Short Research Article

Transportation Energy Opportunities to Reduce Greenhouse Gas Emissions

ABSTRACT

Weather affects almost all modes of transportation in a modern society, and likewise, transportation has an enormous impact on the weather. Transportation infrastructure is planned, constructed, maintained, and functions according to local weather and climate conditions. Transportation is vital to the global economy; however, it is a major source of greenhouse gas (GHG) emissions. The scientific community agrees that an increase in atmospheric concentrations of greenhouse gases is directly correlated to the gradual rise in global temperatures, resulting in a wide array of related climatic disturbances. The ramifications of such intensification are debilitating for the transportation industry in general along with the daily lives of those people who depend on it. This paper examines the relationship between transportation and climate change and considers available energy policy opportunities to reduce the human impact on these two inextricably linked elements of modern society.

Keywords: Transportation, Energy, Policy, Climate Change, Greenhouse Gases

1. INTRODUCTION

Climate change is expected to further intensify tropical storms and cause more frequent outbreaks of violent weather along with the associated high winds and extreme precipitation. Heavy and prolonged rains result from disturbances in the upper atmospheric flow and are capable of flooding extensive geographic areas. Even when small streams overflow their banks, the result is localized urban flooding of transportation infrastructure. Heavy rains also lubricate unstable slopes and initiate mass-wasting events causing debris avalanches and mudflows which can inundate coastal and mountain highways. As abnormally hot days become more frequent, asphalt roadways are subjected to softening while concrete highways undergo joint buckling creating hazardous conditions for motorists. Railroads tend to warp and buckle as well during significant heat events sometimes causing train derailments. Airports experiencing extreme temperatures are more likely to undergo high-density altitude conditions, which affect aircraft engine performance causing reduced lift, longer takeoff rolls, and sometimes runway closures. This phenomenon is especially prevalent at high altitude airports where the air is less dense already. Increasing temperatures also have numerous indirect impacts on transportation and the associated infrastructure. Sea levels are projected to continue rising at an accelerated pace accompanied by higher storm surges and flooding. More major seaports along with the connecting roadway and railway facilities will likely be inundated. Likewise, airports located along coasts are at risk of diminished operations due to rising waters and might require expensive protection measures in the near future.

Aircraft accidents are more negatively affected by high winds such as those that accompany severe thunderstorms which can be strengthened by unstable conditions resulting from extreme surface heating. The National Transportation Safety Board (2010) reported that

between 2003 and 2007 there were 8,657 aviation accidents. Weather was a cause or contributing factor in 1,740 of these accidents. The study identified the following weather conditions as causes or contributing factors to weather-related accidents: wind, visibility/ceiling, high density altitude, turbulence, carburetor icing, updrafts/downdrafts, precipitation, icing, thunderstorms, wind shear, thermal lift, temperature extremes, and lightning. The weather condition most often cited as a cause or contributing factor in accidents was wind, followed by visibility/ceiling and high density altitude, respectively. As climate change and the resultant increase in severe weather events affects aircraft operations, the Federal Aviation Administration, pilots, and air traffic controllers continue to attempt to improve aviation safety. The Bureau of Transportation Statistics (2013) reports that from November 2012 to November 2013 weather accounted for 53 percent of all National Aviation System flight delays, and that during the same time period more than 94,000 flights were cancelled. The ripple effect from flight delays, diversions, and cancellations across the system can be dramatic. The Intergovernmental Panel on Climate Change (IPCC) (2007) notes that a single flight cancellation can cause 15 to 20 delays while the decision to divert a flight can result in as many as 50 flight delays.

2. TRANSPORTATION IMPACTS ON CLIMATE CHANGE

While comprising just five percent of the global population, the U.S. releases 23 percent of the world's carbon dioxide (CO_2). With its rapid economic development, China surpassed the U.S. in terms of total CO_2 output in 2006. However, according to the United Nations (2014) the per capita CO_2 emissions of the U.S. greatly exceed those of any other nation. The transportation sector consumes more than two-thirds of U.S. oil and accounts for approximately one-third of U.S. carbon dioxide (CO_2) emissions. Transportation adds greenhouse gases to the atmosphere by burning gasoline, diesel fuel, aviation gas, and jet fuel. Any engine that burns fossil fuel re-releases the carbon that was stored in fossil rock as CO_2 into the atmosphere. Carbon dioxide has been referred to as the main culprit in global warming. In contrast with trends in emissions from other sectors of the economy, greenhouse gas emissions from transportation continue to rise, in large part because travel growth has outpaced improvements in vehicle energy efficiency. Transportation, in all its forms, emits approximately one-third of the total carbon dioxide (CO_2) in the United States, and motor vehicles account for almost one-quarter of these emissions according to the Energy Information Administration (2014). There are only three countries whose total CO_2 output from all sources combined is greater than just the transportation sector in the U.S. While other gases are more potent greenhouse gases, the smaller amounts in which they are released results in less overall warming. Hydroflourcarbon-134a (HFC-134a), for example, has replaced the ozone-destroying chlorofluorocarbons (CFCs) as a coolant in vehicle air conditioners. However, HFC-134a is 1300 times as potent a greenhouse gas as is CO_2 based on studies conducted by the Union of Concerned Scientists (2014).

When calculating transportation emissions, the Environmental Protection Agency (EPA) uses the term mobile sources which includes both transportation sources and non-transportation sources, such as equipment used for construction and farming. Of the fossil fuel used in mobile sources, CO_2 accounts for 95 percent of the GHG emissions. Other GHGs resulting from fuel combustion are methane (CH4), nitrous oxide (N2O), and the HFC emissions that are used as refrigerants. The emissions from the transportation sector have increased each year by approximately 2.0 percent since 1990, while those from the other economic sectors increased by about 0.8 percent annually during the same period. Emissions from cars have not increased as rapidly as those from locomotives and other highway vehicles, such as light trucks and sport utility vehicles (SUVs), and emissions from domestic flights have grown relatively slowly according to the EPA (2013).

Aviation is responsible for only two percent of the CO_2 emissions worldwide while contributing to eight percent to the global GDP, and in terms of CO_2 emissions from all modes of transportation, aviation accounts for approximately 13 percent, as opposed to road transport which emits 75 percent of that total. During the last decade, fuel and carbon efficiency improved by 20 percent according to the International Air Transport Association (2013) in its industry-wide strategy to address climate change. The airline sector is banking on a 25 percent reduction in fuel consumption by 2020 through measures already available. However, even the combined effects of enhanced fuel efficiency, improvements in the air traffic routing schemes, and more advanced airframe and engine technologies will not be offset by the projected growth of global air traffic of five percent annually for the next decade (Paylor, 2005).

3. ENERGY POLICY OPPORTUNITIES

In light of the finite supply of oil as it is used presently, myriad players in the transportation industry are researching technologies that conserve fuel, that use alternative energy supplies, and they are investigating the development of infrastructure and attitudes that promote reductions in both the number and distance of commutes. In accordance with the United Nations Framework Convention on Climate Change, the United Kingdom reduced greenhouse gas (GHG) emissions by 12.8 percent returning to 1990 emission levels (Hammon, 2006). Sweden, has a developed a comprehensive model for a sustainable transport system to be fully implemented by 2050 that includes energy efficient vehicles, urban planning, and increased Information Technology (IT) service networks (Ackerman & Hojer, 2006).

Several states and cities in the U.S. have taken the initiative to cap their emissions of greenhouse gases. The U.S. Mayors Climate Protection Agreement, initiated by Mayor Greg Nickles of Seattle, has been responded to by at least 227 mayors across the nation. These cities, home to approximately forty-four million Americans, have agreed to reduce greenhouse gas emissions to seven percent below 1990 levels in the near future by improving their mass transit systems, encouraging ride sharing, building bike lanes and trails, curbing urban sprawl, and improving sidewalks (Larsen, 2006). Portland Oregon, the first U.S. city to develop a global warming action plan, has succeeded in increasing public transit use by 75 percent since 1990. A new major light rail line was built and the central city streetcar was reinstated. City workers receive free parking if they car pool and free monthly bus passes, and businesses are encouraged to subsidize public transit commutes just as they do employee parking. Portland also has 430 kilometers of bikeways which it plans to increase two-fold in the next decade. Traffic signals were converted to LED bulbs that have decreased energy use by 80 percent saving the city $500,000 each year, and Portland is currently researching the feasibility of powering all its city facilities with wind energy (Larsen, 2006). There is no shortage of innovative ideas or technical solutions. However, neither is there a shortage of those who have vested interests in maintaining the status quo. Rajan (2006) writes that to reduce emissions to the extent necessary over the next decades, technological, economical and political solutions must be supplemented by land use and life style changes that reduce car dependence.

There are numerous technological solutions to decreasing CO_2 output. By reducing emissions from cars and trucks, new jobs would be created in the automobile industry, Americans could save billions of dollars by buying less gasoline, and our dependence on foreign oil would diminish leading to greater national security. Federal governments can also mandate increased fuel efficiency for all vehicles coming off the assembly line. Over the past decade, corporate average fuel economy (CAFE) standards stagnated and provided loopholes for certain vehicles. Along with the relatively low cost of gasoline over that same

period, the light truck, minivan, and SUV markets flourished. More gasoline was consumed, so more CO_2 entered the atmosphere. Increasing fuel economy is both cost effective as well as technologically feasible. In addition to strengthening CAFE standards for all vehicles, including pickup trucks and SUVs, there should be increased support for the research, development, and marketing of advanced vehicles. Fuel cells, flex fuels, hybrid electrics, and especially the battery electric cars have enormous potential for reducing global warming pollution. Simultaneously, there should be encouragement to invest, perhaps through tax incentives, in renewable fuels.

4. CONCLUSION

The burning of fossil fuels to power vehicles contributes to a rise in carbon dioxide emissions and an increase in the global mean temperature. In light of the increasing amount of incontrovertible evidence of climate change, people are becoming ever more concerned about contributing to this change and gradually more inquisitive about actions that will curtail carbon output. Few argue that it is time for a climate policy regime that is adopted and enforced by all nations. People are beginning to see the evidence of a warming planet. An antiquated argument states that curbing GHG emissions would hurt the economy, yet the truth is many jobs would be created by an eco-friendly economic structure. In reality, as global citizens, we cannot afford not to address this most pressing of our present problems. The public needs to be diligent about expressing concern to its leadership about the necessity and urgency of developing sound climate policy, and our legislators need to have the foresight, courage, and integrity to plan now to ensure a sustainable transportation future. The more that GHG emissions are reduced and the sooner the reductions take place, the better chance there will be to keep economies viable and life styles comfortable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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