THEODOR FRIEDERISZICK, MARCEL STAPKE, ANDRÉ WOLF

BDO INTERNATIONAL BUSINESS COMPASS 2018

Update and Subject Focus: Energy and resource consumption

BDO

HWWI Hamburgisches WeltWirtschafts Institut

Abbreviations

FDI	Foreign Direct Investment
AfDB	African Development Bank
CIA	Central Intelligence Agency
GCI	Global Competitiveness Index
SME	Small and Medium-Sized Enterprise
WIPO	World Intellectual Property Database
OECD	Organisation for Economic Cooperation and Development
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa

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Hamburgisches WeltWirtschafts Institut

„Increasing prosperity in developing and emerging countries could be combined with decarbonisation as a climate-policy objective, at least in the longer term."

BDO

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THE ISSUE OF RESOURCE SCARCITY – CONSENT ON GOALS, DISSENT ON MEANS

Most recently, the conclusion of the Paris Climate Accords in 2015 has shown that a great majority of countries throughout the world now recognise the limiting of CO2 emissions as a strategic goal for the future, in order to slow down the process of global warming. There remain very divergent opinions on the appropriate environmental and energy-policy strategies for combating this threat, however. Whereas countries such as Germany envisage a renunciation in the medium term of both nuclear power and coal and are massively investing in the provision of renewable energy, countries such as France and Sweden consider nuclear power to be an essential component of a sustainable energy mix. Then again, the foremost perception in countries such as the United States is of the risks associated with an energy transition and they fear competitive disadvantages arising from higher energy costs. There are also great discrepancies with regard to the choice of regulatory instruments; the spectrum ranges from prohibitions to market-related solutions such as emissions-certificate trading. For international investors, especially from the energy-intensive sectors, this diversity presents difficulties when deciding where to locate their businesses. Uncertainty with regard to the development of regulatory frameworks predominates, along with energy and emissions costs.

The focus of this year's edition of the BDO International Business Compass (IBC) is therefore the subject of energy and resource consumption. The study compares countries and regions with regard to their use of various types of resources and puts the consequences for society of energy and resource consumption under the microscope. Beyond the main subject focus, we have as usual produced an updated ranking for the IBC All-in-OneAggregate Index as a yardstick for measuring the attractiveness of particular business locations as a whole. This is the seventh occasion on which we have evaluated the economic, politico-legal and socio-cultural framework conditions and combined them to produce a single, clear measure. We have, moreover, updated the Production and Sales Outlets Subindices in comparison to last year. This makes it possible specifically to compare countries with regard to their attractiveness as locations for production and sales, respectively. With this analysis, we hope to provide useful support to internationally oriented enterprises when it comes to choosing locations in which to do business.

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RESOURCE USE – MAKING USE OF DEFICITS AS OPPORTUNITIES

The way that an economy treats its resources says a lot about its state of development, its sense of responsibility and its future sustainability. That is why the corresponding data must always be interpreted in context with other framework conditions. This is what the results of the current BDO International Business Compass (IBC), which focuses on the intensity of resource use, show. Higher energy consumption in Iceland, for example, as a consequence of its naturally occurring geothermal energy, must be assessed quite differently from high consumption in countries and regions that derive their electrical energy primarily from coal-fired generation.

Against the background of the growing global demand for energy, it is encouraging that the share of renewable energy in electricity generation is increasing significantly almost everywhere in the world. That gives grounds for hope that states are perhaps promoting climate-neutral electricity generation for reasons of environmental policy as well as economic self-interest. Increasing prosperity in developing and emerging countries could also be combined with decarbonisation as a climate-policy objective, at least in the longer term.

Many states will also have to pay particular attention to the treatment in future of the ever-growing volume of waste being generated. It is quite striking how the data emphasise the tendency of an economy to produce more waste the more prosperous it becomes. To carry on in this way 'regardless' would, in view of the desolate conditions already prevailing in many poorer countries, be disastrous. In this connection, waste prevention and recycling are the most important starting points for not only reducing the burden on the environment but also retaining valuable resources for reuse in the economic process.

In this context, it is particularly difficult to comprehend the enormous amounts of electronic scrap currently going to waste. Here, the strongly rising level of raw-material prices will probably lead in the first place to the recycling of the 80% that is currently deposited as landfill or even worse, dumped in unauthorised tips.

Existing deficits also constantly offer considerable business potential. Sooner or later, even countries that are currently greatly impoverished will be able to afford smart irrigation systems and sewerage-treatment plants, set up recycling systems for reusable waste and put in place measures to increase energy efficiency. Precisely where deficits are at their most acute can there be considerable sales potential for German businesses offering a range of smart environmental technologies and resource-conserving products.

As an international accounting and consulting organisation, we invite industry and SMEs to avail themselves of the quick overview of market opportunities and risks in almost all the countries of the world that the International Business Compass produced by BDO and HWWI provides. By annually updating this comprehensive analysis we ensure that the data are self-evidently the latest available. And if the IBC helps you in taking even better fact-based business decisions, then we shall have achieved our aim.

PARWÄZ RAFIQPOOR
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EXECUTIVE SUMMARY

MOTIVATION

Over the last few decades, global energy and resource consumption has been growing almost continuously. There are many factors indicating that this trend will continue in the future. Unrestricted population growth, the economic catch-up process in which emerging and developing countries are engaged, combined with the increasing need for mobility brought about by globalisation, are among the first such factors to come to mind. On the other hand, there is also a growing awareness of the consequences of the increasing scarcity of physically limited resources and of the resulting climatic and environmental damage. Despite promising signals such as, most recently, the conclusion of the Paris Climate Accords, the process of balancing economic growth with environmental concerns is currently still in its infancy. The quest for sustainability, understood here as the combination of economic growth and ecological objectives, remains one of the greatest challenges of our age.

At an international level, there is a great deal of disagreement over the appropriate means of meeting this target. The rapidly growing emerging countries show little readiness to endanger their hitherto successful growth strategies by going into reverse, even though countries such as China are meanwhile indicating a rethinking of their economic policy. However, even the group of developed countries is split on this question, especially as regards the future positioning of the energy sector. For enterprises operating internationally, this patchwork quilt has increasing consequences for the location issue.

It is on this question of the consumption of energy and resources that the subject focus of the 2018 BDO International Business Compass (IBC) is found. The aim is, first, to present an overview of the regional and global developmental trends in the use of different kinds of resource and energy sources, identifying specific country patterns in the process. We shall next combine the knowledge so obtained into a resource-use index, which will reflect the intensity with which a country has a call on scarce resources in relation to its size, and then analyse the cost issues associated with resource use by reference to electricity and gas prices by way of example. In the last section, we shall deal in detail by way of conclusion with two forms of negative consequences of resource use: the emission of greenhouse gases and air pollutants. In addition to this main focus, the report will include, as it does every year, the current country rankings in the IBC Aggregate One Index as well as the results of the Sales and Production Subindices.

RESULTS

Compared to last year, there are as a whole only a few changes in the Top 10 of the International Business Compass 2018. There is no change in the first four places. Places one and two are still occupied by the highly developed city states of Singapore and Hong Kong, followed by Switzerland and the Netherlands as the best European countries. Ireland has gone up two places and now occupies fifth place, above all due to its low level of unemployment and lower national debt ratio.

The Scandinavian countries in the Top 10, Denmark and Norway, therefore both go down one place and now lie in sixth and seventh place, above the slightly improved United Kingdom. The rest of the Top 10 is made up of the re-entrants Canada and Australia. Canada leaps three places, from No 12 to No 9, due to improvements in all three markers. Australia was able to gain slightly in the politico-legal marker, above all due to a better score with respect to labour freedom. By contrast, Germany (-4 places) and New Zealand (-3) have fallen out of the Top 10. In both cases, this fall in the rankings is not due to any noteworthy changes in the index score, but rather are they an effect of the especially close scores in this part of the rankings. Overall, the predominance of the OECD countries in the leading rankings is again striking this year. As previously, Singapore and Hong Kong are the only non-OECD countries to feature in the Top 20.

In the middle and lower rankings this year, there have been somewhat greater changes, of up to 30 places. The greatest gainer this year has been Guyana, in South America, which has leapt up 27 places to No 92. This is due mostly to significant improvements in the politico-legal area, with respect to both the rule of law and political stability, as well as to investment freedom. A second South American country to make a giant leap forward is Argentina, which has improved by 26 places to No 98, thanks primarily to greatly increased ratings in the politico-legal framework conditions. The greatest winner among Asian countries is Myanmar, whose ranking has improved by 20 places. This is mainly attributable to a significant fall in unemployment and inflation. However, lying in place No 132, the country is still found amongst the lower rankings. Also moving up are Russia and Botswana, which were able to record double-digit gains this year, without, however, yet being able to break into the higher rankings.

Globally the greatest loser this year is Cape Verde, which has plummeted 30 places, reversing a very positive trend in the two previous years, due above all to a significant deterioration in the economic framework conditions. Liberia has also fallen strongly, as a result in this case of a higher national debt and a fall in direct investment inflows. The next greatest losers are Belize, Jamaica and Turkey. Whereas for Belize and Jamaica it is economic reasons that predominate, in the case of Turkey its position has fallen as a result above all of a critical assessment of its worsening politico-legal situation.

In the IBC Production Subindex, the Netherlands is the leader among OECD countries. This is largely due to its central location in Europe and an internationally oriented economic policy. Next come the United Kingdom, Switzerland, Denmark and Belgium. In Africa, Mauritius remains the leader in the Production Subindex. Compared to last year, there have been some significant changes. Above all, Uganda, the Republic of the Congo and Lesotho have improved considerably. By contrast, Burundi, Malawi and Liberia have fallen sharply. The Production Subindex for Asia is characterised by the excellent scores of Singapore and Hong Kong. These two countries also find themselves as the global No 1 and No 2, which is due to their high market potential and investor-friendly legislation. The other top places in Asia are taken by Bahrain, the United Arab Emirates and Qatar, three Persian Gulf countries. Among European non-OECD countries, the leading place is taken by Latvia, which lies at No 26 in the worldwide Production Subindex. It is followed by Lithuania, Malta and Croatia. The results of the Production Subindex for Latin American countries were largely relatively homogeneous. The best score this year was recorded by Uruguay, followed by Barbados, the Bahamas and Panama. There are hardly any changes to note among the five non-OECD members from Oceania.

As expected, the OECD countries dominate the leading places in the Sales Subindex. The Top 10 places are accordingly taken up exclusively by OECD countries. The leader in the sales Subindex this year is Switzerland, which has exchanged places with Norway. Both countries stand out with their high per capita consumption, a high degree of trade freedom and good infrastructure. They are followed by the United States and Canada, which remain unchanged. In Africa, it is the countries in the southern half of the continent that take up the leading places in the Sales Subindex. Botswana was able to climb several places and is now the continental leader. South Africa remains in second place, followed by Mauritius and Namibia. The Sales Subindex for Asia is led by Singapore and Hong Kong, which are the only non-OECD countries to feature in the global Top 15. They are followed in third place by China, which has again lost the leader ranking that it had last year. The leaders among the European non-OECD countries in the sales rankings are Lithuania, Malta and Latvia. They are the only countries in this region to feature in the Top 50 worldwide. The next places are taken by Croatia, Romania and Bulgaria. This year, the most attractive sales location in Latin America is Uruguay. Panama and Costa Rica are next. Brazil has jumped three places and is now fourth. The non-OECD countries of Oceania are among the upper middle-ranked countries globally. Samoa recorded the best score. Papua-New Guinea lies in last place in the continental rankings.

This year's subject focus has presented a detailed picture of development trends in the various forms of raw-material use and developed a global ranking for use intensity. The consequences for society of raw-material use have also been presented in detail. It has become significant that at the global level a high level of use intensity continues to hold sway. Particularly the advancing loss of forest cover in developing countries and the accumulation of electronic waste in developed countries give cause for concern. With respect to both phenomena, the long-term prognosis – a growing world population and increasing digitalisation – is that a turnaround is not to be expected. Furthermore, our index of use intensity demonstrates that countries at a high stage of development are above all resource-intensive. It is worthy of note in this connection, however, that three Gulf states have entered the Top 10, whereas no Western European country has returned there. It is also the case that a whole number of non-OECD countries occupy the leading places. It is thus becoming significant that emerging countries are definitely catching up in their use intensity. It will be interesting to monitor this process in the coming years. The connection between resource use and economic performance already observed in the individual analysis is also evident in the comparison of index values and gross domestic product. The economic catch-up process being undergone by emerging and developing countries therefore implies that in the medium term, no reduction in resource use can be expected.

CONCLUSION

The overall rankings in the IBC 2018 identify a familiar pattern. First place this year again belongs to Singapore, followed by Hong Kong and Switzerland. The remaining places in the Top 10 are all taken by OECD countries. Within this group, Canada and Ireland had made up the most ground compared to last year. By contrast, Germany and New Zealand have fallen out of the Top 10. Significantly greater changes took place in the middle and rearmost rankings. The greatest gainers at the global level this year were Guyana, Argentina and Myanmar, which have all risen by at least 20 places. This was due to improvements partly in the economic and partly in the politico-legal sphere. Worldwide, Cape Verde, Liberia and Belize have fallen by the greatest number of places, above all due to deterioration in economic markers. In a comparison of global regions, the best results were obtained again this year by Northern Europe, Northern America and Western Europe, while African regions bring up the rear.

TECHNICAL DETAILS

The study covers 174 countries spread over all the continents. As was the case last year, countries with fewer than 150 000 inhabitants were excluded from consideration, as were Cuba, the West Bank, Somalia and Western Sahara. Also excluded was Luxembourg, on account of the exceptional structure of its economy, and especially its extraordinarily high per capita capital inflows when considered on a global scale. These would otherwise have greatly distorted the weighting of direct investment in the calculation of the index. In addition, Syria too was excluded, as in previous years, since the state of the civil war there makes a serious assessment of its future perspectives impossible.

The data were updated by recourse to the selection of data from reliable international sources used last year. As a rule, this took the form of updating 2015 values from the last report to the measured 2016 values. In the case of variables measured over time as average values, such as population growth, the relevant time window was correspondingly carried forward to a period in the future. There was likewise no change with respect to last year's report in the choice of indicators for inclusion in compiling the index. As previously, it reflects what are from a theoretical point of view significant aspects of the quality of a country as a business location. Each indicator was then normalised on a scale of 0 to 100 and allocated to one of three subpillars, as in previous years. The arithmetical mean of the indicators within one subpillar was then derived. Finally, the subpillar values were then geometrically averaged in order to arrive at the overall index value. The calculation of the values for the Sales and Production Subindices was performed by averaging the relevant location factors for the particular subindex. As part of this exercise, the index values for the non-OECD countries were expressed in relation to the continental average for the purpose of intraregional comparisons.

1. INTRODUCTION

Over the last few years, global energy and resource consumption has been growing almost continuously. There are many factors indicating that this trend will continue in the future. Unrestricted population growth, the economic catch-up process in which emerging and developing countries are engaged, combined with the increasing need for mobility brought about by globalisation are among the first such factors to come to mind. On the other hand, there is also a growing awareness of the consequences of the increasing scarcity of physically limited resources and of the resulting climatic and environmental damage. Despite promising signals such as, most recently, the conclusion of the Paris Climate Accords, the process of balancing economic growth with environmental considerations is currently still in its infancy. The quest for sustainability, understood here as the combination of economic growth and ecological objectives, remains one of the greatest challenges of our age.

At an international level, there is a great deal of disagreement over the appropriate means of meeting this target. The rapidly growing emerging countries show little readiness to endanger their hitherto successful growth strategies by going into reverse, even though countries such as China are meanwhile indicating a rethinking of their economic policy. However, even the group of developed countries is split on this question, especially as regards the future positioning of the energy sector. How quickly should a restructuring towards renewable energy supply take place in the key areas of electricity generation, heating and transportation, and what role should forms of conventional power generation that are comparatively less hazardous to the climate, such as natural gas and nuclear power, play in the transition phase? For enterprises operating internationally, this patchwork quilt has increasing consequences for the location issue. This is directly discernible as regards the impact of national incentive and taxation measures on energy prices, but also indirectly it makes sense for an enterprise to deal with the sustainability of resource use in its home location. Reports on environmental damage related to their activities can escalate into long-term image problems through the multiplier effect of digital networks. The concomitant negative environmental effects of excessive resource consumption can also be reflected internally in the form of specific loss of revenues, e.g. through the negative effects of atmospheric pollution on employee productivity. Last but not least, multinational enterprises are now obliged by law to file regular reports in some regions on their approach to sustainability issues.

It is on this question of the consumption of energy and resources that the subject focus of the 2018 BDO International Business Compass (IBC) is found. The aim is, first, to present an overview of the regional and global developmental trends in the use of different kinds of resource and energy sources, identifying specific country patterns in the process. We shall next combine the knowledge so obtained into a resource-use index, which will reflect the intensity with which a country has a call on scarce resources in relation to its size, and then analyse the cost issues associated with resource use by reference to electricity and gas prices by way of example. In the last section, we shall deal in detail by way of conclusion with two forms of negative consequences of resource use: the emission of greenhouse gases and air pollutants. In addition to this main focus, the report will include, as it does every year, the current country rankings in the IBC Aggregate Index as well as the results of the sales and production subindices.

2. RESULTS OF THE IBC 2018

2. OVERVIEW

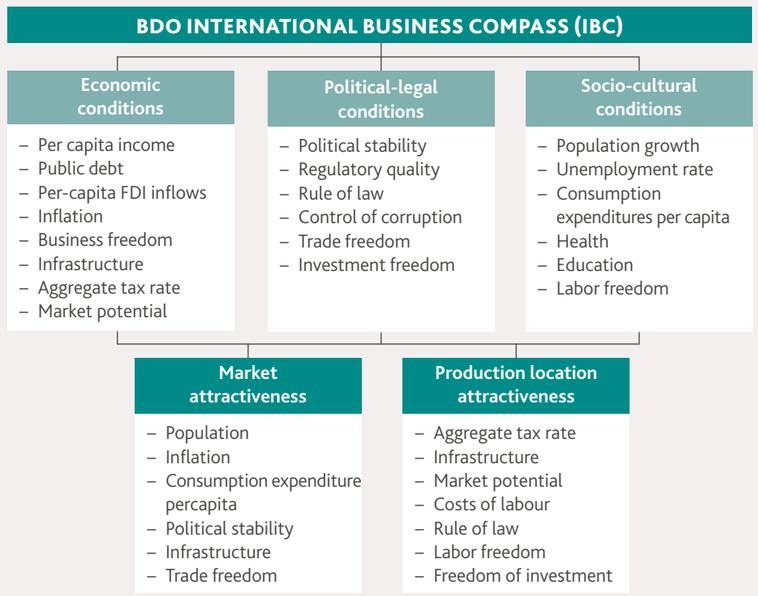
The International Business Compass (IBC) aims to present the overall business development status of countries and regions in the form of a single index value. In this way, we can draw up a ranking of countries by reference to their developmental status. The index can thus serve as an orientation guide for investment by multinational enterprises and other organisations. The IBC has this ranking aspect in common with other established indices such as the Human Development Index (HDI) and the Global Competitiveness Index (GCI). There is nevertheless a significant difference, which can be found in the scope of the chosen perspectives. While the abovementioned indices focus in the final analysis on particular defined aspects of country-related development (such as economic, political or social), the IBC's explicit objective is to merge these various dimensions into one single index score.

In this sense, its construction can be described as an aggregation of the three subpillars: the economic, politico-legal and sociocultural situations, which in turn bundle together a group of associated indicators. These individual indicators are then subjected to a normalisation procedure, after which the normalised values are arithmetically averaged within the subpillars to construct the index. Figure 1 shows the selected indicators and their attribution to the individual subpillars. In order to arrive at an overall score, the results for each subpillars are geometrically averaged. Since in this update there has been no change in the choice of variables, reference should be made in this respect to the 2013 issue.[1]

When interpreting the index, it should be noted that its compilation is based on the premise that for a high overall level of development, a country should be internationally competitive with respect to all three subpillars. The reason for this is the geometric averaging of the indexvalues. A poor value in one subpillar can thus not be readily cancelled out by an excellent value in another subpillar. This leads to the result that certain countries occupy low places in the overall ranking on account of their poor score in a particular subpillar, whereas they might have expected to be better placed on account of their otherwise high level of development.

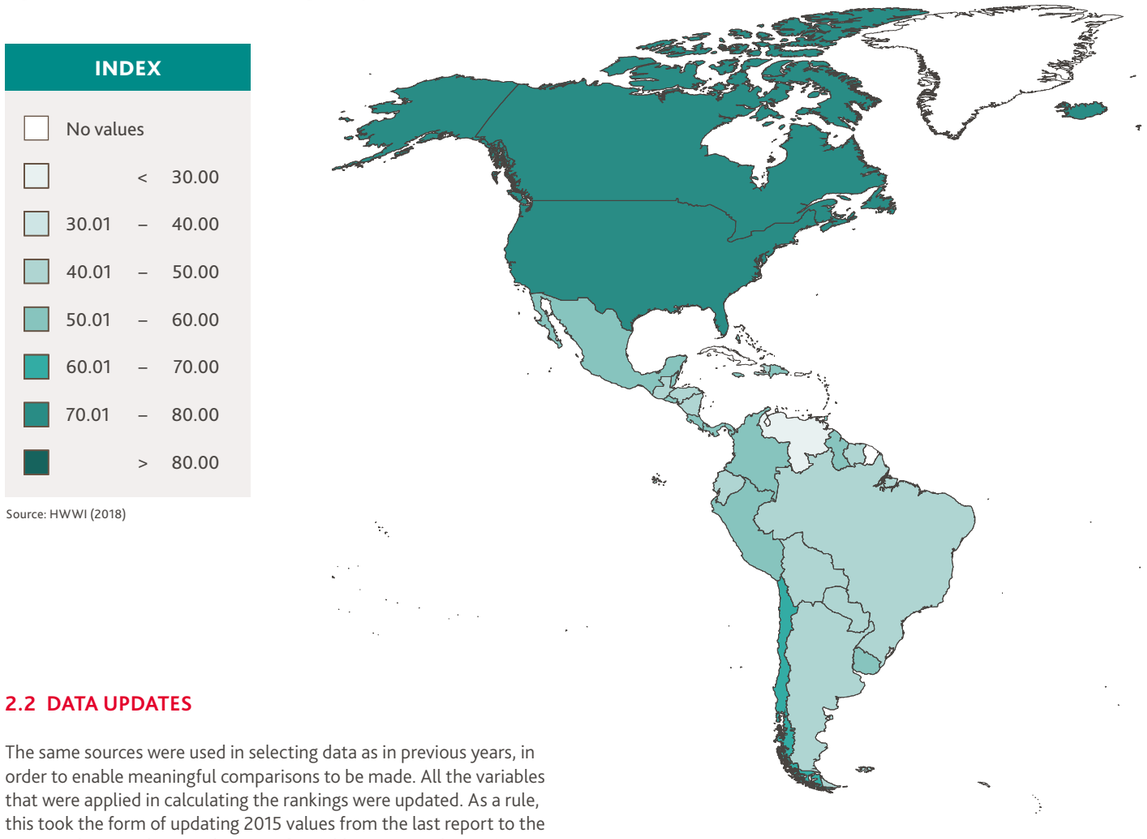
In addition to the Aggregate Index, the available data permit countries to be judged on the basis of more specific aspects of their attractiveness as a business location. In this way, it is possible to distinguish between a country's attractiveness as a sales location and its attractiveness as a production location and to attribute groups of indicators to these component aspects on the basis of sound economic theory. (see Figure 1). The subindices were generated by arithmetically averaging the normalised indicator values. In every case, these subindices are updated annually. In this way, in addition to overall development, it is also possible to judge the performance of a business location with respect to investor-specific characteristics.

Figure 1: Composition of the International Business Compass (IBC)



Source: HWWI (2018)

Figure 2: IBC 2018 index scores as a global pattern



Source: HWWI (2018)

2.2 DATA UPDATES

The same sources were used in selecting data as in previous years, in order to enable meaningful comparisons to be made. All the variables that were applied in calculating the rankings were updated. As a rule, this took the form of updating 2015 values from the last report to the measured 2016 values. In the case of variables measured over time as average values, such as population growth, the relevant time window was correspondingly carried forward to a period in the future.

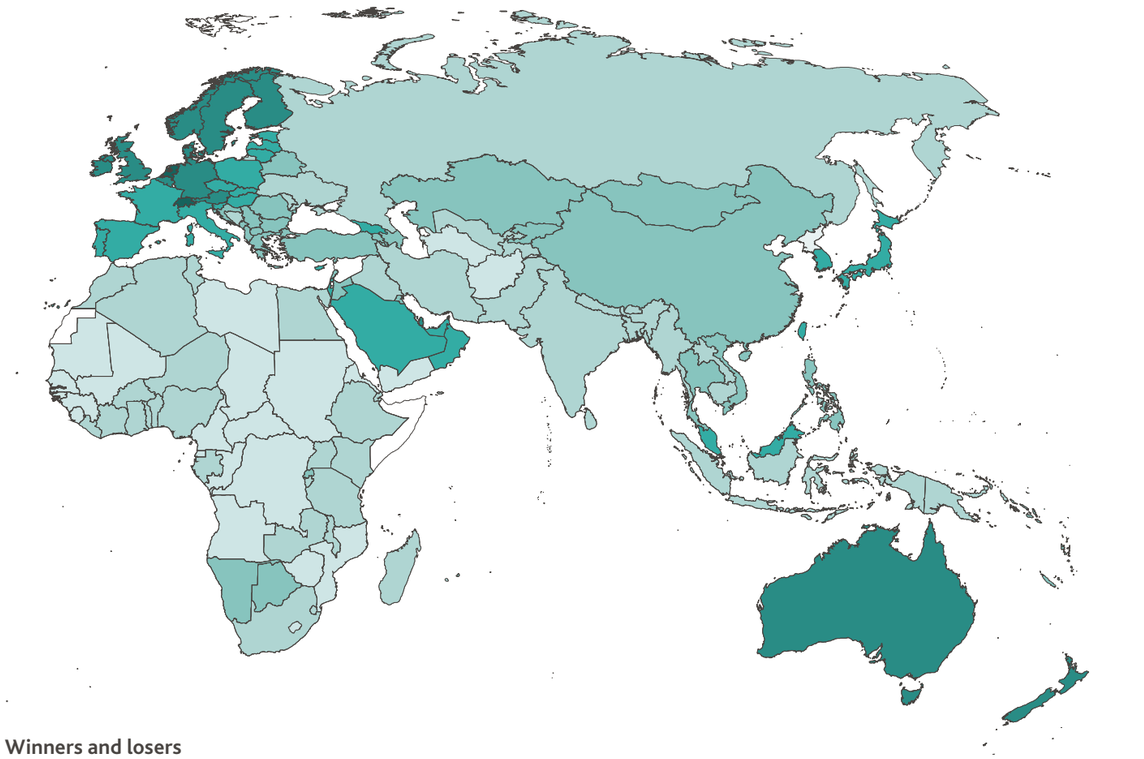
As in previous years, Luxembourg was excluded from the index as a special case. Its primacy as a global financial centre would otherwise have strongly distorted the real economic ranking of countries under the given method. What is problematic for our method here in particular is the enormous level of per capita direct investment in Luxembourg, which would have made the indicator for country comparisons meaningless. We have also again excluded Syria, since the continuing civil war makes it impossible to obtain meaningful data on the country's prospects. Furthermore, we have as a principle set a population threshold of 150,000 as a criterion for inclusion in the IBC.

2.3 RESULTS

2.3.1 2018 Aggregate Index results

The 2018 ranking is mostly based on data from 2016. In addition to long-term developments, the not insignificant number of international crises, including the civil wars in Syria and Yemen (which intensified due to foreign intervention) and the growing confrontation between North and South Korea, had an indirect effect on rankings. However, as in previous years, the global pattern does not bring any great surprises when it comes to index results. Figure 2 shows the global distribution of the 2018 Aggregate Index. This year too, the world's highest-income regions – North America, Oceania and Northern and Western Europe – dominate the index in a general overview. Above all, it is countries in Northern and Middle Africa that achieve decidedly below-average index scores by contrast. The complete list of country rankings may be found in Appendix 3.

Nor are there any dramatic changes in the IBC 2018 in comparison with last year (see Table 1). There is no change in the first four places. Places one and two are still occupied by the highly developed city states of Singapore and Hong Kong, followed by Switzerland and the Netherlands as the best European countries. Ireland has gone up two places and now occupies fifth place, above all due to its low level of unemployment and low national debt ratio. The Scandinavian countries in the Top 10, Denmark and Norway, therefore both go down one place and now lie in sixth and seventh place, above the slightly improved United Kingdom. The rest of the Top 10 is made up of the re-entrants Canada and Australia. Canada leaps three places, from No 12 to No 9, due to improvements in all threesubpillars. Australia was able to gain slightly in the politico-legal subpillar, above all due to a better score with respect to labour freedom. By contrast, Germany (-4 places) and New Zealand (-3) have fallen out of the Top 10. In both cases, this fall in the rankings is not due to any noteworthy changes in the index score, but rather are they an effect of the especially close scores in this part of the rankings. Overall, the predominance of the OECD countries in the leading rankings is again striking this year. As previously, Singapore and Hong Kong are the only non-OECD countries to feature in the Top 20.



Winners and losers

In the middle and lower rankings this year, there have been somewhat greater changes, of up to 30 places. The greatest gainer this year has been Guyana, in South America, which has leapt up 27 places to No 92. This is due mostly to significant improvements in the politico-legal area, with respect to both the rule of law and political stability, as well as to investment freedom. A second South American country to make a giant leap forward is Argentina, which has improved by 26 places to No 98, thanks primarily to greatly increased ratings in the politico-legal framework conditions. The greatest winner among Asian countries is Myanmar, whose ranking has improved by 20 places. This is mainly attributable to a significant fall in unemployment and inflation. However, lying in place No 132, the country is still found amongst the lower rankings. Also moving up are Russia and Botswana, which were able to record double-digit gains this year, without, however, yet being able to break into the higher rankings.

Globally the greatest loser this year is Cape Verde, which has plummeted 30 places, reversing a very positive trend in the two previous years, due above all to a significant deterioration in the economic framework conditions. Liberia has also fallen strongly, as a result in this case of a higher national debt and a fall in direct investment inflows. The next greatest losers are Belize, Jamaica and Turkey. Whereas for Belize and Jamaica it is economic reasons that predominate, in the case of Turkey its position has fallen as a result above all of a critical assessment of its worsening politico-legal situation.

Tabel 1: Top 10 IBC Aggregate Index 2018

Rank	Country	Value	+/-	Rank	Country	Value	+/-
1	Singapore	85.10	0	6	Denmark	78.80	-1
2	Hong Kong	84.08	0	7	Norway	78.22	-1
3	Switzerland	81.84	0	8	United Kingdom	77.06	+1
4	Netherlands	80.14	0	9	Canada	76.97	+3
5	Ireland	78.81	+2	10	Australia	76.17	+1

Source: HWWI (2018)

Table 2: IBC 2018 v. IBC 2017: the greatest rises and falls in rankings

Gainers	Increase	Losers	Fall
Guyana	+27	Cape Verde	-30
Argentina	+26	Liberia	-22
Myanmar	+20	Belize	-14
Russia	+14	Jamaica	-14
Botswana	+13	Turkey	-14

Source: HWWI (2018)

Table 3: IBC Aggregate Index 2018 Regional averages

Region	Ø	Region	Ø
Northern Europe	76.18	Western Asia	53 .96
Northern America	74.92	Eastern Asia	53.56
Western Europe	72.93	Eastern Europe	53.02
Oceania	69.05	Central America	52.91
Southern Europe	60.11	South-East Asia	50.96

Region	Ø	Region	Ø
South America	49.32	Eastern Africa	44.59
Southern Africa	48.99	Northern Africa	43.95
Caribbean	47.84	Western Africa	41.89
Central Asia	47.43	Middle Africa	37.45
Southern Asia	45.91		

Source: HWWI (2018)

Differing regional performance

It is also possible to derive the comparative performance of different regions of the world (UN categorisation) by averaging the index scores of the countries in that region. As a weighting factor for country scores within a region we use the population share.[2] As may be expected from the global distribution of scores, the regions with the strongest economies – Northern Europe, Northern America and Western Europe – take up the leading places (see Table 3). Northern Europe remains in first place. Northern European country rankings range from No 6 (Denmark) to No 37 (Latvia), while the ranking distribution in Western Europe ranges from No 3 (for Switzerland) to No 28 (for France). Fourth place in the regional rankings is taken by Oceania, which benefits from the high scores of Australia and New Zealand.

In the middle rankings can be found in descending order Southern Europe, Western Asia, Eastern Asia and the moderately improved Eastern Europe. The regions of Africa all lie below the global average, with Southern Africa as the only representative at the lower end of the middle rankings. The rest of the continent takes up the bottom places. The bottommost place, at a wide divide from the rest, is occupied by Middle Africa. None of the region's countries is found among the global Top 100. Gabon is the most successful, in place 117.

2.3.2 Results of the 2018 Sales and Production Subindices

The IBC subindices rate countries according to their potential as a production location and a sales outlet. For this purpose, a series of relevant indicators is normalised and merged into the corresponding subindex (see Figure 1). As in previous years, the subindices are the product of addition and not multiplication. This results in less dramatic variations from one year to the next, and extreme results for individual countries are less likely. In what follows, the results are presented continent by continent in order to simplify regional comparisons. To enable a comparison between countries at a similar stage of development, for the continental comparison we restricted ourselves again this year to non-OECD countries. The subindex scores of OECD countries are compared with each other in an additional ranking. In this way, we also obtain a comparison of the attractiveness of developed countries as business locations. A table of the results may be found in Appendix D.

Production location

In the IBC Production Subindex, the Netherlands is the leader among OECD countries. This is largely due to its central location in Europe and an internationally oriented economic policy. Next come the United Kingdom, Switzerland, Denmark and Belgium. These countries are all in the Top 10 as production locations. Among the hindmost OECD countries are Portugal, Turkey, Greece and, last of all, Mexico. This can primarily be attributed to weak infrastructure and limited market potential. The biggest gainers are Hungary and South Korea, which both go up four places. The biggest losers are Germany, Iceland and Norway, which each go down three places.

In Africa, Mauritius remains the leader in the Production Subindex. It is followed by Namibia, Botswana and South Africa. Nevertheless, these countries remain on a global basis below the 75 most attractive production locations. At the bottom end of the list are Eritrea, the Central African Republic and Comoros, and, at the very bottom, the Democratic Republic of the Congo. On a global level, too, these countries lie very low in the rankings; this year, the Democratic Republic of the Congo is the bottommost placed country in the world. Compared to last year, there have been some significant changes. Above all, Uganda, the Republic of the Congo and Lesotho have improved considerably. By contrast, Burundi, Malawi and Liberia have fallen sharply.

The Production Subindex for Asia is characterised by the excellent scores of Singapore and Hong Kong. These two countries also find themselves as the global No 1 and No 2, which is due to their high market potential and investor-friendly legislation. The other top places in Asia are taken by Bahrain, the United Arab Emirates and Qatar, three Persian Gulf countries. At the other end of Asian production locations lie Tajikistan, Turkmenistan and Afghanistan, which are Central Asian countries. India and Bangladesh were the biggest gainers, whereas Timor-Leste and Afghanistan have fallen back the most.

Among European non-OECD countries, the leading place is taken by Latvia, which lies at No 26 in the worldwide Production Subindex. It is followed by Lithuania, Malta and Croatia. The bottom places are occupied by Moldova and, as before, by Russia and Ukraine. The sharpest drop was experienced by Montenegro, which has fallen by four places. Romania, by contrast, was the greatest gainer.

The results of the Production Subindex for Latin American countries were largely relatively homogeneous. The best score this year was recorded by Uruguay, followed by Barbados, the Bahamas and Panama. The Latin American production locations with the lowest scores are Haiti, Bolivia and Venezuela. Among Latin American countries, Bolivia and Venezuela in particular are strongly negative outliers. This is explicable by reference to their restricted freedom of investment and strongly regulated labour market. Worldwide, Venezuela lies third from bottom. Chile would have been the continent's front-runner, were it not an OECD member.

There are no noteworthy changes among the five non-OECD members from Oceania. Samoa recorded the best score, as previously. The Solomon Islands changed places with Papua-New Guinea to lie in last place.

Sales location

As may be expected, the OECD countries dominate the leading places in the Sales Location Subindex. The Top 10 places are accordingly taken up exclusively by OECD countries. The leader in the Sales Location category this year is Switzerland, which has exchanged places with Norway. Both countries stand out with their high per capita consumption, a high degree of trade freedom and good infrastructure. They are followed by the United States and Canada, which remain unchanged. The last places are taken by Greece, Chile, Mexico and, last of all, Turkey. On a global basis, Turkey remains a middle-ranking country, while at the same time lagging behind many countries from Latin America and Asia. Finland has risen highest in comparison to last year, and now occupies place No 10 in the OECD group and is also in the Top 10 globally. New Zealand records the greatest fall in the rankings.

In Africa, it is the countries in the southern half of the continent that take up the leading places in the Sales Location Subindex. Botswana was able to climb several places and is now the continental leader. South Africa remains in second place, followed by Mauritius and Namibia. At the other end lie the Central African Republic, the Democratic Republic of the Congo and Sudan. These countries, together with Burundi, Libya, Mauretania and Chad are among the ten statistically least attractive sales outlets worldwide. Some substantial changes compared to last year are apparent. Uganda and Kenya gained a vast amount of ground relatively within Africa whereas Liberia and Mauretania experienced the greatest falls.

The Sales Location Index for Asia is led by Singapore and Hong Kong, which are the only non-OECD countries to feature in the global Top 15. They are followed in third place by China, which has again lost the leader ranking that it had last year. Then come the United Arab Emirates and Taiwan, which benefit from high per capita consumption and good infrastructure. India has improved its standing slightly, to lie in sixth place. The bottom places are occupied by Iraq, Pakistan and Afghanistan. The biggest falls in ranking were experienced by Armenia, Iraq and the Philippines.

The leaders among the European non-OECD countries in the sales location rankings are Lithuania, Malta and Latvia. They are the only countries in this region to feature in the Top 50 worldwide. The next places are taken by Croatia, Romania and Bulgaria. At the other end can be found Russia, Moldova and Ukraine. Macedonia has risen four places, while Albania, which has fallen seven places, recorded a significantly worse score than last year.

This year, the most attractive sales location in Latin America is Uruguay. Panama and Costa Rica are next. Brazil has jumped three places and is now fourth. On a global level, also, Brazil has risen towards the upper middle rankings by three places to No 63. The bottom places are taken by Bolivia, Honduras, Haiti and, in last place, Venezuela. This country is also in last place worldwide. The greatest rise in places was recorded by Costa Rica, while Jamaica has fallen the farthest compared to last year.

The non-OECD countries of Oceania are among the upper middle-ranked countries globally, occupying places ranging from 27th to 54th. Samoa recorded the best score. Papua-New Guinea lies in last place in the continental rankings. There were no changes compared to last year.

[1] HWWI (2013): BDO International Business Compass – international location index for medium-sized companies (published by Michael Bräuninger).

[2] The allocation of countries to each region can be found in Appendix A.

3. OUR SUBJECT FOCUS – ENERGY AND RESOURCE CONSUMPTION

3.1 INTRODUCTION

The question of how to deal with ever decreasing natural resources has long been a feature of global discourse. Besides the objectives of security of supply and price stability, the negative side-effects of excessive consumption of resources are an increasingly important aspect. To this we can add the greenhouse effect associated with the use of fossil fuels and the stress on breathable air, soil and water concomitant with the emission of hazardous substances, which represent a considerable risk potential for human health and the ecosystem overall. The 2015 Paris Climate Accords have recently made it clear that awareness of the necessity of dealing with these problems is evidently now a global phenomenon.

There remain very divergent opinions on the appropriate environmental and energy-policy strategies for combating this threat. Whereas countries such as Germany envisage a renunciation in the medium term of both nuclear power and coal and are massively investing in the provision of renewable energy, countries such as France and Sweden consider nuclear power to be an essential component of a sustainable energy mix. Then again, the foremost perception in countries such as the United States is of the risks associated with an energy transition and they fear competitive disadvantages arising from higher energy costs. There are also great discrepancies with regard to the choice of regulatory instruments; the spectrum ranges from prohibitions to market-related solutions such as emissions-certificate trading, which have differing respective effects on the price situation in the energy and raw-material markets. International investors, especially from the energy-intensive sectors, place greater emphasis on this divergence than on other difficulties when deciding where to locate their businesses. The subject of sustainability is also recognised as an increasingly weightier factor in consumer acceptance, and in regions such as the EU, is becoming a subject on which the larger enterprises are statutorily bound to report.

Given this background, with the subject focus of this year's IBC we should like to take a closer look at the national pattern in energy and resource consumption and the resulting consequences for society. In this connection, we have made a distinction between different forms of resource use and examine the respective relevant economic and technological trends. We then analyse the associated cost factor by reference to the price of electricity and gas. As a further step, we amalgamate the information obtained in the form of an index in order to illustrate a country's intensity of resource use. As regards the social consequences, we concentrate on two core topics: the development of greenhouse-gas emissions and the effects of air pollutants.

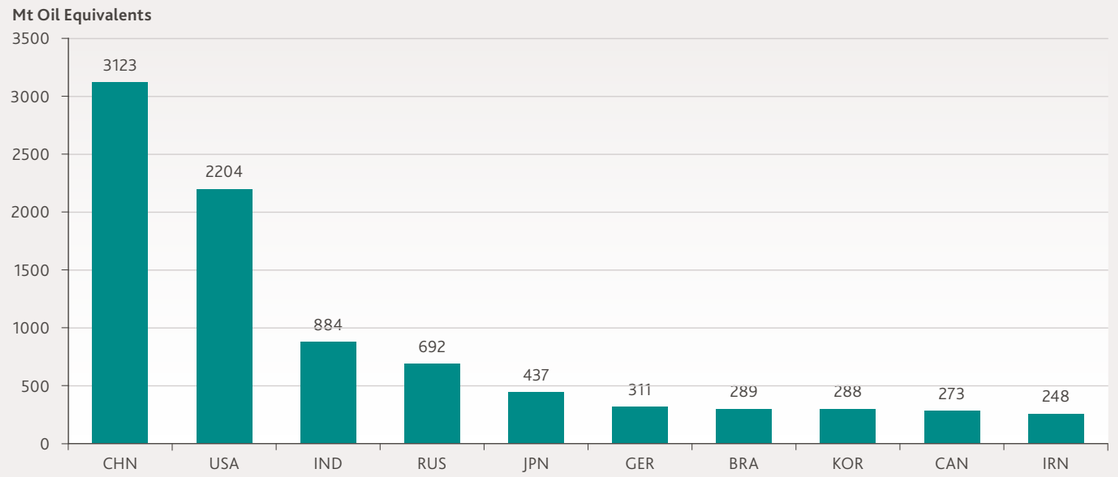
3.2 COUNTRY-BY-COUNTRY COMPARISON OF RESOURCE USE

3.2.1 Energy consumption

A significant corollary of the growth of the global economy over the last few decades is the increasing hunger for energy. According to World Bank estimates, worldwide primary energy consumption[3] between 1994 and 2014 grew by about 55% (World Bank, 2018). This general trend was accompanied by massive structural changes. This concerns firstly the geographical composition of the demand. Whereas the proportion of global consumption attributable to developing and emergent countries was about 45% in 1994, by 2014 it was already 58%. An important source of this change is the extraordinary development of China, which approximately tripled its primary energy consumption in the same period. In contrast, consumption in the strong economies of the OECD member countries increased by a mere 10%. As a consequence, China is some way ahead of the United States and India as the greatest consumer of both primary and end-use energy (see Figure 3). Even expressed in per capita terms, consumption has increased significantly over the same period, at a rate of about 20%. In this respect, growth is occurring exclusively in the group of developing and emerging countries; in OECD countries, per capita consumption has actually decreased.

At the same time, it should not be overlooked that this long-term development has also been characterised by technology-related efficiency increases. This can be illustrated by the development of the relationship between primary energy consumption and economic performance (gross domestic product) as a standard general indicator for the energy intensity of an economy. Its value fell by around 26% in the period from 1994 to 2014. Both high-income and low-income country groups have on average made significant efficiency gains. This is due firstly to technology-related improvements in energy efficiency at the sector level, e.g. in the form of reduced energy conversion and power-line losses within the production process. Secondly, this also reflects the fundamental structural change that economies have carried out in the course of their growth processes. The process of tertiarisation, i.e. the transition from an industrial to a service society brings with it in the first instance a reduction in energy intensity at the overall economic level, since energy as a factor of production naturally plays a smaller role in the services sector than in industry. The economic catch-up process that many emerging countries have so successfully embarked upon leads, indeed, to growing energy consumption. This growth proves to be weaker than the growth in economic output, so the end result is a reduction in energy intensity, i.e. an increase in the country's energy productivity. In this respect, too,

Figure 3: Countries with the highest primary energy consumption in 2016

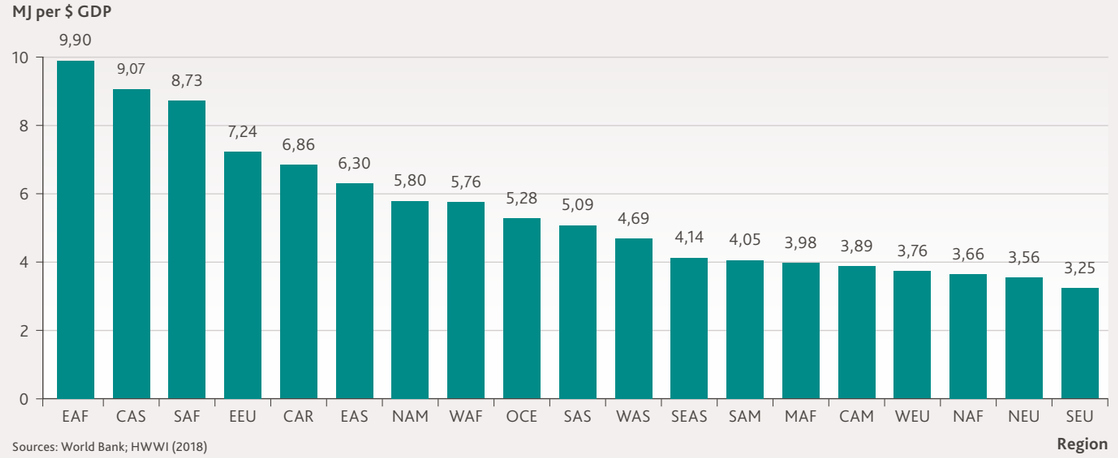


Source: IEA (2017)

China is the best example. The proportion of the services sector in China's value added increased from 34% to 48% between 1994 and 2014. As a consequence, China was able to reduce its energy intensity by nearly 50% over the same period (World Bank, 2018).

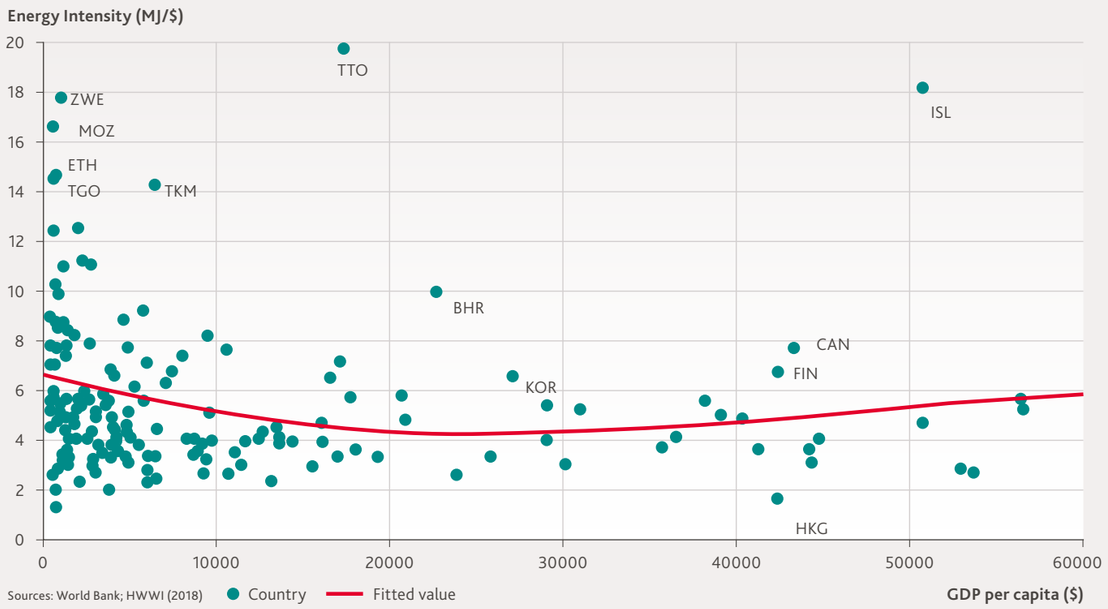
A glance at the distribution among the regions of the world shows, however, that, as was the case previously, there is still a significant discrepancy as regards dependence on the energy factor (see Figure 4). Thus, energy intensity in the Eastern African region was some three times as high on average as in the countries of Southern Europe. This is evidently only partially due to differences in the degree of tertiarisation, i.e. the proportion of value added contributed by the generally less energy-intensive service sector. Although the share of the service sector in the large Eastern African countries of Kenya and Tanzania is somewhat small in global terms, it remains measurably greater than in Western African countries such as Mali and Sierra Leone. However, energy intensity in the Western African area is significantly lower. At the same time, the service sector in Southern European countries such as Italy and Spain is considered as significantly above the global average, but is of somewhat less importance than in France and the United Kingdom. This emphasises firstly the role played by differences in specialisation within the industrial sector, in particular the importance of especially energy-intensive chemical, paper and steel industries. Secondly, it also throws some light on the differences in the degree of efficiency in energy use. This is because a measurement of energy intensity based on primary energy consumption also comprises useful energy lost in conversion processes and transportation. The high measures of energy intensity recorded in a series of developing countries are therefore partly a reflection of lacunae in the energy infrastructure (power-plant efficiency, storage, network management etc).

Figure 4: Energy intensity in 2014 by region



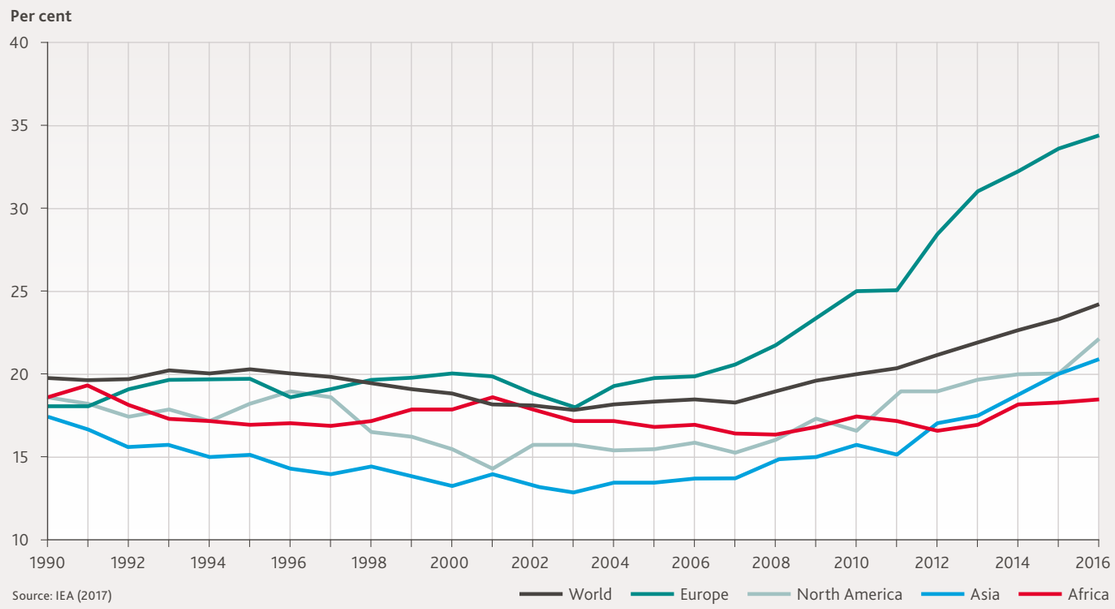
Sources: World Bank; HWWI (2018)

Figure 5: Correlation between economic power and energy intensity



Sources: World Bank; HWWI (2018)

Figure 6: The share of renewable energy in electricity generation



Source: IEA (2017)

Even the correlation with economic development status is not unequivocal, as Figure 5 reveals. The individual dots there denote GDP per capita and energy intensity for individual countries, measured in 2014. In both the lower and higher-income sectors, there are countries with significantly below-average and significantly above-average energy intensity. Thus, one finds two countries with extremely high energy intensity – Trinidad & Tobago and Iceland – which, in terms of development status and economic structure are worlds apart. At the other end of the scale, a highly developed city state such as Hong Kong finds itself in the company of developing countries like South Sudan and Mali. This illustrates the role of country-specific structures, somewhat influenced by climate, infrastructure and the energy-policy framework, which militate against global convergence.

A fundamental shift in the energy sector has taken place in relation to the use of energy carriers. This applies firstly to electricity generation from renewable energy sources ('renewables'). According to the conventional definition, this includes wind power, solar power, geothermal energy, biogas, biomass and water power. In proportion to total electricity production, the contribution of renewables has risen markedly, albeit that at the global level renewables are still far from breaking the dominance of conventional energy carriers. In 2016, according to IEA estimates, the proportion contributed by renewables was around 24.4% (see Figure 6). In 1990, it was still barely 20%. Behind this rather moderate growth there nevertheless lie important regional transformation processes. By far the greatest percentage increase is recorded by the European region. Whereas in 1990, with a renewables proportion of 18.0%, the European continent still lay below the global average, in 2016 it had already reached 34.2%. The decisive driver behind this is the significant increase in wind and solar energy. In 2001, the aggregate share of these two energy carriers in electricity generation was barely 1%; in 2016, it had already reached an estimated 12.0%. By comparison, the contribution of renewables has undergone significantly weaker growth over the last 20 years in Asia and North America. In those regions, the renewables share in 2016 was around 21% and 22%, respectively. In Africa, it is actually stagnating on average (IEA, 2017).

Even within the group of countries that has firmly adopted the aim of a systematic increase in renewable electricity generation, there are significant differences with respect to energy-policy strategy. Noteworthy differences are above all the length of the period for achieving 100% renewable electricity supply and the question of which conventional energy carriers should be relied on as complementary technologies in the transition phase. In Europe, countries such as France, Spain and the United Kingdom are to a lesser or greater extent committed to nuclear power as a bridging technology. France, indeed, is the country that leads the world in the share of nuclear power in energy supply. In 2014, this share was over 75% (World Bank, 2018). On the opposing side are countries such as Germany, Austria and Italy that have either abandoned or are phasing out the use of nuclear energy. A number of countries continue to rely on coal-fired power stations despite their particularly high CO_2 intensity. In South Africa and Botswana, coal-based electricity accounts for over 90%. In Europe, it is Estonia and Poland that are most dependent on coal, whose share there is over 80%. Even in the great emerging nations China and India, more than half of electricity generated is still derived from coal. Alongside this group, there are some countries that meet their electricity demand almost exclusively from the clearly environmentally friendly form of energy that is water power. This is above all the case for a number of African countries such as Ethiopia, the Democratic Republic of the Congo and Namibia. But even a highly developed country such as Norway derives its electricity almost exclusively from hydro-electric power stations (World Bank, 2018).

With a view to the future, we can expect a slowly advancing trend towards decarbonisation of the world's energy derivation. This is so despite the fact that currently prospering emerging countries will in all likelihood continue their economic catch-up process and consequently continue to increase their energy requirement. Analysts assume that structural reforms will take hold in this group of countries, which will rein in their use of conventional energy carriers. Today already, an example worthy of note is China's efforts to cap its coal-fired generation, in that the construction of new coal-fired power stations has been somewhat reined back. This would have a significant effect on the world's demand for coal. The oil and gas giant, BP, bases its analysis on the assumption that the global consumption of coal will still continue to grow in the next few years, but will have reached its peak during the 2020s. As for the global demand for oil, it expects continuous growth until 2030, but at a significantly lower rate. The demand for natural gas will, however, increase considerably more sharply than that for coal and oil, due above all to support for shale gas in the United States and technological improvements in the transport of liquid gas (LNG) (BP, 2017). As regards renewable energy carriers, besides climate-policy requirements, technological developments are an important driver. Further cost reductions in the production of solar cells and batteries, as well as the increased efficiency of wind turbines, will contribute through growing competitive advantage to the further onward march of renewable energies (IEA, 2017). The assumption is also that the geographical distribution of the growth in consumption will continue the trend of the most recent past. BP reckons that almost all growth will be accounted for by the economically prospering emerging and developing countries and that near stagnation in energy consumption can be expected for the OECD countries. Given greater efforts in the area of energy efficiency, a fall in energy consumption by this group of countries may even be conceivable (BP, 2017).

At the same time, some technological question marks remain. This concerns, inter alia, the transformation of the transport sector. The greater demand for individual mobility that has hitherto accompanied growing affluence in the emerging countries can be projected into the future to give rise to a massive increase in the global car fleet. Concepts such as shared mobility and an increase in local public transport services may counter this, but depend ultimately on consumer acceptance. The same holds true for increases in electromobility and other alternative means of propulsion (e.g. fuel cells, natural gas), which may have the potential to reduce the demand for CO_2-intensive energy carriers for road traffic. Furthermore, digitalisation could also contribute to an accelerated transformation of the energy sector. On the demand side, the spread of smart thermostats and lighting in business and residential premises would also reduce energy demand. On the supply side, in electricity generation, for example, dynamic networking of decentralised plants could do away with operating and maintenance costs, which would benefit the efficiency of generation. The triumph of 3D-printing as the currently greatly discussed digital technology could lead in the long term to energy savings, as long as it initiated a switch-over to decentralised supply systems ("Prosumer"). In that case, the importance of long-distance transport in goods traffic and the associated energy demand could reduce. On the other hand, it should not be forgotten that the networking that accompanies digitalisation itself implies additional demand for electricity generated by data centres etc.

3.2.2 Waste generation

The economic catch-up process in which the emerging countries are engaged naturally brings with it a significant increase in the generation of waste associated with the growing affluence of wider sections of the population. This trend presents great challenges for environmental policy. The methane released from landfill sites by the

Table 4: Countries generating most electronic waste per capita in 2016

OECD

kg per capita			
Top 10		Bottom 10	
Norway	28.66	Mexico	7.82
United Kingdom	24.86	Turkey	7.84
Denmark	24.60	Chile	8.88
Netherlands	23.92	Latvia	11.22
Australia	23.79	Poland	11.94
Germany	22.79	Slovakia	12.34
Iceland	22.74	South Korea	12.98
Switzerland	21.98	Hungary	13.85
Sweden	21.71	Israel	14.04
Belgium	21.24	Estonia	14.43

Non-OECD

kg per capita			
Top 10		Bottom 10	
Hong Kong	19.06	Niger	0.38
Brunei Darus.	18.19	Sierra Leone	0.46
Singapore	17.83	Burundi	0.48
Kuwait	16.53	Ethiopia	0.48
Trin. & Tob.	16.12	Ruanda	0.50
Saudi Arabia	15.74	Malawi	0.53
Malta	15.33	Guinea-Bissau	0.55
UAE	14.46	Madagascar	0.56
Bahrain	14.03	Afghanistan	0.58
Cyprus	13.67	Cent. Afr. Rep.	0.59

Source: Baldé et al. (2017)

decomposition of organic waste is one of the chief sources of the man-made share of methane emissions. In addition, there is the problem of waste that does not go to landfill in developing countries, which is a cause of respiratory illness, air pollution and even flooding (Hoornweg & Bhada-Tata, 2012).

To arrive at a country-by-country comparison of waste generation presents many problems in any case. At a global level, there is currently a lack of a single methodology and of the necessary resources in order to enable us to quantify amounts of waste in their totality for a country comparison. Estimates made by the World Bank, however, carry considerable weight. Based on 2012 data, it has estimated that the solid waste originating from the world's cities alone amounts to approximately 1.3 billion tonnes. The World Bank reckons that by 2025, this amount will have increased to 2.2 billion tonnes, virtually double. Increases can be expected in countries of all income levels, but the markedly greatest increase will take place in the group of low-income countries. From the regional aspect, this concerns above all the sub-Saharan countries of Africa and Eastern Asia, where waste generation will more than double by 2025. As a result, Eastern Asia will generate more waste in 2025 than all the OECD countries taken together, which are estimated, at the time of the survey, still to account for about half of the worldwide amount of waste (Hoornweg & Bhada-Tata, 2012).

Figures at the OECD level are more accurate and more current, and here too a country comparison is possible with respect to communal waste generation, although data for the North American member countries are missing. Among the countries for which data are available, in 2015 Denmark recorded the greatest amount of waste generated per capita, at 799 kg. It was followed by Switzerland (742 kg) and New Zealand (701 kg). At the other end of the scale were Poland (286 kg), the Czech Republic (317 kg) and Slovakia (329 kg), all Eastern European countries. A certain correlation with economic power is therefore evident. In relation to gross domestic product, according to OECD data, Hungary has the greatest amount generated, followed by Denmark and Australia. The least waste relative to economic performance is produced by Norway, Luxembourg and the Czech Republic. In connection with these throwaway quantities, one is, of course, with regard to resources, dealing with gross amounts, which take no account of differences between countries in recycling of waste. Here too, comparative figures are available, at least at the EU level, for the recycling rate, i.e. the proportion that recycled materials bear to total waste generated. The highest recycling rate according to the latest data is recorded by Germany, with 66%. Significantly more than half of all municipal waste is also recycled in Belgium, the Netherlands, Austria and Switzerland (Eurostat, 2018).

Particular attention in the field of waste policy should in future be paid to a specific component, namely electronic waste. The worldwide triumph of digital information technology will in future cause this form of waste to grow further, due also to its ever-shorter useful life. According to figures collected by the Global E-Waste Monitors, the quantity of electronic waste generated in the world in 2016 was approximately 44.7 million tonnes. This amount is very unevenly distributed across regions. The greatest share was generated in Asia (18.2 million tons). In per capita terms, the ratios look quite different. In a cross-continental comparison, Oceania and Europe generated the most, with 17.3 and 16.6 kg per head of population, respectively. In Africa, the per capita amount was only 1.9 kg. Table 4 shows the greatest outliers among OECD and non-OECD countries. As could be expected, it is the economically most powerful countries that bear the greatest responsibility in this respect. The contribution of many African countries is dwarfed by comparison. Currently, moreover, only some 20% of the electronic waste generated in the world is recorded as having been collected and recycled. Four percent lands in residual waste in rich countries, while the fate of the remaining 76% is unclear. It is likely that most of this is deposited under poor conditions (Baldé et al., 2017).

In this connection, data capture regarding the enormous exodus of electronic waste from the wealthy countries to Africa and Asia, as witnessed by the existence of giant unlicensed waste sites in the slums of developing countries, is weak. One cause for this is certainly the fact that the export of hazardous waste is actually prohibited under international law under the 1989 Basel Convention. That there is still large-scale trade in this area has evidently cost-based reasons. For many recycling firms, sale to traders in developing countries makes clearly better business sense than internal recycling (Grant & Oteng-Ababio, 2012). In order to prevent future large-scale recycling of electronic waste under conditions hazardous both to the environment and to human health, manufacturers and consumers should both be placed under stricter obligations. Manufacturers should optimise designs more strictly by reference to material efficiency, while consumers should in their behaviour display greater awareness of the recyclability of consumer goods. Target countries should by means of import bans on waste consider how China has lately done so in respect of, inter alia, plastic waste. In developed countries, on the other hand, there is no way of avoiding improved strategies in the area of “urban mining”, i.e. the targeted recycling of obsolete equipment as secondary raw material in the urban space.

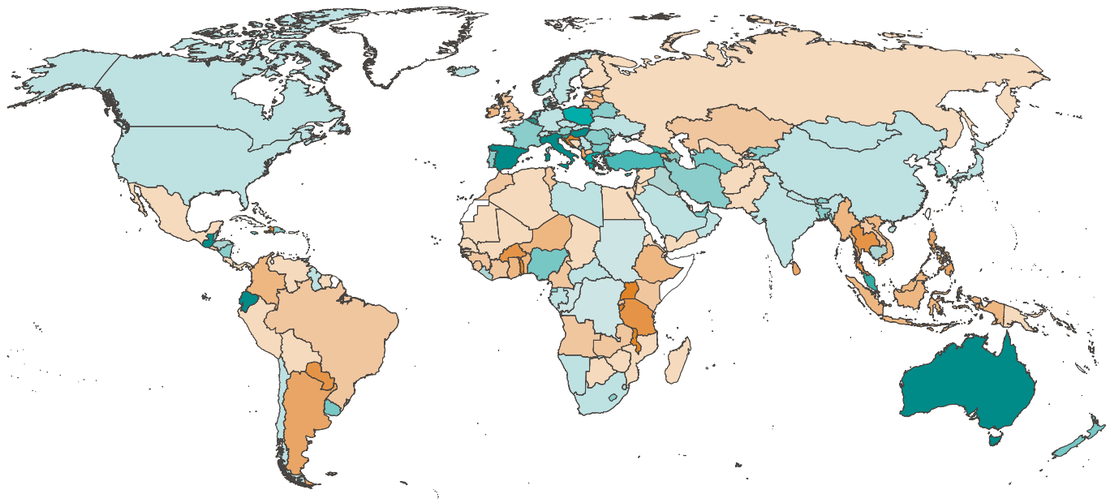
3.2.3 Land dedicated to agriculture

Over the last few decades, the amount of the world's land dedicated to arable and pasture has developed quite differently among regions. Here, too, a country's stage of economic development is an important differential yardstick. According to World Bank figures, whereas the land area used for agricultural purposes in the group of OECD countries had stagnated at an amount of 38-39% in the previous decades, it had, in the years of the new century markedly shrunk, to an estimated 34.2% in 2015. This reversal affected both arable land and pasture. This development was driven by productivity gains in agriculture, in connection with further urbanisation and a restructuring of the agricultural sector towards a smaller number of businesses (Cotula & Berger, 2017). In the non-OECD member group, areas in agricultural usage had also more or less stagnated during the previous decade, but the landmass used as arable land had actually increased slightly when compared to 2000. In percentage terms, the greatest increases were noted in the economically least developed countries. This too is attributable to the interplay of several factors. On the one hand, high population growth in this group of countries implies fundamentally greater demand for food. On the other hand, economic growth in at least one part of these countries has over time brought with it a change in eating habits in favour of foods richer in protein. This has given rise to greater demand for areas under cultivation for animal feed (UNEP, 2014).

In addition, one can mention external influential factors. Thus, price developments in international food markets have long incentivised the creation of additional supply capacity. The HWWI price index for foodstuffs and luxury food and drink, a subindex of the HWWI commodity price index, rose by 42.2% from January 2000 to December 2009 (HWWI, 2018). In addition to the role played by increasing speculator activity, this was also a result of the discussion on the use of agricultural produce as energy commodities (Globalands, 2012). On the one hand, this applies to the use of oil-bearing plants, cereals and other renewable raw materials as biofuels. The discussion on growing CO_2 emissions from road traffic has led, in the United States, Brazil and EU Member States to initially relatively undifferentiated state aid for biofuels, in the form of admixture ratios and tax advantages, which in the case of misplaced incentives have been corrected only little (Araújo et al., 2017). On the other hand, arable plants are being used as a source for extracting biogas, the increased application of which in the energy sector should improve the CO_2 balance in electricity and gas supply. Here, too, incentive packages have added to market incentives. It is precisely in the last few years that no further systematic upward trend in prices can be observed, which did, however, contribute in many regions to a sustained expansion in arable areas as a result of investment inspired by the temporary rise in prices.

At the country level, there is still a somewhat more differentiated picture of development to be seen over the most recent decennial period (see Figure 7, page 22). The areas dedicated to agriculture have increased in the great majority of African and South American countries. A particularly strong net increase relative to total area has been observed in the African countries of Burundi, Gambia and Togo. Here, the proportion of land dedicated to agriculture increased by more than 5% in each case between 2005 and 2015. Among the larger African countries, this is true above all of Tanzania. In South America, it is Argentina that has experienced the proportionally greatest increase. In Europe, there is a significantly greater dedication of land to agriculture in Croatia and Slovenia only, and to a limited extent, in Albania. That apart, there is no noteworthy change in land use, with Italy,

Figure 7: Changes in the overall proportion of land used for agriculture 2005-2015



Source: FAO (2015)

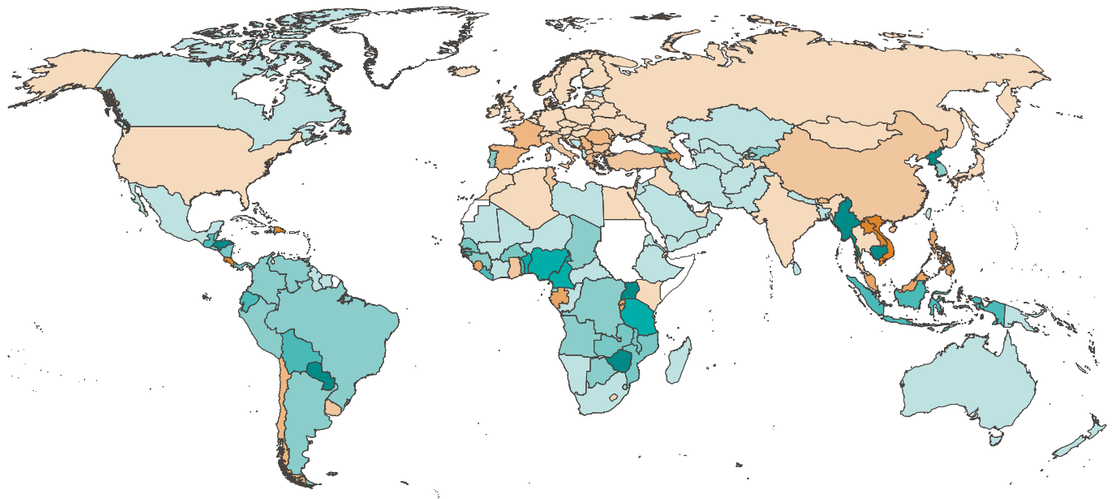
Spain and Hungary as outliers, which have all reduced the proportion of land dedicated to agriculture by more than five percentage points. Similar developments outside Europe have taken place only in Australia, Ecuador and Guatemala.

A further growth in world population would probably still further increase the demand for land to be used for agricultural purposes in the future. The ecological consequences would most probably not only be a further loss of forested land (see 3.2.4), but also a general loss of biological diversity, coupled with overuse of water resources. In addition, the supply of potential arable land would decrease. The reason for this would firstly be the trend towards urbanisation and secondly the phenomena of soil erosion and desertification, brought about by overuse and climate change (Globalands, 2012). The only way for sustainably meeting the food needs of future populations can therefore be by significantly increasing agricultural land efficiency, precisely in today's developing countries. A prerequisite for this is better area planning. In particular, building over fertile areas should be avoided. Impaired soils should so far as possible be cleaned up by appropriate investment. At the technological level, productivity increases in developing countries could be induced by improved access to know-how and agricultural machinery (UNEP, 2014). Finally, however, responsibility also lies with the trade policy of industrial countries. In the sense of classical trade theory, it could be argued that the partially extremely high import duties on agricultural produce from countries belonging to other economic areas artificially distort the distribution of global resource use in agriculture, thereby not only inflicting damage on the economies of the exporting countries but also causing harm to agricultural productivity globally. At the same time, we must also not lose sight of the downside of productivity increases. One of these is the increased use of fertilisers. Globally, fertiliser use relative to the area of arable land increased between 2005 and 2015 from 114.1 kg per hectare to 138.9 kg per hectare. Artificial fertilisers are on the one hand very energy-intensive to manufacture. Some of their elements such as nitrogen can on the other hand have negative effects on the quality of soils and ground water and (by creating nitrogen oxide) lead to an increase in the concentration of greenhouse gases in the Earth's atmosphere (see 3.5.1). Besides, there is the danger that the heavy metals present in fertilisers could enter the food chain (UBA, 2017). With this background stretching into the future, technological innovations and their distribution must play a decisive role.

3.2.4 The use of forest resources

As a source of raw materials for the global production cycle, forests are indispensable. They also fulfil important ecological functions as guarantors of species diversity, preventers of wind and soil erosion and, above all, by photosynthesis of the plants they contain, as CO_2 sinks. One of the downsides of expanding land cultivation (see 3.2.3) is the continuing loss of forests. According to estimates by the World Food Organisation, the afforested areas of the world shrank by about 128 million hectares between 1990 and 2015. At first sight, it appears that the long-term trend of deforestation will therefore continue. Latterly, this shrinkage has, however, markedly decelerated. Whereas in the 1990s, the average annual net loss was estimated at around 0.18% of the total area under forest, this loss amounted to only 0.08% in the period from 2010-2015 (FAO, 2015). Moreover, this overall picture conceals very diverse regional developments.

Figure 8: Changes in the overall proportion of forested land 2005-2015



Source: FAO (2015)

The country-by-country pattern of the decade-long development in the proportion of forest land in Figure 8 therefore appears less surprising, as a virtual mirror image of the development of agricultural land use in Figure 7. The greatest losses are in the tropical regions of Africa, South America and South-Eastern Asia. Relative to their size, Honduras and North Korea have recorded the world's greatest loss of forest, by more than 10 percentage points. In Africa, it is Zimbabwe and Uganda that are most affected. In Europe, Portugal is the only country with a noteworthy loss of forestation; in the rest of the continent, there has, by contrast, been no change or even an increase, as there has been somewhat in Greece, Italy and Spain. The historical process of deforestation in the temperate climatic zones thus seems at least partially reversible. In countries within the polar zone, such as Russia and Canada, where logging ultimately plays an important role in the economy, this is, however, not currently associated with any massive rededication of land. In Russia, the proportion of forest has nevertheless statistically moderately increased. In this connection, however, another problem, especially in these regions, has yet to be addressed: namely, forest degradation. If the stock of trees falls below a critical level due to systematic logging or forest fires, this can permanently damage the ecological functionality of forests. The long regeneration phase could in future be yet further extended by climate change (WWF, 2015).

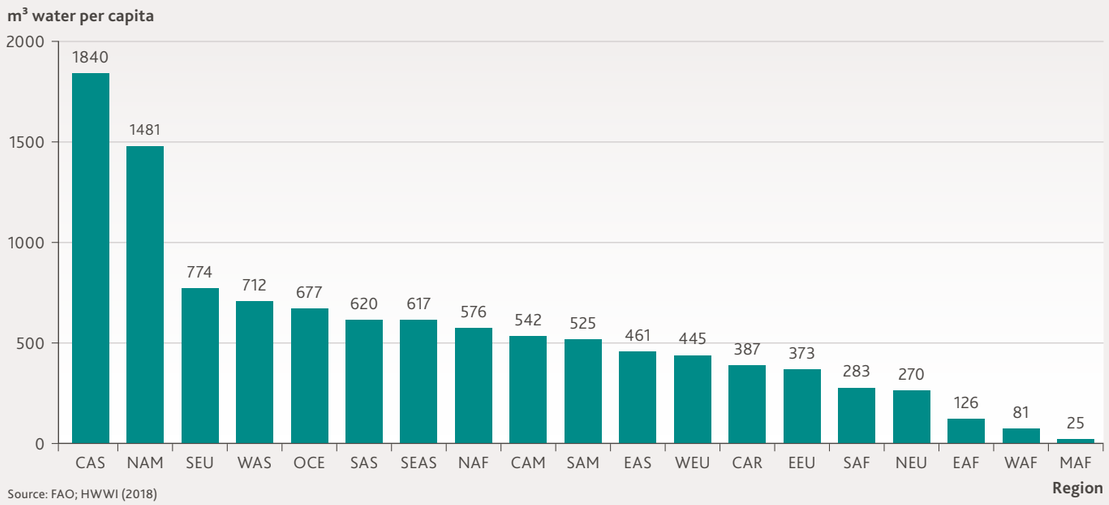
Generally speaking, one can conclude that the deforestation process is mainly taking place in currently poorer countries. Apart from the prospect of profiting from the trade in timber products, this is assuredly also explicable by relatively high population growth, which brings with it additional demand for living space and agricultural land. This demonstrates the difficulties faced by development strategies aimed at ecological sustainability. In order to restrict deforestation effectively, the productivity of land must increase overall, which, however, can have its own negative consequences for ecological balance due to the additional use of fertilisers (see 3.2.3).

What is hopeful in this connection is a global increase in forested land planted by human agency, i.e. reforestation. Between 1990 and 2015, reforested areas grew by a little more than 110 million hectares in total, still only 7% of forested land as a whole in 2015. What is more, in 2015, forest management plans, governing forest use and the protection of trees, soil and ground water, were in place for a bare majority of forested land, about 52%, worldwide (FAO, 2015). The largest area of planted forests is found in the temperate zone. According to FAO estimates, it expanded between 1990 and 2015 in all zones, but most in the polar zone. Artificially planted forests can in principle supply the same range of goods and ecological services as natural woodland. However, the benefit of their expansion is the subject of controversy. Thus, firstly, by their very existence they contribute in many places to a reduction of natural woodland areas. Secondly, in practice they mostly fail to offer the biodiversity of natural forests, which poses a problem in those regions where they are intended to compensate for the loss of natural woodland (Carnus et al., 2006).

3.2.5 Water consumption

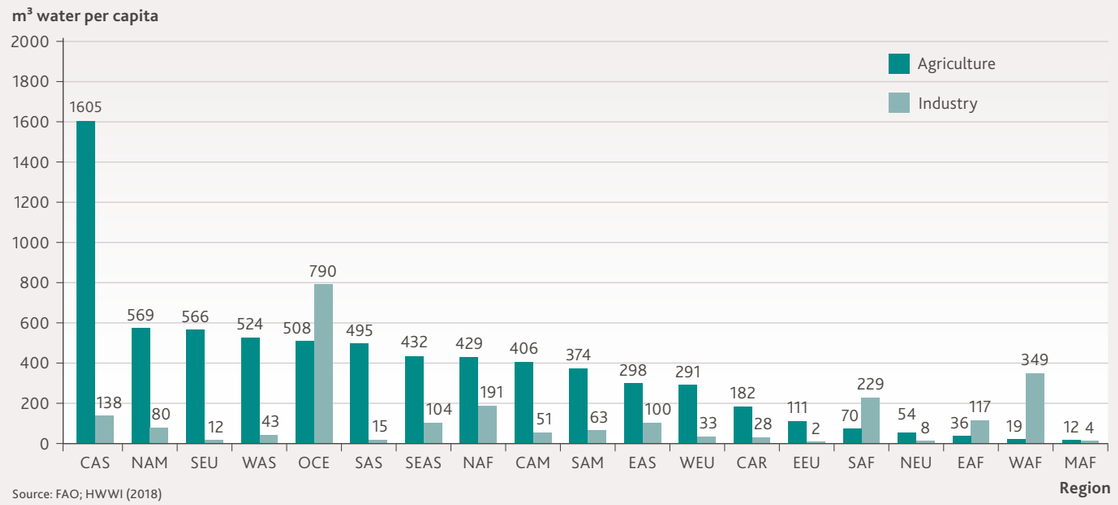
At first sight, the water resource seems virtually limitless on Planet Earth. However, only some 2.5% of the world's water deposits

Figure 9: Fresh water extraction per capita by region



Source: FAO; HWWI (2018)

Figure 10: Per capita extraction of fresh water by sectoral breakdown



Source: FAO; HWWI (2018)

consists of fresh water, and a great part of this is bound up as polar ice. The UN estimates that, in 2014, 3,923 km³ of fresh water was extracted worldwide. Two-thirds of the world's population live in areas of, at the least temporary, water scarcity. Some 50% of these areas are found in China and India (UN Water, 2017). The UN also reckons on a significant increase in the demand for water going forward, across the whole range of uses. At the household level, the demand for drinking water increases along with growing population and the projected trend towards urbanisation. In agriculture, changing eating habits produce increased demand for water. Most of all, the switch to foods richer in protein associated with increasing prosperity in the developing and emerging countries will further raise the water content in food. Furthermore, industrial production has an increasing need for water. Currently, according to UN estimates, the agricultural sector accounts for about 70% of the global consumption of water, but the progressive economic transformation of developing countries would also cause this to change somewhat (UN Water, 2017).

In its Aquastat Database, the World Food Organisation publishes data on water consumption [4] at the country level. The regional averages derived from these data are illustrated in Figure 9. They refer to the extraction of fresh water by agriculture, industry and households (including water from desalinisation plants) relative to the population of the region. The degree of discrepancy in per capita consumption derived in this way should in principle be treated with caution, since the uniformity of the databases in the country comparison cannot be guaranteed. Nevertheless, it is a powerful illustration of the geographical concentration of the global consumption of water. This is particularly high in Central Asia and Northern America. Sub-Saharan Africa, and interestingly also Northern Europe, recorded the lowest per capita consumption. These overall totals, however, are composed in part of very diverse components. In countries with a strong economic focus on the service sector, such as the United Kingdom, Ireland and Luxembourg and a number of city and island states, municipal consumption comprises by far and away the greatest share of fresh-water extraction, to the extent, in part, of over 80%. In countries with stronger industry, such as Belgium, Germany and the Netherlands, by contrast, the industrial consumption of water makes up more than three-quarters of total demand. In many countries where agriculture plays a significant role, it is the agricultural sector that accounts for more than 90% of total consumption.

Figure 10 emphasises the regional differences in the composition of consumption as between industry and agriculture. The high per capita consumption in the Central Asian countries is almost exclusively attributable to local agriculture. In Africa, Asia and Latin America also, the primary sector is significantly more important for water management than industry. The reverse is the case only in Europe (outside Southern Europe) and Northern America. Northern America and Western Europe are also the regions with the highest per capita consumption from the industrial sector. This shows how regionally diverse the starting points for efficiency improvements in water management must be.

A key step towards efficiency improvements particularly in developing countries is investment in waste-water management. While access to sanitary facilities over the last few decades has significantly improved worldwide, systems for waste-water purification remain prevalent only in developed countries. The medium-term consequences of insufficient purification is a deterioration in the quality of ground water and river water. Water pollution thus degrades the fundamental availability of usable water. This poses a great problem above all for poor people living in slums, who are forced to fall back on dirty water. The latest World Bank estimates indicate that within the group of least developed countries approximately 63% of the population live in slums (Weltbank, 2018). Extreme weather events, such as floods and droughts, contribute to water pollution. This ultimately also affects food safety as a whole through negative external effects on the fishing industry and the associated food chains (Guppy & Anderson, 2017). The dangers to health appear especially grave with respect to young children; it is not coincidental that infant mortality is especially high in countries with poorer water quality (Esrey et al., 1990). The first important step in waste-water management is the construction of universally accessible sewerage systems. Besides, quite apart from improved health and hygiene, there are also economic arguments in favour of investment in the efficiency of water usage: it lessens dependence on the globally shrinking resource that is natural fresh water (UN Water, 2017).

3.3 THE RESOURCE-USE INDEX

3.3.1 Motivation

An index has now been derived from the considerations discussed in the previous section. The index makes it possible to present an overall comparison between countries with respect to their resource-use intensity. For this purpose, the previously determined indicators were merged into a single whole, based on appropriate weighting. The index values determined in this way can be compared in a next step with the economic performance of each country (measured by GDP per capita). In this way, countries can be identified which make markedly above or below average use of non-renewable resources relative to the strength of their economy, thereby enabling them to be judged in this respect as more or less efficient or conserving of resources. The index is intended to give a global overview of the intensity with which different resources are used. As a preliminary, we considered and evaluated a large number of indicators. In the end, we reduced the indicators entering into the index, however, to five central yardsticks, each of which covers one of the areas discussed in Chapter 3.2 above. Three reasons can be adduced for this procedure. First, this concentration should avoid swamping the significance of the index and making the index more difficult to interpret. This danger exists in our opinion with many existing indices, which make use in their construction of an inflated number of indicators, without sufficiently identifying their interrelationships and substantive significance for the construct being measured. Second, this ensures transparency in construction and weighting. Third, with this reduction to core indicators, for which a comparatively good global availability of country data can be observed, we are also able to ensure the widest possible range of country coverage (as with the IBC Aggregate Index).

With this overall approach, we distinguish ourselves from existing indices in the subject area of resource usage/sustainability. To a degree, this could be said of the World Economic Forum's Global Energy Architecture Performance Index (WEF, 2017). This index contains altogether 18 indicators with reference to energy supply, which are divided into three component areas (each given equal weighting) of economic development, ecological sustainability and energy security. In this construction, it remains unclear how the suggested exchangeability of economic and ecological development can be justified. That apart, that index adopts an inherently different approach to ours in its focus solely on the energy sector. Another existing index in this subject area is the Country Sustainability Index by RobecoSAM (RobecoSAM, 2015). The term "sustainability" is defined very broadly here; along with environment-related indicators of energy consumption and greenhouse-gas emissions, it also includes yardsticks from the political and sociodemographic sphere such as level of education, life expectancy and defence of property rights in its construction. The index thereby exposes itself to accusations of insufficient sharpness of content. Reference can finally be made to the World Economic Forum and McKinsey Energy Transition Index (WEF, 2018) as the most recent product in this area. This index builds on the Architecture Performance Index, to which we have already referred, but still contains 23 additional indicators with reference to political and economic frameworks. The intention is thereby to measure a country's adaptability to energy transition. In addition to the problems of the index discussed above, the further indicators make its interpretation more difficult. What is more, some of the added indicators are evidently based on the subjective evaluations of the researcher.

3.3.2 Choice of indicators

For energy consumption, we used primary energy consumption per capita. It comprises the extraction of primary energy, the energy necessary for conversion and end-consumption, and the balance between the import and export of energy carriers. In this way, we obtain a good measure of the intensity with which a country uses energy carriers.

Table 5: Indicator selection for the resource-use intensity index

Dimension	Indicator	Unit of measurement	Measurement year	Source
Energy consumption	Primary energy consumption per capita	Megajoule	2014	World Bank
Waste generation	Electronic waste per capita	Kilogram	2016	UN-Global-E-Waste Report
Land area dedicated to agriculture	Increase in area of agricultural land in relation to total land area[5]	Percentage points	2015–2005	World Bank
Use of forest resources	Decrease in forest area in relation to total land area[6]	Percentage points	2015–2005	World Bank
Water consumption	Fresh-water consumption per capita	Cubic metres	2014	World Food Organisation

Source: HWWI (2018)

Electronic waste per capita was used as an indicator of waste generation. This is of increasing relevance, since the majority of hazardous electronic waste from developed countries is exported to developing countries and can cause health issues there in the long term (cp. section 3.2.2).

As a proxy for the land area dedicated to agriculture as well as the decrease in forest land, we used in each case the change in the proportion of total land area per country comprised by each type of use in the period between 2005 and 2015. These indicators are interesting from two aspects. First, because they raise the question of the long-term possibility of feeding a growing population and because they show the direction in which things have been moving there over a decade in which the world population increased by around 850 million. Second, from an ecological perspective, since forests play an essential role as a CO_2 sink.

For water consumption, the consumption of fresh water was used. Since this resource also is a finite one, whose consumption has over the last year has risen ever higher, the discussion on its consumption in times of growing world population gains in relevance (cp. section 3.2.5).

These five indicators provide the objective of the index: the development of resources under the aspect of a growing world population and the ever more prominent ecological concerns. On the basis of this data, the index covers 169 countries, divided into 19 regions. The indicators used are briefly tabulated below.

These five indicators taken together constitute the resource-use intensity index. They all present an insight into the country-wide consumption of resources in a cross-industry form.

3.3.3 Compilation

Further working steps were needed to compile the index. These comprise the imputation of missing values, the treatment of outliers and the normalisation of indicators. These steps are individually explained below.

A prerequisite for working with the data set was to impute missing observations. Since across all 19 regions, there was in every case a minimum of 60% of values available to us for each indicator, imputation by means of a region-specific average could be used. So, for example, a value for electronic waste per capita was missing for Switzerland. Switzerland is part of the Western European region, in which observations were available for all countries. In order to substitute a value for Switzerland, the average value for Western Europe was derived and applied to Switzerland. This procedure was carried out for all indicators across the different regions.

In addition, outliers that have too great an effect on the allocation of a variable can greatly distort the results. However, they are at the same time actually observed values and therefore part of the data set. Casually to dismiss them would of itself constitute a distortion of the results. With this trade-off in mind, values that exceeded plus or minus four times the standard deviation from the mean were deleted. This led to the exclusion of the following countries: Iceland, Luxembourg, Montenegro, Qatar, Sudan, Trinidad and Tobago and Turkmenistan.

As a final step, the indicators had to be normalised to the same unit in order to amalgamate them into a single composite measure. Since different normalisation methods lead to different results, three methods were applied and the results compared with each other. In doing so, we adopted the normalisation approaches set out in the OECD's Handbook on Constructing Composite Indicators (OECD, 2008).

As the first possible approach, the data were standardised. This involved the calculation of the mean and standard deviation for each indicator. Then, the mean was subtracted from each observed value and divided by the standard deviation. This produced both positive and negative outcomes. The disadvantage of this method is that for indicators the observations for which lie within a small interval, the

Table 6: Top 10 placings in the use-intensity index

Rank	Country	Value
1	United States	59.20
2	Canada	57.83
3	Finland	56.61
4	Norway	54.84
5	Brunei Darussalam	53.79

Rank	Country	Value
6	Estonia	53.37
7	New Zealand	50.74
8	Saudi Arabia	50.18
9	Bahrain	50.06
10	Kuwait	49.69

Source: HWWI (2018)

values can influence one another relatively strongly. This is the case, for example, with indicators of changes in land area.

As a second possible normalisation approach, we tried division into percentiles. In this method, five groups consisting of an equal number of countries were formed for each indicator, ranked according to their country scores. The great disadvantage of this method is the high degree of information loss. Both the maximum and the minimum at the extreme ends of a percentile are allocated to the same group.

As the third and last approach, we used the Min-Max approach. Here, the maximum and minimum observed value is identified for each indicator. Then, the smallest value is subtracted from each observation before dividing by the difference between the largest and smallest values. In this way, all values are normalised to produce a range between 0 and 100. With this approach to normalisation, there is neither an overweighting of observations within a small interval of each other nor a great amount of information loss.

It was the Min-Max normalisation approach that was used for the final index. However, the index was computed once for each of the three approaches and the results compared. The results were relatively robust across all three methods.

Following normalisation, the indicators could be aggregated to produce a single index. Since the index lacks the resource-consumption intensity of a country, the indicators portrayed in Table 5 are all included as positive values. Greater consumption of resources results correspondingly in a higher ranking in the index.

The arithmetic rather than the geometric mean is derived. A geometric mean would cause the index as a whole to reduce to zero whenever any indicator for a particular country recorded a zero score. Thus, for example, Australia would be relegated from 21st place to last place, because it presents with the greatest decrease in the relative share of agricultural land and thus records a zero score in this indicator. It was in order to avoid extreme allocations of this kind that the arithmetic mean was used.

3.3.4 Results

The aggregation described above produced a single index value for each country. Countries were then ranked according to these values.

$$\text{Resource-use Index} = \frac{(\text{Energy} + \text{Elektronic waste} + \text{Agriculture} + \text{Forest} + \text{Water})}{\text{No. of Indicators}}$$

It was not particularly surprising to find the majority of OECD members in the top third of the index. By contrast, it is African countries above all that recorded the lowest scores. If one looks at the Top 10, one can see that the United States leads the rankings, followed by other OECD members – Canada, Finland and Norway (see Table 6).

The high places occupied by the developed nations is closely correlated with their high consumption of fresh water and electronic equipment. It was somewhat surprising to find four Asian countries in the Top 10, led by Brunei. By contrast with OECD members, for Brunei, Saudi Arabia, Bahrain and Kuwait, it is primary energy consumption that is the driving factor. Possible reasons for this is the energy expended in oil extraction and the intensive use of air conditioning. In addition, one could add the fact that a majority of OECD countries are making efforts to reduce their use of the resources represented by forest and agricultural land. Nevertheless, the ranking demonstrates that the emerging countries are able to exhibit similar levels of resource use on the whole as the large developed countries.

The Bottom 10 comprises eight African countries, of which Rwanda is bottommost (see Table 7, page 28). A glance at the overall rankings shows that on a global comparison, African countries are relatively far behind. Thus, Togo is the highest placed African country, at No 66. If one looks at the indicators one by one, it is evident that the African countries lag wholly behind when it comes to energy consumption, fresh-water consumption and electronic waste. As regards land-use changes, however, they are found in the upper middle ranks. This is certainly due to the fact that it is above all the OECD countries that exhibit reductions in the proportion of land area dedicated to agriculture and an increase in forested areas. With these characteristics, without large rates of change of these variables, a country finds itself already in the middle ranks. As a result of normalisation, however, such results do not have such a strong weighting.

As in the IBC All-in-One Index, a comparison is possible of the results according to regions of the world (UN demarcation). For this purpose, the index values of all countries in a region were averaged, with the population of each country as a weighting factor. As was the case with the individual analysis, Northern America and Northern Europe can be found at the top (see Table 8, page 28), but Northern America leads by a great margin. The two countries

belonging to Northern America – the United States and Canada – are also the top two in the individual analysis. Even though no Western European countries numbers among the Top 10, Western Europe lies in third place. The Western European countries range from No 13 (the Netherlands) to No 36 (Switzerland). Although three Western Asian countries (Saudi Arabia, Bahrain and Kuwait) feature in the Top 10, Western Asia as a whole is only in seventh place. This is due to the fact that Western Asia includes six countries that are placed in the bottom third of the index. It is no great surprise that five African regions should be found in the bottom seven places. Middle Africa occupies bottom place, and no constituent country of that region manages a place in the Top 100 in the individual analysis.

3.3.5 Use intensity and economic performance

As a whole, the results point as may be expected to a relatively close correlation between the economic power of a country and its placing in the rankings. Figure 11 plots the index value against gross domestic product (GDP) per capita for each country in 2016.

The blue dots represent the index value and GDP per capita for each country. The red line shows the derived correlation between the two variables. The observed values lying above the red line have a lower index value in relation to their GDP and vice versa. It is noticeable that there exists a positive correlation between the size of GDP per capita and the index value. The higher the GDP, the higher the index value. It is, however, interesting that the spread with increasing GDP increases index value respectively. This means that, on the one hand, there are countries with an extremely low GDP that have a high demand for resources and, on the other, that there are countries with an extremely high GDP that have a comparatively more limited use intensity. The two most striking outliers in this respect are North Korea at the bottom and Singapore at the top. In the overall rankings, North Korea is in 11th place. This result is attributable above all to its excessive use of agricultural and the decrease in forested areas. North Korea is, however, not visible on the graph, as its GDP cannot be estimated. The resulting assumption is, however, that it lies far below the global average.

The counterpoint to North Korea is Singapore. This country has the highest per capita GDP but occupies only place No 31 in the rankings. The cause of this may be found in the predominance of the service sector in its economy. As a result, Singapore lies far higher as regards energy consumption and electronic waste, but towards the rear of the middle rankings as regards land-use change and fresh-water use.

3.4 Comparison of costs by country

Besides the technological and overall economic trends discussed in Chapter 3.2, a further factor influencing future resource consumption must not be overlooked: namely, price developments in the energy and raw-materials markets. In considering raw-materials markets, short-term price fluctuations should be distinguished from long-term price trends. Whereas short-term fluctuations represent partly speculation-driven reactions to external shocks and other temporary influencing factors, long-term trends reflect the fundamental relationship of production potential on the supply side to requirements on the demand side. Production potential is the result of the interplay of amounts with natural reserves, their geographical location and their extraction potential. Requirements are the result of economic activity and production technology. Both production potential and requirements are therefore not static but dynamic. Basic prices change in the medium-term as a result of technological innovation, the exploration of new deposits and the associated shifts in supplier structures. The best example of this currently is the situation of the oil market: the massive increase in shale-oil extraction in the United States has fundamentally upset power relationships and the latest price development in this area appears to be the harbinger of a fundamentally transformed price-setting regime (Knauf, 2017).

The economy in end-use energy markets, especially the electricity market, takes a different form. In view of the great importance of electricity as a cost factor in many sectors of the economy, it merits a closer look at price developments. On the one side, these are influenced by procurement costs for the various fuels used in conventional electricity generation. The different kinds of power station are not completely interchangeable but partly serve complementary functions. Thus, as a rule, lignite-fired and nuclear power stations, which operate comparatively favourably with respect to fuel costs, assume the role of so-called base-load power stations, which provide a permanent supply of electricity throughout the day. Those types of power station that relay on more expensive fuels and at the same time enjoy an advantage in the form of flexibility (e.g. gas-turbine and oil-fired power stations), come onto the market only at times of peak consumption and are therefore referred to as peak-load power stations.

An important technical difference in comparison with raw-materials markets lies, on the other side, in the time-limited bridging capability of generation fluctuations. Storage can result only indirectly by conversion into other forms of energy (e.g. in the case of pumped-storage power plants in the form of potential energy) and is currently associated with considerable energy loss and other costs. This implies that electricity supply essentially requires generation and demand to be precisely coordinated in time, which in turn requires a corresponding synchronisation of performance. Responsibility for this is generally borne by the network providers. Their task in the field of network management includes not only carrying out maintenance work but also sourcing balancing energy in the course of load management. The costs so incurred are refinanced in the form of a charge on the electricity price payable by end-consumers. As a consequence, in EU countries, for example, this involves detailed statutory regulation. In countries that have adopted the development of renewable energy as a flagship policy, this cost factor plays an increasing role. The traditional generation structure of base-load and peak-load power stations is increasingly being turned upside down, as due to its dependence on weather conditions, electricity generation from wind and solar power can be forecasted and managed only to an extremely limited degree. Network providers must thus intervene more frequently in order to safeguard network stability, which is still being intensified by an increasingly decentralised generation model.

Added to this is the influence of the state on the prices for end-consumers, which should not be underestimated in the case of many countries. Besides the overt taxation of end-consumption in the form of value added tax and a specific electricity tax, this is also felt indirectly via taxes on the generation side of the process, e.g. a tax on CO_2 emissions from generation (OECD, 2013). Noticeable here too is the application of instruments by the state to incentivise renewable energy, above all in European countries. In countries that guarantee a fixed feed-in rate to owners of electricity-generating plant, this generally assumes the form of funding refinancing levies. In countries that

Table 7: Bottom 10 placings in the use-intensity index

Rank	Country	Value
160	Chad	20.82
161	Bangladesh	20.74
162	Kenya	20.72
163	Djibouti	19.59
164	South Sudan	19.08
165	Central African Republic	18.98
166	Lesotho	18.45
167	Sierra Leone	17.77
168	Laos	17.67
169	Rwanda	16.03

Source: HWWI (2018)

Table 8: Regional averages for the use-intensity index

Region	Ø
Northern America	59.06
Northern Europe	43.67
Western Europe	43.23
Central Asia	41.97
Oceania	39.13
Southern Europe	36.89
Western Asia	34.71
Eastern Europe	34.29
South America	33.76
South-East Asia	33.03

Region	Ø
Central America	31.90
Eastern Asia	31.68
Southern Africa	29.16
Northern Africa	29.04
Caribbean	27.67
Southern Asia	26.01
Eastern Africa	25.62
Western Africa	23.67
Middle Africa	22.92

Source: HWWI (2018)

Figure 11: Correlation between economic power and index value

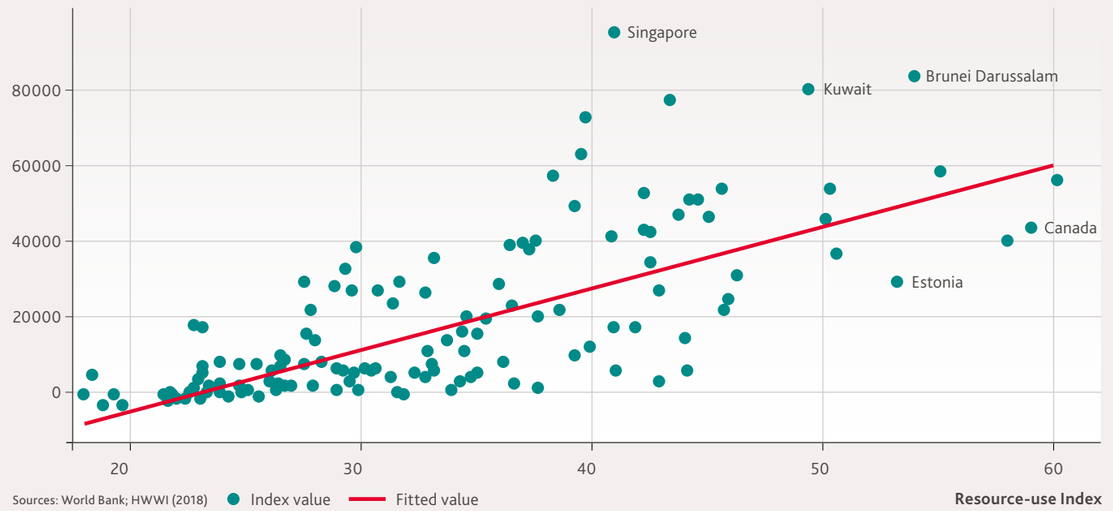


Table 9: Average electricity prices in OECD countries in 2016

Industrial electricity prices

Price (cents/kWh)			
Top 5		Bottom 5	
Italy	18.55	Norway	3.41
Japan	14.68	Sweden	6.05
Germany	14.14	United States	6.78
Switzerland	13.41	Finland	7.32
United Kingdom	12.57	Canada	7.91

Household electricity prices

Price (cents/kWh)			
Top 5		Bottom 5	
Denmark	33.13	Norway	10.49
Germany	33.02	Canada	10.68
Belgium	28.95	Korea	11.95
Italy	27.72	United States	12.60
Spain	26.95	Hungary	12.62

Sources: BEIS (2017); Bundesbank; HWWI (2018)[7]

Table 10: Average gas prices in OECD countries in 2016

Gas prices for industry

Price (cents/kWh)			
Top 5		Bottom 5	
Switzerland	6.21	United States	1.17
South Korea	4.11	Canada	1.32
Finland	3.97	New Zealand	1.54
Sweden	3.87	Poland	2.37
Austria	3.86	Turkey	2.44

Gas prices for households

Price (cents/kWh)			
Top 5		Bottom 5	
Sweden	12.62	Canada	2.70
Japan	10.87	United States	3.33
Greece	10.05	Turkey	3.73
Switzerland	9.81	Hungary	3.92
New Zealand	9.67	Poland	5.05

Sources: BEIS; Bundesbank; HWWI (2018)[8]

prefer state support to take the form of minimum quotas for the share of renewable energy in electricity supply, this makes itself felt indirectly through the passing-on of additional costs for the acquisition of corresponding certificates to prices for end-consumers. Since most countries provide for exceptional regulations for economic reasons in addition to the regulatory burden for their energy-intensive industries, the analysis must in addition differentiate to a greater and greater extent between prices at the industry level and prices for households.

A global price comparison is almost impossible, solely for the reason that in many emerging and developing countries, the market structures are so weakly pronounced that there exist hardly any standardised contracts with respect to supplier performance or obligations. A meaningful comparison therefore remains restricted to the group of developed nations. We rely for this purpose in what follows on the latest statistics published by the UK's Department for Business, Energy and Industrial Strategy (BEIS), which enable a methodically consistent comparison of average electricity prices, differentiating between industry and household prices to be made for 27 OECD countries in all. The outliers shown in Table 9 thus shed light on the enormous discrepancies between countries within both price categories. That such price differences for electricity can fundamentally arise even in the presence of functioning markets has firstly to do with limited market integration. The transmission of electricity across national borders is restricted as a rule to a few nodal points and can also be blocked by technical means, such as the application of phase modifiers. Secondly, as in the case of natural resources, the decentralised nature of generation restricts price harmonisation.

With respect to electricity prices for industry, Italy stands out with an especially high average price. Detailed analysis reveals that in this case this is due less to price components attributable to government intervention and more to high procurement costs above all else. Italy's generating plant is composed of a high proportion of gas-fired power stations, where the gas necessary for its operation is more expensive than alternatives such as coal and must additionally mostly be imported across wide distances from Russia and North Africa (Fraunhofer ISI, 2015). The high prices for industry in Japan are attributable above all to the restructuring of the electricity sector made necessary by the nuclear accident in Fukushima in 2011. The forced shutdown of all nuclear power stations has led to high unfunded fixed costs for energy suppliers, which have partly been passed on to industrial customers. However, it is also the fact that Japanese energy supply had for decades been characterised by regional monopolies before market liberalisation in 2016, which was reflected in prices. In other countries with similarly high industrial electricity prices, a more important role is played by contrast by price components attributable to state action. This is true especially of Germany. There, wholesale prices for electricity have fallen in recent years, but as a result of EEC levies and electricity tax, on average a higher industrial electricity price has been established (Fraunhofer ISI, 2015). Certainly, for particularly energy-intensive manufacturing businesses, the possibility of exemption exists, but the criteria for this vary sharply according to each instrument and are subject ultimately to frequent legislative changes.

These price components have an even more significant effect on household electricity prices, where as a rule no options for exemption exist. This is also evidenced by the fact that, besides Germany, Denmark, another country with a very high national tax and duty component in the electricity price, features at the top of the rankings. At the same time, Denmark is the country with the greatest gap in percentage terms between household and industrial electricity prices. This results principally from the fact that businesses have the possibility of reimbursement for the otherwise extremely high electricity tax payable on electricity consumed directly in the production of taxable products (Eurelectric, 2014). Particularly lower electricity prices for both industry and households are charged in Denmark's neighbour, Norway. The reason for this is the completely opposite generating structure. Norway relies almost exclusively on hydro-electric power, a resource that by its nature hardly ever fluctuates, unlike wind and solar energy, and is additionally available in great quantities. It is also the case that incentives for renewable energy, given their small share in generation, have virtually no role to play (Fraunhofer ISI, 2016).

Apart from the price of electricity, the price for natural gas as an energy carrier are also of particular interest, since by its many applications it constitutes a key factor in the development of the energy systems of the future. This concerns primarily the electricity sector. Especially in Arab countries, but also in Russia and a few OECD countries, gas-fired power stations provide the majority of electricity production. The World Energy Council estimates their share in global electricity generation to have been 22% in 2016 (WEC, 2016). The second most important area of application is the industrial use of natural gas, on the one hand as energy carrier in the generation of process heat, among other things, and on the other hand as a raw material in the chemical industry, e.g. in the manufacture of ammonia. Its domestic use in central heating is a further area of application, particularly in developed countries. With regard to setting targets for the avoidance of greenhouse-gas emissions, natural gas will have an even greater role in the medium term. By means of its high energy content, it can contribute to the reduction of CO_2 emissions, by contrast to the use of other conventional energy carriers. In electricity generation, gas-fired power stations can as a complementary technology additionally facilitate the network integration of electricity from renewable energy sources, in that it can help smooth the natural fluctuations in the supply of electricity from wind and solar sources. In addition to the hitherto dominant applications, there are growing possibilities of its application in the transport sector through its use as a fuel.

In this case too, we have country-comparison data available to us from BEIS, broken down into industry and household prices. According to the BEIS data, the highest industry gas prices by far operated in Switzerland (see Table 10). In addition to the market structurwe, the CO_2 tax, levied on the use of all fossil fuels, plays its part (OECD, 2016a). The equally relatively high prices in South Korea are, by contrast, evidently demand-driven. The government's plans to steer the electricity sector, which has long been dependent on coal, in the direction of a higher share in electricity production for natural gas as the energy carrier have led, for one, to a significant increase in domestic gas consumption (Reuters, 2017). At the level of private households, the top of the price range looks quite different. For this user group, it is Sweden that records the highest average price. The country's strong dependence on imports in this area, in combination with a relatively concentrated supply structure, could be cited as reasons for this (OECD, 2016b). Import dependence is also a significant factor behind high gas prices for households in the case of Japan. Conversely, the vast (conventional and unconventional) domestic extraction of natural gas can explain the extremely low prices by international standards for both industry and households in Canada and the United States.

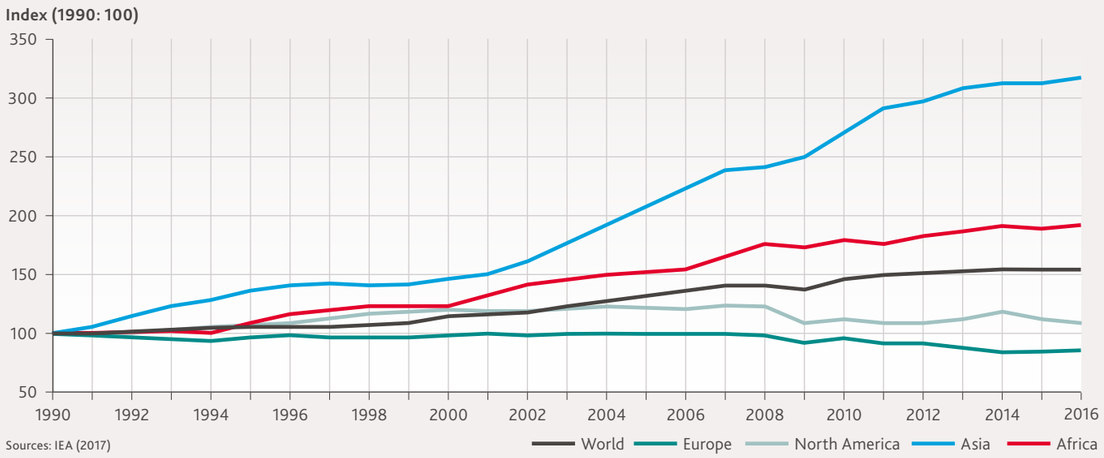
3.5 THE CONSEQUENCES FOR SOCIETY

3.5.1 Greenhouse gases

The consequences of increasing resource consumption worldwide are not only to be found in a growing scarcity of raw materials but also in a worsening of the negative environmental effects associated with resource consumption. Observations have focused for some time on the emission of greenhouse gases. This concerns a group of gases found in the atmosphere that absorb a part of the heat radiated from the Earth's surface and partly reflect it back to the surface. Their existence contributes in considerable measure to the increasing average temperature of the planet. The greater their concentration in the atmosphere, the greater the so-called greenhouse effect. To a certain degree, greenhouse gases act as a support for human activity. An ever-growing concentration, however, as has been observed to be the trend over the last 200 years, harbours great risks for the ecosystem through its impact on global warming. Worthy of mention here firstly are rising sea levels caused by the melting of ice, which bring with them a greater risk of inundation and tidal flooding. Secondly, an increasing occurrence of drought in arid regions, which threatens human health, incites social crises with concomitant phenomena such as mass migration and war, and can result in the extinction of animal and plant species (IPCC. 2014).

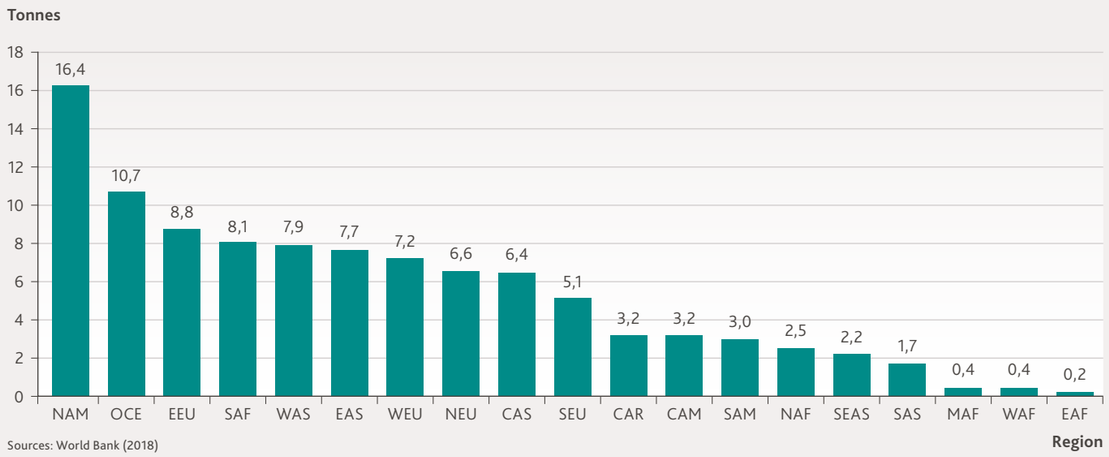
Alongside natural sources, a broad majority of climate researchers also regard human activity as a decisive factor in the increasing concentration of greenhouse gases. An indication of this is the fact that a significant increase in the concentration of CO_2 can be established as dating from the beginning of industrialisation. In the climate policy debate, this greenhouse gas has particular significance, since it is likely to be responsible for more than 60% of the augmentation of the worldwide greenhouse gas effect (IPCC. 2014). Fossil fuels contain great concentrations of carbon, the combustion of which releases CO_2 into the atmosphere. The ever-increasing use of coal and (later) natural gas and oil as energy carriers is therefore regarded as the most important cause of the manmade share of the greenhouse effect. To this must be added the manmade loss of plant matter as a natural carbon sink (absorption of CO_2 in photosynthesis), as is evidenced above all by the loss of forest cover (see 3.2.4).

Figure 12: Development of CO_2 emissions since 1990



Sources: IEA (2017)

Figure 13: Per capita emissions of CO_2 by region in 2014



Sources: World Bank (2018)

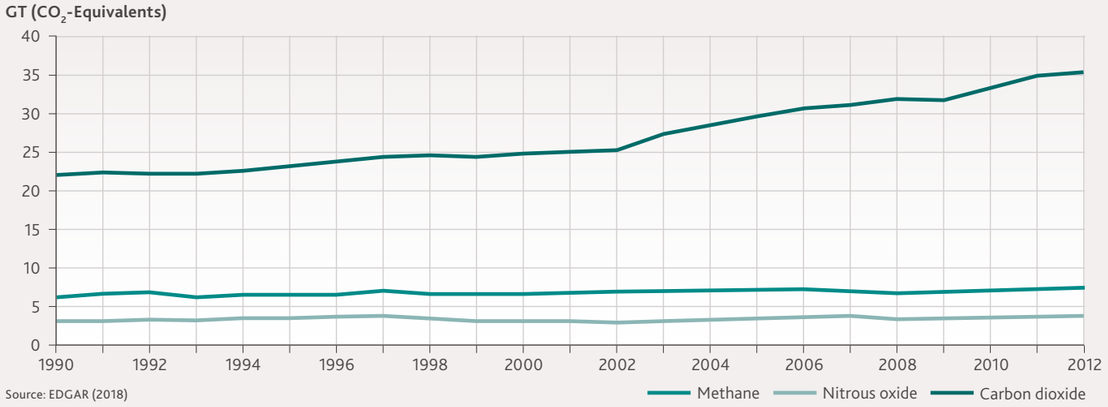
From a global point of view, annual CO_2 emissions rose by approximately 55% in the period from 1990 to 2016 (see Figure 12). The prime responsibility for this is development in Asia, first and foremost in China and India. China has virtually quadrupled its annual emissions since 1990, an obvious side-effect of its economic rise and its preference for coal as energy supplier. In absolute terms, China has meanwhile become the greatest emitter of CO_2 in the world. India too has broadly quadrupled its emissions in the same period and in 2016 was the third greatest emitter, after China and the United States. By contrast, in Europe and North America, emissions have been declining since the beginning of the 21st century. Political targets, such as the EU's goal of reducing greenhouse-gas emissions by 20% compared to 1990 and the associated instruments (CO2 taxes, emissions trading, subsidies for renewable energy) have certainly measurably contributed to this turnaround. The countries of the African continent have certainly doubled their CO_2 emissions in this 25-year period, but their contribution to the worldwide increase remains decidedly modest, and is additionally concentrated in the northern African region and South Africa. The countries of Western and Middle Africa have, as previously, no noteworthy part to play in this respect. A country of such considerable land area and population as Nigeria emitted in absolute terms less CO_2 in 2016 than much smaller Belgium (IEA. 2017).

The worldwide spread of emissions measured per head of population are correspondingly extreme. Northern America particularly stands out, due to the exceptionally high per capita emissions from the United States and Canada. In both countries, it is the high proportion of oil and natural gas in the fuel mix that contributes to this exceptional placing. In future, this may well increase further, due to the increasing extraction of synthetic oil in the form of shale oil (US) or from oil sands (Canada), which is additionally itself associated with high energy requirements. Responsibility for the high per capita emissions from Oceania is primarily Australia's. In this case, the front-line cause is the high use of coal, due to the large domestic deposits of both black coal and lignite. Within Europe, it is the East that has the highest per capita emissions. The CO2 intensity of economic output (i.e. the ratio of emissions to gross domestic product) is especially high in this region, caused both by the strong focus on coal as an energy carrier and on energy-intensive industries. In strong contrast to the global average lies the South American region. This can be explained by the widespread use of hydro-electric power as a clean energy source and the limited demand for heating due to the climate. At the extreme end of the regional comparison can be found wide stretches of Africa, primarily due to their modest degree of economic development (World Bank, 2018).

According to the current state of knowledge, CO_2 is the most significant, but not the only, gas whose existence contributes to the greenhouse gas effect. Other notable greenhouse gases are methane and nitrogen oxide. In the case of methane, too, an increased concentration in the atmosphere has been diagnosed over the last 200 years, which can also, at least in part, be attributed to human agency. The agricultural sector plays a large role here, as it is particularly via animal husbandry and rice cultivation that methane is released into the environment. Methane is also released in the extraction of natural gas, coal mining and the fermentation of organic waste. In each case, there is thus a close connection with the consumption of resources we analysed in the previous section. At the same time there is a vicious circle of interaction with climate factors. Thus, for example, climate-induced higher water levels and higher temperatures are conducive to the formation of methane from decomposition in wetlands which, due to its effect as a greenhouse gas itself in turn intensifies climate change. Much the same holds true for the danger of releasing extensive methane reserves that have hitherto been locked in the ocean bed in the form of frozen methane hydrates (Archer et al., 2009). Equally significant are emissions of nitrous oxide (dinitrogen monoxide or laughing gas). This gas by its nature absorbs heat due to similar wavelengths in interaction in turn with the concentration of methane in the atmosphere. The higher the methane content, the less the climatic effect of nitrous oxide. For this reason, with respect to the overall effect, attention should be paid to the concentration of both gases. The emission of nitrous oxide also has natural and manmade causes. The most significant human influence is the intensified application of fertilisers. These contain nitrogen, which through the decomposition of dead plant matter is converted to nitrous oxide and is released into the atmosphere from the ground.

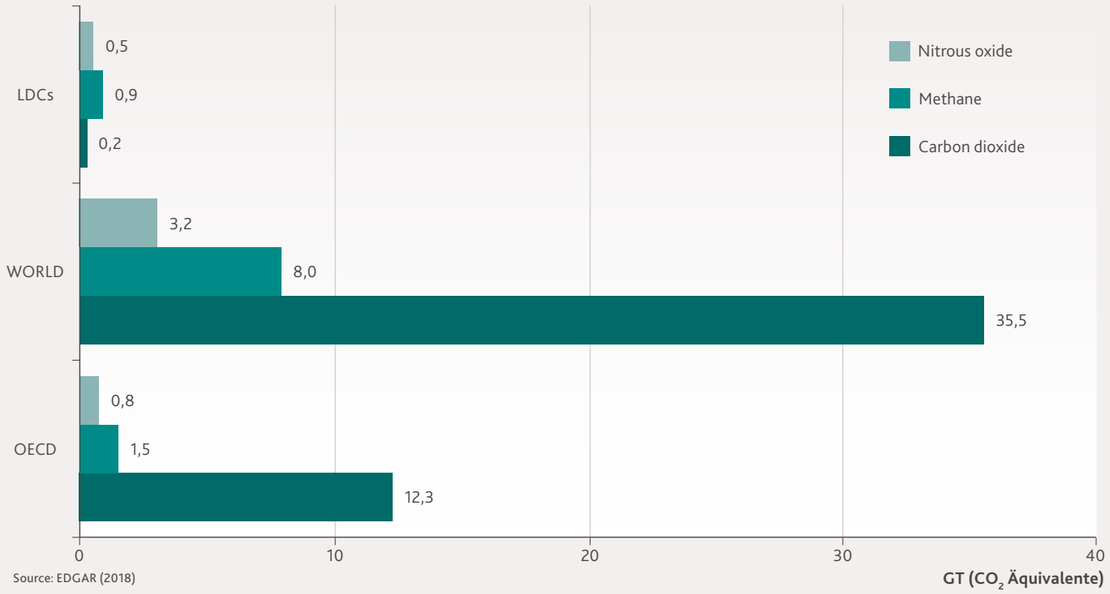
An estimate of the total amount of manmade methane and nitrous oxide emissions is methodically extremely difficult in view of the great number of possible sources. For this purpose, we have used data from the Emission Database for Global Atmospheric Research (EDGAR), prepared by the Joint Research Centre of the EU Commission. At the time of the study, estimated values for global emissions of methane and nitrous oxide were available up to 2012 and not beyond. These values are contrasted with emissions of CO_2 as measured in CO_2 equivalents in Figure 14. This means that emissions from methane and nitrous oxide were first converted into the amount of CO_2 that would provide the equivalent contribution to global warming. The amounts of the different gases were thus made comparable with respect to their effect on the climate. It is evident from Figure 14 that in this representation, the contribution of CO_2 far exceeds that of the other gases. This is the case at the present time more strongly than in the past, as in both relative and absolute terms, global CO_2 emissions have grown significantly more strongly when measured by their effect on the climate since 1990 than emissions of methane or nitrous oxide. This dominance is not equally reflected over the world as a whole, as Figure 15 (page 34) shows. In the least developed countries (LDCs) in the latest year for which we have data, methane was the most significant component of greenhouse gases. Emissions of methane from LDCs in 2012 contributed some two-thirds of all emissions in OECD countries. With respect toCO_2 emissions, the global contribution of LDCs appears by contrast to be almost completely negligible. This is primarily due to their different economic structure, i.e. particularly the greater importance of agriculture in the LDCs, but also to their generally different technological level. This in turn demonstrates how important it is to develop regionally differentiated solutions for climate issues. Furthermore, changes in greenhouse gas concentration in the atmosphere cannot be automatically attributed to the development of emissions. In this respect, both natural changes and changes brought about by human agency in the absorption capacity of natural sinks are also of importance, as are non-anthropogenic sources, the exact interaction of which continues to be an object of study in climate research.

Figure 14: Global emission volumes of different greenhouse gases



Source: EDGAR (2018)

Figure 15: Composition of greenhousegas emissions by country groups in 2012



Source: EDGAR (2018)

On the basis of the agreement concluded at the Paris Climate Conference in December 2015, nearly all the nations of the world[9] have committed themselves to the target of permanently reducing the manmade increase in global average temperature in comparison to the pre-industrial era to below 1.5° Celsius if at all possible, and in every case to significantly below 2°. As a concrete measure, nations should present national climate action plans for reducing domestic CO_2 output, which are to be reviewed for compliance after a five-year period and be gradually made more ambitious. Poorer nations should be supported in this connection through an equalisation fund fed by (private and public) contributions from developed countries. Compared to past climate agreements, this certainly represents a significant breakthrough, but the fact that countries can themselves determine the extent and the period to and over which the reduction should take place remains problematic. The reduction targets published to date are, taken as a whole, particularly far from sufficient if the overarching target for temperature limitation is to be achieved. The UN estimates in its Emissions Gap Report 2017 that the implementation of the national action plans submitted to date would ensure only about one-third of the emissions reductions necessary for achieving the temperature-limitation target in a cost-efficient way. Furthermore, the emissions gap should preferably be closed before 2030, since even if the action plans were implemented in full, only 80% of the emissions maximum required for achieving the target would be attained by 2030.

At the same time, the UN emphasises that the gap could be completely closed earlier than 2030 by a systematic application of environmentally friendly technologies that already exist today. These include, for example, the intensified use of wind and solar power in the energy sector, measures to increase energy efficiency in industry, the promotion of alternative motive technologies in the mobility sector and systematic reforestation of lost forest land (UNEP, 2017). Even in such a scenario, however, uncertainties remain. These concern first the future contribution of technologies that are currently still in their test phase, such as carbon capture and storage and the conversion of renewably generated electricity into gas by electrolysis ("Power-to-Gas"). Second, uncertainty also surrounds the interaction of economic and energy transformation. Should, say, Africa manage in the next decade to follow the Eastern Asian by entering into a new phase of economic development with permanently higher growth rates, all global progress in reducing emissions could be brought to nothing in the absence of huge efficiency gains in energy use.

3.5.2 Air pollutants

Apart from greenhouse gases, consideration is normally given to harmful substances that are not in the forefront of interaction with the climate but can still have a negative effect on human health through contamination of the air, soil or bodies of water. They are collectively referred to as "air pollutants". Their concentration in the air we breathe is nevertheless directly or indirectly connected with human economic activity, and whose effect and source can, depending on the particular substance, differ considerably. An illustration of this is given in Table 11, in the case of individual conspicuous substances taken from the long list of harmful substances. With respect to their effects, no claim is made as to completeness.

Associated with the primary pollutants described above there are also secondary pollutants, which are not directly emitted but are formed in chemical reactions with substances present in the air. In this class, we can number ozone, which is created in the presence of intensive solar radiation by photochemical processes with the participation of e.g. nitrogen oxides. At great heights, this gas certainly has a positive effect in that it protects the Earth's surface from ultraviolet radiation from the sun, but nearer the surface, it constitutes a harmful substance, as a high concentration of ozone can adversely affect human lung function and cause respiratory illnesses (UBA, 2017). Secondary substances can also include fine dust particles in part, which arise in the air through the reaction of, inter alia, sulphur and nitrogen oxides This list makes it evident that the origin and effects of air pollutants are characterised by a great degree of complexity (and thereby also incalculability). Over the years, obligatory ceilings have been imposed in developed countries on the concentration of a few of the named pollutants in the atmosphere. A prerequisite for this was firstly the development of suitable methods of measurement. Depending on the pollutant, these have developed and been internationally standardised to differing degrees.

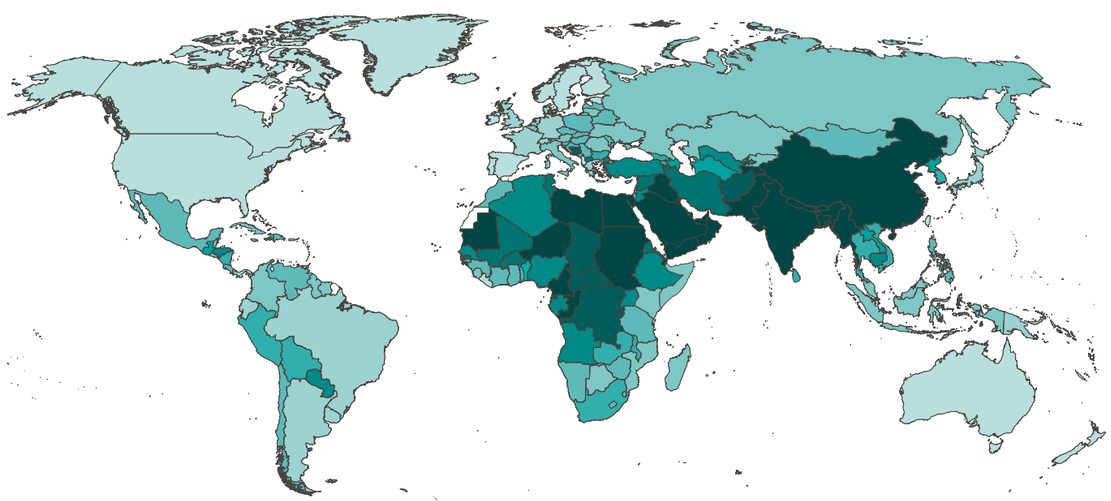
Particular attention is being paid recently to fine particulate matter (PM2.5). Here, we are concerned with particles with a cross-section of under 2.5 micrometres. Precisely because of their small size, these particles are considered to be especially harmful, as they can penetrate bronchial passages, pulmonary alveoli and even the bloodstream. One of their main sources is road traffic, as is the case with many other harmful substances, particularly associated with the use of diesel as a fuel. Their concentration can now be measured with relative precision through a combination of satellite data, physical models and meteorological information and is also capable of international comparison (Ritchie & Roser. 2017). In what follows, we present current data obtained from Cohen et al. (2017) in a comparative study carried out by a large team of researchers and commissioned by the Global Burden of Disease Network. Figure 16 (page 36) shows the concentrations of PM2.5 to which an inhabitant of each country was on average exposed (measured in both urban and rural environments) in 2015. This portrays an extremely striking geographical distribution. Countries in the Near East, Central Africa and South-East Asia experience a median particulate concentration way above the international average. At the national level, Qatar, Saudi Arabia and Egypt are ranked highest in the world with a concentration of over 100 micrograms (mcg) of particulate per cubic metre (m3). The global median is 44.0 mcg/m3. Which cause in detail contributes how much to the

Table 11: Effects and sources of selected air pollutants

Substance	(Possible) effects on human health	Principal sources
Ammonia	Adverse effect on the quality of breathable air and water	Agriculture (principally animal husbandry and application of fertilisers)
Benzol	Damage to internal organs and bone marrow; carcinogen	Road traffic (component of HGV exhaust)
Particulate matter (PM_{10}; $PM_{2,5}$)	Irritation and inflammation of mucous membranes, bronchia	Road traffic (engine activity, tyre wear); Industry (metal and steel manufacture); agriculture (secondary fine-dust formation)
Carbon monoxide	Adverse effect on oxygen absorption; damage to the central nervous system	Road traffic (incomplete fuel combustion)
Sulphur dioxide	Irritation of mucous membranes and eyes; respiratory problems	Energy industry and manufacturing (combustion of fossil fuels)
Nitrogen oxide	Bronchial tube contraction (particularly in asthma sufferers)	Road traffic (component of HGV exhaust); energy industry and manufacturing (combustion of fossil fuels)

Source: UBA (2017)

Figure 16: Mean particulate concentration by country in 2015



Source: Cohen et al. (2017)

high particulate value has still not been clearly established by current research. As a result, there is no definitive answer as to what degree this concentration is manmade. There are, however, some clues as to the influence of human activity. In the case of Africa, the combination of rapidly progressing urbanisation and the maintenance of traditional ways of life could play an important role. This applies to cooking with open fires and the use of electricity generators driven by diesel fuel (Roy, 2016). The massive burning of refuse on vast unregulated landfill deposits could also be a contributory factor to the extent of the regional problem (see 3.2.2). In the Near East, on the other hand, the strong dependence on fossil fuels could be an obvious explanation, while in South-East Asia, the rapidity of the general economic upswing should be significant. Outside Europe, perhaps, the problems would not necessarily be associated primarily with road traffic.

Compared with 1990 values, according to the measurements carried out by Cohen et al. (2017), the mean global particulate concentration has risen by a moderate amount (from 39.6 to 44.0 mcg/m3). For the group of OECD countries, however, a decrease has been recorded, while the increase has been experienced disproportionately strongly above all in the Near East and East Asia. For the future, it is the situation in Africa that is of the greatest concern. There, unlike the case of East Asia, the currently high particulate concentration cannot be explained by strong economic growth and an associated developmental leap forward. As a consequence, Africa, unlike perhaps China, currently lacks the technology to come to grips with the particulate problem. An increase in economic growth in the region over the next decade could even exacerbate the situation, as increasing urbanisation and the demand for personal mobility would cause additional pressures.

Admittedly, such a representation of the country-wide mean offers only limited information on the extent of the danger to health experienced by the population of that country. For that purpose, it is above all important to know in which places and how often in the year threshold values of particulate concentration are crossed. Cohen et al. (2017) have modelled estimates supplementing these background data for the mortality risk of three forms of air pollution and on that basis calculated so-called age-standardised mortality rates. These represent the (potential) number of deaths per 100,000 persons in an age-standardised form. That is to say, age-specific mortality rates have been weighted by the proportion of the population in each age group in order to take account of differences in the demographic structure of countries. The role of ozone and the pollution of interior spaces by the burning of solid fuels (primarily, in coal-fired and wood-fired stoves) were investigated as sources of danger in addition to particulate matter. As concrete causes of death, primarily various forms of lung disease were identified by this means. Table 12 shows for each cause of death the ten countries with the highest estimated death rates in 2015. According to the table, the death rates from particulate exposure were recently highest in Eastern European countries, even where the recent levels of particulate concentration in this region were lower than in many parts of Africa and Asia. The main explanation for this could be demographically-related differences in vulnerability, especially as this region has a significantly higher average age compared with Africa. As regards deaths from the pollution of internal spaces, the picture is quite different. Among the ten most affected countries, eight are in Africa. The relevant death rates in these countries are considerably greater than those from particulates. This shows that technological improvements not only in industrial production but also in people's everyday living environment must be undertaken in order to tackle the pollution problem in developing countries. Considered globally, the danger from ozone appears to be significantly more marginal in comparison. Here, as far as mortality is concerned, there is a certain concentration in Asia, but even in this region ozone as a risk factor is less important than both the other sources of danger.

Table 12: Countries with the highest estimated death rates from air pollutants in 2015

Particulates

Death rate (per 100,000 inhabitants)		
Rank	**Country**	
1	Bulgaria	130.94
2	Ukraine	126.81
3	Belarus	126.57
4	Georgia	97.74
5	Latvia	94.54
6	Russia	92.45
7	Afghanistan	90.35
8	Lithuania	86.75
9	Hungary	84.26
10	Central Afr. Rep.	83.76

Ozone

Death rate (per 100,000 inhabitants)		
Rank	**Country**	
1	India	8.22
2	North Korea	8.14
3	Nepal	6.03
4	China	5.19
5	Greece	4.96
6	Bangladesh	4.91
7	Italy	4.64
8	Myanmar	4.36
9	Spain	3.71
10	United States	3.60

Pollution of internal spaces

Death rate (per 100,000 inhabitants)		
Rank	**Country**	
1	Central Afr. Rep	152.73
2	Somalia	121.87
3	Guinea-Bissau	112.56
4	Chad	102.62
5	Afghanistan	100.64
6	Guinea	98.42
7	South Sudan	97.05
8	Lesotho	96.40
9	Sierra Leone	90.71
10	North Korea	86.16

Source: Cohen et al. (2017)

[3] Primary energy consumption is generally defined as the total of all internally derived energy carriers and the import-export balance, together with changes in stock levels. In contrast to final energy consumption, it contains quantities of energy lost in transportation and conversion as well as the amount of energy used by end-consumers.

[4] Including cooling water for nuclear power stations, but excluding hydro-electric plants.

[5] A sample determination: in Germany, the land area dedicated to agriculture was 48.8% of total land area in 2005. In 2015, this percentage was 48%. This represents a change of -0.8 percentage points. The reason for using the change in percentage points rather than the change in terms of percentage is that countries with a limited area of agricultural land with a small absolute increase would already record a large relative increase.

[6] Analogous to the determination of the change in the land area dedicated to agriculture.

[7] Authors' translation from prices in pounds sterling quoted by the BEIS into US dollars based on the average exchange rate for the year 2016.

[8] Authors' translation from prices in pounds sterling quoted by the BEIS into US dollars based on the average exchange rate for the year 2016.

[9] At the time of this study, 169 nations had ratified the climate protection agreement.

4. CONCLUSION

The overall rankings in the IBC 2018 identify a familiar pattern. First place this year again belongs to Singapore, followed by Hong Kong and Switzerland. The remaining places in the Top 10 are all taken by OECD countries. Within this group, Canada and Ireland had made up the most ground compared to last year. By contrast, Germany and New Zealand have fallen out of the Top 10. Significantly greater changes took place in the middle and rearmost rankings. The greatest gainers at the global level this year were Guyana, Argentina and Myanmar, which have all risen by at least 20 places. This was due to improvements partly in the economic and partly in the politico-legal sphere. Worldwide, Cape Verde, Liberia and Belize have fallen by the greatest number of places, above all due to deterioration in economic markers. In a comparison of global regions, the best results were obtained again this year by Northern Europe, Northern America and Western Europe, while African regions bring up the rear.

This year's subject focus has presented a detailed picture of development trends in the various forms of raw-material use and developed a global ranking for use intensity. The consequences for society of raw-material use have also been presented in detail.

It has become significant that at the global level a high level of use intensity continues to hold sway. Particularly the advancing loss of forest cover in developing countries and the accumulation of electronic waste in developed countries give cause for concern. With respect to both phenomena, the long-term prognosis – a growing world population and increasing digitalisation – cannot be counted as a positive development. Furthermore, our index of use intensity demonstrates that countries at a high stage of development are above all resource-intensive. It is worthy of note in this connection, however, that three Gulf states have entered the Top 10, whereas no Western European country has returned there. It is also the case that a whole number of non-OECD countries occupy the leading places. It is thus becoming significant that emerging countries are definitely catching up. It will be interesting to monitor this process in the coming years. The connection between resource use and economic performance already observed in the individual analysis is also evident in the comparison of index values and gross domestic product. The economic catch-up process being undergone by emerging and developing countries therefore implies that in the medium term, no reduction in resource use can be expected.

By contrast, there is growing environmental awareness in the OECD countries. Thus, the tendency there is for forested areas, which are needed as CO2 sinks, to be on the increase and for land dedicated to agriculture to be on the decrease. In addition, the recycling of accumulated waste is coming into the foreground. Nevertheless, the harmful consequences for society of the high use of raw materials are immense. The majority of climate researchers are agreed that human activities are a driving force in global warming. In most highly developed economies, there are therefore corresponding political targets that also have a measurable impact on the economy and affect location decisions. Thus, the existence of energy-related taxes, duties and incentivising levies leads to higher energy prices for industry.
The present overview makes it clear that in the short term we cannot expect any easing-up on the theme of carbon dioxide. Accordingly, it is foreseeable that the economy will continue to be involved and will have to develop appropriate strategies for dealing with the subject of sustainability.

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APPENDIX A

COUNTRY OVERVIEW

Africa		
Eastern Africa	EAF	Burundi, Comoros, Djibouti, Ethiopia, Eritrea, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Tanzania, Uganda, Zambia, Zimbabwe
Middle Africa	MAF	Angola, Central African Republic, Chad, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Republic of Congo, São Tomé and Príncipe
Northern Africa	NAF	Algeria, Egypt, Libya, Morocco, Sudan, Tunisia
Southern Africa	SAF	Botswana, Lesotho, Namibia, South Africa, Swaziland
Western Africa	WAF	Benin, Burkina Faso, Cape Verde, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Mali, Mauretania, Niger, Nigeria, Senegal, Sierra Leone, Togo

Asia		
Central Asia	CAS	Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan
East Asia	EAS	China, Hongkong, Japan, Mongolia, North Korea, South Korea, Taiwan
Southern Asia	SAS	Afghanistan, Bangladesh, Bhutan, India, Iran, Maldives, Nepal, Pakistan, Sri Lanka
South-East Asia	SEAS	Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste, Vietnam
Western Asia	WAS	Armenia, Azerbaijan, Bahrain, Cyprus, Georgia, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen

Europe		
Eastern Europe	EEU	Belarus, Bulgaria, Czech Republic, Hungary, Moldova, Poland, Romania, Russia, Slovakia, Ukraine
Northern Europe	NEU	Denmark, Estonia, Finland, Ireland, Iceland, Latvia, Lithuania, Norway, Sweden, United Kingdom
Southern Europe	SEU	Albania, Bosnia and Herzegovina, Croatia, Greece, Italy, Kosovo, Malta, Macedonia, Montenegro, Portugal, Serbia, Slovenia, Spain
Western Europe	WEU	Austria, Belgium, France, Germany, The Netherlands, Switzerland

America		
Northern America	NAM	Canada, United States of America
Caribbean	CAR	Bahamas, Barbados, Dominican Republic, Haiti, Jamaica, St. Lucia, Trinidad and Tobago
Central America	CAM	Belize, Costa Rica, Guatemala, Honduras, Mexico, Nicaragua, Panama
South America	SAM	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, El Salvador, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela

Oceania		
Oceania	OCE	Australia, Fiji, New Zealand, Papua New Guinea, Solomon Islands, Samoa, Vanuatu

APPENDIX B

OVERVIEW OF VARIABLES

Variable	Definition	Description	Source
Population	Total population	All inhabitants, regardless of legal status or citizenship - excluding refugees without a permanent abode in the country of asylum, who would normally be included in the population of their country of origin.	2016 World Bank, World Development Indicators Online
Population growth	Average rate of growth of population	The annual rate of growth is calculated as the nth root of the total rate of growth, where n is the number of years in the period under consideration.	2012-2016 World Bank, World Development Indicators Online
GDP per capita	Gross domestic product per head adjusted for purchasing power	Gross domestic product – total value of all commodities (goods and services) converted to purchasing power parity.	2016 IMF, World Economic Outlook Database [10]
Unemployment rate	Unemployment rate (%)	Proportion of job seekers relative to all workers.	2016 IWF, World Economic Outlook Database [11]
National debt	Gross national debt (% of GDP)	Gross national debt relative to GDP; reflects total government securities in the national currency, less repayments.	2016 IMF, World Economic Outlook Database [12]
Per capita FDI inflows	Average FDI inflow per head	Average inflow per head of foreign direct investment (FDI).	2012–2016 World Bank, World Development Indicators Online
Inflation	Inflation (%)	Annual percentage change in average consumer prices.	2016 IMF, World Economic Outlook Database
Per capita consumer spending	Consumer spending per head by households (in constant 2000 US$)	Average consumer spending per head by private households. Consumer spending by private households is the market value of all goods and services purchased by households, including durable goods.	2016 World Bank, World Development Indicators Online [13]
Political stability	Between -2.5 and 2.5	Reflects the perception of the probability that the government will not be destabilised or overthrown by unconstitutional or violent means, including politically motivated violence and terrorism.	2016 World Bank, Worldwide Governance Indicators
Regulatory quality	Between -2.5 and 2.5	Reflects perceptions of the extent to which actors have confidence in and comply with the rules of society; especially the quality of contract performance and execution, property rights, police, courts, as well as the probability of crime and violence.	2016 World Bank, Worldwide Governance Indicators
The rule of law	Between -2.5 and 2.5	Reflects the perception of the extent to which public authority is exercised for private purposes; includes minor and major forms of corruption, as well as the "take" from the state by elites and private interests.	2016 World Bank , Worldwide Governance Indicators
Control of corruption	Between -2.5 und 2.5	Reflects the perception of the extent to which public authority is exercised for private purposes; includes minor and major forms of corruption, as well as the "take" from the state by elites and private interests.	2016 World Bank, Worldwide Governance Indicators
Health	Life expectancy at birth	Life expectancy at birth (index with a minimum value of 20 years and observed maximum values between 1984 and 2014).	2016 UNDP, Human Development Index
Education	Average school education	Average school education (index of average time spent in school education (adults) and expected time in school education (children).	2016 UNDP, Human Development Index
Business freedom	Between 0 and 100	Combines the general regulatory burden with the efficiency of the state in the regulatory process (measured value for the degree of bureaucracy).	2016 Index of Economic Freedom, Heritage Foundation
Trade freedom	Between 0 and 100	Lack of barriers to trade that hinder the export and import of goods and services.	2016 Index of Economic Freedom, Heritage Foundation
Investment freedom	Between 0 and 100	Extent of restrictions on the flow of investment capital.	2016 Index of Economic Freedom, Heritage Foundation
Labour freedom	Between 0 and 100	The legal and regulatory framework conditions for a country's labour market.	2016 Index of Economic Freedom, Heritage Foundation
Infrastructure	Between 1 und 5	Quality of trade- and transport-related infrastructure (e.g. ports, railways, roads, information technology).	2016 Daten der World Bank, Logistics Performance Index
Overall tax rate	Tax burden on business profits (%)	The proportion of taxes and duties on business profit after deductions and exemptions.	2016 Daten der World Bank, World Development Indicators Online
Market potential	Real market potential	The total economic performance of all countries worldwide, weighted for bilateral trading distance.	Own calculation
Wage costs	Based on gross domestic product per head adjusted for purchasing parity	Gross domestic product converted to purchasing power parity.	2016 IMF, World Economic Outlook Database

[10] Complemented by World Bank and CIA data.

[11] Complemented by data from the CIA and the African Development Bank.

[12] Complemented by World Bank data.

[13] Complemented by World Bank data.

APPENDIX C

INDEX RANKINGS

Country	Conti-nent	Index			Economic		Politico-legal		Socio-cultural	
					Framework conditions					
		Rank	Change	Value	Rank	Value	Rank	Value	Rank	Value
Singapore	AS	1	0	85.10	2	83.04	1	97.33	5	76.24
Hong Kong	AS	2	0	84.08	1	85.35	10	92.97	7	74.92
Switzerland	EU	3	0	81.84	5	71.47	3	95.87	1	79.99
The Netherlands	EU	4	0	80.14	3	79.37	6	94.24	18	68.81
Ireland	EU	5	2	78.81	4	77.15	12	90.60	15	70.02
Denmark	EU	6	-1	78.80	11	67.76	7	93.79	4	76.99
Norway	EU	7	-1	78.22	10	68.18	8	93.13	6	75.38
United Kingdom	EU	8	1	77.06	9	69.06	14	90.13	11	73.52
Canada	NAM	9	3	76.97	15	66.26	9	93.03	8	73.96
Australia	OC	10	1	76.17	25	60.85	11	90.94	2	79.85
Sweden	EU	11	4	75.92	14	66.72	4	94.90	17	69.10
Germany	EU	12	-4	75.39	6	70.52	16	89.66	19	67.78
New Zealand	OC	13	-3	74.99	35	59.37	2	96.53	10	73.60
United States	NAM	14	0	74.69	22	62.34	19	85.16	3	78.49
Austria	EU	15	1	73.28	20	62.95	15	89.87	16	69.55
Iceland	EU	16	1	72.95	29	60.08	13	90.34	14	71.52
Belgium	EU	17	-4	72.82	13	67.17	18	86.04	21	66.82
Finland	EU	18	0	72.71	17	64.38	5	94.84	29	62.96
Qatar	AS	19	2	72.04	7	69.77	40	73.98	12	72.42
Japan	AS	20	0	69.91	51	54.96	20	84.34	9	73.71
Israel	AS	21	3	68.70	32	59.58	36	75.51	13	72.07
South Korea	AS	22	3	68.32	12	67.63	43	72.90	25	64.69
United Arab Emirates	AS	23	3	68.07	8	69.48	46	72.19	30	62.89
Czech Republic	EU	24	-1	67.83	26	60.53	23	80.10	26	64.37
Taiwan	AS	25	-3	67.41	16	66.18	26	79.65	46	58.11
Brunei Darussalam	AS	26	5	67.21	18	63.30	35	76.05	28	63.06
Estonia	EU	27	3	67.16	28	60.35	17	86.89	50	57.76
France	EU	28	-9	66.91	19	62.99	30	78.29	35	60.75
Malta	EU	29	-2	66.84	41	57.38	22	82.78	31	62.87
Oman	AS	30	2	66.09	33	59.54	48	71.72	20	67.59
Slovenia	EU	31	2	65.55	30	59.80	31	78.14	36	60.27
Cyprus	AS	32	-4	65.15	27	60.37	32	77.65	42	59.00
Chile	LAM	33	-4	64.37	58	53.52	21	83.10	38	59.98
Lithuania	EU	34	7	63.99	24	61.13	29	78.42	60	54.64
Poland	EU	35	-1	63.49	40	57.65	34	76.54	48	58.01
Bahrain	AS	36	1	63.03	34	59.45	57	65.06	24	64.75
Latvia	EU	37	2	62.72	31	59.70	33	76.58	63	53.97
Hungary	EU	38	7	62.55	38	58.05	44	72.67	49	58.01
Slovakia	EU	39	4	62.41	36	58.93	38	74.73	57	55.20
Italy	EU	40	-5	62.36	45	56.35	45	72.41	39	59.43
Malaysia	AS	41	-5	62.35	37	58.74	53	67.07	33	61.53
Kuwait	AS	42	4	62.31	21	62.37	76	58.56	22	66.24
Spain	EU	43	-1	61.67	44	56.80	28	78.78	75	52.41
Saudi Arabia	AS	44	6	60.94	23	62.14	77	58.37	32	62.39
Portugal	EU	45	-5	60.73	52	54.46	25	79.81	82	51.53
Samoa	OC	46	-2	60.63	74	50.85	54	66.95	23	65.47
Georgia	AS	47	0	60.43	57	53.94	41	73.37	53	55.76
Uruguay	LAM	48	1	59.96	70	51.13	24	79.90	72	52.77
Mauritius	AF	49	-1	59.53	76	50.79	27	78.89	74	52.64
Romania	EU	50	1	59.50	48	55.50	49	69.73	61	54.45
Panama	LAM	51	6	58.48	47	55.56	58	64.78	55	55.57
Barbados	LAM	52	-11	57.97	126	46.40	39	74.38	52	56.44
Bahamas	LAM	53	0	57.85	66	51.61	61	63.91	44	58.71
Jordan	AS	54	11	57.46	86	50.27	60	63.95	41	59.02
Bulgaria	EU	55	1	57.05	53	54.37	55	66.14	81	51.64
Costa Rica	LAM	56	3	57.02	101	48.09	42	73.04	71	52.78
Croatia	EU	57	4	56.79	49	55.06	47	71.85	113	46.29
Vanuatu	OC	58	1	56.63	97	48.74	64	62.85	40	59.29
St. Lucia	LAM	59	-5	56.18	96	48.91	50	69.61	79	52.07
Botswana	AF	60	13	56.16	59	53.21	37	74.91	123	44.42
Namibia	AF	61	4	56.14	83	50.49	52	68.26	84	51.35
Fiji	OC	62	1	55.77	136	45.80	75	59.47	27	63.70
Montenegro	EU	63	-7	55.62	61	52.35	56	65.78	90	49.96
Trinidad & Tobago	LAM	64	-4	55.53	71	51.08	70	60.71	56	55.21
Kazakhstan	AS	65	7	55.38	46	55.90	105	52.18	45	58.24
Peru	LAM	66	2	55.36	82	50.50	63	63.25	67	53.12
Turkey	AS	67	-14	54.64	39	57.74	91	55.53	87	50.88
Azerbaijan	AS	68	1	54.23	56	53.98	119	49.15	37	60.12
Kosovo	EU	69	2	54.22	42	57.27	89	55.78	91	49.91
Mongolia	AS	70	5	54.21	90	49.68	83	57.53	54	55.75
Thailand	AS	71	-5	54.20	50	55.05	92	55.39	78	52.20
Mexico	LAM	72	2	53.91	80	50.62	88	56.13	58	55.13
Armenia	AS	73	4	53.84	62	52.30	69	60.90	96	48.99
Serbia	EU	74	5	53.61	73	51.01	67	61.37	94	49.21
Colombia	LAM	75	-8	53.50	104	47.93	72	60.43	69	52.87
Jamaica	LAM	76	-14	53.31	123	46.50	59	64.00	86	50.89
Macedonia	EU	77	4	52.91	43	57.03	74	60.07	127	43.24
Albania	EU	78	-2	52.87	75	50.79	62	63.26	115	45.99
Greece	EU	79	-1	52.60	87	50.11	66	62.21	109	46.67
Belarus	EU	80	7	52.54	79	50.63	122	48.57	43	58.97
Sri Lanka	AS	81	9	52.47	108	47.63	94	54.33	52	55.80
Dominican Republic	LAM	82	-2	52.38	110	47.48	73	60.08	89	50.36

Country	Conti-nent	Index			Economic		Politico-legal		Socio-cultural	
					Framework conditions					
		Rank	Change	Value	Rank	Value	Rank	Value	Rank	Value
Rwanda	AF	83	1	52.37	106	47.72	65	62.75	101	47.97
Vietnam	AS	84	-1	52.00	91	49.59	101	52.92	65	53.58
Solomon Islands	OC	85	1	51.58	100	48.32	118	49.19	51	57.72
China	AS	86	-1	51.57	54	54.25	127	47.78	68	52.93
Kyrgyzstan	AS	87	11	51.46	94	49.04	126	47.88	47	58.05
Lebanon	AS	88	3	51.35	134	45.87	123	48.44	34	60.94
Philippines	AS	89	3	51.16	88	49.89	107	51.85	80	51.76
Moldova	EU	90	5	50.93	81	50.58	103	52.84	93	49.42
El Salvador	LAM	91	-3	50.09	132	45.98	68	61.20	122	44.65
Guyana	LAM	92	27	50.05	116	46.99	93	55.39	100	48.18
Bhutan	AS	93	-4	49.93	131	45.98	80	58.00	110	46.67
Paraguay	LAM	94	10	49.80	98	48.52	84	57.41	124	44.34
Russia	EU	95	14	49.61	55	54.12	140	43.19	77	52.23
Belize	LAM	96	-14	49.54	129	46.04	109	51.51	85	51.27
Maldives	AS	97	0	49.50	65	51.81	131	46.21	88	50.68
Argentina	LAM	98	26	49.46	149	43.31	99	53.45	76	52.27
Nicaragua	LAM	99	0	49.38	121	46.64	96	53.86	103	47.93
Cape Verde	AF	100	-30	49.33	155	42.81	51	69.09	140	40.57
Brazil	LAM	101	-5	49.27	119	46.81	102	52.85	98	48.35
Ghana	AF	102	-8	49.24	137	45.57	79	58.18	118	45.01
Indonesia	AS	103	-3	48.99	93	49.06	108	51.84	114	46.24
Tanzania	AF	104	10	48.97	122	46.60	104	52.81	104	47.73
South Africa	AF	105	5	48.89	60	53.01	81	57.82	153	38.12
Morocco	AF	106	-1	48.89	99	48.47	71	60.71	147	39.71
Bosnia Herzegovina	EU	107	-14	48.86	64	51.81	78	58.27	151	38.64
Guatemala	LAM	108	-2	48.50	109	47.54	98	53.57	119	44.80
Uganda	AF	109	9	48.49	130	45.99	106	52.10	105	47.60
Ecuador	LAM	110	1	48.44	107	47.70	136	45.12	70	52.82
Suriname	LAM	111	-8	48.35	144	43.52	114	50.54	83	51.39
Cambodia	AS	112	-5	48.23	138	45.16	113	50.70	95	49.01
Timor-Leste	AS	113	-11	47.80	69	51.16	128	47.77	120	44.70
Papua-New Guinea	OC	114	-6	47.75	135	45.81	137	45.10	73	52.70
Tunisia	AF	115	-14	47.75	72	51.06	129	47.70	121	44.70
Zambia	AF	116	-3	47.37	128	46.14	87	56.15	134	41.03
Gabon	AF	117	-5	47.33	143	43.97	124	48.42	92	49.80
Laos	AS	118	-3	46.99	117	46.97	125	48.08	116	45.94
Kenya	AF	119	8	46.88	102	48.04	133	46.01	111	46.61
Egypt	AF	120	-4	46.79	89	49.84	135	45.48	117	45.18
Honduras	LAM	121	-4	46.76	140	44.87	110	51.42	125	44.32
India	AS	122	4	46.64	84	50.43	116	49.88	143	40.34
Bangladesh	AS	123	7	46.55	92	49.21	141	43.07	107	47.59
Iraq	AS	124	-1	45.95	105	47.81	155	37.28	62	54.42
Madagascar	AF	125	-4	45.94	158	42.42	117	49.33	112	46.33
São Tomé and Príncipe	AF	126	-4	45.76	145	43.50	90	55.58	148	39.63
Algeria	AF	127	4	45.74	77	50.75	149	38.67	97	48.77
Tajikistan	AS	128	4	45.58	118	46.95	153	37.56	64	53.70

Country	Conti-nent	Index			Economic		Politico-legal		Socio-cultural	
					Framework conditions					
		Rank	Change	Value	Rank	Value	Rank	Value	Rank	Value
Malawi	AF	129	-9	45.38	159	42.31	112	50.71	126	43.54
Benin	AF	130	-2	45.32	133	45.98	85	56.60	158	35.77
Ukraine	EU	131	3	45.27	103	48.04	145	40.56	106	47.60
Myanmar	AS	132	20	45.21	111	47.44	144	40.62	102	47.95
Djibouti	AF	133	3	45.17	125	46.41	120	48.84	139	40.65
Senegal	AF	134	-5	44.65	146	43.43	82	57.58	160	35.60
Uzbekistan	AS	135	3	44.36	68	51.36	165	31.08	59	54.70
Swaziland	AF	136	-3	44.13	95	48.96	95	53.98	166	32.53
Ivory Coast	AF	137	10	43.67	124	46.41	100	52.96	164	33.88
Nepal	AS	138	1	43.36	85	50.43	154	37.53	128	43.08
Iran	AS	139	5	43.33	63	52.22	164	32.31	99	48.21
Burkina Faso	AF	140	-5	43.33	127	46.40	97	53.71	165	32.64
Pakistan	AS	141	-1	43.30	78	50.67	146	39.35	137	40.71
Niger	AF	142	4	42.97	157	42.53	132	46.03	141	40.51
Togo	AF	143	-1	42.87	154	42.82	115	50.50	157	36.43
Gambia	AF	144	-7	42.71	167	39.70	111	51.20	152	38.33
Bolivia	LAM	145	-4	42.45	160	42.27	150	38.50	108	47.00
Ethiopia	AF	146	-1	41.25	148	43.32	152	37.65	129	43.03
Liberia	AF	147	-22	40.96	152	42.94	139	43.41	156	36.86
Nigeria	AF	148	1	40.76	120	46.79	160	35.36	135	40.93
Comoros	AF	149	2	40.65	173	35.65	134	45.68	132	41.24
Burundi	AF	150	-7	40.41	151	43.11	151	37.92	142	40.36
Haiti	LAM	151	-3	40.24	163	41.55	147	39.25	144	39.97
Cameroon	AF	152	4	39.74	150	43.14	156	36.51	146	39.86
Republic of the Congo	AF	153	6	39.73	170	39.08	148	38.76	131	41.41
Equatorial Guinea	AF	154	6	39.40	161	42.16	162	33.84	130	42.87
Mozambique	AF	155	-1	39.13	166	40.62	143	41.84	161	35.26
Lesotho	AF	156	-6	39.07	142	44.02	86	56.27	174	24.07
Guinea	AF	157	-4	38.73	156	42.57	142	42.25	167	32.31
Sierra Leone	AF	158	-3	38.70	153	42.92	121	48.82	172	27.66
Turkmenistan	AS	159	3	38.26	115	47.01	167	29.14	136	40.89
Angola	AF	160	-3	38.13	164	41.53	157	36.21	155	36.86
Yemen	AS	161	4	37.97	114	47.19	163	33.27	162	34.88
Mauretania	AF	162	2	37.54	169	39.13	138	44.23	170	30.57
Libya	AF	163	7	37.43	113	47.22	169	27.28	138	40.70
Mali	AF	164	-1	37.06	141	44.04	130	46.43	173	24.90
Guinea-Bissau	AF	165	1	36.74	162	41.94	161	34.27	163	34.51
Zimbabwe	AF	166	2	36.63	165	41.12	166	30.61	150	39.06
Dem. Republic of the Congo	AF	167	-6	36.60	139	45.06	168	27.72	149	39.25
Chad	AF	168	-1	35.61	168	39.23	158	36.04	168	31.93
Central African Republic	AF	169	0	34.24	171	38.33	159	35.96	171	29.12
Eritrea	AF	170	2	33.56	172	38.09	170	26.06	154	38.08
Afghanistan	AS	171	-13	33.47	112	47.25	173	19.33	133	41.07
Sudan	AF	172	1	30.81	147	43.42	171	21.26	169	31.68
Venezuela	LAM	173	-2	29.96	174	32.10	172	20.99	145	39.90
North Korea	AS	174	0	27.76	67	51.49	174	11.66	159	35.62

APPENDIX D

SALES AND PRODUCTION SUBINDEX RANKINGS

Country	Production location			Sales location		
	Value	Rank	Change	Value	Rank	Change
AFRICA						
Algeria	51.13	24	7	41.52	27	6
Angola	42.92	38	3	38.77	40	-14
Benin	54.44	16	-6	45.66	12	12
Botswana	64.69	3	0	56.54	1	3
Burkina Faso	53.24	18	-5	43.47	23	6
Burundi	39.05	44	-23	35.60	48	-10
Cameroon	44.15	33	6	38.09	43	2
Cape Verde	56.91	11	-2	47.64	8	0
Central African Rep.	34.39	49	-5	34.07	49	-1
Chad	43.20	36	-2	36.48	45	-1
Comoros	31.30	50	1	45.39	13	-1
Dem. Rep. Congo	29.95	51	-3	34.04	50	0
Djibouti	55.58	12	6	39.77	35	7
Egypt	59.26	5	3	44.91	15	-1
Equatorial Guinea	39.67	43	2	38.52	41	-16
Eritrea	34.45	48	2	39.76	36	11
Ethiopia	43.66	35	1	37.95	44	-3
Gabon	52.62	20	2	42.70	25	-5
Gambia	51.55	22	-2	41.05	30	1
Ghana	58.59	6	-1	43.68	22	-9
Guinea	43.03	37	-4	39.77	34	2
Guinea-Bissau	39.72	42	1	39.84	32	0
Ivory Coast	53.85	17	2	43.21	24	-1
Kenya	57.09	9	3	44.72	16	19
Lesotho	51.28	23	14	43.90	20	-14
Liberia	36.88	47	-19	38.87	39	-20
Libya	48.34	28	12	35.63	47	2
Madagascar	43.84	34	-4	43.70	21	1
Malawi	47.03	30	-23	44.10	19	-9
Mali	49.43	26	0	39.36	37	6
Mauretania	45.05	32	-3	36.41	46	-19
Mauritius	66.02	1	0	54.96	3	-2
Morocco	55.50	13	1	48.21	6	5
Mozambique	38.24	45	-3	40.87	31	-3

Country	Production location			Sales location		
	Value	Rank	Change	Value	Rank	Change
AFRICA						
Namibia	65.91	2	0	54.01	4	-1
Niger	41.97	41	-6	39.84	33	7
Nigeria	53.17	19	-2	38.19	42	-3
Republic of the Congo	47.50	29	17	41.14	29	17
Rwanda	58.49	7	-3	46.42	9	7
São Tomé & Príncipe	50.46	25	0	45.26	14	-7
Senegal	49.25	27	-3	44.36	17	-2
Sierra Leone	42.80	39	-12	42.24	26	-8
South Africa	61.13	4	2	55.95	2	0
Sudan	42.60	40	7	31.17	51	0
Swaziland	57.06	10	1	50.11	5	0
Tanzania	54.85	15	1	47.71	7	10
Togo	46.67	31	1	44.17	18	3
Tunisia	55.12	14	1	41.17	28	6
Uganda	58.25	8	30	46.31	10	20
Zambia	52.30	21	2	46.24	11	-2
Zimbabwe	37.98	46	3	39.34	38	-1

Country	Production location			Sales location		
	Value	Rank	Change	Value	Rank	Change
ASIA						
Afghanistan	37.92	44	-9	31.43	44	0
Armenia	65.47	14	2	44.98	31	-9
Azerbaijan	63.39	16	1	49.82	21	-1
Bahrain	74.96	3	1	52.46	14	3
Bangladesh	57.07	24	9	41.63	38	1
Bhutan	56.25	26	-1	45.10	30	-6
Brunei Darussalam	71.03	7	0	59.72	9	-1
Cambodia	55.06	29	-6	47.97	24	-1
China	59.51	20	-1	69.00	3	-2
Cyprus	69.67	9	-1	59.19	10	-1
Georgia	67.62	11	0	50.62	19	-1
Hong Kong	92.46	2	0	69.50	2	1
India	57.28	23	6	63.45	6	1
Indonesia	53.27	34	-3	50.82	18	-2
Iran	48.71	38	4	42.47	36	4
Iraq	55.03	30	-3	40.64	42	-9
Jordan	65.39	15	-1	52.11	15	12
Kazakhstan	61.96	18	2	48.71	22	4
Laos	49.26	37	-3	46.41	26	2
Kuwait	66.09	12	0	54.24	12	0
Kyrgyzstan	56.50	25	-3	41.70	37	1
Lebanon	58.94	21	0	45.75	28	4
Malaysia	68.82	10	-1	55.89	11	-1
Maldives	56.13	27	5	44.17	33	-3
Mongolia	60.07	19	-1	48.22	23	-2
Myanmar	51.91	35	2	45.41	29	6
Nepal	44.78	40	-1	41.08	41	1
North Korea	46.42	39	1	41.22	40	-4
Oman	70.36	8	2	61.38	8	3
Pakistan	54.95	31	-3	39.44	43	-2
Philippines	57.61	22	2	44.08	34	-9
Qatar	73.29	5	1	61.87	7	-3
Saudi Arabia	65.95	13	0	53.22	13	0
Singapore	95.72	1	0	71.67	1	1
Sri Lanka	53.57	33	5	47.62	25	4
Taiwan	73.15	6	-3	63.53	5	0
Tajikistan	43.38	42	-1	41.55	39	-5
Thailand	63.06	17	-2	50.13	20	-1
Timor-Leste	51.36	36	-6	51.09	17	-2
Turkmenistan	38.51	43	1	45.80	27	4
United Arab Emirates	74.51	4	1	66.42	4	2
Uzbekistan	44.76	41	2	43.87	35	2

Country	Production location			Sales location		
	Value	Rank	Change	Value	Rank	Change
ASIA						
Vietnam	55.70	28	-2	51.37	16	-2
Yemen	53.59	32	4	44.60	32	11

Country	Production location			Sales location		
	Value	Rank	Change	Value	Rank	Change
EUROPE						
Albania	58.68	12	-1	48.35	12	-7
Belarus	55.09	13	1	46.94	13	0
Bosnia & Herzegovina	64.08	11	1	49.74	7	2
Bulgaria	65.48	7	-2	50.21	6	0
Croatia	68.76	4	2	57.72	4	0
Kosovo	66.23	6	1	48.54	11	0
Latvia	74.20	1	1	57.87	3	0
Lithuania	73.86	2	-1	61.63	1	1
Macedonia	64.58	10	0	49.16	8	4
Malta	71.01	3	0	60.68	2	-1
Moldova	54.02	14	-1	46.12	15	-1
Montenegro	65.34	8	-4	48.88	10	-3
Romania	68.20	5	3	54.66	5	3
Russia	51.19	15	0	46.70	14	1
Serbia	64.81	9	0	49.02	9	1
Ukraine	50.83	16	0	41.98	16	0

Country	Production location			Sales location		
	Value	Rank	Change	Value	Rank	Change
LATIN AMERICA						
Argentina	49.83	20	3	49.16	10	3
Bahamas	62.21	3	2	52.10	5	-3
Barbados	63.82	2	-1	51.64	6	-5
Belize	53.08	17	-3	47.41	16	-1
Bolivia	35.04	24	0	44.44	22	1
Brazil	55.52	15	0	52.15	4	3
Colombia	60.90	7	0	45.71	20	0
Costa Rica	58.41	11	0	52.74	3	5
Dominican Republic	58.68	10	-1	48.60	11	0
Ecuador	49.73	21	0	46.51	17	2
El Salvador	57.10	13	-1	48.47	12	-2
Guatemala	52.19	19	-2	46.08	19	-3
Guyana	57.41	12	4	46.30	18	3
Haiti	42.73	23	-3	37.13	24	0
Honduras	46.74	22	0	43.98	23	-1
Jamaica	62.12	5	-3	47.52	15	-6
Nicaragua	53.85	16	2	47.60	14	4
Panama	62.20	4	4	55.27	2	2
Paraguay	52.32	18	1	48.25	13	4
Peru	59.48	9	1	50.58	8	4
St. Lucia	61.26	6	-3	50.75	7	-1
Suriname	56.57	14	-1	45.31	21	-7
Trinidad & Tobago	60.08	8	-2	50.14	9	-4
Uruguay	66.34	1	3	56.41	1	2
Venezuela	33.97	25	0	25.15	25	0

Country	Production location			Sales location		
	Value	Rank	Change	Value	Rank	Change
OCEANIA						
Fiji	55.59	3	0	57.00	4	0
Papua-New Guinea	47.92	4	1	55.30	5	0
Solomon Islands	45.90	5	-1	58.40	3	0
Samoa	63.03	1	0	62.23	1	0
Vanuatu	59.61	2	0	60.19	2	0

Country	Production location			Sales location		
	Value	Rank	Change	Value	Rank	Change
OECD						
Australia	76.67	17	2	71.71	11	-1
Austria	83.21	9	0	71.07	12	2
Belgium	87.16	5	-2	69.32	14	-1
Canada	85.57	7	0	74.75	4	0
Chile	70.68	29	0	55.48	31	-2
Czech Republic	77.94	14	-1	61.80	21	3
Denmark	88.05	3	1	71.98	9	2
Estonia	75.04	20	0	59.04	28	-5
Finland	77.42	16	-2	71.71	10	6
France	76.45	18	-1	66.65	18	-1
Germany	86.50	6	0	73.45	6	-1
Greece	63.59	32	0	58.24	30	-3
Hungary	70.96	28	-4	60.36	25	5
Iceland	72.37	24	3	66.74	17	1
Ireland	83.83	8	0	68.83	16	-1
Israel	74.55	21	1	59.30	27	4
Italy	72.35	25	0	66.30	19	0
Japan	82.71	10	0	73.00	7	1
Mexico	60.09	33	0	50.55	32	1
Netherlands	92.05	1	0	72.83	8	-2
New Zealand	77.73	15	1	68.85	15	-6
Norway	78.62	13	2	78.41	2	-1
Poland	71.13	27	-1	58.42	29	-1
Portugal	68.36	30	0	61.65	23	-2
Slovakia	71.32	26	2	59.47	26	0
Slovenia	73.07	23	0	61.76	22	0
South Korea	76.42	19	-1	60.57	24	1
Spain	73.71	22	-1	64.85	20	0
Sweden	79.99	12	0	73.92	5	2
Switzerland	87.59	4	1	78.77	1	1
Turkey	66.05	31	0	48.87	33	-1
United Kingdom	89.28	2	0	70.78	13	-1
United States	81.99	11	0	75.78	3	0

APPENDIX E

RESOURCE-USE INDEX RANKINGS

Country	Use index		Subindicators (normalised 0-100)				
	Rank	Index	Energy	Electronic waste	Agriculture	Forest	Water
United States	1	59.20	66.01	67.53	46.83	39.96	75.67
Canada	2	57.83	75.29	69.20	47.00	43.61	54.06
Finland	3	56.61	59.39	73.29	49.68	41.15	59.55
Norway	4	54.84	53.25	100.00	48.94	43.03	28.96
Brunei Darussalam	5	53.79	90.20	62.98	52.70	52.34	10.70
Estonia	6	53.37	44.20	49.68	62.27	45.81	64.89
New Zealand	7	50.74	43.70	70.23	38.72	43.94	57.14
Saudi Arabia	8	50.18	65.90	54.30	49.45	43.32	37.95
Bahrain	9	50.06	100.00	48.27	46.70	42.42	12.89
Kuwait	10	49.69	87.18	57.10	49.44	43.11	11.60
North Korea	11	47.00	28.30	40.18	50.80	98.97	16.75
The Netherlands	12	46.62	41.32	83.21	35.80	41.47	31.28
Slovenia	13	46.14	30.71	55.16	75.30	42.01	27.54
Kazakhstan	14	46.07	40.54	27.85	57.98	43.37	60.61
Chile	15	45.92	19.30	30.04	48.95	31.28	100.00
Belgium	16	45.52	44.99	73.74	40.87	41.71	26.29
United Arab Emirates	17	45.24	72.98	49.76	39.26	42.65	21.55
Sweden	18	45.23	47.04	75.41	47.80	42.50	13.39
Germany	19	44.55	35.39	79.23	45.40	42.84	19.91
Australia	20	44.17	51.19	82.77	0.00	45.31	41.58
Guyana	21	43.82	9.87	20.14	49.65	45.36	94.08
Iraq	22	43.76	13.23	19.65	48.99	43.25	93.70
Portugal	23	43.20	19.11	60.29	42.95	50.18	43.48
Oman	24	42.89	59.49	45.79	49.66	43.32	16.19
Japan	25	42.85	34.52	58.20	47.01	43.04	31.50
South Korea	26	42.81	50.03	44.53	41.84	49.37	28.28
Uzbekistan	27	42.64	13.21	15.34	49.94	44.25	90.47
United Kingdom	28	42.58	26.62	86.56	53.22	40.63	5.89
Austria	29	42.37	36.03	72.21	41.65	42.00	19.96
Argentina	30	41.72	18.82	28.32	68.76	49.25	43.44
Singapore	31	41.55	49.16	61.71	48.77	46.86	1.27
Paraguay	32	41.02	7.01	21.78	73.14	85.25	17.93
France	33	40.89	34.72	71.22	43.77	32.43	22.30
Iran	34	40.53	29.31	26.40	44.65	43.32	58.97
Ireland	35	39.83	26.57	67.54	58.54	38.78	7.73
Switzerland	36	39.77	28.94	75.17	44.60	38.36	11.77
Thailand	37	39.58	18.49	24.68	73.13	40.23	41.37

Country	Use index		Subindicators (normalised 0-100)				
	Rank	Index	Energy	Electronic waste	Agriculture	Forest	Water
Denmark	38	39.37	28.36	85.64	41.82	35.73	5.31
Suriname	39	38.92	11.35	32.84	50.08	44.64	55.68
Russia	40	38.54	47.73	32.75	50.22	41.26	20.72
Hong Kong	41	38.09	18.76	66.03	40.90	43.32	21.45
Taiwan	42	37.72	28.30	40.18	47.23	51.42	21.45
Czech Republic	43	37.68	37.49	54.89	46.81	41.86	7.37
Timor-Leste	44	37.66	0.71	8.68	47.98	83.13	47.80
Croatia	45	37.53	17.89	43.58	77.67	41.52	7.01
Italy	46	37.31	22.78	66.10	20.32	33.65	43.70
Spain	47	37.00	23.03	69.45	21.10	31.74	39.67
Malta	48	36.66	18.71	52.86	63.58	43.32	4.83
Venezuela	49	36.61	20.54	27.10	49.63	49.49	36.31
Libya	50	36.61	5.77	37.98	49.51	43.32	46.47
Greece	51	36.60	19.30	60.83	28.26	30.94	43.69
Tajikistan	52	36.54	2.62	15.34	53.49	43.11	68.16
Israel	53	36.16	26.32	48.29	53.91	40.88	11.42
Armenia	54	35.98	9.28	15.57	61.67	43.32	50.08
Lithuania	55	35.91	22.90	45.43	62.69	38.24	10.29
Myanmar	56	35.01	2.91	2.33	60.48	77.84	31.50
Uruguay	57	34.98	12.60	36.63	39.09	33.56	52.99
Azerbaijan	58	34.90	13.98	21.47	50.24	26.56	62.24
Honduras	59	34.63	5.23	6.02	53.25	100.00	8.65
Indonesia	60	34.42	7.90	15.90	63.28	63.29	21.72
Bulgaria	61	34.31	22.97	37.84	38.56	34.81	37.34
Bahamas	62	34.29	19.61	42.93	50.08	43.32	15.52
Kyrgyzstan	63	34.24	5.69	2.83	44.89	49.72	68.07
Haiti	64	33.82	3.16	35.42	79.27	44.85	6.39
Togo	65	33.73	3.78	1.62	100.00	62.56	0.70
Mexico	66	33.67	14.14	26.32	49.94	46.15	31.82
Slovakia	67	33.18	28.83	42.29	47.73	42.36	4.69
Albania	68	33.01	7.51	23.24	66.68	45.42	22.20
Sri Lanka	69	32.81	4.29	14.49	67.24	47.36	30.68
Latvia	70	32.78	20.31	38.33	61.28	38.23	5.74
Brazil	71	32.72	13.87	24.77	55.45	51.66	17.84
Kosovo	72	32.63	10.91	44.79	50.61	32.65	24.17
Egypt	73	32.13	7.34	17.01	51.04	43.29	41.97
Uganda	74	31.71	2.04	0.78	76.12	79.27	0.36
Malaysia	75	31.66	27.72	30.39	59.79	22.33	18.04
Zimbabwe	76	31.54	7.27	1.49	50.84	87.00	11.11
Panama	77	31.33	9.89	27.57	51.35	55.05	12.80
Pakistan	78	30.95	4.03	4.16	51.39	46.27	48.93
El Salvador	79	30.68	5.60	18.71	58.19	54.54	16.38
Hungary	80	30.67	22.14	47.63	18.99	39.49	25.11
Peru	81	30.15	6.82	18.90	53.71	49.74	21.56
Ukraine	82	30.03	21.87	20.41	49.41	42.56	15.92
Serbia	83	29.95	17.76	24.20	50.61	28.57	28.60
China	84	29.93	21.07	17.14	54.93	34.72	21.79

Country	Use index		Subindicators (normalised 0-100)				
	Rank	Index	Energy	Electronic waste	Agriculture	Forest	Water
South Africa	85	29.77	25.72	18.95	47.06	43.32	13.83
Tanzania	86	29.75	3.96	1.07	72.89	66.35	4.49
Belize	87	29.72	7.67	20.81	51.29	54.96	13.88
Lebanon	88	29.43	12.42	28.67	51.95	42.90	11.21
Colombia	89	29.35	6.12	18.63	58.74	51.41	11.84
Philippines	90	29.21	3.94	8.57	67.10	26.20	40.23
Cyprus	91	29.20	16.09	47.00	28.89	43.40	10.60
St. Lucia	92	29.18	8.05	30.43	47.24	48.52	11.68
Cambodia	93	29.13	3.42	1.79	52.30	81.46	6.68
Romania	94	29.09	15.20	39.74	42.26	32.59	15.64
Vietnam	95	28.97	6.43	4.03	75.28	14.41	44.69
Georgia	96	28.86	10.65	18.61	51.57	39.52	23.97
Barbados	97	28.84	14.05	45.79	27.23	43.32	13.81
Botswana	98	28.84	11.82	23.79	50.95	53.60	4.00
Bosnia & Herzegovina	99	28.78	20.64	23.78	52.04	43.32	4.13
Poland	100	28.74	23.43	40.86	25.61	39.19	14.62
Macedonia	101	28.70	11.54	24.13	58.21	36.81	12.79
Malawi	102	28.63	0.78	0.51	80.72	57.61	3.51
Bolivia	103	28.46	6.95	10.34	52.90	62.69	9.41
Belarus	104	28.13	28.64	25.43	40.82	38.26	7.52
Swaziland	105	28.07	8.44	13.65	49.04	29.49	39.72
Turkey	106	27.90	17.40	26.35	32.87	36.09	26.78
Tunisia	107	27.48	8.53	18.18	57.31	39.03	14.35
Madagascar	108	27.32	1.04	0.64	53.77	46.69	34.47
Solomon Islands	109	27.18	1.86	1.01	52.87	53.89	26.28
Algeria	110	27.09	12.09	20.59	50.10	42.39	10.29
Mauritius	111	26.76	10.30	29.43	23.54	42.28	28.25
Equatorial Guinea	112	26.65	18.23	6.63	42.74	65.36	0.31
Ecuador	113	26.64	7.91	18.07	16.46	60.07	30.68
Costa Rica	114	26.63	9.31	33.59	50.17	15.89	24.21
Benin	115	26.21	3.40	1.32	59.41	66.75	0.17
Cameroon	116	25.84	3.00	1.51	55.06	67.92	1.71
Namibia	117	25.70	6.69	18.61	49.54	48.08	5.60
Burkina Faso	118	25.70	1.55	0.73	69.46	54.89	1.86
Mongolia	119	25.61	17.11	15.00	47.91	39.08	8.95
Morocco	120	25.49	4.68	11.38	56.09	40.58	14.72
Jamaica	121	25.34	8.83	19.51	39.39	45.27	13.71
Gambia	122	25.30	1.04	2.46	86.67	34.44	1.89
Vanuatu	123	25.12	2.26	2.57	51.18	43.32	26.28
India	124	25.06	5.47	3.92	48.95	38.03	28.91
Gabon	125	24.95	25.43	23.65	49.60	22.81	3.24
Afghanistan	126	24.91	0.47	0.69	49.60	43.32	30.46
Guinea-Bissau	127	24.74	3.39	0.60	53.02	62.11	4.60
Zambia	128	24.74	5.57	1.85	56.55	55.16	4.56
Nicaragua	129	24.61	5.34	6.70	39.97	58.69	12.37
Jordan	130	24.58	8.31	14.73	51.63	43.35	4.87
Liberia	131	24.20	3.84	2.51	53.85	59.78	1.02

Country	Use index		Subindicators (normalised 0-100)				
	Rank	Index	Energy	Electronic waste	Agriculture	Forest	Water
Nigeria	132	24.10	6.70	3.91	39.57	67.09	3.25
Samoa	133	23.97	4.84	7.71	37.71	43.32	26.28
Angola	134	23.95	4.58	9.94	55.77	48.61	0.85
Ethiopia	135	23.57	4.18	0.34	62.43	45.97	4.95
Bhutan	136	23.52	18.17	7.51	41.10	29.55	21.28
Senegal	137	23.49	2.00	2.09	51.90	54.30	7.16
Mozambique	138	23.40	3.52	0.73	53.88	57.69	1.16
Mali	139	23.12	0.26	1.01	52.79	46.74	14.81
Burundi	140	23.08	0.84	0.33	89.49	23.77	0.99
Mauretania	141	22.94	2.34	2.84	49.83	43.54	16.13
Guinea	142	22.87	3.47	0.93	57.02	51.06	1.88
Fiji	143	22.54	5.26	16.75	48.81	37.55	4.32
Dem. Rep. Congo	144	22.27	3.17	6.63	50.98	50.58	0.00
Nepal	145	22.27	3.41	1.45	46.88	43.32	16.28
São Tomé & Príncipe	146	22.13	2.47	2.19	48.10	56.53	1.36
Eritrea	147	21.95	3.46	0.77	52.93	45.62	6.99
Comoros	148	21.92	0.95	1.32	49.60	57.52	0.19
Ivory Coast	149	21.85	5.29	1.93	55.65	43.38	2.97
Dominican Republic	150	21.75	6.37	18.24	43.13	7.11	33.88
Cape Verde	151	21.70	3.08	14.38	54.37	35.04	1.62
Guatemala	152	21.68	7.44	12.93	15.13	62.95	9.96
Republic of the Congo	153	21.68	4.62	7.62	50.73	45.44	0.01
Moldova	154	21.53	8.37	4.92	43.96	35.89	14.49
Maldives	155	21.52	12.24	19.82	31.97	43.32	0.27
Niger	156	21.34	0.86	0.00	59.92	43.84	2.10
Ghana	157	21.30	2.60	3.54	62.28	36.72	1.36
Yemen	158	21.15	2.26	4.03	49.81	43.32	6.32
Papua-New Guinea	159	20.93	5.96	1.71	51.30	43.63	2.06
Chad	160	20.82	0.74	0.80	51.15	48.63	2.77
Bangladesh	161	20.74	1.52	1.73	45.29	44.37	10.78
Kenya	162	20.72	4.33	1.42	54.91	39.92	3.03
Djibouti	163	19.59	2.23	2.03	49.81	43.32	0.58
South Sudan	164	19.08	0.00	18.06	29.66	45.29	2.39
Central African Republic	165	18.98	0.64	0.73	48.56	44.64	0.34
Lesotho	166	18.45	6.16	1.54	41.73	42.27	0.56
Sierra Leone	167	17.77	1.62	0.27	58.73	27.21	1.03
Laos	168	17.67	2.12	2.57	57.60	0.00	26.06
Rwanda	169	16.03	1.37	0.40	55.22	22.97	0.20

APPENDIX F

LIST OF COUNTRY CODES

Code	Country	Code	Country
BHR	Bahrain	ISL	Iceland
BRA	Brazil	JPN	Japan
CAN	Canada	KOR	South Korea
CHN	China	MOZ	Mozambique
ETH	Ethiopia	RUS	Russian Federation
FIN	Finland	TGO	Togo
GER	Germany	TKM	Turkmenistan
HKG	Hong Kong	TTO	Trinidad und Tobago
IND	India	USA	USA
IRN	Iran	ZWE	Zimbabwe

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