

THE CHOICES WE FACE

ENERGY IS GDP:

Building Societies of Superabundance

GERARD HOLLAND



About the Author

Gerard Holland is the Chief Executive Officer of the Page Research Centre. Prior to joining Page, Gerard has held roles as the Director of Outreach and Strategic Partnerships at the Alliance for Responsible Citizenship (“ARC”) in London and led the secretariat for the Legatum Institute’s Transformation of Society programme. Gerard has also worked as an electorate officer to former Regional Development and Communications Minister and Deputy Leader of the National Party, the Hon. Fiona Nash.

This paper was edited by Benedict Rogers, Joshua McNicholas, and Anna Webb.

This research has been produced and published by ARC Research, a not-for-profit company limited by guarantee registered at Companies House with number 14739317, which exists to advance education and promote research.

ISBN: 9978-1-916948-43-3

www.arcforum.com

February 2025

Energy Is GDP:

Building Societies of Superabundance

Gerard Holland

Energy and Prosperity: The Forgotten Miracle

Humanity has never been richer, healthier, or more comfortable. We live in an era of unprecedented abundance, where clean water, warm homes, and technological marvels are within reach for billions. Yet, the invisible force that made all of this possible—energy—rarely gets the credit it deserves. Energy is the great enabler of human progress, the lifeblood of modern civilisation, and the foundation upon which economic growth is built.

From the dim glow of the preindustrial world to the electrified hum of modern cities, energy has been the silent architect of progress, underpinning everything from economic growth to societal welfare. This reality, however, is often obscured in a discourse increasingly dominated by the urgency of tackling climate change. This is a mistake. Without abundant and affordable energy, human flourishing would grind to a halt.

If we are to tackle the challenges of the twenty-first century, we must understand and appreciate the vital link between energy and human prosperity.

The History of Energy Use: From Fire to Fusion

The history of humanity is, in many ways, the history of energy. From the first spark of fire to the modern power grid, our ability to harness energy has not just improved our lives but fundamentally transformed them. This is the story of how abundant, affordable energy powered the extraordinary economic transformations that shaped the modern world—a story often overlooked or taken for granted.

Preindustrial Societies: Living on a Narrow Energy Budget

For most of human history, life was energy-poor. Before the Industrial Revolution, the vast majority of energy available to humans came from muscle power—either their own or that of animals. A farmer ploughed fields behind oxen, while a sailor relied on wind to move his ship. Societies supplemented these sources with biomass, primarily wood, for heating and cooking. These sources were renewable but highly limited in scale and efficiency.

In the absence of abundant energy, economic growth was negligible. Living standards barely improved, and most of humanity toiled at subsistence levels. A farmer in seventeenth-century Europe, for instance, likely lived no better than one in ancient Rome. Energy constraints placed strict limits on productivity. To grow more crops, one needed more oxen, more hands, and more land.

The Industrial Revolution: Coal and the Engines of Prosperity

The transition from living energy systems to ancient, fossilised energy stores represented a fundamental turning point in human history. The Industrial Revolution, beginning in the late eighteenth century, was driven by coal—a dense, abundant, and cheap energy source that revolutionised every aspect of life.

Coal freed societies from the energy constraints of muscle and biomass. James Watt's steam engine, first deployed in the 1770s, turned coal's stored energy into mechanical power, revolutionising industry and transportation. Factories sprang up, producing goods at unprecedented scales, and railways connected cities, enabling commerce like never before.

The results were transformative. Economic output soared, and living standards began to rise. Between 1850 and 1950, Britain's gross domestic product ("GDP") per capita nearly tripled, while life expectancy increased dramatically. The widespread availability of coal was not just a convenience—it was the bedrock of modern industrial society.

Oil and Electrification: Powering the Twentieth Century

As the nineteenth century turned into the twentieth, oil emerged as the next great energy source, providing abundant, cheap heating and lighting and powering the internal combustion engine. This development revolutionised transportation, enabling

automobiles, aeroplanes, and mechanised agriculture. Oil's versatility and portability made it indispensable, fuelling the globalisation of trade and travel.

Meanwhile, the electrification of cities and industries fundamentally reshaped daily life. Electricity, generated largely by coal, brought light to homes, powered appliances, and transformed manufacturing. It allowed for new industries, from telecommunications to computing, to emerge. The twentieth century saw living standards rise at an extraordinary pace as energy consumption grew.

Australia provides a vivid example of this transformation. In the early twentieth century, rural Australians relied on kerosene lamps and wood stoves. By the 1950s, thanks to electrification, farms were powered, cities illuminated, and industries mechanised. Abundant energy enabled Australia to move from an agrarian economy to an industrial powerhouse.

Fossil Fuels and Global Prosperity

The post-war era saw the peak of fossil fuel-driven growth. Between 1950 and 1973, global GDP grew at an unprecedented rate, powered by cheap oil and the widespread availability of electricity. This was a golden age of prosperity. Nations rebuilt after the devastation of World War Two, middle classes expanded, and consumer goods like cars, refrigerators, and televisions became staples of daily life.

Energy abundance did not just lift the rich. It also sparked the great escape from poverty for billions in the developing world. China and India offer compelling examples. Over the past three decades, both nations have relied heavily on coal to industrialise, lifting hundreds of millions out of poverty in the process. In China alone, coal consumption increased fivefold between 1980 and 2010, accompanying one of the most extraordinary economic transformations in history.

Energy IS GDP

While history provides a compelling narrative, empirical evidence solidifies the link between energy and economic growth. Studies consistently show a strong positive correlation between energy use and GDP, particularly during the early stages of industrialisation. David Stern's integration of energy into Solow's growth model, for example, demonstrated that abundant energy is a critical driver of economic expansion, particularly during the nineteenth and early twentieth centuries.¹

The elasticity of energy with respect to GDP—the percentage change in energy use in response to a 1% change in income—underscores this relationship. Research has found that energy elasticity remains stable over time, with estimates ranging from 0.6 to 0.8 for middle-income countries.² These figures indicate that as economies grow, their energy consumption also rises, albeit at a slightly slower rate due to efficiency gains.

The inverse relationship between energy costs and GDP further highlights the critical role of affordable energy. When energy costs exceed certain thresholds—typically 8–10% of GDP—economic growth slows significantly.³ Historical examples include the oil shocks of the 1970s, which plunged OECD economies into stagflation.⁴ More recently, energy price surges following the COVID-19 rebound, and the Russian invasion of Ukraine, have constrained global growth.⁵

Energy and Economic Growth: Unlocking the Links

The observation of the connection between energy and economic growth is as old as civilisation itself, yet, understanding *how* these two are linked remains one of the more complex puzzles in economics. Does energy use fuel economic growth, or does economic growth drive energy demand? Scholars have been grappling with this question for decades, and while the answers are nuanced, they reveal fascinating insights about how the engines of prosperity work.

The methods employed to investigate this relationship are well-established statistical techniques, such as **Granger causality tests** and **cointegration analysis**. Though these sound arcane, their purpose is straightforward: to untangle the interplay between energy and GDP over time.

Granger Causality: Predicting Relationships

Clive Granger, a Nobel-winning economist, developed a test to detect whether one thing (say, energy use) can predict another (such as GDP).⁶ If past trends in energy use consistently anticipate changes in GDP, energy is said to “Granger cause” GDP. It is not the same as proving a direct cause-and-effect relationship—it is more like finding a strong clue.

Early studies in this area focused on **bivariate models**, which simply compared energy use and GDP without considering other factors like labour, capital, or energy prices. Predictably, these studies often produced conflicting results. David Stern noted that

some found energy driving GDP, others found the reverse, and still others found no connection at all.⁷

But economic analysis and understanding, like energy, thrives on innovation. By the 1990s, researchers began using **multivariate models**, which added more variables to the mix. Stern's own work in 1993 included capital, labour, and the quality of energy use, leading to stronger evidence that energy *does* Granger cause GDP in many cases.⁸

Cointegration: Long-Term Partnerships

If Granger causality is about short-term predictive relationships, **cointegration analysis** is about long-term trends. Developed by Engle and Granger, this method looks at whether variables like energy and GDP move in tandem over decades.⁹ If they do, it suggests a deeper, structural connection—a kind of equilibrium that keeps them linked despite short-term fluctuations.

The first cointegration study of energy and GDP was conducted by Yu and Jin in 1992.¹⁰ Stern built on this by analysing GDP alongside labour, capital, and high-quality energy use. His findings were striking: energy and GDP were “cointegrated”, meaning their long-term trajectories were fundamentally tied together. Sometimes energy drove GDP, sometimes the reverse, but they were undeniably interdependent.¹¹

Further research reinforced these findings. Warr and Ayres and Oh and Lee showed that this relationship holds across different countries and time periods, particularly in industrialised economies.^{12,13} The takeaway? Over the long haul, energy and GDP march to the same beat, even if their short-term relationship can vary.

In advanced economies, energy remains a crucial input, even if its role is less visible. High energy costs can still derail growth. For example, when energy costs surpass 8–10% of GDP, as they did during the oil shocks of the 1970s, economic growth slows significantly.¹⁴ Bruns et al. and Stern both emphasised that understanding these thresholds is critical for designing sound energy policies.^{15,16}

Understanding Energy Costs and Economic Growth

Economists use the term **ECS** (“Energy Cost Share”) to measure how much of a country's economy (its GDP) is spent on energy. It is like asking, “How big of a slice of our economic pie goes toward paying for energy?”

Energy is GDP —————

The formula for ECS may look complicated, but the key idea is this:

1. **Energy consumption (“E”)** and **energy price (“PE”)** together determine how much energy costs.
2. GDP is adjusted for inflation (using a “GDP deflator” or constant prices) to show the real value of goods and services produced.
3. **Energy intensity (“EI”)** measures how much energy is needed to produce one unit of GDP.
4. **Energy productivity (“EPR”)** is the opposite of energy intensity—it tells us how efficiently energy is used.

In simple terms:

- If energy prices go up, the economy must either become more **energy efficient** (use less energy to produce the same amount) or GDP growth will slow.
- For energy costs to remain stable, any increase in energy prices needs to be matched by an improvement in energy efficiency.

The Impact of High Energy Costs on Growth

Researchers such as Fizaine and Court found that when a country spends too much of its GDP on energy, economic growth slows.¹⁷ For example:

- The US economy struggles when energy costs exceed **11% of GDP**.
- For most countries, when ECS is between **8% and 10%**, growth slows significantly.¹⁸
- In extreme cases, like when US petroleum costs exceeded **5.5% of GDP** between 1970 and 2007, recessions often followed.¹⁹

Why does this happen?

High energy costs reduce the money businesses have for investment and the disposable income households have to spend. This leads to less economic activity overall.

The “Wing Function” Hypothesis

Bashmakov et al. describe the relationship between energy costs and growth as a **wing function**:

- At **low energy costs**, the economy grows steadily.
- But when energy costs exceed certain thresholds, growth slows down rapidly—like the steep drop on the edge of a bird’s wing.²⁰

This is particularly true for **energy-importing countries**. If energy prices spike, these nations face higher production costs and reduced competitiveness in global markets, which can lead to unemployment and slower growth.²¹

The Energy Transition or Regression?

Today, societies are currently attempting a significant shift in energy production as they explore alternatives to fossil fuels. Renewable energy sources, including solar and wind, are being deployed at an increasing rate. Additionally, nuclear power, a low-carbon energy option, continues to be part of the broader energy discussion.

Yet the scale of this challenge is daunting. Fossil fuels still provide 81% of global energy, and their energy density is unmatched by renewables. History teaches us that energy transitions are not instantaneous. It took more than 50 years for coal to overtake wood as the dominant energy source in the nineteenth century, and another century for oil to rival coal.

Critically, as we pursue a cleaner energy future, we must avoid repeating the mistakes of preindustrial societies by underestimating the importance of affordable and abundant energy. The energy crises of the 1970s, when oil prices soared, caused economic stagnation and hardship. Recent struggles in various regions with rising electricity costs, driven by policy missteps and market disruptions, underscore the dangers of underestimating the economic impact of energy shortages.

The Moral Case for Material Flourishing

Material flourishing, while not the sole measure of human success, is an essential foundation upon which families, communities, and nations can build a meaningful and fulfilling society. Wealth, properly understood as a means rather than an end, empowers individuals to overcome barriers, alleviate suffering, and pursue aspirations that matter most to them and their families. Material prosperity should not be mistaken for human flourishing itself, but it is an indispensable precondition for achieving it, particularly when linked to the availability of cheap, reliable energy, which drives economic growth and enables societal progress.

Energy is the bedrock of modern economies. The relationship between energy consumption and GDP growth is undeniable—cheap, abundant energy fuels

industrialisation, powers innovation, and creates opportunities for dignified work. It reduces the time and effort required to produce goods and services, freeing up resources for education, leisure, and creative pursuits. Energy abundance allows societies to escape the constraints of subsistence living and embrace a future where individuals can focus on what matters most to them. Conversely, energy scarcity or costly transitions to unreliable alternatives risk economic stagnation, deepen inequality, and threaten the gains that underpin human flourishing.

Poverty traps individuals and societies in cycles of hardship, preventing them from reaching their full potential. Material prosperity, made possible by affordable energy, removes obstacles to education, healthcare, and personal development, enabling people to make choices that enrich their lives. While money cannot directly buy happiness, it can alleviate suffering and eliminate sources of unhappiness, such as hunger, disease, and insecurity. A society with a robust energy base can provide the economic stability that ensures its citizens can thrive, fostering the freedom to pursue their aspirations rather than struggling for survival.

Beyond individual prosperity, material wealth contributes to the broader social fabric by creating opportunities for dignified work. A nation's industrial mix is critical in this regard. Societies that embrace manufacturing, energy-intensive industries, and skilled trades foster a diverse and resilient economy. These sectors provide employment opportunities for a wide range of educational and socio-economic backgrounds, creating a thriving yeomanry—a middle class of artisans, small business owners, and skilled workers. Such a foundation supports social mobility, personal responsibility, and community resilience. By contrast, economies overly reliant on low-wage service sectors risk perpetuating inequality and creating economic fragility.

Material prosperity also enables investment in cultural, educational, and scientific advancements. Nations with strong economies and abundant energy can afford to support the arts, fund research, and provide quality education for all. These investments enrich public life and ensure that individuals from all walks of life can contribute to and benefit from the achievements of their society. In this way, material flourishing acts as a catalyst for the broader flourishing of human potential.

What are the Threats to Human Flourishing?

While many advocate for a future of boundless energy and economic expansion, it is crucial to acknowledge that not everyone shares this vision. For some, the notion of endless growth and continued resource extraction is neither sustainable nor desirable. Critics argue that such a trajectory risks exhausting finite resources, damaging ecosystems, and ignoring the natural limits of our planet. This perspective calls for a fundamental rethinking of how we measure progress, focusing on well-being and ecological balance rather than perpetuating the pursuit of unrestrained economic growth.

From Thomas Malthus' dire warnings of ecological collapse in the eighteenth century to the contemporary policies influenced by the Club of Rome and Paul Ehrlich,²² a scarcity mindset has perpetually coloured humanity's vision of the future. This mindset, rooted in Malthusian theory, posits that unchecked population growth and finite resources inevitably lead to widespread poverty and environmental collapse. But is this outlook warranted? Or does it hinder human flourishing?

Historical Context of Malthusian Theory

Thomas Malthus—an eighteenth-century English cleric and scholar—posited that the human population grows geometrically, while food production increases only arithmetically. This imbalance, he argued, would result in famines, disease, and misery unless population growth was checked. Malthus saw humans primarily as consumers whose needs would eventually outstrip the Earth's capacity to provide.

This grim vision influenced public policy for centuries. During the nineteenth and early twentieth centuries, governments and intellectuals used Malthusian arguments to justify coercive measures such as population control and eugenics. The so-called “Malthusian Trap” framed human existence as a zero-sum game: more people meant fewer resources for everyone.

Yet Malthus' predictions failed to materialise. The Industrial Revolution spurred unprecedented agricultural innovation, dramatically increasing food production. Instead of mass starvation, the world saw food production skyrocket. By the late nineteenth century, technological advances had decoupled resource scarcity from population growth. While Malthus correctly observed the pressures of population on resources, his failure to anticipate human ingenuity revealed the limitations of his

theory. Yet, despite being discredited, his ideas continue to wield enormous influence on modern thinking.

Lifeboat Ethics

Malthusian thinking experienced a renaissance in the twentieth century, particularly in environmental movements. Paul Ehrlich's *The Population Bomb* warned of imminent mass starvation due to overpopulation.²³ Similarly, the Club of Rome's 1972 report, *The Limits to Growth*, forecasted global collapse unless humanity curtailed economic and population growth.²⁴

The worst excesses of this mindset are revealed in Garrett Hardin's essay *Lifeboat Ethics: The Case Against Helping the Poor*.²⁵ Hardin critiques the humanitarian impulse to share resources, claiming it leads to a "tragedy of the commons" where shared resources are depleted by those who fail to exercise restraint. He posits that aid ultimately encourages population growth in poor nations, creating a cycle of dependency that exacerbates global inequality and environmental strain.

Hardin's argument exemplifies the scarcity mindset's pessimistic assumptions, framing humanity as locked in a zero-sum struggle over finite resources and doomed to environmental devastation if we do not radically cut back on our lifestyles. This worldview dismisses the potential of innovation, technological progress, and cooperative international development to address resource challenges. By focusing narrowly on the limitations of the present, Hardin's approach justifies extreme environmental protection measures and isolationism, ignoring the demonstrated capacity of human ingenuity to expand possibilities and improve living standards for all. The lifeboat ethic, with its fatalistic view of global disparity, reveals the dangers of prioritising self-preservation over collective progress, effectively undermining the long-term potential for global flourishing.

Is Radical Environmentalism the New Lifeboat Ethic?

Catastrophist fears about climate change and the extreme responses they inspire echo the Malthusian thinking and lifeboat ethics of the past, underscoring a persistent tendency to underestimate human ingenuity in solving our greatest problems. Like Thomas Malthus's dire warnings about population outstripping resources, modern climate alarmism often frames humanity's future as a zero-sum game, where immediate sacrifices are demanded to stave off disaster.

This fatalism which calls for drastic decarbonisation risks exacerbating energy poverty and stalling development in vulnerable regions. As the push for aggressive decarbonisation has gained momentum, fossil fuel usage has been deliberately curtailed, often without adequate consideration of the energy security and reliability it provides. This shift has been driven by overly optimistic promises that renewables alone could seamlessly fill the gap, despite their technical and economic limitations in delivering consistent, affordable power at scale.

Renewable energy sources face inherent limitations in producing low-cost, reliable power 24 hours a day, 365 days of the year. Solar and wind energy, being intermittent, require substantial and costly backup systems, such as large-scale batteries, pumped hydro storage, or access to cheap and flexible gas power, to stabilise supply during periods of low generation.

Moreover, the scale of renewable infrastructure needed to power a modern, highly electrified, and industrialised society remains unprecedented. No country has yet demonstrated the capacity to achieve such a transition at the necessary scale without compromising affordability or reliability, or remaining highly dependent on fossil fuel imports from other jurisdictions.

Adding to this challenge, the inherently diffuse nature of renewable energy requires an exceptional amount of land use to produce industrial scale electricity, leading to other trade-offs for either agricultural productivity or environmental conservation.

Policies that favour renewable energy at the expense of fossil fuels often fail to provide the reliability and affordability required to sustain rapid economic growth. For countries where millions still lack electricity, the insistence on abandoning fossil fuels prematurely risks entrenching poverty and stalling progress toward prosperity.

In the developed world, the rush to decarbonise is already eroding living standards. Policies aimed at phasing out fossil fuels have contributed to soaring energy costs, which disproportionately affect low- and middle-income households. Industries reliant on affordable energy face higher production costs, which translate into higher prices for goods and services. The broader economic consequences—slowed growth, reduced competitiveness, and rising unemployment—are stark reminders that energy transitions must be managed with care.

This new Malthusianism, cloaked in the language of environmental responsibility, shares the original ideology's fatal flaw: a fixation on limits rather than possibilities.

Instead of fostering innovation and creating pathways to abundant, clean energy, it relies on restrictive measures that assume scarcity as an unchanging reality. By doing so, it risks sacrificing human flourishing on the altar of precaution, ignoring humanity's proven ability to innovate its way out of challenges. A more balanced approach, one that acknowledges the importance of both environmental stewardship and economic growth, is essential to avoid repeating the errors of Malthusian thinking in the modern age.

The Pro-Human versus the Post-Christian Moral Framework

The resurgence of Malthusian ideas, dressed in the garb of catastrophist environmentalism, underscores a profound philosophical transition in the West. Once anchored in the Christian telos of maximising human flourishing and affirming the infinite worth of each individual, Western ethics has secularised and now often prioritises collective outcomes for all of nature over individual prosperity.

This shift mirrors the utilitarian tendencies of effective altruism, a movement that measures value not through intrinsic worth but by the aggregate impact on life forms, human and non-human alike. The trade-offs inherent in this framework—where the “greatest good” may justify significant individual sacrifices (often via external compulsion as opposed to voluntary sacrifice)—reflect a secular reinterpretation of moral purpose, one that often subordinates material flourishing to the imperatives of ecological or existential triage.

The utilitarian calculus of effective altruism becomes problematic when applied to environmental priorities. Strategies that promote the rapid reduction of fossil fuel use, regardless of the societal cost, often fail to consider the moral implications of energy poverty and economic stagnation in developing nations.

In contrast to this philosophy, one of the traditional pillars of Western Civilisation was the principle of the infinite value of each human being. Inspired by Christianity, this view posits that every human being possesses inherent worth and dignity, not because of their utility or contributions to collective goals but by virtue of their creation in the image of God. This understanding places the human person at the centre of moral consideration, framing environmental stewardship as a duty to sustain creation for the benefit of humanity rather than an end in itself.

The Christian moral framework does not condone the reckless exploitation or destruction of nature; rather, it envisions the natural world as a garden entrusted to humanity's stewardship. At its core, it prioritises human flourishing and agency, seeking to balance our management of nature with the moral imperative to maximise opportunity and personal liberty.

A robust environmental ethic must reconcile ecological responsibility with the inherent worth and dignity of the human person, lest it devolve into an anti-human ideology.

Superabundance: A Rebuttal to the Malthusian Mindset

The Malthusian mindset, still influential in discussions about environmentalism and resource scarcity, is a dour and unimaginative view of the world. It assumes that resources are finite, that growth is unsustainable, and that humanity is a burden rather than a force for progress. This way of thinking ignores the fundamental truth demonstrated time and again throughout history: human ingenuity transforms constraints into opportunities and problems into solutions.

History shows that resource scarcity is not inevitable. Technological advances have consistently increased resource availability by improving efficiency and creating substitutes. Aluminium replaced tin in many uses. Digital technology has replaced countless physical goods. Each time, human creativity has made more out of less. These innovations allow societies to produce wealth and improve quality of life even as populations grow. This is not magic; it is the result of investment in human knowledge and institutional frameworks that encourage innovation and set the human spirit free to imagine and explore.

But innovation cannot be forced—and it is not always predictable where it will come from. You cannot direct a market to scientific innovation; instead, it emerges from the organic interplay of freedom, pragmatism, and the wisdom of crowds. It is a process where countless individuals and entities, each with their unique perspectives, experiment with solutions until the most effective and scalable pathways are revealed. When this natural process is respected, breakthroughs occur in unexpected ways, often solving multiple problems simultaneously.

The current approach to decarbonisation seeks to dictate outcomes by picking winners while outright banning proven tools that have historically delivered reliable results. This

strategy not only stifles the dynamism essential for innovation but also distorts markets, leaving economies vulnerable and weakened. Markets thrive when they are free to adapt and evolve, and it is within that freedom that real progress is made.

Ending Energy Poverty

Billions of people still lack access to reliable electricity, clean cooking fuels, and basic modern conveniences. Over two billion people still cook with wood, dung, or agricultural waste, leading to severe health risks from indoor air pollution.²⁶ Energy poverty remains a significant barrier to improving health, education, and economic opportunities. Simply providing clean cooking fuels could prevent millions of premature deaths annually, a tangible benefit far more immediate than marginal reductions in global carbon emissions.

A key priority over the next quarter of a century should therefore be to end energy poverty—a goal that is not only attainable but also vital for improving global living standards.

Hydrocarbons currently supply over 80% of the world's energy.²⁷ They are essential not only for electricity, but for manufacturing critical materials such as steel, cement, and plastics—the very building blocks of modern civilisation. Dismantling this infrastructure without adequate alternatives is a perilous gamble. Renewable sources like wind and solar, while growing, remain intermittent and are largely confined to electricity generation, which constitutes just 20% of global energy consumption.²⁸ Other sectors, such as manufacturing, transportation, and agriculture, have no viable substitutes for the energy density and reliability of hydrocarbons.

Even in high-income countries, energy insecurity is a growing concern that needs to be addressed. Europe's recent energy crisis, exacerbated by reduced reliance on domestic hydrocarbons, resulted in soaring costs and increased mortality during colder months. The wealthy world's push for rapid decarbonisation often exports emissions to countries like China, where manufacturing remains heavily coal-dependent, further undermining global climate goals.

Climate change is undoubtedly a challenge, but framing it as the singular existential threat ignores more pressing global issues such as malnutrition, air pollution, and endemic diseases. While climate-related risks, like rising sea levels and extreme

weather, require adaptation and mitigation, the immediate human toll of inadequate energy access is an even more pressing challenge.

The path to a sustainable future requires more than rhetoric and lofty goals. It demands a realistic understanding of trade-offs and a commitment to policies that prioritise human well-being. The world's most urgent challenge is to lift more people out of poverty by advancing access to affordable, reliable energy, in order to ensure that no one is left in the dark.

Conclusion—The Pro Human Way

The enduring link between energy and GDP highlights a fundamental truth: the wealth of nations is inexorably tied to the abundance and affordability of energy. Throughout history, from coal to oil and beyond, energy has powered the extraordinary rise of living standards and the material flourishing that underpins human progress. This interplay is not merely economic—it is profoundly moral. It ensures that individuals, families, and societies have the means to overcome subsistence, pursue education, innovate, and create.

However, this progress is not assured. As nations grapple with the dual imperatives of environmental stewardship and economic growth, it is critical to avoid the pitfalls of energy scarcity and prohibitive costs. Policies that inhibit affordable energy risk undoing decades of gains, particularly for the world's most vulnerable. The lessons of history are clear: prosperity flourishes where energy is abundant, reliable, and affordable.

Rejecting the Malthusian narrative is not about ignoring environmental challenges. It is about addressing them without undermining human progress. By embracing a mindset of superabundance—focused on fostering innovation, improving institutional frameworks, and investing in human capital—societies can continue to transform finite inputs into infinite opportunities. By focusing on reducing the cost of energy and increasing its availability, humanity can unlock a new chapter of shared prosperity, ensuring that the arc of progress continues upward for generations to come.

- ¹ David Stern, "Energy-GDP Relationship", in *The new Palgrave Dictionary of Economics*, 2018; D. I. Stern and A. Kander, "The role of energy in the industrial revolution and modern economic growth", *Energy Journal*, (2012) 33 (3): pp. 125–152.
- ² Z. Csereklyei, M. d. M. Rubio Varas, and D. I. Stern, "Energy and economic growth: The stylised facts", *Energy Journal*, 37 (2016) (2): pp. 223–255.
- ³ C. King, "Comparing world economic and net energy metrics, Part 3: macroeconomic historical and future perspectives", *Energies* 8, (2015) pp. 12997–13020.
- ⁴ Geoff Barnard and Patrice Ollivaud, "Energy expenditures have surged, posing challenges for policymakers", *Ecoscope*, 20 January 2023, <https://oecd ecoscope.blog/2023/01/20/energy-expenditures-have-surged-posing-challenges-for-policymakers/>.
- ⁵ Jonty Flottmann, "Australian energy policy decisions in the wake of the 2022 energy crisis" *Economic Analysis and Policy*, Elsevier, (2024) vol. 81(C), pp. 238–248.
- ⁶ David Stern, "Energy-GDP Relationship", in *The new Palgrave Dictionary of Economics*, 2018; D. I. Stern and A. Kander, "The role of energy in the industrial revolution and modern economic growth", *Energy Journal*, (2012) 33 (3): pp. 125–152.
- ⁷ Ibid.
- ⁸ D. I. Stern, "Energy use and economic growth in the USA: A multivariate approach", *Energy Economics* (1993) 15: pp. 137–150.
- ⁹ David Stern, "Energy-GDP Relationship", in *The new Palgrave Dictionary of Economics*, 2018; D. I. Stern and A. Kander, "The role of energy in the industrial revolution and modern economic growth", *Energy Journal* (2012) 33 (3): pp. 125–152.
- ¹⁰ E. S. H. Yu and J. C. Jin, "Cointegration tests of energy consumption, income, and employment", *Resources and Energy*, (1992) 14: pp. 259–266.
- ¹¹ D. I. Stern, "A multivariate cointegration analysis of the role of energy in the U.S. macroeconomy", *Energy Economics*, (2000) 22: pp. 267–283.
- ¹² B. Warr and R. U. Ayres, "Evidence of causality between the quantity and quality of energy consumption and economic growth", *Energy*, (2010) 35: pp. 1688–1693.
- ¹³ W. Oh, and K. Lee, "Causal relationship between energy consumption and GDP revisited: The case of Korea 1970–1999", *Energy Economics*, (2004) 26: pp. 51–59.
- ¹⁴ C. King, "Comparing world economic and net energy metrics, Part 3: macroeconomic historical and future perspectives", *Energies* 8, (2015) pp. 12997–13020.
- ¹⁵ S. B. Bruns, C. Gross, and D. I. Stern, "Is there really Granger causality between energy use and output?" *Energy Journal*, (2014) 35 (4): pp. 101–134.
- ¹⁶ David Stern, "Energy-GDP Relationship", in *The new Palgrave Dictionary of Economics*, 2018; D. I. Stern and A. Kander, "The role of energy in the industrial revolution and modern economic growth", *Energy Journal*, (2012) 33 (3): pp. 125–152.
- ¹⁷ F. Fizaine, and V. Court, "Energy expenditure, economic growth, and the minimum EROI of society", *Energy Policy*, (2016) 95, pp. 172–186.
- ¹⁸ C. King, "Comparing world economic and net energy metrics, Part 3: macroeconomic historical and future perspectives", *Energies* 8, (2015) pp. 12997–13020.
- ¹⁹ D. J. Murphy, C. A. S. Hall, "Adjusting the economy to the new energy realities of the second half of the age of oil", *Ecol. Model* (2011) 223, pp. 67–71.
- ²⁰ I. Bashmakov, M. Grubb, P. Drummond, R. Lowe, A. Myshak, and B. Hinder, "'Minus 1' and energy costs constants: Empirical evidence, theory and policy implications", *Structural Change and Economic Dynamics*, (2024) 71, pp. 95–115.

²¹ V. Court, F. Fizaine, “Long-term estimates of the Energy-Return-on-Investment (EROI) of coal, oil, and gas global productions”, *Ecol. Econ.* (2017) 138 (2017), pp. 145–159.

²² Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, William Behrens III, “The Limits to Growth”, *The Club of Rome*, 1972; Paul R. Ehrlich and Anne H. Ehrlich, *The Population Bomb* (1968).

²³ Paul R. Ehrlich and Anne H. Ehrlich, *The Population Bomb* (1968).

²⁴ Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, William Behrens III, “The Limits to Growth”, *The Club of Rome*, 1972.

²⁵ Garrett Hardin, “Lifeboat Ethics: the Case Against Helping the Poor”, *Psychology Today*, September 1974.

²⁶ Ibid.

²⁷ “Statistical Review of World Energy”, *Energy Institute*, accessed 7 January 2025, <https://www.energyinst.org/statistical-review>.

²⁸ “Bettering Human Lives”, *Liberty Energy*, 2024, <https://libertyenergy.com/esg/bettering-human-lives/>.



In this new collection of papers, ARC has brought together some of the world's best thinkers to analyse how we arrived at our current civilisational moment and explore where we might be headed if we fail to make the right choices.

Looking at issues across our Social Fabric, Free Enterprise and Governance, and Energy, Resources and Our Environment streams, these papers offer groundbreaking ideas for how we might chart a better course forward, to unlock abundance and human flourishing, and renew our civilisation.