# Sun Corridor
# Value-Impact Analysis (VIA) Module

## User Guide

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# 1. Introduction to User Guide

This User Guide introduces the Value Impact Analysis (VIA) Toolkit and summarizes the needed inputs for scenario analysis using the VIA Toolkit. It provides some insight on how the user can think about preparation of input values into the Toolkit's TREDIS-based interface and also covers the outputs of the VIA Module developed for enhanced reporting of aspects of interest to the VIA Program. The User Guide is accompanied by a Case Study Examples document and Technical Documentation prepared for the Sun Corridor VIA Program under the National Economic Partnerships grant, as well as supporting documentation for features leveraged from the TREDIS framework.

Throughout this User Guide, the term "VIA Toolkit" refers to the capabilities of the TREDIS platform and the features of the added VIA Module as well as the processes for leveraging them. Chapter 2 covers the inputs that compose a scenario. Model constants that are combined with these scenario-specific constants are the purview of the Sun Corridor VIA Technical Documentation. Chapter 3 covers the outputs of a VIA scenario analysis, focusing on the added VIA Module reports. Chapter 4 provides a series of Frequently Asked Questions (FAQs) developed during the course of the Toolkit and Module development.

**In-System Help and Guidance**

In addition to the static documentation of the TREDIS platform that powers the VIA Toolkit analyses which is packaged with these materials, all pages of the TREDIS and VIA Module websites include online help systems that can help a user more quickly find descriptions of Toolkit concepts and suggestions on how to use the inputs and interpret the outputs.

## 1.1 VIA Module Overview

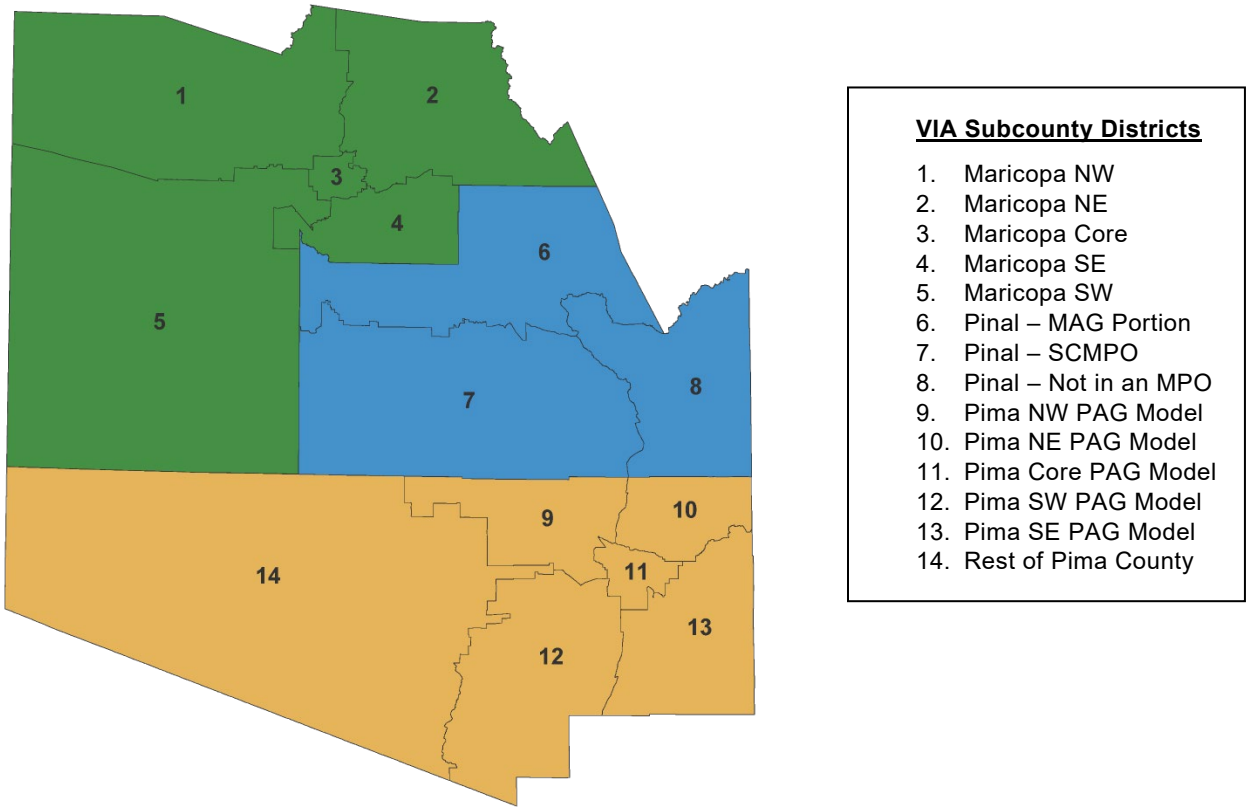
The purpose of the VIA Toolkit is to expand users' economic analysis capabilities by assessing additional regional performance measures beyond the county-scale regional impacts that have typically been available, including those in TREDIS' standard benefit-cost and economic impact analyses.[1] The Toolkit's computational capabilities are delivered through a VIA Module for TREDIS that uses local inputs to estimate the distributional effects of transportation projects on land value and job quality at multiple geographic scales. These scales include the combined megaregion, the MPO modeling jurisdictions, and subcounty geographies.[2] Reporting results at each scale has distinct applications, including Federal coordination, metropolitan planning, and stakeholder engagement.

As a regional economic modeling platform, TREDIS examines impacts geographically. While normally analyzed at the county level, the VIA Module reports results for a series of subcounty districts (Figure 1). The fourteen subcounty districts in the Sun Corridor Megaregion subdivide the three constituent counties and separate metropolitan cores from their surrounding regions, converting an enormous area into more meaningful pieces. Subcounty reporting includes dividing Pinal county into separate MAG, SCMPO, and non-MPO portions, as well as separating out the portion of Pima County that is outside the PAG model region.

[1] See Technical Documentation for the platform on which the VIA Toolkit builds at https://tredis.com/support/tech-docs, which includes the TREDIS User Manual which covers many useful aspects of setting up and interpreting projects when applying the VIA Toolkit.

[2] Defined in the Sun Corridor VIA Technical Documentation.

Figure 1. SCVIA Subcounty Districts




Importantly, the VIA Module also assesses the social equity implications of these distributional effects for a number of communities of concern, including:

— Ethnic and racial minorities, i.e. persons identifying as black or African American, Native American and Alaskan Native, Hispanic and Latinx, Asian American, Native Hawaiian and other Pacific Islanders

— Low-income populations, i.e. those whose median household income falls below the US Federal poverty guidelines

— Populations with disabilities, i.e. those who self-report any of the disability types classified by the US Census Bureau (difficulty with hearing, vision, cognitive, ambulatory, self-care, or independent living)

— Elderly populations, i.e. persons above age 60

— Youth populations, i.e. persons at or below age sixteen

— Populations with limited English language proficiency

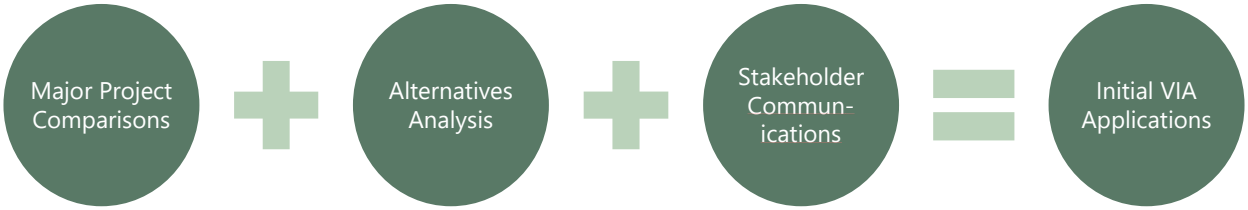
The definition and development of the subcounty districts and communities of concern as well as the details of the land value module and other features of the VIA Toolkit are described in the Sun Corridor VIA Module Technical Documentation.

## 1.2 VIA Toolkit Use Cases

The VIA Toolkit is intended to supplement and build on existing agency business processes to provide new perspectives on projects and programs.

The primary use case for the project is evaluation of regionally significant major infrastructure projects. Many of these projects are major highway corridors that, over the next 20-30 years, may have effects that shape the three Sun Corridor MPOs. The goal of the VIA Toolkit is also to lay the foundation for the evaluation of megaregional projects such as high-speed rail or regional commuter rail. By adding evaluation components for transportation investment that existing modeling resources do not provide in an integrated manner, the VIA Toolkit should support stakeholder outreach around major investment decisions as well as comparisons between major projects and exploration of alternatives for major corridor investments (Figure 2).

Figure 2. Initial VIA Applications Explored During the Program




Many other agencies have used analytic components of the TREDIS platform, which underlies the VIA Toolkit, for types of analysis not initially explored in the Sun Corridor VIA Program. These include the evaluation of funding programs (enabling the comparison between the economic benefits of pavement preservation programs of different sizes or between bridge and pavement programs of a given size), evaluation of programs of work (such as a five-year investment plan or a major transit system redesign), or evaluation of complete plans of projects, either to communicate the value of a 20- to 30-year program versus no action or between different plan alternatives. These uses of the VIA Toolkit are not precluded by any work done during the Sun Corridor VIA Program.

## 1.3 Getting Started with VIA Toolkit Applications

Access the VIA Toolkit computing resources (TREDIS with the VIA Module features enabled) by logging into via.tredis.net using a username and password.[3] This log-in page is previewed in Figure 3 with the credential fields in the red box at the upper right. Under the initial system set-up, two usernames are available for MAG staff that also support SCMPO and one username is available for PAG staff.

By leveraging existing features of the TREDIS platform, the VIA Toolkit uses an existing robust system for managing projects prepared for analysis within the platform. The relationships between user logins, the contracts available to users, and the projects a user can edit or view are well documented in the TREDIS User Manual's Project page.[4] Project management features are available on the first page loaded after log-in into the VIA Toolkit (Figure 4).

[3] It is also possible to access the VIA tool from the standard tredis.net log-in page using a username associated with a VIA-enabled contract.

[4] Available at https://500.tredis.net/Help_Files/help_project.aspx after logging in or as a section of the User Manual (https://tredis.com/images/graphics/User_Docs/TREDIS User Manual.pdf)

Figure 3. The Log-In Screen for the Project at via.tredis.net

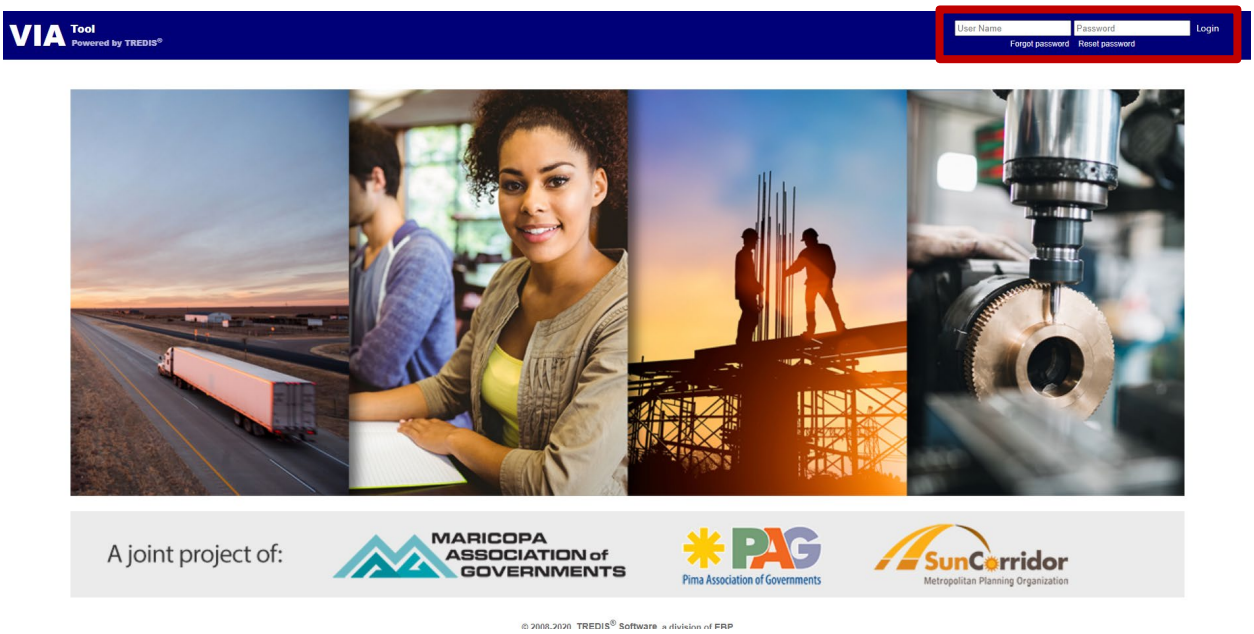
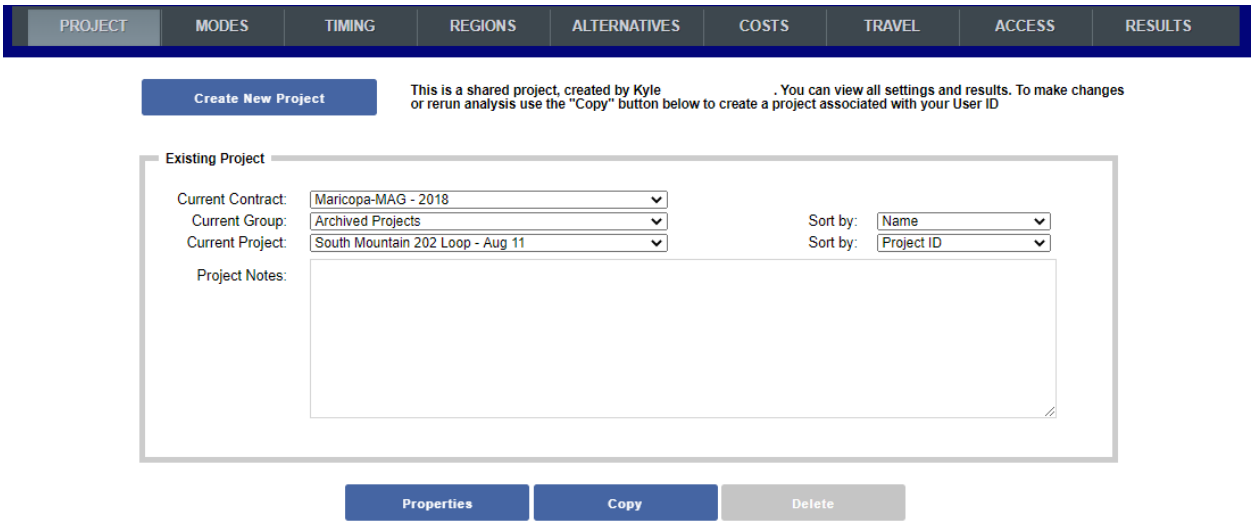



Figure 4. Project Selection Screen




The VIA Toolkit enables collaboration through two primary tools. Project groups allow users to store projects under one umbrella, which is particularly useful for organizations that may use the VIA Toolkit for multiple project categories or rounds of related analysis.[5] Projects can also be shared between users. The default settings make new projects private to the user who created them, so users will need to update this setting as needed to facilitate review by other users. Project sharing settings and a project's assigned group can be modified within the Properties interface opened from the button at the bottom of Figure 4. The following section describes how to set up a project in the VIA Toolkit in more detail.

[5] Available at https://500.tredis.net/Help_Files/help_group_options.aspx after logging in or as a section of the User Manual (https://tredis.com/images/graphics/User_Docs/TREDIS User Manual.pdf)

# 2. VIA Scenario Inputs

This section describes how to use the VIA Toolkit software. Most of the inputs to an analysis with the VIA Module are the same as the inputs to standard TREDIS. The VIA Toolkit inputs are well documented in the TREDIS User Manual[6] and help screens. The objective of this chapter is to summarize input preparation considerations highlighted during the VIA Program processes (including lessons learned during case studies) to leverage the core features and make use of the module's added capabilities.

Section 2.1 discusses the structure of a project to be analyzed in the VIA Toolkit. Many of the terms used to describe scenario analysis in the Toolkit framework may have similar or different meanings in other contexts that benefit from clarification.

Section 2.2 discusses the cost and agency spending data used for estimating the economic impacts of construction and calculating benefit-cost analysis summary menus.

Section 2.3 discusses the travel input components used to measure changes in efficiency, which are a primary input category of interest for megaregional economic impact and societal benefit estimation.

Section 2.4 discuss the new accessibility inputs for the VIA Module, which influence all new reporting options.

Section 2.5 touches on further considerations for applications of the TREDIS framework not considered during the VIA Toolkit development process.

**TREDIS Import Spreadsheet**

In addition to inputting projects through the graphical user interface described in this document and the TREDIS User Manual, it is possible to import multiple projects and export simplified reports on them via a spreadsheet interface that is often used for automated input preparation. See the TREDIS User Manual or request support for details.

## 2.1 Structuring Project Inputs

The User Interface progresses along set up pages that establish the project dimensions that will be used to input project cost, travel, and access data. Each page affects the subsequent pages to ensure consistency across the analysis. The sub-sections that follow are laid out in the hierarchical order of the Travel page (the page that is highlighted in Figure 5, an overview of the full set of primary pages in the TREDIS User Interface). Users navigate between the input pages by clicking along the top navigation bar after completing each page.

Users enter travel characteristics as aggregate or system-average values for the following groups: analysis alternatives, regions, years, modes, and trip purposes. (These might be further divided by periods if desired.) On the Costs page, spending figures are entered by facility, which is determined by the modes selected. On the Access page, inputs that determine dimensions of the VIA Module are limited by the years entered on the Timing page.

Figure 5. The User Interface's Primary Page Navigation Bar

[6] https://tredis.com/images/graphics/User_Docs/TREDIS User Manual.pdf

## Alternatives

The VIA Module focuses on understanding how transportation changes affect the regional economy and society. The Module captures incremental impact, and thus scenarios are always constructed from **two alternatives** (see Figure 6 for a visual presentation). The Toolkit's focus is not to provide broad metrics of a world where the project has been completed, because , although transportation forms an essential component of the region's activities, baseline economic and societal conditions dwarf the impacts even from large projects. The Toolkit's economic baseline is therefore not precisely calibrated to match regional forecasts precisely, as those forecasting methods may change in ways inconsistent with the Toolkit's perspective and will vary significantly across different megaregions or even different regions and agencies within a megaregion. Instead, the Toolkit and the framework it is built on were developed to provide consistent and reliable measures of the incremental impact of projects, as described in detail in the Sun Corridor VIA Technical Documentation and supporting resources.

Figure 6. Focus on Project Impacts as a Difference Between Alternatives

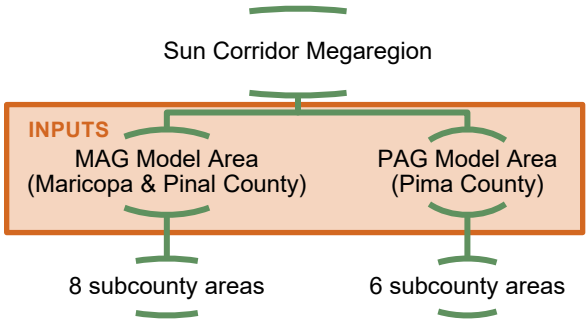
The VIA Toolkit always assumes the user is analyzing a scenario that compares two alternatives. The default alternatives for a project are "Base" and "Project." While these often refer to no-build and build infrastructure alternatives, they can also be different policy alternatives or operational/service alternatives. The alternatives can be renamed if desired to support project management. Because results are reported as the incremental impact and change between alternatives, alternative names are rarely used in outputs and are therefore primarily visible to the analyst.

While the user interface Alternatives page allows addition of more than two scenarios, this is not recommended for most users' workflows. It is typically preferable to create two projects with two alternatives each to conduct comparisons between different options for one corridor, although some users may leverage the Alternatives page for this purpose.

## Regions

The most important geography for the TREDIS platform is the **region**, which refers both to the extents of the travel demand model(s) (TDMs) used and the economic data (based on counties) associated with those extents. These regions represent the middle level of the three geographic levels needed for the VIA Toolkit, which Figure 7 shows. While the travel demand models do not align exactly with the county boundaries, only a few traffic analysis zones (TAZs) are outside the primary counties for the PAG and MAG areas. The VIA Toolkit requires model geographies to be matched to counties as closely as possible for

Figure 7. Hierarchy of Geographies for the VIA Toolkit with the Primary Input Geography Highlighted

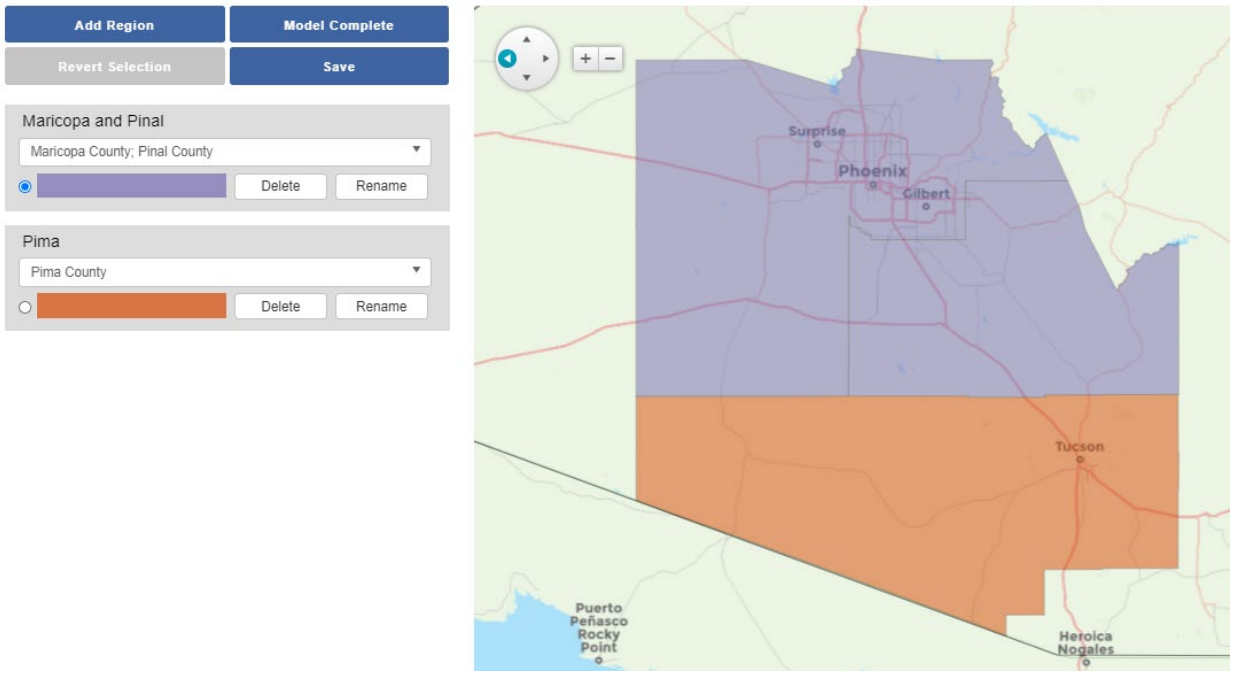


connection between the travel data and economic data. Counties will usually be a satisfactory unit of analysis for other megaregions with multiple MPO jurisdictions, and in most cases a single agency will be responsible for the majority of the activity in a county. Although portions of counties outside of MPO TDM boundaries may be included in the economic analysis, the impact of projects captured in the TDMs on these less dense areas will usually be very small in magnitude compared to the impacts within MPO parts of counties where activity levels, population and employment are much higher. The VIA Toolkit therefore uses county names and “model area” designations interchangeably when discussing TREDIS and VIA Module inputs and outputs.

For TDM model areas that cover multiple counties, users analyzing multi-jurisdictional regions may consider whether to segment TDM results to separately represent different areas’ travel. The county geography or a similar area should still be respected in this case. This option requires additional trip table manipulation and possibly adjustment to other travel characteristics to accurately represent flows between the geographies. This option allows more differentiation of project impacts in places where modeling tools may be shared between MPOs, or where a megaregion is leveraging a statewide model for multi-regional analysis, or if there are significant geographically distinct sub-economies in a region. This application is not explored further in the VIA Toolkit but TREDIS staff, possibly through support services available with the VIA Module subscription, could help test this application if it were judged appropriate for a project. A major project in the SCMPO area may be one such situation associated with the Sun Corridor.

In general, however, despite reporting available for the subcounty geographies, travel inputs should be provided for the entire extent of the TDM. Figure 8 shows a typical Sun Corridor region set-up with the MAG model area as the first region and the PAG model area second. Inputs will not typically be entered for the second region.

Figure 8. A Typical Regions Set-up for Megaregional analysis in the Sun Corridor




See the TREDIS User Manual for more information on setting up multi-regional models and the model build process, which typically takes just a few minutes for a megaregion such as the Sun Corridor.

## Years (Timing Page)

Two pairs of years define a project's extent on the Timing page. The Construction Start and End years define the years that capital spending can be input (for any alternative). Operation Start and End years define the years that operational spending can be input. Operation Start and End years also set the limits for when Travel inputs can be provided. The available years are based on when economic forecast data in the TREDIS framework is available.

The VIA Toolkit is expected to operate with a minimum amount of temporal input, usually a designated **initial year**, which should closely follow the opening of a major project, and a designated **horizon year** of travel forecast.

Travel page inputs do not need to be provided for every year of the range chosen for the Operation years on the Timing page. The TREDIS framework imputes all Operation years not provided directly – before, after or between input years. For logical imputation, at least two years of Travel data should be provided whenever possible.

If an initial year following project opening is not easily available, some TREDIS users occasionally choose to utilize validation year travel data to represent both the base and project initial conditions. In this case, the system would assume steady divergence in conditions from the validation year to the horizon year. This optional step, while helpful when data is not available, typically misses much of the benefit that occurs after project opening before future travel demand growth starts to erode the improvements' incremental effect. Conversely it can also significantly overestimate benefits of a project that may not open for many years.

Another alternative to minimize TDM runs is to input only a single year's model outputs for the horizon year (or opening year) of interest and to set the Operation Start and End years to both be equal to that year. This project set-up does not support benefit-cost measure interpretation but is appropriate for quicker economic impact analysis and societal benefit measure estimation and does support the VIA Module.

The VIA Module's Access page inputs are restricted to five-year increments, for which PAG and MAG have developed detailed SE data that was provided to the project team. As described in Section 2.4, these years will often match Travel input years, but otherwise should simply be matched as closely as possible with Travel data. Some VIA Module results reporting leverages imputation to other years, while other reporting is based only on the years chosen on the Access page.

## Periods (Timing Page)

Both MAG and PAG have four-period TDM outputs available. The Timing page also offers a flexible option for adding these periods by renaming the default "Annual" period and including 3 additional periods. This adjustment dimensions the Travel page to track distinct periods and subsets of traffic volume, such as peak-period congestion. This feature could also be used to analyze separate seasonal traffic patterns or distinguish weekend from weekday traffic, for example.

## Vehicle Types (Modes Page)

The **travel modes** around which inputs are organized should be adapted to the regional TDMs just like all other data for the model. In the development of Sun Corridor VIA applications, data reviews suggested use of TREDIS default modes rather than region-specific modes. For the Sun Corridor agencies, the TDM output modes presented in Table 1 are adjusted slightly to match

TREDIS default modes. Some adjustment of defaults at the scenario level, especially in terms of occupancy, are described in Section 2.3.

Table 1. Output Modes Prepared from the TDMs during the SCVIA Program

| MAG Modes for a Highway Project From TDM | TREDIS Default Mode Used | PAG Modes for a Highway Project From TDM | TREDIS Default Mode Used |
|---|---|---|---|
| — LOV – Vehicle which did not use an HOV-restricted lane during peak period | — Passenger Car | — SOV – Vehicles composed of travelers driving alone | — Passenger Car – SOV |
| — HOV – Vehicle which used an HOV lane | — Passenger Car – HOV | — HOV – Vehicle composed of travelers making Shared Ride trips | — Passenger Car – HOV |
| — Light Truck | — Passenger Car[7] | — Trucks – All freight trucks | — Truck – All |
| — Medium Truck | — Light/Medium Duty Truck | | |
| — Heavy Truck | — Tractor Trailer Truck | | |

In the event that users are combining multiple TDMs, the outputs may need to be reconciled to share a common structure across the different TDMs. Alternatively, it is possible to use unique modes for each TDM based on the Custom Modes capabilities of the TREDIS platform.[8]

In addition to the default truck and auto modes listed above, the VIA Toolkit offers a variety of default options for bus and rail transit, active transportation, on-demand passenger car modes, freight rail, aviation, and more. These are discussed in TREDIS documentation including the Data Sources and Default Values document, but most were not a focus of the initial Sun Corridor VIA Program. The Rural Road BRT case study levered a single transit grouping. This variety of modes may be useful for even larger megaregions which have air transportation travel share or regions with diverse transit options with significant differentiation.

## Purposes (Modes Page)

The economic model uses different **trip purposes** than are commonly found among TDM parameters. The four primary purposes in the TREDIS framework are business, commute, personal and freight. Freight is straight-forward to associate with goods-moving trucks and trains. Matching local data to the passenger purposes can be significantly more involved than matching modes. However, establishing some detail on purposes is essential to economic impact modeling.

While the TREDIS framework does include a No Split or “all-purposes” option for most modes, its use is typically discouraged except for very early sketch analyses. Especially in travel modeling with multiple periods and complex economic geographies, the fixed purpose splits of the mode and other factors will limit the quality of results. Instead, users should, where possible, determine explicit rules for splitting total assigned volumes by mode between purposes or pursue traffic assignment that maintains purpose detail.

[7] The Light/Medium Duty Truck model of TREDIS refers to freight-carrying vehicles and uses cost factors from sources like FHWA for single unit trucks. It is often not consistent with light duty truck models that consider a higher share of service vehicles and trips not for the purpose of delivering freight. Because of this, vehicles from the light truck model are classified as passenger cars which have the best default values for light-duty vehicles. The Light/Medium Duty truck mode is more appropriate for the Medium Truck model.

[8] See the TREDIS User Manual or the help file at https://500.tredis.net/Help_Files/help_MODES.aspx (while logged in).

The commute mode is typically easy to separate from other TDM trips using a home-based work (HBW) purpose. Many other TDM purposes represent various kinds of personal travel. While from a TDM perspective, shopping and recreation trips may have different generation and distribution characteristics, they are treated the same way in economic models and can be grouped. During the Sun Corridor VIA Program, MAG and PAG modeling staff adjusted assignment results reporting to include HBW trips as a separately reported item to represent commuting.

The most important purpose of travel for economic purposes can be difficult to segment in travel models. Business travel should represent trips that have a direct cost or opportunity cost for firms, whether these are commercial services like taxi drivers, plumbers, construction workers, home health agents, realtors, etc., or professionals traveling between meetings or to the airport, for example. We also often refer to business travel as “on-the-clock” travel or perhaps as non-freight commercial travel. Segmenting business travel is essential because these are the hours that result in meaningful changes in business costs or productivity. Even when workers are not paid for their time spent traveling, travel time delays could reduce the number of appointments they can fill in a single day or prevent meetings from starting on time and efficiently.

The US DOT benefit-cost guidance[9] suggests that 11.8 percent of local surface transportation in light duty vehicles can be counted as on-the-clock/business travel. Individual areas may vary and can use local data. Because business travel is not a standard purpose used by planners and modelers, it may be available in existing data but not readily available or obvious to Toolkit users. As an example, based on the AZ oversample in NHTS 2017, business trips represent about 3.17 percent of VMT. This is much lower than the US DOT guideline, but common among many household travel surveys, which explicitly exclude much travel outside of regular household activities including commercial vehicles and local on-the-clock tours such as waste remediation and postal service workers. These may be captured by TDMs through commercial vehicle rather than passenger models. Ambiguity still exists for travelers such as home health aides that might use their personal vehicles to travel between appointments. Regional travel surveys often do not include a question that can differentiate business travel from non-home-based travel for personal reasons such as stopping by the grocery store on the way home from work. However, it may be worthwhile for users to review their latest surveys to determine if they should use a more appropriate regional percentage.

If a definitive local data source cannot be determined, an alternative is to establish heuristics that can be consistently applied and are within the US DOT guidelines.

[9] https://www.transportation.gov/sites/dot.gov/files/2020-01/benefit-cost-analysis-guidance-2020_0.pdf

**How MAG identifies the Business Purpose for their VIA Applications**

MAG's TDM includes a light duty commercial vehicle tour module that is calibrated to observed light truck traffic and distinct from the passenger models or freight truck models. This mode alone represented more than 11.8 percent of light duty traffic and was selected to represent business travel as a single occupancy vehicle at the default average value of travel time savings and other characteristics. Selecting a TDM assignment mode to represent the business travel means that traffic shares, congestion levels, trip lengths and more vary by period to period and over time and alternatives.

**How PAG identifies the Business Purpose for their VIA Applications**

PAG's TDM does not include a default mode representing light duty commercial travel. Instead, as they did with HBW trips, PAG segmented non-home-based (NHB) trips from other trips for tracking during assignment. NHB trips are judged to be the most likely to include on-the-clock trips between job sites, work meetings, etc. However, it is also acknowledged that they include many personal purposes such as trips to the bank, stops for dinner on the way home from work, etc. Because of this, 1/3 of NHB trips were considered business. Additionally, 1/3 of external trips entering or exiting the region were assumed to be business. This represents 10 percent of trips being counted as business and 12.5 percent of VMT.

## 2.2 Costs (or Agency Spending)

The VIA Tool allows agency spending for each alternative to be input using two methods: a Basic Costs page or an Advanced Costs page, each of which are described in the TREDIS User Manual and in-system help screens.[10]

Agency spending has two important uses in the VIA Toolkit. It forms the "cost" part of "benefit-cost analysis." Additionally, it is used to estimate the economic impacts of agency outlays on the regional economy.

From the perspective of BCA, the type of spending does not matter, only the time periods in which it occurs. From the perspective of EIA, the VIA Toolkit offers eight categories for which spending values can be provided:

— **Property Acquisition:** land purchases to provide right-of-way for the project

— **Engineering & Design:** Pre-construction professional services (construction management is typically included in the construction industries that are covered by the following two items)

— **Right of Way Improvements:** Ground-level construction work, like site prep, grading, paving, line painting, landscaping, etc.

— **Transport Structures:** traffic interchanges, bridges, ramps, major highway signage, anything using structural steel or concrete, etc.

— **Vehicles:** service equipment, buses, trainsets, etc.

— **Facilities:** transit stations, maintenance storage facilities, toll booths, rest areas, etc.

— **Operations:** annual recurring cost for snow plowing, toll collection, etc. Also transit operations.

[10] https://401.tredis.net/Help_Files/help_COSTS.aspx

— **Maintenance and Rehab:** annual recurring cost for patching, painting, routine roadside or street sign replacement, mowing, etc.

The first six are capital spending categories that are grouped together in the Basic Costs interface. These are expected to occur during a construction period before project opening that is set on the Timing page. The last two are operating spending categories that occur over the life of the project analysis. Each category involves a different industry mix (which also depends on the type of facility involved).

For most projects, the exact timing of investments and the exact allocation among the categories offered by the VIA Toolkit is not available. This is understandable and this portion of the Toolkit is more forgiving of imprecise inputs than some others may be. Industries are still rough groups with some overlap between them. They do not distinguish between rigid pavement and asphalt, for example, and Right-of-Way and Structures both heavily involve the non-building construction industries. As such, best estimates based on available data are acceptable and data collection and preparation effort should be kept to a reasonable level. It is important to spread investment dollars over a reasonable number of years, if possible, to avoid representing unreasonable demand for construction labor, etc., that affects wage levels and immigration during the construction period that may not be likely. Construction spending should not be too far removed from project opening and the period for which operations have been modeled. It may be appropriate to adjust years on the Timing page to better match construction and spending among the available years in the tool, even if this may not exactly make a probable reality.

## 2.3 Travel Input Components

Outputs from travel analysis (typically TDMs but also other modeling tools and sketch level estimates) serve as inputs to the VIA Module.

The subsections that follow discuss parameters that can be modified to describe scenarios. The TREDIS User Manual and online help systems provide a wealth of overviews.[11] These sections focus on additional context for developing data and lessons learned for the Sun Corridor region during the project effort.

For details on how these scenario input parameters are combined with model parameters to calculate the VIA Toolkit outputs, consult the Sun Corridor VIA Technical Documentation.

### Trips, Distance, and Hours

The basic requirements of an analysis focused on non-transit on-road modes (cars and trucks) include aggregate vehicle trips, vehicle miles traveled (VMT), and vehicle hours traveled (VHT).

In order to estimate benefit-cost ratios and annual economic impacts, the TREDIS framework expects aggregate travel measures to be provided for the year rather than from the daily perspective typically taken by TDMs. This requires the simple use of an annualization factor applied to prepared daily (or period) data. For MAG this factor is 336, while for PAG it is 340. Both numbers are consistent with other planning activities conducted by the agencies.

Trips are primarily important for identifying: 1) if there is any induced activity resulting from transportation improvements and 2) the relationship of trips and their associated mileage and time

[11] A PDF of the User Manual is included with this document in the Toolkit or online at (https://tredis.com/images/graphics/User_Docs/TREDIS User Manual.pdf and the related online resources can be found at https://500.tredis.net/Help_Files/help_travel.aspx after logging in.

to the model regions for assigning economic impacts. Trips are also used as scale factors for reliability and charge variables discussed later.

Time and distance are the principle variables for estimating travel cost changes. Aggregate time and distance are typically prepared from a loaded network file by multiplying volumes for each mode by segment lengths and congested times to traverse the segment and then summing over all segments.

Alternatively, system aggregates could be prepared by multiplying skimmed times and distances between zones by the trip volumes between those zones, as expressed in trip tables. This method may be more consistent with trip counting for some agencies but may also make measuring congestion more difficult without establishing custom skims. This is an especially attractive option for a megaregion where neighboring geographies are available as external zones. Because MAG and PAG both utilize four-step models based on external gates instead of zones, this was not explored extensively as an option for multi-regional analysis. It is also computationally more demanding, which often makes network summary more efficient, however it was necessary for non-network analysis in the Sun Corridor cases studies for modes like transit.

**Public Transportation and Transit Analysis**

For public transportation modes (buses, transit rail modes, intercity and commuter rail), data on person trips, in-vehicle travel time and out-of-vehicle travel time is leveraged for estimating travelers' costs rather than the vehicle variables. Public transportation vehicle metrics primarily affect agency operating costs rather than passenger impacts. Person trips are used in the same way as vehicle trips are described in the prior paragraph and also as the typical scale factor for fare calculations. Person-miles of travel can also be provided to enable use of distance-based fares.

**Considerations for Transit Modeling in the MAG and PAG Regions**

Based on the Rural Road BRT case study, it was determined that the low transit market share in the Sun Corridor Megaregion may limit the appropriateness of full VIA Toolkit applications for transit projects.

Even high-frequency BRT and LRT service may not be able to have a significant enough impact on non-transit shares to meaningfully affect the light duty vehicle skims used for the Land Value Module and VIA reporting. Transit skims were not integrated into this model implementation because they represent such a small share of travel and high-capacity service covers such a small share of the region. The Sun Corridor VIA Technical Documentation discusses this further.

The slight changes to travel time skims due to reduced car traffic as transit became more competitive affected the truck models in a manner that was very small as a proportion of regional traffic but represented a large amount of additional cost from the economic models perspective (see the Case Study Document for details).

Unlike with roadway improvements, changes to transit service provision in the MAG model had a meaningful effect on mode choice, including other modes not summarized for input into the VIA scenario. This necessitates the use of the Trip Balancing features of TREDIS as discussed in the next sub-section.

For transit analysis, it may be preferable to limit the analysis to only passenger modes if commercial vehicle benefits are expected to be negligible. Additionally, if transit services models, or sketch level models are available, these could be explored as an alternative to the TDM inputs.

**Trip Balancing and Induced Travel**

The VIA Toolkit includes tools to account for induced travel that stems from latent demand or attracting travelers from modes outside the region or the scope of modes prepared for input to the VIA software.

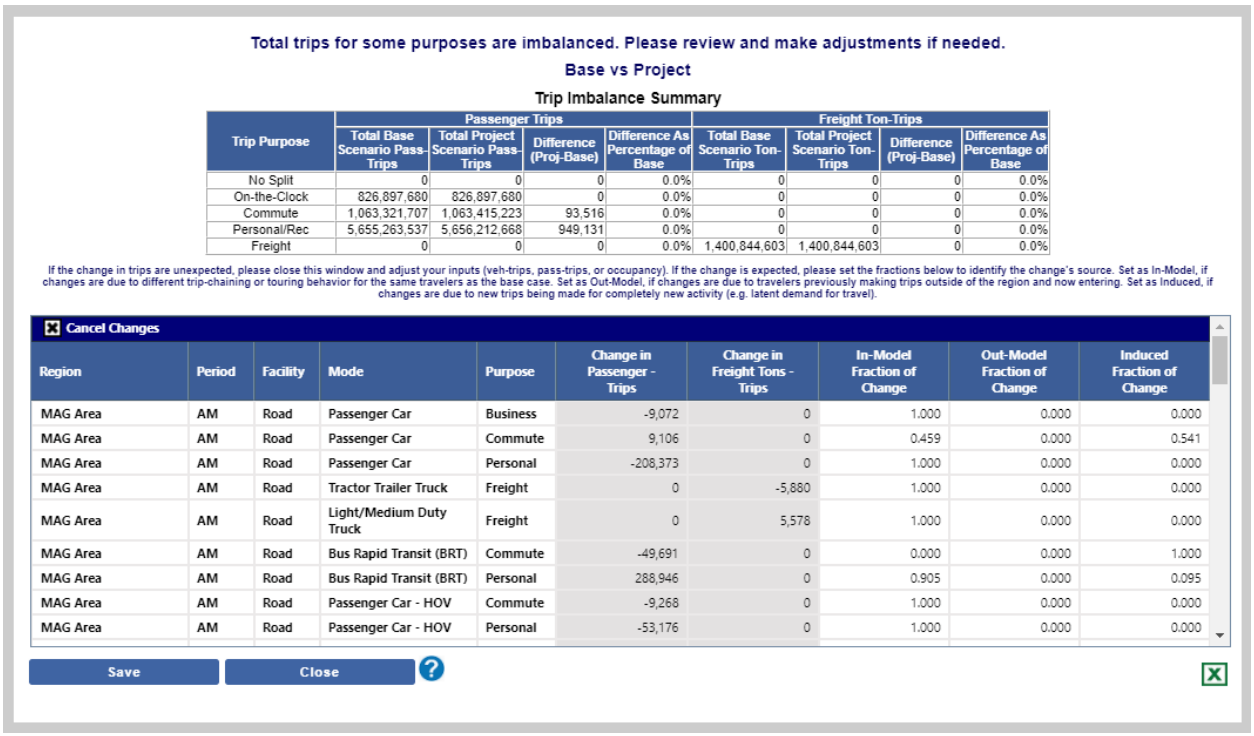
In the MAG and PAG travel demand models, there are no external trips which could be attracted into the model region, so estimating induced travel from outside the study region is more of a concern when modeling a sub-area of a model's overall coverage.

Additionally, MAG and PAG travel demand models do not include trip generation responses to network changes so there is no increase in demand expected from releasing latent trip demand.

However, transit case studies using the MAG model did attract trips from walking and biking or other non-car, non-transit modes. Unless these trips are noted as new trips induced into taking the transit mode by more competitive service characteristics, they will be counted as additional travel cost with negative effects on benefits and impacts. Figure 9 shows the user interface feature where these changes can be noted after saving a year of Travel inputs.[12]

[12] TREDIS Software, Inc., has noted that they are likely to make additional usability improvements to these features in the next year or so.

Figure 9. Trip Balancing Interface



Total trips for some purposes are imbalanced. Please review and make adjustments if needed.

Base vs Project

Trip Imbalance Summary

| Trip Purpose | Passenger Trips | | | | Freight Ton-Trips | | | |
|---|---|---|---|---|---|---|---|---|
| | Total Base Scenario Pass-Trips | Total Project Scenario Pass-Trips | Difference (Proj-Base) | Difference As Percentage of Base | Total Base Scenario Ton-Trips | Total Project Scenario Ton-Trips | Difference (Proj-Base) | Difference As Percentage of Base |
| No Split | 0 | 0 | 0 | 0.0% | 0 | 0 | 0 | 0.0% |
| On-the-Clock | 826,897,680 | 826,897,680 | 0 | 0.0% | 0 | 0 | 0 | 0.0% |
| Commute | 1,063,321,707 | 1,063,415,223 | 93,516 | 0.0% | 0 | 0 | 0 | 0.0% |
| Personal/Rec | 5,655,263,537 | 5,656,212,668 | 949,131 | 0.0% | 0 | 0 | 0 | 0.0% |
| Freight | 0 | 0 | 0 | 0.0% | 1,400,844,603 | 1,400,844,603 | 0 | 0.0% |

If the change in trips are unexpected, please close this window and adjust your inputs (veh-trips, pass-trips, or occupancy). If the change is expected, please set the fractions below to identify the change's source. Set as In-Model, if changes are due to different trip-chaining or touring behavior for the same travelers as the base case. Set as Out-Model, if changes are due to travelers previously making trips outside of the region and now entering. Set as Induced, if changes are due to new trips being made for completely new activity (e.g. latent demand for travel).

Cancel Changes

| Region | Period | Facility | Mode | Purpose | Change in Passenger - Trips | Change in Freight Tons - Trips | In-Model Fraction of Change | Out-Model Fraction of Change | Induced Fraction of Change |
|---|---|---|---|---|---|---|---|---|---|
| MAG Area | AM | Road | Passenger Car | Business | -9,072 | 0 | 1.000 | 0.000 | 0.000 |
| MAG Area | AM | Road | Passenger Car | Commute | 9,106 | 0 | 0.459 | 0.000 | 0.541 |
| MAG Area | AM | Road | Passenger Car | Personal | -208,373 | 0 | 1.000 | 0.000 | 0.000 |
| MAG Area | AM | Road | Tractor Trailer Truck | Freight | 0 | -5,880 | 1.000 | 0.000 | 0.000 |
| MAG Area | AM | Road | Light/Medium Duty Truck | Freight | 0 | 5,578 | 1.000 | 0.000 | 0.000 |
| MAG Area | AM | Road | Bus Rapid Transit (BRT) | Commute | -49,691 | 0 | 0.000 | 0.000 | 1.000 |
| MAG Area | AM | Road | Bus Rapid Transit (BRT) | Personal | 288,946 | 0 | 0.905 | 0.000 | 0.095 |
| MAG Area | AM | Road | Passenger Car - HOV | Commute | -9,268 | 0 | 1.000 | 0.000 | 0.000 |
| MAG Area | AM | Road | Passenger Car - HOV | Personal | -53,176 | 0 | 1.000 | 0.000 | 0.000 |

Save Close

Using the interface, a fraction of the trip changes can be designated as induced, signifying they have chosen to travel because of the improvement in conditions. “Out-Model” changes should only be used for trips that were previously outside of the model region.

## Occupancy

The average crew members per vehicle, average vehicle occupancy, and freight capacity per vehicle are provided as default factors, but can be overridden as needed for scenarios.

For applications by the Sun Corridor agencies, defaults are used for crew levels and freight capacity, while custom passenger vehicle occupancies are input for two types of vehicle.

Transit modes do not use occupancy factors as passengers are reported directly.

**How MAG provides occupancy for their VIA Applications**

As discussed in the Vehicle Types sub-section of the previous Section, MAG's passenger car LOV and HOV modes are based on whether a vehicle utilizes HOV lanes during the assignment process. As such, changes to the network may influence what types of trips use HOV lanes. If more multi-occupant vehicles use traditional facilities, the average occupancy of an LOV increases. Additionally, HOV lane use is unrestricted during off-peak periods, so all vehicles are considered LOVs during those times, causing LOV occupancy to be higher during those times. Because of this, passenger trip and vehicle trip data are used to calculate occupancy rates for each alternative, period, and mode and provided as an input.

**How PAG provides occupancy for their VIA applications**

PAG examined their baseline forecast for the mix of HOV2 and HOV3+ vehicle trips composed of shared ride person trips. The way their assignment modes are specified, SOV's always have only one occupant. It is assumed that projects will not significantly affect mode choice between SOV, HOV2 and HOV3+, so that a constant occupancy factor can be used. This is 2.58 and can be input to the travel grid consistently. There were not significant differences between peak and off-peak occupancies, and further analysis between the four periods was not done. PAG could explore a more dynamic occupancy calculation during future workflow automation if they find occupancy changes are causing unexpected costs and impacts.

## Congestion and Reliability

Users can input the **fraction congested** to indicate the share of travel subject to congestion. Fuel consumption is considered greater under congested conditions in the VIA framework, and users may also apply higher vehicle maintenance costs. Because these cost factors are distance-based, the fraction congested value should represent a percentage of VMT.

For on-road modes, it can be calculated as the fraction of VMT subject to a volume-to-capacity ratio (VCR) greater than 0.9. Depending on individual TDMs' specifications, a different VCR may be appropriate. A level-of-service (LOS) standard could also be used to define congestion levels or any other performance measures used by the agencies. When dealing with system-wide aggregates, the impact of any project can be expected to be small, but the VIA Module estimates total impact in a way that still captures significant corridor improvements.

The VIA Module offers default functionality to estimate the order-of-magnitude reliability consequences of congestion using a built-in relationship between fraction congested and the buffer time[13] index (BTI). Alternatively, the average buffer time per trip can be input directly to the tool, which might be a preferable measure depending on an agency's TDM. The estimation function uses inputs of trips, VHT and fraction congested if direct inputs are not available.

[13] Buffer time, measured in hours per trip, is used to capture the cost of travel time variability. Unreliable travel times cause travelers to make early departures to "buffer" against potential delay and is calculated as the extra scheduling time (in hours) required to ensure an on-time arrival every 19 out of 20 vehicle-trips (95 percent). For example, if a sample trip takes 30 minutes on average, but 1 out of every 20 days it takes 45 minutes, then the buffer time is 0.25 hours (15 minutes).

## Trip Flows Relative to the Region

If a trip is simply passing through the Sun Corridor, it has no economic relationship to firms in the megaregion and only will affect the regional economy through its impact on externalities such as congestion. Cost savings for incoming and outgoing trips are both valued at 50 percent for economic impact analysis; through trips have no economic impact.

The VIA Module provides variables to define the fraction of trips, described as Internal, Incoming, Outgoing, and Through trips by origin and destination. Incoming and outgoing trips are reported separately in the framework to allow freight flows to differ by direction when leveraging some freight data add-ons. The four flow measures can be generated by examining the share of trips that cross the external station gates in a TDM.

The share of other measures, such as VMT, VHT, and buffer time by directional flow, are assumed to be proportional to the share of trips provided by this measure.

## Fuel

All of the fuel variables are provided as default model parameters that prepopulate the Travel page, where other scenario parameters are input. They are therefore optional inputs that can be changed if desired, for instance to model different fuel efficiencies or tax rates between separate policy alternatives.

While default fuel consumption is constant over time, this parameter can account for changes in fuel efficiency over time (e.g., due to changing CAFE standards, electrification, etc.) that could result in different household and business costs and fuel tax revenues. The US Department of Energy publishes an Annual Energy Outlook report that is one possible source of forecasts that can be used for this purpose.

In addition to adjusting fuel consumption parameters for scenarios, the cost per gallon and federal and state taxes by type of fuel can be modified.[14]

## Charges, fees, and tolls

There are four variables that can be entered into the VIA Module to capture payments per vehicle-mile, per vehicle-trip, per person-mile, or per person-trip (or some combination of same). These variables may be used to reflect a variety of different payments from system users to system operators or owners, such as transit fares, parking fees, road usage charges, congestion fees, highway tolls, or other. The variables are intentionally generic and flexible to account for different revenue mechanisms. All the charges represent marginal operating costs of some kind and are not meant to represent ownership costs, such as registration or residential parking.

It is important to include any transportation charges that exist in a region to accurately estimate the cost of travel and household and business cost changes, especially when travelers change modes. Average costs should be used whenever possible.

For MAG and PAG, per-trip transit fees are the only charge currently expected to be used.

[14] Or per kilowatt hour for electrified transit (or electric cars) and gallon-of-gasoline-equivalent (GGE) for compressed natural gas (CNG) vehicles.

## Safety and other Parameters

The VIA Module provides default crash rates, but users can modify them on an alternative-specific basis, if desired. When modeling region-wide travel, it is typically not recommended to use the TREDIS-based safety factors for analyzing improvements to a specific corridor.

If a project is expected to provide significant corridor safety improvements, the crash rates can be zeroed out and benefit values based on other safety analysis tools could be substituted.

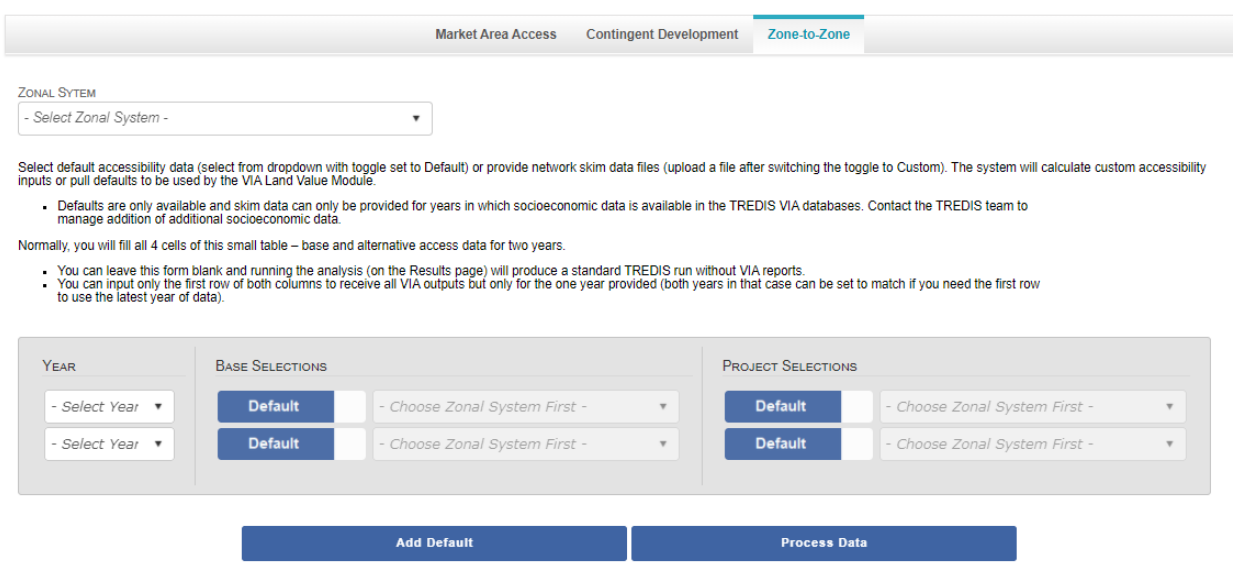
In addition to the travel input parameters discussed here, there are inputs such as the percent of pavement in poor condition (by VMT) that can be used to conduct evaluation of asset management program funding levels, etc. These parameters may be useful for analysis outside the core VIA Module use cases.

## 2.4 Accessibility based on Travel Times Between Zones (Access Page)

The VIA Toolkit requires specific additional inputs beyond those provided by users of standard TREDIS. These include VIA-specific default market accessibility data or user-provided network skims.

The necessary data is input on the Access page within a TREDIS project. The Market Area Access and Contingent Development features of this page are discussed briefly in Section 2.5. The Zone-to-Zone features are only active for VIA Toolkit accounts. Zone-to-Zone inputs are those shown in Figure 10 which represent a different conceptualization of accessibility measures than those on the Market Area Access tab and rely on travel time between zones (typically traffic analysis zones from a travel demand model).

Figure 10. Example VIA Zone-to-Zone Entry Page When Initially Loaded for a new Project




To use this screen to provide the data necessary for accessibility and land value impacts, first select the appropriate Zonal System for the project. For the Sun Corridor and the initial Program, the options for Zonal System include MAG's 2019 TAZs and PAG's 2019 TAZs. Accessibility inputs are currently designed based on single-agency socioeconomic data and travel demand model skims. Accessibility calculations and multiple components of the land value module are calibrated to these zonal systems. Based on the availability of zonal socioeconomic and real estate data and

travel time skim data, the calculations following the Zone-to-Zone inputs could be adapted to many different perspectives.

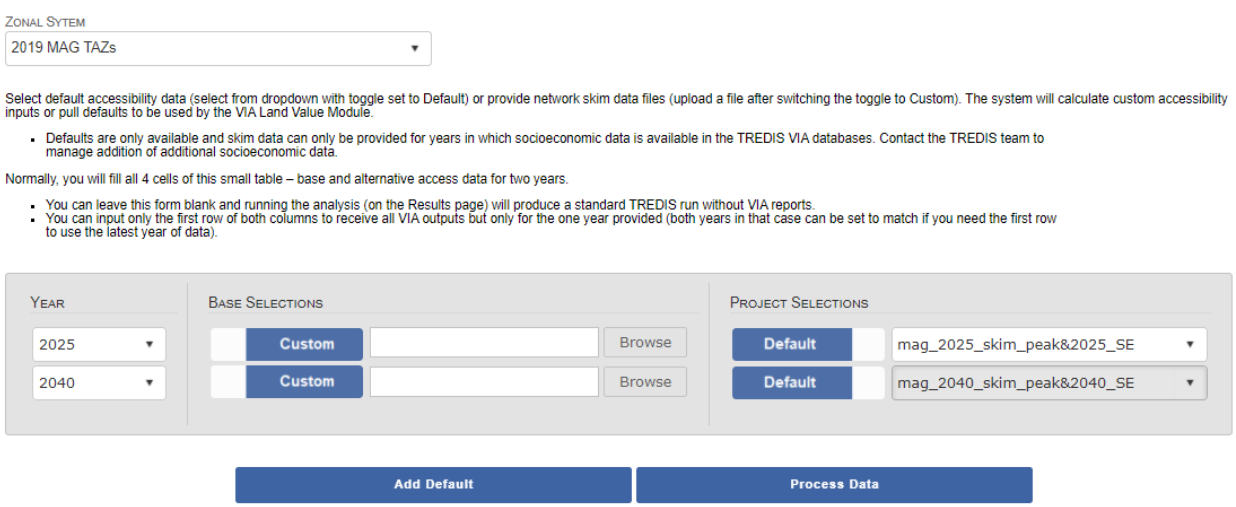
Next, select the analysis years you wish to analyze. These years will typically match the years input on the Travel page if that data was developed using a travel demand model. Many of the VIA Toolkit reports added through the VIA model are only provided for the years shown on this page. There is an option to provide only one year of zone-to-zone access data if additional modeling has not been done for a second year. This year must be entered in the first row of the fields. Only years for which population and employment data for the selected zonal system are available in the databases are available from the dropdown lists.

Once you have selected years, determine whether you will use a prepared default accessibility data set or upload a custom skim. If custom skims are available, toggle the default buttons to the Custom position. Defaults are based on skims that were either provided on software contract set-up or by using the Add Default button. MAG and PAG defaults at the point of contract set-up included baseline forecasts along 5-year increments that included both population and employment growth and network changes expected for those years, as well as a no-build network (2019 existing facilities only) skim combined with their final forecast year's socioeconomic conditions (2040 for MAG and 2045 for PAG).

> Case study examples considered the Build baseline as establishing conditions in the "Project" alternative and removed the facility improvements to generate No-Build conditions that were uploaded as Custom skims.

Default accessibility values can simply be selected from the dropdown lists. Upload any needed custom skims by navigating to the desired file using the Browse button revealed in Figure 11. It will take a few moments to transfer files to the server hosting the VIA Toolkit.

Figure 11. Example of the Zone-to-Zone Entry Page Partially Filled




Once all the necessary inputs have been selected or uploaded, press the Process Data button at the bottom of the page. This will process the custom skims into database tables with indexing for efficient computation of the accessibility measures. Custom skims are combined with preloaded population and employment data and then summarized to zonal accessibility measures. The final step of this process is comparison between alternatives for provision to the land value module and reports. This process could take substantial time as skim tables like those of MAG are very large.

Due to the significant volume of data involved for large regional models, only a single network travel time skim is used. We recommend choosing the PM peak SOV skim to represent the most congested time period – including both standard schedule and alternative schedule commuting. The incremental benefit of this additional data volume is not significant, compared to computational and storage costs for the Sun Corridor region. For regions with high transit shares, it may make sense to enable a VIA Module with both types of skims used for accessibility calculations. When transit mode share is small, transit skims are not expected to drive major labor market effects compared to roadway skims. In some metropolitan areas or for certain industries and real estate types, transit availability and service levels could have significant effects that cannot be captured yet in the Sun Corridor VIA implementation.

## 2.5 Other TREDIS Inputs

The TREDIS framework provides a variety of features which were not the focus of the initial use cases of the VIA Toolkit. These include two other input options available under the Access page.

### Contingent Development

This form provides the option to input regional (county-based) increases in jobs or business sales related to development that relocates to the region contingent on the provision of transportation infrastructure. Inputs are often determined through outreach to developers or the economic development community and are above and beyond regional impacts from travel efficiency changes that are the focus of the VIA Toolkit work.

### Market Area Access

This form allows various inputs related to changes in the number of workers accessible within a labor market boundary of a major employment center of interest to a project (calibrated based on a 40-minute threshold), the number of workers available within a same-day travel market from a major employment center (calibrated based on a 180-minute threshold), and travel times from a point of interest to various passenger and freight intermodal terminals. This module builds on research including the Second Strategic Highway Research Program's C11 project[15] to estimate the economic growth that comes from expanding labor market access, business-to-business and supply chain access, and intermodal connectivity. These economic responses are distinct from and in addition to the travel efficiency effects on regional productivity which the Sun Corridor VIA Program emphasized. They are different from the zone-to-zone perspective developed for the VIA Toolkit, because they are calibrated based on a single point of interest, typically population-weighted centroid of US counties.

VIA Toolkit uses could explore these tools, for which some input measures can be calculated based on the type of socioeconomic data and skims used for zone-to-zone calculations. However, many of these measures are not especially useful for large metropolitan areas like the MAG portion of the region, due to the poly-nucleated nature of labor markets in large metros. They may be of greater interest to PAG and SCMPO among the Sun Corridor agencies.

The TREDIS R&D team has also announced ongoing efforts related to economic impact responses to the exact type of data provided by the Zone-to-Zone inputs as well as forthcoming adjustments to the Area Access features that might be leveraged by VIA Toolkit users.

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[15] Some products of this work can be found at https://planningtools.transportation.org/75/analysis-tools.html where AASHTO currently maintains them as part of the EconWorks suite of tools.

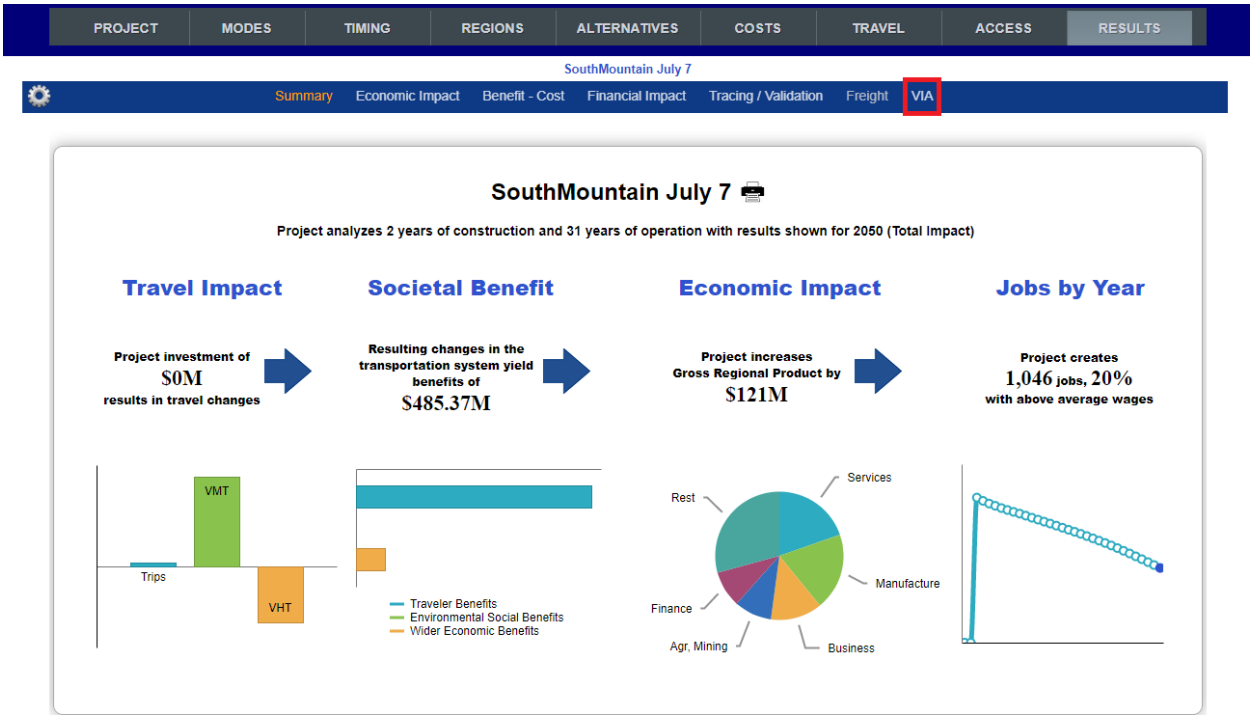
# 3. Scenario Outputs

After completing all scenario inputs, the user is ready to run an analysis. Clicking on the tab along the top navigation bar will advance to the Results Settings[16] page. It is not necessary to change any of the options here in order to run an analysis for the VIA Toolkit. Those of greatest interest to users are the Impact Type field (which defaults to Total, but can be toggled to focus just on Construction or Operational/Travel Performance-derived impacts) and the Industry Aggregation groups.

Once an analysis finishes running in the VIA Toolkit, users see the results summary report (Figure 12). Once an analysis has been run, navigating to the results page will automatically launch the Summary page and provide access to further reports. Users can return to the results settings page by clicking on the gear icon at the right of the results navigation bar.

From the Summary report, those with a VIA subscription can click on the report set titled "VIA" (shown below in the red callout box) to view the value impact analysis results. The VIA Toolkit also includes access to all the standard TREDIS reporting features and can be enabled to include the detail Freight reporting features available with extra freight datasets. The VIA Module results include four sections: Economic Impact, Land Value, Equity, and Tracing, structured similar to the other reporting pages.

Figure 12. Example TREDIS Outputs Summary Page




[16] Available at https://401.tredis.net/Help_Files/help_RESULTS_Settings.aspx after logging in or as a section of the User Manual (https://tredis.com/images/graphics/User_Docs/TREDIS User Manual.pdf).

## 3.1 The TREDIS Output Reports

The TREDIS Tracing/Validation[17] set of reports is essential for VIA Toolkit users to understand how the system interprets the Travel inputs for their project and converts travel performance to cost information that can be used by benefit-cost analysis and economic impact analysis. This is often the first area of the results worth exploring for a new scenario analysis as it may assist in identifying unexpected model behavior. Several of these reports preserve modal detail allowing the user to identify which modes and purposes may be contributing to lower than expected benefits and impacts. The Change in Travel Characteristics, Cost Savings by Type and Cost Savings by Industry reports are especially important for this purpose.

VIA Toolkit users may be interested in exploring the county-based region-level results for Economic Impact[18] for the industry detail available to describe project impacts (up to 544 industries) and for the Impact by Occupation report. While the VIA Economic Impact reports contain the same performance measures for twelve industry aggregations, VIA reports only consider occupational categories in terms of quality of jobs estimates.

VIA Toolkit users also rely on the primary Benefit-Cost reports[19] for all information about how streams of benefits (or costs/disbenefits) are balanced across agency (or private) costs over a project's lifecycle. Because of the perspective of BCA, there was no need to adjust this information to the subcounty district dimension.

## 3.2 VIA Economic Impact

The Economic Impact tab summarizes the modeled results for business output, value added, jobs, and labor income as a result of the project investment (or policy change). The results are organized into a table (Figure 13) and a map (Figure 14). The table reports annual impacts, with expandable menus to show impacts by subcounty district. Users can also expand these district-level results to display impacts by industry sector based on the twelve agent types contained in the Land Value Module.[20] The four economic impact measures available match those from the region-level economic impact reports. Brief definitions are:

— **Business Output** – capturing all sales or receipts (plus spoilage, etc.) by regional firms, this is the most inclusive metric of economic activity.

— **Value Added** – similar to gross domestic product or gross regional product concepts (GDP/GRP), this removes intermediate purchases involved in the production of goods for sale from business output, in a way avoiding double counting components whose value is counted multiple times in long supply chains. Additively it can be described as compensation of employees, taxes paid on production and imports, and gross operating surplus. It is a component of Output.

— **Jobs** – represent position counts rather than FTEs as the economic model is based on data that uses employer records that are not adjusted for hours worked. This is an important nuance to remember when considering labor income per worker and other metrics.

— **Labor Income** – includes sole proprietor income and all workers' wages, salaries, and benefits.

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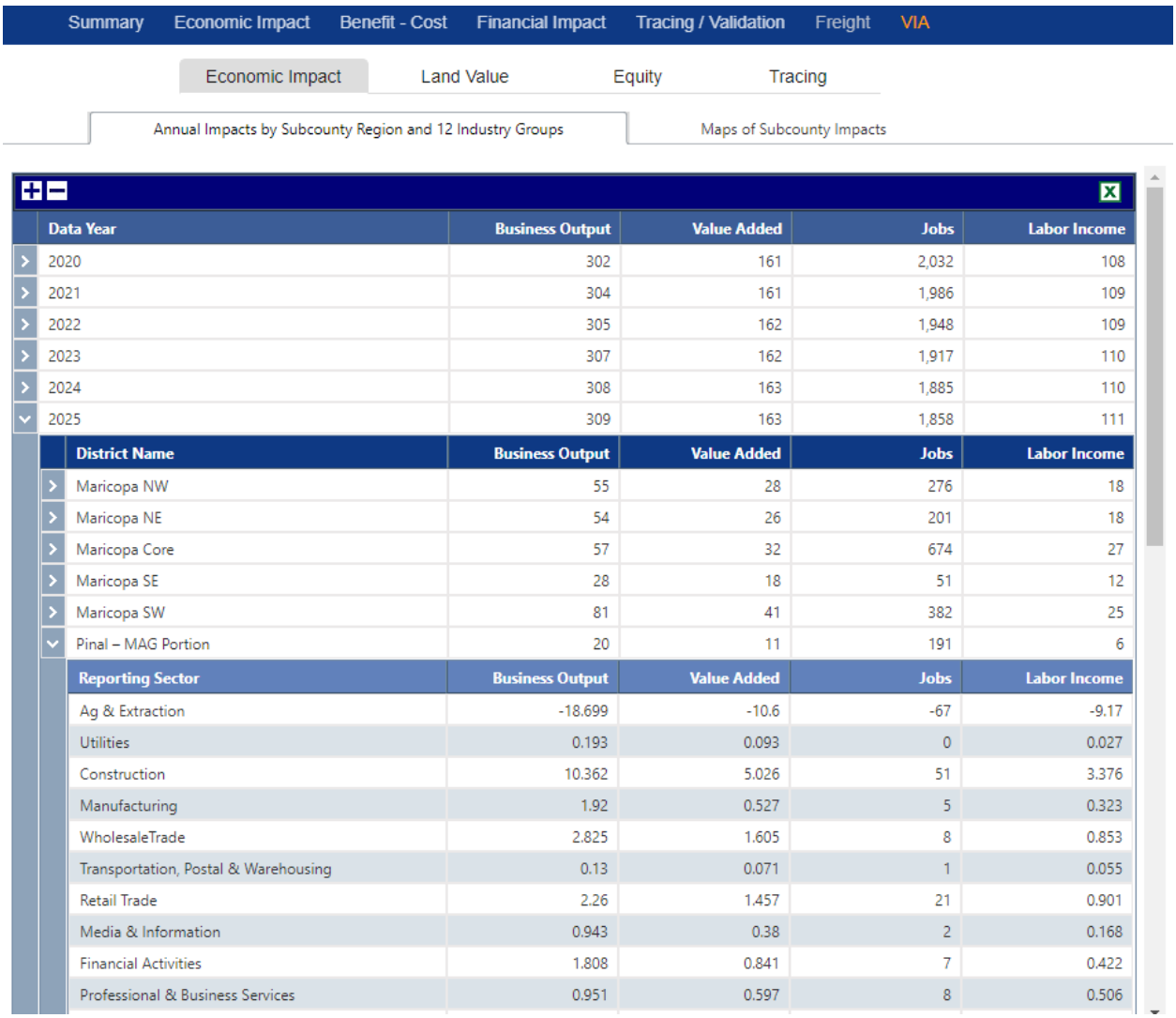
[17] https://401.tredis.net/Help_Files/help_RESULTS_TracingValidation.aspx
[18] https://401.tredis.net/Help_Files/help_RESULTS_EconomicImpact.aspx
[19] https://401.tredis.net/Help_Files/help_results_benefitcost.aspx
[20] See the VIA Technical Documentation for more information on agents role in the LVM.

TREDIS will generate maps of the economic impacts for each of the measures discussed above for each available data year. Simply select the measure and year from the appropriate drop-down menus and click “Submit”. Users may pan around the map, and toggle between displaying the absolute and percent changes modeled. Hovering your mouse over a subcounty district will generate a pop-up with results specific to that district.

Figure 13. VIA Example Results: Economic Impact by Industry

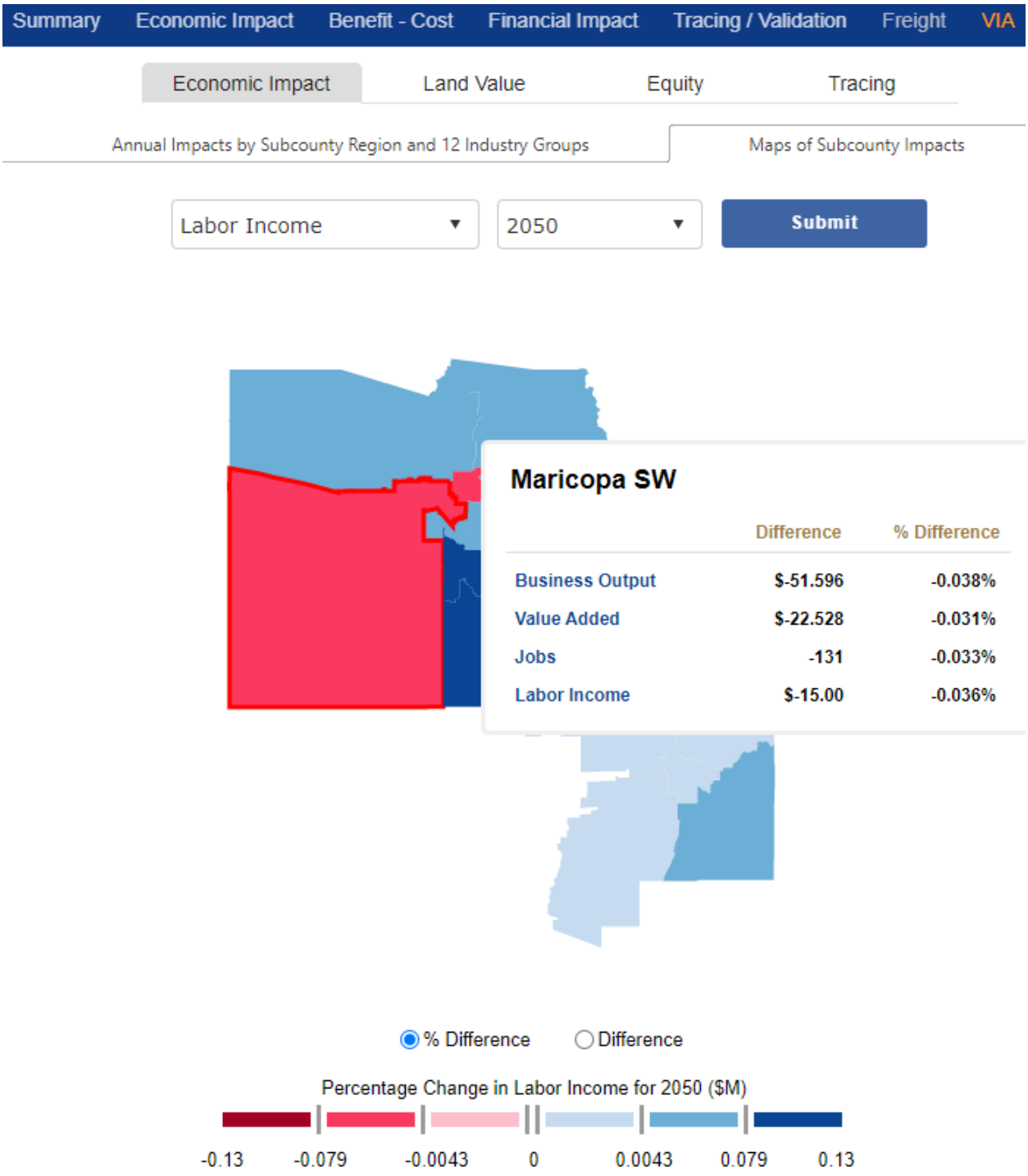



| Data Year | Business Output | Value Added | Jobs | Labor Income |
|---|---|---|---|---|
| 2020 | 302 | 161 | 2,032 | 108 |
| 2021 | 304 | 161 | 1,986 | 109 |
| 2022 | 305 | 162 | 1,948 | 109 |
| 2023 | 307 | 162 | 1,917 | 110 |
| 2024 | 308 | 163 | 1,885 | 110 |
| 2025 | 309 | 163 | 1,858 | 111 |

| District Name | Business Output | Value Added | Jobs | Labor Income |
|---|---|---|---|---|
| Maricopa NW | 55 | 28 | 276 | 18 |
| Maricopa NE | 54 | 26 | 201 | 18 |
| Maricopa Core | 57 | 32 | 674 | 27 |
| Maricopa SE | 28 | 18 | 51 | 12 |
| Maricopa SW | 81 | 41 | 382 | 25 |
| Pinal – MAG Portion | 20 | 11 | 191 | 6 |

| Reporting Sector | Business Output | Value Added | Jobs | Labor Income |
|---|---|---|---|---|
| Ag & Extraction | -18.699 | -10.6 | -67 | -9.17 |
| Utilities | 0.193 | 0.093 | 0 | 0.027 |
| Construction | 10.362 | 5.026 | 51 | 3.376 |
| Manufacturing | 1.92 | 0.527 | 5 | 0.323 |
| WholesaleTrade | 2.825 | 1.605 | 8 | 0.853 |
| Transportation, Postal & Warehousing | 0.13 | 0.071 | 1 | 0.055 |
| Retail Trade | 2.26 | 1.457 | 21 | 0.901 |
| Media & Information | 0.943 | 0.38 | 2 | 0.168 |
| Financial Activities | 1.808 | 0.841 | 7 | 0.422 |
| Professional & Business Services | 0.951 | 0.597 | 8 | 0.506 |

Figure 14. Example VIA Results: Economic Impact Map



## 3.3 VIA Land Value Impacts

The VIA Module presents land value impacts as both maps and tables for years for which accessibility data was provided on the Zone-to-Zone Access page. Measures include the change in prices for five types of real estate (single-family detached housing, multifamily housing units, retail space, industrial space, and other commercial space) as well as single-family home payment-to-income ratios. In maps, these can be viewed as percent changes from the baseline prices modeled for the zone, while the table provides both dollar value changes and percentages. There is also a table that provides the shortage in numbers of units for each type of real estate.

To generate a map, select the measure and the analysis year, and then click “Submit” (Figure 15). Hovering your mouse over a subcounty district will generate a pop-up with results specific to that area. The pop-up displays all six measures of interest, not only the one selected. To avoid attributing false precision to the census tract level estimates, detailed results are only available at the district scale. The module also presents results from the Land Value Impacts as a table (Figure 16).

Figure 15. VIA Example Results: Maps of the Percent Change in 2040 of Housing Cost Burden (Value-to-Income Ratios) in the South Mountain 202 Loop Scenario

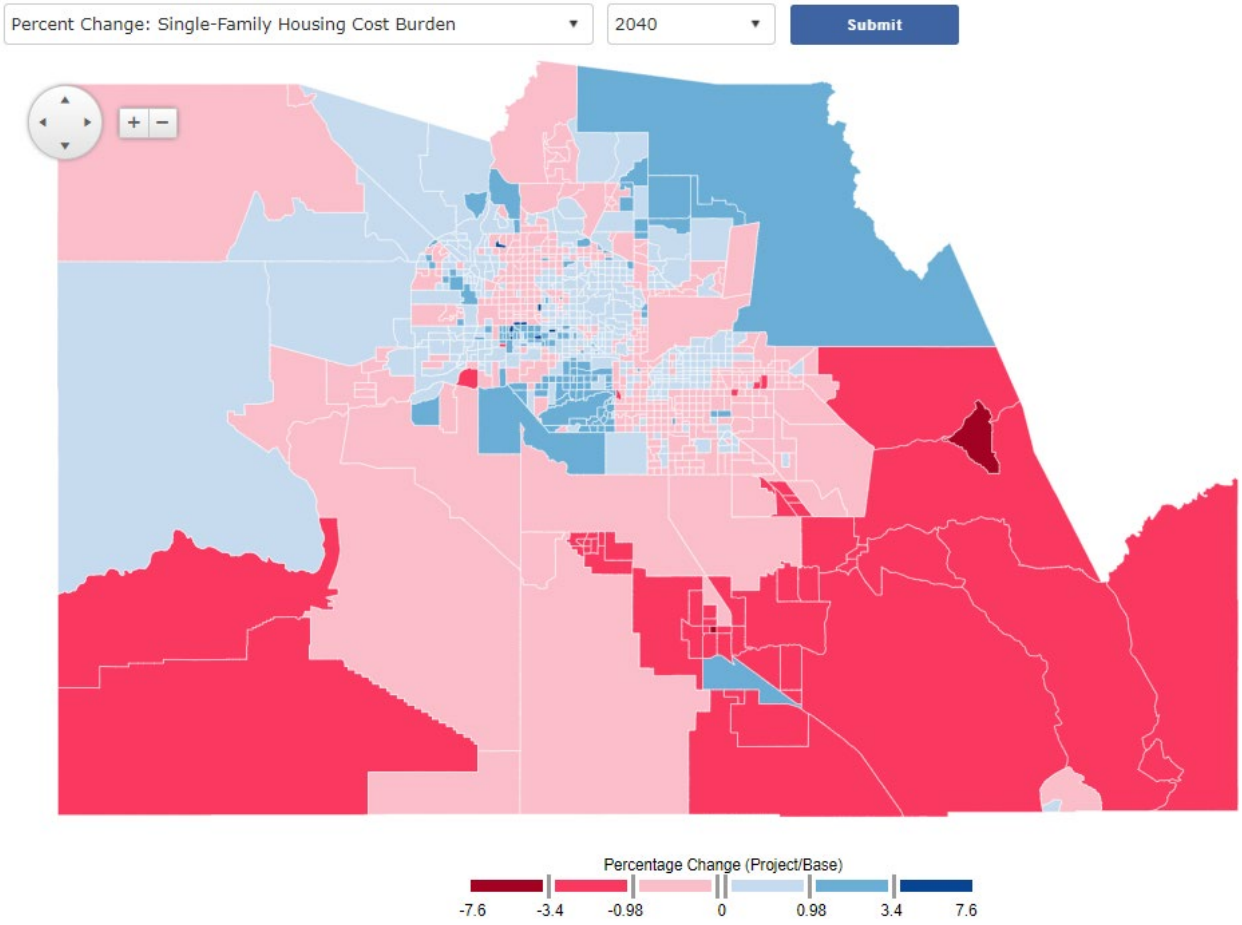


Figure 16. VIA Example Results: Land Value Impact Table

Economic Impact | Land Value | Equity | Tracing

Map | Data 2020 | Data 2040

**Regional Shortfall in Available Units**

| District Name | Single Family | | Multi Family | | Industrial | | Retail | | Other Comm. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Change | % Change | Change | % Change | Change | % Change | Change | % Change | Change | % Change |
| Region-Wide | 810 | 0.06 | 245 | 0.06 | 496 | 0.08 | 292 | 0.07 | 861 | 0.08 |

| District Name | Single Family (per sq.ft.) | | Multi Family (per sq.ft.) | | Industrial (per sq.ft.) | | Retail (per sq.ft.) | | Other Comm. (per sq.ft.) | | Housing Cost Burden | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Change ($) | % Change | Change ($) | % Change | Change ($) | % Change | Change ($) | % Change | Change ($) | % Change | Change | % Change |
| Maricopa NW | 0.25 | 0.25 | -0.34 | -0.43 | 2.50 | 0.63 | 1.15 | 1.27 | 8.83 | 2.73 | 0.04 | 0.15 |
| Maricopa NE | 0.60 | 0.35 | 5.34 | 3.79 | 2.88 | 2.16 | 3.14 | 1.24 | 5.76 | 2.31 | 0.23 | 0.46 |
| Maricopa Core | 0.36 | 0.27 | 0.94 | 1.01 | 3.33 | 3.09 | 1.08 | 1.27 | 5.97 | 6.95 | 0.10 | 0.29 |
| Maricopa SE | 0.04 | 0.04 | 0.90 | 0.89 | 4.40 | 3.59 | 1.40 | 1.19 | 3.73 | 2.84 | 0.00 | 0.01 |
| Maricopa SW | 0.07 | 0.08 | -0.37 | -0.47 | 2.54 | 2.38 | 1.95 | 0.70 | 34.12 | 9.54 | 0.11 | 0.46 |
| Pinal – MAG Portion | -0.65 | -0.78 | -0.31 | -0.58 | 3.13 | 4.38 | 0.38 | 0.83 | 63.38 | 5.83 | -0.16 | -0.74 |
| Pinal – SCMPO | -0.74 | -1.36 | 0.66 | 1.91 | 1.97 | 4.87 | 0.19 | 0.61 | 2.38 | 3.78 | -0.20 | -1.22 |
| Pinal – Not in an MPO | -0.70 | -1.49 | 0.03 | 0.08 | 0.45 | 2.09 | 0.08 | 0.38 | 0.84 | 3.61 | -0.12 | -0.61 |

## 3.4 VIA Equity Reports

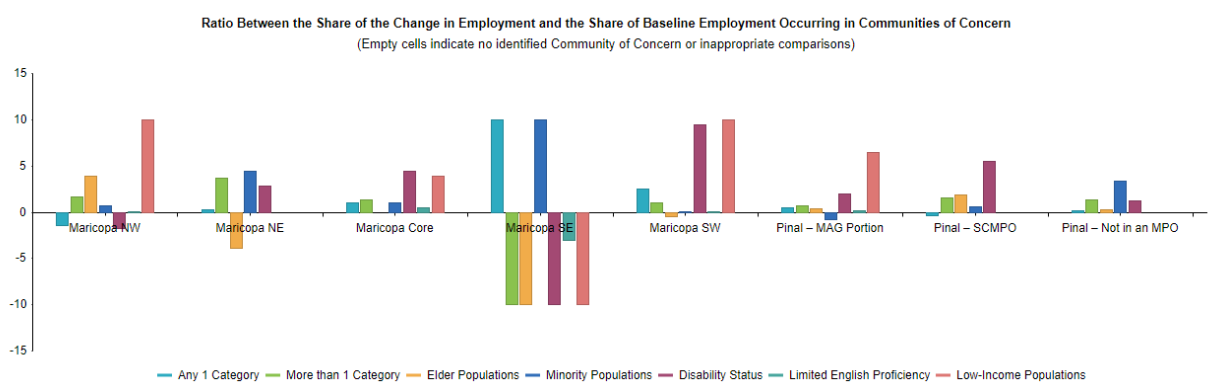
The VIA tool displays the results of the equity analysis for each subcounty district, including changes in the number of jobs, changes in access to jobs, and changes in the quality of jobs. (For more information on the equity analysis, see the Technical Documentation for the VIA Module.) The tool includes a tab for each of these dimensions.

The first tab shows the change in jobs by equity category, i.e. for each Community of Concern analyzed (Figure 17). This includes a bar chart indicating whether a given community of concern in a subcounty district gains more or less (or loses) jobs from the project impact compared to their share of tract jobs in the baseline. For example, in Maricopa NE, tracts identified as a majority minority community gain about a five times larger share of jobs supported by the project than were present in those tracts in the baseline. Jobs in tracts over the threshold defining elderly communities of concern actually decrease based on the land use distribution model. This information is also contained in a table beneath the chart.

Figure 17. VIA Example Results: Change in Jobs by Equity Category

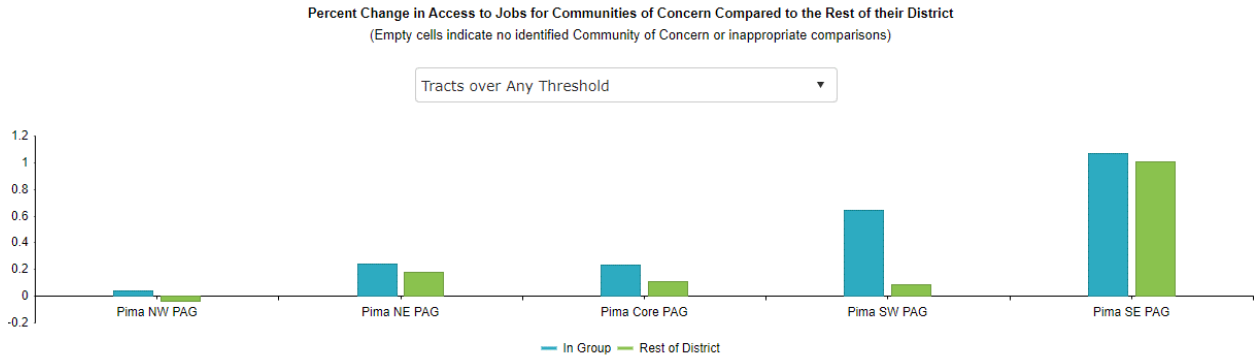
Economic Impact | Land Value | Equity | Tracing

Change in Jobs by Equity Category - 2020 | Change in Access to Jobs by Equity Category – 2020 | Quality of Jobs by Sub-County Region



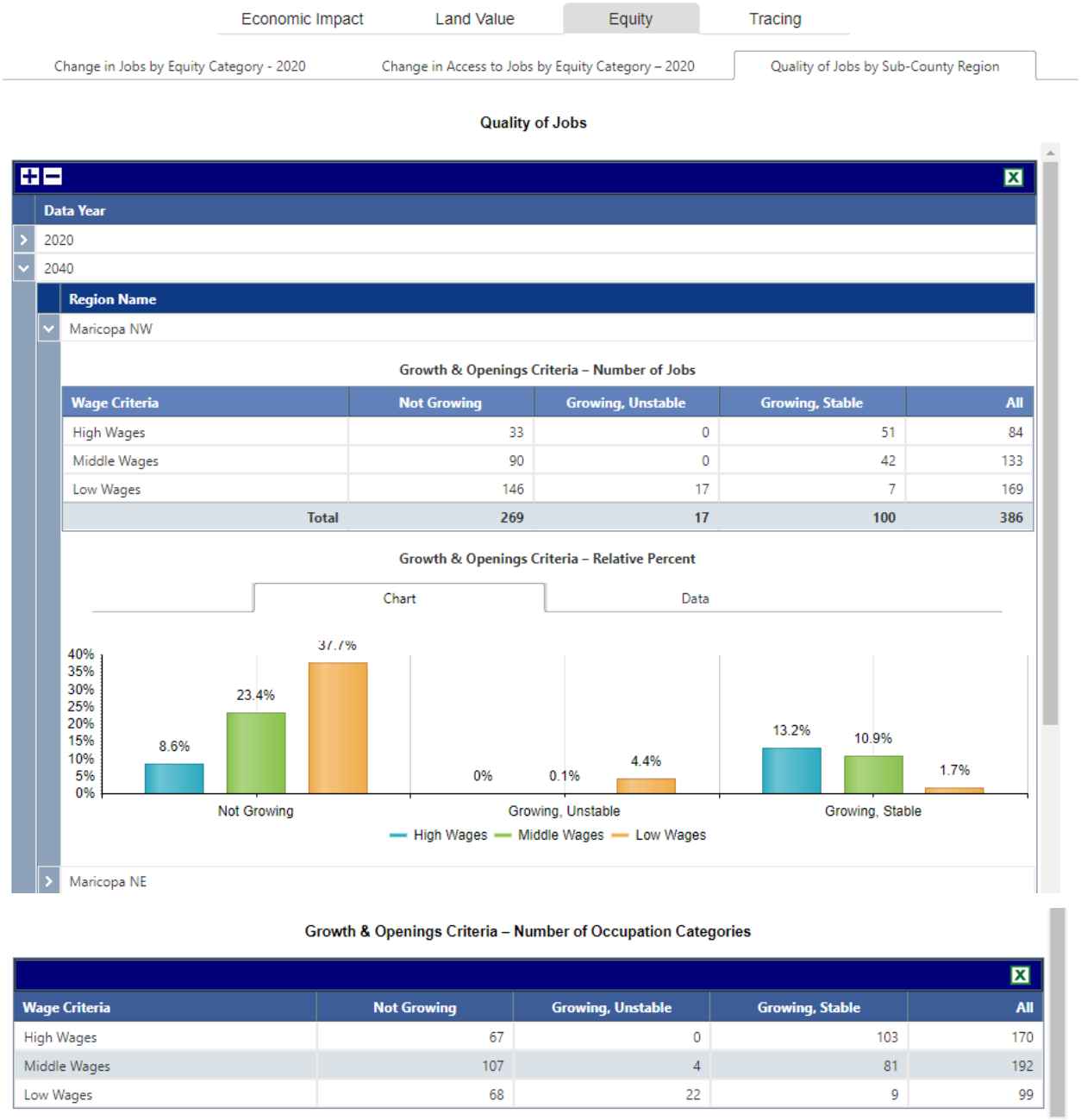
The second tab shows the change in jobs by equity category, i.e. for each Community of Concern analyzed (Figure 18). This includes a bar chart indicating whether a given community of concern in a subcounty district experiences a differential impact from that experienced by the portion of the subcounty district that is not considered part of the Community of Concern. For example, in Maricopa SW, access to jobs in tracts containing any Communities of Concern increases by about double that of other tracts in the district. By contrast, tracts crossing any thresholds and tracts crossing none experience similar outcomes in Maricopa NE. This information is also contained in a table beneath the chart.

Figure 18. VIA Example Results: Change in Access to Jobs by Equity Category




The third tab shows the change in the quality of jobs in each subcounty district (Figure 19). (For more information on the Good Jobs analysis, see the Technical Documentation for the VIA Module.) The expandable table allows users to examine effects for different analysis years and districts. The detailed tables present change statistics for jobs of different wage and growth and openings categories. For example, in Maricopa NW, jobs in growing occupations with low turnover that offer good or and middle wages represent 24 percent of the jobs supported by the project. This report is also now available on the primary Economic Impact set of reports for the county-based regions.

Figure 19. VIA Example Results: Change in Quality of Jobs by Subcounty District




## 3.5 VIA Tracing Reports

The VIA tool displays the results of the overall tracing analysis for each subcounty district in the rightmost tab. This includes maps that detail changes in access to jobs between scenarios (Figure 20), as well as a map displaying the distribution of Communities of Concern in the region (Figure 21). Each map shows pop-up boxes when a user hovers their cursor over a tract in the map. The accessibility map pop-up shows the base and project differences, while the equity map pop-up shows detailed information about the presence of different Communities of Concern in the selected tract.

Figure 20. VIA Example Results: Tracing Access to Jobs by Tract

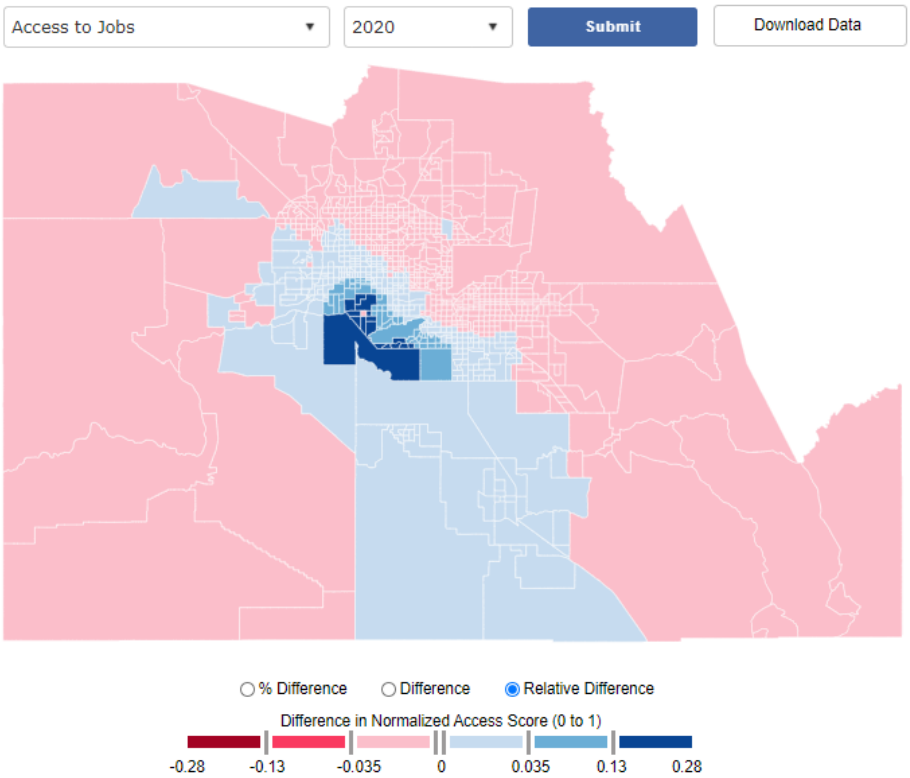
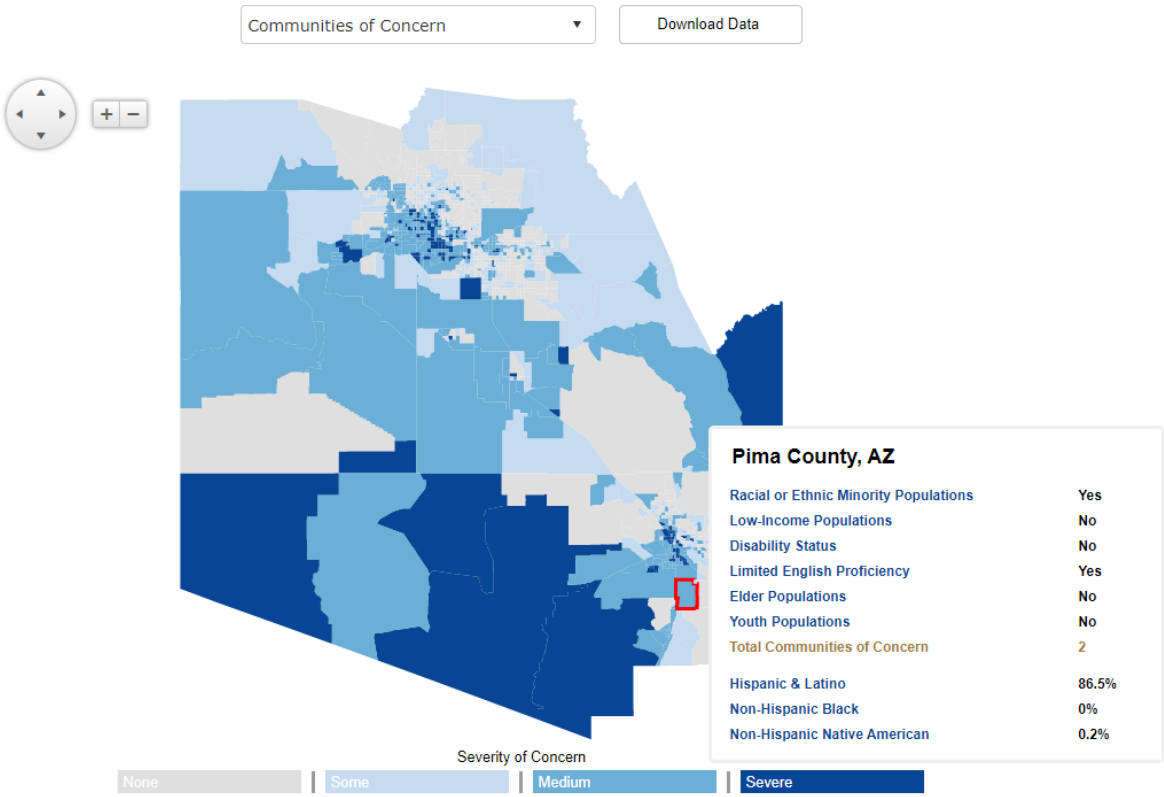



Figure 21. VIA Example Results: Tracing Communities of Concern



# 4. Frequently Asked Questions

**Q: I have never used anything like TREDIS before. How should I even start?**

**A:** No matter what you may think, there is nothing mysterious about TREDIS and the VIA Toolkit. The core TREDIS documentation goes into detail about how the software works, including the concepts behind each analysis.[21] There are a few good practices that those unaccustomed to using TREDIS may find helpful in getting started with the VIA Toolkit:

1) Build your project in the Toolkit before you prepare the inputs. This gives users access to all of the subsequent input pages, allowing you to figure out what you will need and how to arrange it.
2) Have a look at the input template files.[22] This will help you figure out how to organize whatever comes out of your travel model and construction/O&M cost estimators into the format the Toolkit needs to run. However, you do not need to redefine your own model to fit the Toolkit. As long as you can establish some correspondence, reformatting may be simple.
3) Contact TREDIS Support (support@tredis.com). Every annual subscription (including the VIA Toolkit) comes with 10 hours of support or training – reach out which questions, problems with your projects, or to set up a training or refresher for you and your colleagues.

**Q: What makes the VIA Toolkit different from other models or tools?**

**A:** By building on top of TREDIS, the Toolkit offers the possibility to cover all modes – including air, marine and non-motorized modes, as well as road and rail transportation. It follows through by showing how interactions and connectivity among modes makes a difference, and it uses that information to enable comprehensive coverage of wider economic benefits. The VIA Toolkit also provides views of economic impacts and benefits from alternative spatial, governmental, and private sector perspectives. This is important because most public decisions are made by governmental agencies that represent specific spatial areas and constituencies.

The Toolkit offers a consistent framework for Benefit Cost Analysis and Economic Impact Analysis, as well as new insights into transportation effects on land value and equity and distributional impacts. Rather than using numerous tools to derive these insights, the VIA Toolkit identifies overlap between these methods and how they can be used to support each other.

**Q: How should I decide whether the VIA Toolkit is appropriate to evaluate a given project?**

**A:** The VIA Toolkit is most useful to evaluate "significant" projects. This is to say, the Toolkit can evaluate smaller projects such as a one-mile road diet, and the subcounty functionality may reveal more than standard TREDIS' regional focus, but effects still may not register in the results depending on the project.

However, we encourage users to evaluate projects that are significant according to their own definitions. These can use cost thresholds, i.e. only evaluate projects costing above a certain amount, or using relative local understanding, i.e. a project or projects that deemed important to the region, the state, a program, etc. Many of the outputs of the Toolkit are denominated in

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[21] See https://tredis.com/support/tech-docs for documents like TREDIS Quick Start, the TREDIS User Manual, and Technical Documentation of the core modules.

[22] Available from the expandable menu at the top right after logging into TREDIS, on the User Resources page.

millions of dollars so projects with costs of that type of magnitude or travel time savings in the 100,000s of hours are most likely to show insightful results.

**Q: Do I need custom modes?**

**A:** No. Custom modes are useful if you have something specific you are trying to model. However, if you have correspondence with an existing Toolkit mode, simply substitute the names.

For example, Figure 22 shows the approach used to establish correspondence between PAG's travel model outputs and the Toolkit for the I-10/SR-210 case study. PAG's defaults combined mode and purpose, as well as used different labels than the Toolkit. In order to make them fit with existing Toolkit modes, we simply added a new column that matched a TREDIS default mode to a PAG default mode. Subsequent annualization and other calculations were conducted with formulas in a separate tab in the Toolkit format (Figure 23).

Figure 22: Example Input Correspondence I

G3 =INDEX('Names-ModePurpose'!$B$2:$B$10, MATCH(TravelReceived!$F3, 'Names-ModePurpose'!$A$2:$A$10, 0))

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Travel Performance - Base and with Project | | | | | | | | |
| 2 | Project Name | Year | Alternative | TREDIS Alternati | Perio | Default Mode/Purpos | TREDIS Mode | TREDIS Purpose | Occupan |
| 3 | I-10/SR210 SCVIA Case Study | 2019 | Base (no-build) | Base | AM | SOV_NHB | Passenger Car - SOV | Business | 1 |
| 4 | I-10/SR210 SCVIA Case Study | 2019 | Base (no-build) | Base | AM | SOV_HBW | Passenger Car - SOV | Commute | 1 |
| 5 | I-10/SR210 SCVIA Case Study | 2019 | Base (no-build) | Base | AM | SOV_Other | Passenger Car - SOV | Personal | 1 |
| 6 | I-10/SR210 SCVIA Case Study | 2019 | Base (no-build) | Base | AM | HOV_NHB | Passenger Car - HOV | Business | 2.58 |
| 7 | I-10/SR210 SCVIA Case Study | 2019 | Base (no-build) | Base | AM | HOV_HBW | Passenger Car - HOV | Commute | 2.58 |
| 8 | I-10/SR210 SCVIA Case Study | 2019 | Base (no-build) | Base | AM | HOV_Other | Passenger Car - HOV | Personal | 2.58 |
| 9 | I-10/SR210 SCVIA Case Study | 2019 | Base (no-build) | Base | AM | PC_ExternalTrips | None | External | |
| 10 | I-10/SR210 SCVIA Case Study | 2019 | Base (no-build) | Base | AM | Medium Duty Trucks | All Trucks | Freight | |
| 11 | I-10/SR210 SCVIA Case Study | 2019 | Base (no-build) | Base | AM | Heavy Duty Trucks | All Trucks | Freight | |

Figure 23: Example Input Correspondence II

F7 =Assump!$C$8*(TravelReceived!J42*Assump!$C$12+TravelReceived!J45*Assump!$C$14*(1-Assump!$C$10))

| | A | B | C | D | E | F | G | H | M | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | Alternative | Region | Period | Mode | Purpose | Period Veh-Trips | Period VMT | Period VHT | Avg Crew Members per Ve | Avg Veh Occupancy | Freight US Tons per Veh |
| 7 | Base | Pima | AM | Passenger Car - HOV | Business | 2,068,483 | 37,267,949 | 816,195 | 0 | 2.58 | 0 |
| 8 | Base | Pima | AM | Passenger Car - HOV | Commute | 2,649,497 | 39,437,313 | 1,044,703 | 0 | 2.58 | 0 |
| 9 | Base | Pima | AM | Passenger Car - HOV | Personal | 33,214,435 | 263,133,620 | 7,526,641 | 0 | 2.58 | 0 |
| 10 | Base | Pima | AM | Passenger Car - SOV | Business | 6,769,328 | 68,157,794 | 1,788,780 | 0 | 1 | 0 |
| 11 | Base | Pima | AM | Passenger Car - SOV | Commute | 39,056,652 | 430,884,985 | 13,191,413 | 0 | 1 | 0 |
| 12 | Base | Pima | AM | Passenger Car - SOV | Personal | 52,352,995 | 403,402,555 | 12,084,434 | 0 | 1 | 0 |
| 13 | Base | Pima | AM | All Trucks | Freight | 6,628,125 | 58,729,091 | 1,510,444 | 1 | 0 | 12.29 |

**Q: Can I still analyze a project if I do not have cost information?**

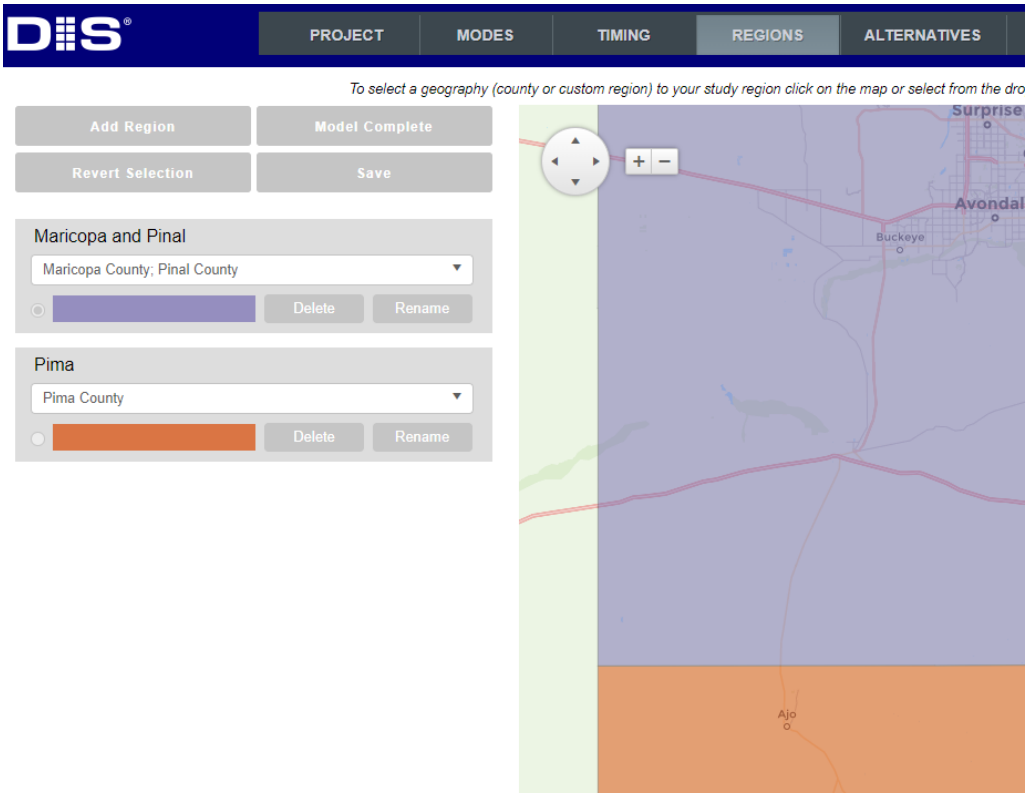
**A:** Yes! The Toolkit will still analyze the economic impacts of travel changes, as construction and maintenance costs do not influence these calculations. However, note that the benefit-cost analysis will not report results in terms of benefit-cost ratios.

**Q: I am analyzing a project in the MAG region, i.e., Pinal and Maricopa Counties. What do I do in the Regions tab?**

**A:** Make two regions! With a few exceptions, it will usually be important to the analyst to separately examine effects in the MAG and PAG regions. To do this, select the appropriate

counties and retitle the first region for MAG, and then create a second region with Pima County alone as the PAG region (Figure 24).

Figure 24: Multi-Region Input Example




**Q: My project has a really high benefit-cost ratio but almost no economic impacts. How can that be?**

**A:** A lot of transportation projects save travelers time that provide a lot of societal benefit. However, if these time savings don't affect business productivity through freight transportation costs or effects on the productivity of business travelers and on-the-clock workers, the economy does not see effects of these improvements. Make sure you are accurately capturing benefits from business and commercial vehicles in your VIA Toolkit inputs.

**Q: Why are my project's benefits so small?**

**A:** One reason could be that the travel information was never annualized – leading to reporting of daily impacts and benefits instead of annual values (which is the expected scale).

Alternatively, check the Change in Travel Characteristics Report in the Tracing/Validation set for any unexpected changes in VMT or PHT. Perhaps some data was transferred from the model incorrectly or one mode is behaving differently than expected.

**Q: I'm not sure the scale of my project is appropriate for using the VIA Toolkit. How should I proceed?**

**A:** If your project already exists in any modeling, we suggest you try to prepare several quick exploratory iterations in the webtool. Toolkit components can run very quickly to provide you rough estimates and help you decided whether to proceed further and if any model results look discouraging.

Skip adding in your megaregional partners on the Regions page for faster run-times of the economic model.

Rather than separating business and commute purposes for passenger cars, just enter all travel from your default assignment modes as personal travel – for exploratory analysis you should focus on benefit cost results and the Cost Savings by Type report – at least for the first run.

There is no need to provide travel model skims for a quick exploratory analysis. By skipping the Zone-to-Zone settings on the Access page, running an analysis will not initiate the land value module – the longest running portion of the VIA Toolkit. Although you will not have access to the VIA Module reports, county-based region results should be available within 5-10 minutes.

**Q: My colleague shared their project with me so I can help them, but I am not able to make any changes. How can I adjust their inputs to complete the analysis?**

**A:** Project sharing supports review of projects by colleagues and other VIA Toolkit users in your megaregion. However, the TREDIS framework does not support editing of other users projects both to make sure it's always clear who was the last person to modify a project and also to prevent multiple users from trying to edit and run the same project at the same time.

Instead of editing your colleagues project, use the copy tool available as a button at the bottom of the Project page to create your own copy. Feel free to share your version with other users right away as well. (There is no notification process when a new project is shared, but it will be immediately visible in other accounts.)

**Q: Is TREDIS a benefit-cost tool or an economic impact tool?**

**A:** TREDIS provides both types of analysis within the broader context of a "decision support system." It provides a way to conduct and apply economic analysis (of benefit, costs and impacts) to inform public discussion of transportation-related policies and plans. And it provides a basis for project prioritization, ranking and funding decisions.

**Q: Are there any special system requirements to install and run VIA Toolkit analyses?**

**A:** There are no computer system requirements for use of the VIA Toolkit. The system is provided via an internet web site portal, using cloud-based servers. That allows you to access from nearly anywhere in the world, using nearly any computer hardware and software system that allows for internet access. You can even access the Toolkit from a tablet computer or smartphone using your username and password.

**Q: Why does MAG enter their Light Truck assignment mode data as Passenger Car – Business in TREDIS?**

**A:** The Passenger Car – Business mode-purpose represents on-the-clock and compensated travel (or travel that directly affects the productivity of workers, for example those that need to travel to job sites). This mode-purpose aligns well with the type of travel that the Light Truck assignment mode is understood to capture.

The Light/Medium Duty Truck model of TREDIS refers to freight-carrying vehicles and uses cost factors from sources like FHWA for single unit trucks. It is often not consistent with light duty truck models that consider a higher share of service vehicles and trips not for the purpose of delivering freight. Because of this, vehicles from the light truck model are classified as passenger cars which have the best default values for light-duty vehicles. The Light/Medium Duty truck mode is more appropriate for the Medium Truck model.

**Q: How can we capture the interactions between projects, since we know sometimes there are benefits that are not additive.**

**A:** There are plenty of examples of users examine complete Statewide Transportation Improvement Plans (STIP) or Long-Range Transportation Plans (LRTP)programs of work or looking at a package of project. These packages could then be broken up into their component projects to look at how projects rely on one another. A similar thing could be done to look at project phasing.

**Q: Can you use the VIA Toolkit if I do not have travel demand model outputs?**

**A:** You can use core TREDIS features with any type of sketch-level travel performance estimates. Without zone-to-zone travel time characteristics it will not be possible to utilize the VIA Module' Land Value Module to drive the detailed reports. However, this does not preclude use of the remaining aspects of the VIA Toolkit.

**Q: Does the VIA Toolkit provide a risk assessment with its economic results?**

**A:** The standard TREDIS model leveraged by the VIA Toolkit provides point estimates of economic performance. There is always significant uncertainty especially about long-range forecasts of both travel behavior and the economy. Some of the uncertainty around economic forecasts it mitigated by the focus on incremental impacts in the Toolkit. One of the best ways to consider uncertainty in the VIA Toolkit is to conduct transportation scenario analysis to see how different outcomes might have varying impacts on the economy. These estimates will use a consistent methodology and comparisons between them should be relative robust despite uncertainty.