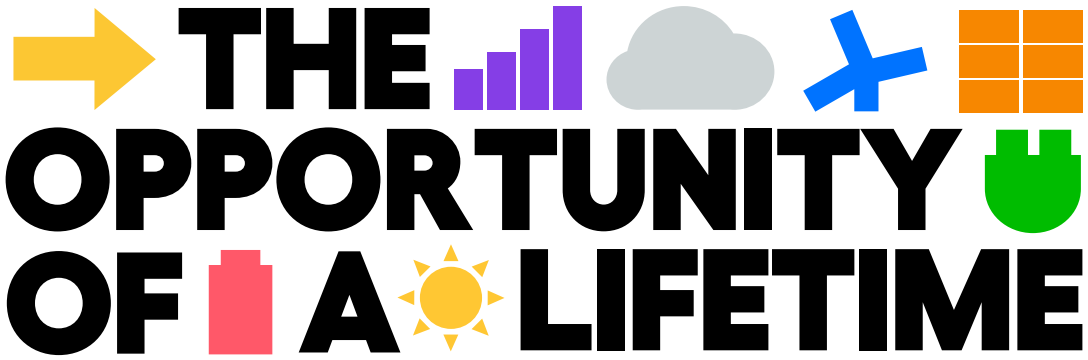


ICC PRINCIPLES FOR THE AGE OF ELECTRIFICATION

A framework for a secure, affordable and competitive energy transition

Policy brief



A climate campaign led by the world's business organisation

About the International Chamber of Commerce

The International Chamber of Commerce (ICC) is the institutional representative of more than 45 million companies in over 170 countries. ICC's core mission is to make business work for everyone, every day, everywhere – through policy advocacy, standard-setting, practical solutions and trusted dispute resolution. This is a pivotal time for global climate cooperation. Through our Opportunity of a Lifetime campaign, ICC is mobilising business and calling on governments to create the enabling environments needed for climate action to scale.

iccwbo.org/TheBusinessOfClimate

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Contents

Executive summary 04

The principles 06

1. Optimise the whole energy system 06
2. Put energy efficiency at the heart of the transition 06
3. Build infrastructure in parallel to the demand 07
4. Value reliability and flexibility, and make demand part of the solution 08
5. Keep electricity affordable enough to electrify 09
6. Decarbonise industry – do not simply relocate it 10
7. Make the transition investable 10
8. Remain technology-open and outcome-focused 11
9. Build resilience through diversification and open markets 12
10. Build the capabilities and know-how the energy transition requires 12

The challenge ahead 13

Executive summary

10 principles for a secure, affordable and competitive energy transition


Optimise the whole energy system


Put energy efficiency at the heart of the transition


Build infrastructure in parallel to the demand


Value reliability and flexibility, and make demand part of the solution


Keep electricity affordable enough to electrify


Decarbonise industry – do not simply relocate it


Make the transition investable


Remain technology-open and outcome-focused


Build resilience through diversification and open markets



Build the capabilities and know-how the energy transition requires

The transformation of our energy systems – across industry, transport, buildings and other parts of the economy – is at the heart of many of the solutions we need to scale in order to achieve the Paris Agreement objectives and keep the 1.5°C goal within sight. At COP28 in Dubai in 2023, countries agreed to a set of goals intended to guide global energy transitions and climate policies, including specific goals for doubling the rate of energy efficiency improvement and tripling the installed capacity of renewables by 2030.

The global business community recognises that the transition is accelerating fast, with growing investments in clean energy and the rapid expansion of renewable energy technologies creating new opportunities across the global economy.[1]

Business also stands firmly behind the ambition set out by the incoming COP31 Presidency and several countries to accelerate electrification by 2035.

Achieving these ambitions will require electrification to accelerate hand in hand with the rapid scale-up of renewable energy, significant improvements in energy efficiency – while also ensuring an affordable, reliable and competitive energy system that supports households and businesses. Progress should be assessed not only by electricity's share of final energy demand, but also by reductions in greenhouse gas emissions, improvements in energy productivity, affordable access and power-system reliability.

1 Global renewable energy deployment is growing at an unprecedented pace, setting consecutive records driven by affordability, energy security priorities, and favourable economics. According to the latest findings from the International Energy Agency (IEA), global renewable capacity additions surged by 16% to reach 800 GW, making it the 23rd consecutive record year of growth. See IEA (2026), Global Energy Review 2026, IEA, Paris https://www.iea.org/reports/global-energy-review-2026 and IEA (2026), Electrification, IEA, Paris https://www.iea.org/reports/electrification

The challenge is no longer simply to deploy clean generation or energies, but to build and operate energy systems that can accommodate growing electricity demand where it emerges and accelerate electrification where progress remains slow – while remaining reliable, affordable and internationally competitive, thereby enabling further investment in the use of such electricity.

Electrification of industry, transport and heating – alongside rapidly growing demand from data centres and artificial intelligence – will require investment measured in trillions of dollars in generation, grids, storage and other enabling infrastructure. Beyond expanding generation and grid capacity, it also demands a smarter, integrated energy system that combines electrification, automation and digitalisation to enhance efficiency, flexibility and resilience.

Electricity currently accounts for just over 20% of global final energy consumption, yet achieving climate objectives will require electricity's share of final energy demand to rise to approximately 35% by 2035.[2] At the same time, the economics of electricity systems are changing. Wind and solar can generate power at very low cost, but integrating larger shares of variable generation requires substantial investments in generation networks, storage, balancing, flexibility and firm capacity.

As electricity systems evolve, generation costs increasingly represent only one component of the final cost borne by consumers, alongside generation networks, storage, balancing and flexibility resources. This matters because the transition will ultimately depend on economic choices made by businesses and households.

Persistently high or volatile electricity prices can deter electrification, weaken industrial competitiveness and undermine public support. These pressures are particularly acute in an open global economy where energy and carbon costs vary significantly between jurisdictions.

On the other hand, electricity price fluctuations also provide important signals of scarcity, helping balance supply and demand and incentivise flexibility. Aligning electricity supply and demand can optimise systems performance and reduce the need for excessive investment in storage and other infrastructure.

When effectively integrated, low-cost renewable generation can contribute to more affordable electricity, limited overall systems costs and reduce dependencies and exposure to volatile global energy markets. As the energy mix evolves, system design and market arrangements need to adapt to these new dynamics to continue to support efficient system operation, affordable electricity, while reducing exposure to external price shocks.

The next phase of the transition is therefore as much a question of system design and economics as technology deployment. Governments must pursue four objectives together: decarbonisation, security, affordability and competitiveness.

The International Chamber of Commerce (ICC), the institutional representative of more than 45 million businesses in over 170 countries, proposes **10 principles** to guide this effort.

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2 The incoming COP31 Presidency announced its ambition to increase electricity's share of global final energy demand to 35% by 2035, as reflected in the UNFCCC Action Agenda. Available at: https://unfccc.int/news/cop31-presidency-announces-new-targets-on-global-electrification-cutting-waste-resilient-cities

The principles

1. Optimise the whole energy system

Energy policy should aim to minimise the total cost of delivering reliable, increasingly low-carbon energy, including electricity and heat, rather than focusing narrowly on the cost or deployment of individual technologies.

Electricity generation, whether centralised or decentralised, is only one component of that cost. Networks, balancing, storage, reserve capacity, taxation and other system services are increasingly important as the generation mix changes. Technologies should therefore be assessed not only according to the electricity they produce, but also according to the costs and benefits they create across the wider system, including their contribution to reliability, flexibility and resilience. In that context, demand-side technologies can also help minimise costs across the system's value chains.

This requires greater attention to whole-system planning and more transparent assessment and optimisation of the full costs of different policy choices. Creating individual obligations for clean energy and capacity that meets national goals has been effective in some power markets.

Whole system planning also requires high quality, timely and analytical data. Digital technologies, including automation and real-time control systems, are increasingly important tools to assess trade offs and identify least cost pathways. Optimisation also means: from the grid to the plug and from the energy edge to the process, integrating supply, networks, buildings, industry, data centres, distributed resources and flexible demand management and response.

These capabilities must be supported by strong cybersecurity for delivering coordination across generation, demand, and governance to protect system integrity and maintain trust. This is something governments can support.

Deployment targets remain important, but installed capacity alone is not a sufficient measure of a successful transition.

2. Put energy efficiency at the heart of the transition

Reducing the energy required to deliver the same economic output can lower bills, cut emissions and reduce the amount of new generation and network capacity that needs to be built.

Energy efficiency should therefore be treated as a central element of energy and industrial policy, not as a secondary conservation measure, but as a strategic source of system capacity.

Governments should remove barriers to commercially viable investments through appropriate standards, incentives and access to finance.

They should look beyond individual industrial sites and consider energy efficiency and energy reuse across three levels: within industrial premises, across neighbouring sites and at system level, enabling

solutions such as waste-heat recovery from industry and data centres, district heating, heat networks and energy communities to turn locally available energy into a shared system resource.

It is important to distinguish between energy efficiency, energy savings and demand flexibility as distinct but complementary resources. Efficiency reduces the energy required to deliver a given service, savings reduce consumption relative to a defined baseline, and flexibility changes when energy is consumed to support system needs.

In many sectors, the technologies needed to deliver significant energy savings already exist. The challenge is accelerating deployment at scale, particularly in energy-intensive industries. Infrastructure planning should also systematically consider whether cost-efficient efficiency measures can reduce or defer the need for additional supply-side investment.

Energy efficiency and electrification reinforce each other: electrifying end uses can improve efficiency, while energy efficiency helps optimise the benefits of electrification. Combined with digitalisation, they can lower costs, reduce emissions and make better use of energy infrastructure.

3. Build infrastructure in parallel to the demand

Electrification cannot proceed faster than the infrastructure that supports it. Meeting future electricity demand will require an unprecedented expansion of grid infrastructure: under IEA scenarios in which national energy and climate targets are met, around 80 million kilometres of transmission and distribution networks may need to be added or refurbished globally by 2040.[3]

Electrification, infrastructure build-out and better use of existing infrastructure should advance together. Electrification can be accelerated by developing new infrastructure alongside demand growth, while making better use of existing assets through digitalisation, grid automation and flexibility solutions.

Transmission and distribution networks, interconnectors, storage and digital infrastructure increasingly need to be planned and developed ahead of anticipated demand. Where investment lags, the consequences are already familiar: generation projects waiting years for connections, renewable output being curtailed, industrial investments delayed and rising congestion costs.

Anticipatory investment should be underpinned by credible demand scenarios, phased deployment, strong connection signals and transparent frameworks for managing the risk of underutilised assets.



Governments should adopt integrated long-term approaches to planning generation, networks and major new sources of electricity demand. Grid investment should not focus solely on building new infrastructure, but also on modernising and optimising the lifecycle performance of the existing grid and generation asset base, including upgrades and repowering, as well as strengthening the digitalisation, flexibility, visibility and control capabilities needed to integrate growing shares of distributed and low-carbon electricity resources.

3 IEA (2023), Electricity Grids and Secure Energy Transitions, IEA, Paris https://www.iea.org/reports/electricity-grids-and-secure-energy-transitions and IEA (2026), Electrification, IEA, Paris https://www.iea.org/reports/electrification

Permitting and regulatory processes should provide clear timelines, coordinated decision-making and appropriate environmental and social safeguards, while enabling infrastructure to be delivered at the speed required. Expedite right of way should be at the centre of regulatory discussions at the national and subnational level.

Grids should be regarded as strategic economic infrastructure that is essential to decarbonisation, future industrial investment and growth. Digitalisation can also unlock capacity faster by improving network visibility and operational planning, reducing connection delays and managing congestion more efficiently. In many cases, better monitoring and control can defer or reduce the scale of physical reinforcement needed.

Grid expansion capacity should be planned as an industrial programme, not only as permitting reform. Governments should address manufacturing and delivery constraints on critical grid equipment – HV transformers, and HVDC equipment and control systems – through long-term development roadmap, standardised specifications and diversified supply chains.

Infrastructure policy should also address the full lifecycle environmental performance of grid assets. Common standards and market incentives can accelerate the deployment of low-emission equipment, including alternatives to fluorinated gases, while encouraging transparent lifecycle assessments, resource-efficient design, repairability and circularity across critical grid supply chains.

4. Value reliability and flexibility, and make demand part of the solution

Electricity has economic value when it is available where and when consumers need it.

As variable generation increases, systems require sufficient firm and flexible capacity to manage periods of low renewable output, changes in demand and unexpected disruption. Depending on national circumstances, this may include storage, hydro, nuclear, interconnection, demand response and other forms of dispatchable capacity, including gas-fired generation that can follow credible pathways towards lower-carbon fuels or carbon capture.

Policy and market frameworks should recognise both the transitional and long-term contribution of these resources to system reliability while supporting their progressive decarbonisation.

Reliability assessments should account for resource duration, climate-related availability, correlated regional shortages and performance during prolonged stress events. Market arrangements should reward demonstrable system services while avoiding unnecessary capacity procurement and long-term emissions lock-in.

Industrial processes, electric vehicles, heating and cooling, batteries and other loads can increasingly adjust when they consume electricity in response to system conditions. Digital technologies, automation and advanced control systems make this possible at a scale that was previously impractical. To scale these, governments should support interoperability standards and appropriate access to granular energy data so that demand side solutions can compete fairly and securely and enable flexibility across existing industrial infrastructure.

Electricity markets and tariff structures should allow businesses and households to benefit from providing flexibility services. Better use of demand response can reduce peak capacity requirements, ease pressure on networks and lower the cost of integrating variable generation.

Market design should ensure that reliability, flexibility and resilience services receive appropriate economic value, with clear incentives that recognise the contribution of a range of technologies according to their performance and system needs. Short-term electricity prices alone may not adequately reward assets whose principal value lies in availability, flexibility or system resilience, particularly where investment is needed to maintain firm capacity while enabling its progressive decarbonisation.

A secure transition therefore requires governments to treat reliability and flexibility as explicit system requirements rather than assuming sufficient capacity will emerge automatically. This is an important shift in the traditional model of the electricity system: Consumers should increasingly be able to participate in balancing the system rather than being treated solely as passive sources of demand.

Interoperable systems, time-varying pricing, demand response, distributed energy resources, microgrids and storage can help enable this shift, allowing demand and supply to respond more effectively to changing system needs.

5. Keep electricity affordable enough to electrify

Electrification will be considerably harder if electricity is structurally expensive.

Governments should therefore scrutinise the full composition of electricity prices, including generation costs, network charges, taxes, levies and policy costs, as well as ensure that these are allocated transparently and efficiently.

This will become increasingly important as a greater share of system costs is fixed rather than linked directly to the amount of electricity generated. Tariff structures that place excessive fixed and policy costs on each additional unit of electricity consumed can create a disincentive to the very electrification that climate policy is seeking to encourage.

Affordability for households is equally important. Where support is necessary, targeted measures should generally be favoured over broad price suppression that weakens incentives and creates significant fiscal costs.

The objective should be to make clean electricity sufficiently affordable and predictable that switching to electric technologies makes economic sense.

Beyond energy price alone, policy should consider technology efficiency, digital optimisation, reduced maintenance, flexibility revenues and avoided carbon emissions exposure that can improve the business case for electrification.

6. Decarbonise industry – do not simply relocate it

Climate policy should reduce global emissions – with energy efficiency and electrification as the two key pillars – not shift production between jurisdictions.

Energy-intensive industries compete internationally and are particularly exposed to differences in electricity prices, carbon costs and regulatory regimes. Persistent cost gaps can influence decisions on where new factories, industrial processes and infrastructure are located.



Governments should therefore design energy, climate, industrial and trade policy together. Carbon pricing can provide an important long-term signal for investment, but greater international cooperation is needed to improve predictability, comparability and interoperability between different systems.

Where sector-specific evidence demonstrates genuine risks of carbon leakage, policy responses should be targeted, transparent and compatible with international trade rules. The ultimate objective should be to make low-carbon production commercially viable rather than to sustain it indefinitely through compensatory subsidies or allow it to migrate elsewhere.

Automation and digitalisation play a direct role in closing the cost and emissions gap between jurisdictions. Linking electrification, automation and digital intelligence as an integrated approach will be key to ensure competitiveness, resilience and decarbonisation. By enabling industries to operate more efficiently and productively, they reduce the energy intensity and emissions of production without requiring relocation.

Policymakers should recognise these technologies as critical enablers of industrial decarbonisation, helping scale electrification and energy efficiency while remaining competitive. Here it is important that progress should be measured by genuine emissions reductions, not simply the transfer of carbon-intensive assets to new owners, and should be supported by demonstrable progress towards lower-carbon alternatives.

7. Make the transition investable

The scale of investment required for the energy transition cannot principally be met from public balance sheets.

The most important role for governments is therefore to create conditions in which private capital can invest at scale: credible long-term policy frameworks, regulatory certainty, efficient permitting, viable utilities and offtakers, transparent procurement and appropriate allocation of risk. Existing climate and energy targets in many countries, such as in the EU provide clear direction; consistent implementation and policy stability are now essential to accelerate deployment, strengthen investment certainty and improve system efficiency.

Appropriately designed electricity contracts with electricity producers can help minimise transition costs and reduce the risk of negative wholesale electricity prices. This is relevant both in emerging markets and in mature markets facing increasing price volatility, price compression and periods of negative prices.

Performance-based business models, such as Energy-as-a-Service, digital measurement and verification, and standardised data can further strengthen project bankability, transparency and confidence in projected savings.

The financing challenge is particularly significant in emerging and developing economies, where high financing costs, currency risk and weaknesses in the investment environment can make otherwise viable projects uneconomic.

Accelerating electrification will require financing approaches tailored to these markets and different user, including small- and medium-sized enterprises (SMEs): project aggregation, energy performance contracts, project preparation support, local-currency financing where feasible, and targeted guarantees with clear additionality can play a key role in this regard.

Public and development finance should concentrate on risks that private markets cannot efficiently absorb. Guarantees, insurance and other risk-sharing instruments can play a particularly important role in reducing the cost of capital and mobilising private investment. Liquid and deep markets can provide some safeguards that allows financing to derisk their credits.

In many markets, reducing the cost of risk will be as important to accelerating deployment as reducing the cost of technology.

8. Remain technology-open and outcome-focused

The energy transition will unfold over decades. Governments cannot know today which technologies or business models will prove most competitive over that period.

Policy should therefore establish clear outcomes and metrics for emissions, reliability, affordability and system performance while preserving room for competition and innovation.

Wind, solar, nuclear, hydro, geothermal, storage, interconnection, carbon capture, low-carbon fuels and emerging technologies will play different roles in different economies. Unnecessary prescription risks locking consumers into higher costs and excluding technologies that may later prove valuable.

Technology openness should operate within transparent criteria covering lifecycle emissions, affordability, environmental impacts, system value and commercial readiness. Direct electrification represent the most efficient and cost-effective decarbonisation pathway across many sectors and should be prioritised where it offers robust efficiency and emissions benefits, while complementary low-carbon solutions should be assessed against clearly defined requirements.

A comprehensive approach must tackle process emissions, improve material efficiency, accelerate circularity and support solutions for sectors and applications that are difficult to electrify.

9. Build resilience through diversification and open markets

The transition will reduce some strategic dependencies while creating others.

Supply chains for critical minerals, clean-energy technologies and key components are often highly concentrated. Governments are right to consider these vulnerabilities as part of energy-security policy.

But resilience should not be equated with self-sufficiency. Attempting to replicate every stage of every energy supply chain domestically would raise costs, fragment markets and slow deployment.



A more effective strategy is to diversify sources of supply, expand production and processing across a wider range of economies, increase recycling and circularity, strengthen international partnerships and maintain open trade in energy technologies and critical inputs.

International markets, when sufficiently diversified and interoperable based on common rules and standards, are an important source of resilience.

10. Build the capabilities and know-how the energy transition requires

The energy transition is increasingly constrained by talent availability. Electrification, automation, digitalisation and AI require new technical skills and know-how across the entire value chain.

Meeting this demand requires governments, industry, academia and all stakeholders to align skills development with needs across the full lifecycle of energy infrastructure – from engineering, manufacturing and construction to commissioning, operation, maintenance and modernisation. Stronger vocational and technical education, industry-recognised qualifications and hands-on training will be essential to develop the engineers, technicians and skilled experts needed to deploy and sustain energy-transition technologies at scale.

Skills strategies should identify priority profiles, certification pathways, training capacity and financing needs, while strengthening collaboration between industry, universities and technical training institutions.



Skills planning should also be integrated into national electrification, industrial and energy-transition strategies. Upskilling, reskilling and lifelong learning are not peripheral to the energy transition; they are essential to delivering it.

The challenge ahead

The next phase of the energy transition will be judged not by capacity deployed alone, but by the delivery at the pace required and effectiveness and resilience of the energy systems it delivers.

Success means lower emissions, greater energy security, predictability, affordable energy for households and internationally competitive businesses, but also scale up of private-sectors expertise and know how to build and operate the systems the transition requires.

ICC calls for an integrated implementation agenda for energy efficiency, clean electrification and power-system decarbonisation to be adopted at COP31. Governments and business should translate global ambitions into nationally appropriate, investable sectoral plans with measurable milestones, transparent reporting and safeguards for affordability, reliability, equitable access and industrial competitiveness.

That is the test policymakers should apply to every major energy decision.





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