In collaboration
with PwC

WORLD ECONOMIC FORUM

Transforming Energy Demand

WHITE PAPER

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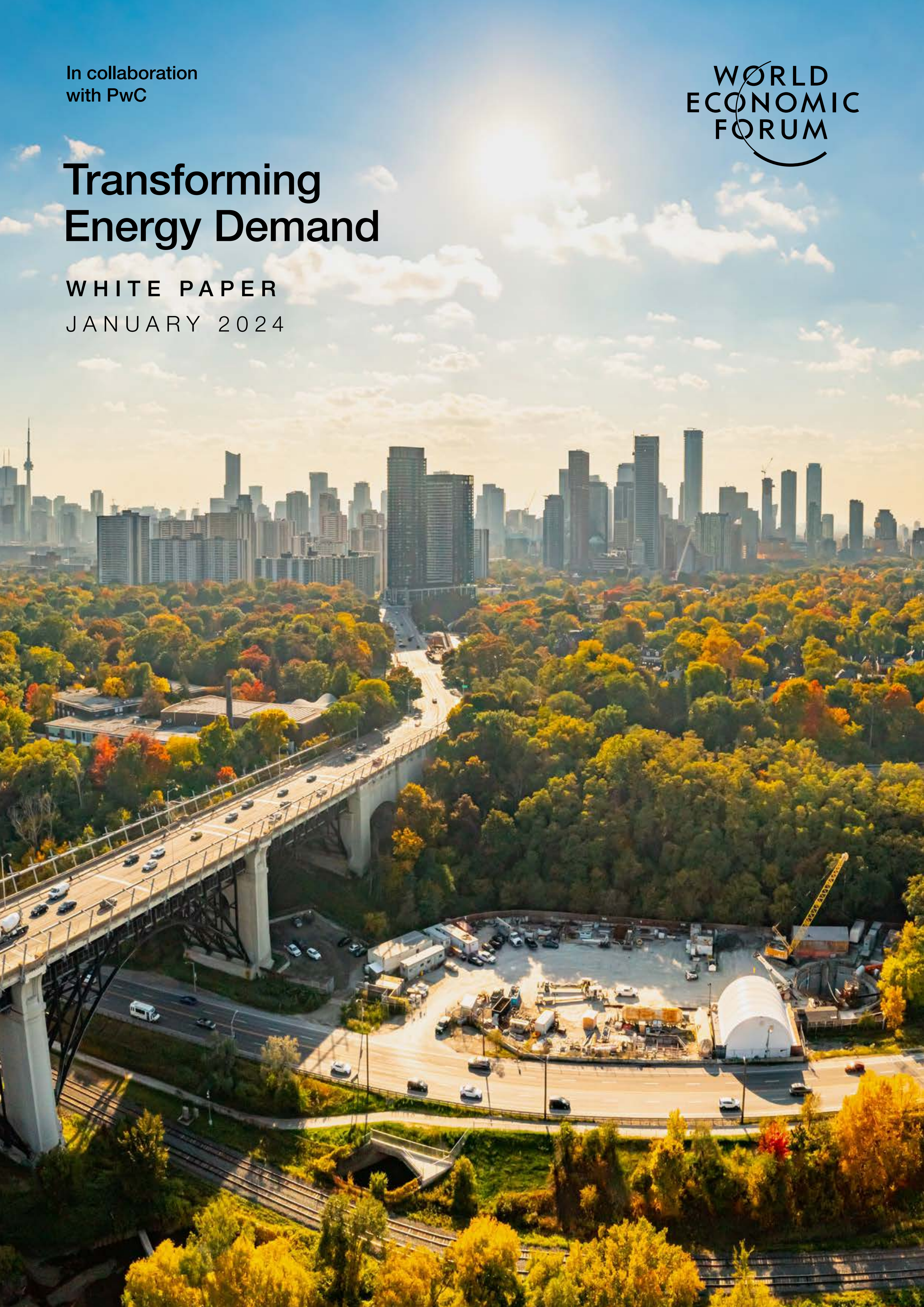

Images: Getty Images

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Foreword

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As the global energy system undergoes a rapid transformation, leaders across all sectors need to collaborate to accelerate an energy transition that creates positive outcomes for people, society and the planet. The private sector can play a leading role in driving this transformation.

That is why a year ago, the International Business Council (IBC), a group that together represents 3% of global energy use, decided to focus on energy demand. This is an under-addressed area that will allow us to increase economic output, while reducing greenhouse gas emissions (GHG) and driving up global access to energy.

Our research shows that there are many tangible actions that all businesses can take today to act on energy demand. The potential of this demand-side action is extraordinary, offering a short-term, cost-efficient 31% reduction of demand, shared across all economic sectors. These gains are deliverable now, at attractive returns, needing no new technology. Such concerted action would unlock growth and productivity while getting the world back on track to meet the targets sets by the Paris Agreement. At the same time, it would support delivery of the pledge by over 120 countries at COP28 to double the global average annual rate of energy efficiency improvement.

These findings should be exciting for all leaders, in growth and mature markets alike, and we thank all the IBC members for their support in driving this work. Our ambition is to get the world to act as much on energy demand as supply its efforts to reach net zero. We hope this paper will inspire many other businesses and governments to join this effort. There is no time to lose.

Executive summary

Actions on energy demand can be taken by all companies now, are profitable and can accelerate progress towards climate goals.

The value of action on energy demand is compelling: a possible 31% reduction in energy intensity and up to $2 trillion in annual savings if measures were to be taken by 2030 (see Appendix, A1: Methodology). Reducing energy intensity – energy used per unit of gross domestic product (GDP) – would boost growth by enabling previously wasted or over-utilized energy to be redirected to more productive activities. It would also help companies save cash and maintain competitive advantage while reducing emissions. This paper outlines the value of actions on energy demand from the private and public sectors and how to deliver them. Actions are doable today, at attractive returns with existing technology, and so it is believed this establishes a compelling case to act as much on energy demand as supply in the journey to net zero.

Finding a way to reduce or even reverse the pace of energy demand growth while supporting economic output is critical. By 2050, the world's population will grow by two billion, and GDP is forecast to double. Emerging markets and developing economies need abundant and low-cost energy to enable growth and meet development goals. Simultaneously, the world is targeting supply decarbonization. Acting on demand and supply simultaneously is the best way to achieve these changes.

Acting on energy consumption is doable, affordable and profitable. This research shows that all companies and countries can use existing levers to reduce energy intensity. Across buildings, industry and transport (BIT), International Business Council (IBC) examples illustrate that these actions, where supported by appropriate public policy, can enable the world to reduce its energy needs by approximately a third while freeing further economic output. Affordability is also clear, with interventions potentially fully paid back globally within a decade, driving estimated annual savings in the range of $2 trillion.

Three levers can deliver this change. First, "energy savings"– operational improvement interventions funded through operating expenditure (OpEx). Results are typically immediate but often overlooked as they require coordinating many interventions across an organization and constant energy cost improvement. "Energy efficiency" pools measures under direct company control that require capital expenditure (CapEx). Together, savings and efficiencies offer businesses the lower-hanging fruit and at least half of the improvements in energy intensity that this research has identified. The final lever is "value chain collaboration", where working directly with suppliers and business partners offers company agency over energy impact, reducing cost and getting ahead of the race to net zero.

Each sector needs a "roadmap" to guide company and government action. Company and national energy transition plans are needed to capture the benefits of managing energy consumption while integrating supply-side actions. Businesses across the energy demand and supply spectrum will need to work together with government to develop these plans and increase awareness of the routes and results available to address barriers to action.

Developing these plans is the essential next step in raising awareness and getting behind action on energy demand. At COP28, over 120 countries pledged to double the pace of energy efficiency improvement. The IBC can be a leading private sector group to support countries in their ambition.

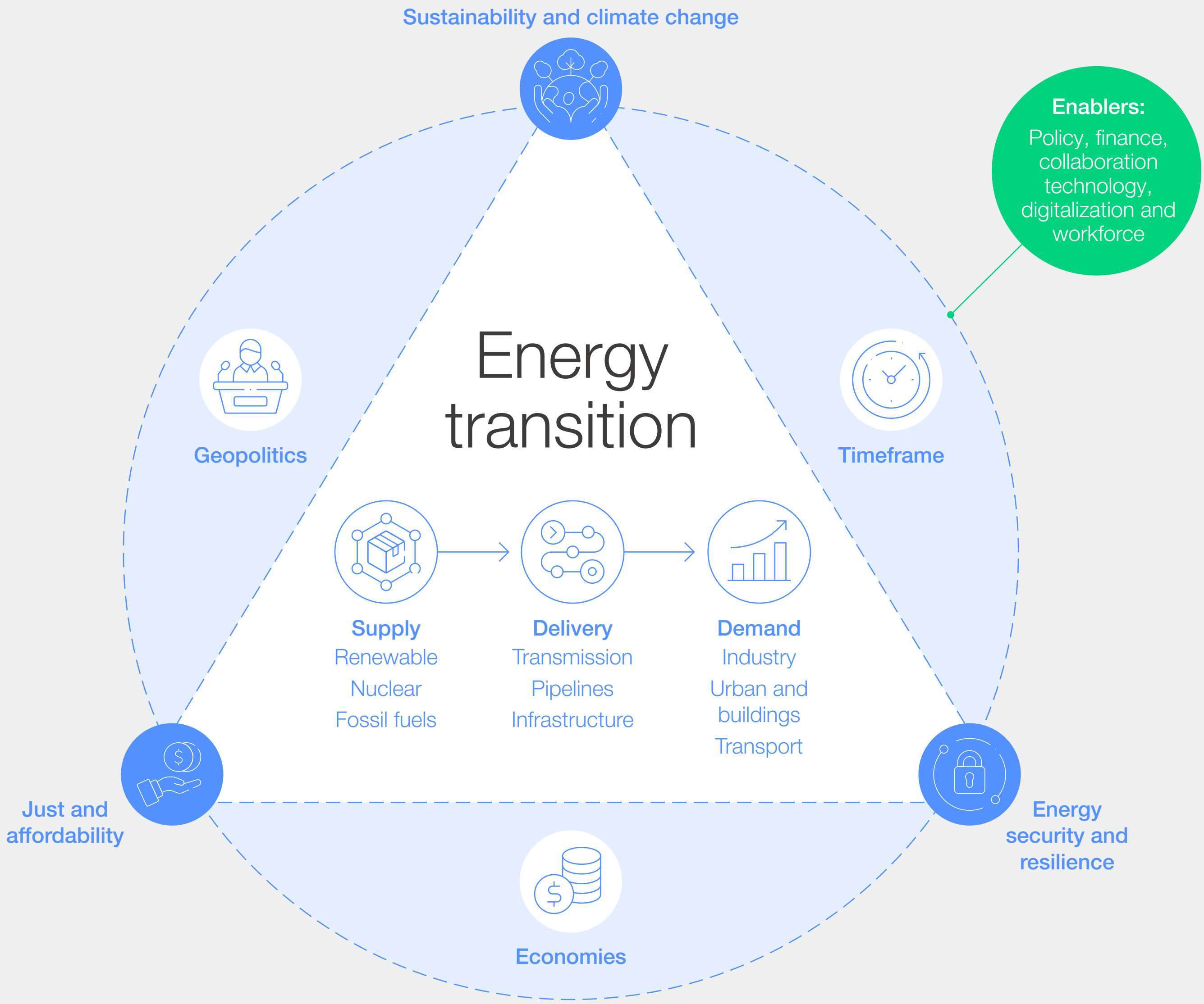
1 Why transforming energy demand matters

Actions on energy demand can reduce energy consumption by up to 31%, saving up to $2 trillion per annum.

What if a business could reduce its annual operating costs by 10% within three years? What would be the implications for a company's stock price if it could increase margins on a sustained basis by 200-300 basis points? All while simultaneously building both measurable progress on reducing greenhouse gas (GHG) emissions and delivering greater resilience in operations.

These are not trick questions, but are based on real examples from IBC members. The answer lies at the root of this study: transforming energy demand.

FIGURE 1 **The energy triangle**



Source: World Economic Forum, *Fostering Effective Energy Transition*, 2023.

Note: The triangle represents the energy trilemma – the imperative of delivering a just energy transition while ensuring affordability, security and sustainability.

> To date, there has been too heavy a reliance on governments and the energy industry, not the wider economy, to deliver net zero.

The problem

The energy transition creates immense and growing tensions between the imperatives of security, affordability and sustainability (see Figure 1).

Security

On energy security, the first challenge is to simultaneously maintain a secure and stable supply of energy amid an increasingly volatile geopolitical situation, all while transforming today's hydrocarbon-dominated supply. In 2021-22, Europe grappled with energy shortages and prices that have threatened the industrial base and forced governments to procure their oil and gas from the flows normally destined to other emerging markets and developing economies (EMDE),[1] which in turn had to resort to higher coal consumption and overall face higher energy prices.

Affordability

The second challenge, affordability, is to ensure that energy is economic not just for businesses but for society in general. While forecasts differ on the level of energy demand in 2050 (see Figure 2), the expected doubling of global gross domestic product (GDP) and the addition of two billion people will intensify pressure on energy supply systems,[2] particularly in EMDE, which are responsible for approximately 60% of current demand. These markets need a clear range of routes to economic growth, which include abundant access to affordable clean energy.[3] If the future level of energy demand is not met by adequate supply, it could lead to higher prices and obstacles to growth and competitiveness.

Sustainability

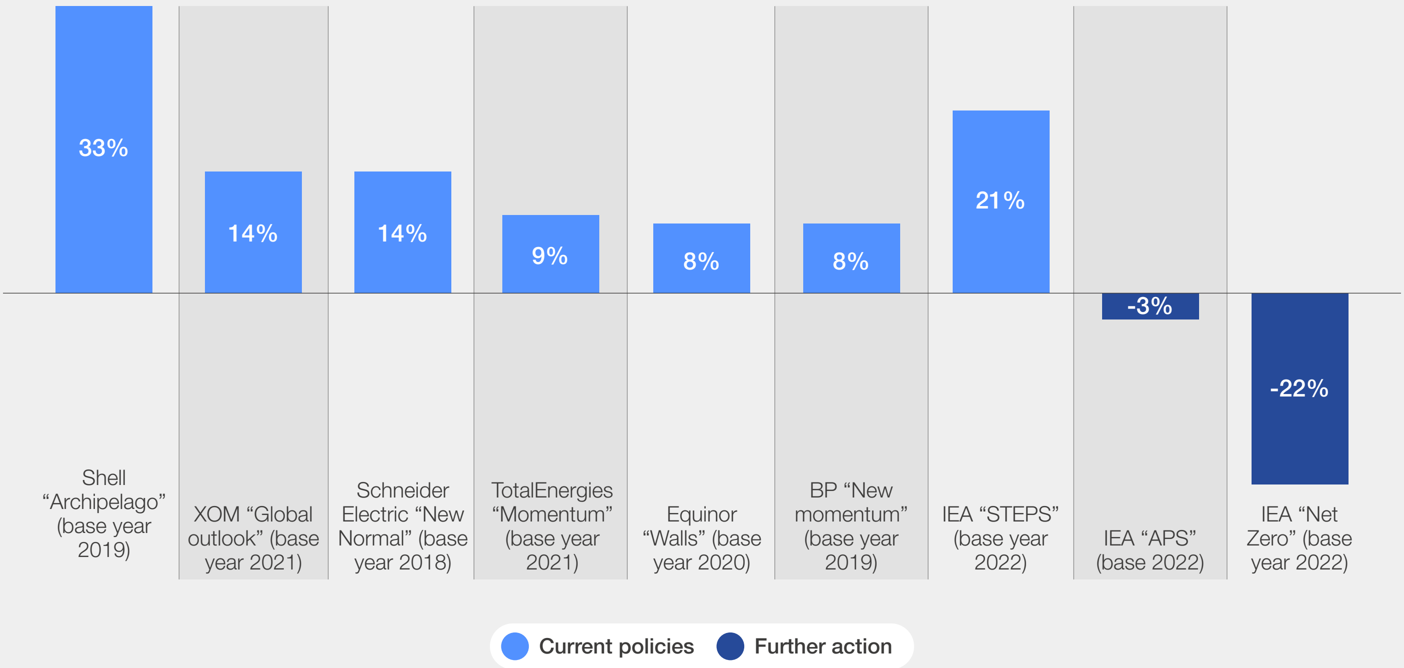
The third challenge, sustainability, is to meet this growth in energy demand in a way that keeps the world on track to meet the 2050 Paris Agreement. Even with an assumed three-fold growth in renewable energy, scenarios forecast a significant shortfall in clean energy supply by 2050 (see Figure 3), which could be met with more fossil fuel-based energy. This is as, if not more, true in EMDE, due to the lack of adequate renewable supply chains.

To date, the majority of debate and action has been focused on governments and energy companies driving changes in energy supply. This has resulted in remarkable changes in the energy system, with rapid increases in emissions-free and decentralised electricity generation. However, the trajectory of the energy transition remains off-track compared to climate and development goals, hindered by issues such as slow permitting and poor access to finance. Therefore, while action on energy supply remains crucial, it will be difficult for it to be the answer alone.

FIGURE 2 **Forecast demand growth to 2050**

Percentage growth in total energy consumption across differing global scenarios (sample)

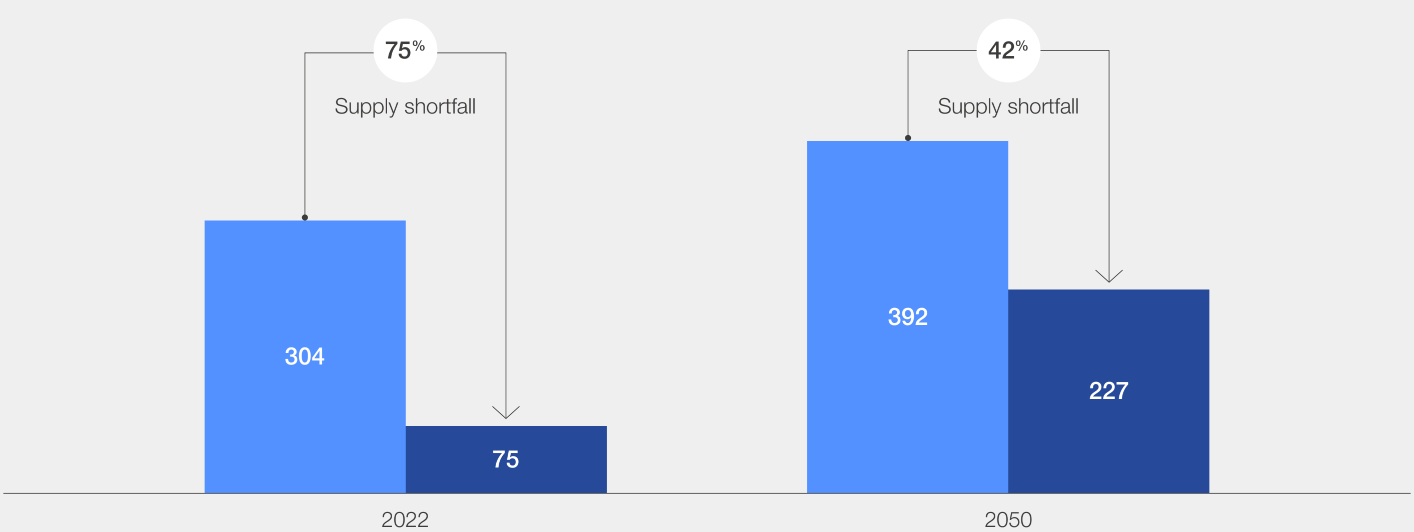
%, base year to 2050



Sources: International Energy Agency (IEA), *Net Zero Roadmap: A Global Pathway to Keep the 1.5C Goal in Reach*, 2023; Shell, *The Energy Security Scenarios*, 2019; ExxonMobil, *ExxonMobil Global Outlook*, 2023; Schneider Electric, *Back to 2050: 1.5°C is more feasible than we think*, 2021; Equinor, *2023 Energy Perspectives*, 2023; bp, *bp Energy Outlook 2023 Edition*, 2023; IEA, *World Energy Outlook 2023*, 2023; TotalEnergies, *TotalEnergies Energy Outlook 2022*, 2022.

FIGURE 3 | **Shortfall in renewable energy supply vs demand from commercial sources**

Global commercial* total final consumption and renewable energy supply and IEA stated policies (STEPS) scenario, exajoules (EJ), 2022-2050



*All energy demand from commercial buildings, industry and transport, excluding residential buildings and road transport.
Sources: IEA, *World Energy Outlook 2023*, 2023.

The solution: action on energy consumption alongside supply

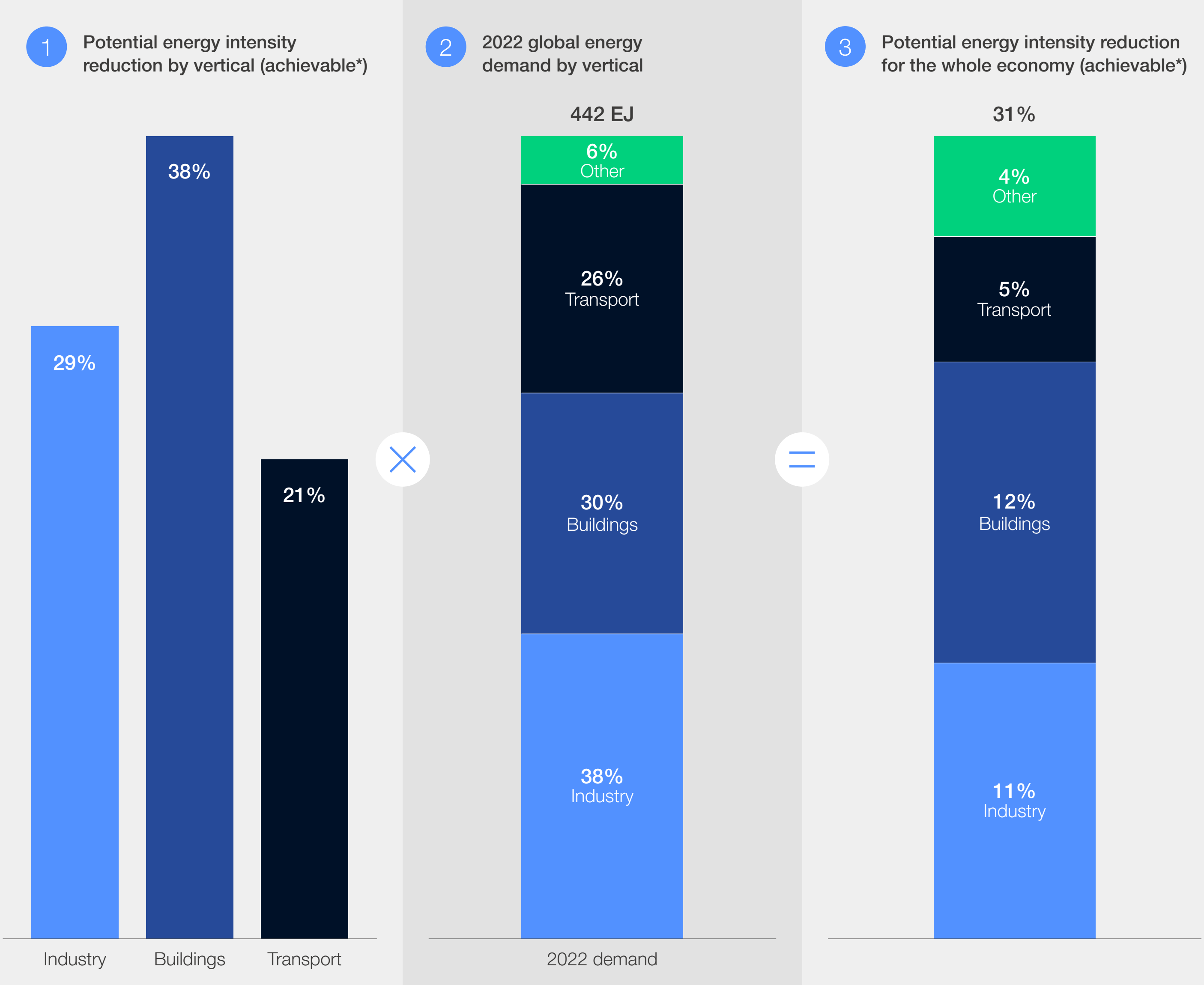
It is, therefore, vital to address energy demand alongside supply, reducing the energy intensity of current activity and future growth. Demand-side action is an area where the business and social cases for demand-side action overlap closely. Such action can increase productivity, while unlocking access to energy and economic growth. This is done by reallocating previously wasted or unnecessarily-used energy to new consumers and/or new uses. After all, the cheapest form of energy is energy that is **not** used. There's also a clear opportunity cost – any delay in action will force increased energy spending and continued missing of climate goals.

The great news is that transforming energy demand is doable and affordable now. All companies, regardless of sector, can tap into existing, affordable technologies to reduce energy intensity – that is, using less energy to create the same (or greater) output. This in turn will reduce emissions intensity (the volume of emissions created in manufacturing a product or providing a service) due to energy-related emissions being reduced. Measures to tackle energy consumption are also beneficial across all markets, as delivering higher output with lower energy use is a universal good. However, benefits will vary in importance between markets. For example, in developed economies, lower energy intensity helps to enhance competitiveness through lower total energy cost while attenuating environmental risks. In EMDE, taking action to manage energy demand as well as focusing on the supply can improve access to secure energy, improving the ability to attract investment while offering the opportunity to avoid low-efficiency legacy systems seen in developed economies.

Size of the energy demand prize

This study breaks global energy demand into "BITs" – buildings, industry and transport. Together, these account for 94% of global demand.[4] Achievable[5] interventions have been identified across these areas that would reduce overall energy intensity by around 31% relative to current levels (see Figure 4), with further, harder-to-deliver interventions increasing this to 42% (see Figure 6).

FIGURE 4 **Short-term reduction potential of energy demand actions (achievable scenario only)**



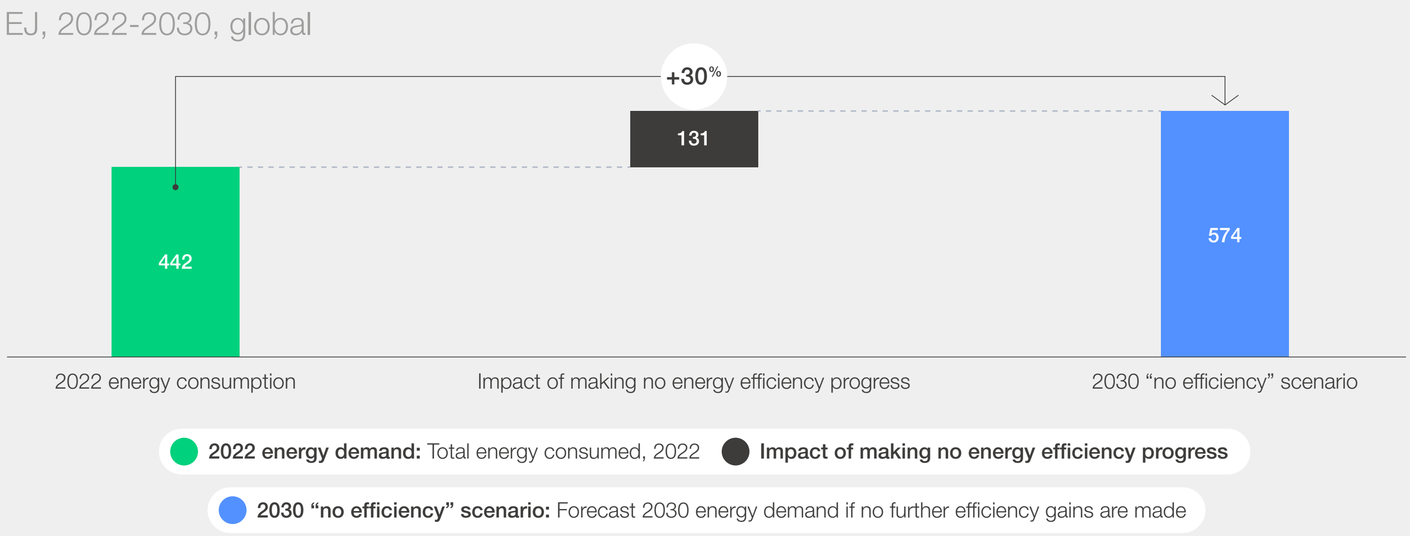
– In (1), individual interventions by vertical are identified (e.g. installing more efficient electric motors), and their potential impact on vertical-wide energy intensity is summed.
– To gain the overall impact of these changes on global demand, these are then scaled by the proportion of energy demand that each vertical represents (2). In addition, an average intensity reduction is applied to sectors not considered in depth (defined as "other")
– This results in (3), the potential combined impact of individual interventions on global energy intensity.

*Achievable is defined as interventions that are currently technologically available at scale with associated data available on their energy intensity impact; **Percentage does not total 31% due to rounding.

Sources: IEA, *World Energy Outlook 2023*, 2023.

To understand how these interventions would affect the world over time, this report considers what would occur if these interventions were globally enacted by 2030 (see Appendix, A1: Methodology). This was achieved by first modelling energy demand in 2030 if no energy intensity improvement were made between 2022 and 2030 ("no efficiency" scenario, see Figure 5).

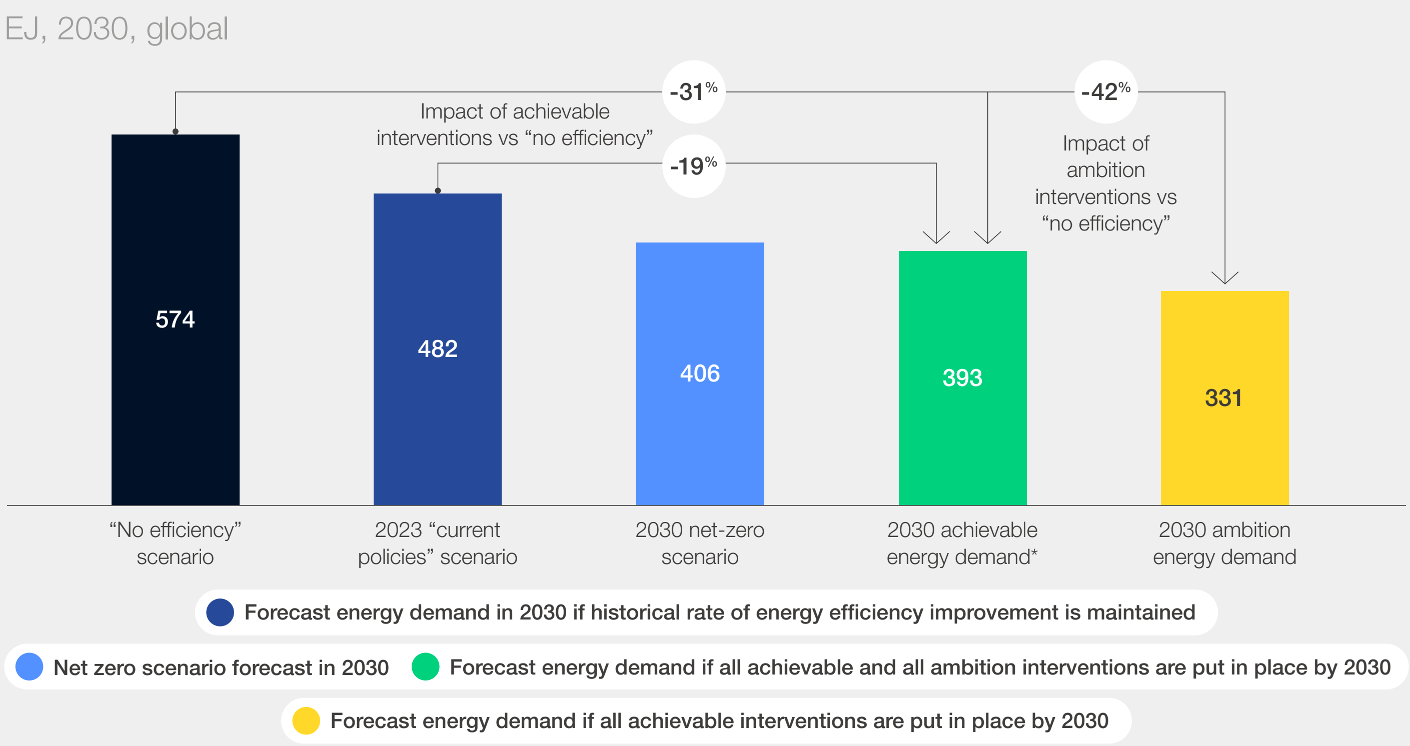
FIGURE 5 | **Forecast of "no efficiency" scenario, 2030**



Source: IEA, *World Energy Outlook 2023*, 2023.

If applied to the "no efficiency" scenario in 2030, these interventions would allow output to be maintained with less energy, resulting in a reduction in energy intensity around 19% below the levels forecast if current policies are enacted (see Figure 6). On an annual basis, this would correspond to an improvement in energy intensity of 4.6% per annum. Such gains are ahead of the target set by the Sustainable Development Goals (SDGs), the International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA) of doubling the current rate to over 4% to reach net zero. **As a result, if delivered, these interventions would put the world ahead of the targets in the Paris Agreements.**

FIGURE 6 | **Impact of proposed interventions on global energy demand, 2030**[6]

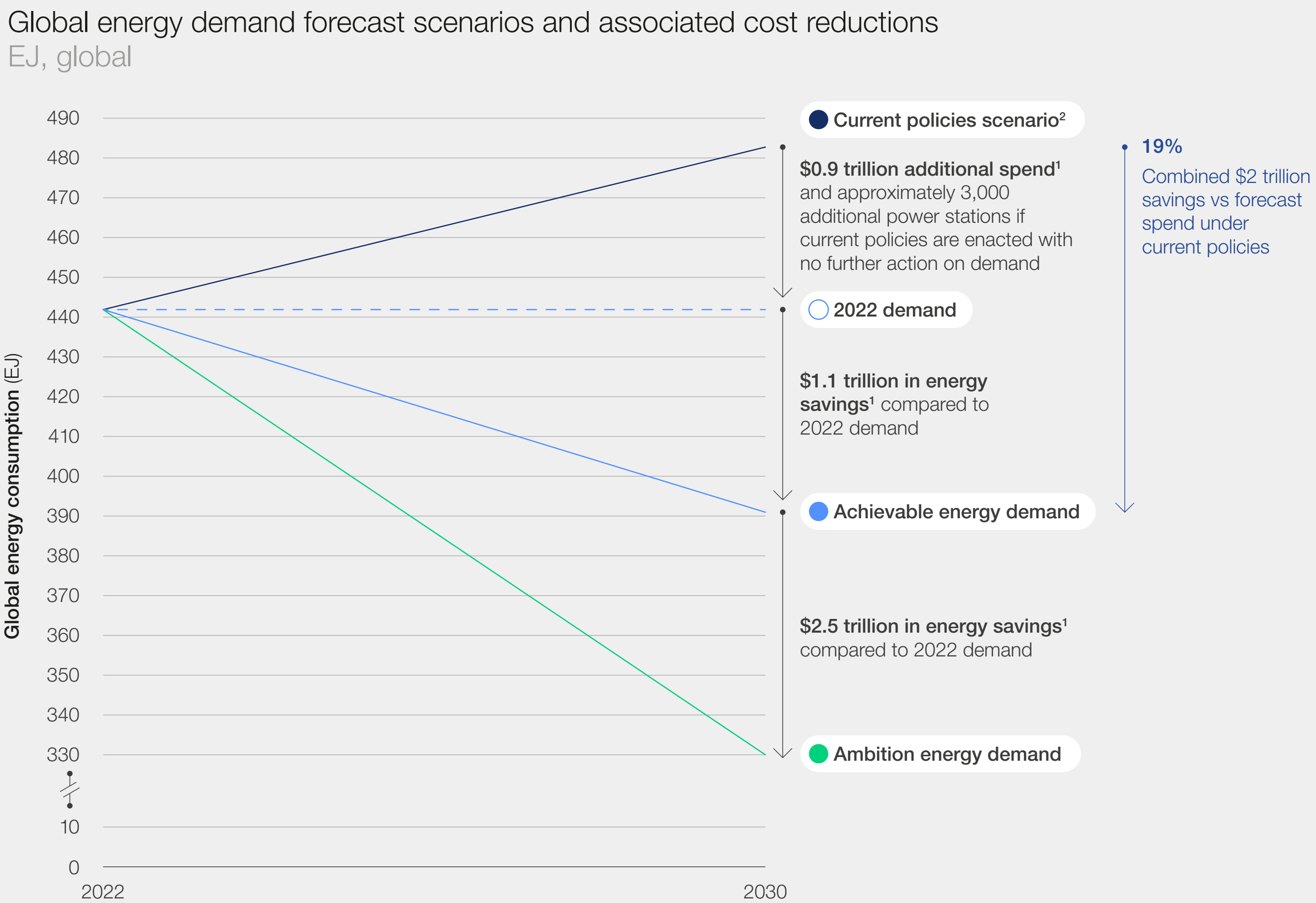


* Achievable" scenario represents difficult steps to implement that will reduce energy intensity, but that are based on technologies that are available at scale today, making them technically achievable. "Ambition" scenario represents the impact of all achievable interventions alongside some less proven, more difficult to scale interventions.

Source: IEA, *World Energy Outlook 2023*, 2023.

Even with the energy numbers being so compelling, these interventions would have to be affordable. Again, acting on energy demand offers good news, suggesting a clear range of routes which come at a fraction of the long-term capital expenditure needed to switch energy supply away from fossil fuel. While a recent report by IRENA puts the cumulative cost of energy efficiency interventions by 2030 to reach net zero at $14 trillion,[7] this study suggests that, of this, up to $8 trillion is repaid during the period, with further annual savings of up to $2 trillion per annum at current prices, depending on how energy pricing varies in response to intensity reduction (see Figure 7).

FIGURE 7 **Impact of energy demand-side levers on global energy demand and illustrative associated cost impacts, 2022-30**



Notes: 1 Assumes current average price per joule to stay constant. This is illustrative and to quantify the theoretical size of the prize based on current spending. Actual figure would vary depending on response of energy prices to reduction in demand, and changes in overall energy systems and their fuel mixes.; **2** IEA STEPS scenario
Source: IEA STEPS scenario

While supply-side interventions remain crucial, interventions on energy consumption are effectively self-funding during the period, can be paid back within the decade and embed long-term efficiency – all while shifting the world's ability to deliver the Paris Agreement.

To help organizations pursue this prize, this report identifies the opportunities and the barriers to adoption, highlighting the levers that will help companies reduce intensity, and developing suggested routes to follow to deliver these changes. Most of these interventions can be deployed now, driving significant improvements in less than a year.

In developing these conclusions, a global survey was conducted, which involved contributions from the 120 members of the World Economic Forum's International Business Council (IBC), a group of multinational companies representing about 3% of global energy demand from their direct operations. The survey aimed to understand the current role that companies are playing in the energy transition, what is preventing further action and how these issues can be overcome. In addition, member interviews were conducted to identify examples of replicable energy consumption-focused measures. The results of these interactions are captures in the recommendations throughout the remainder of this report.

2 The three energy demand levers

There are three existing, deliverable levers to reduce energy intensity, but these face challenges that limit uptake.

FIGURE 8 **Three levers energy demand levers**

	Lever	Description	Median energy intensity impact	Case study
Lower complexity/ shorter payback 1	Energy saving	Interventions to save energy by changing a company's ongoing **core behaviours and activities**, primarily **OpEx funded** with **short-term payback**	Around 10%	– AI-driven software to control existing HVAC systems – Reduces HVAC energy intensity by 20-25%, payback of less than 1 year
2	Energy efficiency[1]	Using less energy to perform the same task, typically funded by **CapEx with medium-term payback by investing in core business processes**	Around 30%	– Retrofitting buildings using smart products, lighting, improved HVAC – Reduced energy required for non-industrial sector operations by 27% – Payback less than 15 years[2]
3 Higher complexity/ longer payback	Value chain collaboration	Scalable, replicable partnerships with adjacent supply chains to achieve energy and emissions intensity improvements through **demand substitution, demand consolidation and flexible demand response**	Around 45%	– Swedish sulphuric acid plant supplying energy to urban district heating – Reduced city's heating energy intensity by 25% – Less than 1-year payback

Note: Impact defined as percentage decrease in energy intensity of a given process – e.g. fitting LED lights can reduce energy intensity of lighting demand by 75% – not the percentage decrease in a company's overall energy intensity

1 While energy efficiency is a widely used and understood term, here it is defined in the sense of a particular intervention type (i.e. CapEx-led ways to use less energy to perform the same task). It therefore is different from "energy intensity" and common use of "energy efficiency" in this context. **2** This example is from Aramco's Lead by Example programme. See online case studies: https://initiatives.weforum.org/energy-and-industry-transition-intelligence/transforming-energy-demand

Levers 1 and 2 offer immediate value. Savings and efficiency interventions can deliver a reduction in process intensity of up to 90% with no need to replace changes with innovation in technology, regulation or external funding. Electrification is a key vector for this, often driving lower energy intensity in existing processes purely through inherent lower levels of wastage compared to combustion-based alternatives. Progress can be driven even further through a focus on repeated application of these levers with a culture of continuous improvement. While each individual action may be small, they can compound to drive major changes in intensity over time (see case study 1).

The third lever, collaboration, shows how companies can create new value pools and revenue streams by collaborating with adjacent supply chains and the public sector. This must be done in concert with energy suppliers and with a long-term view to ensure future-proof change. Rather than waiting for the energy supply-side to fix itself, companies from all sectors can become active participants in the energy transition.

An example of this lever is **energy demand consolidation** – where companies and/or other parties collaborate (e.g. in an industrial cluster) to drive changes in energy intensity, such as through district heating (see Figure 8), or longer-term through the design of circular business models. Businesses can also collaborate to achieve **supply substitution** – using their energy demand, in concert with financiers, energy companies and government, to change their energy and emissions intensity. In South Africa, African Rainbow Minerals and other mining companies partnered with renewable developers, using offtake contracts and grid "wheeling" to create utility-scale solar farms. With local bank support and mining firm guarantees, they achieved rapid grid-scale power deployment in 18 months, faster than seen in most other countries and a significant achievement given the country's unstable coal-based energy supply.

Collaboration can also enable **flexible demand response** – where companies collaborate with their power provider and government to adapt operations based on demand and price signals. This includes reducing operations at peak times and installing energy generation or battery storage to enable flexible energy usage. While demand response predominantly improves emissions intensity (as fossil fuels are commonly used at times of high demand), it can also improve the grid's efficiency and effectiveness.[8]

The challenges: growing awareness and developing an enabling policy environment

42%

of boards discuss energy intensity vs 82% for carbon intensity

While the economic and business case is clear, there are three significant barriers:

1. **Low awareness**
   Through the interviews, a notable lack of awareness was identified among businesses about how to change their energy use, particularly outside energy-intense industries. This focuses on an inability to build and execute measures to address energy consumption, and a lack of clarity on the impact these interventions can have both on their energy bill, the transition and wider resilience. Energy use is simultaneously not a top strategic priority and a difficult number to get a firm handle on: while 82% of companies discuss emissions intensity at the board level, only 42% of companies do so for energy intensity.

   Discussions with business leaders reflect a perception that the energy system is outside their control and is the responsibility of governments and the energy sector to solve. In total, 94% of surveyed IBC organizations said they had a good understanding of their own energy use but only 53% understood the energy use of their supply chains – where energy consumption is often a far larger part of the company's extended energy and climate impact. This can be driven by a lack of tech-enabled monitoring and reporting, as well as limited partnerships and data sharing within supply chains.

   Energy use is widely dispersed – the sum of a huge number of different activities, managed by many different actors within an organization. Since most interventions – changing light bulbs in one location, installing new motors in another – are small, it is hard to get people excited about them, and even harder to take control and deliver change. Many companies lack a single person or department responsible for energy costs, with the survey finding 29% of companies having no single department owner.

2. **Difficulty in achieving appropriate payback**
   Of surveyed members, 38% said that solutions for reducing energy/emissions intensity offered insufficiently attractive returns. The issues stem from extended payback periods. To take one example, building retrofits, which can be very valuable, pay back in less than 8 years, whereas businesses typically have planning cycles of 3-5 years. Developing financing from businesses or financiers that is designed around the savings from energy intensity reductions and their associated longer returns period, rather than revenue growth.

3. **Lack of supportive policy environment**
   Businesses repeatedly highlighted the barriers that policy and regulation pose to further action on energy intensity, among them: a lack of supportive regulation (47% of respondents), clarity (47%) and insufficient incentives (38%). To address these challenges, governments need to develop policies and regulations that create incentives for, and alignment on, reducing energy and emissions intensity.

3

Business solutions – overall approach

All businesses can take three steps to reduce their energy intensity for their direct and indirect operations.

1. **Assess energy use across the buildings, industry and transport (BITs) portfolio:** Break down use across BITs, both directly within the company and in its value chain. Businesses can then consider the specific interventions set out in the chapter 4 (alongside methods used in the case studies in this document and online) to identify levers for change. These will vary by industry. For example, financial companies can provide innovative financing solutions to energy intensity improvement projects. Product manufacturers can find ways to reduce lifetime product energy consumption. It is necessary to tailor these solutions based on geographic context, with businesses in EMDE and fast-growing markets more likely to focus on measures to minimize the energy intensity of growth, rather than retrofitting to improve current operations.

2. **Understand company's role in the energy system:** The second step for every company is to identify its role in the energy system (see Figure 9). While opportunities exist for meaningful impact across all energy system roles, positioning determines the current level of focus and the appropriate and most impactful actions that the business can take.

FIGURE 9 **Energy system roles**

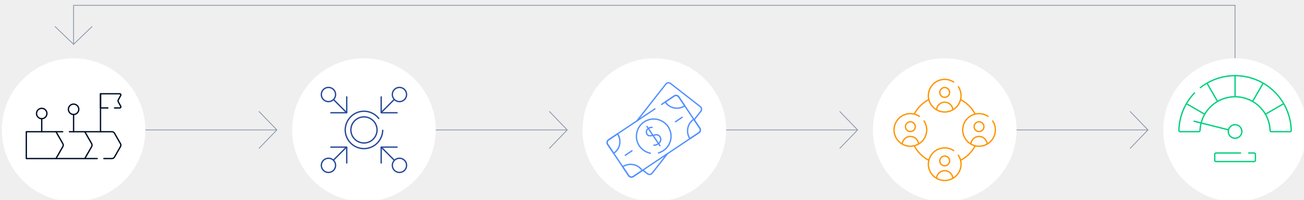
Archetypes		Energy supplier	Supplier and user	High energy user	Low energy user	Enabler
Description		Provider of energy to other businesses	Companies that both supply energy, and use large amount of energy	Company with energy intensive activity; considers energy costs in operations	Companies that are neither suppliers, nor use large amounts of energy in operations	Companies that can enable the energy reduction of other firms
Current energy awareness		H	H	M / H	L	M
Potential energy transition role		Renewable energy supplier, work with customers on intensity reduction	Work across value chain to enable energy transition	Reduction in energy use, share best practice with others	Focus on demand consolidation	Provision of technology, finance or other assistance, e.g. consulting
Highest impact demand levers	Savings		●	●		
	Efficiency		●	●		
	Collaboration	●	●	●	●	●
Example industries		Energy companies Energy generators	Oil and gas	Steel Chemicals Concrete Mining	Fast-moving consumer goods Retail Consumer technology	Professional and financial services Climate and measurement technologies Demand response

3. Institute a programme of change

Finally, businesses should consider how to effectively execute change based around an energy transition plan. Such plans designed by both governments and businesses can aim to double energy efficiency – identifying and capturing demand-side benefits, and to triple renewable capacity – integrating actions alongside the supply side by 2030. Detailed actions for each key sector of the economy should be integrated, linking targets and implementation roadmaps across national and local levels of government in all departments, as well as incorporating costs into market mechanisms. These plans should interrelate between public and private levels, with multiple paths to achieve the overall goal depending on context. These should be distinct from, but integrated into, wider net-zero transition plans.

Based on case studies from businesses affiliated with the Forum, five areas have been identified to focus on to create a systematized approach to developing and executing these plans (see Figure 10).

FIGURE 10 **Execution approach**



Strategize

- Develop an energy transition plan across direct and indirect energy
- Using accurate, digitized measurement
- Include overarching demand targets linked to global goals (e.g. doubling the rate of energy efficiency improvement)
- Create business cases for action to prioritize
- Align ambition, accountability and incentives at all organization levels

Centralize

- Create a centralized team with an energy-intensity mandate and funding
  - This may take the form of a chief energy officer reporting to the chief executive officer/chief finance officer

Finance

- Determine funding mechanisms
- Identify financiers early who are willing to collaborate on complex demand financing
- Promote solutions that share savings from interventions

Collaborate

- Approach government and supply chain participants early
- Use this to build supporting infrastructure for change
- Identify customers and suppliers that can underwrite interventions (e.g. via offtake contracts)
- Engage staff for ideas and then upskills to power delivery

Measure

- Build digital ongoing measurement of impact and benchmark internally/with peers
- Link this to executive and centralized team incentives
- Collaborate cross-company to expand coverage of measurement to adjacent supply chains, enabling wider change

Concrete governance practices are key to drive change, particularly for actions in adjacent supply chains. Because the impact of these measures can be harder to measure, changing mindsets and aligning governance structures and incentives can help to ensure these wider actions that will benefit businesses long term. Having a chief energy officer responsible for driving these changes can act as a focal point to identify the capability, funding and governance changes needed in order to drive widespread change. This approach has particularly high potential given the barriers around awareness and the dispersed solution set, though current uptake is low.

4 Business solutions – selected interventions for change in buildings, industry and transport

Interventions for change are available across all sectors but require concerted private-public collaboration to overcome uptake barriers.

Interventions have been prioritized by their economic sector within BIT and by their impact on total global energy use. Combined, these illustrate possible routes available for change and methods to overcome barriers to action. The focus is on currently-available interventions, while acknowledging technological improvements and removing legacy systems will be needed longer-term. Delivering change will require collaborations between all private and public stakeholders to align available infrastructure and supply chains that will make technically-achievable changes on energy demand deliverable. These collaborations can catalyse action in areas that would be insoluble for any stakeholder alone.

Further upsides can be realized through future technological developments, especially in artificial intelligence (AI) that offers myriad opportunities to reduce energy intensity across all verticals, as outlined below.

BOX 1

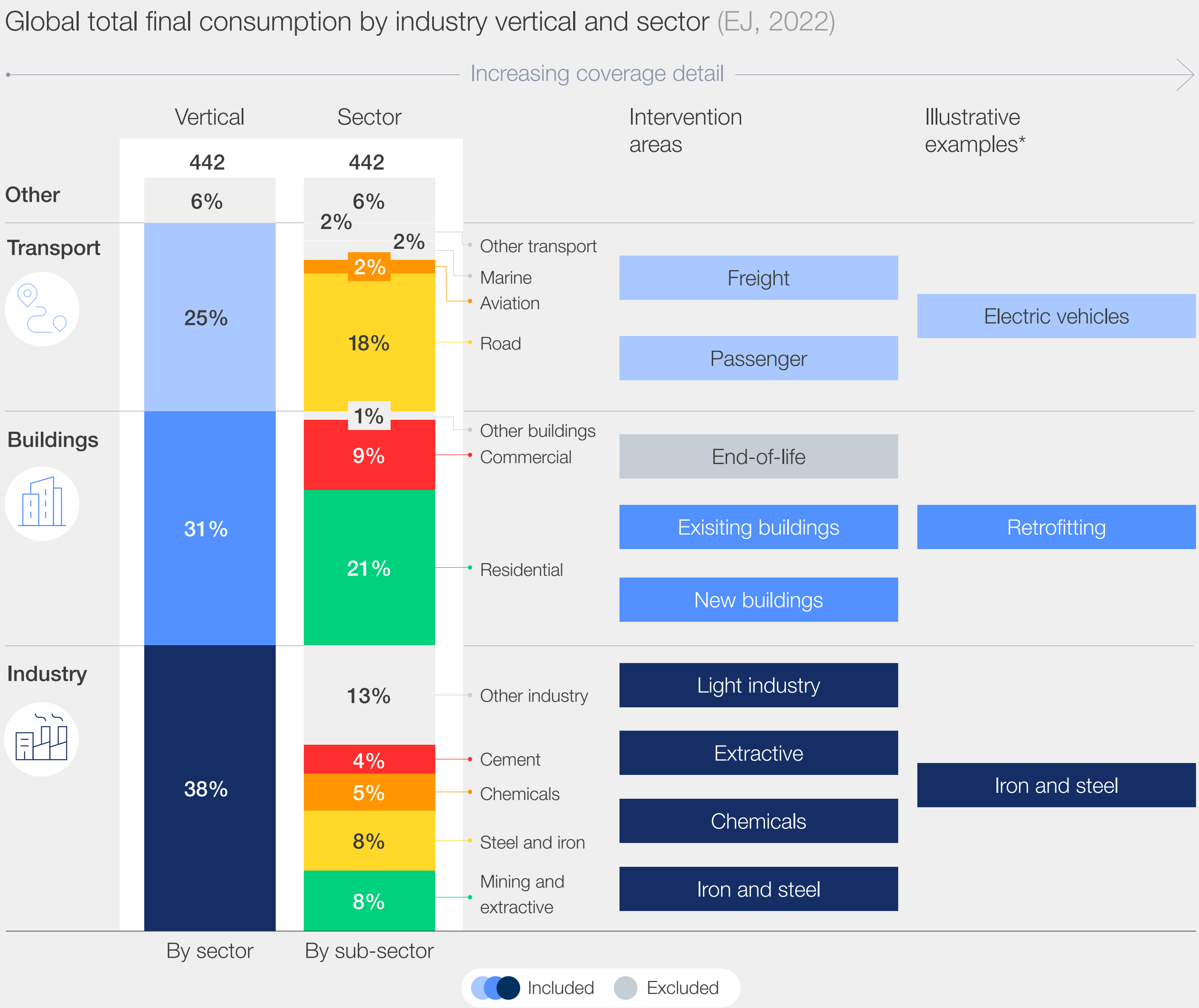
AI and energy intensity – example

AI comes in many forms and is continuing to develop. Crucially, however, certain modalities are already available today that work at scale, delivering profitable changes to energy intensity for companies and consumers. This currently focuses on energy savings – OpEx-based optimization of existing processes in order to reduce energy consumption.

This is typically done through the use of real-time data to better predict environmental conditions and then to change systems in response. Google has multiple examples of this in transport alone. For example, Google Maps now includes an option in several countries to select the most fuel-efficient route, using AI to plan this based on current traffic conditions, topography and speed limits. This is estimated to have avoided more than 2.4 million tonnes of CO_2 equivalent ($MtCO_2e$) of emissions since October 2021, while saving the corresponding amount of energy with no loss in output.

Similar technology can be applied at a company level for fleet routing management to reduce overall fuel costs and energy intensity while maintaining successful routing and delivery. For further information on this and the wider impact of AI on the energy transition, see the report *Accelerating Climate Action with AI*.

FIGURE 11 | **Coverage of industry verticals and sectors within this report**



* These examples represent those that are covered in more detail later in the report. They do not cover all attractive example interventions - e.g. in Transport, in addition to electric vehicles, there are clear opportunities to reduce energy intensity by moving to higher efficiency combustion engine vehicles

Source: IEA, *World Energy Outlook 2023*, 2023.

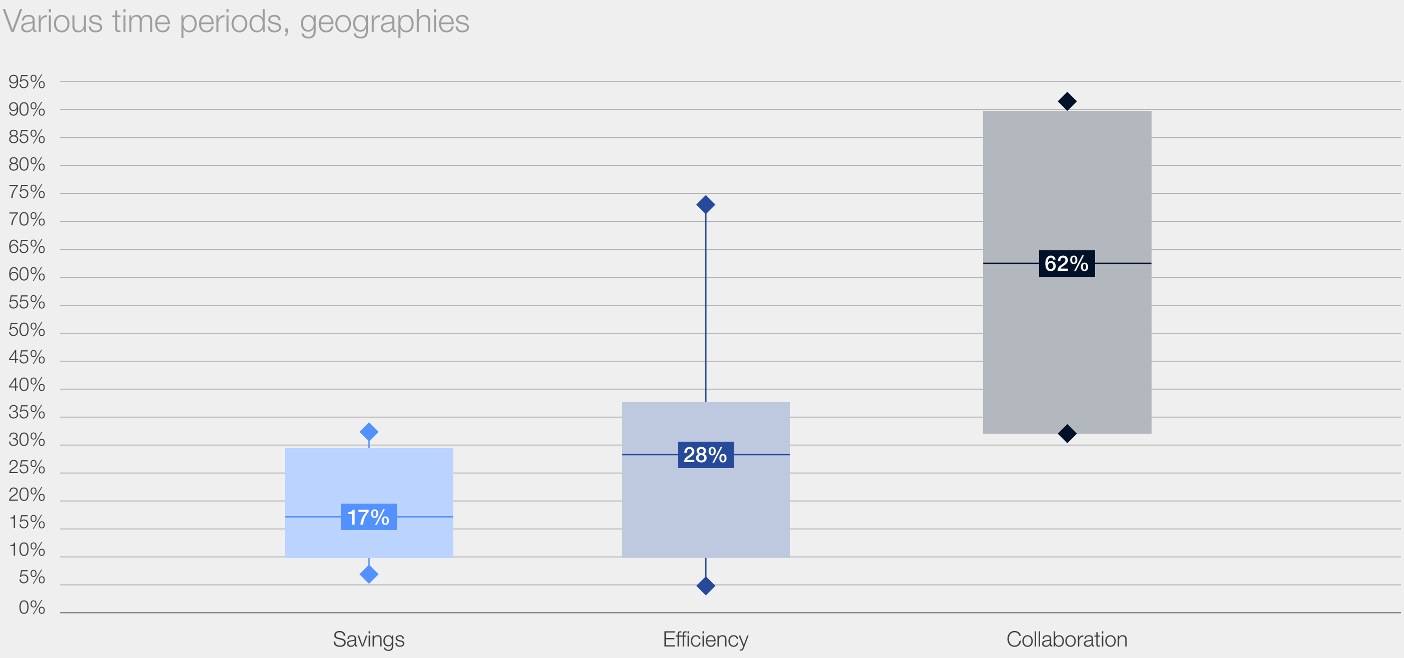
4.1 Industry

The opportunity

Industry is defined, in this report, as the vertical encompassing the production of commercial products, including "heavy" industry (steel, cement, chemicals, aluminium, extractive) and light industry (all others). This sector accounts for around 38% of global energy demand and 21% of GHG emissions.[9] To illustrate the relative energy consumption, examples from chemicals, extractive industries, food and beverage, and pharmaceuticals are provided, along with a more detailed example for steel manufacturing.

Interventions have been identified that can reduce energy intensity of individual industrial processes by up to 90% (e.g. introducing high-efficiency electric motors). If implemented widely, these could drive a reduction of the vertical energy intensity of 29% compared to current levels, reducing overall global energy demand by 11%. This requires action from all companies, as all have industrial components to their value chains.

FIGURE 12 | **Energy impact of individual interventions in industry**



Note: Data represents the impact of individual interventions on a subset of energy use (e.g. the impact of staff training on machine energy intensity), not the impact on industrial energy demand or global energy demand as a whole. Blue datapoints represent the median impact of individual interventions. Datapoints used come from a combination of IBC member case studies and wider research.

FIGURE 13 | **Demand interventions in industry**

Demand interventions in industry

1 Energy saving

- **Intelligent process design, e.g. using AI to optimize factory line design**
- Staff training and awareness raising to reduce wasted materials and energy consumption
- Capture and reuse manufacturing waste within production lines

2 Energy efficiency

- **Switching motors to electric and MEPS for electric motors**
- **Upgrade heating, ventilation and air conditioning (HVAC) equipment**
- **Electrification of heat sources for low heat processes (less than 180 degrees centigrade)**
- **Use of combined heat and power systems (CHPs)**
- Heat recovery and reuse
- Use of power factor correction systems in low power factor machinery, such as motors, heating systems and lighting
- LED lighting

3 Value chain collaboration

- **Recycling inputs for manufacturing**
- Sourcing green raw materials
- Demand consolidation to purchase clean energy and renewable fuels
- Industrial clustering cross-industry to share infrastructure and energy intensity initiatives
- Business-to-business partnerships to improve product energy intensity during its use
- Energy hub enablement and integrated energy solutions

These sectors are often termed "hard to abate" due to their high energy use and introduction of new, efficient technologies, such as direct reduced iron (DRI) steel, effectively requiring a knock-down and rebuild. In this context, the cost of energy demand-side interventions can be prohibitive for industries amortizing installed capacity over 25-40 years. Importantly, the first two levers – savings and efficiency – could deliver significant reduction in energy consumption now without a full rebuild. Too many public policy initiatives focus on "big ticket" transformative changes overlooking these, still impressive, potential gains. This lower-hanging fruit should be as important a focus for players and policy-makers as the dream of a fully modern infrastructure if Paris goals are to be realistic.

Longer term, there are opportunities to drive the development of more energy-efficient products through innovation. An example is a partnership between a chemical company and an environmental services company that initiated a design to facilitate the recycling of electric vehicle (EV) battery metals in Europe, thus securing a local supply source for critical materials. Additionally, the impact of AI is likely to continue to grow, with existing use cases including its deployment to allow for predictive maintenance of industrial machinery. This can increase uptime, remove unnecessary scheduled interventions and extend machinery lifetime.

Industry examples

29% potential reduction in industry energy intensity

1. Heavy industry

Mining and extractive

Extractive industries (mining, oil and gas) constitute around 8% of global energy use.

Within mining, approximately 93% of energy is used for extraction, intra-mine movement and crushing, all of which are equipment focused. Major interventions, therefore, focus on energy efficiency – specifically digital optimization of plant operations, and automation and electrification of transport. An automated truck network has the potential to save 15-20% of transport energy demand, through the optimization of routing, uptime and throttle input. On a per-truck basis in 2018, a multi-national mining company's autonomous trucks operated 700 hours more than human-driven trucks and led to a 15% cost reduction. However, consideration of ensuring a just energy transition must be given here, with care given to the human impact of automation.

Within oil and gas, where processes are typically asset-heavy, energy efficiency is also the major lever for change. For example, improvements in drilling technology can improve overall drilling time and production rates: a major oil and gas company collaborated with an oil and gas service company to deploy a closed-loop automated wired drill string, which provided real-time drilling data. This innovation resulted in an 82% reduction in the overall drilling time per well. By leveraging real-time data, they were able to extract more hydrocarbons in a given area, thereby increasing overall production while reducing the energy intensity of the operation.[10]

Chemicals

The chemicals sector constitutes approximately 10% of global energy demand and is crucial to the energy transition due to its rapid growth (around 4% per annum),[11] driven by need for its end products (e.g. ammonia and methanol).

Feedstocks, which account for about half of energy use, are often difficult to replace due to the precision of chemical synthesis processes. However, in steam cracking, the single most energy-consuming process in chemicals (about 8% of sector energy),[12] intensity can be reduced through switching to non-steam catalytic methods. For example, Dow's UNIFINITY technology, reduces energy use by around 20% compared to incumbent catalytic methods and can be retrofitted to existing steam crackers.

2. Light industry

Pharmaceuticals

In the pharmaceutical industry, which consumed approximately $1 billion of energy in 2021, the primary mode of direct energy consumption is heating, ventilation and air conditioning (HVAC) (around 65% of demand).

Facing significant margin pressure due to the global energy crisis, an American pharmaceuticals company[13] installed a combined heat and power plant (CHP) at one site, using the heat generated to drive manufacturing processes. This drove a 37% reduction in primary energy consumption while reducing emissions. If replicated across the sector, such efforts could reduce energy consumption by up to 20%.

Food and beverages (F&B)

Energy intensity improvement in F&B has lagged historically, with food manufacturing achieving only a 6% decrease from 2000-2020.[14] For one American beverage company, cold drink equipment is the largest contribution to their system's carbon footprint. Working with bottlers and suppliers, the company created a machine consuming 10% less energy overall than an average machine. Additionally, it used power for cooling at night when electricity demand is lower, increasing the efficiency of grid use and limiting the need for more-flexible higher emission intensity energy sources.

Collaborations to overcome barriers to action:

“ Collaboration between stakeholders is key to identifying novel funding and repayment methods.

While actions exist that can be taken in all sectors, they are not being implemented at scale due to industry-specific barriers. These vary between light and heavy industries due to the differing levels of energy use (see below). Yet, all can be reduced through collaboration with adjacent supply chains.

High-levelized costs of production associated with low margins make transformative changes complex within heavy industries and expensive within light industries compared to their rather low energy use. Collaboration between stakeholders is key to identifying novel funding and repayment methods, increasing the attractiveness of equipment replacement, such as extended repayment periods and sharing benefits.

Lack of sufficient creditworthiness and collateral make access to financing complex for industrial small- and medium-sized enterprises (SMEs). This can be addressed by banks and insurance companies collaborating with SMEs to co-design energy intensity-oriented green financial products[15] matching risk profile with required funding.

Limited awareness towards energy intensity measures, particularly within light industries, and fragmented supply chains limit the ability to drive change. Creating cross-industry groups to share learnings and best practices on energy intensity – e.g. information on process heat interventions and anonymous databases on energy intensity for benchmarking purposes. Close cooperation between energy service providers and end users could also create energy-as-a-service models with providers actively optimizing end users' energy intensity.

In the longer term, technical barriers should also be addressed to reduce the energy intensity of energetically and thermally intense processes. Others are encouraged to take similar approaches to the ones taken here in order to drive this technical progress.

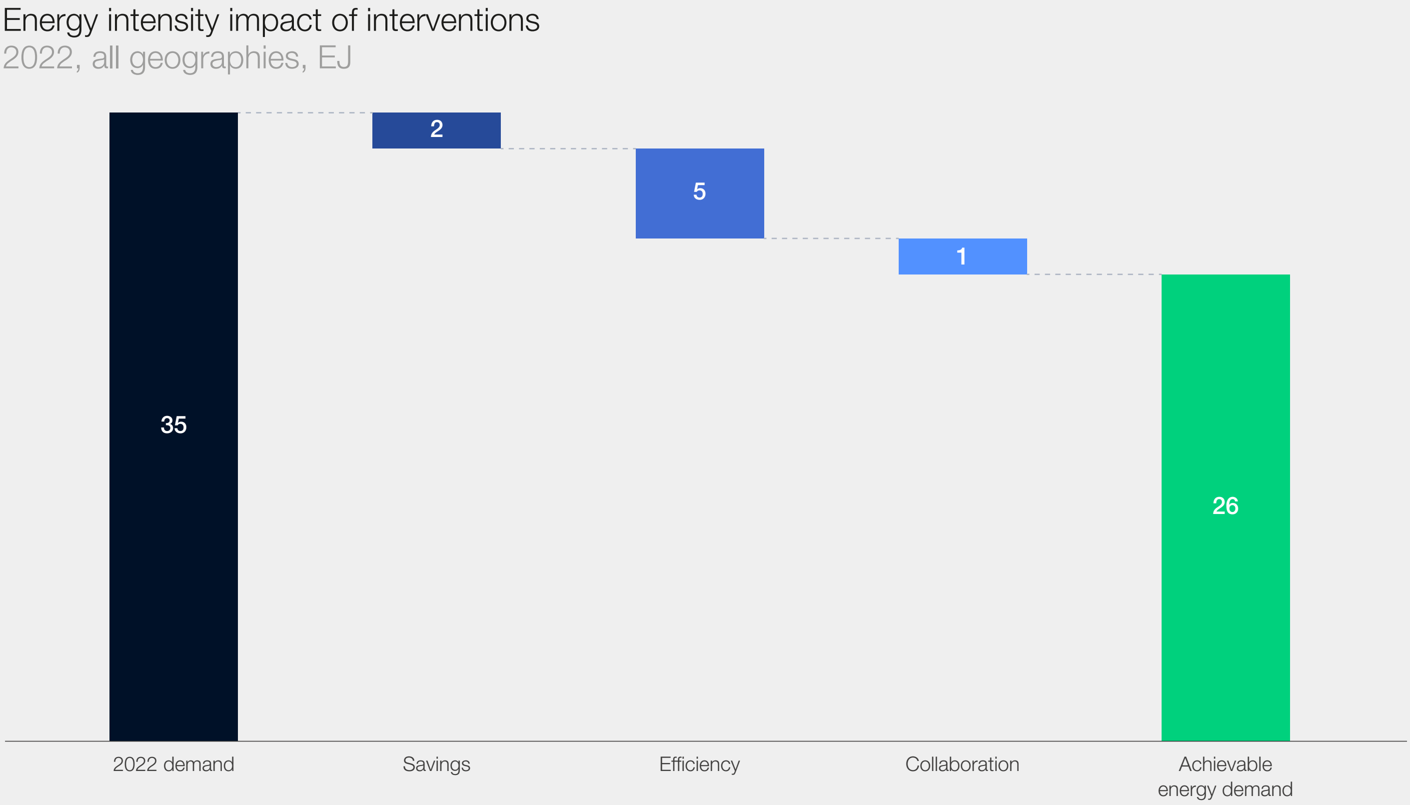
In EMDE, this vertical is key, as 54% of steel and 58% of methanol is produced in China, and 45% of iron ore is mined in China, India, Brazil and South Africa. However, access to reliable energy sources or lack of grid capacity to support vertical electrification have proved challenging. To drive change, key industry players can co-form offtake agreements with both developers and government to encourage clean-energy development. Industrial sites colocation aggregating demand to develop microgrid solutions can also be a key lever in more remote areas.

Detailed sector-specific example: steel energy intensity

The opportunity

Metal manufacturing is responsible for 8% of global energy demand and 7% of global emissions. Iron accounts for 93% of mined metals by tonnage, of which 95% is used in steel production.[16,17] In this hard-to-abate sector, economically and technologically viable interventions that are currently available can deliver an energy reduction of up to **22%** (see Figure 14).

FIGURE 14 **Impact of interventions on steel sector energy demand**



Note: Wider collaborations to drive change are more challenging but can drive further impact.

Source: IEA, *World Energy Outlook 2023*, 2023.

Energy demand interventions

Alongside vertical-wide actions (e.g. staff training, LED lighting), steel-specific interventions can upgrade and optimize existing machinery across all operators. This is driven by the diverse ages and types of manufacturing technology in use in current systems:

Energy savings:

– Blast furnace energy and input optimization

Energy efficiency:

– Upgrading outdated blast furnaces with plug-in cost-effective efficiency solutions, including waste heat recovery, digital optimization, furnace efficiency upgrades

– Implementing energy management systems (EnMS)

– Switch to coke dry quenching from wet quenching, to recover heat and reduce energy intensity

Value chain collaboration:

– Increase the proportion of scrap metal use in electric arc furnace (EAF) steel production

– Increased proportion of steel produced by DRI-EAF

Long-term development of improved technologies should also be pursued. Indeed, a similar collaborative approach focusing on demand signals has already successfully been developed for future steel technologies by the First Mover's Coalition initiative, while wider, long-term demand-side interventions can be found in the Mission Possible Pathways *Making Net Zero Steel Possible* report.

Collaborations actions led by private sector to overcome barriers

Variability of demand: End users committing to low-intensity steel purchasing through guaranteed contracts. A German steel company's planned plant in Sweden was made possible through supply-chain partnerships, securing consistent supply of sustainable iron ore, a 2.3 terawatt-hour (TWh) per year power purchase agreement (PPA) with a major energy company, and offtake contracts with customers guaranteeing around €1.5 billion in demand. The plan was initiated to replace an existing plant at end-of-life and will lead to a 95% reduction in emissions per unit of steel.

Limited supply of scrap metal both in quality and quantity: All sector stakeholders e.g. operator, recyclers, together with construction companies and governments can provide kickback contracts for end-users providing steel, or volume-based discounts on future steel based on scrap steel recovered.

CASE STUDY 1

Path to sustainable energy efficiency

Mahindra: India's largest auto manufacturer by product volume

Region	India
Sector	Industry
Focus	Energy efficiency

Tags

Energy transition plan · Business case · Energy diagnostic · Energy intensity tracking & monitoring

Case study background

Mahindra has publicly pledged to double energy productivity by 2030 (2009 baseline) and to net zero by 2040

Task

Drive operational efficiency improvements to support goals

Actions

1. **Define goals:**
   - Enhance energy efficiency and consumption across Mahindra's operations
2. **Establish baseline:**
   - Analysed existing energy consumption and carbon emissions.
   - Identified areas with high energy use
3. **Identify Gaps:**
   - Assessed areas where energy-saving opportunities exist.
4. Deploy strategies:

   A. Small-scale projects:
   - Switched off lights when not in use
   - Transitioned to energy-efficient LEDs.
   - Implemented process changes (e.g. DC motors for higher efficiency)

   B. Larger high-impact projects:
   - Integrated hybrid solar HVAC systems
   - Compressor heat recovery
   - Energy efficient equipment such as brushless direct current fans and electronically commutated blowers

Blockers and unlockers

Blocker	Unlocker
Upfront equipment investment costs	Highlighting the financial benefits, with typical payback of 1-3 years
Concerns about plant shutdowns and impacts on quality	Gaining top-level executive commitments to energy intensity
Absence of effective regulations and limited impact of carbon pricing	Reporting energy efficiency progress

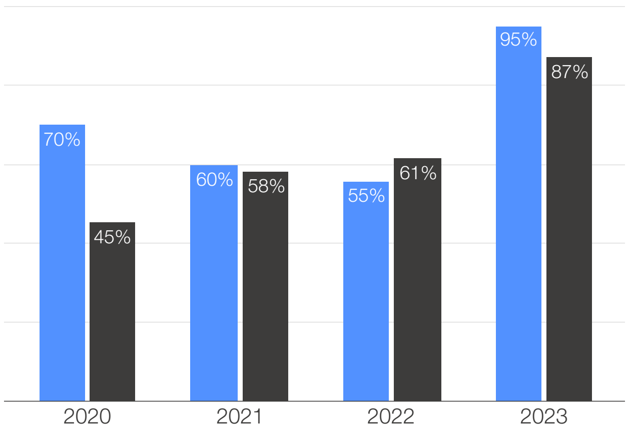
Implications

- Attractive business cases exist for sustainable technology investment
- Significant improvement can be driven through widespread incremental changes
- New facilities can use efficient technologies to ensure low intensity from day one

Results

Energy efficiency increase from a 2009 baseline

Auto · Farm



GHG mitigation (FY2023)	>11,000 tCO_2e
Energy conserved (FY2023)	>80,000 gigajoules
Efficiency increase	95% in 2023 from a 2009 baseline (automotive division)
Investment (FY2023)	>INR 80 million
Cost savings (FY2023)	>INR 100 million

Source: IBC member interviews

CASE STUDY 2

Partnership for cogeneration transformation

Aramco: majority state-owned energy company (listed)

Region	Saudi Arabia
Sector	Industry
Focus	Value chain collaboration; energy efficiency

Tags

Energy intensity measurement and reporting

Energy transition plan

Business case

Case study background

- Aramco has a strong existing focus on energy intensity through its corporate energy policy.
- Historically, Aramco had been purchasing power from the National Power grid, which had a standard grid energy efficiency.

Task

Increase the efficiency and reliability of the company's industrial energy supply to support energy policy goals.

Actions

1 Holistic energy analysis

- Conducted holistic energy analysis to understand current energy use.

2 Strategy development

- Developed a comprehensive master energy plan to deliver on the corporate energy policy.
- This included the installation of combined heat and power plants (cogeneration units).

3 Partner identification

- Identified joint venture and third-party partners to optimize current and future power project needs.
- This ensured better asset management.

4 Installation of cogeneration (cogen) units

- Installed 17 cogeneration facilities for reliable, high-efficiency energy generation.
- Upgraded power blocks for internal energy self-sufficiency in power and heat.

5 Ongoing optimization

- Installed digitized monitoring for all cogen units
- Developed optimization solutions, including CHP software
- Applied CHP software to 45 cogen units across 17 facilities.
- This maximized efficient cogen unit operation by aligning output to current and planned need, avoiding excess steam generation.

Blockers and unlockers

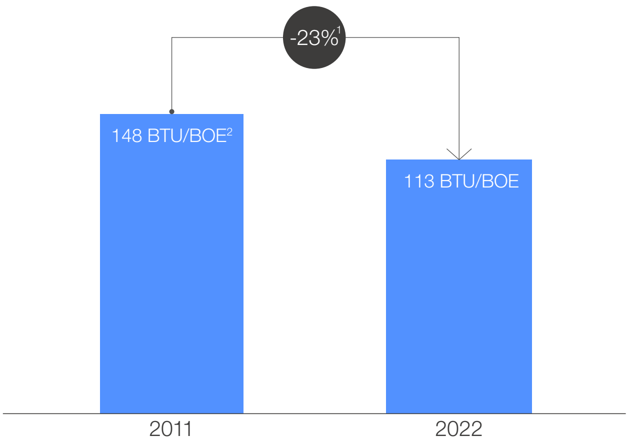
Blocker	Unlocker
Cogeneration units are highly complex, risking energy waste	Extensive data analysis prior to installation Ongoing digital performance monitoring Creation of custom software to optimize operations
High cost of installation and potential downtime during installation	Ability to use wasted natural gas from operations as a fuel Design of commercially-driven business model that enables efficient wheeling of excess power to facilities without cogeneration assets, generating revenue

Implications

- Energy intensity projects should be examined for revenue as well as cost opportunities
- Partnerships and clustering can help to deliver change where there is an insufficient business case to drive action alone (e.g. via joint ventures)
- Digitization offers the opportunity to further continually optimize CapEx-led solutions

Results

Corporate energy intensity



Achieved a total high-efficiency power **output of 5.3 GW** and exported surplus power to the national grid.

CO_2 emissions[3]	7 million tonnes/year reduction

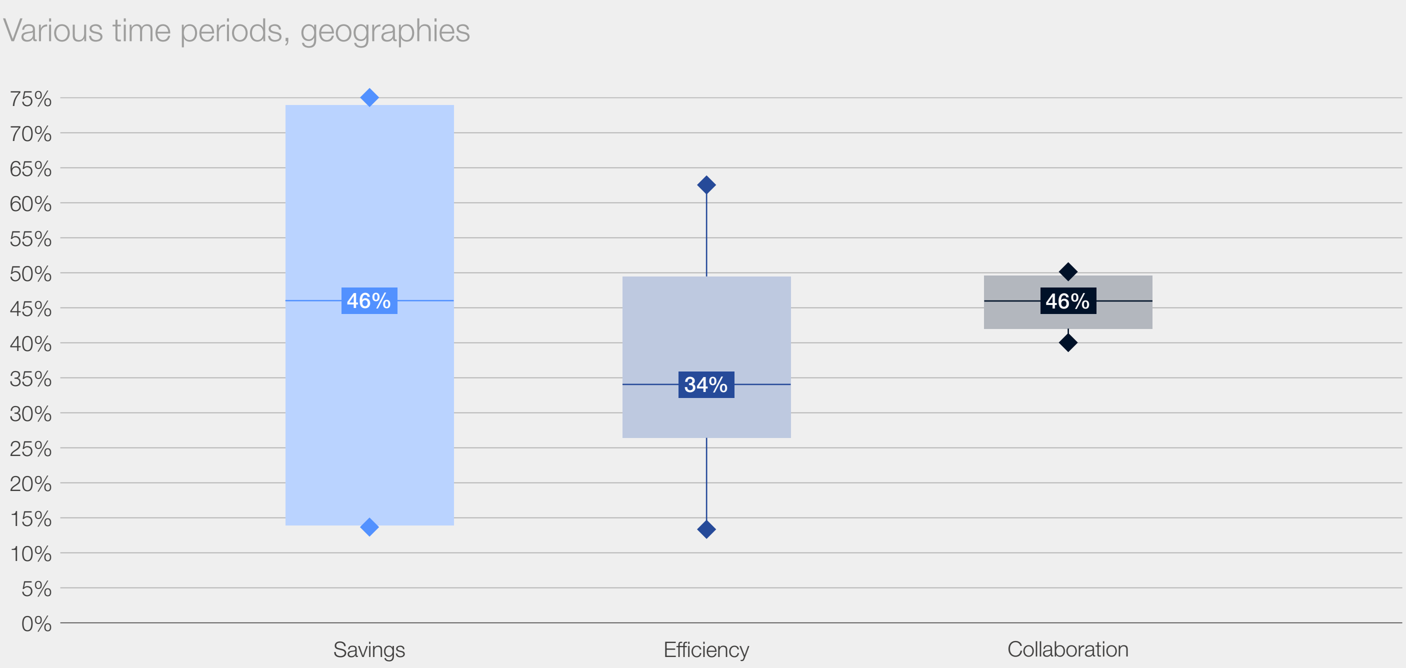
Notes: 1 Total energy intensity has steadily reduced, driven by both the cogeneration programme and several other energy management programmes **2** British thermal unit/barrel of oil equivalent **3** CO_2 emissions reduction driven solely by cogeneration programme

4.2 Buildings

The opportunity

This sector represents about 30% of global energy demand and approximately one-third of global GHG emissions. This energy is used in construction, heating and cooling (around 50%), lighting (around 20%), and operating appliances and equipment installed in them (around 20%).[18,19,20] Interventions have been identified that could reduce building energy intensity approximately by 38%, reducing overall global energy demand by 12%.

FIGURE 15 **Energy impact of individual interventions in buildings**



Notes: Data represents the impact of individual interventions on a subset of energy use (e.g. the impact of LED lights on lighting energy intensity), not the impact on buildings energy demand or global energy demand as a whole. Blue datapoints represent the median impact of individual interventions. Datapoints used come from a combination of IBC member case studies and wider research.

FIGURE 16 | **Energy demand interventions in buildings**

Demand interventions in buildings

1 Energy saving

- **Adjusting room temperatures closer to external conditions**
- **Closing under-used space**
- Turning off unused assets (e.g. lights, equipment)

2 Energy efficiency

- **Whole building retrofit (including roof, walls and windows)**
- **Digitalization of building management systems**
- **Installation of efficient HVAC equipment**
- **Electrification of heat**
- **LED lighting**
- Replacement of old equipment (e.g. computers)

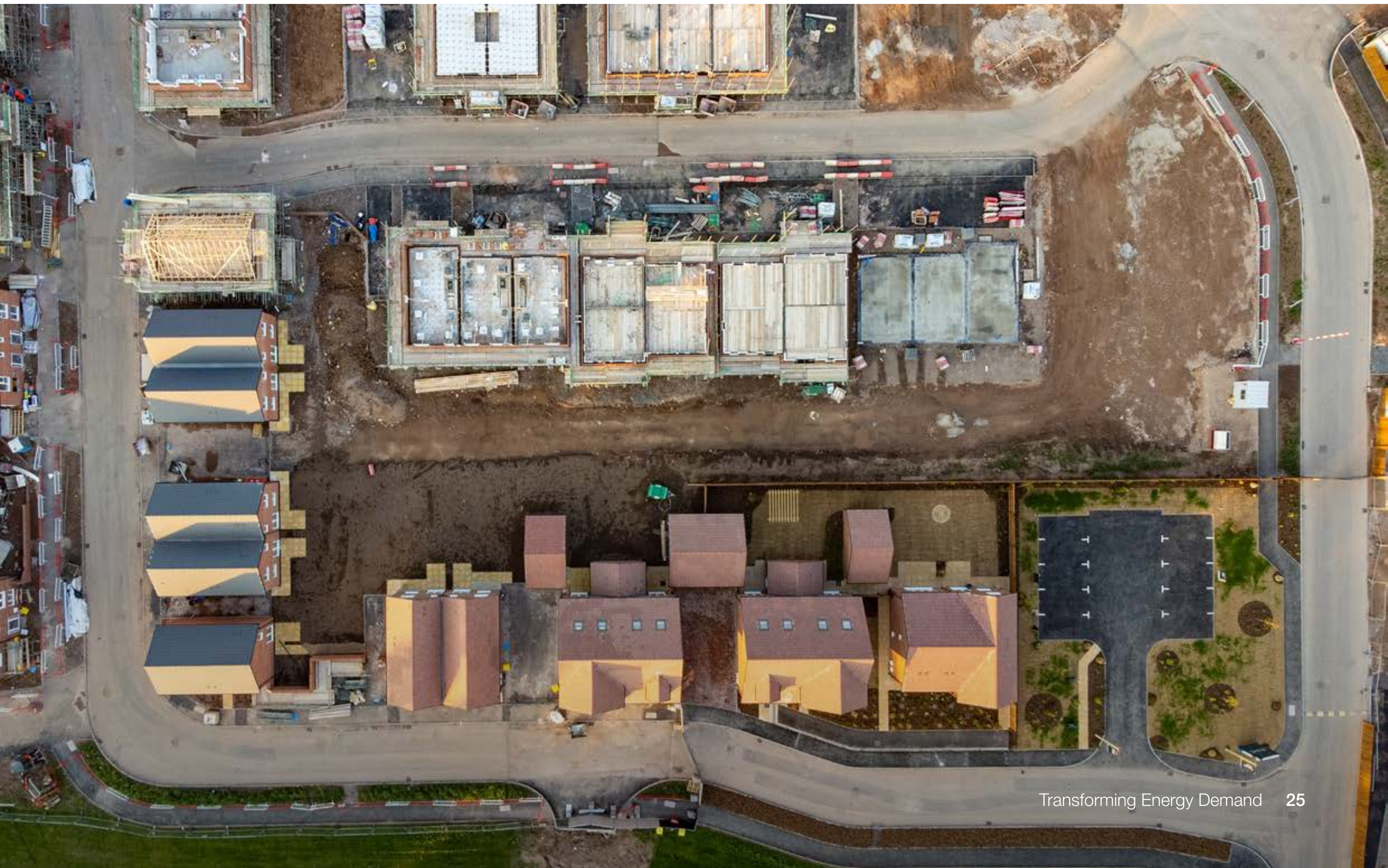
3 Value chain collaboration

- **District heating and cooling systems**
- **Enhanced circularity (including on-site energy production and storage solutions) and greener material use**
- Changes to building design
- District energy management systems
- Demand response programmes

While energy savings are applicable in all buildings, energy efficiency and collaborations can be classified into interventions that improve energy intensity of existing buildings (retrofitting), new buildings (green buildings) and removal of old buildings (end-of-life).

In EMDE, there should be far more focus on building codes as most population growth is expected there and mainly in cities. Two thirds of the required new buildings are in countries that currently lack building energy codes.[21]

Cooperation between the public and private sector is key both to fund retrofit programmes and to secure green building uptake, including integrating green and distributed energy systems. For example, real estate developers in Brazil have engaged in retrofit projects such as energy-efficient lighting and integration of smart building systems for commercial office buildings to meet the increasing demand for modern and sustainable workspaces.



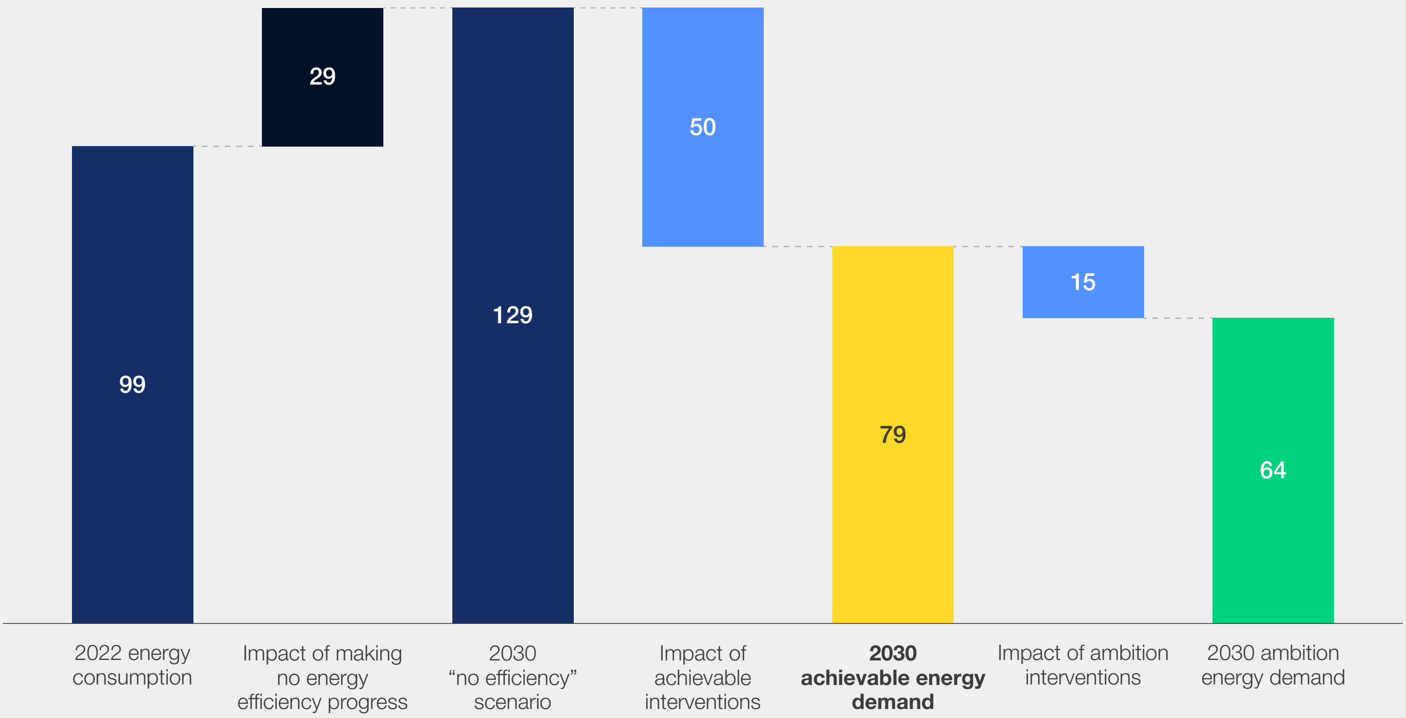
Detailed sector-specific example: building retrofitting

Context

Retrofitting is the key intervention available to drive meaningful impact, quickly. This is because, globally, **75% of buildings that will be standing by 2050 already exist**.[22] Moreover, energy used for building occupation represents about **70%** of building's energy consumption.[23]

Size of the prize

FIGURE 17 **Impact of interventions on existing buildings energy demand**



Source: IEA, *World Energy Outlook 2023*, 2023.

This potential will continue to grow as AI solutions become more develop and prevalent. An example of an already existing energy savings intervention using AI is in HVAC, where installation of AI-driven HVAC management software for existing equipment can lead to reductions in HVAC energy use of up to 25%.

Beyond reducing energy intensity, retrofitting has the potential to provide broader socioeconomic benefits such as reducing staff sickness by **20%**, improving employee productivity (up to **$7,500** per person per year) and the creation of **3.2 million** new jobs per year.[24,25] Additionally, asset values of retrofitted buildings increase by approximately 15%, allowing for rental premiums.

Energy demand interventions

Retrofitting is a disaggregated set of interventions. Most are CapEx-led energy efficiency types, based on installation of higher efficiency systems, equipment and building materials (see case study 3 for examples).

New business models are emerging based on more distributed energy sources, particularly for district heating and cooling. For instance, the City of Paris' district cooling network, operated by Fraîcheur de Paris, plans to cut CO_2 emissions by up to 50% with forecasted sales of €2.4 billion over the 20-year concession contract period.

Wider value chain cooperation is required to retrofit buildings at scale and turn them into key actors of the energy system.

Collaborations to overcome barriers to action

Cashflows and financing: Designing customized green leasing and financing products that enable easy payback at lower costs would support uptake:

- Launch of zero-interest energy efficiency programmes with customers paying the loan through energy bills with a maximum payback period of five years for insulation.[26]

- Support the growth of the energy-as-a-service model with no upfront cost and sharing of energy benefits between the payor and the supplier and co-investment models between dwellers and tenants.[27]

- Lack of agency and desegregation are other key barriers. Creating clusters between insurance companies, property owners and retrofitters to create risk insurance will allow businesses to bundle interventions and improve agency, thus increasing the transfer of risks for retrofitting to insurance companies.

- Energy savings insurance can enable business models for SMEs with limited balance sheets and limited ability to provide guarantees, even though the quality of their project work may be high.[28]

Develop a local retrofit network to upskill workers and secure critical material:

- Cooperate at local levels with cities, universities and technical schools to ensure a pool of skilled resources.

- Cooperate with local industrial clusters to create critical material supply availability and circularity (including recycling).

BOX 2

Green buildings

Designing lower-intensity buildings is a key part of the energy transition, as cities are expected to grow around 50% by 2050. This will be particularly significant in EMDE, where 80% of the growth in buildings is expected. Key aspects of green building design include the use of lower-intensity materials, high levels of insulation to allow for passive heating, design to align buildings for maximum natural light absorption, as well as electrified heating and cooling. Combined, these can additionally reduce building running costs **by approximately 40%**.[29]

The major barriers to the uptake of green buildings are increased cost (around 15% or more for residential and 3-5% for commercial[30,31]) compared to traditional buildings, as well as limited awareness of the principles or benefits.

Companies can address this challenge by securing guaranteed energy demand offtakes from corporate buyers, including by considering the total cost of ownership rather than the initial cost only. Widespread change would also likely require government intervention in standards and building codes (see government leadership section)

CASE STUDY 3

Singapore headquarter retrofitting

Schneider Electric: global building technologies company focused on digital automation and energy management

Region	Singapore
Sector	Buildings
Focus	Energy efficiency

Tags

Energy intensity measurement & reporting

Energy management system

Government engagement

Case study background

In 2017/18, Schneider Electric acquired an existing, 25-year-old, multi-tenant building to be its new East Asia and Japan headquarters.

Task

- Transform the office into a sustainable facility
- Demonstrate retrofitting expertise and savings
- Support the company's climate goals

Actions

1. **Assess existing footprint:**
   - Assessed current energy use across four sites and concluded a consolidation would align with corporate energy goals
   - Selected a single site in Kallang Pulse
2. **Evaluate new site:**
   - Evaluated the energy footprint of the new site,
   - Identified major areas of energy loss and expenditure
   - Decided on measures to implement
3. **Liaise with existing tenants:**
   - Worked with building tenants to understand energy use
   - Designed customized energy solutions for existing tenants, aligned through a single building management system
4. **Install low-energy intensity equipment:**
   - Installed smart HVAC, LEDs, LED lighting systems
   - Implemented onsite solar generation and storage for 100% renewable energy
5. **Ongoing optimization:**
   - Deployed digital twin for energy modelling with occupancy and operations data
   - Integrated real-time weather forecasts into the building management system for improved energy efficiency and performance

Blockers and unlockers

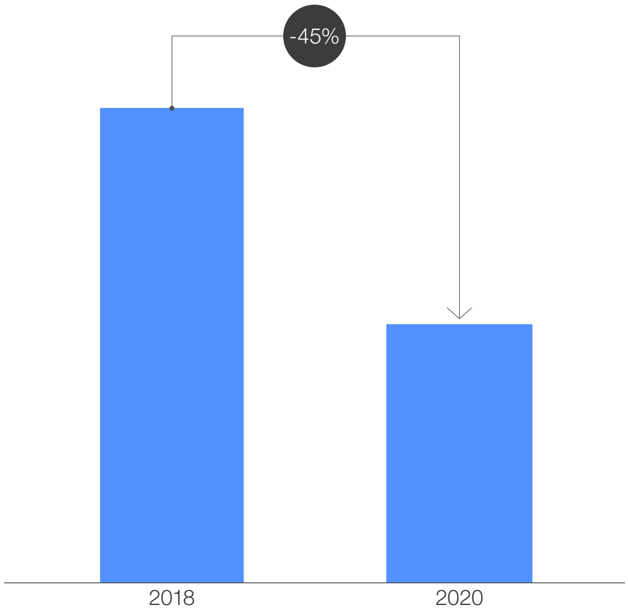
Blocker	Unlocker
Existing inefficient buildings pose structural challenges	Deploying various digital solutions to overcome and adapt limitations
Diverse tenant needs create varying energy demand challenges	Software-managed system balances energy use in building enabling the different entities to balance out their energy use
Variable engagement in energy intensity from tenants	Engagement with tenants to understand needs Policy support from Singaporean government to increase attractiveness (grants, information, certification)

Implications

- Potential to reduce energy intensity in buildings regardless of size and age
- Digitizing buildings enables flexible retrofitting for multi-tenant properties
- Government engagement can help overcome financial barriers and raise awareness

Results

Electricity consumption decrease from 2018-2020



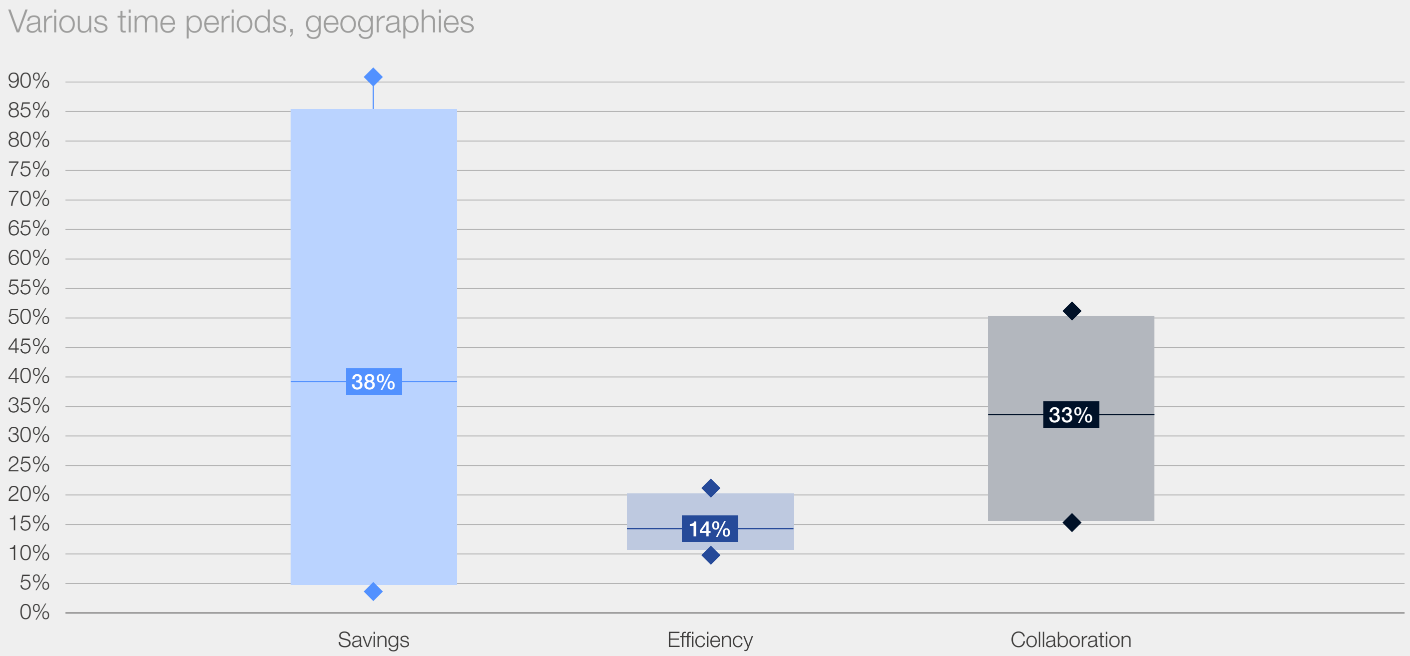
Electricity consumption	Reduced 45%
Water savings per year	3,700m³

4.3 Transport

The opportunity

Transport constitutes the movement of goods and people (excluding off-road industrial vehicles). It represents 26% of global energy demand and 21% of GHG emissions.[32] This study focuses on sector-specific examples in road transport and aviation, representing 76% and 10% of transport energy consumption, respectively.[33] Interventions have been identified that could reduce the energy intensity of processes by up to 90%. If widely applied, they would reduce energy intensity of transportation by 21%, resulting in a 5% reduction in overall global energy demand.

FIGURE 18 **Energy impact of individual interventions in transport**



Note: Data represents the impact of individual interventions on a subset of energy use (e.g. the impact of moving from business class to economy class travel), not the impact on transport energy demand or global energy demand as a whole. Blue datapoints represent the median impact of individual interventions. Datapoints used come from a combination of IBC member case studies and wider research.

FIGURE 19 | **Energy demand interventions in transport**

Demand interventions in transport

1 Energy saving	2 Energy efficiency	3 Value chain collaboration
– **Modal shifting away from higher energy intensity forms of travel and use of public transport** – More efficient driving – Traffic management	– **Switch to smaller vehicles or reduce vehicle weight** – Switch to newer, more efficient vehicles – Optimised routing planning and automation	– **Electrification of transport** – Switching to renewable fuels, including SAF

Technically and economically viable interventions are available that can reduce energy intensity of individual transport activities today. Applicability varies, with savings and efficiency broadly available globally, whereas fuel switching will only be possible where supporting infrastructure exists (e.g. grid capacity for EVs). However, these interventions can have a significant impact while the bigger, "gamechanger" interventions are being developed (e.g. electric aeroplanes).

This similarly applies to applications of AI, which has already been used to optimize use of freight capacity in road transport, reducing empty space in trucks by combining loads and owners. This reduces the number of trucks needed overall in the network, and so energy intensity of transport. This type of solution can be deployed now while new AI applications are developed longer term to drive more transformative change.

In total, 94% of the projected growth in transport energy use occurs in EMDE. However, the lack of reliable grid capacity makes vehicle (mainly two and three wheelers) electrification complex and inhibits cost parity for low-intensity transport options. To encourage electrification uptake, collaboration between all stakeholders is key to support grid expansion, green energy supply and adequate public transport. Businesses can take the lead on transition of systems by switching their own fleets, as is being done by some taxi companies. Companies can also capture low-hanging opportunities to improve intensity by moving to more efficient vehicles and alternative fuels

In Kenya, a start-up is electrifying bikes through the gradual rollout of battery-swapping stations. The start-up is paying around a third of the price for new electric bikes, while customers pay a daily subscription for the outstanding balance and access to battery-swap stations. Profits for motorbike and scooter drivers are around $6-11 a day since joining the scheme.

Detailed sector-specific example: EV rollout

The opportunity

It took Norway over 20 years to reach the point where most cars sold were electric, and the proportion now tops 80%.[34] Electric cars are now cheaper (around 33% price decrease 2010-19),[35] more available, and have better ranges (2.7 times average increase from 2010-21[36]) than ever before. As a result, EV rollout is occurring faster than ever.Electrification drives both lower emissions and efficiency, as EVs can be up to approximately 50% more efficient than ICE vehicles,[37] with the impact on emissions being amplified if input electricity is low- or no-carbon. Full electrification could lead to a reduction in global transport energy demand by up to 22%.

While this is a significant opportunity, it should be noted that electrification is still nascent for heavy vehicles, which make up around 38% of emissions;[38] freight accounts for 78% of heavy vehicles. Additionally, the viability of electrification is currently lower in the Global South due to grid capacity. Companies in all countries can act now though, reducing energy intensity through using more efficient vehicles, and emissions intensity through alternative fuels.

Collaborations to overcome barriers to action (passenger vehicles)

“ EVs can be up to approximately 50% more efficient than ICE vehicles.

Infrastructure and charge point availability are key barriers. Only markets with large and flexible grid capacity, ideally with renewable energy supply, are well suited to rollout**.** Permitting and grid connections for charge points are often complex, resulting in slow rollout.

Energy companies, finance and government can improve the ease of grid connections by targeting planning and development of grid energy capacity and flexibility, including through distributed energy generation and storage solutions. They can lobby for simplified and prioritized planning processes for grid connections. They can also provide private capital and labour to support grid connection creation. Financing and energy companies can create products to accelerate charge point rollout both at homes and in commercial locations.

Charge point operators can work with real estate owners, energy companies, finance and governments to accelerate charge point rollout by identifying attractive locations with existing parking space for further rollout (e.g. supermarkets, workplaces, hotels) and offer installation with shared revenue models.

Affordability is another challenge. To encourage fleet adoption and overcome concerns about affordability, car manufacturers and other stakeholders can run informational campaigns on the relative benefits of EVs and options available. Co-investment from fleet owners, government and manufacturers to subsidize the uptake of vehicles through reducing upfront costs or total cost of ownership.

BOX 3

Aviation

Aviation is a fast-growing area of energy use, with passenger travel forecast to grow at approximately 4% per annum,[39] driven by population expansion and increased global wealth.

Without a viable alternative to jet fuel, actors across the value chain can work to drive change through energy savings and energy efficiency measures. This can include changes to travel policy to encourage the use of less energy-intensive options, like rail. This can be complemented by using carbon footprint travel budgets and compensation metrics, including data in booking platforms and educating employees to drive behavioural change (see case study 3).

Manufacturers and airlines can prioritize weight reduction and replacement of older aircraft with more efficient, modern models. There is potential for governments and industries to collaborate on identifying solutions to address this issue and improve the financial case for more efficient flight.

Sustainable aviation fuels (SAF) present an opportunity to abate the remaining energy use, using existing infrastructure and reducing upfront investments to drive change. The main limitation of SAF is supply of input feedstock from waste sources increased cost compared to standard jet fuel. Offtake agreements can help to create new demand, enabling the SAF market to scale. Businesses such as Boston Consulting Group (BCG) have committed to replacing 5% of its conventional jet fuel with SAF by 2030 and have signed offtake deals with airlines, fuel producers and coalitions such as the Sustainable Aviation Buyers Alliance.

CASE STUDY 4

Modal shifting via employee incentives

Kearney: Global management consultancy

KEARNEY

Region	Global
Sector	Transport
Focus	Energy savings

Tags

Behavioural change · Informed decision-making · Senior leadership buy-in

Case study background

Kearney is the first global consulting firm with SBTi-approved near- and long-term net-zero emissions reduction targets

Task

Reduce air travel, to support achieve a 30% absolute reduction in scope 3 business travel emissions by 2030, in line with SBTi near-term targets

Actions

1. **Baselining:**
   - Established the baseline level of business travel activity across the firm

2. **Build guiding policies:**
   - Global travel policy
   - Varied this locally based on available travel infrastructure
   - Pushed communication on policy changes and reasoning

3. **Develop effective initiatives:**

   Global level:
   - Implemented air travel dashboards at office level
   - Promoted hybrid and remote working

   Local level:
   - Country-specific policies and initiatives to promote sustainable travel (e.g. carpooling between employees).

4. **Track, monitor and grow:**
   - Ongoing tracking and reporting to drive transparency
   - Reviewed policies with employees
   - Planning for an internal carbon price in 2024

Blockers and unlockers

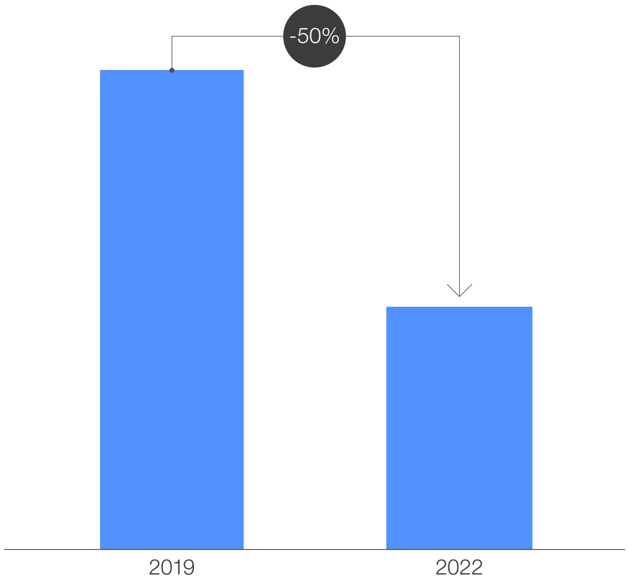
Blocker	Unlocker
Lack of real-time third-party carbon calculators	Developed an in-house carbon tracking solution
Employee engagement levels	Implemented employee feedback mechanisms
	Collaborated with suppliers for IT integration
	Employed a targeted communications strategy with transparency
On-site	Working with teams in hybrid formats

Implications

- Continuous monitoring and progress tracking helps make informed decisions
- Demonstrates impact of low-cost changes without restricting growth

Results

Flights per employee



Double-digit business growth while reducing flights per employee by 50%

Source: IBC member interviews

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Government leadership

Governments can drive change through energy transition plans, public-private collaboration, and sector-specific regulation, incentivization and information.

Governments have already begun to increase focus on energy demand, with ore than 120 countries pledging to double the average annual rate of energy efficiency improvement. To be effective, policy-makers need to build on the traditional tools of taxes and subsidies and increase the focus on the enabling environment, targeting individual sectors or even specific initiatives within sectors. There are number of high-level and specific actions that all governments can take to drive the transition.

Energy intensity policy recommendations

Formulate an energy transition plan

The majority of countries have set net-zero targets or committed to doubling the global energy efficiency annual rate of improvement. However, they are not routinely supported by a detailed delivery plan, let alone a detailed energy transition plan. The existing plans are typically long-dated (2040 or beyond) and focus on the source of energy while largely ignoring measures to better manage energy consumption. It is therefore recommended that all governments produce energy transition plans that focus as much on energy demand as energy supply. The necessary characteristics to include are set out in Figure 20.

FIGURE 20 **Main demand-lens characteristics and actions to integrate in an energy transition plan**

Energy transition planning

Lead

Convey a clear ambition and path for energy intensity

- Define ambitious targets overall and per sector linked to broader global goals (e.g. doubling the rate of energy efficiency improvement).
- Prioritize achieving change in own operations
- Identify areas to reduce energy intensity and, where this is not possible, focus on reducing carbon intensity
- **Create a centralized delivery/coordination team composed of both public and private actors** with executive assessment and decision-making rights.

Inform

Focus on improving awareness among society via:

- Transparent, public data tracking
- Public benchmarks of expected performance by industry.

Regulate

Provide clear guidelines on performance and support permissible activities that promote lower energy intensity through:

- Mandated, funded energy audits
- Inclusion of energy intensity into green certification programmes
- Liberalize energy markets to allow captive generation, energy wheeling and dynamic pricing
- Simplify permitting processes for supporting infrastructure (e.g. grid and supply development)
- Upskill workforce for delivery.

Incentivize

Set both positive and negative incentives for action, including:

- Carbon and energy taxes
- Tax relief on energy efficiency investments
- Certification schemes for best practice.

EMDE and developed economies

Challenges and opportunities related to implementing energy transition plans vary widely across geographies. The political and economic cost of implementation will also vary significantly depending on the specific energy supply and demand situation of each economy.

In developed economies with large, diverse sources of upstream energy and dense, integrated transmission grids, it makes sense that the push to decarbonize focuses largely on adding large-scale renewables to the current grid. At the same time, there are clear inherent benefits to pursuing energy intensity reduction. This is because, by reducing energy intensity, output can increase for the same or lower amounts of energy. This limits total energy costs, supporting profitability and maintaining competitiveness.

In contrast, in EMDE markets with more limited energy sources and limited grid in terms of scale and connectivity, combining economic growth alongside measures to manage energy consumption and secure supply is critical. There is an urgent need for the public sector to shape and drive local, highly adapted energy transition plans.

An example of successful EMDE policy planning is India's UJALA programme. In 2015, India recognized significant levels of wasted energy and cost in domestic lighting, which represented **27%** of domestic energy due in part to the fact that only **0.4%** of the installed lighting base were efficient LEDs. Uptake was prevented by the high cost of LED bulbs, even though they use **75%** less energy and lasting around **25 times** longer than incandescent bulbs. The government overcame this barrier in four ways:

– Created a tender for large-scale LED bulb procurement

– Signed offtake value chain agreements with state governments and utilities to distribute bulbs

– Provided two payment options: upfront and on-bill repayments through electricity bills

– Built swap schemes for rural households where one LED bulb could be swapped for a working incandescent bulb.

Creating economies of scale for LED bulbs lowered upfront costs per bulb to as low as **$0.8**. This drove the uptake of more than **1.15 billion** LED light bulbs by 2020, resulting in annual savings of over **$2.5 billion** and around **47 billion kilowatt hours** (kWh).[40]

This is an example of the opportunity that EMDE have: to "leapfrog" from higher- to lower-intensity technologies, avoiding the incremental retrofit changes that developed economies had to pursue over time. This applies across each of the BIT verticals:

FIGURE 21 **Variations in public sector actions' applicability in EMDE**

Industry

Examples of public sector actions

– Increase grid reach to promote electrification of heating, smelting and extraction
– Introduce MEPS for electric motors across sectors
– Disseminate information and regulations regarding EnMS use

Buildings

Examples of public sector actions

– Launch awareness campaigns (standards and regulations)
– Design and enforce building codes (MEPS) and launch large retrofit programmes (starting with public buildings)
– Invest in grid capacity for modular/micro-grid solutions and standardize permitting
– Support workforce upskilling

Transport

Examples of public sector actions

– Enable electrification of two- and three-wheelers, enabled by distributed energy solutions
– Enforce minimum fuel standards for vehicles
– Improve public transport provision to enable modal switching

Case study

From 2015-2017, the Mexican government undertook the CONUEE programme to **promote EnMS among SMEs**. This involved the **dissemination of information and training of workers on EnMS**. The outcomes of these initiatives were annual **energy savings of 57.7 gigawatt hours (GWh)**, 14.8 kilotonnes (kt) of CO_2 reduction in emissions, **$5 million saved in energy costs**, and improvements in product quality and overall productivity.

Source: Asia Pacific Energy Research Centre, *Compendium of Energy Efficiency Policies in APEC*, 2017.

Inform, regulate and incentivize at a sector-specific level

Within each vertical, governments can take action to use and encourage the levers presented in this paper and can collaborate with the private sector to overcome barriers to action. Figures 22, 23 and 24 represent a non-exhaustive selection for further discussion.

FIGURE 22 **Identified actions for "industry" to integrate the energy consumption-lens of energy transition planning**

Industry

Inform

Collaboration

– Launch industry information campaigns on available technology and best practice to drive behavioural change.
– Introduce energy intensity labelling for machinery and processes.
– Create public benchmarks of expected energy intensity levels by industry to highlight underperformance, increase awareness and drive action.

Regulate

Standalone actions

– Mandate procurement of lower-energy materials and products in government procurement processes – e.g. through carbon contracts for difference.
– Introduce minimum energy performance standards (MEPS) across industries.
– Provide energy audits.
– Introduce non-energy benefits to policy business cases.
– Promote the uptake of energy management systems (EnMS), energy measurement and management frameworks (e.g. ISO 50001).

Collaboration

– Legislate to increase barriers to higher-intensity steel purchasing for companies

Incentivize

Standalone actions

– Build in tax relief on investments into energy efficiency – e.g. faster equipment amortization.

Collaboration

– Provide funding for scrap steel recovery, including from government's own products.
– Provide funding and structures for collaboration between industry players.

Example of public sector action: industry

Economies such as the EU, the US, Canada and Japan have introduced minimum energy performance standards (MEPS) for industrial electric motors. These require that all motors are switched to IE3 or higher in the international efficiency (IE) standards. This switch contributed to an approximate 20% reduction in energy consumption in the Japanese manufacturing sector between 2000 and 2012.[41]

FIGURE 23 | **Identified actions for "buildings" to integrate in a demand-lens energy transition plan**

Buildings

Inform	Regulate	Incentivize
Collaboration – Launch public awareness campaigns. – Mandate digital public tools to track energy consumption. – Publish information on building performance and standards.	**Standalone actions** – Create minimum efficiency building codes for houses and commercial buildings that increase over time. – Legislate to require green building design across new builds to align with a zero-carbon world. – Shorten administrative procedures, including permitting. – Legislate to require scrap steel to be provided from any building at end-of-life.	**Standalone actions** – Allocate programmes and dedicated funding for widespread retrofitting interventions and electrification. **Collaboration** – Provide support for the creation and provision of green mortgages to fund retrofitting. – Invest in local energy communities to generate jobs and economic growth, as well as in critical material and recycling hubs.

Example of public sector action: buildings

In 2010 the California Public Utility Commission[42] launched a zero-interest financing programme to fund energy efficiency investment and assist non-residential energy customers to retrofit buildings. Since August 2023, the programme also supports purchase for water heat pumps and EV charging infrastructure. Customers pay the loans (ranging from $5,000 to $4 million) through monthly instalments on their energy bills with a maximum payback period of five years.

FIGURE 24 | **Identified actions for "transport" to integrate in a demand-lens energy transition plan**

Transport

Inform	Regulate	Incentivize
Collaboration – Set government travel policies to support lower intensity transport use.	**Standalone actions** – Reduce average vehicle size/weight allowances. **Collaboration** – Implement policies and incentives that support the uptake of zero- and low-emission vehicles (such as EVs). – Set mandatory low-emissions zones in cities. – Review planning legislation to ensure charging points have a priority focus. – Review grid infrastructure planning to ensure sufficient electrical capacity and connection points for EVs. – Use of demand-based signals for phase-out of higher emission vehicles, timed in collaboration with private actors.	**Standalone actions** – Invest in public transport, including expanding existing cities to allow for modal shifting. – Invest in optimized route planning for all local and national fleet vehicles.

Example of public sector action: transport

The shift from internal combustion engines (ICE) to EVs in Belgium – now around 50% of the new vehicles market – was accelerated through the use of tax incentives for company cars. The programme included the gradual phasing out of the tax deductibility for ICE by 2028 in favour of EVs (which maintain 100% deductibility) as well as providing 200% tax deductibility for charge points in the first years for uptake.[43]

Conclusion

Transforming energy demand needs to be as much a focus of global effort as transforming energy supply to accelerate the energy transition and deliver commercial benefit. To realize the promise of such efforts, businesses should:

– Baseline energy use, ensure direct central accountability and develop a programme to increase efficiency across the three levels.

– Embed this exercise and target setting into a full energy transition plan covering self-help and collaboration with the supply chain.

– Examine energy costs and the opportunities to drive change.

– Commit to energy intensity targets (e.g. doubling the rate of energy intensity improvement).

– Engage with policy-makers to develop detailed policy frameworks and energy transition plans, in particular, to remove current blockers to action (e.g. access to financing).

The IBC will continue to explore ways in which the energy demand agenda can be progressed, moving into a second phase of the project in 2024.

Appendix

A1 Modelling methodology

Modelling aim

– Quantify the potential impact (size of the prize) that energy intensity interventions can have if implemented over a theoretical timescale.

Approach

1. Identify the impact of an individual intervention on a vertical's energy consumption.

a. Selection of sectors for detailed investigation

   i. Analysis was structured around three verticals: buildings, industry and transport (BIT), totalling 94% of global energy demand.

   ii. Sectors within these were chosen for detailed analysis based on sector energy consumption, sector carbon emissions and relevance to International Business Council (IBC) members.

   iii. Final sectors selected: aviation, road transport, commercial buildings, residential buildings, mining and extractive, steel and iron, chemicals, and other industry.

b. Identification of interventions and their impact

   i. Demand-side interventions that reduce energy intensity were identified in each sector (e.g. energy management systems) that have been proven to have an impact in existing case studies.

   ii. Their impact on a subcategory of demand was determined based on examples from IBC members and wider desktop research, with identified reductions in energy intensity reaching as high as 90%.

c. Scaling of intervention impact to vertical level

   i. Impacts were scaled to represent the total potential impact of an intervention on an entire vertical.

   ii. This was done by multiplying the impact identified in 1b together with the intervention's applicability (i.e. the relevant portion of a vertical's energy use) and the penetration (i.e. an estimate of the feasible level of adoption that an intervention could reach).

      I. For example, for the intervention of passenger vehicle electrification, impact = reduction of energy vs internal combustion engines (ICE) vehicles, applicability = proportion of road transport relevant to (i.e. light vehicles) and penetration = expected proportion of vehicles electrified.

2. Calculate the combined impact of identified interventions on global energy intensity

a. Selection of interventions to include in achievable and ambition cases

   i. Two modelling cases were defined:

      I. "Achievable" where we had a high confidence that the intervention was deliverable and where there was good impact data availability.

      II. "Ambition", which adds further interventions on top of those in the 'achievable' case that are more difficult to deliver or where potential penetration rates were less certain.

   ii. Interventions were then sorted between these two cases, with any interventions that overlapped removed.

b. Determination of total "achievable" and "ambition" impact by vertical

   i. The scaled impacts of each intervention determined in 1c were summed for each vertical to give an overall impact on energy intensity by vertical.

c. Scaling of impact by vertical to total economy

   i. Energy intensity reduction was multiplied by the share of energy demand that each BIT represents in 2022 to give an overall reduction of global energy intensity for both the achievable and ambition cases.

   ii. An average intensity reduction is applied to sectors not considered in depth (defined as other)

      I. Average impact was calculated as a weighted average impact from other interventions in a vertical, or across verticals for the 6% of demand not in BIT.

3. Examine the impact of this reduced energy intensity on energy demand scenarios

a. Creation of “no efficiency” scenario

   i. To understand the impact of these reductions in intensity over time, there needed to be understanding of what total energy demand would be in the future if no improvements were made in global energy intensity.

      I. Forecasts of energy demand based on historical trends in energy intensity (or existing policies) could not be used in order to avoid overlap with identified interventions.

   ii. A “no efficiency” scenario for energy demand in 2030 was calculated by removing energy intensity improvements from the International Energy Agency’s stated policies scenario (IEA STEPS) (i.e. current policies) scenario.

      I. 2030 was selected to illustrate what could happen if the interventions were implemented by this point, rather than suggesting that all interventions definitively can be delivered by this point.

b. Application of intervention impacts to 2030 “no efficiency” scenario

   i. Energy intensity reductions calculated in 2c were multiplied by forecast 2030 energy demand from 3a.

   ii. This was then subtracted from current demand and expected demand growth under current policies (IEA STEPS) to identify the absolute energy demand change under “achievable” and “ambition” scenarios.

c. Modelling of 2022-30 energy demand in “achievable” and “ambition” conditions

   i. Growth in demand was modelled linearly from current demand to illustrate potential overall progression in energy demand to 2030 if identified interventions were to be implemented.

   ii. This assumes a linear rate of improvement.

---

4. Estimate the impact of this reduction on energy spending and need for energy generation capacity

a. The cost per unit of energy in 2022 was calculated based on IEA spend and energy demand data.

b. This was multiplied by the absolute change in energy identified in 3b to give an illustrative level of energy saved.

   i. Cost per unit energy based on current spend on energy divided by current energy demand. This therefore assumes the average price per exajoule (EJ) to stay the same over the period.

c. The energy output of a power station was modelled based on available desktop research data.

   i. The energy output of a power station is based on the average energy output of a coal power station.

d. The absolute change in energy identified in 3b was then divided by this figure to give an illustrative level of new power stations avoided.

Limitations

– The aim of this modelling was to illustrate the potential energy demand reduction through demand-side intervention, rather than being a detailed industry analysis.

– Not all sectors are modelled in detail – sectors were selected based on energy demand, carbon emissions and IBC member presence.

– Within sectors, selected interventions are covered in depth, where impact and applicability can be confidently quantified, and the impact of interventions does not overlap with others.

– Impacts are based on a variety of sources, including the IEA and company websites, in addition to primary research. Impacts for the wider economy are modelled to be achieved in line with these case studies.

– Intervention impacts assume no technological improvements between now and 2030. This may be conservative based on historic improvements, so actual reductions in energy intensity could be greater.

– A penetration value (i.e. scaling of the impact of intervention based on expected feasibility) is applied to all interventions based on our understanding of possible rollout by 2030 e.g. assuming the proportion of steel production that will switch to scrap-electric arc furnace method.

– Where sectors are not covered in detail, an assumed impact is used based on the average impact from sectors covered in detail within the vertical (industry, buildings or transport). For the proportion of energy demand not covered by the three verticals, a weighted average impact is applied.

– The “no efficiency” scenario in 2030 is based on the IEA STEPS scenario and the assumptions underpinning it with energy intensity improvement removed. Subsequent achievable and ambition models implicitly rely on the STEPS scenario’s population and economic growth assumptions.

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Note: Overall engagement includes one-to-one senior leader consultations, workshop attendance, chief executive officer survey responses, detailed demand survey responses and in-person conversation.

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