



CNS/ATM

Cost Efficient Implementation

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Outline

- Macroeconomic considerations
- Specific considerations for Project Analysis & Evaluation
- Cost benefit methodologies
- Costs & Benefits for CNS/ATM
- Implementation options
- Applications

Macroeconomic considerations

Macroeconomic Issues

- Insatiable demand
- Scarcity
- Choice
- Resource allocation
- Social welfare

Trends in macroeconomic policy

- The objective is to improve social welfare
- Through sustained economic growth
- Avoidance of recessions & downturns
- Fighting high taxes and inflation
- Eliminate or reduce budget deficit
- Small government

Concept of a Public Service

→ Definition varies:

→ Geographically

→ Over time

→ A service that is considered vital to the public

→ Continuous

→ Accessible

→ Affordable

Economic considerations for Project Analysis & Evaluation

Project Type

→ Public

✓ Objective: To maximize social welfare

→ Private

✓ Objective: To maximize the firm's profits

Public Project

- Does the project increase social welfare
- Cost Benefit Analysis
 - ✓ Social costs
 - ✓ Social benefits

Costs & Benefits

- Direct & Indirect
- Tangible & Intangible
- Quantitative & Qualitative
- Fixed & Variable

Partners

- Need to identify all partners/stakeholders
- Costs and benefits identified and evaluated for each partner/stakeholder

Discounting Concept

- ▶ A project lifetime spans over a long period
- ▶ Money is worth more today than tomorrow
- ▶ Costs & benefits are estimated in present value terms
- ▶ The discounting concept

Discounting Concept

Example:

Suppose that for you, one dollar today is worth 1.1 dollar next year.

The discount rate to be used is 10 per cent

Suppose you get a loan of 2000 dollars today and you reimburse it in 3 yearly payments of 800 dollars

For you the present value of the first 800 is $800 / 1.1 = 727.27$

Whereas the present of the second 800 is $800 / (1.1)^2 = 661.16$

and the present value of the third 800 is $800 / (1.1)^3 = 601.05$

Therefore the present value of the money you will repay is

$$727.27 + 661.16 + 601.05 = 1989.48$$

If you accept the loan, you will gain 10.52 of today's dollars

Discounting Concept

General:

✓ The present value of an amount A regularly paid during N periods is given by the formula below:

$$✓ PV = A/(1+r) + A/(1+r)^2 + A/(1+r)^3 + \dots + A/(1+r)^N$$

✓ Where r is the discount rate

Discount Rates

- Social discount rate
- Private discount rate

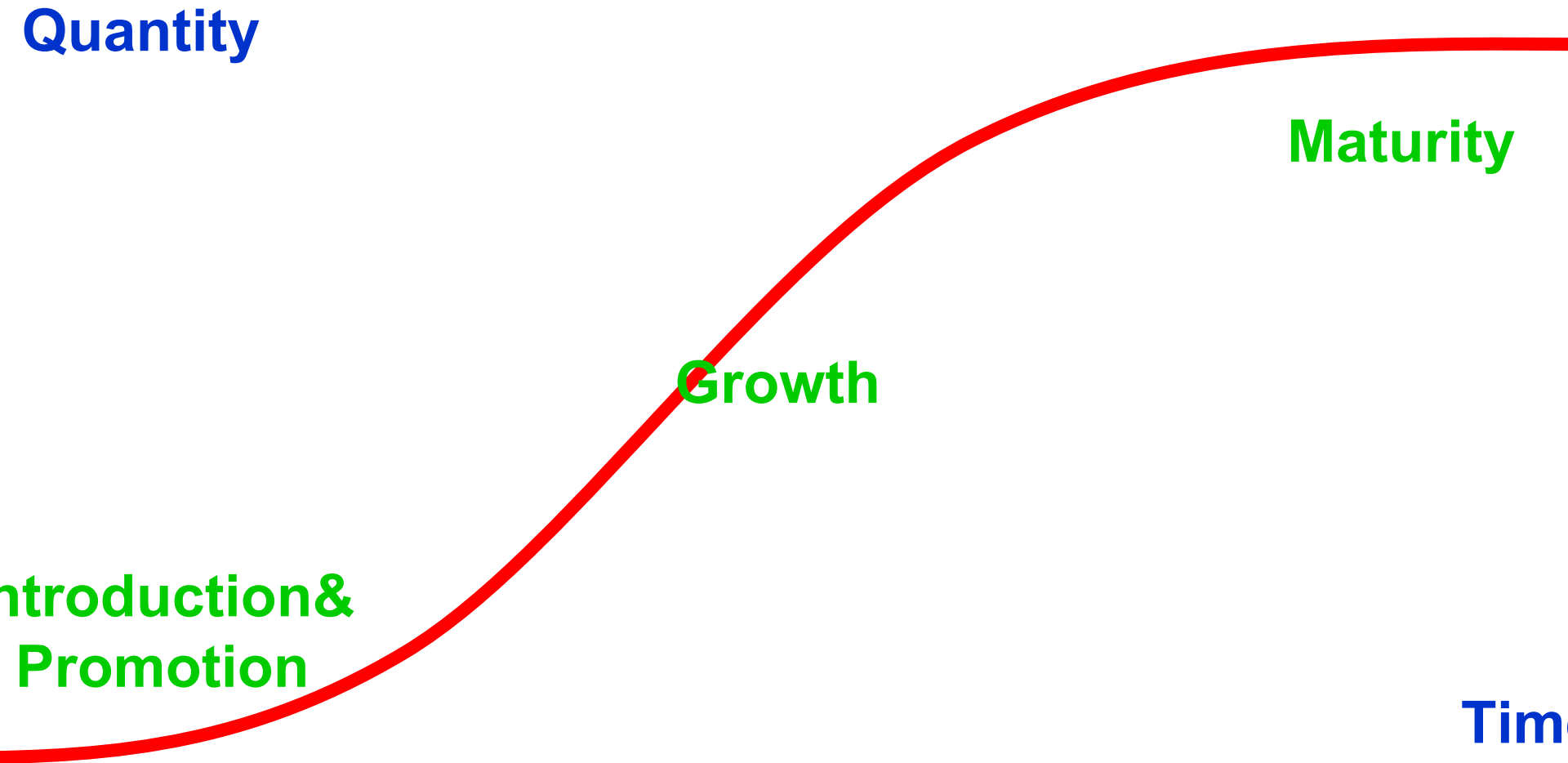
Discount/interest rate

- ▶ Interest rate is related to the marginal productivity of capital in the country
- ▶ Interest rate might be related to the real long term government bond rate plus a risk premium
- ▶ Interest rate is determined by the equilibrium between demand for and supply of money
- ▶ Governments might have an agreed discount rate to apply to public projects

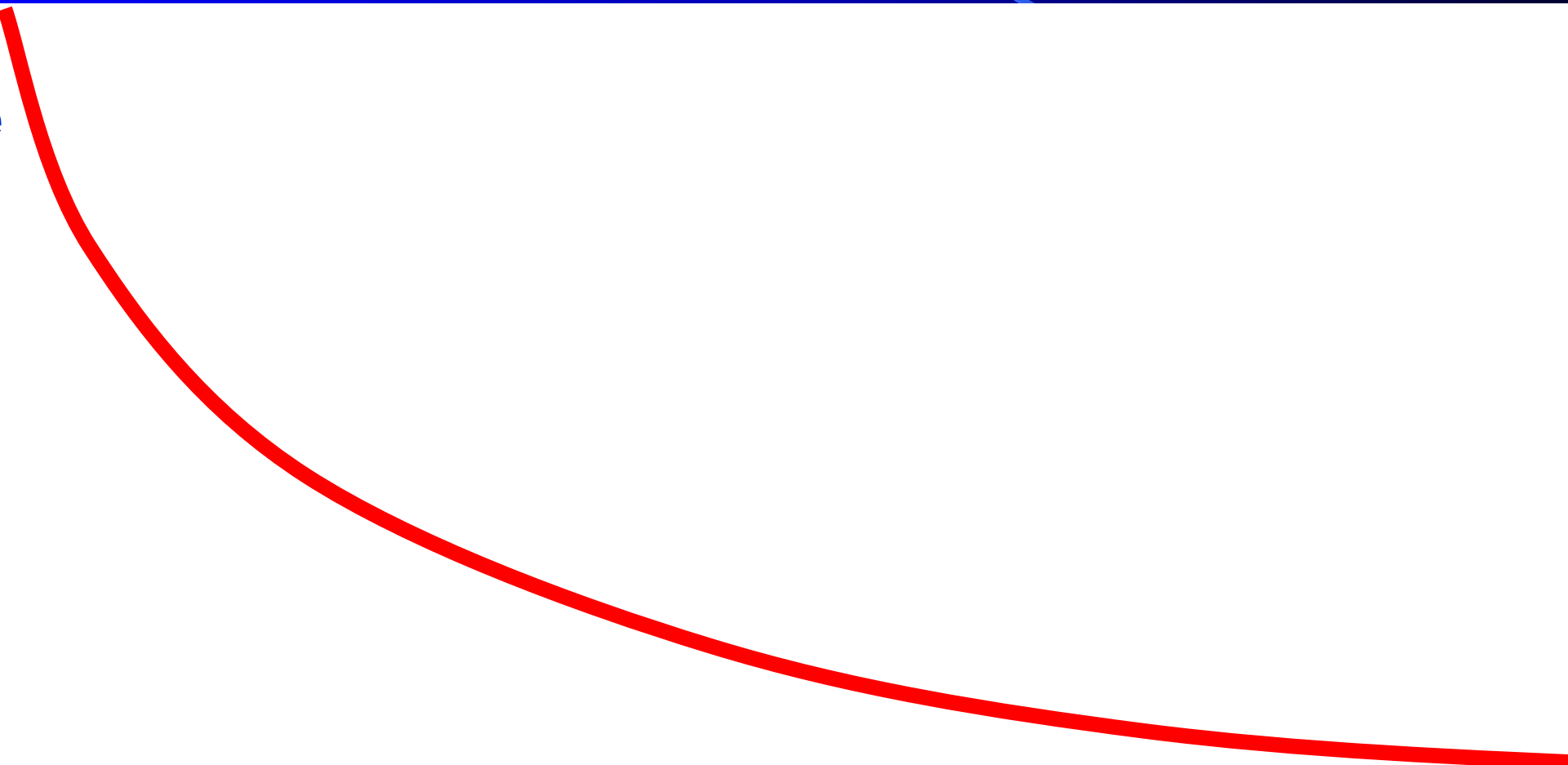
Price changes

- How are price changes treated in a CBA?
- Cost & benefits are most of the time used in constant terms (excluding the effect of price changes)
- The interest rate used for the analysis has also to exclude the effect of price changes
- Real interest rate = Nominal interest rate - Rate of inflation

Product Life Cycle



Supply Curve



Quantit

Cost/Benefit Methodologies

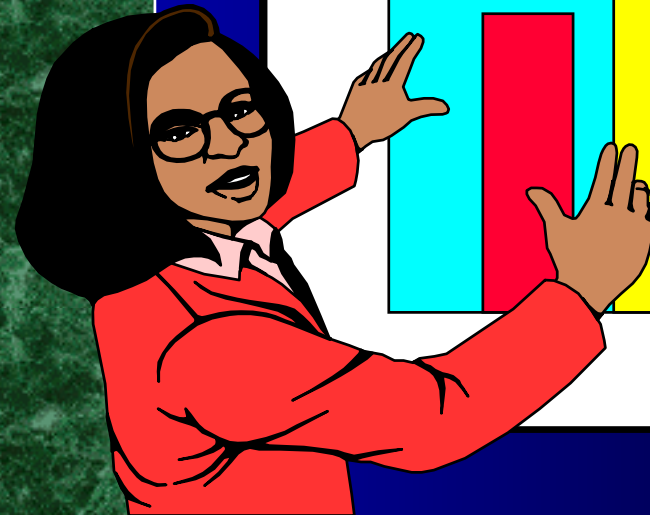
Objectives of Cost/Benefit Analysis

- ➔ Forecast Economic Performance
- ➔ Assess Financial Risks
- ➔ Select Implementation Option
- ➔ Guidance on Timing
- ➔ Assist in Cost Recovery



Dimensions of System Performance

- Cost
- Capacity
- Safety
- Reliability
- Environmental



Project Case

New Investment
CNS/ATM system

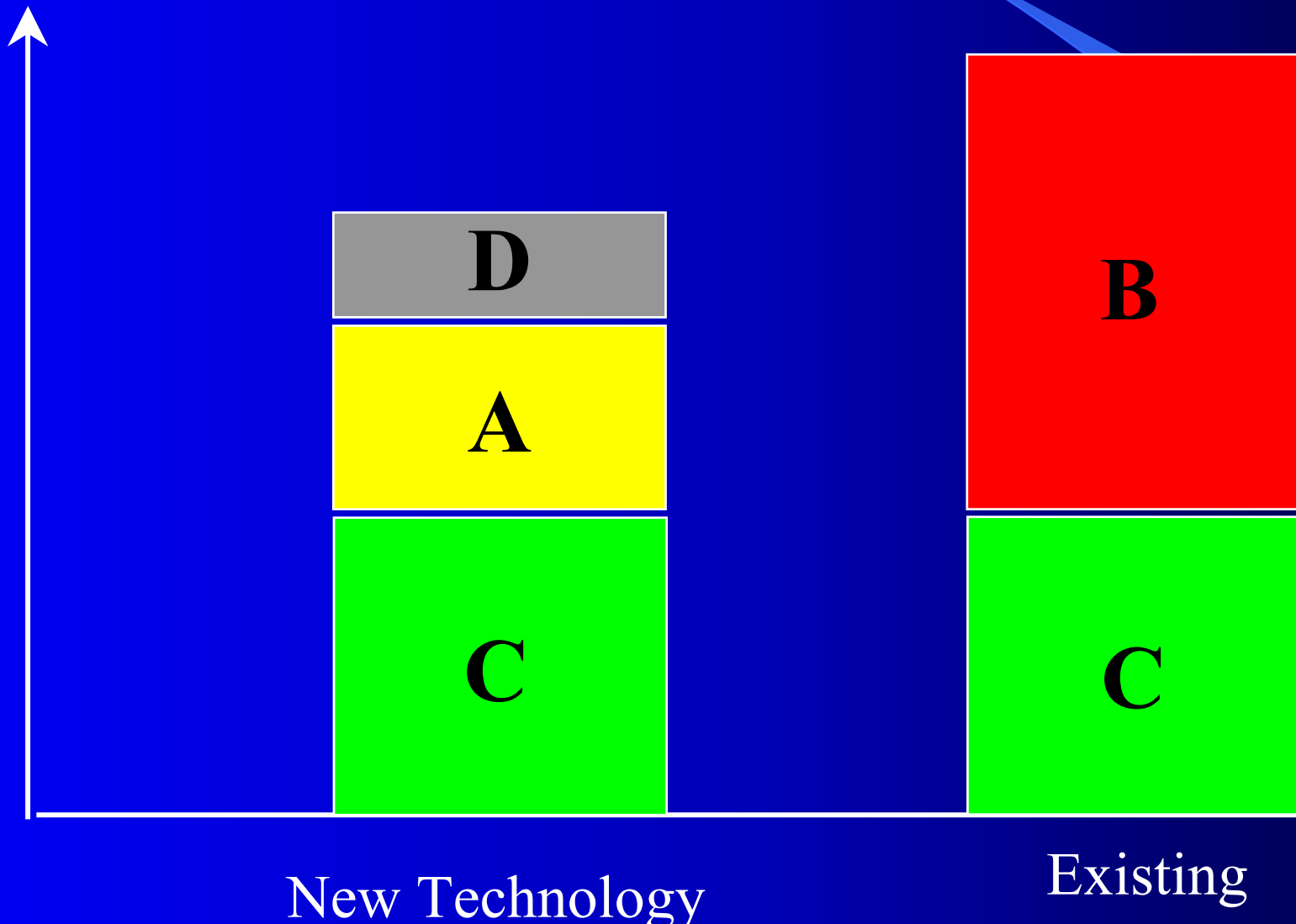
Base Case

Replacement Investment
Existing System

Incremental costs & benefits

- Costs & benefits incurred only in the project case scenario or the base case scenario
- Alternative: Total Cost analysis
- To avoid redundancy
- To simplify the analysis

Incremental costs



Overview of Net Present Value Approach

Traffic Demand (by year)

CNS/ATM Costs (by year)

- equipment
- purchase of services
- training

CNS/ATM Benefits (by year)

- avoided costs of present technology
- savings to aircraft operators
- passenger time savings

Net Benefits (by year)

Net Present Value

- ▶ Forecasts of total flight-hours
- ▶ Capital costs of ground equipment
- ▶ Avionics prices
- ▶ Proportion of fleet equipped with CNS/ATM
- ▶ Quantity of AMSS messages per hour
- ▶ Price of AMSS satellite usage
- ▶ Price for access to GNSS signals
- ▶ Efficiency improvements for aircraft flights
- ▶ Value per hour of passenger time saved

Costs & Benefits of CNS/ATM Implementation

Identify Key partners

→ Customers:

→ Aircraft Operators

- Domestic & International Airlines

- General aviation

→ Passengers & Freight Shippers

→ Service Providers

- Air Navigation service providers

- Third Party Service Providers

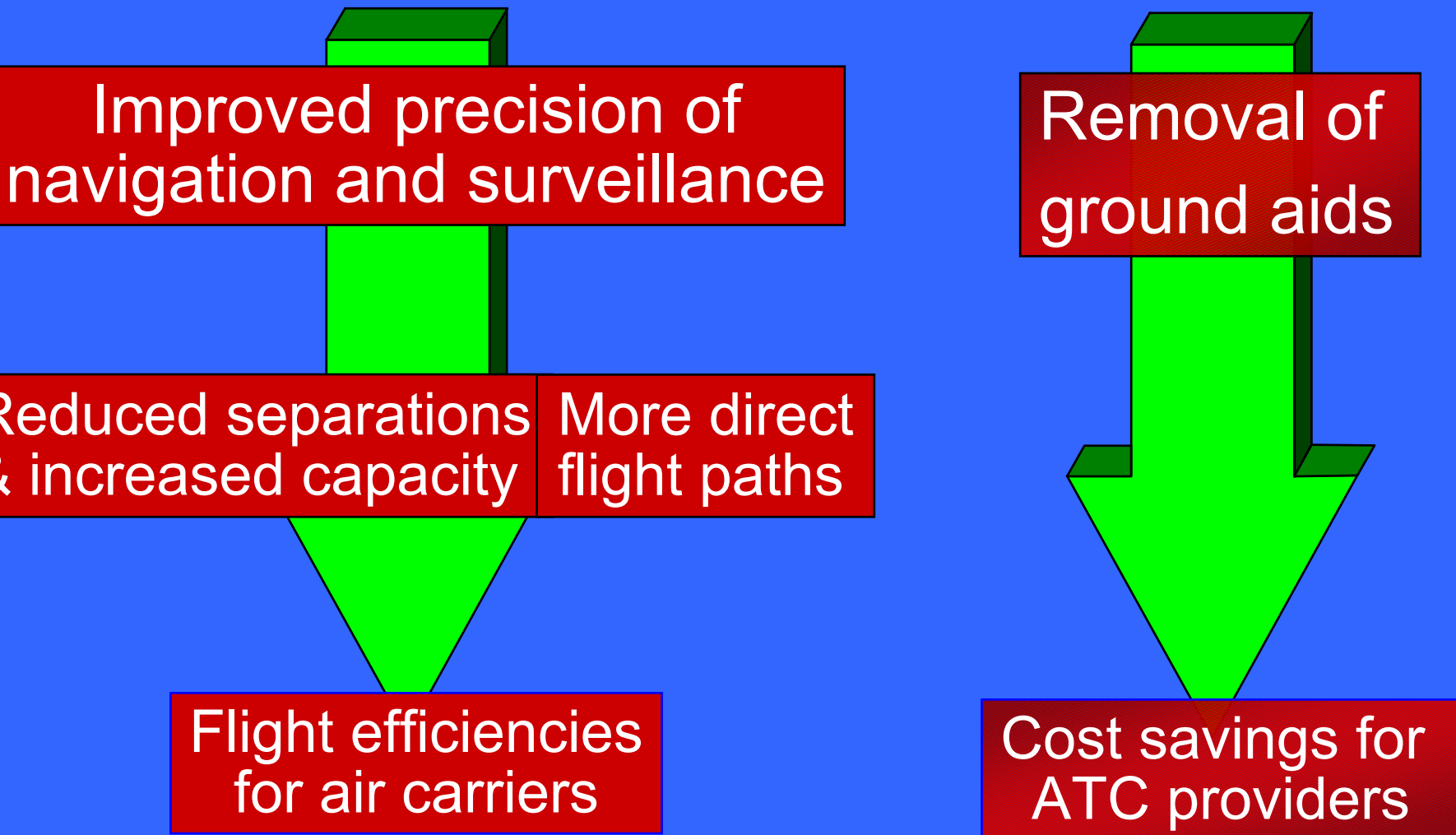
→ Others (eg. Airports)

Customers & Service Providers Analysis

- ✓ Costs to Customers
- ✓ Benefits to Customers
- ✓ Costs to Service Providers
- ✓ Benefits to Service Providers

Simplified View of the Impact of CNS/ATM

CNS/ATM Implementation



Costs to Customers

- Aircraft CNS Equipment (Capital Costs)
- Aircraft CNS Equipment (Operations & Maintenance)
- Purchase of Intermediate Services
- Transition Costs (incl. aircraft downtime)

Costs to Customers

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Benefits to Customers

- ➔ More Direct Flight Paths, Leads to:
 - ✓ Short Journey Time (Pax time)
 - ✓ Reduced Fuel Burn
 - ✓ Better Aircraft Utilization
- ➔ Reduced Separation, Leads to:
 - ✓ Increased Airspace Capacity

Costs to Service Providers

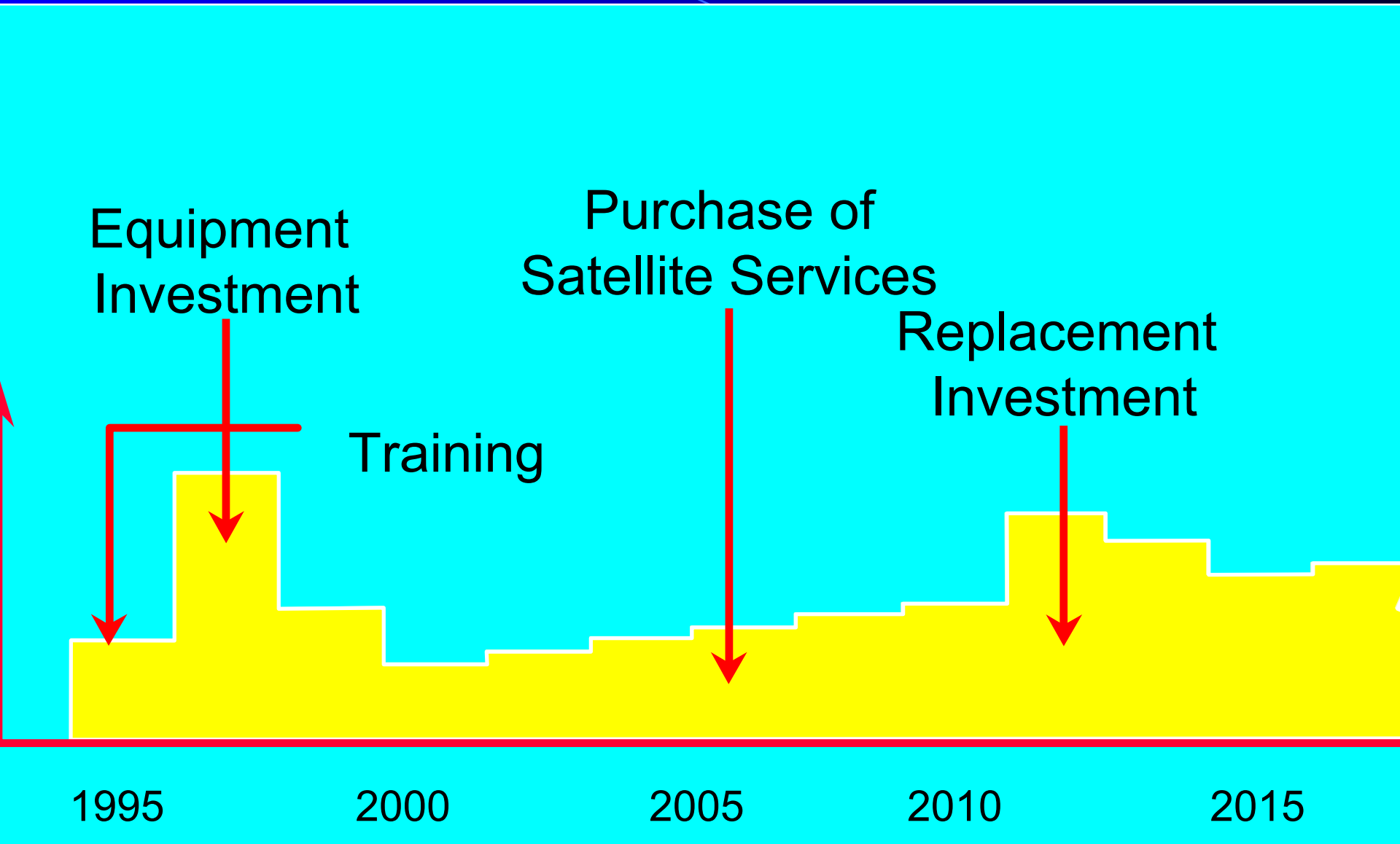
- CNS Equipment (Capital Costs)
- CNS Equipment (Operations & Maintenance)
- Transition Costs
(incl. decommissioning, training and staff redeployment)

Benefits to Service Providers

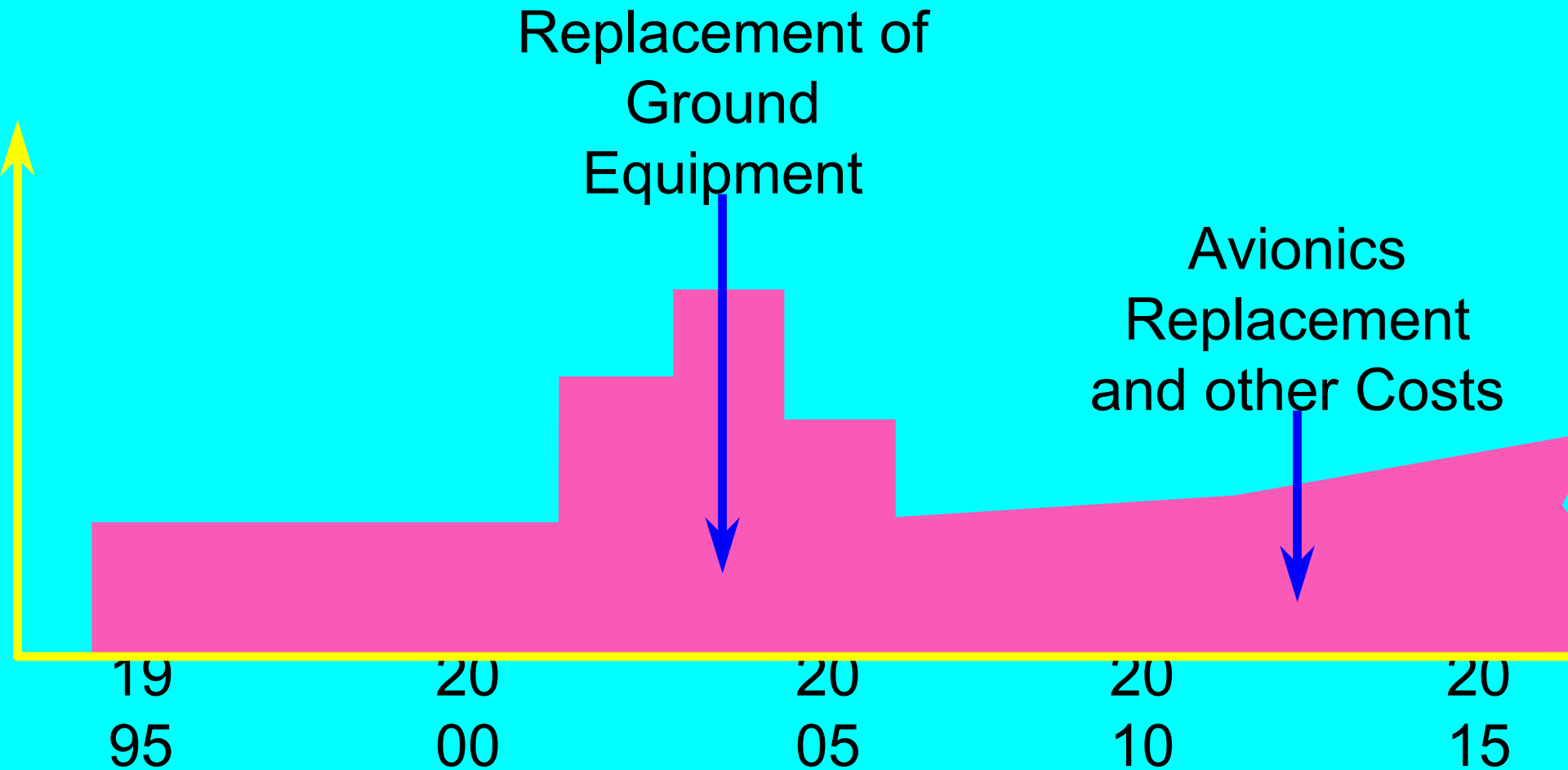
- ▶ Non replacement of Ground Aids
- ▶ Enhanced Efficiency/Productivity
- ▶ Increased Airspace Capacity

	Base year 2001	2002	2003	2004	2005
CNS Provider					
Costs					
Equipment investment					
- CNS/ATM					
- Present technology (Project case)					
Maintenance and operational					
Purchases of intermediate services					
Retraining					
Decommissioning of existing system					
Staff redeployment					
Benefits					
Equipment investment					
- Present technology (base case)					
Maintenance and operational					
Other					
Net Benefits (W)					
Aircraft operators					
Costs					
Equipment investment					
- CNS/ATM					
- Present technology (Project case)					
Maintenance					
Purchases of intermediate services					
Retraining					
Benefits					
Equipment investment					
- Present technology (base case)					
Maintenance					
Aircraft operator efficiency improvements					
Other					
Net Benefits (X)					
Passengers					
Benefits					
Travel time savings (Y)					

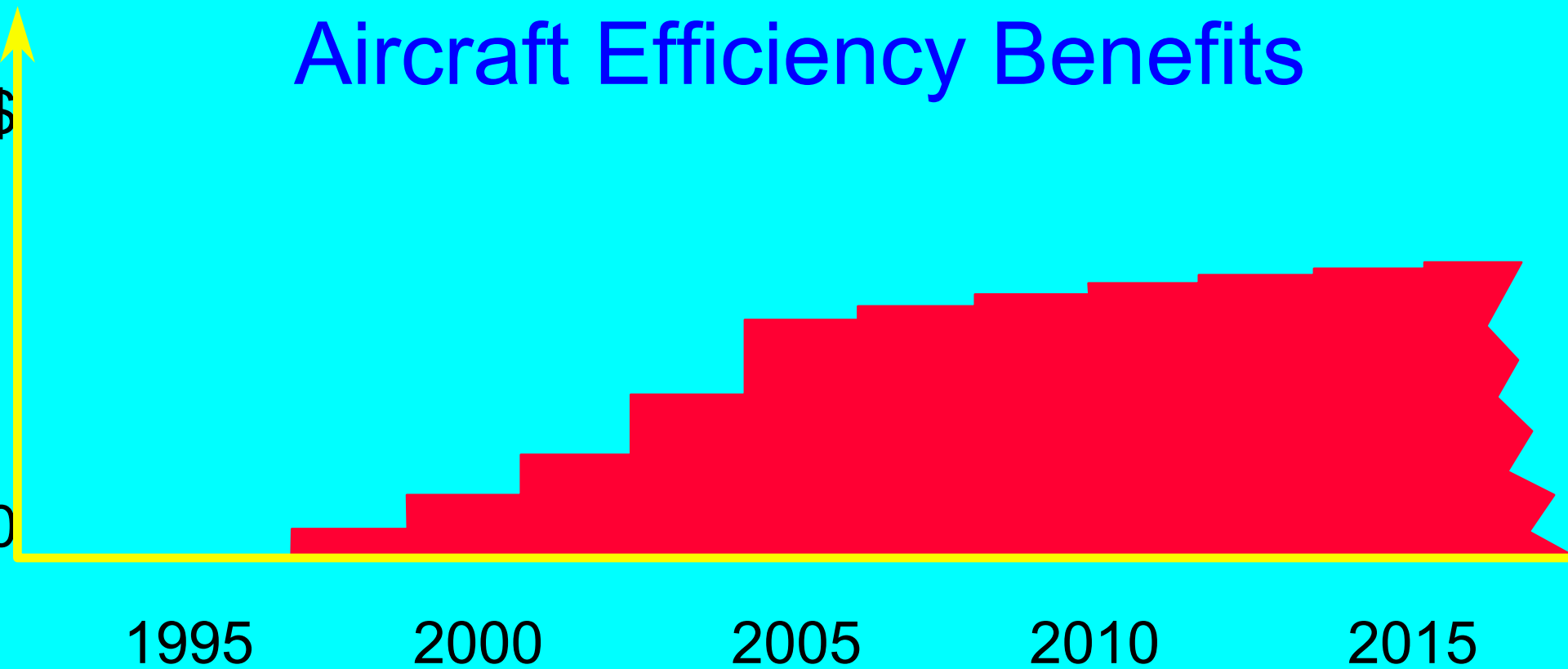
CNS/ATM Costs



Simplified Profile of Present-Technology Costs



Aircraft Efficiency Benefits



Purchase of
Equipment Satellite Services

Simplified Profile of Present-
Technology Costs

Replacement
of
Ground
Equipment Avionics

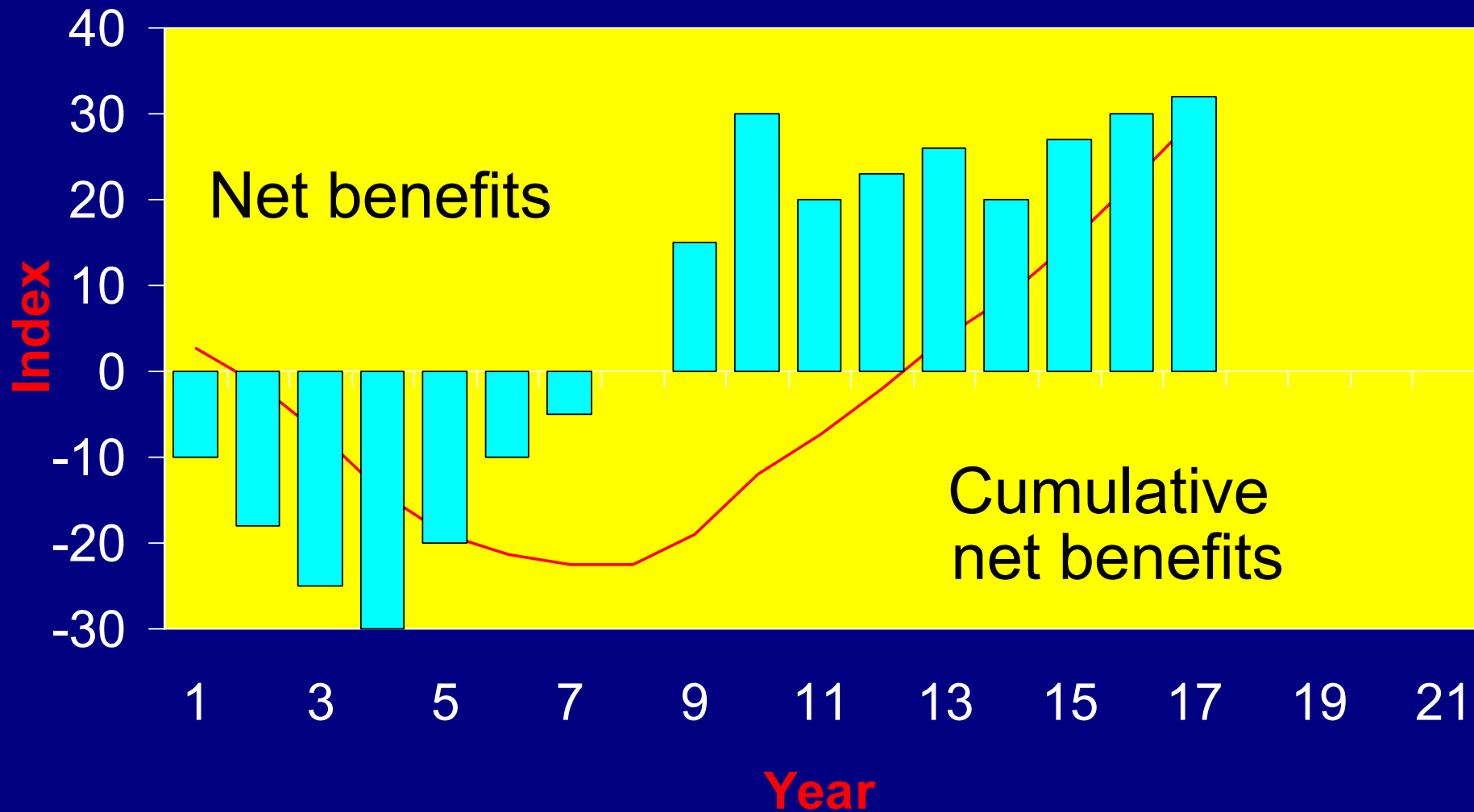


Aircraft Efficiency Benefits

Net Benefits of CNS/ATM



Net Benefits and Cumulative Net Benefits of CNS/ATM



Measures of Economic Viability

- Benefit/Cost Ratio
- Net Present Value
- Rate of Return

Other Methods of Economic Evaluation

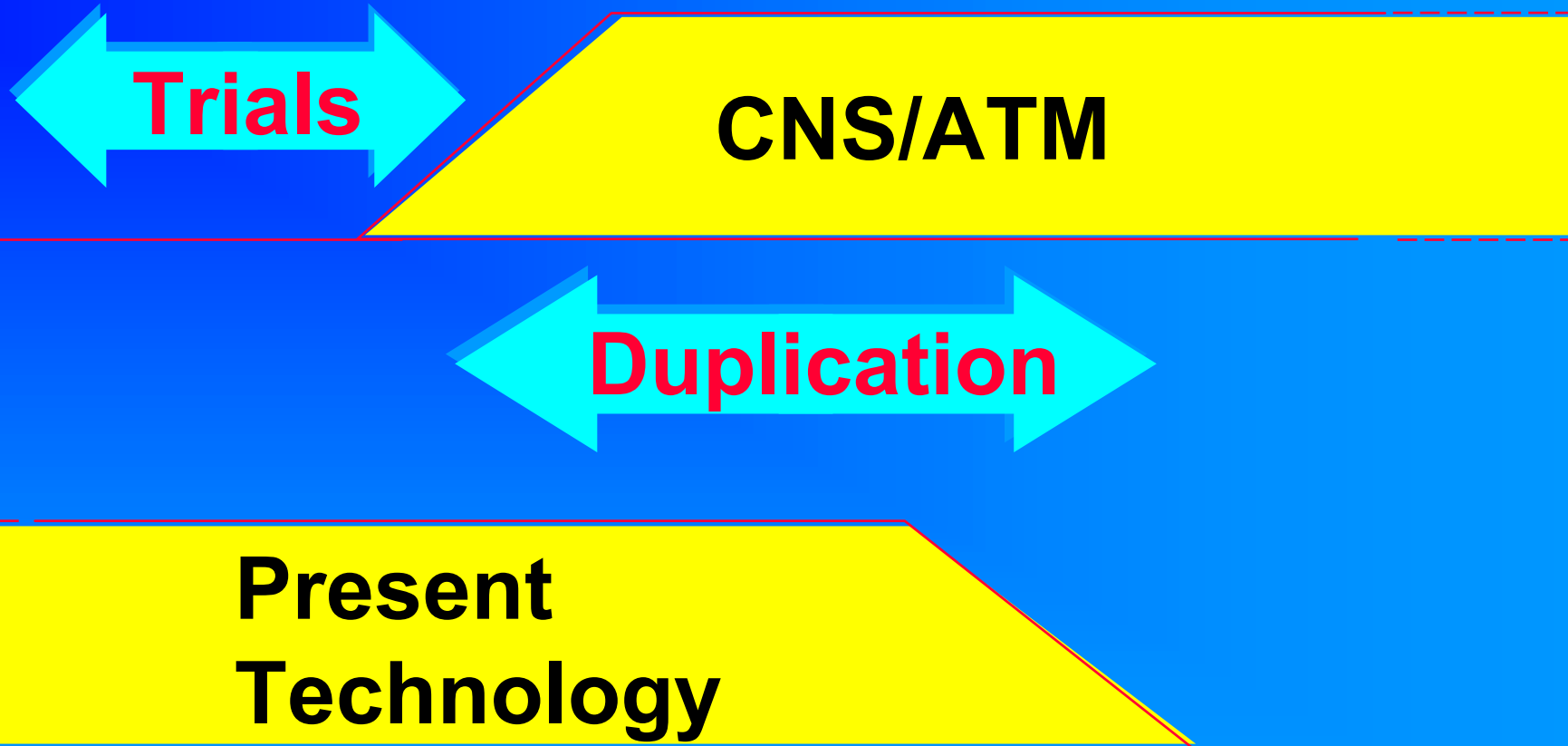
- ➡ Cost-effectiveness Analysis
- ➡ Least-cost Analysis
- ➡ Snapshot Approach
- ➡ Pay-off Period

Financial Comparisons of Implementation Options

Implementation Options

- Institutional arrangements
- Existing equipment
- Traffic density & growth
- Equipment cost
- Pricing policies
- Timing of the transition process

Possible Transition Scenario



Applications
of the
Cost/Benefit Methodology

Location of Costs and Benefits of CNS/ATM

Cost or Benefit Item	CAA	Aircraft operators	Passengers	Totals
Costs of CNS/ATM				
CNS/ATM Equipment Costs				
Ground	X	-	-	
Aircraft	-	X	-	
Training	X	X	-	
Purchases from Intermediate Service Providers	X	X	-	
TOTAL	C_1	C_2		C
Benefits of CNS/ATM				
Avoided Equipment Costs (present Technology)				
Ground	X	-	-	
Aircraft	-	X	-	
Efficiency Improvements	X	X	-	
Passenger Time Savings	-	-	X	
TOTAL	B_1	B_2	B_3	B

Project Case (Example)

→ Assumptions

→ 7% interest rate

→ Traffic Growth: 5% p.a.

→ 3% savings in flight times

→ Avionics cost per aircraft: \$600,000

→ 20 year planning horizon

→ Total NPV (excl. pax travel time savings) = \$263m

→ NPV for Aircraft operators = \$297m

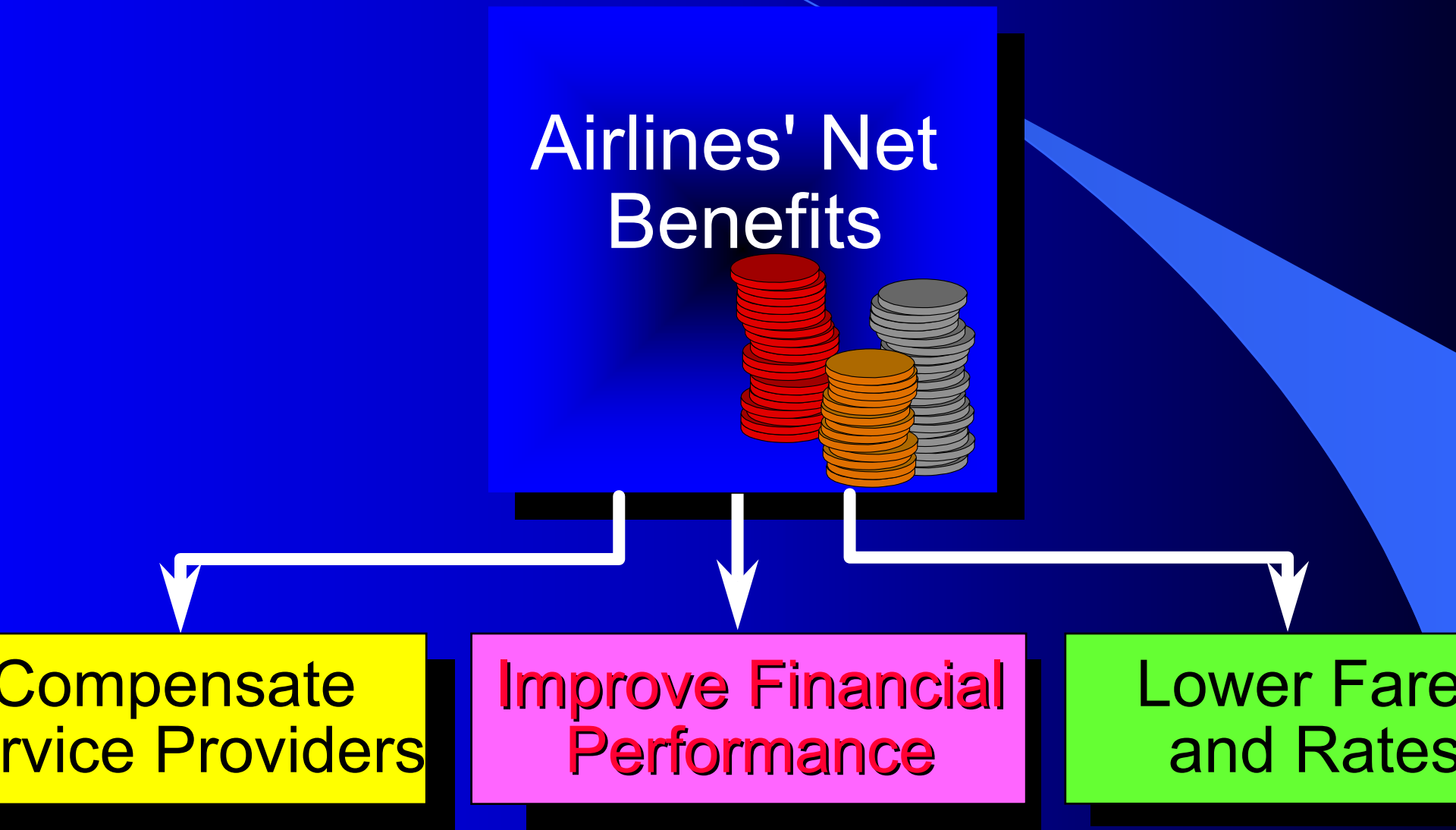
→ NPV for ATC service providers = -\$34m

Project Case (Example)

Sensitivity Analysis

Traffic Growth	Flight Time Savings	Avionics Cost (per aircraft)	NPV (\$M)
5%	2%	\$600,000	147
5%	4%	\$600,000	350
3%	3%	\$600,000	190
7%	3%	\$600,000	325
5%	3%	\$1,200,000	192
5%	3%	\$300,000	278
5%	3%	\$600,000	263

Distribution of Benefits



ICAO。OACI。ИКАО



国际民航组织

المنظمة
الدولية
لحماية
السلامة
والتعاون
في الطيران
المدني