A Tools-Based Approach to Transportation and Land Use GHG Mitigation Policy Analysis

Judith Mueller, Lewison Lem, Ph.D., Scott Williamson, and Rami Chami

Columbia University and Jack Faucett Associates

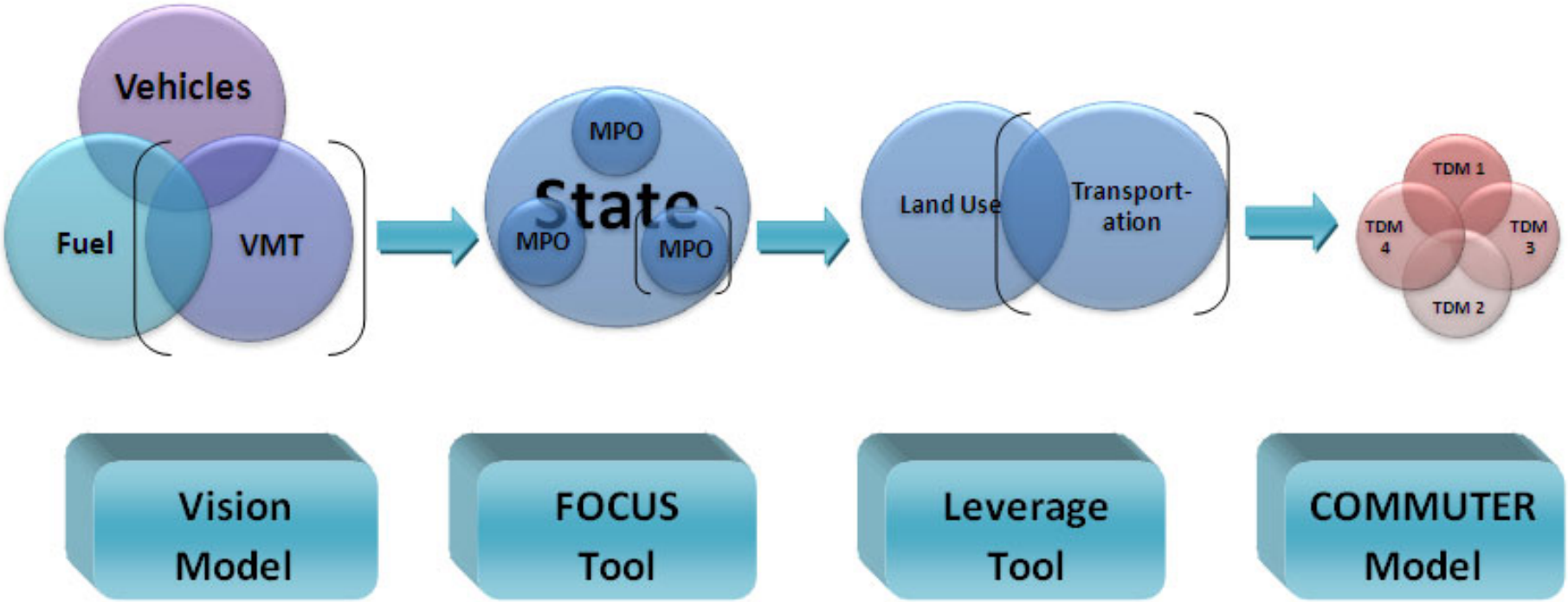
For the Transportation Research Board Annual Conference - January 2011

Economics
Public Policy
Planning
Jack Faucett Associates
Since 1983

Purpose of the Integrated Tool-Based Analysis Approach

- A comprehensive family of integrated analysis tools allows for 'stand alone' and 'integrated' analysis of many transportation and land use policies
- The integrated tool-set provides a consistent and validated method for analyzing different GHG reduction strategies for the transportation and land use sector
- The integrated tool-set can estimate the aggregate effects of multiple policies and also measure overlap and synergistic effects of policies

Comprehensive Integrated Tool-Based Analysis Approach



“Top Down” versus “Bottoms Up” Analysis

- Other Tools and Methods of Analysis rely upon “Top Down” Analysis
- “Top Down” Analysis tools are limited by shortcomings of Aggregate Baseline Scenario Data

A Suite of Tools based upon "Bottoms Up" Analysis

- "Bottoms Up" Tools do not rely upon Aggregate Baseline Scenario Data
- Instead "Bottoms Up" Tools rely upon Scientific Knowledge Base for Unit Effectiveness Factors
- Unit Effectiveness Factors are "Scaled Up" through Strategy Expansion Scenario

Bottoms Up Analysis Provides Improved Ramp Up Scenario Analysis

- Top Down Analysis is helpful for regulatory programs (eg. Vehicle standards, fuel standards)
- VMT Efficiency is generally not implemented through regulation.

Bottoms Up Analysis Provides Improved Ramp Up Scenario Analysis

- Instead VMT Efficiency is achieved through expanded funding and program implementation
- Bottoms Up Analysis Allows for multiple, iterative scenarios of ramp up and program implementation

A Growing Suite of VMT Efficiency Analysis Tools for Strategy Expansion

- Scientifically Based Analytical Capabilities
- Multiple and Iterative Scenario Analysis
- Not Dependent upon Quality of Aggregate Inventory and Forecast

Example of Using EPA COMMUTER Model for Travel Demand Management Strategies

- The EPA COMMUTER Model analyzes Transportation Demand Management (TDM) strategies and provides travel and emission impacts in its results

EPA COMMUTER Model

- The EPA COMMUTER Model analyzes Transportation Demand Management (TDM) strategies and provides travel and emission impacts in its results
- TDM programs include:
  - Transit fare decreases
  - Transit service improvements
  - Ridesharing programs
  - Telecommuting
  - Alternative Work Schedules

EPA COMMUTER Model

- Strategies can be analyzed individually or in concert
- COMMUTER provides overlap and synergistic analysis results when analyzing multiple policies
- COMMUTER analyzes TDM programs for defined regions or for individual employers

Stand-Alone Analysis Example: Bike Infrastructure in Kentucky

Policy Description

- This policy focused on bike infrastructure aimed to improve, construct, and promote sidewalks, bicycle lanes, and shared-use paths to increase pedestrian and bicycle travel.

Policy Design

Goal:

- Walking and bicycling account for 1% of person miles traveled (PMT) by 2020, and 1.5% by 2030.

Timing: 2011-2030

Parties Involved:

Local governments, state agencies, environmental organizations

Methodology

- The analysis was completed using the EPA COMMUTER Model and additional spreadsheet tools were also created by the analysts.

- Individual runs using the employment baseline in 2005 and the employment forecast to 2030 for metropolitan areas, such as Louisville, Lexington, Bowling Green, Elizabethtown and Frankfort, were completed.

- The participation in increased walking and biking was assumed to apply to all central business districts (CBDs) in the state with employment and population rates greater than 20,000 people, which included 18 cities.

Results- GHG Reduction by City and Region

City-Specific, Regional, and Total GHG Emission Savings from TLU-1 Increases in Biking and Walking ($MMtCO_2e$) *

Year	Louisville	Lexington	Bowling Green	Rest of the Region (14 Small Cities)	Total
2020	–0.026	–0.010	–0.002	–0.016	–0.055
2030	–0.044	–0.015	–0.003	–0.024	–0.087

$MMtCO_2e$ = million metric tons of carbon dioxide equivalent.

*Center for Climate Strategies (CCS) Lewison Lem, Judith Mueller, Scott Williamson. Rami Chami. Kentucky State Climate Action Plan"Appendix- Transportation and Land Use". Washington, D.C., February 2011.

Summary Results Table*

Quantification Factors	2020	2030	Units
GHG Emission Savings	–0.055	–0.087	$MMtCO_2e$
Cumulative Emissions Reductions (2011–2030)	–1.049		$MMtCO_2e$
Energy Savings (2011-2030)	–87		Millions of gallons
Net Present Value (2011–2030)	–$445		Millions of 2005$
Cost-Effectiveness	–$424		$/$tCO_2e$

*Center for Climate Strategies (CCS) Lewison Lem, Judith Mueller, Scott Williamson. Rami Chami. Kentucky State Climate Action Plan"Appendix- Transportation and Land Use". Washington, D.C., February 2011.

Stand-Alone Analysis
Example: Car Pooling in China

Policy Description

- Reducing the Vehicle Miles Traveled (VMT) associated with commuters traveling to and from work
- Promoting carpooling and vanpooling through ride-share matching, marketing, and public awareness

Policy Design

Goal:

- Increase the number of car pool and van pool participants by 75% by 2030
- Increase funding for regional and state ride-matching programs

Timing: 2011-2030

Parties Involved:

Local governments, state agencies, environmental organizations, transit providers, major employers, development groups

Methodology

- The analysis was completed using the EPA COMMUTER Model and additional spreadsheet tools were also created by the analysts.
- Individual runs using the employment baseline in the year 2007 and the employment forecast to 2030 for large cities (> 50,000) were completed.
- The rate of increased participation in ridesharing was assumed to be 75% by 2030 with program implementation in 2011.
- A mode share increase by 75% was applied to the carpooling category and SOV mode share was reduced by 75%

Results- GHG Reduction by City*

GHG MMTCO2e per City, Region and Total					
Year	Total	City 1	Area 1	Area 2	Area 3
		Similar to Detroit with Population of 910,920	Comprised of 7 Cities with Population between 100,000 and 200,000	Comprised of 5 Cities with Population between 80,000 and 100,000	Comprised of 16 Cities with Population between 50,000 and 80,000
2020	-0.203	-0.054	-0.058	-0.023	-0.067
2030	-0.343	-0.092	-0.098	-0.040	-0.113
Size: Employment 2030**	2,581,398	720,334	759,273	226,521	875,271

*Work was completed for the Center for Climate Strategies – Guangdong Workshop

**Michigan Data with Chinese Growth Rates and Chinese Employment/Population Ratio

Summary Results Table*

Quantification Factors	2020	2030	Units
GHG emission savings	-0.203	-0.343	$MMtCO_2e$
Net present value (2011–2030)	-$2,122		$ Million
Energy Savings (2011-2030)	-334		Millions of Gallons
Cumulative emissions reductions (2011–2030)	-4.011		$MMtCO_2e$
Cost-effectiveness	-$529		$/$MtCO_2e$

*Work was completed for the Center for Climate Strategies – Guangdong Workshop

Overlap Analysis

Overview

- Stand alone analysis does not give a fully accurate estimate of the emissions reductions or costs that would result from implementation of a set of policies
- Two strategies implemented together may have synergistic effects where the total is greater than the sum of the parts if implemented on their own.
- For example, policy A may ‘enables’ the reductions associated with policy B

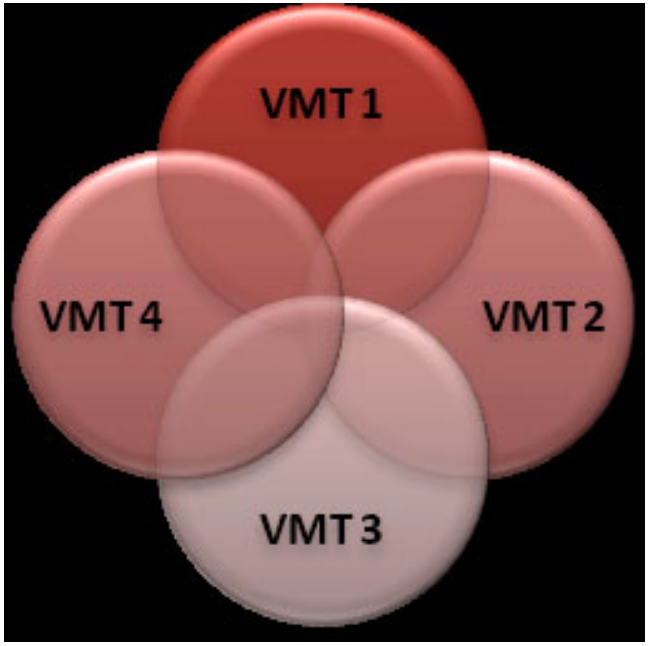
Overview Continued

- Interactions can also occur in the form of overlaps where multiple policies affect the same emissions

- Multiple policies can achieve fewer GHG reductions because some of the same stand-alone estimated GHG reductions overlap with one another

Interaction Between Multiple VMT Strategies

- The interaction between the multiple VMT-related policies is important in evaluating the extent to which overlap or synergistic effects may be anticipated through implementation of multiple policies in concert



Example: Overlap Analysis of Kentucky VMT Strategies

Cumulative and Yearly Emissions Reductions of Four Policies in MMtCO2 with and without Overlap*

Cumulative Emissions Reductions Sum of TLU-1, TLU-3a, TLU-3b/4, TLU-7 without Overlap	Cumulative Emission Reductions Sum of TLU-1, TLU-3a, TLU-3b/4, TLU-7 with Overlap	Yearly Emission Reductions 2030 Sum of TLU-1. TLU-3a, TLU-3b/4, TLU-7 without Overlap	Yearly Emission Reductions 2030 Sum of TLU-1. TLU-3a, TLU-3b/4, TLU-7 with Overlap
-11.961	-9.20997	-0.962	-0.74074

*Center for Climate Strategies (CCS) Lewison Lem, Judith Mueller, Scott Williamson. Rami Chami. Kentucky State Climate Action Plan"Appendix- Transportation and Land Use". Washington, D.C., February 2011.

Example: Kentucky Integration Analysis Results Overall

- Multiple Policies Affecting the Same…
  - Vehicle fleet
  - Population
- Policies Interact
  - Heavy-Duty Policies: 3% overlap
  - VMT Policies: 23% overlap
  - LDV Policies: 6% overlap

Thank you for your interest:

Judith Mueller
Columbia University School of International and Public Affairs (SIPA)
jm3654@columbia.edu
(508) 333 1184

Lewison Lem, Ph.D.
Jack Faucett Associates (JFA)
Lem.JFA@gmail.com
(415) 525-6163
http://www.jfaucett.com/

Economics
Public Policy
Planning
Jack Faucett Associates
Since 1963