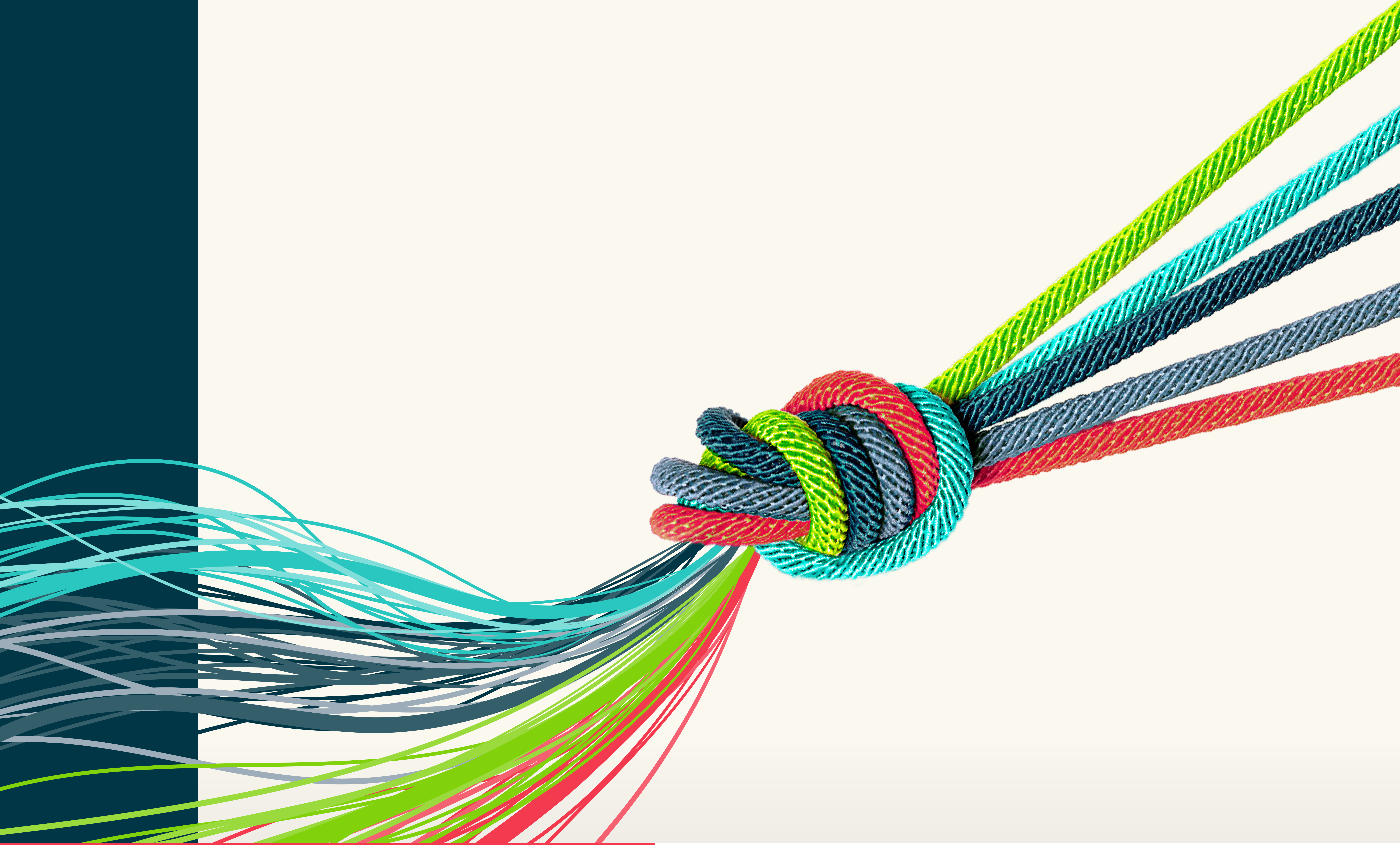
Net zero
at the speed of trust



FROM AMBITION
4
TO REALITY

worley
DELIVERING SUSTAINABLE CHANGE

Princeton E-ffiliates Partnership
eFFILIATES
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Foreword

SUE BROWN
Executive Group Director Sustainability & Corporate Affairs
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The world has 25 years to meet a mid-century net zero ambition. In that time, we need to build an enormous amount of related industrial infrastructure. While the end goal is clear, the challenge is daunting.

Meeting this challenge only remains plausible if we step beyond the traditional approach to delivery. Infrastructure participants need to think and act differently, even radically.

Identifying pragmatic ways to overcome the net zero infrastructure delivery challenges continues to be the focus of our From Ambition to Reality (FATR) series. We're proud to continue this work with Princeton and to present this fourth paper.

We live in a world where it's becoming harder to know who, and what, to trust. The rise of artificial intelligence and declining trust in the media and institutions are just two examples. It's a hot issue.

Our extensive discussions with infrastructure participants, including our customers and leaders at global events, have identified trust as one of the current barriers and potential keys to achieving net zero. We've found that many people are talking about and pointing to trust as an issue, but relatively few are doing systematic work to build and leverage its potential.

For this paper, we've focused on exploring trust in relation to its impact on net zero infrastructure delivery. We've used Princeton's proprietary research, subject matter expert research and input, anecdotal feedback from infrastructure participants, and our collective experience to establish the importance of trust in this context.

This paper outlines our key findings on the slow progress of paradigm change, provides insights into the role of trust in energy infrastructure delivery, and shines a spotlight on the role of trust in the future success of Carbon Capture and Storage (CCS) in the US. It also introduces early thinking on a pragmatic framework for building strong and enduring trust across the infrastructure landscape.

The paradigm shift required to meet mid-century ambitions cannot be achieved by a single participant. We encourage all infrastructure participants to lean in to learn more, challenge, collaborate and adopt change so that together we can accelerate the path from net zero ambition to reality.

PROFESSOR IAIN MCCULLOUGH
Gerhard R. Andlinger '52 Professor for Energy and the Environment
Director, Andlinger Center for Energy and the Environment
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This fourth edition of From Ambition to Reality continues the thought-provoking series that has become a signature product of the Andlinger Center's partnership with a leading global professional services provider of energy, chemicals and resources experts, Worley. Once again, the authors lucidly confront the enormity of the challenge to translate ambitious net zero goals into the reality of clean energy and industrial decarbonization infrastructure. Energy transition progress seriously lags ambitions globally, and our partnership's out-of-the-box thinking on infrastructure delivery is much needed.

This paper's creative exploration of the role that trust among stakeholders plays in accelerating net zero infrastructure, ushers in a broader disciplinary engagement from the past techno-industrial emphasis, to involve faculty and graduate students from the social sciences. Expanding our past techno-industrial collaboration to include experts in Behavioral Sciences and Princeton's Faith & Work Initiative is testament to the truly interdisciplinary character of the Andlinger Center.

The authors signal the potential benefits of an Infrastructure for Trust – a framework and system for creating the conditions for durable trust between diverse stakeholders engaged in and impacted by the energy transition. Indeed, this notion of an Infrastructure for Trust features in two new research programs at the Center which are being supported separately by Worley and the US Department of Energy. While this paper spotlights carbon capture and storage as a case study, it is clear that no energy or industrial infrastructure is immune from the damaging force of the trust deficit among stakeholders.

The Andlinger Center places a strong emphasis on broad engagement with industry, government, and stakeholders. We are extremely proud of our partnership with Worley as a Charter member of the Princeton E-ffiliates program. Helping bridge the gap between scientific discovery and real-world execution, partnerships like these are crucial to delivering a more sustainable world.

The growing impacts of climate change and loss of natural capital provide a call to action. The need to speed up net zero energy infrastructure delivery, while preserving natural capital and social cohesion grows ever more urgent. I recommend all to engage with this work and collaborate on translating the net zero ambition to reality.

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Dr Paul Ebert is Group Director of Sustainability and Energy Transition Leadership at Worley, a role that sits within the corporate sustainability team helping the company consider and respond to an evolving and dynamic sustainability landscape.

Paul is a mechanical engineer whose career started in the steel industry in Australia, but which altered course when he was awarded a PhD scholarship to study wind turbine aerodynamics. This included time working in the UK and Europe's emerging wind energy industry. His career then built up with and grew across the renewables industry, focused in particular on the integration of renewables into fossil-based utility systems.

After a decade building projects, Paul joined Worley and led its renewable energy team working around the world in strategy, business development, consulting and advisory. His experience grew to include solar thermal, various forms of energy storage, low emissions hydrogen, power-to-X, and the full spectrum of energy transition technologies, particularly within heavy industry. His work also branched into related policy and project finance.

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Chris is currently focusing on some of the world's largest future emitters, co-leading collaborative net zero efforts across India and China with plans to expand to Indonesia, Pakistan, Brazil, South Africa, and more.

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CONTENTS

Ambition alone is not enough

Achieving net zero by mid-century requires energy infrastructure delivery at unprecedented scale and speed. We must adopt a new delivery paradigm by 2030 to meet this challenge, or the world will simply fail to build the infrastructure of climate response in time. It may not even get halfway.

Readers of our previous From Ambition to Reality (FATR) papers[1] will recognize these statements and recall our focus on identifying and sharing pragmatic ways to accelerate the paradigm change we need. Our work centers on five shifts in delivery practice – called FATR shifts – that we believe are essential if the world is to have any chance of meeting a mid-century net zero target.

So, is the gap between ambition and reality closing?

In this paper we address this question quantitatively: The gap is closing, but not fast enough. Our shifts are resonating with policymakers, business leaders, and those who share the ambition to drive for net zero. And while steps are being taken to accelerate net zero delivery, it's still not occurring at the scale and speed that mid-century ambitions demand.

The world is failing in this infrastructure challenge, and we think a lack of trust is a key reason why.

In this paper, we draw on the input of thousands of individuals involved in infrastructure delivery and present our findings on trust, to stimulate broad discussion and action. We outline:

- quantitative data on the adoption of the five FATR shifts
- the emerging role of trust and the types of trust needed to deliver net zero infrastructure
- the role of trust in the deployment of a controversial but critical climate response technology – Carbon Capture and Storage (CCS) – in the United States (US) market.

We discover that trust is a key condition for paradigm change: Trust is both enabling of and enabled by, our FATR shifts (Figure 1). Switching this virtuous cycle on may indeed hold a key to the world's ability to deliver the greatest infrastructure challenge humanity has ever faced.

But trust in this context is neither a simple nor singular notion. It is challenging to define, even more challenging to create or rebuild, and easy to lose.

Trust is influenced by perspectives, historical experiences, commercial, political and social norms, and even the type of infrastructure involved. The path to trust also depends on initial states, with a serious deficit of trust impacting some stakeholders and their ability to contribute. And projects can still succeed without trust, meaning aspects such as competence, experience, capability and diligence are also important – yet trust becomes critical if infrastructure needs to be built at speed.

While many are talking about trust, our impression is that few appear to be taking the deep and systematic approach to build and leverage the power of durable trust, that is both strong and long lasting. We've kickstarted fresh thinking and the development of a new framework to do just that. And to provide tangible action, we also preview new guidance on one critical area to a net zero future - sharing value and creating trust with communities.

Ambition alone is not enough to deliver the infrastructure of net zero. A new paradigm is needed, one that removes the roadblocks and drives our delivery response to the scale and speed needed.

Trust is a key to the adoption of this paradigm, and the world's ability to achieve net zero.

We call this net zero at the speed of trust.

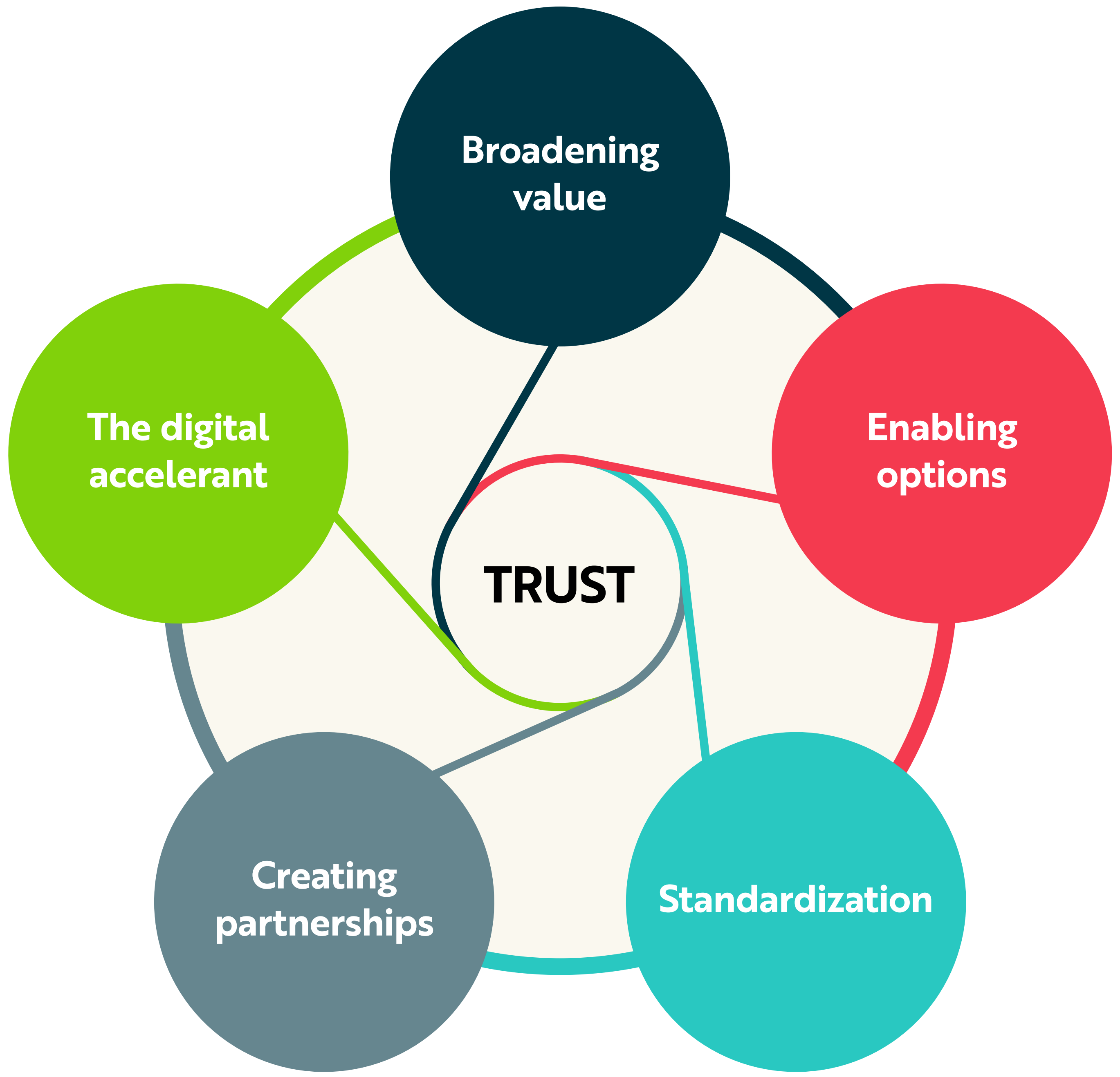


Figure 1 – How trust links across the five FATR shifts in the FATR delivery paradigm.

Note: The FATR series focuses on energy supply side infrastructure and adjacent sectors, although they are just some components of a complex, multi-dimensional ecosystem. To reduce complexity, this work also centers on modern democracies, principally in the Global North.

CHAPTER 1

Are we closing the gap between ambition and reality?

Is the world failing on net zero infrastructure delivery?

For the world to respond to climate change an enormous amount of new infrastructure is needed, and that requires global actions that mobilize and deploy huge amounts of capital. Multi-lateral diplomacy to drive this is progressing, as evidenced by the UAE Consensus[2] and reactions to the Global Stocktake at the 28th Conference of Parties (COP28). But the world is failing to turn climate ambition into reality – in 2023, the world used record levels of oil and coal, and emissions from energy reached a new maximum[3].

In terms of capital deployment, the International Energy Agency (IEA) estimates[4] $4.5 trillion[5] in clean energy investment will be needed each year by 2030 to limit global average warming to 1.5°C. Another recent analysis shows such investments reaching a record $1.8 trillion in 2023[6], with the IEA's own prediction for 2024 around $2B, almost twice that of fossil fuels[7]. Low emissions capital is moving.

But there are barriers to achieving the required speed. For example, we showed in our third FATR paper (FATR3) that interdependencies at investment boundaries have constrained the capital mobilization needed to achieve key goals of the European Union (EU) clean hydrogen policy. As a result, essential capital discipline processes act as a speed limiter on net zero investment. We concluded that the EU's ambitious hydrogen policy could fail without the FATR shifts, which have a crucial role to play in overcoming the barriers involved. This applies to all net zero technology deployment.

Implementing the paradigm change

In our FATR papers we've called on infrastructure participants, or 'participants', to adopt the shifts needed to accelerate net zero infrastructure delivery. This will require radical, yet practical and sensible changes to project delivery. Our definition of these participants is shown in Figure 2.

Asset owners and project developers	Develop, own and operate net zero infrastructure
Banks, investors and insurers	Provide funding and risk mitigation to support the development and construction of net zero infrastructure
EPC services and contractors	Provide consulting, design, environmental assessment, project management and construction services to net zero infrastructure
Supply chain providers	Are involved in the production of upstream materials including mining, processing, refining and primary material manufacture
Equipment manufacturers	Manufacture and supply technologies used in net zero infrastructure
Policymakers and regulators	Includes federal and state government departments that set policies relevant to net zero infrastructure, and both their approval agencies and relevant market governance bodies
Communities, social and environmental NGOs	Are associated with or influential in advocating for/against net zero infrastructure – e.g. landowners, community groups, Non-Government Organizations (NGOs), Indigenous groups
Educators, universities and researchers	Large universities, community colleges, professional development and vocational training institutions, and those associated with net zero infrastructure related research
Labor organizations	Represent workforces in net zero infrastructure related fields, including unions and interest groups

Figure 2 – Definition of net zero 'infrastructure participants' used throughout the paper. These definitions align with the stakeholder groups used in the Princeton Net-Zero Stakeholder Survey.

So, are participants adopting the FATR shifts?

To explore that question, the inaugural Princeton Net-Zero Stakeholder Survey was launched in 2023 to elicit information on delivery practices from participants involved in low and zero carbon projects[8]. This longitudinal cross-sectional panel survey, independently administered by Princeton and partially funded by Worley, will run each year from 2023 until 2030. It is designed to provide quantitative data on the adoption of the FATR shifts, shown in Figure 3 with their 'indicators of change', which are areas where change would be expected if adoption was occurring.

Such quantitative data helps focus our FATR work on removing roadblocks and building momentum to meet a 2030 target for widespread adoption of the FATR shifts. Each year this work is summarized in an updated FATR Framework which guides the path to 2030 – the FATR3 version is shown in Addendum 1. We cover the ideas behind this framework extensively in our first three FATR papers.

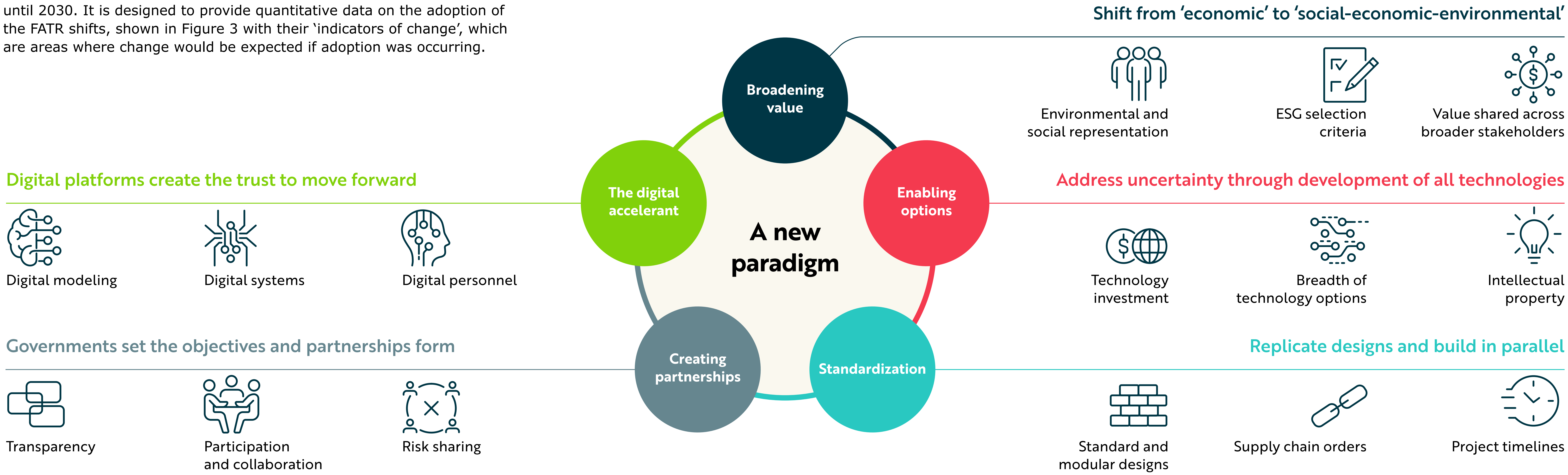


Figure 3 – The five FATR shifts which together make up the FATR delivery paradigm, shown with the three indicators of change for each shift.

In this paper, we've used results from two years of the Princeton Net-Zero Stakeholder Survey to explore shift adoption progress. We also present results of a specialist trust pulse survey used in Chapter 4 concerning CCS. These surveys are described in Pullout 1.

PULLOUT 1

OUR QUANTITATIVE DATA SOURCES

PRINCETON NET-ZERO STAKEHOLDER SURVEY

2023 AND 2024 SURVEY

This is an annual, international survey of experts in net zero energy transition and infrastructure projects. The survey was first deployed in 2023 and will run through 2030. The survey targets experts in three regions: Asia Pacific, Europe, and the United States (US). 'Projects' were defined as low- and zero-carbon energy supply projects and infrastructure, including but not limited to: renewable electricity generation, transmission and/or pipeline infrastructure, firm generation and energy storage (e.g. batteries), low- and zero-carbon hydrogen and fuels production, carbon capture utilization and storage, and nuclear power. The types of stakeholders included in this survey are defined in Figure 2. Experts were identified and recruited through systematic searches of professional databases and outreach through diverse professional networks. Data is collected in March – June each year.

In this paper we have used data from the 2023 survey, which has undergone extensive analyses, to support more detailed conclusions in Chapter 1. As the 2024 survey had only just closed for responses at the time of writing, preliminary results are used to consider indications of future trends in that chapter.

PULSE CHECK ON CCS IN THE US

CCS PULSE SURVEY

This is a one-time survey of experts in CCS and the public in the US and is used in the analysis presented in Chapter 4. The survey targets experts in the US who have direct professional experience on at least one CCS project or have professional experience supplying, regulating, or otherwise supporting a CCS project. Experts were identified and recruited through a third-party survey panel provider. The types of stakeholders included in this survey are enumerated and described in Figure 2.

Two public samples were collected, the first is a demographically representative sample of US residents; and the second is a sample of people who live close to a CCS site. These samples were also identified by a third-party panel provider. Data was collected in February 2024.

A long way from standard practice

The 2023 Princeton Net-Zero Stakeholder Survey (2023 survey) drew input from nearly 550 infrastructure participants from around the world (Figure 4). Detailed results were published in January 2024 (Composto et al. 2024)[9], and indicate FATR shifts in a stage of early adoption, with a long way to go before they become standard practice.

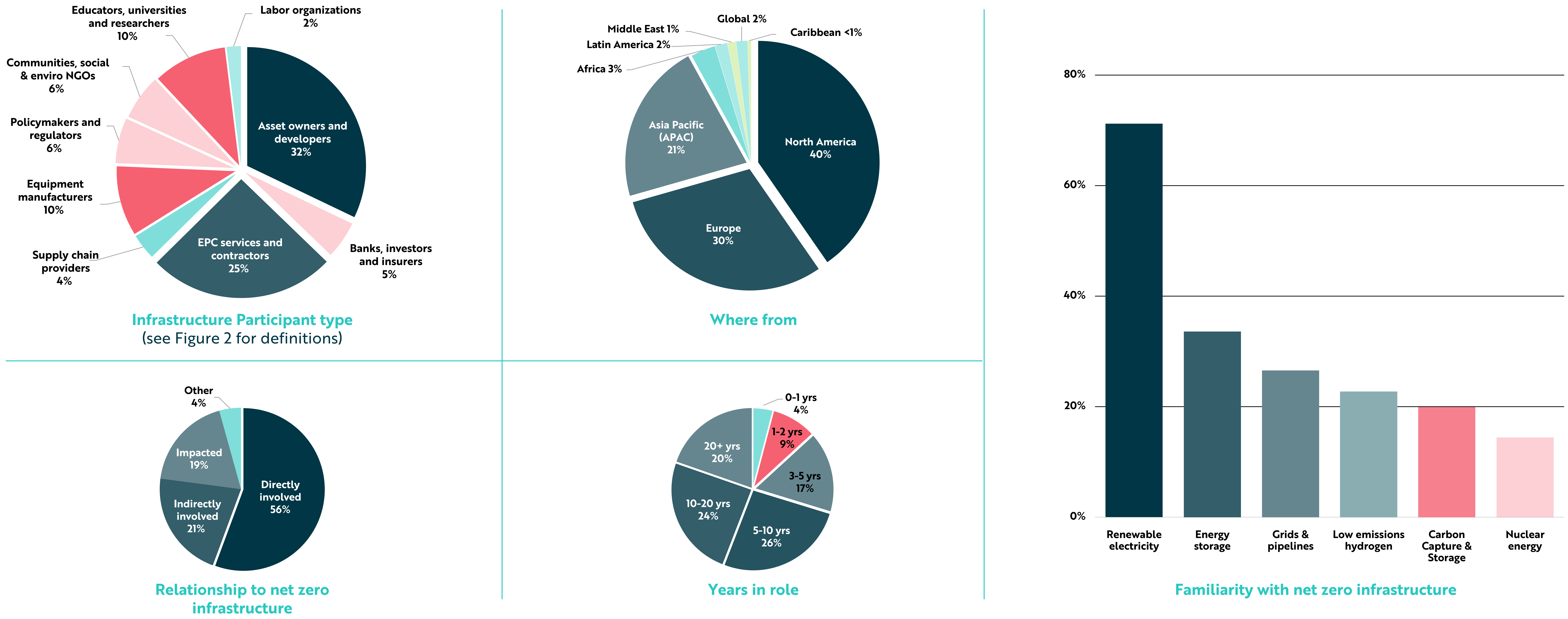


Figure 4 – Breakdown of respondents to the 2023 survey (information courtesy of Princeton University).

Figure 5 shows respondents' views on shift adoption from the 2023 survey across all regions and participant types, with the figure to the left a macro view of progress. Also shown are the FATR shifts predicted by respondents both most – and least – likely to move in the next 12 months.

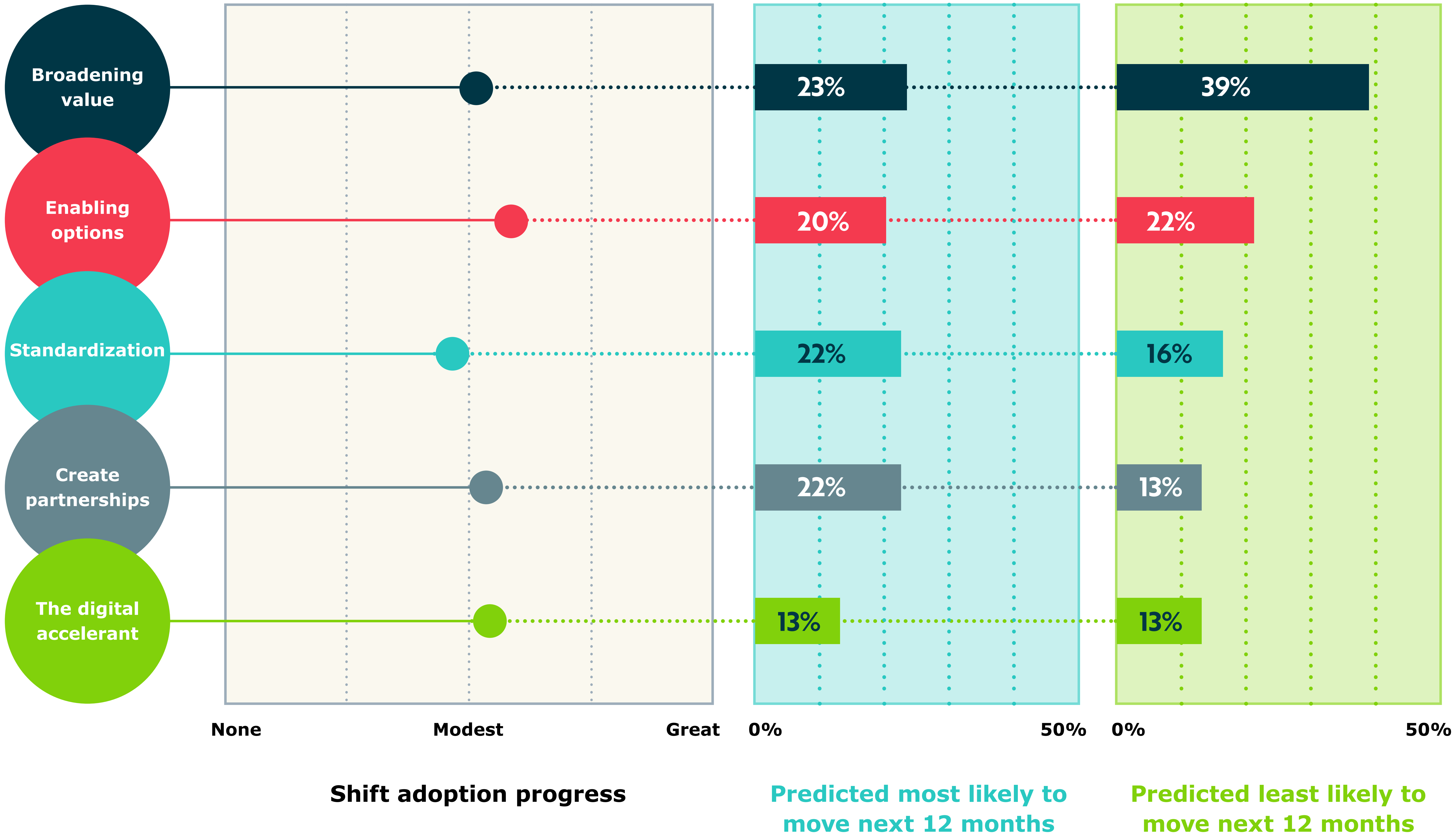


Figure 5 – 2023 survey results in terms of average macro responses to shift adoption progress, and those shifts predicted most and least likely to move in the next 12 months. All data, all regions. Data from both Composto et al. (2024) and courtesy of Princeton University.

Composto et al. (2024) speculate that higher adoption results for the 'Enabling options' shift, which calls for a diverse technology response portfolio, are partly a result of policy support. While relatively low scores for the 'Standardization' shift point to a continuing preference for bespoke projects.

A greater consensus that the 'Broadening value' shift is 'least likely to move' was interpreted as reflecting the scarcity of tools and models for valuing social and environmental benefits on par with financial benefits in project business cases.

Figure 5 suggests that while there is some evidence of early FATR shift adoption, the overall level of paradigm adoption is limited. Based on the 2023 survey result, our resulting summary of the gap between shift adoption in 2023 and required adoption by 2030 (to get to net zero) is shown in Figure 6[10].

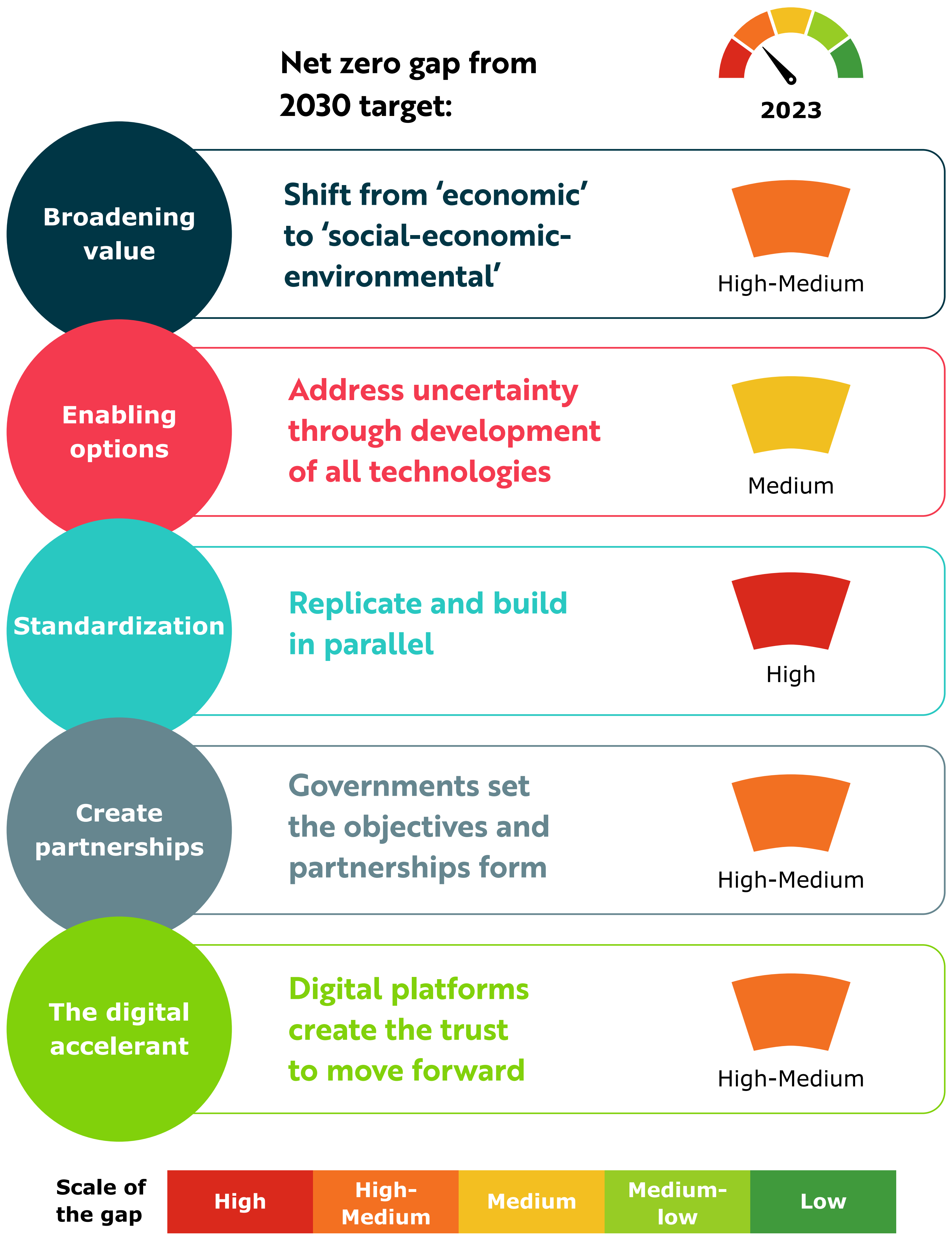


Figure 6 – Our view of the net zero gap based on the 2023 survey. Results are shown in aggregate at the top and for each shift.

A more detailed story emerges when considering the indicators of change for each shift, shown on the left-hand side of Figure 7. Technology, policy and investment trends drive the high rating for the 'Enabling options' shift, but indicator scores around the breadth of technology being advanced and the sharing of intellectual property are much lower. 'Standardization' scores poorly across all indicators, and the inclusion of digital personnel on projects is rated as less common.

Composto et al. (2024) delve deeper into each indicator, exposing more nuanced results. Some examples of these results are shown on the right-hand side of Figure 7. For example, the 'Environmental & social representation' indicator under the 'Broadening value' shift suggests that environmental scientists are more often included on project teams than social scientists. Co-ownership with local communities and sharing information with peers, likewise, do not appear to be common practice.

For the 'Enabling options' shift, sharing intellectual property in the public domain is also uncommon, as is working with competitors on a common net zero mission. In the 'Create partnerships' shift it appears unusual for unions, workers, educators, or researchers, to have input into projects. For the 'Digital accelerant' shift, communities and regulators rarely have access to project data systems, while developers and investors do.

Composto et al. (2024) note that participants express great reluctance to share data, information, plans, and goals, particularly with impacted communities, while most will not work or collaborate with competitors. Participants also have concerns about the authenticity, commitment, and intentions of other stakeholders.

Figure 7 – Average evidence score from the 2023 survey for each indicator of change for each shift (left), and examples of where analysis at the next level of survey question reveals nuances around each (right). All data, all regions. Data from both Composto et al. (2024) and courtesy of Princeton University.

The data suggest a level of inertia or even resistance to change. Composto et al. (2024) conclude that there is a deficit of trust between participants and in practices of procedural trust, and that improving trust between stakeholders could help build momentum for paradigm change.

We see a range of factors contributing here – business as usual is not particularly conducive to the building of trust. Competitive tension and the protection of commercial advantage, the polarization of political agendas, prescriptive regulation, activism, fearmongering, and risk appetite, among many other factors, impact trust between participants.

However, most participants have publicly committed to and share the net zero ambition, and achieving it collectively is far from business as usual. This is why a new paradigm is needed. Finding a path that protects participants’ interests while achieving their shared ambition appears to require new levels of trust, while sticking to the practices of the past will produce much weaker overall climate outcomes.

Has the needle moved on FATR shift adoption?

At the time of writing, the 2024 Princeton Net-Zero Stakeholder Survey (2024 survey) was closing. While detailed analysis of full results won't be available until 2025, an early comparison to the 2023 survey series baseline, shown in Figure 8 provides, for the first time in the FATR series, a look at gap trends.

Approximately 400 responses are included in the preliminary 2024 survey results, and analysis suggests very little change in FATR shift adoption since 2023 in terms of the net zero gap. Good progress has been limited to the 'Standardization' shift only, where the adoption gap improved from 'high' to 'high-medium.'

The overall net zero infrastructure gap is closing slowly, which is directionally encouraging. In addition, Princeton's detailed analysis, likely published in early 2025, may reveal further positive nuances.

However, the message from Figure 8 is that adoption of the FATR shifts is not occurring fast enough. This means that the world remains at risk of not having the delivery paradigm needed to meet the net zero infrastructure challenge.

Unless this changes – and trust is implicated as being important here – the world simply cannot build the infrastructure needed in time.

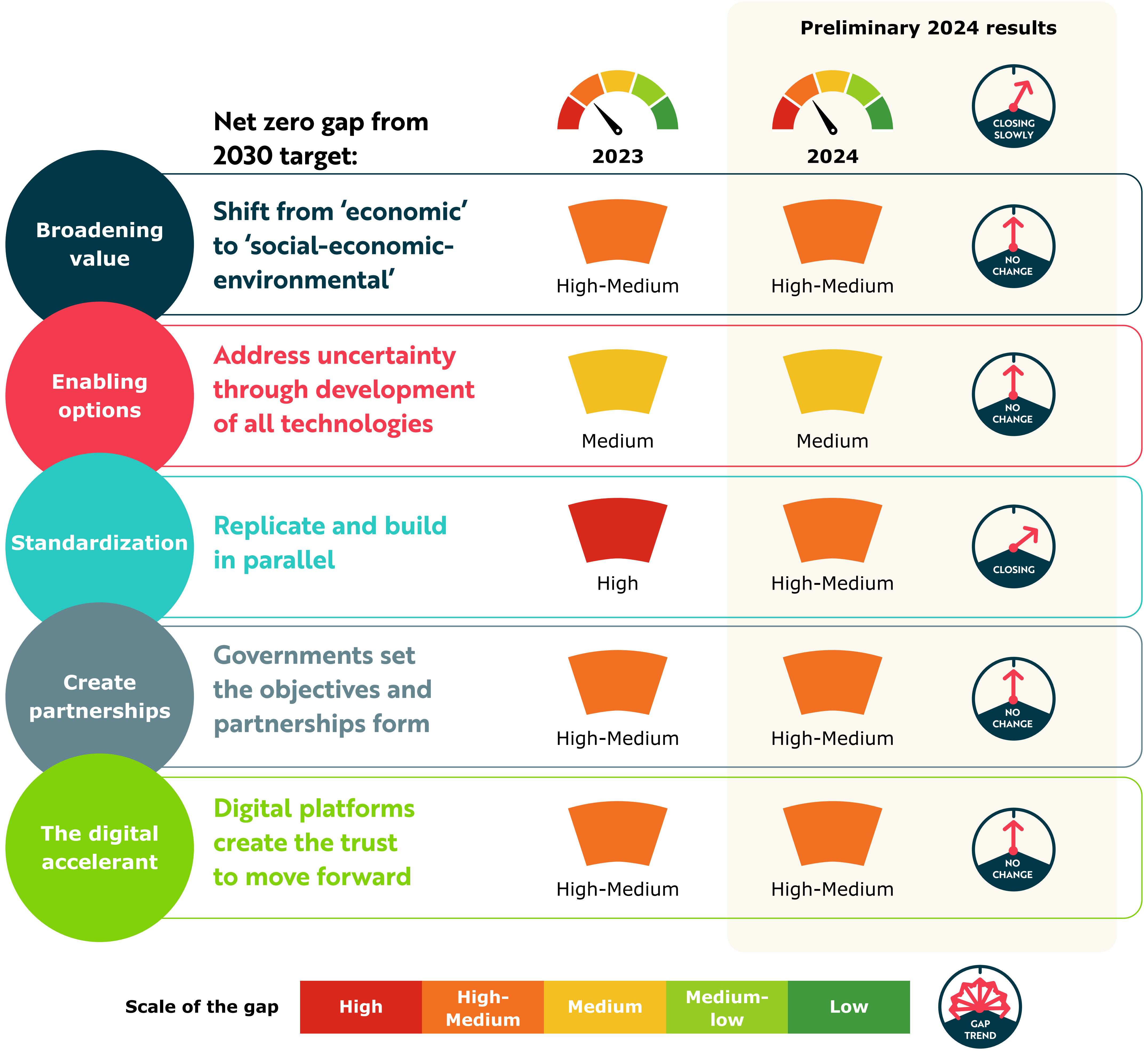
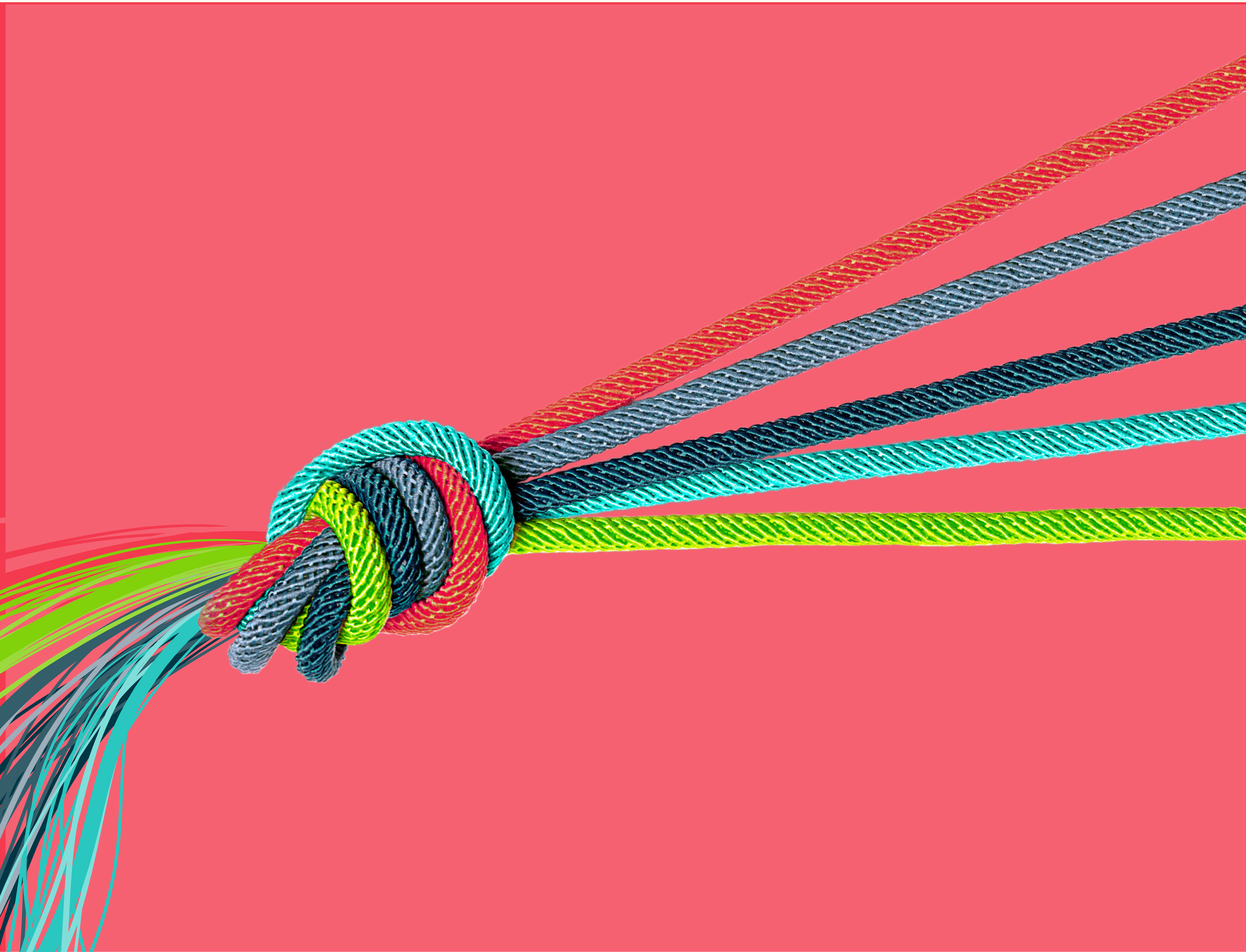


Figure 8 – Preliminary 2024 survey results in terms of the net zero gap from the 2030 target, and trends in that gap from the 2023 baseline.

CHAPTER 2

What could drive things faster?



The importance of trust

A lack of trust is implicated in slowing the adoption of the FATR shifts, and we suggest ultimately the world's ability to drive infrastructure delivery at the speed and scale needed to reach net zero by mid-century. What do other infrastructure participants think?

Princeton and Worley have been engaging with infrastructure participants across the world on the FATR shifts, including forums where the thinking has been shared and challenged, and it is clear that these concepts resonate strongly. But significant challenges hinder their adoption, and the stakeholder view is that trust, in particular, needs work.

When considering the enormous finance rollout needed for net zero, I think trust becomes more important. . . In terms of the ability to get more large capital out the door quickly for projects, trust is essential.

David Scrivener,
Global Head of Energy, Infrastructure and Resources,
Westpac Institutional Bank

What do we mean by trust?

Extensive academic literature explores the meaning of trust, with one recent broad summary describing trust as "one of the principal forces that binds society together."[11] Numerous papers have shown the critical importance of trust to individual wellbeing and interpersonal relationships, including within teams and businesses. And yet trust seems to defy simple definition.

Trust is a mysterious, deeply personal concept that philosophers, psychologists, ethicists, and other researchers have struggled with. It appears to mean different things to different people and is influenced by perspectives, culture and norms, political and legal frameworks, religious beliefs, economic maturity and technical literacy – even such personal attributes as personality and appearance. The interpretations of 'trust' by infrastructure participants in our stakeholder engagement work varied significantly.

It would be easy to dismiss the role of trust in the contract-heavy world of infrastructure, yet the positive role of trust in business is well known[12] – indeed, for thousands of years, a handshake and a person's word were trusted signs of agreement; they still can be, legally.

Trust is in the news

A quick internet search will show that trust is currently a hot topic, so we are not the first to recognize its importance.

It's also not a new issue in the world of climate response. For decades some have used a lack of trust in science to justify climate inaction. When scrutinized, what emerges is not a lack of trust necessarily, but a more complex interplay of political and social self-interest[13]. In the Edelman Trust gauge survey, which included almost 14,000 respondents[14], scientists and experts were ranked highest on trust in relation to climate change information.

So, trust is important, but we need to take care when interpreting why.

In the same survey, while 93% of respondents stated that climate change is a serious threat, half did not trust the institutions charged with leading the climate response. A subsequent survey[15] released alongside the 2024 World Economic Forum (WEF) meeting in Davos – an event themed around 'rebuilding trust' – noted a decline in trust in the institutions responsible for steering change. A subsequent WEF net zero report[16] specifically called for rebuilding trust between governments, businesses, and communities as a fundamental step to drive climate response forward.

Research has also considered the role of trust in the delivery of net zero infrastructure. Otto et al. (2023)[17] reviewed 97 research articles on how trust impacts such projects, reporting a relatively poor understanding of what trust means in this context. They find that most research has focused on trust in relation to social contracts and overcoming community opposition to projects and suggest that trust needs to be considered in a much broader context across infrastructure participants, technology knowledge, and related processes to be truly understood and leveraged.

Leveraging the power of durable trust

We've explored trust within such a broad context, asking for input from hundreds of related professionals and thousands of broader stakeholders to build qualitative and quantitative evidence on the role of trust. Our quantitative data sets were described in Chapter 1. Our qualitative data, which came through conversations, formal workshops, and specific participant interviews, are spread throughout this paper. Highlighted excerpts from these interviews were chosen to be broadly representative of different participant types – the interview process is described in Pullout 2.

But trust is a complex concept – it is easy to state and point to as an issue, but harder to define and understand the conditions for durable trust, which is both strong and long lasting, so caution is needed. Our impression is that many diverse forums are raising the importance of trust globally, but few appear to be taking the deep and systematic approach necessary to build durable trust and work out how its power can be positively leveraged.

We believe trust can be leveraged to drive the net zero infrastructure response the world needs, but to understand how, more work needs to be done.

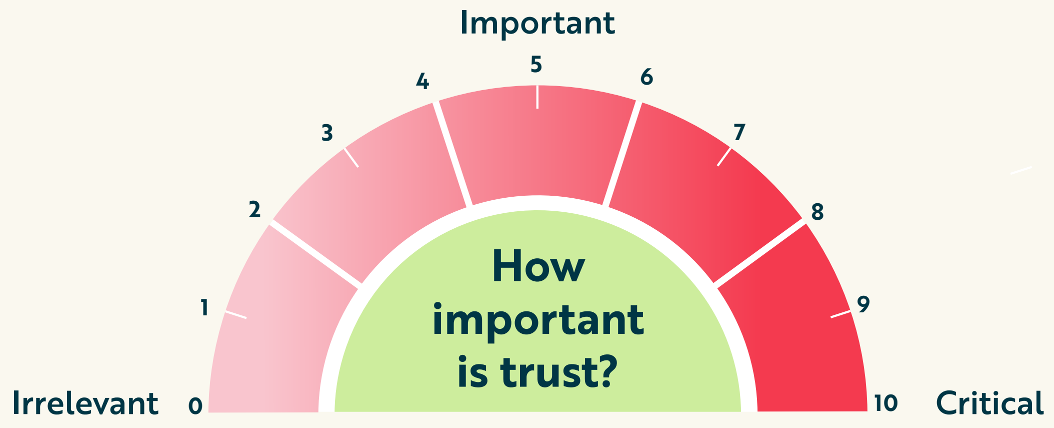
PULLOUT 2
PARTICIPANT INTERVIEWS

Individuals from a range of infrastructure participant categories were interviewed to find out what trust means to them in the delivery of infrastructure. With their permission, their answers to the following questions have been summarized in the 'Interview' pullouts and quotations used throughout Chapters 2, 3 and 4.

QUESTION 1:
In your view, how important is trust between infrastructure participants in developing and delivering an infrastructure project, and where would you rank it from 0-10?

QUESTION 2:
From your experience, what impact does a deficit or lack of trust have on that delivery?

QUESTION 3:
What do you think signals increasing trust between participants – what are the indicators?



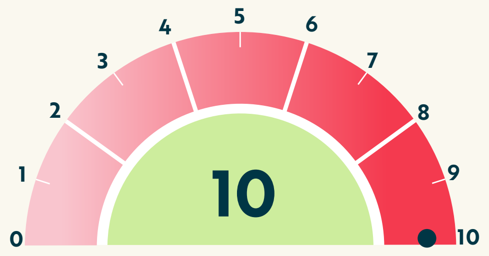
Disclaimer: The statements and opinions expressed in interviews and quotations used in this paper are those of the interviewees cited, and do not necessarily reflect the opinions of the authors, Worley or Princeton University.

ASSET OWNERS AND PROJECT DEVELOPERS

Interviewee:
Karlis Povisils

Role:
SVP Development, Apex Clean Energy

Industry:
Renewables and green H_2, US



How important is trust?

"Trust is critical between developers, policy makers/regulators and communities. If there is a deficit of trust, the zone of engagement is small, or even non-existent, which will influence the ability to obtain permits (the single biggest cause of project success or failure).

If a governing body does not trust developers, project opposition can build, cause chaos, sow doubt, and in turn kill a project due to delays. Here, fear of the unknown is easy to leverage, particularly through social media.

Trust is important in gaining landowner consent. If they don't trust that you can successfully develop the project, it doesn't matter how lucrative the contract; they believe they're never going to receive those rewards, so why would they support you?

Building trust with communities comes through very early engagement – before permits are applied for. If you lose trust on an individual project, you probably cannot rebuild it, although it is possible with work to rebuild it more broadly in a community.

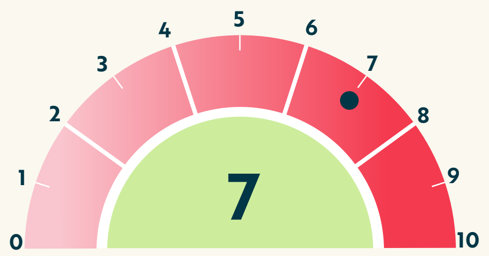
Trust can also drive down pricing with contractors who can price in efficiencies and submit less conservative proposals if they trust you. With bi-directional trust, you know they can supply the right crew and that they will get stable repeat work. Concessions on both sides come from such alignment and successful results."

BANKS, INVESTORS AND INSURERS

Interviewee:
David Scrivener

Role:
Global Head of Energy, Infrastructure and Resources, Westpac Institutional Bank

Industry:
Finance, Australia, Global H_2, US



How important is trust?

"I've been in infrastructure finance for a long time and your trust questions made me pause. From one perspective you could argue it's irrelevant – we have contracts and due diligence which cover for a lack of trust.

But I think there are layers to this. Those we choose to do that diligence we trust. We place a lot of trust in the equity in a project and always think what will happen if things go wrong – do we trust the counterparties to work with us to resolve, or will it be lawyers at 50 paces and 6 months of delay?

We trust the project team's competency; can they deliver and prioritize your project? This is more than education and certifications. We are looking at 25-year relationships here, and I think trust is important across such timeframes, particularly individuals involved where trusting relationships have formed.

When considering the enormous finance rollout needed for net zero, I think trust becomes more important. If I trust the counterparties' experience, their behavior, and their track record, the process is just faster – it could positively impact finance terms, although any impact is likely in the margins.

But trust can speed up the deployment of capital. This extends to trust in banks – issues can be resolved faster with a trusted finance team, and the use of simpler contract terms entertained where people are trusted to do the right thing for the project."

CHAPTER 3

A new role for trust

Trust and the net zero transition

The FATR series has presented a consistent, evidence based case that widespread adoption by infrastructure participants of the five FATR shifts is needed before 2030 if the world is to sustainably deploy the infrastructure needed to realize mid-century net zero goals. Crucially, they require that participants collaborate like never before.

The quantitative and qualitative stakeholder feedback outlined in previous chapters suggests only nascent and somewhat patchy adoption of some of the FATR shifts. It also suggests that trust might be a missing element to faster adoption. This chapter explores the critical role of trust in accelerated infrastructure delivery, different types of trust (or lack thereof), and the interplay of trust between different participants.

Understanding the differences between modeled pathways to net zero and infrastructure deployment in the real world is instructive. The modeling world simulates an ecosystem of rational developers, investors, and stakeholders, collaborating harmoniously, to execute infrastructure projects flawlessly and instantaneously, as capacity is needed. In this world, stakeholders benefit from a combination of perfect foresight, visibility, and cooperation across sectors and supply chains.

The real world never works this way. But must it somehow mimic these idealistic conditions to support the deployment of infrastructure at unprecedented speed and scale, free from supply chain bottlenecks, grid connection queues, contractual disputes, and community opposition? Could trust among stakeholders in the net zero transition be an important enabler of such conditions?

Where trust matters most

To further explore the influence of trust, we held two workshops with diverse subject matter experts (SMEs) from Princeton and Worley. These experts specialize in fields relevant to net zero infrastructure delivery, such as engineering, business, social and behavioral sciences, and project development and delivery (including government and community liaison). We also interviewed individuals external to Princeton and Worley (see infrastructure participant pullouts throughout chapters 2-4).

When asked to rate the importance of trust in successful project delivery, all SMEs ranked trust between important and critical on our trust gauge, Figure 9.

Their view was that trust between stakeholders was likely to drive better outcomes, boost delivery confidence, heighten team performance, improve information flow, foster a sense of shared mission, and produce more reliable relationships. These benefits help increase certainty about key project outcomes, productivity across the value chain, and acceptance by society and stakeholders during project development. These are the same three characteristics we determined as central for superior project outcomes based on the extensive stakeholder engagements we undertook as part of FATR3.

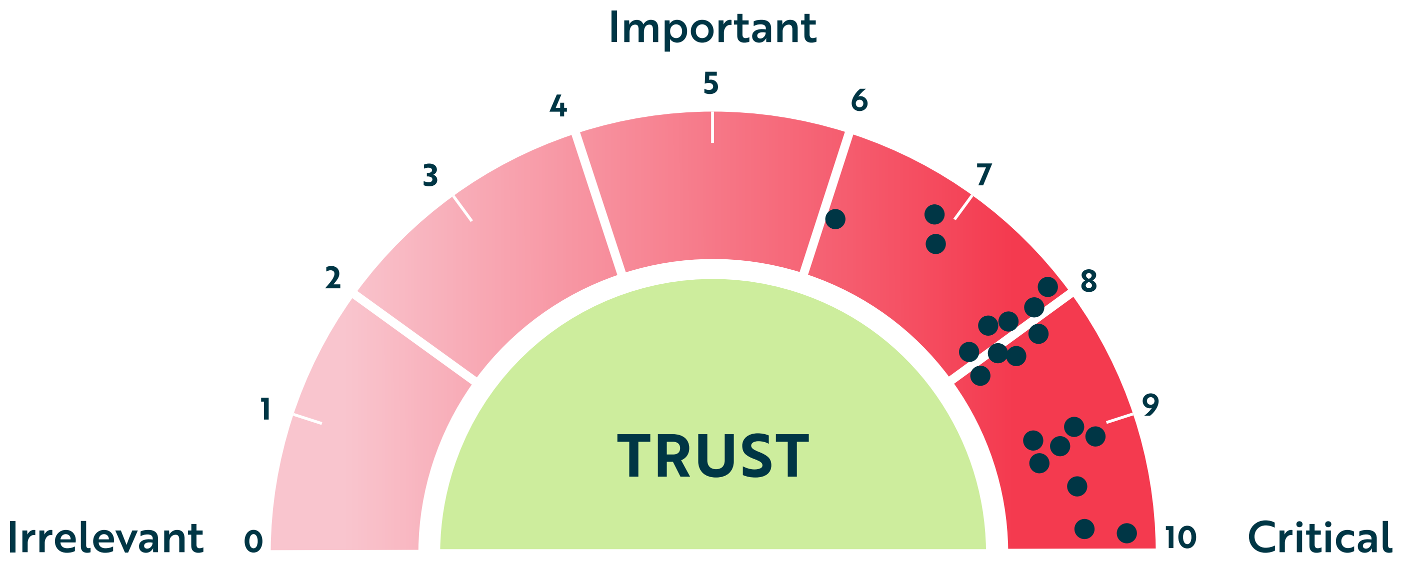


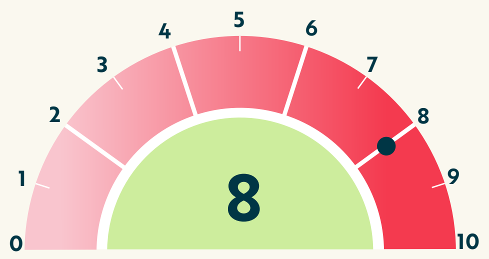
Figure 9 – Importance of trust in delivering projects that achieve exceptional performance. The trust gauge shows workshop SME responses on the importance of trust in projects that achieved key performance indicators (KPIs) like safety, cost, schedule, and benefits.

EDUCATORS, UNIVERSITIES AND RESEARCHERS

Interviewee:
Raphael Heffron

Role:
Researcher in energy law/justice and sustainability

Industry:
Academic, France and UK



How important is trust?

"Trust is important, but it is not everything. Something must be offered to gain that trust – competence for example. Trust is equally important across and between all participant types.

Trust is built when minimum standards are exceeded – which change in time – but where a deficit of trust exists, that exceedance must compensate. So, to overcome a big deficit, you need to go a long way past the minimum acceptable or build an aspiration with other participants to do this together.

Many developers have a trust deficit, e.g. the minerals and mining sector trying to kick-start extraction to supply for energy transition. Poor legacy practices mean that (1) those issues need to be faced, and (2) the new direction believed. There will be no energy transition – no acceleration of infrastructure needed – unless these are overcome, which will need the rebuilding, or in some place building, of trust.

Trust building is evident when projects go faster, often starting with small projects and building on the success of phases. Greater alignment across participants is also evident – new related educational opportunities in universities would be one sign.

Building trust between academics and other participants is important and would benefit our net zero ambition. Capacity building, the sharing of diverse discipline knowledge, and the theory and practice of building trust are examples."

While trust between stakeholders was seen as a critical enabler, it was not, on its own, sufficient for successful outcomes. For example, trust cannot substitute for core competencies and capabilities, strong performance by individual project personnel, inclusive strategies for engagement and participation, and equitable sharing of project benefits and risks. SMEs also noted examples of projects that met objectives despite a deficit of trust.

It is likely then that these other characteristics influence the establishment of trust (or distrust) and are mutually reinforcing.

SMEs expressed different perceptions of the meaning of trust and the difference between trust and distrust. In their view, an absence of trust is different from distrust. Where there has been no prior engagement between stakeholders, there may be no basis for trust. In that case, we cannot assume trust, rather, it needs to form from experience – meaning it must be developed or earned.

When prior experience has resulted in distrust, however, the situation changes. How we think about the role of trust between participants in project delivery will be different, depending on stakeholders' perceptions of their starting positions. For example, are stakeholders starting from a position of limited prior experience, or a long history of positive experience, and therefore seeking to establish or maintain trust? Alternatively, are stakeholders starting with negative experiences that produced a trust deficit, and thus must begin by seeking to restore trust?

SMEs saw trust as more important when accelerated delivery was sought with some, but not all, ranking it closer to critical under these circumstances (Figure 10). They also viewed trust among participants as a key feature of projects that exceed expectations on safety, time, cost, and performance. The obvious question this raises is which comes first? Does a culture of trust result in superior safety, time and cost performance, or does the achievement of superior outcomes drive a culture of trust?

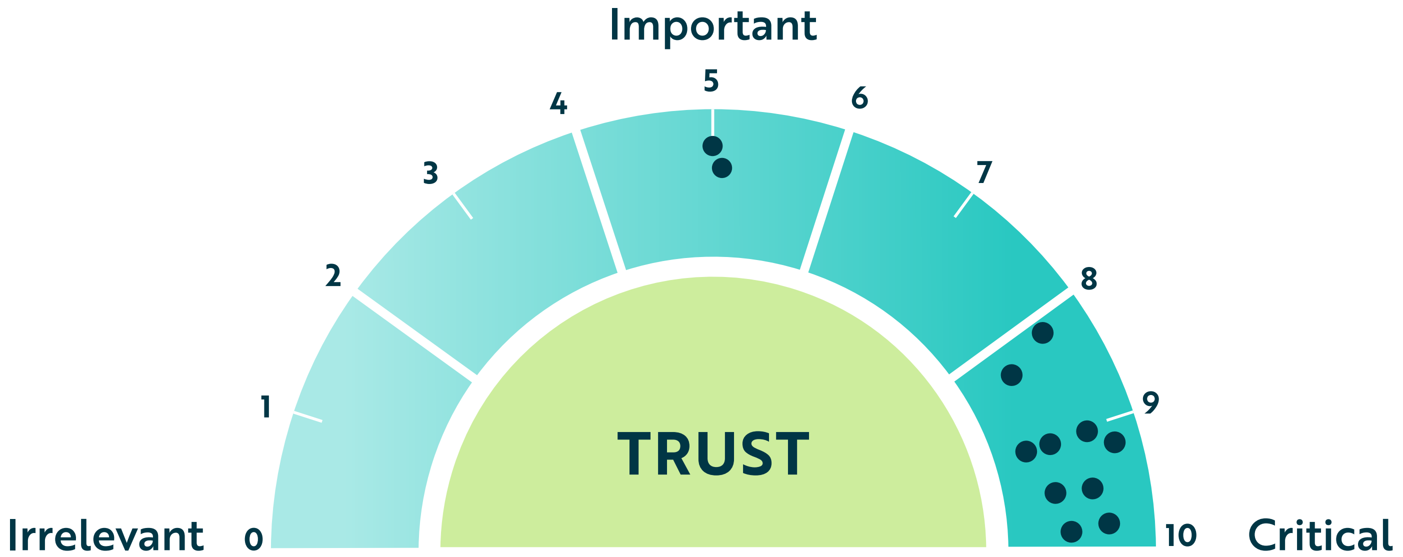
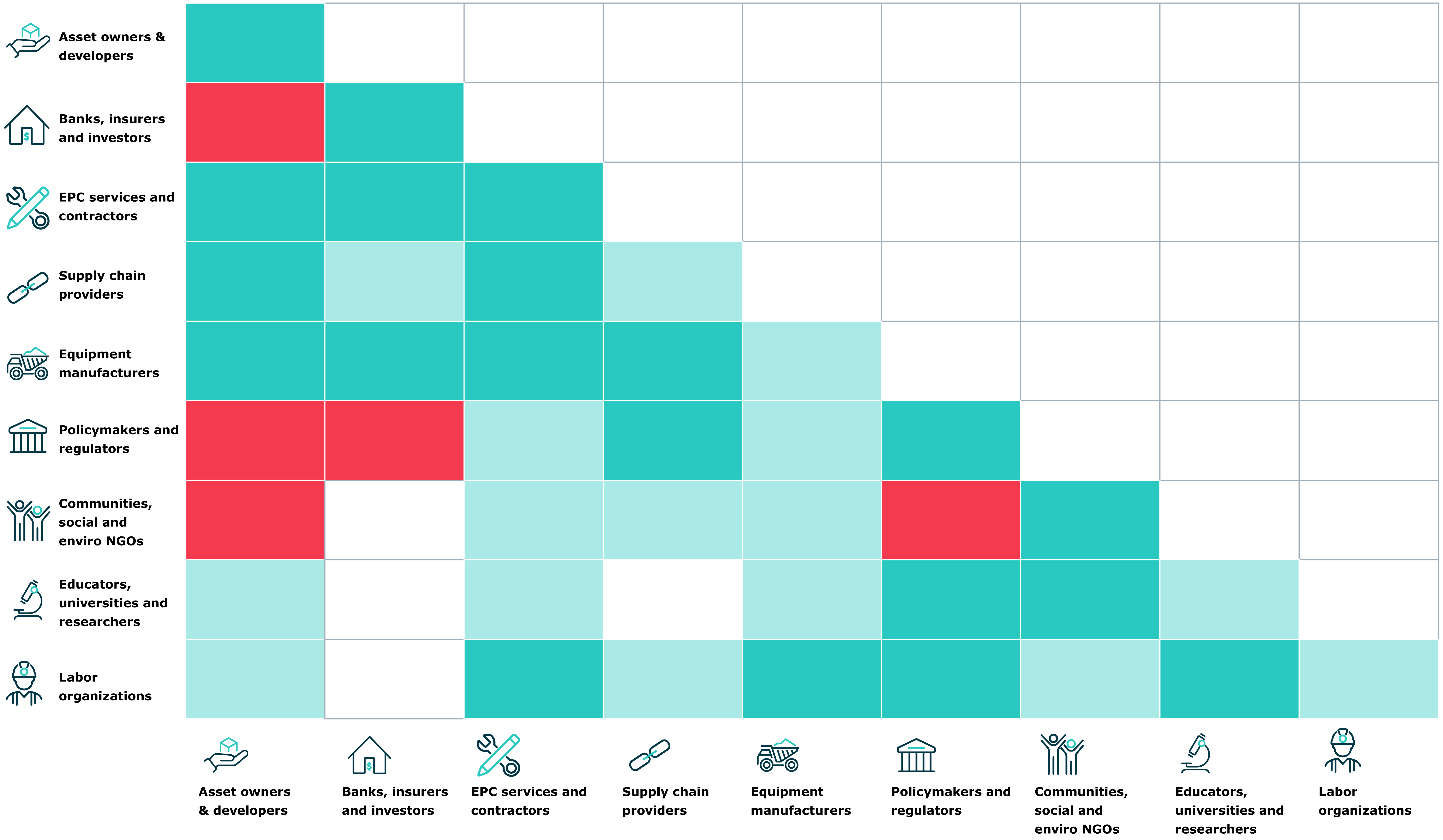


Figure 10 – Importance of trust in delivering projects faster. SME responses on the importance of trust in projects with accelerated schedules while still achieving key performance indicators (KPIs) like safety, cost, schedule, and benefits.

We asked SMEs to nominate the top five participant relationships in which they considered trust was most crucial to enabling faster project delivery (Figure 11). This included relationships between participants in the same category.

The top five relationships where trust is crucial to fast delivery were those among 'asset owners and developers', 'policymakers and regulators', 'communities and NGOs', and 'banks, insurers and investors' participant types. This is not to say that they didn't consider trust important in other relationships with SMEs having significant difficulty limiting the most critical to just five. When asked to rank the importance of trust in remaining relationships, they ranked it high or above in more than 50% of relationships.



Importance of trust to delivery speed

Top 5 most critical	High	Medium	Low

Figure 11 – Perspectives from SMEs on the importance of trust in relationships between infrastructure participants when accelerated project delivery is sought.

The critical nature of trust at these stakeholder intersections was also evident from external interviews. On the question of how important trust is in delivering projects, all rated this above important on the trust gauge, most close to critical, but for a range of different reasons.

For those on the project side, the relationship with the regulator responsible for granting permits was prioritized over the relationships with landowners and communities hosting projects.

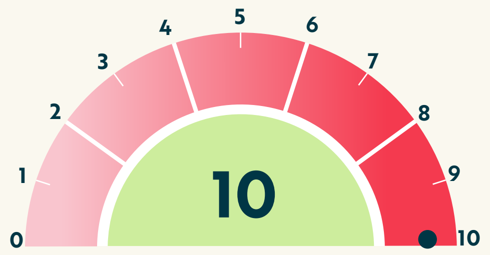
This sense was reinforced in interviews with NGOs that represent the interests of landowners and affected communities, who report a perceived lack of transparency and a tendency on the part of certain developers to withhold information unless disclosure is ordered by a court. These views are indicative of declining trust, if not a deficit of trust.

EPC SERVICES AND CONTRACTORS

Interviewee:
Harry Warren

Role:
President, CleanGrid Advisors

Industry:
Energy transition advisory, US



How important is trust?

"Most definitions of trust have two parts: (1) confidence and reliance on integrity, truthfulness and character; and (2) strength and ability to deliver on promises. In new technology projects, you often deal with individuals and companies you haven't worked with before, and in new situations even entities you think you know can struggle to deliver on commitments.

Trust in people and organizations is especially important when things are new and uncertain. Once things are more routine, you get comfortable dealing with a larger spectrum of parties and perhaps trust is less important.

Good process allows people to increase trust. Negotiating good contracts, performing thorough due diligence, and solid project management and reporting processes bolster confidence that risks are being addressed. When trust is a concern, ramp up the process to compensate.

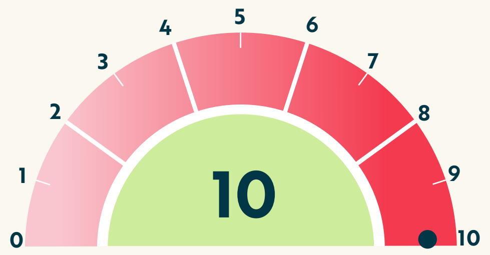
Community benefits agreements can be trust builders with a range of stakeholders. It's interesting that communities don't simply trust their governments to assure that positive benefits of projects, like jobs, are being realized, and that negative impacts of projects, including during construction, are being minimized. That's where benefits agreements can help."

COMMUNITIES, SOCIAL AND ENVIRONMENTAL NGOs

Interviewee:
Jessica Vandenberghe

Role:
Owner, Guiding Star Consulting

Industry:
Indigenous people's interests, North America



How important is trust?

"Infrastructure impacts all our lives, so trust in its development and outcomes, how it's delivered, its uses and value, needs to be high. This is why those adjacent to development need to be involved – what in Canada is called a duty to consult.

But you need engagement, not just consultation, to be a good neighbour – seen often, engaged, active – and for Indigenous communities, to understand their diverse needs. Unless you have that knowledge on your team, the project can misalign.

Historical injustices, failed infrastructure projects, current poor practices, are all things that have and continue to erode trust for Indigenous communities. When building new infrastructure, you need to consider what harm has been done here, and by who.

Indigenous communities think in centuries, of ecosystems and connection between things. Building trust means working out what is important. The oil sands industry got this right, despite significant environmental harm they worked for decades to understand, build community capacity, outreach, value reciprocity, a true partnership of walking together.

When you are invited into Indigenous communities you know trust is improving. But it takes time to build trust, and it can take longer to rebuild trust than to gain it in the first place. And you need trust within companies – if field workers don't trust their own company, how can they build trust with the communities with whom they work?"

The importance of participant starting positions was clear from these interviews. Where legacy practices or past actions have created a trust deficit, a different approach is required to build trust. Those close to Indigenous communities spoke about many decades of trust erosion particularly with government participants, requiring sensitive consideration and examples where trust was lost and where it was rebuilt. Those working with new, low emission technologies, spoke of a lack of trust in the value chain developing and aligning, rather than trust in specific participant types.

It takes longer to rebuild trust than to gain it in the first place.

Jessica Vandenberghe,
Owner, Guiding Star Consulting

Interviewees also recognized other important attributes of successful projects – in other words, trust is important, but it is not everything.

In our workshops and interviews, SMEs and interviewees also reflected on potential indicators of increasing trust in a project setting. These included greater alignment, transparency, empathy, and vulnerability. Many pointed to the link between a high level of trust and faster, more efficient project delivery, with more aligned project teams able to better respond to changes and resolve problems.

There isn't going to be an energy transition acceleration if we don't solve the trust issue on two fronts – overcoming poor legacy practices of the past, and the reasons for a new energy direction.

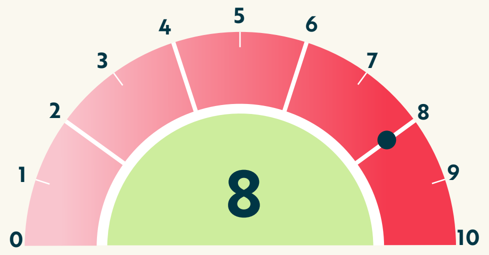
Raphael Heffron,
Researcher in energy law/justice and sustainability

BANKS, INVESTORS AND INSURERS

Interviewee:
Maryam Golnaraghi

Role:
Director of Climate Change & Environment, Geneva Foundation

Industry:
Insurance and risk, Global



How important is trust?

"Meeting the net zero challenge means recognizing the delivery model needs disruption – a more integrated full lifecycle approach, and rethinking and better alignment of stakeholder priorities, who must collaborate. Then trust is needed among stakeholders to implement at the scale and speed needed.

One example is to consider resilience in infrastructure design, construction and operation, to enhance insurability, taking into account the asset's full life cycle. Disruption here would be engaging insurance companies' risk engineers much earlier, as early as pre-site selection. This will allow early risk identification, better risk management, improve insurability and expedite investment decisions. Once parties understand the win-win benefits and come to the table around such, positive impacts can accrue.

Credibility, track record and the ability to deliver are preliminary conditions for counterparty trust. But trust needs to be nurtured, supported and deepened along the way. A deeper trust allows innovation to flourish, better results achieved, and stronger collaboration forged to replicate projects, and speed up scale.

Lack of trust slows progress and can lead to lose-lose situations, even within organizations. Stakeholders are often also constrained by the past. To achieve speed and scale, all parties need to believe they can achieve better together than alone.

Indicators of improving trust and early collaboration include better framing of risks, better risk management, innovative solutions, better speed, and ultimately better results."

Net zero at the speed of trust

So, our qualitative work indicates that while trust is not necessarily everything on a project, if it can be increased then projects should perform better.

The FATR shifts should also accelerate the pace and performance of infrastructure delivery. But it can be challenging to change existing norms and implement the FATR shifts across the net zero infrastructure delivery ecosystem, particularly if there is a lack of trust or confidence in the performance or alignment of other stakeholders.

We believe therefore, that trust enables, and is enabled by, the adoption of the FATR shifts through a virtuous cycle in which the presence of trust increases shift adoption, which in turn builds trust – and vice-versa (Figure 12).

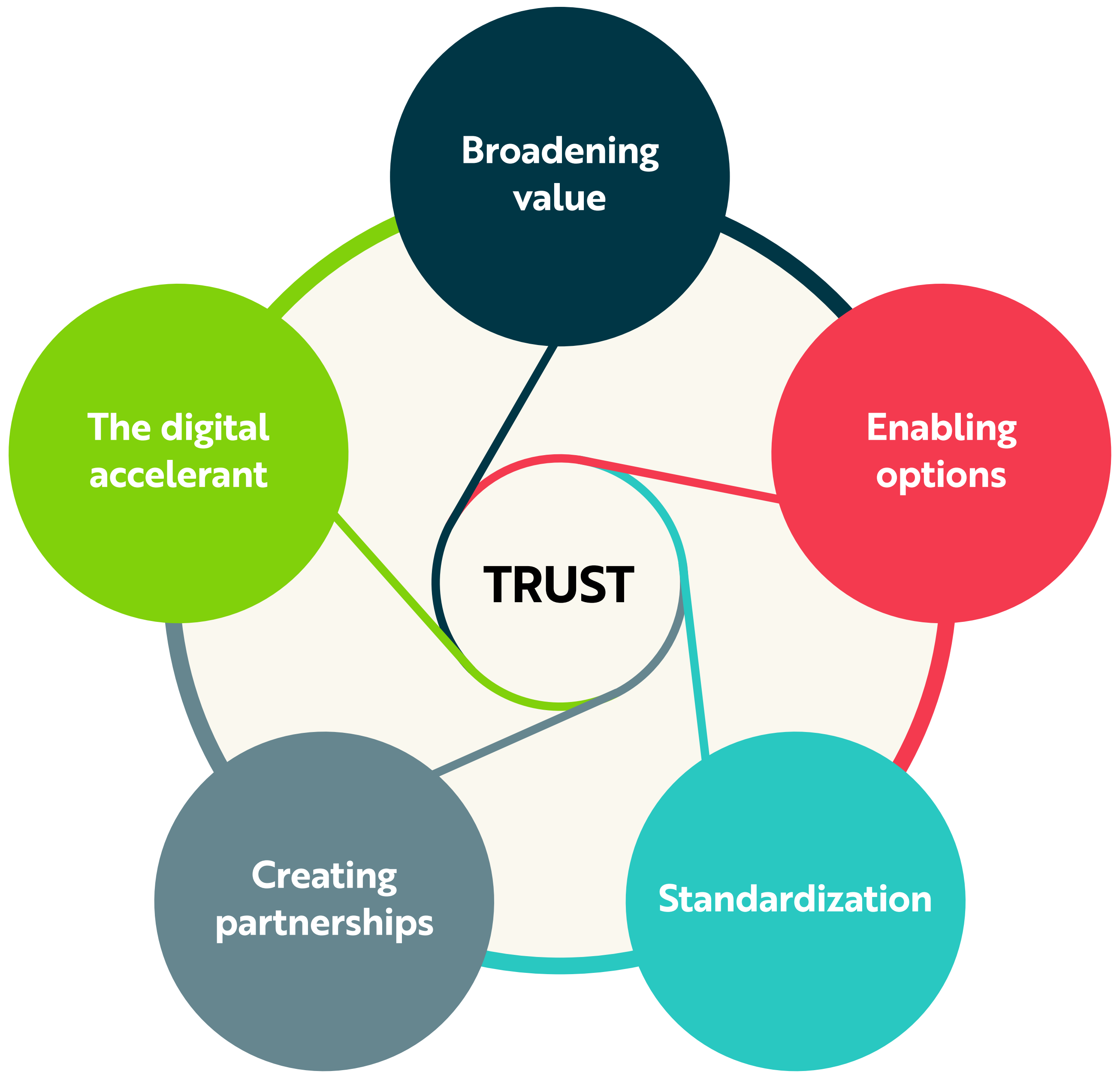


Figure 12 – How trust enables and is enabled by the five shifts of the FATR delivery paradigm.

Establishing durable trust among infrastructure participants may well be essential to achieving mid-century net zero goals – particularly the speed of response: We term this **net zero at the speed of trust**[18].

Understanding the conditions for trust in delivering net zero infrastructure requires consideration of many aspects. This includes justice and fairness in the context of economic costs and benefits, and social norms, such as moral philosophy, gender, religion, race, and politics. It also requires a geographically resolved assessment of the starting position among sectors and participants to distinguish whether the first task is to create, maintain, or restore trust.

This task must be undertaken within a commercial and political context where improving trust may be at odds with stakeholder perceptions of advantage or is seen as introducing greater risk or uncertainty.

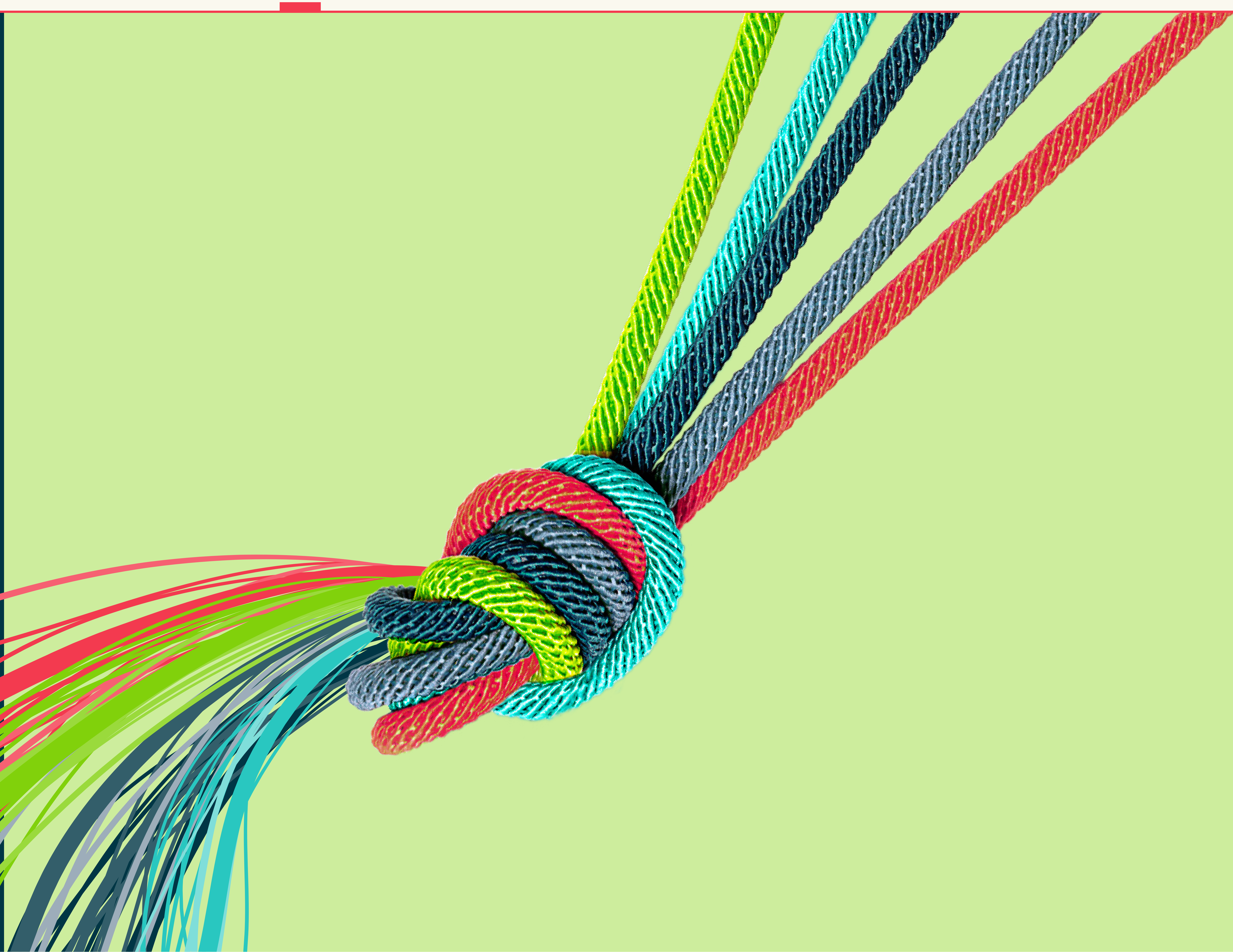
As highlighted earlier, whether participants start from a position of high trust, neutrality, or distrust, matters greatly. It is therefore highly likely that any framework for creating durable trust will need to be differentiated in situations that start with distrust.

Participants starting positions will also influence the pathway required to achieve a level of trust that enables shift adoption and successful project delivery.

This is particularly relevant in decarbonization sectors where some participants have attracted criticism and activism due to past positions and actions. Chapter 4 takes a deep dive into a low emissions value chain where we think a lack of trust and distrust is impairing progress: Carbon Capture and Storage (CCS).

CHAPTER 4

The role of trust: CCS



CCS in context

This chapter explores the role that trust plays in one of the more controversial decarbonization options, Carbon Capture and Storage (CCS). For simplicity, we focus on the US economy, and the geologic storage rather than utilization of captured carbon – hence we do not use the term Carbon Capture Utilization and Storage (CCUS).

All modeled pathways that limit global warming to well below 2°C involve significant, multi-gigatons-per-year (Gt/year) deployment of CCS globally by mid-century, so this technology and its variants are considered very important for climate response. All scenarios in Princeton's Net-Zero America study[19], which we explored in FATR1, require CCS to reach net zero.

In fact, reaching net zero may be impossible technically and economically in the US without CCS, with deployment in different modeling scenarios ranging between 0.7 and 1.76 Gt CO_2/year by 2050. These results suggest a mid-century carbon capture enterprise in the US of the same order as current US oil production, in volumetric terms, using a variety of technologies:

- to mitigate emissions from existing fossil fuel power plants
- to produce 'blue' hydrogen and associated fuel derivatives
- to address emissions from hard to abate, carbon intensive industries such as cement, steel and chemicals
- for carbon dioxide removal (CDR), i.e., primarily bioenergy with CCS (BECCS) or direct air capture with storage (DACS).

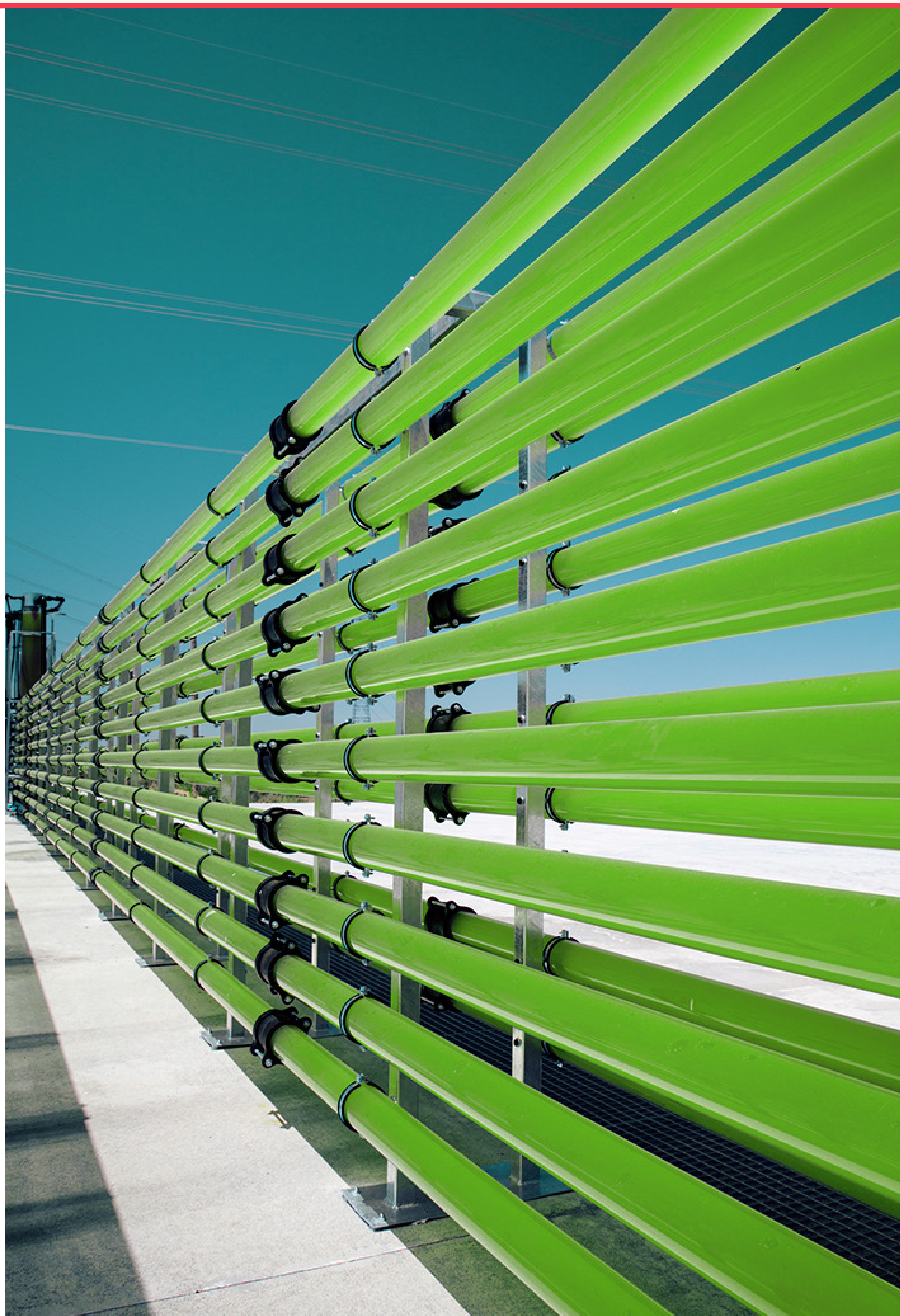
Other countries face a similar CCS deployment scale. In FATR2 we considered Australia's net zero path using the results of the Net Zero Australia study, which requires anywhere between 0.1 and 1 Gt/year[20] of CO_2 sequestration, with the lower value dependent on achieving very challenging levels of domestic renewable energy deployment. While Australia's energy economy is much smaller than that of the US, the country's export-oriented energy industry mostly drives this large CCS requirement.

Despite these national and global projections, however, there is considerable disagreement among academics, industries, NGOs, and policymakers about the role CCS can or should play in a carbon constrained future. Concern about CCS is generally driven by perceptions around high costs and low technical maturity. Additional concerns include health risks to local communities in the event of a CO_2 release, and environmental damage due to CO_2 migration from the subsurface. Some object to CCS on the basis they feel it enables ongoing use of fossil fuels, even an increase in use.

Stakeholder opposition to CCS appears to have grown stronger in recent years as developers look to deploy it at greater scale, particularly in the US, suggesting the emergence of distrust of this technology and those involved.

Trust in people and organizations is especially important when you're collaborating on something new or uncertain.

Harry Warren,
President, CleanGrid Advisors

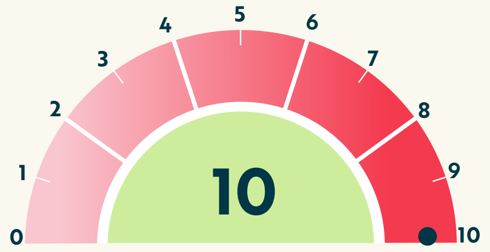


COMMUNITIES, SOCIAL AND ENVIRONMENTAL NGOs

Interviewee:
Kathleen Campbell

Role:
VP, Citizens Against the Heartland Greenway Pipeline

Industry:
NGO, US



How important is trust?

Kathleen:
"In regard to CO_2 pipeline projects; trust is not broken – it was never there to begin with. What little trust there was has gone, eroded through withholding information, no transparency and seemingly to mislead when questioned. People's lives are at risk, their properties likely uninsurable, and developers try to deny it.

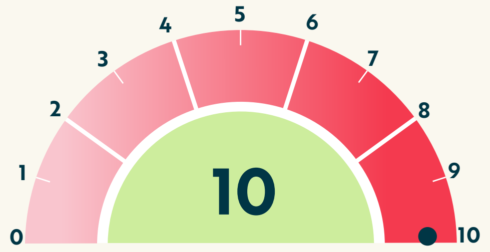
We have to dig to get to the detail, and when you do get there, you find flaws and you then question their experience, expertise and competency. When the community did push back, they had to backtrack and disclose more – suddenly what they had said wasn't an issue, was, so what else are they not telling us? Fighting this is so one sided – the process seems stacked in favor of developers; how can we afford to do plume modeling and hire lawyers to fight often legalistic points for example?

Open disclosure and mandated setbacks, and evidence-based safety processes that people can understand would indicate improving trust. Some landowners are rushing to sign wind and solar farm agreements because of all this – as one way to stop pipeline projects, despite wind and solar opposition building also."

Interviewee:
Richard Stuckey

Role:
Spokesperson, Save our Illinois Land

Industry:
NGO, US



How important is trust?

Richard:
"The developers have made so many blunders trying to convince communities that confidence in them went fast. They could not demonstrate experience designing and installing such pipelines, would not allow people time to truly comment, and signed contracts sealing the deal before disclosing anything to the public. It was simply too late for the public to really influence outcomes.

There have been attempts by developers to push community development proposals for counties to sign, but they restrict the ability to oppose the project. We oppose such as it takes out opposition voices that projects should have. This is one thing that did not lead to a feeling of trust – the feeling of being bought off.

Trust could improve with better regulations, as currently, those that apply for CCS pipelines are deficient. Proper sequencing is critical – understanding the destination point, not just a pipeline to nowhere. Proven models, transparency and open disclosure, very early real engagement and better public access."

Note that this interview was undertaken jointly so is shown in one pullout, though responses are separated to ensure correct attribution.

What is CCS?

CCS involves capturing and purifying CO_2 from an emissions source and compressing it to a supercritical state[21] for transport (usually by pipeline) to a site where it's injected into deep geological formations and permanently sequestered. Figure 13 illustrates this.

The natural gas industry has used carbon capture technology for around a half century to remove CO_2 from saleable methane with this captured CO_2 historically vented to the atmosphere. In the 1970s, mostly in the US, captured CO_2 began to be utilized for enhanced oil recovery (EOR) where it was injected into reservoirs to boost oil production, thus generating commercial benefit[22].

The prospect of deploying CCS as a climate mitigation option first emerged in the 1980s with the introduction of regulatory mechanisms to restrict CO_2 emissions. In countries that established such regulations or otherwise provided sufficient incentives for carbon capture, such as a price on CO_2 and/or capital grants for capture projects, several large-scale projects have been deployed. This includes projects in Norway, North America, the Middle East, and Australia, not associated with EOR.

For CCS to play a role in meeting net zero ambitions, projects will require enabling infrastructure in the form of CO_2 pipelines. As an example, Figure 14 illustrates the physical scale that such linear infrastructure might represent in a middle-of-the-road scenario from Princeton's Net-Zero America study. The scenario involves a network of around 100,000 kilometers of new pipeline ranging in diameter from 6 inches for spur lines from individual point sources to 48 inches for major trunklines to traverse the US.

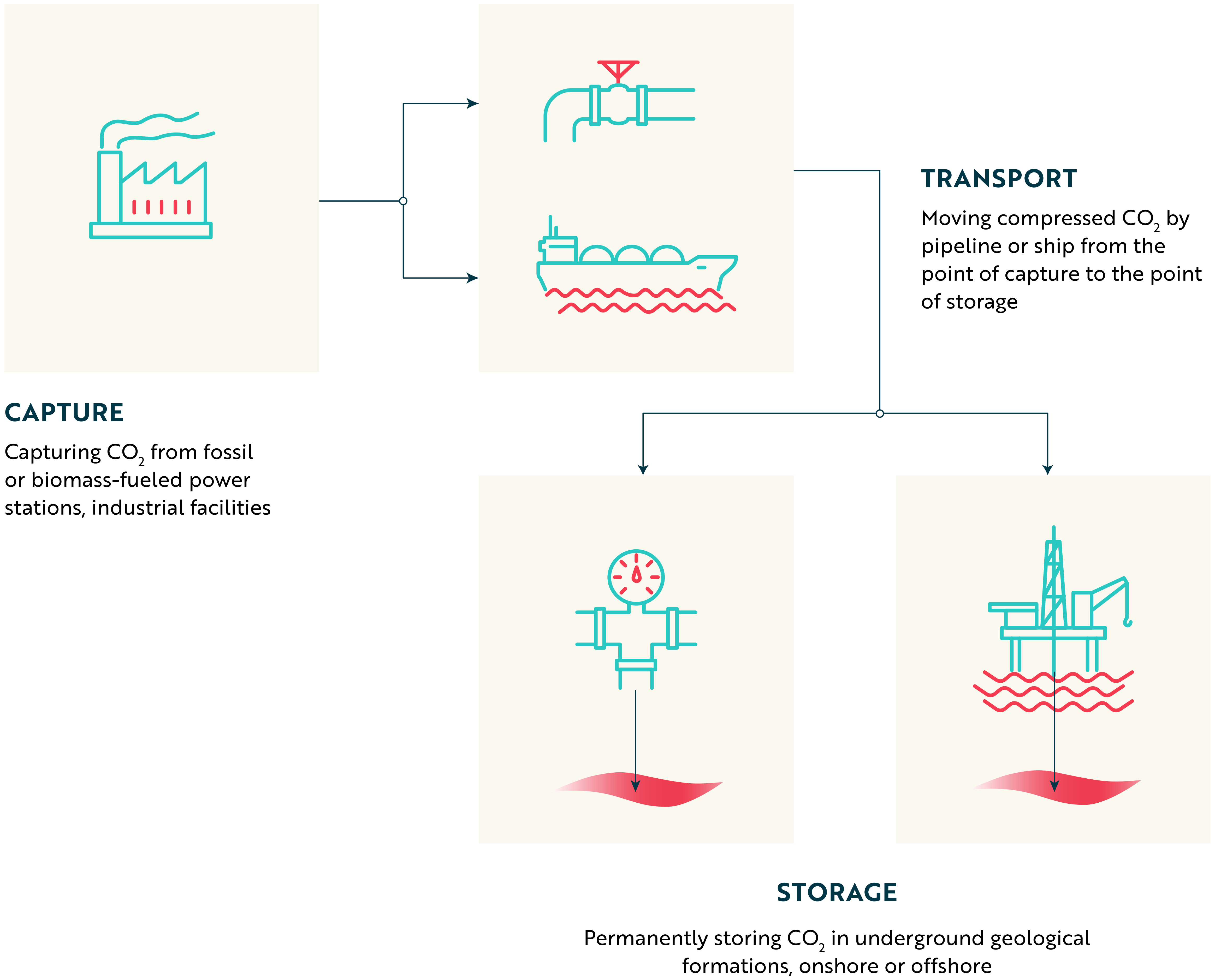


Figure 13 – Basic elements of Carbon Capture and Storage (CCS).

E+ SCENARIO

929 million tCO_2/y 106,000km pipelines
Capital in service: $170B

CO_2 point source type

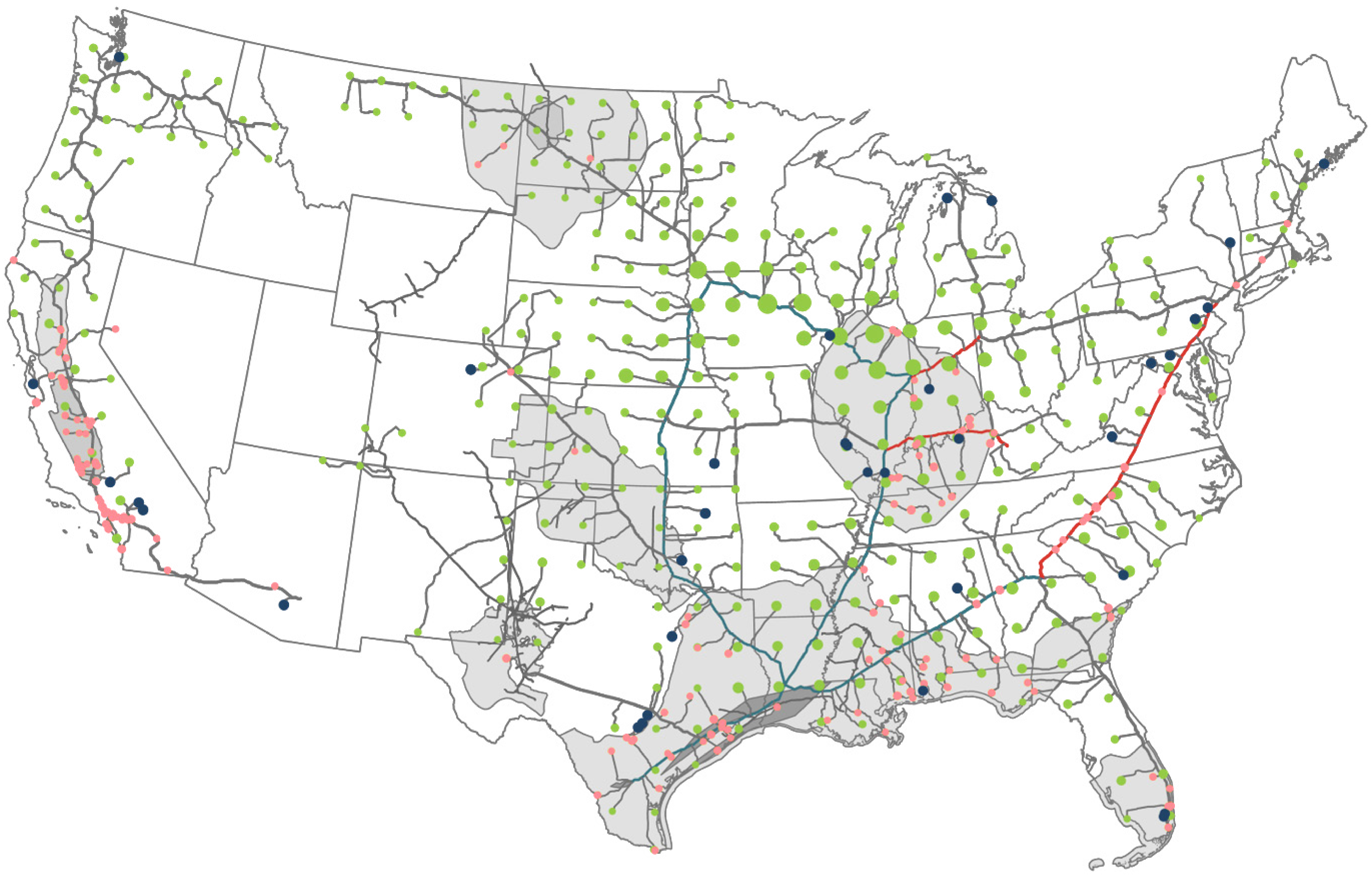
- CO_2 point source
- BECCS - power and fuels
- Cement w/ CCS
- Natural gas power CCS oxyfuel

CO_2 captured (MMTPA)

- 0.0006449
- 7.9144
- 15.8282
- 23.7419

Trunk lines (capacity in MMTPA)

- < 100
- 100 - 200
- > 200



Created by Andrew C. Pascale for Princeton's Net-Zero America study Appendix I: CO_2 Transport and Storage Infrastructure transition analysis.

Figure 14 – Example of the scale of linear infrastructure potentially needed in the US for CCS by 2050, representing over 100,000 km (62,000 miles) of pipelines. From the Net-Zero America study, Princeton University, E+ scenario shown.

CCS progress to date

CCS deployment has fallen far short of the ambitious expectations signaled by a rush of project announcements globally early this century. These projects faced a variety of challenges, including:

- lack of familiarity with CCS technology among owners and operators of emitting facilities
- limited and uncertain policy support
- coordination challenges among multiple stakeholders, both internal and external
- opposition from a variety of stakeholders[23]
- inability to attract capital due to the complex, often first-of-a-kind (FOAK) 'megaproject' nature of many early proposals.

While some CCS projects that have progressed provided valuable lessons, historically most were canceled before they reached the point of final investment decision (FID). At least one project – the Kemper County project in the US state of Mississippi[24] – is widely viewed as a high-profile failure. Costs for this installation exceeded the estimate approved at FID by almost 200%. The project closed in 2017 after being unable to resolve multiple technological challenges, in particular involving coal gasification. Examples like this have created a level of cynicism about CCS among various stakeholders[25].

Where incentives or regulations were clear and commercially sufficient, projects have been completed and are operating today.

This includes Statoil's Sleipner and Snohvit projects in Norway, Archer Daniels Midlands' Decatur project in the US, and Chevron's Gorgon project in Australia. These involve capture at energy and industrial point sources with concentrated CO_2 streams. More recently, in mid-2024, several projects achieved FID in Canada. Projects such as Canada's Boundary Dam and US' Petro Nova capture and store CO_2 emitted from power plants, but operating examples of CCS in power plant applications are rare.

Favorable government policies, such as the Inflation Reduction Act of 2022 (IRA) in the US have boosted prospects for CCS. As have calls for accelerated deployment under the UAE Consensus at COP28. As a result, CCS deployment may be poised to surge. IEA projections[26] suggest that around 50 megatones-per-year (Mt/year) of CO_2 capture will be operating globally by the end of 2024, with 440 Mt/year of CCS capacity either operating, under construction, or in advanced planning by 2030.

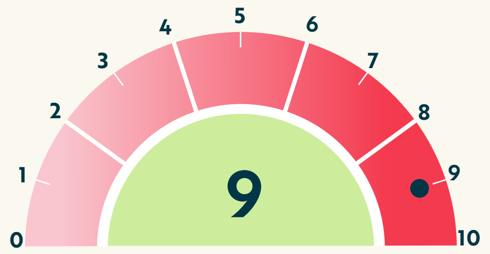
Notwithstanding this more favorable policy environment, in some locations many large CO_2 emitters that will likely rely on CCS are still unfamiliar with the technology and regulatory processes. Supply chains are not prepared for high volumes of projects, and CCS is still not considered bankable by some financial institutions. These challenges, coupled with the stakeholder cynicism noted earlier, present serious headwinds for rapid CCS deployment at scale.

ASSET OWNERS AND PROJECT DEVELOPERS

Interviewee:
Nathan Morgan

Role:
CEO, Kellas Midstream

Industry:
Gas and low emissions H_2, UK



How important is trust?

"Trust is critical. In blue hydrogen there are several moving parts in an emerging value chain and industry players need to act in unison and trust that the others align. That type of collaboration requires high levels of trust.

Sometimes trust is damaged – for example, sudden policy changes or failure to deliver policies in a previously communicated timeframe, can undermine investor confidence.

In some communities, we also see significant opposition to hydrogen blending trials, as people are unsure of the safety aspects. Trust in new technology that will probably be installed into people's homes will naturally need to build in time.

There is a certain deficit of trust around traditional oil and gas players as they are not considered 'purists' – and CCS is also viewed with scepticism by some.

Trust improves when things unlock – you see it when niche projects kind of 'click' into place, often where value chains are already integrated and there are existing relationships between players.

Ultimately, to negotiate successful agreements in these emerging value chains requires trust across a wide range of stakeholders that may be encountering each other for the first time."

The outlook for CCS in the US

A surge in CCS project announcements has occurred in the US, driven by the IRA and the 2021 Bipartisan Infrastructure Law, which incentivize qualifying CCS projects through performance-based tax credits and capital grants, respectively. Of projects that are expected to reach FID in 2024, around 30% are US-based, and most are in an advanced development phase[27]. Other than for higher-concentration CO_2 emitters such as ethanol producers, however, current incentives remain insufficient for many CCS projects to be commercially viable.

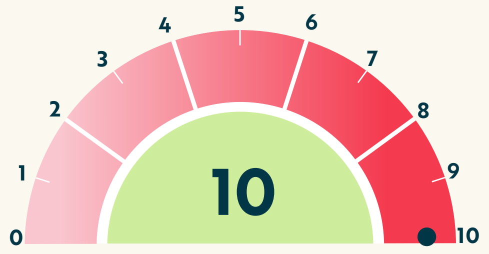
Supporting regulations are also being established, but regulatory gaps and uncertainties remain around both pipeline and CO_2 storage investments[28]. Combined with rising stakeholder opposition, often motivated by environmental and social concerns, these challenges could stymie deployment at scale. Multi-billion-dollar projects such as Navigator[29], which proposed to develop thousands of miles of CO_2 pipeline infrastructure, have been canceled by proponents recently, and others could be facing similar risks.

The industry must overcome these barriers for CCS to achieve the ambitious deployment levels projected in Princeton's Net-Zero America study. And to do this, we need trust.

ASSET OWNERS AND PROJECT DEVELOPERS

Interviewee:
SME with 20 years international CCS experience (note this interviewee wished to remain anonymous)

Industry:
Energy production and supply, Global



How important is trust?

"Trust is critical to CCS projects and one area where we lack it is with communities. This is influenced by where they get information, and the level of climate change education, but there is a level of mistrust already in the US – other countries, like the UK, have done a better job with communities I think.

There can be a lack of trust from the project development and finance communities, and in governments to provide sufficient incentives across the duration of a project. CCS has few proof points, and there's generally a perception of high risk and costs.

Oil and gas companies have not really dealt with public perception well for decades and can suffer from mistrust around CCS projects. They are perceived to be the villains, and CCS a means of continuing production. In their historic communities they do well, but outside these, there's a lot of work to do.

A deficit of trust leads to higher costs and delays. CCS projects have passed FID but just couldn't overcome public mistrust and gain permits. Also, trust that the technology will work, and trust in adoption rates, are all important.

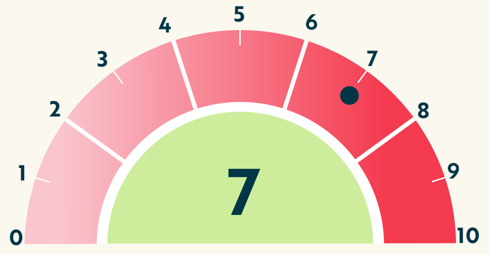
We are seeing project financing in CCS, which signals increasing trust. Other indicators would be projects getting to FID, and especially COD, and faster – and increasing geographic diversity. Not sure about public sentiment, as it's pretty low now and hard to measure. Despite this, I still think the US market-based approach will drive significant CCS volumes."

BANKS, INVESTORS AND INSURERS

Interviewee:
Kash Burchett

Role:
Global Head of Carbon Removal Technologies, HSBC

Industry:
Finance, Global



How important is trust?

"Neo-institutional theory says that trust in institutions to protect individual rights drives economic growth – you can trust that hard earnt benefits won't be taken away. I think this underpins a lot of societal interactions, so trust is important economically.

From the standpoint of a bank, institutions serve as a trust engine – you don't need to have an existing relationship with a company because there's recourse available through those institutions. At the same time, you can never eliminate risk – simply move it around. In CCS, you might be confident that a technology works at a given strike price but to invest, you need to trust the government not to alter the regulatory mechanisms enabling that strike price. So, institutions enable multiple parties to operate but only when they trust the institutions underpinning those relationships.

Rightly or wrongly some firms face a deficit of trust, and in a few cases this is creating bottlenecks. This is undeniably a challenge for the CCS industry. A deficit of trust slows things down and at worst can derail a project. Negotiations take longer, even when you end up with similar contracting end positions. The "what ifs" require more thinking, more work, more time – you can't assume that common sense will prevail, so every scenario has to be poured over in detail.

But ultimately banks are very good at overcoming a deficit of trust – in the end, it's our job to come up with mechanisms which mitigate that risk and enable investment."

New research on CCS and trust in the US

In early 2024, Princeton conducted a pulse survey (CCS pulse survey), which explored attitudes about CCS in the US. The survey collected over 4,200 responses, representing three types of stakeholders:

- General public – demographically representative sample of people living in the US (45%)
- Local public – people who live near a CCS project in the US, targeted by zip code (45%)
- CCS professionals – people in the US who work on CCS in some way (10%).

The breakdown of respondents is shown in Figure 15.

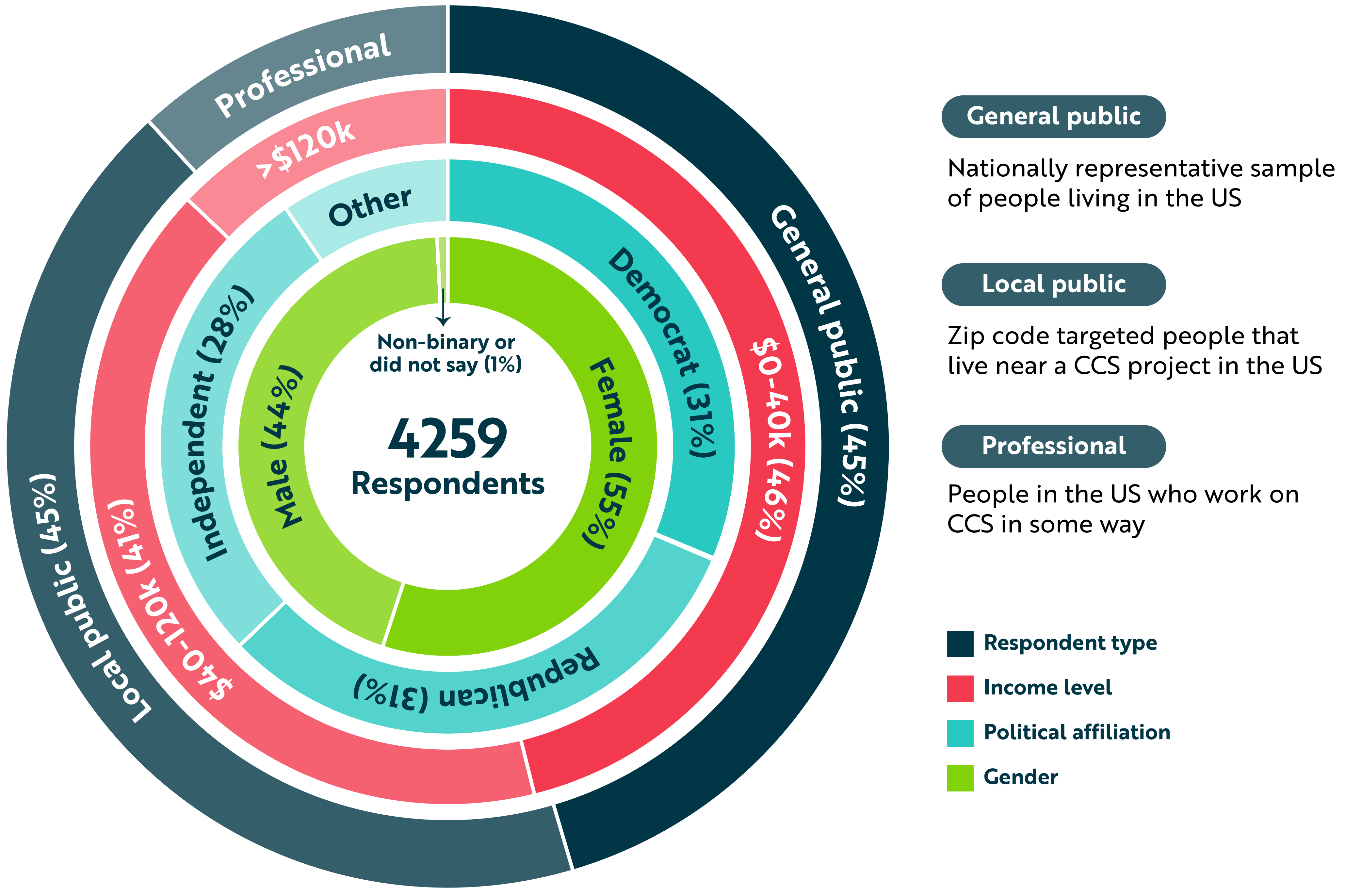


Figure 15 – Breakdown of the CCS pulse survey respondents.

When asked whether most people can be trusted, the majority of respondents showed caution (Figure 16), with professionals most trusting and those close to CCS projects least. Respondents are, on average, more risk averse than risk seeking, across all stakeholder types.

QUESTION:
Can most people be trusted?

QUESTION:
What is your general attitude to risk?

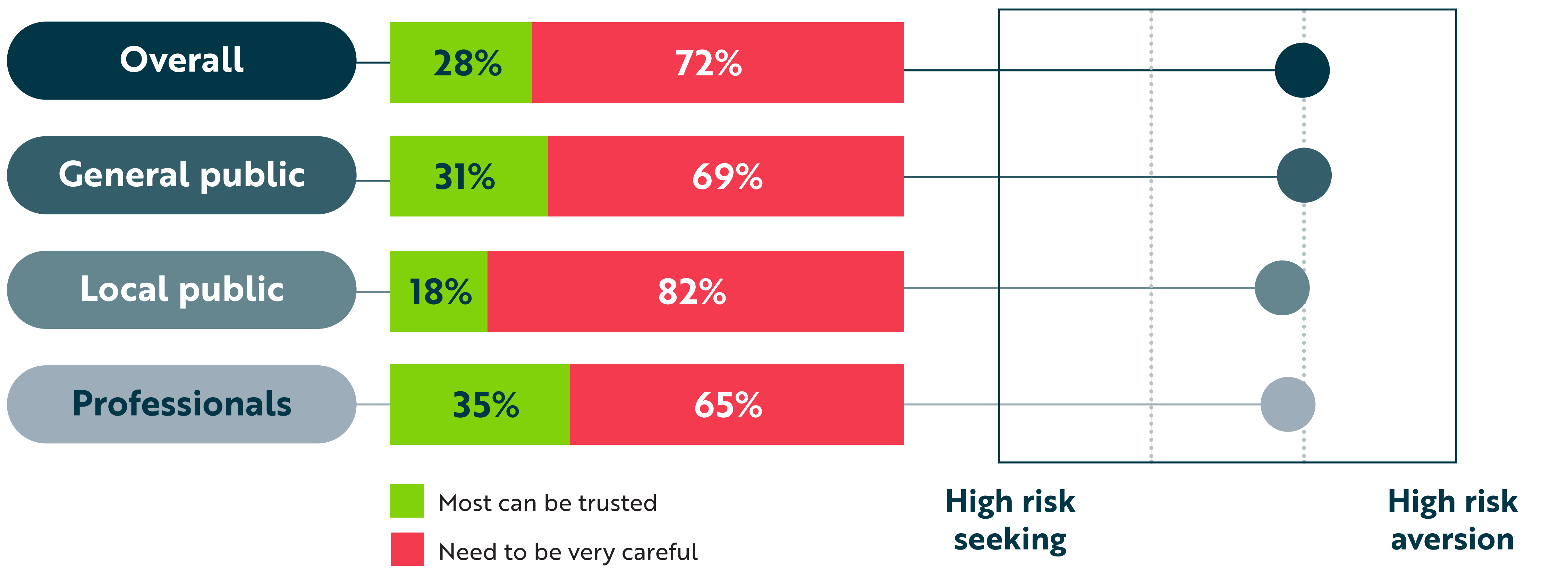


Figure 16 – General respondent attitudes to trust and risk, from CCS pulse survey.

Results showed the public's knowledge of CCS is low (Figure 17), with 28% of respondents across each public sample having heard of the technology and 17% knowing of a specific CCS project. This is likely not driven by apathy about climate change, as the public samples report 'moderate' worry about global warming but may be the industry's relative nascency and suggests leaders should carefully consider public education as CCS scales up.

There are important differences in how stakeholder types perceive CCS risks and benefits (Figure 18). The professional sample is more willing to live near a CCS project and perceived higher associated benefits. The local public – those living near a proposed project – perceived a higher level of risk than both the general public and the professional sample.

When asked how precisely risks associated with CCS are known to those impacted, the professionals report higher precision than the public reports (Figure 18). When compared to the local public, professionals also think that the risks associated with CCS are more common – that is, are the type that people have learned to live with. This indicates a potential area where communication should be improved between project developers and local communities.

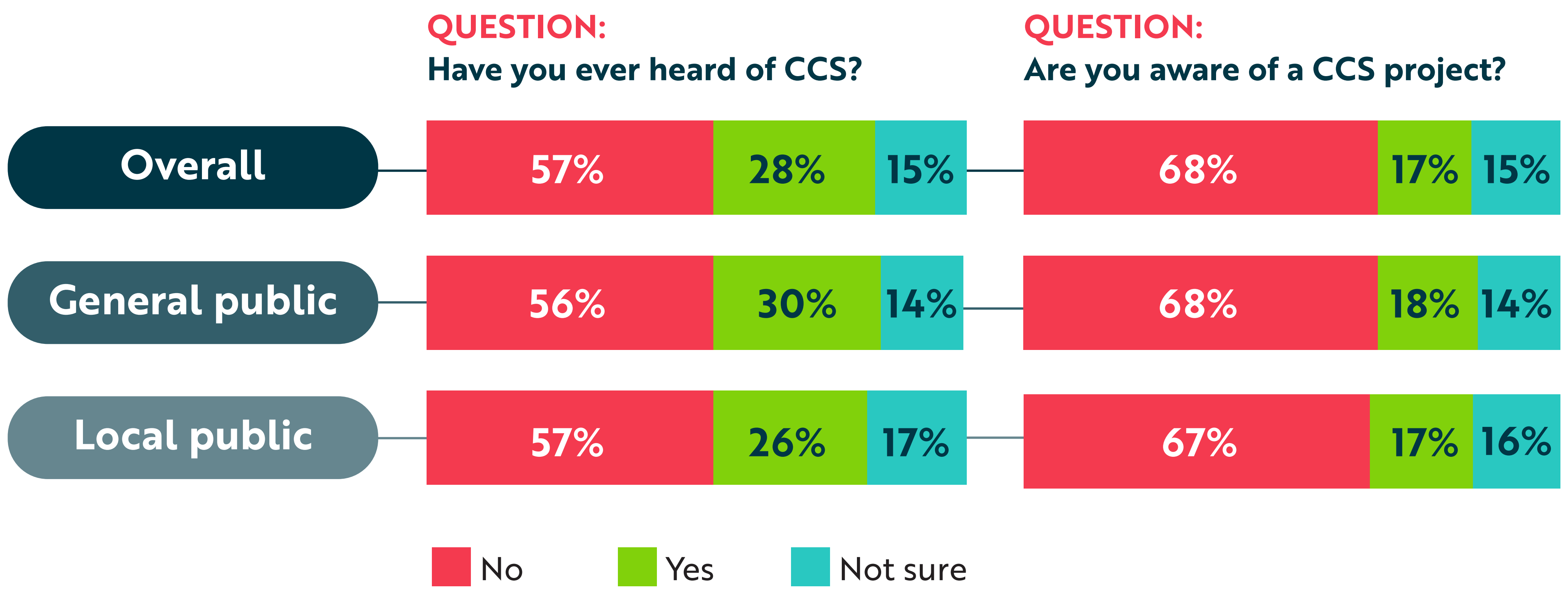


Figure 17 – Public knowledge of CCS, from CCS pulse survey.

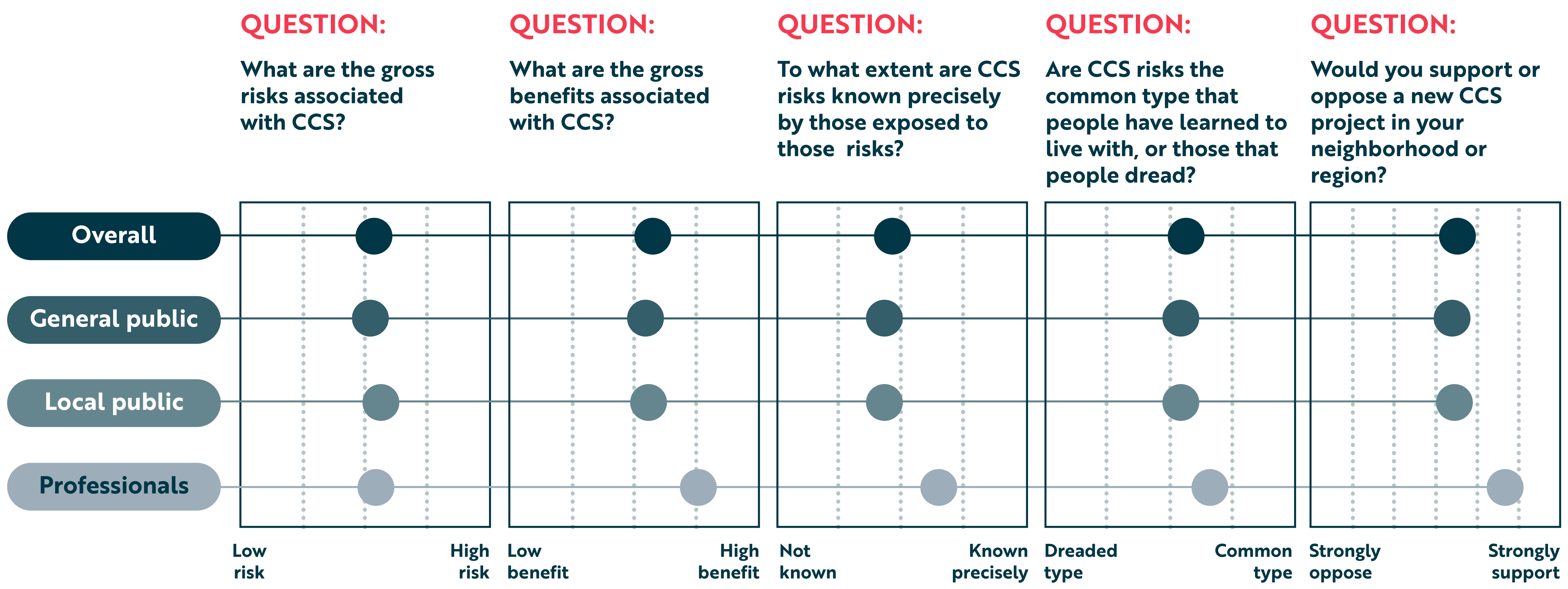
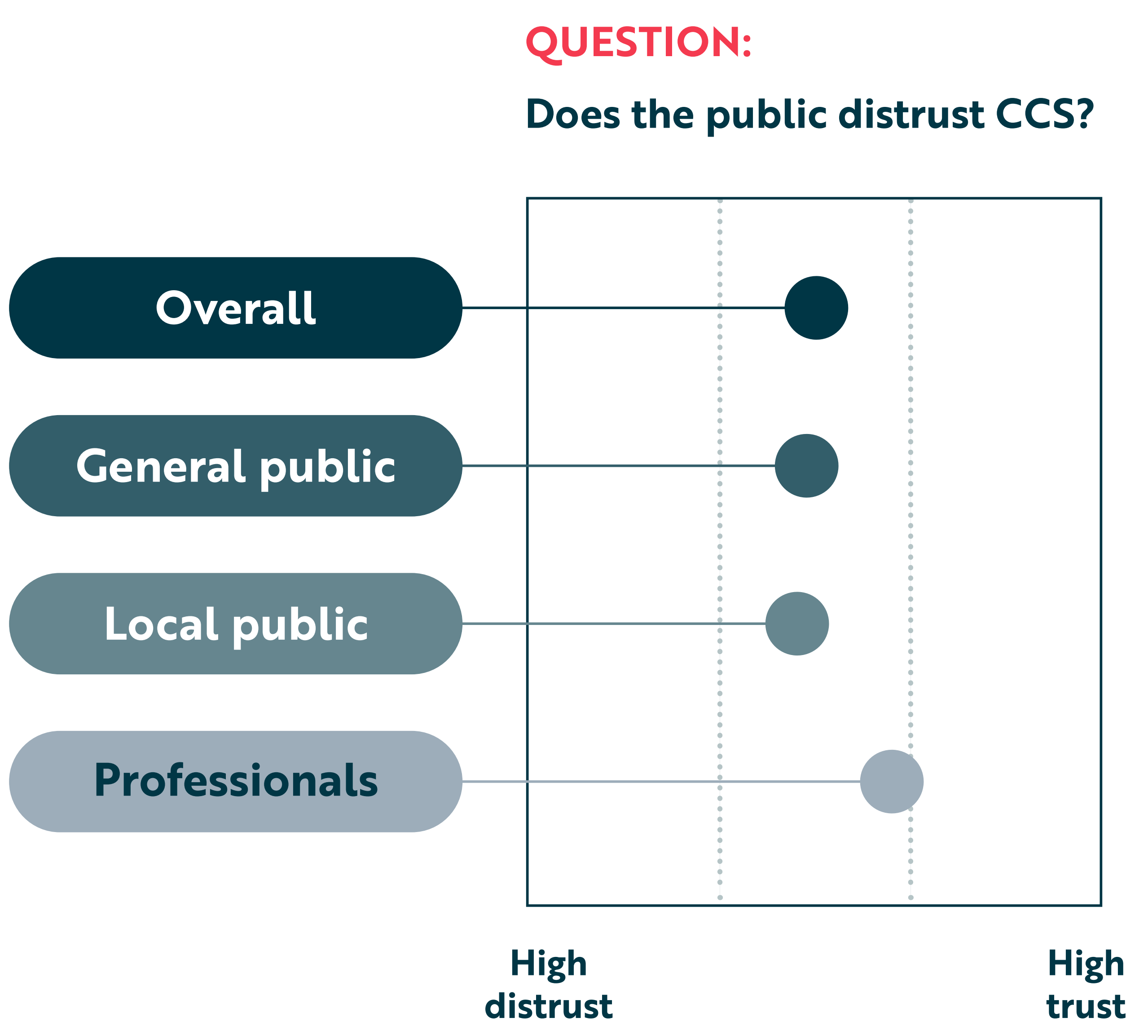


Figure 18 – Perceptions of CCS risks and benefits, from CCS pulse survey.

In response to the question 'Does the public trust CCS?', responses indicate a lack of trust but not distrust (Figure 19). Professionals perceive higher public trust than does the public, which suggests that the public may be less trusting of CCS than professionals think.

When asked about reasons for public distrust in CCS, all respondent groups ranked distrust in government regulations and corporate leadership highest, followed by distrust in CCS technology and unjust impacts on communities.

Concerns about facilitating continued fossil fuel use ranked lowest as a perceived basis for public distrust.



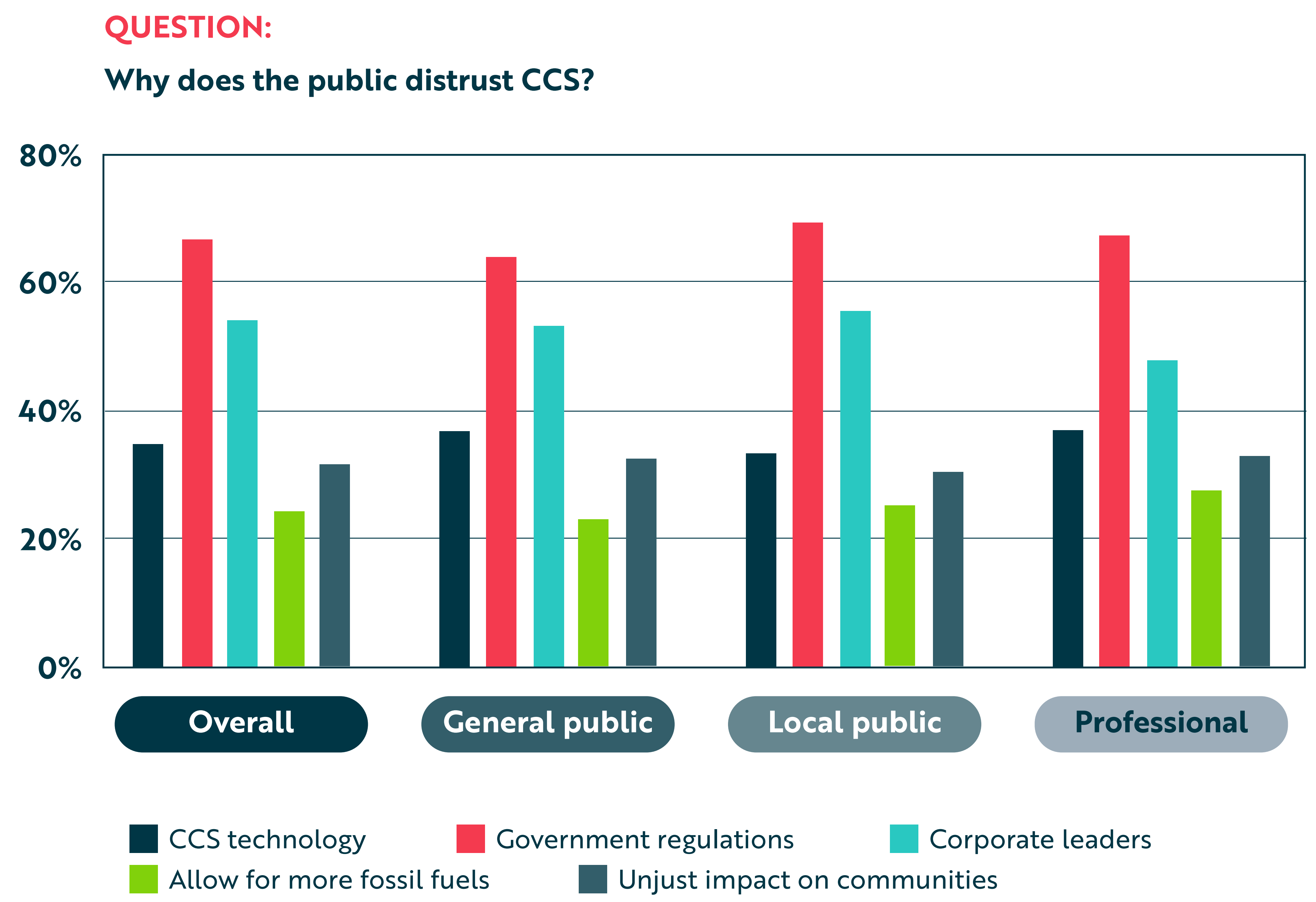


Figure 19 – Public distrust of CCS, from CCS pulse survey. Graph to right only includes responses from respondents who perceive a level of public distrust in CCS.

Participants were asked about their trust in different types of organizations—this was operationalized as confidence in an organization to operate, execute, and communicate about CCS projects, with results shown in Figure 20. Consistently, environmental organizations are trusted most and the media is trusted least.

CCS project developers/owners were ranked neutral by both the public and local populations, while professionals ranked all organizations more highly than the public did, perhaps a result of more experience with a specific CCS project.

QUESTION:

How much confidence do you have in these organizations to execute, run and communicate about CCS?

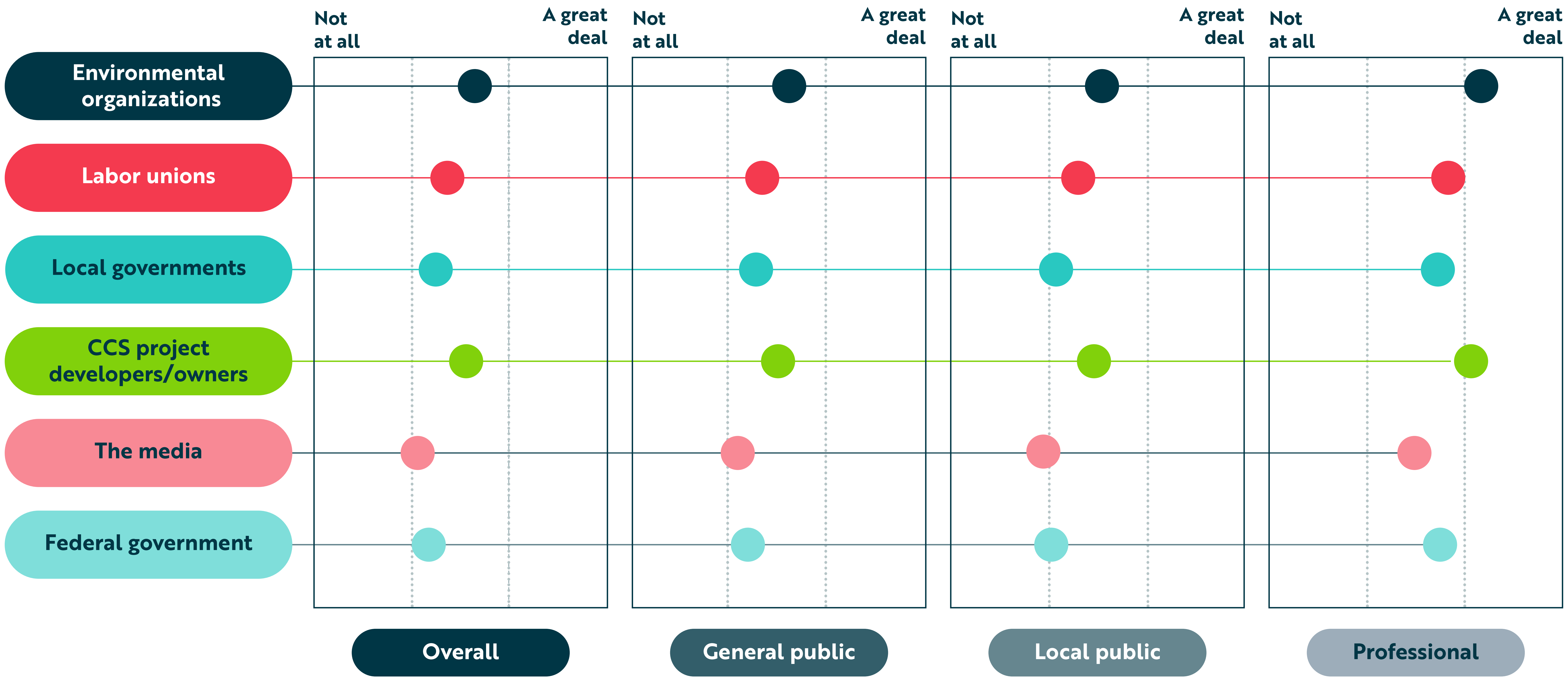


Figure 20 – Trust in different organizations, from CCS pulse survey.

Professionals showed a moderately high level of comfort in the notion/concept of sharing information that is outside of a specific legal agreement (Figure 21). 76% of professionals are comfortable sharing with others working on the same project and 69% would share information with those on a different project.

For most respondents, such sharing was not thought to lead to a disadvantage, although more than half surveyed were skeptical of information provided by others.

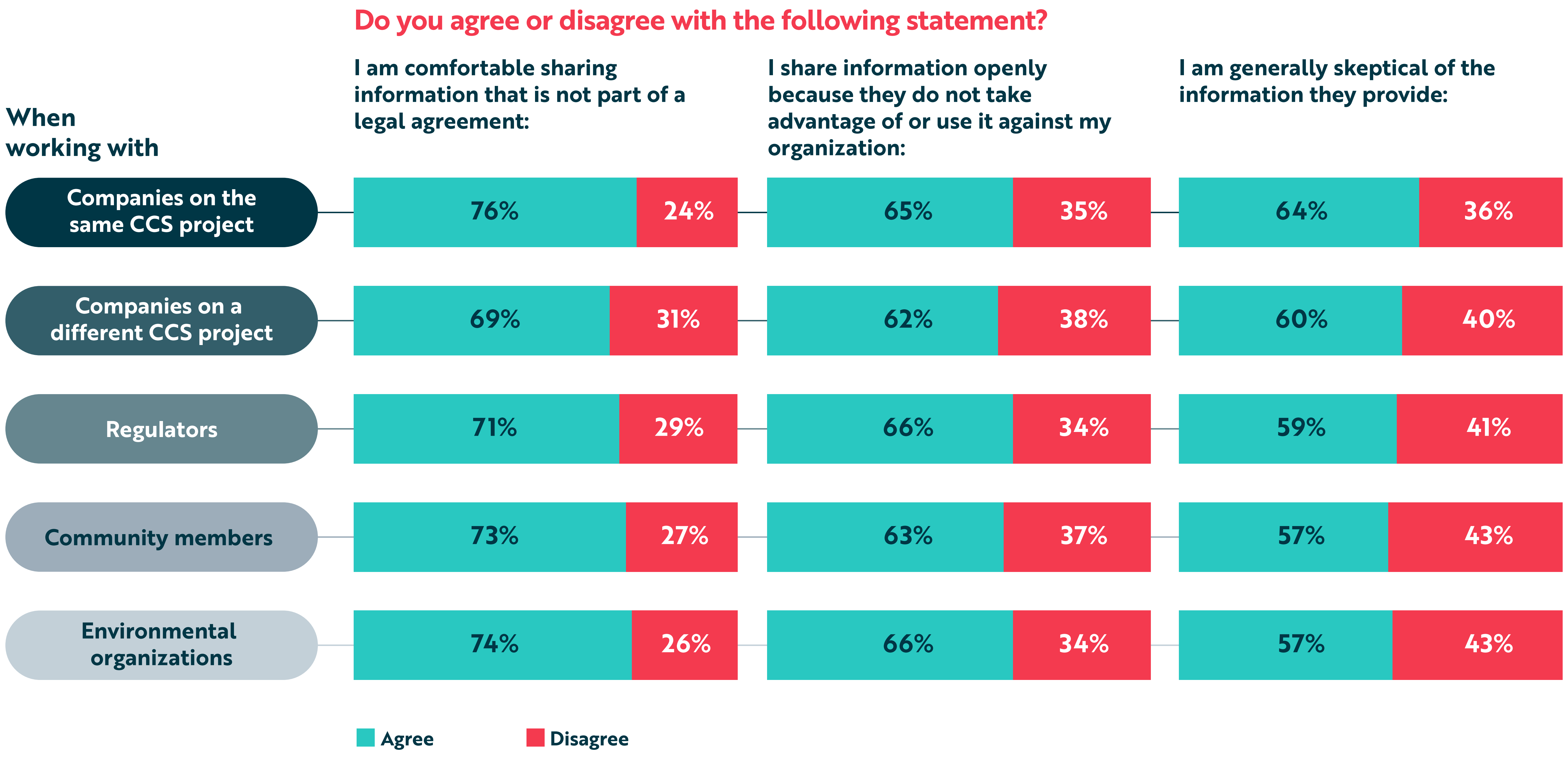


Figure 21 – Response by professionals to sharing information, from CCS pulse survey.

An uncertain pathway for CCS deployment in the US

The US CCS enterprise may be poised for high growth and there is some positive news for the industry in the CCS pulse survey findings. However, the data suggests that the future may be more precarious.

The industry will need to proceed with a high degree of sensitivity to the concerns of stakeholders, most of whom are generally mistrusting, risk averse, and cautious. Significant opposition to recent projects is indicative of a deficit of trust, which, if not remedied, could stall deployment, particularly critical enabling pipelines, severely impacting the CCS industry and ultimately the ability of the world's largest economy to reach net zero.

The public's lack of knowledge, skepticism about, and perception of risks associated with CCS call for increased emphasis on providing clear, consistent, and reliable information, along with much greater levels of transparency. Here, just who fills that information gap is important, as the ability to influence will be impacted by trust, credibility, demonstrable experience, and relevance. In the absence of this from respected CCS experts, the opportunity for actors to undermine CCS with an alternative view is high.

Embedded in the CCS pulse survey was an information intervention that provided participants with a broadly accessible CCS introduction. Results suggest that the intervention improved acceptance of CCS and perception of benefits and decreased perceived risks, implying that early, authentic engagement with host communities and other stakeholders will help underpin the trust needed to accelerate deployment[30]. Similar research supports the positive influence that good information can have[31].

There is evidence that those working in the CCS industry assume a greater level of public trust in CCS than exists and that their efforts may be misaligned as a result. It is also likely that CCS proponents will need to be willing to subject themselves to higher levels of independent scrutiny to build trust – for some participants, this may be a significant cultural challenge.

There is also evidence from survey results and interviews that certain incumbents are burdened by a serious deficit of trust, particularly corporate leaders and specifically the fossil fuel industry. Their ability to rebuild trust may, as a result, rest on even higher standards of transparency, scrutiny, and possibly regulation. For many, this will be a new frontier.

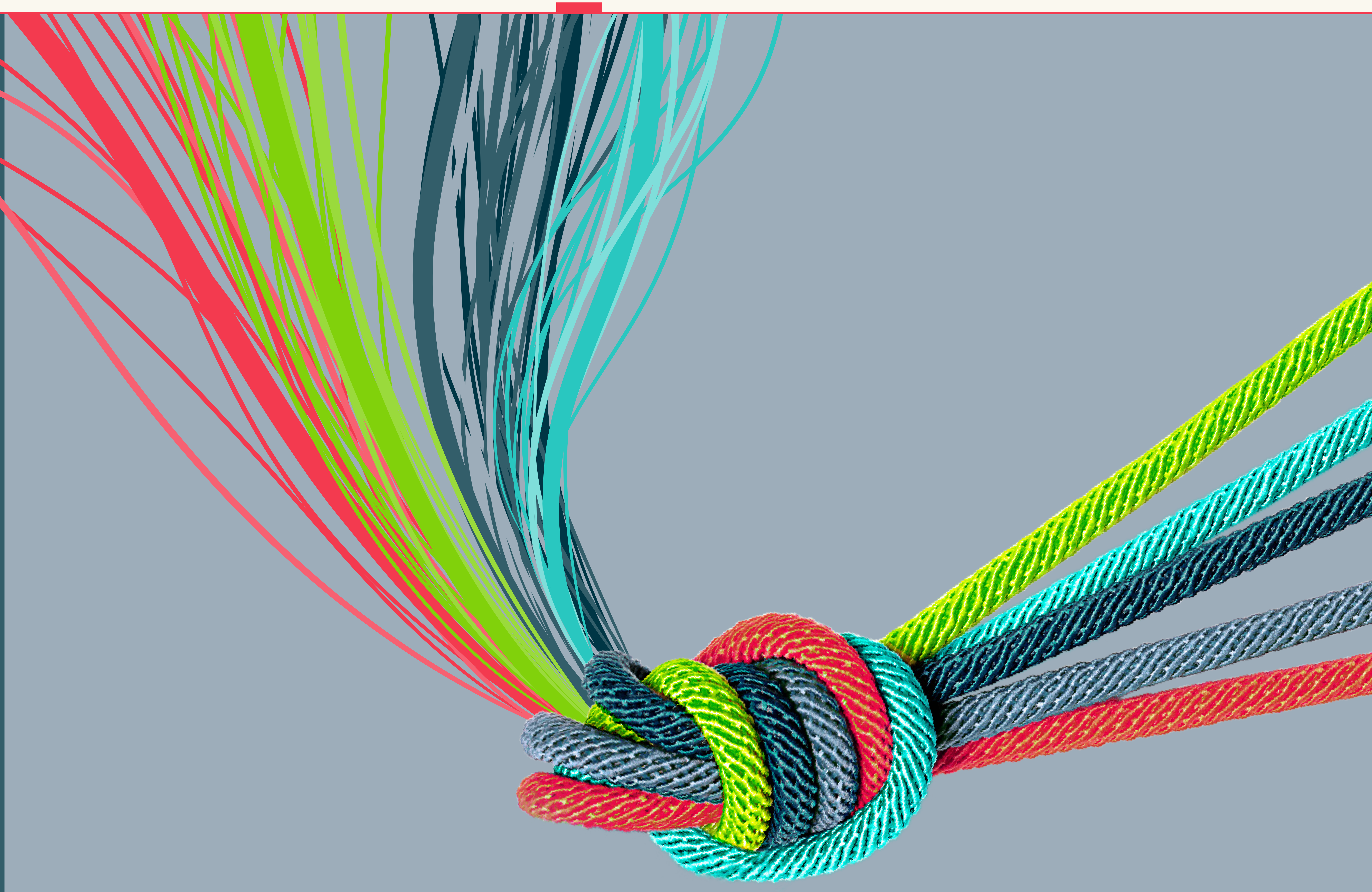
Trust in governments and the media has also declined in recent years[32]. Trust in environmental organizations is higher, although as noted earlier, some NGOs oppose CCS and do not see it as a legitimate tool for decarbonization. Many members of the public will look to such organizations for information, so restoring trust with environmental NGOs presents an important but daunting industry challenge.

Participants involved must work hard to build trust in CCS for it to reach its potential in the US. The same could be said for CCS in other regions, and indeed for other technologies. While some challenges are specific to CCS, most types of net zero infrastructure will face similar hurdles as projects become larger, deployment accelerates, and pressure builds on participant interfaces.

Chapter 5 explores what it might take to build and leverage the durable trust needed to enable net zero infrastructure delivery, including CCS, at the scale and speed the world needs.

CHAPTER 5

Towards durable trust



Leveraging the power of trust

We believe trust is a key factor in the adoption of our FATR shifts and in the world's ability to drive net zero infrastructure delivery at unprecedented scale and speed. Deep and enduring trust among stakeholders (writ large) will help turn global net zero ambitions into reality.

Our work finds that a current deficit of trust, if not addressed, is likely to slow the achievement of net zero. For example, a distrust in fossil fuel companies among certain landowners, communities, environmentalists, policymakers, and other special interest groups is hindering efforts to develop CCS projects and related infrastructure.

Issues around trust are not unique to the fossil fuel industry or CCS infrastructure of course. Opposition from landowners and communities has also been holding back the deployment of electricity transmission infrastructure, as well as wind, solar, and bioenergy projects[33].

Could opposition to other climate-friendly technologies also relate to stakeholder trust, and what are the reasons for a deficit of trust in these cases?

> **Trust is critical. In blue hydrogen there are several moving parts in an emerging value chain and industry players need to act in unison and trust that the others align. That type of collaboration requires high levels of trust.**
>
> **Nathan Morgan,**
> CEO, Kellas Midstream

Given the net zero infrastructure delivery challenges outlined in our FATR papers, establishing and/or restoring trust across the energy transition ecosystem in ways that are effective, widespread, systemic, and beneficial for the broad array of infrastructure participants, is urgent. But what this paper has shown is that developing trust across the delivery landscape can be a nuanced, complex, and challenging task – and one that is poorly understood.

Many are talking about trust but when it comes to building the assets of net zero, few understand how trust can be built, maintained, and leveraged to get the job done. So, we conclude this paper with a path to help achieve just that.

Building a framework for durable trust

Trust is neither a simple nor singular notion. The path to durable trust in an infrastructure delivery situation will depend on initial states, which determine whether the mission at hand involves the creation, maintenance, or restoration of trust.

The path will also be influenced by historical experiences, and commercial, political, and social norms which can be difficult to shift but will impact the timescales for establishing durable trust. Efforts to accelerate the net zero transition could lead to unintended social, economic, and/or environmental consequences, which could further erode trust and jeopardize the effectiveness of climate response.

To create the conditions for durable trust, strategies and practices must be tailored to different geographic, cultural, and socioeconomic settings. They may also need to be customized for different technologies and types of infrastructure. For example, delivering linear infrastructure like transmission and pipelines will be different from developing land-use intensive assets like wind generation and bioenergy, and different again from building complex industrial megaprojects.

To develop a deeper understanding of these issues and identify frameworks that could support durable trust among net zero stakeholders, Worley is supporting a new research program at Princeton titled **Net Zero Infrastructure at the Speed of Trust.** This research will examine definitions of trust from various disciplines and perspectives – economics, moral philosophy, religion, sociology, political science, and psychology – to synthesize definitions of justice and fairness, and develop insights on the creation, re-establishment, and maintenance of trust.

Future research will build on the initial work described in this paper and characterize a broad range of trust relationships between infrastructure participants. It will consider models for enabling net zero infrastructure development in ways that engage public leadership, private enterprise, communities, and special interest groups to overcome reticence and drive action while safeguarding participants' interests and ensuring compliance with laws and regulations.

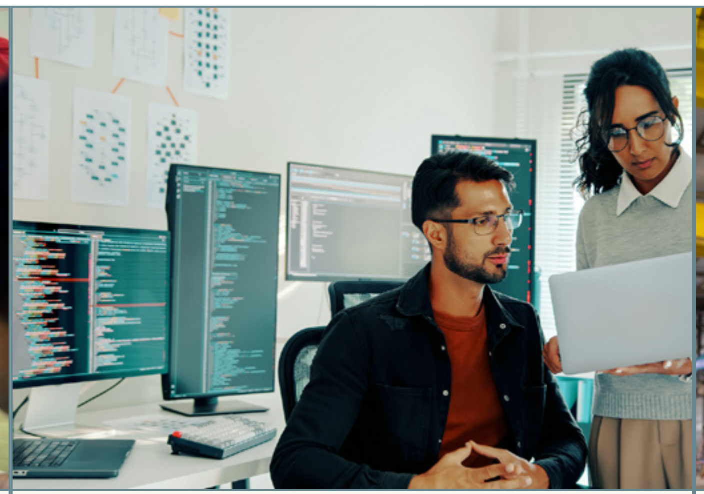
Four key pillars – engagement, transparency, alignment, and adaptability – are already emerging as part of a framework for supporting durable trust in the net zero transition (Figure 22).

PILLAR 1

ENGAGEMENT

Between participants that is authentic, inclusive, sensitive, respectful and enduring

PILLAR 2



TRANSPARENCY

Comprehensive information sharing and verification

PILLAR 3

ALIGNMENT

Participatory decision-making and widespread sharing of benefits and risks

PILLAR 4

ADAPTABILITY

In recognition of cultural, historical, legal, commercial and political nuances

Figure 22 – Four key pillars of an emerging framework for building durable trust.

Conceptually we envisage a kind of ethical infrastructure to help widespread, consistent, and systemic adoption of these four pillars of trust across all participants. We intend the reference to ethical infrastructure to reflect the characteristics of reliability, safety, and durability needed for successful physical infrastructure.

Further, we envisage a governance framework built around multi-stakeholder coalitions such as those used to facilitate market formation and transformation in the pharmaceutical industry, which has dramatically accelerated access to improved healthcare globally[34]. This approach also aligns with Princeton's vision in Mission net-zero America[35], which looked to the formation of stakeholder coalitions composed of landowners, local community organizations, environmental groups, asset operators, investors and banks, engineering firms, original equipment manufacturers, contractors, and others to develop large-scale decarbonization hubs.

Such coalitions would collaborate on design and siting decisions, and systematic assessment and mitigation of risks. They would associate under arrangements that mandate transparency and knowledge sharing. These arrangements would also provide guard rails to limit losses and prevent windfall profits. They also stipulate equitable sharing among all participants – both rewards for exceptional performance and losses for poor performance – giving the whole coalition a stake in success. These kinds of market shaping initiatives may be the next phase, beyond government climate-related policies, to drive faster deployment of decarbonization projects.

Building an ethical infrastructure will be challenging – like achieving net zero scale and speed in infrastructure delivery, it requires a new paradigm. Further research will also explore the links between trust and the FATR shifts, with a focus on driving tangible actions based on the responses that emerge. Our research plan (Figure 22) has several key deliverables, and we will be seeking involvement from infrastructure participants.

Deliverable	1	2	3	4	5
Research goal	**Build the conceptual framework**	**Identify a trust index**	**Engage infrastructure stakeholders**	**Invitation only summit**	**Disseminate results**
Research goal					
What this means	Build the framework for a proposed 'Infrastructure for Trust'. Explore hypotheses around 4 proposed pillars (and/or others) of this infrastructure that create the conditions for establishing and sustaining enduring trust: • Engagement • Alignment • Adaptability • Transparency. Integrate alternative typologies of trust by different academic disciplines: sociology, psychology, economics, business, ethics, religion.	Develop a multidimensional trust index sensitive to differences in types of trust between different stakeholders. Test these metrics through engagement with disciplinary experts and non-expert stakeholders. Propose changes in practices that build trust and metrics that signal changes in trust. Identify signals of growth or decline in trust and track those via the annual Princeton Net-Zero Stakeholder Survey.	Conduct workshops and other engagement activities with stakeholders in the 'Infrastructure for Trust': energy company owners and employees, financiers, project developers, EPC contractors, and consulting firms; and representatives from community groups, NGOs, labor organizations, educators, regulators, and policymakers. These will be designed to extract perspectives, and test/adjust hypotheses from 1 and 2, under conditions of either cooperation or confrontation.	Invitation only event for senior leaders representing government, corporates, academia, NGOs, and other special interest groups. Presentation and discussion of an 'Infrastructure for Trust' proposal, with active feedback elicitation and recruitment of participants for future case studies.	Princeton is committed to publishing its findings in leading peer-reviewed academic journals, along with stakeholder-facing, policy-relevant white papers. Princeton and Worley will synthesize research findings in future industry-relevant articles and outreach as part of our From Ambition to Reality thought leadership series.
Commitment timetable	2024	2025			

Figure 23 – The Net Zero Infrastructure at the Speed of Trust research goals and timetable.

Committed to the FATR path

In Addendum 2 we outline our progress against commitments we made in FATR3 to help build momentum behind FATR shift adoption by 2030. These activities provided the impetus for our focus on trust in this paper and our next phase of research.

We also continue to look for real, tangible actions behind our FATR work. One example is the creation of a guide to sharing value with communities, which is emerging as one of the most significant issues around net zero infrastructure. The guide, a precis of which is included in Addendum 3, outlines a recommended approach to community involvement in which a central tenet is building trust.

We will continue to encourage the adoption of the FATR shifts and pursue related research, host and attend forums to share information and learnings and foster open and honest dialogue around the challenges decarbonization brings with peers, industry partners, governments, and other stakeholders.

In the immediate term, our focus will be on trust, as reflected in our updated FATR Framework (Figure 17). The steps we identified for 2024 remain relevant and serve as a reminder of our challenge to all participants: Take the steps needed with us, as we cannot advance paradigm change alone.

		2023	Steps for 2024	2024	Focus for 2025 Net Zero Infrastructure at the Speed of Trust research	2026	2030
Broadening value	Environmental and social representation ESG selection criteria Value shared across broader stakeholders	High-Medium	**FATR Initiative 1** Facilitate transparency and information sharing	High-Medium	**1** Build the conceptual framework	• Contributing to broader ESG goals • Scorecards with ESG goals • Value added to communities, not subtracted	• Accountable for project success • ESG equality weighted with financial objectives • Community equity
Enabling options	Technology investment Breadth of technology options Intellectual property	Medium	**FATR Initiative 2** Build leading practice guidelines	Medium	**2** Identify a trust index	• Capital moving to early-stage technology development and first movers • Increased number of diverse technologies in early development • Shared among collaborative partners	• First-of-a-kind technologies deployed at record rates required for net zero transitions • Order of magnitude greater technologies at all technology commercial readiness levels • Shared publicly and between countries
Standardization	Standard and modular designs Supply chain orders Project timelines	High	**FATR Initiative 3** Establish consistent terminology and narratives	High-Medium	**3** Engage infrastructure stakeholders	• Modularization becoming more widely used • Investments made to ready supply chains • Projects meeting schedules and some setting new benchmarks	• Standards and standardized designs are widespread even in complex industries • Governments underwriting supply chains for pre-manufacture, lead times <6 months for complex equipment • Continuous improvements on schedule benchmarks
Create partnerships	Transparency Participation and collaboration Risk sharing	High-Medium	**FATR Initiative 4** Expedite the workforce needed	High-Medium	**4** Invitation only summit	• Development of online performance data access platforms • New partnership models forming • New risk/reward models emerging	• Public access to the performance data • Shared ownership and open collaboration • Risk/reward evenly and appropriately distributed
The digital accelerant	Digital modeling Digital systems Digital personnel	High-Medium	**FATR Initiative 5** Convene coalitions for standardization	High-Medium	**5** Disseminate results	• Digital project progression cradle-to-grave has been achieved • Standard digital systems emerging • Digital strategies being implemented on projects	• Assets delivered and data openly available across trusted digital platforms • Assets connected through common systems • Digital considered a core integrated discipline

Figure 24 – Our updated FATR Framework. The qualitative results have been discarded and the 2023 results have been updated based on detailed 2023 survey results. Results for 2024 remain preliminary.

A virtuous cycle

Trust is not simple. It's challenging to define, even more challenging to create or rebuild, and easy to lose. Trust, however, holds a key to meeting the massive infrastructure challenge that climate change presents. Developing guidance for practical ways to build, maintain, and leverage trust among participants in the task of infrastructure delivery is now our focus.

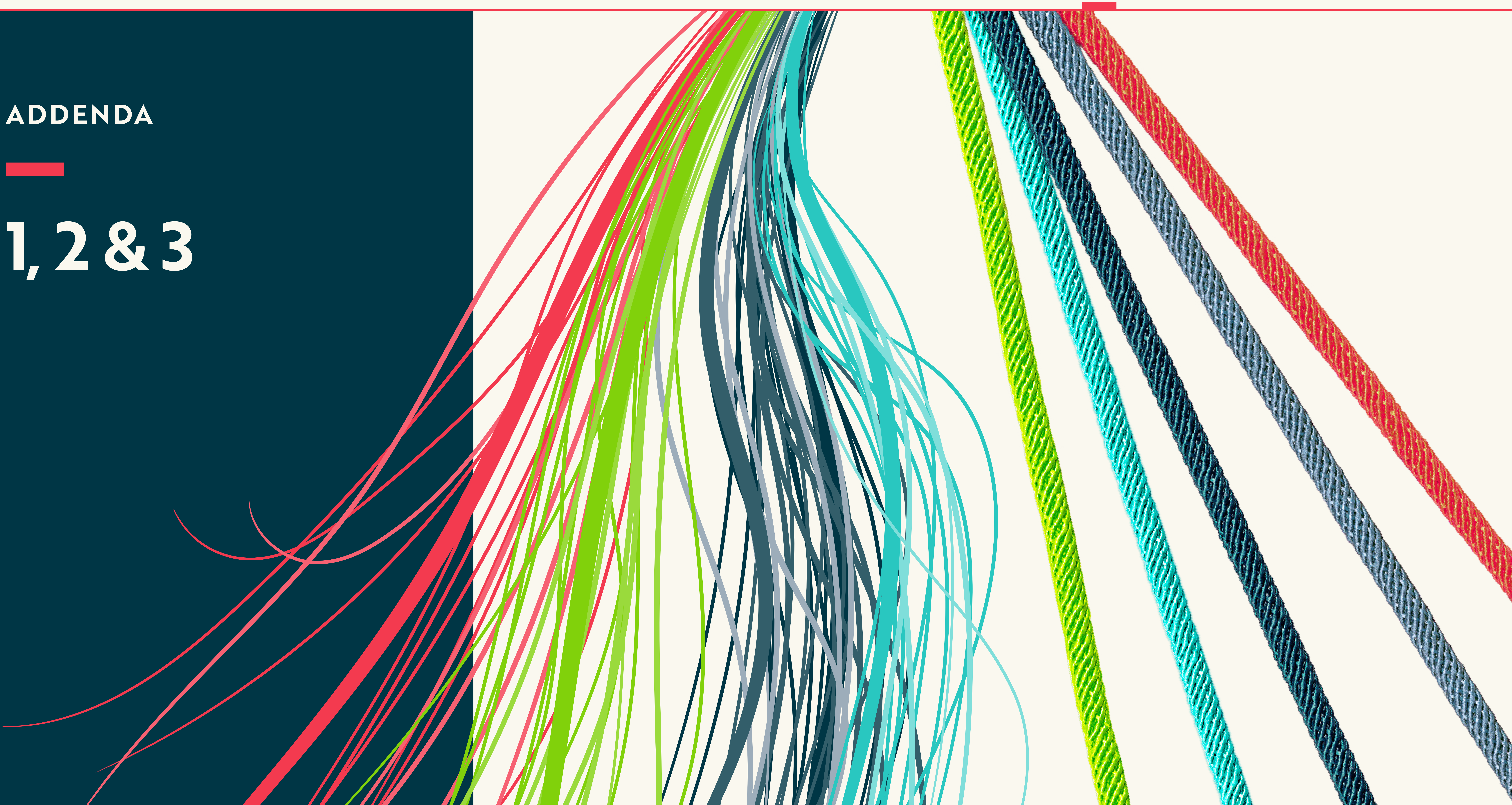
Mistrust and lack of trust act as brakes on the energy transition. Without addressing and building durable trust, the delivery paradigm change we need may fail, and with it our best hope for delivering net zero by mid-century.

But trust is also an enabler. It is enabled by, and is an enabler of, the FATR shifts. Getting this virtuous cycle to work, across the commercial, political, and social complexities in which infrastructure delivery takes place, will drive that paradigm change forward.

This will allow the brakes on the energy transition to be released, and the world to deliver net zero infrastructure at the speed of trust, which in turn will help make our collective climate ambitions a reality.

ADDENDA

1, 2 & 3



Addendum 1 - Our 2023 FATR Framework

The 2023 FATR Framework describes a path to adoption of the five FATR shifts by 2030. The graphic shows ‘indicators of change’ for each shift; these measures indicate movement toward adoption, and what we would expect to see for each shift by 2030.

Note that the net zero gap results presented here for 2023 were noted in FATR3 as preliminary, as the detailed analysis of survey data had not yet been undertaken. That analysis resulted in slightly different results, which are given in the updated figures used for 2023 in Chapter 2.

		2022	2023	2026	2030
Broadening value	Environmental and social representation ESG selection criteria Value shared across broader stakeholders	High	High	• Contributing to broader ESG goals • Scorecards with ESG goals • Value added to communities, not subtracted	• Accountable for project success • ESG equality weighted with financial objectives • Community equity
Enabling options	Technology investment Breadth of technology options Intellectual property	High-Medium	Medium	• Capital moving to early-stage technology development and first movers • Increased number of diverse technologies in early development • Shared among collaborative partners	• First-of-a-kind technologies deployed at record rates required for net zero transitions • Order of magnitude greater technologies at all technology commercial readiness levels • Shared publicly and between countries
Standardization	Standard and modular designs Supply chain orders Project timelines	High-Medium	High-Medium	• Modularization becoming more widely used • Investments made to ready supply chains • Projects meeting schedules and some setting new benchmarks	• Standards and standardized designs are widespread even in complex industries • Governments underwriting supply chains for pre-manufacture, lead times <6 months for complex equipment • Continuous improvements on schedule benchmarks
Create partnerships	Transparency Participation and collaboration Risk sharing	High	High-Medium	• Development of online performance data access platforms • New partnership models forming • New risk/reward models emerging	• Public access to the performance data • Shared ownership and open collaboration • Risk/reward evenly and appropriately distributed
The digital accelerant	Digital modeling Digital systems Digital personnel	High-Medium	High-Medium	• Digital project progression cradle-to-grave has been achieved • Standard digital systems emerging • Digital strategies being implemented on projects	• Assets delivered and data openly available across trusted digital platforms • Assets connected through common systems • Digital considered a core integrated discipline

Steps for 2024

FATR Initiative 1
Facilitate transparency and information sharing

FATR Initiative 2
Build leading practice guidelines

FATR Initiative 3
Establish consistent terminology and narratives

FATR Initiative 4
Expedite the workforce needed

FATR Initiative 5
Convene coalitions for standardization

Addendum 2 - Progress on our 2024 FATR commitments

Initiative step	Princeton Net-Zero Stakeholder Survey	From Ambition to Reality Summit	Industry Leadership Forums	Commitment to Mission Innovation
				
Commitment lead	**Worley and Andlinger Center for Energy and the Environment**	**Worley and Andlinger Center for Energy and the Environment**	**Worley**	**Worley**
FATR3 commitment – What was committed to?	Infrastructure participants survey across three regions examining current and projected net zero infrastructure delivery practices.	A summit to debate, challenge and consider net zero delivery practices. Focused on tangible, practical asset outcomes, delivering step changes in delivery.	A Chatham House Rule, industry-led conference, held independently in Europe, Australia and the US, focused on sharing industry learnings across diverse topics including sustainability and energy transition.	Coordination role for the Net-Zero Industries Mission (NIM) on behalf of 23 countries and the EU, to accelerate global decarbonization of the high intensity and hard-to-abate industry sectors.
FATR3 commitment – Key commitment aims?	To measure and understand practices and their changes. Enable researchers to consider initiatives to align practices with net zero challenges. Provide input for FATR Framework updates.	To build momentum across influential infrastructure players; to ensure research is industry aligned, and has a demonstrable net zero impact.	To improve industry collaboration across key sector issues.	NIM aims to accelerate global uptake of decarbonization technology, through building industry confidence in solution viability via knowledge sharing of operational scale demonstrations and supporting research.
FATR3 commitment – Committed timing?	Annually, starting in 2023 with baseline results and temporal trends from 2024.	First summit in September 2023 at Princeton. Targeted to run every year to 2030.	In-person events to be held in the three locations for the first time in 2024.	Resource provided to 2025. MI is intended to operate through to 2030.
Actual performance – Poor / Medium / Good **Indicator shows overall self-assessment of performance against commitment. Narrative explains why.**	**The 2023 and 2024 Princeton Net-Zero Stakeholder Survey were successfully undertaken. The 2023 survey attracted 547 responses and the 2024 survey ~400 (at the time of writing).** **Detailed results of the 2023 survey have been published by Princeton and inform Chapter 2 of this paper. Preliminary results from the 2024 survey inform the end of Chapter 2, and detailed analysis should be published in January 2025.** **The survey will run again in 2025.**	**The inaugural From Ambition to Reality Summit was held September 2023 at Princeton University involving 60 senior attendees representing most Infrastructure Participant types.** **This Summit examined the five Shifts in a US context, considering specific actions to accelerate net zero infrastructure deployment. More than 70 initiatives were identified and used within the research for this paper.** **The Summit will run again in December 2024.**	**The European Industry Leadership Forum was held in April 2024 in The Hague. Titled "Igniting Collaboration: Unleashing the Power of People & Technology" it attracted around 100 attendees. The Australian event will be held in Perth in November 2024.** **The first North American event will hopefully be held in 2025, most likely in Calgary, Canada.** **The European and Australian events are also expected to run in 2025.**	**Continued support to the Australian government to co-lead NIM, including representation at G20, COP28, and Clean Energy Ministerial and Mission Innovation joint events in Indonesia and Brazil.** **Worley's representative has been invited by the Australian Government and Mission Innovation Steering Committee into workshops to identify opportunities to increase the effectiveness of global industrial decarbonization activities and collaborations to celebrate the Mission Innovation 10th anniversary year in 2025.**

Addendum 2 - Progress on our 2024 FATR commitments

Initiative step		Workforce skills analysis	EU Renewable H_2 Standardization Working Group	Guide for sharing project value and building trust	Net-Zero X Initiative
					
Commitment lead		**Worley and Andlinger Center for Energy and the Environment**	**Worley**	**Worley**	**Andlinger Center for Energy and the Environment**
FATR3 commitment	What was committed to?	Undertake and release results of a study into skills needed to meet projected net zero scenarios.	Formation of the EU's first Renewable H_2 Standardization Working Group, and identification of initial opportunities and targets.	Publication of a new guide on sharing project value and building trust with communities. To be socialized with relevant stakeholders, to build broader momentum.	A deep understanding of what it would take to achieve net zero emissions globally.
	Key commitment aims?	To consolidate current knowledge, and provide a firmer foundation to progress skill development thinking. To socialize findings with relevant stakeholders.	To encourage and accelerate the move towards a standard approach to hydrogen production assets and start leveraging the benefits of standardization.	To share learnings from the field, assist developers to build a social contract, and start establishing broader best practice guidelines.	To expand Princeton's influential, high-resolution net zero country studies to the world's largest future emitters via collaborations with locally led research teams.
	Committed timing?	Targeting publication of the report by end of 2024.	Identification of initial working group by March 2024. Publication and socialization of targets by end 2024.	Publication by August 2024, socialization with stakeholders in September 2024.	Make modeling frameworks fully accessible and open-source by June 2024. Complete India and China net zero studies by December 2026. Progress scoping for Indonesia, Mexico, Brazil, Pakistan and Nigeria by December 2025.
Actual performance	**Poor** **Medium** **Good** **Indicator shows overall self-assessment of performance against commitment. Narrative explains why.**	**This commitment was not progressed, and no report has been published. Basis on industry feedback, FATR funding was refocused to the issue of trust and the program as outlined in Chapter 5.** **The importance of workforce skills remains an acute issue in achieving net zero. However, the FATR team believes trust at this time is a more fundamental and impactful issue to focus on, which itself could engender moves to understand and commit to raising the skilled workforce needed.**	**The potential benefits of standardization in low emissions H_2 is broadly recognized by stakeholders, but shorter-term industry headwinds have made it difficult to progress this commitment.** **Worley remains determined, however, and has explored several paths for progression. Currently the most prospective involves a group of interested companies working in collaboration through the auspices of an independent industry association. The construct for this should be confirmed before the end of 2024.**	**A precis of the *Guide to sharing value and building trust in net zero* is included as Addendum 3 in FATR4 and the full guide will be published in October 2024.** **The guide explores community resistance to energy transition projects and the factors leading to conflict, extended development schedules, and deceleration of net zero response. It outlines ways infrastructure participants can build trust and share value to help overcome those challenges and deliver sustainable projects.**	**Opensource modeling frameworks are completed and accessible by international partners. Net zero India scoping work is underway with IIT-Dehli and Praya Energy Group, targeting completion in Q1 2026.** **Net zero China scoping has commenced with Tsinghua University and is targeting completion in Q2 2026, while the net zero Brazil scoping is scheduled to commence by Q1 2025 – the completion of this work will depend on the identification of funding, as will the scoping of others during 2025 and 2026.**

Addendum 3 - Guide to sharing value and building trust

PRECIS

From community engagement to community involvement – a guide to sharing value and building trust to achieve net zero

Building and maintaining an enduring social contract has become critical for the world's drive to achieve net zero and respond to climate change. This is an energy transition requiring massive amounts of new infrastructure – energy facilities, grids, pipelines, roads, mines, and manufacturing facilities – all delivered at unprecedented scale and speed.

However, a new level of community resistance is impacting the ability of developers to deliver the projects required, and a new level of community engagement is needed to overcome this. One that goes beyond prescribed regulation, is transparent, truly collaborative, and aligned with the priorities of relevant stakeholders.

This is about moving from community engagement to community involvement, which is a journey examined in the new *Guide to sharing value and building trust to achieve net zero* (the guide), prepared as part of commitments made by Worley in the third publication in the FATR series, *From Ambition to Reality 3 – Steps to accelerate net zero delivery* made by Worley in FATR3.

This precis outlines the core elements of this guide – the full guide will be available in October 2024.

The critical role of communities in achieving net zero

Placed-based resistance is forcing significant cancellations, suspensions, or delays to energy transition related projects. Despite having clear positive environmental drivers, and broad benefits for communities, such projects also bring disruption and change: to view-sheds, environments, traditional industries and ways of life - leading to community resistance.

A downward spiral of project related conflict is becoming evident in some locations between developers, communities, and governments, and is likely to worsen as the scale of infrastructure demand for net zero increases, and significant cumulative impacts are felt. This could substantially impact the world's ability to build the net zero infrastructure needed to respond to climate change.

We believe a trust deficit between stakeholders is central to this issue, and has many dimensions:

- some communities distrust that their interests, concerns, needs, and aspirations will be heard and satisfactorily addressed by developers or that project impacts and risks will be adequately managed
- there is distrust in governments adequately planning and regulating energy transition development, which can be worsened in areas where multiple projects are being built
- some developers distrust governments to implement policies and processes to enable the timely progress of their projects, including when projects are being challenged by communities via litigation and 'lawfare'
- some governments lack trust that developers will consistently deliver projects to community engagement and social performance good practice standards
- not all developers trust each other to deliver community engagement well and are concerned that one bad player could ruin it for others.

Through all this, project timelines are being impacted, processes for conflict resolution are becoming lengthy and expensive, and a destructive cycle is emerging.

So, the question becomes: while reaching net zero is the science-based ambition stated by many energy transition participants and communities, how can we achieve it?

Building enduring social contracts

To build trust between stakeholders and deliver infrastructure at a scale and pace that net zero demands, infrastructure participants will need to approach community engagement differently, broadening value to achieve enduring social contracts.

Projects must be planned, sited, designed, delivered, decommissioned, remediated, and or repurposed in much greater collaboration with communities. To achieve this, trust and collaboration will need to be built between all parties involved.

Actions for developers and operators

We've identified four necessary steps for developers that align with thinking on trust in our FATR4 paper:

1. **Go beyond what is prescribed –** deliver engagement that is authentic and goes beyond the minimum that approval paths prescribe
2. **Emphasize sharing and transparency –** be honest about project strengths, weaknesses, impacts, and benefits by providing comprehensive and accessible information
3. **Align with communities –** discern what is important to communities and engender their participation in the fair sharing of value and risks
4. **Be flexible –** recognize that communities have diverse values, views, and interests.

Competent social practitioners are essential. As the 'face of projects' to communities, they act as trust brokers on behalf of project developers and operators. Social scientists should also be involved across all project phases to work in partnership with communities to deliver tangible and sustainable social value.

Actions for governments

The enormous amount of new infrastructure needed for net zero means cumulative impacts will inevitably accrue to communities, creating a specific threat to achieving net zero.

Governments and relevant industry can facilitate community trust through place-based approaches and management measures that address potential cumulative impacts, including:

- master planning involving input from communities and stakeholders
- policies and programs to address potential cumulative industry workforce impacts on housing and social services
- joint capacity-building programs to support workforce transitions to emerging new energy jobs
- participation in multi-party community engagement forums that transparently address potential cumulative impacts
- implementation of mechanisms that encourage developers to pool social investment to enhance coordinated and sustainable regional development
- proactive industry coordination of project logistics, such as the timing of project workforce rosters, and location of workforce accommodation to reduce impacts to the broader community in relation to housing and traffic
- multi-stakeholder environmental and social impact management and monitoring programs.

Creating effective partnerships

Communities sharing value in a project are more likely to be invested in the project's success, helping achieve development, delivery, and operational goals.

Value sharing strategies must be co-designed with local stakeholder groups and reflect their different interests, aspirations, and needs, and be commensurate with the scale and size of the project, and its impacts.

Value mustn't be confused with compensation for impacts. Simply compensating for impacts does not create a net positive social outcome. Similarly, project expenditures related to compliance and permitting are not components of a benefit-sharing strategy with communities.

Sharing project value for energy infrastructure projects could include:

- capacity building programs to enhance local and Indigenous employment and supply
- neighbor payments and neighborhood benefit programs
- social investment including sponsorships, grants, and sustainable development initiatives
- financial contribution to a community fund or trust that is administered by local stakeholders
- employee volunteerism and in-kind contributions
- access to innovative products (such as energy offtake or retail options) or incubation of innovative enterprises (such as energy tourism initiatives)
- mechanisms for building community equity through co-investment, partnerships, and co-ownership.

Community equity, partnership, and co-ownership in energy and resource projects are emerging benefit sharing approaches with significant potential.

Case studies from around the world show that these models can be applied to all types of energy infrastructure technologies, from pipelines and transmission lines to hydrogen production facilities. The main partnership models used include:

- **Equity ownership:** Community members and/or groups purchase equity ownership in the project – providing them with a financial stake
- **Cooperatives:** Cooperatives are member-owned entities, where members democratically control decisions and share profits
- **Limited partnerships:** This model separates general partners with full management control and liability, from limited partners who contribute financially but have limited involvement
- **General partnerships:** A general partnership considers stakeholders as general or equal partners, sharing equal control over decision-making, profits, and liabilities. Decisions typically require the consent of all partners
- **Community trusts:** Community trusts are legal entities that hold assets for the benefit of a community and can be used as community-ownership vehicles for a share of a project and for distributing benefits.

To facilitate community involvement, a mix of partnership models can be implemented by relevant parties. See the guide for relevant case studies.

Choosing the right partnership approach

We must consider social, regulatory, legal, and commercial issues when assessing benefit sharing options. All parties should engage legal and commercial advisors when exploring partnership approaches. High level considerations include:

- **Community desire and aspiration:** Stakeholder engagement is needed to seek input on the community's preferred benefit sharing model/s. This should aim to educate stakeholders on plausible co-ownership, co-investment, and partnership models, and find the level of the community's desire to participate
- **Community capacity:** In consultation with local stakeholders, an assessment will need to be completed of the community's capacity to engage in the preferred benefit sharing model(s) – and consider implementing relevant capacity building programs or the provision of third-party assistance
- **Capacity building:** Capacity building will need to start as early as possible and could leverage existing community development programs, noting there are opportunities for governments and non-government organizations (NGOs) to play roles. Capacity building should also involve project partners learning skills from each other
- **Government incentives:** Developers and communities should identify if government grants or commercial incentives are available to support partnerships, community capacity building programs – and co-ownership and co-investment models
- **Partnership set-up:** An assessment will be required to determine the logistics of the partnership model, including:
  - the extent of the partnership
  - potential size of the community stake in the project
  - timing of the partnership opportunity
  - partnership models and agreement types
- **Participation of stakeholders:** Who are the participants in the co-investment/co-ownership program? Will it be open to the whole regional community, or to select stakeholder groups?
- **Investment structures:** Community investment will likely need to be structured differently than for other (often more mature and larger) investors
- **Use of existing investment platforms:** Many active investment platforms are available to facilitate community investment participation in renewables, which can significantly simplify the process for developers and investors
- **Distribution of accountabilities:** How will project partners allocate responsibilities, liabilities, and profits? The distribution of accountabilities should aim to harness the strengths of each partner. In partnerships involving Indigenous peoples, engagement is needed to ensure that Indigenous peoples' contribution to project decision making supports reconciliation and Indigenous peoples' right to self-determination
- **Incorporation of Indigenous knowledge and cultural practices:** How can partnering structures incorporate and reflect Indigenous knowledge, values, and laws? Consideration should extend to dispute resolution and should reflect traditional practices that involve Elders and other cultural processes
- **Legal and commercial approach:** A legal structure that encourages and governs community participation will be needed to achieve community co-investment and co-ownership. Other factors to be considered include local laws, regulations, tax implications, investment structure(s), and project size
- **Social impact management:** Social impacts need to be considered and managed – for example, benefit sharing with only targeted stakeholder groups (such as impacted landholders) could impact broader community dynamics, and between the 'haves' and 'have nots'
- **Monitoring:** Project partners must consider how best to undertake the monitoring, evaluation, and improvements.

Co-creating a responsible future

To achieve our climate ambitions, energy transition related projects need to be delivered differently. The current paradigm is proving unacceptable to many communities. Escalating conflict across stakeholders and an increasing rate of project cancellations are slowing progress, the opposite of what is needed to achieve net zero.

Moving from community engagement to community involvement – including value sharing that creates net positive outcomes for all – is essential to reverse these trends and successfully deliver large energy transition projects. Efforts to create tangible and sustainable community value can facilitate community acceptance, so models for delivering projects in partnership with communities, including through co-design, co-ownership, and co-investment, need to become the norm.

The path to energy transition and net zero is one that infrastructure participants, including communities, must travel together. Taking the time to work in partnership and to build trust – going beyond the prescribed, being transparent and honest, aligning with what is important to communities, and being flexible in response – outlined in more detail in the guide, will help accelerate that journey.

Where can I get the guide?

For more details, including case studies of successful examples of partnerships and references, see the full guide (published late October 2024).

The guide background

The creation of the guide is part of a commitment made by Worley to share knowledge, collaborate, and partner with infrastructure participants to accelerate sustainable change in net zero infrastructure delivery. It focuses on practical ways infrastructure participants can adopt the "Broadening value" FATR shift.

The authors

The guide's lead author is Elena Miceski, previously Global Environmental and Social Consulting Lead for Worley. A seasoned environmental and social services professional, she has supported 100+ resource and energy projects and is widely recognized as an influential figure in sustainability globally, serving on multiple government and industry leading practice steering committees. Her areas of expertise include community engagement, Indigenous participation, environmental and social impact management, and environmental approvals. Note that Elena authored the guide before taking up a new role with Rio Tinto.

Dr Paul Ebert, Worley's Group Director for Sustainability and Energy Transition Leadership, and one of the lead authors of the FATR series, is a contributing author. Numerous other people contributed to this work and are acknowledged in the full guide.

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FATR4 Units, acronyms and nomenclature

2023 survey	2023 Princeton Net-Zero Stakeholder Survey
2024 survey	2023 Princeton Net-Zero Stakeholder Survey
BECCS	Bioenergy with Carbon Capture and Storage
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilization, and Storage
CDR	Carbon Dioxide Removal
CEO	Chief Executive Officer
CO_2	Carbon Dioxide
COP28	28th Conference of Parties
DACS	Direct Air Capture with Storage
EOR	Enhanced Oil Recovery
EPC	Engineering, Procurement, Construction
ESG	Environmental, Social, & Governance
EU	European Union
FATR	From Ambition to Reality thought leadership series
FATR1	From Ambition to Reality paper #1
FATR2	From Ambition to Reality paper #2
FATR3	From Ambition to Reality paper #3
FID	Financial Investment Decision
FOAK	First-of-a-kind
G20	Group of 20
Gt/year	Gigaton per year
Gt CO_2/yr	Gigatons of carbon dioxide per year
H_2	Hydrogen
IEA	International Energy Agency
IRA	(US) Inflation Reduction Act
Km	Kilometer
Mt/year	Megatons per year
MMTPA	Million metric tons per annum
MI	Mission Innovation
NIM	Net-Zero Industries Mission
NGOs	Non-government organizations
Pulse Survey	Princeton CCS Pulse Survey
SME	Subject Matter Expert
UAE	United Arab Emirates
UK	United Kingdom
US	United States
WEF	World Economic Forum

Thank you for being part of the paradigm change to make net zero ambitions a reality.

For more information on our thinking and previous papers, follow these links:

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Princeton Net-Zero Stakeholder Survey

acee.princeton.edu

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DELIVERING SUSTAINABLE CHANGE

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EFFILIATES
energy ▪ environment ▪ engagement