Advanced Databases in Ansys Granta EduPack software

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University of Cambridge

Cellular structures

Composites

Sandwich structures

Multi-layers

Part cost estimator

Battery Designer

Learning objectives for this lecture unit

Ansys software mentioned	• Ansys Granta EduPack™, a teaching software for materials education

Intended Learning Outcomes	
Knowledge and Understanding	Knowledge about the Advanced Databases
Skills and Abilities	Ability to find advanced material properties and use them in a structured way alongside advanced tools
Values and Attitudes	Appreciation of the complexity of advanced industrial applications

Resources

- White Papers: White Papers describing databases available via the Ansys Education Resources webpage
- Software: *Ansys Granta EduPack*
- A number of *Advanced Industrial Case Studies* available via the Ansys Education Resources webpage

Outline of the lecture unit






- **Available databases and tools**
- **The advanced level**
- **Database overview and subsets**
- **External and temperature dependent data**
- **Sustainability**
- **Advanced Ansys Granta EduPack software tools and capabilities**
- **Advanced Industrial Case Studies**

Advanced databases and tools

Advanced

Level 3 Standard Database

Extra data in:

- Bioengineering
- Polymer
- Aerospace
- Eco Design
- Sustainability

Tools Available:

- Eco Audit
- Enhanced Eco Audit
- Synthesizer
- Engineering Solver
- Find Similar
- Comparison Tables

Standard

Eco Audit

Bioengineering

Eco Audit | Solver | Synthesizer | Find Similar | Comparison Table

Polymer

Eco Audit | Solver | Synthesizer | Find Similar | Comparison Table

Aerospace

Eco Audit | Solver | Synthesizer | Find Similar | Comparison Table

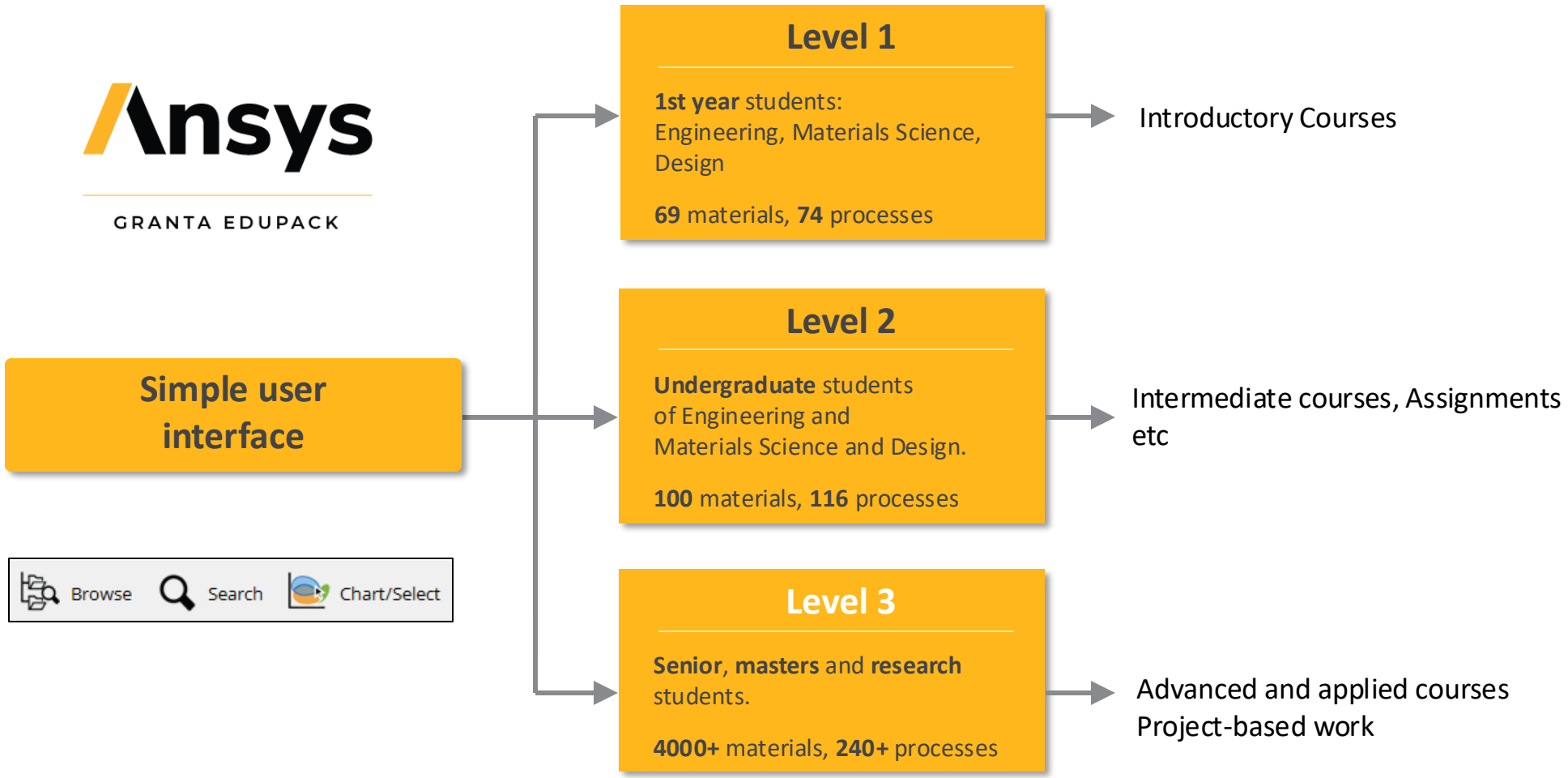
Eco Design

Eco Audit | Solver | Synthesizer | Find Similar | Comparison Table

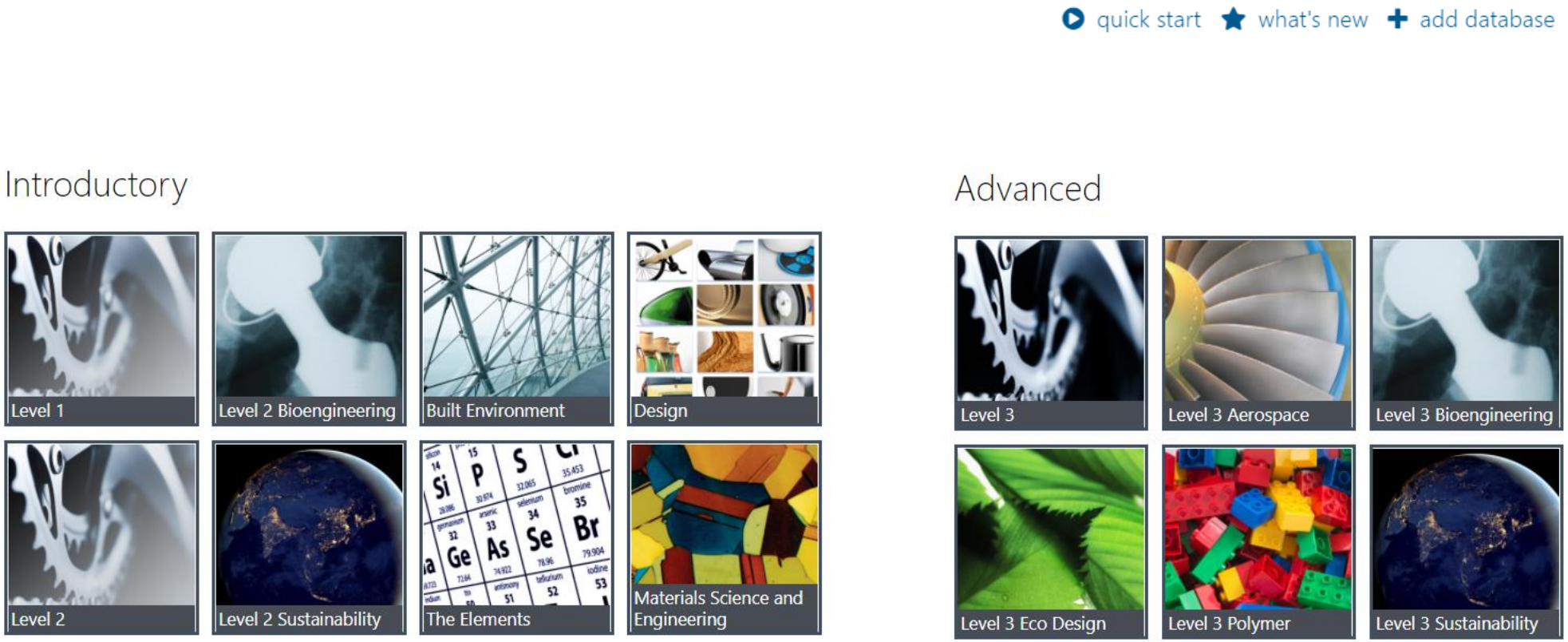
Sustainable Development

Eco Audit | Solver | Synthesizer | Find Similar | Comparison Table

Ansys Granta EduPack software level structure



Ansys Granta EduPack software 2025R1 Databases



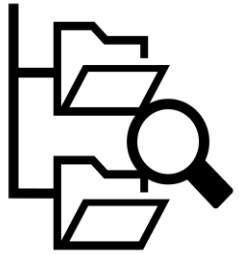
What Databases do you have?

Level 3 Standard database

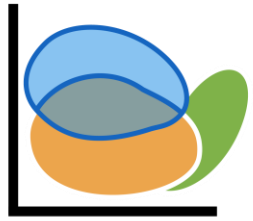
Data:

- Material Universe
  - More than 4,200 Materials and 240 Process records
  - More than 60 engineering properties for each
- Around 100 records for automotive alloys
  - Aluminum alloys (2008.2036, 5182, 6111)
  - Magnesium alloys (AE44, AM60, AS41)
  - High-strength steels (Dual phase/HSLA/Mn-B)
  - Automotive composites (Polyester and Polyamide matrix)

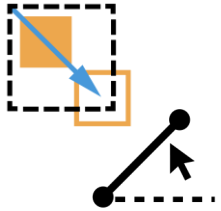
Standard Level 3 EduPackTools:



Reliable data



Charting tools



Materials selection tools

Ansys EDUCATION RESOURCES

Teaching Resources

Eco Audit Tool

Subsets

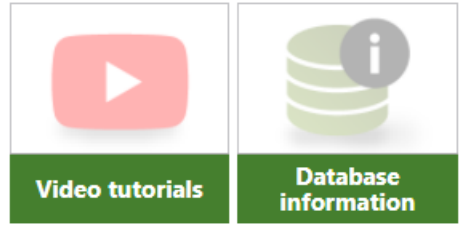
All major material classes including: fibers, particulates, foams and biomaterials

Engineering **materials** – suitable for most design and build projects.

Magnetic materials with remanence, saturation induction, coercive force etc.

500+ Hardwoods, softwoods, tropical, palms, particleboard, fiber board, and plywood

More information



More resources

Level 3 Bioengineering database

Data:

- Additional biological materials and data (4200+ materials and 240+ processes total)
- Data for Medical grades, Medical trade-names, and Sterilizability
- Link to ASM Medical Materials online data
  - Biomedical response data with medical device application information (Orthopaedic, Cardiovascular, Neurological)
- Bio-related subsets
  - Biological, Natural and Biological materials, Bio-derived, Bio-polymers, Bio-medical, Bioceramics
- Information on Medical devices, including over 100 FDA examples linked to relevant materials

Also available in Level 2

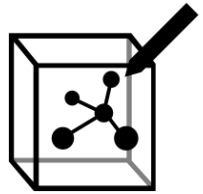
Tools:

Standard Level 3 Tools

ASM Medical Materials

Enhanced Eco Audit

Comparison Table

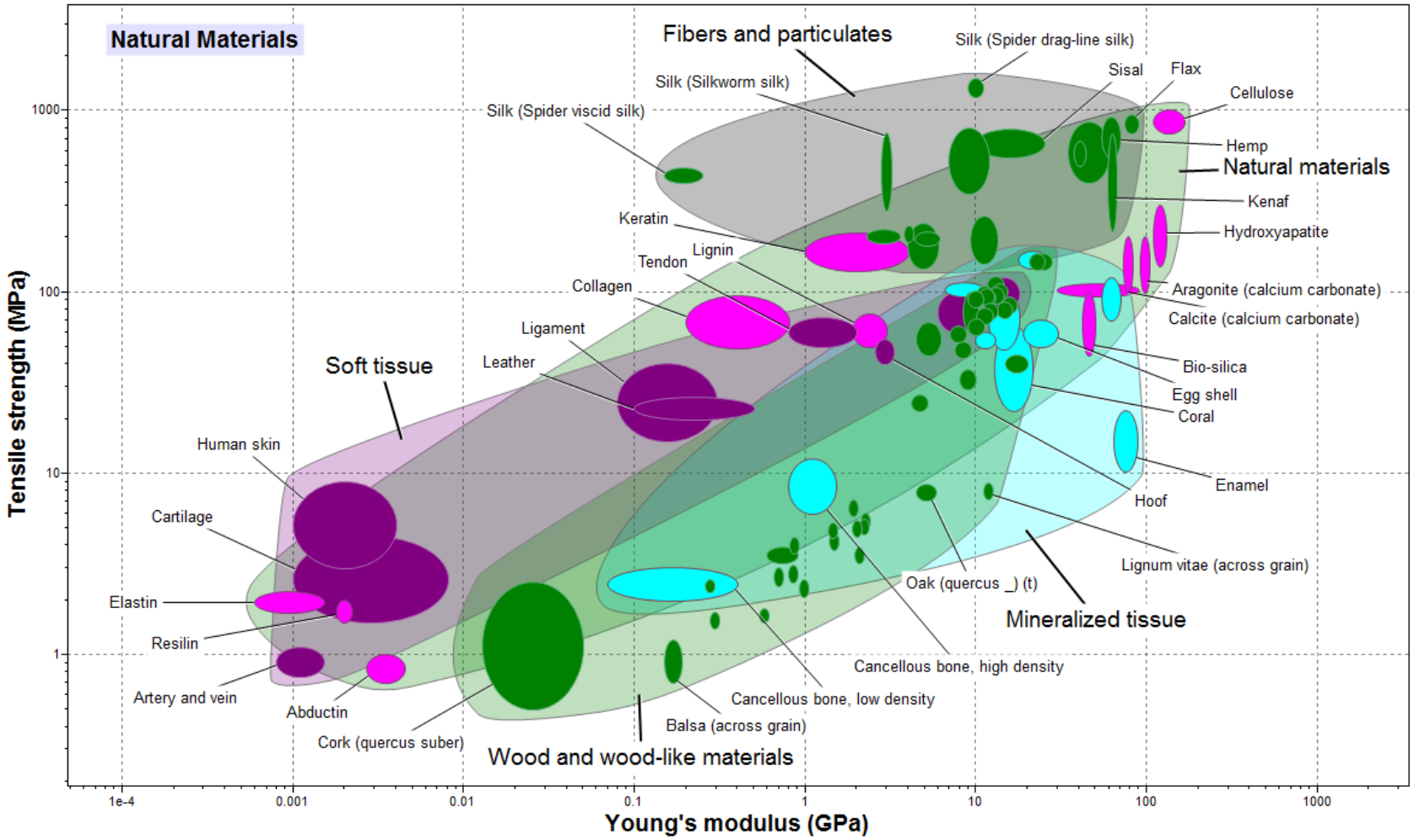


Synthesizer Tool

Engineering Solver

Find Similar

Example of materials in Bioengineering



Level 3 Polymer database

Data:

- MaterialUniverse – 970+ polymer records
  - Includes ChemRes data for resistance to chemical environments.
- Global Polymers Plastics
  - 105,000+ datasheets for commercial polymer grades from suppliers Meeting ASTM or ISO standards.

Tools:

Standard Level 3 Tools

Enhanced Eco Audit

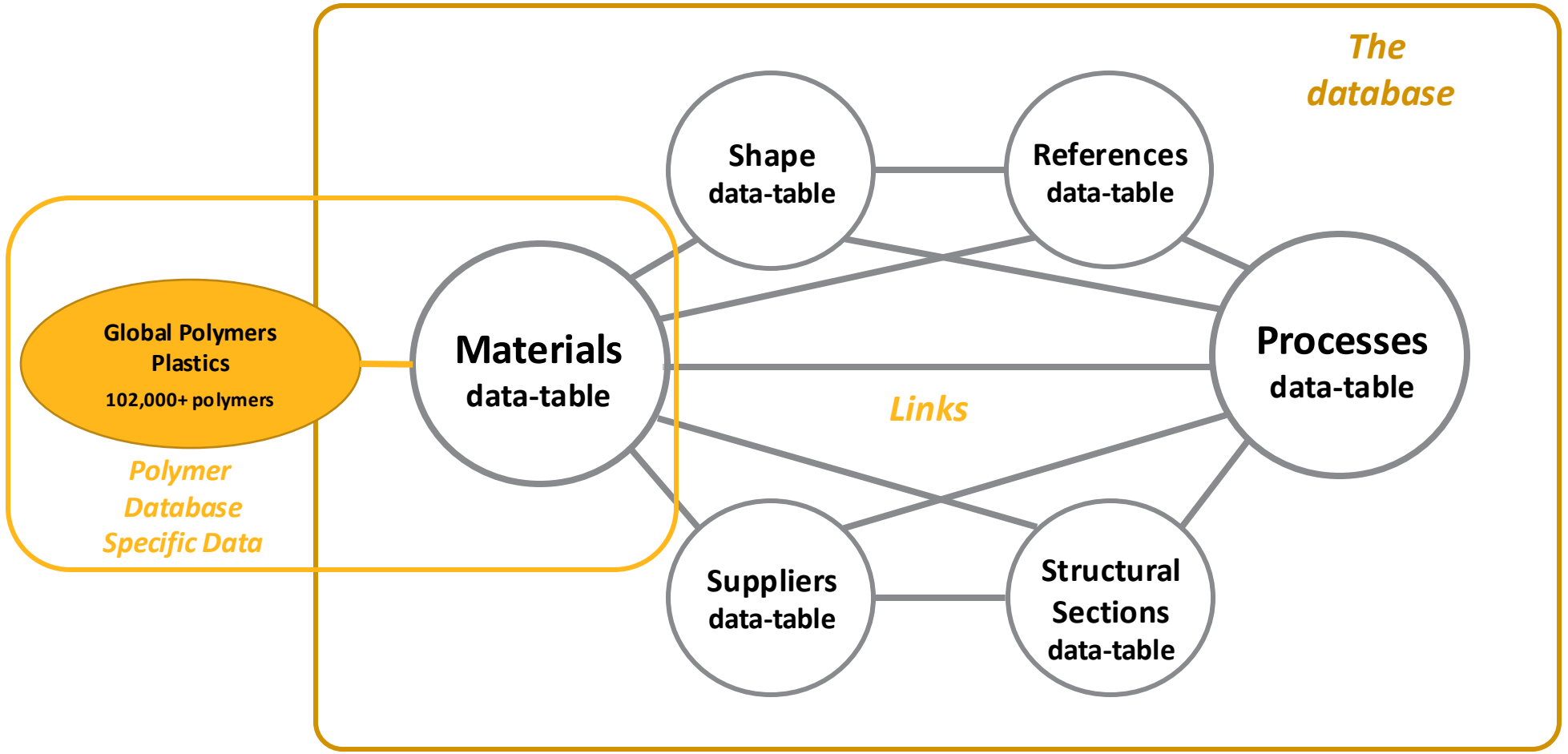
Synthesizer Tool

Comparison Table

Find Similar

Engineering Solver

Granta EduPack Polymer Database structure



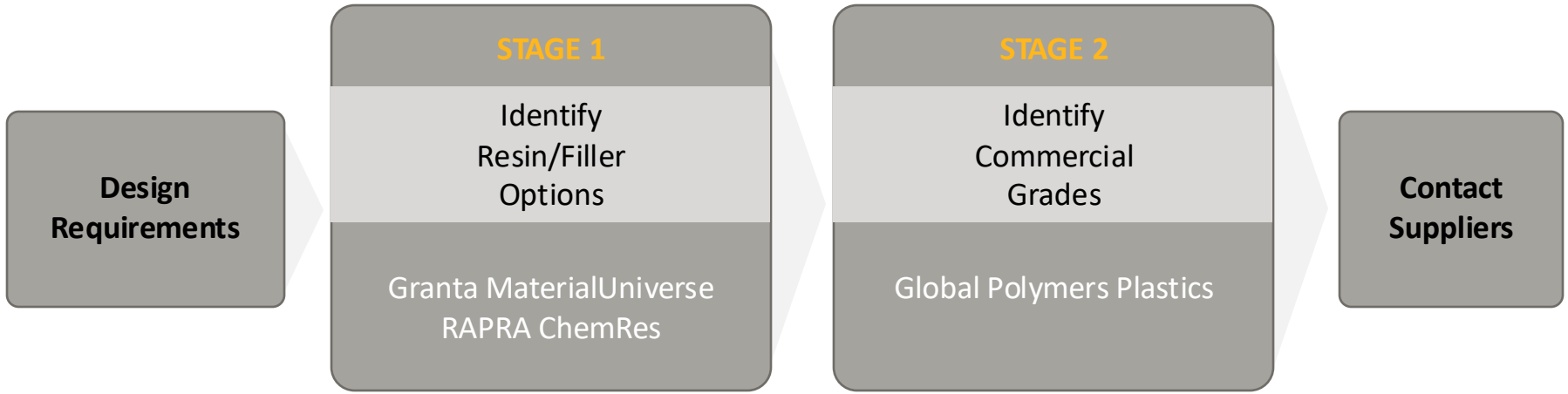
Using the Polymer modules

- **MaterialUniverse**

  Designed for primary, broad materials selection. Enables generic candidates (resin and filler type) to be easily identified.

- **Global Polymers Plastics**

  Once the resin and filler type are known these can be used to find specific commercial grades and possible vendors.



Level 3 Aerospace database

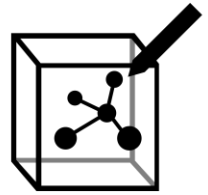
Data:

- Materials Data Tables *(Material Universe)*
  - Additional 'Aerospace Materials' subset with 950+ records with many showing temperature dependent mechanical properties from the MMPDS database
- MMPDS – Metals *(formerly MIL-HDBK-5)*
  2500+ records of statistically-derived design data for aerospace alloys, temperature dependent properties, fatigue curves, and corrosion rankings.
- *MIL-HDBK-17* – Composites
  950+ records of test data for polymer matrix, metal matrix, and ceramic matrix composites.

Tools:

Standard Level 3 Tools

Enhanced Eco Audit



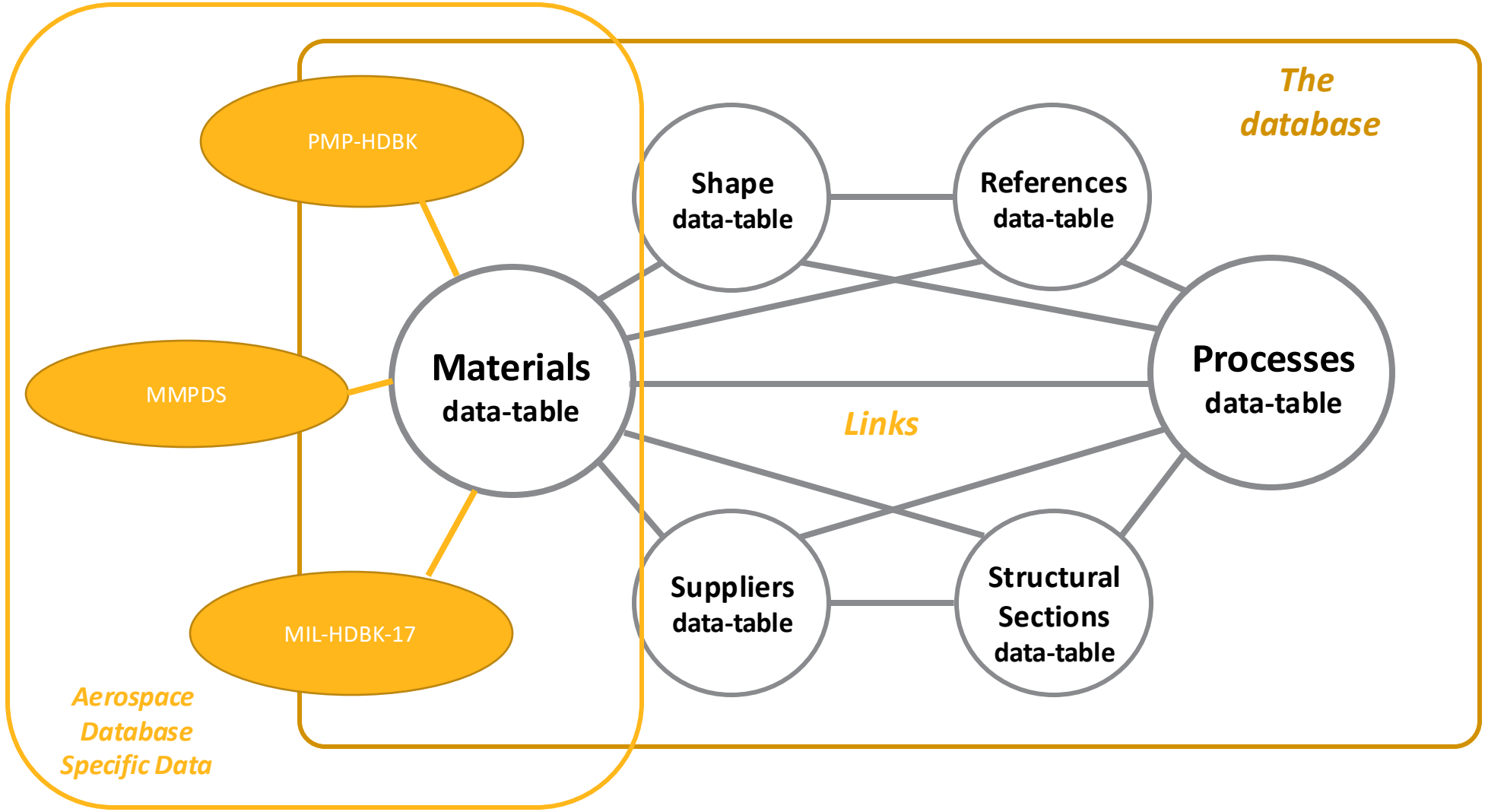
Synthesizer Tool

Comparison Table

Find Similar

Engineering Solver

Granta EduPack Aerospace database structure

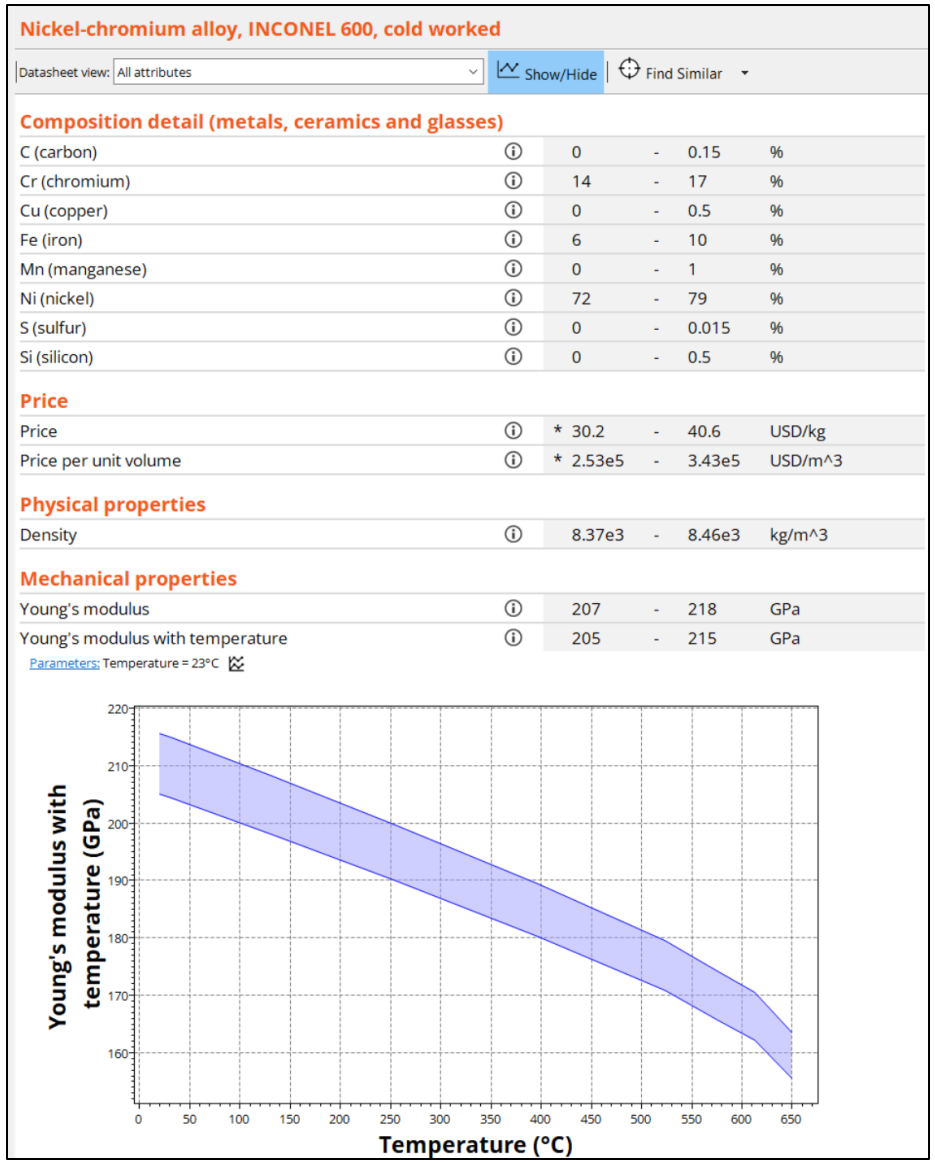


Materials Universe – Aerospace subset

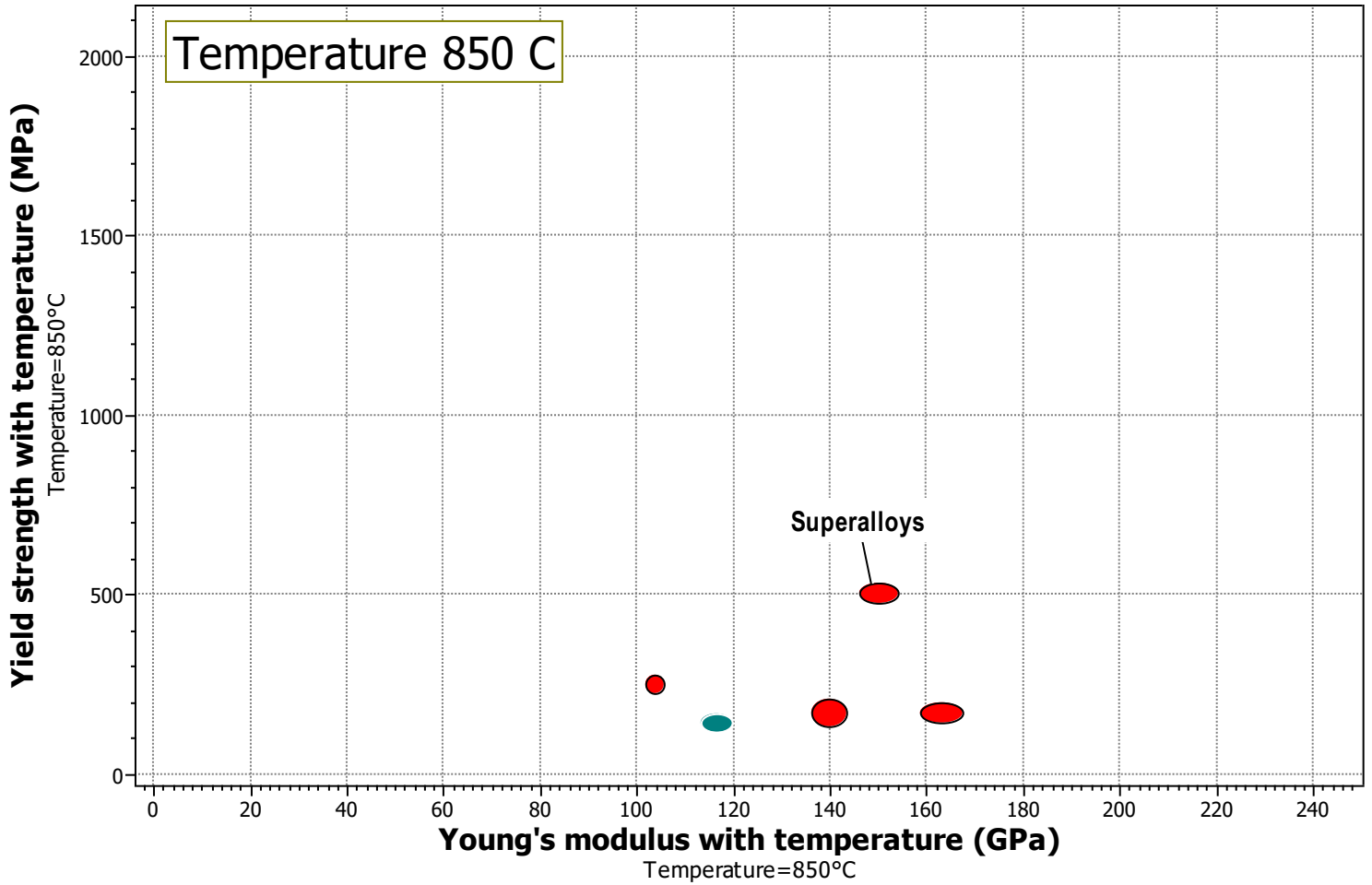
Each material in the Aerospace subset links to the MMPDS (metals) or MIL-HDBK-17 (composites) tables.

Each record has all the attributes of the 'All bulk materials' subset, as well as additional temperature dependant functional data.

It allows materials comparisons and selection on a database with no holes.



Temperature dependence



Level 3 Eco design database

Data:

- Eco Design Level 3 Database – 4200+ materials and 240+ Processes.
- Useful attributes for Eco Design
  - Eco Properties – Energy use, Water usage, CO_2, Traceable CO_2 and Embodied Energy (where available)
  - Geoeconomic data – Criticality, Abundance, reserves etc.
  - Hazard data – REACH, SIN List, RoHS, Food Contact

Tools:

Standard Level 3 Tools

Enhanced Eco Audit

Synthesizer Tool

Comparison Table

Find Similar

Engineering Solver

Examples of additional data

Recycling and end of life

Recycle	ⓘ	✓			
Functional recycle	ⓘ	✓			
Climate change (CO2-eq), recycling	ⓘ	* 1.22	-	1.34	kg/kg
Embodied energy, recycling	ⓘ	* 15.5	-	17.1	MJ/kg
Recycle fraction in current supply	ⓘ	28			%
Combust for energy recovery	ⓘ	✗			
Landfill	ⓘ	✓			
Biodegrade	ⓘ	✗			

Possible substitutes for principal component ⓘ

Aluminum substitutes for copper in various products, such as electrical power cables, electrical equipment, automobile radiators, and cooling/refrigeration tubing. Titanium and steel are used in heat exchangers, and steel is used for artillery shell casings. Optical fiber substitutes for copper in some telecommunications applications. Plastics also substitute for copper in water pipe, plumbing fixtures, and many structural applications.

Geo-economic data for principal component

Principal component	ⓘ	Copper			
Typical exploited ore grade	ⓘ	2.52	-	2.78	%
Minimum economic ore grade	ⓘ	0.3	-	5	%
Abundance in Earth's crust	ⓘ	27	-	70	ppm
Abundance in seawater	ⓘ	2e-4	-	0.003	ppm
Annual world production, principal component	ⓘ	1.85e7			tonne/yr
Reserves, principal component	ⓘ	6.9e8			tonne

Main mining or production areas ⓘ

Chile, 28%
Peru, 12%
China, 8%
Congo, 6%
Zambia, 6%
Australia, 5%
Russia, 4%
United States, 4%
Mexico, 4%
Canada, 3%
Kazakhstan, 3%
Poland, 2%
Other countries, 15%

Healthcare & food

Food contact	ⓘ	Conditional

Notes
Copper alloys can only be used with food if the pH is higher than 6.

Restricted substances risk indicators

RoHS 2 (EU) compliant grades?	ⓘ	✓
EU REACH Candidate List indicator (0-1, 1 = high risk)	ⓘ	0
SIN List indicator (0-1, 1 = high risk)	ⓘ	0

Critical materials risk

Contains >5wt% critical elements?	ⓘ	Yes

Level 3 Sustainability database

Data:

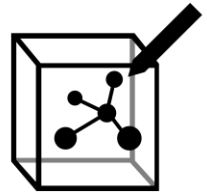
- Nations of the world - attribute per country.
- Legislation and regulation - representative legal framework around technological decisions
- Power Systems-Storage, Power Systems-Generation, and Battery Cells datatables

Also available at Level 2

Tools:

Standard Level 3 Tools

Enhanced Eco Audit



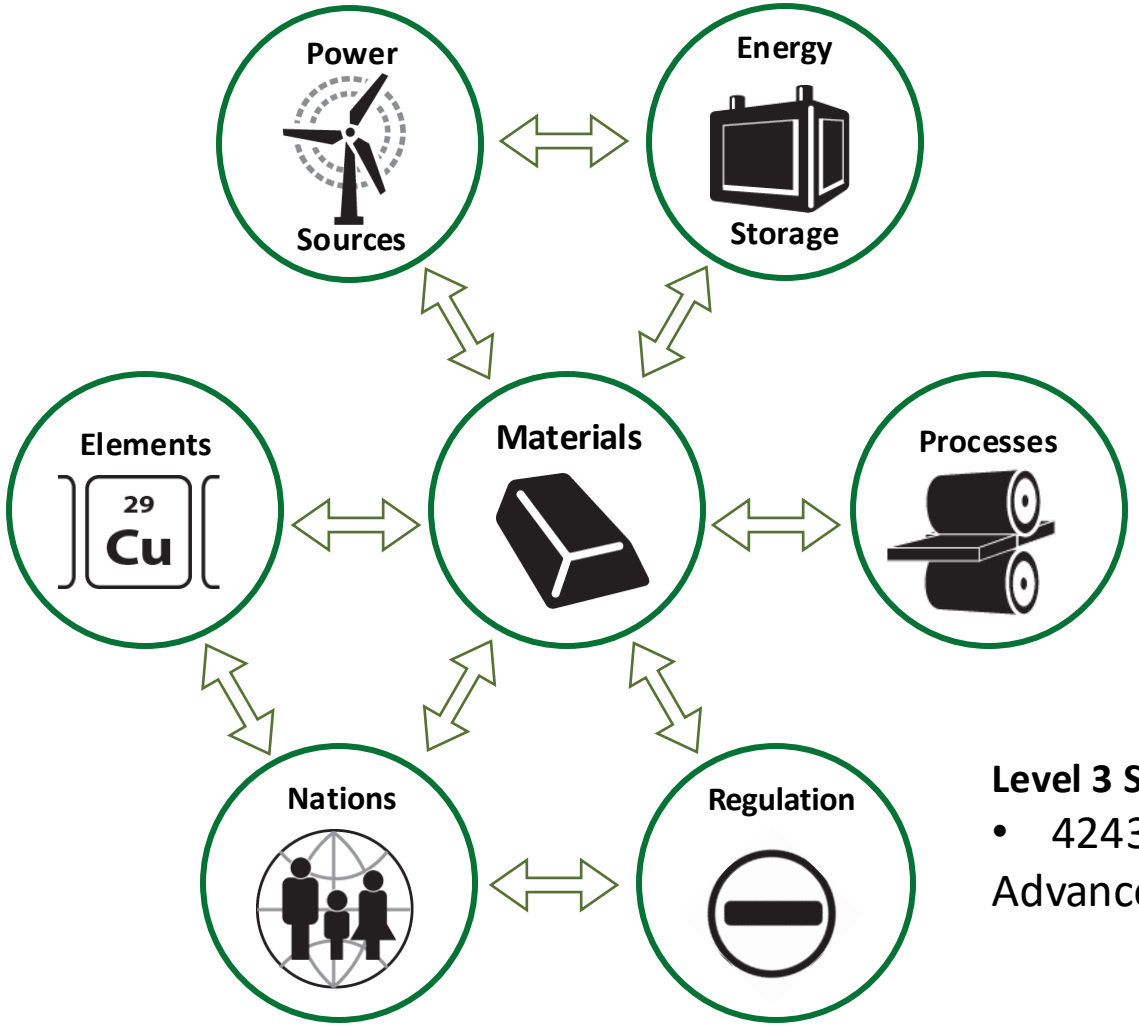
Synthesizer Tool

Comparison Table

Find Similar

Engineering Solver

Sustainability database



Level 2 Sustainability
- 100 Materials

Teach the concepts

Level 3 Sustainability
- 4243 Materials

Advanced Projects

Analysis of Materials Systems

Advanced databases and tools

Advanced

Level 3 Standard Database

Extra data in:

- Bioengineering
- Polymer
- Aerospace
- Eco Design
- Sustainability

Tools Available:

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Standard

Eco Audit

Bioengineering

Eco Audit | Solver | Synthesizer | Find Similar | Comparison Table

Polymer

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Aerospace

Eco Audit | Solver | Synthesizer | Find Similar | Comparison Table

Eco Design

Eco Audit | Solver | Synthesizer | Find Similar | Comparison Table

Sustainable Development

Eco Audit | Solver | Synthesizer | Find Similar | Comparison Table

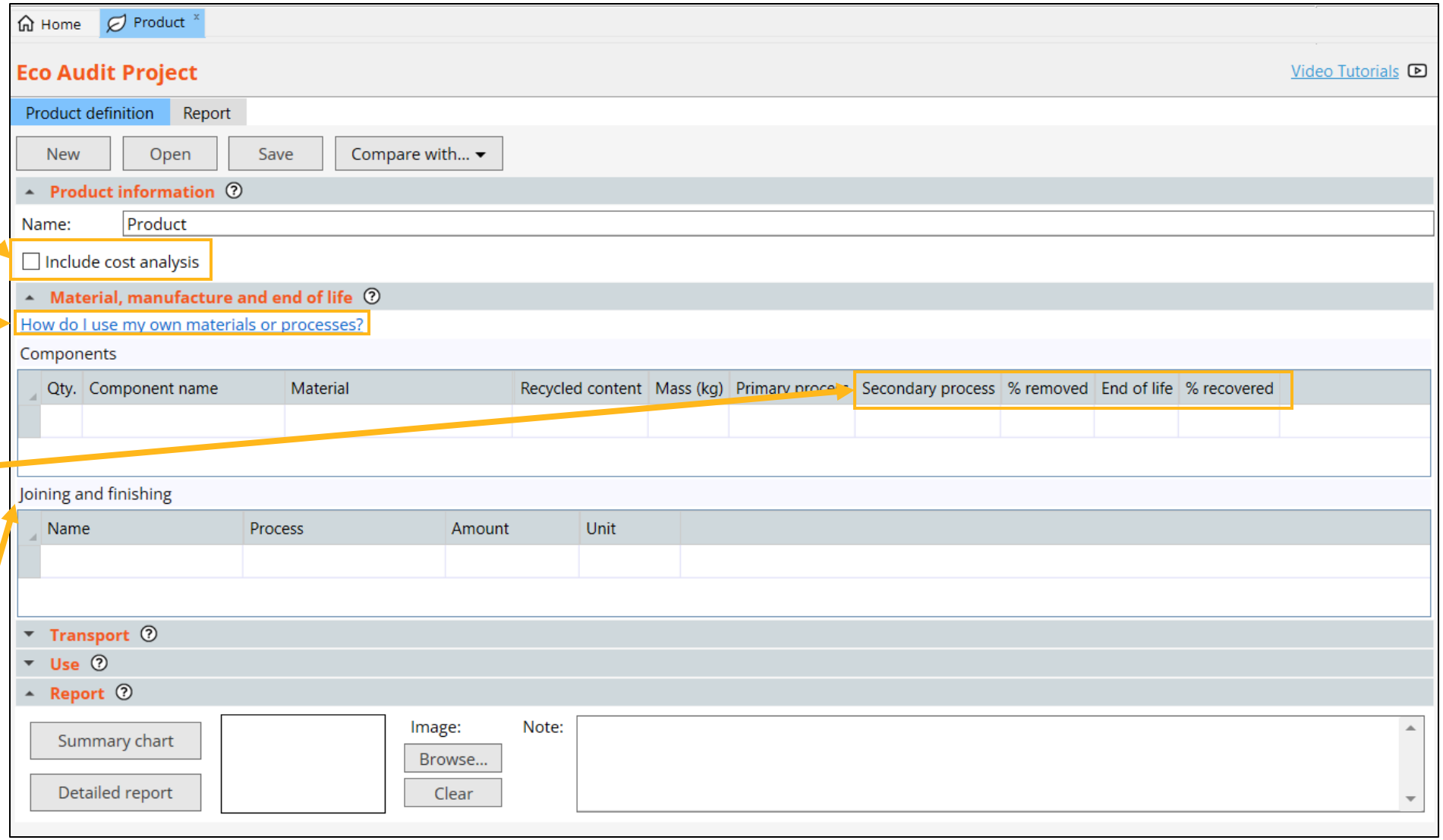
Enhanced Eco Audit

Ability to include cost analysis during audit

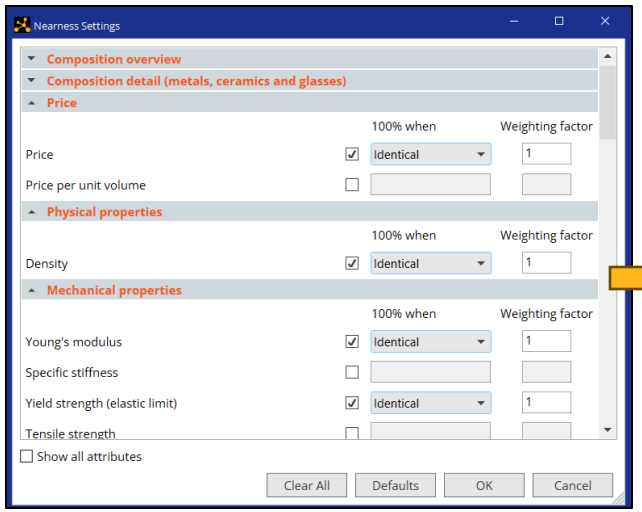
Can use custom records for both materials and processes

More elements to consider during manufacturing, such as secondary processes and % material recovered

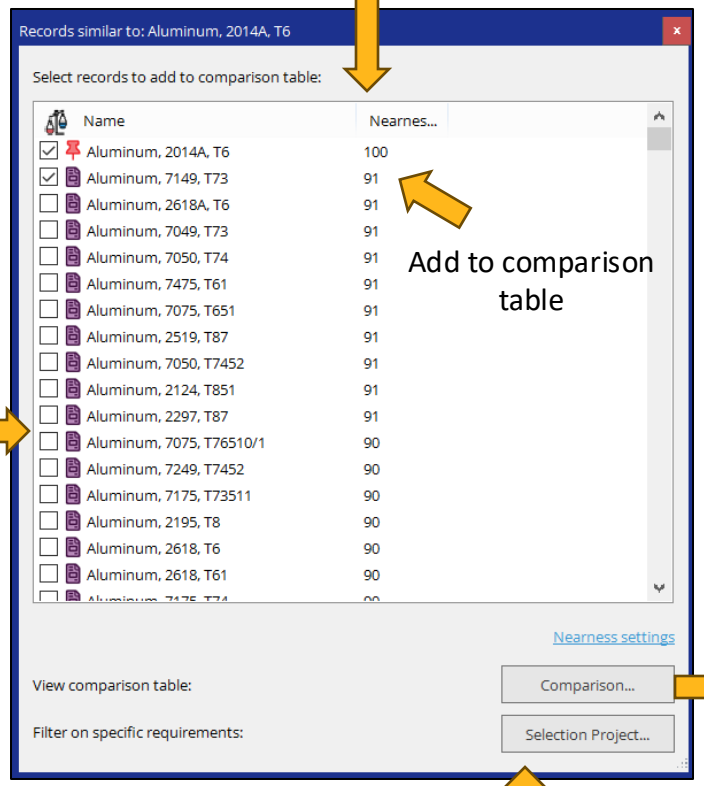
Can consider the impact of additional joining and finishing steps



Find Similar Tool



Ranking
0-100%

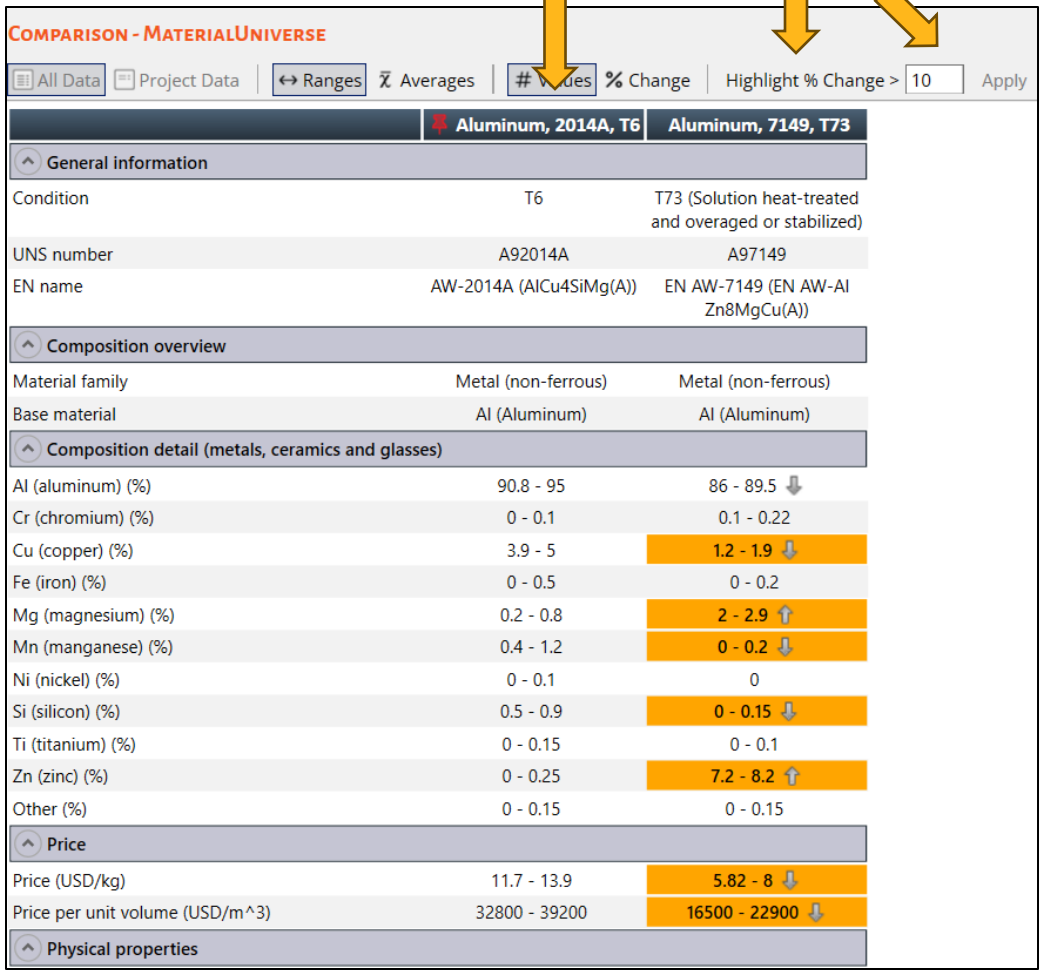


Add to comparison table

Creates selection project
Filters data

Reference

Differences >10%
highlighted in orange

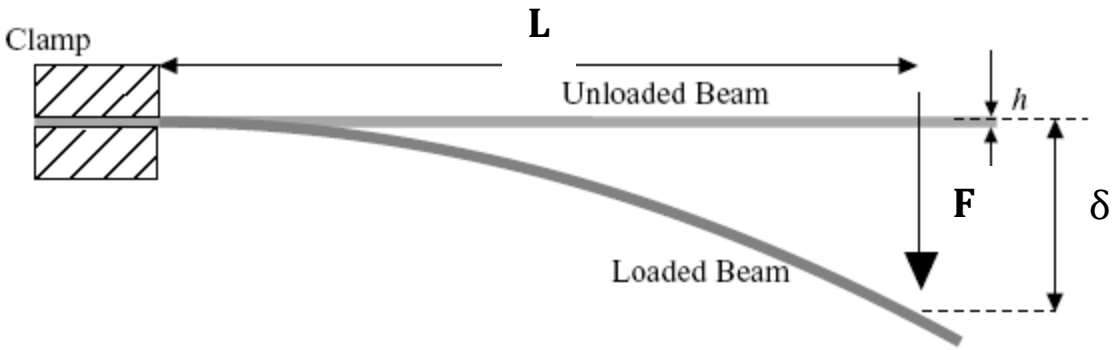


	Aluminum, 2014A, T6	Aluminum, 7149, T73
General information		
Condition	T6	T73 (Solution heat-treated and overaged or stabilized)
UNS number	A92014A	A97149
EN name	AW-2014A (AlCu4SiMg(A))	EN AW-7149 (EN AW-Al Zn8MgCu(A))
Composition overview		
Material family	Metal (non-ferrous)	Metal (non-ferrous)
Base material	Al (Aluminum)	Al (Aluminum)
Composition detail (metals, ceramics and glasses)		
Al (aluminum) (%)	90.8 - 95	86 - 89.5 ↓
Cr (chromium) (%)	0 - 0.1	0.1 - 0.22
Cu (copper) (%)	3.9 - 5	1.2 - 1.9 ↓
Fe (iron) (%)	0 - 0.5	0 - 0.2
Mg (magnesium) (%)	0.2 - 0.8	2 - 2.9 ↑
Mn (manganese) (%)	0.4 - 1.2	0 - 0.2 ↓
Ni (nickel) (%)	0 - 0.1	0
Si (silicon) (%)	0.5 - 0.9	0 - 0.15 ↓
Ti (titanium) (%)	0 - 0.15	0 - 0.1
Zn (zinc) (%)	0 - 0.25	7.2 - 8.2 ↑
Other (%)	0 - 0.15	0 - 0.15
Price		
Price (USD/kg)	11.7 - 13.9	5.82 - 8 ↓
Price per unit volume (USD/m^3)	32800 - 39200	16500 - 22900 ↓
Physical properties		

The Engineering Solver (1)

Basic equations from:
'Roark's formulas of stress and strain'

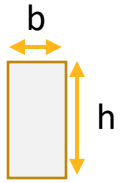
Engineering / Design

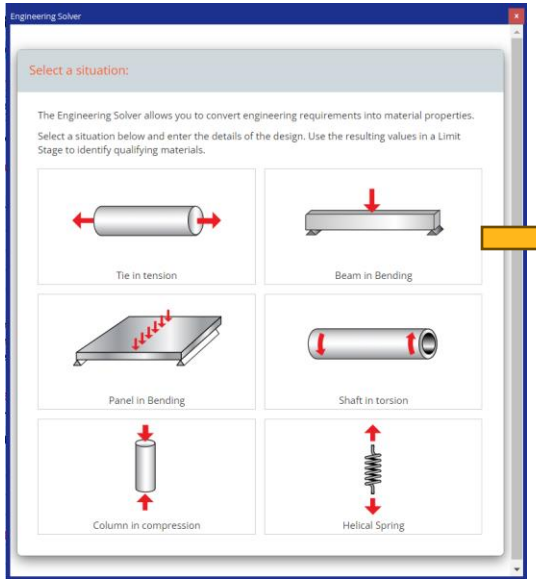


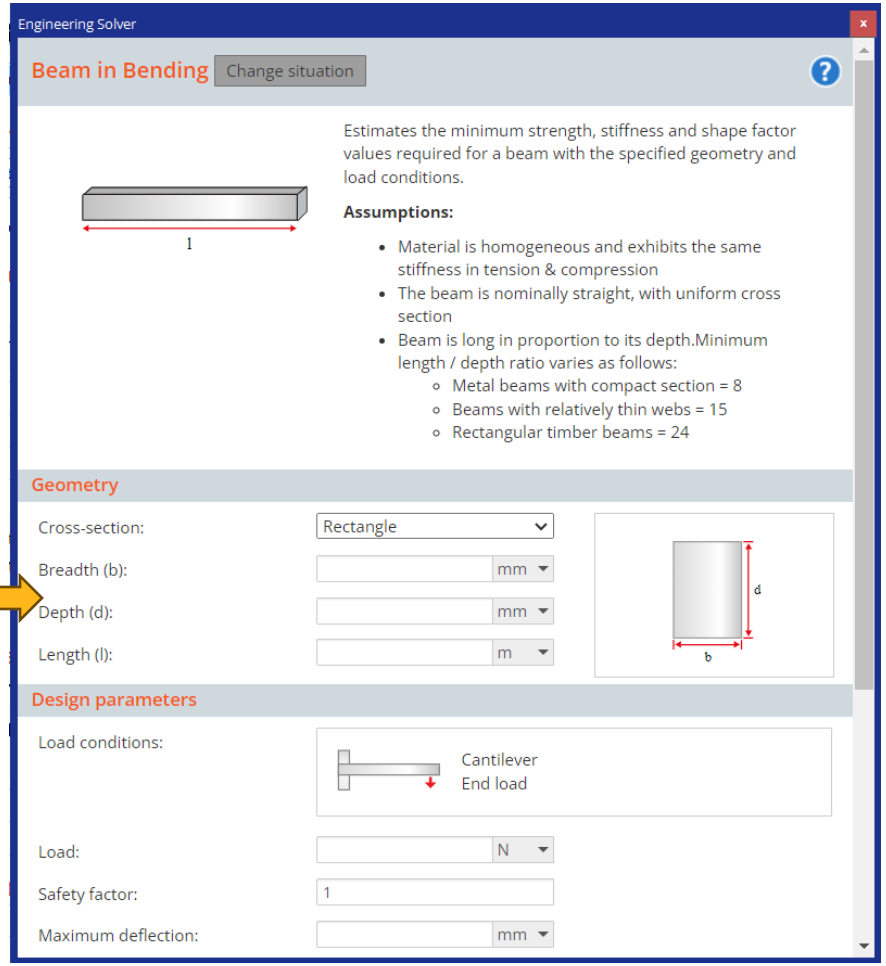
Materials?

Min Strength

Min Stiffness





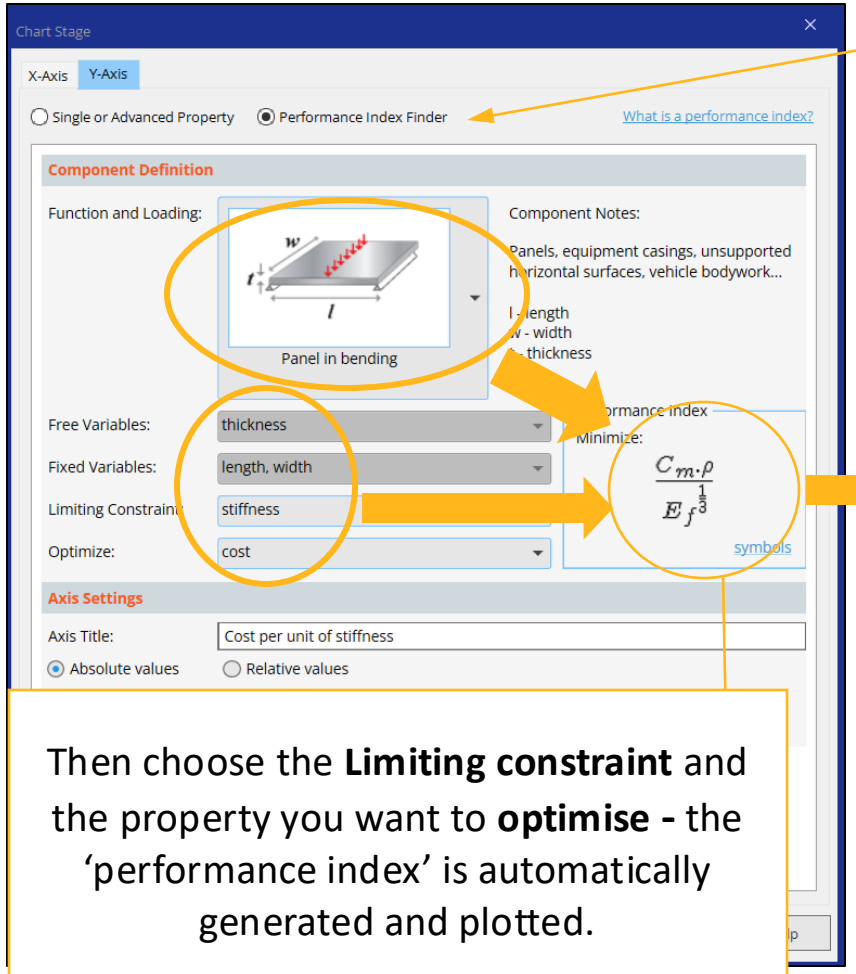


Ansys / GRANTA EDUPACK

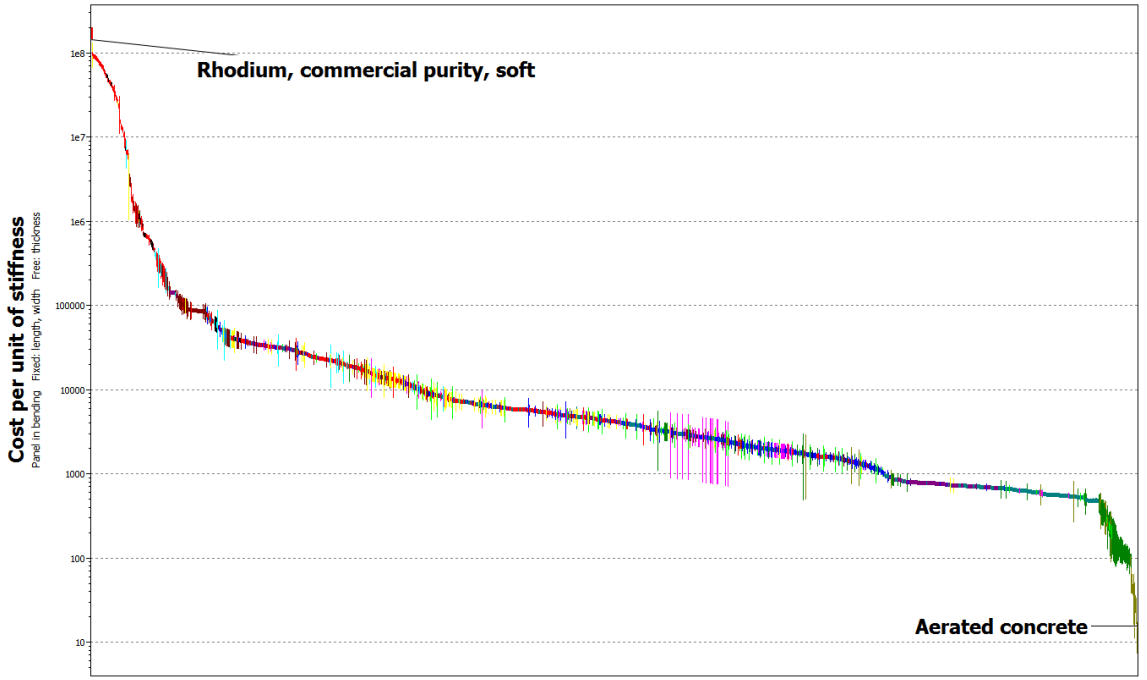
Performance Index finder

Chart/Index

To plot a performance index, click here and choose the model that best fits your function and loading.

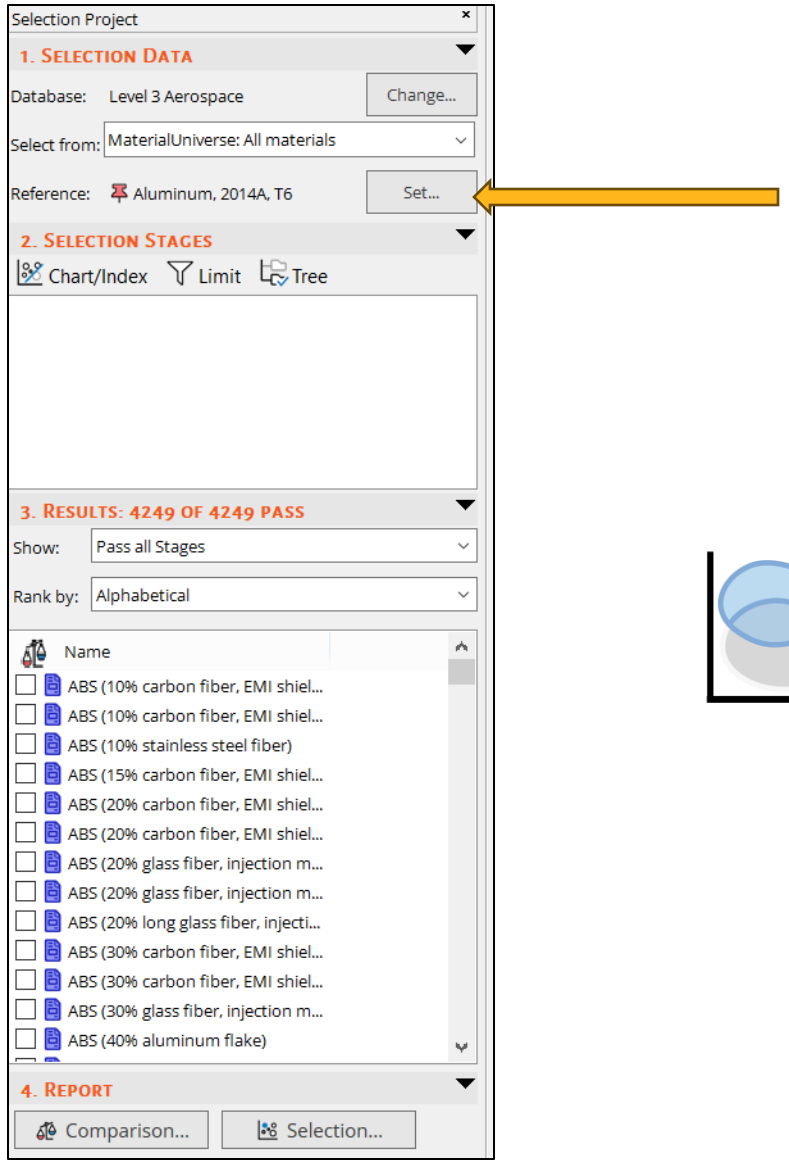


Then choose the **Limiting constraint** and the property you want to **optimise -** the 'performance index' is automatically generated and plotted.

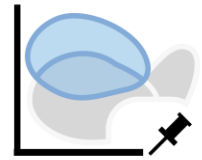


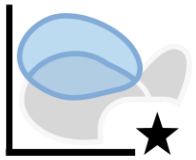
Ansys / GRANTA EDUPACK

Reference Materials



Set reference material here for use in Comparison Tables and easier identification in charts via the “Highlight Reference Record” button

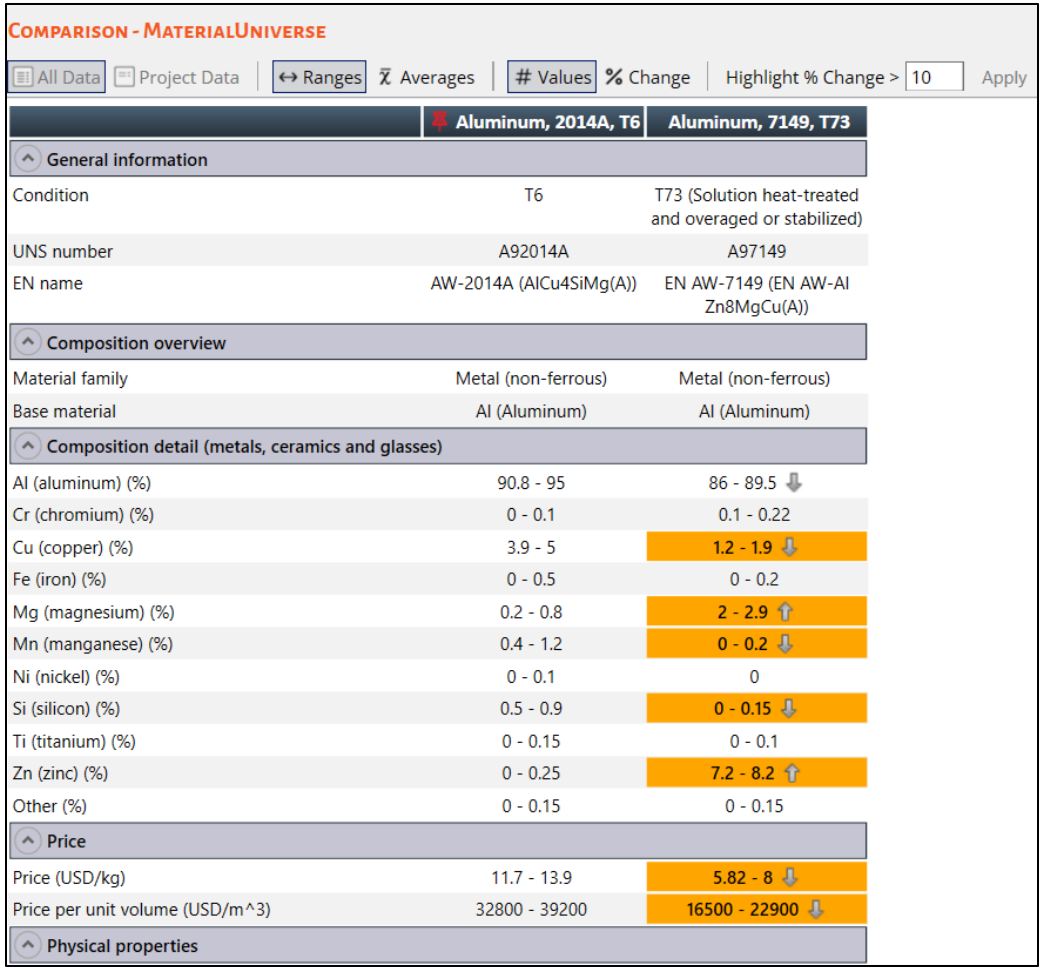




Favorite records are also easier to identify on charts via the “Highlight Favorite Record” button

Comparison Table

- Compare all properties
- Highlight differences in performance
- Identify ‘Gotchas’



COMPARISON - MATERIALUNIVERSE

All Data | Project Data | ↔ Ranges | x̄ Averages | # Values | % Change | Highlight % Change > 10 | Apply

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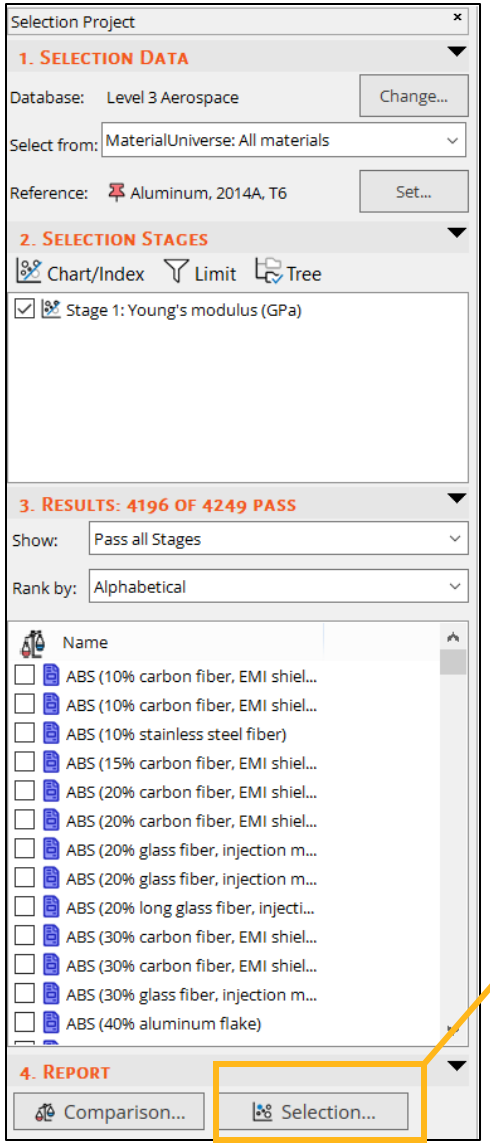
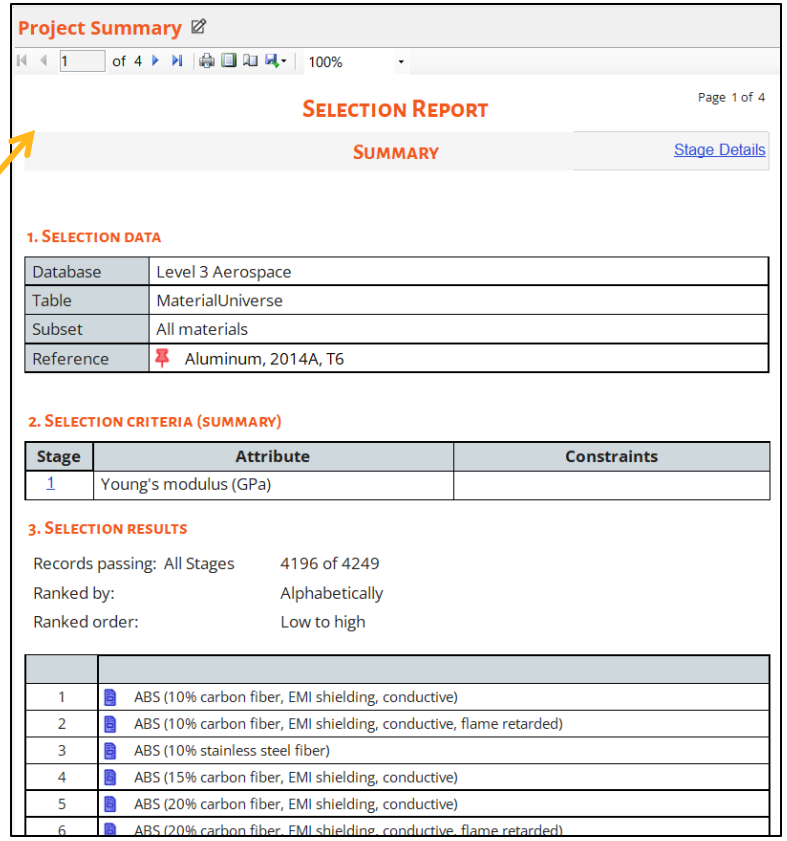
Price		
Price (USD/kg)	11.7 - 13.9	5.82 - 8 ↓
Price per unit volume (USD/m^3)	32800 - 39200	16500 - 22900 ↓
Physical properties		

Reporting tool

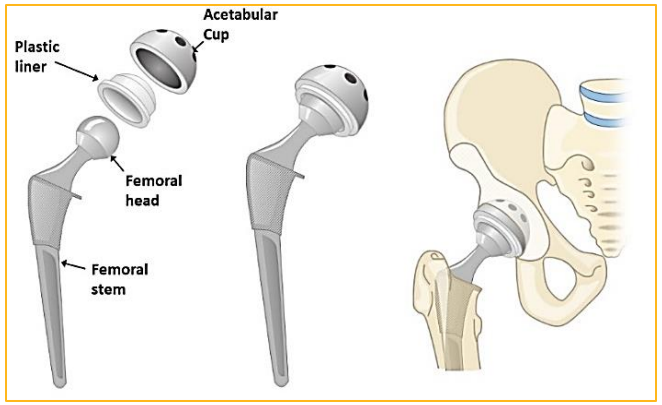


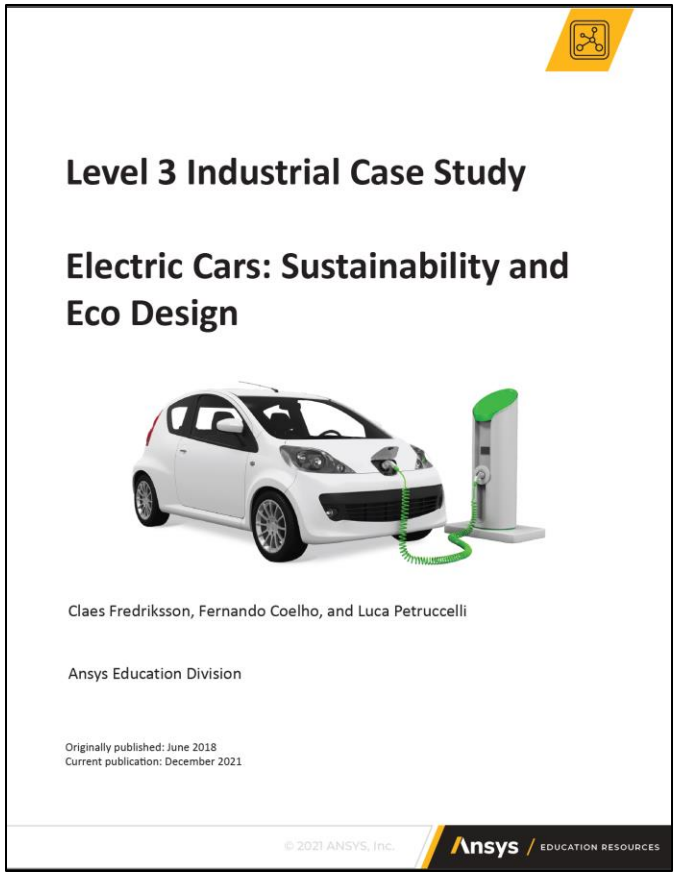
To create a report automatically, click Selection.



You can print and export the report as a PDF or into Word.

Advanced case studies at Ansys Education Resources Webpage





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Document Information

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