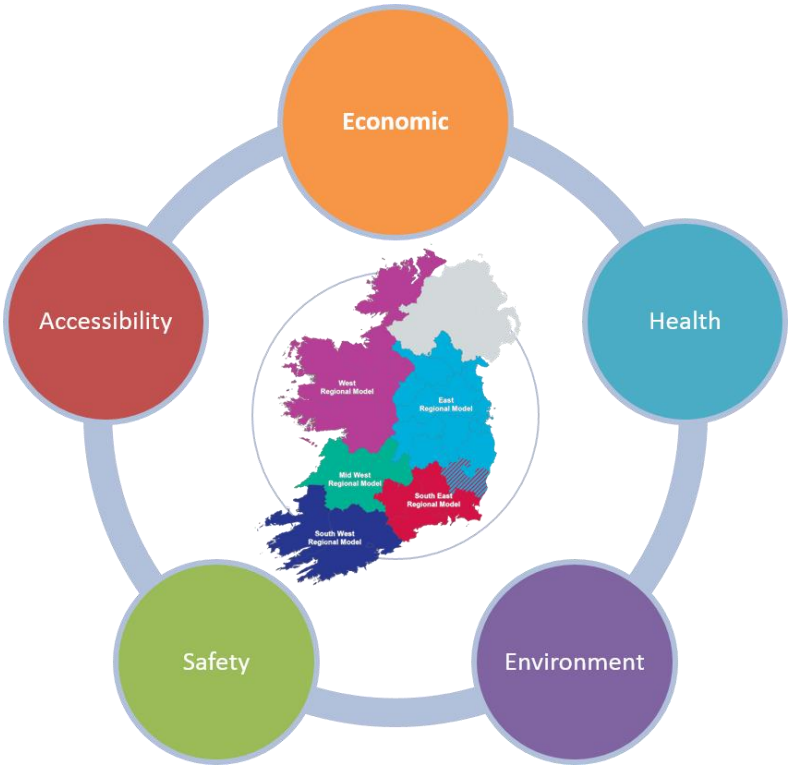
Údarás Náisiúnta Iompair
National Transport Authority



Economic Module

User Guide

March 2021 (v3.1.1)

National Transport Authority,
Dun Scéine,
Harcourt Lane,
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DOCUMENT IDENTIFICATION TABLE	
Client/Project owner	National Transport Authority
Title of Document	Economy Module User guide
Task Order	P4
Deliverable Code	P4.01
Version	3
Document Status	FINAL

DOCUMENT STATUS TABLES

Version 3_7 – V2

	Name	Position	Date
Originated by			September 2018

Version 3.1.0 – V3

	Name	Position	Date
Originated by	Shoham Vaich-Shkolnik	Graduate Transport Modeller	October 2020
Checked by	Chris Bushell	Associate Director	October 2020
Approved by	Chris Bushell	Associate Director	October 2020

Version 3.1.1 – V3

	Name	Position	Date
Originated by	Shoham Vaich-Shkolnik	Graduate Transport Modeller	March 2021
Checked by	Jevgenija Guliajeva	Transport Modeller	March 2021
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NTA Reviewer	Stylianos Papailiou	Transport Modelling PM	March 2021

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Figures and Tables

Foreword

This document is designed to guide both new and experienced users through the main processes of the Economic Module as part of the NTA's Appraisal Toolkit. Note this tool and User Guide have been designed and developed for the V3 RMS models. It includes a troubleshooting section to help guide the user through any known issues that may arise through its use. For more detailed information on the module please see the Economic Module Development Report and Version Control Log.

It is assumed the user has prior CUBE and TUBA experience.

1 What is the tool being used for?

There are three general categories of use for the Economic Module, as shown below. The different steps to be taken for each is as follows:

1) **Economic Appraisal of Do Minimum against a single Do Something (Purpose 1) –**
   - Uses the full tool to test a single Do Something against a Do Minimum. This includes an **automated TUBA run**.
   - Sections to follow for instructions;
     - Section 4 (Scheme File Creator)
     - Section 5.1, Section 5.2 (Cube Program)
   - For further analysis of outputs;
     - Section 6.2 (Extracting Detailed Outputs)
     - Section 7 (TUBA Analyser)

2) **Economic Appraisal of Do Minimum against many Do Somethings (Purpose 2) –**
   - Uses the tool to produce scheme files and skims for many Do Somethings to use against one Do Minimum. This does not include an automated TUBA run.
   - Sections to follow for instructions;
     - Section 4 (Scheme File Creator)
     - Section 5.3, Section 5.4 (Cube Program),
     - Section 6 (Running TUBA)
   - For further analysis of outputs;
     - Section 7 (TUBA Analyser)

3) **TUBA Output Manipulations –**
   - Uses the TUBA Analyser to remove user specified sector-sector movements, focus on a single time period and set minimum benefits boundaries. Outputs a recalculated TEE (Transport Economic Efficiency) table with user specified rules applied.
   - Sections to follow for instructions;
     - Section 6.2 (Extracting Detailed Outputs)
     - Section 7 (TUBA Analyser)

The flowchart below in Figure 1.1 is provided to compliment the above list and help the user identify the tasks required for the appraisal process through a series of yes/no questions. The

flowchart in Figure 2.1 represents the key data inputs, procedures and outputs that comprise the Economic Module.

For **troubleshooting** please refer to Section 7.

1.1 Contents

This document is structured by the different elements of the process, as shown in **Error! Reference source not found.**. These are broken down as follows:

Section **Error! Reference source not found.** – Location of the Economy module and required programmes

Section **Error! Reference source not found.** – Scheme File Creator (Process 1)

Section **Error! Reference source not found.** – CUBE Process (Process 2)

Section 6 – TUBA (Process 3)

Section 7 – TUBA Analyser (Process 4)

Section 8 – Troubleshooting

Appendix A – Files and directories

Appendix B – Model machine matrix

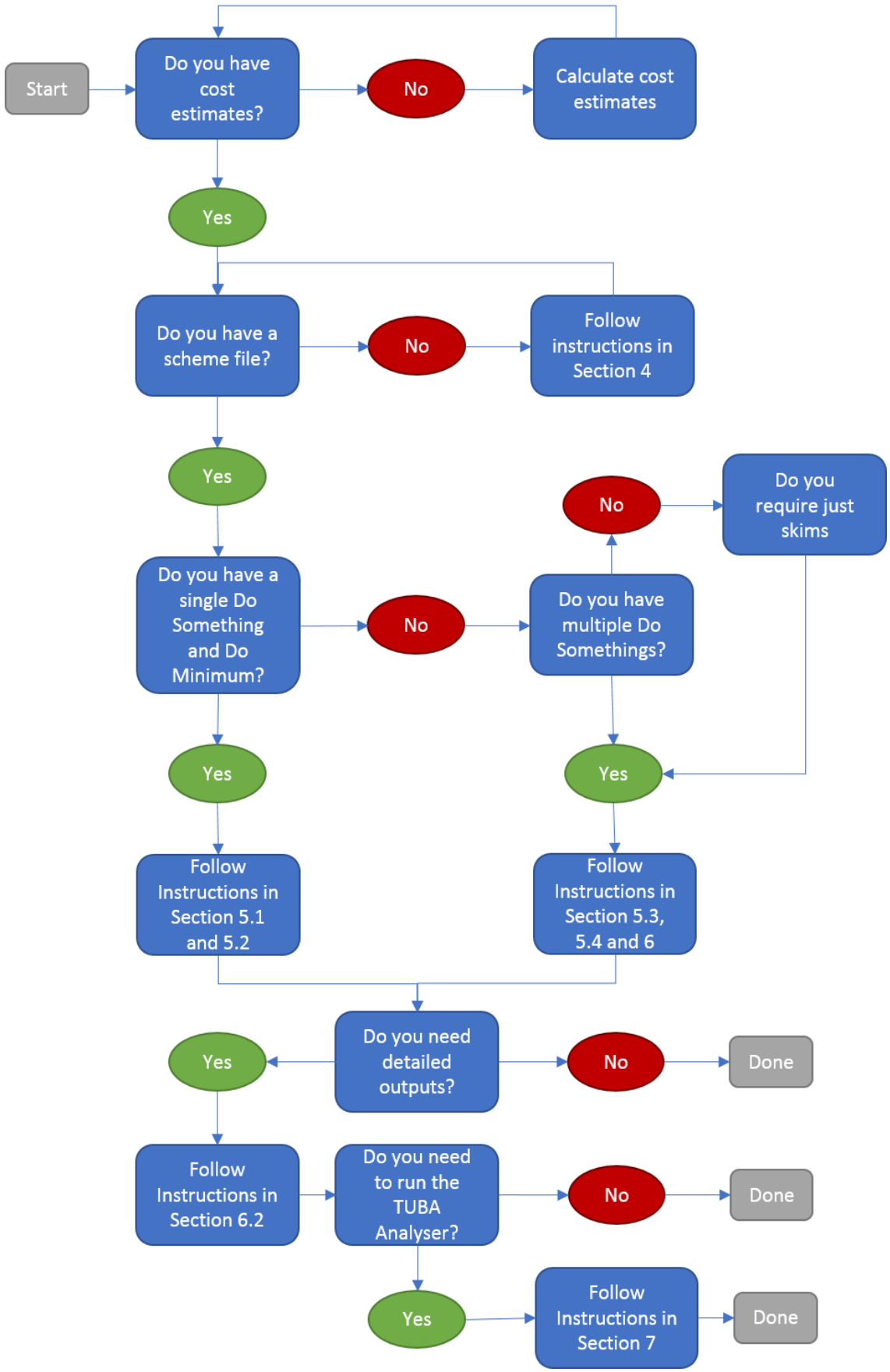

Figure 1.1 Flow chart guide to instructions

2 Overview of Process

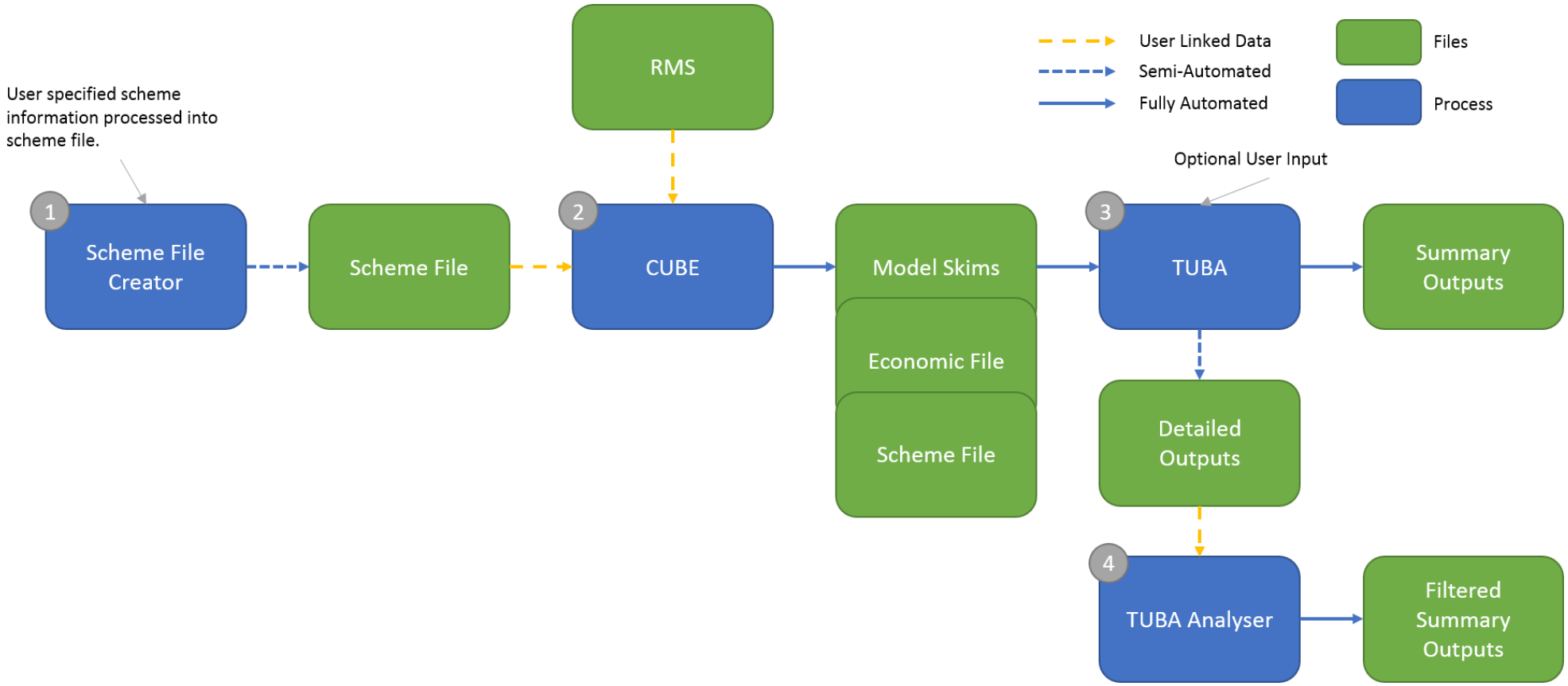

Figure 2.1 Overview of Economic Module Process

3 Before you Start

The latest version of the Economic Module is stored here;

NDFM:\04_Data\Appraisal Tools\Apprasial_Modules_Version_3\Economic

The 0_Version_Control subfolder contains the Version Control Log.

The 1_ Program subfolder contains the Module files for the latest version.

The 2_Economic_File subfolder contains the Economics Input File for TUBA, which defines the Economic Parameters used, and the corresponding Economics Input File version log.

To run Economic Module the following programs must be installed on the local machine;

CUBE Voyager V6 or above

SATURN 10 or 11

Microsoft Excel

TUBA v1.9.14.3

Also included is a program called (Region)_Seq_2_Hier.exe and a file (Region)_SEQ_Hier_Zones.Dat that should sit in the \Params\Zone_Conversion folder of the cube program. A version of this program and equivalence file exists per regional model. This .exe file converts from the Saturn zone system to a hierarchal zoning system for TUBA.

The folder structure and required files to run this tool are shown at the bottom of this document in Appendix A.

4 Scheme File Creator (Process 1)

4.1 Process for Public Transport and Highway Scheme Files

To create a scheme file, follow the steps below;

1) Copy the latest scheme file creator to a working location.

2) Open the scheme file creator

3) If using the tool for Purpose 2 (many Do Somethings) go to step 8, otherwise if you are using the tool for Purpose 1 (1 Do Something vs 1 Do Minimum) continue to step 4

PURPOSE 1

4.2 Purpose 1 – Set up scheme parameters

4) Complete the tab "**TUBA Run**"

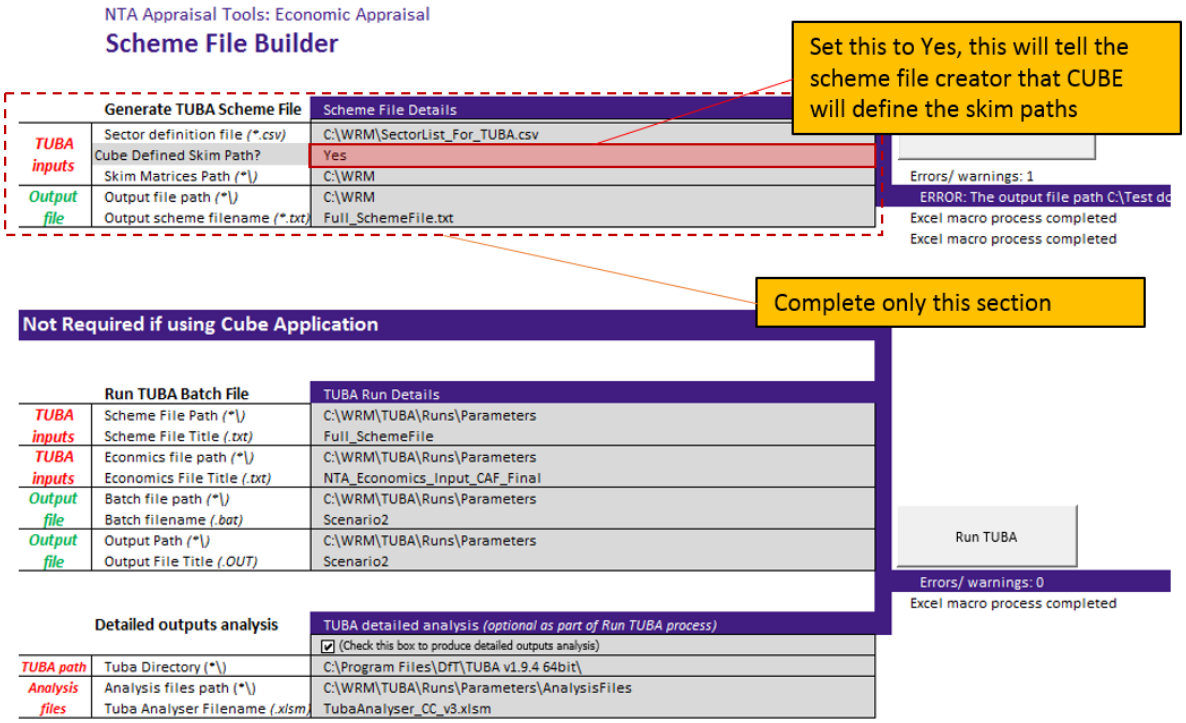

Figure 4.1 TUBA Run tab – Purpose 1

5) Complete the tab "**Scheme Inputs**" - The Scheme Inputs tab contains the basic information required for the scheme file including model names, various year definitions and time slices. Ensure the relevant annualisation factors are inputted for the model/project. Also ensure Forecast year 3 is empty if running a one/two year TUBA.

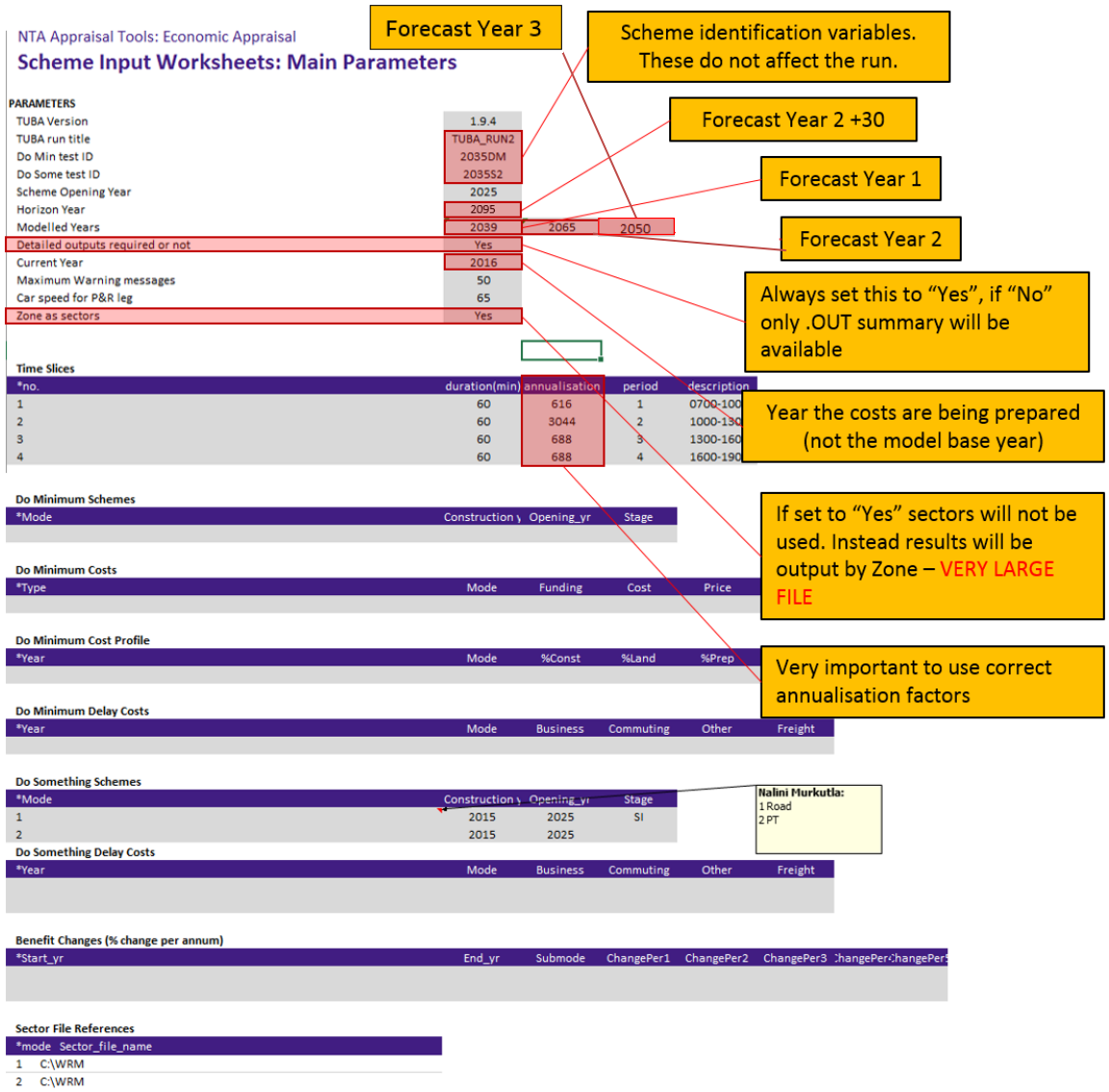

Figure 4.2 Scheme Inputs Tab

6) Complete the tab "**Matrix Inputs**" (If undertaking a 3 year run, go to Matrix Inputs_3Yrs) - The Matrix Inputs tab allows the user to define the location of the skim files created during the Cube TUBA output process. This section also allows factoring of demand to simulate a future year. Only factors highlighted red should be changed.

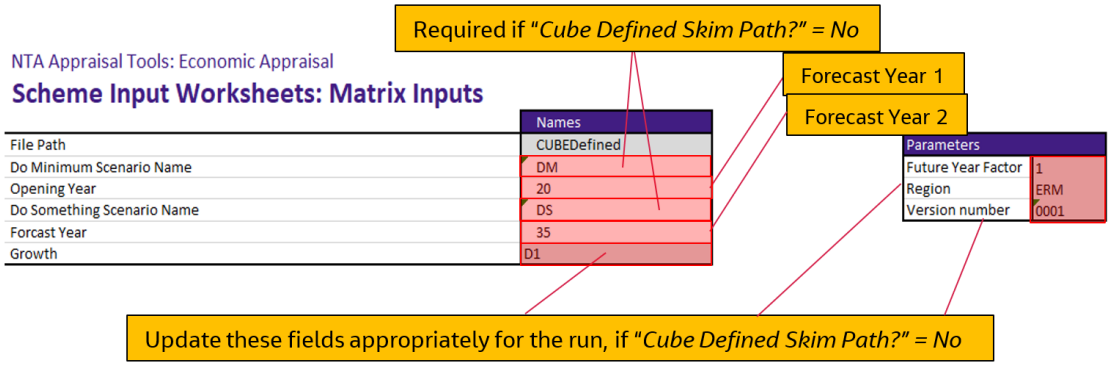

Figure 4.3 Matrix Inputs Tab – Purpose 1

7) Go to Step 11

PURPOSE 2

4.3 Purpose 2 – Set up scheme parameters

8) Complete the tab "**TUBA Run**"

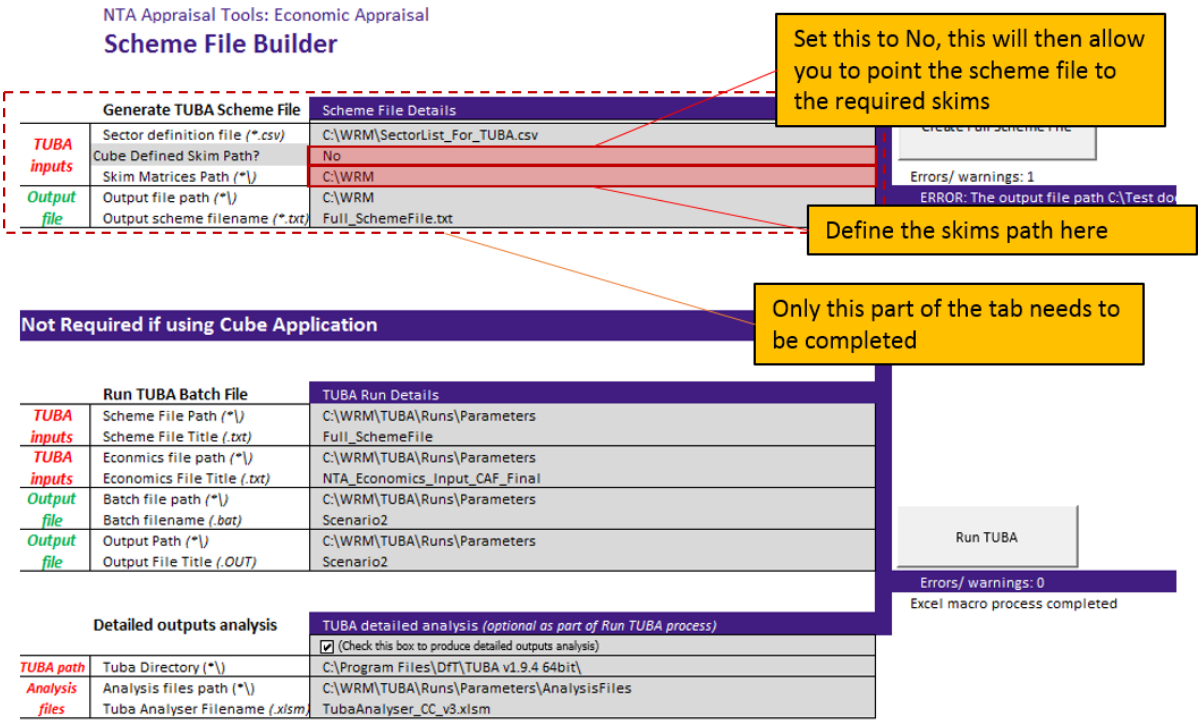

Figure 4.4 TUBA Run tab – Purpose 2

9) Complete the tab "**Scheme Inputs**" - The Scheme Inputs tab contains the basic information required for the scheme file including model names, various year definitions and time slices.

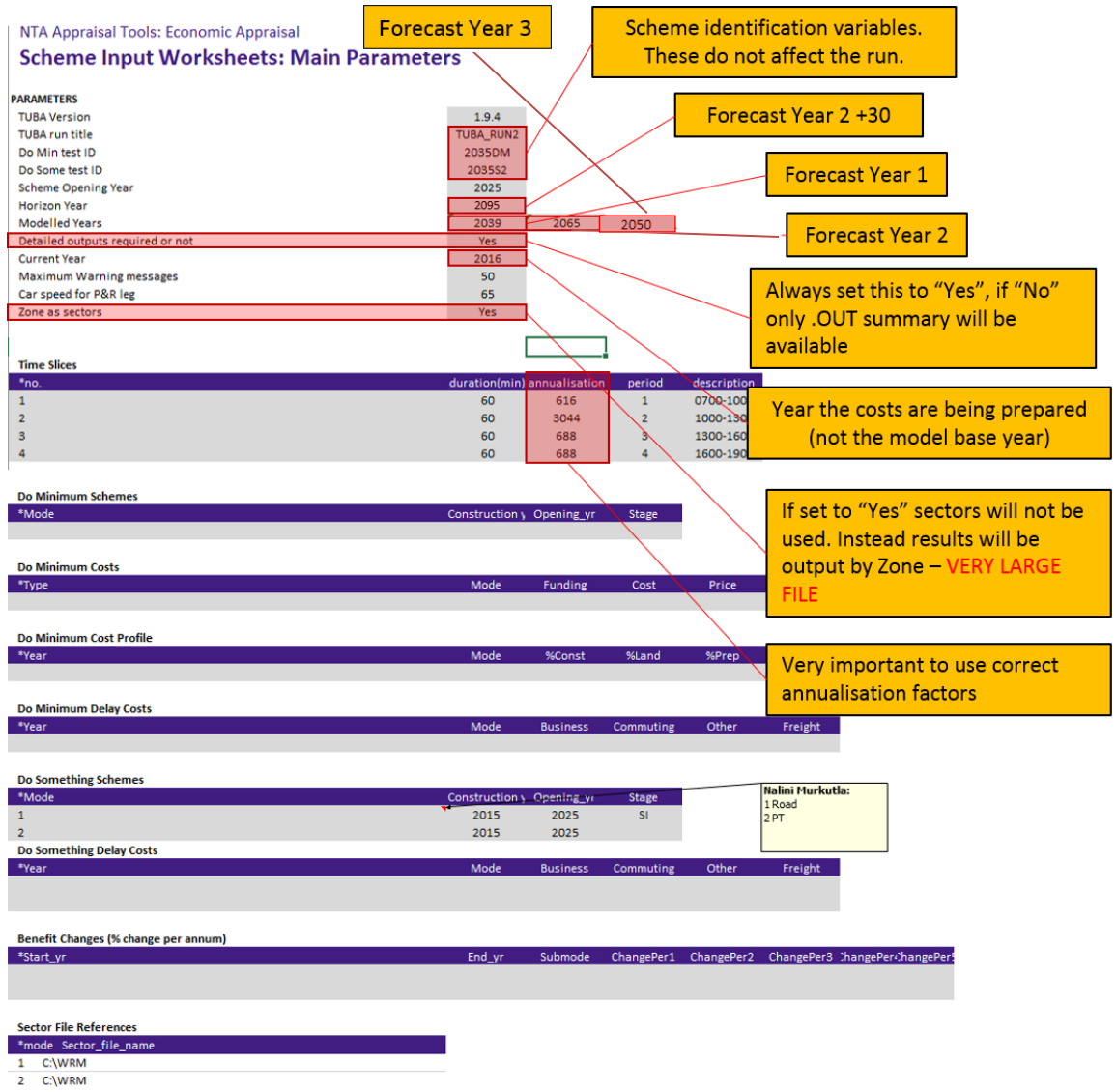

Figure 4.5 Scheme Inputs Tab

10) Complete the tab "**Matrix Inputs**" - The Matrix Inputs tab allows the user to define the location of the skim files created during the Cube TUBA output process. This section also allows factoring of demand to simulate a future year.

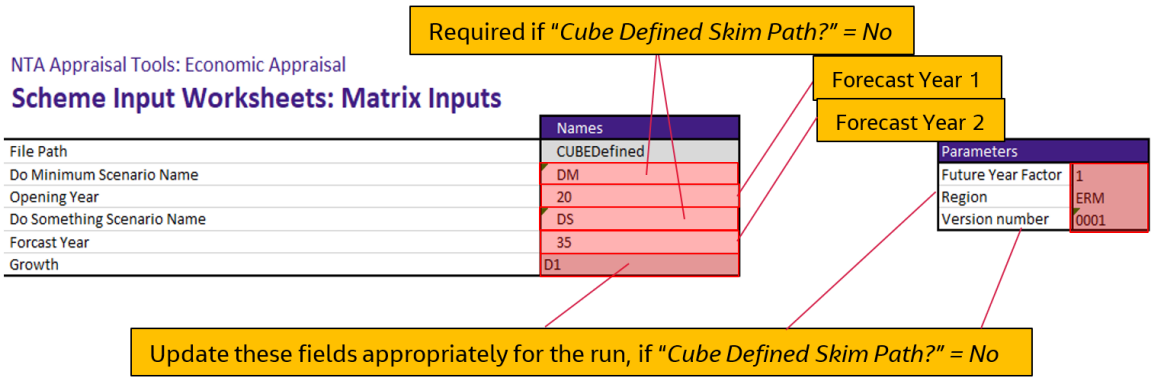

Figure 4.6 Matrix Inputs Tab

4.4 Scheme File Costs (All Purposes)

11) Complete the tab "**Cost Main Parameters**" - The Cost Main Parameters tab includes information on the level of cost detail, time span of assessment, risk allowance and inflation.

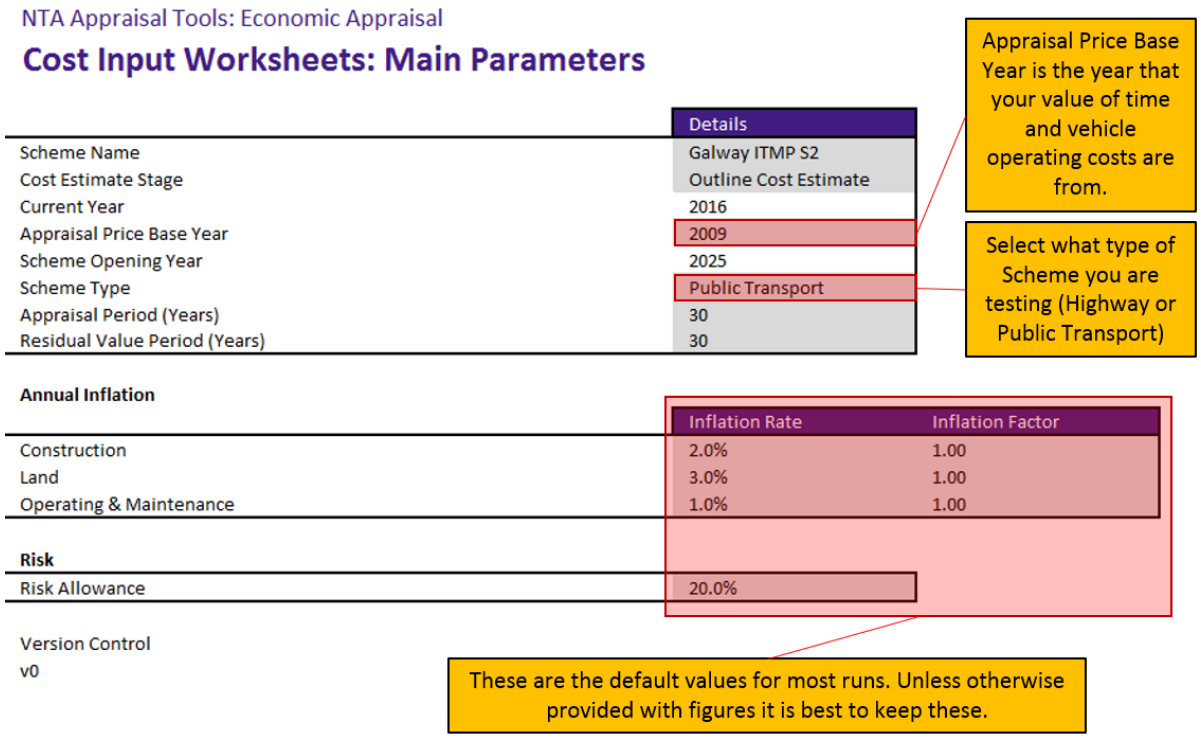

Figure 4.7 Cost Main Parameters Tab

12) Complete the tab "**Capital Cost Inputs**" - The Capital Costs Input tab is where the costs of the project are defined and automatically adjusted to base year prices (to match economics file). The cost spread for capital cost can be entered in value per year *OR* as a percentage of total cost per year (from which the cost per year will be automatically entered).

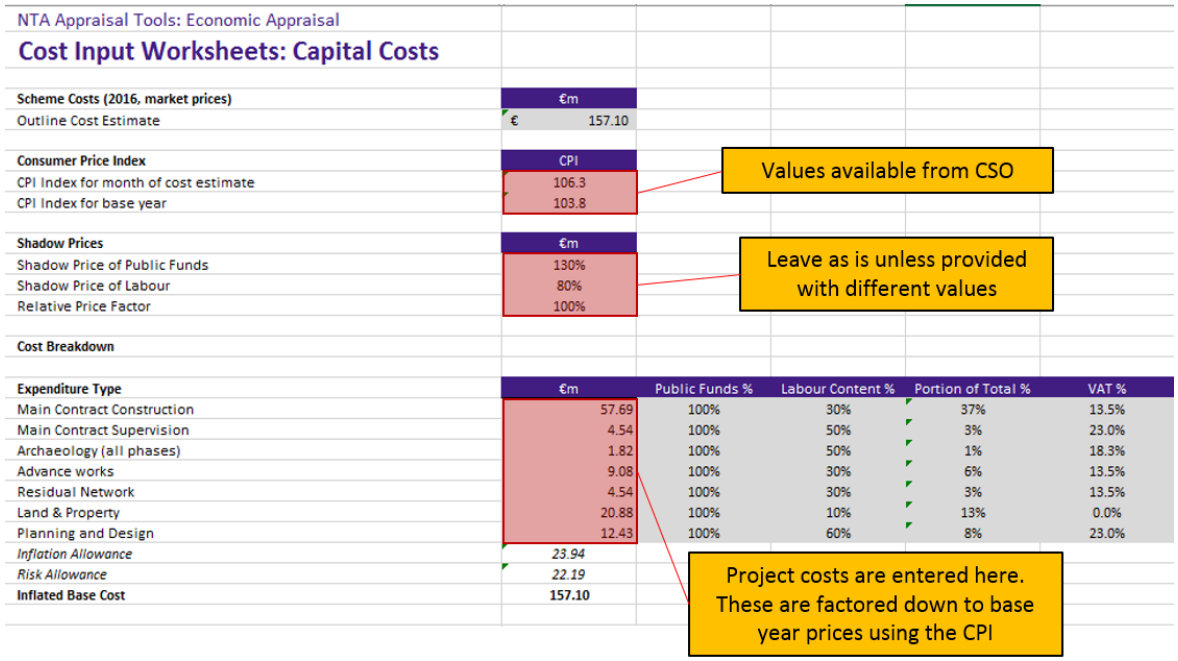

Figure 4.8 Capital Cost Inputs tab (1 of 2)

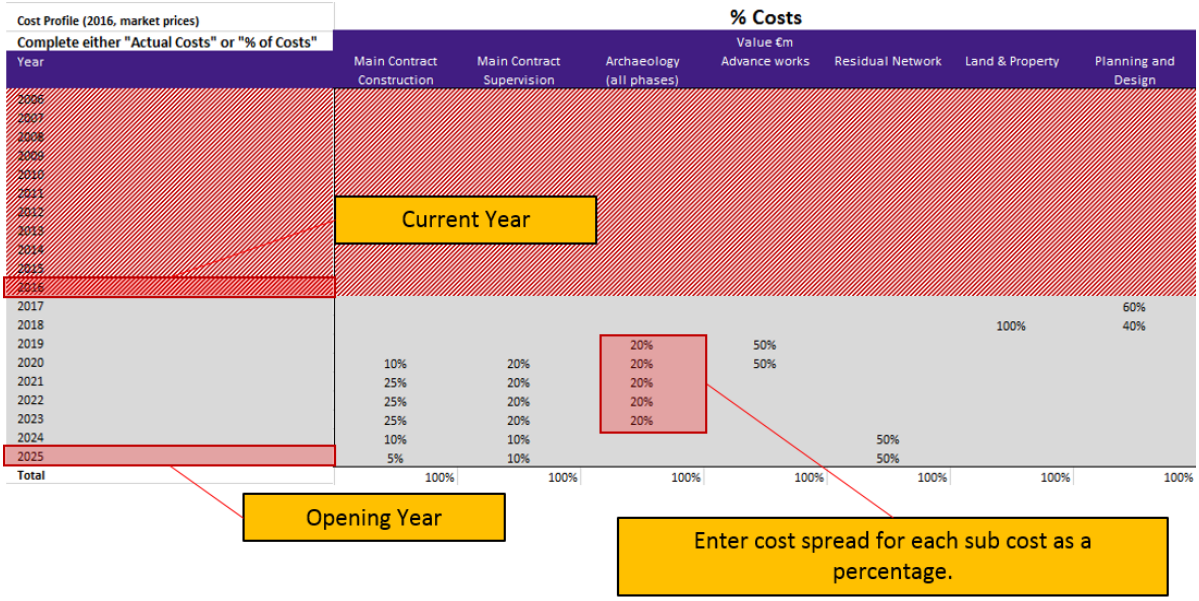

Figure 4.9 Capital Costs Inputs tab (2 of 2)

13) If creating a scheme file for a Public Transport Scheme continue with step 14, if creating a scheme file for a Highway Scheme go to step 18.

PUBLIC TRANSPORT SCHEME FILE

4.5 Public Transport Relevant Costs

14) Complete the "**Annual O&M Costs Inputs**" tab if required - The Annual O&M Cost Input allows Operation and Maintenance annual costs to be entered. If the maintenance costs required are not yearly then the costs should be entered in the Segmented Maintenance tab. Maintenance costs for new roads should be entered into the Annual Road Maintenance tab.

Figure 4.10 Annual O&M Costs Inputs tab (Public Transport)

NTA Appraisal Tools: Economic Appraisal

Cost Input Worksheets: Annual O&M Costs (Public Transport)

Operations	€m	Labour Content %	Public Funds %	Apply	Apply
Staff	10.94	100%	100%	8.752	11.3776
Traction				0	0
Insurance				0	0
Other				0	0

Leave Following Blank if No Annual Maintainance

Vehicles	€m	Labour Content %	Public Funds %		
Routine Maintenance		60%	100%	0	0
Additional Works				0	0
Depot				0	0

Infrastructure	€m	Labour Content %	Public Funds %		
Landscaping				0	0
Road Maintenance				0	0
Track Maintenance				0	0
Tunnel Maintenance				0	0

Other Infrastructure	€m	Labour Content %	Public Funds %		
Routine Maintenance	0.00	60%	100%	0	0
Additional Maintenance				0	0

Complete these sections as needed

	€m
Subtotal	10.94
	%
Contingency	0%
	€m
Total Annual O&M Costs (€m, factor costs, 2016 prices, incl. contigency & shadow prices)	*11.38*
	€m
Total Annual O&M Costs (€m, factor costs, 2009 prices, incl. shadow prices)	11.11

15) Complete the "**Segmented Maintenance**" tab if required - The Segmented Maintenance tab allows inclusion of maintenance costs that only occur every x number of years, as is common for Public Transport.

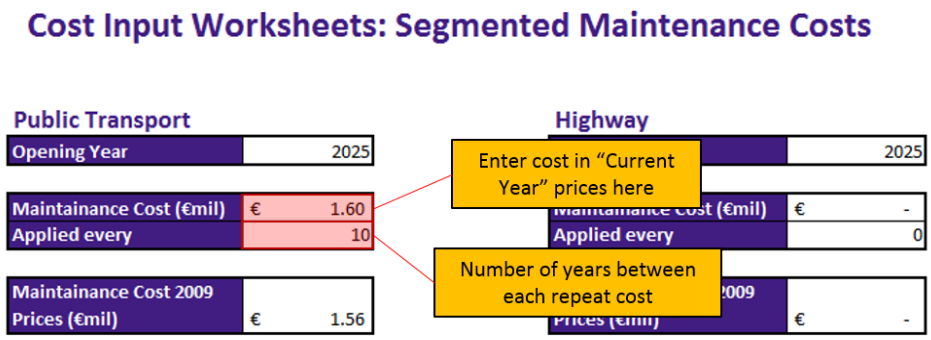

Figure 4.11 Segmented Maintenance tab (Public Transport)

16) Complete the "**Vehicle Fleet Requirements**" tab if required - The Vehicle Fleet Requirements allows costs for fleet purchase and fleet renewal costs to be included in the costs. This should only be filled in if costs are not previously included in capital costs and segmented maintenance.

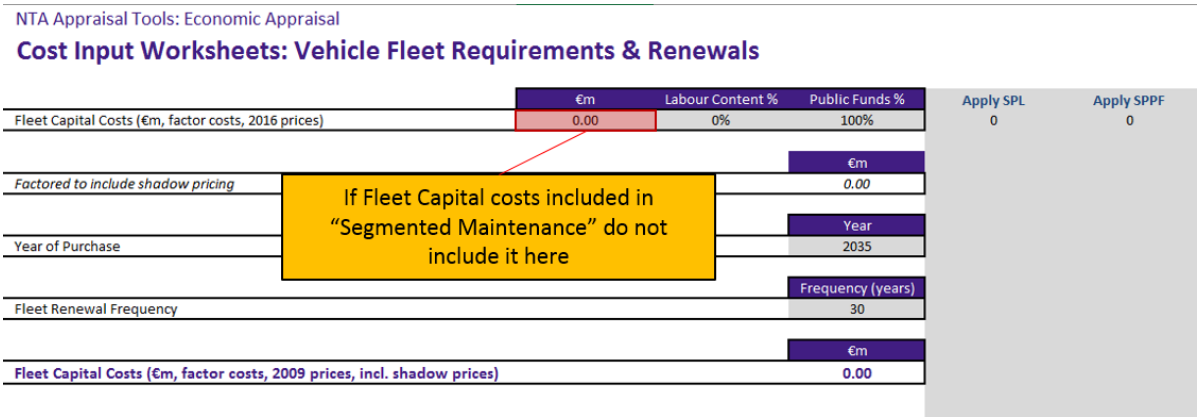

Figure 4.12 Vehicle Fleet Requirements tab (Public Transport)

17) Go to step 20

HIGHWAY SCHEME FILE

4.6 Highway Relevant Costs

18) Complete the "**Annual Road Maintenance**" tab - The Annual Road Maintenance tab allows the user to calculate and include annual maintenance costs for schemes with new roads.

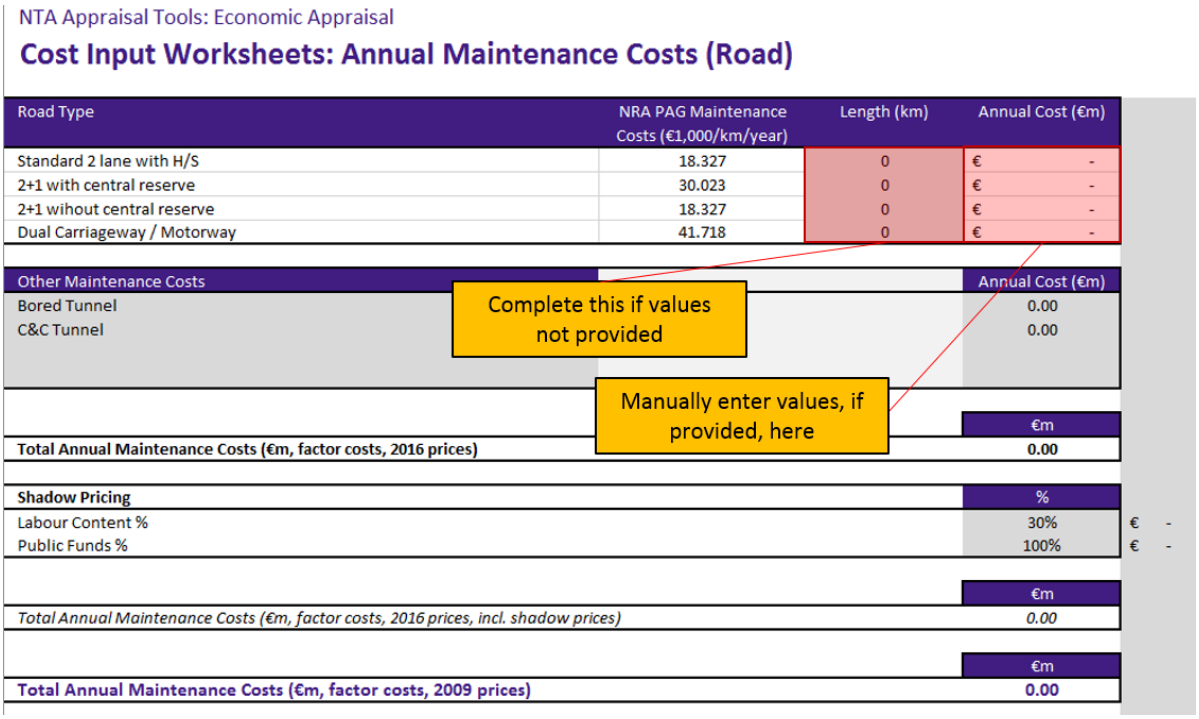

Figure 4.13 Annual Maintenance Tab (Highway)

19) Complete the "**Segmented Maintenance**" tab if required - The Segmented Maintenance tab allows inclusion of maintenance costs that only occur every x number of years, this could be due to bridge or tunnel overhauls.

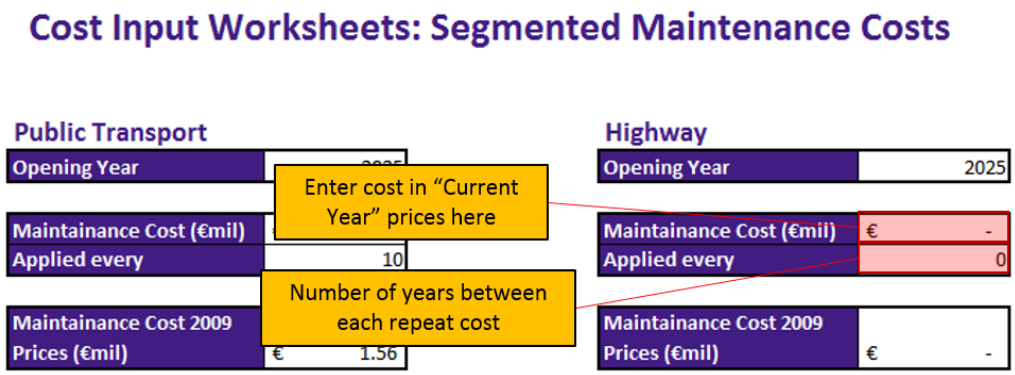

Figure 4.14 Segmented Maintenance tab (Public Transport)

4.7 Export Scheme File (All Purposes)

20) Export the scheme file via the tab "Scheme Inputs"

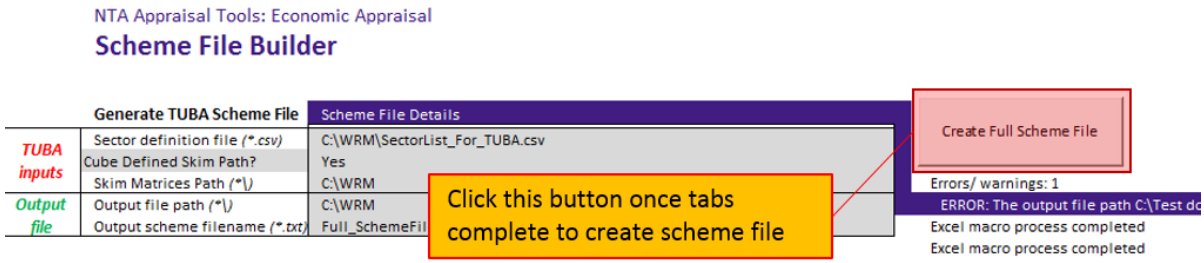

Figure 4.15 Export Scheme File

The above steps exports the scheme file as a text document. The costs and costs profile are not exported by this step. The following step, step 21, needs to be undertaken to obtain these.

21) Copy the contents of Column A of sheet "NTA Standard Cost Spreadsheet" and paste into the newly created scheme file replacing DO_SOM_COSTS and DO_SOME_PROFILE

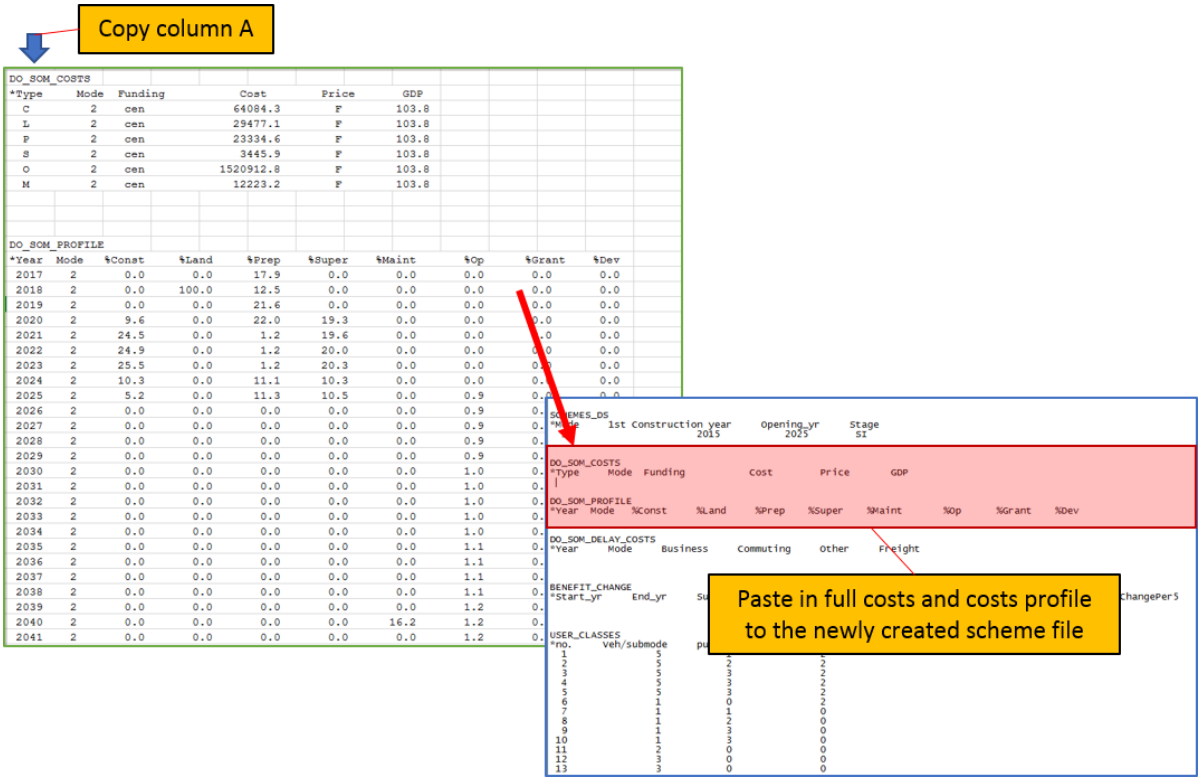

Figure 4.16 Copy out costs profile

22) Continue to checking

4.8 Checking

The following are checks that must be undertaken before moving onto the next section;

- Is "detail" set to Yes in the parameters of the scheme file? (Figure 4.17)
- If no sector system is being used, or the TUBA run is for the Accessibility and Social Inclusion Tool, is "zones_as_sectors" equal to Yes? (Figure 4.17)
- If a sector system is being used (required if using TUBA analyser) is "zones_as_sectors" equal No? (Figure 4.17)

PARAMETERS		
TUBA_version	1.9.4	
run_name	TUBA_RUN1	
do_min_name	ACJ	
do_som_name	ACL	
first_yr	2027	
horizon_yr	2087	
modelled_yrs	2027	2057
detail	Yes	
current_yr	2017	
print_warn	50	
P&R_car_speed	65	
zones_as_sectors	Yes	

Figure 4.17 Parameter table of typical scheme file

- Does the scheme cost profile add up to 100% for each column? (Figure 4.18)

Sum these columns to ensure they add up to 100%. If they do not correct the final year as required.

DO_SOM_PROFILE

*Year	Mode	%Const	%Land	%Prep	%Super	%Maint	%Op	%Grant	%Dev
2018	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2019	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2020	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2021	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2022	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2023	2	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2024	2	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	2	9.8	24.1	0.0	0.0	0.0	0.0	0.0	0.0
2026	2	19.9	24.7	0.0	0.0	0.0	0.0	0.0	0.0
2027	2	20.2	25.3	0.0	0.0	0.0	1.2	0.0	0.0
2028	2	20.6	25.9	0.0	0.0	0.0	1.2	0.0	0.0
2029	2	10.4	0.0	0.0	0.0	0.0	1.2	0.0	0.0
2030	2	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0
2031	2	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0
2032	2	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0
2033	2	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0
2034	2	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0
2035	2	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0
2036	2	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0
2037	2	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0
2038	2	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0
2039	2	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0

Figure 4.18 Do Something Profile in Scheme File

- Are the correct base reference matrices in {Catalog dir}\Program\Base_Ref_Mats?

5 CUBE Process (Process 2)

Figure 5.1 shows the main Cube view seen by the user when opening Cube with annotation describing the main sections.

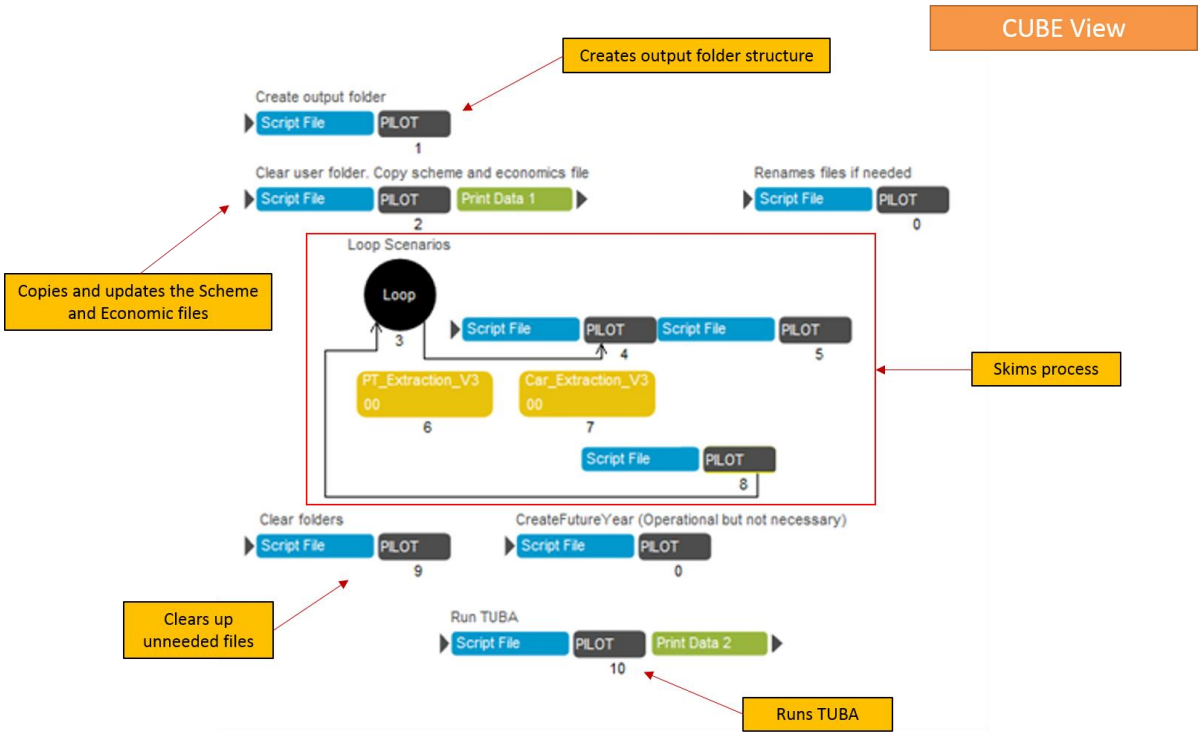

Figure 5.1 Cube process as seen by the user

The CUBE process removes very small ($<10^{-10}$) values and negative values from the demand matrices, as these interfere with the TUBA process. These values get combined and presented in text files, in the following directory: {Catalog dir}\Program\Analysis\SmallNumAndNegNumLogs. These files get produced per run by the following naming convention: {Regional Model}_{Year}_{Run ID}_ SmallNumAndNegNumLog_(User Type).

PURPOSE 1

5.1 Process (Full Run – Purpose 1)

This step assumes you have a checked Scheme file ready to use.

This process tree covers a full run of the Cube Process and assumes that you have a checked scheme file and intend to run TUBA.

1) Copy the latest version of the Economic Module from the network to the local C Drive (see Section 3 for link)
2) Create the folder structure as described in Appendix A, and ensure files are copied to the correct location.

3) Open Cube and allow it to update all file paths. (Figure 5.2)

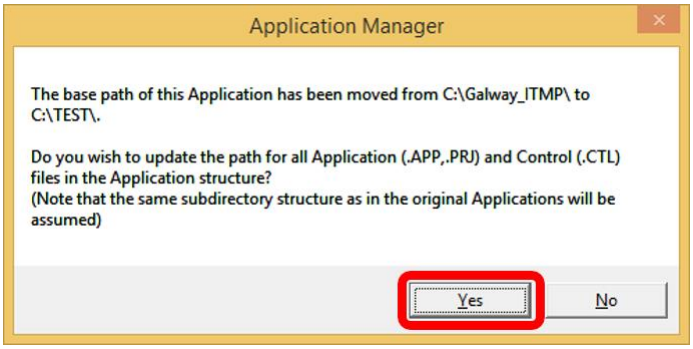

Figure 5.2 Cube prompt to update links

4) Create a new "child" under the correct regional model. This will create a new scenario with the regional model defaults included.

5) Open the new scenario key entry and complete the keys as shown below. Alternatively see Figure 5.4 to 5.7 for a view of the key entries.

Key	Value to be Entered (Purpose 1)
Keys Page 1 (Figure 5.4)	
Region	ERM, WRM, SWRM, SERM, MWRM
Zones	1953 (ERM), 836 (WRM), 834 (SWRM), 654 (SERM), 650 (MWRM)
Temp SATURN Folder	C:\ST
SATWIN Directory	C:\SATWIN\XEXES (Check local machine)
Skims Only?	False
Scheme File Path	File path of Scheme File including scheme file name.
Economic File Path	File path of Economic File inclusion file name.
Tuba Installation	'C:\Program Files\DfT\TUBA v1.9.14 64bit\tuba_g.exe' (Check local machine)
RunTuba	True
Keys Page 2 (Figure 5.5)	
Do Minimum Forecast Year 1	True
Run from remote location	True if model run on the network, false if running from model run catalog directory
Run Folder Directory	Model Run Catalog Directory\Runs
Do Something Forecast Year 1	True

Run from remote location	True if model run on the network, false if running from model run catalog directory
Run Folder Directory	Model Run Catalog Directory\Runs
Forecast Year 1	First forecast year in YY format
DM Run ID	Do Minimum Run ID
DS Run ID	Do Something Run ID
Growth	Demand for first forecast year
Keys Page 3 (Figure 5.6)	
Do Minimum Forecast Year 2	True
Run from remote location	True if model run on the network, false if running from model run catalog directory
Run Folder Directory	Model Run Catalog Directory\Runs
Do Something Forecast Year 2	True
Run from remote location	True if model run on the network, false if running from model run catalog directory
Run Folder Directory	Model Run Catalog Directory\Runs
Forecast Year 2	Second forecast year in YY format
DM Run ID	Do Minimum Run ID
DS Run ID	Do Something Run ID
Growth	Demand for second forecast year
Keys Page 4 (Figure 5.7)	
Do Minimum Forecast Year 3	True
Run from remote location	True if model run on the network, false if running from model run catalog directory
Run Folder Directory	Model Run Catalog Directory\Runs
Do Something Forecast Year 3	True
Run from remote location	True if model run on the network, false if running from model run catalog directory
Run Folder Directory	Model Run Catalog Directory\Runs
Forecast Year 3	Third forecast year in YY format
DM Run ID	Do Minimum Run ID
DS Run ID	Do Something Run ID
Growth	Demand for third forecast year

5.2 Checking (Purpose 1)

The following are checks that must be undertaken before moving onto the next section;

- Are you using the latest version of the tool taken from the network?
- Does the zone number entered in the key match the number of zones in the model?
- Have you unticked *Skims Only*?
- Have you ticked the boxes for each scenario you wish to run?
- Have you ticked *RunTuba*?

Once these checks are complete press "Run" on the keys page. Output summary files from TUBA will be found in the Do Something run folder. For detailed outputs got to Section 5.2.

PURPOSE 2

5.3 Process (Partial Run – Purpose 2)

This step assumes you have scheme files for each run you intend to do checked and with correct file paths.

This process covers how to use the module to produce up to six sets of skims at a time for up to two different demand sets and years.

1) Copy down the latest version of the Economic Module from the network to the local C Drive.
2) Create the folder structure as described in Appendix A, and ensure files are copied to the correct location.
3) Open Cube and allow it to update all file paths. (Figure 5.3)

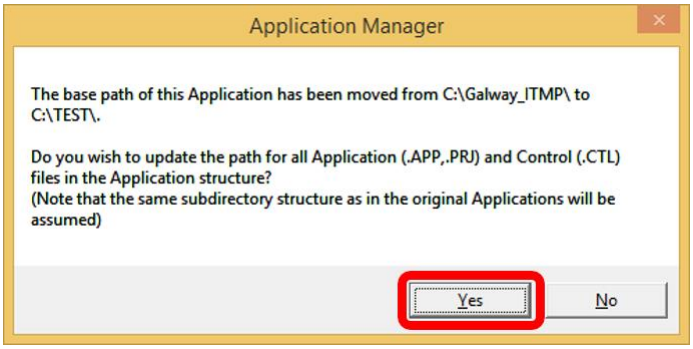

Figure 5.3 Cube prompt to update links

4) Create a new "child" under the correct regional model. This will create a new scenario with the regional model defaults included.
5) Open the new scenario key entry and complete the keys as shown below. Alternatively see Figure 5.8 to 5.11 for a view of the key entries.

Key	Value to be Entered (Purpose 2)
Keys Page 1 (Figure 5.8)	
Region	ERM, WRM, SWRM, SERM, MWRM
Zones	1953 (ERM), 836 (WRM), 834 (SWRM), 654 (SERM), 650 (MWRM)

Temp SATURN Folder	C:\ST
SATWIN Directory	C:\SATWIN\XEXES (Check local machine)
Skims Only?	True
Scheme File Path	A – Placeholder value as key not used
Economic File Path	A – Placeholder value as key not used
Tuba Installation	'C:\Program Files\DfT\TUBA v1.9.14 64bit\tuba_g.exe' (Check local machine)
RunTuba	False
Keys Page 2 (Figure 5.9)	
Do Minimum Forecast Year 1	True – Will include this model run, can be run without
Run from remote location	True – CUBE will take the next key as the run path False – CUBE will use the current Catalog Directory
Run Folder Directory	Model Run Catalog Directory\Runs
Do Something Forecast Year 1	True – Will include this model run, can be run without
Run from remote location	True – CUBE will take the next key as the run path False – CUBE will use the current Catalog Directory
Run Folder Directory	Model Run Catalog Directory\Runs
Forecast Year 1	Year of input runs in YY format
DM Run ID	First run with same demand as defined by Growth key and year defined by *Forecast Year 1* key.
DS Run ID	Second run with same demand as defined by Growth key and year defined by *Forecast Year 1* key.
Growth	Demand for input runs
Keys Page 3 (Figure 5.10)	
Do Minimum Forecast Year 2	True – Will include this model run, can be run without
Run from remote location	True – CUBE will take the next key as the run path False – CUBE will use the current Catalog Directory

Run Folder Directory	Model Run Catalog Directory\Runs
Do Something Forecast Year 2	True – Will include this model run, can be run without
Run from remote location	True – CUBE will take the next key as the run path False – CUBE will use the current Catalog Directory
Run Folder Directory	Model Run Catalog Directory\Runs
Forecast Year 2	Year of input runs in YY format
DM Run ID	First run with same demand as defined by Growth key and year defined by *Forecast Year 2* key.
DS Run ID	Second run with same demand as defined by Growth key and year defined by *Forecast Year 2* key.
Growth	Demand for input runs
Keys Page 3 (Figure 5.11)	
Do Minimum Forecast Year 3	True – Will include this model run, can be run without
Run from remote location	True – CUBE will take the next key as the run path False – CUBE will use the current Catalog Directory
Run Folder Directory	Model Run Catalog Directory\Runs
Do Something Forecast Year 3	True – Will include this model run, can be run without
Run from remote location	True – CUBE will take the next key as the run path False – CUBE will use the current Catalog Directory
Run Folder Directory	Model Run Catalog Directory\Runs
Forecast Year 3	Year of input runs in YY format
DM Run ID	First run with same demand as defined by Growth key and year defined by *Forecast Year 3* key.
DS Run ID	Second run with same demand as defined by Growth key and year defined by *Forecast Year 3* key.
Growth	Demand for input runs

5.4 Checking (Purpose 2)

The following are checks that must be undertaken before moving onto the next section;

- Are you using the latest version of the tool taken from the network?
- Does the zone number entered in the key match the number of zones in the model?
- Have you ticked *Skims Only*?
- Have you ticked the boxes for each scenario you wish to run?
- Have you unticked *RunTuba*?

Once these checks are complete press “Run” on the keys page. Output skims can be found in the run folders under the specified years and are ready for use in TUBA, see section 6.

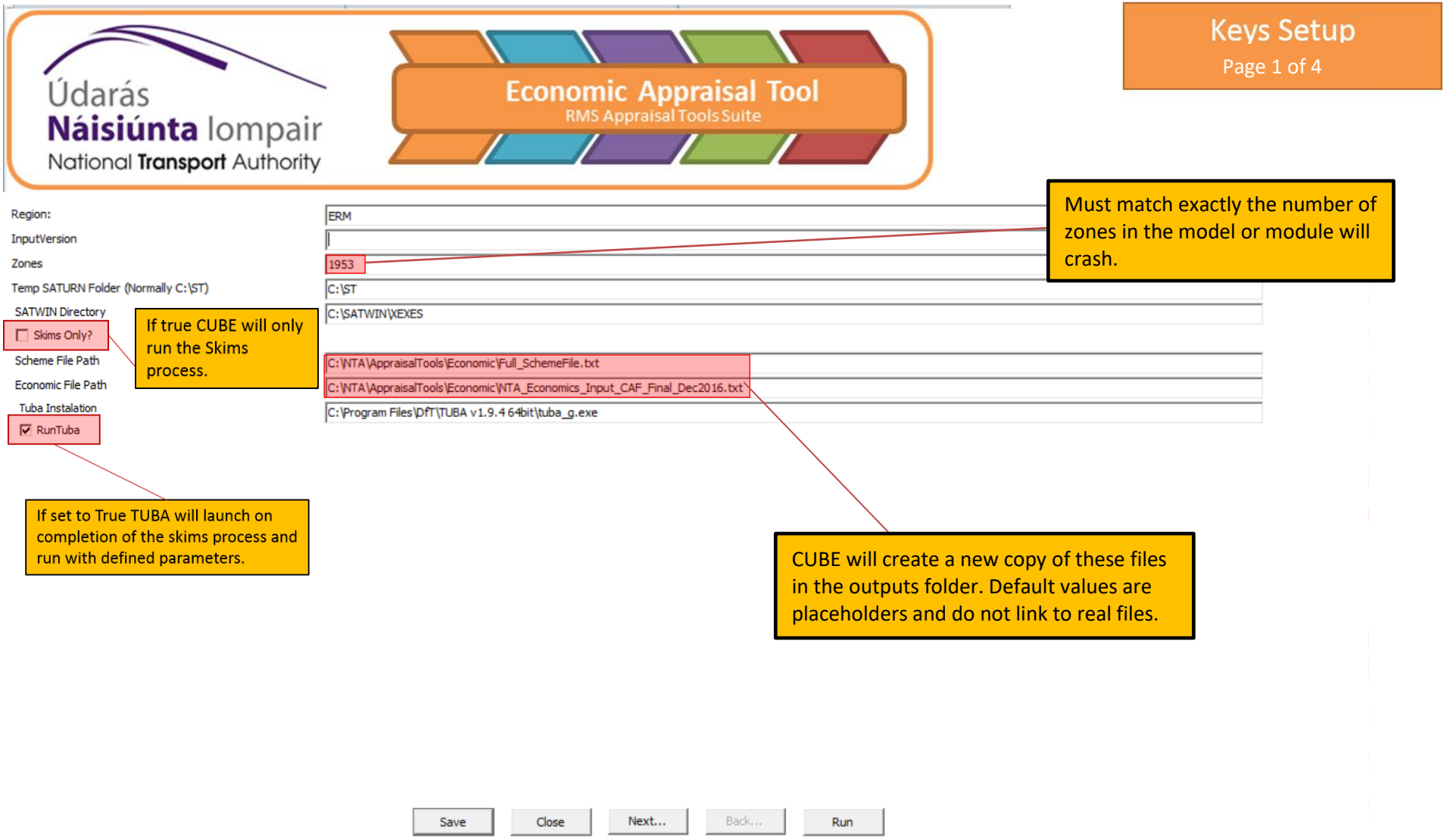

Figure 5.4 CUBE keys page 1

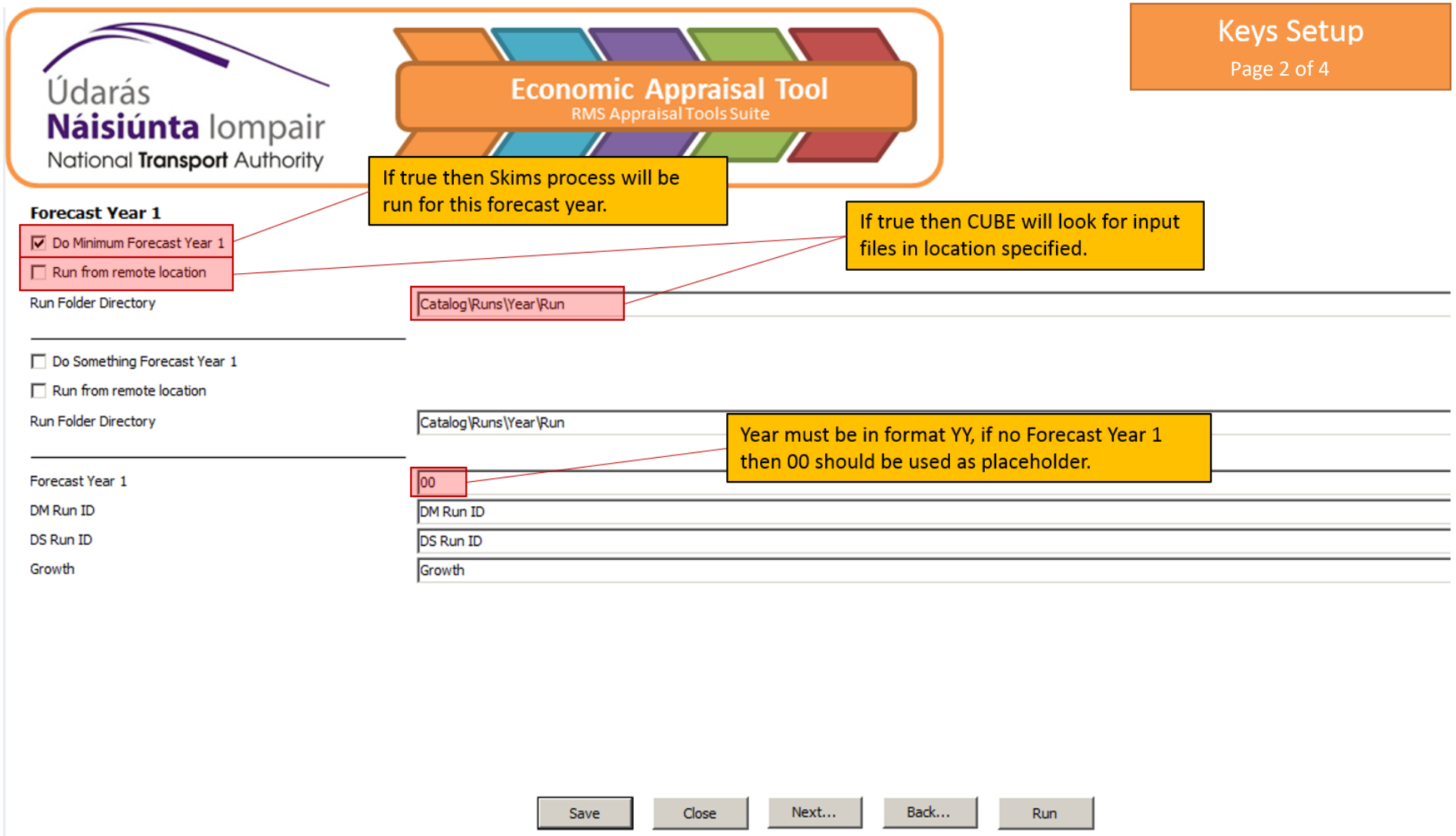

Figure 5.5 CUBE keys page 2

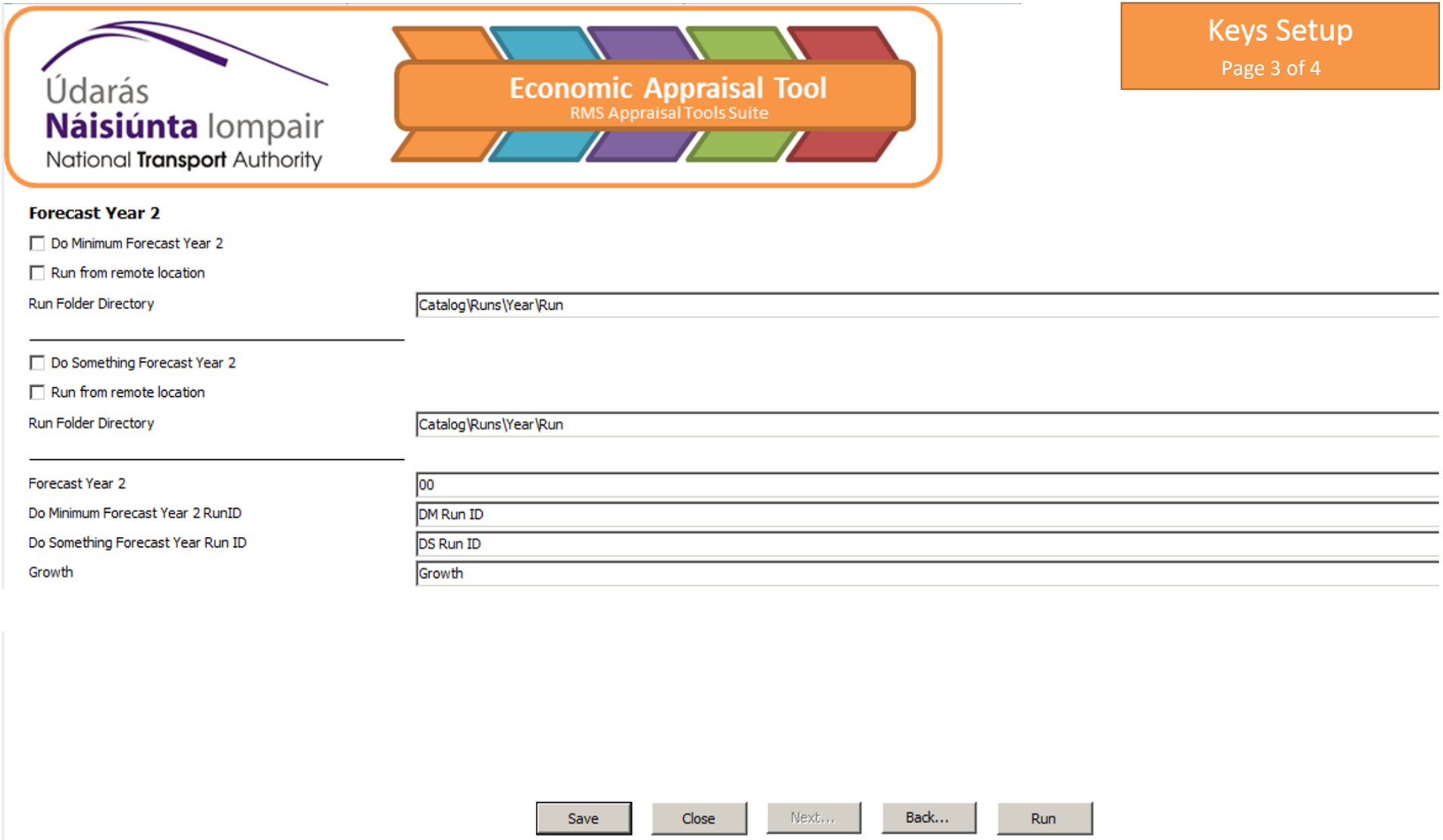

Figure 5.6 CUBE keys page 3

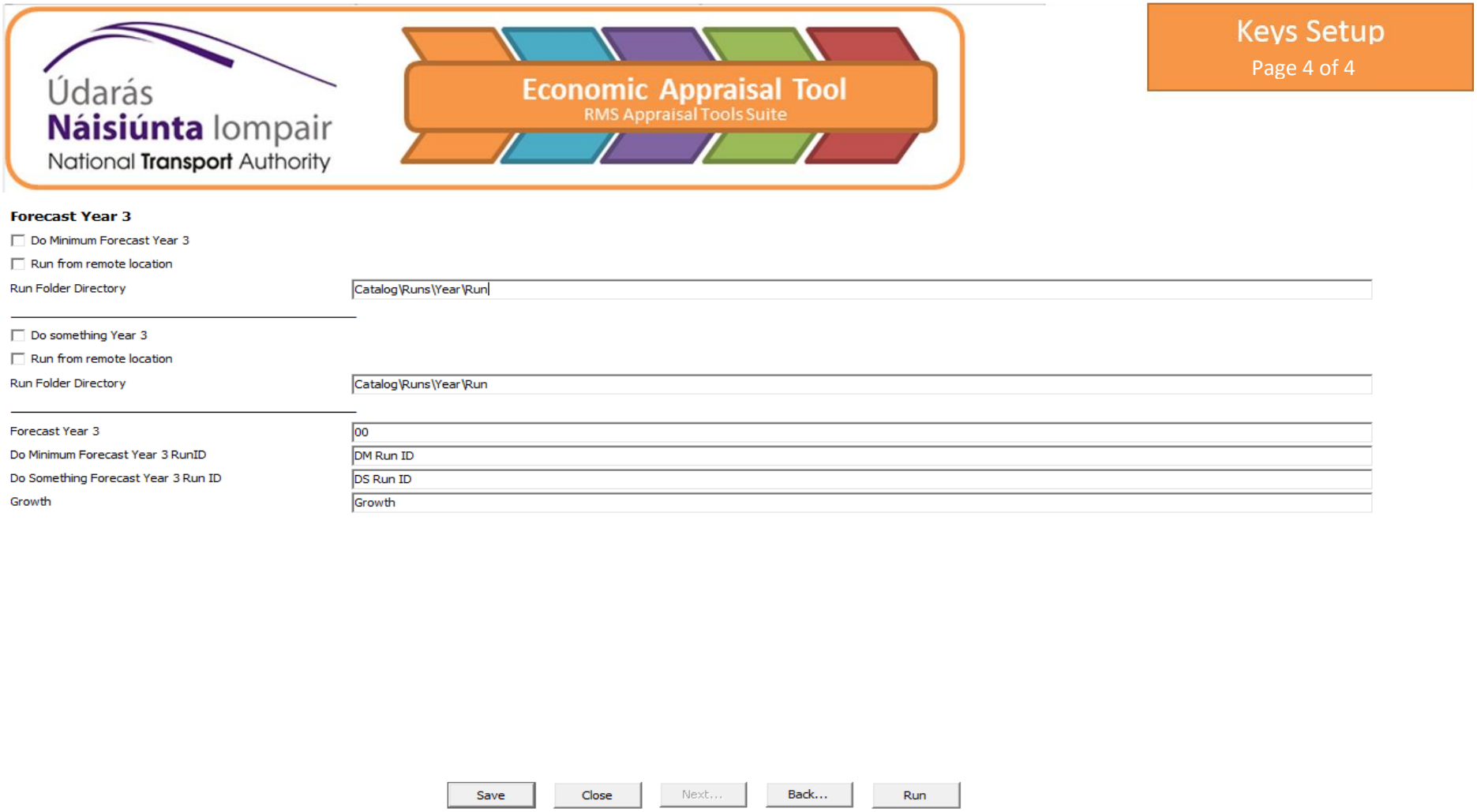

Figure 5.7 CUBE keys page 4

6 TUBA (Process 3)

6.1 Running TUBA Manually

This step assumes you have scheme files for each run you with correct file paths.

1) Open TUBA from the Start Menu
2) Under the start menu select *New* (figure 6.1)
3) Fill in the box with the relevant file paths and tick "Run one user class at a time" (figure 6.2)

If "Run one user class at a time" is not selected then the run will crash.

4) Click OK. If the scheme file and economic file are all correct the window will close. If not, a warning message will appear (see Section 8). If a warning message appears follow the following steps;
   a. Click *View*
   b. Select *Output*, this will open the .OUT file
   c. Use the errors reported in the .OUT file to determine the error.
   d. Repeat from step 2

5) Under start menu select *Save Batch As*
6) Save your run as a batch file somewhere easy to find. This will allow you to reload the run once complete or after a failure.
7) Select *Run > Run Now* (Figure 5.3)
8) **While running TUBA may appear as Not Responding. This is normal. Typical run times are shown in table 6.1 below**;

Table 6.1 Typical runs times for TUBA for a 60 year appraisal period with 3 modelled years.

	Typical Run Time				
Regional Model	**ERM**	**WRM**	**SWRM**	**SERM**	**MWRM**
Run time	9hr 00mins	1hr 45mins	1hr 30mins	0hr 50mins	0hr 55mins

Note: These run times will vary based on the machine that is being used. For all runs at least 32 GB of RAM is recommended. For the ERM 64 GB of RAM is recommended. However, if this is not possible, 32 GB of RAM would work too; the run would just take longer. All these runs were done on a laptop with 32 GB of RAM.

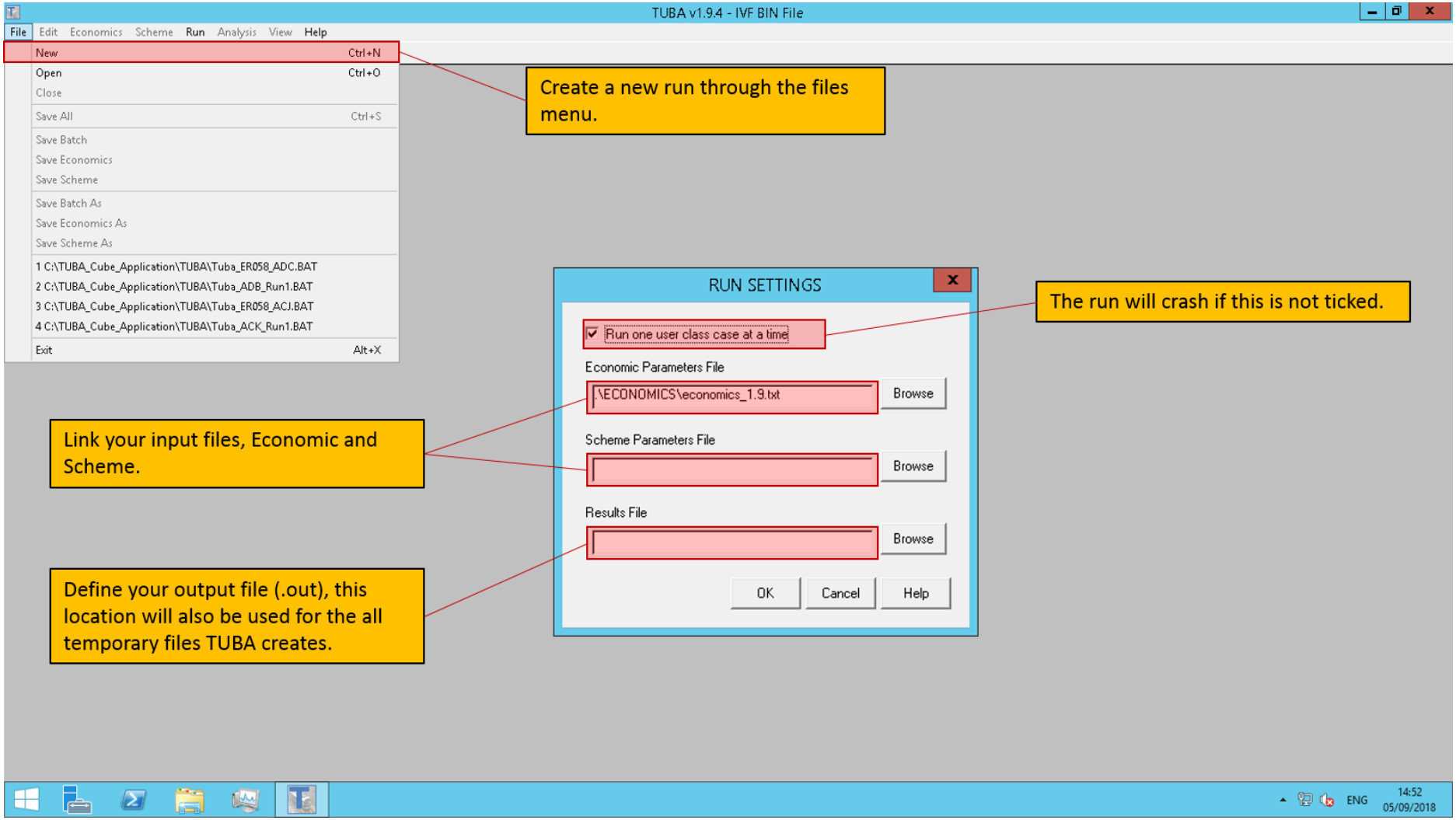

Figure 6.1 Creating a new run in TUBA

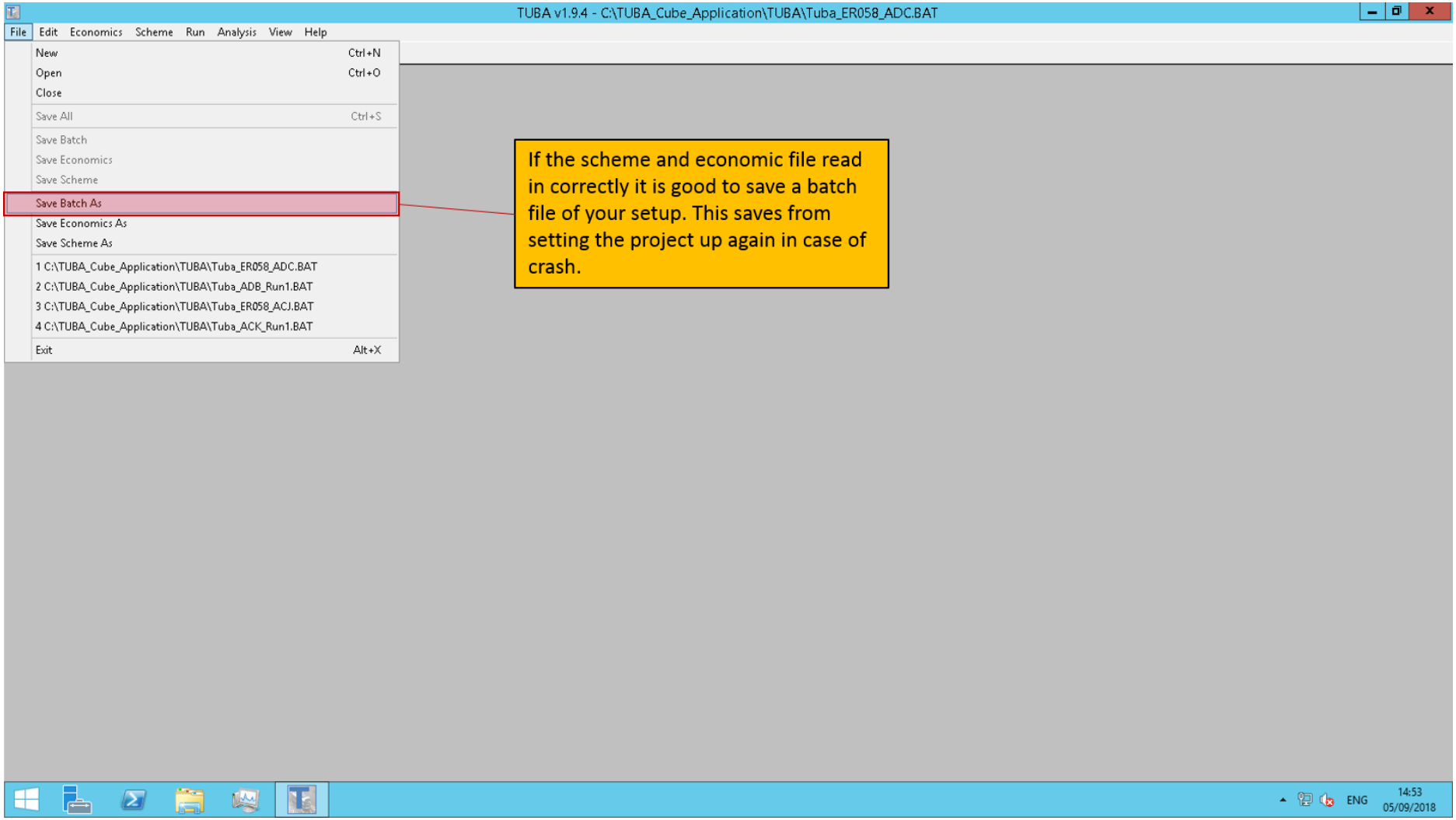

Figure 6.2 Saving batch file in TUBA

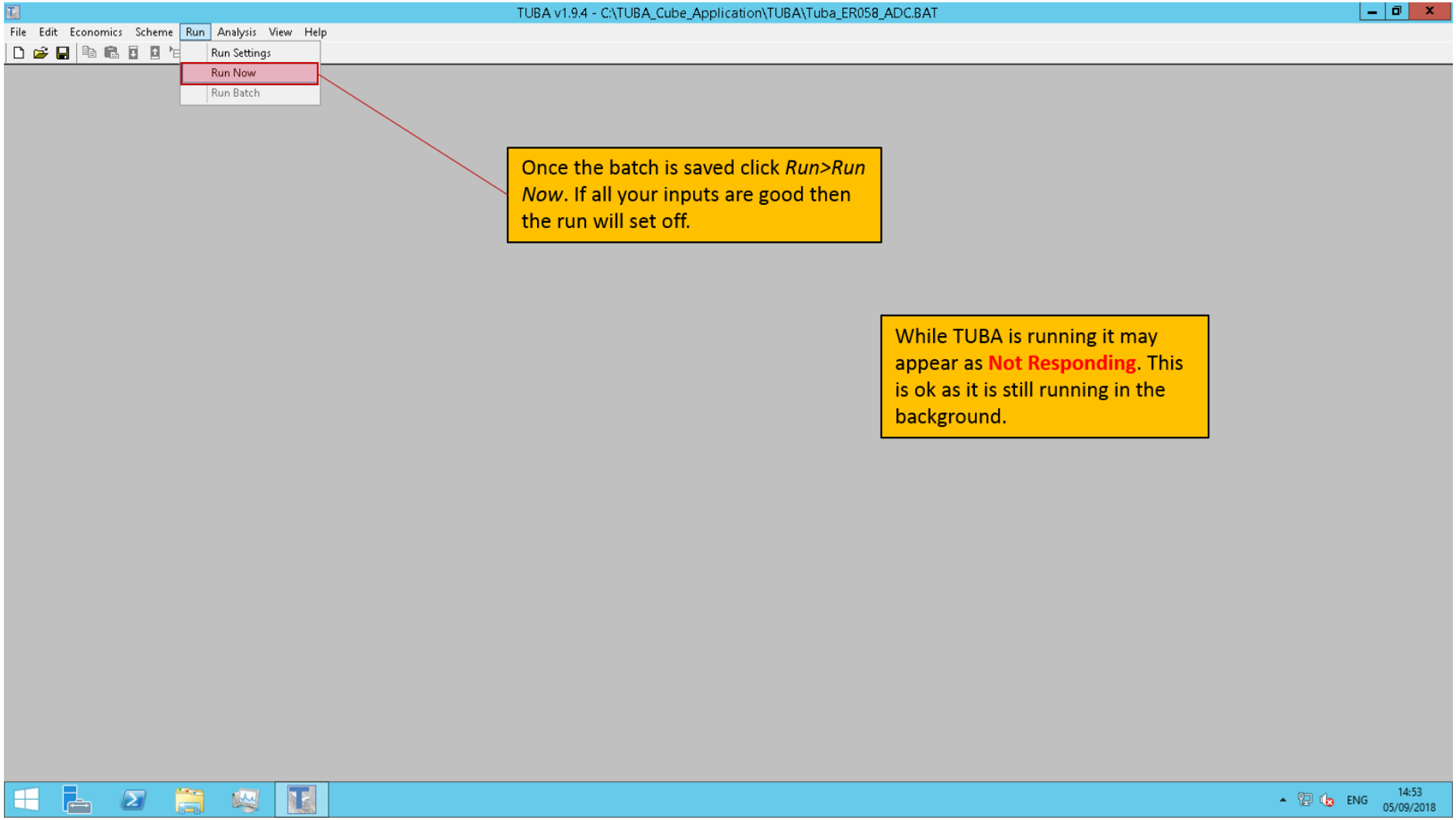

Figure 6.3 Launching a TUBA run

6.2 Detailed Results Extractions

TUBA will automatically produce a .OUT file. At the end of this document you will get a TEE table (Transport Economic Efficiency) which contains the total benefits, costs and BCR see figure 6.4 below for an example;

```
Broad Transport Budget                                    1673959
Present Value of Costs (PVC)                              1673959

OVERALL IMPACTS
Net Present Value (NPV)                                   4621676
Benefit to Cost Ratio (BCR)                                 3.761
```

Figure 6.4 Example of .OUT file with BCR

To extract detailed outputs, benefits by sector, follow the steps below.

This is required to use the TUBA analyser

If TUBA was closed follow these steps first;

1) If TUBA has been closed open TUBA
2) Select *File > Open*
3) Select the batch file for the run and open it

If TUBA was not closed start from here;

4) Select *Analysis > Export Data* (Figure 6.5)
5) In the pop-up box select the year required for analysis. If left as "All" the output CSV will contain every year making the file very large.
6) Specify the location to save the export CSV
7) Click OK. Depending on the size of the data you are exporting this can take time. Table 6.2 below gives a guide to the output file size.

Table 6.2 Approximate file sizes for detailed outputs

Number of Sectors	Number of Rows per Year	Approx. File Size per year
10	5,200	20MB
20	20,800	100MB
30	46,800	230MB
836 (WRM Zones)	36,342,592	75GB
1953 (ERM Zones)	198,338,868	150GB

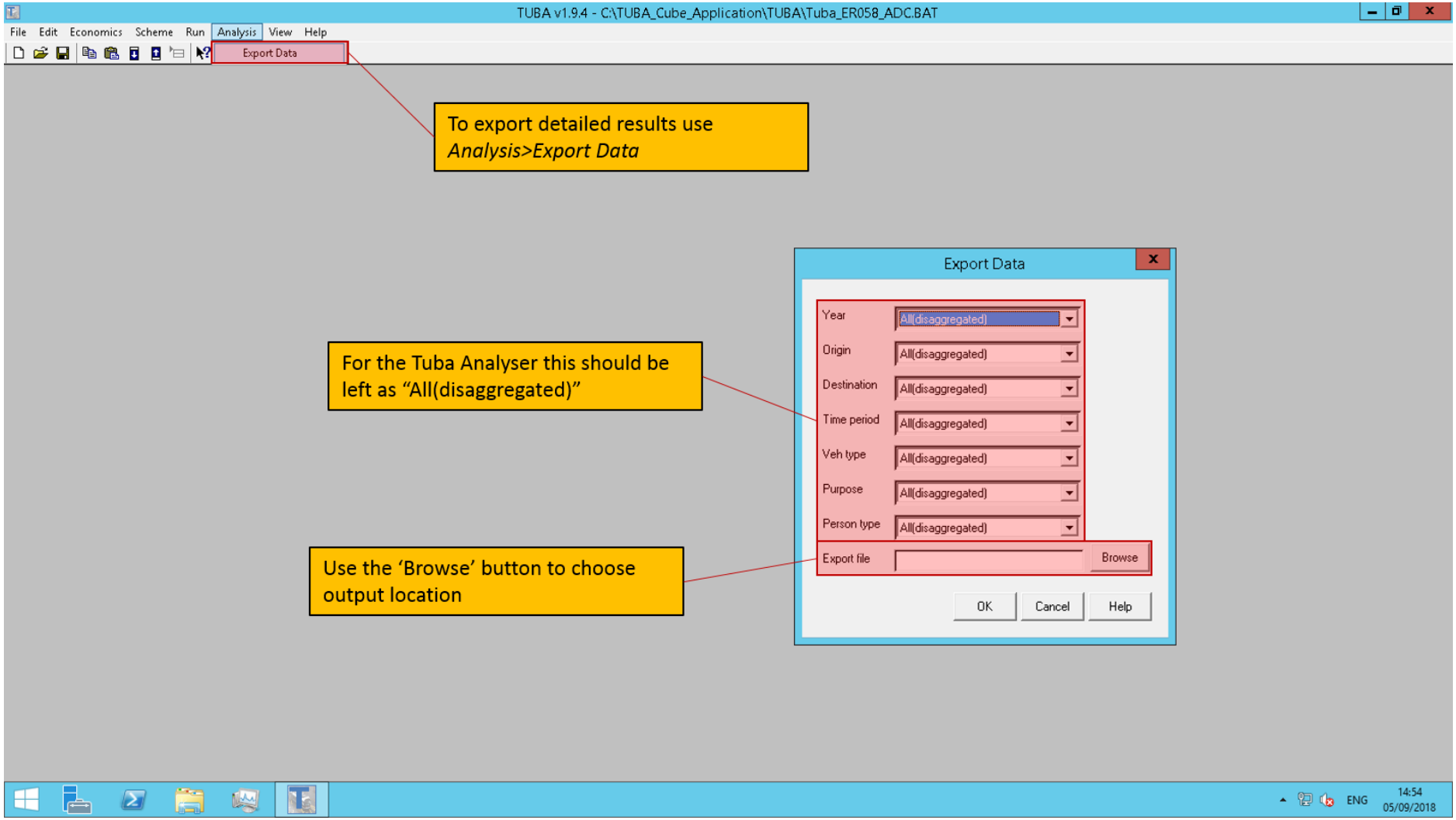

Figure 6.5 Extracting detailed outputs from TUBA

7 TUBA Analyser (Process 4)

The TUBA Analyser spreadsheet can be used to filter the sector to sector results of a TUBA run to reduce noise or focus on one particular area. The process to use the TUBA analyser is set out below;

1) Copy the latest version of the TUBA Analyser to your local C Drive from the main toolkit folder.

Running the TUBA Analyser from the network is not recommended due to the size of the spreadsheet. Note: it currently has a limit of up to around 35 sectors for a 60 year appraisal.

2) Open the workbook and enable macros

3) Fill in the "Inputs" tab

4) Click "Clear all Data Inputs"

5) Click "Click Here to Get Data"

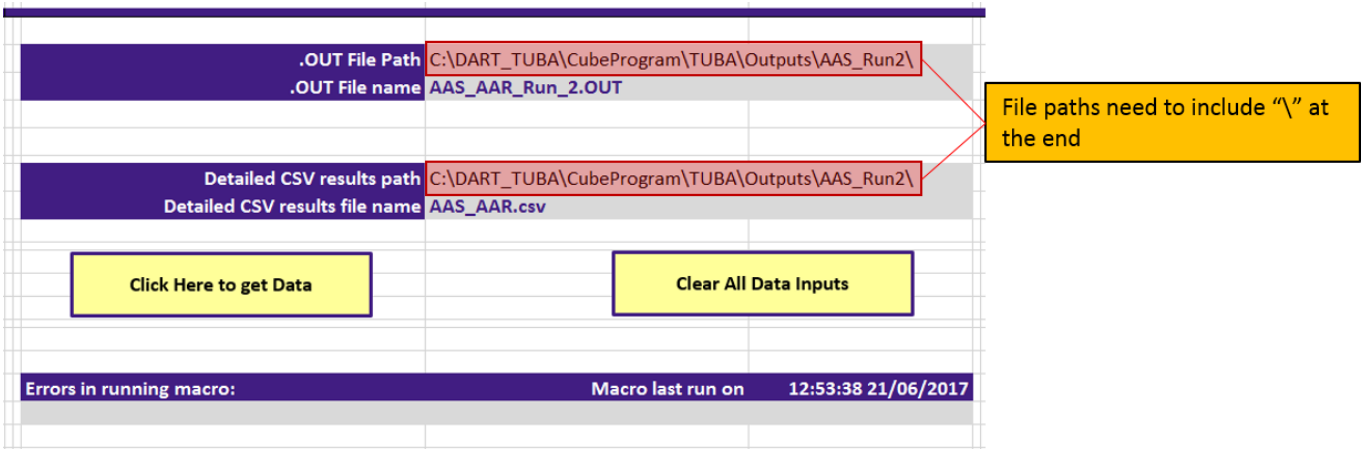

Figure 7.1 Input tab of TUBA Analyser

6) On the "Readme" tab complete the Spreadsheet Options box. Filtered option shown below in Figure 7.2 is covered in step 7.

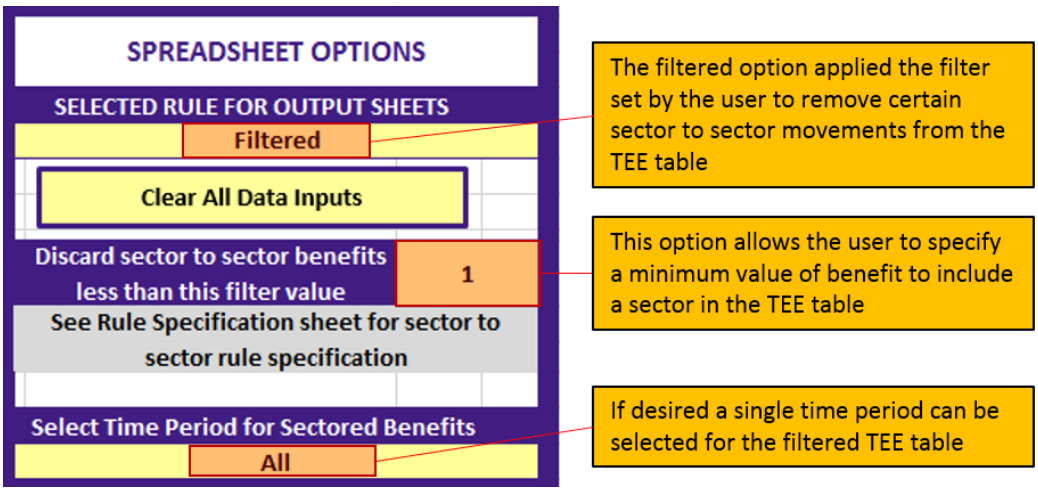

Figure 7.2 Spreadsheet Options table from Readme tab of TUBA Analyser

7) Fill in the "Rule Specification" tab, where 1 includes the benefits between two sectors and 0 excludes it.

		Sector 1	Sector 2	Sector 3	Sector 4	Sector 5
		1	2	3	4	5
Sector 1	1	1	1	1	0	0
Sector 2	2	1	1	1	0	0
Sector 3	3	1	1	1	0	0
Sector 4	4	0	0	0	0	0
Sector 5	5	0	0	0	0	0

Figure 7.3 Example of Filter Matrix in Rule Specification tab of TUBA Analyser

8) The results based on the rules specified will be displayed on the tabs;
   - **TEE Filtered** – A recalculated TEE table excluding any sectors marked for exclusion on the Rule Specification, less than the minimum value or outside the time period.
   - **TEE Unfiltered** – The original TEE table taken from TUBA

8 Troubleshooting

In all cases the print files (.prn for CUBE and .OUT for TUBA) will provide the best clues as to why the run has not worked.

PROBLEM SOFTWARE	PROBLEM	SOLUTION
TUBA	TUBA reports error “Parameters Table Missing”	Scheme text file encoded in incorrect format, should be UTF-8
TUBA	TUBA reports error “Data Repeats”	Tick box under Scheme options to run one user class at a time
TUBA	Dynamic Memory Error	Tick box under Scheme options to run one user class at a time
TUBA	TUBA closes without completion or error message	You have insufficient storage space to continue the assessment
TUBA	No export outputs option	Ensure that "Detail" in the scheme file is set to “Yes”
CUBE	F(222): FILEO PRINTO[1] specified 2 times.	Run all steps prior to Loop manually and then start CUBE run from skims loop
CUBE	ConsoleApplication1 has stopped working	Incorrect Seq_2_Hier.exe in the Params folder, change for the correct .exe for your regional model
CUBE	Program crashes during Highway Skims but does not specify missing or problematic files	Incorrect Zone number entered, CUBE has either underrun or overrun the matrix.

PROBLEM SOFTWARE	PROBLEM	SOLUTION
TUBA	TUBA says a column does not add up to 100%	Check the sums of the cost profile columns and ensure they all add up to 100%
TUBA	Dynamic memory problem	This can occur for several reasons. To solve this, try the following steps: • Make sure there is around 30 – 70 GB of hard disk space free depending on the regional model that is being run. • Close other programs to release RAM during the TUBA run. • Defragment the hard drive if it is close to being full. • Check that the page system file is set to “Automatically manage paging file size for all drives”. Do this by following the following steps below: ○ Press Windows Key + Pause Break from the keyboard to open the System Properties. Then choose ‘Advanced System Settings’ in the left pane and then click on the ‘Settings’ button in the ‘Advanced’ option. ○ In the ‘Performance Options’ window, go to the ‘Advanced’ tab and then click ‘Change’. ○ The box saying ‘Automatically manage paging file size for all drives’ should be ‘checked’. If it has been set manually, then the maximum size needs to be increased. ○ Click 'OK' and then click 'OK' again. ○ Now, Click 'OK' twice to close the 'Performance Options' and 'System Properties' window.

PROBLEM SOFTWARE	PROBLEM	SOLUTION
		○ Click 'Restart now' to apply the changes.

If the problem cannot be resolved from the print files or troubleshooting table please email ntamodel@nationaltransport.ie to get technical support.

If you have any feedback on the NTA Toolkit operation or documentation please also contact the above.

9 Appendix A – Files and directories

9.1 Input files and directory

An update has been made to the tool based on the latest supplied structures of the directories for the runs of the models. The latest structure is {CATALOG_DIR}\\Runs\(Region)\(Year)\(Scenario)\ 4_Outputs_(Region)_(Year)_(Growth Scenario)_(Scenario)_Input_(Version number). The {CATALOG_DIR} is user-specific (usually on C: Drive). An example of the path and the variables that were used to test the model for one run are presented below:

{CATALOG_DIR} = C:\NTA\AppraisalTools\Economic

{Region} = ERM

{Model Year} = 20

{Run ID} = Metro1

The input folder contains 3 subfolders. The first folder is the Appraisal Tools folder. The other two folders are the PT and Road folders, in which the time periods and the run files are assumed to be. The complete list of input files needed to run the tools are listed below. (These are assumed to be the same files as were required for V2 of the model, but they are listed here as well).

Please note: the folder structure must be created before the run.

Input files required from the RMS model - PT:

- AM_PT_EMP.MAT for each {Run ID},{Growth} and {Model Year} combo
- AM_PT_COM.MAT for each {Run ID},{Growth} and {Model Year} combo
- AM_PT_OTH.MAT for each {Run ID},{Growth} and {Model Year} combo
- AM_PT_EDU.MAT for each {Run ID},{Growth} and {Model Year} combo
- AM_PT_RET.MAT for each {Run ID},{Growth} and {Model Year} combo
- PT_AM_{Run ID}{Growth}{Model Year}.PTM
- LT_PT_EMP.MAT for each {Run ID},{Growth} and {Model Year} combo
- LT_PT_COM.MAT for each {Run ID},{Growth} and {Model Year} combo
- LT_PT_OTH.MAT for each {Run ID},{Growth} and {Model Year} combo
- LT_PT_EDU.MAT for each {Run ID},{Growth} and {Model Year} combo
- LT_PT_RET.MAT for each {Run ID},{Growth} and {Model Year} combo
- PT_LT_{Run ID}{Growth}{Model Year}.PTM
- SR_PT_EMP.MAT for each {Run ID},{Growth} and {Model Year} combo

- SR_PT_COM.MAT for each {Run ID},{Growth} and {Model Year} combo
- SR_PT_OTH.MAT for each {Run ID},{Growth} and {Model Year} combo
- SR_PT_EDU.MAT for each {Run ID},{Growth} and {Model Year} combo
- SR_PT_RET.MAT for each {Run ID},{Growth} and {Model Year} combo
- PT_SR_{Run ID}{Growth}{Model Year}.PTM
- PM_PT_EMP.MAT for each {Run ID},{Growth} and {Model Year} combo
- PM_PT_COM.MAT for each {Run ID},{Growth} and {Model Year} combo
- PM_PT_OTH.MAT for each {Run ID},{Growth} and {Model Year} combo
- PM_PT_EDU.MAT for each {Run ID},{Growth} and {Model Year} combo
- PM_PT_RET.MAT for each {Run ID},{Growth} and {Model Year} combo
- PT_PM_{Run ID}{Growth}{Model Year}.PTM

Input files required from the RMS model - ROAD:

- ROAD_Skims_AM_{Run ID}{Growth}{Model Year}.MAT
- ROAD_AM_{Run ID}{Growth}{Model Year}.HWM
- ROAD_Skims_LT_{Run ID}{Growth}{Model Year}.MAT
- ROAD_LT_{Run ID}{Growth}{Model Year}.HWM
- ROAD_Skims_SR_{Run ID}{Growth}{Model Year}.MAT
- ROAD_SR_{Run ID}{Growth}{Model Year}.HWM
- ROAD_Skims_PM_{Run ID}{Growth}{Model Year}.MAT
- ROAD_PM_{Run ID}{Growth}{Model Year}.HWM

10 Appendix B – Model machine matrix

Model Machine	NTA-Mod-01	NTA-Mod-02	NTA-Mod-03	NTA-Mod-04	NTA-Mod-05	NTA-Mod-06	NTA-Mod-07	NTA-Mod-08	NTA-Mod-09	NTA-Mod-10
Cube Version	6.4.2	6.4.2	6.4.2	6.4.2	6.4.2	6.4.2	6.4.2	6.4.2	6.4.2	6.4.2
TUBA	1.9.4	1.9.4	1.9.4	1.9.4	1.9.4	1.9.4	1.9.4	1.9.4	1.9.4	1.9.4
Economic Module	x	x	x	x	x	x	x	x	x	x

The table above shows which NTA model machines can currently run the Economy Module. At the time of writing the NTA are obtaining the latest version of TUBA 1.9.14 to work with the latest version of the tool.