

2016

ICAO FUEL SAVINGS ESTIMATION TOOL (IFSET Version 2.1) User Guide



20/10/2016

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ICAO FUEL SAVINGS ESTIMATION TOOL (IFSET)

1-Introduction

Against a background of increasing concern regarding the impact of aircraft engine emissions on the environment, the ability to adequately estimate fuel burn and emissions savings accrued from operational improvements being put in place by all members of the ATM community on a system wide scale is of high importance.

Operational improvements are a key strategy that can be applied to deliver tangible reductions in aircraft fuel consumption. The Global Air Navigation Plan (Doc 9750) and the Operational Opportunities to Minimize Fuel Use and Reduce Emissions (Circular 303) are among several documents providing guidance regarding operational improvements being implemented to improve efficiency of the ATM System.

However, to-date, a tool to assist those States without an automated means to estimate, model or report those benefits in a harmonized way, has not been available.

This *User's Guide* will detail the steps that the user of this application follows to generate the estimated fuel savings from the implementation of operational improvements.

2-Objective

This document describes the ICAO Fuel Savings Estimation Tool (IFSET) developed to be applicable globally with the ability to capture the difference in flight trajectory performance in terms of fuel consumption before and after implementation of operational improvements at local, regional or global level.

The tool is to assist the States to estimate and report fuel savings consistently with the models approved by ICAO's Committee on Aviation Environmental Protection (CAEP) and aligned with the Global Air Navigation Plan.

3-Description

The tool is not intended to replace the use of detailed measurement or modelling of fuel savings, where those capabilities exist. Rather, it is provided to assist those States without such facilities to estimate the benefits from operational improvements.

IFSET allows you to estimate relative fuel savings between different operational scenarios for different aircraft categories in terms of ground track and vertical profile. The fuel burn estimates provided by IFSET are based on typical values for the different aircraft seat classes using modelled values. These values can be taken as an indication of the likely impact of changing operational procedures but cannot replace detailed studies based on precise aircraft performance modelling

Fuel savings can be enabled through the implementation of operational improvements in the general categories listed in Table 1.

Table 1. Operational improvements to be evaluated by IFSET.

- Reduced cruise distance or time
- Availability of optimal (preferred) altitude
- Reduced taxi time
- More efficient departure and approach/arrival procedures

4-Assumptions

Simplifying assumptions are made regarding, *inter alia*, aircraft weight, aircraft centre of gravity (CG), engine thrust setting, meteorology, airframe/engine combinations, etc. As a result, the tool is not suitable for assessing the effects related to aircraft weight, thrust settings, or differences between aircraft/engine models.

The tool is intended to report differences in fuel consumption based on the comparison of two scenarios and therefore is not appropriate to use the tool to compute the absolute fuel consumption for a specific procedure. It cannot be used for flight planning purposes or any other purpose that may affect safety of operations.

5-Methodology

The tool will estimate the difference in fuel mass consumed by comparing a pre-implementation (i.e. “baseline”) case against a post-implementation case (i.e. “after operational improvements”), as illustrated notionally in Figures 1 and 2.

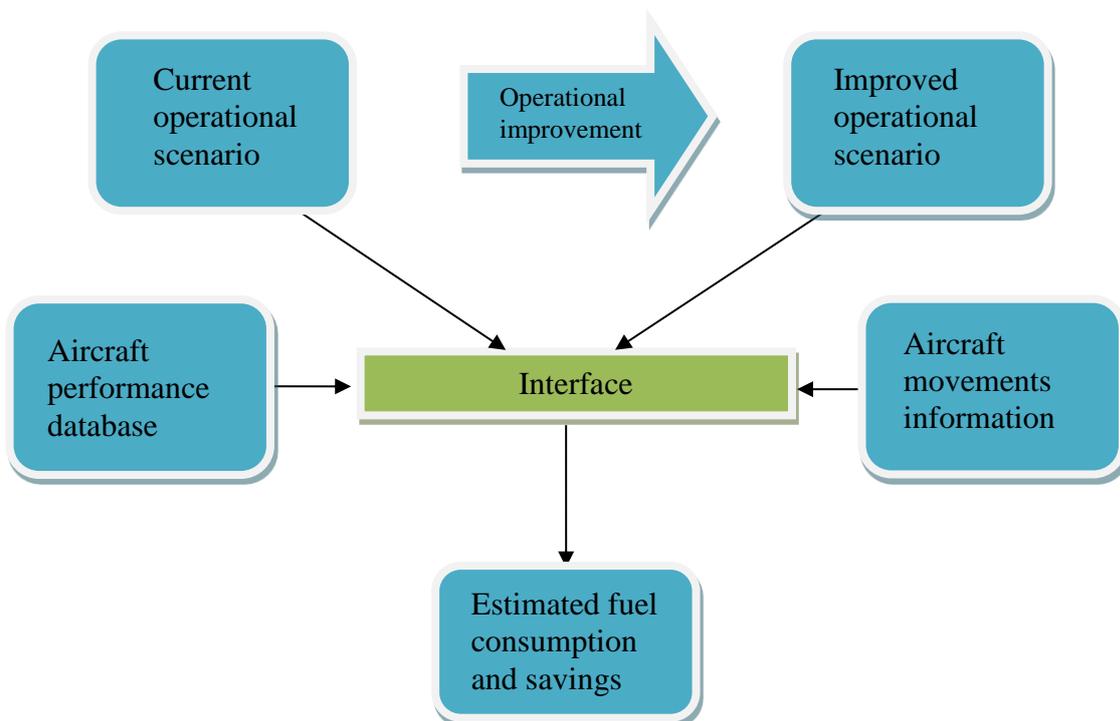


Figure 1. Notional flux gram.

The selection of the baseline case is an important step of the process. It will be defined by the user and could correspond to:

- the published or planned procedure (AIP, flight plan) scenarios;
- the daily practices;
- a combination of the two;
- other criteria as appropriate.

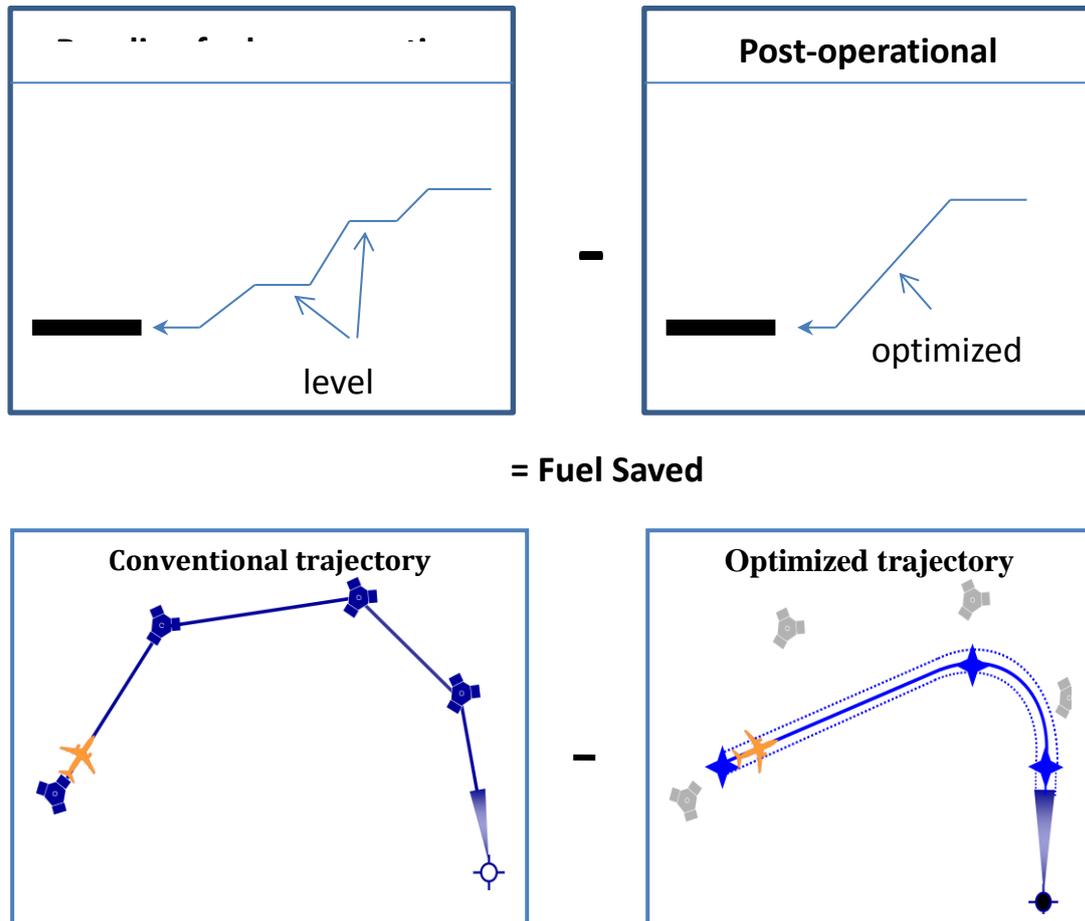


Figure 2. Notional illustration of fuel savings.

In order to compute the fuel consumed in two different scenarios, the following information listed in Table 2 will be required for both scenarios.

Table 2. Data required to compute fuel consumption changes.

- Number of operations by aircraft category

Plus, a combination of the following elements that describes both scenarios

- Average taxi time
- Time spent or distance flown at a specific altitude
- Top of descent altitude and bottom of descent altitude
- Base of climb altitude and top of climb altitude
- Distance flown in a climb or descent procedure

6-Requirements

The user interface is intended to be easy-to-use, requiring minimal input from the user.

All analyses begin with describing the baseline and post-implementation cases. As defined in Table 2, the user begins by specifying the number of operations in both scenarios.

This is accomplished by selecting the aircraft types from a dropdown list of available types and then entering the number of operations. The list also contains basic aircraft categories that can be selected. Those aircraft categories include: single engine piston, multi engine piston, turboprop, short range single aisle jet, medium range single aisle jet, twin aisle jet (2 engine), and twin aisle jet (3+ engines). The number of operations entered can be hourly, daily, annually, etc. The resultant fuel savings will be reported on the same basis. The reason that the operations need to be defined in both cases is to permit the consideration of procedures that will only be available to properly equipped aircraft.

7-The Tool Step by Step

7.1 Main Screen

Objective

Operational measures are one of the instruments available to States to improve fuel efficiency and reduce CO2 emissions. The ICAO Fuel Savings Estimation Tool (IFSET) has been developed by the Secretariat with support from States and international organizations to assist the States to estimate fuel savings in a manner consistent with the models approved by CAEP and aligned with the Global Air Navigation Plan. The ICAO Fuel Savings Estimation Tool (IFSET) is not intended to replace the use of detailed measurement or modelling of fuel savings, where those capabilities exist. Rather, it is provided to assist those States without such facilities to estimate the benefits from operational improvements in a harmonized way.

New Scenario

Saved Scenario

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Command Buttons on this screen (Top)

New Scenario- will open a blank screen allowing users to input new scenarios.

Saved Scenario - will enable the users to select an appropriate scenario among multiple scenarios saved in the database. After selection the scenario can be deleted or the aircraft mix on the second half of the screen can be edited.

INPUT

Start by selecting **New Scenario** tab, the following screen opens

7.2 Operations Definition

Step 1 - Define New Scenario

Scenario Name

ID	Aircraft	Base Flights	New Flights	Continuing Old Flights	Remaining Trip (nm)
1	Choose Category ▾	<input type="text"/>	<input type="text"/>	0	<input type="text"/>

Save any change on the page by clicking "Save" before clicking "Next Step".

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Command Buttons on this screen

Back - will bring the user to the main screen.

Aircraft Category Map - the User can see the various aircraft types and the associated aircraft categories so that he can make an appropriate input of the required aircraft type.

Add - will add a blank row under the same scenario.

Delete - the user can select a row associated with an aircraft, the number of operations and remaining trip distance and delete that row.

Save - will save this scenario and the related aircraft mix.

INPUT

Scenario Name - Give a descriptive name for the operational scenario.

Aircraft - Input the aircraft mix relating to the scenario under the aircraft category column from a drop down list. If required make use of the Aircraft Category Map Button indicated earlier to help in the selection of the appropriate aircraft category.

Base flights - indicate the number of flights under the old operational scenario.

New flights - indicate the number of flights under the new operational scenario. It means the number of operations benefiting from the operational improvement.

Continuing Old flights - indicates those flights though being part of the new operational scenario continues to follow the old operational definitions. It means number of operations not benefiting from the operational improvement.

Remaining Trip (nm)- is the average stage length in nautical miles (NM) appropriate for the aircraft category selected. If not known, the tool assumes a default value based on data already tested.

Click **Save** – it will save this scenario and the related aircraft category mix.

Click **Next Step** – it will bring the user to the next step.

Click **Back** – it will bring the user back to the main screen.

7.3 Procedure Definitions (Old/New)

Step 2 - Saved Old/New Procedure Definition

Scenario Name:

Old Procedure Definition

ID	Action	From Alt (ft)	To Alt (ft)	Distance (nm)	Time (sec)
1	Choose action	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

New Procedure Definition

ID	Action	From Alt (ft)	To Alt (ft)	Distance (nm)	Time (sec)
1	Choose action	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

If specifying the Climb/Descent Distance manually, the value entered must be greater than or equal to the minimum required distance shown in grey.
To view the aircraft performance for Climb/Descent after entering the altitudes, double click the Distance cell.
Save any change on the page by clicking "Save" before clicking "Calculate".

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Enter the **Action** followed under the old operational procedures. The allowable actions are Level, Descend, Climb and Taxi selected from a drop down list.

For "Level" Action either the distance in nautical miles or time in seconds can be entered.

For "Taxi" Action only Time in seconds can be entered.

For all actions except "Taxi" enter the "From" and "To" altitudes in feet. For the level action the "To" altitude will be automatically entered after entering the "From" altitude and clicking the "Tab" button.

For "Climb" or "Descend" actions, if there are variations in distance between the old and the new procedures, the user can tab to the distance (nm) column after entering the altitude columns. If there are no variations in the distance then the user can proceed directly to enter the next row to enter the action and leave the distance (nm) blank. Time cannot be entered by the user for a climb or descend action.

If there are variations in distance and the user after entering the altitudes associated with a "Climb" or "Descend" action tabs to enter the distance (nm), the modelled distance associated with that action for the entered altitudes is display in the distance tab in grey.

This information will facilitate the users' task to input meaningful distance (nm) associated with a climb or descend action for the altitudes entered by the user.

To maintain the integrity of the outputs, for the Climb action the user cannot enter a distance smaller than the distance in the underlying model. For the descend action the user is warned if the entered distance is smaller than the distance in the underlying model.

Command Buttons on this screen

Add will enable the user to add a blank row of Action.

Delete will enable the user to select a row of Action and delete it.

Back will bring the user to the previous page (Step 1 – Find Saved Scenario).

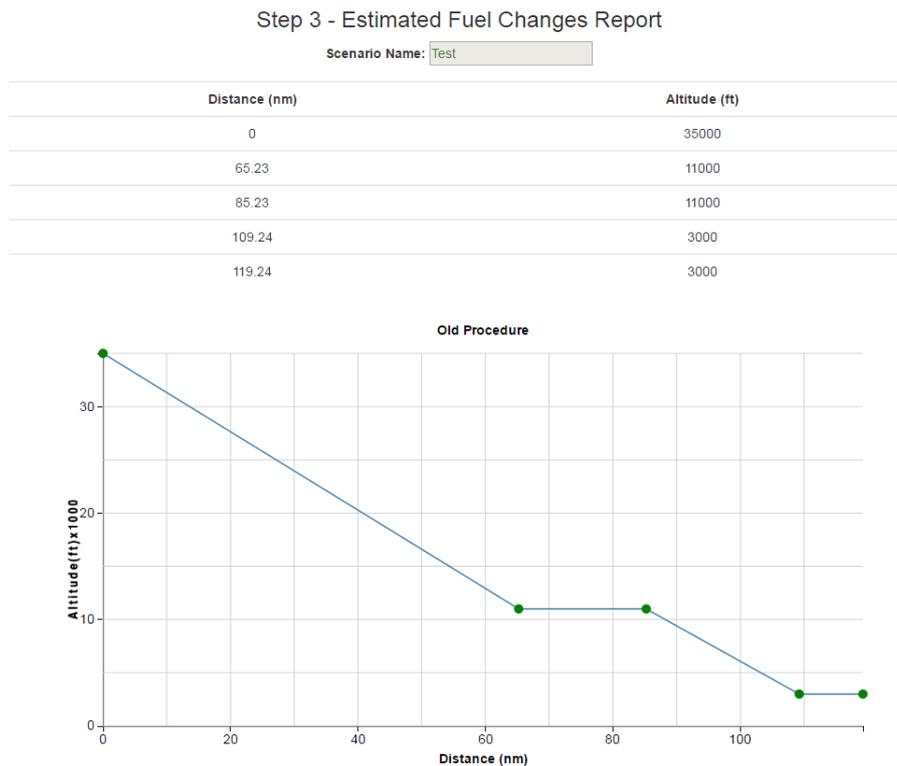
Reset will clean up the input.

Save will save the action associated to the procedure definitions for the selected scenario.

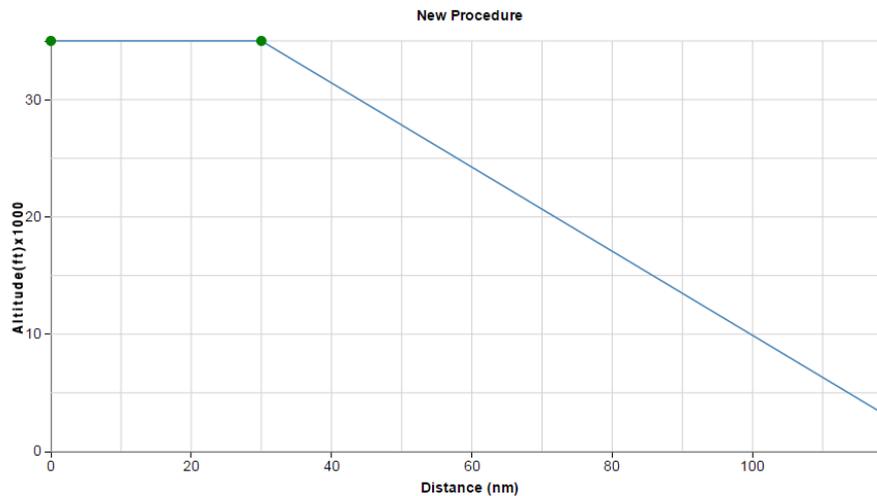
Calculate will open the charts associated with the different scenarios and display the results.

7.4 Report Generation

On clicking the **Calculate** button, the charts associated with the different scenarios will open up as indicated below -



Distance (nm)	Altitude (ft)
0	35000
30	35000
119.24	3000



The user can see in a graphical form the distance and altitude associated with the old and new procedures for each scenario defined by the user. The distance is indicated in the X axis and the altitude in the Y axis.

Estimated Fuel Changes Report

Scenario Name	Old Fuel Consumption (KG)	New Fuel Consumption (KG)	Savings (KG)	Savings (%)
Test	600	200	-400	-67.10

Estimated Detailed Fuel Changes Report

Old Climb Fuel (KG)	New Climb Fuel (KG)	Climb Savings (KG)
0	0	0
Old Descent Fuel (KG)	New Descent Fuel (KG)	Descent Savings (KG)
200	200	0
Old Level Fuel (KG)	New Level Fuel (KG)	Level Savings (KG)
400	0	-400
Old Taxi Fuel (KG)	New Taxi Fuel (KG)	Taxi Savings (KG)
0	0	0

Back
Export to Excel

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The fuel consumption in Kg (rounded off to the nearest 100 Kg.) under old and new operational definitions for each scenario will be displayed along with the estimated savings.

RMK: The savings displayed in the report represents the benefits of reduced fuel consumption due to the adoption of new operational procedures and is restricted only to the phase of flight defined under each scenario.

7.5 Report Generation in Excel

To facilitate the exchange of messages or summation of results, the user can also export the results to an Excel file. For this, just click the “Export to Excel” tab in the appropriate reports as indicated in section 7.4 Report Generation. An Excel file of the consolidated and the detailed fuel savings reports will be generated for the user’s information and can be stored by the user in a desired directory on his computer.

7.6 Summary

IFSET provides a robust platform for estimating the incremental fuel burns from adopting procedures different from the baseline. IFSET has demonstrated that it is capable of providing a reasonable estimate of changes in fuel consumption in a manner that is consistent with more sophisticated approaches. In IFSET, scenarios are defined by climb/descent phases (by specifying height differences), level phases (by specifying time or distance) and taxi phases (by time). Climb and descent rates are not specified, IFSET default values are used. The estimates generated by IFSET can be improved if savings in distance or time inputted into IFSET comes from empirical radar tracks and or using the domain expertise of the air navigation service provider. The release of the first version of IFSET to the Contracting States, the feedback received from them and other users will serve ICAO in making necessary updates to the tool in its future versions.
