What is Fuel Conservation?

Fuel conservation means managing the operation and condition of an airplane to minimize the fuel used on every flight

How Much Is A 1% Reduction In Fuel Worth?

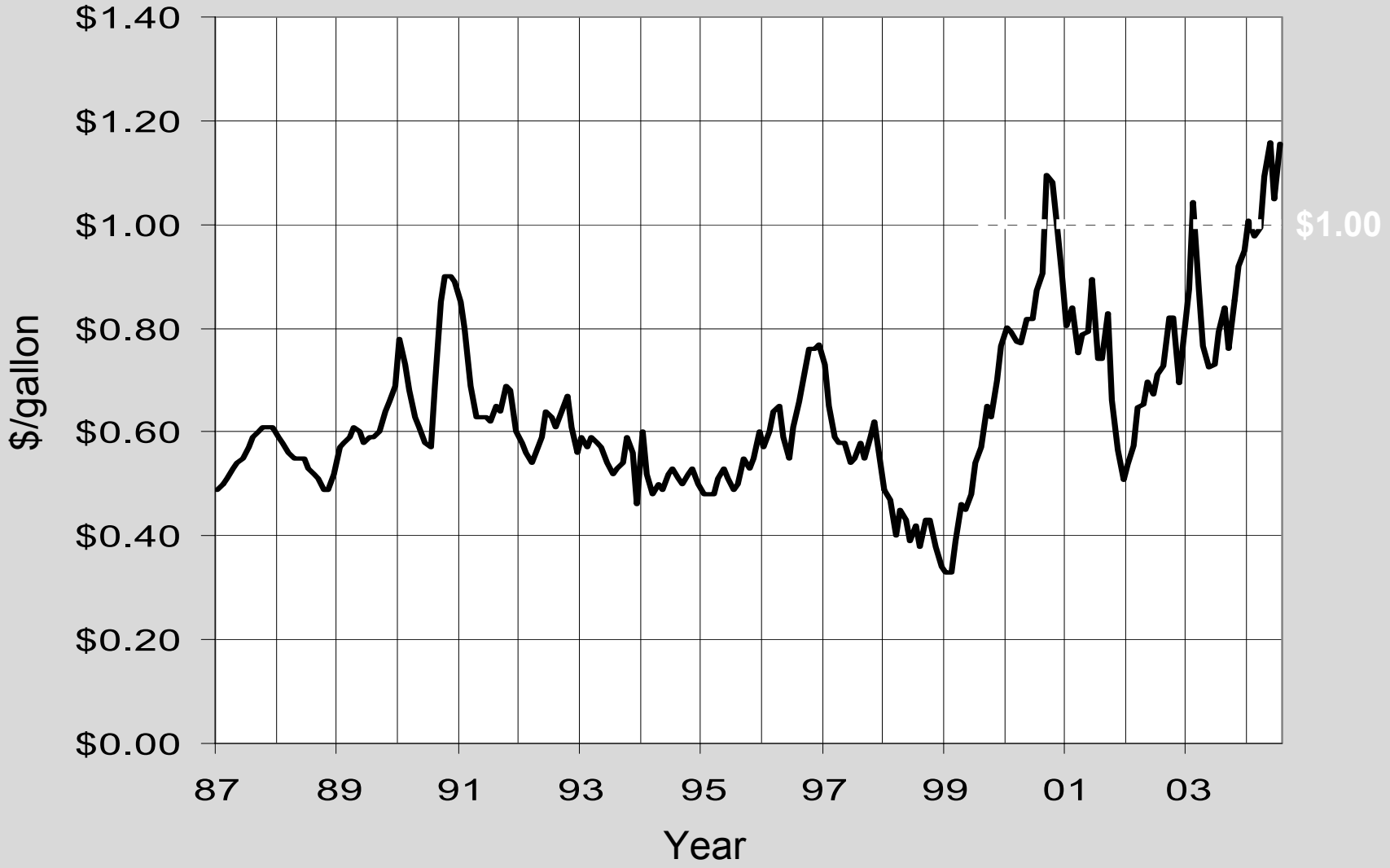
Airplane type	Fuel savings* gal/year/airplane
777	70,000 → 90,000
767	30,000 → 40,000
757	25,000 → 35,000
747	100,000 → 135,000
737	15,000 → 25,000
727	30,000 → 40,000

*Assumes **typical** airplane utilization rates. Actual utilization rates may differ.

How Much Is This Worth In $$?

Depends on Current Fuel Prices!

Jet Fuel Prices



Source: *Air Transport World*

How Much Is A 1% Reduction In Fuel Worth?

Airplane type	Fuel savings* gal/year/airplane	Fuel savings* $/year/airplane
777	70,000 → 90,000	$70,000 → 90,000
767	30,000 → 40,000	$30,000 → 40,000
757	25,000 → 35,000	$25,000 → 35,000
747	100,000 → 135,000	$100,000 → 135,000
737	15,000 → 25,000	$15,000 → 25,000
727	30,000 → 40,000	$30,000 → 40,000

*Assumes $1.00/gallon

*Assumes **typical** airplane utilization rates. Actual utilization rates may differ.

What Is Fuel Conservation From An Airline Business Viewpoint ?

Fuel conservation means managing the operation and condition of an airplane to minimize the ~~fuel used on~~ every flight total cost of

How Much Is A 1% Reduction In Fuel Worth?

Airplane type	Fuel savings* gal/year/airplane	Fuel savings* $/year/airplane	Cost to Implement	Total Cost Savings/AP
777	70,000 → 90,000	$70,000 → 90,000	??	??
767	30,000 → 40,000	$30,000 → 40,000		
757	25,000 → 35,000	$25,000 → 35,000		
747	100,000 → 135,000	$100,000 → 135,000		
737	15,000 → 25,000	$15,000 → 25,000		
727	30,000 → 40,000	$30,000 → 40,000		

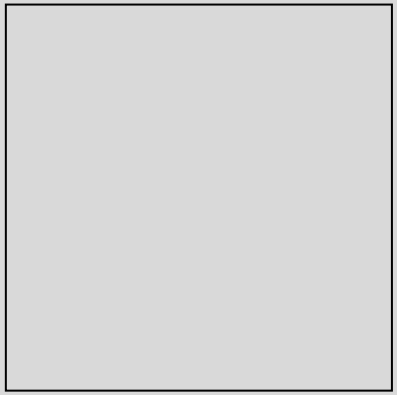
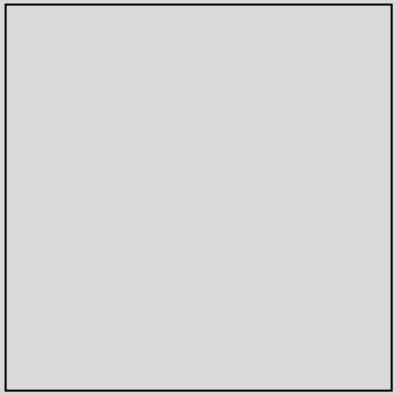
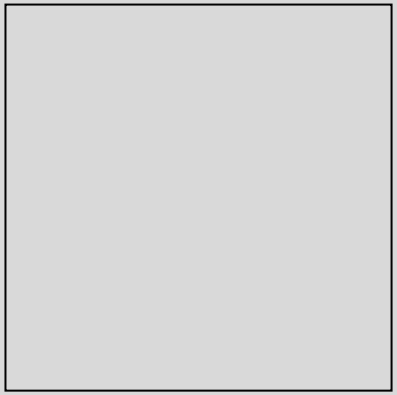
Total savings = fuel savings - cost to implement

*Assumes $1.00/gallon

*Assumes **typical** airplane utilization rates. Actual utilization rates may differ.

Saving Fuel Requires Everyone's Help

- Flight Operations
- Dispatchers
- Flight Crews
- Maintenance
- Management

Flight Operations / Dispatchers

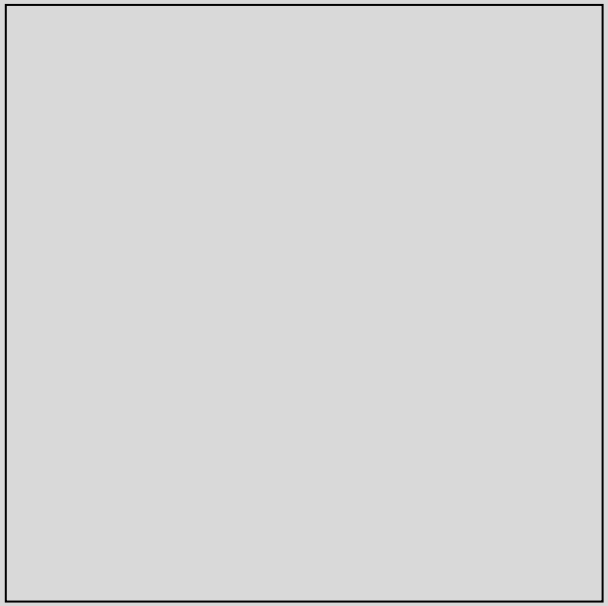
Opportunities For Fuel Conservation

- Landing weight
- Fuel reserves
- Airplane loading
- Flap selection
- Altitude selection
- Speed selection
- Route selection
- Fuel tankering

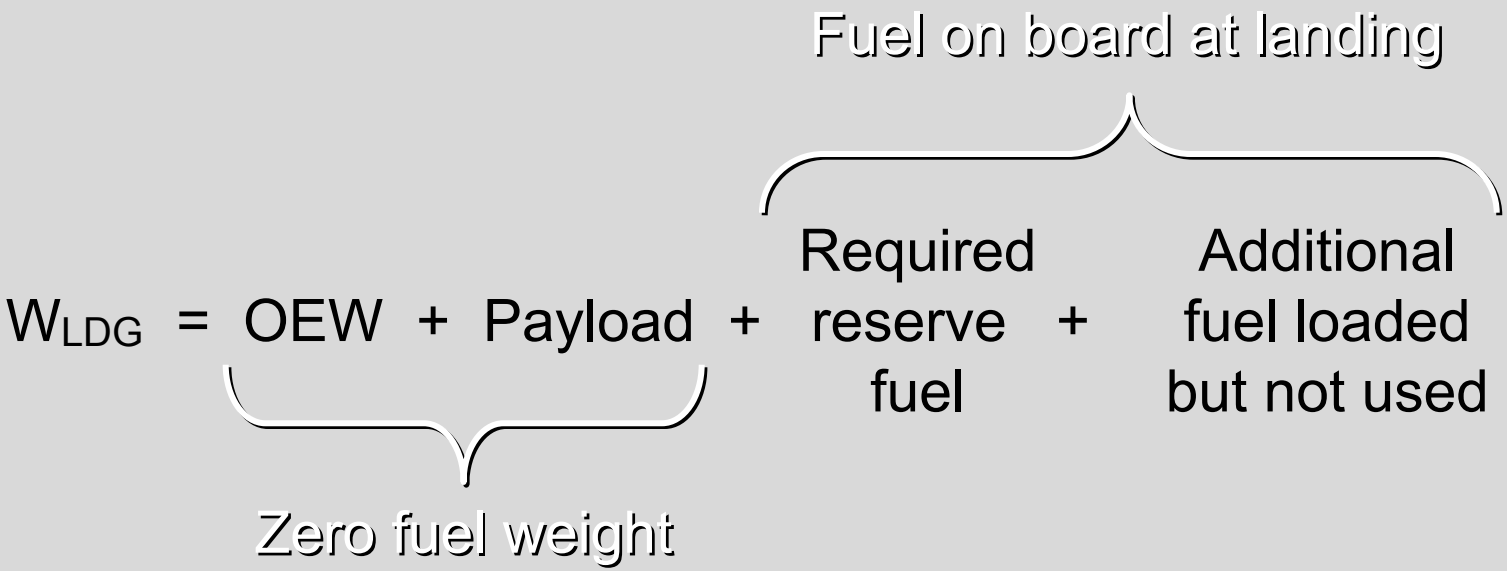
Reduced Landing Weight

1% reduction in landing weight produces:

- ≅ 0.75% reduction in trip fuel (high BPR engines)
- ≅ 1% reduction in trip fuel (low BPR engines)



Components Of Landing Weight



Reducing ZFW Reduces Landing Weight

Approximate % Block Fuel Savings Per 1000 Lb (454 Kg) ZFW Reduction

717-200	737-3/4/500	737-6/7/8/900	757-200/300	767-2/3/400	777-200/300	747-400
.9%	.7%	.6%	.5%	.3%	.2%	.2%

Reducing OEW Reduces Landing Weight

Items To Consider

- Passenger service items
- Passenger entertainment items
- Empty Cargo and baggage containers
- Unneeded Emergency equipment
- Excess Potable water

Reducing Unnecessary Fuel Reduces Landing Weight

- Practice cruise performance monitoring
- Flight plan by tail numbers

Fuel Reserves

- Carry the appropriate amount of reserves to ensure a safe flight and to meet your regulatory requirements
- Extra reserves are extra weight
- Airplane burns extra fuel to carry the extra weight

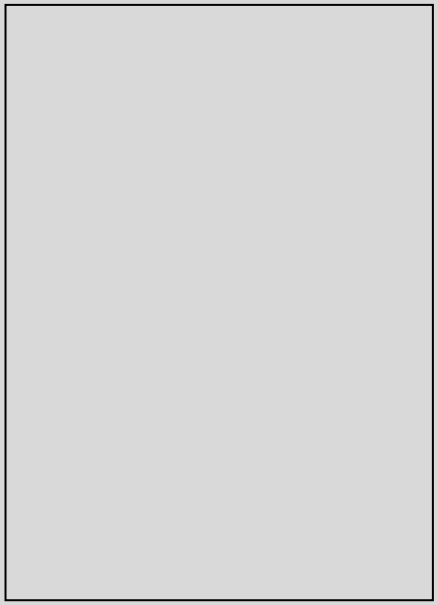
Fuel Reserves

The amount of required fuel reserves depends on:

- Regulatory requirements
- Choice of alternate airport
- Use of re-dispatch
- Company policies on reserves
- Discretionary fuel

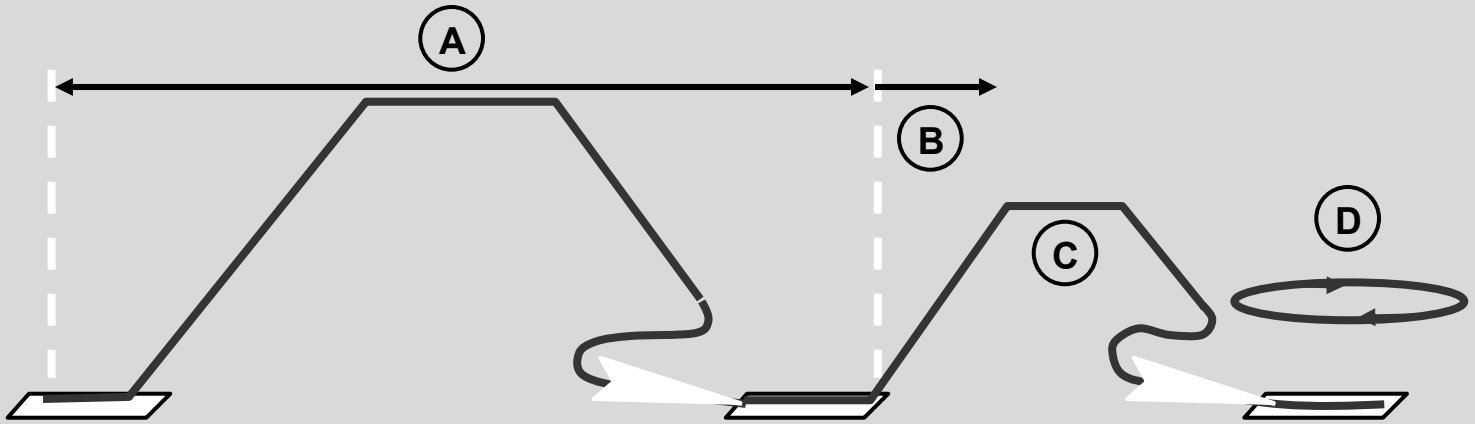
Regulatory Requirements

- Is this an international flight?
- FAA rules?
- ICAO rules?
- Other rules?



FAA “International Reserves”

FAR 121.645(b)



(A) To fly to and land at the airport to which it is released;

Contingency → (B) After that, to fly for a period of **10 percent of the total time** required to fly from the airport of departure to, and land at, the airport to which it was released;

Alternate → (C) After that, to fly to and land at the **most distant alternate airport specified in the flight release**, if an alternate is required; and

Holding → (D) After that, to fly for **30 minutes at holding speed** at 1,500 feet above the alternate airport (or the destination airport if no alternate is required) under standard temperature conditions.

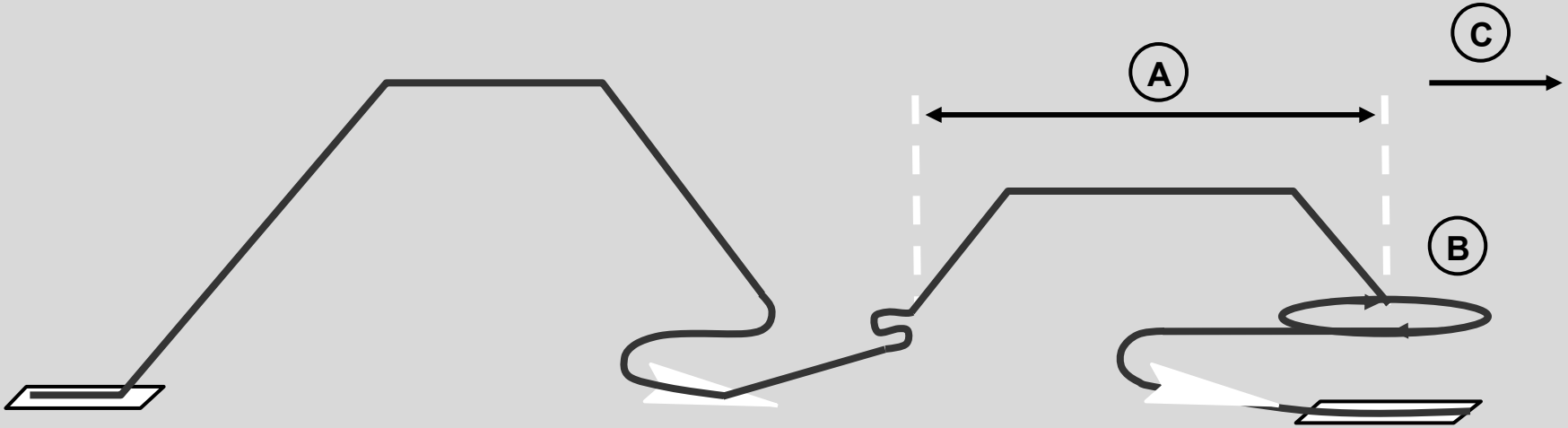
FAA “Island Reserves”

FAR 121.645(c)

- No alternate is specified in release under Section 121.621(a)(2) or Section 121.623(b).
- Must have enough fuel, considering wind and other weather conditions expected, to fly to destination airport and thereafter to fly for 2 hours at normal cruising fuel consumption

ICAO International

ICAO Annex 6 (4.3.6.3)



4.3.6.3.1 When an alternate aerodrome is required;

To fly to and execute an approach, and a missed approach, at the aerodrome to which the flight is planned, and thereafter:

Alternate — A) To fly to the **alternate aerodrome specified in the flight plan**; and then

Holding — B) To fly for **30 minutes at holding speed** at 450 M (1,500 ft) above the alternate aerodrome under standard temperature conditions, and approach and land; and

Contingency — C) To have an additional amount of fuel sufficient to provide for the increased consumption on the occurrence of any of the potential contingencies specified by the operator to the satisfaction of the state of the operator **(typically a percentage of the trip fuel: 3% to 6%)**.

Alternate Airport

What items should you consider when choosing an alternate airport?

- Airline facilities
- Size and surface of runway
- Weather
- Hours of operation, lighting
- Fire fighting, rescue equipment

Alternate Airport

What items should you consider when choosing an alternate airport?

- Airline facilities
- Size and surface of runway
- Weather
- Hours of operation, lighting
- Fire fighting, rescue equipment

DISTANCE

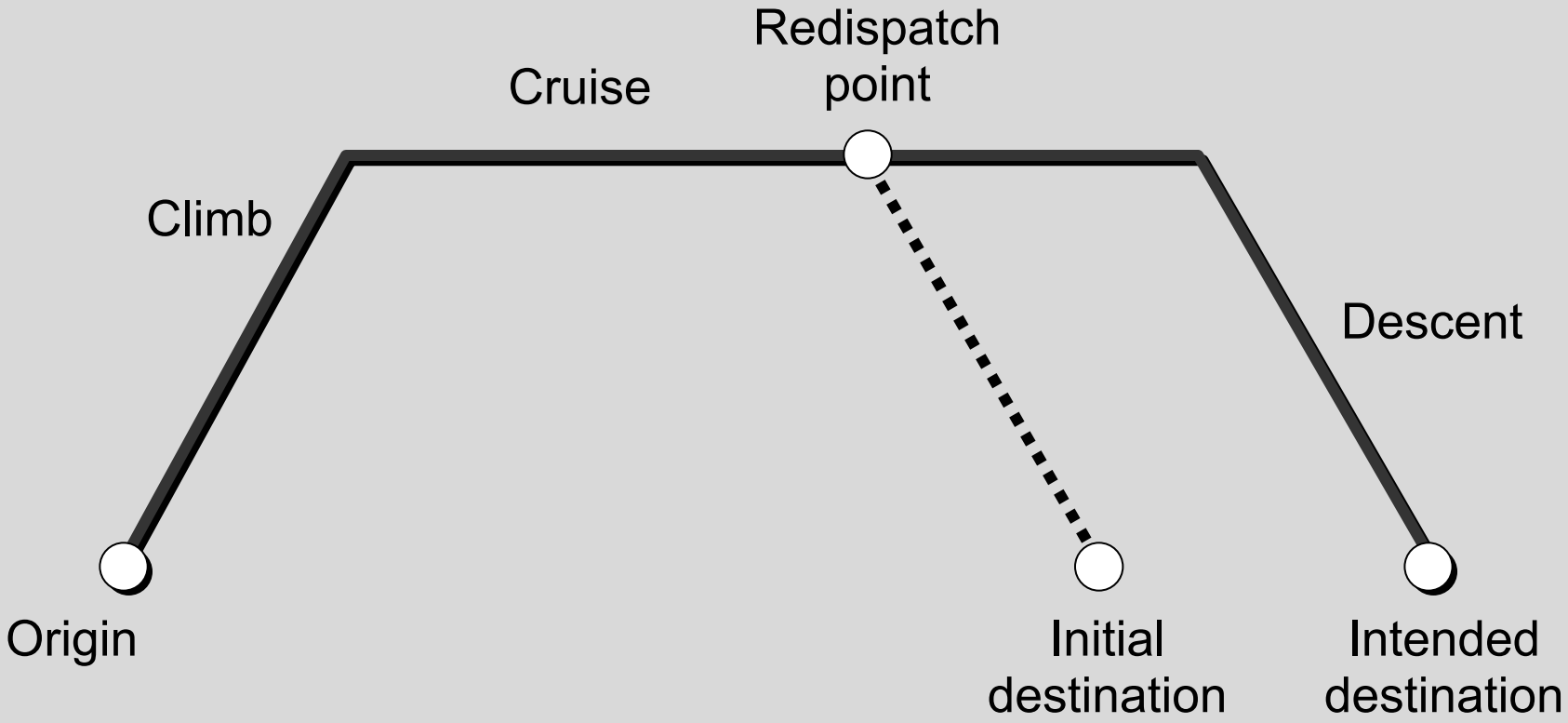
Speed Selection for Holding

- Want to maximize time per kilogram of fuel
- Use published/FMC recommended holding speeds

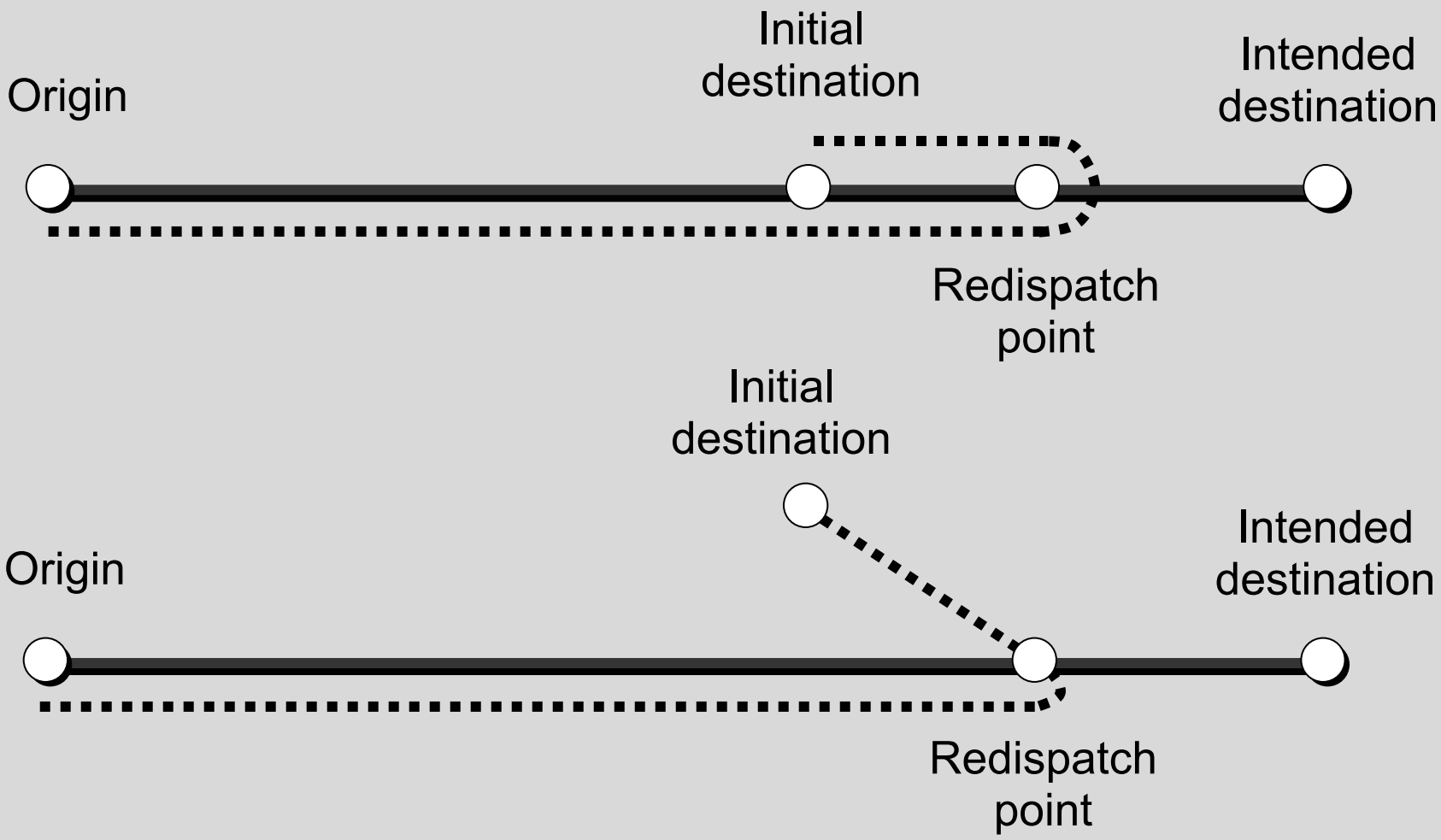
Use Redispatch to Lower Contingency Fuel

- Reserve/contingency fuel is a function of trip length or trip fuel burn
- Originally implemented to cover errors in navigation, weather prediction, etc...
- Navigation and weather forecasting techniques have improved, decreasing the chance that contingency fuel will actually be used

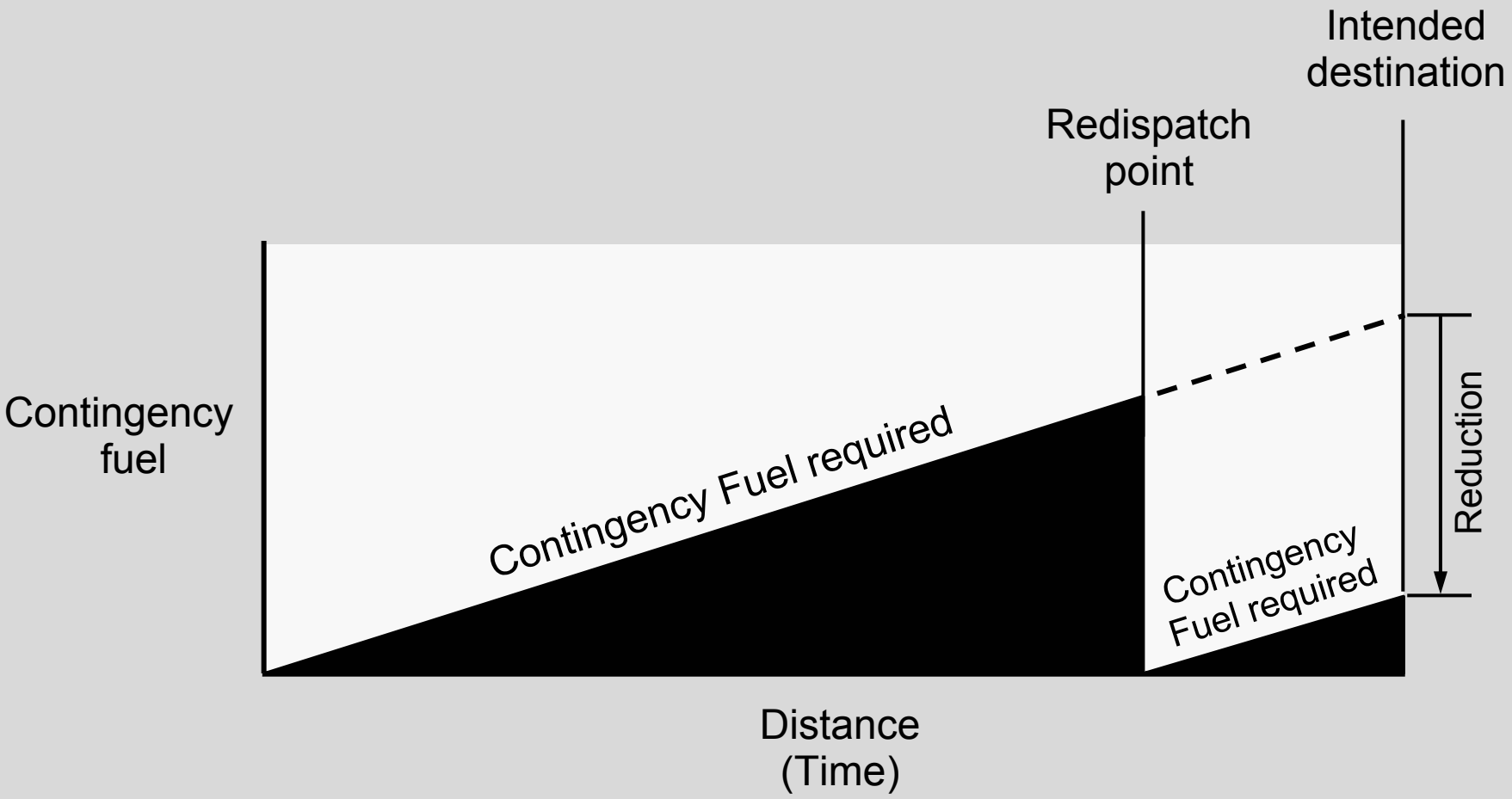
How Redispatch Works



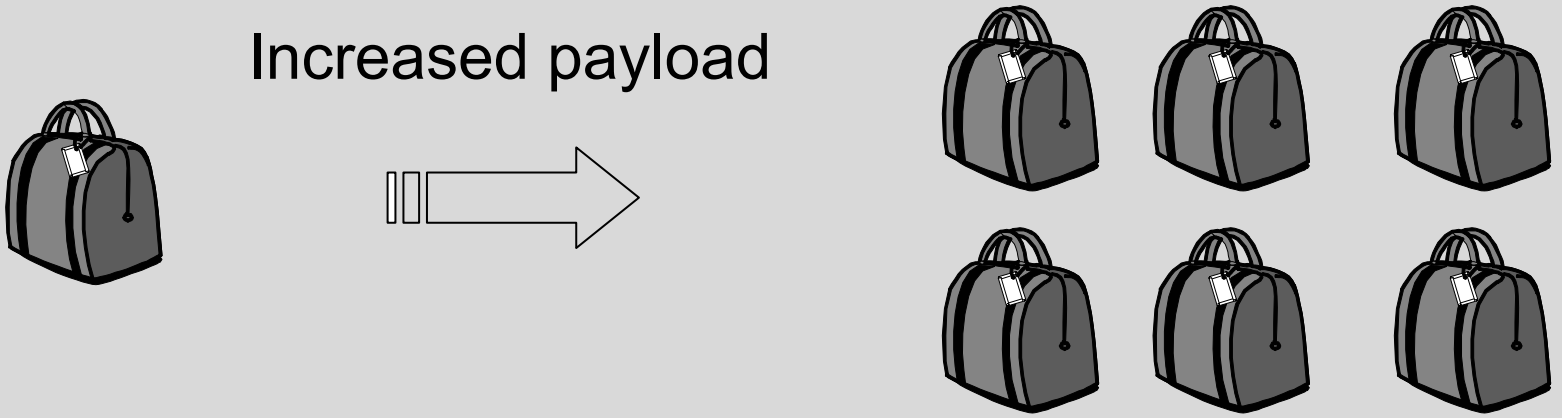
Off Track Initial Destination



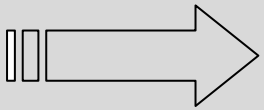
Intent is to lower the Contingency Fuel On Board at the Final Destination



Benefits of Redispatch



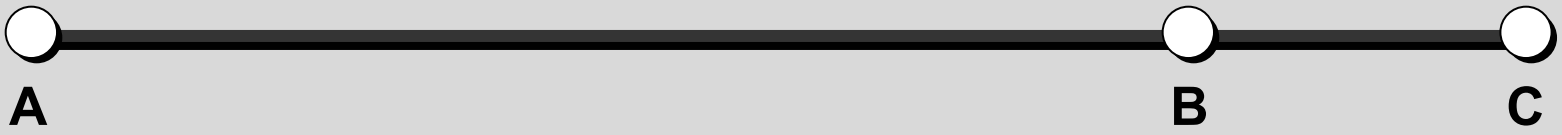
Reduced fuel load



Examples of Using Redispatch

To: 1) Increase payload

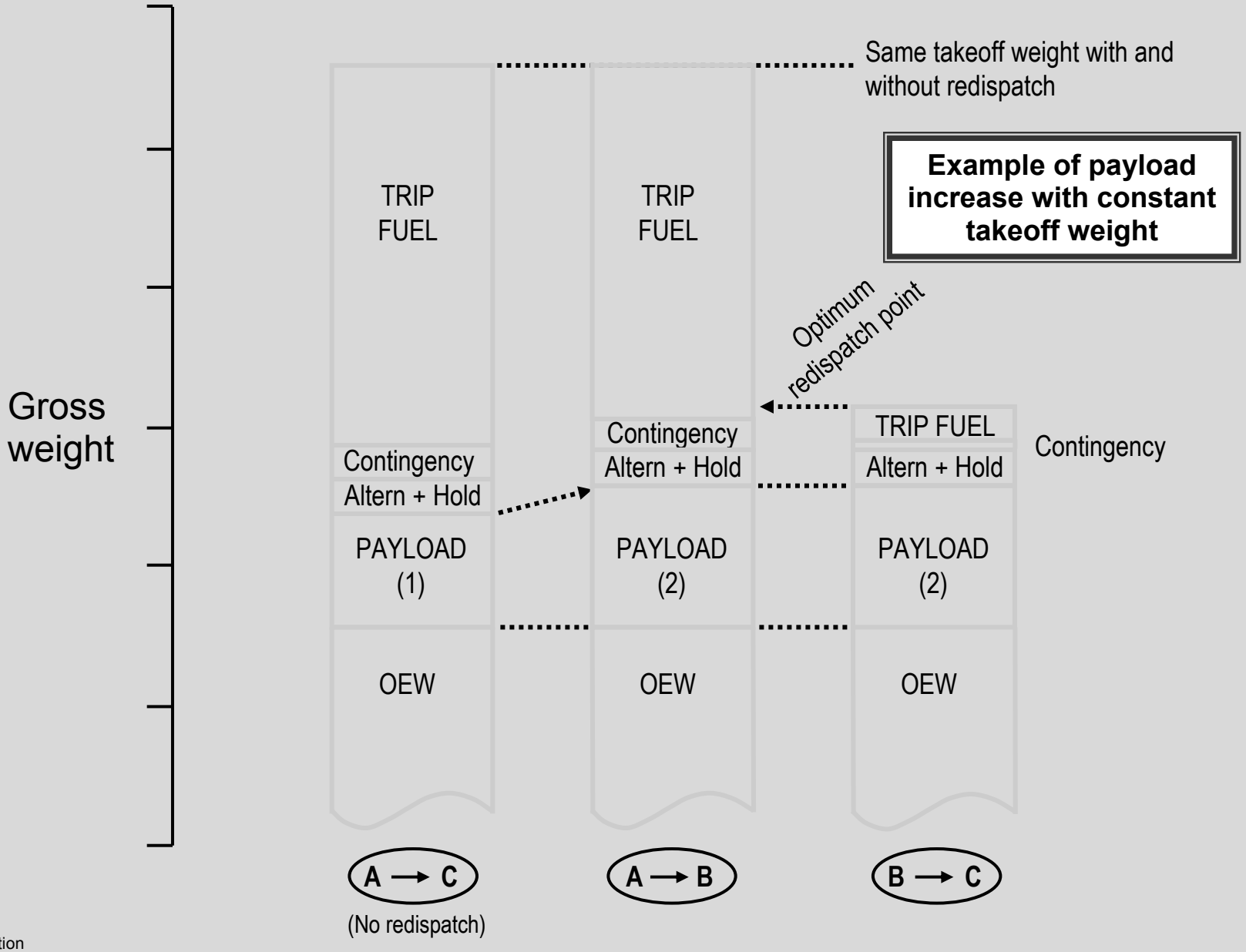
2) Decrease takeoff and landing weight (by reducing fuel load)

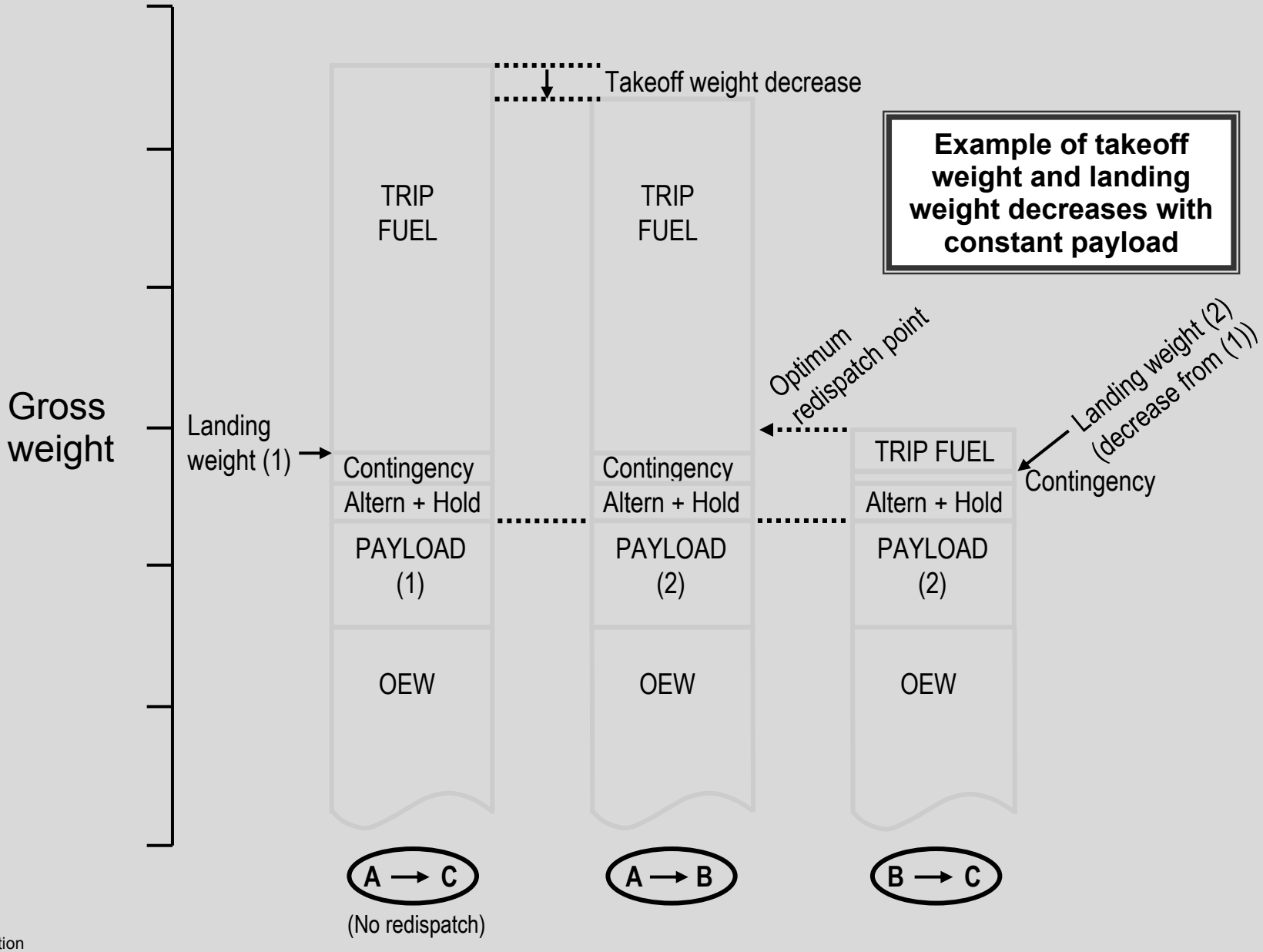


Origin

Initial destination

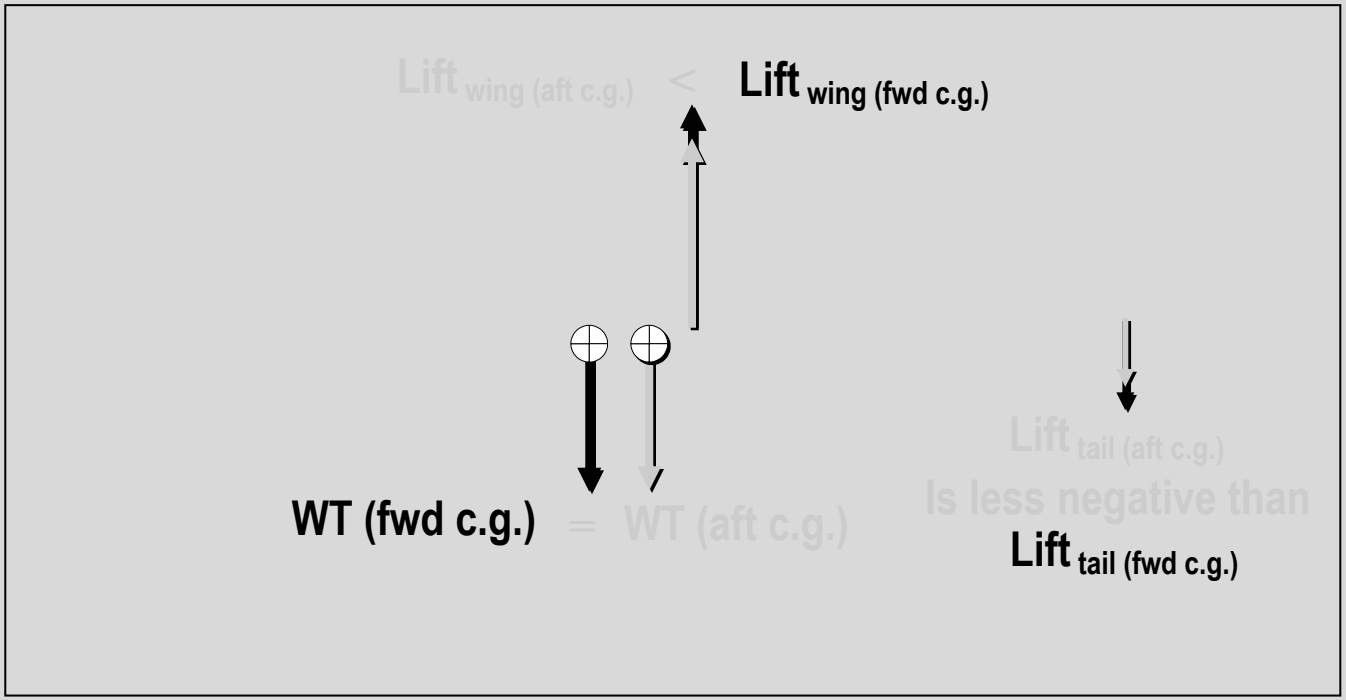
Final destination


Gross weight
Same takeoff weight with and without redispatch
Example of payload increase with constant takeoff weight
TRIP FUEL
TRIP FUEL
Optimum redispatch point
Contingency
Altern + Hold
PAYLOAD (1)
OEW
Contingency
Altern + Hold
PAYLOAD (2)
OEW
TRIP FUEL
Altern + Hold
PAYLOAD (2)
OEW
Contingency
A → C
(No redispatch)
A → B
B → C


Gross weight
Landing weight (1)
Takeoff weight decrease
TRIP FUEL
Contingency
Altern + Hold
PAYLOAD (1)
OEW
TRIP FUEL
Contingency
Altern + Hold
PAYLOAD (2)
OEW
Optimum redispatch point
TRIP FUEL
Contingency
Altern + Hold
PAYLOAD (2)
OEW
Landing weight (2) (decrease from (1))
A → C
(No redispatch)
A → B
B → C
Example of takeoff weight and landing weight decreases with constant payload

Airplane Loading

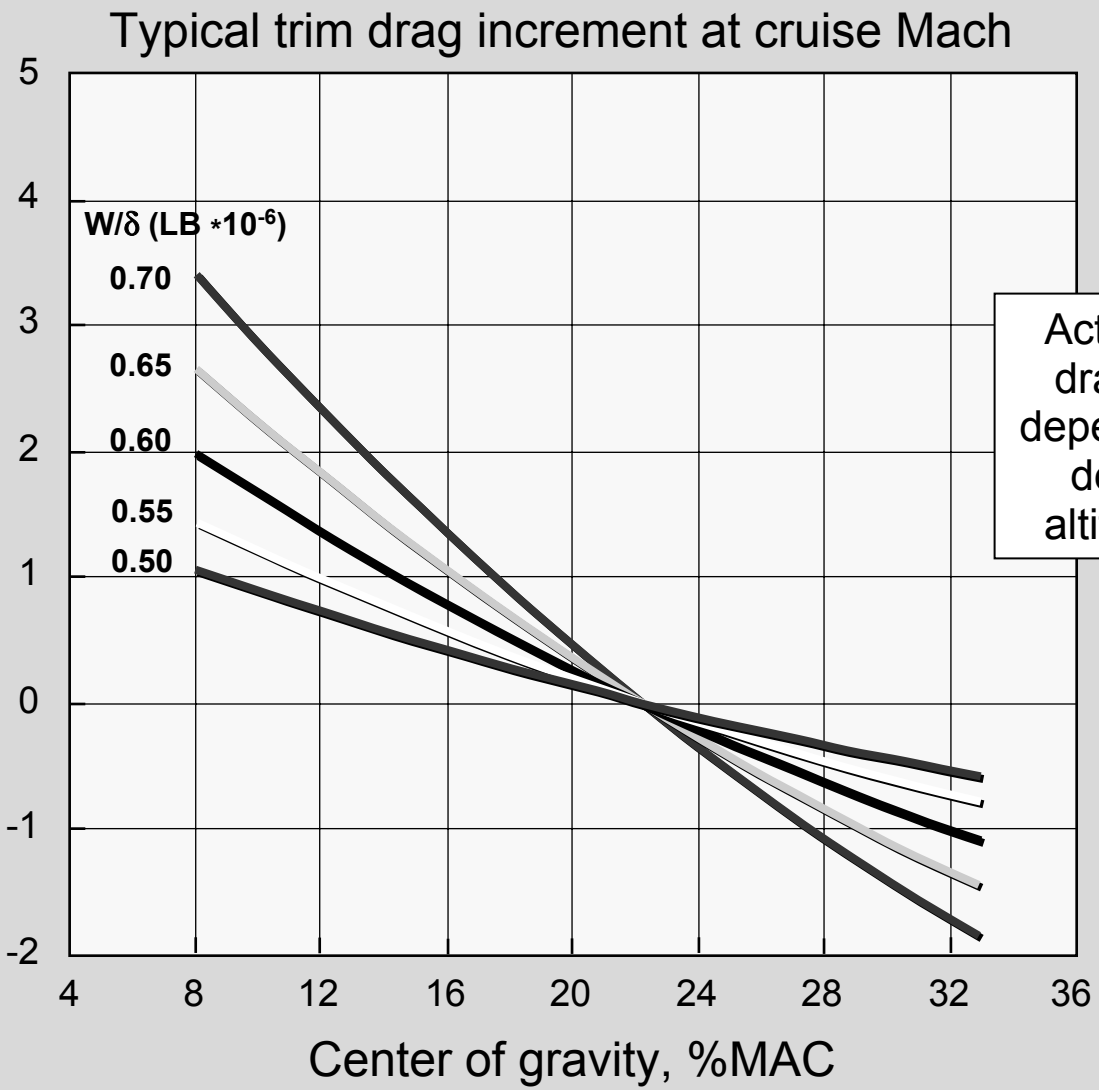
Maintain C.G. In The Mid To Aft Range



- At aft c.g. the lift of the tail is less negative than at forward c.g. due to the smaller moment arm between $Lift_{wing}$ and WT
- Less angle of attack, α, is required to create the lower $Lift_{wing}$ required to offset the WT plus the less negative $Lift_{tail}$
- Same $Lift_{total}$, but lower $Lift_{wing}$ and therefore lower α required

Airplane Loading (continued)

Maintain C.G. in the Mid to Aft Range



Actual variation in drag due to C.G. depends on airplane design, weight, altitude and Mach

Flap Setting

Choose lowest flap setting that will meet takeoff performance requirements:

- Less drag
- Better climb performance