Rising operating expenses and relatively low electricity prices are increasing compression of profit margin for many plants.	• Lower cost alternatives are becoming more attractive, e.g. natural gas price drops of 11% US and 15% Europe by 2040.
Renewables	• Political views can impact investment risk perception. • Uncertain regulatory and policy structure. • Subsidies in many countries increase regulatory risk as schemes can be re-designed or cancelled.	• Rapidly evolving technology outside comfort zone of many investors. • Risk of obsolescence due to technology developments. • Intermittency remains a key concern and the development of storage technology lags behind. • Need for new transmission and distribution lines that often are not publicly accepted.	• Lack of credit history. • Concerns over viability of scaling new technology and supply chain. • Cost and competitiveness remain major issue in many places.	• Can face difficulty achieving competitive prices given small scale.
Power (electricity generation)	• Pressures to transition to lower carbon generation mix. • Incentives for renewables. • Increasing number and ambition of renewable energy targets.	• Increase in distributed generation (could represent 2% of generation in US by 2016 and 290 GW of Europe capacity by 2030).	• Rising costs to operate, maintain, decarbonise ageing infrastructure. • Long-term electricity prices may be settling at lower level and profits of utilities may continue to decrease.	• Slow growth in electricity demand in OECD countries (1% per year in last decade); demand rising rapidly in developing nations. • Fuel cost fluctuations driving high competition in parts of market. • Emerging competitors (for example, IT companies or home improvement providers), in energy management and supply.

There are four key areas for the energy sector to focus on to improve the capacity to attract and absorb available capital:

- Developing an adequate pipeline of bankable projects.
- Standardisation of project processes.
- Improved data disclosure to enable investors to effectively assess projects.
- New pricing models that enhance the risk–reward equation for investors while maintaining energy equity for consumers.

Figure 23
Cumulative global energy investment by type
Source: IEA, 2014: World Energy Investment Outlook



Build a pipeline of bankable projects

The majority of interviewees emphasised the need to develop a well-maintained pipeline of bankable projects – that is, well-prepared concepts and technically sound projects that can be put up for funding by the private sector. As one interviewee observed, “The primary barrier is not money, it’s not investment. It’s actually [poorly packaged proposals], which includes the structuring of the financing, engineering work on the ground, discussions with the energy sector, and the dealing with the governments”.

The challenges of developing bankable projects for all forms of energy are particularly acute in developing countries, no matter if assets are privately or publicly owned, and many interviewees expressed the view that the lack of a pipeline of bankable projects and the lack of human capital are the two key hurdles to overcome. This is also illustrated by the ‘Back of the pack’ countries in the 2014 Energy Trilemma Index. There are a number of enablers and components to a bankable project. One critical aspect is the overall business environment and the degree and nature of restrictions around foreign investments or ownership in energy infrastructure. For reasons of energy security, many countries have some restrictions on foreign ownership of some portions of energy infrastructure. Another enabler is an overall political, regulatory and

legal environment with strong institutions to support investments in the country. Finally, investment is stimulated where there is an ease of doing business and a key element in the decision to invest in a foreign economy is the overall framework and process for starting a business and low administrative barriers for foreign investors.[99] Interviewees noted that development banks and development agencies play a huge role in helping countries develop the regulatory framework and institutional strength to support a robust investment environment for energy projects. “In developing countries it is crucial to have the institutions that can properly negotiate these contracts and address risks.”

Bankable projects also rely on the right assembly of participants and provision of information. Financers examine several risk dimensions, not only price but also the sponsors, who the contractors will be, the resources and how it was measured. The challenge of assembling all the pieces for a bankable project was highlighted by one interviewee: “At the moment, as a bank, we have a pipeline of roughly 40 to 45 projects that we are studying and assessing. The bulk of those projects will not be financed because they lack something: [the wrong] people taking leadership, location in places where the indigenous community might oppose the project, or the project is located too far away from the grid”.

In the power sector, it is particularly important to line up a purchaser (or ‘off-taker’) for the energy generated. Long-term sales contracts or power purchase agreements (PPA) with, for example, a municipality or large industry, provide assurance to investors of a secure and stable payment stream for the power producer. These agreements are crucial to rendering a power generation project bankable and capable of being ultimately sold on to other investors. However, projects can get stalled in a ‘chicken and egg’ situation as purchasers may not wish to sign a PPA until a project is completed and financing can be stalled in absence of an off-taker. The challenges of pulling together all the necessary pieces, including PPAs, for an energy deal to attract private sector investment are illustrated by Ghana’s efforts to reform its power sector (see Box 12). The government worked to create an attractive regulatory and pricing regime for independent power producers (IPPs). The IPPs, in turn, faced challenges to ensure reliable fuel supplies and PPAs to secure financing.

Box 12: Ghana’s challenges with power sector reforms and creating bankable projects

In 2004, the government of Ghana introduced reforms to the power sector, including unbundling the vertically integrated monopoly and the evolution to a competitive industry. The ultimate goal was to meet growing power demands to support continued social and economic development and overcome the constraints in power supply by removing perceived policy, regulatory and institutional barriers and increasing private sector participation and investment in the power sector.

Following the unbundling of the power sector, the main focus has been on attracting private sector investment into the generation sector as independent power producers (IPPs) and restoring the financial health of the national

[99] International Finance Corporation, 2013: Starting a Foreign Investment Across Sectors

power utilities – Ghana's off-takers and distributors of electric power – through performance improvement and cost-reflective tariffs.

Implementing cost-reflective tariffs and removing subsidies on end-user prices has been one of the greatest challenges. However, during 2013, Ghana made significant strides towards this goal. In October 2013, after more than a year without an adjustment in tariff rates, the Public Utilities Regulatory Commission (PURC) approved and announced a rate increase of 78.9%. The electric utilities had requested a hike of over 250% in tariffs, but the PURC agreed to increase tariffs by an average of 150% spread over a period of one year, taking into account the impact a one-time increment would have on consumers. As a consequence, the 78.9% increase was approved as the first of planned quarterly increments. However, prior to implementing this new tariff, public opposition compelled the government of Ghana to direct that the initial increase should be limited to 59.1%. In addition to the one-time increase, an automatic adjustment formula was introduced which takes into account changes in exchange rates and fuel prices on a quarterly basis. The first such automatic adjustment went into effect on 1 January, 2014 with an increment of 9.73% for the first quarter of 2014, resulting in a gross tariff increase of about 74.6% since October 2013.[100]

As in many other developing countries, there are also major constraints to the development of IPPs caused by the lack of a reliable fuel supply. While the development of domestic energy resources has helped fill the void and increased reliability of fuel supply to some extent, high fuel subsidies have led to fuel shortages as the government was not able to pay importers on time. Furthermore, the West African Gas Pipeline, which is supposed to bring in gas from Nigeria has been unreliable and, even though supply has become more stable, it has never reached the contractual supply.

At the end of 2013, IPPs had installed a total of 546 MW of new generation capacity. In addition, one of the IPPs had achieved financial closure on a planned 110 MW generation capacity expansion project; four new IPPs that were still developing their power projects had reached advanced stages for installing an additional 1,073 MW of generation capacity. Beyond these projects, there are 23 provisionally licensed IPPs that are making efforts to secure power purchase agreements (PPAs) and the financing that would enable them to execute their projects.[101]

Develop capacity

Closely linked to the lack of bankable projects is the urgent need to continue the development of local capacities – technical, managerial and financial. The necessary skill sets and resources to pull together a bankable project are considerable. Some estimates put project preparation and arranging funding at between 5–10% of total

[100] Kumasi Institute of Technology and Environment, 2001: Power Sector Reform in Ghana: The untold story
[101] Partnership for Growth, 2014: Ghana–United States Annual Scorecard Report, March 2013–February 2014

project costs and interviewees noted that, “You need more than 15 different professions to structure an energy deal”. Gaps in expertise can easily add two to three years to the project development process and greatly slow the velocity of the overall project pipeline.[102] Over the short term, much of the expertise may be hired internationally, but local capacity needs to be developed strategically for the long term in many countries.

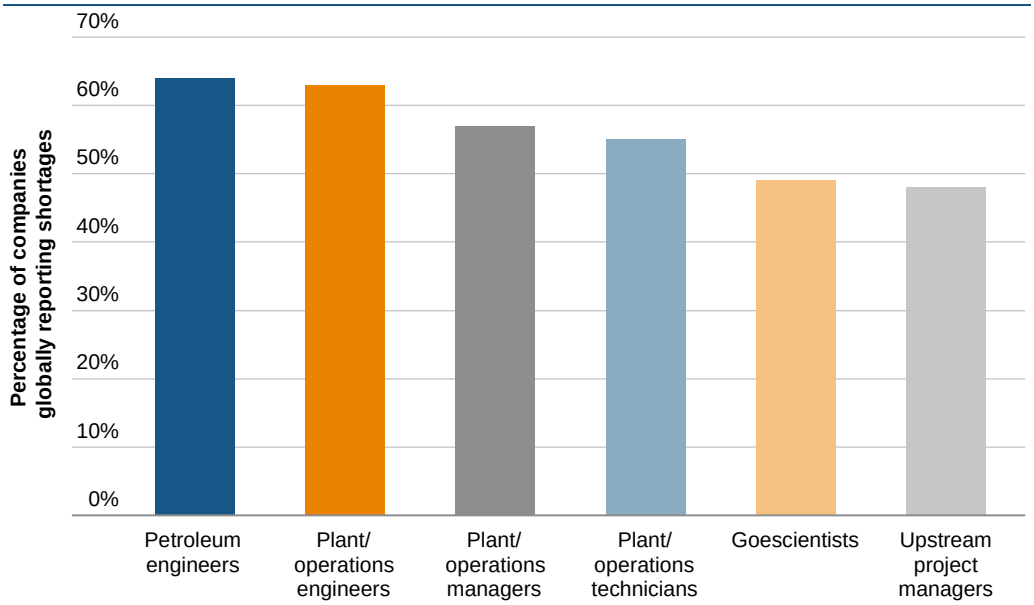
The capacity gaps exist on the policymaker side as well as the private sector. For example, policymakers and regulators need to understand how to set out clear regulations and pricing regimes to attract the private sector.

Looking at the talent gaps, there is also a real shortage of project developers. The number of international project developers has been reduced, as leading international energy companies have pulled back from those activities over the past decade. Acknowledging that, “Finance people don’t have the time or capability to be the actual project developers and that is what we are missing.” interviewees pointed to the key role played by development banks in building human capacity and supporting the development of bankable projects in many countries (see also Chapter 2). Indeed, development banks are putting greater emphasis on this need, for example, the European Investment Bank is stressing the importance of providing technical assistance for project preparation and implementation in low-income countries. The newly announced New Development Bank, formerly known as the BRICS Development Bank for Infrastructure, will also focus on technical assistance for project implementation and for project preparation through a proposed centre of expertise.[103]

Figure 24

Talent shortage affecting oil and gas industry

Source: Mercer, 2014: Oil & Gas Talent Outlook and Workforce Practices Survey



[102] Centre for Climate Change Economics and Policy, Grantham Research Institute on Climate Change and the Environment, 2012: Infrastructure for Development: Meeting the challenge

[103] Griffith-Jones, S, A BRICS Development Bank: A Dream Coming True?, United Nations Conference on Trade and Development, Discussion Papers, No. 215, 2014

The energy trilemma profile of the 'Back of the pack' is tightly clustered and countries struggle to make progress on all three trilemma dimensions. The profile is represented by less-developed and developing countries from all over the world.

Back of the pack

Figure 25

Trilemma profile and illustrative countries: Back of the pack

Source: WEC/Oliver Wyman, 2014

Countries	Index rank	Balance score
Dominican Republic	97	BCD
Nicaragua	105	BDD
Honduras	107	BDD
Jordan	108	BDD
Nepal	109	BDD
Jamaica	111	CCD
Morocco	112	CCD
Libya	114	CCD
Lebanon	123	CDD
Moldova	124	CDD
Senegal	126	CDD
Yemen	127	CDD
Benin	128	DDD

In the absence of a sufficient energy infrastructure, these countries are typically not yet locked into high-carbon or fossil fuel energy infrastructures and have the potential to take a more sustainable approach to energy and economic development. However, countries in this profile need financial and human capital to meet their energy investment needs.

Lower contextual performance (political, societal and economic strength), driven by political instability, low regulatory quality, lack of control of corruption, and compliance with rule of law, leads to speculative debt grades and sovereign credit ratings, and hinders both domestic and foreign investment.

To attract capital and exploit resources, these countries must develop the institutional frameworks to support investment. Financial investments and energy projects must be managed by people and, as discussed elsewhere in this report, human capital constraints are key barriers to increasing the velocity and volume of bankable projects in many countries. The lack of technical, financial and management skills in these countries is a key focus for many development efforts. In this regard, the role of multinational development banks is crucial in working with governments to develop institutional strength and domestic financial markets, provide financial guarantees and support, and help build local human capacity. If the right investment conditions can be created, the development opportunities are significant.

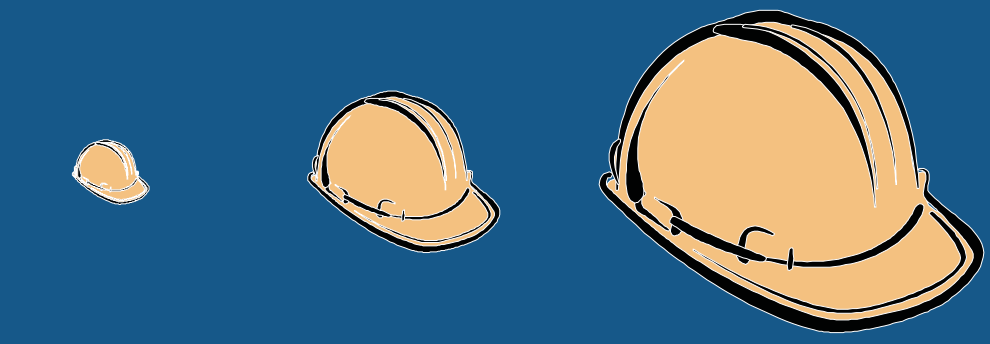
Countries such as Gabon show how nations have been able to develop offshore oil with financial support from international oil companies and boost their economies with production royalties. Many of the Back of the Pack countries are on the cusp of a similar energy boom if certain conditions are realised. For example, Morocco (ranked 111) has already developed the policies to promote investment in the estimated 20 trillion cubic feet of recoverable shale oil and gas

resources that remain largely unexplored.[104] In addition, the country has tremendous solar power potential. Tanzania (ranked 121) and Mozambique (ranked 97) are expected to become liquefied natural gas (LNG) exporters after 2020, but Mozambique needs US$50bn to develop its large hydrocarbon reserves, an estimated 3.5 times the country's gross domestic product (GDP).[105]

Projects such as the Power Africa initiative, launched in 2013, could be replicated and help spur economic and social development. The initiative aims to support economic growth and social development by increasing access to reliable, affordable, and sustainable power in Africa. The programme is designed as a multi-stakeholder partnership among the governments of the United States, Tanzania, Kenya, Ethiopia, Ghana, Nigeria, Liberia, and the African private sector. The African Development Bank (AfDB) has been a key partner in the design of the initiative and will continue to be during its implementation. The AfDB expects to allocate as much as US$3bn over the next five years in the form of investment loans, reforms, advisory services, and guarantees. This is expected to leverage at least four times more investments in the energy sector.[106]

The challenge facing the Back of the Pack countries is monumental, but the development of domestic energy sectors could help these countries begin the journey to economic growth, social development, and sustainability.

Figure 26
Estimated number of scientists and engineers per 10,000 population
Source: UNESCO, 2010: Engineering: Issues challenges and opportunities for development



Poorest countries	Developing countries	Developed countries
1	**5**	**20–50**

[104] EIA, 2013: Technically Recoverable Shale Oil and Shale Gas Resources: An assessment of 137 shale formations in 41 countries outside the United States
[105] The Economist, 2014: Africa's Energy Outlook, 31 July, 2014
[106] African Development Bank Group, 2014: Power Africa Initiative (www.afdb.org/en/topics-and-sectors/initiatives-partnerships/power-africa-initiative/energy-power)

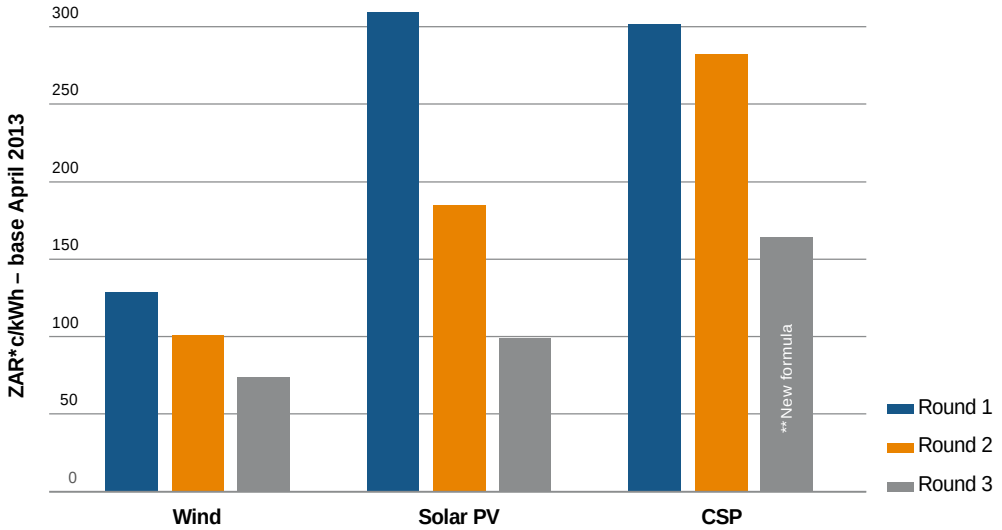
The competition for all talent in the energy sector is intense. The talent gaps are seen globally – especially for certain in-demand jobs and skill sets – and have the potential to affect the industry in the short- and mid-term (see Figure 24). A survey of more than 120 companies representing more than 1 million employees across 50 countries found that 74% of organisations cited ”technical skills gap” as a critical problem. The survey also highlighted leadership, management, and supervisor skills as being in short supply. One cause of the gap is the upcoming retirement waves in the energy sector. For example, in the US, the existing workforce is ageing and 30% of utility industry employees are eligible to retire in less than five years; in the EU, 30% of utility workers are older than 50 years.[107] The other cause of the gap is the growth of the energy sector. The oil and gas industry is predicted to add more than 530,000 positions in core professional and technical jobs over the next five years and more than 1.1 million positions over the next 10 years. More than half of the world’s largest oil- and gas-producing countries will not have an adequate supply of talent to meet this demand.[108]

Developing countries particularly face broad skills shortages and human capital gaps. Currently, “based on the availability of local human capacity there are limitations on the number of projects that can be done”. For example, despite the availability of fossil fuel reserves and the great potential for the exploitation and use of renewable energy resources, regions like sub-Saharan Africa and Southern Asia remain the least-developed in the world, with the lowest levels of human and economic development. Although sub-Saharan Africa and Southern Asia have increasing numbers of graduates from universities and institutions that teach specific capacities, there is a need to create more vocational programmes, training workshops, and supporting research institutions for skills-building that will enable the development, construction, operation and maintenance of much-needed energy infrastructure. For example, South Africa had the explicit goal of increasing local technical capabilities as it designed the competitive bidding process for its Renewable Energy Independent Power Producer Procurement Programme (see Box 13).

Figure 27

Average contract prices for the major technologies

Source: Department of Energy, South Africa, 2013: Renewable Energy IPP Procurement Programme: Bid Window 3, preferred bidders’ announcement



* US$1 = ZAR1123.5 cents; ** CSP = concentrated solar thermal

[107] Britt, M, How to Create a No-regrets Utility Strategy, Oliver Wyman Energy Journal, 2014
[108] Mercer, 2014: Oil & Gas Talent Outlook and Workforce Practices Survey

Box 13: South Africa's competitive bidding process

After the failed attempt to introduce a feed-in tariff programme in 2009, South Africa's Department of Energy introduced a competitive bidding process, known as the Renewable Energy Independent Power Producer Procurement Programme (REIPPP) in 2011. The goal of the REIPPP is to promote investment in renewables to diversify the country's electricity generation mix, historically dominated by coal-fired power, and simultaneously reduce carbon-intensity. In addition the programme seeks to attract foreign expertise and funding, develop local manufacturing and technical capabilities and deliver benefits for the country's previously disadvantaged communities.

Although South Africa's long-term electricity plan – known as the Integrated Resource Plan (or IRP) 2010 – calls for renewable energy to contribute a significant share of total generation by 2030, the 2011 REIPPP set a more moderate target of 6,725 MW. The original plan envisaged up to five auctions, with successful bidders being required to sign 20-year off-take agreements with the single buyer, which is housed in Eskom, the national utility. Though dominated by wind and solar photovoltaics, REIPPP aimed to attract investment across seven renewable technologies.

Progress in implementing the REIPPP has not been quite as rapid as initially anticipated. To date, four bidding rounds have been completed. During the first three bidding rounds, awards totalled 3,916 MW, close to 60% of the targeted capacity.[109] It appears likely that the programme will have to be extended beyond five rounds if the original capacity target is to be met. However, a number of projects have already been developed and are delivering energy to the grid.

One of the most positive aspects of the REIPPP has been the trend in energy prices over the first three completed bidding rounds (see Figure 27). The three technologies that have seen successful bids in all three rounds and have all achieved significant price reductions in each successive bidding round. This will benefit South African consumers via a relatively benign impact on tariffs.[110]

Due to the success of the REIPPP, the Department of Energy has recently issued a request for potential bidders for coal-fired capacity to register projects,[111] so that they may be assessed for their respective network implications, in anticipation of a formal request for proposals later in 2014. Should the coal request prove successful, it seems likely that the Department of Energy will continue to use competitive bidding processes to meet other independent power requirements set out in the IRP 2010 and its successors. As one investor noted, "It would seem for emerging markets that there's a lot

[109] Although bidding closed on schedule for the fourth round, at the time of publication, the preferred bidders, as well as the total MW awarded, or the technology mix, have not been announced.
[110] Department of Energy, South Africa, 2011: Integrated Resource Plan for Electricity 2010-2030, Final Report; Eberhard, A, 2013: Feed-In Tariffs or Auctions? Procuring Renewable Energy Supply in South Africa: World Bank, Viewpoint Note Number 338; Department of Energy, South Africa, 2013: Renewable Energy IPP Procurement Programme: Bid Window 3, preferred bidders' announcement
[111] Department of Energy, South Africa, 2014: Coal Baseload Independent Power Producer Procurement Programme website, www.ipp-coal.co.za

of momentum behind these auctions. I would say South Africa, Brazil and the way they've been able to drive down prices has been very impressive. We'll see if everything gets built, but I think many would say that yes, that seems to be the way to go."

In the past, many energy companies have imported necessary technical or industry expertise while local resources are being developed. This option is increasingly complicated due to two factors. First, as noted above, there are insufficient trained workers to staff expatriate or international positions. Second, many countries have implemented more stringent local content requirements and quotas. Such requirements represent an effort to ensure that domestic communities benefit from foreign investments through the hiring and training of local nationals or requirements to produce a specific share of a final good domestically. However, these local content requirements (LCRs), often introduced in oil- and gas-producing states, present challenges that should not be underestimated by either the host government or the company investing in the country. For example, while LCRs may help build up domestic workforces and the manufacturing sectors in the short term, they can also slow down development and in some instances impose too much of a barrier and prevent foreign investment altogether. Moreover, mandated investment often does not align the interests of investors and host countries, and therefore makes it more difficult to build the desired foundations for sustainable growth.

Standardisation of information and processes

Pulling together an energy deal requires a significant number of complicated legal contracts and documents, including, but not limited to, request for proposal documents, bid responses, PPAs, construction and operating contracts, site purchase/lease agreements, equipment supply and transport contracts, interconnection agreements, and environmental impact assessments. Standardisation of many elements of the information, data and transaction structures around energy projects can help to smooth investments into the sector. As discussed in Chapter 2, this can include standardising project financing structures, clear processes to assign credit ratings and regular, standardised reporting and disclosure to investors. In addition, there is the opportunity to develop efficient, predictable and standardised procurement processes around energy infrastructure projects, including standardised lease, contracts and PPAs. For example, Kenya has developed standardised PPAs for renewable energy generators which are freely accessible via an online portal.[112]

The development of standard information frameworks is seen as key to the success of the public–private partnership/private finance initiative (PPP/PFI) markets in the UK, US, Canada, and the Netherlands.[113] Also, the adoption of a standardised procurement model helped to increase interest in infrastructure investment opportunities in Eastern European countries which relatively recently joined or are looking to join the EU.

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[112] Renewable Energy Portal Kenya at http://renewableenergy.go.ke
[113] Standards and Poor's, 2013: How To Unlock Long-term Investment In EMEA Infrastructure

Existing templates and best practices can be adapted by developing countries to help streamline project development and infrastructure procurement. Issues that should be addressed include: the format and structure of bidding process documentation, such as submission and response templates for expression of interest and request for proposals; timing expectation for each phase of the process; legal and regulatory rules and interpretations; contract structures and language (for example, English, French, and others); and terminology consistency.[114]

The energy and financial sectors can work with regulators and international institutions to develop or adapt existing frameworks created by leading countries to develop energy-project-specific frameworks, templates and processes to improve project development predictability and efficiency.

There are many examples of private-sector-led efforts to create standards and rules. Indeed, the last decade has seen the growth of private standard-setting and rule-making by business groups, financial institutions and civil organisations. These industry-formulated standards promote international rules of conduct. Examples include the United Nations (UN) Global Compact, UN Guiding Principles (or 'Ruggie Principles' for author John Ruggie), International Labour Organization (ILO), or OECD Guidelines. To illustrate with two examples, the Transparency International and guidelines governing mining and resource sector investments are produced by the Extractive Industries Transparency Initiative (EITI) and are aimed at limiting corruption and bribery. Another example is the industry guidelines in the area of corporate social responsibility (CSR) which have mostly been driven by the private sector and not by government decree or regulation. Indeed, many energy companies are now aligning their CSR policies with international standards for sustainable development, including the OECD Guidelines for Multinational Enterprises, the Carbon Disclosure Project (CDP) and the Global Reporting Initiative (GRI). Banks and other lenders are following these environmental sustainability guidelines in their lending policies and project financings for the energy sector.

Data and disclosure standards and best practices

The specific information and presentation of the information required by the financial community is critical. "If companies are trying to access larger-scale capital by tapping into the capital markets, they're going to have to think about how they disclose their business and their financial profiles." Standardisation would support greater transparency in project data and disclosure of project performance, which is critical to assess investments across energy projects and, in particular, new renewables projects. This can include information such as insights on operations, financial statement categories, and the effect of events and conditions such as the consequences of adverse weather on a project's operations or disputes over the terms of the contract.[115] "The lack of standardisation inhibits development. A lot of investors are not yet comfortable with the asset class performance and the lack of data on how these systems perform hinders access to capital." For example, in the US, the working group, Solar Access to Public Capital (SAPC) has brought together developers, law firms, investment banks, and accounting firms to facilitate the investment ecosystem to support faster deal flow and due diligence requirements. The team is working on datasets on system performance, technology performance and credit performance,

[114] World Economic Forum, 2014: Infrastructure Investment Policy Blueprint
[115] SwissRe, Institute of International Finance, 2014: Infrastructure Investing. It Matters.

best practices, and engagement of rating agencies and investors to stimulate ‘mob securitisation’ and a specific rating from the risk perspective for the asset class.

Lastly, interviewees emphasised the need “to communicate the genuine risk pattern associated with the respective technology”. As discussed earlier, developments in the sector, including the rapid shifts in the production of shale gas, advancements in the production of deep- and ultra-deep-water offshore oil and gas, the rapidly decreasing cost of low- and zero-carbon energy technologies or the increase in distributed electricity generation, are significantly changing the risk profile of many projects. Common standards on the disclosure of information and risk information in a period of technology change are crucial to support the flow of funding for energy infrastructure projects.

Create new tariff and pricing models to reflect changes in energy supply

The energy sector will need to work with regulators to apply technical and financial expertise to develop effective tariff and pricing models to reflect changes in energy supply and energy technology.

For example, the increase in distributed generation stimulated by solar PV by commercial and residential customers will strain the traditional utility pricing model where utilities (including the generation and transmission) are charged per unit of electricity consumed. Under the traditional pricing model, with the increase in distributed generation, the cost of providing transmission and distribution will be carried by a smaller number of customers, while the size and cost of the transmission and distribution grid remains largely unchanged. Thus, pricing models will need to be adjusted to reflect the changes in the energy supply model and ensure a method to cover the costs of a public good such as the grid, the benefits of the utility providing back-up. This challenge is also prompting questions of energy equity in a number of countries as the benefits of reduced energy costs or tax incentives of residential solar PV generation are most enjoyed by home owners who can afford the initial outlays, leaving less-affluent customers with limited options.

There is also an opportunity within the energy sector to develop innovative pricing models that address the cost of any given technology. For example, while electricity generated from renewable energy sources is highly intermittent and marginal operating costs are low, thermal power generation is stable, but needs to be guaranteed a certain load factor to be commercially viable. Other costs that need to be reflected include the cost of ramping up and down thermal power plants, and the increased maintenance due to higher stress on the asset. While in many countries electricity from renewable energy is still more expensive than electricity from conventional thermal power plants, in other countries, electricity from renewable sources such as onshore wind, is now at grid parity with fossil fuels. Turning this equation around, making ‘green electricity’ less expensive while paying a premium for available capacity for coal- and gas-fired power plants may be a model to explore. In fact, this is happening with the advent of ‘capacity payments’ in some European countries and some areas of the US.

Summary and action items

The energy sector will need to take a number of steps to attract and absorb the necessary capital to ensure the transformation and extension of energy systems. Alone, or in collaboration with the financial community and policymakers, the energy sector needs to:

- look for opportunities to collaborate with development banks and other financial institutions to build robust project pipelines, including a greater emphasis on capacity-building in both the public and private sectors
- focus on developing guidelines and frameworks for bankable projects
- collaborate to develop best practices or guidelines on the standardisation of processes in developing energy projects and associated information
- identify and share best practices for data and disclosures to support the development of energy projects, including contracts, performance reporting, or risk profiles
- support the creation of new pricing models, especially in the power-generation sector, that meet the new reality of changing business models, with an increasing share of distributed and intermittent generation, and encourage demand-side response
- understand local context in terms of demand-side requirements, supply-side capabilities, and the barriers that limit local worker and local company participation and engage with policymakers in developing local content requirements that enable foreign investment in the short and long term.

“

Policymakers, project developers, the financial sector and energy sector – everybody needs to understand their role in the game

”

4. Conclusion

Access to sustainable energy sources is a prerequisite for modern life. Yet nearly all countries are struggling to maintain a balance on the energy trilemma. In the developed world, governments and industry leaders are grappling with ageing assets, integrating new sources of generation, ensuring a sustainable energy supply, while at the same time keeping energy services affordable and economically competitive. In the developing world, the challenges centre on provision of energy to a growing, often industrialising population where access to energy is far from universal and national and/or regional risk perceptions hamper investment.

Meeting the challenge is crucial to global economic development and social cohesion, yet the global investments challenge is greater than the gross domestic product (GDP) of many countries. A fundamental shift is needed in many of the mechanisms that encourage and guide investment in the sector, if the estimated US$48 to US$53trn investment needed between 2014 and 2035 are to be unlocked.[116] Not included in these estimates are the effects of extreme weather events, climate change and other emerging risks on energy infrastructure assets, which will require further adaptation and investment to maintain resilience.

The 2014 Trilemma research has shown that there is sufficient private sector capital to invest. However, energy competes with other investment opportunities. Governments, the financial sector, and the energy industry all need to take actions to ensure the conditions and mechanisms are in place to encourage the flow of investment needed. This report, together with the World Energy Trilemma 2012: Time to get real – the case for sustainable energy policy and the World Energy Trilemma 2013: Time to get real – the agenda for change, provides a strong call to action by leaders and peers in the energy and finance community to collaborate in order to design and implement mechanisms that will support and stimulate investment.

Government

National governments and multinational bodies have a fundamental role in setting the regulatory and policy environments to encourage investment in energy. Energy is a sector that has been particularly vulnerable to policy intervention and changes, driven in part by the mismatch between political cycles (five years or less) and asset lifetimes (often spanning decades). This results in a risk premium being applied on a country-by-country basis to investment in the energy sector and, in some cases, discouraging investment all together.

Governments (and, where they exist, multinational organisations such as the EU) need to take greater account of the conditions that will encourage investment and

[116] IEA, 2014: World Energy Investment Outlook

have the confidence, once implemented, to maintain these conditions. These measures include:

- clear signposting around future energy mix and energy strategy
- coherent, predictable, long-term, and transparent regulatory and policy frameworks
- robust, independent regulators that are free from political cycles
- interventions that balance encouraging long-term investment with energy equity
- a transparent reduction of incentives over time so that emerging technologies are encouraged to compete on a fair basis, with legacy assets and existing technology options
- provision of seed capital and/or debt guarantees to stimulate investment that would otherwise not take place.

Governments need to better engage and understand the energy and financial sectors. In recent decades, the rise of renewable energy sources, off-grid and microgeneration, and shale gas and oil have changed the energy sector. In the coming decades there will be further technology developments that will disrupt existing models of energy provision and consumption. The message is clear: while governments should not be picking ‘winners’ from the emerging technology, they do need to have a better understanding of the emerging technologies and accompanying opportunities, so that they can shape the markets to allow these technologies to compete and thrive.

Financial community

The projected financing needs of the energy sector offer significant opportunities for the finance community over the coming decades. While governments and the energy community have a role to play in building our energy systems, the financial community is vital to ensuring that projects can be financed as they come to market. Unlocking the trillions of dollars necessary will depend in part on evolutions in the financial sector, and its collaboration and exchange of information within and outside of the financial sector, especially with public and private energy sector stakeholders.

A recurring theme among many of the people interviewed for this report is that the investment environment is still biased towards traditional sources of energy extraction and generation. This is for a number of reasons, including greater understanding of the technology, longer credit history of the companies involved and a better understanding of how to model the opportunities.

It is apparent that the finance community has to help policymakers and the energy sector understand what the role of different financial investors and instruments is in funding energy infrastructure projects at various stages of a project life cycle. This will allow those who seek capital to attract the right kind of funding.

The role of new players and initiatives needs to be considered carefully. There are many voids to be filled, including the lack of aggregation platforms for bundling of smaller-scale energy projects, standardised processes to rate energy and other infrastructure projects, or support in cultivating domestic financial markets in developing or emerging economies. These represent opportunities for different players in the finance community to step up. Furthermore, the crowding out of private sector investors by, for example, multilateral development banks due to a lack of

bankable projects, is a concern that was raised multiple times and needs to be addressed.

While the majority of the investment needed over the next two decades will be related to fossil-fuel-related projects, (which are familiar to investors due to the long history of doing business with the sector and the vast amount of data available on these kind of projects), many of the investment opportunities in the coming decades will be in new emerging technologies. Especially if a meaningful post-2015 climate change agreement is to be achieved, there is an urgent need to better understand these new assets and to benefit from best practice examples to increase the level of comfort. One strategy to better understand barriers to investment is through pilot projects with small-scale investments to understand emerging technologies and markets and extrapolating learning from these projects in order to make use of this knowledge when it comes to larger-scale projects.

Energy sector

Investors are often frustrated by the energy sector's ability to attract and absorb the available funding. Two of the biggest obstacles are closely linked: the lack of a well-maintained pipeline of bankable projects and the growing, global talent gap.

To address this, in developed nations a greater dialogue and joint approaches are needed between governments and the energy sector to address the problems of an ageing workforce and find solutions to minimise the potential effects on the industry in both the short and long term. In developing and emerging economies, the energy sector needs to seek opportunities to collaborate with development banks and other financial institutions to build robust project pipelines, including a greater emphasis on capacity building. Furthermore, as international operating companies invest in foreign, often developing or emerging markets, they need to better understand the local context in terms of demand-side requirements, supply-side capabilities, and the barriers that limit local worker and local company participation. Companies must engage with policymakers in host countries in developing local content requirements that enable foreign investment and the domestic energy industry to flourish in the short and long term.

Moreover, the energy sector needs to better engage the financial community to understand the prerequisites for investment. Focusing on the development of frameworks for bankable projects, including best practices or guidelines on the standardisation of processes in developing energy projects and associated information, can help speed up the process of project evaluation and approval of funding.

There is also an opportunity for the energy sector to build the dialogue with the financial community, either through stronger, more effective engagement through the bodies that already exist or the development of new forums. While platforms exist that look at particular aspects of energy financing – for example, the United Nations (UN) Sustainable Energy for All initiative, which looks at the financing of energy access, renewable energy and energy efficiency – thought needs to be given to a forum that looks at the system as a whole and not only at selected dimensions. The energy sector as a whole has the opportunity to initiate such a platform, inviting government, financial sector and other stakeholders to join the discussion.

Call to action

Greater engagement is needed from all parties to build understanding and trust across policymakers, investors and the energy sector.

The US$48trn target represents both significant challenges and opportunities for governments, the energy sector and the financial community over the next 20 years and beyond, to deliver sustainable energy systems. All sides need to know that it is within their power to attract this investment and build the balanced, sustainable energy systems needed. Failure to do so will deny people access to the energy they need, seriously harm global economic growth, and ultimately polarise countries and regions into the ‘haves’ and ‘have nots’ of the energy world.

Appendix A: Finance community participation

The WEC and Oliver Wyman, a subsidiary of Marsh & McLennan Companies, would like to thank the following finance community leaders and their teams for taking the time to talk to us during the preparation of this report and for taking an active role in driving forward this critically important dialogue regarding our global energy future. Your perspectives and insights on key concerns of how to unlock the investment necessary have been very helpful and enriched the process greatly.

- Daniel Schroth, Principal Energy Specialist, African Development Bank
- David Jones, Head of Renewable Energy, Allianz Capital Partners
- Karsten Löffler, Managing Director, Allianz Climate Solutions
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- Magnus Magnusson, Chief, Partnerships and Communications Unit, UN Capital Development Fund
- Ben Goldsmith, Founder, WHEB group
- Rick Gibbons, Former President, Zurich Global Energy, Zurich Insurance Group

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- Michael Liebreich, Chief Executive, Bloomberg New Energy Finance
- Angelina Galiteva, Board of Governors, California Independent System Operator
- Paul Simpson, Chief Executive Officer, Carbon Disclosure Project (CDP)
- Maria Allen, Special Adviser to Minister for Climate Change, Department of Energy and Climate Change, United Kingdom
- James Hughes, Chief Executive Officer, First Solar
- Maria van der Hoeven, Executive Director, International Energy Agency
- Michael Mendelsohn, Senior Financial Analyst, National Renewable Energy Laboratory
- Eric Usher, Manager of Seed Capital Programmes, United Nations Environment Programme (UNEP)
- Mohinder Gulati, Chief Operating Officer, United Nations Sustainable Energy for All
- Kate Richard, Founder & Chief Executive Officer, Warwick Energy Group

Appendix B: Project participation

The project team would like to thank the individuals who informed the project's approach, supplied information, provided ideas, and reviewed drafts. Their support and insights have made a major contribution to the development of the report.

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Appendix C: Index methodology and balance score system

The Energy Trilemma Index ranks countries in terms of their likely ability to provide a stable, affordable, and environmentally-sensitive energy system. The rankings are based on a range of country-level data and databases that capture energy performance and the contextual framework. Energy performance considers supply and demand, the affordability and access of energy, and the environmental impact of the country's energy use. The contextual indicators consider the broader circumstances of energy performance including societal, political and economic strength and stability.

Each country is also given a balance score identifying those that address the three dimensions of energy sustainability – energy security, energy equity, and environmental sustainability – equally well by giving them a score for high performance (AAA). Other letter scores (for example, BBC, CCD) show where countries need to improve to balance the energy trilemma. The goal of the score system is to help energy leaders identify areas to focus on to develop a balanced energy profile, necessary for minimising uncertainties and risks.

The findings of the Index analysis are complemented with the individual country profiles – of WEC member countries only – captured in this report.

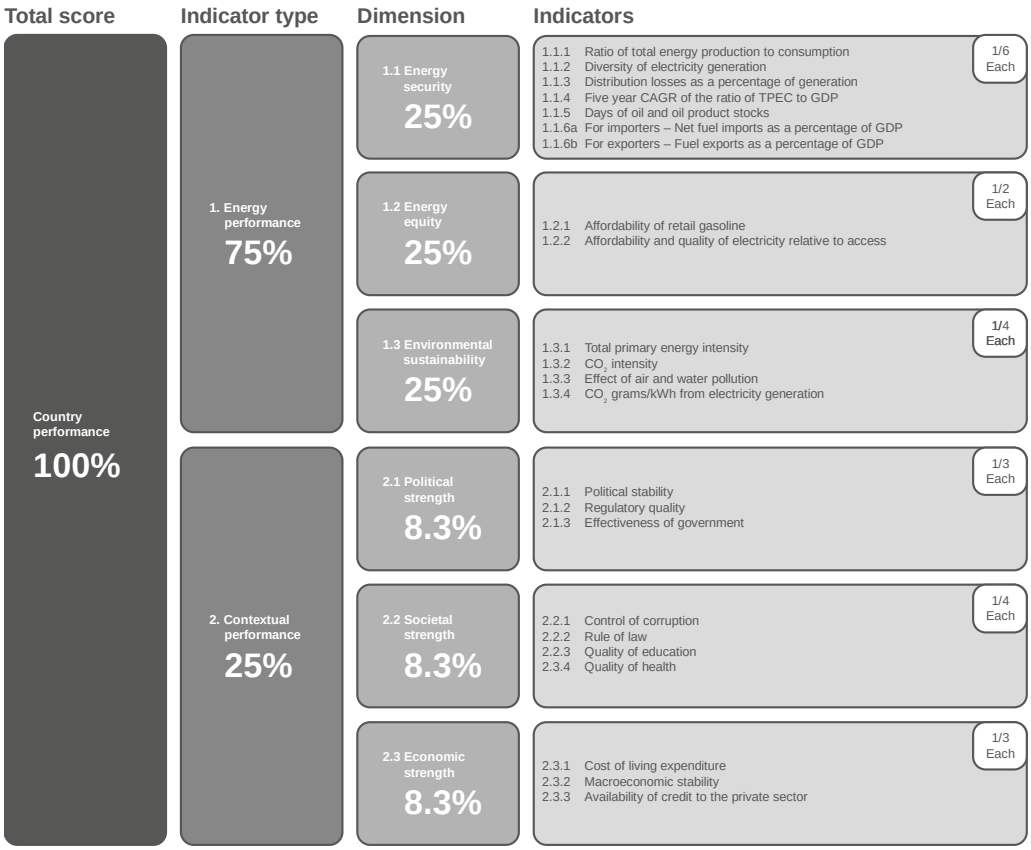
Indicators were selected based on the high degree of relevance to the research goals, exhibited low correlation, and could be derived from reputable sources to cover a high proportion of countries. The Index also includes 36 non-WEC member countries and, since 2013, measures the performance of 129 countries. Data sources used include the International Energy Agency, the US Energy Information Administration, the World Bank, the International Monetary Fund, the World Economic Forum, Enerdata, the WEC and others.

The structure of the Index and the coverage of its 23 indicators are set out in Figure C-1. More than 60 data sets are used to develop 23 indicators. The Index is weighted in favour of the energy performance axis by a ratio of 3:1, with the scores for each dimension carrying equal weight within their axis.

Overall, the Index displays the aggregate effect of energy policies applied over time in the context of each country and provides a snapshot of current energy sustainability performance. It is very difficult to compare the effectiveness of particular policies across countries, since each one interacts with a unique set of policies specific to that country. But it is possible to broadly measure the aggregate outcome of policies – for example, how countries with similar levels of energy intensity per capita perform in mitigating their environmental impact or the overall use of electricity per capita.

Full details of country scores in the three dimensions, further key metrics and analytical commentaries for each country can be found in the country profiles online at www.worldenergy.org or in the companion report 2014 Energy Trilemma Index: Benchmarking the sustainability of national energy systems. The full methodology can be obtained on request.

Figure C-1
Index structure
Source: WEC/Oliver Wyman, 2014



Structure of the Index and selection of indicators

The structure of the Index and the selection of indicators have been governed by a suite of intellectual and pragmatic principles:

1. Relevance: Indicators are chosen or developed to provide insight into country situations in the context of the project goals.
2. Distinctiveness: Each indicator focuses on a different aspect of the issue being explored, unless reinforcement is required.
3. Balance: Indicators within each dimension (and dimensions across the Index) exhibit coverage of different issues.
4. Contextual sensitivity: Indicators capture different country situations (for example, wealth, size) and, where appropriate, indicators are normalised by gross domestic product (GDP) at purchasing power parity (PPP) and per capita.
5. Coverage: Individual indicators are required to provide data for 85% of WEC member countries. Only countries with data available for at least 75% of all indicators were included in the Index calculation.
6. Robustness: Indicators to be taken from reputable sources with the most current information.
7. Comparability: Data to calculate an indicator is derived from a single source to ensure comparability between countries.

Data updates

The Index is based on 60 data sets which are used to develop 23 indicators. While some of the indicators are derived from a single data set, others are a combination of two, three or more sub sets.

Where possible, data has been updated. However, due to constraints on the collection, processing, and dissemination of data, the current Index generally reflects data from 2010 to 2013. Recent world events that could affect the Index's outcomes are not completely captured. Policies generally take two to three years to become fully implemented and it may take longer for their effects to become evident.

While the majority of the indicators are updated annually or biannually, some are reviewed irregularly or at longer time intervals. These irregular updates sometimes lead to more significant changes of the individual indicator results, and hence the dimensional rankings.

For example, the World Bank's International Comparison Program (ICP) was published only twice so far: the first time with results for 2005 and the second time with results for 2011. The ICP produces internationally comparable price and volume measures for GDP with component expenditures based on purchasing power parities. The recently published ICP includes additional countries that were not covered before; others, such as Argentina and Lebanon, are not included anymore. As can be observed in the 2014 Index, the data update and change of data availability for certain countries caused significant changes for indicators underlying the Index's energy equity and economic stability dimensions.

Index results by GDP group

To understand how each dimension of the Index is affected by wealth, countries were also organised into four economic groups:

- Group I: GDP (PPP) per capita greater than US$33,500
- Group II: GDP (PPP) per capita between US$14,300 and US$33,500
- Group III: GDP (PPP) per capita between US$6,000 and US$14,300
- Group IV: GDP (PPP) per capita lower than US$6,000.

Figures C-2 through to C-5 present the rankings of each country in these GDP groups.

Figure C-2
Country ranking for GDP Group I
Source: WEC/Oliver Wyman, 2014

GDP group rank	Country	Importer/ Exporter	Energy security	Energy equity	Environmental sustainability	2014 Index
1	Switzerland	I	22	5	1	1
2	Sweden	I	20	19	6	2
3	Norway	E	45	15	5	3
4	United Kingdom	I	9	22	18	4
5	Denmark	E	6	47	9	5
6	Canada	E	1	2	56	6
7	Austria	I	44	10	8	7
8	Finland	I	26	16	37	8
9	France	I	41	11	10	9
10	Germany	I	27	42	27	11
11	United States	I	8	1	83	12
12	Australia	E	10	3	98	13
13	Netherlands	I	55	33	31	14
14	Luxembourg	I	109	4	23	18
15	Qatar	E	3	6	103	20
16	Belgium	I	65	29	32	21
17	Ireland	I	69	39	13	22
18	Japan	I	62	20	41	23
19	Hong Kong, China	I	101	9	60	27
20	Iceland	I	94	18	36	31
21	Taiwan, China	I	75	14	86	34
22	Singapore	I	124	35	50	41
23	Israel	I	104	27	88	66
24	Kuwait	E	79	26	121	76

Figure C-3
Country ranking for GDP Group II
Source: WEC/Oliver Wyman, 2014

GDP group rank	Country	Importer/ Exporter	Energy security	Energy equity	Environmental sustainability	2014 Index
1	New Zealand	I	16	28	42	10
2	Spain	I	37	46	24	15
3	Slovakia	I	15	37	34	17
4	Slovenia	I	52	40	45	24
5	Portugal	I	53	65	22	25
6	Malaysia	E	28	21	84	26
7	Czech Republic	I	12	38	87	28
8	Italy	I	70	48	21	29
9	Croatia	I	74	31	26	32
10	Hungary	I	43	53	35	33
11	United Arab Emirates	E	47	8	102	35
12	Lithuania	I	90	45	20	37
13	Mexico	E	30	43	74	38
14	Uruguay	I	91	41	7	39
15	Poland	I	32	36	91	42
16	Latvia	I	96	59	14	43
17	Panama	I	86	50	17	44
18	Mauritius	I	107	60	15	46
19	Bahrain	I	40	13	126	47
20	Gabon	E	33	89	12	49

GDP group rank	Country	Importer/ Exporter	Energy security	Energy equity	Environmental sustainability	2014 Index
21	Russia	E	2	44	104	50
22	Greece	I	59	23	82	51
23	Chile	I	89	55	67	53
24	Korea (Rep.)	I	98	25	85	55
25	Argentina	E	14	96	44	60
26	Barbados	I	117	34	40	61
27	Cyprus	I	106	32	77	63
28	Trinidad and Tobago	E	50	30	112	64
29	Malta	I	128	51	65	65
30	Saudi Arabia	E	68	7	125	68
31	Oman	E	97	12	124	72
32	Turkey	I	63	76	69	73
33	Estonia	I	71	68	115	75
34	Botswana	I	126	98	71	91
35	Lebanon	I	127	123	68	123

Figure C-4
Country ranking for GDP Group III

Source: WEC/Oliver Wyman, 2014

GDP group rank	Country	Importer/ Exporter	Energy security	Energy equity	Environmental sustainability	2014 Index
1	Colombia	E	5	63	4	16
2	Costa Rica	I	51	56	2	19
3	Brazil	I	29	86	19	30
4	Ecuador	E	23	52	28	36
5	Peru	I	18	97	38	40
6	Tunisia	I	36	58	57	45
7	El Salvador	I	61	71	11	52
8	Romania	I	4	78	95	54
9	Kazakhstan	E	13	17	118	56
10	Albania	I	83	84	3	57
11	Angola	E	25	100	25	59
12	Bulgaria	I	24	80	109	67
13	Azerbaijan	E	21	57	99	71
14	China	I	19	82	127	74
15	Paraguay	E	81	103	16	77
16	Algeria	E	80	49	78	79
17	Sri Lanka	I	77	83	49	80
18	Venezuela	E	56	62	73	82
19	South Africa	E	42	85	129	83
20	Egypt	E	58	54	89	85
21	Namibia	I	123	92	46	88
22	Iran	E	66	24	120	89
23	Thailand	I	95	77	107	90
24	Swaziland	I	72	94	79	92
25	Ukraine	I	54	74	116	94
26	Montenegro	I	116	69	93	95
27	Dominican Republic	I	111	87	54	97
28	Macedonia	I	103	75	111	102
29	Jamaica	I	121	79	90	112
30	Libya	E	73	91	108	114
31	Serbia	I	105	70	119	116

Figure C-5

Country ranking for GDP Group IV

Source: WEC/Oliver Wyman, 2014

GDP group rank	Country	Importer/ Exporter	Energy security	Energy equity	Environmental sustainability	2014 Index
1	Guatemala	I	31	73	29	48
2	Philippines	I	34	93	51	58
3	Bolivia	E	7	88	70	62
4	Indonesia	E	17	64	106	69
5	Cameroon	E	38	111	30	70
6	Georgia	I	102	67	39	78
7	Nigeria	E	11	108	81	81
8	Armenia	I	92	66	75	84
9	Côte d'Ivoire	E	35	110	66	86
10	Vietnam	E	39	99	101	87
11	Mozambique	E	67	124	61	93
12	Ghana	I	78	106	76	96
13	Mongolia	E	49	95	128	98
14	Mauritania	I	48	115	94	99
15	Congo (Dem. Rep.)	E	46	126	58	100
16	Chad	E	85	121	48	101
17	Malawi	I	93	129	33	103
18	Kenya	I	84	114	63	104
19	Nicaragua	I	100	101	59	105
20	Tajikistan	I	82	107	53	106
21	Honduras	I	114	102	55	107
22	Jordan	I	112	61	114	108
23	Nepal	I	125	117	43	109
24	Niger	I	57	127	92	110
25	Morocco	I	118	72	96	111
26	Zambia	I	108	118	62	113
27	Ethiopia	I	99	119	47	115
28	Cambodia	I	115	113	64	117
29	Pakistan	I	60	104	97	118
30	Syria	E	64	81	117	119
31	Madagascar	I	88	125	72	120
32	Tanzania	I	110	128	52	121
33	India	I	76	105	123	122
34	Moldova	I	119	90	113	124
35	Bangladesh	I	113	112	80	125
36	Yemen	E	87	109	110	126
37	Senegal	I	122	116	100	127
38	Benin	I	129	120	105	128
39	Zimbabwe	I	120	122	122	129

2014 Index profile groups

To support decision makers, the 2014 Index analysis (for the second time) highlights five distinct profiles. Countries in each group share common energy trilemma characteristics and challenges. While simplified and not comprehensive, these profiles serve as benchmark guides to other countries with similar preconditions.

- Pack leaders: top performers in terms of both dimensional balance and overall ranking on the Index.
- Fossil-fuelled: well-endowed with fossil fuel resources, tend to rely heavily on fossil fuels for electricity generation with associated comparatively high CO_2 emissions per kWh generated, trilemma profile is imbalanced and is tilted towards energy security and energy equity, while they struggle to minimise their environmental impact.
- Highly-industrialised: emerging economies with large manufacturing sectors (30% or higher), trilemma profile is imbalanced and is tilted heavily towards energy security, with progress needed to ensure energy equity and environmental sustainability.
- Hydro-powered: have a high share of electricity generation from hydropower (40% or higher), trilemma profile is imbalanced and is tilted towards the environmental sustainability dimension, although these countries also perform reasonably well on the energy security dimension.
- Back of the pack: tightly clustered, less-developed and developing countries that struggle to make progress on all three dimensions.

Only 42 of the 95 WEC member countries are included in the five illustrative groups. While some countries may be closely associated with one group from the point of view of region, economy, or structure of the energy sector, others cannot be readily classified into a single profile as they may align to two profiles.

Readers are encouraged to review the detailed country profiles presented in the companion report 2014 Energy Trilemma Index: Benchmarking the sustainability of national energy systems to consider which energy profile serves as a guide for a particular country.

Score system methodology

The Index ranking measures both energy and contextual performance of a country. Although the weighting of the dimensions is tilted towards the energy dimensions, the contextual dimensions often give an advantage to developed countries while penalising developing countries. Furthermore, the Index ranking does not indicate how well a country is meeting the energy trilemma challenge (balancing the three dimensions).

To overcome this challenge, a balance score system that highlights how well a country manages the trade-offs between the three competing dimensions was introduced. The score looks at the energy performance only – energy security, energy equity and environmental sustainability. This leaves aside the performance in the three contextual dimensions – political, societal and economic strength.

The score enables the WEC to identify and show countries that perform very well in the energy dimensions and balance the energy trilemma, by giving them an easy-to-understand score for high performance. High performers receive a score of AAA, while countries that do not yet perform well receive a DDD score.

The scores are calculated by splitting the normalised 0–10 results on the energy performance dimensions into four groups. Countries were then provided with a three-letter score. Note, the sequence of the letters in the score does not correspond to a

specific energy dimension, but presents the letter scores in descending alphabetical order.

The best score A was given for results higher than 8. Countries with normalised results higher than 5 were given score B. Average results of between 2.51 and 5 were given a C. Lastly, the score D was given for underperformance.

To ensure that countries' scores are up- or downgraded only in the cases of a systemic trend (as opposed to a short term fluctuation), a 10% 'margin of appreciation' is used (see Figure C-6). For a country to be awarded a new score for any of the dimensions it has to exceed the set margin in case of an improvement or fall below in case of deterioration. Otherwise, the 2013 balance score remains in place.

The following countries' scores fall within the margin of appreciation and were hence not up or downgraded in 2014: Angola, Belgium, Cambodia, Colombia, Estonia, Finland, Indonesia, Iran, Korea (Rep.), Kuwait, Latvia, Mauritania, Mongolia, New Zealand, Oman, Peru, Portugal, Saudi Arabia, Senegal, and Swaziland.

Figure C-6

Balance score system

Source: WEC/Oliver Wyman, 2014

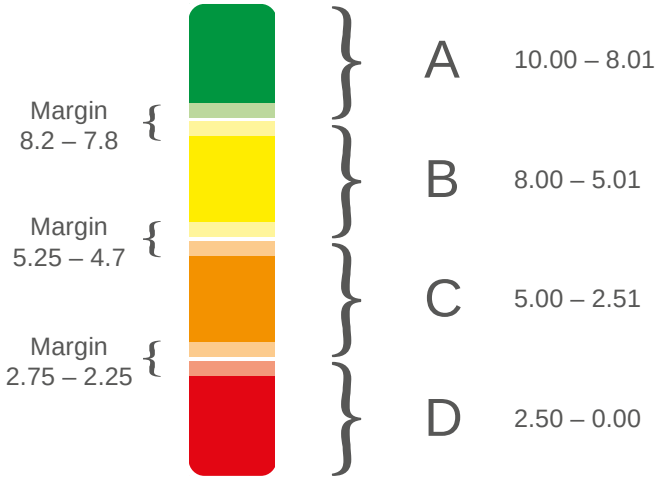


Figure C-7

2014 Energy Trilemma Index ranking and balance score

Source: WEC/Oliver Wyman, 2014

Index	Country	Balance score	Energy security	Energy equity	Environmental sustainability
1	Switzerland	AAA	22	5	1
2	Sweden	AAA	20	19	6
3	Norway	AAB	45	15	5
4	United Kingdom	AAA	9	22	18
5	Denmark	AAB	6	47	9
6	Canada	AAB	1	2	56
7	Austria	AAB	44	10	8
8	Finland	ABB	26	16	37
9	France	AAB	41	11	10
10	New Zealand	AAB	16	28	42
11	Germany	BBB	27	42	27
12	United States	AAC	8	1	83
13	Australia	AAD	10	3	98
14	Netherlands	BBB	55	33	31
15	Spain	ABB	37	46	24
16	Colombia	AAC	5	63	4
17	Slovakia	ABB	15	37	34
18	Luxembourg	AAD	109	4	23
19	Costa Rica	ABB	51	56	2
20	Qatar	AAD	3	6	103
21	Belgium	ABB	65	29	32
22	Ireland	ABC	69	39	13
23	Japan	ABB	62	20	41
24	Slovenia	BBB	52	40	45
25	Portugal	ABB	53	65	22
26	Malaysia	ABC	28	21	84
27	Hong Kong, China	ABD	101	9	60
28	Czech Republic	ABC	12	38	87
29	Italy	ABC	70	48	21
30	Brazil	ABC	29	86	19
31	Iceland	ABC	94	18	36
32	Croatia	ABC	74	31	26
33	Hungary	BBB	43	53	35
34	Taiwan, China	ACC	75	14	86
35	United Arab Emirates	ABD	47	8	102
36	Ecuador	ABB	23	52	28
37	Lithuania	ABC	90	45	20
38	Mexico	BBC	30	43	74
39	Uruguay	ABC	91	41	7
40	Peru	ABC	18	97	38
41	Singapore	BBD	124	35	50
42	Poland	BBC	32	36	91
43	Latvia	ABD	96	59	14
44	Panama	ABC	86	50	17
45	Tunisia	BBB	36	58	57
46	Mauritius	ABD	107	60	15
47	Bahrain	ABD	40	13	126
48	Guatemala	BBC	31	73	29
49	Gabon	ABC	33	89	12
50	Russia	ABD	2	44	104
51	Greece	ABC	59	23	82
52	El Salvador	ABC	61	71	11
53	Chile	BCC	89	55	67
54	Romania	ACC	4	78	95
55	Korea (Rep.)	BCD	98	25	85
56	Kazakhstan	AAD	13	17	118
57	Albania	ACC	83	84	3
58	Philippines	BBC	34	93	51
59	Angola	ABD	25	100	25
60	Argentina	ABC	14	96	44
61	Barbados	BBD	117	34	40
62	Bolivia	ACC	7	88	70
63	Cyprus	BCD	106	32	77
64	Trinidad and Tobago	BBD	50	30	112
65	Malta	BCD	128	51	65

Index	Country	Balance score	Energy security	Energy equity	Environmental sustainability
66	Israel	BCD	104	27	88
67	Bulgaria	ACD	24	80	109
68	Saudi Arabia	ABD	68	7	125
69	Indonesia	ACD	17	64	106
70	Cameroon	BBD	38	111	30
71	Azerbaijan	ABD	21	57	99
72	Oman	ACD	97	12	124
73	Turkey	BCC	63	76	69
74	China	ACD	19	82	127
75	Estonia	BCD	71	68	115
76	Kuwait	BCD	79	26	121
77	Paraguay	ACD	81	103	16
78	Georgia	BCD	102	67	39
79	Algeria	BCC	80	49	78
80	Sri Lanka	BCC	77	83	49
81	Nigeria	ACD	11	108	81
82	Venezuela	BBC	56	62	73
83	South Africa	BCD	42	85	129
84	Armenia	CCC	92	66	75
85	Egypt	BBC	58	54	89
86	Côte d'Ivoire	BCD	35	110	66
87	Vietnam	BDD	39	99	101
88	Namibia	BCD	123	92	46
89	Iran	BCD	66	24	120
90	Thailand	CCD	95	77	107
91	Botswana	CDD	126	98	71
92	Swaziland	CCD	72	94	79
93	Mozambique	BCD	67	124	61
94	Ukraine	BCD	54	74	116
95	Montenegro	CCD	116	69	93
96	Ghana	CCD	78	106	76
97	Dominican Republic	BCD	111	87	54
98	Mongolia	BDD	49	95	128
99	Mauritania	BDD	48	115	94
100	Congo (Dem. Rep.)	BBD	46	126	58
101	Chad	BCD	85	121	48
102	Macedonia	CDD	103	75	111
103	Malawi	BCD	93	129	33
104	Kenya	BCD	84	114	63
105	Nicaragua	BDD	100	101	59
106	Tajikistan	BCD	82	107	53
107	Honduras	BDD	114	102	55
108	Jordan	BDD	112	61	114
109	Nepal	BDD	125	117	43
110	Niger	BCD	57	127	92
111	Morocco	CCD	118	72	96
112	Jamaica	CCD	121	79	90
113	Zambia	BDD	108	118	62
114	Libya	CCD	73	91	108
115	Ethiopia	BDD	99	119	47
116	Serbia	CDD	105	70	119
117	Cambodia	CDD	115	113	64
118	Pakistan	BDD	60	104	97
119	Syria	BCD	64	81	117
120	Madagascar	CCD	88	125	72
121	Tanzania	BDD	110	128	52
122	India	CDD	76	105	123
123	Lebanon	CDD	127	123	68
124	Moldova	CDD	119	90	113
125	Bangladesh	CDD	113	112	80
126	Yemen	CDD	87	109	110
127	Senegal	CDD	122	116	100
128	Benin	DDD	129	120	105
129	Zimbabwe	DDD	120	122	122

Figure C-8

2013 Energy Trilemma Index ranking and balance score

Source: WEC/Oliver Wyman, 2014

Index	Country	Balance score	Energy security	Energy equity	Environmental sustainability
1	Switzerland	AAA	19	6	1
2	Denmark	AAA	3	25	10
3	Sweden	AAA	24	14	6
4	Austria	AAB	33	7	7
5	United Kingdom	AAA	11	8	19
6	Canada	AAB	1	2	60
7	Norway	AAB	51	10	8
8	New Zealand	AAB	15	26	37
9	Spain	AAA	22	16	23
10	France	AAB	44	5	9
11	Germany	ABB	31	11	30
12	Netherlands	ABB	42	23	35
13	Finland	ABB	37	21	45
14	Australia	AAD	10	3	97
15	United States	AAC	12	1	86
16	Japan	ABB	48	17	33
17	Belgium	ABB	63	13	34
18	Qatar	AAC	8	9	95
19	Luxembourg	ABD	107	4	29
20	Ireland	ABC	82	30	15
21	Costa Rica	ABB	57	45	2
22	Slovakia	ABB	20	38	48
23	Portugal	ABB	55	53	20
24	Colombia	AAC	5	85	4
25	Slovenia	BBB	60	27	42
26	Argentina	ABB	14	33	38
27	Taiwan, China	ABC	71	22	59
28	Italy	ABC	69	34	24
29	Panama	ABB	53	58	18
30	Croatia	ABC	66	31	21
31	Hungary	BBB	46	42	44
32	Czech Republic	ABC	16	32	90
33	Iceland	ABC	96	15	41
34	Brazil	ABC	27	86	17
35	Ecuador	ABB	25	62	28
36	Tunisia	BBB	28	57	56
37	Malaysia	BBC	34	40	92
38	Bahrain	AAD	23	19	125
39	Greece	ABC	54	18	81
40	Hong Kong, China	ABD	99	24	58
41	Mexico	BBC	29	47	75
42	Lithuania	ABC	93	46	26
43	Latvia	ABD	98	54	14
44	United Arab Emirates	BBD	49	37	102
45	Peru	ABC	21	96	43
46	Uruguay	ACC	92	67	5
47	Singapore	BBD	124	43	51
48	Poland	BBC	38	39	94
49	El Salvador	ABC	68	64	11
50	Barbados	ABD	118	41	25
51	Saudi Arabia	ABD	45	12	124
52	Romania	ACC	9	70	88
53	Mauritius	ABD	109	60	16
54	Russia	ABD	2	61	99
55	Bolivia	ACC	4	84	71
56	Gabon	ABC	35	92	12
57	Chile	BCC	90	56	72
58	Kazakhstan	ABD	6	35	116
59	Angola	ABD	7	104	31
60	Albania	ACC	87	76	3
61	Guatemala	BBC	40	75	36
62	Oman	ACD	78	20	120
63	Cyprus	BCD	104	36	80
64	Korea (Rep.)	BCD	103	49	85
65	Philippines	BBC	39	93	54

Index	Country	Balance score	Energy security	Energy equity	Environmental sustainability
66	Kuwait	**BCD**	73	28	122
67	Israel	**BCD**	102	29	83
68	Estonia	**BCD**	65	51	117
69	Sri Lanka	**BCC**	72	80	40
70	Bulgaria	**ACD**	26	77	108
71	Malta	**BCD**	128	48	65
72	Georgia	**ACD**	106	66	22
73	Indonesia	**ACD**	17	83	104
74	Paraguay	**ACD**	84	99	13
75	Turkey	**BCC**	64	82	70
76	Egypt	**BBC**	47	59	84
77	Venezuela	**BBC**	41	55	82
78	China	**ADD**	18	101	126
79	South Africa	**BCD**	43	78	128
80	Congo (Dem. Rep.)	**BBD**	30	121	27
81	Azerbaijan	**BCD**	32	74	98
82	Cameroon	**BBD**	62	107	39
83	Montenegro	**BCD**	115	71	57
84	Nigeria	**ACD**	13	111	79
85	Armenia	**CCC**	95	69	73
86	Macedonia	**BCD**	89	50	106
87	Syria	**BBD**	52	52	113
88	Algeria	**CCC**	86	68	74
89	Thailand	**CCD**	91	88	101
90	Namibia	**BCD**	123	94	49
91	Iran	**BCD**	75	44	119
92	Swaziland	**BCD**	61	98	76
93	Côte d'Ivoire	**BCD**	36	108	68
94	Malawi	**BCD**	74	129	32
95	Mongolia	**BDD**	50	100	129
96	Jordan	**BDD**	119	63	107
97	Ukraine	**BCD**	59	73	114
98	Trinidad and Tobago	**CCD**	79	95	115
99	Botswana	**BDD**	126	97	62
100	Honduras	**BCD**	111	90	52
101	Vietnam	**CDD**	77	102	105
102	Ghana	**CCD**	85	105	77
103	Mozambique	**CCD**	67	124	66
104	Chad	**BCD**	83	123	50
105	Morocco	**CCD**	110	79	96
106	Serbia	**CDD**	101	65	118
107	Tajikistan	**BCD**	81	109	61
108	Kenya	**BCD**	88	114	63
109	Lebanon	**CCD**	127	87	89
110	Dominican Republic	**BDD**	114	106	55
111	Nepal	**BDD**	125	122	46
112	Ethiopia	**BDD**	97	119	47
113	Nicaragua	**CCD**	100	91	87
114	Pakistan	**BDD**	56	103	100
115	India	**CDD**	76	110	121
116	Tanzania	**BDD**	117	125	53
117	Libya	**CCD**	70	72	123
118	Cambodia	**CDD**	121	113	67
119	Mauritania	**BDD**	58	117	112
120	Zambia	**BDD**	108	120	64
121	Jamaica	**CDD**	116	81	110
122	Niger	**CCD**	80	127	91
123	Bangladesh	**CDD**	113	115	78
124	Madagascar	**CDD**	105	126	69
125	Moldova	**CDD**	122	89	109
126	Senegal	**CDD**	120	118	93
127	Yemen	**CDD**	94	112	111
128	Benin	**DDD**	129	116	103
129	Zimbabwe	**DDD**	112	128	127

Figure C-9

2012 Energy Trilemma Index ranking

Source: WEC/Oliver Wyman, 2014

Index	Country	Energy security	Energy equity	Environmental sustainability
1	Switzerland	26	4	1
2	United Kingdom	3	5	20
3	Sweden	18	21	8
4	Austria	30	7	7
5	Denmark	5	34	19
6	Norway	44	10	6
7	New Zealand	19	18	36
8	Germany	24	13	31
9	France	41	8	9
10	Canada	2	2	66
11	Finland	25	20	49
12	Spain	31	24	23
13	Netherlands	48	22	39
14	Japan	49	9	29
15	Australia	14	3	99
16	United States	17	1	88
17	Qatar	7	11	94
18	Luxembourg	96	6	28
19	Argentina	11	23	38
20	Belgium	69	15	41
21	Ireland	85	28	15
22	Slovakia	20	40	46
23	Slovenia	57	36	37
24	Taiwan, China	67	17	63
25	Portugal	58	48	26
26	Colombia	6	86	4
27	Italy	76	29	22
28	Hungary	39	41	44
29	Panama	54	60	14
30	Croatia	59	38	21
31	Barbados	70	45	25
32	Iceland	98	12	40
33	Malaysia	22	42	85
34	Tunisia	15	55	59
35	Czech Republic	16	37	90
36	Lithuania	80	46	16
37	Costa Rica	77	47	2
38	Hong Kong, China	84	25	60
39	Uruguay	68	66	5
40	Ecuador	23	65	27
41	Peru	9	91	34
42	Latvia	78	54	18
43	Chile	61	50	64
44	Brazil	43	89	12
45	Singapore	123	43	48
46	Mexico	35	52	73
47	Albania	63	71	3
48	Bahrain	40	19	126
49	Saudi Arabia	38	14	124
50	Poland	34	44	93
51	El Salvador	71	67	11
52	Romania	4	59	92
53	United Arab Emirates	56	39	106
54	Korea (Rep.)	89	32	86
55	Greece	88	26	76
56	Mauritius	107	61	17
57	Kazakhstan	8	35	119
58	Russia	1	57	102
59	Cyprus	109	27	84
60	Bolivia	21	80	65
61	Kuwait	62	33	122
62	Gabon	46	97	10
63	Israel	100	30	83
64	Guatemala	51	72	35
65	Estonia	64	51	117

Index	Country	Energy security	Energy equity	Environmental sustainability
66	Bulgaria	28	74	107
67	Oman	97	16	121
68	Malta	126	58	62
69	Sri Lanka	72	82	45
70	Venezuela	29	53	79
71	Philippines	42	99	55
72	Angola	10	121	32
73	Egypt	52	56	81
74	Georgia	103	69	30
75	Cameroon	32	108	42
76	China	12	100	125
77	Iran	50	31	118
78	Vietnam	45	98	100
79	Azerbaijan	27	78	97
80	Trinidad and Tobago	74	49	116
81	Paraguay	95	96	13
82	Montenegro	114	77	43
83	Armenia	83	70	68
84	South Africa	55	75	129
85	Algeria	80	63	77
85	Indonesia	37	94	109
87	Turkey	91	81	72
88	Congo (Dem. Rep.)	47	124	24
89	Thailand	82	85	103
90	Nigeria	13	109	82
91	Côte d'Ivoire	36	111	61
92	Namibia	125	93	50
93	Jordan	108	62	110
94	Syria	33	87	116
95	Macedonia	99	64	105
96	Mozambique	66	120	56
97	Honduras	116	83	53
98	Botswana	121	96	69
99	Ukraine	60	73	114
100	Serbia	81	68	120
101	Malawi	92	129	33
102	Morocco	112	79	95
103	Mongolia	65	102	128
104	Ghana	90	106	75
105	Lebanon	122	84	87
106	Tajikistan	87	105	58
107	Swaziland	104	92	78
108	Nepal	118	122	47
109	Libya	53	90	113
110	Ethiopia	102	118	51
111	Dominican Republic	119	107	54
112	Cambodia	111	112	71
113	Kenya	93	114	74
114	Tanzania	117	123	57
115	Zambia	101	119	67
116	Jamaica	127	76	98
117	India	86	110	123
118	Nicaragua	105	101	89
119	Bangladesh	110	115	80
120	Mauritania	75	116	112
121	Pakistan	73	103	108
122	Madagascar	106	127	70
123	Yemen	94	104	101
124	Chad	124	126	52
125	Senegal	120	117	91
126	Moldova	128	88	111
127	Niger	115	128	96
128	Benin	129	113	104
129	Zimbabwe	113	125	127

Figure C-10

2014 mapping of the balance scores using the heat map system

Source: WEC/Oliver Wyman, 2014

Index	Country	Balance score	Energy security	Energy equity	Environmental sustainability
1	Switzerland	AAA	8.35	9.68	10.00
2	Sweden	AAA	8.51	8.59	9.60
3	Norway	AAB	6.56	8.90	9.68
4	United Kingdom	AAA	9.37	8.35	8.67
5	Denmark	AAB	9.60	6.40	9.37
6	Canada	AAB	10.00	9.92	5.70
7	Austria	AAB	6.64	9.29	9.45
8	Finland	ABB	8.04	8.82	7.18
9	France	AAB	6.87	9.21	9.29
10	New Zealand	AAB	8.82	7.89	6.79
11	Germany	BBB	7.96	6.79	7.96
12	United States	AAC	9.45	10.00	3.59
13	Australia	AAD	9.29	9.84	2.42
14	Netherlands	BBB	5.78	7.50	7.65
15	Spain	ABB	7.18	6.48	8.20
16	Colombia	AAC	9.68	5.15	9.76
17	Slovakia	ABB	8.90	7.18	7.42
18	Luxembourg	AAD	1.56	9.76	8.28
19	Costa Rica	ABB	6.09	5.70	9.92
20	Qatar	AAD	9.84	9.60	2.03
21	Belgium	ABB	5.00	7.81	7.57
22	Ireland	ABC	4.68	7.03	9.06
23	Japan	ABB	5.23	8.51	6.87
24	Slovenia	BBB	5.93	6.95	6.56
25	Portugal	ABB	5.93	5.00	8.35
26	Malaysia	ABC	7.89	8.43	3.51
27	Hong Kong, China	ABD	2.18	9.37	5.39
28	Czech Republic	ABC	9.14	7.10	3.28
29	Italy	ABC	4.60	6.32	8.43
30	Brazil	ABC	7.81	3.35	8.59
31	Iceland	ABC	2.73	8.67	7.26
32	Croatia	ABC	4.29	7.65	8.04
33	Hungary	BBB	6.71	5.93	7.34
34	Taiwan, China	ACC	4.21	8.98	3.35
35	United Arab Emirates	ABD	6.40	9.45	2.10
36	Ecuador	ABB	8.28	6.01	7.89
37	Lithuania	ABC	3.04	6.56	8.51
38	Mexico	BBC	7.73	6.71	4.29
39	Uruguay	ABC	2.96	6.87	9.53
40	Peru	ABC	8.67	2.50	7.10
41	Singapore	BBD	0.39	7.34	6.17
42	Poland	BBC	7.57	7.26	2.96
43	Latvia	ABD	2.57	5.46	8.98
44	Panama	ABC	3.35	6.17	8.75
45	Tunisia	BBB	7.26	5.54	5.62
46	Mauritius	ABD	1.71	5.39	8.90
47	Bahrain	ABD	6.95	9.06	0.23
48	Guatemala	BBC	7.65	4.37	7.81
49	Gabon	ABC	7.50	3.12	9.14
50	Russia	ABD	9.92	6.64	1.95
51	Greece	ABC	5.46	8.28	3.67
52	El Salvador	ABC	5.31	4.53	9.21
53	Chile	BCC	3.12	5.78	4.84
54	Romania	ACC	9.76	3.98	2.65
55	Korea (Rep.)	BCD	2.42	8.12	3.43
56	Kazakhstan	AAD	9.06	8.75	0.85
57	Albania	ACC	3.59	3.51	9.84
58	Philippines	BBC	7.42	2.81	6.09
59	Angola	ABD	8.12	2.26	8.12
60	Argentina	ABC	8.98	2.57	6.64
61	Barbados	BBD	0.93	7.42	6.95
62	Bolivia	ACC	9.53	3.20	4.60
63	Cyprus	BCD	1.79	7.57	4.06
64	Trinidad & Tobago	BBD	6.17	7.73	1.32
65	Malta	BCD	0.07	6.09	5.00

Index	Country	Balance score	Energy security	Energy equity	Environmental sustainability
66	Israel	BCD	1.95	7.96	3.12
67	Bulgaria	ACD	8.20	3.82	1.56
68	Saudi Arabia	ABD	4.76	9.53	0.31
69	Indonesia	ACD	8.75	5.07	1.79
70	Cameroon	BBD	7.10	1.40	7.73
71	Azerbaijan	ABD	8.43	5.62	2.34
72	Oman	ACD	2.50	9.14	0.39
73	Turkey	BCC	5.15	4.14	4.68
74	China	ACD	8.59	3.67	0.15
75	Estonia	BCD	4.53	4.76	1.09
76	Kuwait	BCD	3.90	8.04	0.62
77	Paraguay	ACD	3.75	2.03	8.82
78	Georgia	BCD	2.10	4.84	7.03
79	Algeria	BCC	3.82	6.25	3.98
80	Sri Lanka	BCC	4.06	3.59	6.25
81	Nigeria	ACD	9.21	1.64	3 75
82	Venezuela	BBC	5.70	5.23	4.37
83	South Africa	BCD	6.79	3.43	0.00
84	Armenia	CCC	2.89	4.92	4.21
85	Egypt	BBC	5.54	5.85	3.12
86	Côte d'Ivoire	BCD	7.34	1.48	4.92
87	Vietnam	BDD	7.03	2.34	2.18
88	Namibia	BCD	0.46	2.89	6.48
89	Iran	BCD	4.92	8.20	0.70
90	Thailand	CCD	2.65	4.06	1.71
91	Botswana	CDD	0.23	2.42	4.53
92	Swaziland	CCD	4.45	2.73	3.90
93	Mozambique	BCD	4.84	0.39	5.31
94	Ukraine	BCD	5.85	4.29	1.01
95	Montenegro	CCD	1.01	4.68	2.81
96	Ghana	CCD	3.98	1.79	4.14
97	Dominican Republic	BCD	1.40	3.28	5.85
98	Mongolia	BDD	6.25	2.65	0.07
99	Mauritania	BDD	6.32	1.09	2.73
100	Congo (Dem. Rep.)	BBD	6.48	0.23	5.54
101	Chad	BCD	3.43	0.62	6.32
102	Macedonia	CDD	2.03	4.21	1.40
103	Malawi	BCD	2.81	0.00	7.50
104	Kenya	BCD	3.51	1.17	5.15
105	Nicaragua	BDD	2.26	2.18	5.46
106	Tajikistan	BCD	3.67	1.71	5.93
107	Honduras	BDD	1.17	2.10	5.78
108	Jordan	BDD	1.32	5.31	1.17
109	Nepal	BDD	0.31	0.93	6.71
110	Niger	BCD	5.62	0.07	2.89
111	Morocco	CCD	0.85	4.45	2.57
112	Jamaica	CCD	0.62	3.90	3.04
113	Zambia	BDD	1.64	0.85	5.23
114	Libya	CCD	4.37	2.96	1.64
115	Ethiopia	BDD	2.34	0.78	6.40
116	Serbia	CDD	1.87	4.60	0.78
117	Cambodia	CDD	1.09	1.25	5.07
118	Pakistan	BDD	5.39	1.95	2.50
119	Syria	BCD	5.07	3.75	0.93
120	Madagascar	CCD	3.20	0.31	4.45
121	Tanzania	BDD	1.48	0.07	6.01
122	India	CDD	4.14	1.87	0.46
123	Lebanon	CDD	0.15	0.46	4.76
124	Moldova	CDD	0.78	3.04	1.25
125	Bangladesh	CDD	1.25	1.32	3.82
126	Yemen	CDD	3.28	1.56	1.48
127	Senegal	CDD	0.54	1.01	2.26
128	Benin	DDD	0.00	0.70	1.87
129	Zimbabwe	DDD	0.70	0.54	0.54

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