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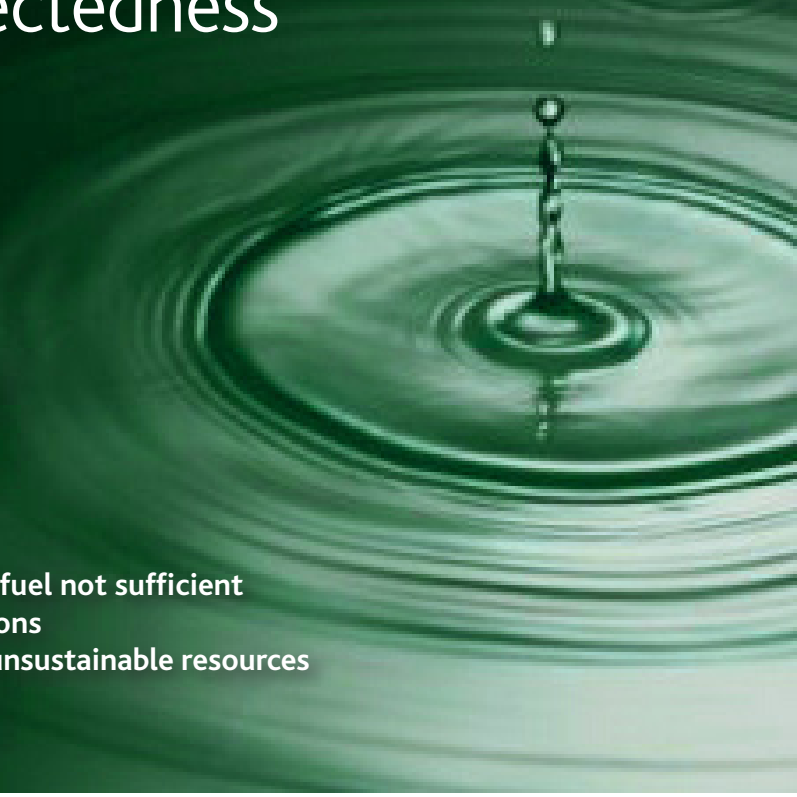
Sustainability Outlook

Researched by University of Cambridge
Programme for Sustainability Leadership

Sustainability rests on a simple premise: the interconnectedness of all things.



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OUR ECOLOGICAL DEBT CRISIS

'The global economy is badly overleveraged, and there is no quick escape without a scheme to transfer wealth from creditors to debtors, either through defaults, financial repression or inflation'. We are facing the 'second great contraction'. [i] This is how Harvard professor and former International Monetary Fund chief economist Kenneth Rogoff describes the current economic situation. From Greece to Portugal to Ireland to the United States, the high and rising levels of public debt are a source of daily headlines. There are, however, several parallels between the debt crisis and a global crisis in the biophysical world – a crisis with implications far more grave.

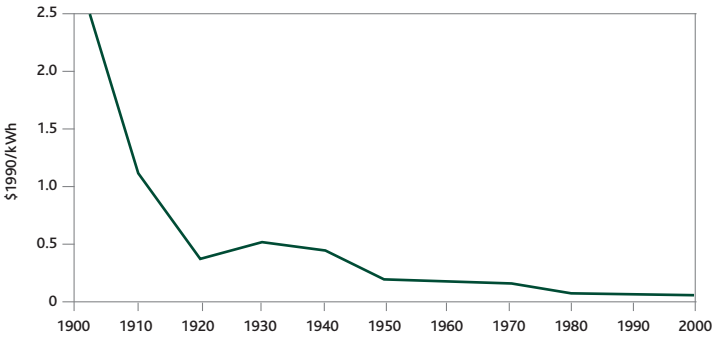
In a series of recent articles in *Vanity Fair* the financial journalist Michael Lewis chronicles various countries in relation to the debt quandary. His central thesis is that, from the early 2000s, the financial markets offered cheap and virtually unlimited credit to almost everyone, which was tantamount to leaving people in a dark room where they could live out all their fantasies without anyone knowing what they got up to. When the lights were eventually turned on, some fundamental problems in the socioeconomic conditions of many countries were revealed. In similar vein, we have been mostly in the dark with regard to our overuse of our biophysical resources.

According to figures published by the Organisation for Economic Cooperation and Development (OECD) the total public debt levels of OECD countries increased from 63,8% of GDP in 1992 to 95,8% of GDP in 2010. In France it increased from 43,9% to 93,8%, in the UK from 39% to 82,3% and in Germany from 40,9% to 80,9%. The United States's public debt started at 70,2% in 1992, then declined to 54,4% in 2001 and subsequently increased to 89,6% in 2010.[ii]

Owing to cheap credit, people and countries took on more and more debt. In Greece the government, with the help of US investment banks, securitised future receipts from the national lottery, highway tolls, airport landing fees, and even funds granted to the country by the European Union, and sold it for cash upfront. In the United States banks offered home loans to people who could not actually afford it, and packaged these mortgages as collateralised debt obligations that were sold to banks around the world. By 2007 Irish banks were lending 40% more money to property developers than they were lending to the entire Irish population in 2000.

In the biophysical world the last century has seen a great reduction in the price of energy and commodities. A composite index of resources declined by 30% during the 20th century and the real price of a kilowatt-hour of electricity in the United States decreased by almost 98% during that period.[iii] As with cheap credit, cheap energy and cheap commodities are not bad things. In fact quite the contrary, but the indiscriminate use thereof and the fact that they are derived from finite resources is creating problems.

Figure 1: Average price of US electricity per kWh, 1900 to 2000 | **Source:** Smil, *Energy in the Twentieth Century* (2000)



The use of fossil-derived energy increased sixteenfold from 1900 to 2000 and the use of oil increased by 55% from 1973 to 2008.[iv] The United Nations Environment Programme (UNEP) International Resource Panel points out that, between 1900 and 2005, the extraction of construction materials grew by a factor of 34, ores and minerals by a factor of 27, fossil fuels by a factor of 12 and biomass by a factor of 3,6. Total extraction of materials per capita doubled over that period.[v]

Figure 2: Composite resource price index (at constant prices, 1900 to 2000) | **Source:** UNEP International Resource Panel (2011)

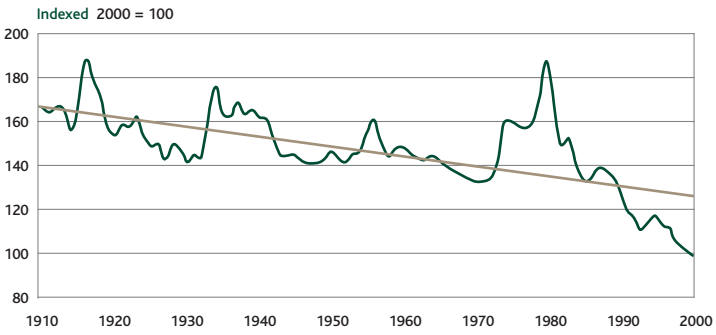


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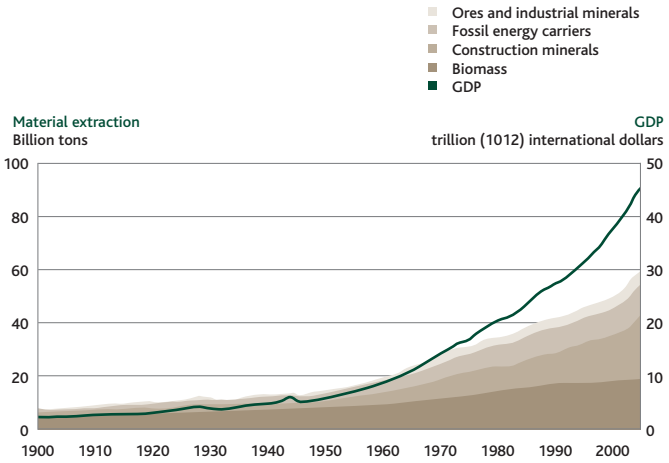
Figure 3: Global material extraction in billion tonnes, 1900 to 2005 | **Source:** UNEP International Resource Panel (2011)



Similar to the Greeks, who discounted all the future cashflows from their assets to use the money in the present, society is eroding its natural capital. This is measured through the ecological footprint calculation, which measures the amount of biologically productive land and water that is required to produce all the resources an individual, a population or an activity consumes and that is required to absorb the waste they generate. When the global ecological footprint exceeds 1, it means the population uses more resources than what can be regenerated naturally. In 1961 the ecological footprint was just above 0,5, but by 2006 it was 1,4. Humanity as a whole is thus depleting the earth's natural capital to meet current consumption.

Tax avoidance

On the other side of increased government lending and spending, Lewis points out, is a culture of resistance to paying taxes. In Greece an estimated two-thirds of doctors reported incomes under €12 000 a year, which was below the minimum taxable income. This meant that even plastic surgeons making millions a year paid no tax at all. In Ireland investors were lured to the country with very low corporate tax rates, thus kickstarting the 'boom' that lead to the massive property bubble. In the United States, despite the outcry by the Tea Party, the federal tax as a percentage of GDP is currently below 15%, the lowest since 1950, and still many refuse any tax increases. A recent Institute for Policy Studies analysis showed that US corporate income taxes made up only 9% of federal receipts in 2010, down from 35% in 1945. The effective income tax rate for corporations was 10,5%, compared to the official rate of 35%.[vi] In 1992 the top 400 US earners made $16,9 billion and paid 29,2% in taxes. Today their income is $90,9 billion and they pay 21,5%. [vii]

When it comes to the biophysical world, in our current economic setup there is a culture of non-payment in that we do not pay for negative externalities. Despite concepts such as the polluter pays, Pigouvian taxes and an understanding of the tragedy of the commons, many forms of pollution are untaxed and the destruction of natural capital is not included in prices. As a consequence, the emission of greenhouse gasses, for example, has increased so much that the wellbeing of the planet is in jeopardy. Lord Stern correctly called climate change the 'greatest market failure ever'. UNEP Finance Initiative and the Principles for Responsible Investment published a report in 2010 estimating the environmental damage caused annually by the 3 000 largest public companies in the world at $2,2 trillion. The World Bank indicates that, after making adjustments for the depletion of certain non-renewable resources and pollution damage, several countries, including South Africa, had negative adjusted net savings in 2008.[viii]

A further element of the debt crisis is a gradual breakdown of trust between people. Lewis remarks that Greeks have grown increasingly suspicious of each other and expressed public distrust of their countrymen. This has been mirrored by lowering levels of trust in politicians and the financial system in several countries. Joseph Stiglitz describes the current state of affairs as 'having the predictable effect of creating alienation'. [ix]

Mistrust and tension within and between countries are growing as a consequence of the biophysical crisis. The failure of climate negotiations is an example where countries, instead of cooperating, are blaming and mistrusting each other. Much has been written about the role of food insecurity in contributing to the conflicts in the Middle East and the protectionist behaviour of countries in response to food insecurity. International conflict over access to water, something that academics have long warned about, is also coming increasingly into focus, especially in Eastern and Northern Africa.

The debt crisis has revealed how interdependent countries are and that a default in one place can have major implications for the rest of the world, as countries hold one another's debt. While nature cannot default, scientists have defined a safe planetary operating space circumscribed by nine planetary boundaries within which humanity must remain if we are to continue to thrive and develop. Exceeding these boundaries could lead to abrupt, catastrophic environmental changes. Three of the boundaries, namely climate change, biodiversity loss and disruption of the nitrogen cycle, have already been breached and we are fast approaching four others.[x]

While the world's attention is on the debt crises in several OECD countries, a far more serious ecological crisis is building up. If nothing is done about this crisis, the world will face a 'greater contraction' from which it will be very difficult to recover.

INNOVATING TO ZERO

Technology and innovation can play a very important role in leading us to a low-carbon economy. Not all emission reduction technologies, or policy interventions, can, however, lead to improvements of the scale that is required. There is definite value in incremental improvements and focusing on 'low hanging fruit', but since many technologies and policies create some type of lock-in for many years, it is important to keep the end goal in mind and not just to focus on making things slightly better than before.

The end goal of emission reductions is zero emissions by 2050. Keeping in mind that we need to get to zero by 2050, provides a useful lens for evaluating different courses of action.

Is it really zero?

In public and political discourse average warming of 2 °C above preindustrial levels has emerged as a sort of limit that we should not cross. This is based on various scientific studies that indicate that above 2 °C there is a risk of triggering high-risk climatic tipping points.

The Intergovernmental Panel on Client Change's fourth assessment report (of 2007) indicated that, to keep warming to between 2,0 and 2,4 °C, atmospheric concentrations of $CO_{2\text{-eq}}$ should stabilise at between 445 and 490 parts per million (ppm). To reach this it is estimated that we need to reduce emissions by 50% to 80% relative to 2000 by 2050. Given subsequent increases, the required cut from 2008 levels to 2050 is 60% to 84%. Stated in per capita terms, and assuming the global population increases to 9,3 billion people by 2050 according to United Nations estimates, then per person emissions should be between 1,2 and 0,5 tonnes per year. That is a reduction of 71,2% to 88,5% from current levels. In South Africa's case, given our current emissions of about 10 tonnes per person, the reduction we need to achieve is between 88% and 95% per capita.

Another way of thinking about this is to use the Kaya Identity, named after Professor Yoichi Kaya, which shows there are four – and only four – macroscale policy levers that are available for achieving emission reductions. These are population, wealth (as a proxy for consumption), energy intensity (meaning units of energy per unit of GDP) and carbon intensity (meaning the amount of carbon produced per unit of energy). In the case of populations the lever is population management and for wealth the lever is to reduce the size of the economy. Both of these policies, aside from the ethical issues around population management, seem unlikely to be contemplated. For energy intensity the lever is to increase energy efficiency. The International Energy Agency projects that, despite very robust estimates of efficiency improvements, global demand for energy will triple between today and 2050 (it increased sixteenfold during the 20th century). Using the lower target of a 50% reduction in absolute emissions, this means an 87% reduction in the carbon intensity of the global energy supply. Even if energy use increases only by a factor of two, the required reduction in carbon intensity is still 75%.

David MacKay, in his 2008 book *Sustainable Energy – without the hot air*, and a group of academics, at a meeting convened in 2009 by the London School of Economics and the Saïd Business School at Oxford[xi], all concluded that this is an endeavour that, for all practical purposes, requires the same breakthroughs in cost and performance as the complete decarbonisation of the global energy supply.

Similarly, in the Shell energy scenarios to 2050 it is concluded that limiting atmospheric concentrations to 450 ppm $CO_{2\text{-eq}}$ will require 'a zero-emission power sector by 2050 and a near zero-emission transport sector in the same time period, complete electrification of the residential sector, with remaining energy-related emissions limited to niche areas of transport and industrial production.' These niche areas include for example aviation and cement manufacturing.

Bill Gates, in a 2010 TED talk, referred to the need to invest in ideas that can offer zero carbon energy, and global consulting firm Frost & Sullivan called 'innovating to zero' one of its 30 megatrends in 2010.

The idea of innovating to zero is thus a useful lens to evaluate appropriate technology pathways, not in the sense of 'picking winners' but for highlighting which technologies cannot get us to zero. Using this framework it becomes clear that more efficient internal combustion engines or switching from coal to gas electricity generation, for example, is at best transition technologies, but they cannot take us all the way. The value of technologies as transition technologies thus depends on how much their deployment facilitates or crowds out resources for zero carbon solutions and to what extent they can be decommissioned before 2050. Keeping the target of zero emissions in mind is also valuable in designing policy measures, since knowing which path to take depends on what the desired destination is.

PRICE ON CARBON CONTENT OF FUEL NOT SUFFICIENT TO DEAL WITH VEHICLE EMISSIONS

In Cancún, at the end of 2010, all countries in the world agreed to limit the increase in average global temperature to at most 2 °C. Accordingly, many governments are now looking at mechanisms that will lead to significant reductions in carbon emissions in their economies. The preferred policy instrument, for reasons of flexibility and efficiency, is the implementation of a price on carbon either through a cap and trade scheme or a carbon tax. Putting a price on carbon at a time when the global economy is under strain and dealing with rising energy and commodity prices is, however, very difficult to implement. The strong opposition to Australia's recently announced carbon pricing mechanism is a good example. Similarly, the South African National Treasury's discussion paper on carbon tax has drawn vocal reaction from various parties.

It is clear that a price on carbon should be implemented in a way that provides flexibility and time for business to prepare and does not ruin the economy. These goals must be balanced against some of the principles of a carbon price with the aim of reducing emissions. These are: (i) including as near as possible to all sources of emissions; (ii) the price should be high enough to change behaviour and incentivise new technologies; and (iii) it should be revenue neutral from a fiscal point of view (not just more revenue for government). Achieving all of this is very difficult, and particularly when it comes to liquid fuels used for transport.

The current Treasury discussion paper proposes an upstream fuel input tax on the carbon content of fossil fuels rather than a downstream CO_2 emissions tax. It basically means taxing the carbon content of coal used for electricity and coal to liquids (CTL) and of crude oil for petroleum products. The appeal of such an approach is that fewer sources need to be taxed, making administration and collection much easier. In the case of electricity it is also appropriate, as all the emissions are at the point of production. With liquid fuels and transport it is different. Coupled with Treasury's proposal to tax liquid fuels only at production and exempt consumption, an input tax on liquid fuels excludes the majority of transport-related emissions and is most likely inadequate for changing behaviour.

The source of transport emissions

Globally 93% of transport is dependent on crude oil. The CO_2 emissions from extracting and transporting crude oil and refining it into liquid fuel are about 0,5 kg/l of petrol and diesel. The CO_2 emissions from using liquid fuel in an internal combustion engine (or burning it by any other means) are 2,5 kg/l. This means that the tailpipe emissions from using liquid fuels are about five times greater than the process emissions.

In the case of CTL, as produced by Sasol, the equation is different. There the process emissions (mine to tank) are about 40% more than the tailpipe emissions. Given that one-third of South Africa's liquid fuel comes from CTL, our transport emissions per litre are higher than the global average. But, overall process emissions are still 40% less than tailpipe emissions, which means that an input tax on liquid fuels will only cover about 37% of emissions associated with transport. Apart from the problem of limited coverage, the impact of a carbon tax on the inputs of liquid fuels is much smaller than in other sectors. A tax of R100 per tonne of CO_2 will, for example, increase the petrol price by less than R0,15 per litre, or 1,5% of the current price of R10. That is about the same price effect as the rand depreciating by 3% or the oil price increasing by 3% – fluctuations that can occur on a weekly basis. In contrast, the R100 per tonne carbon tax has an impact of R0,10 per kilowatt-hour on electricity prices, which is a 25% increase on Eskom's average price or the same price as the coal per kilowatt-hour.

This means that, to address emissions from transport seriously, more progress can be made by focusing on tailpipe emissions rather than on process emissions. A short example illustrates the point:

Reducing the overall liquid fuels from CTL by 20%, with a commensurate 10% increase in oil imports, thus keeping overall litres constant, leads to a reduction of emissions of only 4,8%. Decreasing CTL by 40% in favour of oil reduces emissions by 9,6%. Switching from CTL to oil does have a significant negative economic impact for South Africa though, as a 20% increase in imported oil would mean an additional R12 billion per year leaving the country.

By contrast, decreasing overall liquid fuel demand by 10%, even if we keep CTL production constant at current levels, leads to a 7,6% reduction in emissions, and a 20% reduction in demand, again keeping CTL output constant, leads to a reduction in emissions of 15,2%. Lower oil imports would give the balance of payments a boost of R9,1 billion and R18,2 billion respectively under these scenarios at current oil prices. Increasing the availability of efficient public transport would be an important enabler of lower liquid fuel demand.

The point of this illustration is not to argue for or against imported oil or locally produced CTL, but to highlight that process emissions are relatively less important than tailpipe emissions. Since all petrol and diesel are sold with the intention of being burned, it is practical to include the tax on tailpipe emissions at the point of sale and thereby still getting the benefit of only having a few entities to tax. Including tailpipe emissions in this way will mean the tax on liquid fuels is R0,40 per litre instead of R0,15. This would probably still be too small to make a serious impact on consumption behaviour. Including all emissions in the tax is, however, more logically consistent and this can be supplemented with efficiency targets for vehicles.

Table 1: Summary of figures

Process emissions for petrol or diesel (made from crude oil)	0,5 kg/l
Tailpipe emissions from using petrol or diesel	2,5 kg/l
Impact of R100/t carbon tax on input fuel only	R0,15/l or 1,5%
Impact of R100/t carbon tax on electricity	R0,10/kWh or 25%
Impact of R100/t carbon tax when process and tailpipe emissions are included	R0,40/l or 4%

Currently South Africa has an emissions tax on new vehicles, but it would make more sense to replace this with an efficiency standard or tax. That is not taxing vehicles on the emissions per kilometre but on the kilometres per unit of energy. This would mean that hybrid and electric vehicles will be covered under the same mechanism, making the instrument neutral in terms of technology.

If a carbon tax, or even a carbon trading scheme, is designed, it would be important to include as much of total emissions as possible under the policy to maximise the potential of actually reducing carbon emissions. With most transport emissions coming from the tailpipe and not from the manufacturing of liquid fuels, tailpipe emissions should be included in any carbon pricing scheme. This is necessary, albeit insufficient on its own, to bring about a significant reduction in CO_2 emissions. At the same time mechanisms need to be implemented to assist consumers and businesses through the difficult transition to a low-carbon economy.

SUSTAINABLE BENEFITS FROM UNSUSTAINABLE RESOURCES

The mining and extractive industries are under pressure from two sides. On the one side there are some environmentalists who feel that the environmental damage caused by mining practices and the unsustainable nature of mining non-renewable resources are reasons for reducing or preventing mining. On the other side there are those who feel that the socioeconomic benefits from mining are not reaching enough people and therefore demand greater government intervention.

Both of these arguments, while they have some merit, risk triggering policy responses that can do more harm than good and would seriously undermine the goals of sustainable development. Amidst these twin attacks on mining, the latest book by Oxford economist Paul Collier, entitled *The Plundered Planet* (2010), adds an interesting perspective to the debate.

Collier firstly investigates the unique characteristics of natural assets such as forests, minerals and metals. He asserts that, unlike manufactured assets, they have no natural owners, so societies are free to assign the rights any way they like. Most societies have chosen to vest the initial ownership of natural assets collectively. South Africa is no exception, as the government owns all mineral rights and confers it to private companies through mining licences. Building on the work in his book *The Bottom Billion*, Collier argues that, should governments prevent the exploitation of natural resources, it will make it significantly more difficult for the world's poorest to escape from poverty. This is especially true in Africa, where the current value of mineral reserves is estimated at about $50 trillion. If mining can be done in an environmentally responsible way, it could thus create revenues that can be used for development of the continent.

The second issue is that of equity and how socioeconomic benefits are distributed in a country. There are strong emotions around natural resources and a drive in many areas of the world to capture more benefits from the proceeds of mining, particularly as the prices of natural assets rise. Collier's theory is that all the mining profit over and above the risk-adjusted return on investment is 'rent' and should be captured by governments for their citizens. Even if this were so, in practice calculating a risk-adjusted return on such investments is incredibly complex. Many countries, including South Africa, have instead opted for royalties as a way to share in the proceeds of mining and, although they do not benefit from the upside of high profits, they still get income even when prices are low.

The idea of a windfall tax or tax on super profits has in the past been mooted in Australia and Tanzania as a way for the country to share in the commodities boom. But such a scheme carries the danger of disincentivising mining companies from doing further exploration or investments. One idea that Collier proposes is for governments to share the risk in exploration, but this too might not always be possible.

Nationalisation is an extreme form of trying to derive maximum equity for a country's citizens. However, most governments reject this alternative because of the inevitable efficiency losses. Studies[xiii] show that production in government-owned entities tends to deteriorate over time on reduced investment, among other problems. Even in cases where governments own a share in many of the mines, such as in Botswana and Namibia, they are still operated by private companies.

But the issue of equity is not just one of private mining companies versus citizens. Government capturing an increasing proportion of the revenue from a country's natural resource does not in itself provide the guarantee of increased wellbeing of citizens either now or in the future. Benefits can be wasted if the proceeds from non-renewable resources are consumed by the current generation without leaving any benefits for future generations. Income from non-renewable resources should therefore be invested for the benefit of future generations. Non-renewable natural capital that is extracted should be replaced with physical and human capital that is sustainable.

One way of doing this is demonstrated by the Norwegian government buying equity stakes in companies all over the world and using only the return of these investments for current consumption. But, in developing countries such as those in Africa, a case can be made that investments in the local economy can possibly yield higher returns. There, for example, the money can be used to invest in human capital, clean-energy infrastructure, public transport or even to enhance the systems that provide ecosystem services. Many of these investments will also in the longer run have the benefit of making private sector investment more lucrative.

A practical case study in the diversification and investment in infrastructure with the yields from mining is the Royal Bafokeng community in the North West Province of South Africa. Owning the land on which the world's richest platinum deposits were discovered, they have over the last few decades used the royalties and dividends from the mines to invest in infrastructure and the development of human capital in the area. They have also diversified their investments away from just mining companies into other investments that will yield a return long after the platinum reserves have been depleted.

Collier concludes in his book that nature + technology + regulation = prosperity. But those regulations should take into account not just the needs of the current generation. It is ethically incumbent on us to respect the rights of future generations. We can fulfil our ethical obligation by bequeathing to the future other kinds of assets of an equivalent value. We thus have a responsibility to save and to invest and not just to consume. In a society where the current generation has many unfulfilled needs this is difficult. But, building a fair and prosperous society is never easy and demands of us to have a longer-term framework.

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