

Final Report: Sustainable Transportation

CENG 440 Gonzaga in Delft: Sustainable Cities

By Esme Nelson

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Gonzaga University

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Introduction: Cities as Leaders in Sustainability

The past several years has necessitated continual iterations of "sustainability" regarding urban development. The working definition of sustainable development, as first defined by the UN World Commission in 1987, is "meeting the needs of the present without compromising future generations' ability to meet their needs." However, the current commonly used definition has expanded from just human "needs" to human "well-being" (Ayers, 2017). The three pillars of sustainable development (social, economic, and environmental) are all interconnected. To have a sustainable economy, a city needs a sustainable society, and in order to have a sustainable society, a city needs a sustainable environment (Ayers, 2017).

Sustainable cities are also resilient cities. Resiliency is the ability to face challenges and disasters relatively unscathed and retain functionality. This is a critical aspect of being able to meet the needs of future generations, especially considering the current and future impacts of climate change. The pressure that climate change exerts is testing the resiliency of our infrastructure. Cities that practice sustainability not only focus on infrastructure inside the city's limits, but also take a much broader look at the environmental impact of imported goods like energy, food, and water. Cities are part of an interconnected system and cannot be isolated from the rest of the global economy when considering sustainability. When the citizens of a community are more self-reliant and resilient, they are less vulnerable to disruptions in the supply chain (Carucci, Malec and Santini, 2019).

The current state of transportation safety and sustainability is an issue that all nations are facing. Up until 2020, the number one cause of child death in the United States was motor vehicle crashes. Currently, motor vehicle crashes are the second leading cause of death in children (Goldstick et al., 2022). In the US, fatalities per 100,000 users for pedestrians is 59.8, compared to 2.7 fatalities per 100,000 users in the Netherlands (Kello, 2018). Figure 1 shows how many pedestrians (out of ten) that would survive a vehicle collision at 20 MPH, 30 MPH, and 40 MPH. The difference between survival rate at each of these speeds is astounding. Measures need to be taken to make more transportation more safe, efficient and equitable. The necessity of sustainable development is increasingly apparent. Local governments must be an example for citizens, as they "get their own house in order." Implementing more sustainable practices like energy efficient building techniques for city halls and police stations and prohibiting the use of

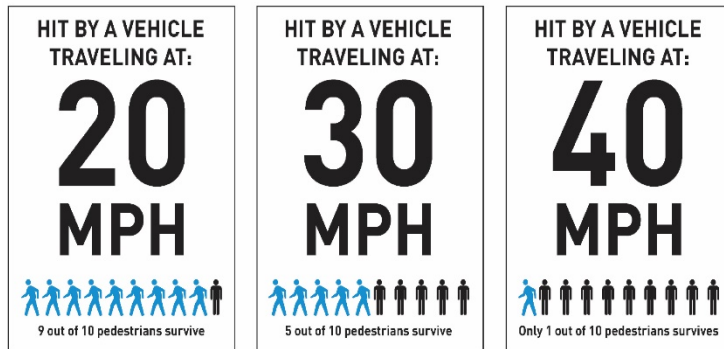


Figure 1. Graphic showing the frequency of pedestrian survival when hit by a vehicle traveling at 20, 30, and 40 MPH. Source: Seattle Department of Transportation

synthetic pesticides in parks and on school grounds are a few ways local governments can lead this charge to their residents. This helps to develop a “pride of place,” where citizens have buy-in in their community.

Policy set forth from the national stage has little immediate bearing on an individual citizen’s life.

Conversely, things like traffic calming measures can make tangible improvements in the livability of a neighborhood quickly. Local governments have the ability to be more agile in their improvements, encouraging regular citizens to be more invested and involved in the sustainability of their city. It is imperative the City of Spokane take purposeful strides towards sustainable leadership in eastern Washington.

This type of development requires the cooperation of not just local stakeholders, but also professionals and organizations. As one of the oldest and most respected professions, civil engineers are responsible for some of the greatest achievements in the built environment. The sacred texts of this long-standing profession are the standards. Some have suggested the standards are to an engineer what the Christian bible is to a priest (Marohn, 2021). Although standards in engineering are important for efficiency and safety, they can no longer be treated as “gospel.” Facing challenges never imagined, engineers cannot cling blindly to the practices of the past just because they served us well. Civil engineers are uniquely suited to frame this sustainable future, only if we are willing to examine the dogma of the last 100 years.

There are countless ways in which civil engineers help develop sustainable urban environments, through projects in the building and energy, transportation and land use, water resources, and waste management areas. These areas all intersect at some point, but this report focuses on how an integrated approach to transportation and land use planning can further sustainability goals and improve the quality of life in the City of Spokane.

The next section of this report will give a brief overview of transportation and land use planning, and how this topic impacts cross-cutting issues mentioned in Spokane’s SAP. Civil engineers

have a duty to protect the health, safety and wellbeing of citizens. It is written in the code of ethics. Why then, is efficiency in moving cars the priority in our transportation systems, rather than safety?

Transportation & Land Use in Sustainable Cities

Transportation demands have grown and are expected to continue to grow dramatically in the next several years (International Transportation Forum, 2019). The adverse effects of living in a society where the use of gas-powered vehicles is firmly stitched into the fabric of our lives are also becoming increasingly evident. One of the main challenges that sustainable cities address is the necessity of becoming low carbon. The natural layer of carbon dioxide and other greenhouse gases in the atmosphere keep the earth warm enough for life. However, excessive greenhouse gas emissions have devastating environmental, economic, and societal implications. Global warming and poor air quality are just a couple of these implications. Typically, when discussing lowering our carbon footprint, fossil fuel-powered transportation is one of the first culprits to come to mind, along with temperature control in buildings. Eastern Washington, much like the rest of the United States, lives in an extremely car-centric society. It is necessary to look at ways to increase sustainable transportation and land use planning in order to meet goals set at state and local levels.

Figure 2 is a breakdown of what makes up the community-wide greenhouse gas (GHG) emissions in Spokane, according to the city's Sustainability Action Plan. Narrowly edged out by "Energy from Buildings" at forty-eight percent, transportation makes up the second largest portion of emissions, at forty-six percent. In Spokane, personal vehicles contribute the most to transportation GHG emissions (Spokane Sustainability Action Subcommittee, 2021). Infrastructure that encourages residents to use alternative modes of transportation must be intelligently

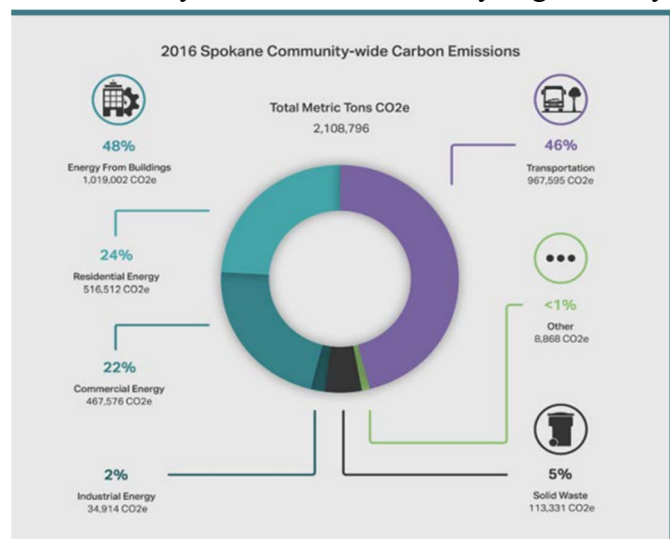


Figure 2. Spokane Community-wide Carbon Emissions in 2016 by category. Source: Spokane's Sustainability Action Plan, 2021.

designed and implemented. The City of Spokane's Sustainability Action Plan includes several goals related to improving the sustainability of transportation in the area. A list of these goals is shown in Table 1.

Spokane's SAP Transportation & Land Use Goals
GOAL 1. Encourage land use policies that support walkable, livable, sustainable communities for all
GOAL 2. Reduce motor vehicle miles traveled (VMT) and promote active transportation modes
GOAL 3. Advance alternative and low carbon fuel in regional transportation
GOAL 4. Integrate Sustainability Action Plan goals, strategies, and actions into City planning

Table 1. List of the Transportation & Land Use goals as stated in the City of Spokane's Sustainability Action Plan

The City's first goal centers around encouraging land use policies that support communities in their journey towards sustainable transportation. This is critical, as policy is foundational to implementing successful design change. The second goal is to minimize motor vehicle miles traveled and promote active transportation. This offers not only environmental benefits, but also physical and mental health benefits for Spokane residents. Reducing the distances traveled by car within a city also has economic advantages. Most of the money that citizens spend on transportation disappears from the local economy. When people spend less on cars and fuel, that money is more likely to stay closer to home (Speck, 2012). When people are driving through a neighborhood at 35 miles per hour, they don't necessarily notice the coffee shop on the corner has live music that day. If someone is on a bicycle, they are much more likely to notice and stop at a local business. The third goal looks at alternative (electric) and low carbon options for regional transportation, and the last goal is to integrate these all these goals into city planning.

This report is the result of one student's participation in Gonzaga University's study abroad program that focuses on sustainability in civil engineering. To gain insight from one of the world's leaders in sustainability, a group from Gonzaga University traveled to the Netherlands to study sustainable cities for several weeks. The Netherlands is an inspiring place to study a multitude of sustainable practices in different disciplines, including water resources, transportation, waste management, and buildings & energy. Many of the techniques the Dutch use can be adapted to help the City of Spokane reach their SAP goals. In the Netherlands, pedestrians and bicyclists are often given the priority in urban areas and city centers. In their short time in the Netherlands, the group of Gonzaga students saw children, elderly, and people in

mobility scooters all using the bicycle facilities. Traffic calming is built into Dutch society and underpins pedestrian and bicyclist safety. The goal of the Netherlands' Sustainable Safety vision is to prevent road crashes and minimize severe injury when crashes do occur. It integrates human behavior and infrastructure design for a proactive and systematic approach to road safety (Kello, 2018). The Sustainable Safety policy is one of the reasons it is convenient and safe to use bicycles as an everyday form of transportation in the Netherlands. This was not always the case. In the mid-20th century, the Netherlands was headed in the same car-centric direction as the U.S. However, staggering traffic fatalities coupled with an oil crisis pushed citizens to demand safer infrastructure, eventually leading to the modern bicycle facilities in the Netherlands today (Wagenbuur, 2021).

Currently, it is difficult to live and be productive in Spokane without a car. Making the switch to electric vehicles could be another way to reduce transportation carbon emissions. Planning for easily accessible electric vehicle charging stations is crucial, as well as ensuring a sustainable supply of electricity. With the rising prices of cars and fuel, socioeconomically disadvantaged communities face the brunt of the consequences of cities built for cars instead of people. Electric vehicles are still financially out of reach for a large portion of this population, making reliable and efficient public transportation essential. When the public transportation system does not provide a consistent and viable alternative, marginalized communities face a steep uphill climb toward stability. It is impossible to maintain a job or stay in school when your transportation is not secure. A city cannot be considered resilient without finding ways to minimize the gap in sustainable development opportunities between different levels of socioeconomic standing.

The next section of this report examines specific strategies for safe and sustainable transportation used in the Netherlands. Traffic calming is one specific strategy used everywhere in the Netherlands to create communities. It will look at how strategies used in the Netherlands can be adapted to and implemented in Spokane to help meet the City's climate goals and create a safer community for generations to come.

Safe and Active Transportation

The multi-modal transportation system in the Netherlands is a focal point in their society. The amount of people who use active transportation and public transportation in the Netherlands is



Figure 3. Cyclist with a child carrier on the roads in Amsterdam.
Source: theguardian.com article City breaks with kids: Amsterdam

extremely high, as is the number of trips that combine cycling and walking with public transportation. The features that make this possible are numerous, including a totally different mindset towards cars, pedestrians and bicyclists than the US. In the Netherlands, active transportation is both safe and convenient for people to use. Reducing the points of friction for something to happen is the

surest way to being successful in meeting the goal. Often, the mode of transportation people use is a product of their built environment. According to the Bureau of Transportation Statistics, about 52% of daily trips (any mode of transportation) in 2021 in the USA were under 3 miles in distance and 28% were under 1 mile. Targeting these shorter trips, making active transportation safe and convenient, and having a reliable public transportation system are ways the City of Spokane can reduce personal vehicle miles traveled, which is the second transportation goal in City's SAP. Even with high public transportation ridership and bicycle use, car ownership in the Netherlands is still common. The goal is not to completely remove cars from the equation, but to find ways to incorporate alternate modes of transportation into everyday life and blend them as seamlessly as possible with our existing automobile infrastructure.

In addition to the environmental advantages, improving access and ease of use for active and public transportation also offers tremendous health benefits, both physical and mental. In his book titled *Walkable City*, Jeff Speck discusses how "the methodical eradication from our communities of *the useful walk* has helped to create the least active generation in American history." The culture created by neighborhoods that have infrastructure supporting pedestrians vastly improves the quality of life of the residents (Speck, 2012). Several recent reports support the idea that active transportation is associated with better mental health. The social interactions that come with walking or cycling in a low-stress environment have a positive impact on psychological wellbeing (Hancock, 2021). Walkable cities provide physical exercise and opportunities for engagement for the elderly, while also allowing them greater independence. However, the lack of viable infrastructure for active transportation creates both actual and

perceived unsafe circumstances. The idea that walking around one's community is unsafe is a huge barrier for people who would otherwise be interested in using alternative modes of transportation. Figure 4 shows research results by the City of Portland. The four categories represent the circumstances in which people are willing to ride a bicycle. Sixty percent are interested but concerned, citing safety as a barrier to regular riding (Spokane Bicycle Master Plan, 2017). Having a connected bike network, as opposed to bike lanes that disappear after a few blocks, would provide people with the option to leave their car in the driveway for a sizable number of their outings. The Netherlands is a mostly flat country, but some southern cities, like Maastricht, have more varied terrain. The hills don't stop people from cycling in these Dutch cities. Although the hilly terrain of Spokane adds another challenge to regular bicycle ridership, it is not a deal-breaking obstacle.



Figure 4. Types of transportation cyclists determined by the City of Portland. Source: Spokane Master Bicycle Plan

The Dutch were one of the first to implement a proactive and systematic approach to road safety. The design of a street—everything from the width and textures of the road to the street canopy— influence the speed at which drivers feel comfortable. Traffic calming is a design method that deliberately slows the speed of traffic and makes drivers more aware and attentive to their surroundings. The Dutch bicycle facility design manual, the CROW Manual, has solutions to different problems based on the type of street, the surrounding land use, vehicle volume, etc. Whether a project calls for a protected bike lane, for example, or a road with a low speed limit where cars and bikes share the road, will depend on the situation. There are many different traffic calming techniques ranging from simple to complex, but a few include speed reduction, raised crossings, and lane narrowing. The City of Spokane would benefit from further research on implementing holistic traffic calming techniques used by the Dutch to create safer neighborhoods and roads for all types of users.

Conclusions and Recommendations

The City of Spokane can no longer afford to slow-walk the movement towards transportation safety and sustainable development. The Netherlands has some of the best bicycle and pedestrian infrastructure in the world. Plug-and-play strategies will most likely not be effective but bringing in qualified consultants to enable well-informed discussions early in the design process is advised. The US does many things well; but Americans are often reluctant to deviate too far from the traditional ways cities and urban areas are currently designed.

Becoming a more sustainable city has a multitude of economic, environmental, and social benefits. Spokane has a unique opportunity to be a strategic innovator, in the face of the unprecedented urban challenges imminent climate change presents. The most integrated and inclusive solutions for the bicycle network will fall flat unless the citizens of Spokane feel safe hopping on their bicycle. Traffic calming strategies need to be implemented to create a space where active transportation is a viable alternative to personal vehicles. They are a powerful visual reminder of the City's commitment to the safety of its active transportation participants.

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