THE ERA OF **SUSTAINABLE**

LOGISTICS

ENABLING A SUSTAINABLE FUTURE

ZONE 7 DIGEST

CLEAN ENERGY & MOBILITY

A condensed look at the energy transition and the role of logistics as a key enabler as explored at the Era of Sustainable Logistics Global Summit.

ENABLING A WORLD POWERED BY CLEAN ENERGY AND MOBILITY

INTELLIGENT COORDINATION, COLLABORATIVE INNOVATION

The all-important shift from fossil fuels to renewables is essential for a more sustainable world. But a new energy landscape has massive implications for the energy and auto-mobility sectors, chief of which is the exponential increase in complexity associated with new forms of energy generation, storage, distribution, and usage.

The key to enabling a world powered by clean energy and mobility is **collaboration.** This means smart coordination and collaborative innovation across the entire ecosystem, from auto-mobility manufacturers and suppliers to energy companies and logistics providers.

In the following pages, we look at the current situation, outline the challenges, and explore the components of a clean technology future.

> *Instead of always evolving the automobile, we should be looking at how we design mobility differently in the future.*
>
> **Hans Peter Dürr**
> Physicist and advocate for scientific and energy responsibility

THE CURRENT TRAJECTORY

THE RIGHT PATH, THE WRONG PACE

Innovation and investment in clean technologies have increased dramatically in recent years, with profound shifts in the public and private spheres. Nearly every country has pledged to embrace sustainability and achieve net zero by 2050 or shortly after. Companies of all sizes have also made commitments, recognizing that sustainable solutions are not simply a cost factor but rather an investment in profitability and value creation.

However, the International Energy Agency (IEA) says that half the technologies the world needs to achieve net-zero emissions do not yet exist. The IEA also estimates that we'll need a 20-fold increase in solar power and a 10-fold increase in wind power between now and 2050 to meet the expected demand for electricity.[1] Transporting the equipment necessary for this will require a 1,000-fold increase in logistics volumes.

The International Renewable Energy Agency (IRENA) stresses the need for a radical shift in current energy usage across all sectors, driven by electrification and efficiency and supported by renewables, hydrogen, and other solutions.[2] An entirely new energy value chain must emerge – from generation to storage and distribution to usage.

The world is on the right path, but we must pick up the pace considerably.

Meeting the world's energy needs by 2050

11x	20x	1,000x
Increase in wind power	Increase in solar power	Increase in logistics volumes

Sources: IEA, DHL

THE CHALLENGES

REDUCING EMISSIONS WHILE DRIVING GROWTH

A sustainable world must remain a mobile one. Goods and people need to keep moving but with a much lighter footprint. That's going to take green electricity.

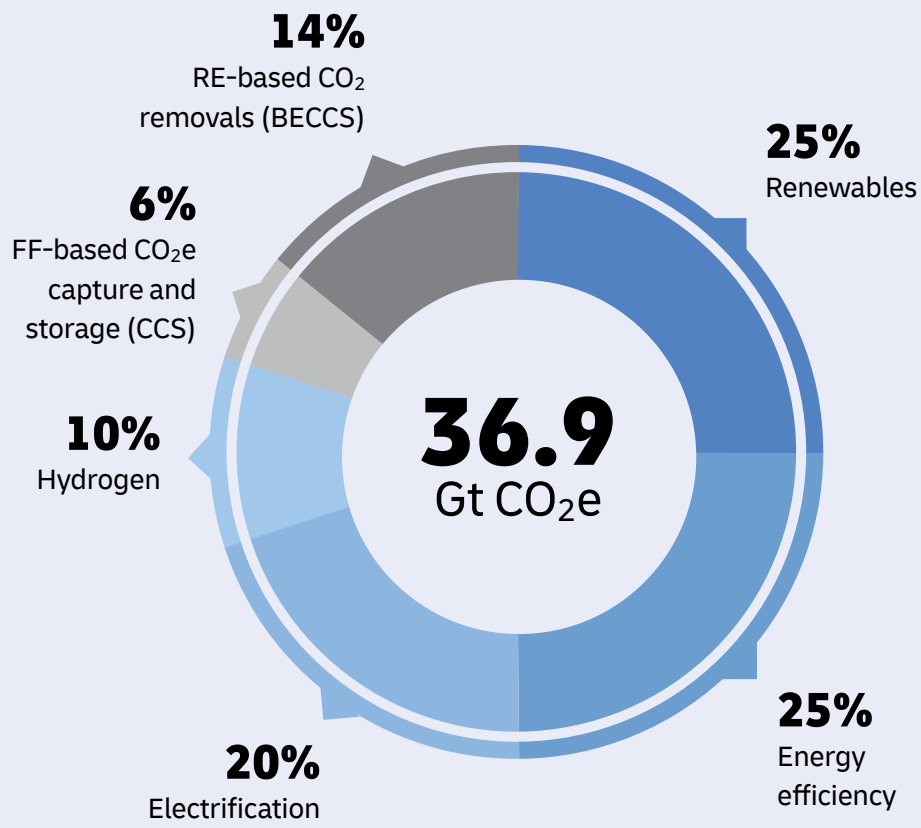
The greatest challenge is transforming today's centralized grid of large power plants into a decentralized system of wind and solar farms. For example, it takes 50 wind turbines or 500,000 solar panels to match the output of one 200 megawatt gas turbine. But that's only the beginning. IRENA says the road to net-zero emissions runs along six technical avenues: renewables, energy efficiency, electrification, hydrogen, carbon capture and storage, and bioenergy with carbon capture and storage.

The demand for energy is only going up with more e-vehicles, automation, and data services. Some 250 million electric vehicles will be on the road by 2030, requiring 150 million chargers and 1,000 terawatt-hours of electricity. Data centers and transmission networks already account for 1–1.5% of today's global electricity use.

This requires a completely redesigned energy supply chain with new, smart, and agile logistics solutions.

> *"I think calling it climate change is rather limiting. I would rather call it the 'everything change'."*
>
> **Margaret Atwood**
> Poet, novelist, and environmental activist

Achieving net-zero emissions requires working simultaneously across six technological avenues:



Source: IRENA

THE CLEAN ENERGY ECONOMY IN ACTION

STAYING MOBILE WHILE GOING GREEN

Sustainable mobility will only be possible through a combination of careful planning, deliberate investments, and new technologies to meet all our needs effectively, efficiently, and economically. The change will have many moving parts, each playing an essential role and with logistics supporting the entire process.

So what will it take to stay mobile while going green? Here's a look at the clean energy economy in action:

Massive increase in renewables-based electricity

Costs have decreased significantly, making solar and wind power the default options for new installations in many regions. This approach must steadily expand worldwide, and logistics companies must embrace the change and develop the required supply chain solutions.

Substantial improvements in energy efficiency

Optimizing resources and improving energy efficiency can significantly lower demand and greenhouse gas emissions. Companies must start by understanding their carbon footprint and identifying potential. The often-overlooked side benefits include cost savings and energy security.

Electrification of end-use sectors such as EVs

The continued electrification of end uses, such as transport vehicles, is essential. By 2050, overland transport must rely almost entirely on renewable energy.[3] This will require significant investments in charging infrastructure and battery supply chains.

Adoption of clean hydrogen and its derivatives

Clean hydrogen production and consumption must become scalable. The technology is available, but it has to move quickly from pilot status to a significant energy source. Innovation must bring costs down substantially to drive up demand.

Appropriate use of bioenergy and carbon capture

Innovation in bioenergy with carbon capture and storage is essential. Biofuels will help decarbonize heavy-duty transport, especially in the short term.

Adapted logistics solutions

Producing clean energy will turn today's mostly centralized grid of large power plants into a decentralized system of smaller power generators, requiring more logistics touchpoints and individual shipments. The logistics of storing and distributing energy will grow equally complex. New logistics and supply chain solutions must adapt to the changing requirements, including more regionalized sources, multimodal and low-carbon transportation, and carbon-neutral warehouses and distribution centers.

DECENTRALIZED POWER PLANTS

LOGISTICS HUBS MUST BECOME POWER DISTRIBUTION CENTERS

Today's centralized grid of large power plants will become a decentralized system of smaller power generators, such as wind and solar farms. But large logistics centers could also become part of that decentralized system, functioning as dynamic urban power stations.

State-of-the-art warehouses with 20+ electric delivery vehicles are effectively small power plants connected to the grid. Make them carbon neutral, with renewable energy generated via roof-top solar panels, and you reduce the demand for external power even while energy usage increases to support electrification, automation, and cold storage requirements.

DHL Group Logistics Hub in Dubai

68,000 tons
CO_2 savings

14,270
solar panels
with a total area of
27,000 m²

Energy supply
for entire facility
+ 8 e-vehicle
charging stations

THE LOGISTICS OF CLEAN ENERGY

SUPPLY CHAINS MUST ADAPT TO HIGH VOLUMES AND COMPLEXITY

Massive investments in renewables must meet the growing power demand, with significant implications for logistics. More wind turbines require more ships and oversized trucks to transport the massive towers and rotors. More solar panels will also mean more touchpoints and individual shipments. Estimates predict a 1,000-fold increase in logistics volumes.

A clean energy supply chain will be a dense web requiring more regionalized sources, multimodal and low-carbon transport options, and carbon-neutral warehouses.

CLEAN ENERGY SUPPLY CHAINS: 4 KEY CHALLENGES

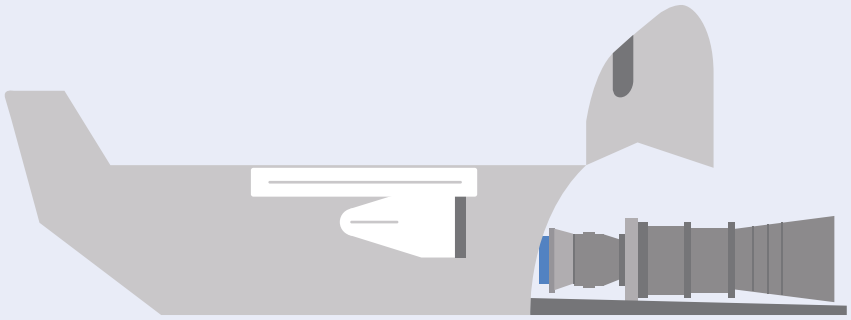
1. Increasing demand for logistics

2. Rising costs for logistics assets and services

3. Increasing complexity and need for visibility

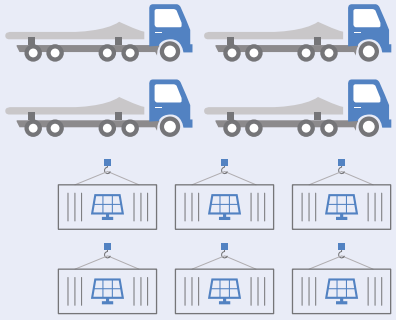
4. Growing need for low-carbon solutions

Logistics for a 200 MW gas turbine compared with wind and solar



200MW is equal to

1 Gas turbine
50 Wind turbines, or
500K Solar panels



Renewables equipment might require a **1,000x increase** in logistics volumes, and a **significant increase** in logistics **complexity.**[4]

THE LOGISTICS OF E-MOBILITY

SUPPLY CHAINS MUST ADAPT TO ENABLE CLEAN MOBILITY

The high demand for energy in the future will be driven mainly by the growth in e-vehicles, including transport vehicles. Forecasts estimate some 250 million electric cars worldwide will be on the road by 2030, requiring 150 million charging stations and a 10-fold increase in battery production between 2021 and 2030. The need for battery recycling as a source of raw materials will also increase. To reach net-zero emissions by 2050, the IEA estimates that overland transport must rely almost entirely on renewable energy.[5]

Supply chains must adapt to the requirements of moving raw materials and components for electric and hydrogen vehicles, such as proper temperature controls and compliance with dangerous goods regulations. Massive investments in charging infrastructure and battery supply chains will be needed to meet these challenges.

EV SUPPLY CHAINS: 4 KEY CHALLENGES:

1. **Materials sourcing**
2. **Battery management**
3. **Charging infrastructure**
4. **Sustainability**

Accelerated EV market

250 million	>56%	290 million
EVs expected on the road by 2030	Projected EV share of new car sales by 2030	Estimated charging points needed globally by 2040

Source: Frost & Sullivan, 2023

THE LOGISTICS OF CLEAN STORAGE AND DISTRIBUTION

SUPPLY CHAINS MUST ADAPT TO BATTERY REQUIREMENTS

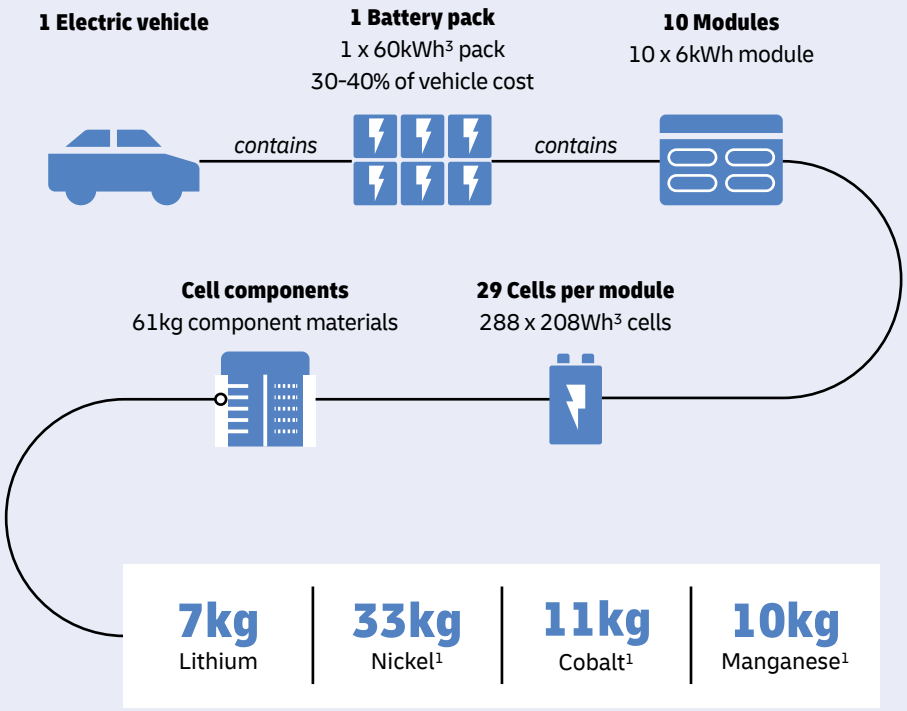
Storage and distribution technologies will be critical for the transition to clean energy. Battery storage needs to grow significantly, and future power grids must be smarter and more flexible. Logistics will play a crucial role, with battery and hydrogen technology presenting distinct challenges. The logistics of storing and distributing energy will grow increasingly complex – a development we're already seeing in today's electric car battery supply chains.

Battery supply chains are complex, and transporting batteries is a real challenge. Just look at what goes into one electric car battery (see graphic). They are classified as dangerous goods and subject to international and domestic regulations. Many safety measures are required for compliant transport, which can vary depending on the continent, country, region, and means of transportation.

BATTERY SUPPLY CHAINS: 4 KEY CHALLENGES

- **1. Materials sourcing**
- **2. Compliance**
- **3. Safety**
- **4. Sustainability**

Battery supply chains are complex



1. 2019 Chevrolet Bolt, NMC622 cathode, 60kWh battery pack, 138WH/kg
Source: Bernstein 2020 EV market report Chevrolet Bolt 2019 Technical Specs

THE LOGISTICS OF CLEAN STORAGE AND DISTRIBUTION

SUPPLY CHAINS MUST ADAPT TO HYDROGEN REQUIREMENTS

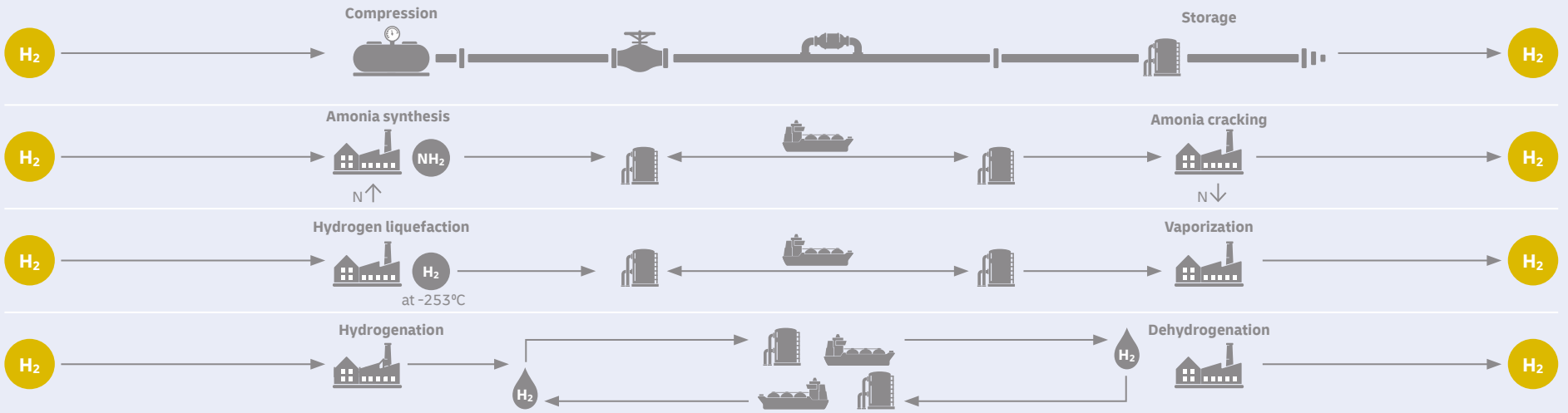
Hydrogen technology lags behind electric, but its adoption will be critical to achieving net-zero emissions. The transition is already underway, and the technology is getting greener. Hydrogen supply is projected to shift from nearly 100% gray hydrogen to 60% clean production by 2035 as costs decline and policymakers increase support.

Hydrogen can be transported in various forms, such as liquid or gas, with each requiring specialized supply chains. Because hydrogen production is more efficient in some regions than others, large volumes will likely need to be transported across long distances. Parts of the hydrogen supply chain will also require temperature controls and compliance with dangerous goods regulations.

HYDROGEN SUPPLY CHAINS: 4 KEY CHALLENGES

1. **Infrastructure**
2. **Complex forms**
3. **Long transport distances**
4. **Transportation costs**

Converting hydrogen for storage, transport and reconversion



Source: McKinsey Hydrogen Insights & Roland Berger

KEY TAKEAWAYS

ENABLING A WORLD POWERED BY CLEAN ENERGY AND MOBILITY

Massive scale up to power growth

Keeping to a maximum 1.5ºC increase in global temperatures against the backdrop of growing power demand will require an exponential scale up in renewable power generation.

Logistic hubs as power hubs

Logistics hubs will evolve to have the capability of storing, managing and even generating significant amounts of renewable energy. This raises the possibility of logistics hubs contributing to their local power grids.

Adapted logistics an enabler

The energy and mobility transition is extremly complex. Logistics for batteries and renewables will be a crticial piece of the puzzle.

Completely new energy infrastructure to be built

Significant investment in energy storage & distribution technologies will be required to support the energy transition, not forgetting the logistics required to move them into piece.

Clean transport and mobility fuel renewable power growth

The rapid growth of electrified mobility and clean transportation will drive the power demand for renewables to a large extent.

Sources

1. **IEA, Net Zero by 2050.** https://www.iea.org/reports/net-zero-by-2050
2. **IRENA, World Energy Transitions Outlook 2022**
   https://www.irena.org/Digital-Report/World-Energy-Transitions-Outlook-2022
3. **IEA, ibid.**
4. **For further reading on the logistics of the energy transition, please see:**
   https://www.dhl.com/global-en/home/insights-and-innovation/thought-leadership/white-papers/logistics-of-the-energy-revolution.html
5. **IEA, ibid.**