Economic Assessment of Tolling Schemes for Congestion Reduction

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Contents

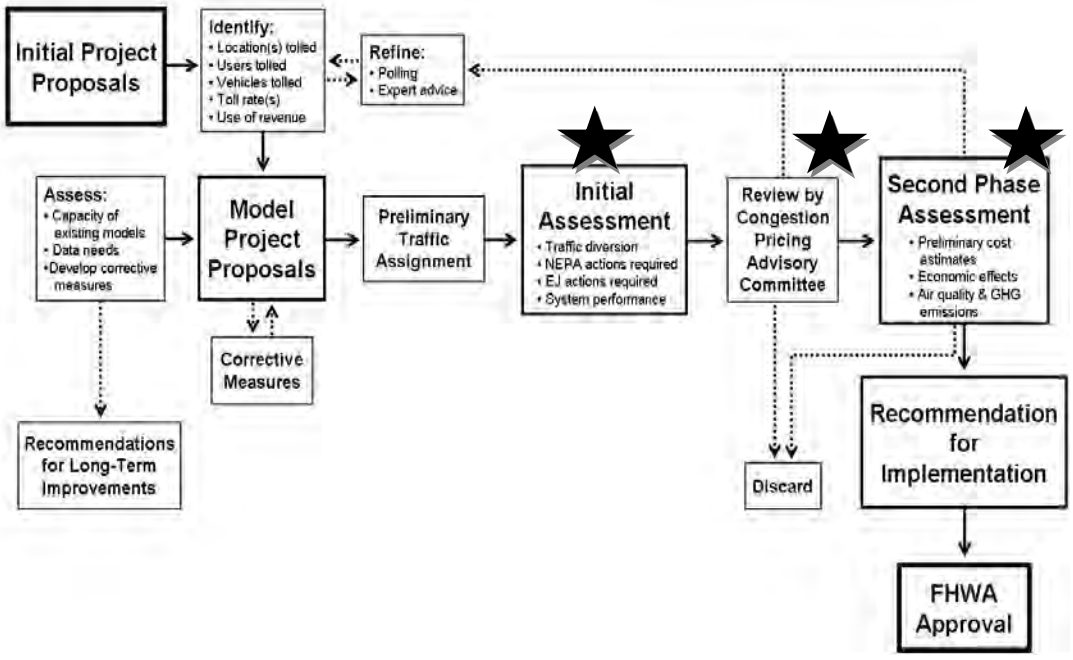
INTRODUCTION

Overview. This document provides guidance for conducting a systematic economic assessment of proposed congestion pricing pilot projects (herein referred to as "tolling schemes."). The process involves two phases: (1) an *initial screening assessment* to identify the potential for undesirable local economic consequences, and (2) a *regional impact assessment* to evaluate regional scale economic consequences – but only for those proposals that pass the initial screening process.

Background. The Oregon Department of Transportation (ODOT) has been instructed by the state legislature to develop a pilot program for congestion pricing in the Portland metro region. The term "congestion pricing" generally refers to the imposition of some form of toll (or fee) on a congested road or area, to reduce traffic congestion and promote more efficient use of the available road capacity. Congestion is reduced insofar as some travelers respond by traveling at a different time of day, via a different mode, via a different route, or by traveling less often or to a different destination. However, the effectiveness of congestion pricing may vary depending on details of the tolling scheme and where it is implemented. In addition, a tolling scheme could lead to unanticipated and undesired local consequences that disproportionately affect some neighborhoods, sectors of the economy or socioeconomic groups.

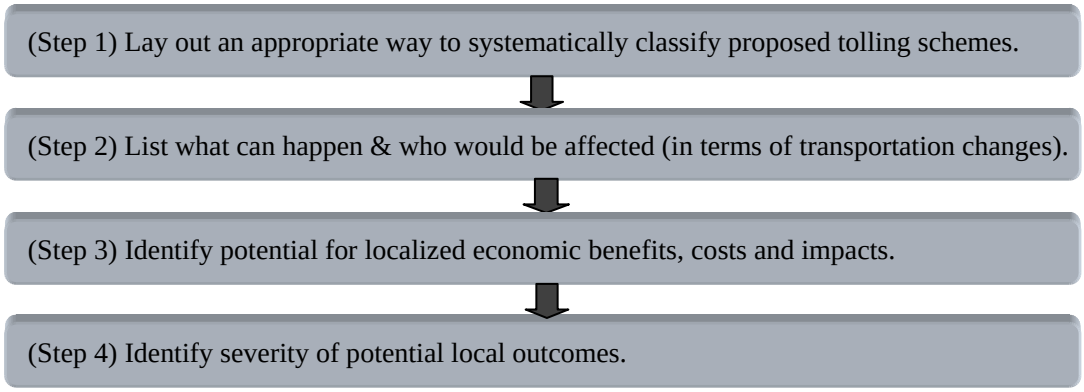
To address these issues, ODOT set out a process to: (1) develop proposals for alternative tolling schemes, (2) conduct an initial screening to determine the nature of their local impacts, (3) review findings of the initial screening to reject those with undesired or unacceptable local consequences, (4) conduct detailed assessment of their total cost and regional-level economic and environmental impacts, and (5) use findings from the detailed assessment to recommend actions for implementation. This process is illustrated in the flowchart below.

Congestion Pricing Pilot Process (★ denotes element addressed by this document)



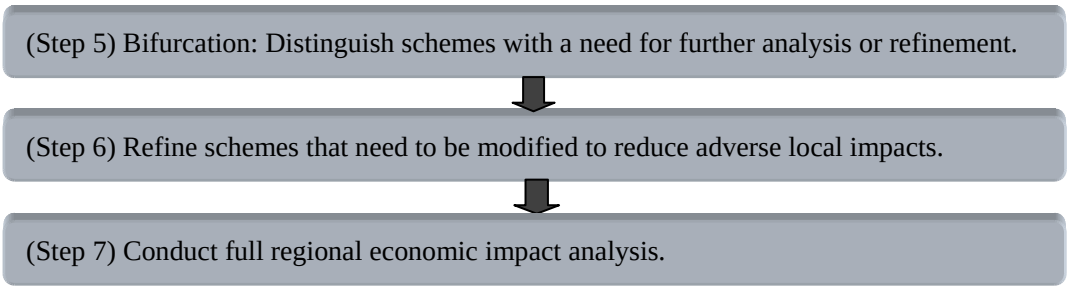
Phased Steps. This document lays out procedures for applying diagnostic tools to address the traffic and economic elements of the Phase 1 "Initial Screening Assessment" and Phase 2 "Regional Impact Assessment." Through this process, it also provides information that may be useful for separate assessments of system performance, environmental justice, air quality and greenhouse gas impacts. It is intended to help decision makers understand the logic of how the imposition of tolls can affect economic activity, and how that information can be used to help refine and select among alternatives.

Phase 1: Initial Screening Assessment involves a sequence of four steps:



The four steps of initial screening together provide a process for consideration of local economic impact factors and consequences, to pinpoint those that are potentially problematic in terms of adverse effects. They allow for "red flags" to be raised if any schemes are likely to lead to unacceptable levels of negative local consequences. The information from this initial screening will provide input to a formal review of proposed tolling schemes, and only those that pass the review will then be candidates for the follow-on regional analysis.

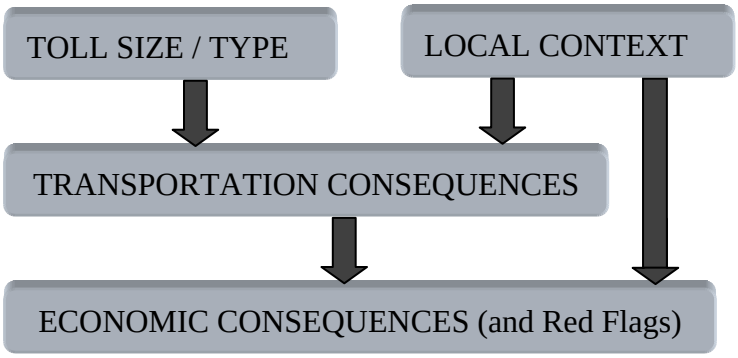
Phase 2: Regional Impact Assessment involves three additional steps:



The three steps of regional assessment together provide a process for distinguishing schemes in need of either local refinement, special analysis or regional assessment. The results will indicate which schemes can potentially serve to improve the economic health of the region, and which ones are likely to have negative overall impacts on productivity, competitiveness, jobs and income in the region. This will represent one form of input to the broader ODOT process for making recommendations regarding implementation.

STEP 1: CLASSIFY TOLLING PROPOSALS

Approach. In order to assess the economic consequences of potential tolling options, it is first necessary to establish the factors that determine those consequences. Quite simply, there are two sets of factors affecting these consequences: (a) the amount and type of toll, and (b) the context in which it is implemented. All other transportation and economic consequences occur as a direct or indirect consequence of those two types of factors, as illustrated below.



To illustrate these interdependencies, consider the case of a new bridge toll. If the toll raises vehicle travel costs for a major commuting corridor, then travelers may shift to other bridges or else shift to other modes, depending on the options available to them. If some travelers move to use another bridge, then the transportation consequences may include a shifting of congestion to that other location. And if increased congestion on that other bridge and its access routes causes increased delays in freight deliveries to a major just-in-time manufacturer, then the economic consequences may be an adverse effect on business costs and economic competitiveness.

Of course, it is also possible that the toll may not shift travelers to other routes, but merely cause some travelers to shift their time-of-day work and travel patterns, thus leading to more efficient use of the transportation facilities with reduced congestion for all. And the economic consequences of more reliable and timely employee arrivals at work may include additional job growth in the affected business centers. At this juncture, all we can know for sure is that both positive and negative consequences are possible, depending on the specific type of tolling and the local context in which it is to be applied.

1.1 Toll Size and Type

The step 1 classification of tolling options starts with a worksheet process that can display explicit assumptions about the types of tolling that are being proposed. All potential tolling proposals are broken down and rated in terms of three key components: (1) *the spatial aspect* – i.e., the area over which tolling is to be applied, (2) *the pricing aspect* – i.e., the size of tolls and how are set, and (3) *the implementation aspect* – how they would be collected. We discuss each of these components below, and then provide a form to be used for classifying alternative tolling options.

- ***Spatial Aspect*** – Is the tolling applied to (a) a *single point* such as a bridge, (b) a *highway corridor* of a given length, (c) a *local system* such as a highway corridor along with its access and feeder links that serve a popular destination, or (d) an *area* defined by a perimeter that includes multiple roads, such as an office or commercial district.

  Spatial Design of Tolls
  - Single point
  - Highway
  - Corridor system
  - Area-wide

  The importance of this factor is that it plays a major role in determining the extent to which a toll is likely to cause traffic to be shifted to other transportation facilities and routes. These four options represent a range of increasingly broad-based tolling. In general, the broader the area or set of road facilities being covered, the harder it is for travelers to circumvent the toll collection.

  The recommended process is to classify all projects in terms the most applicable of these four categories, but then accompany it with an explanation of the extent to which the specific project may have elements pertaining to one or more of these categories.

  This approach allows us to fully recognize that the project type distinctions are not necessarily clean and simple, and care must be taken to properly classify tolling proposals. For example, even tolls collected at only a single point (such as a bridge) may effectively represent a corridor-wide toll if the facility is the only way around an obstacle or if the bridge is necessary for longer distance travel along a popular corridor.

  The reverse may also occur, as a toll intended to apply to an entire highway corridor may end up serving as a single point toll if it is collected at only one spot along the corridor. There are plenty of cases of toll roads in which some traffic exits at an interchange before the toll collection and then enters again at another interchange after the toll collection.

  Thus, the spatial aspect becomes important because the cost and complexity of toll collection rises with multi-point toll schemes, but the likelihood of traffic shifts to circumvent the toll also falls with multi-point tolls. This framework makes it possible for tradeoffs in toll collection and traffic shifts to be explicitly considered.

- ***Pricing Aspect*** – How will the toll levels differ by (a) *class of vehicle* – e.g., weight and type, (b) *class of highway service* – e.g., express or local lanes, (c) *time of day* – e.g., fixed pricing, time-of-day preset pricing, or continuously variable "real time" pricing and other/or other factors (e.g., VMT-based charges) ?

  Pricing Design of Tolls
  - Class of vehicle
  - Time of day
  - Real time adjustment

  The importance of this factor is that it plays a major role in determining the distribution of toll cost burden among various user segments or groups, as well as the distribution of benefits among these same groups.

  The recommended process is to explicitly enumerate the pricing associated with standardized categories of vehicle, service and time classes for each proposed tolling option. This is to be accompanied by an explanation of the extent to which the specific project may have additional elements pertaining to one or more of these elements of pricing.

This approach allows us to objectively represent the distribution of tolling charges among classes of trips, and compare the distribution of tolling costs and benefits among parties. Of course, it is important to note that the distribution of tolling costs and benefits can seldom or never be completely synchronized, for a variety of reasons. First, both congestion levels and the mix of trip purposes (commuting to work, business product/service deliveries, and personal trips) differ by time of day. Second, the ability of travelers to shift to other travel modes, travel routes and travel times differs by trip purpose. Third, the availability of mode and route options also varies by area. And fourth, the economic costs of delay also vary by trip purpose. The limited ways in which tolls can be altered– primarily by time of day and vehicle type – cannot be fully responsive to these differences in trip purpose, cost of delay and available options.

Variation in who pays and who benefits from tolls is inevitable. For instance, congestion fees that encourage car drivers to switch to other times or travel modes may help reduce high costs of delay for time sensitive cargo movements. Since freight movements generally cannot make use of transit options and some are sensitive to schedule constraints, it could be appropriate in some cases for car tolls to be used to help free up more highway space for truck freight movements.

On the other hand, the most egregious disparities, in which one population group is fully subsidizing another group, are generally not popular with the general public. This framework makes it possible for tradeoffs in pricing schemes and benefit impacts to be explicitly considered.

- ***Implementation Aspect*** – How will the tolls be implemented, in terms of technologies such as: (a) *transponder* – e.g., with overhead sensors that allows for full speed movement and automated money transfers, (b) *optical readers* – e.g., systems with license plate readers and mailed-out billings, (c) *automated lane machines* – e.g., with exact change, user pass or credit card options, and/or (d) *toll booths* – e.g., manned facility to provide change to travelers?

  Implementation Design
  - Transponder or equiv.
  - Automated toll lanes
  - Manual toll booths

  The importance of this factor is that the toll collection technology directly affects travel speed and delay characteristics as well as potential use of the toll facilities. In general, the higher technology solutions allow for less disruption in travel speeds and less need for lane changing, but they can discourage some users. For instance, most people can use automated coin collection equipment, though exclusive use of such machines may discourage those who do not have the exact change. More sophisticated technologies, requiring transponders or bar code passes, may discourage those without who operate on a cash only basis without the required credit card or pre-pay accounts.

  The recommended process is to classify all projects in terms the most applicable of these four toll collection/implementation categories, but then accompany it with an explanation of the extent to which the specific project may have elements that are either a combination or variation on these basic categories.

It is useful to note the tradeoffs involved in toll implementation designs depend on the type of road or facility and its profile of users. Many of the technology solutions that involve special equipment work well for corridors used mainly by commuters and other local travelers who repeatedly make the same trip, but they present challenges for corridors that have significant portions of traffic originating out of the area. While this can be addressed by offering more than one option – e.g., a high speed lanes for local subscribers, automatic toll payment lanes for minimal stoppage, and manned toll lanes for all others – also generates additional capital and operating requirements associated with multiple lanes and multiple implementation technologies.

Implementation strategies that do not allow for multiple levels of service may fall either at the "low tech" end – in which case everyone stops to give coins and some delay occurs for everyone, or at the "high tech" end – in which case cars without transponders or subscriber passes may end up moving to alternative routes. Either way, there can be consequences that lead to sub-optimal traffic congestion results in some cases, as well as higher costs for classes of vehicles or trips that are unable to take advantage of the toll collection process. The framework outlined here makes it possible for these kinds of tradeoffs in toll collection and traffic shifting to be explicitly considered.

1.2 Local Context

As noted earlier, the type of tolling being proposed (previously enumerated in terms of three major aspects) interacts with the local context to determine both resulting traffic changes and their economic consequences. The local context has two major elements: (a) *traffic* routes affected and (b) *constituencies* affected. We discuss each of these components below, and then provide a form to be used for classifying local context.

- ***Affected Routes*** – A proposed tolling scheme may be applied to one or more facility, route or system of roads. Depending on details of the tolling scheme, some portion of traffic may be given incentive to bypass or minimize the toll impact by switching to an alternative route, mode or time of day or even trip destination. It is also possible that some trips may be avoided.

  A key part of the screening process is to explicitly identify affected transportation routes and services, including: (1) tolled routes, (2) the feeder network of non-tolled roads leading to and from the toll route, (3) alternative routes that allow vehicles to bypass or minimize tolls paid and (4) alternative modes allow travelers to bypass or minimize tolls paid.

  Each of these four physical classes of transportation routes and services may be affected directly by toll rates, or indirectly as some travel is shifted in terms of time (schedule of travel) or space (destination of travel). Most importantly, the impacts on travel route and service shifts will directly affect traffic levels and congestion rates that result as a consequence of tolling, as well as net cost and time impacts for travelers and other users and beneficiaries of the transportation system.

Affected Routes
- Tolled routes
- Feeder routes
- Alternative routes
- Alternative modes

(Note: trips eliminated and trips diverted from these routes are both shown on the Step 2 Form on p. 13.)

- ***Affected Constituencies*** – Tolling impacts on both tolled and non-tolled facilities will affect various user groups or constituencies. These constituencies are defined in terms of the mix of (1) vehicle types, (2) trip purposes and (3) origin/destination pattern of vehicles using the affected routes. Depending on details of the tolling scheme and where it is implemented, various classes of vehicles or person trips may be disproportionately affected because of differences in their time sensitivity, ability to shift routes, ability to shift modes or the toll charges assigned to them.

  Affected Constituencies
  - Vehicle types
  - Trip purposes
  - Origin-destination groups
  - Multi-modal access trips

  A key part of the screening process is to identify the mix of vehicles and trips affected by each proposed tolling project. This should include the following categories:

  - *Vehicle types* – mix of car, bus, heavy truck, van/light truck, bicycle, other;
  - *Trip purposes* – mix of commuting, business deliveries, cargo movements, other;
  - *Origin/destination* – locally-based traffic, long distance Oregon-based traffic, and interstate pass-through traffic;
  - *Multi-modal access* – extent of traffic oriented towards movements to/from airports, marine ports, rail facilities and cross-border movements.

  This information will be used in two ways. First, it will be used as part of the current screening phase to identify cases where a tolling scheme is proposed for corridors that have particularly high portions of commuting, truck delivery or multimodal terminal-oriented traffic. Second, it will be used as part of the later detailed evaluation phase to assess differences in the business and economic impacts of alternative tolling proposals. Thus, the determination of traffic shifts will be at the heart of the process for determining broader economic impacts of tolling schemes.

Step 1 Form: Classification of Tolling Proposals for Oregon

The following data entry table will be filled out for each proposed tolling scheme. The entries will enumerate the key factors affecting transportation and economic outcomes, which will be used for both initial screening and later evaluation of congestion pricing proposals.

FACTOR	Check applicable factors	Additional Explanation
TYPE OF TOLLING		
Spatial Design of Tolls		
• Single point	___	
• Highway	___	
• Corridor system	___	
• Area-wide	___	
Pricing Design of Tolls		
• Differs by class of vehicle	___	
• Differs by time of day	___	
• Real time adjustment	___	
Implementation Design of Tolls		
• Transponder or optical reader	___	
• Automated toll lane machines	___	
• Manual toll booths	___	
LOCAL CONTEXT		
Affected Traffic Routes		
• Tolled routes	___	
• Non-tolled feeder routes	___	
• Non-tolled alternative routes	___	
• Alternative modes	___	
Affected Constituencies		
• Mix of vehicle types	___	
• Mix of trip purposes	___	
• Origin-destination	___	
• Multi-modal access	___	

STEP 2: DETERMINE TRANSPORTATION IMPACTS

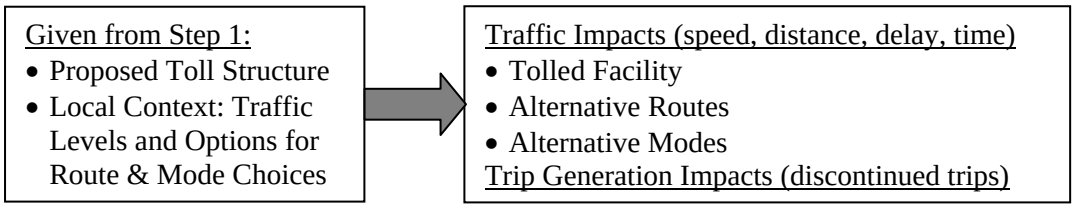
Overview. Whereas the first step classified tolling proposals, this second step uses that information to identify *what can happen* (in terms of traffic changes) and *who would be affected* (in terms of key user groups and affected activities).

Approach. The basic logic underlying this step is that economic assessment depends critically on the nature of traffic changes that would occur after the implementation of tolls, which are driven in large part by factors identified in Step 1. That step classified the affected section of roadway and its surrounding context, including the nature of its current use and the extent to which there are alternative routes or alternative modes available as options to avoid paying the toll. And once we know the likely nature of traffic changes, the general form of user and non-user impacts can be identified.

Types of Transportation Impact. This step 2 screening of transportation impacts is accomplished through a sequence of three related elements: (1) *traffic patterns* – i.e., effects on other routes, mode split and traffic conditions on tolled and other facilities; (2) *user market segments* – i.e., market segments defined by vehicle type and trip purpose; and (3) *distribution of impacts* among population and business groups. We discuss each of these elements below, and then provide a form to be used for noting the key forms of impact.

2.1 Traffic Patterns and Locations

In most cases, the applicable regional agency has some form of travel demand modeling system, including a transportation network model, that can be used to make initial forecasts of the expected impact of alternative tolling schemes on traffic patterns. The nature of traffic diversion is expected to be driven in large part by the form, level and location of proposed tolls, as well as the context of local transportation choices – all of which were identified in Step 1.



The traffic impact forecast of imposing tolls can be shown in terms of four forms of traffic change: (a) changes in volume and speed for traffic that stays on the now-tolled facility, (b) traffic shifts to alternative routes, (c) traffic shifts to alternative modes, and (d) traffic that goes away (trips cancelled).

The forecast traffic changes can be validated against the reasonable expectation of ODOT staff and its evaluation contractor, using some basic "sketch planning" decision rules:

a. Assume that *delay and safety on tolled routes* are likely to be major issues only when: (a) traffic levels on the route (or at the bottleneck location) are already high and (b) the toll

collection method will cause further delays due to physical constraints on toll collection points and/or added time delay caused by the toll collection method, and (c) there is no expectation of offsetting speed improvement enabled by a shift of traffic off of the tolled route to reduce its congestion.

b. Assume that *traffic shift* is likely to be a major issue only when: (a) there is one or more parallel route that allows travelers to easily bypass the tolls, and (b) either the proposed tolls will be high or delay on the tolled route (defined above) will be high enough to encourage significant traffic route shifts.

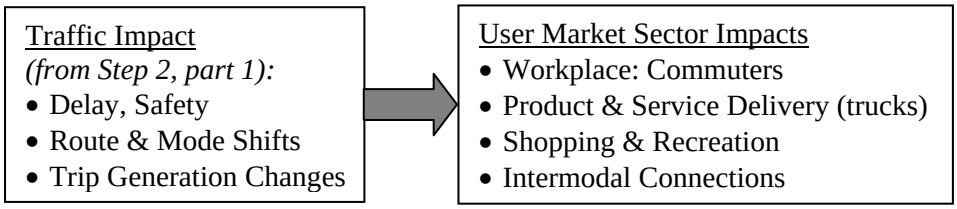
c. Assume that *mode shift* is likely to be a major issue only when: (a) there is an existing public transportation service with an alignment separate but parallel to the tolled route with easily-available Park-&-Ride facilities at the relevant stations, and (b) either the proposed tolls will be high or delay on the tolled route (defined above) will be high enough* to encourage significant mode shifts.

d. Assume that *trip reduction* is likely to be a major issue only when: (a) the route serves as access to a sports, recreation or shopping area that is visited as a discretionary (non-work related) choice, and (b) either the proposed tolls will be high or delay on the tolled route (defined above) will be high enough to discourage a discernable portion of those trips from occurring.

This approach summarizes findings from transportation network models and professional validation through use a rating form shown at the end of this task. This makes it possible for ODOT and evaluation staff to identify situations where the potential for traffic changes deserves further study and scrutiny, and separate them from other tolling proposals where no such shifts are possible or likely to occur.

2.2 User Market Segments

Once the traffic effect of a proposed toll scenario has been subject to the screening process, it will be possible to identify potential impacts on specific user groups. This will be necessary only for those tolling scenarios in which significant traffic impacts (as identified above) are expected.



This is accomplished by obtaining transportation model results distinguishing impacts on four major market segments of road users (who now use facilities that are proposed for tolling): (a) commuting trips, affecting workplace and household job access, (b) product and service delivery trips using trucks and vans, largely affecting businesses in industrial centers, (c) shopping and recreation trips affecting visitation to retail centers and parks, and (d) travel to and from intermodal terminals including airport, marine port and intermodal rail terminals.

For each of these four market segments, the recommended process it to rate each of the proposed tolling location in terms of whether it has a greater-than-average importance in serving one of these four trip types. Of course, essentially all roads and bridges serve a mix of multiple trip types, so there is only interest in identifying the subset of cases where the corridor or location is particularly critical for a particular use. Thus, we again accept some simple decision rules:

a. Identify proposed tolling sites located along major *commuting corridors* serving either a downtown district or an outlying office park or employment center.

b. Identify proposed tolling sites located along major *truck routes* serving as access to/from *industrial centers* in the Portland region or elsewhere in Oregon. (Note: effects on trucks passing through the region will not directly affect the local or state economy.)

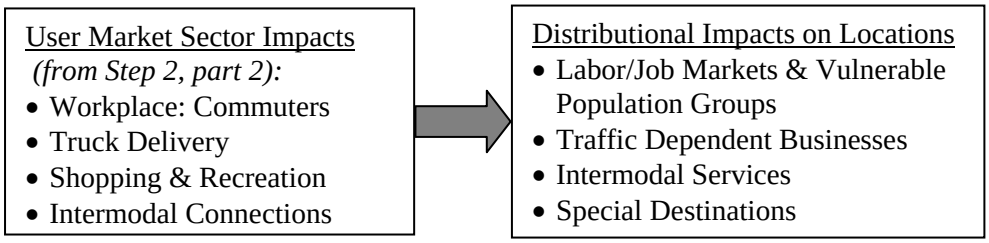
c. Identify proposed tolling sites located along routes that provide *access to/from major retail centers or sports/recreation venues* in the region.

d. Identify proposed tolling sites located along routes that provide *connectivity with airport, marine port or intermodal rail centers* in the region.

This approach also makes use of the rating form shown at the end of this task. This makes it possible to identify situations where the potential for traffic changes deserves further study and scrutiny, and separate them from other tolling proposals where no such shifts are possible or likely to occur.

2.3 Distributional Aspect

Once the potential impact on key user market segments has been subject to the screening process, it will be also possible to identify the potential distributional shift impacts on locations of economic activity in the region. This will be necessary only for those tolling scenarios in which significant impacts on particular market segments (as identified in the previous discussion) are expected.



This is accomplished by identifying four major classes of distributional impacts that may potentially result from the from imposition of tolling: (a) shifts in the attractiveness of various labor/job markets, affecting places to live and work, (b) shifts in business among traffic dependent business on various routes that stand to gain or lose pass-by traffic, (c) shifts in attractiveness and potential competitive position of intermodal services (airport, marine and

intermodal railroad terminals) that stand to gain or lose customers if access speed is improved or degraded, and (d) recreation activities that stand to gain or lose customers if access speed is improved or degraded.

For each of these four types of distributional impact, the recommended process is to rate the tolling proposals in terms of distributional impacts, but only for those proposals in which there are notable impacts on one or more market segment. For all other proposals, the likelihood of distributional impacts may be rated as low. The applicable decision rules are recommended to be as shown below:

a. If the tolling proposal affects a *commuting corridor,* then rate the corridor on the basis of whether is serves disproportionately low income neighborhoods, and whether it has a net positive or negative impact on cost and travel time, relative to other competing office or employment centers.

b. If the tolling proposal affects access to/from *industrial centers,* then rate whether it has a net positive or negative impact on cost and travel time, relative to other competing industrial centers.

c. If the tolling proposal affects access to/from *major retail centers or recreation venues,* then rate whether it has a net positive or negative impact on cost and travel time, relative to other competing retail or recreation centers in the region.

d. If the tolling proposal affects access to/from *airport, marine port or intermodal rail centers,* then rate whether it has a net positive or negative impact on cost and travel time, relative to other competing airport, marine port or intermodal rail centers.

This approach also makes use of the rating form shown at the end of this task. This makes it possible to identify situations where there is a potential for disproportionately affecting certain business centers or locations, and separate them from other tolling proposals where no such shifts are possible or likely to occur.

Step 2 Form: Rating Traffic and User Impacts of Tolling Proposals

The following data entry table will be filled out for each tolling proposal. It will explicitly enumerate the key factors affecting traffic impacts and implications for user groups, which will be used for both initial screening and later evaluation of congestion pricing proposals.

FACTOR	**Direction of Impact**			**Likelihood of Impact**		
	Positive	Negative		Low	Medium	High
Traffic Patterns & Locations						
• Congestion: Delay, Safety	___	___		___	___	___
• Traffic Route Shift	___	___		___	___	___
• Mode Shift	___	___		___	___	___
• Trip Reduction (Elimination)	___	___		___	___	___
User Market Segments						
• Commuter Corridor	___	___		___	___	___
• Truck/Delivery Corridor	___	___		___	___	___
• Shopping Center Access	___	___		___	___	___
• Recreation Center Access	___	___		___	___	___
• Intermodal Connections	___	___		___	___	___
Spatial Distribution Impacts						
• On Vulnerable Populations	___	___		___	___	___
• On City Center	___	___		___	___	___
• On Outlying Office Center	___	___		___	___	___
• On Industrial Center	___	___		___	___	___
• On Major Retail Center	___	___		___	___	___
• On Airport	___	___		___	___	___
• On Marine Port	___	___		___	___	___
• On Intermodal Rail Terminal	___	___		___	___	___
• On Other Special Destination	___	___		___	___	___

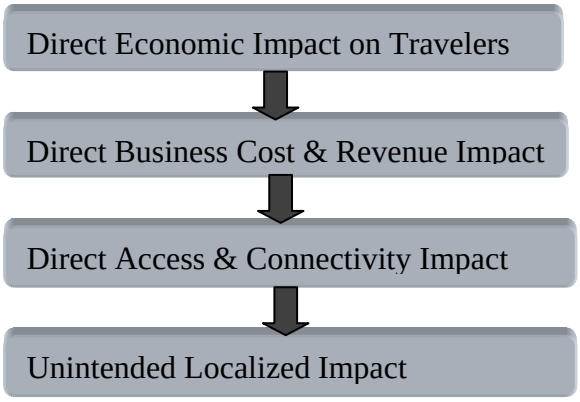
STEP 3: LOCAL ECONOMIC IMPACT ASSESSMENT

Approach. The economic impacts that are examined in this third step are defined as direct effects on local business revenues, local business costs and local household expenses. While these local impacts also lead to wider (indirect and induced) economic effects at a regional level, this step focuses only on direct localized impacts. The basic logic underlying this step is that expected economic impacts of imposing tolls are determined largely by (a) size of the toll charges, (b) location and context in which these charges are applied, (c) expected changes in traffic conditions and (d) profile of affected users. (The first two factors were previously identified in Step #1 and the other two factors were identified in Step #2.)

Types of Economic Impact. This step 3 screening of economic impacts is accomplished by considering four types of impact, any of which may be either positive or negative:

- Direct impact for *travelers* now using routes where tolling is proposed, or switching to other routes and modes after the toll is imposed;
- Direct impact on *businesses that are directly affected* because of changes in speed, reliability or cost for their worker travel, customer visits or truck delivery movements;
- Direct impact on *access and connectivity* that affect other elements of local business revenue, cost or market and competitiveness; and
- *Unintended consequences on spatial patterns* of property values, investment, employment and income.

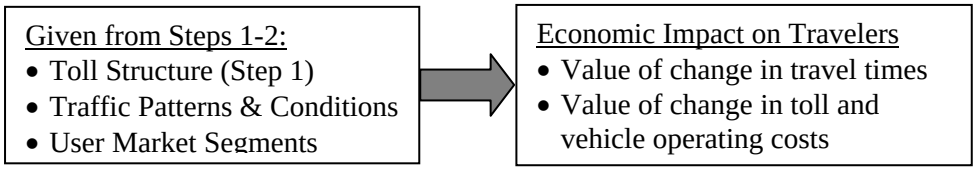
We discuss each of these elements below, and then provide a form to be used for portraying the major economic consequences. Since this is part of the initial screening process, there is no formal economic modeling to be done to predict economic impacts. Rather, this step involves identifying tolling proposals where there is reason to expect major positive or negative impacts on the economy, at either a localized neighborhood or regional level.



3.1 Direct Impact on Local Travelers

For any route where tolling is proposed, travelers now using that route will experience some time or cost changes. The traveler response to tolling will be some combination of: (a) continuing to use the tolled facility, (b) switching to alternatives (other modes, routes or times of day), or (c) eliminating trips.

The availability of alternative travel options, and likelihood there may be significant conversion to them, were previously assessed as part of the Step 2 traffic impact modeling process. The potential for positive or negative transportation impacts was also identified in that step. Based on those findings, the likely range of VMT, VHT and congestion (V/C) impacts can now be converted to dollar terms representing the value of direct economic impact on travelers. This can be done by applying factors representing average toll cost and time delay values, as well as applicable accident rates and reliability impacts.



The calculation involves three elements (shown below) to represent the magnitude of $ cost differences between "pre-toll" and "post-toll" scenarios. The calculations can be done using existing spreadsheet tools, or through use of a pre-built direct travel cost impact accounting framework (such as the web-based TREDIS user cost module or HERS framework).

(1) Size of Affected Groups. For each tolling scenario, use information from Step 2 to identify the options that would be expected to get substantial portions of the travelers: (a) those that stay on the tolled route during peak toll periods, (b) those that shift to other travel times, (c) those that shift to other routes, (d) those that shift to other modes and (e) traffic that goes away.

(2) Value of Travel Changes. For each of these four options, estimate average $ values for:
- *Travel Times* - change in vehicle travel time, multiplied by a typical value of time (e.g., $25/hour, considering occupancy rates and trip purposes ranging $12 - $75/hr.)
- *Toll/Fare - the addition of a toll (for groups 1a, 1b) or fares (for group 1d).*
- *Vehicle Operating Cost - based on change in idling delay (for groups 1a, 1b) or extra distance driven (for group 1c).*

(3) Total Cost Impact. Given the difference in typical costs, estimate the shares or number of affected trips in each group. Multiply the value of travel time changes by number in each group and sum all values to get the total direct economic impact for travelers. High and low estimates may be provided if desired.

The most important use of this calculation is to highlight options that appear to show negative economic value, as that can indicate a toll price or delay at toll collection points that may offset savings from congestion reduction.

3.2 Direct Impact on Route Reliant Businesses

Once the magnitude of traveler cost impact is estimated, it can be assigned to (or split among) one or more of the travel market segments previously identified in Step 2: commuting, truck delivery, shopping, recreation, and port/terminal connections. The assignment can be made on the basis of route-specific factors, e.g., vehicle mix and locations served. (Examples are truck deliveries to/from industrial parks, commuting to downtown or major office centers, truck freight connections to key terminals, car access for specific neighborhoods or pass-through freight movements.) The allocation of impacts by market sector can then be simplified by translating it into effects on major business destinations, as shown in the table below.

Market Sector Impact:		***Translation to Business Result at Destinations:***
Time/cost for shopping trips	→	Retail center destinations: revenue (visit rate)
Traffic pattern for pass-by trips	→	Retail: Revenue at traffic-dependent businesses
Time/cost for commuting trips	→	Office center destinations: wage rate & operating cost
Time/cost for truck trips	→	Industrial center destinations: cost competitiveness
Time/cost for neighborhoods	→	Residential neighborhoods: property values
Time/cost for terminal access	→	Intermodal trips: cost competitiveness

At this point in the screening process, only rough estimates are needed since the intention is to distinguish tolling scenarios that may have major (positive or negative) consequences for particular types of business. The allocations can be done using "back of the envelope" calculations or rough estimates. For each affected business sector, it also should be possible to identify the associated location of industrial parks, office centers, residential neighborhoods or intermodal facilities that would be most affected (drawing also on information collected earlier in Step 2). The information should be noted in the form provided at the end of this step.

3.3 Direct Impact on Broader Market Access and Connectivity

Once the direct business impacts have been identified, it will be possible to identify other localized economic impacts related to access and connectivity. This will be necessary only for those tolling scenarios in which there are expected to be significant direct impacts on business.

Since this is still part of a screening process, there is no need to actually acquire or apply regional input-output multipliers or use any regional economic model. Instead, the recommended procedure is to note the proposed tolling scenarios affecting route(s) with a disproportionately high portion of trips associated with:

- Truck trips to/from major industrial parks (including high tech clusters)
- Truck trips to/from intermodal rail or marine port facilities
- Car or truck trips to/from the international airport (PDX)
- Car or truck trips to/from major office centers (downtown or office parks)

The information to make this determination was already provided as part of the form produced in Step 2. Tolling scenarios with potentially high access or connectivity impact should be noted in the rating form provided at the end of this step.

3.4 Unintended Consequences on Spatial Patterns of Economic Impact

The preceding elements of Step 3 have assessing the overall magnitude of economic impacts on travelers market segments, and translated them into sectors of the regional economy and types of business. However, those are aggregate impacts. There is also a need to identify unintended consequences on specific locations that are served by the toll route. For instance, it is possible that tolling may relieve congestion along a busy travel corridor and achieve significant regional benefit, but at the same time make it expensive for residents of a low income area to get into and out of their own neighborhood.

More generally, we identify four key types of unintended consequences:

- *Unintended Cost Burden for Vulnerable Group* – increase in living cost for low income and vulnerable populations that cannot easily avoid the toll (to be defined by the evaluation contractor in consultation with ODOT staff);
- *Unintended Dispersal of Economic Activities* – pressure to disperse homes and businesses away from affected areas;
- *Unintended Shift in Mix of Economic Activities* – pressure to discourage shipping/ warehousing or other economic activities that generate or rely on traffic;
- *Unintended Land Use Changes* – a consequence of the prior two factors, reducing density of development and concentrations of economic activity, or encouraging new development to move out to the periphery of the region (including effects on development outside of the urban growth boundary).

To identify such situations, the analysis must consider both (a) cases where a proposed tolling scheme may provide little or no alternative for accessing certain residential or business locations (using information collected for Step 1), and (b) cases where the tolling scheme will divert traffic to new areas (using information from Step 2).

Step 3 Form: Rating Economic Impacts of Tolling Schemes

The following data entry table will be filled out for each tolling proposal. It will explicitly enumerate the key factors affecting traffic impacts and implications for user groups, which will be used for both initial screening and later evaluation of congestion pricing proposals.

3.1 Impact on Travelers: Change in $	**Toll Route**	**Alt. Time**	**Alt. Route**	**Alt. Mode**	**TOTAL**
• Value of Time	___	___	___	___	___
• Toll & Vehicle Operating Cost	___	___	___	___	___
• Total Change	___	___	___	___	___

3.2 Impact on Business Revenue/ Cost	**% of Impact**	**Area(s) Most Affected**
• Industrial Centers (truck delivery)	___	_____
• Office Centers (commute)	___	_____
• Shopping Centers (shopping trips)	___	_____
• Intermodal Freight (marine, air, rail)	___	_____
• Intermodal Passenger (airport)	___	_____
• Traffic-dependent businesses	___	_____

3.3 Regional Impact Rating	**Rating**
1. Low (pass-through traffic)	___
2. Normal (typical traffic mix)	___
3. High (inter-modal or industry center)	___

3.4 Unintended Local Consequences	**Rating**	**Explanation**
• Cost Burden: Local Neighborhood	___	_____
• Dispersal of Economic Activities	___	_____
• Shift in Mix of Economic Activities	___	_____
• Land Use & Density Changes	___	_____

STEP 4: SCREENING PROCESS CONCLUSIONS

Overview. This step summarizes findings and draws conclusions from the screening analysis (steps 1-3). It provides information to inform decisions (to be made step 5) regarding rejection or acceptance of tolling proposals for additional economic impact analysis.

Approach. This step establishes indicators of the acceptability of proposed tolling schemes on the basis of four dimensions of economic impact, which emerge from information and analysis provided in Steps 1-3:

- Negative direct economic impacts,
- Distributional impacts on sectors of the economy,
- Localized impacts on neighborhoods and business districts, and
- Equity impacts on sectors of the population.

Together, these four types of economic impact can help inform a range of other considerations pertaining to land use, sustainability, cost burden and political acceptability.

4.1 Negative Direct Economic Impacts

The worksheet from Step 3 provides an estimate, for each tolling scheme, of the potential magnitude of direct economic gain or loss for businesses and households. They provide a means for distinguishing those proposals that can trigger significant negative impacts due to either: (a) a level of toll that triggers significant and undesirable spillover congestion on non-tolled routes, or (b) new bottlenecks associated with the toll collection method itself. Both forms of impact can be inadvertently triggered when retrofitting a tolling mechanism on existing routes.

It is important to note that this distinction is based on economic impacts, rather than on congestion reduction for affected routes. This is an important distinction, for setting what is the optimal toll for reducing congestion on key routes can (in some cases) lead to unacceptable increases in economic costs associated with either traffic diversion or implementation of tolling processes. This information allows such situations to be identified.

RED FLAG: ***Tolling proposals that trigger negative impacts*** affecting travel costs and market areas, leading to reduced business sales and jobs.

4.2 Distributional Impacts on Sectors of the Economy

The worksheets from Steps 2-3 also provide an estimate of the potential distribution of impacts on various classes of vehicle (car, truck), classes of users (household, business) and sectors of the economy (industrial, office, retail, intermodal supply chain movements). They also distinguish tolling proposals that can positively or negatively affect activities with greater than normal consequences for growth of regional economy (because they affect "traded" industries that bring income flowing into the region).

While every tolling proposal will have some distributional consequences, depending on the specific corridors being affected and their mix of traffic, that is not necessarily a problem. It only rises to become a problem if there is severe and unacceptable inequity between "who pays" and "who benefits." Information shown on these worksheets will enable consideration of this issue. Situations where it can potentially be problematic can thus be identified.

RED FLAG: ***Tolling proposals that generate a mismatch between who pays and who benefits*** - which may occur among different sectors of the economy.

4.3 Equity Impacts on Sectors of the Population

While the preceding discussion considered access and property value impacts on low income *neighborhoods*, there can be a different form of equity impact on low income *travelers* now using routes in which tolling is proposed. This problem has two elements:

- Lower income travelers, many of whom can ill afford new tolls, tend to seek alternative routes and modes at a greater rate than other travelers;

- Lower income travelers who stay on tolled routes have lower rates of adopting toll collection scanning methods (such as transponder, RF or optical reader technologies) because they commonly require credit or pre-payment accounts. As a result, they are more likely to have to endure longer waits at manual payment lanes if available.

The breadth of these two forms of differential income impact is potentially an equity concern. The recommended approach to address this issue is to (a) summarize income characteristics of the regional car-reliant population, and proposed toll rates and toll collection methods, and (b) relate them to the existing body of research on the income equity implications of road pricing. However, this is only meant to be a "first cut" screening process to identify whether there may be a potential issue. Ultimately, ODOT has a separate process for screening tolling schemes in terms of their "environmental justice" (EJ) consequences.

RED FLAG: ***Tolling proposals that have undesired equity impacts on low income travelers*** due to toll rates and collection methods.

4.4 Localized Impacts on Neighborhoods and Business Districts

The worksheet from Step 3 further identifies specific business centers or residential areas that are likely to be particularly affected by the tolling because of limited options to avoid the tolls. Depending on the nature of those affected areas, such an impact may be judged good or bad. For instance, forcing pass-through traffic and daily commuters to pay a toll may be deemed appropriate, but it may be undesirable if this also leads to: (a) disproportionate cost impact on low income neighborhoods, (b) unintended reduction in property values for some neighborhoods, (c) incentive for some employment activities to leave

RED FLAG: ***Tolling proposals that generate undesired land use impacts*** such as reduced property values or incentives for greater dispersal of development (including development across the urban growth boundary).

the city, (d) diversion of traffic onto local streets or (e) shifts in development and investment from higher density mixed use areas to lower density outlying areas.

The potential breadth and severity of each of these potential adverse impacts is identified in Step 3. However, it is difficult to set a boundary for what constitutes an unacceptable level of impact or incentive shift, so it may be more appropriate to rank the proposed tolling schemes by the degree of impact that they represent. This can be done by rating the extent to which the affected groups are "captive" to, or have other options to avoid, the (desired or undesired) toll impact. Situations where this issue can potentially be problematic can thus be identified. (See Step 4 form.)

Step 4 Form: Red Flags – Highlighting Adverse Local Consequences

The following data entry table will be filled out for each tolling proposal. It will explicitly rate the extent of adverse local consequences associated with the proposed scheme.

Dimension of Impact	Specific Group(s)	Size of Group(s)	Sensitivity of Group	Impact (+ or -)	Red Flag (y/n)
4-1 Impact Class					
• Time Impact	___	___	___	___	___
• $ Cost Impact	___	___	___	___	___
• Reliability Impact	___	___	___	___	___
• Traffic Diversion Impact	___	___	___	___	___
• Noise Impact	___	___	___	___	___
• Other	___	___	___	___	___
4-2 Traveler Class					
• Cars - Commuter	___	___	___	___	___
• Freight Movement (truck)	___	___	___	___	___
• Local Delivery Vehicle	___	___	___	___	___
• Buses	___	___	___	___	___
• Bicycle	___	___	___	___	___
• Other	___	___	___	___	___
4-3 Location Class					
• Downtown	___	___	___	___	___
• Residential Neighborhood	___	___	___	___	___
• Industrial Parks/Sites	___	___	___	___	___
• Commercial (office, retail)	___	___	___	___	___
• Recreation Areas	___	___	___	___	___
• Other	___	___	___	___	___
4-4 Population Class					
• Low Income	___	___	___	___	___
• Minority	___	___	___	___	___
• Other	___	___	___	___	___

STEP 5: BIFURCATION: NEED FOR REFINEMENT

Overview: This step draws on the findings of prior steps to classify proposed tolling schemes into two groups – (1) those schemes that need to be modified (to mitigate critical local problems) before they can be considered further, and (2) those that can now be fully assessed in terms of their regional economic impacts and overall benefits.

Approach: For each tolling proposal, three issues are addressed:

- Classify severity of "red flag" issues identified in Step 4.
- Determine need for further refinement of tolling proposals.
- "Bifurcate" tolling options into (a) those that need to be modified or examined further through some form of special analysis, and (b) those that can go on to further economic impact analysis (in step 7).

5.1 Classify Severity of "Red Flag" Issues

The worksheet from Step 4 is designed to highlight those projects that have significant distributional inequities – i.e., disproportionately hurt some local neighborhood, some portion of local travelers or some sector of local business in a way that is likely to raise significant objections or controversy. The Step 4 worksheet provides information, for each tolling option, to assess the severity of any such problems. That information should now be used to decide whether any such problems represents: (1) a "fatal flaw" that effectively eliminates the tolling option (as currently defined) from further consideration, (2) an issue that warrants some form of special analysis in order to insure it is properly understood by the public and decision makers, (3) a "fixable problem" that may be reduced or eliminated with further modification in specification of how the tolling option would work, or (4) a "minor matter" that might be addressed in implementation planning, or else ignored as it will not by itself eliminate the tolling option from further consideration.

The split of tolling proposals is to be made by considering four factors:

- Level of adverse impact: *Is the adverse impact large enough to represent a significant hardship" (in terms of time, cost, access or lost income) for the affected parties?*
- Scale of affected groups – *Do the adversely affected parties constitute a large share of travelers or nearby residents?*
- Vulnerability – *Are the adversely affected parties comprised disproportionately of low income, minority, senior citizen or other vulnerable parties?*
- Availability of Solutions – *Are there straightforward ways to modify the tolling option, or make offsetting compensation, to eliminate or reduce the adverse impacts?*

While it is possible to estimate the level and scale of impacts, sensitivity of affected groups and availability of solutions, there are no simple definitions of what constitutes "significant" hardship, "large" group, "vulnerable" party or "straightforward" solution. Thus some element of judgment

is required and that can be best addressed through discussion between the evaluation contractor and staff of Oregon DOT (and if appropriate, other public agencies).

5.2 Identify Need for Additional Analysis or Refinement of Tolling Proposals

Additional Analysis. If a tolling proposal is found to require some form of special analysis, then a further effort should be made to further conduct a more detailed examination of the issue of concern. For instance, there could be concern that some particular class of traveler or residential neighborhood or commercial area is potentially vulnerable to disproportionate impact, but that the impact is not proven due to limitations in the spatial and/or time-of-day detail inherent in the transportation network model that was used, or some other aspect of the initial screening process. In that case, it could be appropriate to conduct a more detailed traffic analysis of alternative routes and times of day in which traffic diversion is likely to be most severe. Or it might be that more detailed land use analysis is necessary. It is also possible that more information is needed to better gauge likely business or resident responses, in which case it could be appropriate to conduct interviews, polls or workshops with representatives of affected parties. Then, depending on the findings, a tolling proposal may be rejected or passed on for further refinement.

Further Refinement. If a tolling proposal is deemed to have adverse effects (either flaw or fixable problem), then a further effort should be made to identify exactly (1) what part of the proposal causes the problem and (2) what kind of planning or implementation action may be available to mitigate it. These problems and potential actions may be related to factors such as toll pricing levels, payment collection mechanisms, physical structures, entry/exit routes, and/or alternative bypass routes.

Based on this determination of causes and available mitigation options, the evaluation contractor and staff of Oregon DOT should together decide whether the tolling option should be (1) immediately modified to address the problem before its economic impact is assessed, or (2) "sent back to the drawing board," i.e., referred back to Oregon DOT for reconsideration, elimination or revision before any further economic assessment is conducted.

5.3 Memo on Bifurcation of Tolling Options

Prepare a memo to Oregon DOT staff, that may be reviewed by proponents of various tolling options and other interested parties, that explains the split of all current tolling options between (1) those that have local issues concerning adverse impacts that need to be modified or eliminated before further analysis is considered, and (2) those that can now be subject to further consideration in terms of regional economic impacts and overall benefits. Form 5 lays out a summary format that may be used (or substituted with a suitable alternative) format for that memo.

Step 5 Form: Rating Economic Impacts of Tolling Proposals

	Tolling Alternatives:		
	#1	**#2**	**#3 etc.**
Tolling Option • Tolling Option Name/Identifier	_____	_____	_____
Recommended Category • Refer for Local Refinement • Conduct Regional Economic Analysis	_____ _____	_____ _____	_____ _____
Problem Category • Rating: Severity of Adverse Impact • Explanation: Cause of Adverse Impacts	_____ _____	_____ _____	_____ _____
Response Categories • Mitigation Options • Redesign Options • Replacement Options • Rejection Option	 _____ _____ _____ _____	 _____ _____ _____ _____	 _____ _____ _____ _____

STEP 6: REFINING SCHEMES WITH LOCAL ISSUES

Overview: For all applicable tolling schemes, this step identifies the issues of local adverse impact that need to be further considered in order to make a tolling scheme more acceptable. A review process by ODOT will serve to assess and substantiate specific concerns and needs, and then draw up plans for revision or rejection of the proposed tolling schemes as appropriate to address those issues.

Approach: For each tolling proposal deemed to have local adverse impacts, three elements of work should be completed:

- Identification of relevant parties for the review process;
- Review process to substantiate adverse impact issues and decisions;
- Redesign and reconsideration of the process for tolling schemes.

6.1 Identify Relevant Parties for the Review Process

A review of tolling schemes will be conducted by ODOT or an ODOT-initiated *ad hoc* advisory group. Additional input may be provided representatives of key stakeholder groups such as affected neighborhood or business groups. ODOT staff will generate a list of tolling schemes that were considered, and their ratings in terms of potential for adverse local impact (based on the Step 5 product). Staff also can identify the nature of the potential adverse impacts and the types of resident or business groups that would potentially be affected, so that ODOT can determine the extent to which it desires to contact specific parties to initiate further dialog.

6.2 Support the Review Process to Substantiate Impact Issues and Decisions

The review process must first consider and substantiate the extent to which certain tolling schemes are flawed by serious adverse impacts. The evaluation contractor will provide supporting information to (1) help establish the extent to which adverse impacts are indeed a valid concern, and if requested, to (2) help identify options available to alleviate or mitigate the adverse impacts through redesign of the tolling scheme or the addition of compensation schemes to offset expected adverse impacts. The redesign and compensation options should span five dimensions:

- Proposed toll levels, and their implementation over time, across areas of the region, and among classes of vehicles and types of trips;
- Proposed toll collection implementation schemes and options;
- Proposed location for tolling, and its relationship to type of trips and users;
- Likely traffic route diversion impacts and their implications for diverting traffic patterns onto alternative routes; and
- Other actions that can be taken to mitigate adverse impacts (which might include additional compensation for low income groups, special pricing for residents of specific neighborhoods, or additional changes in traffic regulation or access routes for various neighborhoods or classes of vehicle).

6.3 Redesign and Reconsideration Process

If some tolling schemes are to be modified or redefined to alleviate adverse impacts, then they can be reconsidered in the initial assessment. For this to be done, a three-part process is necessary.

1) Staff of ODOT will have to provide new specifications defining the modified tolling scheme(s), including the five dimensions of redesign and compensation identified in the preceding Section 6.2.

2) Each of the modified schemes will then have to go back through the initial assessment process, which is comprised of steps #1-4. This includes analyses of traffic diversion, highway system performance, environmental justice and other elements of distributional and efficiency impact.

3) Based on those new findings, a decision can then be made as to whether the modified tolling scheme should be continued on for regional economic analysis in Step 7.

Outcomes should be summarized in a memo incorporating the type of information shown in the Step 6 Form shown below.

Step 6 Form: Summary of Review Process Outcomes

	Tolling Alternatives:		
	#1	**#2**	**#3 etc.**
Tolling Option			
• Tolling Option Name/Identifier	_____	_____	_____
• Tolling Option Type	_____	_____	_____
Review Outcome			
• Accepted (as is) for regional analysis	_____	_____	_____
• Modified for reconsideration	_____	_____	_____
• Rejected from further consideration	_____	_____	_____
Nature of Modification (if relevant)			
• Level and Form of Toll	_____	_____	_____
• Toll Collection Method	_____	_____	_____
• Tolling Locations	_____	_____	_____
• Traffic Routing	_____	_____	_____
• Mitigation Elements	_____	_____	_____

STEP 7: REGIONAL ECONOMIC IMPACT ANALYSIS

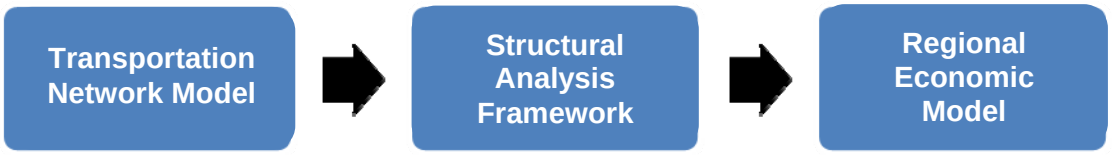
Overview: This step completes an analysis of the regional economic impacts of proposed tolling schemes that have passed the initial and regional assessment phases. It considers both short-term and long-term impacts on the health of the regional economy, and specifically on the growth of jobs, income and business activity in the region. This information will be used – together with separate studies of cost, traffic and environmental impact considerations – as input in the rating of tolling schemes and recommendations to be made for implementation.

Approach: For each tolling proposal, there is a four part process:

7.1 Select and calibrate an analysis framework and regional model;
7.2 Develop relevant scenarios and inputs for economic modeling;
7.3 Implement the economic impact modeling process; and
7.4 Summarize outcomes from the economic analysis.

7.1 Select and Calibrate the Appropriate Economic Impact Framework

The analysis of economic impacts requires two parts: (1) a regional economic impact assessment model, and (2) a structural analysis framework that can translate the transportation network model results from Step 2 into economic model inputs. This process is illustrated below. The evaluation team, together with ODOT staff, can make a final determination of the specific regional model and analysis framework to be used. Available options are discussed in the text that follows.



Regional Economic Model. The regional economic model should: (a) correspond to the desired region of study, (b) forecast economic impacts by year, (c) distinguish direct impacts, productivity and competitiveness impacts, and overall impacts, (d) break down impacts by sector of the economy, including households and industries, and (e) present results in terms of jobs, income, value added (GDP) and business output (revenue). A variety of regional economic impact models, that are customized for the affected metropolitan area or locally, may be used.

The selection of model should be made with consideration of: (1) cost of acquisition, and (2) sensitivity to cost and access differences among classes of vehicles, modes, and freight.

Structural Analysis Framework. There is also need for an analysis framework that can extract required information from the travel model and process it to generate direct inputs to the economic model. This information may include:

- Costs of implementing applicable road *pricing* mechanisms

- Differential *traffic movement* impacts affecting VMT, VHT, operating cost, accident and reliability impacts, varying by:
  - classes of vehicles,
  - times of day (peak/off-peak),
  - commuter movements (by industry/occupation),
  - local truck delivery and longer freight movements (by commodity/industry),
  - regional traffic flows (internal, pass-through and internal-external).
- Differential *access impacts* depending on location and routes affected, which affect:
  - intermodal connections (airport access, port access and intermodal rail access),
  - highway connectivity (interstate highway and bridge connections).

Most of these factors can be readily derived from outputs of metropolitan transportation models (including transportation network models), and then translated to inputs to the regional economic model. The intermodal, connectivity and traffic flow impacts are particularly important because of the special nature of the Portland metro region as a center of international trade, high tech industry, office and distribution activities. Thus, it is important to adopt an overall analysis framework that incorporates these factors.

There are essentially three choices for this framework. One is the TREDIS analysis framework – a system of modules that can work with essentially any regional economic model. Alternatively, a customized spreadsheet workbook that incorporates the same basic factors could also be used together with any of the previously-cited economic models. Finally, a front end tool called TranSight can be used to prepare inputs to the REMI economic model, but would have some limitations in this context associated with intermodal and highway connectivity measurement.

7.2 Develop Relevant Scenarios and Inputs for Economic Modeling

Each tolling scheme that has been selected for economic impact analysis must be translated into inputs for the economic impact framework. This requires information from a combination of sources, which must be obtained by the evaluation contractor from ODOT and/or local transportation agencies. These inputs, to be developed for each tolling scheme, are as follows:

1) Specification of the tolling scheme, including price levels for applicable times of day, vehicle classes and locations (from ODOT staff);

2) Assumptions to be made about implementation, including start year and if possible, preliminary estimate of capital and operating cost over time (from ODOT staff);

3) Traffic movement data including VMT, VHT, and characteristics of vehicle mix and flow patterns (drawn from basic output of a transportation network model);

4) Market access impacts including travel times for work, truck deliveries, and intermodal facilities (produced by specified transportation network model "skim trees"); and

5) Reliability and safety impacts (based on models or measurement) and translation of VMT and VHT factors into associated costs).

7.3 Implement the Economic Impact Modeling Process

Once the inputs are developed for each tolling scheme, then it is a straightforward matter to implement the analysis framework and run the regional economic model. The process can be done manually -- by putting transportation network model results into spreadsheet files, which are separately loaded into a structural analysis framework that translates them into the form of data necessary to run the economic model. Alternatively, that same process can be done automatically, through a scripting process in which transportation network model results are automatically generated, passed as input to the structural analysis framework and applied to the economic model.

If the proposed tolling scheme is forecast to generate positive net revenue (over operating costs), then an additional step of analysis is needed to identify how that revenue would be likely to be invested in transportation system improvements. Depending on the magnitude of the revenues generated, and the type of transportation system investments to be made, the change in travel conditions along affected network links (speed, reliability or safety) may or may not be large. If it is significant enough to affect the transportation network model outcomes, then that model and the entire economic impact analysis process would then be rerun. This represents a form of "feedback loop" in the analysis process.

In any case, results of the regional economic model should be presented for each tolling scheme as specified in part 7.4 (which appears next).

7.4 Summarize Outcomes from the Economic Analysis

Regional economic impacts should be produced in terms of changes in jobs, income, value added (GDP) and business output (revenue). Results should be presented for the first year and for a selected future year (such as 2020 or 2030). Results for the sum of all years from 2010 to 2030 should also be calculated and presented, along with a breakdown of impacts by industry in the metro region.

A memo should be produced that explains the calculated impacts on the economy, for each tolling scheme. It is presumed that this text will be accompanied by tables and graphics as appropriate to tell a story explaining how:

1) The addition of toll charges leads to *added cost* for various sectors of the economy,
2) The reduction in congestion leads to *reduced cost* for various sectors of the economy,
3) The cost increases and decreases affect *different elements* in the economy, and
4) The overall impact on jobs and income in the region can differ depending on key elements of the type and level of toll, as well as where and how it is applied.

The text should also be accompanied by charts and graphs as appropriate to display impact growth over time and the distribution of economic impacts among sectors of the economy (including households and key affected industries).

The last product is a summary table of key findings (on total impact and distribution of impact) for all proposed tolling schemes. This table then can be used by ODOT to rank or rate the alternative tolling schemes in terms of their positive or negative impact on the regional economy. That information can be combined with other studies of costs and environmental impacts, to support a final ODOT recommendation on recommendations for implementation of proposed tolling schemes.