Climate Change and The Common Good

A Statement Of The Problem
And
The Demand For Transformative Solutions

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DECLARATION

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. There is still time to mitigate unmanageable climate changes and repair ecosystem damages, provided we reorient our attitude toward nature and, thereby, toward ourselves. Climate change is a global problem whose solution will depend on our stepping beyond national affiliations and coming together for the common good. Such transformational changes in attitudes would help foster the necessary institutional reforms and technological innovations for providing the energy sources that have negligible effect on global climate, atmospheric pollution and eco-systems, thus protecting generations yet to be born. Religious institutions can and should take the lead in bringing about that change in attitude towards Creation.

The Catholic Church, working with the leadership of other religions, can now take a decisive role by mobilizing public opinion and public funds to meet the energy needs of the poorest 3 billion people, thus allowing them to prepare for the challenges of unavoidable climate and eco-system changes. Such a bold and humanitarian action by the world's religions acting in unison is certain to catalyze a public debate over how we can integrate societal choices, as prioritized under UN's sustainable development goals, into sustainable economic development pathways for the 21st century, with projected population of 10 billion or more.

SUMMARY

This century is on course to witness unprecedented environmental changes. In particular, the projected climate changes or, more appropriately, climate disruptions, when coupled with on-going massive species extinctions and the destruction of ecosystems, will doubtless leave their indelible marks on both humanity and nature. As early as 2100, there will be a non-negligible probability of irreversible and catastrophic climate impacts that may last over thousands of years, raising the existential question of whether civilization as we know it can be extended beyond this century. Only a radical change in our attitude towards Creation and towards our fellow humans, complemented by transformative technological innovations, could reverse the dangerous trends that have already been set into motion inadvertently. A sustainable future based on the continued extraction of coal, oil and gas and their use in the "business-as-usual mode" will not be possible, because it raises the specter of a world that could be significantly warmer than 2°C by the end of this century. Such a temperature rise, occurring in a warm inter-glacial epoch that we call the Holocene, has not been seen in tens of millions of years. This creates a serious risk that Earth will cross critical thresholds and tipping points, pushing whole environmental systems, such as rain forests, continental ice sheets, coastal wetlands, monsoon patterns and marine food webs into different states or even annihilation. To quote the most recent IPCC (Intergovernmental Panel on Climate Change) Synthesis Report released in 2014: We risk "increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems."

The climate system is highly complex and it could respond in surprising ways that have not yet been anticipated by models that project the future climate. But the uncertainty can go both ways. For example, the actual warming of the planet to continued build up of the greenhouse gases, can be a factor of 2 smaller or larger than the projected values. Climate change that is a factor of two larger than the predicted changes poses unacceptable risks to society, ecosystem and the economy, particularly since the life time of carbon dioxide in the atmosphere is a century or longer and the life time of the heat added to the deeper layers of the oceans can exceed several centuries.

There is still time, however, to mitigate unmanageable climate changes and thus to protect humanity and nature. Adequate technological solutions and policy options have been clearly prescribed in numerous reports and need no extended repetition here. Suffice it to note that the most important steps involve the shift from fossil fuels to zero-carbon and low carbon sources and technologies, coupled with a reversal of deforestation, land degradation, and air pollution. In contemplating these needed "deep de-carbonization" transformations, however, we must not ignore the underlying socio-economic factors that are responsible for our current predicament. Our problems have been exacerbated by the current economic obsession that measures human progress solely in terms of Gross Domestic Product (GDP) growth, a practice that could be justified only if natural capital were of infinite size. Present economic systems have also fostered the development of unacceptable gaps between the rich and the poor. The latter still have no access to most of the scientific and technical benefits of the modern age. During the 20th Century by far the greatest emitters of carbon were the world's rich nations. In the 21st century world it is, again, the rich who are doing most of the greenhouse polluting, but the rich now are no longer confined to the rich world. The three billion poorest people continue to have only a minimal role

in the global warming pollution, yet are certain to suffer the worst consequences of unabated climate change.

The Catholic Church, working with the leadership of other religions, could take a decisive role in helping to solve this problem. The Church could accomplish this by mobilizing public opinion and public funds to meet the energy needs of the poorest 3 billion in a way that does not contribute to global warming but would allow them to prepare better for the challenges of unavoidable climate change. The case for prioritizing climate-change mitigation depends crucially on accepting the fact that we have a responsibility not only towards those who are living in poverty today, but also to generations yet unborn. We have to reduce the potentially catastrophic threat that hangs over so many people.

Though it is late in the day, the world's governments are recognizing the challenges that we face on a global level. The UN Member States have announced their determination to place Sustainable Development at the center of global cooperation, building a holistic cooperative strategy on the pillars of economic progress, social inclusion and environmental sustainability. This would involve the adoption of new Sustainable Development Goals (SDGs) to help guide global cooperation during the course of future generations. All people of good will should encourage their governments to undertake these commitments to action. We should also advance our intellectual capacities as well as scientific knowledge, both of the natural and the social sciences, which can be expected to insure the well being of many future generations in a relatively stable environment

Over and above institutional reforms, policy changes and technological innovations for affordable access to zero-carbon energy sources, there is a fundamental need to reorient our attitude toward nature and, thereby, toward ourselves. Finding ways to develop a sustainable relationship with our planet requires not only the engagement of scientists, political leaders and civil societies, but ultimately also a moral revolution. Religious institutions can and should take the lead on bringing about such a new attitude towards Creation.

SCIENTIFIC BACKGROUND

The declaration, the summary as well as the background material in what follows draw heavily on two workshops: The first organized by PAS in 2011, entitled: Fate of Mountain Glaciers in the Anthropocene; and the Second, organized jointly by PAS and PASS in 2014, titled: Sustainable Humanity, Sustainable Nature, Our Responsibility. The proceedings of both these workshops are available at the website of the Pontifical Academy of Sciences. See also a summary in: Dasgupta and Ramanathan (Science, 345, P.1457, 2014). The entire document also benefited significantly from three reports: i) What we know: The Reality, Risks and Response to Climate Change, Molina et al, 2014, published by AAAS; ii) Climate Change 2014: Synthesis Report of the IPCC, 2014. iii) Turn Down the Heat: Why a 4°C warmer world must be avoided. Schellnhuber et al, 2013. Published by the World Bank.

HOW DID WE GET HERE?

The technological prowess we have achieved during the last two centuries has brought us to a crossroads. We are the inheritors of remarkable waves of technological change: steam power, railroads, electrification, automotive transport, aviation, telephones, industrial chemistry, modern medicine, computing, and now the digital revolution, biotechnologies and nanotechnologies. We have also changed our natural environment to such an extent that many scientists feel compelled to redefine the current period as the Anthropocene epoch. Today, human activities, involving the unsustainable exploitation of fossil fuels and other forms of natural capital, are having a decisive and unmistakable impact on the planet. The aggressive exploitation of fossil fuels and other natural resources has damaged the air we breathe, the water we drink, and the land we inhabit. For instance, some 1000 billion tons of carbon dioxide and other climatically-important "greenhouse" gases have already been accumulated in the atmosphere. Over the course of a relatively short time, the concentration of carbon dioxide, CO_2, has increased by 40%, and now exceeds the highest levels in at least the last million years. Carbon dioxide is a major driver of the natural climate as well as biotic processes in both terrestrial and marine ecosystems, making possible life on Earth. The problem we now face is that fossil fuel combustion and deforestation have significantly altered the carbon balance of the atmosphere and the biosphere. Fossil fuel exploitation has also taken a huge toll on human wellbeing. The air pollution caused by the unsustainable consumption of natural capital causes about 7 million premature deaths each year, as well as the annual destruction of over 100 million tons of wheat, rice and other crops. Human activities have changed the climate system through emissions of CO_2, other non-CO_2 greenhouse gases and particulate pollution. Vast transformations of the land surface, including loss of forests, grasslands, wetlands, and other ecosystems, are also contributing to climate change.

WHAT ARE THE CHANGES WE HAVE SEEN ALREADY?

As a result of human activities, the concentration of the greenhouse gases, notably CO_2, methane and nitrous oxide, have reached levels unprecedented in at least the previous million years. The climatic and ecological impacts of this human interference with the Earth System are expected to last for many thousands of years into the future. The planet has warmed by 0.85°C since the 1880s. Glaciers and Arctic sea ice have continued to shrink. For example, the Alpine glaciers in Europe and elsewhere have lost more than half of their mass over the course of the past 200 years. The glaciers in the Hindukush-Himalayan-Tibetan region are also shrinking, thus posing a threat to local communities and the many more people farther away who depend on the mountain water resources to which these glaciers contribute significantly during the dry parts of the year. Everywhere, snow packs are melting earlier in spring, which, coupled with higher temperatures, has led to more frequent and extensive forest fires in the bordering ecosystems. Recent decades have also seen the accelerated melting of Greenland and West Antarctic glaciers and an Arctic Ocean that is increasingly open in summer. The melting glaciers and the extension of the warming to ocean depths below 1000 meters have increased sea level worldwide, an effect that will soon become an existential problem for many island nations, coastal cities, coastal and low-lying agricultural areas and wetlands everywhere.

WHAT ARE THE IMPACTS ON THE NATURAL SYSTEMS?

Global warming is already having major impacts on extreme weather and climate events. Many regions of the world have witnessed an increase in the number of warm temperature extremes, increase in the frequency of heavy precipitation events, and high sea levels. Natural feedbacks in the system have amplified the warming. As examples, increases in atmospheric humidity have enhanced the greenhouse effect of water vapor; the pole-ward retreat of the Arctic sea ice since the mid-20th century has exposed the darker sea, thus enhancing the absorption of sunlight by the Arctic Ocean; the storm-track cloudiness have also retreated pole-wards, which in turn has allowed more sunlight to reach the surface over the northern hemisphere's extra-tropical oceans. Since 1900 these amplifiers, taken together, have enhanced the direct warming by CO_2 and other warming pollutants by more than double. About a third of the carbon dioxide entering the atmosphere as a result of fossil fuel burning and deforestation is absorbed in the oceans, thus making them increasingly acidic. Hydrogen ions, which are the metric for acidity, have already increased by 26%. This increase in acidity is proceeding faster than any similar event during the past tens of millions of years. It has major consequences for the development of corals and of shelled organisms, such as mollusks and crustaceans.

Every component of the earth system - the oceans, the land, the atmosphere and the cryosphere - has warmed, leading to the pole-ward migration of animal and plant species to the extent possible or to their extinction. Collectively, this warming and the extreme events it has brought in its wake, such as heat waves, intense storms, and forest fires, and the accompanying melting of mountain glaciers, rising sea level, and erosion of wet lands have damaged natural ecosystems and human health in multiple ways, many of which have yet to be documented, let along analyzed rigorously. In addition, surface warming, changing precipitation patterns coupled with early melting of snow packs and glaciers, have affected water resources and reduced crop yields.

THE HISTORICAL CONTEXT

The historical context for the climate changes we have experienced during the 20th century is important for understanding these changes properly. About 10,000 years ago, when we humans were first beginning to cultivate crops for food, world population was approximately one million, with about 100,000 in Europe. As agriculture spread and our numbers grew, the world enjoyed a relatively stable climate. There have been a few exceptions, such as the medieval warm period from the 10th to the 13th century, and the Little Ice Age that followed it. Before human numbers began to grow so remarkably, there were many periods when Earth's climate changed dramatically. During the Pleistocene Era of the past 2.6 million years, glacial periods alternated with interglacial ones about every 100,000-40,000 years. The most recent extensive glaciation of Earth ended about 18,000 years ago, leaving it in the midst of an interglacial (warm) period that started about 11,000 years ago. And it was then that our scattered hunter-gatherer ancestors began to experiment with farming. Such dramatic changes in past climates have been used by some to argue as follows:

"Since the Earth has experienced alternating cold periods (ice ages or glacials) and warm periods (inter-glacials) during the past, today's climate and ice cover changes are entirely natural events".

In response, we state: The primary triggers for ice ages and inter-glacials are well understood to be changes in the astronomical parameters related to the motion of our planet within the solar system and to natural feedback processes in the climate system. The time scales between these triggers are in the range of 10,000 years or longer. By contrast, the human-induced changes observed in carbon dioxide, other greenhouse gases and soot particle concentrations are taking place on 10-100 year timescales –at least 100 times as fast. Incoming solar energy also varies on the decadal to century time scales. However, direct measurements of solar irradiance from satellites and surface stations, reveal that variations in solar energy on decadal to century time scales are about $0.3 Wm^{-2}$ (Watts per square meter of earth's surface area) which is about 10% of the 3 Wm^{-2} increase in infrared energy trapped by manmade greenhouse gases.

WHAT IF WE CONTINUE BUSINESS AS USUAL?

It is particularly worrying that the present release of global warming pollutants is occurring during an interglacial period when Earth is already at a natural temperature maximum. A warming of the planet by more than 2°C during an interglacial would be unprecedented compared with what the planet and its ecosystems have experienced in the last 800,000 years. Yet the most advanced climate models are predicting that if current levels of increase in the emission of carbon dioxide and other warming pollutants continue unabated, the increase in mean global temperature could reach 2°C by mid-century and could be more than 4°C beyond 2100. Roughly 45% of the anthropogenic greenhouse heating added to the planet is due to gaseous pollutants other than carbon dioxide (e.g., see IPCC Working Group-1 , 2013); many of these gaseous pollutants, such as the hydrofluorocarbons (HFCs) used as refrigerants, are increasing at alarming rates. Unfortunately, global climate models have underestimated the pace at which Arctic sea ice is retreating, the rate at which the Greenland glacier is melting, and the rate at which sea levels are rising. The models have also tended to miscalculate some of the regional changes that have been observed in the second half of the last century. Conceptual and empirical models of climate based on past climate changes have derived probability distributions of probable climate changes. When these are applied to the observed and predicted build-up of greenhouse gases, they suggest a long low-probability tail of warming that is so large that we ultimately run the risk of abrupt climate

changes and collapses of regional ecosystems, arctic sea ice, ice sheets, and the massive release of biogenic methane gas from permafrost and other polar systems. The latter have the potential to affect the global climate that is, on a per molecule basis, 20 to 90 times more potent than carbon dioxide.

SO HOW SHOULD SOCIETY RESPOND?

By any measure, the projected changes for 2100 and beyond should be viewed by a rational society as being large enough to take the necessary steps immediately to sustainable and clean energy. The world must achieve deep de-carbonization of the energy system by mid-century, and reach near-zero carbon emissions by around 2070 if the rise in mean global temperature is to be below the 2°C upper limit. Generations to come will experience and will likely suffer from the environmental consequences of the fossil fuel consumption of the last two centuries. They are likely to wonder what took 21st century citizens of the world so long to respond to these frightening climate trends. The problem is not one of how well our children and grandchildren will fare in the world of the future, but whether civilization as we know it can be extended beyond the next 100 years.

In addition to the issue of inter-generational equity, climate change from fossil-fuel burning poses a major problem of intra-generational equity. During the 20th Century the overwhelming bulk of carbon emissions was made by today's rich countries. But there are still three billion people today who do not have access to modern energy sources. They are obliged to cook and heat their homes by burning solid fuels, thus producing indoor smoke to a degree that is dangerous to their health. Although, their contribution to the greenhouse gas emissions is minimal (<10%), this bottom three billion are the ones likely to suffer the most from extreme weather and climate events. We have to solve both the inter-generational and the intra-generational equity problems resulting from our unsustainable consumption of fossil fuels. Achievement of this goal would require nothing short of widespread moral reform in which we might collectively give up the greedy behavior that was so necessary for our hunter-gatherer ancestors to survive and instead become truly social beings, living together in comfort and sustainably.

WHAT ARE THE REQUIRED ECONOMIC REFORMS?

Fortunately, there is still time to mitigate climate change significantly and avert catastrophic consequences for society and ecosystems. There are specific steps we can and should take to slow the pace of climate change. In doing so we must not ignore the underlying socio-economic factors that are responsible for our current predicament. Market forces alone, bereft of ethical values, cannot solve the intertwined crises of poverty, exclusion, and the environment. Problems have been exacerbated by the current economic measurement in terms of Gross Domestic Product (GDP). GDP misleads because it does not incorporate the degradation of nature that accompanies production and consumption in the contemporary world. Our perception of the world is influenced deeply by the statistics we read. Unlike private firms, national economies do not produce balance sheets. International agreement is now needed to move to a system of national accounts that records movements in the true wealth of nations and the true wealth of communities within nations. National balance sheets would offer citizens a picture of the impact their activities have on nature. Recent estimates of movements in the wealth of nations have revealed that wealth

per capita has declined in recent decades in a remarkable number of countries, even while their GDP per capita has increased. The move to a sustainable world will not be cost-free for all: the options we face are not "win-win". Present economic systems have been accompanied by the development of unacceptable gaps between the rich and the poor, the latter still lacking access to most of the scientific and technical benefits that we have developed in the industrial world. We should be prepared to accept a reallocation of the benefits and burdens that accompany humanity's activities both within nations and between nations.

THE BROADER CONTEXT OF SUSTAINABLE DEVELOPMENT

Unsustainable consumption coupled with the already record size of the human population and the uses of inappropriate technologies are causally linked with the destruction of the world's sustainability and resilience and the loss of millions of species of the organisms on which we depend directly for life, as well as the widening inequalities of wealth and income in many societies.

Over the 10,000 years that humans have depended on agriculture, it has been spread over a third of the earth's land surface, doubtless causing the extinction of at least hundreds of thousands and perhaps millions of species of organisms in the process. During the last two centuries, however, our numbers have grown at an unprecedented rate from one billion to more than seven billion people, with expectations for ever-increasing consumption rising even faster than the populations themselves. Although we are an inseparable part of the living world, entirely dependent on it for every aspect of our lives, we are destroying it with blinding speed through habitat destruction, global climate change, moving invasive species (including pests and parasites) rapidly throughout the world, and harvesting many kinds of wild plants and animals unsustainably. Considering the fact that we have found and named only a small proportion of the species of organisms that occur on earth, we will never even be directly aware of most of those that we drive and have driven to extinction. Our activities constitute a direct rejection of the Biblical injunction to care for the world by good stewardship: they not only deny benefits that we enjoy now to future generations but also seriously threaten global sustainability. The destruction of so many of what are, as far as we know, our only living companions in the universe, is clearly, as Harvard Professor E.O. Wilson has put it, the sin for which our descendants will be least likely to forgive us, as it is completely irreversible. To save as much of the sustainable fabric of the world as possible, we need to take many steps, among them reaching a level and sustainable population; just consumption rates throughout the world; the empowerment of women and children everywhere and their incorporation into the management of our one planet; and the development of many new and more sustainable technologies that must be made widely available. With such achievements, hunger could be conquered, with one proviso concerning the distribution of food resources. Without taking these steps, there is little hope for societal advance in the future.

Tragically, a third of the food currently produced is wasted, which as Pope Francis has said is "like stealing from the table of the poor and the hungry". Currently, the carbon footprint of this wasted food is the largest contributor to global warming after the carbon emissions of China and USA. Considering the persistence of poverty, the widening of economic and social inequalities and the continued destruction of the environment, the world's governments called for the adoption by

2015 of new Sustainable Development Goals (SDGs) to guide planetary-scale actions thereafter. To achieve these goals will require global cooperation, technological innovations that are within reach, improvements in education and supportive economic and social policies at the national and regional levels. It has become abundantly clear that humanity's relationship with nature needs to be undertaken by cooperative, collective action at all levels – local, regional, and global.

RECOMMENDED MEASURES: CLIMATE MITIGATION

● *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. All nations must focus on a rapid transition to renewable energy sources and other strategies to reduce CO_2 emissions. Nations should also avoid removal of carbon sinks by stopping deforestation, and should strengthen carbon sinks by reforestation of degraded lands. These actions must be accomplished within a few decades, reaching net-zero carbon emissions by around 2070.*

● *Reduce the concentrations of short-lived climate warming air pollutants (dark soot, methane, lower atmosphere ozone, and hydrofluorocarbons) by as much as 50%, to slow down climate change during this century, and to prevent a hundred million premature deaths between now and 2050 as well as hundreds of millions of tons of crop loss during the same period.*

● *Prepare especially the most vulnerable 3 billion people to adapt to the climate changes, both chronic and abrupt, that society will be unable to mitigate. In particular, we call for a global capacity building initiative to assess the natural and social impacts of climate change in mountain systems and related watersheds, and in highly vulnerable dryland regions.*

● *The Catholic church, working with the leadership of other religions, can take a decisive role by mobilizing public opinion and public funds to meet the energy needs of the poorest 3 billion to better prepare them to cope with impending climate changes and more generally to raise the incomes, education, healthcare and quality of life of the world's poorest under the aegis of the SDGs.*

● *Over and above institutional reforms, policy changes and technological innovations for affordable access to renewable energy sources, there is a fundamental need to reorient our attitude toward nature and, thereby, toward ourselves. Finding ways to develop a sustainable relationship with nature requires not only the engagement of scientists, political leaders, educators and civil societies, but will succeed only if it is based on a moral revolution that religious institutions are in a special position to promote.*

RECOMMENDED MEASURES: BEYOND CLIMATE CHANGE

● *We must find ways to protect and conserve as large as possible a fraction of the tens of millions of plants, animals, fungi and microorganisms that make up the living fabric of the world. We depend on them for the maintenance of the sustainable properties of the earth and for virtually every facet of our existence, and yet we have recognized only a very small fraction of them up to the present date. If we don't save them now, we clearly will not be able to save them later.*

● *In view of the persistence of poverty, the widening of economic and social inequalities, and the continued destruction of the environment, we support and endorse the call for the adoption by 2015 of new universal goals, to be called Sustainable Development Goals (SDGs), to guide planetary-scale actions after 2015.*

● *Only through the empowerment and education of women and children throughout the world will we be able to attain a world that is both just and sustainable. We have a clear moral obligation to do this, and will benefit greatly by succeeding in this goal.*

A Partial Record of the Growths in Human Activities (1880s to 1990s)

WORLD POPULATION	*FACTOR OF SIX*
URBAN POPULATION	*FACTOR OF THIRTEEN*
WORLD ECOCNOMY	*FACTOR OF FOURTEEN*
INDUSTRIAL OUPUT	*FACTOR OF FORTY*
ENERGY USE	*FACTOR OF SIXTEEN*
COAL PRODUCTION	*FACTOR OF SEVEN*
CARBON DIOXIDE EMISSION	*FACTOR OF SEVENTEEN*
SULFUR DIOXIDE EMISSION	*FACTOR OF THIRTEEN*
LEAD EMISSION	*FACTOR OF EIGHT*
WATER USE	*FACTOR OF NINE*
FISH CATCH	*FACTOR OF THIRTY FIVE*
BLUE WHALE POPULATION	*NINETY NINE PERCENT DECREASE*

Taken from Crutzen's presentation at PAS/PASS Sustainability Workshop. Source for the data: J.R. Mcneill : Something new under the sun.