

VECTO 3.x

16.3.2023



Release Notes

Vecto 0.7.10.2996 Development Version

March 2023

- **Important Note**

This is a development release for xEV-Lorries. Bus related functionalities may be broken.

- **Changes**

- Implementation of Declaration-Mode for xEV-Lorries
 - Support for xEV-JSON-Jobs in Declaration Mode
 - New generic vehicles (XML & JSON)
- Test settings:
 - Charge-Sustaining-Mode:
 - Iterative simulation for OVC-P-HEVs can be disabled
 - Charge-Depleting-Mode:
 - Central SOC can be overridden for Charge-Depleting-Mode
- Declaration values can be overridden by copying the particular file to <VectoDir>\Declaration\Override and changing the desired value.
- New XSD-Schema for XML Reports
- Updated Hybrid Strategy and Gearshifting

2nd Amendment Test Settings

☒ P-HEV Single Simulation in Charge Sustaining Mode

☐ Charge Depleting Mode Central SOC Override

[%]

Declaration Mode Lorries – Overview (1/2)

- VECTO Development Version **0.7.10.2996** as released on **March 15**, features the Declaration Mode for Lorries according to the 2nd Amendment.
- This enables the official output XMLs (MRF, CIF) to be generated using the official input XMLs.
- The result values correspond to the official results, subject to minor adjustments and additions from the testing period (see later slides).
- With this version, the Declaration Mode can also be calculated via the GUI (json + csv). This mode also contains some special features for the upcoming test phase (see later slides).

Declaration Mode Lorries – Overview (2/2)

- Overview new elements
 - Generic parameterisation of auxiliaries
 - Generic parametrisation of P-HEV strategy including update of gear shift strategy
 - Generic parametrisation of S-HEV strategy
 - Generic parametrisation of usable SOC range
 - Separate approach for „Charge depleting mode“ simulation
 - Calculation of energy consumption at “battery terminals” considering battery charging losses during external charging
 - Range calculations
 - Automation of the various simulation runs necessary for PHEVs plus post processing elements
 - Generic e-PTO cycle for PEV and S-HEV in the MUN cycle
 - Generation of MRF and CIF

DECL Lorries – Generic parameterisation of auxiliaries

- Basic principles of generic data used in DECL
 - Relevant auxiliary systems:
 - Pneumatic system
 - ICE cooling fan + conditioning power for electric propulsion components
 - Steering system
 - HVAC: for lorries only “yes/no”
 - Electric board net (is called “electric system”): for lorries only headlights technology (LED or standard)
 - Respective tables with generic power demand for each auxiliary system can be found in specific subfolder “Declaration\VAUX” under VECTO main path as csv-files
 - General table structure looks as follows:

| Technology | applicability for architecture (indicated with 0/1) | | | | can be directly supplied by REESS if present (indicated with 0/1) | cycle specific <u>mechanical</u> power demand [W] | | | | |
|------------|--|-------|-------|-----|--|--|----------------------|-------------------|----------------------|--------------|
| | conventional | P-HEV | S-HEV | PEV | fully electric | Long haul | Regional delivery | Urban delivery | Municipal utility | Construction |
| Tech #1 | | | | | | | | | | |
| Tech #2 | | | | | | | | | | |
| Tech #3 | | | | | | | | | | |
| Tech #... | | | | | | | | | | |

DECL Lorries – Generic parameterisation of auxiliaries

- Basic principles of generic data used in DECL
 - Details of application in DECL:
 - **For all HEV:** "fully electric" technology is connected to REESS
 → mechanical power (i.e. respective alternator drive power) is converted to electric power with generic alternator efficiency of 0.7 used consistently throughout whole VECTO auxiliary approach
 (i.e. mechanical power from table is multiplied by 0.7 and therefore reduced)
 - **For all PEV:** only "fully electric" technology can be declared (acc. to Annex specifications as well)
 → same principle of conversion from mechanical to electrical power (as explained above applies)

| Technology | applicability for architecture (indicated with 0/1) | | | | can be directly supplied by REESS if present (indicated with 0/1) | cycle specific <u>mechanical</u> power demand [W] | | | | |
|------------|--|-------|-------|-----|--|--|----------------------|-------------------|----------------------|--------------|
| | conventional | P-HEV | S-HEV | PEV | fully electric | Long haul | Regional delivery | Urban delivery | Municipal utility | Construction |
| Tech #1 | | | | | | | | | | |
| Tech #2 | | | | | | | | | | |
| Tech #3 | | | | | | | | | | |
| Tech #... | | | | | | | | | | |

DECL Lorries – Generic parameterisation of auxiliaries

- Basic principles of pneumatic system in DECL
 - Structure of table is slightly different, stating mechanical and electrical power demand at the same time
 - Reason is that generic saving of AMS technologies is reduced for xEV vehicles (only minus 10%) due to reduced recuperative potential compared to conventional ones

PS-Table.csv

applicability for architecture
(indicated with 0/1)

can be directly
supplied by REESS
if present
(indicated with 0/1)

cycle specific indication of
power demand [W]

| Technology | conventional | P-HEV | S-HEV | PEV | fully electric | mechanical power demand [W] | electrical power demand [W] |
|----------------------|--------------|-------|-------|-----|----------------|-----------------------------|-----------------------------|
| Tech mechanical #1 | | | | | | | |
| Tech mechanical #2 | | | | | | | |
| Tech mechanical #3 | | | | | | | |
| Tech mechanical #... | | | | | | | |
| Tech electrical #1 | | | | | | | |
| Tech electrical #2 | | | | | | | |
| Tech electrical #3 | | | | | | | |
| Tech electrical #... | | | | | | | |

Block of
mechanical
technologies

Block of
electrical
technologies

DECL Lorries – Generic parameterisation of auxiliaries

- Basic principles of ICE fan and electric components conditioning power in DECL
 - ICE fan power is always fully applied when ICE = on in simulation
 - **For PEV and S-HEV:** values from table below are fully applied when at least one EM = on in simulation (i.e. electric powertrain is propelling/braking) or when E_PTO = on
 - **For P-HEV:** values from table below are applied according to equations further below with scaling factor “x” reflecting actual split of propulsion power for each timestep
 - $x = \text{ABS}(P_{\text{EM}}) / [\text{ABS}(P_{\text{EM}}) + \text{ABS}(P_{\text{ICE}})]$
with and P_{EM} and P_{ICE} being the mechanical power of EM and ICE
 - Applied electric components conditioning power equals: “table value” multiplied by x
 - For further details please refer to **VECTO-DEV WS#12 18.05.2022 (slide 15ff)**

| Electric conditioning power demand applied to electric system [W] | | | | |
|--|-------------------|----------------|-------------------|--------------|
| Long Haul | Regional Delivery | Urban Delivery | Municipal utility | Construction |
| 600 | 600 | 550 | 550 | 600 |

DECL Lorries – Generic parameterisation of auxiliaries

- Basic principles of steering system in DECL
 - Foundation of approach is that basic power demand defined per cycle is multiplied by technology dependent scaling factors (CFs)
 - 3 sub-groups of power demands defined:
 - U&F: unloaded and friction
 - B: banking
 - S: steering
 - Total steering power acc. to equation below is calculated separately for mechanical and electrical steering power demand:
 - All CFs are averaged over all steered axles with electric technology
 - All CFs are averaged over all steered axles with mechanical technology
- If all axles are electric technologies, total steering power is applied as electrical power to REESS
- With at least one mechanical techn. present. total steering power is applied as mechanical load

$$P_{tot} = P_{U\&F,tot} * \Phi(CF_{U\&F,i}) + P_{B,tot} * \Phi(CF_{B,i}) + P_{S,tot} * \Phi(CF_{S,i})$$

SP-Tech.csv +
SP-Table.csv +
SP-Axles.csv

DECL Lorries – Generic parameterisation of auxiliaries

- Basic principles of HVAC system in DECL
 - **Conventional and P-HEV:**
 - HVAC load is applied as mechanical auxiliary
 - **S-HEV and PEV:**
 - HVAC load is applied as electrical auxiliary
 - Conversion from mechanical to electrical is done by dividing mechanical base power by generic efficiency of 0.8

HVAC-Table.csv

DECL Lorries – Generic parameterisation of auxiliaries

- General remark about post-processing of “missing” auxiliary power demand for mechanically driven auxiliaries in timesteps where the ICE is off:
 - These topic is related to “Utility Factor (UF) for Engine-Stop-Start (ESS)”
 - For lorries only the very simple case is relevant (application case 1)
 - Basic rule: for auxiliaries operated independently of ICE status energy demand over cycle is the same with missing portion being accounted for in post-processing
 - For further details please refer to:
VECTO-DEV WS#6 12.07.2021 (slide 7ff)

Combination of ESS & Bus auxiliaries & HEV (1/5)

• Application case 1 (for beginners): Conventional lorries, bus-aux Case A, bus-aux case C2b

$P_{aux_mech_base} = P_{fan} + P_{STP} + P_{PTP}$ (in case of battery) + P_{PTP} (in case of battery) + P_{HVAC} (mech)
 $P_{aux_mech_C2b_off_on} = P_{STP} + P_{PTP}$ (in case of battery) + P_{PTP} (in case of battery) + P_{HVAC} (mech)
 $P_{aux_mech_C2b_off_off} = P_{STP}$ (in case of battery) + P_{PTP} (in case of battery) + P_{HVAC} (mech)

$P_{ESS} = \text{sum of all electric consumers} + P_{ESS}$ (in case of electric fans) + P_{STP} (in case of electric starting pumps) → only used in case of battery
 $P_{ESS_C2b_off_on} = \text{sum of all electric consumers} + P_{STP}$ (in case of electric starting pumps) → only used in case of battery
 $P_{ESS_C2b_off_off} = \text{sum of all electric consumers}$ → only used in case of battery

| Driving behavior | mode | P_{aux_mech} | $P_{mech_ESS_on}$ | $P_{mech_C2b_consumer_on}$ | $P_{mech_ESS_off}$ | $P_{aux_ESS_mech}$ | $P_{aux_ESS_mech_C2b_on}$ | $P_{mech_ESS_off_on}$ | $P_{mech_ESS_off_off}$ | $P_{mech_ESS_off_on_off}$ |
|------------------|------|---|---------------------|--------------------------------|----------------------|--|--|--------------------------|---------------------------|-------------------------------|
| Driving | on | $P_{aux_mech_base} + P_{mech_ESS_on} + P_{mech_C2b_consumer_on}$ | $P_{mech_ESS_on}$ | $P_{mech_C2b_consumer_on}$ | $P_{mech_ESS_off}$ | $P_{aux_mech_base} + P_{mech_ESS_off}$ | $P_{aux_mech_base} + P_{mech_ESS_off}$ | $P_{mech_ESS_off_on}$ | $P_{mech_ESS_off_off}$ | $P_{mech_ESS_off_on_off}$ |
| Driving | off | 0 | 0 | $P_{mech_C2b_consumer_off}$ | 0 | $P_{aux_mech_base} + P_{mech_C2b_consumer_off}$ | $P_{aux_mech_base} + P_{mech_C2b_consumer_off}$ | 0 | 0 | 0 |
| Driving | off | 0 | 0 | 0 | 0 | $P_{aux_mech_base} + P_{mech_C2b_consumer_off}$ | $P_{aux_mech_base} + P_{mech_C2b_consumer_off}$ | 0 | 0 | 0 |
| Driving | off | 0 | 0 | 0 | 0 | $P_{aux_mech_base} + P_{mech_C2b_consumer_off}$ | $P_{aux_mech_base} + P_{mech_C2b_consumer_off}$ | 0 | 0 | 0 |
| Driving | off | 0 | 0 | 0 | 0 | $P_{aux_mech_base} + P_{mech_C2b_consumer_off}$ | $P_{aux_mech_base} + P_{mech_C2b_consumer_off}$ | 0 | 0 | 0 |
| Driving | off | 0 | 0 | 0 | 0 | $P_{aux_mech_base} + P_{mech_C2b_consumer_off}$ | $P_{aux_mech_base} + P_{mech_C2b_consumer_off}$ | 0 | 0 | 0 |
| Driving | off | 0 | 0 | 0 | 0 | $P_{aux_mech_base} + P_{mech_C2b_consumer_off}$ | $P_{aux_mech_base} + P_{mech_C2b_consumer_off}$ | 0 | 0 | 0 |

DECL Lorries – Generic parametrisation P-HEV strategy

- Operation in Charge sustaining (CS) mode

- Fixed number of 3 simulations to determine optimal strategy parameters done automatically
- **1st run:** generic start value for equivalence factor (EF) depending on vehicle group, mission, payload and usable SOC range applied
 - refer to \Declaration\HEVParameters\Lorry\HEV_Strategy_Parameters_fequiv_XXsoc.csv
 - **XX** = 10, 20 or 40 depending on usable SOC range in percent (interpolation, no extrapolation)

- **2nd run:** from resulting ΔSOC_1 of 1st run ($\Delta SOC_1 = SOC_{end} - SOC_{start}$) new EF is calculated according to following equations:

$$k = \frac{f_{equiv,2} - f_{equiv,1}}{SOC_{end} - SOC_{start}}$$

equivalence factor used in 1st simulation run

$$k = 0.4 + 0.6 * (SOC_{usable} - 0.4)$$

refer to \Declaration\HEVParameters\Lorry\Gradient_40.csv

- **3rd run:** from resulting ΔSOC_2 of 2nd run new equivalence factor is calculated according to following equation:

$$f_{equiv,3} = \frac{0 - \Delta SOC_1}{SOC_{end} - \Delta SOC_1} * (f_{equiv,2} - f_{equiv,1}) + f_{equiv,1}$$

- For further details please refer to: **VECTO-DEV WS#8 16.11.2021 (slide 7ff)**

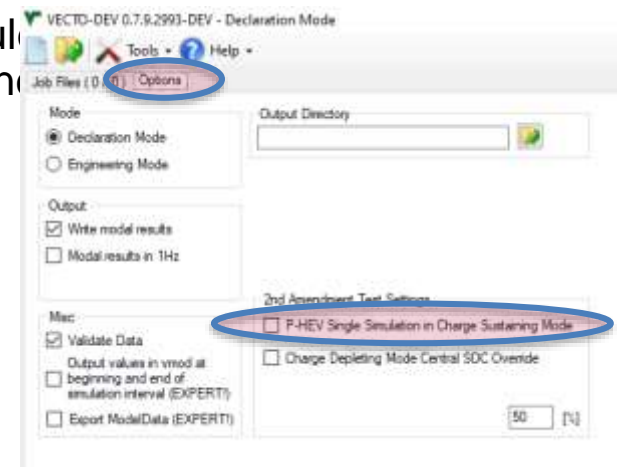
DECL Lorries – Generic parametrisation P-HEV strategy

- Operation in Charge sustaining (CS) mode
 - Dedicated GUI feature available in order to overrule 3 iterations and perform calculation with single individual EF only (for engineering exercise)
 - Instructions:
 - Copy files from “\Declaration\HEVParameters\Lorry\HEV_Strategy_Parameters_fequiv_XXsoc.csv” to “\Declaration\Override\” without adding any sub-directories
 - Adapt respective values for individual EF in files (per vehicle group, mission profile and payload)

| vehiclegroup | longhaul | regionaldelivery | urbandelivery | municipalutility | construction |
|--------------|----------|------------------|---------------|------------------|--------------|
| 53 | | 2.6/2.3 | 2.7/2.3 | | |
| 54 | | 2.6/2.3 | 2.7/2.3 | | |
| 1s | | 2.6/2.3 | 2.7/2.3 | | |
| 1 | | 2.6/2.3 | 2.7/2.3 | | |
| 2 | 0.1/0.1 | 2.6/2.3 | 2.7/2.3 | | |
| 3 | | 2.6/2.3 | 2.7/2.3 | | |
| 4 | 1.4/1.3 | 2.2/2.6 | 1.9/2.3 | 2.1/2.1 | 2.1/2.1 |
| 5 | 1.4/1.3 | 2.2/2.6 | 1.9/2.3 | | 2.1/2.1 |
| ... | ... | ... | ... | ... | ... |

DECL Lorries – Generic parametrisation P-HEV strategy

- Operation in Charge sustaining (CS) mode
 - Dedicated GUI feature available in order to overrule calculation with single individual EF only (for engine)
 - Instructions:
 - Step 3:
Activate GUI feature under “Options” tab to apply single run with individually set EF loaded from “\Declaration\Override\” folder
 - **ATTENTION:** Only loaded when VECTO is launched initially (updates during active VECTO session have no effect)!



- To be checked: Handling of vehicles with very small batteries in LH
(due to high amount of energy being captured at the very end of the cycle)

Updated P-HEV gear shift model (DECL + ENG)

- Gear shift model for P-HEV used slightly wrong ICE operation point for evaluation of fuel costs
 - mainly relevant for overdrive drivetrain configurations
 - effect for non-overdrive drivetrains:
 - Typical LH application: from slight decrease <1% up to slight increase <1% of HEV FC
 - Typical dynamic (urban) application:
 - More realistic (higher) acceleration behavior and better following of speed trace like ICE-only counterpart
 - Still some percent decrease of FC of HEV compared to previous version
- In actual simulation nothing was changed, the change only affects methods used for cost evaluation

Updated P-HEV gear shift model (DECL + ENG)

- Class 4 vehicle on RD reference load;

| Test | Consumption [-] | Direct gear usage [% time] | Overdrive gear usage [% time] |
|--------------------|-----------------|----------------------------|-------------------------------|
| ICE | 1 | 42% | 26% |
| Direct + overdrive | 0.965 | 7% | 68% |
| Direct only | 0.895 | 78% | - |
| Direct + overdrive | 0.870 | 57% | 12% |

overdrive;

- Much better results after the update compared to the previous implementation;

Updated time-based with gear mode for AT (ENG only)

- Several manufacturers reported that the TC can be briefly active in higher gears – mainly during gearshifts;
- Allow input of "TC active" signal in vdri in this mode;
- Changes apply only in engineering mode. Included in the upcoming DEV release;

DECL Lorries – Generic parametrisation usable SOC range

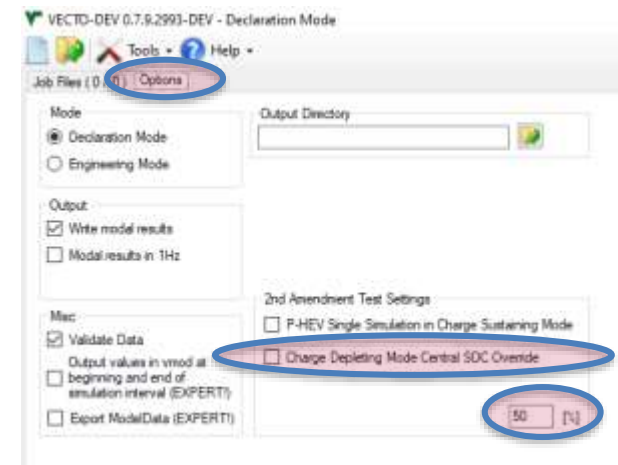
- Actual SOC range used for simulation is determined according to 3 elements:
 - Generic SOC range for new vehicle
 - Defined separately for PEV, OVC-HEV, Non-OVC-HEV (NOVC-HEV)
 - Declared SOC range for new vehicle acc. to Annex III (*P413* + *P414*)
 - Deterioration factor applied for half of lifetime
 - Preliminary assumption: 5% decrease of usable SOC range

| | new vehicle | new vehicle | new vehicle | new vehicle | new vehicle | new vehicle | new vehicle | half of lifetime | half of lifetime | half of lifetime | half of lifetime |
|----------|-----------------|-----------------|------------------|------------------|----------------|----------------|-------------------|-------------------|----------------------|------------------|------------------|
| | generic SOC min | generic SOC max | declared SOC min | declared SOC max | actual SOC min | actual SOC max | useable SOC range | useable SOC range | average of SOC range | actual SOC min | actual SOC max |
| PEV | 5% | 95% | 10% | 92% | 10% | 92% | 82% | 77.90% | 51.0% | 12.05% | 89.95% |
| OVC-HEV | 15% | 85% | | | 15% | 85% | 70% | 66.50% | 50.0% | 16.75% | 83.25% |
| NOVC-HEV | 25% | 75% | | | 25% | 75% | 50% | 47.50% | 50.0% | 26.25% | 73.75% |

- Further discussions regarding final values ongoing
→ see separate agenda point

DECL Lorries – Separate approach „CD mode“ simulation

- „Frozen“ SOC (infinity battery) at „SOC_{center}“ applied (i.e. average of actual SOC_{max} and SOC_{min})
→ see previous slide
- GUI feature to set frozen SOC to other values than „center SOC“ (see figure)
 - Value needs to be between actual SOC_{max} and SOC_{min} for each individual battery installed
- Influence factors on result:
 - Limitation of maximum battery power = f(SOC)
 - Internal resistance = f(SOC) (i.e. battery losses)
- Discussions ongoing which SOC level(s) shall be considered for final method
→ see separate agenda point



DECL Lorries – Calculation EC at “battery terminals”

- Case PEV:
 - Only re-charging in depot relevant for charging losses
(since no detailed information in charging behaviour is available)
 - Power level for determining charging losses in battery defined by following equation:
nominal charging power in kW = **$\max(10, (\text{usable SOC in kWh}) / 6h)$**
 - Usable SOC is determined by integration of OCV-data from actual SOC_{min} to SOC_{max}
 - Charging efficiency is determined as follows:
 - Nominal charging current:
Charging power above is divided by OCV at SOC_{center} (i.e. average of actual SOC_{max} and SOC_{min})
 - Charging losses: nominal charging current and internal resistance at SOC_{center}
 - Charging efficiency: $1 - (\text{charging losses} / \text{charging power})$

DECL Lorries – Calculation EC at “battery terminals”

- Case OVC-HEV :
 - Charging in **depot** as well as **stationary during mission** (acc. to generic usage data) relevant for charging losses
 - Power level for determining charging losses in battery defined as follows:
 - **Depot:**
 - same as for PEV (see previous slide)
 - but limited with declared maximum charging power acc. to Annex III (*P402*)
 - **Stationary during mission:**
 - determined from matrix of generic usage data as already defined for OVC-UF calculation (function of vehicle group and mission profile)
 - limited with declared maximum charging power acc. to Annex III (*P402*)
 - 2 separate values of charging efficiency determined as described on previous slide
 - → weighted averaging by amount of charged energy for depot and stationary during mission to determine final charging efficiency

DECL Lorries – Calculation EC at “battery terminals”

• Case OVC-HEV calculation example:

- Charging power levels: Depot 100 kW, Stationary during mission 250 kW
- Battery related data and charging efficiencies:

| | | |
|---|----|-----------|
| Charging power Depot | kW | 10.00 |
| LossPower charging Depot | kW | 0.0051148 |
| Charging efficiency Depot | - | 0.9995 |
| Charging power Stationary during mission | kW | 250.00 |
| LossPower charging Stationary during mission | kW | 3.1206110 |
| Charging efficiency stationary during mission | - | 0.9875 |

• Charging losses and efficiencies:

| | | |
|---|----|-----------|
| Charging power Depot | kW | 10.00 |
| LossPower charging Depot | kW | 0.0051148 |
| Charging efficiency Depot | - | 0.9995 |
| Charging power Stationary during mission | kW | 250.00 |
| LossPower charging Stationary during mission | kW | 3.1206110 |
| Charging efficiency stationary during mission | - | 0.9875 |

| | | |
|---|-------|----------|
| Charged energy DEPOT | [kWh] | 2.109375 |
| Charged energy STATIONARY DURING MISSION | [kWh] | 1.406250 |
| Battery charging efficiency DEPOT | [-] | 0.9995 |
| Battery charging efficiency STATIONARY DURING MISSION | [-] | 0.9875 |
| Final battery charging efficiency weighted | [-] | 0.99470 |

Energy charged in depot limited by:

- Usable battery capacity
- Real world usage factor (0.75)

Energy charged during mission limited by:

- Max. charging power
- Duration of event
- Usable battery capacity
- Number of charging events
- Real world usage factor (0.5)

DECL Lorries – Calculation EC at “battery terminals”

- For further details please refer to: ***VECTO-DEV WS#9 11.01.2022 (slide 23ff)***
- ***Excel will be distributed together with meeting material***

DECL Lorries – Automation of OVC-HEV simulation

- OVC-HEV are HEV with external charging feature (“Plug-in HEV”)
 - Declared acc. to Annex III (*P401*)
- 2 operation modes for OVC-HEV defined in VECTO:
 - Charge depleting mode (CD) where the propulsion energy is provided by the electric storage only
 → *results: kWh_{el}/km, electric range*
 - Charge sustaining mode (CS) where the propulsion energy is provided by the fuel storage
 → *SOC is balanced over complete cycle, thus no electric energy consumption (kWh_{el}/km = 0 per definition!)*

DECL Lorries – Automation of OVC-HEV simulation

- Separate simulation runs are performed in VECTO for each mode automatically
- Separate results for CD and CS are weighted for final result based on utility factor (UF)
 - UF is defined as share of electric range in CD mode on total daily mileage of each mission profile
 - electric range is defined by:
 - Electric energy consumption in the specific mission in [kWh/km] as result from the simulation
 - Usable electric energy, which in turn is defined by:
 - battery capacity due to initial SOC
 - generic assumptions for re-charging during each mission (number and duration of charging events, available charging power from infrastructure)

- Weighted results (fuel or energy consumption) are calculated according to the following equation:

$$RES_{tot} = UF \times RES_{CD} + (1-UF) \times RES_{CS}$$

UF utility factor as function of electric range

RES_{CD} ... Result in charge depleting mode

RES_{CS} ... Result in charge sustaining mode

DECL Lorries – Range calculations

- Overview of different ranges in result matrix in VECTO

| Electric range | Definition | | |
|---|--|--------------------|------------|
| Actual charge depleting range (R_{CDA}) | The range that can be driven in charge depleting mode based on the usable amount of REESS energy, without any interim charging. (Annex IV) | | |
| Equivalent all electric range (EAER) | The part of the actual charge depleting range that can be attributed to the use of electric energy from the REESS, i.e. without any energy provided by the non-electric propulsion energy storage system. (Annex IV) i.e. R_{CDA} mathematically reduced by energy content of fuel used (based on fuel consumption in charge sustaining mode) | for OVC- HEV | for PEV |
| Zero CO₂ emissions range (ZCER) | The range that can be attributed to energy provided by propulsion energy storage systems considered with zero CO ₂ impact. (Annex IV) | | |

DECL Lorries – Automation of OVC-HEV simulation

- Schematic overview of result matrix in VECTO for CD + CS mode

| Mission profile | Payload | Result level | v_average | Fuel consumption per fuel type | CO2 emissions | Electric energy consumption | Actual charge depleting range R _{CDA} | Equivalent all electric range (EAER) | Zero CO2 emissions range |
|-----------------|---------|--------------|-----------|--------------------------------|---------------|-----------------------------|--|--------------------------------------|--------------------------|
| | | | [km/h] | [lit/100km] ... | [g/km] ... | [kWh/km] ... | [km] | [km] | [km] |
| #1 | low | OVC mode CD | X | X | X | X | (X) | (X) | --- |
| #1 | low | OVC mode CS | X | X | X | --- | --- | --- | --- |
| #1 | low | Total | X | X | X | X | X | X | X |
| #1 | rep. | OVC mode CD | X | X | X | X | (X) | (X) | --- |
| #1 | rep. | OVC mode CS | X | X | X | --- | --- | --- | --- |
| #1 | rep. | Total | X | X | X | X | X | X | X |
| #2 | low | OVC mode CD | X | X | X | X | (X) | (X) | --- |
| #2 | low | OVC mode CS | X | X | X | --- | --- | --- | --- |
| #2 | low | Total | X | X | X | X | X | X | X |
| #2 | rep. | OVC mode CD | X | X | X | X | (X) | (X) | --- |
| #2 | rep. | OVC mode CS | X | X | X | --- | --- | --- | --- |
| #2 | rep. | Total | X | X | X | X | X | X | X |
| #3 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| weighted | | | --- | X | X | X | X | X | X |

Comments:

- General structure given by XML schema structure
- The "final results" for each mission profile and payload case are always output in the XML element "Total"
- FC, CO2, EC in XML element "Total" are weighted with UF
- Ranges in XML element "Total" are identical to results from CD mode for OVC-HEV
- Zero CO2 emissions range equals EAER for OVC-HEV

- For further details please refer to: **VECTO-DEV WS#13 04.07.2022 (slide 12ff)**

DECL Lorries – Automation of OVC-HEV simulation - EX

| | | |
|---|-----------|--------|
| Max stat. charging power | [kW] | 120 |
| Useable battery capacity | [kWh] | 200.0 |
| Electric energy consumption CD mode (battery internal, SOC) | [kWh/km] | 0.915 |
| FC CD mode | [l/100km] | 3.850 |
| FC CS mode | [l/100km] | 27.350 |

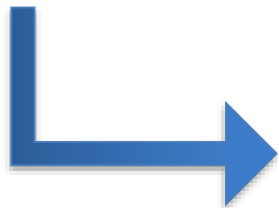
Declared / Component data

„Raw“ results by VECTO



Calculation of different specific ranges from data above

| | | |
|---|------|-------|
| Actual charge depleting range (R_{CDA}) | [km] | 218.5 |
| Equivalent all electric range (EAER) | [km] | 187.8 |
| Zero CO2 emissions range | [km] | 187.8 |



Relevant for CO2 Standards Regulation, not for weighting of CD+CS results

DECL Lorries – Automation of OVC-HEV simulation - EX

| | | |
|---|------|--------|
| Daily specific mileage | [km] | 480 |
| Stationary charging during mission max. power from infrastructure | [kW] | 500 |
| Stationary charging during mission - average duration per event | [h] | 0.5 |
| Stationary charging during mission - number of events | [-] | 1.00 |
| Real world factor usage start SOC (part of max useable) | [-] | 0.75 |
| Real world factor usage charge during mission | [-] | 0.50 |
| Charging efficiency battery | [-] | 0.9882 |

Generic data



Calculation of UF specific ranges from consumption figures (previous slide) and generic data above

| | | |
|---|-------|-------|
| Electric range for UF from start SOC (stat charging at depot) | [km] | 163.9 |
| Electric energy charged during mission from stat infrastructure | [kWh] | 29.3 |
| Electric range for UF from stat charging during mission | [km] | 32.0 |

R_{CDA} corrected by real world factor

Due to re-charging during mission



Calculation of UF as share of electric range in CD mode on total daily mileage (163.9 + 32.0 = 195.8 / 480)

| | | |
|--|-----------|--------|
| UF | [-] | 0.409 |
| Charging losses (ElectricEC in CD mode refers to battery internal) | [-] | 1.012 |
| EC_el_terminal CD | [kWh/km] | 0.926 |
| Electric energy consumption weighted CD + CS | [kWh/km] | 0.379 |
| Fuel consumption weighted CD + CS | [l/100km] | 17.741 |

$RES_{tot} = UF \times RES_{CD} + (1-UF) \times RES_{CS}$

DECL Lorries – Generic e-PTO in MUN cycle

- e-PTO applied for PEV and S-HEV in the MUN cycle (generic refuse body)
- e-PTO cycle $P_{el,PTO} = f(t)$ derived from:
 - generic hydraulic pump cycle for ICE and the allocated ICE high idle speed
 - assuming an average e-PTO efficiency of 80%
- Calculation is included time-resolved in the vmod file
- Electric energy consumption is considered in electric range for MUN cycle

DECL Lorries – Known issues with current version

- Elements not yet implemented
 - Battery connectors / junction box not included
 - define and implement generic additional resistances (i.e. loss factors)
 - Generic P-HEV strategy:
 - To be tested whether an alternative post-processing method for vehicles with very small batteries is needed as back-up
 - Technical elements as resulting from the revision of the CO₂ Standards to be added
 - Sub-group allocation for the for the newly covered vehicle groups
 - Generation of weighted results for vocational vehicles
- Elements still under discussion
 - Medium lorries mission profile and payload weighting factors (equally weighted, only preliminary)
 - Generic SOC min/max ranges and deterioration (only preliminary values)
 - Multiple SOC level(s) for VECTO PEV simulation and respective weighting of results

DECL Lorries – Testing requests and organ. of feedback

- Testing requests:
 - Test configurations relevant in your portfolio
 - Specific analysis regarding open issues as mentioned on slide “Known issues with current version”
- Feedback
 - Bug reports, questions etc.: please **ONLY use JIRA** (no specific emails regarding those topics in the upcoming period)
 - If there is an urgent need for a meeting before the next DEV workshop (e.g. because of a special problem), this will be announced separately.
- Bug fixing and support
 - TUG will focus on finalising the DECL for buses in the coming weeks.
 - Topics for the DECL for lorries will be collected and sorted by priority.
 - Unless urgent bugfix releases for blocking issues, there will be no new release before May.

Vecto 0.7.9.2864 JRC Development Version

November 2022

- **Important Note**

This is a special development release by JRC to validate the time-runs for BEVs.

- **Changes**

- Implementation of measured speed cycle for BEVs (E2, E3, E4, IEPC)
- Implementation of measured speed with gear for BEVs (E2, IEPC)
- Implementation of Pwheel mode for BEVs (E2, E3, E4, IEPC)
In this type of cycle, the input field **<n>** stands for the speed of the electric motor.
- The E2 vehicle job “Generic Vehicles\Engineering
Mode\GenericVehicleE2\BEV_ENG_timeruns.vecto” is preconfigured to run time-run cycles.

Vecto 0.7.9.2741 Development Version

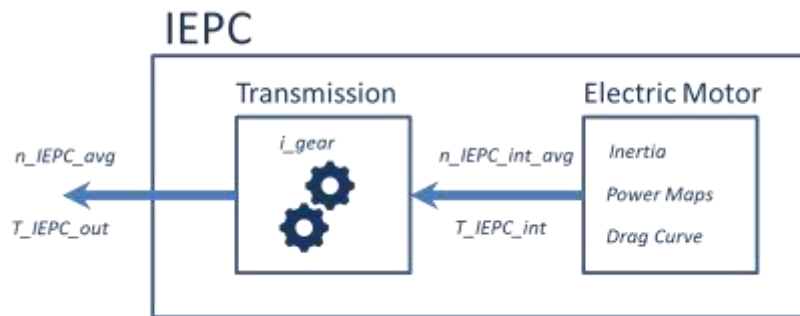
June 2022

- **Changes/Bugfixes**

- Implementation of IEPC
- Implementation of IEPC-S
- Implementation of IHPC
- Adaptations HEV-S strategy, SoC correction for HEV-S
- PTO idle drag losses for PEV, adapting PTO idle losses according to 2nd amendment
- Bugfixes
- Hashing tool crashes in .net version 6.0
- Corrected length for BusAux volume calculation

Modeling of IEPC component

- IEPC is modelled as APT-N transmission and electric machine
 - Using already available models, same shift strategy as for E2/S2
 - Simplified transmission in case of single-speed IEPC



***_int* signals refer to the out-shaft of the electric motor**

Peculiarities of IEPC

- Model parameters (max torque, power maps) refer to IEPC out-shaft
 - Internally converted to electric motor
- Overload parameters are measured in the gear with the ratio closest to 1
- 2 options for drag curve acc. to Annex Xb:
 - A single drag curve is provided
(measured in gear with ratio closest to 1)
 - Drag curve for every gear is provided

Input data for IEPC component

- IEPC powertrain architecture definition
 - Specific system layout is described by setting of 3 parameters (for detailed description please refer to Annex Xb)

| IEPC layout case # | Differential Included | DesignType WheelMotor | DesignTypeWheel MotorMeasured | Layout schematics | Comments |
|--------------------|-----------------------|-----------------------|-------------------------------|-------------------|--|
| 1 | No | No | n.a. | | Regular axle component required in job file → usage of transmission type „IEPC Transmission – dummy entry“ (allows axle component alone without a min. number of gears) |
| 2 | Yes | No | n.a. | | No axle component All parameterization via IEPC specific window |
| 3 | No | Yes | 1 | | Component test performed in L-config acc. to Annex Xb (only one side) → All torque and power values in input data are multiplied with a factor of 2 |
| 4 | No | Yes | 2 | | Component test performed in T-config acc. to Annex Xb (both sides) |

Input data for IEPC component

- IEPC General parameters

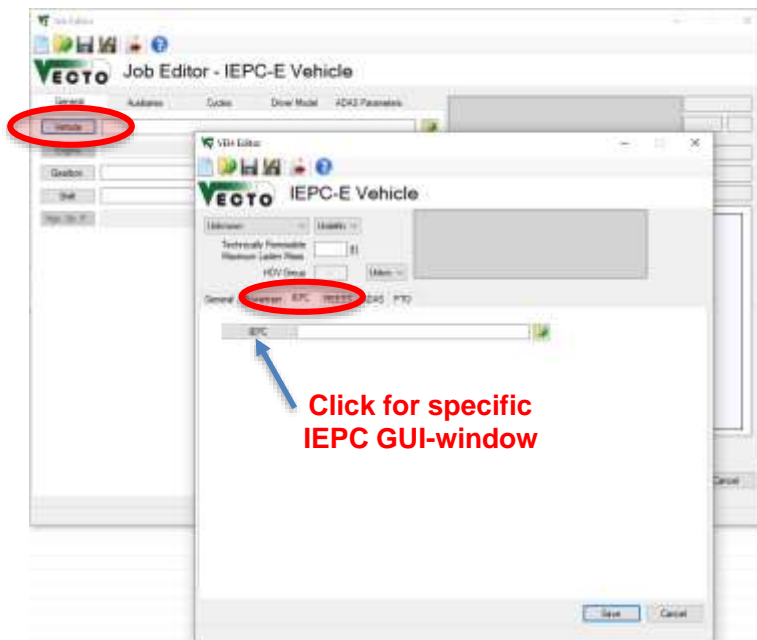
| Parameter name | Description |
|------------------------------|--|
| RotationallInertia | For EM inertia, gearbox parts not to be considered (as for regular transmission components). Reference point for definition of inertia is EM output shaft. Determined in accordance with point 8 of Appendix 8 of Annex Xb. |
| DifferentialIncluded | Set to 'true' in the case a differential is part of the IEPC |
| DesignTypeWheelMotor | Set to 'true' in the case of an IEPC design type wheel motor |
| DesignTypeWheelMotorMeasured | Input only relevant in the case of an IEPC design type wheel motor, in accordance with paragraph 4.1.1.2 of Annex Xb. Allowed values: '1', '2' |

Input data for IEPC component

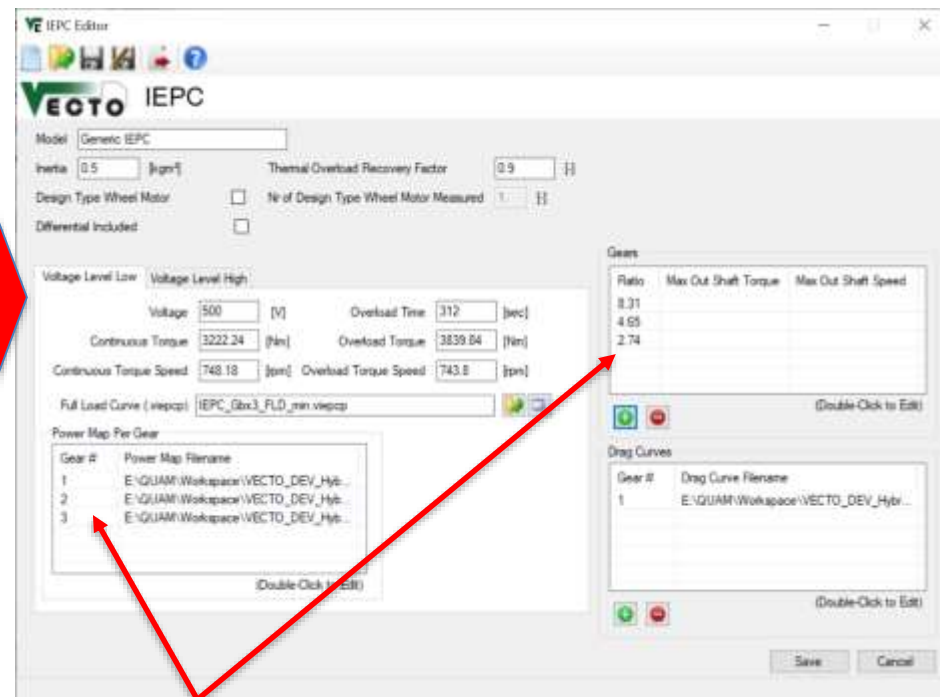
- IEPC performance parameters

| Parameter name | Description |
|-----------------------|--|
| Gear data | For each gear: number, ratio, MaxOutputShaftTorque (optional), MaxOutputShaftSpeed (optional) |
| Overload data | Overload and Continuous operation point and Overload Time For each voltage level separately Measured in gear closest to ratio 1 acc. to Annex Xb |
| Max/min torque limits | Full load curve (only for one gear closest to ratio 1 acc. to Annex Xb) For each voltage level separately |
| Drag torque | Only for one voltage level acc. to Annex Xb |
| Electric power maps | For each gear For each voltage level separately |

IEPC Input Form



Definition of IEPC component via
"Vehicle \ IEPC-Tab"



Lists with gear entries are
synchronized, gears can be
added/removed in the gear-list
on the right

Gearbox Form for IEPC Vehicles

- No gearbox file needs to be provided for IEPC with differential included (case 2)
- New IEPC gearbox type for all other variants where only the axlegear ratio needs to be provided

Modeling of IHPC component

- IHPC transmission is modeled as APT-N
- IHPC electric motor is modeled as regular electric motor at position P2
 - Gear-dependent power maps
- Peculiarities of IHPC
 - Drag-curve shall be set to **0 Nm** acc. to Annex Xb
- For detailed description of component characteristics as well as testing and measurement post-processing methods please refer to Annex Xb

Input data for IHPC component

- IHPC general parameters EM (*same as for basic EM component*)

| Parameter name | Description |
|--------------------|--|
| RotationallInertia | For EM inertia, gearbox parts not to be considered (as for regular transmission components). Reference point for definition of inertia is EM output shaft. Determined in accordance with point 8 of Appendix 8 of Annex Xb. |

Input data for IHPC component

- IHPC performance parameters EM
→ same as for basic EM component, except **multiple El. power maps**

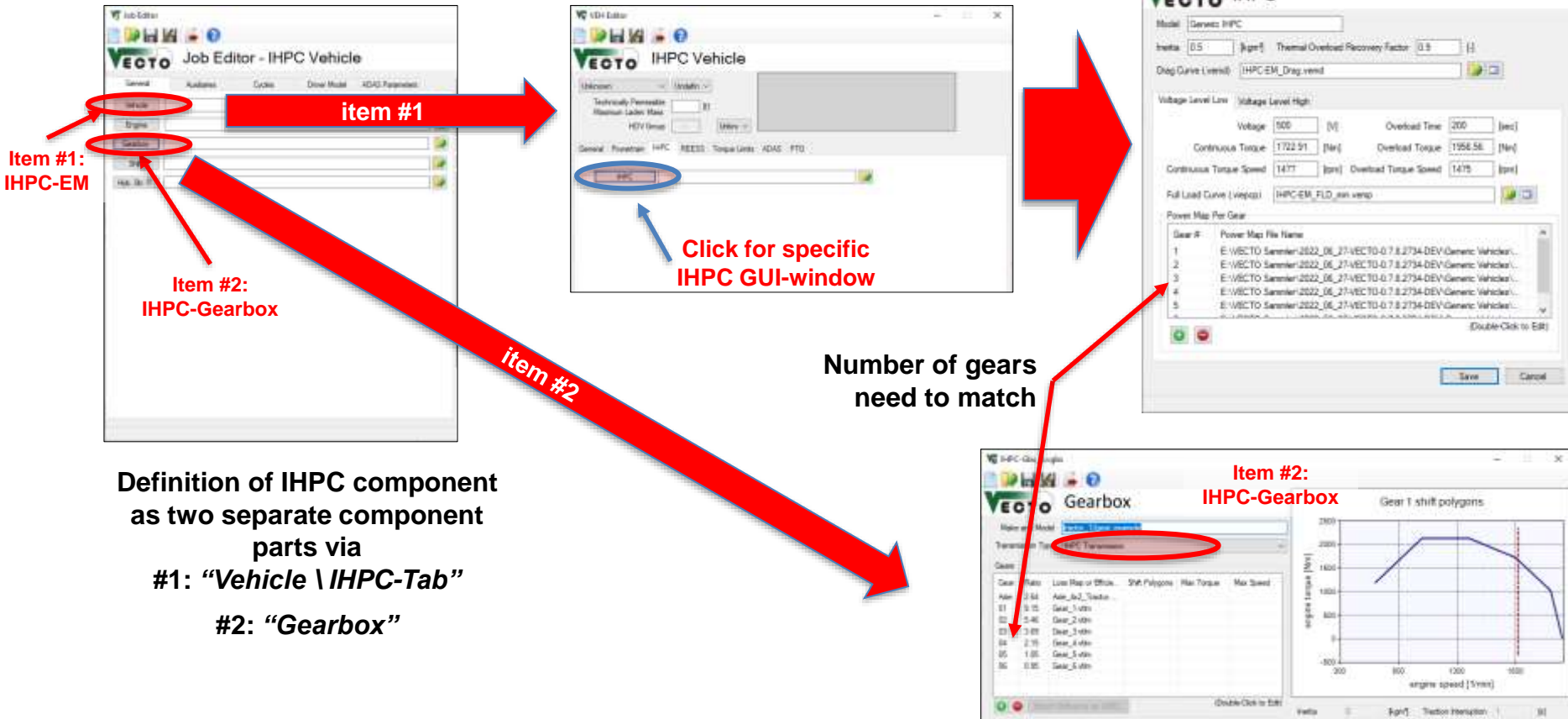
| Parameter name | Description |
|-----------------------|--|
| Gear data | For each gear: number (needs to match with specifications in gearbox file) |
| Overload data | Overload and Continuous operation point and Overload Time For each voltage level separately Measured in gear closest to ratio 1 acc. to Annex Xb |
| Max/min torque limits | Full load curve (only for one gear closest to ratio 1 acc. to Annex Xb) For each voltage level separately |
| Drag torque | <u>NOT MEASURED</u> acc. to Annex Xb, but input of “0 Nm” drag torque required! |
| Electric power maps | For each gear For each voltage level separately |

Input data for IHPC component

- IHPC parameters Gearbox
 - *same as for basic transmission component*
 - *transmission type needs to be set to **"IHPC Transmission"***

| Parameter name | Description |
|-----------------|---|
| Gear identifier | For each gear (number needs to match with specifications in IHPC file) → Regular axle component to be specified as well |
| Ratio | For each gear → Regular axle component to be specified as well |
| Loss Map | For each gear → Methodology how to derive data acc. to Annex Xb (esp. braking side needs to be measured separately as well – as opposed to copy-paste for regular transmission testing) → Regular axle component to be specified as well |

IHPC Input Form



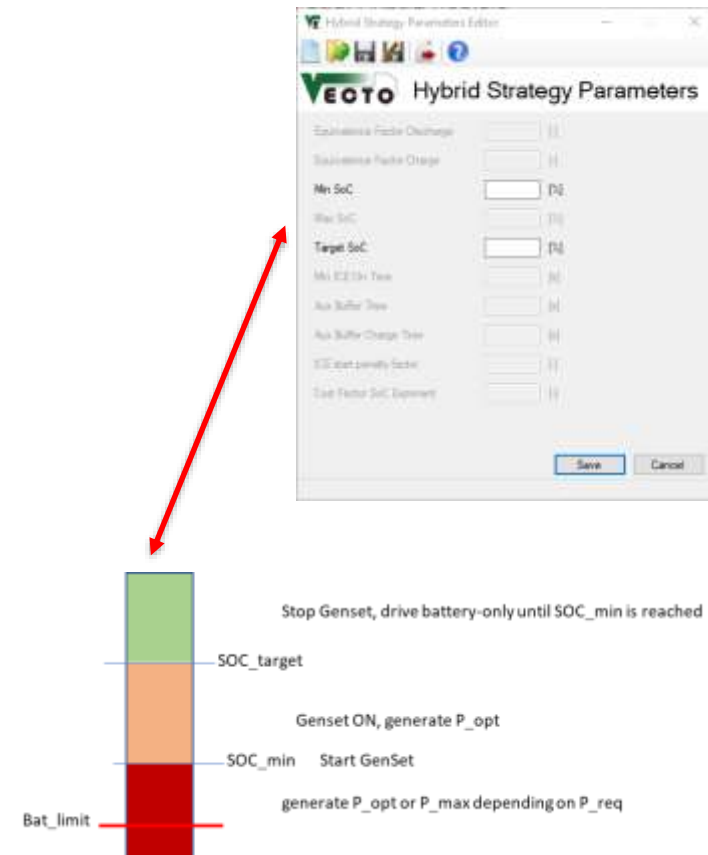
Adaptations Serial Hybrid Strategy (1/3)

- Observation: GenSet often switching between optimal and maximum power, while operating constantly at optimal power would be sufficient



Adaptations Serial Hybrid Strategy (2/3)

- Minor changes in Serial Hybrid Strategy
 - GenSet is switched on as soon as SoC falls below SoC_min
 - GenSet is switched off as soon as SoC reaches SoC_target
 - GenSet operation points P_opt and P_max:
 - In total 4 points defined, for GenSet in regular and in de-rating condition
 - $\text{SoC}_{\min} \leq \text{SoC} < \text{SoC}_{\text{target}}$: P_opt
 - $\text{SoC} < \text{SoC}_{\min}$:
 - requested el. power > P_opt: GENSET @ P_max
 - requested el. power ≤ P_opt: GENSET @ P_opt
 - *Note: SoC_min shall be above battery's min SoC*



Adaptations Serial Hybrid Strategy (3/3)

- GenSet now always operates in optimal point
- Speed profile is unchanged, SoC trace slightly different



SoC Correction for HEV-S

- REESS SoC for HEV is corrected using the engine line
 - Engine line makes no sense for HEV-S as the ICE is decoupled from the drivetrain and operates only in certain points
- SoC Correction:

$$FC_{\text{gen,charging}} = \sum FC_{\text{mod,final}} \cdot dt$$

$$E_{\text{gen,el}} = \sum P_{\text{em,el}} \cdot dt$$

$$FC_SOC = \Delta E_REESS \cdot \frac{FC_{\text{gen,charging}}}{E_{\text{gen,el}}}$$

... in case the GenSet was on during the simulation

$$FC_SOC = \Delta E_REESS \cdot \frac{FC_{\text{gen,optimal}}}{E_{\text{gen,el,optimal}}}$$

... in case the GenSet was not on during the simulation

Vecto 0.7.8.2679 Development Version

April 2022

- **Changes/Bugfixes**

- Multi-Target Executables in .net 6.0 and .net Framework 4.8 (and .net Framework 4.5, but this will be removed with the next release)
- Implementation Serial Hybrid Vehicles S2, S3, S4
- Implementation APT-S/P with E2 and S2 vehicle architecture
- Correct handling of retarder positions with HEV and PEV, adding axlegear input retarder option
- Update hashing tool to handle new powertrain components (electric motor, battery, supercap)
- Changing EM overload buffer calculation: interpolate between both voltage levels (pre-processing)
- Handling of torque limitations (engine torque limit, boosting torque limits, gearbox torque limits) for P2 architecture
- Connect electric WHR system to REESS in case of hybrid vehicles
- Update LH cycle
- GUI improvements: enable/disable some fields in Job Form, Vehicle Form, and Hybrid Strategy Parameters to simplify user interface and avoid erratic entries.

Serial Hybrid Implementation

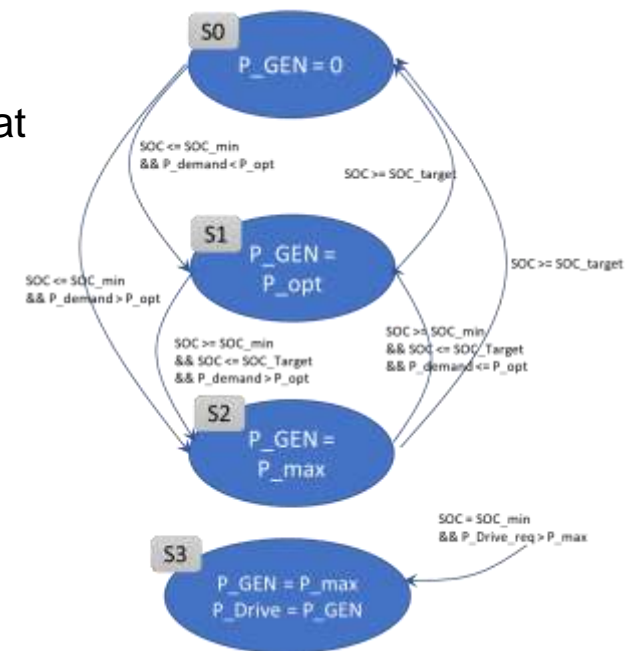
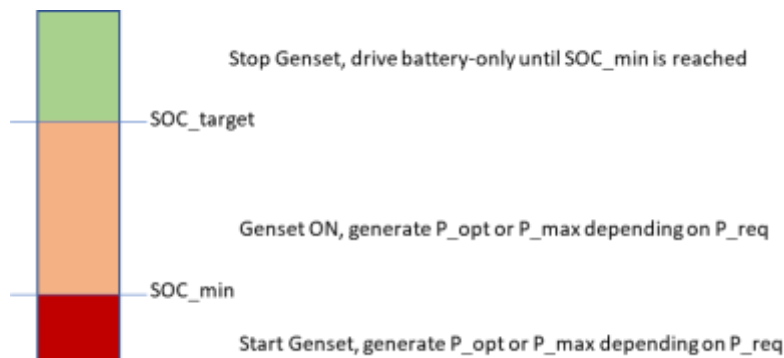
- General approach
 - Simple operating strategy, not ECMS–based
 - Three-point controller for GenSet (off/optimal point/maximum power)
 - Operate GenSet in optimal load-points whenever required and possible
 - Drivetrain similar to PEV

Serial Hybrids: GenSet Pre-Processing

- Find optimal points for the GenSet
 - Iterate from 0 to maximum power of the ICE (20 steps)
 - Iterate from ICE idle speed to n_{95h} speed (20 steps)
 - Calculate electric power and fuel consumption for all load-points
 - Select operating points:
 - Maximum electric power, EM de-rated/not de-rated
 - Optimal operating point (minimum FC per electric power generated), EM de-rated/not de-rated

Serial Hybrid Strategy (main principles)

1. Calculate max. electric power GenSet can provide
2. Calculate power demand of electric motor, assuming max. electric power (REESS + GenSet)
3. Depending on drivetrain power demand and SoC turn on ICE and operate GenSet either in optimal point or at maximum power (considering de-rating of GenSet)



Note: SOC_{min} and SOC_{target} are parameters of the SerialHybridStrategy, not REESS

Serial Hybrids: GenSet

- When switching on the ICE, it is often not possible to directly operate it in the desired operating point (high ICE speed, too high torque demand due to inertia)
- ➔ Ramp-up ICE with electric machine switched off (usually 1 or 2 simulation steps) and then turn on the electric machine

Serial Hybrid Strategy Parameters

- MinSoC
- TargetSoC



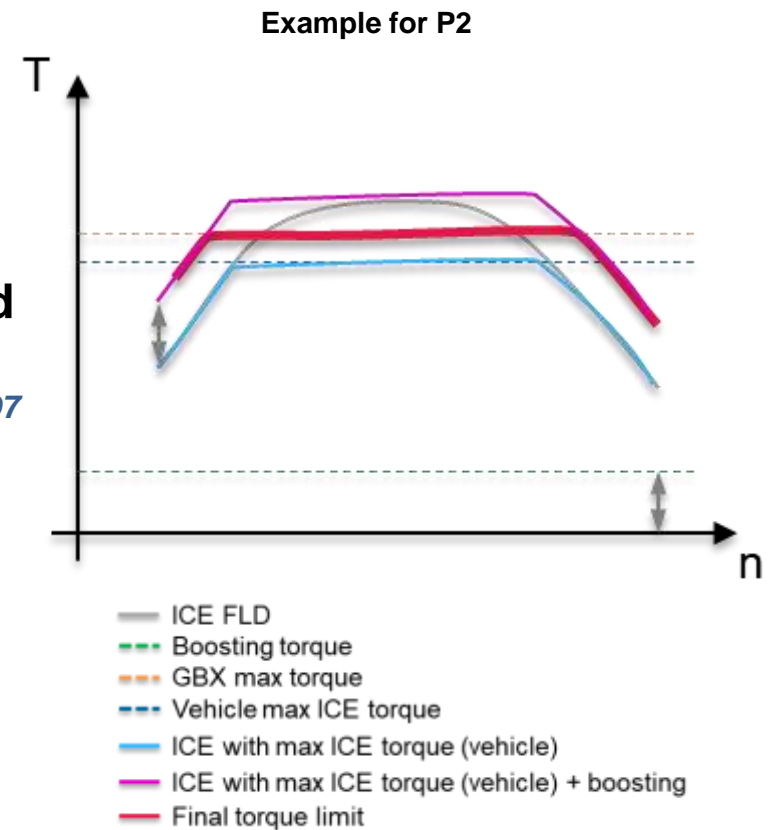
EM: overload buffer calculated from both voltage levels

- Input parameters of EM measured for min and max voltage level
 - Overload data
 - Continuous Torque
 - Overload Torque + Overload Duration
 - Maximum and Minimum torque limitations
 - Electric power map
- Implementation in software:
 - From overload data above, thermal buffer is calculated for each voltage level separately (acc. to equations in VECTO user manual)
 - Applied values for simulation run are calculated by line $E_{th,buf} = (P_{loss,ovl} - P_{loss,cont}) \cdot t_{ovl}$ two voltage levels, where average of usable SOC range is used
 - Overload buffer
 - Maximum and Minimum torque limitations
 - Continuous Torque

Consider gearbox MaxTorque limits for HEV

- Ref. to ticket nr. 1478+1479
- Only relevant for P1 + P2 HEV where EM is located upstream of transmission
- Starting Point: ICE FLD
 1. Crop with max ICE torque declared at vehicle level (per gear)
'Vehicle/EngineTorqueLimits' per gear – P196 + P197
 2. Add boosting torque
Boosting limitations for parallel HEV – P415 + P416
 3. In case of P1 or P2: crop with gearbox max input torque (per gear)
MaxTorque – P157

➔ Torque limits per gear applied by HybridStrategy



Vecto 0.7.8.xxx Development Version

April 2022

- **Detailed Changes/Bugfixes (See [CITnet/Jira](#))**
 - [VECTO-1541] - Implement E2/S2 with APT-S/P
 - [VECTO-1549] - Error in gearshift behavior for AT transmissions when braking
 - [VECTO-1466] - 076.2451 E2 significant increase of calculation time
 - [VECTO-1479] - Maximum gearbox torque not respected
 - [VECTO-1519] - 077.2457 E2 Gear oscillation
 - [VECTO-1520] - 077.2457 P2 Crashing at takeoff
 - [VECTO-1531] - ElectricMotor Lookup Maximum Torque: Object reference not set to an instance of an object
 - [VECTO-1532] - 077.2547 P2 crashing with 600 RPM idling speed
 - [VECTO-1539] - Engine speed ramping up before vehicle halt
 - [VECTO-1551] - AT-P Transmission Bus Application: Error during braking phase
 - [VECTO-1559] - battery internal resistance curve
 - [VECTO-1411] - Switching to new .NET version
 - [VECTO-1456] - Cycle Cache in engineering mode
 - [VECTO-1478] - Torque limits only apply to ICE
 - [VECTO-1521] - Updating tyre dimensions
 - [VECTO-1522] - VECTO warning if there are more steered axles than steering pump technologies

Vecto 0.7.8.xxx Development Version

April 2022

- **Detailed Changes/Bugfixes (See [CITnet/Jira](#))**
 - [VECTO-1525] - PCC Preprocessing
 - [VECTO-1533] - Multi-Target Compilation and .NET Upgrade
 - [VECTO-1538] - Transmission ratios limitation of input value to ≤ 25
 - [VECTO-1540] - Retarder Types AxleGearInputRetarder
 - [VECTO-1543] - Calculation of EM Overload buffer, and continuous torque
 - [VECTO-1545] - WHR electric - connect to REESS
 - [VECTO-1548] - Update Coach cycle
 - [VECTO-1560] - update toolchain for generating usermanual
 - [VECTO-1562] - Adapting WHTC Correction Factor weighting for LH Cycle
 - [VECTO-1563] - Electric Motor: Calculation of Overload Buffer
 - [VECTO-1564] - XML Schema adaptations
 - [VECTO-1565] - VECTO warning if there are more steered axles than steering pump technologies
 - [VECTO-1569] - Bugfix: Extrapolation warning in PEV shift strategy
 - [VECTO-1573] - Update LH Cycle and WHTC correction factor weighting

Vecto 0.7.7.2547 Development Version

December 2021

- **Changes/Bugfixes**

- Implementation APT-N Gearbox + shift strategy
- Update EM model (drag curve independent of voltage level)
- Update EM electric power map interpolation method
- Update user manual
- Update/bugfixes PEV shift strategy (influence of drag curve, error in calculation of costs)
- Bugfix calculation E_EM_off_loss
- Update generic shift lines for PEV E2
- Bugfix post-processing fuel consumption correction bus auxiliaries (in case of no alternator)
- Bugfixes PCC for xEV

Vecto 0.7.7.2547 Development Version

December 2021

- **General comments (1/x)**

- All topics in this section will also be explained in the next xEV workshop #9 on 11.01.2022
- Also topics for testing and feedback will be discussed in this workshop.
Until then, no feedback on the distributed version is expected.
- Calculation of overload buffer for EM
 - Overload buffer is currently calculated with data for lower voltage level only
 - Update of calculation method based on two voltage levels will be implemented once all details reg. the method are clarified
- Propulsion Torque Limits (Vehicle Boosting Limits)
 - In the rotational speed range from 0 to engine idling speed the full load torque available from the ICE equals the ICE full load torque at engine idling speed due to the modelling of the clutch behaviour during vehicle starts.
 - Any arbitrary number of values may be declared in between the range of zero and the maximum rotational speed of the ICE full load curve.
 - Declared values lower than zero are not allowed for the additional torque.
 - For detailed explanation refer to user manual (“Vehicle Editor – Torque Limits Tab”, “Torque and Speed Limitations”)
- Pulse-duration dependency of internal resistance of battery
 - For detailed explanation refer to user manual
- HEV operation strategy method for declaration mode
 - Method explained in “User Manual/HEV_DECL_method_20211221.pptx” distributed together with VECTO archive
 - Generic values defined per (vehicle group, mission, payload and usable SOC range) in “User Manual/HEV_Strategy_Parameters.xlsx” distributed together with VECTO archive
 - For further details refer to distributed material/recording from xEV workshop #8

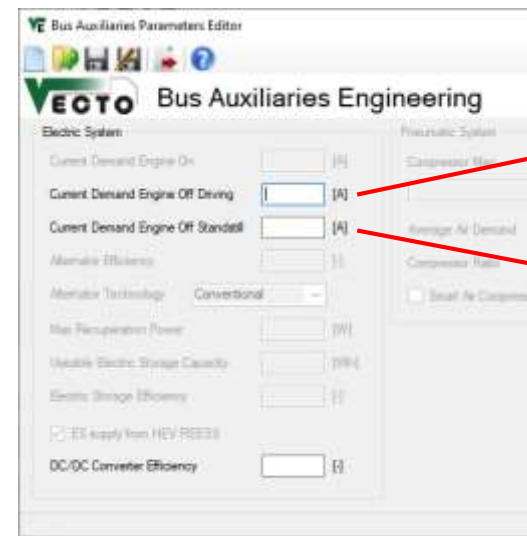
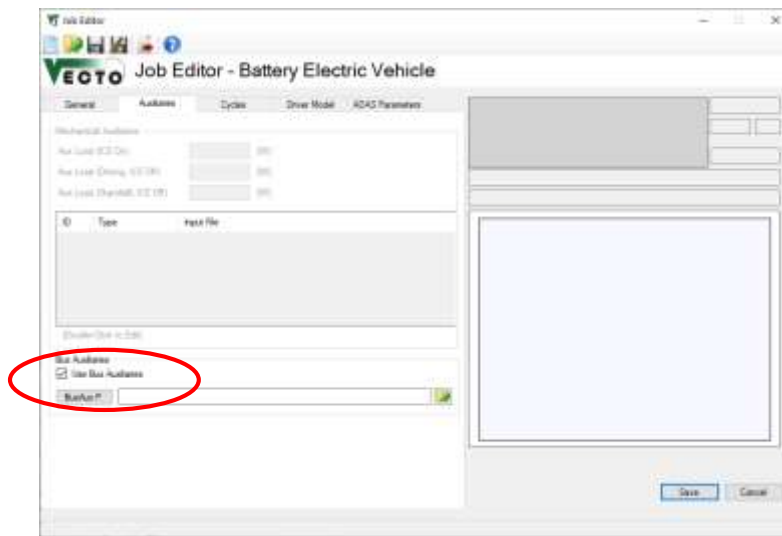
Vecto 0.7.7.2547 Development Version

December 2021

- **General comments (2/x)**

- Auxiliaries for PEV

- Electric power demand of auxiliaries for both, lorries and buses, need to be parameterized via the “BusAux” GUI window



Demand during vehicle driving

Demand during vehicle standstill

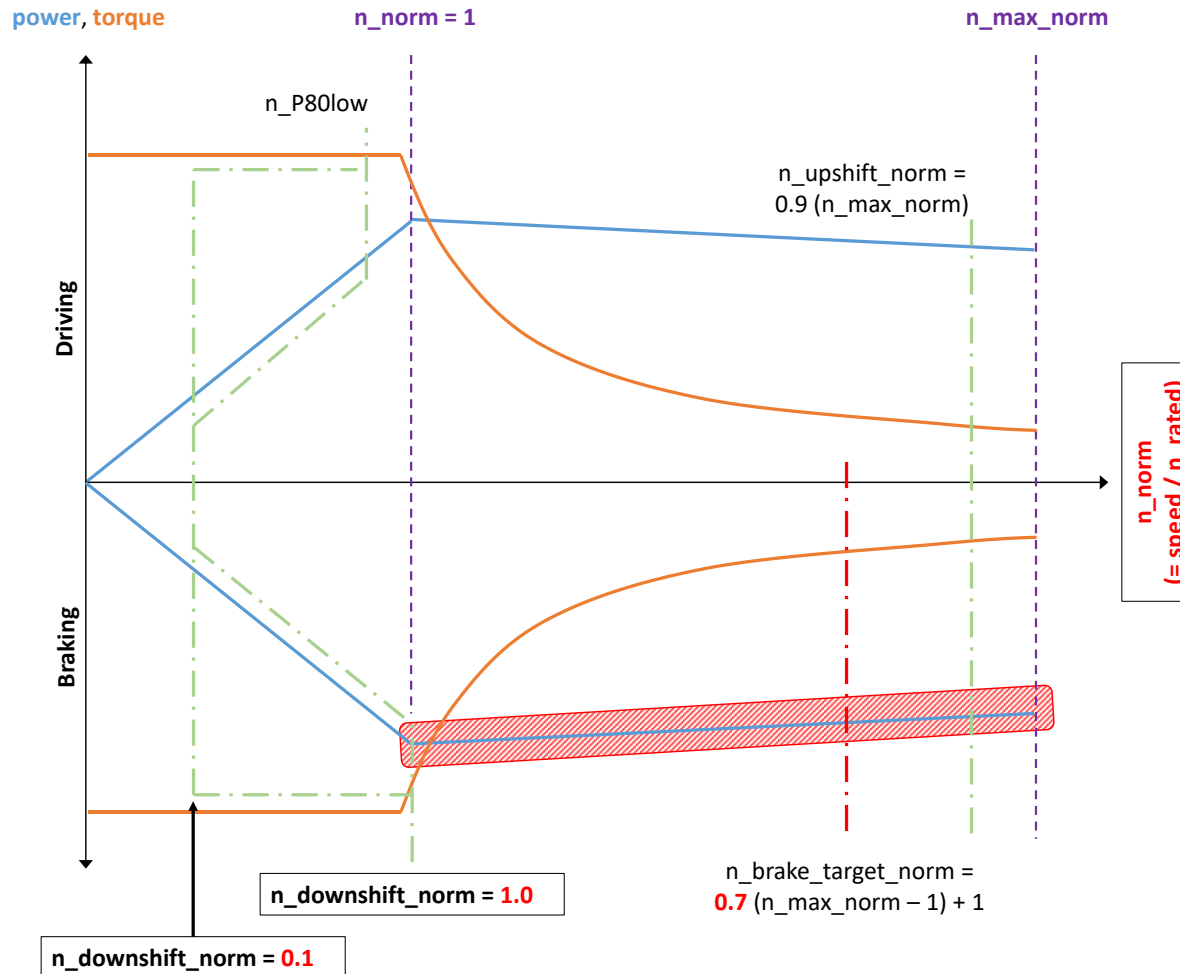
- Gearshift model for PEV

- Details explained on next slides

Vecto 0.7.7.2547 Development Version

December 2021

• Gearshift model for PEV (1/x)



▪ Basics:

- Downshift for operation point left of green dot-dashed downshift lines
- Upshift for operation point right of green dot-dashed upshift line
- EffShift method applied for operation point between downshift and upshift lines (refer to user manual)

▪ Driving:

- Maximum downshift speed always located at **n_{P80low}** (where 80% of max power is available)
- For EM in de-rating **n_{P80low}** is calculated from the de-rated power curve

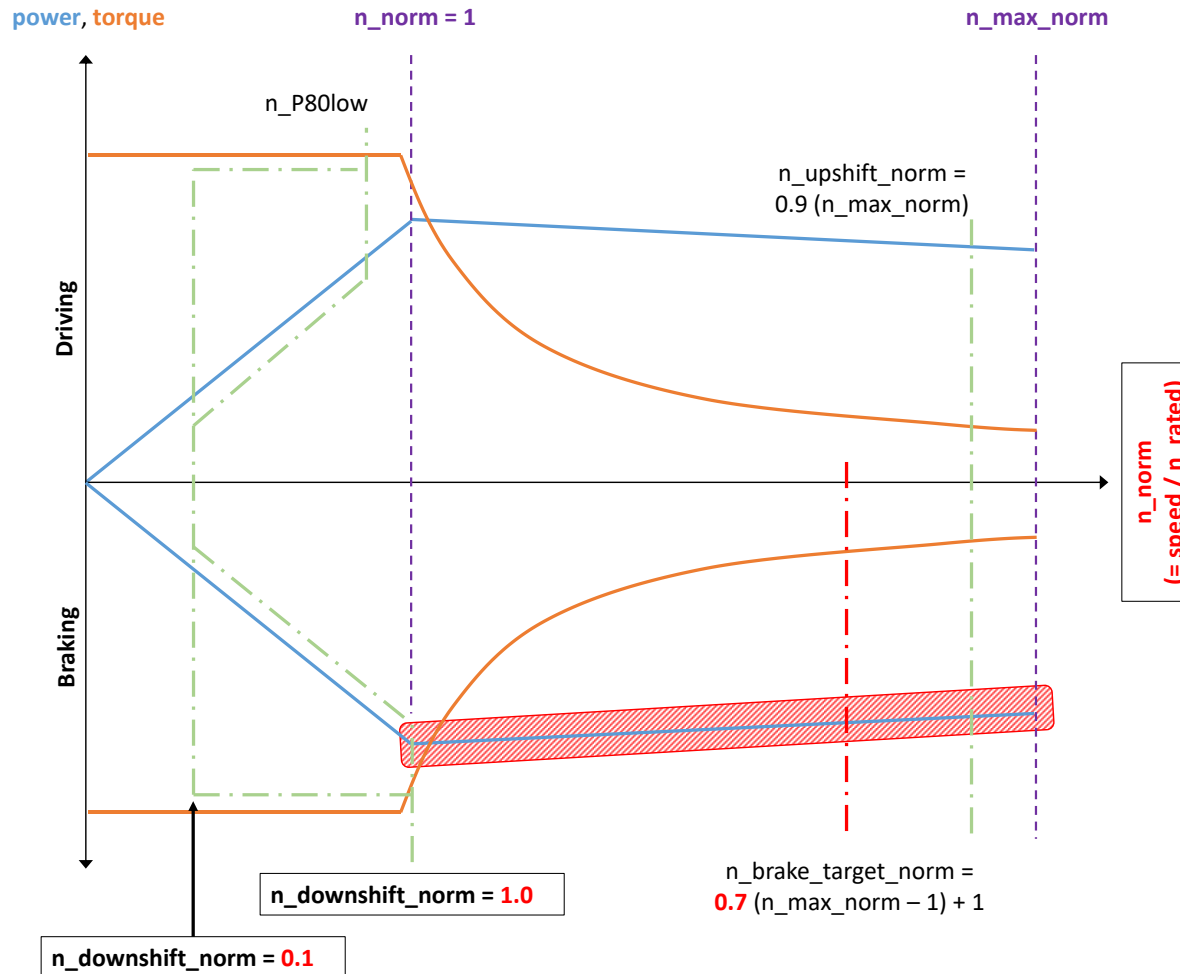
▪ Braking:

- EffShift is suppressed for operation point within red shaded area (2% below max recuperation power)
- New gear after downshift is selected so that operation point is closest to and above **$n_{\text{brake_target_norm}}$** (or only closest to **$n_{\text{brake_target_norm}}$** in case no operation point with higher speed exists)

Vecto 0.7.7.2547 Development Version

December 2021

• Gearshift model for PEV (2/x)



- **All factors in bold red can be tuned via shift parameter file .vtcu**
 - Refer to sample file for User Manual/PEV_ShiftParameters.vtcu distributed together with VECTO archive

Vecto 0.7.7.2547 Development Version

December 2021

- **Detailed Changes/Bugfixes (see [CITnet/JIRA](#))**

- [VECTO-1460] - APT-N Gearbox
- [VECTO-1501] - Update EM Map interpolation method
- [VECTO-1477] - Update user manual
- [VECTO-1383] - E2 PEV, 2-speed AMT: "Failed to find operating point"
- [VECTO-1384] - E2 PEV, 2-speed AMT: Downshifts missing
- [VECTO-1414] - E2 selects high gear at low speed after take-off, does not reach target acc
- [VECTO-1443] - 0.7.5.2356 EC_el_final calculated from REESS terminal signals
- [VECTO-1445] - 073.2356, E2 Missing Downshifts, simulation abort
- [VECTO-1464] - Engine Off not working with activated PCC (Hybrid Vehicles)
- [VECTO-1465] - PEV PCCState oscillates between Interrupt and UseCase1
- [VECTO-1467] - PCC HEV Small Spike at end of UseCase1 when Target speed is reached
- [VECTO-1468] - EM map interpolation comments
- [VECTO-1470] - 076.2463 EM drag torque questions/findings
- [VECTO-1482] - Hybrid Vehicle EM speed gets very high, no gearshift
- [VECTO-1483] - Job aborting: E4_Group 5 LH_Il_LongHaul_mod5_id_2
- [VECTO-1484] - Job aborting: P2_Group5_s2c0_rep_Payload_LongHaul_mod5_id_27
- [VECTO-1486] - NG PI fuel type not working with Engine GUI (.veng) in Engineering Mode
- [VECTO-1487] - Calculation of EM efficiency during recuperation
- [VECTO-1490] - Exceeded max iterations: Operating Point could not be found

Vecto 0.7.7.2547 Development Version

December 2021

- **Detailed Changes/Bugfixes (see [CITnet/JIRA](#))**

- [VECTO-1491] - Electric Energy Storage Editor does not show values
- [VECTO-1499] - Energy balance when ICE is turned on in a P1 hybrid configuration
- [VECTO-1514] - Modeldata uses wrong inertia in case multiple EMs are used on a position
- [VECTO-1515] - Output in vsum file
- [VECTO-1516] - GUI: PEV vehicle, disable hybrid parameters
- [VECTO-1489] - Engine-off eco-roll for P1 hybrids
- [VECTO-1448] - 075.2356, E2 Selecting high gear in downhill, needs to use wheel brakes
- [VECTO-1472] - Do not end PCC if acceleration is still high enough
- [VECTO-1473] - Additional tyre dimensions
- [VECTO-1476] - Update EM GUI, EM component
- [VECTO-1493] - Use EngineStartStop in PCC-Events for Hybrid P1
- [VECTO-1498] - Crosswind correction in engineering mode
- [VECTO-1508] - EM-Off Losses in .vsum
- [VECTO-1509] - SP Technology "Electric" already contains mechanical power demand
- [VECTO-1510] - Remove selection of shift strategy in job dialog
- [VECTO-1511] - Error Message for "HEVs and BEVs not supported in Declaration Mode"
- [VECTO-1512] - Adapt shift lines for xEV vehicles
- [VECTO-1513] - Bus Aux post-processing correction
- [VECTO-1481] - New warning message regarding transmission: what does it mean?

Vecto 0.7.6.2451 Development Version

September 2021

- **Changes**

- ADAS for HEV and PEV vehicles
 - For HEV vehicles interaction of PCC and HEV strategy under further analysis
- Update electric motor model: support for different voltage levels
- Update battery model: modular battery components
- Update battery model: pulse-duration dependent internal resistance
- Bugfixes

Vecto 0.7.5.2353 Development Version

June 2021

- **Changes**

- Bugfixes in shift strategy for PEV (E2)
- Additional Powertrain architectures
 - P1 AMT and APT-S/P
 - P2.5 (transmission ratio EM per gear)
 - P3 & P4 with APT transmissions
- Loss-map for electric machine
- Bus auxiliaries in engineering mode
- Combine Bus auxiliaries with HEV powertrains
- Refactoring Engine Stop/Start approach
 - ICE is always off during simulation, balance missing energy in case ICE is on / ICE is off for all auxiliaries in .vmmod.
 - Correct for missing aux energy in post-processing (not fully implemented in this version)
- Added vehicle propulsion limits (relative to ICE max torque)
 - P2, P3, and P4
- Refactored EM model: continuous torque, overload torque as separate inputs

Vecto 0.7.3.2164 Development Version

December 2020

- **Changes**

- Bugfixes in shift strategy for PEV (E2)
- Refined electric motor model: model transmission stage of electric machine as individual sub-component instead of transforming the maps. Adapted columns in .vmod and .vsum regarding electric machine. See user manual for details.
- Bugfixes SuperCap model
- Removed E_REESS from .vmod file, calculate delta_E_REESS from P_REESS in .vsum file

Vecto 0.7.2.2118 Development Version

October 2020

- **Changes**

- Implementation of PEV architecture E2 with EffShift-like gearshift strategy
- Bugfix REESS Dialog (.vimax)
- Bugfix in output of EM overload output in .vmod file

Vecto 0.7.1.2108 Development Version

October 2020

- **Changes**

- More stable operating point search hybrid strategy
- Bugfixes hybrid strategy
- Adding Super Cap as REESS
- Adding electric machine thermal de-rating
- Modified battery model: max charge/discharge current over state of charge
- Improvements simulation time hybrid vehicles

Note: As the model data for electric machine and battery changed from the previous VECTO version for hybrid vehicles it is necessary to open the models and provide the newly added model parameters.

Vecto 0.7.0.2076 Development Version

September 2020

- **Changes**

- *This release is the first beta version with capabilities to simulate hybrid and battery electric vehicles.*
- It covers powertrain architectures “P2”, “P3”, “P4” for hybrid electric vehicles (HEV) and “E3”, “E4” for battery electric vehicles (PEV, pure electric vehicles).
- The definitions of the powertrain architectures and other input parameters on vehicle level can be found in the document *Input parameters vehicle level 20200907.docx*. This document is an excerpt of working document 3 of the HDV CO2 Editing board. Items marked in red are not yet featured by the tool and will follow in the next releases.
- Known limitations
 - Electric machine system overload feature not available – work in progress
 - Supercaps not implemented – work in progress
 - Engine Stop Start Utility Factor has to be set to 1 – further discussions in task force needed how UF-approach shall be aligned with hybrid control strategy
 - P_aux_el are electric auxiliaries connected to the high-voltage system. For hybrid electric vehicles this model parameter shall currently be set to 0. – further discussions in task force needed
 - APTs with HEV – to be implemented
 - Eco-roll and PCC not implemented

Vecto 0.6.1.1975 Development Version

May 2020

- **Bugfixes**

- Change passenger density primary vehicle for IU cycle
- primary vehicle: ignore TPMLM (to limit payload, do not abort simulation)
- completed vehicle: limit total mass with TPMLM (abort simulation)
- consider `I_drivetrain`. this length is subtracted from internal length for HVAC calculation only (bus volume for ventilation, max cooling capacity); completed vehicle
- set alternator gear efficiency to 1 to align with lorries (currently 0.92)
- electric system / radio: all vehicles are equipped with radio. modify consumed amps to consider 'usage factor' - updated already in master excel.
- Update generic values for primary HF vehicles `CdxA`
- HVAC: check/correct internal height for coaches (shall be 1.8m)
- HVAC: subtract driver compartment from total volume for max cooling capacity passengers
- HVAC: add configuration #10, add sanity checks (i.e. if driver AC is provided for configurations #2,
- Steering pump power demand: tubing factor only applied for first steered axle (as the additionally steered axles are close to the engine and the distance is not known)
- Allow enabling/disabling LAC in declaration mode via GUI (not persistent). Additional input on "Options" tab to set min activation speed
- `.vsum` file: `E_AUX_SUM` matches sum of individual AUX entries; bugfix writing `P_busAux_ES_mech`
- Update user manual on VTP cycle file format
- APT gearbox (all gears) generic efficiency 0.925
- retarder: set factor for generic retarder losses from 0.5 to 1 (i.e., use standardvalues)
- VTP engineering mode - `vsum` actual CF different to declaration mode

- **Improvements**

- Switch GUI to 64bit mode (see VECTO-1270)
- New normalization/denormalization method for generic engine FC-Map (see VECTO-1269)
- `.vsum`-file: new entries `P_ice_fcmap`, `P_wheel_in`, `k_vehline` (previous `k_vehline` is now `k_engine`)
- Bus VTP: Fan Parameter C4
- don't write CIF for primary vehicle

Vecto 0.6.1.1957 Development Version

May 2020

• Improvements

- Declaration mode for complete and completed buses via “factor method”
- VTP mode for heavy buses
- VTP mode for dual-fuel vehicles (new cycle file required!)
- “Single bus” mode with generic data from segmentation table completed vehicle (previous version used generic data from primary vehicle)
- Adding highway sections on coach cycle (required for PCC)
- New graphical user interface (VECTO3.exe) (*alpha version!*)
 - Creating & editing complete(d) bus XML
 - Creating & editing complete(d) bus job file (PIF + completed XML)
 - Creating & editing single bus job file (primary XML + completed XML)
 - Simulation of all types of VECTO jobs
 - Currently, other existing job files can not be edited in the new GUI – planned to be extended in future
 - Functionality similar to currently official VECTO version, for further information see separate user manual on new GUI
- XML reports (MRF, CIF, PIF) according to draft Annex IV
- *Expert feature*: allow adding torque converter data to PIF manually (not added by VECTO automatically) to investigate on generic TC data for APT-P (see generic vehicles for reference)
- *Expert feature*: allow writing internal model data used for VECTO simulation as JSON file. Allows to compare model data between primary bus, completed bus generic body, completed bus specific body (factor method) as well as single bus

Vecto 0.6.1.1957 Development Version

May 2020

- **Bugfixes heavy buses**

- Correcting power demand for engine fan
- Consider electric auxiliaries (fan, steering pump) as electrical consumer
- Correcting power demand pneumatic system with mechanical clutch
- Correcting electrical consumers LED bonus
- Correction for double compensation of smart electrics (battery & generated vs. consumed)
- Correcting passenger count depending on HVAC configuration

- **Bugfixes medium lorries**

- New technologies for electric steering pump
- New tyre xml supported
- Bugfixes graphical user interface
- New sample data VTP

Vecto 0.6.0.1908 Development Version

March. 2020

- **Bugfixes**

- Consider vehicle's max speed when validating input data, calculating velocity drop during traction interruption
- Reading vehicle design speed (85km/h) from segment table (also related to vehicle's max speed)
- Fix JobEditor GUI – toolbar with icons not visible
- Fix null-reference exception simulating vehicles in engineering mode

Vecto 0.6.0.1884 Development Version

Feb. 2020

• Improvements

- Refactoring and bug fixes in bus auxiliaries model (former Ricardo AAUX model), parametrization of bus auxiliaries model (HVAC) from “primary bus” input data and generic values in segmentation matrix,
- Support for P0 hybrids in bus auxiliaries model
- Support for “primary bus” (declaration mode)
- Support for “single bus” – combine input parameters of primary bus and completed bus to a single simulation (no factor method) (declaration mode)
- Support for medium lorries
- Support for vehicles with front-wheel drive (axlegear included in gearbox)
- VTP Mode for medium lorries
- New XML schema for new vehicle categories, adapted XML schema for generated reports (MRF, CIF, PIF)

This development version includes all features already included in version 0.5.0

Vecto 0.5.0 Development Version

Dec. 2019

- **Improvements**

- Adding in-the-loop simulation of advanced driver assistant systems (ADAS)
 - Engine stop-start during vehicle stop
 - Eco-roll with and without engine stop
 - Predictive cruise control: dip coasting, crest coasting
- Adding support for dual-fuel vehicles
- Adding support for waste- / exhaust-heat recovery systems (electrical and mechanical)
- New gear shift strategy (EffShift) for AMT and AT transmissions

Details on the new models, model parameters, and new signals in the output are described in the user manual

Vecto 3.3.10.2401 Official Release

2020-07-29

- **Improvements**

- Handling of exempted vehicles (not changed since release candidate) – see next slides for details

- **Bugfixes**

- No additional bugfixes compared to VECTO 3.3.10.2401

Vecto 3.3.10.2373 Release Candidate

2020-07-01

- **Improvements**

- [VECTO-1421] – Added vehicle sub-group (CO₂-standards to MRF and CIF)
- [VECTO 1449] – Handling of exempted vehicles: See next slide for details
- [VECTO-1404] – Corrected URL for CSS in MRF and CIF

- **Bugfixes**

- [VECTO-1419] – Simulation abort in urban cycle: failed to find operating point on search braking power with TC gear
- [VECTO-1439] – Bugfix handling duplicate entries in engine full-load curve when intersecting with max-torque of gearbox
- [VECTO-1429] – error in XML schema 2.x for exempted vehicles – MaxNetPower1/2 are optional input parameters

Vecto 3.3.10.2373 Release Candidate

2020-07-01

Handling of exempted vehicles

- Axle configuration and sleeper cab are optional input parameters for exempted vehicles (XML schema 1.0 and 2.2.1).
 - OEMs are recommended to provide these parameters for exempted vehicles.
 - If the axle configuration is provided as input parameter, the MRF contains the vehicle group.
 - The sleeper cab input parameter is also part of the MRF if provided as input.
- Input parameters MaxNetPower1/2 are optional input parameters for all exempted vehicles.
 - If provided in the input these parameters are part of the MRF for all exempted vehicle types
 - It is recommended that those parameters are used to specify the rated power also for PEV (pure electric vehicles)

Vecto 3.3.9.2175 Official Release

2020-12-15

- **Bugfixes (compared to version 3.3.9.2147)**
 - [VECTO-1374] - VECTO VTP error – regression update

Vecto 3.3.9.2147 Release Candidate

2020-11-17

- **Bugfixes**

- [VECTO-1331] - VTP Mode does not function for vehicles of group 3
- [VECTO-1355] - VTP Simulation Abort
- [VECTO-1356] - PTO Losses not considered in VTP simulation
- [VECTO-1361] - Torque Converter in use for the First and Second Gear VTP file does not allow for this
- [VECTO-1372] - Deviation of CdxA Input vs. Output for HDV16
- [VECTO-1374] - VECTO VTP error

- **Improvements**

- [VECTO-1360] - make unit tests execute in parallel

Vecto 3.3.8.2052 Official Release

2020-08-14

- **Bugfixes**
 - No additional bugfixes compared to VECTO 3.3.8.2024

Vecto 3.3.8.2024 Release Candidate

2020-07-17

- **Bugfixes**

- [VECTO-1288] - Simulation Abort UD RL
- [VECTO-1327] - Simulation abort Construction RefLoad: unexpected response ResponseOverload
- [VECTO-1266] - Gear 4 Loss-Map was extrapolated

Vecto 3.3.7.1964 Official Release

2020-05-18

- **Bugfixes**

- [VECTO-1254] - Hashing method does not ignore certain XML attributes
- [VECTO-1259] - Mission profile weighting factors for vehicles of group 16 are not correct

Vecto 3.3.6.1916 Official Release

2020-03-31

- **Bugfixes**
 - [VECTO-1250] - Error creating new gearbox file from scratch

Vecto 3.3.6.1898 Release Candidate

2020-03-13

- **Improvement**

- [VECTO-1239] - Adaptation of Mission Profile Weighting Factors
- [VECTO-1241] - Engineering mode: Adding support for additional PTO activations

- **Bugfixes**

- [VECTO-1243] - Bug in VTP mode for heavy lorries
- [VECTO-1234] - urban cycle at reference load not running for bug when find braking operating point

Vecto 3.3.5.1812 Official Release

2019-12-18

- **Bugfixes** (compared to VECTO 3.3.5.1783-RC)
 - [VECTO-1220] - Simulation Abort Urban Delivery RefLoad

Vecto 3.3.5.1783 Release Candidate

2019-11-19

- **Improvement**

- [VECTO-1194] - Handling input parameter 'vocational' for groups other than 4, 5, 9, 10
- [VECTO-1147] - Updating declaration mode cycles values in user manual
- [VECTO-1207] - run VECTO in 64bit mode by default

- **Bugfixes**

- [VECTO-1074] - Vecto Calculation Aborts with Interpolation Error
- [VECTO-1159] - Simulation Abort in UrbanDelivery LowLoading
- [VECTO-1189] - Error in delaunay triangulation invariant violated
- [VECTO-1209] - Unexpected Response Response Overload
- [VECTO-1211] - Simulation Abort Urban Delivery Ref Load
- [VECTO-1214] - Validation of input data fails when gearbox speed limits are applied

Vecto 3.3.4.1716 Official Release

2019-09-13

- **Bugfixes** (compared to VECTO 3.3.4.1686-RC)
 - [VECTO-1074] - Vecto Calculation Aborts with Interpolation Error ([VECTO-1046])
 - [VECTO-1111] - Simulation Abort in Municipal Reference Load

Vecto 3.3.4.1686 Release Candidate

2019-08-14

- **Improvement**

- [VECTO-1042] - Add option to write results into a certain directory
- [VECTO-1064] - add weighting factors for vehicle groups 1, 2, 3, 11, 12, 16

- **Bugfixes**

- [VECTO-1030] - Exceeded max iterations when searching for operating point! Failed to find operating point!
- [VECTO-1032] - Gear 5 LossMap data was extrapolated in Declaration Mode: range for loss map is not sufficient
- [VECTO-1067] - Vair and Beta correction for Aerodynamics
- [VECTO-1000] - Error Loss-Map extrapolation in Declaration Mode
- [VECTO-1040] - Gear 6 LossMap data was extrapolated in Declaration Mode
- [VECTO-1047] - Failed to find operating point on construction cycle, ref load, AT gearbox

Vecto 3.3.3.1639 Official Release

2019-06-27

- **Bugfixes** (compared to VECTO 3.3.3.1609-RC)
 - [VECTO-1003] - Vecto Error: Loss-Map extrapolation in declaration mode required (issue VECTO-991)
 - [VECTO-1006] - Failed to find torque converter operating point on UD cycle (issue VECTO-996)
 - [VECTO-1010] - Unexpected Response: ResponseOverload in UD cycle (issue VECTO-996)
 - [VECTO-1015] - XML Schema not correctly identified
 - [VECTO-1019] - Error opening job in case a file is missing
 - [VECTO-1020] - HashingTool Crashes
 - [VECTO-1021] - Invalid hash of job data

Vecto 3.3.3.1609 Release Candidate

2019-05-29

- **Improvement**

- [VECTO-916] - Adding new tyre sizes
- [VECTO-946] - Refactoring XML reading
- [VECTO-965] - Add input fields for ADAS into VECTO GUI
- [VECTO-966] - Allow selecting Tank System for NG engines in GUI
- [VECTO-932] - Consistency in NA values in the vsum file

- **Bugfixes**

- [VECTO-954] - Failed to find operating point for braking power (Fix for Notification Art. 10(2) - [VECTO-952])
- [VECTO-979] - VECTO Simulation abort with 8-speed MT transmission (Fix for Notification Art. 10(2) - [VECTO-978])
- [VECTO-931] - AT error in VECTO version 3.3.2.1519
- [VECTO-950] - Error when loading Engine Full-load curve
- [VECTO-967] - Engine-Only mode: Engine Torque reported in .vmod does not match the provided cycle
- [VECTO-980] - Error during simulation run

Vecto 3.3.2.1548 Official Release

2019-03-29

- **Bugfixes (compared to 3.3.2.1519-RC)**

- [VECTO-861] - 3.3.1: Torque converter not working correctly
- [VECTO-904] - Range for gear loss map not sufficient.
- [VECTO-909] - 3.3.2.1519: Problems running more than one input .xml
- [VECTO-917] - TargetVelocity (0.0000) and VehicleVelocity (>0) must be zero when vehicle is halting
- [VECTO-918] - RegionalDeliveryEMS LowLoading - ResponseSpeedLimitExceeded
- [VECTO-920] - Urban Delivery: Simulation Run Aborted, TargetVelocity and VehicleVelocity must be zero when vehicle is halting!

Vecto 3.3.2.1519 Release Candidate

2019-03-01

- **Improvements**

- [VECTO-869] - change new vehicle input fields (ADAS, sleeper cab, etc.) to be mandatory
- [VECTO-784] - Configuration file for VECTO log files
- [VECTO-865] - Extend Sum-Data
- [VECTO-873] - Add digest value to SumData

- **Bugfixes**

- [VECTO-729] - Bugs APT submodel
- [VECTO-787] - APT: DrivingAction Accelerate after Overload
- [VECTO-789] - APT: ResponseUnderload
- [VECTO-797] - VECTO abort with AT transmission and TC table value
- [VECTO-798] - VECTO abort with certified AT transmission data and certified TC data
- [VECTO-807] - VECTO errors in vehicle class 1/2/3
- [VECTO-827] - Torque converter inertia
- [VECTO-838] - APT: ResponseOverload

cont.

Vecto 3.3.2.1519 Release Candidate

2019-03-01

• Bugfixes

- [VECTO-843] - AT Transmissions problem on VECTO 3.3.1.1463
- [VECTO-844] - Error with AT gearbox model
- [VECTO-847] - Simulation abort due to error in NLog?
- [VECTO-848] - AT Gearbox Simulation abort (was: Problem related to Tyres?)
- [VECTO-858] - Urban Delivery Abort - with APT-S Transmission and TC
- [VECTO-861] - 3.3.1: Torque converter not working correctly
- [VECTO-872] - MRF/CIF: Torque Converter certification method and certification nbr not correctly set
- [VECTO-879] - SIMULATION RUN ABORTED DistanceRun got an unexpected resp.
- [VECTO-883] - Traction interruption may be too long
- [VECTO-815] - Unexpected Response: SpeedLimitExceeded
- [VECTO-816] - object reference not set to an instance of an object
- [VECTO-817] - TargetVelocity and VehicleVelocity must not be 0
- [VECTO-820] - DistanceRun got an unexpected response: ResponseSpeedLimitExceeded
- [VECTO-864] - Prevent VECTO loss-map extension to result in negative torque loss

Vecto 3.3.2.1519 Release Candidate

2019-03-01

- **Installation Option (VECTO-784)**
 - VECTO 3.3.2 adds a new feature to run as ‘installed application’ instead of the ‘portable’ mode
 - VECTO as ‘installed application’
 - Needs no write permissions to the VECTO application folder
 - All configuration files and settings are written to %AppData%\VECTO\<Version>
 - All log files are written to %LocalAppData%\VECTO\<Version>
 - Switch to ‘installed application’
 1. Copy the VECTO directory and all its files and subdirectories to the appropriate location where the user has execute permissions
 2. Edit the file ‘*install.ini*’ and remove the comment character (#) in the line containing

ExecutionMode = install

Vecto 3.3.1.1492 Official Release

2019-02-01

- **Bugfixes (compared to 3.3.1.1463-RC)**

- [VECTO-845] - Fixing bug for VECTO-840
- [VECTO-826] - DistanceRun got an unexpected response: ResponseSpeedLimitExceeded
- [VECTO-837] - VECTO GUI displays incorrect cycles prior to simulation
- [VECTO-831] - Addition of indication to be added in Help and Release notes for simulations with LNG

cont.

Vecto 3.3.1.1463 Release Candidate

2019-01-03

- **Changes according to 2017/2400 amendments**

- [VECTO-761] - Adaptation of input XML Schema
- [VECTO-762] - Extension of Input Interfaces
- [VECTO-763] - Extension of Segmentation Table
- [VECTO-764] - ADAS benefits (according to Annex III Point 8. of amendment to 2017/2400)
- [VECTO-766] - Update power demand auxiliaries (for extended segmentation table)
- [VECTO-767] - Report for exempted vehicles
- [VECTO-768] - VTP mode
- [VECTO-770] - Fuel Types
- [VECTO-771] - Handling of exempted vehicles
- [VECTO-824] - Throw exception for certain combinations of exempted vehicle parameters
- [VECTO-773] - Correction Factor for Reference Fuel
- [VECTO-790] - Adapt generic data for construction/municipal utility
- [VECTO-493] - Implementation of generic body weights and air drag values for construction cycle
- [VECTO-565] - Consideration of LNG as possible fuel is missing

cont.

Vecto 3.3.1.1463 Release Candidate

2019-01-03

• New input parameters

- The new input fields (see table below) are optional in this version. When this release candidate will be an official version manufacturers MAY certify their new vehicles using the new input parameters. As from 1st July 2019 the new input fields will become mandatory. Further details are provided in the timetable on the next page.
- Default values when the new input parameters are not provided:

| Input parameters vehicle – Table 1 Annex III | |
|--|---|
| Field | Default value |
| VehicleCategory | No default value but input 'rigid truck' will be converted automatically into 'rigid lorry' |
| ZeroEmissionVehicle | 'No' |
| NgTankSystem | 'Compressed' (only applicable to gas vehicles) |
| SleeperCab | 'Yes' |
| Input parameters ADAS – Pt. 8 Annex III | |
| Field | Default value |
| EngineStartStop | 'No' |
| EcoRollWithoutEngineStop | 'No' |
| PredictiveCruiseControl | 'No' |

- Currently **only** the fuel type '**NG PI**' for the **engine certification** is allowed by 2017/2400. For LNG vehicles, therefore, the engine fuel type has to be set to '**NG PI**' and at the vehicle level NgTankSystem has to be set to **liquefied**. For CNG the same engine fuel type is used but NgTankSystem has to be set to **compressed**.

cont.

Vecto 3.3.1.1463 Release Candidate

2019-01-03

- **Timetable**

| Planned Date | Version | Description |
|---------------|------------|--|
| 1. Feb. 2019 | 3.3.1.x | Release of official version of release candidate 3.3.1.1463 |
| 1. March 2019 | 3.3.2.x-RC | Release candidate, new input parameters are mandatory (+ further bugfixes) |
| 1. April 2019 | 3.3.2.x | Official version of VECTO 3.3.2 |
| 1. May 2019 | | Mandatory use of 3.3.1.x for certification |
| 1. July 2019 | | Mandatory use of 3.3.2.x for certification |

cont.

Vecto 3.3.1.1463 Release Candidate

2019-01-03

• Changes/Improvements

- [VECTO-799] - Remove TUG Logos from Simulation Tool, Hashing Tool
- [VECTO-808] - Add Monitoring Report
- [VECTO-754] - Extending Loss-Maps in case of AT gearbox for each gear, axlegear, gearbox
- [VECTO-757] - Correct contact mail address in Hashing Tool
- [VECTO-779] - Update Construction Cycle - shorter stop times
- [VECTO-783] - Rename columns in segmentation table and GUI
- [VECTO-709] - VTP editor from user manual not matching new VECTO one: updated documentation
- [VECTO-785] - Handling of Vehicles that cannot reach the cycle's target speed: Limit max speed in driver model
- [VECTO-716] - Validate data in Settings Tab: update documentation
- [VECTO-793] - Inconsistency between GUI, Help and Regulation: update wording in GUI and user manual
- [VECTO-796] - Adaptation of FuelProperties
- [VECTO-806] - extend loss-maps (gbx, axl, angl) for MT and AMT transmissions
- [VECTO-750] - Simulation error DrivingAction: adapt downshift rules for AT to drive over hill with 6% inclination

cont.

Vecto 3.3.1.1463 Release Candidate

2019-01-03

- Update of Fuel Properties [VECTO-796]

| Fuel type | Reference for fuel properties | Density | CO2 emission factor | Lower Heating Value | Data Source |
|---|-------------------------------|----------------------|---------------------|---------------------|---|
| [-] | [-] | [kg/m ³] | [g_CO2/g_Fuel] | [MJ/kg] | [-] |
| Diesel | B7 | 836 | 3.13 | 42.7 | CONCAWE/JEC (2018) |
| ED95 | ED95 | 820 | 1.81 | 25.4 | CONCAWE/JEC (2018) |
| Petrol | E10 | 748 | 3.04 | 41.5 | CONCAWE/JEC (2018) |
| E85 | E85 | 786 | 2.10 | 29.3 | Calculated from E0 and E100 from CONCAWE/JEC (2018) |
| LPG | LPG | not required* | 3.02 | 46.0 | CONCAWE/JEC (2018) |
| CNG | CNG (H-Gas) | not required* | 2.69 | 48.0 | CONCAWE/JEC (2018) |
| CONCAWE/JEC (2018) specifications are based on a recent analysis (2018) performed by CONCAWE/EUCAR and shall reflect LNG typical fuel on the European market. The data is scheduled to be published in March 2019 in the context of the study: Well-To-Wheels Analysis Of Future Automotive Fuels And Powertrains in the European Context – Heavy Duty vehicles | | | | | |
| * VECTO does not provide volume based figures for gaseous fuels | | | | | |

cont.

Vecto 3.3.1.1463 Release Candidate

2019-01-03

• Bugfixes

- [VECTO-819] - object reference not set to an instance of an object
- [VECTO-818] - SearchOperatingPoint: Unknown response type. ResponseOverload
- [VECTO-813] - Error "Infinity [] is not allowed for SI-Value"
- [VECTO-769] - DrivingAction Brake: request failed after braking power was found.ResponseEngineSpeedTooHigh
- [VECTO-804] - Error on simulation with VECTO 3.3.0.1433
- [VECTO-805] - Total vehicle mass exceeds TPMLM
- [VECTO-811] - AMT: ResponseGearShift
- [VECTO-812] - AMT: ResponseOverload
- [VECTO-822] - SIMULATION RUN ABORTED by Infinity
- [VECTO-792] - Vecto Hashing Tool - error object reference not set to an instance of an object (overwriting Date element)
- [VECTO-696] - Problem with Primary Retarder: regression update, set torque loss to 0 for 0 speed and engaged gear
- [VECTO-776] - Decision Factor (DF) field is emptied after each simulation
- [VECTO-814] - Error: DistanceRun got an unexpected response: ResponseGearshift

Vecto 3.3.0.1433 Official Release

2018-12-04

- **Bugfixes (compared to 3.3.0.1398)**
 - [VECTO-795] – VECTO Hashing Tool crashes
 - [VECTO-802] – Error in XML schema for manufacturer's record file
- **Bugfixes (compared to 3.3.0.1250)**
 - [VECTO-723] - Simulation aborts with engine speed too high in RD cycle
 - [VECTO-724] - Simulation aborts with error 'EngineSpeedTooHigh' - duplicate of VECTO-744
 - [VECTO-728] - Simulation aborts when vehicle's max speed (n95h) is below the target speed
 - [VECTO-730] - Simulation Aborts with ResponseOverload
 - [VECTO-744] - ResponseEngineSpeedTooHigh (due to torque limits in gearbox)
 - [VECTO-731] - Case Mismatch - Torque Converter
 - [VECTO-711] - Elements without types in CIF and MRF
 - [VECTO-757] - Correct contact mail address in Hashing Tool
 - [VECTO-703] - PTO output in MRF file
 - [VECTO-713] - Manufacturer Information File in the legislation is not compatible with the Simulation results
- **Improvement (compared to 3.3.0.1250)**
 - [VECTO-704] - Allow VTP-simulations for AT gearboxes

Vecto 3.3.0.1398 Release Candiate

2018-10-30

• Bugfixes

- [VECTO-723] - Simulation aborts with engine speed too high in RD cycle
- [VECTO-724] - Simulation aborts with error 'EngineSpeedTooHigh' - duplicate of VECTO-744
- [VECTO-728] - Simulation aborts when vehicle's max speed (n95h) is below the target speed
- [VECTO-730] - Simulation Aborts with ResponseOverload
- [VECTO-744] - ResponseEngineSpeedTooHigh (due to torque limits in gearbox)
- [VECTO-731] - Case Mismatch - Torque Converter
- [VECTO-711] - Elements without types in CIF and MRF
- [VECTO-757] - Correct contact mail address in Hashing Tool
- [VECTO-703] - PTO output in MRF file
- [VECTO-713] - Manufacturer Information File in the legislation is not compatible with the Simulation results

• Improvement

- [VECTO-704] - Allow VTP-simulations for AT gearboxes

Vecto 3.3.0.1250

2018-06-04

- **Improvement**

- [VECTO-665] - Adding style information to XML Reports
- [VECTO-669] - Group 1 vehicle comprises vehicles with gross vehicle weight > 7.5t
- [VECTO-672] - Keep manual choice for "Validate data"
- [VECTO-682] - VTP Simulation in declaration mode
- [VECTO-652] - VTP: Check Cycle matches simulation mode
- [VECTO-683] - VTP: Quality and plausibility checks for recorded data from VTP
- [VECTO-685] - VTP Programming of standard VECTO VTP report
- [VECTO-689] - Additional Tyre sizes
- [VECTO-702] - Hashing tool: adapt warnings
- [VECTO-667] - Removing NCV Correction Factor
- [VECTO-679] - Engine n95h computation gives wrong (too high) engine speed (above measured FLD, n70h)
- [VECTO-693] - extend vehicle performance in manufacturer record

Vecto 3.3.0.1250

2018-06-04

- **Bugfixes**

- [VECTO-656] - Distance computation in vsum
- [VECTO-666] - CF_RegPer no effect in vehicle simulation -- added to the engine correction factors
- [VECTO-687] - Saving a Engine-Only Job is not possible
- [VECTO-695] - Bug in vectocmd.exe - process does not terminate
- [VECTO-699] - Output in manufacturer report and customer report (VECTO) uses different units than described in legislation
- [VECTO-700] - errorr in simulation with 0 stop time at the beginning of the cycle

Vecto 3.2.1.1133

2018-02-07

- **Improvement**

- [VECTO-634] - VTP Mode: specific fuel consumption

- **Bugfixes**

- [VECTO-642] - VECTO BUG – secondary retarder losses:
IMPORTANT: Fuel-consumption relevant bug! wrong calculation of retarder losses for retarder ratio not equal to 1
- [VECTO-624] - Crash w/o comment: Infinite recursion
- [VECTO-627] - Cannot open Engine-Only Job
- [VECTO-629] - Vecto crashes without error message (same issue as VECTO-624)
- [VECTO-639] - Failed to find operating point for braking power: cycle with low target speed (3km/h). allow driving with slipping clutch
- [VECTO-640] - Exceeded max. iterations: driving fully-loaded vehicle steep uphill. fixed by allowing full-stop and drive off again
- [VECTO-633] - unable to start VTP Mode simulation
- [VECTO-645] - Encountered error while validating Vecto output (generated by API) through Hashing tool for vehicle without retarder

Vecto 3.2.1.1079

2017-12-15

- **Improvement**

- [VECTO-618] - Add Hash value of tyres to manufacturer's record file
- [VECTO-590] - Handling of hash values: customer's record contains hash of manufacturer's record
- [VECTO-612] - Continuously changing hashes: Info in GUI of HashingTool
- [VECTO-560] - Change Mail-Address of general VECTO contact
- [VECTO-616] - SI-Unit - display derived unit instead of base units

- **Bugfixes**

- [VECTO-608] - Power balance in EPT-mode not closed
- [VECTO-611] - Invalid input. Cannot cast Newtonsoft.Json.Linq.JObject to Newtonsoft.Json.Linq.Jtoken
- [VECTO-610] - TyreCertificationNumber missing in Manufacturer Report
- [VECTO-613] - Incomplete description of allowed values of LegislativeClass (p251) in VECTO parameter documentation
- [VECTO-625] - Update XML Schema: Tyre dimensions according to Technical Annex, trailing spaces in enums

- **Support**

- [VECTO-615] - Error torque interpolation in declaration jobs exported to XMLImprovements

Vecto 3.2.1.1054

2017-11-20

Improvements

- [VECTO-592] - VTP Simulation Mode
- [VECTO-605] - Improve simulation speed

Bugfixes

- [VECTO-602] - Error in simulation without airdrag component
- [VECTO-589] - Scheme .xml error

VTP Simulation Mode

- Verification Test Procedure (VTP) Simulation Mode
 - Similar to Pwheel mode, different cycle format (see user manual)
 - Requires:
 - Vehicle in declaration mode (XML)
 - Measured driving cycle
 - Parameters for engine-fan model
 - VECTO calculates the gear based on the wheel speed and engine speed (and vehicle parameters) and ignores the gear provided in the driving cycle
 - Fuel consumption interpolation is done using the engine speed from the cycle and calculated power demand (to avoid wrong engine speeds due to wrong gear selection)
 - Simulation uses all auxiliaries except engine fan
 - Engine fan is modeled separately, power demand depends on fan speed (see user manual)
 - Auxiliary power selected according to segment table, BUT power demand depends on vehicle speed
 - $v < 50$ km/h: Urban
 - $50 \leq v < 70$ km/h: Rural
 - $v > 70$ km/h: Long haul
 - Gear and fuel consumption in the driving cycle are optional for now, may be used in future versions

Vecto 3.2.0.1022

2017-10-19

Bugfixes

- [VECTO-585, VECTO-587] – VECTO Simulation aborts when run as WCF Service
- [VECTO-586] – Gearshiftcout in reports too high
- [VECTO-573] – Use of old library references .net framework 2.0

Vecto 3.2.0.1005

2017-10-02

Improvements

- **Release of Vecto Hashing Tool**
- [VECTO-557] Engine speed simulated too high during long stops

Bugfixes

- [VECTO-569] - 'Engine Retarder' not correctly recognized as input
- [VECTO-571] - Customer Report – wrong output format of average RRC
- [VECTO-573] - Correction of displayed units in graph window
- [VECTO-575] - Correction of simulation aborts (due to gearbox inertia, engineering mode)
- [VECTO-577] - Correction of XML export functionality
- [VECTO-579] - Bug fix GUI crashes on invalid input
- [VECTO-558] - Correction of output in .vsum file – BFColdHot always 0
- [VECTO-564] - Bug fix: correct output of vehicle group in XML report
- [VECTO-566] - Vehicle height not correctly read (engineering mode)
- [VECTO-545] - Update documentation on Settings dialog

Vecto 3.2.0.940

2017-07-28

Bugfixes

- [VECTO-546] - GearboxCertificationOptionType Option 2 not accepted by VECTO
- [VECTO-547] - Engine Manufacturer and Engine Model are empty in .vsum
- [VECTO-548] - online user manual
- [VECTO-549] - Inconsistent (and wrong) decimal separator in XML output (manufacturer report)
- [VECTO-551] - Average Tyre RRC not in Customer Information File output
- [VECTO-536] - GUI: improvements vehicle dialog (add missing pictures for vehicle categories)
- [VECTO-550] - Allow custom settings for AirDensity in Engineering mode
- [VECTO-552] - set engine rated power, rated speed to computed values from FLD if not provided as input

Vecto 3.2.0.925

2017-07-14

Improvements

- [VECTO-366] added EMS vehicle configuration, EMS is only simulated when engine rated power > 300kW
- [VECTO-463] add pneumatic system technology 'vacuum pump'
- [VECTO-465] change RRC value of trailers (declaration mode) from 0.00555 to 0.0055 (due to limits in user interface)
- [VECTO-477] AT Gearbox, powershift losses: remove inertia factor
- [VECTO-471] update cross-wind correction model: height-dependent wind speed (see Excel spreadsheet in User Manual folder for details)
- [VECTO-367] Add Vehicle Design Speed to segmentation table
- [VECTO-470] Add XML reading and export functionality
- [VECTO-486] Adding hashing library
- [VECTO-469] Limit engine max torque (either due to vehicle or gearbox limits), limit gearbox input speed
- [VECTO-466] Update vehicle payloads: 10% loaded and reference load are simulated
- [VECTO-467] Add generic PTO activation in municipal cycle
- [VECTO-468] Add PTO losses (idle) in declaration mode
- [VECTO-479] Added PTO option 'only one engaged gearwheel above oil level' with 0 losses

Vecto 3.2.0.925

2017-07-14

Improvements

- [VECTO-483] Adapt CdxA supplement for additional trailers
- [VECTO-494] Implementation of different fuel types
- [VECTO-502] Implementing standard values for air-drag area (if not measured)
- [VECTO-501] Implement engine idle speed set in vehicle (must be higher than engine's idle speed value)
- [VECTO-504] Adding HVAC technology 'none'
- [VECTO-489] Extrapolate gearbox lossmaps (required when torque limitation by gearbox is ignored)
- [VECTO-505] Implement AT transmissions in declaration mode
- [VECTO-507] Allow to ignore validation of model data when starting a simulation (significant improvement on simulation startup time - about 10s)
- [VECTO-506] modified method how torque-converter characteristics in drag is extended. allow drag-values in the input, only add one point at a high speed ratio
- [VECTO-509] Add axle-type (vehicle driven, vehicle non-driven, trailer) to GUI
- [VECTO-511] Add engine idle speed to Vehicle input form (GUI)
- [VECTO-510] Write XML reports (manufacturer, customer information) in declaration mode
- [VECTO-474] new driving cycles for Municipal and Regional Delivery

Vecto 3.2.0.925

2017-07-14

Improvements

- [VECTO-522] step-up ratio for using torque converter in second gear set to 1.85 for busses (still 1.8 for trucks)
- [VECTO-525] remove info-box with max loading in GUI
- [VECTO-531] Payload calculation: limit truck payload to the truck's max payload. (earlier versions only limited the total payload of truc + trailer to the total max. payload, i.e. allowed to shifted loading from truck to the trailer)
- [VECTO-533] allow second driven axle, rdyn is calculated as average of both driven axles
- [VECTO-537] new Suburban driving cycles
- [VECTO-541] increase declaration mode PT1 curve to higher speeds (2500 is too low for some engines)
- [VECTO-542] reduce overspeed in declaration mode to 2.5km/h

Vecto 3.2.0.925

2017-07-14

Bugfixes

- [VECTO-462] fix: decision if PTO cycle is simulated
- [VECTO-473] fix: adapt range for validation of torque converter characteristics
- [VECTO-464] fix: extrapolation of engine full-load curve gives neg. max. torque. Limit engine speed to n95h
- [VECTO-480] fix: a_pos in .vsum was less than zero
- [VECTO-487] fix: Duration of PTO cycle was computed incorrectly if PTO cycle does not start at t=0
- [VECTO-514] fix: sort entries in .vsum numerically, not lexically
- [VECTO-516] fix: consider axlegear losses for estimation of acceleration after gearshifts
- [VECTO-517] fix: valid shift polygon was considered invalid when extended to very high torque ranges
- [VECTO-424] fix: VectoCore.dll could not be found when the current working directory is different to the directory of the vectocmd.exe
- [VECTO-425] fix: vectocmd.exe - check if the output is redirected, and skip updating of the progress bar when this is the case
- [VECTO-426] fix: vectocmd.exe - log errors to STDERR
- [VECTO-519] fix: computation of n95h fails for a valid full-load curve due to numerical inaccuracy. add tolerance when searching for solutions
- [VECTO-520] fix: gearashift count in vsum is 0

Vecto 3.1.2.810

2017-01-18

Improvements

- [VECTO-445] Additional columns in vsum file
- Allow splitting shift losses among multiple simulation intervals
- Allow coasting overspeed only if vehicle speed > 0
- Torque converter: better handling of 'creeping' situations

Bugfixes:

- [VECTO-443] Bugfix in AMT shift strategy: skip gears not working correctly

Vecto 3.1.2.796

2017-03-07

Improvements:

- [VECTO-405] Adding clutch-losses for AMT/MT gearboxes during drive-off, reduce drive-off distance after stop from 1m to 0.25m, set clutch closing speed (normalized) to 6.5%, changes in clutch model
- [VECTO-379] Make GUI more tolerant against missing files. Instead of aborting reading the input data the GUI shows a suffix for missing input files
- [VECTO-411] Allow a traction interruption of 0s for AMT/MT gearboxes
- [VECTO-408] Gearbox Inertia for AT gearboxes set to 0
- [VECTO-419] Adapted error messages, added list of errors
- [VECTO-421, VECTO-439] Added volume-related results to vsum file (volume is computed based on default bodies)
- [] Energy balance (vsum) and balance of engine power output and power consumers (vmod) level
- [VECTO-430] AT shift strategy: upshifts may happen too early
- [VECTO-431] AMT shift strategy always started in first gear due to changes in clutch model
- [VECTO-433] adapt generic vehicles: use typical WHTC correction factors
- [VECTO-437] set vehicle speed at clutch-closed to 1.3 m/s
- [VECTO-436] fix simulation aborts with AT gearbox (neg. braking power, unexpected response, underload)

Bugfixes:

- [VECTO-415] Powershift Losses were not considered for AT gearboxes with PowerSplit
- [VECTO-416] Measured Speed with gear failed when cycle contained parts with eco-roll (computation of next gear failed)
- [VECTO-428] Sum of timeshares adds up to 100%
- [VECTO-429] Min Velocity for lookahead coasting was not written to JSON file

Vecto 3.1.1.748

2017-01-18

Bugfixes:

- [VECTO-404] Driving Cycle with PTO stopped simulation after first PTO activation

Vecto 3.1.1.742

2017-01-12

Improvements:

- [VECTO-390, VECTO-400] Adapt engine speed to estimated engine speed after gear shift during traction interruption (double clutching)
- [VECTO-396, VECTO-388] Add shift losses for AT power shifts
- [VECTO-389] new gear shift rules for AT gearboxes
- [VECTO-387] added max input speed for torque converter
- [VECTO-385] Automatically add generic torque converter data for drag
- [VECTO-399] Add missions and loadings for vehicle categories 11, 12, and 16 (declaration mode)
- [VECTO-384] cleanup memory after simulation run
- [VECTO-394] new option for vectocmd to disable all output
- [VECTO-392] make the GUI scale depending on the Windows font size
- [VECTO-391] Gearbox output speed and output torque added to .vmod files
- [VECTO-386] Gearbox window: disable input fields not applicable for the selected gearbox type

Bugfixes:

- [VECTO-401] Computation of n_{95h} etc. fails if engine's max torque is constant 0
- Lookup of Airdrag parameters in declaration mode
- [VECTO-378] Improved file-handling in AAUX module

Vecto 3.1.0.683

2016-11-14

Bugfixes:

- [VECTO-375] Fixed bug when braking during slope change from negative to positive values.
- [VECTO-372] Added check for unusual acceleration/deceleration data which could lead to error when halting.
- [VECTO-371] Added additional behavior to overcome such situations
- [VECTO-370] Added additional behavior to overcome such situations
- [VECTO-369] CrosswindCorrection is now saved and read again from JSON files
- [VECTO-373] WHTC-Engineering correction factor now correctly read/write in JSON files
- [VECTO-368] Fixed validation for specific cases when values are intentionally invalid.
- [VECTO-357] Updated GUI to not show ECO-Roll option to avoid confusion
- Fixed numerous bugs in AT-ShiftStrategy regarding the Torque Converter
- Fixed numerous bugs in MeasuredSpeed Mode (and MeasuredSpeed with Gear) in connection with AT-Gearbox and TorqueConverter
- Fixed a bug when PTO-Cycle was missing
- Corrected axle loss maps for Generic Vehicles in Declaration Mode to match technical annex
- Corrected SumFile Cruise Time Share. Added that timeshares must add up to 100%

Vecto 3.1.0.683

2016-11-14

Improvements:

- [VECTO-355] Updated documentation, added powertrain schematics in chapter "Simulation Models"
- [VECTO-374] Check range for Torque Converter speed ratio input data to be at least between 0 and 2.2
- Updated many error messages to be more explicit about the reason of error
- Added "Mission Profiles" Directory with driving cycles publicly available in the application root directory.
- Added "Declaration" directory with the declaration data files in the application root directory.
- Added warning when engine inertia is 0
- Added check that engine speed must not fall below idle speed (even in measured speed mode)
- Shift curve validation for AT gearboxes: shift curves may now overlap due to different shift logic in AutomaticTransmissions.
- Updated Crosswind Coefficients for Tractor+Semitrailer

Vecto 3.1.0.662

2016-10-24

- **Bugfixes:**

- [VECTO-360] Fixed error during startup of VECTO (loading of DLLs).
- [VECTO-358] Fixed errors during simulation where vehicle unintentionally was driving backwards. Fixed 1Hz-Filter for ModFiles (distance was wrong under certain circumstances, vehicle seemingly jumping back before halt)
- [VECTO-361] Fixed classification of vehicles with GVM of exactly 7500kg
- [VECTO-364] Fixed an error in measured speed mode (run aborts).
- [VECTO-363] Compute shift polygons in declaration mode now uses correct boundary for full load margin.
- [VECTO-365] Fixed editing gears in declaration mode

- **Improvements:**

- [VECTO-355] User Manual updated (Screenshots, Descriptions, File Formats, Vecto V2 Comments removed).
- [VECTO-317] Declaration data for Wheel sizes updated
- [VECTO-359] Simplified code regarding PT1 behavior.
- [VECTO-323] PTO-Cycle may now be left empty when not used in driving cycle.

Vecto 3.1.0.652

2016-10-14

- **Main Updates**

- Removed VECTO Core 2.2
- Refactoring of the User-Interface Backend: loading, saving files and validating user input uses Vecto 3 models
- AT-Gearbox Model: differentiate between AT gearbox with serial torque converter and AT gearbox using powersplit
- Numbering of gears with AT gearbox corresponds to mechanical gears, new column TC_locked in .vmod file to indicate if torque converter is active
- Torque converter gear no longer allowed in input (added by Vecto depending on the AT model)
- New implementation of torque converter model (analytic solutions)
- Added PTO option for municipal utility vehicles: PTO idle losses, separate PTO cycle during standstill
- Added Angledrive Component
- Option for constant Auxiliary Power Demand in Job-File

Vecto 3.1.0.652

2016-10-14

- Main Updates (cont.)
 - Normalize x/y values before triangulating Delaunay map (transmission loss-maps, fuel consumption loss map)
 - Additional fuel consumption correction factor in declaration mode: cold/hot balancing factor
 - Added fuel consumption correction factor (WHTC, Cold/Hot balancing, ...) in engineering mode
 - Update auxiliaries power demand according to latest whitebook
 - Allow multiple steered axles
 - Adapted engine idle controller (during declutch) – engine speed decreases faster
 - SUM-File: split E_axl_gbx into two columns, E_axl and E_gbx
 - New columns in mod-file: PTO, torque converter
 - Removed full-load curve per gear, only single value MaxTorque
 - Removed rims (dynamic wheel radius depends on wheel type)
 - Fixes in AAUX module: open correct file-browser, save selected files

Status quo VECTO software and open issues (Oct. 2016)

Next issues on the to do list

- **Further development of the AT model**
Consideration of losses during power shifts, update of gear shift logics
- **Reimplementation of engine stop/start**
- **Declaration mode: implementation of EMS vehicle configurations**

Items waiting for decision on methods and resources:

- **Update engine data (according to update of Annex II)**
Other fuels than diesel, “top torque” feature, correction factor for periodic regenerating DPFs
- **Declaration mode:**
 - **Revision of calculated vehicle loads**
 - **implementation of refuse cycle (instead “municipal”)**
Update of driving cycle, consideration of generic PTO loads during collection part, generic body weight and payload
 - **VECTO output (approval authorities, customer info, monitoring)**
 - **Buses**
- **Predictive ADAS**

Vecto 3.0.4.565

2016-07-19

- Bugfixes
 - AAUX HVAC Dialog does not store path to ActuationsMap and SSMSource
 - GUI: check for axle loads in declaration mode renders editing dialog useless
 - Vecto 2.2: Simulation aborts (Vecto terminates) when simulating EngineOnly cycles
 - Vecto 3: Building SimulationRun EngineOnly simulation failed

Vecto 3.0.4.544

2016-06-28

- Main Updates
 - New gear shift strategy according to White Book 2016
 - New coasting strategy according to White Book 2016
 - New input parameters (engineering mode) for coasting and gear shift behavior
 - Use SI units in Advanced Auxiliaries Module and compile with strict compiler settings (no implicit casts, etc.)
 - Allow efficiency for transmission losses (in engineering mode)
- Bugfixes
 - Auxiliary TechList not read from JSON input data
 - Improvements in driver strategy
 - Bugfixes in MeasuredSpeed mode

Notes for using Vecto 3.x with AAUX (1)

- The AdvancedAuxiliaries module requires the number of activations for pneumatic consumers (brakes, doors, kneeling) and the (estimated) total cycle time. This can be configured in the .APAC-file (actuators file). For standard bus/coach cycles (i.e., the cycle file contains “bus” **and** “heavy_urban” or “suburban” or “interurban” or “urban”; **or** the cycle contains “coach” (*case insensitive*)) the actuators file already contains the number of activations and the cycle time. For other cycles the filename without extension is used to lookup the activations in the .APAC file (*case sensitive*)

Notes for using Vecto 3.x with AAUX (2)

- Vecto 3 uses an average auxiliaries load (determined by the AAUX module depending on the settings) for the simulation. The AAUX module computes the fuel consumption in parallel to VectoCore and accounts for smart consumers (e.g., alternator, pneumatics, ...).
- Output
 - The .vmod file contains both, the fuel consumption calculated by VectoCore (per simulation interval) and AAUX (accumulated and per simulation interval). Columns in .vmod file:
 - AA_TotalCycleFC_Grams [g]: accumulated fuel consumption as computed by the AAUX model, considering smart consumers
 - FC-Map [g/h]: fuel consumption as computed by VectoCore interpolating in the FC-Map, using an average base load of auxiliaries
 - FC-AUXc [g/h]: fuel consumption corrected due to engine stop/start (currently not applicable)
 - FC-WHTCc [g/h]: WHTC-corrected fuel consumption (not applicable in engineering mode)
 - FC-AAUX [g/h]: fuel consumption per simulation interval, derived from AA_TotalCycleFC_Grams
 - FC-Final [g/h]: final fuel consumption value with all (applicable) corrections applied (stop/start, WHTC, smart auxiliaries)

Notes for using Vecto 3.x with AAUX (3)

- Output .vsum
 - Columns in .vsum file:
 - FC-Map: total fuel consumption as computed by VectoCore interpolating in the FC-Map, using an average base load of auxiliaries
 - FC-AUXc: total fuel consumption corrected due to engine stop/start (currently not applicable)
 - FC-WHTCc: WHTC-corrected fuel consumption (not applicable in engineering mode)
 - FC-AAUX: fuel consumption per simulation interval, derived from AA_TotalCycleFC_Grams
 - FC-Final: final fuel consumption value with all (applicable) corrections applied (stop/start, WHTC, smart auxiliaries)

Vecto 3.0.3.537

2016-06-21

- Main Updates
 - Plot shift lines as computed according to WB 2016 declaration mode in GUI
- Bugfixes
 - GUI: Buttons to add/remove auxiliaries are visible again
 - Error in calculation of WHTC correction factor
 - Fix: consider gearbox inertia (engineering mode) for searching operating point
 - Wrong output of road gradient in measured speed mode (correct gradient for simulation)
 - Fuel consumption in .vsum file now accounts for AdvancedAuxiliaries model
 - GraphDrawer (Vecto): handle new .vmod format of Vecto 3
 - AdvancedAuxiliaries: language-settings independent input parsing
 - Paux was ignored when running Vecto 2.2
 - Error in massive multithreaded execution
 - Fix unhandled response during simulation
 - Fix output columns in .vmod

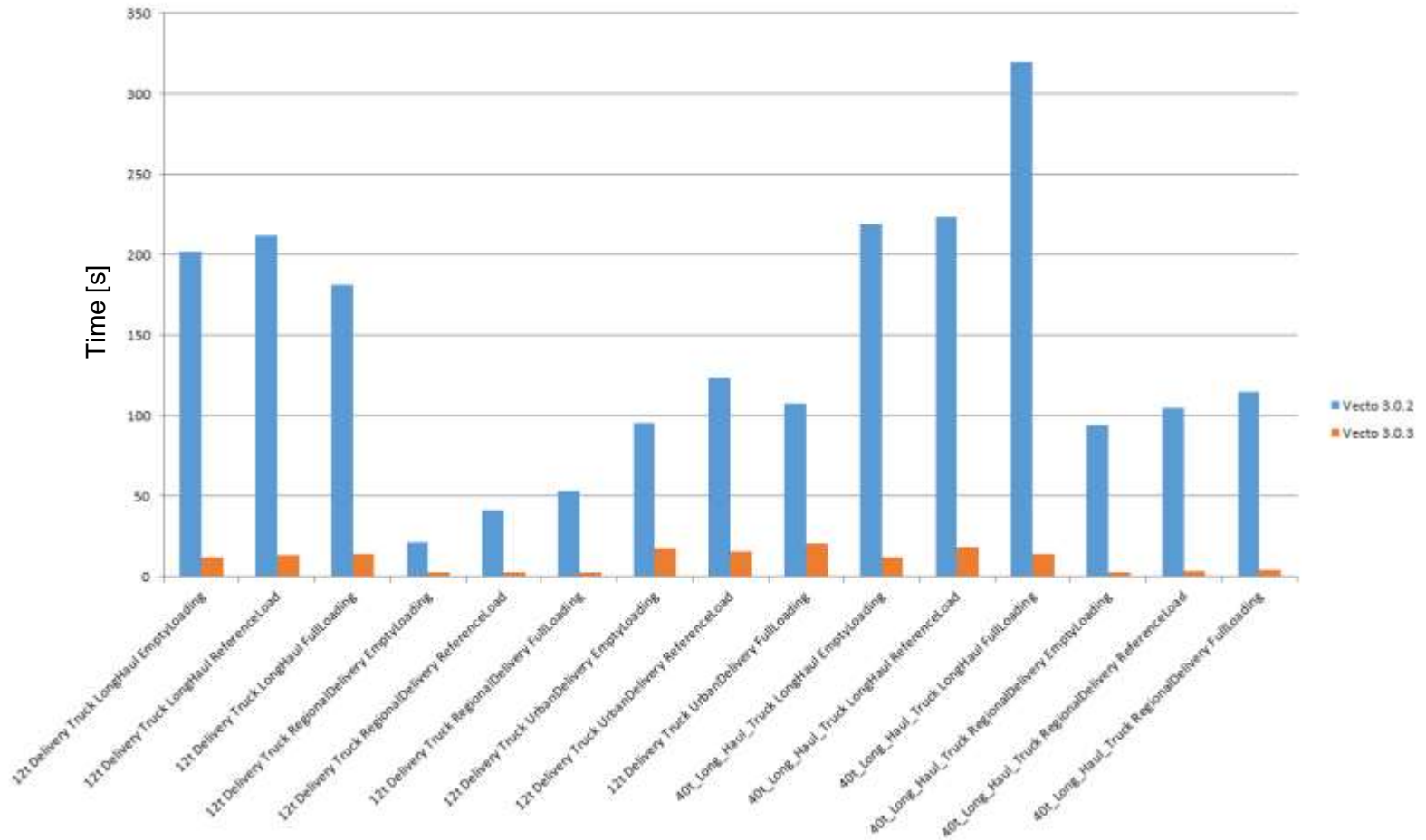
Vecto 3.0.3.495

2016-05-10

- Main Updates
 - Support for Advanced Auxiliaries (Ricardo) in Vecto 3.0.3 and Vecto 2.2
 - Performance improvements
 - Gearshift polygons according to WB 2016
 - Revision of SUM-data file, changed order of columns, changed column headers
- Bugfixes
 - Delaunay Maps: additional check for duplicate input points
 - Creation of PDF Report when running multiple jobs at once
 - Sanity checks for gear shift lines
 - Improvements DriverStrategy: handling special cases

Performance Comparison

Execution Times (all 15 runs in parallel)



Total execution time (15 runs in parallel): Vecto 3.0.2: 6min 6s; **Vecto 3.0.3: 35s**

VECTO 3.0.2

2016-03-11

Main updates

- New simulation modes:
 - Pwheel (SiCo),
 - Measured Speed (with/without gear)
 - v_{air} /beta cross-wind correction (vcdb)
- Adaptations of powertrain components architecture
 - Move wheels inertia from vehicle to wheels
 - Auxiliaries no longer connected via clutch to the engine but via a separate port
 - Engine checks overload of gearbox and engine overload
- Fixed some driving behavior related issues in VectoCore:
 - When the vehicle comes to a halt during gear shift, instead of aborting the cycle, it tries to drive away again with an appropriate gear.
- ModData Format changed for better information and clarity
- Added validation of input values (according to latest VectoInputParameters.xls)
- Various bugfixes

Pwheel (SiCo) Mode

- Function as already available in Vecto 2.2 also added in Vecto 3.0.2
 - Driving cycle specifies power at wheel, engine speed, gear, and auxiliary power
 - No driver model in the simulation.
 - The Vecto gear-shift model is overruled.
 - Function used for creating reference results for SiCo tests
 - For details see user manual: Simulation Models / Pwheel Input (SiCo)

Measured Speed Mode

- Functionality already available in Vecto 2.2 added in Vecto 3.0.2
 - Driving cycle not defined by target speed but by actual speed. No driver model in the simulation.
 - Gear and engine speed can be specified in the driving cycle. In this case the Vecto gear-shift model is overruled.
 - Function used for “proof of concept” purposes
 - For details see user manual: Calculation Modes / Engineering Mode / Measured Speed

.vmod File Update

- In Vecto 3.0.2 the structure of the modal data output has been revised and re-structured. Basically for every powertrain component the .vmod file contains the power at the input shaft and the individual power losses for every component. For the engine the power, torque and engine speed at the output shaft is given along with the internal power and torque used for computing the fuel consumption.
- For details see the user manual: Input and Output / Modal Results (.vmod)

Changelog 3.0.2

- - New simulation modes:
- + Measured Speed
- + Measured Speed with Gear
- + Pwheel (SiCo)
- - Adaptations of powertrain components architecture
- + Move wheels inertia from vehicle to wheels
- + Auxiliaries no longer connected via clutch to the engine but via a separate port
- + Engine checks overload of gearbox and engine overload
- - Fixed some driving behavior related issues in VectoCore:
- + When the vehicle comes to a halt during gear shift, instead of aborting the cycle, it tries to drive away again with an appropriate gear.
- - [ModData Format](#modal-results-.vmod) changed for better information and clarity
- - Entries in the sum-file are sorted in the same way as in Vecto 2.2
- - In engineering mode the execution mode (distance-based, time-based measured speed, time-based measured speed with gear, engine only) are detected based on the cycle
- - Added validation of input values
- - Gravity constant set to 9.80665 (NIST standard acceleration for gravity)
- - Improved input data handling: sort input values of full-load curves (engine, gbx, retarder)
- - Better Integration of VectoCore into GUI (Notifications and Messages)
- - v_{air}/β cross-wind correction (vcdb) implemented
- - For all calculations the averaged values of the current simulation step are used for interpolations in loss-maps.
- - Allow extrapolation of loss maps in engineering mode (warnings)
- - Refactoring of input data handling: separate InputDataProvider interfaces for model data
- - Refactoring of result handling: separate result container and output writer
- - New Long-Haul driving cycle included
- - User Manual updated for VECTO V3.x
- - Fix: sparse representation of declaration cycles had some missing entries
- - Bugfix: error in computation of engine's preferred speed
- - Bugfix: wrong vehicle class lookup
- - Bugfix: duplicate entries in intersected full-load curves
- - Bugfix: retarder takes the retarder ratio into account for lossmap lookup
- - Bugfix: use unique identifier for jobs in job list
- - Bugfix: error in triangulation of fuel consumption map