TECHNOLOGY BENCHMARKING FOR COMPARATIVE LCA AND TEA

produced by the DOE Advanced Manufacturing Office (AMO)

Technology Benchmarking for Comparative LCA and TEA

A tutorial - produced by the DOE Advanced Manufacturing Office.

Welcome to the AMO video tutorial series on cost and environmental impact analysis!

Heather

In this module, we'll be discussing technology benchmarking.

- In comparative life cycle assessment (LCA) or techno-economic analysis (TEA), it can be useful to compare an emerging technology to an incumbent technology (the commercial benchmark).
- In this module, we'll discuss best practices for identifying commercial benchmarks for use in LCA or TEA analysis.

Welcome to the AMO video tutorial series on cost and environmental impact analysis.

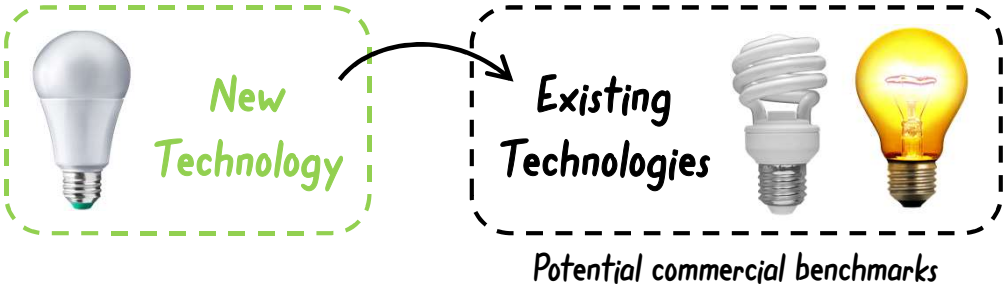
I'm Heather.

In this module, we'll be discussing technology benchmarking. In comparative life cycle assessment or techno-economic analysis, it can be useful to compare an emerging technology to an incumbent technology, also called the commercial benchmark. This allows us to quantify the new technology's potential impacts in a comparative analysis.

In this module, we'll discuss best practices for identifying commercial benchmarks for use in LCA or TEA analysis.

WHAT IS A COMMERCIAL BENCHMARK?

To assess the potential impacts of a new technology, we must first understand the technology's potential market, including the existing commercial technologies currently in use.

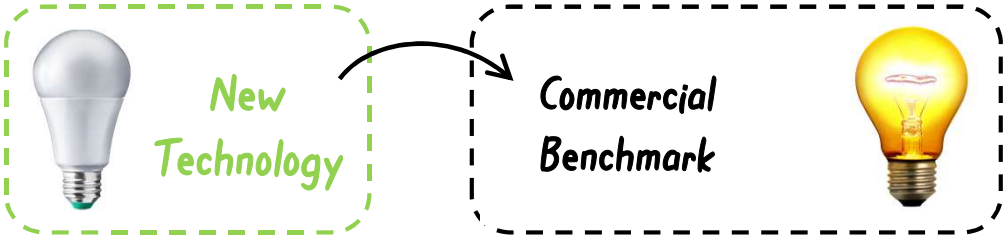


Potential commercial benchmarks

To assess the potential impacts of a new technology, we must first understand the technology's potential market, including the existing commercial technologies currently in use.

Will the new technology ultimately displace one or more existing technologies? If so, those existing technologies represent potential commercial benchmarks.

WHAT IS A COMMERCIAL BENCHMARK?



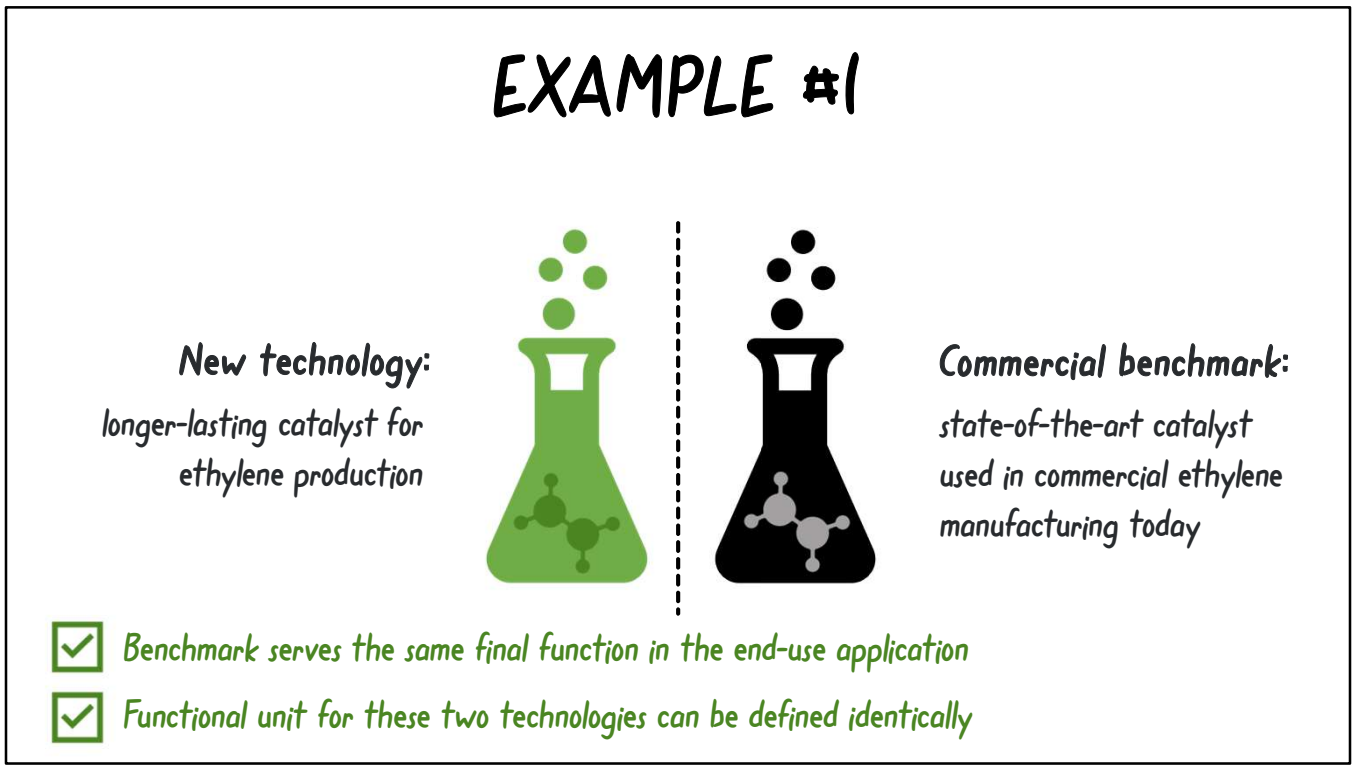
Commercial benchmark technology: the primary technology in the marketplace that the new technology would displace

- Will serve as the main point of comparison for the new technology in techno-economic analysis (TEA) and life cycle assessment (LCA)
- Should be clearly defined and used consistently throughout analysis

Here, we will define the "commercial benchmark technology" as the primary technology in the marketplace that the new technology would displace (assuming successful commercialization and adoption).

The commercial benchmark technology will serve as the main point of comparison for the new technology in techno-economic analysis (TEA) and life cycle assessment (LCA).

Therefore, the commercial benchmark should be clearly defined, and used consistently throughout the analysis.



Let's take a look at a few examples.

If we are analyzing the potential impacts of a longer-lasting catalyst for ethylene production, the commercial benchmark may be the state-of-the-art catalyst used in commercial ethylene manufacturing today.

This benchmark technology is an appropriate comparison for the new catalyst because it represents an existing, commercial product that serves the same final function in the end-use application. The functional unit for these two technologies can be defined identically, enabling objective comparison.

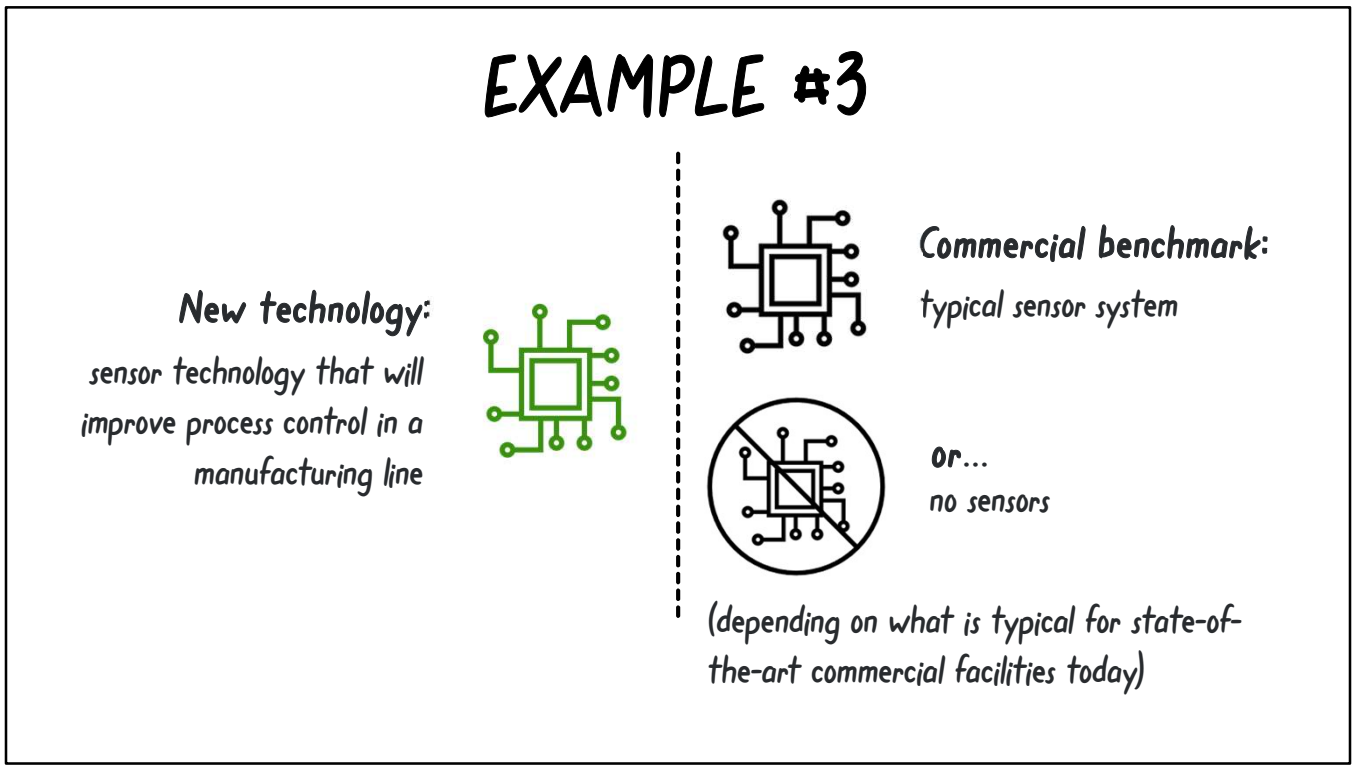
EXAMPLE #2

New technology:
Novel heat treatment method for high-strength steel

Commercial benchmark:
conventional heat treatment method

Let's try another.

If we are analyzing the potential impacts of a novel heat treatment method for high-strength steel, the commercial benchmark may be a similar grade of steel processed using the conventional heat treatment method.



Here's one more.

If we are analyzing the potential impacts of a new sensor technology that will improve process control in a manufacturing line, the commercial benchmark may be the same manufacturing line with typical sensor systems, or with no sensors—depending on what is typical for state-of-the-art commercial facilities today.

SPECIAL CASE:

MULTIPLE POSSIBLE COMMERCIAL BENCHMARKS

Once you decide on the best commercial benchmark to use, maintain consistency throughout the analysis.

If you identify multiple potential commercial benchmarks, you can:

- *Choose the single best commercial benchmark*
- *Compare the new technology systematically to each of the relevant benchmarks.*

Benchmarks may be application-dependent!

Make sure to choose a benchmark that's consistent with the end-use application described in your functional unit.

You may have noticed in some of these examples that some technologies have multiple possible commercial benchmarks. However, once you decide on the best commercial benchmark to use, it is important to maintain consistency throughout the analysis.

If you identify multiple potential commercial benchmarks that would make useful comparisons, you have a few options:

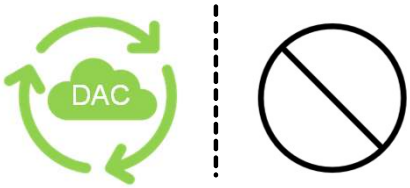
- One option is to choose the single best commercial benchmark.
- Your other option is to select multiple benchmarks, and compare the new technology systematically to each of the relevant benchmarks in turn. If you choose this option, maintain consistency by carrying all of the benchmarks you've chosen through all analysis steps; avoid switching between them

Keep in mind that a new technology may have multiple possible applications – and the best commercial benchmark may be application-dependent. Make sure to choose a benchmark that's consistent with the end-use application described in your functional unit. For more information on functional units for LCA and TEA analysis, check out our module on functional units.

SPECIAL CASE:

NO COMMERCIAL BENCHMARK

This situation may arise if the new technology would initiate an entirely new commercial market.



If there is no commercial benchmark, you may need to explore alternative comparisons, such as:

- Anticipated thresholds for market acceptance
- Established cost, energy, or emissions targets (e.g., given in a funding opportunity)

The absence of a commercial benchmark should be noted in your analysis with an explanation and alternative approach for assessing impacts.

In rare cases, you may also come across a technology for which there is no commercial benchmark.

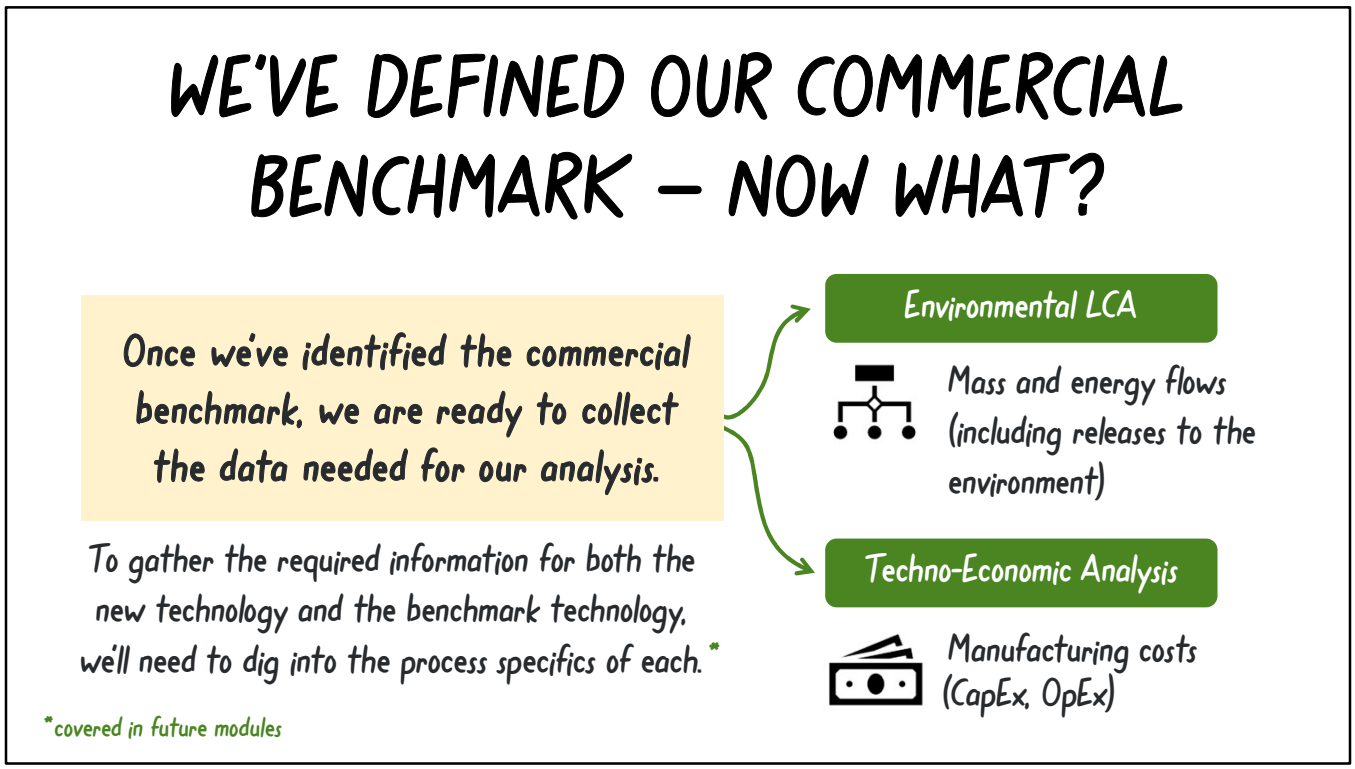
This situation may arise if the new technology would initiate an entirely new commercial market.

For example, you might be interested in analyzing a new sorbent for direct air capture of carbon dioxide, for which there are no similar technologies yet available in the commercial marketplace.

If there is no commercial benchmark, you may need to explore alternative comparisons for the new technology.

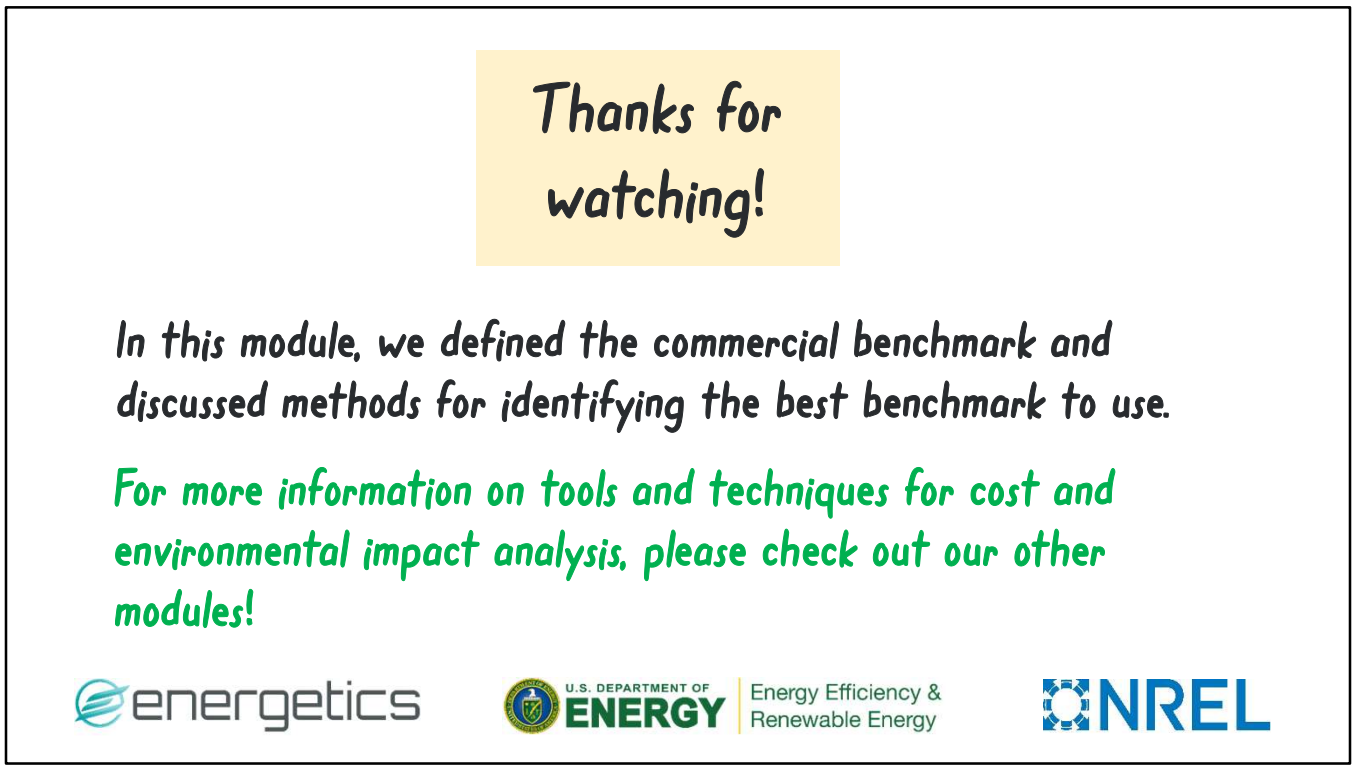
- For example, in some fields there may be anticipated thresholds for commercial acceptance of a new technology given in the literature.
- Depending on the purpose of the analysis, it may also be appropriate to compare the new technology to an established cost, energy, or emissions target – such as one given in a funding opportunity announcement or roadmap report.

The absence of a commercial benchmark should be noted in your analysis with an explanation and alternative approach for assessing impacts.



Once we've identified the commercial benchmark, we are ready to collect the data needed for our analysis. For environmental LCA, this will include mass and energy flows, including releases to the environment. For techno-economic analysis, this will involve assessment of manufacturing costs, including both capital and operating expenses.

To gather the required information for both the new technology and the benchmark technology, we'll need to dig into the process specifics of each. In future modules, we'll discuss resources and techniques for data collection, estimation and analysis.



In this module, we defined the commercial benchmark technology and discussed methods for identifying the best benchmark to use. The chosen commercial benchmark technology will be used as a point of reference throughout our analysis to assess the impact potential of the new technology.

For more information on tools and techniques for cost and environmental impact analysis, please check out our other modules.