

## Vision 2050: Estimating the order of magnitude of sustainability-related business opportunities in key sectors

PricewaterhouseCoopers (PwC) has been one of the key corporate sponsors of the 'Vision 2050' project of the World Business Council for Sustainable Development (WBCSD). As part of our contribution to this project, we have prepared this short illustrative analysis of the order of magnitude of the additional global business opportunities that might arise in key sectors if this vision of a more sustainable future in 2050 is realised.

We adopted a top-down approach to this task rather than attempting to do a bottom-up analysis of all the possible business opportunities that might arise between now and 2050, which would be a huge task if indeed it was possible at all over such a timescale. We did, however, make use of the bottom-up analysis that has previously been carried out in the climate change area. The analysis focused on required additional investment or spending in two key areas where sustainability issues, broadly defined as in the Vision 2050 study, are particularly critical: natural resources (including energy, forestry, agriculture and food, water and metals) and health and education (in terms of social sustainability). Our approach in these areas, as described further below, was as follows:

- **Natural resources:** estimates of required additional investments in the energy sector related to reducing carbon emissions are based on projections in the IEA's 2008 Technology Perspectives 2050 report; estimates for other natural resources sectors are benchmarked against these energy estimates, taking account of the relative size of different sectors and a broad judgemental assessment of the required scale of the transformation in each sector to achieve desired Vision 2050 outcomes; these opportunities will be broadly spread across the world economy; and
- **Health and education:** estimates here are based on raising emerging economy health and education GDP shares to 2005 G7 levels by 2050 (bearing in mind that G7 education and health spending shares of GDP will probably have increased further by then); we then make a broad judgemental assumption on the proportion of the increased health and education spending in emerging economies that will translate into increased spending on private sector goods and services. Some of this demand, however, could be met by businesses from OECD countries.

Table 1 below summarises the illustrative estimates arising from this analysis. Given the large uncertainties involved in any such exercise, we would advise paying more attention to the range of estimates presented than to the mid-point values.

**Table 1: Illustrative estimates of the global order of magnitude of potential additional sustainability-related business opportunities in key sectors in 2050**

Sectors	Annual value in 2050 (US\$ trillion at constant 2008 prices: mid-points with ranges shown in brackets)	% of projected world GDP in 2050
Energy	2.0 (1.0-3.0)	1.0 (0.5-1.5)
Forestry	0.2 (0.1-0.3)	0.1 (0.05-0.15)
Agriculture and food	1.2 (0.6-1.8)	0.6 (0.3-0.9)
Water	0.2 (0.1-0.3)	0.1 (0.05-0.15)
Metals	0.5 (0.2-0.7)	0.2 (0.1-0.3)
<b>Total: Natural resources</b>	<b>4.1 (2.1-6.3)</b>	<b>2.0 (1.0-3.0)</b>
Health and education	2.1 (0.8-3.5)	1.0 (0.5-1.5)
<b>Total</b>	<b>6.2 (2.9-9.8)</b>	<b>3.0 (1.5-4.5)</b>

Source: PwC estimates drawing on data from IEA, OECD and the World Bank

Overall, our estimates suggest **additional global business opportunities building up steadily to an annual amount of the order of around \$3-10 trillion in 2050 at today's values**. The sustainability agenda is therefore likely to be of considerable potential significance to business, whatever the precise estimates adopted from within this broad range.

## Further details of analysis and assumptions for each sector

### 1. Natural resource sectors

We began here by estimating the size of the five natural resource sectors under consideration. For the sake of consistency across countries, we use the latest available input-output tables from the OECD (generally for 2005) for ten major economies that together account for around 65% of world GDP: the G6 advanced economies and the four emerging BRIC economies<sup>1</sup>.

These ten economies should give a reasonable basis for estimating global sector sizes (see Table 2 below), given that no sectoral output data are readily available on a fully comprehensive global basis. We use the OECD data to estimate sector shares of GDP (or, more precisely, gross value added or GVA) and then turn this into a current value based on World Bank estimates of actual world GDP in 2008.

**Table 2: Estimates of global sector shares and sizes**

Sectors	Shares of world GVA	Estimated sector size (\$ trillion at 2008 prices)	Assumed % real growth pa (2009-50 average)	Estimated sector size in 2050 (\$ trillion at 2008 prices)
Energy	4.3%	2.6	1.5% (1-2%)	4.8 (3.9-5.9)
Forestry	0.7%	0.4	1.5% (1-2%)	0.8 (0.6-1.0)
Agriculture/food	5.2%	3.2	1.5% (1-2%)	5.9 (4.8-7.2)
Water	1.0%	0.6	1.5% (1-2%)	1.1 (0.9-1.4)
Metals	1.5%	2.0	2% (1.5-2.5%)	4.7 (3.8-5.7)
<b>Total: natural resource sectors</b>	<b>14.6%</b>	<b>8.8</b>	<b>1.6% (1.1-2.1%)</b>	<b>17.3 (14.0-21.2)</b>
<b>World GDP</b>	<b>100%</b>	<b>60</b>	<b>3% (2.75-3.25%)</b>	<b>208 (188-230)</b>

Source: PwC estimates based on OECD input-output data on sector GVA shares for G6 and BRIC economies (in 2005 or latest available year). Growth rates for 2009-50 and estimated sector sizes in 2050 are expressed as mid-point estimates together with a range for use in sensitivity analysis.

Since our aim is to project potential long-term business<sup>2</sup> opportunities in 2050, we need to make some assumptions as to how the size of these sectors may evolve over that period. A detailed assessment of long-term sectoral growth prospects is beyond the scope of this short study, but we have made assumptions here that we consider broadly plausible, namely that:

- World GDP will grow at an average of around 3% per annum in real terms over the period from 2009-50; this is broadly in line with global growth assumptions arising from our own previous World in 2050 reports and other long-term growth assessments by the IEA (in their Technology Perspectives 2050 reports) and other bodies;
- the energy, forestry, agriculture and food, and water sectors will grow at only half the rate of GDP (i.e. 1.5% per annum in real terms) as emerging economies move away from dependence on natural resource sectors and in response to sustainability concerns; and
- the metals sector will grow somewhat faster at 2% per annum on average, reflecting high demand for metals during the industrialisation phases of economic development in China and other large emerging economies over the next couple of decades; but this will nonetheless be slower than overall GDP growth as even these emerging economies will eventually mature and become more dominated by service sectors in the longer term.

<sup>1</sup> G6 = US, Japan, Germany, UK, France and Italy; BRICs = Brazil, Russia, China and India.

<sup>2</sup> 'Business opportunities' here refers to additional investment carried out by both private companies and state enterprises (some of the funding for this may come from government, but if this is spent on goods and services provided by business then it is still included here).

Combining these growth assumptions with the sector size estimates for 2008 gives the projections for sector sizes in 2050 shown in the final column of Table 2 above. For the five natural resource sectors combined, our mid-point estimate is that their global gross value added (GVA) could almost double from around \$8.8 trillion in 2008 to just over \$17 trillion in 2050 (at constant 2008 prices). Their share of total world GDP would, however, be projected to decline from 14.6% to 8.3% over this period due to the relative slower growth expected in natural resource sectors as compared to the world economy as a whole.

To reflect the considerable uncertainties surrounding any such long-term projections, we have also considered the impact of low and high scenarios based on sector growth rates that average 0.5% per annum higher or lower than in our main scenario. Half of this growth variation is assumed to be associated with lower or higher global GDP growth (which therefore has a range of 2.75-3.25% per annum), with the other half reflecting variations in relative sector growth rates. The ranges of assumptions made and the implications for estimated sector sizes in 2050 are shown in the final two columns of Table 2 above.

### Scale of sustainability-related business opportunities relative to sector sizes

While future growth in natural resource sectors is clearly subject to many uncertainties, an even greater uncertainty surrounds the scale of additional sustainability-related business opportunities relative to the size of each sector. The only sector for which we are aware of such estimates being produced in any detail is energy in relation to the additional investment needed in order to achieve the desired transition to a low carbon economy by 2050. We therefore start from these estimates (by the IEA) and then make a judgemental assessment of the broad order of magnitude of additional business opportunities in other natural resource sectors relative to the estimates for energy, allowing for differences in sector sizes.

Table 3 below summarises the outcomes of this analysis, showing an estimated scale of additional sustainability-related business opportunities in 2050 of around \$2-6 trillion in natural resource sectors (at constant 2008 prices). A sector-by-sector commentary follows the table.

**Table 3: Potential scale of additional sustainability-related business opportunities in 2050**

Sectors	Estimated sector size in 2050 (\$ trillion at 2008 prices)	Business opportunities in 2050 as % of sector size	Value in 2050 (\$ trillion at constant 2008 prices)	% of projected world GDP in 2050
Energy	4.8 (3.9-5.9)	42% (26-51%)	2.0 (1.0-3.0)	1.0 (0.5-1.5)
Forestry	0.8 (0.6-1.0)	21% (13-26%)	0.2 (0.1-0.3)	0.1 (0.05-0.15)
Agriculture/food	5.9 (4.8-7.2)	21% (13-26%)	1.2 (0.6-1.8)	0.6 (0.3-0.9)
Water	1.1 (0.9-1.4)	21% (13-26%)	0.2 (0.1-0.3)	0.1 (0.05-0.15)
Metals	4.7 (3.8-5.7)	11% (6-13%)	0.5 (0.2-0.7)	0.2 (0.1-0.3)
<b>Total: natural resource sectors</b>	<b>17.3 (14.0-21.2)</b>	<b>24% (15-30%)</b>	<b>4.1 (2.1-6.3)</b>	<b>2.0 (1.0-3.0)</b>

Source: PwC estimates based on IEA estimates for energy sector; sector size here is measured by gross value added (GVA)

#### (a) Energy

The IEA's 2008 report on Technology Perspectives to 2050 provides the most comprehensive study of which we are aware of the additional investment required in energy-related areas<sup>3</sup> to

<sup>3</sup> These areas include not just power generation but also transport, housing and other buildings and industrial production. But the focus is always on energy use by these other

move the world to a low carbon economy by 2050. Although investment does not equate directly to business opportunity, there is a clear link. Even if some of the required investment is funded by governments, private sector contractors are likely to do most of the work.

The IEA estimate total required additional energy-related investment of around \$45 trillion (at 2008 prices) over the period from 2010 to 2050. They estimate this to equate to around 1.1% of GDP on average over this period. The implied average annual investment would be around \$1.1 trillion per annum (at 2008 prices) over the period, but this would disguise an upward trend over time due to the normal process of economic growth.

The IEA do not provide year-by-year estimates, but our own calculations suggest that it would be plausible that implied annual investment by 2050 might be of the order of \$2 trillion<sup>4</sup> per annum (at 2008 prices). As shown in Table 3 above, this would correspond to around 42% of our estimate of the gross value added (GVA) of the global energy sector in that year, or around 1% of global GDP in 2050 (similar to the IEA estimate expressed as a share of GDP<sup>5</sup>).

We recognise, however, that there are considerable uncertainties surrounding any such estimates of future required investment. To reflect these uncertainties, we look at a range of \$1-3 trillion for the scale of the additional energy-related investment in 2050 (at constant 2008 prices), which translates to around 0.5-1.5% of world GDP at that date, or around 26-51% of estimated energy sector GVA allowing for our alternative low and high scenarios for sector size.

These results for the energy sector then form the basis for making estimates for other natural resource sectors, as described below.

#### **(b) Natural resource sectors other than energy**

The energy sector requires a radical transformation by 2050 if global carbon emissions are to be kept to levels consistent with eventual stabilisation of atmospheric CO<sub>2</sub> levels at levels (e.g. 450 ppm) that are considered to be broadly acceptable according to the current scientific consensus on climate change.

Other natural resource sectors also face very significant sustainability challenges, as highlighted by the Vision 2050 project, but the transformation required seems unlikely to be quite as radical as that for the energy sector. As such, our starting point is that the scale of additional investment required (and associated business opportunities) in the other natural resource sectors, while significant, will not be as large relative to the size of these sectors as in the case of energy.

In the case of **forestry**, there is clearly a need for a considerable shift in forestry management techniques and policies in order to first halt deforestation and ultimately reverse it so that net afforestation can make a positive contribution to limiting CO<sub>2</sub> concentrations in the atmosphere by boosting forest-related carbon sink capacity before 2050. This will also have

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sectors and so the relevant measure of value added is primarily that for energy, rather than the value added by these other sectors over and above their energy consumption.

<sup>4</sup> The Stern review made a similar calculation based on the IEA's 2006 Technology Perspective report to suggest estimated business opportunities in 2050 of around \$500 billion, but this was based on a much less ambitious scenario for carbon reductions than in the IEA's updated 2008 report. The Stern review also quoted an alternative \$2 trillion estimate from Shell Springboard research that is more in line with our own estimate based on the updated IEA projections.

<sup>5</sup> In their latest World Economic Outlook report, the IEA suggest that additional energy-related investment might need to reach around 1% of GDP by 2030 in their low carbon '450' scenario, so the level of investment might be expected even higher by 2050 although their WEO estimates do not extend that far. In this sense, our estimates in this paper may be somewhat on the low side, but we prefer to be conservative given the uncertainties involved.

downstream effects in requiring much greater efficiency in the use of forestry products such as wood and paper. All of these areas will create challenges for existing industries, but also additional opportunities for business to drive forward this transformation. Given these considerations, we assume that the scale of the additional business opportunity in forestry will be around half that of the energy sector, relative to their respective sizes. As shown in Table 3, this implies business opportunities in forestry of the order of 13-26% of sectoral GVA, which translates to around 0.1% of world GDP in 2050 or around \$0.2 trillion in 2050 (at constant 2008 prices).

One cross-check for this estimate for forestry is the interim TEEB report on biodiversity<sup>6</sup>, which estimated that an annual investment of around \$45 billion in protected areas could be hugely valuable<sup>7</sup> in sustaining ecosystems. This would equate to around 0.075% of current world GDP and so is of the same order of magnitude as our estimate for forestry of around 0.1% of GDP. While the TEEB study covers biodiversity more generally, the interim report from which this estimate was taken focused primarily on forestry.

As Table 3 shows, we made a similar judgment on the relative scale of business opportunities for the **water, agriculture and food** sectors. All of them require significant transformations if long-term sustainability is to be achieved, and indeed the need for sustainable water supplies is clearly fundamental to achieving required levels of agricultural and food production to serve a growing global population that is set to reach around 9 billion by 2050 according to UN estimates. Better water infrastructure can also make a critical contribution to urban development in emerging economies. However, while carbon emissions are required to be reduced by something of the order of 75-80% by 2050 relative to a Business As Usual (BAU) scenario, similar estimates for water and food would suggest smaller reductions of around 20-30% relative to a BAU scenario would be sustainable, although it should be noted that there is an important further issue here in relation to water and food not being distributed at all evenly across the globe, so requiring major investment in infrastructure such as water pipelines from Southern to Northern China and food distribution programmes in Africa and other very poor countries, as well as just the need to improve the efficiency of production processes in a sustainable way.

Taking all these considerations into account, our judgement is therefore that the additional investment required for water, agriculture and food might (like forestry) be of the order of around 13-26% of GVA in these sectors, which is around half that assumed for energy. This translates as shown in Table 3 to additional annual investment in 2050 of the order of around 0.35-1% of world GDP for these two sectors combined, or around \$0.7-2.1 trillion in 2050 (at constant 2008 prices).

In the case of **water**, we could cross-check our estimate that the additional investment might need to be around 0.1% of GDP by 2050 against a recent WHO estimate<sup>8</sup> that required investment to meet the Millennium Development Goal on water and sanitation would be around \$70 billion per annum on average between 2006 and 2014. Since world GDP over this period might plausibly average around \$60-70 trillion, this would also be around 0.1% of GDP per annum, broadly in line with our estimate (although the latter is over a longer timeframe).

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<sup>6</sup> The Economics of Ecosystems and Biodiversity (TEEB) project interim report, May 2008 ([www.teebweb.org](http://www.teebweb.org)).

<sup>7</sup> The TEEB report estimates a long-term welfare benefit of the order of \$2-5 trillion, which is the discounted present value of estimated effects over the lifetime of the relevant ecosystems. Such estimates are, however, subject to many uncertainties and controversies over the precise methodology and assumptions used. They are not comparable to estimates of annual investment needs, but serve to reinforce the case for making such investments.

<sup>8</sup> G. Hutton and J. Bartram, 'Global costs of attaining the Millennium Development Goal for Water and Sanitation', World Health Organisation, 2009.

In the case of **agriculture and food**, a recent FAO report<sup>9</sup> suggested that feeding the growing world population up to the middle of this century would require average net investment of around \$83 billion per annum over the period to 2050, which would equate to around 0.6% of average projected world GDP of around \$130 trillion over the period from 2008 to 2050. This includes investment needs in primary agriculture and downstream food processing and storage facilities, but not associated investment required in roads, large-scale irrigation projects, electrification and other supporting infrastructure needed to support food programmes. The FAO estimate does, however, appear to be broadly in line with the central estimate of 0.6% from our analysis.

The **metals** sector is difficult to assess since sustainability concerns may not be quite as pressing as for areas relating to climate change or food and water supply, but nonetheless the rapid industrialisation of China and other large emerging economies has already put upward pressure on metal prices and this pressure can only be expected to increase in coming decades. To some degree this could be met by incremental improvements in the efficiency with which metals are used further down the supply chain, better recycling and also developing new supplies of metallic ores using more advanced extraction technologies.

Estimating how much of this could reasonably be described as a sustainability-related new business opportunity is problematic, but our pragmatic approach is to assume that the broad scale of these opportunities is around quarter of those in energy, or around a half of levels in forestry, water and food, relative to sector sizes. As shown in Table 3 above, this translates into an assumed scale of opportunities of around 6-13% of estimated metals sector GVA, which equates to around 0.1-0.3% of global GDP in 2050 with a projected value of around \$0.2-0.7 trillion at constant 2008 prices. This actually seems to us to be a relatively conservative estimate given the size of this sector.

Adding up these estimates for different natural resource sectors gives the total estimated additional annual investment required in 2050 of the order of around \$2-6 trillion (at constant 2008 prices), as shown in Tables 1 and 3 above.

### **Geographical distribution of investment opportunities**

Natural resources are used throughout the world economy, so it is clear that the additional investment opportunities discussed above will be widely spread. China, India and other relatively fast-growing emerging economies like Brazil and Russia will take a significant and growing share of the total: these four BRIC economies might account for around 38% of total world GDP by 2050 according to our estimates. But there are clearly also great challenges in the US, Europe and other OECD countries in moving to low carbon economies that also meet more general sustainability objectives in terms of use of all key natural resources.

There will also be particular local challenges in relation to, for example:

- reducing and ultimately reversing deforestation in countries like Brazil, Indonesia, Canada, the US (in Alaska in particular) and Russia;
- sustainable use of water in areas like the Middle East, Saharan regions of Africa and northern China;
- improving agricultural yields and access to food in areas with continued relatively rapid population growth, particularly Africa and India; and
- dealing with the systemic sustainability challenges associated with rapid urbanisation across the emerging economies.

Even if many of these challenges arise in emerging economies, however, there are clearly great opportunities for companies based in OECD economies to provide many of the technologies and services needed to deliver sustainable outcomes in emerging markets. At

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<sup>9</sup> Food and Agricultural Organisation, paper for High Level Expert Forum on How to Feed the World in 2050, Rome, 12-13 October 2009.

the same time, companies from China, India and other emerging economies can be expected to continue to widen the scope of their activities in OECD markets.

## 2. Health and education

While sustainability is sometimes limited to environmental considerations, which tends to lead to a focus on natural resource use, the Vision 2050 project and indeed much past work by PwC adopts a broader approach that also emphasises the importance of improving health conditions and education standards in developing economies.

Estimating the business opportunities associated with these 'social sustainability' issues requires a rather different methodological approach, although we have also tried to link this back to a common source of sectoral size estimates from the OECD's latest published input-output tables for ten leading economies (G6 plus BRICs) together accounting for around 65% of the world economy.

From these input-output tables, we were able to calculate that in the latest available year (generally 2005), the GVA of health (including social work) and education averaged:

- 11.1% of total GVA for the advanced G6 economies; but
- only 5.7% of GVA for the four emerging BRIC economies.

The basis for our calculation is then that the BRICs and other emerging economies should move up to current G6 levels of health and education spending as a share of total world GDP by 2050 (by that date, of course, G6 gross value added in health and education may well have risen further as a share of total GDP given that these tend to be 'superior goods' that nations spend relatively more on as they grow richer). We assume here that the BRICs are representative of emerging economies as a whole, although this may well understate the actual gap to be filled.

Drawing on earlier PwC modelling, we estimate that the share of world GDP (at PPPs) accounted for by emerging economies might rise from around 45% in 2008 (23% from the BRICs) to around 60% in 2050 (38% from the BRICs). Total emerging market GDP in 2050 might on this basis rise to around \$125 trillion by 2050. A rise in the share of this on health and education of around 5.4 percentage points (to close the G6-BRICs gap calculated above) would therefore translate to around \$6.7 trillion in 2050 (at constant 2008 prices).

Not all of this extra spending would represent an opportunity for private business, however, as health and education tend to be highly labour-intensive sectors and so much of this additional spending would just be by governments (supported in part by overseas aid) on employing more people in their state health and education services<sup>10</sup>. Nonetheless, there would also be additional spending on areas like new or refurbished buildings, pharmaceuticals, medical equipment and school books and computers that would be sourced from private sector suppliers to a large degree in most emerging economies. We assume that the share of the \$6.7 trillion rise in health and education accruing to private businesses in this way would be around 30%, so the total value in 2050 might be of the order of \$2 trillion in 2050 (at constant 2008 prices) or around 1% of projected world GDP of just over \$200 trillion in 2050.

As with our estimates for the natural resource sectors, we also consider alternative low and high scenarios in which the share of emerging economies in world GDP varies from 55-65% in 2050 (so reducing the base for the calculation) and the share of total increased spending accruing to private businesses varies from 15-45%. This gives an estimated range for increased private sector business opportunities arising from increases in emerging economy spending on health and education of the order of 0.5-1.5% of world GDP in 2050, or around \$0.8-3.5 trillion in 2050 (at constant 2008 prices).

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<sup>10</sup> There is a marked contrast with the natural resource sectors, where the additional spending is likely to be heavily focused on infrastructure investment.

Although our analysis focuses on health and education spending increases in emerging economies, many of these business opportunities (e.g. for increased use of pharmaceuticals in Chinese and Indian health services) will fall to companies from OECD countries. At the same time, emerging market businesses will surely arise in these areas to exploit domestic opportunities and use this as a base for international expansion in the longer term.

## Conclusions

It is very difficult to estimate the scale of the additional business opportunities that might arise from moving to a more sustainable world in 2050 given the huge number of uncertainties involved and the lack of systematic bottom-up studies to support this analysis except in the climate change area. But our illustrative estimates suggest that the broad order of magnitude of these effects could be around \$3-10 trillion per annum in 2050 at today's prices, or around 1.5-4.5% of world GDP in 2050. This compares to IEA estimates of around 1% of GDP just for the additional investment required to reduce carbon emissions from energy use to a sustainable level by 2050.

If we additionally assumed a broadly linear build-up of this additional investment and spending over time as a share of GDP, then an illustrative pathway to 2050 might be as follows (with all values in 2008 prices and with ranges rounded to the nearest \$0.5 trillion to avoid spurious accuracy):

- 2020: around \$0.5-1.5 trillion per annum;
- 2030: around \$1-3 trillion per annum;
- 2040: around \$2-6 trillion per annum; and
- 2050: around \$3-10 trillion per annum.

Whether this huge potential is realised remains to be seen, but there are certainly likely to be significant business opportunities arising over the next decade or two as the foundations for a sustainable future in 2050 begin to be put in place. Many of these opportunities will arise in emerging economies such as the BRICs, which will account for a rising share of world GDP (from 23% now to around 38% in 2050 according to our illustrative estimates), but there will still be very significant opportunities in OECD markets. There will also be increasing global competition between OECD-based and emerging market-based businesses to take advantage of these sustainability-related opportunities, wherever they arise.

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