Argonne NATIONAL LABORATORY

... for a brighter future

PSAT Training

Part 03
How to use PSAT
A - Define Simulation

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U.S. Department of Energy

UChicago Argonne LLC

Office of Science
U.S. DEPARTMENT OF ENERGY

A U.S. Department of Energy laboratory managed by UChicago Argonne, LLC

FreedomCAR & Fuel Partnership

Outline

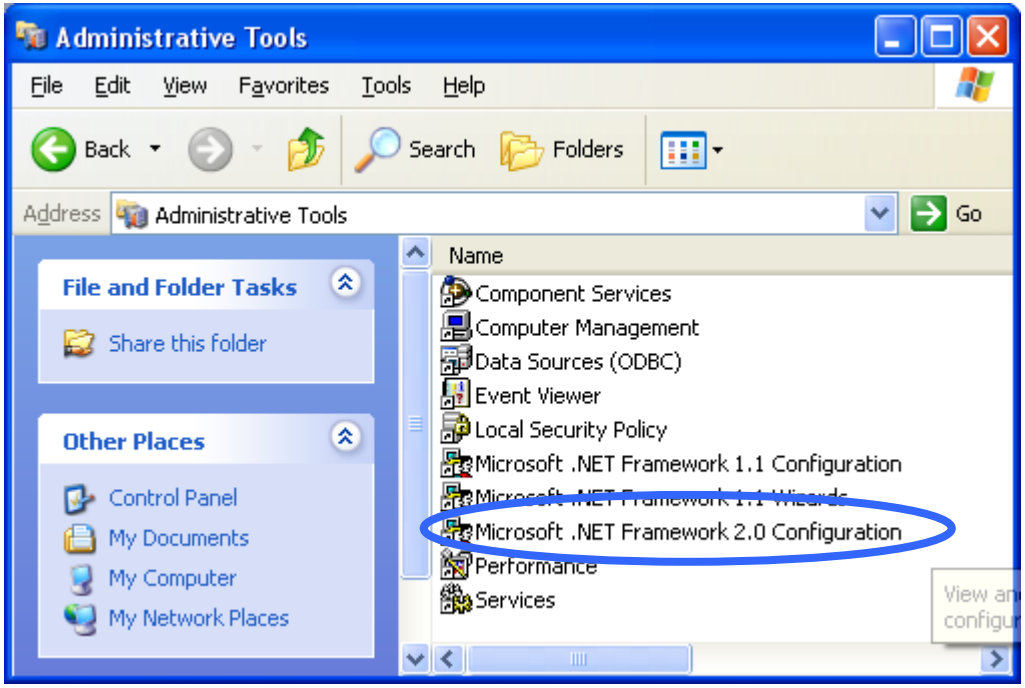
- Install PSAT
- Launch PSAT
- Define the vehicle
- Select the type of simulation
- Run the simulation
- Menu Options
- Model building

1 – Install PSAT

- Install Microsoft.NET Framework 2.0
- Launch CD
- Install USB Driver
- Install PSAT
- Insert USB Key
- Uninstall PSAT

! The user must be an Administrator to perform the installation

Install Microsoft.NET Framework 2.0



To check if Microsotf.NET Framework is already installed, go to Control Panel / Administrative Tools

Install Microsoft.NET Framework 1.1

If Microsotf.NET Framework is not installed, go to

http://v4.windowsupdate.microsoft.com/en/default.asp

and scan for updates…

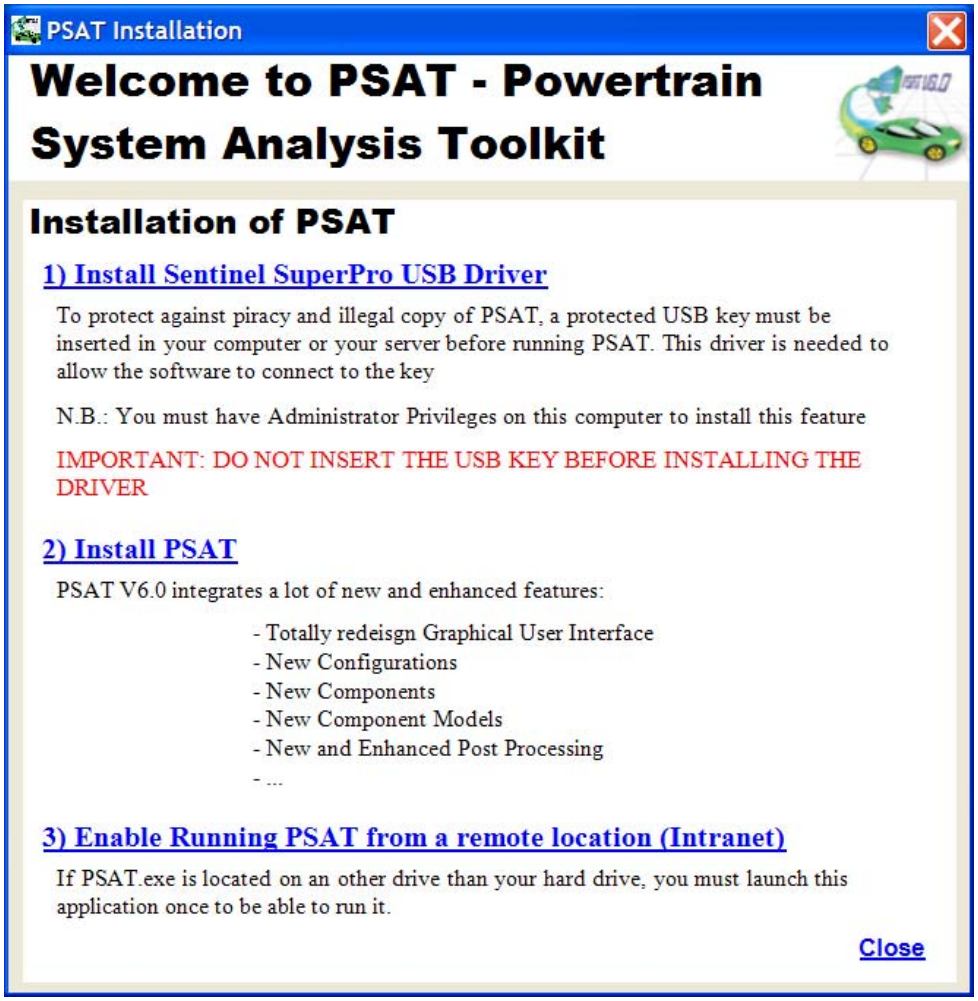
Launch CD

Insert CD

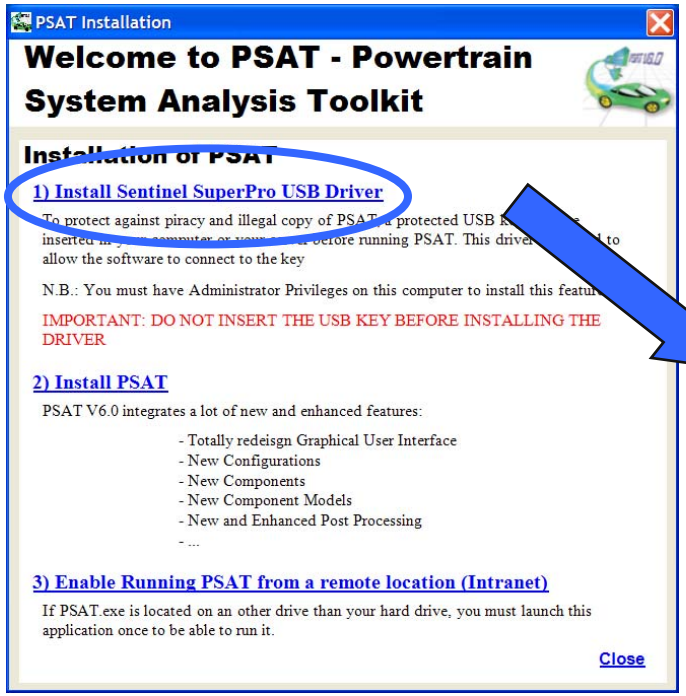
PSAT_installation.exe

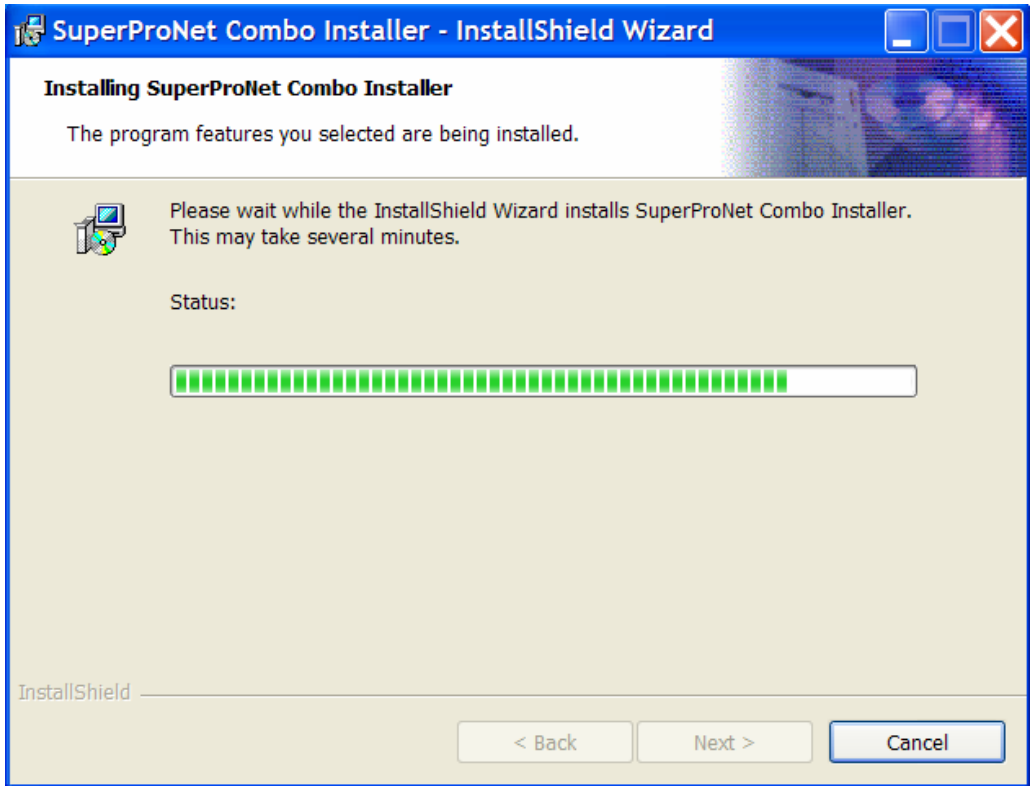
Automatic start

Manual start

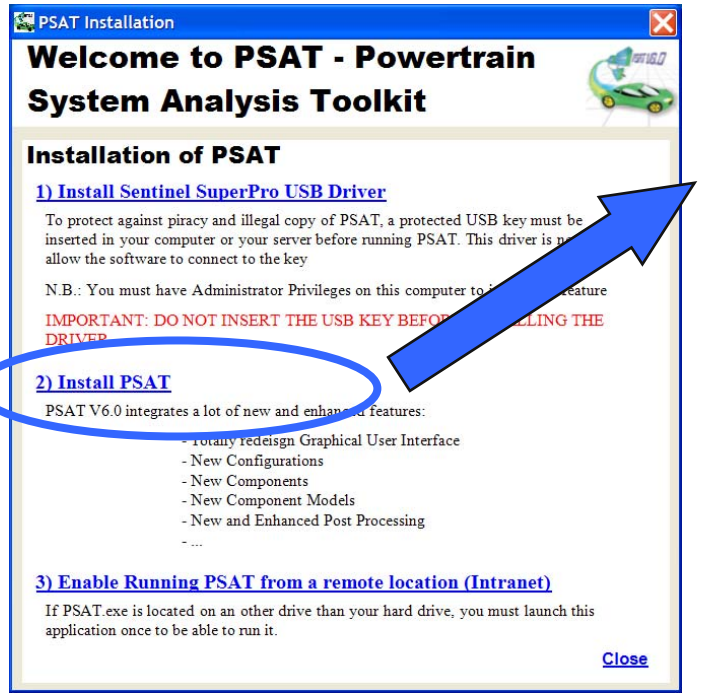


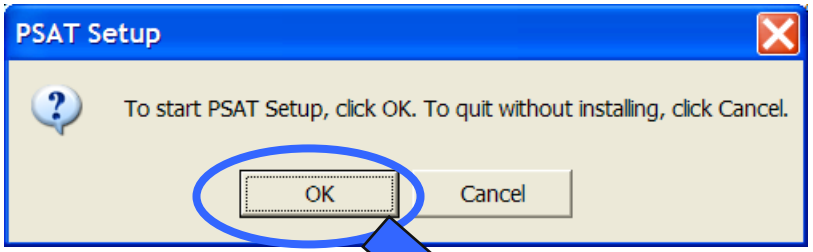
Install USB Driver

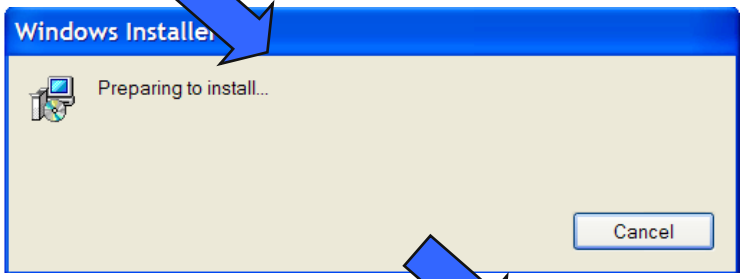


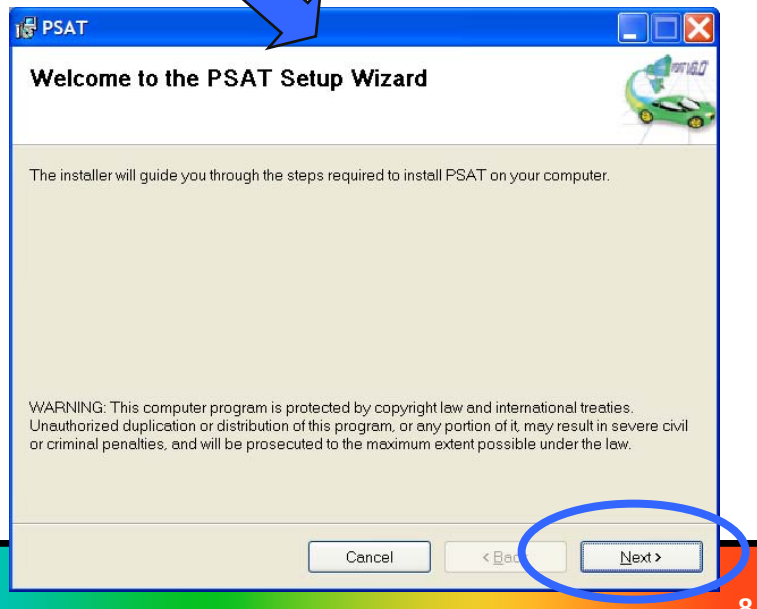


Install PSAT

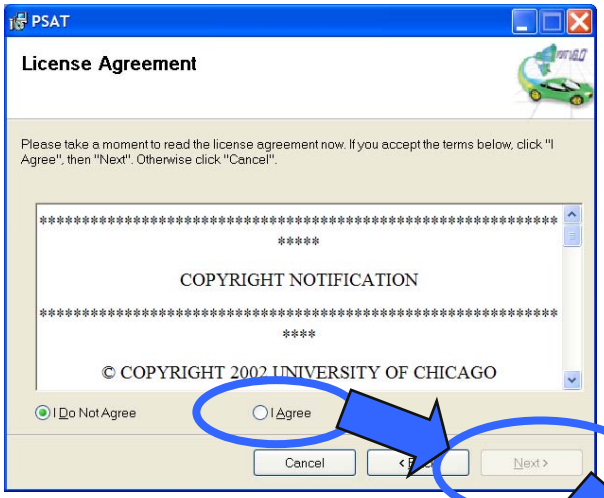


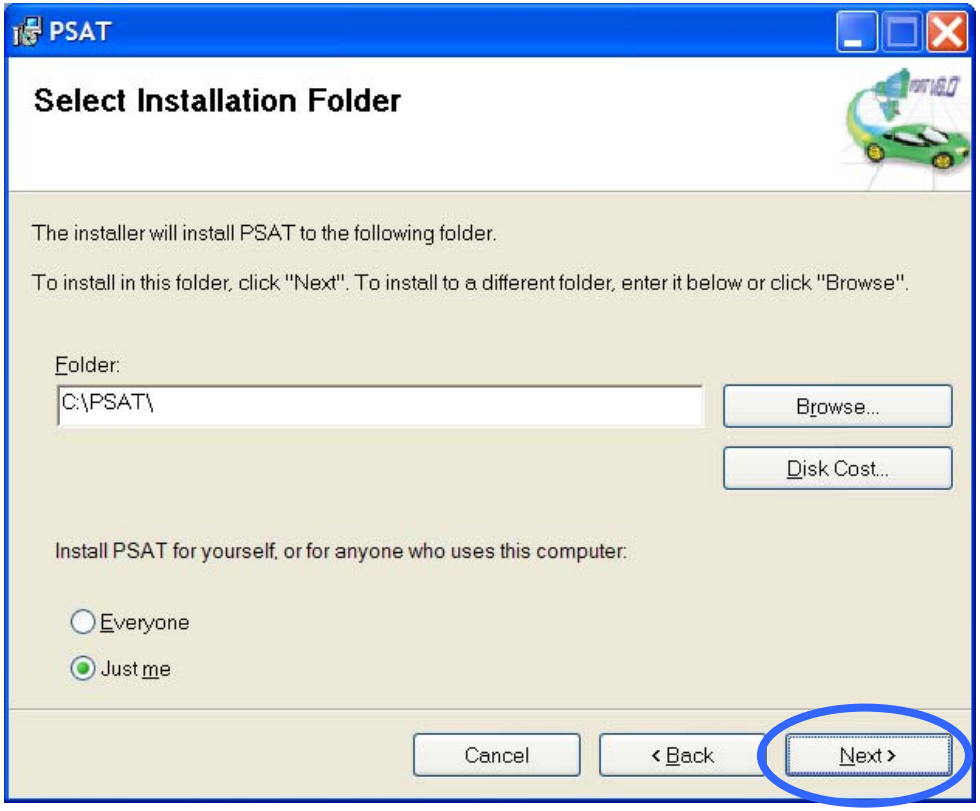




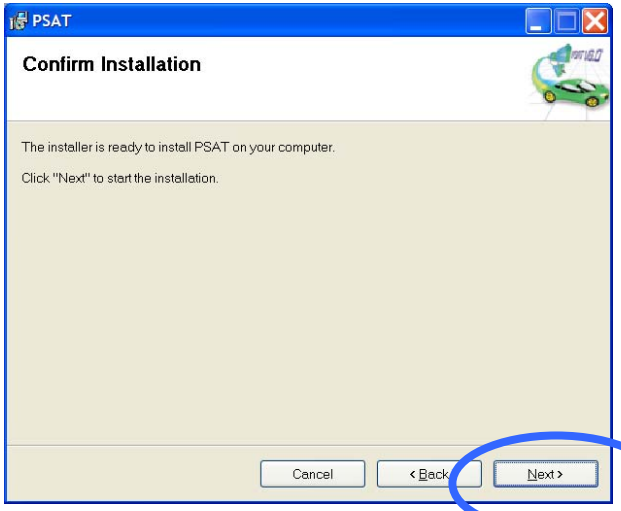


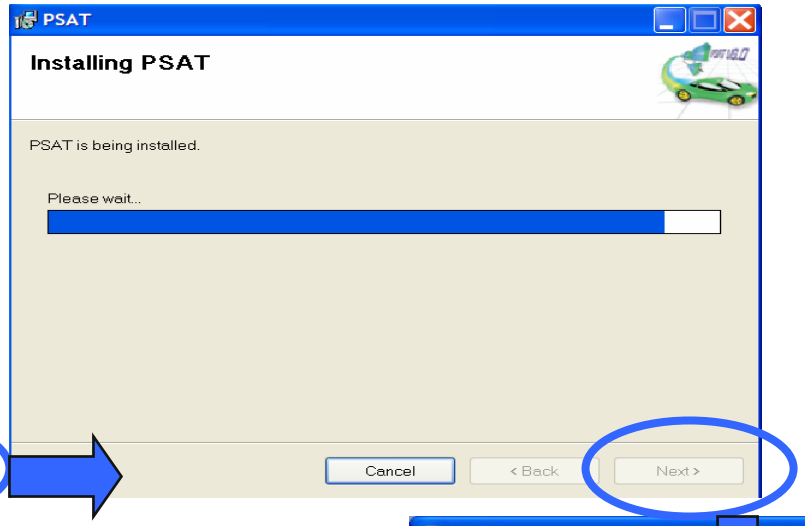
Install PSAT (cont)

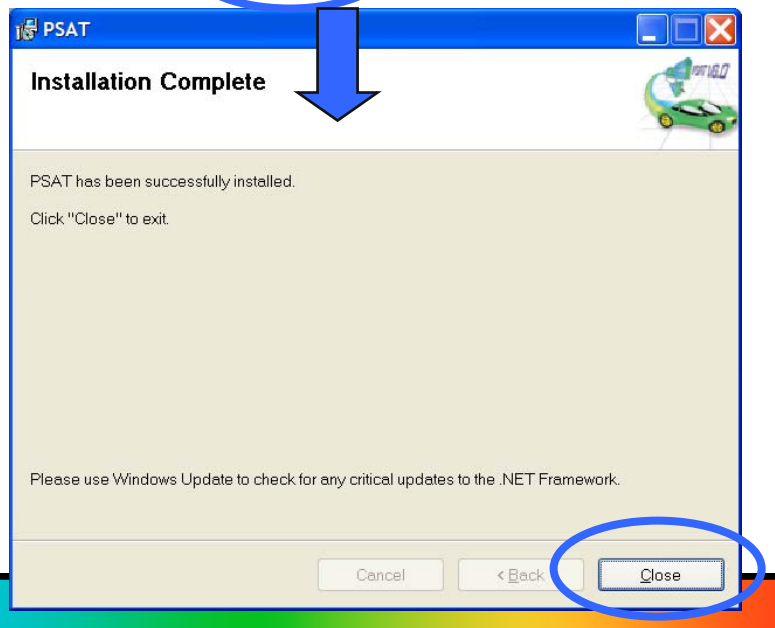




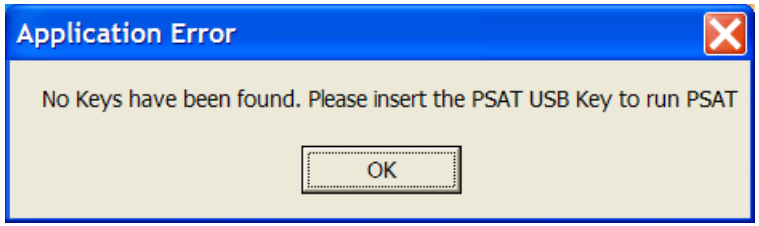
Install PSAT (cont)



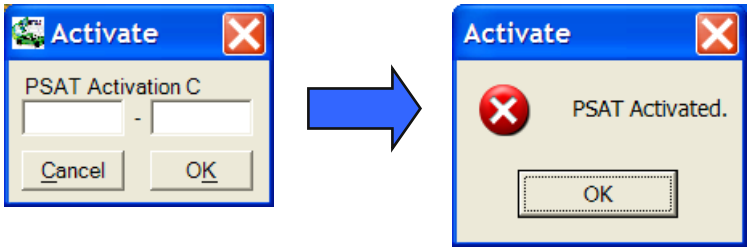




Install USB Key



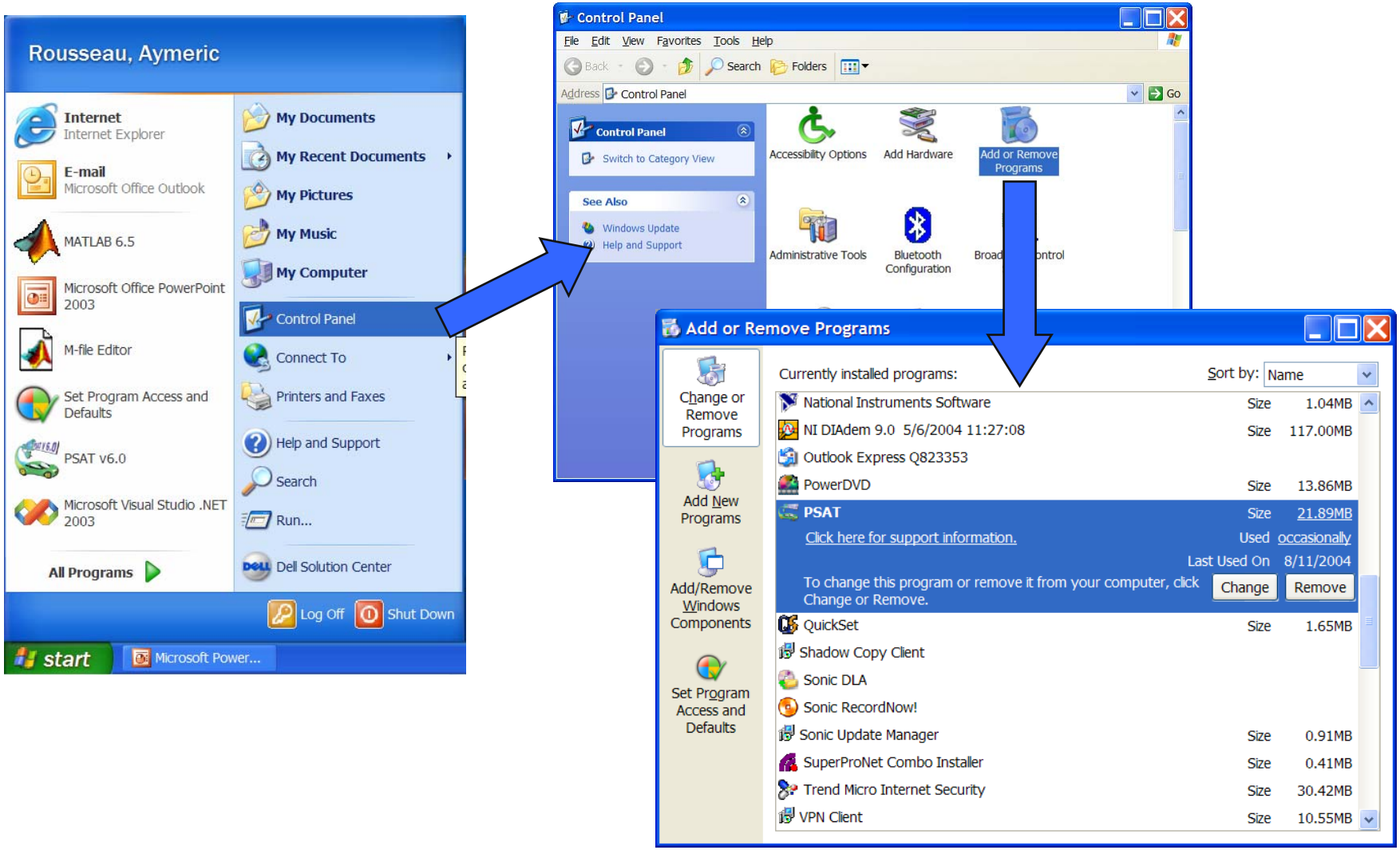
1 – Error message if no key is detected



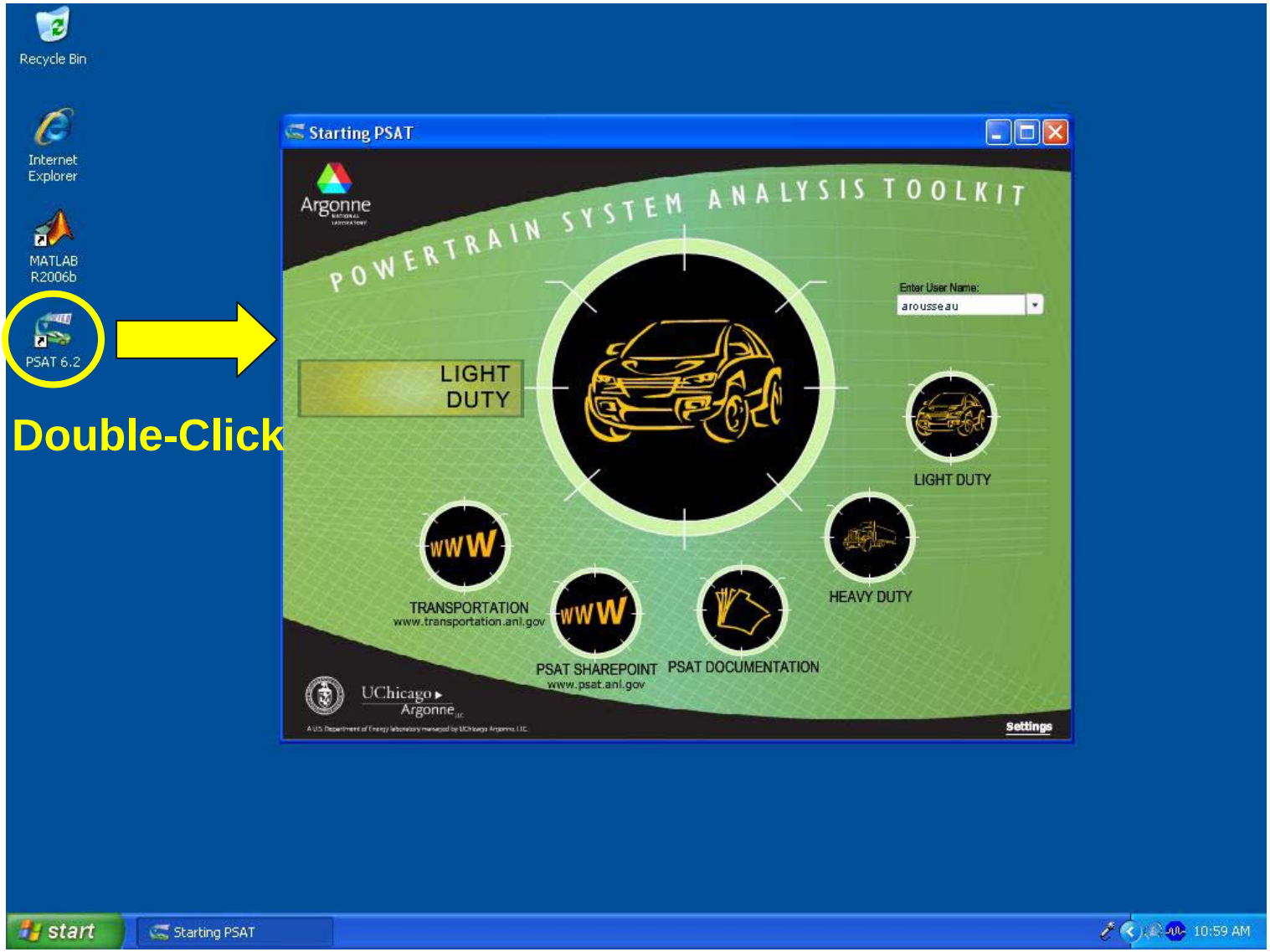
2 – When the key is inserted, enter the Activation code

3 – Error message if the key is taken out after PSAT is launched

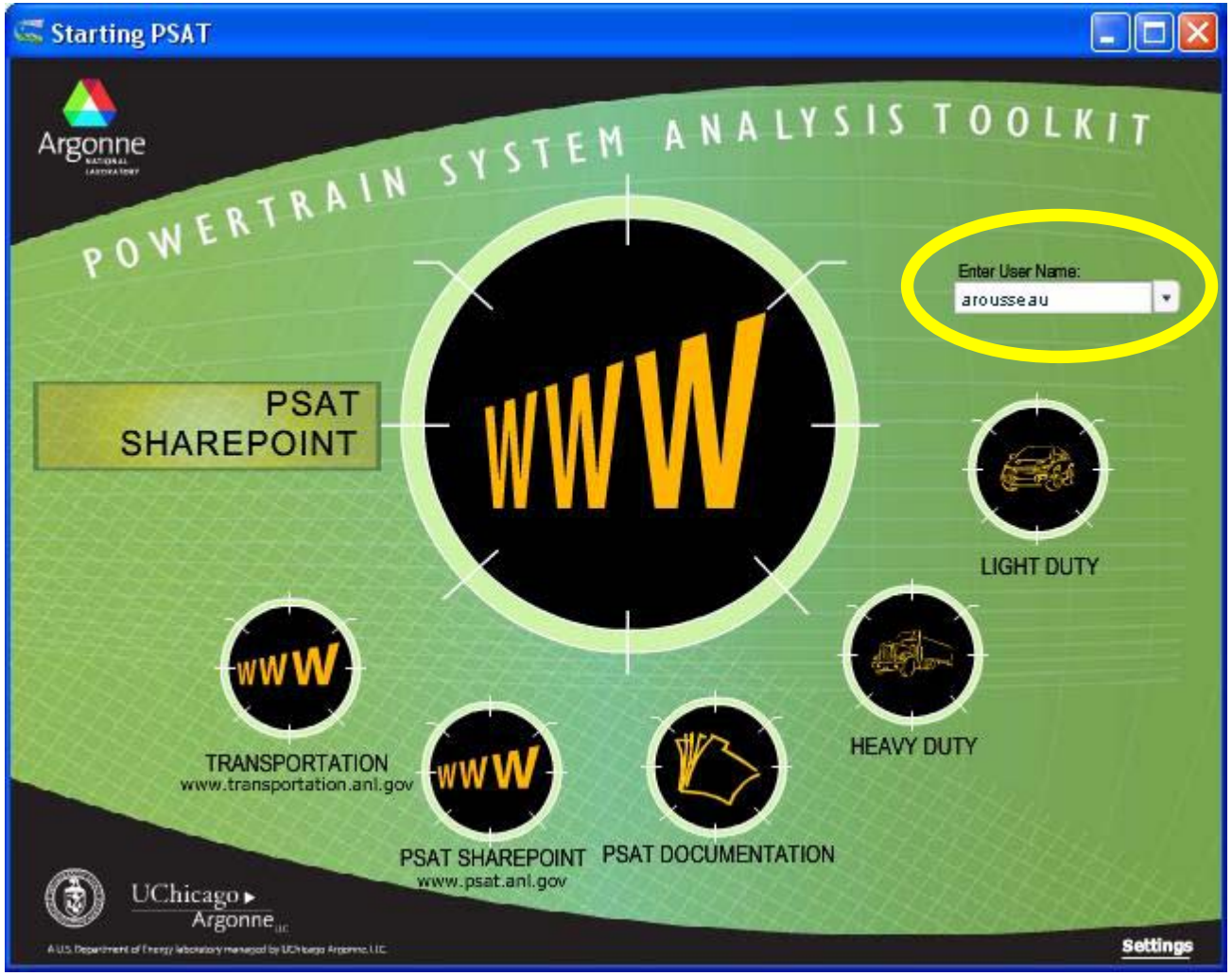
Uninstall PSAT



2 - Launch PSAT from the Desktop



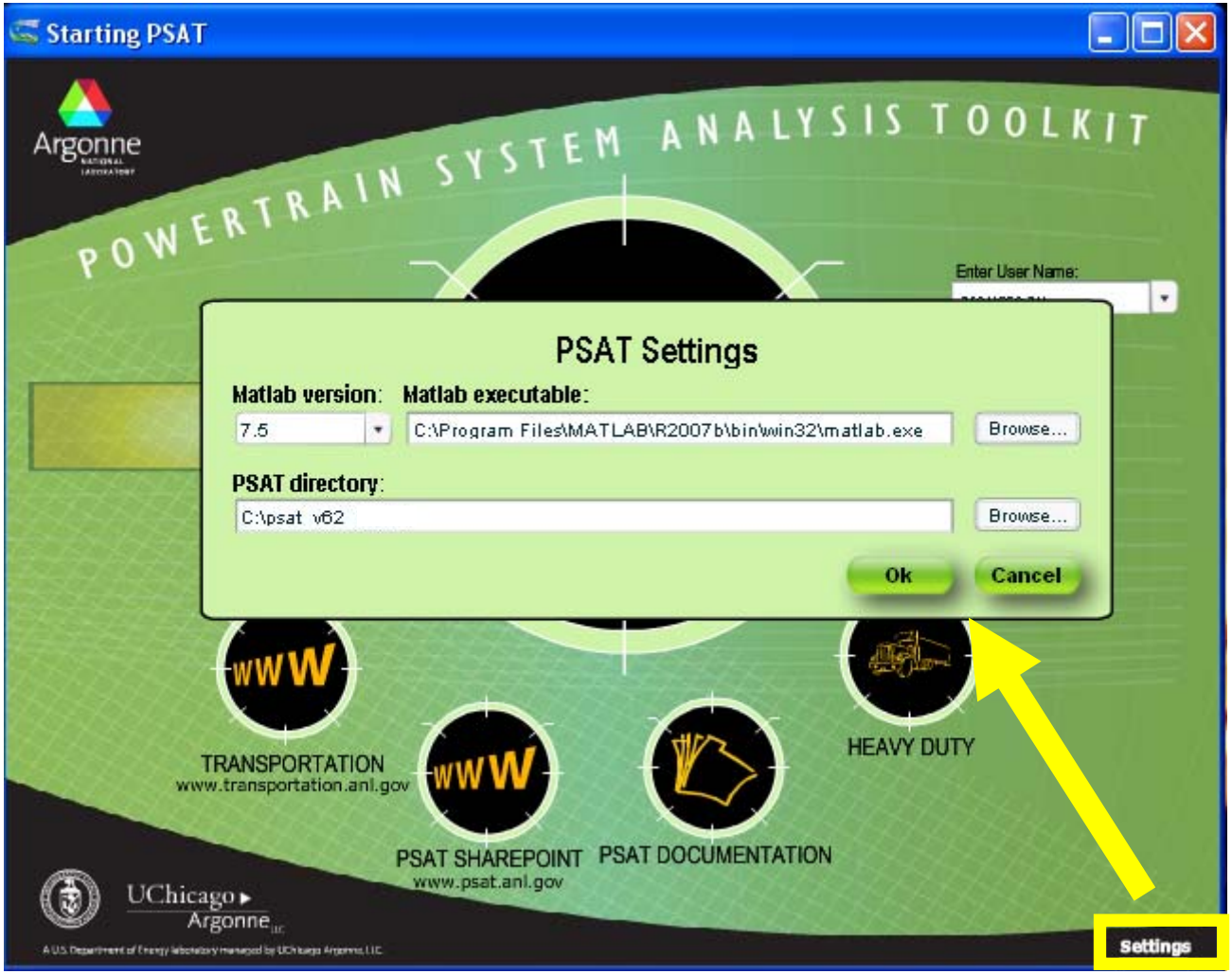
The First Time, Enter your UserName



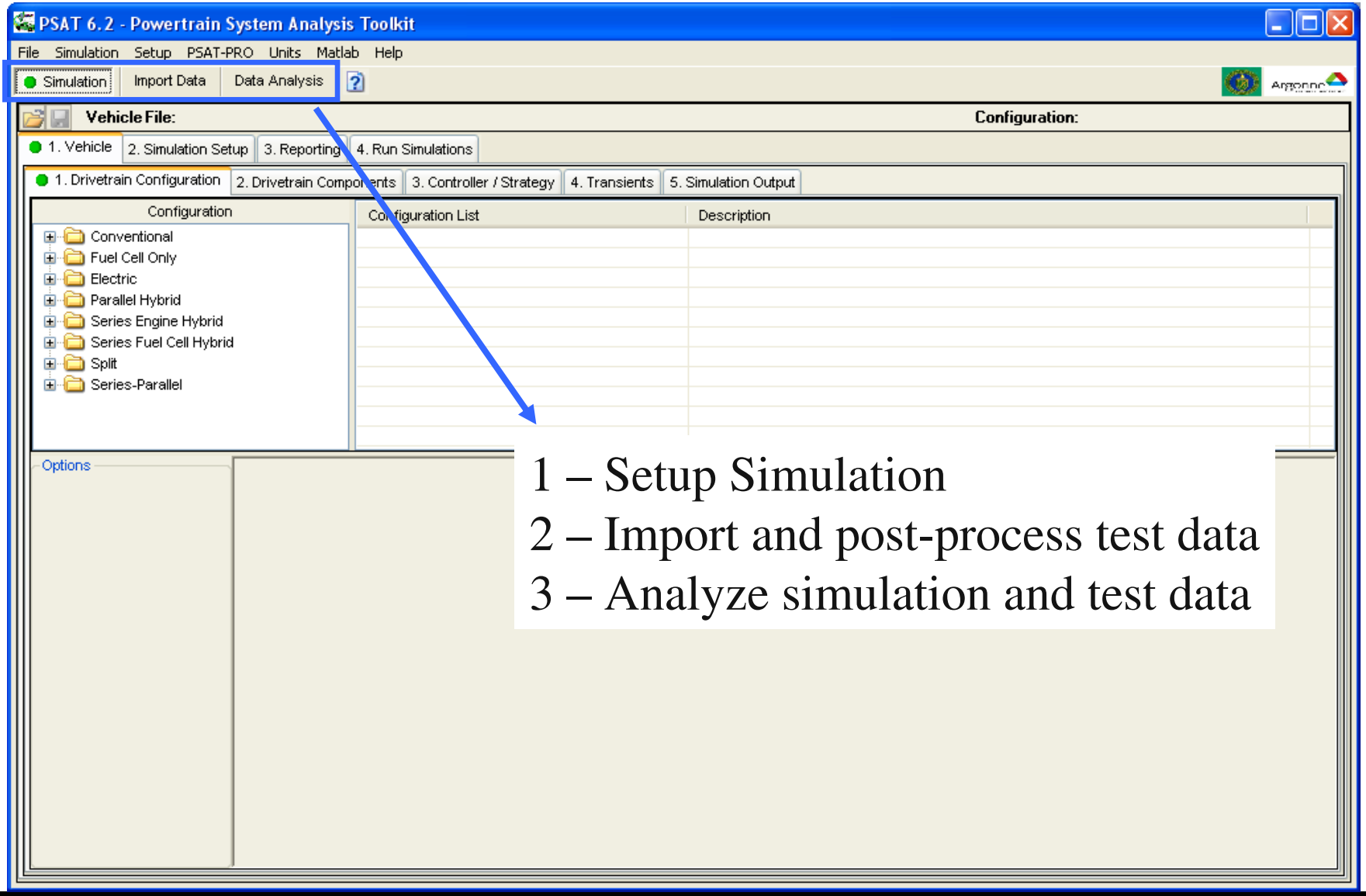
The Next Time, Select your initial UserName

Select the MathWorks Version to be Used

!! R2007b is PSAT V6.2 Required Version !!



PSAT GUI

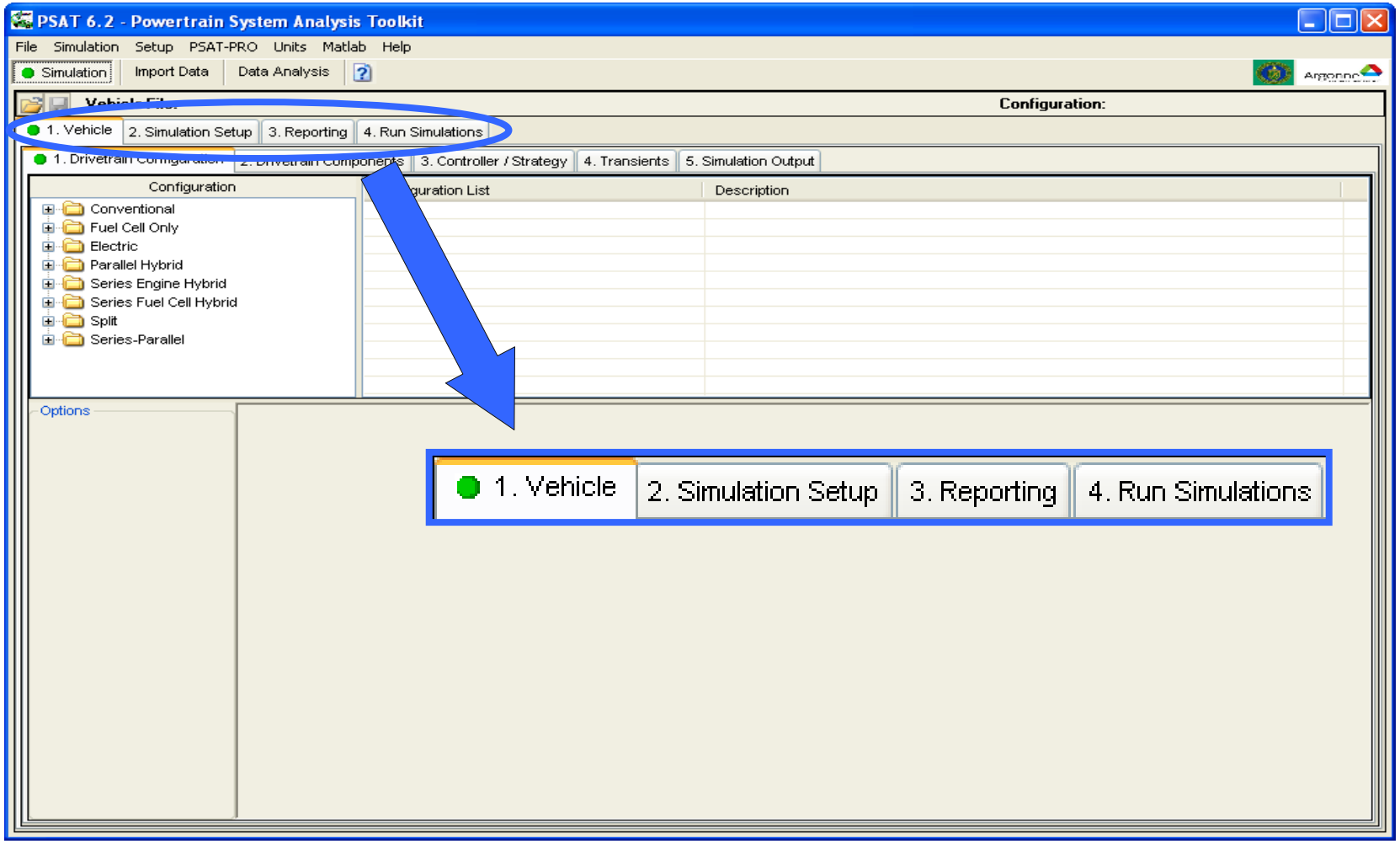


1 – Setup Simulation
2 – Import and post-process test data
3 – Analyze simulation and test data

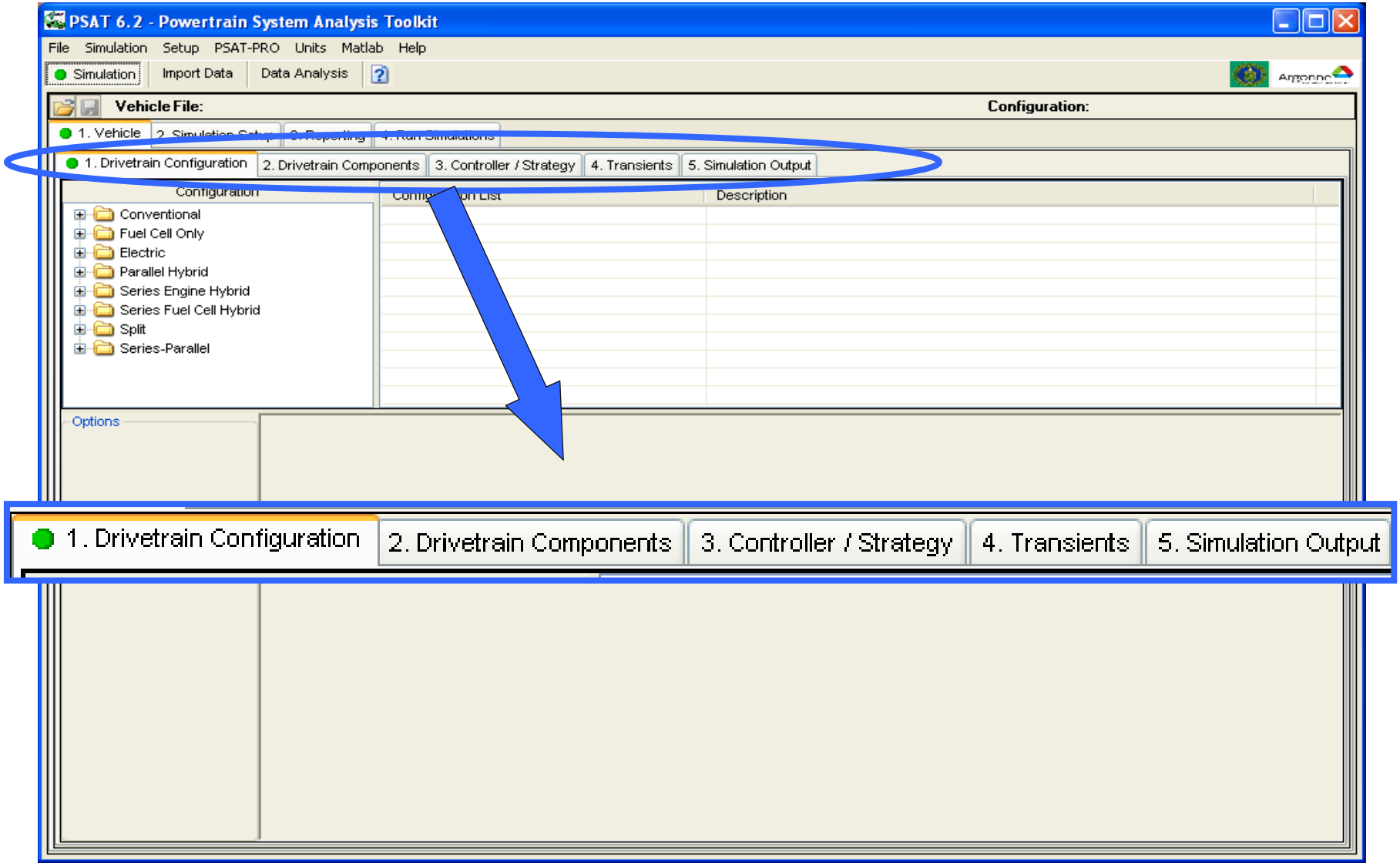
3 – Define the Vehicle

- Select the Drivetrain configuration
- Define Component Characteristics
- View Component Characteristics
- Save your choices
- Select the parameters to be monitored

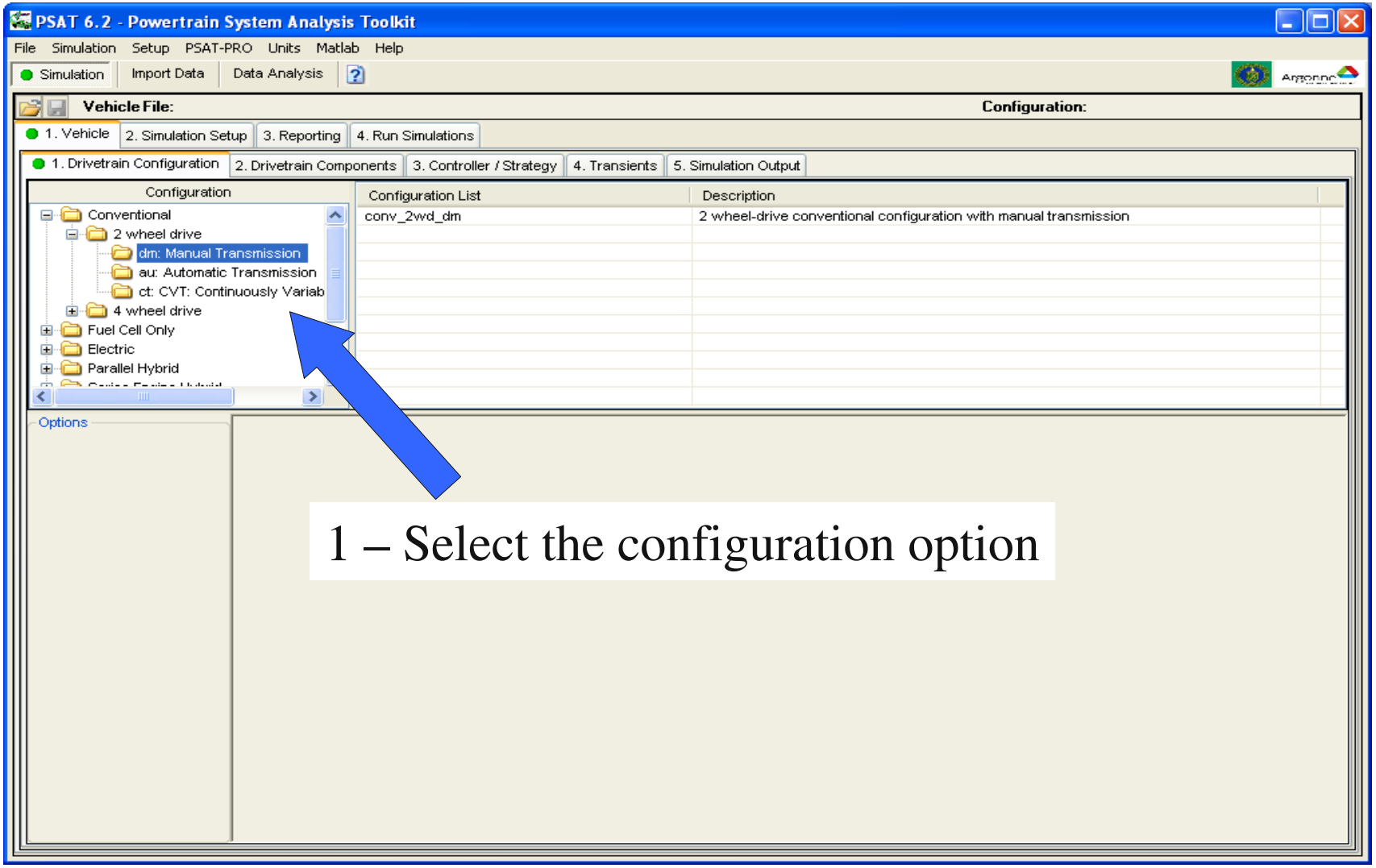
Simulation Tab



Vehicle Tab

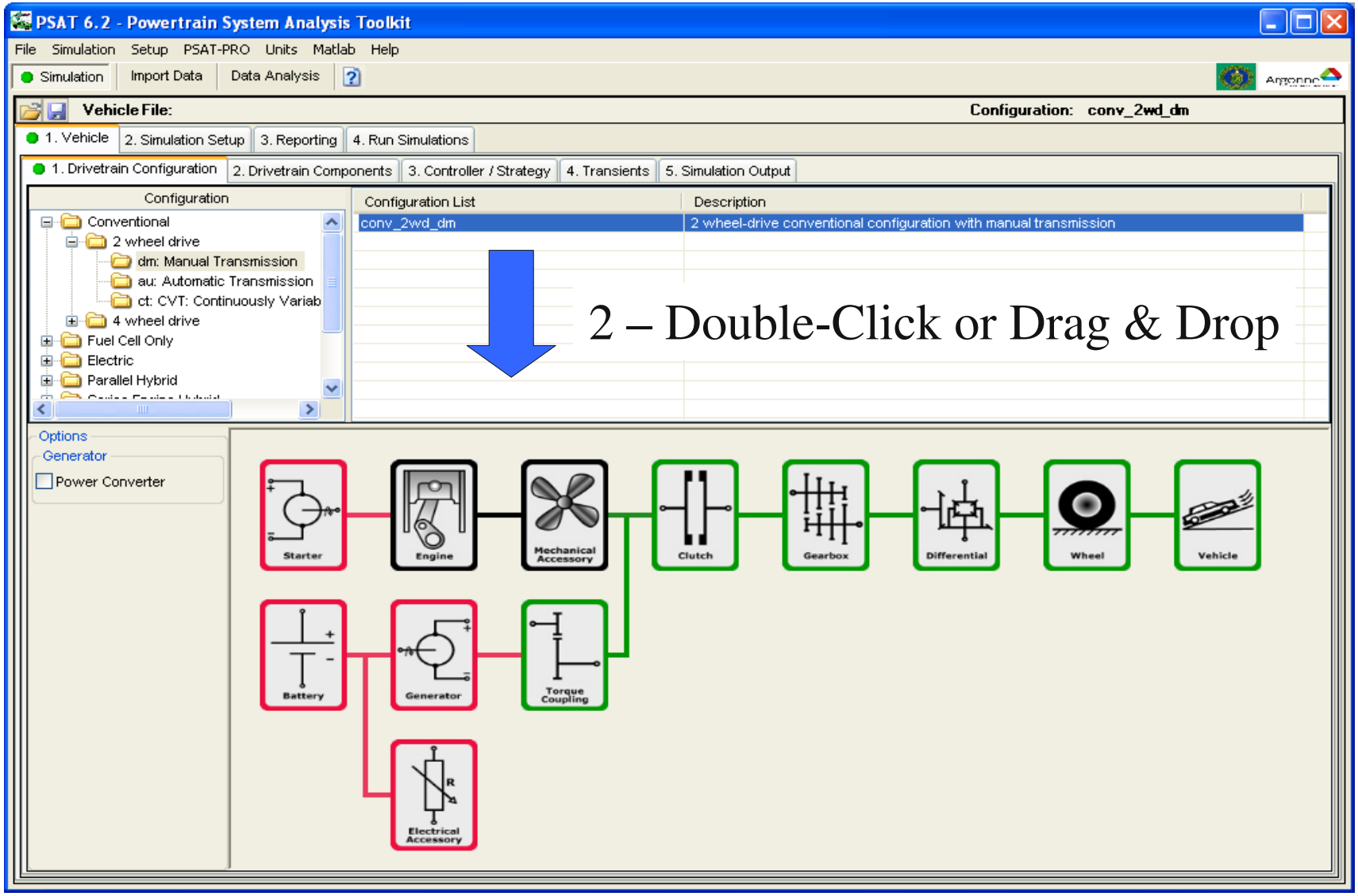

PSAT 6.2 - Powertrain System Analysis Toolkit
File Simulation Setup PSAT-PRO Units Matlab Help
Simulation
Import Data
Data Analysis
Vehicle File:
Configuration:
1. Vehicle
1. Drivetrain Configuration
2. Drivetrain Components
3. Controller / Strategy
4. Transients
5. Simulation Output
Configuration
Description
Conventional
Fuel Cell Only
Electric
Parallel Hybrid
Series Engine Hybrid
Series Fuel Cell Hybrid
Split
Series-Parallel
Options

Select The Drivetrain Configuration

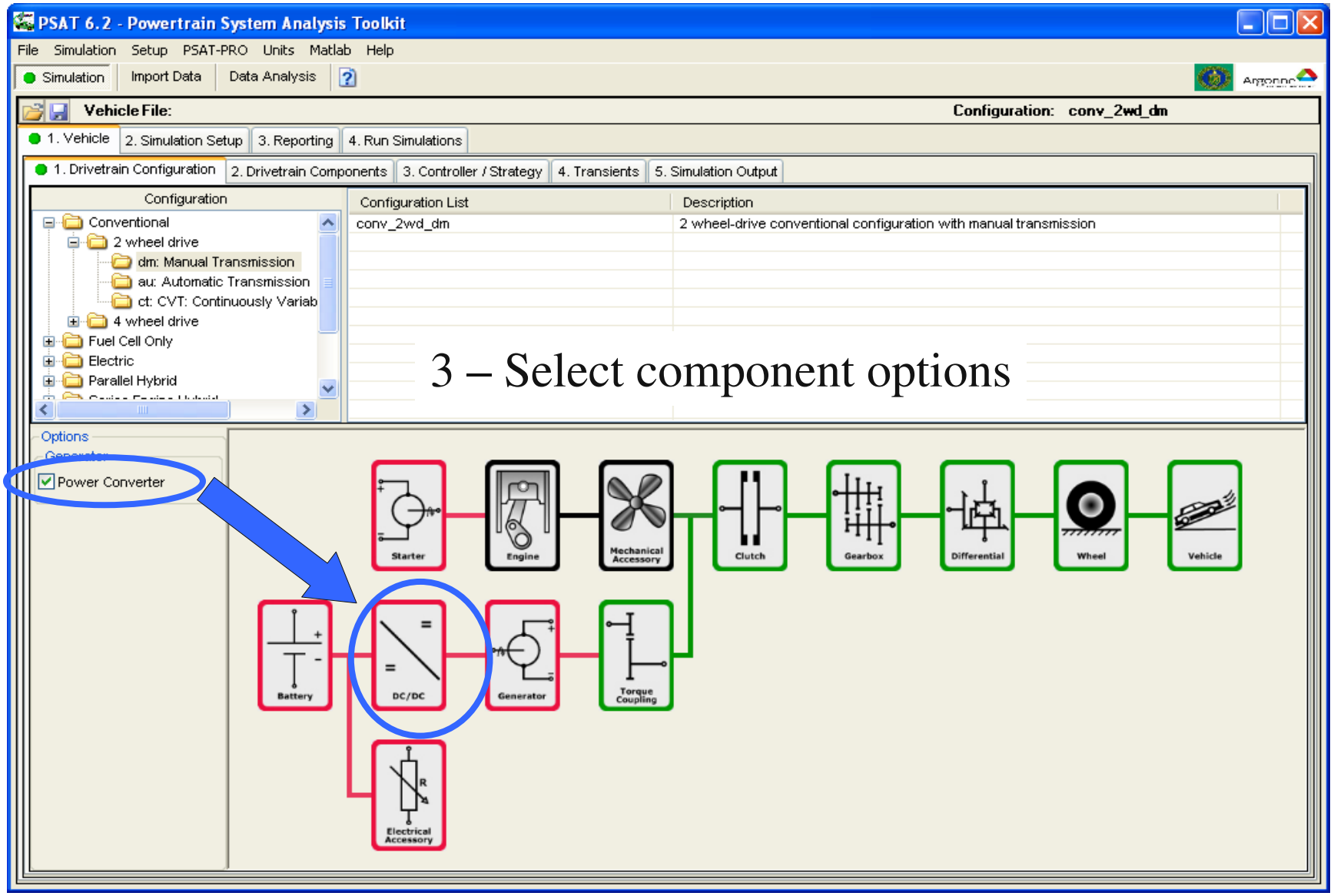


1 – Select the configuration option

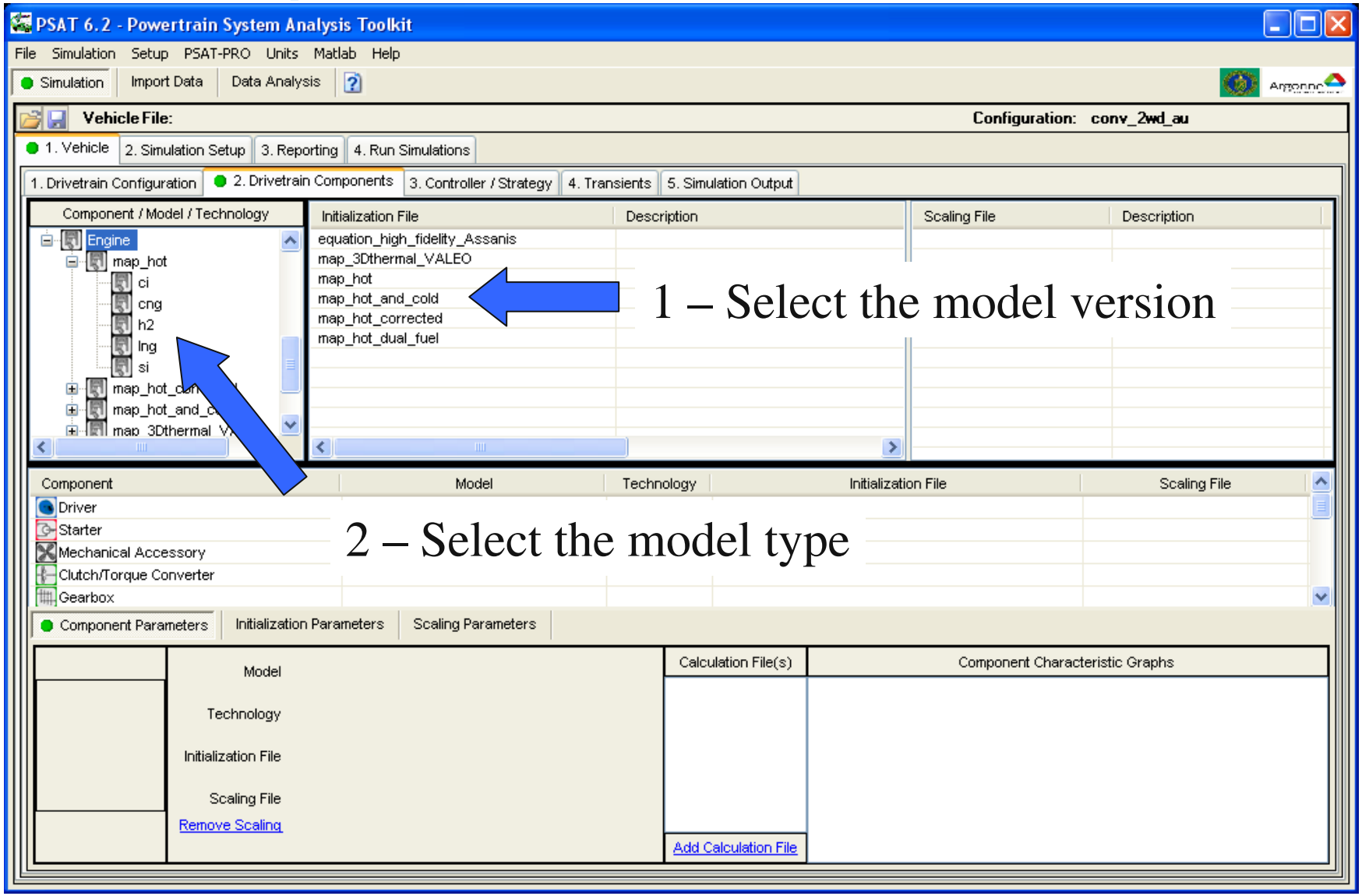
Select The Drivetrain Configuration



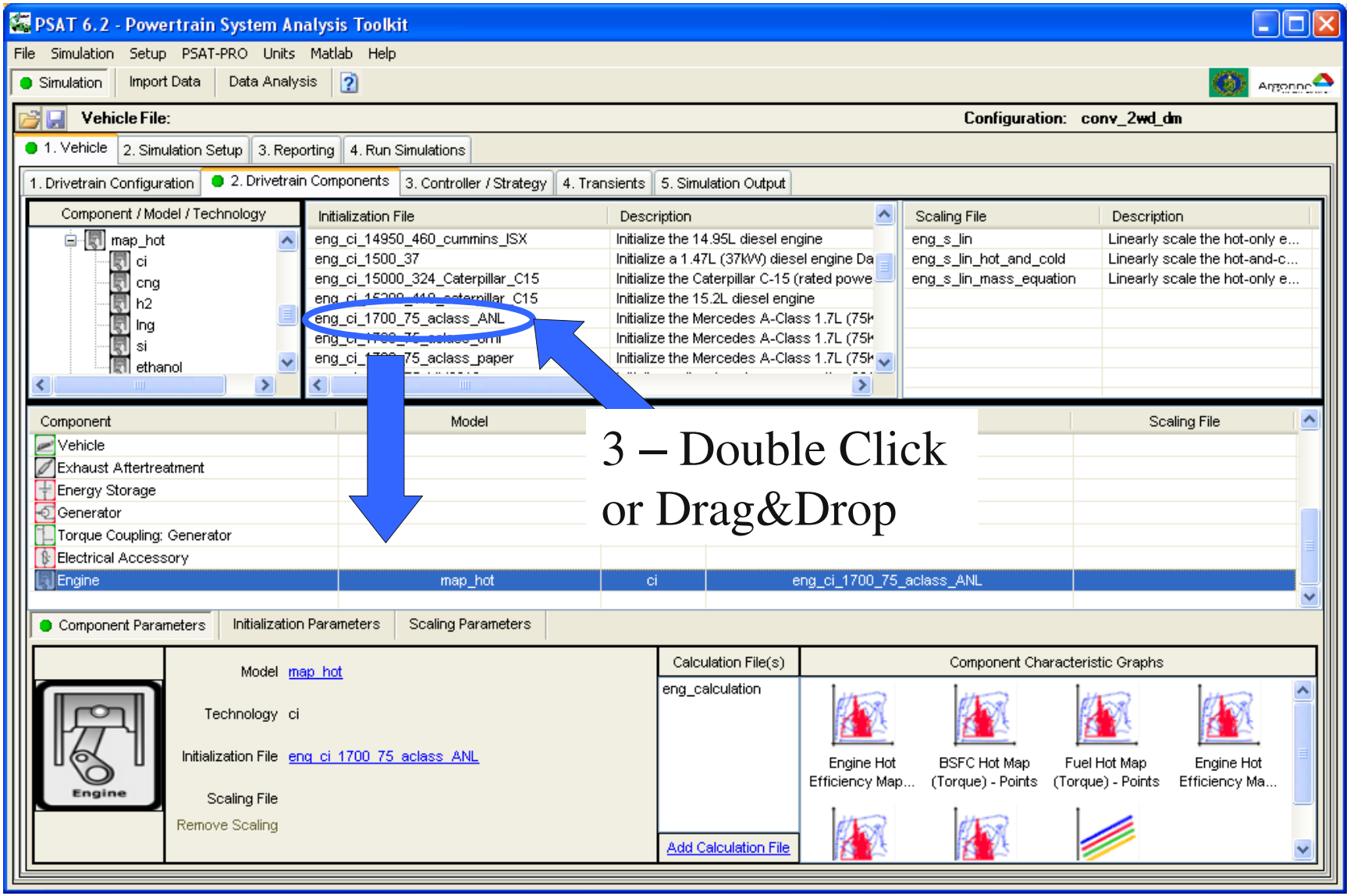
Select The Drivetrain Configuration



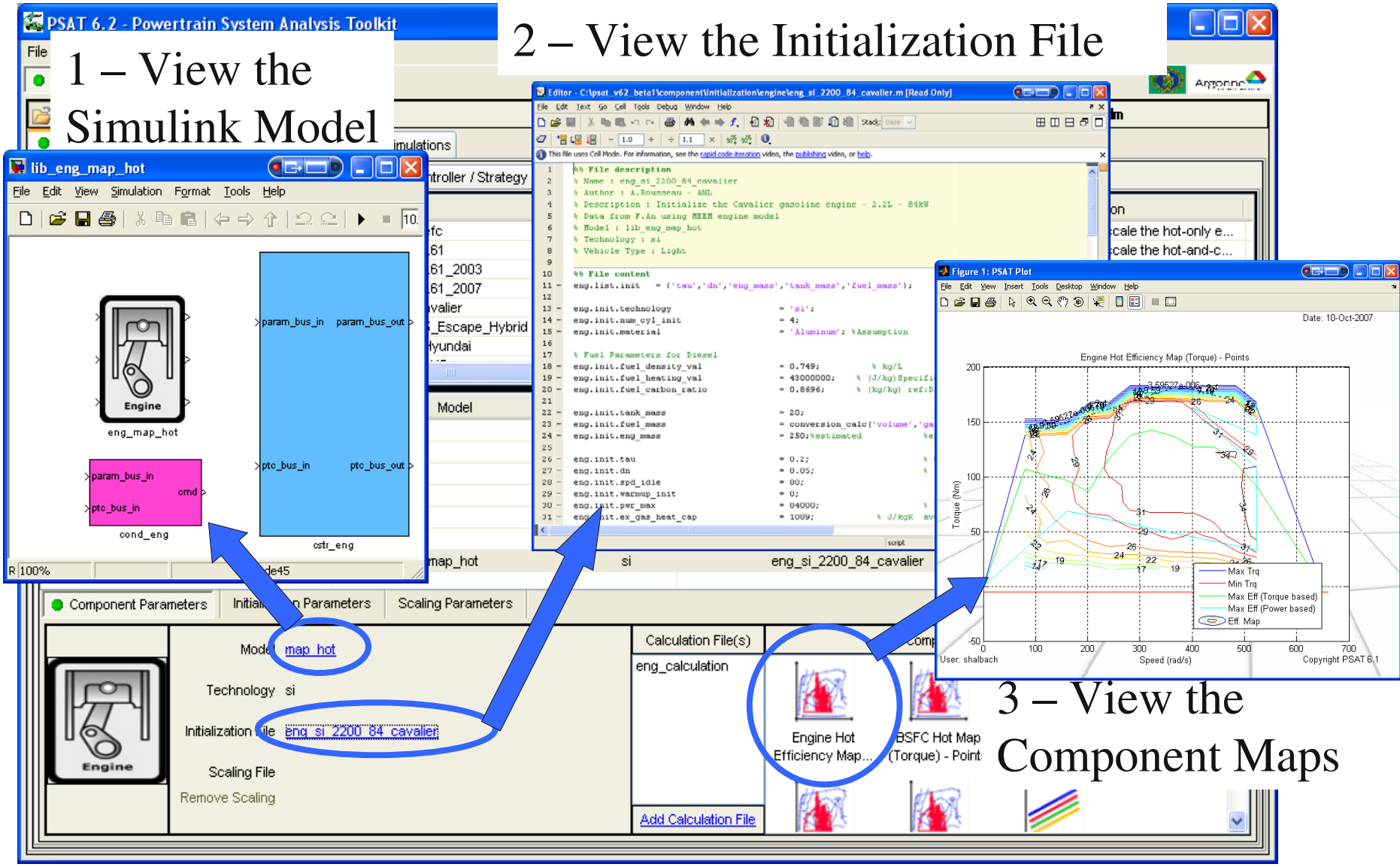
Define Component Characteristics



Define Component Characteristics



View Components Characteristics



Modify One Parameter

PSAT 6.2 - Powertrain System Analysis Toolkit

File Simulation Setup PSAT-PRO Units Matlab Help

Simulation | Import Data | Data Analysis

Vehicle File: gui_par_midsize_average_ISG_in Configuration: par_2wd_p1_dm

1. Vehicle | 2. Simulation Setup | 3. Reporting | 4. Run Simulations

1. Drivetrain Configuration | 2. Drivetrain Components | 3. Controller / Strategy | 4. Transients | 5. Simulation Output

Component / Model / Technology

- Driver
- Mechanical Accessory
  - constant_pwrloss_trq_in
- Clutch/Torque Converter
- Energy Storage
- Motor
- Gearbox

Initialization File	Description
accmech_0	Initialize the mechanical accessory powe
accmech_0_Hyundai_jay	Initialize the mechanical accessory powe
accmech_1000	Initialize the mechanical accessory powe
accmech_1000_conv_SUV	Initialize the mechanical accessory powe
accmech_1100	Initialize the mechanical accessory powe
accmech_1200	Initialize the mechanical accessory powe
accmech_1266_silverado	Initialize the mechanical accessory powe

Scaling File	Description

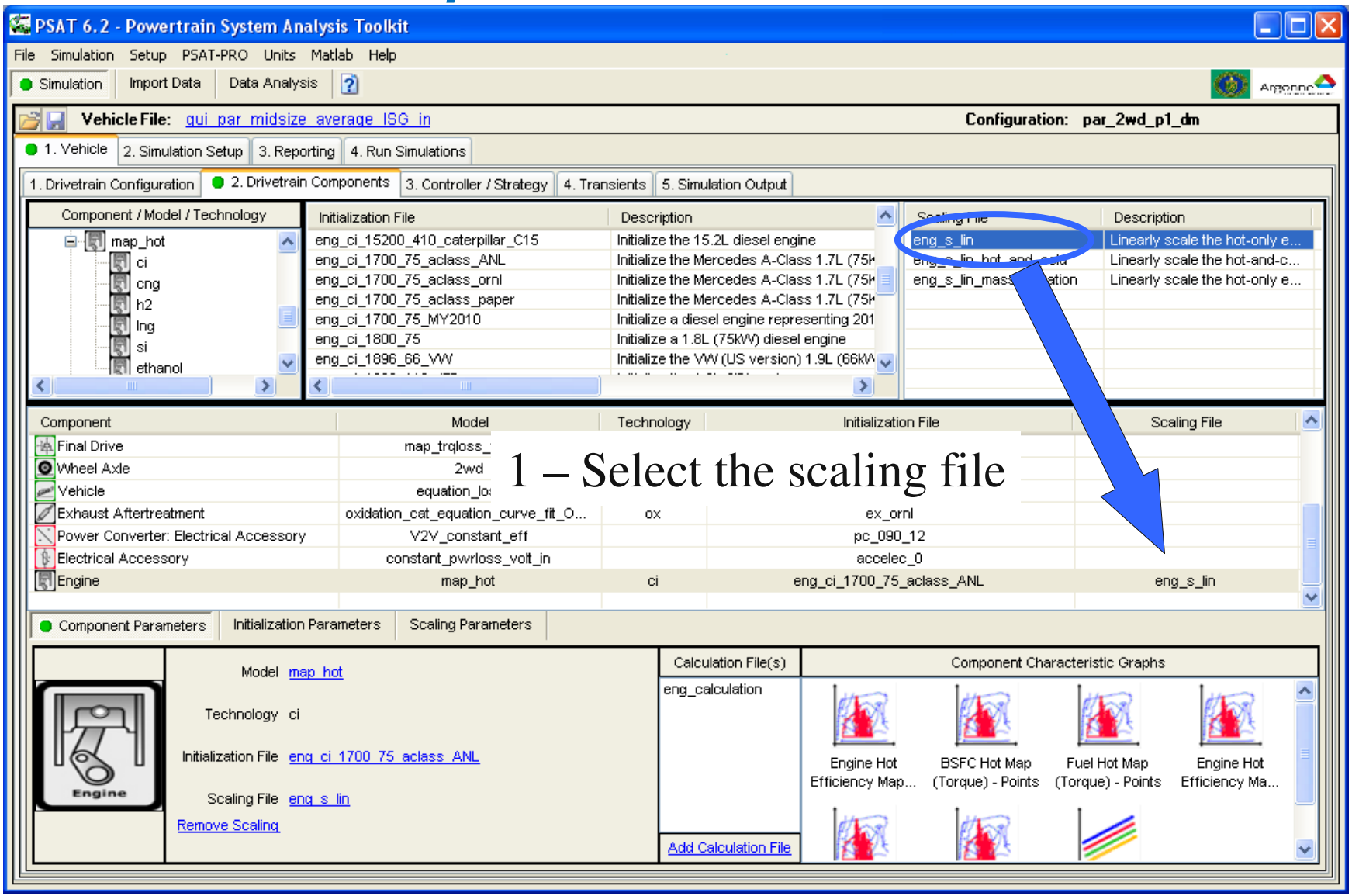
Component	Model	Technology	Initialization File	Scaling File
Motor	map_Pelec_funTW_volt_in	id	mc_id_33_66_Ecostar	mc_s
Gearbox	manual_map_trqloss_funTWratio		gb_4_dm_302_16_1_069	
Final Drive	map_trqloss_funTW		fd_363_cavalier	
Wheel Axle	2wd		wh_0317_P195_65_R15	
Vehicle	equation_losses		veh_800_18_038_cavalier	
Exhaust Aftertreatment	3way_cat_map		ex_3c	
Power Converter: Electrical Accessory	V2V_constant_eff		pc_090_12	
Electrical Accessory	constant_pwrloss_volt_in		accelec_0	

Component Parameters | Initialization Parameters | Scaling Parameters

Parameter Name	Default	Value 1	Value 2	Value 3	Value 4	Unit	Description
wh.init.number_wheels	4						Total number of the wheels (Range: [0,Inf])
wh.init.mass_per_wheel	30					kg	Mass per wheel (Range: [0,Inf])
wh.init.trq_brake_max	2000					Nm	Maximum braking torque of the vehicle (Range: [0,Inf])
wh.init.inertia_per_wheel	1					kg.m^2	Inertia per wheel (Range: [0,Inf])
wh.init.radius	0.30115	0.25	m			m	Wheel radius (Range: [0,Inf])
wh.init.coeff_roll1	0.008						0'th order coefficient of the rolling resistance polynomial (Range: [0,Inf])
wh.init.coeff_roll2	0.00012						First-order coefficient of the rolling resistance polynomial (Range: [0,Inf])

Multiple Values / Parametric Study Type: Individual Parameters All Combinations

Scale The Components



Scale The Components

PSAT 6.2 - Powertrain System Analysis Toolkit

File Simulation Setup PSAT-PRO Units Matlab Help

Simulation | Import Data | Data Analysis

Vehicle File: gui_par_midsize_average_ISG_in Configuration: par_2wd_p1_dm

1. Vehicle | 2. Simulation Setup | 3. Reporting | 4. Run Simulations

1. Drivetrain Configuration | 2. Drivetrain Components | 3. Controller / Strategy | 4. Transients | 5. Simulation Output

Component / Model / Technology

- map_hot
  - ci
  - cng
  - h2
  - lng
  - si
  - ethanol

Initialization File	Description
eng_ci_15200_410_caterpillar_C15	Initialize the 15.2L diesel engine
eng_ci_1700_75_aclass_ANL	Initialize the Mercedes A-Class 1.7L (75k
eng_ci_1700_75_aclass_ornl	Initialize the Mercedes A-Class 1.7L (75k
eng_ci_1700_75_aclass_paper	Initialize the Mercedes A-Class 1.7L (75k
eng_ci_1700_75_MY2010	Initialize a diesel engine representing 201
eng_ci_1800_75	Initialize a 1.8L (75kW) diesel engine
eng_ci_1896_66_VW	Initialize the VW (US version) 1.9L (66kW

Scaling File	Description
eng_s_lin	Linearly scale the hot-only e...
eng_s_lin_hot_and_cold	Linearly scale the hot-and-c...
eng_s_lin_mass_equation	Linearly scale the hot-only e...

Component	Model	Technology	Initialization File	Scaling File
Final Drive	map_trqloss_funTW		fd_363_cavalier	
Wheel Axle	2wd		wh_0317_P195_65_R15	
Vehicle	equation_losses		veh_800_18_038_cavalier	
Exhaust Aftertreatment	oxidation_cat_equation_curve_fit_O...	ox	ex_ornl	
Power Converter: Electrical Accessory	V2V_constant_eff		pc_090_12	
Electrical Accessory	constant_pwrloss_volt_in		accelec_0	
Engine	map_hot	ci	eng_ci_1700_75_aclass_ANL	eng_s_lin

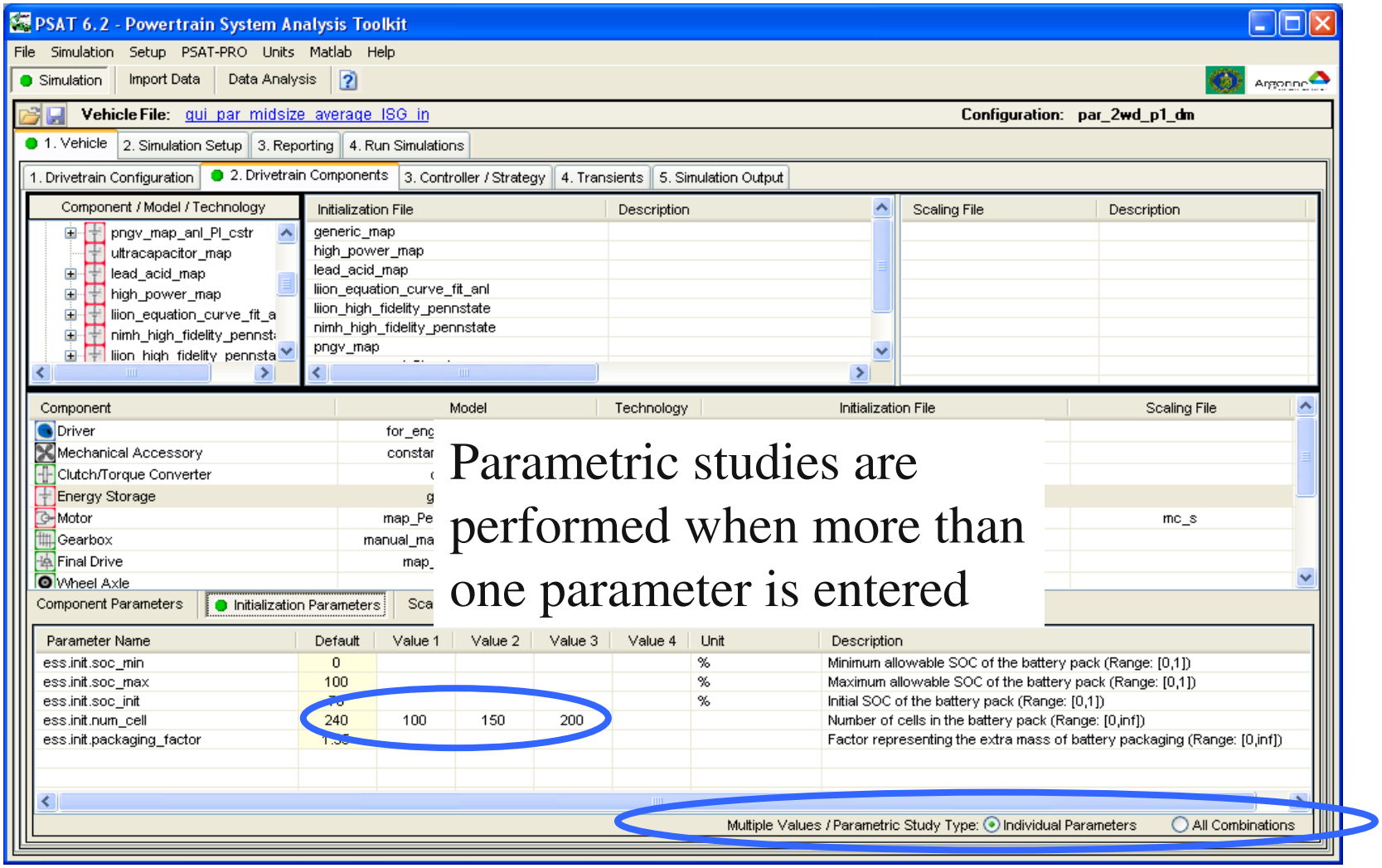
Component Parameters | Initialization Parameters | Scaling Parameters

Parameter Name	Default	Value 1	Value 2	Value 3	Value 4	Unit	Description
eng.scale.pwr_max_des	75.87					kW	Desired maximal power (Range: [0,inf])
eng.scale.eff_max_des	38.7463	42	%			%	Desired maximal efficiency (Range: [0,inf])
eng.scale.specific_power	401.4286					W/kg	Specific power (Range: [0,inf])

2 – Scale the parameters

Multiple Values / Parametric Study Type: Individual Parameters All Combinations

Perform Parametric Study

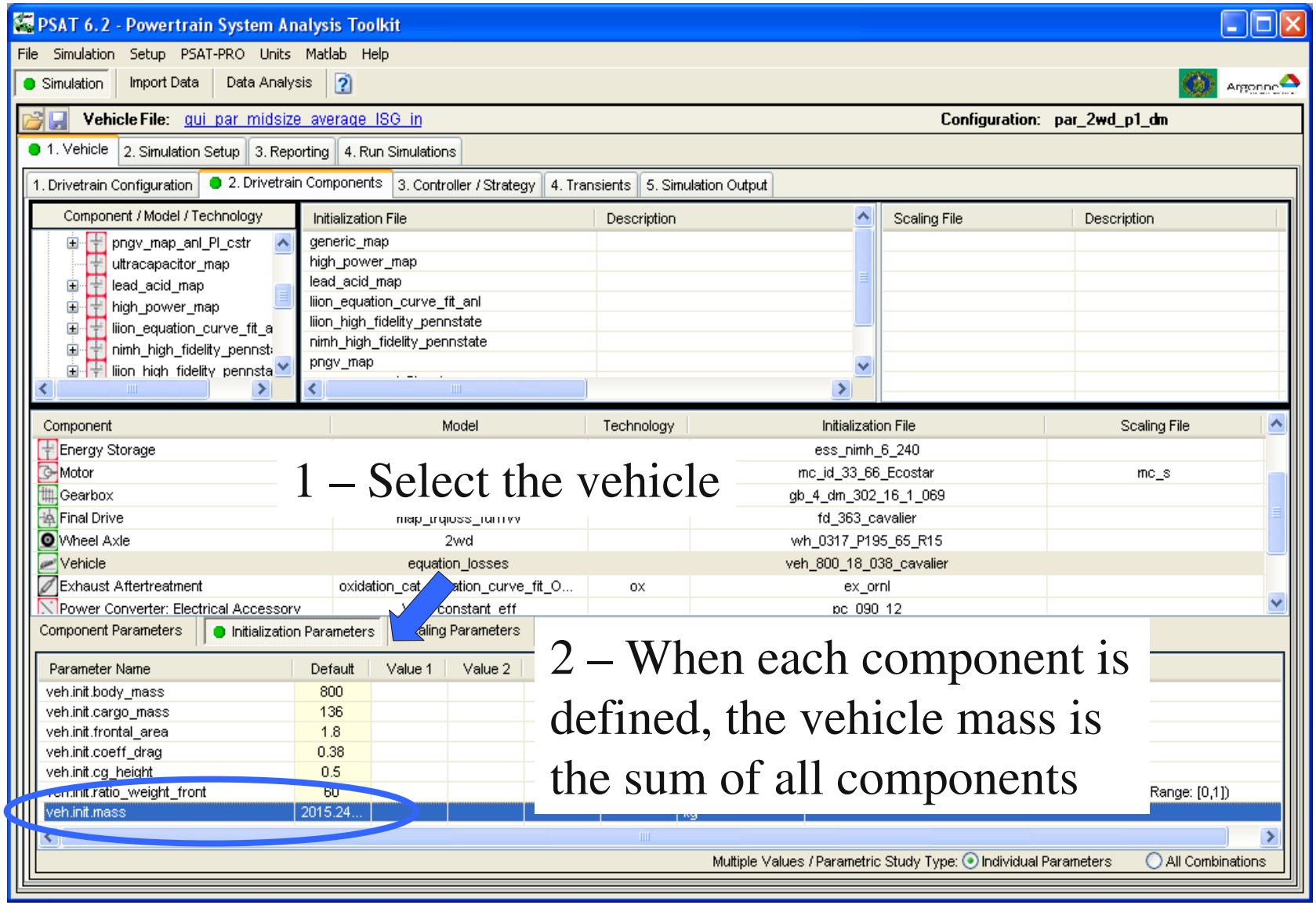


Parametric studies are performed when more than one parameter is entered

Individual parameters => Only one is modified for each simulation

All Combinations => All parameters are modified simultaneously

Define the Vehicle Mass



1 – Select the vehicle

2 – When each component is defined, the vehicle mass is the sum of all components

Select The Control Strategy

PSAT 6.2 - Powertrain System Analysis Toolkit

File Simulation Setup PSAT-PRO Units Matlab Help

Simulation | Import Data | Data Analysis

Vehicle File: | Configuration: par_2wd_p2_au

1. Vehicle | 2. Simulation Setup | 3. Reporting | 4. Run Simulations

1. Drivetrain Configuration | 2. Drivetrain Components | 3. Controller / Strategy | 4. Transients | 5. Simulation Output

Strategy

- Propelling
  - p_stf_par_1mc_conso_p2_eng_eff
  - p_stf_par_1mc_pretx
  - p_stf_par_direct_pwr_1mc_pretx
  - p_stf_par_1mc_pretx_mc_volt_map
- Shifting
  - s_stf_au_accel_gear_speed_thresh
  - s_stf_au_eng_veh_spd_accel_pedal

Strategy File	Description
p_stf_par_1mc_conso_p2_eng_eff	Pre-tranmission parallel vehicle - control strategy based on engine efficiency...

Strategy Type	Model	Initialization File
Propelling	p_stf_par_1mc_conso_p2_eng_eff	p_stf_par_1mc_conso_p2_eng_eff
Shifting	s_stf_au_eng_veh_spd_accel_pedal	tx_stf_shift_n_gen_eng
Braking	b_stf_par_pretx_1mc	b_stf_par_pretx_1mc

1 – Select each part of the control

a – Propelling (when vehicle accel)

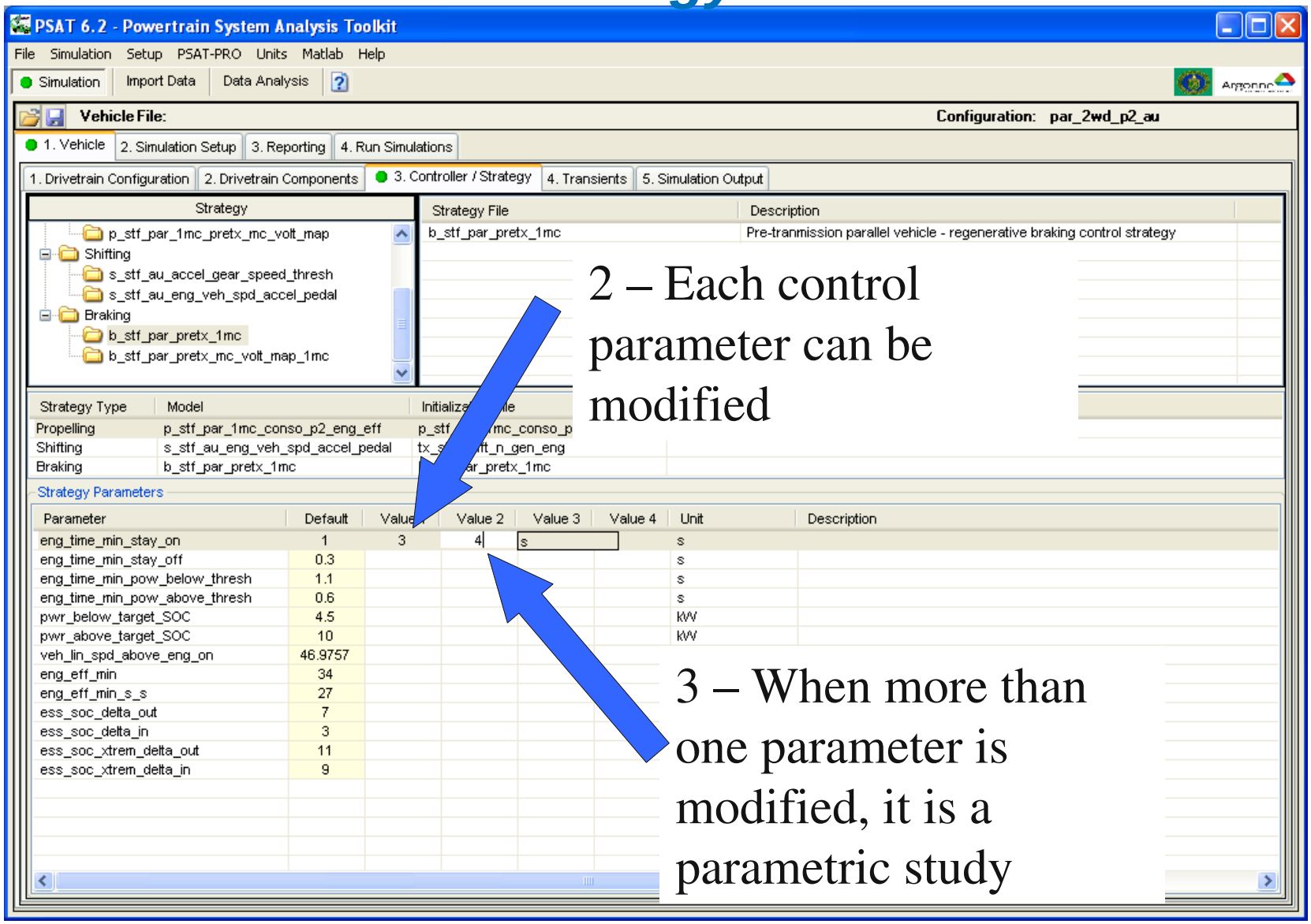
b – Regen (when vehicle decel)

c - Shifting

Strategy Parameters

Parameter	Default	Value 1	Value 2	Value 3	Value 4	Unit	Description
eng_soc_ess_above_turn_off	90					%	SOC above which the engine is turned OFF (Range: [0,1])
eng_soc_ess_below_turn_on	80					%	SOC below which the engine is turned ON (Range: [0,1])
mc_spd_below_charging_forbidden	30					rad/s	Below this motor speed regenerative braking is disabled (Range: [0,inf])
mc_percent_regen_zero_decel	100					%	Percentage of maximum motor torque that is used to decelerate the vehicle. Tl
mc_percent_regen_interm_decel	100					%	Percentage of maximum motor torque that is used to decelerate the vehicle. Tl
mc_percent_regen_max_decel	0					%	Percentage of maximum motor torque that is used to decelerate the vehicle. Tl
veh_spd_below_charging_forbidden	2.2369					mile/h	Below this vehicle speed regenerative braking is disabled. (Range: [0,1])
veh_decel_regen_interm	1					m/s2	When the requested deceleration of the vehicle (m / s^2) is excessively large
veh_decel_regen_max	2					m/s2	When the requested deceleration of the vehicle (m/s^2) is excessively large.
wh_regen_time_blend	0.5					s	The duration of time to switch from regenerative braking to friction brakes wh

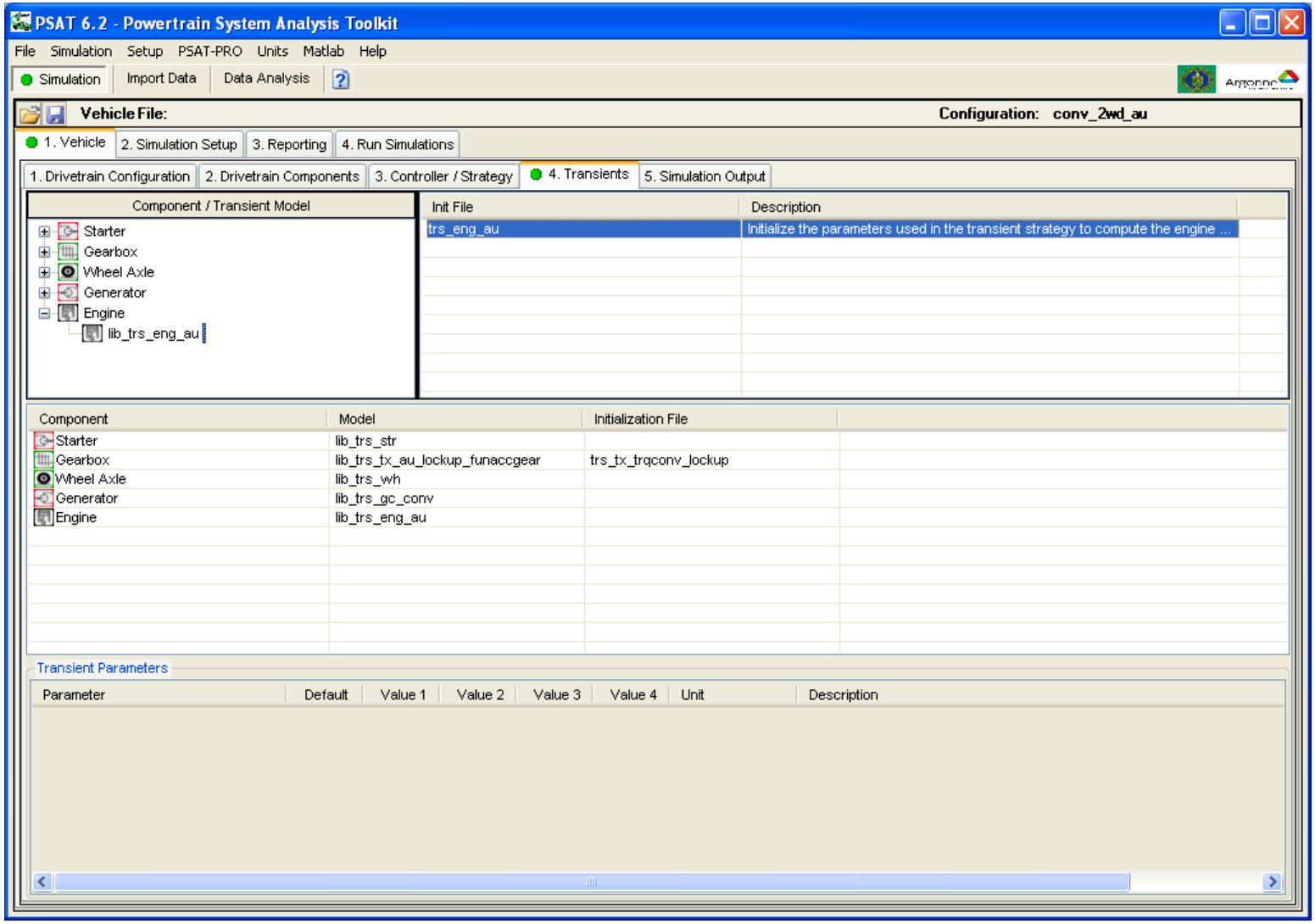
Select The Control Strategy



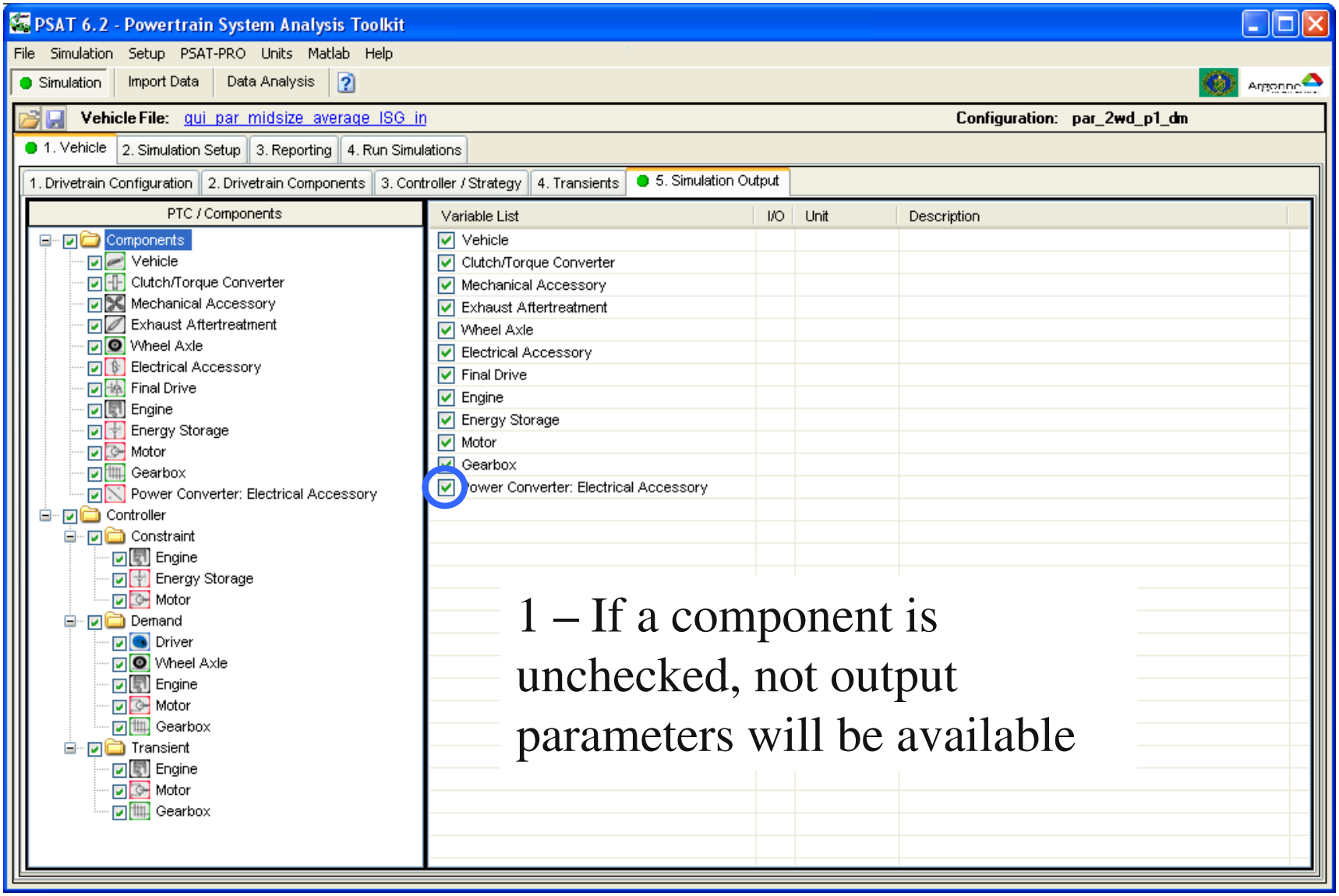
2 – Each control parameter can be modified

3 – When more than one parameter is modified, it is a parametric study

Select The Transient Control Logic

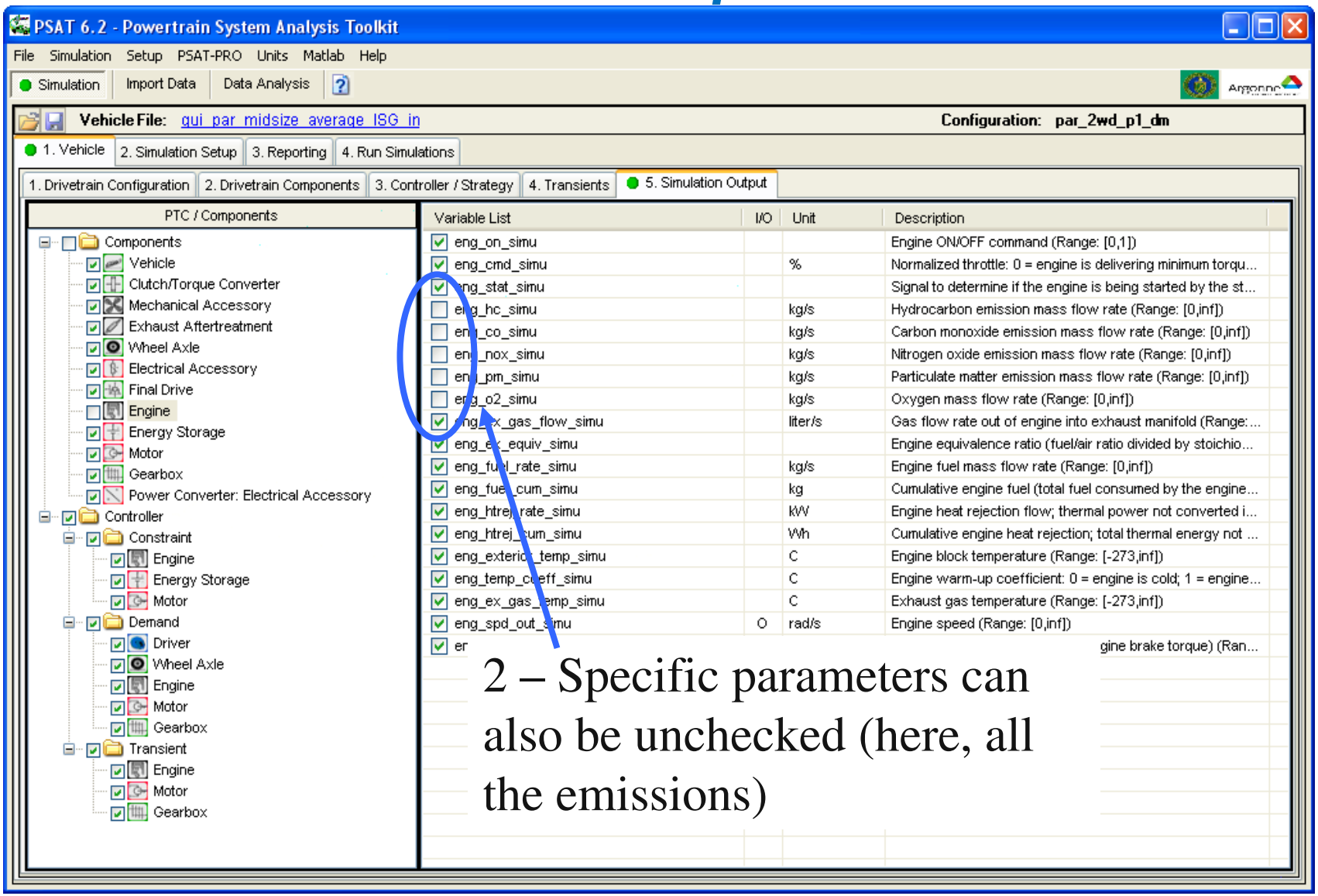


Select The Simulation Outputs



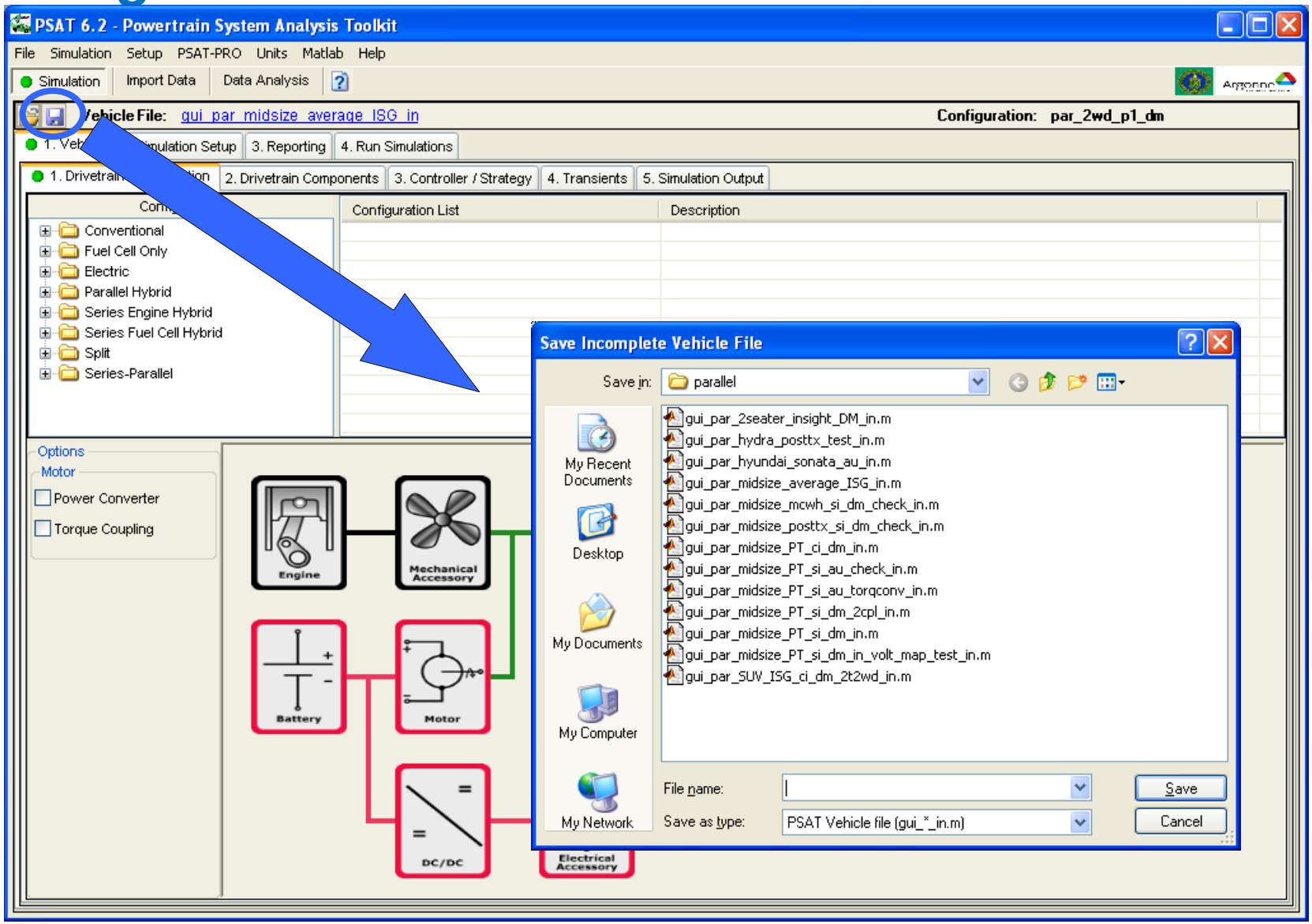
1 – If a component is unchecked, not output parameters will be available

Select The Simulation Outputs

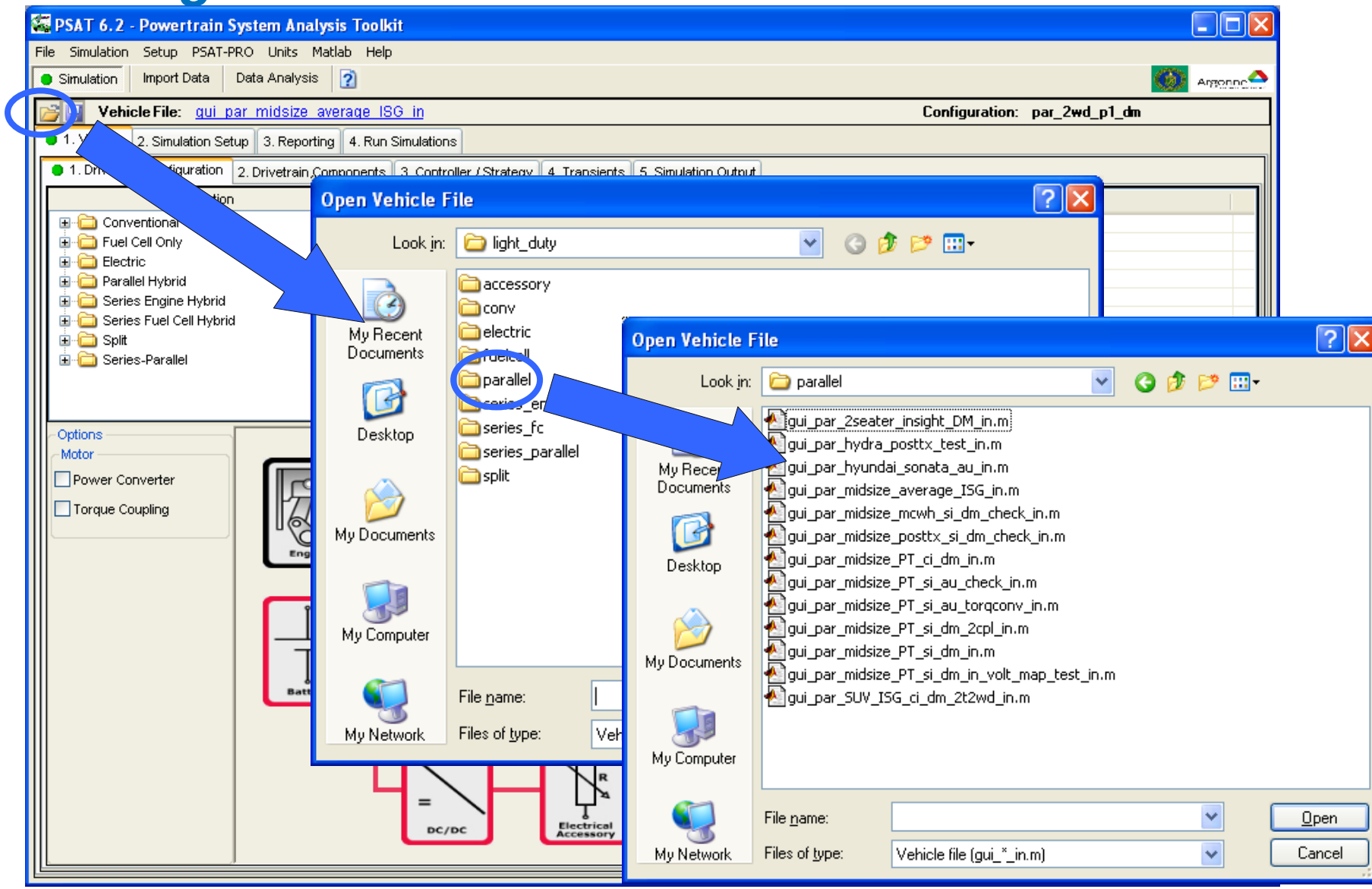


2 – Specific parameters can also be unchecked (here, all the emissions)

Saving a Vehicle



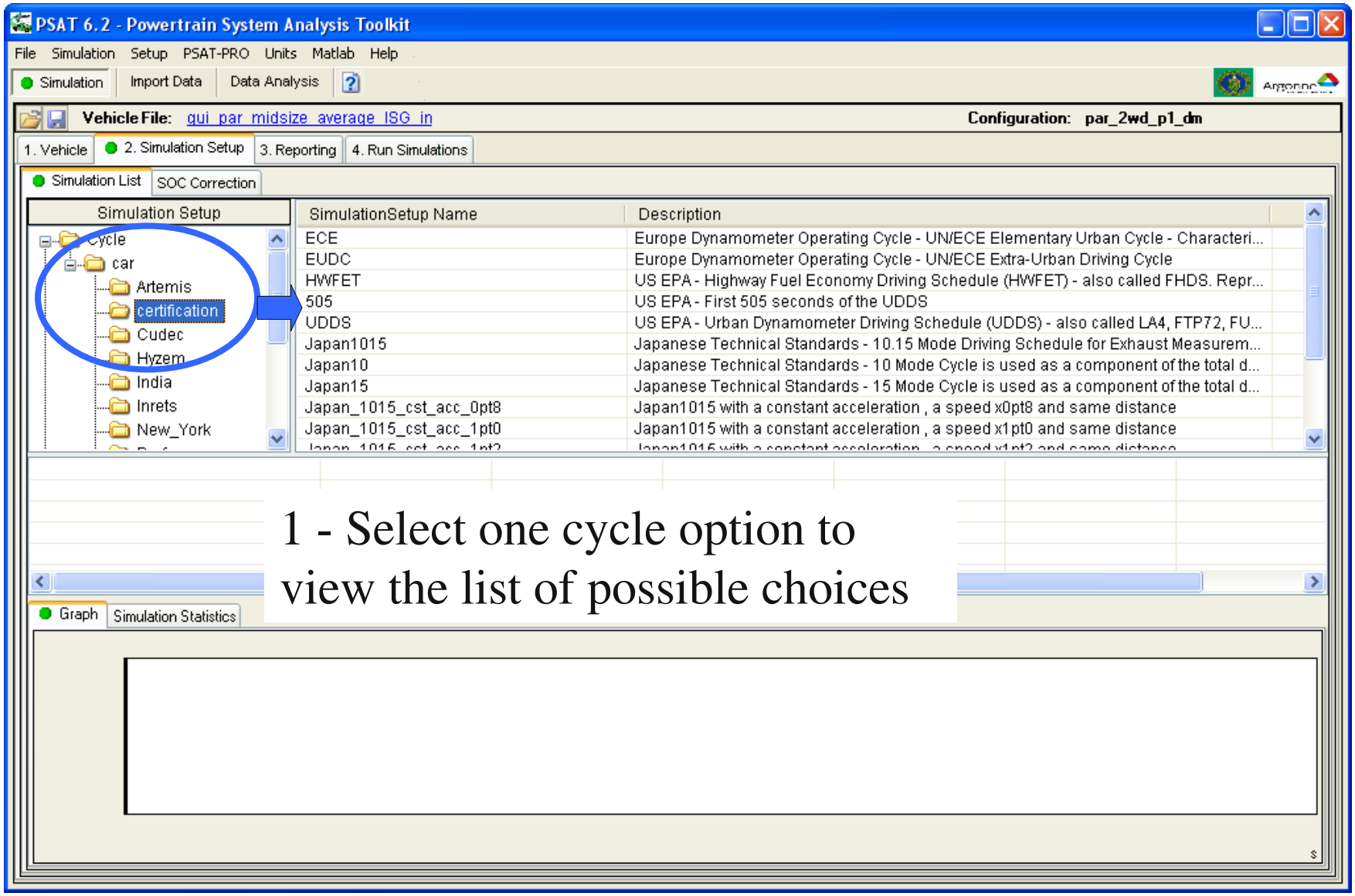
Loading a Vehicle



4 – Select the Type of Simulation

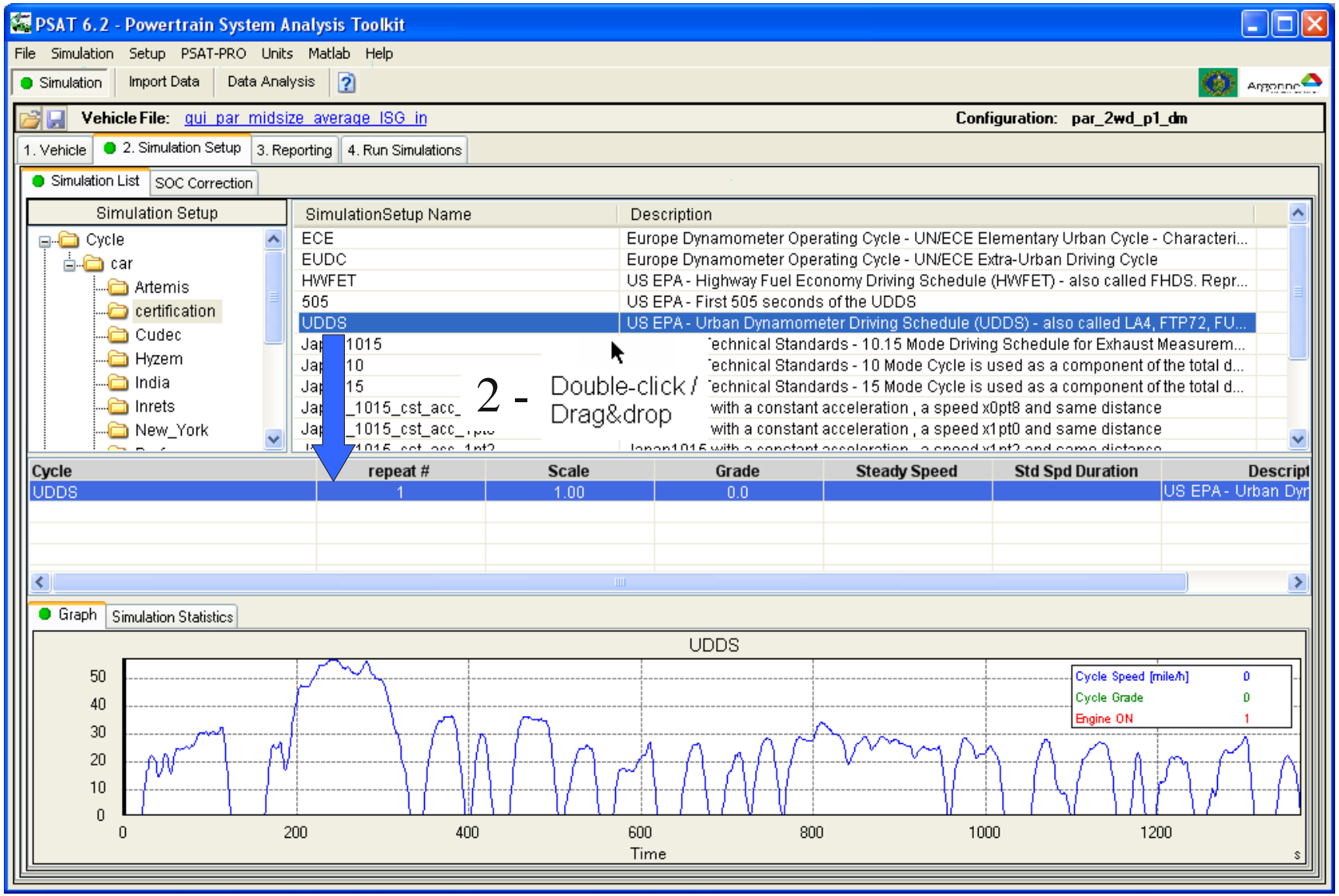
- Select a driving cycle
- Run multi-cycle simulation
- Run procedure
- Run road load match/performance
- SOC correction

Select A Driving Cycle

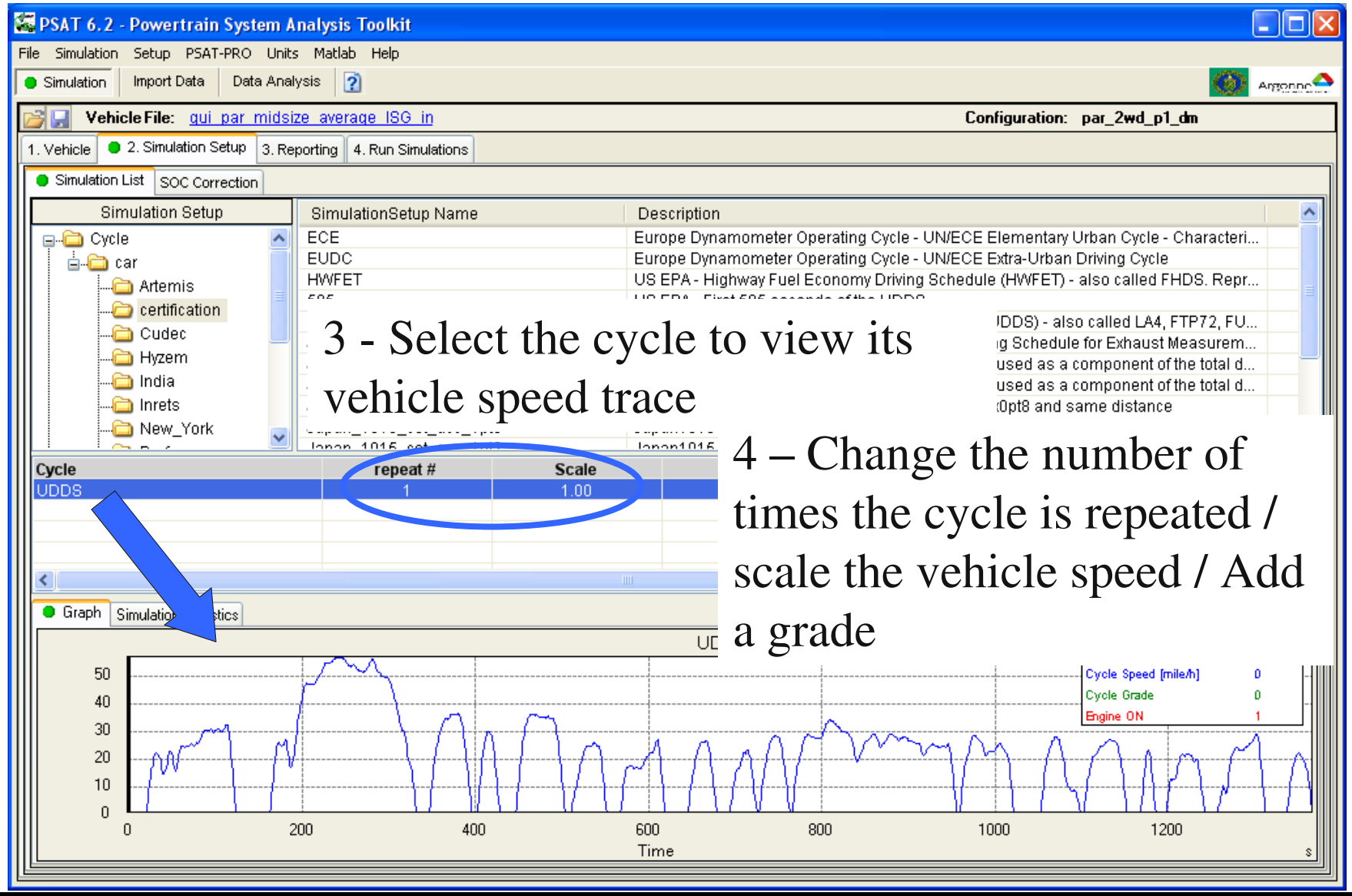


1 - Select one cycle option to view the list of possible choices

Select A Driving Cycle



Select A Driving Cycle



3 - Select the cycle to view its vehicle speed trace

4 – Change the number of times the cycle is repeated / scale the vehicle speed / Add a grade

Select A Driving Cycle

PSAT 6.2 - Powertrain System Analysis Toolkit

File Simulation Setup PSAT-PRO Units Matlab Help

Simulation | Import Data | Data Analysis

Vehicle File: gui_par_midsize_average_ISG_in Configuration: par_2wd_p1_dm

1. Vehicle | 2. Simulation Setup | 3. Reporting | 4. Run Simulations

Simulation List | SOC Correction

Simulation Setup

- Cycle
  - car
    - Artemis
    - certification
    - Cudec
    - Hyzem
    - India
    - Inrets
    - New_York

SimulationSetup Name	Description
ECE	Europe Dynamometer Operating Cycle - UN/ECE Elementary Urban Cycle - Characteri...
EUDC	Europe Dynamometer Operating Cycle - UN/ECE Extra-Urban Driving Cycle
HWFET	US EPA - Highway Fuel Economy Driving Schedule (HWFET) - also called FHDS. Repr...
505	US EPA - First 505 seconds of the UDDS
UDDS	US EPA - Urban Dynamometer Driving Schedule (UDDS) - also called LA4, FTP72, FU...
Japan1015	Japanese Technical Standards - 10.15 Mode Driving Schedule for Exhaust Measurem...
Japan10	Japanese Technical Standards - 10 Mode Cycle is used as a component of the total d...
Japan15	Japanese Technical Standards - 15 Mode Cycle is used as a component of the total d...
Japan_1015_cst_acc_0pt8	
Japan_1015_cst_acc_1pt0	

Cycle	repeat #	Descript
UDDS	1	US EPA - Urban Dyr

5 – View the drive cycle statistics

Graph | Simulation Statistics

Cycle Time 1369 sec | Distance 7.4504 mile

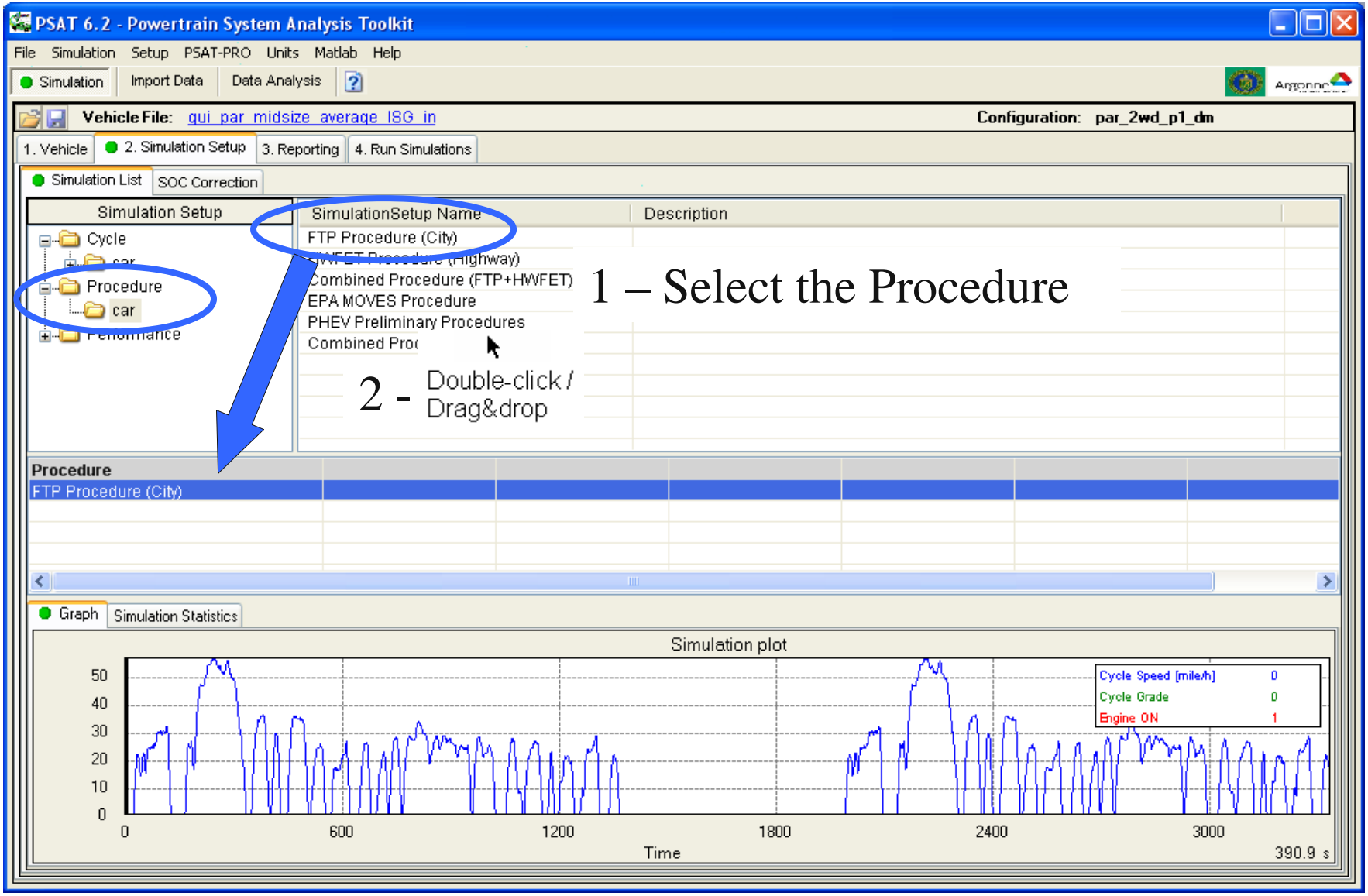
	Maximum	Average	Standard Deviation	Unit
Speed	56.7	19.5777	14.6959	mile/h
Acceleration	1.4752	0.50456	0.45096	m/s
Deceleration	-1.4752	-0.57786	0.51905	m/s

km/h
m/s
mile/h

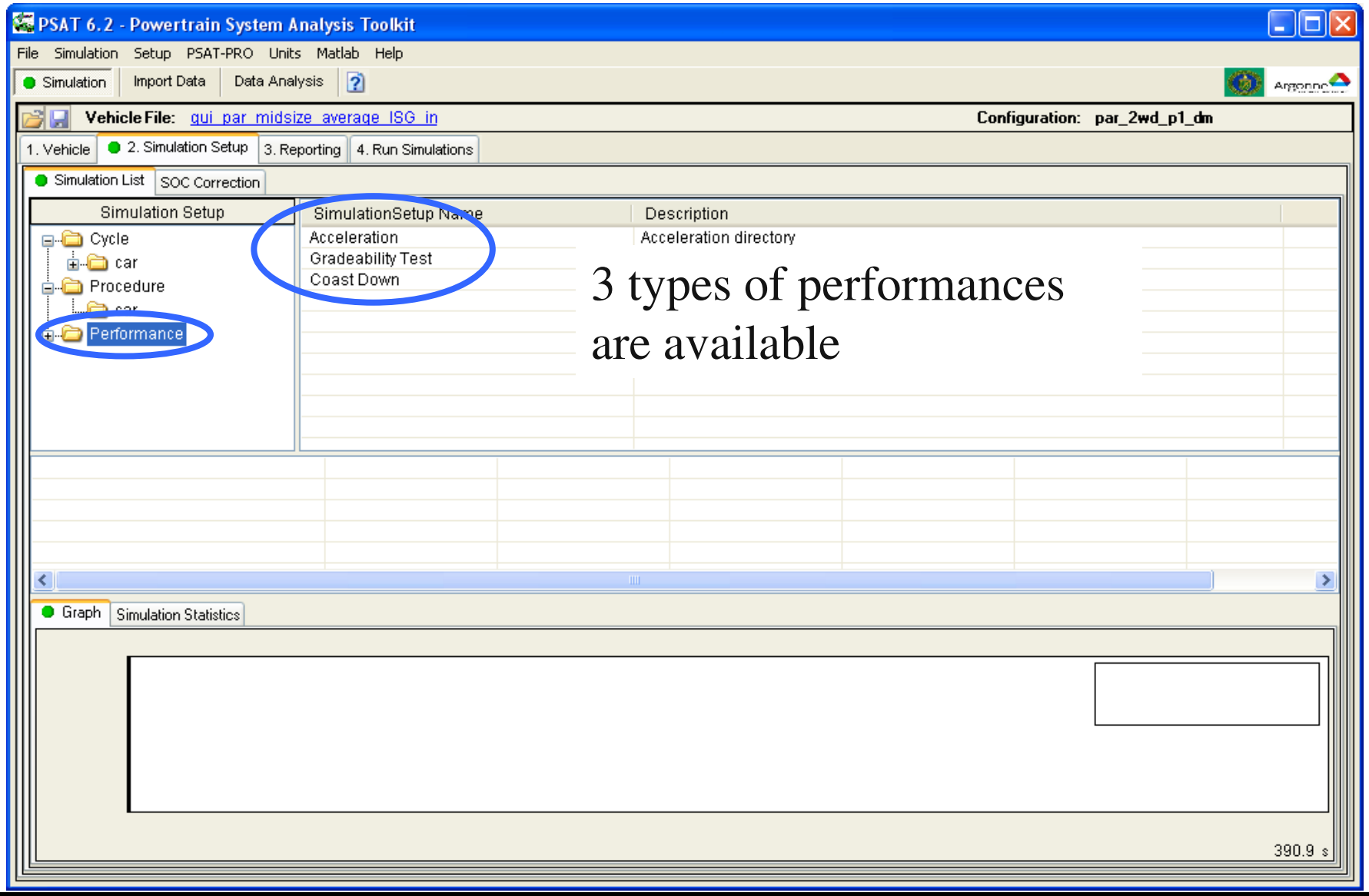
	Number	Frequency	Duration	Percent of Cycle
Stop	17	0.00141782	259	18.918919

Predefined Plots

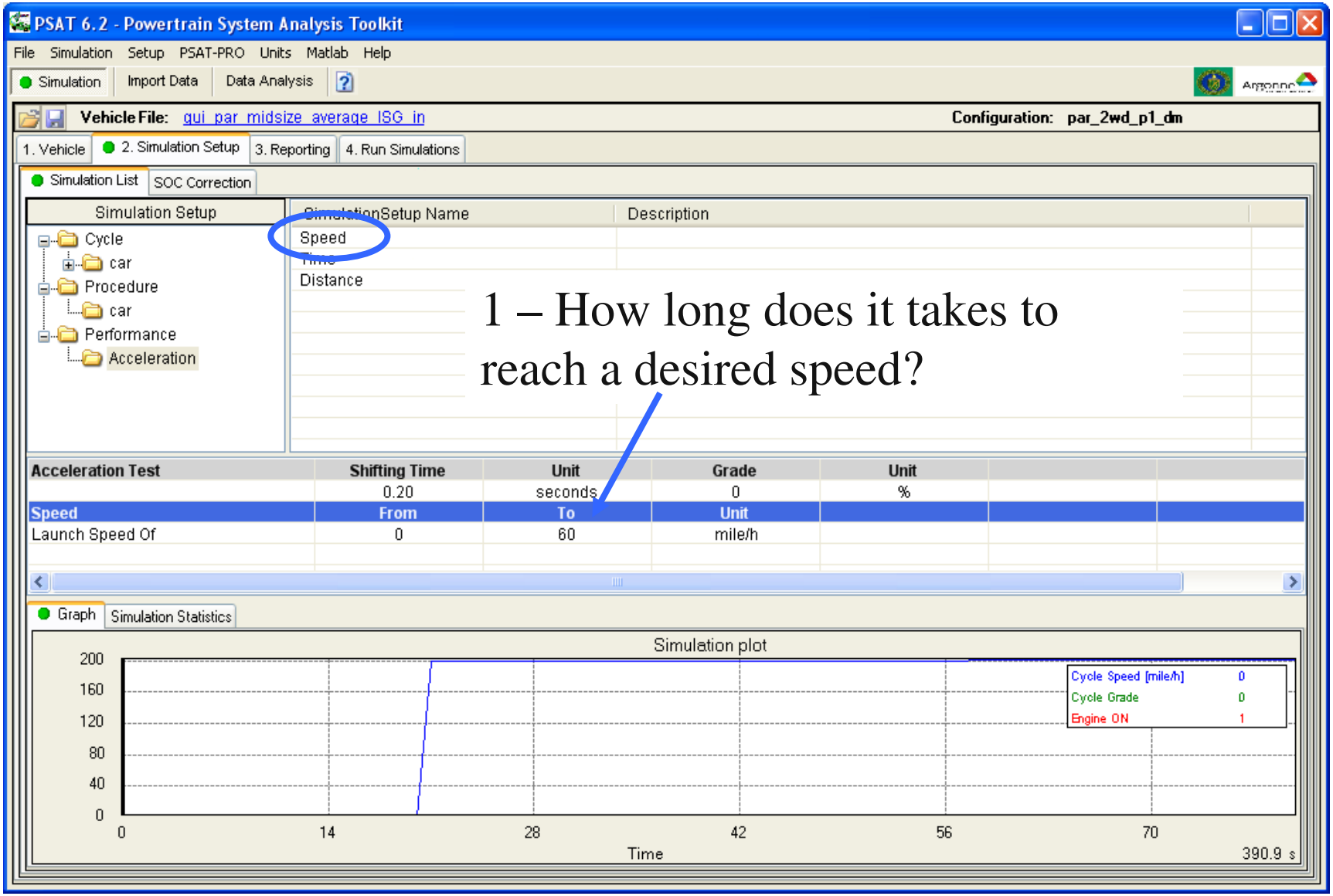
Run Procedure



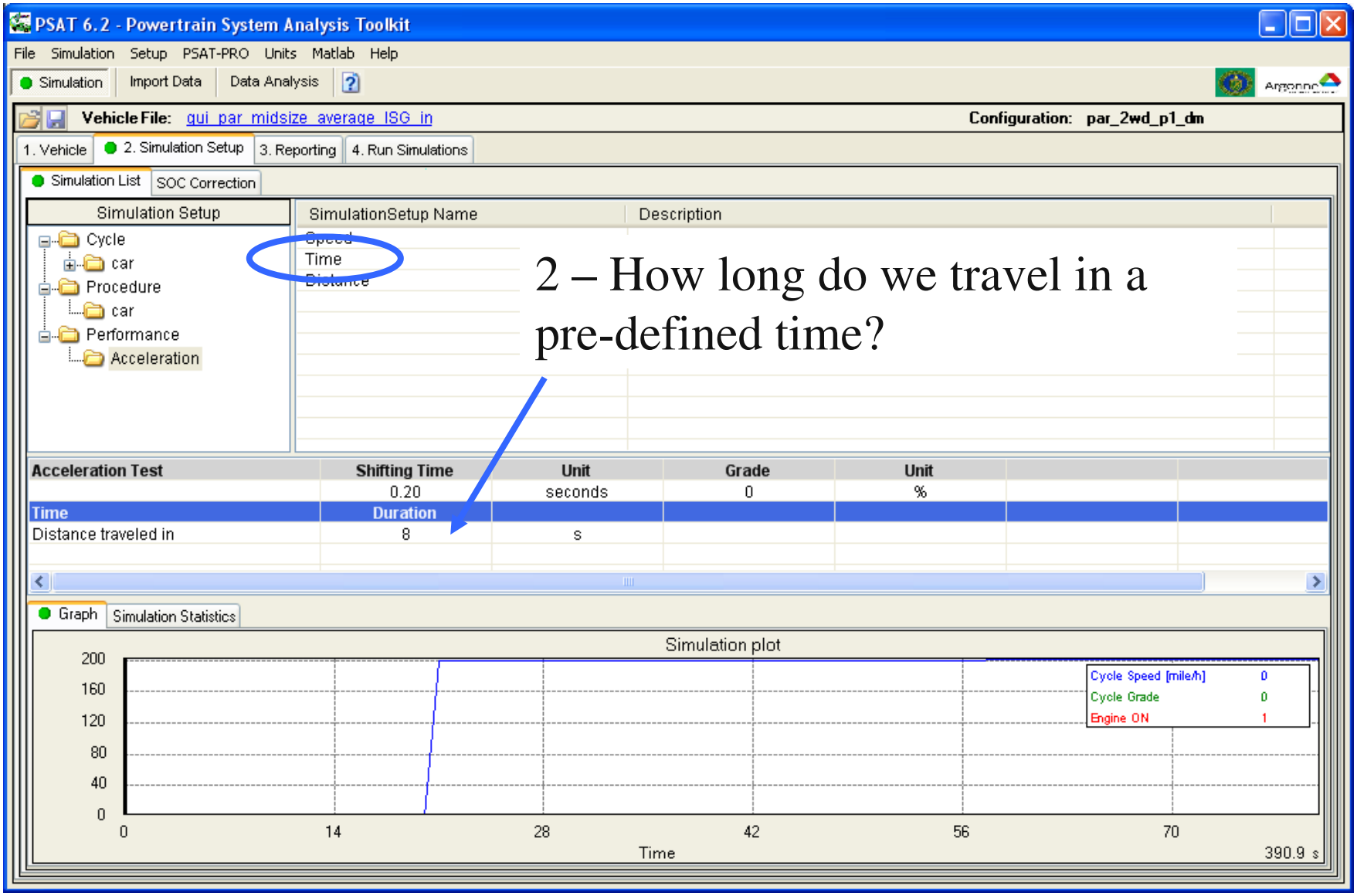
Run Performance



Run Acceleration

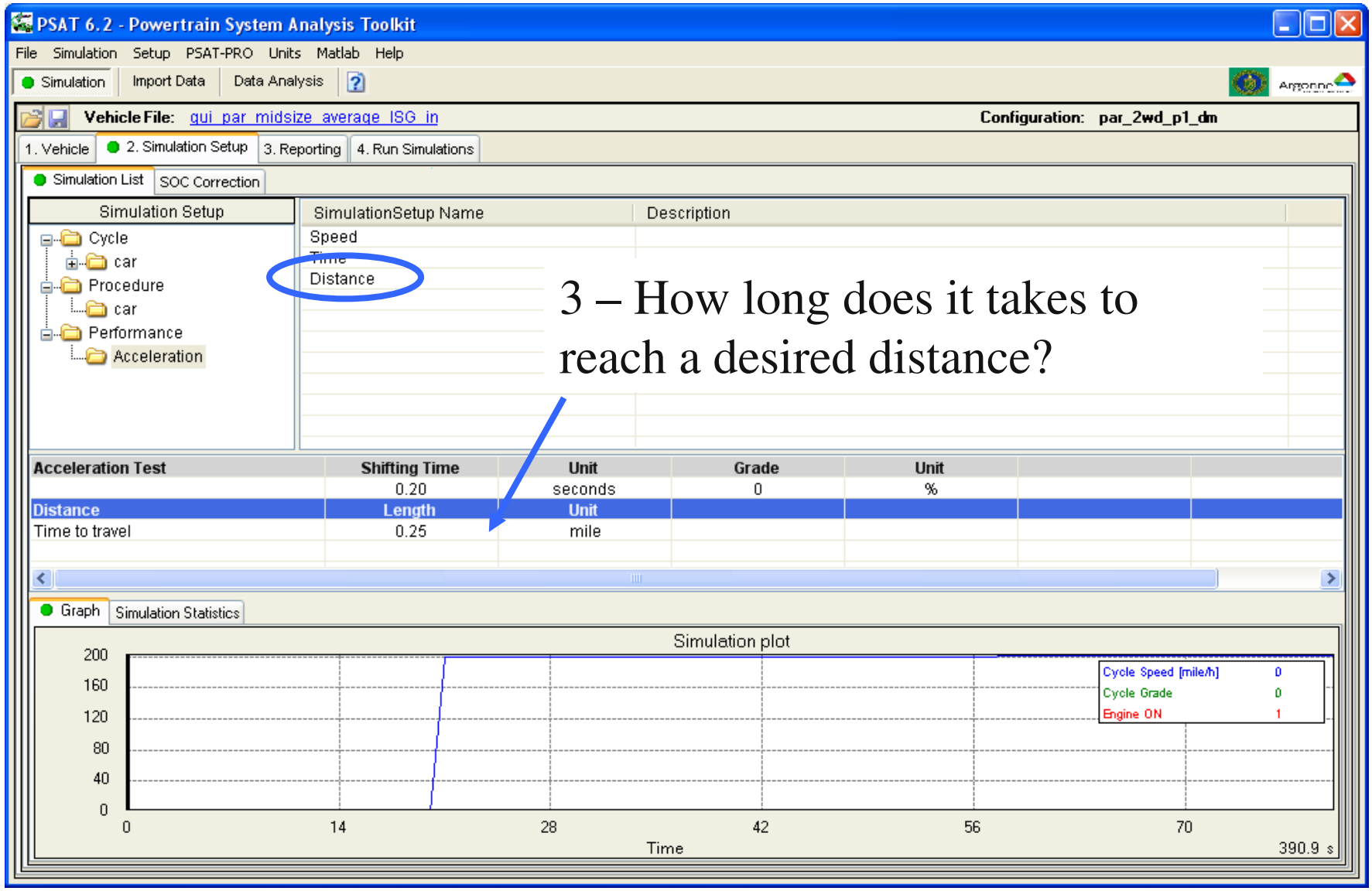


Run Acceleration



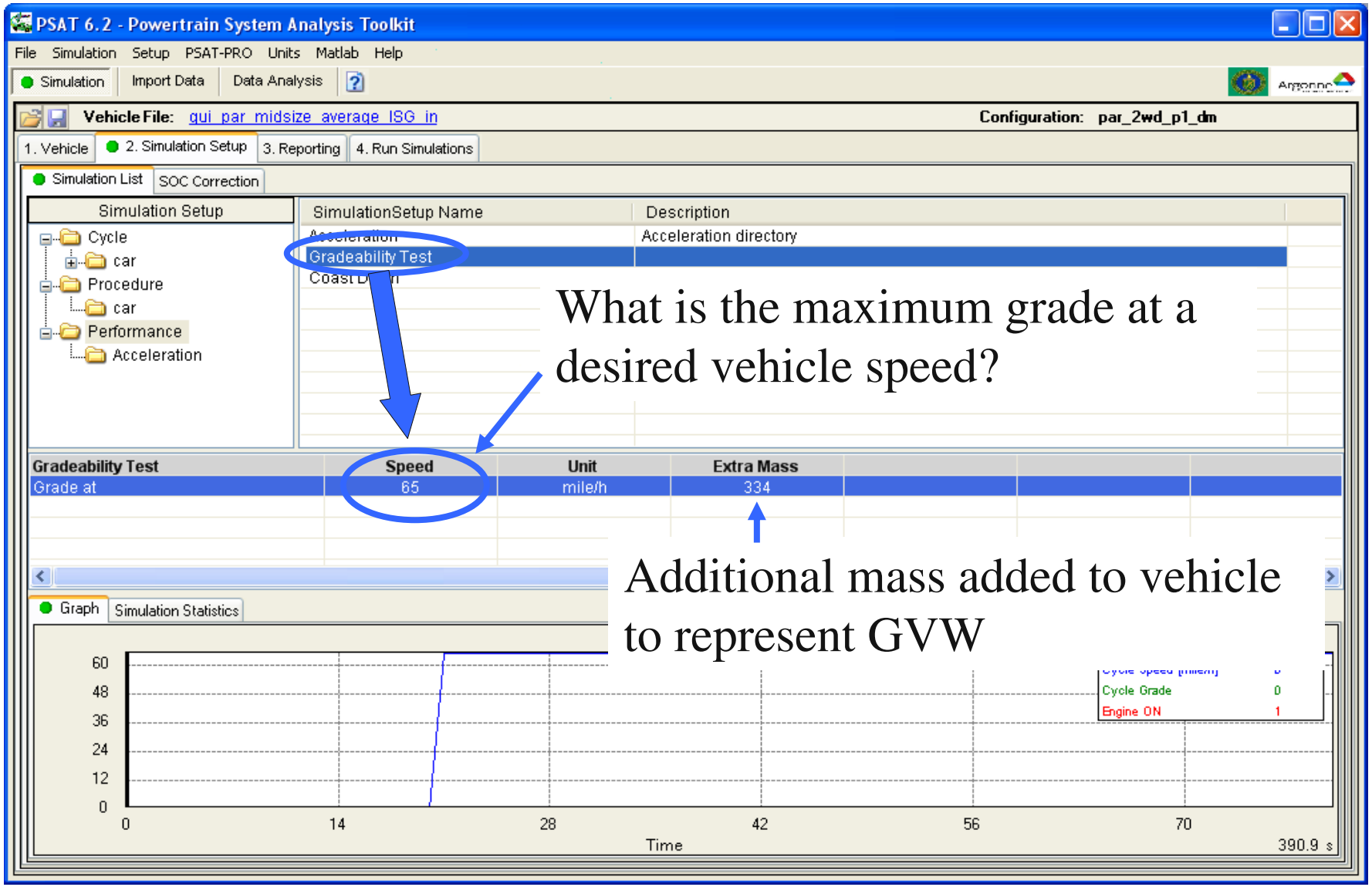
2 – How long do we travel in a pre-defined time?

Run Acceleration



3 – How long does it takes to reach a desired distance?

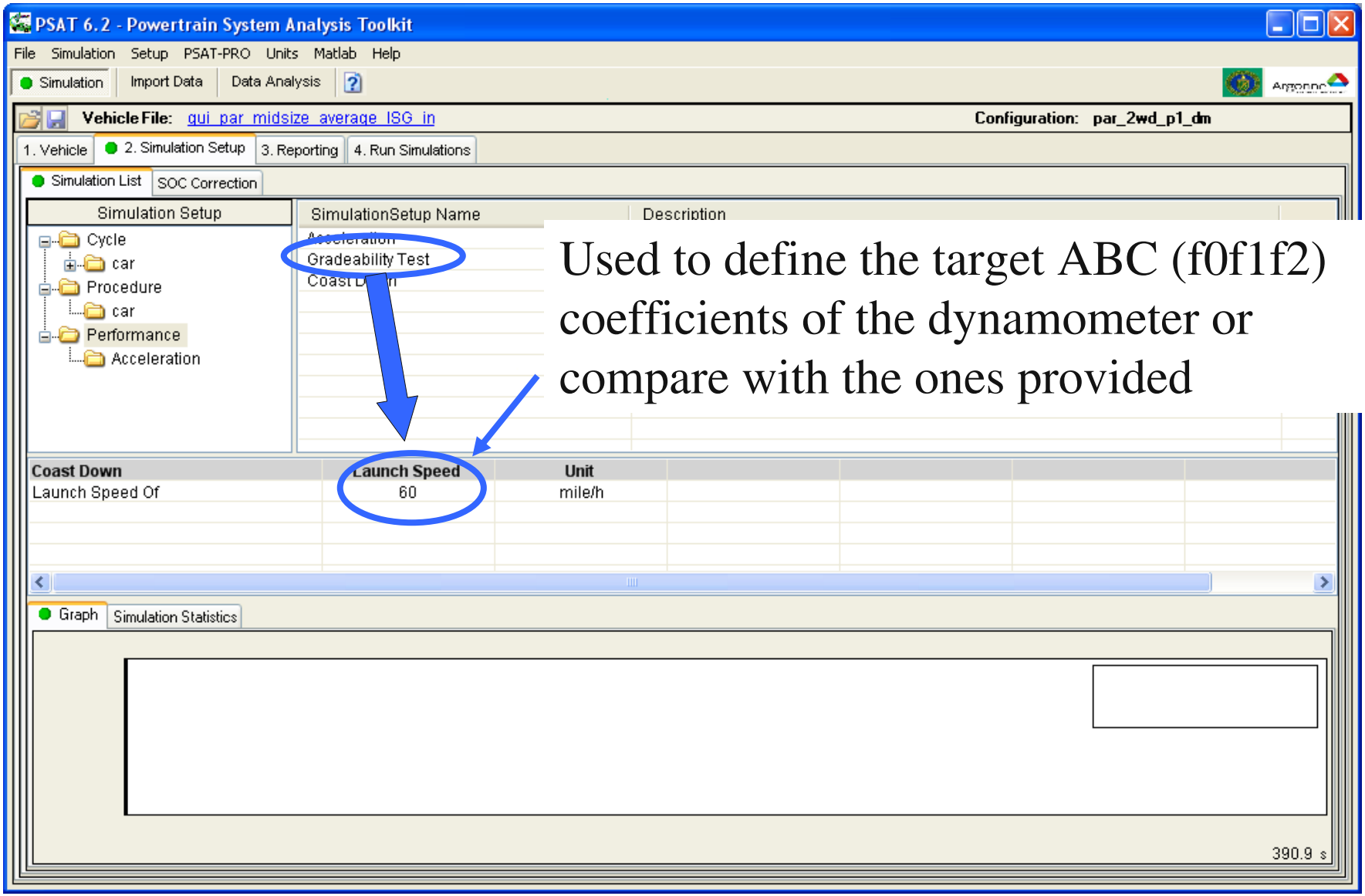
Run Gradeability



What is the maximum grade at a desired vehicle speed?

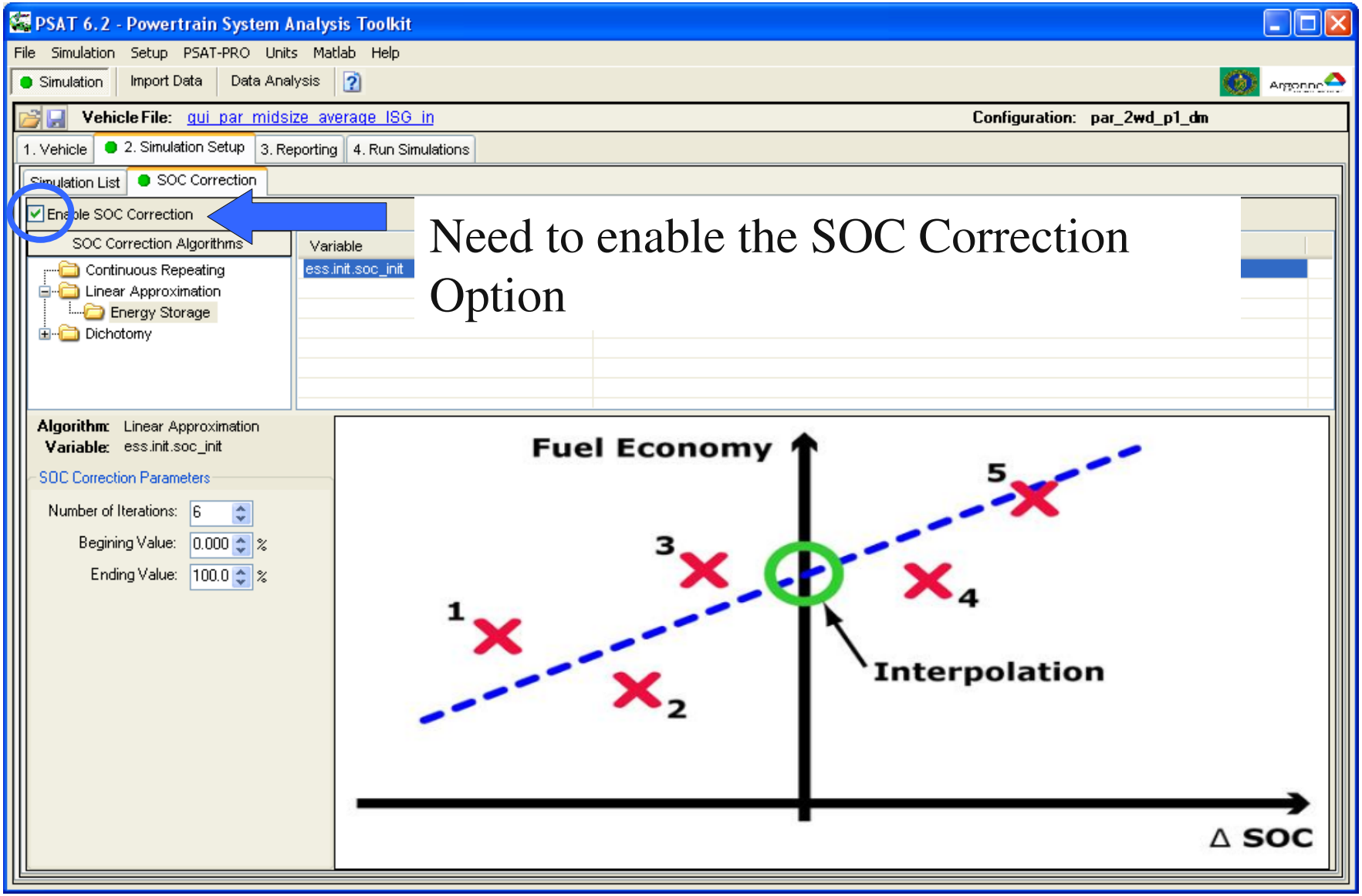
Additional mass added to vehicle to represent GVW

Run Coast-down

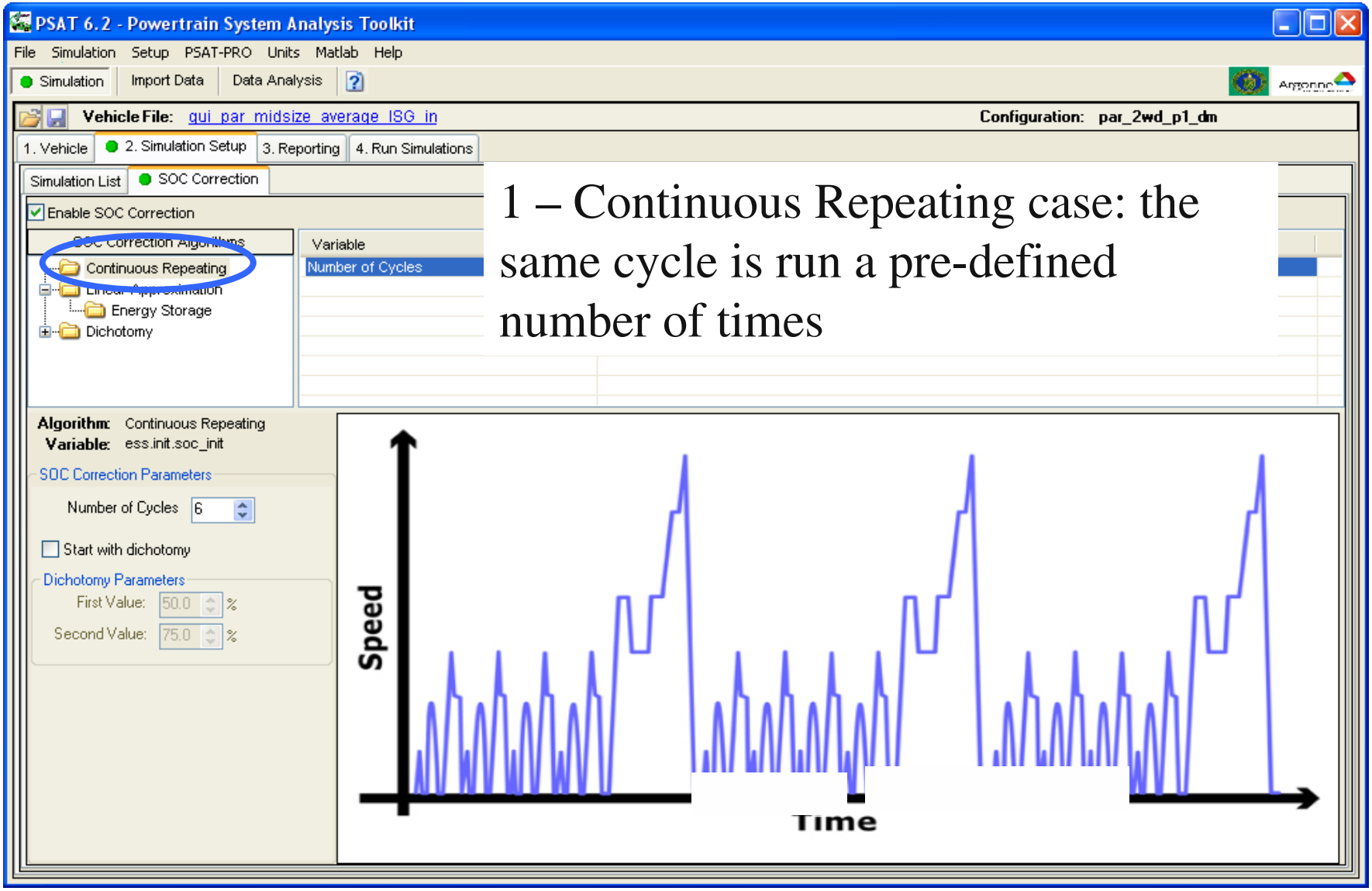


Used to define the target ABC (f0f1f2) coefficients of the dynamometer or compare with the ones provided

Run SOC Correction

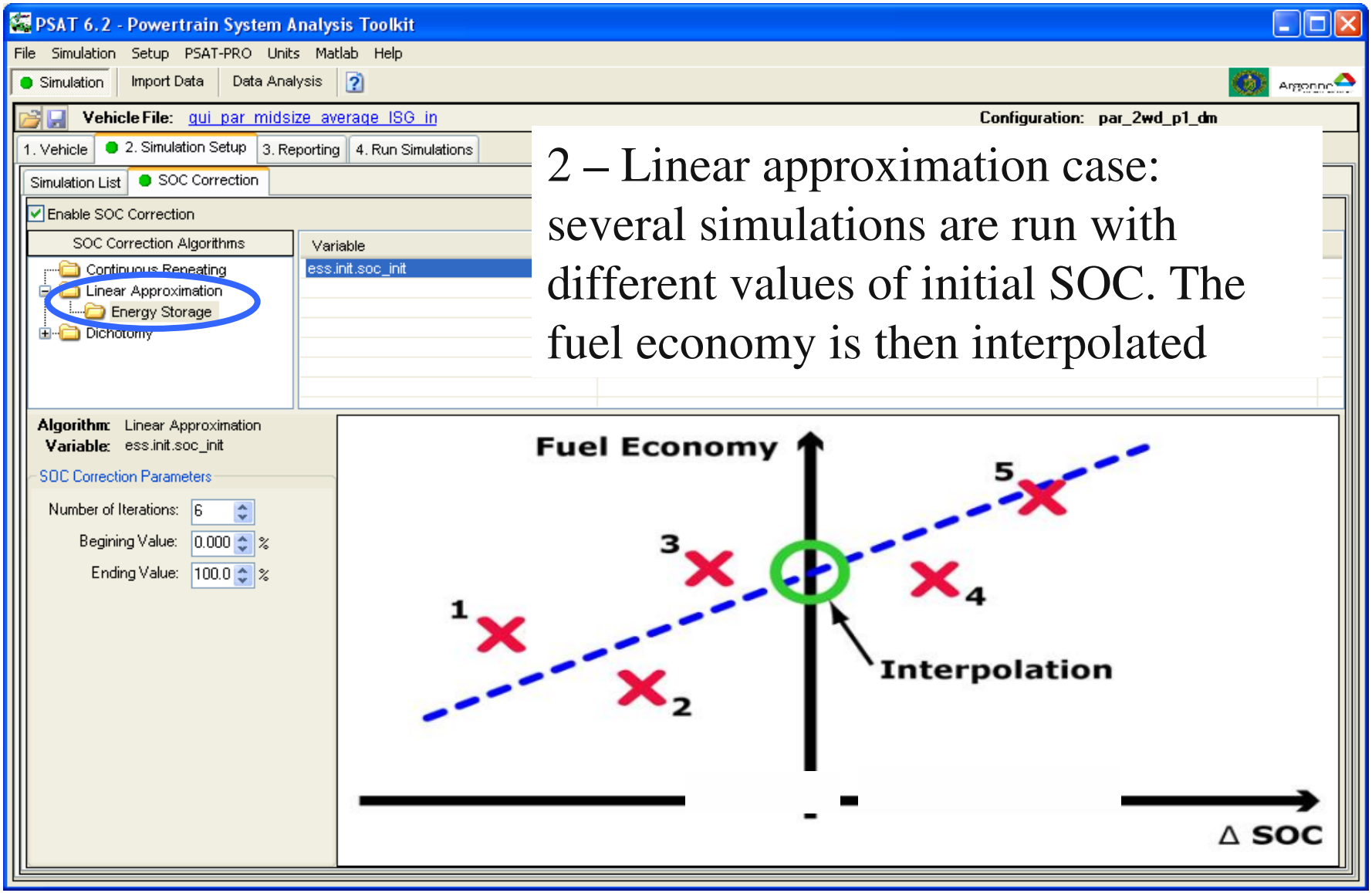


Run SOC Correction



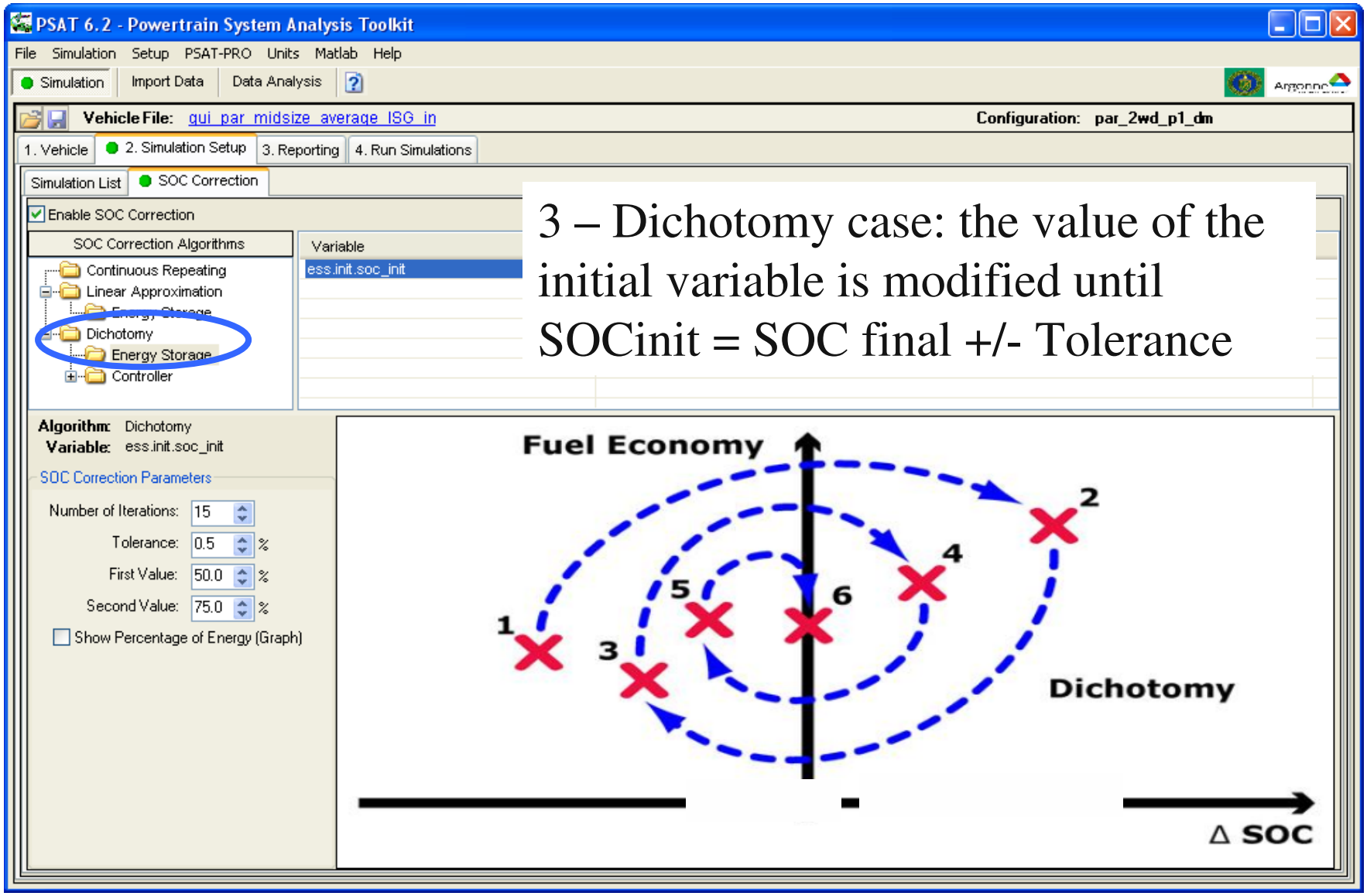
1 – Continuous Repeating case: the same cycle is run a pre-defined number of times

Run SOC Correction



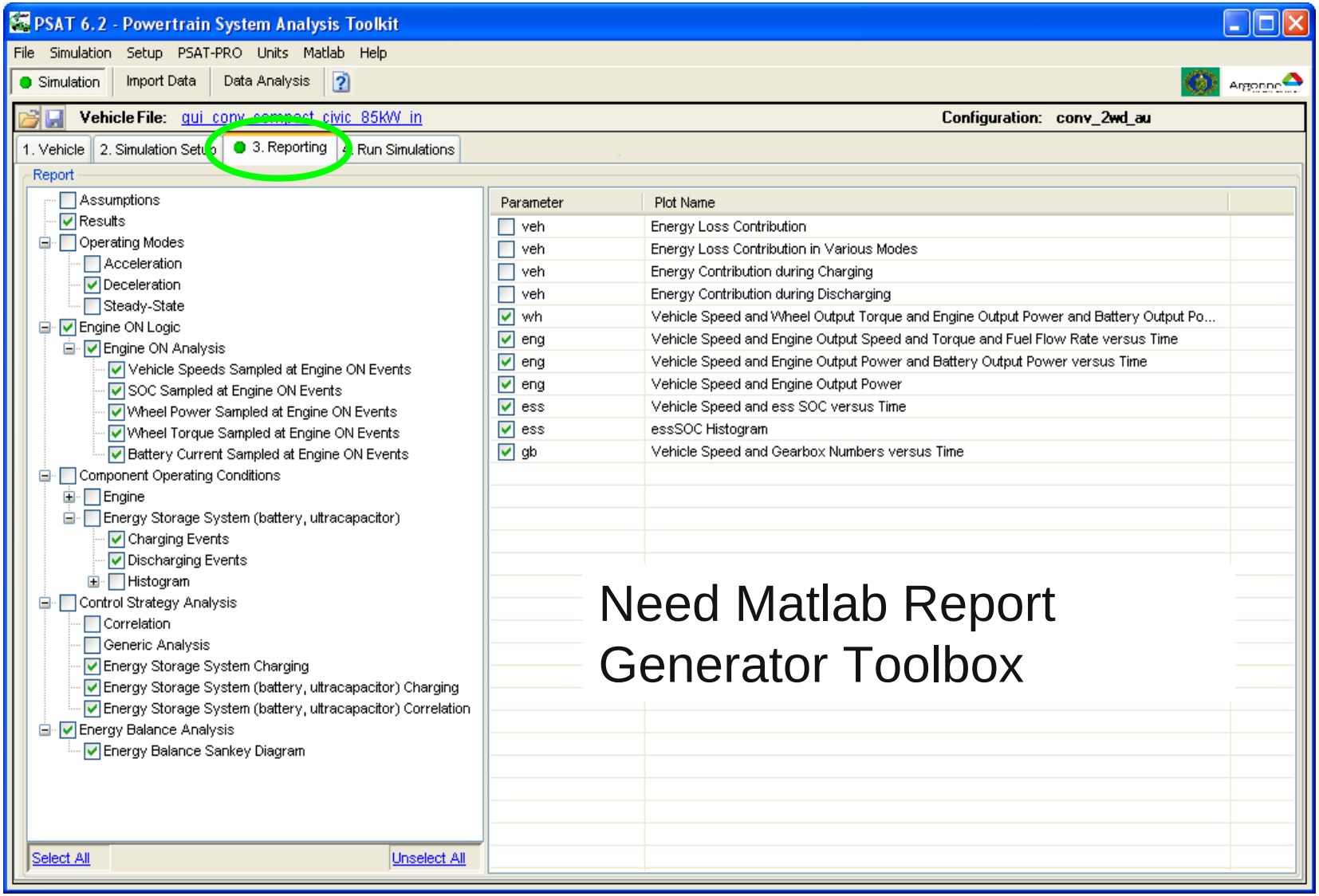
2 – Linear approximation case: several simulations are run with different values of initial SOC. The fuel economy is then interpolated

Run SOC Correction



3 – Dichotomy case: the value of the initial variable is modified until SOCinit = SOC final +/- Tolerance

5 - Generate HTML Report From Simulation



6 – Run the Simulation

- Select the rerun file
- Chose options
- Select the solver

Select the Rerun file

PSAT 6.2 - Powertrain System Analysis Toolkit

File Simulation Setup PSAT-PRO Units Matlab Help

Simulation | Import Data | Data Analysis

Vehicle File: gui_conv_compact_civic_85kW_in Configuration: conv_2wd_au

1. Vehicle | 2. Simulation Setup | 3. Reporting | 4. Run Simulations

Simulation List: Current Simulation, jmk

Simulation File	Description
rerun01	Simulation defined in the Previous Tabs (1.Vehicle & 2.Simulation Setup)

1 - Double-click / Drag&drop

Browse...

#	File Path	File Na...	Configuration	Strategy	Simulation Setup
1		rerun00.m	conv_2wd_au	build: p_conv + b_conv + s_stf_au_eng_veh_sp...	Cycle 1: UDDS

2 – Select the rerun to view the choices details

Run the Simulations...

Structure	Value	Unit	Description
a.b vehicle			
a..z name	gui_conv_compact_civic_85kW_in		
a..z type	Light		
a.b building			
a..z name	conv_2wd_au		
a..z pos2			Position of the second motor for parallel configurations
a..z pos1			Position of the motor for parallel and type of transmission of r s...
a..z trans	au		Type of transmission (manual, automatic, continously variable,...
a..z axle	2 wheel drive		Type of axle (two-wheel-drive, four-wheel-drive, all-wheel-drive)
a..z pwt	Conventional		Powertrain family
a.b drivetrain			

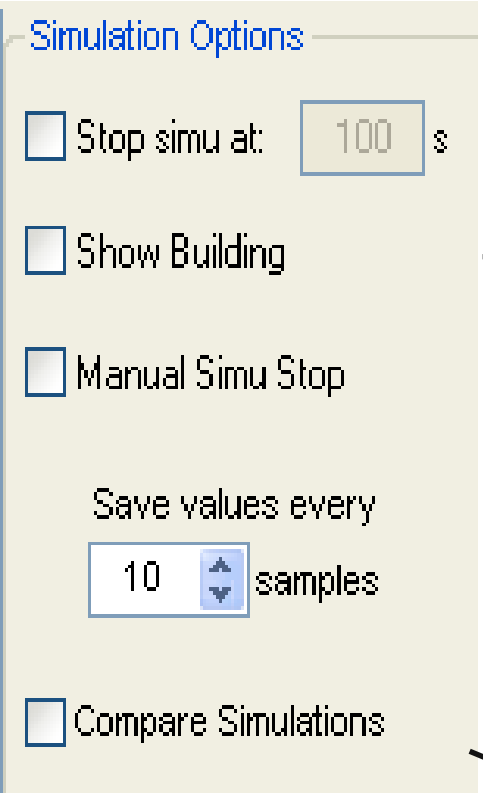
Simulation Options

- Stop simu at: 100 s
- Show Building
- Manual Simu Stop

Save values every 10 samples

- Compare Simulations

Chose Simulation Options



Used to stop the simulation after X seconds

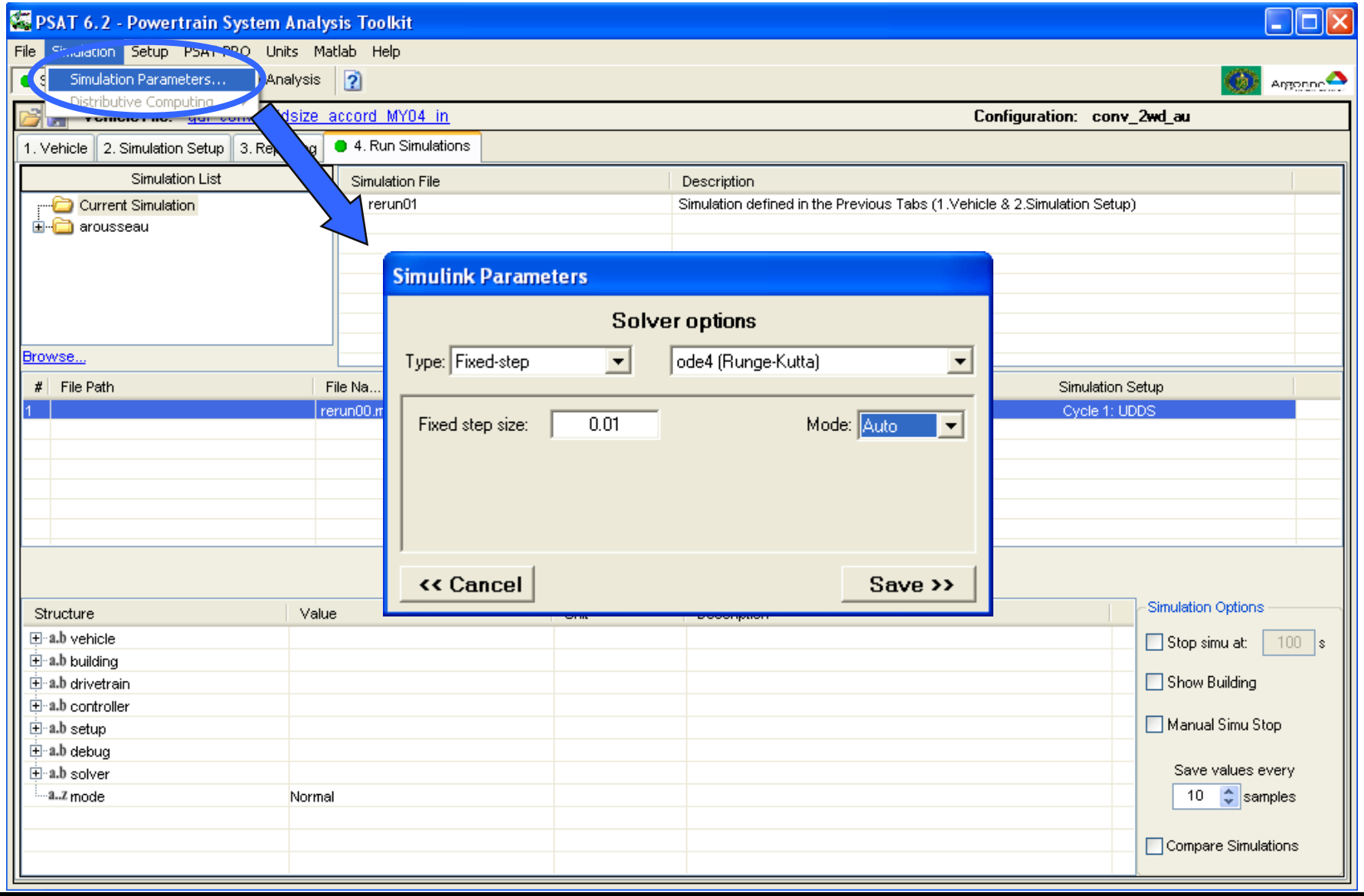
Used to show the powertrain building

Used to stop after the vehicle is built. The simulation will then have to be started manually

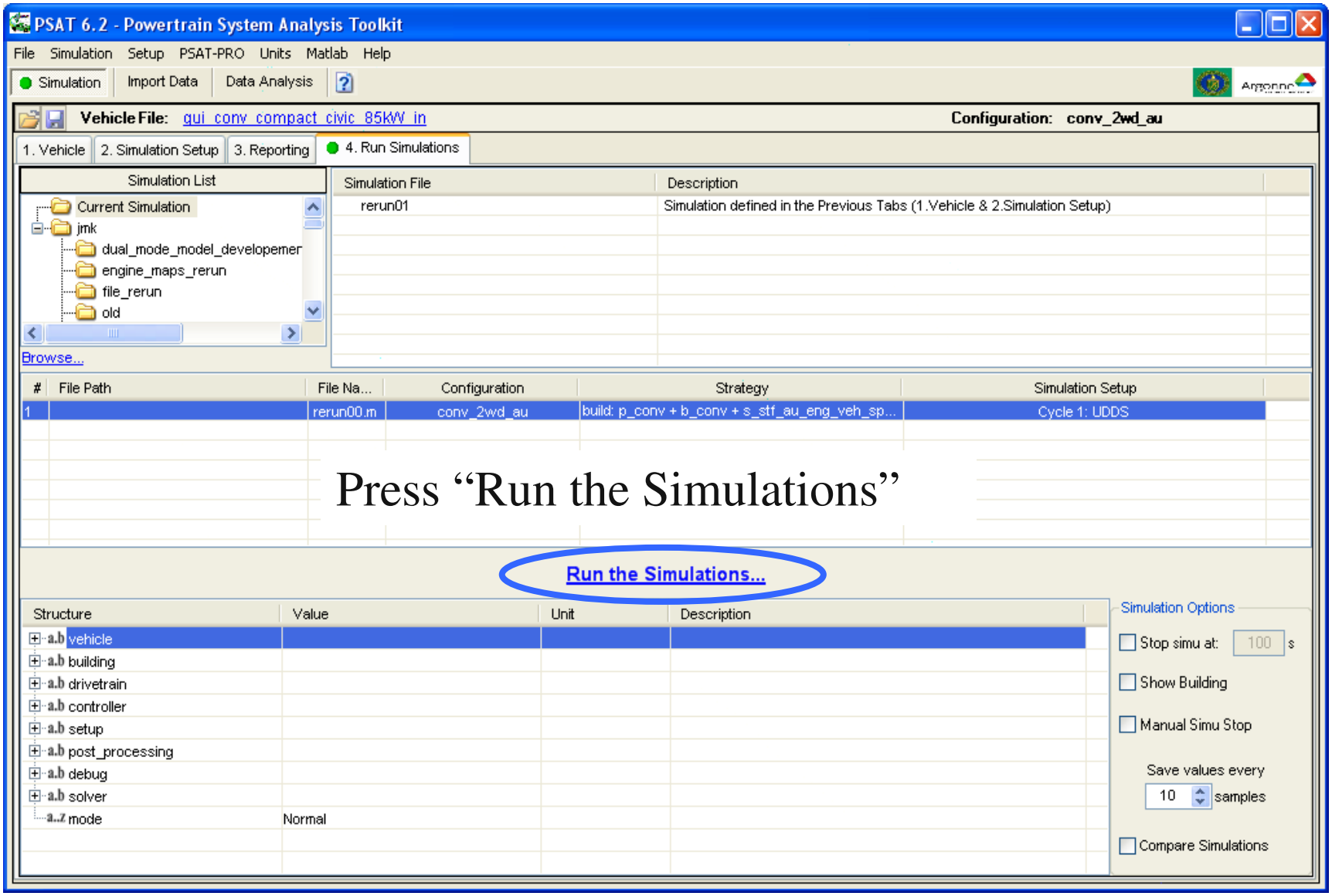
Used to save 1 parameters every X sample.

Used to compare the simulations.

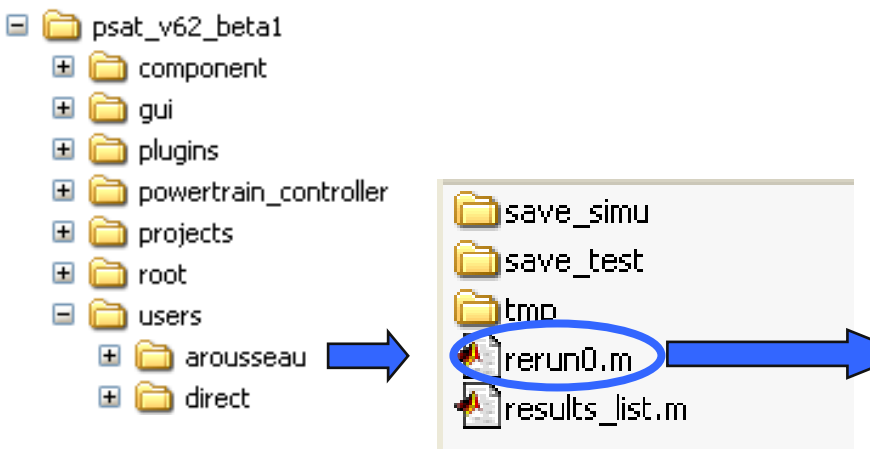
Select the Solver

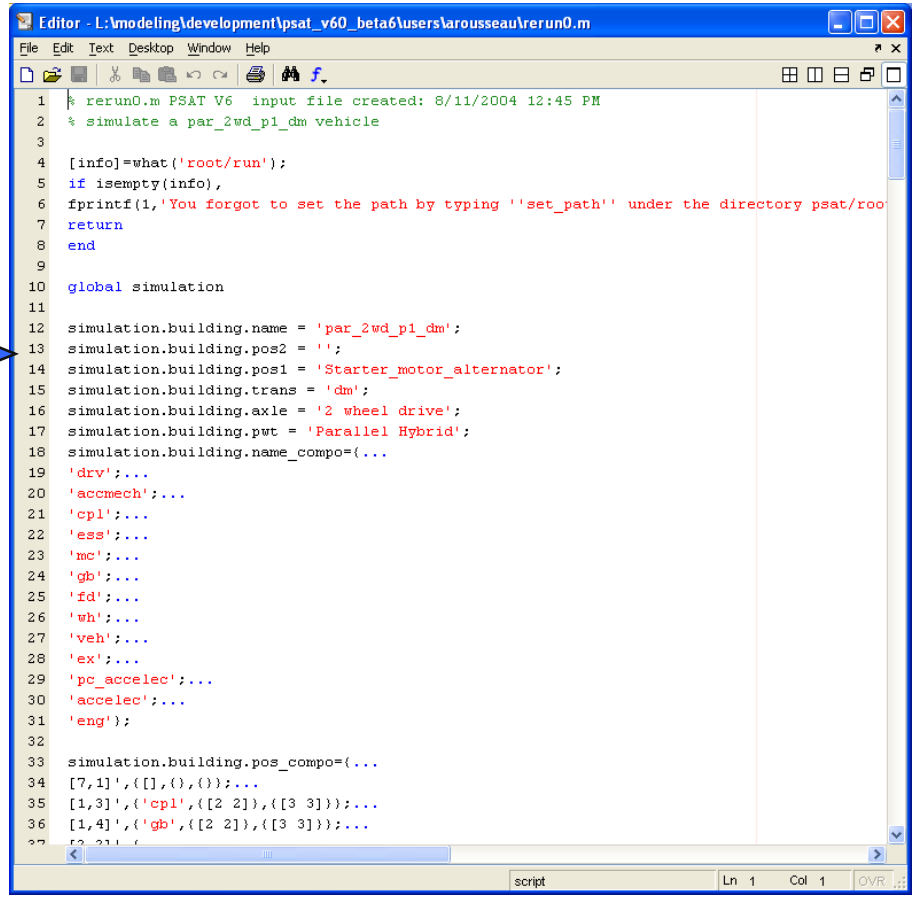


Launch the Simulation from the GUI



Creation of a Rerun.m File





This file contains all the choices made by the user in the GUI

Launch the Simulation without the GUI

1- Start Matlab

2 – Go in the root directory

```
>> cd psat_v62/root
```

3 – Set the path

```
>> clear all;close all;pack;user_name = 'arousseau';set_path
```

4 – Copy the rerun.m files in the user directory

5 – Rename the rerun files to have rerun0.m, rerun1.m…

6 – Launch the simulation

```
>> launch_simulation
```

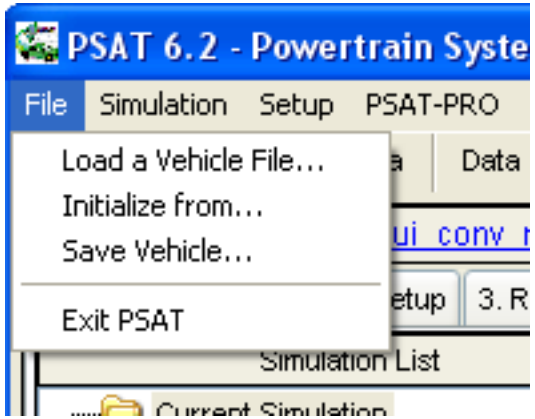
7 – If the simulation has been launched manually (simulation.debug.manual_sim_stop = 1), the post processing can be launched by typing

```
>> launch_post_processing
```

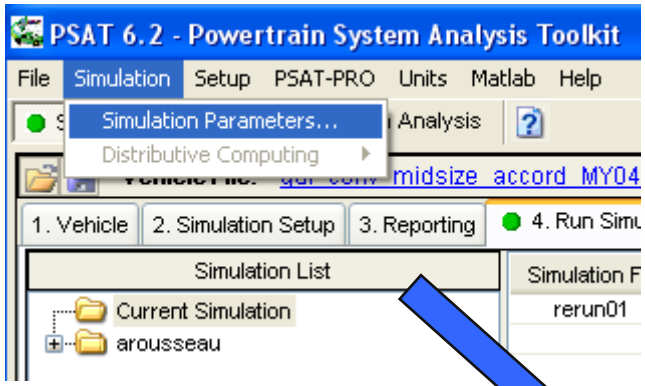
7 – Menu Options

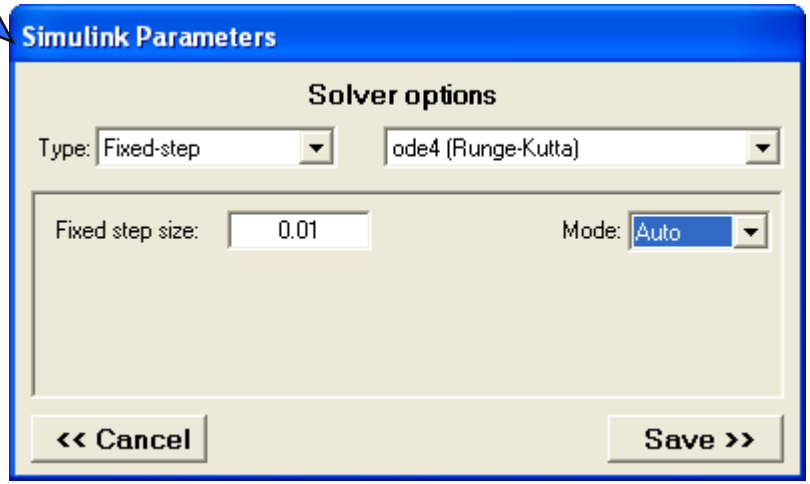
- File
- Simulation
- Setup
- PSAT-PRO – not discussed
- Units
- Help

File Menu

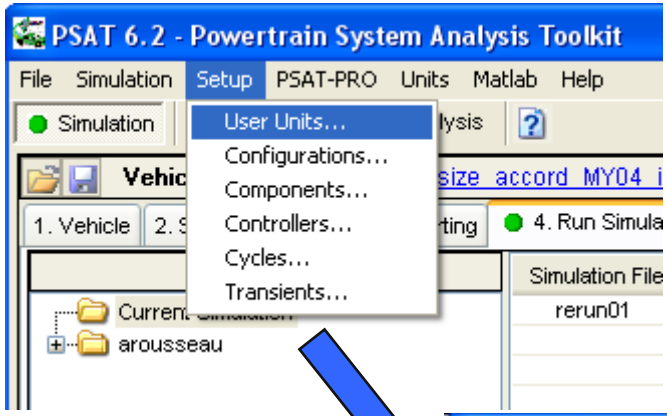

PSAT 6.2 - Powertrain Syste
File
Simulation
Setup
PSAT-PRO
Load a Vehicle File...
Initialize from...
Save Vehicle...
Exit PSAT
Data
Simulation List

Simulation Menu



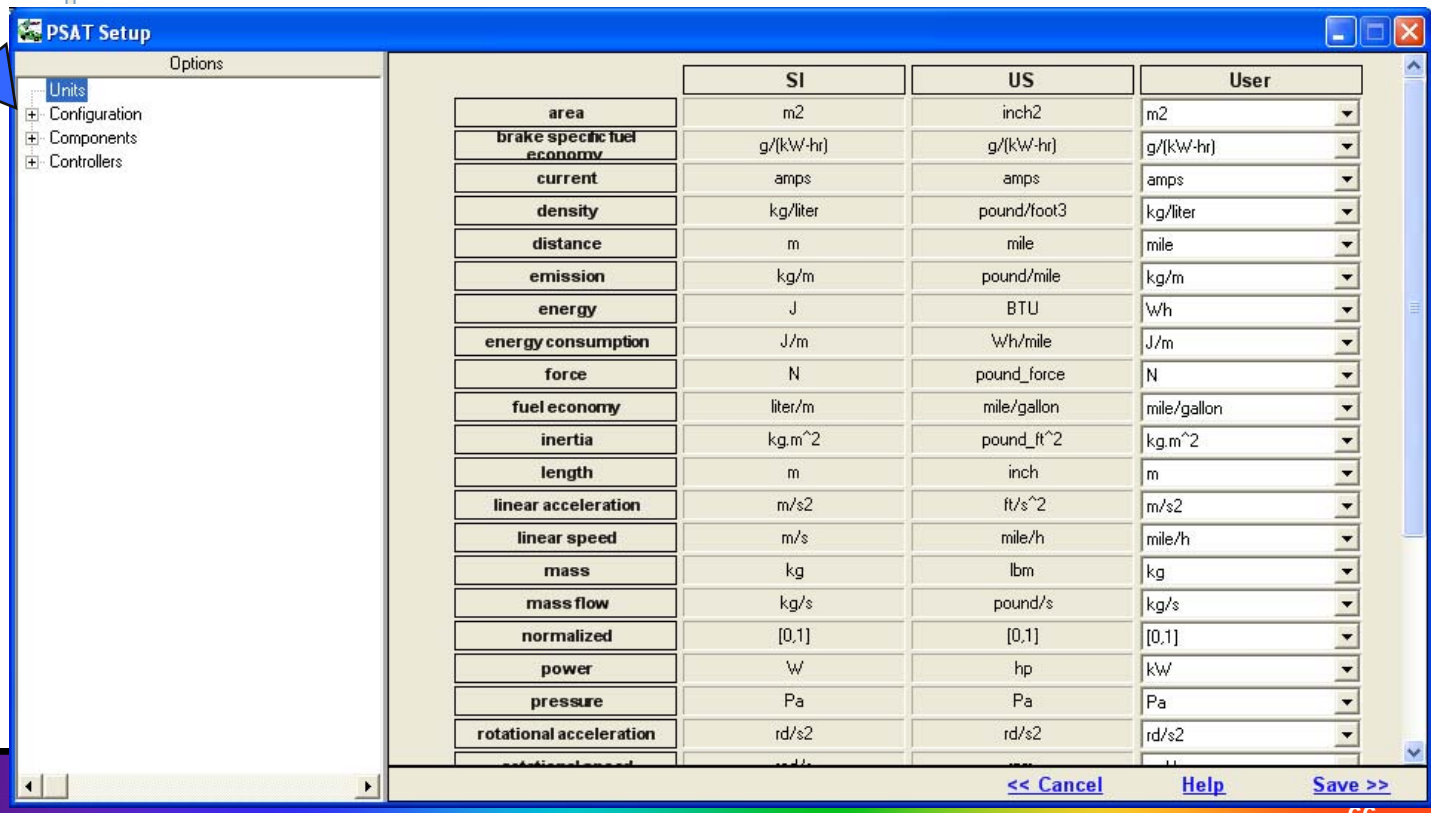


Setup Menu



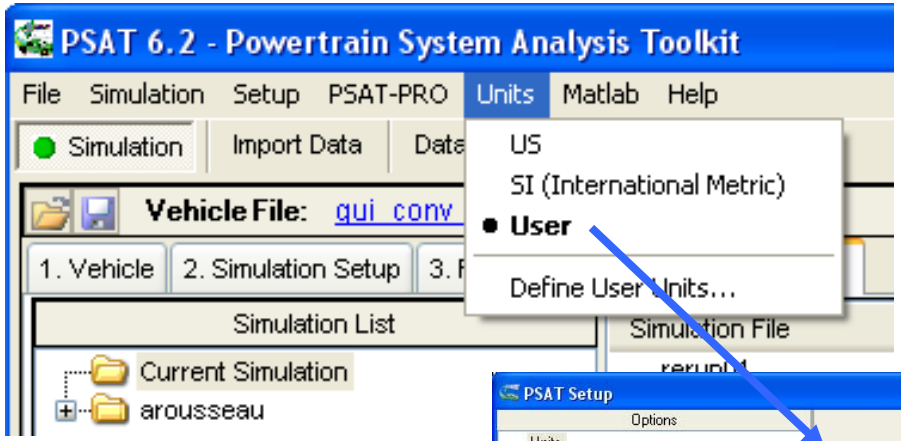
Menu used to change the units, the configurations, components and controllers compatibilities

Refer to Chapter 9 for more information

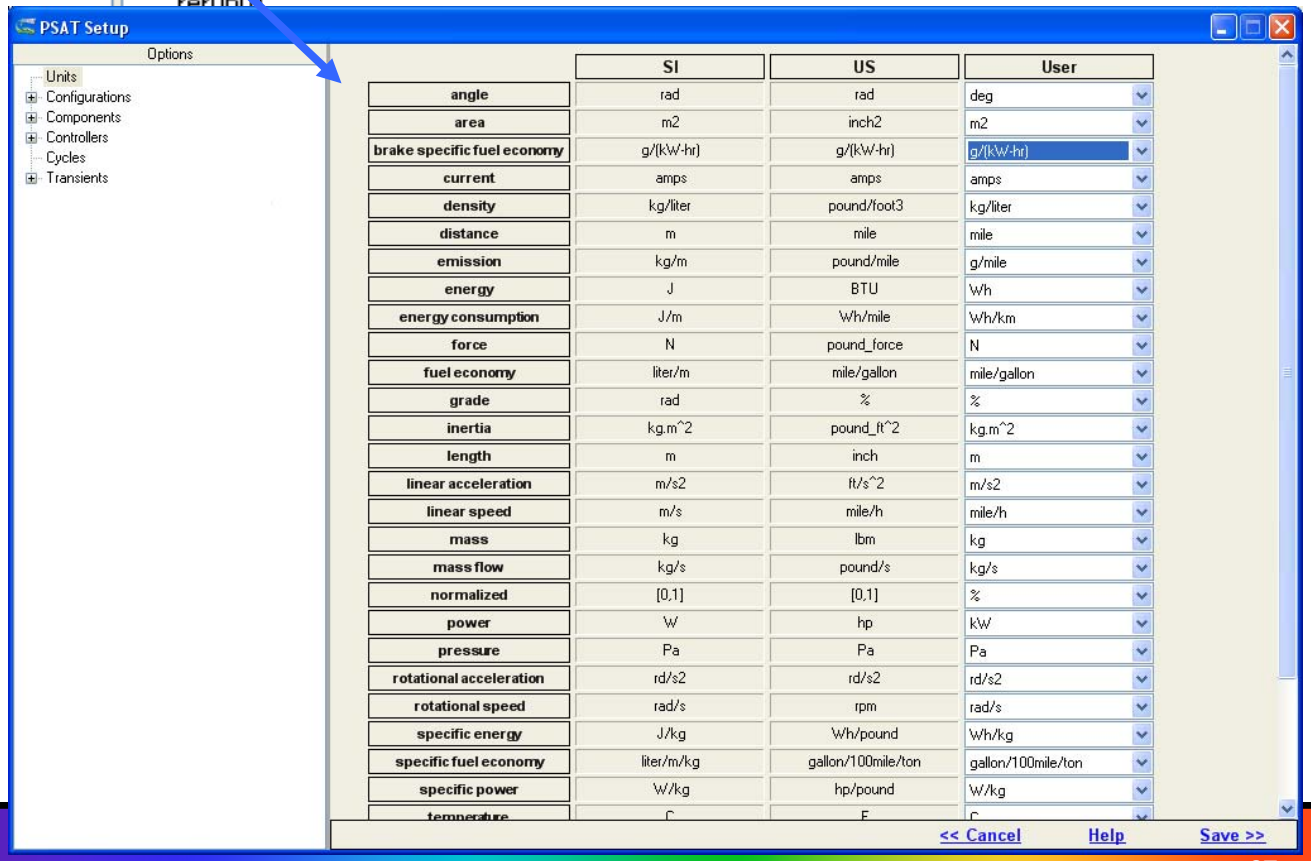


	SI	US	User
area	m2	inch2	m2
brake specific fuel economy	g/(kW-hr)	g/(kW-hr)	g/(kW-hr)
current	amps	amps	amps
density	kg/liter	pound/foot3	kg/liter
distance	m	mile	mile
emission	kg/m	pound/mile	kg/m
energy	J	BTU	Wh
energy consumption	J/m	Wh/mile	J/m
force	N	pound_force	N
fuel economy	liter/m	mile/gallon	mile/gallon
inertia	kg.m^2	pound_ft^2	kg.m^2
length	m	inch	m
linear acceleration	m/s2	ft/s^2	m/s2
linear speed	m/s	mile/h	mile/h
mass	kg	lbm	kg
mass flow	kg/s	pound/s	kg/s
normalized	[0,1]	[0,1]	[0,1]
power	W	hp	kW
pressure	Pa	Pa	Pa
rotational acceleration	rd/s2	rd/s2	rd/s2

Units Menu

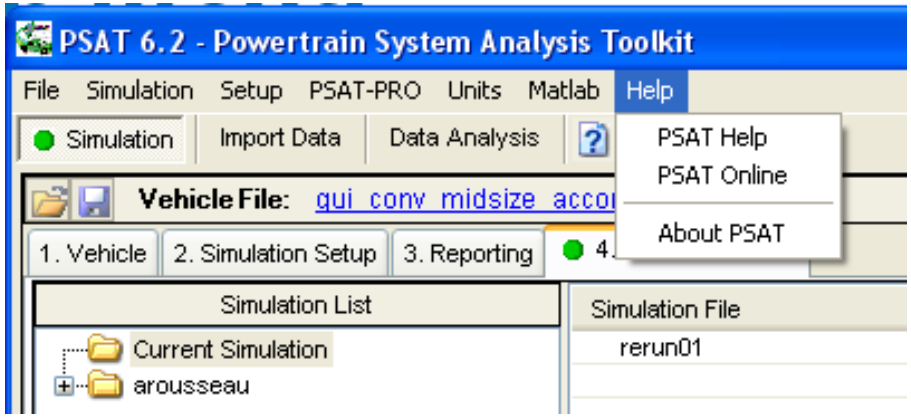


Allow the user to select predefined US or SI units or define its own units for each parameter



	SI	US	User
angle	rad	rad	deg
area	m2	inch2	m2
brake specific fuel economy	g/(kW-hr)	g/(kW-hr)	g/(kW-hr)
current	amps	amps	amps
density	kg/liter	pound/foot3	kg/liter
distance	m	mile	mile
emission	kg/m	pound/mile	g/mile
energy	J	BTU	Wh
energy consumption	J/m	Wh/mile	Wh/km
force	N	pound_force	N
fuel economy	liter/m	mile/gallon	mile/gallon
grade	rad	%	%
inertia	kg.m^2	pound_ft^2	kg.m^2
length	m	inch	m
linear acceleration	m/s2	ft/s^2	m/s2
linear speed	m/s	mile/h	mile/h
mass	kg	lbm	kg
mass flow	kg/s	pound/s	kg/s
normalized	[0,1]	[0,1]	%
power	W	hp	kW
pressure	Pa	Pa	Pa
rotational acceleration	rd/s2	rd/s2	rd/s2
rotational speed	rad/s	rpm	rad/s
specific energy	J/kg	Wh/pound	Wh/kg
specific fuel economy	liter/m/kg	gallon/100mile/ton	gallon/100mile/ton
specific power	W/kg	hp/pound	W/kg
temperature	C	F	C

Help Menu

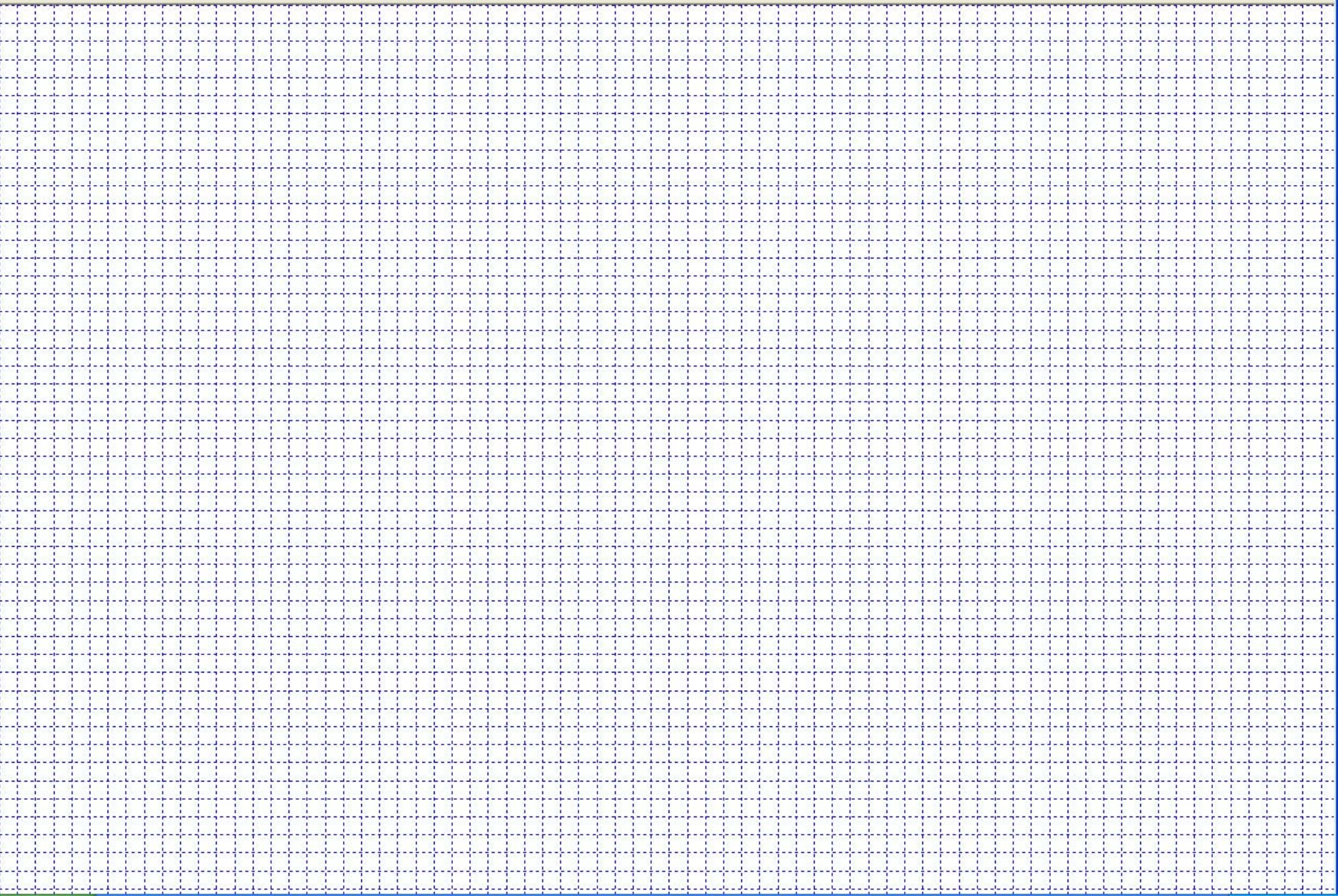

PSAT 6.2 - Powertrain System Analysis Toolkit
File
Simulation
Setup
PSAT-PRO
Units
Matlab
Help
Simulation
Import Data
Data Analysis
PSAT Help
PSAT Online
About PSAT
Vehicle File:
gui_conv_midsize_accor
1. Vehicle
2. Simulation Setup
3. Reporting
Simulation List
Current Simulation
arousseau
Simulation File
rerun01

8 – Model Building

- Allows us to have a very large number of drivetrain configurations

split_2wd

File Edit View Simulation Format Tools Help



start | Inbox - Mic... | L:\Vehicle_... | AyR - SAE0... | MATLAB | I:\modeling\... | Simulation ... | split_2wd | 11:27 AM

split_2wd *

File Edit View Simulation Format Tools Help

0

clock

time_simu

main_disclosure

Vehicle Controller

powertrain_controller

pto_bus

Building The Simulink Model, Please Wait...

lib_powertrain_controller

File Edit View Simulation Format Tools Help

Vehicle Controller

powertrain_controller

Ready 100% ode45

start Inbox... L:\Veh... AyR - ... MATLAB I:\mod... Simula... split_2... lib_po... 11:28 AM

split_2wd *

File Edit View Simulation Format Tools Help

0

clock

time_simu

main_disclosure

Vehicle Controller

powertrain_controller

pto_bus

Component Controller

cond

Building The Simulink Model, Please Wait...

lib_cond

File Edit View Simulation Format Tools Help

Component Controller

cond_v01

Ready 100% ode45

start Inbox... L:\Veh... AyR - ... MATLAB I:\mod... Simula... split_2... lib_cond 11:28 AM

split_2wd *

File Edit View Simulation Format Tools Help

0

clock

time_simu

main_disclosure

Vehicle Controller

powertrain_controller

pto_bus

Component Controller

cond

cmd_hk

Building The Simulink Model, Please Wait...

powertrain_model

meas_out

pwt_bus

start

Inbox - ... | L:\Vehicl... | AyR - S... | MATLAB | I:\modeli... | Simulatio... | split_2wd * | 11:28 AM

split_2wd *

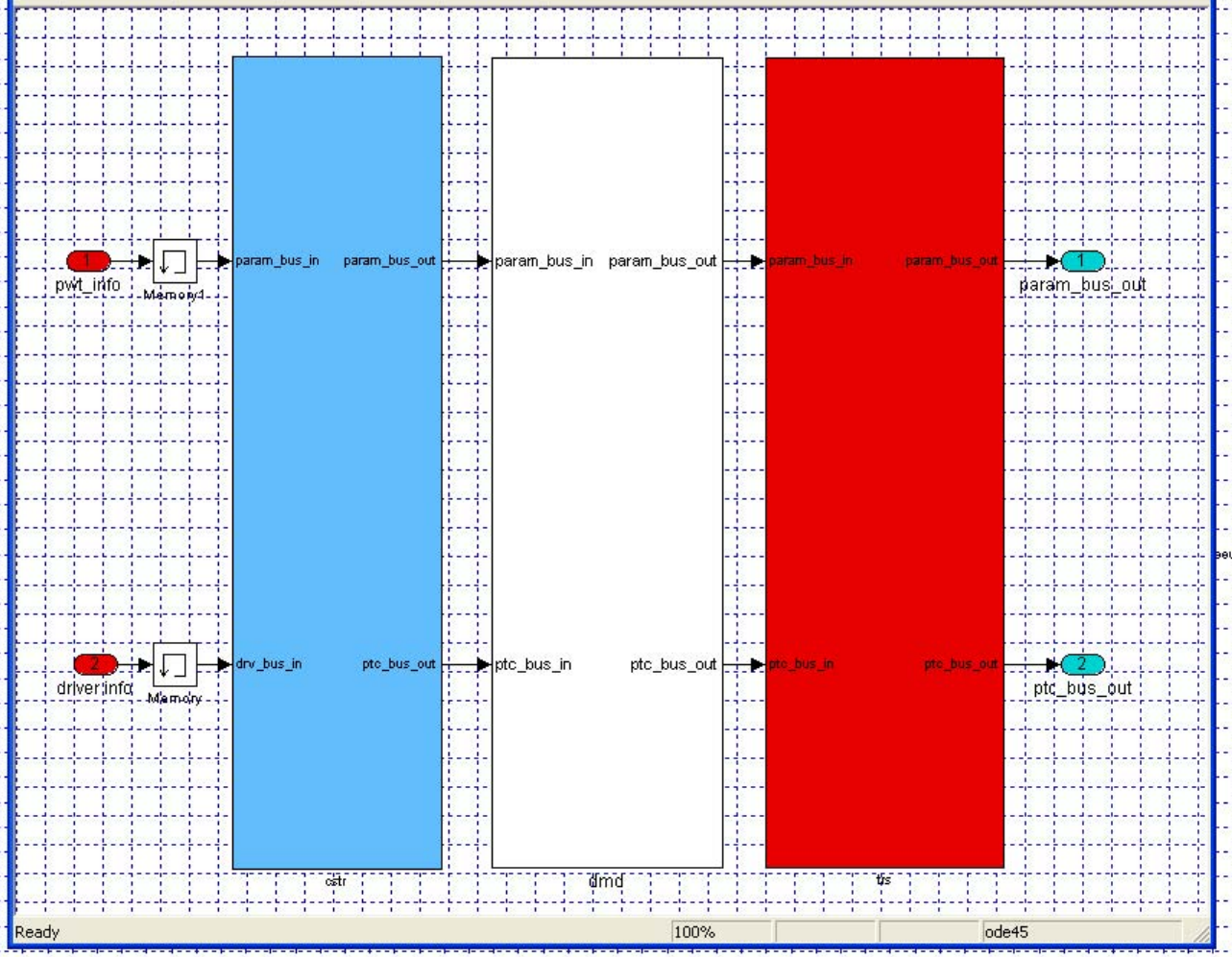
File Edit View Simulation Format Tools Help

0

clock

split_2wd/powertrain_controller *

File Edit View Simulation Format Tools Help



Ready 100% ode45

main_disclosure

powertrain_model

start Inbox... L:\Veh... AyR - ... MATLAB I:\mod... Simula... split_2... split_2... 11:29 AM

split_2wd *

File Edit View Simulation Format

0

clock

time_simu

split_2wd/powertrain_controller/dmd *

File Edit View Simulation Format Tools Help

1 param_bus_in

2 ptc_bus_in

param_bus_in

dmd

ptc_bus_in

propel_block

1 param_bus_out

2 ptc_bus_out

mux

Ready

lib_p_split_best_eng_2wd

File Edit View Simulation Format Tools Help

param_bus_in

dmd

ptc_bus_in

p_split_best_eng_2wd

Ready 100% ode45

start

Inbo... L:\V... AyR... MAT... I:\m... Simu... split... split... lib_p...

11:29 AM

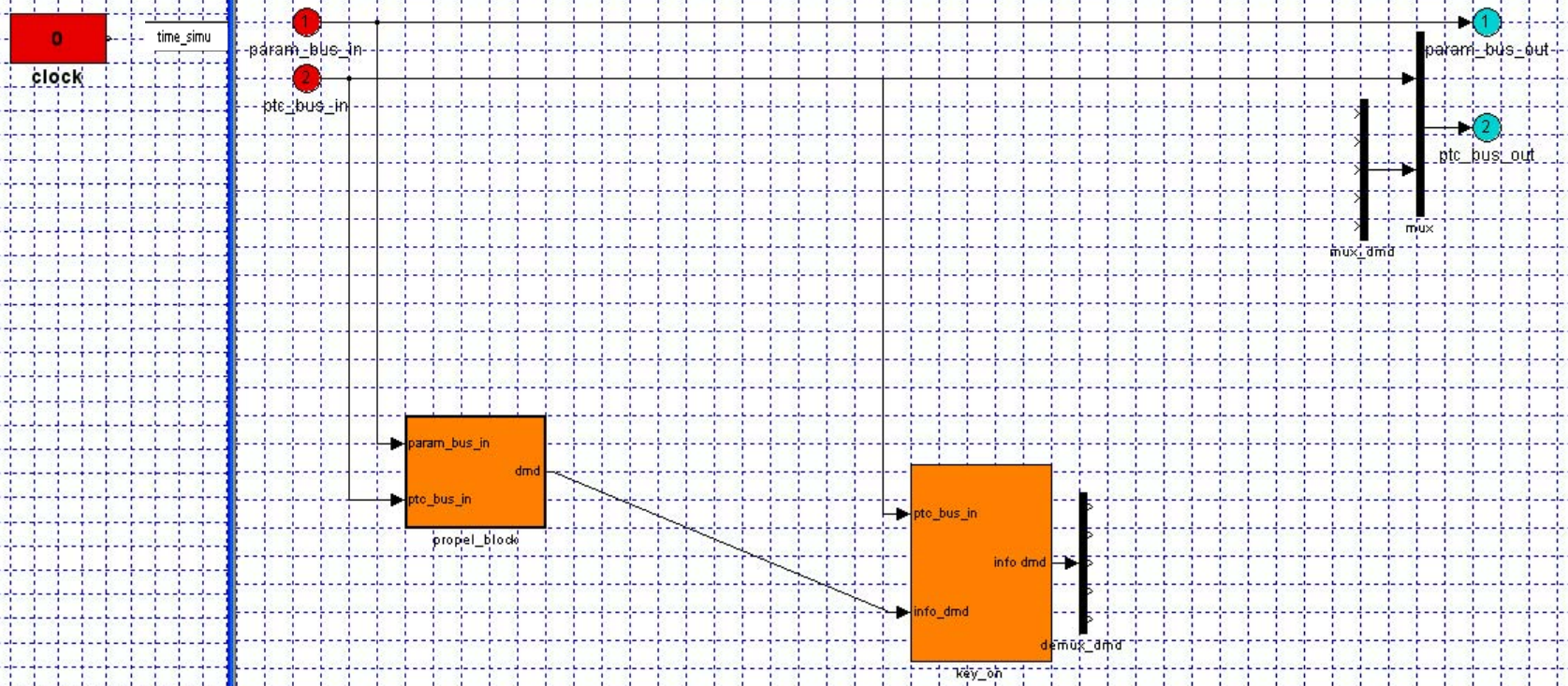
NATIONAL LABORATORY

split_2wd *

File Edit View Simulation Format T

split_2wd/powertrain_controller/dmd *

File Edit View Simulation Format Tools Help



Ready 100% ode45

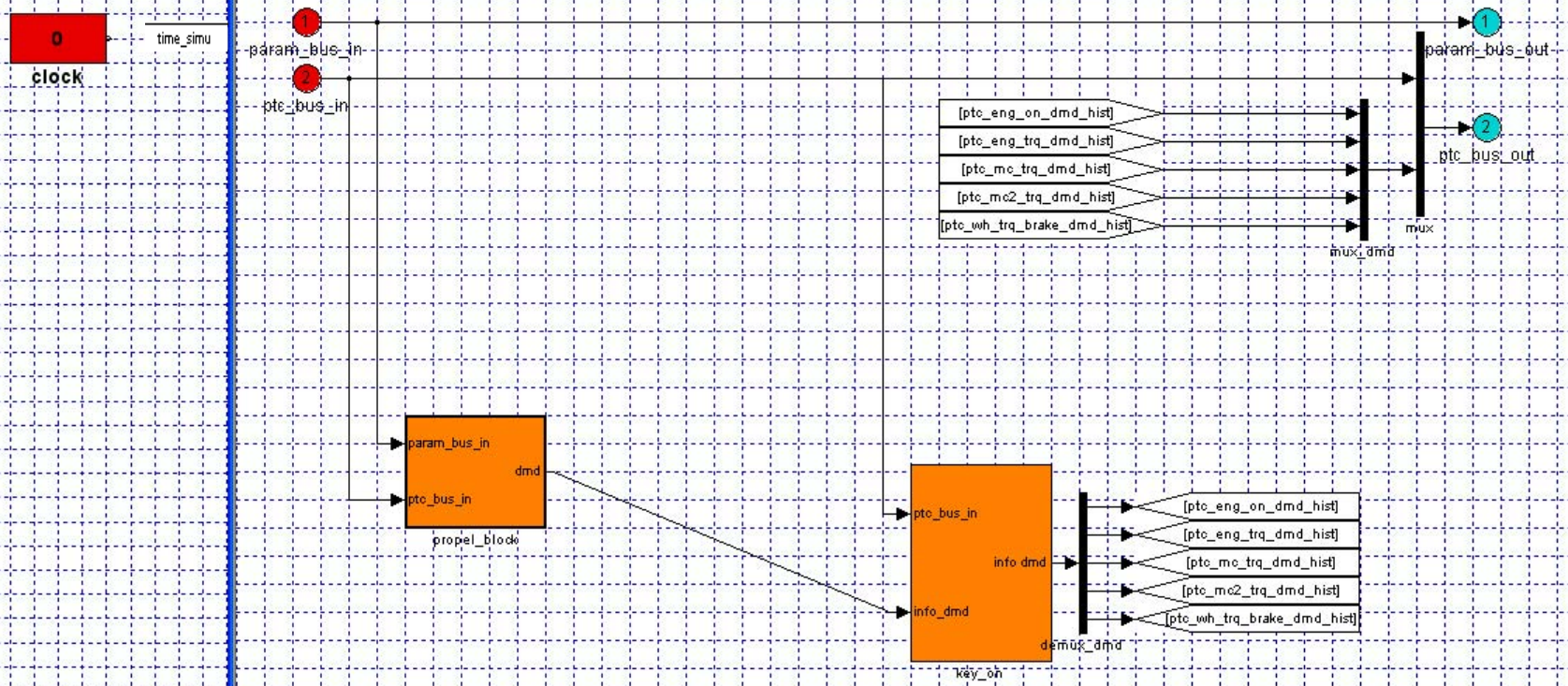
start Inbox... L:\Veh... AyR - ... MATLAB I:\mod... Simula... split_2... split_2... 11:30 AM

split_2wd *

File Edit View Simulation Format T

split_2wd/powertrain_controller/dmd *

File Edit View Simulation Format Tools Help

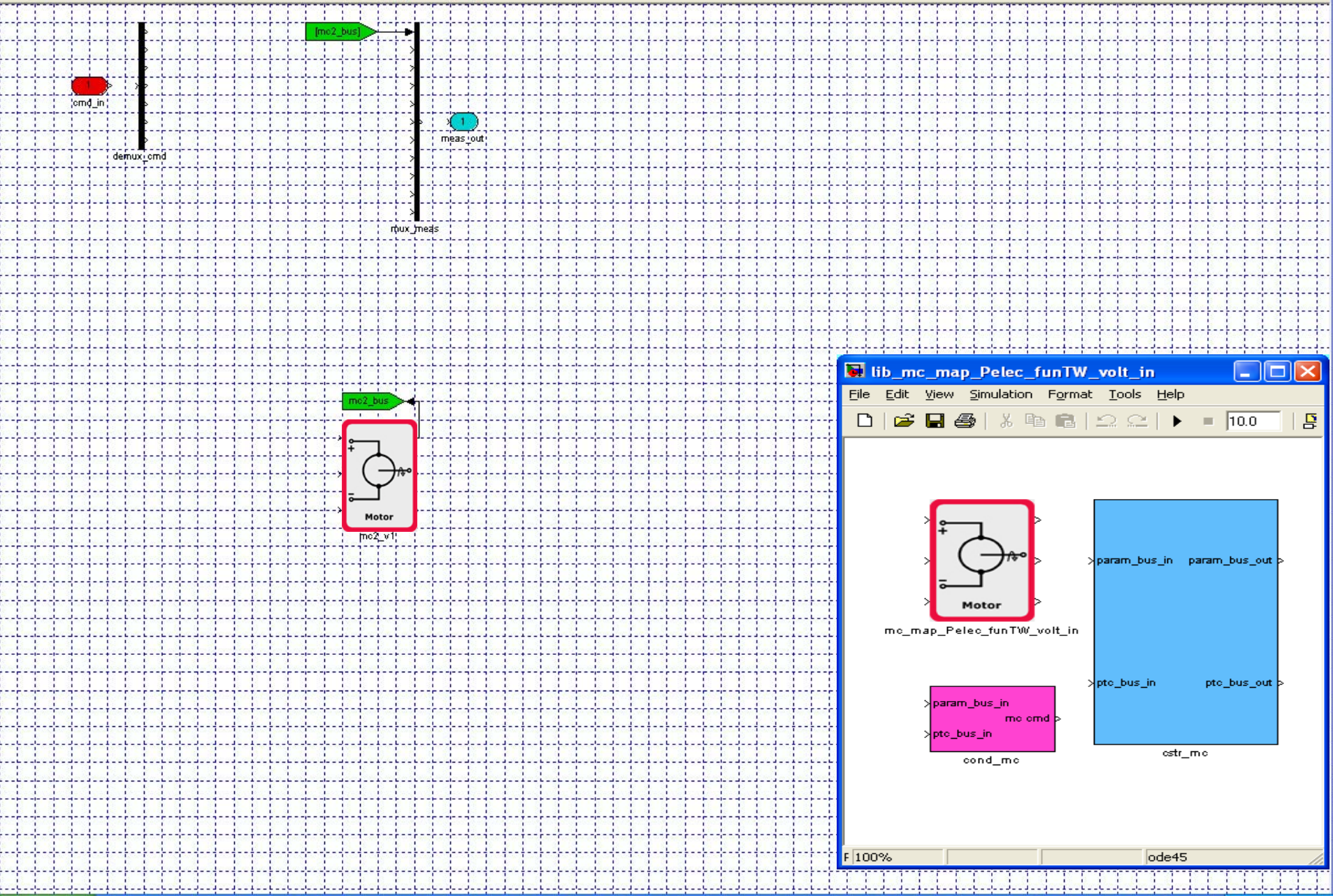


Ready 100% ode45

start Inbox... L:\Veh... AyR - ... MATLAB I:\mod... Simula... split_2... split_2... 11:30 AM

split_2wd/powertrain_model *

File Edit View Simulation Format Tools Help



split_2wd/cond *

File Edit View Simulation Format Tools Help

param_bus_in

ptc_bus_in

param_bus_in

ptc_bus_in

mc cmd

cond_mc2

mux_cond

cm_bus_out

lib_mc_map_Pelec_funTW_volt_in

File Edit View Simulation Format Tools Help

10.0

Motor

mc_map_Pelec_funTW_volt_in

param_bus_in

ptc_bus_in

mc cmd

cond_mc

param_bus_in

param_bus_out

ptc_bus_in

ptc_bus_out

cstr_mc

100%

ode45

Ready

100%

ode45

start

11:31 AM

split_2wd/powertrain_controller/cstr *

File Edit View Simulation Format Tools Help

1 param_bus_in

2 drv_bus_in

param_bus_in param_bus_out

ptc_bus_in ptc_bus_out

cstr_mc2

1 param_bus_out

2 ptc_bus_out

Ready 100%

2 driver_info

Memory

drv_bus_in ptc_bus_out

ptc_bus_in ptc_bus_out

ptc_bus_in ptc_bus_out

cstr

dmd

tts

Ready 100%

lib_mc_map_Pelec_funTW_volt_in

File Edit View Simulation Format Tools Help

10.0

Motor

mc_map_Pelec_funTW_volt_in

param_bus_in

ptc_bus_in

mc cmd

cond_mc

param_bus_in param_bus_out

ptc_bus_in ptc_bus_out

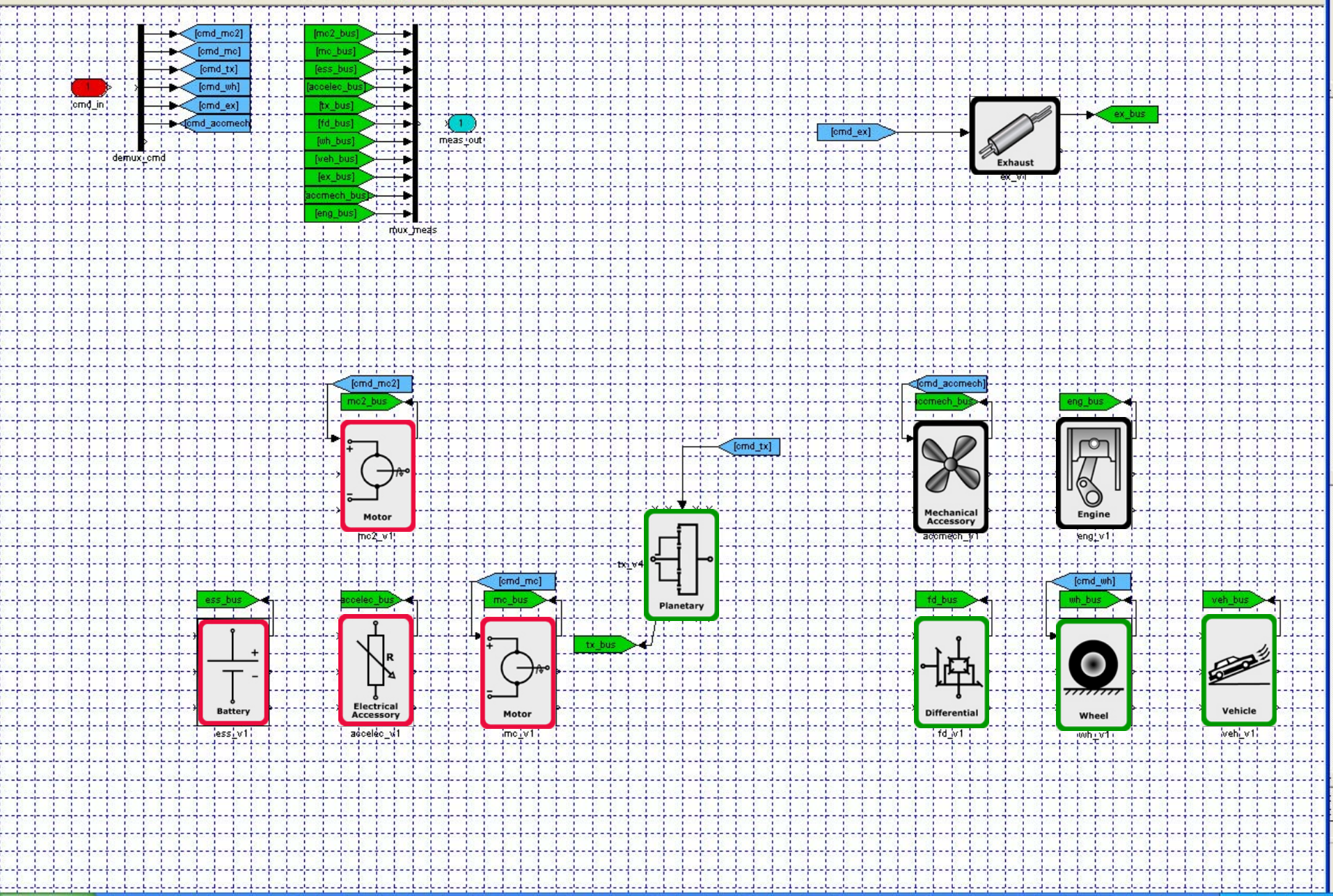
cstr_mc

100% ode45

start 11:32 AM

split_2wd/powertrain_model *

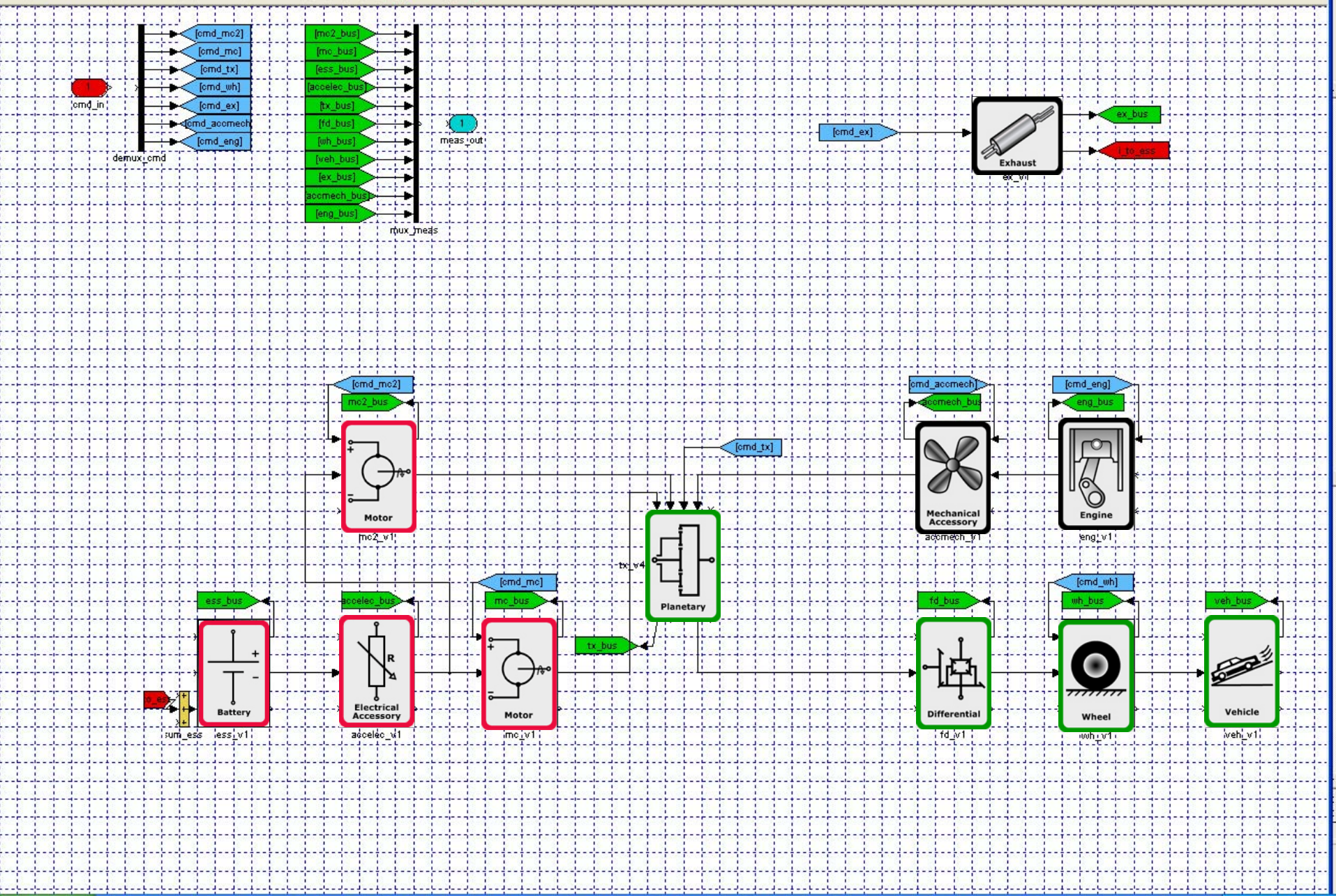
File Edit View Simulation Format Tools Help



start Inbox... L:\Veh... AyR - ... MATLAB I:\mod... Simula... split_2... split_2... 11:33 AM

split_2wd/powertrain_model *

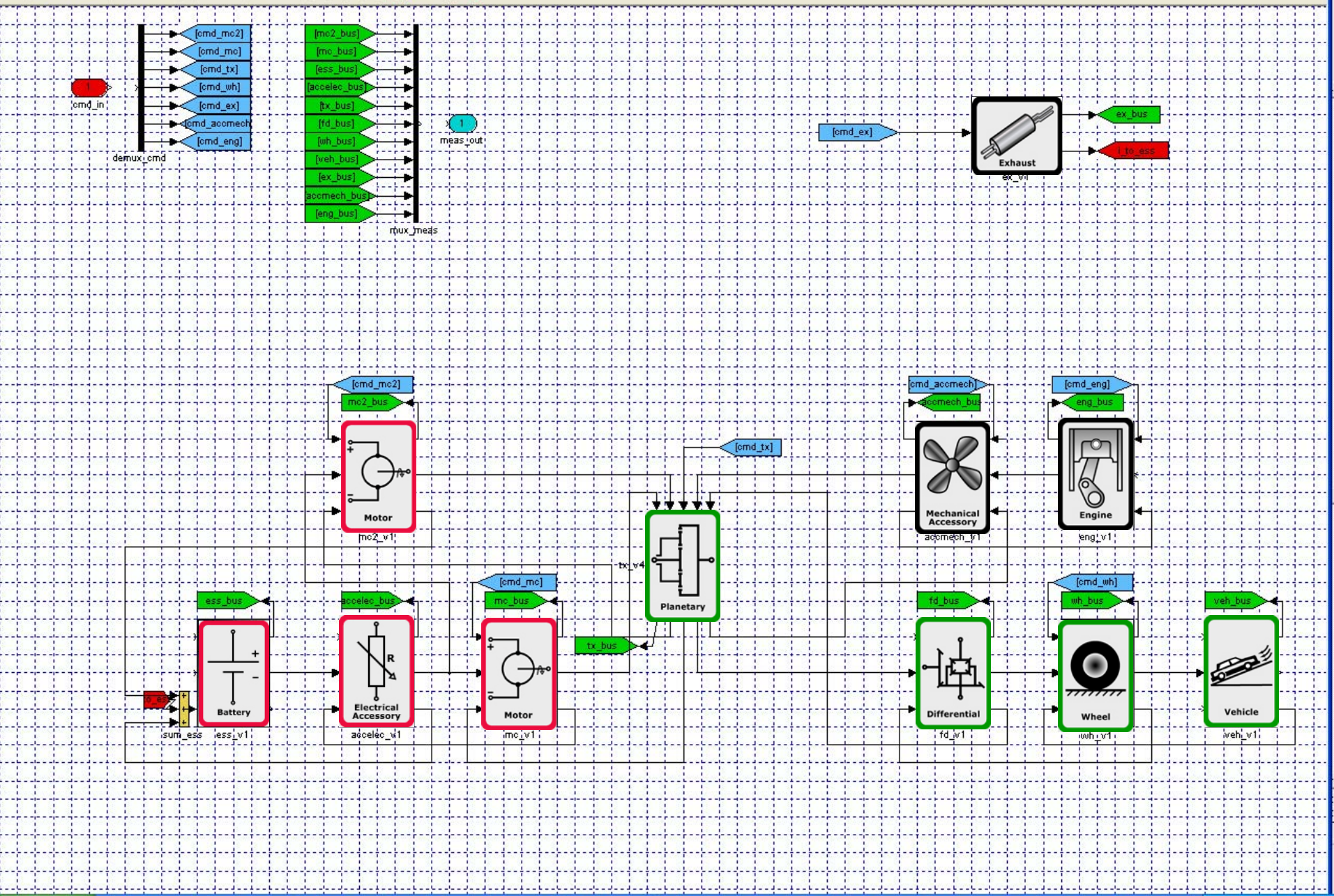
File Edit View Simulation Format Tools Help



start Inbox... L:\Veh... AyR - ... MATLAB I:\mod... Simula... split_2... split_2... 11:34 AM

split_2wd/powertrain_model *

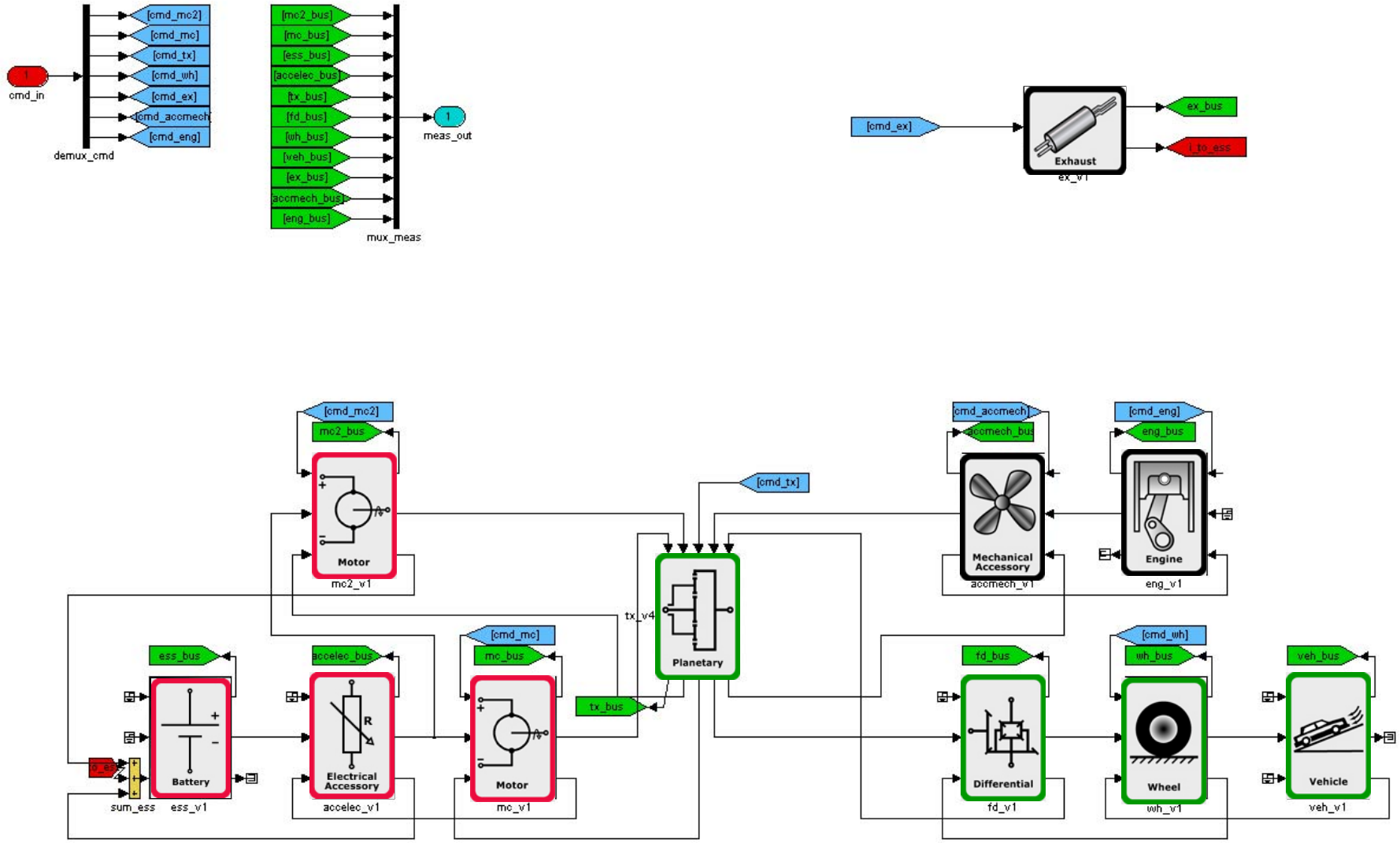
File Edit View Simulation Format Tools Help



start Inbox... L:\Ve... AyR -... MATLAB I:\mo... Simul... split_... split_... 11:34 AM

split_2wd/powertrain_model *

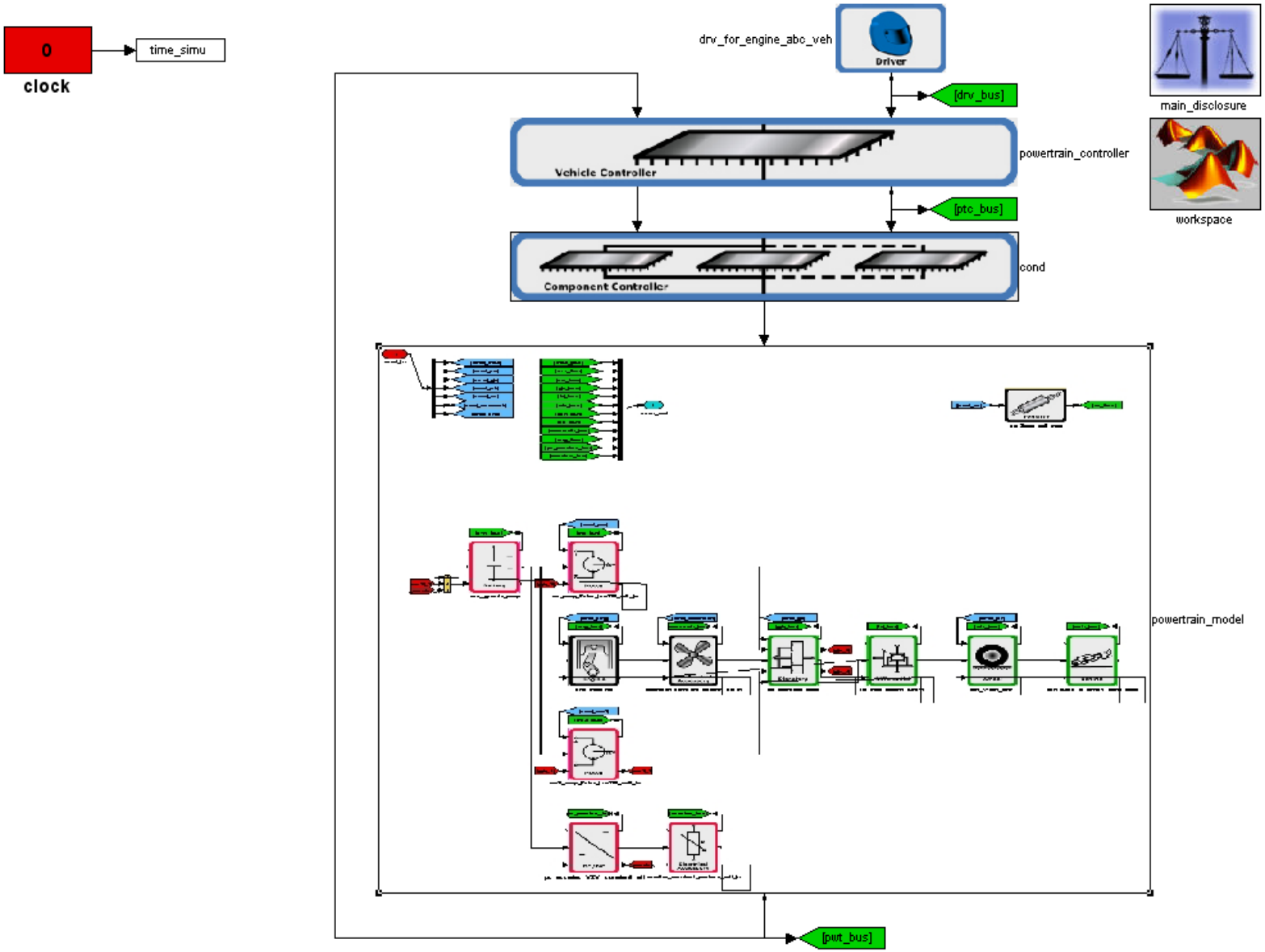
File Edit View Simulation Format Tools Help



start Inbox... L:\Ve... AyR -... MATLAB I:\mo... Simul... split_... split_... 11:34 AM

split_2wd *

File Edit View Simulation Format Tools Help



start | Inbox - Mic... | L:\Vehicle_... | AyR - SAE... | MATLAB | I:\modeling... | Simulation ... | split_2wd * | 11:34 AM