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ENERGY, ECONOMIC GROWTH AND EMISSIONS

ENERGY IN CONTEXT SERIES

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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

- Decarbonising today's energy systems
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- Financing a just, orderly and equitable transition
- Financing innovation in energy systems
- Synergies between energy and AI, technology
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Energy is at the centre of almost everything we do and has been for generations. But as the world works to account for the consequences of more than a century of increasing emissions from our energy system, nations are examining how to take the energy transition forward while still growing their economies. The challenge is how to balance economic growth while protecting the environment, a huge and systemic challenge that requires ensuring that global energy supply and economic outputs are as low-carbon as possible.

Better methods

Smarter ways of working have gradually been tipping the balance away from uncontrolled greenhouse gas (GHG) emissions, which are the main cause of human-driven global climate change. In January, the International Energy Agency (IEA) suggested that most economies had experienced a "growing divergence" between emissions and economic growth as they displayed "steady improvements" in energy intensity[1].

Advanced economies account for well over half of global GDP and more than one-third of energy demand "In advanced economies, continued growth in GDP has been accompanied by a peak in CO2 emissions in 2007, followed by a decline. In the United States, GDP has doubled since 1990, but CO2 emissions have returned to the level back then. In the case of the European Union (EU), the economy is 66% larger now, while CO2 emissions are 30% lower than in 1990,"[1] Siddharth Singh, an IEA energy investment analyst wrote.

Other economies

The GDP growth vs emissions picture has also been improving in many emerging and developing economies, according to the IEA:

- **China has witnessed** 14-fold growth since 1990, yet its CO2 emissions are only five times what they were in 1990.
- **India's GDP growth** has outpaced its CO2 emissions, rising by more than 50%.
- **Other emerging and developing economies**, such as those in Africa, Eurasia and Latin America, have also seen divergent trends between economic activity and emissions.[1]

Room for improvement

However, not all nations can declare a weakening of the link between economic growth and emissions.

- **In Southeast Asia** hydropower has not kept pace with rising electricity demand while the share of coal in power generation and industrial energy demand more than doubled between 1990 and 2022[1].

In the Middle East, the availability of cheap fossil fuels, inefficient subsidies for fossil fuel consumption, and the doubling of energy intensity in industry between 1990 and 2022 has meant that twice as much energy is now needed to generate the same unit of industrial activity in the region than three decades ago, said the IEA[1].

So how do we change the equation?

The transformation of the world's energy system represents an unparalleled opportunity for economic development not seen since the First Industrial Revolution. With the current pace of development, there is room for optimism. Based on today's policy settings (the Stated Policies Scenario, or STEPS) the IEA's World Energy Outlook forecasts the continued loosening of the relationship between GDP and CO2 emissions accelerating across the board and leading to a global CO2 emissions peak well before 2030, even as global GDP continues to grow. This can be attributed to various factors:

Swift increase in energy investment growth – For every US dollar spent on fossil fuel infrastructure, only 50 cents was spent on clean energy 20 years ago. That scenario has altered dramatically since; the ratio increased to 1:1 in 2016. In 2024, US$1.8 is invested in clean energy for every dollar invested in fossil fuels[1].

Rise of electrification – This switch in fossil fuel and clean energy capital flows is evidenced most in the electricity sector where the share of low-emissions generation – renewables and nuclear – is already above 40%, with the IEA suggesting all forecast growth in electricity demand through 2026 will be met from low-emissions sources.

This is combined with the growing global electrification trend, including the uptake of electric mobility, electrification of industrial and agricultural processes, and electric cooking. This enables emissions reductions as well as intrinsic gains in efficiency, such as electric motors compared to those fuelled by fossil fuels.

Technical energy efficiency gains – A broad range of energy-consuming devices, from industrial boilers and refrigerators, to air conditioning units and vehicles, employ technologies that are becoming more efficient. This has meant, since 1990, a 36% decline in the amount of energy required to generate a unit of global GDP. A major escalation in action resulted from the 2022 energy crisis as nations representing 70% of global energy demand introduced or significantly strengthened efficiency policy packages.[1]

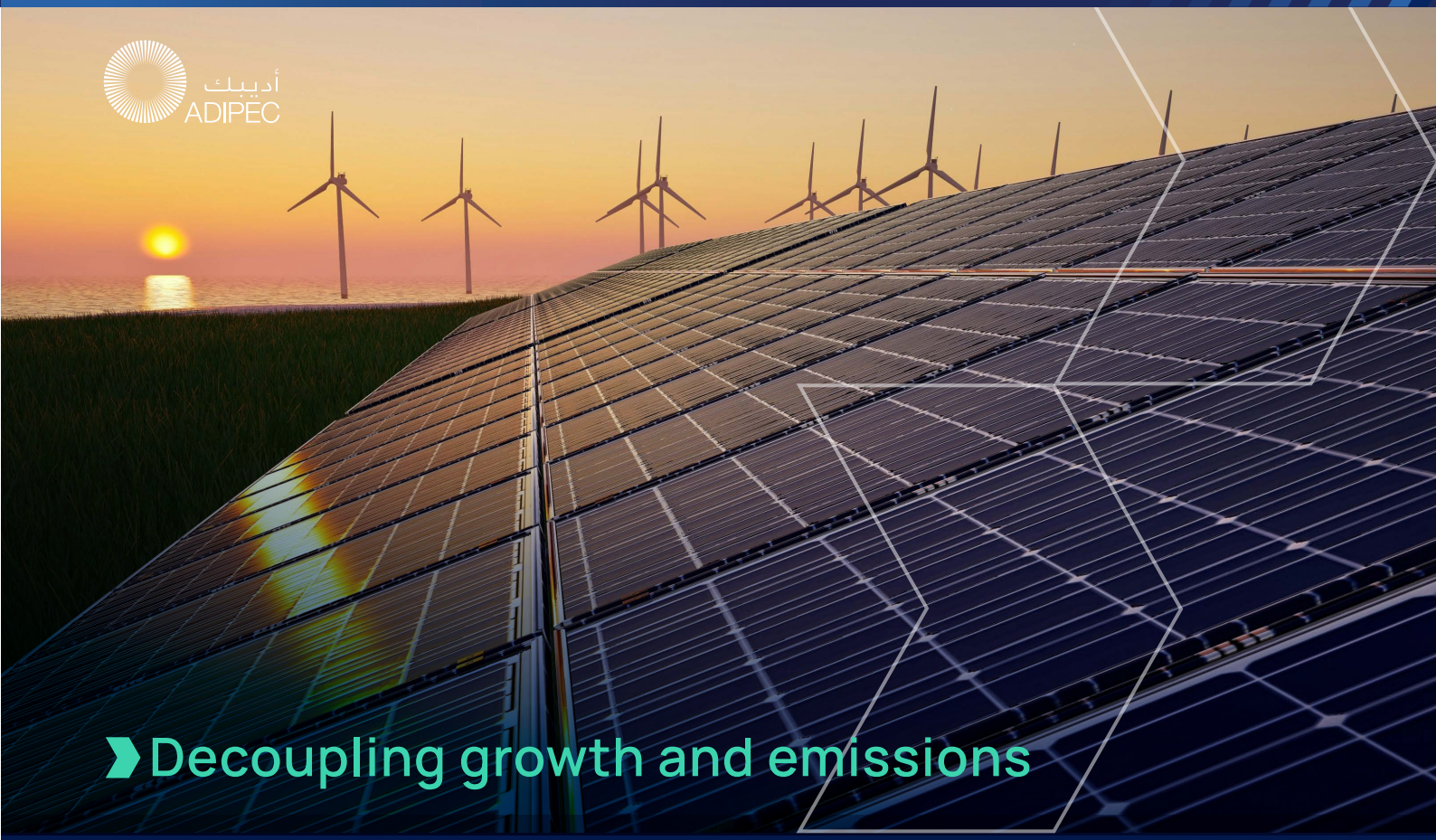
Less role for coal – The attractiveness of coal has diminished for many advanced economies. In the US, for example, a surge in production of cheap domestic natural gas has been driving a switch from coal to gas-fired power generation. This is in parallel to the rapid growth in renewable electricity generation capacity.

All of this feeds into economic growth as the focus shifts to new energy sectors and the revenue and jobs they create.

The industrial nuances of the transition can play a significant role in redefining the relationship between economic growth, energy and emissions, notably in the form of how to deal with existing emissions. That's why the pursuit of energy security and the global energy crisis has prompted governments, energy investors and companies to recalibrate their strategies in balancing sustainability, affordability and supply security – and in some cases adding a layer to the energy trilemma.

As OPEC Secretary General Haitham Al-Ghais said at CERAWeek last year: "Maybe the trilemma should become the quadrilemma and add to it energy reality… The sense of reality and realism and practicality when we talk about energy transition is what I would add to that energy trilemma."

While the disruption to global energy markets has been a stark reminder to global policymakers of the urgent need to reduce the dependency on a single fuel source, drastically replacing all hydrocarbons with renewables is neither realistic nor possible with current technology, a position that has been repeatedly underscored by stakeholders across the spectrum of the industry. According to Al Ghais, the focus of the energy transition should be on curbing emissions rather than securing specific forms of energy[2].



Decoupling growth and emissions

> "The golden question facing our societies today is how to continue expanding our economic goods while reducing the ensuing environmental bads."
>
> **Nathalie Girouard, Head of Environmental Performance at OECD**

Noting how the energy ecosystem could help spur economic growth across various forms of energy without carbon emissions and environmental damage, the United Nations' SDG Action stated: "To achieve the [UN Sustainable Development Goals], or even just retain what we have, that link needs to be broken." It said the decoupling process has started but will need to be "total".

Nathalie Girouard, Head of Environmental Performance and Information Division Environment Directorate, Organisation for Economic Co-operation and Development (OECD), said: "The golden question facing our societies today is how to continue expanding our economic goods while reducing the ensuing environmental bads."[3]

The idea of decoupling environmental pressures from economic growth was one of the main objectives of the OECD Environmental Strategy for the First Decade of the 21st Century. The strategy involved implementing structural changes to create a more sustainable economy that can stand the test of time, outgrowing itself and its own impacts. Girouard said: "Experience in the OECD area over the past three decades shows us that decoupling GHG emissions from economic growth is not only possible but well on its way."

She cited 2021's International Programme for Action on Climate (IPAC) for supporting the journey towards a more sustainable economy by 2050 through measures like price signals. These signals, she said, have been instrumental in leading the way for the substitution of fossil energy and the decoupling of emissions from economic growth, while the Climate Action Dashboard has helped track climate-related tax revenue, effective carbon rates, and climate policy stringency, providing real-time impact data[3].

Challenges and hope ahead

According to the IEA, the "significant loosening of the ties between GDP and CO2 emissions" – as seen in the STEPS – is not enough to reach global climate goals. "What is needed is to break this relationship completely," said Singh, as prescribed in the Announced Pledges Scenario (APS) in which all countries achieve their national energy and climate goals in full, and even more quickly in the Net Zero Emissions (NZE) by 2050 Scenario, which represents the pathway to limit global average temperature rise to 1.5 degrees above pre-industrial levels in 2100[1].

According to Nobuo Tanaka, Executive Director-Emeritus of the IEA, adding another decade to the energy transition and reaching net zero by 2060 could help with a better transformation of the energy sector, as well as preparing for the adaptation. "But do we have that time? While being pragmatic, we have to be aware that the risk is lurking, and we cannot be complacent," he said.

"We have to do our best to innovate and to put our investment into the necessary areas as quickly as possible. Maintaining that delicate balance between technology, the supply side as well as lowering emissions needs a long list of actions, but at this moment, the most important thing is that governments must work and prepare the environment – with the two main pillars being regulation and carbon pricing."

The economics of carbon capture

Tanaka cited the prospect of developments such as direct air capture (DAC) as potentially impactful. "If the cost of DAC becomes low enough, we don't have to be bothered by difficult technologies to decarbonise in heavy industries like steel or cement," he added, while also talking of the need for governments to go beyond simply financing research and development for new technologies to focus on scaling up and providing the finance for their deployment.

Mitigating the emissions of our carbon-producing energy systems requires the development of technologies and systems to capture carbon. And capturing, transporting and storing greenhouse gas emissions from fossil fuel power stations, energy-intensive industries, and gas fields and injecting it back into the ground will come at a cost.

Deloitte describes CCS as a multi-billion capital project with perceived high risks while Wood Mackenzie estimated the full cost of CCS projects – including capture, transportation and storage – as ranging from US$20-150 per tonne of CO2, with the average weighted cost at US$58 per tonne. It estimated that global carbon capture capacity can surge up to 440Mtpa and storage capacity will go up to 664 Mtpa, requiring US$196 billion of total investment by 2034[7].

It's report CCUS: 10-year market forecast said nearly half of the investment globally is associated with CO2 capture, with the remaining US$53 billion from transport and US$43 billion from storage. About 70% of the investment will be in North America and Europe across the value chain, it says.

There are around 45 commercial capture facilities operating globally, with a total annual capture capacity of more than 50 Mt CO2. Up to 10 large-scale (capture capacity over 100,000 tCO2/year, and over 1,000 tCO2/yr for direct air capture applications) capture facilities entered operation in 2023[6].

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> Haitham Al-Ghais, Secretary General of OPEC

Enabling carbon capture to have a meaningful impact on the global energy transition requires multiple possible capture, storage and use routes, beyond carbon capture, utilisation, and sequestration (CCUS). Speaking about CCUS, Howard Herzog, Research Engineer at the Massachusetts Institute of Technology's Energy Initiative, said: "There is no 100% solution… we need a lot of 10-20% solutions, and this is one of them." There are ready commercial uses for CO2 – such as for carbonated drinks and oilwell injection – but many can still result in the eventual release of the gas, requiring the development of more permanent sequestration solutions[4].

Even with the large, forecasted increase in projects, Wood Mackenzie does not expect supply of carbon capture to meet demand. It says industries will need up to 640 Mtpa of carbon capture capacity by 2034 as they look to decarbonise; projects expected to come into operation fall around 200 Mtpa short of that[7].

CCS faces key challenges including cost, regulatory requirements, storage capacity, technical difficulty and potential economic barriers - plant operators must balance the cost of CCS implementation against the financial benefits of continued operations and financial incentives such as tax credits, subsidies and monetisation opportunities.

Public perception can also be an issue as critics have raised concerns about safety, the impact of long-term storage, and CCS effectiveness.

Seizing opportunities driven by global collaboration

As this exploration of the need and ongoing efforts to decouple carbon emissions from economic growth illustrates, it is impossible to address these tightly bound outputs at a company or country level alone. Instead, what is urgently needed is a unified, open platform for high-level, action-oriented discussions that drive collaboration, alignment, and investment across the three vectors of the trilemma.

It is only by exploring all sectors and solutions, spanning energy, technology, finance, government and non-government organisations, and capitalising on the many development opportunities that offer attractive economic potential from across the energy spectrum, can the world collectively create a new energy agenda that limits emissions while enabling economic growth.

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