

# Measuring Costs

*presented by*  
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# Measuring Costs

- **Objective of presentation: cover all aspects of costs**
- **Costs are generally considered to be the costs of the transportation facility**
- **Most “benefits” are reductions in costs (generally, the costs to users and to society as a whole) compared to the situation without the new facility**
- **This presentation identifies cost categories, provides advice on updating or forecasting costs, and provides references and links**

# Measuring Costs: Interim Notice Stresses Need to Document All Costs and Benefits, by Year

- **State of good repair (condition, performance, improvement to long term costs)**
- **Economic competitiveness (long term efficiency, cost competitiveness, productivity)**
- **Livability (user costs, improve choices and accessibility and services for disadvantaged, seniors, disabled)**
- **Environmental sustainability (energy, GHG, avoidance of environmental costs, mitigation or reduction of costs)**
- **Safety (number, rate, consequences of crashes)**

# Economic Analysis Primer – The Framework

- **Agency Cost Types**

- Design and Engineering, Land Acquisition, Construction, Reconstruction and Rehabilitation, Preservation and Routine Maintenance, Mitigation
- Other Costs– Safety, Preservation, Freight, Environment

- **User Cost Types - Delay and Time Costs, Crash Costs, Operating Costs**

- **Externality Cost Types - Emissions, Noise, Other**

- <http://www.fhwa.dot.gov/infrastructure/assetmgmt/primer.cfm>

# Measuring Costs: Reminders

- **Both future costs and future benefits should be shown in constant uninflated dollars, as illustrated in the Federal Register Vol. 75, No. 79, April 26, 2010, page 21714**
- **It is not legitimate to show costs in today's dollars and benefits in inflated dollars**
- **The recommended discount rates are to be applied to costs and benefits expressed in constant dollars for all future years**
- **Remember that the discount rate is not about inflation; it is about preferences for what it is worth to receive the same constant dollar value in different future years**

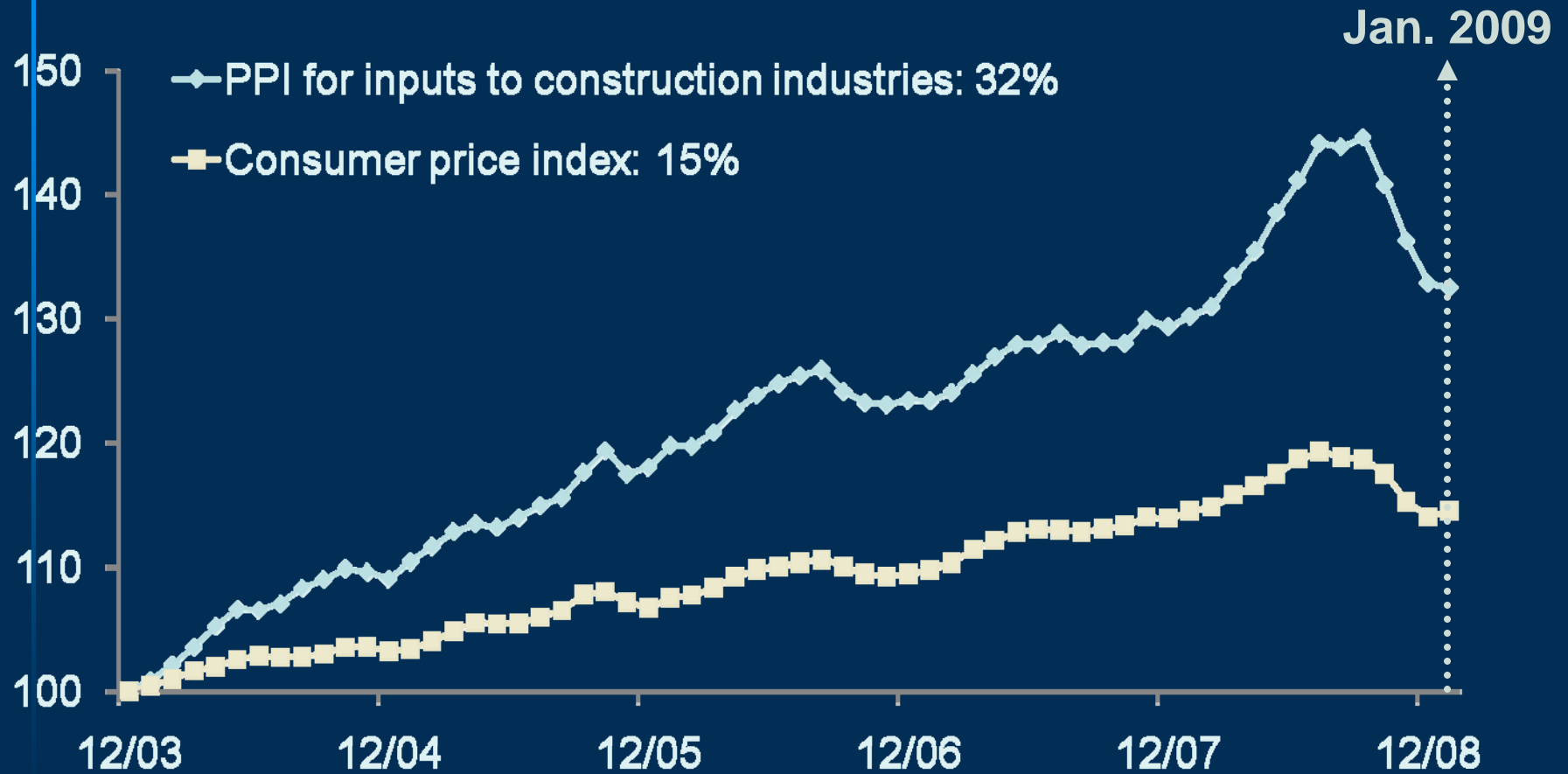
# Categories of Costs

- **Capital (including equipment and preliminary costs, if any), and relationship to life-cycle costs**
- **Operating – agency, user**
- **Travel time, including excess travel time**
- **Safety and security**
- **Environmental – GHG, sustainability, community, livability, water quality, etc.**
- **Equity**

# Updating Capital Costs to Today's \$ (Including Equipment and Preliminary Costs, If Any)

- Capital costs – applicants are assumed to have solid and detailed capital and equipment cost estimates
- Updates to costs (if needed) can utilize appropriate data series:
  - Primary capital cost update sources are Bureau of Labor Statistics Producer Price Indices at: <http://www.bls.ppi>
  - BLS will have “Focus on Prices and Spending” series starting May 2010
  - Very useful secondary sources are John Semmens’ data series publications “Price Trends for Major Roadway Inputs” <http://www.mtkn.org/products/pt/index.htm> and Ken Simonson’ s AGC Data Digest articles at <http://www.agc.org/>

# Example: Change in Producer Prices for Construction vs. Consumer Prices, 2003 - 2009 (December 2003 = 100) (Source: Ken Simonson, AGC)



Source: BLS (CPI, PPI)

# Updating Highway and Bikeway Capital Costs to Today's Dollars

- **John Semmens compiles these series (by BLS code #):**
  - **Asphalt WPU5810112**
  - **Construction Labor CEU2023730008**
  - **Diesel WPU05730302**
  - **Gasoline WPU0571**
  - **Lumber WPU081**
  - **Plastic Construction Products WPU072106**
  - **Portland Cement WPU13220161**
  - **Steel Rebar WPU101708**
  - **Highway and Street Construction PCUBHWY**

# Updating Transit Capital Costs to Today's Dollars

- **Comparable BLS items for updating transit capital cost elements of interest (by BLS code #)**
  - **Elevators/escalators WPU114201**
  - **Buildings for Stations/Facilities PCUBBLD - - BBLD - -**
  - **Other Facility/Station Elements PCUBMNR - - BMNR - -**
  - **Guideways (Steel Mill Products) WPU1017**
  - **Catenary, Contact Rail (nonferrous wire/cable) WPU1026**
  - **Communications WPU1176**
  - **Systems (Electrical Machinery and Equipment) WPU117**
  - **Other Highway-type Elements PCUBHWY**
  - **APTA has files of every agency's costs for all vehicle types**

# Updating or Estimating “Soft” Capital Costs to Today’s Dollars

- Applicants are expected to show all costs for the proposed investment, including any remaining preliminary costs for project development
- FTA, APTA, and the transit industry have developed analyses of preliminary or soft costs; the latest very useful document is TCRP Report 138 “Estimating Soft Costs for Major Public Transportation Fixed Guideway Projects” is available at:
- <http://gulliver.trb.org/Publications/PubsTCRPPProjectReports.aspx>

# Life Cycle Costs

- Applicants are expected to show life cycle costs for the proposed investment, and how the investment impacts on life cycle costs
- Excellent life cycle cost guidance and explanations of procedures can be found at the web site for the FHWA Office of Asset Management:
- <http://www.fhwa.dot.gov/infrastructure/asstmgmt/lcca.cfm>
- Some assets will have longer asset lives than twenty years, as acknowledged in Notice; questions should be posed to DOT on showing residual values in the analysis

# Updating Capital Versus Other Costs to Today's Dollars

- Applicants are expected to show costs and benefits in constant dollars for the same year (\$2008, \$2009?)
- Capital costs should be updated between various past years and the present using as specific as possible a producer price index data series for the specific costs
- Operating and travel time and other costs should be updated between various past years and the present using a consumer price index
- CPI info is at BLS site, and CPI for all past years is at <ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt>

# Operating Costs

- Applicants are expected to base their own agency operating cost estimates on their own experience with costs or similar experiences, explaining any differences
- For user operating costs, HERS has operating costs by vehicle type, periodically updated with indices; HERS ST is available through the FHWA Office of Asset Management 202 366-4657; link to the download is at <http://www.fhwa.dot.gov/infrastructure/asstmgmt/hersprep.cfm> - (could just use the cost parameters themselves)
- AAA has private vehicle costs in “Your Driving Costs” <http://www.aaaexchange.com/Assets/Files/200948913570.DrivingCosts2009.pdf> - (and other years)

# Freight Operating and Other Costs: More Detailed Costs Available in DOT Reports

- **Freight Benefit Cost Study: Phase III – Analysis of Regional Benefits of Highway-Freight Improvements ( HLB Decision Economics)**

- **<http://www.ops.fhwa.dot.gov/freight>**

- **Economic Costs of Freight in Bottlenecks**

- **<http://www.fhwa.dot.gov/policy/otps/freight.cfm>**

# Travel Time Costs

- **Highway vehicle costs – all vehicle types have travel time and operating cost parameters in HERS and HERS ST**
  - **By vehicle type and by business versus personal travel**
  - **Capability to use 2.0 X higher value for delay time (not used)**
  - **Overall travel values for vehicle types range from \$20.42 to \$22.16 for personal travel and \$30.87 to \$37.48 for business travel**
  - **Average value of time for all travel on rural roads is \$24.86 and for all travel on urban roads is \$23.96**
  - **Variations should be explainable**
- **Research by HLB and others has shown higher costs for time spent in delay: but, please follow DOT guidance**

# Estimating Current Travel Time Costs and Forecasting Future Year Travel Time Costs

- **Benefit-cost models already incorporate or embed travel time costs and other costs**
- **Forecasts of increases in future year travel time costs for personal vehicles may not be realistic – they will depend on growth in income per capita**
- **Income per capita does not always grow – particularly for those groups whose travel is income-limited**

# Per Capita Real Income - Percentage Changes in Recent Periods by Income Level (US Data)

<http://www.census.gov/hhes/www/income/reports.html> (and related)

Period	Lowest Quintile	Second Quintile	Third Quintile	Fourth Quintile	Ninety Fifth %
2000 to 2008 (8yrs) ( <u>mostly before the recession</u> )	-8%	-5%	-4%	-2%	-1%
1992 to 2000 (Over 8yrs)	+18%	+14%	+14%	+17%	+22%
1980 to 1992 (Over 12 yrs)	+2%	+4%	+7%	+11%	+18%
1967 to 1980 (Over 13 yrs)	+10%	+5%	+14%	+17%	+18%

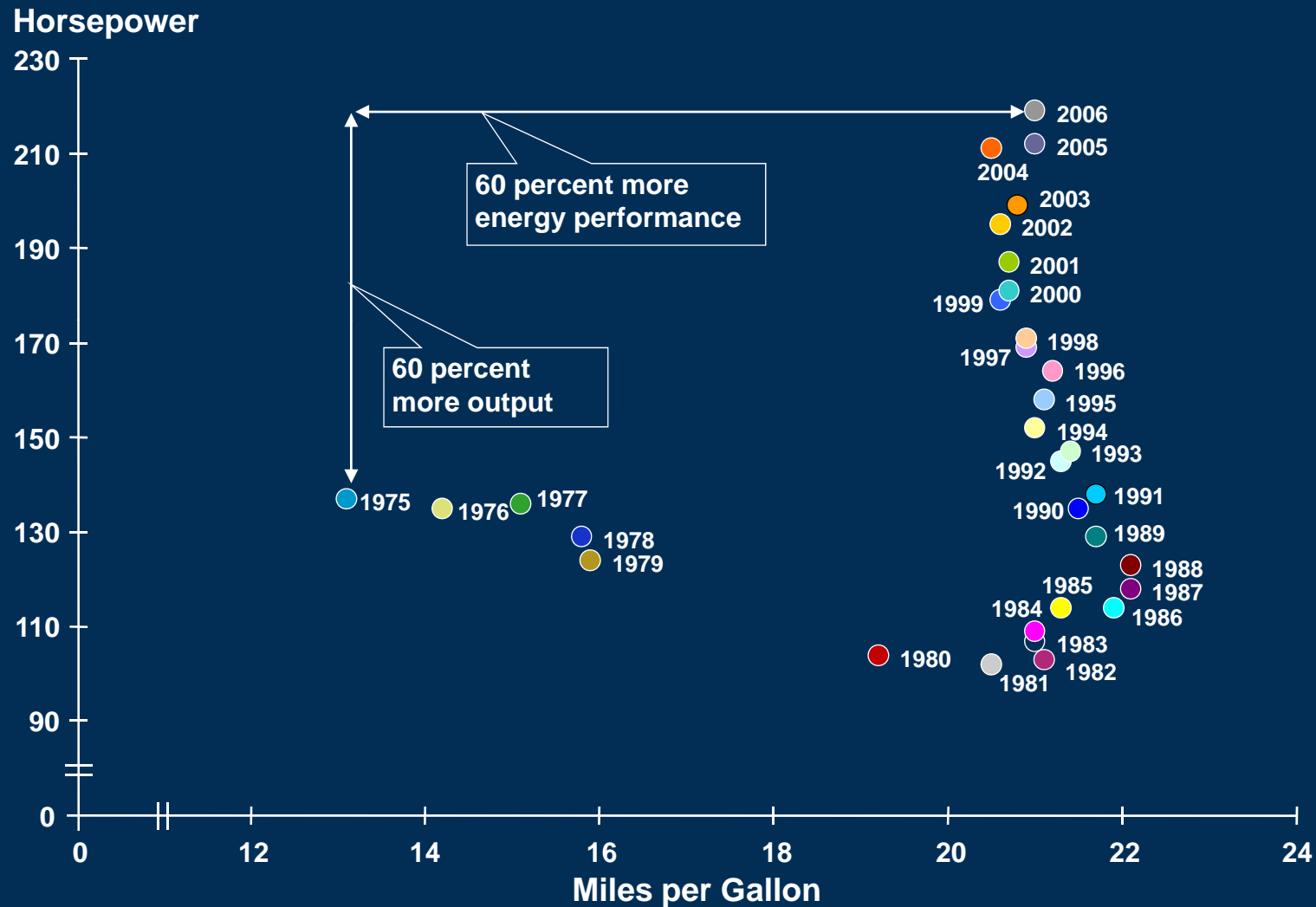
# Safety Costs

- Highway safety costs – all highway crash types have safety cost parameters in HERS and HERS ST: for fatalities, injury, and property damage only crashes
- AAA has sponsored a very useful document on safety related costs:  
<http://www.aaanewsroom.net/Assets/Files/20083591910.CrashesVsCongestionFullReport2.28.08.pdf>
- AAA concluded that crash costs exceed congestion costs
- Safety costs should be updated to today's dollars with CPI adjustments

# Fuel Costs and Fuel Types

- US DOE's Alternative Energy Outlook (AEO) provides forecasts of energy prices and modal energy usage rates by year, with alternative scenarios; these should be the basis for GHG emissions estimates
- <http://www.eia.doe.gov/oiaf/aeo>
- Table 3 has prices; Table 7 has model usage factors and forecasts
- HERS is periodically updated with AEO's modal usage forecasts

# On-Road Fuel Economy for New Light-Duty Vehicles 1975-2006 Model Years' Sales-Weighted Horsepower and MPG



Source: Environmental Protection Agency, Light Duty Automotive Technology and Fuel Economy Trends: 1975-2006, July 2006.

# GHG and Air Quality Impacts and Costs

- US DOT's GHG Report to Congress has estimates of the impacts on GHG emissions of generic actions; these can provide suggestions for estimating the GHG emissions consequences of projects. Report is available at:
- [http://ntl.bts.gov/lib/32000/32700/32779/DOT Climate Change Report - April 2010 - Volume 1 and 2.pdf](http://ntl.bts.gov/lib/32000/32700/32779/DOT_Climate_Change_Report_-_April_2010_-_Volume_1_and_2.pdf)
- Agencies should calculate estimates of GHG impacts using modal fuel efficiencies from sources such as the AEO – note that future light duty mpg will be increasing

# Equity Impacts and Costs

- Analyses on equity impacts are sparse
- Applicants should show impacts on accessibility and transport services and costs for target groups including economically disadvantaged populations, non-drivers, senior citizens, and persons with disabilities
- Portions of household budgets spent on transportation items by income groups can be found in the consumer expenditure survey data of the Bureau of Labor Statistics:

<http://www.bls.gov/cex/2008/aggregate/quintile.pdf> (and related tables for each year of interest)

# Equity Costs Example: PSRC User Benefits Versus Costs of Tolls (\$ Thousands Per Day)

User Group	Total of All Savings	Tolls Paid by Group	Ratio: Percent of Benefits per Dollar of Tolls	Percent of Total Tolls Paid	Percent of Total Savings (Benefits)
<b>Drive Alone Home Based Work</b>					
Low Income	\$2.5	\$111.5	2.24%	0.84%	0.04%
Low Middle Income	\$56.7	\$391.6	14.48%	2.97%	0.93%
High Middle Income	\$345.1	\$1,054.1	32.74%	7.99%	5.66%
High Income	\$980.8	\$1,745.2	56.20%	13.22%	16.07%
<b>Drive Alone Non Work</b>	\$739.4	\$4,203.8	17.59%	31.85%	12.12%
<b>Carpool and Vanpool</b>	\$446.7	\$1,978.3	22.58%	14.99%	7.32%
<b>Public Transportation</b>	\$156.1	\$0.0	NA	0.0%	2.56%
<b>Light Truck</b>	\$1,914.7	\$2,147.5	89.21%	16.27%	31.39%
<b>Medium Truck</b>	\$693.1	\$707.3	97.99%	5.36%	11.36%
<b>Heavy Truck</b>	\$770.1	\$861.1	89.43%	5.52%	12.62%
<b>Totals For All Groups</b>	\$6,102.3	\$13,200.3	46.23%	100.00%	100.00%

# Equity Costs Example: Distributional Impacts of Carbon Tax and Lump Sum Rebate (Source: MIT)

Income Decile	Carbon Tax as Percent of Income (Income Loss)	Lump Sum Rebate as Percent of Income (Income Gain)	Net Impact as Percent of Income
1	-3.7	5.6	1.9
2	-3.0	4.0	1.0
3	-2.3	3.1	0.8
4	-2.0	2.4	0.4
5	-1.7	2.1	0.4
6	-1.5	1.6	0.1
7	-1.3	1.3	0.0
8	-1.2	1.2	0.0
9	-1.0	0.9	-0.1
10	-0.8	0.6	-0.2

# Overall Costs Are Inter-Related

- **Costs of investing and operating can impact demand and usage on a multimodal basis, and cost analyses should be integrated**
- **The recent TCRP Report “Economic Impact of Public Transportation Investment” provides detailed guidance on the successive calculations of inter-related costs of various modes and their impacts on wider or broader economic factors (Weisbrod and Reno, 2009)**
- **[http://www.apta.com/resources/reportsandpublications/Documents/economic\\_impact\\_of\\_public\\_transportation\\_investment.pdf](http://www.apta.com/resources/reportsandpublications/Documents/economic_impact_of_public_transportation_investment.pdf)**

## ***TCRP Example: Multimodal Costs Inter-Relationships***

- 1. Transit ridership increase from service expansion***
- 2. Cost per new rider***
- 3. Auto use reduction from transit increase***
- 4. Passenger cost savings for those switching to transit***
- 5. Auto & truck cost savings from reduced congestion***
- 6. Business productivity from greater labor access***



***Overall Economic Impact: jobs, income, tax revenue***

# Costs Are Embedded In Models

- If embedded costs are directly useable, then the models results do not need adjustment, but if embedded costs need adjusting, care is necessary in adjusting the results
- Types of costs covered are dependent on the types of models used in the analysis
- Review costs embedded in models and make needed adjustments, inside the models or through post-processing
- Reminder – use constant dollars, and discount all future years' benefits and costs similarly

# Usefulness of United Kingdom Examples

- The Eddington Report identifies an evolution of economic analysis and benefit cost analysis to culminate in the framework called “Value for Money” which incorporates wider economic benefits and monetizes other benefits to the extent possible
- TREDIS (EDRG) and other U.S. work such as HEAT has also sought to broaden the analysis towards a similar framework as what Eddington terms “Value for Money”
- The UK Transport Ministry identified a “Transportation Appraisal Guidance” (TAG) framework

# Usefulness of United Kingdom Examples

- The TAG is structured as evolving modular guidance on specific performance objectives and economic methods, and links performance objectives to economic analysis consistently and transparently
- The guidance is regularly updated, organized by topic area, and housed electronically at:  
<http://www.dft.gov.uk/webtag/documents/index.php>
- TAG Units can be explored for their usefulness; they address a very wide range of topics
- Of course, applicants must use U.S. parameters

# Final Thoughts - Considerations for Meeting USDOT TIGER Requirements

- **Build on your previous TIGER experience**
- **Follow DOT's instructions which specify best practices**
- **Review all cost parameters and update costs**
- **Utilize models which embed costs and benefits – with care as needed**
- **Follow the DOT Notice – not this or any other advice**
- **Behave yourself**