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World Energy Trilemma

Time to get real – the case for sustainable energy policy

World Energy Council

Project Partner
OLIVER WYMAN

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Foreword by Pierre Gadonneix

I am glad to unveil the 4th edition of our *World Energy Trilemma* report. This new name and new edition marks a decisive step in what has been a decisive year: 2012 was the year when the world gathered in Brazil for the Rio+20 summit. Many who attended had mixed feelings, hopes mingled with fears in the face of the huge task of assessing the results of a 20-year awareness of the environmental, economic, and social challenges that confronted our world. 2012 was also the year that UN Secretary General Ban Ki Moon dedicated to promote access to "Sustainable energy for all", thus recognising the fundamental role that energy plays in achieving the worlds' millennium goals. He rightly identified the need to monitor progress in reaching our goal to help achieve global human development. In these respects, 2012 marks the return of the energy issues to the very heart of the global agenda.

Clearly there is reason for this. All countries are experiencing growing difficulties and uncertainties in securing their energy supply, and in engaging at the same time a cleaner growth pattern. This is emphasised by the current economic crisis that threatens long term efforts to protect our environment in many countries.

It is expected that energy demand will double by 2050. Therefore if we do not act now and invest in generation and network infrastructures, it is very likely that more countries will suffer from blackouts like the one the USA experienced this year, or worse, like the one more than 600 million Indian people underwent in July 2012. In the same period we have to cut by half our current volume of greenhouse gas emissions if we want to limit the deterioration of our environment. The summer of 2012 has seen further melting of the Arctic ice cap.

We, in 2012, cannot escape the fact that 1.3 billion people still lack access to modern forms of energy. This figure could still increase due to demographic shifts, urbanisation, and the impact of the economic crisis on many parts of the world and jeopardising human development everywhere.

That is why I cannot stress enough the need to act now on the three intertwined dimensions of the energy trilemma: energy security, social equity, and environmental impact mitigation. Now, 'how to act' is the real question. 2012, and namely the Rio+20 summit, showed that awareness and benevolence were strong everywhere, but in a world with disparate levels of development and uneven resource distribution, clear roadmaps, pragmatic yet comprehensive tools and, above all, timely coordination were more difficult than ever to come up with.

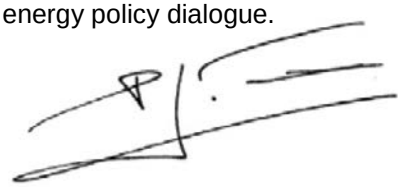
Yet, solutions do exist and men and women from all around the world know them and are ready to implement them. They all plead for more interconnected policy within each country and for more coordination among countries.

The World Energy Council, in its role as principal impartial network for energy leaders, has decided to make the 2012 and 2013 *World Energy Trilemma* report the place for our energy leaders' community to express their vision for a sustainable future. In 2012, the floor is given to the industry leaders. Next year it will be the turn of government leaders to engage in the dialogue.

The real lesson to be learned from industry leaders is that they strongly believe we have the means to solve the energy trilemma; we have the tools, technologies, and resources it takes. What lacks is the method, the master plan to assemble them as well as a scheme to release market resources and initiatives. What also lacks is the monitoring tool to have a clear vision of progress, but here, our Energy Sustainability Index can be of use.

What strikes me and what I want to highlight as a conclusion is that industry leaders deliver us a message of hope in the future as well as a message of confidence in technological progress. At a time when scepticism and fear of technology arise in many parts of the world this is provoking a rejection of new investments. It is true that the world has to face the consequences of severe accidents like Fukushima and the oil spills in the Gulf of Mexico and more recently in the Gulf of Nigeria. It is therefore necessary to reaffirm both our strong belief in technological progress and our equally strong belief in the fact that there is on earth only room for a safe technology that is controlled and monitored by man's enduring vigilance.

I wish you an inspiring dive in the first part of our energy policy dialogue.



Pierre Gadonneix
Chair, World Energy Council

Foreword by Joan MacNaughton

Delivering policies which simultaneously address energy security, universal access to affordable energy services, and environmentally-sensitive production and use of energy is one of the most formidable challenges facing governments - indeed some might argue that it is the most formidable, or even the most important. The *World Energy Trilemma* report, now in its fourth year, aims to help governments rise to the challenge of tackling this 'trilemma'.

Even if global economic circumstances were more benign, governments could not tackle the challenges without the private sector. Investment is needed on an unprecedented scale, as developing countries build out their infrastructures, as developed countries replace their ageing capital stock, and as recovering and transporting energy sources becomes ever more financially and technically challenging. Globally, countries at every stage of development must clean up their energy act, to avoid damage to their domestic environments and above all to contribute to tackling climate change. The IEA has estimated that in addition to global investment in energy supply infrastructure and to provide energy for all USD36 trillion may be needed in the energy sector by 2050 in order to deliver clean energy solutions.

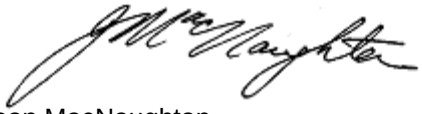
Yet again the *World Energy Trilemma* report contains important pointers to how countries can improve their performance against the trilemma goals. The Energy Sustainability Index ranks countries against the three dimensions on the basis of selected measures for which data is widely available. As we enhance the Index methodology year on year – this year we have improved the assessment of the social equity and environmental impact mitigation dimensions – it becomes necessary to recalculate the rankings in previous years, in order for countries to understand how their performance has changed over time. This we have done. It is also important to see the Index as a starting point for understanding the sustainability of countries' policy approaches, since it does not and cannot capture all relevant aspects of performance. Nevertheless, additional analysis by our partners Oliver Wyman of the data underpinning the Index shows how countries can benefit from effective policy approaches – regardless of their natural resource endowments. There is some correlation between greater wealth and for example energy security or the ability to take a more developed approach to safeguarding the environment. This is perhaps unsurprising, but nevertheless it is striking that some less affluent countries do outperform their peers in terms of GDP per capita. The fact that they do seems to owe a great deal to the quality of their policy approaches.

What makes for good policy? The answer must depend on local needs and circumstances. But common themes emerge: a long-term, stable approach to policy; predictability and consistency in the regulatory process; the ability to harness the power of markets and the private sector to public goals; and the need for strong support for research and development across all areas of energy technology. Having a master plan – and, if politically possible, an approach which does not rule out any individual source of energy or any specific technology – certainly helps in striking a balance among the three objectives of the

trilemma. So countries with a significant proportion of renewables in their energy use and those with a significant penetration of nuclear seem to do better than comparable countries who have not taken advantage of these energy sources.

The execution of policy in a consistent way is also important. It is clear that governments will succeed in fitting the detail of their policy making within such a strategic overall framework if they take advantage of the expertise and perspectives of all key stakeholders. They should accordingly engage in a genuine dialogue with such stakeholders, among whom must be counted the business community who understand what works in practice including in terms of energy regulation. It is they who will make the crucial investment decisions.

This is the unambiguous message from more than 40 CEOs and senior executives whom we interviewed for the report. As they – and we – say, in confronting the energy trilemma, it is time to get real.



Joan MacNaughton
Executive Chair, WEC World Energy Trilemma

“We need private sector engagement for real sustainable solutions”

“Behaviour determines energy demand”

“The most precious thing for energy development internationally is good and sound public policy”

“If you think about why governments don’t usually take correct decisions, it is often a problem of political will and not a lack of capability”

“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 need an open societal debate about which kinds of energy systems are required to fulfill people’s needs for mobility, heat, and electricity services in the medium to long-term future”

“Governments need corporations to provide low-carbon and green technology, the skills to deploy and operate it, and the funds of financiers to invest in delivering it”

“Financial institutions need to become more unconventional”

“You need a supportive policy and you need the consensus of the people”

“We need to take a more inclusive look to energy pricing and compare the global effects”

“Governments need good, scientific, evidence-based advice on the best way to generate power and shouldn’t let the political process and ideologies control this”

“You can’t develop policy in isolation–policymakers must engage with industry and vice-versa to improve clarity and the path forward for sustainable energy systems”

“Having a master plan is very important”

“We need a global mindset in order to succeed”

“Getting together for discussions can be helpful in broadening the understanding”

Executive Summary

"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."

You can see it in the faces of the 670 million people who recently suffered through blackouts in India, or sense it from the frustrations expressed by three million Americans forced to live without power in the middle of a record heat wave. After decades of work to advance sustainable energy solutions, an energy gap is growing as energy systems around the world buckle under significant strain.

Policymakers and the energy industry urgently need to work together to correct this mismatch by making the hard decisions necessary to realise sustainable energy systems on a much broader scale. If the supply of sustainable energy continues to lag behind rapidly rising demand globally, billions of people could be forced to live without reliable electricity and economic growth could be put in jeopardy. Already, 1.3 billion people live without access to electricity. This number could rise if demand continues to jump by as much as 30% over the next two decades.[1]

Goals supported at The United Nations Conference on Sustainable Development (Rio+20) in June 2012 could also remain out of reach. Unless action is taken now, it will be difficult to double the rate of energy-efficiency improvement, ensure universal access to modern energy, or to double the share of renewable energy in the global energy mix by 2030.

To assist policymakers and the energy industry with pressing forward sustainable energy systems, the World Energy Council, in collaboration with global management consulting firm Oliver Wyman, has prepared the report *World Energy Trilemma*: *Time to get real – the case for sustainable energy policy*. This first of a two-part series of reports examines the drivers and risks preventing the development of sustainable energy systems. It then recommends actions to address these risks and to accelerate a global transition to a low-carbon future which will present new opportunities for economic growth.

The 2012 report describes what senior energy industry executives believe they need from policymakers to advance sustainable energy systems. It is based on interviews with more than 40 energy industry CEOs and senior executives and the 2012 Energy Sustainability Index built on an analysis of 22 indicators across 93 World Energy Council member countries. The 2013 *World Energy Trilemma* report will focus on what policymakers need from the energy industry.

Three dimensions of energy sustainability

The World Energy Council's definition of energy sustainability is based on three core dimensions - energy security, social equity, and environmental impact mitigation. The development of stable, affordable, and environmentally-sensitive energy systems defies simple solutions. These three goals constitute a 'trilemma', entailing complex interwoven links between public and private actors, governments and regulators, economic and social factors, national resources, environmental concerns, and individual behaviours.

[1] International Energy Agency (IEA), 2011: *World Energy Outlook 2011*

Energy sustainability dimensions

- *Energy security*: For both net energy importers and exporters, this refers to the effective management of primary energy supply from domestic and external sources, the reliability of energy infrastructure, and the ability of participating energy companies to meet current and future demand. For countries that are net energy exporters, this also relates to an ability to maintain revenues from external sales markets.
- *Social equity*: This concerns the accessibility and affordability of energy supply across the population.
- *Environmental impact mitigation*: This encompasses the achievement of supply and demand-side energy efficiencies and the development of energy supply from renewable and other low-carbon sources.

Energy industry recommendations

CEOs and senior executives from leading energy companies have three main recommendations for how policymakers must expedite the development of sustainable energy systems: 1) Design coherent and predictable energy policies, 2) Support market conditions that attract long-term investments, and 3) Encourage initiatives that foster research and development in all areas of energy technology.

Recommendation 1: Design coherent and predictable energy policies

Policymakers must establish coherent, long-term, accessible, predictable, and transparent policies that rise above narrow interests to respond to energy needs holistically. Contradictory and ad hoc policies developed in isolated 'silos' hinder energy investments. Sound and coherent policies that are oriented toward results rather than around the types of energy or technology used to achieve them can - and should - enable the world to achieve energy sustainability.

A master plan must be developed that connects energy policies on two fronts. First, national energy policies must complement and link together national industrial, financial, environmental, transportation, and agricultural goals and policies. Second, policies concerning energy resources, infrastructure, environmental issues, and regulations must be regionally coordinated. Sharing resources across borders enables countries to increase regional energy security, reduce power costs, and attract investments by creating greater market scale to interest investors, optimise natural resources, and develop common infrastructure.

To make sure that these policies are predictable for industry, governments must develop regulations that are consistent, clear, and simple, in spite of the complexities that they address. Equally important, policymakers should separate energy policies from short-term politics to guarantee that they reflect a well-defined, long-term view. A significant hurdle to policy longevity, as perceived by industry, is the

conflict between the long-term nature of energy investments and the comparatively short-term nature of politics.

Consumer education and awareness is also crucial. To encourage energy efficiency, for example, governments must not only establish environmentally responsible construction and manufacturing standards, but can also set a regulatory framework for progressive energy tariffs to make consumers more aware of energy efficiency as a means to reduce overall national energy costs, introduce tax reductions on energy-efficient equipment (on VAT or on import duties), or on energy-efficiency investments (reduction in VAT rate).

Recommendation 2: Support market conditions that attract long-term investments

With consistent and committed regulatory approaches, policymakers must encourage the development of attractive markets to stimulate long-term private investments in energy infrastructure and technologies. Simultaneously, they must support the development of new investment mechanisms that can reduce risks and stimulate greater private sector investment in the energy sectors. Such mechanisms can include green banks, a green bond market, and public-private partnerships. These efforts must be underpinned by a stable and predictable carbon price necessary to drive the transition to a low-carbon energy system.

Huge investments are required to improve access to energy worldwide, develop new energy technologies, and to build new and replace ageing infrastructure. Cash-strapped governments have limited funds to support a shift to a low-carbon future. Unfortunately, capital from the private sector and from investment funds remains largely on the side lines. Less than 1% of pension investment funds worldwide, for example, are invested in infrastructure projects designed to improve the supply of electricity.[2]

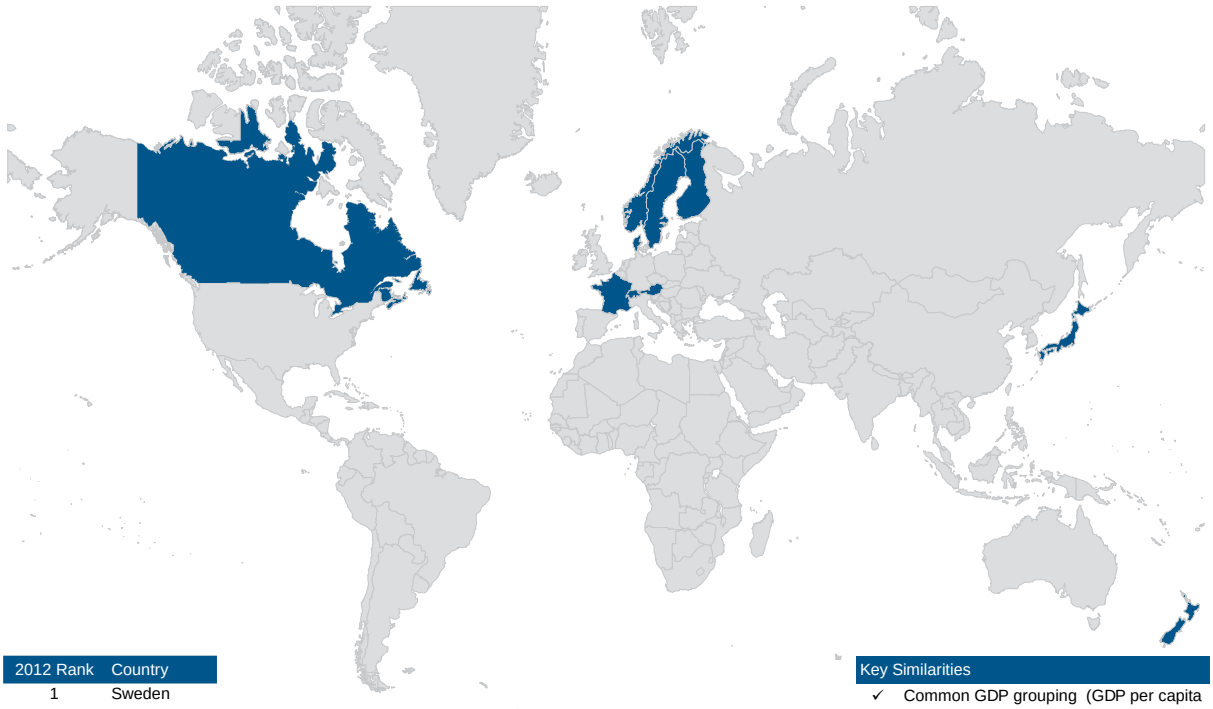
The use of subsidies should be minimised, since they increase political and regulatory uncertainty. This distorts competition and erodes investor confidence. If used, subsidies must be focused on achieving a specific outcome, and have a clear sunset built-in from the start.

Recommendation 3: Encourage initiatives to foster research and development in all areas of energy technology

To drive innovation further in all areas of energy technology, policymakers should implement goal-driven policies rather than prescriptive policies. New renewable energy and fossil fuel technologies can bring the world much closer to attaining sustainable energy systems and potentially spur economic growth. For this to happen, however, policymakers need to leave it to the market to decide which types of technology should survive so that they can remain competitive in the long term.

[2] Organisation for Economic Co-operation and Development (OECD), 2011: *Pension Funds Investment in infrastructure: A Survey*

Figure 1
Similarities and differences for the top 10 performing countries in 2012 Index



2012 Rank	Country
1	Sweden
2	Switzerland
3	Canada
4	Norway
5	Finland
6	New Zealand
7	Denmark
8	Japan
9	France
10	Austria

Key Similarities
✓ Common GDP grouping (GDP per capita greater than USD33,500)
✓ OECD members
✓ Post-industrial economy
✓ High (>10%) renewables in electricity mix
Key Differences
× Nuclear and non-nuclear power producers
× Low and high fossil fuel reserves
× Net energy exporters and importers
× Various geographic locations

‘Technology-neutral’ research and innovation policies should be supported with economic incentives and appropriate accountabilities.

Intellectual property rights must also be strongly enforced for the private sector to invest in environmentally responsible and energy-efficient technologies.

Finally, governments must support the research, development, and demonstration of new technologies to boost investor confidence. Policymakers will encourage companies to invest in developing new technologies if they establish a strong research-oriented environment that promotes national and international collaborative research and funds large-scale demonstration projects that support companies' efforts to bring their technologies to market.

Energy Sustainability Index

The 2012 Energy Sustainability Index shows that developed countries such as Sweden, Switzerland, and Canada are closest to achieving sustainable energy systems. This is in large part because a higher share of their energy mix comes from low-carbon energy sources, such as hydro power and from nuclear power. These countries are leaders in terms of energy security largely because of their diversified energy mixes.

The top three performers also have a significant advantage when it comes to mitigating their energy systems' environmental impact because they have long-term programs in place. Sweden, for example, has significantly reduced its greenhouse emissions even though its GDP is rising mainly because it has set long-term sustainable energy and climate policies and goals for 2020.

Nevertheless, developing sustainable energy systems overall remains a challenge. Countries at all stages of development still have trouble balancing the trade-offs involved in providing secure, affordable, and environmentally-sensitive energy. Developing countries, for example, struggle to use cleaner forms of energy as they industrialise.

Sound policy making determines to what extent a country will be able to develop a sustainable energy system. The energy industry and policymakers should assist in helping nations to forge an alternative path of energy development. As Figure 1 shows, the top ten performers all have high GDPs per capita. They are OECD member countries with predictable and strong political, societal, and economic frameworks. However, there are also key differences between them, underscoring that there is not one single solution. France is a significant user of nuclear power. Canada is a net energy exporter. By contrast, Japan is a net importer.

Conclusion

Energy systems around the world remain at vastly different stages of development. But all countries share a common problem: They are far away from achieving sustainable energy systems.

To make affordable, secure, and environmentally-sensitive energy systems a reality, policymakers urgently need to develop interconnected, lasting, and coherent energy policies. Policymakers and energy industry executives must develop a common understanding of what energy sustainability is, its importance for economic growth, and the steps necessary to achieve it. Only then can they work together to build on clearly defined sustainability goals that will encourage all forms of energy in every nation's energy mix by taking a technology-neutral approach.

With clearly defined, coherent, and predictable energy policies, the energy industry will be able to mobilise the natural and human resources, finances, and technologies necessary to realise sustainable energy systems. Without them, billions of people will continue to live without secure, affordable, and environmentally-sensitive energy. Global prosperity could also be threatened. There is no time to waste.

"Will countries recognise that it is in their genuine interest to move towards this new sustainable energy system?"

"Reduction of CO_2 emissions also assumes major societal shifts and changes in how people live"

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

"You want investments but also diversified technologies that take environmental concerns into account"

"Governments must understand that energy is a priority"

"Develop clear goals and make sure you put your money where your mouth is"

"Ideas need to be translated into clear targets, then you can work on a policy to achieve these targets and you need to think about how to engage people"

"A CO_2 tax could be more certain. But who would have the political will to drive up the levels of tax since 80-90% of the electorate is opposed to carbon pricing at the consumption level"

"Governments must realise that they are not an island and that an integrated approach is necessary"

"Aiming at an energy mix that relies only on renewables and energy efficiency hinders economic growth and would be like driving with the foot on the break"

"Approaches to and views on energy sustainability are very different and no universal definition or understanding of sustainable energy systems exists"

"Free markets work better than subsidies: If renewables cannot compete with gas or coal, then governments can only prop them up for a limited amount of time"

"Most important is that the rule of law protects the investment"

"Governments are often not in phase with the market rhythm"

"Governments need to realise that they cannot address building robust energy systems alone"

Introduction

This report is the fourth annual assessment of energy and climate policies across the globe by the World Energy Council (WEC) and builds on the findings and recommendation made in previous reports. Earlier studies were based on in-depth reviews of selected energy policies from around the world. This year's report takes a new approach and is structured to support a global dialogue between industry and policymakers.

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

The goal of the 2012 report is to provide policymakers with the energy industry's views on what the industry needs from policies and policymakers to succeed in providing environmentally-sensitive, affordable, accessible, and secure energy. The purpose was to capture industry perspectives on what makes an effective policy to support sustainable energy goals.

The report findings are based on three sources of research: interviews with more than 40 energy industry CEOs and senior executives from across the sector and around the world (see Appendix A), supporting research, and empirical data analysis supporting the Energy Sustainability Index. Throughout this report, statements in quotation marks capture the insights and comments of the interviewees.

This report will be followed up in 2013 with the views of policymakers on what they need from industry to be assured the policies will have the intended effects of supporting sustainable energy. The 2012 and 2013 reports' methodology is based on the guiding premise that energy sustainability involves both the efforts of industry and policymakers. Together the publications will support an evolving dialogue to develop knowledge and understanding of effective strategies and policies and thus to deliver the necessary transformation of the energy system.

Consistent with previous studies, this report includes the Energy Sustainability Index. The Index captures and aggregates country-level data to outline the relative energy performances and contextual attributes of WEC member countries. It provides a comparative ranking of countries' ability to provide a stable, affordable, and environmentally-sensitive energy system and highlights current challenges. The findings of the Index analysis are complemented with the individual WEC member country profiles captured in the companion report *World Energy Trilemma: 2012 Energy Sustainability Index*.

The research and formulation of the 2012 report's recommendations to policymakers have benefited from the extensive involvement of energy industry leaders and experts around the world. The World Energy Council 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.

Iconography

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

Energy performance dimensions:

 Energy security

 Social equity

 Environmental impact mitigation

Contextual performance dimensions:

 Political strength

 Societal strength

 Economic strength

Additional:

 Innovation score

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

“How you define sustainability targets gives you very different outcomes”

“Can objectives be reconciled within a reasonable economic framework without compromising economic growth?”

“Energy policy cannot be considered in one dimension but must realise interconnections of different objectives”

“The shift towards low-carbon fuel consumption will depend on manufacturers and on the horizon in which new technologies can become more cost-efficient”

“Nowhere are leaders standing up to say ‘All we have is a choice among evils’ – we don’t have a clean solution”

“If it is going to be sustainable the economic model can’t be hinder growth. If energy prices are drastically higher than now, it drives GDP growth away”

“A coherent energy system cannot be established unless the country or the region is politically and economically stable”

“Nordic countries are the most stable and most aspects are market based: There may be uncertainty, but there is no random decision making”

“Environmental aspects and the price gap have to be considered in the decision whether or not a certain energy type is desirable overall”

“Governments have a lot of leverage through their resource endowments, probably a lot more than they realise”

“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”

“Energy is a global issue. In the long run people will understand this and we will be able global energy mix”

“A global information society depends on globally secure power supply”

“The fact that this is a diversified solution is good news”

“Energy access has to be driven by policies”

1. 2012 Energy Sustainability Index

Comparing country situations

The 2012 Energy Sustainability Index ("Index") confirms that developed countries are in a better position to provide secure, affordable, and environmentally-sensitive energy and to balance the 'trilemma of energy sustainability'. This is driven by their increased reliance on low- and zero-carbon emission producing forms of energy such as renewables, including hydro power, and nuclear power.

However, a deeper analysis shows that even top performing countries face challenges. Energy sustainability remains a far-off objective as trade-offs within the energy trilemma persist for countries at various stages of development. Moreover, the Index shows that countries face specific challenges as they pass through the stages of economic and social development.

For example, developed Middle Eastern countries with large fossil fuel endowments often face a trade-off between maintaining affordable energy and attempts to set incentives for energy consumption reductions and lowering energy and emissions intensity per capita. Developing countries, on the other hand, struggle with providing electricity access and energy services for their growing populations, while emerging countries often increase their environmental impact as they achieve economic growth.

For the deeper Index analysis countries were organised in four economic groups[3]:

- Group A: GDP per capita greater than USD33,500
- Group B: GDP per capita between USD14,300 and USD33,500
- Group C: GDP per capita between USD6,000 and USD14,300
- Group D: GDP per capita lower than USD6,000

The 2012 Energy Sustainability Index results are exhibited in Figure 2. Figure 3 shows the ranking of countries across the three dimensions underlying their energy performance – security, affordability, and environmental sensitivity. This illustrates how countries are balancing the energy trilemma.

[3] GDP per capita on a purchasing power parity (PPP) basis; International Monetary Fund (IMF), 2010

Figure 2
2012 Energy Sustainability Index rankings

2012 Rank	Country	Importer / Exporter	GDP Group	2011 Rank	2010 Rank
1	Sweden	I	A	4	7
2	Switzerland	I	A	3	1
3	Canada	E	A	1	2
4	Norway	E	A	5	3
5	Finland	I	A	2	4
6	New Zealand	I	B	6	5
7	Denmark	E	A	8	8
8	Japan	I	A	11	11
9	France	I	A	7	6
10	Austria	I	A	9	10
11	Germany	I	A	10	18
12	United States	I	A	12	9
13	Belgium	I	A	18	12
14	Netherlands	I	A	16	13
15	United Kingdom	I	A	28	21
16	Spain	I	B	15	26
17	Slovakia	I	B	20	17
18	Luxembourg	I	A	13	16
19	Hungary	I	B	21	25
20	Australia	E	A	24	20
21	Italy	I	B	31	33
22	Slovenia	I	B	25	14
23	Iceland	I	A	14	15
24	Croatia	I	B	17	40
25	Portugal	I	B	29	19
26	Russia	E	B	27	29
27	Korea (Republic)	I	A	37	34
28	Argentina	E	B	19	24
29	Czech Republic	I	B	26	22
30	Ireland	I	A	39	28
31	Lithuania	I	B	22	27
32	Taiwan, China	I	A	33	35
33	Colombia	E	C	32	37
34	Hong Kong, China	I	A	35	32
35	Estonia	I	B	38	23
36	Uruguay	I	C	34	30
37	Latvia	I	B	23	31
38	Bulgaria	I	C	40	51
39	Ukraine	I	C	36	45
40	Albania	I	C	41	58
41	Qatar	E	A	48	38
42	Greece	I	B	52	44
43	Kazakhstan	E	C	30	49
44	United Arab Emirates	E	A	49	50
45	Bolivia	E	D	-	-
46	Saudi Arabia	E	B	47	42
47	Poland	I	B	53	47
48	Iran (Islamic Republic)	E	C	63	39
49	Cyprus	I	B	51	48
50	Mexico	E	C	46	53
51	Trinidad & Tobago	E	B	62	55
52	Paraguay	E	D	56	59
53	Brazil	I	C	45	56
54	Kuwait	E	A	60	54
55	Egypt (Arab Republic)	E	C	50	36
56	Romania	I	C	42	41
57	South Africa	E	C	55	46
58	Peru	I	C	59	63
59	Gabon	E	B	73	-
60	Tunisia	I	C	66	52
61	Israel	I	B	61	73
62	Macedonia (Republic)	I	C	58	43
63	Thailand	I	C	67	72
64	Turkey	I	C	75	61
65	Cameroon	E	D	65	66
66	Serbia	I	C	44	82
67	Kenya	I	D	69	65
68	Jordan	I	C	70	60
69	Congo (Dem. Republic)	E	D	77	83
70	Côte d'Ivoire	E	D	74	81
71	China	I	C	71	78
72	Zimbabwe	I	D	-	-
73	Sri Lanka	I	D	68	70
74	Nepal	I	D	78	74
75	Philippines	I	D	57	64
76	Syria (Arab Republic)	E	D	64	69
77	Lebanon	I	B	72	67
78	Algeria	E	C	84	79
79	Namibia	I	C	81	68
80	Swaziland	I	D	43	57
81	Ghana	I	D	80	76
82	Tanzania	I	D	79	80
83	Indonesia	E	D	76	71
84	Nigeria	E	D	83	77
85	Mongolia	E	D	85	88
86	Chad	E	D	-	-
87	Morocco	I	D	82	85
88	Libya	E	C	86	75
89	Ethiopia	I	D	92	91
90	Niger	I	D	90	90
91	Botswana	I	B	87	86
92	Pakistan	I	D	88	87
93	India	I	D	89	84
94	Senegal	I	D	91	89

Figure 3
2012 Country rankings for energy performance dimensions

2012 Rank	Energy security (2011 rank)	Social equity (2011 rank)	Environmental impact mitigation (2011 rank)
1	Canada (1)	United States (1)	Paraguay (8)
2	Sweden (9)	Canada (2)	Sweden (1)
3	Denmark (5)	Australia (3)	Iceland (2)
4	Zimbabwe (-)	Switzerland (4)	France (3)
5	Colombia (6)	Luxembourg (5)	Norway (4)
6	Slovakia (28)	United Kingdom (8)	Finland (6)
7	Japan (16)	Austria (7)	Albania (15)
8	Russia (2)	France (10)	New Zealand (7)
9	Norway (21)	Japan (6)	Lithuania (5)
10	Hungary (20)	Norway (11)	Switzerland (14)
11	Germany (13)	Germany (12)	Austria (18)
12	Switzerland (15)	Belgium (9)	Canada (12)
13	Finland (7)	New Zealand (13)	Latvia (9)
14	Croatia (11)	Finland (14)	Slovakia (17)
15	Czech Republic (38)	Qatar (15)	Belgium (24)
16	New Zealand (33)	Sweden (33)	Russia (11)
17	Spain (27)	Argentina (20)	Slovenia (20)
18	Ukraine (8)	Saudi Arabia (18)	Luxembourg (13)
19	Italy (49)	Spain (17)	Hungary (22)
20	Kenya (23)	Netherlands (22)	Netherlands (31)
21	Gabon (10)	Iceland (19)	Brazil (16)
22	Bolivia (-)	Taiwan, China (21)	Uruguay (19)
23	Portugal (39)	Greece (16)	Ukraine (23)
24	Nigeria (18)	Ireland (24)	Japan (37)
25	Australia (42)	Korea (Republic) (25)	Denmark (28)
26	Congo (Dem. Republic) (30)	Italy (23)	Croatia (26)
27	United States (32)	Kuwait (31)	Taiwan, China (47)
28	Slovenia (41)	Denmark (26)	Bulgaria (43)
29	France (29)	Cyprus (28)	Nepal (25)
30	Côte d'Ivoire (3)	Hong Kong, China (29)	Argentina (27)
31	Belgium (61)	Iran (Islamic Republic) (30)	United States (39)
32	Cameroon (17)	Czech Republic (27)	Korea (Republic) (35)
33	Egypt (Arab Republic) (14)	Croatia (32)	Italy (48)
34	Netherlands (53)	Mexico (34)	Colombia (33)
35	Argentina (12)	Slovakia (35)	United Kingdom (53)
36	Romania (46)	Hungary (39)	Trinidad & Tobago (34)
37	United Kingdom (58)	Portugal (36)	Ethiopia (66)
38	Kazakhstan (34)	Poland (38)	Portugal (40)
39	Austria (37)	United Arab Emirates (40)	Ghana (38)
40	Bulgaria (25)	Kazakhstan (37)	Spain (46)
41	Turkey (68)	Slovenia (41)	Germany (44)
42	Estonia (69)	Romania (43)	Ireland (41)
43	Greece (63)	Israel (42)	Tanzania (49)
44	Albania (26)	Uruguay (44)	Kazakhstan (21)
45	Mexico (51)	Lithuania (45)	Bolivia (-)
46	Peru (48)	Estonia (46)	United Arab Emirates (55)
47	Iran (Islamic Republic) (71)	Russia (48)	Congo (Dem. Republic) (51)
48	Chad (-)	Trinidad & Tobago (49)	Niger (81)
49	Sri Lanka (40)	Egypt (Arab Republic) (47)	Hong Kong, China (60)
50	Poland (57)	Latvia (50)	Estonia (29)
51	Tunisia (60)	Tunisia (51)	Iran (Islamic Republic) (50)
52	Philippines (31)	South Africa (52)	Gabon (79)
53	Lithuania (36)	Turkey (53)	South Africa (57)
54	Syria (Arab Republic) (19)	Macedonia (Republic) (58)	Cameroon (62)
55	Libya (70)	Jordan (54)	Swaziland (42)
56	Macedonia (Republic) (43)	Colombia (59)	Côte d'Ivoire (77)
57	Ireland (88)	Serbia (57)	Namibia (73)
58	Thailand (67)	Ukraine (56)	Chad (-)
59	China (45)	Bulgaria (60)	Saudi Arabia (56)
60	Indonesia (47)	Algeria (55)	Peru (45)
61	Korea (Republic) (83)	Albania (67)	Czech Republic (32)
62	Paraguay (54)	Thailand (63)	Serbia (30)
63	Uruguay (50)	Lebanon (62)	Cyprus (59)
64	Latvia (22)	Bolivia (-)	Qatar (75)
65	Lebanon (44)	Brazil (65)	Poland (63)
66	Israel (52)	Morocco (66)	Egypt (Arab Republic) (74)
67	Serbia (35)	Peru (68)	Jordan (67)
68	Tanzania (56)	Syria (Arab Republic) (71)	Macedonia (Republic) (58)
69	Trinidad & Tobago (86)	China (72)	Kenya (54)
70	Swaziland (4)	Paraguay (69)	Algeria (84)
71	Iceland (55)	Sri Lanka (74)	Zimbabwe (-)
72	Luxembourg (81)	Indonesia (61)	Syria (Arab Republic) (70)
73	Pakistan (64)	Libya (64)	Australia (72)
74	Mongolia (72)	Botswana (73)	Kuwait (68)
75	Algeria (65)	Swaziland (70)	Mongolia (78)
76	Hong Kong, China (66)	Namibia (75)	Greece (83)
77	Brazil (62)	Philippines (76)	Pakistan (71)
78	South Africa (59)	Gabon (77)	Philippines (52)
79	United Arab Emirates (80)	Mongolia (78)	Thailand (65)
80	Morocco (77)	Pakistan (79)	Romania (36)
81	Qatar (91)	Ghana (80)	Nigeria (88)
82	Nepal (76)	India (84)	Sri Lanka (61)
83	Taiwan, China (73)	Cameroon (81)	Mexico (64)
84	Kuwait (92)	Nigeria (82)	Turkey (69)
85	Saudi Arabia (85)	Côte d'Ivoire (85)	Lebanon (82)
86	Senegal (78)	Kenya (86)	Senegal (85)
87	India (84)	Niger (88)	Morocco (76)
88	Ghana (79)	Chad (-)	Libya (92)
89	Botswana (87)	Senegal (87)	Tunisia (80)
90	Namibia (75)	Ethiopia (92)	Indonesia (90)
91	Cyprus (90)	Congo (Dem. Republic) (89)	China (87)
92	Niger (74)	Nepal (90)	Israel (89)
93	Jordan (82)	Tanzania (91)	India (86)
94	Ethiopia (89)	Zimbabwe (-)	Botswana (91)

Index methodology

The Energy Sustainability Index ranks WEC member countries in terms of their likely ability to provide a secure, affordable, and environmentally-sensitive energy system. The rankings are based on a range of data and databases that capture both energy performance and the context of that energy performance. Energy performance indicators consider 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. Indicators were selected based on the high degree of relevance to the research goals; each is distinct, could be derived from reputable sources and captured for most WEC member countries.

Overall, the Index displays the aggregate effect of energy policies applied over time in the context of each country. It is important to see the Index as a starting point for understanding the sustainability of countries' policy approaches. More details on the methodology, which has been improved since the 2011 report – this year the assessment of the social equity and environmental impact mitigation dimensions has been enhanced – can be found in Appendix C. Index rankings for 2010 and 2011 were calculated retrospectively with the improved methodology to allow a year-to-year comparison. The complete 2010 and 2011 Index ranking can also be found in Appendix C.

There are leading countries but energy sustainability remains a distant target

Governments seek to provide affordable energy in an environmentally-sensitive way to ensure social and economic well-being of people in the long run. However, developing and maintaining energy sustainability involves a shifting balance of trade-offs between the three dimensions of the energy trilemma – energy security, energy access and affordability, and mitigating the environmental impact – with no single 'silver bullet' formula. The Index shows that a few countries have achieved significant traction in providing sustainable energy, but most countries, no matter if developed, emerging or developing, struggle with the balance between the three dimensions.

A focus on top-performing Sweden

Sweden's top ranked position in the 2012 Energy Sustainability Index is based on its top rankings in two energy performance dimensions of the Index and a relatively high position (16th) in the social equity dimension. A number of elements of the Swedish energy policy support this high position. Overall, the country's energy policy is based on the same three pillars as energy policy for Europe - energy sustainability, competitiveness, and security of energy supply.

Sweden has a high share of renewable energy compared to many other countries (about 48% of total final energy consumption in 2010) with hydro power and bioenergy as the two main sources. Bioenergy comprises 29% of total final energy consumption, equivalent to that of hydro

power and nuclear power together (final consumption) and larger than the domestic consumption of oil. Historically, Sweden has been very dependent on the import and use of fossil fuels. But the development of nuclear power, starting in the 1970s, together with earlier development of large-scale hydro power, and later on bioenergy, has enabled Sweden to diversify its energy mix, improve energy security, and move towards being a low-carbon economy.

In the transport sector, renewable energy has reached almost 10% (2011) with ethanol, biodiesel and biogas as the three main biofuels. Furthermore, HVO (synthetic diesel) from tall oil[4] was introduced into the market in 2011.

The heating sector - to a large extent based on district heating (about 40% of heating demand) - is practically fossil fuel free as a result of the increased use of biomass and heat pumps. There is very limited use of natural gas.

The same is true for the electricity sector, where hydro and nuclear power stand for the bulk of the production and wind power is increasing rapidly.

These developments have allowed Sweden to manage its energy and emissions intensity very effectively. Since 1990, the emissions of greenhouse gases (GHGs) decreased by approximately 10% while GDP increased by more than 50%.

In 2009, the Swedish Government agreed on a long-term and sustainable energy and climate policy with specific goals set for 2020:

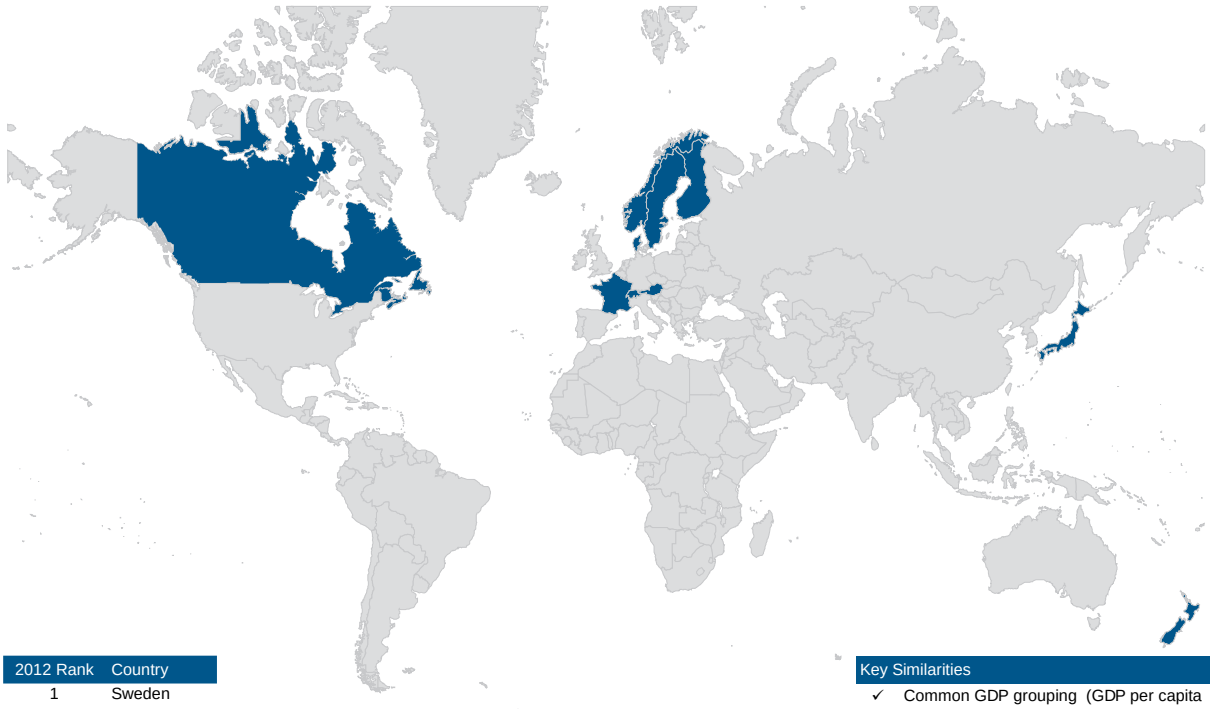
- 40% reduction of GHG emissions compared to 1990
- At least 50% share of renewable energy in the energy mix
- At least 10% share of renewable energy in the transport sector
- 20% more efficient use of energy compared to 2008

Looking beyond 2020, Sweden is aiming for a vehicle stock that is independent of fossil fuels by 2030.

The main policy measures in Sweden are general economic instruments: providing financial incentives aiming for cost-effective solutions and promoting competition among technologies. Instruments include CO_2 and energy taxation, emissions trading and tradable certificates for renewable electricity. Sweden has established joint policy approaches with its neighbours; for example, since 2012 the electricity green certificates market is a joint Swedish-Norwegian market. Sweden is also a member of Nord Pool, the Nordic wholesale electricity market, which operates in Norway, Denmark, Sweden, Finland, Estonia, and Lithuania.

[4] Tall oil is a mixture of mainly acidic compounds found, like turpentine, in pine trees and obtained as a by-product of the pulp and paper industry.

Figure 4
Similarities and differences for the top 10 performing countries in 2012 Index



2012 Rank	Country
1	Sweden
2	Switzerland
3	Canada
4	Norway
5	Finland
6	New Zealand
7	Denmark
8	Japan
9	France
10	Austria

Key Similarities
✓ Common GDP grouping (GDP per capita greater than USD33,500)
✓ OECD members
✓ Post-industrial economy
✓ High (>10%) renewables in electricity mix
Key Differences
× Nuclear and non-nuclear power producers
× Low and high fossil fuel reserves
× Net energy exporters and importers
× Various geographic locations

Few countries manage to balance the trade-offs within the energy trilemma

The top performers in the Index were able to maintain their strong positions over the last couple of years and exhibit strong performance in both the contextual as well as the energy dimension. Moreover, the top 10 countries in the overall Index ranking are almost identical to the top 10 countries in energy security performance only.

Figure 4 shows that top performers are all high GDP per capita, OECD member countries with stable and strong political, societal and economic frameworks. The majority of the countries is post-industrial and generates most of its GDP from the service sector. All countries have a well-diversified energy mix with an increasing share of renewable energy. However, there are also key differences: some of them are nuclear power producers, some are net energy exporters while others are net importers and some countries have very high fossil fuel reserves. This further confirms that policymakers' choice is a discriminating factor in providing energy sustainability. There is no specific single solution for energy sustainability. Countries which consider available indigenous resources and develop a policy framework that supports energy sustainability through the value-chain to the end-user can overcome the energy trilemma.

While countries like Norway, Canada, and Sweden manage to balance the three dimensions of energy sustainability extremely well, other top performing countries exhibit weaknesses in some dimensions and underlying indicators. Countries throughout the Index exhibit trade-offs; in particular between affordability and low environmental impact.

Figure 5
At higher levels of GDP per capita countries attain greater overall energy security[5]

Metric	GDP Group A (> USD33,500)	GDP Group B (USD14,300–33,500)	GDP Group C (USD 6,000–14,300)	GDP Group D (< USD6,000)
Five-year growth rate of energy consumption	0.0%	0.0%	1.0%	2.5%
Diversity of electricity generation (Shannon index)	0.44	0.44	0.33	0.35
Proportion of countries that are net energy importers	71%	78%	65%	58%

Countries at various stages of development struggle with energy security

Developing and emerging countries (GDP Groups C and D) primarily struggle with energy security due to their strong energy consumption growth rate, which is necessary for their industrial, economic, and social development. This energy consumption growth rate tends to slow down as economies mature and shift towards the service sector. In addition, as economies mature, countries are better able to support and promote investments in energy efficiency; for example, the Brazilian labelling programme (PROCEL seal) for energy-efficient household and energy consuming equipment and China's 1,000 Enterprise Program.

Countries with higher GDP per capita have a more secure energy supply. Besides better managed consumption growth, this is further supported by a well-diversified electricity generation mix with higher shares of renewable, including hydro, and nuclear energy (see Figure 5). To achieve these developments, however, a country needs political will, strong institutional frameworks, and the availability of the necessary financial means.

For emerging countries, maintaining a good ratio of production to total energy supply becomes a challenge as they have to develop the needed infrastructure and generation capacity. Such development is required to keep up with rapidly increasing energy consumption driven by increasing industrialisation, urbanisation and more energy-intensive lifestyles. But it is also the case that developed countries struggle with the ratio of production to total energy demand, as consumption has outpaced their ability to expand domestic production of energy.

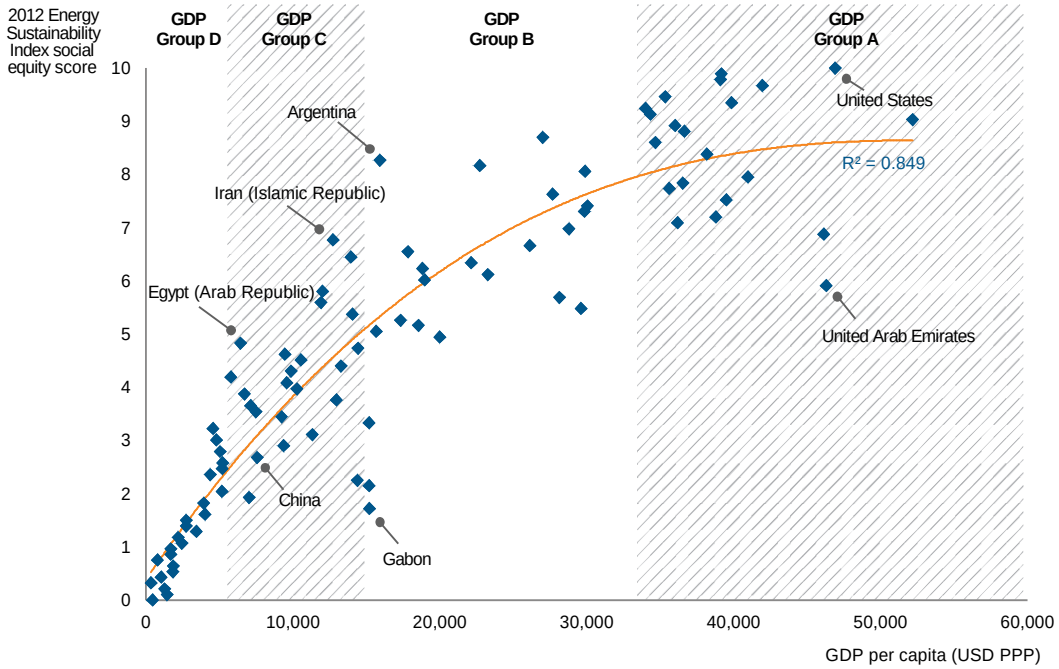
Providing high quality and affordable energy access remains a significant challenge for developing and partly for emerging countries

As demonstrated in Figure 6, countries with higher GDP per capita are more likely to provide high-quality and affordable electricity access, as well as affordable gasoline prices (as measured in the 'social equity' dimension). However, fuel poverty is also becoming a topic of increasing importance in some of these countries and should not be underestimated.

For developing countries, the main challenge is that large parts of the population remain without access to electricity. Scarce financial resources on the demand and supply side limit the functioning of markets and the ability to attract investments in the energy sector. One result of the lack of modern energy is the reliance on traditional biomass for cooking with a tremendous negative impact on the local environment. In Sub-Saharan Africa only 31% of the population has electricity access and 80% relies on the traditional use of biomass. In India more than 400 million people do not have electricity

[5] The Shannon diversity index was calculated using the contributions to total electricity generation of four components: conventional thermal (oil, gas, and coal), nuclear, hydro, and non-hydro renewables. The index values are normalised to one, such that a country producing 25% of its electricity from each source would score a 1. A country receiving 100% of its electricity scores a 0 on the index.

Figure 6
Countries improve their ability to provide affordable and high quality energy with increasing GDP per capita



access and more than twice as many people as that do not have clean cooking facilities.[6]

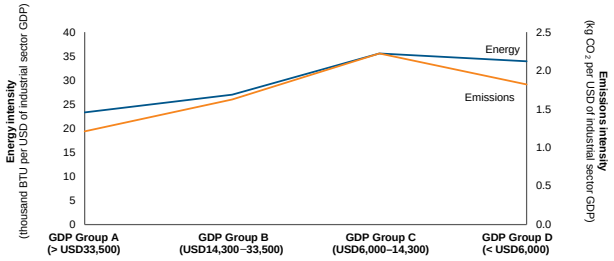
However, there are also examples of countries achieving dramatic improvements in electricity access. For example, China has secured rural energy access for many millions of people in the past decade and is expected to achieve universal access by 2015. Vietnam has increased access to electricity from less than 5% all the way to 98% in the last 35 years.[7] Latin and South America have also expanded electricity access during recent years, with targeted policies and subsidy programs to improve electricity access and affordability.

Environmental impact mitigation is a universal problem

In general, as countries' GDP per capita increases they demonstrate improved ratings in the Index's measures of environmental impact mitigation. However, a deeper analysis of the driving forces shows that countries improve only in certain areas, while they face new challenges with rising economic development.

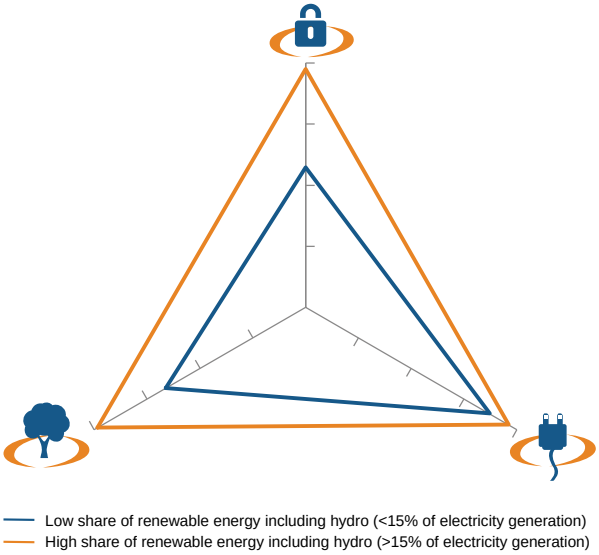
Figure 7 shows that countries with lower GDP per capita have higher levels of energy and emission intensity per unit of economic output. In general, these countries have low levels of energy consumption, partly due to insufficient electricity access and low energy services. However, due to inefficient energy generation, lower GDP per countries tend to exhibit high CO_2 emissions per kWh from electricity and heat generation and strong pollution of air and water. Therefore, while overall energy intensity usage is low (low levels of energy use per capita), the countries still perform poorly in environmental impact mitigation overall.

Figure 7
Countries with higher GDP per capita exhibit stronger environmental impact mitigation



[6] IEA, United Nations Development Programme (UNDP), United Nations Industrial Development Organization (UNIDO), 2010: *Energy Poverty: How to make modern energy access universal?*
[7] United Nations Sustainable Energy for All, 2012: *Achieving universal energy access*

Figure 8
Countries with higher shares of renewables, including hydro, in their electricity generation outperform economic peers with less diversified generation



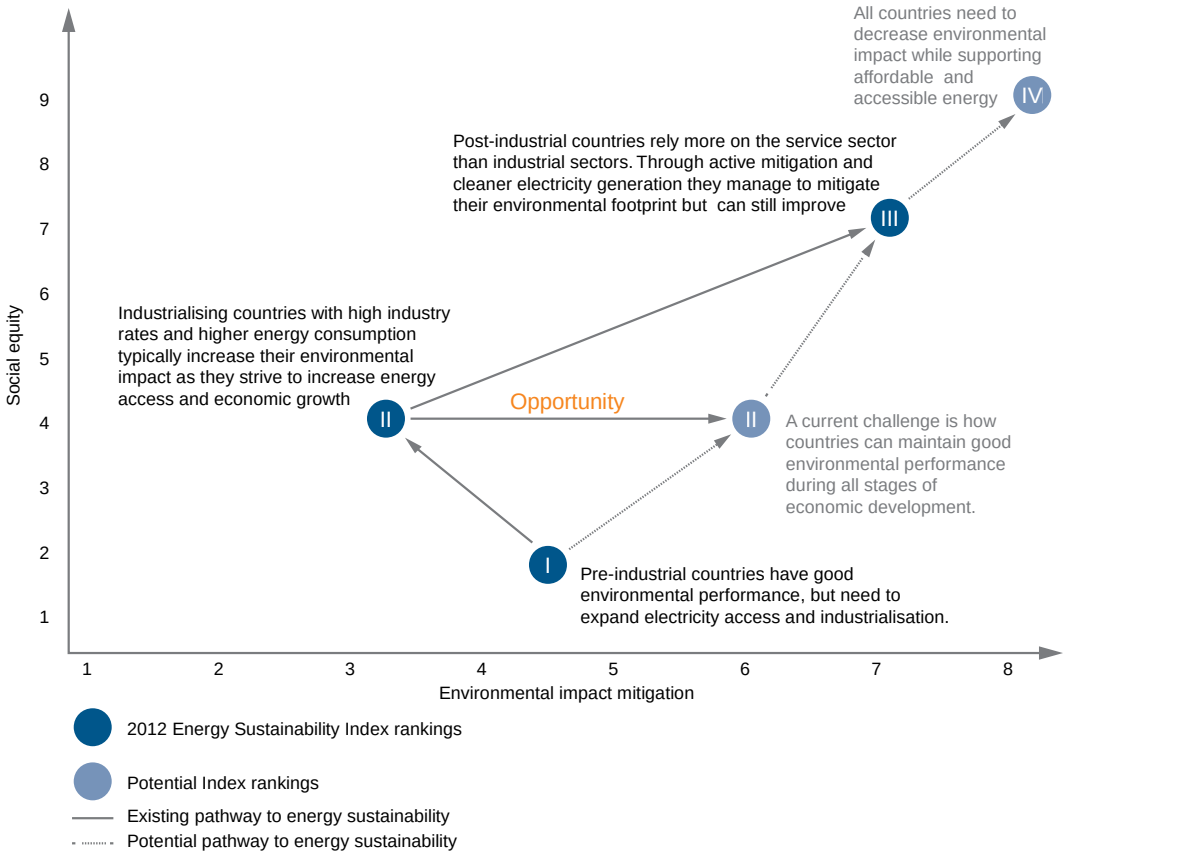
Countries with higher GDP per capita face opposite challenges. They have very high levels of energy and emissions intensity per capita. This is based on energy-intensive consumption behaviours and lifestyles, which are further supported by highly affordable energy. However, most developed countries are likely to successfully engage in active measures to mitigate CO_2 emissions per kWh from electricity and heat generation and to improve the air and water quality. Among other initiatives, this is driven by their stronger reliance on renewables, including hydro, and nuclear in their power generation.

Based on the 2012 Index results, a comparison between groups with similar GDP per capita confirms that countries with larger shares of renewables, including hydro, in their electricity generation have significant advantages in mitigating their environmental impact. This is measured by indicators of 'cleaner' electricity, lower heat generation as well as lower levels of air and water pollution. These countries also exhibit better performance in providing a secure energy supply, due to greater diversification of electricity production. However, there are little differences in their ability to provide affordable electricity (social equity), as illustrated in Figure 8. One reason could be that 'new' renewable technologies such as solar and wind are currently more expensive than conventional generation methods.

At present, absorbing renewable energy into the energy mix poses several challenges and developed countries appear to be better at leveraging this opportunity. Due to intermittent production with wind and solar, there is a need for back-up capacity (often gas), energy storage facilities, and efficient transmission and distribution systems to transport energy from the production sites to end consumers. This requires substantial infrastructure investments, which are considered high-risk projects for private investors due to long lead times as well as regulatory, market, and technology uncertainties. Because renewable energies struggle to compete with conventional energy sources, they often rely on financial support. Technological development will help drive down the cost curve of renewable energy technologies and support meeting current and future global energy needs in an environmentally sustainable way.

Developing countries often lack the financial resources, market sophistication and economic stability needed to deploy new technologies as they still prioritise expansion of access to electricity and satisfaction of energy demands from their industries. Developed countries, on the other hand, have already established complete electricity access at affordable prices and can invest in decarbonising their energy mix, thus improving their performance in all dimensions of the trilemma.

Figure 9
Current and potential pathways to energy sustainability



Pathways to a sustainable energy system

Figure 9 plots the current social equity and environmental impact performance of pre-industrial, industrial and post-industrial country groups in the Index.[8] The Index data highlights the question of whether the current trajectory during development stages could be changed in the future so that a drop in environmental performance could be avoided.

Pre-industrial countries have relatively low environmental impact due to low energy and emissions intensity per capita. However, this reflects their low energy consumption, low levels of industrialisation and limited access to modern energy. At the same time, these countries have poor performance in social equity (see Group I, Figure 9). It is crucial that these countries modernise and increase their energy services to improve human well-being, reduce poverty, improve health and contribute to the country's economic development through productivity increases and competitiveness enhancements.

As countries succeed in addressing these challenges by increasing energy services, they typically embark on a path of strong macroeconomic growth, accompanied by increasing industrialisation and urbanisation which also leads to higher energy and emissions intensity per capita. To meet rapidly increasing energy demand countries currently rely heavily on fossil fuel-based generation and therefore exhibit high CO_2 emissions per kWh from electricity and heat generation and strong air and water pollution, compromising their environmental sensitivity (see Group II, Figure 9). Many countries do not have the capability to invest heavily in decarbonising solutions at this point as they lack financial

[8] Levels of industrialisation and GDP per capita classify a country's development stage: pre-industrial countries that rely most heavily on agriculture are the least developed; emerging, industrial countries have the highest development rates and usually exhibit strong economic growth rates; and post-industrial countries are the most developed, with the highest GDP per capita and a stronger reliance on the service sector.

resources and human capital. At this development stage, the focus of political priorities and resource allocation is to improve social and economic stability, which is a pre-condition to attract foreign investors.

Once countries have reached a certain level of development and have established a strong political, social and institutional framework, they are more likely to invest in decarbonising their energy mix and improve performance across all dimensions (see Group III, Figure 9). However even post-industrial countries struggle with several underlying indicators such as high energy and emissions intensity per capita. These countries face trade-offs between affordable energy prices and the need to set incentives to reduce energy intensity through energy-efficiency programs or changes in consumption behaviour. Targeted energy policies are needed to improve performance across all dimensions of the Energy Sustainable Index (Group IV).

Summary

The Energy Sustainability Index identifies the need for countries to be proactive in mitigating their environmental impact while passing through various stages of their economic development. At international climate summits, this is a consistent focus: can emerging economies commit to stricter CO_2 reduction targets while they still struggle with expanding energy services and with responding to energy demands from their growing economy? Multiple analyses point out that developing countries have the highest potential to develop renewable energy sources such as solar, wind, hydro, and geothermal, but that this potential is currently barely exploited.[9]

It is crucial to deploy technologies, existing and new, with appropriate economic incentives and well-targeted support to enable economic and social development while at the same time addressing energy sustainability and increasing access to affordable energy. Given recent technological advances, with proper planning and adequate policies and regulations, countries have the potential to attract investments, embrace an alternative pathway and to make progress on all three aspects of energy sustainability. The balance of this report captures the energy industry perspectives on key actions required by policymakers to achieve this goal.

[9] United Nations Environment Programme (UNEP), February 2012: *Financing renewable energy in developing countries*.

“We need a global mind-set in order to succeed”

“Energy savings are nice, but don’t generate energy”

“No policy can work if the genuine understanding of the general public isn’t there”

“Achieving energy sustainability has to be a joint effort between policymakers, industry, and the public”

“If it doesn’t work in the market place, it is not sustainable”

“Without clear direction it is difficult to get to a meaningful policy”

“We don’t need to resolve the debate around the climate changes since most people can see that we have to find a better answer than digging things up and burning them”

“With existing technology and commitment an awful lot can be achieved”

“Diversification is an insurance policy against external shocks”

“It is important to find the balance among different energy sources”

“We shift carbon emissions to other parts of the world where the total energy package is cheaper and then we import the very same product and finger-point to the country as a CO_2 emitter. But we should regard consumers of the final product as the CO_2 emitter.”

“We need private sector engagement for real sustainable solutions”

“The greenest energy is energy saved”

“The fifth energy source is energy conservation”

“Right now we are spending energy like drunken sailors”

2. Framing the energy sustainability discussion

Energy benefits people far beyond what they use individually at home, at work or on the road. Access to energy is critical to the development of a modern economy be it for agriculture, transport, computing, manufacturing, construction, or health and social services. Energy is part of people's lives more than ever before. The shift from primary energy to electricity is a key feature of modern society and the impact of electrification on the quality and standard of living is significant, with benefits for general health, opportunities for more productive activities that can generate additional sources of income and new possibilities for education and media.

The projected economic and population growth from roughly 7 billion to 9.3 billion people by 2050[10] as well as the aspirations of a rapidly growing global middle class, will drive energy demand. This increased demand will put even greater pressures on energy resources, energy infrastructure and the environment.

Sustainable energy is not only an opportunity to transform societies and grow economies, but also a necessity - a prerequisite to meet growing energy demand and reduce the carbon footprint. The energy industry plays a vital role in securing the transformation to a sustainable energy system. *"Achieving [energy] sustainability has to be a joint effort between policymakers, industry and the public."* To reach a common understanding of what energy sustainability is, its importance for economic growth, the challenges and issues to be addressed, and the steps necessary to achieve it, energy industry emphasised the need for an adequate debate between policymakers, the energy industry and the public.

Global energy sustainability requires addressing three challenges in the energy sector:

1) Energy security - whether it is security of supply or demand - to fuel economic growth;

2) Energy access and the reduction of energy poverty; and

3) Environmental impact mitigation.

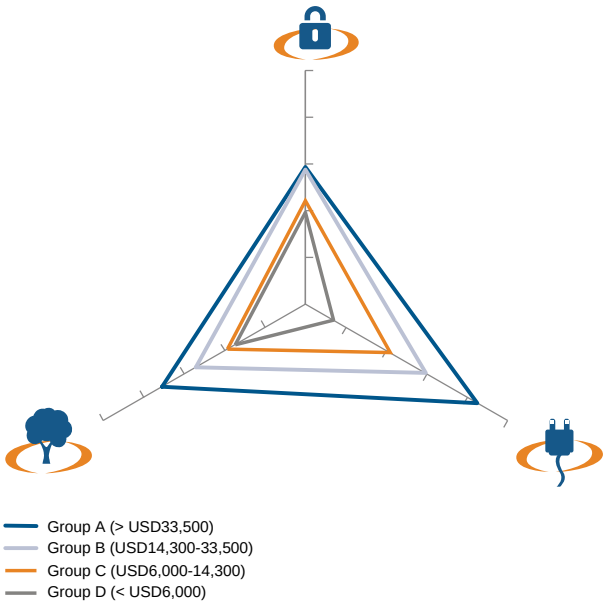
Ideally, advances in meeting these challenges are aligned so that progress in all three areas is interdependent and complementary.

Today, energy systems around the world remain at vastly different stages of development. But they all share a common problem: they are far away from being sustainable. *"If a sustainable energy system is something that is more secure than currently, at a cost that will support economic development particularly in developing countries, but which is also less carbon-intensive than currently, then you are probably looking at somewhere in the middle of the current century – around 2050. If someone says otherwise they are not dealing with reality."*

Perspectives on urgency of the three pillars of energy sustainability vary across countries, making it hard to define a common playground for all participants in the market place. All countries are very focused on energy security and price volatility. However, there is more variability when it comes to energy access and affordability, the social equity

[10] UN, 2010: *2010 Revision of World Population Prospects*

Figure 10
Relationship between economic development (measured by GDP per capita) and prioritisation of pillars in energy trilemma



pillar, and even more so for the environmental mitigation pillar (see Figure 10). Each country faces unique challenges in meeting the energy trilemma and must chart its own path though the hard choices which need to be made.

Developing countries in Sub-Saharan Africa, South East Asia, and Latin America need to build out their energy infrastructure to increase access to electricity and ensure reliable energy supply to support economic growth. Developing and emerging countries are asking the question: *"Shall we get electricity from whatever source is currently available or wait to get electricity from a cleaner source?"*

Similarly, emerging economies and high-growth regions need to increase energy availability and reliability quickly to ensure supply security, to maintain a strong long-term economic development and to meet the aspiration of a rapidly growing middle class. Moreover, many of these countries, for example China and India, also face the challenge of supporting massive urban growth and an increasing number of mega-cities.

In developed regions with slow economic growth and a mature energy infrastructure, the focus is on energy security, transforming the energy system and mitigating environmental impact. For example, in the USA, energy independence is at the centre of attention on the federal level with lesser attention paid to environmental aspects and system efficiency. Within Europe, the focus is on adjusting the energy mix and the transformation of the energy system. The move towards renewable energy, away from a fossil-fuel based economy, is also based on a desire to be more independent and less vulnerable to geopolitical uncertainties. *"The transformation towards renewable energy does not emerge out of purely good nature, but also problems of limited resources and increasing difficulty to access resources - especially fossil fuels."* The challenge here is how to increase the share of renewable energy in the system, diversify generation, and ensure load balancing.

Driving three global energy goals

There is a growing focus on the energy trilemma and the importance of energy in economic development. Most recently, its importance was recognised at the Rio+20 conference. The United Nations Conference on Sustainable Development (Rio+20) held in June 2012 as a 20-year follow-up to the 1992 United Nations Conference on Environment and Development (UNCED) produced a vision statement "The future we want". The Rio+20 vision statement clearly supports the initiative

by the UN Secretary-General on Sustainable Energy for All launched in 2011.[11]

The initiative's ultimate goal is to achieve three key objectives by 2030:

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

Since its launch Sustainable Energy for All calls on all sectors of society to make commitments to achieve these goals. To date, the private sector has committed over USD50 billion and several billions of dollars have been committed by other key stakeholders, including governments, multilateral development banks, and international and members of the civil society.[12]

Underlying this effort is the need to benchmark and track policy performance to ensure progress. To this goal, tools such as the annual WEC Energy Sustainability Index are critical.

The energy industry noted that debates on achieving energy sustainability must include and recognise the following:

- Have a master plan with clearly defined energy sustainability goals
- Ensure the approach is economically viable
- Include all forms of energy in the energy mix
- Recognise that the transformation of the energy system is a long-term process

Have a master plan with clearly defined energy sustainability goals

To provide energy systems that are simultaneously affordable, stable, and environmentally-sensitive is a universal aspiration and industry repeatedly stressed that *"having a master plan is very important." "Without clear direction it is difficult to get to a meaningful policy; that is why we see policymakers and politicians muddling through and changing policies at any given time depending on where the wind blows or where voters tend to."* Currently, there is no common global roadmap, no common global targets have been agreed on, and there are no agreements on what 'sustainability' should include for each country. Furthermore, there are many different views on how to provide sustainable, affordable, and reliable energy among politicians, scientists, general public, and other stakeholders - which makes it difficult for policymakers to craft policies. This adds to the high degree of uncertainty for industry.

To develop a master plan - on a national or global level - a clear vision describing what needs to be accomplished in the mid-term or long-term future is needed. Sustainability is a moving target and the *"toughest issue for policymakers is to define what stable, affordable, and environmentally-sensitive*

[11] http://www.sustainableenergyforall.org/actions-commitments/high-impact-opportunities/item/109-rio-plus-20
[12] WEC not only welcomes and supports the UN *Sustainable Energy for All* Initiative, but is engaged in contributing to the ongoing monitoring of the initiative's goals beyond 2012.

means." Countries have different economic development, structure of the economy, resource endowments, skill sets, and technologies. Each country must leverage its competitive advantage to achieve sustainable energy. South Africa for example has solar resources, the USA has shale gas, or Brazil has hydro resources. The definition of the master plan will drive industry investment and innovation to leverage indigenous resources.

The majority of interviewed industry executives made the point that energy sustainability should be defined by outcomes (for example, overall reduction in CO_2 emissions) rather than by inputs (for example, increased share of renewable energy in energy mix). Industry suggested that *"maybe it would be better to focus on reducing CO_2 emissions because it is less expensive to hit the target and leaves more options on the table."* Choices made now will have significant impacts on future energy portfolio.

Ensure the approach is economically viable

In considering the path to a sustainable energy system, industry leaders stressed the importance of recognising that projects must also be economically sustainable. *"Sustainability is an expression which often focuses just on environmental factors. However, if it doesn't work in the market place, it is not sustainable."* It is most important for policymakers to develop a business model perspective and understand that companies do not invest where there are only adequate or fair returns, but where they expect secure returns which match or exceed other investment opportunities.

Include all forms of energy in the energy mix

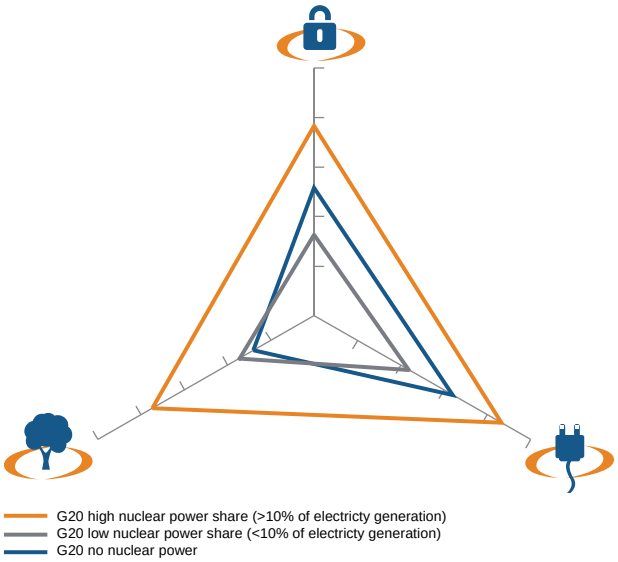
Currently, the global energy mix is composed of around 80% fossil fuels, including coal, oil, and gas, and 20% carbon-free energies, such as nuclear, hydro, and other renewables.[13] By 2035 this is expected to have changed to approximately 60% fossil fuels and 40% carbon-free energies.[14] Executives predominantly agree with this prediction and emphasised that fossil fuels will continue to play a dominant role for the next two to three decades. *"With fossil fuel, at best, you can burn it in the smartest way. There is no choice but to keep burning."*

Ultimately, the future energy mix will depend on indigenous fuel sources, technologies available and the economic drivers for those. Policy has a huge impact on the timing and path taken. Given the magnitude of the challenge, industry across different regions and sectors called on policymakers to *"have technology-neutral frameworks that bring all options to the table"* and include all forms of energy in the future energy mix.

"All available forms of energy should be included in countries' energy portfolios, supported by technologies to mitigate the environmental impact of fossil fuels and energy-efficiency efforts." There is an urgent need to recognise the range of energy sources; none is the single answer. Intertwined solutions are necessary and combinations will not be the same everywhere. It is beneficial to create structures where private investment flows into a

[13] IEA, 2011: *World Energy Outlook 2011*
[14] IEA, 2011: *World Energy Outlook 2011* (450 ppm Policy Scenario, based on policies under consideration)

Figure 11
G20 countries with a higher percentage of nuclear electricity in the portfolio outperform in all dimensions of the energy trilemma



mix of different energy sources and technologies (see Figure 11). The entire value chain needs to be taken into consideration. *"Diversification is an insurance policy against external shocks."*

The role of shale gas

Unconventional gas has been one of the biggest game changers in the energy space in this generation. Given the slow pace of change and long lead-times typical to the energy sector, it is remarkable how different the global outlook for shale gas is today compared to only a few years ago. A technological revolution in drilling and gas production technologies has greatly increased the world's reserves of natural gas and changed the outlook for fossil fired electricity generation over the next decade and possibly longer. Furthermore, if the United States (USA) and China, now hydrocarbon importers, become hydrocarbon neutral or even exporters in the future, it will impact the energy sector globally.

Change in types of hydrocarbons could also be remarkable from an environmental point of view with ramifications on carbon emissions and management strategies and abatement technologies, as already seen in the USA. For example, the use of CCS for gas facilities and the policy debate around the benefits of natural gas and renewable energy. As one executive noted: *"It is a relatively easy switch from oil to gas and the emission reduction can be considerable. Gas can also scale up or down very easily to meet changing demand. The more gas in the portfolio mix, the more renewables (and the intermittency) can be accommodated."*

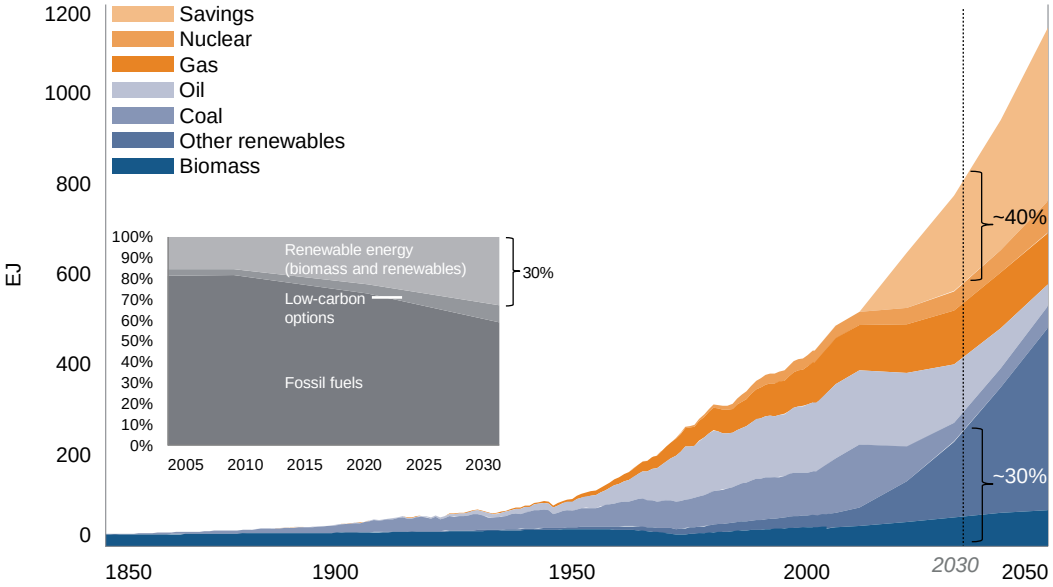
If unconventional gas is developed in a responsible way, the upside can be tremendous. If it is done irresponsibly, a backlash is possible and the full potential of the resource may be delayed. The USA can lead the way and encourage other countries, especially in Europe, to adopt similar approaches in dealing with uncertainties around regulation, technology (for example, the use of chemicals in hydraulic fracking, assessment and evaluation of fractures, liquefaction and handling) and market integration (for example, integration with LNG, pipeline transport, and gas balancing). *"The potential use of unconventional gas has a big upside potential, but requires policy decisions in order to develop it in a responsible way."*[15] While shale gas is certainly an important game changer in the USA - with its impact on the usage of coal and nuclear power - it is far from being a proven game changer elsewhere in the world. Numerous barriers, such as environmental concerns, accessibility and exploitability of reserves, as well as human resources, technology and policy capacity build-up, make replicability elsewhere difficult.

[15] World Energy Council (WEC), 2012: *Survey of Energy Resources: Shale Gas – What's New*

Figure 12

Historical energy transformations and an energy future that meets the sustainable energy for all objectives[16]

Source: UN Sustainable Energy for All, 2012: *Technical Report of Task Force 2*; International Institute for Applied Systems Analysis (IIASA), 2012: *Global Energy Assessment – Toward a Sustainable Future*



Recognise that the transformation of the energy system is a long-term process

The energy system is massive and has a *"large turning radius"*. From the perspective of the energy industry, it will take until the middle of the current century – around 2050 – to change the energy system significantly (see Figure 12). This is in large part because of the time-lag. Innovations come at a slower pace and R&D processes often have a time horizon of several decades. New energy infrastructure takes a long time to build. Furthermore, *"economic growth requires energy which currently requires fossil fuels."* It is likely to take a very substantial period of time to move away from fossil fuels altogether as *"fossil fuels are such an efficient carrier of energy and the infrastructure delivering those fuels is long lived, embedded and very expensive to change."*

Increasing the share of renewable energy is a long-term goal that requires a number of changes in many sectors. For example, in the transportation sector it is necessary to increase the use of biofuels, improve fuel efficiency, and electrify surface transportation amongst other changes. In the electricity sector there is a need to consider the shift in infrastructure demands to support an increased share of renewables and the more efficient use of energy. Moreover, major societal shifts and changes in how people live need to be taken into account.

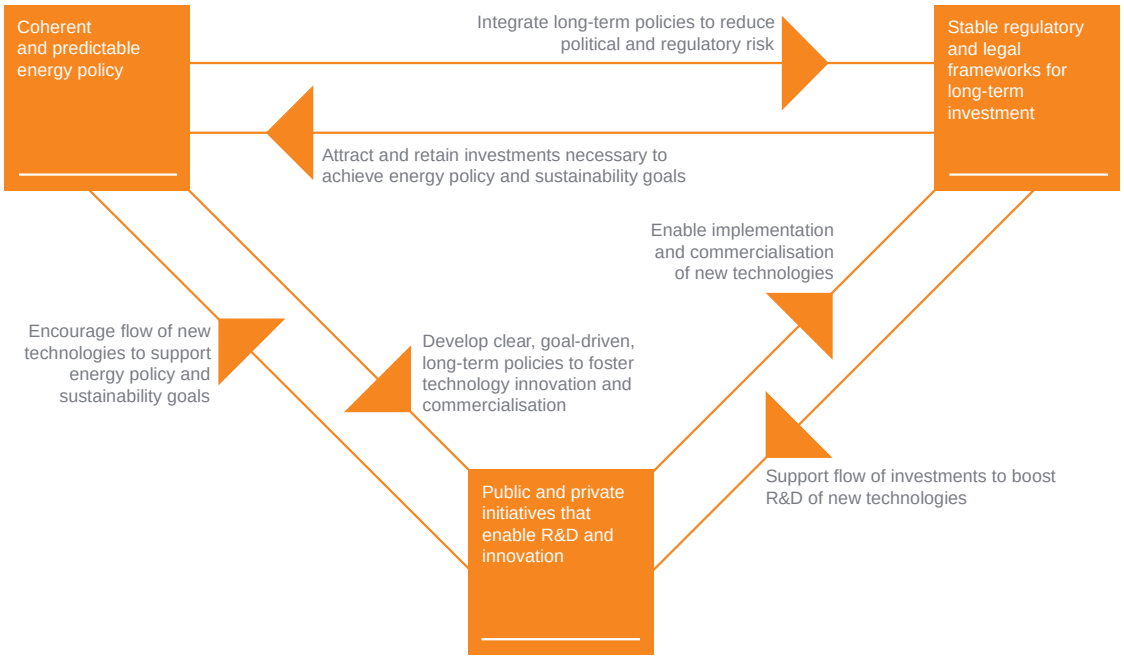
Lowering CO_2 emissions by increasing the share of renewable energy and decreasing the share of fossil fuels, while meeting growing demand from population and economic growth, requires focused resources and commitment. Policymakers will need to devise, implement, and commit to policies that provide the *"push on the steering wheel."*

The question of wealth transfer

The challenge of establishing a system within a country for carbon abatement will have a social impact and inevitably lead to a substantial transfer of wealth within the economy - from one sector to another, from the private sector to government, from consumers to government. Political questions about the redistribution of wealth need to be addressed. Those questions are very controversial and tend to delay the implementation of effective policy.

[16] The grey area represents energy demand that could be avoided through energy-efficiency improvements. New renewables includes solar, wind, hydro and geothermal power. In this scenario, traditional biomass is replaced by modern biomass. The historical data are shown in primary energy, while the inset figure shows final energy demand.

Figure 13
Three key interconnected policy areas are necessary to support the transition to sustainable energy



Summary

In addressing the sustainability challenge, executives emphasised the need to develop a clear vision that encompasses a mix of different energy sources and technologies. As illustrated in Figure 13, governments must set the framework and the boundaries to help overcome the hurdles surrounding regulations, markets, technologies, and customer preferences by setting a clear agenda in three key interconnected policy areas:

- Define a coherent and predictable energy policy
- Enable market conditions that attract long-term investments
- Encourage public and private initiatives that foster R&D in all areas of energy technology

The following chapters discuss each of these areas in turn.

“Simplicity in the regulation is important”

“It is becoming increasingly harder to reliably build a business plan in the political and legislative environment”

“The private sector should play a more important role in providing guidance, stakeholder impact and technical expertise”

“Knitting policies together from bottom-up is more likely to be successful than UN regulations”

“You have to make a plan and stick to it - it needs to be predictable”

“Public awareness of the true cost of energy is important to pursue energy efficiency”

“Detach politics from policies”

“Consistency in policymaking is a prerequisite for optimising the energy mix”

“In the energy space it is important to have non-partisan policies with clear objectives”

“Decisions on energy policies are not made any more to achieve long-term industrial objectives, but to capture voters, leading to an unpredictability of policies”

“People need to be much more educated and aware of things when it comes to energy”

“We need to work towards a technology affinity, not aversion”

“Industry needs frameworks set by politicians that are stable, transparent, long-term, and level the playing field”

“Until we find something, we have to be more efficient with current technology”

“Decisions are driven by the mainstream political view instead of relying on consistently developed, clear objectives”

3. Define a coherent and predictable energy policy

The challenge

Energy policy is highly complex as it must balance energy security, affordability, and environmental sensitivity. In addition, energy is vital to all areas of economic development while, in turn, changes to the economy and society affect the energy agenda.

Selecting the right instruments to drive energy goals is challenging, given the interdependencies and cause-and-effect mechanisms between energy sustainability dimensions and the overall economy. Industry expressed concerns over policymakers' silo-thinking, with separate departments for climate change, energy transformation systems, taxation, transportation, etc. This can promote contradictory ad-hoc policies that can hinder energy developments. For example, policies such as the EU Water Framework Development should address water use relating to both energy and agricultural use.

Added to this complexity is the fact that crafting energy policy is often highly political, which can detract from effective public debate. As industry executives noted, achieving sustainability is not yet a joint effort and all stakeholders, including end-users and consumers, need to be included in the dialogue. Without adequate public debate with open, honest facts on the table, there will be no genuine policy decisions that will be in place long enough to ensure that investments are being made.

Industry recommendations

In the face of these challenges, industry executives make the following six recommendations for policymakers with regards to energy policies (see Figure 14).

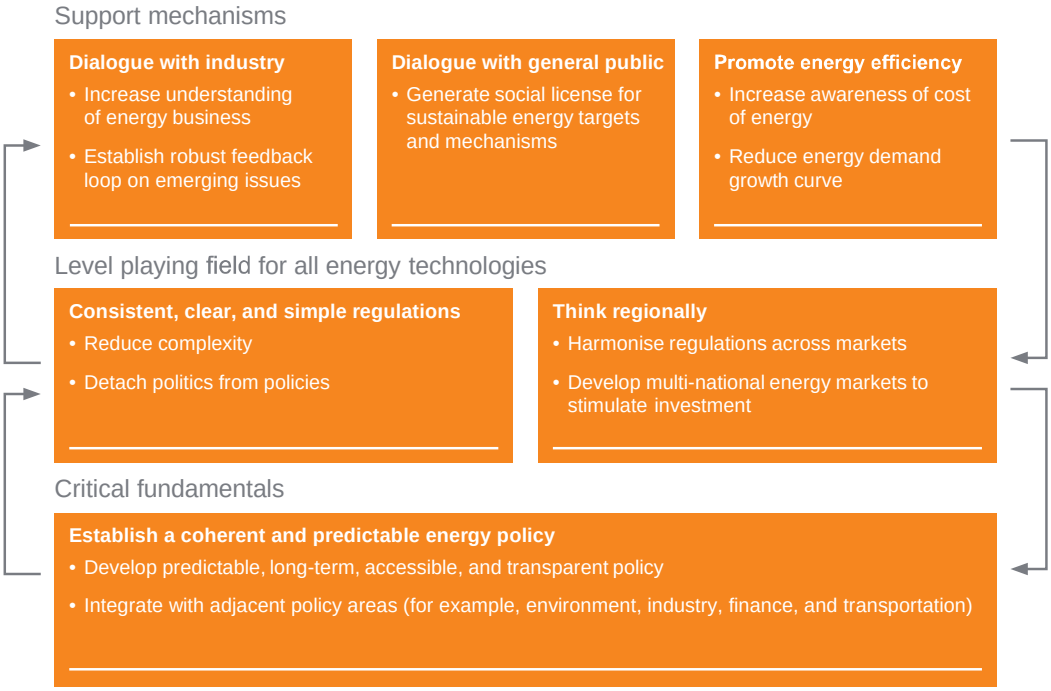
Develop an integrated and coherent energy policy framework

Industry uniformly called on policymakers to develop a coherent and comprehensive energy policy, but noted: *"formulating and articulating an actual energy policy is a huge hurdle."* Industry needs to have a clear understanding of the broad goals and business opportunities within a country. As noted, *"We need to start with a national energy strategy to come to an understanding where we are, which needs we must serve, and where we want to be."*

A country's energy policy should therefore be based on a clear assessment of its energy sustainability balance considering affordability and accessibility, environmental mitigation, and energy security. Within that triangle, policymakers need to ask:

- What are the main needs of the country?
- What are the economic goals?
- What industries do we need to support over the next 20 years?
- Where are investments needed?
- Which instruments will we choose to address needs?

Figure 14
Recommendations to establish a coherent and predictable energy policy



Executives noted that setting an energy policy is challenging: *"policymakers and regulators have to be aware of the country's fundamental energy needs and have to address them by installing a credible and capable political and regulatory system, while simultaneously proving that sustainability dimensions and side questions are understood and balanced."* Furthermore, energy policy must be aligned with the policy of numerous adjacent fields (see Figure 15). Above all, industry called on governments to establish energy policies that are long-term, accessible, predictable, and transparent and serve to level the playing field for technologies and nations. *"Consistency in policymaking is a prerequisite for optimising the energy mix."*

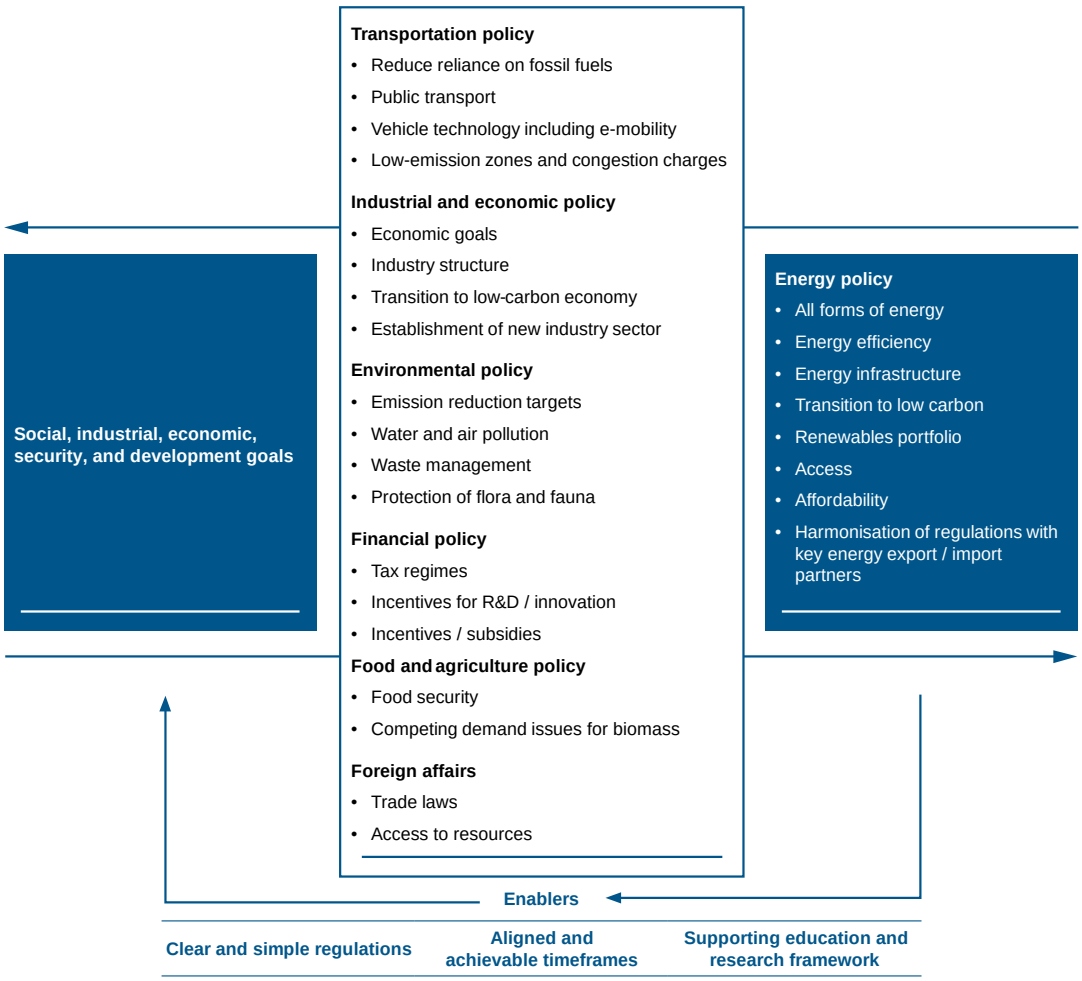
Industry pointed to positive aspects of the energy policies of a number of countries, including:

- UAE's nuclear energy policy to meet growing demand and lower GHG emissions
- South Korea's smart grid initiative as a national policy to achieve the vision of 'low-carbon, green growth'
- China's Five Year Plans, continually updating its policies to address emerging vulnerabilities in the sector
- Brazil's energy auctions, which support a competitive tender between energy sources
- Colombia's consistent framework for the electricity sector set in 1994 (under Laws 142 and 143) with only a few changes over the years
- South Africa's integrated resource plan, a broad national process which aims at balancing energy security, social equity, resource efficiency, and environmental improvement

Think regionally to harmonise regulations and develop energy markets and assets

Energy resources and markets are rarely bound by national borders; however, policies and regulations remain defined by national boundaries. There is a growing need to take a broader perspective with regards to energy decisions. Industry called on policymakers to examine opportunities to adopt regionally coordinated approaches to energy

Figure 15
Elements of a coherent energy policy
A coherent energy policy recognises that energy goals must support and be aligned with the goals of critical adjacent policies



resources, infrastructure, and regulations. As one executive noted, *"Getting countries together to discuss can be helpful in broadening understanding … and components of an international energy strategy may be achievable."*

For emerging economies, developing a regional energy policy or a framework for cross-border resource-sharing would enable countries to build market scale to attract investments, leverage shared natural resources, and develop common infrastructure. These frameworks, such as the proposed ASEAN power grid objectives for 2020, are viewed as a means to both increase regional energy security and power reserves and reduce power costs and investment needs.[17] Similar opportunities to increase energy security exist in Latin America. Some African nations have developed regional power pools that bring together a number of countries with the aims of setting common standards and policies, including detailed items such as the joint exploitation of resources or the management of cross border transmission lines and electricity trade agreements including legal and regulatory frameworks including tariffs. *"These kinds of agreement open up a larger market for power companies, where the potential market size of a single country alone may not be sufficient."*

[17] See http://www.aseansec.org/20918.htm and http://www.theborneopost.com/2012/01/28/asean-expected-to-integrate-power-grids-by-2020-for-regional-power-security-says-thai-energy-expert/#ixzz21B3ZoxTP

Building a regional market: Eastern Africa Power Pool (EAPP)

The EAPP is a regional intergovernmental body of seven Eastern Africa countries: Burundi, Democratic Republic of Congo, Egypt, Ethiopia, Kenya, Rwanda, and Sudan. By pooling and coordinating electrical energy resources, the EAPP aims to make available affordable, sustainable and reliable electricity and increase the rate of access to electricity. Supported by a broader East African Community (EAC) Treaty, the EAPP is developing an East African Power Master Plan (EAPMP) that will embrace the concept of public private partnerships (including human capital training), and the development of a code to guide design and operation of electricity interconnections in the region. It is hoped that this coordinated approach with its 25-year horizon will serve to reduce electricity production cost and create an environment conducive for investment. One example of this shared approach is the proposed regional hydro power plant, Rusizi III, which could produce 145 MW to be shared among Rwanda, the Democratic Republic of Congo and Burundi.[18]

To advance global integration, improve market access and overcome trade barriers, international agreements, such as the recent agreement of Asia-Pacific Economic Cooperation (APEC) members, serve as leading examples. Members agreed to cap tariff rate on 54 'environmental goods' at 5% by 2015, and this offers an immediate path forward and may set the stage for subsequent action in the World Trade Organization and free trade agreements.[19]

Mature energy markets also benefit from regional approaches through regulatory coordination. Industry pointed to the challenges presented by overlapping regional and national regulatory mechanisms as evident in the European Union. Countries such as Denmark, Finland, and Sweden have implemented a carbon tax and also operate within the European Union's Emissions Trading Scheme. In effect, the countries face a doubling of regulations on CO_2 emissions, which can lighten the overall responsibility of other players in the European Emissions Trading Scheme and distort the carbon price. As result, there are no additional benefits at the regional level: *"if one part is very speedy and successful in emissions reduction, other parts in Europe have no responsibilities anymore."*

Looking at the development of energy infrastructure, industry commented that there are few *"… positive examples of cooperation in supply and demand issues across borders, usually it's rather a nightmare for infrastructure companies."* A positive example is the establishment of Nord Pool, the Nordic wholesale electricity market, which operates in Norway, Denmark, Sweden, Finland, Estonia, and Lithuania. However, it was noted that there are still multiple distinct electrical power

[18] http://www.eappool.org/

[19] Many of these 'environmental goods' are energy products and reducing both tariffs and non-tariff market access barriers will lower the cost of new energy-efficient technologies, thereby spurring their utilisation and ultimately assisting in the realisation of broader development and environmental goals for the world community at large, as recommended by the WEC Task Force on Rules of Trade.

markets across Europe. Different regulators apply different tariffs at different stages and on different parties, either consumers or producers, which makes it difficult to build a large single overarching electrical grid.[20] Industry noted, *"… there would be improvement to the energy system as a whole if there were a greater willingness for governments to cooperate on the development of large scale transmission infrastructure."*

Coordinated regulation would also help improve cross-county links and encourage the adoption and implementation of new and currently available technologies. Differing energy targets can hinder existing cooperative energy agreements. For example, alternative energy targets may compromise capacity and can lead to breaches in capacity support in inter-regional agreements. Dis-harmony in the regulatory process can also require companies to go through separate processes of reviews and standards. For example, Canada and the USA trade large volumes of electricity across the border. Both countries require similar toll, economics, and environmental impact statements, but due to small differences in standards, companies must go through each process twice.

Apply clear, basic and simple regulations

Guided by a clear energy policy, supporting regulations must be developed and implemented to achieve defined goals. Industry noted the importance of consistent, clear, and simple regulations. Governments can have a sound policy but implementation often falters due to regulatory complexity. Industry pointed out that *"simplicity in regulation is important"* and regulators should *"reduce the complexity of their policy instruments."* In particular, industry noted the most effective regulations are those that set clear targets or objectives that do not overlap or overly specify mechanisms or technologies to reach those goals.

While calling for simplicity, industry also cautioned policymakers against 'single issue' regulations since these will typically lead to distortions or bubbles in the overall energy system and a sub-optimisation of performance and investments. Comprehensive policies can be more effective than multiple, potentially overlapping and narrowly-focused policy regimes which create a complex policy landscape with potential unforeseen risks and unintended impacts. Policies must be considered with a framework of how sectors interact on a macroeconomic scale. Only by taking into account the feedback of economic impacts across all sectors and regions, can the total effectiveness of the energy policy be optimised.

Regulators can also examine how to implement regulations with a 'single window' concept to streamline processes. This can be particularly important for new technologies where all processes and associated regulatory frameworks necessary for planning and permitting may not yet be fully mapped out. For example, solar power developers in India must secure permission to transfer land from agriculture to non-agricultural use and may

[20] The member states of the EU have recognised the challenges of multiple electricity markets and have agreed on an ambitious plan of building the biggest market of electricity, connecting more than 500 million consumers throughout the continent. The "Third energy package" includes actions to removing technical obstacles to cross-border energy trade and coordinates activities of national energy regulators.

have to acquire and document water rights for the life of the project from local water authorities, secure approval of the pollution control board and the aviation ministry to achieve overall approval at state and national level.[21] In some European countries waiting for permits for roof-top solar project can account for 50% of the total project timeline.[22]

Finally, industry called on policymakers to *"detach politics from policies"* and noted the importance of regulators that are independent from governmental changes as a mechanism to support consistency. *"In the energy space it is important to have non-partisan policies with clear objectives."* Industry noted that short-term, inconsistent, and opaque regulatory frameworks limit or stop a company from investing in a country's energy infrastructure. As one executive noted: *"The greater the political consent on an energy policy, the more willing I would be to invest in the country."*

Increase the dialogue between policymakers and industry

"The feedback loop with policymakers is very important" and greater dialogue with policymakers is critical to developing sustainable energy strategies. Executives noted: *"Industry is vital to solving the sustainability challenge"* and acknowledged that *"… on the policy side, the private sector should play a more active important role in providing guidance, stakeholder impact and technical expertise …"* to achieve energy sustainability. For example, a dialogue with industry is crucial to assess the cost and efficacy of technologies and thus inform policymakers' in setting sustainability goals.

"Much of the energy space is changing – especially for renewables. You can't develop policy in isolation." Policymakers must engage with industry and vice-versa to improve clarity and the path forward for sustainable energy systems. Policymaking can be enhanced through an ongoing and long-term dialogue between industry and government. Some countries noted for having effective ongoing dialogue between policymakers and industry include Korea (Republic) and Colombia.

Industry Initiatives to drive the sustainable energy dialogue

The Global Sustainable Electricity Partnership, which includes many members of the World Energy Council, is a non-profit international organisation, composed of leading electricity companies looking to promote sustainable energy development through renewable energy projects and capacity-building activities in developing and emerging nations worldwide. Initially formed by European and North American utilities in 1992, the organisation expanded in 2010 to include counterparts from major emerging economies including Brazil, South Africa, China, and Mexico. The initiative focuses on supporting the development of joint policy frameworks, engaging in the global debates on electricity-related issues, and bringing together competencies, experience

[21] Rikki Stancich, February, 11, 2011: *India site procurement: Overcoming DNI data availability, permitting and regulatory challenges* (see http://social.csptoday.com)
[22] IEA, 2012: *Tracking Clean Energy Progress*

and motivated individuals to tackle the challenges of sustainable and accessible energy. Recently, the partnership organised the "Global Summit to Strengthen Public Private Partnerships (PPP) to Accelerate Global Electricity Technology Development" with the United Nations. The Summit highlighted recommendations from 2011 and 2012 global surveys of public and private PPP practitioners and the learnings from over 30 case studies. [23]

Increase the dialogue with general public

A country's energy policy must be underpinned by a 'social license', that is to say, broad approval from the general public. *"Achieving sustainability has to be a joint effort between policymakers, industry and the public."* This license must be based on adequate and engaged public debate around energy sustainability challenges. Governments can play a critical role in information dissemination, awareness raising and stimulating broad stakeholder engagement in the discussion of energy issues since *"no policy can work if the genuine understanding of general public isn't there."*

Industry noted that there must be honest communication and debates with consumers and end-users about trade-offs and related energy costs. Currently, in many countries, energy discussions quickly dissolve into disputes over climate change that can stall discussions on energy strategy. Industry noted that structuring energy discussions solely around climate science is not helpful on the grounds that in can often become controversial. As one oil and gas executive bluntly noted: *"We don't need to resolve the debate around the climate change since most people can see that we have to find a better answer than digging things up and burning them."*

Industry recommended that policymakers re-frame the energy discussion to focus on the overall costs of energy, the benefits of new energy technologies (for example, smart meters) and the need to foster energy efficiency. *"Public awareness of true cost on energy is important: it is a political role to speak clearly to consumers to give them a clear message and get acceptance of the cost of energy from the people."*

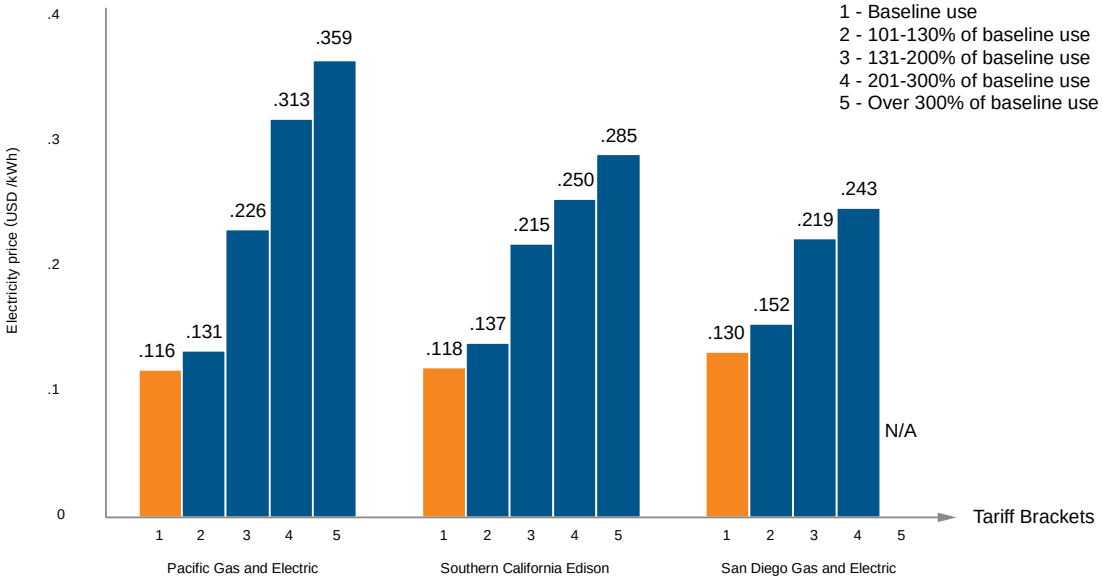
Industry noted that government also has a key role to play in promoting the awareness and acceptance and in emphasising the advantages and the attractiveness of new and emerging energy technologies. *"We need to work towards a technology affinity, not aversion. Policymakers should more actively shape opinions in this matter."* Currently, many renewable projects can take several years to secure permits. The challenge is to *"create an inclusive process that still gets to a decision that is predictable for investors in a 'do-able' timeframe."*

Promote energy efficiency

Energy executives noted the importance of greater energy efficiency to reduce the growth rate of energy demand. *"With the current technology, energy resources are finite."*

[23] www.globalelectricity.org and http://www.un.org/News/briefings/docs/2011/110602_Energy.doc.htm

Figure 16
Examples of progressive pricing in California (USA)
Source: CEC Workshop on rate design, incentives and market integration, June 2008



"Until we find something, we have to be more efficient with the current technology" and *"Policymakers should prioritise increasing energy efficiency."* There are gains to be made in improving the efficiency of energy generation and transmission. For example, the continued implementation of smart grid technologies can, as some studies show, reduce energy consumption and transmission losses by 2-5%.

Energy-efficiency behaviour can *"… be driven by our wallet"* but raising energy costs as a mechanism to drive energy efficiency has limits. As executives noted, policies must ensure that households are not put into energy poverty, and this is especially true given the correlation between energy poverty and highly inefficient housing stock. Progressive electricity tariffs and budgetary transfers to the poorest with the market price set at full cost can be used to deliver the right economic signals to consumers and at the same time protect and ensure access and affordability for poor and low-income consumers. These programs can be complemented by broad government-run energy-efficiency awareness programs.[24] As industry noted, *"government need to engage citizens on energy efficiency."* Governments have a significant role to play in consumer education and awareness of the need for and benefits of energy efficiency as a mean to reduce overall national energy demands and costs.

Progressive energy tariffs to drive efficiency

In Dubai, UAE, where energy is still highly subsidised, a new progressive residential / commercial tariff structure was introduced in 2008 with electricity charges ranging from 23 fils per kWh (USD0.06 per kWh) for monthly consumptions below 2,000 kWh to 38 fils per kWh (USD0.10 per kWh) for consumptions more than 6,000 kWh per month. In addition, a variable fuel surcharge of currently 6 fils (USD0.02) is added per kWh consumed. A similar tariff structure applies for industrial users.[25]

Japan, Toronto (Canada), and California (USA) have also introduced progressive energy tariffs to reduce the energy use growth curve. In Japan the introduced electricity tariff is a function of power subscribed and a unit price per kWh consumed, which depends on the slice of volume consumed.

Where in Dubai and Japan the slices of volume consumed monthly are fixed, in California (see Figure 16) and Toronto slices evolve daily according to public holidays and temperatures and a 'baseline' is defined for each day.

[24] For more information about effective energy-efficiency policies, please see WEC, 2011: *Policies for the Future: 2011 Assessment of Country Energy and Climate Policies*

[25] http://www.dewa.gov.ae/tariff/tariffdetails.aspx

The approach implemented in California and Toronto depends on a reliable system of invoicing that can only be set up with real time metering (for example, smart meters) and daily posting of the consumption that allows consumers to have the ability to actively monitor their own energy consumption.[26] In contrast, the Dubai and Japan approach, with fixed slices and defined monthly volumes, progressive tariffs can be introduced without smart meters and is thus easier to roll-out.

Promoting energy efficiency

Residential energy use (including the energy efficiency of homes) represents a key focus for energy-efficiency programs. In many countries, regulators have set out energy-efficiency obligations (EEOs) for energy providers to meet and deliver. Most recently, for example, Australia is examining the benefits of establishing a national Energy Savings Initiative. This market-based tool for driving economy-wide improvements in energy efficiency would place obligations on energy retailers to find and implement energy savings in households and businesses.

Leveraging energy providers to drive energy-efficiency programs has many advantages. Utilities have existing commercial relationships with a wide range of end-users and also are looking for opportunities to transform themselves from commodity energy suppliers to providers of value-added energy services, including energy efficiency. Utilities can target consumer demand for energy-efficiency services by applying customer data analytics, developing customised offerings and compelling messages for specific markets, and learning to integrate energy efficiency with the overall utility customer experience management.

However, utilities face real challenges in driving through the full potential adoption of energy-efficient technologies and behaviour. Uptake is hindered by mixed incentives for users and suppliers of energy; the up-front costs of more efficient technology, and the increasingly widespread use of consumer electronics - in particular, personal computers, televisions, and related devices which are a growing component of household energy use. Added to this are sophisticated pricing and tariffs that mask the true costs of energy (particularly electricity), the complexities of human behaviour, the lack of knowledge of the opportunities for and benefits of energy efficiency, and the 'rebound effect'.[27]

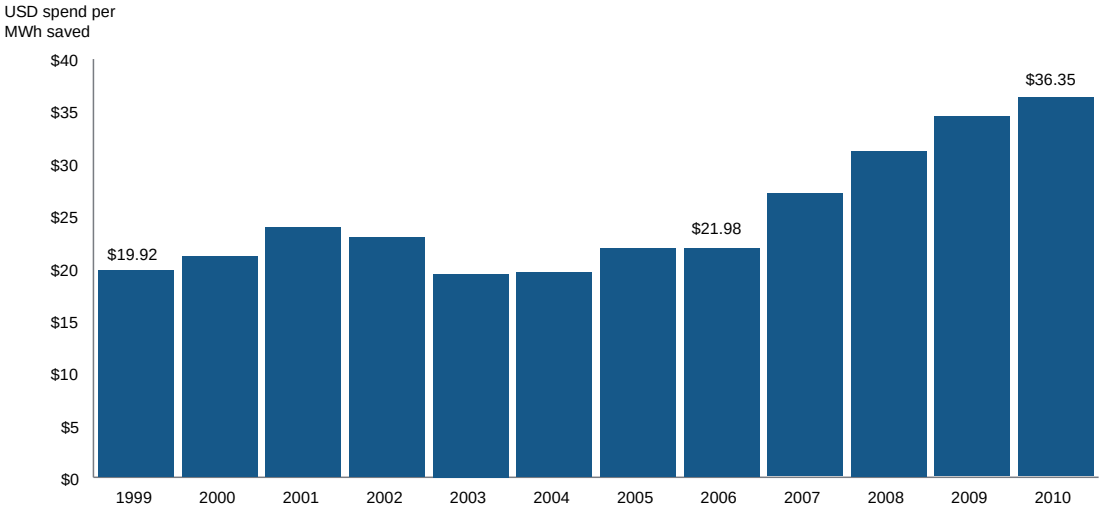
As shown in Figure 17, the average cost of one MWh of energy saving in the USA has increased by 82%, from approximately USD20/MWh in 1999 to USD36/MWh in 2010.

This illustrates that efficiency gains get harder and more costly to achieve once the 'low hanging fruit', such as equipment upgrades, have been implemented.

[26] http://energy.sia-partners.com/580

[27] WEC, 2011, *Policies for the Future: 2011 Assessment of country energy and climate policies*

Figure 17
Average cost of one MWh of energy saving in the USA
Source: U.S. Energy Information Administration (EIA), 2011: *Electric Power Annual 2010 (EIA form 861)*; Oliver Wyman analysis



Continued gains in the success of utility energy-efficiency programs will require efforts by both policymakers and utilities:[28]

- Policymakers can support and implement energy-efficiency awareness-raising programs and consumer demand for efficiency services, including promoting efficient household appliances (for example, stimulus rebates, tax credits, free appliance recycling), and where appropriate, banning old technologies.
- Policymakers and utilities can engage in dialogue to agree on how to implement energy-efficiency measures from the transformation of energy to the final consumption of energy with clear program objectives, and effective regulatory structures that create innovative incentives for utilities to operate with lower overall energy demand. Methods such as cost recovery methods should be considered to assure alignment of interests between shareholders, regulators, and consumers.

Summary

Energy industry outlines a series of inter-related recommendations for policymakers to ensure energy policy sets the conditions to support the achievement of energy sustainability:

- Develop an integrated and coherent energy policy framework
- Think regionally when developing energy markets and assets
- Apply clear, basic and simple regulations
- Increase the dialogue between policymakers and industry
- Increase the dialogue with general public based on an impact assessment that shows benefits and costs to support the discussion
- Promote energy efficiency

Predictable energy policies with defined goals, enacted by clear regulations and supported by engagement with industry and the general public, and the critical untapped ‘fuel source’ of energy efficiency will enable industry to apply investments and innovations at lowest cost.

[28] IEA for European Union Regional Workshop, 18-19 January 2012: *Policies for Energy-Provider-Delivered Energy Efficiency*; Michael Britt, Oliver Wyman, 2011: *Is Energy Efficiency Losing its Efficiency?*

"Market participants are usually better informed and better qualified to find most economical solutions that can achieve environmental goals"

"Industry investment cycles and political cycles don't fit together"

"The key thing is to put a price on CO_2"

"Generally, it is very difficult for political systems to abolish bad instruments once the illusion has been created that this policy is needed"

"The issue of financial constraints is not a problem but it comes back to the business model"

"To secure investment you need three main things: a master plan, clarity on expectations, and the ability to negotiate quickly"

"The real tipping point is whether or not policies allow and actively support the country's ability to attract investments"

"Investors need guarantees of political commitment and protection against legal changes"

"Over time subsidies have proven to always be a losing policy"

"If you give private sector room and a simple set of rules that are predictable and maintained, we will innovate and figure out how to make money"

"It is more effective to jack up prices for particular energy types than providing subsidies or feed in tariffs"

"We need a corporate bond market for the renewable segment to be able to tap into a larger capital market"

"In general, prices should reflect the true economic value and cost of production"

"A sense of continuity that allows investment"

"We need assurance that investments are secured with the transaction and there is a social benefit or return on investment in the short or long term"

4. Enable market conditions that attract long-term investments

The challenge

Huge investments are necessary to expand energy access, develop new energy technologies, replenish aging infrastructure and build new energy infrastructure assets and associated supply chains. It is estimated that capital investment of about USD1.5 trillion per year will be required from 2011 to 2035 to maintain energy services at current levels and begin the transition to more sustainable energy system. Expansion of modern energy services to the approximately 1.3 billion people without electricity and 2.7 billion without clean cooking facilities is estimated to require USD48 billion per year until 2030, representing only a 3% increase on total investment.[29]

Cash-strapped governments have limited capacity to fund the increased energy access and shift to a low-carbon future. Private sector capital must be attracted to invest in the sector.

Industry recommendations

Industry made the following six inter-dependent recommendations to policymakers to help their countries attract the necessary levels of private sector investment and ensure those are directed to meeting the country's energy goals and anticipated future demands (see Figure 18). In making these recommendations, industry stressed the importance of 'connecting the financial dots' to optimise investment opportunities. For example, investors calculating net present value (NPV) factor in all financial instruments, including any subsidies, feed-in tariffs, or CO_2 prices. Policies around these instruments must be aligned and work in synergy.

Ensure policy consistency

Governments need to show commitment and consistency in regulatory approaches. For example, uncertainty increases when policies that are temporary approach their expiration, or when political control changes and new leaders reject policies of the previous government. As one executive noted: *"We are very sensitive to how countries clarify their rules of engagement and policy framework and how stable they are in order to create the right investment conditions in these countries."* Overwhelmingly, industry noted that *"... the single best mechanism to drive investment is a stable, predictable policy framework."*

A significant hurdle to policy predictability, as perceived by industry, is the conflict between the political and regulatory timescales and the timescales of energy investments, including research and development, project lead-time, project realisation, and the lifetime of the asset. *"Industry investment cycles and political cycles just don't fit together.*" Attracting investments to the energy sector will require politicians and policymakers to address this fundamental challenge. *"At the time of investment, you are looking for guarantees that these policies will stay valid for these particular plants for a certain period of time (for example, 20 years)."* Instability of returns pushes up required rates of return and deters investments. As one executive noted, *"We're not short of cash, we're short of stable returns."*

[29] IEA, 2011: *World Energy Outlook 2011*

Figure 18
Recommendations to attract long-term investments

The challenge is even greater for companies in developing countries, no matter if privately or publicly owned. Beyond securing funding, projects require expertise to support processes such as the preparation of a feasibility study or transactions skills which can affect the time to agree on a concession purchase agreement. Many companies in developing countries have limited expertise in these areas and these gaps in expertise can easily add 2-3 years to the project development process.

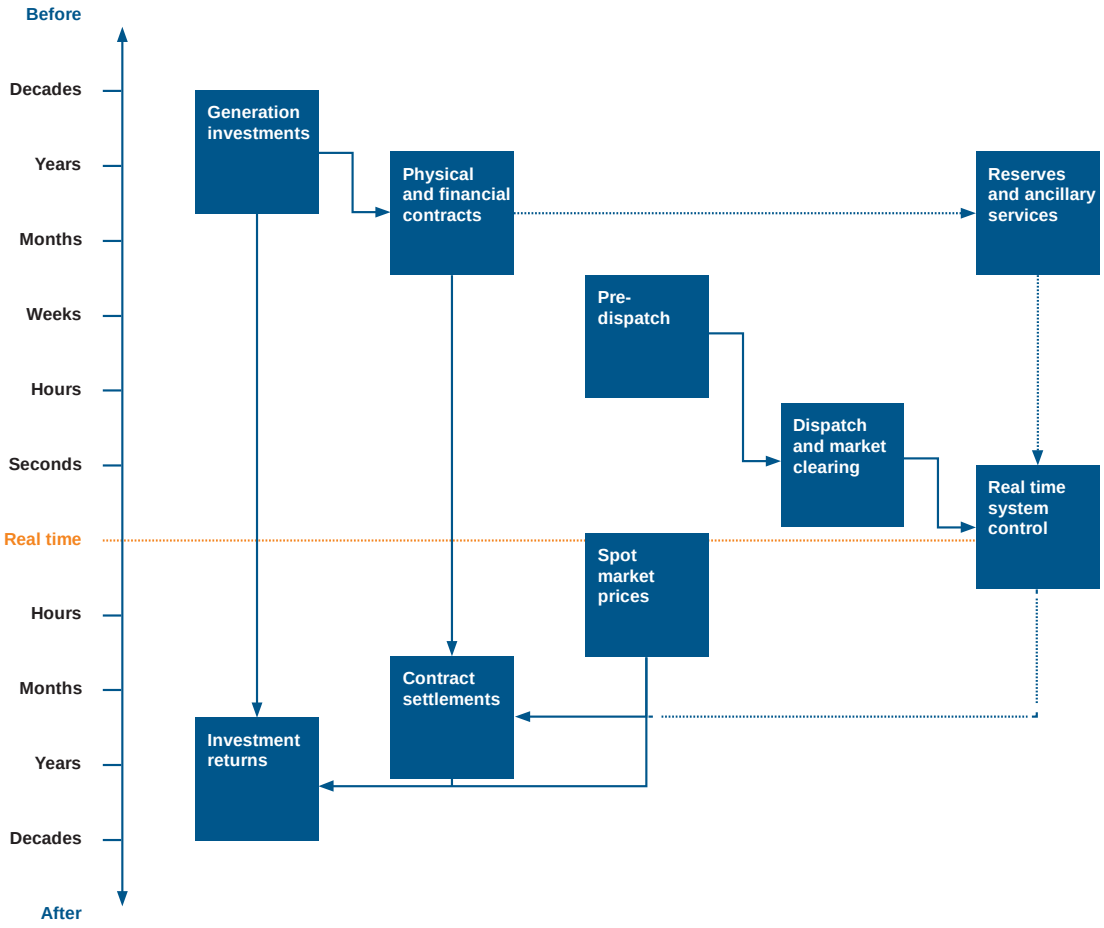
The challenge of forecasting return on investment

The return on investment (ROI) for energy infrastructure, such as electricity power generation plants, implementing electricity transmission networks, or building gas pipelines is often captured over a 25-30 year timeframe and is based on projections and models of energy demand. Government decisions on energy policy, regulatory decisions relating to energy or other areas such as environment, transport, or industry policy can greatly affect the return ROI of energy projects in the short and long term. As illustrated below, real-time electricity economics are related to the efficient use of existing and available generation assets. Long-term electricity economics are related to the efficient investment in power plants and other assets. What happens on timescales of seconds can have a profound impact on the long-term economic performance of assets with lives of decades or more (see Figure 19).

Support mechanisms to increase energy investments

Policymakers can support the development of mechanisms that will compensate for underlying

Figure 19
Electricity economics timescales go from seconds to years
Source: NERA, Oliver Wyman 2012



externalities and market failures and stimulate investments in the energy sector. Both mature and emerging technologies and infrastructure projects face challenges in accessing financing from traditional sources (see Figure 20).

Energy investments require large amounts of long-term, reasonably priced debt and equity finance to provide investors with the necessary returns and ensure affordable energy to consumers. Traditional sources of private finance (debt and equity) for infrastructure projects are becoming more constrained in their capacity to provide long-term capital. Utilities face uncertain energy demand, increased borrowing costs and the need to reduce their leverage to protect their credit ratings. Thus, the commercial market is constrained by risk aversion and a competition for funding resources at banks. The banks, in turn, currently face capital and liquidity constraints, including legislation requirements for higher capital ratios, and show lesser interest in lending for investments in potentially risky carbon reduction projects.

New technologies, particularly new low- or zero-carbon infrastructure and technologies, face even greater difficulties in raising capital to demonstrate commercial viability. As one executive noted: *"You don't see a rapid deployment of renewables as they don't yet have bankable systems."* Private equity, venture funds or infrastructure funds can be sources of investments into energy infrastructure. However, these funds require greater certainty about the legislation governing the returns generated by these projects and more transparency on the funding process and parties involved before they will invest.

Buttressed against these specific finance challenges is regulatory and political uncertainty that affects large, long-term energy projects. For example, in Europe, the investment market for low

Figure 20
The funding challenge for low- and zero-carbon technologies and energy infrastructure[30]

Typical funding sources	Current challenges
Utilities (bonds)	• Uncertain energy demand • Increased borrowing costs • Need to reduce leverage to protect credit ratings • Internally competing demand for capital – across business units and geographies • Uncertain regulatory structures in evolving mature markets and developing emerging markets
Banks and commercial market (project finance)	• Financial recession reduced ability to deliver volumes of debt capital required • New legislation (for example, Basel III) requiring higher capital ratios may further limit ability to lend
Pension funds/ institutional investors	• Project complexity, especially if a PPP project • Large number of government bodies involved in this area • Lack of the necessary level of expertise and experience to directly in specific projects or direct construction risk • Pension funds can only invest in top-rated securities
Venture capital funds	• Regulatory stability and certainty • Long time frames associated with proving commercial viability of many projects (for example, wave and tidal projects can require 15-20 years)
Private equity funds	• Project development risk • Market adoption risk • Scalability issues as small projects may offer unattractive economic returns for many banks and investors yet have same transaction and diligence costs as large projects
Infrastructure funds	• Construction and operation risk • Lack of clarity on business models, some of which are likely to be based on public-private structures, or on source of returns for new and as yet unregulated infrastructure assets such as a CO_2 transport network, electric car charging networks, heat networks or smart grids

and zero carbon technologies is negatively affected by a current carbon pricing regime that does not present a sufficiently stable price signal for investors to select environmentally-sensitive over high-carbon projects. One industry executive noted of investments *"… first a project must be sufficiently priced to make it profitable, and secondly it has to be sufficiently secure and this is even more so with newer technology and renewables."*

Catalyse private sector investment in low- and zero-carbon technology and energy infrastructure

Effectively applied, public funds can be used to unlock and leverage significant amounts of private capital to drive investments in energy infrastructure. Lowering the perceived or real risk is critical to reducing the cost of capital. This can be achieved by allocating funds from either governments or multinational investment banks to provide incentives, or by acting as a guarantee for private investors. Examples include a fund to purchase policy insurance that mitigates political or regulatory risks and thereby enables the financing of a project.

Energy investments require a long-term approach focused on lowering risk to levels that the market will finance. Policymakers can support the development and expansion of sources of financing and, in particular, green banks and green bonds can be promoted.

Green banks are intended to provide low-cost financing to clean energy projects and help fill the gaps that markets, commercial banks and other classical financial institutions cannot effectively serve. A number have been established. For

[30] Green Investment Bank Commission, 2010*: Unlocking investment to deliver Britain's low-carbon future*

example, the USA's first green bank, the Clean Energy Finance and Investment Authority (CEFIA), established in June 2011, functions as a quasi-public corporation providing low-interest loans to projects that will generate clean energy and promote energy efficiency. The bulk of its funding comes from an existing surcharge on electricity bills and additional funds from the Connecticut Green Loan Guaranty Fund. It can also tap into any federal funds made available to finance state green banks and contract with private capital.

In the United Kingdom (UK), the Green Investment Bank (GIB) is expected to be launched in 2012 with an initial seed funding of £3 billion to 2015 (with the expectation that it will not need to borrow before 2015). Its focus will be green infrastructure projects including offshore wind, commercial and industrial waste, energy from waste, non-domestic energy efficiency, and support for the UK government's "Green Deal". KfW Banking Group (Kreditanstalt für Wiederaufbau) is a German government-owned development bank and acts as a second-tier bank. It covers over 90% of its borrowing needs in the capital markets, mainly through bonds guaranteed by the federal government. This, along with its exemption from corporate taxes, allows KfW to provide commercial banks with liquidity at low rates and long maturities. The bank is especially active in promoting energy-efficient housing for owner-occupied houses as well as for landlords, both for new houses and refurbishments.

There is currently no widespread green bond market and industry noted: *"We need a corporate bond market for renewable segment to be able to tap into a larger capital market."* Multilateral development banks, including the World Bank and the European Investment banks, have issued green energy bonds of USD7.2 billion. The USA government has also established a Clean Renewable Energy Bonds program that has allocated USD2.4 billion. A well-structured green bond market would enable institutional investors to be a greater source of debt financing.

The main institutional investors in the OECD, including pension funds, insurance companies and mutual funds, held over USD65 trillion at the end of 2009. In non-OECD countries with mandatory Defined Contribution (DC) pensions, large pension fund asset pools have also been accumulated. The assets are smaller, but growing more rapidly than in OECD countries.[31] In principle, the long-term investment horizon of pension funds and other institutional investors should make them natural investors in less liquid, long-term assets such as infrastructure. As one industry executive commented: *"If we could have pension funds and insurance companies enter the area, we would get access to capital that is satisfied with 4-5% annual return, then the cost of projects could be cut in half and renewable energy would be quite competitive."*

Yet, it has been estimated that less than 1% of pension funds worldwide are invested in energy infrastructure projects. Institutional investors often

[31] In Latin America, total assets of private pensions are much smaller, amounting to USD283 billion in June 2008. Their smaller size is due to the only recent introduction of mandatory DC pensions, to the low coverage of pension systems and, to the smaller GDP size in these countries. However, assets grew at an annualised value of 22% in the period 2003-2008, double the average growth in OECD countries. Brazil is considered one of the fastest growing pension markets.

lack the necessary level of expertise and experience to directly invest in large scale infrastructure projects. Further, regulations can limit or prohibit pension fund investments in perceived 'risky' projects. Policymakers can support the development of new mechanisms, such as green bonds, that would facilitate institutional investment in energy infrastructure.

Increasing institutional investments in infrastructure

The prospect for increased institutional investment in infrastructure is strong. The financial crisis and the gradual maturing of pension plans' demographic profiles have underlined liquidity issues and at the same time lowered risk appetite for many investors. There is growing interest in good quality – income-oriented – inflation-linked investments that can match their liabilities. In addition, the growth in 'Socially Responsible Investing' (SRI) has increased the demand for 'ethical' projects including renewable energy.

Emerging economies generally face an even greater opportunity to develop their institutional investors sectors as, with few exceptions, their financial systems are largely bank-based. Whether such growth materialises will depend on policy decisions, such as the establishment of a national pension system with a funded component, a common feature in most OECD countries.

Despite the growth potential, currently, only a few pension funds are investing in infrastructure, including energy projects. In order to attract greater pension fund investment in infrastructure, governments can take measures to help overcome three current broad barriers to investment (see Figure 21).

Minimise the use of subsidies to reduce regulatory and political risk

Industry noted that policymakers should carefully consider how subsidies are applied to ensure these policies do not create regulatory or political risks around investments into emerging low- or zero-carbon technologies.

There are a number of examples where subsidies have generated booms and busts in renewables when governments could no longer afford the subsidy. Significant uptake of subsidies can drive up costs for clean megawatt-hours, leading to reduced public support for renewables, and often increase total policy costs beyond initial estimates. In extreme instances, this can lead to abrupt policy cancellations by government, such as occurred in Spain. Following the 2008 financial crisis, the Spanish government drastically cut its subsidies for solar power and capped future increases. In 2012, the Spanish government went further, placing a moratorium on renewable energy subsidies with the aim of saving several billion Euros owed under the policy.

These examples illustrate how misaligned subsidies can increase political and regulatory uncertainty and erode investor confidence, as the market ultimately relies on government interventions (subsidies, renewable obligation

Figure 21
Policymakers can focus on the following areas to help overcome barriers to greater institutional investments in infrastructure
Source: OECD, 2011: *Pension Funds Investment in Infrastructure: A Survey*

contracts) which may change over time. This, in turn, can make it harder to secure funding and investments in these technologies. As a whole, subsidies negatively influence market dynamics, mask the real costs of the energy, and increase uncertainty since it is unclear what the customer is willing to pay. As one executive noted, *"We look at overall affordability of energy and are deterred [from investing] where the model doesn't work if you extrapolate it to its end points and people cannot afford this."*

While cautioning on the use of subsidies, industry clearly differentiated between subsidies on the supply and the demand side, and recognised that effectively designed subsidies can help to increase energy access for the very poor and alleviate energy poverty. Further, some executives noted

Figure 22
Global fossil fuel consumption subsidies compared to renewable energy support
Source: IEA, 2012: *World Energy Outlook 2012*

$523bn
Fossil fuel subsidies consumption (2011)

$88bn
Renewable energy support (2011)

that where subsidies are effectively directed to low income consumers, it can help secure the return of investment in the whole chain of generation, transmission, and distribution markets. However, it was noted that consumption and end-use subsidies do not always benefit the intended recipients. The IEA notes that subsidies are an extremely inefficient mean of assisting the poor, as only 8% of the USD409 billion spent on fossil-fuel consumption (demand) subsidies in 2010 went to the poorest 20% of the world's population.[32] Subsidies can also discourage energy efficiency as the true price of energy is masked.

Despite the implementation challenges, subsidies nonetheless play an important role in stimulating the adoption of new and emerging technologies − by providing higher support at critical points in a project's lifecycle to prompt the market to invest. However, governments have to be very careful that policies do not become a financial burden. Industry advised policymakers to carefully consider the following before applying a subsidy to stimulate investment:

- Ensure subsidy policy is clearly defined with stated targeted outcomes, and designed with a high degree of financial literacy so that investors are given the certainty they need and public finance is effectively directed.
- Maintain controls through economic evaluation to ensure the subsidy is not overly costly to the government. As industry noted, *"… subsidies will be gamed."*
- Include a mechanism that reduces the level of subsidy over time from the onset 'clear built-in sunset' to ensure that projects are sustainable long-term without the subsidy. For example, reduce the subsidy to the point where the differential between the cost of the emerging technology and energy in the market place effectively becomes zero. Industry noted that if it becomes clear that that gap cannot be narrowed sufficiently in a reasonable period of time, the subsidy regime should be terminated.

Industry noted, *"Ultimately, commercial feasibility is the best and most effective motivation and driving force for sustainability."*

Use public private partnerships to stimulate investments

Governments can stimulate private sector investment and foreign direct investment by helping to reduce or remove, especially country risk, out of the equation. Public private partnerships (PPPs) can be particularly effective risk reduction mechanisms in emerging and developing countries which may not yet have the experience to create a structure or institutions within which private investment can occur. *"To spur PPPs, the public sector should assume risks that cannot be fully borne by the private sector."*

Public private partnerships can exist in many forms. Illustrative formats include: a publicly-owned electricity distribution utility signing a power purchase agreement (PPA) with a private power plant; a publicly-owned oil and gas company

[32] IEA, Paris, 4 October 2011: *World Energy Outlook 2011 - IEA analysis of fossil-fuel subsidies*

signing a fuel supply contract with privately-owned plant; build operate or build transfer models; and concessions which are granted by public entities, for example, public lands to access resources and explorations. The range of structure and models allows countries to *"… align market forces with their needs and goals."*

In developing countries, PPPs should be structured to include a clear focus on human capital. Industry advised that *"based on legislative frameworks and bilateral agreements, private sector collaboration should be strengthened to cover construction, operation and human resources development.*" Many developing nations face a scarcity of technical and management skills in the energy sector. This affects the prospects for developing the country's energy resources and reduces the scope for effective policy-making and the planning and operations of energy producing, marketing, and consuming institutions. *"Utilities need to build within themselves the capacities to help play a role between investors, regulators and themselves especially where they act in a quasi-private / public sector role."*

Apply market-based economic approaches to curb carbon emissions

Industry noted that market-based approaches, properly structured by policies, are more effective in driving the shift to an economically sustainable low-carbon energy system. *"Market-based approaches are needed to achieve a low-carbon future."*

An emission trading system (ETS) for carbon, which includes self-reinforcing market incentives, would be a significant signal to investors, funding institutions, and utilities. *"Introduce some form of carbon pricing in the form of a market based instrument."* In short, industry called for carbon pricing and noted: *"a liquid, harmonised global carbon market would be the most effective mechanism."*

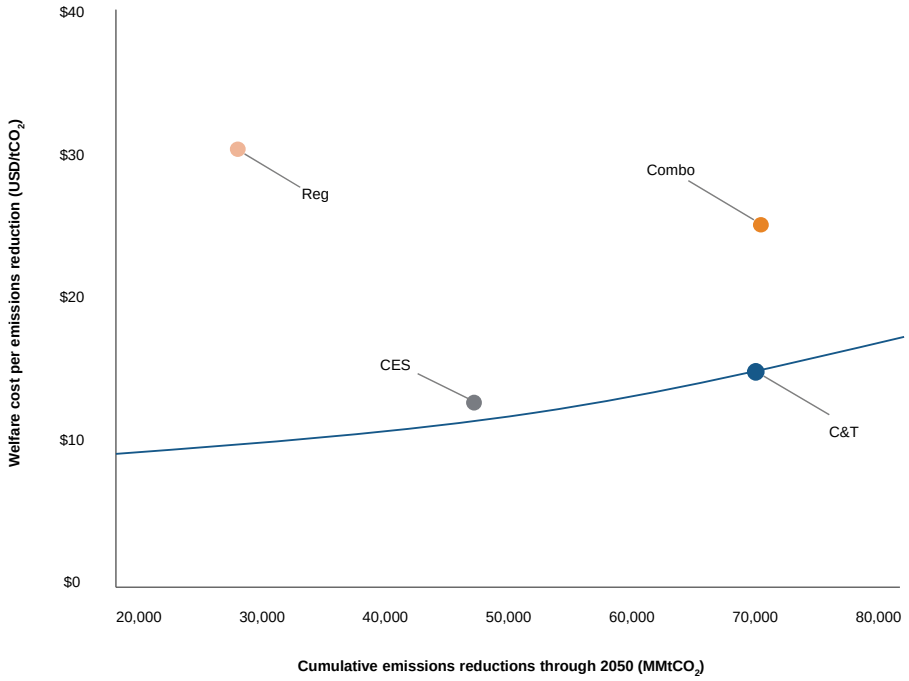
Currently, there are carbon markets in the EU, New Zealand, Australia, and British Columbia (Canada). California (USA) is starting the implementation and China is undertaking pilot projects while considering implementing a carbon market. Un-harmonised markets will reduce the overall effectiveness of the mechanism and support regulatory arbitrage. The trend towards harmonisation and linking of current and upcoming emission trading schemes, for example, the European and Australian market[33], is viewed as an important step in overcoming the risk of un-harmonised markets.

Success story: Acid rain market-based cap and trade programs

The USA's Acid Rain Program was established under Title IV of the 1990 Clean Air Act Amendments to reduce acid rain by reducing emissions of sulphur dioxide and nitrogen oxide. Using a market-based cap-and-trade approach, the program sets a permanent cap on the total amount of SO_2 that may be emitted by electric power plants nationwide. By 2002,

[33] http://ec.europa.eu/clima/policies/ets/linking/index_en.htm

Figure 23
Modelling the average cost per tonne removed and cumulative tonnes of CO_2 reduced
Source: NERA, Oliver Wyman, 2012



sulphur dioxide emissions from power plants were 9% lower than the year 2000 and 41% lower than 1980.

A 2003 Office of Management and Budget (OMB) study found that the Acid Rain Program accounted for the largest quantified human health benefits of any major federal regulatory program implemented in the last 10 years, with benefits exceeding costs by more than 40:1.[34]

A carbon price offers a number of benefits. Firstly, the trade opportunities would be significant for economies as CO_2 certificates can become a new commodity. Secondly, a carbon price would help level the playing field for emerging low- or zero-carbon technologies. Thirdly, it would stimulate investments in new technologies to reduce carbon emissions. Implemented in tandem with a carefully applied and limited amount of highly targeted regulation, or transitional support for emerging low- or zero-carbon technologies, a carbon price would send a clear market signal to investors and ensure that low-carbon investments are offering the same level of risk-adjusted returns as high-carbon investments. A carbon price can be determined by carbon markets or by a carbon tax. *"It is important that we come to an agreement where you have a harmonised market-based system that sets a price that supports the development of new technologies."*

It should however be noted that, in the absence of low-cost alternatives, a carbon price will increase the costs of energy in an economy. This means that for poorer economies there has to be a means of securing credits to offset the increased costs of a low-carbon energy sector.

While calling for an emission trading system (ETS) for carbon, industry cautioned that the system should not be applied to only one sector of the economy. Industry also noted that a carbon pricing could be applied at the consumption level but: *"80-90% of the electorate is opposed to carbon pricing at the consumption level"* and this deters politicians.

[34] United States Environmental Protection Agency: *Cap and Trade: Acid Rain Program Results*

A market-based approach to carbon emissions reductions

The potential effectiveness of carbon policies under consideration in the USA were examined for their effectiveness and economic impact. Four approaches and scenarios were examined: a clean energy standard (CES), an economy-wide cap-and-trade scenario (C&T), a regulatory policy and mandate scenario (Reg), a combination scenario that includes the regulatory mandates as well as the cap-and-trade scenario (Combo).

As illustrated in Figure 23, the analysis and model indicates that an economy-wide cap-and-trade (with banking) policy proves to be the least-cost, or economically most efficient means of reducing emissions from an economy. Under this approach, sectors with higher costs of abatement make fewer emission reductions while sectors with lower marginal costs of abatement make more reductions and sell them to sectors with higher abatement costs. This ability to trade equalises the cost across all covered sectors in the economy and reduces the targeted level of emissions at the least cost. Thus, carbon cap-and-trade was modelled to be the most effective of the four policies as a way to achieve carbon reduction goals, even though it has among the largest of the economic impacts.[35]

Summary

A combination of inter-related measures is necessary to stimulate private sector investment in sustainable energy and carbon reduction. Most important is policy and regulatory consistency and predictability. This sets the context for policymakers to support mechanisms to supplement existing financing options, such as green banks and the development of a green bond market. Market instruments to curb carbon emissions will help level the economics for renewable technologies and signal the need for investments and innovations in low-carbon technologies.

- Ensure policy predictability
- Support mechanisms to increase investment in sustainable energy, including green banks and green bonds
- Minimise the use of misaligned subsidies and where deployed, ensure the program includes clear built-in subsidy sunsets from the onset to reduce regulatory and political risk
- Use public private partnerships to stimulate investments
- Catalyse private sector investment in low- and zero-carbon technology and energy infrastructure
- Apply market-based economic instruments approaches to curb carbon emissions

[35] NERA Economic Consulting, Dr. Sugandha D. Tuladhar, Sebastian Mankowski, and Scott Bloomberg, March 14, 2012: *Analyzing the Changing US Carbon Policy Landscape*

"It is a fundamental contradiction to encourage investment and protect an idea but to also share this IP with emerging countries"

"IPR is the basis on which one can invest and know that one can get a return for it"

"The incentive always has to be that the innovation can be profitable by itself"

"Technological innovation could allow us to change conventional power generation system into sustainable energy systems"

"Policymakers have to credibly signal openness to technologies and their deployment"

"International standards would help achieve economies of scale, lower costs, and increase efficiency"

"To secure technology investments you need a clear framework to ensure payback"

"You can foster investments by creating a framework with returns on innovation, but not by paying for innovation"

"The key is to have more efficient systems with current technology"

"Technology should not be seen as the scapegoat, but as the solution to the problem"

"Uncertainty is a real killer for investors. The more things shift back and forth, the less innovation occurs"

"The efficient way of government supporting R&D is not through financing but by establishing institutions"

"Policymakers need to think about the industry's business model to promote innovation"

"Governments can help support the demonstration and commercialisation of technologies"

"It will not work if policymakers define the technology that should be developed and pay to ensure that this technology finds its way into the marketplace. This is just costly and inefficient"

5. Encourage public and private initiatives that foster R&D in all areas of energy technology

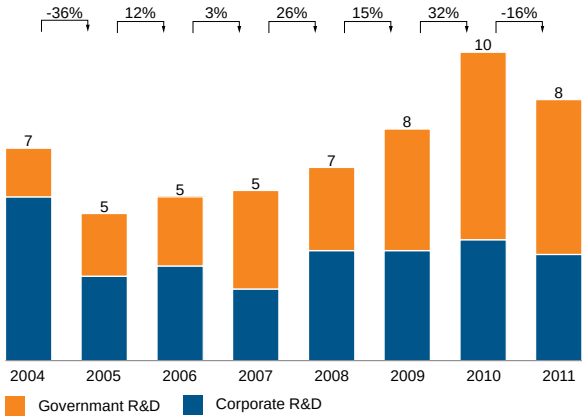
The challenge

Addressing the trilemma of energy sustainability presents extraordinary environmental, social and economic challenges requiring national and international action not only by governments, but also the private sector and civil society. The way energy is produced and used must be transformed in order to ensure reliability and to mitigate environmental impact and greenhouse gas (GHG) emissions. In addition, technologies must be developed to enable the rapid expansion of reliable energy access to millions.

To achieve these goals, there is an urgent need to improve existing fossil fuel and renewable energy technologies, advance the energy-efficiency agenda, improve transmission and distribution network technologies, but also to add completely new technologies to the mix over the medium and long term. Energy leaders noted, *"There is a lot of technology and innovation to come in the energy space"* but as for now, it is not yet clear which technologies or technology families will prove the most competitive. Robust enabling environments and political will are required, including appropriate technology mechanisms and a global trade and investment regime that facilitates and encourages investment, innovation, and technology uptake.

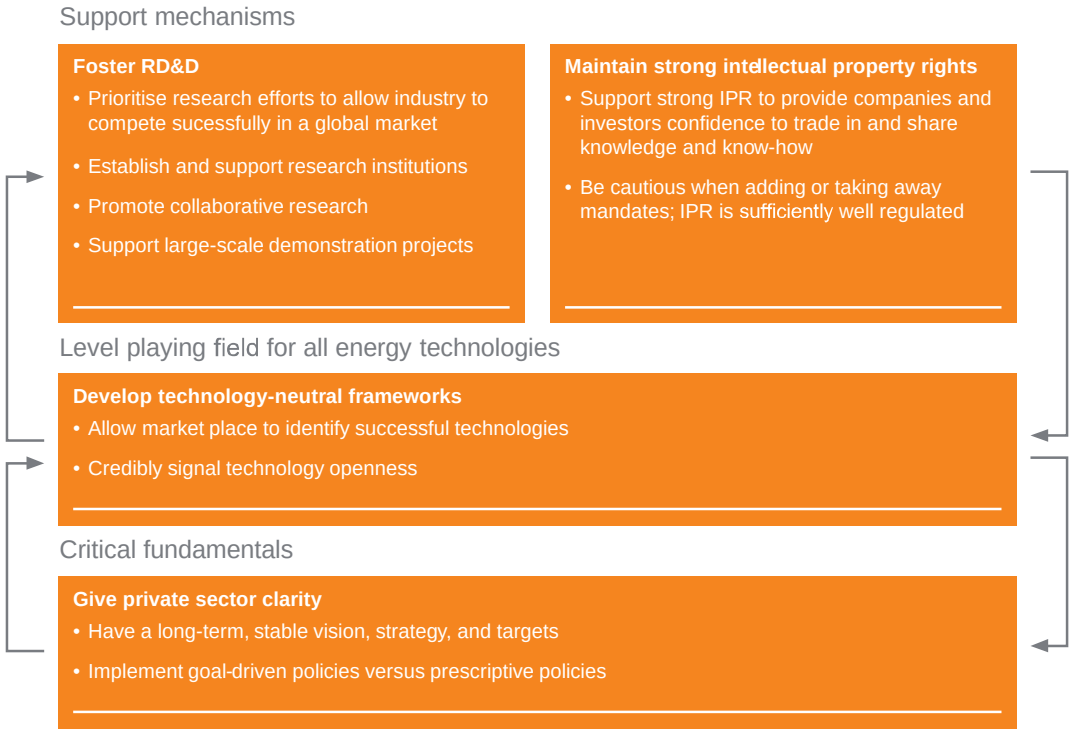
A large part of the innovation challenge is adequate allocation of resources and investments to bring new and advanced technologies to maturity and reduce costs so they can be commercially developed. Research and development (R&D) relies heavily on private sector expertise, experience and investment; it is a necessity and needs to be encouraged. But because of 'spillover effects' industry needs to be sufficiently incentivised to invest in basic research. In 2009, the private sector in OECD countries accounted for almost two thirds of total R&D investment.[36] Global research, development and deployment spending on cleaner energy technology at the same time amounted to nearly USD25 billion, 60% of which was financed by the private sector (see Figure 24).

Figure 24
R&D investment in sustainable energy, 2004-2011 (billion USD)
Source: Frankfurt School - UNEP Collaborating Centre for Climate Change & Sustainable Energy Finance, 2012: *Global trends in Sustainable Energy Investment 2012*



[36] OECD, 2011: *Main science and technology indicators, 2010/2*; OECD, 2012: *Main science and technology indicators, 2011/2*

Figure 25
Recommendations to foster R&D and innovation



Industry recommendations

In light of these challenges industry made the following four recommendations to policymakers, shown in Figure 25, to encourage both public and private initiatives that foster R&D in all areas of energy technology.

Provide clarity on goals to the private sector

Industry noted that: *"there is a big policy component"* to encourage private sector investment into R&D and that a: *"clear market driver for where the R&D investment will go"* is needed. For example, clear targets with regards to the composition of the energy mix, emission reductions or energy savings help identify technology gaps and steer R&D in the intended direction. Industry noted that, with rapidly changing and significant shifts in vision, strategies, and targets it is hard to maintain a long term R&D program. *"Uncertainty is a real killer for investors: the more things shift back and forth, the less innovation occurs."*

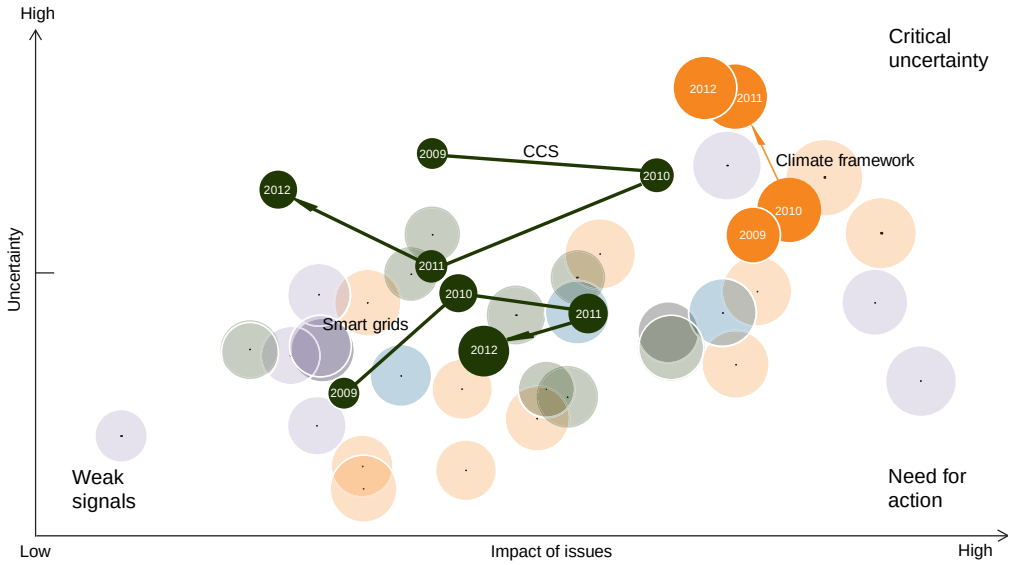
In formulating polices and targets, policymakers must consider how they define policy targets. Industry recommended: *"goal-driven policies versus prescriptive policies*" as this will drive R&D and innovation agendas. For example, a steady, long-term policy with the goal to reduce CO_2 emissions in a certain timeframe will drive innovation towards low- and zero-carbon emitting technologies, whereas the goal to reach a certain penetration of renewable energy will drive innovation towards renewable energy technologies. *"If there is clarity of policies and therefore clarity of industry interest, then people come up with creative solutions and investment in the development of technologies."*

Develop technology-neutral frameworks

Energy leaders cautioned policymakers not to *"select or dictate the 'right technology' or the 'right solution'"* as *"market participants are usually better informed and qualified to find most economical solutions that can achieve environmental (or other) goals."* An interesting example of 'technology-forcing' regulation is California's zero emission vehicle mandate. Adopted in 1990, it mandated major car companies in the USA to offer electric vehicles, assuming a greater potential of electric

Figure 26

WEC 2012 World Energy Issues Monitor shows that energy industry remains highly uncertain about energy issues such as climate framework, CCS, or smart grids[37]



vehicles and underestimating the improvements in conventional vehicle technology. Consequently, the policymakers needed to change the program, eventually moving to providing credit for new types of clean conventional vehicles. In the end, the adapted mandate led to nearly the same level of reductions of regulated air pollutant emissions as would have been achieved through the original target.[38]

As illustrated by this example, research can be stimulated in areas policymakers want to prioritise, but researchers should have the freedom to determine in which direction they go. Industry noted, *"It doesn't work if policymakers define the technology that should be developed and pay to ensure that this technology finds its way into the marketplace."* Diversification of energy sources and technologies is key to secure a resilient energy system. Research and development can help find the best technologies to diversify the energy mix while optimising existing assets and developing new sources.

However, industry noted that, when encouraging innovation and fostering R&D: *"policymakers have to signal credible openness to technologies and their deployment."* There were cases in which R&D was encouraged, but then technologies or their deployment were not permitted. One such example is a case in Germany which has provided public funding for research projects on CO_2 storage and the quantification of CO_2 storage potential since 2005. In addition Germany supported international R&D activities within the EU framework programs, the Zero Emission Fossil Fuel Power Plants Technology Platform and others. However, the more than two years of ongoing political debate surrounding the country's transposition of the EU directive on CO_2 storage has deterred national and international investors.[39]

Continue fostering research and development

Industry called on governments to continue their focus on fostering R&D. *"Government's engagement in R&D provides more certainty as investment will receive support from policymakers for some time as they actually invest in it themselves."* In particular, governments can support long-term research programs, on the scale of 10 to 15 years, and initiate R&D with public funding that requires matching funds from the

[37] The annual *WEC World Energy Issues Monitor* gathers the views of 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.

[38] WEC, 2011, *Policies for the future: 2011 Assessment of energy and climate change*

[39] http://www.globalccsinstitute.com/community/blogs/authors/jonashelseth/2011/10/10/ccs-germany-it-game-over

Figure 27

Ranking of top patenting countries in selected cleaner energy technologies (CETs; 1988-2007)

Source: UNEP, EPO, and ICTSD, 2010: *Patents and Clean Energy bridging the gap between evidence and policy*; WIPO, *Global Innovation Index 2012*; WEC, *2012 Energy Sustainability Index*

	Selected CETs	Solar PV	Solar thermal	Wind	Geo-thermal	Hydro/-marine	Biofuels	Carbon capture	Carbon storage	IGCC	WEC Index Ranking	WIPO Index Ranking
Japan	1	1	3	3	3	3	3	2	3	2	8	25
United States	2	2	2	2	1	1	1	1	1	1	12	10
Germany	3	3	1	1	2	2	2	3	4	3	11	15
Korea (Republic)	4	4									27	21
France	5	5	4			5	4	4	2		9	24
United Kingdom	6					4	5	5	5	4	15	5
Italy	7		5								21	36
Canada	9				5				5		3	12
Denmark	12			4							7	7
Spain	13			5							16	29

private sector. This funding is particularly important in accelerating investments the in the pre-competitive, early stage of technology development which otherwise might not happen at that point.

One such example is the USA's National Renewable Energy Laboratory and its research on photovoltaic films that helped to drive innovations in PV panels and significant decreases in costs.

In applying R&D resources, policymakers must consider their country's competitive advantage and *"… choose one or two areas for technological breakthrough in which they believe their country can excel and compete in a global market."* When looking at cleaner energy technology patents, countries such as Italy, Denmark, Canada, Norway, or Sweden excel in only one or two fields seemingly linked to resource availability and specific country needs (Figure 27). Those countries also perform relatively well in other, similar country comparisons, such as the WEC's Energy Sustainability Index or the World Intellectual Property Organization's (WIPO) Global Innovation Index. A similar trend is visible in some emerging markets with innovation primarily occurring in niche technology areas, for example, Brazil and Mexico focus on hydro / marine and biofuels technology; China, having some of the leading manufacturers of solar PV and wind, has emerged as a an innovator hub in the field, but also in the fields of geothermal, CCS and integrated gasification combined cycle (IGCC).[40]

Five countries, Japan, the USA, Germany, Korea (Republic), and France, account for almost 80% of patent filings worldwide for cleaner energy technology and also score relatively high in WEC's Energy Sustainability Index (Figure 27). All these countries have created a strong research-oriented environment with government support that allows deployment and application of technologies.

"The efficient way of government R&D support is not through financing but by establishing institutions." For example, in Germany, one of the leading countries, the establishment of research institutions such as Fraunhofer and Max-Planck Society and the development of clusters between universities and research institutes have proven to be as very successful in driving technology research and development.

National and international partnerships can accelerate the technology research and development process. *"It is important for governments around the world to jointly promote collaborative research and development."* Sharing technology development roadmaps, identifying

[40] UNEP, European Patent Office (EPO), and International Centre for Trade and Sustainable Development (ICTSD), 2010: *Patents and clean energy bridging the gap between evidence and policy*

common areas of interest for joint national and international collaborative R&D efforts or supporting R&D alliances can be mutually beneficial undertaking. For example, Canada's Oil Sands Innovation Alliance (COSIA), an alliance of oil sands producers, was founded after the government gave a clear mandate to improve the environmental performance in Canada's oil sands. Enabled by a framework designed by the government, the industry was able to develop a collaborative approach to sharing technological advances to accelerate the pace of innovation in environmental performance, while remaining competitors.[41] *"It is a very proactive intervention from the government."* However, in the support of cooperation it is important to consider how to protect intellectual properties and prevent technology leaks so as to not discourage private sector R&D involvement and find an optimal balance between competition and cooperation.

Demonstration of technologies requires governmental support

Industry noted that a large amount of basic R&D for the development of new technologies necessary for the energy transition has been done. However, given the size of demonstration projects, a greater governmental support for pilot and demonstration projects to help get the cost curve down is needed. *"Government can help support demonstration projects – especially on the overall networks needed for energy systems."* For example, if a new fuel or technology, such as biofuels, CCS, smart grids, or electric vehicles, is to be rolled out, a whole network needs to be in place to support its application and adoption. Once the technology is demonstrated and tested, government needs to step back and let market take over.

A practical example is the European Union's GRID4EU project, which aims to enhance several major smart grid pilot projects around Europe. The project is part of the Seventh Framework Programme (FP7) of the EU and is carried out by six distribution system operators (DSOs), which cover more than 50% of the metered electricity customers in Europe, and 27 partners including utilities, energy suppliers, manufacturers and research Institutes. The main objectives of the four-year program (November 2011 to December 2015) are:

- Develop and test innovative technologies
- Define standards through the setup of demonstrators
- Guarantee the scalability of these new technologies
- Guarantee the replicability over Europe
- Analyse smart grid cost benefits[42]

Maintain strong intellectual property rights[43]

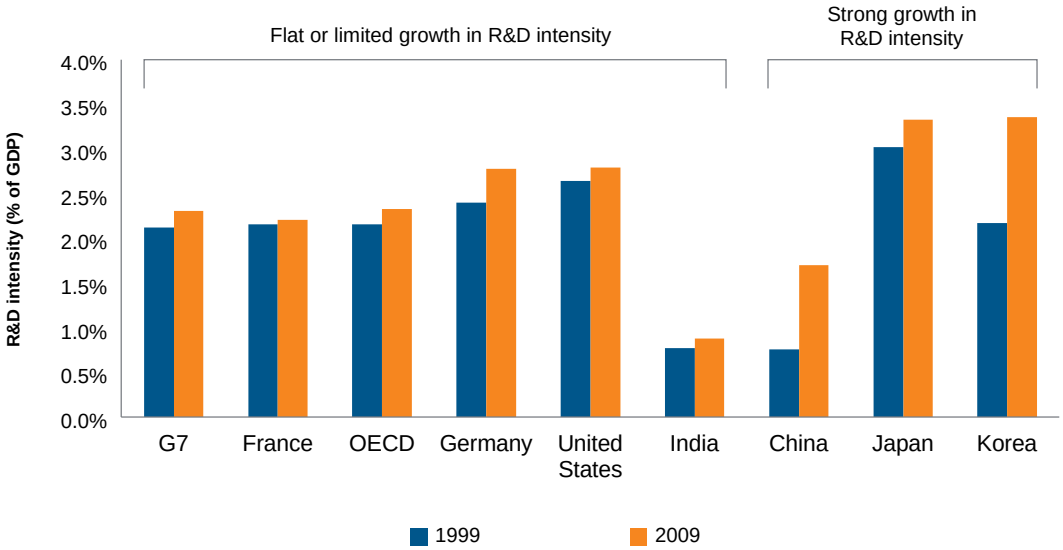
Intellectual property rights (IPR) are a key instrument and a pre-requisite for the private sector to invest in environmentally-sensitive and energy-

[41] http://www.cosia.ca

[42] http://grid4eu.info/overview.php

[43] WEC, 2011: *Energy sector environmental innovation: understanding the roles of technology diffusion, intellectual property rights, and sound environmental policy for climate change*

Figure 28
Greatest R&D intensity gains are in Asia 1999-2009
Source: OECD,2011: *OECD Factbook 2011-2012 - Economic, Environmental and Social Statistics*



efficient technology and the diffusion of technology and knowledge. Industry cautioned that *"undermining the IPR system for innovations, including climate change-related technologies and solutions, is one of the most counterproductive moves."*

It is crucial to address issues around technology transfer in general and around the funding of clean energy technologies in developing countries in particular. However, making technologies freely available is not a solution and can create huge problems. First, the 'best' technology to address climate change is not yet available. Undermining the IP system would therefore inhibit the investment process as industry will not invest without the expectation of returns. Creating a 'public good' and thereby taking returns away will bring investment, R&D and innovation to a halt. Secondly, human resources and expertise are often not available in developing countries to apply and maintain technologies effectively and therefore need support from the technology developers themselves.

Technology diffusion as a side-effect of market expansion should be supported. When technologies are adopted locally, know-how gets shared, the local population and workforce learns how to use the new technologies, and installation and service teams provide a foundation for further sharing of technology and follow-on innovation.

Avenues for technology sharing and for countries to access new technologies are through trade, including product sales, foreign direct investment (FDI), cooperative agreements such as joint ventures, or the assignments of rights through licensing or patent sales. As the private sector focuses on enhancing the value and long term sustainability of their enterprises, it must be able to profit from introducing innovations to the market in order for technology to flow. *"There needs to be a strong institutional framework to protect technological innovation."*

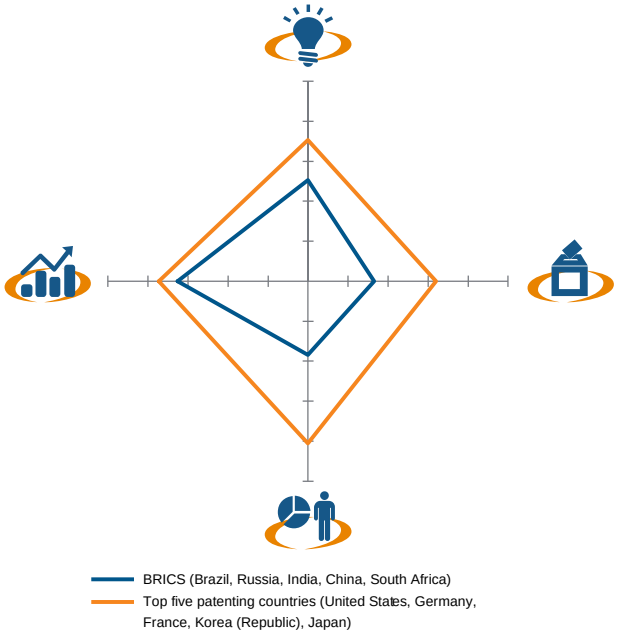
Industry emphasised that intellectual property is, for the most part, sufficiently well regulated at the international level, and cautioned against adding new, potentially conflicting mandates, for example, into UNFCCC negotiations or elsewhere.

However, protection of IPR alone is not sufficient and more efforts are still needed to build the right foundation for innovation, including a stable, long-term and transparent policy framework, adequate financing, infrastructure, and absorptive capacity. Without this, technology diffusion generally, and sustainable private sector engagement specifically, is unlikely to occur.

Innovation and R&D in emerging economies

Innovation and R&D is not limited to developed countries. Technology advances also come

Figure 29
Capacity to innovate increases as political, societal, and economic strength improve
Source: WEC, *2012 Sustainability Index*; WIPO, *Global Innovation Index 2012*



from emerging and developing economies, especially innovation around clean energy technology. Unhampered by the legacy infrastructure of the developed world, the most effective solutions may therefore originate from the emerging and developing world. As a result, an increasing number of private companies spend noteworthy R&D budget outside their home countries to access local talent and the ideas they generate.[44]

China is the third largest investor when it comes to R&D, and countries such as Brazil, Russia, and India are in the process of catching up. Currently, R&D spending in Asia overall exceeds EU levels and is likely to overtake USA levels in the next five years, if the current pace of R&D investment, most notably in China and Korea (Republic), continues. China's spending on R&D has on average increased by 20% annually, and by 8% per year in Korea (Republic) compared to an average growth rate of 3.2% annually in the same period in G7 countries.[45] This growth in R&D investment is aligned with, and supported by, the expansion of higher education, especially in science and engineering (see Figure 28 and Figure 29) in the region.

As emerging and developing countries enhance their technical foundations, their future economic growth depends on their ability to develop and export 'home-grown' technology solutions and become a true part of global supply chains. Reliable IPR supports these goals.

Summary

Sustainable energy to meet rising demand will require a great deal of innovation and basic research, development and design in existing and new fossil fuel and renewable technologies. A combination of coherent, long-term energy policies and a stable regulatory and legal framework is necessary to encourage and facilitate private sector investment, innovation, and technology uptake.

- Provide clarity on goals to the private sector
- Develop technology-neutral frameworks
- Continue fostering research and development
- Maintain strong intellectual property rights

[44] Jaruzelski B, Dehoff K, Strategy & Business Magazine, Issue 53, 2008. pg.56-57: *Beyond Borders: The Global Innovation 1000*
[45] Global Markets Institute, September 2010: *The New geography of Global Innovation*

"We need to do our homework with regard to policies"

"Policymakers should prioritise increasing energy efficiency"

"Commercial feasibility is the only motivation"

"The public sector should assume risks that cannot be fully borne by the private sector"

"If there is clarity of policies and therefore clarity of industry interest, then people come up with creative solutions and investments into the development of technologies"

"It is important for governments around the world to jointly promote collaborative research and development"

"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 toughest issue for policymakers is to define what stable, affordable, and environmentally sensitive means"

"If a country puts the right price on energy it penalises itself against its neighbours. That is why international cooperation and cross-agreements between governments and industry are needed"

"It is important to set price signals to enable the development of technologies"

"Any transitional support for emerging low carbon technology should be self-sun-setting"

"We need to understand who all the stakeholders are…are we missing other stakeholders that could help?"

"The single best mechanism to drive investment is a stable, predictable policy framework"

"Ultimately, unless utility or industry can get ROI, you are simply tinkering at the edges"

"Financial institutions need to become more unconventional"

6. Conclusion

The world faces daunting challenges to deliver energy reliably and affordably to its entire population, including the 1.3 billion people who currently lack access to electricity and 2.7 billion who do not have clean cooking facilities. While accelerating the pace of tackling these challenges is vital, another urgent issue looms – how to reduce emissions from energy production and consumption at a scale commensurate with the increasing risks from man-made climate change.

To achieve both of these goals requires improving existing fossil fuel, renewable energy and transmission and distribution network technologies as well as advancing the energy-efficiency agenda. In addition, completely new technologies must be developed over the medium and long term. Robust enabling environments and political will are required including a global trade and investment regime which facilitates and encourages investment, innovation, and technology dissemination and diffusion.

The 2012 Energy Sustainability Index reveals the challenges in simultaneously addressing all three dimensions of energy sustainability - energy security, affordable energy access, and environmental impact mitigation. Usually there are trade-offs to be considered among these three policy areas, which is known as the trilemma of energy sustainability.

Moreover, the path to sustainable energy systems has to be economically viable. Market-based approaches, such as carbon pricing, are perceived to be more effective in driving the shift to an economically sustainable low-carbon energy system. Buttressed by well-designed policies, an effective carbon market with consideration of both production and consumption level would be a significant step towards setting the right incentives for investors, funding institutions, and utilities.

Economic and market instruments to curb carbon emissions will help level the playing field and signal the need for investments and innovations in low-carbon technologies.

The policy driver

While allowing market mechanisms to spur change, governments need to set the right frameworks within which energy sustainability goals can be delivered. Governments must accordingly:

- Develop a clear, long-term vision with challenging but realistic targets
- Implement goal-driven, technology-neutral policy frameworks
- Integrate predictable, long -term energy policy frameworks with the goals of critical adjacent policies
- Support policy frameworks by clear and simple regulation to reduce regulatory uncertainty and attract and attain the necessary investments in existing and new technologies over the long-term.

Such a coherent and long-term approach is the way to stimulate further innovation and commercialisation of new technologies.

Given the difficulties of achieving the balance among the three dimensions of energy sustainability, how can countries improve their capabilities? One answer is to enhance transparency at different stages of the process, while ensuring the protection of commercially sensitive information. An increased dialogue, supported by rigorous impact analysis, between policymakers, industry, and general public will help businesses and consumers understand the trade-offs involved in adopting specific policies and their broader implications. This dialogue will also serve to provide policymakers with guidance on the impact of policy decisions, to harness industry's technical expertise, and to ensure a better understanding of the timescale of energy infrastructure investments.

Finally, the implementation of policy and regulation must be monitored to ensure that it is delivering as intended, including ensuring consistency across policy dossiers. It is vital that policymakers are able to balance the need to provide markets with long-term policy predictability against the necessary flexibility to adapt and change policies that are clearly failing, or which are no longer appropriate because circumstances have changed.

The innovation driver

While a stable and transparent policy framework, adequate financing, infrastructure, adequate R&D and innovation policy, effective economics, accountability and absorptive capacity are a good foundation for innovation, they are not enough on their own. The protection of intellectual property rights (IPR) is a pre-requisite for the private sector to invest in environmentally-sensitive and energy-efficient technology and for the diffusion of technology.

Undermining the IPR system for innovation, including climate change-related technologies and solutions, is a counterproductive effort. It would inhibit investment and innovation as the private sector will not invest without the expectation of enhancing the value and long-term sustainability of their enterprises. To ensure the flow of technology, it must be profitable to introduce innovations to the market.

Technology advances, especially innovation around clean energy technology, do not come from developed economies with incumbent industries alone. Emerging and developing economies with nascent industries will contribute significantly. Unhampered by the legacy infrastructure of the developed world, some of the most effective solutions could originate in the emerging and developing world.

As emerging and developing economies enhance their technical foundations, their future economic growth is likely to improve with their ability to develop and export indigenous technology solutions and become an integral part of global supply chains.

Intellectual property rights support this evolution and are thus a critical enabler of not only innovation, but also of the development and diffusion of environmentally-sensitive and energy-efficient technology around the world.

Summary

There is no single instrument which can drive the attainment of all three goals of the 'trilemma of energy sustainability' – energy security, access to affordable energy, and environmental impact mitigation.

Most countries, whether developed, emerging or developing, struggle to strike the balance. Very few countries have achieved significant traction in providing sustainable energy. Analysis of the results of the WEC's Energy Sustainability Index shows that a clear vision, long-term programs and adequate instruments, a diversified energy mix, and an increased reliance on low- and zero-carbon emitting energy generation are important components of this balance.

An indispensable, integral part of a well-functioning energy policy is a national implementation programme, based on broadly accepted sets of well-tuned, locally efficient implementation measures.

The challenge is to translate global findings about successful policy instruments into arrangements and settings that work in the local context. This translation can be facilitated through a dialogue between international energy policy experts, industry executives, stakeholders, and policymakers from various jurisdictions.

The energy sector faces the challenge of meeting an unprecedented need for investments 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 should be a priority for governments to increase the ease or attractiveness of investment and policymakers should feel encouraged to apply internationally emerging lessons to the benefit of their countries.

Appendix A. Industry Participation

The World Energy Council and Oliver Wyman would like to thank the following executives 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. Hearing your perspective and insights on key concerns for government policymaking has been very helpful and enriched the process greatly.

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BNL Clean Energy (Switzerland)
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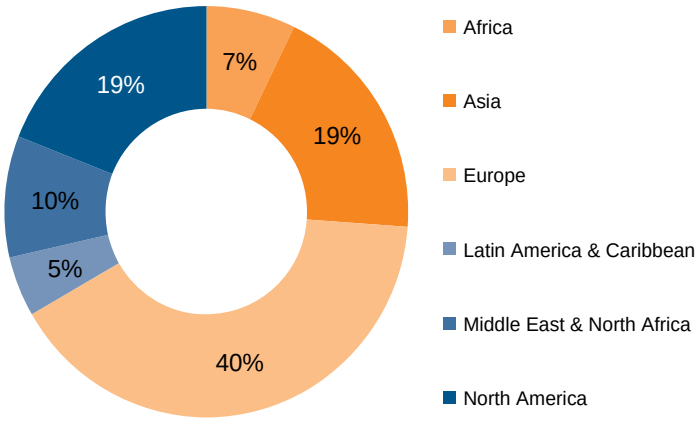
Figure A1
Geographical representation of interviewees



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Patrick Daniel
Chief Executive Officer

ENI S.p.A. (Italy)
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Saeed Khoory
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E.ON AG (Germany)
Johannes Teyssen
Chairman and Chief Executive Officer

Eskom Holdings (South Africa)
Brian Dames
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GE Energy (USA)
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Appendix B. Project Participation

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

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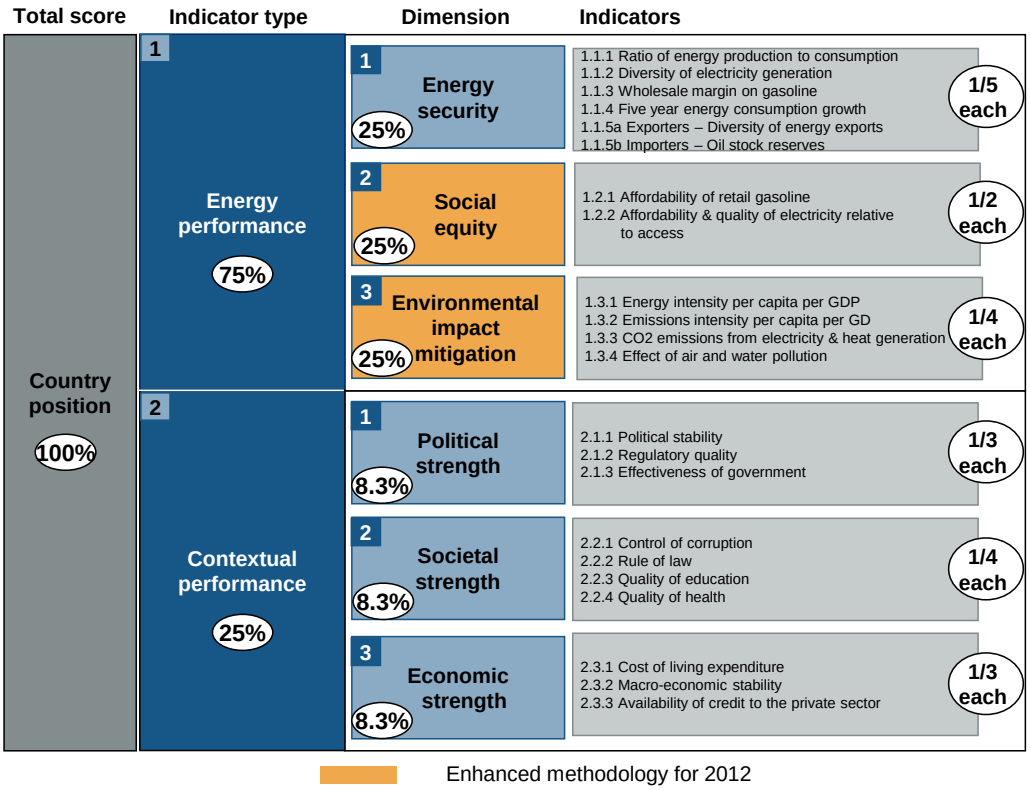
Appendix C. Index rationale, structure and methodology

The Energy Sustainability Index ('Index') ranks WEC member 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.

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 member countries. These sources include the International Energy Agency, the U.S. Energy Information Administration, the World Bank, the International Monetary Fund, the World Economic Forum and others.

The structure of the Index and the coverage of its 22 indicators are set out in Figure C-1. 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.

Figure C1
Index structure and weighting



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 2009-2011. Recent world events that could affect the Index's outcomes are not completely captured (for example, turbulence in global nuclear power industry due to Fukushima, or the 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. That noted, repercussions from the financial and economic crisis in 2008 are increasingly becoming visible as we see strong fluctuations in economic performance for several countries. It is possible that the financial crisis had further impacts on countries' energy policies, such as cuts of subsidies due to financial and economic pressures. However, it is difficult to disentangle the origins as well as the effects from individual policy changes.

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 organized in four economic groups:

- Group A: GDP (PPP) per capita greater than USD33,500
- Group B: GDP (PPP) per capita between USD14,300 and USD33,500
- Group C: GDP (PPP) per capita between USD6,000 and USD14,300
- Group D: GDP (PPP) per capita lower than USD6,000

Figures C-2 through C-5 show the rankings of each country within these GDP groups.

Figure C2
Country Ranking for GDP Group A

Rank	Country	Importer / Exporter	Energy security rank	Social equity rank	Environmental impact mitigation rank	2012 Index rank
1	Sweden	I	2	16	2	1
2	Switzerland	I	12	4	10	2
3	Canada	E	1	2	12	3
4	Norway	E	9	10	5	4
5	Finland	I	13	14	6	5
6	Denmark	E	3	28	25	7
7	Japan	I	7	9	24	8
8	France	I	29	8	4	9
9	Austria	I	39	7	11	10
10	Germany	I	11	11	41	11
11	United States	I	27	1	31	12
12	Belgium	I	31	12	15	13
13	Netherlands	I	34	20	20	14
14	United Kingdom	I	37	6	35	15
15	Luxembourg	I	72	5	18	18
16	Australia	E	25	3	73	20
17	Iceland	I	71	21	3	23
18	Korea (Republic)	I	61	25	32	27
19	Ireland	I	57	24	42	30
20	Taiwan, China	I	83	22	27	32
21	Hong Kong, China	I	76	30	49	34
22	Qatar	E	81	15	64	41
23	United Arab Emirates	E	79	39	46	44
24	Kuwait	E	84	27	74	54

Figure C3
Country Ranking for GDP Group B

Rank	Country	Importer / Exporter	Energy security rank	Social equity rank	Environmental impact mitigation rank	2012 Index rank
1	New Zealand	I	16	13	8	6
2	Spain	I	17	19	40	16
3	Slovakia	I	6	35	14	17
4	Hungary	I	10	36	19	19
5	Italy	I	19	26	33	21
6	Slovenia	I	28	41	17	22
7	Croatia	I	14	33	26	24
8	Portugal	I	23	37	38	25
9	Russia	E	8	47	16	26
10	Argentina	E	35	17	30	28
11	Czech Republic	I	15	32	61	29
12	Lithuania	I	53	45	9	31
13	Estonia	I	42	46	50	35
14	Latvia	I	64	50	13	37
15	Greece	I	43	23	76	42
16	Saudi Arabia	E	85	18	59	46
17	Poland	I	50	38	65	47
18	Cyprus	I	91	29	63	49
19	Trinidad & Tobago	E	69	48	36	51
20	Gabon	E	21	78	52	59
21	Israel	I	66	43	92	61
22	Lebanon	I	65	63	85	77
23	Botswana	I	89	74	94	91

Figure C4
Country Ranking for GDP Group C

Rank	Country	Importer / Exporter	Energy security rank	Social equity rank	Environmental impact mitigation rank	2012 Index rank
1	Colombia	E	5	56	34	33
2	Uruguay	I	63	44	22	36
3	Bulgaria	I	40	59	28	38
4	Ukraine	I	18	58	23	39
5	Albania	I	44	61	7	40
6	Kazakhstan	E	38	40	44	43
7	Iran (Islamic Republic)	E	47	31	51	48
8	Mexico	E	45	34	83	50
9	Brazil	I	77	65	21	53
10	Egypt (Arab Republic)	E	33	49	66	55
11	Romania	I	36	42	80	56
12	South Africa	E	78	52	53	57
13	Peru	I	46	67	60	58
14	Tunisia	I	51	51	89	60
15	Macedonia (Republic)	I	56	54	68	62
16	Thailand	I	58	62	79	63
17	Turkey	I	41	53	84	64
18	Serbia	I	67	57	62	66
19	Jordan	I	93	55	67	68
20	China	I	59	69	91	71
21	Algeria	E	75	60	70	78
22	Namibia	I	90	76	57	79
23	Libya	E	55	73	88	88

Figure C5
Country Ranking for GDP Group D

Rank	Country	Importer / Exporter	Energy security rank	Social equity rank	Environmental impact mitigation rank	2012 Index rank
1	Bolivia	E	22	64	45	45
2	Paraguay	E	62	70	1	52
3	Cameroon	E	32	83	54	65
4	Kenya	I	20	86	69	67
5	Congo (Dem. Republic)	E	26	91	47	69
6	Côte d'Ivoire	E	30	85	56	70
7	Zimbabwe	I	4	94	71	72
8	Sri Lanka	I	49	71	82	73
9	Nepal	I	82	92	29	74
10	Philippines	I	52	77	78	75
11	Syria (Arab Republic)	E	54	68	72	76
12	Swaziland	I	70	75	55	80
13	Ghana	I	88	81	39	81
14	Tanzania	I	68	93	43	82
15	Indonesia	E	60	72	90	83
16	Nigeria	E	24	84	81	84
17	Mongolia	E	74	79	75	85
18	Chad	E	48	88	58	86
19	Morocco	I	80	66	87	87
20	Ethiopia	I	94	90	37	89
21	Niger	I	92	87	48	90
22	Pakistan	I	73	80	77	92
23	India	I	87	82	93	93
24	Senegal	I	86	89	86	94

2012 Methodology enhancements

The Index methodology was enhanced in the 2012 Index to better assess the countries' ability to mitigate their environmental impact and to provide social equity.

Changes to Social Equity dimension

The social equity dimension (affordability of energy access) was modified to minimise the effects of scale. In previous versions of the Index, large countries were privileged due to a scale effect (for example, very large populations) as both indicators, the gasoline prices and household electricity expenditure were normalised respectively by aggregate household consumption expenditure and by aggregate expenditure on housing, water, electricity, gas and other fuels. Furthermore, countries that emphasised affordability, but faced challenges with the quality of electricity supply were privileged as the latter was not formally included in the index.

To remove scale effects, the aggregate, individual consumption as well as the electricity expenditure indicator are now scaled by population, thus measuring the indicators on a per capita level. The 'per capita' amendment to Social Equity is in line with the rest of the Index and negates inadvertently privileging larger populations.

In addition, an indicator for "Quality of Electricity supply" is now included in the indicator 1.2.2 which measures affordability and quality of electricity supply. The indicator is applied after we normalise cost of electricity by access. The new data is available for almost all countries, with the exception of four African countries for which the African average is used as a proxy. This change reduces the instances of countries with poor grid infrastructure capturing anomalously high rankings. Best scores are now obtained for complete, high quality, and affordable access.

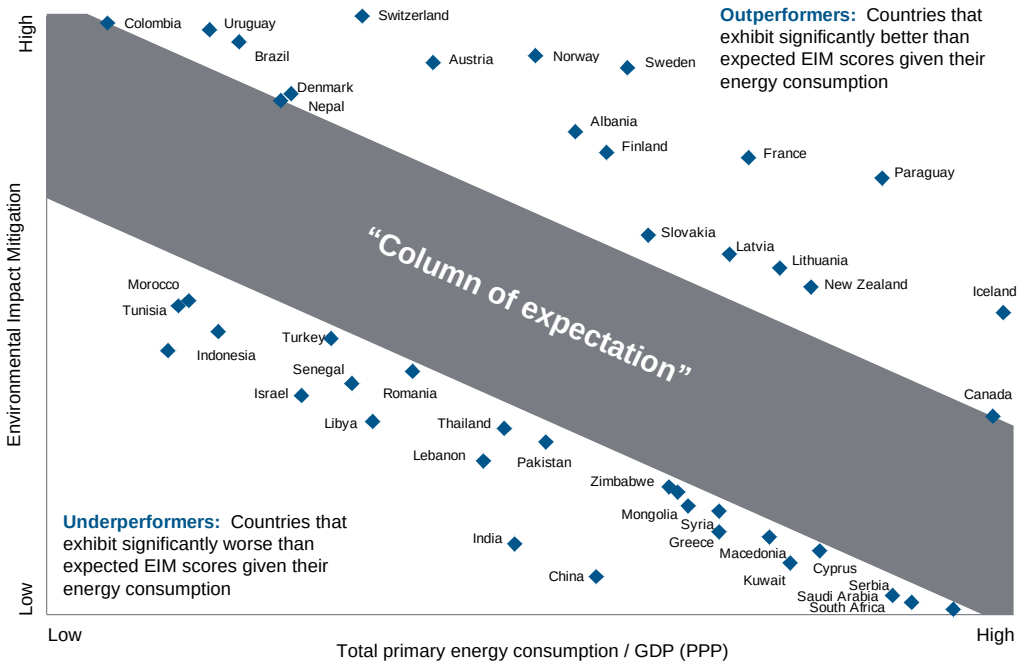
Changes to Environmental Impact Mitigation (EIM) dimension

In the 2010 and 2011 Index, countries with very low energy consumption, due to poor energy access and low levels of industrialisation, were privileged in EIM for their comparatively low environmental footprint as measured by carbon emissions and energy intensity per capita. Two main changes were conducted to privilege countries that are able to combine economic and social development with environmental sensitivity.

First, the indicators of energy and emission intensity per capita per GDP PPP (1.3.1. and 1.3.2) were normalised by the percentage of energy access and the industrial sector percentage of total GDP. This provides a better 'apples-to-apples' country comparison as environmental impact mitigation accounts for the 'per capita' consuming energy and the burden of an industrialised nations.

In addition, the calculation of the EIM dimension was modified to identify those countries that out-perform peers for their given level of energy

Figure C6
Regression-based projections of environmental impact mitigation (EIM) scores identify under- and outperformers



consumption. After the environmental impact was assessed with the regular weighting system, this preliminary score is now regressed against the total primary energy consumption per capita per GDP. This regression allows estimating a projected environmental impact value for the sample of countries based on their energy consumption per capita per GDP. The final EIM score is then refined as the deviation from the expected and the actual environmental impact value. Countries that outperform against their estimate on EIM given their energy consumption are likely to be making concentrated efforts to mitigate their environmental impact, and vice-versa for underperformers. Figure C-6 presents the 'column of expectation' based on the 2012 regression trend as well as the out- and underperformers for the 2012 Index.

Rankings for previous years were calculated with the new methodology to allow for a comparison in performance between the years (see Figures C-7 and C-8).

Figure C-7
2011 Country ranking for the overall Index and energy dimensions

Rank	2011 Overall index ranking	2011 Energy security ranking	2011 Social equity ranking	2011 Environmental impact mitigation ranking
1	Canada	Canada	United States	Sweden
2	Finland	Russia	Canada	Iceland
3	Switzerland	Côte d'Ivoire	Australia	France
4	Sweden	Swaziland	Switzerland	Norway
5	Norway	Denmark	Luxembourg	Lithuania
6	New Zealand	Colombia	Japan	Finland
7	France	Finland	Austria	New Zealand
8	Denmark	Ukraine	United Kingdom	Paraguay
9	Austria	Sweden	Belgium	Latvia
10	Germany	Gabon	France	Tajikistan
11	Japan	Croatia	Norway	Russia
12	United States	Argentina	Germany	Canada
13	Luxembourg	Germany	New Zealand	Luxembourg
14	Iceland	Egypt (Arab Republic)	Finland	Switzerland
15	Spain	Switzerland	Qatar	Albania
16	Netherlands	Japan	Greece	Brazil
17	Croatia	Cameroon	Spain	Slovakia
18	Belgium	Nigeria	Saudi Arabia	Austria
19	Argentina	Syria (Arab Republic)	Iceland	Uruguay
20	Slovakia	Hungary	Argentina	Slovenia
21	Hungary	Norway	Taiwan, China	Kazakhstan
22	Lithuania	Latvia	Netherlands	Hungary
23	Latvia	Kenya	Italy	Ukraine
24	Australia	Tajikistan	Ireland	Belgium
25	Slovenia	Bulgaria	Korea (Republic)	Nepal
26	Czech Republic	Albania	Denmark	Croatia
27	Russia	Spain	Czech Republic	Argentina
28	United Kingdom	Slovakia	Cyprus	Denmark
29	Portugal	France	Hong Kong, China	Estonia
30	Kazakhstan	Congo (Dem. Republic)	Iran (Islamic Republic)	Serbia
31	Italy	Philippines	Kuwait	Netherlands
32	Colombia	United States	Croatia	Czech Republic
33	Taiwan, China	New Zealand	Sweden	Colombia
34	Uruguay	Kazakhstan	Mexico	Trinidad & Tobago
35	Hong Kong, China	Serbia	Slovakia	Korea (Republic)
36	Ukraine	Lithuania	Portugal	Romania
37	Korea (Republic)	Austria	Kazakhstan	Japan
38	Estonia	Czech Republic	Poland	Ghana
39	Ireland	Portugal	Hungary	United States
40	Bulgaria	Sri Lanka	United Arab Emirates	Portugal
41	Albania	Slovenia	Slovenia	Ireland
42	Romania	Australia	Israel	Swaziland
43	Swaziland	Macedonia (Republic)	Romania	Bulgaria
44	Serbia	Lebanon	Uruguay	Germany
45	Brazil	China	Lithuania	Peru
46	Mexico	Romania	Estonia	Spain
47	Saudi Arabia	Indonesia	Egypt (Arab Republic)	Taiwan, China
48	Qatar	Peru	Russia	Italy
49	UAE	Italy	Trinidad & Tobago	Tanzania
50	Egypt (Arab Republic)	Uruguay	Latvia	Iran (Islamic Republic)
51	Cyprus	Mexico	Tunisia	Congo (Dem. Republic)
52	Greece	Israel	South Africa	Philippines
53	Poland	Netherlands	Turkey	United Kingdom
54	Tajikistan	Paraguay	Jordan	Kenya
55	South Africa	Iceland	Algeria	United Arab Emirates
56	Paraguay	Tanzania	Ukraine	Saudi Arabia
57	Philippines	Poland	Serbia	South Africa
58	Macedonia Rep.	United Kingdom	Macedonia (Republic)	Macedonia (Republic)
59	Peru	South Africa	Colombia	Cyprus
60	Kuwait	Tunisia	Bulgaria	Hong Kong, China
61	Israel	Belgium	Indonesia	Sri Lanka
62	Trinidad & Tobago	Brazil	Lebanon	Cameroon
63	Iran (Islamic Republic)	Greece	Thailand	Poland
64	Syria (Arab Republic)	Pakistan	Libya	Mexico
65	Cameroon	Algeria	Brazil	Thailand
66	Tunisia	Hong Kong, China	Morocco	Ethiopia
67	Thailand	Thailand	Albania	Jordan
68	Sri Lanka	Turkey	Peru	Kuwait
69	Kenya	Estonia	Paraguay	Turkey
70	Jordan	Libya	Swaziland	Syria (Arab Republic)
71	China	Iran (Islamic Republic)	Syria (Arab Republic)	Pakistan
72	Lebanon	Mongolia	China	Australia
73	Gabon	Taiwan, China	Botswana	Namibia
74	Côte d'Ivoire	Niger	Sri Lanka	Egypt (Arab Republic)
75	Turkey	Namibia	Namibia	Qatar
76	Indonesia	Nepal	Philippines	Morocco
77	Congo (Dem. Republic)	Morocco	Gabon	Côte d'Ivoire
78	Nepal	Senegal	Mongolia	Mongolia
79	Tanzania	Ghana	Pakistan	Gabon
80	Ghana	United Arab Emirates	Ghana	Tunisia
81	Namibia	Luxembourg	Cameroon	Niger
82	Morocco	Jordan	Nigeria	Lebanon
83	Nigeria	Korea (Republic)	Tajikistan	Greece
84	Algeria	India	India	Algeria
85	Mongolia	Saudi Arabia	Côte d'Ivoire	Senegal
86	Libya	Trinidad & Tobago	Kenya	India
87	Botswana	Botswana	Senegal	China
88	Pakistan	Ireland	Niger	Nigeria
89	India	Ethiopia	Congo (Dem. Republic)	Israel
90	Niger	Cyprus	Nepal	Indonesia
91	Senegal	Qatar	Tanzania	Botswana
92	Ethiopia	Kuwait	Ethiopia	Libya

Figure C-8
2010 Country ranking for the overall Index and energy dimensions

Rank	2010 Overall index ranking	2010 Energy security ranking	2010 Social equity ranking	2010 Environmental impact mitigation ranking
1	Switzerland	Canada	United States	Iceland
2	Canada	Switzerland	Canada	Sweden
3	Norway	Denmark	Australia	France
4	Finland	Slovenia	Switzerland	Norway
5	New Zealand	Japan	Luxembourg	Estonia
6	France	Finland	France	Lithuania
7	Sweden	Norway	United Kingdom	Latvia
8	Denmark	Russia	Norway	Tajikistan
9	United States	Cameroon	Austria	Switzerland
10	Austria	Germany	Greece	Slovakia
11	Japan	Netherlands	Belgium	New Zealand
12	Belgium	Portugal	Japan	Luxembourg
13	Netherlands	Sweden	New Zealand	Canada
14	Slovenia	Czech Republic	Germany	Russia
15	Iceland	Slovakia	Finland	Finland
16	Luxembourg	Nigeria	Iceland	Albania
17	Slovakia	New Zealand	Qatar	Brazil
18	Germany	Colombia	Spain	Austria
19	Portugal	United States	Argentina	Uruguay
20	Australia	United Kingdom	Saudi Arabia	Kazakhstan
21	United Kingdom	France	Denmark	Nepal
22	Czech Republic	Argentina	Taiwan, China	Egypt (Arab Republic)
23	Estonia	Macedonia (Republic)	Italy	Ukraine
24	Argentina	Hungary	Netherlands	Hungary
25	Hungary	Belgium	Iran (Islamic Republic)	Croatia
26	Spain	Poland	Czech Republic	Belgium
27	Lithuania	Spain	Ireland	Argentina
28	Ireland	Romania	Cyprus	Slovenia
29	Russia	Indonesia	Croatia	Denmark
30	Uruguay	Austria	Sweden	United States
31	Latvia	Ukraine	Korea (Republic)	Paraguay
32	Hong Kong, China	Tunisia	Hong Kong, China	Ireland
33	Italy	Egypt (Arab Republic)	Kuwait	Colombia
34	Korea (Republic)	Iran (Islamic Republic)	Portugal	Kenya
35	Taiwan, China	Kenya	Slovakia	Trinidad & Tobago
36	Egypt (Arab Republic)	Australia	Slovenia	Peru
37	Colombia	Turkey	Hungary	Bulgaria
38	Qatar	Paraguay	Poland	Portugal
39	Iran (Islamic Republic)	Swaziland	United Arab Emirates	Japan
40	Croatia	Uruguay	Israel	Iran (Islamic Republic)
41	Romania	Syria (Arab Republic)	Kazakhstan	Philippines
42	Saudi Arabia	Côte d'Ivoire	Mexico	Swaziland
43	Macedonia (Republic)	Lithuania	Lebanon	Macedonia (Republic)
44	Greece	Italy	Romania	Namibia
45	Ukraine	South Africa	Uruguay	Netherlands
46	South Africa	Estonia	Lithuania	Czech Republic
47	Poland	Tajikistan	Estonia	Jordan
48	Cyprus	Mexico	South Africa	Korea (Republic)
49	Kazakhstan	Iceland	Jordan	Hong Kong, China
50	UAE	Greece	Latvia	Romania
51	Bulgaria	Congo (Dem. Republic)	Egypt (Arab Republic)	Tanzania
52	Tunisia	Libya	Turkey	Congo (Dem. Rep.)
53	Mexico	Bulgaria	Russia	Ghana
54	Kuwait	Albania	Tunisia	Cyprus
55	Trinidad & Tobago	Latvia	Trinidad & Tobago	Sri Lanka
56	Brazil	Algeria	Libya	Serbia
57	Swaziland	India	Macedonia (Republic)	Italy
58	Albania	Tanzania	Ukraine	Taiwan, China
59	Paraguay	Philippines	Serbia	Syria (Arab Republic)
60	Jordan	Ghana	Thailand	South Africa
61	Turkey	Sri Lanka	Colombia	Saudi Arabia
62	Tajikistan	Qatar	Algeria	Spain
63	Peru	Korea (Republic)	Bulgaria	Germany
64	Philippines	Ireland	Brazil	United Arab Emirates
65	Kenya	Taiwan, China	Morocco	Côte d'Ivoire
66	Cameroon	Saudi Arabia	Indonesia	Australia
67	Lebanon	Pakistan	Paraguay	Thailand
68	Namibia	Lebanon	Peru	Pakistan
69	Syria (Arab Republic)	Peru	Syria (Arab Republic)	United Kingdom
70	Sri Lanka	Kazakhstan	Sri Lanka	Morocco
71	Indonesia	China	Botswana	Tunisia
72	Thailand	Kuwait	China	Mongolia
73	Israel	United Arab Emirates	Namibia	Mexico
74	Nepal	Luxembourg	Philippines	Kuwait
75	Libya	Nepal	Swaziland	Turkey
76	Ghana	Croatia	Albania	Qatar
77	Nigeria	Hong Kong, China	Côte d'Ivoire	Lebanon
78	China	Trinidad & Tobago	Pakistan	Cameroon
79	Algeria	Brazil	Ghana	Poland
80	Tanzania	Niger	India	China
81	Côte d'Ivoire	Israel	Mongolia	Niger
82	Serbia	Namibia	Nigeria	Algeria
83	Congo (Dem. Republic)	Mongolia	Cameroon	Nigeria
84	India	Jordan	Senegal	Senegal
85	Morocco	Thailand	Tajikistan	Ethiopia
86	Botswana	Senegal	Niger	Greece
87	Pakistan	Ethiopia	Kenya	India
88	Mongolia	Morocco	Congo (Dem. Republic)	Indonesia
89	Senegal	Cyprus	Ethiopia	Botswana
90	Niger	Botswana	Nepal	Libya
91	Ethiopia	Serbia	Tanzania	Israel

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