Design Advisor Workshop

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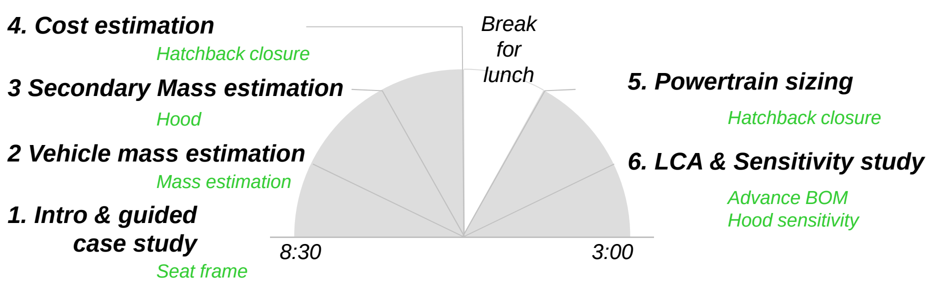


Case Study 1 Seat Frame

Component: Seat Frame

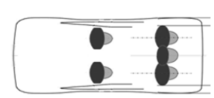
Original Component

Steel
Stamped
17 kg total seat mass
10 kg frame mass

Competitor Component

Magnesium,
High pressure die cast
13 kg total seat mass
6 kg frame mass

Vehicle Parameters



Sedan/Hatchback
5 passenger
100 kg cargo
OAL=*4.7 m*
OAW=*1.8 m*
New architecture
Internal Combustion-gasoline
Powertrain is fixed and will not change
6.8 liter/100 km (HYZEM schedule)
Life time range =*155,000 km*

Case Study 1b Effect of vehicle size and powertrain selection on vehicle mass

Vehicle Parameters

2009
Toyota Venza
Cross over
5 passenger
100 kg cargo
OAL=*4.8 m*
OAW=*1.9 m*

I C-G

Assessment of Mass Reduction Opportunities for a 2017 – 2020 Model Year Vehicle Program, Lotus Engineering

2011
Honda Accord
Sedan/Hatchback
5 passenger
100 kg cargo
OAL=*4.938 m*
OAW=*1.831 m*

I C-G I C-D BEV

Mass Reduction for Light-Duty Vehicles for Model years 2017-2025, Singh, H.

Purpose: To see how vehicle size and powertrain selection will change vehicle curb mass and subsystem masses

Go to ***Solution Map*** and select ***Define Nominal Vehicle***

1. Change vehicle dimensions to Toyota with IC-G

Note: Toyota Venza is a cross-over vehicle which is slightly heavier than a Sedan/hatchback due to towing requirements. Account for this by increasing estimated mass by <u>one standard deviation</u> above a nominal Sedan/hatchback

2a. Change vehicle dimensions to Honda (make use to set standard deviations back to zero)
2b. Change powertrain type

Vehicle	Powertrain type	Curb Mass	Powertrain mass	Body Structure mass	Ferrous content %/ (kg)
Toyota	IC-G				/
Honda	IC-G				/
Honda	IC-D				/
Honda	BEV				/

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Case Study 2- Hood

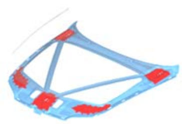
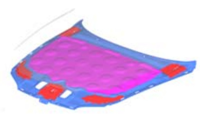
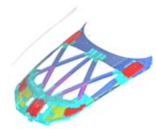
Plans for 20xx vehicle

hood area=1.5 m²

Vehicle type: Hatchback
L=4.2 m
W=1.750 m
100 kg cargo

New architecture
Internal Combustion-Gasoline
Powertrain is fixed and will not change
6. liter/100 km (HYZEM schedule)
Life time range =*155,000 km*

Component: Hood

		
Area=2 m²	*Area=2 m²*	*Area=2 m²*
Original Component	**Competitor 1 Component**	**Competitor 2 Component**
AHSS Stamped 14.66 kg	Aluminum Stamped 11.00 kg	SMC SM Press 18.00 kg

Purpose: To see how the secondary mass method affects results

Load input data by starting at the ***Set Nominal Vehicle*** sheet and stepping through sheets using the forward arrow in upper right corner. Begin with AHSS vs Aluminum hood

1. Make sure to enter original and new hood area on ***Input Component Data*** sheet
2. On ***Resize Nominal Vehicle*** Sheet choose *Analytical* , *Simple as secondary mass method*
3. On ***Vehicle Comparison Summary*** sheet observe mass, cost, and GHG results
   Record data in the table below
4. Use the circle icon in the upper right corner to go to ***Solution Map***.
   Choose ***Resize Nominal Vehicle*** icon
5. Change secondary mass method as shown in the table below
6. Use forward arrow in the upper right corner to go to ***Vehicle Comparison Summary***
7. Observe Mass, Cost, and GHG results
   Record data in the table below
9. If time permits, repeat for AHSS vs. SMC hood

Secondary Mass Method	Primary Mass change	Subsystem Mass change	Secondary cost change	GHG change
Analytical, Simple				
Analytical, Compounded				
Regression, Simple				
Regression, Compounded				

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Case Study 3 – Hatchback closure, Cost Analysis

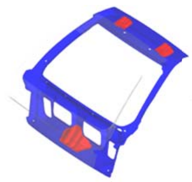
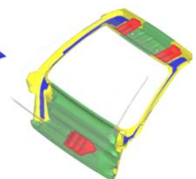
Plans for 20xx vehicle

Hatch door area=1 m^2

Vehicle type: Hatchback
L=4.2 m
W=1.750 m
100 kg cargo

New architecture
Internal Combustion-gasoline
Powertrain is fixed and will not change
6. liter/100 km (HYZEM schedule)
Life time range =*155,000 km*

Component: Hatchback closure

		
Area=1 m^2	*Area=1 m^2*	*Area=1 m^2*
Original Component	**Competitor 1 Component**	**Competitor 2 Component**
AHSS Hydroformed 7.81 kg	Aluminum Stamped 6.77 kg	SMC SM Press 8.05 kg

Purpose: To examine cost analysis results, to see how batch size affects results, to change material cost per kg

Keep vehicle input data the same
1. Input component data for AHSS vs Aluminum hatchback
2. Go to Component Cost sheet and observe relative costs

Note: This comparison uses default material cost per kg values. The MIT paper used the following material costs AHSS=1.1 \$/kg, Aluminum=4.8 \$/kg, SMC=3.0 \$/kg
To change these default values, go to the Solution Map sheet, select Instructions, scroll to bottom of instructions page and select Protection=OFF, click Return in upper right corner, select Cost for Part icon on Solution Map, go to cell C177. Here you will see a list of material cost. Change the three values to agree with the values in the MIT study. Scroll up to se the changed results

3. Record the costs for the AHSS and Aluminum hatchbacks

Optional

4. Go back and enter component data for AHSS vs SMC hoods
5. Observe and record the costs below
6. Change the batch size to 30,000 units and record results for AHSS vs SMC hoods

Batch size	AHSS hood cost (1.1 \$/kg)	Aluminum hood cost (4.8 \$/kg)	SMC hood cost (3.0 \$/kg)
100,000			
30,000			

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Case Study 4 – Hatchback closure, powertrain influence

Plans for 20xx vehicle

Hatch door area=1 m²

Vehicle type: Hatchback
L=4.2 m
W=1.750 m
100 kg cargo

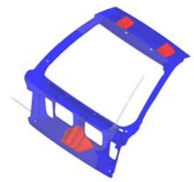
New architecture
Internal Combustion-gasoline
Powertrain is fixed and will not change
6. liter/100 km (HYZEM schedule)
Life time range =*155,000 km*

Component: Hatchback closure

Area=1 m²

Original Component

AHSS
Hydroformed
7.81 kg



Area=1 m²

Competitor 1 Component

Aluminum
Stamped
6.77 kg

Purpose: To investigate the Use phase GHG analysis, to see how powertrain resizing affects results, to change powertrain and fuels and see how results change

Continue with the Hatchback closure case study
1. Use data for AHSS vs. Aluminum hatchback (Use *regression*, *simple* for secondary mass)
2. Record relative GHG, and material preference based on LCA
3. Click the bar for Use Phase GHG, this will take you to Use Phase GHG, click box ***Resize Powertrain for equal performance***
4. Click back arrow in upper right corner, this will take you back to results. Observe how PT resizing has affected results and record data for the IC-gasoline resized
5. Go back to Size Nominal Vehicle and *change the powertrain to a BEV –make sure you choose the fuel consumption value for BEV using the graph on Size Powertrain sheet*
6. Repeat steps 3 and 4 for BEV

Note: On* Mass Compounding *sheet- the powertrain and battery box should be checked (for resize), or unchecked (for no resize)

Powertrain Type	Powertrain Resizing	Fuel consumption Original vehicle / Resized vehicle	Relative LCA GHG (challenger relative to original)
IC-G	No PT resizing	/ *l/100km*	
IC-G	with PT resizing	/ *l/100km*	
BEV	with PT resizing	/ kWh/100 km	
BEV	No PT resizing	/ kWh/100 km	

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Case Study 5 – Changing Bill of Materials

Component	Vehicle Parameters
Original and competitor Component Component: Other Subsystem: Body non-structure 0 kg Material and process do not matter	*Sedan/Hatchback, L=4.8 m, W=1.9 m, no P.T. resize, HYZEM* **Conventional BOM** *Vehicle mass* ***+1σ*** *heavier than average* ***Run 1*** ***IC-Gasoline*** ***Run 2*** ***IC-Diesel BioDiesel fuel*** **High Development BOM** *Reduced vehicle mass by* ***-4σ*** *relative to average* ***Run 3*** ***IC-Gasoline*** ***Run 4*** ***IC-Diesel BioDiesel fuel***

Purpose: To see how an advanced BOM affects GHG,
to see how advance powertrains and fuel changes the preferred materials

1. ***Input component data***
   Components and parts will have zero mass

2 ***Set Nominal Vehicle***
   Set dimensions to those given (select *1σ* above average mass)
   Leave BOM at default values
   Select IC gasoline

3. ***Size powertrain***
   a. Select 155,000 km life time range
   b. Select gasoline
   c. Choose HYZEM
   d. Determine fuel consumption from graph (also shown on case study sheet)

--Go to ***Vehicle Comparison Summary*** and record GHG results for nominal vehicle onto data sheet—

4. Repeat steps 2 to 3 for Diesel with Biodiesel fuel (This is done first with conventional BOM) . Be sure to size the powertrain fuel consumption on the size powertrain sheet-step 3b and 3d

6. Now open the spreadsheet ***advanced material BOM.xls*** and copy the blue range representing a high development BOM

7. Go to Design Advisor, ***Set Nominal Vehicle*** sheet and paste this into the blue range to change the BOM. Also set ***Std. dev. from average curb mass*** to *-4*
8. Now repeat steps 3 to 5 for the advance BOM

	IC-Gas		Bio Diesel	
	conventional BOM	High Dev BOM	conventional BOM	High Dev BOM
	m+1σ	*m-4σ*	*m+1σ*	*m-4σ*
Recycle				
Use				
Material				
LC GHG				

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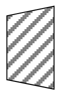
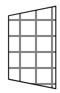
Case Study 6 Hood Sensitivity Analysis

Component: Hood

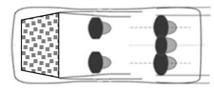


A=2.0 m^2



A=2.0 m^2

Vehicle Parameters



A=1.5 m^2

Note: This data is in the original Design Advisor file

Original Component

Steel
Stamped
13kg total seat mass
12 kg frame mass

Competitor Component

Aluminum
Stamped
10 kg total seat mass
9 kg frame mass

Sedan/Hatchback
5 passenger
100 kg cargo
OAL=*4.5 m*
OAW=*1.7 m*
New architecture
Internal Combustion-gasoline
Powertrain is fixed and will not change
5.3 liter/100 km (US schedule)
Life time range =*155,000 km*

Purpose: To use the Sensitivity Analysis capability

1. Input data has been pre-loaded in the Design Advisor file distributed – use as is.
2. Go to Sensitivity Analysis and investigate parameter changes which may ‘flip’ relative GHG
   For convenience, use ±10 % changes in parametes

Important parameters____

Unimportant parameters____