

Case Study Analysis: Transportation and Land Use

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Abstract

Completely sustainable cities produce zero emissions and use entirely renewable materials and energy. Sustainable urban areas are the key to stopping the effects of climate change.

Transportation and land use in urban areas are two important aspects of a city's infrastructure that contribute to greenhouse gas emissions and material depletion in the world. Encouraging a mode shift from cars to other modes of transportation, such as biking, walking, and public transportation, is one strategy that can help improve the sustainability of urban areas. The City of Spokane can look to the Netherlands to help reach their goals seen in their own Sustainability Action Plan.

Chapter 1: Sustainable Cities

A sustainable city is one that meets the needs of the present without compromising future generations. Something that is sustainable does not pollute the environment or take from natural materials that cannot be replaced. Instead, a sustainable object or practice uses renewable resources that can be recycled and reused and does not produce any emissions that threaten the atmosphere. The threat of global warming has become an important discussion across the planet. The causes of warming are related to the release of greenhouse gases from industries, buildings, and vehicles. As much of the populations in the world are condensed into cities, the largest percentage of greenhouse gas emissions come from these areas (KPMG, 2012). A large amount of infrastructure is built in urban areas, so a pressure is being put on the environment to produce resources for cities (KPMG, 2012). Because of this, the sustainability of urban areas is very important for the future of our planet.

A sustainable city will enhance air quality through reduced air pollution and carbon dioxide (CO₂) emissions. Sustainable practices aim to reduce emissions from the power grid, buildings, and transportation vehicles. Using renewable energy, such as solar, hydro, and wind, is one way to reduce the emissions into the urban environment. Building designs can also focus on being more energy efficient inside the building. Eco-friendly public transportation is another aspect of an urban environment that makes a city sustainable. Motor vehicles are responsible for 75% of carbon monoxide pollution in the United States (The Zebra, 2021). A city can become sustainable by building walkable and bikeable infrastructure to encourage less vehicular transportation. Sustainable cities will also protect natural resources by using reusable or renewable materials when building infrastructure. This includes materials that can be reused at the end of their design life and natural renewable resources such as wood. Using fewer resources is also a sustainable building method. A completely sustainable city will have zero emissions and use entirely renewable materials and energy.

Sustainability starting at a city level as opposed to state and national level is important for a bottom-up approach to climate change and sustainable cities. Sustainability that starts at a city level could allow individuals to be in favor of changes regarding sustainable practices. This is a more favorable approach than the national or state government imposing these changes from the top-down approach. It would be much easier to create sustainability as a state or nation when cities start the approach instead of imposing rules upon a city. Citizens might be more inclined

to work towards the common goal if they are the ones to start the movement themselves. Starting sustainability at a city level is also much easier. Passing laws and bills to create sustainability on larger scale is harder than getting a smaller group of people to agree on sustainable practices. Creating sustainability at a city level first allows much more versatility in an experimental and applicable sense. Sustainability is also different for each city in the United States. Some sustainable practices will not apply to, or work in other cities. This is another reason that a state and national government cannot pass specific sustainability laws. Cities can create their own sustainable practices that work in their own areas. Once cities can agree on sustainability practices within their limits, it will be much easier to extend their ideas to higher levels.

Civil Engineers are very important to promoting more economically, socially, and environmentally sustainable urban practices. They are responsible for designing and building a city's infrastructure. Civil Engineers design public transportation, water and sewage systems, electrical grids, and other basic infrastructure. They are also involved in decisions at the end of infrastructure design life. It is up to them to create infrastructure that has sustainable practices. Environmentally, a Civil Engineer's designs must be energy-efficient, use fewer and renewable resources, and create pedestrian and bike friendly transportation systems. Economically, a Civil Engineer can create a sustainable environment by using materials that won't produce waste, creating a circular economy. Their infrastructure can be used to promote economic growth by connecting cities more efficiently. Some designs, such as water features can also provide recreational opportunities for the economy. Socially, a Civil Engineer can create infrastructure with an infusion of natural resources, like trees and water, that can make residents feel more connected to the environment. This will improve health and well-being of citizens. Infrastructure can produce a higher quality of life for residents. Sustainable infrastructure is the base of a sustainable city and Civil Engineers are the vehicle for creating these sustainable environments.

Sustainable cities are very important for the future health of the planet. Urban infrastructure must be made to produce zero greenhouse gas emissions and use renewable resources and energy. Civil Engineers are responsible for designing, building, and deciding on infrastructure and its design life. Urban sustainability must start being built at a city level so residents may be more inclined to become sustainable. Sustainable practices can be tested in

cities and expanded to higher levels. With the largest percentage of greenhouses coming from cities, creating sustainable urban infrastructure may be the best chance at combating the effects of climate change.

Transportation and Land Use

The sustainability of urban infrastructure may be the solution to reversing the effects of climate change and protecting future generations. Transportation infrastructure and land use are two aspects of urban infrastructure and are both very important to the success of a city.

Transportation infrastructure determines how people and goods around a given area.

Transportation systems influence connection, livability, exercise, and other aspects of a person's life. Effective transportation design will move people and goods in the fastest and most efficient way, without jeopardizing safety and destroying too much of the natural environment.

Transportation design includes any and all ways a person will move themselves from one place to another. Common transportation infrastructure consists of roadways, walking paths, bike lanes, and train paths. Land use is how an area in question is designed to be used. The United States Environmental Protection Agency (US EPA) defines land use as the economic and cultural activities that area practiced at a given place. Land use applies to both private and public land. Some land use designations include agricultural, residential, industrial, mining, and recreational. Transportation and land use work together to create a part of infrastructure. The land use in an area will determine the transportation that is available or needs to be available to access the land. Similarly, the transportation infrastructure available can determine how land can be used or developed. Land use can also restrict the development of transportation in an area.

Transportation and land use play a large role in the sustainability of cities.

Transportation is a prominent factor in air pollution in the world. In the US, the transportation sector accounts for around 27% of the total greenhouse gas emissions, which is the largest contributor (Environmental, 2022). For a city to become sustainable, this number must decrease dramatically. Emissions from vehicles is the main factor that contributes to this number. While electric vehicles and renewable fuel can combat against emissions produced, the transportation infrastructure developed can also help fix the problem. Safe, practical bike and pedestrian paths can be created to encourage and rationalize biking or walking as a replacement to car trips. Bus and train infrastructure can be increased to encourage the use of public transportation as a

reliable form of transportation. If buses and trains can be used to help people get somewhere quicker and easier than using their own car, it will be an obvious choice. This will reduce the emissions that would have been created from a car.

The Netherlands exceeds the United States in walking, biking, bus, and train infrastructure, and comparisons have shown that Dutch citizens use these modes of transportation more often than American citizens in similar sized cities. Figure 1 shows a statistic shown in Lucas van der Linde's presentation for MSC Urban Planning.

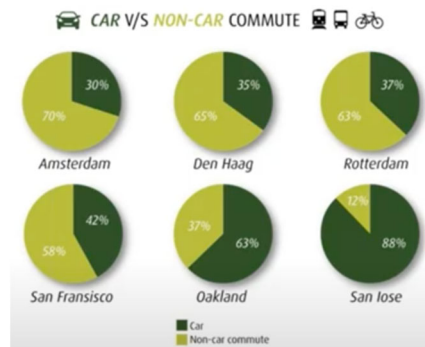


Figure 1. Car vs. non-car commutes in notable cities

The US can look at the Netherlands and see that building transportation infrastructure that discourages the use of cars will yield the results they are looking for. Improved transportation infrastructure in cities will increase the sustainability of a city immensely.

Land use also plays a role in the sustainability of a city. It can affect air quality, water quality, waste production, wildlife, climate, and health. As stated earlier, land use affects transportation and can also help to limit transportation emissions. If land is urbanized, vehicle trips will increase and create more air pollution. If land is developed it immediately creates water pollution. Construction can create impervious surfaces and change how water filters into the ground. The way groundwater aquifers recharge and filter will change. If an area is completely urbanized on a large scale, the entire climate of the area may change, as well as add pollution with emissions and lights. If land is used agriculturally, water pollution will be created from pesticides and fertilizer. Water use in the area will also change due to its needs for the crops. Wildlife may also be introduced and affect the vegetation and other wildlife. If water and air pollution are introduced because of a change in land use, a person's health can be affected.

Land use can also protect an area from development. In an urban environment, parks can be created to preserve the natural environment. Forests and other natural areas can be protected. This will improve air quality, water quality, climate, and health. Land use has a large impact on how sustainable a city can be.

The city of Spokane created its own Sustainability Action Plan (SAP) with multiple “Areas of Action.” One area they are focusing on is transportation and land use. Spokane highlights their goal to make livable neighborhoods for all people by minimizing impacts on the environment and promoting equity in developments. A few of their specific goals include supporting all modes of transportation in all neighborhoods, promoting walkable neighborhoods, and expanding green spaces. Spokane also has the goal of creating zero carbon emissions from vehicles by 2050. Their plan can be seen in Table 1 where their reduction goal is shown every decade.

Table 1. Spokane emissions goals

Sector Level GHG Targets: Transportation & Land Use

Vehicle Type	2016 Baseline		2030 Reduction Target 45% & 948,958 MT		2040 Reduction Target 70% & 1,476,155 MT		2050 Reduction Target 95% & 2,003,356 MT	
	Metric Tons CO ₂ e	Percent of Total	Metric Tons CO ₂ e	Percent Reduction	Metric Tons CO ₂ e	Percent Reduction	Metric Tons CO ₂ e	Percent Reduction
Passenger, light duty truck, motorcycle	600,227	28%	300,114	50%	60,227	90%	0	100%
City Fleet (also included above)	10,070	.5%	5,035	50%	2,517	75%	0	100%

Spokane’s SAP goes on to state their strategies to reach their goals. Specific goals include advancing land use planning to minimize vehicle miles traveled. Another strategy is to increase transit ridership by increasing frequency, coverage, and operational hours. Spokane also wants to increase walking, cycling, and micro mobility through a prioritization of aspects relating to their networks. They are also working to encourage more sustainable land use to help with climate action. Spokane has the goal of improving their transportation systems to have less vehicle miles traveled, create zero emissions, and put more focus on land use to create a more sustainable city.

The Netherlands has a similar action plan as the City of Spokane. When comparing the Netherlands and the United States, it is clear that the Dutch use their legs, bike, and take transit more often than Americans. The Dutch do not have a specific action plan layed out like The

City of Spokane, but they do have clear goals outlined on their government website. The Netherlands has the goal of reducing greenhouse gas emissions by 95% by 2050. They want to be seen as the leaders in smart cities and connectivity. The Dutch want to construct their infrastructure to ensure less traffic jams, quicker movement, and optimal mobility. This is a long-term goal for them because they want to make sure they do everything correct. Similar to Spokane, the Dutch want to make public transport more accessible, reliable, and efficient.

Transportation and land use is important for creating sustainable cities because it impacts economics, natural environments, and the health of the city. Good transportation infrastructure increases efficiency of the city and can allow better access to all businesses around the city. It could potentially create jobs as well. Land use can determine the economic output of a specific area. As mentioned previously, the transportation system of a city can improve greenhouse gas production from vehicles, and land use determine how much of a natural environment must be lost to create a city. Land use can help protect the natural environment and let it exist in urbanized areas. An efficient and easier transportation system will leave citizens in better moods while traveling and improve their overall mental health. People who don't drive to work every day will experience health benefits from enjoying the fresh air by biking or walking for daily trips. Including the natural environment into land use will improve people's health by making them feel connected to nature and improving air and water quality. A simple park in a city can allow people to get a break from the busy, stressful urban areas. The transportation and land use in a city will affect much more than just how citizens move through the city.

Mode Shifts

In order to meet goals in their SAP, Spokane can look at transportation mode shifts, as well as a change in land use, to encourage sustainable living. Mode shifts could include the removal of car lanes to reduce vehicle miles traveled, or an increase in the adoption of walking, biking, and public transportation by making it safer and more practical. Car lanes can be removed in the most heavily trafficked areas by pedestrians, such as the center of downtown, to encourage more walking and biking. Multiple areas in the Netherlands that utilized this strategy saw a thriving pedestrian culture that was not interrupted by cars. More pedestrian traffic was drawn to these areas. The addition of bike paths and bike "highways" in the Spokane area would also contribute to a mode shift. Bike highways could be used to connect areas such as Spokane

and Spokane Valley. This would allow people to bike between cities efficiently and safely and avoid driving on I-90. Larger, protected bike lanes throughout the city would encourage biking as a way to commute, as seen in the Netherlands. A more connected and frequent public transportation system would be very beneficial to the Spokane area to reduce vehicle miles traveled. A mode shift from cars to other forms of transportation using any of these strategies would immediately reduce vehicle miles traveled in the Spokane area.

Transportation mode shifts to reduce vehicle miles traveled would have a positive impact on the economy, environment, and health and well-being of Spokane. The removal of car lanes in busy pedestrian areas would boost the economy. As seen in the Netherlands, these areas without car lanes produced more foot traffic and allowed easier access into adjacent stores and businesses. If this was implemented in downtown Spokane, pedestrians could access stores and restaurants much easier and boost the economy of the city. These strategies would benefit the environment by reducing emissions. An increase in bike infrastructure and pedestrian only areas would result in less cars on the road. More natural environments could be created in the city where cars once drove. Fountains and greenery could be added to create better air quality and reduce the built environment. The health and well-being of Spokane would also be improved with these strategies. The replacement of car use with pedestrian traffic and bikes would allow people to be outside in the fresh air. This could have a positive impact on mental health and physical health. Less car emissions would keep the air cleaner, and less built environment would lower the temperature of the city on hot days. The strategies outlined would not only reduce vehicle miles traveled, but also positively impact the economy, environment, and health of Spokane.

Conclusion

Sustainable building and infrastructure is very important to the future health of our planet. An emphasis can be put on urban areas where pollution is at its highest and the built environment is the largest. Cities can become sustainable by producing zero emissions and using renewable energy and building materials. Civil Engineering is important to the goal of sustainable cities. Civil Engineers are responsible for designing and building the infrastructure that makes a city sustainable. Transportation and land use are two aspects of a city that greatly affect the overall sustainability. Transportation can dictate a large portion of the greenhouse gas

emissions, while land use determines if an area is part of a built or natural environment. One way the city of Spokane can reach their SAP goal of reducing vehicle miles traveled is by a transportation mode shift throughout the city and surrounding areas. A mode shift will positively impact the economy, environment, and health and well-being of the city. The ideas presented in this paper may help the City of Spokane create a specific plan to become the sustainable city they are striving to be.

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