Preface

Human prosperity has been intimately tied to our ability to capture, collect, and harness energy. The control of fire and the domestication of plants and animals were two of the essential factors that allowed our ancestors to transition from a harsh, nomadic existence into stable, rooted societies that could generate the collective wealth needed to spawn civilizations. For millennia, energy in the form of biomass and fossilized biomass was used for cooking and heating, and for the creation of materials that ranged from bricks to bronze. Despite these developments, relative wealth in virtually all civilizations was fundamentally defined by access to and control over energy, as measured by the number of animal and humans that served at the beck and call of a particular individual.

The Industrial Revolution and all that followed have propelled an increasingly larger fraction of humanity into a dramatically different era. We go to the local market in automobiles that generate the pull of hundreds of horses, and we fly around the world with the power of a hundred thousand horses. Growing numbers of people around the world can take for granted that their homes will be warm in the winter, cool in the summer, and lit at night. The widespread use of energy is a fundamental reason why hundreds of millions of people enjoy a standard of living today that would have been unimaginable to most of humanity a mere century ago.

What has made all this possible is our ability to use energy with ever increasing dexterity. Science and technology have given us the means to obtain and exploit sources of energy, primarily fossil fuel, so that the power consumption of the world today is the equivalent of over seventeen billion horses working 24 hours per day, 7 days per week, 365 days a year. Put another way, the amount of energy needed to keep a human being alive varies between 2,000 and 3,000 kilocalories per day. By contrast, average per capita energy consumption in the United States is approximately 350 billion joules per year, or 230,000 kilocalories per day. Thus, the average American consumes enough energy to meet the biological needs of 100 people, while the average citizen in OECD countries uses the energy required to sustain approximately 50 people. By comparison, China and India currently consume approximately 9–30 times less energy per person than the United States. The worldwide consumption of energy has nearly doubled between 1971 and 2004, and is expected to grow another 50 percent by 2030, as developing countries move—in a business-as-usual scenario—toward an economic prosperity deeply rooted in increased energy use.

The path the world is currently taking is not sustainable: there are costs associated with the intensive use of energy. Heavy reliance on fossil fuels is causing environmental degradation at the local, regional, and global levels. Climate change, in particular, poses global risks and challenges that are perhaps unprecedented in their magnitude, complexity, and difficulty. At the same time, securing access to vital energy resources, particularly oil and natural gas, has become a powerful driver in geo-political alignments and strategies. Finally, if current trends continue, inequitable access to energy, particularly for people in rural areas of developing countries, and the eventual exhaustion of inexpensive oil supplies could have profound impacts on international security and economic prosperity.

While the current energy outlook is very sobering,
we believe that there are sustainable solutions to the energy problem. A combination of local, national, and international fiscal and regulatory policies can greatly accelerate efficiency improvements, which remain in many cases the most cost-effective and readily implemented part of the solution. Significant efficiency gains were achieved in recent years and more can be obtained with policy changes that encourage the development and deployment of better technologies. For developing countries with rapidly growing energy consumption, ‘leapfrogging’ past the wasteful energy trajectory historically followed by today’s industrialized countries is in their best economic and societal interests. Providing assistance to these countries aimed at promoting the introduction of efficient and environmentally friendly energy technologies as early as possible should therefore be an urgent priority for the international community.

A timely transition to sustainable energy systems also requires policies that drive toward optimal societal choices, taking into account both the short- and long-term consequences of energy use. Discharging raw sewage into a river will always be less expensive at a micro-economic level than first treating the waste, especially for ‘up-stream’ polluters. At a macro scale, however, where the long-term costs to human health, quality of life, and the environment are folded into the calculation, sewage treatment clearly becomes the low-cost option for society as a whole. In the case of climate change, the predicted consequences of continued warming include a massive reduction of water supplies in some parts of the world, especially those that rely on the steady run-off of water from glaciers; the spread of malaria, cholera, and other diseases whose vectors or pathogens are temperature- and moisture-dependent; increased devastation from extreme weather events such as floods, droughts, wildfires, typhoons, and hurricanes; permanent displacement of tens to hundreds of millions of people due to rising sea levels; and significant loss of biodiversity.

Meanwhile, other types of emissions associated with common forms of energy use today impose significant adverse health impacts on large numbers of people around the world—creating risks and costs that are often not captured in energy market choices or policy decisions. Thus, it becomes critical to consider the additional costs of mitigating these impacts when attempting to assess the true low-cost option in any long-term, macro-economic analysis of energy use and production. The cost of carbon emissions and other adverse impacts of current modes of energy use must be factored into market and policy decisions.

In addition to extensive energy efficiency enhancements and rapid deployment of low-carbon technologies, including advanced fossil-fuel systems with carbon capture and sequestration and nuclear energy, a sustainable energy future will be more readily attainable if renewable energy sources become a significant part of the energy supply portfolio. Science and technology are again essential to delivering this part of the solution. Significant improvements in our ability to convert solar energy into electricity are needed, as are economical, large-scale technologies for storing energy and transmitting it across long distances. Improved storage and transmission technologies would allow intermittent renewable sources to play a greater role in supplying

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the world’s electricity needs. At the same time, efficient methods of converting cellulosic biomass into high-quality liquid fuels could greatly reduce the carbon footprint of the world’s rapidly growing transportation sector and relieve current supply pressures on increasingly precious petroleum fuels.

At this point, much has been written about the sustainable energy problem and its potential solutions. The defining feature of this report by the InterAcademy Council (IAC) is that it was developed by a study panel that brought together experts nominated by over ninety national academies of science around the world. Members of the panel in turn drew upon the expertise of colleagues within and outside their own countries, so that the resulting report—which was further informed by a series of workshops held in different parts of the world and by numerous commissioned studies—represents a uniquely international and diverse perspective. It is our hope that the conclusions and actionable recommendations contained in Chapter 5, The Case for Immediate Action, will provide a useful roadmap for navigating the energy challenges we confront this century. Effecting a successful transition to sustainable energy systems will require the active and informed participation of all for whom this report is intended, from citizens and policymakers to scientists, business leaders, and entrepreneurs—in industrialized and developing countries alike.

It has also become evident to us, in surveying the current energy situation from multiple vantage points and through different country lenses, that it will be critical to expand and improve the capacity of international institutions and actors to respond effectively to global challenges and opportunities. Accordingly, we have personally recommended that the UN Secretary General appoint a small committee of experts who can advise him and member nations on implementing successful technologies and strategies for promoting sustainable energy outcomes. By identifying promising options and recommending modifications, where necessary, to suit different country contexts, this committee could accelerate the global dissemination of sustainable energy solutions. At the same time, it could promote a dialogue with industrial stakeholders and policymakers to identify the most effective incentives, policies, and regulations that would lead to the implementation of those solutions. Appropriately designed changes in government policy can, like the rudder of a ship, be used to steer a shift in direction that produce enormous course changes over time. We have seen examples where relatively modest government policies in our own countries have led to great successes—from California’s success in holding constant the electricity consumption per capita over the last thirty years (at a time when electricity use in the rest of the United States had grown by sixty percent) to Brazil’s success in nurturing a pioneering biofuels industry that has leapt ahead of far more economically developed countries.

In sum, we believe that aggressive support of energy science and technology, coupled with incentives that accelerate the concurrent development and deployment of innovative solutions, can transform the entire landscape of energy demand and supply. This transformation will make it possible, both technically and economically, to elevate the living conditions of most of humanity to the level now enjoyed by a large middle class in industrialized countries while substantially reducing the environmental and energy-security risks associated with current patterns of energy production and use. What the world does in the coming decade will have enormous consequences that will last for centuries; it is imperative that we begin without further delay.
On December 10, 1950, William Faulkner, the Nobel Laureate in Literature, spoke at the Nobel Banquet in Stockholm:

... I believe that man will not merely endure: he will prevail. He is immortal, not because he alone among creatures has an inexhaustible voice, but because he has a soul, a spirit capable of compassion and sacrifice and endurance.

With these virtues, the world can and will prevail over this great energy challenge.

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