Supporting Calculations

Method of Calculating Economic Impact
Using a Discounted Cost-Benefit Analysis

Based off of a cost benefit model developed by NCTCOG staff, the US 175/IH 45 connector project should have a net positive effect on the economy of $145.1 million annually and create 1,577 jobs when completed. During construction there will be a net benefit to the economy of $138.8 million and 754 jobs over each of the two years of the project. This project will have a long-term return on investment of 973 percent and generate 243 percent in taxes as the project cost (assuming a 25 percent capture rate).

$$W_t = B_t - C_t$$

$$J = W_t / Y$$

$$B_t = (CO2*Z) + (\text{Hours Saved}*L) + (G_t*M) + (\text{GasSaved}*P_G) + (\text{Lives}*\beta)$$

$$C_t = \frac{PV(1+r)^t * r}{(1+r)^t - 1}$$

W_t = Net effect
B_t = Benefits
C_t = Costs
G_t = Government Spending
M = Multiplier
r = Interest Rate
t = time
Y = Economic output per job.
J = Total jobs created
PV= Present Value
P_G = Price of Gas
β = Economic Value of a human life

B_t = Benefits will use available data on benefits to core economic activities (excluding real estate). Consideration has been given to the economic benefit of hours saved and pollution reduction. The long-term benefits are $159,988,175 annually.

β = Economic Value of a human life is set at $6 million according to TIGER grant application.

C_t = Costs are based on just the TIGER funds of the project (PV) or $150 million. These costs have been annualized to match benefits. The annual cost is $14,908,484.

Gas Saved = The total amount of gallons of gas saved as a result of the project. This project is predicted to save 14,698 gallons a day in fuel. This number is then multiplied by 250 to get the total saved.

G_t = Government Spending is the actual amount of construction spending that occurs in any given period. For the US 175/IH 45 connector project it is assumed to be $71 million during each of the two years of construction. The total cost is $185 million with $43 million going towards acquiring land.

Hours Saved = Total hours saved for the region each year after completion of the project will be 5,364,000 hours according to NCTCOG. This is based on a daily savings of 21,456 hours. No numbers exist for congestion created by the construction. Traffic is assumed to be unaffected by construction.

L= The cost of one-hour spent in traffic. According to the Texas Transportation Institute, the cost of 1 hour is $15.47 per hour for personal transportation and $102.12 for freight traffic. NCTCOG Traffic studies have found that approximately 10 percent of all traffic is freight traffic. The combined numbers are $24.14 per hour saved.

Lives = Number of traffic fatalities prevented as a result of roadway improvements. There have been 245 wrecks in the project area with 14 fatalities. There have not been any studies on the expected reduction. Interviews with engineers involved indicate that removing a sharp-curve known locally as “dead-man’s curve” will result in a two-thirds drop in fatalities. This would save 3.6 lives per year or 108 lives over the next 30 years.

M = this is the multiplier applied to construction spending. It is a made up number assumed to be 1.5. The range provided by the Congressional Budget Office for infrastructure projects is 1.0 to 2.5 over the short term.

CO2 = Carbon Dioxide reduced. NCTCOG model found a decrease of 141.53 tons per day. This was multiplied by 250 to get an annual total.

P_G = Price of Gas is set at $2.10 per gallon of unleaded.

PV= Total cost of the project in today’s dollars. The total cost is $185 million with $150 million coming from TIGER grant.

r = The interest rate will have a significant effect on the outcome of the model. The lower the rate used the larger the benefits of the project. The model is set at seven percent as required in TIGER grant application.

t = Time is the number of years that will be used to price the project out over. The longer the period used, the larger the benefit of the project. The model is set at 30 years.

Y= Economic output per job is the amount of Gross Domestic Product required to create one job. The White House Council of Economic Advisors set this at $92,000.

Z= the cost of one ton of Carbon Dioxide set at $33. This number is specified in the TIGER application.

Table 1. Economic Impact Summary

Total Construction Costs	$142,000,000
Amount of TIGER Requested	$150,000,000
Travel Time Savings/Hours Saved per Year	21,456
CO_2 (tons/day)	141.53
Fuel Saved (gallons/day)	14,698
Cost of an Hour	$24.14
Cost/Ton of CO_2	33
Cost of Gallon of Fuel	2.1
Lives Saved	3.603
Cost of Life Lost	$6,000,000
Annual Cost	$14,908,485
Net Benefits (per year)	$159,988,175
Net Effect	$145,079,175
Net Benefit of Hours Saved	$129,486,960
Net Benefit of Pollution	$1,167,623
Net Benefit of Fuel Saved	$7,716,450
Net Benefit of Lives Saved	$21,617,143
Years to Complete	2
Short-Term Construction Benefit	138,750,000
Jobs in Short Run	754
Jobs in Long Run	1,577
Total Short Run	1,508
Benefit to Cost Ratio	10.73
ROI (total economy)	973.14
Tax Revenue Replaced	243.28%

Sources:

Texas Transportation Institute at Texas A&M Study on Traffic Congestion
http://tti.tamu.edu/infofor/media/archive.htm?news_id=5206

Texas Commission on Environmental Quality funding methods
http://www.ectausa.com/documents/07Wescott_001.pdf

Method of Calculating Sustainability Impact

In the build and no-build analysis for this project, vehicle hours of travel (VHT), average loaded speed, congested delay, and traffic delay were analyzed as a performance measure. Fuel consumption and carbon dioxide (CO_2) emissions were estimated from the VHT reduction from the build and no build scenario.

Methodology:

- Fuel Consumption: 0.685 gallons/hour factor was utilized to calculate the Fuel Consumption from Vehicle Hours of Travel. [1]
- CO_2 Emission: 8,788 grams/gallon of gasoline emission factor was used to calculate the CO_2 Emissions from Fuel Consumption.[2]
- Project Life: 40 years is used as project life for all highway projects.
- Global CO_2 Emission Benefits: $33/Metric Tons of CO_2 emission was used to calculate the Global CO_2 Emission Benefits. [3]

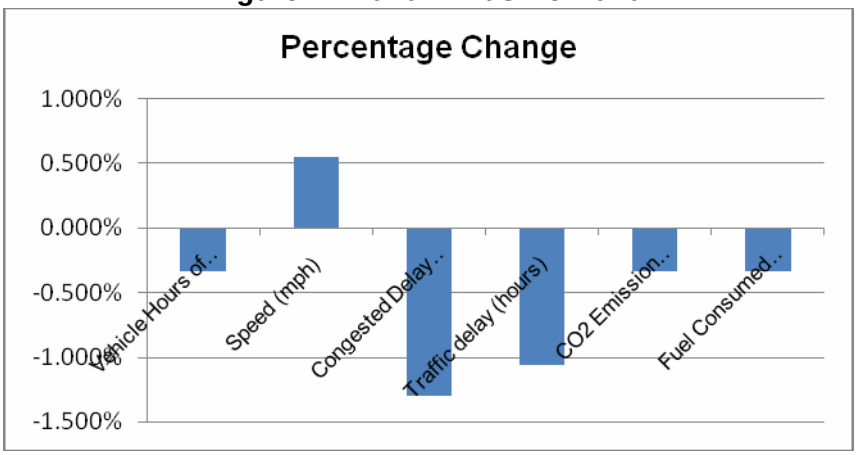
Performance Analysis:
Table 2 shows the net reduction and percent change from Build case to No Build case.

Table 2. Build minus No Build

Parameter	Build – No Build	Percentage Change
Vehicle Hours of Travel (hours)	-21,456.31	-0.340%
Speed (mph)	0.21	0.551%
Congested Delay (hours)	-14,438.68	-1.306%
Traffic delay (hours)	-6,477.34	-1.065%
CO_2 Emission (tons/day)	-142.37	-0.340%
Fuel Consumed (gallons/day)	-14,697.58	-0.340%

Figure 2 graphically represents the percent changes on all the analysis parameters.

Figure 2. Build minus No Build



Summary:
At the regional analysis, this project reduces travel time by 223 million hours, CO_2 emissions by 1.5 million tons and fuel usage by 153 million gallons, with a CO_2 global benefit of 44 million dollars over the project life. Summary of the benefits are shown in Table 3.

Table 3. Performance Summary

Parameters	Benefits/day	Benefits/ Project-Life
Vehicle Hours of Travel (hours)	21,456.31	$223,145,624.00
CO_2 Emission (tons)	142.37	1,480,696.86
Fuel Consumed (gallons)	14,697.58	152,854,823.68
Cost Benefit (dollars)	4,261.42	$44,318,737.69

Fuel consumption and travel time reduction suggests that other criteria pollutants, such as Carbon Monoxides (CO), Volatile Organic Compounds (VOC), Nitrogen Oxides (NOx), Particle Matters (PM), will also be reduced.

Sources:

1. "2009 URBAN MOBILITY REPORT" July 2009, report published by Texas Transportation Institute.
2. EPA, "Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle" < http://www.epa.gov/otaq/climate/420f05004.htm>, September 3, 2009.
3. Tiger Grant Application requirements.