

November 2024

Dear Reader,

Hello and welcome to The Agna Museletter. As we stand at the crossroads of technological advancement and environmental responsibility, the choices we make today will shape the legacy we leave for generations to come.

Energy isn't just a resource; it's the lifeblood of innovation, powering economies and shaping futures. Yet, the global demand for cleaner, smarter, and more sustainable energy solutions has never been more pressing. As we grapple with climate imperatives and rapid urbanisation, how we harness, store, and distribute energy is undergoing a seismic shift.

Emerging technologies, from AI-driven energy grids to breakthroughs in renewables and storage, are not just meeting the challenge—they're setting new benchmarks for efficiency and resilience.

Join us as we unpack this energy revolution, exploring the innovations and opportunities propelling us toward a greener, smarter tomorrow.

MUSELETTER HIGHLIGHTS:

Agna Insights

Read through the transformative journey of the quest for energy

Agna Perspectives

Interesting and insightful reads we published over the last month

Agna Team

Engagement and interaction

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Team Agna's curated recommendations for you

Agna INSIGHTS

Introduction

Energy is not merely a utility; it is the lifeblood of modern civilisation, powering every aspect of our existence. From lighting our homes to fuelling global industries, energy forms the foundation of societal growth and technological progress. Yet, this indispensable force faces a paradox: as our dependence on it deepens, its environmental consequences threaten the very systems it sustains.

Global energy consumption drives 75% of greenhouse gas emissions, with demand set to grow 18% by 2050 due to urbanisation, electrification, and population growth. Energy-intensive technologies like AI, blockchain, and cloud solutions exacerbate the challenge, with data centres needed for these alone projected to consume 9% of global energy by mid-century. Addressing this surge requires innovative solutions in renewables, storage, and grid optimisation to sustain technological progress while protecting the planet.

At the heart of this journey lies a critical question: how do we secure sustainable, reliable energy for a growing world? The answers will shape not only the trajectory of our planet but also our ambitions beyond it.

Current Demand Drivers and Future Projections

Energy demand is influenced by a confluence of factors that underscore its centrality to economic and technological evolution.

- **Demographic Shifts:**

The global population is projected to surpass 9.7 billion by 2050, with emerging economies driving the majority of this growth. These regions are experiencing rapid urbanisation, with millions joining the middle class each year. This transformation translates into higher consumption of electricity for residential and industrial use.

- **Technological Transformation:**

The rise of cloud solutions, cryptocurrency, and artificial intelligence (AI) is leading to the rapid growth for data centres globally transforming energy requirements. For instance, according to McKinsey,

1. Data centres are anticipated to consume up to 4,500 terawatt-hours (TWh) annually by 2050—equivalent to 5-9% of global electricity demand.
2. AI technologies alone could add between \$10 trillion and \$15 trillion in global economic value annually but require an additional 50-75 GW of clean energy infrastructure to sustain growth.

- **Electrification Across Sectors:**

Transport, heating, and industrial processes are undergoing a dramatic shift towards electrification. EVs, hydrogen fuel cells, and high-temperature industrial heat pumps are becoming mainstream solutions, further intensifying the need for robust and sustainable energy systems.

How have energy resources evolved?

History offers a fascinating narrative of how we have powered progress—from the simple crackle of fire to the hum of renewable technologies. Each shift has been a response to societal needs, with innovation steering the course. Today, we stand at the brink of another transformation, driven by sustainability and technological breakthroughs.

- **The Age of Fire:**

Early humans tamed fire, marking a pivotal moment in the evolution of civilisation. Fire provided warmth, light, and protection, enabling communities to extend their working hours and develop tools, ultimately transforming survival into a foundation for societal growth.

- **Harnessing Natural Forces:**

Before the advent of fossil fuels, ancient civilisations harnessed the power of the sun, wind, and water for their needs. The Ancient Greeks and Romans used wind-powered water pumps to irrigate crops, while water wheels in Persia and China were employed to grind grain. These natural energy solutions laid the groundwork for renewable energy's role in human innovation long before industrialisation.

- **Coal and the Industrial Revolution:**

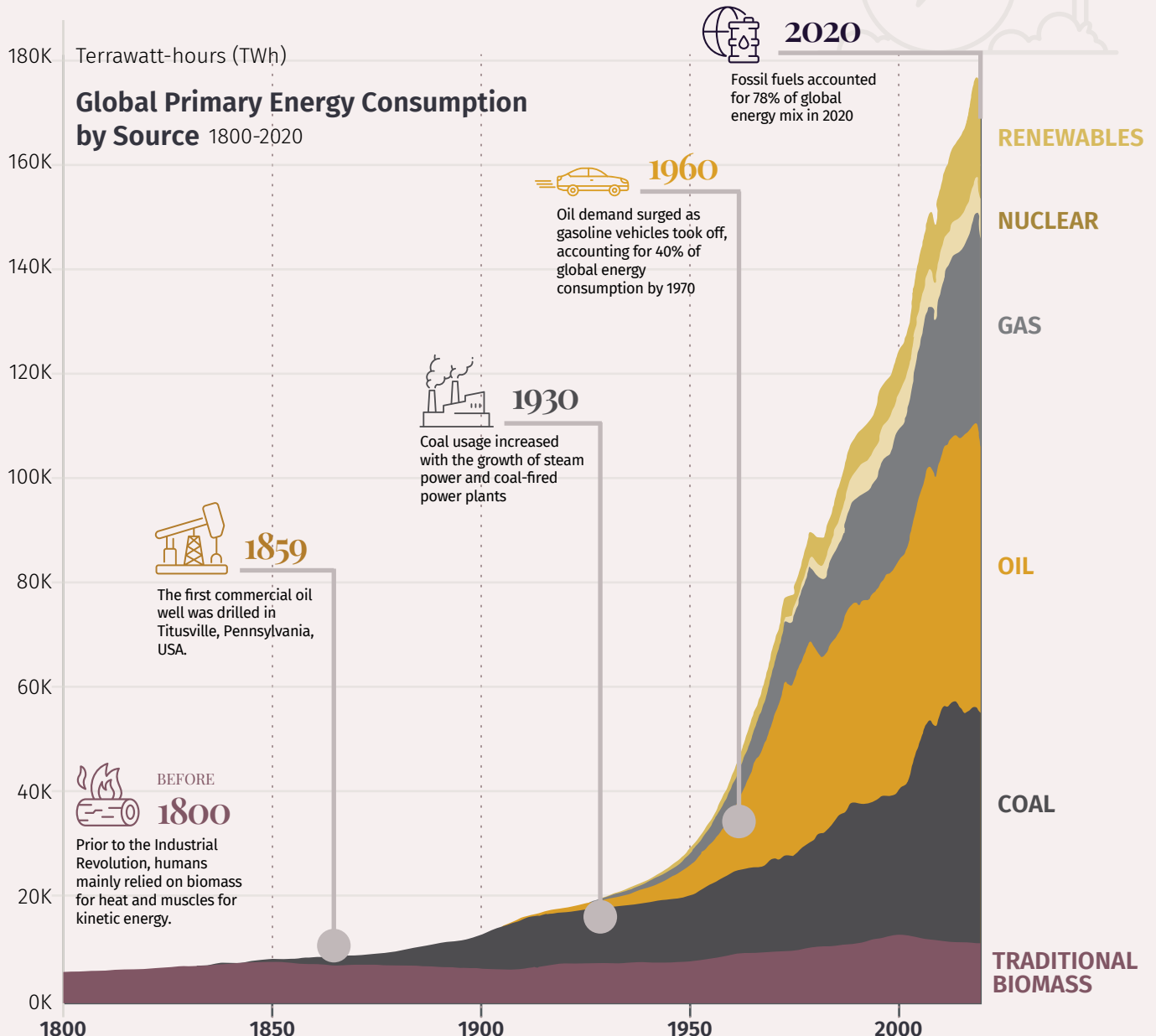
The 18th and 19th centuries saw coal rise to dominance, powering steam engines and factories. This ushered in the Industrial Revolution, an era defined by mass production, rapid urbanisation, and unprecedented economic expansion. Coal became the bedrock of industrialised societies, driving mechanisation and progress.

THE HISTORY OF

Energy Transitions

The economic and technological advances over the last 200 years have transformed how we produce and consume energy.

Here's how the global energy mix has evolved since 1800.



Source: Vaclav Smil (2017), BP Statistical Review of World Energy via Our World in Data

- **Oil and Gas Dominance:**

The 20th century witnessed the rise of oil and natural gas as the backbone of modern industry, transportation, and infrastructure. From powering automobiles to fuelling global industries, these energy sources shaped economies and geopolitics. Their high energy density and transportability made them indispensable during this period.

- **Renewables Revolution- Resurgence:**

In parallel to this, with the rise of the environmental movement and increasing concerns about the negative impacts of fossil fuels on the planet, interest in renewable energy began to grow again. In the 1970s, the oil crisis led to a renewed focus on energy independence and the development of alternative energy sources. Governments around the world began to invest in research and development of renewable energy technologies.

Meeting the Needs of Tomorrow: Key Energy Solutions

As history teaches us, energy evolution is not about abandoning the past but building on it. Solar, hydrogen, and nuclear energy represent the promising current conduits in this ongoing journey. Each has its strengths and hurdles, but together, they hold the key to meeting the energy demands of a growing and greening world.

Solar energy stands as a beacon of accessibility and sustainability, having witnessed an 80% reduction in costs over the past decade. This has established it as the cornerstone of renewable energy. Its applications are vast, from powering cities through large-scale solar farms to enabling individual households with rooftop panels.

For example, the Noor Abu Dhabi Solar Plant in the UAE, one of the world's largest single-site solar power plants, generates 1.17 GW of power, enough to supply energy to around 90,000 homes. Beyond Earth, solar energy propels space exploration, fuelling satellites and spacecraft. The Solar Arrays on the International Space Station (ISS) generate up to 120 kW of power, enabling the station to operate and carry out scientific research far beyond Earth's atmosphere. To meet net-zero targets, solar energy must constitute 40-60% of global energy by 2050 ([Source](#)). However, its intermittent nature and efficiency challenges necessitate advancements in energy storage solutions to fully realise its potential.

Hydrogen energy emerges as a versatile powerhouse for decarbonisation, playing a pivotal role in the energy transition. Its relevance comes from its potential applications for lowering emissions in energy intensive sectors that are difficult to electrify. As per DNV, to align with the goals set by the Paris Agreement, hydrogen and its derivatives- ammonia, e-methanol, and other e-fuels- need to account for about 15% of the world's energy demand by 2050, however projections based on global uptake indicate

that it will be about 4% by 2050. However, we can expect significant progress made in hydrogen technology and infrastructure over the next three decades. The predominant application of hydrogen will be in manufacturing (73%), followed by transport (14%), and buildings (7%), with the remaining portion allocated for electricity generation and various other purposes.

It can be produced as green hydrogen, using renewable energy for zero emissions, or as blue hydrogen, derived from natural gas with carbon capture. The hydrogen spectrum is diverse, with types classified based on production methods: Black and Brown hydrogen, the most carbon-intensive, rely on coal (bituminous and lignite) respectively; Grey hydrogen, produced from natural gas, has the potential for reduced carbon emissions; and cleaner variants like Blue and Green are widely recognised for their environmental benefits. However, their cost efficiency of these production methods will play a critical role in their eventual adoption.

Nuclear energy has historically provided high efficiency, minimal emissions, and reasonable costs, offering a reliable solution for the energy transition. Recent innovations, such as Small Modular Reactors (SMRs), provide scalable and safer energy solutions at a competitive cost, even for remote areas or regions unsuitable for large-scale renewable deployment. They also address the energy needs of industries with high manufacturing demands, such as steel, cement, and petrochemicals. Meanwhile, experimental fusion energy holds the promise of virtually limitless and cost-effective power in the future.

Globally, nations like France derive over 50% of their electricity from nuclear energy, benefiting from its affordability and reliability. Similarly, the UAE's Barakah Nuclear Energy Plant, the country's largest electricity source, meets up to 25% of national energy needs—all produced carbon-free and at a sustainable cost.

As McKinsey analysts point out, "*The power sector is rapidly becoming a key player in the AI landscape,*" highlighting that access to reliable power is now crucial for new data centre development.

Constellation Energy is set to reopen the Three Mile Island plant in Pennsylvania in collaboration with Microsoft, while Oracle plans to use small modular nuclear reactors to power its data centres. Google is also investing in small modular reactors being developed by Kairos Power. Amazon has already acquired a data centre powered by nuclear energy in Pennsylvania and is further investing in small nuclear reactors.

This growing demand, combined with the push for "net-zero" carbon emissions, is significantly increasing expectations for nuclear power. Currently, nuclear energy accounts for 20% of electricity generation in the U.S., and the International Atomic Energy Agency predicts that nuclear capacity in North America could nearly triple by 2050.

Innovations that are driving the energy transition

As we venture into the future of energy, it's clear that technological innovation is the key to making the energy transition not just possible but sustainable. Picture this: a world where AI is the brains behind the grid, predicting energy needs and balancing supply and demand with pinpoint accuracy. Smart grids, powered by AI, are transforming how we manage renewable energy, ensuring that the lights stay on even when the wind isn't blowing or the sun isn't shining.

But it's not just AI at the helm. Energy storage technologies are breaking new ground, with solid-state batteries and hydrogen storage systems offering the promise of long-term energy storage solutions that will help us tackle the intermittency of solar and wind power. Companies are already scaling up flow batteries, which can store energy for days rather than hours, making them a powerful tool for balancing the grid over longer periods.

- **AI and Smart Grids:**

Artificial intelligence (AI) optimises energy distribution through predictive analytics, ensuring efficient balancing of supply and demand across regions and time zones. Smart grids, enhanced by AI, integrate renewable energy sources more effectively, mitigating fluctuations and reducing curtailment. For instance, the European Union's investment in cross-border infrastructure, projected to reach €6 billion annually through 2040, is expected to save €9 billion per year in generation costs and avoid 42 TWh of renewable energy curtailment annually. This will help optimise renewable energy usage, reduce CO₂ emissions by 31 million tonnes per year, and support broader climate goals, enhancing environmental sustainability. [Source](#).

- **Energy Storage Technologies:**

Solid-state batteries and advancements in hydrogen storage are addressing the intermittency of renewables. Technologies like flow batteries, which provide extended discharge durations, are emerging as cost-effective solutions for grid-scale storage. Additionally, pumped hydro storage offers an established but scalable option, capable of providing medium- to long-term energy reserves.

- **Circular Energy Systems:**

Recycling and reusing materials from solar panels, wind turbines, and nuclear waste form a circular economy model in energy production. For instance, Japan's photovoltaic recycling initiatives and advancements in wind turbine blade repurposing have demonstrated the economic and environmental benefits of material reuse.

The final frontier? Space Energy

When envisioning the future of energy, it's time to think beyond the confines of Earth. Space is fast

emerging as the next frontier in our pursuit of sustainable energy solutions, bringing bold ideas closer to reality.

Take Space-Based Solar Power (SBSP), for instance—a once sci-fi concept that's now a hotbed of global research. Japan's JAXA is leading trials on wireless energy transfer systems, aiming to beam solar energy from orbital farms directly to Earth. In Europe, ESA is funding SOLARIS, a programme exploring gigawatt-scale solar stations in orbit. These massive solar farms could collect uninterrupted solar radiation and transmit clean, renewable energy, solving the persistent challenge of energy intermittency on Earth.

Beyond solar, nuclear energy is making transformative strides in space innovation. NASA, in collaboration with the US Department of Energy, is advancing nuclear thermal propulsion systems that can cut travel times to Mars nearly in half. Meanwhile, modular nuclear reactors are being prototyped for lunar missions, such as NASA's Kilopower Project. These small reactors promise to power everything from life support to resource extraction on the Moon and Mars, paving the way for permanent off-world settlements.

Even asteroid mining ventures are drawing on these advancements. Companies like AstroForge envision combining autonomous technology with nuclear-powered systems to harvest rare metals and water, essential for both deep-space missions and Earth's resource needs.

Space energy isn't just a future possibility—it's becoming a tangible element of humanity's energy blueprint. From revolutionising Earth's grids with limitless solar power to supporting extraterrestrial habitats, the innovations born in space today promise transformative impacts for energy systems here at home. Perhaps, the final frontier isn't just exploration; it's the cosmos as a catalyst for sustainable energy solutions.

Challenges to a Renewable Future

With all this potential, it's easy to get swept up in the optimism of a cleaner, greener energy future. But let's hit pause and acknowledge the challenges that lie ahead. Renewable energy sources like solar, hydrogen, and wind, while revolutionary, come with their own set of hurdles. One of the biggest challenges? Intermittency. The sun doesn't always shine, and the wind doesn't always blow. This makes it tricky to rely solely on renewables without advanced systems to store and distribute the energy when we need it most. However, as storage technologies like advanced batteries and grid management systems evolve, they are helping to bridge these gaps.

From an economic perspective, the Levelised Cost of Energy (LCOE) of solar and wind has seen a dramatic decline over the past decade. For example, the global LCOE for utility-scale solar fell by 88% from

\$359/MWh in 2010 to \$45/MWh in 2023, and onshore wind dropped by 68% from \$89/MWh to \$28/MWh over the same period. These figures now rival or even undercut traditional fossil fuels, whose LCOE typically ranges from \$50 to \$177/MWh, depending on the type of fuel and region.

Yet, for the end user, the primary concern often isn't how energy is generated but how affordable it is. Whether the energy comes from solar panels, a nuclear plant, or a natural gas pipeline, the focus remains on keeping costs low. This highlights the critical need for renewable technologies to be not just cleaner, but also cost-competitive and reliable.

Nuclear energy, though often perceived as expensive, holds significant long-term potential for cost reduction through innovations like Small Modular Reactors (SMRs). The LCOE of traditional nuclear power plants averages between \$120 and \$200/MWh due to high upfront costs and extended construction times. However, SMRs are projected to lower these costs to as low as \$60 to \$90/MWh, with construction times reduced to a fraction of traditional plants. These reactors, with capacities ranging from 50 to 300 MW, offer scalability, affordability, and a cleaner energy source with consistent output, making them a game-changer for the future of nuclear energy.

Take hydrogen as another example. While it is a promising clean energy source, its production costs remain high, particularly for green hydrogen produced via electrolysis using renewable energy. Current costs average \$3 to \$6/kg, compared to \$1 to \$2/kg for hydrogen produced from fossil fuels (gray hydrogen). However, with advancements in electrolysis efficiency and the falling cost of renewables, green hydrogen is expected to reach \$1.50/kg by 2030, making it competitive.

Traditional fossil fuels have historically dominated because of their established infrastructure and lower apparent costs. Yet, these costs don't fully account for the environmental and social damages they cause, which could add another \$30 to \$100/MWh in external costs. As renewable energy technologies mature, their declining LCOE and reduced externalities are gradually making them the more economical choice, particularly in markets where subsidies and carbon pricing reflect the true cost of fossil fuels.

Ultimately, affordability is as critical as achieving sustainability goals. The potential of SMRs in nuclear energy, alongside innovations in energy storage, grid modernisation, and hydrogen production, must all be pursued with an eye on cost reduction. For the end user, affordability remains the key driver, and achieving cost parity—or better yet, cost superiority—with fossil fuels will be instrumental in accelerating the shift to renewables.

The path to a renewable future is paved with challenges, but every challenge presents an opportunity. By focusing on reducing costs while advancing cleaner energy systems, we can meet both the demands of everyday users and the broader goal of a sustainable, resilient, and net-zero future.

So TL;DR?

Our energy story has been one of ingenuity, resilience, and ambition. Today, we have the opportunity to script a chapter that prioritises both progress and preservation. By embracing sustainable solutions, we not only secure our planet but also set the stage for humanity's limitless potential—on Earth and beyond. The future of energy is in our hands. Let's power it wisely.

Agna PERSPECTIVE

In-Principle Approval (IPA):

We officially announced our ***In-Principle Approval (IPA) for the Fund Manager License*** from the Dubai Financial Services Authority (DFSA).
[Read more](#)

The Pangenome:

The pangenome, the complete gene set of a species, reveals a hidden order in evolution, unlocking potential for advancements in medicine, agriculture, environmental science, and biotechnology.
[Read more](#)

Global Entrepreneurship Week:

Our campaign for Global Entrepreneurship Week where the theme was "Entrepreneurship is for all"
[Read more](#)

AI & Medicine:

How AI algorithms analyse cellular data to predict diseases, personalise treatments, and revolutionise healthcare, promising a future of precision medicine and improved patient outcomes.
[Read more](#)

TEAM ENGAGEMENT



Webinar by Multipliers VC

Our Founder Pranav Sharma, attended the webinar hosted by Multipliers VC on LinkedIn, sharing his experience and knowledge on the Future of Tech Funding with Igor Bershadsky on the panel and Melanie Sierra as the moderator.



We're Official!

We are excited to announce that we recently received the IPA (in-principle approval) for Fund Manager License under Category 3C from the Dubai Financial Services Authority (DFSA). Based out of the Dubai International Financial Centre (DIFC), we are ready to drive innovation!

On the 'FRONTIER TECH

Defence exports

India recently reached a significant milestone in its hashtag#DefenceExport ambitions by delivering the first Akash air defence missile system battery to Armenia.

[Read More](#)

Jet devices

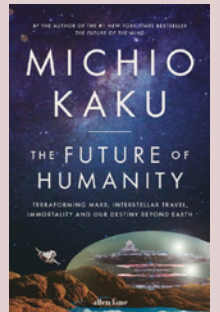
How drugs are delivered without a need for needles using squid-inspired jet devices.

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Agna RECOMMENDS

Future of Humanity by *Michio Kaku* explores groundbreaking concepts such as terraforming Mars, interstellar travel, and the quest for immortality, delving into how these innovations could shape humanity's future beyond Earth. Kaku combines scientific theories with visionary possibilities, offering a glimpse into a multi-planetary and advanced future for humanity.

[Read more](#)



The Fourth Age by *Byron Reese* examines how artificial intelligence will usher in a new era, transforming society, economy, and even human identity. The book explores the potential for AI to reshape civilisation, presenting both its challenges and immense opportunities for human progress.

[Read more](#)



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[We invite you to engage with us and collaborate.](#)

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Team Agna

