

Exercising a megaregion analysis framework in the Chesapeake Bay area

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Abstract: Megaregions are a new geography that may well form the “nation’s operative regions when competing in the future global economy,” according to the March 2010 FHWA Strategic Plan. To assess the impact of policies and scenarios, a hypothetical Megaregion governing board, responsible for the broad welfare and economic competitiveness of an interacting region, will need to employ a broader set of tools than is typically used in typical Metropolitan Planning Organization (MPO) or State Department of Transportation (DOT) models. The analysis framework, resulting from a Federal Highway Administration’s Exploratory Advanced Research Program project, suggests an integrated model including travel driven by economic and land use decisions, and capturing effects on the environment, as well as enhancing the travel component to include long distance truck and person travel, the former driven by economic commodity flows. The paper discusses how this analysis framework was exercised in a proof-of-concept High Energy Price scenario for the Chesapeake Bay megaregion.

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Exercising a megaregion analysis framework in the Chesapeake Bay area

In many parts of the world megaregions, large agglomerations of economically connected metropolitan areas and their supporting hinterlands, represent an emerging development pattern. Examples in North America include the Northeast corridor in the United States covering Boston, MA to Richmond, VA and the industrial areas of the United States and Canada surrounding the Great Lakes. A challenge is to determine how to foster greater efficiencies in these megaregions by creating a stronger infrastructure and technology backbone in the Nation's surface transportation system. To effectively function and to allocate scarce resources to infrastructure investment, megaregions must not only understand their relationships with other megaregions, but must also understand their own region's internal economic flows and the interactions between these flows and the transportation system.

Analytic methods are needed to address issues at the megaregion level. This report first proposes a generalized analytic framework for analyzing megaregion issues, and then develops a proof of concept application of the framework for the Chesapeake Bay Megaregion (CBM). We show how solid analytic tools can provide a much greater understanding of linkages within the megaregion and better inform decision makers on the effectiveness of anticipated policies. We conclude with the value of the megaregion view in planning as demonstrated in this effort.

1. Megaregion Analysis Framework

An analysis framework applicable to any megaregion should be structured in part based on issues of interest at this broader level. Many planning decisions are more appropriately made at the megaregional level than at the traditional MPO or state level. The larger scale is relevant in cases of spillovers between areas, economies of scale, demand heterogeneity, and administrative cost efficiencies. Key examples of the value of coordinated planning include economic development and economic linkages, freight and land use planning and emergency response. In each of these examples even the best of policies can be unwittingly thwarted by the actions of adjacent communities. While megaregion issues may be similar to those addressed elsewhere, the scale of the issues differs significantly from issues faced by an MPO or even a state government. Also, the emphasis on specific issues may differ, with a megaregion more concerned about impacts to economic competitiveness v.

1.1. Framework

To assess the impact of policies and scenarios, a hypothetical Megaregion governing board, responsible for the broad welfare and economic competitiveness of an interacting region, will need to employ a broader set of tools than typically used in Metropolitan Planning Organization (MPO) or State Department of Transportation (DOT) models. An analytic framework for a megaregion would include three considerations not typically found in current MPO and statewide models:

- **Study area definition** –Megaregions are defined by naturally occurring economic, demographic, and environmental factors rather than political boundaries. A regional characterization can identify the factors which tie the megaregion together, as well as the issues which the megaregion analytic tool must address.

- 1 • **Economic issues** – For a megaregion economic competitiveness is paramount, with
2 transportation, land use, and the environment supporting a vibrant economy. Thus,
3 megaregion models should be driven by a national economic model, as well as an
4 analysis of key industry sectors and goods movement flows within the megaregional
5 economy providing linkages to the transportation system. The transportation needs of
6 these economic flows provide a key input to new infrastructure investment decisions.
- 7 • **Interaction with other megaregions** – Due to the geographic size of the megaregion, it
8 is important to model the economic and long distance transportation (freight and person
9 travel) interactions with other megaregions and the rest of the country.

10 Since megaregions encompass a larger area than typically covered by MPOs or DOTs, a larger
11 analytic view is required as well. This necessitates the inclusion of economic motivations for
12 travel and a focus on longer distance travel. Local detail enables sensitivity to policies where
13 local changes may impact the larger region and where evaluation of performance measures
14 requires such detail.

15
16 The megaregion analysis framework must include short- and long-distance travel and freight as
17 well as passenger movements. Therefore, it is more appropriate to employ integrated models
18 where travel is driven by economic and land use decisions, and employ a multi-level model
19 where activities are assessed at an appropriate national, regional, or local context reflecting the
20 scale at which the phenomenon occurs. Such a suite of models would aspire to address:

- 21 • Economic, Transportation, Land Use and Environmental Impacts.
- 22 • Multi-Modal Transportation Systems.
- 23 • Short- and Long-Distance Travel.
- 24 • Multi-Scale Projects.
- 25 • Diversified Megaregion Context.

26
27 A multi-tiered approach with three layers – Global, Megaregion, and Local layers - represents
28 the context for travel decisions by the market segments important to megaregions. This approach
29 enables a tailoring of the spatial scale to data and decision-makers represented in the model
30 components. It also facilitates the integration with existing local (MPO/DOT) models. Most
31 important is tailoring this framework to the policy questions of the particular megaregion
32

33 Figure 1 shows the model components and structure for megaregion analysis. The Megaregion
34 analytical framework is built on the economy. The economy defines the region geographically
35 and serves as a driver for activity locations and associated travel demands. A land use model
36 allows the analysis of coordinated policies that can work towards efficiencies rather than
37 competitions. Indicator models are important measures of performance. The data flows and
38 feedbacks between them that reveal the complex interplay of forces.

39
40 Megaregion models must consider both short and long distance trips. The explicit distinction
41 between short and long-distance travel has behavioral and technical implications for the
42 framework. In terms of travel behavior, long-distance trips differ significantly from short-
43 distance trips due to differences in travelers' income, mode and destination choice, as well as trip
44 purpose. More limited information available to long distance travelers affects their time of day,

mode selection and route selection; while longer trip lengths may reduce sensitivity to congestion and costs of travel.

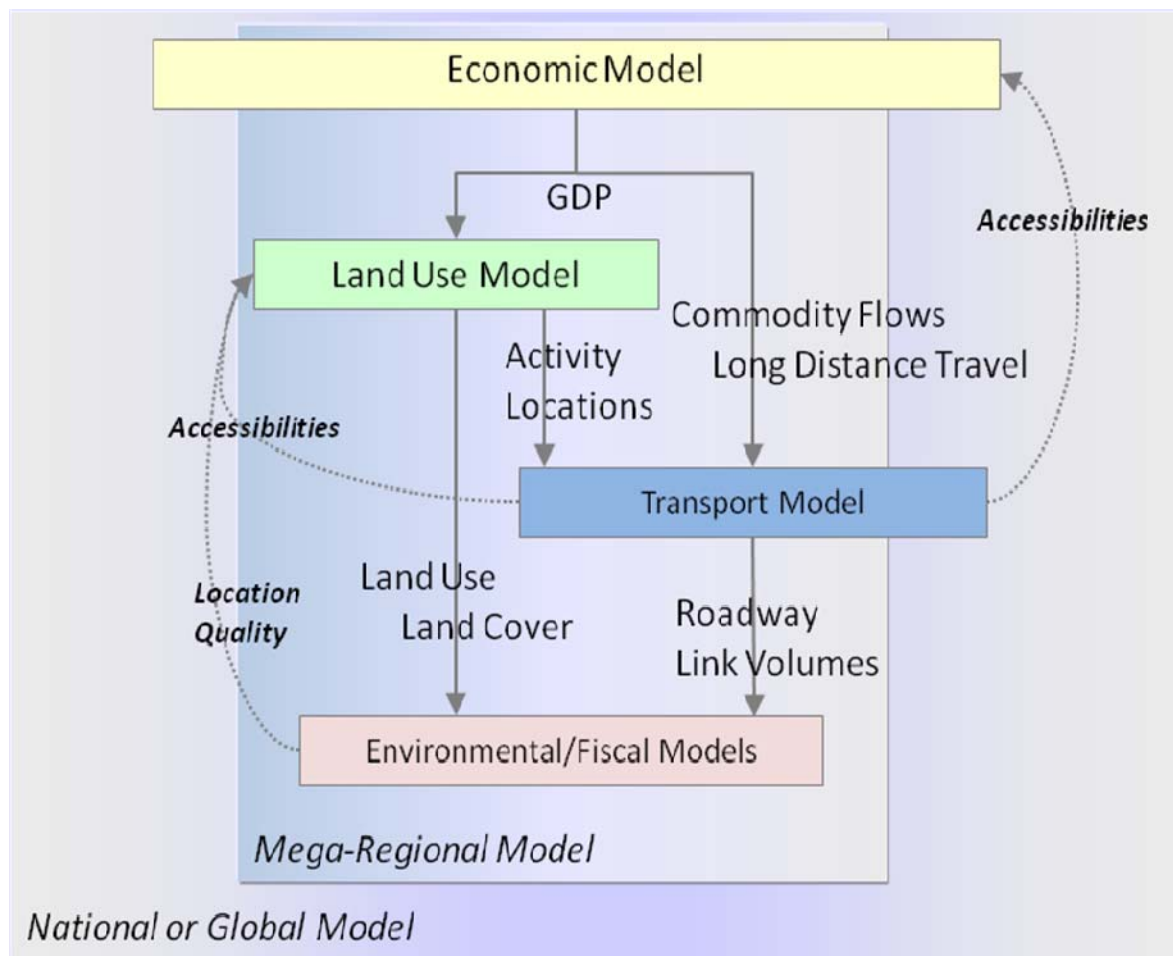


FIGURE 1 Megaregion Analysis Framework

The level of detail, at which each element of the framework operates, very much depends on the policy questions that are likely to be asked. The following describes each of the framework components.

- **Economic model** (yellow in Figure 1). Changes in the national economy will have effects on the megaregion, both with respect to growth in population and employment as well as trade with other megaregions. Important economic interactions occur at different geographies. A global scale captures interactions with other megaregions and drivers of national freight flows, while congestion has a local economic impact.
- **Land-use model** (green in Figure 1). The land use model forecasts the likely development patterns as a result of the location decisions of forecast population and employment.

- **Transport models** (blue in Figure 1). Transport models forecast the number of trips made, origins and destinations, and mode. They do this for short and long distance passenger trips and short and long distance freight trips. They also place trips on a multi-modal network and estimate congestion levels.
- **Indicator models** (pink in Figure 1). Indicator models are post-processor models which are used to address specific issues of a megaregion. Examples include air quality, water quality and local economic impacts.

1.2. Implementation Issues

The specific policy issues and conditions of each megaregion will guide the application of this framework. The region should carefully review the local conditions, issues to be addressed as well as available data, and design the analytical framework (models) with these in mind.

The framework as described assumes traditional modeling methods, such as a gravity model for trip distribution and static assignment techniques for network analysis. More advanced methods, such as activity-based demand models and dynamic assignment techniques may be used depending on need. Indeed, the megaregion's questions should be broader than a typical urban model. The tool should cover a larger scope both in disciplines (e.g., economic and land use) and geography. With limited resources, these added model attributes will force compromises elsewhere, such as the level of detail and consistency used in urban models. This is to be expected, as the role of the megaregion board is as an advocate for broader policies. Such policies, once identified would continue to be coordinated at the megaregion level, but in collaboration with follow-up more detailed study and implementation at a local level. Ideally, a basic megaregion analysis tool can be put in place quickly, with each use of the tool enabling further prioritization of model improvements to those techniques that best address the most pressing questions of interest to the megaregion at a strategic level of detail.

2. Case Study Application

As a demonstration of the framework above for analysis of issues in a U.S. megaregion analysis, a case study application was performed of the Chesapeake Bay Megaregion. The effort began with an understanding of the region's characterization, which led to a tool design customized to local needs, issues, data and existing models. The case study went on to evaluate a high energy price future and the resulting impact, policies the region could adopt to shore up its vulnerable areas to retain economic strength under such a future.

2.1. Regional Characterization

The Chesapeake Bay Megaregion (CBM) has a dominant spine running north-south along the I-95 corridor from Wilmington, DE to Hampton Roads, VA, which houses the urban services of government services, hospitals, military bases, and manufacturing. Manufacturing spills east and west into areas dominated by natural resource (farming, forestry, mining), and recreation services. Significant economic flows occur between subareas of the megaregion, as measured by the value of shipments. The north south movements, particularly along I-95, are historically important and likely to grow, highlighting linkages along the full north-south spine of the

1 megaregion. Key exports fueling the megaregion economy are manufacturing, mining,
2 agriculture, government services, and tourism.

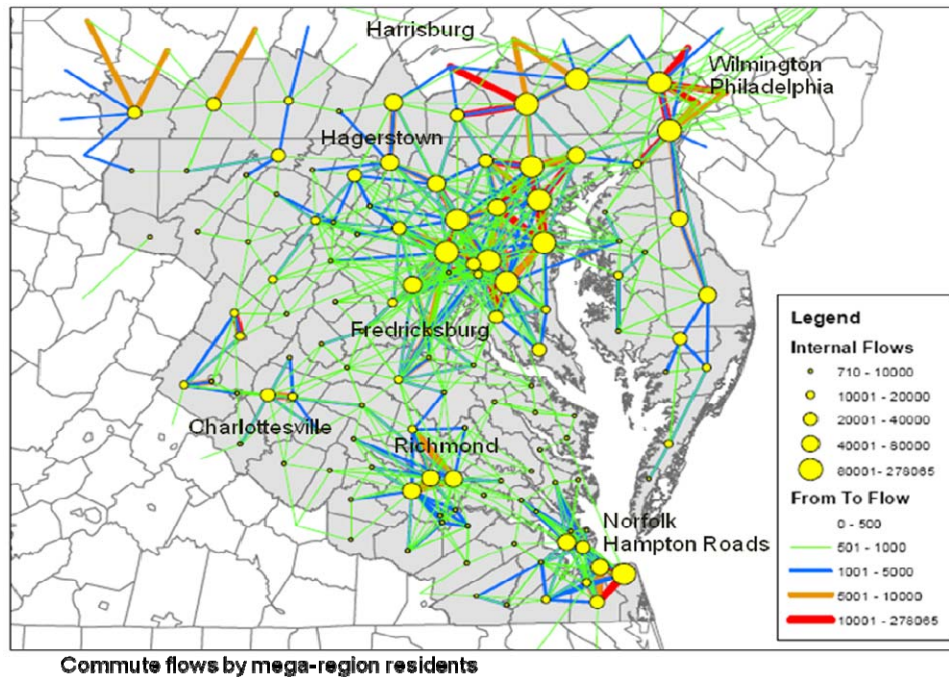
3
4 Figure 2a illustrates the commuting flows between counties in the Megaregion;¹ clearly both
5 Maryland and eastern Virginia are closely tied to Washington DC, with more isolated linkages in
6 western Virginia and weaker links across state lines into Pennsylvania and North Carolina.
7 Travel within the CBD is dominated by personal auto trips; over 90% of the trips in the
8 megaregion are for local auto travelers. In the Baltimore –Washington area transit is well
9 established and used by a significant portion of travel. , Even in the suburbs and outlying areas,
10 shared ride is used by over 25% of travellers.

11
12 Further supporting the regional linkages are the dominant freight flows that bind the CBM.
13 Figure 2b illustrates the dollar value of truck goods movement between various sub-regions,
14 based on the IMPLAN data set². As can be seen the greatest truck flows by value are along the
15 northeast corridor, from Wilmington through Baltimore, Washington DC and extending through
16 Fredricksburg to Richmond and then to the seaports in Norfolk. Urban and rural connections to
17 this trunk line are bolstered by agriculture, fisheries, and recreation-tourism.

¹ 2000 U.S. Census Transportation Planning Package, county to county labor flows.

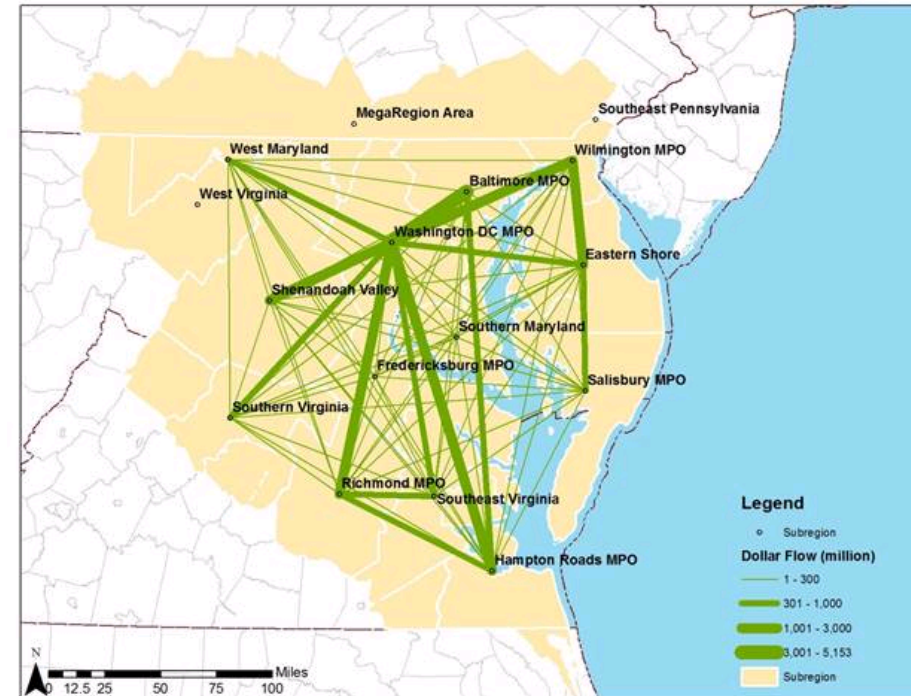
² IMPLAN/EcoNorthwest http://implan.com/V4/index.php?option=com_multicategories&view=article&id=632:632&Itemid=10

COMMUTING FLOWS



Source: 2000 Census CTPP county-to-county labor flows.

ECONOMIC (FREIGHT) FLOWS



Source: 2000 IMPLAN data, EcoNorthwest Haul-Model of truck-dependent industries.

FIGURE 2 Commute and Freight Flows in the Megaregion

2.2. Analysis Framework

The Chesapeake Bay Megaregion demonstration is largely built on the Maryland Statewide Transportation Model (MSTM) originally developed for the Maryland State Highway Administration. In the MSTM a national economic model forecasts basic employment at the statewide level; further disaggregated to counties and then to zones. Local employment is then estimated from basic employment and both employment and residents are located. The economic model also informs freight movements. Bolstered with data from the Virginia Statewide Model the MSTM was expanded to cover the entire Chesapeake Bay Megaregion area.

The implemented megaregion case study starts with a market analysis of the CBM region, which revealed key issues, urban area strengths, industry clusters, and available data and models. Based on this understanding of the region, the resulting modeling framework was designed with sophisticated long distance person and freight components as well as strong short distance person mode choice and pricing components given the region's high transit usage and regional issues of interest. Upgrades to the MSTM short distance travel models were based on needs identified in validation and sensitivity testing.

The implemented components (consistent with Figure 1) can be summarized as follows. Further information can be found in the FHWA final report on this effort, as well as the noted references:

- **National Economic Model** (University of Maryland INFORUM I-O productivity analysis). A proprietary national economic forecasting model built by the INFORUM group at the University of Maryland was applied. It forecasts marginal consumption and production in 65 economic sectors and allocates these forecasts to states. These future allocations are also used to adjust the forecast marginals of the FHWA Freight Analysis Framework (FAF3) multi-modal commodity flows. The linkage between the INFORUM model and the FAF ensures consistency between economic development and demand for freight flows
- **Land Use Model: Zonal Level Allocation** (gravity-based allocation). State level forecasts of basic employment are allocated to counties based on historic patterns of development. Population, followed by retail and service employment is then allocated to counties in 5-year increments. In the horizon year of 2030, a Lowry (gravity-based) top-down land use model then allocates county population and employment totals to model zones.
- **Transport Model: Long-Distance Freight** (FHWA FAF). The truck portion of the economic model's commodity flow output is disaggregated from FHWA FAF zones to model zones using employment data and inter-industry input-output relationships. Truck trips are assigned to a U.S. network. Flows within the megaregion are added to traffic projected by other model components and assigned to a more detailed network. Exogenous adjustments to mode shares can be applied; reflecting commodity-distance specific rules and local market knowledge (e.g., rail capacities).
- **Transport Model: Long-Distance Person** (NELDT/NHTS). The Nationwide Estimate of Long-Distance Travel (NELDT) model using NHTS long-distance travel data and traveler attributes forms a national model of long-distance travel. This travel is assigned

to a full U.S. network with flows within the megaregion added to traffic projected by other model components.

- **Transport Model: Short-Distance Person** (modified MPO model). The 5-step MSTM was transferred and applied region-wide. Trip purposes, mode choices, and socio-economic data were standardized. The gravity-type trip distribution model was upgraded to a destination choice model to better address differences in trip lengths and to incorporate regional differences in modal options.
- **Transport Model: Commercial Vehicles.** The MSTM commercial vehicle model (simulating both service-oriented non-freight trips and freight-carrying truck trips) was transferred, recalibrated, and applied region-wide.
- **Transport Model: Assignment and Time of Day.** The MSTM multi-modal networks and volume-delay functions were borrowed and standardized. Additional U.S. networks were pulled from GIS/travel assignment software packages and inter-city rail/air modal options were added. Time of day factors were developed from Maryland Department of Transportation traffic count data and local MPO models.
- **Indicator Models:** The indicator models include a greenhouse gas emissions estimator based on EPA's MOVES model, a water quality model based on land cover and soil type, a capital infrastructure cost model and a regional economic flow analysis (impacts of transport conditions on particular local industries and corridors). In this case study the greenhouse gas emissions and the economic flow analysis were used.

Thus developed, the megaregion case study is customized to local market conditions and embodies the key components of the analysis framework identified in Section 1. This includes a definition of the study area defined by labor and freight flows rather than political boundaries, as well as the use of an integrated modeling framework, where travel is a derived demand of economic transactions and associated land use decisions with feedback among these components. Reflecting a megaregion's larger view, the model emphasizes interactions with other regions through national economic scenarios and performance measures, showing the economic impact on local regions and industries. As expected, the incorporation of economic and land use tools covering such a large area in the CBM model, required compromises in bridging data inconsistencies and level of detail. Nonetheless, the tool is valuable in identifying broad trends across the region and setting policy strategies that can be further studied and implemented collaboratively across the region for broadest benefit.

2.3. Chesapeake Bay Megaregion (CBM) Area

Taking into account the economic connections in the region (Figure 3), the final CBM modeling area was developed based primarily on the work of Catherine Ross (2009) who defines 10 U.S. megaregions including the Chesapeake Bay subset of the Northeast Seaboard megaregion. In order to properly model boundary conditions, the study area was expanded to include Southern Pennsylvania and Wilmington, Delaware, both essential to getting proper entries and exits from the megaregion. Finally the analytic model was developed by expanding the Maryland Statewide Transportation model to cover the entire CBM, as shown in Figure 3. The area in maroon is the megaregion as defined by Ross, the areas in pink were added by the MSTM and are necessary

for boundary conditions. The tan areas are rural and were added to smooth the borders for improved analysis.

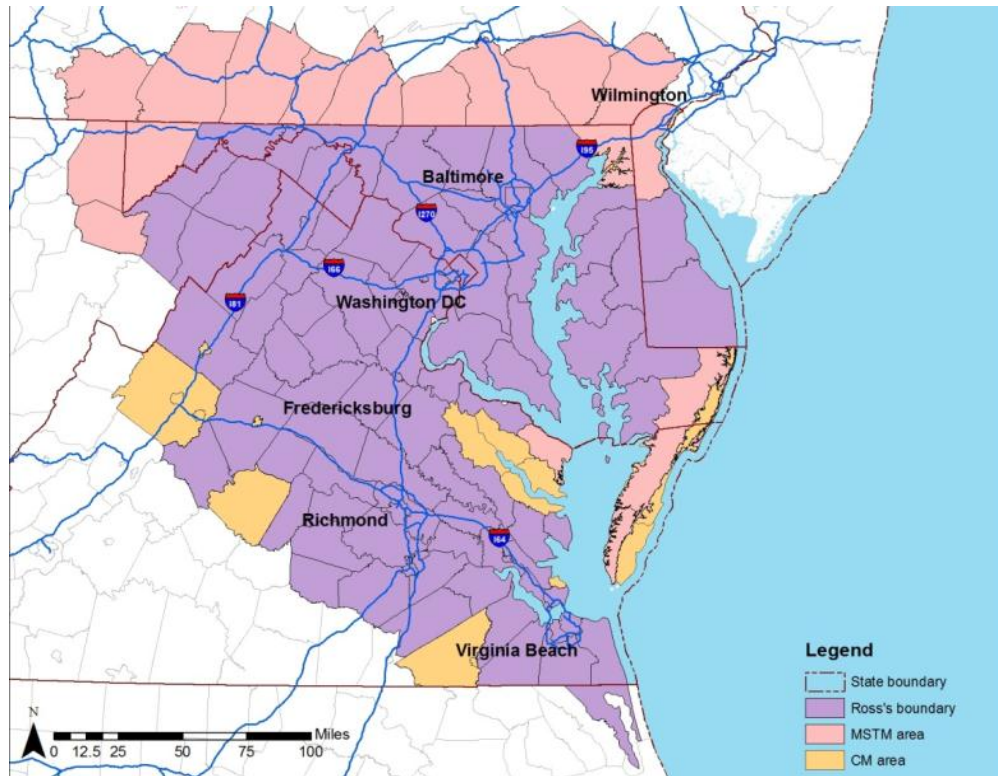


FIGURE 3 The CBM Model Area

2.4. Scenarios

To exercise the analysis framework on CBM issues, two possible future energy price scenarios were identified spanning the possible effects: the **Reference Scenario**, in which the price of petroleum rises only slightly, reflecting historical trends and MPG follows CAFÉ standards between 2007 and 2030; and a **Price Spike** in which the price of energy remains relatively constant through 2029, then jumps to a very high level in a very short period of time. An alternative scenario where energy prices rise more steadily would fall within these extremes, as households and businesses would respond to anticipated price increases (e.g., location and vehicle purchase decisions), leading to a less severe impact than the modeled Price Spike scenario.

Several components of the basic Chesapeake Bay Megaregion model noted above were enhanced to test a scenario of high energy prices. The following describe additional changes to each element of the framework components in preparation for the high energy scenarios (see Figure 1):

1
2 **Economic Model:** Dampened economy under steady rise in energy prices (not modeled).

3 **Land Use:** Households and employment locate in response to travel costs.

4 **Accessibilities:** Incorporate travel costs into accessibility measures.

5 **Transport:** Increase sensitivity to travel costs.

- 6 • Discretionary travel (Trip Generation)
 - 7 • Trip chaining (Trip Generation)
 - 8 • Trip lengths (Trip Distribution)
 - 9 • Mode choice (transit and HOV) (Mode Choice)
 - 10 • Vehicle fleet changes (assumed auto-operating cost)
 - 11 • Freight – No change assumed, higher costs passed to consumers
- 12

13 **2.5. Findings**

14 The Analysis provides some intriguing findings regarding the Megaregion's resilience to a high-
15 cost energy future, including results directly from analysis and those conjectured based on our
16 understanding of the modeling tools and work to date. This latter category included elements of a
17 steady price rise scenario (not fully modeled), in which the price of petroleum rises to a high
18 level but slowly over a long period of time; as well as the full effects of the economic and land
19 use impacts (assumed fixed) and environmental models (outside the scope of this effort) of the
20 modeled Price Spike scenario.

21 *Reference Scenario*

22 The **Reference Scenario** shows that employment and population are expected to roughly
23 increase at a 1.2% annual average growth rate. As a result of the more dispersed jobs and stable
24 household growth, the jobs-rich CBD and urban areas become less so. A more balanced jobs-to-
25 household ratio occurs in 2030 due to new employment locating outside the CBD closer to
26 residences. Another key trend is the shift of manufacturing/industrial share of employment from
27 30% to less than 20%, and the corresponding rise in retail and office employment.

28
29 In 2030, due to growth under assumed continuation of low transport costs and the challenge of
30 absorbing more growth in the dense urban areas, more development occurs in suburban and rural
31 areas. The region currently exhibits many hours of congestion. With the forecasted dispersed
32 travel patterns and limited growth in transportation infrastructure, this appears to worsen in the
33 future. The slight improvement in jobs-per-household balance across the region is not enough to
34 compensate for the longer trips made by activities in these less dense regions. The net effect is
35 increased vehicle miles and vehicle hours travelled, even with a decline in average auto trip
36 length. With the dispersed location of employment growth as transport costs remain low, is the
37 need for expanded transportation infrastructure to serve growing east-west economic
38 movements.

39
40 While total travel will grow between now and 2030, air quality will improve due to the increased
41 CAFÉ standards. Indeed, using the current fleet mix with 2030 forecast VMT, the 2030
42 **Reference Scenario** GHG would increase by 12%, when under the expected CAFÉ fleet
43 changes, emissions are expected to drop below 2007 levels by 15%.

Energy Price Spike Scenario

Several industries were found to be more sensitive to the high-energy prices, consistent with the literature. Both indicate that the largest impact of an energy price spike is the impact on consumer's disposable income. Higher energy prices act as a tax on purchasing power, and the proceeds of this tax are largely spent outside the megaregion, reducing the purchasing power of the local economy as a whole. This tends to dampen the consumer sectors such as wholesale, retail, and construction. A second key economic effect of higher energy prices is on energy-intensive industries. Figure 4 shows the energy intensity by sector nationally. In the megaregion, the most affected industries are energy, transportation, manufacturing (durable goods, others), pulp/paper, forestry products, agriculture (fertilizer costs) and the food industry. Other sectors, such as finance and insurance, will be relatively unaffected by energy costs.

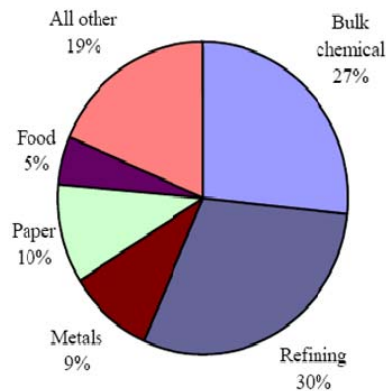
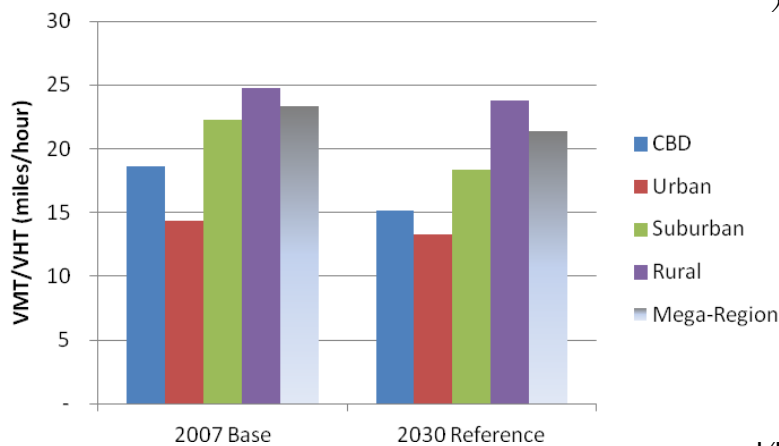


FIGURE 4 Energy Intensity of Various Economic Sectors

A sudden energy **Price Spike** would have a pronounced immediate impact on travel both personal and freight. Residents can be expected to reduce the number of trips, change trip destinations to allow for shorter trips, make more direct routes and chaining of multiple trips, as well as increase the use of any alternative transportation options available to them, such as carpooling and transit services.

In the Baltimore-Washington area, where a wide range of transit options is available, the analysis showed a significant increase in transit ridership. In contrast, outside the Washington D.C. suburbs including urban areas in Virginia, transit service is limited thus the model predicted a shift to carpools and shorter trips. The analysis highlights that the non-urban and low-income communities are more vulnerable to rising energy prices. Both are disproportionately located in the rural/exurban areas of the megaregion with less access to transit options. These rural communities grew under the reference scenario when auto operating costs were kept low by stable prices and greatly improved fuel efficiency (under federal CAFÉ standards), increasing the impact under an energy **Price Spike scenario**. The resulting drop in personal auto vehicle miles traveled, for the reasons noted above, lead to congestion relief, with congested speeds an improvement relative to 2007 levels, most pronounced in the non-urban areas. (Figure 5)



Source: 2007 Base & 2030 Reference CBM scenarios.

FIGURE 5 2007 & 2030 Megaregion Congested Speed (VMT/VHT)

For freight movements, the economic impact of a **Price Spike scenario** would be mixed. The case study makes two assumptions with respect to freight. First, the cost of shipping is borne primarily by the shippers, not the freight carriers, reflecting long-term contracts. Second, in industry processes, particularly those requiring assembly of intermediate goods and shipment for final assembly, destinations cannot be easily be changed. Thus, by lowering congestion the decrease in traffic can actually have a net benefit to freight and the economy. This benefit can be particularly important for shipments, which are high value and /or time sensitive. Particularly in urban areas freight was able to move more quickly in the 2030 **Price Spike scenario** due to the reduction in person travel, and associated congestion relief.

An Economic Post-Processor provides further information on the importance of limiting congestion on the I-95 corridor. Figure 6 illustrates the impact of high energy prices on freight movements. The green lines indicate where freight travel costs have dropped due to lowering of congestion. (Even though fuels prices increase, the composite cost of travel declines due to less traffic on the roads). The red lines indicate where freight travel costs increase under the high energy price scenario, primarily in rural areas where congestion is not an issue. This illustrates a counter-intuitive result, i.e., that increased fuel costs can actually support freight and the regional economy. (NOTE: The scenario only includes the immediate impact on freight movements. In the longer term industries could potentially relocate, changing the results.)

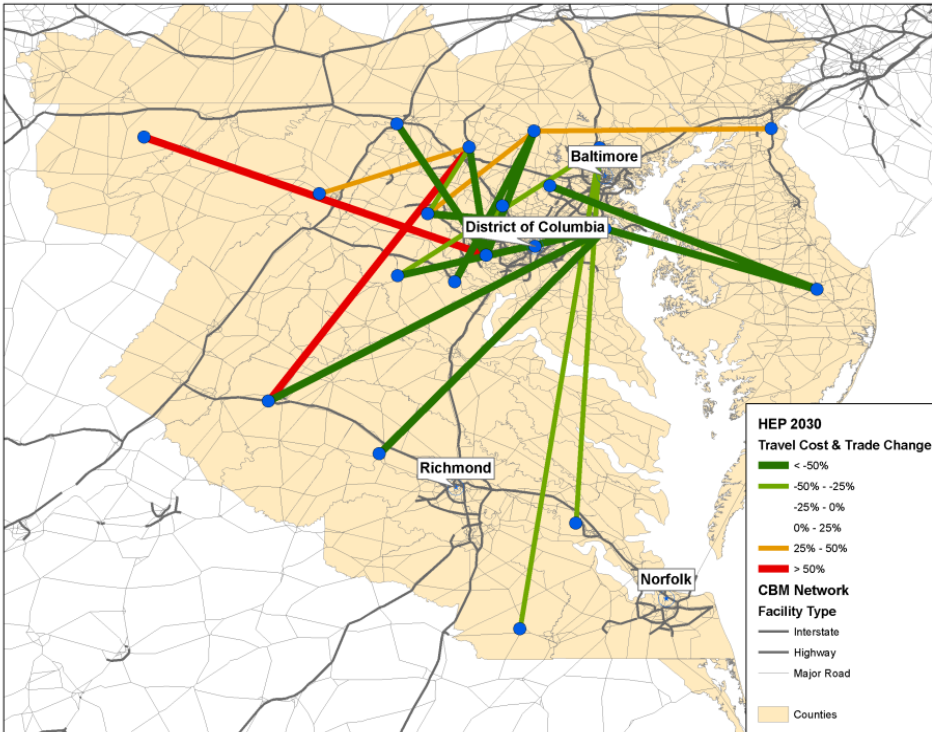
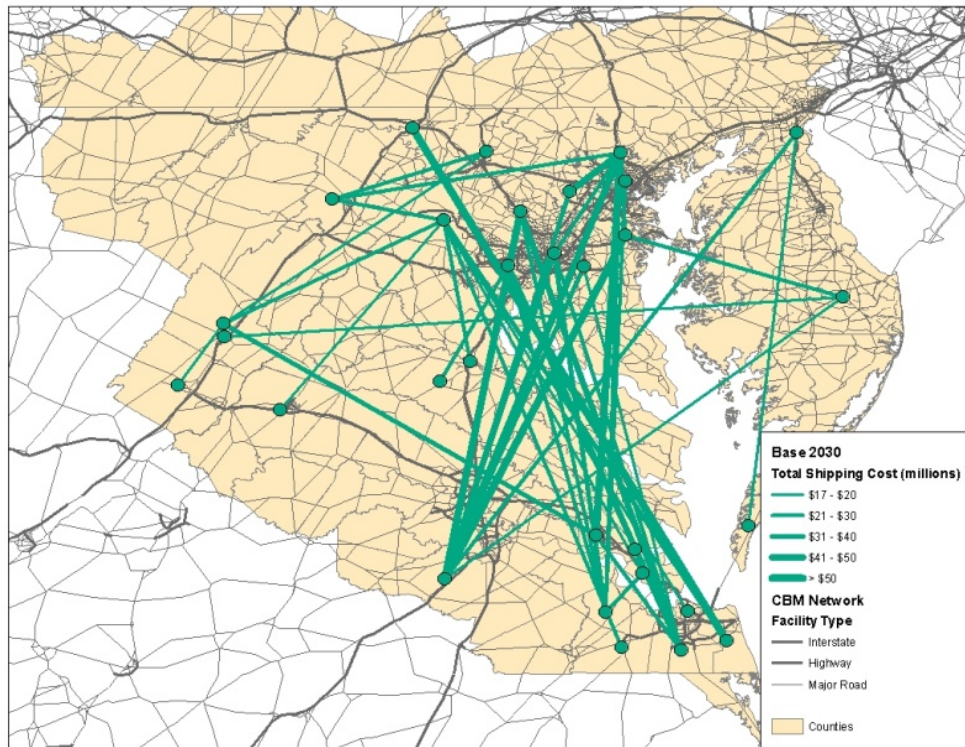


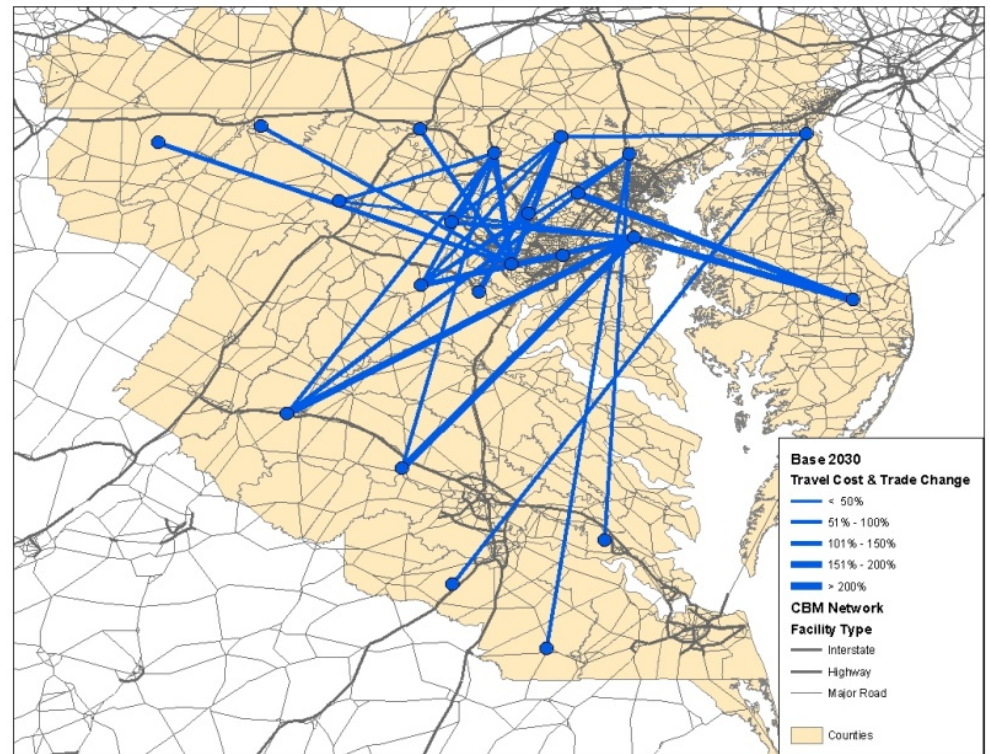
FIGURE 6 Impact of High Energy Prices on Freight Costs

Figure 7a identifies the shipping cost for key county-to-county flows in the Megaregion in the 2030 **Price Spike scenario**. A generalized cost is used in the calculation, which includes (future congested) time, tolls (current, held fixed), and auto operating costs (reflecting constant maintenance costs and the scenario's varying energy price assumptions). The figure highlights how the largest flows predominantly utilize the I-95 corridor, at significant cost. The second Figure 7b highlights the largest 2007-2030 change in shipping costs and tonnage change to the top 25 county-to-county pairs. The corridors shown are those that will be most affected by rising shipping costs in 2030. It is interesting to note that many of these goods flow in an east-west direction that may not be well served by the current roadway network. The need for these east-west goods movements seems to be the result of the more dispersed growth of the 2030 **Reference scenario**. The megaregion may have incentive to build infrastructure to accommodate this growth, or alternatively set policies now to channel this growth to locations that are better served by existing facilities or have shorter trip lengths. These infrastructure needs, important to bolster the region economically in a future of high energy prices are only evident with the broad view of this CBM tool spanning the large geographic region, and accounting for not just transport but economic and land use effects.

BASE SHIPMENT COSTS



CHANGE IN COSTS



Source: 2007 Base & 2030 Reference CBM scenarios.

FIGURE 7 2030 Good Shipment Costs (tonnage x generalized cost) and 2007-2030 Change in Costs

3. Value of Megaregion view

This analysis highlights the need for a megaregion view of many critical issues. A Megaregion Board (MRB), a hypothetical body charged with planning for a megaregion, could use tools similar to those in the case study to analyze policies in isolation or combination, to determine their collective effect on the megaregion and on local jurisdictions. In the megaregion view, policies in one jurisdiction can be seen to have spillover effects on the rest of the megaregion. Individual areas can develop policies, which are optimal for one area but have negative effects on adjacent areas. Within the megaregion, with the linkages spanning many jurisdictions, the spillover effects can be wide ranging. For example, policies that attempt to foster economic development in one area may have the effect of removing development from another area.

Of particular concern in today's climate is the economy. This case study shows the fact that the CBM is tied together economically. As shown in Figures 7 and 8, while the CBM is growing and north-south freight movements still dominate, east-west freight movements are set to increase rapidly if energy prices stay low and don't provide price signals to dispersed growth patterns. A megaregion concerned about economic development would want to consider whether actions are required to alter future growth patterns or improve current infrastructure to support these movements.

Finally, in addition to land use, transportation and the economy, the CBM should address specific policies at the megaregion level, such as the collective impact of individual local policies. The analysis framework has helped to identify these policies. The framework could also serve to test the impact of implementing such policies in a coordinated or uncoordinated way across the jurisdictions within the megaregion.

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