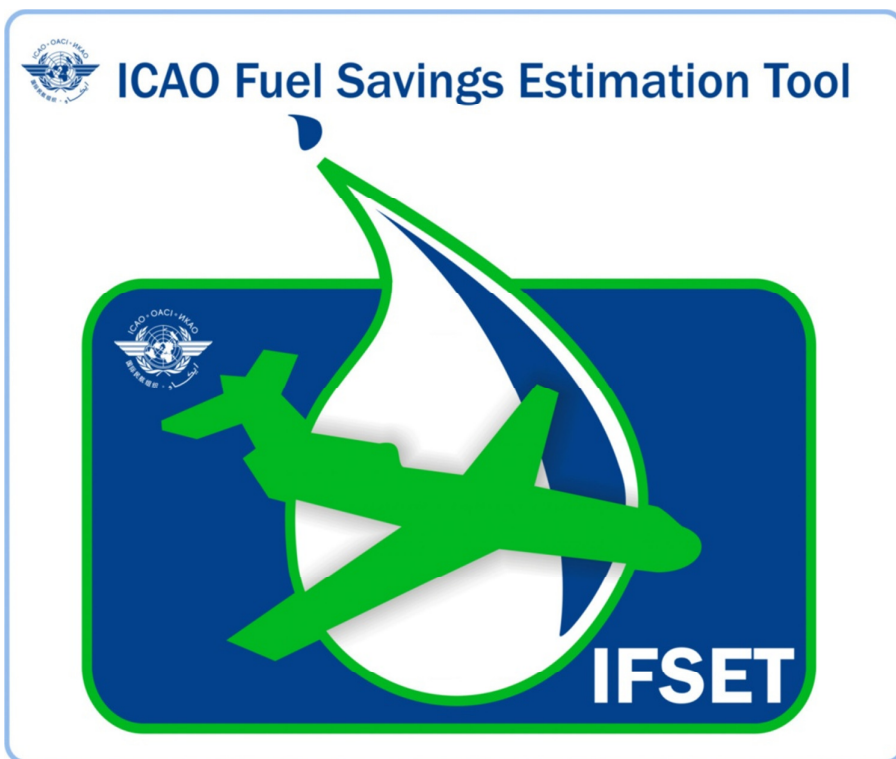


2012

ICAO FUEL SAVINGS ESTIMATION TOOL (IFSET Version 1.1) User Guide



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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.

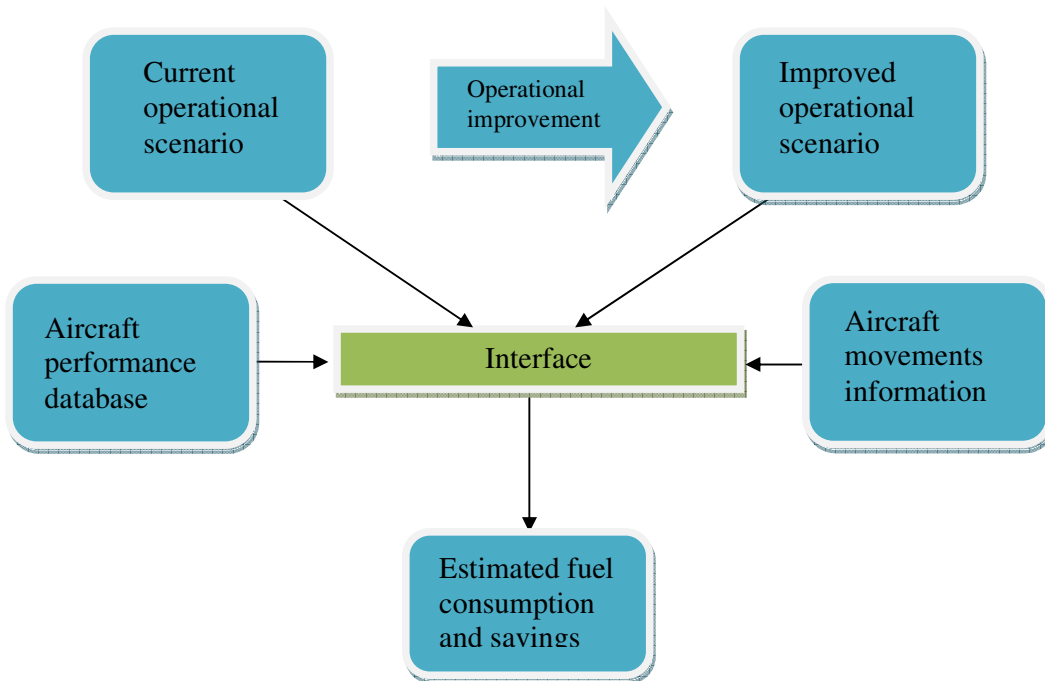


Figure 1. Notional fluxogram.

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.

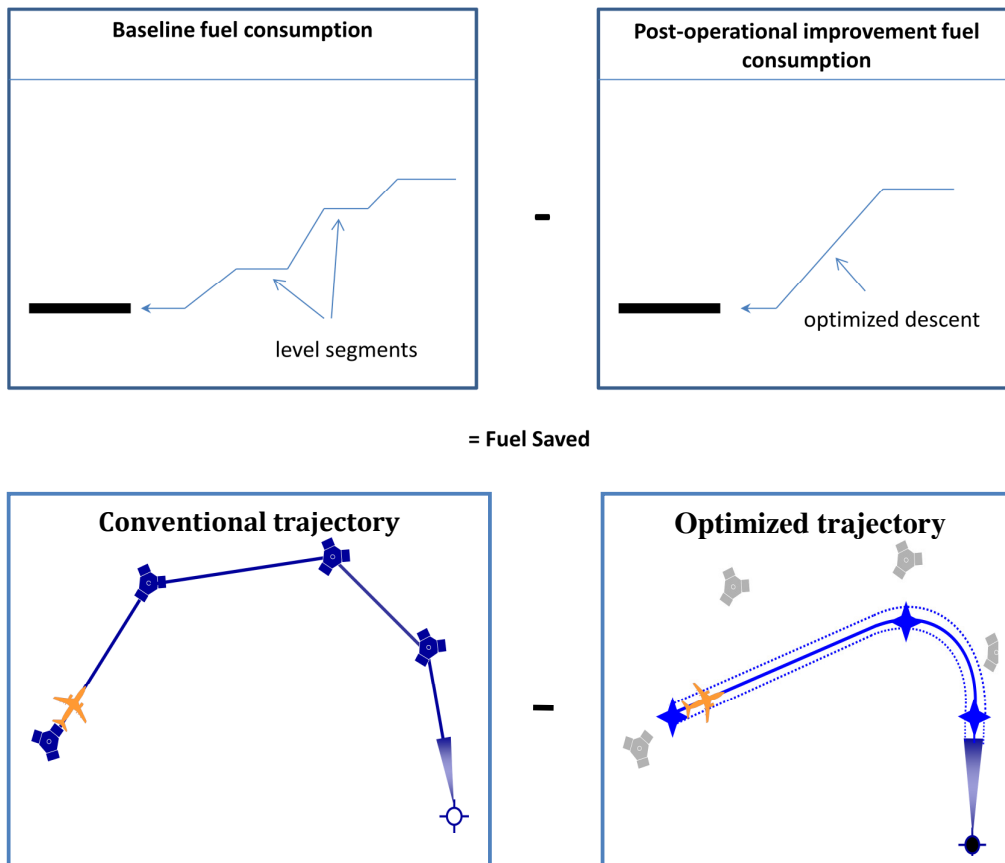


Figure 2. Notional illustration of fuel savings.

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

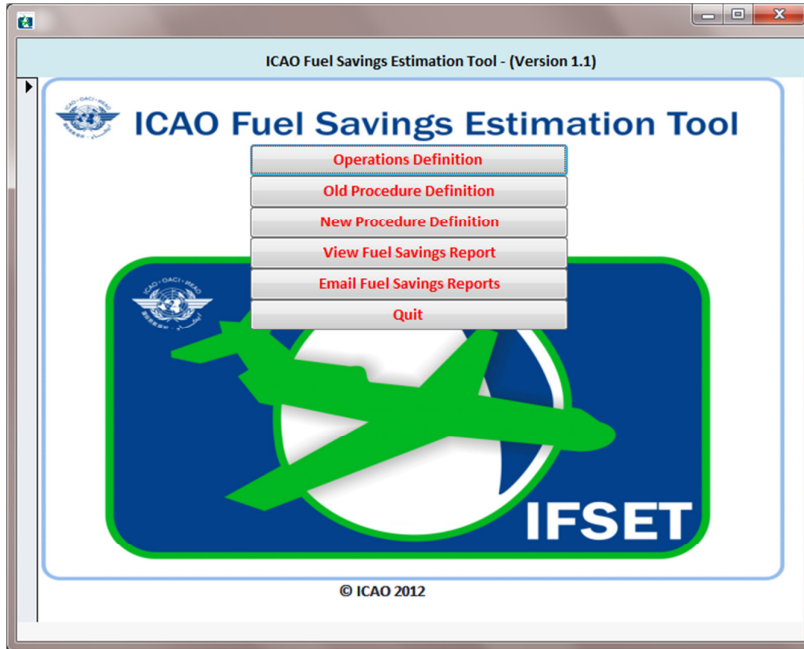
The tool will be a Microsoft Windows application that requires running an operating system of Windows XP or newer. The user interface is intended to be easy-to-use, requiring minimal input from the user.

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



INPUT

Start by selecting **Operations definition** tab, the following screen opens

7.2 Operations definition



Aircraft	Base Flights	New Flights	Continuing Old Flights	Remaining Trip (nm)
Single Aisle Jet	1	1		1160

Command Buttons on this screen (Top)

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

Delete - will delete the scenario, the aircraft mix and all associated operational definitions.

Return - will bring the user to the main screen.

Find - 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.

Command Buttons on this screen (Bottom)

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

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

Help - 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.

Clicking on **Return** will bring you to the Main Screen where the user will select **Old Procedure Definition**.

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 Help 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 distance - 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 **Return** - it will bring the user back to the main screen.

7.3 Old procedure definition

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

Find the **scenario name** which you have entered earlier under Operations definition by clicking the **Find** Button. Select the Scenario Name and either add or edit appropriate actions associated to the operational procedures for the selected scenario. The scenario name on this screen is locked and no entry is allowed.

Navigate to the second half of the screen and 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 parameters associated with that action for the entered altitudes opens up in a separate window to display the following –

- Time in seconds
- Speed in nautical miles per hour
- Distance in nautical miles

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 (Top)

Find – as explained above, this allows the user to select the scenario name entered earlier under operations definition and either add or edit appropriate old operational procedures for the selected scenario.

Return will bring the user to the main screen.

Command Buttons on this screen (Bottom)

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

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

7.4 New procedure definition

A screen identical to the **Old Procedure Definition** will open;

STEP 3 - NEW PROCEDURE DEFINITION
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Scenario Name:

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

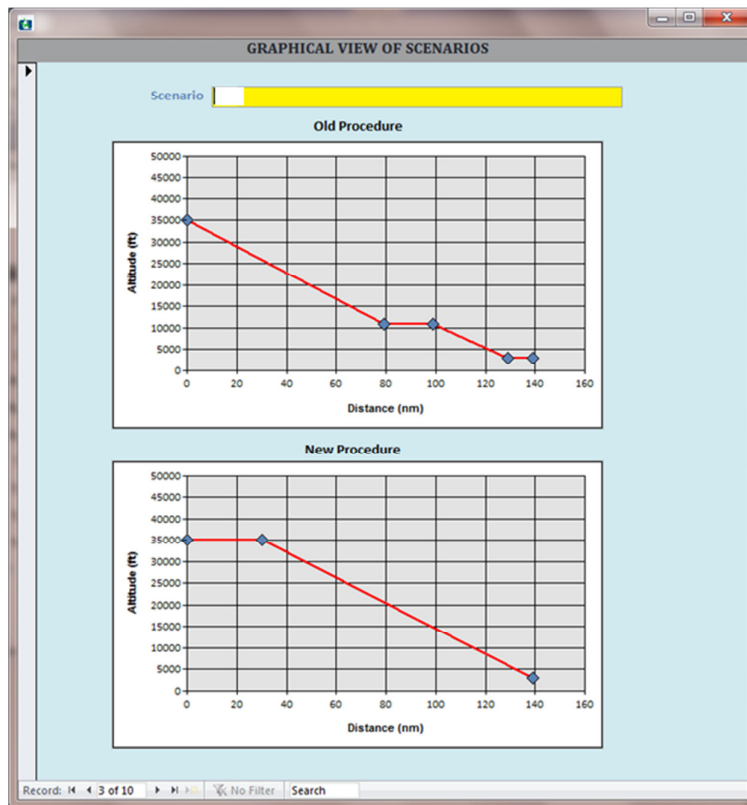
Record: 1 of 11 | No Filter | Search

Enter the new operational procedures associated with the selected scenario as described under the “**Old Procedure Definition**”. All the command buttons in this screen are identical to the ones explained under the Old Procedure Definition (7.3)

Clicking on Return will bring you to the Main Screen where the user can select “**View Full Burn Report**”.

7.5 Report generation

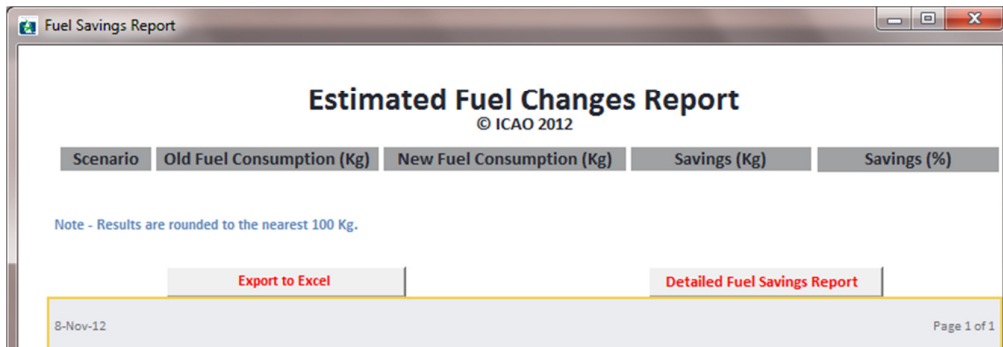
On clicking the View Fuel Savings Report Tab, the charts associated with the different scenarios will open up as indicated below -



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.

The user can navigate to different inputted scenarios using the navigation button on the bottom left corner of the Graphical View of Scenarios screen. The chart will facilitate the work of the user to identifying the incremental benefits or otherwise of adopting new procedures for each inputted scenario.

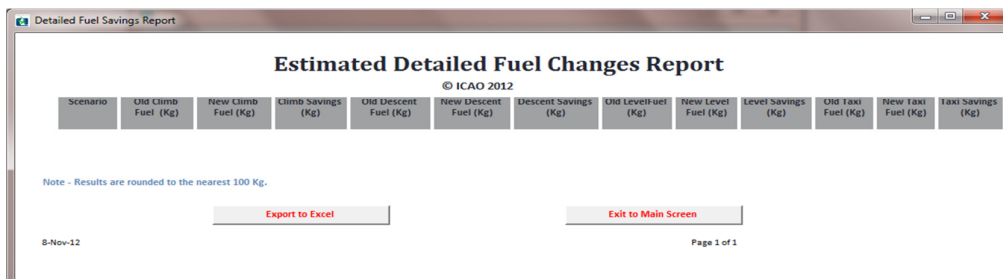
When the user closes this “Graphical View of Scenarios” screen the Estimated Fuel Changes Report window pops up.



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.

The user also has the option to generate the detailed report by action or phase of flight by just clicking the “Detailed Fuel Savings Report” Tab.



7.5.1 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 7.5 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.

7.7 Sending the report via Email

The report can be sent automatically to the people in charge of generation of the global report by just clicking the “Email Fuel Savings Report” key. A message will be automatically generated to the group in charge of the generation of the global report through Microsoft Outlook with the attachment of the actions and associated fuel savings.

7.8 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.
