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DECARBONISING TODAY'S ENERGY SYSTEMS

ENERGY IN CONTEXT SERIES

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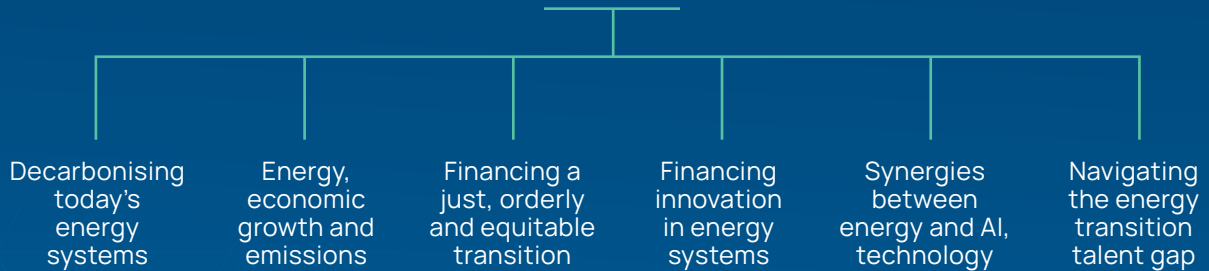
▶ WHAT IS THE ENERGY IN CONTEXT SERIES?

The transformation of the world's energy system offers a unique opportunity for economic growth, with the energy sector driving global advancement.

ADIPEC's **Energy in Context** series presents high-value briefs and case studies that showcase progress, foster dialogue and fast-track innovation to accelerate the energy transition.

The series explores key pillars driving the industry's transformative journey towards a secure, equitable, and sustainable energy future.

KEY PILLARS OF ADIPEC



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Decarbonising economies and our energy systems: how and why it must happen

The global economy needs to decarbonise if we are to halt global warming, and it must happen while still creating the energy required to power our future.

Now, the entire world is grappling with the need to transition the global energy system to one that delivers energy that is secure, sustainable, and equitable.

That presents an era-defining challenge, but where there is a challenge, there are solutions. And where solutions arise, so do opportunities.

To address the global energy trilemma, the wider energy ecosystem must evolve and grow. Ensuring that these changes take place quickly and effectively will require a number of broad actions. These include the provision of clean energy and climate finance, cross-sector collaboration, and the introduction of new technologies and policies that facilitate decarbonisation and enhance energy efficiency.

The complexity of the challenge ahead, and the potential solutions, are explored in the following report.



► The global challenge

US\$5.7
trillion per year

Amount of investments the 1.5°C Scenario will require until 2030⁴

The Paris Agreement in 2015 set out an ambition to limit global warming to below 2°C above pre-industrial levels and prevent temperatures from rising by more than 1.5°C – in part by pursuing net-carbon neutrality by 2050¹.

The substantial reduction of carbon dioxide (CO₂) and other greenhouse gas (GHG) emissions will limit the increase in global temperature. To achieve this, industries need to decarbonise.

Decarbonisation in this context refers to the reduction or elimination of carbon dioxide emissions from human activity, including processes such as manufacturing and energy production.

In practice, getting to net-zero emissions requires shifting from fossil fuels to alternative low-carbon energy sources. However, the switch to low-carbon energy sources must be balanced with equitable global economic development and prosperity, especially as electrification grows in emerging economies.

Energy accounts for more than three-quarters of annual GHG emissions, according to the International Energy Agency (IEA), with 80.3% of the global energy mix still sourced from fossil fuels².

However, the IEA's 'CO₂ Emissions in 2023' report found that clean energy growth had limited the annual increase of energy-related global emissions to 1.1% in 2023, down from 1.3% in 2022.

Meanwhile, emissions from advanced economies fell 4.5% – a record decrease³.

The International Renewable Energy Agency (IRENA) says in its 'World Energy Transitions Outlook 2023' that the success of the energy transition rests upon the transformation of the global energy sector from fossil-based to zero-carbon sources by the second half of this century⁸. But it warns decarbonisation requires "urgent action on a global scale to accelerate" the transition and realise the decarbonisation commitments of nations and regions⁸.

Between 2019 and 2023, total energy-related emissions increased around 900 Mt. Without the growing deployment of five key clean energy technologies since 2019 – solar photovoltaic, wind, nuclear, heat pumps, and electric cars – the emissions growth would have been three times larger³.

"An aggressive energy efficiency strategy, combined with the ramping up of renewables to replace fossil fuels, is the most realistic path towards halving emissions by 2030," IRENA says in the Energy Transition Outlook⁴.

"Yet phasing out fossil fuels is a complex task for countries heavily reliant on coal – especially given the imperatives of a just and fair transition for workers and communities. Concerted action and international co-operation are therefore essential for timely progress."

That includes energy efficiency, something the IEA says represents more than 40% of the emissions abatement needed by 2040⁵.

What is clear is that we must act if we are to avoid the worst consequences of climate change.

The impact of rising temperatures is already being felt. Extreme heat in developing countries has led to drought and failed crops while in other nations shifting weather patterns have brought deadly storms, extensive flooding and devastating forest fires. These events can, in turn, result in poverty, population displacement, food shortages, rising sea levels, and loss of species.

► Creating a connected energy future

Energy is a core need for all people, making its supply, cost, security, and impact very important. The complex challenge of ensuring that all of these conditions are met is encapsulated in the term 'energy trilemma', coined by the World Energy Council to refer to the need to ensure that energy is affordable, secure, and sustainable.

Meeting the challenges of the energy trilemma is a major focus of the global energy industry today. Across the sector, efforts are being undertaken to increase sources of low and zero-carbon fuels, improve energy efficiency, and mitigate emissions, all while ensuring a stable and accessible energy supply for consumers.

But these elements cannot be addressed solely at the company or even country level. They urgently require a unified, open platform for high-level, action-oriented dialogue that drives collaboration*, alignment, and investment across the three vectors of the trilemma, to bring about a just and equitable transition to a low-carbon economy.

By exploring all sectors and solutions – spanning from energy, technology and finance and including government and non-government entities – there can be true progress towards decarbonisation while capitalising on the many development opportunities that offer attractive economic potential from across the energy spectrum.

While the application of nascent and fast-evolving technologies including artificial intelligence can help facilitate the seamless integration of renewable energy and other energy sources, much more needs to be done on both sides of the energy equation across delivery and consumption.

*Join the **ADIPEC Strategic Conference** session “*Accelerating Decarbonisation through Mutually Beneficial Cross-Sector Partnerships*” to hear how various sectors are working together to speed up the energy transition.

With that action comes the need for a comprehensive set of policies, covering all technological avenues, in order to achieve the necessary levels of deployment by 2030. Nations can be unified by a holistic global policy framework, enabling a just transition that strengthens international finance flows, capacities and technologies, and leaves no one behind.

Progressive policy and regulatory measures would generate greater benefits from the energy transition for all and pave the way for broader international collaboration for the greater good.



► What are the key energy transition enablers?

In addition to the main pillars of decarbonisation*

in the Net Zero Emissions by 2050 Scenario – namely energy efficiency, renewables, low-emissions fuels, and carbon capture technologies – the IEA identifies “cross-cutting enablers”. These include innovation, international collaboration, and digitalisation, accelerating progress by strengthening policy or providing more effective technological solutions.

Digital technologies offer huge potential to help the energy system get on track with a net-zero pathway that will also rely on emerging energy technologies not yet ready for widespread use, including hard-to-abate sectors like long-range transport.

International coordination is essential to provide the necessary policy impetus and to ensure all countries have the support that they need to advance their energy transitions.

* Join the **ADIPEC Strategic Conference** session “*Transition and innovation: how companies are shaping the future of energy*” to hear Energy leaders on how their organisations are navigating the energy transition.



▶ Collaborative action to advance energy decarbonisation

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An aggressive energy efficiency strategy, combined with the ramping up of renewables to replace fossil fuels, is the most realistic path towards halving emissions by 2030.”

International Renewable Energy Agency

The complex and interconnected nature of the global energy system and our climate means that the large-scale decarbonisation required for the energy transition cannot be achieved by one country or region alone. Collaboration is, therefore, a key component on the pathway to realising decarbonised energy goals.

Cooperative efforts between major energy players, governments or emerging disruptors, are essential and in many cases are already showing promise and yielding results. Successful alliances and shared projects can form the template for viable solutions and galvanise new opportunities that can be scaled or adopted across other territories and markets.

International collaboration on technology and innovation will help drive the global decarbonisation agenda. Examples include TotalEnergies joining seven major companies to create the 'e-NG Coalition' supporting the development of production and use of electric natural gas (e-NG), a sustainable fuel that can be transported and stored using existing infrastructure.

Meanwhile, Shell, Schneider Electric and AVEVA are working together to explore opportunities to co-develop integrated end-to-end energy solutions to power decarbonisation in hard-to-abate industries, which include steel, cement and shipping.


In Europe, ExxonMobil and FuelCell Energy have been leading efforts in global-scale carbon capture using molten carbonate

fuel cell technology, focusing on both gas-fired and coal-fired plants.

In December 2023, the Oil and Gas Decarbonisation Charter (OGDC) was launched during COP28, in Dubai. Billed as a “unique collaboration”, it seeks to decarbonise the oil and gas sector and the 53 signatories so far represent more than 42% of global oil production. The participants have committed to net-zero operations by 2050, to ending routine flaring by 2030, and more than 50 companies are set to collaborate on implementing the charter and advancing the sustainable socio-economic development agenda.

And in 2020, His Majesty King Charles III, then The Prince of Wales, founded the Sustainable Markets Initiative to facilitate a coordinated global effort to enable the private sector to accelerate the achievement of global climate, biodiversity and Sustainable Development Goal targets. In this regard, it has produced the Energy Transition Task Force to determine how entities across the energy value chain can play a leading role in driving and accelerating the transition.

The Energy Transition Task Force has identified a need for:

-  **Global frameworks** for regulation and policy on emissions abatement to ensure a level playing field across regions and industries, along with more alignment on carbon accounting practices.
-  **Policy and incentive support** as demand for green products grows with policymakers implementing incentives and regulations that encourage sustainable procurement practices.
-  **Policymakers to ensure subsidies**, incentives, and regulatory frameworks are in place to support the required rapid scaling of energy infrastructure and capacities.
-  **Establishment of transformational investments** including funding programmes, grants, subsidies, and low-interest loans specifically targeted at supporting the adoption of low-carbon solutions across sectors.
-  **Governments to support adoption and advancement** of low-carbon technologies by further increasing funding and incentives for green technology-related research, patents, and piloting.

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► The role of the circular economy in the energy trilemma

Another element of decarbonisation is the reduction of consumption overall. This can be achieved by focusing on developing a circular economy, which is an economic system in which the reuse and regeneration of materials or products is at the core.

In the context of decarbonisation, the application of circular economy practices can contribute to the efficient use of energy by creating a regenerative system where waste is minimised, materials are continually reused, and resources are optimised.

A briefing document on the subject by the European Environment Agency (EEA) in February 2024 outlined how waste and circular economy actions can contribute to reducing demand for new primary resources and the associated GHG emissions linked to their extraction and processing. It described the circular economy as important to reducing emissions through more efficient material flows.

“Countries can uncover policy opportunities for additional emission reductions by better integrating circular economy actions into national climate policies,” the document states.

Even our transition to clean energy can be made more ‘circular’. For example, with around 78 million tonnes of solar panels forecast to be decommissioned globally, according to the IEA⁶, and 43 million tonnes of wind turbine blades ending up in waste by 2050⁷, it is critical that circularity be worked into renewable energy technology design for longer life and disposal planning.

Some progress is already being made on this front. In 2021, Siemens Gamesa launched the world’s first wind turbine blade that can be recycled at the end of its lifecycle. Meanwhile, Australian researchers currently lead in developing techniques to make solar panel recycling more viable.

The Ellen MacArthur Foundation, a non-profit organisation committed to accelerating the transition to the circular economy,



The circular economy gives us the tools to tackle climate change and biodiversity loss together while addressing important social needs.”

The Ellen MacArthur Foundation

says: “The circular economy gives us the tools to tackle climate change and biodiversity loss together while addressing important social needs. It gives us the power to grow prosperity, jobs, and resilience while cutting greenhouse gas emissions, waste, and pollution.”

► Leveraging existing energy industry expertise and resources

Decarbonisation continues to be a long-term global goal, but the security of energy supply is critical for the day-to-day functioning of the entire world and the economic progress of every population.

Energy from renewables continues to scale, but hydrocarbons will also continue to play a significant role both in energy delivery now, and in enabling the energy transition that is coming.

The oil and gas industry also has the capital – both human and financial – to drive and enhance the transition process by applying its workforce expertise alongside the financial investment required to scale new fuel development and adoption.

In its December 2022 report into how the industry could “lead the race to decarbonisation”, consulting and strategy firm EY identified five ways oil and gas companies were “primed to accelerate the development and commercialisation of the renewable technologies” that will drive the energy transition⁹:

► **Capital strength** - The sector has enduring experience in raising capital – including in extremely competitive markets – alongside maintaining robust balance sheets and consistent returns.

► **Market intelligence** - The sector has long harnessed market intelligence to direct the right energy to where it is needed when required, and at the right price, something crucial as renewable energy markets develop at pace, technology advances and clean energy options grow, adding complexity to choices about the best fuel source for each initiative.

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- **Supply chain excellence** - Rich experience in managing complicated global supply chains, optimising assets and mastering the logistics of delivery will be valuable in a more complex, connected renewable energy market as renewable energy projects around the world scale and require complex ecosystems of suppliers, partners and assets.
- **Cost optimisation through technology** - Tough economic conditions, such as higher inflation or supply chain costs, make it tougher to deliver large-scale clean energy projects on budget. Oil and gas companies' abilities to use digital technology to reduce costs and improve productivity can be used to help ease profitability pressures likely to intensify as competition increases between conventional and green energy.
- **Risk management** - Oil and gas companies are highly skilled in identifying and mitigating risks inherent in large projects, as well as those that come from operating in multiple jurisdictions, in a highly volatile market where there is the possibility of project cost overruns and delays.

➤ Transition progress to a decarbonised world requires finance:

US\$700
billion

Annual fossil fuel investments that should be redirected to energy transition technologies⁴

What is clear is the energy transition will be costly as well as long. To achieve a scenario where the world's average temperature does not exceed that of preindustrial times by 1.5°C will require investments of US\$5.7 trillion per year until 2030, the IRENA World Energy Transitions Outlook 2023 states⁴. But investment decisions are long-lived and the risks of stranded assets are high, so decisions must be guided by long-term logic⁴.

The World Energy Transitions Outlook estimates that US\$700 billion of annual investments in fossil fuels should be redirected towards energy transition technologies.



The private sector is expected to provide most additional capital, through allocations like that of ADNOC, which in January boosted its budget for landmark decarbonisation projects, technologies and lower-carbon solutions to US\$23 billion.

On the public funding side, however, IRENA says allocations must be doubled to catalyse private finance and create an enabling environment for a transition yielding optimal socio-economic gains, including transition-related jobs and GDP⁴.

In the meanwhile, numerous financial instruments are available to help fund decarbonisation efforts at different scales and for different situations, ranging from carbon credits and green bonds to energy efficiency-linked mortgages, international grants and funds, and even crowdfunding at a citizen level.

► Embracing change, collaboration and opportunity*

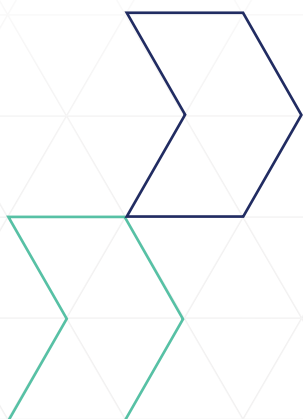
There is no backing away from the need to decarbonise our economies. And there is no denying that achieving a just and equitable energy transition represents an era-defining challenge.

It also presents a generational opportunity for innovation, equitable growth and prosperity that can shape our planet's future for the better.

Collaboration and action – as well as a realistic grasp of transition timelines and methodology – are critical to ensuring the energy transition can deliver a level of economic development not witnessed since the First Industrial Revolution.

Enabling and accelerating a just and orderly energy transition demands enhanced cooperation and alliances between multiple

* Join the **ADIPEC Finance & Investment Conference** session *"Bridging the gap: energy and financial cross-sector collaboration to advance new projects"* to hear how leading investors and banks can collaborate with the energy industry.



stakeholders. This can be facilitated through open and inclusive discussions, including multiple sectors and geographies that identify opportunities for collaboration, enable adaptation of innovation, and facilitate finance and investment.

By connecting industry and political leaders across the entire wider energy ecosystem, we can unleash the power of equitable, sustainable and secure energy as a catalyst for shared global prosperity and well-being.

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