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The Future of Downtown Parking in Northfield

Introduction: A vision for sustainable transportation in Northfield

It is no mystery that transportation has a profound impact on climate change. The consequence of deeply ingrained automobile culture in the United States is that the transportation sector is the largest contributor to greenhouse gas (GHG) emissions, producing 28% of the country's total emissions in 2018 (Environmental Protection Agency [2019?]). 82% of these emissions originate from light-duty vehicles and medium and heavy-duty trucks (EPA [2019?]). What's more, GHG emissions increased more in transportation than in any other sector between 1990 and 2018 (EPA [2019?]). Northfield is not an exception to this trend of growing car use and its detrimental impact on the environment. According to its Climate Action Plan, the transportation sector composes 12% of total community-wide GHG emissions (City of Northfield 2019). While Northfield has recently made progress in terms of transportation sustainability, by adding bike lanes, for example, there remains much work to be done. To adequately address the issues caused by a transportation system that does not meet the community's needs nor its commitment to sustainability, the city must explore policies that will transform the current system extensively.

One method communities have used to successfully decrease vehicle usage is the introduction of market-based pricing for parking. Donald Shoup, the leading scholar on market-based parking, argues that the failure to charge market rates for curb parking causes traffic congestion, air pollution, fuel waste, and vehicular accidents due to the phenomena known as cruising (2006). In the context of a small city such as Northfield, cruising may not be an issue

because parking is not solely free on the curbs and parking is less scarce than it is in highly populated urban centers. Here, the high costs of free parking may present as increased housing/building prices, unjust subsidies for cars, distorted transportation choices, sprawl, social inequity, and economic and environmental degradation (Shoup 2005). The United States Environmental Protection Agency sums up the free parking issue well. "The cost of parking is generally subsumed into lease fees or sale prices. However, providing anything for free or at highly subsidized rates encourages overuse and means that more parking spaces have to be provided" (Development, Community, and Environment Division 2006, 29). The mispricing on the streets is cited as the central problem of urban parking, leading to other issues such as irrational minimum parking requirements (Manville 2014). According to Shoup and several other scholars, the optimal solution to the parking problem is to charge market prices for curb parking (Anderson 2004; Dorsett 2014; Klein 2013; Manville 2014; Shoup 2005; Shoup 2006). Shoup claims that if drivers are consistently able to find available parking spaces close to their destination, market-priced curb parking will save time, reduce congestion, conserve energy, improve air quality, and produce public revenue (2005). The EPA maintains that "pricing strategies bring substantial environmental and congestion benefits, particularly since they tend to reduce peak-period vehicle trips the most" (Development, Community, and Environment Division 2006, 29). While the literature is unanimously in favor of market-based parking, the real obstacle localities often face to implementing these types of policies is political resistance (Shoup 2005). To overcome this political barrier, I outline how Northfield stands to benefit greatly from paid parking downtown.

Northfield's primary motivator for adopting paid parking downtown should be its aim to reduce car dependency, which accounts for a substantial proportion of the community's carbon

emissions. If executed properly, the introduction of parking meters downtown will effectively disincentivize people from commuting downtown in single-occupancy vehicles. Instead, commuters will opt to use ride-sharing, public transit, or bicycles, or choose to walk. Based on the study of other communities, the dilution of automobile use, particularly single-occupant vehicles, attributed to the installation of parking meters will be sizable (Bianco 2000, de Groote 2019, Khordagui 2019, Wang 2020). Consequently, these behavioral changes will translate to enormous advancements in sustainability and improvements to the local environment in Northfield. Besides achieving sustainability goals, a paid parking initiative will further the city's aspiration to have a strong economy. While the installment of parking meters may initially seem incompatible with the idea of a flourishing economy, paid parking will be incredibly advantageous to the local economy. Among the ways in which parking meters will benefit downtown businesses are the increased business resulting from a higher turnover of customers, financial investment into the downtown area in the form of beautification efforts and snow and ice removal, and transportation system improvements via the revenue generated by the meters, and greater tourism as a result of the environmental-friendliness and improved transportation infrastructure of the city. This ties into the third overarching objective of a policy plan to transform Northfield's transportation system: ensuring that transportation is as effective and equitable as possible for the community. Making alternatives to driving more viable by improving sidewalk conditions and adding bike lanes, for example, will encourage commuters to pursue these options. A more robust transportation system will more adequately support those non-car owners while prompting all community members to preserve Northfield's beautiful landscape by commuting in a more sustainable manner.

To keep in line with the city's vision to provide excellent quality of life (City of Northfield [2021?]), Northfield should implement the twenty-year plan outlined below to incrementally build toward a better, more sustainable transportation system that works for all by enhancing the existing transportation options, adopting market-based pricing for downtown parking, and being intentional about the allocation of generated revenue, maintenance, and assessment of new transportation policies and programs.

Stage 1: Strengthening the current transportation system by making alternative transportation more viable

Despite the existence of a public transit system (Hiawathaland Transit 2019), plentiful sidewalks throughout the city, and some designated bike lanes, Northfield continues to be a heavily car-dependent place. The city is fairly spread out, but citizens often rely on their personal automobiles for even short-distance trips. Before the city can implement serious strategies to curb this behavior, namely introducing market-based pricing for downtown parking, it must ensure that there are viable transportation alternatives available to all. The first step in transitioning Northfield toward more sustainable transportation is improving the existing infrastructure that fails to adequately meet the transportation needs of its residents and visitors.

In order to provide a more robust transportation system, improving the walkability of the local community is essential. The city of Northfield currently has a walking score of 29, which is the average walking score for the 63 largest cities in Minnesota (Walk Score, n.d.). However, Minneapolis and St. Paul have walking scores of 70 and 60, respectively (Walk Score, n.d.). Under the Walking Score methodology, a score of 29 indicates a car-dependent area, where most

errands require a car (Walk Score [2021?]). Clearly, there is ample room for improvement in this department. While the policy used to address this issue could focus on targeted commercial development in residential neighborhoods to decrease the distance between amenities and homes, I will focus on the measures of pedestrian friendliness that also comprise this score. Northfield is not yet pedestrian-friendly, which is a serious issue if the city strives to adopt a more sustainable transportation system, i.e. one less dependent on vehicles. Thankfully, policies to improve the walkability of the community should be popular, efficient, effective, affordable, and relatively easy to implement within the next five years.

Increasing the number of bump-outs, for example, is a simple yet effective tool at making roads and intersections safer for pedestrians to cross and walk along. Bump-outs, also known as curb extensions, extend the sidewalk into a parking lane to narrow the roadway and provide additional pedestrian space at target locations (Tribune County Agency 2015). Curb extensions enhance pedestrian safety by increasing pedestrian visibility, shortening crossing distances, slowing turning vehicles, and visually narrowing the roadway. Therefore, I propose adding bump-outs throughout residential areas to make it safer for folks to commute downtown or elsewhere. Such a placement would be most effective given the already existent bump-outs downtown. Exact locations should be determined based on remaining needs, but with careful consideration and concerted effort to include all neighborhoods equally. It is worth pointing out that bump-outs are not without their controversy. Concerns about bicycle-vehicle accidents were prevalent during Northfield's initial conversation about downtown bump-outs in 2005 (Currier 2005). Equity concerns and overall hesitations persisted before the 2020 Mill & Overly Street Project was narrowly passed by the Northfield City Council in November of 2019 (Knight 2019). In 2016, though, "the Northfield City Council authorized the installation of temporary curb bump

outs in an effort to reduce the number of crashes that occur" (Bornhoft 2016). The installment of bump-outs is an effective method to improve safety that Northfield has employed in the past, so I would encourage the city to continue these efforts in order to prioritize pedestrian safety.

Additionally, Northfield must prioritize pedestrians by making sidewalk maintenance and snow removal a higher priority. According to the Sidewalk and Trail Inspection and Maintenance Policy adopted on September 18th, 2018, the goal of the city of Northfield is to minimize conditions that create unreasonable hazards for pedestrians (City of Northfield 2018). This does not go far enough. To truly make walking in Northfield a reasonable option for everyone, including those who may be handicapped, the city needs to aim for higher quality sidewalks year-round. The standard for replacement or repair should be adjusted to accomplish this. Perhaps the criteria should be altered to include cracks or joints with deviations in elevation of a half-inch (½") or more, a 50% decrease from the current criteria of one inch (1"). Another way to ensure better quality sidewalks would be to allocate more of the city budget toward annual, or better yet, semi-annual, inspections and subsequent repairs. A special dedication to maintaining the sidewalks downtown would be advantageous to supplement the other policies that will encourage pedestrian activity in that area. During the winter months, sidewalk and crosswalk maintenance currently does not adequately support the walking community, especially older residents. This insufficiency is reflected in the results of the 2017 Age-Friendly Northfield Community Survey (AARP 2019). Clearing sidewalks, especially those in and around downtown, to bare pavement would be prudent. Again this change in practice may require additional funding, but it is worth it to allow Northfield residents the opportunity to walk in and around downtown throughout the entire year. Cold weather may already be a barrier to

commuters who wish to walk, but if the sidewalks are at least cleared of snow and ice, this population may be open to changing their behavior.

Objective 1: Northfield city officials should adopt policies such as increased bump-outs, sidewalk maintenance, and snow removal that will quickly improve the walkability of the city in the next five years. This will in turn reduce the community's dependency on automobiles.

Continuing to ensure that biking is a viable option is similarly crucial to shift transportation behavior away from less sustainable options. Modifying the existing infrastructure to further support bikers will also encourage such behavior. The City of Northfield's Comprehensive plan adopted in 2008 planned to encourage alternative forms of transportation. Specifically addressing bicycling, TR 1.5 states the plan to "establish bicycling as a sustainable, safe, and convenient, year-round mode of transportation in Northfield" (City of Northfield 2019). The current plans for on-street bikeways, in the form of standard bicycle lanes, buffered bicycle lanes, advisory bicycle lanes, or bicycle boulevards are a good start, but the city should consider adding on-street bikeways to all streets within a 5-mile radius of the historic downtown area to encourage people to bike downtown. In Northfield, there are about 26 miles of combined bike and walking trails that cross the City (City of Northfield 2019). Many of these trails have gaps and would benefit from better connectivity and protection, as can be seen in the map below of Northfield's pedestrian and bike trails in 2019 (City of Northfield 2019). Since 2019, as per the Complete Streets Policy, some infrastructure has been added (City of Northfield 2012). However, Northfield could still stand to implement more trails, prioritizing those streets within a 5-mile radius of the historic downtown area. Another recommendation to accommodate the probable

influx in bicycles resulting from these policies is to install additional bike racks in Northfield's C-1 district. Increasing the number of on-street bikeways near downtown Northfield and adding bike racks would help motivate bikers to visit downtown shops and businesses via bicycles.

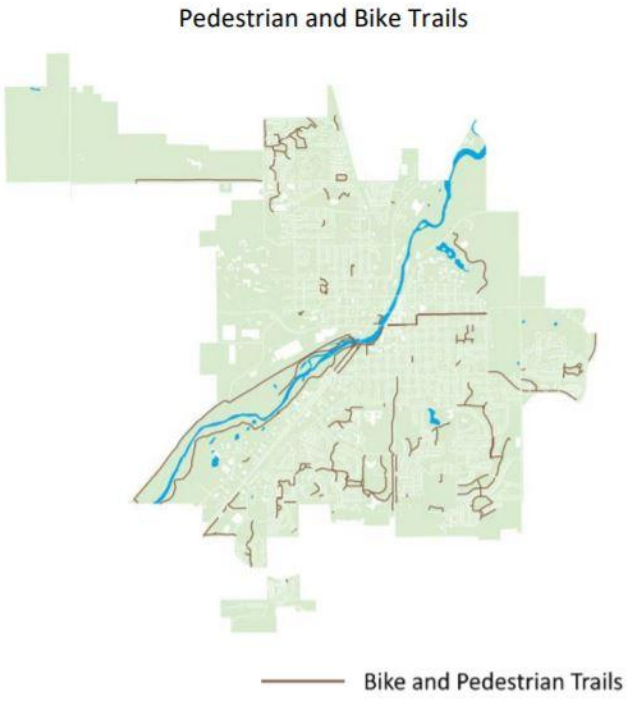

Figure 14. Pedestrian and bicycle trails in Northfield, MN. Source: City of Northfield Public Works Department, 2019; generated by Jessi Wyatt.

Objective 2: Northfield city officials should continue to develop bicycle infrastructure such as bicycle lanes and bike racks that will encourage biking as a healthy and sustainable form of transportation throughout the city. Promoting biking by adding such infrastructure will also reduce the community's dependency on automobiles.

Another intermediate step that will make Northfield transportation more sustainable is to significantly enhance the public transit system, i.e. the Hiawathaland bus service. The May 2019 Hiawalthand Public Transit survey that was conducted for Northfield indicated that satisfaction

with the public transit services is low. 52.8% of respondents (163) said that they feel the service in their area is not adequate for their transportation needs (Hiawathaland Transit 2019). Most complainants cite the limited schedules and routes, unreliability, inaccessibility, unclear schedules, timing concerns (routes take far longer than they would by personal vehicle), and general inconvenience. Reflecting these concerns, approximately 0.5% of Northfield residents reported using public transit through the American Community Survey in 2017 (City of Northfield 2019). While expanding these services may be challenging for a city with a population of just 20,000, such an endeavor would be worthwhile to reduce car emissions. Strengthening the shared taxi services that currently exist in Northfield would also be a step in the right direction. In a 2013 study comparing conventional bus transit with automated shared taxis in Ann Arbor, findings indicated that automated shared-ride taxi transit could provide a higher level of service at a lower cost and with lower emissions than the bus system (Merlin 2017). Furthermore, this study showed how taxi transit without ridesharing led to the highest level of service, but with higher levels of carbon emissions than the bus system. Thus, the study concluded that ridesharing is essential to obtaining the full cost savings and environmental benefits for an automated taxi system. In Northfield, reducing barriers to taxi services while incentivizing ridesharing, perhaps by offering discounts to groups of passengers, may be one method to redirect personal vehicle use into shared use of taxi services.

Objective 3: Northfield city officials should work to expand public transit options so they best serve the community's projected needs following a decrease in personal vehicle usage. Supporting a broader range of community members in this way will incentivize them to use public transit as an alternative to driving, specifically for trips within the city.

By making automobile alternatives such as walking, biking, and public transit more viable, Northfield will have a more robust transportation system. Accordingly, personal automobile usage will be discouraged and other policies such as paid parking will be easier to garner support for, implement, and enforce. Providing better alternatives to personal vehicle use is the critical first step toward more sustainable transportation in Northfield.

Stage 2: Market-based pricing for downtown parking

Once substantive measures to improve transportation alternatives are implemented over the next five years, Northfield should begin the process of charging for downtown parking. Using meters next to parking stalls, the City will make drivers pay a fee determined by the market. Discouraging vehicle use, especially single-occupancy vehicle use, at least downtown will allow Northfield to achieve several aspects of its vision, but especially the dedication to sustainably enhancing and preserving an excellent quality of life.

Market-based pricing has been well demonstrated as an effective strategy to reduce vehicle usage. As mentioned earlier, the hidden costs of free parking may present as increased housing/building prices, unjust subsidies for cars, distorted transportation choices, sprawl, social inequity, and economic and environmental degradation (Shoup 2005). Free parking encourages overuse, which has harmful effects on the environment given the large contribution of vehicle emissions to the city's total carbon emissions (Development, Community, and Environment Division 2006). "The problem is that when free or underpriced parking is provided, it typically causes the most valuable spaces— those that are located adjacent to local businesses, services,

and entertainment venues—to be overused" (Dorsett 2014, 2). These parking spaces tend to remain occupied by these same parkers throughout the day, which makes finding a parking space more difficult, especially during peak hours of downtown activity. In addition to reducing the number of open spaces, this practice also dramatically increases roadway congestion. Drivers must circle blocks looking for available spaces or waiting for occupied spaces to open up. Such "unnecessary congestion makes roadways less safe for both drivers and pedestrians, and needlessly generates unhealthy emissions" (Dorsett 2014, 2). In essence, the far too common practice of providing free parking ends up frustrating drivers trying to get to local businesses and those who are trying to just travel through due to a lack of open spaces and congestion. It is widely acknowledged that the optimal solution to the issues caused by free parking is to charge market prices for curb parking (Anderson 2004; Dorsett 2014; Klein 2013; Manville 2014; Shoup 2005; Shoup 2006). "In the absence of road pricing, efficient pricing of parking may be an effective policy tool for combating congestion on the road and in parking" (Anderson 2004, 14). Setting a goal of 85 percent occupancy for on-street parking spaces, as recommended Donald Shoup argues (2005), can be achieved by installing parking meters. This threshold ensures sufficient on-street parking while simultaneously reducing the level of vehicle usage. Dorsett argues that downtown parking spaces, especially those in close proximity to high-demand destinations, are worth a premium, and they should be priced as such (2014). "For these spaces, parking prices should be set at levels that will be acceptable to short-term parkers, but too high for long-term parkers, which will depend on the market" (Dorsett 2014, 15). I suggest using technology to determine such rates, as I will further explain later in this paper.

Logistically, I recommend instituting paid parking in and around the historic district of downtown Northfield. The plan would include both spots where free two-hour and

twenty-minute parking are currently located as well as the four public parking lots in the downtown area. Where two-hour parking spots currently reside, short-term (two-hour) meters should be installed. For spots that currently have twenty-minute parking, even shorter-term meters should be installed matching that time limit (twenty minutes). Long-term parking meters would be more appropriate for the four public parking lots in downtown Northfield. These would run for a duration of five hours primarily to allow some space for tourists to visit the area with greater leisure, but to also meet the needs of community members who need to spend a longer time downtown for whatever reason. All parking meters should have a pay-by-phone option to ensure that people without access to coins or cash can still park downtown if necessary.

At the forefront of a decision to install parking meters downtown are concerns surrounding equity. Under the assumption that the parking meters would charge the same price for every vehicle, this policy would present a greater financial burden on those commuters with less money. This disproportionate impact on low-wage earners is compounded by the fact that they are also the most likely to have difficulties in affording a vehicle and its associated costs. Low-wage earners' access to other transportation options is also limited because most, if not all, forms of transportation have costs associated with them (even walking requires the purchase of shoes). Such a regressive policy must be counteracted with corrective measures. Improvements to the existing transportation infrastructure as mentioned in stage 1 do accomplish this by making it easier to get around without a car. Those steps that progress the quality of being a pedestrian or biker are especially important for low-wage earners since these options are often the most affordable alternative to personal vehicles. Making public transit more affordable, though, may also help those who cannot afford paid parking, but would be able to afford bus tickets. However, these significant measures are not sufficient. To fully support those individuals in the community

with the most financial need, it would be a good idea to provide limited downtown parking free of cost to those who can demonstrate significant need. Perhaps the Community Action Center can provide codes to use while paying over the phone for a parking meter in the same way that it provides bus tokens and gas vouchers (Community Action Center of Northfield, n.d.). These subsidies are necessary at least in the short-term, but one must also recognize that this policy will have conflicting effects for the disadvantaged. As Weinberger summarizes this duality in her chapter on parking trends in the U.S. (Weinberger 2014, 236): "new paradigms in parking policy could increase the cost of auto use (disadvantaging the poor), but decrease auto dependence (favoring the poor)". Ultimately, a paid parking policy in Northfield would both harm and help those with less financial security, but corrective measures can be a useful tool for reducing the repercussions.

In thinking about how many Northfield residents would rely on a system that assists with parking costs, it is sensible to consider the target population of a paid parking policy. Many individuals in the Northfield community do not spend significant time in the historic downtown area. Much of grocery shopping, recreation, and other activities occur outside this area in places like Target or Cub Foods. In fact, it would seem that downtown Northfield is not designed to target so-called 'townies'. Marketing websites and brochures often feature Northfield's downtown shops and buildings. Branding this area as a tourist attraction is fitting given the nature of the stores, businesses, restaurants, and shops that are located there. Shops such as Makeshift Accessories, Echo DVDs and Games, and The Sketchy Artist offer unique items and gifts that are naturally appealing to visitors. Everyday items that consumers purchase are not commonly found in these downtown stores, so locals are not as likely to frequent downtown. The restaurants are suitable for a night out for those residents that can afford it, but such visits are not

typically everyday occurrences for most people in Northfield. Other locals cite hostility and discrimination as sources for their discomfort in spending time downtown. Marginalized individuals, specifically the Latinx community, express sentiments of not belonging downtown as a result of negative experiences and shops that are not targeted to them (in terms of products/services and costs), among other reasons (Bouzard et al. 2013). The downtown composition of businesses coupled with the fact that minorities do not feel welcome downtown translates to the makeup of the downtown population largely consisting of tourists. Then the target group of paid parking downtown in terms of generating revenue for the City is the tourists, who already tend to stimulate the local economy when exploring downtown Northfield. If they already plan to make purchases at downtown businesses, asking them to pay for parking as well makes sense. It is also reasonable then to expect the target population for behavioral change, Northfield residents who spend comparatively less time downtown, to transition from personal vehicle use to more sustainable alternatives in commuting downtown. Given how ease of transportation is directly proportional to distance, especially for more time-intensive methods such as walking and biking, it can be expected that the installation of market-based pricing for downtown parking will have a greater impact on residents that live closer to downtown Northfield. Residents who live closer to this area will hopefully realize more quickly that traveling downtown via foot or bike is worth the minor effort to avoid paying for parking and the associated costs of driving. This line of action paired with the revenue generated mostly from tourists is the primary intention of instituting a paid parking system in downtown Northfield.

Stage 3: Results and maintenance of paid parking downtown

One of the most immediate effects of adopting paid parking downtown will be the revenue that is generated from the parking meters. The money collected from these meters can be used in a variety of ways, but to maximize the effectiveness of the paid parking policy, it would be wise to direct the money in ways that will support the primary purposes of the program: stimulating the local economy and making transportation more sustainable in Northfield.

Upon analyzing other localities that have effectively implemented market-based pricing for parking, I propose keeping approximately half of the revenue generated by the parking meters downtown in some capacity rather than putting it in the City's general budget, where the money may be directed elsewhere. Directly investing half of the money into maintaining or improving the vibrancy of Northfield's historic downtown makes sense both economically and politically. Keeping the money generated downtown makes economic sense because those paying in will directly receive those benefits that result. Politically, it is easier to convince downtown stakeholders, particularly business owners, that adopting paid parking is worthwhile if they get to experience some of the positive outcomes of the policy. Examples of how the revenue may be used to support the downtown district include paying for the baskets of flowers that beautify Division St. during the warmer months and increasing snow removal efforts on sidewalks and streets. A plus to investing in beautification efforts is that it has the potential to boost tourism, which reinforces the ability of parking meters to generate revenue. A focus on clearing snow and ice, on the other hand, furthers the goals outlined in stage 1. Higher-quality sidewalks, crosswalks, and bike lanes in the winter incentivize walking and biking in the winter. This outcome does not generate more revenue, but it does push the city towards more sustainable transportation, the other main hallmark of the paid parking policy. Other ideas for keeping the

generated revenue downtown should be considered so long as they contribute to the goals of the paid parking policy. To balance the various goals, perhaps the ideal strategy for distributing the half of revenue that will be kept downtown is selecting a combination of options that work toward different goals. For example, funds could be allocated to beautification, snow/ice removal, and downtown businesses to bolster tourism, improve pedestrian-friendliness, and stimulate the local economy. Here there will be some overlap with how the other half of the revenue is distributed.

The other half of the revenue generated from parking meters should be directed to improving the transportation system in Northfield. The literature suggests that the reinvestment of revenue generated from market-based parking into public transportation most successfully diminishes rates of personal vehicle use (Bianco 2000). This argument follows from the idea I stressed in stage 1 that improvements to transportation alternatives will further incentivize individuals to utilize them. One study suggests that pairing parking price increases with bicycle subsidies can motivate commuters to switch their method of transportation from cars to bikes, so a proportion of the revenue generated from the parking meters could go towards these subsidies (de Groote 2019). Besides such subsidies, increasingly implementing the ideas raised as part of stage 1 would be fitting. Since stage 1 will have occurred prior to the installation of parking meters, this strengthening of transportation of infrastructure will have already begun in a meaningful way at this point. The purpose of this revenue then will be to expand public transportation even further. Beyond making the city more pedestrian and biker-friendly, the enhancement of the public transit system will be especially prudent once paid parking has begun. Increasing the availability of routes and times of Hiawathaland buses will be essential to meet the increased demand that results from the new costs to parking downtown. Since the city aims

to reduce all vehicle emissions, though, strategies to encourage biking and walking will be more beneficial in the long-run. At this stage, creative methods can be introduced to incentivize community members to commute downtown by foot or bike. The bicycle subsidies mentioned above are one example of this. A bike lending program, a pedestrian discount in downtown shops, or free biking lessons for children could also be ways to motivate personal behavioral change in terms of transportation. Reinvesting in transportation at this phase with the revenue generated from the parking meters is key to reducing personal vehicle use long-term by offering healthier, more sustainable, and affordable alternatives to driving downtown.

The next observed benefit of market-based pricing for downtown parking will be the boom in downtown business as a result of the generated revenue, increased turnover, and eventual influx in tourism. Clearly, downtown businesses stand to benefit from the generated revenue, either through direct payments, beautification efforts, snow/ice removal, or other monetary infusions into the downtown community as described earlier. In addition to the benefits that will result from the revenue generated, downtown shops can expect increased business due to a higher turnover of customers (Shoup 2005). The disincentive to park downtown for long periods comes from the fact that the price of parking compounds based on the duration specified by the car owner. For best results in terms of turnover, city officials should consider charging for parking based on smaller periods. A rate determined in segments of 10 minutes, for example, would motivate commuters to shorten their trip to 10 minutes or the nearest 10-minute interval, likely rounding down, assuming the consumer's goal is to save as much money as possible. In other words, market forces generate greater turnover in on-street parking. Shortening the maximum time limits for the paid parking spots would also contribute to higher turnover. The initial establishment of parking meters downtown should probably maintain the current parking

limits, but over the course of the five years after implementation, the city should assess whether or not shortening these limits would be advantageous. Shoup argues that parking meter prices should vary to maintain occupancy of 85% at all times, a strategy known as performance parking (2005). Once prices have been set for the parking meters downtown, it will be necessary to conduct regular assessments that determine whether or not this threshold is met. Occupancy sensors, a relatively new technology, can facilitate this supervision (Shoup 2005). An occupancy level of about 85% is ideal because parking is always available to those who need it, yet turnover is relatively high. Greater turnover means more customers, and more customers lead to more sales and higher profits, all of which are great for downtown businesses. The third way in which downtown businesses will benefit from a paid parking program will be less immediate. The environmental gains Northfield will make due to reduced vehicle use will happen quite gradually, but eventually, such progress will have a favorable effect on the atmosphere of the community. Reduced car emissions will translate to cleaner air, reduced car use will translate to safer streets, and a more environmentally-friendly community will translate to a more healthy and equitable place to be. Like many of the benefits described in this section, these outcomes act as a positive feedback loop. A sustainable community with a higher quality of life will attract more tourists, who will give more of their money to downtown parking meters and businesses, which will allow the city to further invest in sustainable transportation. The cycle continues. It is important to recognize, though, that increased tourism as a result of environmental progress will not take place on a noticeable scale for quite some time. While tourism growth is not the only, nor primary, reason for adopting paid parking downtown, downtown businesses should be aware of these long-term returns. All in all, downtown businesses can experience quite favorable effects

of paid parking downtown via parking meter revenue (indirectly), higher customer turnover, and increased tourism.

Though the environmental gains that will result from the reduced rate of single-occupancy vehicle use will take the longest to become apparent, these improvements are key in evaluating the effectiveness of the policy to reduce vehicle emissions in Northfield. Achieving long-term sustainability goals is the most compelling reason to adopt paid parking in Northfield, so assessing the program's ability to do so is paramount. Detection of effective reduction in fuel consumption and traffic congestion can be expected soon after implementation, while air pollution reduction will take somewhat longer to observe (Development, Community, and Environment Division 2006). The exact reduction of driving, the principal objective of this policy, can be difficult to forecast given confounding factors such as employer-paid parking (Development, Community, and Environment Division 2006). We can look to case studies, though, to get a better sense of the range of plausible impacts on driving behavior. One case study out of California estimates that a 10% increase in parking prices leads to a 1-2 percentage point decline in the probability of driving to a workplace (Development, Community, and Environment Division 2006). However, this quantification is based on the assumption that parking had a previous, non-zero price before the price increase. In Northfield's case, since downtown parking is currently free in the sense that vehicle owners do not have to directly pay for a parking space, any price that were to be established would be a 100% increase in price. Thus, this quantification method could not be used for Northfield. A case study of the introduction to paid parking in the Lloyd District of Portland, Oregon may be more insightful. Researchers attribute the 7 percent decrease in single-occupancy vehicle use for work-related commutes from September 1997 (when their transportation plan was launched) to September

1998 to the installment of parking meters and a discounted transit pass program (Development, Community, and Environment Division 2006). Market-based pricing is highly effective at reducing single-occupancy vehicle use. Paid parking also has been shown to encourage carpooling, further decreasing the prevalence of single-occupancy vehicle use. In Boulder, Colorado in the 1990s, a program that used revenue from downtown parking meters to pay for free bus passes, increased employee carpooling by 35% in just 4 years (Development, Community, and Environment Division 2006). The declines in fuel consumption, traffic congestion, energy consumption, and emissions of carbon dioxide and other harmful substances will be noteworthy within a year of the implementation of market-based pricing for downtown parking. The environmental degradation that results from vehicles is well-studied, but the gains that have been made from local applications of paid parking specifically have not been well documented. However, we can infer from the reduction in single-occupancy vehicle use and subsequent increases in alternative forms of transportation (walking, biking, public transit, ride-sharing, etc.) that there will be dramatic improvements to the local environment. According to the EPA's Office of Mobile Sources, 21.05 grams of carbon monoxide, 2.97 grams of nitrogen oxides, and 1.71 grams of hydrocarbons are emitted per vehicle mile traveled (VMT)(Development, Community, and Environment Division 2006). Even just a 5% decrease in Northfield's total VMTs in a year, based on its 2017 level of about 66 million, would be a reduction of 1.2 million VMTs, returning to a level of about 57 million that Northfield was at in 2002 (City of Northfield 2019). A decrease in 1.2 million VMTs then would reduce carbon monoxide emissions by 27.8 tons, nitrogen oxide emissions by 3.9 tons, and hydrocarbon emissions by 2.3 tons in a single year. These significant air quality developments that are a product of reduced vehicle use, and corresponding decreases in congestion and fuel

consumption, will have dramatic implications for public health. Given the relationship between air pollution and serious health conditions including aggravated cardiovascular illnesses, aggravated respiratory illnesses, and allergy-related illnesses, efforts to decrease Northfield's level of VMTs by introducing incentives to not drive downtown (parking meters, improved transportation alternatives, etc.) are both vital and urgent.

The evaluation of market-based pricing in downtown Northfield is an integral part of stage 3 of making transportation more sustainable. During the first year after parking meters are installed, parking behavior should be monitored very closely. To aid in this process, the city should consider installing occupancy sensors. This relatively new technology would allow the city to adjust parking prices to meet occupancy goals at least monthly, though these sensors can be expensive (Shoup 2005). It may be more worthwhile to invest in smart meters, an increasingly popular style of parking meters that allows drivers to pay by phone and only pay for the time parked. This technology would provide real-time data about occupancy as well as facilitate pricing variations based on time of day, day of the week, occupancy level, and other relevant factors (Shoup 2005). At $250 to $500 per meter, installing smart meters would be a large investment (CBS58 2017). The long-term returns, however, outweigh the high cost of installment. Not only will commuters be able to pay more conveniently, but the city will also be able to conduct essential assessments of paid parking with access to real-time data and easily adjust parking prices as frequently as desired. One must consider, too, that changing behavior is generally cheaper than investing in expensive infrastructure as the city has historically done (roundabouts by schools). After one year, Northfield city officials should review aggregated data about downtown parking as well as measure the effectiveness of other actions to make transportation more sustainable. A thorough review by professionals in transportation policy

should be coupled with a survey of public opinion on the transportation changes to understand the holistic impact of the program on Northfield. Following the one-year mark, it would be prudent to continue to monitor the ability of these policies to achieve their goals by undergoing evaluations at least every 5 years. The city council should be actively involved in reviewing these assessments to determine if adjustments are required. The frequent and robust evaluation of market-based pricing for downtown parking and the complementary measures (stage 1) that aim to make transportation in Northfield more sustainable will be imperative in ensuring that these actions are meeting, or exceeding, their expectations.

Conclusion

I advise Northfield's governance and community members to actively advocate for and adopt market-based pricing for downtown parking in the next twenty years by strengthening the existing transportation infrastructure, implementing a payment scheme, identifying and employing strategies to minimize inequities, and regularly assessing the execution of these endeavors. It is in the community's best interest to prioritize sustainable transportation in the next 20 years, and these steps provide a necessary starting point. The urgency of climate change should be enough to realize that actions to reduce Northfield's carbon footprint are imperative, but a transformation of the city's transportation system would have numerous, significant benefits beyond sustainability. The extent to which climate change threatens communities like Northfield will require a holistic approach, but making advancements in transportation using the framework detailed above is an essential component of this ongoing work.

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