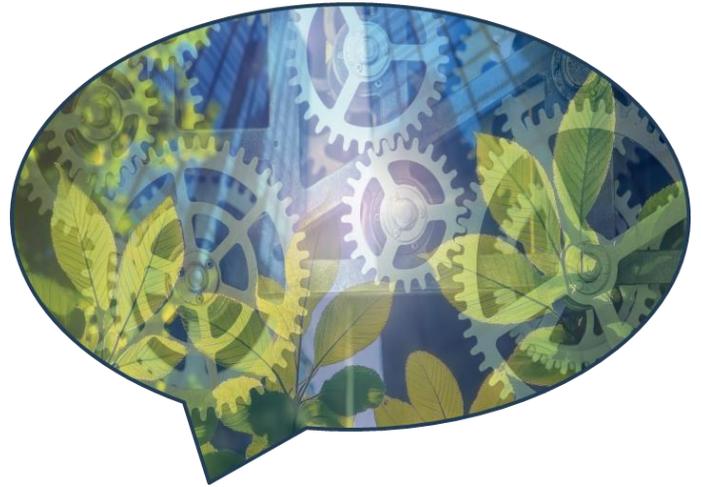


Sustainability Insights FAQ



Sustainable product development and manufacturing strategies help product manufacturers and suppliers mitigate climate change, and can also position companies for a competitive advantage.

Read our frequently asked questions (FAQ) for details about our Manufacturing Insights solution, which can help to reduce a product's carbon footprint by analyzing product design, sourcing, manufacturing process, and factory location.

FAQ Sections

- 1 General Product/Solution Questions
- 2 Sustainability Data and aPriori Analysis
- 3 Technical Product Questions
- 4 How aPriori Complements LCAs



1. What sustainability problems are manufacturers solving with aPriori?

Customers are using aPriori to address the following manufacturing challenges:

- Identify low cost/low carbon suppliers
- Evaluate alternate materials to reduce CO₂e
- Investigate CO₂e impacts by changing manufacturing processes
- Conduct “what if” scenarios to make product cost, carbon, and manufacturability decisions in real time

2. What sustainability challenges does aPriori help address?

aPriori provides sustainability insights that enable manufacturing customers to answer a range of questions and issues. Examples include:

- How to evaluate CO₂e alongside cost to improve sustainability without harming profitability
- How to identify the most significant contributors to CO₂e emissions and product cost
- Making design changes and conducting trade-off analyses
- Simulating & optimizing manufacturing processes
- Assessing alternative materials
- Investigating the impact of using alternative suppliers in different geographic regions
- How to gain full transparency and visibility regarding cost, sustainability, and manufacturability

3. Which departments and groups use aPriori Sustainability Insights?

Five primary manufacturing groups use our sustainability solution, but anywhere a 3D CAD model

can be leveraged to evaluate embodied carbon, there is potential for aPriori. We are most frequently utilized in these departments:

- Value Engineers looking to establish baselines or collaborate with various stakeholders in engineering and procurement
- Design Engineers looking to assess CO₂e when designing new or making updates to new products
- Sourcing Professionals looking to better understand suppliers and supply chain CO₂e
- Estimating/Quoting teams at Contract Manufacturers
- Sustainability teams focused on reducing carbon emissions and improving business performance.

4. Which companies are using aPriori Sustainability Insights?

aPriori’s manufacturing sustainability technology is commercially deployed, and accessible to a number of leading manufacturers. Carrier, Dana, FuelCell Energy, Rheem, ASML, Ferrari, Gordon Murray Technologies, Kone, FMC and many more have Sustainability Insights as part of their aPriori implementation.

5. Is the aPriori Sustainability Solution Certified?

Using aPriori can help a company without the solution needing to be certified itself. Certifications are often about auditable processes, and due to our transparent, granular approach, we are well suited to helping companies achieve their goals in this area. Calculations in aPriori are far more precise than LCAs which are often relied upon for reporting.

6. How does aPriori differ from other sustainability software tools?

aPriori takes a “bottom-up” approach to sustainability modeling to capture CO₂e at a granular level. With our unparalleled understanding of the manufacturing process, we provide a precise understanding of emissions related to manufacturing, including:

- Material extraction and processing
- Factory machine cycle times
- Energy consumption
- Variances in the energy mix by region
- Rough mass (the mass of material required to manufacture the product, not just the finish mass)
- Material waste generated, including the regrinding/remelt impact
- Real-world simulation, including the ability to calibrate and configure “digital factories” based on specific factory equipment and other specifications
- The ability to conduct “what if” scenarios to make product cost, carbon, and manufacturability decisions in real time

7. Which manufacturing process groups are currently available?

The most popular process groups are included today:

- Machining (all 35+ types and sub-processes)
- Sheet Metal & Transfer Die
- Plastic Injection and Compression Molding
- Bar & Tube Fabrication (all 30+ sub-processes)
- Casting (including 36 methods/sub-processes)
- Assembly Processes
- Secondary Treatments (e.g. Heat & surface treatments).

We continuously develop further manufacturing process groups in line with customer demand.

8. Which aPriori apps will have Sustainability Data?

All aPriori apps can review the CO₂e data generated. aP Design, aP Pro (including Bulk and Matrix analysis) and aP Generate calculate the data, and aP Workspace and aP Analytics can interrogate the data.

11. Where will aPriori’s Sustainability Insights be most valuable?

There are four main use cases that aPriori can support:

- Sustainable design
- Sustainable manufacturing
- Sustainable sourcing
- Sustainable quoting/estimating

12. What actions have the most significant impact on a product’s CO₂e footprint?

Depending on the industry, the “in-use” phase of a product’s lifecycle can have the most significant proportion of its environmental impact (think fuel/energy used by a car for its entire serviceable life or the power used by an electronic device). Making the product as lightweight and efficient as possible will determine this. However, the material selection and manufacturing phase is where we can help.

aPriori can assess how changes in the following drivers help stakeholders make the right decisions for their product design, manufacturing, and sourcing. aPriori conducts analysis based on the 3D CAD geometry, material, manufacturing process and carbon factor of the electricity used to manufacture the product.



2. Sustainability Data and aPriori Analysis

13. Where do you get your sustainability data? Can you use more than one database?

We use ecoinvent, a leading third-party data provider to give everyone a baseline of environmental data. However, the data can be configured using additional sources if required.

14. What is ecoinvent?

[ecoinvent](#) is leading third-party data provider. The non-profit organization provides a high-quality database for the sustainability assessments of products and processes worldwide.

Importantly, aPriori can configure and customize ecoinvent data to provide customers with an even greater level of precision.

15. Is the environmental data used “out of the box” or adapted?

We use the ecoinvent database. Additionally, some customers use GaBi Databases. For this application, we map the GaBi material and electricity carbon factors to our materials and digital factories.

16. How large is the ecoinvent database?

The ecoinvent database is quite extensive, and features more than 21,000 activities. Learn more about the ecoinvent database at www.ecoinvent.org

17. What database version is being used for the carbon footprint calculations?

aPriori uses the latest version of ecoinvent’s database. As soon as ecoinvent release an update, the development team at aPriori starts work updating the process models and materials.

18. Which data and allocation methods do we use for our carbon factors?

We use the Intergovernmental Panel on Climate Change (IPCC 2021) CO₂-equivalent (CO₂e) using the Global Warming Potential with a time horizon of 100 years (GWP 100).

19. What allocation method is being used? (APOS, Consequential, Cut-off)

aPriori uses the system model “Allocation, cut-off by classification.” This cut-off system model is based on the recycled content, or cut-off, approach. In this system model waste is the producer’s responsibility (“polluter pays”). And there’s an incentive to use recyclable products burden free (cut-off). Read more about [ecoinvent’s system models \(including allocation\)](#) online.

20. Which effect categories are implemented? (GWP, EP, AP, TOX, etc.)

Currently, GWP (Global Warming Potential) is implemented. We will add more over time.

21. What is the workflow? e.g., do you have connectors (e.g., BOM import, results / report export)?

aPriori gathers most of our data directly from 3D CAD models and can automate integration with most PLM systems including Siemens Teamcenter, PTC Windchill, etc.

22. How do you achieve coupling of cost and sustainability results?

Cost and carbon are calculated at the same time with our 3D CAD analysis engine which simulates the manufacturing process. Manufacturability is also assessed concurrently.

3. Technical Product Questions

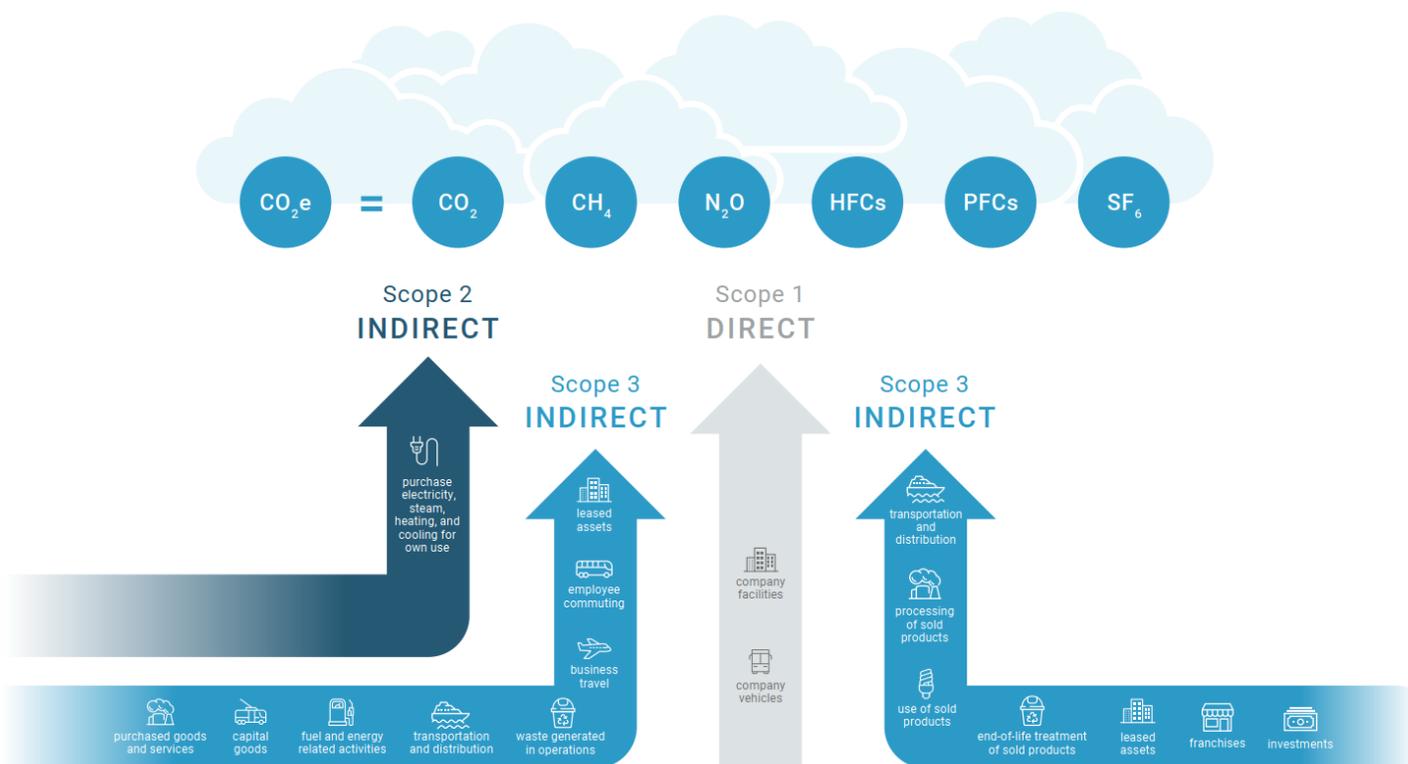
23. What does Scope 1, 2, and 3 refer to?

Emissions are categorized into three different levels of analysis, as provided by the Greenhouse Gas (GHG) Protocol:

- **Scope 1:** direct emissions from owned or controlled sources. aPriori supports Scope 1
- **Scope 2:** indirect emissions from the generation of purchased energy. aPriori supports Scope 2
- **Scope 3:** upstream and downstream emissions. aPriori supports product-level Scope 3 from a “cradle to gate” perspective (e.g., product design and manufacturing, not currently transportation and logistics)

The following figure provides additional background (adapted from the Greenhouse Gas Protocol):

All GHGs are converted to CO₂e to create a standard measurement for emissions



24. Do you perform cradle-to-gate or cradle-to-grave calculations?

Currently, we provide cradle-to-gate calculations, but we are looking to expand this over time.

25. If a company recycles all of its scrap/waste from the manufacturing process, is that considered in the analysis?

Recycling waste is credited to the company using the recycled product in its process and not credited to the company that recycles the material. If both were considered, it would have a double-count effect, and both recycler and user of recycled material would benefit. But in reality, the CO₂e is only saved once, and is generally credited in the use stage (end product).



26. Do you also calculate the transportation and in-use phases of the product lifecycle?

No, not currently, but transportation in most cases is a tiny percentage of the overall CO₂e footprint (unless using air freight). The in-use phase data required is not usually part of the 3D CAD model but can be a relatively straightforward calculation. aPriori's strength is knowledge of the manufacturing process, which is where we are currently focused.

27. Do you also provide additional sustainability insights beyond CO₂e e.g water use and other environmental impact categories such as ecotoxicity?

Not currently. We are looking to add other categories of impacts and potentially transportation, but this will be in-line with customer demand.

28. Can we set CO₂e targets during the early design phase to provide early warnings if CO₂e targets have been surpassed?

Yes, just like cost, we can attach targets for CO₂e values.

29. Do I need to be upgraded to aPriori 23.1 or later to use aPriori Sustainability Insights?

Yes – unless you are a new customer and therefore starting on 23.1 or later, there will need to be an upgrade of any customized cost/process models.

30. As a part of aPriori's calculations, is the mass of the finished product used to calculate material carbon?

No. Since significant material can be wasted as part of the manufacturing process(es), aPriori calculates how much material is required to produce the design, and uses that amount for material carbon. This ensures a much more representative figure.

4. How aPriori Complements LCAs

31. What is LCA (Life Cycle Assessment), and how does aPriori differ?

LCA covers from cradle to grave of a product and assesses CO₂e emissions, water and air pollution, transportation, in-use, and end-of-life in terms of environmental impact. In other words, LCAs measure CO₂e emissions of a product's life cycle once the product is designed and produced.

But LCAs don't provide the rapid sustainability analysis that product development teams require during the early design stage. aPriori focuses on the material and processing of the manufacturing process (Cradle to Gate). This is typically the area when product developers and manufacturers can influence the most.

32. How does aPriori analyze carbon compared to an LCA?

Unlike aPriori, the LCA data on finish mass misses a lot of the material CO₂e created for a product – and does not identify opportunities to increase material utilizations to save carbon. Here's how aPriori works:

- aPriori takes a bottom-up approach to calculating carbon emissions based on rough mass and energy used during the manufacturing process. The rough mass is used and determined by the manufacturing process, material regrind opportunities, and material utilization.
- aPriori calculates the amount of raw rough mass required to make the selected part. This approach provides more precise CO₂e analysis than the finished mass calculations that LCA tools provide.



33. How does aPriori's rough mass analysis provide more precise CO₂e calculations than LCA alternatives?

Process CO₂e in aPriori's platform utilizes our knowledge and model of manufacturing cycle time and energy used to create the specified part. In our method, cycle time and energy used during the cycle time drive the process CO₂e calculation. The geometry, wall thickness, and mass drive the cycle time.

Because cycle time drives the process CO₂e calculation, two parts with very different masses can have similar cycle times and similar process CO₂e emissions. Also, two parts with similar cycle times can run on different-sized machines with different energy use.

34. How does aPriori evaluate cycle time and energy use for each part?

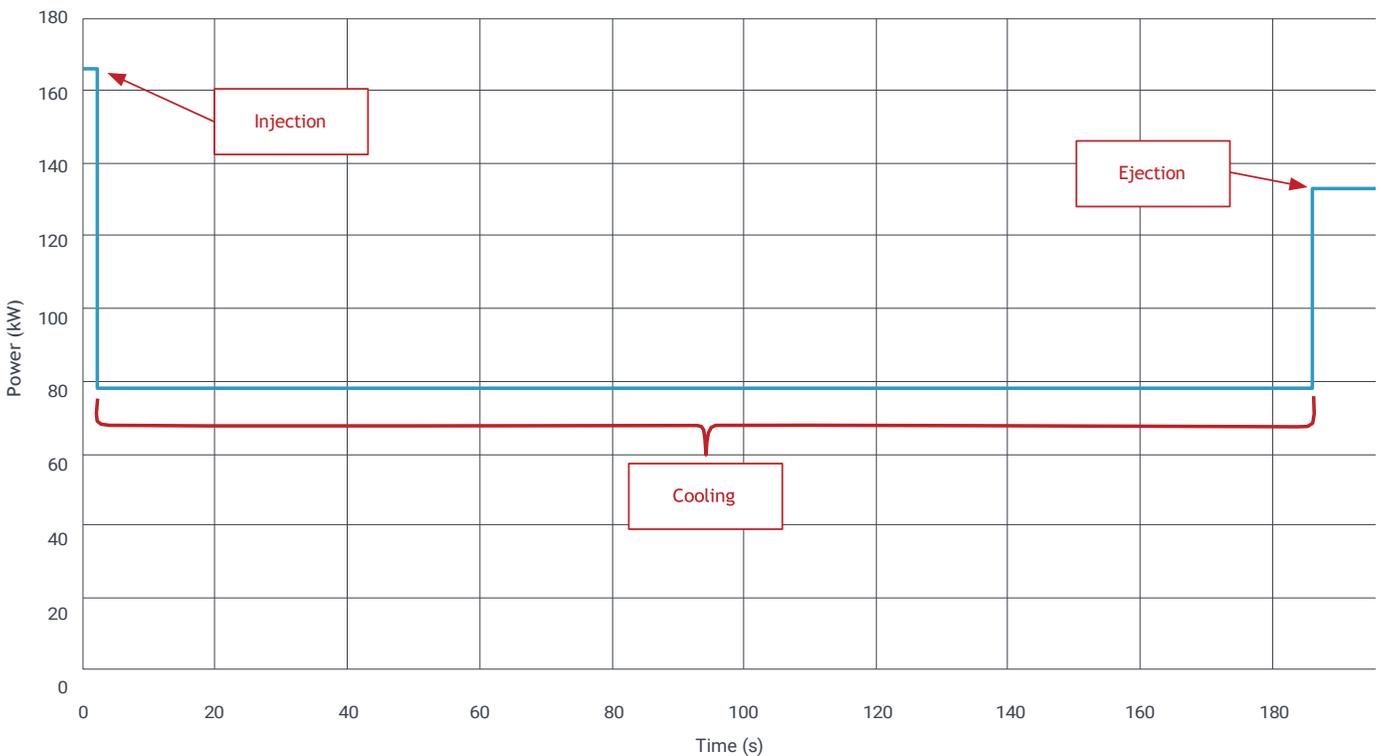
Here’s how aPriori calculates cycle time and energy use for each part, along with additional process background.

- Cost and Carbon Tradeoffs: aPriori allows users to calculate cost and carbon at the same time to see cost and carbon trade-offs in real-time. LCA does not generate costs.
- Time to Calculate: LCA range in time to complete and are highly customized. Tracking assumptions is challenging. The time to complete for LCA can be three weeks to months depending on the availability of the LCA team and the complexity of the product.

LCA vs aPriori Difference in Calculations:

	LCA	aPriori
MATERIAL CARBON	Finish Mass (Does not account for carbon for material utilization, Regrind/Remelt)	Required mass = finish mass + scrap mass
PROCESS CARBON	Finish Mass (Can't track design changes that impact cycle time and carbon)	Calculates cycle time and energy use

Power Time Injection Molding



Based on Injection Molder 30,000kN Clamp Force 302.6 kW Machine

This graphic shows energy used throughout one injection mold cycle. The machine uses high energy as the molten polymer is forced into the mold; then the energy level drops during the cooling phase. Next the mold is pulled apart, which triggers the release of the cooled/solidified part at the same time. This movement uses more energy and so it goes up again. There is always energy used as the plastic is heated and then forced into the mold.



35. Why do I need aPriori Sustainability Insights if I already have an LCA solution which covers more aspects of environmental impact i.e. water, logistics, etc.?

aPriori can improve the precision that an LCA tool reports on, and we can deliver results in minutes, rather than weeks to help you to mitigate CO₂e emissions earlier, and compare different product development options to help you make the right decision, rather than report on it once it is done.

We complement LCA tools, and we can help you make decisions to reduce CO₂e during the product development cycle.

WANT TO LEARN MORE?

[CLICK HERE](#) to schedule a demo of aPriori Manufacturing Insights.

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