



Decarbonization Investment:

Opportunities and Implications for EPCs

Survey Findings and Analysis

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Opportunities Presented by Sustainability Investment

Sustainability and energy security are two countervailing forces facing today's engineering procurement and construction firms (EPCs) and the large capital projects business. These factors, along with global economic growth, volatility, and other variables, have contributed to a complicated mix of opportunity and uncertainty for the EPC industry in the near future. Adding to this unpredictable outlook are new influences such as investment funds centered on sustainability, activist investors and green incentives that differ by region. These have the potential to impact the economics of energy transition projects, further complicating the ability to predict which sustainability and energy efficiency pathways will prevail. As these new capital investments take hold,

making the right strategic decisions on how to best organize resources, invest in knowledge regarding sustainability solutions, and implement the right digital twin design tool are vital to position EPCs and owner firms for success.

According to a January 2022 *Insight Article* published by McKinsey and Company, accelerating the decarbonization of the US economy to achieve net zero targets by 2050 will require approximately \$275T USD in cumulative capital spending over the next 30 years¹—close to \$10T USD/year. To spur this massive spending, leading capital funding institutions, including BlackRock, JPMorgan Chase and Barclays, have signaled to the industrial community they will be increasingly prioritizing those companies that have demonstrated a commitment to accelerated decarbonization when directing funding sources moving forward.

Larry Fink, CEO of BlackRock, calls decarbonization initiatives the “biggest investment opportunity of our lives.” ExxonMobil estimates the carbon capture and storage market alone will be \$4T USD/year by 2050. In his 2022 letter to CEOs, Fink also emphasized the crucial importance of innovation to drive down the Green Premium on low-carbon technology. Meanwhile, Occidental Petroleum (Oxy), arguably the most aggressive of the upstream companies in carbon mitigation investing to date, has announced intentions to construct and operate between 70 and 130 carbon capture facilities by 2030.²

Deloitte research finds that reallocation of capital to decarbonization could deliver net economic gains by the late 2040s, adding an estimated \$3T to the US economy over the next 50 years.³



However, as MOL Group's Béla Kelemen remarked in a Paris seminar in May 2022, "The energy transition will be bumpy. Energy security and ensuring enough conventional supply also are emerging as a top concern." Kelemen's comment aligns with current industry trends which reveal that investments in upstream and refining assets will continue to be significant, especially in the areas of energy efficiency and emissions reduction. This will also generate the capital needed to invest in the energy transitions arena.

The Impact to EPCs and Owner-Operators

We wanted to learn more about how sustainability investment impacts capital projects, and how EPCs and their clients—the asset owners—view the next five years in terms of sustainability work. In what areas are projects

expected to be concentrated? How are companies organizing to react? What are the challenges—and what are the opportunities?

To get answers to these questions and others, in February 2022, AspenTech® partnered with *Hydrocarbon Processing* to survey decision-makers from asset-intensive industries around the world. One hundred eighty-five companies responded, representing a cross section of industries: 10 percent were integrated energy companies, 27 percent upstream and downstream, 17 percent chemicals and 25 percent engineering services. The remaining were mining, pulp and paper and power companies. Respondents represented five continents, with 27 percent from North America, 18 percent from Europe, 28 percent from Asia, 10 percent from the Middle East, and the remainder from South America and Africa.





Pivoting of Capital Projects to Sustainability and Energy Transition Has Accelerated

The past year has seen a significant shift in strategy, planning and initiatives among process industry leaders, a change that we saw reflected in the findings of the 2022 survey compared to our June 2021 survey⁴. For example, in 2021, 21 percent of over 200 companies predicted a shift in capital spending of more than 20 percent over the next five years. Less than one year later, in February 2022, 57 percent of companies predicted nearly half of the capital business to invest in sustainability within five years (see Figure 1).

This change illustrates a nearly 3X increase in the number of respondents seeing a shift of investments in sustainability-focused capital projects—a huge perception shift in less than one year. Projects seem evenly split between new plant construction and the modification of existing plants.

Sustainability Work Will Increase Significantly Over Next 5 Years

What percent of your firm's work is for sustainability and/or energy transition projects?

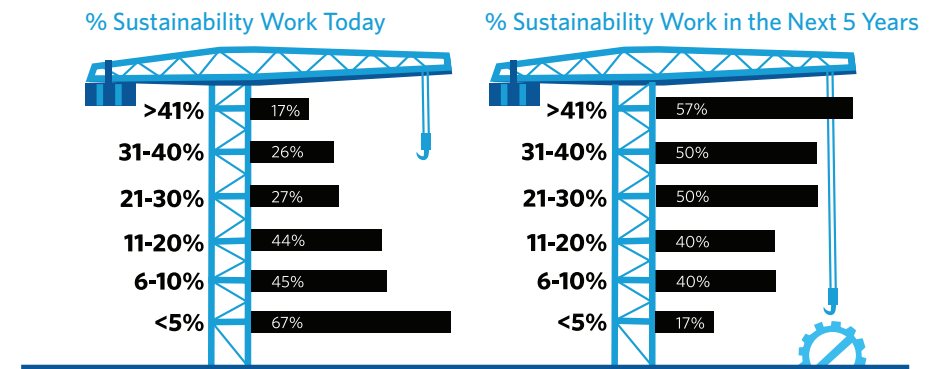


Figure 1. Sustainability and energy transition projects will increase significantly over the next five years. (Source: AspenTech/Hydrocarbon Processing Global Survey©, February 2022)

Another 2021 result that supports the pivot: 77 percent of respondents said they believed that carbon mitigation leadership will provide a competitive advantage.

Challenge: Changing the Way Projects Are Executed and Re-Skilling Teams

As energy and chemical companies reposition themselves, how do traditional EPC firms effectively pivot to take advantage of new sustainable economy capital opportunities? Will they be able to leverage their experience and corporate memory built on executing large energy, chemical and infrastructure projects? Or will a new generation of innovative sustainability-focused engineering companies drive the future?

It is clear that the conventional way of executing projects will be inadequate over the next 10 years. If engineered the traditional way, project schedules are too long to satisfy the aggressive net zero targets by clients, and EPCs have not implemented digital infrastructure sufficiently enough to be managed by a digitally native work force. As global volatility continues, traditional EPC workflows will not be flexible enough and the economics will fall short. New tactics are needed to support a digital project execution, one that supports infrastructure for rapid, repeatable designs, the incorporation of AI and a self-optimizing plant approach.

A recent analysis by International Energy Agency (IEA) makes the compelling case that there are too few

capital projects in the pipeline today relative to those needed to meet global climate goals. To meet these targets, the award rates for energy efficiency and energy transition capital project contracts must accelerate and be supported by new project execution strategies (see *Figure 2*).

Evolving traditional project methods and achieving even higher capital project investments to meet sustainability demands must be supported through critical changes on multiple fronts. In addition to new digital execution approaches, it is essential the industry is strengthened through regulatory frameworks, financing and tax incentives, new market players and partnerships forged by industry veterans.

It is up to senior management and subject matter experts to successfully navigate any challenges. It's a tricky balancing act requiring a pivot in the short term to areas like energy efficiency, bio-feedstocks and carbon

capture, with a longer-term focus on areas like electrification, hydrogen and advanced recycling.

The 2022 survey provided additional valuable insights on EPC and owner firm behaviors in relation to sustainability and decarbonization. For instance, less than half of the respondents, including owner companies, have created a focused sustainability team while the majority have not (see *Figure 3 next page*).

**Large-Scale Carbon Capture Projects
(Actual vs. Net Zero Scenario, 2020-2030)**

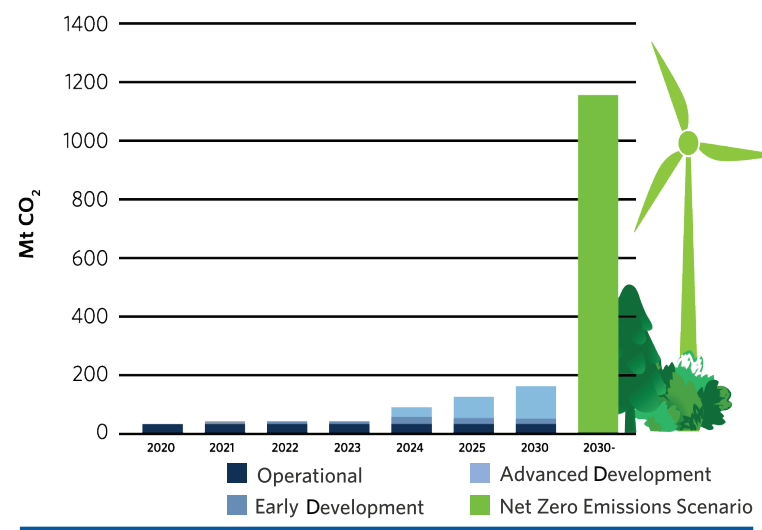


Figure 2. Actual carbon capture projects currently in pipeline for 2030 vs number to achieve net zero. (Source: IEA)

43% of Respondents Have Separate Sustainability Division or Department

Has your company set up a separate sustainability division or department?

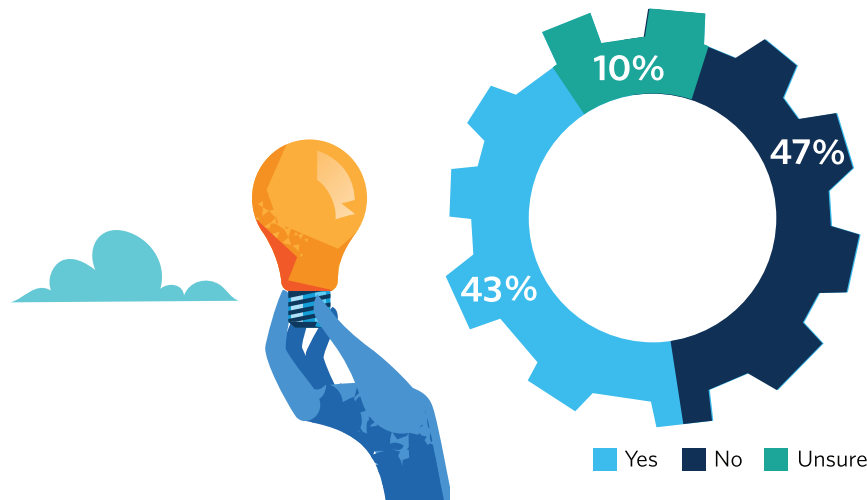


Figure 3. Prevalence of dedicated sustainability departments within companies. (Source: AspenTech/Hydrocarbon Processing Global Survey©, February 2022)

The survey findings also revealed that 72 percent of respondents see the biggest barrier facing sustainable capital projects to be economic feasibility.

Economic feasibility is impacted by external factors which include forecasting future carbon taxes, credits and offsets, renewable energy incentives, bio-feedstock incentives and the manufacturability risks associated with new low-carbon processes.

Digital solutions can optimize early design phases reducing overall engineering and construction costs, schedules and risks. Strategic use of these innovative digital solutions achieves improved replication of

repeatable, best-available designs, modular designs and constructability. Advanced model-based estimating provides better visibility into economic and projection execution costs earlier in the capital allocation process reducing cost uncertainty.

This is a prime example where digital solutions and new ways of working are crucial. Integrated workflows between process design and cost engineering (see Figure 4), that enable optioneering and risk assessment at very early feasibility stages become strategic differentiators for EPCs. Collaborative workflows also ensure the optimal flow of information and avoid duplication of work.

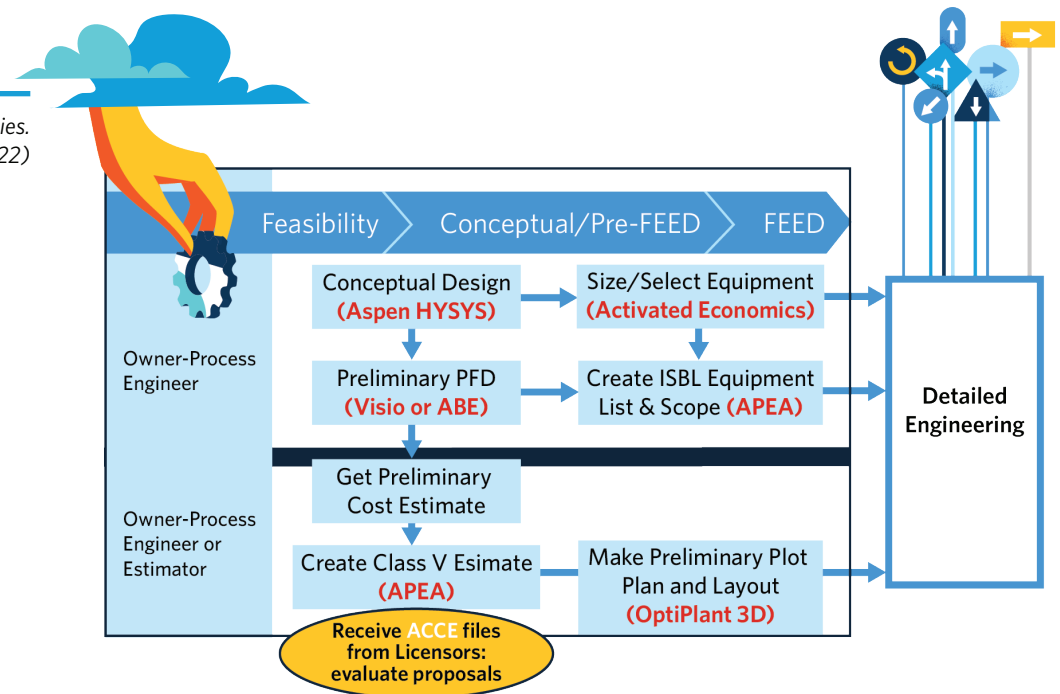


Figure 4. Sample digital workflow between design and estimating for optioneering (Source: AspenTech, 2022)

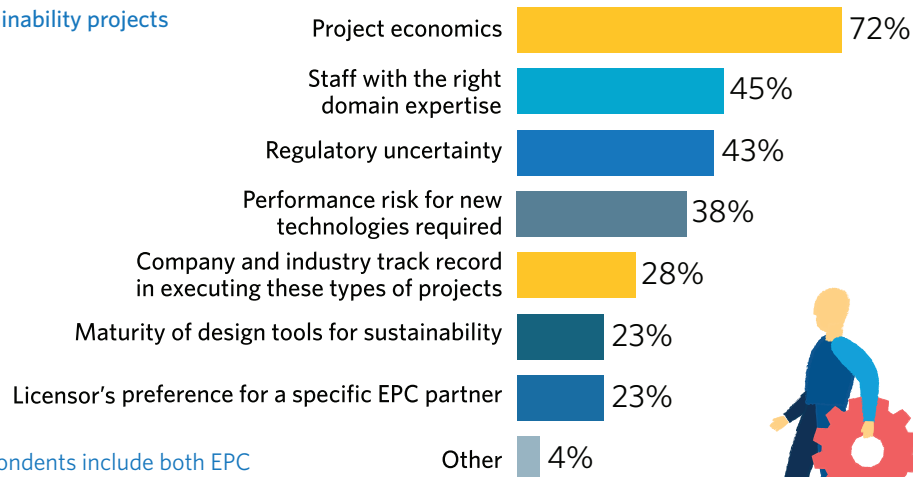
A second project challenge, cited by 43 percent of respondents, is regulatory uncertainty (see Figure 5). Better transparency and auditability, both of which are facilitated by digital execution project approaches, will assist project leaders in navigating the regulatory ambiguities and changes.

EPCs that succeed in improving economic feasibility at the earliest stages and enhance concurrent collaborative workflows will emerge as leaders and define the industry's future.

Top Barriers to Sustainability Mitigation Pathways

What are the main barriers to the successful execution of sustainability projects by EPCs?

Project economics is the top barrier for EPCs to execute sustainability projects



Respondents include both EPC and Owner Operator



Figure 5. Top EPC barriers to executing sustainability projects. (Source: AspenTech/Hydrocarbon Processing Global Survey©, February 2022)

Closing the Skills Gap is Top of Mind

Building a staff of engineers with the right domain expertise was cited by 45 percent of the survey respondents, as the second most cited barrier (see Figure 5), right behind project economics. This current trend plaguing the industry is better known as the skills gap.

In terms of building a workforce with the right expertise, companies are pursuing a range of approaches. The results are telling, 54 percent of respondents will invest in their employees through in-house sustainability design training as a top strategy, while 42 percent plan to incentivize staff to take supplemental sustainability design training, and 30 percent plan on hiring recent engineering graduates with a sustainability focus. Thirty-four percent see the need to invest in software tailored to addressing the new design and economic challenges of sustainability projects (see Figure 6).

Companies Plan on Training Existing Staff to Overcome Skills Gap in Performing Sustainability Projects

What are the best strategies for overcoming the skills gap in performing sustainability projects?

Re-skilling engineering teams to address sustainability is preferred industry approach

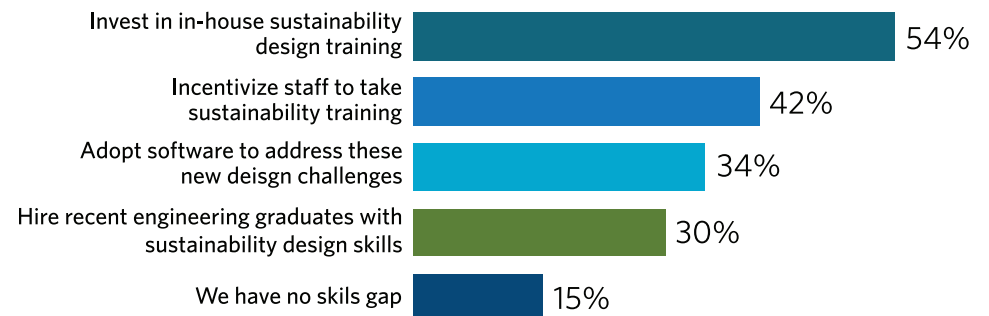


Figure 6. Top strategies for overcoming the skills gap in support of sustainability initiatives. (Source: Aspen Tech Sustainability Global Survey, February 2022.)

Further Insight into EPC Sustainability Opportunities

What specific initiatives are driving capital spending momentum?

Hydrogen, energy efficiency projects, and Carbon Capture and Storage (CCUS) lead the pack in project investments while renewables, materials recycling and bio-feedstock switching initiatives are not far behind. Per our 2022 survey results, Hydrogen, energy efficiency and CCUS projects are cited as potentially being awarded by 51 percent, 48 percent and 47 percent of respondents, respectively. These numbers are up approximately 20 percent from the 2021 survey (*Figure 7*).

Expected Sustainability CAPEX Projects in the Near Term

What are the primary sustainability projects expected will be awarded?

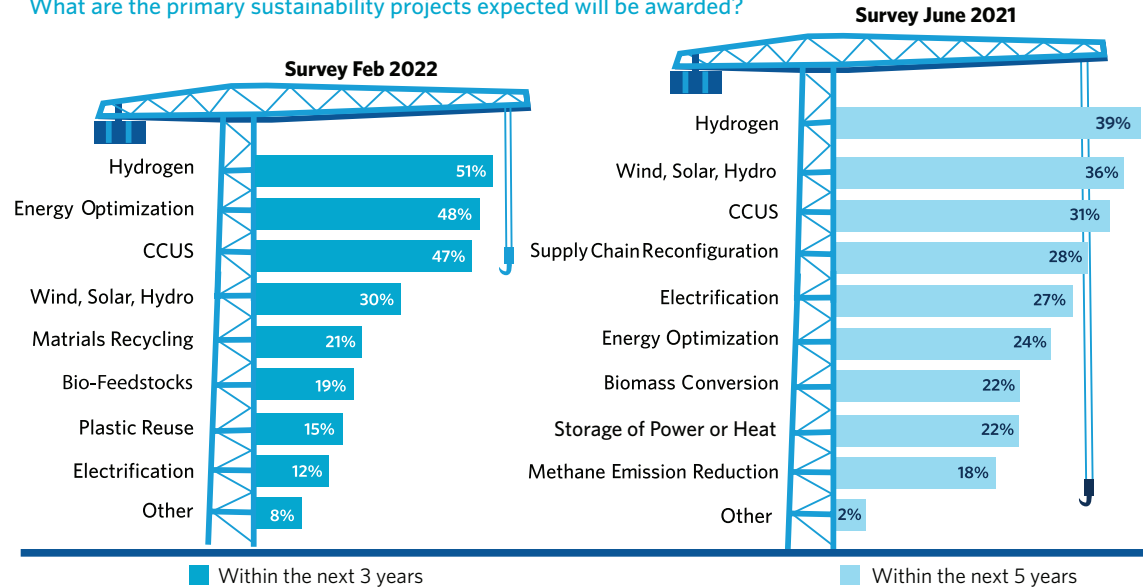


Figure 7. Top sustainability projects expected to be awarded over the next five years. (Source: AspenTech/Hydrocarbon Processing Global Survey©, June 2021 and February 2022)

Europe is leading the way in energy efficiency investments. Carbon taxes and government incentives in the region are driving refiners and chemical manufacturers to invest in systematic and broad scale-ups of energy efficiency initiative deployments. Depending on the asset and the process, further efficiency improvements between 15 and 30 percent are possible and feasible for many sites. For example, two of Europe's largest downstream organizations deployed advanced adaptive process control across their enterprise to meet near-term carbon footprint reduction commitments. This is a broader and further accelerated scale-up of this proven energy efficiency and carbon reduction technology than ever seen before.

New Partnerships Are Emerging

Multiple participants and extended value chains are driving new types and levels of partnerships. For example, in a recent forum, Eni's Chief Operating Officer for Energy Evolution provided two examples of new partnership types. The first example is carbon capture in which companies, with old hydrocarbon reservoirs that can store CO₂ and have the technical ability, will develop joint solutions with industries—such as steel—that are difficult to decarbonize. The second example is biofuels, where landowners that produce biomass to supply refineries provide local employment initiatives in emerging economies such as central Africa while refiners increase the renewable content of their end products. These varying types of partnership will address multiple sustainable objectives simultaneously.

Fifty percent of companies say they are pursuing owner-engineer partnerships. Forty-two percent are looking at cross industry partnerships including with, for example, upstream companies and metals' refiners, while 38 percent of EPCs are looking at consortia or partnerships that link up multiple EPCs with different skill sets (Figure 8).

Companies Considering a Variety of Partnerships for Sustainability Projects

What types of partnerships are you considering for sustainability projects?

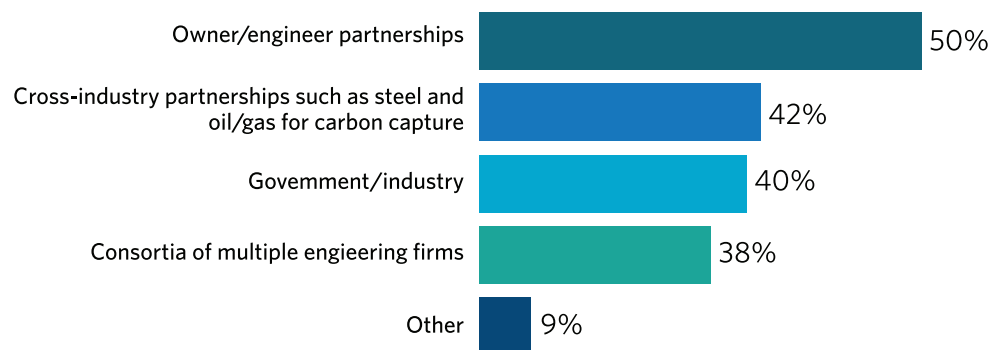


Figure 8. Companies are considering partnerships for future sustainability projects. (Source: AspenTech/Hydrocarbon Processing Global Survey©, February 2022)

These and other types of partnerships will require EPCs to improve how they use digital technologies and how they collaborate in the design process and the sharing of data. This new level of collaboration will be greater than what many process industry players are accustomed to.



There Are Still Hurdles to Overcome

With the wide range of sustainability initiatives and energy efficiency directions the industry is taking, EPCs are facing a diverse basket of capital project opportunities. However, therein lies a challenge. How do they decide which initiatives to focus on and which are best aligned with their capabilities and expertise?

One CEO of a mid-sized EPC North American company responded that he is investing a significant amount of time positioning his company for strategic growth in sustainability projects as he believes this direction is critical for his firm's successful future. This CEO's focus on sustainability strategies is one of the key factors at play—sustainability project work is a strategic pivot that requires executive attention as leadership emphasis is needed to acquire new technologies, target specific skill sets, and build a portfolio of project offerings.

For his company, as a mid-sized contractor with a strong reputation, business is significantly tied to ongoing relationships dating back to multiple successful projects over the years. The challenge is to maintain that trusted relationship with clients and to assemble the right capabilities to maintain credibility, while proving themselves again as the EPC of choice in new sustainability technology areas. These technology areas encompass topics such as bio-based feedstocks, carbon capture, hydrogen, and new materials. It is an owner's market for technology experts and experienced practitioners in those areas. The largest EPCs are focused on assembling a critical mass of staff with the right skill-sets, leaving smaller players with the task of building niche strengths in an expensive free agent market.

A group of key executives at another larger, multi-national EPC made the decision to set up a separate group for sustainability projects that reports to an autonomous executive directly reporting to the CEO. This organizational approach can win in terms of getting the right executive focus and direction necessary to achieve more green project award wins and attracting the necessary skilled workforce. It could also provide transparency in measuring the progress building the team's capabilities and execution performance while anticipating and mapping directly to clients' goals around sustainability. On the other hand, it could be argued that looking ahead, nearly all projects will have a sustainability component, potentially making this dedicated executive component unnecessary and less of a differentiator. In the short term, it does bode well for EPCs to clarify their market niche and sustainability focus within and outside the company as they build their track record and skillset in the green arena.

Improving Economics with Advanced Digital Technologies

The elephant in the room is the economic investment required for sustainability initiatives and reducing what Bill Gates refers to as the Green Premium.⁵ Seventy-two percent of respondents feel that economics are a significant barrier to gaining momentum in these projects (see Figure 4 on page 7).

EPCs who look at this opportunistically will see there is a way to strongly differentiate themselves by going further than “designing to meet a specification.” Instead, the best design teams will embrace the most advanced digital technologies, including hybrid models that incorporate artificial intelligence, through rigorous design tools and advanced approaches to achieve a low-risk, repeatable, modular design.

Sixty-one percent of EPCs say that they are offering or positioning themselves to bid energy efficiency project services, with 52 percent offering hydrogen asset design and EPC services, and 43 percent planning to provide carbon capture design services. The top six types of projects that respondents are seeing are hydrogen, carbon capture and storage and utilization, energy optimization, solar/wind generation assets, materials recycling, and bio-feedstocks. Interestingly, bio-feedstocks and biofuels projects are further down the list in reviewing the comparison of predicted capital project areas and planned EPC service offering areas (see Figure 9 next page).



EPC Customer Success Stories

Industry players have been demonstrating progress in their digital approaches to the current round of sustainability projects. **Zachry Group** employs concurrent engineering solutions from AspenTech, utilizing rigorous model optionality in process design for blue hydrogen and carbon capture. Process modeling is enabling them to rapidly evaluate alternatives, improve CO₂ capture and optimize from a CAPEX and OPEX feasibility standpoint.⁶

Air Products and Chemicals employs an integrated solution from AspenTech to create virtual models of networks of its hydrogen plants, monitor performance from one technology center based on streams of plant data and identify options for improved yields and operating strategies. Projected financial benefits—over \$1M USD/year.⁷

Eni Progetti, the project arm of Eni S.p.A., uses front-end concurrent engineering solutions from AspenTech to capture conceptual designs of alternative carbon capture processes, enabling faster feasibility studies and incorporated template-based repeatable design for future projects.

ExxonMobil uses a combination of process modeling, conceptual estimating and conceptual 3D layout solutions from AspenTech to greatly accelerate its process-select phase of projects, achieve “visual estimating” and consequently, reduce capital costs and front-end project timetables by as much as 30% to 50%.⁸

How Sustainability CAPEX Areas Map to EPC Sustainability Service Focus

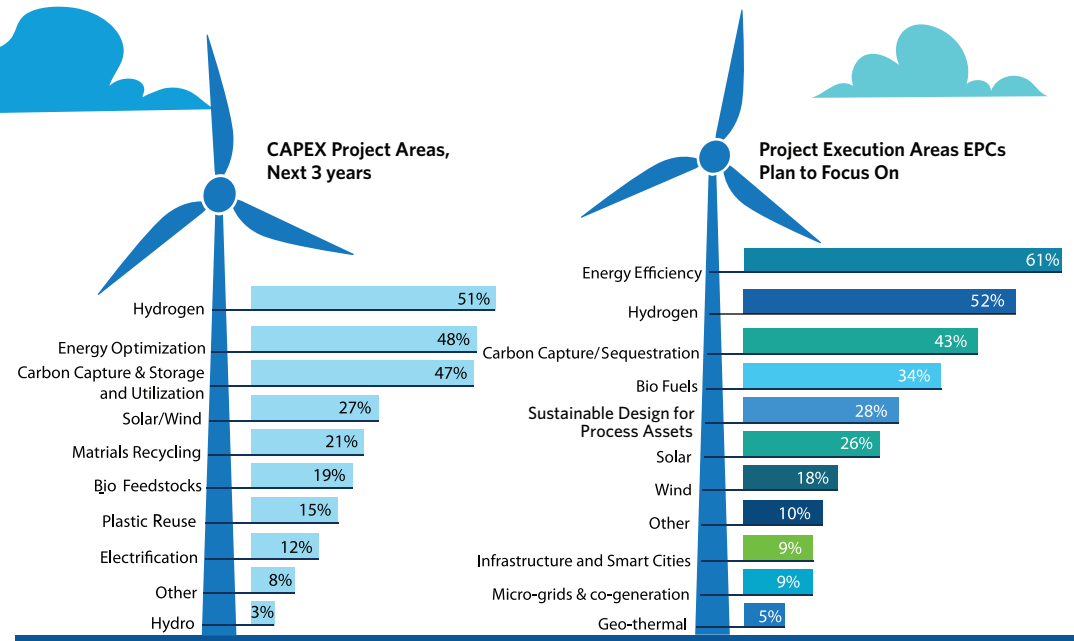


Figure 9. Mapping of sustainability project and EPC execution areas. (Source: AspenTech/Hydrocarbon Processing Global Survey©, February 2022)



Major Takeaways for EPC Leaders

The opportunity to play a leading role in reducing the Green Premium on the pathway to net zero carbon is here. Digitalization of the capital projects business will be a key contributor. Market trends as exemplified by the survey indicate projects in areas ranging from carbon capture to bio-feedstocks to hydrogen are on an upward cycle. To achieve global geopolitical, financial, and social goals, investments will accelerate. The companies that will emerge as the big winners are those that look for step changes in project delivery methods to fast-track schedules, reduce costs and mitigate risks to eliminate the Green Premium over those that look for conventional incremental changes. Companies that successfully implement advanced adoption of digital solutions to optimize energy utilization, emissions management, and process control will steer the EPC industry as it completes a digital transformation.

Future market leaders will be those EPCs that incorporate sustainability results into all capital project bids and execution strategies. There are significant hurdles that largely revolve around developing the proven capability and expertise to conduct sustainability projects and mitigate future risks. However, despite the many hurdles and challenges faced by today's EPCs, with so many companies across various industries and geographies being strongly committed to meaningful capital projects within numerous sustainability dimensions, it is only a matter of time before viable innovations emerge and disrupt the market we see today.

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About AspenTech

Aspen Technology, Inc. (NASDAQ:AZPN) is a global software leader helping industries at the forefront of the world's dual challenge meet the increasing demand for resources from a rapidly growing population in a profitable and sustainable manner. AspenTech solutions address complex environments where it is critical to optimize the asset design, operation and maintenance lifecycle. Through our unique combination of deep domain expertise and innovation, customers in capital-intensive industries can run their assets safer, greener, longer and faster to improve their profitability and operational excellence.

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