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ENERGY INVESTMENT BANKING

# MUSINGS FROM THE OIL PATCH

**June 25, 2013**

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**Note**: *Musings from the Oil Patch reflects an eclectic collection of stories and analyses dealing with issues and developments within the energy industry that I feel have potentially significant implications for executives operating and planning for the future. The newsletter is published every two weeks, but periodically events and travel may alter that schedule. As always, I welcome your comments and observations.* Allen Brooks

## Popular Symbol Of Global Warming May Not Be Threatened

**The iconic polar bear population was in danger of being wiped out by the shrinking of the sea ice**

Over the past two years, Arctic sea ice has shrunk seasonally to unusually minimal levels. The reaction of many climate change proponents is that it was due to the planet's warming, which seems to be overly concentrated in the Arctic region as Antarctic sea ice is at unseasonably high levels. Global warming proponents began a campaign a number of years ago that the iconic polar bear population was in danger of being wiped out by the shrinking of the sea ice since it would rob the bears of food foraging habitat, forcing bears to swim long distances during which they could possibly drown. Who can forget those moving environmental group ads showing polar bears struggling to move from ice flow to ice flow and swimming in the Arctic Ocean?

**Exhibit 1. Is The Polar Bear Really Endangered?**

**Source:** www.bbc.co.uk

As a result of the environmental movement's campaign, in 2008, polar bears became the first vertebrate species to be listed by the

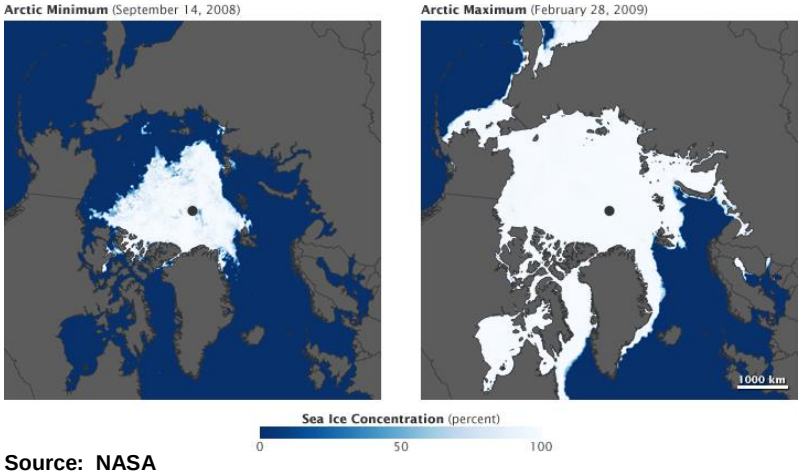
**Polar bears are like other bears in that they are omnivores**

U.S. Endangered Species Act as threatened by extinction primarily due to global warming. The threat assessment was tied to the loss of the bears' habitat of Arctic sea ice. This area is where the bears live and hunt for food, primarily seals, although the bears are also known to eat whale carcasses and walruses. Polar bears are like other bears in that they are omnivores meaning they are both herbivores and carnivores, eating both meat and fruit. In the winter, it is meat, and in the summer, polar bears come onshore and eat berries and plants.

**The Endangered Species Act has listed polar bears as threatened everywhere in the world they occur**

Rising temperatures in the world's oceans have caused sea ice to disappear for longer and longer periods during the late summer, leaving polar bears insufficient time to hunt. This is considered a worldwide problem, and the Endangered Species Act has listed polar bears as threatened everywhere in the world they occur. Polar bears can only survive in areas where the oceans freeze.

**Exhibit 2. Minimum To Maximum Arctic Ice Cover**

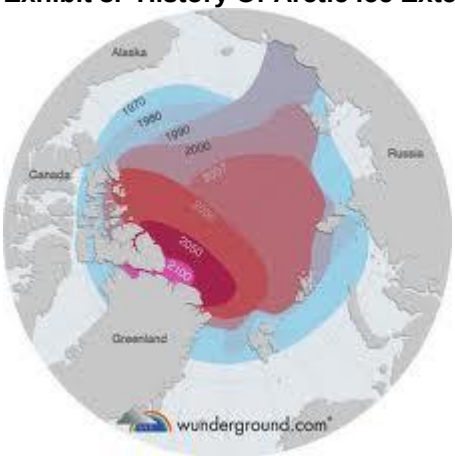



**Source: NASA**

**The fate of the lovable polar bear quickly became a sympathetic symbol of what might happen to our ecology, animal life and human subsistence**

Orbiting satellites have been able to track the seasonal extent of sea ice since 1979. Normally, the minimum sea ice extent occurs in mid-September with the maximum reached in late February. In the 1990s, as the earth's temperatures began rising, the trend for the areal extent of Arctic sea ice at its seasonal peak began to become worrisome. As we entered the new century and global warming hysteria grew, environmentalists began to focus on the shrinking of the winter Arctic sea ice, not just because of its impact on polar bears but also because shrinking sea ice exposes more of the Arctic region to exploitation of its potential hydrocarbon and mineral resources. As the environmental movement used their computer models to predict the possible impact of rapid global warming on the planet's ecology, the hysteria over a cataclysmic global catastrophe due to increasing carbon dioxide concentrations in the atmosphere exploded. The fate of the lovable polar bear quickly became a sympathetic symbol of what might happen to our ecology, animal life and human subsistence.

**Exhibit 3. History Of Arctic Ice Extent**




**Source: wunderground.com**

Based on computer models that assume acceleration in carbon emissions will lead to further and rapid global warming causing shrinkage in the areal coverage of Arctic sea ice in future decades, graphs of the ice coverage outlook were generated such as the one in Exhibit 3. The most recent minimum Arctic sea ice low was established in 2012, surpassing the previous minimum of 2007, but since that low the recovery in the ice coverage has been rapid.

**The report offers good news for the bears, but also has implications for the global warming hysteria**

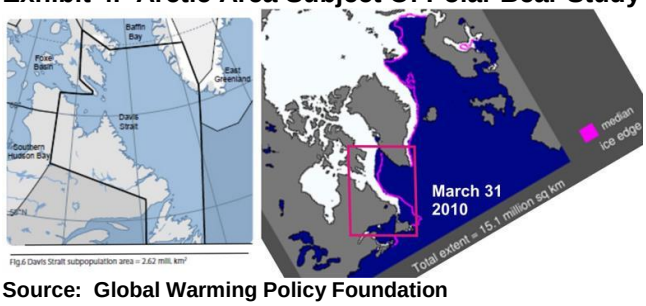
In the past year, various researchers began challenging the assumption about the eventual demise of the polar bear population. A new peer-reviewed paper published in *Journal of Wildlife Management* tracking the subpopulation of polar bears in the Davis Strait region of Canada has just been published. The report offers good news for the bears, but also has implications for the global warming hysteria. Interestingly, the report was published this February, but without a press release and thus it received no publicity. Its results suggest why it has been ignored.

**"There aren't just a few more bears. There are a hell of a lot more bears."**

When the study ended in 2007 and the preliminary population count was released, polar bear biologist Mitch Taylor was quoted in the media stating, "There aren't just a few more bears. There are a hell of a lot more bears." There was some publicity in 2009 when the official government report was issued, which was based on the preliminary data but focused only on the population increase. This new report focuses on other considerations than population growth.

The Davis Strait subpopulation region runs from just below the Arctic Circle at the north end to at least 47oN in the south. It covers 2.62 million square kilometers (1.01 million square miles) but the "suitable ice habitat in spring" is only 420,100 square kilometers (162,202 square miles), which is about 16% of the total area. A large portion of the area is land. The total area of the Davis Strait is almost as large as the three Hudson Bay subpopulations together – Western Hudson Bay, Southern Hudson Bay and Foxe Basin.

**Exhibit 4. Arctic Area Subject Of Polar Bear Study**




**Source: Global Warming Policy Foundation**

**This study concluded that polar bear numbers in the Davis Strait have not only increased to a greater density than other seasonal-ice subpopulations, but it may now have reached its "carrying capacity," meaning the population is not likely to grow further**

The new study compared data from polar bear mark-recapture studies done in 1974-1979 to those undertaken in 2005-2007. The study's authors state that in the Davis Strait, "the overall amount of sea ice declined and breakup has become progressively earlier" since the 1970s. Despite the decline in sea ice, the authors estimated the number of polar bears at about 2,158 compared to only about 1,400 bears in 1993. This study concluded that polar bear numbers in the Davis Strait have not only increased to a greater density (bears per 1,000 square kilometers) than other seasonal-ice subpopulations, but it may now have reached its "carrying capacity," meaning the population is not likely to grow further. The lack of growth is due either to population density or deteriorating sea ice, but there is no clear answer. Paraphrasing Mark Twain, the reports of the death of polar bears may have been greatly exaggerated.

**Exhibit 5. Caption Contest: Anybody Home?**

**Source: www.picturesdepot.com**

In researching polar bears for this article, we came across the picture above, which we couldn't ignore. The picture suggests the polar bear is looking for a food handout. Then again, maybe there are other conclusions. The picture leads us to consider running a "best caption" contest. As the *Musings* is a free subscription, we'll

have to think of another prize. Send us your caption and we'll report on what we receive in two weeks.

# What China's "Small City-ization" Does For Energy Demand?

Global economists, Wall Street investors and politicians worldwide are growing concerned about the pace of growth of China's economy. Absent a robust U.S. economy, trapped on a slow-growth path by structural and government policy challenges, and saddled with political sclerosis in Western Europe, the world economy is searching for the next driving force for growth. That force is supposed to be the developing Chinese economy, which had been growing at double-digit rates for the past several decades. Lately, China's economic growth has slowed to high single digits rates but now appears to be slowing more. Recently, the World Bank cut its 2013 growth forecast to 7.7% from its prior 8.4% estimate. Other financial institutions have issued new Chinese economic forecasts that call for even slower growth this year and barely any increase next. The latest economic data from China appears to be confirming the slowing and highlighting the challenge the government faces in boosting the growth rate.

**Lately, China's economic growth has slowed to high single digits rates but now appears to be slowing more**

The problem for China is that its economy's rapid growth in the past was due to it becoming the low-cost manufacturing center for the global economy. China's economic growth came via expansion of its export sector. To handle that new role, which resulted from China's large pool of unskilled, thus cheap, labor, the country invested in plants and infrastructure to foster export growth. That expansion also meant significant increases in consumption of raw materials and energy. To feed its low-cost labor pool, the country encouraged migration of rural residents to manufacturing centers located near large cities in the coastal provinces. There are estimates that 17% of China's population currently living in its cities does not have official urban status allowing them to register for schools and social benefits. These migration trends and growth policies have contributed to the major pollution problems that impact the livability of major Chinese cities. Estimates are that every year China experiences 400,000 premature deaths from respiratory diseases due to air pollution.

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As a possible way to reorient China's economy and boost its sustainable growth, the government is engaging in a kind of populist urbanization, which is really focused more on "small city-ization" rather than traditional "urbanization." This policy is meant to focus on developing emerging cities rather than expanding large existing ones. The policy is being implemented by bulldozing farms and villages and moving the people into newly constructed cities with high-rise residential towers. By 2025, China is expected to have over 200 cities with populations of more than one million people. What lies behind this new strategy? According to Chinese Premier

**By 2025, China is expected to have over 200 cities with populations of more than one million people**

**Premier Li also cited the reality that the services sector is "capable of absorbing the largest number of new employees and is an important driving force behind scientific and technological innovation."**

Li Keqiang, city residents spend more than rural residents on services such as schools, healthcare, leisure and financial advice. This spending would help boost the country's services sector and reduce the economy's dependence on exports. Premier Li also cited the reality that the services sector is "capable of absorbing the largest number of new employees and is an important driving force behind scientific and technological innovation." In a nutshell, the plan is to bring rural citizens to where their children can obtain better educations, health care and training that will make the future Chinese labor force more skilled and productive, able to compete on an international scale rather than to be limited to competing only based on low cost labor and manufacturing capacity.

**Projections call for China's rural population to represent less than 40% by 2030**

According to China's 2010 census, 51.3% of the country's population resided in rural areas, down from 63.9% in 2000, when a different counting system was employed. In 1970, the rural population represented 70% of all citizens in China, down from 95% in 1920. Projections call for China's rural population to represent less than 40% by 2030. To understand the scale of this government urbanization effort, there are about 800 million rural peasants and migrant workers. Of that total, 500 million are farmers and 300-400 million are excess unskilled rural laborers. The government's target is to move 250 million rural residents to these newly constructed cities. The big impact of this urbanization program will be to boost average annual family incomes and spending, and change spending patterns. Studies show that migrant rural workers tend to maintain their historical spending patterns and send most of their money home. Their new urban domicile is just a place to sleep and eat according to Nielsen Greater China.

**Exhibit 6. How Many More Cities Will Appear On Map?**


**Source:** ***Wikipedia***

**Urban household income is significantly higher than rural incomes, which helps support the increased spending on services**

Urban household income is significantly higher than rural incomes, which helps support the increased spending on services, but also boosts spending on appliances and gadgets, all of which will have an impact on China's future energy needs. Studies show that every 100 households in rural areas own on average 89 color televisions, 22 refrigerators and 62 cell phones. The same number of urban households own 137 color televisions, 92 refrigerators and 153 cell phones.

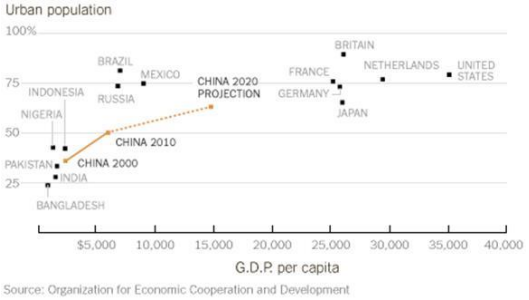
**It is estimated that by 2022, 75% of urban Chinese will have annual household disposable income between 60,000 yuan and 229,000 yuan ($9,000-$34,000) a year**

The growth in household incomes and the disparity between rural and urban incomes is a long standing issue, which the government attempted to address in the past. An article from *China Daily* in 2010 cited income statistics from China's National Bureau of Statistics showing that in 2009 annual urban household disposable income was 17,175 yuan ($2,515) versus rural incomes of only 5,153 yuan ($758), or a ratio of 3.31:1. In 1978, China introduced the household contract responsibility system in rural areas. As a result, the then urban to rural household income ratio of 2.56:1 declined to 1.82:1 by 1983, its narrowest ratio in modern times. The income gap widened starting in 1985 as the focus of the reform shifted to cities. A projection from McKinsey & Company shows that if the government's urbanization measures go as planned, by 2022, 75% of urban Chinese will have annual household disposable income between 60,000 yuan and 229,000 yuan ($9,000-$34,000) a year. A key aspect of the government's new plan is that when relocating rural citizens, they will be provided new apartments cost-free plus the state will pay the farmers for their land, or provide a monthly stipend or dividend stream from the payment for the land taken.

**Land reform, such as now, has been a key aspect of past economic and political programs**

Land reform, such as now, has been a key aspect of past economic and political programs. During the 1950s, the Communist Party gave small plots of land with the encouragement for people to farm. A few years later those same farms were collectivized by the Party, but the peasants' rights to use land were restored at the start of the reform era. Now, the government is trying to obliterate small landholders to help re-orient China's economy and growth prospects. By boosting the percentage of urban residents, China hopes to lift per capita income.

**Exhibit 7. China's Urbanization And Income**

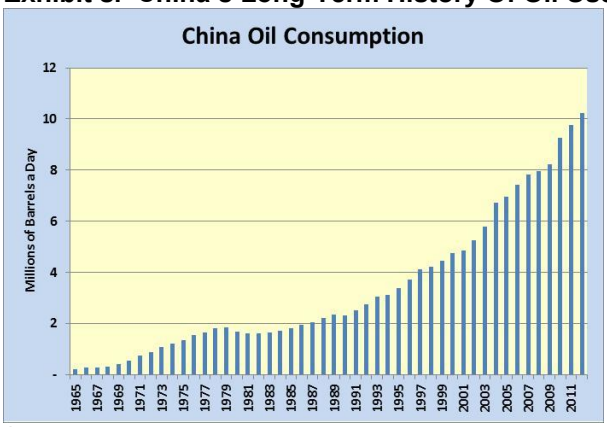



**Source:** ***The New York Times***

**China's consumption of crude oil and refined petroleum products has demonstrated a steadily rising trend**

So what does all this mean for China's future energy consumption, and especially for its use of oil? Given the country's huge population (1.354 billion people) and its rapid economic growth over the past 47 years, China's consumption of crude oil and refined petroleum products has demonstrated a steadily rising trend. Expectations are the trend will continue.

**Exhibit 8. China's Long-Term History Of Oil Use**




**Source: BP, PPHB**

**For the past decade the world has marveled at the efforts of Chinese state energy companies to secure ownership of and access to fuel resources and energy technologies around the world**

The belief is that as China's economy, currently ranked second in the world, grows and eventually surpasses the United States as the world's largest economy, its need for increased energy, and especially oil, will grow. There are many stories about how China is building a new electric power plant every week and how its use of coal, the fuel source of choice at the present time, is growing rapidly. For the past decade, the world has marveled at the efforts of Chinese state energy companies to secure ownership of and access to fuel resources and energy technologies around the world. In fact, the efforts of some of these companies to buy western energy and raw material producers has provoked high profile intellectual (political) struggles over free markets versus national security issues in the host countries. It is also instructive, after considering the historical growth of China's oil use, seeing where the country ranks among other leading economies in terms of per capita energy consumption. Data from the World Bank in Exhibit 9 shows per capita energy consumption, based on kilograms of oil equivalent per capita. The measure is calculated based on taking a country's indigenous production plus imports and stock changes minus exports and fuels supplied to ships and aircraft engaged in international transport.

As shown, China's per capita use of energy has grown, but still remains well below that of other wealthy and developed economies in Asia, Europe and, of course, the United States. The country listing shows that China's energy consumption is more equivalent to that of countries such as Brazil and Mexico, but three times the consumption of residents of India. China's energy use is about a

**The Chinese automobile industry is now producing vehicles at a 22 million units per year rate, 50% more than the U.S. and nearly twice the new car sales in Europe**

quarter of that of Canada and the U.S., 45% of Japan's use and a little under half the use in Germany and France. As China's middle class expands, its desire for a life style that mirrors that of western countries will likely boost its energy use. The Chinese automobile industry is now producing vehicles at a 22 million units per year rate, 50% more than the U.S. and nearly twice the new car sales in Europe. Importantly, a third of China's new cars are less fuel-efficient SUVs. Although Chinese are buying many small and fuel-efficient vehicles, there is also a large luxury car market, meaning fuel consumption will grow. The Asian Development Bank predicts that the number of cars in China could increase by 15 times the present level by 2035, producing three times the carbon dioxide emissions.

**Exhibit 9. China's Energy Use Is Climbing**

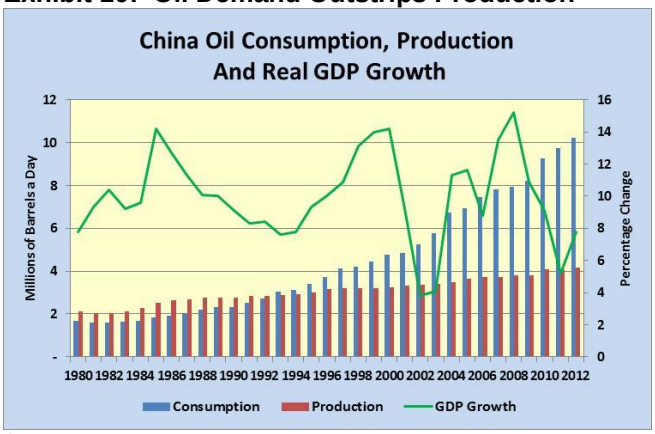
| Energy Per Capita For Selected Countries | | | | |
|---|---|---|---|---|
| (kg/oe) | 2008 | 2009 | 2010 | 2011 |
| China | 1,575 | 1,690 | 1,807 | |
| Australia | 5,810 | 5,784 | 5,653 | 5,366 |
| Brazil | 1,297 | 1,243 | 1,363 | |
| Canada | 7,946 | 7,435 | 7,380 | 7,426 |
| France | 4,114 | 3,917 | 4,031 | 3,843 |
| Germany | 4,069 | 3,872 | 4,003 | 3,755 |
| India | 526 | 559 | 566 | |
| Japan | 3,879 | 3,701 | 3,898 | 3,584 |
| Korea, Dem. | 836 | 791 | 761 | |
| Korea, Rep. | 4,636 | 4,660 | 5,060 | 5,175 |
| Mexico | 1,637 | 1,559 | 1,570 | 1,629 |
| Saudi Arabia | 5,888 | 5,888 | 6,168 | |
| USA | 7,488 | 7,057 | 7,164 | 7,069 |

**Source: World Bank, PPHB**

**The tech implosion and 9/11 created a global economic contraction that was felt by China as its economic growth slumped to 4% before rebounding back to double-digit growth**

To examine the relationship between China's economic growth and its oil consumption, production and imports, we plotted figures from BP's statistical database. We measured China's economic growth as calculated in purchasing power parity terms. Until 1993, China was a net producer of crude oil, but as consumption began accelerating the country was forced to begin importing oil. That demand acceleration came as the economy's growth ramped up from 8% to 14% between 1993 and 2000. The growth was surprising given the Asian currency crisis of the late 1990s, but demonstrated how the technology boom of that decade was powered by manufacturing in China. The tech implosion and 9/11 created a global economic contraction that was felt by China as its economic growth slumped to 4% before rebounding back to double-digit growth. With the exception of a brief slump to 9% growth in 2006, China has enjoyed double-digit growth until the global financial crisis exploded in 2008. Despite slowing growth, China's oil consumption has accelerated – both due to infrastructure investment and the start of a huge strategic oil storage program.

**Exhibit 10: Oil Demand Outstrips Production**

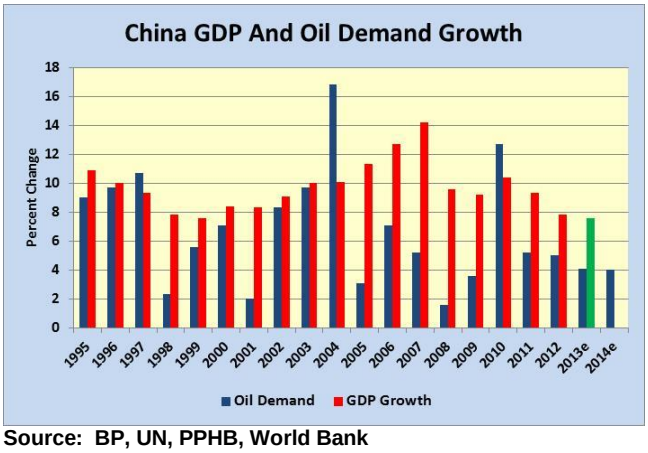



**Source: BP, UN, PPHB**

**The three smallest yearly oil demand increases coincided with years of serious economic downturns**

Taking a closer look at China's oil demand and economic growth, we can see how the country's demand has slowed along with the economy. The chart in Exhibit 11 (below) shows that the three smallest yearly oil demand increases coincided with years of serious economic downturns. However, when we look at the oil demand growth projections for 2013 and 2014 from the U.S. Energy Information Administration's (EIA) Short Term Outlook, they will rank among the lowest annual increases in the last 17 years. The key question is do the small yearly increases suggest significantly slower Chinese economic growth or does it reflect a shift in oil use?

**Exhibit 11. Demand And Economic Growth Estimates**




**Source: BP, UN, PPHB, World Bank**

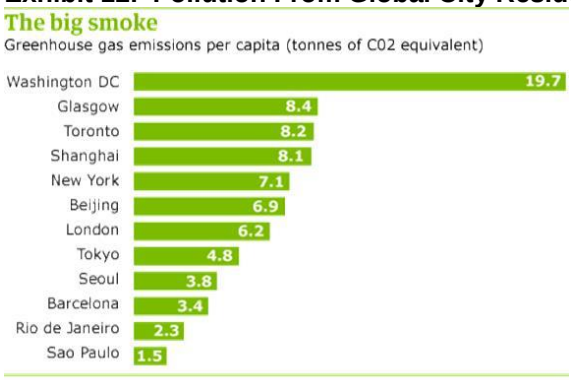
**U.S. cities had 14% lower energy footprints than the average for the country, meaning that cities are more energy-efficient**

When we consider the Chinese government's efforts to stimulate its services sector through its small city-ization program, we have to wonder what impact that could have on oil consumption. A Brookings Institute study in 2008 showed that U.S. cities had 14% lower energy footprints than the average for the country, meaning that cities are more energy-efficient. That conclusion was supported by a broader study from the International Institute for Environment

**London's citizens emitted 6.2 tons of CO2 each annually versus 11.19 tons on average for each citizen of the UK**

and Development (IIED) of 11 cities around the world. They identified lower energy consumption as a result of denser housing and increased use of public transit. The IIED study also measured carbon dioxide emissions and found that in 2004, London's citizens emitted 6.2 tons of $CO_2$ each annually versus 11.19 tons on average for each citizen of the UK. The comparison of city dwellers to average citizens was even more dramatic in the United States where citizens of New York City emitted 7.1 tons each per year versus a national average of 23.92 tons. Lower emissions equals lower energy consumption.

**Exhibit 12. Pollution From Global City Residents**




**Source:** ***Guardian*****, IIED**

**Tokyo's per capita emissions are below those of both Shanghai and Beijing suggesting that greater prosperity of a city's residents doesn't have to mean greater pollution**

We would make two observations from the chart of $CO_2$ emissions of the various cities included in the study in Exhibit 12. First, Tokyo's per capita emissions are below those of both Shanghai and Beijing suggesting that greater prosperity of a city's residents doesn't have to mean greater pollution. Second, the official explanation for Washington, D.C.'s high per capita emissions figure is its small population size. The author of the study suggests it might be more appropriate to measure the emissions for the metropolitan area rather than the city. We wonder if the high figure is due to all those government vehicle caravans hauling politicians and visiting dignitaries around Washington, or maybe there is something to all the "hot air" talk there.

**A 2007 study in *The Nation* by Elizabeth Economy, stated that city residents in China use 250% more power than their rural counterparts**

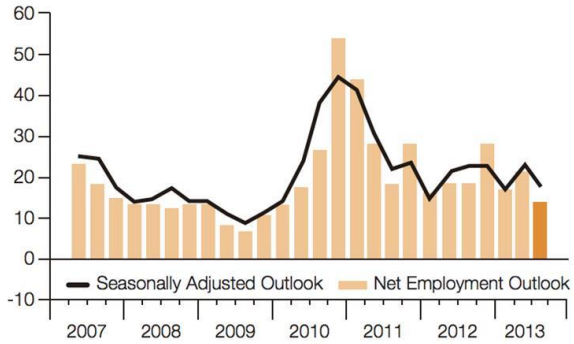
At this point we don't know whether there will be a permanent downshift in oil use as China's economy grows, especially in response to the government's urbanization efforts. A 2007 study in *The Nation* by Elizabeth Economy, the C.V. Starr Fellow and Director of Asia Studies at the Council on Foreign Relations, stated that city residents in China use 250% more power than their rural counterparts. The report attributed the poor power relationship to the sorry state of China's construction industry. Ms. Economy says that China's buildings use 250% more energy than buildings in countries with comparable climates. The problem with many of these energy efficiency studies is that they are using older data and China's economy is growing and evolving rapidly. The rapid

increase in new cities built to more exacting energy efficiency standards will also skew old energy/population relationships.

**A recent report says government officials have halted a plan to spend $6.5 trillion of investment for roads, homes, social welfare benefits and other public services**

The big push to urbanize the population to boost the service sector may be in some trouble, though, as a recent report says government officials have halted a plan to spend $6.5 trillion of investment for roads, homes, social welfare benefits and other public services. The most likely reason for the suspension is concern about the level of local government debt and volatility of the property market.

**Exhibit 13. Employment Outlook Means Slowing**




**Source: Urbanization Nation, *Manpower Employment Outlook Survey***

**If this urbanization program doesn't work, China's shift away from an export-based economy may not be achieved**

The latest HSBC Holdings plc (HBC-NYSE) preliminary purchasing managers' index for China's services industry registered its second-lowest reading since August 2011 and sequential decline from the prior month. The latest Manpower Group Inc. (MAN-NYSE) survey of 4,241 employers in China showed service sector employers reporting their lowest hiring expectations since 2010. So if this urbanization program doesn't work, China's shift away from an export-based economy may not be achieved, making the economy increasingly subject to global economic trends and increasing cheap-labor competition from other Asian and Latin American countries. Without this economic shift, China's demographic challenges of a rapidly aging population along with a shrinking work force will significantly alter the country's existing energy consumption pace. At the moment there is no clear answer to how it may change, but energy markets are growing increasingly nervous.

## Three Cheers For The U.S. Oil Industry! Hold The Predictions

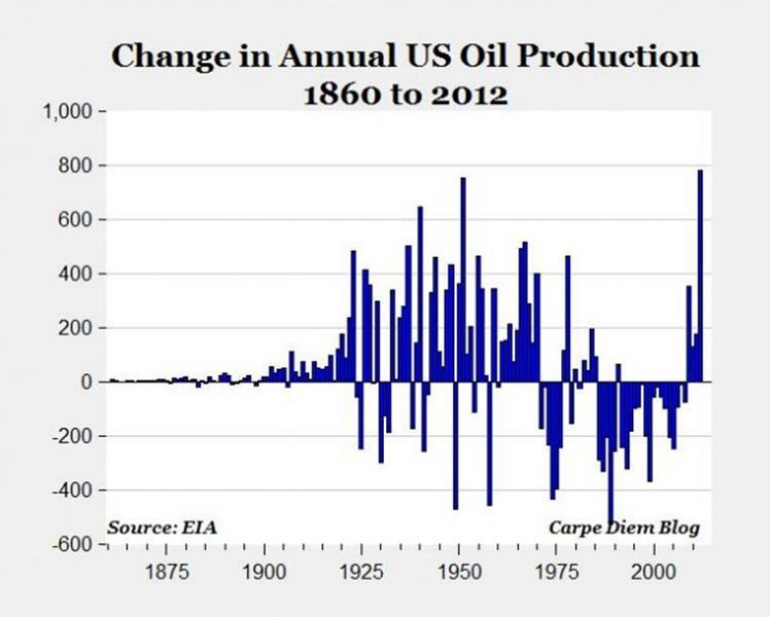
**The United States experienced the largest increase in annual oil production ever for the industry last year**

The United States experienced the largest increase in annual oil production ever for the industry last year. According to the annual review of world energy markets prepared by BP plc (BP-NYSE), the one-million barrels a day increase in output was the largest in the history of the United States going back to the oil industry's beginning in 1859. BP also cited the country's strong growth in natural gas production, too. But maybe more significant was the 2.8% decline in energy demand last year, which has certainly helped the country

**Performance of the domestic oil and gas industry has forecasters making aggressive predictions**

reduce its balance of payments due to lower oil imports. The problem, however, is that the strong performance of the domestic oil and gas industry has forecasters making aggressive predictions about its future production growth and the resulting impact on global energy markets and the political environment.

**Exhibit 14. Record Increase In U.S. Oil Output**




**Source:** ***Business Insider***

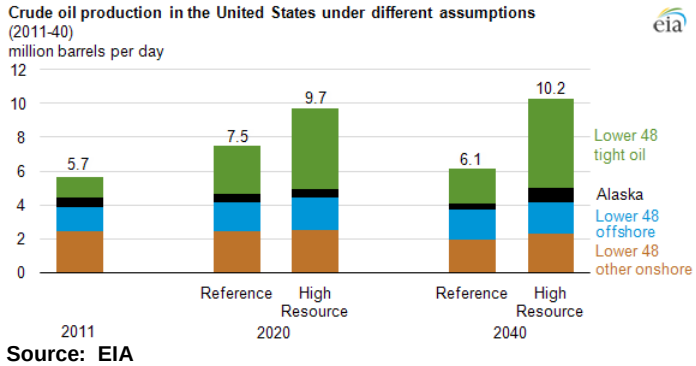
**These gains are significant and reflect the collective efforts of the industry to exploit shale deposits across the country and in particular the Bakken and Eagle Ford oil shale formations**

On a comparison of oil output growth based on average production for 2011 and 2012, the increase was about 800,000 barrels a day (b/d). On the other hand, if the output change was measured between the final days of the respective years, as reported by the Energy Information Administration (EIA), the increase was 1.139 million b/d. And if we use the four-week averages for December of each year from the EIA, then the increase amounts to 1.069 million b/d. These gains are significant and reflect the collective efforts of the industry to exploit shale deposits across the country and in particular the Bakken and Eagle Ford oil shale formations.

The strong performance of the oil and gas industry has caused forecasters, such as the EIA, the International Energy Agency (IEA), and private forecasters, including Citibank, to project the U.S. becoming a net exporter of oil within the next decade and that the U.S. could even out-produce Saudi Arabia by 2020 reclaiming the world's number-one oil producer ranking once again.

The EIA suggests in its Annual Energy Outlook for 2013 that between 2011 and 2020, U.S. oil production will grow by 1.8 million b/d in its Reference case and by four million b/d in its High Resource case. With over a million barrels of net new production in 2012, the

**Exhibit 15. Optimistic EIA Oil Output Forecast**




**Source: EIA**

industry is well on its way to meeting the Reference projection and a quarter of the way to the High Resource target. But will production continue to grow at the rate it has for the past two years? That will depend on the trajectory of global oil prices, trends in drilling and production, regulatory policy and the performance of existing reservoirs.

**The key question is whether future technological gains will continue boosting initial production and ultimate recovery rates at a pace similar to that experienced in recent years**

The petroleum industry continues to make progress in reducing the number of days needed for drilling the horizontal wells required to exploit shale resources. It is also advancing completion technology, including hydraulic fracturing, to boost initial well production and increase total reservoir recovery rates. All of these improvements will reduce finding and development costs and improve company financial returns. The key question is whether future technological gains will continue boosting initial production and ultimate recovery rates at a pace similar to that experienced in recent years. If the answer is yes, and government regulation and restrictions on access to land are not inhibitors, then the industry has the potential to further boost output and reduce U.S. oil imports. On the other hand, if the answer to the question is no, then due to the rapid production decline rates for shale wells, the industry will be stepping onto a drilling and fracturing treadmill as the industry will need a steady increase in producing wells merely to hold shale output steady, or to limit its rate of decline.

**The more important issue will be how the shale outlook answer impacts the overall U.S. energy balance and global energy and political dynamics**

The business scenarios flowing from the answers to our question reflect the two ends of a spectrum, with the likely outcome falling somewhere in between. Just where we land along this spectrum will dictate the level of future petroleum industry activity and thus that of the service companies who perform the work. The more important issue will be how the shale outlook answer impacts the overall U.S. energy balance and global energy and political dynamics. While we remain optimistic for the petroleum industry's outlook, we are not ready to sign on to energy independence or the return of the U.S. to the number one oil producer in the world. We welcome being proven wrong, however.

# How To Deal With Climate Change And Rising Sea Levels

The New York/New Jersey metropolitan area and the southeast part of New England are still struggling to recover from last fall's Super Storm Sandy. The storm, while not a hurricane when it came ashore in the region, happened to coincide with an abnormally high tide that produced a destructive storm surge causing extensive damage to coastal areas and communities and especially communities located in low-lying areas.

Sandy, a Category 3 hurricane at its peak, formed in late October and moved through the Caribbean and up the U.S. East Coast before coming ashore at the border between New York and New Jersey. The storm was responsible for 196 deaths – 71 in the Caribbean and 125 in the United States. There were 60 storm-related deaths in New York, 48 of them in New York City, and 34 deaths in New Jersey, 16 in Pennsylvania and seven in West Virginia where a large snow fall attributed to the storm contributed to the deaths. Super Storm Sandy, as it was dubbed since the storm was not a hurricane on landfall, cost the United States an estimated $62 billion in damages - the vast majority in the New York/New Jersey area. A recent estimate says New York City sustained $19 billion in damage and lost economic benefits due to the storm. Sandy was the second most destructive storm behind Hurricane Katrina that cost the Gulf Coast $128 billion in inflation-adjusted dollars. Sandy spread 850 miles from side to side and measured 5.8 on the 0-6 scale for kinetic energy from storm surge and wave "destructive potential." It was the highest ever measured by the National Oceanic and Atmospheric Administration (NOAA).

**A recent estimate says New York City sustained $19 billion in damage and lost economic benefits due to the storm**

Numerous homeowners in places such as Brooklyn, Staten Island and Toms River, New Jersey, among others, continue to battle with the Federal Emergency Management Administration (FEMA) over payments for storm-related damage under their government-sponsored flood insurance policies. Many of these homeowners are now confronting the challenge of rebuilding or repairing their damaged homes in light of the new FEMA flood maps, the significantly higher flood insurance premiums mandated by the belief there will be more frequent and extensive flooding, and strictly enforced rebuilding requirements to minimize flood risk. Under flood insurance mandates, if more than 50% of the structure is damaged, rebuilding requires the construction be built to the new standards including significant structural elevation to minimize future flooding episodes. In some areas, the owners' choice often is either elevating the home 10-14 feet above ground level, at a cost of $100,000 or more, or paying $30,000 annual flood insurance premiums. Some climate change proponents claim that Sandy was the result of climate change forces unleashed by higher $CO_2$ concentrations in the atmosphere and that this extra carbon will lead to more frequent massive and destructive storms like Sandy. Climate change advocates are also concerned about the impact of

**In some areas, the owners' choice often is either elevating the home 10-14 feet above ground level, at a cost of $100,000 or more, or paying $30,000 annual flood insurance premiums**

rising sea levels on flooding and storm surges associated with these stronger and more frequent storms.

**The plan involves spending money to fortify infrastructure like the city's power grid, renovating buildings to withstand hurricanes and defending the shore**

Two weeks ago, New York City Mayor Michael Bloomberg unveiled a $20 billion plan to protect the city from climate change and the associated increase in Sandy-like storms. The plan will eventually cost more than the estimated price tag, but quantifying how much more is impossible now. The plan involves spending money to fortify infrastructure like the city's power grid, renovating buildings to withstand hurricanes and defending the shore. The report details 250 recommendations including installing flood walls and other measures to protect some of the worst hit areas by Sandy and Hurricane Irene in 2011.

**The plan envisions building barriers of stone or concrete bulkheads and in other areas creating dune systems**

In the first phase of the plan, the city would erect barriers at Hunts Point in the Bronx to protect a food distribution center, on the East Harlem waterfront along Franklin D. Roosevelt Drive, on the Upper East Side where most of the city's hospitals are concentrated, on the Lower East Side, in Chinatown, in the financial district and in Red Hook, Brooklyn. On Staten Island, the plan calls for permanent levees. The plan envisions building barriers of stone or concrete bulkheads and in other areas creating dune systems. While dunes are a visually attractive alternative, the environmental issues for dredging the material to use can be a significant and the effort costly. In addition, there always remains the possibility the dunes will be wiped out by future storms such as what occurred to parts of the barrier along the Rhode Island coast.

**Today, almost 400,000 New York City residents live in the 100-year flood plain**

FEMA has recently introduced new flood maps for the New York harbor area, the first update since 1983 although there have been interim updates. Today, almost 400,000 New York City residents live in the 100-year flood plain, and projections based on the new maps call for a doubling of that number by 2050.

**Exhibit 16. NYC Flooding Exposure To Hurricanes**


**Source:** www.thinkprogress.com

Hurricane Irene in 2011 and Sandy last fall were wakeup calls to the new era of tropical storm routes. For nearly 40 years, the predominant North Atlantic tropical storm pattern has seen developing hurricanes move through the Caribbean either to the Florida peninsula and Gulf Coast regions and occasionally Southeast states along the East Coast, or they would turn north and die in the North Atlantic never making landfall. Now the path of hurricanes is reverting to that experienced in 1930-70 when hurricanes left the Caribbean and hugged the East Coast making landfall somewhere along the way north. This pattern means there is a greater chance of major hurricanes landing in mid-Atlantic and New England states. Having grown up in southern Connecticut during 1940-1970, we experienced numerous hurricanes, some of which caused extensive damage to New Jersey, Long Island, Connecticut and Rhode Island. After decades with nary a hurricane visiting the New York metropolitan area, people have become either complacent or have never experienced such a storm. Likewise, young journalists and 24-hour news cycles have created a cadre of reporters possessing no hurricane experience but who are familiar with how hurricane coverage made the career of a young Dan Rather. In 1961, Mr. Rather was the news director of Houston's KHOU-TV and with his television crew was covering from Galveston Hurricane Carla's assault of the upper Texas Gulf Coast. He is famous for one on-air scene during the storm holding on to a palm tree for safety. During the storm coverage he also pioneered the practice of superimposing the weather bureau's radar onto a map of Texas, which in this case clearly showed the areal extent of Carla and encouraged a mass evacuation that probably saved many lives. This coverage led to Mr. Rather being discovered by CBS News, becoming the network's national correspondent, White House correspondent and 24-year anchor of the evening news. Mr. Rather has been honored for inventing hurricane coverage now considered routine regardless of a storm's significance.

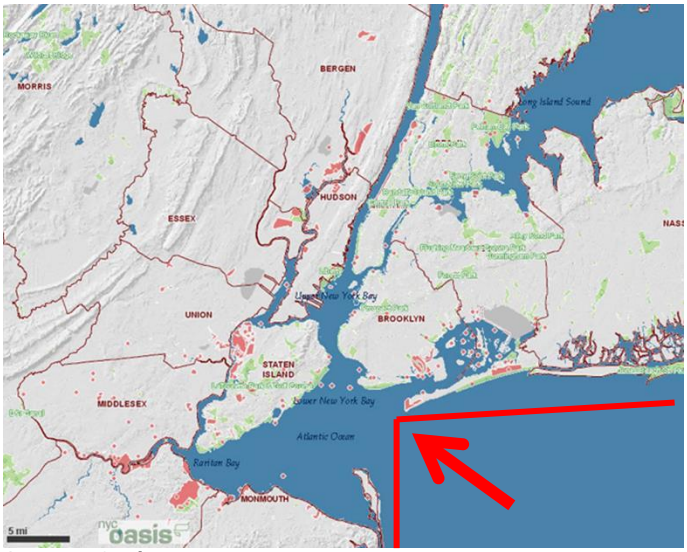
**After decades with nary a hurricane visiting the New York metropolitan area, people have become either complacent or have never experienced such a storm**

With the experience of Hurricane Irene and Super Storm Sandy and drumbeats from climate change proponents about the increased frequency of strong storms with greater storm surges due to rising sea levels, is it any surprise that New York City is calling for federal government money to help build defenses against these storms? There are issues with this plea. First, history has shown that around every 40-70 years a major hurricane (Category 3 or above) hits New York. Second, the location of the city accentuates the natural forces associated with a major hurricane when it hits the area. New York City lies at the vortex of a right angle created between Long Island and the New Jersey coastline. As a result, New York harbor becomes a catch basin for the storm surge with no outlet.

**History has shown that around every 40-70 years a major hurricane (Category 3 or above) hits New York**

The storm surge pushes the wall of water into the harbor and up the Hudson and East Rivers where it will be trapped with no option but to spill over the banks flooding neighboring land areas. A crucial consideration about a storm surge's impact is the timing of the tides.

**Exhibit 17. NY Harbor Lies At Vortex Of Land Masses**




**Source:** ***Oasis***

**At the Battery, observers watched as water rose as fast as 13 feet an hour, but fortunately the storm landed at low tide**

Hurricane Gloria in September 1985, a Category 2 storm, made landfall just above the mouth of New York Harbor, passing north of Manhattan. The storm hit at low tide, some five feet below where it had been a mere six hours earlier. The great hurricane of 1821 passed right over Manhattan and actually cut the island in two as the Hudson and East Rivers met above Canal Street. At the Battery, observers watched as water rose as fast as 13 feet an hour, but fortunately the storm landed at low tide.

**The significant difference between Irene and Sandy is that the latter landed during an abnormally high tide due to the full moon, which added significantly more water to the storm surge**

New York City was hit by another storm in 1892 but there was little damage done. The last great hurricane to hit the city was the 1983 Long Island Express that roared ashore in Rhode Island creating widespread death and destruction in New York State, New Jersey and much of New England. This was the last major storm to hit the New York metropolitan area as both Hurricane Irene, although it had been a Category 1 when it first made landfall along the Carolina coast, and Sandy were only tropical storms when they landed in the New York City area. The city escaped a disaster when Irene's storm surge was 12 inches below the level that would have flooded subways and thousands of homes. The significant difference between Irene and Sandy is that the latter landed during an abnormally high tide due to the full moon, which added significantly more water to the storm surge. Sandy was predicted to be a powerful storm with a storm surge in New York harbor reaching 11 feet, but the surge crested at 13.88 feet, nearly three feet higher than anticipated.

A preview of what would happen with Sandy occurred in December 1992 when a strong nor'easter hit New York. The sea level at the tip of Manhattan rose eight feet and flooded Battery Park Tunnel with six feet of water. The storm forced the closure of LaGuardia Airport

and shut down the entire New York City subway system stranding many passengers. The storm created so much havoc that it effectively shut down the entire city and impacted 21 million people in the city and surrounding area or about 7% of U.S. population.

**The heart of New York City lies below sea level just as does New Orleans that was devastated during Hurricane Katrina in 2005**

Sea levels and storm surges are major concerns. The heart of New York City lies below sea level just as does New Orleans that was devastated during Hurricane Katrina in 2005. In New York City's case, however, it is that the heart of the city lies underground – subway and railroad tracks, car tunnels such as the Holland and Battery, which connect the city to New Jersey, multi-level parking garages, basements and utility tunnels. Part of Mayor Bloomberg's plan for protecting the city is to elevate hospital, emergency and building power systems to higher floors to prevent them from being flooded.

**Developers have rushed in to put up expensive rental and condominium towers from Battery Park City to Long Island City, transforming warehouse and wharf districts**

Another aspect of the protection plan for New York is to try to offset the impact of development that has aggravated conditions that make the storm surge stronger. We can highlight what has occurred just during the Bloomberg administration. Much of the city's waterfront has been revitalized with the city spending hundreds of millions of dollars to improve parks, build esplanades and create infrastructure necessary for residential development. Additionally, developers have rushed in to put up expensive rental and condominium towers from Battery Park City to Long Island City, transforming warehouse and wharf districts.

**Exhibit 18. Future Coastal Population At Risk**


**Source:** ***Wikipedia***

**Those areas represent 25% of America's population including many people in a number of major cities**

There is significant concern among climate change proponents and many politicians about rising sea levels. NOAA predicts that sea levels could rise between one and four feet over the balance of this century. Most of the rise is predicated on the melting of the glaciers and the heating of the oceans, one of which will lead to more water while the other suggests expanding volumes. As result, studies have been prepared to show how much of the East Coast and Gulf Coast could be underwater. The areal extent of this flooding is shown in red in Exhibit 18. Those areas represent 25% of America's population including many people in a number of major cities.

We are not going to debate climate change and the potential for more and stronger tropical storms. We touched on the issue of increasing sea levels, although there are issues such as subsidence, especially along the Gulf Coast, and the tipping of continent associated with plate tectonics that come into play. These are important topics needing to be covered, but they are not within the scope of this article. What we want to focus on, however, is the little known fact of how New Yorkers have expanded Manhattan Island narrowing the Hudson and East Rivers, which magnifies the damage from storm surges. We have been aware of this issue for many years and see it at work elsewhere along the East and Gulf Coasts and in Europe, too. Interestingly, the areas of New York reclaimed from the rivers are the same areas most likely to flood, meaning that New Yorkers have magnified their own storm issues by messing with Mother Nature.

**There is the little known fact of how New Yorkers have expanded Manhattan Island narrowing the Hudson and East Rivers, which magnifies the damage from storm surges**

On September 12, 1609, Englishman Henry Hudson, under the employment of the Dutch East India Company, sailed his ship, Half Moon, into New York harbor and up the river that now bears his name. He was seeking a route to Asia, which he failed to find, but he did find abundant beaver whose pelts were in fashion in Europe at that time. That September date, over 400 years ago, is used to establish the history of New York City. In researching this article we found a fascinating science and history project called the Mannahatta Project. Eric Sanderson, an ecologist, author and founder of the project, wrote a book, Mannahatta: A Natural History of New York City. In an interview with Friends of the Pleistocene, he offered an interesting observation about the attitude of New Yorkers to their city's history in relation to that of citizens of other cities around the world. His observation is something we can identify with about the "youngster" we call America, when we visit Europe, the Middle East and Asia. As Mr. Sanderson put it, "…New York City seems like a place that doesn't seem to think about its history. When you go to London or Paris, or even Delhi or Tokyo, there is this sense that you are part of a historical phenomenon. That there were people before you and they were doing things, and there will be people beyond you and they are going to be doing things and you are sort of part of that." He went on to say, "In New York City, people come here and accept it as they find it at the time, and then start to build their futures from whatever they have found."

**As Mr. Sanderson put it, "…New York City seems like a place that doesn't seem to think about its history…."**

Mr. Sanderson pointed out how New Yorkers generally start their history with Hudson's voyage, although in reality its first European visitor was Giovanni da Verrazano, in command of the French ship, La Dauphine, in 1524. It is believed he sailed into Upper New York Bay, where he encountered native Lenape before moving on. He named the area Nouvelle-Angoulême (New Angoulême) in honor of Francis I, King of France and Count of AngoulêmeIt. The colony was developed by the Dutch with the aid of slaves and was known as New Amsterdam. The English took over the colony in 1664 and changed its name to New York. As an ecologist, Mr. Sanderson

**The colony was developed by the Dutch with the aid of slaves and was known as New Amsterdam**

**He focused on the history of the Lenape and their ancestors, people who resided in the area for perhaps 10,000 years before Hudson arrived**

wanted to investigate what the area was like prior to Hudson's voyage and put New York City's subsequent evolution into context. As a result, he focused on the history of the Lenape and their ancestors, people who resided in the area for perhaps 10,000 years before Hudson arrived. Lenape meant "the Real People." To their peers in the region, they were honored as the "Ancient Ones," and respected as the oldest of the northeastern Algonquin cultures.

As Mr. Sanderson put it, there are all kinds of processes going on in nature that move at different time scales. So to understand the evolution of New York City, one has to understand maybe 200 years of land use by the Lenape. Mr. Sanderson's project modeled on developments during that time period. He also had to understand the glacial history of the landscape, in terms of how ice had shaped the landscape and shaped the hills, and then how the retreat of the glaciers left parallel beds of sediments that then became important for how water moved through the landscape, both in the surface and subsurface. All of that knowledge is then laid over the bedrock geology and the much longer geological history of Manhattan Island.

**In the early 1620s when the Dutch colony was established, Manhattan Island was 80-85% forested with maybe a million trees covering 10,000+ acres of the then 13,000 acre island**

An example of land use is that in the early 1620s when the Dutch colony was established, Manhattan Island was 80-85% forested with maybe a million trees covering 10,000+ acres of the then 13,000 acre island. From a colony with only a handful of people, to one of only 7,500 people a century later, how could they have harvested a million trees in less than 100 years? Today, the forests of Manhattan Island are only a few thousand trees on a few hundred acres in parkland in the northern area.

In Exhibit 19 is one of the iconic photos of Manhattan Island, then and now. Many people are shocked to see the forests, but this was true of much of New England where the forests of today represent second generation growth. That fact is attested to by the large number of stone walls found within the woods.

**Exhibit 19. Manhattan Island: Then And Now**

**Source: Mannahatta Project**

**By having filled in areas of both the Hudson and East Rivers, is it any surprise that storm surges, especially if they coincide with high tides, can inundate New York City causing significant damage?**

In our quest to understand what New Yorkers have done in the past that increases the odds of greater storm damage in the future, one only needs to examine the photo in Exhibit 20. The green outline around the island shows its present dimensions. We are also reusing a photo from earlier in the article in order to put the flooding risk from different categories of hurricanes with the current and historic shape of Manhattan Island. By having filled in areas of both the Hudson and East Rivers, is it any surprise that storm surges, especially if they coincide with high tides, can inundate New York City causing significant damage?

**Exhibit 20. How Manhattan Island Has Expanded**

**Source: Mannahatta Project**

**Exhibit 21. Flooding Risk Due To Hurricanes**


**Source: www.thinkprogress.com**

To further illustrate the impact of filling in the harbor and changing the volume and flow of water that can be absorbed are the following two charts related to the creation of Battery Park. The outlined area in Exhibit 22 (next page) shows how much land was added off the original tip of Manhattan Island. The finished product is shown in Exhibit 23. But compare the views with the flood area from a Category 1 hurricane (light red area) at the tip of New York in Exhibit 21. Obviously stronger storms create greater storm-related damage,

but even tropical storms and strong nor'easters can create serious flooding in the Battery Park area as shown above. This doesn't even take into consideration any impact from higher sea levels in New York harbor.

**Exhibit 22. Expanded Battery Park Landmass**

**Source: Mannahatta Project**

**Exhibit 23. Battery Park Seen Today**

**Source: Mannahatta Project**

**Mayor Bloomberg wants American taxpayers to bail out New York City residents for the sins of their grandfathers**

Climate change promoters want to chastise the public's use of energy for the sins of our grandfathers. On the other hand, Mayor Bloomberg wants American taxpayers to bail out New York City residents for the sins of their grandfathers. A real effort needs to be made to save our natural protections. Raising flood insurance premiums is one step that will slow the pace of coastal development, a trend that has accelerated in recent decades. At one time that development was necessary in order to obtain life-sustaining supplies. Now it is more for life style and recreation.

Just to be clear, Houston is approximately 50 feet above the Gulf of Mexico and our house in Rhode Island, while across the street from a salt water pond with access to the Atlantic Ocean (the pond is formed by a sand dune), is 14 feet above sea level to the floor of our walkout basement and nearly 22 feet to the first floor. We pay for flood insurance policies on both houses, although we are not required to, and we have no problem with higher premiums as a price for living where we do and want to.

Rising sea levels, greater storm surges and the increased risk of catastrophic damage from tropical storms will become additional

issues utilized by climate change proponents to attack the fossil fuel industry and siphon more tax dollars for climate change protection schemes. Mayor Bloomberg is a leader in that movement.

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