Bedre Megaprosjekter

Megaproject ESG: Relevant KPIs

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Sammendrag

Norske megaprosjekter, inkludert storskala infrastruktur som E39 Kyststamveien, energiprosjekter som Johan Castberg og Hywind Tampen, samt karbonfangstinitiativer som Longship, representerer komplekse og omfattende satsinger med betydelige miljømessige, sosiale og økonomiske konsekvenser. Effektive ESG-nøkkelindikatorer (KPI-er) på megaprosjektnivå er avgjørende for å styre disse prosjektene mot bærekraftige resultater, etterlevelse av relevant regelverk samt målbar ytelse.

Denne rapporten tilbyr en praktisk, trinnvis veiledning for utforming av ESG-KPI-er tilpasset megaprosjekter. Først introduserer vi veiledende prinsipper for ESG-vurdering som integrerer de tre ESG-pilarene med sentrale kjennetegn ved megaprosjekter. Dette inkluderer deres omfang, antall involverte organisasjoner, sektorer og krav til ytelse. Disse prinsippene fremhever behovet for sektorrelevante miljøindikatorer, konsistente sosiale- og arbeidsstandarder, samt styringsmekanismer som sikrer ansvarlighet, åpenhet og integrering av ESG.

Deretter gjennomgår vi eksisterende praksis for ESG-rapporterings og relevant litteratur for å identifisere sentrale fokusområder, og utvikler en målrettet liste over ESG-KPI-er som er relevante for megaprosjekter. Med utgangspunkt i disse prinsippene og listen presenterer vi en sammenhengende, trinnvis veiledning som støtter praktikere i å utforme prosjektspesifikke ESG-KPI-er på en strukturert måte.

Ved å anvende denne trinnvise veiledningen kan ledere av megaprosjekter utvikle skreddersydde ESG-KPI-er, forbedre beslutningstaking, redusere ESG-relaterte risikoer, styrke tilliten blant interessenter og levere prosjekter som bidrar til Norges grønne omstilling, støtter samfunnets behov og oppfyller nasjonale og europeiske standarder for bærekraft.

Report summary

Norwegian megaprojects, including large-scale infrastructure like the *E39 Coastal Highway*, energy projects such as *Johan Castberg* and *Hywind Tampen*, and carbon capture initiatives like *Longship*, represent complex, high-impact undertakings with substantial environmental, social, and economic effects. Effective megaproject-level ESG KPIs are essential to guide these projects toward sustainable outcomes, regulatory compliance, and measurable performance.

This report offers a practical, step-by-step guideline for designing ESG KPIs tailored to megaprojects. We first introduce guiding principles for ESG assessment that integrates the three ESG pillars with key characteristics of megaprojects, including their scale, number of involved organizations, sectors, and compliances. These principles highlight the need for sector-relevant environmental metrics, consistent social and labor standards, and governance mechanisms that ensure accountability, transparency, and ESG integration.

Following this, we reviewed existing ESG reporting practices and relevant literature to identify key focus areas and developed a targeted shortlist of ESG KPIs applicable to megaprojects. Building on the guiding principles and shortlist, a coherent, step-by-step guideline that supports practitioners in designing megaproject-specific ESG KPIs in a structured manner.

By applying these step-by-step guidelines, megaproject leaders can design a tailored-megaproject ESG KPIs and enhance decision-making, reduce ESG-related risks, foster stakeholder trust, and deliver projects that contribute to Norway's green transition, support societal needs, and meet national and EU sustainability standards.

Terms and Abbreviations

Term (English)	Term (Norwegian)	Abbreviation	Definition / Context
Environmental, Social, and Governance:	Miljø-, sosiale- og forretningsetiske forhold	ESG	A framework used to assess an organization's impact and sustainability performance.
Key Performance Indicator	Resultatindikator	KPI	A quantifiable measure used to evaluate the success of a project in meeting sustainability objectives.
Corporate Sustainability Reporting Directive	Direktiv om bærekraftsrapportering	CSRD	EU regulation that significantly increases expectations and requirements for ESG reporting.
European Sustainability Reporting Standards	Europeiske standarder for bærekraftsrapportering	ESRS	Standardized requirements for disclosure under the CSRD framework.
Global Reporting Initiative	Global Reporting Initiative	GRI	A widely used international standard for sustainability reporting adopted by major Norwegian firms.
Megaproject Social Responsibility	Sosialt ansvar i megaprosjekter	MSR	Indicators specifically designed to assess community well-being and the social impacts of large-scale projects.
Material Circularity Indicator	Sirkularitetsindikator for materialer	MCI	A metric measuring the percentage of reused or recycled materials versus virgin materials in project input.
Environmental Gain at Cost	Miljøgevinst per krone	EGAC	The monetary value of CO2 avoided divided by the additional cost of implementing green solutions.
Social License to Operate	Sosial aksept for prosjektet	SLO	A composite score reflecting community approval, stakeholder engagement, and grievance management.
Lost Time Injury Frequency Rate	Frekvens for fraværsskader	LTIFR	A fundamental safety indicator measuring the rate of occupational injuries resulting in time away from work.

1 Introduction

Norway is widely recognized as a global leader in integrating sustainability into many aspects of business and societal activities. Through its *Climate Action Plan 2021–2030,* the government has positioned multiple initiatives as a key driver for reducing national greenhouse gas emissions, also those involved and implemented through megaprojects. In practice, this has led to strong progress in what can be described as *technical sustainability*. For example, Oslo has introduced zero-emission construction sites, significantly lowering on-site emissions, while projects such as *Mjøstårnet* demonstrate how alternative materials like timber can reduce reliance on carbon-intensive steel and concrete. Similarly, new initiatives emerge such as in project E18, where they test the SiGS waste materials together with Eramet Norway and SINTEF as substitution for virgin mineral aggregates.

Despite these advances, important challenges remain. Major infrastructure developments, such as the *E39 coastal highway*, continue to raise concerns about biodiversity loss and environmental trade-offs. At the same time, most sustainability efforts are still focused on direct emissions during construction, while indirect impacts remain difficult to measure and manage, particularly those arising from supply chains (Scope 3 emissions). Beyond that, the full lifecycle sustainability impact of megaprojects is not yet approached in harmonized ways.

In parallel, the regulatory landscape is evolving rapidly. New requirements such as the Corporate Sustainability Reporting Directive (CSRD) and the European Sustainability Reporting Standards (ESRS) are significantly increasing expectations for ESG reporting. Norwegian organizations including *Statsbygg, Equinor,* and *Bane NOR* are already aligning with frameworks such as the Global Reporting Initiative (GRI) and the UN Sustainable Development Goals (SDGs). However, these frameworks are primarily designed at the corporate level and for annual reporting. For project-based industries operating with larger time frames, this creates a practical challenge: *how to design megaproject ESG KPI framework so that it fits with megaproject particularities and complies with broader regulatory expectations?* In reality, a company's ESG performance is largely determined by the outcomes of its individual projects. Yet there is currently no standardized way to define, measure, and compare ESG performance at the megaproject level.

Looking at the existing literature, a range of methods have been developed to measure ESG performance. However, most of these approaches focus on specific aspects rather than providing a complete picture. For the *Environmental* pillar, some models use energy-based assessments to evaluate the systemic resource

impact of infrastructure projects (Cristiano and Gonella, 2019). Others combine greenhouse gas (GHG) monitoring with earned value management (EVM) to track emissions in real-time during construction (Abdi *et al.*, 2018). In the *Social* pillar, frameworks for megaproject social responsibility (MSR) have been developed to assess community well-being (Lin *et al.*, 2017). In parallel, tools such as social network analysis (SNA) are used to map stakeholder relationships and identify potential risks (Xia and Xiang, 2023). Regarding *Governance*, practitioners typically rely on methods such as multi-criteria decision making (MCDM) or grey ordinal priority approaches to evaluate and select sustainable suppliers (Liang and Chong, 2019; Mahmoudi *et al.*, 2021).

While these methods are useful, they tend to address isolated parts of a project, such as carbon emissions, specific social risks, or supplier performance, rather than the megaproject as a whole. Moreover, these methods are theoretically designed without consideration of megaproject inherent characteristics. As a result, they do not provide a holistic ESG assessment. This fragmented approach makes it difficult for project managers to compare projects in a consistent way or to deliver the integrated data increasingly required for corporate-level reporting.

Looking at the best practice, major megaproject-oriented organizations have recently just started to adopt ESG reporting systems and guidelines (e.g., CSRD, GRI, ESRS) at the corporate level, so there is an even larger gap emerging between corporate level reporting and megaproject-specific reporting. Large entities operate within a complex mix of international and national regulations. For example, the Norwegian Directorate of Public Construction and Property *(Statsbygg)* applies the GRI Standards and uses double materiality assessments to identify key environmental impacts. Other major players, including *Bane NOR, Nye Veier,* and *Equinor,* are aligning their reporting with requirements such as the EU CSRD, the Corporate Sustainability Due Diligence Directive (CSDDD), and the Norwegian Transparency Act *(Åpenhetsloven)*.

However, ESG data is aggregated at the organizational level to meet annual reporting requirements. While it is technically possible to measure ESG performance at more detailed levels, from business units down to specific activities, there is still no standardized framework for megaproject-level assessment. Even large flagship projects, such as *Johan Castberg,* generate sustainability data that is primarily structured to fit corporate reporting formats, rather than to provide a detailed, project-specific ESG evaluation. For practitioners, this means there is currently no off-the-shelf system that can directly translate

complex, site-specific project data into a transparent and comparable ESG performance score.

Given the unique nature of these undertakings, there is a compelling need to develop a dedicated ESG KPI framework specifically for megaprojects. Corporate ESG frameworks are ill-suited for the project because megaprojects are massive, temporary, and highly complex organizations, evolving in phases with different characteristics. The logic of megaprojects is site-centric, moving from the transport of materials to on-site construction, and ultimately to the long-term operational stage. This complexity is heightened by the involvement of multiple stakeholders whose activities often overlap across different lifecycle phases. This multi-organizational involvement makes it difficult to measure and define megaproject-specific ESG performance. Furthermore, they involve a vast ecosystem of stakeholders, including government bodies, local communities, NGOs, and a web of contractors, each with different ESG priorities. In terms of timing, while a corporation's ESG performance is usually measured in annual cycles, a megaproject is highly dynamic; its ESG focus shifts dramatically from the design and construction phases to, typically, decades of operation.

Because of this mismatch, relying solely on corporate-level metrics risks overlooking critical site-specific impacts, such as local social displacement or immediate ecological damage, which can easily be diluted in aggregated annual reports. Imposing corporate-level ESG indicators on megaproject sustainability will also cause conflicts due to inherent temporal difference between annual reporting mandate and megaproject-specific durations. More importantly, the diversity and complexity of megaprojects means that a single, standardized set of ESG KPIs applicable to all projects is neither practical nor desirable. Differences in scale, location, stakeholders, and lifecycle phases make it unrealistic to define one universal megaproject ESG KPI measurement system that captures all relevant impacts.

Instead, what is needed is a structured way for megaprojects to tailor their own ESG metrics by combining universal dimensions and megaproject particularities. This report therefore does not attempt to develop a one-size-fits-all KPI framework. Rather, it focuses on establishing a set of guiding principles for designing megaproject-specific ESG KPIs applicable to types of industries or sectors. By applying these principles, Norwegian project professionals can move beyond generic corporate reporting and develop tailored, evidence-based measurement systems that better reflect the actual sustainability performance of their megaprojects, while still maintaining alignment with broader ESG requirements.

The remainder of this report is structured to provide a practical roadmap for project-level ESG implementation. Section 2 defines the core pillars of ESG. Section 3 analyzes the unique characteristics of megaprojects and how these factors drive the need for a different approach to KPI design. Section 4 presents a framework and guiding principles for developing project-specific ESG assessment systems. Section 5 explores the key internal and external factors influencing ESG performance in practice. Finally, Section 6 provides a shortlist of indicative ESG KPIs, offering a practical starting point for managers seeking to move from corporate compliance to more impactful project-level performance.

2 ESG concept and core pillars

Since 2004, ESG has evolved from a niche concept into a widely used framework for assessing long-term performance, risk exposure, and sustainability, mainly for corporate-level outcomes. It captures how organizations impact the environment and society, as well as how effectively they are governed in terms of leadership, controls, and transparency. Historically, sustainability in a business context was framed through the concept of the Triple Bottom Line[1], which emphasized balancing ESG outcomes. Over time, this perspective has shifted toward a more materiality-driven approach. Today, non-financial factors such as emissions, workforce conditions, and governance practices are increasingly measured, managed, and linked directly to financial performance, risk management, and regulatory compliance.

This shift is reflected in the growing standardization of ESG reporting. Frameworks such as the GRI, along with regulatory requirements like the CSRD, have established more consistent expectations for disclosure. In practice, widely used industry frameworks such as the Refinitiv ESG model[2] organize ESG into three core pillars: Environmental (E), Social (S), and Governance (G). These pillars provide a structured way to assess sustainability performance across different organizations and industries.

2.1 The environment pillar (E)

The Environmental pillar evaluates an organization's impacts on and management of natural systems, including climate, resources, ecosystems, and pollution. In the LSEG Sustainability Ratings and Data framework launched in March 2026, this pillar aggregates scores from five key ESG Themes: Climate Transition, Energy & Resource Use, Biodiversity, Water Use, and Waste & Pollution.

Climate Transition focuses on how organizations manage greenhouse gas emissions and prepare for a low-carbon economy, covering Scope 1–3 emissions, transition risks, adaptation plans, and alignment with net-zero pathways. High

[1] The *Triple Bottom Line* is a sustainability framework introduced by *John Elkington* in 1994. It expands traditional financial reporting to include three dimensions: People (social), Planet (environmental), and Profit (economic). The concept emphasizes that companies should measure and manage performance across all three bottom lines rather than focusing solely on profit.

2 The *Refinitiv ESG model* is a widely adopted quantitative ESG rating framework. It evaluates companies using over 630 ESG metrics grouped under the three core pillars and is commonly used by investors for benchmarking, risk analysis, and investment decisions.

performance requires quantified targets, scenario analysis, and verifiable reductions, making it central to regulatory compliance and investor expectations in high-emission sectors. *Energy & Resource Use* examines efficiency in consuming energy, materials, and other resources across operations and supply chains. It emphasizes renewable energy adoption, energy intensity reductions, and circular practices; companies must demonstrate quantified targets to exceed mid-level scores, linking cost savings to lower environmental strain. *Biodiversity* addresses impacts on ecosystems, species, and habitats from land use, operations, and supply chains. As a more nascent theme with lower disclosure maturity, scoring rewards disclosure of risks, mitigation measures, and alignment with frameworks like TNFD, highlighting growing regulatory and stakeholder pressure. *Water Use* evaluates withdrawal, consumption, and stewardship of freshwater resources, particularly in water-stressed areas. Metrics include efficiency improvements, recycling rates, and risk assessments; strong performance reduces operational vulnerabilities and supports sustainable resource management. *Waste & Pollution* covers generation, treatment, and prevention of waste, hazardous materials, effluents, and air pollutants. It promotes zero-waste goals, circular economy integration, and pollution controls, ensuring compliance and minimizing health/ecosystem harm. Together, these five themes capture both direct environmental footprints and long-term resilience strategies.

2.2 The social pillar (S)

The Social pillar assesses an organization's management of relationships and impacts on people, including employees, workers in value chains, communities, and end-users. Under the 2026 LSEG framework, this pillar aggregates three core Themes: Labour Relations, Health & Safety, and Human Rights & Community

Labour Relations evaluates fair treatment of workers, including wages, working conditions, collective bargaining, diversity & inclusion, and employee development. It drives productivity and retention by focusing on equitable practices and training, with mature disclosure enabling clear benchmarking. *Health & Safety* measures prevention of occupational injuries, illnesses, and fatalities across operations and supply chains. Scoring caps apply for recent fatalities or poor disclosure; strong performance reflects robust systems, training, and culture, directly linking to workforce well-being and operational reliability. *Human Rights & Community* examines respect for international standards (e.g., ILO conventions, UN Guiding Principles), supply chain due diligence, and positive/negative impacts on local communities. Amid regulations like the Norwegian Transparency Act, it

emphasizes stakeholder engagement, grievance mechanisms, and contributions to public well-being.

2.3 The governance pillar (G)

The Governance pillar examines the structures, processes, and behaviors that ensure ethical, accountable, and transparent decision-making. In the 2026 LSEG framework, this pillar aggregates four Themes: Board & Management (or Board & Engagement), Shareholder Rights, Conduct & Anti-Corruption, and Tax Transparency & Accounting. Strong governance enables effective E and S implementation and builds stakeholder trust.

Board & Management focuses on board composition, independence, diversity, skills, and executive incentives aligned with long-term sustainability. It ensures leadership oversight of ESG risks/opportunities and strategic integration into decision-making. *Shareholder Rights* address equitable treatment of investors, voting mechanisms, transparency in governance, and protections against conflicts of interest, fostering accountability and fair capital allocation. *Conduct & Anti-Corruption* evaluates ethical business practices, bribery prevention, compliance programs, and whistleblower protections. It mitigates reputational and legal risks through robust policies and incident management. *Tax Transparency & Accounting* examines responsible tax strategies, reporting, and avoidance of aggressive schemes. It promotes fair contribution to public finances and alignment with ethical standards. Strong governance is often seen as an enabler of ESG performance overall, as effective management systems are necessary to successfully implement environmental and social initiatives.

While these ESG pillars provide a clear and widely accepted foundation, they have largely been developed with permanent organizations in mind—particularly large companies with stable structures and annual reporting cycles. This raises an important question: how well do these same concepts apply to megaprojects, which are temporary, complex, contextualized, and highly dynamic by nature? The following section explores this question by examining the unique characteristics of megaprojects and how they challenge the direct application of traditional ESG approaches.

3 Megaproject characteristics and their impact on ESG KPIs

Megaprojects are not simply larger versions of conventional projects. They are complex, high-risk systems with long timelines, significant environmental and social impacts, and high public visibility. Often times, megaprojects are organized with more than one participating organization, and blurring the boundaries of operations, since multiple organizations are involved on sites to deliver a single outcome. This marks a significant difference from traditional corporate-based business. As a result, applying standard corporate ESG metrics directly to megaprojects is often insufficient and inappropriate. To measure ESG performance effectively, KPIs must reflect the specific characteristics of megaprojects. This section outlines five key features and their practical implications for megaproject ESG KPI design.

3.1 Large-scale and environmental footprint

One of the most defining characteristics of megaprojects is their scale. These projects require large volumes of materials, energy, and labor, and are delivered across extensive geographic areas over long timeframes. This scale amplifies environmental impacts, making them more immediate, concentrated, and visible than in typical corporate operations. It also means that even small inefficiencies can result in significant cumulative impacts.

In this context, traditional ESG metrics based on absolute values, such as total emissions or total energy consumption, offer limited insight. Companies sometimes also adopt per revenue or per product metrics, but these business operations-oriented measuring principles do not reflect the capital-heavy construction-intensive nature. For megaproject KPI design, a more effective approach is to focus on *intensity-based metrics,* where environmental impacts are measured relative to per unit of capacity. For example, emissions can be assessed per kilometer of infrastructure delivered or relative to the volume of materials used, or per metric ton of load capacity. This allows for more meaningful comparisons across projects of different sizes and helps project teams track improvements in efficiency over time. It also supports better decision-making during design and construction, where early choices have long-term environmental consequences. Practical examples of this approach can be found in the infrastructure sector, such as Railway projects utilizing CO_2 per kilometer of track to benchmark carbon efficiency, or energy

megaprojects measuring lifecycle emissions per megawatt (MW) of installed capacity to ensure resource optimization.

3.2 Multiple firms and supply chain complexity

Megaprojects are rarely delivered by a single organization. Instead, they involve a temporary network of project owners, contractors, subcontractors, and suppliers. This creates a fragmented delivery structure, with responsibilities distributed across multiple actors that may have different capabilities, incentives, and levels of control.

In practice, ESG performance depends on the alignment and coordination of this entire network. Weak performance by a single subcontractor, particularly in areas such as safety, labor practices, or environmental compliance, can affect the overall outcomes of the megaproject. A focal contractor can shift the emission-heavy tasks to its suppliers so that its ESG performance looks better, also known as carbon leakage or greenwashing. For KPI design, this means that ESG measurement cannot be limited to the core project organization. It must also capture supply chain performance. This includes tracking contractor compliance, monitoring Health, Safety, and Environmental (HSE) performance across all tiers, and ensuring that sustainability requirements are consistently applied throughout the project. As a result, clear contractual expectations, regular audits, and shared accountability mechanisms become essential components of ESG management.

3.3 Sector-specific differences

Megaprojects are implemented across a wide range of sectors, including energy, transport infrastructure, and construction, each of which presents distinct sustainability challenges and priorities. The relative importance of ESG issues varies significantly depending on the sector, as well as the specific context in which the project is delivered.

For example, energy projects often place strong emphasis on long-term environmental performance, particularly in relation to emissions reduction, resource efficiency, and ecological impact during operation. In contrast, construction and infrastructure projects are often more exposed to immediate social and environmental pressures during the construction phase, such as noise, dust, land use, and disruption to local communities. These differences influence not only what should be measured, but also when and how it should be measured. This variation means that ESG KPI frameworks cannot be fully standardized across

all megaprojects. Instead, they must be *adaptable and context-sensitive,* allowing practitioners to prioritize the most material issues for each project. Without this flexibility, there is a risk that ESG measurement becomes either overly generic or misaligned with actual project impacts.

3.4 Lifecycle perspective: construction and operation

Another critical characteristic of megaprojects is the clear distinction between the construction phase and the operational phase. These two phases differ significantly in terms of duration, activities, and sustainability impacts. The construction phase is typically shorter but more intensive, involving high levels of resource consumption, environmental disturbance, and occupational risk. The operational phase, by contrast, extends over decades and determines the long-term environmental performance and societal value of the project.

An effective ESG assessment must therefore adopt a *lifecycle perspective* that captures both phases in an integrated manner. During construction, the focus is typically on managing site-level impacts, including emissions, waste, and health and safety performance. During operation, attention shifts toward system efficiency, reliability, and the long-term operational costs. Failing to account for both phases can lead to incomplete or misleading conclusions. For example, a project may achieve low emissions during construction but have a high long-term maintenance cost, or vice versa. A comprehensive megaproject ESG KPI system must therefore bridge short-term impacts and long-term outcomes.

3.5 Sustainability “of” and “by” megaprojects

Lastly, sustainability in megaprojects can be understood from two complementary perspectives: the sustainability impacts *of* the megaproject and the sustainability impacts *by* the megaproject. The first perspective focuses on the direct impacts associated with how the megaproject is delivered and operated, including environmental emissions, labor conditions, and governance practices. The second perspective considers the broader contribution that the megaproject makes to society and the economy.

This distinction is particularly important because the value of megaprojects often extends beyond their immediate footprint. For example, a transport project may enable shifts toward lower-emission mobility, while an energy project may support the transition to low-carbon systems. For megaproject ESG KPI design, this means combining measures of direct performance with indicators that capture

broader outcomes. Megaprojects need to assess not only how sustainably they are delivered, but also the long-term societal benefits they create. In addition, ESG assessment should account for *resilience and legacy value,* including the project's ability to adapt to future environmental and social conditions and its contribution to local communities through employment, skills development, and long-term economic benefits.

4 Guiding principles for megaproject ESG assessment

As discussed in the previous sections, most existing ESG frameworks are designed for corporate-level applications and do not fully capture the complexity of megaproject environments. At the same time, both the literature and current industry practice show that ESG assessment at the project level remains fragmented, often focusing on isolated aspects rather than providing a structured and comprehensive approach.

To address this gap, this report proposes the *guiding principles* for ESG KPI design in megaprojects, shown as *Table 1.* Rather than prescribing a fixed set of indicators, the principle emphasizes understanding what should be measured and why, allowing practitioners to develop KPIs that are context-specific, actionable, and aligned with established ESG standards. It is built on two key inputs. First, it draws from the three core ESG pillars. Second, it incorporates the defining characteristics of megaprojects identified in Section 3, including scale, the number of participants, sector, and compliance environment. By combining these two dimensions, this guiding principle ensures that ESG assessment remains both standardized in principle and sensitive to the specific context of each megaproject.

Table 1. Guiding principles for megaproject ESG KPI design

		Megaproject characteristics			
ESG Pillar		***Megaproject scale***	***Involved organizations***	***Sector***	***Compliances***
	E	Impact intensity-based and systemic utility-delivering	Supply chain environmental alignment	Sector-specific environmental priorities	Align with CSRD, ESRS, GRI
	S	Scale amplifies community impacts	Consistent labor and safety standards	Context-driven social impact focus	Follow Norwegian and global standards
	G	Complexity requires structured oversight	Clear roles and responsibilities across all actors	Project-specific authority-agreed oversight	Ensure transparency and reporting alignment

The guiding principles should be read as a practical guide for designing ESG KPIs in megaprojects. Each cell highlights what practitioners need to pay attention to when translating ESG principles into measurable indicators. The goal is not to add complexity, but to ensure that ESG measurement reflects the complex dimension needs to be considered for megaprojects delivery.

For the ***E pillar,*** megaproject scale directly affects how performance should be measured. In megaprojects, total emissions or resource use will naturally be high and will fluctuate across different phases of construction. This makes absolute numbers difficult to interpret, and only focusing on per revenue or per product

metrics can also be misleading. In practice, teams should focus on intensity-based measures with a focus on systemic utility delivered, and probably go beyond the mere *per kilometer built* or *energy use*, to even the *per unit of output to the utility delivered*, for example *per metric ton of load capacity*. These metrics allow for consistent tracking over time and make it relatively easier and reasonable to compare performance across similar megaprojects.

When multiple contractors and suppliers are involved, environmental performance is largely driven by the supply chain. A significant share of environmental impact comes from subcontractors rather than the main contractor. This means that environmental requirements cannot remain only internal. They need to be built into procurement processes and contracts and leveraging the buying power of project owners to imposing ESG orientations on suppliers. In practice, this includes setting clear environmental standards for suppliers and requiring consistent data reporting across all tiers.

Environmental priorities also depend on the type of project. For example, road and rail projects typically need to focus on land use, biodiversity, and material reuse, while energy projects may prioritize emissions reduction and ecosystem protection. This means that megaproject teams should avoid generic environmental KPIs and instead select indicators that reflect the main environmental risks of their specific project.

Finally, environmental KPIs can benefit from aligning with existing reporting requirements. In practice, this means ensuring consistency with frameworks such as the GRI and regulatory requirements like the CSRD. This often involves navigating across different levels of reporting for megaproject-oriented firms, including EU-level reporting (GRI, CSRD), sector-level reporting (Governments and ministries), etc. Aligning project-level data with these frameworks reduces reporting gaps, resolving diverging requirements and avoids duplication of work.

For the ***S pillar,*** scale increases both impact and visibility. Megaprojects often affect local communities in significant but embedded ways, especially in infrastructure development. Issues such as noise, traffic disruption, and land use can lead to resistance from local stakeholders—the so-called “Not In My Backyard” effect. In practice, this means that stakeholder engagement and communication cannot be handled informally. Projects need structured processes for engagement, feedback, and, where necessary, compensation. These processes should be scaled with the size and impact of the project.

With multiple contractors involved, maintaining consistent labor and safety standards becomes a key challenge. In the Norwegian context, this is closely linked

to risks of social dumping and uneven working conditions across subcontractors. To manage this, projects need to apply the same standards across all participants. This includes using consistent safety metrics, such as lost time injury frequency rates, and ensuring that all contractors follow the same requirements for working conditions and worker protection.

Social priorities also vary depending on the project context. In urban areas, the focus is often on community impact and stakeholder relations, while in more remote or industrial projects, workforce conditions and safety may be more critical. This means that social KPIs should be selected based on where the main risks and impacts are.

Compliance is particularly important for the social dimension. In Norway, the Norwegian Transparency Act requires organizations to carry out due diligence on human rights and working conditions, including within their supply chains. For projects, this means that social KPIs must support these requirements, especially in areas such as labor conditions, supplier practices, and risk assessments.

For the ***G pillar,*** project scale increases the need for structured decision-making and control. Large investments and long timelines mean that governance cannot rely on informal processes. In practice, projects should use structured decision points, such as stage-gate or phase-gate models, where progress is reviewed before moving forward. ESG considerations should be included in these decision points, ensuring that sustainability issues are addressed early and not only at the reporting stage.

The involvement of multiple organizations makes it essential to clearly define roles and responsibilities. One of the most common issues in megaprojects is unclear accountability between owners, contractors, and subcontractors. To address this, governance structures need to go beyond contracts. In practice, this can include joint governance mechanisms, such as cross-organizational ESG committees, to ensure alignment and coordination.

Governance arrangements also depend on the type of project and its regulatory context. Many megaprojects operate under specific agreements with public authorities or sector regulators. This means that governance KPIs should reflect these arrangements, including how decisions are made, who has authority, and how compliance is monitored.

Finally, governance KPIs must support transparency and reporting. ESG performance needs to be documented in a way that is consistent with both internal requirements and external expectations. This ensures that project-level data can

be used for corporate reporting and that stakeholders, including regulators and the public, can trust the information provided.

5 Shortlist of megaproject ESG KPIs

Building on the guiding principles (Section 4), this section develops a practical shortlist of ESG KPIs for megaprojects. In addition to conceptual reasoning, this process illustrates the key indicators for megaproject ESG reported in real megaproject contexts.

A key observation from practice is that ESG performance is not only shaped by what should be measured, but also by what is currently being measured. To better understand this gap, we conducted a text-based analysis of ESG-related disclosures from major Norwegian projects and organizations.

To identify what practitioners focus on in real projects, a natural language processing (NLP) approach was applied to a dataset of ESG-related documents. These included environmental reports and permit applications submitted by major organizations such as Equinor (e.g., Johan Castberg project) and Statsbygg (e.g., Regjeringskvartalet development). The analysis followed a structured process. First, relevant documents were collected and pre-processed using Python-based scripts. Norwegian stop words were removed, while technical and domain-specific terms were retained to preserve the meaning of project-level reporting. Second, high-frequency terms were extracted and visualized through a word cloud. The results (shown in *Figure 1*) show a very clear pattern. Larger font size and more central position indicate higher frequency and greater prominence in the corpus. Appendix A shows the full frequency list of the top terms.

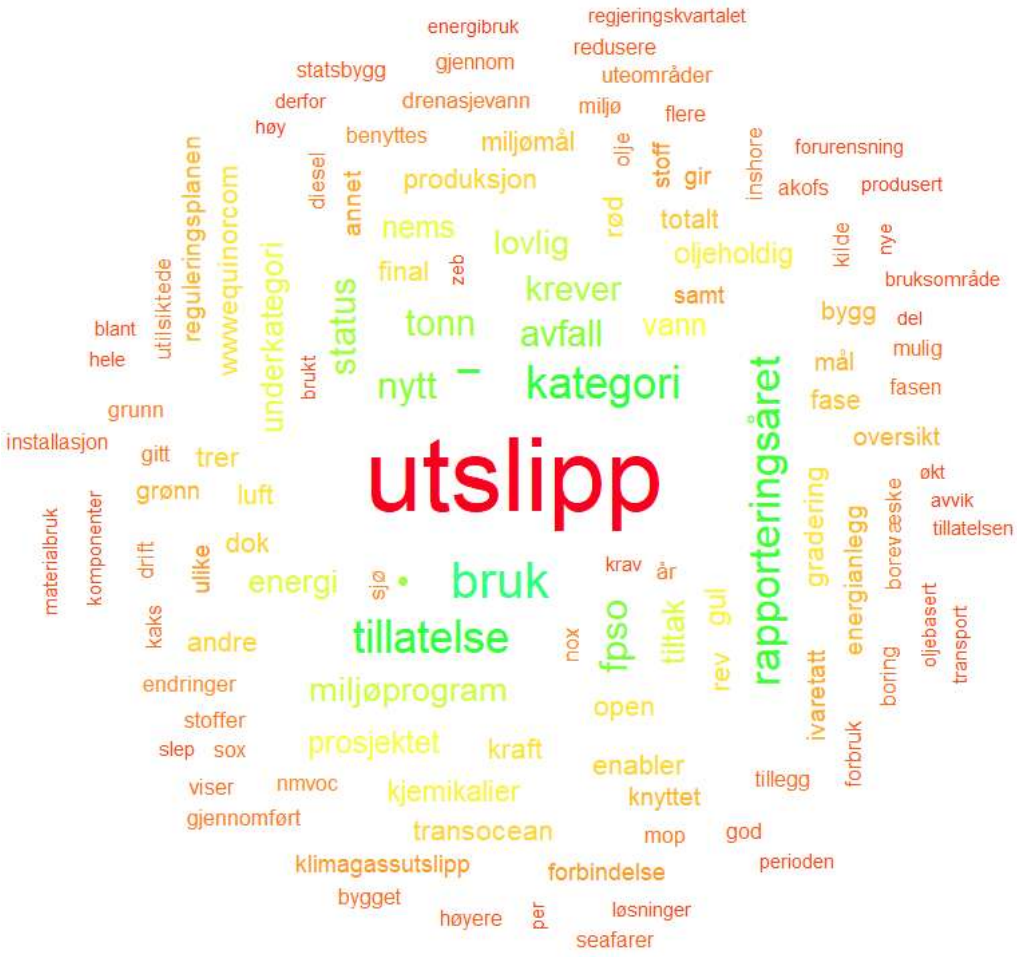

Figure 1. Word cloud of high-frequency terms in ESG report on megaproject-oriented organizations

As shown in Figure 1, the most dominant terms include “utslipp” (emissions), “tillatelse” (permits), and “avfall” (waste). These terms significantly outweigh others in frequency and prominence. This indicates that current ESG practice in megaprojects, at least in the Norwegian context, is heavily environment- and compliance-driven. The primary focus is on meeting regulatory requirements, particularly related to emissions, waste handling, and environmental permits. In contrast, broader ESG considerations, especially within the social and governance dimensions, receive significantly less attention at the project level.

To better understand how ESG is currently approached in practice, we compare project-level reporting (megaprojects) with company-level ESG reporting. As shown in Table 3, this comparison highlights a fundamental structural difference in how ESG is interpreted, measured, and communicated. The comparison reveals

a structural mismatch between *what is currently emphasized in project reporting* and *what is required for a balanced ESG assessment*.

Table 3. Comparison: Megaproject vs. Company ESG Reporting

Dimension	Megaproject (Project-Level Reporting)	General Company (Corporate Reporting)	Key Interpretation
Focus Level	Operational, site-specific, execution-oriented	Strategic, company-wide, planning-oriented	Project reports focus on "doing"; corporate reports focus on "planning and disclosure."
E	Concrete metrics: emissions, waste, permits, quantities (e.g. utslipp, avfall, tillatelse)	Strategic targets: emissions, energy, impacts, goals	Projects track physical footprint and compliance; companies track overall performance and targets
S	Almost absent	Moderately covered (e.g., diversity, impacts)	The social dimension is underdeveloped at the project level
G	Compliance-driven (permits, legal requirements)	Governance frameworks and disclosures (risk, reporting, ESG systems)	Projects focus on "following rules"; companies focus on "governance systems."
Measurement Style	Highly quantitative (e.g., tons, categories, subcategories)	Framework-based and narrative (e.g., ESRS, performance reporting)	Project reporting resembles monitoring logs; corporate reporting resembles ESG summaries
Typical Keywords	emissions, permits, waste, energy use, measures	sustainability, ESG frameworks, financials, risks, impacts	Projects emphasize execution and compliance; companies emphasize strategy and transparency

At the project level, reporting is highly operational and focused on measurable, site-specific indicators. Environmental topics dominate, particularly those linked to regulatory compliance. Emissions, waste, and energy use are typically quantified in detail, often in the form of monitoring logs or permit-based reporting. In contrast, company-level ESG reporting tends to operate at a more strategic level. It focuses on overall targets, risk management, and alignment with frameworks such as ESRS. Social and governance dimensions are more visible at this level but are often not translated into project-specific metrics. This difference can be summarized as follows: project reporting is execution-oriented and compliance-driven, while corporate reporting is strategy-oriented and disclosure-driven. As a result, there is a disconnect between *what is measured on-site and what is reported at the corporate level.*

Most importantly, the analysis highlights two critical gaps. First, the social dimension is underrepresented in project-level ESG measurement, despite being one of the most sensitive areas in megaproject delivery. Second, governance is

treated primarily as compliance, rather than as an active management system involving accountability, incentives, and transparency.

The purpose of this analysis is not to criticize current practice, but to use it as a foundation for more effective megaproject KPI design. The findings suggest that a practical KPI system for megaprojects should do two things simultaneously. First, it should retain what is already working well, particularly the strong emphasis on measurable environmental indicators and regulatory compliance. These areas are well-established, data-driven, and directly actionable. Second, it should expand the scope of measurement to include underdeveloped areas, especially social and governance dimensions. By combining empirical observations with conceptual insights, it becomes possible to define a set of KPIs that are both grounded in practice and aligned with broader ESG expectations.

Based on the combined analysis, the following shortlist, shown in Table 4, represents a balanced and practical set of ESG KPIs for megaprojects. These indicators reflect current industry focus while addressing identified gaps.

Table 4. Megaproject ESG KPI Shortlist

Pillar	Sub-pillar	Proposed Exemplar KPI	Proposed Exemplar Metric	Notes	Reference
Environment (E)	**Resources**	Material Circularity Performance	Material Circularity Indicator (MCI) or % of reused/recycled materials (steel, concrete aggregates, excavated spoil) vs. virgin materials in total project input (by mass/volume). Target: >30–50% depending on project phase.	Megaproject focus: Track across design, procurement, and demolition phases; treat excavated material as resource bank.	
	Emissions	Environmental Gain at Cost (EGAC)	Monetary value of GHG avoided (through low-carbon materials/tech) divided by additional cost of green solutions.	Retained and suitable; align with Scope 1–3 emissions reporting common in infrastructure.	
	Ecology	Soil & Site Ecosystem Stability	Real-time or periodic index of erosion, runoff, and habitat disturbance at excavation/spoil sites (e.g., turbidity levels, vegetation cover %, or stability score from sensors/drones).	Adapted for megaprojects with massive earthworks; include biodiversity offset compliance.	Adapted from Mahmoudi *et al.* (2021), Abdi *et al.* (2018)
	Energy	Energy System Efficiency	Transmission & distribution losses (%) + on-site renewable energy share (%) and overall energy intensity (e.g., GJ per $M project value or per km constructed).	Megaproject adaptation: Account for temporary power setups, long-distance transmission, and construction-phase energy (often diesel-heavy).	Li (2022), Ward *et al.* (2016), OECD 2025 Report
	Pollution &Waste	Waste Circularity & Diversion Rate	% of total waste (by weight/volume) diverted from landfill via recycling, reuse, or recovery (construction & demolition waste focus). Include hazardous waste handling rate.	Common in construction ESG; target >70% diversion. Aligns with OECD sustainable infrastructure guidance.	
	Execution	Low-Carbon Logistics Adoption	% of material & equipment transport (tonne-km) via low-carbon modes (rail, barge, electric) vs. road trucking.	Critical for megaprojects due to massive material volumes moved over long distances.	

Pillar	Sub-pillar	Proposed Exemplar KPI	Proposed Exemplar Metric	Notes	Reference
Social (S)	**Human Rights**	Fair Labor & Wage Compliance	Audit/compliance score (%) for equal pay, no forced labor, and migrant vs. local worker protections (including living wage benchmarks).	megaprojects often involve large migrant workforces and supply-chain risks.	Adapted from Chen *et al.* (2023), Lin *et al.* (2017), Xie *et al.* (2023), Liu *et al.* (2018), OECD 2025 Report
	Community	Social License to Operate (SLO)	Social License Index (SLI): Composite score from community surveys, grievance logs, and social media sentiment analysis (e.g., quarterly % approval or net promoter score).	Essential for megaprojects due to land acquisition, displacement, and long-term community impacts.	
	Diversity	Workforce Diversity & Inclusion	Gender pay gap (%) + % of women, local, and underrepresented groups in workforce and leadership roles.	Megaproject adaptation: Include local content/hiring quotas common in infrastructure projects.	
	Human Capital	Workforce Retention & Development	Annual employee/contractor turnover rate (%) + average training hours per worker (with focus on safety & skills).	High turnover common in remote megaproject sites; track camp conditions and retention incentives.	
	Health	Worker Health & Wellbeing Coverage	% of workforce with access to on-site mental/physical health support, medical facilities, and fatigue management programs vs. total personnel.	Megaprojects involve high-risk environments, shift work, and isolation; include incident rates (e.g., lost-time injury frequency rate).	
	Conflict	Stakeholder Disruption Management	Number of project days delayed due to community protests, labor actions, or disputes (tracked monthly).	megaprojects frequently face “social risk” delays	
Governance (G)	**Contracts**	ESG Contractual Flow-Down	% of ESG requirements in prime contract mirrored in sub-contracts and supplier agreements (with performance-linked penalties/bonuses).	critical for fragmented megaproject supply chains	Adapted from Subaie *et al.* (2023), Zheng *et al.* (2023), Coskun *et al.* (2023), Xue *et al.* (2020), Dimitriou *et al.* (2016), OECD 2025 Report
	Ethics	Integrity & Anti-Corruption Training	% of management, site leads, and key suppliers who completed certified anti-corruption/integrity training annually.	High corruption risk in large public tenders; align with OECD Infrastructure Anti-Corruption Toolbox.	

Pillar	Sub-pillar	Proposed Exemplar KPI	Proposed Exemplar Metric	Notes	Reference
	Risk	ESG Performance Variance	Monthly/quarterly variance (%) or absolute delta between planned vs. actual ESG KPIs (with root-cause analysis).	Useful for long-duration megaprojects with phased delivery.	
	Policy	Policy-Alignment	Multi-Criteria Analysis (MCA) score or % alignment of project decisions with national priorities and UN SDGs (e.g., weighted scorecard).	Megaprojects often funded via public/international finance requiring SDG reporting.	
	Anti-Corruption	Supplier Integrity Due Diligence	% of suppliers/subcontractors subjected to anti-corruption, human rights, and ESG due diligence screening (with red-flag resolution rate).	OECD-aligned; vital for complex international supply chains in megaprojects.	
	Governance Structure	ESG Oversight Effectiveness	Number and % of ESG-related resolutions/decisions passed by project board/governance committee (plus frequency of ESG reporting to board).	megaprojects need strong independent oversight bodies due to scale and political sensitivity.	

Note: OECD (2025) refers to the official OECD report titled Behind ESG Ratings: Unpacking sustainability metrics (OECD, 2025). The exemplar metrics marked “Adapted from OECD (2025) Report” were selected and adapted from Table 2 of this report (“Examples of metric characteristics that impact performance measurement”, p. 30), see Appendix B.

In the *E pillar,* carbon intensity (emissions per unit of output) serves as a core indicator, allowing performance comparison across projects and phases. This is complemented by Scope 3 emissions coverage, which captures how much of the supply chain impact is measured and managed. Indicators such as waste recovery rate, energy use intensity during construction, and biodiversity mitigation implementation further reflect operational and sector-specific environmental performance.

In the S *pillar,* Lost Time Injury Frequency Rate (LTIFR) remains a fundamental safety indicator, particularly when applied consistently across all contractors. To address supply chain risks, the percentage of contractors compliant with labor and human rights standards provides a critical measure of alignment. Community-related indicators such as stakeholder engagement effectiveness and grievance resolution time capture how well the project manages its interaction with external stakeholders. In addition, local employment contribution reflects the project's broader social value.

In the *G pillar,* the focus shifts to how ESG is embedded into decision-making and accountability structures. The integration of ESG criteria into stage-gate decisions ensures that sustainability is considered at key project milestones. The proportion of contracts including ESG requirements reflects how expectations are translated into enforceable obligations. Indicators such as ESG reporting completeness and consistency, aligned with frameworks like the Global Reporting Initiative, and audit coverage of ESG-related activities provide assurance mechanisms that are actively implemented.

The combined findings from empirical analysis and conceptual development highlight a key message for practitioners: ESG in megaprojects is currently strong in environmental compliance but remains underdeveloped in social and governance integration. A robust KPI system should therefore not start from scratch but rather build on existing practices while systematically addressing missing dimensions. By doing so, megaproject teams can move from a compliance-driven approach toward a more balanced and strategic ESG management system.

6 Step-by-step guidelines of designing megaproject-specific ESG KPI

Building upon the proposed guiding principles in Section 4 and the shortlist of megaproject ESG KPIs summarized in Section 5, we offer a practical, actionable protocol for designing megaproject-specific ESG KPIs. This guideline is shown in Figure 2. It is specifically designed to be implemented during the pre-inception phase, allowing involved megaproject organizations to collaborate on how the project will report its own performance before the first stone is turned.

By synthesizing existing corporate databases, our proposed design principles, and the KPI shortlists derived from both literature and public ESG practices, this structured approach moves from generic firm-level data to a customized megaproject KPI set. It ensures that during implementation, every involved organization knows exactly what data is required and which specific roles they must play to maintain the project's ESG license.

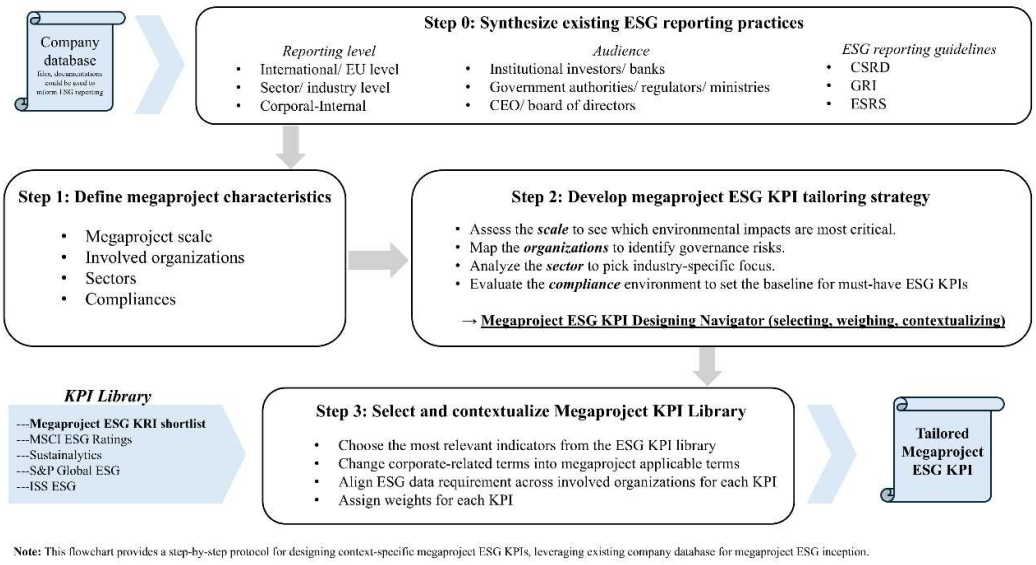

Figure 2. The guideline of designing megaproject-specific ESG KPI

Step 0: Synthesize of existing ESG reporting practices

Step 0 serves as the vital preparatory phase where the foundation for the megaproject ESG KPI is laid. At this stage, the megaproject managing team needs to collect and organize the data already held by involved organizations. This includes auditing internal databases to extract information relevant to ESG reporting, specifically focusing on the existing reporting levels, the target audience,

and the current guidelines such as CSRD or GRI that the firms are already accustomed to using. By starting with this internal data synthesis, we ensure that the newly designed megaproject ESG KPIs are not created in a vacuum but are built upon the actual data capabilities and regulatory experience of the megaproject involved organizations.

6.1 Step 1: Define megaproject characteristics

Once the baseline is established, the process moves to Step 1, which is the formal definition of the megaproject's characteristics. Multiple organizations work together to profile the megaproject across four essential pillars: its scale, the number of involved organizations, the specific industrial sector, and the unique compliance requirements. These characteristics are essential for the customization process. They ensure that the megaproject is treated differently, reflecting the specific risks and opportunities inherent in the megaproject's DNA.

6.2 Step 2: Develop megaproject ESG KPI tailoring strategy

In Step 2, four specific actions are used to develop the actual megaproject ESG KPIs design strategy. First, the most critical environmental impacts are assessed based on the megaproject's scale. Second, the involved organizations are mapped to identify management and governance risks. Third, the specific sector is analyzed to select the appropriate sector focus. Finally, the legal and compliance environment is evaluated to establish the required baseline. By completing these four actions, the *Megaproject ESG KPI Designing Navigator* is created.

This Navigator serves as a strategic guide. It takes the megaproject details obtained in Step 1 and converts them into specific weighting logic. In simple terms, if a "large scale" or an "energy sector" project is selected, the *Navigator* indicates that greater importance should be assigned to certain megaproject ESG KPIs. It enables megaproject managers to clearly understand which indicators are prioritized and which are less critical, particularly in different phases, thereby ensuring that time and resources are allocated to the areas that matter most.

6.3 Step 3: Select and Contextualize Megaproject KPI Library

The final step is the selection and refinement of the actual metrics based on the strategy provided by the Navigator. This step consists of four practical actions. First, the most relevant indicators are selected from the research shortlist and global ESG libraries. A shortlist has been proposed. Second, corporate-related terms are adapted into megaproject-applicable terms—for example, a general water usage goal is translated into liters of water used per kilometer of track laid. Third, ESG data requirements are aligned across all involved organizations for each KPI to ensure that the same data is collected in a consistent manner. Finally, weights are assigned to each KPI to reflect its relative importance during different project stages, such as placing greater emphasis on safety during the construction phase and on energy efficiency during the operation phase.

6.4 Guideline summary and practical application

In practice, this flowchart functions as a collaborative bridge between the various organizations involved in a megaproject. For a practitioner, using this tool means the megaproject team can move away from fragmented, firm-level reporting and toward a unified megaproject-level language. This structured approach ensures that the ESG reporting of the megaproject is as robust and well-engineered as the infrastructure itself.

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Appendix A. Top 40 most frequent terms in megaproject-oriented ESG reporting documents

No.	Norsk	English	Frequency
1	utslipp	emissions	167
2	bruk	use	69
3	kategori	category	58
4	tillatelse	permit	57
5	avfall	waste	42
6	nytt	new	42
7	tonn	tonnes	40
8	status	status	39
9	krever	requires	38
10	miljøprogram	environmental programme	35
11	lovlig	legal	34
12	tiltak	measures	33
13	energi	energy	32
14	nems	NEMS (system)	21
15	underkategori	subcategory	21
16	vann	water	30
17	prosjektet	project	29
18	gul	yellow (waste category)	28
19	kjemikalier	chemicals	28
20	oljeholdig	oil-containing	28
21	final	final	26
22	gradering	grading/ classification	26
23	kraft	power/ energy	26
24	luft	air	26
25	open	open	26
26	rev	rev (revision)	26
27	produksjon	production	25
28	trer	enters/comes into force	25
29	andre	other	24
30	enabler	enabler	24

Appendix B. Examples of metric characteristic that impact performance measurement

Pillar	ESG topics	ESG metric characteristics combination		
		Quantitative output metrics	Quantitative input metrics	Qualitative input metrics
Environment	GHG Emissions	Scope 3 emissions intensity	Absolute scope three reduction target	Existence of Scope 3 GHG emissions reporting
	Environmental Management	Cost of environmental fines	Total amount of expenditure allocated to environmental management	Existence of a certified Environment Management System
	Water Management	Freshwater withdrawal (total in litres)	KPIs on water use reduction	Water risk management system
	Pollution & Waste	Waste recycled to total waste	Target waste reduction	Internal recycle and reuse awareness programme
	Energy Management	Transmission and distribution losses as a % of total energy entering the system	Reduction target for energy transmission leakages	Measures to minimise environmental impacts of electricity transmission and distribution
Social	Human Rights	N.A.	Share of suppliers subject to human rights training programme	Existence of a human rights training programme
	Human Rights	Share of complaints with remediation provided	Share of suppliers covered by grievance	Existence of a grievance mechanism
	Community Relations & Impacts	Share of local hiring	Investment (in USD) in community relation programmes	Local procurement policy
	Health & Safety	Contractor fatalities rate	Costs related to employee safety protection, health, and safety	Supplier factory monitoring and auditing programme
	Human Capital	Employee turnover rate	Share of employees who responded to survey	Existence of surveys to monitor employee satisfaction
	Diversity, Equity, and Inclusion	Gender-pay gap	Gender-pay gap reduction target	Gender pay equality programme
Governance	Corruption, bribery & fraud	Cost of fines, penalties, settlements in relation to corruption	Percentage of suppliers subject to anti-corruption due diligence processes	Anti-corruption due diligence programme on third party
	Corporate Governance	Number of ESG-related resolutions	Voting cap in percentage	Disclosure of voting results

Note: Each line associates three metrics with similar performance measurement outcomes. Metrics can be from distinct products.