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THE IMPACT OF U.S. POPULATION GROWTH ON GLOBAL CLIMATE CHANGE

An NPG Forum Paper
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EXECUTIVE SUMMARY

On the first Earth Day, April 22, 1970, the nation paused to consider the impact of human activity on the global environment. The greatest threat – as seen that day – was the prospect that future generations would run out of food, fuel, and natural resources. Neither global warming nor population growth was on the environmental radar.

The following predictions were made that day[1]:

- Paul Ehrlich, author of *The Population Bomb*, predicted that 4 billion people – including 65 million Americans – would starve to death between 1980 and 1989.
- *Life* magazine wrote: "...by 1985 air pollution will have reduced the amount of sunlight reaching earth by one half."
- Ecologist Kenneth Watt said: "The world has been chilling sharply for about twenty years. If present trends continue, the world will be about 4 degrees colder for the global mean temperature in 1990, but 11 degrees colder in the year 2000. This is about twice what it would take to put us into an ice age."
- Watt also stated: "By the year 2000, if present trends continue, we will be using up crude oil at such a rate… that there won't be any more crude oil."

None of these apocalyptic prophecies came to pass:

- Mass starvation was averted by the development of high-yielding crop varieties, new irrigation infrastructure, modern management techniques, synthetic fertilizers, and other advances in agricultural technology. The "Green Revolution" lowered food prices throughout the world, while reducing the amount of land that would have been deforested for agricultural purposes. Greenhouse gas emissions are considerably lower today because of these advances.
- Global dimming gave way to a "brightening" trend after passage of the Clean Air Act in 1970. The two pollutants thought to prevent sunlight from reaching Earth – particulates and sulfur dioxide emissions from aerosol – fell 80% and 53%, respectively, between 1970 and 2006. By 1975, the masked effects of trapped greenhouse gases on global warming finally started to emerge and have dominated ever since[2].
- Global cooling? Another false alarm, the result of a slight downward blip in temperatures from the 1940s to the early 1970s and press reports that ignored a rapidly-growing body of scientific literature projecting global warming due to greenhouse gas emissions.
- Increased fuel efficiency standards for automobiles, appliances, and building codes have cut oil consumption by about 50% below what would have been the case under pre-1970 standards. The only "shortage" in the 2016 oil market lies in the capacity of tanks available to store excess oil.

In retrospect, the 1970s was a Golden Age for conservation – a period when most Americans believed that changes in our consumption habits along with new energy-saving technology could control, or even reverse, the degradation of our natural environment. January 1, 1970 was a watershed moment. On that day President Nixon signed the single most important environmental statute in American history: the National Environmental Policy Act (NEPA).

The new law ordered federal agencies to conduct Environmental Impact Statements (EISs) for any future actions – e.g., construction projects, programs, permits – that might "significantly" affect environmental quality. Unfortunately, NEPA never ordered agencies to study the environmental impact of carbon dioxide (CO_2), the greenhouse gas associated with global warming.

Anthropogenic global warming – warming caused by human activities – comes from the CO_2 generated by burning carbon-based fuels, principally coal, oil, and natural gas, along with deforestation and soil erosion.

CO_2 is also produced by natural sources. In fact, natural sources of carbon dioxide are more than 20 times greater than those produced by human activity. However, naturally occurring CO_2 is removed from the atmosphere by plant and forest growth (photosynthesis), as well as by the oceans where CO_2 is dissolved and converted to carbolic acid. As a result of this natural balance, geologists find that carbon dioxide levels remained steady for the 10,000 years between the end of the last ice age and the start of the industrial revolution (about 1750).

Human activity has upset that delicate balance. CO_2 concentrations have increased by 40% since 1750, according to an article published in 2016[3]. In fact, current CO_2 concentrations are above anything experienced on Earth during the last 800,000 years, according to reliable data that has been extracted from ice cores[4].

Energy-saving technology has reduced per capita carbon dioxide emissions since the first Earth Day. Total emissions are higher, however, because of population growth. This could have been avoided had the 1970 environmental law ordered Congress to study the impact of its own actions – especially the immigration laws that dramatically increased U.S. population growth.

As highlighted below, our liberal immigration policies have triggered a massive transfer of population from countries with comparatively low per capita CO_2 emissions to one of the highest per capita CO_2 emitters in the world. A more rational immigration policy would help reduce, if not reverse, the impact of U.S. population growth on the global environment.

POPULATION GROWTH AND CLIMATE CHANGE

Many environmentalists still argue that Americans need focus only on reducing pollution and consumption in order to curb environmental degradation. They are right to push for less consumption and increased energy efficiency, but wrong to assume such efforts can replace a reduction of our population. A growing population can overwhelm improvements in energy efficiency and emissions abatement. Indeed, over most of our recent history reductions in energy use per capita and per dollar of GDP have failed to offset the increased numbers of "capitas." Over the long run, energy use and CO_2 emissions have risen steadily due to population growth.

Ecologists use a simple formula to illustrate impact of human activity on the environment:

$$I = P \times A \times T$$

In the so-called "IPAT" equation, I (the Impact of human activity) is the product of three factors: P (total Population), A (Affluence, as measured by GDP per capita), and T (the Technology used to produce the goods and services measured in GDP).

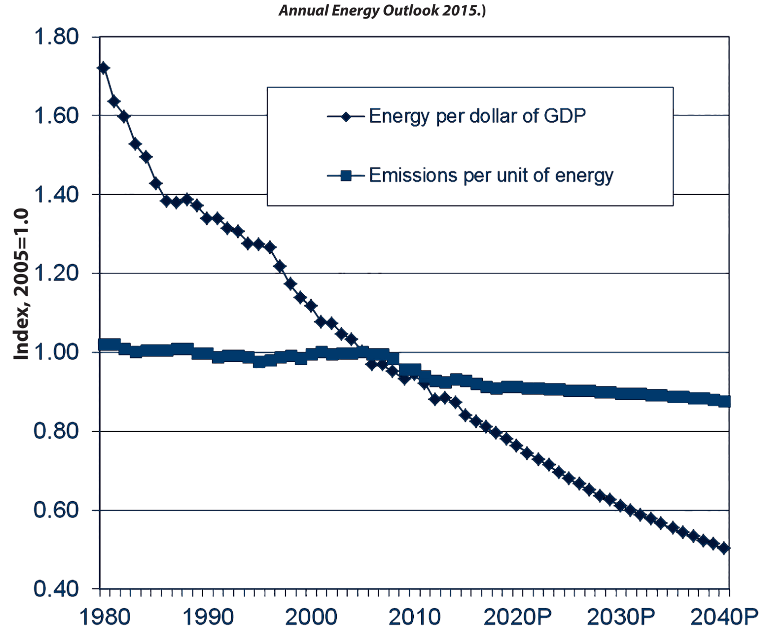
In the particular case of climate change, the following variation of the IPAT equation has been suggested[5]:

$$CO_2 \text{ emissions} = P \times (\text{GDP/population}) \times (\text{energy/GDP}) \times (\text{emissions/energy})$$

The CO_2 equation tells us that while population is important, it is by no means the only factor driving emissions. Affluence, as measured by GDP per capita, also matters. The wealthier we become, the more "stuff" we buy – and that stuff (whether cars, houses, vacations, etc.) is produced by burning fossil fuels that emit CO_2 into the atmosphere. All other things equal, a rapidly-growing economy will generate more CO_2 and other greenhouse gases than a slowing or shrinking economy.

But all other things are never equal. Over the past four decades, population has increased steadily while the other three factors in the equation have either stumbled or are in long-term decline. Affluence, measured by GDP per capita, fell sharply in the Great Recession of 2008-09 and has not attained its pre-recession growth rates. The last two factors in the CO_2 equation – energy usage per dollar of GDP and CO_2 emissions per unit of energy usage, which together comprise the T (or Technology) component – have also declined, reflecting advances made in energy-saving technology as well as structural changes in the U.S. economy.

Fig. 1 **Energy per dollar of GDP and Emissions per unit of Energy, 1980 to 2040P**
(P=projection; Source: Energy Information Administration, *Annual Energy Outlook 2015.*)



From 1980 to 2014, total energy use increased from 78 quadrillion BTUs (quads) to 98 quads, an increase of 26%. Over the same period, however, real U.S. GDP increased by

149%[6]. As a result the energy/GDP ratio – often called the "energy intensity" of the economy – declined by 49% from 1980 to 2014, and is projected to fall by another 42% by 2040[7].

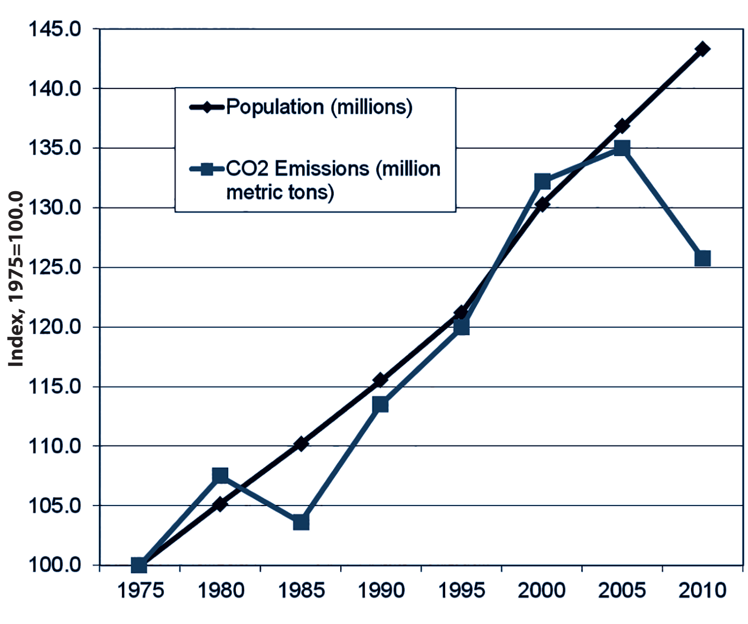
Reduced energy intensity is the result of many small and large efficiency gains since 1980, among them: a 25% improvement in fuel economy of passenger vehicles; a nearly 40% reduction in industrial energy use per unit of industrial output, a more than 25% reduction in energy lost in our electricity power grid, and a 70% reduction in energy used by new clothes washers. About 40% of the entire energy intensity decline is due to shifts in the U.S. economy away from energy intensive sectors (e.g., heavy manufacturing) towards services such as health care[8].

By comparison, the fall in what we might call "emissions intensity" – CO_2 emissions per unit of energy – has been fairly small: about 10% since 1980, projected to fall by another 6% from 2014 to 2040. The main factors influencing emissions intensity include substitution of natural gas for coal in electricity generation, the increased use of renewable energy, and improved emissions control systems in U.S. automobiles.

The upshot is that per capita CO_2 emissions have been roughly flat or falling over the last four decades. If U.S. population had stabilized during that period, CO_2 emissions would have remained unchanged or even declined. But that was not the case: U.S. population rose from 216 million in 1975 to 318 million in 2014, a gain of 102 million or 47%.

Figure 2 depicts growth in U.S. population and total CO_2 emissions from 1975 to 2010.

Fig. 2 **Growth in U.S. Population and CO_2 Emissions, 1975 to 2010**
(Source: DOE, Energy Information Administration.)



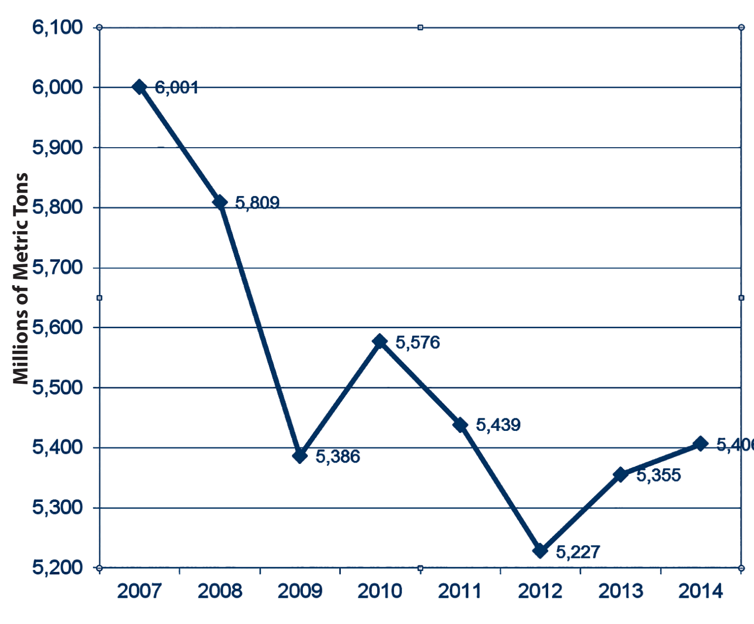
Population and CO_2 emissions moved more or less in tandem until the last several years, when CO_2 emissions fell as a result of the Great Recession of 2008 and its lingering after-effects. This decline in the A, or Affluence, component of the IPAT equation is unlikely to continue. Eric Larsen, a research scientist at Princeton University's Energy Systems Analysis Group, writes:

> **"Recent declines in carbon emissions are the result of a combination of factors including the recession, increased natural gas production and the related decline in coal fired electricity generation, continuing improvements in efficiencies of energy use, and growth in renewable, particularly wind, power. The recession, however, appears to be the most significant factor in the decline. Consequently, as the economy rebounds the fall in emissions is likely to be neutralized or overtaken by growing population and incomes… In the face of such growth… modest improvements in energy efficiencies and expansions of lower carbon energy alternatives will not provide the level of change in the energy economy needed for carbon emissions to fall by 2050 to a level that most climate scientists believe is needed to avoid severe impacts of climate change[9]."**

Bearing out Larsen's prediction, emissions ticked up in 2013 and 2014, the latest years of available data.

Although emissions remain below pre-Great Recession levels, future population growth will inevitably reverse the CO_2 downdraft. The latest Census Bureau projection – published in December 2014 – shows U.S. population reaching 416.8 million in 2060. That is 98 million, or 31%, above the population reported for 2014.

Fig. 3 **CO_2 Emissions, 2007 to 2014**
(Source: Energy Information Administration. http://eia.gov/environment/emissions/carbon.)



Immigration will account for about 65% of all population growth over this period. By the 2050s, as much as 82% of annual population growth will be from this component[10].

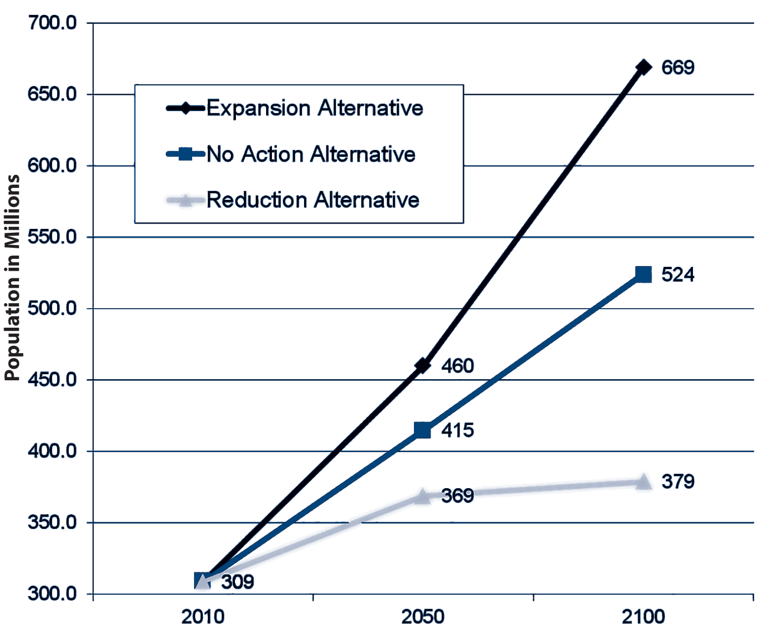
POPULATION DRIVES CO_2 EMISSIONS

Progressives for Immigration Reform (PFIR), a Washington, DC-based organization devoted to immigration policy in the interest of American workers, has published an extensive study of the impact of immigration on U.S. population growth and the environment. The impact of U.S. CO_2 emissions on global climate change is one of the issues explored in their report[11].

The PFIR study is, in effect, an Environmental Impact Statement (EIS) for U.S. immigration policy. As part of their EIS, PFIR analysts developed three population projections corresponding to three reasonable immigration scenarios for the period 2010 to 2100:

- **The No Action Alternative** keeps immigration levels about where they are now, 1.25 million per year (legal and illegal immigration combined).
- **The Expansion Alternative** increases immigration by 1 million per year, to 2.25 million annually. This corresponds to the levels proposed under the so-called "comprehensive immigration reform" championed by the Obama Administration and the Gang of Eight in the U.S. Senate. Population more than doubles – reaching 669 million in 2100 – under this scenario.
- **The Reduction Alternative** reduces immigration by 1 million, to 0.25 million (250,000) per year. This is close to more traditional levels which prevailed before the 1965 Immigration Act triggered mass immigration into the U.S.

Fig. 4 **U.S. Population Under Three Immigration Scenarios, 2010 to 2100**
(Source: PFIR EIS.)



The No Action Alternative would lead to a U.S. population of 524 million in 2100, an increase of 70% above the 309 million of 2010. Predicting CO_2 emissions for the year 2100 under this – or any – immigration scenario is, of course, next to impossible. Accuracy depends on predicting how the three non-population variables in the CO_2 equation above will change over the 85-year projection period. The range of possibilities is daunting:

- **GDP/population** – The per capita income, or Affluence, factor could range from a fraction of what it is today (if the worst case scenarios envisioned by some ecologists and economists come to pass), to more than a four-fold increase (if GDP per capita increases by a mere 2% over the next 85 years). This could easily imply a ten-fold variation between the best and worst economic growth scenarios – far greater than the roughly 2-fold difference between the low and high population projections evaluated in the EIS by PFIR.
- **Energy/GDP** – This is more predictable than the other two non-population variables in the CO_2 equation. As noted above, energy intensity fell 49% from 1980 to 2014, and the U.S. Energy Information Administration (EIA) projects another 42% decline by 2040. It is reasonable to expect this downward trend to continue for the duration of the 21st century, although it will likely level off as technological breakthroughs become more costly and difficult to achieve.
- **CO_2 per unit of energy** – This is the wildcard, because it depends on the mix of energy sources rather than the aggregate amount of energy used. At present about 80% of our energy is derived by burning fossil fuels, which release CO_2 into the atmosphere upon combustion. Less than 20% is comprised of nuclear energy and renewable sources such as hydropower, wind, solar, and biomass. It is inevitable that fossil fuels will increase in price as they become more difficult to find and extract – and, as a result, the share of energy generated by fossil fuels in 2100 will be far lower than at present.

Population is the only factor whose growth is "known" with certainty, because it is fixed in accordance with the immigration and demographic assumptions of the No Action Alternative scenario. As stated above, U.S. population is projected to grow by 70% from 2010 to 2100 under this scenario. In other words, if there were no change in any of the three non-population factors, or if those changes cancelled each other out, CO_2 emissions from the U.S. would be 70% higher in 2100. By comparison, climatologists claim that an **80% reduction** in CO_2 emissions by 2050 – and their **complete elimination** by 2100 – is needed to stabilize Earth's temperature at, say, only two degrees above pre-industrial levels[12].

At present, about 25% of global CO_2 emissions come from the U.S. If the rest of the world embraced the No Action Alternative, the planet would face average warming of four degrees Celsius or more by 2100, according to the PFIR study.

What would happen in a four-degrees-warmer world?

- A sea level rise of 20 to 39 inches by 2100 (this is in addition to a rise of several feet in coming centuries, which is already locked in place by past warming).
- Existing water scarcity would worsen in many regions, particularly northern and east Africa, the Middle East, and South Asia. In Africa, entire countries will face water shortages.
- Wildfires and species extinction on an unprecedented scale. The loss of biodiversity that would accompany a four-degrees-warmer world would drive the Earth's ecosystems to a condition **"unknown in human experience[13]."**
- An increase of about 150% in the acidity of the ocean – **"a rate of change unprecedented in the known history of the Earth."**
- Coral reefs may stop growing and actually start to dissolve. **"The regional extinction of entire coral reef ecosystems, which could happen well before 4°C is reached, would have profoundly negative consequences for their dependent species as well as for the millions of people who depend on them for protein, income, tourism, and protection from waves and storms[14]."**

Two points need to be made. First, the four degree rise in average global temperature would not be evenly distributed. The largest warming would occur over land areas and would range from 4ºC to 10ºC. Average summer temperatures are expected to rise by 6ºC (or 11ºF) across vast areas of the world, including the contiguous United States. Extreme summer heat waves will become "the new normal."

Second, the accuracy of these projections is only as good as the climate models used to project those changes. Disruptive, large scale changes to the Earth's ecosystem are generally not included in the climate modeling exercises used to develop the models or in impact assessments. A four degree rise in global warming could alter Earth's ecosystem in ways that climate models are incapable of analyzing. Examples include the disintegration of the West Antarctic ice sheet, leading to a more rapid sea-level rise than projected – or a large-scale die-off of the Amazon rainforest, potentially adding substantially to 21st century global warming from the loss of this colossal CO_2 removal mechanism[15].

The cumulative impact of the No Action Alternative is summarized in terms required in federal Environmental Impact Statements:

- **Duration of Impact:** ***Long-term to permanent.*** The duration of the impact on CO_2 emissions and climate change associated with the projected population growth under the No Action Alternative would range from "would likely last for a decade or more" to "indefinite or everlasting, and for all intents irreversible."
- **Extent of Impact:** ***Large.*** The extent of the impact on CO_2 emissions and climate change associated with the projected population growth under the No Action Alternative "would affect a resource on a regional, national, or global scale."
- **Magnitude of Impact:** ***Major.*** The magnitude of the impact on CO_2 emissions and climate change associated with the population growth under the No Action Alternative would be Major, representing a "substantial impact or change in a resource area that is easily defined, noticeable, and measurable, or exceeds a standard."
- **Likelihood of Impact:** ***Probable.*** The likelihood of the impact on CO_2 emissions and associated with the population growth under the No Action Alternative is "more likely than not to occur, i.e., approximately 50% likelihood or higher." While these impacts may be ameliorated partially by the other factors discussed above, it is unlikely that these factors (improved energy and carbon efficiency) would be able to completely offset the adverse, overall effects of population growth on CO_2 emissions and climate change.

The bottom line:

> **"Overall, the net effect of the No Action Alternative on CO_2 emissions and global climate change would be adverse, significant, and long-term[16]."**

The same dire conclusions apply to the Expansion and Reduction scenarios in PFIR's EIS. 85 years of cumulative population growth – no matter how large or small – will have devastating effects on global climate. The brutal reality is that <u>a prolonged period of negative population growth</u>, combined with the replacement of fossil fuels with renewable energy sources, <u>may be required to reduce CO_2 emissions</u>.

The Reduction alternative offers one ray of hope, however:

> **"…under the Reduction alternative, in contrast to the No Action and Expansion alternatives, it would be far more feasible for the United States to make a constructive contribution to the global partnership urgently needed to address the climate predicament[17]."**

ALL IMMIGRANTS ARE NOT CO_2 EQUAL

Over the long run, U.S. population growth is the most important factor in CO_2 emissions emanating from this country. Whether a new immigrant or a baby born to a U.S.-born mother, the number of children the new arrival chooses to have is far more important to 2100 climate than whether he or she recycles, bicycles to work, drives a hybrid vehicle, or sets the thermostat high or low.

In this sense, the act of immigrating is no different from the act of giving birth: both add a new source of future CO_2 emissions from this country. Of course, had immigrants remained in their home countries they would have still produced some CO_2, but their output would have been far less. Immigration to the U.S. represents a large-scale transfer of population from countries with comparatively low per capita CO_2 emissions to one of the highest per capita CO_2 emitters in the world.

Table 1. CO_2 Emissions Per Capita: U.S. vs. Top 20 Countries of Origin of Immigrants, 2013

	Metric Tons per Person	U.S. as Multiple of Each
United States	**17.08**	**1.0x**
Mexico	3.87	4.4x
China	6.40	2.7x
India	1.98	8.6x
Philippines	0.91	18.8x
Dominican Republic	2.14	8.0x
Cuba	2.36	7.2x
Vietnam	1.58	10.8x
South Korea	12.97	1.3x
Colombia	1.54	11.1x
Haiti	0.20	85.4x
Jamaica	4.81	3.6x
El Salvador	1.03	16.6x
Nigeria	0.56	30.5x
Pakistan	0.76	22.5x
Canada	16.98	1.0x
Ethiopia	0.10	0.10
Nepal	0.16	106.8x
United Kingdom	7.61	2.2x
Iran	8.00	2.1x
Burma	0.24	71.2x

Source: Top 20 countries of origin as ranked in DHS, *Annual Flow Report, 2013*, Table 3; CO_2 Emissions from EIA, International Energy Statistics; 2013 population from Population Reference Bureau, 2013 World Population Data Sheet

The Table shows that most of the top countries of origin of U.S. immigrants have far lower per capita CO_2 emissions. This is not surprising, since most immigrants come here to improve their standard of living – the A, or Affluence, factor in the IPAT equation – and this generally entails a higher level of energy consumption and CO_2 emissions than if they had stayed home. Per capita CO_2 emissions in the U.S. in 2013 were 4.2 times the average for the rest of the world (17.1 versus 4.1 metric tons). As a result, immigration to the U.S. has an immediate impact on global CO_2 emissions.

This is not saying that new immigrants immediately generate as much CO_2 as the average American. Income matters. There is a strong positive correlation between income and emissions. High-income Americans consume more fossil fuels than low-income Americans. They are more likely to own a car, live in unattached houses that take more energy to heat and cool, commute from distant suburbs, travel by airplane, and purchase goods and services with substantial energy embodied in their manufacture, production, and delivery. Low-income Americans and immigrants are more likely to live in apartments or other group quarters, carpool or take public transportation, travel less, and buy fewer consumer goods.

No governmental energy data source disaggregates U.S. CO_2 emissions into the parts generated by native-born citizens and those generated by immigrants. However, a study by the Center for Immigration Studies (CIS) used income differences as a proxy for differences in per capita emissions of the two groups[18]. Their conclusion: immigrants earn about 85% as much as the average person (native-born and immigrant) living in the U.S. Applying this percentage to the 17.09 metric tons of CO_2 generated by the average American in 2013, and multiplying by the 41.3 million immigrants living in the country that year, we estimate that immigrants generate about 600 million metric tons of CO_2 annually – or about 11.1% of the U.S. total of 5,402 million metric tons in 2013. This is somewhat below their share of the population due to their lower average income.

It is useful to put the immigrant CO_2 number into context. 600 million metric tons is roughly equal to the combined 2013 emissions of Argentina, Venezuela, Colombia, Chile, Ecuador, and Bolivia. It also equals the CO_2 emitted by the United Kingdom, Ireland, and Sweden together.

If the 41.3 million immigrants living in the U.S. were a separate country, they would rank 9th in CO_2 emissions – behind China, the United States, India, Japan, Russia, Germany, South Korea, and Iran.

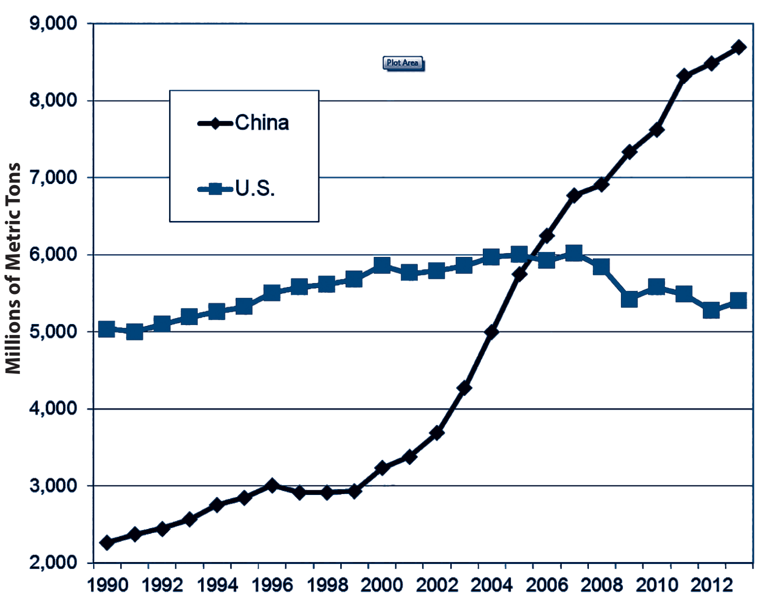
Had they remained in their country of origin and emitted CO_2 at the average rate for persons in those nations, we estimate their CO_2 emissions in 2013 would have been only 167 million metric tons. This represents a reduction of 433 million, or 72%, below the 600 million tons they emit in this country.

The net impact of U.S. immigration on global CO_2 emissions – 433 million metric tons in 2013 – represents 1.3% of that year's global emissions, and 3% of the increase in global emissions since 1980. By contrast, the 41.3 million immigrants living here in 2013 represented only 0.6% of the Earth's population.

CHINA OVERTAKES THE U.S.

In 1990, China was a largely rural country on the cusp of an historic economic transformation. Its aggregate CO_2 emissions that year were less than half of ours; on a per capita basis, they emitted less than one-tenth as much. By 2006, a mere 16 years after the western-style economic program was inaugurated, China's annual CO_2 emissions passed that of the U.S. In 2013 (latest available data), China emitted 61% more than the U.S. – 8,687 million versus 5,402 million metric tons of CO_2. China now generates more CO_2 than the U.S. and Europe combined.

Fig. 5 **Changing Places: CO_2 Emmissions from U.S. and China, 1990 to 2013**
(Source: DOE, Energy Information Administration.)



For years China denied culpability in global warming, insisting that the vast bulk of greenhouse gases were generated by western countries whose industrializations long preceded its own. This may have been a valid point at one time – but no longer. China is poised to surpass the U.S. as the main cause of man-made global warming. Based on data presented in Figure 5, we estimate that China's cumulative greenhouse gas emissions since 1990 – when governments first became aware of climate change – could outstrip those of the United States in 2014, or at the latest 2015.

The IPAT equation can help explain why these two powerhouses are on such different greenhouse gas trajectories. In Table 2, we see the growth rates of P (Population), A (Affluence), and T (Energy technology) for the U.S. and China over the 1990 to 2013 period.

Although China's population in 2013 was about four times larger than the U.S., our population grew at a significantly faster rate over the 1990 to 2013 period – 26.4% versus 18.2%. More importantly, the average American generated nearly three times as much CO_2 than his Chinese counterpart – 17.1 metric tons versus 6.4 metric tons in 2013. For the U.S., population growth was the most important factor driving CO_2 emissions over this period.

By contrast, affluence (A) – as measured by GDP per capita – is the prime driver of Chinese emissions. Since 1990, China's real per capita GDP rose by a whopping 1,144% – 30 times the 37.7% rise in U.S. per capita GDP over that period. Thanks to the Great Recession, U.S. per capita GDP actually declined by 0.2% from 2007 to 2013; while China's rose by an enviable 79%.

Of course, much of China's prosperity depends on the amount it exports to the U.S. A weak U.S. economy may impel many U.S. consumers to buy cheap goods from China – think Walmart, the nation's largest importer. At the same time, imports from China exacerbate U.S. economic weakness, lowering GDP, employment – and CO_2 emissions.

Thus while U.S. immigration – the importation of people from abroad – increases global CO_2 emissions, foreign trade – the importation of goods from abroad – is likely to decrease global emissions. The CO_2 emitted in the course of transporting Chinese goods to the U.S. is undoubtedly considerable.

Both countries have invested in energy saving technology (T), as evidenced by the declines in energy intensity (energy usage per unit of GDP) and CO_2 per unit of energy. China, however, has reduced both usage and emissions by larger percentages than we have over the 1990 to 2013 period. In absolute terms, however, China is still the bigger energy hog. In 2013 China used 10,242 BTUs of energy per dollar of GDP, and emitted 74 million metric tons of CO_2 per each quadrillion BTUs of energy consumed. Corresponding numbers in the U.S.: 7,028 BTUs per dollar of GDP, and 56 million metric tons of CO_2 per each quadrillion BTUs of energy.

Economists find that life-threatening pollutants increase during the early phase of a country's economic development, and fall when per capita income exceeds a certain level. The threshold income varies from country to country – but in general, the relationship between per capita income and per capita pollutants is shaped like an inverted "U." CO_2 is different, however. People do not die from it immediately. Its health and environmental impacts take decades, or even centuries, to manifest themselves. For China, and most developing countries, the positive correlation between per capita income and per capita CO_2 emissions is likely to persist for the foreseeable future. As a result, the U.S. share of global emissions is likely to continue falling.

As stated before, U.S. immigration is the wildcard. Under current immigration policies (the No Action Alternative), **U.S. population is projected to rise to over half a billion by 2100** – just 84 years from now. That will make it difficult for America to reduce its total CO_2 emissions, and – more importantly – difficult for us to persuade China and other less developed countries to do likewise.

CONCLUSION

When it comes to global warming, U.S. environmentalists have focused on policies aimed at curbing new sources of fossil fuels, increasing the efficiency with which fossil fuels are used, and encouraging the use of renewable fuels such as wind, solar, and battery power. They have studiously avoided the "demand" side of the energy equation – the role U.S. population growth plays in increasing the demand for goods and services, which require energy.

Per capita CO_2 emissions are significantly higher in the U.S. than in most other countries in the world. A growing population can overwhelm improvements in energy efficiency and emissions abatement. Indeed, for most of our recent history, reductions in energy use per capita and per dollar of GDP have failed to offset the increased demand for energy brought on by population growth.

Over the long run, U.S. population growth is the most important factor in CO_2 emissions emanating from this country – and immigration is likely to be the main determinant of how fast our population grows. We must, therefore, enforce responsible immigration policies which dramatically reduce our annual admissions – and enact national population policies which work to slow, halt, and eventually reverse our population growth. Only then can we hope to lessen – let alone reverse – our nation's contribution towards global climate change.

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17. PFIR, *op. cit.*, page 3-218.
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