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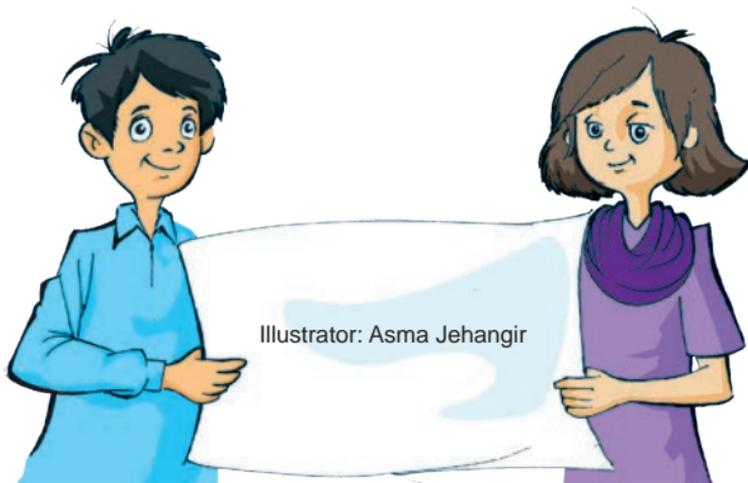


EASY KNOWLEDGE

NO. 6

Smart Transport





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Introduction

When we talk about services and facilities that are important to making a city function properly, than 'transport' is a service that is of critical significance. Urban ground transport includes the key transport infrastructure like roads, sidewalks, bridges, railway tracks, fuelling stations, workshops, car parks etc. Then there are the modes of transport like cars, motorcycles, para transit like rickshaws, wagons, and trucks and buses, trains. Nowadays there is a strong focus on promoting walking and bicycling – modes of mobility that are termed as 'Non-Motorized Transport (NMT).

Modern forms of transport were a by-product of the age of industrialization when for transporting the mass produced goods and growing population, rail systems were introduced and the factory towns or the modern industrial cities were shaped by the automobile. So there was a time when the automobile ruled. Most of the infrastructure like highways, motorways was laid to help movement of the automobile. However, now we are actually discouraging the use of automobiles and instead promoting the use of bicycles and making it more comfortable and appealing for people to walk. Mainly this is because we now know that automobile emissions, primarily carbon, are adding greatly to the greenhouse gases load in the atmosphere leading

to global warming and resultant climate change. So other than making it more convenient to walk and bicycle, we are also transitioning to electric run cars and moving away from cars fuelled by petrol and diesel that are carbon emission sources.

The present publication, that is focussed on raising the awareness and education levels of our youth on smart transportation first looks into the history of transportation – how the mobility modes of the humans changed over time and then focuses on the modern trends in transportation and mobility – smart transportation – becoming part of the smart cities of the future. There is also a discussion on the particular forms of transportation challenges that we face in the major cities of Pakistan.

Farhan Anwar
Editor
June, 2019

History of Transportation

We begin our journey in understanding the history of human mobility from the very beginning. 'Transport' began the mode for human mobility

Throughout history, transportation techniques and technologies have played a vital role in war, trade, cultural development and sport. Though technology has not always developed quickly, transportation is vital to modern life. Without effective and low-cost transportation, it would be extremely difficult for countries to export goods like cars and computers to foreign countries. Likewise, countries that need to import resources like oil, steel and food would be limited to trade with their immediate neighbors.¹

Transport is the way in which things are carried from one place to the other. Today, the sight of a man travelling to space is quite normal but it has taken a long time for humankind to travel like this. How did people and things travel many years ago?

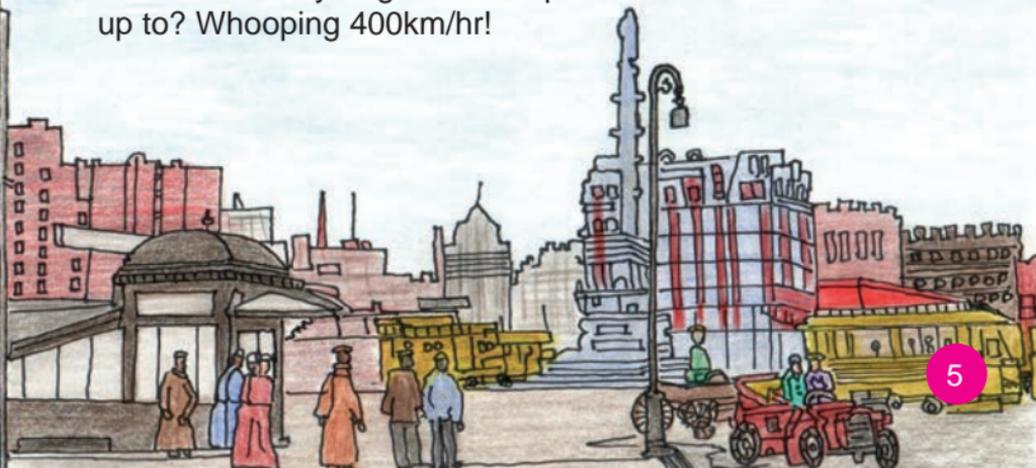
Earliest humans had no fancy transport to travel. So what did they do when they felt the need to travel and explore? They used their legs. Humans and animals walked to travel from one place to other. For faster mode of transport, they used animals to carry things. However, this was a slow process. But this went on for many years until some round

1 The History of Transportation: An Introduction for Students -History Facts, Study Sheets & Homework Help / By Winston Smith / Homework Help & Study Guides – Bright Hub Education

and spiky was discovered. Can you guess what it was? A Wheel! - The invention of wheel 5000 years ago changed the way people traveled. Coaches drawn by horses were used. This increased the speed of travel to 20 km an hour from a mere 7-8 km per hour. Wheeled carts also meant that heavier loads could be transported over longer distances. Travel became faster than before.

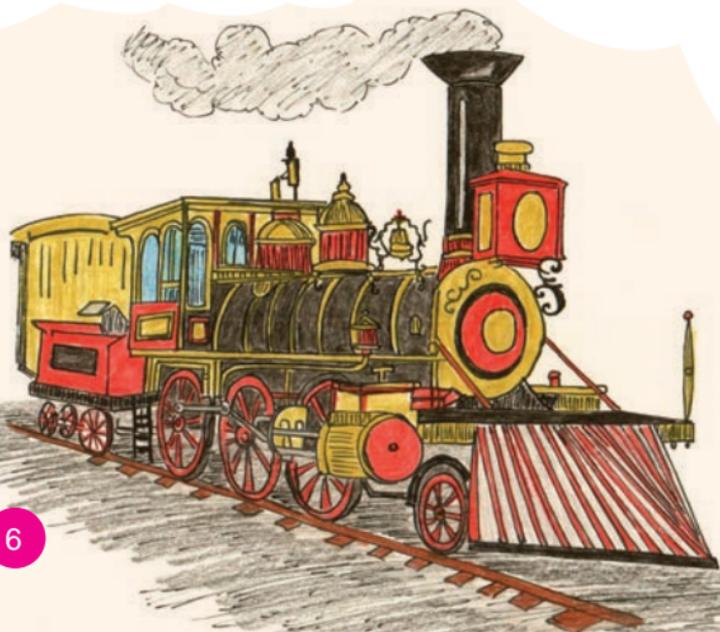
Roads

Slowly the roads were improvised. Coaches or carts were pulled by using pack animals – donkeys, oxen or horses. They were used to transport goods and people. In 1886, a German inventor Karl Benz came up with the idea of motor run wagons. A wagon that carried its own engine or motor that made the wagon run faster and pulled more number of people. This event is often known as the 'birth of the modern automobile'. These wagons were mainly constructed for the transport of people rather than goods. In 1900's, the first commercial motor car 'Model T Ford' was made in America. It was cheap and built in huge numbers. It could reach the speed of 64–72 km an hour. Today, the fastest running car is Ferrari. Can you guess the speed that Ferrari can reach up to? Whooping 400km/hr!



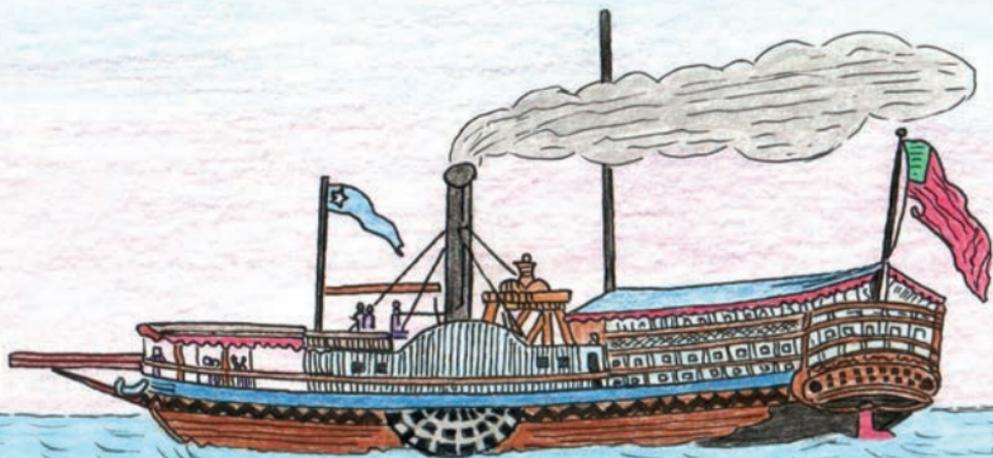
Rail

Why railways? Wasn't road travel good enough? No. Not for the transport of heavy goods in big quantities. Imagine you are living in 1800's. If you had to carry 2000 Kg of coal from one place to other, how would you have done it? That's when the concept of rail took birth. When wheels roll in the grooves on a rail, they requires less energy to run and also run faster than the road transport due to less friction. Thus, railroads became suitable for carrying heavy goods and were faster. Slowly, people also began to travel as it made travel cheaper and quicker. Earliest rails were known as 'Wagonways'. The invention of steam engine gave a historic leap to the rail travel. The first basic steam engine was developed by Thomas Newcomen. In 1781, James Watt created a steam engine that produced continuous rotative motion. This concept was applied in railway locomotives where steam produced from water and coal fuelled the engine.



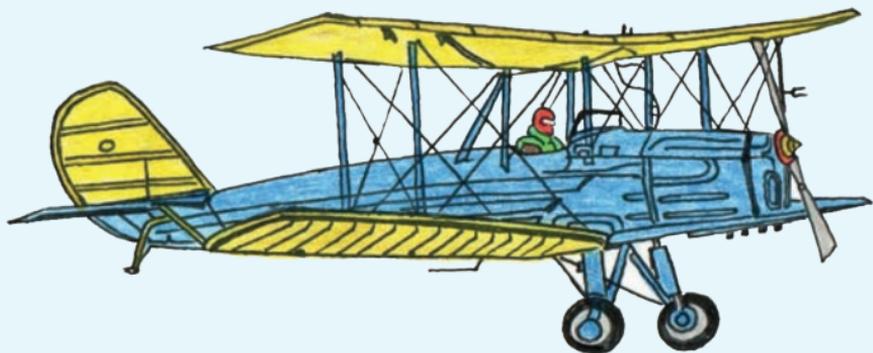
Water

In primitive times, boats were developed to be used in rivers for fishing. Egyptians made boats out of bundles of bound papyrus reeds. Then sail were invented and they used the wind to move the ship. Sailing ships were used to carry cargo for trade. Ships were also used in war.



Air

Your grandmother's grandmother would not have imagined that anything other than birds would ever fly in the air! Can you guess what the first man-made flying objects were? Kites! The famous painter Leonardo da Vinci had conceived the idea of flying machines, but never constructed them. Before aero-planes into being, Montgolfier brothers invented the first hot air balloon. The first aero-plane ever was built by two American brothers, Wilbur and Orville Wright in 1903. The plane called The Wright Flyer was the beginning of air travel.



Space

The first human spaceflight was achieved with the Soviet space program's Vostok 1 mission in 1961. Yuri Gagarin was the first astronaut. Do you know who was the first man ever to step on the moon? Neil Armstrong. So you can see that transportation means have also evolved with the human civilization and it would keep on doing so.²

Early History of Transportation

- **Horses:** Horses have been used for several thousand years to pull wagons, send messengers, and transport soldiers. Horse training and horseback riding technologies like the stirrup (invented in China 2000 years ago; in use in Europe by 700 A.D, stirrups help riders to more easily control their horses).
- **The Compass:** First used by Chinese sailors around 1100 A.D., the compass made navigating ships and traveling long distances much more reliable and safe.
- **Circumnavigation:** As better ships and maps were developed, European explorers embarked on longer voyages. The first known expedition to successfully sail around the world was led by Ferdinand Magellan (1519-1522). Magellan set out on his journey with five ships but only ship returned to Spain; Magellan himself died in a battle during the voyage.

19th Century

The nineteenth century was a great age of transportation advances that would only be eclipsed by the achievements of the twentieth century. The development of steam power, iron clad ships, accurate clocks (needed to determine a ship's longitude accurately at sea), railways and other technologies defined the century. Large steam powered ships carried millions of European emigrants to America, Canada, and Australia. Let's review some of the century's landmark moments in travel technology.

- **Early 19th Century:** Canal building in England and the United States was very popular in the early 19th century. For example, the Erie Canal (completed in 1825) made heavy transportation in New York State much cheaper
- **1825:** The Stockton and Darlington Railway opens in England, the world's first passenger railway. The line covered 26 miles and took more than two hours to complete the journey

- **1869:** The first transcontinental railway is completed in America. The line was completed at Promontory Summit, Utah. Thousands of workers worked on building the railway

20th Century

Aircraft, space ships and cars are just some of the defining technologies of the twentieth century. The automobile changed the configuration of cities in America and around the world. In contrast to the earlier periods, the 20th century is also noteworthy for making travel more affordable.

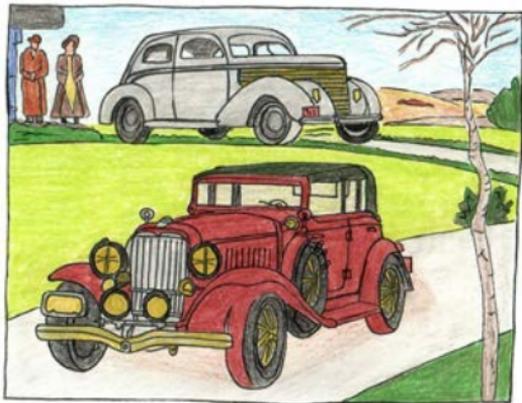
- **1903:** The Wright Brothers conduct the world's very first flight at Kitty Hawk, North Carolina. Aircraft did not become widely available until the First World War when aircraft were used for espionage, attacks and other military purposes
- **1908:** The first Model T Ford automobile is built-in Detroit, Michigan. Various automobiles and cars had been built before 1908, but Ford is generally credited with successfully producing affordable cars in large numbers
- **1927:** Pilot Charles A. Lindbergh completes the first non-stop trans-Atlantic flight from America. He covered a distance of more than 3,600 miles in only 33 hours. Passenger air transportation companies also came into service in this period
- **1961:** Russian cosmonaut Yuri Gagarin becomes the first human being to reach space in the Vostok 1 spacecraft. The first American in space, Alan Shepard, went into space later in 1961

Source: *The History of Transportation: An Introduction for Students -History Facts, Study Sheets & Homework Help / By Winston Smith / Homework Help & Study Guides – Bright Hub Education*

Automobiles Reshape Cities

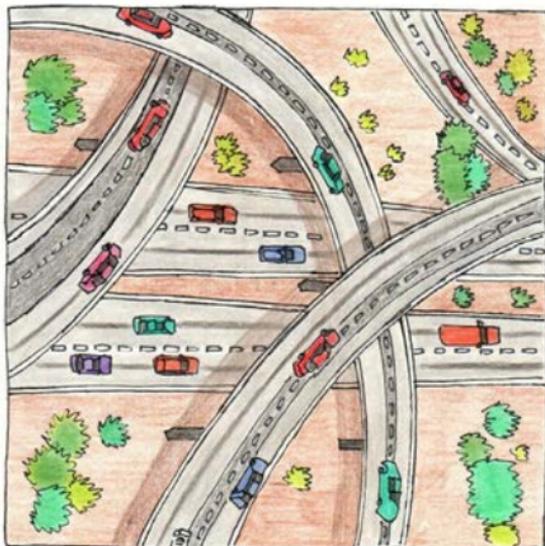
Automobiles cause a few problem also. When the automobile came on the roads in the early 20th century, it of course provided a lot of benefits. Faster mobility and connectivity led to economic growth in the industrial age but there were a lot of problems that were also created. Much of the land in the cities started being used to support automobiles. Streets for the cars to travel on and parking space for the cars to be parked took a lot of the city space. In the post second world war period this increased a lot.

If we take the case of the most car friendly city in the world, the United States of America, a parking study conducted in California stated that about 59 percent of the ground area in Los Angeles' central business district (CBD) in 1960 was devoted to streets and parking. In Detroit (1953), streets and parking made up 49.5 percent of the central city; in Chicago (1956), 40.7 percent; in Minneapolis (1958), 48.3 percent; Nashville (1959), 39 percent; and in Dallas (1961), 41.4 percent.³



3 Automobile in American Life and Society – The Automobile Shapes the City, Martin V. Melosi

So what were activities the streets and parking spaces were replacing that was not such a good thing? People started to walk much less. Spaces became less friendly for walking and for gathering in public spaces because of traffic accident hazards, smoke and noise and also such spaces for mobility



on foot and on bicycles became less as large streets, roads and expressways took over that land. So this was not that good as when you walk, when you gather in road side parks, markets and eateries it enriches the social and cultural life of the city and then walking and bicycling is a healthy activity also!

However, one more very scary problem was being created about which early on no one realized or had much knowledge! The automobiles, and other motorized forms of transportation were polluting the air we breathe in and causing global warming – that we now know leads to climate change – which is the most deadly challenge facing humanity now. In the next section we now understand climate change and how motorized modes of transportation are contributing to increase in global warming and climate change.

Climate Change and Transportation

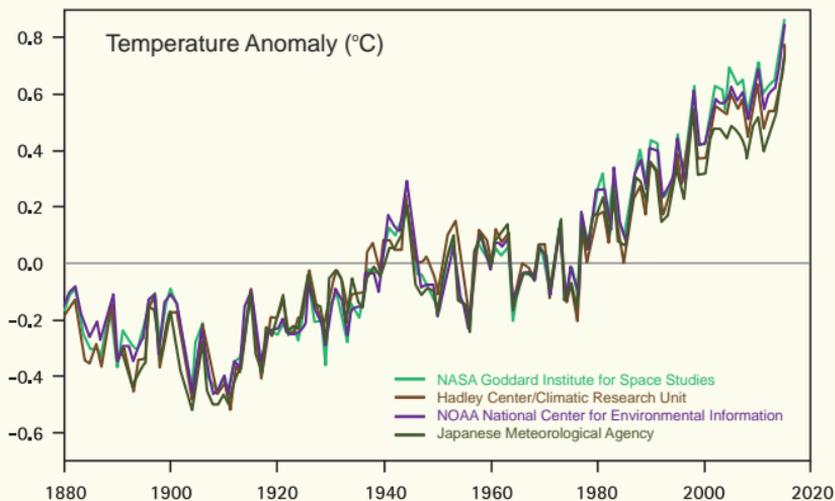
This section looks at understanding how climate is changing, its implications for humankind and what role the transport sector is playing in altering the global climate

The Climate is Changing

The recently published (October 08, 2018) UN Report, Global Warming of 1.5 C, prepared by the Inter Planetary Commission on Climate Change (IPCC), paints a grim picture on the scale and implications of climate change. In this report, leading climate scientists of the world have warned that there is only a dozen years for global warming to be kept to a maximum of 1.5C, beyond which even half a degree will drastically worsen risks of sea level rise, drought, floods, extreme heat and poverty for hundreds of millions of people. The Report states that 'Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate (high confidence). Warming greater than the global annual average is being experienced in many land regions and seasons, including two to three times higher in the Arctic. Warming is generally higher over land than over the ocean.'⁴

4 Talking Sense, Climate Change – An Easy Introduction, Farhan Anwar, 2018, Friedrich Naumann Foundation

The Temperature is 'Rising'



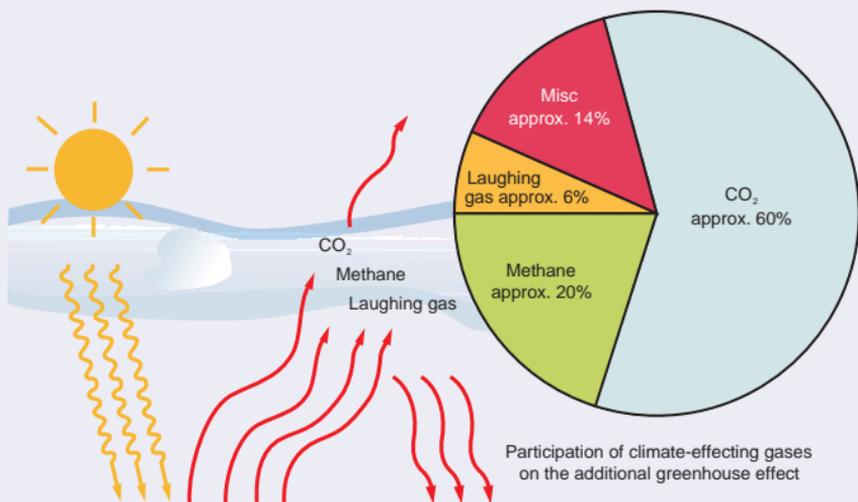
This graph from NASA shows changes in global temperatures over the years. The different lines show the data collected by separate research centres.

The 'Green House' effect

Trace gases such as water vapor, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (laughing gas N₂O), and ozone (O₃) though only show up in very slight amounts in the earth's atmosphere, have a substantial impact on climate: all have the similar effect as 'glass windows' do in a 'green house'. They allow sun ray of shorter wavelengths to pass, while filtering longer wave lengths of radiant energy by partially hanging the sun rays after reaching the surface. These gases are therefore known as 'green house gases' (GHGs). They are responsible for the natural 'green-house effect' that keeps the earth's average temperature at about 15°C – without them about - 18°C. The natural greenhouse effect is what makes life on earth possible by providing protection from the loss of heat and the functioning of the 'carbon cycle' has provided a good part of this protection. However, human activities of the modern age have now significantly enhanced the concentrations of GHGs in the atmosphere. This is referred to as an 'additional' or 'manmade greenhouse effect'. With regard to this, carbon dioxide plays a key role. Its participation in the man-made greenhouse effect is placed at approximately 60% of the overall effect of the contributing gases. As a consequence, Earth's natural capacity to maintain the appropriate balance of the carbon cycle is diminishing, resulting in global changes in average temperatures.⁵

5 Talking Sense, Climate Change –An Easy Introduction, Farhan Anwar, 2018, Friedrich Naumann Foundation

The Additional Greenhouse Effect



Source: *Information on the Topic of Climate: Fundamentals, History and Projections (2005, Allianz Foundation for Sustainability)*



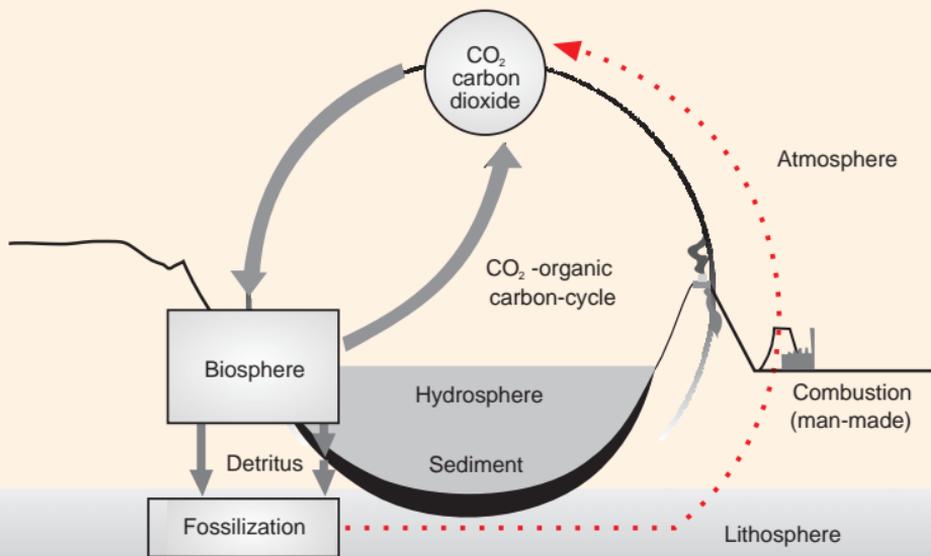
Industrial revolution – key ‘Trigger’ to global climate change

The most significant ‘trigger’ that has caused carbon levels to expand exponentially, thus disturbing the natural ‘carbon cycle’ and resulting in altering of the global climate at a pace never seen before has been the ‘industrial revolution’ – onset being the start of the 19th century (an increase of about 100 parts per million since the dawn of industrialization has led to a dramatic alteration of both the carbon cycle and the climate system). The industrial revolution, driven by the extraction and use of ‘fossil fuels’ (oil, gas and coal) linked with industrial emissions, deforestation and changes in land use has led to a build-up of GHGs in the atmosphere, while at the same time there has been a reduction in the capacity of oceans and vegetation to act as natural ‘sinks’ by absorbing GHGs. Approximately three quarters of the manmade increase in CO₂ has resulted from the burning of fossil fuels.⁶

6 Talking Sense, Climate Change –An Easy Introduction, Farhan Anwar, 2018, Friedrich Naumann Foundation

Carbon Makes a Comeback!

At the beginning of the 20th century the technical and economical development as well as the increasing population drove energy consumption higher and higher. This energy consumption is, to a great extent, covered by fossil fuels. Owing to this factor, carbon, which was once taken out of the atmosphere and bonded into underground storages, found its way back again into the atmosphere in the form of CO₂.



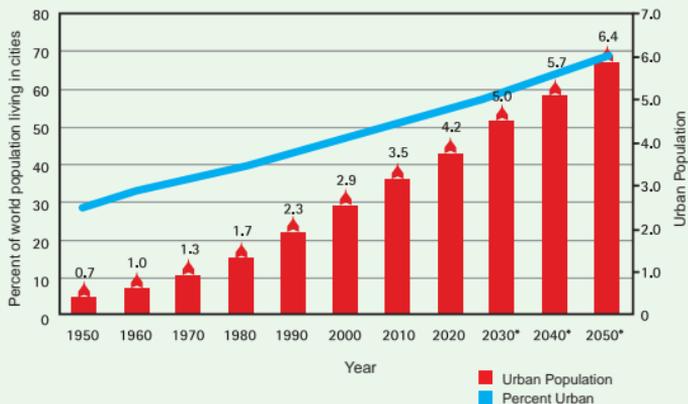
Source: *Information on the Topic of Climate: Fundamentals, History and Projections* (2005, Allianz Foundation for Sustainability)

Climate Change and Urban Context

The connection between cities and climate change is critical to an understanding of how human activities are contributing to global warming and on how cities, while being the major contributors to climate change, also serve as our best hope of finding solutions to tackling this challenge. 'Large cities take up only 2% of the Earth's land mass, but they are responsible for about 75% of the heat trapping greenhouse gases that are released into the atmosphere.'⁷

Urban Population in Asia (1990-2025)

Figure 6
People Living
in Cities
(percentage of
world population
and total)



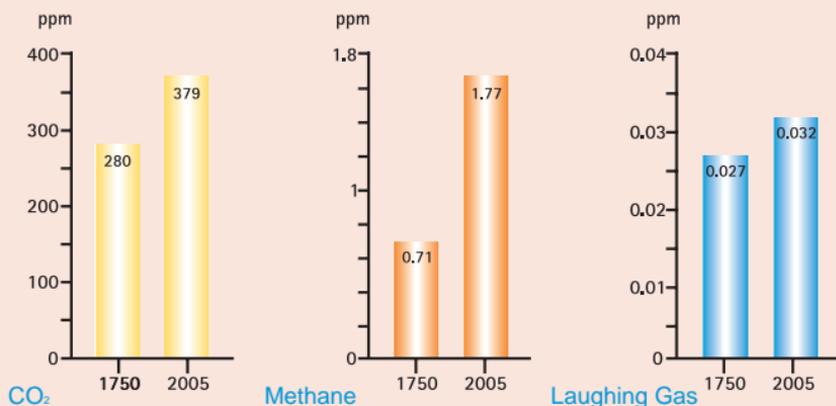
Source: UN, Department of Economic & Social Affairs, Population Division.

Globally, 55% of the population lives in urban areas today, and this trend is expected to continue – by 2045, the number of people living in cities will increase by 1.5 times to 6 billion, adding 2 billion more urban residents. By 2050, 68% of the world's population will be urban.⁸

The main sources of GHG emissions from urban areas are related to the consumption of fossil fuels. They include energy supply for electricity generation (mainly from coal, gas and oil); transportation; energy use in commercial and residential buildings for lighting, cooking, space heating, and cooling; industrial production; and waste'.

The 'Contributors'

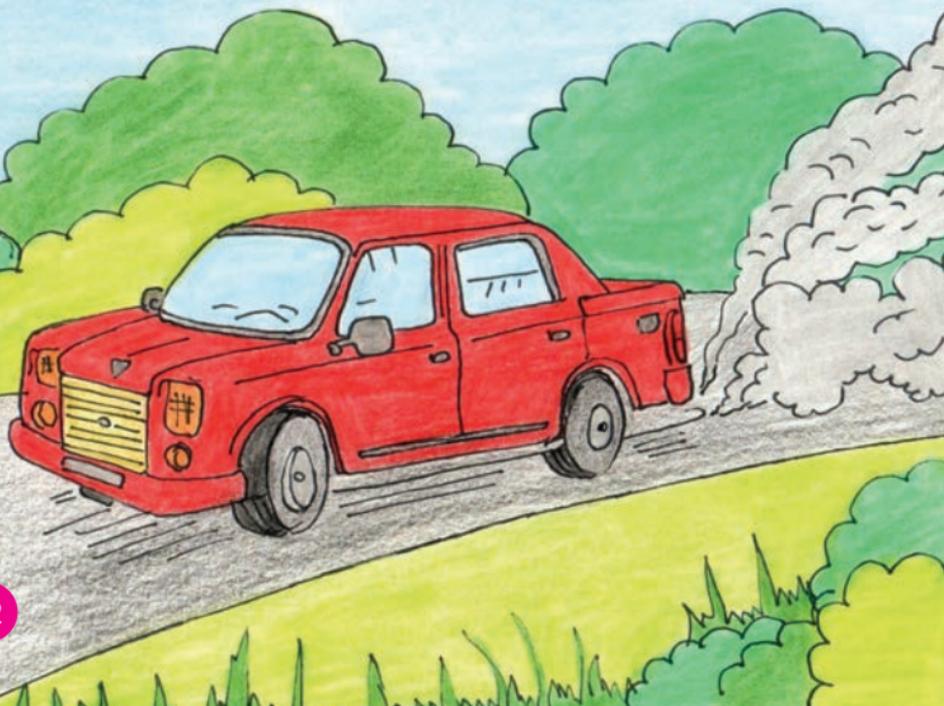
Changes in the concentration of climate-influencing gases



Source: (Source: IPCC, 2007)

Transport and Climate Change - What is Car Pollution?

Did you know that there are more than 246 million cars in the United States? While cars are a wonderful luxury that people are lucky to have, they are also responsible for car pollution, which is a type of air pollution. Car engines release poisonous gases that pollute the air, especially the extremely harmful greenhouse gas called carbon monoxide. Carbon monoxide can cause people to get really sick or even die. In fact, 80% of lung diseases are a result of car pollution. It is easy for children to get sick from carbon monoxide, so make sure that you are not in a place where you are breathing in the gases from a car.



Effects on the Environment

Car pollution causes instant and long-standing effects on the environment. One major effect on the environment is its effect on global warming, which is the gradual increase of the Earth's temperature. If global warming is not controlled, it will be difficult for plants, animals and even humans to live on planet Earth. Have you ever sat too close to a fire and started to get too hot? You would probably want to back away from the fire. If global warming gets out of control, it would be like that, except you would not be able to back away.

Another effect that car pollution has on the environment is acid rain. Acid rain is a very dangerous form of rain that is formed when poisonous gases are blown into the sky, mixes with the clouds and poisonous rain comes out. Acid rain can kill plants, destroy animals that live in lakes or rivers, and can contaminate our water.

Common Air Pollutants

Carbon dioxide and carbon monoxide are the primary air pollutants produced by a car. Carbon dioxide is a greenhouse gas that keeps solar radiation trapped within the atmosphere. Carbon monoxide is a poisonous gas that can lead to health problems, because it prevents blood from carrying oxygen to vital organs of the body.

Pollution Rates

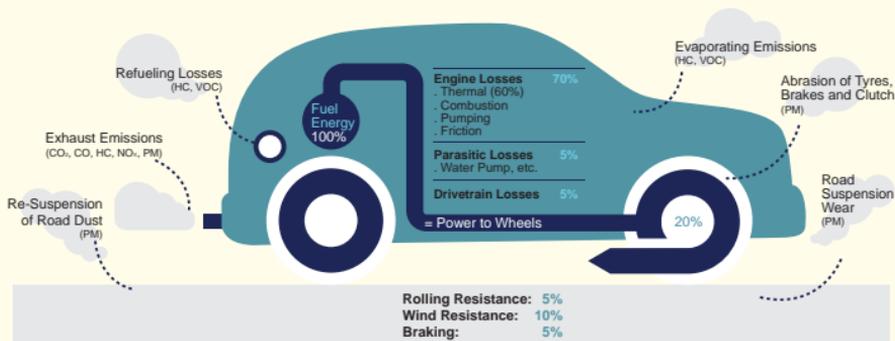
Cars release approximately 333 million tons of carbon dioxide into the atmosphere annually, which is 20 percent of the world's total, according to the Environmental Defense Fund. Motor vehicles also contribute 72 percent of the nitrogen oxides and 52 percent of reactive hydrocarbons. Burning fossil fuels to power our vehicles gives off CO₂ emissions, which is the leading cause of global warming. The United States is the world's highest producer of these harmful gases. Burning fuel can also produce toxic substances such as sulfur dioxide and carbon monoxide (which can be fatal). Ozone appears when hydrocarbons and nitrogen oxide -- two common ingredients of air pollution -- come together. Sunlight causes a chemical reaction that makes the combination especially potent and dangerous, resulting in general respiratory problems such as wheezing and shortness of breath, as well as nausea and headaches. What's even more worrisome is that repeated exposure can cause irreversible lung damage and increase the risk of lung cancer.

Sitting in traffic has a bigger impact on your health than you may think. As tempers flare and stress levels simmer, all the pollution being generated by neighboring vehicles can actually seep into your car's cabin, creating a concentrated solution of toxic air. As the air recycles through the car, the toxins can reach levels of up to 10 times those found in normal city air. These pollutants, which are sometimes referred to as particulate matter, are absorbed by the lungs, and can cause problems with the respiratory system, the

heart, asthma, lung cancer and various other infections. Exposure to particulate matter pollution can also result in decreased life expectancy. Diesel vehicles are the worst offenders, responsible for 79 percent of vehicle-oriented particulate matter pollution.⁹

Vehicle emissions and efficiency

Fossil fuel powered road transport represents the most significant source of transport related air pollution. Each vehicle releases pollutants from a number of sources.



(*) The drivetrain of a motor vehicle is the group of components that deliver power to the driving wheels. This includes the transmission, the axles and the wheels.

HC - Hydrocarbons; VOC - Volatile Organic Compound; PM - Particulate Matter; CO - Carbon Monoxide; CO₂ - Carbon Dioxide; NO_x - Nitrogen Oxides

Source: EEA Report — Explaining road transport emissions — a non-technical guide (2016)

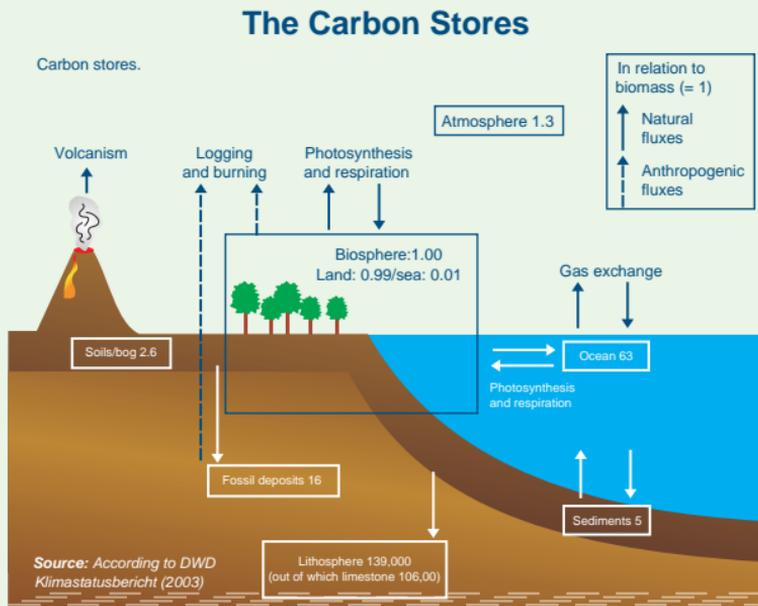
Car Pollution Facts!

Air pollution is a serious issue this day and age. Here are 10 car pollution facts we should all learn from in order to move on and improve the world. Although car pollution has decreased drastically in the last ten to twenty years, it's still fairly significant in terms of pollution levels. The switch from leaded to unleaded gasoline has arguably made the biggest difference, but unleaded gasoline is by no means perfect.

- Cars pollute the air in several, different ways. Out of three main forms of pollution, namely air, ground and water pollution, air pollution is by far and away the most dangerous one. Cars pollute all three forms, causing serious environmental issues and problems
- Over half of all carbon monoxide pollution in the air (around 51 percent) is caused by cars alone. It also contributes greatly to smog pollution
- Cars also contribute to around 34 percent of nitrogen oxide and all volatile organic compounds in the environment. In addition to increasing smog, both substances cause serious harm on the plant life as well as a human's respiratory system
- The most lethal air pollutant, carbon dioxide, is the biggest factor when discussing global warming. A staggering 31 percent of all CO₂ in the atmosphere comes from cars alone
- The particulates which originate from car exhausts contribute to the creation of more clouds, but weirdly, less rain. Less rain equals less wind. In a way, cars have a significant impact on the amount of wind power available as well
- The harmful exhaust gases aren't the only thing cars can and do pollute the air, water and ground with. Brake dust, oil, dirt and gasoline, all play their role in pollution originating from cars. All of them can end up in the water that we drink and the air that we breathe via the runoff.
- Most people don't realize it, but noise pollution is no laughing matter. Not only is it sometimes annoying and inconvenient, but large amount of noise pollution can cause various hearing problems

Global Warming

Car pollution is one of the major causes of global warming. Cars and trucks emit carbon dioxide and other greenhouse gases, which contribute one-fifth of the United States' total global warming pollution. Greenhouse gases trap heat in the atmosphere, which causes worldwide temperatures to rise. Without greenhouse gases, the Earth would be covered in ice, but burning excessive amounts of fossil fuels, such as gasoline and diesel, has caused an increase of 0.6 degrees Celsius, or 1 degree F, in global temperatures since pre-industrial times, and this will continue to rise over the coming decades. Warmer global temperatures affect farming, wildlife, sea levels and natural landscapes.



Source: Information on the Topic of Climate: Fundamentals, History and Projections (2005, Allianz Foundation for Sustainability)

Air, Soil and Water

The effects of car pollution are widespread, affecting air, soil and water quality. Nitrous oxide contributes to the depletion of the ozone layer, which shields the Earth from harmful ultraviolet radiation from the sun. Sulfur dioxide and nitrogen dioxide mix with rainwater to create acid rain, which damages crops, forests and other vegetation and buildings. Oil and fuel spills from cars and trucks seep into the soil near highways, and discarded fuel and particulates from vehicle emissions contaminate lakes, rivers and wetlands.

Human Health

Particulate matter, hydrocarbons, carbon monoxide and other car pollutants harm human health. Diesel engines emit high levels of particulate matter, which is airborne particles of soot and metal. These cause skin and eye irritation and allergies, and very fine particles lodge deep in lungs, where they cause respiratory problems. Hydrocarbons react with nitrogen dioxide and sunlight and form ozone, which is beneficial in the upper atmosphere but harmful at ground level. Ozone inflames lungs, causing chest pains and coughing and making it difficult to breathe. Carbon monoxide, another exhaust gas, is particularly dangerous to infants and people suffering from heart disease because it interferes with the blood's ability to transport oxygen. Other car pollutants that harm human health include sulfur

dioxide, benzene and formaldehyde. Noise from cars is also harmful, damaging hearing and causing psychological ill-health.¹⁰

10 Effects of Car Pollutants on the Environment, 2019, Sciencing



Our Transport Woes!

If we look at the transport system in the major cities of our country, Pakistan, then things are pretty bad! We rely heavily on private automobiles and have inefficient public transport systems. Private automobiles that are also not very well maintained release emissions that cause health hazards such as respiratory illness and also increased psychological stresses. Noise pollution is another serious health hazard. Then as mentioned earlier, carbon is one of the major greenhouse gas causing global warming and climate change. Accident hazards increase due to heavy traffic. There is increased congestion on the roads that other than further raising the pollution levels also results in loss of time and energy. Ever increasing numbers of motor cycles are also causing similar kind of problems.

Those that can't own cars are at a great disadvantage as

we do not have proper public transport system (buses/trains) and no spaces for people to walk or bicycle. Since the limited number of buses are incapable of meeting the demand, they are often overloaded



with passengers that makes for a very bad quality of travel experience and increases risks of accidents happening. Our sidewalks are encroached in many ways. Vendors do business there, shopkeepers and restaurants extend their activities on the sidewalks, there can be garbage, fixed generators, even cars and motorcycles parked and all this makes it almost impossible



to walk on what are actually public walking spaces. Often there are cases of people falling in manholes as covers are missing. Streets are not well lighted which makes walking even more dangerous during the night. As a result, people



walk on the roads exposing themselves to accident hazards. Then in many cases, we don't have shady trees, or canopy covers, benches on sidewalks that can make it comfortable



for people to walk, particularly in the stifling heat of the summers. Similarly, bicycle tracks do not exist and it is very difficult and dangerous to bicycle on the busy streets with unruly heavy traffic all around you.



Nowadays, globally there is a strong push to promote walking and bicycling that are termed as Non-Motorized Transport (NMT). However, we are yet to give consideration for promoting NMT in our urban transport planning.

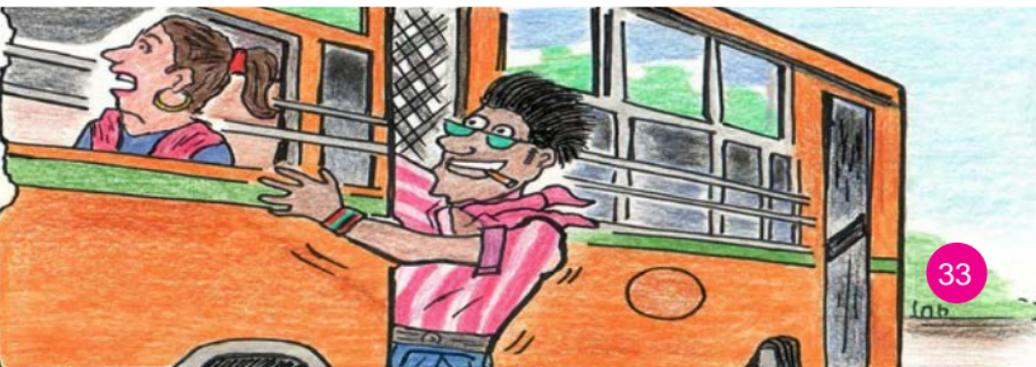
Then there is no consideration for differently abled people – about their mobility needs. There are no ramps on our sidewalks or in buildings and public spaces for people in wheel chair to mobilize. People who are visually impaired also cannot mobilize. We do not provide sidewalks with



'tactile tiles' installed that facilitate the mobility of visually impaired people. We also do not have braille imprinted way finders. Car riders often do not observe important traffic rules such as stopping at zebra/pelican crossings for pedestrians that makes crossing of roads a highly dangerous and risky exercise. When you design streets, public spaces and buildings for improved accessibility for pedestrians – elderly, women, children, and differently abled people, than such spaces are called 'Universally Accessible' spaces. We are yet to focus on this extremely important aspect of mobility and transport planning to make our transport systems inclusive.



Women also are vulnerable and disadvantaged when it comes to accessing public transport. Our buses have very limited spaces for women and also they at times face issues of harassment. Therefore their mobility and thus productivity is constrained and reduced.



Smart and Climate Friendly Transportation

The realization that climate change is a threat to the future of humankind, has led to a rethink in how we design, plan and run cities. Sustainable, smart, green, and resilient cities are now the future. Here, we are promoting mixed, integrated neighborhoods and walking and bicycling supportive streets, walkways and destinations. Climate change phenomenon is resulting in mapping out of a development agenda that aims to interface aspects of social, environmental and economic dimensions of development.

Promoting Walking and Bicycling

Nowadays, cities are being designed to facilitate more walking and bicycling. There are many reasons for that. Greater use of private automobiles is adding to the greenhouse load in the atmosphere causing global warming that in turn is leading to climate change. So automobile use is being discouraged and cities are being designed in a way that destinations, particularly at the neighborhood level are at a walkable distance – that means about a 5 minute walking distance. For example, the city of London, United Kingdom, by the year 2041 would become 80% walkable, meaning 80% of the city will have streets and spaces designed in a way that they are walkable.

So how do you make a city walkable?

Well you need to have end to end pavements – which we also call sidewalks – on which people can walk. You walk on the sidewalk and when the block ends and you have to cross the road then you have proper pelican and zebra crossings. Sidewalks also need to have benches and shading. Shading can be provided by having shady trees or canopies. Pedestrian level street lights have to be installed to ensure safety. Such streets have proper sign boards (way finders) for direction. Garbage bins have to be placed or installed. In many cases, people design their walls of homes or shop frontages in such an artistic way that walking becomes an experience also. All these assortments that go to make a 'walkable and smart street' are called street furniture and they render the walking experience comfortable, safe and pleasing.



A walkable city has a multitude of benefits. Some are discussed below:

- **Social benefits:** the most obvious are the health benefits that accrue from walking. Then when cities are designed for walking, with gathering spaces and more people are walking and using such places, more interaction happens between people in neighborhoods and in public spaces like market spaces leading to more community bonding. Walkable cities are also known to have reduced level street related crimes.
- **Environmental benefits:** When we walk, we are making a decision not to use our private car or cab thus cutting down on the harmful carbon and other automobile related emissions that results in improved environment.
- **Economic benefits:** There are many economic benefits of walking. Property values are higher in more walkable neighborhoods and districts. Markets that are more walkable and pedestrianized are found to have better sales. Better health from walking also leads to cutting down on health costs. When we don't take out our cars and walk instead, we are also cutting down on car/fuel costs.

It is also very important that streets and public spaces are designed for 'Universal Access' which means people that are differently abled can also access them. For people in wheelchair, access is provided by having ramps at the proper points on the sidewalk. For easing the access of people with visual impairment we provide a special type of

tiles called 'Tactile Tiles', embedded in the sidewalks that have varying designs placed on them that indicate to a visually impaired person using a cane when to keep walking and when to stop – say when a road is reached. Similarly, access is provided to differently abled people in open public spaces and building spaces.

Promoting bicycling!

To promote bicycling we first need to have the proper space created. Bicycles cannot be running in the same lanes as fast moving cars and buses. So we need separate bicycling tracks at the sidewalk level or protected bike lanes on the roadways. The Columbian city of Bogota for example has built more than 300 kilometers of such 'greenways'.



Infrastructure, however, is not just about bike lanes. Bike share schemes around the world have lured both residents and tourists onto two wheels. In Hangzhou, China, the world's largest bike-lending program gives residents free use of a bike for the first hour. To tackle air pollution, the city also bans cars with certain license plate numbers on specific days. However, similar programs.



Bicycle Safety

12 RULES OF THE ROAD

<p>1 OBEY ALL TRAFFIC REGULATIONS!</p> <p>Red and green lights, stop signs, highway directions.</p>	<p>2 KEEP TO THE RIGHT ... FOLLOW TRAFFIC.</p> <p>Always ride in a straight line, never weave in and out.</p>	<p>3 HAVE PROPER LIGHTS FRONT AND REAR.</p> <p>Never ride at night unless you have a white headlamp in front, and state approved red reflector in the rear.</p>	<p>4 HAVE A PROPER SIGNALLING DEVICE.</p> <p>Warn others of your approach with a horn or bell.</p>
<p>5 YIELD THE RIGHT OF WAY TO PEDESTRIANS.</p> <p>Avoid the sidewalks and use care at crosswalks.</p>	<p>6 WATCH OUT FOR CARS.</p> <p>Beware of cars pulling out or doors opening unexpectedly.</p>	<p>7 NEVER HITCH RIDES.</p> <p>Hanging on a moving vehicle while riding is extremely dangerous. Never "stunt".</p>	<p>8 ALWAYS RIDE ALONE.</p> <p>Bikes made for one rider should never carry two — don't overload.</p>
<p>9 CHECK YOUR BRAKES.</p> <p>Be sure they work efficiently and safely without squeek or failure.</p> <p>Added caution must be used in wet conditions, See page 7.</p>	<p>10 WATCH THE INTERSECTIONS.</p> <p>Slow down and look to right and left before crossing.</p>	<p>11 USE HAND SIGNALS.</p> <p>Let the other driver know your intent, use hand signals.</p>	<p>12 NEVER WEAVE OR SWERVE.</p> <p>Unexpected moves cause accidents. Ride safely and watch out for the other rider.</p>

Source: HASTE – Hub for Active School Travel, Vancouver, Canada

Another issue is secure parking for bikes, especially at rail and bus stations. Amsterdam, for example, has a multi-story park house that can accommodate 6,000 bikes. Utrecht Central Station, also in the Netherlands, will soon have the world's largest bike shed, with room for 12,500 bicycles.¹¹

What is Public Transportation?

Public transportation is a form of travel offered locally that enables more people to travel together along designated routes. Typical examples of forms of public transportation include buses, trains, and trams. High-speed rails, airlines, and coaches dominate public transportation between cities.

Various Public Transportation Modes

Bus — Bus transport is one of the oldest and most common modes of transportation aimed at facilitating movement of people within a city or to remote locations. It has the advantage of being affordable and convenient if there is no traffic. The bus services are also required to be accessible to people with disabilities.



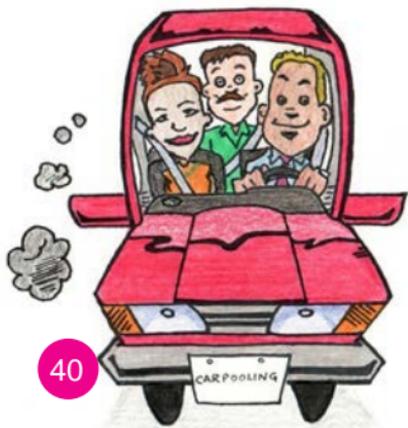
11 How to get a City Cycling, Katia Moskvitch, 2015, BBC Future



Train — Train transportation is rapidly growing. This is evident by the sea of humanity lining up at railway stations to commute to and from work. Most governments are ramping up the growth of this mode of transportation by increasing the number of trains and upgrading existing ones in the busiest routes. These governments are stepping up their efforts because trains contribute immensely to the reduction of traffic congestion and keeping more cars out of roads.

Tram — A tram goes by many names such as tramcar, trolley, trolley car or street car depending on the city you live in. It's a rail vehicle that runs on track built on city streets. They can also run on segregated right of way. The networks or tracks

managed by tramcars are known as tramways. Trams are mostly operated by electricity and are found in large cities where demand for public transportation is high. They are also best suited for large cities because they have the capacity to transport many passengers. A bus, on the other hand, is designed to transport fewer passengers.



Light rail — This is a mode of urban public transport that lies between a tram and train. Light rail operates at higher capacity and travels long distances than a tram. However, it travels slowly than a train and has more stops than a train or tram. It's, therefore, ideal for regional routes with short distances.

Metro systems — Metro systems have the highest performance, speed, capacity and reliability compared to other modes of transportation. They are common in large cities across the world such as New York, London, Rotterdam and so on. Metro systems operate underground, which means they don't interact with normal road traffic. Just like trams and buses, the urban regions and provinces are fully responsible for the safety of people and the metro systems underground.

Benefits of Public Transportation

Economic Benefits

- **Reduces congestion:** Urban congestion is one of the greatest challenges of developed nations. Statistically, Australian cities incur a cumulative annual cost of \$12.9 billion due to traffic congestion. The solution to this nightmare lies in the expansion of public transportation. For instance, a single railway can get rid of 1000 cars from the roads.
- **Increases land value:** Improved access to public transport has shown to increase land and property value. Planning that puts public transportation development on top of its agenda reaps huge benefits

in the long run. Land that would have been used for parking and roads is put to profitable use such as generation of revenue to the city council

Environmental Benefits

- **Ensures a cleaner ecosystem:** Public transportation significantly reduces the number of cars on the road. This means less pollution from motor vehicle emissions. Fumes produced by vehicles can lead to respiratory diseases.
- **Reduces carbon footprint:** Public transportation offers an immediate alternative for individuals seeking to reduce their energy use and carbon footprints. This action far exceeds the benefits of other energy saving household activities, such as using energy efficient light bulbs or adjusting thermostats.

Social Benefits

- **Improves health:** Public transport ensures citizens are at their best health wise by encouraging them to walk to bus and railway stations, at the same time alleviating the stress that comes with driving a car on congested roads. Research learns that every hour spent driving a car increases the possibility of obesity by more than 6%.

While public transportation may not be enjoyable to many like riding in your personal car, it plays a huge role in reducing traffic congestion, minimizing emissions and according you a whole lot of quality time to watch and interact with your neighbors. To add to that, public transportation lets you relax, read newspaper or book,

take a nap during commute rather than experiencing the stress that comes with driving on the busy roads. Enhancing the quality and efficiency of public transport systems is critical to encouraging individuals to change up to public transport.¹²

12 Conserve Energy Future, 2019



Electric Cars

In the more developed countries of the world, cars fueled by petrol or diesel are being replaced by electrically charged cars that have many environmental, economic and climate change related benefits.

Electric cars are greener

Electric cars are greener than internal combustion engine vehicles by a number of key measures, with the exception of the carbon intensity of the manufacturing process (although this will change as economies of scale are achieved through mass production)



Energy Efficiency

Electric cars are far more energy efficient (85-90% efficient) than internal combustion engine cars (17-21%), which means that they use less energy to get you from A to B. Less energy used means less produced, which in turn means less CO₂ emissions produced by non-renewable energy sources and the wider energy supply chain

Exhaust Emissions

Electric cars have zero exhaust emissions, which means they do not emit any harmful exhaust gases or soot in densely populated areas. Likewise, with coal now becoming a small part of the power mix, very little air pollution at all is released from modern power generation.

In contrast, the exhaust emissions from vehicles with internal combustion engines is a significant source of CO₂ that contributes to global climate change and air pollutants that harm people's health at a local level.



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About FNF

The Friedrich Naumann Foundation for Freedom (FNF) was established in Germany in 1958. The Foundation is committed to promoting personal freedom and individual rights, rule of law, market economy and an innovative society with opportunities for all. We have offices in over 60 countries around the world, spanning Europe, Africa, Asia, North and Central America.

We have been working for a peaceful and progressive Pakistan since 1986 - supporting, regional, and national initiatives and awareness campaigns in the areas of climate change, smart cities, rule of law, democracy, digitalization, local governance and engaging different groups including, youth, women, academics, media, public and private sector to have a wide-ranging impact on the society.

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