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Richard Golaszewski
GRA, Incorporated

115 West Avenue • Jenkintown, PA 19046 • USA
☎ 215-884-7500 • 🖷 215-884-1385
✉ richg@gra-inc.com

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Background

- Questions on value of NGATS
  - Funding bodies
  - Users
- Potential need for regulatory changes
  - Require benefit-cost analysis (BCA)
- Justification for investment program
  - NASA R&D
  - FAA JRC
  - OMB 300
- Sound program management must understand benefits and costs to government and users
- Need to consider interdependencies
  - User equipage
  - Benefits estimates

Approach to Long-Term Investment Analysis

- Understand performance of future system without NGATS investment
  - What is already underway (e.g., OEP)?
  - Secular improvement in ATM system productivity
- Models abstract futures that can be highly divergent
  - 2 X capacity in 2025 vs. 3 X capacity in 2025
- Order of investment can affect results (some capacity benefits overlap)
- Marginal delays without investment can be quite large—expand demand while holding capacity constant
- In sector with very long lived physical assets (such as aircraft), sequencing and coordination of implementation plans are essential

Cost-Benefit Approach for JPDO

- Differences from internal FAA cost benefit analysis
  - Multi-agency
  - Longer time horizon
  - Not only discounted “cash-flow” analysis (traditional internal FAA process)
- Provides reference and context for all agencies participating in NGATS
- Provides platform for input of industry on specific product/segment costs
- Uses modeling and simulation platforms to estimate benefits of acquiring package(s) of improvements
- Allows JPDO to respond to multiple needs
  - FAA (ATO-F, ATO-P, APO, JRC, etc.)
  - NASA (PART)
  - Other agencies
  - OMB

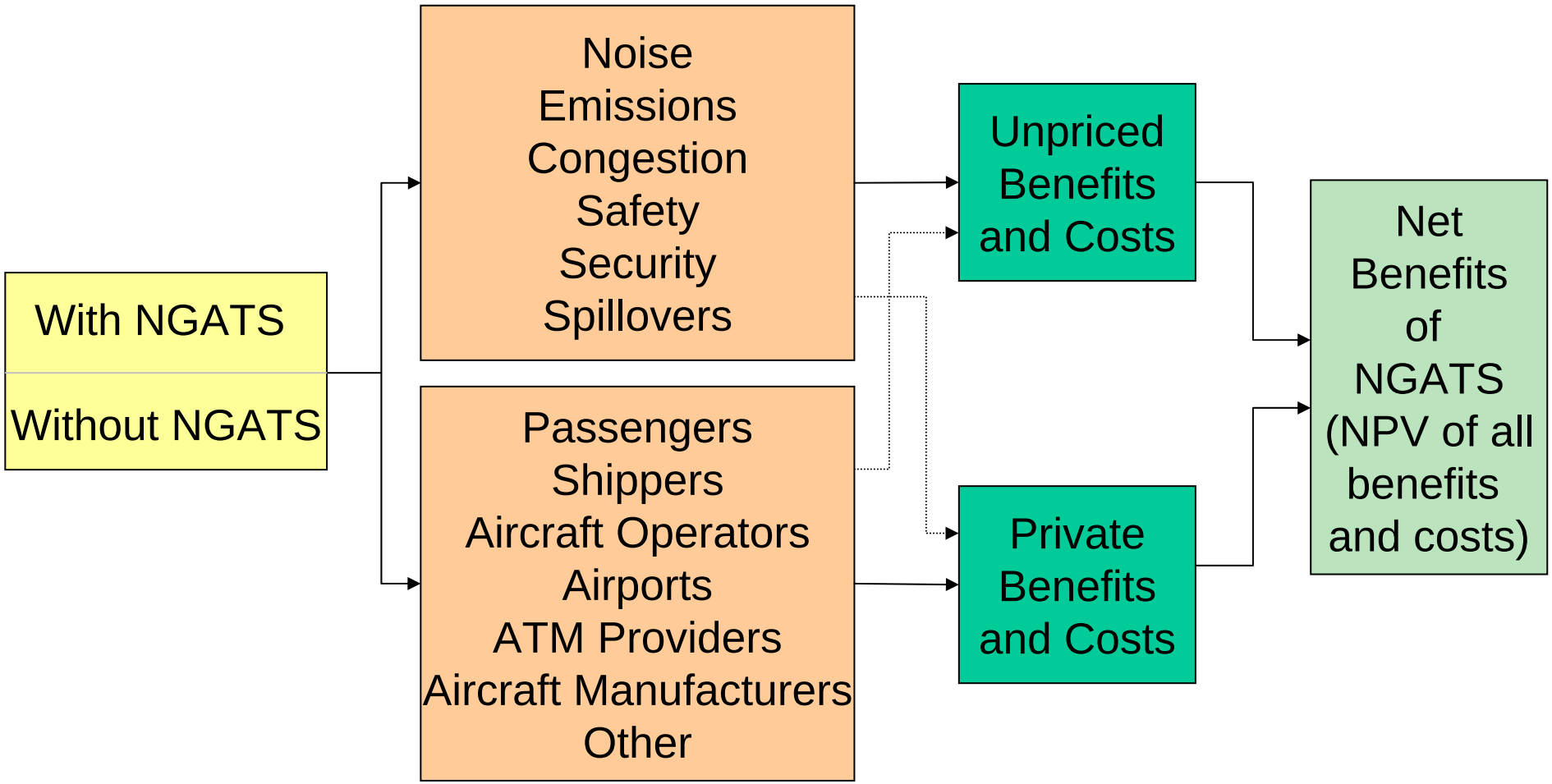
Identifying Benefits and Costs

- Both intangible and tangible benefits and costs should be recognized
- Calculation of net present value should be based on incremental benefits and incremental costs
- Possible interactions between the benefits and costs being analyzed and other government activities should be considered
- Analyses should focus on benefits and costs accruing to the citizens of the United States; impacts outside of U.S. economy noted separately
- There are no economic gains from a pure *transfer payment* matched by the costs borne by those who pay for it

Measuring Benefits and Costs

- The principle of *willingness-to-pay*
- Market prices
- Externalities, monopoly power, and taxes or subsidies can distort market
- Inframarginal benefits and costs—The economist's concept of *consumer surplus* measures the extra value consumers derive from their consumption compared with the value measured at market prices
- Indirect measures of benefits and costs—Most reliable when they are based on actual market transactions
- Multiplier effects—Employment or output multipliers that purport to measure the secondary effects of government expenditures on employment and output should not be included in measured social benefits or costs

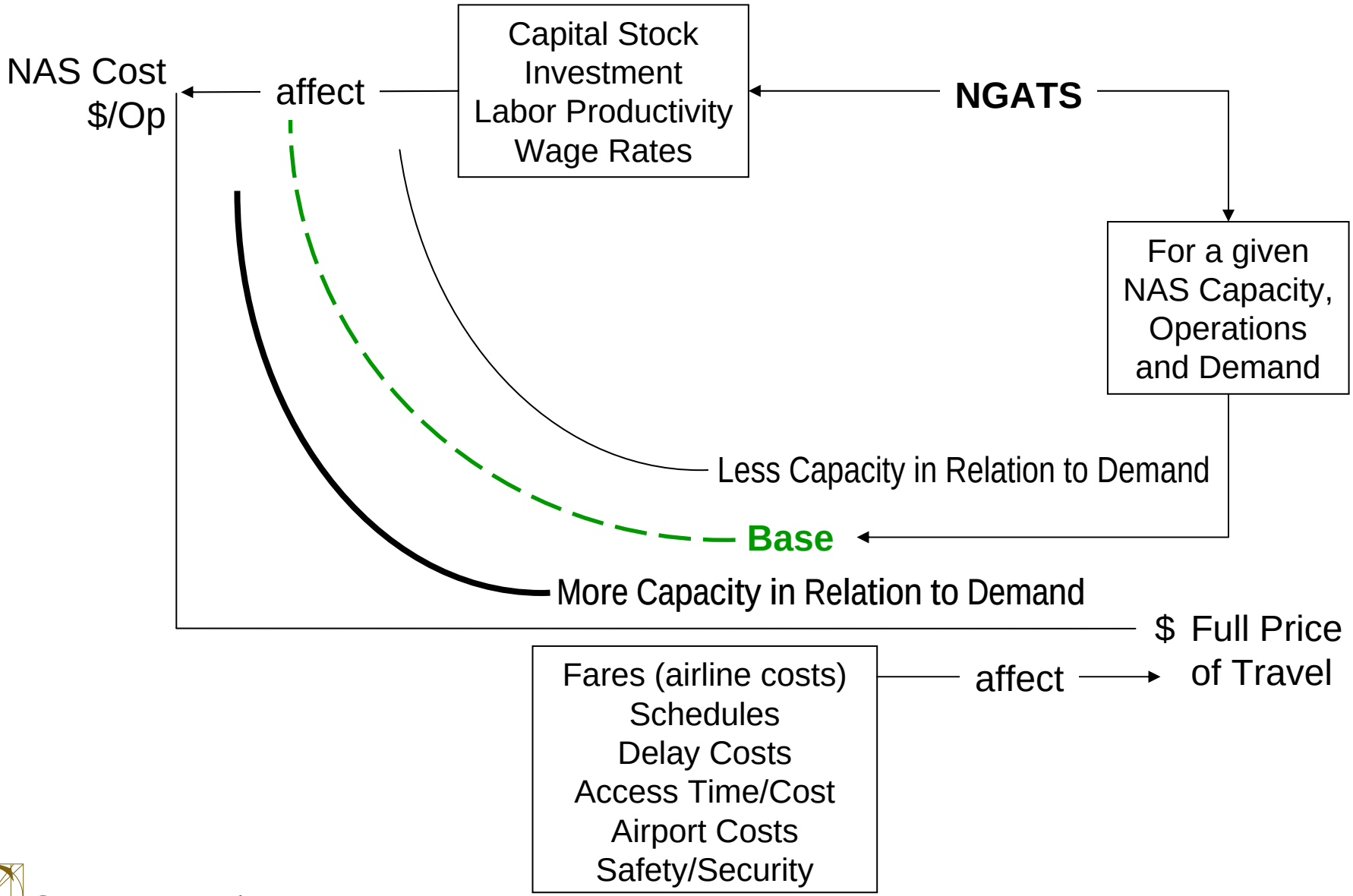
NGATS Benefit-Cost Framework



Issues in Estimating NGATS Costs

- Projecting O&M costs needs estimates of labor input to future systems
- What will be primary and backup systems?
- What will be required to operate in various categories of airspace?
- Will equivalent throughput increase?
  - Reduced separation
  - Reduced runway occupancy time

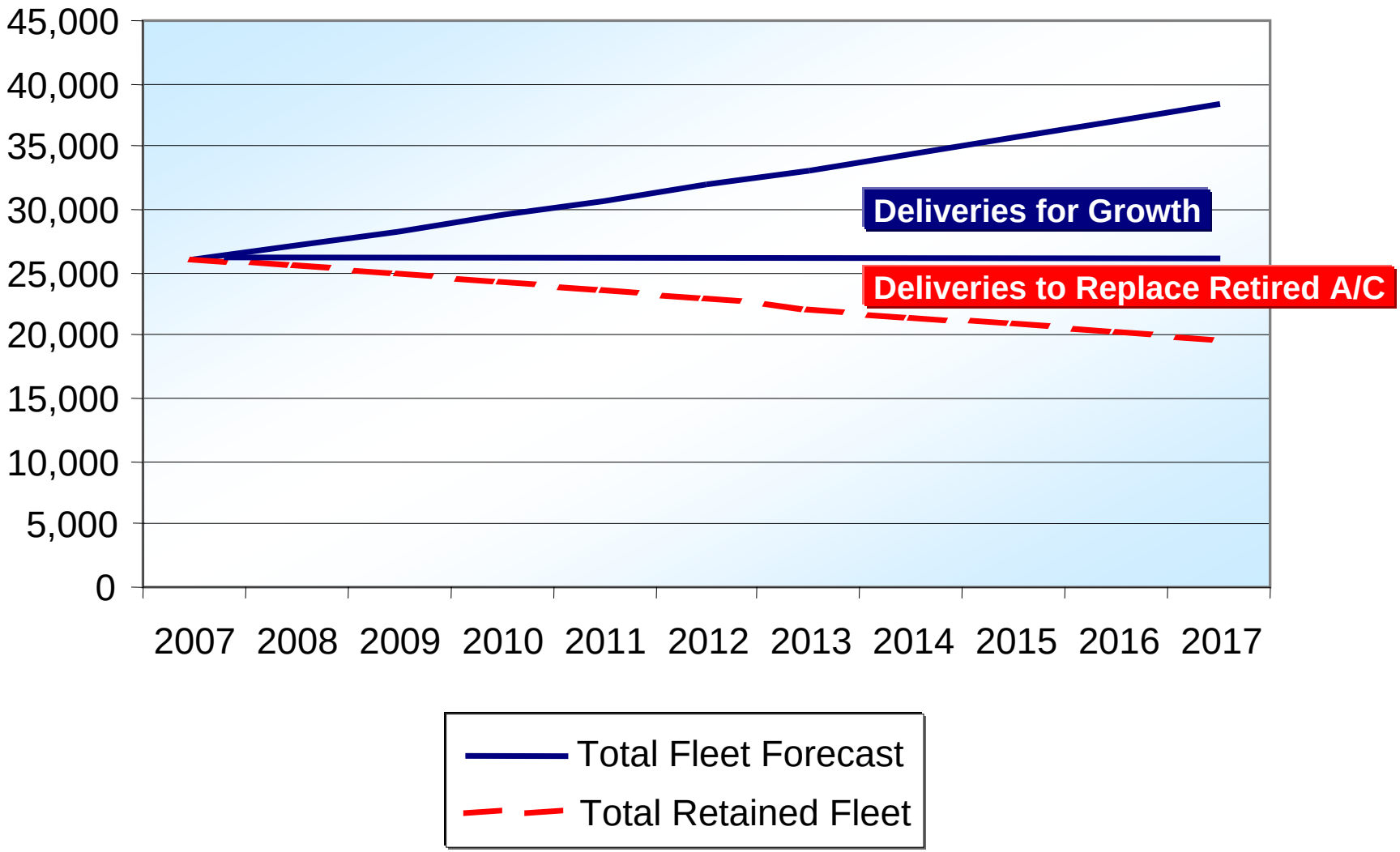
Illustration of Cost Tradeoff for NAS



Changes to Avionics Could Be Major Cost Impact of NGATS

- Many capabilities may require new equipage
- Fleet has long turnover
- GA fleet has a large number of old aircraft with low utilization
- New deliveries cover market growth and retirements
- About 50% of existing high performance fleet will still be operated in 2017
- Will equipage and retrofit strategies be designed to minimize cost impact?
  - Related systems
  - Out of service costs

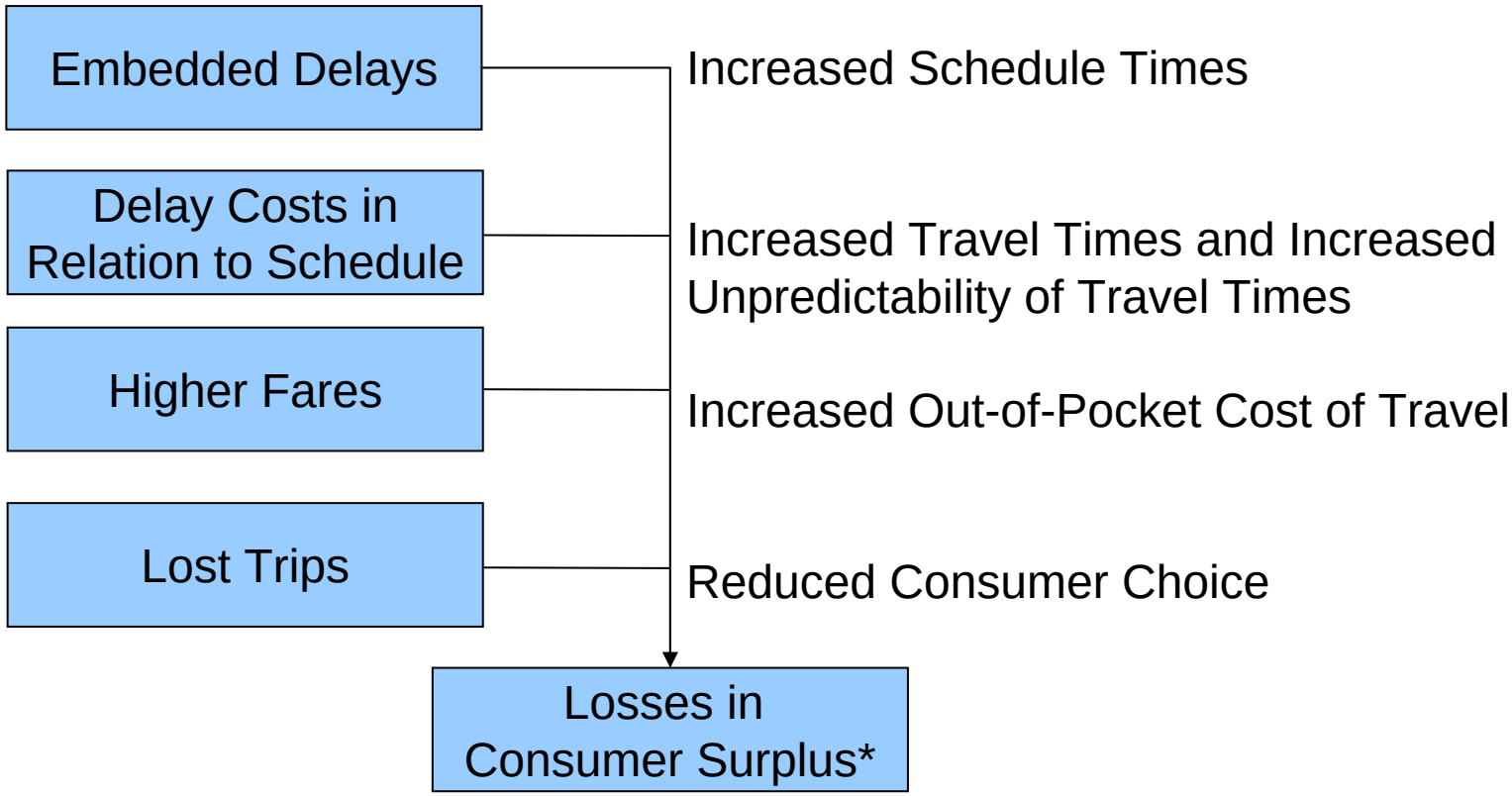
High Performance Fleet Forecast and Retained Fleet Summary



What Are NGATS Objectives and Benefits?

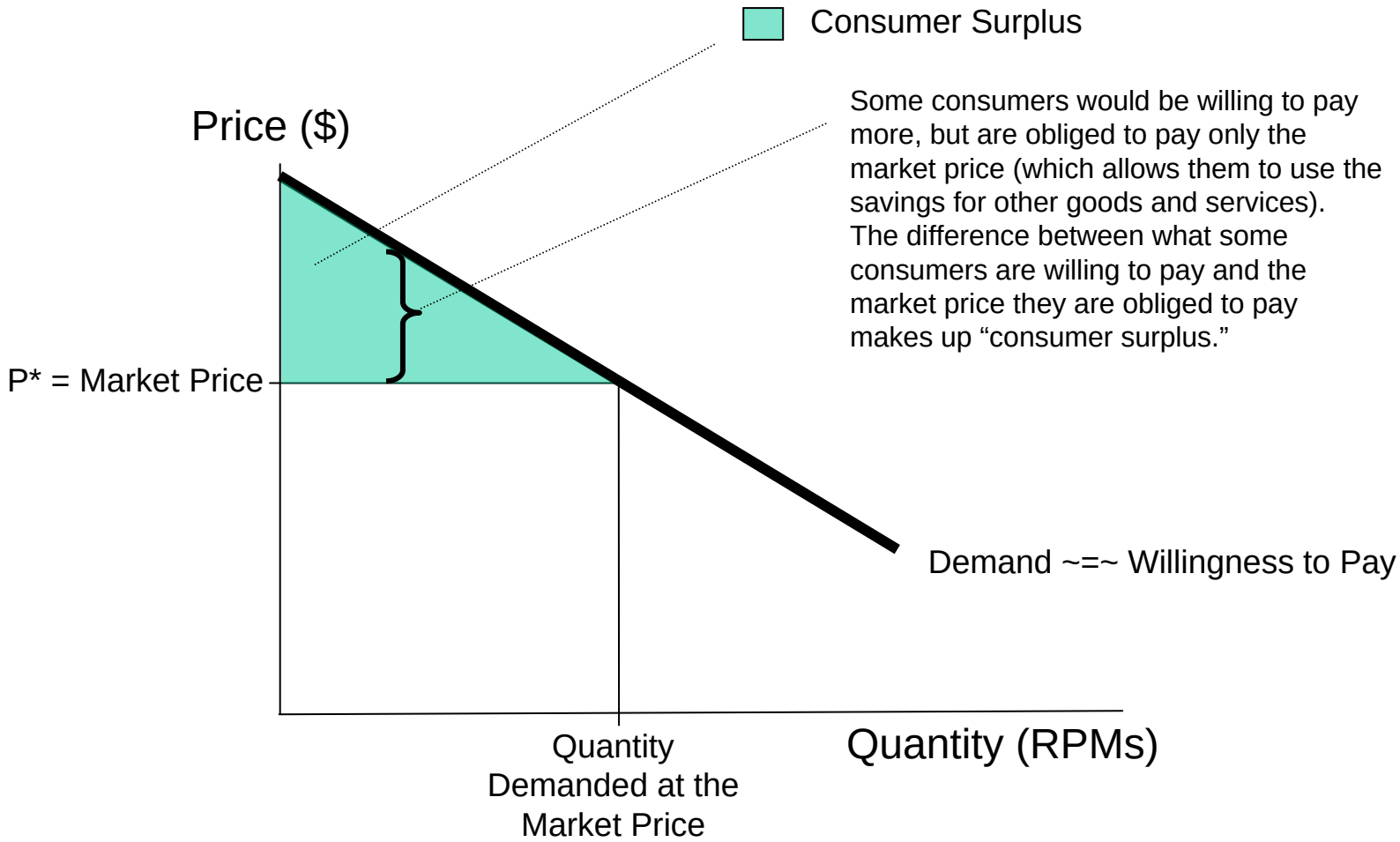
- Make service like today's (in terms of transit times, reliability, etc.) possible at fares like today's
  - Also able to serve tomorrow's demand level
  - Maintaining today's service delivery quality seems pedestrian, but requires challenging innovation to achieve
- Make tomorrow's service even better
  - Improving service qualities while also meeting future demand levels is even more challenging
- Most users of aviation system (passengers) value service qualities like reliability of schedules and curb to curb times, but are indifferent to the means used to achieve them

Economic Costs of a Shortfall



*Difference between what consumers would be willing to pay and what they have to pay for a given quality level – measure of economic consequences used and recommended by OMB

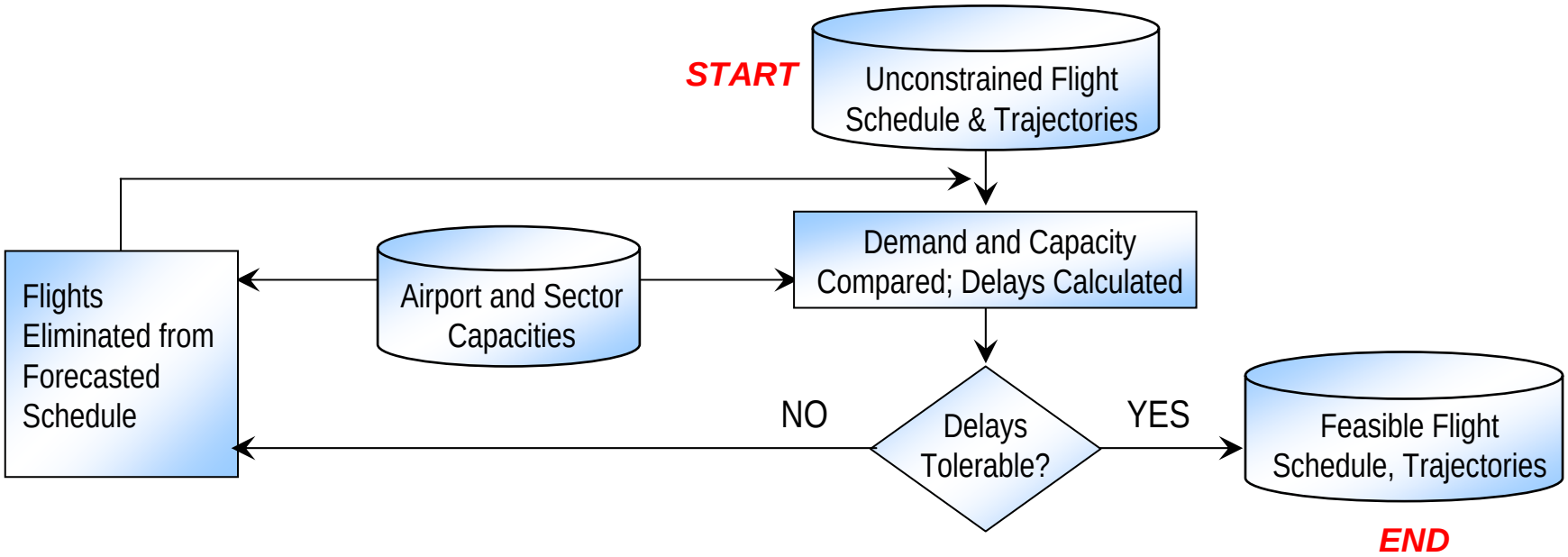
Consumer Surplus



Balancing Supply and Demand in Benefit-Cost Analysis

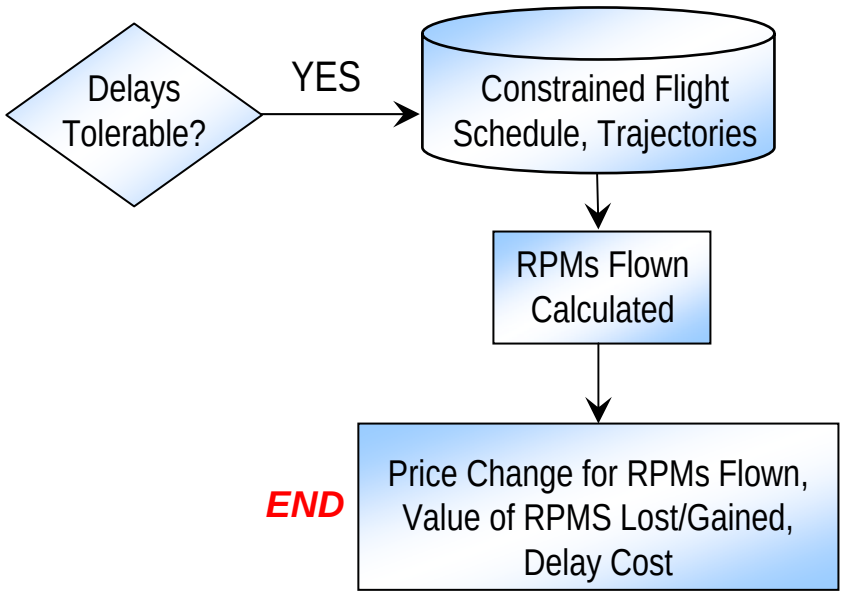
- Currently the baseline method used by EAD analysts to balance demand and capacity is to “eliminate” flights
- In a market driven system, these flights will never occur because passengers and airlines will adapt to the new reality (higher delays, lack of capacity, etc.)
- Added delays in the system over a long time affect the aviation demand function
- Former aviation passengers shift to competing modes (auto, rail, etc.)
  - For example, drops in short-range commercial flights after 9-11 with added processing-slack times
- EAD has models to study mode choice shift effects

From Unconstrained Demand to Feasible Throughput



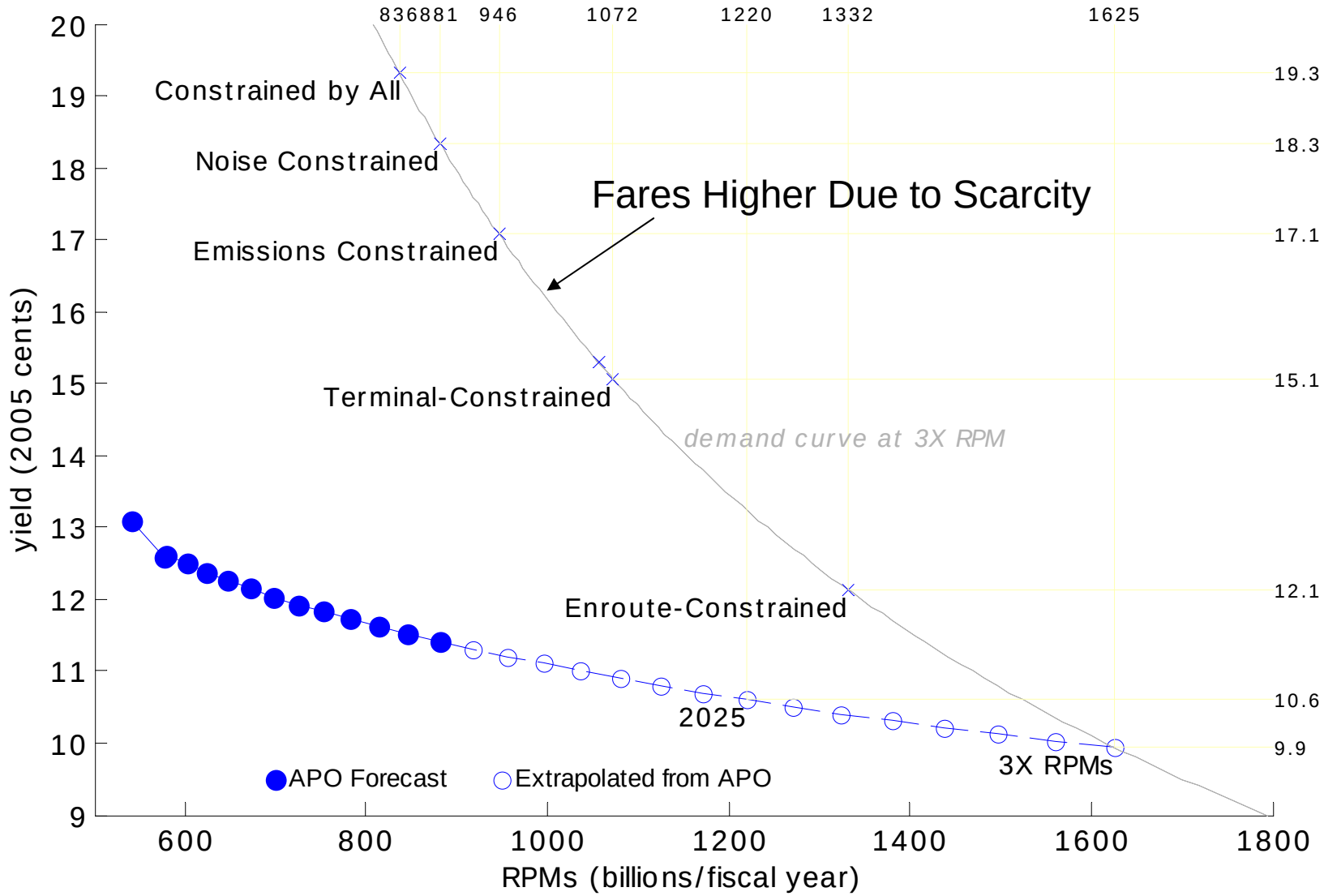
- Future flight schedules would incur huge and unrealistic delays if all demanded flights actually flew
- Excessive delay must be dealt with in the planning stage
- Capacity constraints will restrict the demand
- Solving the congestion problem
  - *Alternative route*
  - *Alternative departure time*
  - Flight elimination (some demand is left unsatisfied)

Economic Valuation



- A "constrained" schedule is produced in which not all of the demanded flights actually materialize
- The flights that were eliminated have economic value
- We translate these lost flights into lost seats (revenue passenger miles)
- We estimate the yield increase necessary to match demand with constrained supply of RPMs
- We value the lost RPMs using the concept of "consumer surplus"
- We also quantify the cost of the delay that will exist due to capacity shortages
  - Airline variable operating costs
  - Passenger value of time

Illustration of Constraints Analysis Yield and Consumer Surplus



Incremental Successes with OIs Lead to Incremental Capacity Gains

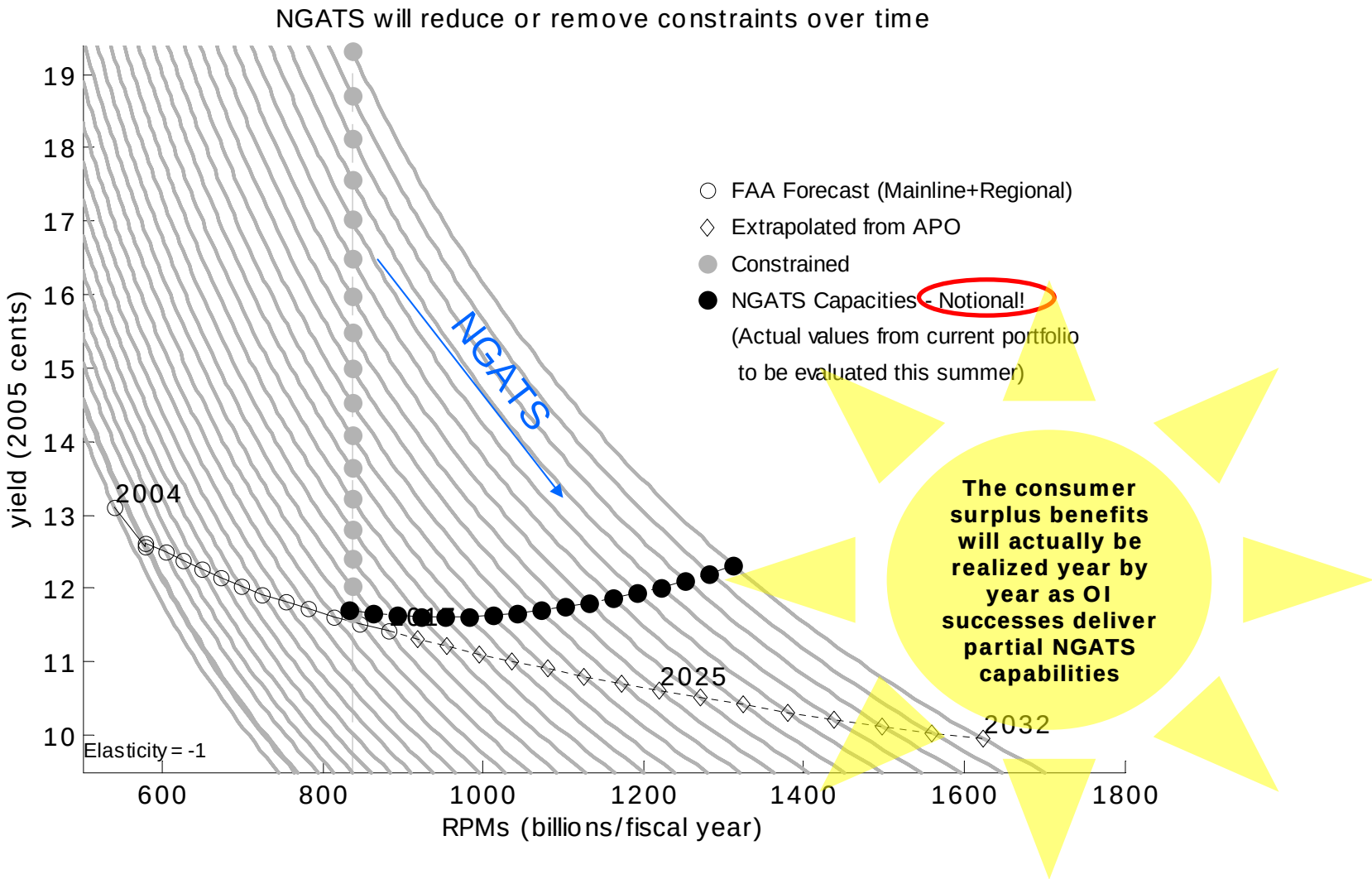
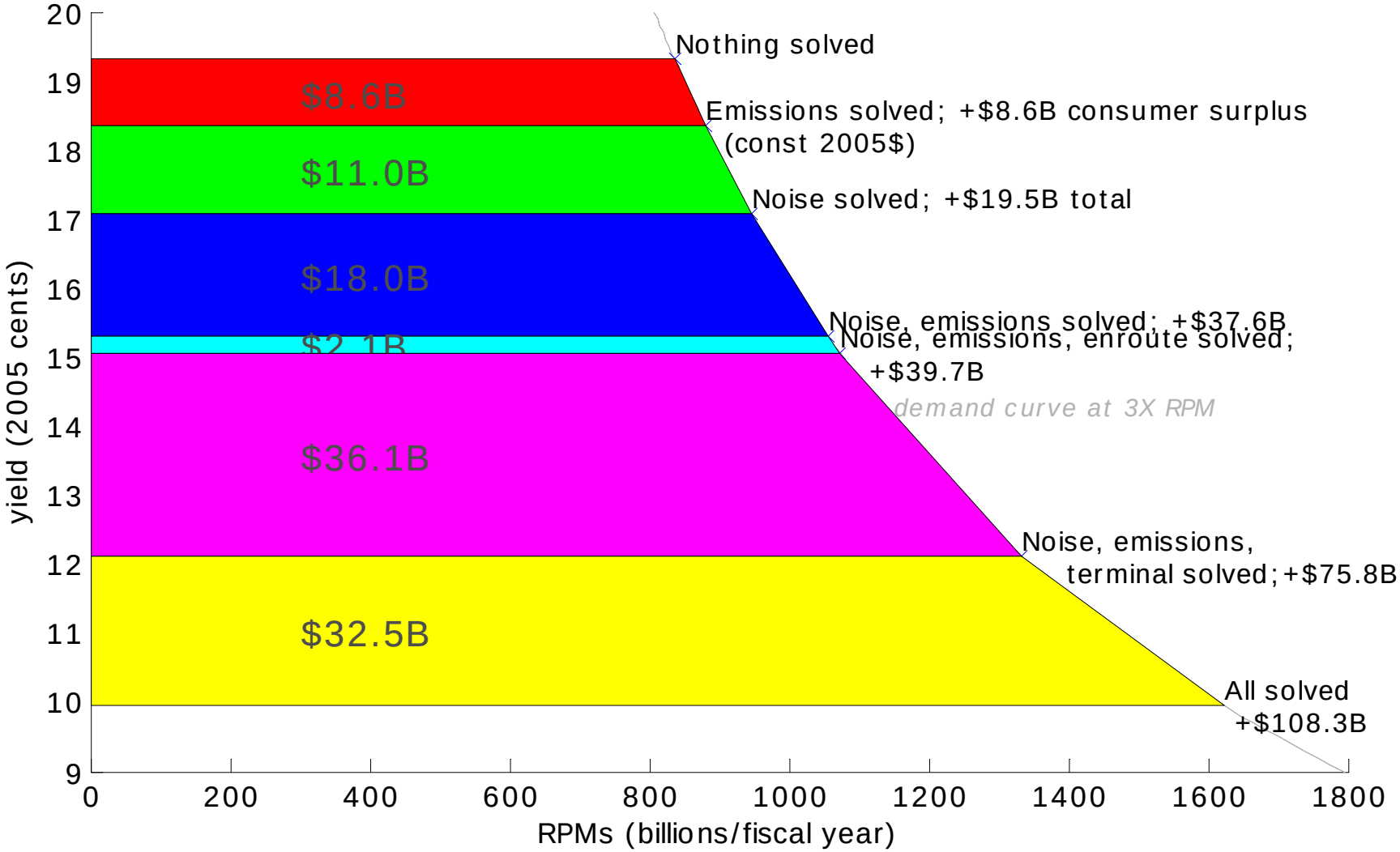


Illustration of Benefits

Note: Order likely to change relative magnitudes



Wrap Up

- Benefit-cost analysis will be a continuing need
- EAD building “tool sets” using multiple models
  - NAS modeling/simulation
  - Environmental modeling
  - Security models
  - User impacts
- Opportunity to extend and improve techniques
- Need to retain linkages to agency investment analysis standards

Back Up

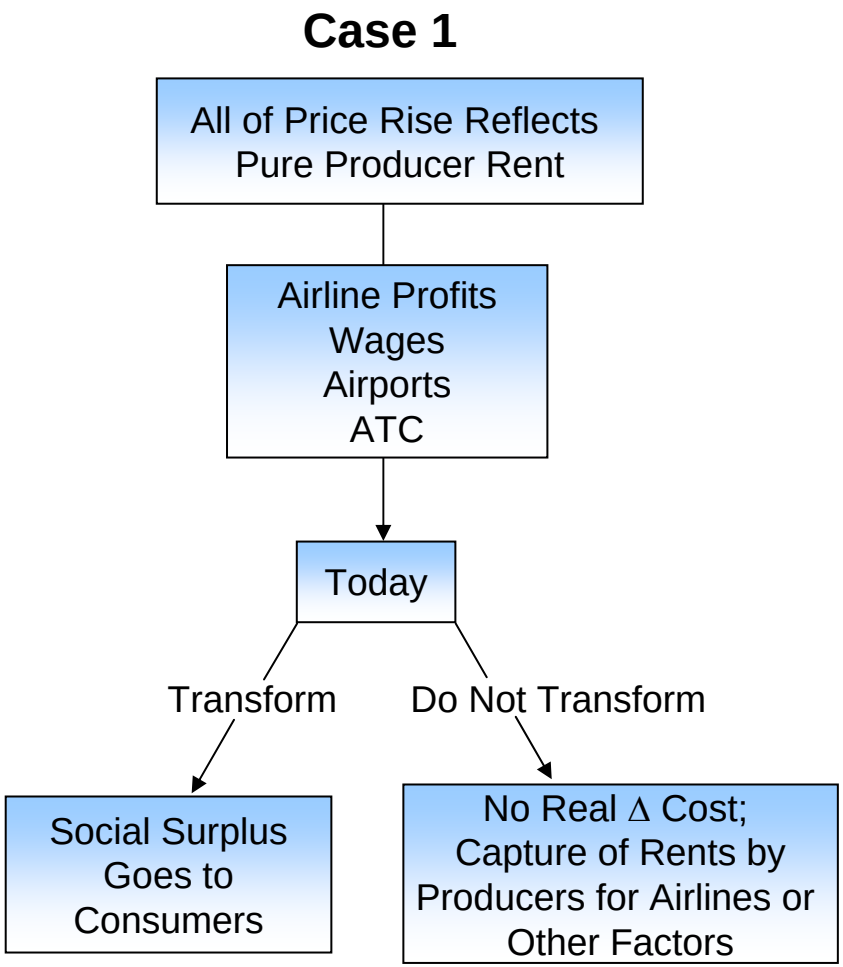
Traditional Benefit-Cost Analysis

- Used to justify NAS investments
  - Most appropriate tool
  - Meets OMB investment analysis standards
- Should consider all benefits
  - Airline (or other user) costs and revenues
  - FAA investment and operations and maintenance costs
  - Value of passenger time (not always included but should be)
  - External effects
    - Environment
    - Congestion
    - Safety
- Compensation principle
  - Pareto improving: benefits exceed costs and winners could compensate losers

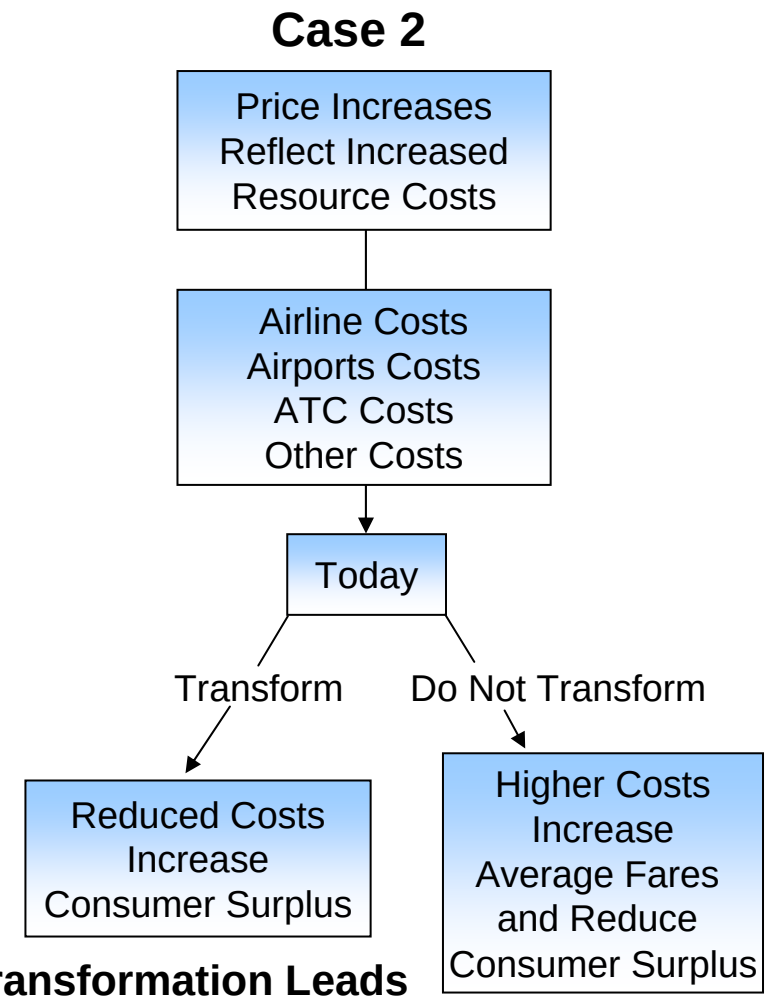
Quantitative Analysis of Uncertainty

- Quantitative analysis characterizing the probabilities of the relevant outcomes and an assignment of economic value to the projected outcomes
- Balance throughness with the practical limits on your analytical capabilities
- Estimates cannot be more precise than their most uncertain component
- Disclose qualitatively the main uncertainties
- Use a numerical sensitivity analysis
- Apply a formal probabilistic analysis of the relevant uncertainties

Rise in Average Yield to Model Impact of Reduced Supply in Constrained World



Equivalent Amounts of Social Surplus



Transformation Leads to Real Resource Savings

What Drives NAS Demand/Capacity Requirements?

- Commercial passenger NAS users (airlines) compete in several areas to satisfy passenger demand for air transportation services
  - Fares
  - Flight frequency
  - Travel time
  - Expected delay time and reliability
  - Flight comfort and amenities
- Demand growth is not uniform across all airports—unique regional patterns of population and economic growth lead to different levels of demand growth at individual airports
- Airlines and other NAS users provide personal and commercial services through ***flights***
  - Flights are a common measure of demand/capacity, but, as shown on the next slide, several related measures are also used

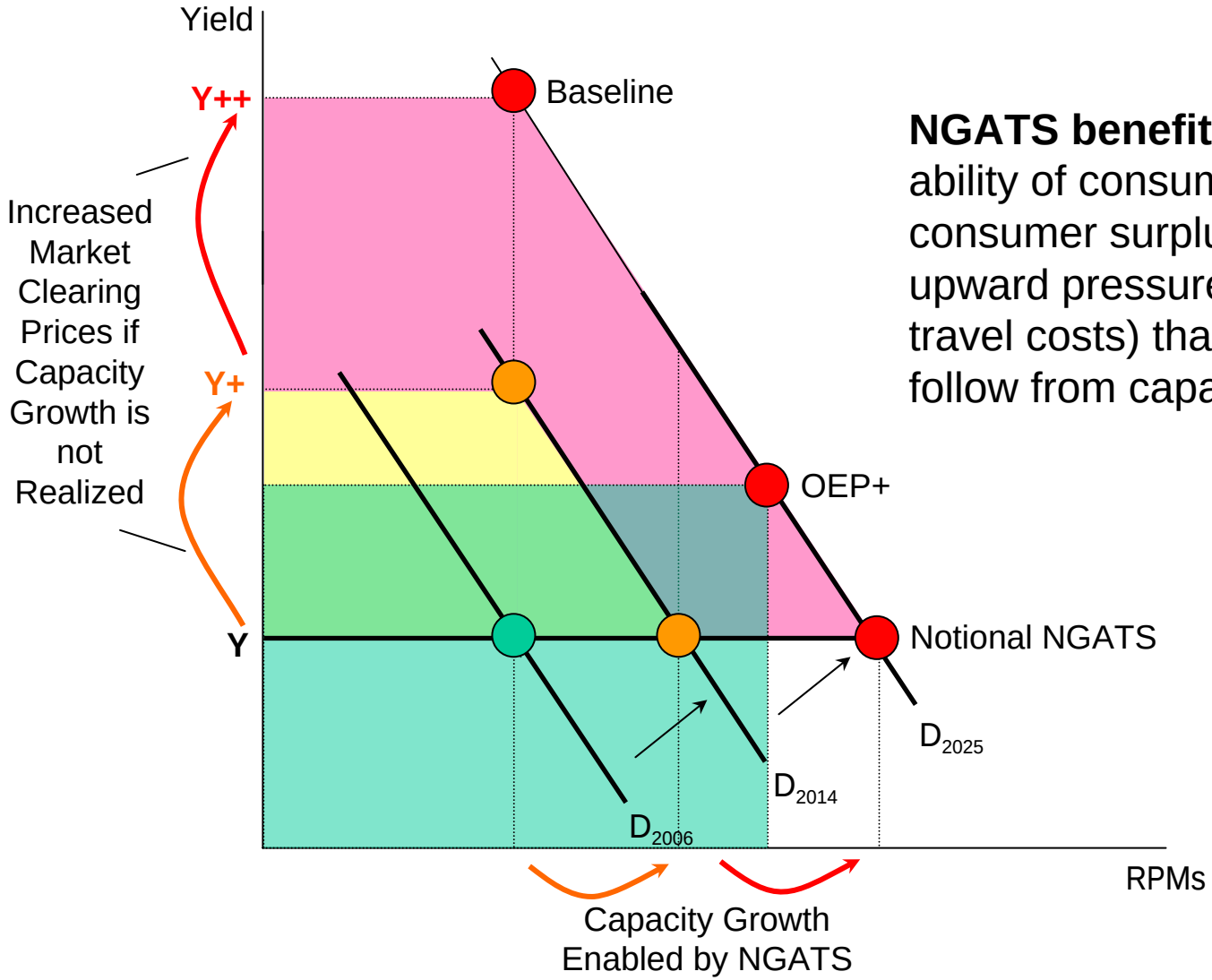
Quality Factors Affect Aviation Demand

- Perceived safety/security
- Schedule frequency / schedule delay (when can I travel, relative to when I actually want to go)*
- Delays/schedule reliability*
- Back up choices (what happens if I miss flight)
- Frequent flyer and other amenities

Demand Capacity Analysis Metrics

- Our composite capacity metric is ***"feasible throughput"*** which is measured in terms of number of flights
  - Flights eliminated based on delay tolerance
- "Unconstrained demand" represents the public's desire for air transportation
  - The FAA's Terminal Area Forecast does not consider whether future NAS capacity will be sufficient to accommodate all the demand
  - Capacity constraints will force some of the demand to be left unsatisfied
  - Confounded by lack of prices for infrastructure
- Capacity is location specific as far as terminals/portals are located (door-to-door)—different terminals have different levels of service and are more or less appealing in meeting demand—there is a lot of excess capacity at airports in terms of both locational and time-of-day demand

NGATS Benefit as Consumer Surplus



NGATS benefit is the continuing ability of consumers to derive consumer surplus* by circumventing upward pressure on yields (and other travel costs) that would otherwise follow from capacity shortfalls

*Consumer surplus is the difference between consumer willingness to pay for a good or a service and the market price they must pay. It is the measure of benefits preferred by OMB and other federal agencies.

Overall Benefit-Cost Framework