
The Economics of Incremental Weight in Narrow-Body Airline Operations

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A practical research paper for airline commercial, ancillary, network, and operations teams. This document distinguishes average allocated fuel cost from true incremental fuel cost, builds plug-and-play formulas, and benchmarks popular single-aisle aircraft variants using current fuel pricing and public manufacturer / industry inputs.

\$1.53	Current fuel benchmark per kg, derived from IATA's latest global average jet fuel price of \$195.19/bbl
3.01 kg/km	Benchmark narrow-body en-route burn, derived from EUROCONTROL's 40.1 kg/min and an 800 km/h planning speed
\$0.021 - \$0.024 fuel/kg/1000 km	Marginal fuel-burn range from published research on incremental aircraft weight

Executive Takeaway

The cost of carrying weight has two valid but different answers. Average allocation tells you how to apportion the total fuel bill across payload already on board. Incremental cost tells you what one more kilogram actually adds to fuel burn. For ancillary pricing, assortment, and loading decisions, incremental cost is the economically relevant number.

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1. Research question and analytical framing

A repeated question in airline commercial discussions is why carrying 1 kg across a flight can appear to cost materially more than adding 1 extra kg. The answer is that the two numbers describe different cost concepts. The first is an allocation of the total fuel bill across payload already on the aircraft. The second is the marginal fuel required when a small additional weight increment is added to an aircraft that is already flying.

1.1 Definitions

Average allocated fuel cost	Total mission fuel cost divided across payload. Appropriate for cost attribution, route accounting, and commercial analysis.
Incremental fuel cost	Extra fuel caused by one more kg of weight. Appropriate for decision-making on product loading, baggage, and cargo.
Passenger system weight	Average passenger plus checked baggage and carry-on weight used for commercial payload planning.
Ops weight	Catering, potable water, printed material, service equipment, and other recurring operating items not related to payload.

1.2 The Simple Intuition

An aircraft is already burning fuel to carry its own structure, crew, systems, reserves, and the payload already on board. When one more kilogram is added, the airline does not re-pay the full mission fuel bill; it only pays the extra lift-and-drag penalty created by that additional kilogram.

Why the numbers can differ by roughly 6x to 10x

Average allocation = a share of the whole fuel bill. Incremental cost = the extra burn from one more kg. Both are valid. They simply answer different management questions.

1.3 Core formulas

Fuel price per kg	$\text{Fuel price (per kg)} = \text{Fuel price (per barrel)} / (159 \times \text{density (kg/litre)})$
Burn per km	$\text{Burn (kg/km)} = (\text{En-route burn (kg/min)} \times 60) / \text{Ground speed (km/hr)}$
Commercial payload	$\text{Payload (kg)} = (\text{Seats} \times \text{Load factor} \times \text{Passenger system weight}) + \text{Ops weight} + \text{Belly cargo}$
Average allocated cost	$C(\text{avg}) = (\text{Burn (kg/km)} \times \text{Distance (km)} \times \text{Fuel price (per kg)}) / \text{Payload (kg)}$
Incremental cost	$C(\text{inc}) = \text{Extra weight (kg)} \times k \times \text{Fuel price (per kg)} \times (\text{Distance (km)} / 1000)$

In the incremental formula, k is the marginal fuel-burn factor. Published research places it at roughly 0.02 to 0.03 kg of fuel per added kg per 1,000 km. This paper uses 0.024 for current-generation ceo / NG aircraft and 0.021 for newer neo / MAX aircraft as conservative analytical anchors.

2. Benchmark inputs used in this paper

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