NCSG
National Center for Smart Growth Research & Education

PRESTO!

Toward a More Sustainable Maryland

Science and Technical Advisory Committee
Maryland Climate Change Commission
June 20, 2017

SESYNC
NATIONAL SOCIO-ENVIRONMENTAL SYNTHESIS CENTER

Town Creek Foundation

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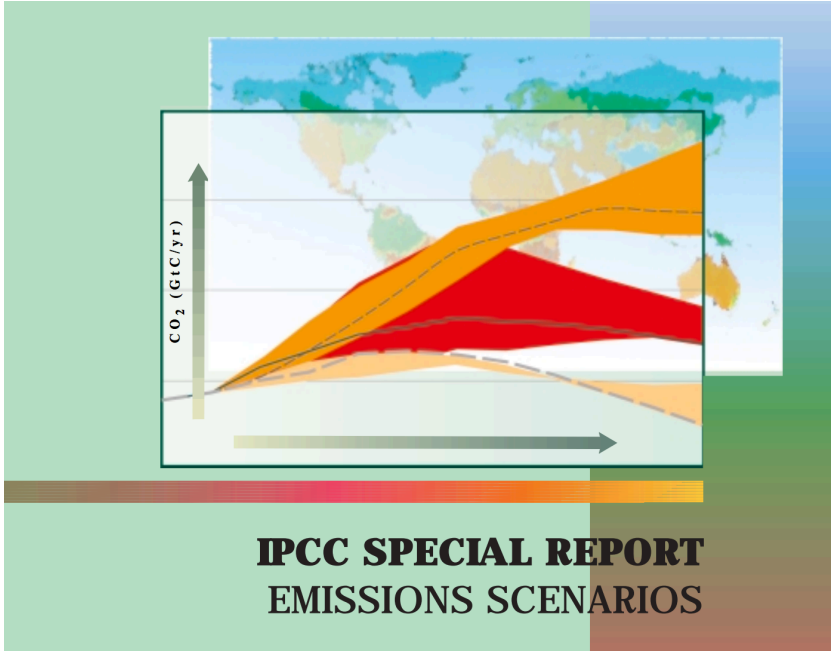
The Science of Scenario Planning

Robust Plans and Contingent Plans

Scenario Planning for an Uncertain World

Arnab Chakraborty, Nikhil Kaza, Gerrit-Jan Knaap, and Brian Deal



U.S. Department of Transportation
Federal Highway Administration

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OFFICE OF OPERATIONS

21ST CENTURY OPERATIONS USING 21ST CENTURY TECHNOLOGIES

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Advancing Transportation Systems Management and Operations Through Scenario Planning

Section 4: Opportunities for Scenario Planning to Advance Transportation Systems Management and Operations

Planning for transportation systems management and operations (TSMO) occurs both formally and informally at the statewide, regional, subarea, local, corridor, project, and multi-state level. Scenario planning is a tool that planners and operators can apply in all of those contexts to prepare for uncertainty, resolve competing visions, create more robust

Scenarios and their Purpose

- Future greenhouse gas (GHG) emissions are the product of complex dynamic systems, shaped by demographic change, socio-economic development, and technological change and --- are therefore highly uncertain.
- Scenarios are alternative images of how the future might unfold and are appropriate tools for analyzing how driving forces may influence future outcomes
- They assist in climate change analysis, including climate modeling and the assessment of impacts,

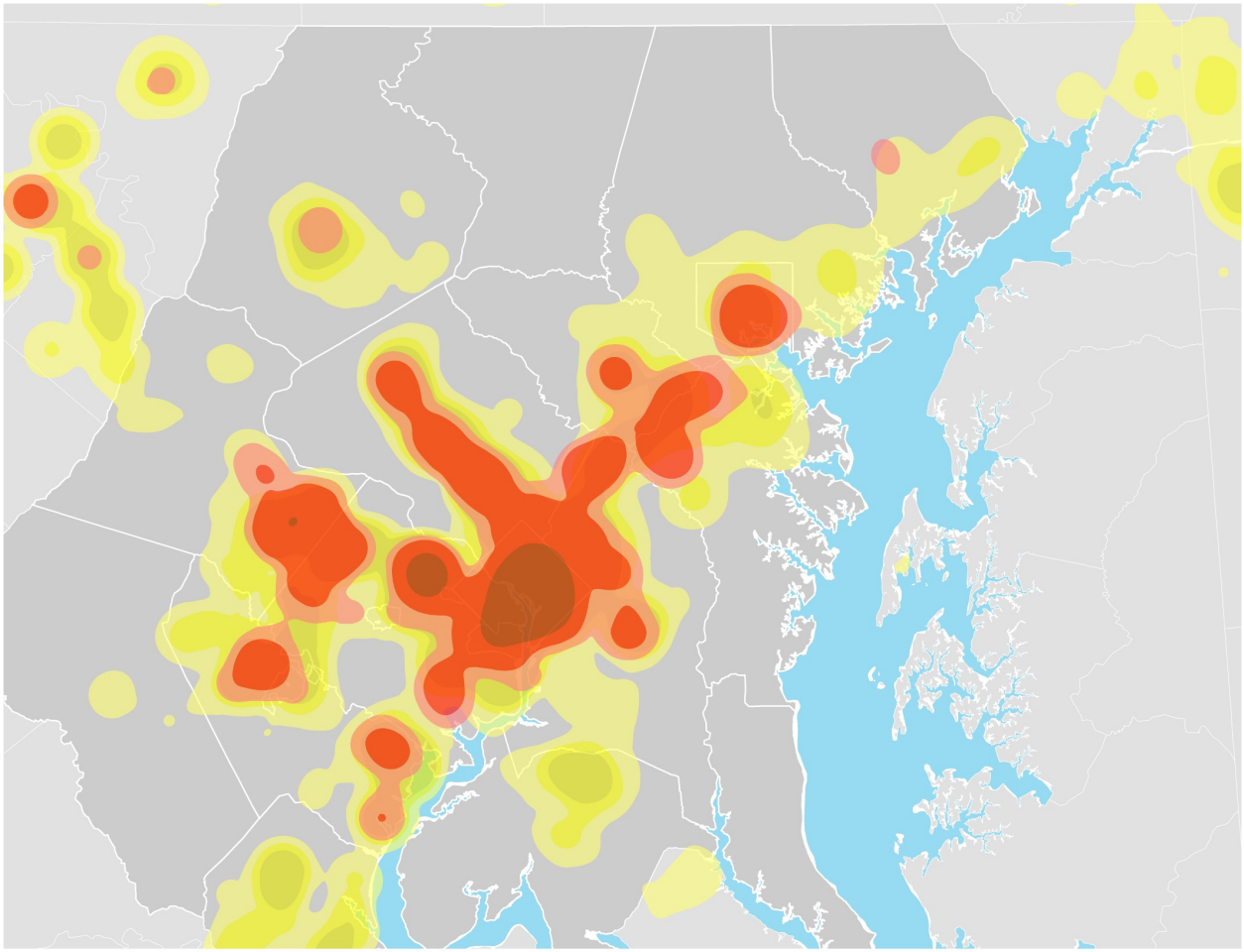
BAU and Four Scenarios

- **BAU:** Continuation of current policies and trends
- **Revenge of the Nerds:** Strong economic growth, autonomous vehicles, and growing inequality
- **The Blue Planet:** Strong economic growth, embrace of green technology, and major transit investments
- **Ashes and Diamonds:** Slow growth, land use deregulation, highway expansion, and limited tech change
- **Last Call at the Oasis:** Resource scarcity, high fuel prices and slow economic growth

BAU Assumptions

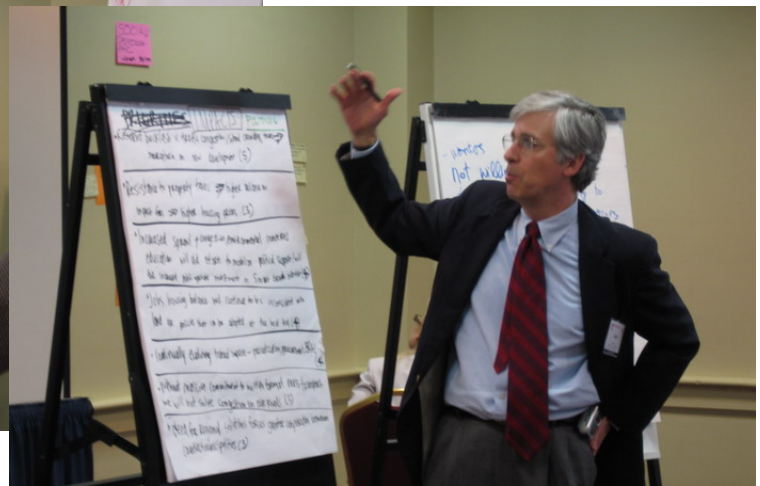
- Constrained Long Range Transportation Plan
  - BMC, WashCOG
  - Households, jobs, transportation infrastructure
- Maryland, Delaware, West Virginia, and Pennsylvania state forecasts
- Maryland Department of Planning capacity estimates
- Constant Real Gas Prices
- Implementation of CAFÉ standards

Baseline Growth Pattern

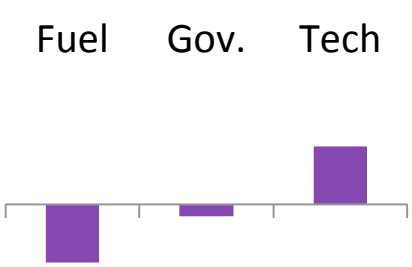


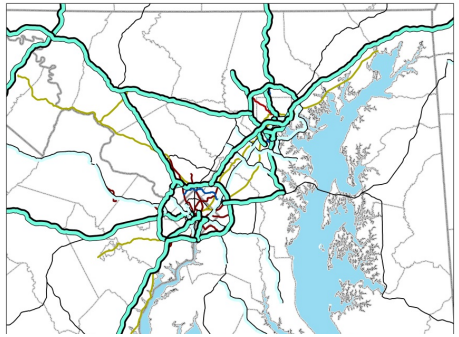
Employment Growth Household Growth

Constructing Alternative Scenarios

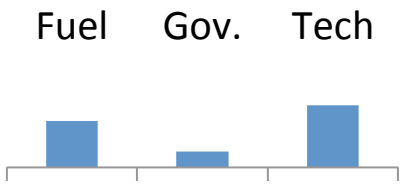


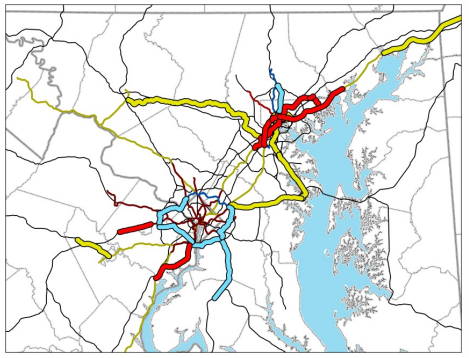
Revenge of the Nerds



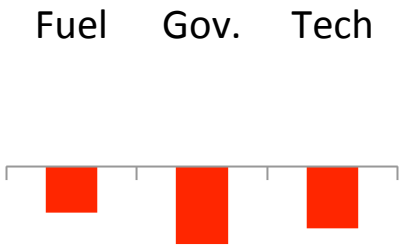


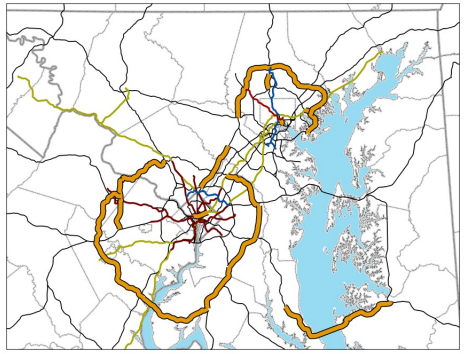
Blue Planet



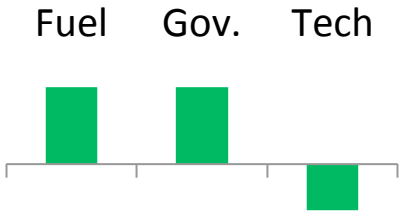


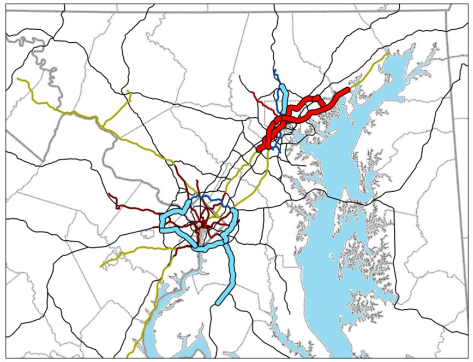
Ashes and Diamonds



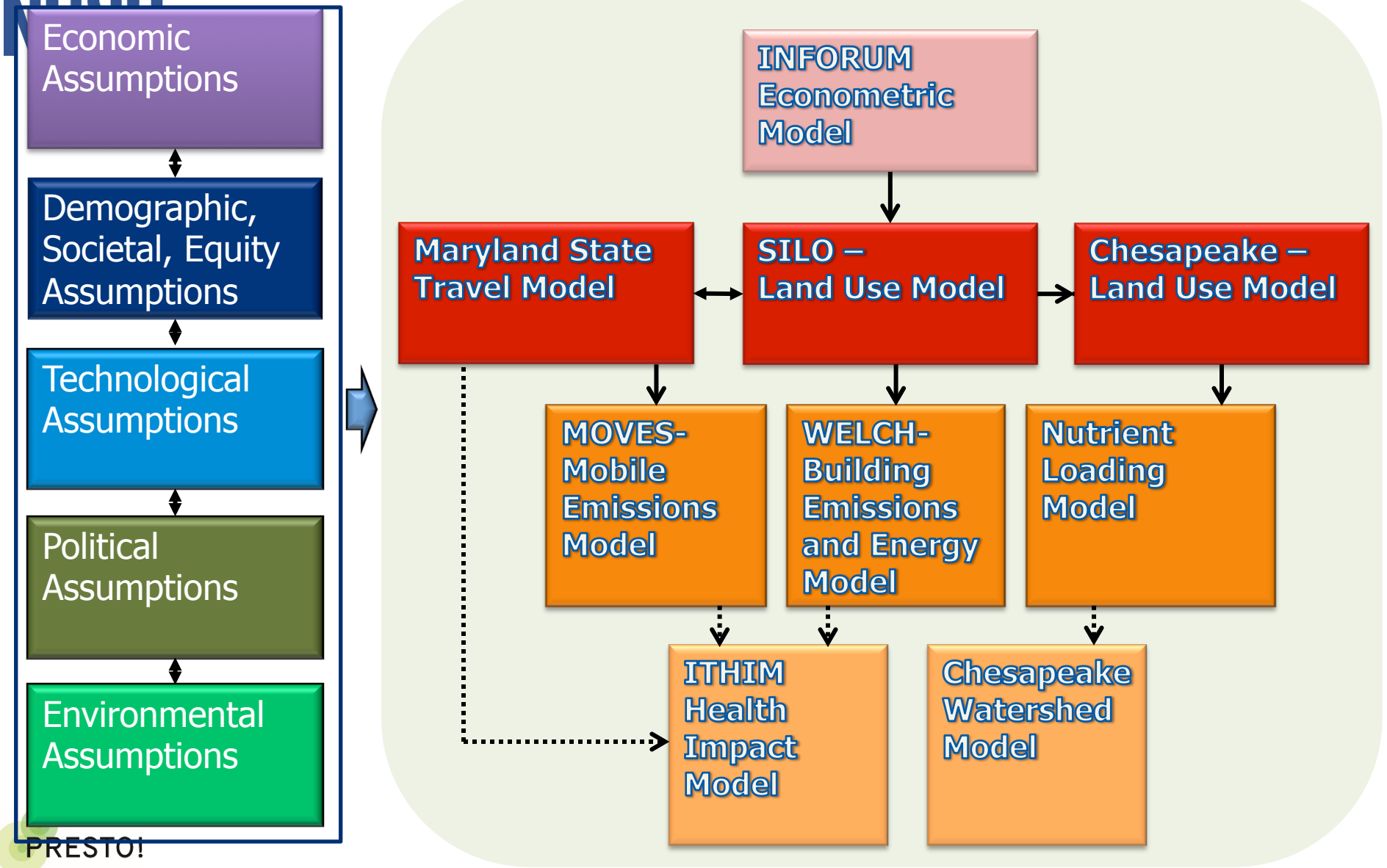


Last Call at the Oasis

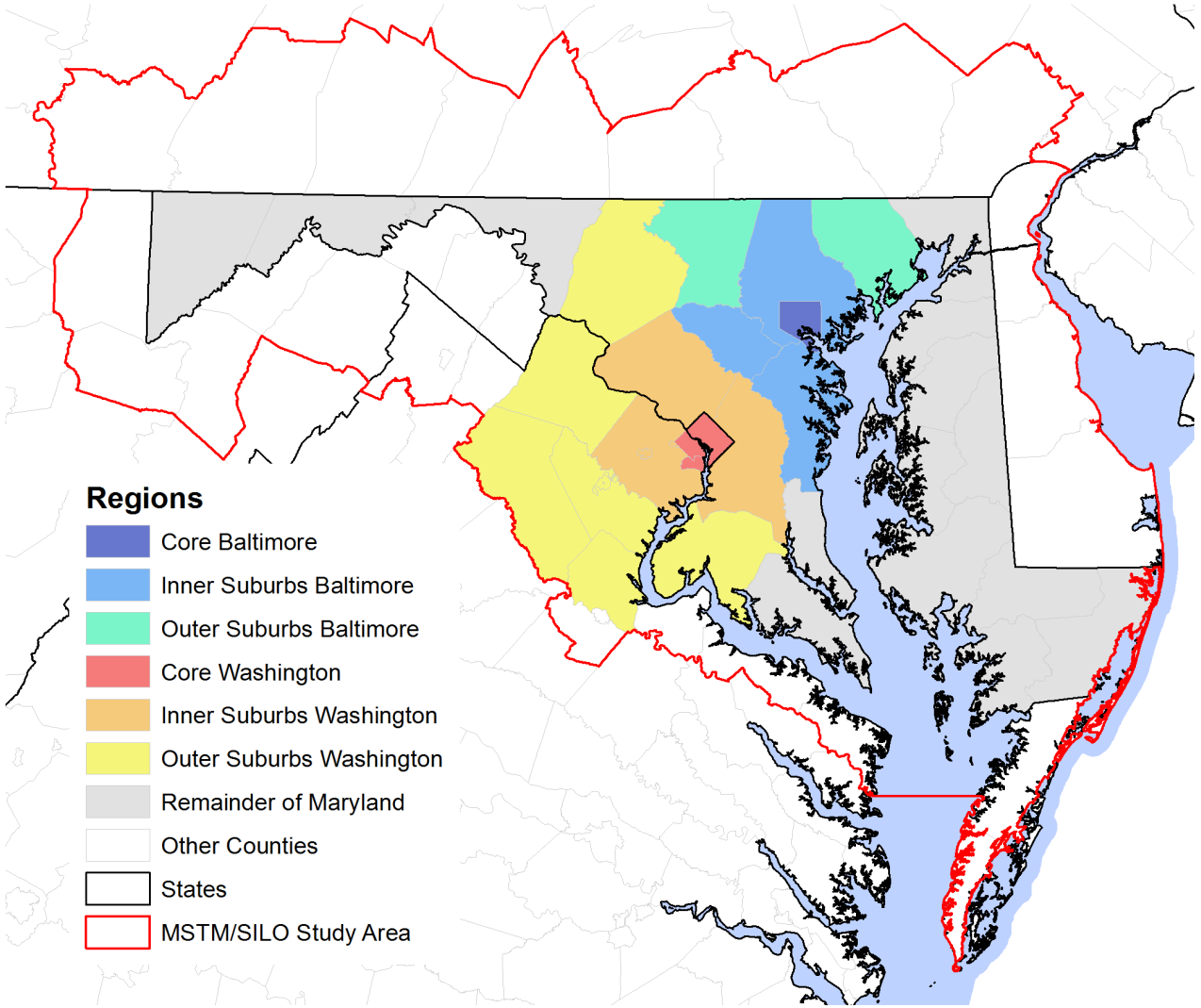




The PRESTO Modeling Suite



The PRESTO Modeling Region



Processing flow order and simulation periods

2001-2007
- SILO

2007
- MSTM

2007-2030
- SILO

2030
- MSTM
- MEM
- BEM
- CBLCM

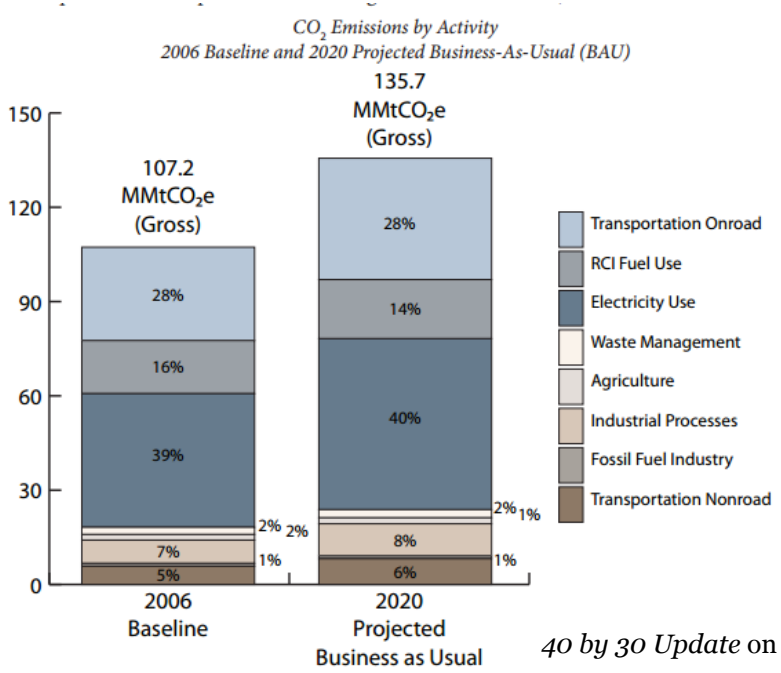
2030-2040
- SILO

2040
- MSTM
- MEM
- BEM
- CBLCM

Number of runs (simulated years)	
SILO	39
MSTM	3
MEM	2
BEM	2
CBLCM	2

Determining MDE Estimates

- 2015 Plan Update for 2020 Estimates
- 2030 estimates determined from *40 by 30 Update* on April 21, 2017
- Used same proportion for sectors for 2030
- Updated MDOT number to match *MDOT Climate Change: Status Update & Trends Overview* on Sept. 26, 2016

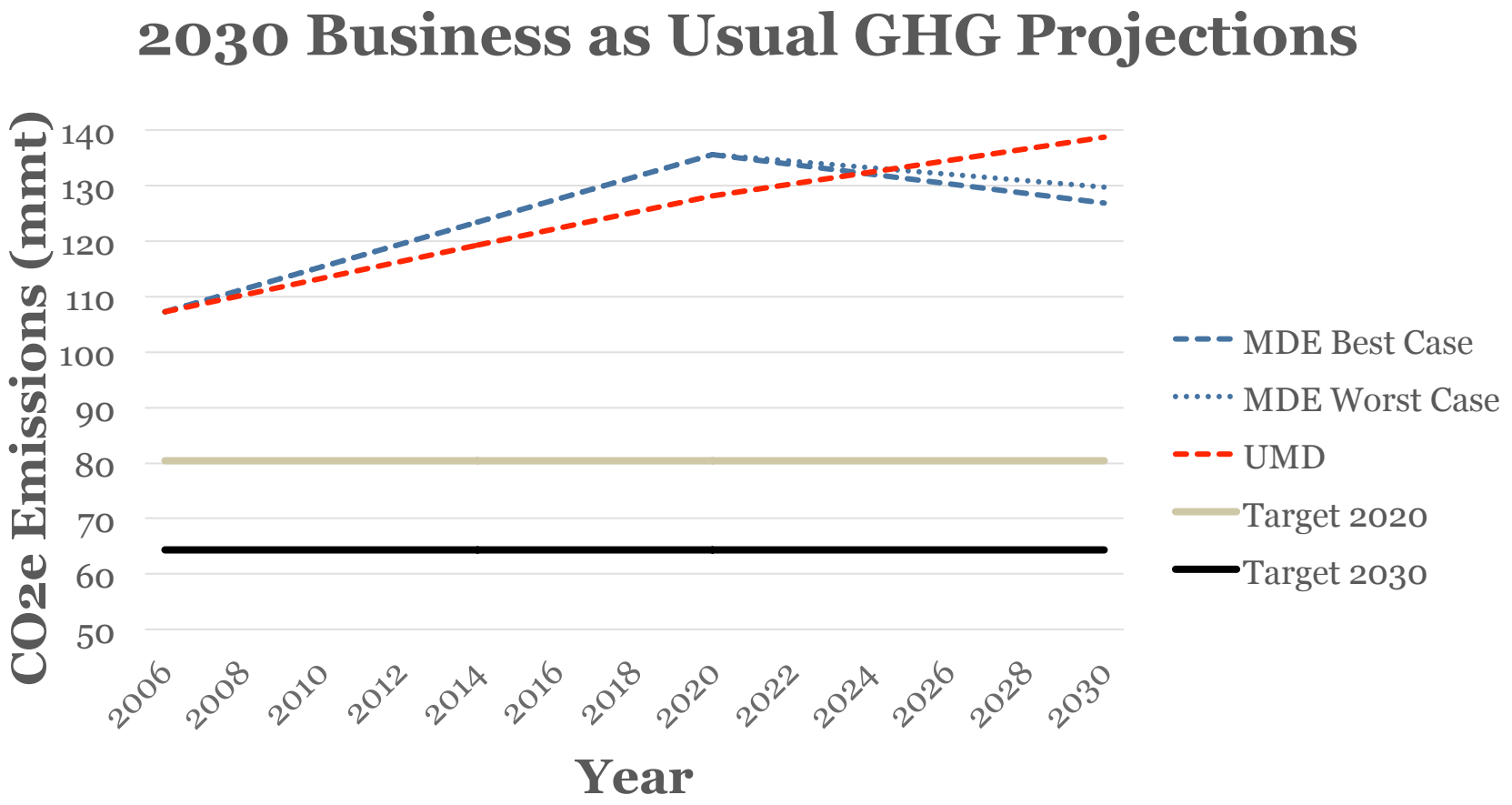


40 by 30 Update on April 21, 201

Reduction Scenario	Estimated Reductions Most Optimistic	Estimated Reductions Least Optimistic
Reductions needed by 2030	57 $MMtCO_2e$	61 $MMtCO_2e$

MDOT Climate Change: Status Update & Trends Overview on Sept. 26,

UMD Projects Higher Business as Usual Emissions



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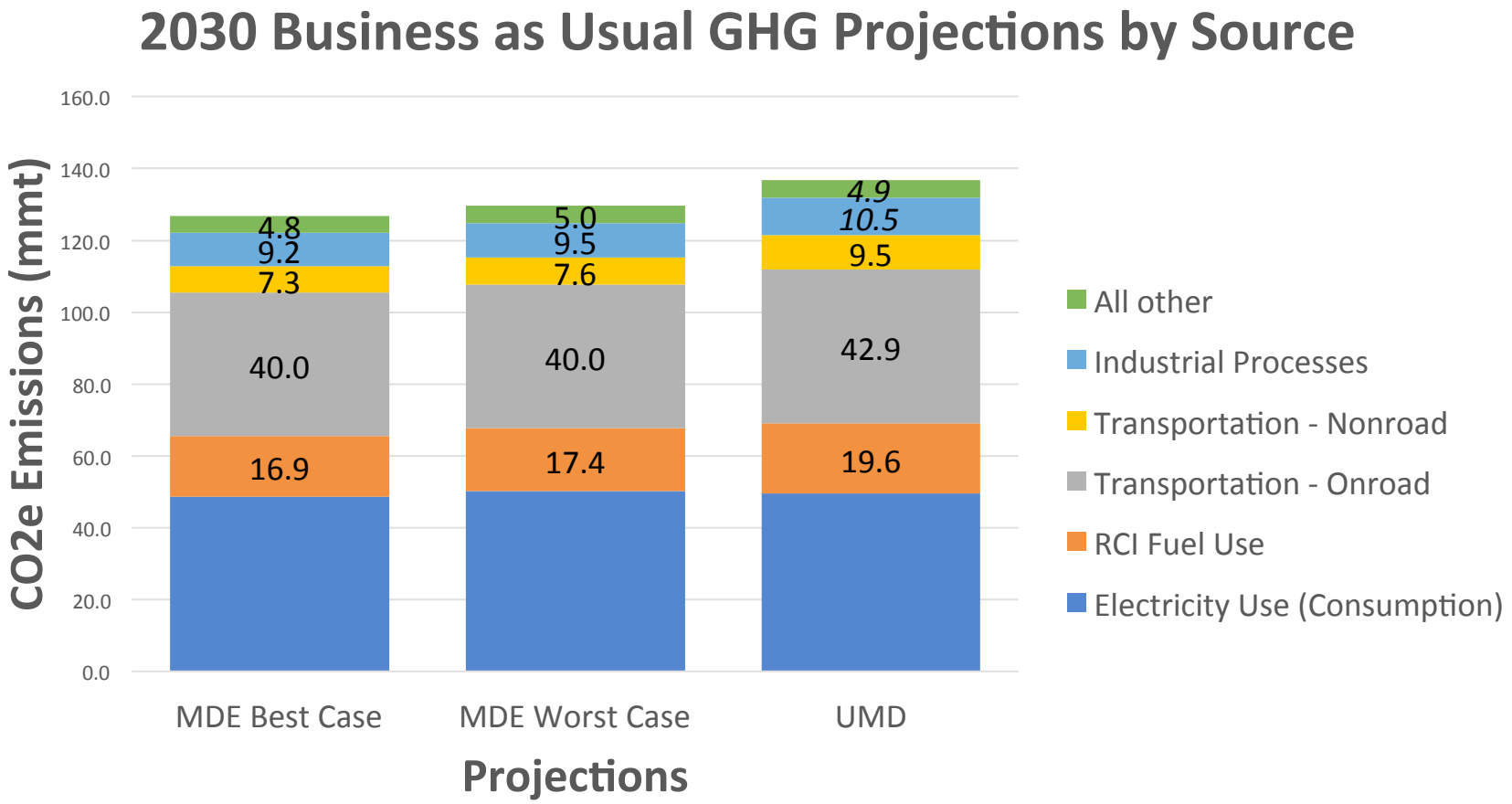
NCSG Models Project Higher Emissions from Transportation and RCI



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Five Critical Input Categories

- Employment Growth and Location
- Vehicles Characteristics including fuel efficiency and cost
- Transportation Investments
- Land Use Controls
- Building Efficiency

Selected Inputs for Alternative Scenarios

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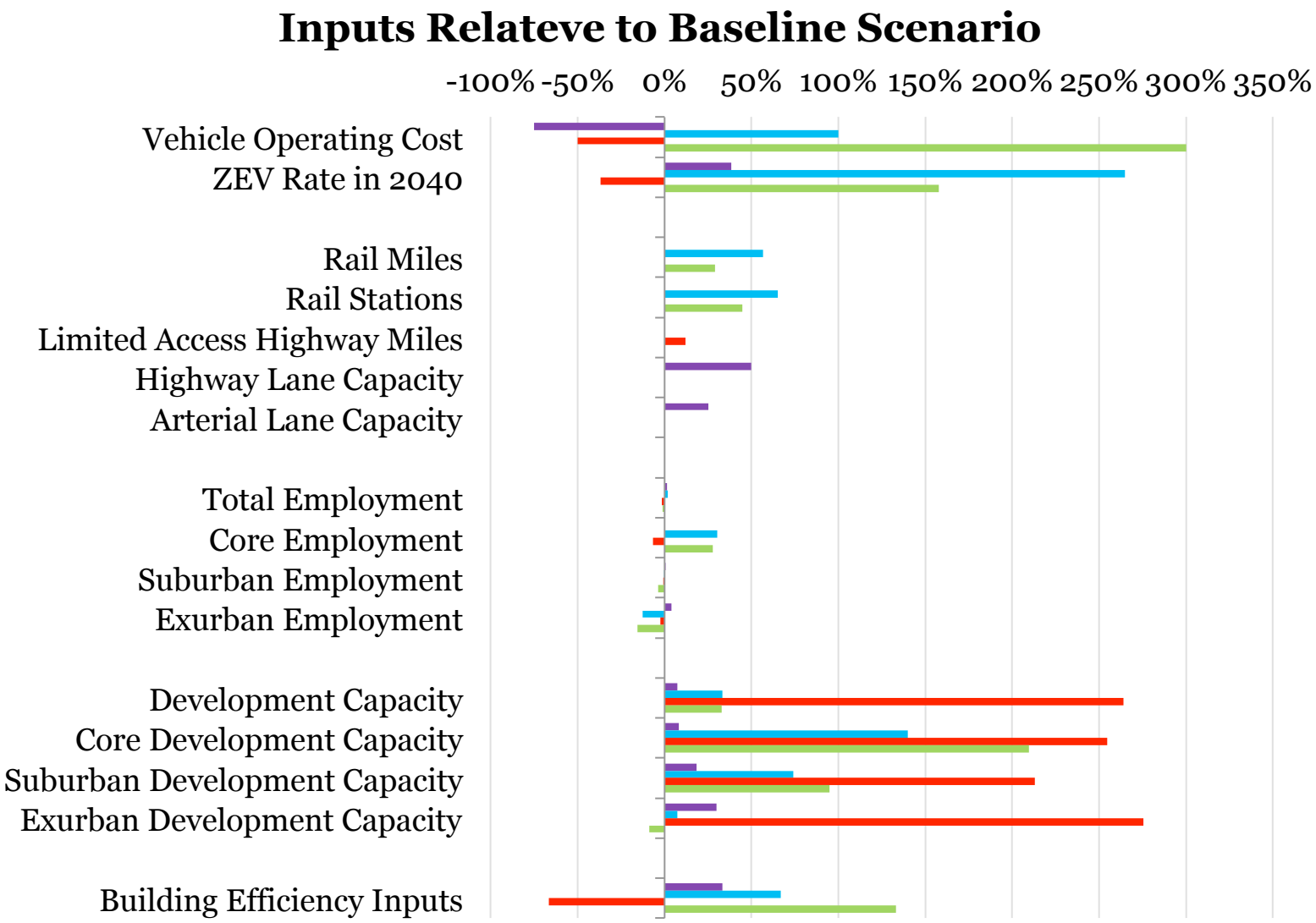
Vehicle Characteristics

Network Characteristics

Economic Projections

Development Capacity

Climate Policy



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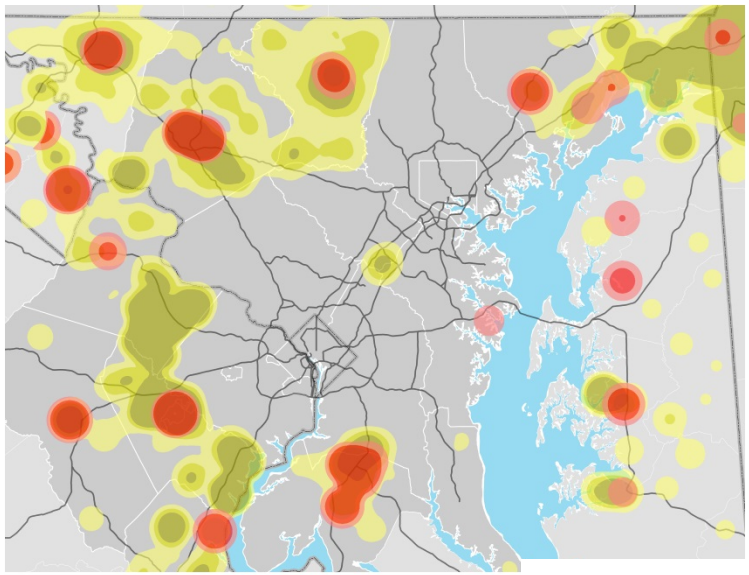
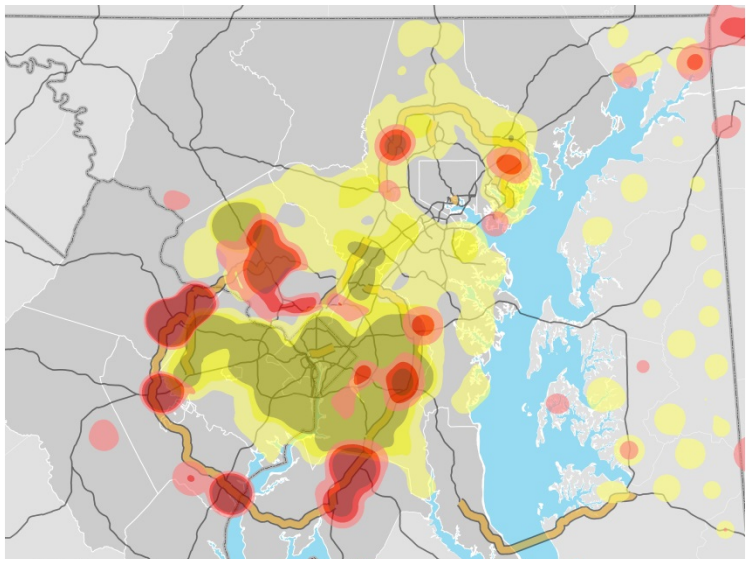
Revenge of the Nerds Blue Planet Ashes and Diamonds Last Call at the Oasis

Residential Patterns Reflects Employment location, Travel Costs, and New Residential Capacity

Revenge of the Nerds



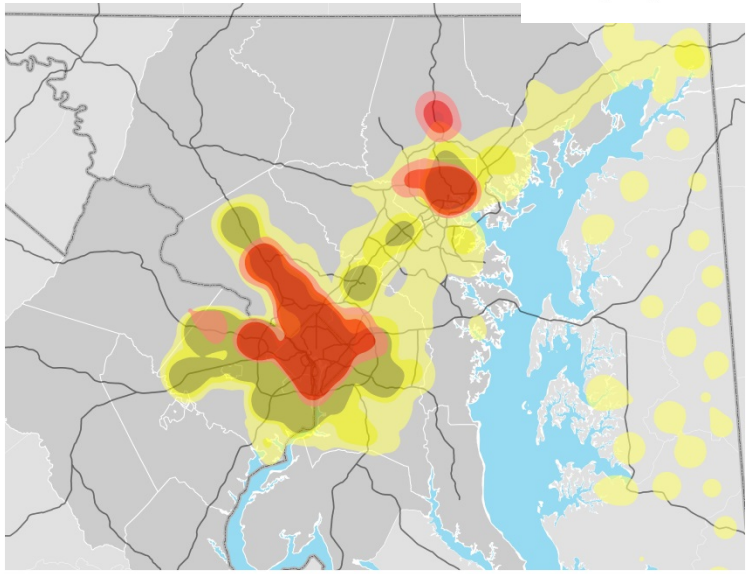
Ashes and Diamonds



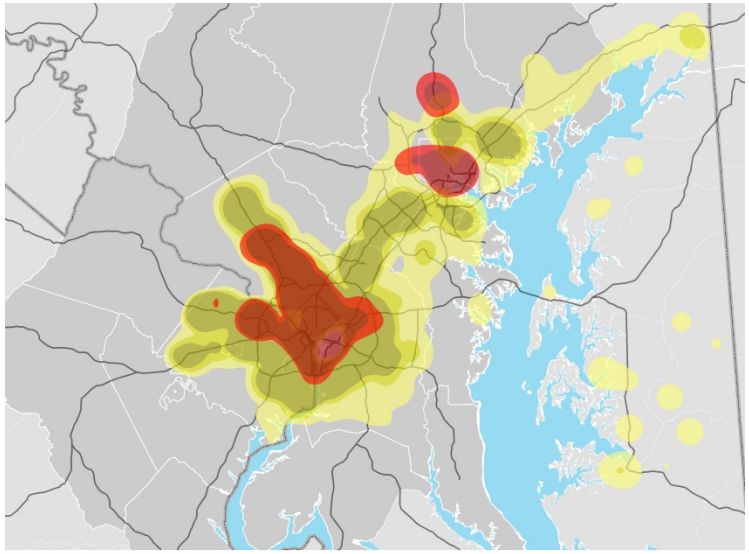
Employment Growth

Household Growth

Blue Planet



Last Call at the Oasis



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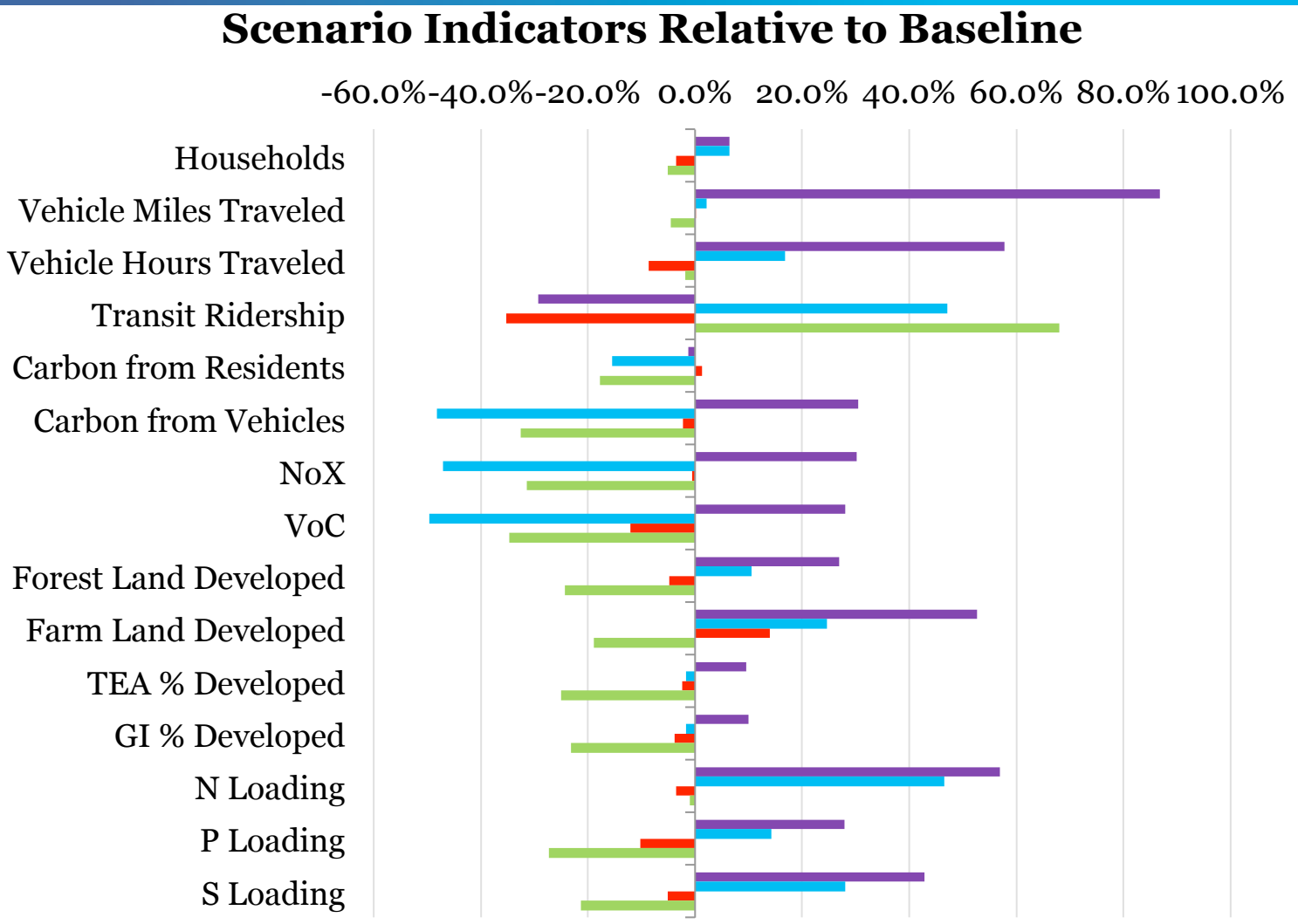
Selected Results

- Land Use
- Transportation
- Carbon
- Air Pollution
- Land Cover
- Eco. Areas
- Nutrient Loading

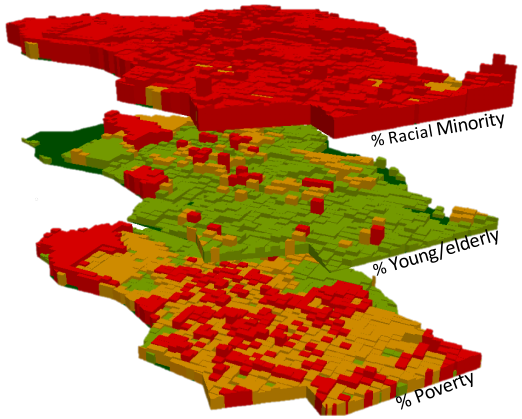


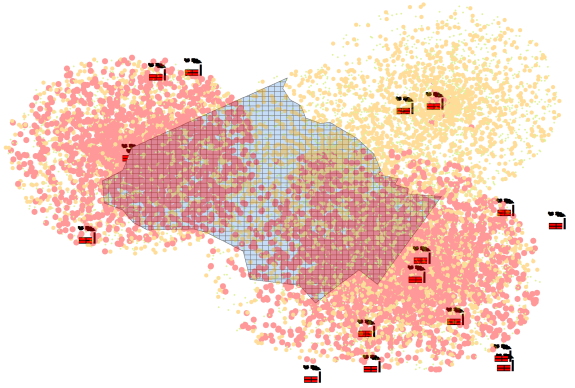
PRESTO! Revenge of the Nerds lue Planet shes and Diamonds Last Call at the Oasis

Next Steps

Emissions and Equity Measurement Integrated Tool

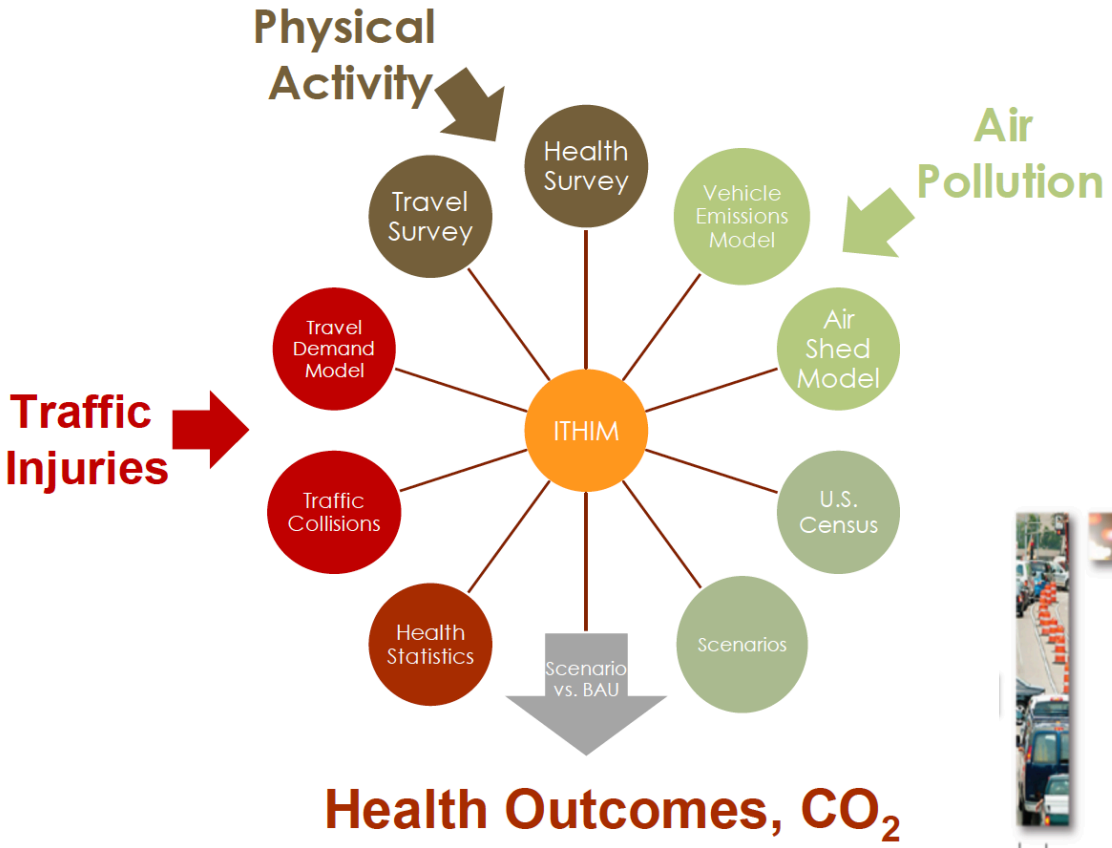
- Estimate detailed demographic and socio-economic data w/ vulnerability measures
  - At a grid cell level – size determined by user
- Distribution and concentration of five criteria pollutants (Nox, SO2, CO, PM2.5 and PM10)
- Monte Carlo Gaussian Plume/Dispersion model using:
  - Plant characteristics (emission flow rate (grams/second), heat input, heat rate, fuel type, smock stack height)
  - Natural environment (prevailing wind direction and speed, atmospheric pressure and topology)
- Lots of data: a single power plant produces 50,000 data points
- The model is fully longitudinal: we can simulate exposure to the population as as for back as 1995 and forecast exposure to 2035





Health Impact Analysis

Figure 1.1 ITHIM Integrates Data on Health and Travel



Methane Modelling

- Modelled Sectors:
  - Oil and gas production
    - active wells
  - Gas distribution
    - to customer meters
  - Residential/commercial consumption
    - from customer meter
  - Landfill emissions *(in development pipeline)*
  - Agriculture *(in development pipeline)*

- Approach:
  - Broad model integration
    - Building Emissions model
    - Mobile Emissions model
    - Power Sector Model
  - Bottom-up
    - calibrate results with top-down estimates
  - Monte Carlo simulation
    - estimate emission factors from specific equipment
    - multiple simulations, with 95% confidence interval
  - Rate calibration
    - with top down estimate modification
  - Cross-validation
    - with existing published research
    - multiple international datasets

Summary

- NCSG models produce results similar to MDE/ MDOT estimates but suggest slightly higher BAU emissions;
- By testing alternative scenarios NCSG models are able to identify sources of uncertainty and the effects of alternative policy strategies;
- NCSG models are spatially explicit and well suited for exploring issues of health and equity.

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Thanks to:

Fred Ducca, Sevgi Erdogan, Tim Welch, Rolf Moeckel, Harut Shabhamayan, Dan Engelberg, and many graduate students

For more information, see:

www.smartgrowth.umd.edu