

North America shapes the energy transition

Per capita emissions are among the highest in the world, but significant reductions have already been achieved towards decarbonization. Further developments position the U.S. as a role model for advancing green business.

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Energy transition: North America's thirst for energy is huge – and so are its emissions

North America has one of the highest levels of emissions per capita in the world. But, as highlighted at the North America Energy Talks in Houston, the region has already achieved significant reductions and is overall making good progress on decarbonization. For further reductions to be possible, a concerted effort is needed at all levels of industry, politics, and society.

An evolutionary shift is transforming traditional energy structures across the globe, redefining what it means to create a sustainable energy system. The Energy Talks conferences, a series of events each focusing on a different geographical region, hosted by Siemens Energy and partners, brought together industrial, political and societal leaders from around the world to tackle the increasingly serious challenges that face not only the energy industry but society at large.

Participants in the conference were asked about the importance of a range of key "energy priorities," which together form a complete framework for a successful energy transition. They

were also asked what progress they believe had been achieved so far on each of the priorities.

Our investigation found that North America's thirst for energy is huge – as is its level of per capita emissions. The United States and Canada alone were responsible for 15% of global emissions in 2021. However, North America is also one of the few regions in the world where emissions have declined since 2005. Now, the pace of progress must be stepped up, and the region must act as a role model for the rest of the world in the journey to clean energy.

“I want to challenge everybody: Let's go for it! The year 2050 is going to be here before we know it. Now is the time to act.”

Rich Voorberg, President of Siemens Energy
North America

“To go fast, you go alone. To go far, you go together. To go really fast, you go together in alignment. It is all about collaboration.”

Janice Linn, Founder and CEO, Green Hydrogen Coalition

Key insights

The North America Energy Talks focused on the region's progress and prospects with the energy transition. First, it is worth noting that North America is one of the few regions around the globe where CO₂ emissions have fallen significantly since 2005. The region managed to keep the level of primary energy consumption constant over the last decade, achieving economic growth while maintaining a constant energy supply. At the same time, energy consumption shifted from fossil fuels to less CO₂ emitting sources of energy and renewables, with oil consumption shrinking by around 10% over the period. Coal consumption also dropped by over 50%, as many of those facilities reached their end of life and were replaced by more advanced gas-fired generation technologies. However, the United States and Canada alone were responsible for 15% of global emissions in 2021. Hence the need for the Inflation Reduction Act (IRA) recently signed by President Biden.

The IRA puts in place significant incentives for clean power initiatives. Furthermore, it provides production tax credits (PTC) for existing nuclear power plants and wind, solar, and battery projects. The IRA can incentivize new business models to work towards net zero targets.

Conference participants reported that progress on the energy priorities overall was fairly advanced, although dedicated efforts would be needed to achieve climate targets. The most progress has been made on exiting coal and accelerating renewables. Participants also perceive the decarbonization of industry to be advancing. By contrast, progress on Power-to-X solutions has been slow so far, requiring more advancements in technology and Research & Development (R&D). Discussions at the Energy Talks were conducted around decarbonization goals in North America and the strategies to follow in the years to come. How do we meet these goals while keeping energy affordable, reliable and sustainable? Four key topics were emphasized in the discussions.

#1 Renewables are key enablers for the new energy system

While clean energy is often associated with wind and solar as abundant and “free” sources of energy, when it comes to the development of zero-carbon technologies, the focus must be on systems of meaningfully complementary and interconnected technologies and business models. Examples are the combination of low-cost produced green energy with energy storage. Or the use of renewables for H₂ production and green heating. Traditional central or distributed power systems can co-exist with a whole new ecosystem of players, but to interconnect these systems, updated infrastructure is required. It's clear that renewables don't come for free.

#2 Infrastructure needs to be resilient for future technology evolution

Recent meteorological crises such as those seen in the Texas ice storm in 2021 and the heatwave in California in summer of 2022 have shown that current infrastructure lacks resilience when confronted with extreme conditions. In addition, solar farms in the south and wind farms in the central U.S. are continuously expanding. To avoid stranded generation assets, power transmission grids must be improved to more efficiently move energy from generation sources to load centers. Infrastructure for the export of Liquefied Natural Gas (LNG) also needs to be upgraded to satisfy increasing demand from Europe and Asia. If hydrogen is indeed going to be a low-carbon fuel source, we need to modify pipelines to transport hydrogen to off takers. As previously mentioned, there is a need to improve the infrastructure if we are to implement these initiatives sustainably. To do it quickly is another issue – we heard throughout the conference that permitting processes need to be improved and streamlined to enable faster infrastructure development.

“Transmission enables us to overcome some of the inefficiencies of renewable generation. Making sure we can really use our renewable energy all the time and in different parts of the country is an exciting challenge.”

Tim Holt, Executive Board Member,
Siemens Energy

The Energy Transition Readiness Index

During the conference, participants (experts and decision-makers across the energy sector in North America) in each session completed a short survey on the session's topic. More than 100 participants answered the survey. The Energy Transition Readiness Index is calculated based on these survey results. Participants were asked to give their expert opinion on the progress of each of 11 energy priorities (see page 6). The Index aggregates the answers of the experts by combining progress on each priority ("readiness") with the assessment of its respective importance ("system maturity" as measured by the average importance of all priorities, with a higher average pointing to a more systemic approach to the energy transition). The Index describes the perceived readiness, on a scale of 0–100%, of the energy transition towards net zero in North America.

"We need a reality check and not group-think. Of course, renewables are going to continue to form an increasing share of the world's energy supply. But we still need low carbon LNG as an enabler of renewables and as a dependable transitional fuel."

Leo Power, President and CEO, LNG Newfoundland and Labrador Limited

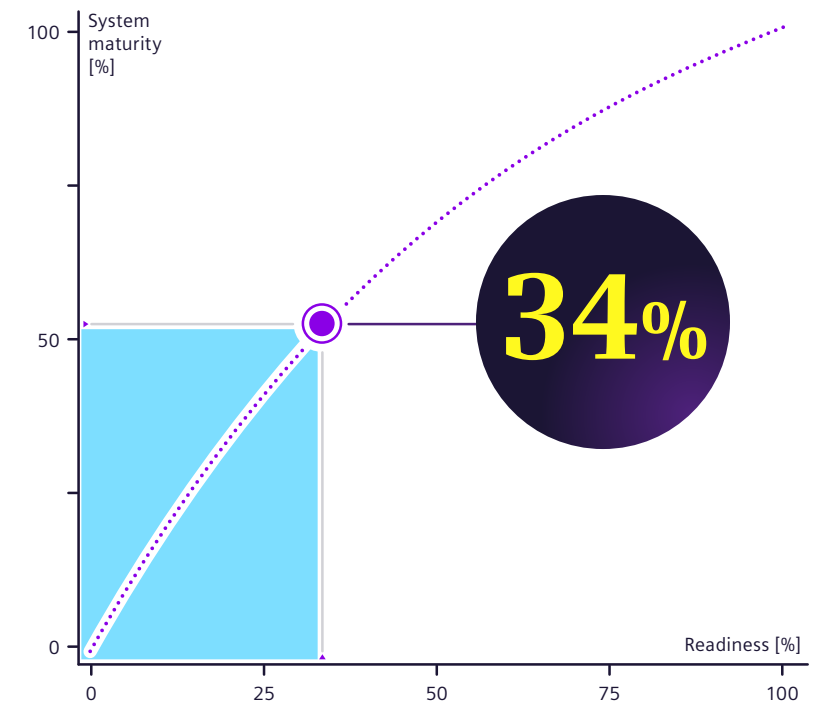
#3 Fossil fuels, especially natural gas, still have a role to play

While fossil fuels have been under attack for some time because of their CO₂ emissions, key industry insiders see them as a critical bridge to a new energy future – as fast, dispatchable energy and capacity when intermittent renewables and infrastructure follow expected massive growth ambitions. Even while new technologies to reduce emissions are under development or already being adopted, such as circuit breakers that eliminate F-gases and the elimination of combustion by conversion to hybrid or fully electric drives, there was widespread agreement that expanding the use of renewables today is not possible without also expanding the use of bridging fuels, such as LNG, or similar fuel types. As mentioned previously, there will need to be improvement on processes, like permitting, to meet the optimistic targets for net zero, and dispatchable power will be necessary for reliability.

One opportunity exists in the export of LNG, which has garnered particular attention since the beginning of Russia's war in Ukraine. North America now has an opportunity to export LNG to gas-dependent Europe, which still has insufficient installed renewable capacity to consistently cover its needs. However, no consensus was reached at the Energy Talks as to whether the war in Ukraine will ultimately speed up or slow down the energy transition.

#4 Carbon capture is seen as playing a vital role in decarbonization

According to IEA's net zero scenario, we will need to store 7.6 billion tons of CO₂ by 2050. Today, we are just at 40 million tons. Most of the conference participants agreed that Carbon Capture Utilization and Storage (CCUS) will be an absolute game changer by removing 95% of the CO₂ from power emissions. Currently technologies are under development including Direct Air Capture projects. The IRA addresses incentives for the engineering community to develop technologies to recover CO₂ from major point-sources such as coal or gas fired power plants. Progress on the different "energy priorities" (see p. 9) varies. In the power sector, coal is already being phased out and renewable energy ramped up. Initial steps are underway regarding energy storage and the decarbonization of industry. On the other hand,



little progress has been made on energy priorities such as sector coupling, Power-to-X solutions, and emission markets. Greater awareness is needed for the fact that not only the power sector needs to decarbonize, but the economy as a whole.

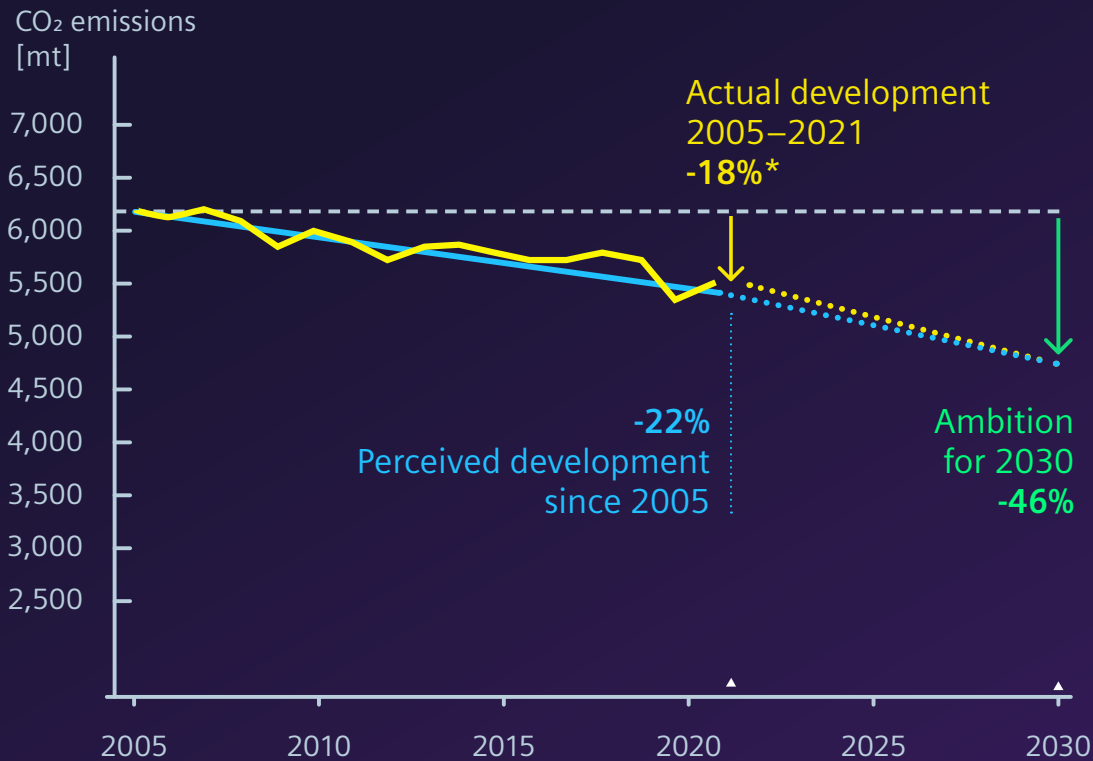
Overall, North America scores 34% on the Energy Transition Readiness Index, which is a leading score compared to other global regions. Moreover, North America achieved an 18% reduction in emissions between 2005 and 2021. However, per capita emissions in North America remain relatively high and must be reduced further to be sustainable.

Participants in the Energy Talks agreed that decarbonization still has a way to go in North America. For system maturity, the region scores 53%. The path to carbon neutrality must include raising this score and urgently starting systematic implementation of energy priorities.

CO₂ emission reduction

North America makes a disproportionate contribution to global emissions

What is the level of CO₂ reduction in your country today and what will it be in 2030 compared to 2005?



Source: bp Statistical Review of World Energy July 2022

North America is responsible for around 15% of global emissions.

During the Energy Talks, we asked participants what they thought had already been achieved on climate change. We discovered that perceptions of what progress had been made only slightly exceeded reality. Conference participants estimated that the region had cut emissions by 22% since 2005, while the actual figure was 18%. In any case, this is a remarkable achievement compared to other

global regions. The reduction is mainly due to the switch from coal to gas in the electricity sector combined with the increased use of renewables and energy-efficiency measures. However, economic growth has also led to increased energy demand. It remains to be seen how the post-COVID recovery will affect emissions and whether they will continue to fall.

Ambitious targets for 2030

When it comes to the outlook, conference participants' expectations were ambitious and lead to high expectations. They estimated that emissions levels on average would be 46% below their 2005 level in 2030. Given that emissions decreased by 18% in the 16 years between 2005 and 2021, it is highly optimistic to believe that a reduction of twice that size could be achieved in the remaining years until 2030.

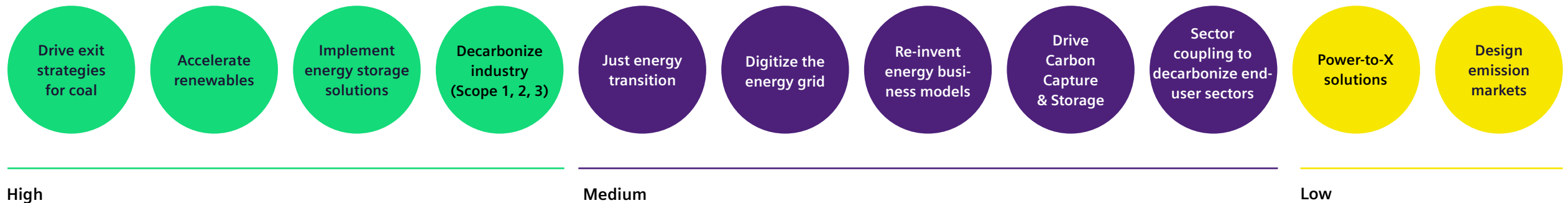
To speed up decarbonization, emissions need to fall not just in the energy sector but also in industry and transportation, both of which are heavy users of fossil fuels such as oil, gas, and coal. Electrification will be the key to achieving decarbonization targets in these sectors and realizing the goal of a maximum 1.5°C increase in global temperatures and climate neutrality by 2050.

Ranking the energy priorities

In the period to 2030, how strongly will each of the energy priorities impact your achievement of climate targets? (Low impact = 1; medium impact = 2; high impact = 3)

“The Inflation Reduction Act provides long-term certainty for all of our work within clean energy. This legislation ramps up the availability of capital and investment in these projects, which don’t come for free. They’re capital intensive for sure.”

David Balfrey, Apex Clean Energy, Senior VP, Technology and Asset Management



Identifying energy priorities

Global management consultancy and Energy Weeks/Talks partner Roland Berger, in close collaboration with Siemens Energy, identifies 11 priorities for tackling the energy transition. Successfully addressing these priorities on a global level will result in significant decarbonization and is likely to lead to net zero emissions.

In general, conference participants believe that all 11 energy priorities have at least some impact on their achievement of climate targets. Energy priorities affecting the electricity sector are thought to be particularly impactful, namely exit strategies for coal, accelerating the use of renewables and implementing energy storage solutions. The phasing out of coal and use of renewables is already well advanced in North America, especially in the power sector. Conference participants expect Power-to-X solutions and the development of emission markets to have less impact, reflecting the fact that such solutions are little used at present – indeed, Power-to-X solutions are still in the development stage. Areas such as the digitization of the energy grid require further work.

Overall, achieving decarbonization will require a holistic approach. Presently, the focus has been to decarbonize a specific sector without examining the impact on other sectors (e.g. increasing light duty electric vehicles will reduce CO2 emissions in mobility but increase energy demand from the power sector). An overarching framework, such as that created by emission markets, could help significantly accelerate the business case for decarbonization solutions.

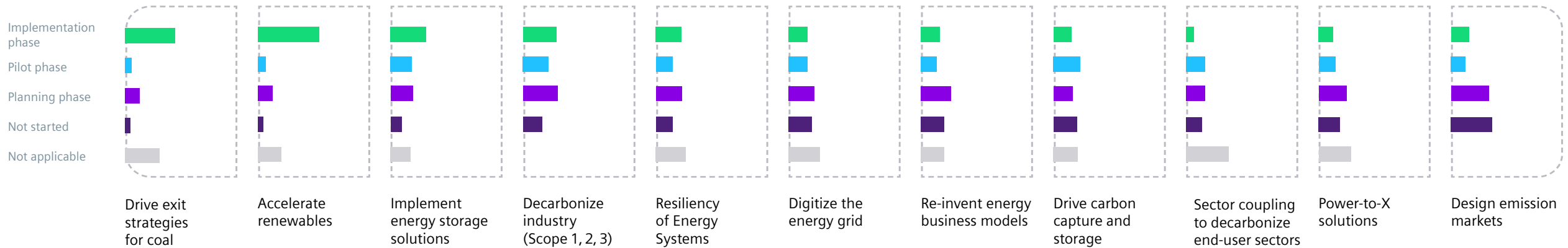
Current progress

Participants in the Energy Talks report that progress on the 11 energy priorities is varied. The greatest progress has been made in power generation: around 50% of participants report that the phasing out of coal and increased usage of renewables is already in the implementation phase. But there is room for further improvement: In 2021, 20% of power generation in North America was from coal, compared to just 13% from renewables (wind and solar).

Our analysis reveals several blind spots, or areas that are expected to have a high impact but currently show little progress. Around one-third of conference participants said that the creation of emission markets has not even begun in North America – despite that fact that the California RGGI (Regional Greenhouse Gas Initiative) is already functioning as an emissions trading system in more than ten U.S. states. Another blind spot is sector coupling, the electrification of end-user sectors. Here, around two-thirds of participants said that this has only reached the planning stage at best. Overall, progress on many priorities is low, with little progress made towards implementation.

“If we’re going to get onto a more stable, sustainable path, we need all the constituencies in our society to build a consensus and to bring that to the political system.”

Ron Brownstein, CNN Senior Political Analyst



What progress have you achieved on each of the energy priorities?

What needs to be done?

“Companies that will be successful in the future are taking their existing workforce and upskilling them. So many of the skill sets are transferable and work across energy systems, from oil and gas to renewables, nuclear to micro nuclear.”

Leslie Beyer, CEO of the Energy Workforce and Technology Council

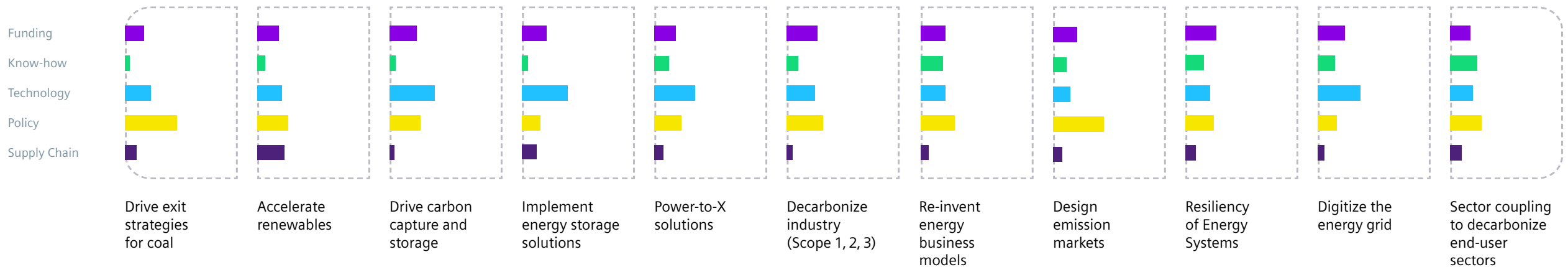
According to the conference participants, action is needed ...

on policies being developed with much stronger local and global collaboration. Roughly one-third of participants say that this needs attention, particularly as a key enabler for further driving exit strategies for coal, accelerating renewables systems and creating emission markets. In the discussions, it was often emphasized that it can't be done alone. Private-public partnerships are needed, as well as partnerships in the industry between suppliers and customers, plus a certainty around the regulatory framework.

By contrast, technology is not seen as a critical issue in the near term. Both Europe and the U.S. have consistently reduced their carbon emissions while growing their economies. Technologies are available today to continue this expansion. But innovations will be required to sustain that expansion in the longer term. We need to be able to scale these new developments in a sustainable, economical way. Also, we need the people with the right skills and training to enable the new technology, e.g., for renewables, driving storage and carbon capture solutions and digitizing the energy grid.

Clean energy jobs require highly skilled and technical experience, and they are becoming increasingly digital. If you worked in the fossil fuels or hydro-carbon industries you may not easily transition to a career in renewables, especially in the energy services sector, without upskilling.

Funding is seen as equally important for all energy priorities, with existing U.S. investment programs for Clean Energy and Climate Change mitigation from the Build Back Better Act viewed as a step in the right direction. Prominent examples are: **1)** Ten-year expanded tax credits for utility-scale and residential clean energy, transmission and storage, clean mobility, and clean energy manufacturing (\$ 320 bn), **2)** Resilience Investments to address extreme weather and pollution (\$ 105 bn), **3)** Targeted incentives for new supply chains and technologies, like solar, batteries, and advanced materials, boosting the competitiveness of existing industries steel, cement, and aluminum (\$ 110 bn). The IRA further expands on these initiatives, including credits for nuclear energy.



What is most needed for the future development of each energy priority?

Energy priorities in detail

Drive exit strategies for coal

Decarbonization requires a step-by-step phase out of power and heat generation from coal. Strategies must manage this while simultaneously ensuring a secure supply of power and heat. Coal's role in the transition to carbon neutrality must be clearly defined within these strategies.

Accelerate renewables

The speed of the expansion of renewable energy is strongly linked to the speed of decarbonization. However, technological, societal, and bureaucratic barriers partly impede progress. Lifting these barriers is key to speeding up the roll-out of renewable energy solutions.

Drive Carbon Capture and Storage

Carbon capture and storage (CCS) is a technological solution for capturing emissions and storing carbon in a way that lessens its climate impact. Decarbonization strategies must define the role of CCS technologies in the transition towards climate neutrality.

Digitize the energy grid

A greater share of intermittent renewable energies makes it more challenging for power grids to maintain a secure power supply. The safe and reliable set up, maintenance and operation of the future energy grid requires new digital solutions.

Implement energy storage solutions

The intermittency of renewables necessitates both short-term and long-term energy storage solutions. Technological and economic solutions must be devised to ensure that 100% renewable energy delivers a highly secure supply.

Power-to-X solutions

The transformation of power to hydrogen and other Power-to-X fuels enables the storage of otherwise curtailed renewable energy. Additionally, Power-to-X fuels can be used in hard-to-abate sectors such as aviation and shipping or high-temperature industrial processes.

Decarbonize the industry (Scope 1, 2, 3)

Industrial production can generate significant carbon emissions. These must be reduced across Scopes 1, 2 and 3 to move towards a carbon-neutral industry and society. The roll-out of new production processes and energy-efficiency measures must define a pathway to carbon neutrality.

Sector coupling to decarbonize end-user sectors

All energy end-user sectors must be decarbonized to create a truly climate-neutral society. With an increased share of renewable power generation, the heating and mobility sectors can be decarbonized via the electrification of end-user appliances.

Re-invent energy business models

Energy business models are a key enabler for fostering investment in decarbonization technology, for example, via contracting solutions. Solutions such as PPAs (power purchase agreements) and long-term trading can secure payment streams over the investment period, which makes investments bankable and suitable for low-interest financing.

Design emission markets

An overarching regulatory framework must ensure the cost-efficient reduction of carbon emissions wherever possible. Implementation of emission markets and/or carbon pricing mechanisms is crucial to align incentives across continents, countries, and sectors.

Just energy transition

Social acceptance is an essential component of the energy transition. A fair energy transition further includes affordable energy supply and decent working conditions, as well as diversity and inclusion. Social distortions must be avoided, as well as energy poverty and resistance to renewable energy.



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