

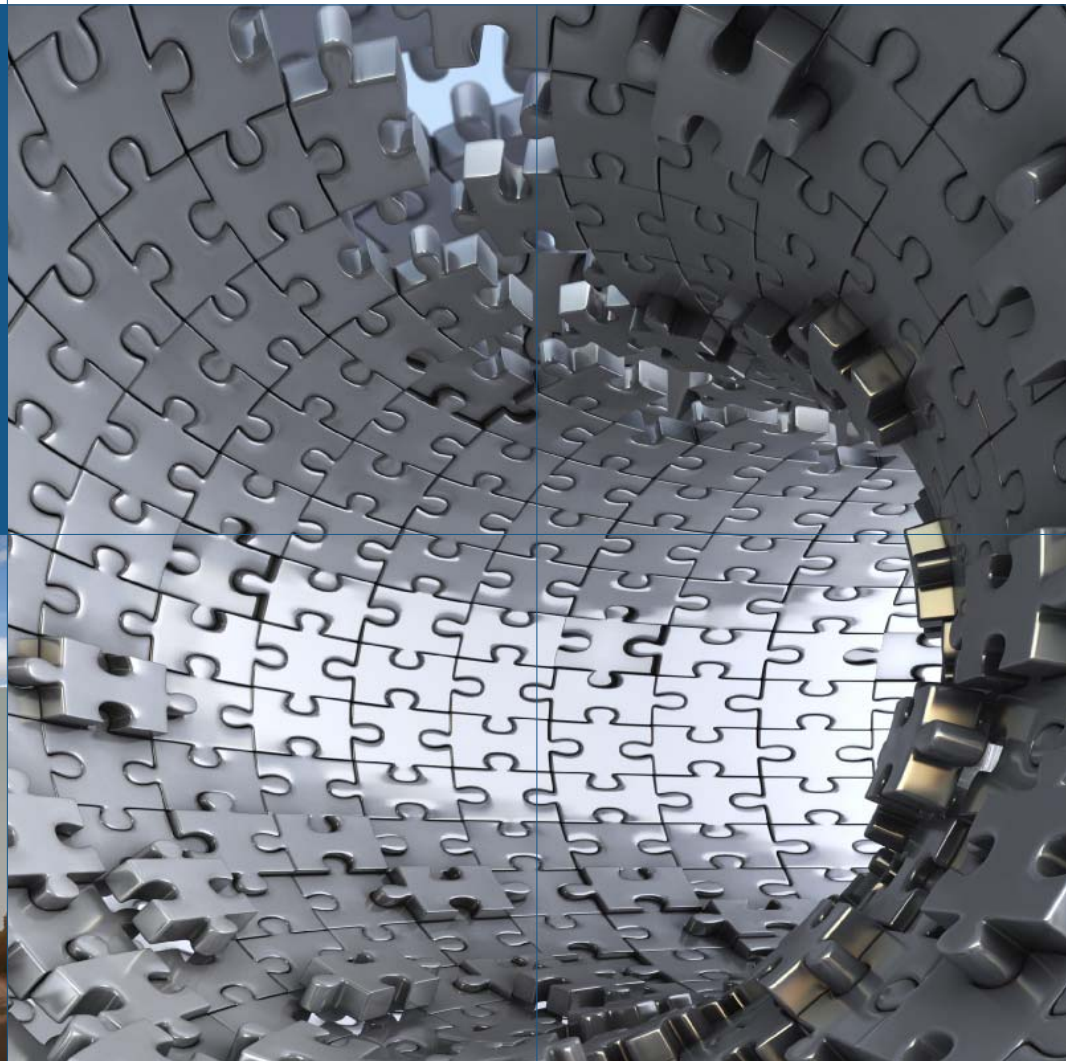


**WORLD ENERGY COUNCIL**  
CONSEIL MONDIAL DE L'ÉNERGIE

# World Energy and Climate Policy: 2009 Assessment

Annex 1: Methodology  
World Energy Council 2009

Promoting sustainable energy for the  
greatest benefit of all



# World Energy and Climate Policy: 2009 Assessment

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**World Energy and Climate Policy: 2009 Assessment**

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# Annex 1: Methodology

## 1. Overall Methodology

This chapter outlines the methodology used in the World Energy and Climate Policy: 2009 Assessment. The methodology consists of two parts:

- An evaluation of existing national policies, regulations, and standards, in general as well as for energy in particular, and their effectiveness in practice for energy issues. This is related to the overall capability of each country to develop and implement energy policy and practices, based on a broad range of indicators (currently 46) compiled from publicly available data. These are shown in Table A1-1 in the appendix to this annex.
- An analysis, based on feedback from WEC members, of specific energy policies within each country, covering how they have worked or are working in practice. The analysis also includes a compilation of key lessons learned from the country responses.

A comparison within and between countries, was made in order to provide examples of policies and practices. This is summarised in this report under three broad categories: energy equity, energy security, and climate change.

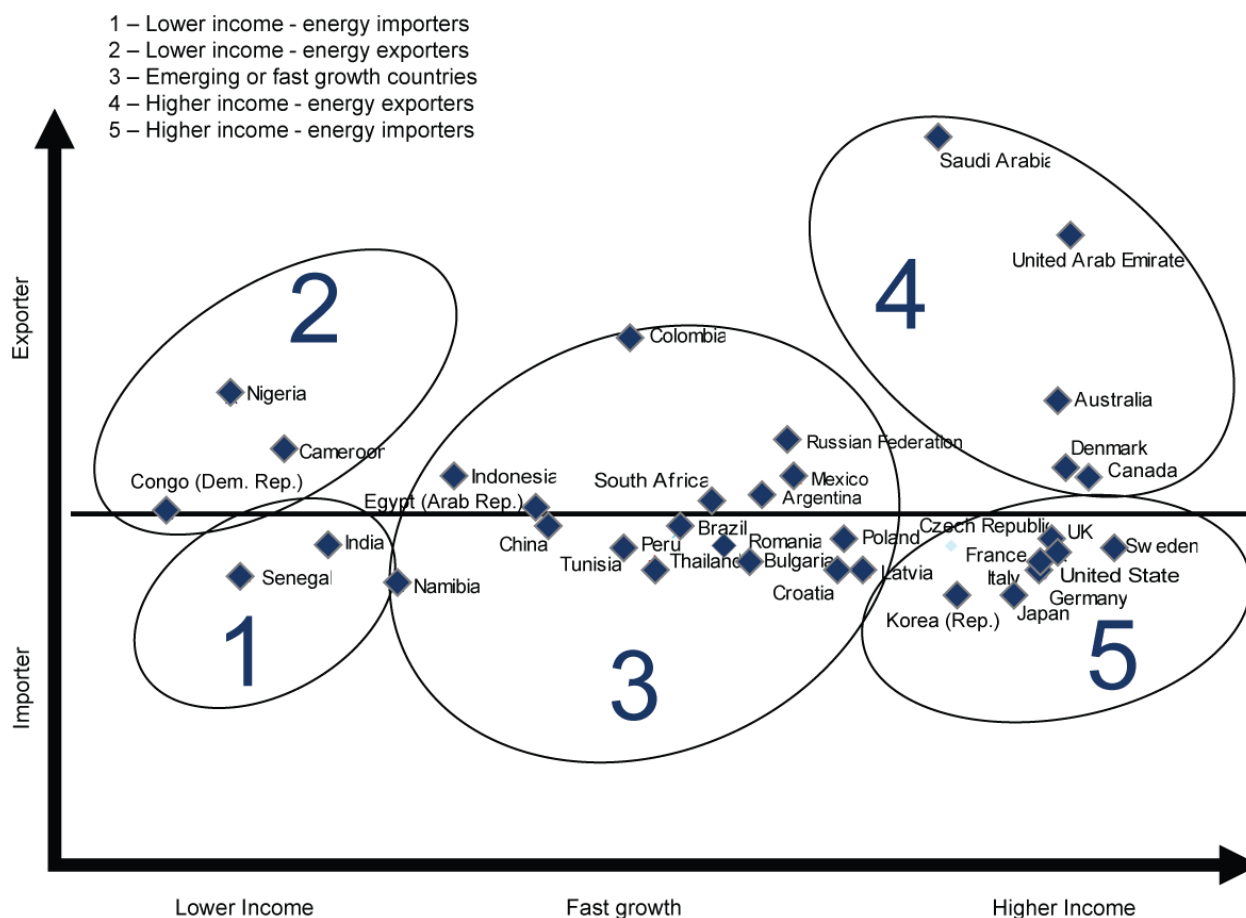
When comparing countries, we need to be aware of the differences between them in terms of economic development and natural resources, and the wide variations in their policy, its foci and objectives. Nevertheless, many countries still present broadly similar circumstances, so that countries can be grouped together for purposes of

comparison. The assessment considers five groups of countries or “country clusters,” reflecting the relative balance of economic development (per capita income) and energy resources (net export/import).

These five country clusters, shown in Figure A1-1, comprise the following countries:

1. **Lower-income (<\$4,000/year) net energy importers** (13 countries): Ethiopia, Ghana, India, Kenya, Mongolia, Morocco, Nepal, Pakistan, Philippines, Senegal, Sri Lanka, Tajikistan, and Tanzania.
2. **Lower-income (<\$4,000/year) net energy exporters** (7 countries): Cameroon, Congo (Dem. Rep.), Côte d'Ivoire, Indonesia, Nigeria, Paraguay, and Yemen.
3. **Fast-growth countries** (31 countries): Algeria, Argentina, Botswana, Brazil, Bulgaria, China, Colombia, Croatia, Egypt (Arab Rep.), Iran (Islamic Rep.), Jordan, Latvia, Lebanon, Libya, Lithuania, Macedonia (Rep.), Mexico, Namibia, Peru, Poland, Romania, Russian Federation, Serbia, South Africa, Syria (Arab Rep.), Thailand, Trinidad & Tobago, Tunisia, Turkey, Ukraine, and Uruguay.
4. **Higher-income (>\$18,000/year) net energy exporters** (8 countries): Australia, Canada, Denmark, Kuwait, Norway, Qatar, Saudi Arabia, and United Arab Emirates.

**Figure A1-1**  
**Country Clusters (with examples)**



**5. Higher-income (>\$18,000/year) net energy importers** (29 countries): Austria, Belgium, Cyprus, Czech Republic, Estonia, Finland, France, Germany, Greece, Hong Kong (China), Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea (Rep.), Luxembourg, Netherlands, New Zealand, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Taiwan (China), United Kingdom, and United States.

The Index is based on the principle that the effectiveness of national energy policy is determined by four key factors or "supports," which in turn are composed of 12 "building blocks." Each building block has a number of indicators to assess the performance of a country. The number of indicators per building block varies from a minimum of three to a maximum of six (there are 46 indicators in total).

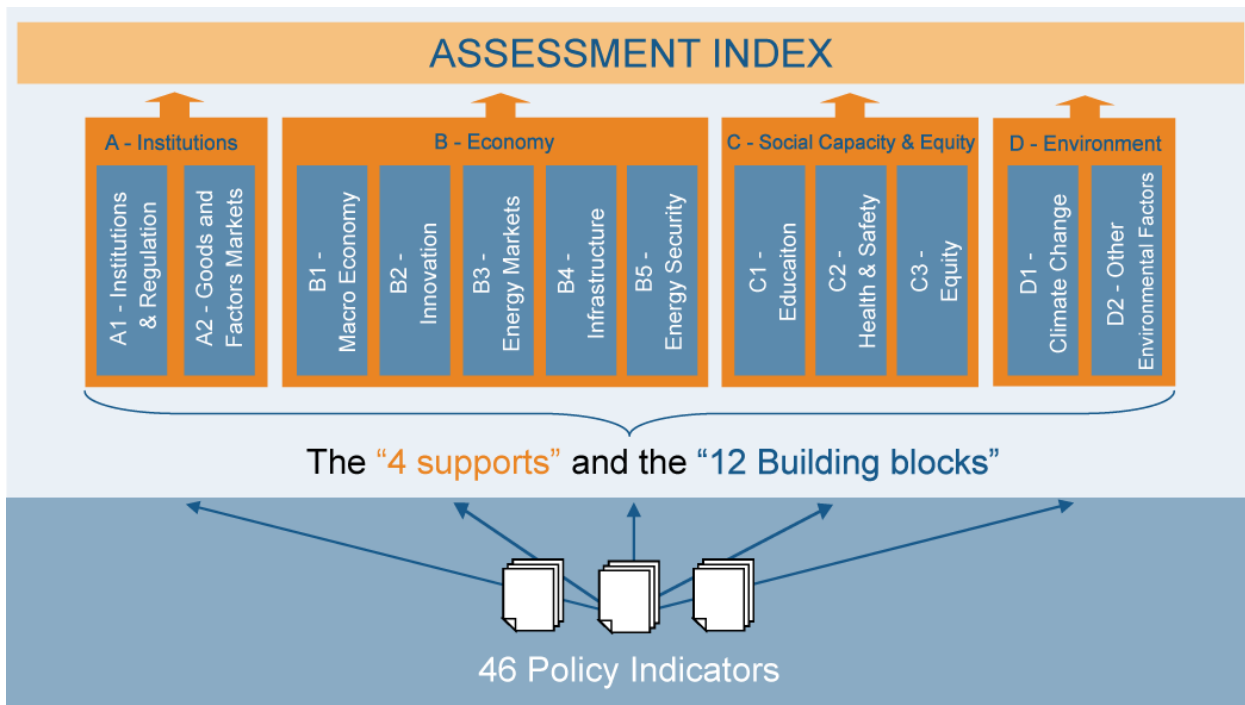
#### Part I – The Overall Assessment

Central to Part I is the Assessment of Energy Policies and Practices Index (Assessment Index), which measures the extent to which a country has the necessary attributes to achieve its energy policy objectives. The Index measures energy policy effectiveness, such that the higher the value of the index the more effective is a country's energy policy.

The Assessment Index structure is presented in Figure A1-2. The four supports and their 12 building blocks are:

- **Institutions**, with two building blocks: institutions and regulation; and goods and factors markets. Institutions are an essential pre-requisite for successful policy development. This support measures the capacity, robustness, and transparency of decision-making bodies in developing, implementing and enforcing policies.

**Figure A1-2**  
**Assessment Index Structure**



- **Economy**, with six building blocks: macro-economy; innovation; energy markets; investment; infrastructure; and energy security. This support measures the strength and structure of an economy, and its ability to innovate and invest so as to ensure a reliable and secure energy supply. A strong building block for economy allows for high-quality policy and practices.
- **Social capacity and equity**, with three building blocks: education; health and safety; and equity. This support examines the overall wellbeing of society and is the basis for the provision of energy services. Strong societies with access to modern forms of energy are critical to inspiring best practice.
- **Environment**, with two building blocks, climate change and other environmental factors. The condition of the environment is one key indicator of the performance of policy. This becomes more important as economic development takes place; it varies across country clusters.

Details of the building blocks and indicators are included below in Box A1-1 and in Table A1-1.

**Box A1-1: Supports and Building Blocks**

**A. Institutions**

A1. Institutions and regulation: energy systems require capital-intensive investments. These are only possible if investors think that expropriation is unlikely. This requires that the government guarantees that rule of law is enforced, property rights are respected, a high level of security is ensured, with low levels of corruption, and that private arrangements are facilitated by providing the right “checks and balances” in the economy (such as minority shareholder’s protection, auditing standards, and the ability of courts to equitably settle disputes).

A2. Goods and factors markets: energy systems do not work in isolation from other parts of the economy. They require the use of other goods and services, capital, and the employment of workers. As a consequence, efficient goods and services, financial and labour markets are key enablers of effective energy policies.

## **B. Economy**

B1. Macro-economy: energy is an essential element of economic growth and development. One of the major achievements of effective energy policies is their ability to sustain growth. On the other hand, a strong and stable economy, namely low cost of capital and low inflation rates, provides a positive support for the implementation of business policies, not least in business. These policies facilitate the mostly highly capital-intensive investments of the energy sector.

B2. Innovation: innovation is very important to support the continuous development of new solutions to the ever-changing challenges emerging in the energy sector. It is crucial for companies and governments as they struggle to find new energy resources and new ways to use existing ones in a sustainable, efficient and safe manner. This requires an environment that is conducive to innovative activity, supported by both the public and the private sectors.

B3. Energy markets: efficient energy markets are a key result of effective energy policies. This building block measures the efficiency of energy markets (in particular the presence and effectiveness of price signals), by looking at the level of subsidies and the share of energy spending in the economy. The share of FDI in energy investments is also a potential indicator of the openness of a national energy system.

B4. Infrastructure: the existence of high-quality infrastructure is critical for ensuring the efficient functioning of the energy system. Economies depend on electricity supplies (and other sources of energy) free of interruptions and

shortages, to ensure that businesses and factories can work unimpeded. High-quality infrastructure also helps ensure that households receive reliable energy at affordable prices. Energy systems depend also on many other key infrastructures: roads, rail, ports to transport the fuels or the materials, and telecommunication networks that enable modern and reliable management of the system, etc.

B5. Energy security: secure supplies of energy are vital for the efficient functioning of all economies. At the same time, secure and predictable foreign demand for energy resources is critical for energy rich countries. Security of supply/demand is also essential to avoid extreme price volatility of energy resources with consequent negative economic impact. From this perspective, energy security has two main dimensions:

- ▶ Long-term security measures the risks of demand (or supply), shocks, and disruptions. It is measured by the diversity of supply/demand (a more diverse supply/demand is more resilient to shocks); the degree of reliance on imports; and the energy intensity of the economy (energy consumption/GDP). The less dependent an economy is on energy, the less it is exposed to potential shocks.
- ▶ Short-term security: measured by the existence of spare capacity or reserves (for example, in the form of oil stocks, gas storage or spare electricity generation capacity).

### C. Social Capacity and Equity

C1. Education: a high standard of education is an important pre-condition for a skilled labour force and for sustaining a robust rate of innovation. It is important to help guarantee investment in, and the efficient functioning of, the energy system. This building block measures the quantity and quality of education in the general population, the training of professionals, and the availability of engineers and scientists.

C2. Health and safety: investments in health services and in safety are important, not only for the wellbeing of the society (and therefore the capacity/flexibility to adjust to changes), but also for the performance of the economy and its energy sector since it helps ensure a more productive workforce.

C3. Equity: balanced distribution of income and access to services (including energy) are important elements for the development of a country and the creation of a productive environment in which policies, including energy policies, can be implemented. Policies must play a role in the avoidance of social tensions within a country by preventing an inordinate level of inequalities (e.g., access to affordable energy).

### D. Environment

D1. Climate Change: this building block measures the performance of a country in terms of its policies to reduce greenhouse gas emissions (measured as CO<sub>2</sub> equivalent). This is measured, not only by considering emissions per capita, but also emission per unit of

economic output, and the emissions intensity of key sectors (electricity generation and transport).

D2. Other environmental factors: the environmental performance of a country's energy policy is also measured by means of a factor connected to its levels of air and water pollution, and water stress.

## 2. Calculation of the Assessment Index

The process adopted in calculating the Assessment Index is:

- Data collection: data were obtained from published, international sources; unavailable data were excluded from the calculations for a building block.
- Normalisation: data were normalised via homogeneous transformation to a range of 0 to 10 (with 0 as the low value and 10 the high value).
- Weighting: weights were calculated for each building block, supports, and overall Assessment Index using averages and equal weighting.
- Presentation of results: the results of the Assessment Index are presented in four divisions within each cluster.

### Data collection and sources

The principle behind the data collection was to obtain data from published, international sources that would allow ease of comparison and replicability. Details of sources are included in the table at the end of this annex. One complication arose around the timing of the data; collecting information from different sources meant that the latest available data is not always for the same year for every indicator. For most of the indicators the most recent date was 2006 and this has been used in this analysis.

### Unavailable data

One of the main difficulties in the analysis has been data availability. Overall, around 15 percent of data was missing, predominantly for countries in clusters 1 and 2. Some indicators are heavily impacted by the missing data. In the current assessment, unavailable data gaps were not filled. Where the lack of data made the indicator unsuitable, the indicator was dropped. There are currently 46 indicators in the index out of a total of the 57 indicators originally selected. For the remaining missing data, the number was left blank and not included in the average when calculating the index, except for RD&D indicator, where missing values were set at zero.

### Normalisation

To allow comparison between indicators, and enable the data to be aggregated into an index, the

raw data was normalised. Normalisation was done using homogeneous transformation to a range of 0 to 10 (where 0 is the low value and 10 the high value). For some indicators, the highest value in the raw data equaled the highest normalised value; and for some indicators the lowest value in the raw data equaled the highest normalised value. Finally for some indicators, an optimal intermediate value, equal to the highest normalised value, was used. This is the case where the indicator presented U-curve characteristics. An example occurs in the capacity margin in the electricity sector, where 25 percent reserve margin was set as optimal value, and values scored less well the greater the absolute value difference to this optimum.

### Weights in Assessment Index

In the Assessment Index, the weighting of each of the indicators, building blocks, and supports is crucial to the final result. Ideally, this weight is based on their effectiveness in reaching the objectives of the energy policy. Additionally, some indicators may be more significant in achieving the overall effectiveness of the building block and these indicators are given a stronger weight.

In this initial examination of weighting, an equal weighting approach has been used. Other methods were considered in this initial examination, such as the Principal Component Analysis (PCA) and experts to determine the weights using the Analytic Hierarchy Process (AHP). The difference in results using different weighting methods was minimal. This will be examined in ongoing Assessments.

## Presentation of Results

For each country in the Assessment, there is a set of indicators and calculated values for building blocks, supports, and the Assessment index. These values have been placed in order, and for each value, countries are identified as belonging to one of four divisions, each containing one quarter of the countries:

- First division: classified in top 25 percent
- Second division: classified in range 25–50 percent
- Third division: classified in range 50–75 percent
- Fourth division: classified in bottom 25 percent

The divisional results by cluster are shown in Annex 2.

## Part II – Policy Instruments Analysis

The policy analysis establishes the rationale behind a country's achievement of its energy policy objectives. In trying to understand what makes a successful energy policy, it is important to understand the trade-offs and tensions involved. Effective energy policies often have to reconcile economic, social, environmental, and institutional objectives, which may not be compatible with each other. For example, addressing climate change has cost implications which can lead to higher energy prices, with consequences for economic growth and social cohesion.

A questionnaire was sent to each member committee in WEC. The purpose was to validate the data used in the Assessment Index and to obtain specific country examples of energy and/or energy-related policies and how they have worked in practice. The questionnaire focused on:

- Identifying the lessons learned from both effective policies (and the factors that supported effective policies); and less effective policies (and the constraints that limited the impacts of these policies)
- Assembling an overview of key national (and international) policies related to some of the key energy issues, such as, energy prices; public acceptance of new infrastructure; energy security; energy efficiency; renewable energy, climate change; access to energy and affordability; and RD&D.

Analysis of the policy responses obtained from the questionnaire focused first on the link between the Assessment Index and actual policies, identifying energy policy and non-policy related factors that influenced performance in the strongest (i.e., best performing) building blocks. This analysis also helped clarify the key constraints and barriers to achieving high performance. Secondly, it provided information on the salient energy policies in each country for key policy areas. This provided an overview of the countries that offered examples of best practice. Finally, it provided the material for the analysis of policies summarised in Chapters 2 to 5 of this report.

## Appendix: Assessment Indicator

**Table A1-1**  
Indicators and Data Sources

<b>Support: Institutions</b>				
Building Block	Indicator	Source	Type of Indicator	Description of Indicator
A1. Institutions	A11. Rule of law	World Bank Governance Indicators	Index based on expert assessment; range from -2.5 to 2.5 with high number indicating better performance	Measures perceptions of agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.
	A12. Protection of property rights	World Economic Forum, Global Competitiveness Report	Index based on survey; range from 0 to 10 with high number indicating better performance	This component is from the Global Competitiveness Report's survey question: "Property rights, including over financial assets are poorly defined and not protected by law (= 1) or are clearly defined and well protected by law (= 7)."
	A13. Level of corruption	Transparency International	Index based on surveys and expert assessment; range from 0 to 10 with high number indicating better performance	Measures the overall extent of corruption (frequency and/or size of bribes) in the public and political sectors.
	A14. Regulatory quality	World Bank Governance Indicators	Index based on expert assessment; range from -2.5 to 2.5 with high number indicating better performance	Measures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.
	A15. Private institutions	WEF – Global Competitiveness Report	Index based on surveys; range from 0 to 10 with high number indicating better performance	Measures transparency and quality of reporting standards in private companies
A2. Goods and factors markets	A21. Goods markets	WEF – Global Competitiveness Report	Index based on surveys; range from 0 to 10 with high number indicating better performance	Measures the efficiency of goods markets to produce the right mix of products and services given supply-and-demand conditions.

<b>Support: Institutions</b>				
Building Block	Indicator	Source	Type of Indicator	Description of Indicator
A2. Goods and factors markets	A22. Financial markets	WEF – Global Competitiveness Report	Index based on surveys; range from 0 to 10 with high number indicating better performance	Measures the efficiency of the financial sector to allocate the resources saved by a nation's citizens as well as those entering the economy from abroad to their most productive uses.
	A23. Labour markets	WEF – Global Competitiveness Report	Index based on surveys; range from 0 to 10 with high number indicating better performance	Measures the efficiency and flexibility of the labor market to ensure that workers are allocated to their most efficient use in the economy.
	A24. Ease of business	World Bank (Doing business project)	Time in days	The measure captures the median duration that incorporation lawyers indicate is necessary to complete a procedure with minimum follow-up with government agencies and no extra payments.

<b>Support: Economy</b>				
Building Block	Indicator	Source	Type of Indicator	Description of Indicator
B1. Macro-economy	B11. GDP growth rate	International Monetary Fund	Gross domestic product, constant prices, annual per cent change	Annual percentages of constant price GDP are year-on-year changes; the base year is country-specific. This average over 10 year period (1995-2005)
	B12. Inflation rate	International Monetary Fund	Average consumer prices. Annual per cent change	This data averages inflation over a five year period 2000-2005. Data for inflation are averages for the year, not end-of-period data.
	B13. Long term interest rate	Global Insight	Long term interest rates (10 yrs)	This data averages interest rates over a five year period 2000-2005. Data for interest rates are averages for the year, not end-of-period data.
	B14. GDP per capita	International Monetary Fund	Percentage	Gross domestic product based on purchasing-power-parity (PPP) per capita GDP.
	B15. Industry share of GDP	World Bank Development Indicators	Industry share of GDP in percentage	Industry covers mining, manufacturing (also reported separately), construction, electricity, water, and gas. Total GDP is measured at purchaser prices. Value added by industry is normally measured at basic prices.

<b>Support: Economy</b>				
Building Block	Indicator	Source	Type of Indicator	Description of Indicator
B1. Macro-economy	B16. Investment/GDP	World Bank Development Indicators	Gross Capital Formation as % of GDP (2005)	Gross capital formation consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories and valuables.
B2. Innovation	B21. Total R&D expenditure/GDP	UN Human Development Index	Research and Development expenditures as % of GDP (average 2000-2005)	
	B22. Energy R&D/GDP	International Energy Agency	Government Energy R&D expenditures as % of GDP	
	B23. Innovation index	World Bank	Knowledge Index	Innovation index - index calculated as part of the broader World Bank Knowledge index
B3. Energy markets	B31. Energy intensity	International Energy Agency	Percentage	Total Primary Energy Supply/GDP (PPP) (toe/thousand 2000 US\$ PPP) – for year 2006
	B32. Oil products price wedge	International Energy Agency	Difference between wholesale and retail (pre-tax) gasoline prices	
	B33. Technical efficiency	International Energy Agency	Technical efficiency of fossil fuel power plants	
B4. Infrastructure	B41. Quality of infrastructure (general)	WEF – Global Competitiveness Report	Index based on survey; range from 0 to 10 with high number indicating better performance	
	B42. Reliability in gas networks infrastructure (network losses)	International Energy Agency	Percentage	Network distribution losses as percentage of gas consumed
	B43. Reliability in electricity networks infrastructure (network losses)	International Energy Agency	Percentage	Network distribution losses as percentage of electricity generation

<b>Support: Economy</b>				
Building Block	Indicator	Source	Type of Indicator	Description of Indicator
B5. Energy security	B51. Diversity of supply	International Energy Agency	Shannon-Wiener index for the total primary energy supply (range from 0 to 1.94)	This measure used the Shannon Wiener index, calculated on the Total primary Energy Supply and based on a maximum of seven different fuel supplies.
	B52. Energy investment/ Total investment	National accounts	Gross capital formation in the energy sector over total gross capital formation	
	B53. Capacity margin (electricity)	European Transmission System Operator, Asia-Pacific Economic Cooperation, Arab Union of Producers, Transporters and Distributors of Electricity, North American Electric Reliability Cooperation	Margins calculated as difference between net generating capacity and peak demand	
	B54. Stocks of oil (commercial and government owned)	Joint Oil Data Initiative (JODI)	Number of days of consumption	Industry and Government-Controlled Petroleum Stocks
	B55. Level of import/consumption (for net energy importers)	International Energy Agency	Net Energy Imports	The measure describes the country' net energy imports, i.e., imports minus exports for total energy. A positive number denotes net imports, and a negative number denotes net exports.

<b>Support: Social capacity and equity</b>				
Building Block	Indicator	Source	Type of Indicator	Description of Indicator
C1. Education	C11. Enrolment percentages (for secondary education)	UN Human Development Index	Net secondary enrolment rates (%) – 2005	Where 2005 data not available 1991 data is used.

<b>Support: Social capacity and equity</b>				
Building Block	Indicator	Source	Type of Indicator	Description of Indicator
	C12. Number of engineers and scientists	UN Human Development Index	Tertiary students in science and engineering	
	C13. Internet users	World Bank	Internet users (per 100 people)	
C2. Health and safety	C21. Health spending/capita	UN Human Development Index	Health expenditure per capita (PPP USD) - 2004	
	C22. Life expectancy	UN Human Development Index	Life expectancy at birth (years) – estimates for 2000-2005	
	C23. Infant mortality	UN Human Development Index	Infant mortality rate (per 1,000 live births) - 2005	
C3. Equity	C31. Gini index	UN Human Development Index	Gini Index (2007)	Measure of income inequality. A value of 0 represents absolute equality, and a value of 100 absolute inequality.
	C32. Energy spending/Households income	World Bank	Calculated as spending on housing, electricity, gas and fuels as a percentage of total household spending	
	C33. Access to electricity (% of population)	UN Human Development Index	Electrification rate (%) – 2000-2005 (Data refer to the most recent year available during the period specified)	

<b>Support: Environment</b>				
Building Block	Indicator	Source	Type of Indicator	Description of Indicator
D1. Climate change	D11. CO <sub>2</sub> (eq) emissions per capita	International Energy Agency	CO <sub>2</sub> /Population (t CO <sub>2</sub> /capita) - 2006	

<b>Support: Environment</b>				
Building Block	Indicator	Source	Type of Indicator	Description of Indicator
	D12. CO <sub>2</sub> (eq) emissions per unit of GDP	International Energy Agency	CO <sub>2</sub> /GDP (kg CO <sub>2</sub> /2000 US\$) - 2006	
	D13. Emissions intensity of power sector	International Energy Agency	Emissions per electricity generation (CO <sub>2</sub> /kWh) - 2006	
D1. Climate change	D14. Emissions intensity of industry (CO <sub>2</sub> per GDP from industry sector)	Yale – Environmental Performance Index	.85 tons of CO <sub>2</sub> per \$1000 (USD, 2005, PPP) of industrial GDP (Estimated value associated with 50% reduction in global GHG emissions by 2050, against 1990 levels)	Original data from International Energy Agency and World Development Indicator
D2. Environmental factors	D21. Air pollution	Yale – Environmental Performance Index	Index (0 to 100) – Air Pollution (effects on human) from EPI 2008	Combines indicators for Urban particulates, Indoor air pollution and local ozone
	D22. Water quality	Yale – Environmental Performance Index	Index – water quality (0 to 100) from EPI 2008	Original data from UNEP GEMS/Water
	D23. Biodiversity	Yale – Environmental Performance Index	Index (0 to 100) – Biodiversity and Habitat from EPI 2008	Combines indicators for Conservation risk index, Effective conservation, Critical habitat protection, Marine Protected Areas
	D24. Water stress	FAO – Aquastat database	Percentage – water withdrawal over water resources	Total water withdrawal per capita (m <sup>3</sup> /inhab/yr) divided by Water resources: total renewable per capita (actual) (m <sup>3</sup> /inhab/yr)

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