

# Towards a Common Framework for ESG in Advanced Manufacturing

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# Introduction

## Advanced manufacturing supporting companies transition to stakeholder capitalism while driving productivity and efficiency.

“ Transitioning to ESG reporting through innovation, workforce engagement and sustainability.

Global megatrends – such as climate change, geopolitical shifts and the continuous emergence of disruptive technologies, as well as the COVID-19 pandemic – have made sustainability issues, and environmental, social and governance (ESG) metrics even more pressing for executives, boards and policy-makers.

Leaders across industries – from mining and metals, chemical industries, life sciences and oil and gas, to automotive and aerospace – are looking for new ways to adopt new metrics within their operations and supply chain ecosystems and accelerate the transition towards stakeholder capitalism. However, many are still struggling with data availability, accuracy and consistency to measure and track the progress of existing and new applications and there are still no standard benchmarks.

In this context, companies in advanced manufacturing – from machinery and robotics to software and providers of technologies and solutions – have a unique opportunity to address the above challenges while solving business problems across industries. Advanced manufacturing can help accelerate the transition to ESG reporting across areas such as:

1. Innovation: Leveraging innovative technologies and solutions to address business problems while driving growth and keeping track of sustainability impact.
2. Workforce: Empowering workers with new technology, tools and solutions, enhancing the adoption of new sustainable metrics.
3. Sustainability: Providing next generations of technologies and solutions to enable sustainability, helping companies track and report on the new sustainability metrics.

Understanding this urgency, the Advanced Manufacturing Industry Community action group at the World Economic Forum came together to design a common framework for the industry to measure the impact of solutions and technologies on sustainability metrics (i.e. ESG) and then support companies' transition to stakeholder capitalism.<sup>1</sup> The intent is not to create new standards but to shed light on the role that advanced manufacturing can play as an enabler for companies across the entire value chain.

The framework highlights the role of advanced manufacturing across three dimensions. First, it shows how advanced manufacturing is driving both productivity and efficiency, as well as supporting the tracking and reporting of sustainability metrics (people, planet, prosperity) in specific areas. Second, it provides an overview of specific ESG metrics in the advanced manufacturing ecosystem. Finally, it provides a common mechanism to benchmark and then set up new sustainable goals.

In this briefing paper, we present an application of this framework. Section 1.1 shows a selection of more than 25 use cases across multiple industries, where advanced manufacturing is already easing the adoption of ESG metrics while driving growth and sustainability value. These use cases are classified into five high-impact areas. Based on this sample analysis, we identify key performance indicators (KPIs) for the advanced manufacturing ecosystem (section 1.2) and present two concrete applications to provide evidence of the role of advanced manufacturing in specific impact areas (section 2.3). We also describe the business challenges addressed and the enabling technologies.

We hope that these insights help mobilize the global manufacturing community across sectors and geographies to support the dissemination and adoption of the new sustainability metrics and enable consistent, evidence-based reporting.

### BOX 1 The Stakeholder Capitalism Metrics

For the past two years, the World Economic Forum, with Partners including Deloitte, EY, KPMG and PwC, has drawn upon existing frameworks and identified a set of universal metrics and disclosures – the [Stakeholder Capitalism Metrics](#) (SCM). It includes 21 core metrics, organized into 4 pillars, aligned with the UN's 2030 Agenda. The 4 pillars are: people, planet, prosperity and the principles of governance (see Figure 1).



## Principles of Governance

- 1 Setting purpose
- 2 Governance body composition
- 3 Material issues impacting stakeholders
- 4 Anti-corruption
- 5 Protected ethics advice and reporting mechanisms
- 6 Integrating risk and opportunity into business process



## Planet

- 7 Greenhouse gas (GHG) emissions
- 8 The Task Force on Climate-Related Financial Disclosures (TCFD) implementation
- 9 Land use and ecological sensitivity
- 10 Water consumption and withdrawal in water-stressed areas



## People

- 11 Diversity and inclusion
- 12 Pay equality
- 13 Wage level
- 14 Risk of incidents of child, forced or compulsory labour
- 15 Health and safety



## Prosperity

- 16 Absolute number and rate of employment
- 17 Economic contribution
- 18 Financial investment contribution
- 19 Total research and development expenses
- 20 Total tax paid

Source: World Economic Forum, Towards Common Metrics and Consistent Reporting of Sustainable Value Creation, (2020)

Although significant progress has been made developing the above set of 21 core stakeholder capitalism metrics drawn from existing standards and frameworks, there is still a need for more industry-specific key performance indicators (KPIs) to benchmark against peers.



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# Towards a common framework for ESG in advanced manufacturing

Industry 4.0 in advanced manufacturing offers other industries the ability to more accurately measure and report ESG metrics.

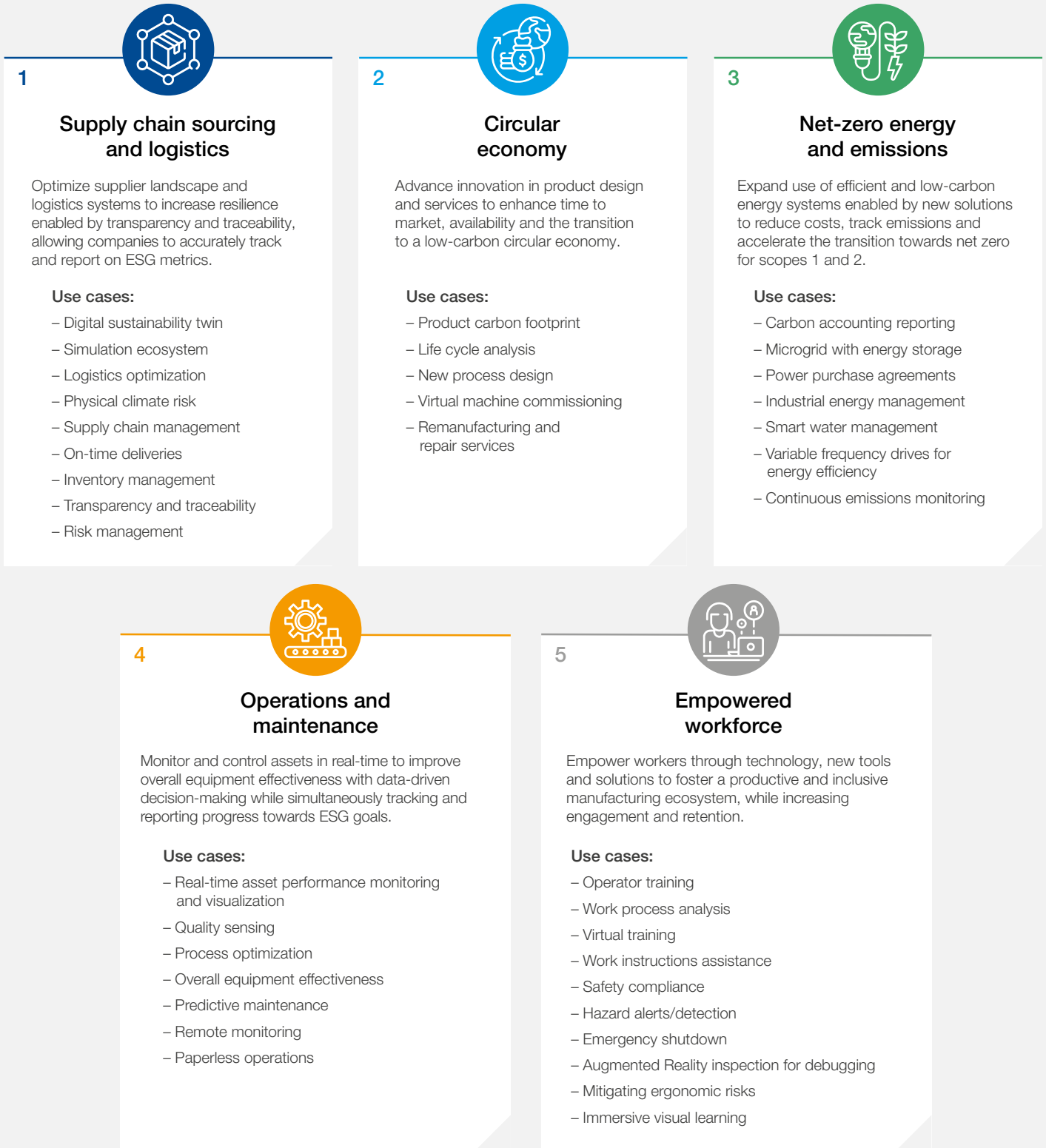


# 1.1 Five high-impact areas

Advanced manufacturing plays a unique role in driving both productivity and efficiency and enabling companies to track sustainability metrics (people, planet, prosperity). The Advanced Manufacturing Industry Community has identified more than 25

existing use cases where its technologies and solutions are already enabling sustainability and profitability. Based on the use cases submitted, five high-impact areas across the value chain emerged for ESG in advanced manufacturing (see Figure 2).

FIGURE 2 High impact areas for ESG in advanced manufacturing








Source: World Economic Forum and Advanced Manufacturing Industry Community

## 1.2 The next level of granularity for ESG in advanced manufacturing

As mentioned in the introduction, the Stakeholder Capitalism Metrics (SCM) includes 21 industry-agnostic core metrics. This section presents a sample of specific ESG metrics for advanced manufacturing, identified by the community as industry specific KPIs based on the use cases (see Figure 3).

FIGURE 3 Sample of advanced manufacturing ESG metrics and KPIs

Pillar	Metrics	KPI (units)
	<b>1. Greenhouse gas emissions</b>	<b>Carbon footprint:</b> tonnes (t) CO <sub>2</sub> equivalent (e-) <b>Process emissions:</b> volatile organic carbons* (VOCs) <b>Transportation</b> (fleet, distribution, logistics): miles travelled) <b>Energy cost</b> (global, regional, site, asset, device): \$ <b>Energy intensity</b> (megawatt per hour (MWh)/ unit produced) <b>Low carbon energy:</b> % renewable, % carbon captured, % energy storage ...
	<b>2. Water</b>	<b>Water intensity:</b> thousand cubic meters (m <sup>3</sup> ) / unit produced <b>Water recovery &amp; reuse:</b> % recovered <b>Waste-water treatment/Effluent:</b> % treated, efficiency unit ops Physical climate risk (future) ...
	<b>3. Materials &amp; waste</b>	<b>Waste intensity:</b> tonnes (t)/unit produced <b>Quality and yield optimization (avoided raw material waste):</b> tonnes (t)/year <b>Waste sent to landfill:</b> % <b>Repaired waste:</b> tonnes/year <b>Recycled content in new products:</b> % <b>Sustainable packaging materials:</b> % recyclable ...
	<b>4. People health &amp; safety</b>	<b>Total recordable incident rate:</b> injury rates/total employees Well-being of employees (future) ...
	<b>5. Training</b>	<b>Training time:</b> # hours spent, \$ cost ...

The complete list of use cases is available on the [community site](#).




Source: World Economic Forum and Advanced Manufacturing Industry Community

## 1.3 Providing evidence

Companies across industries are looking for common mechanisms to benchmark their ESG performance and facilitate the application and implementation of ESG metrics as a source of value creation for advanced manufacturing and value chain ecosystems. Proper benchmarks allow companies to set up new sustainable goals and raise ambition.

From the sample analysed, the two most common impact areas that advanced manufacturing technology and solutions are enabling today in terms of profitability and sustainability are net-zero energy and emissions, and an empowered workforce. Figure 4 shows the application of this framework for two use cases.





FIGURE 4 Use case examples

Impact dimension	ESG use case	Description
 <b>Net-zero energy and emissions</b>	Real-time energy management	Real-time energy information systems provide visibility into energy usage/storage and operations at the equipment level to better understand, manage, report on and benchmark the performance of energy-consuming processes. This includes assets responsible for heating and cooling process areas such as boilers, chillers, heat pumps and combined heat and power applications, as well as renewable energy, storage and industrial operational energy efficiency.
<b>Business challenges</b>		<b>Enabling technologies</b>
<ul style="list-style-type: none"> <li>– Data is auditable</li> <li>– Reduce greenhouse gas emissions to comply or meet goals</li> <li>– Upfront infrastructure to achieve granular energy monitoring</li> <li>– Monitor and improve energy consumption to reduce cost per unit</li> <li>– Resilient energy</li> <li>– Cost: Make non-value-adding energy consumption transparent to implement optimization measures on shop floor level</li> <li>– Risk management integration</li> <li>– Supply chain data sharing that is authenticated and trusted</li> <li>– Government compliance, regulations, fines/fees</li> </ul>		<ul style="list-style-type: none"> <li>– Secure network infrastructure</li> <li>– Simulation/modeling tools to analyze current and future energy demand depending on location, climate, use and goals</li> <li>– Cloud infrastructure</li> <li>– Manufacturing execution system to allocate energy measurements</li> <li>– Advanced analytics</li> <li>– Industrial energy management software</li> <li>– Digital monitoring and control</li> <li>– Internet of Things, connected meters, flow instrumentation</li> </ul>
<b>KPI improvements</b>		<b>Impact range observed</b>
 <b>Prosperity</b>	Productivity increase (time savings) Overall equipment effectiveness (OEE) Operating cost reduction Maintenance cost reduction	4-15% 2-43% 10-40% Not observed
 <b>Planet</b>	GHG emissions Scope 1 and Scope 2 (tCO <sub>2</sub> -e) Low carbon energy (% onsite renewable, % captured, % storage) Energy intensity (kilowatt-hour (kWh) per unit produced) Water intensity (m <sup>3</sup> per unit produced) Physical climate risk (future)	15-100% 7-30% 13-30% 2-20% Not observed

Source: World Economic Forum and Advanced Manufacturing Industry Community



FIGURE 4 | Use case examples (continued)

Impact dimension	ESG use case	Description
 <b>Empowered workforce</b>	Remote training	Provide digital tools to enable workers to optimally run process, ensure proper set up and quickly troubleshoot issues.
<b>Business challenges</b>		<b>Enabling technologies</b>
<ul style="list-style-type: none"> <li>– Workforce shortages</li> <li>– Loss of knowledge</li> <li>– Long ramp-up period for new line workers</li> <li>– High training cost and travel requirements</li> <li>– Reliance on full-time on-site trainers</li> <li>– Trainer-to-trainer inconsistencies</li> <li>– Faster and effective inspections with predictive intelligence</li> <li>– Improved worker safety/reduced fatalities</li> <li>– Proficiency gained before real-world experience and increased availability of ongoing training</li> </ul>		<ul style="list-style-type: none"> <li>– Wearable computers with software</li> <li>– Secure remote connectivity</li> <li>– Digital tools for visibility</li> <li>– Maintenance documentation, subject matter to document process, etc.</li> <li>– Employees willing to use technology</li> </ul>
<b>KPI improvements</b>		<b>Impact range observed</b>
 <b>Prosperity</b>	Productivity increase (time savings) OEE increase Operating cost reduction Maintenance cost reduction	4-220% up to 12% 20% Not observed
 <b>Planet</b>	GHG emissions (avoided distance travel) Waste intensity (t/unit produced) Quality optimization avoided raw material Repaired waste	80-90% 4-80% 20-50% up to 60%
 <b>People</b>	Training (# hours per employee) Zero injury goals Reduced employee turnover	increase 50-100% Not observed Not observed

Source: World Economic Forum and Advanced Manufacturing Industry Community

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# The way forward

Even though there is evidence of solutions and technologies in advanced manufacturing easing the adoption of ESG metrics, there is still significant value creation to unlock in innovative impact areas. This can be done by adopting new tracking and reporting methods enabled by advanced manufacturing and fostering the exchange of best practices and benchmarking. In the coming

months, the framework presented in this briefing paper will be used to mobilize action by advanced manufacturing companies. It aims to help companies in advanced manufacturing to engage with other industries and policy leaders, fostering greater collaboration towards common ESG metrics and accelerating the transition towards [stakeholder capitalism](#). This includes:

## Short term

- **Developing a new shared narrative** on how advanced manufacturing solutions have increased productivity and sustainability.
- **Collecting and sharing** best practices and solutions that leverage advanced manufacturing technologies to ease the adoption of ESG metrics, and capturing key enablers and exploring opportunities with adjacent industry groups.
- **Facilitating discussions with sustainability and operational leaders** that help inform the development of companies' and countries' strategies on ESG.

## Long term

- **Agreeing on a common reporting and benchmarking approach to measure the real impact** that advanced manufacturing is enabling.
- **Helping small to medium-sized businesses** to adopt ESG for value creation, focusing efforts on the specific pain points of smaller companies.

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# Endnotes

1. World Economic Forum, *Measuring Stakeholder Capitalism: Towards Common Metrics and Consistent Reporting of Sustainable Value Creation*, 2020, <https://www.weforum.org/reports/measuring-stakeholder-capitalism-towards-common-metrics-and-consistent-reporting-of-sustainable-value-creation>.





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