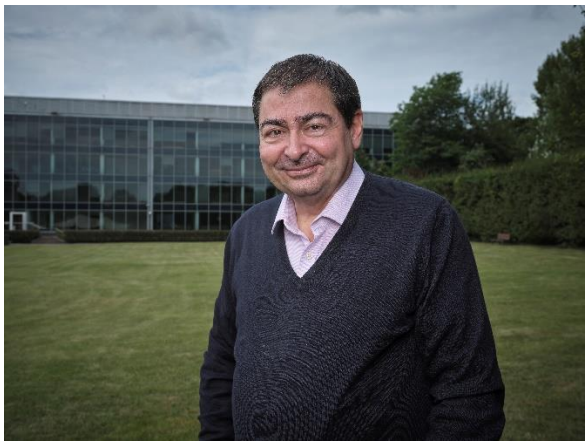
DISCUSSION PAPER

ADOPTING A TECHNOLOGY NEUTRAL APPROACH FOR SUSTAINABLE AND INCLUSIVE MOBILITY

Foreword



Bosch is a leading global supplier of technology and services. For more than a century we have been at the cutting edge of technology in mobility and many other sectors, and it's been quite a journey throughout that time. The speed of change has constantly accelerated, and in parallel so has the focus on climate-friendly technologies.

Much of the legislative framework that we've been working within has been too prescriptive. For example, in the mobility sector there are many ways to power zero or low emission vehicles. We're determined to show that across all industries a technology neutral approach is much better for everybody – from consumers to legislators, from businesses to manufacturers. And most of all, for the climate too.

When we talk about technology neutrality, a good example is hydrogen. It has clear use cases in mobility, in heavy industry, and in home heating. Yet it seems many people take a strong view on hydrogen, whether for or against. This isn't right.

We should acknowledge how useful hydrogen can be in providing a solution to industries that would otherwise be hard to decarbonise[1].

Hydrogen is by far the best way to store and transport green energy over long distances[2]. One day heavy commercial vehicles on our motorways could be powered by hydrogen and could be emitting nothing but water, and many businesses in the UK are already installing industrial boilers that can run on hydrogen[3].

This Discussion Paper aims to explain why hydrogen is needed and how it can become an everyday fuel in the UK and across Europe. A fuel that will enable us to reach our legally binding goal to reach net zero.

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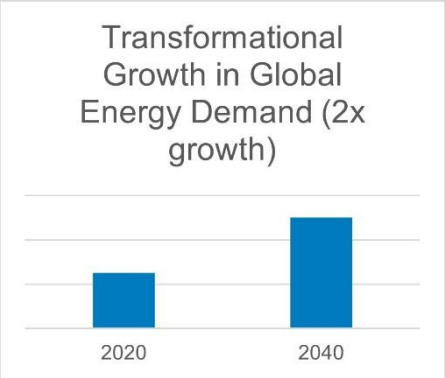
Energy Transformation, Hydrogen, and the Role of Regulators

Current Power Generation Mix

In the UK and across major European nations, renewable energy sources such as wind, solar photovoltaic, hydro, and biomass currently account for half of the electricity mix, while fossil fuels (gas, coal) and nuclear make up the remainder[4].

Power demand is projected to increase significantly by 2040, potentially doubling current levels[5]. This surge will be driven by the electrification of key sectors such as road transport, industrial production, and heating. Vast data centres developed to power the surge in artificial intelligence will contribute to the problem.



With great effort, renewables, particularly offshore wind, will see considerable growth from their current levels[5,6,7], but the anticipated demand will result in renewables comprising at best 50% of the overall electricity generation mix by 2040[8]. This growth is potentially constrained by factors such as the availability of wind turbines, offshore infrastructure, and supply chains for related components.

As a combination, the traditional power sources, gas, coal, and nuclear will likely increase in absolute terms, but with demand doubling their share in the overall mix will decrease.

The Challenge: Power Supply Gap

Although UK **electricity demand** is expected to as much as **double by 2040**, and collectively the output of gas, coal, and nuclear energy might rise, their share of the total energy mix will see decline.

We therefore see a substantial power supply gap, which must be filled. And in light of the UK and EU's climate-neutrality goals, this **gap must be filled by non-fossil fuel sources**.

Global Solutions: Partnering with the Global South

Several countries in the Global South, particularly in regions like the Middle East, Africa, and South America, possess significant potential for producing green power through solar and wind resources at very competitive costs and above their current demand[9].

These regions are already developing renewable energy projects[10] to support local demand[11] and could also serve as strategic partners for Europe in meeting its future energy needs.

The potential offtake from these countries is a critical opportunity for the UK and Europe. If we can work with those countries to increase their energy production and offtake the excess, we can then transport that energy from where it's produced to where it will be used.

Therefore, resolving the power supply-demand imbalance requires effective methods to store and transport green power produced in the Global South.

Hydrogen: A Key Alternative for Transport, Storage and Energy Security

1. In the Global South, we can use green power to produce, from seawater via electrolysis, hydrogen and related products, such as ammonia and hydrogen-based synthetic fuels that can be shipped via sea vessels[12].

2. On a smaller scale, hydrogen can be transported in gaseous form via pipelines from nearby regions, such as North Africa and the Caucasus, to Europe[13].

3. Large-scale green hydrogen production in Europe will likely play a limited role, as local green power will primarily be used for electrification in sectors like transport, industrial production, and heating. However, hydrogen can be a crucial solution for power storage during periods of surplus from solar and wind production[14].

4. To facilitate this, governments must urgently negotiate long-term, binding agreements within the framework of international energy partnerships to trigger necessary investments. The private sector will need to support and commit to such agreements.

5. In the wake of the war in Ukraine, European governments are wary of new energy dependencies on autocratic regimes. However, this risk can be mitigated by diversifying energy sources and maintaining emergency backup solutions such as gas and coal.

6. On the demand side, it is critical to foster the development of technologies capable

of utilising hydrogen in gaseous or liquefied form, ammonia, or hydrogen-based synthetic fuels. This includes fuel cells, hydrogen internal combustion engines, and hydrogen boilers.

7. Synthetic fuels in particular will play an important role in applications such as aircraft, ships and freight trains, but also in road traffic, allowing decarbonisation of existing vehicle fleets which would otherwise take many decades to phase out[15.]

8. While renewable fuels from biomass such as HVO are not fully carbon-neutral, they can equally make an important contribution during a transition phase as long as they are not produced in competition to food production.

9. Critics often argue that hydrogen and its derivatives are inefficient and costly due to energy losses during production. However, the capital costs of solar installations have significantly decreased in recent years[16]. When factors like land availability, sunlight hours, electrolyser efficiency, and economies of scale are favourable, the inefficiencies in hydrogen production become negligible.

The Role of Regulators

Governments should focus on setting challenging yet realistic long-term CO_2 reduction targets and avoid making mid-course adjustments. Regulations should not favour specific technologies over others, nor should they ban particular solutions.

Innovation incentives should meet three criteria:

i) they should reward consumers rather than penalise manufacturers
ii) they should align with existing market trends instead of creating new ones
iii) and they should remain technology neutral.

Building on the improved UK/EU relationship we must keep UK regulatory frameworks for hydrogen and renewable energy aligned with the EU. This will ease cross-border trade in clean energy technologies and fuel products.

Adopting a Technology Neutral Approach for Mobility

- Achieving a fast, resilient, and sustainable contribution to reducing CO_2 requires embracing all technologies that support decarbonisation efforts.

- A holistic approach, incorporating all technologies, is necessary to achieve realistic decarbonisation goals, empower supply chain resilience, and provide consumers with more choices.

- Battery electric vehicles (BEV): This technology will likely be the primary route to decarbonise road traffic. It is particularly suited for densely populated areas with medium travel distances and sufficient idle periods for charging. Its consolidated CO_2 footprint ("well-to-wheel") is up to 50% below a comparable petrol vehicle[17]. Hybrids and range extenders can compensate for range and charging infrastructure limitations.

- Hydrogen fuel cell vehicles (FCV): The benefits of this technology include local CO_2 neutrality, a long range, and rapid refuelling. This technology is particularly suited for heavy goods vehicles with their heavy payloads and long daily travel distances.

- Hydrogen combustion engines (H2E): These engines demonstrate a direct CO_2 reduction, with no significant difference between fuel cell or battery electric vehicles in terms of air quality.

- Synthetic and renewable fuels: While there will be limited availablity for some time, they can make an important contribution to reduce CO_2, particularly with existing vehicle fleets.

Summary

There are two ambitions that will have a significant impact on the ability of the UK and Europe to have a future energy mix that's cost effective and, most importantly, reliable. These are:

- The ability to generate green electricity locally
- The ability to import hydrogen and related products to use on an everyday basis

Further, governments must urgently negotiate international energy partnerships and adopt a technology-agnostic approach to regulations to meet net zero targets.

Key policy recommendations[18].

Encourage Technological Diversity: Allow a range of technologies to contribute towards CO_2 targets in road transport.

For example, China's tax exemption policy for 'new energy vehicles' includes battery electric vehicles, plug-in hybrids and hydrogen fuel cell vehicles; and on the commercial vehicle side, it expects a significant proportion of decarbonisation to be delivered by improvements in engine efficiency and hybridisation.

Extend Plug-in Hybrid Use: Permit plug-in hybrids, including range extenders, beyond 2035, as seen in markets like China and the US.

For example, in California plug-in hybrids have been instrumental in reducing greenhouse gas emissions while providing consumers with greater flexibility. By extending the use of hybrids, governments can ease the transition to full electrification.

Create a Low Carbon Fuels Category: Introduce a category for vehicles using low carbon fuels.

For example, Brazil has successfully implemented policies supporting the use of biofuels, particularly ethanol from sugarcane, which has significantly reduced CO_2 emissions in the transport sector. The country's blend mandates for ethanol in gasoline, which has led to a substantial decrease in fossil fuel dependency.

Adopt Life-Cycle Approaches: Apply consistent, well-to-wheel approaches, and develop a consistent method of measuring the well-to-wheel impact of different technologies.

For example, the Department for Transport has adopted a life cycle analysis framework to evaluate the emissions associated with various fuel types, which ensures that policies are based on comprehensive environmental assessments. This can guide investments in low-carbon technologies and help to inform consumers about environmental impacts.

Reference Links

1. Hydrogen update to the market: July 2025 Pg 9-14
2. Longer duration energy storage Pg 4
3. Green whisky: The distilleries turning to hydrogen for net zero in Scotland
4. Energy Trends September 2025
5. The Seventh Carbon Budget - Climate Change Committee
6. Energy and emissions projections 2022 to 2040 Pg 23-24
7. Energy and emissions projections 2023 to 2050 Pg 20
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11. MoroccoNoorQuarzazateSolar_WBG_AfDB_EIB.pdf
12. Researchers expand the promise of seawater as a source of hydrogen | Johns Hopkins | Bloomberg School of Public Health
13. Consortium Completes Feasibility Study for Hydrogen Corridor Linking Africa to Europe | Pipeline Technology Journal
14. 23 Smart hydrogen storage operation and power-to-power routes
15. RTFO statutory review and future of the scheme - GOV.UK
16. The cost of solar power: how low can we go?
17. While no single accepted definition of ‘well-to-wheel’ exists, we accept that well-to-wheel figures will vary dramatically depending on the source of the energy that’s put into a vehicle (its fuel) throughout its lifetime use.
18. EUR-Lex - 52025DC0095 - EN - EUR-Lex

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