

# VECTO 1.3.1

16.05.2013



## Update Notes

# VECTO 1.3.1

## Update Overview (since V1.0):

- Driver Model:
  - Overspeed
  - Eco-Roll
  - Look Ahead Coasting
- New Gear Shift Model
  - Shifting based on used-defined shift polygons
  - Sequential shifting or gear skipping
  - Optional shifting inside polygons
  - Start gear calculation
- Torque Converter Calculation
- Engine Only Mode
- Engine Start/Stop
- Visualizer (GRAPHi)
- User Manual updated with function descriptions
- Error messages linked to user manual
- Demo Data updated

# Driver Model

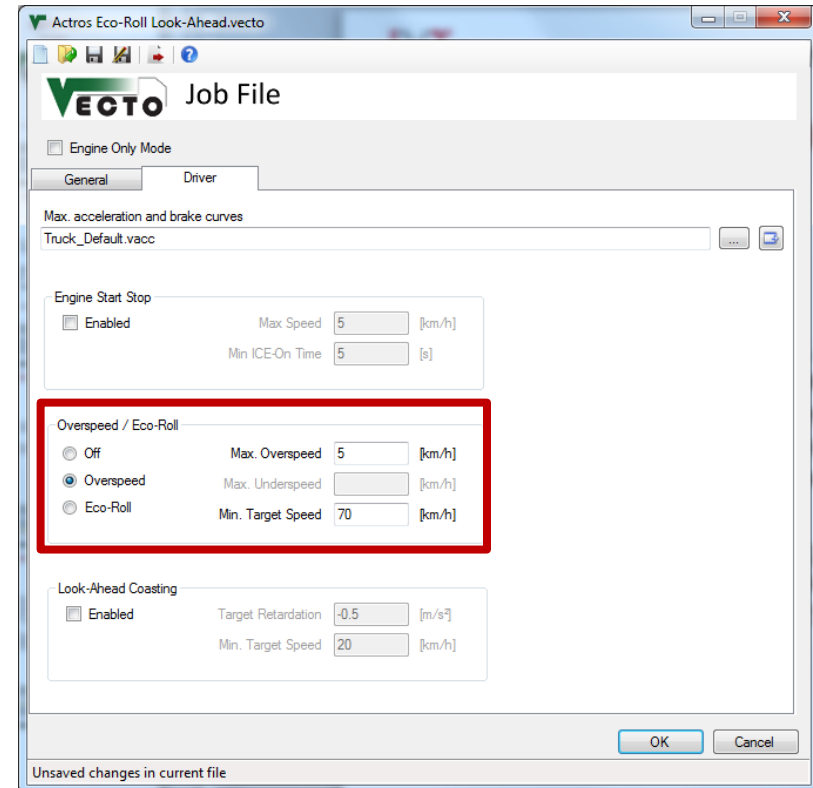
## Overview:

- Overspeed
  - If  $P_{\text{wheel}} < 0$ : Coasting with brakes not applied for speed  $<$  target speed + allowed overspeed
- Eco-Roll
  - If  $P_{\text{wheel}} < 0$ : Neutral gear, engine idling.
  - Engine and service brake if target speed + allowed overspeed is reached.
  - Normal driving if target speed + allowed underspeed is reached.
- Look Ahead Coasting
  - Phase of coasting put in front of braking phases

# VECTO Editor - Driver Tab

## Overspeed:

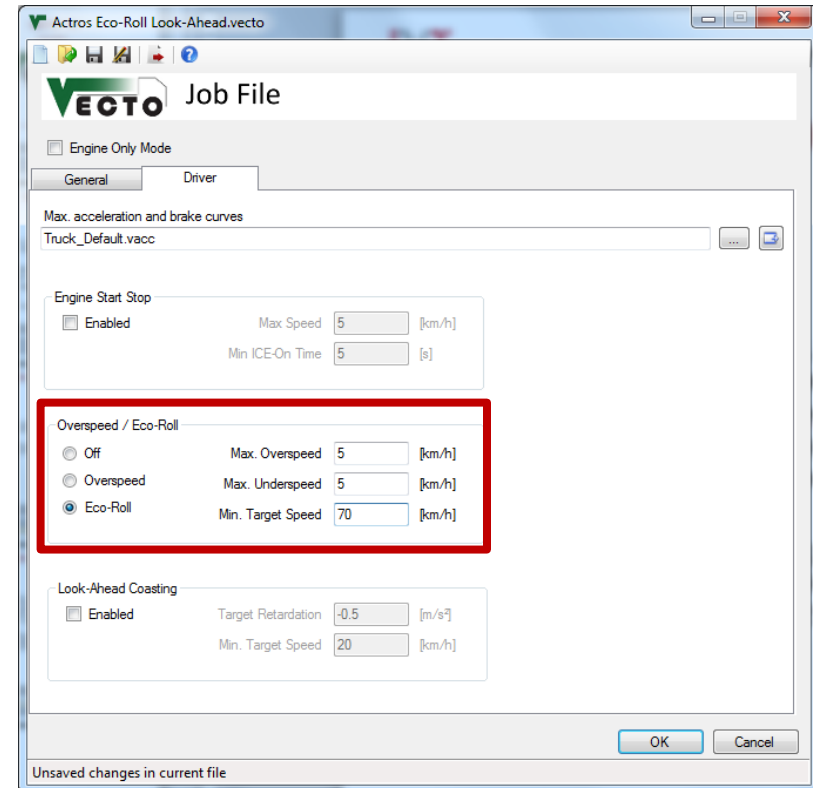
- **Functionality:**
  - If  $P_{\text{wheel}} < 0$ : Coasting with brakes not applied for speed < target speed + allowed overspeed
- **Parameters:**
  - Minimum Target Speed, e.g. 70km/h
  - Allowed Overspeed, e.g. 5km/h



# VECTO Editor - Driver Tab

## Eco-Roll:

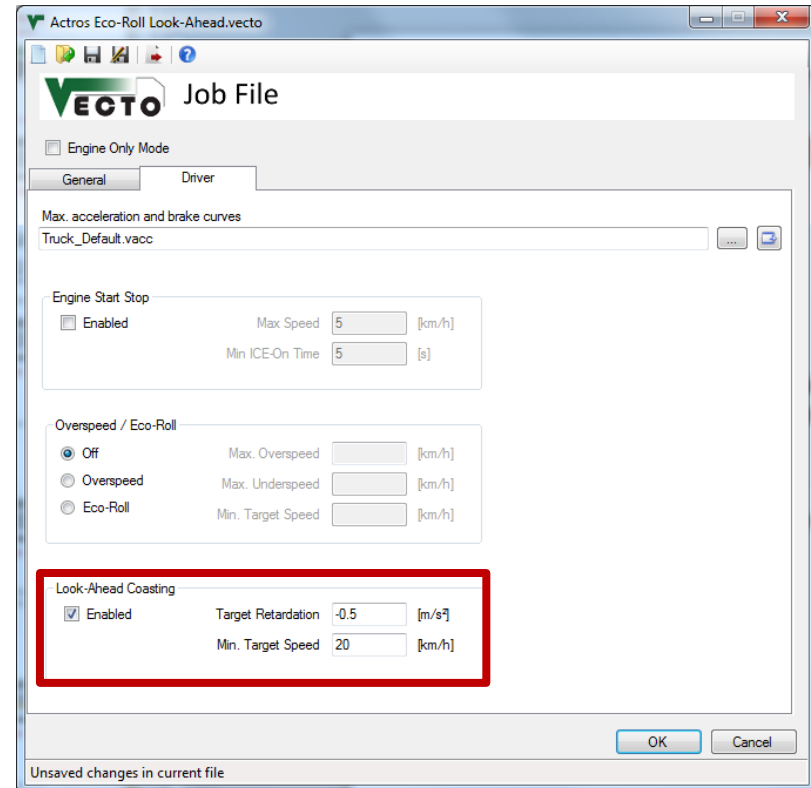
- **Functionality:**
  - If  $P_{\text{wheel}} < 0$ : Neutral gear, engine idling.
  - Engine and service brake if target speed + allowed overspeed is reached.
  - Normal driving if target speed + allowed underspeed is reached.
- **Parameters:**
  - Minimum Target Speed, e.g. 70km/h
  - Allowed Overspeed, e.g. 5km/h
  - Allowed Underspeed, e.g. 5km/h



# VECTO Editor - Driver Tab

## Look-Ahead Coasting:

- **Functionality:**
  - **Phase of coasting put in front of braking phases**
- **Parameters:**
  - Reference (target) deceleration, e.g.  $-0.5\text{m/s}^2$
  - Minimum speed, e.g. 55km/h (e.g. might be used for citybus driving)



# VECTO 1.2

09.04.2013

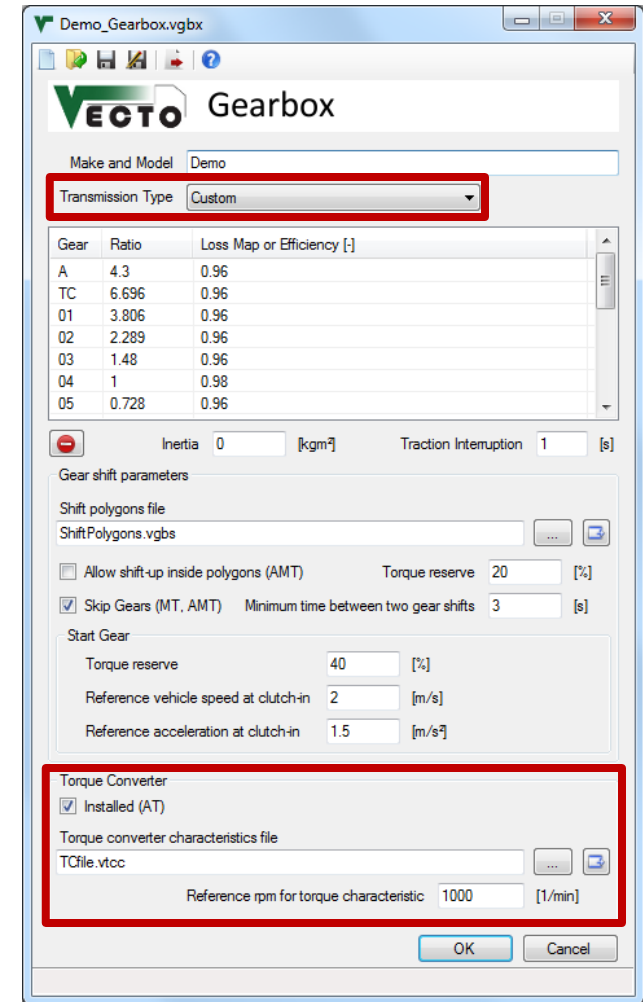


## Update Notes

# Gearbox updates

## Overview:

- Default settings for each transmission type
- Torque Converter implemented
- (Shift Polygons are described in the 1.1 beta Update Notes attached below)



The screenshot shows the 'Demo\_Gearbox.vgbx' window in the VECTO software. The window title is 'Demo\_Gearbox.vgbx'. The main title is 'VECTO Gearbox'. Below the title, there is a 'Make and Model' field set to 'Demo'. A red box highlights the 'Transmission Type' dropdown menu, which is currently set to 'Custom'. Below this is a table with columns 'Gear', 'Ratio', and 'Loss Map or Efficiency [-]'. The table contains the following data:

Gear	Ratio	Loss Map or Efficiency [-]
A	4.3	0.96
TC	6.696	0.96
01	3.806	0.96
02	2.289	0.96
03	1.48	0.96
04	1	0.98
05	0.728	0.96

Below the table, there are fields for 'Inertia' (0 [kgm²]) and 'Traction Interruption' (1 [s]). The 'Gear shift parameters' section includes a 'Shift polygons file' field set to 'ShiftPolygons.vgbs'. There are checkboxes for 'Allow shift-up inside polygons (AMT)' (unchecked) and 'Skip Gears (MT, AMT)' (checked). The 'Torque reserve' is set to 20 [%] and the 'Minimum time between two gear shifts' is set to 3 [s]. The 'Start Gear' section includes fields for 'Torque reserve' (40 [%]), 'Reference vehicle speed at clutch-in' (2 [m/s]), and 'Reference acceleration at clutch-in' (1.5 [m/s²]). A red box highlights the 'Torque Converter' section, which includes a checked checkbox for 'Installed (AT)', a 'Torque converter characteristics file' field set to 'TCfile.vtcc', and a 'Reference rpm for torque characteristic' field set to 1000 [1/min]. At the bottom right, there are 'OK' and 'Cancel' buttons.



# Gearbox updates

## Transmission Type:

- **Manual Transmission (MT):**
  - Activates the "Skip Gears" option. No torque converter.
- **Automated Manual Transmission (AMT)**
  - Activates the "Allow shift-up inside polygons" and "Skip Gears" option. No torque converter.
- **Automatic Transmission (AT)**
  - Torque converter is set and must be parameterized.
- **Custom**
  - Enables all options for user-defined settings.

**VECTO Gearbox**

Make and Model: Demo

Transmission Type: Custom

Gear	Ratio	Loss Map or Efficiency [-]
A	4.3	0.96
TC	6.696	0.96
01	3.806	0.96
02	2.289	0.96
03	1.48	0.96
04	1	0.98
05	0.728	0.96

Inertia: 0 [kgm²]    Traction Interruption: 1 [s]

**Gear shift parameters**

Shift polygons file: ShiftPolygons.vgbs

☐ Allow shift-up inside polygons (AMT)    Torque reserve: 20 [%]

☒ Skip Gears (MT, AMT)    Minimum time between two gear shifts: 3 [s]

**Start Gear**

Torque reserve: 40 [%]

Reference vehicle speed at clutch-in: 2 [m/s]

Reference acceleration at clutch-in: 1.5 [m/s²]

**Torque Converter**

☒ Installed (AT)

Torque converter characteristics file: TCfile.vtcc

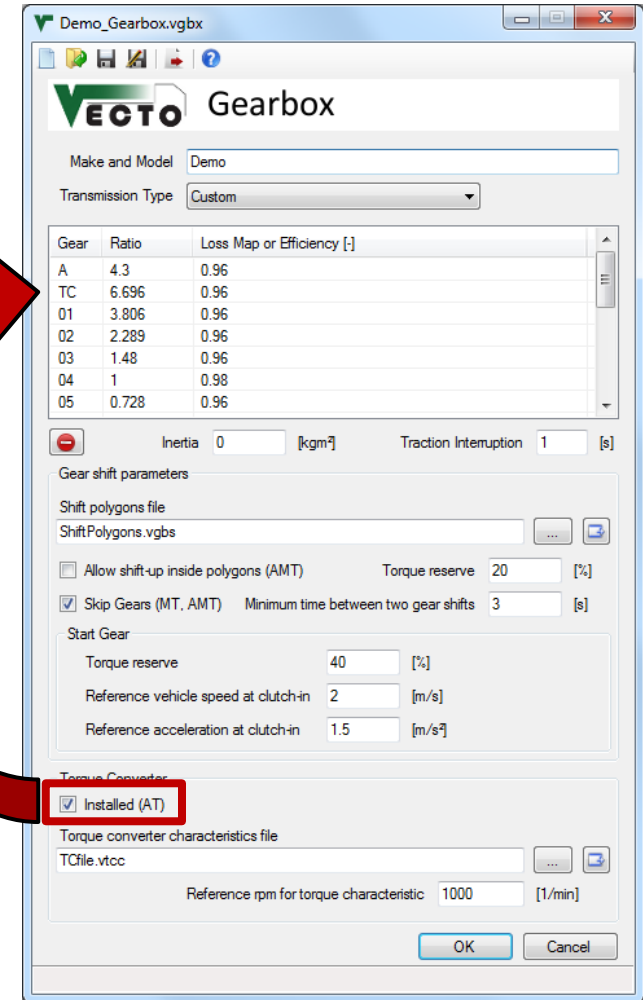
Reference rpm for torque characteristic: 1000 [1/min]

OK    Cancel

# Gearbox updates

## Torque Converter (TC):

- "Installed" can only be changed if Transmission Type is "Custom"
- The torque converter is only used in the first gear (TC), i.e. the lock-up clutch is open. After TC comes gear 1 (first gear with closed lock-up clutch).



**Demo\_Gearbox.vgbx**

**VECTO Gearbox**

Make and Model: Demo

Transmission Type: Custom

Gear	Ratio	Loss Map or Efficiency [-]
A	4.3	0.96
TC	6.696	0.96
01	3.806	0.96
02	2.289	0.96
03	1.48	0.96
04	1	0.98
05	0.728	0.96

Inertia: 0 [kgm<sup>2</sup>] Traction Interruption: 1 [s]

**Gear shift parameters**

Shift polygons file: ShiftPolygons.vgbs

☐ Allow shift-up inside polygons (AMT) Torque reserve: 20 [%]

☒ Skip Gears (MT, AMT) Minimum time between two gear shifts: 3 [s]

**Start Gear**

Torque reserve: 40 [%]

Reference vehicle speed at clutch-in: 2 [m/s]

Reference acceleration at clutch-in: 1.5 [m/s<sup>2</sup>]

**Torque Converter**

☒ Installed (AT)

**Torque converter characteristics file**

TCfile.vtcc

Reference rpm for torque characteristic: 1000 [1/min]

OK Cancel

# Gearbox updates

## Torque Converter characteristics file (.vtcc):

- Defines:
  - torque ratio** (= Output Torque / Input Torque) and **input torque** at reference engine speed
  - over speed ratio** (= Output Speed / Input Speed)
- Must include data for motoring (speed ratio > 1)!**

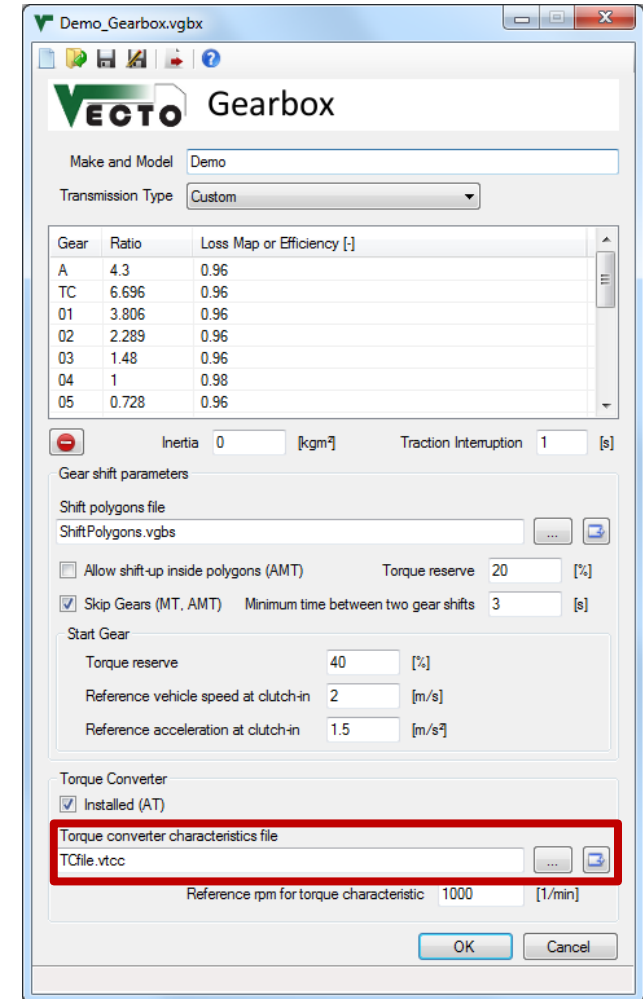
c Speed Ratio v	Torque Ratio $\mu$	Input Torque at reference rpm
c [-]	[-]	[Nm]
0	...	...
0.1		
...	...	...
>1!	...	...

### \*VECTO CSV Format:

List Separator: Comma ","

Decimal-Mark: Dot "."

Comments/headers: "c" at the beginning of the comment line. Number and position of comment lines is not limited.



**Demo\_Gearbox.vgbx**

**VECTO Gearbox**

Make and Model: Demo

Transmission Type: Custom

Gear	Ratio	Loss Map or Efficiency [-]
A	4.3	0.96
TC	6.696	0.96
01	3.806	0.96
02	2.289	0.96
03	1.48	0.96
04	1	0.98
05	0.728	0.96

Inertia: 0 [kgm<sup>2</sup>] Traction Interruption: 1 [s]

**Gear shift parameters**

Shift polygons file: ShiftPolygons.vgbs

☐ Allow shift-up inside polygons (AMT) Torque reserve: 20 [%]

☒ Skip Gears (MT, AMT) Minimum time between two gear shifts: 3 [s]

**Start Gear**

Torque reserve: 40 [%]

Reference vehicle speed at clutch-in: 2 [m/s]

Reference acceleration at clutch-in: 1.5 [m/s<sup>2</sup>]

**Torque Converter**

☒ Installed (AT)

Torque converter characteristics file: **TCfile.vtcc**

Reference rpm for torque characteristic: 1000 [1/min]

OK Cancel

# Gearbox updates

## Reference rpm for torque characteristic:

- Needed to calculate the actual engine torque

## Calculation of engine torque (if lock-up clutch is open, gear "TC"):

$$T_{in} = T_{ref}(v) * \left( \frac{n_{in}}{n_{ref}} \right)^2$$

with:

$T_{in}$  = engine torque [Nm]

$T_{ref(v)}$  = reference torque at reference rpm (from .vtcc file) [Nm]

$n_{in}$  = engine speed [1/min]

$n_{ref}$  = reference rpm (from .vgbx file) [1/min]

Demo\_Gearbox.vgbx

**VECTO Gearbox**

Make and Model: Demo

Transmission Type: Custom

Gear	Ratio	Loss Map or Efficiency [-]
A	4.3	0.96
TC	6.696	0.96
01	3.806	0.96
02	2.289	0.96
03	1.48	0.96
04	1	0.98
05	0.728	0.96

Inertia: 0 [kgm²] Traction Interruption: 1 [s]

**Gear shift parameters**

Shift polygons file: ShiftPolygons.vgbs

☐ Allow shift-up inside polygons (AMT) Torque reserve: 20 [%]

☒ Skip Gears (MT, AMT) Minimum time between two gear shifts: 3 [s]

**Start Gear**

Torque reserve: 40 [%]

Reference vehicle speed at clutch-in: 2 [m/s]

Reference acceleration at clutch-in: 1.5 [m/s²]

**Torque Converter**

☒ Installed (AT)

Torque converter characteristics file: TCfile.vtcc

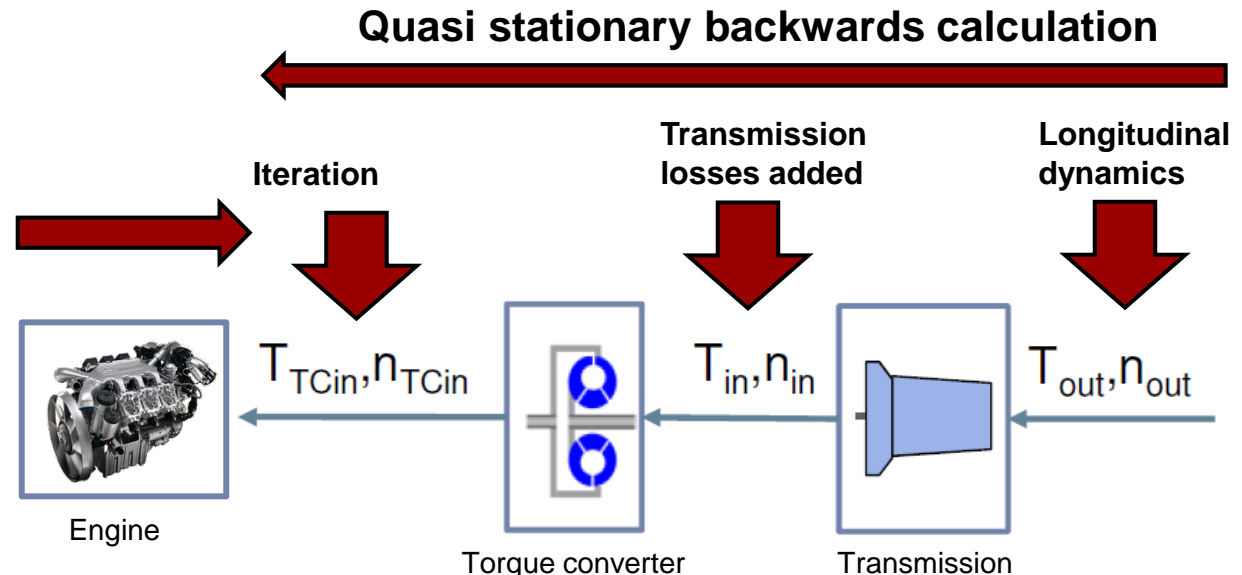
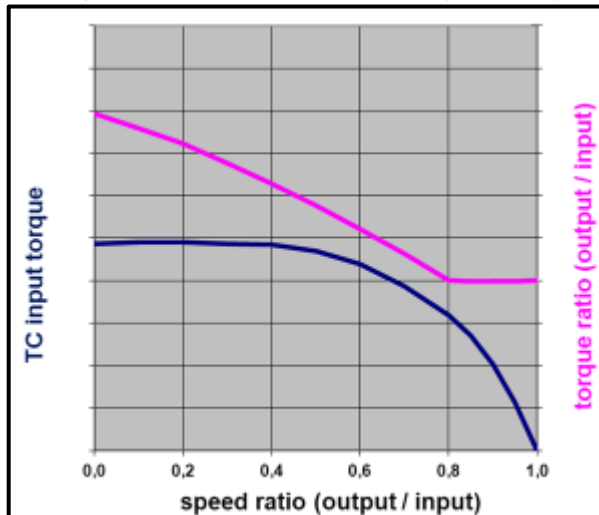
Reference rpm for torque characteristic: 1000 [1/min]

OK Cancel

# Torque Converter Calculation

- Same polygon-based gear shift model as MT/AMT
- Torque Converter (TC):
  - Defined as (virtual) separate gear, i.e. **only first gear with TC active**
  - While TC active: Iterative calculation of engine torque and speed based on TC characteristic
  - Creeping: Engine speed set to idling. Brakes engaged to absorb surplus torque

Torque converter characteristic (.vtcc file)

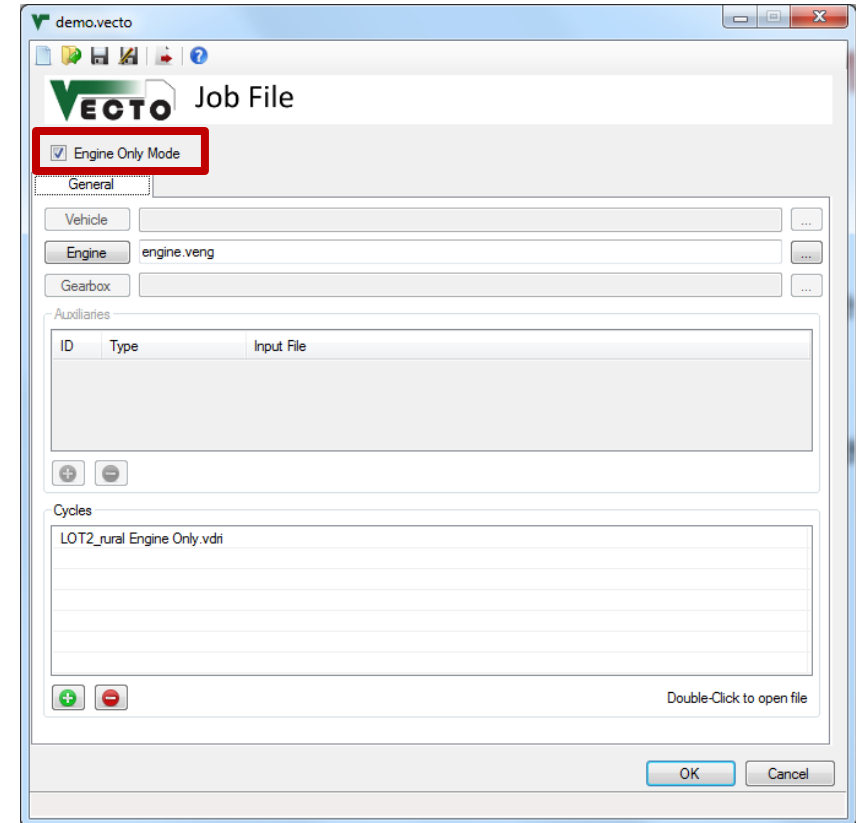


# Engine Only Mode (.vecto file)

- Calculate fuel consumption using a predefined load cycle
- No gearbox, vehicle or Aux file required
- Cycle format (see User Manual):
  - engine speed **<n>** [1/min]
  - engine power **<Pe>** [kW]

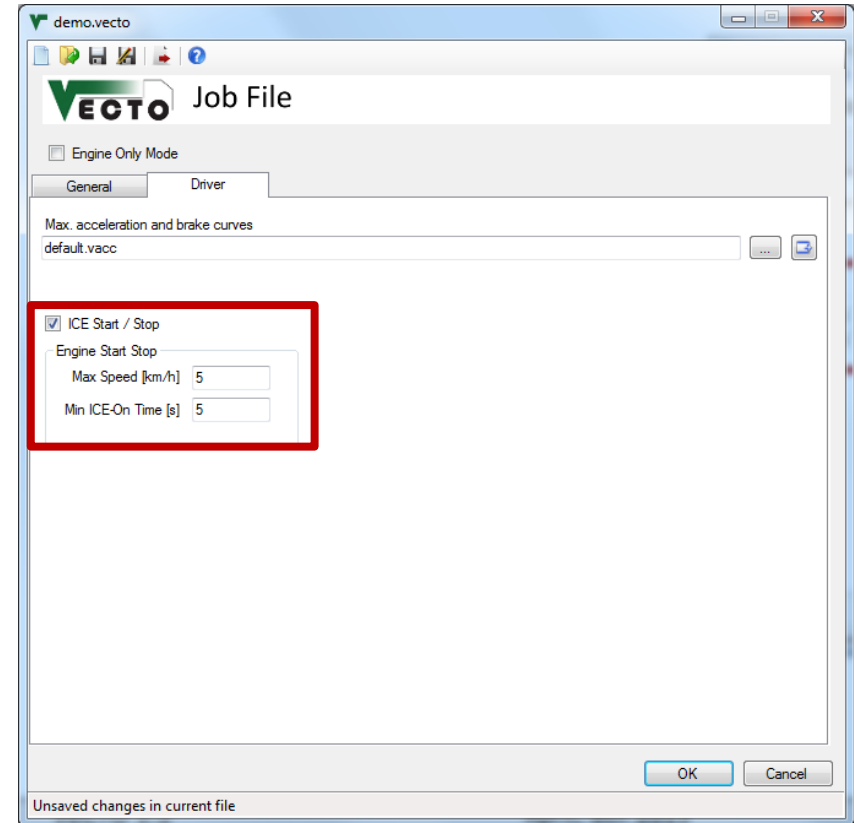
**or**

  - engine torque **<Me>** [Nm]
  - [Optional] Additional power demand (aux) **<Padd>**
- **Engine inertia (from .veng file) is added to the input torque!**

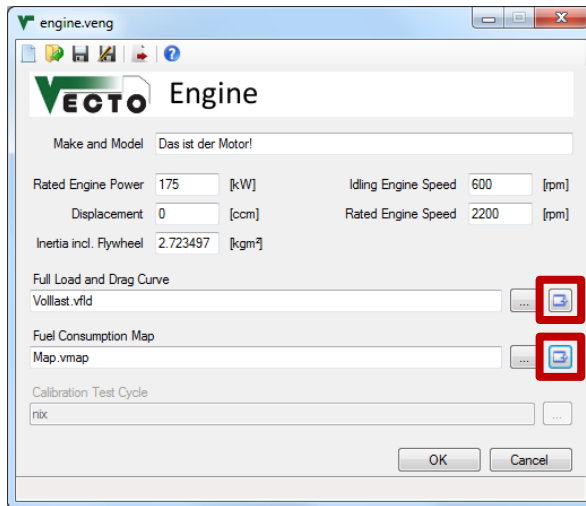


# Engine Start / Stop (.vecto file)

- Engine will be turned off if:
  - Power demand (without Aux)  $\leq 0$
  - Vehicle speed is below "**Max speed [km/h]**"
  - Engine was running for at least "**Min ICE-On Time [s]**"
- **TBD: Invalid auxiliary consumption work over cycle**



# New "Open file" button



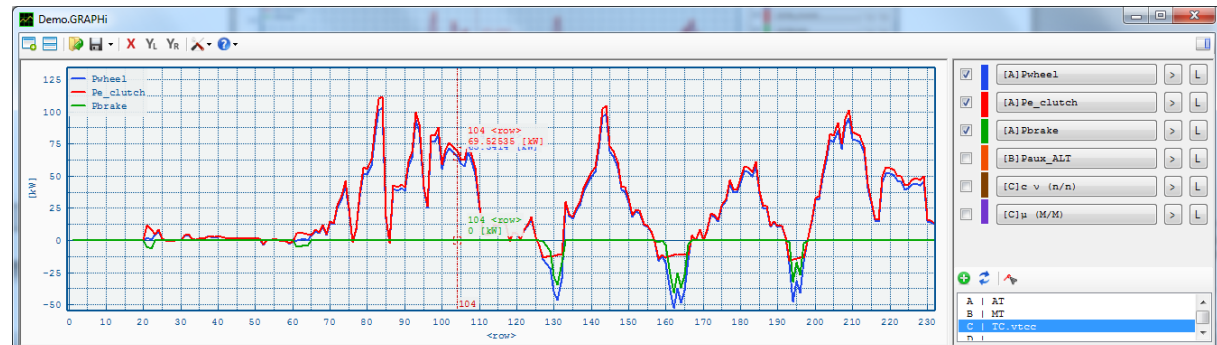
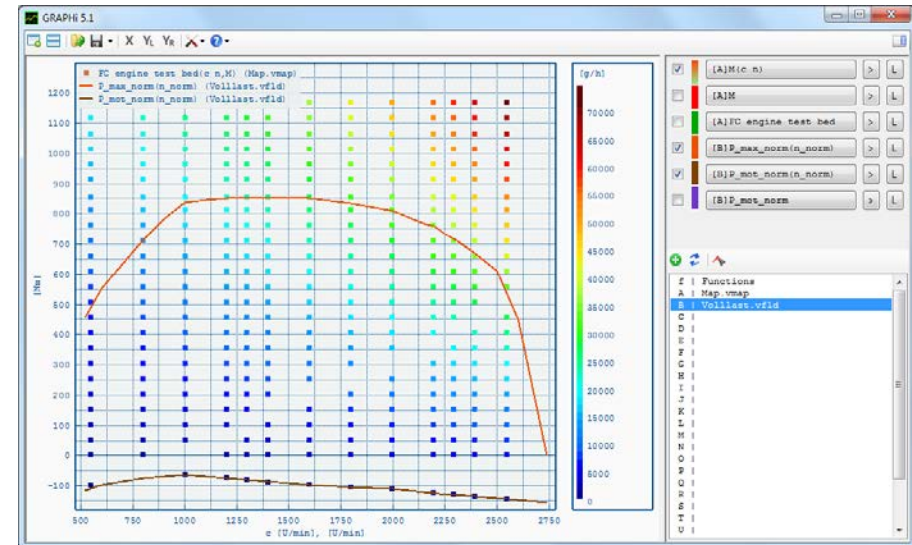
Opens a menu with three options:

- Open with GRAPHi (see next slide)
- Open with user-defined tool (see Settings)
- Show in Folder (opens explorer)



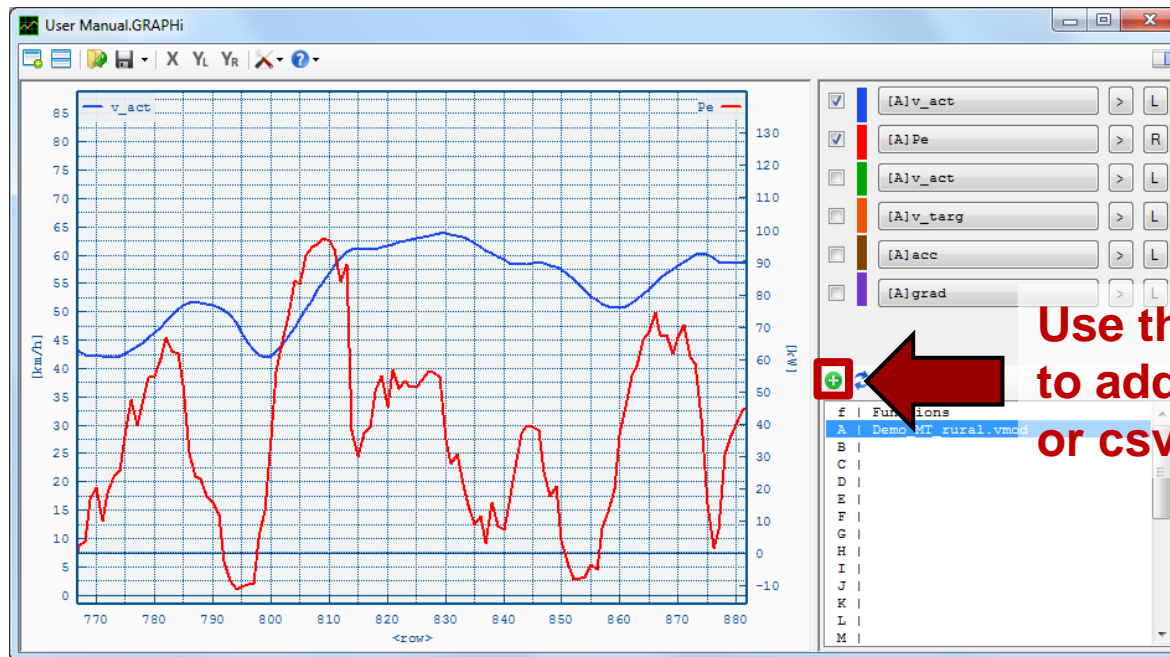
# Visualizer (GRAPHi)

- Independent 2D visualisation tool (see "GRAPHi" subfolder)
- Supports CSV and MS Excel files
- User Manual included ("?" button)
- Located in "GRAPHi" subfolder
- Note: GRAPHi is not a permanent part of VECTO and will be provided by TUG for a limited time only



# GRAPHi Quick Start (1/5)

## Opening files



Use the "+" Button to add files (excel or csv)

Once a file is loaded, it remains in memory without accessing the file on the hard drive (unless manually reloaded).

# GRAPHi Quick Start (2/5)

## Mouse Controls



**Move**

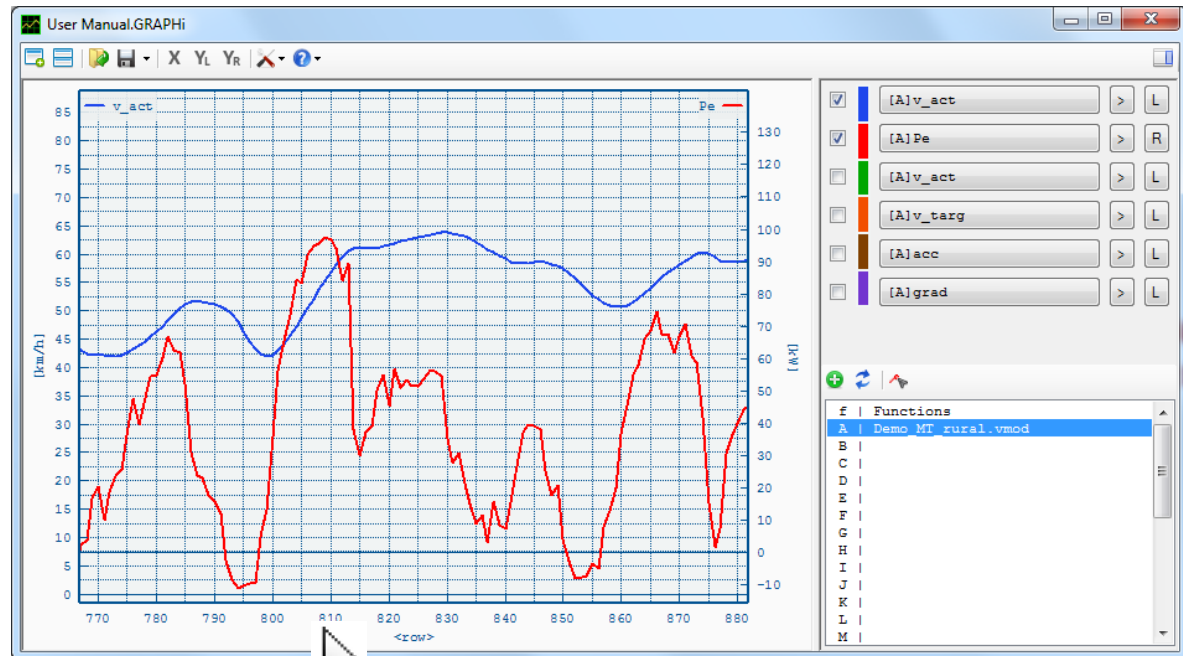


**Zoom**



**Zoom-Box**

Click 1: 1<sup>st</sup> corner  
Click 2: 2<sup>nd</sup> corner  
(Right-Click to Cancel)

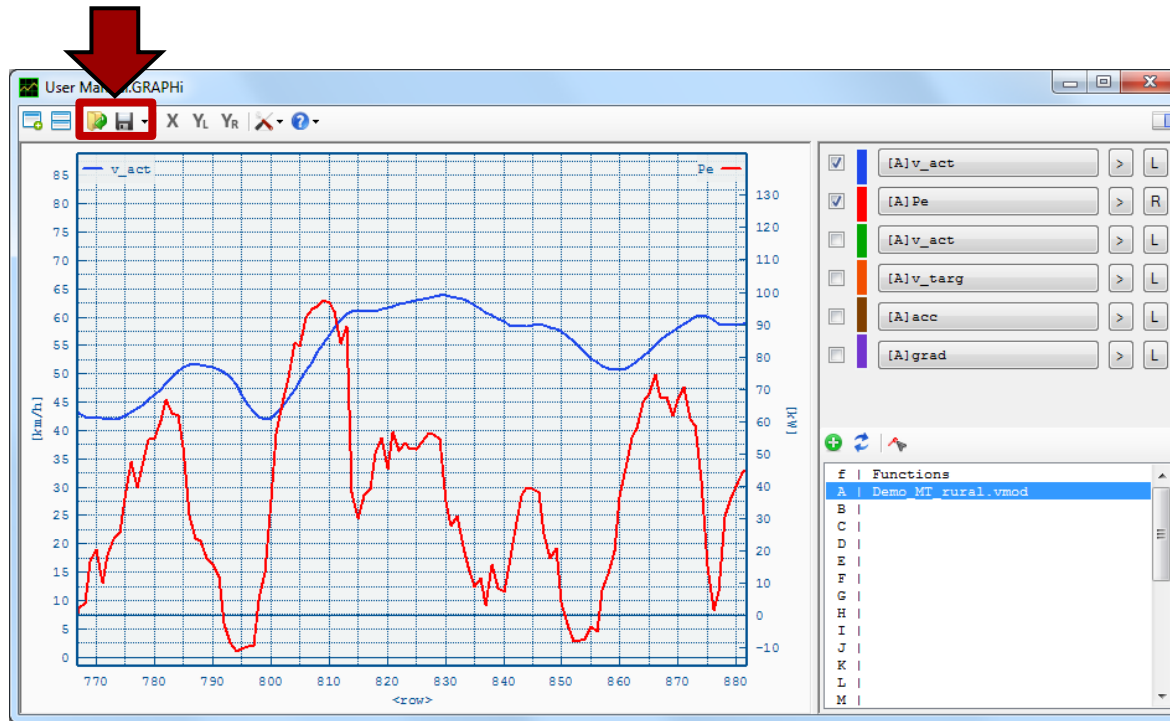


**Hold cursor over x-axis to zoom/move x-axis only!!!**

# GRAPHi Quick Start (3/5)

## Opening and Saving Sessions

Save/Load Session (.GRAPHi file)



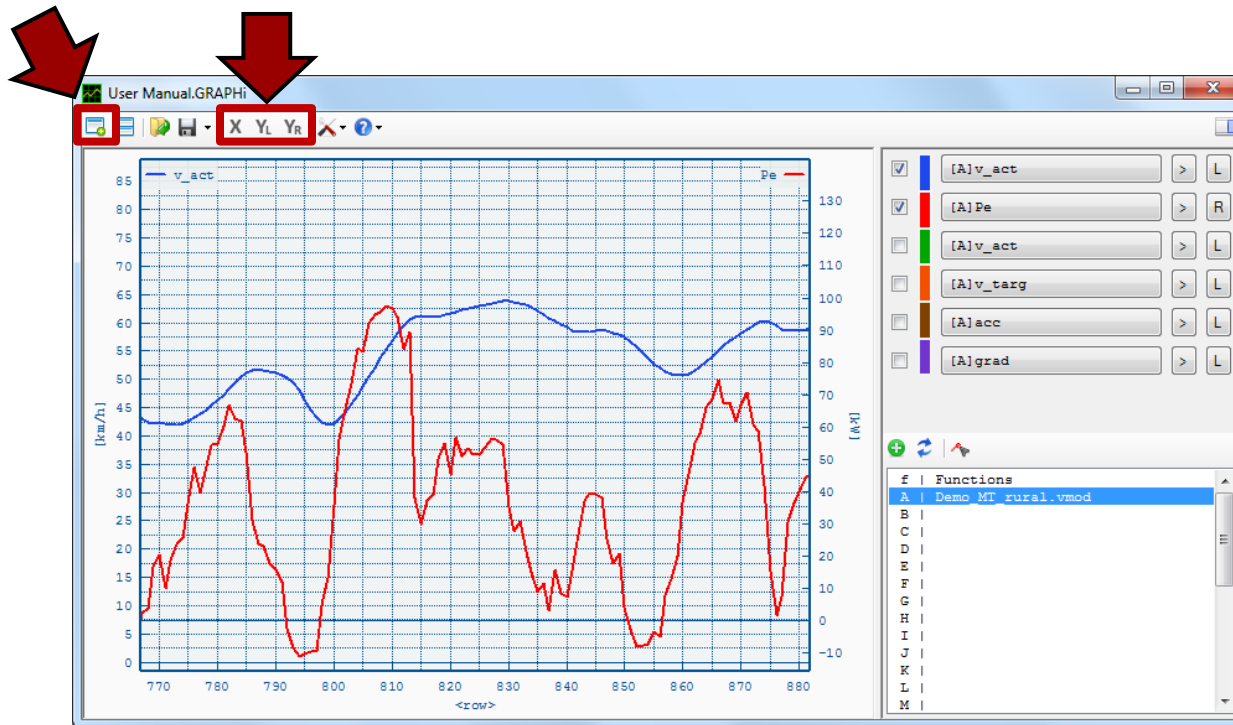
**Session files (.GRAPHi) include all data to restore a session. Source files are saved only as reference, i.e. the original files must be accessible.**

# GRAPHi Quick Start (4/5)

## Windows and Syncing

Add Window

Sync open windows (x-axis, left and right y-axis)

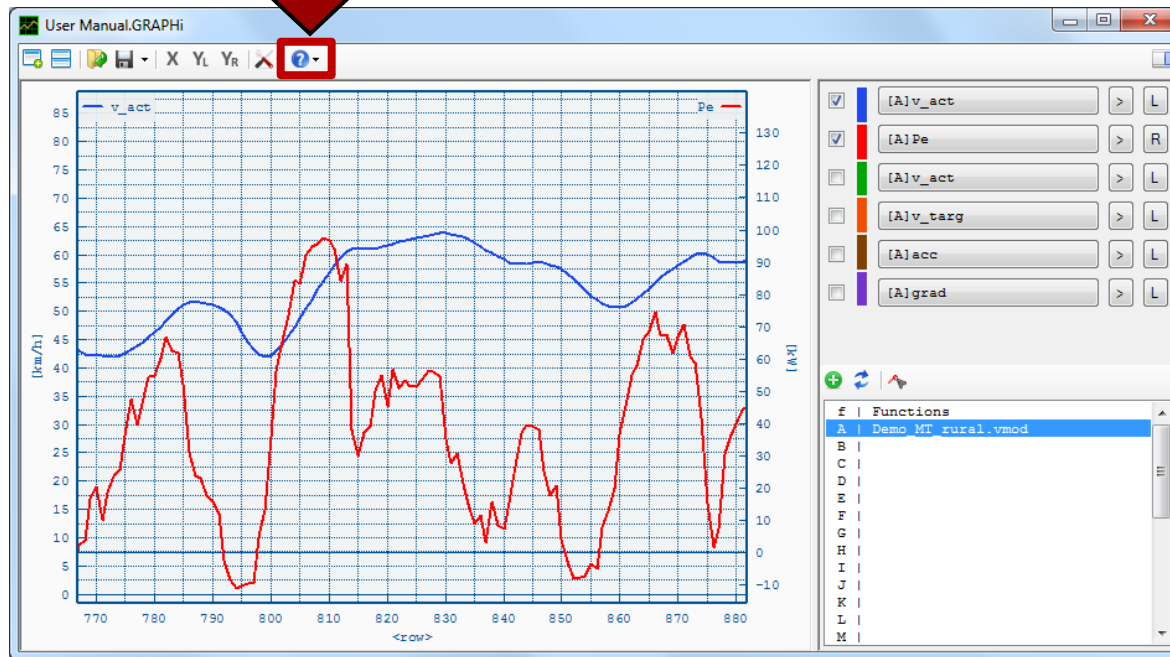


**Syncing means changes to the synced axes in one window are reflected by all other windows which have the same axes synced.**

# GRAPHi Quick Start (5/5)

## User Manual

The User Manual can be opened here



# Full Changelog V1.2

## VECTO 1.2

- Engine Start/Stop implemented
- Bugfix: Fixed error in FC interpolation (invalid extrapolation errors)
- FC Extrapolation will abort the calculation
- Transmission Type selection in Gearbox (.vgbx) file.
  - Enables/Disables transmission type-specific options
  - In Proof-Of-Concept mode "Custom" type is available with all options enabled.
- Automatic Transmission mode with Torque converter: Input parameters in Gearbox file !!still being tested!!
- Option to open files with GRAPHi or user-defined tool
- User Manual updated
- Bugfix: Files with relative paths were not located correctly
- Corrected comment line for wheels inertia and axle config in .vveh file
- Changed RRC unit in GUI from [-] to [N/N]
- Transmission Loss Maps are not converted to n,Pe-Maps anymore. Should fix non-linear interpolation effects.
- Engine Only Mode

# VECTO 1.1 beta

05.02.2013



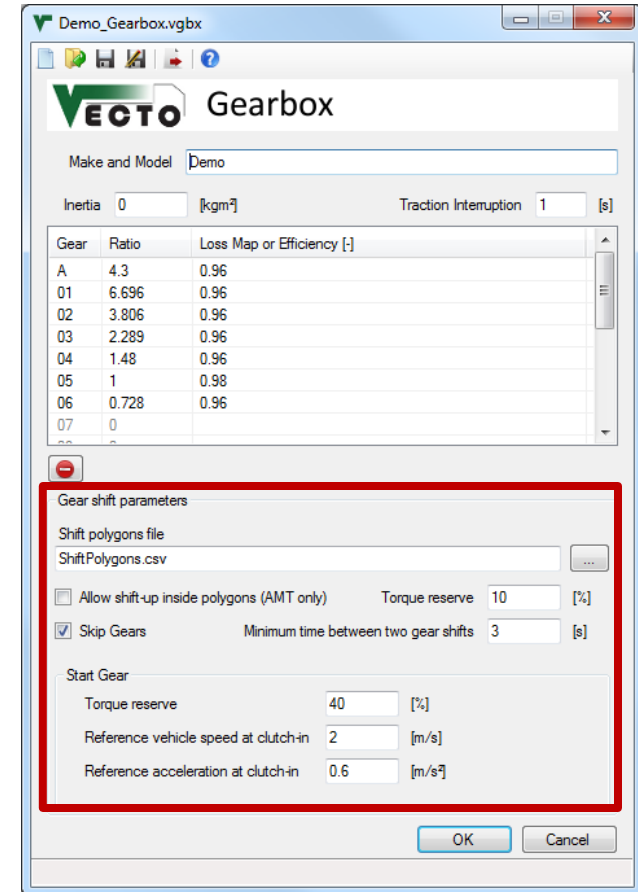
## Update Notes



# New gear shift model for MT and AMT

## Overview:

- Shifting based on user-defined shift polygons
- Sequential shifting or gear skipping
- Optional shifting inside polygons
- Customisable start gear calculation

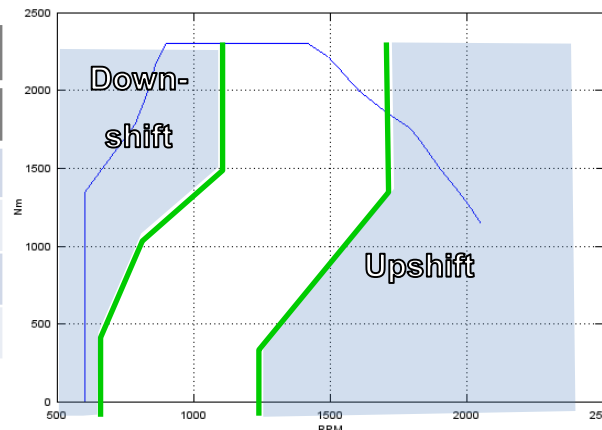


# New parameters in .vgbx file

## Shift polygons file:

- CSV file\* defining up- and downshift rpms over torque
- File must cover full engine range including motoring
- Two or more rows required

c Torque	Downshift	Upshift
c [Nm]	[rpm]	[rpm]
-500	650	900
0	650	900
500	700	950
...	...	...

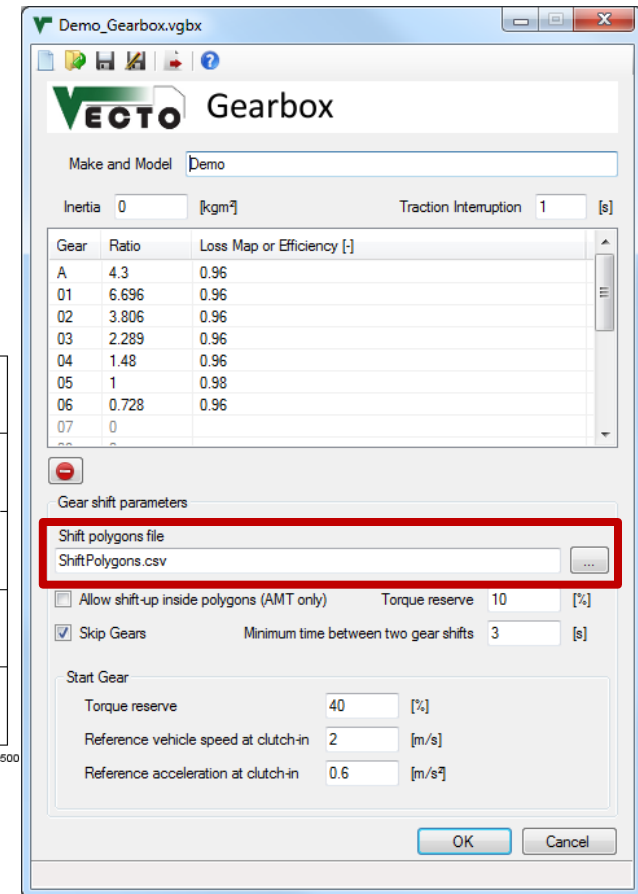


### \*VECTO CSV Format:

List Separator: Comma ","

Decimal-Mark: Dot "."

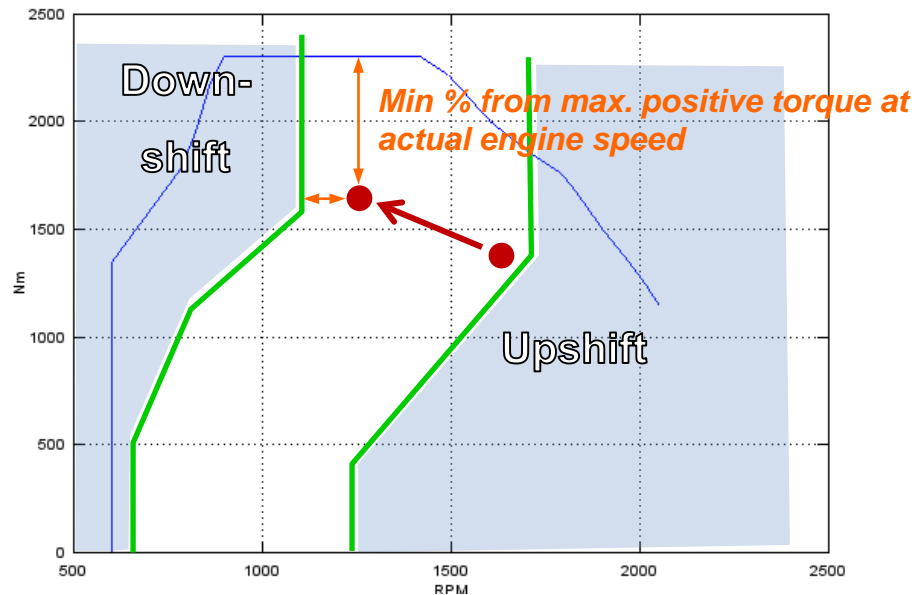
Comments/headers: "c" at the beginning of the comment line. Number and position of comment lines is not limited.



# New parameters in .vgbx file

## Allow shift-up inside polygons (AMT):

- Only if **torque reserve** is provided and **rpm** is still above **Down-shift-rpm**



Demo\_Gearbox.vgbx

**VECTO Gearbox**

Make and Model: Demo

Inertia: 0 [kgm<sup>2</sup>] Traction Interruption: 1 [s]

Gear	Ratio	Loss Map or Efficiency [-]
A	4.3	0.96
01	6.696	0.96
02	3.806	0.96
03	2.289	0.96
04	1.48	0.96
05	1	0.98
06	0.728	0.96
07	0	

**Gear shift parameters**

Shift polygons file: ShiftPolygons.csv

☒ Allow shift-up inside polygons (AMT only) Torque reserve: 10 [%]

☒ Skip Gears Minimum time between two gear shifts: 3 [s]

**Start Gear**

Torque reserve: 40 [%]

Reference vehicle speed at clutch-in: 2 [m/s]

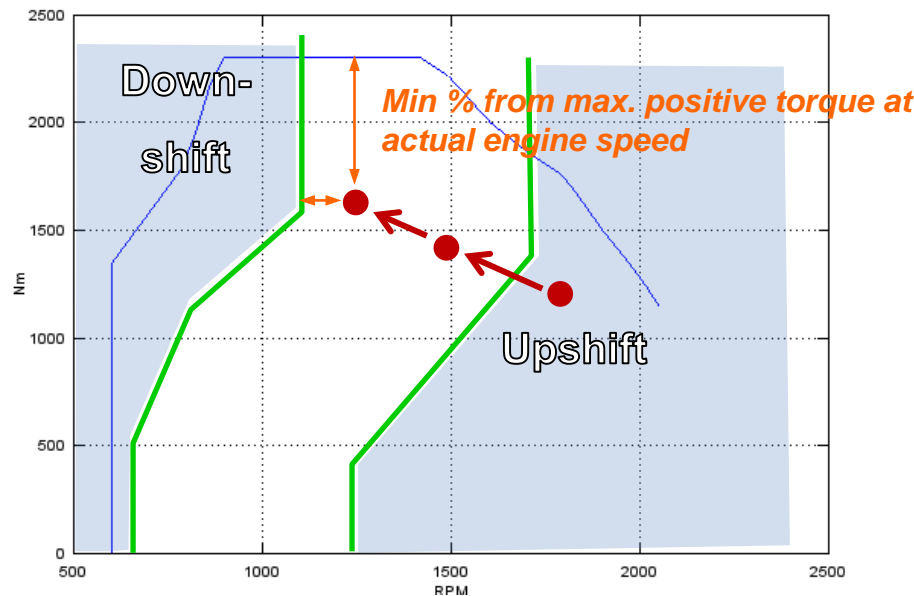
Reference acceleration at clutch-in: 0.6 [m/s<sup>2</sup>]

OK Cancel

# New parameters in .vgbx file

## Skip gears (AMT, MT):

- Whenever gear shift is initiated (because rpm crosses up- or down- shift polygon) it is possible to skip gears
- Torque reserve** must be provided and **rpm must remain below Down-shift-rpm**



The screenshot shows the 'Demo\_Gearbox.vgbx' configuration window. The 'Gearbox' section includes a table of gear data:

Gear	Ratio	Loss Map or Efficiency [-]
A	4.3	0.96
01	6.696	0.96
02	3.806	0.96
03	2.289	0.96
04	1.48	0.96
05	1	0.98
06	0.728	0.96
07	0	

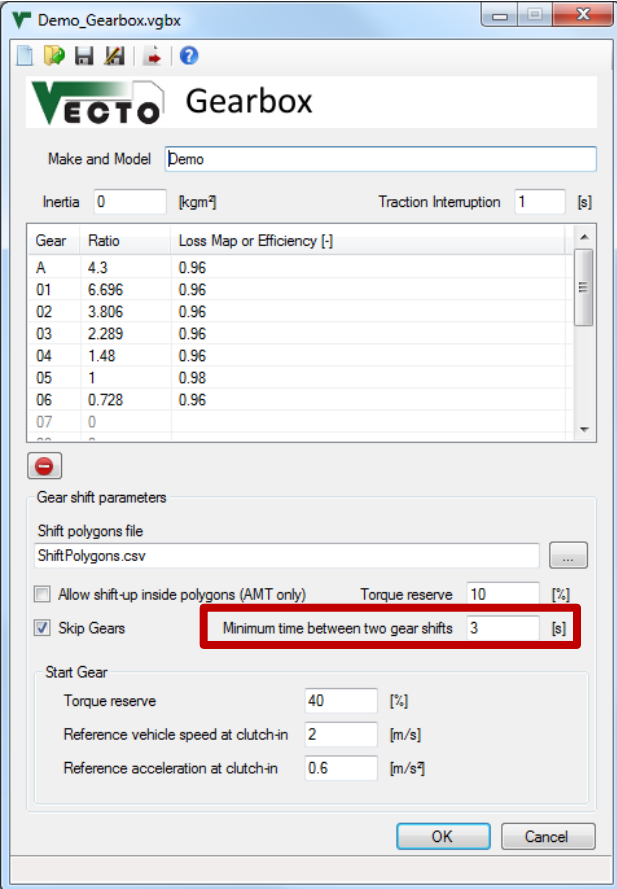
The 'Gear shift parameters' section includes the following settings:

- ☒ Skip Gears
- Torque reserve: 10 [%]
- Minimum time between two gear shifts: 3 [s]
- Start Gear:
  - Torque reserve: 40 [%]
  - Reference vehicle speed at clutch-in: 2 [m/s]
  - Reference acceleration at clutch-in: 0.6 [m/s²]

# New parameters in .vgbx file

## Minimum time between two gear shifts:

- Limits the time between two gear shifts in whole seconds
- Rule will be ignored if rpms are too high/low
- High values may cause high rpms during acceleration



**Demo\_Gearbox.vgbx**

**VECTO Gearbox**

Make and Model: Demo

Inertia: 0 [kgm<sup>2</sup>] Traction Interruption: 1 [s]

Gear	Ratio	Loss Map or Efficiency [-]
A	4.3	0.96
01	6.696	0.96
02	3.806	0.96
03	2.289	0.96
04	1.48	0.96
05	1	0.98
06	0.728	0.96
07	0	

**Gear shift parameters**

Shift polygons file: ShiftPolygons.csv

☐ Allow shift-up inside polygons (AMT only) Torque reserve: 10 [%]

☒ Skip Gears **Minimum time between two gear shifts: 3 [s]**

**Start Gear**

Torque reserve: 40 [%]

Reference vehicle speed at clutch-in: 2 [m/s]

Reference acceleration at clutch-in: 0.6 [m/s<sup>2</sup>]

OK Cancel

# New parameters in .vgbx file

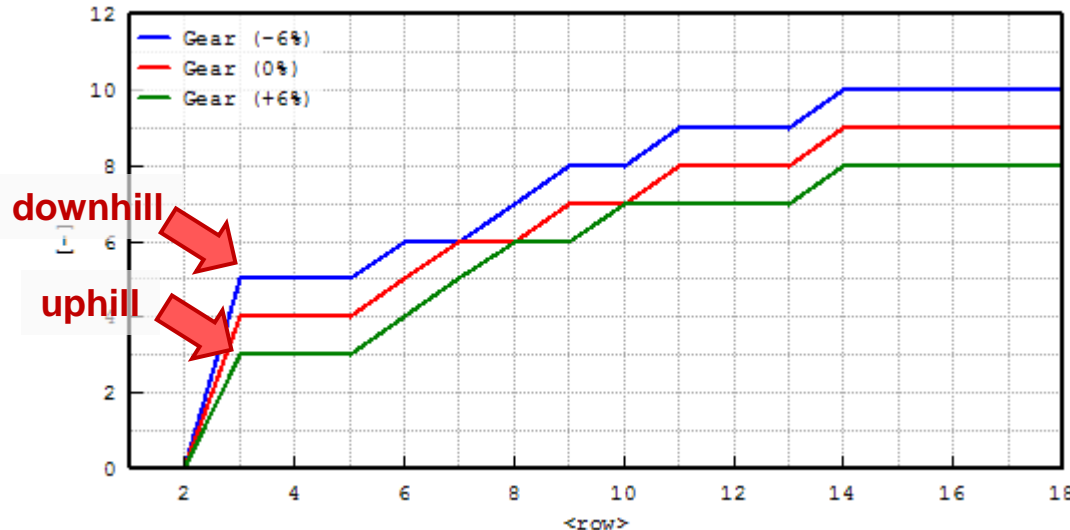
## Start gear (first gear after vehicle standstill):

- Calculated using a fictional load case with:
  - Reference speed
  - Reference acceleration
  - Actual road gradient, transm. losses and aux. power demand



**independent from target speed**

Example: Half-loaded articulated truck, 80km/h target speed:



Demo\_Gearbox.vgbx

VECTO Gearbox

Make and Model: Demo

Inertia: 0 [kgm<sup>2</sup>] Traction Interruption: 1 [s]

Gear	Ratio	Loss Map or Efficiency [-]
A	4.3	0.96
01	6.696	0.96
02	3.806	0.96
03	2.289	0.96
04	1.48	0.96
05	1	0.98
06	0.728	0.96
07	0	

Gear shift parameters

Shift polygons file: ShiftPolygons.csv

☐ Allow shift-up inside polygons (AMT only) Torque reserve: 10 [%]

☒ Skip Gears Minimum time between two gear shifts: 3 [s]

**Start Gear**

Torque reserve: 40 [%]

Reference vehicle speed at clutch-in: 2 [m/s]

Reference acceleration at clutch-in: 0.6 [m/s<sup>2</sup>]

OK Cancel

# Important notes

- The demo data is updated for VECTO 1.1 and ready to run with the new gear shift model
- Format of .vecto files has changed:
  - Old .vecto files (V1.0) can be used with VECTO 1.1.
  - New .vecto files (V1.1) can NOT be used with VECTO 1.0.
- Format of .vgbx files has changed:
  - Old .vgbx files (V1.0) can be opened in the gearbox editor but gear shift parameters must be set before starting calculation.
  - New .vgbx files (V1.1) can be used with VECTO 1.0 but saving files will remove the new parameters.
- The old gear shift model is NOT available in VECTO 1.1.
- The User Manual and Quick Start Guide do not cover the new gear shift model yet.

# Full Changelog V1.1 beta

## VECTO 1.1 beta

- Speed values below 0.09km/h are set to 0km/h
- New gear shift model
  - Replaces old gear shift model!
  - New parameters in .vgbx file including path to gear shift polygons file
  - Old gear shift model parameters removed from .vecto file
- Command Line Arguments processing (see User Manual):
  - Changed prefix form "/" to "-"
  - Bugfix: Argument "-run" was not processed
  - Job files and driving cycles can be added via command line
  - Files without path are expected in the Working Directory
- User Manual update for command line arguments
- Various fixes in GUI
- Bugfix: Error in Cycle Conversion (distance- to time-based) when using Aux Power Input.
- Distance Correction is now active only in acceleration and cruise phases.
- Fixed cycles starting with vehicle speed = 0. In V1.0 the first and second time step were averaged to speed values > 0.
- Demo data updated for new gear shift model
- New independent licensing dll replaces TUG's version