Product Design Suite 2013

Eco Materials Advisor and Strategic Sustainability in Design Engineering

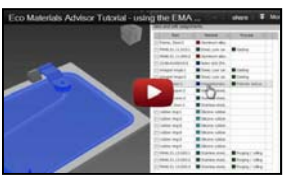
Exercise: Assess and find alternative Materials

In this exercise you will learn how to utilize the Eco Materials Advisor (EMA) in Autodesk® Inventor® software to evaluate the environmental impact of the design choices that you have set from within Autodesk Inventor. The EMA is a tool that will help quantify the environmental impacts of your assembly and search for alternative material options.

To complete the steps in this hands-on test drive you will need Autodesk® Product Design Suite 2013. If you are not currently a user, click here to download your free, 30-day trial of Autodesk® Product Design Suite Ultimate 2013.

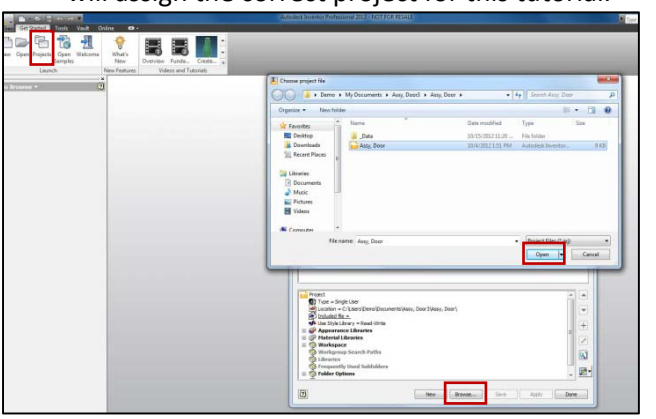
Before you start:

- For this exercise, you will need to have the assembly *'Assy, door.iam'*. Available here.
- Read the introduction to the Eco Materials Advisor in Inventor® by Granta Design here.
- Watch the short introductory videos and tutorial guide by clicking on a thumbnail below

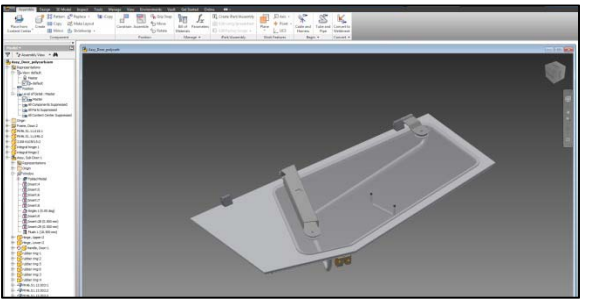


Open the Assy Door file and launch the EMA:

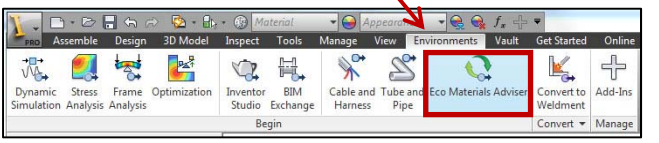
1. Open Autodesk® Inventor®, click on *'projects'* in the ribbon, click *browse* for the project file *'Assy, Door.ipj'*, click *open* and then select *done.* This will assign the correct project for this tutorial.



2. Select *file* then *open* and select *'Assy, Door .*
3. This is what the assembly should look like.



4. Open the Eco Materials Advisor (EMA). In Inventor, on the ribbon, click on the *'Environments'* tab and click on the *'Eco Materials Advisor'* icon.



5. The Eco Materials Advisor will open on the right hand side of the Inventor window.
6. The main toolbar is located at the top of the EMA window.

7. Take a few moments to familiarize yourself with the EMA toolbar features by hovering your pointer over each icon to activate a popup menu. Below is a list of each icon's features:

The **toolbar** provides access to the main functions and tasks. Hover over an icon to see the function name.

Home - returns to the Eco Materials Adviser homepage

View and edit assignments - shows the materials and processes currently assigned to each part, and allows you to assign new materials and processes

Browse - shows a tree view of your Eco Materials Adviser database, and allows you to browse for materials

Search - allows you to search for materials by name, or by material or environmental properties

Manage your favorites - allows you to view and edit a list of favorite materials

View dashboards - shows the results of an eco-impact analysis of your current design, in a visual format

View reports - allows you to view and print a PDF report of your analysis

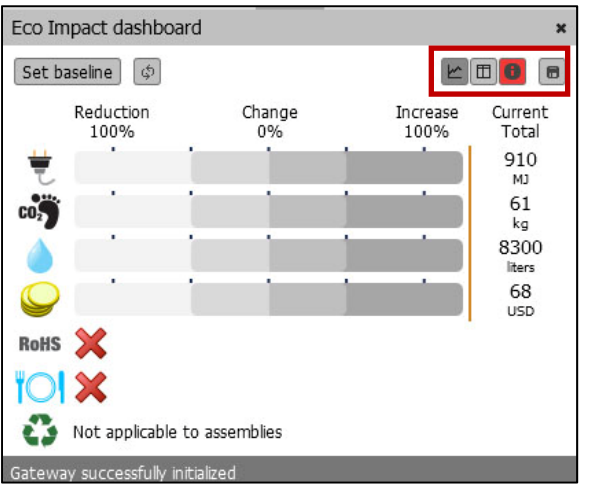
Settings - allows you to choose your preferred currency and unit system, and see your database settings

Help - opens the User Guide in a browser window

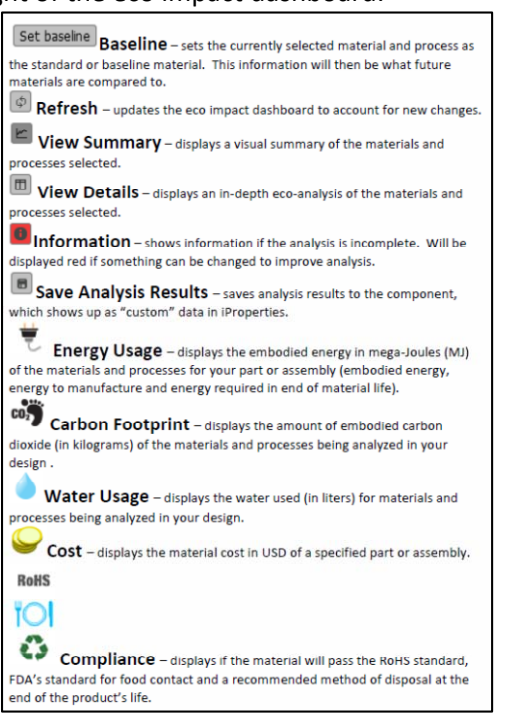
Review the data for the current assembly:

8. Select the *'view dashboards'* icon from the EMA toolbar.

9. The eco impact dashboard will appear is the bottom half of the EMA window

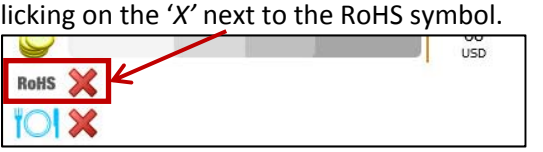


10. This is where you can review the results data once you start the comparison.
11. Familiarize yourself with the icons on the top right of the eco impact dashboard.

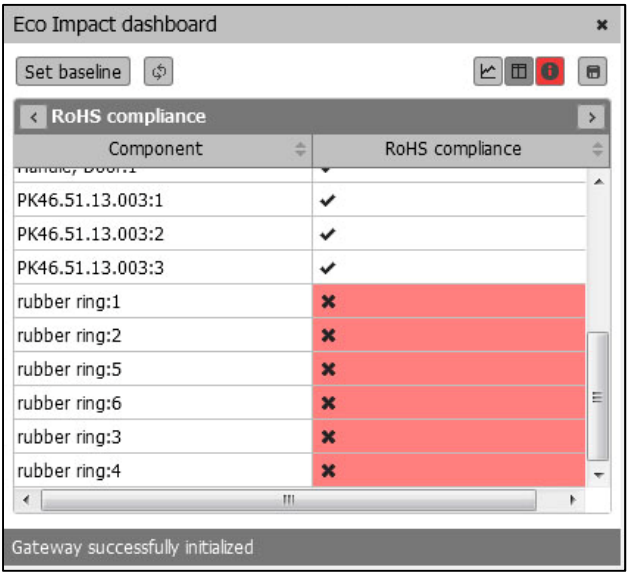


Browse for a material and assign to part:

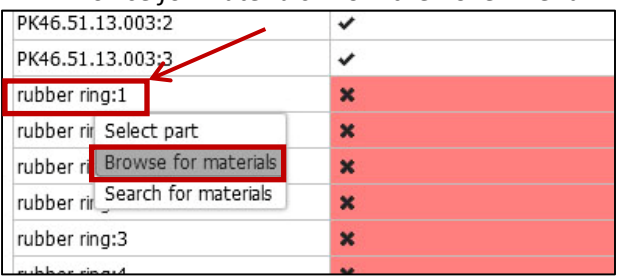
12. There is a red cross next to the 'RoHS' icon, this means the assembly is non-compliant with the Restriction of Hazardous Substances Directive. We can find out why and resolve the issue by clicking on the '*X*' next to the RoHS symbol.



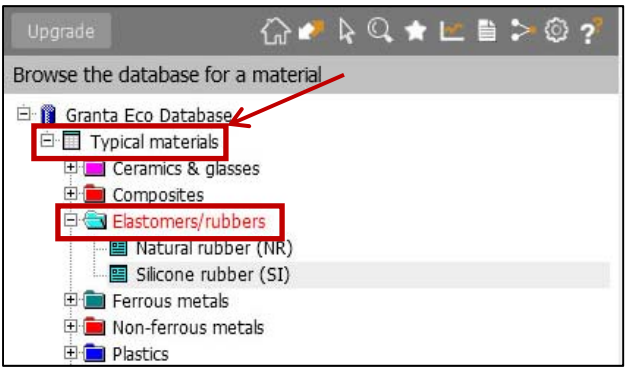
13. A table will appear. Scroll down till you see the red highlighted components. This is indicating that there is no material assigned to these components. You need to resolve this before you can continue.



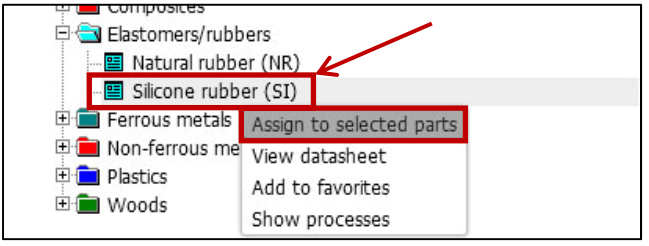
14. Left click on the *'rubber ring:1'* and click on *'Browse for materials'* from the hover menu.



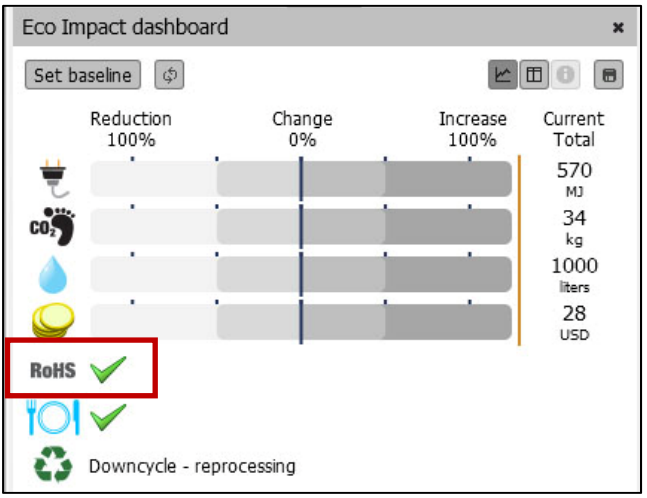
15. The browse option box will open at the top of the EMA window. Click on '*Typical materials'* then *'Elastomers/rubbers'.*



16. Click on *'Silicone Rubber'* from the hover menu, select '*Assign to selected parts'.*



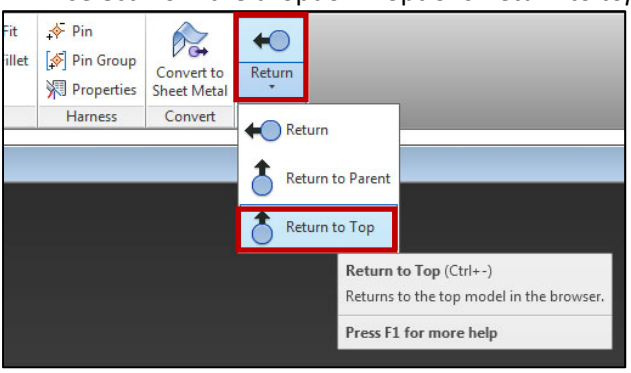
17. The bill of materials will update and the eco impacts dashboard will appear again indicating that your assembly would be RoHS Compliant*.



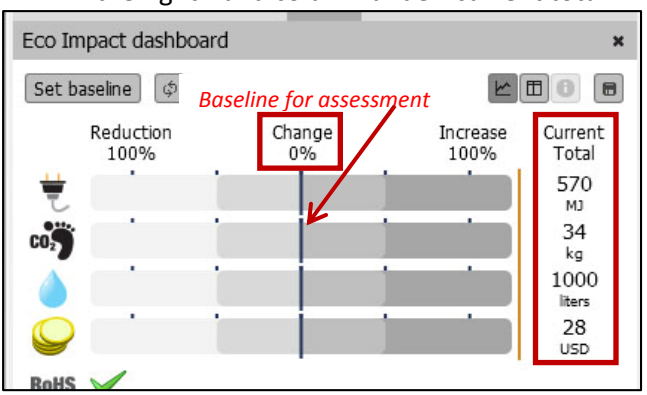
*The EMA provides an indication of RoHS compliance based on material choices assigned to your assembly – however it is best to obtain specific data from the manufacturer on RoHS compliance.

Set baseline for material comparison:

18. From the ribbon, click on the *'return'* icon and select from the dropdown options *'return to top'*.

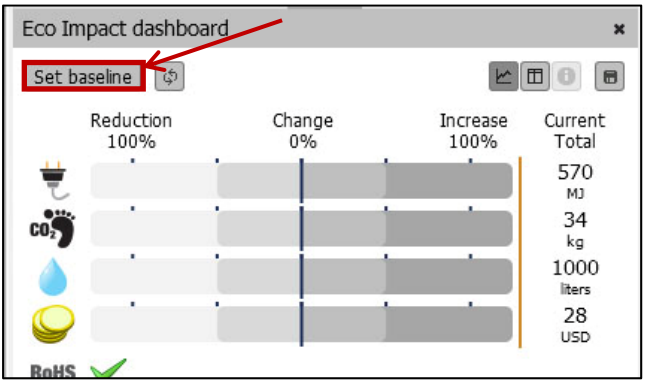


19. You will notice that currently there are no impacts on the graph in the eco impact dashboard - this is because you have not assigned a material to compare against yet.
20. There is data on the current assembly presented in the right-hand column under 'current total'.



21. The EMA works by informing you where environmental hotspots (the area with the largest impacts) are occurring in your current design and then assists in searching for lower impact alternative materials.
22. Once you have assigned a new material, you can make a comparison to see what environmental and cost savings your material substitution would have.

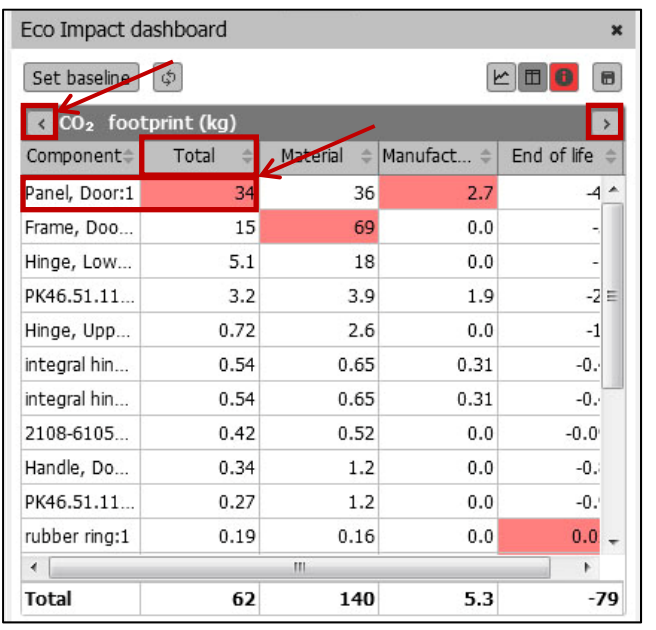
23. All the parts now have materials assigned so you can set a baseline to compare against, then, once you have searched for and assigned a material alternative, the EMA graph will update with the impact savings.
24. In the EMA Eco Impact Dashboard, click on the *'Set baseline'* button. This will set the baseline.



Review eco hotspot for current design:

25. You now need to find out where the eco hotspots are for our current design. Click on the *'Co_2'* icon in the eco impact dashboard.

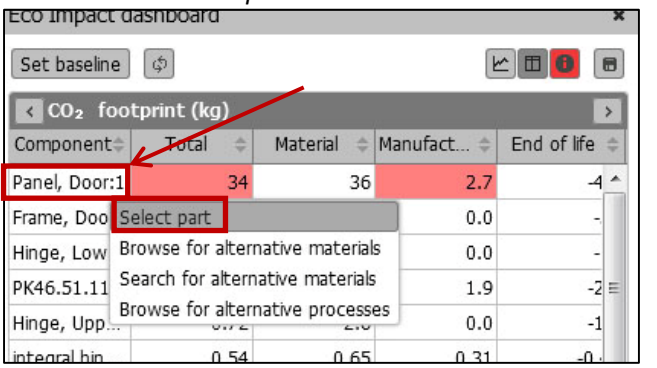
26. You will now see the carbon footprint for the entire assembly, the highlighted red sections are the eco hotspots indicted by the EMA.
27. You can scroll through the other impact categories (energy, water and cost) by clicking the arrows in the corners.



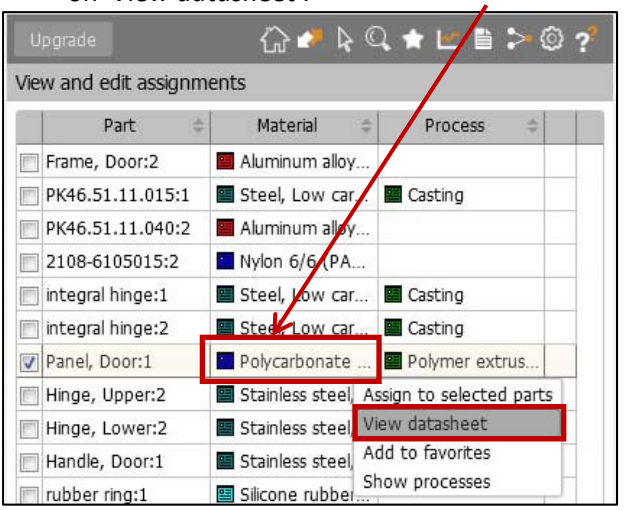
28. The eco hotspot is identified as being in the 'window' part of the design (*Panel, door1*) with a total point score of '34'. You can now review the datasheet on the part's material.

Review a material datasheet:

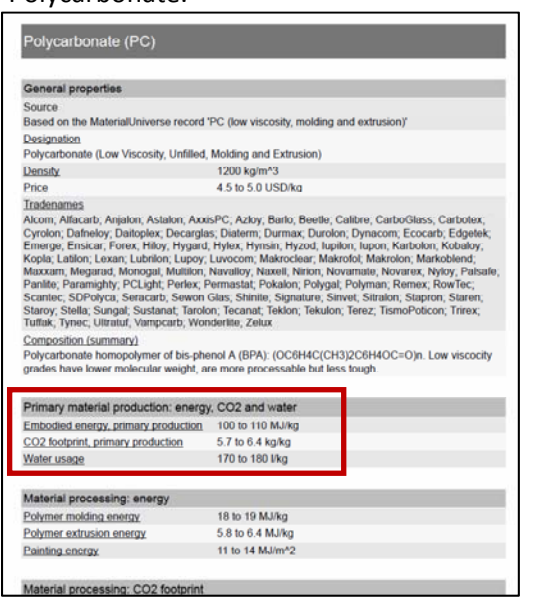
29. Click on *'Panel, Door1'* and from the hover menu click on *'select part'.*



30. In the top part of the EMA a list of materials will appear. From the '*panel, door:1'* line, click on the *'Polycarbonate'* and from the hover menu click on *'View datasheet'.*



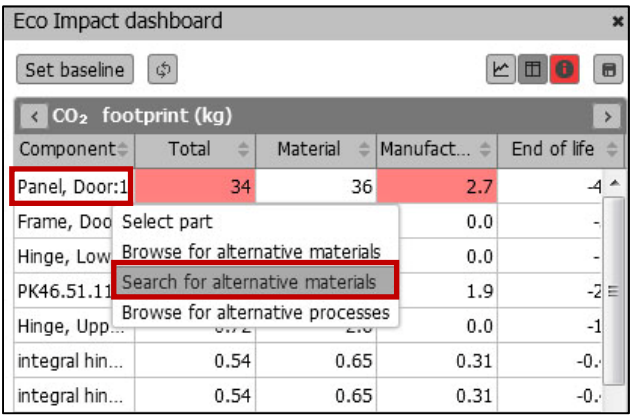
31. A PDF datasheet will open and you can review the associated environmental impacts for Polycarbonate.



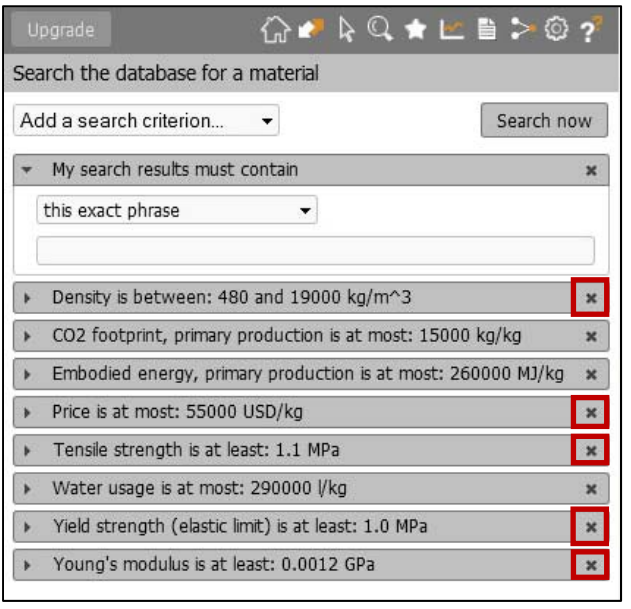
32. On the first page you will see the impact categories (Co_2, energy, water) with hyperlinks to detailed information on these categories.
33. You are interested in the section titled *'Primary Material Production'.* This gives you a benchmark for seeking alternative, lower impact materials in the EMA.
34. You can see that the CO_2 footprint is high (5.7 to 6.4 kg/kg), as is the water inputs - you will use this data as your search criteria for finding an alternative material to the polycarbonate.
35. Keep the PDF open and return to the EMA. You can now search for a lower impact material alternative for the window part.

Search for an alternative material:

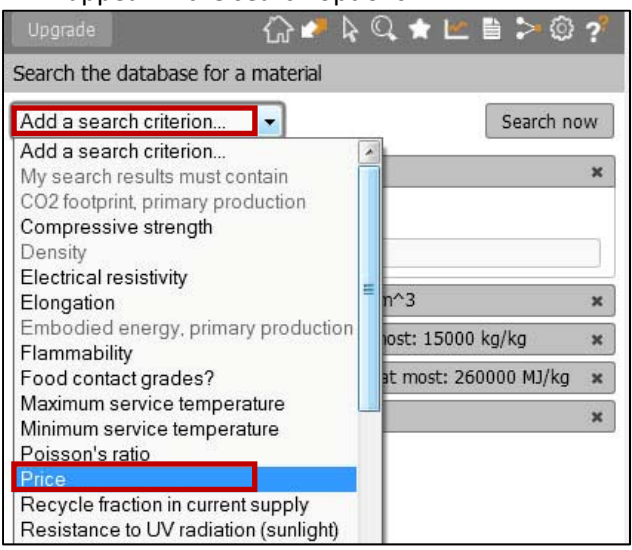
36. In the eco impact dashboard click *'Panel, Door:1*' and from the hover menu select, *'Search for alternative materials'.*



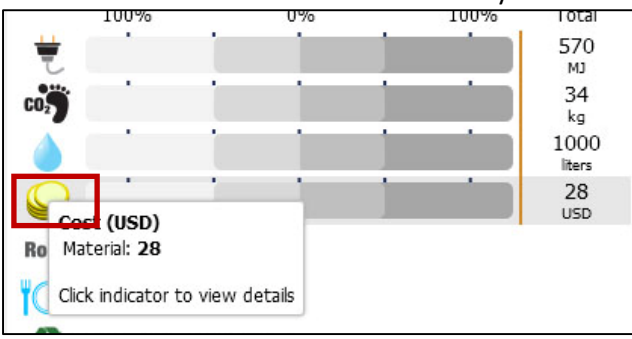
37. The search options will appear in the top section of the EMA window.
38. There are a variety of search criteria that can be used to find an alternative material. However, you will not be using all the search criteria so you can remove it from the list. Click on the 'x' in the corner of the search criteria shown below:



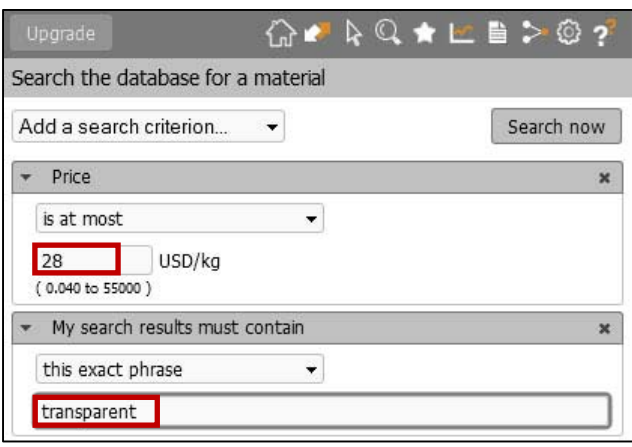
39. It will be useful to look for a material that is cost comparative to your existing design, so you need to re-add the cost option.
40. Click on the dropdown box at the top that's says *'Add a search criterion'*, select *'Price'*. It will re appear in the search options.



41. Hover your mouse over the money symbol in the eco impact dashboard and you will see that $28 is the estimated cost of the assembly.



42. You can use this as an upper limit for your search. In the *'Price'* section type *'28'* under *'is at most'*.
43. One of the core functions of the 'window' in your assembly is to let light in so you want to restrict your search to only transparent materials. Type *'Transparent'* into the field under in the box *'My search results must contain'*.

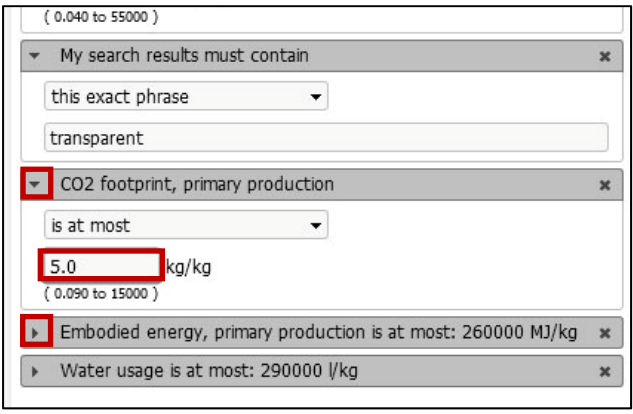


44. Expand the search option *'CO_2 footprint'* by clicking on the small arrow to the left.

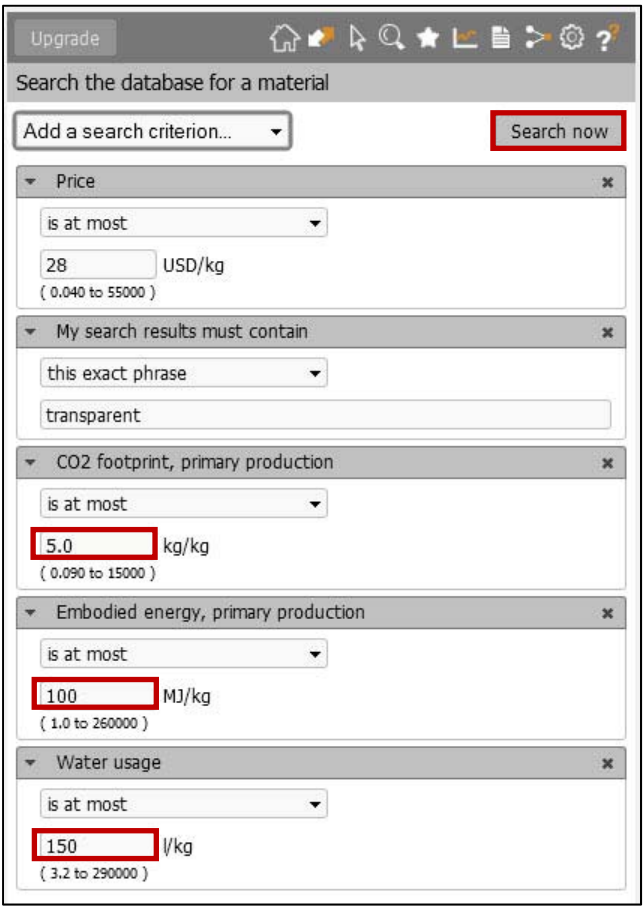
45. Refer back to the Polycarbonate PDF under the CO_2 footprint it says between 5.7 to 6.4 kg/kg.

Primary material production: energy, CO2 and water	
Embodied energy, primary production	100 to 110 MJ/kg
CO2 footprint, primary production	5.7 to 6.4 kg/kg
Water usage	170 to 180 l/kg

46. Back in the EMA enter *'5.0'* where it currently has the default of *'1500'.*

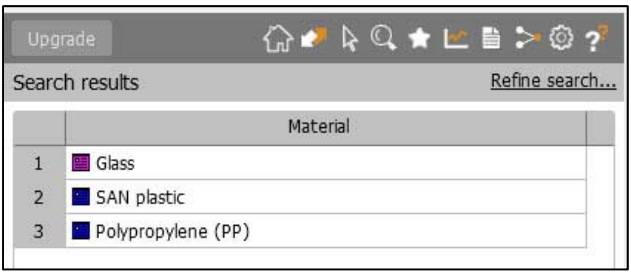


47. You can use the rest of the data in the polycarbonate datasheet as a guide for your search since you are seeking to reduce the impacts of the polycarbonate.
48. Fill the in the rest of the fields to be identical to the image below. *Water: 150,* and *Energy: 100.* Then click *'search now'* and the EMA will search for materials based on the criteria.

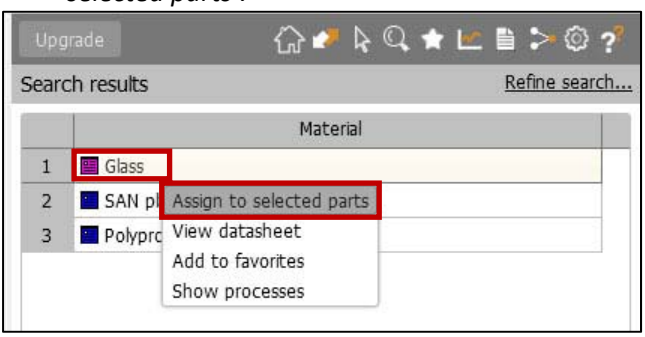


Assign a new material to a part:

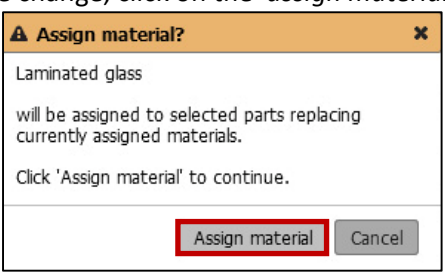
49. Three options will appear (the free version of the Eco Materials Advisor only has access to a 50 basic materials in the database – upgrade here for access to the full materials universe.



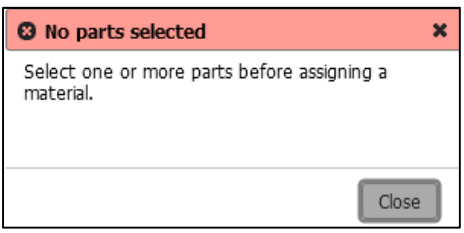
50. Click on *'Glass',* from the menu select *'Assign to selected parts'.*



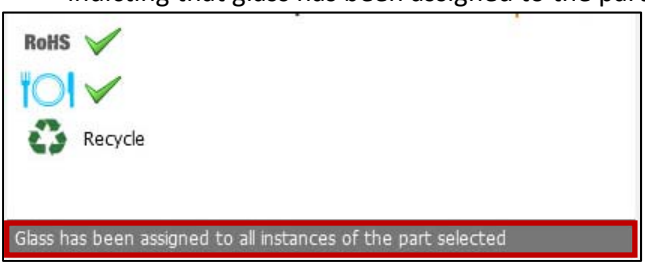
51. This dialog box will appear asking you to confirm the change, click on the *'assign material'* button.



52. *If you get error message below, your part has been deselected, click 'close', and repeat steps 33 onwards.*

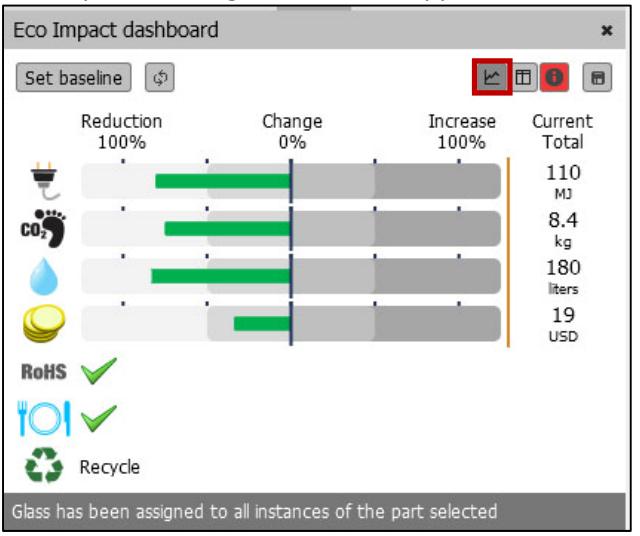


53. A message will appear at the base of the EMA indicting that glass has been assigned to the part.

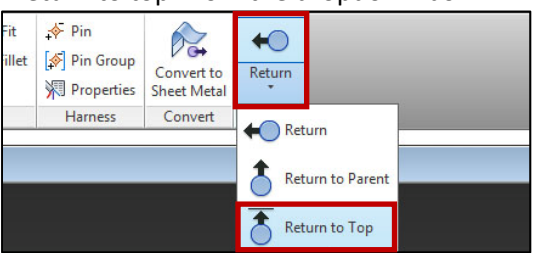


Review the material comparison results:

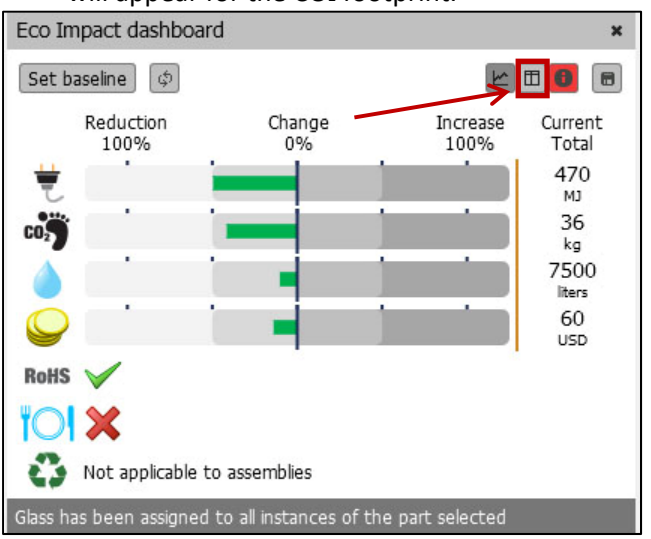
54. In the eco impact dashboard you will see it has updated and green lines will appear.



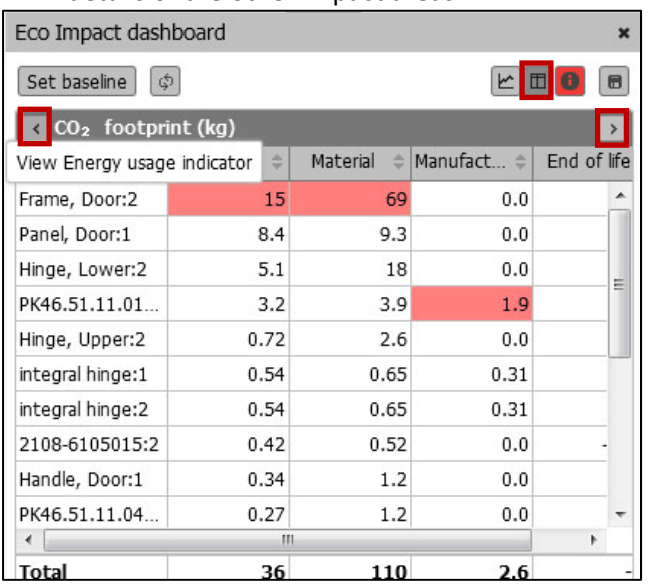
55. Previously you set the baseline for the polycarbonate design so the data you are viewing is the comparison between the new material, glass and the version with the polycarbonate.
56. You can see that there is an improvement in the embodied energy and carbon footprint, and a 14% lower estimated cost of production
57. These results are just for the window, you can also check the impact of the entire assembly.
58. Click on 'Return' in the Inventor ribbon, click on 'Return to top' from the dropdown box.



59. The Eco Impact Dashboard will update and present results for the entire assembly.
60. Click on the table icon and the list of materials will appear for the CO_2 footprint.

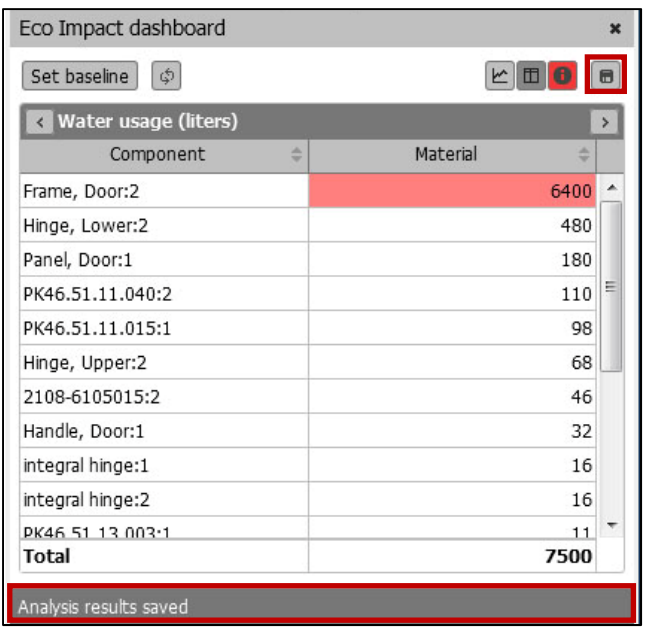


61. You will see that the CO_2 footprint for the window has dropped to 15, but still has one of the largest impacts for the assembly mainly due to the mass/size of the part.
62. Click through the arrows in the corners to see the details of the other impact areas



Save your analysis to your assembly:

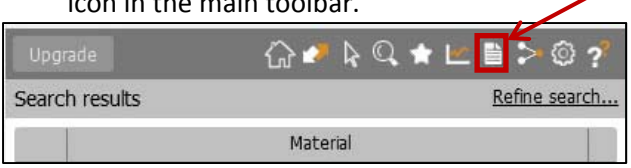
63. Save your analysis results to your assembly by clicking on the save icon in the top right-hand corner.



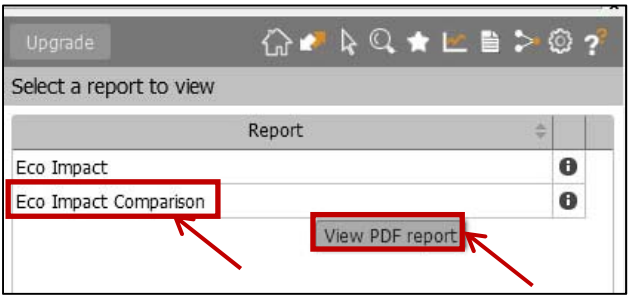
64. A notification of the Analysis being saved will appear at the bottom.

Generate a comparison report:

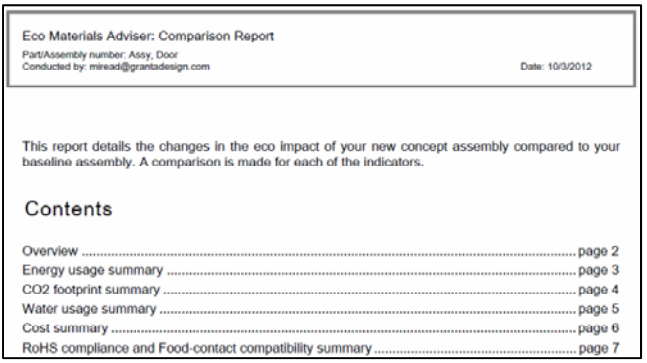
65. To view the full details of the materials assessment and comparison, click on the report icon in the main toolbar.



66. Click on *'Eco Impact Comparison'* and from the menu select *'View PDF report'.*



67. A PDF report will open in Adobe.


Eco Materials Adviser: Comparison Report

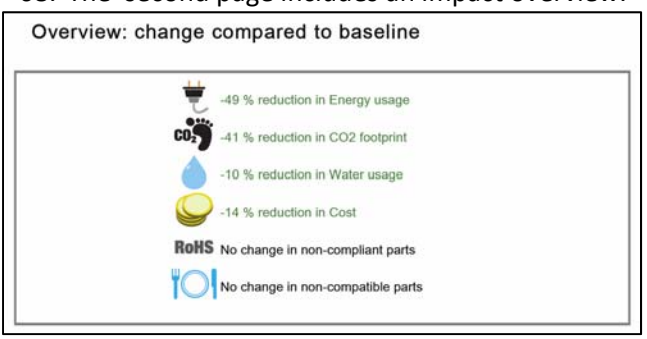
Part/Assembly number: Assy, Door
Conducted by: miread@grantadesign.com
Date: 10/3/2012

This report details the changes in the eco impact of your new concept assembly compared to your baseline assembly. A comparison is made for each of the indicators.

Contents

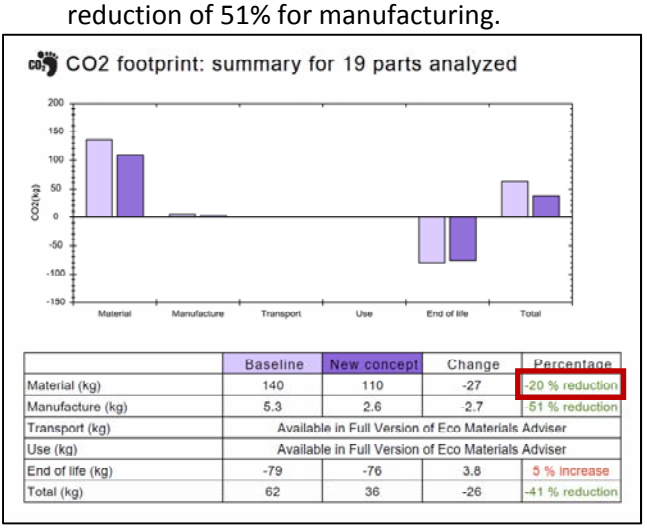
Overview ..... page 2
Energy usage summary ..... page 3
CO2 footprint summary ..... page 4
Water usage summary ..... page 5
Cost summary ..... page 6
RoHS compliance and Food-contact compatibility summary ..... page 7

68. The second page includes an impact overview.


Overview: change compared to baseline

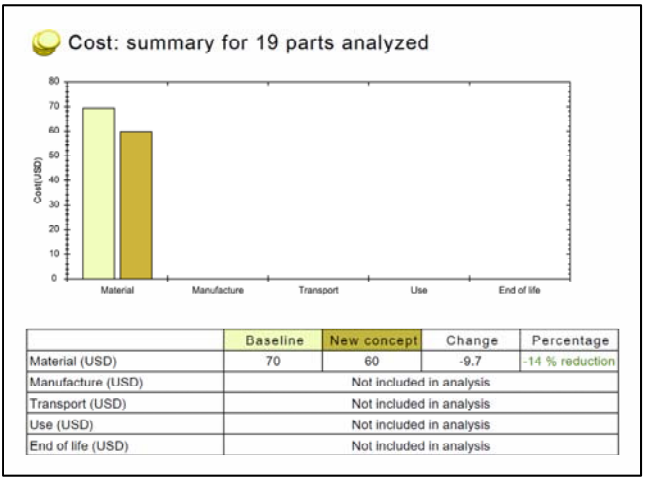
-49 % reduction in Energy usage
-41 % reduction in CO2 footprint
-10 % reduction in Water usage
-14 % reduction in Cost
RoHS No change in non-compliant parts
No change in non-compatible parts

69. More details are presenting such as the impacts across the main life cycle stages (there is no data for transport or use as they are only available in the full version of the EMA).
70. You can view the CO_2 savings and see that there has been a 20% reduction in the embodied impacts of material production and a significant reduction of 51% for manufacturing.


CO2 footprint: summary for 19 parts analyzed

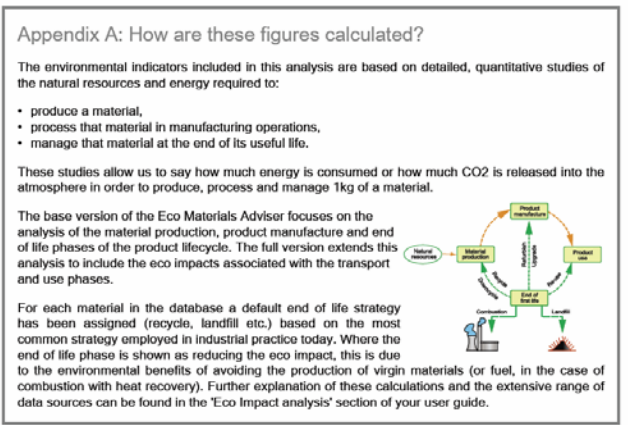
	Baseline	New concept	Change	Percentage
Material (kg)	140	110	-27	-20 % reduction
Manufacture (kg)	5.3	2.6	-2.7	-51 % reduction
Transport (kg)	Available in Full Version of Eco Materials Adviser			
Use (kg)	Available in Full Version of Eco Materials Adviser			
End of life (kg)	-79	-76	3.8	5 % increase
Total (kg)	62	36	-26	-41 % reduction

71. You can view the cost reduction for the raw material and see that it has decreased by 14% (this is an estimate).



	Baseline	New concept	Change	Percentage
Material (USD)	70	60	-9.7	-14 % reduction
Manufacture (USD)	Not included in analysis			
Transport (USD)	Not included in analysis			
Use (USD)	Not included in analysis			
End of life (USD)	Not included in analysis			

72. The appendix includes information on how the results are calculated.



Appendix A: How are these figures calculated?

The environmental indicators included in this analysis are based on detailed, quantitative studies of the natural resources and energy required to:

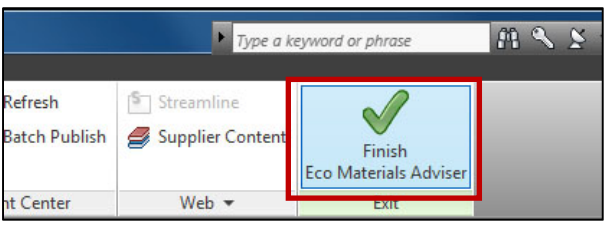
- produce a material,
- process that material in manufacturing operations,
- manage that material at the end of its useful life.

These studies allow us to say how much energy is consumed or how much CO2 is released into the atmosphere in order to produce, process and manage 1kg of a material.

The base version of the Eco Materials Adviser focuses on the analysis of the material production, product manufacture and end of life phases of the product lifecycle. The full version extends this analysis to include the eco impacts associated with the transport and use phases.

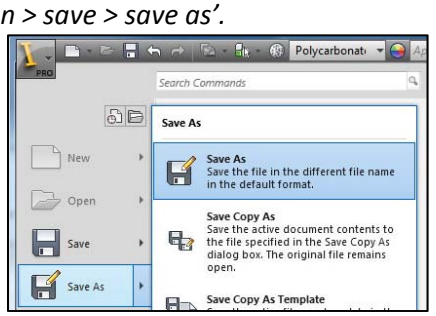
For each material in the database a default end of life strategy has been assigned (recycle, landfill etc.) based on the most common strategy employed in industrial practice today. Where the end of life phase is shown as reducing the eco impact, this is due to the environmental benefits of avoiding the production of virgin materials (or fuel, in the case of combustion with heat recovery). Further explanation of these calculations and the extensive range of data sources can be found in the 'Eco Impact analysis' section of your user guide.

73. Save your PDF report (*File > save as > PDF*) as this can be attached to Vault files or used later for further comparisons.
74. To exit the EMA, up on the ribbon, click on the 'Finish Eco Materials Advisor'.



Save assessment:

75. Create a 'save as' version of your assessment to demonstrate the design iteration.
76. In Inventor in the top left hand corner click on *'I icon > save > save as'.*



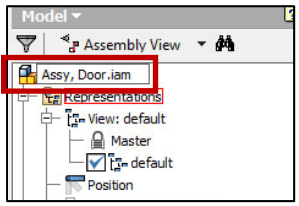
77. Save as *'Assy_Door_Glass'.*

Exercise 2: Dematerialization

Since you have changed the material type, you can now consider how you can make changes to the design to further reduce the environmental impacts by using eco-design strategies.

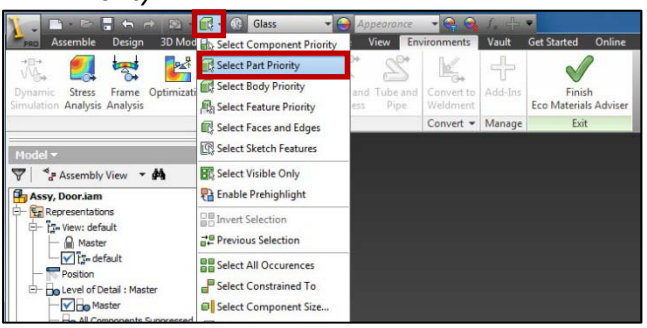
Consider which eco-design strategy is relevant:

78. You could consider a variety of eco design strategies such as *lightweighting* and *dematerialization* – especially for the glass window since the material change would have increased the mass.
79. Let's reduce the thickness of the glass window to see if this will affect the eco impact. The EMA does not let you compare between assemblies at this stage, but you can generate separate reports, from separate part files, for your design interactions and compare the results.
80. In Autodesk® Inventor®, make sure you have the '*Assy_door*' assembly open, that the entire assembly is active (in the browser click on the *Assy,Door* at the top of the assembly tree) and that the Eco Materials Advisor is closed (from the ribbon select '*Finish Eco Materials Adviser*').

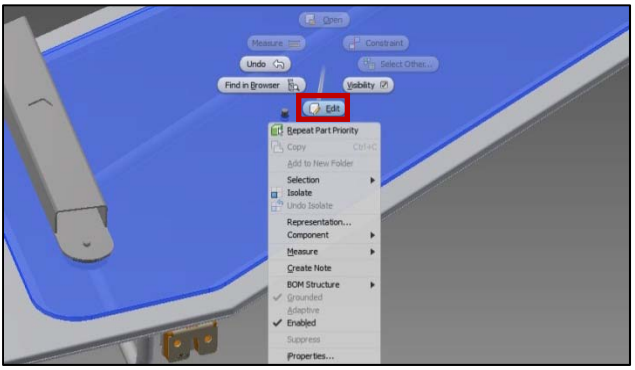


Reduce material thickness:

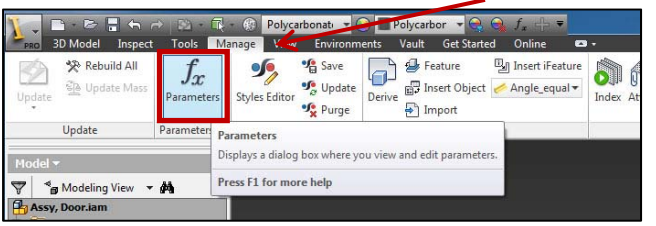
81. Click on the component priority dropdown located above the ribbon, click on '*Select Part Priority*'.



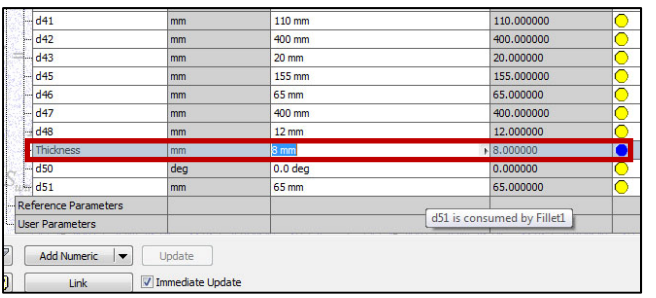
82. Click on the window component within the assembly, right click and select *'edit'*.



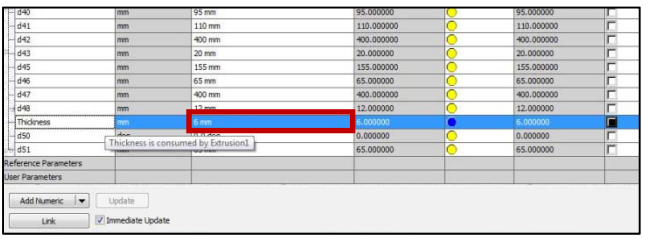
83. Select the *'Manage'* tab from the ribbon and click on the '*Parameters'* icon.



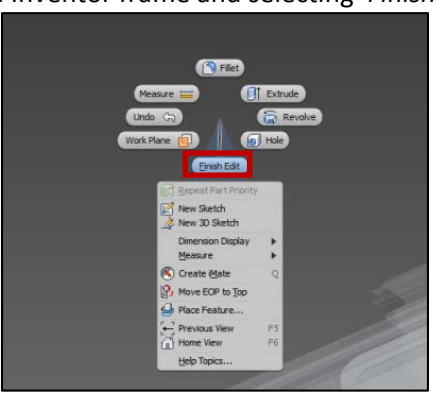
84. From the parameters window, scroll down until and select 'thickness'.



85. Where is shows 8 mm under the '*equation*' column, change the number to '*6 mm' and* click *'done'.*

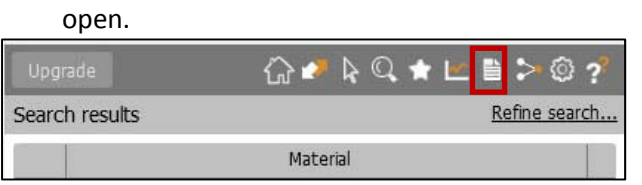


86. Deselect the part by right clicking anywhere in the Inventor frame and selecting *'Finish edit'.*

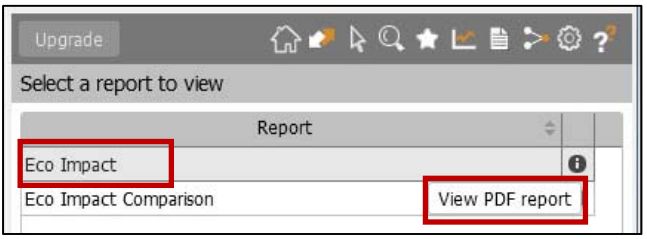


Generate new report in the EMA:

87. From the ribbon, click on the '*Environments'* tab and select *'Eco Materials Advisor'.* The EMA will open.



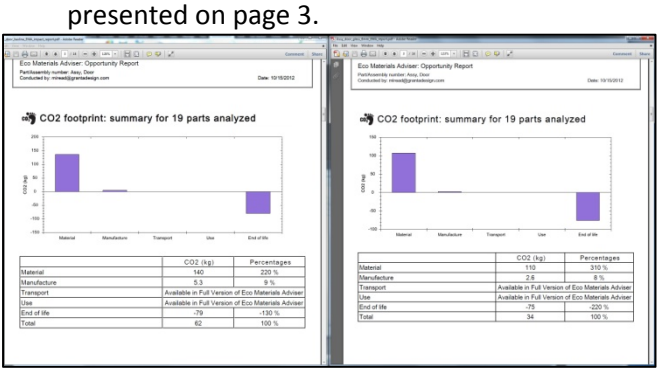
88. Click on the report icon from the tool bar and select '*Eco Impact'* then *'view PDF report'.* A PDF will open with the report for your assembly with 6mm thick glass.



Tip: Be sure to name your PDF reports with clear descriptions of your design analysis so that you can review and compare with ease later. Include material used, design iteration name ect. This will make it easier to keep track of your different 'analysis runs' and you can then upload PDF reports to assembly files in Vault.

Compare Eco Impacts Report for window part:

89. Open the PDF titled *'Assy_door_baseline_EMA_Report'* from the tutorial pack folder and compare the environmental impacts for the carbon emissions presented on page 3.



90. You can see that there has been a reduction in the carbon footprint for the window part from 140kg to 110kg as a result of reducing the material thickness.

Learning outcomes:

From completing the tutorials you have learnt:

- ✓ How to open and navigate the Eco Materials Advisor
- ✓ Obtained an overview of how the EMA works
- ✓ Assigned materials to parts in the EMA
- ✓ Reviewed eco material datasheets
- ✓ Identified the eco hotspots of the assembly
- ✓ How to search for alterative materials in the EMA based on baseline data
- ✓ Generating comparison reports
- ✓ Review and interpret results

What Next:

If you are interested in learning more about the EMA or upgrading to the full version click here.

To find out more about strategic sustainable design click on one of the topic areas below:

> Life cycle thinking
> Life cycle assessment
> Eco design strategies