



The Pontifical Academies' **BROKEN MORAL COMPASS**

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About the author

Indur Goklany is an independent scholar and author. He was a member of the US delegation that established the IPCC and helped develop its First Assessment Report. He subsequently served as a US delegate to the IPCC, and an IPCC reviewer. He is a member of the GWPF's Academic Advisory Council.

Note

An earlier version of this report included an error for the estimate of the reduction in the number of people living in absolute poverty (see p.3). Previously the figure shown was 847 million. This version shows the correct figure of 947 million.

Summary

This paper is a commentary on the opening four sentences of the pontifical academies' joint declaration, *Climate Change and the Common Good: A Statement of The Problem and the Demand for Transformative Solutions*, echoes of which resonate in the recent papal encyclical. The paper finds that the premise behind the academies' call for deep decarbonization and a rapid reduction in fossil-fuel use is fundamentally flawed.

The academies claim that fossil-fuel use has reduced the world's sustainability and resilience. But despite record human numbers and carbon-dioxide emissions, human wellbeing has never been higher, by virtually any measure whether climate-sensitive or not. The average person has never lived longer or been healthier or wealthier. Living standards are at their highest ever; poverty, hunger, malnutrition, and mortality from vector-borne diseases and extreme events are at record lows. There is no indication that these trends are being reversed.

Prior to the Industrial Revolution virtually all of humanity's basic needs – food, fibre, fuel, energy, materials – were met by the rest of nature. Fossil-fuel technologies and associated economic development increased the terrestrial biosphere's natural productivity to provide these basic needs, shifted humanity's demand for energy away from biomass and animal power, and increased its reliance on man-made fibres and materials. Consequently, the share of humanity's demand for life's basic necessities filled by the rest of nature has never been smaller despite exploding demand. Also, because of carbon-dioxide fertilization, nitrogen deposition, and possibly a more equable climate, all caused by fossil-fuel use, the terrestrial biosphere's productivity now exceeds pre-industrial levels. This allows the biosphere to sustain larger biomass.

Thus greater fossil-fuel use has been accompanied by advances in both human wellbeing and terrestrial biosphere's ability to sustain biomass. That is, our reliance on fossil fuels has *increased* the world's sustainability and resilience. Another result has been that conversion of wild land to farmland has almost peaked worldwide, allowing some societies to reserve land for conservation.

Also contrary to the academies' claims, inequality, which is secondary to poverty, hunger, and malnutrition as indicators of wellbeing, has shrunk among the world's population in recent decades. Moreover, there is no empirical evidence for their claim that agriculture is 'doubtless causing' hundreds of thousands if not millions of extinctions.

The academies' assertion that fossil-fuel use poses existential risks for the poor and future generations must necessarily rest on models of future impacts of climate change. But impact models use climate models that overestimate global warming two- to four-fold. Moreover, neither climate nor impact models have been validated using external data, climate models often contradict each other regarding the direction of precipitation change at regional and local scales, and the impact models do

not fully account for the increased adaptive capacity of future generations, who will be wealthier and technologically-more sophisticated than we are.

The academies' 'transformative solutions' are based on a delusion that economic alternatives to cheap fossil fuels are widely available, a notion belied by the government mandates and subsidies that prop up these alternative energy sources. These purported solutions would therefore be counterproductive for both humanity and the rest of nature. They would slow the ongoing broad advance in human wellbeing, retard poverty reduction, and reduce the ability to adapt and cope with adversity in general and climate change in particular, especially harming the poor. They would also reduce the future productivity of the terrestrial biosphere, increasing pressure on species and ecosystems.

In exchange for reducing both humanity and the rest of nature's sustainability and resilience, the academies would solve future problems that may not even exist or, if they do, might be more easily solved by future generations who should be richer, both economically and technologically. Essentially, these policies would give up real gains in human and environmental wellbeing to solve hypothetical problems forecast by models which, if they have a track record, is for inaccuracy.

The academies are right that climate change is a moral and ethical issue. Unfortunately, they are on its wrong side. Apparently their moral compass is broken.

1 Introduction

In a joint declaration entitled *Climate Change and the Common Good: A Statement of the Problem and the Demand for Transformative Solutions* (hereafter 'the statement'), the pontifical academies – of sciences and social sciences – asserted that:

Unsustainable consumption coupled with a record human population and the uses of inappropriate technologies are causally linked with the destruction of the world's sustainability and resilience. Widening inequalities of wealth and income, the world-wide disruption of the physical climate system and the loss of millions of species that sustain life are the grossest manifestations of unsustainability. The continued extraction of coal, oil and gas following the 'business-as-usual mode' will soon create grave existential risks for the poorest three billion, and for generations yet unborn. Climate change resulting largely from unsustainable consumption by about 15% of the world's population has become a dominant moral and ethical issue for society.¹

Based on these assertions, the statement demanded 'transformative solutions' including, among other things, 'deep de-carbonization',² a reduction in worldwide carbon-dioxide emissions 'without delay',³ and a 'shift from fossil fuels to zero-carbon and low-carbon sources and technologies, coupled with a reversal of deforestation, land degradation, and air pollution'.⁴

The statement was meant to serve as a major input to the latest papal encyclical, *Laudato Si*.⁵ And, indeed, echoes of its text reverberate throughout the encyclical. They can be heard, for instance, in the assertions that, 'We all know that it is not possible to sustain the present level of consumption in developed countries and wealthier sectors of society...';⁶ that the 'exploitation of the planet has already exceeded acceptable limits';⁷ and that each year thousands of species are being lost forever.⁸ They are also evident in the calls for humanity to 'recognize the need for changes of lifestyle, production and consumption, in order to combat...warming';⁹ drastically reduce carbon dioxide and other emissions,¹⁰ and redistribute wealth.¹¹

But the statement is fatally flawed. It is riddled with sins of omission and commission bolstered by wishful thinking. For instance, it ignores decades of well documented empirical data that show that human wellbeing has advanced throughout the world and that the terrestrial biosphere's productivity has increased above pre-industrial levels, allowing it to support more biomass, in no small part because of carbon dioxide emissions from humanity's use of fossil fuels. The advances in human wellbeing include reductions in poverty, hunger, malnutrition, death and disease, and increases in life expectancy and standards of living across the world. The poor have been major beneficiaries of these advances.

The statement also overlooks the fact that inequality has declined as fossil-fuel-powered economic growth has lifted billions out of poverty in developing countries, particularly in east and south Asia.

The statement also claims that continued use of fossil fuels poses existential risks for the poor and future generations, but neglects to inform us that these claims are suspect: they are based on results of models that have not been validated, overestimate temperature changes, give contradictory results for changes in other climatic variables, and largely ignore humanity's time-tested ability to cope with and adapt to adversity, a capacity which should increase in the future as humanity becomes technologically more sophisticated and wealthier, just as it did over the past quarter of a millennium.

In the following sections, I will elaborate on these and other defects in the statement. But because life is short and the document's flaws are numerous, I will focus only on its first four sentences.

2 First sentence

Unsustainable consumption coupled with a record human population and the uses of inappropriate technologies are causally linked with the destruction of the world's sustainability and resilience.

This sentence implies that the world's sustainability and resilience have been diminished, but is that really so?

Humanity's sustainability and resilience

If that were the case, the world's population would either be smaller today, worse off than in the past, or both. But by the academies' own admission the world's population is at a record level. Equally important, human wellbeing is at or near its peak by virtually every objective broad measure. Consider that:

- Between 1990–92 and 2014–16, despite a global population increase of 35% (or 1.9 billion), the population suffering from chronic hunger declined by 216 million.^{12,13} Consequently malnutrition also declined. Since reductions in hunger and malnutrition are the first steps to better public health, age-adjusted mortality rates have declined and life expectancy has increased.¹⁴
- Even in low-income countries, life expectancy, probably the single best indicator of human wellbeing, increased from 25–30 years in 1900 to 42 years in 1960 and 62 years today.¹⁵
- People are not just living longer, they also are healthier. This is true in the richer as well as the poorer segments of the world. Healthy life expectancy – that is, life expectancy adjusted downwards to account for years spent in a less-than-healthy condition (weighted by the severity of that condition) – was 53 years in 2012 in low-income countries, far exceeding their *unadjusted* life expectancy in 1960 (42 years).¹⁶

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- Between 1950 and 2013, the average person's standard of living, as measured by GDP per capita,¹⁷ has increased from \$2100 to \$8200.^{18,19} This statistic understates the relative increase in the standard of living because long-term changes in GDP per capita do not properly account for the fact that some goods and services available today – e.g. cell phones, the Internet, personal computers – were simply unavailable at any price a few decades ago. Nor do they account properly for improvements in the quality of others; compare the bulky, grainy black-and-white analogue TVs of yesteryear with the light, 80-inch HD 3-D colour models of today.
- More importantly, the global population in absolute poverty declined from 53% to 17% between 1981 and 2011.²⁰ There were about 947 million fewer people living in absolute poverty in 2011 than in 1981, although the population of the developing world increased by 2.5 billion.²¹ Not accidentally, the most rapid reductions in poverty occurred in east and south Asia, the areas with the fastest economic growth. This was all supported by fossil fuels.
- Education and literacy, once the domain of the clergy and the wealthy, have advanced. In low-income countries between 1980 and 2012, enrolment in secondary schools increased from 18% to 44%.²²
- The average person has never had greater and faster access to information, knowledge and technology to help them learn, adapt and solve whatever problems they face. Mobile (cell) phone subscriptions have risen from 0% of population in 1997 to 55% in 2013 in low-income countries, while Internet users rose from virtually nil to 7% of the population over the same period.²³

These indicators reflect the very factors that enhance resilience and adaptive capacity, no matter what the threat.²⁴ And as humanity's vulnerability to adversity has declined, the negative consequences of climate and weather in particular have been reduced. Therefore the more narrowly focused climate-sensitive indicators have, predictably, also improved. Specifically:

- Global death rates from all extreme weather events have declined by over 98% since the 1920s.²⁵
- Crop yields have improved steadily across the world. Between 1961 and 2013, cereal yields increased by 85% in the least-developed countries and by 185% worldwide, and show no sustained sign of decelerating, let alone reversing.²⁶
- Despite population increases, which in theory should have made clean water less accessible, the number of people with access to a safe supply has actually increased worldwide. Between 1990 and 2012, the population with such access increased from 75.9% to 89.3%, some 2.3 billion additional people.²⁷ Concurrently, an additional 2.0 billion people got access to improved sanitation.²⁸

- The global mortality rate for malaria, which accounts for about 80% of the burden of vector-borne diseases that may pose an increased risk due to global warming,²⁹ declined from 194 per 100,000 in 1900 to 9 per 100,000 in 2012, an overall decline of 95.4%.^{30,31}

Thus trends in both the broad indicators of human wellbeing and the narrower climate-sensitive indicators show that, despite population growth, both sustainability and resilience have advanced markedly, in direct contrast to the claims made by the pontifical academies. Figure 1 shows that, globally, both life expectancy and real GDP per capita – representing public health and the standard of living, and perhaps the two most important measures of human wellbeing – have been increasing in parallel with carbon-dioxide emissions. Similar graphs can be produced showing improvements in the various indicators of human wellbeing with economic development.^{32,33}

But these are no mere correlations. The improvement in human wellbeing have been enabled, directly or indirectly, through the use of fossil fuels or fossil-fuel powered technologies and economic growth.^{34,35,36,37} This is because every human activity – whether it is growing crops, cooking food, building a home, making and transporting goods, delivering services, using electrical equipment for any purpose, studying under a light or going on holiday – depends directly or indirectly on the availability of energy (see below). In today's world, energy is virtually synonymous with fossil fuels; they supply 82% of global energy used.³⁸ Even human inactivity cannot be maintained for any length of time without energy consumption. A human being who is merely lying around needs to replenish their energy just to maintain basic bodily functions. The amount of energy needed to sustain inactivity is called the basal metabolic rate (BMR). It takes food – a carbon product – to replace this energy. Insufficient food, which is defined in terms of the BMR, leads to starvation, stunting, and a host of other physical and medical problems, and, possibly, death.³⁹

Nature's sustainability and resilience

It may be argued that the increase in humanity's sustainability and resilience has come at the expense of the rest of nature. Indeed, this *was* the case for millennia, with an approximately linear relationship existing between land clearance on the one hand and human population and standard of living on the other. This was because virtually everything humanity needed and used – food, fuel, clothing, medicine, mechanical power, and much of its housing, shelter, material goods, energy and transportation – was obtained directly or indirectly via the services or products of living nature. The slow rate of technological change meant that if living standards had to improve or the population increased then, barring favourable weather, the increase in demand for food, fuel or any other good would have to be met mostly through addi-

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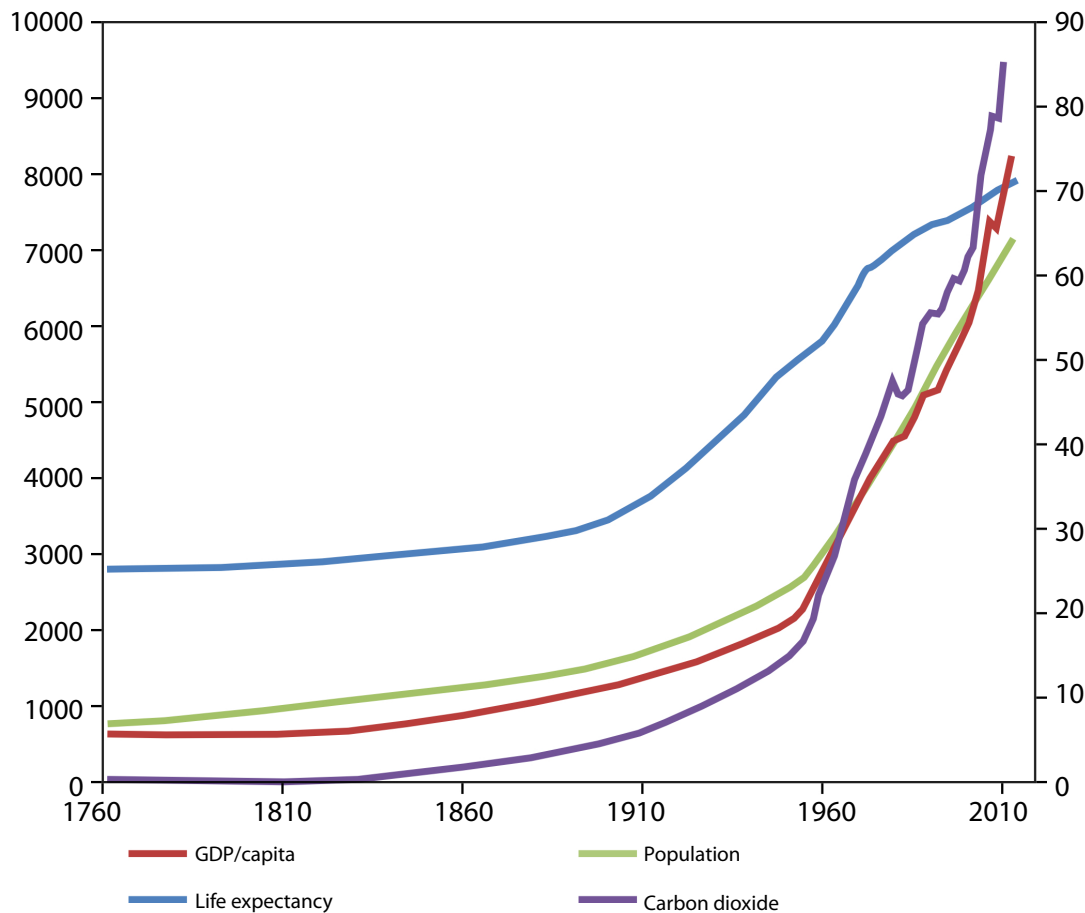


Figure 1: Carbon dioxide and improving human wellbeing

Long-term trends in population, standard of living, health, and carbon-dioxide emissions, 1760–2013. GDP (1990 PPP-adjusted dollars), population (millions) and carbon-dioxide emissions (MMT) are per the left-hand scale. Life expectancy (years) is on the right-hand scale. Source: Updated from Goklany (2011).

tional land clearance. Thus initially the Industrial Revolution saw population increases accompanied by higher conversion of land per capita to agricultural use. However, this trend was eventually reversed due to a host of fossil-fuel-based technologies. Firstly, these technologies increased the productivity of land to provide the needed goods and services. Secondly, they began to displace the goods and services that humanity traditionally obtained from nature. The following paragraphs list specific examples.^{40,41}

Food Synthetic fertilizers and pesticides derived from fossil fuels, both of which were unknown in 1900, increased crop yields during the 20th century. Together they are responsible for at least 60% of today's global food supply.⁴² Crop yields have also

been augmented by other fossil-fuel powered technological advances, such as the drilling, pumping and distribution of irrigation water. The amount of food produced (or consumed) per acre of cultivated land has been further stretched by reductions in post-harvest and end-use losses, also enabled by fossil-fuel-derived technologies such as refrigeration, faster transportation, plastic packaging and storage, and more efficient processing methods.

Fibre About 63% of the world's fibre production is of synthetic fibres, which are made from fossil fuels. Of the remainder 79% comes from cotton, which is also substantially dependent on synthetic fertilizers and pesticides.⁴³ Synthetic fibres were little more than curiosities until the 1900s, but since that time have diminished the need to hunt and trap for furs and skins, helping defuse a major threat to biodiversity.⁴⁴

Fuel and energy Biofuels (mainly wood) provided 52% of global energy in 1900. Today their share is down to 11%, while the share of fossil fuels has increased from 42% to 82%.^{45,46} Along the way, fossil fuels displaced animal power for transporting goods, people, and doing other work on and off the farm. Feeding these animals used to consume a substantial share of agricultural produce. In the US, for instance, 27% of the land harvested for crops in 1910 was devoted to feeding the 27.5 million horses and mules. Thus displacing animal power with fossil fuels freed up land to feed people and limit habitat loss.⁴⁷ Habitat loss is generally considered to be the single largest threat to biodiversity.

Materials Biomass was responsible for 74% of material use in 1900 but only 30% in 2009.⁴⁸ This was enabled by the invention of new materials (e.g. plastics and new alloys) and the application of new, often energy-intensive processes to old and not-so-old materials (cement, iron, steel, engineered woods) to extract, manufacture, fabricate and transport them.

Thus the use of fossil fuels has allowed humanity to vastly increase the quantity of goods and services that it obtains from the rest of nature while limiting land conversion. The trend towards greater land productivity is reinforced by the fact that higher carbon dioxide concentrations in the atmosphere increase the rate of vegetation growth, and the efficiency with which plants use water. Nitrogen deposition from fossil-fuel and fertilizer use further increases the biosphere's productivity. Together, these factors have enabled humanity to meet its growing needs without adding proportionately to its already considerable burden on the rest of nature. Consequently, as shown by Figure 2, the amount of land used for humanity's needs per capita had peaked by the second half of the twentieth century: between 1990 and 2012, although global population increased 33%, the increases in global cropland (3%) and agricultural area (2%) were ten-fold smaller.⁴⁹ That is, habitat conversion to crops and other agricultural land has almost plateaued globally. Agricultural uses, since time

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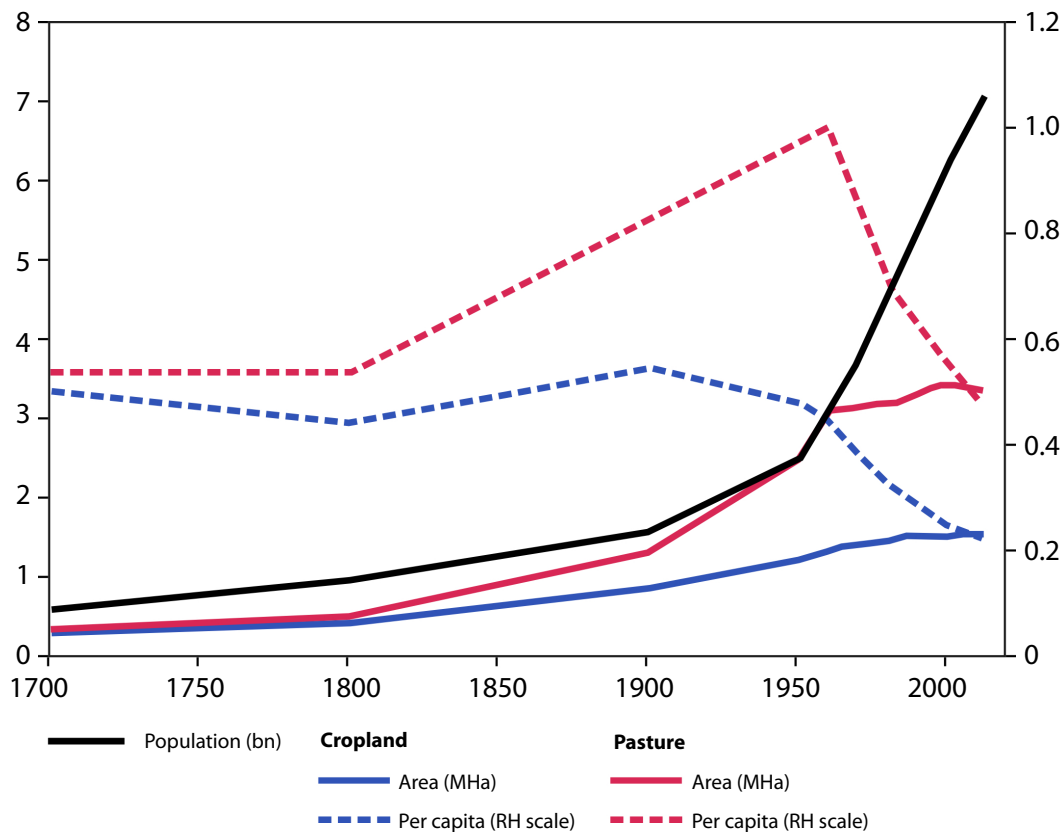


Figure 2: Global habitat conversion to agricultural uses, 1700–2012.

Left-hand scale: population in billions and area in MHa. Right-hand scale, hectares per capita. Sources: Kees Klein Goldewijk et al.,⁵⁰FAO.⁵¹

immemorial, have been the major cause of habitat conversion.

Equally important, despite a 52% population growth⁵² and any land clearance and degradation, satellite data indicate that the productivity of global ecosystems *increased* by 14% from 1982 to 2011.⁵³ They also show that 31% of the global vegetated area has become greener while 3% has become less green. All vegetation types – tropical rain forests, deciduous and evergreen boreal forests, scrubland, semi-deserts, grasslands and all other wild ecosystems – have increased their productivity. The IPCC Working Group II's Fifth Assessment notes (with emphasis added) that:

'[d]uring the decade 2000 to 2009, global land net primary productivity was approximately 5% *above the preindustrial level*, contributing to a net carbon sink on land... *despite ongoing deforestation*' [and land-use change].⁵⁴

These increases have been attributed to higher carbon dioxide levels; nitrogen deposition from fossil-fuel combustion and fossil-fuel-derived fertilizer use, and possibly a more favourable climate.^{55,56} Thus, at least over the past thirty years, fossil fuels have

helped the planet increase its productivity above its pre-industrial level; that is, the ability of the planet to sustain plant and animal biomass⁵⁷ has increased.

To appreciate the scale of the positive effect of fossil-fuel technologies in limiting and reversing habitat loss, consider that fossil fuels currently are 'directly or indirectly responsible for at least 60% of humanity's food and fibre. Thus, absent fossil fuels, global cropland alone would have to increase by *at least* 150% (or 2.3 billion hectares) just to meet current demand. This is equivalent to the combined land area of South America and the European Union.^{58,59} Such action would have further exacerbated the greatest threat to biodiversity, namely, the conversion of habitat. To put into context the land saved by fossil fuels in this way, consider that the area concerned exceeds the total amount of land set aside worldwide in any kind of protected status (2.1 billion hectares).⁶⁰

So contrary to the pontifical academies' claim, empirical trends show that sustainability and resilience – both of humanity and of the rest of nature – have *advanced* rather than diminished. Moreover fossil fuels have been an integral reason for these advances. Curiously, the pontifical academies also claim to have demonstrated a causal link between this alleged decline and 'unsustainable consumption coupled with a record human population and the uses of inappropriate technologies'. This claim is obviously risible, given that one cannot establish such a link when the phenomenon concerned, namely the alleged reduction in the world's sustainability and resilience, has not been observed.

The divergence between the academies' claims and empirical reality is due to their omission, for whatever reason, of any examination of a host of indicators of human wellbeing and global biological productivity. Less charitable souls may note that these indicators are not arcane, and that their favourable trends have persisted for decades and have also been repeatedly noted by researchers.^{61,62,63} They may therefore wonder if the academies' oversight is wilful: a sin of commission. But it could also be due to wishful thinking rooted in confirmation bias, or to plain ignorance, although the latter seems implausible given the qualifications of the members of the academies.

3 Second sentence

Widening inequalities of wealth and income, the world-wide disruption of the physical climate system and the loss of millions of species that sustain life are the grossest manifestations of unsustainability.

This sentence implies that inequalities of wealth and incomes are not only valid – but also significant – measures of human wellbeing.

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Firstly, it is not clear that inequality is, by itself, a legitimate public policy issue unless the wealthy have stolen from the less wealthy directly, or indirectly through public policies that sanction crony capitalism or interventions in the marketplace that increase burdens disproportionately on the less wealthy. Examples include subsidies for low- or no-carbon energy sources such as wind, solar, biomass and biofuels, which are paid to landowners and politically-connected middlemen from fees and taxes extracted legally from the rest of the population. Such subsidies increase the cost of energy, fuel and food for all of society. But because these are basic necessities, increases in their cost have a greater impact on the poorer segments of society. They effectively increase poverty (by reducing consumption among the poor).

Secondly, the focus on increasing inequality does not take into account that the marginal utility of an extra dollar of consumption declines as consumption increases. What this suggests is that the marginal utility of an extra dollar for a relatively poor person outweighs the marginal utility of several extra dollars for a much wealthier person.

Thirdly, and most importantly, is inequality more significant than increases in life expectancy or decreases in the numbers living in poverty, which, as we have seen, have improved markedly? Prior to the Industrial Revolution the average person lived between 25 and 30 years and GDP per capita was \$900.⁶⁴ Today, the average person worldwide lives 71 years and even in low-income countries the figure is 62 years. Global GDP per capita is above \$11,600.⁶⁵ Similarly, there are far fewer people living in absolute poverty today than probably any time since at least 1950. These advances are owed in large part directly or indirectly to economic development, which in turn relied largely on the use of fossil fuels.

This begs the question of whether the average person is better off today than previously. Are the vast gains in health and life expectancy and the standard of living overridden by any increase in inequality? By what moral calculus is inequality a superior measure to either the population living in absolute poverty or improvements in life expectancy? Is it morally acceptable to have more poverty so long as fewer are really wealthy?

It is ironic that the academies should dwell on inequality as if it were a measure of wellbeing, despite it being rooted in one of the seven cardinal sins: envy. Regardless, such data as exists (see Figure 3) shows that while inequality between *countries* may have increased for much of the period following the start of the Industrial Revolution, inequality in the *global population* – a much more important criterion – has declined at least since the 1990s, chiefly due to higher incomes in China and India. On some measures the effects may have been felt even earlier.

The statement's second sentence also suggests that millions of species have been or are being lost. Page 8 provides additional information on this claim:

Over the 10,000 years that humans have depended on agriculture...doubtless

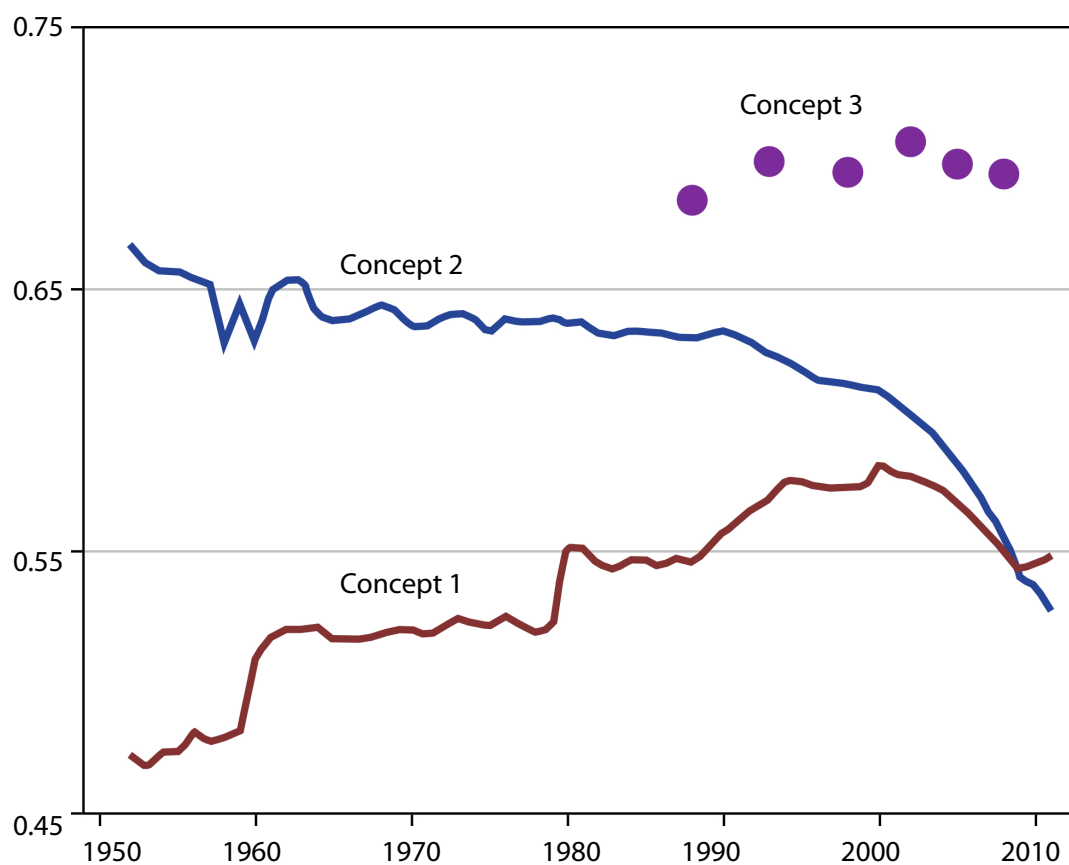


Figure 3: Trends in global inequality

Gini coefficients representing three different concepts of inequality are shown. Concept 1 is based on inequalities between average incomes of countries; Concept 2 on average incomes of countries *considering their population sizes*; Concept 3 on inequalities between countries and populations within the countries. The major decreases in inequality, on all three measures, during the 1990s and 2000s were the result of higher incomes in China and India, in large part because of fossil-fuel-driven industrialization. Source: Milanovic B (2012).⁶⁶

causing the extinction of at least hundreds of thousands and perhaps millions of species of organisms in the process.

This suggests an average extinction rate of tens or hundreds of species per year since humans settled and turned to agriculture. Actual data on documented and confirmed extinctions do not support such fanciful rates.^{67,68} Moreover, there is no record of mass extinctions since the start of the Industrial Revolution. And with respect to the role of climate change on the number of extinctions, even the IPCC's latest assessment report notes, not without some skepticism:

Climate change may have already contributed to the extinction of a small num-

ber of species, such as frogs and toads in Central America, but the role of climate change in these recent extinctions is the subject of considerable debate.⁶⁹

More importantly, as we have seen, fossil fuels have, if anything, diminished the threat to mass extinction because they have reduced land conversion while enhancing the terrestrial biosphere's productivity. Thus it would be counterproductive to implement the academics' primary solution:

Reduce worldwide carbon-dioxide emissions without delay, using all means possible to meet ambitious international targets for reducing global warming and ensuring the long-term stability of the climate system.⁷⁰

Reducing carbon-dioxide emissions without delay would halt, if not roll back, the increase in the productivity of agriculture and farming. Since food demand is not about to diminish any time soon, this would raise food prices everywhere, increase habitat conversion to make up for the loss in production, or both. To the extent that food prices increase, the very poorest will be priced out of the food market, increasing hunger and disease among the very population for which the academics profess concern. Thus their solution would actually exacerbate the 'existential risks for the poorest three billion, and for generations yet unborn'.⁷¹

We have had a preview of this. In an attempt to reduce the use of fossil fuels for transport, subsidies were offered for biofuels, resulting in crops being diverted from the production of food. According to one estimate, in developing countries an additional 32 million people were pushed into absolute poverty in 2010 as a result. This is estimated to have led to 192,000 premature deaths worldwide in 2010 alone.⁷²

Perhaps the academics are victims of wishful thinking, namely that good intentions rooted in the desire to increase sustainability cannot have unintended negative consequences. This, of course, is enabled by a sin of omission, namely failing to explore the negative consequences of the proposed 'transformative solutions'. But in fact there will always be unintended consequences, at least some of which are negative and foreseeable.

4 Third sentence

The continued extraction of coal, oil and gas following the 'business-as-usual mode' will soon create grave existential risks for the poorest three billion, and for generations yet unborn.⁷³

This claim is presumably based on the modelling exercises that purport to estimate the future impacts of climate change. But the extent of these impacts and the alleged rapidity of their occurrence are vastly exaggerated.

Firstly, these exercises use the results of global climate models to drive various downstream biophysical and socioeconomic models and thus to estimate the future impacts of changes in climatic variables. However, the climate models run too hot.

An analysis of the performance of 117 simulations using 37 models indicates that the average global temperature would increase $0.30 \pm 0.02^\circ\text{C}$ per decade for 1993–2012 but empirical data from HadCRUT4 surface temperature data set show that global temperature increased at half that rate ($0.14 \pm 0.06^\circ\text{C}$ per decade).^{74,75} For the more recent 15-year period of 1998–2012, the average modelled trend was *quadruple* the observed trend ($0.21 \pm 0.03^\circ\text{C}$ per decade vs $0.05 \pm 0.08^\circ\text{C}$). However, the academies omitted any mention of how model results compare with reality.

Secondly, most climate impact assessment models, in addition to downplaying positive effects of carbon dioxide, assume little or no endogenous (or autonomous) adaptation. For example, most studies of the impacts of climate change on water resources assume, contrary to what actually happens in the real world, that no adaptive measures will be taken individually or collectively to reduce adverse impacts from floods, droughts or reductions in water availability. This is despite the fact that such measures – dams, reservoirs, and water conservation, for example – are among the oldest and best-tested climate adaptations known to humanity.^{76,77} Similarly, 63% of the studies used by the IPCC to estimate future impacts on crop yields did not consider improvements in the agricultural sector's adaptive capacity.⁷⁸ Moreover, some studies that did only considered technologies that were available as of the 1990s or early 2000s. But because of secular technological change, one should expect even newer and more effective technologies to be on hand by whatever date the impacts are being projected (usually in the 2050–2100 period, or beyond). Neglecting adaptive capacity in impact assessments results in a double exaggeration: it both overstates the negative effects while understating the positive ones.

Experience shows that failure to account for increases in adaptive capacity can lead to overestimating negative impacts by an order of magnitude or more. For example, if one assumed no improvement in adaptive capacity from 1900 onward, the global mortality rate for malaria would have been frozen at 194 per 100,000.⁷⁹ In fact, it dropped by 95.4% to 9 per 100,000 in 2012.⁸⁰ This improvement can be attributed to an increase in adaptive capacity. Similarly, long-term increases in adaptive capacity have reduced the global mortality rate from all extreme weather events by over 98% since the 1920s.⁸¹ The poorest segments of society have been the overwhelming beneficiaries of these advances in adaptive capacity, many of which were facilitated by fossil fuels.

Thirdly, most assessments of species' range and distribution ignore the positive impacts of carbon dioxide on plant photosynthesis and water-use efficiency, as well as the productivity enhancements from nitrogen deposition, although these have both contributed to a more productive biosphere.^{82,83} For example, Thomas et al. (2004), in their paper, 'Extinction risk from climate change', which has been cited over 4000 times according to Google Scholar,⁸⁴ ignored these direct carbon dioxide and nitrogen effects on plants. This is not an exception.

In addition, the academies omit any discussion of the confidence, if any, that can

be placed on climate impact assessments. While climate models are able to hindcast *globally averaged temperatures* with some skill (mainly because they are adjusted or tuned to reproduce those temperatures), their results become progressively less accurate as one moves from the global to the continental, regional, national and local scales.⁸⁵

Even in hindcast mode, no matter the geographic scale, their ability to reproduce precipitation is even worse.^{86,87} But for humanity and the rest of nature, precipitation may be a more critical climatic variable than temperature. However, because the geographical features that determine precipitation are spatially heterogeneous, as are other variables, such as soil composition, that affect the distribution and composition of species, the ecological impacts of climate change must necessarily be modelled at the local scale. However, precipitation projections at less-than-global scales from different models often contradict each other. For example, a recent study of annual precipitation changes in California indicates that, '12 projections show drier annual conditions by the 2060s and 13 show wetter'.⁸⁸ Similarly, a study of climate change impacts on hydrology in the American Midwest found that some models predicted drier soil conditions, while others predicted wetter conditions.⁸⁹ Thus, impact assessments that use the outputs of these climate models are good for speculation, but little else. They cannot and should not be relied upon to develop policies, particularly if they are consequential in terms of costs or benefits.

Nevertheless, these uncertain results serve as inputs for the bioclimatic models that are used to estimate the impact of climate change on species, ecosystems and biodiversity. But as a rule, species and ecological impacts models, like global climate models, have not been validated with external data. Among other things, they ignore species' adaptability, evolutionary changes, species persistence, species competition, predator-prey relationships and the long-term ecological history of the species under consideration.^{90,91,92,93,94,95}

To summarize, climate models exaggerate the rate of temperature change; one cannot rely on them to even get the direction of precipitation change right; and even if they were able to get climate change right, climate impact models vastly inflate their net negative socioeconomic impacts by downplaying the adaptive capacity of future populations who will be wealthier and more technologically advanced than today's. The uncertainties in climate models are compounded by those associated with bioclimatic and other models used to estimate the impacts of climate change on species and ecosystems.

Even if these shortcomings are ignored, some cost-benefit analyses indicate that that some additional warming is not necessarily net harmful.⁹⁶ It is possible to use impacts estimates to calculate a lower bound for the 'net' GDP per capita for future generations by adjusting the future GDP downward to account for the equivalent welfare loss due to damages from global warming. One of the largest estimates for global warming damages was provided by the Stern Review. It provided a 95th per-

centile estimate for damages from warming due to market, health, and environmental impacts,⁹⁷ putting the figures for the total welfare loss at 7.5% and 35.2% of global GDP by 2100 and 2200, respectively. Based on these estimates, for both developing and industrialized countries, net GDP per capita – albeit an imperfect surrogate for human wellbeing–should be:

- double the current US level by 2100 under the warmest scenario
- lowest under the poorest IPCC scenario but highest under the warmest scenario through 2200.⁹⁸

That is, whatever problems global warming may bring, the average person should be better off in the future than they are today. This is a very robust finding considering the Stern Review's *central* estimate itself was an outlier– beyond the 95th percentile of other estimates according to a review article.⁹⁹ Other cost–benefit analyses indicate that an additional warming of 1–1.2°C relative to today should be a net benefit for the world.¹⁰⁰ One may argue that it does not matter that some warming will be a net benefit or that climate models exaggerate the warming rate because all that means is that the world will get warmer – and reach any tipping point – later rather than sooner. Therefore, this argument would go, we still need to shift out of fossil fuels. But this case overlooks the fact that the observed low rate of warming is important because it indicates a relatively low sensitivity of temperature (and climate) to a doubling of atmospheric carbon dioxide. If the equilibrium temperature sensitivity is, say, 1.5°C per doubling of carbon dioxide concentrations as opposed to 3.0°C, it suggests that an octupling of carbon dioxide from the pre-industrial level of 275 ppm to 2200 ppm – a level that exceeds the projections using the IPCC's hottest scenario¹⁰¹ – would raise the equilibrium temperature by 4.5°C instead of 9.0°C, since the temperature increase is logarithmic in carbon dioxide.¹⁰²

Moreover, the evidence for any tipping point is, at best, weak. Table 1 is a summary of the IPCC's most recent assessment of the likelihood of various proposed tipping points occurring in the 21st century based on modelled climatic changes under various IPCC scenarios which, as noted, have substantially overestimated the rate of warming. All in all, very little confidence can be placed in their occurrence.

Perhaps more importantly, climate change's impact on both humanity and the rest of nature depends critically on the rate of change. The faster the change, the greater the negative impact because it gives less time for new and improved technologies to be developed and/or deployed for adaptation. If one assumes that the globe warms at the rate of 0.5–1.4°C per century, as per Fyfe et al.'s analysis,¹⁰³ the net impacts of global warming will be in positive territory at least through the foreseeable future.

Given the credibility of the models involved, it would be foolhardy, if not immoral, to spend scarce resources on problems derived from models that so far have failed to track reality, particularly since those resources can be put to better use solving prob-

lems we *know* exist here and now, and are amenable to solution.^{104,105} Nor should it be overlooked that limiting the use of fossil fuels would slow not only the increase in the terrestrial biosphere's productivity but also the progress toward reducing poverty and solving real (though mundane) problems – hunger, malaria and other vector-borne diseases, access to cleaner water, sanitation, education – and otherwise enhancing human wellbeing.

5 Fourth sentence

Climate change resulting largely from unsustainable consumption by about 15% of the world's population has become a dominant moral and ethical issue for society.

By this statement, the academies imply that their 'transformative solutions' such as 'deep decarbonization' are driven by an ethical and moral calculus. Let us examine the consequences of their solutions.

Firstly, as noted above, for the last quarter of a millennium the global increase in carbon-dioxide emissions has been accompanied by economic development and improvements in virtually every indicator of human wellbeing, including those affected by climatic factors (see, for example, Figure 1). The increases in income and reductions in poverty have also enabled households and societies in the more developed parts of the world to shift from biomass and coal for cooking and heating to cleaner fuels, and to gain access to electricity. Despite these improvements, poverty, hunger and their associated problems still persist, mainly in populations that lack access to affordable and reliable energy. The academies' solution – a shift away from fossil fuels – could, by limiting access to cheaper energy, impede economic development worldwide and hinder this progress. In particular it would perpetuate poverty for the three billion the academies claim to champion, and slow their transition from biomass and coal to cleaner fuels.

Secondly, poverty, for practical purposes, is an independent risk factor for death and disease. Retarding the rate of poverty reduction would therefore increase mortality rates and lower life expectancies. A World Health Organisation analysis of the difference in the burden of disease per capita for 24 risk factors between low-income countries and low-middle-income countries indicates that at least ten risk factors are higher in the former; that is, they are exacerbated by poverty or the conditions associated with it.^{106,107} Ironically, the risk factor that is the most sensitive to poverty is global warming. The other nine risk factors were:

- underweight (largely synonymous with chronic hunger)
- zinc deficiency
- Vitamin A deficiency

Table 1: Confidence in the occurrence of various tipping points

Change in climate system component	Potentially abrupt (AR5 definition)	Irreversibility if forcing reversed	Projected likelihood of 21st century change in scenarios considered
Atlantic MOC collapse	Yes	Unknown	Very unlikely that the AMOC will undergo a rapid transition (high confidence)
Ice sheet collapse	No	Irreversible for millennia	Exceptionally unlikely that either Greenland or West Antarctic Ice sheets will suffer near-complete disintegration (high confidence)
Permafrost carbon release	No	Irreversible for millennia	Possible that permafrost will become a net source of atmospheric greenhouse gases (low confidence)
Clathrate methane release	Yes	Irreversible for millennia	Very unlikely that methane from clathrates will undergo catastrophic release (high confidence)
Tropical forests dieback	Yes	Reversible within centuries	Low confidence in projections of the collapse of large areas of tropical forest
Boreal forests dieback	Yes	Reversible within centuries	Low confidence in projections of the collapse of large areas of boreal forest
Disappearance of summer Arctic sea ice	Yes	Reversible within years to decades	Likely that the Arctic Ocean becomes nearly ice-free in September before mid-century under high forcing scenarios such as RCP8.5 (medium confidence)
Long-term droughts	Yes	Reversible within years to decades	Low confidence in projections of changes in the frequency and duration of megadroughts
Monsoonal circulation	Yes	Reversible within years to decades	Low confidence in projections of a collapse in monsoon circulations

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- unsafe sex
- unsafe water, sanitation and hygiene
- unmet contraceptive needs
- indoor smoke from solid fuels
- sub-optimal breast feeding
- iron deficiency.

In 2004, the cumulative toll for these factors was estimated to be 11.3 million deaths and 384 million lost disability-adjusted life years. Thus, any actions that perpetuate poverty also increase death and disease on this planet.

Thirdly, decreasing warming will itself lead to a host of perverse outcomes. Examples are described below.

Higher death rates The optimum temperature for many locations lies between the 60th and 90th percentiles of its annual range.^{108,109} That is, human beings are better adapted to warmth.¹¹⁰ A recent study based on an analysis of 74 million deaths from 384 locations in 13 countries estimates that 17 times more deaths are attributable to colder-than-optimum temperatures than warmer-than-optimum temperatures.¹¹¹ Many of these locations are in tropical and sub-tropical locales in Brazil, Thailand, Taiwan and China. The study estimated that 7.29% of extra deaths were attributable to cold versus 0.42% for heat. If this estimate applies to all deaths worldwide, then 3.8 million more deaths per year can be attributed to cold than to heat.

Water shortages Both the net global population at risk of water shortage and the demand for irrigation water may increase.^{112,113,114,115,116}

Reductions in the terrestrial biosphere's productivity Moving away from fossil fuels would slow, if not halt, the increase in the planet's productivity and increase pressure on the rest of nature.

Reductions in adaptive and mitigative capacity Reduced growth would retard the capacity to address climate change, both by mitigation and adaptation, especially in low-income countries.¹¹⁷

Fourthly, and as noted above, the inordinate emphasis on deep decarbonization will divert resources from more critical priorities, which are also more easily amenable to solution and can be addressed more cost-effectively.^{118,119} With respect to public health, results from WHO's study of 24 risk factors for 2004 indicated that global warming ranked 23rd based on mortality, and last in terms of the burden of disease.¹²⁰ Nor is its significance expected to increase dramatically in the foreseeable future. Projections based on a 4°C increase in global warming by 2100, which seems unlikely given the current rate of temperature increase, indicate that in 2085 global warming

will add only fractionally (13%) to cumulative mortality from hunger, extreme events, and malaria.¹²¹

Finally, asking today's relatively poorer generations to reduce greenhouse gas emissions immediately for the benefit of future generations will essentially transfer wealth from today's poorer generations to tomorrow's wealthier and technologically better-endowed populations. In effect, it would exacerbate intergenerational inequality in wealth – a perverse outcome considering the academies' articulated concern for 'widening inequality'.^{122,123,124}

Deep decarbonization and a shift from fossil fuels would, therefore, retard humanity's progress in advancing its wellbeing and reduce the planet's productivity, while depriving today's poorer generations of resources to solve today's real problems on the off chance that this will allow tomorrow's wealthier and technologically better-equipped generations to avoid problems from climate change that may never materialize.

6 Conclusion

Despite its many sins of omission and commission, the academies did get one thing right: climate change is a moral and ethical issue. However, the academies' moral calculus is a strange one. It at once endorses policies that would reduce existing gains in human wellbeing, increase the cost of humanity's basic necessities, increase poverty, and reduce the terrestrial biosphere's future productivity and ability to support biomass. Moreover, it does this in order to address future problems that may not even exist or, if they do, are probably more easily dealt with by future generations who should be richer, both economically and technologically. And because food, fibre, fuel and energy – basic necessities – consume a disproportionately large share of the income of the poorest, they would also pay the highest price for these policies. So much for the academies' concern for inequality.

Today's world may not be perfect, but without access to cheaper energy alternatives – fossil fuels, like it or not, are usually the cheapest available option – it would be more imperfect. Someday it may be possible to meet humanity's basic necessities without fossil fuels. But we are not there yet. As the academies note, three billion people still have unmet energy needs. Insisting on doing 'the right thing', but at the wrong time, could make matters worse. Even if one is confident that a child nearing adulthood could leap across a ten-foot chasm, it would be lethal to insist that a three-year old do the same thing. Similarly, there may be a fossil-fuel-free world in the future, but now is not the future. Insisting on a fossil-fuel-free world now would only prolong poverty and limit the terrestrial biosphere's productivity.

Notes

1. Pontifical Academy of Sciences (2015), *Climate Change and the Common Good*, p. 1, <http://www.casinapioiv.va/content/accademia/en/events/2015/protectearth.html>, visited 28 April 2015.
2. Ibid., p. 2.
3. Ibid., p. 9.
4. Ibid., p. 2.
5. Encyclical Letter '*Laudato Si*' of the Holy Father Francis on care for our common home, available at http://w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_protect_20150524_protect_enciclica-laudato-si.html.
6. *Laudato Si*, paragraph 27, p. 9.
7. *Laudato Si*, paragraph 27, p. 9.
8. *Laudato Si*, paragraph 33, p. 10.
9. *Laudato Si*, paragraph 23, p. 7.
10. *Laudato Si*, paragraph 26, p. 9.
11. *Laudato Si*, paragraph 109, p. 32.
12. FAO (2015), <http://www.fao.org/hunger/key-messages/en/>, visited June 7, 2015.
13. This occurred despite the diversion of land and crops from production of food to the production of biofuels in large part in response to climate change policies. According to one estimate, such diversions helped push 130–155 million people in 2008 into absolute poverty, exacerbating hunger in this most marginal of populations which, in turn, may have led to 190,000 premature deaths worldwide in 2010 alone. Goklany IM (2011), Could biofuel policies increase death and disease in developing countries? *Journal of American Physicians and Surgeons* 16 (1): 9–13.
14. World Bank (2014), *World Development Indicators*.
15. World Bank (2014), *World Development Indicators*, 08/18/2014.
16. World Health Organization (2014). *World Health Statistics 2014, Part III Global Health Indicators*, p. 68.
17. In 1990 international PPP-adjusted dollars.
18. Maddison A (2010), Statistics on World Population, GDP and Per Capita GDP, 1–2008 AD, University of Groningen, 2010, http://www.ggdc.net/MADDISON/Historical/protect_Statistics/vertical-file/protect_02-2010.xls.
19. World Bank (2014), *World Development Indicators*.
20. World Bank (2014), *PovcalNet*, at <http://iresearch.worldbank.org/PovcalNet/index.htm?1>, visited 15 May 2015.
21. The threshold for 'absolute poverty' is conventionally defined at \$1.25 per day (or about \$460 per year) in 2005 international PPP-adjusted dollars. The academies' declaration refers repeatedly to the 'poorest 3 billion', which would correspond to employing a poverty threshold of approximately \$2.75 per day, or about \$1,000 per year in 2005 international PPP-adjusted dollars.

22. World Bank (2014), *World Development Indicators*, 2 May 2015.
23. World Bank (2014), *World Development Indicators*, 2 May 2015.
24. Goklany IM (2007), Integrated strategies to reduce vulnerability and advance adaptation, mitigation, and sustainable development, *Mitigation and Adaption Strategies for Global Change* DOI 10.1007/s11027-007-9098-1.
25. Goklany IM (2011), *Wealth and safety: the amazing decline in deaths from extreme weather in an era of global warming, 1900–2010*. Reason Institute.
26. FAOSTAT, 6 October 2014
27. World Development Indicators, visited 18 August 2014.
28. World Development Indicators, visited 18 August 2014.
29. Institute of Medicine (US) *Forum on microbial threats. Vector-borne diseases: understanding the environmental, human health, and ecological connections, Workshop Summary*. Washington (DC): National Academies Press (US); 2008. Summary and Assessment. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK52939/>.
30. WHO (1999), 'Roll back malaria'. *World Health Report 1999*.
31. WHO (2013), *World Malaria Report 2013*, Annex 6B.
32. Goklany IM (2012), *Humanity unbound: how fossil fuels saved humanity from nature and nature from humanity*. Policy Analysis, No. 715, Cato Institute
33. Goklany IM (2007), *The improving state of the world*, Cato Institute.
34. Goklany IM (2012), *Humanity unbound*. *Ibid*.
35. Belke, A, Dobnik F, and Dreger C. 'Energy consumption and economic growth: new insights into the cointegration relationship'. *Energy Economics* 33.5 (2011): 782–789.
36. Fei, Li, et al. 'Energy consumption-economic growth relationship and carbon dioxide emissions in China'. *Energy policy* 39.2 (2011): 568–574.
37. Historically economic development and energy use have gone hand-in-hand. However, in recent decades the grip keeps relaxing because of technological change and the expansion of the service sector (itself a result of technological change). Hence, the declining trend in GDP per energy use.
38. International Energy Agency (2014), *Key world energy statistics 2014*. p. 6.
39. Goklany IM (2011), Economic development in developing countries: advancing human wellbeing and the capacity to adapt to climate change. In: Patrick J. Michaels, ed., *Climate Coup: Global Warming's Invasion of Our Government and Our Lives*. Cato Institute, pp.157–184.
40. Goklany IM (1998), 'Saving habitat and conserving biodiversity on a crowded planet', *BioScience* 48 (1998): 941–953.
41. Goklany IM (2012), *Humanity unbound*. *Ibid*.
42. Goklany IM (2012), *Humanity unbound*. *Ibid*.
43. Discover natural fibres initiative (2015), World production of natural and man-made fibres, 2008–2013, at dnfi.org/wp-content/uploads/2012/01/Fiber-Production.xlsx, visited 1 June 2015.

44. Goklany IM (2009), Technological substitution and augmentation of ecosystem services. In: Simon A. Levin et al. (eds), *The Princeton Guide to Ecology*. Princeton University Press, Princeton, 2009.
45. Krausmann, F. et al. (2009), Growth in global materials use, GDP and population during the 20th century. *Ecological Economics* 68: 2696–2705. Data on material and energy use downloaded from <http://www.uni-klu.ac.at/socec/inhalt/3133.htm> on 13 January 2013.
46. International Energy Agency (2014), *Key World Energy Statistics 2014*. p. 6.
47. Goklany IM (2012), *Humanity unbound*. *Ibid*.
48. Krausmann, F. et al. (2009), Growth in global materials use, GDP and population during the 20th century. *Ecological Economics* 68: 2696–2705. Data on material and energy use downloaded from <http://www.uni-klu.ac.at/socec/inhalt/3133.htm> on 13 January 2013.
49. FAOSTAT (2015), 8 May 2015.
50. Kees Klein Goldewijk et al. (2011), 'The HYDE 3.1 spatially explicit database of human-induced global land-use change over the past 12,000 years', *Global Ecology and Biogeography* 20: 73–86.
51. FAO, FAOSTAT, <http://faostat.fao.org/>, visited 16 May 2015.
52. FAOSTAT, May 9, 2015.
53. Zhu Z and Myneni RB (2014), A greener Earth (?), Global vegetation monitoring and modeling, Avignon, France, 3–7 February 2014.
54. IPCC AR5 WG2, Chapter 18, p. 989.
55. See also: IPCC WG1, AR5, p. 502.
56. Donohue RJ, Roderick ML, McVicar TR, Farquhar GD (2013), 'Carbon dioxide fertilisation has increased maximum foliage cover across the globe's warm, arid environments'. *Geophysical Research Letters*, 2013; DOI: 10.1002/grl.50563.
57. In other words, the sum of the product of number of species and representatives of each species.
58. This calculation ignores additional habitat conversion that would be required to maintain biomass plantations and livestock needed to fulfill current demand for fuel, energy and materials. It also assumes that crop yields can be maintained at the current average level. This is unlikely because the most productive lands are already being used.
59. Goklany IM (2012), *Humanity unbound*. *Ibid*.
60. UNEP-WCMC (2014), *Protected Planet Report 2014*. UNEP-WCMC: Cambridge, UK.
61. Simon J, ed. (1995), *The State of Humanity*. Blackwell, Boston.
62. Ridley M (2010), *The Rational Optimist*.
63. Goklany IM (2007), *The Improving State of the World*. Cato Institute.
64. In 2005 international PPP-adjusted dollars, equivalent to \$636 in 1990 international PPP-adjusted dollars.
65. Again, in 2005 international PPP-adjusted dollars.

66. Milanovic B, *Global income inequality by the numbers: in history and now – an overview*. World Bank, Policy Research Working Paper 6259.
67. IUCN. The Red List
68. CREO (2015)
69. IPCC WG2 AR5 Report, p. 295.
70. Pontifical academies (2015), p. 9.
71. Pontifical academies, third sentence, p. 1.
72. Goklany IM (2011), Could biofuel policies increase death and disease in developing countries? *Journal of American Physicians and Surgeons* 16(1): 9–13.
73. Pontifical academies, p. 1.
74. Fyfe JC, Gillett NP, and Zwiers W (2013), Overestimated global warming over the past 20 years. *Nature Climate Change* 3: 767.
75. The number following the \pm sign indicates the 95% confidence interval. Thus, a trend of $0.30 \pm 0.02^\circ\text{C}$ per decade informs the reader that the researchers are 95% confident that the decadal trend is between 0.28 and 0.32°C .
76. Goklany IM (2007), Is a richer-but-warmer world better than poorer-but-cooler worlds? *Energy & Environment* 18(7 and 8): 1023–1048.
77. Goklany IM (2012), Is climate change the number one threat to humanity? *Wiley Interdisciplinary Reviews: Climate Change* 3: 499.
78. IPCC AR5 WG2, Chapter 7, p. 506, Figure 7-7. According to this figure, yields *after* adaptation are marginally worse than yields without adaptation in tropical areas. Similarly, Figure 7-4, p. 498, indicates that maize yields in tropical areas would on average be lower with adaptation. Fortunately, Chapter 7 recognizes that such adaptations are unlikely to be implemented. See p. 516, Figure 7-8. However, such absurd results – and the amount of ink devoted to them in the chapter – do not inspire confidence in the impacts assessment.
79. WHO (1999), *Roll back malaria*. World Health Report 1999.
80. WHO (2013), *World Malaria Report 2013*, Annex 6B.
81. Goklany IM (2011), *Wealth and safety: the amazing decline in deaths from extreme weather in an era of global warming, 1900–2010*. Reason Institute.
82. Donohue RJ, Roderick ML, McVicar TR, Farquhar GD (2013), Carbon dioxide fertilisation has increased maximum foliage cover across the globe's warm, arid environments. *Geophysical Research Letters*, 2013; DOI: 10.1002/grl.50563.
83. Zhu Z and Myneni RB (2014), A greener earth. *Ibid*.
84. Thomas CD et al. (2004), Extinction risk from climate change, *Nature* 427: 145–148.
85. Goklany IM (2009), Trapped between the falling sky and the rising seas: the imagined terrors of the impacts of climate change. Prepared for University of Pennsylvania Workshop on Markets & the Environment, draft, 13 December 2009: 12–13.
86. Goklany IM (2009), Trapped between the falling sky and the rising seas. *Ibid*.
87. Goklany IM (2012) Is climate change the number one threat to humanity? *Ibid*.

88. Pierce DW, Cayan DR, Das T et al. (2013), The key role of heavy precipitation events in climate model disagreements of future annual precipitation changes in California, *J. Climate* 26: 5879–5896.
89. Winter JM, Yeh P, Fu X, and Eltahir EAB (2015). Uncertainty in modeled and observed climate change impacts on American Midwest hydrology. *Water Resources Research*. DOI: 10.1002/2014WR016056.
90. Botkin DB et al. (2007), Forecasting the effects of global warming on biodiversity. *Bioscience* 57: 227–236.
91. Jeschke JM and Strayer DL (2008), Usefulness of bioclimatic models for studying climate change and invasive species. In: Ostfeld RS and Schlesinger WH (eds), *The Year in Ecology and Conservation 2008, Annals of the New York Academy of Sciences* 1134. Blackwell, pp. 124.
92. Dormann CF et al. (2012), Correlation and process in species distribution models: bridging a dichotomy, *Journal of Biogeography* 39: 2119–2131.
93. Bahn V and McGill BJ (2012). Testing the predictive performance of distribution models, *Oikos* 000: 001–011, doi: 10.1111/j.1600-0706.2012.00299.x
94. La Sorte FA and Jetz W (2010). Avian distributions under climate change: towards improved projections, *Journal of Experimental Biology* 213: 862–869.
95. Araújo MB and Peterson AT (2012), Uses and misuses of bioclimatic envelope modeling, *Ecology* 93: 1527–1539. <http://dx.doi.org/10.1890/11-1930.1>.
96. Tol RSJ (2014), Correction and update: the economic effects of climate change, *Journal of Economic Perspectives* 28: 221–225.
97. Stern N (2007), *The economics of climate change*. London: Her Majesty's Treasury.
98. Goklany IM (2012), *Is climate change the number one threat to humanity?*. *Ibid*.
99. Tol RSJ (2008). The social cost of carbon: trends, outliers and catastrophes. *Economics* 2: 1–24.
100. Tol RSJ (2014), Correction and update. *Ibid*.
101. IPCC AR5 (2013), Appendix, p. 1422.
102. Lewis N (2015), The implications for climate sensitivity of Bjorn Stevens' new aerosol forcing paper. Climate Audit, March 19.
103. Fyfe JC, Gillett NP, and Zwiers W (2013), Overestimated global warming over the past 20 years. *Nature Climate Change* 3: 767.
104. Lomborg B, ed. (2015), *The Nobel Laureates' Guide to the Smartest Targets for the World 2016–2030*. Copenhagen Consensus Center.
105. Goklany IM (2009), Is climate change the 'defining challenge of our age'? *Energy & Environment* 20(3): 279–302.
106. WHO (2009), *Global health risks*, available at http://www.who.int/healthinfo/global\protect_burden\protect_disease/global\protect_health\protect_risks/en/, visited June 13, 2015.
107. Goklany IM (2011), Could biofuel policies increase death and disease in developing countries? *Journal of American Physicians and Surgeons* 16(1): 9–13.

108. Guo Y, Gasparrini A, Armstrong B et al. (2014), Global variation in the effects of ambient temperature on mortality: a systematic evaluation. *Epidemiology* 25(6): 781–789.
109. Gasparrini A et al. (2015), Mortality risk attributable to high and low ambient temperature: a multicountry observational study. *The Lancet*, May 2015 DOI: 10.1016/S0140-6736(14)62114-0
110. This may be why retirees often long to go to warmer climes.
111. Gasparrini et al. (2015). *Ibid.*
112. Goklany IM (2012), Is climate change the number one threat to humanity? *Ibid.*
113. IPCC AR5 WG2, Box CC-VW, p. 158.
114. Gerten D et al. (2011), Global water availability and requirements for future food production. *Journal of Hydrometeorology* 12(5): 885–899.
115. Konzmann M et al. (2013), Climate impacts on global irrigation requirements under 19 GCMs, simulated with a vegetation and hydrology model. *Hydrological Sciences Journal*, 58(1): 88–105.
116. Wiltshire A et al. (2013), The importance of population, climate change and carbon dioxide plant physiological forcing in determining future global water stress. *Global Environmental Change* 23.5: 1083–1097.
117. Goklany IM (2012), *Is climate change the number one threat to humanity? Ibid.*
118. Goklany IM (2009), Is climate change the defining challenge? *Ibid.*
119. Lomborg B, ed. (2015), *The Nobel Laureates Guide to the Smartest Targets for the World 2016-2030*. Copenhagen Consensus Center.
120. Goklany IM (2012), *Is climate change the number one threat to humanity? Ibid.*
121. Goklany IM (2012), *Is climate change the number one threat to humanity? Ibid.*
122. Pontifical Academies, p.1.
123. IPCC (2000), Special Report on Emissions Scenarios.
124. Goklany IM (2012), Is climate change the number one threat to humanity? *Ibid.*

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GWPF BRIEFINGS

1	Andrew Turnbull	The Really Inconvenient Truth or 'It Ain't Necessarily So'
2	Philipp Mueller	The Greening of the Sahel
3	William Happer	The Truth about Greenhouse Gases
4	Gordon Hughes	The Impact of Wind Power on Household Energy Bills
5	Matt Ridley	The Perils of Confirmation Bias
6	Philipp Mueller	The Abundance of Fossil Fuels
7	Indur Goklany	Is Global Warming the Number One Threat to Humanity?
8	Andrew Montford	The Climate Model and the Public Purse
9	Philipp Mueller	UK Energy Security: Myth and Reality
10	Andrew Montford	Precipitation, Deluge and Flood
11	Susan Crockford	On the Beach
12	Madhav Khandekar	Floods and Droughts in the Indian Monsoon
13	Indur Goklany	Unhealthy Exaggeration
14	Susan Crockford	Twenty Reasons not to Worry about Polar Bears
15	Various	The Small Print
16	Susan Crockford	The Arctic Fallacy
17	Indur Goklany	The Benefits of Carbon Dioxide
18	Judith Curry	The Climate Debate in the USA
19	Indur Goklany	The Papal Academies' Broken Moral Compass
20	Donoughue and Forster	The Papal Encyclical: a Critical Christian Response

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Our main focus is to analyse global warming policies and their economic and other implications. Our aim is to provide the most robust and reliable economic analysis and advice. Above all we seek to inform the media, politicians and the public, in a newsworthy way, on the subject in general and on the misinformation to which they are all too frequently being subjected at the present time.

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