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For sustainable energy.

World Energy Trilemma

Time to get real – the case for sustainable energy investment

World Energy Council

Project Partner
OLIVER WYMAN

Time to get real – the case for sustainable energy investment

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Foreword by Pierre Gadonneix

I am particularly happy to unveil the fifth edition of our World Energy Trilemma report. This new edition comes at the right time to support the world's energy leaders in their actions to realise the transition to a more sustainable energy future.

A greater number of countries are committed to transforming their energy systems in order to reconcile economic growth with protecting the environment.

In China, for the first time in its history the requirement of developing an 'ecological civilization' was inscribed in the national constitution. In the United States (US), where in June 2013 President Obama committed in a speech at Georgetown University to *"act before it's too late"* focusing on three pillars: cut carbon pollution in the US, prepare the country for the impacts of climate change, and lead international efforts to address global climate change. In Europe, results of the current energy and climate policy pave the way to a new reflection on what should be Europe's pragmatic actions and positions from 2020 onwards. France is currently drawing conclusions from its national debate on the energy transition that will bring about a new investment bill and shape the future energy infrastructure, while Germany is assessing the benefits and costs of its Energiewende (transition) plan for sustainable energy. In Brazil, the population is increasingly rising in protest against large energy projects that compete with land and water use. The government is willing to find alternatives, but it struggles to reconcile economic growth and energy security with the environmental aspirations of the people in the long term.

Why is the energy transition becoming so high on the agenda of national decision makers? The answer: we can no longer escape the reality of the 'energy trilemma' – the triple challenge of finding solutions that support secure, affordable, and environmentally-sensitive energy.

Climate-induced disasters, like the floods in India, Canada and Europe in June 2013 which caused tremendous economic damage, people losing their homes and personal items, or even their lives; the toxic fires in California; or the even more severe droughts in Africa, call for more urgent action to protect the environment. We cannot continue on the current path, which could lead to a +6°C increase in global average temperature by 2050 and bring about many more human tragedies as well as economic losses. The energy sector, which accounts for two-thirds of global emissions, is at the forefront of the challenge.

However, economic growth remains imperative as the context of economic downturn is now impacting not only industrialised countries but also emerging and developing economies. In a world where the population is to grow by an additional 1.6 billion people by 2035, essentially in developing countries, a strong economic growth is vital for social development. But this will require additional energy supply. Global demand for primary energy is expected to increase by between 27% and 61% by 2050. Supplying energy to fuel the economic and social growth at an acceptable cost is key. Discoveries of new unconventional sources of oil and gas could be of great help, if in parallel specific strategies to mitigate CO_2 emissions are implemented. Hence, a truly long-term vision is

necessary to develop efficient energy and climate policies.

Of the more than 7 billion people living on the planet today, 1.1 billion subsist on US$1.25 a day, below the internationally accepted extreme-poverty line. Not surprisingly, almost the same number of people does not have access to either safe drinking water or electricity. Energy supply is one of the key drivers to lift people out of extreme poverty. Nearly 1 billion people have been pulled out of extreme poverty over the past 20 years. We should aim to continue but speed up this success; it goes hand-in-hand with providing universal access to energy. We are all well aware of the fact that the main issue regarding energy access is not the amount of money needed. Rather, it has much more to do with designing smart public policies, choosing the right technologies, building capacities and skills, and creating supportive governance.

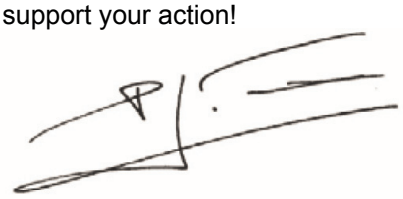
The task, to reconcile the three aspects of the energy trilemma – energy security, energy equity, and environmental sustainability – is hard. And, as time elapses, it will get even harder and more expensive.

The World Energy Council, in its role as principle impartial network for energy leaders, decided to make the 2012 and 2013 World Energy Trilemma reports the place for our energy leaders' community to express their vision for a sustainable future and engage in a dialogue on what is to be done in order to get there.

While in 2012 we interviewed energy industry leaders, this year the floor is given to public stakeholders and decision makers. Together, the contributions enable us to map effective solutions and give opportunity to learn by understanding each other's views and experiences.

As we get close to the point of having a shared vision and a list of smart, pragmatic instruments, there is no time to waste. In a world crippled with fear of the economic downturn, in a world where temptations of nationalistic withdrawal become more frequent, in a world with only a few leaders ready to go ahead, it is time to show that a pragmatic, common vision is within reach in the energy sector, building the backbone of the smart energy and climate policies we need to develop for a sustainable future.

I wish you a stimulating read of the second part of our energy policy dialogue and I hope it will actively support your action!



Pierre Gaddoneix
Chair, World Energy Council

Foreword by Joan MacNaughton

The 2013 World Energy Trilemma report enhances our understanding of how policymakers and industry should collaborate to deliver sustainable energy systems. Individual countries vary widely in the nature of their legacy systems, their natural resource endowments and the strength of their political, economic, and social frameworks. But some common themes emerge from our research with industry in 2012 and with the public sector this year.

There is a strong consensus on the need for energy policies and regulatory processes to be coherent, stable and transparent; on the need for government intervention to correct market failures and ensure the conditions exist to encourage greater investment in infrastructure and clean energy solutions; and on the need for more joint effort, between the public and private sectors, on research and development. Indeed, the degree of consensus is striking. Why then is it so difficult to achieve these outcomes?

According to the large number of policymakers we interviewed, rapidly changing conditions in energy markets and in technologies are exacerbating the difficulty of coping with changing patterns of energy supply and demand. Policymakers call upon the energy industry to be proactive in making expert input to help them keep abreast of developments, to help manage more diversified and more complex systems, and to avoid locking in to systems that could potentially become obsolete. They also highlight the difficulty of building consensus and a long-term vision on energy goals, and they call upon industry to make a more visible contribution to the public debate. Further, they stress the need for industry to engage with them to identify how best to allocate risk in energy investments where it can be best managed, as well as taking a lead role in driving the investments needed to fill the energy gap and support the transition to low-carbon solutions. One specific proposal is to increase the involvement of non-traditional investors, who will need help to become comfortable enough to make sizeable investments in what is for them an unfamiliar sector.

From these policymaker responses, and from this year's findings of our Energy Sustainability Index, it is clear that governments are struggling to balance the three competing dimensions of the energy trilemma – energy security, environmental sustainability, and energy equity. Only five countries, out of the 129 analysed, feature in the top 25 for all three dimensions and thus achieve a score of 'AAA' – demonstrating that they are both high performing and balanced in their policy approach. They are at the core of the 'Pack Leaders' group, characterised by having clear targets for reducing their greenhouse gas (GHG) emissions while delivering affordable energy services to the majority of their populations. We also identify some other significant clusters – the 'Fossil-fuelled', the 'Highly-industrialised', the 'Hydro-powered', and the 'Back of the Pack'. There is significant scope for countries in these clusters to learn from others, whether in their own cluster or beyond.

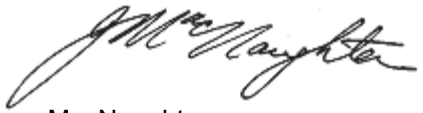
For example, some countries have shown there is an alternative to the traditional path of industrial development being accompanied by degradation of their environment and increases in GHG

emissions. By taking full advantage of sustainable energy sources many in the 'Hydro-powered' group have reconciled the need to meet significant growth in demand for energy with containing their environmental footprint. This alternative path is described in Chapter 5 and should be studied by developing and emerging economies which might emulate it, as well as by those giving development assistance to them.

In this respect, and in many others, the World Energy Trilemma report and the Energy Sustainability Index can serve as a powerful tool to support the process of learning from others.

A final message: if, overall, countries are to improve the sustainability of their energy services, they must continue to work hard at identifying, and successfully implementing, balanced and forward-looking policies (as indeed will the high performers if they are to maintain a high score). Doing this will require a more sophisticated and proactive partnership with the private sector. For the private sector have the expertise – and will have to provide the bulk of the finance – to drive the higher level of energy investment which is now required. The private sector will need to be prepared to invest in developing further their understanding of how policy is made and how they can most effectively contribute to it. They also need to gear up to take a more proactive role across a broad range of stakeholders (including at the international level) to help build understanding of the long-term goals, the real nature of the challenges in meeting them, and the full implications of the options for doing so. Only in that way will it be possible to develop the consensus needed to move away from ad hoc approaches dominated by debate about short-term costs.

The trilemma process, and the opportunity for dialogue provided at the triennial World Energy Congress this year, aim to advance the dialogue between the energy industry and policymakers. We believe all stakeholders can find value in this report and we call on them to pay need to the messages it delivers.



Joan MacNaughton
Executive Chair, WEC World Energy Trilemma

"There is a role for everyone on this journey"

"It is possible to slowly build a national consensus on the energy pathway for the country"

"There is a lack of global concern for energy poverty except for the countries which have energy poverty"

"Industry should focus on the energy services sector and take more initiative to find creative solutions for consumers"

"How do we balance the cost for the electricity infrastructure to be built while keeping it affordable for the person that's supposed to be paying for the electricity?"

"We've reached the consensus that we need to clean the environment, so let's move on, let's take it forward"

"The institutional architecture in energy needs massive reform in some parts of the world"

"The most sensible way of developing regulations is voluntary pioneers and willingness for dialogue"

"Look how much has been accomplished in the past 20 years and imagine what we will be able to accomplish in the next 20 years"

"Markets cannot solve the problems of the energy sector on their own. Public policies are needed"

"Things are changing so rapidly and we need to ensure that we make the best and smartest investments"

"We should not be in competition, but rather engage in mutually supportive activities"

"If we don't have honest discussions, we're going to be solving the wrong problems all the time"

"We've reached the consensus that we need to clean the environment, so let's move on, let's take it forward"

"Industry must work with the government to develop recommendations and create better market conditions"

Executive summary

"We can't make the necessary hard choices if we don't have the dialogue. We need to make decisions together."

By 2030, the United Nations hopes there will be universal access to modern energy services, a doubling of the share of renewable energy sources in the global energy mix, and a doubling of the global rate of improvement in energy efficiency. But after decades of work to advance sustainable energy solutions, an energy gap continues to grow as energy systems around the world struggle under significant strain.

Global demand for primary energy is expected to increase by between 27% and 61% by 2050.[1] Yet 1.2 billion people still do not have access to electricity and 2.8 billion lack access to clean cooking facilities.[2] It will take between US$19.3 trillion and US$26.7 trillion cumulative global investments in electricity infrastructure alone between now and 2050 to close this gap and support growing global energy needs.[3]

At the same time, energy policies have been shifting and policy changes have become hard to predict because of radical changes in energy supply, such as that unleashed by the technological revolution in horizontal drilling in unconventional gas. Technological breakthroughs have also accelerated the adoption of renewables.

At the same time, some countries are shifting away from nuclear energy and increasing the demand for fossil fuels. These policy shifts could serve to decrease overall energy security as uncertainty around energy policy slows investment in new energy sources, in updating ageing infrastructure, and in building the new plants and networks necessary to support sustainable energy systems.

As a result, it is not only more difficult, but also more important than ever, for public and private stakeholders to work together to develop a new governance for sustainable energy policies. The external environment public and private sectors operate in has changed over the past 10–20 years. Today, public stakeholders expect more from the private sector. For example, when the United Nations Millennium Development Goals were agreed to in 2000, there was no direct request for business to play an active role in the achievement of set targets. Twenty years later, looking at the UN's post-2015 development agenda, cash-strapped governmental institutions acknowledge that the private sector has a role to play. Public stakeholders encourage the private sector to think critically about their role in society and to reconsider how they operate in the face of a changing external environment.

Policy decisions reached during this historic moment of flux in energy policymaking could tip the balance. They could make it possible for billions of people to experience sustainable energy systems decades into the future, or they could prevent the goal from being reached.

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[1] World Energy Council (WEC), 2013: World Energy Scenarios: Composing energy futures to 2050; The lower number refers to 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.

[2] Sustainable Energy for All (SE4All), 2013: Global Tracking Framework

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

To assist with this challenge, the World Energy Council (WEC), in collaboration with global management consulting firm Oliver Wyman, have prepared the fifth edition of the World Energy Trilemma report. This second of a two-part series of reports examines the drivers and risks preventing the development of sustainable energy systems. It then recommends an Agenda for Change to address these risks and to accelerate a global transition to more diversified, and therefore sustainable, energy systems that will present opportunities for economic growth.[4]

In response to the 2012 World Energy Trilemma report, describing the policies that more than 40 energy industry CEOs and senior executives consider are necessary to advance sustainable energy systems, the 2013 report describes what public sector stakeholders believe they need from the energy industry. It is based on interviews with more than 50 energy and environmental ministers, policymakers, government officials, representatives from multilateral development banks, international non-governmental organisations, and experts from more than 25 countries.

The report also reflects the results of the 2013 Energy Sustainability Index prepared by the WEC in partnership with Oliver Wyman. The Index evaluates how well countries balance the three often conflicting goals of energy sustainability – energy security, energy equity, and environmental sustainability – what the WEC defines as the 'energy trilemma'. Each of the three legs of the trilemma is vital to the economic and social development of a country. Secure energy is critical to fuelling economic growth, energy must be accessible and affordable at all levels of society, and the impact of energy production and energy use on the environment needs to be minimised to combat climate change and maintain good air and water quality.

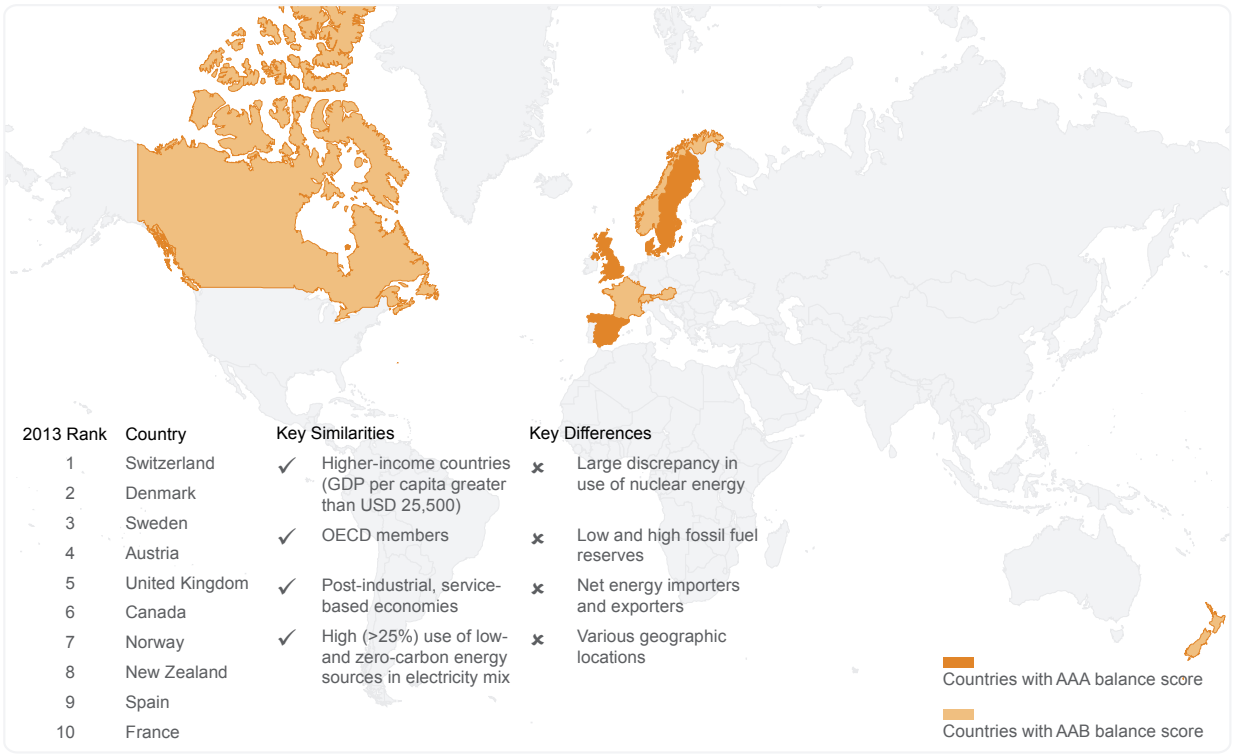
Based on an analysis of 60 data sets used to develop 23 indicators across 129 countries (including 37 non-WEC member countries), the Index provides a comparative ranking and a balance score for how well countries manage the trade-offs among the three core elements of sustainable energy systems – energy security, energy equity, and environmental sustainability. The rank measures overall performance on the Index. For the first time the balance score highlights how well a country manages the trade-offs between each of the dimensions.

Box 1: Energy sustainability 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.

[4] WEC, 2013: World Energy Trilemma: Time to get real – the agenda for change

Figure 1
Top performing countries in the 2013 Energy Sustainability Index



Three dimensions of energy sustainability

The results of the 2013 Energy Sustainability Index show that developed countries with higher shares of energy coming from low- or zero-carbon energy sources supported by well-established energy-efficiency programmes such as Switzerland, Denmark, and Sweden, outperform most countries across all three dimensions of the energy trilemma. Nevertheless, it is clear that all countries still struggle to attain balance. Only five countries rank in the top 25 countries across all three dimensions. Only two are in the top 20. There is no single solution, but countries take full advantage of available indigenous resources and develop a policy framework that supports energy sustainability through the value-chain to the end-user can meet the challenge of the energy trilemma.

None of these rankings are set in stone. Even top performers could fall behind if they fail to draft, support and successfully implement prudent, forward-looking energy policies based on strategies that reflect their local resources and capabilities.

Moreover, there are already signs that developing countries could forge an entirely new path toward sustainable energy systems if they were able to mobilise sufficient investment. As renewable energy sources become more widely available, powerful and cost-effective, fast-growing developing countries may be able to leverage environmentally-sensitive and affordable energy sources to support their industrialisation and improve their populations' access to energy. For example, by relying heavily on hydropower and other renewable energy sources, Brazil and Uruguay have been able to maintain relatively environmentally-sensitive profiles while significantly growing their economies and improving access to electricity in remote areas.

Based on their current performance on the individual dimensions countries are also awarded a balance score. The purpose of this balance score is to help energy leaders to identify which areas to focus on to develop a more balanced energy profile. A score of 'AAA' represents the highest potential score that is reserved for countries which balance the score dimensions of the energy trilemma extremely well and achieve high comparative performance in each dimension. In

2013 only five countries were awarded a balance score of 'AAA': Denmark, Sweden, Switzerland, Spain, and the United Kingdom (UK). The letters B, C, and D indicate areas where energy leaders may want to direct initiatives to achieve better performance and more balanced energy systems.

Absolute rank is not the most important result provided by the Index. All countries have a chance to improve their energy performance, regardless of whether they are ranked first or last. Decision makers in both the public and private sectors are encouraged to look at trends in performance over the years, particularly in each dimension, and to compare their countries against their respective peer groups – regardless of whether those peer groups take a regional, economic, or structure-of-the-energy-sector point of view.

To support this analysis, the 2013 report examines five distinct country energy profiles from the Index analysis to highlight the common challenges countries face. For example, 'Pack Leaders', including Switzerland and Denmark, have reduced their environmental impact and increased their energy security by setting clear targets for both reducing GHG emissions and increasing the percentage of renewables in their electricity fuel mix. 'Fossil-fuelled' countries such as Saudi Arabia or Malaysia struggle to manage the environmental impact of their secure and affordable energy services. 'Highly-industrialised' countries, for example, India and Mexico, wrestle with providing accessible and environmentally-sensitive energy while continuing to experience double-digit economic growth. 'Hydro-powered' nations such as Brazil and Colombia provide energy that is relatively less accessible and affordable, but environmentally-sensitive. 'Back of the Pack' countries such as Zimbabwe and Nicaragua suffer from the lack of energy investment, but have the opportunity to emerge on a new path to sustainability.

Public stakeholder recommendations

In 2012, energy industry executives had three main recommendations for how policymakers could expedite the development of sustainable energy systems:

- Define a coherent and predictable energy policy.
- Implement stable regulatory and legal frameworks to support long-term investments.
- Encourage public and private initiatives that enable innovation and foster research, development and demonstration (RD&D).

The interviewees for the 2013 report broadly agreed with these goals. But, in many ways their recommendations underscored the need for increased dialogue between public and private stakeholders. Public stakeholders expressed concerns about how the lack of a global agreement on the target profile of a future energy system is exacerbating policy challenges at the national level. The challenge to craft and implement long-term energy policies is further complicated given the dramatic shifts underway in the energy sector, particularly in terms of emerging technologies and rapidly shifting patterns of energy supply and use.

Interviewees acknowledged that, in the absence of a regional or global consensus on climate change, and given the pace of technology development, it will remain difficult for both public and private stakeholders in the energy sector to determine the best course of action. But, they called on the energy industry to adopt and help promote a long-term energy vision and share information and knowledge on implications, realistic targets, and potential alternative approaches to overcome these hurdles and achieve the goals set.

Other recommendations for the energy industry include:

Recommendation 1: Be more proactive in improving energy policies

To make sustainable energy systems a reality, energy executives must be more proactive in sharing their knowledge, insights, and experiences with policymakers and regulators on several fronts. Against the backdrop of a dynamic sector constantly shifting to accommodate significant changes on the energy supply and demand side, governments struggle to design long-term policies that will encourage technological advances toward sustainable energy systems. This will also avoid locking their countries into technologies that could become rapidly obsolete. To develop better market conditions and regulations, policymakers urged the private sector to share more of its technical expertise and to contribute more actively to a long-term vision and associated policies for sustainable energy systems. Greater energy industry involvement can help to bridge the knowledge gap and facilitate effective dialogue by enabling both policymakers and business to speak the same language.

Public stakeholders recognised the importance of a consensus on long-term energy goals that is based on national values and a 'social licence'. They called on the energy industry to assist in managing public perceptions through increased communication. Reaching such a national consensus requires conversations involving all stakeholders: citizens, the media, activist groups, non-governmental organisations, parliamentarians, policymakers, regulators, and the energy industry.

Governments view the energy industry as a key player in managing the technological and behavioural change needed to realise sustainable energy systems. By providing information about evolving energy options, the cost of energy, the benefits of new technologies, and the need to foster energy efficiency, the private sector can support this transformation. All of these issues could increase public support for a shift towards sustainable energy systems and help enable governments to enact long-term energy policies.

Recommendation 2: Advance the alignment of risks

Huge investments are required to improve access to energy worldwide, develop new energy technologies, and to build new and replace ageing infrastructure. It will take between US$19.3 trillion and US$26.7 trillion cumulative global investments in electricity infrastructure alone between now and

2050.[5] Yet cash-strapped governments have limited funds to support the shift to more sustainable energy systems.

As a result, public stakeholders are looking to the energy industry and the financial sector, including non-traditional investors such as pension funds and other long-term investors, to take the lead in these investments. Overall, interviewees call on the private sector to be 'less risk averse' with regard to investments in energy infrastructure and technology.

For this to happen, however, there needs to be better alignment of risk with those best able to bear it. The 'right' risk allocation starts with a coherent energy policy and a clearly defined and well implemented energy regulatory framework to minimise political and regulatory risk. Public stakeholders recognise that the returns on energy investments must be commensurate with levels of risk and also competitive with the returns on other options for investment. However, development banks and policymakers noted that the perception of a country's risk often inhibits energy investments even in countries where the underlying economics of the energy sector are strong.

One way the energy industry can help to break the present deadlock is by engaging with other stakeholders to identify approaches and mechanisms that allocate associated risks to those best suited to manage them. For example, the private sector can improve the confidence of potential investors by sharing perspectives about the underlying project economics of power projects or highlighting the strength of a nation's power sector and its ability to manage construction, technology, and operational risks.

Public stakeholders are looking at the private sector to play a lead role in the technology development and innovation that will reduce the cost of energy and enable countries to lower their carbon emissions. Policymakers acknowledge the crucial role of the public sector in creating the right environment for RD&D and the possibility of being involved in pre-competitive, early stage technology development and/or large-scale demonstration projects. To avoid shifts driven specifically by politics, public stakeholders called on the energy industry to help coordinate and support broader coalitions to align behind research plans on the basis of evidence about what is likely to work, and work most cost-effectively.

Recommendation 3: Assist developing countries with charting a new course

Today, 17% of the global population is without access to electricity and 41% lacks access to clean cooking facilities, especially in Sub-Saharan Africa, Eastern Asia, Southern Asia, and South-Eastern Asia. Traditionally, fast growing, developing and emerging nations have struggled to maintain an environmentally-sensitive footprint as they strive to improve their populations' access to energy and their nations' economic growth. But, recently some countries are starting to chart a new course to sustainability by harnessing the potential of hydro, solar, and wind power.

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

Public stakeholders recognise that, to change the trajectory of industrialisation and growth in energy use, attractive policy and regulatory frameworks encouraging investment in the development of energy infrastructure need to be created. Interviewees pointed out that developing consistent, stable energy policies and regulation, and maintaining a healthy energy infrastructure, requires a degree of experience, knowledge, and acquired skills that may not exist in some least-developed, developing or emerging countries. In their opinion, the private sector needs to play an important role on two fronts. First, the energy industry and also other investors should engage in dialogue with public stakeholders to identify and lower the barriers impeding investment. Second, the energy industry needs to be more proactive in assisting developing countries with adopting proven technologies, in part by working with them to explore ways to reduce the cost of technology transfer.

A particular concern raised by public stakeholders, especially multilateral development banks, is the lack of 'technically good projects' that can readily attract investment. Both public and private sector need to work with the respective developing countries to generate more bankable projects.

Conclusion

United Nations Secretary-General Ban Ki-moon noted that *"energy is the golden thread that weaves together economic growth, social equity, and environmental sustainability"*. The importance and benefits of sustainable energy systems are clear.

But creating a policy framework to achieve those goals remains a challenge for all countries.

To make secure, affordable, and environmentally-sensitive energy systems a reality, public and private stakeholders need to work together to develop a new paradigm for sustainable energy policies. Policymakers urgently need to create the interconnected, lasting, and coherent energy policies. But the energy industry also has an important role to play in assisting policymakers in creating an environment that will mobilise the natural and human resources, finances, and technologies necessary to realise the transformation of current energy systems.

Creating a master plan to achieve diversified, and therefore sustainable, energy systems worldwide may take years to get right, especially given recent dramatic shifts in energy supply and the lack of a global agreement on the target profile of a future energy system. All public and private stakeholders should start down the path now. Too much is at stake for them to hold back. The investment required will take decades to fully transform energy systems and infrastructure. A start needs to be made immediately if sustainable energy systems are to be developed at an affordable cost. It is time to cut through the present uncertainty and to translate the consensus identified into actions on the ground.


"Government and private sector have to sit at a table and say: what can we afford, at what pace, and for how long"
"Energy transition cannot be based on one or two sources but rather take a broad approach and always remain flexible to potential change"
"Countries are very concerned about their competitiveness and their access to energy"
"We can't just look at energy issues with a 40 years perspective. We also have to make decisions for the next five or ten years"
"We need to look at the overall affordability of energy - governments have to be able to afford this as well or else you might end up with bankrupt governments"
"We have to take into account social sensitivity"
"We can´t use the old paradigms if we really want to make changes"
"We are facing dramatic energy changes and it is very hard to have a master plan"
"Business needs to stand up and speak up"
"The biggest challenge is to combine the main elements of energy policy to tackle climate change while guarantying security of supply and a competitive energy price"
"Industry needs to play a broader role in the change management and communication"
"The private sector needs to be more involved simply because we are struggling to see all the issues"
"The previous thinking that we are separate entities in the same country, those days are numbered"
"A bureaucrat is a bureaucrat, a businessman is a businessman"
"We have to avoid technology ideologisation"

Introduction

This report is the fifth annual assessment of energy and climate policies across the globe by the WEC and builds on the findings and recommendation made in previous reports. In particular, this report is the second part of a dialogue between energy industry leaders and policymakers.[6]

With the challenges of transforming the global energy system ahead of us, policymakers and industry urgently need to collaborate to design and implement broadly supported mechanisms to address energy demands in the near and long term. To facilitate such collaboration, the WEC acts as a catalyst in building dialogue and sharing best practices among energy leaders. The WEC's World Energy Leaders' Summits and the triennial World Energy Congress are milestones in this process of bringing policymakers, industry and inter-governmental organisations together.

The goal of the 2013 report is to continue supporting the global dialogue and to provide the energy industry with the views of leaders in governments and inter-governmental organisations on what they need from the private sector to succeed in providing environmentally-sensitive, affordable, accessible, and secure energy.

The report findings are based on three sources of research: interviews with more than 50 energy and environmental ministers, policymakers, government officials, representatives from multilateral development banks, inter-governmental organisations, and experts from more than 25 different countries (see Appendix A), supporting research, and empirical data analysis supporting the Energy Sustainability Index. Throughout this report, statements in quotation marks are the direct insights and comments of the interviewees.

This report will be followed by a summary report *World Energy Trilemma: Time to get real – the agenda for change* which synthesises the recommendations made by energy industry executives in 2012 and the insights and feedback gathered during the interviews with governments and inter-governmental organisations in 2013. The summary will identify key areas where action can help better balance the energy trilemma and enable energy leaders to deliver the necessary transformation of the energy system.

Consistent with previous studies, this report includes the annual Energy Sustainability Index (see Chapter 1). The Index, based on 60 data sets which are used to develop 23 indicators, captures and aggregates country-level data to outline the relative energy performances and contextual attributes of WEC member countries.

For the first time the Index includes an additional 37 non-WEC member countries. The 2013 Index provides a comparative ranking of 129 countries' ability to provide a stable, affordable, and environmentally-sensitive energy system and highlights current challenges.

Countries are also awarded a 'balance score'. The balance score identifies the countries that currently address the three dimensions of sustainability –

[6] WEC, 2012: World Energy Trilemma Report : Time to get real - the case for sustainable energy policy presents the views of energy industry leaders, www.worldenergy.org/publications

energy security, energy equity, and environmental sustainability – equally well by grading them an 'A' for high performance. The balance score reveals the trade-offs that exist in other countries and what is necessary to develop a balanced energy profile and minimise the uncertainties and risks associated with an unbalanced approach.

The findings of the Index analysis are complemented with individual country profiles – of WEC member countries only – captured in the companion report, *World Energy Trilemma: 2013 Energy Sustainability Index*.

The WEC conducted the overall project in partnership with the global management consulting firm Oliver Wyman. 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 2: Iconography

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

Energy performance dimensions:

 Energy security

 Energy equity

 Environmental sustainability

Contextual performance dimensions:

 Political strength

 Societal strength

 Economic strength

Energy Sustainability Index results and country profiles can be found on the WEC website at www.worldenergy.org/data/sustainability-index.

"The private sector has to have good governance and return something back to society"

"Whatever we do, there is a 'hue and cry' from the industry or consumer or both"

"The concept of sustainability only crept up in our lifetime"

"We need to avoid creating policies that are unrealistic and do not take into account market situations and what technology can really provide"

"It's an issue of policy clarity and walking the talk"

"Countries have to become more attentive to the small gains which can be made through energy efficiency without much investment"

"It is impossible to look for an energy sustainability solution that fits all countries"

"Being energy conscious or greenhouse gas conscious doesn't mean you stick renewable technologies where they don't work"

"The competitiveness of industry goes hand in hand with the development of the energy sector"

"We have to be honest when talking about renewable energy and also talk about energy storage"

"We're trying to run a tech race and at the present we don't know what technologies are going to win it"

"When you ask for a predictable business environment, it is not only a question of what your home country does, but also what your neighbors do, and what happens at a global level"

"Energy is an input cost for many other issues, be they social or economic development. As such, it's not an area with astronomical returns"

"We need something that we don't have yet and don't even know what it is"

"A less emotional view on the energy mix would allow us to improve global capacity"

1. 2013 Energy Sustainability Index

Introduction

Secure energy is critical to fuelling economic growth. Energy must be accessible and affordable at all levels of society, and the impact of energy production and energy use on the environment needs to be minimised in order to combat climate change and maintain good air and water quality. The 2013 Energy Sustainability Index quantifies this 'energy trilemma'. The Index provides an assessment tool for public and private stakeholders to evaluate where their country is positioned against others in the ability to address the energy trilemma. The Index data also points to areas where action must be taken in order to achieve balance as each of the three legs of the trilemma is vital to the economic and social development of a country.

This year, each country is given both an Index rank and a 'balance score'. The rank measures overall performance on the Index while the balance score – for the first time – highlights how well a country manages the trade-offs between the three competing dimensions. The best score 'A' is given for a very high performance. Countries with good results are awarded with the score 'B'. A mediocre performance is recognised with the score 'C' and low performance with the score 'D'.

Figure 2 shows each country's overall Index performance, its dimensional rankings, and its balance score.[7] Note, the sequence of the letters in the balance score does not correspond to a specific energy dimension but rather presents the letter scores in descending alphabetical order.

Box 3: Index methodology

The Energy Sustainability Index comparatively ranks countries in terms of their ability to provide a secure, affordable, and environmentally-sustainable energy system. The rankings are based on a range of databases 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.

The Index illustrates the trade-offs that exist with the energy trilemma and points to key areas that countries must give extra attention to in order to further develop a balanced energy profile and minimise the uncertainties and risks associated with an unbalanced approach.

[7] Additional insights on WEC member countries' energy balance and challenges are presented in individual country profiles in the companion report, World Energy Trilemma: 2013 Energy Sustainability Index and on the WEC website at www.worldenergy.org/data/sustainability-index

Figure 2
2013 Energy Sustainability Index ranking and balance score

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 3
Five profiles of the energy trilemma

	Illustrative members	Key strengths	Core challenges
Pack Leaders	Switzerland, Denmark	Overall high performance and balance	Ensuring achievement of 2020 climate targets
Fossil-fuelled	United Arab Emirates, Malaysia, Saudi Arabia	Affordability and security of energy	Energy and emission intensity challenges and mitigation of impact on the environment
Highly-industrialised	India, Mexico	Energy security and strong GDP growth	Impact of rapid industrial growth, energy security and environmental sustainability
Hydro-powered	Brazil, Colombia	Strong use of renewables leads to low emissions and higher electrification rates	Improving energy access and affordability
Back of the Pack	Zimbabwe, Nicaragua	Countries are not yet locked in to fossil fuel heavy development path	Lower GDP and country risk ratings may hinder possible investment

Although the overall Index ranking may be the most eye-catching figure, trends and balance within the three dimensions provide the most 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. This means that a country can track the results of energy policies not only on a macro level, but on each dimension as well. The Index also provides the ability for peer group comparisons, be it from a regional, economic or structure-of-the-energy-sector point of view. 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.

Finally, it is important to note that the Index methodology continues to be improved. To enable year-on-year comparison, the previous three years are recalculated to reflect any methodology changes. The 2011 and 2012 Index rankings included in this year's report have been updated in order to enable comparisons between years. Further information on Index methodology, previous rankings, and the score system can be found in Appendix C.

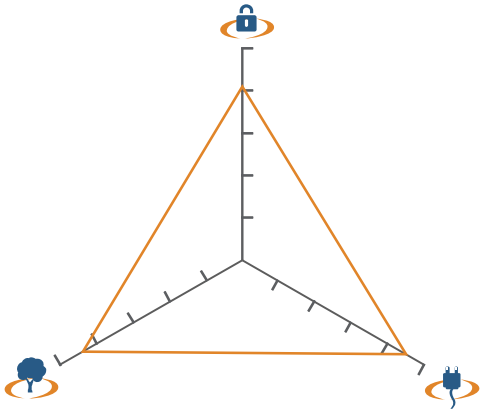
Five profiles of the energy trilemma

There is no single best method to achieving a balance on the energy trilemma. Each country faces its own challenges that are shaped by region, developmental stage, resource endowment, policies and regulations, as well as the country's own economic and societal goals and needs. However, patterns exist and grouping countries with similar energy trilemma profiles can help policymakers identify existing or emerging successful approaches to common problems. Sharing of know-how and experiences in the development of policies, regulation, research and technology can bring countries with common issues closer to achieving energy sustainability goals – including increasing energy efficiency, decreasing carbon emissions, and growing the share of renewables.

The energy sustainability challenges facing countries can be understood by examining five distinct profile groups that can be identified from the Index analysis – with countries in each group sharing common energy trilemma characteristics and challenges. These profiles serve as benchmark guides to other countries with similar preconditions.[8] The illustrative profile groups and

[8] For illustrative purposes, not all WEC member countries are included in one of the groups discussed in this chapter. A list of additional WEC countries and the profile groups they are likely to be closest associated with can be found in Appendix C.

Figure 4
Trilemma profile and illustrative countries: 'Pack Leaders'



	Index Rank	Balance Score
Austria	4	AAB
Denmark	2	AAA
France	10	AAB
Germany	11	ABB
Netherlands	12	ABB
New Zealand	8	AAB
Spain	9	AAA
Sweden	3	AAA
Switzerland	1	AAA
United Kingdom	5	AAA

their characteristics are outlined in Figure 3. The profiles are based on the three energy dimension scores of the Index: energy security, energy equity, and environmental sustainability. With the exception of the 'Pack Leaders', the following illustrative groupings are not based on a country's absolute performance, but rather on its relative and comparable performance on the three dimensions. 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.

'Pack Leaders'

The Pack Leaders are top performers in terms of both dimensional balance and overall ranking on the Energy Sustainability Index (see Figure 4). These countries rank in the top one-third of all countries on each of the three dimensions. Top performers are all high GDP-per-capita, OECD member countries with stable and strong political, societal and economic frameworks. They generally have set specific targets for both reducing GHG emissions and increasing the percentage of renewables in their electricity fuel mixes in efforts to reduce their environmental impact and increase their energy security (see Figure 5). These countries are post-industrial and generate most of their GDP from the services sector. It is important to note that, although all Pack Leaders have comparatively high prices of both electricity and gasoline because of fairly high GDP per capita, energy services remain affordable to the majority of the population (see Figure 10).

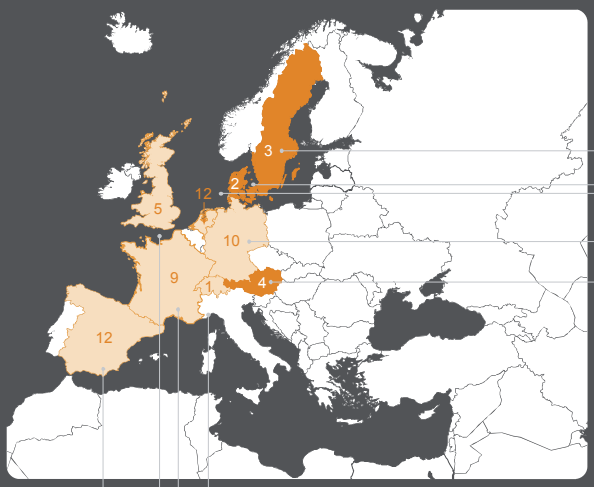
Although these countries are the current Pack Leaders, there is no guarantee that they will remain part of this elite group in the future unless they continue to support and successfully implement prudent, forward-looking energy policies based on strategies that reflect their local resources and capabilities.

Role of renewables and low-carbon energy

Renewable and low-carbon energy sources (including nuclear) play a key role in a country's overall Index performance and its ability to balance the trilemma. These energy sources both reduce the environmental impact of electricity generation and improve energy security by reducing reliance on energy imports and increasing the diversity of production. Pack Leaders generally have higher-than-average shares of renewables and low-carbon energy, with 60% of electricity generated from renewable energy, hydropower or nuclear sources – as compared to the overall global average of 40%. The Netherlands and the UK are the exceptions in this group, with only 15% and 23% of electricity coming from low-carbon and renewable energy sources, respectively. There are differences, however, in the energy sources favoured by different countries. In Denmark, for example, 35% of electricity comes from new renewable energy sources, whereas in France 76% of electricity comes from nuclear power (see Figure 6).[9]

[9] US Energy Information Administration (EIA), 2011: International energy statistics (www.eia.gov)

Figure 5
Pack Leaders' 2020 and 2050 energy goals
Source: European Commission, 2013: Europe 2020 in Your Country; Oliver Wyman analysis[10]



Sweden
2020: 50% of total energy consumption from renewable sources and 17% GHG emission reduction from 2005
2050: Zero net GHG emissions

Denmark
2020: 30% of total energy consumption from renewable sources and 20% GHG emission reduction from 1990
2050: Independent of fossil fuels

Netherlands
2020: 16% GHG emission reduction from 2005 and 14% of total energy consumption from renewable sources
2050: 80–95% GHG emission reduction from 1990

Germany
2020: 14% GHG emission reduction from 2005
2050: 80–95% GHG emission reduction

Switzerland
2020: 20% GHG emission reduction from 1990
2050: Under development

Austria
2020: 16% GHG emission reduction from 2005 and 34% of total energy consumption from renewable sources
2050: 100% self-sufficient

France
2020: 14% GHG emission reduction from 2005 and 23% of total energy consumption from renewable sources
2050: Under development

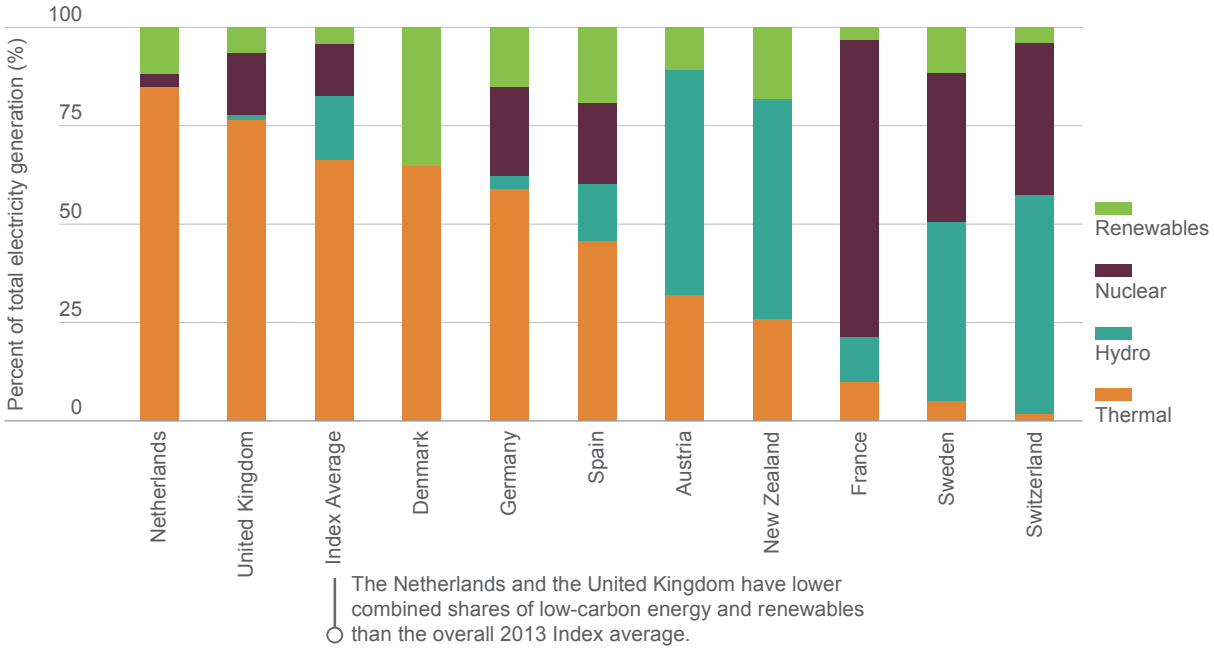
United Kingdom
2020: 20% GHG emission reduction from 1990 levels and 15% of total energy consumption from renewable sources
2050: 80% GHG emission reduction

Spain
2020: 10% GHG emission reduction from 2005
2050: None

New Zealand
2020: 10–20% GHG emission reduction from 1990 and 90% of electricity generation from renewable sources
2050: 50% GHG emission reduction

Goal of fossil fuel independence by 2050
\# Numbers indicate 2013 Index rank

Figure 6
Diversity of electricity generation
Source: EIA, 2010: International energy statistics; Oliver Wyman analysis



As nuclear power production has become of increasing concern to the public in some countries, policymakers are faced with the challenge of replacing nuclear power and further developing new ways of generating low- or zero-carbon energy. For example, Switzerland recently decided to phase out nuclear energy in the wake of the 2011 accident at Japan's Fukushima nuclear power plant. Going forward, Switzerland does not plan to replace its nuclear power stations (the last one started production in 1984) and current nuclear power stations can be operated as long as safety can be guaranteed. Germany intends to phase-out nuclear by 2022. In addition, the EU is planning to implement new safety protocols, which will cost between €30 million and €200 million per reactor.[11] Nuclear energy currently accounts for an average of 22% of electricity generation among the Pack Leaders, but increasing costs and potential phase-outs will necessitate the use of other sources of energy to meet energy demand.[12]

Although the types of feasible renewable energy options differ by region and with resource endowment, the Pack Leaders' diversity of primary energy supply and electricity generation can provide a model for the rest of the world. For instance, Denmark supplements its conventional thermal power generation by adding biomass and wind to the mix, Austria uses hydropower, and New Zealand hydropower and geothermal to diversify their generation portfolio. Although it may be more difficult for less-wealthy countries to stimulate and incentivise investment in renewables (through, for example, feed-in tariffs), the falling cost of renewable energy technologies, plus more favourable conditions, may support greater cost-competitive uses of renewables in non-OECD countries (see Box 13, Chapter 4 for details on renewables in Uruguay and Brazil).

However, even for the Pack Leaders, the integration of decentralised and intermittent renewable energy sources such as wind and solar energy poses challenges on the grid as those

[10] The Swedish -17% target (compared with 2005) is the EU-target for the Non-ETS sector. The national target for the Non-ETS sector at -40% 2020 (compared with 1990) is more ambitious and equivalent to -26% (compared with 2005).
[11] European Commission (EC), 2012: Communication from the Commission to the Council and the European Parliament on the comprehensive risk and safety assessments ("stress tests") of nuclear power plants in the European Union and related activities

[12] EIA, 2011: International Energy Statistics

Figure 7

Pack Leaders' 2020 targets for gross GHG emission reduction and share of renewables

Source: European Commission, 2013: Europe 2020 in Your Country; Oliver Wyman analysis

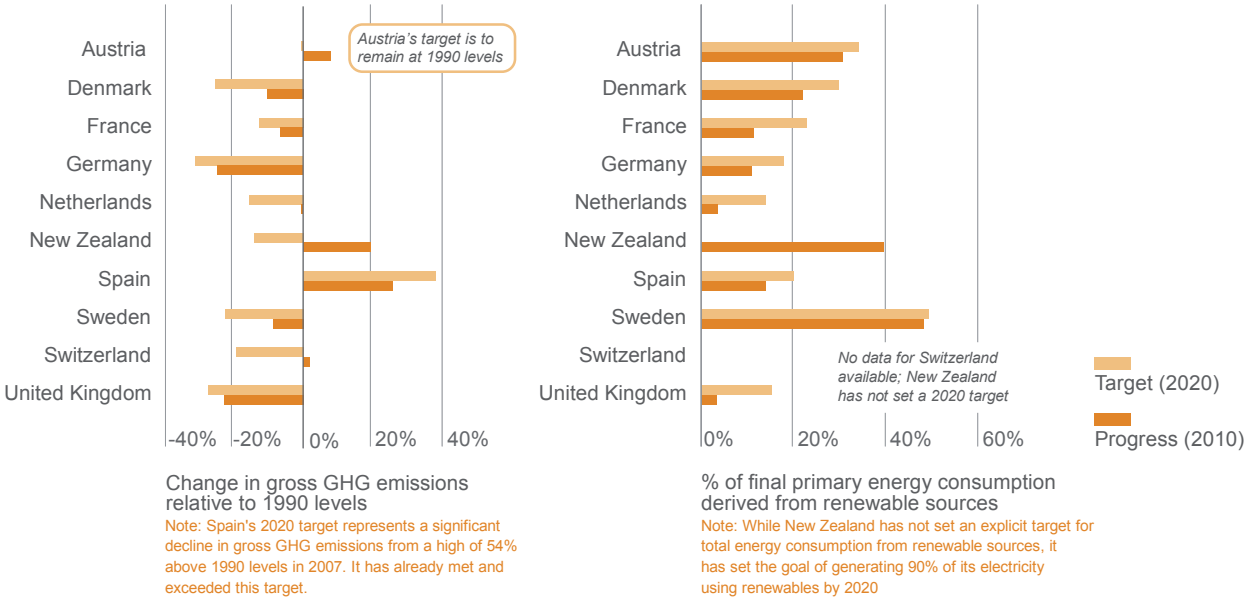
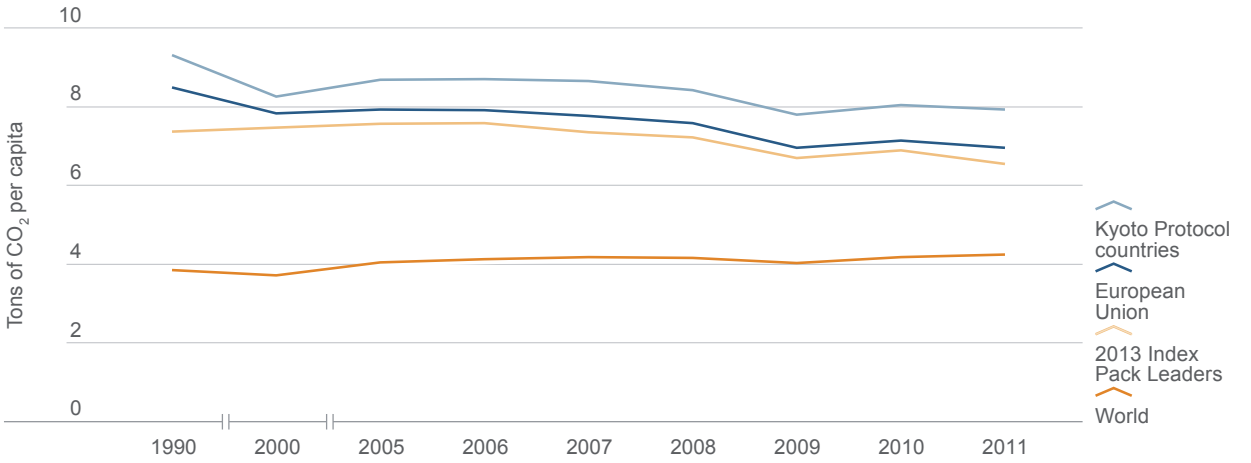


Figure 8

CO_2 per capita emissions for Pack Leaders, EU countries, Kyoto protocol 1990–2011

Source: WEC/ Enerdata, 2013: Energy efficiency indicators database; Oliver Wyman analysis



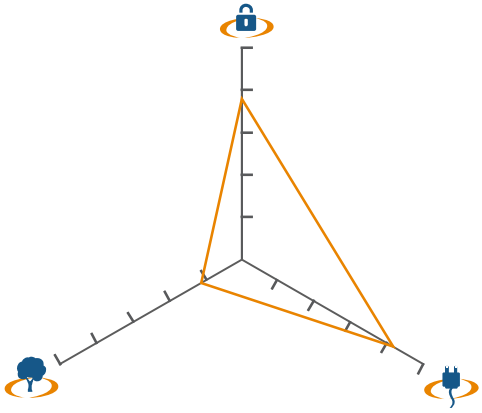
renewables are characterised by strong daily and seasonal variations, and require accurate forecasting. Increasing the energy system's flexibility while maintaining the reliability and quality of the electricity supply are new requirements for the entire electricity system; making them will require a timely development of the grid infrastructure.

Are they hitting their targets?

Many Pack Leaders have set themselves high goals for increasing the use of renewable energy and decreasing GHG emissions, but are they on track to achieve these targets? All of the Pack Leaders signed the Kyoto Protocol and subsequent Copenhagen Accord and established GHG emission reduction targets for 2012 and 2020. While the majority of the Pack Leaders are well on track in meeting the GHG emission reduction targets, some countries – for example, Austria and New Zealand – are lagging behind.

The rapid and accelerating rate of increase of CO_2 in the atmosphere shows that, despite many

Figure 9
Trilemma profile and illustrative countries: 'Fossil-fuelled'



	Index Rank	Balance Score
Australia	14	AAD
Canada	6	AAB
Egypt	76	BBC
Kazakhstan	58	ABD
Kuwait	66	BCD
Malaysia	37	BBC
Oman	62	ACD
Qatar	18	AAC
Saudi Arabia	51	ABD
United Arab Emirates	44	BBD
United States	15	AAC

countries' best intentions, cutting back even the rate of growth of carbon emissions is a daunting task. Without energy-efficiency improvements, on both the supply and demand side, CO_2 levels will rapidly approach the 450 parts per million level. This level is viewed by many scientists as the point at which the heat-trapping effects of CO_2 raise the risk of potentially dangerous and irreversible climate change in coming decades.[13] Pack Leaders are employing a number of energy-efficiency measures to meet targets, for example, complementing existing fossil fuels with alternative low- and zero-carbon energy sources and decarbonising the way fossil fuels are produced and consumed with carbon capture and storage.

'Fossil-fuelled'

Countries that illustrate the fossil-fuelled profile have an energy trilemma balance that is tilted towards energy security and energy equity, and they struggle to minimise their environmental impact. For example, the average price of gasoline in this group is US$0.65 per litre, which is less than half of the worldwide average, and one-third of the Pack Leaders' average price (see Figure 10). While this group's economies benefit from affordable and secure access to energy, high per-capita consumption of energy leads to high levels of GHG emissions and a greater environmental impact overall. The group is generally made up of energy exporters, notably Saudi Arabia, Canada, and the United Arab Emirates (UAE) as well as the US, which is on course to becoming an energy exporter. The Fossil-fuelled group has a relatively high per-capita GDP, except Egypt and Kazakhstan. Not surprisingly, this group tends to rely heavily on fossil fuels for electricity generation and has fairly high CO_2 emissions per kWh generated.

Diversification of energy sources and decarbonising electricity generation is a key next step on the path to balancing the trilemma profile for the countries in this group. The US and Canada have already made steps in this direction. Both countries have 2020 emission targets that are as aggressive as those of several of the Pack Leaders and, as a result of shale gas and the reduction in coal-fired power generation, these countries are making progress towards meeting those targets.

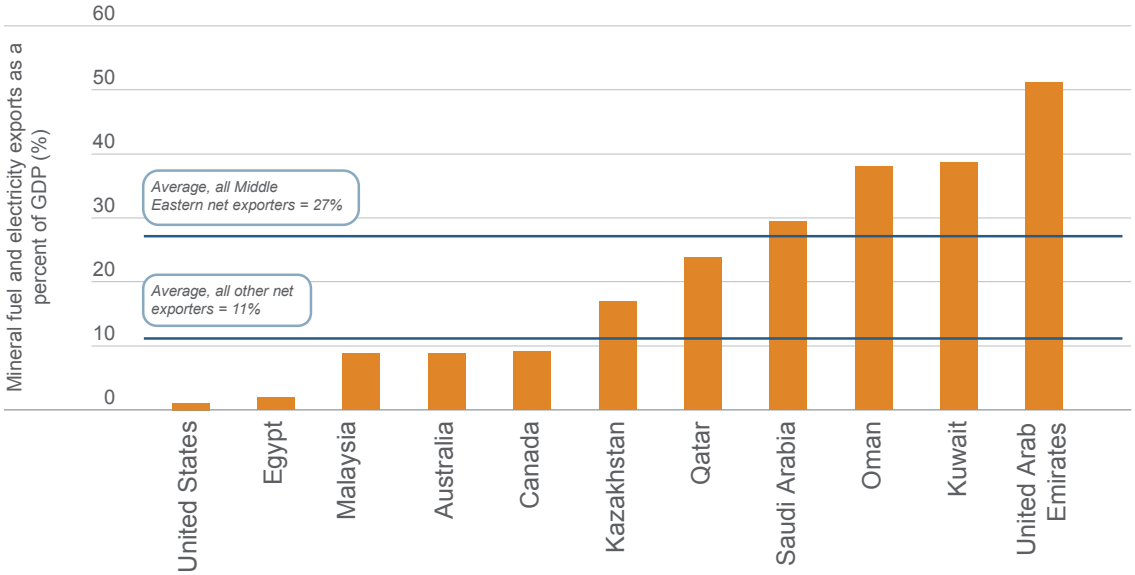
The significant increase in the use of shale gas has played a major role in helping the US address both energy security and environmental challenges. Between 2000 and 2012, the share of shale gas in the US's natural gas production rose from 1% to 34%, according to the US Energy Information Administration, with a four-fold increase since 2007. Forecasts suggest that total natural gas production in the country might exceed consumption in 2020 and, by 2035, more than three-quarters will be from unconventional sources. This platform is supporting federal efforts to enhance energy security, restrain price rises, and boost the competitiveness of domestic industries. It is also helping to lower GHG emissions in the short-to-medium term as gas becomes a more viable substitute for coal in the power sector. For

[13] Gillis, J, 2013: Heat-Trapping Gas Passes Milestone, Raising Fears (10 May 2013, The New York Times)

Figure 10
Average super gasoline price by country group
Source: GIZ, 2013: International Fuel Prices 2012–2013; Oliver Wyman analysis

	Fossil-fuelled	Pack Leaders	Highly-Industrialised	Hydro-powered	Back of the Pack
Average gasoline price (US$ cents/litre)	65	197	120	133	123
Average GDP based on PPP per capita (US$)	37,439	37,117	8,275	8,913	5,030

Figure 11
Demand concerns
Source: The World Bank, 2010: World Development Indicators; Oliver Wyman analysis



example, US CO_2 emissions resulting from energy use during the first quarter of 2012 were the lowest in two decades for any January–March period.[14]

For many of these countries, fuel exports are the lifeblood of the economy – for example, 29% of Saudi Arabia's and 51% of the UAE's GDPs are linked to the export of mineral fuels and electricity. A survey of 157 executives across the Middle East revealed that nearly three out of five (57%) of executives are concerned about the impacts of shale and tight oil and gas discoveries in other parts of the world on the global markets and price of oil with the associated impact on fossil-fuel based economies.[15] With concerns about the security of external demand, there is also an increasing awareness that internal energy demands need to be managed carefully, as oil and gas endowments are not limitless. Many of these countries are focusing on managing demand by implementing energy-efficiency programmes and more efficient technologies. Several countries are also looking to diversify their energy supply by investing heavily in renewable energy technologies as a means to increase both economic security, and energy and water security, while reducing any negative environmental impacts.

[14] EIA, 2012: US energy-related CO_2 emissions in early 2012 lowest since 1992 (1 August 2012, Today in Energy)

[15] Oliver Wyman-Zogby Research, 2012: Seventh Middle East Business Confidence Survey

Lessons from this profile group

As a leader in this profile group, Canada can offer lessons on how to develop a sustainable energy system in a high energy consumption economy. Canada, whose fuel exports have risen to 9% of GDP, is home to the Canadian oil sands, which are the third-largest proven crude oil reserve in the world. Against a backdrop of growing national and international public concerns about the environmental impacts of the extraction of crude oil from the Canadian oil sands, Canada's federal and Alberta's provincial governments enacted tougher regulations. Tougher environmental standards as well as increased monitoring and reporting also prompted the formation of the Canadian Oil Sands Innovation Alliance (see Box 17 in Chapter 4).

Strong examples of government-led initiatives to reduce GHG emissions can be found elsewhere in the world too. For example, since 1992, the US government backed Energy Star programme has provided efficiency standards for products and buildings.[16] The UAE has followed suit with the Emirates Energy Star programme, which targets energy use in and carbon emissions of buildings.[17] Elsewhere, Australia is now the site of the largest windfarm in the southern hemisphere. Its 420 MW capacity will reduce Australia's GHG emissions by 1.7 MM tons per year.[18]

Box 4: Masdar – a futuristic city

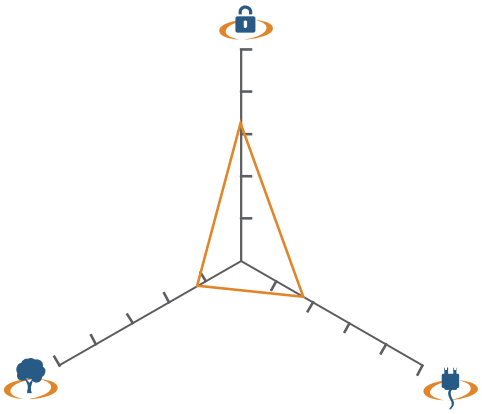
Seeking to prove that an ultra-sustainable urban development can be both commercially viable and offer a high quality of life, Masdar, the clean-tech commercial, research, and investment subsidiary of Abu Dhabi's government-owned Mubadala Development Company, is building a futuristic 6 km^2 city on the outskirts of Abu Dhabi (UAE). Masdar City, which is already operational and is expected to be completed in 2025 at an estimated total cost of US$19 billion, is a mixed-use space that has commercial, retail, and residential buildings and will one day see 40,000 residents and 50,000 commuters.

Masdar City is designed to be a testing ground and a global model for what the sustainable city of the future can and should look like. Some design aspects are passive – for example, optimising the orientation of buildings towards the sun and strategically creating wind tunnels along the city's narrow streets to reduce the radiant temperature outdoors by 20°C compared to nearby downtown Abu Dhabi. Others techniques – like installing 'smart' building energy and water management systems – are more costly, but can be applied to other cities.

Currently, Masdar City is entirely powered by on-site renewable energy. As the city grows, the longer-term goal is to keep at least 20% of the required energy supply coming from on-site facilities, while still ensuring that 100% of the energy used comes from renewable sources. Masdar City is targeting per-person water usage levels that are 20% of those of a normal

[16] Energy Star, 2013 (www.energystar.gov)
[17] Emirates Energy Star, 2013 (www.ees.ae)
[18] AGL Energy Limited, 2013: Macarthur Wind Farm

Figure 12
Trilemma profile and illustrative countries: 'Highly-industrialised'



	Index Rank	Balance Score
Bolivia	55	ACC
China	78	ADD
India	115	CDD
Indonesia	73	ACD
Mexico	41	BBC
Pakistan	114	BDD
Philippines	65	BBC
Russia	54	ABD
South Africa	79	BCD
Thailand	89	CCD
Tunisia	36	BBB
Turkey	75	BCC
Vietnam	101	CDD

Figure 13
Average emission intensity by country group
Source: WEC/ Enerdata, 2013: Energy efficiency indicators database; Oliver Wyman analysis

	Highly-Industrialised	Pack Leaders	Fossil-fuelled	Hydro-powered	Back of the Pack
Kg CO_2 per US$ PPP	0.44	0.21	0.59	0.16	0.49

city, and 100% of waste water will be recycled for landscaping. Regular gasoline-powered vehicles are banned from Masdar City and it is designed to minimise the need for private car use. A number of intelligent transport solutions are being tested including automated Freight Rapid Transit and Personal Rapid Transit systems (automated single-cabin trams) as well as electric cars for point to point commuting. The shaded streets are optimised for walking and cycling – supported by electric buses and trains linked to the rest of Abu Dhabi.

'Highly-industrialised'

The Highly-industrialised profile represents industrialised countries with large manufacturing sectors. This regionally-diverse group includes four of the five BRICS, 'Next 11' countries[19], as well as G20 members. The GDP per capita ranges from Pakistan's US$2,800 to Russia's US$17,000. The average rate of industry as a per cent of GDP is 34%. The balance of the energy trilemma for the countries in this group is tilted heavily towards energy security, with progress needing to be made in ensuring energy equity and managing the environmental impact.

These economies are based on energy- and emission-intensive activities, which raise their average emissions intensity 22% above the Index countries' average of 0.36 kg CO_2 per US dollar.[20] Similarly, the energy intensity of this profile group is 67% higher than that of the Pack Leaders. High degrees of both air and water pollution are also challenges faced by this group. It is worth noting that, combined, the countries with this energy trilemma profile account for 52% of the world's population. The impact the rapid rate of economic growth and associated energy demand in these countries has had on their citizens' economic status has been significant. For example, China pulled 680 million people out of abject poverty between 1981 and 2010, and reduced its extreme

[19] BRICS – the five major emerging national economies: Brazil, Russia, India, China and South Africa; Next 11 – Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan, Philippines, Turkey, South Korea, and Vietnam – the 11 countries identified as potentially joining BRICS as the world's largest economies in the 21st century.

[20] WEC/ Enerdata, 2011: Energy efficiency indicators database (www.worldenergy.org)

poverty rate from 84% to 10% in the same timeframe.[21]

Lessons from this profile

Despite challenges on the energy equity and environmental sustainability dimensions, this profile group offers examples of how to better balance the energy trilemma while still continuing to develop and strengthen economic growth. For example, in Mexico City, pollution, particularly from traffic, is an enormous problem. The transportation sector accounts for 49% of energy use, and in 2010, 86% of total energy needs were satisfied by burning fossil fuels.[22] To alleviate some of the resulting congestion and pollution, the city has shifted its focus towards urban planning. The city has closed some streets to vehicles in order to encourage foot traffic and has started a new bike-sharing programme.

Mexico's private sector is also turning to more sustainable methods of manufacturing. Ford Motor Company recently signed a US$1.3 billion agreement with Mexican solar power producer Sonora 80M, backing a large solar power plant in Northern Mexico.[23] This private investment in renewable energy will allow for continued economic growth and job creation, while securing the company's electricity supply and managing GHG emissions.

Another positive example is China, where the total amount of electricity generated through renewables and nuclear power increased by 13% per year between 2008 and 2010.[24] China also invested US$52 billion in renewable energy in 2011, which represents 20% of the global investment in renewables in 2011.[25]

'Hydro-powered'

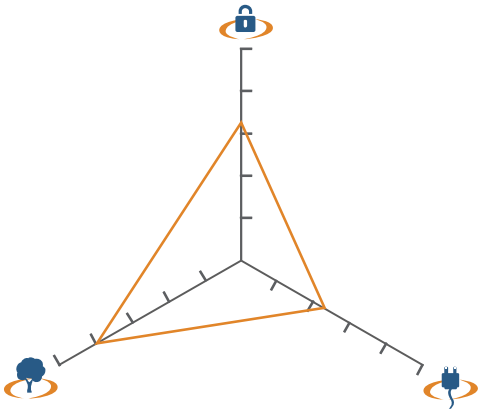
The energy trilemma profile of the Hydro-powered group of countries tilts towards the environmental sustainability dimension, although these countries also perform reasonably well on the energy security dimension. These emerging economies have, at an average of 73%, the highest share of hydropower in electricity generation of any group.[26] The Hydro-powered countries are predominantly in Latin America (due to the region being endowed with numerous powerful rivers), and generally have per-capita GDP in the Group III (US$6,000 to US$14,300) and IV (less than US$6,000) ranges.[27]

While most of these economies are still developing, the heavy use of hydropower has allowed these countries to meet a growing demand for electricity while minimising the negative impact on air and water quality that can result from increased energy generation and use. Historically, industrialising countries have substantially increased their impact on the environment as they strive to boost

[21] The Economist, 2013: Towards the end of poverty (1 June 2013)
[22] WEC, 2010: Energy and Urban Innovation, Mexico City Case Study
[23] Dunbar, C, 2013: Ford to Invest in 20 MW Solar Plant in Mexico (3 June 2013, American Solar Energy Society)

[24] EIA, 2011: International energy statistics
[25] Perkowski, J, 2012: China Leads the World in Renewable Energy Investment (27 July 2012, Forbes)
[26] EIA, 2011: International energy statistics
[27] For WEC's GDP per capita on a purchasing power parity (PPP) basis see Appendix C

Figure 14
Trilemma profile and illustrative countries: 'Hydro-powered'



	Index Rank	Balance Score
Brazil	34	ABC
Cameroon	82	BBD
Colombia	24	AAC
Costa Rica	21	ABB
Ecuador	35	ABB
Ethiopia	112	BDD
Panama	29	ABB
Paraguay	74	ACD
Peru	45	ABC
Sri Lanka	69	BCC
Uruguay	46	ACC

Figure 15
Average emission per kilowatt hour of electricity generated by country group
Source: IEA, 2012: CO_2 Emissions from Fuel Combustion; Oliver Wyman analysis

	Hydro-powered	Pack Leaders	Fossil-fuelled	Highly-Industrialised	Back of the Pack
grams CO_2 / kilowatt hour	178.9	240.5	599.5	565.2	582.8

economic growth and access to energy. However, Hydro-powered countries like Brazil, Panama, and Uruguay are proving that industrialisation and environmental sustainability are not mutually exclusive. By pursuing a renewables-fuelled path to development, these countries have proved that it is possible to provide the same level of energy equity as their equally-industrialised peers without the trade-off of sacrificing environmental performance. For example, the Hydro-powered group of countries only emits an average of 179g of CO_2 per kWh of electricity generated, compared to 565g CO_2/kWh for the developing countries in the Highly-industrialised group and a global average of 451g CO_2/kWh. (For a more detailed discussion of this emerging sustainable pathway to development, see Figure 30 in Chapter 5.)

While the 'cleanliness' of hydropower is praised as one of the big benefits compared to fossil fuels, this source of energy does not come without its own set of social and environmental challenges that must be managed. The construction of a dam floods the land behind it, creating a reservoir that displaces not only people, but the natural flora and fauna as well. Protecting the local ecological balance must be a consideration when a river's power is harnessed for electricity. Other costs of hydropower that should be weighed include the damage that the constant holding and surging of a river does to fish populations and the 'hidden', often unaccounted-for GHG emissions released by the trees and plants that rot when a reservoir is repeatedly flooded and drained. Nevertheless, hydropower has numerous benefits and can certainly be an overwhelmingly net positive addition to a country's energy system, provided that all the environmental considerations are properly accounted for.[28]

Worth noting is that although the list of illustrative countries for this grouping includes mostly countries in Latin America, it does not suggest that hydropower is only possible or economical in that region of the world; rather, many other countries – particularly in sub-Saharan Africa and south Asia – have a considerable volume of hydropower potential that remains untapped.[29]

[28] Environment Canada (Government of Canada), 2010: Environmental Impacts of Hydro Power (www.ec.gc.ca)
[29] For example, a proposed regional hydropower plant to be developed by Rwanda, Congo (Dem. Rep.) and Burundi, which could produce 145 MW. See WEC, 2012: World Energy Trilemma: Time to get real – the case for sustainable energy policy

Lessons from this profile

The Hydro-powered countries present an interesting case study for other emerging markets. The high share of hydropower and a focus on other renewable and low-carbon energy sources has allowed the countries in this group to maintain a comparatively low environmental footprint while improving access to energy in remote areas. The group's average electrification rate has for most of the Latin American countries in this group reached almost 100%, while the African countries have almost doubled their electrification rates in the past 20 years, and many of these countries have adopted targeted programmes.[30]

Brazil's Light for All is one such programme which aimed to improve access to electricity in poorer, rural areas where extending the traditional power grid was not economically feasible. The Brazilian government invested US$6.2 billion, with an additional US$2.4 billion coming from power distributors[31] into this programme which used mainly mini- or micro-hydro or biomass generators (but also some solar and wind power) to provide remote communities with clean energy. As a result, the successful Light for All programme brought electricity access to nearly 15 million additional Brazilians – representing 8% of the country's population.[32] The current electrification rate in Brazil is 99%[33], and 86% of the country's electricity comes from hydro and other renewable energy sources.[34]

Brazil and Uruguay have also supported the use of wind power as highlighted in Box 13 in Chapter 4. These examples show that increasing energy equity and improving the environmental sustainability in a country does not have to be mutually exclusive; rather, the use of renewables and hydropower can increase access to electricity in a sustainable, environmentally-sensitive manner.

'The Back of the Pack'

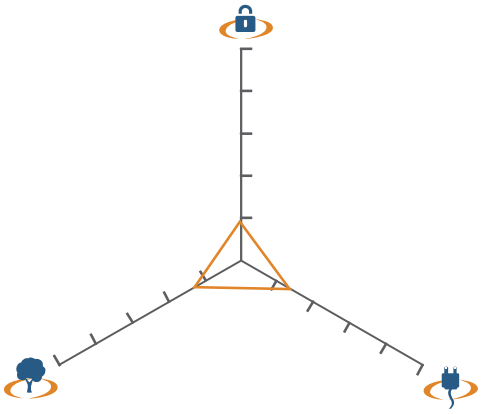
As illustrated, the energy trilemma profile of the Back of the Pack is tightly clustered and highlights how these countries are struggling to make progress on all three energy dimensions. The profile is represented by least-developed and developing countries from all over the world.

In the absence of a sufficient energy infrastructure, oil stocks and investments, the Back of the Pack is not yet locked into high-carbon or fossil fuel energy infrastructures and has the potential to take a more sustainable approach to energy and economic development. Unfortunately, lower per-capita GDP, lower contextual performance and speculative debt grades hinder both domestic and foreign investment. Small scale, renewable energy projects as well as policies to improve the overall investment climate can help improve performance on all three dimensions of the trilemma.

[30] SE4All, 2013: Global Tracking Framework
[31] United Nation Environment Programme (UNEP), 2012: Energy Access Knowledge Database, Energy Access Program in Brazil: Lighting for All
[32] Ministry of Mines and Energy, Brazil, 2009: Sustainable Energy and Development in Rural Brazilian Amazon

[33] SE4All, 2013: Global Tracking Framework
[34] EIA, 2011: International energy statistics

Figure 16
Trilemma profile and illustrative countries: 'Back of the Pack'



	Index Rank	Balance Score
Benin	128	DDD
Dominican Republic	110	BDD
Honduras	100	BCD
Jamaica	121	CDD
Jordan	96	BDD
Lebanon	109	CCD
Libya	117	CCD
Moldova	125	CDD
Morocco	105	CCD
Nepal	111	BDD
Nicaragua	113	CCD
Senegal	126	CDD
Yemen	127	CDD
Zimbabwe	129	DDD

Figure 17
Average growth of renewable energy by country group
Source: EIA, 2011: International energy statistics; Oliver Wyman analysis

	Back of the Pack	Pack Leaders	Fossil-fuelled	Highly-Industrialisd	Hydro-powered
2000–2010 CAGR (%)	7.1	2.4	0.9	4.5	3.5

Signs of progress?

Typically, as countries develop, they need to find a quick and cost-effective way to provide energy – and lots of it – in order to build their economies. The trade-off between accessibility and environmental protection is difficult to manage, but the Back of the Pack has an opportunity to chart a low-carbon path to development. This group of countries has the strongest average growth in renewable electricity generation at 7.1% per year between 2000 and 2010, compared to a global average of 4.6%.[35] This increase is strongly policy-driven and many of the countries have stated policies to increase renewable power.

Nicaragua provides an example of a country that is looking to leverage renewable energy sources to help accomplish economic, societal, and environmental goals. Nicaragua's government has set the goal for 94% of its electricity to be generated using hydropower and other renewable sources of energy by 2017. Nicaragua has reduced its reliance on foreign oil down from over 80%, and is also now generating an electricity surplus (which is sold abroad using the Central American Electrical Interconnection System (SIEPAC), an interconnection of the power grids of six Central American countries). The government has announced that, this year, it is on pace to import two million fewer barrels of oil, freeing up US$200 million that can be invested to pursue development goals. This example highlights how countries can use the development of renewable energy to diversify energy sources and lift themselves out of the Back of the Pack to follow a different path to energy sustainability.[36]

Other countries are just beginning to develop energy policies that include provisions surrounding renewables. Zimbabwe's energy policy states that "renewable energy is a local resource that should be fully utilised, as it can bring both access to energy and environmental benefits", but does not set out any specific targets or actions.[37]

[35] EIA, 2011: International energy statistics

[36] Rogers, T, 2013: Is Nicaragua`s renewable energy revolution maxing out?, Nicaragua Dispatch (20 May 2013, The Nicaragua Dispatch); Priebe, MB, 2013: Nicaragua's Bid for Energy Self-Reliance: An Investor's Dream? (6 June 6, 2013, www.thegreeneconomy.com); Dolezal, A and Ochs, A, 2012: Moving Renewable Energy Forward in Nicaragua (13 September 2012, blogs.worldwatch.org)

[37] Republic of Zimbabwe, 2012: National Energy Policy

Affordability of renewables, investment in infrastructure and targeted policies will all be necessary for the further development of clean, accessible power.

The UN has identified accessibility of energy as a key factor in the achievement of development goals. The UN's Sustainable Energy for All effort seeks to improve energy access, as well as increase the use of renewables and improve energy efficiency in order to reduce energy costs and provide inexhaustible energy sources. The recent Climate Investment Funds' initiative, Scaling up Renewables in Low Income Countries, is designed to increase investment in renewable energy in the world's poorest countries. Through this programme, over US$500 million has been pledged since 2009 for ongoing solar, wind, bio-energy, geothermal, and small hydro technologies projects.[38]

Summary

Providing sustainable, affordable and secure energy is a challenge for every country. The Energy Sustainability Index helps identify each country's unique successes and shortcomings. The energy trilemma profiles illustrated in this chapter highlight a few common situations in the hope that decision makers can learn from one another. These include the challenges that oil-exporting countries face, the experiences of countries that have developed a high share of renewables or hydropower, and the trade-offs that fast growing economies have to manage.

Absolute rank is not the most important result provided by the Index; every country has a chance to improve its energy performance, regardless of whether they are ranked first or last. Decision makers in both the public and private sectors are encouraged to look at trends in performance over the years, particularly within each dimension, and to compare their countries against their respective peer groups – regardless of whether those peer groups are selected from a regional, economic, or structure-of-the-energy-sector point of view.

Developing countries have a rare opportunity. As renewable energy sources become more widely available and cost-effective, countries may be able to leverage affordable renewable energy sources to minimise their environmental impact. These countries have the highest potential of developing renewable energy sources, but mobilising private investment will be crucial to the success of these future projects.[39]

[38] Climate Investment Funds, 2013: Scaling Up Renewable Energy Program in Low Income Countries

[39] UNEP, 2012: Financing renewable energy in developing countries

“I don’t think there is a shared global vision for sustainable energy systems”

“It’s about informing the consumer and letting the consumer rise to the challenge and the moral obligation of making informed choices”

“The private sector should supply us with reliable information about their activities”

“A clear policy does not mean a static policy”

“Having a good policy is one thing, but having something implementable is something else”

“To be realistic, we are still far from getting sustainable energy systems”

“We need to integrate climate change actions at three levels: the international framework, national policy and corporate action”

“There is basic disagreement on what the problems is and even if there is a problem at all, which makes it difficult to come together, define targets, and find coherent, long-term answers”

“We have to engage economic ministries and business leaders with more than sound bites – they must be involved in the analytical and intellectual questions”

“Users must have an opportunity to ar`ticulate their perspectives, so that we can empower the players”

“We will see a more diverse energy system as a whole”

“Will countries recognize that it is in their genuine interest to move towards this new sustainable energy system?”

“Ongoing technological changes are making the energy sector change very fast”

We are going to get to the tipping point of low carbon and then things will really accelerate. How do we get to the tipping point faster”

“I welcome that the industry has engaged themselves in advising and guiding the political process. It is very important that they do so”

2. Framing the sustainability challenge: an increasing complexity

Creating a policy framework that simultaneously supports secure, affordable, and environmentally-sensitive energy – a sustainable energy system – is one of the most important challenges facing governments today. This triple challenge is known as the 'energy trilemma'.

1) Energy security is 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.

2) Energy equity involves the accessibility and affordability of energy supply across the population.

3) Environmental sustainability encompasses the achievement of supply and demand-side energy efficiencies and the development of energy supply from renewable and other low-carbon sources.

Interviews with governments and inter-governmental organisations confirm that each country faces unique challenges in crafting its path to energy sustainability under varying preconditions and priorities.

All countries are very focused on energy security; however, their perspectives on energy access and affordability, and environmental sustainability differ. Echoing the perception of energy industry executives in 2012, interviewees are concerned about the lack of a shared vision for sustainable energy systems: *"I don't think there is a shared vision for sustainable energy systems, globally."*

While some countries are closer to balancing the energy trilemma on a national scale: *"to be realistic, we are still far from getting sustainable energy systems globally."*

Energy security remains a challenge and even large industrialised countries can still be subject to major energy disruption caused by electricity system failure due to high-load, natural disaster or harmful action. Countries have not yet succeeded in agreeing to a global binding protocol that addresses the issue of GHG emissions and climate change.

"The fact that we can continue to generate energy, the fact that we continue to produce products that do not reflect the cost – the internalised cost – of the carbon emissions of that product is just completely irresponsible and unsustainable."

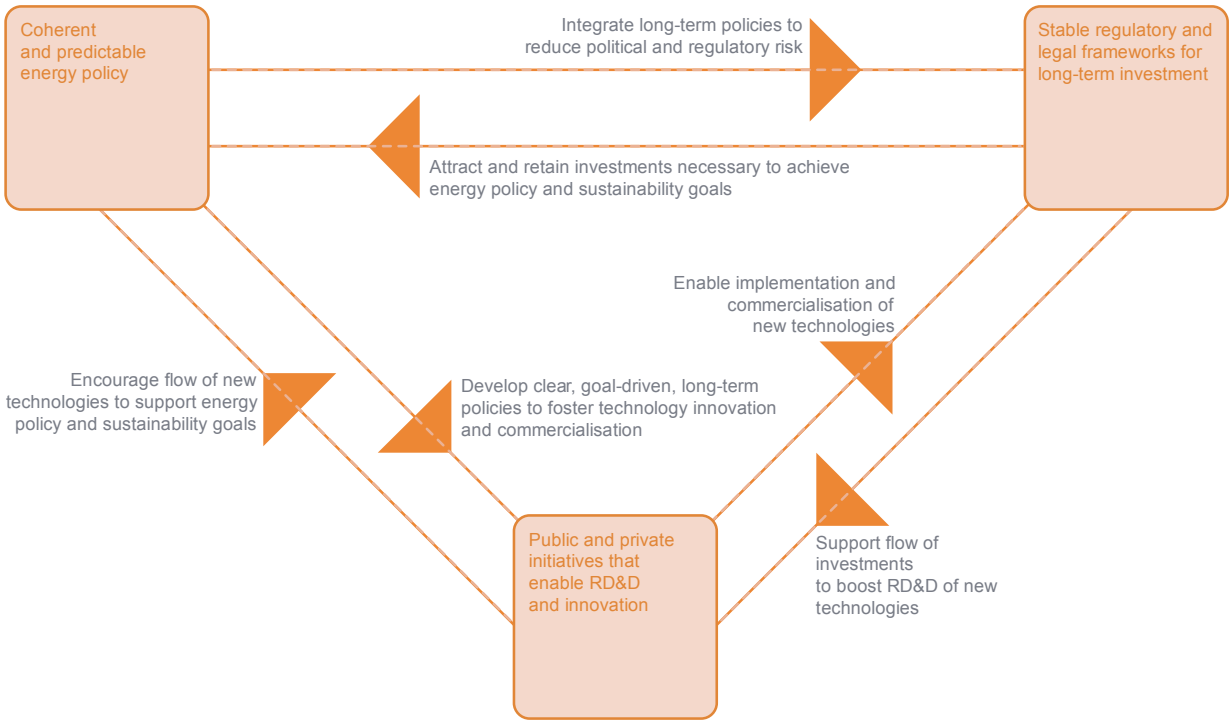
Lastly, there are still 1.2 billion people without access to electricity and 2.8 billion lack access to clean cooking facilities.[40]

Even if global economic circumstances were better, cash-strapped governments have limited capacity to fund investments in energy infrastructure and are not able to tackle these challenges without the private sector. Investment is needed on an unprecedented scale for developing countries to build their infrastructures and for developed countries to replace their ageing capital stock.

Good policies are critical to steer countries toward energy goals and the transition to a low-carbon

[40] SE4All, 2013: Global Tracking Framework

Figure 18
Three key interconnected policy areas are necessary to support the transition to sustainable energy
Source: WEC, 2012: World Energy Trilemma: Time to get real – the case for sustainable energy policy



economy. But what makes for good policy? Energy executives interviewed in 2012 stressed that all good energy policies have common features. In particular, a 'master plan' that leverages all energy sources and technologies is key to striking a balance among the three objectives of the trilemma.

In 2012 energy industry executives called on policymakers to focus efforts on three interrelated and mutually reinforcing areas (see Figure 18):

1) Define a coherent and predictable energy policy;

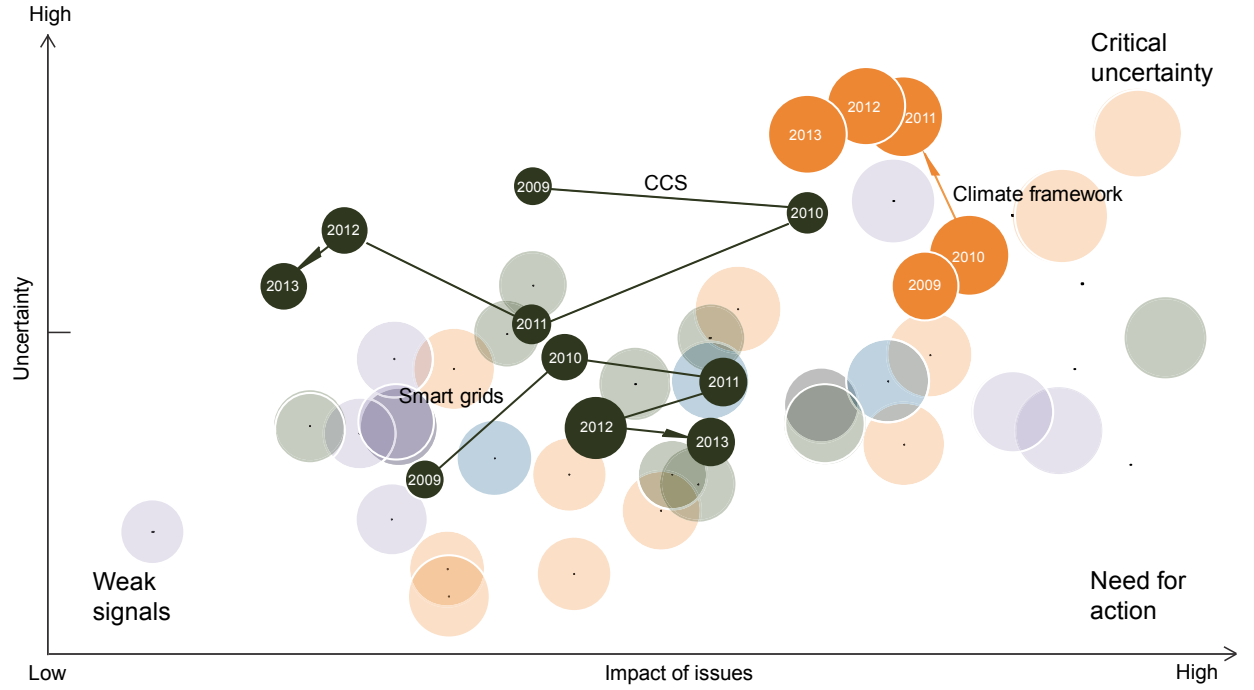
2) Implement stable regulatory and legal frameworks to support long-term investments;

3) Encourage public and private initiatives that enable innovation and foster research, development and demonstration (RD&D).

All of those interviewed in 2013 – ministers for energy and the environment, senior policymakers and regulators, as well as high-level representatives from inter-governmental organisations – appreciate the comments of the energy industry and broadly agreed with the recommendations made by energy executives. However, policymakers asked how these recommendations can be achieved: The views of those interviewed indicate that the main players may be *"on the same page"*, however, it does pose the question whether the lack of trust between the key stakeholders prevents them from thinking of themselves as being *"in the same boat"* to make change happen at the necessary pace.

However, interviewees remain hopeful as there are positive instances that allow for optimism: *"Look at the improvement in the energy efficiency and performance of the European car fleet over recent years. The European Commission set out a clear direction of travel for emissions standards or performance targets, and the industry has really geared up to make some significant improvements."*

Figure 19
Uncertainty caused by lack of a climate framework[41]
Source: WEC, 2013: World Energy Issues Monitor



There are three key challenges in addressing the energy trilemma identified by those interviewed in 2013, namely:

- The lack of an agreement on the target profile of a future energy system on a global level.
- The challenge of designing an energy policy framework that encompasses the dynamics of rapidly changing energy supply and demand.
- The inherent difficulties in crafting and implementing national policies.

No consensus on the target profile of a future energy system

One of the critical uncertainties identified by energy leaders from the public and private sector is the lack of a global climate framework (see Figure 19). Public stakeholders understand that in the absence of a regional or global consensus on climate change, it will remain hard for the energy sector – both private and public – to determine what its activities should be towards a low-carbon energy system. For example, without appropriate pricing and policy frameworks for carbon emissions, and technologies to avoid emissions, such as carbon capture and storage, there is the risk adding costs and reducing energy efficiency. *"The private sector know they are going to have to do something, but they don't know when, how much and in what particular respect. There just is so much uncertainty."*

The WEC 2013 World Energy Issues Monitor shows that the lack of a climate framework is a critical uncertainty for the energy sector. Currently there is no harmonious vertical integration of an international climate framework, the national policy level, and the corporate or sectorial level (see Box 5).

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

Box 5: Is it time for a change in climate negotiations?

The United Nations Framework Convention on Climate Change (UNFCCC) was approved in 1992 and entered into force in 1994 to limit the average global temperature increases and the resulting climate change. The Convention was ratified by 195 countries that are called Parties to the Convention.[42]

Countries are divided into three main groups according to differing commitments:

- Annex I parties include industrialised countries that were OECD members in 1992, as well as countries with economies in transition (so-called EIT parties).
- Annex II parties are the OECD members of Annex I, which are required to provide financial resources and technical support to EITs and developing countries to assist them in adapting to adverse effects of climate change.
- Non-Annex I parties are mainly low-income developing countries. Special consideration is given to parties classified as least-developed countries.

Furthermore there are observer organisations – over 1,598 non-governmental organisations (NGOs)[43] and 99 inter-governmental organisations (IGOs) – that are also allowed to attend sessions of the Conference of the Parties (COP). NGOs represent an extensive spectrum of interests from business and industry, environmental groups, farming and agriculture, indigenous populations, local governments and municipal authorities, research and academic institutes, to labour unions, women and gender and youth groups.

The most important body of the Convention and the highest decision-making authority is the COP that consists of the countries that are Parties to the Convention. Furthermore, there are two permanent subsidiary bodies: the Subsidiary Body for Scientific and Technological Advice (SBSTA) and the Subsidiary Body for Implementation (SBI) that are mainly responsible for giving advice to the COP. Any party and government can participate in these bodies and governments often send representatives who are experts in their respective fields.

The current structure of the UNFCCC process suggests that industry in general and the energy industry in particular only have an indirect influence on the processes and decisions in the treaty, and is vulnerable to the lobbying power of companies with high emissions who might be impacted by a global agreement. Indirect involvement takes place as part of an observer organisation or of the subsidiary bodies if selected as a representative by the respective government. A direct involvement of the private sector is not yet foreseen. However, there were dialogues with businesses before COP16 in Cancun, Mexico.

[42] United Nations Framework Convention on Climate Change (UNFCCC), 2013 (unfccc.int)
[43] WEC is a formal observer organisation in the UNFCCC process.

To facilitate change, hearing the energy sector's voice in the climate negotiations, for example, in form of a committee or consultation process with business, may help in getting to the "tipping point" sooner.

There is a strong belief that a concerted approach can accelerate the transition to a low-carbon energy system. Interviewees note that *"we need business to feed the negotiations with insights on the impact of targets on industry; what industry could achieve; what might be a better way to achieve goals."*

Policymakers strongly believe that private sector knowledge can improve the ongoing negotiations and would encourage opening the climate negotiations to the corporate sector.

The lack of an agreement on the target profile of a future energy system cascades and exacerbates other national policy challenges.

Creating energy policy that anticipates the changing energy supply and demand

Public stakeholders recognise that action needs to be taken now in order to complete the transformation of the energy system in the given timeframe. Newly economically viable energy sources and ongoing technological developments enable significant changes on the energy supply and demand side and make the energy sector very dynamic. *"We have ongoing technological changes which make the energy sector appear to change fast."* For example, many mature economies are seeing significant changes in generation and distribution models potentially leading to more diverse energy source and a different energy system as a whole in the future (see Box 6) a technological revolution in drilling and gas production technologies has greatly increased the world's recoverable reserves of natural gas and transformed the outlook for fossil fuel fired electricity generation; carbon capture and storage as a cost-efficient CO_2 mitigation option could play an important role after 2030 – independent of the assumed price on carbon.[44]

Against this context of dramatic energy changes, determining the energy future is increasingly complex and, policymakers point out that *"it is very hard to have a master plan"* and *"diversification of both energy sources and technologies is a real challenge for everyone."*

Box 6: The impact of distributed generation

Distributed generation (DG) systems are usually located close to where electricity is used. They provide an alternative to or an enhancement of the existing conventional electric power grid and can improve the resilience of the electric system – a feature that is of growing concern in many developed countries with ageing infrastructure and concerns over extreme weather events. Distributed energy technologies include energy generation and storage systems, for example, wind or solar power systems, combined heat and power schemes, fuel cells, and hybrid

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

systems. They may be installed by individuals, businesses, communities, schools, commerce or industry.

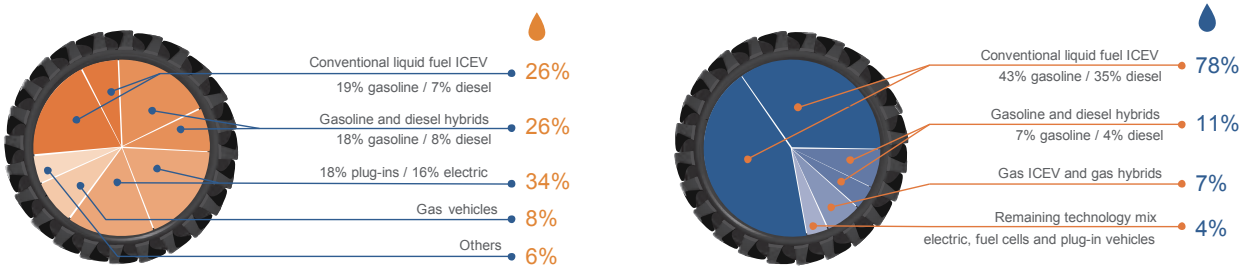
Advantages

- Local positioning avoids transmission and distribution losses and eliminates the cost, complexity, interdependencies, and inefficiencies associated with transmission and distribution.
- Local positioning allows use of close, available sources of energy – for example, waste products or renewable resources, and can help meet growing energy demand in a sustainable way.
- Can help increase access to modern energy services and drive economic growth in remote areas of less-developed and developing countries where they can be standalone and independent from the main grid; the same is true for less populated areas in general.
- Opportunity to reduce peak loads and provide additional services such as reactive power and voltage support, and thereby improve power quality and greater service reliability of the overall electric system.
- Increased ability to cope with potential physical attacks to the central grid.
- Small capacity additions can be made more quickly.
- Black start capability, which means the ability of a system to go from a shutdown condition to an operating condition without assistance from the electric system, for some distributed energy technologies.

Challenges

- Can have a very disruptive effect on the viability amount and placement of grid investment related to centralised power generation and how that grid investment will interact with and interplay with investments in distributed technologies.
- Technical issues, mainly related to balancing the system, may become apparent as often existing distribution networks are not designed to cope with new capacity and coordination efforts are not appropriate. Associated challenges include: alignment of provisions for stable, secure and economic integration of renewable energy; system operations and dynamic stability; integrated communication; development of technical standards for off-grid renewable energy applications; asset management, and so on.
- Regulatory barriers as distribution network operators have little incentive to give access to the distribution network.
- Unintended environmental impact as distributed generation is not necessarily clean – for example, often back-up generators run with diesel engines.
- Unintended impact on energy equity as energy service costs need to be borne by often less-well-off consumers.

Figure 20
Technology mix scenarios in the transportation sector
Source: WEC, 2011: Global Transport Scenarios 2050



There are also significant potential changes in energy demand. Critical sectors such as transportation, which accounted for more than 60% of global oil consumption in 2010[45], are facing potential breakthroughs in fuel sources and uses.

For example, fuels for the transportation sector will continue to expand beyond fossil fuels with increased shares of electricity, biogas, biodiesel, ethanol and others, leading to a much more diverse energy system as a whole (see Figure 20). In the US alone, green-car sales – hybrids, battery-electric vehicles, and plug-in hybrids – rose by 30% compared to 2012.[46] Toyota's global sales of gasoline-electric hybrid vehicles passed 5 million recently, with hybrids now accounting for 14% of its global sales.[47] Other manufacturers see similar trends.

The potential technology mix in the transportation sector will lead to a much more diverse fuel mix in the transportation sector and impact the energy system as a whole. In Figure 20, the orange 'Tollway' scenario describes a regulated world where governments intervene in markets to promote technology solutions and infrastructure development. The blue 'Freeway' scenario envisages a world where pure market forces prevail to create a climate for open global competition.

Against this level of change, policymakers acknowledge the need for polices that enable sustainable energy systems. That is to say, *"A policy and regulatory framework which meets the dynamics of the sector but will still make investment interesting and provide credibility".* However, in creating policy frameworks that are predictable and consistent, governments ask the energy industry to be supportive and transparent, and to share information and know-how to improve their understanding of the technical solvability of the energy sectors challenges.

Policymakers also noted the need for industry insights on how to adjust policies where the development of a specific technology does not deliver the intended results. *"We cannot get ahead of where technology and markets can realistically reach or lock ourselves in solutions that in five years will be obsolete."*

Translating policy into effective regulations

Policymakers acknowledged the difficulties in translating policy into effective regulations. As one policymaker noted, *"having a good policy is one thing, but having something implementable is something else".* In most countries, the process requires cooperation and coordination across different governmental agencies and entities to ensure the actual regulations enact the policy as designed. *"Coordination between the regulator, the regulated entities, and the government is very critical to ensure that everyone is moving in the same direction."* Although the energy industry in many countries is already involved in the consultation process, policymakers and regulators

[45] IEA, 2012: Key World Energy Statistics
[46] King, D,, 2013: Green-car sales rise 30% compared to 2012 (5 June 2013, green.autoblog.com)
[47] Kageyama, Y, 2013: Toyota Passes Milestone in Selling 5 Million Hybrid Cars (17 April 2013, www.dailyfinance.com)

grapple with choosing the appropriate form of consultation and asking the right questions that will generate the specific feedback needed to further develop and improve the proposals made. *"Sometimes what happens is that you get the strong opponents and the people who benefit the most being very vocal, but that is it."*

Box 7: Overcoming difficulties in coordinating regulation

In 2010 the US Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) enforced national standards for light- and heavy-duty vehicles build as of 2012 to reduce GHG and improve fuel efficiency.[48] In addition, the programme is expected to enhance the US competitiveness and job creation, improve energy security, reduce cost of personal transportation and transport of goods, and support growth of the clean energy sector. A nationwide consultation process ensured involvement of car manufacturers, energy industry, various industry and consumer associations and academics in the formulation of the standards.

The first phase of the 'National Program of harmonized GHG and fuel efficiency standards' apply to passenger cars, light-duty trucks, and medium-duty passenger vehicles covering model years 2012–2016. In 2012 the National Program was extended to cover model years 2017–2025. It is projected that, during the first phase, US GHG emission can be reduced by 960 million metric tons, saving 1.8 billion barrels of oil. During the second phase the National Program is projected to save an additional 2 billion metric tons of GHG emissions and 4 billion barrels of oil.

A similar approach was taken for the development of GHG and fuel efficiency standards for medium- to-heavy duty engines and vehicles built 2014–2018. It is expected that the National Program will help reduce CO_2 emissions by about 270 million metric tons and save about 530 million barrels of oil over the life of model year 2014 to 2018 vehicles. A second phase of regulations is planned for model years beyond 2018.

The development of national standards for light and heavy duty vehicle shows that, even in a country like the US, where the regulatory system is highly complex and influenced by many federal, state and local agencies, coordination among departments and agencies is possible despite conflicts surrounding jurisdiction, cost allocation, integration and many other issues.

Policymakers particularly recognised the importance, and the difficulty, of coordination among ministries and departments. For example, as one policymaker listed: ministries of economy or finance will target growth, but have to keep an eye on the effects on natural resources and distribution; environment ministers concentrate on decreasing the pressure on natural resources, while ensuring employment, growth and state financing; the ministry of energy focuses on security of supply and to some degree on reducing emission levels;

[48] US Environmental Protection Agency (EPA), 2013 (www.epa.gov)

and the ministry of transport looks at building enough motorways and diversifying the transportation modes with an eye on the environment. To reduce the risk of variance between ministries and departments, coordination of policies and regulation can be improved if it is driven, harmonised and monitored by an independent body or at the highest level, such as a Prime Minister or Central Planning Commission. The government of Sweden, for example, is a unitary government with a collective decision-making process. Therefore, any decision by the Swedish government that follows a proposal made by a certain ministry is always seen as taken by the whole government. Here, legal advisers monitor the consultation process among relevant ministries to ensure that a discussion takes place prior to presenting a final proposal to the collective government, for example, a bill to parliament.

The challenges of crafting a coherent and integrated national policy also comes into play as governments look to agree on global targets and develop global frameworks or regionally integrated policies with neighbouring countries – a recommendation promoted by the energy industry. As one interviewee stated bluntly: *"What is at the top of the agenda of countries at the moment, is not regional cooperation or de-carbonisation of the economy, it is really affordability and competitiveness."*

While some countries believe that more of a *"think globally act locally"* mantra is needed, others see the opportunities in the development of energy markets and assets, and harmonisation of regulation on a regional level. *"We need standards and cooperation between countries in a much more integrated way."* But this approach can create political risk and uncertainties: *"The challenge is … you sit down, you spend time putting together agreements and plans, governments change, and everything collapses."* Policymakers noted that policy coherency can be greatly affected by national policies and regional and global actions and policies.

Box 8: Cooperation in the Nordic market

In WEC's Energy Sustainability Index, Nordic countries including Denmark, Sweden, Norway, and Finland perform very well overall and in managing the trade-offs between the three dimensions – energy security, energy equity, and environmental sustainability. All four countries have a clear vision and set ambitious targets to decarbonise their energy system over the next 30–40 years. Denmark's target is to be 100% reliant on renewable energy, including hydro, expected to result in a 75% reduction in GHG emissions by 2050. Finland plans to cut emissions by 80% in 2050. Norway and also Sweden aspire to be carbon-neutral by 2050.[49]

Besides having ambitious targets, the countries coordinate research and policy development regionally at Nordic Energy Research and have a common market for electricity, a good example of how countries can liberalise electricity markets across country borders.[50]

[49] European Environment Agency (EEA), 2013: Data and Maps (www.eea.europe.eu); Nordic Energy Research, 2013 (www.nordicenergy.org)
[50] The Nordic Energy Research also includes Iceland.

"Creating a genuine single market is the only solution to guarantee the peak capacity at a reasonable price even in the future."

"Having long-term goals for 2050 is important, but you can say more or less anything you want. In addition to those long-term goals you also need realistic goals to 2020 or 2030." To pursue their 2050 target of being carbon-neutral, Sweden and Norway created a common electricity certificate market in January 2012, a market-based support system to increase the production of renewable electricity and make it more cost-efficient. The joint market permits trading and receiving certificates for renewable electricity production in either country. The goal until 2020 is to increase production of electricity from renewable energy sources by 26.4 TWh.[51]

Summary

In addressing the sustainability challenge, interviewees recognise the need for a continued strong involvement of the energy industry in an open and transparent dialogue with the public sector to improve national conditions, and at the international level to support the transition to a low-carbon energy system. *"There is a role for everyone on this journey."*

Policymakers and industry recognise the need to work together to address this challenge by making the hard decisions, necessary to realise sustainable energy systems on a much broader scale. *"We must accept that we have to make hard choices in this generation to bring about real changes for future generations and the planet. Politicians and the industry must get real."*

The lack of an agreement on the target profile of a future energy system cascades and exacerbates other policy challenges including the challenge of designing policies in the face of a shifting energy sector, emerging technologies and changing energy use, and the inherent difficulties in crafting and implementing national policies.

To overcome these hurdles public stakeholders are looking at the energy industry to:

- Improve energy policies and regulation by being pro-active in sharing knowledge, insights and experiences.
- Increase investment in energy infrastructure and technology through better risk alignment.
- Support least-developed, developing and emerging economies in taking a new path to sustainability.

[51] Swedish Energy Agency, 2012: The Electricity Certificate System

“We need to make decisions together”

“Risks associated with innovation should be carried by industry”

“Industry should push us policymakers for better market conditions and regulations”

“It always works best if we have a really honest discussion about what is and isn’t possible in the energy sector”

“Many political leaders today say we should avoid the environmental and climate issues because of the financial crisis. I see it in the opposite way. Never waste a good crisis”

“Dialogue is important but the industry really needs to be committed and convey a vision”

“Good policy is not a sound bite. Good policy takes experts”

“The energy policy of the country should be the subject to a huge discussion and once chosen it should be taken forward”

“Certainty of the regulatory framework is very good for long term investment, it is good for the state, the public sector, and the private sector”

“Energy companies need to adopt a long term vision of cooperation and partnership that transcends both short term hurdles and immediate rewards”

“The private sector has to explain to the government changes in regulation that would better fit new technology and benefit the whole country”

“The knowledge gap between the industry and the policymaker is quite substantial and creates instability and lack of vision”

“Consumer information totally changes the market for high-efficiency household appliances”

“We have on-going technological changes which makes the energy sector change very fast”

“We can’t make the necessary hard decisions if we don’t have the dialogue”

3. Improving energy policies and regulation: the role of industry

Public stakeholder recommendations

Policymakers presented a number of recommendations on how industry can help craft a path to energy sustainability and effective energy policies. Specifically, industry is asked to step forward on three areas: help build a national consensus, adopt and support a long-term energy perspective, and increase policy feedback and industry knowledge sharing.

Help build a national consensus on energy strategy

Policymakers acknowledged that in many countries political parties do not share a common view on energy needs nor the energy issues to be addressed. There was some frustration expressed on this. *"When there's basic disagreement on what the problems are or even if there is a problem, it makes it difficult to come together and find coherent long-term answers."*

Box 9: Building a national consensus – France's three-phase national debate

France recently launched a six-month national debate to review its long-standing energy policy and set the framework for a new 'energy transition law'. By 2025, the President aims to alter the energy mix as follows: 25–50% less reliance on nuclear power; less reliance on oil; nearly doubling the use of renewable energy and more energy savings.

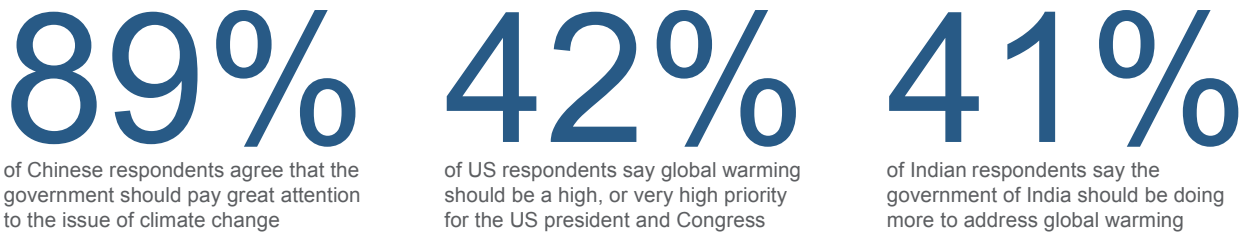
The process supporting this national debate is specifically geared to capture a wide range of perspectives and with an eye to ensuring the framework addresses environmental effectiveness, economic efficiency and social justice (see Figure 21).[52]

Figure 21
France's three-phase national debate on energy policy
Source: Oliver Wyman analysis

Interviewees stressed the importance of a consensus on long-term energy goals that is based on national values. Reaching such a national consensus requires communication and debate that involves all stakeholders: citizens and consumers, including end-users, the media, activists groups and non-profits/non-governmental organisations, government (including parliamentarians), policymakers and regulators,

[52] Boselli, M, 2012: France seen turning to renewables in policy shake-up (12 November 2012, Reuters); World Nuclear News, 2012: France to debate 'energy transition' (21 September 2012, www.world-nuclear-news.org)

Figure 22
Public support for action on global warming/climate change
Source: Yale Project on Climate Change, 2012 and 2013; Yale Project on Climate Change with China Center for Climate Change Communication, 2012



and the energy industry. For example, in late 2012, France embarked on a national debate on the future of its energy policy (see Box 9).

Recognising that there is a lack of trust not only in governments but also in businesses, policymakers called on industry to play a supporting role in increasing public awareness of the energy challenges. They point to the necessity of a well informed and engaged public, not only in the beginning of the process to adopt a policy, but throughout its implementation and review. Interviewees further emphasised that *"informing the consumer and letting the consumer rise to the challenge of making informed choices"* needs to be part of the solution.

Governments view the energy industry as a key player in presenting information about the cost of energy, the benefits of new technologies, and the need to foster energy efficiency; all issues that would enable the public to support the shift towards sustainable energy systems and associated policies. Policymakers suggest that is it is industry's enlightened self-interest to support a robust dialogue with the public. *"Industry needs to play a broader role in the change management and communication."*

Policymakers' call for greater efforts to develop national consensus echoes comments by industry who also noted that energy policy must be underpinned by a social licence, that is to say, broad approval from the general public. As noted in the industry-focused 2012 World Energy Trilemma report, achieving sustainability has to be a joint effort between policymakers, industry and the public. Further, industry believed policymakers should take a substantial role in shaping national discussions on energy strategies, noting: *"it is a political role to speak to consumers to give them a clear message and gain acceptance"*.[53]

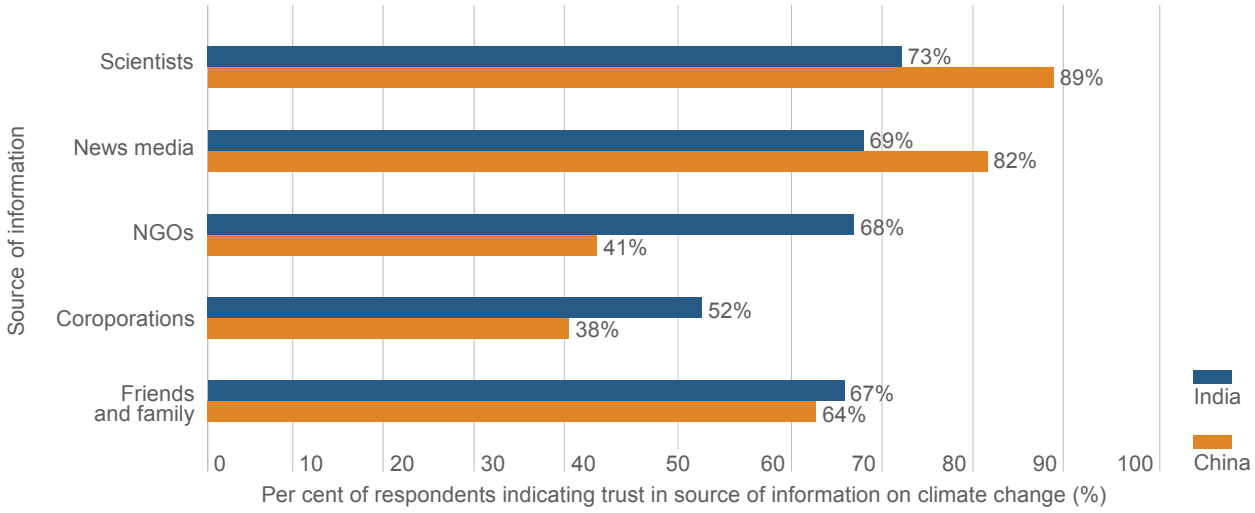
Box 10: Public views and perceptions of climate change affect attitudes to energy strategies

As noted by energy industry executives in the 2012 World Energy Trilemma report, in many countries, currently energy discussions can quickly dissolve into politically divided disputes over climate change and inhibit the development of a national consensus on energy strategy. However, global studies indicate the public generally supports government action on climate change – including energy-related measures (see Figure 22).

Research also suggests that there are opportunities to craft national dialogues on energy sustainability that include the input of many stakeholders including industry, news media, policymakers, non-governmental organisations (civil society organisations) and scientists. As noted below, individuals look to a variety of sources for information on climate change and energy (see Figure 23).

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

Figure 23
Most trusted sources of information about climate change and global warming
Source: Yale Project on Climate Change, 2012 and 2013; Yale Project on Climate Change with China Center for Climate Change Communication, 2012



Adopt and support a long-term energy perspective

Policymakers called on the energy industry to proactively contribute to a long-term vision for sustainable energy system and associated policies: *"Dialogue is important but the industry really needs to be committed and convey a vision."* And another asked: *"What does the private sector see as their contribution and role toward achieving the energy goals?"*

While calling on industry to promote a long-term energy vision, policymakers and regulators acknowledge the effects of the mis-match between political timeframes, politics and coherent energy policies. This issue was also noted by industry executives in the 2012 World Energy Trilemma report. In that report, industry called on policymakers to *"detach politics from policies"* and they also lamented the disconnect between short-term political timeframes (often based on electoral cycles of four or five years) and necessary long-term views for energy policies. However, policymakers noted that industry can contribute to the 'short-termism' due to shareholder pressures.

In speaking about the effects of politics, policymakers noted the importance of elected politicians and legislative bodies and the development and acceptance of energy policies. In short, public perspectives and sentiment on energy sustainability and energy policy often have a significant effect on what can be politically achieved. Therefore, policymakers noted: *"If you build on the national values and create a national consensus, then politicians and the governments can come and go, but a clear message from the people remains."*

Establishing coherent, long-term, predictable, and transparent policies that rise above political change is challenging but not impossible. For example, Uruguay (ranking 46 in the Energy Sustainability Index) adopted its current energy policy in 2008 for the next 25 years and in 2010 it was endorsed by all of the country's political parties.

Developing a common long-term energy perspective in markets where energy assets are fully in the private sector (including utilities) can be particularly difficult. In such markets, each player develops optimised business strategies or plans and it can be challenging for policymakers to obtain a holistic view of the entire energy sector. As one policymaker noted, in some instances *"… central planning and the development of long-term view is the biggest casualty of de-regulation of the energy industry."*

Some policymakers called for the benefits of creating a long-term planning model or forums as a mechanism to support the development of a national energy consensus.

Sharing knowledge and feedback to overcome information asymmetry

Policymakers called on industry to be proactive and engage in the energy policy dialogue and share insights on 'what works'. As one noted: *"Industry is the technology expert and we need its innovations, investments, and the commitment."*

In particular, policymakers want industry to share knowledge, insights and experiences to enable better policy and regulations to offset information asymmetries about the industry and the unique needs of each energy sector. Policymakers and regulators recognise that often they do not have the technical know-how or the deep understanding of what makes a project profitable or not. One interviewee acknowledged: *"Policymakers see the true edge of the knife. But the policymakers probably don't see the profitability of it."*

Box 11: Addressing quick wins first: a lesson from the transportation sector

Carbon dioxide emissions from the transportation sector amounted to about 23% of global CO_2 emissions (2010) and policymakers have focused much attention on reducing CO_2 emissions from land-based transport.[54] However, closer examination of the transportation sector reveals alternative opportunities to target emissions and achieve the quick, tangible results needed to maintain and generate additional support for emissions-reduction programmes.

The EU has made enormous efforts to significantly decrease GHG emissions caused by land-based vehicles. For example, mandatory emission reduction targets and fuel-efficiency standards for passenger cars have reduced the average CO_2 emissions from 185 grams per kilometre in 1995 to 140 grams in 2010.[55] These regulations have required the efforts of thousands of players in the auto manufacturing, distribution and logistics, public transportation, and tourism industries (to name a few), and affected millions of drivers across Europe. A similar point could be made with relation to the US Corporate Average Fuel Economy (CAFE) standards.

In contrast, the maritime shipping industry is a relatively consolidated industry in which 15 large shipping companies dominate the sector. Around 90% of world trade in tonnes is carried by ships at roughly 14 grams of CO_2 per tonne per kilometre,[56] maritime shipping is one of the lowest emitting freight transport options. However, at more than 1,000 Mt CO_2 emitted per year, the carbon footprint of this industry is similar to that of some of the world's largest economies (for example, Japan or Germany).[57]

Yet, international shipping remains the only mode of transport not included in the EU's GHG

[54] EC, 2012: Road Transport: reducing CO_2 emissions from vehicles

[55] The International Council on Clean Transportation, 2011: A Ten-Year Retrospective

[56] EEA, 2011: Specific CO_2 emissions per tonne-km and per mode of transport in Europe, 1995-2011

[57] International Maritime Organisation (IMO), 2009: Second IMO GHG Study 2009

emissions reduction commitment. As a result, CO_2 emissions from shipping in the EU increased by 48% between 1990 and 2008, and are expected to continue to rise in the future.[58] However, with appropriate technical and operational efficiency measures, substitution of heavy fuel oil by cleaner biofuels, and by including the shipping sector in the CO_2 cap-and-trade or tax systems, energy intensity in maritime shipping could be halved by 2050, which would undoubtedly lead to a significant drop in CO_2 emissions.

In June 2013 the European Commission proposed a strategy to tackle GHG emissions from maritime shipping. However, the proposed strategy would not require initial action until 2018 when owners of large ships using EU ports would need to report their verified emissions. Thereafter, policymakers would define GHG emissions reduction targets for maritime transport followed by the last step of implementing further measures, including global market-based measures. Given the small number of key players in the industry and the potential benefits, there would seem to be opportunities to shorten this timeline.[59]

Greater industry involvement and an effective dialogue provide a number of benefits. It helps bridge knowledge gaps that can develop between policymakers and the industry and enable them to speak the same language. Policymakers called on industry to help identify the real needs of the market, and consequently the real benefits for investors to provide valuable tools and insights for legislators. *"If we don't have honest discussions, then we're going to be solving the wrong problems all the time."* This information asymmetry gap, coupled with the potential uncertainty created by lobbying efforts, can lead to a lack of trust. *"We need to have much more dialogue to build transparency and trust."*

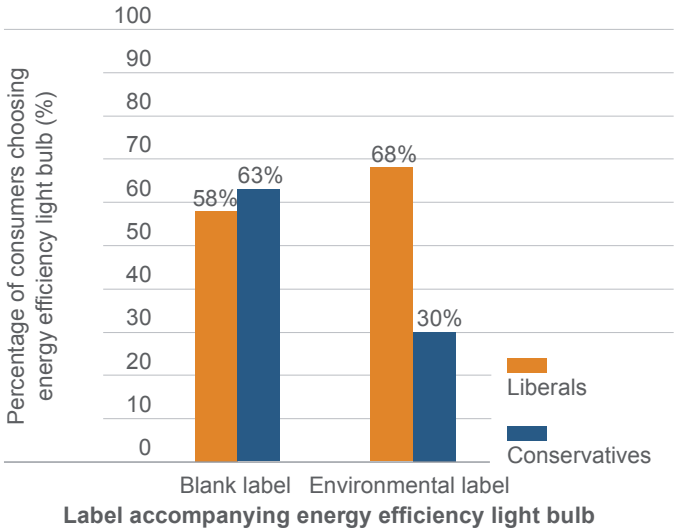
Box 12: Political affiliation can affect response to energy efficiency messages

Increasing energy efficiency is a key component of many countries' energy strategies. Policymakers also called on industry to take more initiative and find more creative solutions for consumers. However, even where energy-efficiency solutions are available, achieving changes in consumer behaviour is difficult and often affected by household income, ease of use, political beliefs and views on the environment.

Research by the Wharton Risk Management and Decision Processes Center examined how an individual's values can affect how they respond to energy-efficiency messages. Through a series of tests, researchers examined how political affiliation was associated with response to different benefits of energy efficiency including the environmental benefits (reducing carbon emissions), energy independence (reducing dependence on foreign oil) and cost (saving money).

[58] EC, 2013: Integrating Maritime Transport Emissions in the EU's Greenhouse Gas Reduction Policies
[59] EC, 2013: Reducing emissions from the shipping sector (www.ec.europe.eu)

Figure 24
Effects of labels accompanying energy-efficient light bulbs
Source: Gromet et al, 2013



The US-based research found that using environmental messages can deter otherwise interested consumers from purchasing an energy-efficient light bulb. Although political liberals and conservatives choose the energy-efficient bulb at the same rate when the energy-efficient bulb is unlabelled, conservatives' willingness to purchase a more expensive energy-efficient light bulb decreases when it has a 'protect the environment' label (see Figure 24).[60]

The research highlights how messages can polarise demand for energy-efficiency options and policymakers and industry must consider how these factors can be used to improve the energy-efficiency campaigns. To determine whether this is a unique US phenomenon or not the research would have to be replicated elsewhere.

An open process and mechanism for dialogue and information sharing would enable fine-tuning of regulations especially in the face of changing energy supply and demand, and support-focused discussions on challenging issues such as subsidy reduction, tariff revisions, energy-efficiency options and regulations for emerging technologies. For example, policymakers recognised the lead role of the private sector in innovating and inventing new energy technologies and solutions. As those new technologies and improved solutions come to the market, the energy policies and regulations may need to be updated or revised. Dialogue and greater understanding of energy technology developments is crucial to the maintenance of an effective and sustainable energy policy and regulations. Policymakers asked industry to share with government their expectations, their perceptions, and their experiences.

Public stakeholders also highlighted how the industry itself actively affects and changes the market conditions for the sector: *"On the one hand business is asking for a predictable business environment and predictable energy policy and then on the other side we have a market economy where the decisions are made by the market players. What they are doing and what they are not doing is influencing the business environment."*

Given this, policymakers noted the importance of joint planning, feedback and assessment on regulations to enable flexible and responsive policy implementations.

[60] Gromet, DM, Kunreuther, H, and Larrick, RP, 2013: Political ideology affects energy efficiency attitudes and choices (Proceedings of the National Academy of Sciences)

While calling for greater dialogue, policymakers cautioned about the effects of lobbying. These activities can distort understanding of energy issues and can stimulate 'flavour of the month' shifts in energy policy as politicians respond to lobbying pressures. This caution highlights the value of mechanisms and forums that support knowledge-sharing and dialogue across the energy sector (nuclear, renewables, coal, natural gas, and so on) and with policymakers.

This call from policymakers strongly echoes the comments from the energy industry which stressed that the feedback loop with policymakers is very important. Overall, in the 2012 World Energy Trilemma report industry noted: *"The private sector should play a more active important role in providing guidance, stakeholder impact and technical expertise."*[61] Given the common perspective on the importance of strong feedback, policymakers and all sectors of the energy industry can consider mechanisms or forums that facilitate an open exchange of information. Examples of such mechanisms are already present.

Forums in Europe include the Florence Electricity Regulatory Forum and the Madrid Gas Regulatory Forum, where the European Commission, industry, consumer associations and regulators can debate policies, standards, and good practices. In Colombia, public and private sector dialogue is facilitated by Comités Técnicos Mixtos. These technical committees support the National Commission of Competitiveness and Innovation (CNCeI) and are designed to support input and coordination among the different entities of the government and private sector. Every committee has a plan of concrete work, which in some cases is translated in specific policy recommendations with the overall goal to improve the competitiveness and productivity of the national markets.

Summary

Both the energy industry and policymakers point to the importance of a national consensus and a 'social licence' on energy approaches as the foundation for effective energy policy. Further, both call for greater dialogue and knowledge sharing to ensure policies and a robust energy sector that supports energy security, affordable energy and reduced environmental impact. The goal is to create sustainable long-term energy policies that adapt to a changing sector while not creating instability in policy or regulation.

However, despite the calls for greater industry and policymaker dialogue, there are gaps to be closed. Policymakers are looking to industry to take a stronger role in informing the public about evolving energy options. Another area for focus is mechanisms to facilitate dialogue while not tipping into a narrowly, self-interested lobbying process. Finally, there is the continued push-pull between the public and private sectors. This exchange between policymakers and the energy industry was summed up by one policymaker:

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

"Business says, 'well give us long-term policy certainty', government says 'You guys figure out your long-term goals and assure me that you will continue to invest and you will continue to produce economic growth for the country.'"

To close the gaps, public stakeholders asked for support from the private sector in three interrelated areas:

- Help build a national consensus on energy policy.
- Adopt and support a long-term energy perspective.
- Increase policy feedback and industry knowledge sharing.

“Subsidies are the biggest hurdle to the development of sustainable energy systems”

“The question of carbon price remains politically contested”

“Someone needs to sit down with the pension funds, sit down with long-term investors and say: let`s work out a slightly different credit rating”

“The role of the governments is to lay the environmental conditions that enable the private sector to drive the economy”

“We need to get in close contact with pension funds and institutional investors to ensure they’re engaged as well”

“Industry has to support the sustainable energy and lead adoption of new technology for the drive to reduced costs”

“The most important risk is the country risk and not the energy sector or energy policy risk per se”

“The most important risk is investors’ fear that the country will not honor the contract”

“The dialogue between the policymakers, the possible investors and other players is quite stalled”

“For renewable projects where the cost is all upfront, the key issue is the certainty of the revenue stream”

“Every technology, every energy generation that is carbon intensive should be recognized as being risk-intensive, because all of those are going to be stranded assets.”

“Industry has to share risks with governments by promoting new and clean technologies”

“The challenge for governments is how to focus R&D activities when there are tens, maybe hundreds of different ideas in the energy sectors”

“Industry needs to make investors aware of the difference between the sovereign credit of a country and the credit of a power sector”

“We need more thinking on smart subsidies for vulnerable groups.”

4. Increasing energy investments through better risk alignment

Public stakeholder recommendations

Cumulative investment of US$37 trillion (oil and gas supply account for US$19 trillion and the power sector, including for generation, transmission and distribution accounts for US$17 trillion) is needed in the world's energy supply system over 2012–2035. The majority of the investment (61%) is needed in non-OECD countries.[62] Unless investors have a specific mandate to invest in energy projects, the energy sector is facing a competition for capital with other infrastructure projects. The returns on energy investments must be commensurate with levels of risk and also competitive with the returns on other options for investments.

Both industry and policymakers agree on their respective roles in meeting the world's energy investment requirements. Policymakers must set the frameworks for investment so that investors can clearly assess the risk-return potential and energy industry is expected to take the leading role in providing the necessary capital to increase energy access and transform the energy sector. As several policymakers noted, their key role *"is to lay the conditions that enable the private sector to drive the economy."* In turn, *"the private sector will play a major role in sustainable energy systems worldwide by providing the capital financing, the technology and the know-how."*

With improved knowledge sharing and dialogue, as set out in the previous chapter, policymakers can better establish the market conditions, including reduced political and regulatory risk to support the necessary investment in energy infrastructure. Policymakers acknowledged that market conditions cannot be achieved without a long-term predictable energy policy with strong political support. In turn, policymakers call on industry to be less risk averse with regards to investments in energy infrastructure and research and development (R&D). A stable and improved regulatory environment can also support greater investments by development banks, institutional investors, and non-traditional investors especially if those organisations can develop more insightful methodologies to assess potential energy projects.

Effective risk allocation to reduce the cost of capital

Public stakeholders called on the private sector to be less risk averse in terms of investments in energy infrastructure and technology. *"In a lot of issues related to [energy] investment, the private sector is really risk averse. But you can't go into business without taking certain risks."* Another noted, *"Often if an external investor goes into a new country where they haven't had operations before, they tend to request conditions which are not a normal allocation of risk."* Further to this, some policymakers and representatives of development banks noted that the energy industry (across all sectors) has become very dependent on subsidies, incentives or guarantees to realign risks. Although policymakers and industry have clearly

[62] International Energy Agency (IEA), 2012: World Energy Outlook 2012

and strongly stated that *"a market cannot develop in a subsidised environment."*

In calling for the private sector to be less risk averse, public stakeholders also spoke of the importance of effective risk alignment to stimulate investments in energy infrastructure and the effective pricing of capital. This was reinforced by a development bank which noted the importance of an objective risk allocation to drive down capital costs and sustainable contract implementation. The most capital efficient allocation is supported by allocating risks to those most capable of managing them.

Box 13: Stimulating renewables without subsidies

Both policymakers and industry agree that supply-side subsidies, especially those to increase the share of renewable energy, must be carefully applied with clearly defined sunset clauses. In particular, both agreed that subsidies can increase overall investment risk in the mid- and long-term. For example, a number of OECD countries faced sharp boom-and-bust cycles in renewable investments driven by government subsidy schemes facing expiration or policy shifts.

One policymaker noted: *"Where a subsidies scheme, for example, a subsidy such as feed-in tariff, is not financial sustainable, or broadly politically supported, there is increased risk of policy shifts and an unexpected cut to the subsidy."*

This perspective closely mirrors those expressed by the industry executives in the 2012 World Energy Trilemma report who noted that *"all subsidies should have a clear built-in sunset."*

Mindful of the experiences of other countries and potential high administrative costs of subsidies, a number of developing and emerging countries are using market-based mechanisms to stimulate investment in renewables. In particular, reverse auctions have been applied. These auctions also allow governments to contract sector-specific capacity and thereby maintain a high degree of control regarding the rollout of renewable energy technologies. This type of mechanism has been implemented in countries such as Brazil, Uruguay and Peru.[63]

Uruguay

In response to its hydro sector's vulnerability, and facing a growing dependency on costly energy imports from Brazil and Argentina in years of low rainfall, Uruguay has focused on the development of wind power with a target to 1 GW of wind capacity by 2015 (representing 30% of total installed capacity).[64] It is projected that the increase in wind power will support a reduction in the country's electricity costs by an estimated 30% by 2015.[65]

Investor confidence in the Uruguay approach has been increased by the lack of subsidies

[63] Ernst and Young, 2012: Renewable Energy Country Attractiveness Indices
[64] Sciaudone, C, 2012: In Depth: Little Uruguay stands tall among wind-power giants (25 November 2012, www.rechargenews.com)
[65] Ernst and Young, 2012

and by the reduction in political risk. Uruguay's current energy policy was adopted in 2008 for the next 25 years; in 2010 it was endorsed by all of the country's political parties. [66]

Brazil

Brazil is making use of the strong winds in the country, particularly in the north-east, to aim for an estimated 9,000 MW of installed wind power capacity by 2017. These winds enable a high average capacity factor – Brazil's newer wind turbines are at 57% compared with an average of 25% for wind farms in Europe.[67]

Brazil has awarded contracts to build new power capacity through competitions that have pitted wind against fossil fuels, including natural gas and diesel. Wind farms, competing against other types of power plants, have been price competitive against gas and coal plants and won 55% of the contracts to sell power in 2011 and 2012.

While the Brazilian wind energy market has grown strongly without the support of subsidies from the government, many project developers have leveraged debt financing from the Brazilian Development Bank (BNDES).[68]

Despite the success, wind will not meet all of Brazil's growing energy needs nor cover the impact of droughts on big hydropower dams. As a result, the country will continue to build gas-fired thermal power plants to meet its energy needs. However, in order not to disadvantage fossil fuels in power contracts, under recently revised rules for power auctions, coal and gas-fired producers will not have to bid for the same power contracts as wind energy producers. The expansion of wind power may also be affected by its decreasing price. At a wind auction in December 2012 prices awarded were US$43.3/MWh. This put the price of Brazilian wind generation on a par with shale gas-fired US generation.

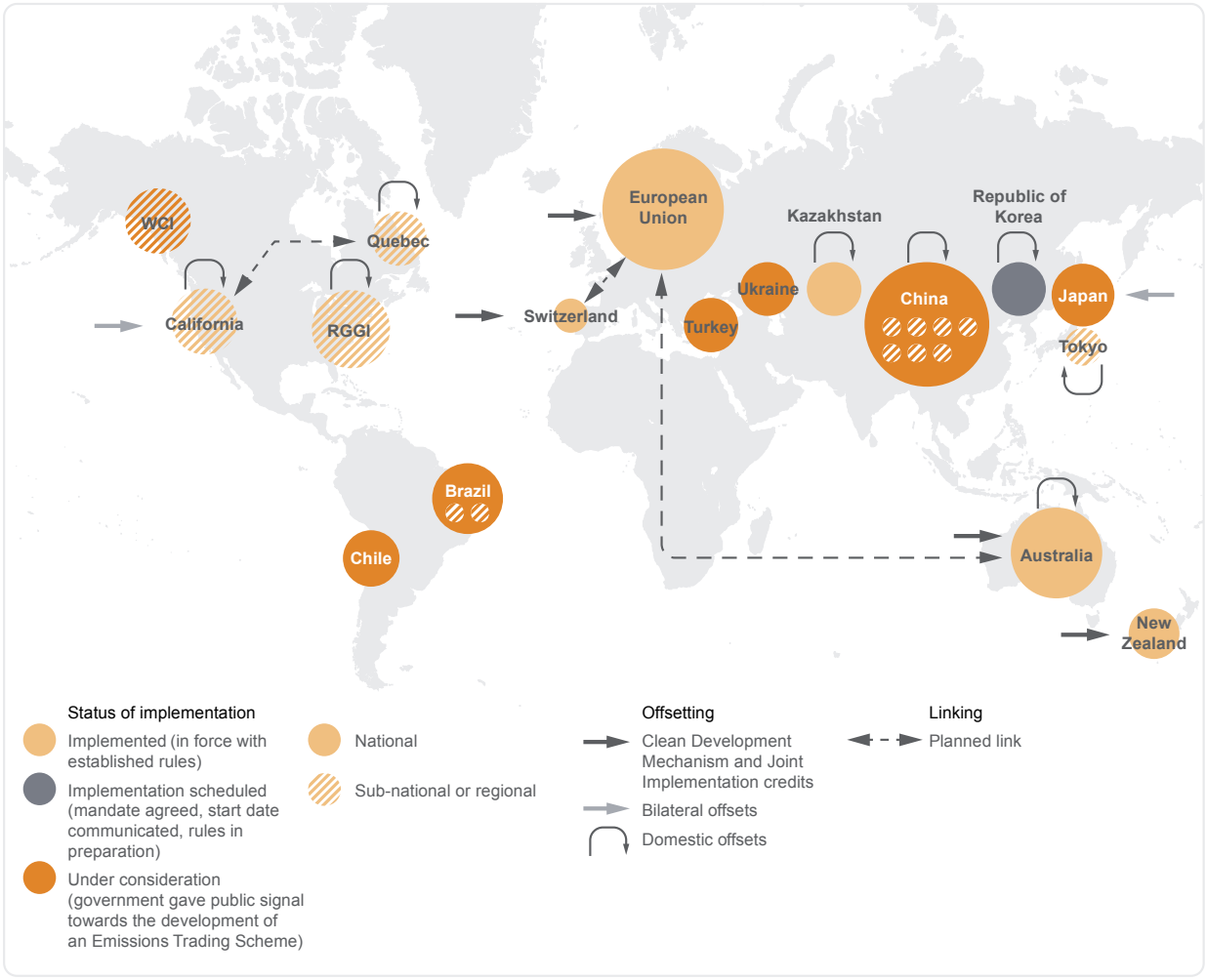
The 'right' risk allocation starts with a coherent energy policy and well implemented energy regulatory framework to minimise political and regulatory risk. This point was stressed by industry in the 2012 World Energy Trilemma report where it was noted that the best mechanism to drive investment is a stable, predictable policy framework. Where risks are not effectively managed, the investments are deterred or the cost of investments is increased due to higher interest rates. As one development bank observed, the payoff period has to be very quick or very high where investors are not confident about the stability of the regulatory and financial regime.

[66] Acosts, I, 2012: In Uruguay, the Answer Is Blowing in the Wind (28 August 2012, www.ipsnews.net). The country is also looking to private investment and financing through the sale of carbon credits to the World Bank's Spanish Carbon Fund to help cover the costs.

[67] Nielsen, S and Lima, MS, 2013: World Cup Energy Demand Favoring Gas Over Wind in Brazil (8 May 2013, Bloomberg); Leahy, J, 2013: Energy in the Americas (15 May 2013, Financial Times)

[68] De Angelis, A, 2013: Capacity within the Brazilian wind power market reached 2500 MW in 2012 (5 June 2013, www.companiesandmarkets.com)

Figure 25
Map of existing, emerging and potential emission trading schemes
Source: The World Bank, 2013: Global Emissions Trading Schemes Map



Policymakers agreed and many noted that *"Uncertainty regarding the regulatory and economic framework surrounding energy systems does not support private investment."* Policymakers and regulators spoke to the importance of minimising policy and regulatory risk and their lead role in ensuring policy stability. As one noted: *"What really refrains people from making investments …is the risk of adverse material change in regulation."*

Box 14: Carbon prices and the impacts on investments

In the 2012 World Energy Trilemma report, industry called on policymakers to introduce carbon pricing in the form of a market-based instrument and also noted that *"a liquid, harmonised global carbon market would be the most effective mechanism."* These schemes can help drive fuel-switching and energy-efficiency initiatives, and enhance the market penetration of low- and zero-carbon technologies. Over 40 national and 20 sub-national jurisdictions have either implemented or are considering mechanisms that put a price on carbon.[69] Further, linkages and agreements are being put in place across schemes, for example, between the EU Emissions Trading Scheme (ETS) and Australia's Carbon Pricing Mechanism and between the cap-and-trade programmes of California and Quebec.

Increased harmonised and coverage of carbon emissions schemes could have significant impact on all sectors of the energy industry as it would adjust the risk profile of energy

[69] The World Bank, 2013: Mapping Carbon Pricing Initiatives

investments including renewable and nuclear. It could help stimulate investments in low-carbon technologies by sending clear market signals to investors.

"Every technology, every energy generation that we have, that is actually high in carbon and carbon intensive, should be recognised as being risk-intensive, because all of those are going to be stranded assets, once you begin to look at all these through a carbon price."[70]

Against the backdrop of a carbon price, renewables and other low-carbon energy sources begin to look increasingly attractive.

However, the increasing linkages between emission trading schemes underscores the need for careful structure and implementation. For example, the EU ETS which serves as a cornerstone for several other schemes, faces a surplus of allowances and prices of the allowances have dropped 83% from 2008–2013. In light of these challenges, some are questioning whether a global market can be effectively developed and regulated or if carbon tax system could be more effective system. Carbon taxes could have advantages (if government set the levels in advance, they would give greater price certainty) but would be more difficult – probably impossible – to link globally.

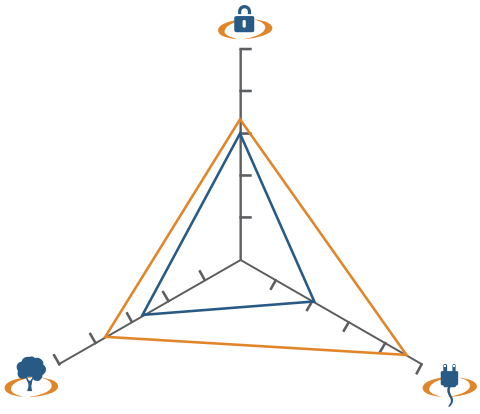
Policymakers also acknowledge the importance of a stable legal and institutional framework that supports transparency and assurance for the protection of investments. This should include assuring investors of the ability to export returns on investments of dividends. As noted, *"the most important risk is the country risk and not the energy sector or energy policy risk per se but the fear of investors that the country will not honour the contract."* Some countries, especially emerging democracies, are making efforts to 'lock-in' energy policy stability and minimise the potential for political interference with laws and enforcement mechanisms.

Despite the apparent alignment between policymakers and industry on the need for political and regulatory stability, challenges remain. A brief 2013 WEC/Oliver Wyman survey of top energy industry leaders found that the regulatory and policy risk as well as country risk (for example, expropriation, civil war, and deteriorations in the rule of law) are the two biggest risks negatively impacting on energy investments. Further, respondents noted that these risks are disproportionately misallocated to the private sector and believed that the majority of political risk should be borne and managed by governments – with institutional investors assuming the smallest amount of political risk.

Policymakers also acknowledge that the effects of political and regulatory risk may not be uniformly appreciated. *"… not all governments realise that you need to have a stable regulatory framework that enables the private sector to do their job."* Another noted how changing regulations or an

[70] See also: Carbon Tracker and The Grantham Research Institute, LSE, 2013: Unburnable Carbon 2013: Wasted capital and stranded assets

Figure 26
Higher levels of corruption have a negative impact on a country's ability to perform well in the energy trilemma



High levels of corruption

Low levels of corruption

Note: Corruption determined by the World Bank WGI data which is on a -2.5 to 2.5 scale. Below 0 is considered high and greater than 0 is considered low

Unstable business environment detracts investments: *"… if you change regulation often, it becomes very difficult to attract investment. It goes back to the very simple concept of track record, or credibility, and the business world is built on credibility at the end of the day."*

Box 15 Transparency and corruption impact the investment climate and energy performance

Transparency and clarity around processes such as tendering are important for setting a credible business climate. Policymakers acknowledged the damaging role of corruption in attracting investment and the struggle faced by many countries. Policymakers recognise the need to tackle corruption. But there is a role for the private sector as well in managing this risk. One policymaker summed this up: *"There is a corruptor and a corruptee"* (see Figure 26).

With a backdrop of political and regulatory consistency, the effective risk alignment for any single project can be determined. This dialogue on risk allocation can be particularly import for a project that may be supported by public-private partnerships but is relevant for all large capital projects.

Box 16: Effective project risk alignment stimulates green infrastructure investments

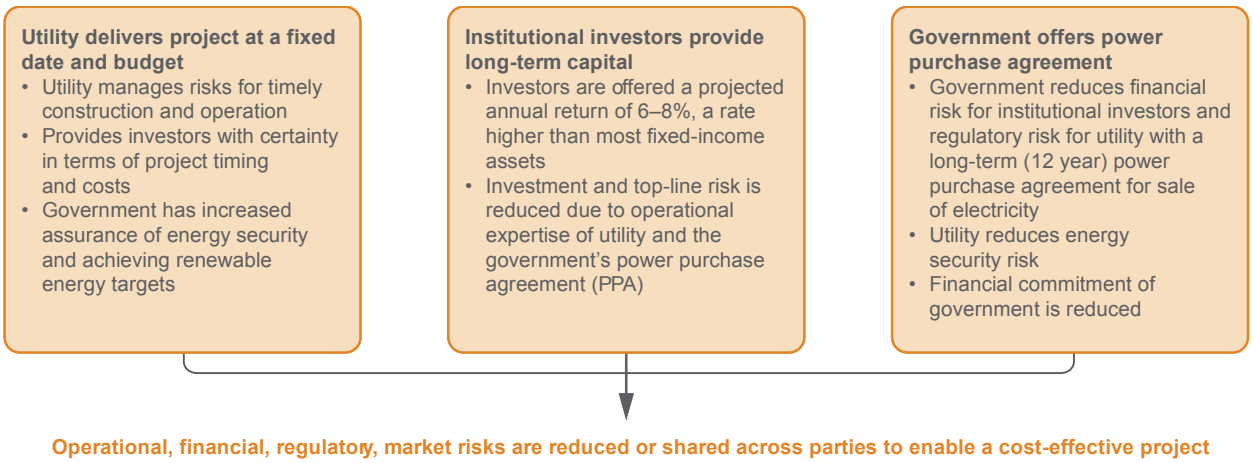
PensionDanmark bought a 50% stake in Denmark's state-owned DONG Energy's, 166 MW Nysted Wind Farm off Denmark's shores in 2010. With a goal of developing 5 GW of offshore wind capacity in addition to the 1 GW it operates currently, DONG was looking to financial partners to allow it to leverage capital. Effective project risk alignment enabled the company to raise €2.5 billion from financial partners, including funds based in Japan and the Netherlands (see Figure 27).[71] The process is an example of policymaker efforts to *"create a minimum level of guarantee that will increase the confidence of the investors, but which will not hamper the market foundations."*

The wind project offered the pension fund stable and predictable cash flows over a long term. It is interesting to note that the pension fund acknowledged that purchase price agreement from the government was critical to shifting the risk profile of the project. Without the agreement, the investment case would have been different and the risk associated with investment would be substantially higher.[72]

[71] Goddard, J, 2012: Leading firms PensionDanmark, Allianz Specialised Investments, Riverstone, Dong Energy, Mainstream Renewable Power, EDF-ER, Masdar Capital all looking to further their wind exposure, (26-27 June 2012, www.renewableenergyworld.com)

[72] Sulugiuc, G, 2013: Danish pension funds put the wind up government bonds and invest in energy (17 January 2013; www.independent.ie) ; Lee, A, 2012: Pension funds turn to wind power projects for higher returns (20 August 2012, www.europeanpensions.net)

Figure 27
Effective project risk alignment in the Nysted wind farm
Source: Oliver Wyman analysis



Insurance can help manage political and regulatory risks

With risks broadly allocated, specific risk mitigation mechanisms can be applied. In some instances 'informal mechanisms' can help address challenges. For example, development banks can help mitigate country risks via their official dialogue with the host country government, where it may be challenging for the private entities to engage with officials. This dialogue and engagement with host countries local officials also helps policymakers more quickly understand the issues pertaining to attractive investment regimes and what type of regulatory structures ensure an *"investment grade energy policy."*[73]

Investors are also turning to political risk insurance to help manage political or country risks, especially in developing countries. The 2013 WEC/Oliver Wyman survey found that political risk insurance is widely considered the financial instrument that is most effective in risk mitigation developing countries. This finding is supported by other surveys which show that political risk insurance has increased over the last several years to over 12% of foreign direct investment inflows into developing countries.[74] The main drivers of this growth have been the recent political instability in North Africa, such as the events of the Arab spring, expropriations in Latin America, and contract renegotiations in resource-rich countries.

However, while political risk insurance is considered effective, it is also viewed as less readily available and much less affordable than other mechanisms like loan guarantees, bonds, or public-private partnerships. The development and increasing capacity of the political risk insurance industry may address some of these problems in the near future.

Public stakeholders also acknowledged that there are limits to this insurance and countries with very low credibility or a poor track record may not be able to leverage this tool. Put differently, if a country is not considered a stable place to invest for normal commercial activities, it is also unlikely to attract the necessary large-scale energy investments.[75]

Policymakers can also take a lead role in reducing other risks, especially those presented by developing countries such as currency risk. One policymaker noted: *"I strongly believe that government, not the private sector, has to carry certain guarantees on risks, for example exchange rates and currency risk."*

[73] Hamilton, K, 2009: Unlocking Finance for Clean Energy: The Need for 'Investment Grade' Policy (Chatham House)
[74] The World Bank, 2013: World Investment and Political Risk 2012

[75] Standard & Poor's, 2010: Can Capital Markets Bridge the Climate Change Financing Gap?

Move beyond country ratings to support deeper understanding of energy project economics

Development banks and policymakers noted that the perception of a country's risk can inhibit energy investments even in countries where the underlying economics of the energy sector are strong. This can be particularly true for the power generation sector. Policymakers and development banks pointed to difficulties in effectively applying a credit rating to potential power projects. Industry can play a role in making investors aware of the differentiation between the sovereign credit of a country and the credit of a power sector. Currently, in many instances, *"the dialogue between policymakers, possible investors and other players is quite stalled."*

The economic crisis has limited the ability of many governments to incentivise new infrastructure due to high levels of government debt. At the same time, the ability of commercial banks to provide long-term finance has been weakened due to the need for deleveraging, the higher cost of capital associated with projects that are perceived to be high risk, and the anticipation of further prudential regulation. This is particularly affecting the financing of projects with long maturities such as those represented by infrastructure projects.

As highlighted in the 2012 World Energy Trilemma report, institutional investors including pension funds represent a potential source of funding for infrastructure. Infrastructure investment, including energy, is an increasingly attractive asset class given the current low interest rate environment and weak economic growth prospects in many countries. If well packaged, such projects could provide pension funds with stable and predictable cash flows that align well with their long-term liabilities, as well as opportunities for portfolio diversification and inflation hedging.

Pension fund investment in infrastructure is increasing, albeit slowly. Few European pension funds are investing directly in the equity or debt of renewable energy projects. Looking beyond the OECD, there is also growth in domestic pension funds investment in infrastructure in some African, Asian, and Latin American countries. Examples are Chile, Peru, Brazil and Mexico, where pension funds have gained direct exposure to infrastructure mainly through structured products and project bonds. A new investment channel has appeared recently with the development of dedicated infrastructure funds. Recent data shows more than US$15 billion are invested in infrastructure projects by domestic pension funds in a range of African, Asian, and Latin American countries, and 'south-south' investing (cooperation between developing countries) is also likely to rise in importance, with activity by pension funds, sovereign wealth funds and other institutional investors.[76]

Despite the potential for win-win solutions, challenges remain. Some of the hurdles are internal to pension funds. For example, some funds lack the expertise to evaluate opportunities or appropriate governance arrangements for such investments.

[76] OECD, 2012: Infrastructure Investment in New Markets: Challenges and Opportunities for Pension Funds

Figure 28

Appropriate policy strategy and instruments can help unlock pension fund capital for investment in infrastructure

Source: G20/OECD, 2012: G20/OECD Policy Note on Pension Fund Financing for Green Infrastructure and Initiatives; Oliver Wyman analysis

	Key actions for policymakers	Commentary
1	**Ensure a stable and transparent regulatory environment for infrastructure projects**	• Establish smooth process for granting concessions and a fair and balanced legal framework for dispute resolution • Avoid retroactive changes in the rules (for example, feed-in tariffs)
2	**Develop a national, long-term strategy for the infrastructure sector**	• Compose long-term strategies beyond the political cycle • Ensure a steady pipeline of investment opportunities
3	**Promote appropriate financial risk transfer in infrastructure projects and investments**	• Utilise tax incentives, debt guarantees, co-investments and other risk-sharing mechanisms to increase attractiveness of investments
4	**Adapt prudential regulatory frameworks for pension funds**	• Remove undue restrictions on infrastructure investment while preserving necessary governance mechanisms
5	**Support the creation of appropriate investment vehicles and collaboration**	• Provide initial capital for new funds if required • Allow pension funds to collaborate within and across borders
6	**Enable appropriate valuation and reporting of infrastructure investments**	• Employ transparent models and independent value appraisals to ensure appropriate valuation of infrastructure securities
7	**Promote capital market development**	• Push for development of fixed income markets to facilitate pricing of long-term infrastructure investments

Canadian and Australian pension funds are clear leaders in their capabilities with over 10 years' experience in infrastructure investments. Other investment barriers stem from how infrastructure projects are set up, the restrictions of prudent regulation and uncertainties about credit ratings of energy infrastructure investments.

A sovereign credit rating cap is based on a range of factors within the country profile and economy, only some of which will affect the power sector. Yet in many instances, the economics and attractiveness of energy projects are negatively skewed by a reliance on the sovereign credit rating in assessing the investment. In such cases, power companies or 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 utility seem similar to those in OECD countries.

Credit rating factors also limit potential investments by institutional investors and pension funds. In general, pension funds are looking to make infrastructure, especially 'green' investments, via well-known debt instruments, such as bonds. Most require that these bonds carry at least investment grade ratings. However, ratings agencies are typically conservative, particularly when trying to assess very long-term projects or contracts, and especially if there is a limited long-term performance history on which to draw. Given this, few green infrastructure projects – including some renewable energy projects – are able to secure the

vital investment grade rating.[77] Nevertheless, research has outlined a number of steps and approaches policymakers can take to reduce the risk of green or infrastructure investments for pension funds and ensure that these investments offer competitive risk-adjusted returns (see Figure 28).

Pension funds and investors require support and encouragement to invest in new asset areas. Learning from leading investors and the experience of peers could assist in building their confidence. As one policymaker noted:

"Someone needs to sit down with the pension funds, sit down with the long-term investors and say: let's work a slightly different rating of credit rating because you aren't going to lend much with a cookie-cutter approach."

Policymakers asked the energy industry to play a stronger role in generating a dialogue with prospective financers to improve confidence and increase project investments. For example, industry can better highlight the strength of the power sector and their overall risk management capabilities in managing construction, technology, operational risk and other risks.

[77] G20/OECD, 2012: Policy Note on Pension Fund Financing for Green Infrastructure and Initiatives

Industry needs to invest in technology to reduce energy costs

Policymakers are looking to the private sector to play a lead role in energy technology developments and innovation, especially enhancements to enable low-carbon emissions and drive down the cost of renewables. Policymakers called on the energy industry to apply their know-how and expertise to support the adoption of new technology for sustainable energy. Some policymakers also commented on the rapid rate of innovation in sectors such as telecommunications and computing and compared it to the rate of innovation in energy. Noting, *"Short-term commercial focus needs to be brought into the energy system. We really need to allocate the R&D in a way whereby we make what we have more sustainable and competitive right now."*

Box 17: Industry driving change

Canada's Oil Sands Innovation Alliance (COSIA) provides a model for industry to drive environmental change through collaborative R&D efforts. The group was founded after the government developed stricter environmental performance requirements for Alberta's oil sands. COSIA brings together 14 member companies to share and leverage new technologies and techniques with each member company held to varying levels of contribution, depending on their size, stage of development and specific expertise. The hope is that with this alliance, the oil sands industry can begin to break down the barriers that have plagued the industry: intellectual property protection, difficulty procuring funding and human capital

shortages. COSIA will publicly set goals to address environmental sustainability and report on the progress made. Efforts have focused on four major areas: tailings, water, land, and greenhouse gases. COSIA will also establish relationships with other stakeholders, and even recruit those who can offer expertise as members, including universities, government entities and technology providers. To date, members have shared 446 such innovations that have cost US$700 million to develop.

Policymakers acknowledged the crucial role of the public sector in creating the right environment for RD&D in the energy area. Specifically, there is a role for government to play in commercialisation, to the extent that they can identify non-economic, non-market barriers that inhibit investments and research in the pre-competitive, early stage of technology development and/or large-scale demonstration projects of energy networks. This role was also emphasised by industry in the 2012 World Energy Trilemma report where it was noted: *"Government can help support the demonstration and commercialisation of technologies."*

Box 18: The marriage of innovation and policy

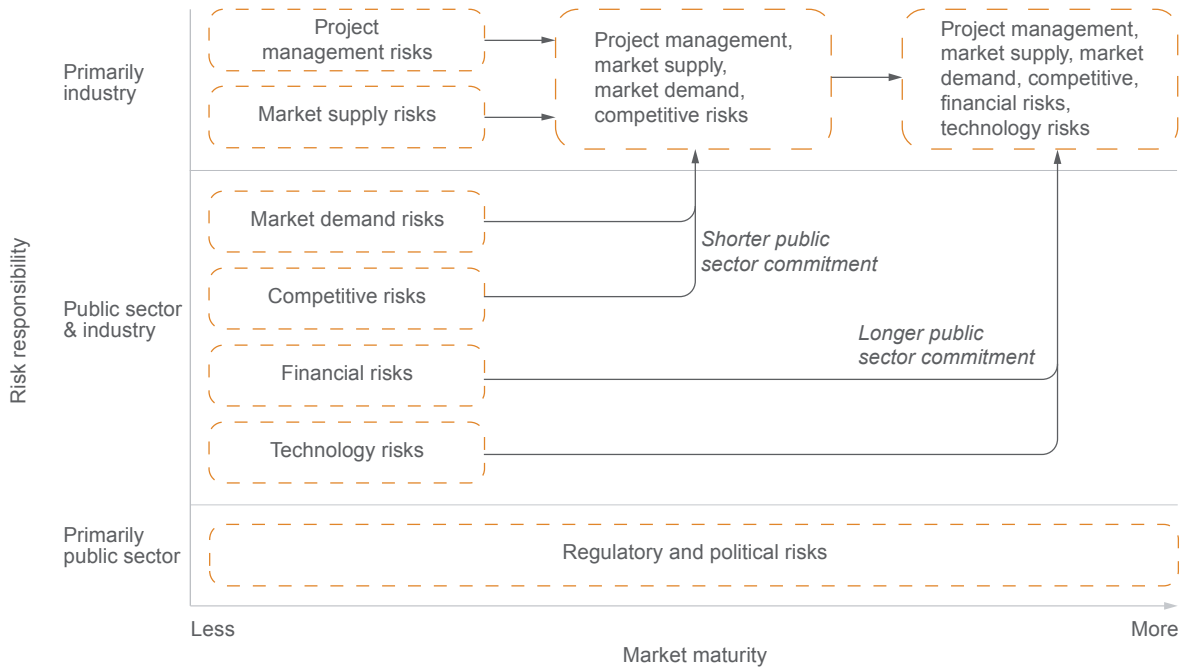
A key trait shared by many top-performing countries in the 2013 Energy Sustainability Index is a high degree of innovation. Second-ranked Denmark provides examples of both technological and financial innovation, underpinned by a clearly defined, long-term energy policy. For example, Denmark's Combined Heat and Power and District Heating (CHPDH) system, developed over the past 25 years, is a main driver of the country's high performance. The CHPDH system was born when Denmark, which was very dependent on foreign oil, entered an oil crisis in the 1970s.[78] The Danish government has played a large role in promoting CHPDH by offering subsidies, enforcing regulations and working with the private energy sector to ensure that heat and electricity remains affordable for consumers.[79]

This system is extremely advanced, and CHPDH is responsible for 80% of the nation's heating needs. This is partially enabled by advanced intelligent control systems, which are similar to smart grid technology. Denmark also uses biomass to fuel its CHPDH systems through its waste-to-energy programme, allowing for a projected 60% decrease in power sector emissions from 1990–2030.[80]

However, policy support or early stage development or commercialisation must be carefully applied with the risks and rewards thoughtfully aligned. It was noted that *"the risks linked to the development of new technologies cannot be absorbed by only consumers and the public sector."* Put differently, both the upside and downside risks of technology development have to be allocated across industry and the public sector. This effective allocation of risk is a particularly acute issue when governments are under

[78] IEA, 2011: Energy Policies of IEA Countries, Denmark 2011 Review
[79] OECD, 1999: The Case of CHP in Denmark and Perspective in Other Countries
[80] Climate Consortium Denmark, 2011: State of Green: Combined Heat and Power Plants

Figure 29
Policymakers and industry risk alignment in the development and commercialisation of technology should evolve over time
Source: Oliver Wyman analysis



pressures to reduce R&D risks at a time of financial constraints.

Given funding limitations, choices must be made when supporting the commercialisation of emerging technologies or else research funds will be too diluted to be effective. Inevitably, the process includes making choices among options and selecting 'winners' and 'losers'. The process can be subject to politics, lobbying, interest groups and sometimes evolving national views. As one policymaker noted, *"in government, there are too many risks. So it's going to be a political triage. And which ones we choose to focus on has more to do with the ideology and the balance of current politics."* Funding limitations, political pressures and risk aversion can together result in a reduction of the necessary 'all-in' mind-set that is often needed to mature new technologies.

Shifting political views on R&D can also generate mixed signals for industry and where they should apply research resources. *"Industry looks to the government for signals as to where they should be devoting their research. And when you keep changing the signal, you end up with a variety of industrial investments that were half completed and then discarded."* As a buttress to shifting political choices, or a tendency to chase the 'flavour of the month', policymakers called for industry to help coordinate and support broader coalitions to align behind research plans. Supporting coalitions of major research institutions, universities, and business roundtables or industry coalitions can help push through and maintain political and financial support for long-term energy research.

Development banks also spoke about how they can support demonstration technology and the early deployment phase of new technologies where public sector money provides critical funding to bridge the 'valley of death'. This has the additional benefit of helping to drive down the costs of implementing new technologies as the industry and others 'learn by doing'.

Summary

The necessary steps to stimulate energy investments needs are substantially identified and broadly agreed by both policymakers and industry. However, comparing the views of industry and policymakers reveals that there are issues around policy and regulatory consistency which still need to be addressed. Getting the risk alignment right is vital to stimulate energy investments. Policymakers called on the industry and the private sector to:

- Be less risk averse in energy investments and to continue to invest in R&D to support the shift to low carbon energy.
- Take a greater role in informing and communicating with potential investors the underlying economics of power projects.
- Help support and coordinate coalitions to align behind RD&D necessary for long-term energy technology development.

“We don’t want to waste time reinventing the wheel. We need technology transfer and lower costs”

“We need to focus more on adaption than mitigation”

“Industry needs to view the challenge as an opportunity”

“Affordability is the driver for making energy systems function”

“The private sector is not coming to do charity. It’s coming to do business and for business to succeed the market has to be attractive”

“Polices should not be left as just policy statements but they should be upgraded into law”

“One thing that is lacking, that can`t be done by the private sector, is generating enough technically good projects that can be put up for funding”

“If you provide satisfactory framework conditions for the private sector to come in, they’ll bring the competence and ensure knowledge is transferred”

“It doesn’t work to come off the plane with the answer in your hand”

“It is important not to impose solutions that work in some countries on other countries as you have to understand how it may work in a developing country”

“We don’t have a quick solution to provide energy for all without exploiting all resources”

“Sustainability has to be more than green infrastructure. We also need sustainable human resources”

“The givers of advice have to be sensitive to local conditions – that is critical”

“Government cannot shoulder the cost of development alone”

“Information sharing and spreading best practice is critical to getting projects to work”

5. The new path to sustainability: an opportunity for developing countries

Public stakeholder recommendations

Many developing countries have unbalanced energy profiles that may be low on all aspects of the energy trilemma or skewed towards one of the three dimensions: energy security, energy equity, and environmental sustainability. Yet, they all face similar challenges: how to provide access to the 17% of the world's population that does not have access to electricity and the 41% that lacks access to clean cooking facilities, and how to meet growing energy demand. While least-developed countries must ensure basic energy supply to support economic and social development, some developing and emerging countries are looking to sustain economic growth and to satisfy the aspiration of a growing middle class.

Addressing these energy needs will take significant investments. Unfortunately, lower per-capita GDP, lower contextual performance and speculative debt grades hinder both domestic and foreign investment. As one policymaker in a developing economy noted: *"The private sector is not coming to do charity. It's coming to do business and for business to succeed the market has to be attractive."*

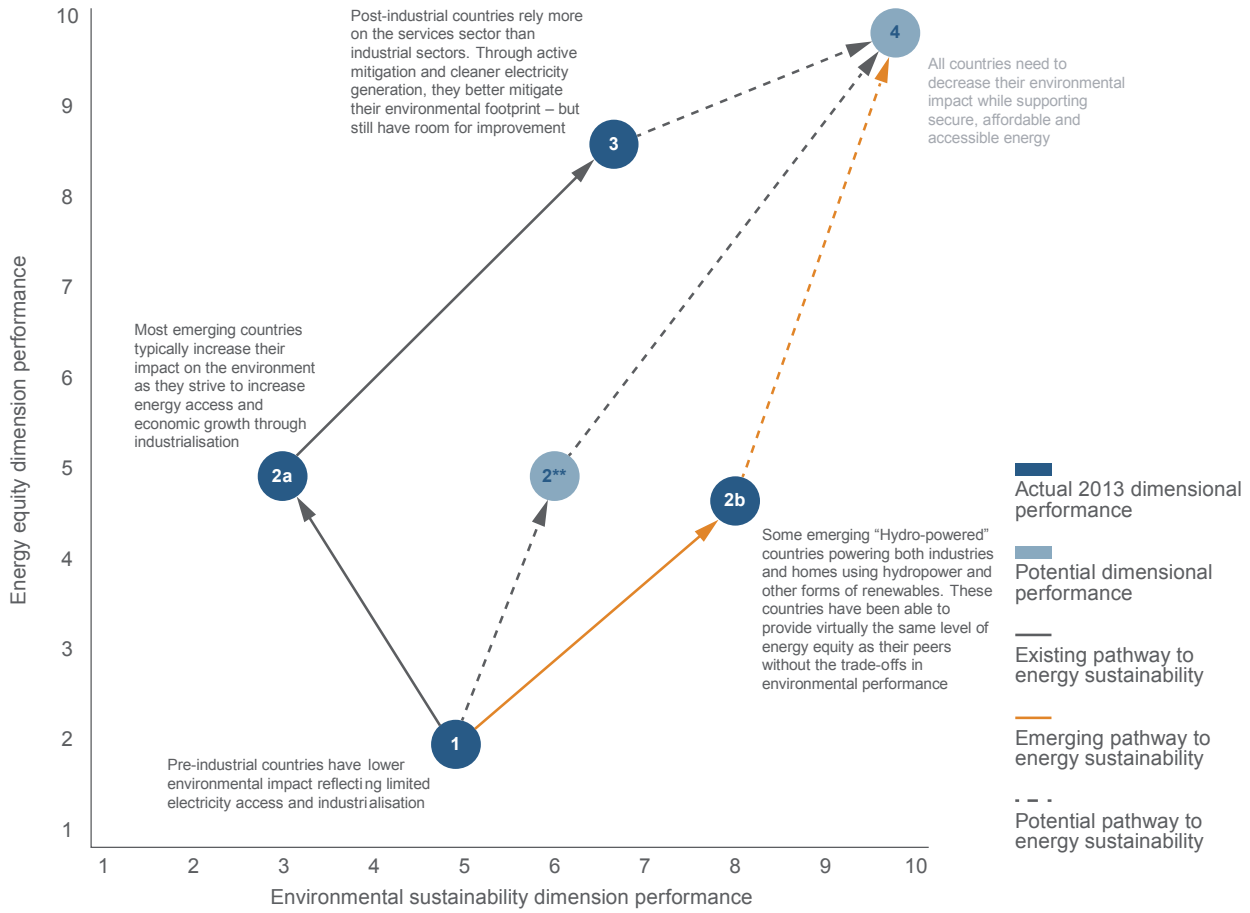
Discussions with public stakeholders on energy sustainability highlight that *"it is not just difficult but impossible to look for a solution that works for all countries. There are too big differences between countries in the entire world."* Each country must chart its own path to addressing the energy trilemma. However, as developing countries try to provide basic access and build an energy sector that can power their economy, are they destined to follow the historic energy path of the twentieth century or will they be able to emerge on a new path to energy sustainability?

Several interviewees pointed to rapid technology developments that could allow least-developed and developing nations to 'leapfrog' the energy transition and not repeat the mistakes of the past. However, governments in Sub-Saharan Africa and Southern Asia countries, where the majority of people without access to modern energy services live, rightfully state: *"We don't ask where the electricity is coming from and whether it is from a green source. First and foremost we want electricity."*

There is an understanding that getting electricity from a 'dirty' source will affect humans and the environment, and that there is limited capacity to address the consequences: *"We cannot concentrate on mitigating the environmental impact of our economies; we have to concentrate more on adaptation to climate change."* Nevertheless, interviewees ask the national and international energy industry and investors to work together on finding a new path for secure, affordable and sustainable energy solutions.

The 'pathways to development' as illustrated in Figure 30 takes the majority of countries through three main stages, but, as the 2013 Energy

Figure 30
Current and potential pathways to development

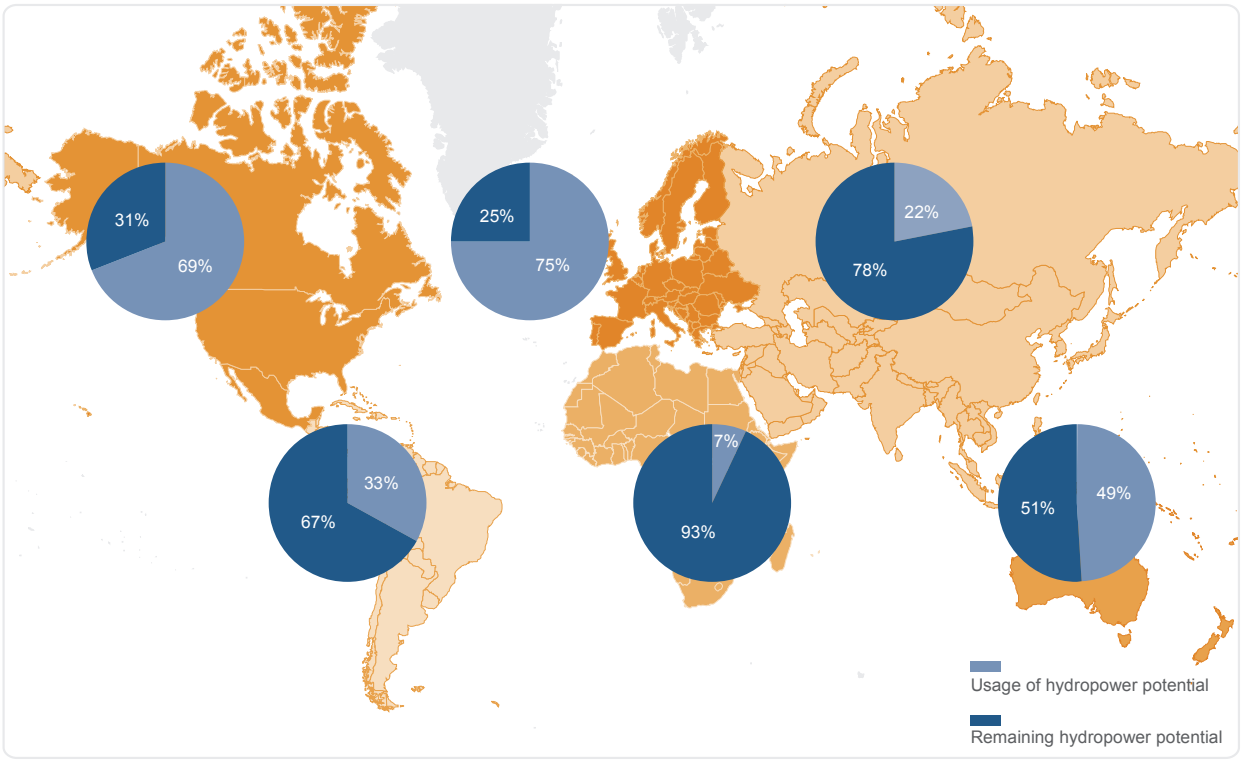


Sustainability Index shows, some countries are beginning to chart a new, more sustainable pathway to energy sustainability by leveraging hydro, solar and wind power.

Historically, emerging countries shifting from pre-industrialised (group 1 in Figure 30) to industrialised (group 2a) economies increase their negative impact on the environment as they increase economic development and access to energy. As these countries with large industrial sectors develop further economically, a less energy-intensive, services-based economy emerges and environmental sustainability improves (group 3). However, by taking a more environmentally conscious and sustainable approach to development, a second group of developing countries (group 2b) has been able to provide equally high levels of energy equity but without sacrificing environmental performance. For example, in Brazil, one of the fastest-growing major economies in the world, hydropower today accounts for more than 80% of the county's electricity generation mix and its increased use has supported sustained economic growth and has increased energy access, while keeping the country's environmental footprint at a relatively low level. A similarly sustainable pathway to development can be seen in a number of other Latin American countries, such as Panama and Uruguay.

This second group of developing countries offers a new, alternative energy development path, with significant advantages in the medium- to longer-term by avoiding being locked in to fossil-fuel dominated infrastructure and could serve as a model to the pre-industrial countries (some of which are in the Back of the Pack Index grouping). To date, the global installed hydropower capacity is estimated at 946 GW with more than 50% of

Figure 31
Global usage and potential of hydropower
Source: WEC, 2010: Survey of Energy Resources



capacity in Asia and Latin America.[81] However, there remains huge potential for hydropower, especially in Africa, South and Southeast Asia, and Latin America (see Figure 31). With proper foresight and adequate investment in renewable energy infrastructure, currently pre-industrialised countries that have large amounts of hydropower potential and are looking to boost economic development – for example, Rwanda, Congo (Dem. Rep.), or Myanmar – can eschew the typical dip in environmental performance that comes with industrialisation.

Some less-developed Hydro-powered countries, such as Ethiopia and Cameroon, are already doing this. Looking beyond hydropower, similar energy development pathway opportunities certainly exist for geothermal, solar and wind power. As a result, this alternative model of sustainable growth is increasingly viable for all industrialising countries – not just those that have been naturally endowed with powerful rivers. One example is Morocco, which has invested heavily in solar and wind power. Hopefully, future editions of the Energy Sustainability Index will see more pre-industrialised countries follow this new, sustainable path to development, rather than the traditional high environmental-impact one.

However, there are a number of barriers and challenges that have to be addressed to put more developing and emerging countries on a new path out of the energy trilemma. Policymakers globally recognise that changing the path to sustainability and overcoming the trajectory relies on the willingness to learn from the experiences and solutions made in other parts of the world. In their aim to create wealth and reduce poverty through sustainable economic and infrastructure development, governments from least-developed, developing and emerging economies ask for support in four inter-related areas:

- Creating attractive policy and regulatory frameworks.
- Generating opportunities for investment.

[81] WEC, 2013: World Energy Resources

- Developing local capacity to establish and maintain an energy sector.

- Developing a path that recognises the knowledge gap and applies proven technology.

Creating attractive policy and regulatory frameworks

While focusing on improving political, economic and social stability is one major way to overall attract foreign investment, concentrating efforts on establishing a robust energy sector may attract additional investment into the sector independent of the sovereign risk rating of a country. As one development bank noted: *"just because a country rating is poor, doesn't mean that the [energy] sector or [power] company rating has an equally poor rating."*

Developing a master plan and subsequently the supporting coherent and predictable policy framework and regulation to establish a robust energy sector is a difficult task. It requires information about local circumstances, including demand projections, human capacity and availability of resources, and builds on experience and know-how of markets, but also the availability and dynamics of technology.

One of the challenges identified by policymakers and regulators is the need for more information from the actual or potential energy sector. In some instances, energy industry may be able to provide that data. For example, to enable policymakers and regulators to make reliable projections and plan properly, they need information, including energy consumption patterns and its expected growth, planned expansion projects, production outputs, and energy imports.

"The coordination of planning between the regulator, the regulated entities, and the government is very critical to ensure that everyone is moving in the same direction. If we don't plan, and those plans are not communicated properly, then you'll never be moving in the same direction."

One of the specific issues for least-developed, developing and emerging economies when attracting both domestic and foreign investment is how to make energy services affordable. For a large share of the population in these countries access to modern energy services is not affordable unless supported by the government. While opportunities exist to engage the private sector, capital remains on the side of investment stalls, as tariffs are often not high enough to encourage the building of the additional, much-needed infrastructure. Policymakers pointed to the challenge of balancing the expectations of industry to build and pay for the infrastructure and receive a return and the individual's assumption that they will be able to afford the services provided. Countries must develop an electricity regulatory framework which provides for both economic and environmental sustainability, while creating an efficient and competitive market that contributes to reduce energy costs.

Developing consistent and stable energy policies and regulation that builds on the collected information then requires a degree of experience,

knowledge and acquired skills which sometimes may not exist within the country itself. Interviewees recognise that least-developed, developing and even emerging economies continue to have a strong need for technical and regulatory framework assistance: *"It's not as if there's nothing being done, but I think more can be done"* and *"advice and knowledge-spreading is really important."* However, when experiences are shared and knowledge is transferred it needs to be with caution and sensitivity to the local conditions of the particular country and market: *"All countries are different, and it doesn't work to come off the plane with the answer in your hand."*

Box 19: Designing a better electricity market: Nigeria's Multi-Year Tariff Order

In 2005 the Electric Power Sector Reform Act was enacted in Nigeria to address the power problems of the country. The generation, transmission and distribution of electricity were dis-aggregated from one state-owned company into 11 distribution companies, six generation companies and one transmission company. Furthermore the Nigerian Electricity Regulatory Commission (NERC) was established to oversee the reform and to ensure an investor-friendly industry and efficient market structure.[82]

According to the NERC the absence of a cost-reflective tariff was the major reason for the problems in Nigeria's power sector. The NERC established a first Multi-Year Tariff Order (MYTO) to provide a 15-year tariff path for the Nigerian electricity supply industry in 2008, with the goal of ensuring a reasonable return on the capital and establishing an incentive-based regulation to considerably improve the performance of the energy industry. The MYTO was developed with the close cooperation of industry, consumers, organised labour, and government with the intention of reducing tariff regulations once the energy sector becomes more competitive.[83]

MYTO 1 was terminated on end of May 2012. It failed because certain projections, for example, forecasts of load, capacity, fuel costs, investment, levels of losses and consumer numbers, were not realised and the tariffs charged were neither sufficient to cover costs nor efficiently collected.

MYTO 2 came into effect in June 2012 and will terminate at the end of May 2017. The new tariffs are intended to be cost-reflective and provide financial motivations for incremental investments in the industry to drive significant improvement in the quantity of energy and quality of service. [84]

Under MYTO 2 tariffs increased and different rates apply for households and heavy consumers like manufacturers, and small-to-medium-sized enterprises who will pay more. To support the poor in both urban and rural areas, NERC has negotiated a federal

[82] Nigerian Electricity Regulatory Commission (NERC), 2013 (www.nercng.org)

[83] Nigeria Electricity Privatisation, 2013 (www.nigeriaelectricityprivatisation.com); NERC, 2013

[84] NERC, 2012: Electricity Prices Are Rising – Why?; allAfrica, 2013: Nigeria: Fixed Charges On Electricity Tariffs Reviewed Yearly (18 June 2013, www.allafrica.com); Oni, A, 2011: Investing in the Nigerian electricity supply industry (5 May 2011, www.businessdayonline.com)

government subsidy for electricity tariffs amounting to N60 billion in 2012 and N50 billion in 2013 respectively. In addition, a Power Consumer Assistance Fund was established to help underprivileged consumers. The securitisation fund consists of the contributions delivered from eligible consumers and any subsidies received from the federal government of Nigeria as appropriated by the National Assembly. It is disbursed to distribution companies for electricity supplied to designated consumers, or classes of consumers.[85]

The price increases under MYTO 2 will cause short-term discomfort. It remains to be seen whether it will deliver the intended results and strengthen the Nigerian energy sector.

Generating opportunities for investment

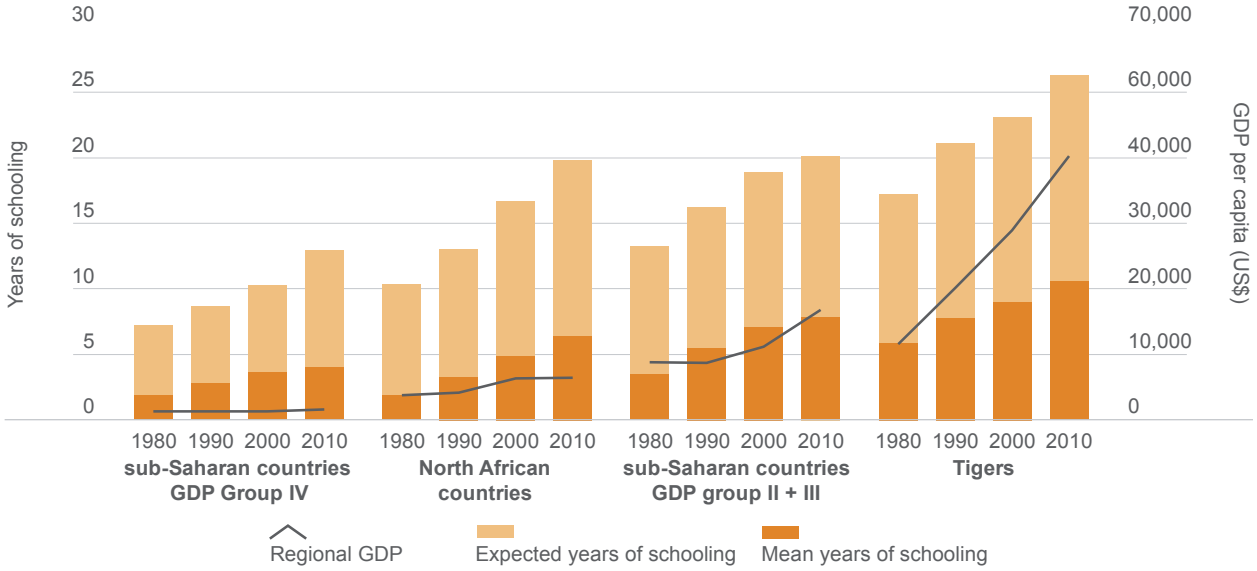
There can be a mismatch between the availability of potential funding and effectively scoped energy projects. *"There are a lot of projects that are interesting for the private sector to be taken up for funding, but because there is too much money flying around from institutions like us or funds [available] there is a crowding-out taking place."* Multilateral development banks are concerned about the lack of 'technically good projects' and note that the currently existing gap could be closed with their support. Development banks stressed the importance of working with countries on developing technically good projects and well-prepared concepts that can then be put up for funding by the private sector. For example, proposing a site for a wind energy project requires wind measurements over a number of years, a hydro project will need long-term hydrological data, geothermal energy projects require exploratory drilling, and so on. Feasibility studies and environmental impact assessments in general are very costly. The private sector may not be able to fund the preparation of such projects alone.

Financial support for feasibility studies is especially vital in helping countries prepare projects for private and public sector involvement. Better data and data gathering can help confirm the expected output, optimal location and layout of a project. Furthermore, it will ultimately decrease related risks, drive the costs of the project down and support overall lower tariffs for consumers. As one policymaker explained: *"If we have data with a project variance of +/- 10% and we go talk to an investor, he is always going to focus on the -10% variance and price accordingly."* In such instances, there is significant payback on the investment for better data preparation that can reduce the cost of capital on a multi-million dollar project.

Policymakers stressed the role of the public development institutions to work with governments on developing bankable projects. One source of funding is project development assistance which the majority of the development banks offer as part of their services to their clients, including central governments, provinces, municipalities, private firms and non-governmental organisations. Furthermore, many development banks have

[85] NERC, 2005: Electric Power Sector Reform Act 2005; NERC, 2012: Electricity Prices Are Rising – Why?

Figure 32
Correlation between human development and economic growth
Source: The World Bank, International Monetary Fund



dedicated feasibility study funds.[86] Both support the development of bankable sustainable energy projects and can include the financing of pilot business models, undertaking market research, preparing feasibility studies, enabling capacity building and supporting learning and dissemination activities.

Developing local capacity to establish and maintain an energy sector

Policymakers acknowledge that the lack of available experience and know-how, as well as human capital in general, makes it difficult to create the right circumstances to attract investment and sustain the initial benefits. The importance of human capital to economic growth can perhaps be illustrated by the outstanding records of Japan, Taiwan, Hong Kong, South Korea, and other fast-growing East Asian economies. These East Asian economies have grown rapidly since the 1950s despite a lack of natural resources, in part due to a focus on developing a well-trained and well-educated labour force (see Figure 32).

Despite the availability of fossil fuel reserves – such as coal, oil and natural gas – and the great potential for the exploitation and use of renewable energy resources – in particular hydro and solar – regions like Sub-Saharan Africa and Southern Asia remain the least-developed areas in the world with the lowest levels of human development.

One of the major barriers affecting the energy sector in those countries is the lack of human capital, especially the availability of technical and management skills. 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 construction, operation and maintenance of much-needed energy infrastructure. Currently, *"based on the availability of local human capacity there are limitations as to what can be done."*

Box 20: Enabling local economic development

In 2004 the Washington-based non-profit organisation, EnterpriseWorks/VITA, implemented a pilot wind power project Power to the Poor in Ghana. The goal was to increase availability of electricity for poorer rural communities where an estimated 83% of rural households did not have access. Project partners were the local Renewable Energy and Environment Systems (Ghana) and the UK-

[86] For list of Feasibility Study Funds, see Infradev site: www.globalclearinghouse.org/infradev/content.cfm?id=33

based company Scoraig Wind Electric. The project had a budget of approximately US$176,000 and was funded by the World Bank Development Marketplace. [87]

To support local economic development, a sustainable market for small-scale wind power systems that are entirely built in communities without grid connection had to be created. During the one-year project, nine off-grid wind turbines were installed at different rural communities by a group of 17 local technicians who were trained in design, construction, installation, and operation of wind energy-generation equipment. The wind turbines were built with mostly locally available material and local capacity. As a result, the units cost only half the price of imported energy technology and the facilities could be repaired by local trained technicians. The Power to the Poor project demonstrates how remote communities in least-developed, developing and emerging economies can be empowered to maintain renewable energy systems locally while stimulating economic growth.[88]

Governments recognise the lack of knowledge and skills in the energy sector and ask for continued support from the energy industry – *"There is a big role for the private sector to play in skills and capacity building for the energy sector"* – but also for public development institutions. Universities and other educational institutions, departments of mechanical, agricultural or electrical engineering teach the fundamental principles of science and mathematics in systems design. However, most may not cover topics such as energy production, delivery and utilisation, renewable energy, energy management and efficiency or energy economics, policy and regulation. As one policymaker noted: *"The private sector could support setting up high-quality technical schools that are not too expensive but where skills and knowledge is transferred. We are open to grant licences to the private sector, to private groups that want to get involved in capacity building."*

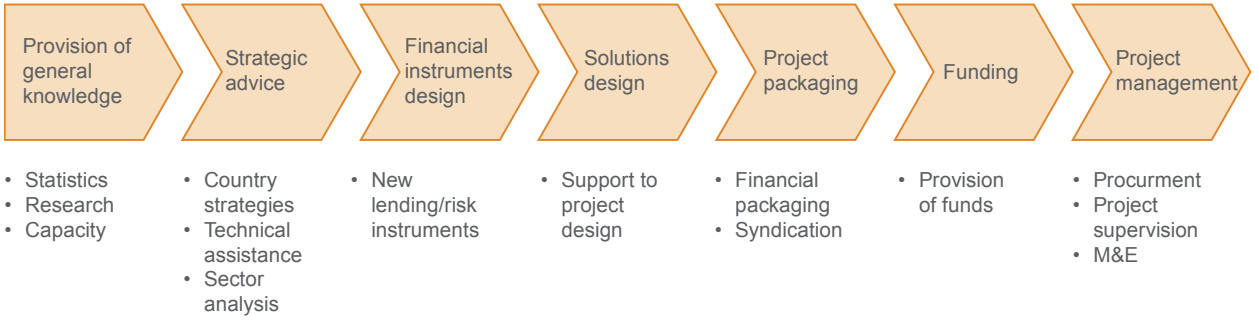
Box 21: Money alone cannot solve the problems

To achieve growth and reduce poverty, investments combined with increased knowledge and know-how transfer is necessary. The success of every project depends on the people who implement and sustain it. However, in many less-developed and developing countries, the existing human capacity is not sufficient. The development of human capacity is a centrepiece of technical assistance programmes and projects carried out by development banks in order to achieve long-term and lasting effects.

Between 2007 and 2010 the Asian Development Bank (ADB) allocated approximately 40% of its funds for technical assistance to capacity development in order to improve the technical, managerial, and financial capabilities of recipients to strengthen

[87] Darroll, L,2004: Turning Wind Turbines in Ghana (African Energy Journal)
[88] Enterprise Works/VITA, 2013: *Power to the Poor in Ghana* (www.enterpriseworks.org)

Figure 33
Capacity building – the first step in the project value chain
Source: African Development Bank Group, 2008: Medium-Term Strategy 2008–2012



organisations and institutions implementing, operating and managing ADB-financed projects.[89]

The African Development Bank identified insufficient human capacity in public and private sectors in Africa as a major impediment to the attainment of poverty-reduction goals. The bank therefore includes capacity building in almost all its operations, projects and programmes as well as in its national strategy papers, regional integration strategy papers and sector strategies.[90] Capacity building is the first step in every project value chain (see Figure 33).

Interviewees agree that public-private partnerships, especially in developing and emerging economies, have great potential to be successful in pursuing various objectives, such as to bring affordable, sustainable energy to the poor, to raise the standard of living for recipients, and to transfer skills and build human capacity.

Developing a path that recognises the knowledge gap and applies proven technology

Governments describe the path for a developing economy's energy sector similarly: *"First we have to realise that we need to build our own capacity. Second is to gear our capacity to adapting technologies that have been developed somewhere else and see what we can do with our own local resources. And third, we may come up with new technologies in areas that we think we have a comparative advantage in."*

However, currently, when it comes to new clean energy technology, many countries have adopted a policy of cautious technology followers rather than early adapters. For example, carbon capture and storage is currently a relatively expensive technology, and many countries with their limited funds therefore prioritise power generation.

With the apparent shortage of skilled people and the limited funds for energy infrastructure development, less-developed and developing economies tend to apply tried and tested technologies, and focus capacities on adapting technologies that have been developed elsewhere. Local content and technology transfer requirements need to be well thought through before being established so they do not dissuade potential vendors with the potential infringement of intellectual property rights. *"What we are trying to do is to see we don't waste too much time reinventing the wheel but only focus on retro-fitting to site specifications."*

Policymakers ask for support in exploring ways to reduce the cost of technology transfer: *"We are battling to reduce the importation cost of technology from countries such as Germany and China. For example, is there a way to reduce the cost for solar photovoltaic projects which are being set up in five different African countries at the same time by one supplier? How can we improve regional coordination?"*

[89] Asian Development Bank, 2010: Capacity Development Action Plan: Annual Progress Report 2010
[90] African Development Bank Group, 2010: Bank Group Capacity Building Strategy

Box 22: The Clean Development Mechanism – a win-win opportunity?

The Clean Development Mechanism (CDM) promotes collaboration among developing nations, developed nations and the private sector by helping developing countries to achieve sustainable development and developed countries to meet their emission reduction targets. CDM projects are usually implemented in developing countries where they generate certified emission reduction credits (CERs) which may then be transferred to other entities – developed countries – to counterbalance or offset GHG emissions.

Due to a combination of financial and capacity barriers, only about 3% of CDM projects registered with the UNFCCC are in Africa. However, there are numerous good practice examples in the region of how carbon finance can be a win-win opportunity both for host countries and its partners.

One of those examples is the 35 MW Bagasse Based Cogeneration Project in Kenya which is sponsored and operated by the local Mumias Sugar Company Limited. The goal of the project was to expand Kenya's power capacity to meet the increasing demand for electricity by generating electricity using sugarcane – GHG-neutral biomass (bagasse) – on site. Japan Carbon Finance committed to purchase the CERs generated and fund some of the CDM transaction costs. No other public funding was required. The project was designed to generate 35 MW of electricity with 10 MW for internal consumption by the factory and 25 MW available for 'export' to the national grid. It planned to install a new 25 MW turbine, and to continue using the existing 12 MW generation capacity. The overall GHG emission reductions were expected to be 1,295,914 tCO_2e between 2008 and 2018, achieved by replacing grid electricity with bagasse electricity generation, plus methane abatement by avoiding bagasse decomposition.[91]

The first monitoring report published in March 2012 shows that the project has led to an emission reduction of 140,544.8 tCO_2 over 24 months. Due to some 'teething problems' this is at a lower rate than the original estimate of 129,627 tCO_2 over 12 months of steady operations.

The installed 34.2 MW turbo-generator is considerably larger than the originally proposed 25 MW turbine. Originally registered as a large-scale project, this result of design optimisation is not considered material to the integrity or additionality of the emission reductions claimed. The report finds that, since commissioning in February 2009, the project has contributed to the sustainable development of Kenya in many different ways, such as, the conservation of fossil fuels and the improvement of local air quality. The project has contributed to the economic development, as several local businesses supply goods to the company or to the staff. A significant proportion of all goods for the project – more than 20% – were purchased locally. During the construction, about 1,000 workers were employed and for the operation 11 permanent positions were created. In

[91] UNFCCC, 2008: 35 MW Bagasse Based Cogeneration Project (CDM, Project 1404, project design document)

Figure 34
Regional distribution of CDM projects
Source: UNEP Risoe Centre, 2013

Total in the CDM pipeline	Number of projects	Percent of total (%)	2012 kCERs	Percent of total (%)	Population (mio.)	2012 CER per capita
Latin America	1,193	13.5	330,363	13.9	449	0.74
Asia & Pacific	7,212	81.3	1,909,303	80.1	3,418	0.56
Europe and Central Asia	97	1.1	25,194	1.1	149	0.17
Africa	260	2.9	84,947	3.6	891	0.10
Middle East	104	1.2	32,472	1.4	186	0.17
Less developed world	**8,866**	**100.0**	**2,382,279**	**100.0**	**5,093**	**0.47**

CERs - Certified emission reduction units, 1 kCERs = 1,000 CERs

addition, local banking systems, communication systems, accounting offices, legal advisers and professional consultants were engaged in the process. Furthermore, the project helped improve economic sustainability, as it contributed to the production of more reliable energy by reducing Kenya's overreliance on hydropower when it is highly susceptible to droughts. Lastly, the sale of CERs generated will boost the financial viability of the project.[92]

Despite the number of successful projects in Africa, there are improvements to be made to the CDM to enable a broader number of countries to gain meaningful access to its benefits. The High-Level Panel on the CDM Policy Dialogue stated that it is crucial to create more demand for international carbon transactions in order to generate more opportunities for low-income countries with currently low levels of emissions to participate in the CDM. The lack of demand has resulted in a sizeable overhang of carbon credits from the CDM. There is an urgent need to address the supply and demand imbalance if the CDM is to be revitalised. In addition, the High-Level Panel recommends that the CDM should enhance its openness, transparency and opportunities for stakeholder participation as well as reduce costs and delays.[93] Furthermore, some countries, especially in Africa, require a simplification of the applying procedures.[94]

Without overcoming these barriers, the opportunities the CDM could provide will remain largely untapped, especially in Africa but also in some of the other least-developed countries.

When technologies are transferred from 'north to south' and adopted locally, know-how gets shared, the local population and workforce learn how to use it, and installation and service teams provide a foundation for further sharing of technology and follow-on innovation. By the end of 2012 only 3% of CDM projects registered by the UNFCCC are in Africa compared to more than 80% in the Asia and Pacific region (see Figure 34). Policymakers recognise that there is more potential to utilise international sources of carbon financing, such as CDM or the World Bank's Carbon Finance Unit, to bring investment and clean energy technologies to less-developed regions. But there are a number of capacity and financial barriers including, as discussed earlier, insufficient human capacity to meet project needs or the lack of regional and institutional coordination as well as perceived high risk, uncertain and slow returns, high start-up costs or limited funding sources.

Summary

Today, close to 1 in 5 of the global population is without access to electricity and 4 in 10 lack access to clean cooking facilities, mostly concentrated in Sub-Saharan Africa, Eastern Asia, Southern Asia, and South-Eastern Asia. For the most part these economies still have a relative low impact on the global environment, which may increase as they industrialise and their economy grows, and as access to modern energy services expands and

[92] UNFCCC, 2012: 35 MW Bagasse Based Cogeneration Project (CDM, Project 1404, monitoring report)
[93] CDM Policy dialogue, 2012: Climate Change, Carbon Markets and the CDM: A call to action
[94] NEPAD-OECD Africa Investment Initiative, 2009: Boosting Africa's Energy Sector through Carbon Finance

poverty reduces. As they evolve along the development path less-developed, developing and emerging nations of Asia and Africa have the opportunity to adopt a different trajectory during development stages. To do so, they need support from the international community in four interrelated areas:

- Creating attractive policy and regulatory frameworks.
- Generating opportunities for investment.
- Developing local capacity to establish and maintain an energy sector.
- Developing a path that recognises the knowledge gap and applies proven technology.

Lastly, as part of the engagement of the international community in supporting the economic and social development, public stakeholders encourage the private sector especially to capture and share the experiences made when investing in least-developed, developing and emerging countries.

"It's a dance between the public and private sector with each saying 'You first'. We have to get out of that Catch-22"

"We cannot go on thinking that we are separate entities in the same country"

"You have to be passionate about finding solutions"

"Cleaning up the environment goes beyond just a clean environment - it's a trade issue"

"The private sector has to accept that it is not possible to create perfect conditions for everybody in all dimensions"

"Risk has to be given to the person who is best placed to be able to manage it"

"If you get the investment climate right, the money will pretty much follow"

"The private sector will play a major role in sustainable energy systems worldwide by providing the capital financing, the technology and the know-how"

"More regional policies on carbon emission are needed, if this issue cannot be handled globally"

"Will the tipping point for sustainable energy be reached because of the recognition of the opportunity?"

"Sustainable energy is always a vision that each country would like to achieve. But it's all talk, where is the action?"

"We rely on the industry to come up with innovations, to do the research, and we as governments must make sure that the playing field is level"

"There is a role for government to play in commercialization to the extent that we can identify non-economic, non-market barriers that are impeding promising technologies from moving forward"

"Look how much has been accomplished in the past 20 years and imagine what we will be able to accomplish in the next 20 years"

"We cannot get ahead of where technology and markets can realistically reach or lock ourselves in solutions that in five years will be obsolete"

6. Conclusion

Energy is fundamental to human society, social development and economic growth. It benefits people far beyond what they use individually at home, at work or on the road, and is critical to the development of a modern economy – be it for agriculture, transport, computing, manufacturing construction, education or health and other social services. Perhaps surprisingly, the United Nations' eight Millennium Development Goals for 2015, established in 2000, did not include increasing access to modern energy services. Securing sustainable energy is expected to be among the international development goals proposed for the UN's Post-2015 Development Agenda and will capture the three targets of the UN's Sustainable Energy for All initiative:

- Ensure universal energy access to modern energy services.
- Double the global rate of improvement in energy efficiency.
- Double the share of renewable energy in the global energy mix.

The focus on energy is a recognition, as Secretary-General Ban Ki-moon noted, that *"energy is the golden thread that weaves together economic growth, social equity, and environmental sustainability."*

The importance and benefits of sustainable energy are clear. But creating a policy framework to achieve those goals remains a challenge for all countries. This fifth edition of the Energy Sustainability Index captures the three objectives of the Sustainable Energy for All initiative as part of the three energy dimensions – energy security, energy equity, and environmental sustainability. The newly introduced balance score highlights countries closest to achieving what the WEC defines as sustainable energy systems, and also identifies that all countries struggle with the trade-offs among the dimensions. This is known as the trilemma of energy sustainability.

Analysis of the 2013 Energy Sustainability Index drew out five illustrative profiles of the energy trilemma that highlight a few common situations in the hopes that public and private sector decision makers can learn from one another. For example, the challenges facing exporting countries were examined, the experiences of countries that have a high share of renewables or hydropower were illustrated, and the trade-offs which fast growing economies have to manage were explored.

In the 2012 *World Energy Trilemma report: Time to get real – the case for sustainable energy policy*, policymakers were provided with clear feedback from over 40 energy industry CEOs and senior executives from across the sector and around the world about the policy frameworks they need to develop to unlock investment and overcome the energy trilemma. Three interconnected critical policy areas were identified:

- Predictable and durable energy policies that go beyond political cycles with defined goals, enacted by clear regulations lie at the cornerstone of a sustainable energy system.

- Private sector investment in energy infrastructure must be supported by consistent, stable regulatory and legal frameworks, and effective use of market-based economic instruments.

- Public and private initiatives that enable innovation as well as RD&D are necessary to transform the way energy is produced and used.

All three areas require cooperation and collaboration between the public and private sectors.

In 2013, policymakers addressed these recommendations from industry. The critical role of the three interconnected policy areas were recognised and accepted in interviews with more than 50 ministers for energy and the environment, senior policymakers, and regulators, as well as high-level representatives from inter-governmental organisations. Public stakeholders highlighted areas where the energy industry needs to take on a more active role.

The lack of an agreement on the target profile of a future energy system exacerbates other policy challenges, including the challenge of designing policies in the face of a shifting energy sector, emerging technologies and changing energy use, and the inherent difficulties in crafting and implementing national policies. To overcome these hurdles, interviewees look at the energy industry to:

- Engage in the ongoing climate negotiations by sharing information and knowledge on implications, realistic targets, and potential alternative approaches to achieving targets.

- Play a broader role in change management and communication with the general public to increase understanding and help build a national consensus and long-term vision on energy goals.

- Be proactive in sharing knowledge, insights and experiences with policymakers and regulators as they push for better market conditions and regulations.

- Engage with other stakeholders to identify approaches and mechanisms to allocate risks associated with long-term energy infrastructure investments and the development of new technologies to those best suited to manage it.

- Take a lead role in investments to fill the energy gap and support the transition to low-carbon energy systems and help to increase investments by non-traditional energy investors (including institutional investors).

While it was recognised that it is impossible to find mechanisms and processes that work for all countries, and that each country must chart its own path, it was agreed that least-developed, developing and also emerging economies have the opportunity to emerge on a new path to sustainability. This requires willingness to learn from the experiences made and solutions developed in other parts of the world. But it also requires support in four interrelated areas:

- Creating attractive policy and regulatory frameworks.
- Generating opportunities for investment.
- Developing local capacity to establish and maintain an energy sector.
- Developing a path that recognises the knowledge gap and applies proven technology.

At a time where the energy sector – both public and private – faces the challenge of meeting an unprecedented need for investment to broaden access to energy in developing countries, to replace ageing legacy infrastructure in developed countries, and to drive the deployment of cleaner technologies globally it is necessary to move beyond the old paradigms and emerge on a new path of joint action to make sustainable energy systems become a reality.

Appendix A: Public stakeholder participation

The WEC and Oliver Wyman would like to thank the following energy and environmental ministers, policymakers, government officials, representatives from multilateral development banks, inter-governmental organisations, experts and their teams for taking the time to talk to us during the preparation of this report and taking an active role in driving forward this critically important dialogue regarding our global energy future. Your perspectives and insights on key concerns for government policymaking have been very helpful and enriched the process greatly.

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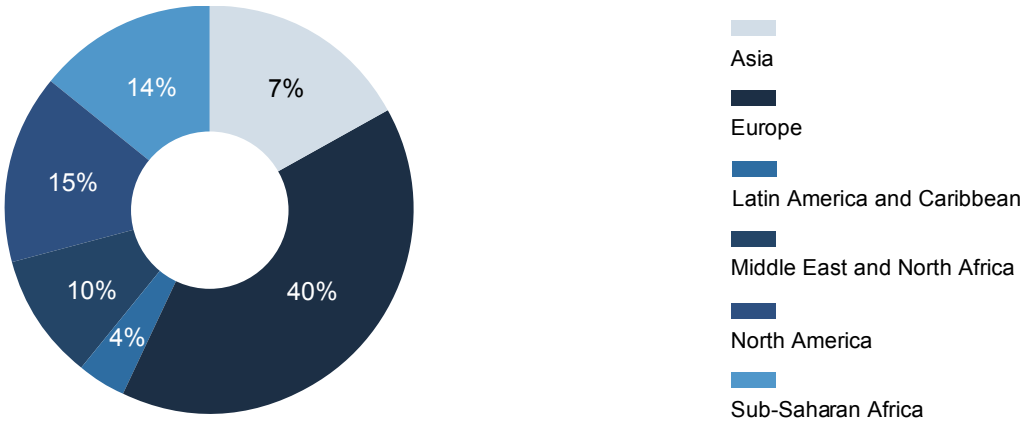
Figure A-1
Geographical representation of interviewees



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Namibia

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Appendix C: Index methodology and balance score system

The Energy Sustainability Index (the 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 both 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.

This year, 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 the companion report *World Energy Trilemma: 2013 Energy Sustainability Index*.

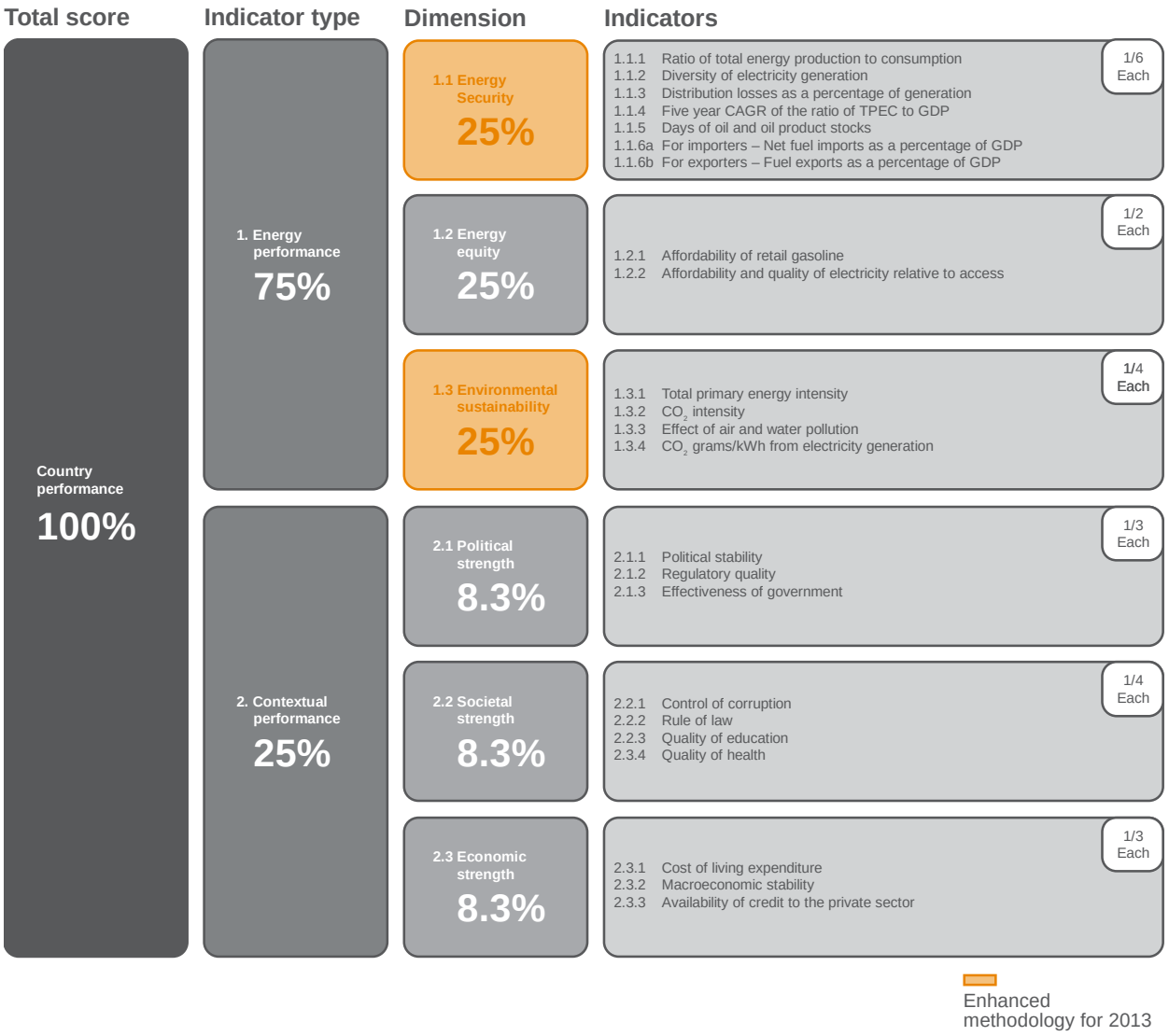
Indicators were selected based on the high degree of relevance to the research goals, exhibited low correlation, and could be derived from reputable sources to cover a high proportion of WEC member countries. For the first time the Index also includes 37 non-WEC member countries and now measures the 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 factor 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 policy 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.

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 2010–2012. Recent world events that could affect the Index's outcomes are not completely captured. This includes, for example, turbulence in global nuclear power industry due to Fukushima nuclear accident, or the

Figure C-1
Index structure



political unrest in the Middle East. Further, policies generally take two to three years to become fully implemented and it may take longer for their effects to become evident.

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.

Index results by GDP group

To understand how each dimension of the Energy Sustainability Index is affected by wealth, countries were also organised in 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 C-5 present the rankings of each country within these GDP groups.

Figure C-2
Country ranking for GDP Group I

GDP group rank	Country	Importer/ Exporter	Energy security	Energy equity	Environmental sustainability	2013 Index
1	Switzerland	I	19	6	1	1
2	Denmark	E	3	25	10	2
3	Sweden	I	24	14	6	3
4	Austria	I	33	7	7	4
5	United Kingdom	I	11	8	19	5
6	Canada	E	1	2	60	6
7	Norway	E	51	10	8	7
8	France	I	44	5	9	10
9	Germany	I	31	11	30	11
10	Netherlands	I	42	23	35	12
11	Finland	I	37	21	45	13
12	Australia	E	10	3	97	14
13	United States	I	12	1	86	15
14	Japan	I	48	17	33	16
15	Belgium	I	63	13	34	17
16	Qatar	E	8	9	95	18
17	Luxembourg	I	107	4	29	19
18	Ireland	I	82	30	15	20
19	Taiwan, China	I	71	22	59	27
20	Iceland	I	96	15	41	33
21	Hong Kong, China	I	99	24	58	40
22	United Arab Emirates	E	49	37	102	44
23	Singapore	I	124	43	51	47
24	Kuwait	E	73	28	122	66

Figure C-3
Country ranking for GDP Group II

GDP group rank	Country	Importer/ Exporter	Energy security	Energy equity	Environmental sustainability	2013 Index
1	New Zealand	I	15	26	37	8
2	Spain	I	22	16	23	9
3	Slovakia	I	20	38	48	22
4	Portugal	I	55	53	20	23
5	Slovenia	I	60	27	42	25
6	Argentina	I	14	33	38	26
7	Italy	I	69	34	24	28
8	Croatia	I	66	31	21	30
9	Hungary	I	46	42	44	31
10	Czech Republic	I	16	32	90	32
11	Malaysia	E	34	40	92	37
12	Bahrain	I	23	19	125	38
13	Greece	I	54	18	81	39
14	Mexico	E	29	47	75	41
15	Lithuania	I	93	46	26	42
16	Latvia	I	98	54	14	43
17	Uruguay	I	92	67	5	46
18	Poland	I	38	39	94	48
19	Barbados	I	118	41	25	50
20	Saudi Arabia	E	45	12	124	51
21	Mauritius	I	109	60	16	53
22	Russia	E	2	61	99	54
23	Gabon	E	35	92	12	56
24	Chile	I	90	56	72	57
25	Oman	E	78	20	120	62
26	Cyprus	I	104	36	80	63
27	Korea (Rep.)	I	103	49	85	64
28	Israel	I	102	29	83	67
29	Estonia	I	65	51	117	68
30	Malta	I	128	48	65	71
31	Turkey	I	64	82	70	75
32	Trinidad and Tobago	E	79	95	115	98
33	Botswana	I	126	97	62	99
34	Lebanon	I	127	87	89	109

Figure C-4
Country ranking for GDP Group III

GDP group rank	Country	Importer/ Exporter	Energy security	Energy equity	Environmental sustainability	2013 Index
1	Costa Rica	I	57	45	2	21
2	Colombia	E	5	85	4	24
3	Panama	I	53	58	18	29
4	Brazil	I	27	86	17	34
5	Ecuador	E	25	62	28	35
6	Tunisia	I	28	57	56	36
7	Peru	I	21	96	43	45
8	El Salvador	I	68	64	11	49
9	Romania	I	9	70	88	52
10	Kazakhstan	E	6	35	116	58
11	Albania	I	87	76	3	60
12	Bulgaria	I	26	77	108	70
13	Paraguay	E	84	99	13	74
14	Egypt	E	47	59	84	76
15	Venezuela	E	41	55	82	77
16	China	I	18	101	126	78
17	South Africa	E	43	78	128	79
18	Azerbaijan	E	32	74	98	81
19	Montenegro	I	115	71	57	83
20	Macedonia	I	89	50	106	86
21	Algeria	E	86	68	74	88
22	Thailand	I	91	88	101	89
23	Namibia	I	123	94	49	90
24	Iran	E	75	44	119	91
25	Ukraine	I	59	73	114	97
26	Serbia	I	101	65	118	106
27	Dominican Republic	I	114	106	55	110
28	Jamaica	I	116	81	110	121

2013 Index profile groups

To support decision makers, the 2013 Energy Sustainability Index analysis highlights five distinct profiles:

- Pack Leaders
- Fossil-fuelled
- Highly-industrialised
- Hydro-powered
- Back of the Pack.

Countries in each group share common energy trilemma characteristics and challenges.

While only 45 of the 93 WEC member countries are included in the five illustrative groups, other countries may be closely associated with one group from a regional, economic, or structure-of-the-energy-sector point of view. About 20 countries 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 *World Energy Trilemma: 2013 Energy Sustainability Index* to consider which energy profile serves as a guide for a particular country.

The following list indicates which profile group WEC member countries not included in the five profile groups may be closely associated with:

- **Pack Leaders:** Argentina, Belgium, Croatia, Finland, Ireland, Italy, and Japan
- **Fossil-fuelled:** Bahrain, Iran, Syria, and Ukraine
- **Highly-industrialised:** Gabon, Korea (Rep.), and Nigeria
- **Hydro-powered:** Albania, Angola, Congo (Dem. Rep.), and Ghana
- **Back of the Pack:** Botswana, Kenya, Namibia, Niger, Serbia, and Tanzania

Figure C-5
Country ranking for GDP Group IV

GDP group rank	Country	Importer/ Exporter	Energy security	Energy equity	Environmental sustainability	2013 Index
1	Bolivia	E	4	84	71	55
2	Angola	E	7	104	31	59
3	Guatemala	I	40	75	36	61
4	Philippines	I	39	93	54	65
5	Sri Lanka	I	72	80	40	69
6	Georgia	I	106	66	22	72
7	Indonesia	E	17	83	104	73
8	Congo (Dem. Rep.)	E	30	121	27	80
9	Cameroon	E	62	107	39	82
10	Nigeria	E	13	111	79	84
11	Armenia	I	95	69	73	85
12	Syria	E	52	52	113	87
13	Swaziland	I	61	98	76	92
14	Côte d'Ivoire	E	36	108	68	93
15	Malawi	I	74	129	32	94
16	Mongolia	E	50	100	129	95
17	Jordan	I	119	63	107	96
18	Honduras	I	111	90	52	100
19	Vietnam	E	77	102	105	101
20	Ghana	I	85	105	77	102
21	Mozambique	E	67	124	66	103
22	Chad	E	83	123	50	104
23	Morocco	I	110	79	96	105
24	Tajikistan	I	81	109	61	107
25	Kenya	I	88	114	63	108
26	Nepal	I	125	122	46	111
27	Ethiopia	I	97	119	47	112
28	Nicaragua	I	100	91	87	113
29	Pakistan	I	56	103	100	114
30	India	I	76	110	121	115
31	Tanzania	I	117	125	53	116
32	Libya	E	70	72	123	117
33	Cambodia	I	121	113	67	118
34	Mauritania	I	58	117	112	119
35	Zambia	I	108	120	64	120
36	Niger	I	80	127	91	122
37	Bangladesh	I	113	115	78	123
38	Madagascar	I	105	126	69	124
39	Moldova	I	122	89	109	125
40	Senegal	I	120	118	93	126
41	Yemen	E	94	112	111	127
42	Benin	I	129	116	103	128
43	Zimbabwe	I	112	128	127	129

2013 Methodology enhancements

The Index methodology was enhanced in 2013 to better assess countries' ability to mitigate their environmental impact and to provide energy security and energy equity. To enable year-on-year comparison, the previous three years are recalculated to reflect Index methodology changes. The 2011 and 2012 Index rankings included in this year's report have been updated in order to enable comparisons between years (see Figures C-8 and C-9).

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 a coverage of different issues.

4) Contextual sensitivity: Indicators capture different country situations (for example, wealth, size) and where appropriate indicators are normalised by GDP (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 common unique source to ensure comparability between countries.

Changes to energy security dimension

A number of improvements were made to the indicators in this dimension. The overall goal was to reduce the volatility of the dimension results, capture the link between economic growth and energy consumption, ensure a common treatment of energy exporters and importers, and add an indicator that addresses the quality and reliability of the electricity infrastructure.

Improvements made to address the challenges mentioned include:

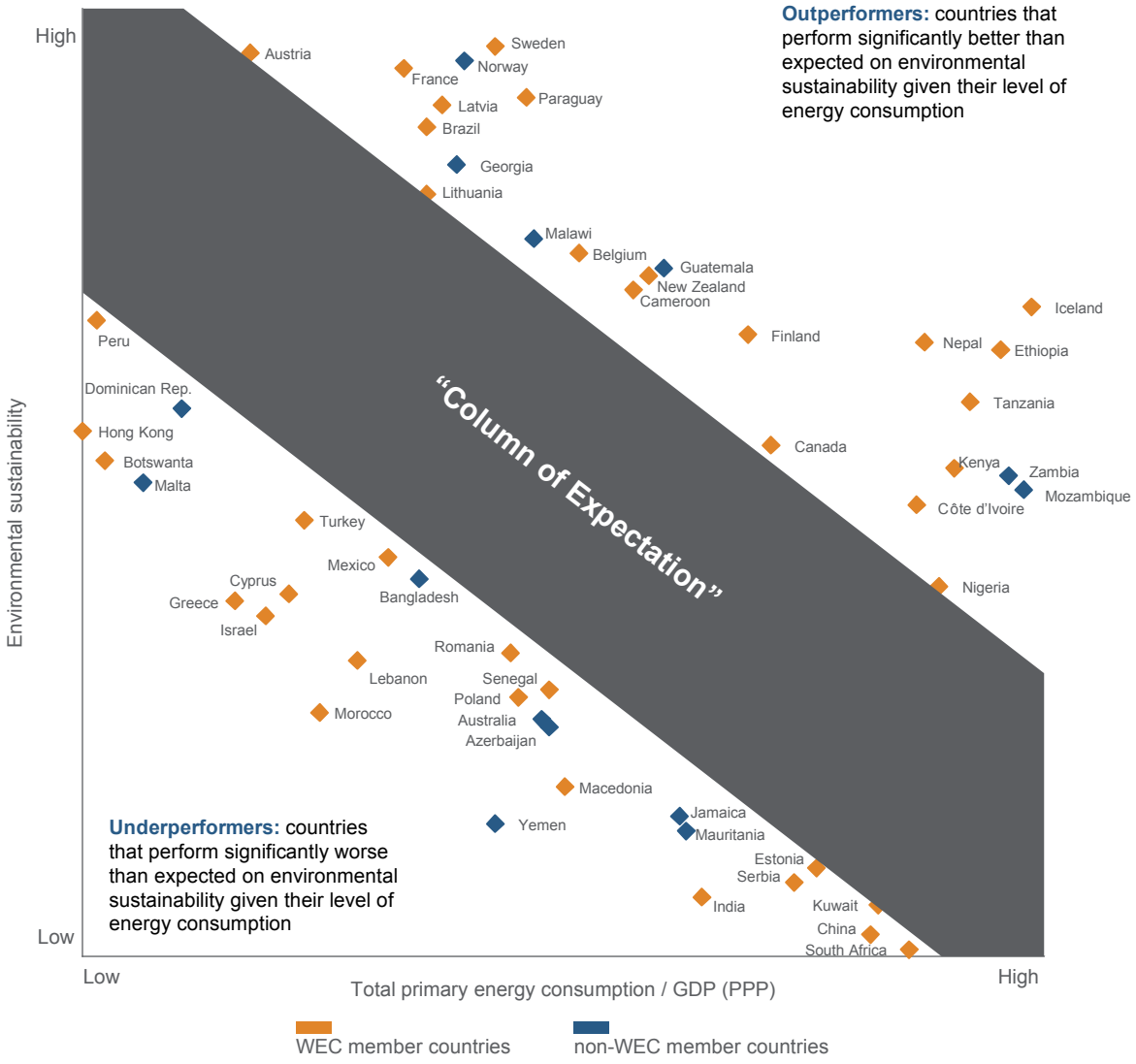
- Modifying the former five-year compound annual growth rate (CAGR) energy consumption by linking it to a country's GDP growth over the same time period.
- Adding an indicator that captures distribution losses as percentage of generation and the reliability of the power system to reflect the quality of power infrastructure and efficiency of energy systems.
- Adjusting the indicator previously used to measure oil stocks of energy importers with a common indicator for both importers and exporters that examines products stocks, crude production and crude stocks.
- Adjusting the indicator previously used to measures a country's dependence on energy exports by adding a similar indicator for energy importing countries looking at a country's dependence on energy imports (fuel imports / exports as % of GDP).

The indicators measuring the ratio of energy production to consumption and diversity of electricity generation remained untouched (see Figure C-1).

Changes to energy equity dimension

The data source for the indicator for electricity access was updated to the recently published data from the UN's Sustainable Energy for All Global Tracking Framework. The May 2013 report is a comprehensive snapshot of more than 170 countries. The WEC was part of the Sustainable Energy for All steering group, which was responsible for the development of the report. In the report, 2010 is established as the baseline year against which progress will be measured. The Energy Sustainability Index uses the established baseline data for all three Index years calculated.

Figure C-6
Environmental sustainability results identify underperformers and outperformers
Source: EIA, 2011; IMF, 2011; Oliver Wyman analysis



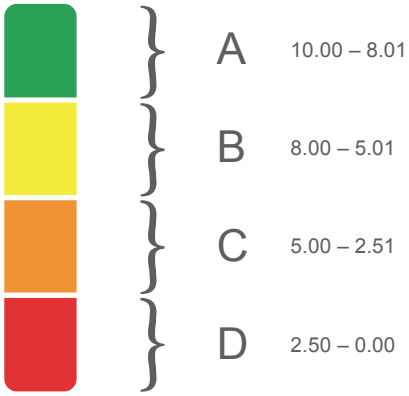
Changes to environmental impact dimension

The 2012 methodology used to calculate the environmental impact of a country's energy system was replaced. The changes are geared to acknowledge the high priority of CO_2 emission reduction and energy-efficiency policies better. The assessment of a country's environmental sustainability is based on the following four indicators:

- Total primary energy intensity: measures the total amount of energy necessary to generate one unit of GDP
- CO_2 (emission) intensity: measures CO_2 emissions from fuel combustion by GDP
- CO_2 emissions per kilowatt hour of electricity generated
- Effects on air and water.

With this methodology, industrialised countries sometimes score lower than non-industrialised countries, reflecting a reality policymakers are facing as a higher environmental impact is driven by a country's economic (industrial) policy (see Figure C-6).

Figure C-7
Balance score system



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 balance across 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 – energy security, energy equity, and environmental sustainability – only and leaves performance in the three contextual dimensions – political, societal and economic strength – aside.

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 in 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 rather 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'. Mediocre results of between 2.51 and 5 were given a 'C'. Lastly, the score 'D' was given for underperformance.

Figure C-8
2012 Energy Sustainability Index ranking

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-9
2011 Energy Sustainability Index ranking

Index	Country	Energy security	Energy equity	Environmental sustainability
1	Switzerland	26	4	1
2	Denmark	3	28	16
3	Sweden	13	26	6
4	United Kingdom	6	10	21
5	Austria	31	11	7
6	Norway	44	7	5
7	France	40	6	9
8	Canada	2	2	61
9	New Zealand	20	15	40
10	Germany	23	14	32
11	Finland	22	16	44
12	Spain	37	20	23
13	Japan	46	8	31
14	Netherlands	48	27	35
15	Australia	14	3	101
16	United States	19	1	90
17	Luxembourg	96	5	26
18	Belgium	70	9	34
19	Qatar	16	19	97
20	Slovenia	56	25	38
21	Argentina	7	21	46
22	Ireland	84	35	17
23	Slovakia	24	42	43
24	Taiwan, China	64	17	65
25	Portugal	59	52	29
26	Barbados	68	51	19
27	Panama	55	59	11
28	Croatia	53	37	28
29	Colombia	12	86	4
30	Costa Rica	71	46	2
31	Hong Kong, China	77	33	64
32	Czech Republic	18	32	91
33	Italy	83	32	24
34	Hungary	49	41	45
35	Tunisia	15	58	55
36	Malaysia	25	45	87
37	Latvia	76	53	14
38	Iceland	98	13	42
39	Uruguay	63	66	8
40	Chile	57	49	64
41	Lithuania	86	47	22
42	Mauritius	113	23	12
43	Brazil	36	91	13
44	El Salvador	61	63	15
45	Ecuador	27	71	25
46	Singapore	115	44	48
47	Peru	8	99	34
48	Saudi Arabia	32	18	124
49	Mexico	28	62	71
50	Poland	35	43	93
51	Romania	4	57	95
52	United Arab Emirates	58	36	106
53	Bahrain	45	29	125
54	Greece	97	12	78
55	Korea (Rep.)	92	39	81
56	Kazakhstan	5	40	122
57	Guatemala	47	69	30
58	Bolivia	21	82	49
59	Albania	82	84	3
60	Russia	1	65	102
61	Cyprus	109	30	88
62	Israel	99	24	86
63	Oman	88	22	118
64	Philippines	38	96	53
65	Gabon	50	97	10

Index	Country	Energy security	Energy equity	Environmental sustainability
66	Estonia	74	48	115
67	Angola	11	116	20
68	Egypt	42	56	83
69	Bulgaria	33	75	104
70	Venezuela	29	54	74
71	Malta	121	64	59
72	Cameroon	34	107	37
73	Sri Lanka	72	90	41
74	China	10	102	127
75	Azerbaijan	17	83	100
76	Paraguay	67	100	18
77	Kuwait	95	38	120
78	Trinidad and Tobago	66	50	116
79	Georgia	103	74	39
80	South Africa	52	73	129
81	Algeria	65	61	75
82	Turkey	94	60	76
83	Indonesia	39	93	108
84	Thailand	79	81	103
85	Montenegro	111	79	67
86	Libya	41	72	111
87	Vietnam	60	98	98
88	Nigeria	9	115	79
89	Jordan	107	55	112
90	Iran	73	34	121
91	Namibia	122	89	60
92	Armenia	81	77	80
93	Congo (Dem. Rep.)	51	125	27
94	Mozambique	62	123	54
95	Ukraine	54	70	114
96	Côte d'Ivoire	43	108	68
97	Syria	30	92	117
98	Botswana	123	94	69
99	Macedonia	101	68	109
100	Honduras	116	86	57
101	Lebanon	125	76	84
102	Ghana	86	106	77
103	Malawi	89	129	36
104	Morocco	118	80	94
105	Swaziland	105	95	72
106	Serbia	93	67	119
107	Kenya	90	113	62
108	Tajikistan	91	104	58
109	Tanzania	117	121	52
110	Nepal	119	122	47
111	Dominican Republic	120	111	56
112	Yemen	78	88	105
113	Mongolia	80	105	128
114	Cambodia	108	109	73
115	India	87	110	123
116	Zambia	100	120	66
117	Ethiopia	104	120	50
118	Jamaica	128	78	96
119	Nicaragua	102	101	85
120	Pakistan	75	103	107
121	Mauritania	69	118	113
122	Bangladesh	110	117	82
123	Madagascar	106	124	70
124	Senegal	124	112	89
125	Moldova	127	87	110
126	Chad	126	128	51
127	Niger	114	126	92
128	Benin	129	114	99
129	Zimbabwe	113	127	126

Figure C-10
2013 mapping of the balance scores using the heat map system

Index	Country	Balance score	Energy security	Energy equity	Environmental sustainability
1	Switzerland	AAA	8.59	9.60	10.00
2	Denmark	AAA	9.84	8.12	9.29
3	Sweden	AAA	8.20	8.98	9.60
4	Austria	AAB	7.50	9.53	9.53
5	United Kingdom	AAA	9.21	9.45	8.59
6	Canada	AAB	10.00	9.92	5.39
7	Norway	AAB	6.09	9.29	9.45
8	New Zealand	AAB	8.90	8.04	7.18
9	Spain	AAA	8.35	8.82	8.28
10	France	AAB	6.64	9.68	9.37
11	Germany	ABB	7.65	9.21	7.73
12	Netherlands	ABB	6.79	8.28	7.34
13	Finland	ABB	7.18	8.43	6.56
14	Australia	AAD	9.29	9.84	2.50
15	United States	AAC	9.14	10.00	3.35
16	Japan	ABB	6.32	8.75	7.50
17	Belgium	ABB	5.15	9.06	7.42
18	Qatar	AAC	9.45	9.37	2.65
19	Luxembourg	ABD	1.71	9.76	7.81
20	Ireland	ABC	3.67	7.73	8.90
21	Costa Rica	ABB	5.62	6.56	9.92
22	Slovakia	ABB	8.51	7.10	6.32
23	Portugal	ABB	5.78	5.93	8.51
24	Colombia	AAC	9.68	3.43	9.76
25	Slovenia	BBB	5.39	7.96	6.79
26	Argentina	ABB	8.98	7.50	7.10
27	Taiwan, China	ABC	4.53	8.35	5.46
28	Italy	ABC	4.68	7.42	8.20
29	Panama	ABB	5.93	5.54	8.67
30	Croatia	ABC	4.92	7.65	8.43
31	Hungary	BBB	6.48	6.79	6.64
32	Czech Republic	ABC	8.82	7.57	3.04
33	Iceland	ABC	2.57	8.90	6.87
34	Brazil	ABC	7.96	3.35	8.75
35	Ecuador	ABB	8.12	5.23	7.89
36	Tunisia	BBB	7.89	5.62	5.70
37	Malaysia	BBC	7.42	6.95	2.89
38	Bahrain	AAD	8.28	8.59	0.31
39	Greece	ABC	5.85	8.67	3.75
40	Hong Kong, China	ABD	2.34	8.20	5.54
41	Mexico	BBC	7.81	6.40	4.21
42	Lithuania	ABC	2.81	6.48	8.04
43	Latvia	ABD	2.42	5.85	8.98
44	United Arab Emirates	BBD	6.25	7.18	2.10
45	Peru	ABC	8.43	2.57	6.71
46	Uruguay	ACC	2.89	4.84	9.68
47	Singapore	BBD	0.39	6.71	6.09
48	Poland	BBC	7.10	7.03	2.73
49	El Salvador	ABC	4.76	5.07	9.21
50	Barbados	ABD	0.85	6.87	8.12
51	Saudi Arabia	ABD	6.56	9.14	0.39
52	Romania	ACC	9.37	4.60	3.20
53	Mauritius	ABD	1.56	5.39	8.82
54	Russia	ABD	9.92	5.31	2.34
55	Bolivia	ACC	9.76	3.51	4.53
56	Gabon	ABC	7.34	2.89	9.14
57	Chile	BCC	3.04	5.70	4.45
58	Kazakhstan	ABD	9.60	7.34	1.01
59	Angola	ABD	9.45	1.95	7.65
60	Albania	ACC	3.28	4.14	9.84
61	Guatemala	BBC	6.95	4.21	7.26
62	Oman	ACD	3.98	8.51	0.70
63	Cyprus	BCD	1.95	7.26	3.82
64	Korea (Rep.)	BCD	2.03	6.25	3.43
65	Philippines	BBC	7.03	2.81	5.85

Index	Country	Balance score	Energy security	Energy equity	Environmental sustainability
66	Kuwait	BCD	4.37	7.89	0.54
67	Israel	BCD	2.10	7.81	3.59
68	Estonia	BCD	5.00	6.09	0.93
69	Sri Lanka	BCC	4.45	3.82	6.95
70	Bulgaria	ACD	8.04	4.06	1.64
71	Malta	BCD	0.07	6.32	5.00
72	Georgia	ACD	1.79	4.92	8.35
73	Indonesia	ACD	8.75	3.59	1.95
74	Paraguay	ACD	3.51	2.34	9.06
75	Turkey	BCC	5.07	3.67	4.60
76	Egypt	BBC	6.40	5.46	3.51
77	Venezuela	BBC	6.87	5.78	3.67
78	China	ADD	8.67	2.18	0.23
79	South Africa	BCD	6.71	3.98	0.07
80	Congo (Dem. Rep.)	BBD	7.73	0.62	7.96
81	Azerbaijan	BCD	7.57	4.29	2.42
82	Cameroon	BBD	5.23	1.71	7.03
83	Montenegro	BCD	1.09	4.53	5.62
84	Nigeria	ACD	9.06	1.40	3.90
85	Armenia	CCC	2.65	4.68	4.37
86	Macedonia	BCD	3.12	6.17	1.79
87	Syria	BBD	6.01	6.01	1.25
88	Algeria	CCC	3.35	4.76	4.29
89	Thailand	CCD	2.96	3.20	2.18
90	Namibia	BCD	0.46	2.73	6.25
91	Iran	BCD	4.21	6.64	0.78
92	Swaziland	BCD	5.31	2.42	4.14
93	Côte d'Ivoire	BCD	7.26	1.64	4.76
94	Malawi	BCD	4.29	0.00	7.57
95	Mongolia	BDD	6.17	2.26	0.00
96	Jordan	BDD	0.78	5.15	1.71
97	Ukraine	BCD	5.46	4.37	1.17
98	Trinidad and Tobago	CCD	3.90	2.65	1.09
99	Botswana	BDD	0.23	2.50	5.23
100	Honduras	BCD	1.40	3.04	6.01
101	Vietnam	CDD	4.06	2.10	1.87
102	Ghana	CCD	3.43	1.87	4.06
103	Mozambique	CCD	4.84	0.39	4.92
104	Chad	BCD	3.59	0.46	6.17
105	Morocco	CCD	1.48	3.90	2.57
106	Serbia	CDD	2.18	5.00	0.78
107	Tajikistan	BCD	3.75	1.56	5.31
108	Kenya	BCD	3.20	1.17	5.15
109	Lebanon	CCD	0.15	3.20	3.12
110	Dominican Republic	BDD	1.17	1.79	5.78
111	Nepal	BDD	0.31	0.54	6.48
112	Ethiopia	BDD	2.50	0.78	6.40
113	Nicaragua	CCD	2.26	2.96	3.28
114	Pakistan	BDD	5.70	2.03	2.26
115	India	CDD	4.14	1.48	0.62
116	Tanzania	BDD	0.93	0.31	5.85
117	Libya	CCD	4.60	4.45	0.46
118	Cambodia	CDD	0.62	1.25	4.84
119	Mauritania	BDD	5.54	0.93	1.32
120	Zambia	BDD	1.64	0.70	5.07
121	Jamaica	CDD	1.01	3.75	1.48
122	Niger	CCD	3.82	0.15	2.96
123	Bangladesh	CDD	1.25	1.09	3.98
124	Madagascar	CDD	1.87	0.23	4.68
125	Moldova	CDD	0.54	3.12	1.56
126	Senegal	CDD	0.70	0.85	2.81
127	Yemen	CDD	2.73	1.32	1.40
128	Benin	DDD	0.00	1.01	2.03
129	Zimbabwe	DDD	1.32	0.07	0.15

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