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GENERATING GROWTH, CREATING  
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We are part of  
**THE CLEAN REVOLUTION**

# AN **AMERICAN** CLEAN REVOLUTION

Why the US should play to win on the clean economy

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# Foreword

Throughout history, American innovation and entrepreneurship have prompted some of the world's greatest advances. Transcontinental railroads and highways, the space program and the internet each created new markets and opportunities, bringing prosperity to millions. The Wright brothers, Thomas Edison and countless other heroes of American ingenuity have changed the lives of American families for the better.

Today, though, the prospects of providing our children with the same opportunities we've fought for and enjoyed are facing two major threats: a stagnant economy, and the increasingly devastating and costly impacts of climate change. The drought, spiking agricultural commodity prices to almost record levels this summer, is just one example of how deeply intertwined these two problems are.

If we don't address climate change, we are setting ourselves up for further, more serious economic repercussions brought about by droughts, storms and rising seas. Food bills for American families will rise. Insurance losses for American businesses will escalate. Agriculture will have to relocate. Our health care system will struggle to deal with new diseases. And aging infrastructure will be subjected to more extreme weather.

The challenge is like few others in our history. We must find a new way forward for our nation. We need a new American Revolution. An American Clean Revolution.

This is our opportunity for a better future. A clean revolution means a swift, massive scale-up of clean energy and infrastructure, and of smart technologies and design. It is the commonsense road to a smarter, better, more prosperous world.

Research by Google has shown breakthroughs in clean tech innovation could generate an extra \$155-244 billion of GDP per year from 2030 if the right investments are made today. This would result in over \$3 trillion of additional, cumulative economic output by 2050. International business opportunities for US companies are also potentially huge. The global clean energy market, for example,

will be worth \$2.2 trillion by the end of the decade according to HSBC. The market for clean economy goods and services is already half this size in the US alone. And the Harvard Business Review tells us that stocks of corporations investing in sustainability are outperforming their peers.

Failure to take global leadership of the fast-growing clean energy market will be the biggest missed opportunity of a generation. China already leads the world in wind energy investment and deployment and is on the cusp of a major expansion in solar power generation. In 2010, it overtook the US (and Japan) to become the number one filer of patent applications. America's choice as to who will lead the world in the development of clean technologies will have a major impact on our long-term interests.

The American Clean Revolution will help guarantee our security in the new global economy. It will protect us from the threats we face from our reliance on fossil fuels. The US accounts for one fifth of global oil consumption – but has less than 2% of proven reserves. The cost – financial and in terms of lives – of deploying our troops to patrol unstable oil lanes could be a price too great to bear. In 2010 the Pentagon warned that global warming will aggravate many of the world's already challenging security problems.

The American Clean Revolution is the new American frontier; our chance to re-establish American leadership in the new global world economy, and pioneer the very technologies that will define the 21st century. It is the promise of millions of new jobs, improvements to the homes of Americans across the country, energy savings for hard-working families, and clean energy that meets the needs of a revitalized economy.

Leadership and innovation is not only what built America: it's what will take us forward. The passive acceptance of economic decline through climate change is not the American way. It's time for bold leadership to drive this transformation, revive our economy, and make our country great again.

It's time for us to start a revolution: an American Clean Revolution.



**Bill Moomaw**

Professor of International Environmental Policy,  
Tufts University



**Steve Westly**

Managing Partner  
The Westly Group



**Paul Dolan**

Managing Partner  
Paul Dolan Family Ranches

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US Board Members, The Climate Group

# Introduction

“While I take inspiration from the past, like most Americans, I live for the future.” [President Ronald Reagan](#)

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**Two divergent paths.** In the closing months of 2012, the US sits at a fork in the road in its quest to reverse the economic downturn and maintain its global leadership. There is broad consensus around the challenges to be solved: America needs more home-grown jobs, it needs to wean itself off foreign oil, it needs to re-establish its competitiveness with rapidly emerging economies like China, and it needs to ensure economic growth is sustainable in the face of the realities of dwindling resources and a growing world population. But the debate around solving these challenges is increasingly disconnected from both the urgent threat of climate change and the major opportunity that comes from addressing these challenges in an integrated way.

The two paths we can choose from look very different. The first is based on ‘business as usual’, where we continue to use domestic fossil energy to drive growth, betting that the path that made America great will continue to lead us in the right direction. The second path is based on utilizing renewable energy resources and low carbon innovation to transform the economy: a ‘clean revolution’. Both paths present economic opportunities for the next four to eight years. But, as we will argue in this report, if the US wants to play to win in the longer term, only the second path – a clean revolution – works.

**The climate reality.** The urgency to this argument lies in climate change and the related issues of resource depletion and population growth. Climate change is becoming a present-day reality. At home in the US and around the globe, the last 18 months have continued to bring the most extreme weather events in recorded history. Last year we experienced disasters such as May’s tornado in Joplin, Missouri and August’s Hurricane Irene, which inundated much of the Northeast, causing \$1.3 billion of damage to New York State<sup>1,2</sup>. This year saw record-breaking heat across the US, and the lowest level of Arctic sea ice ever measured.

Scientists and advocates for action have frequently speculated on the question of what it will take to raise the issue of climate change up the political agenda. Suggestions put forth have invariably included the very scenario we have just witnessed – multiple extreme weather events around the globe, and at home in the US, with devastating and far reaching economic consequences. And yet, in the run up to the 2012 Presidential Election, climate is as far from the public and political debate as it has been in the last ten years.

**The political challenges.** Indeed at the time of writing, both political parties have only mentioned the issue in oblique terms, leaving commentators to speculate on progress by counting instances of the terms ‘climate change’ and ‘global warming’ in political speeches. Existing strong US clean energy policies are now in question<sup>3</sup>. But climate change has always been portrayed as controversial in the US public arena. It became particularly so from late 2009, after a perceived failure of the Copenhagen negotiations and the subsequent ‘Climate-gate’, where the scientific process that provides the foundations for policy setting was questioned. While certain questions were in some cases valid, such as errors in IPCC reports, issues ultimately proved to be minor<sup>4</sup>. However, confidence in the process was undermined and it provided ammunition for opponents of clean energy policy. Progress has further been hindered by mixed results from the current Administration’s efforts to promote efficiency and clean technology, including the failure of the America Power Act in 2010. And so the mud has stuck, compounded by concerns that action on climate will somehow undermine recovery in the world’s largest economy.

**The impact of shale gas.** Some advocates for greater leadership on clean tech and clean energy have also partly been to blame, perhaps too stridently promoting green jobs and energy security benefits<sup>5</sup>. Recently, the discovery at home of abundant natural shale gas reserves is overriding clean energy-driven growth claims in the media. It has led to calls for fast-track licensing for new domestic gas fields, to unlock economic recovery and drive energy security. But while the extent of influence is debated, the switch from coal to gas generation has contributed to an unprecedented reduction in US CO<sub>2</sub> emissions from power generation, as well as a fall in market prices for gas. The dash for gas has left regulators trying to catch up to protect local environments around shale gas extraction sites, and to properly quantify the climate impact of escaped methane from poorly formed wells, which is some 20 times more potent than CO<sub>2</sub> as a greenhouse gas (GHG).

**Candidate proposals.** So much has changed since the 2008 US elections, when both presidential candidates ran supporting cap-and-trade policy for GHG emissions and acknowledged climate change as a key economic threat. President Obama is now seeking re-election on the back of an 'all of the above' energy strategy, retaining incentives for renewable energy and energy efficiency, but also promoting plans to mobilize domestic oil and shale gas. Governor Romney has promised to remove EPA's ability to regulate CO<sub>2</sub>, and to end government incentives for wind generation. The Republican energy strategy for the election focuses almost exclusively on expanding domestic fossil fuel extraction (coal, oil and shale gas)<sup>6</sup>.

The increasingly divergent positions of the two main parties on the urgency of climate science<sup>7</sup> and the strategies to deal with it, make it difficult to find non-partisan ground from which to take the debate forward. But while climate change itself seems at times to have fallen from the agenda, its solutions can still offer remedies to undisputed critical challenges for the US today: recovery from recession, creating new jobs for Americans, improving energy security and re-inventing US leadership on the world stage. The pursuit of a cleaner economy – choosing to continue to scale up clean energy, drive energy efficiency and deploy greener infrastructure and technology rather than stepping back – can address all of these.

**Five reasons for an American Clean Revolution.** This report lays out five reasons that make the case for a rapid transition to a clean economy – a process we term a 'clean revolution' – which can credibly address each challenge. We illustrate the broad American support for taking the 'clean' road in each challenge by using published quotes from individuals in government, business, academic and medical institutions, the military, civil society and more, framed by a set of interviews with experts from our network. The report also draws on existing published research from respected (and mostly non-partisan or bipartisan) institutions and individuals.

The five key reasons for an American Clean Revolution that we address in this report are as follows:

- **Competitiveness and innovation:** A clean revolution will play to America's long-established strengths in innovation and entrepreneurship.
- **Growth:** While gas, oil and coal might deliver a 'quick hit,' the clean economy has untapped wealth creating potential and will drive growth in employment and prosperity.
- **Security:** A clean economy offers independence from foreign energy and its costs and can help mitigate the danger of climate change as a 'threat multiplier'
- **Infrastructure:** Transforming outdated buildings, transit systems and power stations to become smarter and more efficient will future-proof our infrastructure.
- **Costs of inaction:** Failure to cut fossil fuel dependency or take action to mitigate and adapt to climate change will lead to increasing public health problems and extreme weather costs.

**The only path to long term prosperity.** It would be disingenuous to assert that a 'clean revolution' is the only solution to America's economic predicament for the next two presidential terms of office. It is clear that for four to eight years at least, the opening up of US fossil fuel reserves might also drive growth, create much-needed American jobs, and reduce dependency on foreign oil. So it is understandable that in 2012, this plan forms the lynchpin of Republican energy policy, and indeed a significant strand of the Democrats' policy too.

But unless the environmental and economic cost of carbon emissions is taken into account – coupled with the fact that economies like Europe and China are moving ahead of the US on clean technology and energy solutions – we risk a path forwards that is harmful to both the climate and to US competitiveness. For the reasons this report lays out, a fossil fuel-driven growth strategy ultimately takes America down a dead-end path, forsaking opportunities to lead the clean energy race, and leading to new crises of competitiveness and economic impact through 2020 and beyond.

So while a clean revolution is not the only path out of recession for America right now, it is the only path that offers sustained prosperity in the medium and long term. And as this report shows, this view is shared by leading members of the military, the business world, the medical community, farmers and academic institutions.

Taken individually, the arguments for an American Clean Revolution are compelling. Together they are overwhelming. To play to win, both at home and on the global stage, the US must proceed on the clean revolution path today.

## REASON 1

# Innovation and competitiveness

**“There is no nation better positioned today to lead the world in innovation than the United States... But before America can do that, it will need to recognize that its leadership position has been lost, at least for the time being.” Robert Atkinson and Stephen Ezell in *Innovation Economics*<sup>8</sup>**

Developing a clean economy plays to America’s unique strengths in innovation and entrepreneurship. The US Department of Commerce has described innovation as “the key driver of competitiveness, wage and job growth, and long term economic growth.”<sup>9</sup> This chapter looks at innovation’s role in creating America’s prosperity; the threats to the country’s innovation leadership; the lessons from today’s clean tech innovators; and the challenges that these innovators still face.

## INNOVATION’S ROLE IN AMERICA’S PAST, PRESENT AND FUTURE PROSPERITY

Innovation is perhaps an over-used term. Many think of it in terms of advances in information and technology, but its application and significance are much wider. In their recent book *Innovation Economics*, Robert Atkinson and Stephen Ezell describe the innovation that is critical to economic prosperity as “bringing to production, to the marketplace, and to society new products, processes, services, and functionalities that consumers and organizations find useful and valuable.”<sup>10</sup>

For over 100 years American businesses have been turning this theory into practice. Creating game-changing new business models, pushing the boundaries of technology development and producing groundbreaking research have been the hallmarks of national prosperity and economic growth since the 1960s. From Henry Ford to Elon Musk, America’s prosperity has been driven by the new ideas, technologies and visions of companies and individuals that have imagined and then created a better way of doing things.

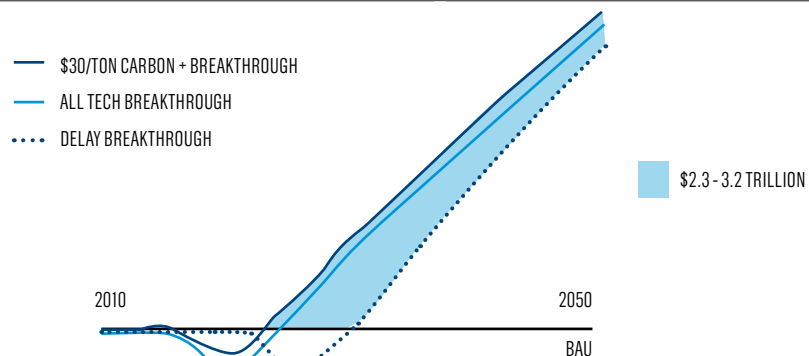
But today, the US is at risk of falling behind in its capacity to innovate. In 2010, China passed the US (and Japan) as the number one filer of patent applications<sup>11</sup>. Chinese research and development (R&D) spending across all sectors as a percentage of GDP has tripled over the past fifteen years from 0.5% to 1.5%, and is set to reach 2.5% by 2020<sup>12</sup>. This would bring Asia’s biggest economy in line with what the US currently spends on R&D as a percentage of GDP<sup>13</sup>. US Government spending on energy R&D, meanwhile has been in long-term decline. Energy gets less than 2% of the Government’s total R&D budget, equivalent to just 0.03% of GDP<sup>14</sup>. The comparative GDP figure for China is 0.11% and 0.10% for Japan.

Significant limitations remain in China’s state-sponsored innovation program however, and the key building blocks for success are still in place for the US: strong intellectual property law, healthy private sector innovation, world-leading academic institutions, government research labs and world-leading high-tech innovation capacity in Silicon Valley. To ensure these building blocks are properly used for clean energy innovation, various groups, including major business figures, have called for a tripling of federal R&D spending in energy to \$16 billion per year<sup>15,16,17</sup>.



**The fact of the matter is, other countries are putting a lot more money into nurturing new industries than we are, and we are not going to win unless we do something like what they’re doing. Eric Schmidt, Executive Chairman, Google<sup>18</sup>**

**FIG 1. DELAYING BREAKTHROUGHS = DELAYING BENEFITS<sup>20</sup>: GDP GAINS 2010-2050**



NOTE FOR FIGURE 1 SCENARIOS. THE ‘\$30 CO<sub>2</sub> BREAKTHROUGH’ SCENARIO INVOLVES BREAKTHROUGHS IN A RANGE OF KEY TECHNOLOGIES SUPPORTED BY A \$30 PER TON CARBON PRICE. THE ‘ALL TECH BREAKTHROUGH’ SCENARIO INVOLVES BREAKTHROUGHS IN ALL KEY TECHNOLOGIES WITHOUT ANY POLICY SUPPORT. THE ‘DELAY BREAKTHROUGHS’ SCENARIO IS ONE IN WHICH KEY TECHNOLOGY BREAKTHROUGHS ARE DELAYED BY FIVE YEARS.

The current global shift towards a cleaner economy will continue to require widespread innovation in technology, finance, and business models. As a result, innovation will only become more central to competitiveness. Countries with a strong capacity to innovate, like the US, stand to benefit most in this transition. Google, for example, predicts that driving US innovation in the clean energy sector could grow the economy by \$155-244 billion per year depending on the extent of federal incentives. This could create 1.1-1.9 million net new jobs and save consumers more than \$900 per household each year<sup>19</sup>. In total, they predict \$2.3-3.2 trillion of GDP is at stake post-2020 if the required investment in clean energy innovation is delayed by just five years from today (see Figure 1).

### LESSONS FROM TODAY'S CLEAN ECONOMY INNOVATORS

Leadership in clean tech innovation is already in place in a growing number of America's top companies and public bodies (see Boxes 1 and 2 for examples). Such change is also driving shifts in investment. Although the clean tech investment sector has been challenging in 2012, US venture capital investment in clean tech companies still totaled \$4.9 billion in 2011, up 29% from 2009<sup>21</sup>. Warren Buffet invested \$3.8 billion into two solar companies at the end of 2011 and increased his wind portfolio to a total of \$6 billion<sup>22,23</sup>. Meanwhile, Google has invested more than \$915 million in clean energy projects to power its data centers<sup>24</sup>.

#### BOX 1. PUTTING CLEAN TECH INNOVATION AT THE HEART OF SUSTAINABLE BUSINESS

General Electric (GE) and Nike are leading US examples of success in seizing opportunities from the shift to a clean economy. In 2004, GE committed to doubling its investment in research and clean technology sales, alongside reducing the impact of its own activities. Its resulting Ecomagination business unit was already generating product sales of \$18 billion by 2009<sup>25</sup>. GE believes that innovation is the basis for the unit's success<sup>26</sup>.

In 2007, Nike identified a range of trends that impacted on its business, including climate change, water scarcity and increasing energy use. Nike's response was to develop new products that addressed threats to its supply chain, required less energy and lowered its environmental impact. In doing so, Nike merged the sustainability and innovation functions within its business, giving the new team Board-level oversight. Through its newly created Considered Design program, Nike also launched a number of high profile, sustainability-inspired products in the run-up to the 2012 Olympic Games.

#### BOX 2. THE DEPARTMENT OF DEFENSE: THE PUBLIC SECTOR'S CLEAN TECH INNOVATOR

As it has done in the past with the development of now commonplace technologies such as the internet and GPS satellite navigation system, the Department of Defense (DoD) is now pioneering new energy technologies. These advances are likely to have transformative impacts in the civilian world as well.

In 2011, the DoD and the Advanced Research Projects Agency – Energy (ARPA-E), launched a program to develop and build small, scalable hybrid energy modules. It established another to evaluate grid storage and improve reliability and energy security at the DoD's 500-plus bases around the world<sup>31</sup>. Both projects are designed to overcome obstacles to the increasing use of intermittent renewable energy sources, such as wind and solar. These projects are just two examples of a range of low carbon initiatives being pioneered by the DoD.

Much of what is being developed also has considerable civilian application. This can produce positive feedback for the DoD since rising use in civilian sectors means that new technology costs will invariably come down. The DoD plays a lynchpin role in making this virtuous cycle work. Due to the scale of procurement that the Department can leverage, the strategic importance of finding solutions to its energy challenges, and the financial strength the federal government provides, the DoD is uniquely able to de-risk new and emerging technologies and crowd-in private sector investment.

**All of the influences that got us into Ecomagination four years ago are actually more intense [after the financial crisis] and these dynamics are unstoppable. Natural resources are shrinking and population is growing: do the math. Business will have to be more responsive and aware of that, and if they are, they will grow and become more relevant. Mark Vachon, VP Ecomagination, GE<sup>29</sup>**

**If you look at innovation through [the] lens of sustainability, you find yourself creating new and better products. You open up new markets. Hannah Jones, VP of Sustainable Business and Innovation, Nike<sup>30</sup>**

### INNOVATION'S 'INCUMBENT' PROBLEM

It would be complacent to assume, however, that America can simply stroll towards a clean economy thanks to the efforts of a few entrepreneurial companies and individuals and their smart ideas. The reality is that the landscape for innovative – or disruptive – clean technologies and business models is a difficult one. In the key sectors of energy and transportation, for example, which account for 34% and 27% of America's GHGs respectively<sup>33</sup>, disruptive clean technologies face formidable incumbents. Today's fossil-fuel based energy and transportation systems have a century or more of investment and fine-tuning behind them<sup>34</sup>. They are generally effective, efficient, reliable and price competitive in what they do. In the absence of government support or intervention, disruptive clean technologies need to match and better these incumbents if they are to be adopted.

Relying on incumbent businesses to drive low carbon innovation themselves also poses problems. The American Energy Innovation Council (AEIC), a grouping of US CEOs that includes Bill Gates, Jeff Immelt and Chad Holliday, identifies four key barriers to energy innovation from the private sector, as set out in Table 1.

**TABLE 1. KEY BARRIERS TO ENERGY INNOVATION IN THE PRIVATE SECTOR**

1. WRONG DRIVERS	THE KEY DRIVERS FOR CLEAN ENERGY INNOVATION TEND TO BE PUBLIC GOOD ONES (E.G. NATIONAL SECURITY AND ENVIRONMENTAL PROTECTION) RATHER THAN COMMERCIAL ONES.
2. HIGH RISK INVESTMENT	LARGE SCALE DEPLOYMENT OF NEW ENERGY TECHNOLOGIES REQUIRES MAJOR CAPITAL INVESTMENT THAT IS OFTEN DEEMED TOO RISKY FOR PRIVATE INVESTORS.
3. DECLINING R&D	CORPORATE R&D BUDGETS HAVE BEEN IN LONG-TERM DECLINE.
4. SLOW PLANT TURNOVER	THE RATE OF TURNOVER OF POWER PLANTS IS SLOW. LIFESPANS OF 50 YEARS OR MORE MAKE THEM VERY CHEAP TO RUN ONCE BUILT, WITH LITTLE INCENTIVE TO RENEW EARLY.



**[Cleantech is] just like every other technology industry. First you do it, and it's very expensive; the technology and the manufacturing economies of scale aren't idealized at all. Then the market develops, competitors come in, and prices fall. Alan Salzman, CEO and Managing Director, VantagePoint Capital Partners<sup>32</sup>**

### OTHER CHALLENGES – AND SOME SOLUTIONS

Innovation in clean energy technology and business models carries with it other specific challenges. But there are also particular benefits for those that are successful.

Innovation expert Andrew Hargadon from the University of California, Davis, highlights a number of challenges for clean innovation in mature markets that are relatively unique to the sector. These include:

- the need to drive scale, reliability and profitability simultaneously;
- dealing with technology, market, and regulatory risk and;
- bias in policy incentives towards technology breakthroughs rather than the innovative deployment of known solutions<sup>35</sup>.

Hargadon's 2011 report for the Center for Climate and Energy Solutions (C2ES), reviews a range of best practices that companies use to bring low carbon innovations to market. He concludes that overcoming the 'barriers to entry' to succeed in the clean economy sector, carries a competitive advantage.

Others like Innosight, the firm established by Harvard innovation expert Clay Christensen, argue for a holistic approach to solve the challenges of clean economy innovation. In this case, new clean technology solutions are supported by enabling systems, innovative business models, careful market adoption strategies and favorable government policy<sup>36</sup>. Innovators must work to break through in all of these areas simultaneously.

Regardless of the precise prescription for success, it is clear that leadership in clean tech innovation is no birthright. The US' leadership crown could easily slip without a shared commitment from business and government to embrace new disruptive technologies and business models. But the country's innovation history, its fertile entrepreneurial environment and the leadership of its best businesses and public bodies suggest that a new age of American innovation, competitiveness and growth is there for the taking.



## REASON 2

# Growth

**“If we get clean energy right, the world will be our customer. This past year’s 11.2% increase in clean energy jobs [in Massachusetts] means that we are getting it right and the world knows it.” Governor Deval Patrick (D), Massachusetts**

A clean economy, and the transition to it, can deliver real economic growth for America through increased investment, job creation and the expansion of competitive, sustainably focused businesses. This chapter demonstrates that while this shift is already underway, the US has only scratched the surface of the clean economy’s wealth creating potential.

## AMERICA’S QUIET SUCCESS STORY

The clean economy has been America’s quiet success story. Over the past two decades it has grown to a trillion-dollar market in goods and services<sup>37</sup>. Today it encompasses hundreds of categories of commercial activity in thousands of towns and cities across America. Research by the Brookings Institution paints a picture of robust activity, with greater economic output than the bioscience sector<sup>38</sup>. Far from being a recent phenomenon, the clean economy is built around mature and familiar industries like manufacturing, and public services such as waste management and mass transit.

## GROWING INVESTMENT IN CLEAN ENERGY

According to Bloomberg, investment in the US clean energy sector is in good health, although subject to challenges from policy uncertainty and the impact of cheap shale gas<sup>39</sup>. In 2011, investment in renewable energy in the US hit \$51 billion, up 57% on the previous year. This growth was driven in part by soon-to-expire government support programs, which helped make the US the world’s number one renewable energy investor, supplanting China. The majority of this funding (\$40.3 billion) was in asset finance for utility scale projects. This included investment in solar photovoltaic (PV) projects (\$25.3 billion). Encouragingly, solar is increasingly seen as a mainstream investment – a fact underlined by the \$850 million bond issue in late 2011 by Warren Buffett’s MidAmerican Holdings for a PV project.

By contrast, investment in wind amounted to only \$11.3 billion, down significantly from a record \$18.1 billion in 2008. According to Bloomberg, this reflected the uncertainty surrounding the future of the federal production tax credit (PTC) and the implications of cheap shale gas. The latter has made it difficult for developers to negotiate attractive power purchase agreements with utilities. Failure to address these challenges could put at risk the US’ share of a global clean energy market that is expected to be worth some \$2.2 trillion by 2020<sup>40</sup>.

## SIGNIFICANT UNTAPPED NATURAL CAPITAL

These and earlier investments have helped keep the US in the clean energy game. But equally, they have not fully leveraged the abundant renewable resources at America’s disposal. Installed solar PV generating capacity in the US, for example, is still only one fifth that of Germany<sup>42</sup>. Similarly, the estimated 1.1 million renewable energy sector jobs in the EU (an economy of similar size to America’s) is more than double the figure in the US<sup>43</sup>. This underlines the untapped potential of clean economy job creation. Even where the US does take a leading position, such as in the wind sector, its 47 gigawatts of installed capacity<sup>44</sup> is only a little over double Spain’s – an economy one tenth its size.

Certain areas of the country are particularly well placed to benefit from the growth in the clean economy due to their natural resource capital. The states of Arizona, California, Colorado, Nevada, New Mexico and Utah are cases in point. Large areas of federal land within these jurisdictions are currently underutilized and could be given over to solar, wind and geothermal energy generation. Analysis suggests these states could realistically install 34 gigawatts of renewable energy over the next two decades, stimulating more than \$137 billion in investment, creating 209,000 direct jobs and providing electricity for 7 million homes<sup>45</sup>.



**If you take the view that fossil fuel costs will continue to rise and that natural resources will become increasingly more scarce; then focus day by day on making your business more efficient and the opportunities will come to you.**

**Tony Prophet, Senior VP Operations, HP<sup>41</sup>**



**While we understand that there might be short-term challenges associated with this effort [to reduce global emissions by 80% by mid-century], we believe that there will be great short-, medium-, and long-term economic, health, social and environmental benefits, including achieving energy independence for the US as quickly as possible. American College & University Presidents' Climate Commitment<sup>57</sup>**

### CLEAN ECONOMY JOBS

The clean economy is already an important job creator. Today, clean economy businesses collectively employ 2.7 million Americans, which is more than the fossil fuel industry<sup>46</sup>. Recent research highlighted that almost 40,000 jobs could be created from 70 major new clean energy projects that were announced across 30 US states in the second financial quarter of 2012. One third of these new projects are based in the Midwest states, with the leading clean energy sectors comprising public transport, electric vehicle production and power generation<sup>47</sup>. Between July 2011 and July 2012, the clean energy economy in Massachusetts alone grew 11.2%. The state's clean energy sector now employs over 71,000 people<sup>48</sup>.

The clean economy is also good for lower-skilled workers, manufacturing and exports. Employment in the sector supports 13% higher median wages than the US average, with a higher percentage of better-paid jobs for lower skilled workers<sup>49</sup>. Overall, the sector is also relatively manufacturing and export-intensive; 26% of clean economy jobs are involved in these activities compared to 9% in the overall economy<sup>50</sup>. In addition, the installation of clean energy and energy efficient infrastructure, from solar panels to triple-glazed windows, cannot be outsourced abroad.

### THE ENERGY EFFICIENCY OPPORTUNITY

Although the shale gas revolution of recent years has undeniably changed the nature of the climate-energy-jobs debate, it has not removed the fact that the clean economy remains an important means for delivering significant economic growth. The previous chapter highlighted the extra \$155-244 billion in GDP per year that could be generated from innovation breakthroughs in clean energy technologies. In addition, research by McKinsey & Company has identified a further \$1.2 trillion of savings that could be achieved by 2020 from a comprehensive national energy efficiency strategy<sup>51</sup>. With required investment estimated at \$520 billion, the business case is a simple one. More efficient lighting will be a key part of this strategy and research has shown that city governments could halve their energy bills simply by switching to light-emitting diode (LED) lighting<sup>52</sup>. In the home, meanwhile, simple energy efficiency measures could help American families to cut their energy consumption by nearly a quarter by 2020<sup>53</sup>. American companies, like Johnson Controls, are already exploiting the growth potential of this largely untapped energy efficiency market (see Box 3).

#### BOX 3: JOHNSON CONTROLS

When Warren S. Johnson introduced the first electric room thermostat in 1885 he revolutionized the efficiency of heating and cooling technologies in buildings. Since then, Johnson Controls, the company he founded in Milwaukee, Wisconsin, has put research and development (R&D) at the heart of its operations. The company now invests \$723 million a year in R&D<sup>54</sup>. Innovative technologies developed through the company's Building Efficiency division have generated over \$19 billion in energy savings for customers<sup>55</sup>.

"Most people believe that sustainability costs extra and that you are trading off financial returns for environmental or social benefits. In the area of energy efficiency, it is clear that you can achieve all three of the "triple bottom line" returns from a single investment. Energy efficiency investments in buildings are like bonds producing double-digit returns with the earnings (energy savings) guaranteed when implemented by a credit-worthy energy service company." – Clay Nesler, Vice President for Global Energy and Sustainability, Johnson Controls<sup>56</sup>

### COMPETITIVE CLEAN COMPANIES

Of course, aggregate figures do not tell the whole story. For those companies that have already taken the steps to be part of a clean economy, the benefits are real and tangible.

Dow Chemical's investment in resource and energy efficiency is well known. Since the early 1990s the company has made savings from reducing water and energy use of some \$9.8 billion, from investments of less than \$2 billion<sup>58</sup>. Dow, however, is not alone. A recent Harvard Business School study of 180 companies found that those that had embedded environmental and social policies into their business, "significantly outperformed" their counterparts in the stock markets over 18 years<sup>59</sup>.

The success of the clean revolution will be driven by these pioneering companies. By leveraging the growing investment in clean energy, tapping America's rich renewable resources, and harnessing the opportunities from energy efficiency, these companies will be the job and growth generators of a smarter, better, and more prosperous clean economy.

## REASON 3

# Security

**“Our oil addiction is our greatest threat to our national security. Because CO<sub>2</sub> emissions and climate change, and the instability that that all drives, increases the likelihood there will be conflicts in which American soldiers are going to have to fight and die somewhere.” Brigadier General Steven Anderson (Retired), former US Army Chief of Logistics under General Petraeus<sup>60</sup>**

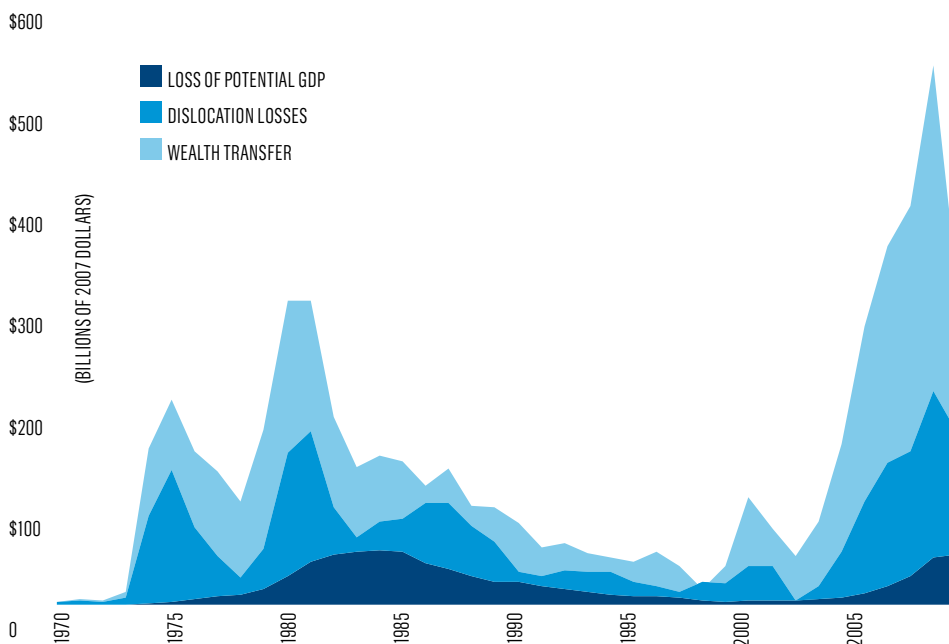
The creation of a clean economy offers the means to address costs from two key areas of vulnerability in the US’ energy and national security, namely: the country’s continued dependence on imported oil, and the destabilizing consequences of climate change on the world’s already troubled security hotspots.

## REDUCING DEPENDENCE ON FOREIGN OIL

Today, 40 years after the first great oil price shock, the US still relies heavily on imported oil and other petroleum products. Although the country consumes around 22% of the world’s oil<sup>61</sup>, it has less than 2% of the world’s proven reserves<sup>62</sup>. In 2011, the US spent nearly \$1 billion every day importing oil, gas and other derivatives<sup>63</sup>, accounting for 45% of total annual consumption<sup>64</sup>. This equates to around \$1,100 per year for every single man, woman and child in the country.

Such dependency has a substantial economic price tag. It amounts to what renewable energy investor and oilman T. Boone Pickens describes as *“the greatest transfer of wealth in history”*<sup>65</sup>. The Department of Energy estimates that oil dependence cost the economy \$1.7 trillion in the five years from 2005 to 2009. One trillion of this was simply defined as ‘wealth transfer’ payments (approximately half of which went to OPEC countries), with the remainder the result of GDP losses from oil price shocks (so-called ‘dislocation losses,’ see Figure 2 below<sup>66</sup>).

FIG 2. COSTS OF OIL DEPENDENCE TO THE US ECONOMY, 1970-2009<sup>67</sup>



Increasing cleaner domestic energy production and improving energy efficiency to cut this dependency would provide important economic benefits, as well as improve energy security. It would insulate the economy from oil price volatility and help reduce general price inflation. As oil is traded on a global market, simply increasing domestic oil production as an alternative to cleaner energy production would provide limited protection from price shocks.

**...we need on a national scale to stabilize energy, prevent energy shortages, and achieve national energy independence. Continued investment and innovation in clean energy technologies are integral to advancing these goals. Senator Susan Collins (R-ME)<sup>68</sup>**

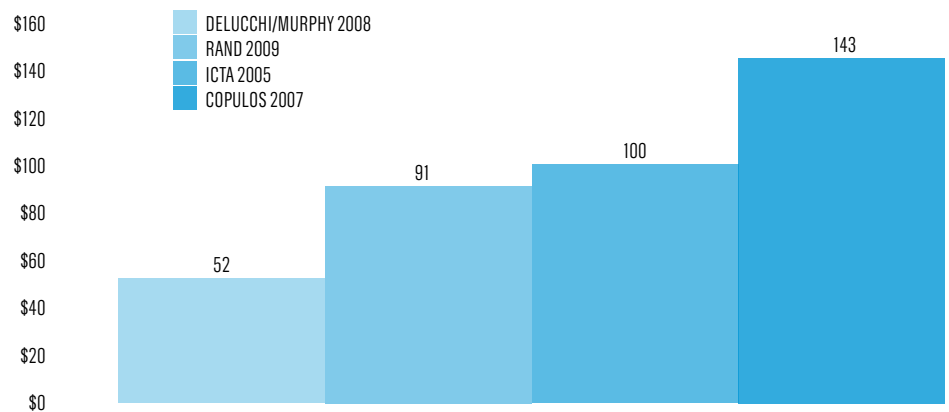
Reducing petroleum imports also lowers America's trade deficit. This would help grow the economy as spending is redirected from foreign to domestic consumption, investment or debt reduction. With oil imports averaging the equivalent of 26% of the US trade deficit over the last decade – climbing as high as 40% some years<sup>69</sup> – the impact would likely be significant.

### ENHANCED SECURITY FOR AMERICA'S SERVICEMEN AND WOMEN

There are also national security benefits from reduced dependence on foreign oil. While Canada and Mexico remain the US' number one and two petroleum suppliers respectively, a good proportion of US oil spending is still with regions whose interests are less aligned with those of America<sup>70</sup>. Sending large sums of money to areas of the world with at best ambivalent attitudes to American interests, runs counter to security interests.

The US also continues to spend significantly to ensure key oil supply routes remain open, with the annual military cost of maintaining America's oil supply estimated at between \$50-140 billion (see Figure 3 below). At a time of austerity, and with a long-term need to reduce government debt, any actions that reduce the dependency on oil could well provide important fiscal savings.

FIG 3. ANNUAL MILITARY COST OF US OIL SECURITY (\$BILLION, 2009)<sup>72, 73</sup>



Energy seems to only be found in unstable places. Finding alternative energy is vital to our national security. Many of these places are not places that you want to enrich with oil and gas. **Condoleezza Rice, Former US Secretary of State**<sup>71</sup>

For the US military, a clean energy revolution has important tactical benefits. Continuing reliance on gas and diesel for running operational bases puts American servicemen and women in harm's way. According to the Pentagon, the US suffers one casualty for every 24 fuel convoys it runs in Afghanistan<sup>74</sup>. Approximately 80% of the military's supply convoys in the country are dedicated to delivering fuel<sup>75</sup>. Unsurprisingly, significant resources are therefore required to protect these energy lifelines. The cost of getting fuel to front line Marine units in Afghanistan, for example, was estimated to be nearly \$400 per gallon in 2009<sup>76</sup>. A clean energy revolution would help accelerate the development and deployment of technologies that would free America's defense personnel from the very real human cost of this oil dependence. The good news is that this revolution is already underway (see Box 2, Chapter 1).

### REDUCING LONGER TERM INTERNATIONAL POLITICAL INSTABILITY

Creating a clean economy also benefits long-term national security as a result of reducing GHG emissions and addressing climate change.

In its 2010 Quadrennial Defense Review, the Pentagon identified climate change as a 'threat multiplier'<sup>77</sup>. In other words, expected climate change impacts such as rising sea levels, increased incidence of drought and floods, and reductions in agriculture production, are expected to worsen existing security tensions around the globe. Indeed, many of today's forgotten conflicts are in part driven by the dislocation of people as a result of changes in local climate, such as droughts or floods. These regional wars in some parts of Africa and Asia offer a frightening glimpse of what could become a more widespread phenomenon.

America's action to cut its GHG emissions through building a clean economy isn't a panacea for climate-induced political instability. But equally no solution to this global threat is possible without the US playing its part – at home and abroad. The Pentagon points out that clean energy and dealing with climate change isn't some 'feel-good' effort, but a simple, hard-nosed matter of national security<sup>78</sup>.

## REASON 4

# Infrastructure

**“Before we start making long term investments in future major infrastructure, after we have paid that which we’ve neglected for so long, we need to look at it through a 21st century lens, in a very different climate, and not take a 19th century climate and assume that that is going to be the norm.”**

**Patricia Mulroy, General Manager, Southern Nevada Water Authority<sup>79</sup>**

Infrastructure is the skeleton of any economy. It provides the underlying structure upon which all other economic activity depends. Renewing America’s aging infrastructure is a strategic priority. Ensuring that it is also smart, clean and climate-proof will mean that it is fit for purpose for the economic and environmental challenges of the 21st century.

## AMERICA’S INFRASTRUCTURE CHALLENGE

America’s infrastructure – that is to say its roads, railways, power plants and grid, water supply and control systems, as well as its stock of buildings – is in urgent need of renewal. The American Society of Civil Engineers (ASCE) rated the system a ‘D’ in its most recent report card<sup>80</sup>. The World Economic Forum ranks the US in 25th place in overall infrastructure quality in 2012, just above Qatar and Taiwan<sup>81</sup>. At 2.4% of GDP, US relative investment in infrastructure currently lags China (9%) and the EU (5%)<sup>82</sup>. ASCE identifies a range of significant economic costs that will be incurred by 2020 if the US fails to plug gaps in its investment (Table 2), predicting significant impacts on jobs, exports and growth.

**TABLE 2. PROJECTED COST OF CONTINUED UNDERINVESTMENT IN KEY US INFRASTRUCTURE\*** <sup>83, 85, 86</sup>

INFRASTRUCTURE TYPE	CUMULATIVE COST
ELECTRICITY SYSTEM	\$197 BILLION
TRANSPORTATION SYSTEM	\$912 BILLION
WATER SYSTEM	\$206 BILLION
<b>TOTAL</b>	<b>\$1.3 TRILLION</b>

\*BY 2020, FOR HOUSEHOLDS AND BUSINESSES.

## THE IMPORTANCE OF THE ‘RIGHT’ INFRASTRUCTURE

Most infrastructure is long lived - in the case of power plants or buildings, a 50 year life span is normal and expected. This means that the decisions made today will result in infrastructure that could still be operational in 2060 or beyond. Today’s infrastructure decisions define tomorrow’s economy.

Business and political leaders must therefore make their infrastructure investment decisions based on the needs of the future, not simply the experiences of the past. Replacing like with like is not an option. Decision makers must instead think much further ahead than they have before. Such long-term strategic planning can only tell them two things. On the economic side – as studies from McKinsey & Company<sup>87</sup> and investor Jeremy Grantham<sup>88</sup> have argued – the economy of the coming decades is one that must be vastly more productive, to cope with the demands of a global population approaching 9 billion. On the environmental side – as the overwhelming weight of scientific evidence makes clear – is a future of increasingly severe and costly climate impacts. The implications for America’s future renewed infrastructure are simple and unambiguous. It must be clean, resource efficient and resilient.

## AMERICA’S SMART FUTURE

The good news is that an increasing number of the technologies that will define America’s new and enhanced infrastructure are beginning to compete in today’s marketplace, even if their full potential is yet to be realized. The electricity sector is embracing many of these. On the supply side there is the growing market penetration of wind and solar power generation. In certain areas of the country these technologies are delivering substantive levels of power at competitive rates. Iowa, for example, generated 18.8% of its electricity from wind in 2011. For South Dakota the figure was 22.3% - the highest in the country<sup>89</sup>.

**“If we try to run America on a shoddy infrastructure, we are doomed to a downward spiral in our economy, standard of living, and world stature. The hidden costs of lost time and productivity, excess pollution, and general ill-will are incalculable.”**  
**Dr Mitchell D. Erikson, Director, Northeast Operations, Interagency and First Responder Coordination, Science and Technology Directorate, Department of Homeland Security<sup>86</sup>**



**We are at an emerging tipping point on smart infrastructure. We have the potential not just to baseline behavior but also to look at altering behavior patterns through a range of mechanisms. Once we understand patterns of behavior we can interpret and design for them – the US should be leading and not following on this.**

**Chris Luebke, Director for Global Foresight and Innovation, Arup<sup>95</sup>**

Progress is also being made on future-proofing the demand side of America's energy infrastructure. Utility PG&E, for example, is set to install 9.7 million smart meters as part of a \$2.2 billion upgrade to its network<sup>91</sup>. This is part of a much larger \$29 billion effort by utilities nationwide, to introduce smart meters as a first step towards creating more flexible and efficient smart electricity grids<sup>92</sup>. The Department of Energy has calculated that a grid that was even 5% more efficient would equate to permanently eliminating the fuel and GHGs of 53 million cars<sup>93</sup> (approximately 20% of the US fleet of passenger vehicles). A smarter system will also bring substantial savings. A planned \$476 billion national upgrade over 20 years is projected to deliver \$2 trillion in customer benefits<sup>94</sup>. This crucial infrastructure overhaul will not only allow for better matching of supply and demand, but will also make it easy to integrate growing levels of intermittent renewable energy from solar and wind sources. Creating precisely the kind of cleaner, more efficient electricity system the future US economy requires.

### TRANSPORTATION SYSTEMS

'Smartness' will also need to define America's renewed transport infrastructure, where information technology will increasingly play a part in running a far more efficient system. Mass transit systems are already benefiting from the arrival of personal smart phones and similar devices. Applications can be downloaded today that provide urban residents with real time information on transport options. Apps for New York's public transport services, for example, have been developed using the Metropolitan Transport Authority's (MTA) Open Data. This information is free, with MTA actively promoting its use by developers to build tools for their passengers<sup>96</sup>. These apps allow customers to plan their journeys better – and by improving the experience of public transport, encourage its greater use.

### BUILDINGS

In the building sector, improvements in energy efficiency offer tremendous opportunities for future-proofing a key pillar of America's infrastructure. Two iconic Manhattan buildings provide excellent case studies for what can be done with old and new. The retrofit of the Empire State Building illustrates the former, while the still-under-construction One World Trade Centre (1WTC) highlights the latter.

In the Empire State Building, a \$20 million upgrade, including installation of new windows, added insulation, and upgrading of air conditioning and building management systems, is expected to reduce energy use by 38%, saving \$4.4 million per year<sup>97</sup>. The estimated payback period, based on incremental cost, is just over three years. When the final work is completed in 2013, this venerable 82 year old will be one of the country's most energy efficient commercial buildings.

The 1WTC, by contrast, is the embodiment of what can be achieved when modern sustainable engineering and design is applied from the ground up. The building is constructed in part from recycled materials, it incorporates rainwater recycling to help power its cooling system, and bright sunshine auto-dims its room lights. The building will also get up to 70% of its power from renewable sources, including 400 on-site fuel cells, and is expected to obtain the US Green Building Council's Leadership in Energy Efficiency Design (LEED) Gold standard<sup>98</sup>.

### A NATIONAL CLEAN RETRO-FIT

The benefits of a clean-retrofitted infrastructure compared to one that is simply rebuilt like-for-like are wide ranging, but several important benefits are worth underlining.

The very 'smartness' of a greener infrastructure, for example, should play to one of America's key competitive strengths – information technology (IT). The US continues to lead the world in IT – the key enabler of the smart grids, buildings and transportation systems of a green infrastructure. American companies are of course already active in this space, such as Johnson Controls and GE to name just two. But the potential for greater IT integration remains enormous given the scale of infrastructure overhaul required. American companies are uniquely placed to capture this opportunity.

Another key benefit of a low carbon infrastructure is its increased resilience to climate impacts. An electricity network with a high proportion of wind and solar PV generation is a case in point. Neither of these sources is reliant on water for power generation – unlike thermal power plants such as coal, oil and gas, which use it for essential cooling. In periods of drought when water is in short supply, solar PV and wind provide flexibility and resilience to a network. During this year's hot, dry summer, numerous thermal plants in the US were shut down or run at lower capacity due to a lack of water. The National Energy Technology Laboratory described these plants as the 'hidden casualties of droughts'<sup>99</sup>.

**FUTURE-PROOFED**

Ensuring a clean, efficient and resilient new infrastructure is created, is the smartest way for meeting the economic and environmental challenges that America faces this century. By building smart grids and transport systems, overhauling buildings, and expanding renewable energy generation, America can reap the benefits of greater resource efficiency, less economic volatility, enhanced business competitiveness and improved climate resilience. In short, America will become a nation future-proofed.

Photo: Flickr.com, Lance Cheung



“

**If the US fails to invent new technologies and create new markets and new jobs that will drive the transformation and revitalization of the \$5 trillion global energy industry, we will have lost an opportunity to lead in what is arguably the largest and most pervasive technology sector in the world. However, if the U.S. successfully innovates in clean energy, our country stands to reap enormous benefits.<sup>100</sup>**

**The American Energy Innovation Council (AEIC).**

Members are: **Norm Augustine**, former chair and CEO, Lockheed Martin; **Ursula Burns**, chair and CEO, Xerox; **John Doerr**, partner at Kleiner Perkins; **Bill Gates**, chair and former CEO, Microsoft; **Charles O. Holliday**, chair, Bank of America and former chair and CEO, DuPont; **Jeff Immelt**, chair and CEO, GE; **Tim Solso**, chair and CEO, Cummins Inc.

## REASON 5

## The cost of inaction

**“There will be costs to our economic security from climate change — and significant ones at that — if we do nothing but continue business as usual.”** Governor Christine Todd Whitman (R-NJ), former Administrator, Environmental Protection Agency<sup>100</sup>

If America chooses not to follow the path to a clean economy it will mean more than simply forgoing the many opportunities outlined in the previous chapters. There are other costs of inaction. This chapter reviews the climate-related and public health costs that America could face in the future, if it fails to reduce fossil fuel use or take action to mitigate and adapt to climate change.

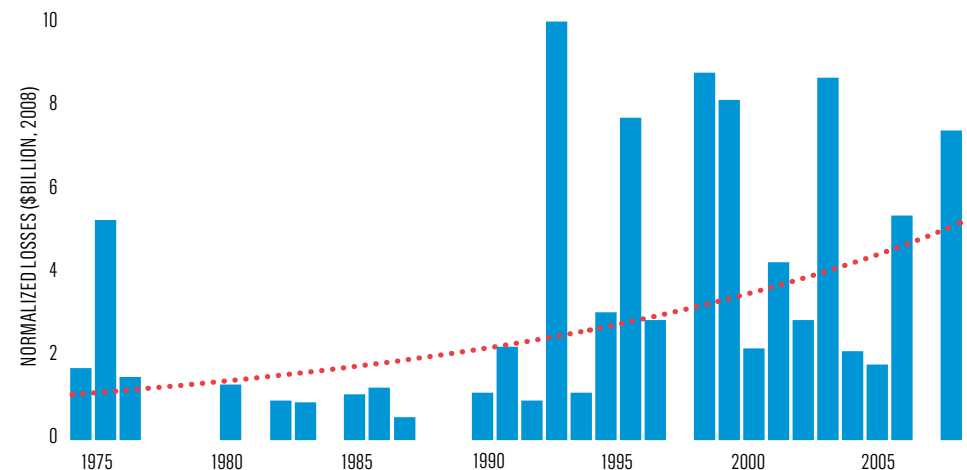
### CLIMATE-RELATED COSTS

Each year, weather imposes costs on the US economy. Some of these are well known, such as those created by tornadoes or hurricanes. But the weather has an economic impact far wider and deeper than these single extreme events. According to a report in the Journal of the American Meteorological Society, the US' economic activity may differ by up to \$485 billion between years due to weather variability<sup>103</sup>. This broader impact is a reminder of the sensitivity of the American economy to a changing climate. Equivalent to 3.4% of GDP at 2008 values, this economic impact is a substantial sum to which the loss of life and the devastation on communities could also be added. Seeking to minimize this cost is common sense in any circumstances. In a world of increasing climate change it should be an imperative.

As temperatures rise with climate change, scientists predict that the frequency, intensity and duration of extreme weather events will increase, while their geographic extent will also grow<sup>104</sup>. For the US this should be a wake-up call, given the type of extreme weather it already experiences. Unfortunately, climate change of some kind is now inevitable due to the nature of the global climate system and the amount of GHGs already emitted<sup>105</sup>. The exact degree of change will depend on what action the US and other major emitters take in the coming few years to reduce emissions. This in turn will determine the final economic cost of a changing climate for America and the world.

The economic cost of inaction will not be trivial, given the trends witnessed already over the last three to four decades. Research by Swiss Re, for example, shows that the average weather related insurance loss in the US in the 1980s was in the region of \$3 billion per year<sup>108</sup>. By the end of the first decade of this century this had increased to approximately \$20 billion annually. These findings concur with other data which shows the cost of weather disasters has been steadily increasing over the past 40 years in the US at an average rate of 4% per year, as Figure 4 below illustrates<sup>109</sup>. This increase in cost mainly reflects greater levels of insurance coverage, as well as increased exposure of insured assets to normal weather events<sup>110</sup>. While climate change has not been a driver of increasing cost to date, its future impacts can only worsen this rising cost trend.

FIG 4. NORMALIZED INSURED LOSSES FROM 'CONVECTIVE'<sup>111</sup> WEATHER EVENTS\*



\*CAUSING MORE THAN \$500 MILLION (2008) IN DAMAGES IN THE US (1973-2008)



**We will tackle climate change because we will have no choice. The question is which scenario will we opt for? Do we choose the reluctant approach where change only happens because it is the only viable option left? Or do we quickly reach a policy consensus and act in a proactive, far sighted manner?** Walter Bell, Chair, Swiss Re America<sup>106</sup>



The weather events of the 2012 summer have provided further indication of what unmitigated climate change could look like for the US, and the likely scale of costs involved. The summer's heat waves broke over 40,000 temperature records and brought drought to 80% of the country<sup>112</sup>. Thousands of counties declared states of emergency<sup>113</sup>. Some estimates suggest the total national cost of events in 2012 will reach \$50 billion, a figure similar to the \$55 billion cost from extreme weather in 2011<sup>114,115</sup>. While this cost is expected to be absorbed relatively easily by the \$15 trillion US economy, in major agricultural areas affected the impact will be more keenly felt.

The greater danger lies in a future of potentially more frequent and similarly severe droughts. These would have a cumulative effect on water supplies, agricultural investment, and consequently, long term food prices. Recent spikes in global agricultural commodity prices, such as those seen in 2008 and the surge in corn prices as a result of the US drought, show that this kind of scenario is not implausible. The principle effects of higher prices would be felt in poorer countries where food makes up a much larger proportion of household spending. Although US consumers might be insulated from these kinds of shocks, such global food insecurity is clearly not in America's broader national interest.

At the other weather extreme, the 2011 and 2012 crops of hurricanes and tornadoes provide a yearly reminder and harbinger of past, present and likely future costs associated with these events. Since 1980, damages from coastal disasters have surpassed \$560 billion in damages, with Hurricane Katrina alone potentially costing upward of \$200 billion (over 1% of US GDP)<sup>117</sup>. Each year, the western US Gulf Coast faces an average of \$14 billion in damages, driven by high winds and storm surges from hurricanes.

The 2011 tornado season meanwhile, was the second most active on record, with April recording the highest ever monthly figure for these destructive storms – beating the previous record by over 200<sup>118</sup>. The financial and human cost was also high. A total of 550 people were killed in 2011, including 158 as a result of the tornado that hit Joplin, Missouri in May. The cost of that disaster alone was \$2.8 billion, the most expensive tornado for over 60 years<sup>119</sup>. As temperatures rise with climate change, the frequency and intensity of these events can only get worse. It seems inevitable that the human and financial cost will mirror this change.

It would be disingenuous, however, to suggest that building a clean economy would do away with these disasters and their costs. Such phenomena are a part of America's natural environment. But a clean economy will mitigate the escalating future costs of more frequent, intense and widespread weather disasters. By decarbonizing the world's largest economy, America has a critical role in helping stabilize global temperatures at a level that will minimize the negative impacts of a changing climate.

## HEALTH-RELATED COSTS

**“We really don't appreciate the public health dimension of what this [coal use] is costing us.”**

**Dr. Paul Epstein, Harvard Medical School, 1943-2011**

Failure to create a clean economy is likely to have important public health implications for the US. A 'business as usual', high-carbon economy will exacerbate existing public health costs created by fossil fuel use and accelerate the emergence of new, climate-related ones.

According to research by Harvard Medical School, the life cycle impacts of coal use cost the US public between \$345-500 billion dollars a year due to the negative health effects<sup>120</sup>. These impacts include traumas associated with mining and transport, the health effects of heavy metals, and the particulate pollution created during combustion. Increased mortality and morbidity is also associated with areas of coal mining and in the vicinity of coal-fired power plants.

The use of fossil fuels also leads to significant air pollution costs in America's cities. Caused by vehicles and other emission sources, this pollution worsens allergies and asthma, contributing to a \$32 billion yearly bill for these conditions<sup>121</sup>. A warmer climate is expected to increase this cost, since higher temperatures help urban smog form<sup>122</sup>.

A changing climate, characterized by warmer temperatures across all seasons is also leading to increased incidence of once uncommon and foreign diseases. Infections of the West Nile Virus, first detected in the US in 1998, reached an all time high in 2012, with nearly 2000 cases reported by August, and 87 deaths<sup>123</sup>. As temperatures increase, the arrival and spread of other diseases is expected<sup>124</sup>.



**I fear that these increasingly severe dry periods may make it difficult to raise vegetables in our area. Irrigation does not fully replace the cool moist conditions that vegetable crops thrive in. Also, we will be forced to sell about half of the breeding stock in our beef herd in the next few weeks, due to vanishing pasture. [Merlin Friesen, Farmer from Filley, Nebraska](#)<sup>116</sup>**

Accidental deaths and injuries are also on the increase as a result of more dangerous climate events. According to statistics from the National Weather Service, fatalities from flooding, tornadoes, and heat waves in 2011 were all significantly above the ten year average<sup>126</sup>. With the proportion of over-65s in the population estimated to reach 21% by 2050 (up from 12% today)<sup>127</sup> government analysis projects increased risk of illness and death from extreme heat waves, which are expected to increase in frequency<sup>128</sup>.

All of the above health impacts come with price tags. A swift transition to a clean economy can help eliminate those costs associated with fossil fuel use (particularly for coal). But given that some degree of future warming is already locked in, certain diseases and climate risks are now likely to add a permanent cost to America's health system. This will invariably require adaptation but it also underscores the need for a clean economy to head off the threat of even greater climate change and even higher health costs.



**We are seeing the most rapid outbreak of West Nile Virus in the US happening now, and we don't know how it will end. Next it could be malaria, it could be Dengue fever. This is coupled with the fact that we have just had a very hot summer. Whether or not this was climate change-related, we know this is what climate change looks like. [Georges C. Benjamin MD, Executive Director, American Public Health Association](#)<sup>125</sup>**

# The way forward

**“Clean energy can stimulate the economy, and a strong economy is more secure. It gives us opportunity to tap into the innate entrepreneurial drive and intellectual capital of this nation in a big way. This is a nation that put a man on the moon 42 years ago and no one else has come close since then. This is the power of this great nation when we are appropriately focused and incentivized.”** Brigadier General Steven Anderson (Retired), former Chief of Logistics under General Petraeus<sup>130</sup>

While the debate on climate change has become increasingly politicized in the US, the scale of the opportunity presented by the creation of a clean economy – driven by an American Clean Revolution – remains undiminished.

Choosing this path plays to America’s strengths in innovation and entrepreneurship. The clean economy is already creating jobs that are better paid than average and resistant to outsourcing. It is supporting energy and national security. It is providing a much-needed new generation of smart infrastructure. But the fact remains; while shorter term fixes might be on the table, the US cannot afford to turn away from the clean economy path, for the sake of its future health, stability and global competitiveness.

We close with a four point call to action:

## 1. PLACE CLEAN GROWTH AT THE HEART OF ENERGY POLICY

Regardless of which party wins the 2012 election, if the US is to play to win, policymakers must finally **place clean growth centrally in America’s energy and economic strategy.**

This is important for two reasons. Firstly, as other economies like China and Europe seek to increase capability on clean energy, clean technology and energy efficiency, placing clean growth centrally in US energy policy will help ensure the US remains fit to compete in a world economy that is moving inexorably towards a lower carbon model. Secondly, climate change is not going away, and energy policy will fall well short of preventing the worst consequences for the US economy unless climate science is a central pillar of policy development.

Granted, this is a global challenge. But as a major emitter, America’s carbon output has a direct bearing on the rate of climate change. And by demonstrating leadership itself, others are more likely to follow. But regardless of what others do – or fail to do – the US is extremely well placed to benefit from taking the various actions laid out in this report.

Policymakers must also address the question of shale gas. Integrating its use into a low carbon energy system in a way that balances economic opportunity with environmental objectives is a priority. Done right this could improve energy security, create jobs and reduce emissions. This will require assessing the climate impact of methane leakage and the economic effect of cheap gas on emerging clean technologies. Priority must be given to maximizing the efficient use of clean energy in order to guarantee long-term energy security as well as address climate change.

## 2. MAINTAIN THE US LEAD IN CLEAN ENERGY INVESTMENT

In 2011, the US was the leading destination for clean energy investment at US\$51 billion, in large part due to government incentives for the industry set to expire this year. Without appropriate incentives and standards for clean energy in the US, investment will go elsewhere and the US will fall behind in the defining energy transition of the 21st century.

A key first step is to level the playing field for clean energy by removing market distortions. One way of doing this is by ensuring that clean energy companies have access to the same kind of government incentives used by the fossil fuel industry. The other key lever is to ensure that the full costs and benefits of each energy technology – so-called ‘externalities’ – including **climate and public health impacts, are properly reflected in the cost of energy production and consumption.**

One obvious means for dealing with the ‘externalities’ of differing technologies and fuels is through **policies that place a price on carbon.** This can be done in a way that is revenue neutral by lowering personal and/or corporate rates as part of a wider overhaul of the tax system. Alternatively, incentives and standards that encourage lower carbon economic activity could also be used.



**You can’t change the plan for addressing a long-term issue every four years. Climate change didn’t come to be in four years, and a four-year plan won’t get us out of it. Policymakers need a sustained plan that transcends election cycles. It may be difficult, but it’s the only rational option.** Walter Bell, Chair, Swiss Re America<sup>131</sup>

### 3. RETAIN AND STRENGTHEN THE US LEAD ON LOW CARBON INNOVATION

In 2011, the US led the world on clean energy R&D with a \$2.3 billion investment from business and government<sup>132</sup>, representing 31% of total government investment globally<sup>133</sup>. However, government support for energy R&D represents less than 2% of the federal R&D budget, and at 0.03% of GDP, trails other countries like China (0.11%) and Japan (0.10%) in relative terms<sup>134</sup>.

We support previous calls for **annual federal energy R&D funding to be tripled to \$16 billion**<sup>135,136, 137</sup>.

### 4. FOSTER LEADERSHIP IN THE PRIVATE SECTOR

Government cannot act alone. Leadership in the private sector is a critical catalyst for an American Clean Revolution. In June we laid out in our Leadership for a Clean Revolution report<sup>138</sup>, a framework for corporate (and government) leadership, including five traits that we believe will increasingly define successful low carbon businesses in the US and overseas. These are: fostering innovation; early adoption of low carbon technologies; reducing carbon emissions; focusing on clean strategies that are aligned with other key business drivers; and opening up to collaboration and communication around key challenges.

We call on **US businesses to secure their global competitiveness by driving forward leadership on the clean revolution** and for a **reinvigorated, bi-partisan, public-private partnership of government and corporate leaders in support of low carbon entrepreneurship**. As with America's great advances of the past, freeing the creativity and ingenuity of US entrepreneurs can build a better, smarter and more prosperous economy of the future.

Success breeds success, so we also call on **US businesses to work with The Climate Group and our Clean Revolution ambassadors** to tell their success stories and take the next steps in transforming their companies and markets. By communicating today's achievements and taking transformative actions that will deliver tomorrow's, business leaders can accelerate the transition to the clean economy.



## ANNEX - FURTHER READING

## INNOVATION AND COMPETITIVENESS

**Title:** “Clean Tech Nation: How the U.S. Can Lead in the New Global Economy”<sup>139</sup>

**Authors:** Ron Pernick and Clint Wilder | **Date:** 4th September 2012

**Publisher:** HarperBusiness

Industry experts analyze the current global situation and offer a seven-point Action Plan for Repowering America that recommends, among others, a smart infrastructure bank and clean tech investment tools.

**Title:** “A Business Plan for America’s Energy Future”<sup>140</sup>

**Authors:** Various | **Date:** 2012

**Publisher:** American Energy Innovation Council | **Website:** <http://americanenergyinnovation.org>

Preeminent American business leaders, including Bill Gates of Microsoft and Chad Holliday of Bank of America, contend that the current energy system is deficient in ways that are causing serious harm to the economy, national security and the environment.

**Title:** “The Business of Innovating: Bringing Low-Carbon Solutions to Market”<sup>141</sup>

**Authors:** Andrew Hargadon | **Date:** October 2011

**Publisher:** Center for Climate and Energy Solutions (C2ES) | **Website:** [www.c2es.org/](http://www.c2es.org/)

Andrew Hargadon of the University of California (Davis) explores how business can accelerate the innovations that are needed to achieve carbon emission reductions while boosting economic growth. Leading companies are profiled and seven keys to low carbon innovation are recommended.

**Title:** “The Impact of Clean Energy Innovation: Examining the Impact of Clean Energy Innovation on the United States Energy System and Economy”<sup>142</sup>

**Authors:** Various | **Date:** July 2011

**Publisher:** Google.org | **Website:** [www.google.org/](http://www.google.org/)

Google estimates the potential impact clean innovation could have on the US economy and energy landscape, using McKinsey & Company’s US Low Carbon Economics Tool.

## GROWTH

**Title:** “Sizing the Clean Economy: A National and Regional Green Jobs Assessment”<sup>143</sup>

**Authors:** Mark Muro, Jonathan Rothwell and Devashree Saha | **Date:** 2011

**Publisher:** The Brookings Institution | **Website:** [www.brookings.edu](http://www.brookings.edu)

The Brookings Institution quantifies the expanse and effect of green jobs. The results provide a comprehensive assessment of the clean economy at both a national and regional level, from employment geography to economic performance, while providing key recommendations for government policymakers.

**Title:** “The Impact of a Corporate Culture of Sustainability on Corporate Behavior and Performance”<sup>144</sup>

**Authors:** Robert Eccles, Ioannis Ioannou and George Serafeim | **Date:** May 2012

**Publisher:** Harvard Business School | **Website:** [www.hbs.edu](http://www.hbs.edu)

An investigation into the effect of a corporate culture of sustainability on multiple facets of corporate behavior and performance, based on a sample of 180 companies. The results provide evidence that those which adopted environmental and social policies significantly outperform those that had not, over the long-term, both in terms of stock market and accounting performance.

## SECURITY

**Title:** “National Security and the Threat of Climate Change”<sup>145</sup>

**Authors:** Various | **Date:** 2007

**Publisher:** The CNA Corporation | **Website:** [www.cna.org](http://www.cna.org)

The CNA Corporation, with an expert advisory board of 11 retired three- and four-star admirals and generals, assessed the impact of global climate change on key matters of national security, concluding that it poses a major threat, acts as a threat multiplier, and that energy dependence, climate change and national security are a related set of global challenges.

**Title:** “U.S. Department of Defense & Renewable Energy: An Industry Helping the Military Meet Its Strategic Energy Objectives”<sup>146</sup>

**Authors:** Various | **Date:** 2012

**Publisher:** American Council on Renewable Energy (ACORE) | **Website:** [www.acore.org](http://www.acore.org)

This report details how the military’s traditional energy approach, and its dependence on fossil fuels, is a strategic risk, and identifies renewable energy and efficiency investments as key risk mitigation measures.

## INFRASTRUCTURE

**Title:** “Failure to Act”<sup>147</sup> series & “Quadrennial Report Card for Infrastructure”<sup>148</sup>

**Authors:** American Society of Civil Engineers (ASCE) | **Date:** 2012 & 2009

**Publisher:** American Society of Civil Engineers (ASCE) | **Website:** [www.asce.org](http://www.asce.org)

The American Society of Civil Engineers details the contemporary crisis in American infrastructure, and the dangerous and inefficient future facing the country if action is not taken. Each “Failure to Act” report looks at a key area of the infrastructure in detail and offers solutions, which are summarized in the 2009 Report Card for America’s Infrastructure. This stresses the optimality of environmental protection, sustainability and technological efficiency, among others.

**Title:** “Resource Revolution: Meeting the World’s Energy, Materials, Food, and Water Needs”<sup>149</sup>

**Authors:** Richard Dobbs, Jeremy Oppenheim, Fraser Thompson, Marcel Brinkman and Marc Zornes

**Date:** November 2011

**Publisher:** McKinsey & Company | **Website:** [www.mckinsey.com](http://www.mckinsey.com)

With global food prices experiencing severe volatility recently – and as three billion people are set to join the global middle class – high prices and resource scarcity are set to become the staple of an increasingly vulnerable resource supply chain. McKinsey & Company analyze the trends and model future considerations, concluding with recommendations for a step change in extraction, conversion and usage practices – highlighting 15 areas, from energy-efficient buildings to improved irrigation, that could deliver 75% of potential increases in resource productivity.

**Title:** “The Smart Grid: An Introduction”<sup>150</sup>

**Authors:** Department of Energy’s Office of Electricity Delivery and Energy Reliability | **Date:** 2008

**Publisher:** US Department of Energy | **Website:** <http://energy.gov>

The U.S. Department of Energy provides introductory booklets for members of the public, policymakers and industry members to explain the concept, necessity and benefits of a smart grid system. Each booklet provides statistics and information on the efficiency measures that come with such grids, and the monetary, social and environmental benefits.

## THE COST OF INACTION

**Title:** “Mining Coal, Mounting Costs: The Life Cycle Consequences of Coal”<sup>151</sup>

**Authors:** Center for Health and the Global Environment | **Date:** January 2011

**Publisher:** Harvard Medical School | **Website:** <http://chge.med.harvard.edu>

A Harvard-led academic report examining the public health costs of coal use in the Appalachia area from extraction through to combustion. The report highlights the ‘externalities’ created by the coal industry, which are borne by the public through increased health costs that the researchers estimate amount to a third to over one-half trillion dollars annually. The paper concludes that taking these costs into account would conservatively double to triple the price of electricity from coal.

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#### **ABOUT THE CLIMATE GROUP**

The Climate Group is an independent, not-for-profit organization working to inspire and catalyze leadership for a Clean Revolution: a low carbon future that is smarter, better and more prosperous. For all.

- We work internationally with a coalition of companies, states, regions, cities and public figures.
- We inspire leaders by communicating a compelling narrative for change; we equip them by delivering evidence of success; and work in partnership with them in driving transformative change.
- Together with our partners, we are building a successful low carbon future of opportunity that boosts economies, creates jobs, enhances energy security, improves the quality of life of communities around the world, and averts the crippling impacts of runaway climate change.

Founded in 2004, The Climate Group has operations in North America, Australia, China (Beijing and Hong Kong), Europe and India.

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#### **ABOUT THE CLEAN REVOLUTION INITIATIVE**

The Clean Revolution is a partnership of international statesmen and governments, business leaders and corporations, thinkers and opinion formers. It is coordinated by The Climate Group. It calls for a swift, massive scale-up of clean energy and infrastructure, and of smart technologies and design. We believe this is the only feasible path to a smarter, better, more prosperous future.

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