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FREIGHT IN A LOW-CARBON ECONOMY: MANAGING THE RISKS

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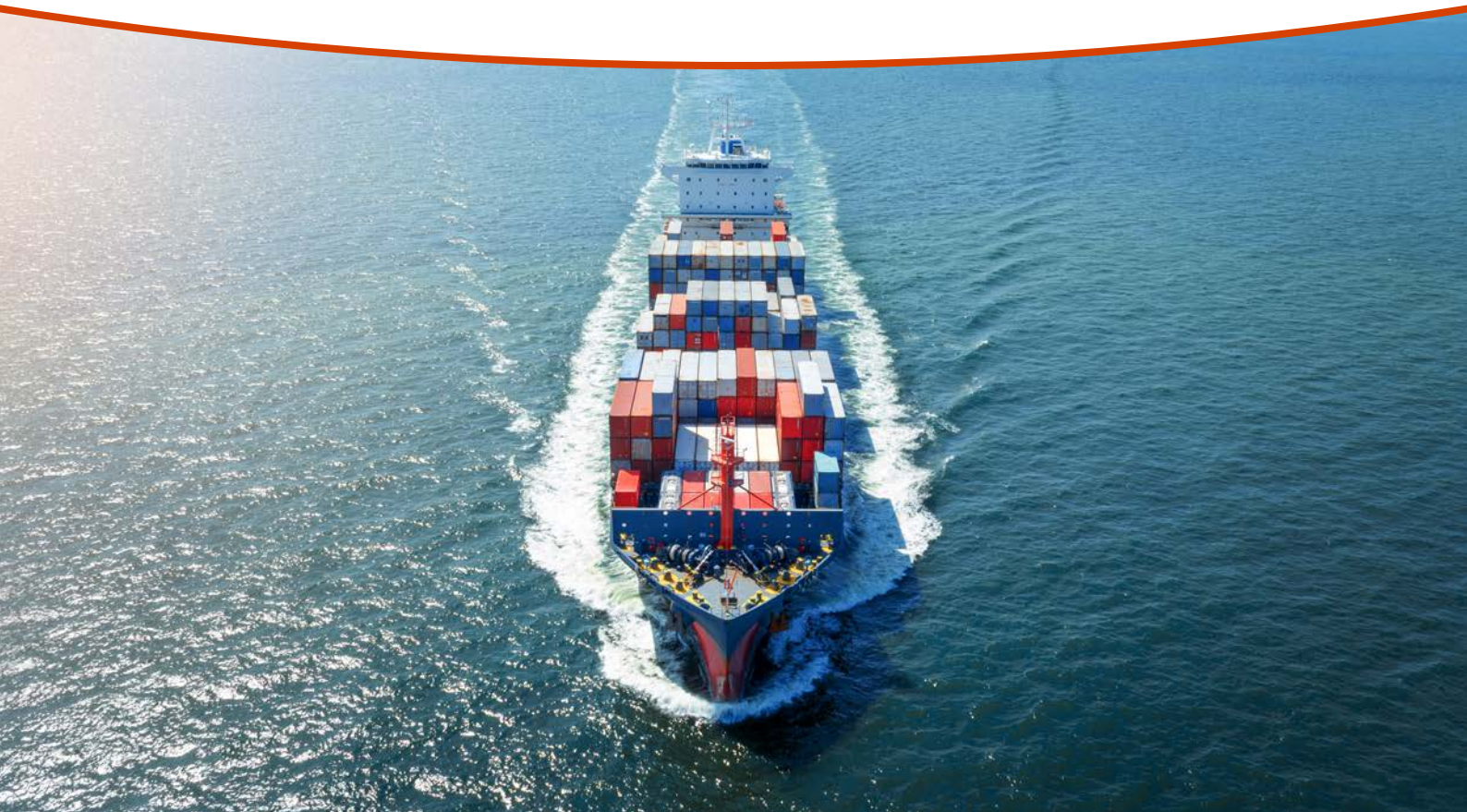

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ELECTRICITY IS DECARBONIZING. WHAT HAPPENS NEXT?

In 2025 global energy markets witnessed something that had not been seen in more than a century. For the first time since 1919, the share of electricity produced from renewable energy exceeded that from coal.

Wind and solar met an unprecedented 99% of new electricity demand,[1] marking a structural shift away from non-fossil fuel generation within the global energy system.

This is important since alternatives to fossil fuels can improve energy security while reducing utility bills — witness Spain, largely insulated from gas price shocks in 2026 thanks to "a long-term, ambitious push on wind and solar," according to Chris Rosslowe, senior analyst at think tank Ember.[2]

Because of such benefits, "the future energy mix is going to become a lot more complex," says Vicky Roberts-Mills, Global Head of Energy Transition at global commercial insurer AXA XL.

And already, she adds, "it's become a lot stronger. The historical energy system was very centralized with big generating assets delivering power through one-way grids. In the future, there will be more local production.

"Individual businesses and commercial hubs — such as ports — can generate and store their own power. That provides flexibility and diversification."

However, electricity generation is just one part of the global energy system. For society to enjoy the wider energy security, affordability and sustainability benefits of a low-carbon economy, decarbonization will need to expand to a range of other sectors — including transportation.

NEW WAYS OF POWERING FREIGHT TRANSPORTATION

Transportation is key to global economic growth yet faces significant energy security, affordability and sustainability challenges.

It is the second-largest source of global carbon emissions, contributing almost half as much as electricity and heat production, and its reliance on fossil fuels puts it at risk from price shocks and supply shortages, such as those seen in 2026 with the closure of the Strait of Hormuz.[3]

Unlike electricity production, which is increasingly being handled globally by non-fossil energy sources such as solar, wind and nuclear, transportation faces significant challenges in moving away from fossil fuels.

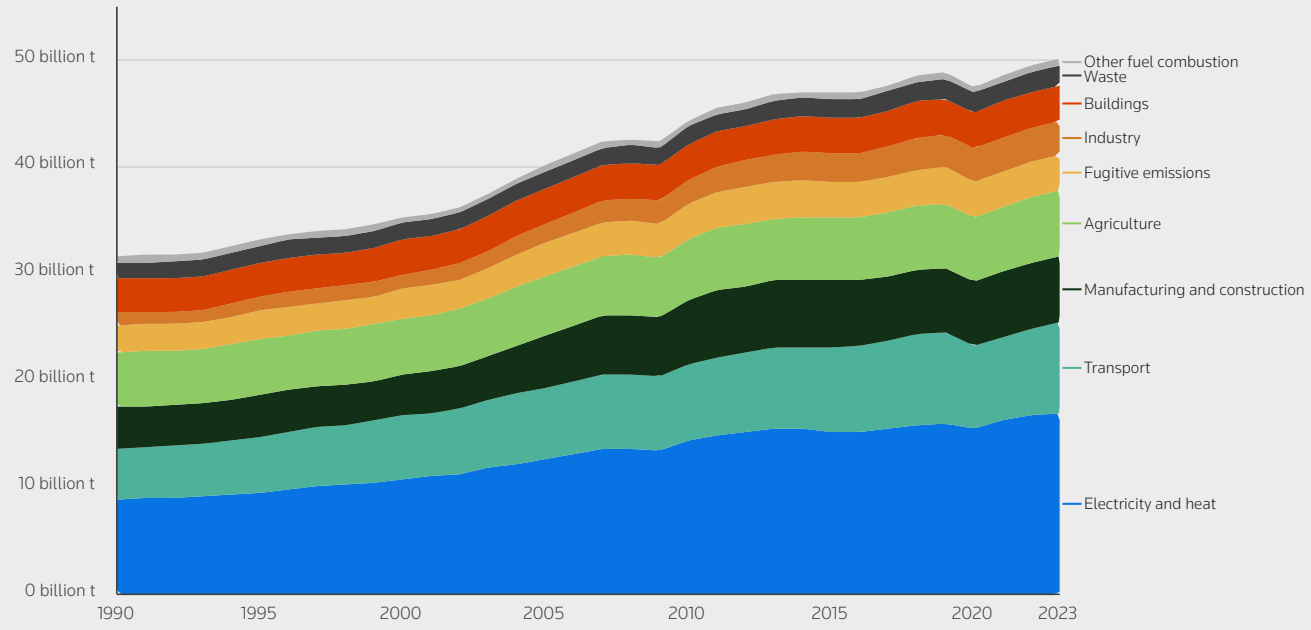
While road and rail transportation can in theory run mostly on electricity, for air and maritime transport the path away from fossil fuels is unclear and technically challenging.

Navigating this route requires collaboration with a wide range of stakeholders, including sectors such as insurance, that are already well-versed in handling the risks of moving to decarbonized operations.

FIGURE 1

Electricity generation is just one goal towards a sustainable future

Metric tons of greenhouse gas emissions by sector worldwide, 1990 to 2023



Source: Our World in Data.[4]

THE LONG ROUTE TO LOW-CARBON MARITIME FREIGHT

The challenges in decoupling freight transportation from fossil fuels are most acute at sea, not just because of the difficulty in powering ships with alternatives to bunker fuel, but also because of the sheer scale of this mode of transport.

Although lack of data means there are no reliable statistics on the global movement of goods, the logistics giant DHL estimated in 2023 that around 90% of the world's freight is transported by sea.[5]

Currently, almost all commercial shipping relies on bunker fuel, a catch-all term for a range of heavy to medium-grade oils that have been subject to increasingly stringent regulations to reduce sulfur and carbon emissions.

These regulations have sparked interest in sulfur-removing scrubber technologies and alternative fuels. Some of the latter could potentially allow the maritime sector to move away from fossil fuels altogether, but the path is far from clear. There is no one-size-fits-all solution.

FIGURE 2

Alternative maritime fuels: many options, no winners

Alternative fuel types and propulsion systems for commercial shipping, in approximate order of viability

Fuel / Technology	Availability & Cost	Carbon Reduction	Infrastructure Readiness	Engine Compatibility	Scalable Usefulness	Safety Profile	Maturity / TRL	Regulatory Readiness
LNG	●	◔	●	●	◕	◕	●	●
LPG	◕	◔	◕	◕	◑	◕	●	◕
Biofuel	◕	◑	◕	●	◑	◕	●	●
Methanol	◕	◑	◑	◕	◕	◕	◕	◕
Ammonia	◑	●	◑	◑	●	◔	◑	◑
Hydrogen	◔	●	◔	◔	◑	◑	◑	◑
Battery (Electric)	◕	●	◑	◑	◔	●	◕	◕
Wind-Assisted Propulsion	●	◕	◕	◕	◑	●	◕	●
Nuclear	◑	●	◔	◔	◕	◑	◔	◔

Score key

○ Very low / not viable ◔ Low / early stage ◑ Moderate ◕ Good / strong ● Excellent / fully viable

TRL: Technology readiness level; LPG: liquid petroleum gas. Source: Reuters Events analysis.

A major problem for the sector is that the most technically and economically viable alternative fuels — such as liquefied natural gas, which is readily available today and already in use in hundreds of vessels — have only limited carbon reduction potential but may play a transitional role.

Conversely, the options with greatest decarbonization potential all have significant drawbacks. Ammonia, for example, could deliver a greenhouse gas reduction of around 90% compared to traditional marine fuel oil if produced with hydrogen created through electrolysis powered by renewable energy.

But ammonia is not as energy dense as traditional marine fuel, meaning greater volumes are needed per journey, reducing cargo capacity. It is highly toxic and interim gudelines on its use as a shipping fuel were only approved in May 2026. AXA XL is part of the ARISE consortium that is investigating the potential impact of an accidental release of ammonia into the sea. The research will allow insurers to help their clients manage the risks of using alternative maritime fuels in the future.[6]

Similarly, batteries could reduce reliance on fossil fuels to zero but cannot provide enough power for intercontinental routes. Wind power reduces emissions but is not steady enough for reliable, deadline-based travel. Nuclear power is almost limitless and carbon-free but requires very high initial investment and needs specialist operators.

Because of these issues, there is a growing consensus that shipping of the future may rely on a range of power sources depending on the trips and types of vessels involved.

Furthermore, the power sources are likely to change over time as more sustainable options reach maturity and come down in cost compared to the most viable options being considered today.

Even what is deemed sustainable is subject to change, depending on whether emissions are measured at the point of release or — as is increasingly the case — on a well-to-wake basis.

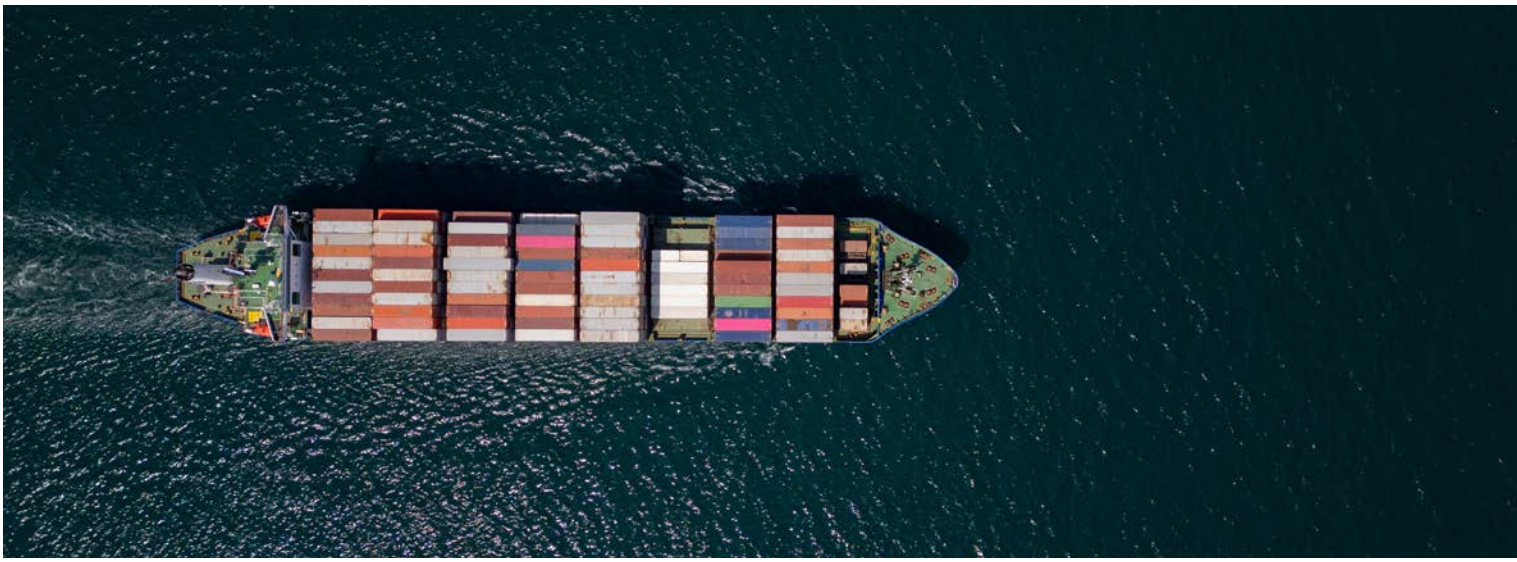
With all of this, "I think the industry is very confused," says Jarek Klimczak, Chief Risk Consulting Officer, Specialty, at AXA XL. "Modern maritime engines are no longer designed to operate on one type of fuel, but a minimum of two if not three."

Insurers are working to improve their understanding of the risks attached to new fuels and power systems.

AXA XL, for instance, joined the Nuclear Energy Maritime Organization in February 2026 to "allow us to learn from the shipping and nuclear sectors while bringing our voice to the table to help shape standards and regulations for floating nuclear technology solutions," says Roberts-Mills.[7]

This knowledge is helping inform the risk mitigation strategies that shipping will need in a low-carbon economy.

For example, a move to toxic or explosive fuels such as ammonia or hydrogen may mean that "bunkering will be different from the way we did it in the past," says Jan Scharrer, a Marine Risk Consultant with AXA XL. "It will be more like chemical tankers, with special jetties in remote locations."



ROAD TRANSPORTATION GRAPPLES WITH EV RISKS

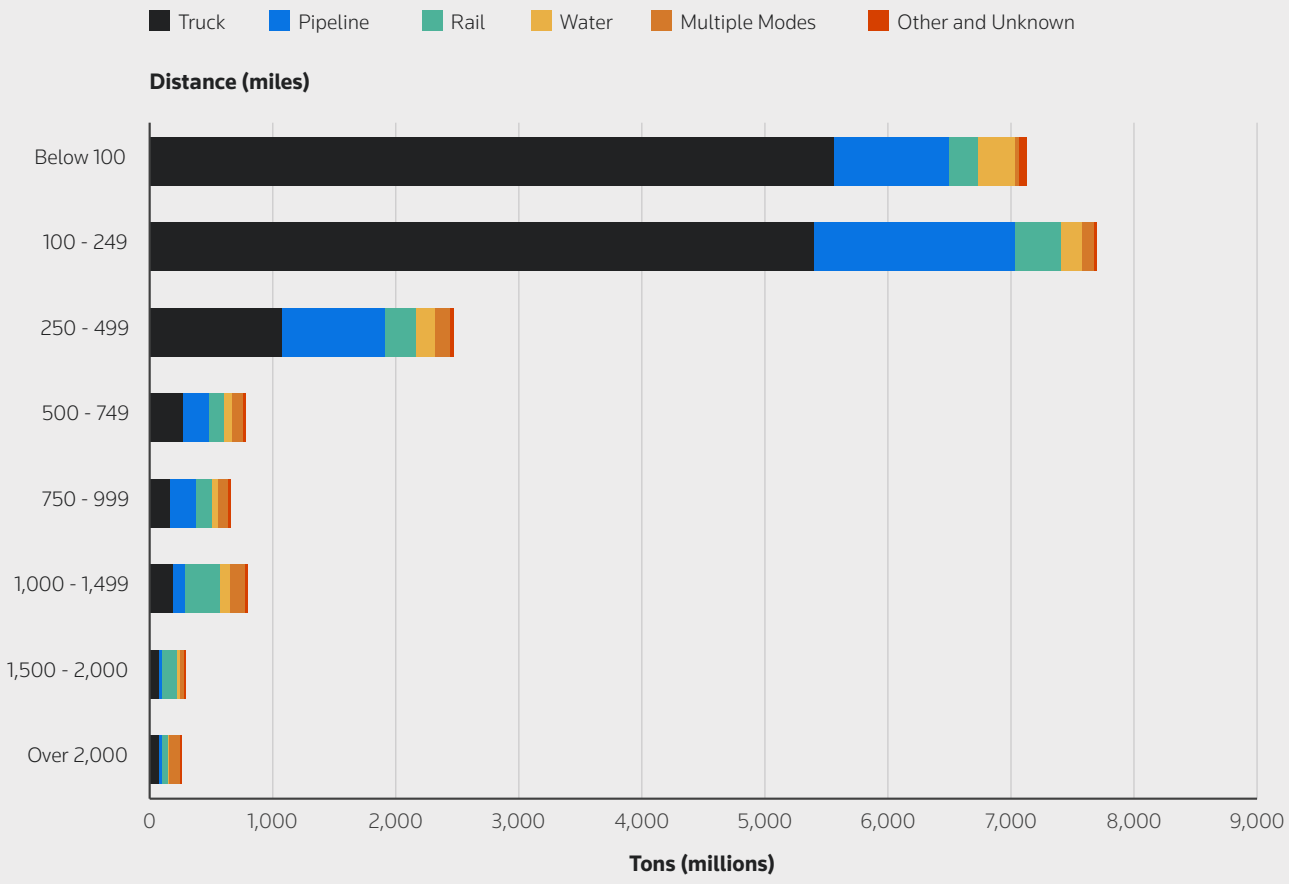
In road transportation, the question over future power sources seems clearer. A longstanding debate over whether trucks and lorries might best be served with hydrogen fuel cell or battery-electric drive trains is increasingly being settled in favor of the latter.[8]

"Fuel cell electric vehicles (FCEVs) are a mature technology, but battery electric vehicles, with their rapid and sustained growth, will outcompete FCEVs in most road transport segments," notes consultancy DNV in a recent report.[9]

FIGURE 3

Road transportation is the main freight transport mode in the U.S.

Weight of freight by mode and distance, 2023



Source: U.S. Library of Congress. [10]

But that does not mean all is done in terms of road transportation's energy transition. On the contrary "Electric vehicles introduce a risk profile that differs from traditional fleets" says Thomas Saive, AXA XL's Head of Underwriting for motor in Asia Pacific and Europe.

"The collision frequency appears to be comparable, or even improved, but the severity of losses can increase significantly due to repair costs, battery replacement due to repair and battery replacement costs."

These factors mean electric vehicles can cost between 20% and 25% more to repair than internal combustion models with equivalent levels of damage, says Poonam Sejpal, a London-based Head of Motor Underwriting for UK & Lloyds at AXA XL.

Another problem is that the rush to bring new electric models to market is stretching the capacity of repair facilities and body shops. "Last year we had four new manufacturers enter the UK market, which led to repair challenges due to supply chain, lack of bodyshops and skilled technicians that have the calibration equipment required to repair to manufacturer standards" Sejpal says.

In the motor market, this is leading to big delays for EV repairs, she says, with an average three-month repair time for one major electric vehicle manufacturer. It means the cost of repairs can exceed the cost of the vehicle, because of the need for replacement hire vehicles over long durations.

This is unlikely to be an option for freight vehicles, with truck electrification frontrunner the Tesla Semi selling for $290,000 and operators needing to keep the vehicle on the road for at least a couple of years to recoup the purchase price.[11]

For markets such as the U.S., where freight is overwhelmingly carried by road, it is unclear how the issue of EV truck repairs will be resolved.

THE POWER PROBLEMS FACING AIR AND RAIL

Rail and air account for a small fraction of global freight transportation — which is probably a good thing, given that both face significant challenges in moving away from fossil fuels. Rail transportation at least has the option of going electric, and some railways are already fully electrified.

But levels of rail electrification vary widely by country, with European rates going from 100% in Switzerland to just 3% in Ireland, for example.[12] And trackside power cables may not work for class 1 railroads in the U.S., according to industry sources.[13]

In air transportation, electrification is only an option for very short routes. Instead, the industry is looking at sustainable aviation fuels based on biofuels, which are hard to scale, or synthetic compounds, which are currently expensive and in short supply.

In June 2026, Willie Walsh, director general of industry trade body the International Air Transport Association, said it was becoming "more challenging" to meet a 2050 goal for transitioning away from traditional fuels. "We've not made the progress that we had expected," he said.[14]

CASE STUDY: **SUSTAINABILITY-LINKED INSURANCE HELPS RAIL OPERATOR TO REDUCE CARBON EMISSIONS**

SBB CFF FFS

Situation

SBB, Switzerland's national rail operator wanted to create a way to incentivize reductions in its carbon emissions across its operations. It hoped to adapt the concept of financial vehicles linked to sustainability targets, instead using insurance contracts.

Solution

- SBB agreed with AXA XL and two other insurers to include a flexible sustainability component to their property and casualty insurance contracts, linked to sustainability goals.
- This component directed a portion of funds from the structure to agreed sustainability projects. If the railway operator exceeded a pre-defined carbon emissions reduction target, the insurer would direct a rebate earned by the operator to the project, and if the target was missed the operator would contribute.

Outcome

A true win-win situation was created, where both parties have the chance to contribute to sustainability projects.

CONCLUSION: **RISKY PATHS CALL FOR EXPERT PARTNERS**

Weaning transportation off fossil fuels is not easy — and in some areas there is already a risk of missing global targets. For many transportation sectors, the adoption of more secure, affordable and sustainable sources of power will require major technological leaps and infrastructure buildouts.

This is an area that the insurance industry is well placed to support thanks to products and services including:

- Risk consulting, where insurance's deep pool of risk expertise is put at the service of clients. In transportation, for example, insurers can use crash and repair data to advise on which EV models might pose the least risk in a logistics fleet.
- Captive insurance, where corporations create and own licensed units to cover specific business risks. This can help spread the risks of emerging technology and is ideal for large-scale, country-level investments.
- Political risk, credit and bond insurance, which ensures business continuity and investor returns in the event of unforeseen geopolitical risks.

For transportation, the message is that energy transition risks do not need to be faced alone. Insurers have already worked hard to help de-risk renewable energy production and now stand ready to assist transportation in the quest for a more secure, affordable and sustainable future.

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