FAA NAS Strategy Simulator (NSS)

Overview

Presented to:	National Airspace System Performance Workshop
By:	Anne Yablonski Suissa
Date:	March 16, 2006

NSS Key Points

Key Dates

- Model development began in late 2001
- Feedback generated from training in 2003
- Model overhaul in 2004 – problem focused
- Key Validation Activities 2004/2005
- Model results widely used beginning 2005

Data Sources

Federal Aviation Administration

Bureau of Transportation Statistics

Air Transport Association

Model Contributors

VENTANA systems, inc.

The National Center of Excellence NEXTOR For Aviation Operations Research

MITRE

LMI

The CNA Corporation

Sample NEXTOR Contributions

- **UMD**
  - Capacity and delay modeling
- **Virginia Tech**
  - General aviation and VLJ modeling
  - Demand reaction to tax changes
- **UCB**
  - Economic analysis of changes to aircraft, tax structure, and air traffic control
- **GMU**
  - Validation and verification
- **MIT**
  - Analysis of different cost schemes
  - Airline profitability analysis

Advantages of the NSS

- **Real-time simulation**
  - Simulates in less than one second
  - Apply a system change to two tax scenarios and watch both scenarios change simultaneously
- **Consolidates all aspects of the system**
  - Passenger and cargo demand
  - Airline supply and costs
  - FAA expenses and revenues
- **Flexible**
  - Able to add more views that model other system details

Recent Model Improvements

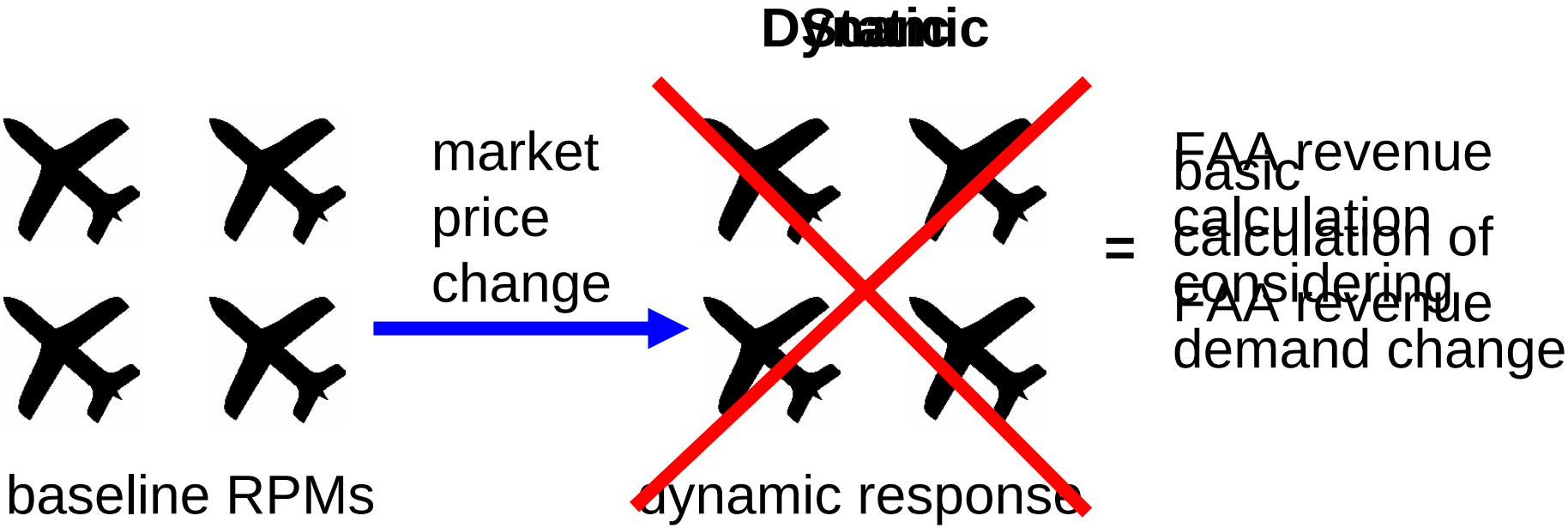
- **Demand response mechanisms**
- **Flight delay versus passenger delay relationship**
- **Fee structure and impacts on demand**
- **Model Enhancements**
  - User classes
  - Static and dynamic capabilities
  - Improvements to user interface
    - Scenario modeling
    - Results displays

User Classes

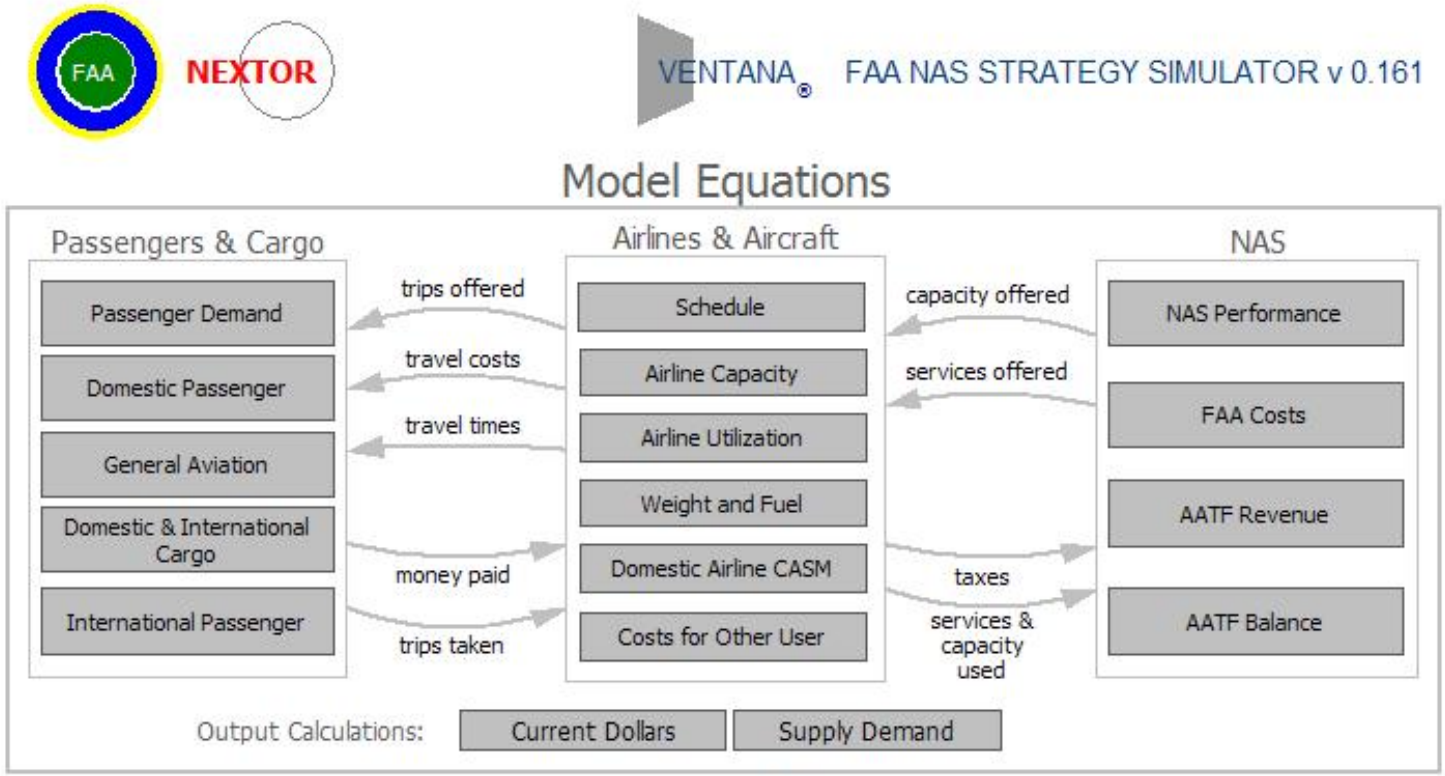
Static and Dynamic Capabilities

Focus on trust fund formulation resulted in development of static-dynamic capability to answer

- ***Does total revenue change because of a tax structure change or a user group response to the tax structure?***



NSS Overview



Click on sector boxes to go to corresponding views. Click on "home" icons to return to this overview. Toggle 'h' to hide/show hidden variables. Copyright © 2001 - 2006 Ventana Systems, Inc. and contributors as noted.
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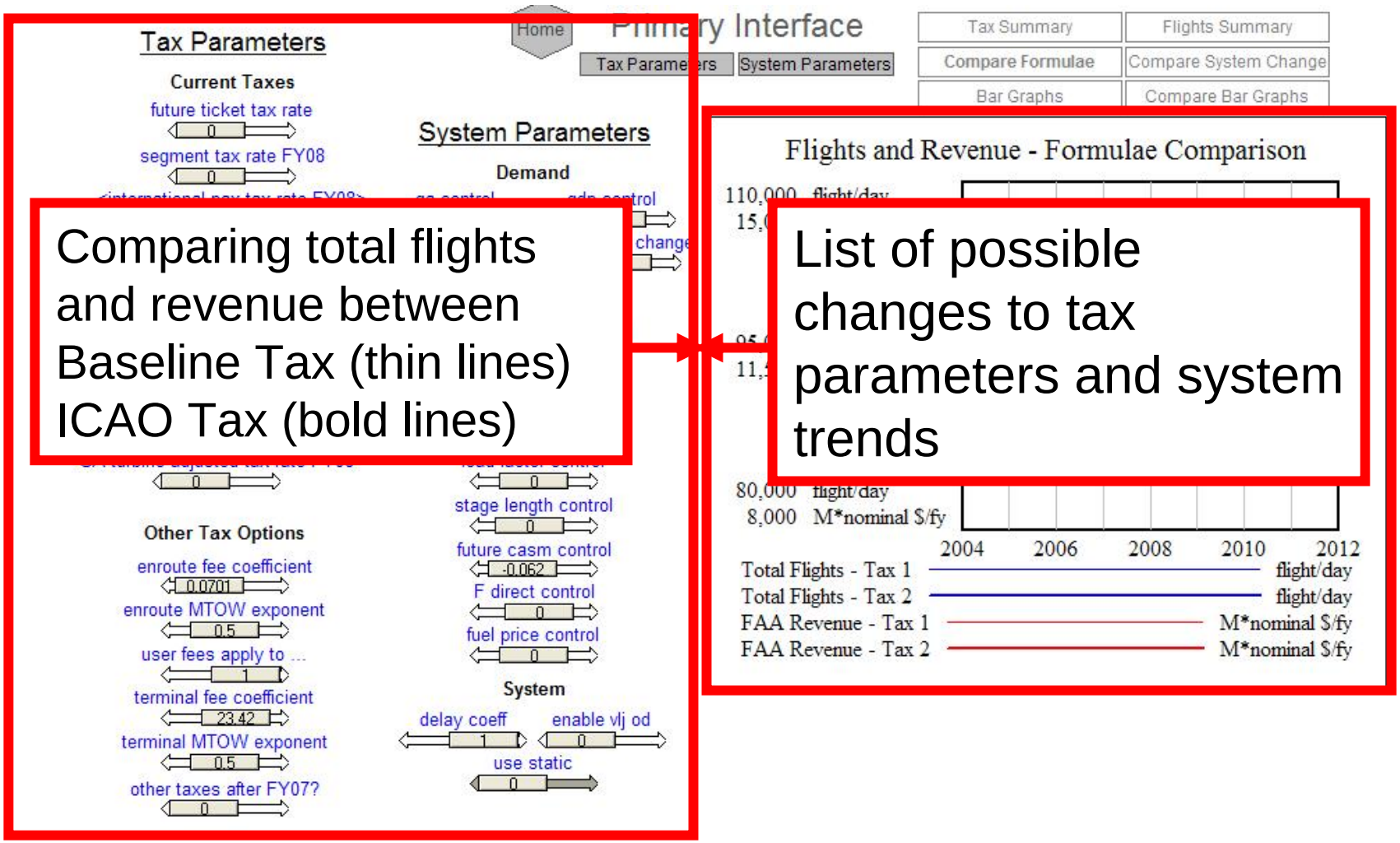
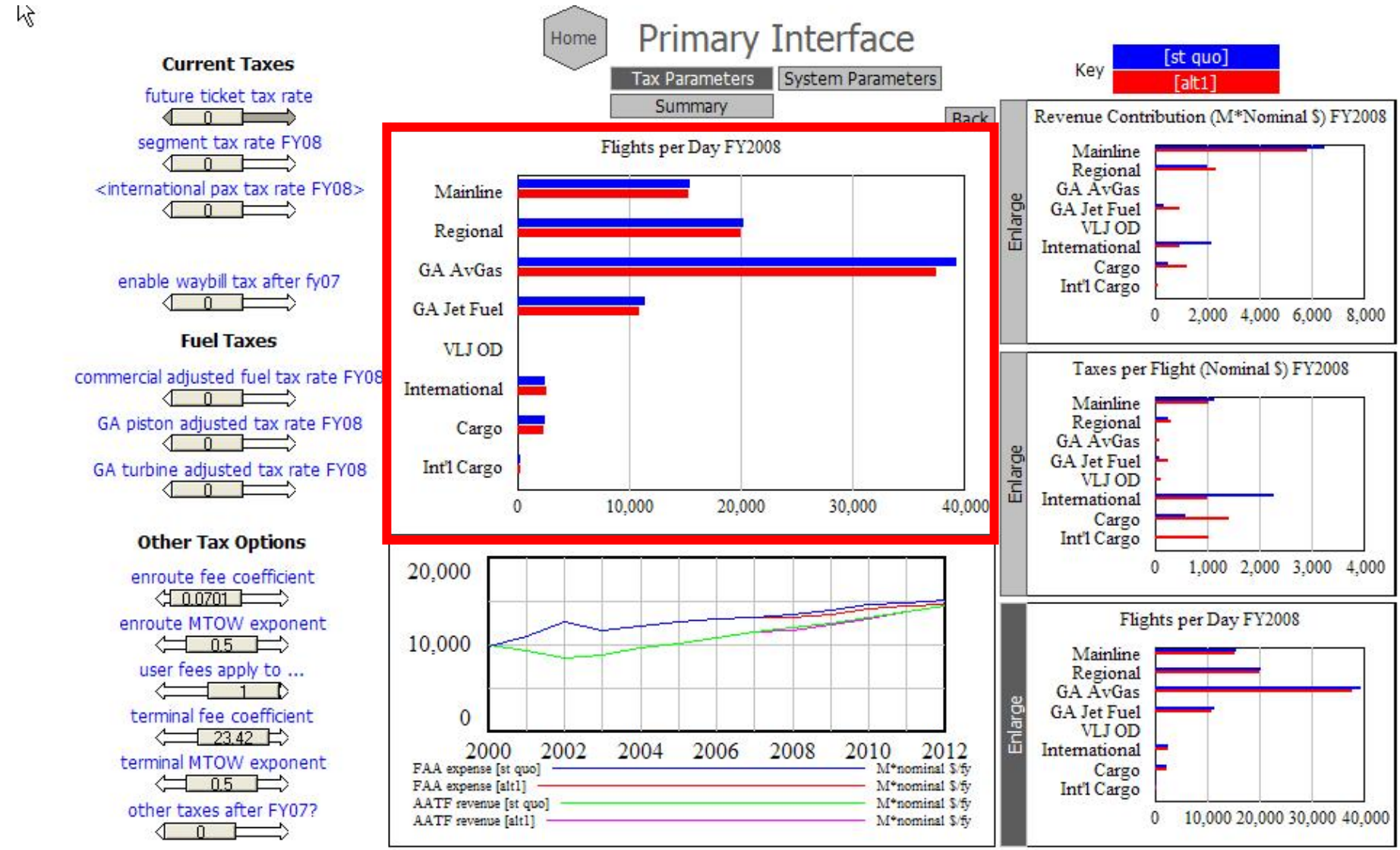
NSS Interface – Sample Scenario

Comparing baseline tax structure to ICAO formula

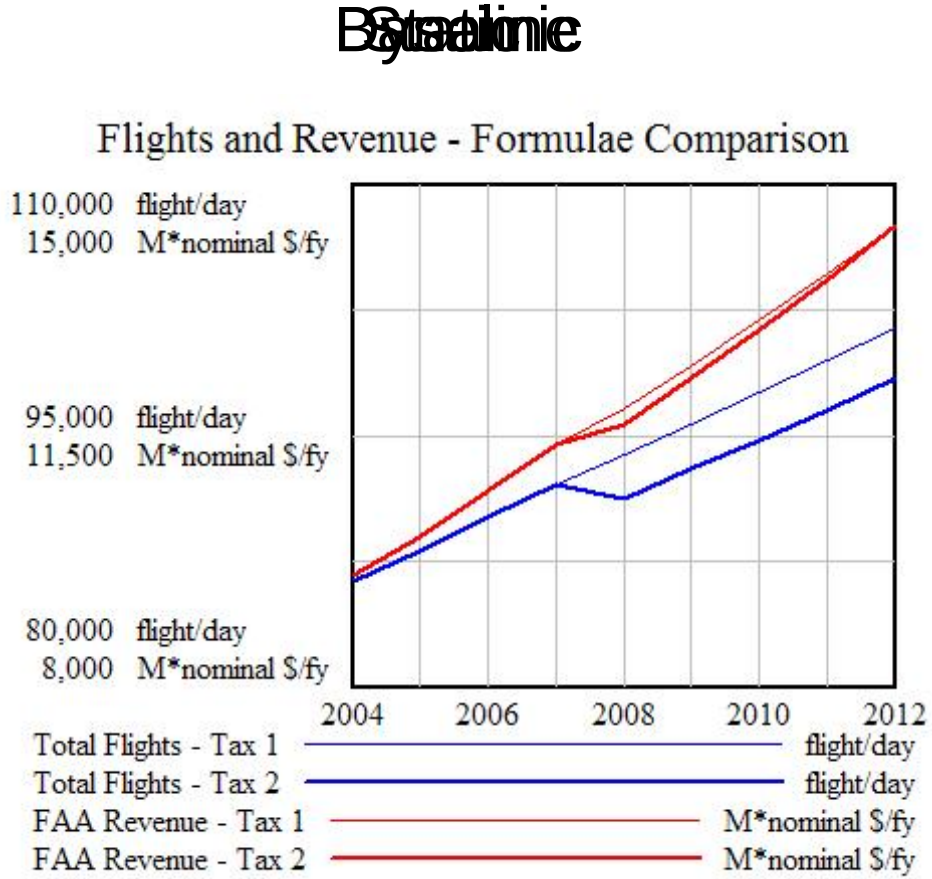


NSS Interface with User Groups



ICAO Formula: Static versus Dynamic

ICAO Formula compared to baseline tax structure in static and dynamic condition.



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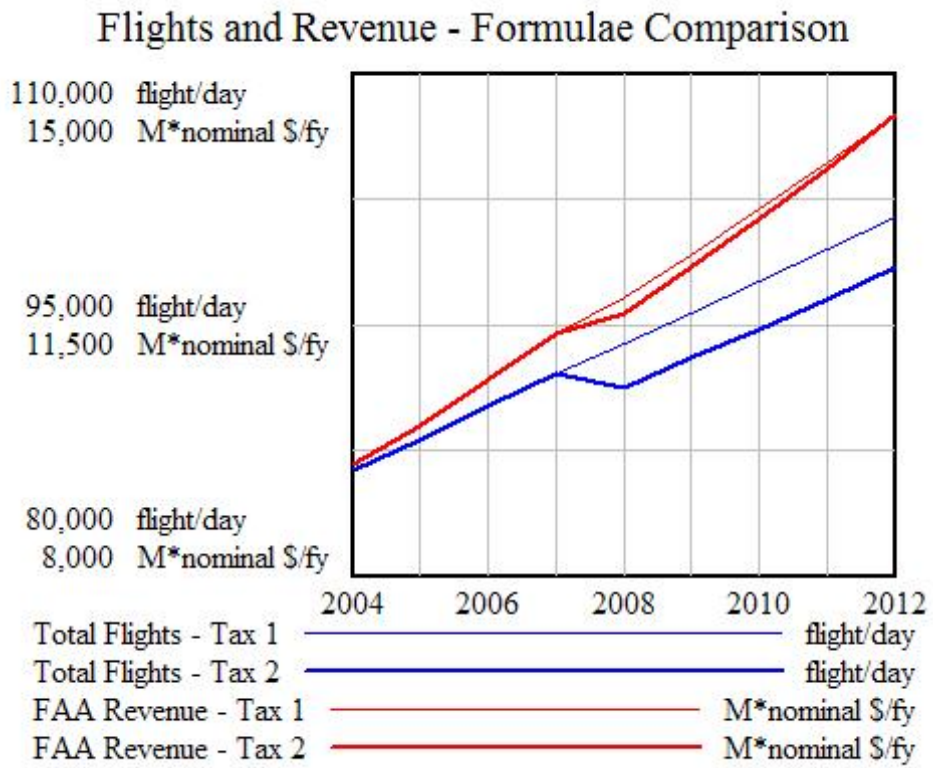
Dynamic

Static

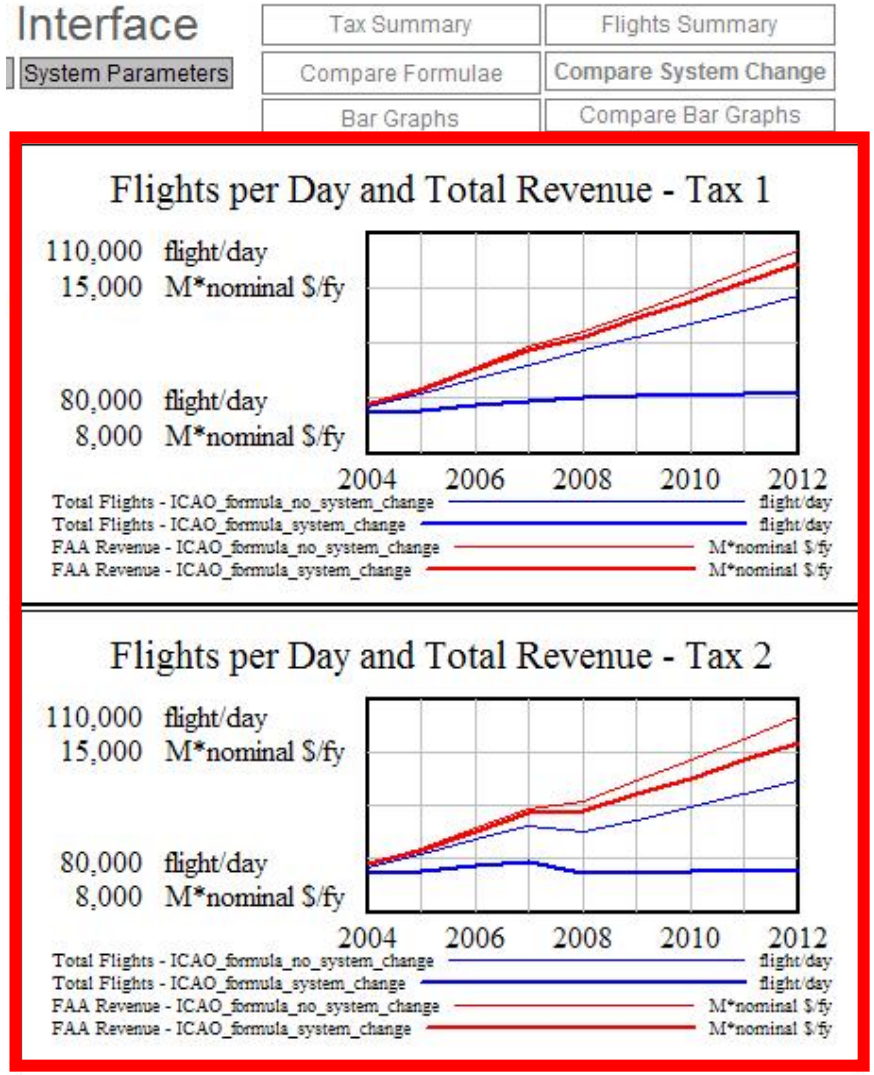


Comparing Base Tax Formula (Tax 1) with ICAO Formula (Tax 2) under Increase in Fuel Price

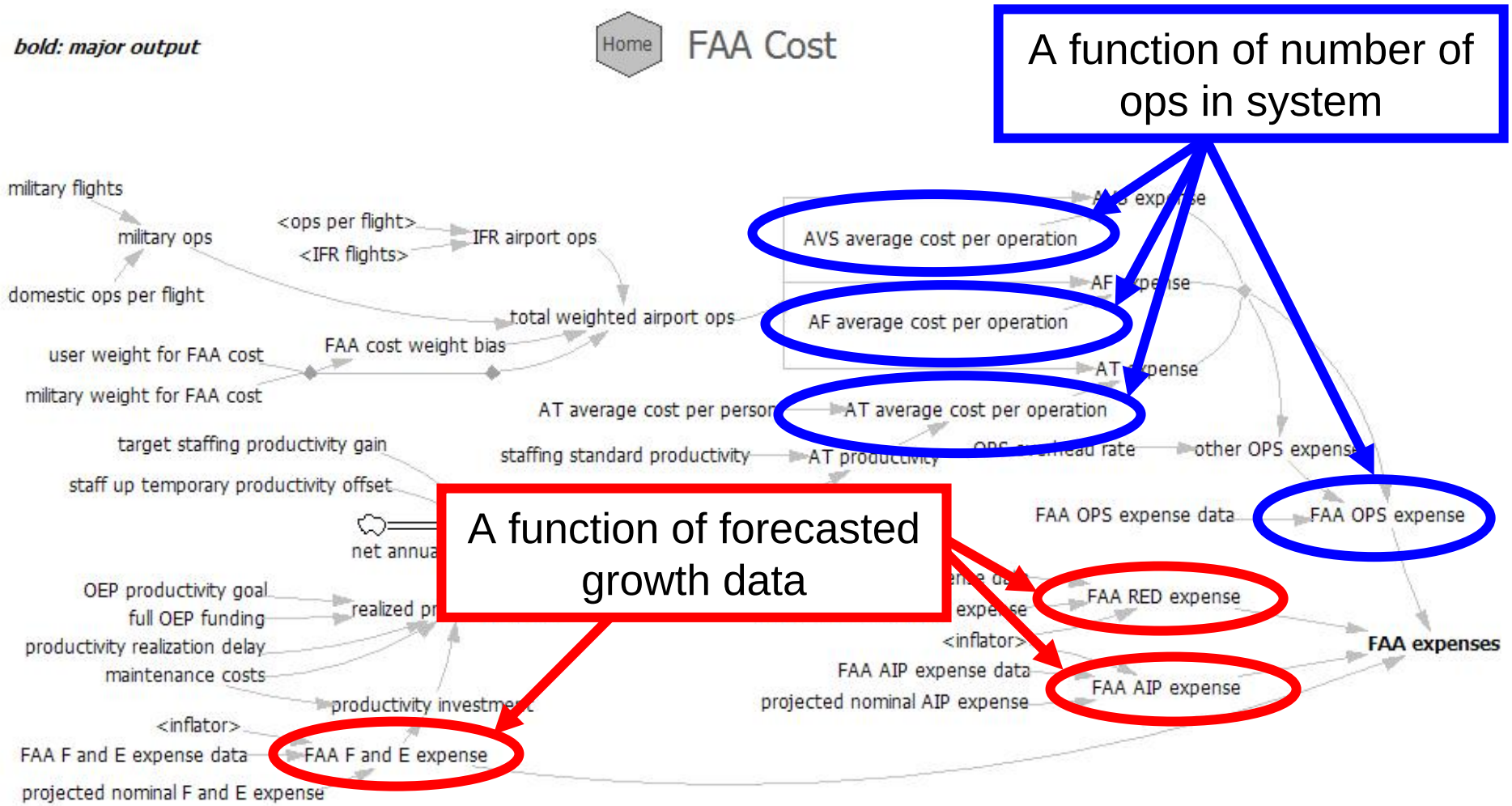
If fuel prices increase…

- For existing structure, larger decrease in flights than ICAO formula, but…
- Smaller decrease in revenue than ICAO formula.

Operations-based formulae may not collect the revenue amount needed to sustain the system.



NSS Cost View



Improvements in cost model needed to provide more accurate, detailed simulations

Future Improvements / Applications

- **Improve cost modeling**
  - Tailor costs according to user groups, type of service (i.e., oceanic, en route)
  - Ops tail
- **GA and Airline Modelling**
- **Capital investment strategy**
  - NAS operations cost changes
  - Customer benefits
- **Estimating VLJ Impact**
- **Next Generation Air Transportation System (NGATS) modeling**
- **Testing forecast assumptions**
- **Scenario and Risk modeling to support strategic decisions**
- **Further model validation**

Questions?

Anne Yablonski Suissa

Anne.Yablonski@faa.gov

Backup Slides

Demand Response Mechanisms

- **Commercial Users = *f*(demand/supply curve)**
  - Mainline, Regional, VLJ
- **Other Users = *f*(demand elasticity)**
  - International, International Cargo, GA AvGas, GA Jet Fuel
- **Domestic Cargo = *f*(demand elasticity, passenger belly cargo, GDP)**

Model Applications

- **FAA business planning**
- **Russ Chew's briefing for the 2005 FAA Forecasting Conference**
- **Planning for the Trust Fund Formulation and its impact on workload**
  - Testing demand impacts of various formulations
  - Examining impacts of risk to formulations
- **Model results presented to numerous organizations (inside and outside the FAA)**

Model Validation

- **Developed and coordinated model documentation (v.122) with NEXTOR team (Fall 2004)**
  - As a result, model was corrected to better reflect the requirements
- **Theoretical Validation Activities:**
  - NEXTOR University team reviewed model and documentation for
    - Structure – logic of feedback loops
    - Overall assumptions
    - Accuracy of model components
  - Professor Tom Willemain of RPI reviewed and commented on the model
- **Comparison against historical data**
  - Key activity in developing and calibrating model results

Model Validation (Cont)

- **Model-to-Model Activities:**
  - Part of JPDO exercise ensured common input and output magnitude of results.
  - As part of NEXTOR research (UCB models and TSAM)
- **Empirical Validation - Ran scenarios and analyzed results as part of studies**
    - Delays
    - FAA revenue under changing forecast assumptions
    - FAA revenue and demand changes by user class
- **New model release verification activities**

Upcoming validation activities

1. Calibration to more extensive historical dataset

- Evaluate closeness of fit
- Determine uncertainty in estimated parameters and corresponding forecast
- Prioritize areas for model development, model simplification

2. Catalog of cause-and-effect behaviors

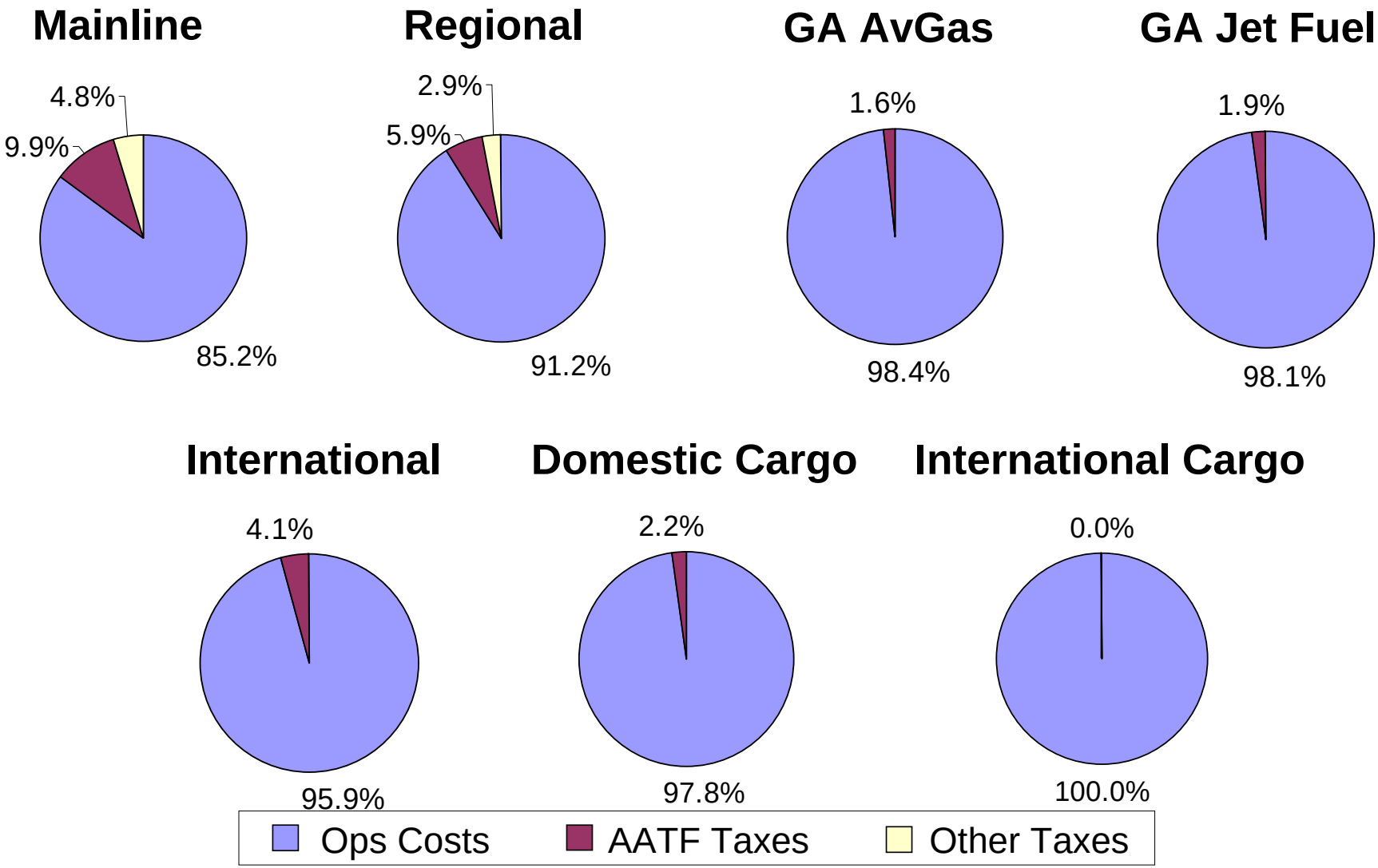
- Crosswalk of which inputs affect which outputs and in what direction
- Example: verify that raising a user's taxes results in reduced flights, all else equal
- Can be coded into a Reality Check® library of automated checks* to quickly scan each new model release for compliance with dozens or hundreds of similar common-sense expectations
- Can be used as a quick reference for which effects are, or are not, included in the model" (ie, in the current model, faster economic growth drives greater commercial activity but not greater GA traffic)

3. Ongoing review by NEXTOR, GRA

In addition, ongoing development based on industry, academic, and government sources will continually increase the breadth and quality of model assumptions

*Subject to ATO development priorities

Taxes versus Operating Costs (Under Current Tax Structure)

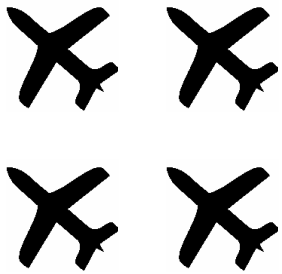


Static versus Dynamic Calculation

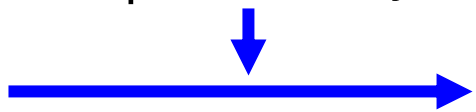
Under static condition, demand/RPMs do not change but number of flights might

Mainline

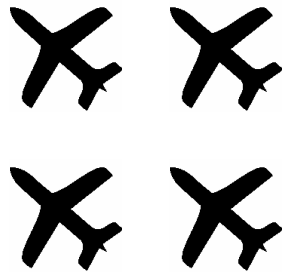
baseline flights and RPMs



fuel price increase



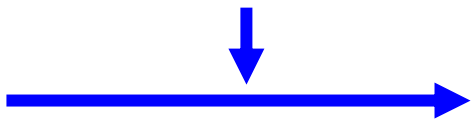
same number of flights, RPMs the same



GA

baseline flights

fuel price increase



same number of flights

Future Research Areas

- **Cost analysis**
- **General Aviation**
- **Airline modeling**
- **Model validation**