



# Health and Safety Benefits of the Transit Improvement Program

April 3, 2018

## Executive Summary

The *Let's Move Nashville Transit Improvement Program* (TIP) is expected to bring Metro Nashville and Davidson County (Metro) various benefits that go well beyond increased and improved transit service. Transit-oriented development (TOD) includes mixed-use development centered around or located near transit stations, which attracts people and can result in vibrant, connected communities. TOD tends to have a positive effect on the quality of life of residents in many ways including, but not limited to, better lighting in and around stations, improved landscaping, increased perceived and actual safety, a larger variety of amenities, economic returns to landowners and businesses, reduced air pollution, and increased physical activity.<sup>1</sup>

Transit provides other multiple benefits that come in the form of healthier and safer Davidson County residents. For example, transit encourages increased physical activity such as walking and biking when system users travel to and from boarding stations for trips, yielding several health benefits. Dense development often associated with TOD can also alleviate development pressure on open space. Reduced air pollutant and greenhouse gas emissions can have significant societal impacts as well. To supplement this, reduction of vehicles on the road translates to fewer car accidents. As described below, numerous health and safety benefits have transpired in other cities where TOD has taken place and are expected to occur in Nashville due to the TIP.

## Physical Activity

- A study conducted for a mixed-use neighborhood along Salt Lake City's light rail line found that obesity was much higher among non-riders (65%) than new riders (26%) and continuing riders (15%).<sup>2</sup>
- The annual cost of obesity-related diseases is \$1,429 per person in the U.S.<sup>3</sup> In Metro Nashville and Davidson County, 26% of the population is classified as

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<sup>1</sup> Federal Transit Administration (2018) Transit-Oriented Development.

<sup>2</sup> Brown, B and Werner, M (2009) Before and After a New Light Rail Stop. *Journal of American Planning Association* 75(1):5-12

<sup>3</sup> RTI International (2009) Obesity Costs U.S. About \$147 Billion Annually, Study Finds.

obese, which translates into \$255 million per year in potential additional health care costs for Metro's residents.<sup>4 5</sup>

- A Seattle study compared pedestrian traffic before and after the opening of a new light rail station. The study found that those living within walkable distances from a station, defined as a ½ mile radius, walked more in general than those who did not live proximate to the station. This represents not only walking to and from the station, but also the walking that takes place along the corridor, which has been shown to generate economic and social activity in addition to increasing physical activity. For people living ½ - ¾ mile away from a station, a 26% growth in walking was seen. Individuals living even closer, within ¼ - ½ mile from a station, saw an even higher increase in walking of 44% after construction of the light rail station.<sup>6</sup>
- The American Public Health Association found that people are more likely to walk to transit if they are from lower income households, are non-white, and live in urban areas with access to rail systems. With transit users walking an average of 0.75 more miles a day than non-transit users, the TIP may be particularly beneficial to these populations since they tend to be at greater risk of obesity.<sup>7</sup>
- Research has shown that rail commuters:
  - Walk an average of 30% more steps per day
  - Reported having walked for a period of 10 minutes or more while traveling significantly more often, and
  - Were 4 times more likely to walk 10,000 steps during a day than car commuters.<sup>8</sup>
- According to the Nashville Area Metropolitan Planning Organization's (MPO) Land Use Model, by 2033 nearly 103,000 people will live along the LRT corridors. If the area along each corridor were to develop in a transit-oriented manner, the neighboring residents could also enjoy the benefits that occur with this type of development such as increased physical activity, increased economic activity, and improved safety from lower traffic speeds.

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<sup>4</sup> Metro Public Health Department (2011) Davidson County Behavioral Risk Factor Surveillance System Report.

<sup>5</sup> It is important to note that this estimation should not be added to the estimated \$15.1 million in health benefits described on page 1 due to possible double-counting that may result.

<sup>6</sup> Huang, R et al. (2017) Light rail leads to more walking around station areas. *Journal of Transport and Health* 6:201-208

<sup>7</sup> Sparks, P et al. (2012) A Demographic Analysis of Metro/Nonmetro Differences in Adult Normal Weight, Overweight, And Obesity. *Journal of Rural Social Sciences*.

<sup>8</sup> Wener, R et al. (2007) A Morning Stroll: Levels of Physical Activity in Car and Mass Transit Commuting. *Environment and Behavior* 39 (1) 62-74

- To lower the risk of all-cause mortality, cardiovascular disease, type 2 diabetes, stroke, and depression, The Physical Activity Guidelines for Americans recommend walking at least 22 minutes per day.<sup>9</sup> On average, public transit users walk 0.75 miles more than those who do not use public transportation.<sup>10</sup> The TIP is expected to result in \$15.1 million annually in health benefits in 2033 (in 2017 dollars) from increased physical activity associated with active transport.

## Methodology

To estimate health benefits associated with increased physical activity, 2040 ridership projections from the *Let's Move Nashville Technical Analysis* were used and deflated to reflect 2033 projections using an annual Davidson County growth rate. Additionally, a cost savings estimation of \$3.36 (in 2017 dollars) per mile walked in health benefits was used alongside the finding that transit users walk an average of 0.75 miles more than non-transit users. By multiplying the additional amount that transit users walk by the cost savings estimation and finally accounting for anticipated ridership, it was found that the TIP is expected to result in \$15.1 million in health benefits annually.

## Safety

- The fatality rate for public transit passengers is approximately 90 percent less than the fatality rate for automobile occupants.<sup>11</sup>
- In locations where there are more walkers and cyclists, the likelihood of an injury caused by a motorist is lower.<sup>12</sup> Another study found that if the number of cyclists on the road doubles in mixed traffic, the risk of injury decreases by 34%.<sup>13</sup>
- In 2017, a total of 405 and 89 accidents involving pedestrians and cyclists, respectively, were reported by the Tennessee Department of Safety and Homeland Security.<sup>14</sup>

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<sup>9</sup> U.S. Department of Health and Human Services (2008) Physical Activity Guidelines Advisory Committee Report.

<sup>10</sup> NZ Transport Agency (2013) Improving the cost-benefit analysis of integrated PT.

<sup>11</sup> American Public Transportation Association (2016) The Hidden Traffic Safety Solution: Public Transportation.

<sup>12</sup> Jacobsen, PL (2003) Safety in numbers: more walkers and bicyclists, safer walking and bicycling. *Injury Prevention* (9):205-209

<sup>13</sup> Robinson, D (2005) Safety in numbers in Australia: more walkers and bicyclists, safer walking and bicycling. *Health Promotion Journal of Australia* 16(1):47-51.

<sup>14</sup> Tennessee Department of Safety and Homeland Security (2017) Crash Data.

- According to the National Highway Traffic Safety Administration, Nashville experienced 2.14 pedestrian fatalities per 100,000 population in 2015 compared to 1.67 nationally, which illustrates the increased need for safety measures in Nashville.<sup>15</sup>
- The TIP is expected to provide \$15 million in annual safety benefits in 2033, in 2017 dollars, due to avoided vehicle crashes from reductions in vehicle use.<sup>16</sup>

The rate of traffic injuries per 100 million VMT in Davidson County was determined using the Davidson County traffic crash data and total VMT data.<sup>17</sup> Combining the rate of traffic crash injuries with projections from the program's technical analysis produced the avoided traffic injuries. Safety benefits were then calculated using U.S. DOT's recommended monetized values for avoided injuries and adjusted using a growth rate for Davidson County to obtain the estimated benefits in 2033.<sup>18</sup>

### Methodology

To estimate safety benefits, three data sources were used. The first data source was output from the STOPS model from the *Let's Move Nashville Technical Analysis*. Additionally, Davidson County data on traffic crash injuries by severity was obtained from the Tennessee Department of Safety and Homeland Security and total VMT estimations from the MPO's MOVES model were used.

### Open Space

- To accommodate the county's growth between 2007 and 2012, 16% of Davidson County's farmland was lost, amounting to 6,500 acres.<sup>19</sup>
- Transit-oriented development, good access to high-quality public transportation, and active spatial planning regulations combined with increasing travel costs may increase the appeal of living in urban neighborhoods.<sup>20</sup> By drawing more residents to urban areas and areas of denser development, the need to clear land to accommodate for suburban development may decrease. Additionally,

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<sup>15</sup> National Highway Traffic Safety Administration (2015) Traffic Safety Facts.

<sup>16</sup> The U.S. DOT estimates the benefit of preventing an injury or fatality using the Value of a Statistical Life, defined as "the additional cost that individuals would be willing to bear for improvements in safety, that in the aggregate, reduce the expected number of fatalities by one."

<sup>17</sup> Tennessee Department of Safety and Homeland Security (2017) Tennessee Traffic Crashes by Year, Type and County.

<sup>18</sup> U.S. DOT (2017) Benefit-Cost Analysis Guidance for Discretionary Grant Programs.

<sup>19</sup> Census of Agriculture (2007) County Summary Highlights: 2007.

<sup>20</sup> De Vos, J et al. (2013) Transportation policy as spatial planning tool; reducing urban sprawl by increasing travel costs and clustering infrastructure and public transportation. *Journal of Transport Geography* 33:117-125.

Metro will have a reduced need for additional infrastructure such as water and utility lines if there is more development along corridors rather than dispersed throughout the county.

## Clean Air

- The TIP will reduce air pollutant and greenhouse gas (GHG) emissions through switching to an all-electric bus fleet, the inclusion of 5 light rail corridors, and the reduction of cars on the road. Through these improvements, Metro will avoid \$7.2 million annually, in 2017 dollars, in social and environmental damages in 2033.

## Methodology

Emissions factors for EPA-regulated criteria air pollutants and greenhouses gases were obtained from the EPA and the MPO's MOVES Model for each mode of transportation associated with the No-Build and Build scenario. Using the emissions factor for each mode, the net emissions were estimated by considering the change in rider behavior due to the transit improvements. Finally, damage costs provided by the U.S. DOT and EPA were used to estimate the reduction in societal damages associated with the calculated emissions, which were interpreted as avoided social costs.

- The TIP would avoid GHG emissions of about 22,235 metric tons of CO<sub>2</sub>e.<sup>21</sup> The EPA estimates that these emissions equate to 3,333 homes' electricity use for one year or 5.8 wind turbines running for a year.<sup>22</sup>
- In order to reach the reduction in GHG emissions provided by the TIP, over 1 million trees would need to be planted and allowed time to mature. This estimation translates into over 2,500 football stadiums worth of forest area.

## Methodology

In order to evaluate the reduction of emissions of GHGs provided by the TIP in terms of the number of trees that would be required to offset an equivalent amount of emissions, the yearly absorption rate of CO<sub>2</sub> by one mature tree, 48 pounds, was obtained.<sup>23</sup> Following this, the estimated emissions of each GHG considered was then converted to a CO<sub>2</sub> equivalent using EPA-recommended Global Warming Potential factors. Global Warming Potential factors were

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<sup>21</sup> CO<sub>2</sub>e is a standard unit for the measurement and comparison of greenhouse gases. It expresses the impact of each GHG in terms of the amount of CO<sub>2</sub> that would create the same amount of warming.

<sup>22</sup> EPA (2018) Greenhouse Gas Equivalencies Calculator.

<sup>23</sup> American Forests (2018) Forest Facts.

developed to allow comparisons of global warming impacts of different gases.<sup>24</sup> Upon converting each GHG to a CO2 equivalent, emissions in kilograms were converted to pounds to estimate the number of trees that would need to be planted to offset an equivalent amount of GHG emissions avoided by implementing the TIP. It was estimated that 1,021,228 would need to be planted and allowed to mature over time to offset the same amount of GHG emissions. The forest area, in square feet, required to plant over 1 million trees is equal is surface area to over 2,500 football stadiums.

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<sup>24</sup> U.S. EPA (2018) Understanding Global Warming Potentials.