APPENDIX K

Upward Scenario

MetroPlan 2045 Regional Transportation Plan

Upward Scenario and Methodology

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1.0 Introduction

Two scenarios were evaluated as part of *Stride Forward,* the MetroPlan 2045 Regional Transportation Plan (RTP) – Onward and Upward. Both Onward and Upward were developed with the same future levels of population and employment. Onward examines the effects of existing plans and transportation investments for growth in the MetroPlan area. Onward aligns with previously approved voter initiatives for development while maintaining fiscal constraints. The second, illustrative scenario for consideration in the Stride forward program, Upward, examines the strategies needed to achieve the transportation-related goals in the Carbon Neutrality Plan (CNP) and their effects to the Flagstaff area. The goals tested include:

- Hold vehicle miles traveled (VMT) in the community to 2019 levels
- 54% of all trips will be taken by biking, walking, or taking the bus by 2030
- 34% of all work commute trips will be taken by biking, walking, or taking the bus by 2030

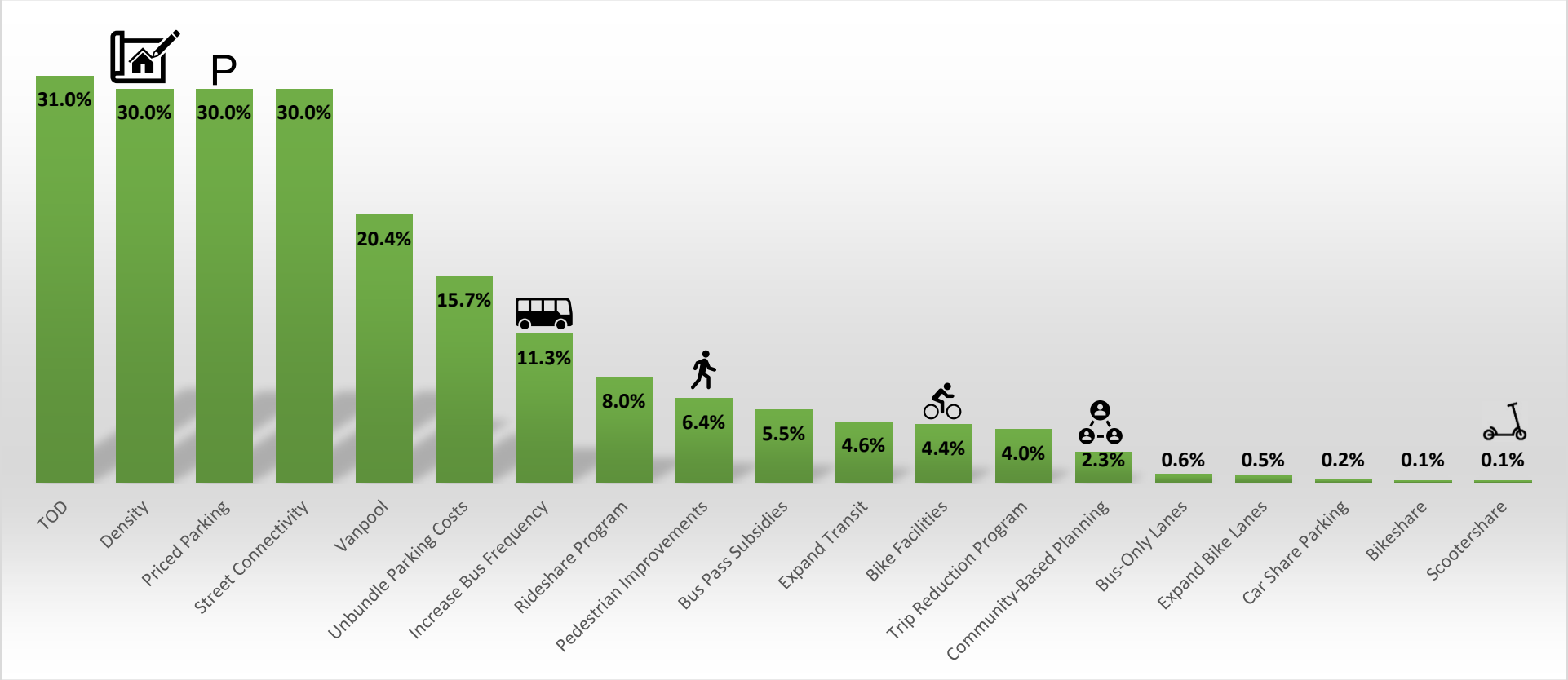
These targets are specific to trips that start and end in the City of Flagstaff (Flagstaff) per the CNP. The CNP includes a goal for regional electric vehicle adoption; this was not examined within this analysis. An Electric Vehicle Readiness Plan was completed in conjunction with Stride Forward and is included in ***Appendix G***.

2.0 Methodology

A literature review of best practices and empirical research on Vehicle Miles Traveled (VMT) reduction strategies, emerging trends and the implications of COVID-19 on travel behavior, applications of Intelligent Transportation Systems (ITS), electric and autonomous vehicles and performance measures served as a reference for the development of the Upward scenario. See the literature review conducted as part of this RTP and included in ***Appendix F*** for more information.

Several VMT reduction strategies identified from the literature review were considered. ***Figure 1*** provides a summary of the most effective strategies for reducing VMT. Strategies tested were selected based on their potential effectiveness as well as input from the Advisory Group and public. Their effects are not cumulative; in other words and referencing ***Figure 1***, combining transit oriented development (TOD), density, priced parking, and street connectivity does not eliminate all VMT. For purposes of this analysis, once a strategy was vetted and selected for use, it was included in all subsequent strategy testing to account for this dampening.

Figure 1 – TDM Measures and Their VMT Benefit (% Reduction)



Source: *Fehr & Peers, 2021*. From the Updated Draft CAPCOA Handbook on GHG Reduction Strategies.
Note: A combination of TDM measures is not the cumulative sum of the individual VMT benefits; meaning there is a *dampening effect* given most of the measures are not mutually exclusive and can influence travel behavior when offered to individuals simultaneously.

Testing was done with the MetroPlan regional travel demand model for existing and 2045 conditions. As such, VMT was linearly interpolated to 2030 to assess CNP target performance. This was achieved by taking the 2045 VMT from the model and assuming straight-line growth from 2019. Holding VMT to 2019 after 2045 will be increasingly difficult but new transportation investments and guided density will be beneficial. Relative measures for VMT are:

- Onward 2019: 2,358,632 VMT
- Onward 2045: 3,450,770 VMT
- Onward 2030: 2,820,690 VMT

This establishes 2,358,632 as the VMT target for Upward in 2030 and equates to a 16.4% decrease in VMT from Onward in 2030.

Onward serves as the 2045 land use, transportation network, population, and employment assumptions for Upward unless modified. Modifications to these variables were tested in the travel demand model as described within this document. Both scenarios assume the hospital relocation occurs prior to 2030. Policy-level decisions, such as leveraging a travel demand management program, were applied universally without use of the model.

The CNP targets trips starting and ending in Flagstaff (internal-internal trips); for simplicity and comprehensiveness, the majority of this analysis looks at all trips within Flagstaff and starting/ending in MetroPlan (internal-external trips). Trips that cross MetroPlan but neither start nor end there (external-external) were assumed to be uninfluenced by changes within Flagstaff, which aligns with the approach in the CNP. ***Section 0*** reviews performance in Flagstaff.

The following outlines the effectiveness of individual strategies and provides a potential future scenario that would achieve the goals in the CNP.

3.0 Increased Density

Increasing population and employment density was vetted first due to its potential effectiveness. Intensification of density assumed no change to existing population and employment patterns. Instead, density increases target the increase in population and employment between 2020 and 2045. Density was only increased for target areas. For reference, the 2019 population and employment are 93,000 and 47,400, respectively; these numbers increase to approximately 120,000 and 61,000 by 2045, respectively. This yields about a 29% population increase and a 29% employment increase. Linear interpolation yields 2030 population and employment at approximately 104,500 and 53,200, increasing 12.4% and 12.2% from 2019, respectively. Intensification was achieved by uniformly shifting increased population (11,500 new residents) and employment (5,800 jobs) from the entire Flagstaff region and relocating it uniformly to target areas at the traffic analysis zone (TAZ) level. **Table 1** provides an example of redistribution for 20% intensification if there were four TAZs, three outside the intensification area and one experiencing intensification. Note in Table 1, the TAZ with no growth projected reflects no redistribution and that the total population is unchanged between the 2045 Population and Adjusted 2045 Population.

Table 1 – Sample Population Redistribution (20% Intensification)				
TAZ Type	**2019 Population**	**2045 Population**	**Adjusted 2045 Population**	**2045 Population Redistributed**
Decreased Intensity	3,000	3,500	3,400	-100
Decreased Intensity	2,000	3,000	2,800	-200
Decreased Intensity	1,500	1,500	1,500	0
Increased Intensity	2,000	2,500	2,800	+300

3.1. Scenarios

Three potential land use scenarios were considered. In Upward Concept 1, density intensification is concentrated in downtown Flagstaff. In Upward Concept 2, density intensification is divided evenly in two locations within downtown Flagstaff and 4th Street. In Upward Concept 3, density intensification occurs throughout East Route 66. ***Figure 2, Figure 3,*** and ***Figure 4*** illustrate the areas of densification for each scenario, respectively.

Figure 2 – Upward Concept 1 – Growth Downtown

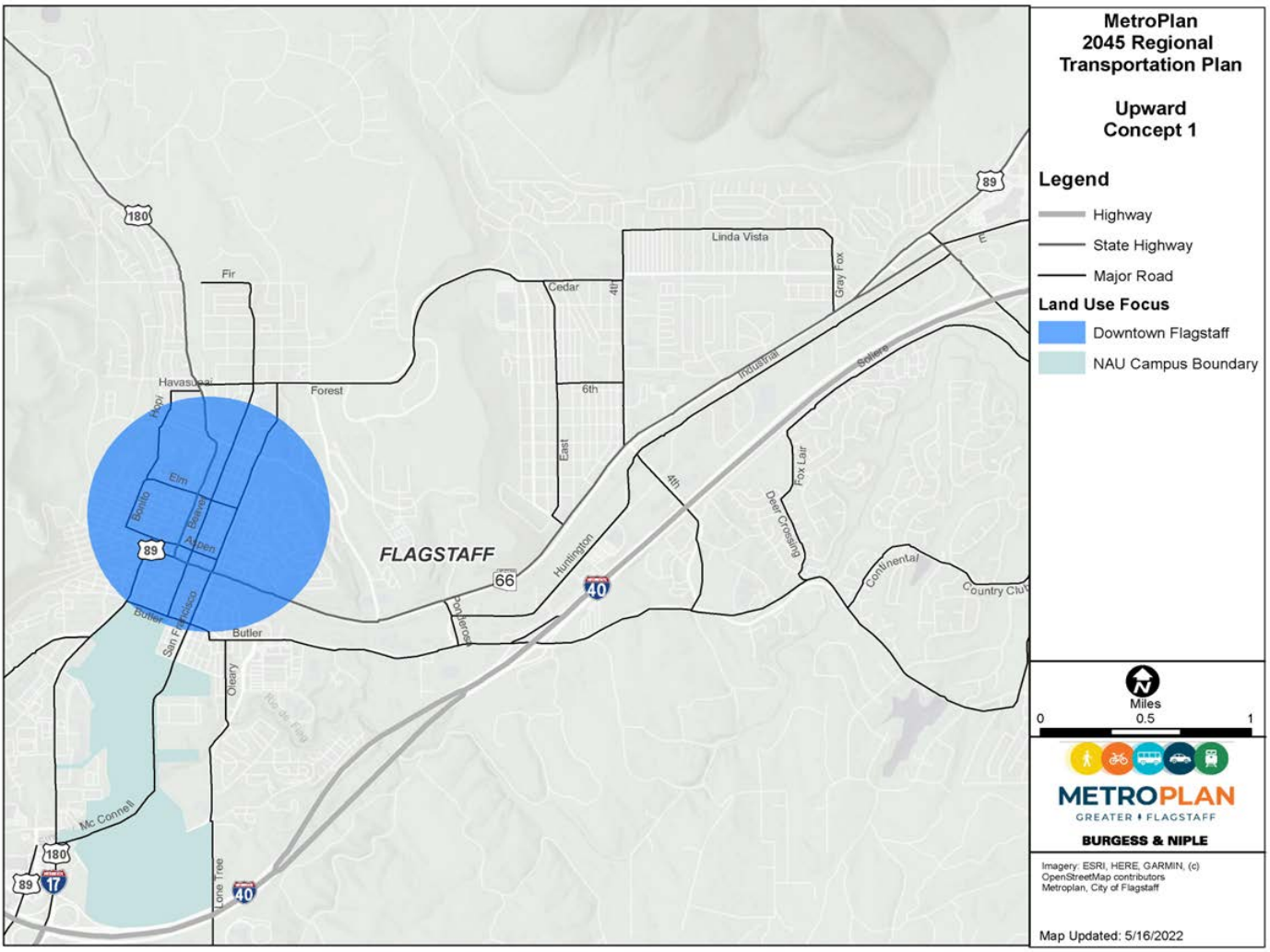


Figure 3 – Upward Concept 2 – Growth Divided between Downtown Flagstaff and 4th Street

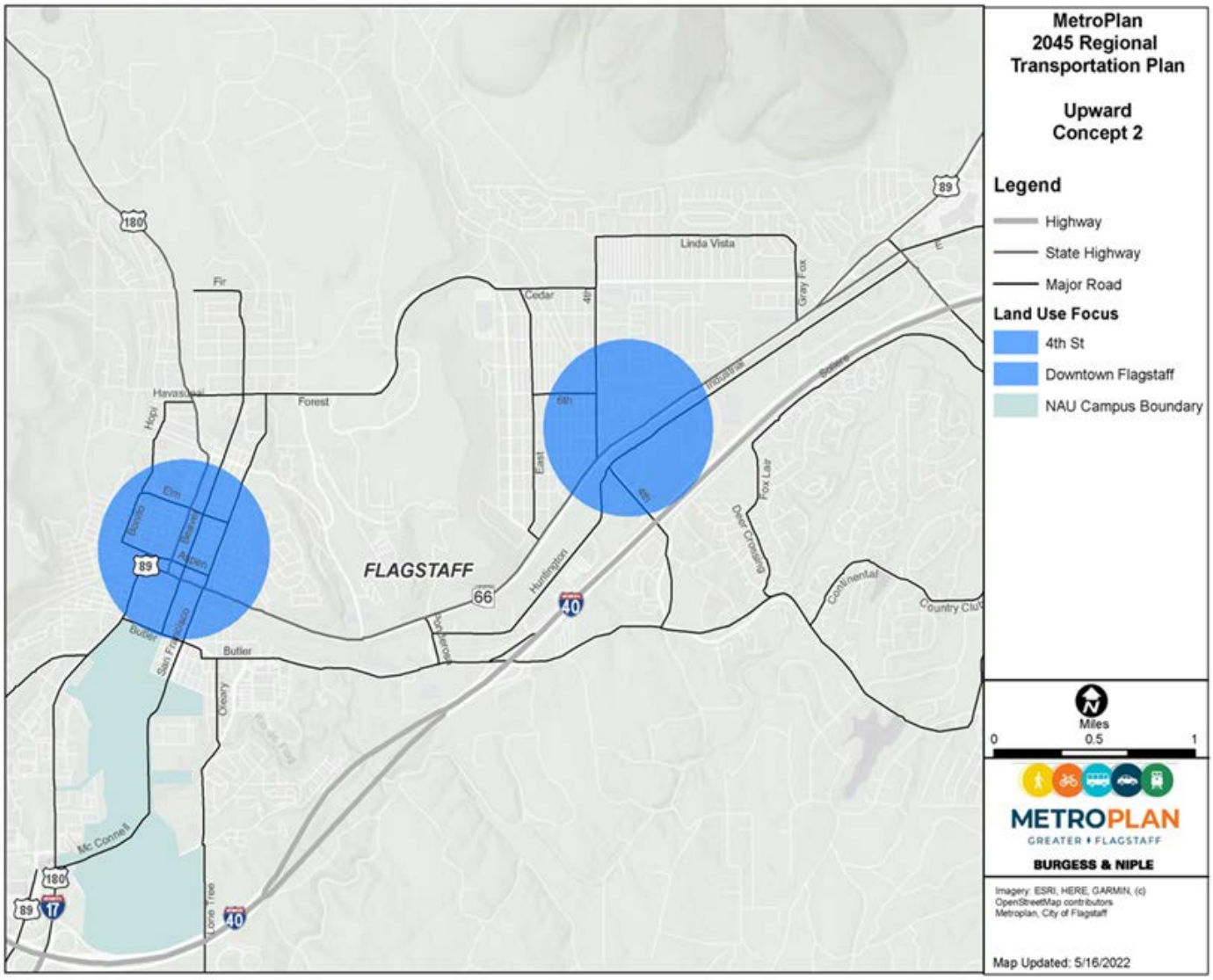
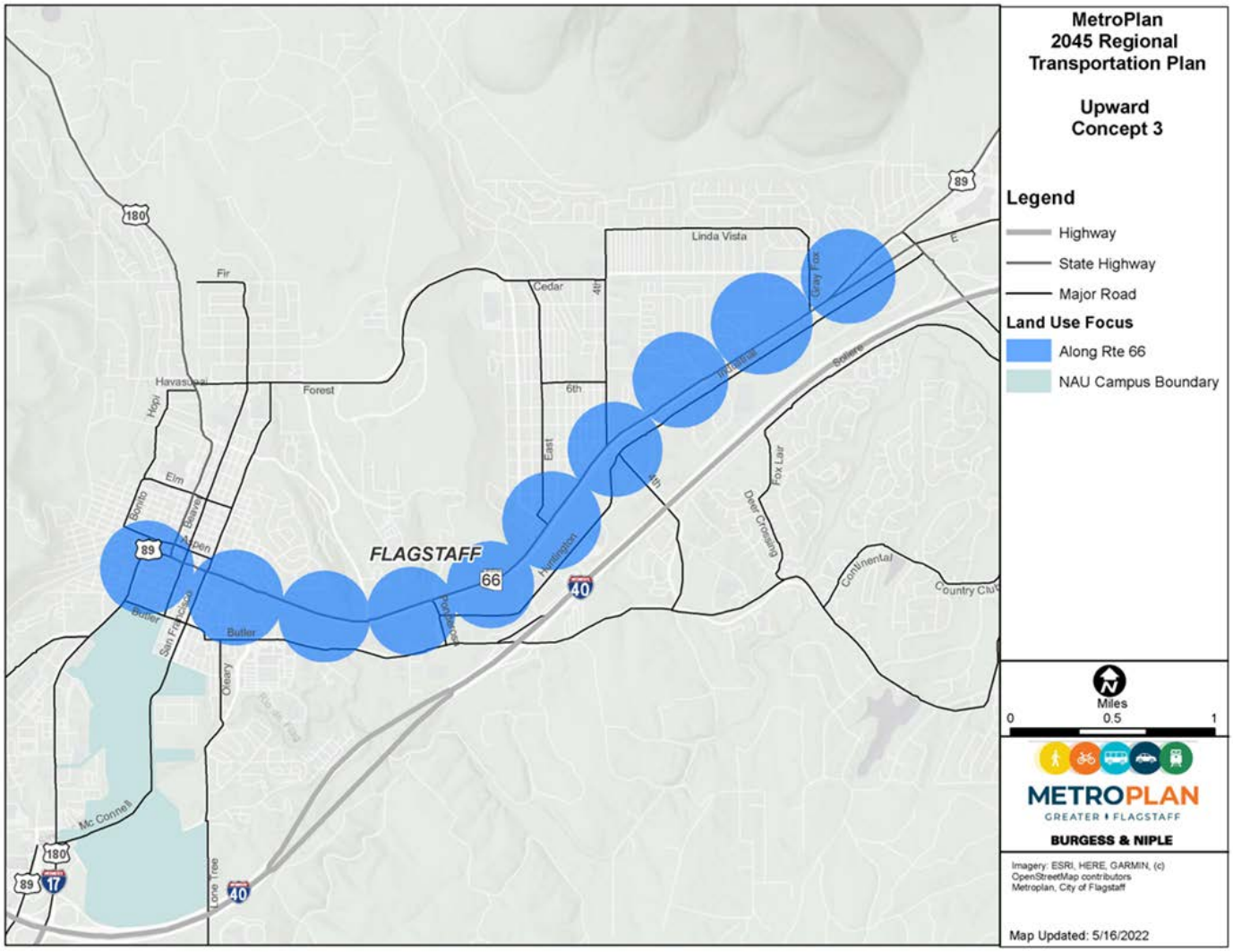


Figure 4 – Upward Concept 3 – Growth Along Route 66



These scenarios were all vetted using the travel demand model and an 80% density intensification to assess whether one would provide an advantage over the others. This analysis indicated performance was comparable; model VMT is summarized in Table 2; model outputs are provided in ***Appendix Up-1***.

Table 2 – Performance of Upward Land Use Concepts

Concept	2045 VMT	2030 VMT	Multimodal Mode Share
Onward	3,450,770	2,820,690	13.0%
Upward Concept 1	3,138,688	2,748,660	16.3%
Upward Concept 2	3,160,463	2,759,548	16.1%
Upward Concept 3	3,248,240	2,803,436	15.4%

The strong similarities in Concept performance allowed flexibility in selection; as such, the Concepts were presented to the Technical Advisory Committee and Advisory Group for input; both groups indicated a preference for Upward Concept 2. Reasons cited include:

- Less pressure on Downtown historic properties when compared to Upward Concept 1

- Vacant land availability
- Redevelopment potential
- Feasibility

Upward Concept 2 was used in all subsequent analyses. For context, in the model environment, the intensified area was approximately 0.7 square miles split between the two areas (downtown and 4th Street).

3.2. Density Targets

After the preferred Upward intensification concept was selected, varying degrees of intensification were modeled in Upward Concept 2. This was done to demonstrate the influence of intensification on performance, vet potential dampening within the intensification strategy, and allow for a comparison of feasibility to effectiveness. Intuitively, higher targets for intensification are progressively more challenging to implement in a real-world environment, which was considered in density target selection. Density intensification of 25%, 50%, 80%, and 100% were modeled; their performance is summarized in **Table 3**; model outputs are provided in ***Appendix Up-1***.

Table 3 – Performance of Various Density Targets

Concept	2045 VMT	2030 VMT	2030 % Over 2019 Target	Multimodal Mode Share
Onward	3,450,770	2,820,690	16.4%	13.0%
Upward – 25% density intensification	3,295,058	2,754,812	14.4%	14.4%
Upward – 50% density intensification	3,250,348	2,735,896	13.8%	15.2%
Upward – 80% density intensification	3,213,785	2,720,428	13.3%	16.2%
Upward – 100% density intensification	3,095,239	2,670,273	11.7%	17.0%

Notably, increasing density of future development provided less benefit than suggested by the literature review. This is attributable to the small amount of growth, 29% by 2045 and less than 12.4% by 2030, balanced against existing population and employment levels and patterns – the proportion of new population and employment in intensified patterns is very low compared to existing, largely suburban patterns. This resulted in an observation of relatively small VMT and mode share benefits gains by greater intensification. Further model manipulation also suggests that allowing some spread for employment – intensification less than 50% - is beneficial to reduce VMT, potentially because there is existing population sprawl. Also, the 2045 transportation network was not revised to reduce congestion in areas with increased density; congestion would cause drivers to take longer routes, so trips starting outside these areas and ending in or near them may be longer with increased density. Lastly, increased employment density in the target areas modeled may attract people to take longer trips (operating under gravity model).

Based on effectiveness and feasibility, the 50% and 80% density intensifications were both considered in the following analyses with Upward Concept 2.

4.0 Multimodal Improvements

The second strategy investigated was multimodal improvements. In a real-world environment, bicycle and pedestrian improvements could include connectivity, system completeness, or enhanced crossings. Transit improvements could include an increased number of stops, frequency, or new routes. These treatments were evaluated using the travel demand model. In the model environment, bicycle, pedestrian, and transit levels of service (LOS) are assigned by TAZ. Pedestrian and bicycle LOS are based on intersection density, external connectivity outside the zone, planned system completeness, and frequency and type of crossings. Uniform, system-wide increases in service were evaluated, which was achieved by multiplying the current TAZ LOS and performing a model run. Transit mode share is reported independently from bicycle and pedestrian mode share, while bicycle and pedestrian mode share are reported jointly.

In addition to uniform increases in LOS, two bus rapid transit (BRT) alternatives were assessed; one with BRT service on Route 66, the second with BRT on Route 66 and Milton Road. TAZ-level transit LOS scores were established for these alternatives using calibrated and validated techniques. Modeling BRT was achieved by increasing the LOS in TAZs along the BRT routes to levels similar to existing Route 10, a BRT through the NAU campus. All other TAZs were subject to the uniform increase factor. Multimodal enhancements were assessed with both the 50% and 80% intensification strategies. Model VMT and multimodal mode share are summarized in **Table 4** and **Table 5**; model outputs are provided in ***Appendix Up-1***.

Table 4 – Performance of Multimodal Improvements with 50% Density

Concept	2045 VMT	2030 VMT	2030 % Over 2019 Target	Multimodal Mode Share
Onward	3,450,770	2,820,690	16.4%	13.0%
Transit/Pedestrian/Bicycle LOS increase 1.5 times	3,181,101	2,706,600	12.9%	17.3%
Transit/Pedestrian/Bicycle LOS increase 2.25 times + BRT on Route 66	3,102,982	2,673,549	11.8%	19.4%
Transit/Pedestrian/Bicycle LOS increase 2.25 times + BRT on Route 66 and Milton Road	3,064,597	2,657,310	11.2%	20.3%
Pedestrian/Bicycle LOS increase 4 times + Transit LOS increase 2 times	2,817,244	2,552,660	7.6%	31.6%
Pedestrian/Bicycle LOS increase 4 times + Transit LOS increase 3 times	2,620,385	2,469,374	4.5%	47.6%

Table 5 – Performance of Multimodal Improvements with 80% Density

Concept	2045 VMT	2030 VMT	2030 % Over 2019 Target	Multimodal Mode Share
Onward	3,450,770	2,820,690	16.4%	13.0%
Transit/Pedestrian/Bicycle LOS increase 1.5 times	3,128,690	2,684,426	12.1%	18.7%
Transit/Pedestrian/Bicycle LOS increase 2.25 times + BRT on Route 66	3,043,552	2,648,406	10.9%	21.2%
Transit/Pedestrian/Bicycle LOS increase 2.25 times + BRT on Route 66 and Milton Road	3,007,334	2,633,083	10.4%	22.1%
Pedestrian/Bicycle LOS increase 4 times + Transit LOS increase 2 times	2,813,640	2,551,135	7.5%	31.0%

The performance of the 50% density increase scenario with pedestrian/bicycle LOS increased 4 times + transit LOS increase 2 times is very comparable to 80% density increase scenario with pedestrian/bicycle LOS increase 3 times + transit LOS increase 2 times in terms of VMT and mode share. When paired with other strategies, these thresholds can

meet VMT goals in the Carbon Neutrality Plan. The information presented in **Table 4** and **Table 5** was shared with the Advisory Group for input. They provided the following input, which was used to select the final Upward Concept:

- Preference for 50% density shift (more feasible)
- Large increases in bicycle and pedestrian LOS were preferred to large increases in transit LOS. Reasons include:
  - Alignment with survey results – public preference to ride a bicycle
  - Bicycle and pedestrian facilities may have a heavier capital cost but typically lower long-term operation and maintenance costs

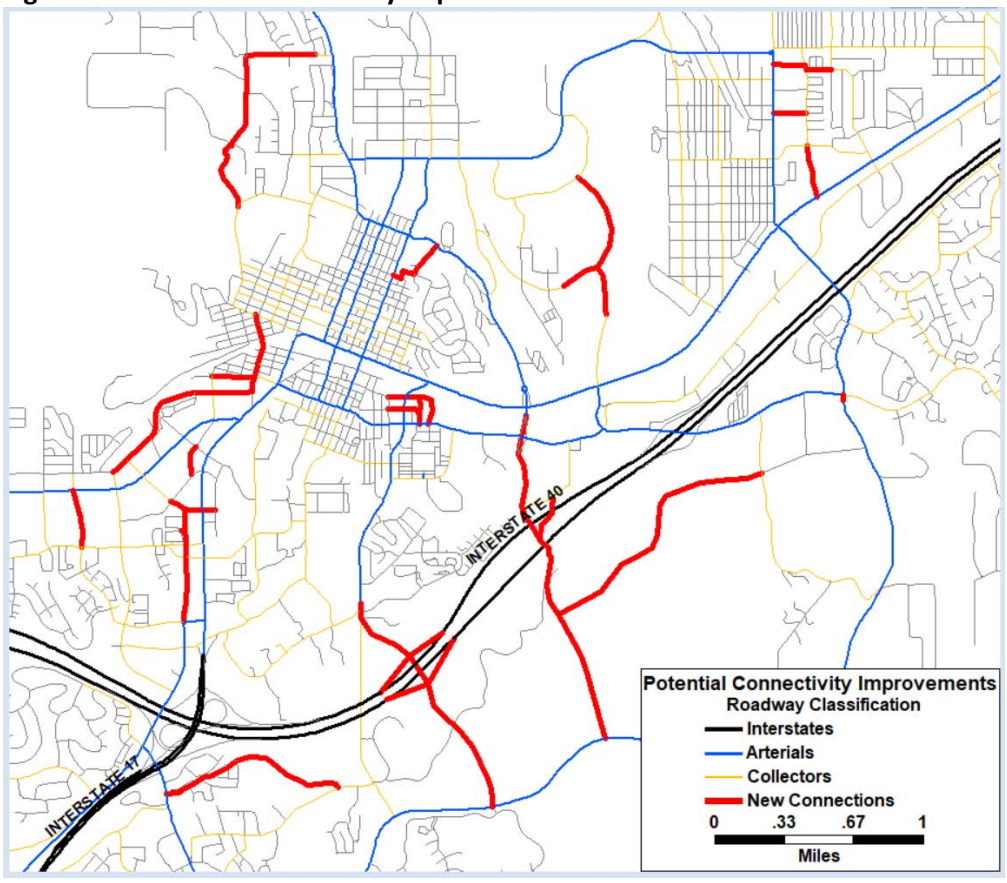
Based on this input, the 50% density increase scenario (target areas only) with pedestrian/bicycle LOS increased 4 times + transit LOS increased 2 times was advanced for use with other strategies and is now referred to as the **Upward Concept.**

From a density perspective, the Upward Concept increases residential dwelling unit (DU) density in target areas by approximately five-fold, shifting from an average density of approximately 3.8 DU/acre to 19.1 DU/acre. Office retail also increased density nearly 2.5 times. Assumption for hotels and schools were also redistributed to accommodate the change in land use for trip generation purposes but do not influence total population and employment.

5.0 Enhanced Connectivity

The third strategy investigated was enhanced roadway connectivity. MetroPlan's Blueprint 2040 RTP considered this as a potential strategy and identified network enhancements that included 16 miles of new roadways, shown in **Figure 5**. This network was leveraged in the model to vet enhanced connectivity.

Figure 5 – Potential Connectivity Improvements



Source: MetroPlan Blueprint 2040 RTP

New connections include:

- Milton Road
  - Yale Street
  - West Route 66
  - Beulah Boulevard
- Fourth Street
  - King Street
  - King Street to Route 66
- Switzer Canyon to J.W. Powell Boulevard

For demonstrative purposes, this network was tested in the 80% density scenario and yielded a 0.2% reduction in VMT, model output is provided in ***Appendix Up-1***. Based on the benefit and cost to implement, it was eliminated from consideration for the time period to 2045. Note that the majority of connectivity miles were added to the arterial and major collector network. Industry research and MetroPlan modeling at the corridor level demonstrate VMT reduction benefits to small blocks with enhanced connectivity.

6.0 Policy and Program Strategies

Policy and program-level strategies like travel demand management were applied uniformly to VMT estimates. These factors cannot be tested in the model environment because there are no mechanisms in the model environment to address them.

6.1. Support Continuance of Work from Home Trend

COVID-19 caused significant disruption to travel patterns; a particularly pronounced and lasting effect is a rise in work from home (WFH). The impact of WFH to overall VMT is complicated. Outside of this RTP effort, the consultant team did internal research to understand how VMT changes across trip purposes (e.g., work, shopping, school) due to WFH or telework. The research is based on the Sacramento Regional Travel Study, conducted in spring 2018, which included questions associated with teleworking. High-level key findings are listed below.

- Teleworking one day per week generally may not be an effective VMT mitigation strategy, as workers who telework one day per week do not generate significantly less VMT than workers who do not telework, compared to teleworking two or more days per week.

- Teleworking, even one day per week, may be an effective VMT reduction strategy for workers who live further away from their workplaces. Workers who live closer to their workplaces, even when they telework four or more days per week, may replace work trips with other trips, resulting in little or no reduction in VMT.

- When VMT is compared across entire households, teleworking is an effective VMT-reduction strategy for one-worker households, but not for multiple-worker households.

- Teleworking may be a more effective strategy in households with kids than households without kids, with the note that sample sizes for this are small and results should therefore be regarded with caution.

- Teleworking may be a more effective VMT reduction strategy for lower income households than for higher income households.

Within the MetroPlan region, approximately 30% of jobs could be performed from home. Per recent trip diary surveys, the average commute length in the MetroPlan region is 5 miles. Per the MetroPlan model, Home-Based Work VMT is

557,285, or 16% of VMT in the Onward 2045 scenario. Various WFH participation was tested to establish a potential reduction that could be recognized in MetroPlan. To be effective, estimates included participation by 50-80% of people that could work from home either 2 or 4 days a week. The impact of this shift could be to reduce VMT by 1.0% to 3.1%, based on best available information. Economic impacts of broad WFH, potential land use changes, and implementation strategies to achieve high WFH rates were not evaluated as part of this analysis. This analysis did not consider potential increase of food delivery services (groceries and meals), Amazon effect, or other services which could influence VMT and could occur in conjunction with increased WFH.

In order to achieve CNP goals, this effort presumed 80% of eligible workers (30% of the workforce) would WFH 4 days a week. The associated VMT reduction is reflected in **Table 6**. Worker and job locations were not considered. In a real-world environment, focusing on workers farther from their employers may help achieve this reduction.

Table 6 – Performance of Multimodal Improvements with 50% Density and WFH

Concept	2045 VMT	2030 VMT	2030 % Over 2019 Target	Multimodal Mode Share
Onward	3,450,770	2,820,690	16.4%	13.0%
Upward	2,729,909	2,473,528	4.5%	31.6%

6.2. Travel Demand Management Program

TDM strategies and their effectiveness were informed by the literature review performed as part of this RTP. For purposes of this analysis, TDM strategies include:

- Bike/pedestrian amenities
- Bike share
- Scooter share
- Car share parking
- Transit pass
- Employer van pool
- Carpool voluntary commute reduction
- TDM marketing
- Rideshare
- Parking fees

Geographic limitations, interaction between strategies (dampening), and participation were estimated to develop a range of effectiveness estimate for each strategy. Strategy effectiveness and associated assumptions are summarized in **Table 7.**

Table 7 – Potential Effectiveness of TDM Strategies										
TDM Strategy[1]	Max VMT reduction		Geography[2]		Interactivity[3]	Trip Purposes HBW/HBU/ HBO/HBS/NHB	Response[4]		TDM VMT Reduction	
	Low	High	Low	High			Low	High	Low	High
End of bicycle/ pedestrian trip amenities	4%	4%	15%	20%	100%	40%	50%	80%	0.13%	0.35%
Bike share	0%	1%	35%	50%	50%	40%	50%	80%	0.01%	0.06%
Scooter share	1%	1%	25%	40%	50%	40%	50%	80%	0.02%	0.06%
Car share parking	15%	18%	15%	20%	33%	100%	50%	80%	0.37%	0.48%
Transit Pass	6%	6%	50%	70%	33%	100%	50%	80%	0.45%	0.51%
Employer van pool	3%	20%	20%	35%	33%	20%	50%	80%	0.02%	0.92%
Carpool voluntary commute reduction	4%	4%	60%	80%	33%	20%	50%	80%	0.08%	0.42%
TDM Marketing	4%	4%	60%	80%	60%	100%	50%	80%	0.72%	0.77%
Rideshare	8%	8%	60%	80%	33%	40%	50%	80%	0.32%	0.84%
Parking fees	30%	30%	15%	20%	33%	60%	50%	80%	0.45%	0.79%
Total Strategies Applied								100%	2.6%	5.2%
								75%	1.9%	3.9%
								50%	1.3%	2.6%

[1]Literature Review
[2]Limits of effectiveness
[3]Related measures assigned equal effect. CAPCOA recognizes dampening effect
[4]Participation within Geography - application limited to a few locations, such as Downtown, mall, major employers, etc.

In order to achieve CNP goals, this effort presumed all of the strategies would be leveraged and that they would be used to the maximum extent feasible for a 5.2% VMT reduction, reflected in **Table 8.**

Table 8 – Performance of Multimodal Improvements with 50% Density, WFH, and TDM				
Concept	2045 VMT	2030 VMT	2030 % Over 2019 Target	Multimodal Mode Share
Onward	3,450,770	2,820,690	16.4%	13.0%
Upward	2,587,954	2,344,904	(0.7%)	31.6%

Combined with other strategies explored, this represents the Upward scenario, which is one path toward achieving the goals in the CNP. This achieves the CNP goal for VMT and makes significant progress toward the mode share goals. In fact, successful TDM implementation would lead to higher multimodal mode share.

7.0 Upward Strategy Summary

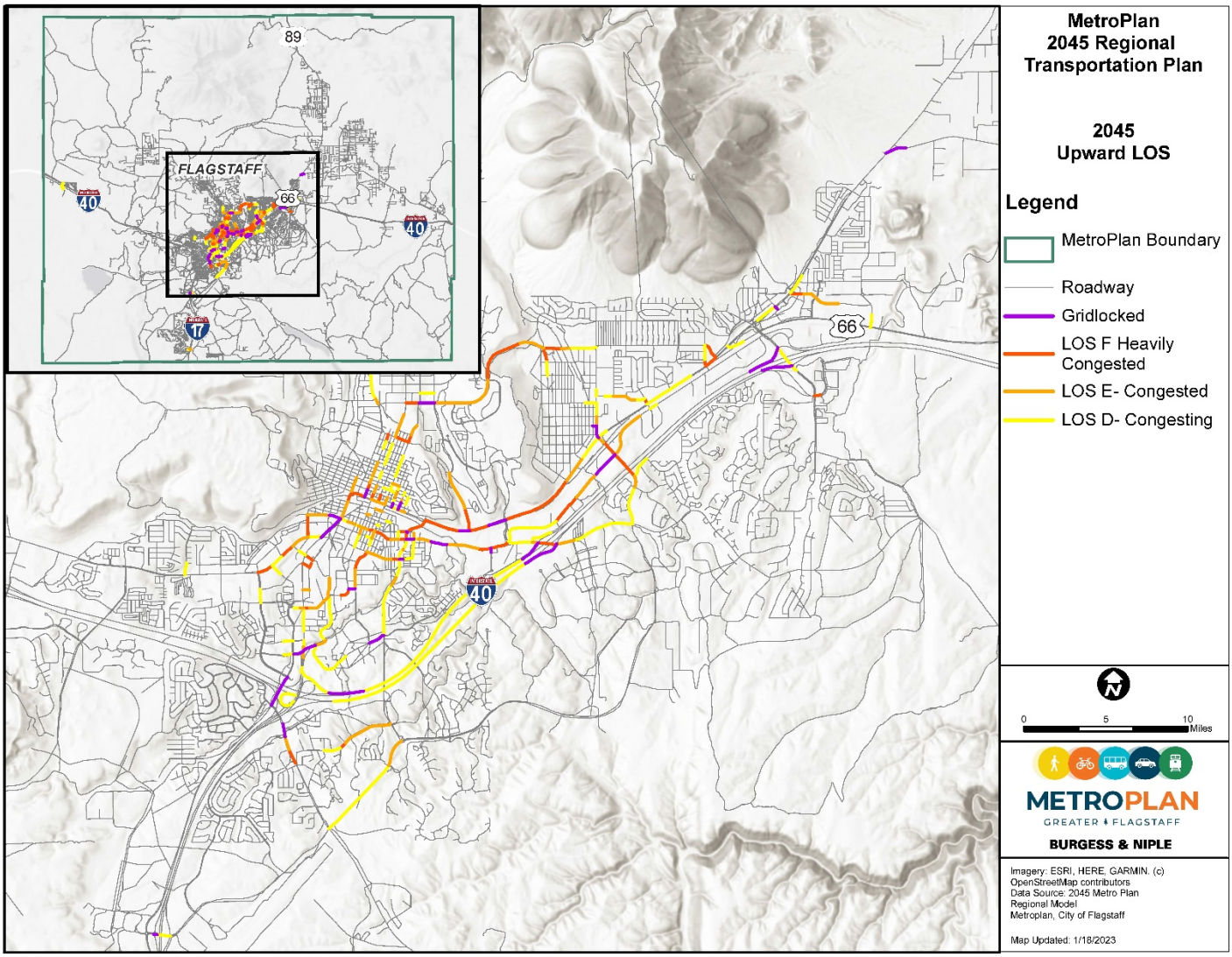
Upward aggressively leverages TDM strategies to achieve the goals of the CNP. Strategies, their associated reduction, and potential lead agencies to implement them are identified in **Table 9.** Upward was evaluated without Proposition 419 and 420 projects as well; their inclusion reduces VMT and VHT. In other words, they are beneficial to both scenarios.

Table 9 – Summary of Upward Strategies and Potential

Strategy	Reduction	Lead Agency
Increased Density - Concentrate 50% of projected future development in target areas	2.6%	Flagstaff/County
Multimodal Improvements - Quadruple quantity/quality of pedestrian and cyclist facilities and double transit service	6.2%	Flagstaff/County/NAIPTA
Policy and Program - Continue WFH trend	3.1%	All
Policy and Program - Implement TDM program	5.2%	MetroPlan
TOTAL		**17.1%**
2030 Reduction Required		**16.4%**
2030 Upward Compared to Target		**(0.7%)**

The 2045 level of service (LOS) associated with Upward is shown in ***Figure 6.***

Figure 6 – Upward 2045 LOS



Many roadways experience improved LOS compared to Onward, including Milton Road, Country Club, Lone Tree Road, J W Powell, and others. Conversely, Cedar and N. Fourth Street experience a degradation in LOS.

8.0 Performance within Flagstaff

Upward model results were assessed to determine performance within Flagstaff (as opposed to the entire MetroPlan region) compared to CNP goals. The model results for 2019 as well as 2045 Onward and Upward were assessed. **Table 10** summarizes performance for the region as a whole; **Table 11** summarizes Flagstaff performance. Note, this excludes benefits from policy and program benefits, including TDM and WFH. Preliminary findings were presented at public meetings in October 2022; findings have been updated to reflect a more refined analysis.

Table 10 – Regional Performance					
	X-X VMT	**I-I VMT**	**X-I VMT**	**I-X VMT**	**Total VMT**
Base 2019	628,000	1,225,000	162,000	146,000	2,160,000
Onward 2045	746,000	1,868,000	244,000	221,000	3,078,000
Upward 2045	742,000	1,338,000	251,000	229,000	2,559,000
Upward 2030	677,000	1,273,000	200,000	182,000	2,329,000
Percent Change from 2019					
Onward 2045	18.8%	52.5%	50.6%	51.4%	42.5%
Upward 2045	18.2%	9.2%	54.9%	56.8%	18.5%
Upward 2030	7.8%	3.9%	23.5%	24.7%	7.8%
Definitions: X-X VMT – VMT from trips that start and end outside the region I-I VMT - VMT from trips that start and end inside the region X-I VMT - VMT from trips that start outside and end inside the region I-X VMT - VMT from trips that start inside and end outside the region					

Table 11 – Flagstaff Performance					
	X-X VMT	**I-I VMT**	**X-I VMT**	**I-X VMT**	**Total VMT**
Base 2019	706,000	836,000	313,000	306,000	2,159,000
Onward 2045	902,000	1,272,000	457,000	445,000	3,076,000
Upward 2045	847,000	881,000	421,000	410,000	2,558,000
Upward 2030	766,000	856,000	359,000	350,000	2,328,000
Percent Change from 2019					
Onward 2045	27.8%	52.2%	46.0%	45.4%	42.5%
Upward 2045	20.0%	5.4%	34.5%	34.0%	18.5%
Upward 2030	8.5%	2.4%	14.7%	14.4%	7.8%
Definitions: X-X VMT – VMT from trips that start and end outside Flagstaff I-I VMT - VMT from trips that start and end inside Flagstaff X-I VMT - VMT from trips that start outside and end inside Flagstaff I-X VMT - VMT from trips that start inside and end outside Flagstaff					

A few key inputs:

- In both Onward and Upward, the majority of the population increase is assumed to occur within Flagstaff, with a higher proportion in Upward.
- The majority of the bicycle, pedestrian, and transit level of service investments modeled in Upward were within Flagstaff.

Key findings:

- Upward infrastructure and transit investments alone do not achieve CNP goals within Flagstaff by 2030.
- Without Upward investments and with the anticipated increase in population, I-I VMT within Flagstaff would increase 52.2% by 2045. With Upward transit and infrastructure investments, I-I VMT in Flagstaff increases 2.4% by 2030 and 5.4% by 2045.
- There is a lower percentage of excess VMT in 2030 when assessing Flagstaff I-I VMT compared to the total VMT for the region as a whole. VMT reduction through TDM management or other means is necessary to achieve the CNP goals; however, more easily attainable goals for that program could be set (e.g., 2.4% reduction in lieu of 3.9%).
- WFH is likely to be less impactful in Flagstaff as an I-I VMT reduction strategy – these represent shorter trips that are more likely to be replaced by other trip types.
- WFH is more likely to be impactful in the County as a VMT reduction strategy.

- Upward offers nearly a 10% reduction by 2045 in each X-X, I-X, and X-I trips and over a 45% reduction in I-I trips by 2045 within Flagstaff.
- The majority of the VMT reduction aligns with the investments made (investments focused in Flagstaff reduced VMT in Flagstaff).

9.0 Upward Performance

Performance measures that support the Carbon Neutrality Plan were vetted as part of *Stride Forward;* ***Table 12*** provides a summary of those used. This summary includes reductions associated with policy and program strategies. Preliminary findings were presented at public meetings in October 2022; these have been updated to reflect a more refined analysis. These performance measures are also used with Onward. Additional performance measures were considered, but not assessed at this time due to data availability or other limitation. The following table assumes default (current trends) in the GHG emissions for a conservative estimate.

Table 12 – Stride Forward Performance Measures

Performance Measure		Target and Baseline	Target Reference	Upward Performance
	Vehicle miles traveled (VMT)	Maintain internal VMT at 2019 levels - 2,160,000 VMT regionally 836,000 Flagstaff internal VMT	Carbon Neutrality Plan	2,140,000 region-wide Outperforms target by 0.9% 784,000 Flagstaff Internal VMT Outperforms target by 6.2%
	Greenhouse Gases (GHGs) from Transportation (Metric tons of carbon dioxide equivalent) (MTCO2e)	Reduce GHGs from transportation by 35% compared to 2030 business as usual - 147,900 MTCO2e	Carbon Neutrality Plan	167,700 MTCO2e 13.4% over target
	Total (%) mode share of walking/biking/ transit trips	54% mode share by 2030	Carbon Neutrality Plan	31.6% 22.4% under target
	Vehicle Hours Traveled (VHT)	No target established	Provides insight to congestion paired with VMT	68,000 hours

VHT is reported, though no target is set. For comparison, Onward VHT was 96,000 hours, more than a 40% increase from Upward. The Carbon Neutrality Plan identifies a goal to have 30% of internal VMT from electric vehicles; that metric was evaluated separately using the ClearPath Forecast Tool to examine its impact and summarized in ***Table 13.*** Both Onward and Upward are reported for comparison. As illustrated, EVs make a significant contribution to achieving GHG emission goals.

Table 13 – GHG Emissions with Varying EV Adoption Rates		
Scenario	**Emissions (MTCO2e)**	**% Relative to Target**
2019 Actual	252,654	170.8%
Onward 2030, default EVs	205,572	139.0%
Onward 2030, 30% EVs	172,902	116.9%
Onward 2030, 50% EVs	***136,025***	***92.0%***
Onward 2045, 30% EVs	211,525	143.0%
Onward 2045, 50% EVs	164,519	111.2%
Upward 2030, default EVs	167,700	113.4%
Upward 2030, 30% EVs	***141,041***	***95.4%***
Upward 2045, 30% EVs	154,298	104.3%
Note: Bold, green text is used to illustrate values that surpass the CNP goal		

Notably, while Upward does not meet the CNP goal for GHG reduction, Upward with 30% EV adoption exceeds the goal, as does Onward with 50% EV adoption. This indicates the role broad EV adoption could have and the extent necessary to achieve CNP goals. Based on a preliminary literature review, EV adoption is anticipated to reach 7-10% of the vehicular fleet by 2030.

10.0 Planning-Level Conceptual Costs

The ambitious nature of Upward creates challenges to formulating specific cost estimates. Order of magnitude cost estimates were derived through coordination with other agencies, including Flagstaff and Mountain Line and are summarized in ***Table 14***.

Table 14 – Planning-Level Conceptual Costs for Upward

Strategy	Planning-Level Cost
Community Design Incentives	Unquantified
Travel Demand Management	Initial cost: $160,000 Full program cost: to be determined
Double Transit Service	$25 million annually
Quadruple Bicycle and Pedestrian Facilities	$394.4 million

Note: Maintenance costs for pedestrian and bicycle facilities will in addition to estimated capital costs. Transit operation and maintenance costs are included in the planning-level cost.

Community Design Incentives

There is no framework to incentivize concentrated development and/or discourage development of undeveloped properties. Undeveloped private property exists away from any development or activity center; its development would create long trips. Allowing taller buildings, reducing parking requirements, and prioritizing public infrastructure investments in targeted growth areas could attract development densification. Other strategies like the purchase of development rights were not investigated as part of this plan but would likely be very costly. Transfer of development rights would require the cost of establishment and administration but also come with uncertainty or no guarantee of success.

Travel Demand Management

The cost to implement a program as robust as needed to achieve a 5.2% reduction in VMT is unknown. However, MetroPlan now receives federal Carbon Reduction Program funds and will staff a TDM program at an initial cost of $80-100,000 leaving $60-80,000 annually for program support.

Double Transit Service

Mountain Line indicated the relationship between service cost and service coverage is roughly linear. As such, the cost to double transit service is estimated to be $25 million annually or approximately double the current cost.

Quadruple Bicycle and Pedestrian Facilities

Flagstaff's Active Transportation Master Plan (ATMP) identifies a wide range of active transportation focused infrastructure enhancements. The outreach, engagement, and analysis performed in conjunction with this effort suggests this is both the most likely and most effective path forward identified to achieve a dramatic increase in bicycle and pedestrian LOS. Implementing all four priority tiers in the ATMP doubles or more these LOS infrastructure components: bike lanes, FUTS and crossings. A simple assumption is to assume quadrupling LOS may cost twice as much as the ATMP. The total ATMP cost is $197.2 million. Doubling that yields $394.4 million. The City has $34.5 million in Proposition 419 and section 5307-5339 grant funds. Therefore, the unfunded planning-level cost for Upward bicycle and pedestrian infrastructure is estimated at $357 million.

There are two important caveats to this high-level planning cost estimate. First, sidewalks in this assumption will be underbuilt. However, the private sector will build many of these. In many low traffic volume neighborhoods where they are missing, their absence does not preclude all walking. Second, the cost method does not factor in two important LOS factors: connectivity internal and external to the TAZ. Again, regulatory reform can direct connectivity in newly developing areas. Retrofitting connectivity to existing development will come at additional cost.

11.0 Conclusion

The VMT reduction goal in the CNP within Flagstaff can be achieved but requires an aggressive approach to achieve the Big Shift. While this scenario explored one approach, the magnitude of land use and multimodal network changes necessary suggest any successful program would need to outpace current progress to achieve these goals by 2030. In a real-world environment, delivering the infrastructure and transit enhancements assumed herein by 2030 would be very challenging, and nearly impossible with current staff availability and fiscal constraints. Shifting future land use patterns presents similar challenges. That said, Upward is hugely impactful in VMT reduction, especially within Flagstaff. Though it is unlikely Upward or a similar approach can be implemented by 2030 to achieve the CNP goals, there is merit to extending the implementation horizon to achieve much of the intent.

VMT within the region has increased since 2019. A potential nearer-term focus (during implementation) could be to maintain VMT per capita or total GHG emissions from transportation. Other communities using a VMT approach toward transportation offer concessions for certain development types (e.g., those near existing transit or low-income housing). The region has a VMT tool for use with development; the region will need to determine how to deploy this tool to reduce VMT and achieve broad community goals.

Appendix Up-1: Upward 2045 Travel Demand Model Results

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Flagstaff MPO 3d Model Daily Summary Report
Roadway Link Performance (excludes connector)
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Directory: C:\Flagstaff Model\Model Runs\Stride22_On&Up\Up_50G_Lp4_Lt2\

3D Model VMT:	2,817,244	
Auto Model VMT:	3,029,862	
3D Model VHT:	67,608	
Auto Model VHT:	91,627	
3D Model Av Delay (Hr):	8,251	
Auto Av Delay (Hr):	24,689	
3D Model Av Speed:	41.7	
Auto Model Av Speed:	33.1	
3D Person Trips:	862,005	
3D Walk Trips & Share:	188,858	21.9
3D Transit Trips & Share:	83,970	9.7
3D Auto Trips & Share:	589,177	68.3
3D Vehicle Trips:	469,288	
Auto Vehicle Trips:	647,421	
3D Av Veh Trip Length:	6.0	
Auto Av Veh Trip Length:	4.7	
3D Av Veh Trip Time:	8.6	
Auto Av Veh Trip Time:	8.5	
3D PM VMT:	229,427	
Auto PM VMT:	217,133	
3D PM VHT:	5,302	
Auto PM VHT:	5,979	
3D PM Av Speed:	43.3	
Auto PM Av Speed:	36.3	
3D PM Delay (Hours):	559.9	
Auto PM Delay (Hours):	1,162.6	