Inventing tomorrow's energy system

The road ahead for molecules and electrons

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The revolution is here

The energy transition is fully underway, with a major shift from fossil fuels to renewable sources. Spurred by innovation, capital and regulation, business models are evolving rapidly, forging new equations for creating value. As companies and investors place decarbonisation at the centre of their strategy, societal and consumer pressures are compelling new forms of collaboration. The 2015 Paris Agreement and the 2020 net-zero pronouncements by China and the newly elected Biden administration in the US have transformed governments from cheerleaders of decarbonisation to directors of the transition. From South Korea to the US and Europe, massive economic stimulus packages that are intended to spur a comeback from the pandemic are aimed at building more resilient and sustainable economies and energy systems.

The forces of policy, investment and technological change have put into place a set of dynamics not seen in the energy sector since the Industrial Revolution. In the coming decade, new energy systems will start to emerge. Industries such as oil and gas, power and utilities, and chemicals, once sharply delineated, will converge and form into integrated energy systems. New industrial clusters will arise, spurred by the advent of novel vectors forged by renewable molecules and electrons. Investors will deploy vast sums of capital. The International Renewable Energy Agency predicts that US$13tn will be needed to bolster power transmission and distribution networks across the globe through 2050. We estimate that the cost of transforming the electricity networks in Europe alone will be at least US$2tn over the next 30 years. More than US$500bn will be spent in Europe by 2030 just on infrastructure for the nascent hydrogen export market.[1]

The upshot: the ways in which electrons and molecules are created, the way they move through systems, how they're stored and their ultimate end use will change rapidly. In forging new paths, they will create a new future and inspire a set of reactions. They will lead to integrated networks that facilitate the flow of electricity, gas, hydrogen, heat, steam and CO_2; the creation of new business clusters; the formulation of innovative new strategies; and a host of responses from the public and private sectors. The state and the market have always been intertwined in these industries, many of which are regulated or characterised by a high level of state involvement. But the two parties must learn how to tango as they move into this uncertain future. Participants will need to fundamentally rethink the efficacy of a purely market-based approach and accept the presence of a more visible hand, guiding and orchestrating markets over the next decades.

1 IRENA, *Global Renewables Outlook 2020,* Apr 2020, www.irena.org/publications/2020/Apr/Global-Renewables-Outlook-2020.

An accelerating energy transition

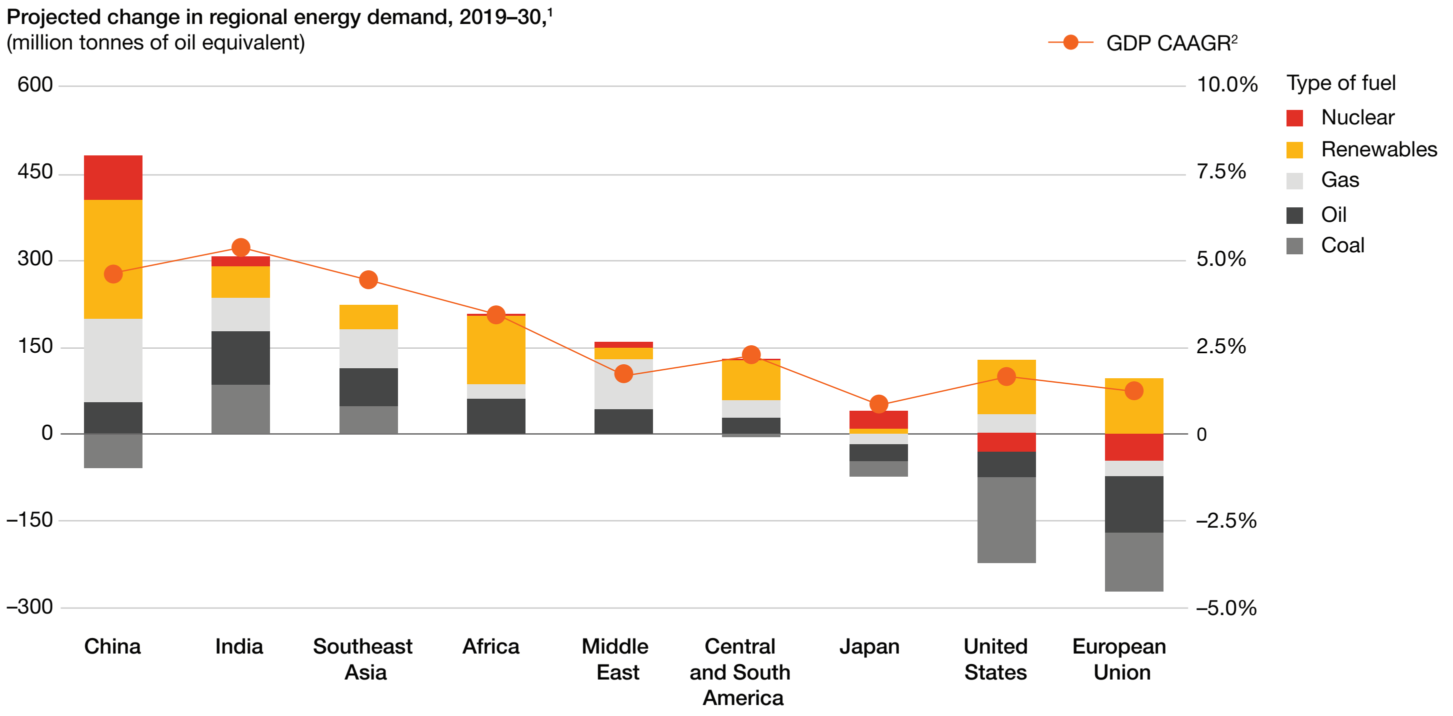
The world needs more energy. The International Energy Agency (IEA) projects that total global demand for the molecules and electrons that power our world will rise by 23% by 2040.[2] In the near term, fossil fuels will continue to account for a large percentage of the molecules that fuel transport and the electrons that provide electricity and heat. As the IEA World Energy Outlook 2020 forecasts, developing economies will rely more on fossil fuel–based energy sources over the next decade, even as more developed economies rapidly reduce their stock of coal- and oil-based energy sources (see Exhibit 1). Although coal is predicted to enter structural decline over this decade, natural gas, driven by US shale production and a growing export market for liquefied natural gas, will continue to play a major role in the global energy supply chain.

Taking a longer view, the direction of the energy transition is clear. As time goes on, carbon-free energy sources—chiefly electrons, but a rising proportion of green molecules—will account for a greater share of production. An inflection point is coming in the next five years. Already, 21% of private companies and 61% of national governments have set ambitious decarbonisation or net-zero targets.[3] More than 190 countries have committed to the goals of the 2015 Paris Agreement, which include aggressive reductions in emissions. These pledges are backed up with subsidies, incentives, investments and carbon-pricing schemes.

As companies and financial institutions internalise the goals of a lower-carbon economy, they are eschewing investments in carbon-intensive industries and ploughing investments into renewable energy and new energy vectors. In 2020, investors poured a record US$350bn[4] into sustainable investment funds, more than double the 2019 total. A great deal of capital is being invested into innovation, R&D, technology and scaling efforts that help bring down the cost of renewable energy production, energy storage, green hydrogen and other low- or no-carbon innovations. Those lower costs, in turn, support the policy efforts and may encourage more ambitious goals and standards, which will inspire more companies and investors to act.

2 IEA, World Energy Outlook 2020, October 2020, www.iea.org/reports/world-energy-outlook-2020; relative difference between most recent datapoint (2019) and 2040.
3 Oxford Net Zero and the Energy & Climate Intelligence Unit, Taking Stock: A global assessment of net zero targets, Mar 2021, https://eciu.net/analysis/reports/2021/taking-stock-assessment-net-zero-targets.
4 Morningstar, Global Sustainable Fund Flows: Q4 2020 in Review, Jan 2021, www.morningstar.com/lp/global-esg-flows.

Exhibit 1: Geographical shifts

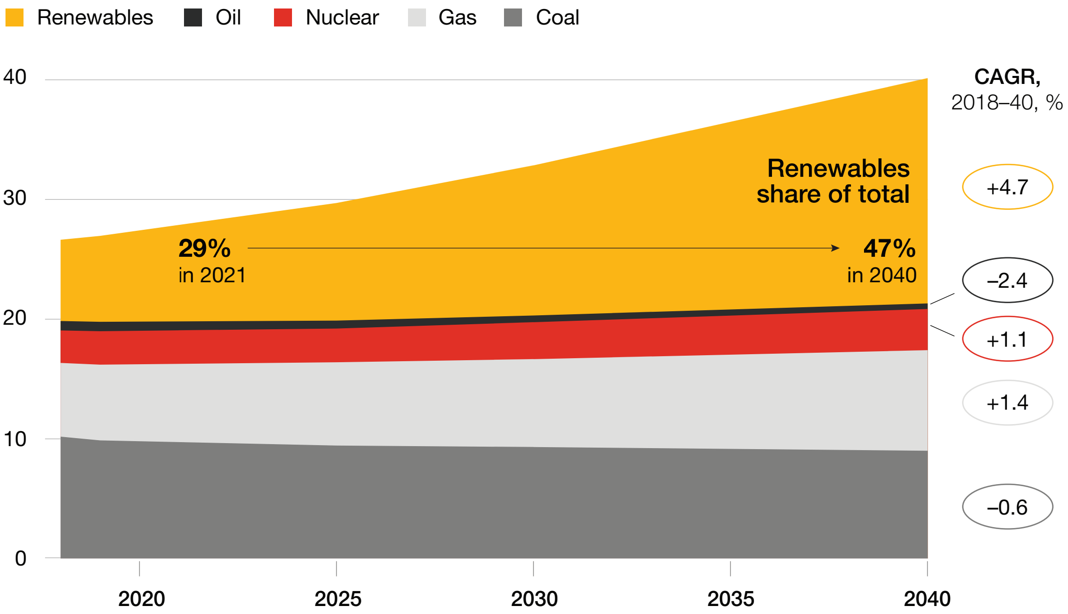


[1]Based on current announced policy initiatives.
[2]Compound average annual growth rate of GDP.
Source: International Energy Agency (IEA), *World Energy Outlook 2020*, "Changes in primary energy demand by fuel and region in the Stated Policies Scenario, 2019–2030"

Looking to the decade beyond 2030, renewable energy will take a greater share of the global electricity market, as coal declines and natural gas grows modestly. According to the IEA, by 2040, powered by strong growth in wind and solar, renewables will account for about 47% of the electricity market, up from 29% today. And of course, the ambitions of the world now aim to drive those trends even further (see Exhibits 2 and 3).

Exhibit 2: A changing mix

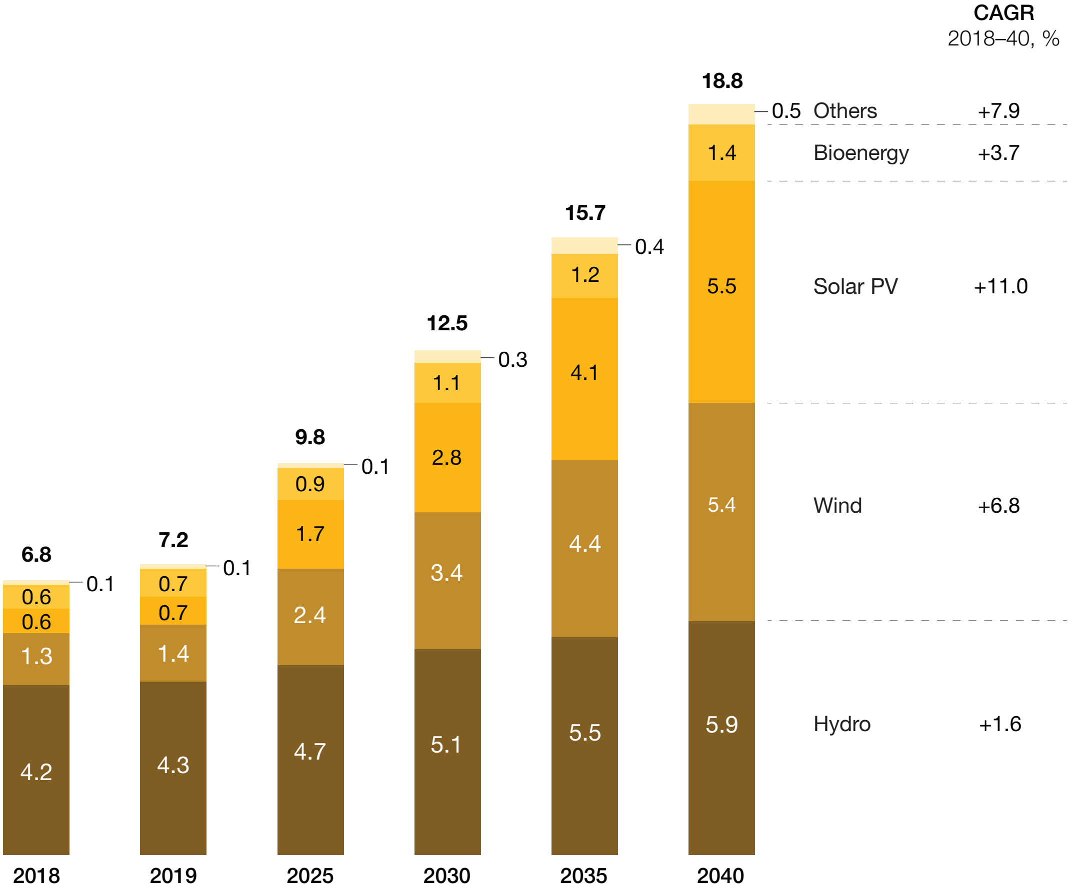
Projected global electricity generation by source, 2018–40, petawatt hour



Source: International Energy Agency (IEA), *World Energy Outlook 2020*; International Renewable Energy Agency (IRENA), Renewable Capacity Statistics; MSCI country classification

Exhibit 3: Carbon-free growth

Projected global renewable electricity generation by source, 2018–40, petawatt hour



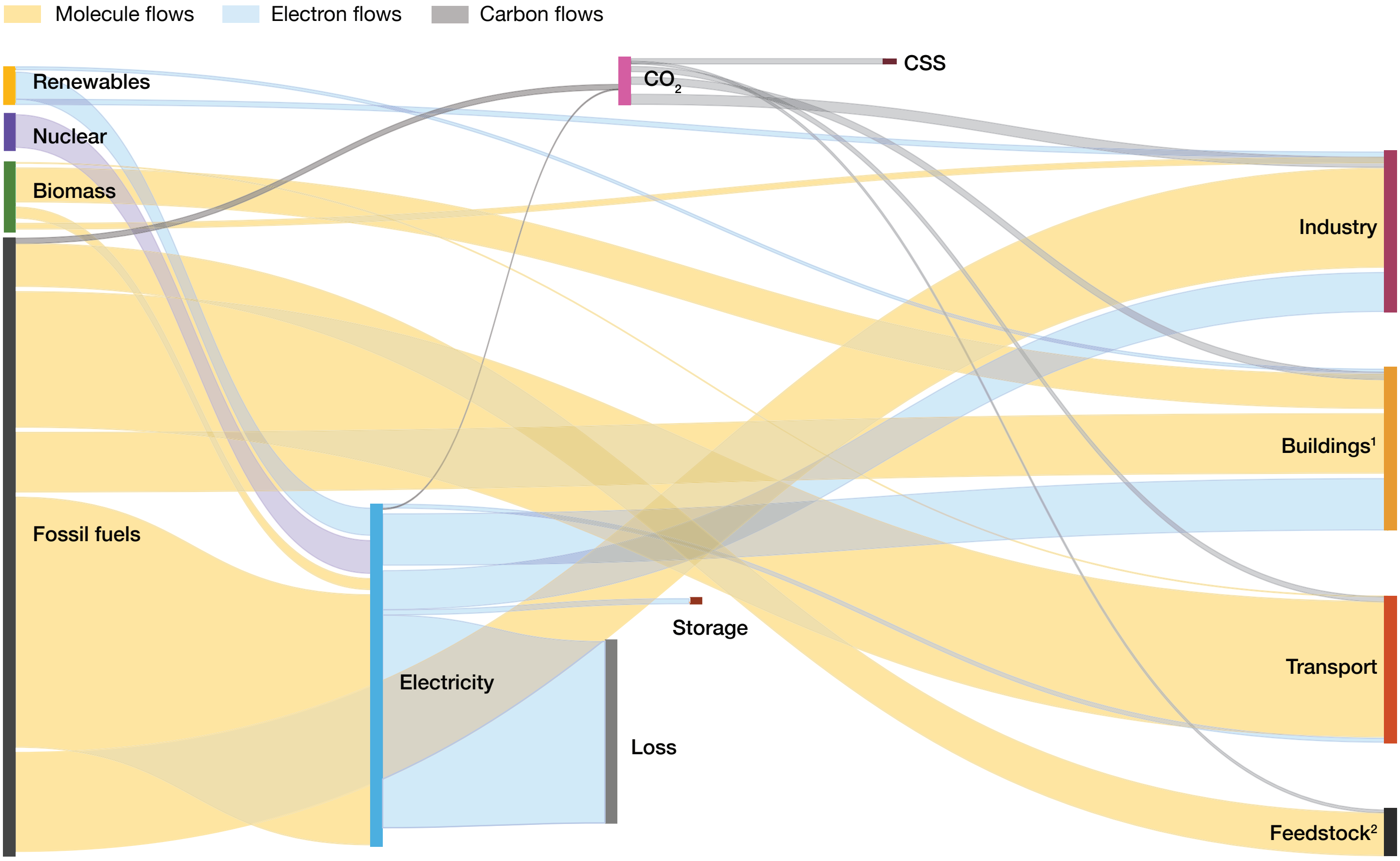
Source: International Energy Agency (IEA), *World Energy Outlook 2020*; International Renewable Energy Agency (IRENA), Renewable Capacity Statistics; MSCI country classification

A new energy system: Lower carbon and higher complexity

The transition from our current energy system, which is dominated by fossil-fuel molecules, into one based on renewable-powered electrons and carbon-free molecules, has enormous implications. This transformation can best be understood by looking at the paths that energy molecules and electrons take from the point of creation to the point of consumption or use—what those paths look like today and what they will look like in the future. As Exhibit 4 shows, today, global energy usage still relies heavily on fossil-fuel sources and is traditionally segmented into clearly delineated sectors. Despite all the investments made in renewables to date, oil, coal and natural gas still account for 80% of the total energy used to produce electricity and provide refined products across the three core application areas: industry, transport and buildings.

Exhibit 4 shows the comparatively simple and linear flows of electrons through the electricity value chain and molecules through the oil and gas and chemicals value chains. Today, fossil fuels create most of the electrons that power buildings and industry, as well as the molecules that heat buildings, power factories and fuel most forms of transport. Carbon-free sources—renewable and nuclear—provide a small percentage of the electrons that power buildings and the transport sector. And there is a clear delineation between the oil and gas, power and utilities, and chemicals sectors. The one point of clear overlap is between oil and gas and chemicals in the petrochemical sphere.

Exhibit 4: Current energy flows, 2018, by source and target (illustrative)



[1]Includes residential, both commercial and public.
[2]Includes agriculture, forestry, fishing and non-specified.
Source: For illustration purposes based on various sources; analysis by Strategy&

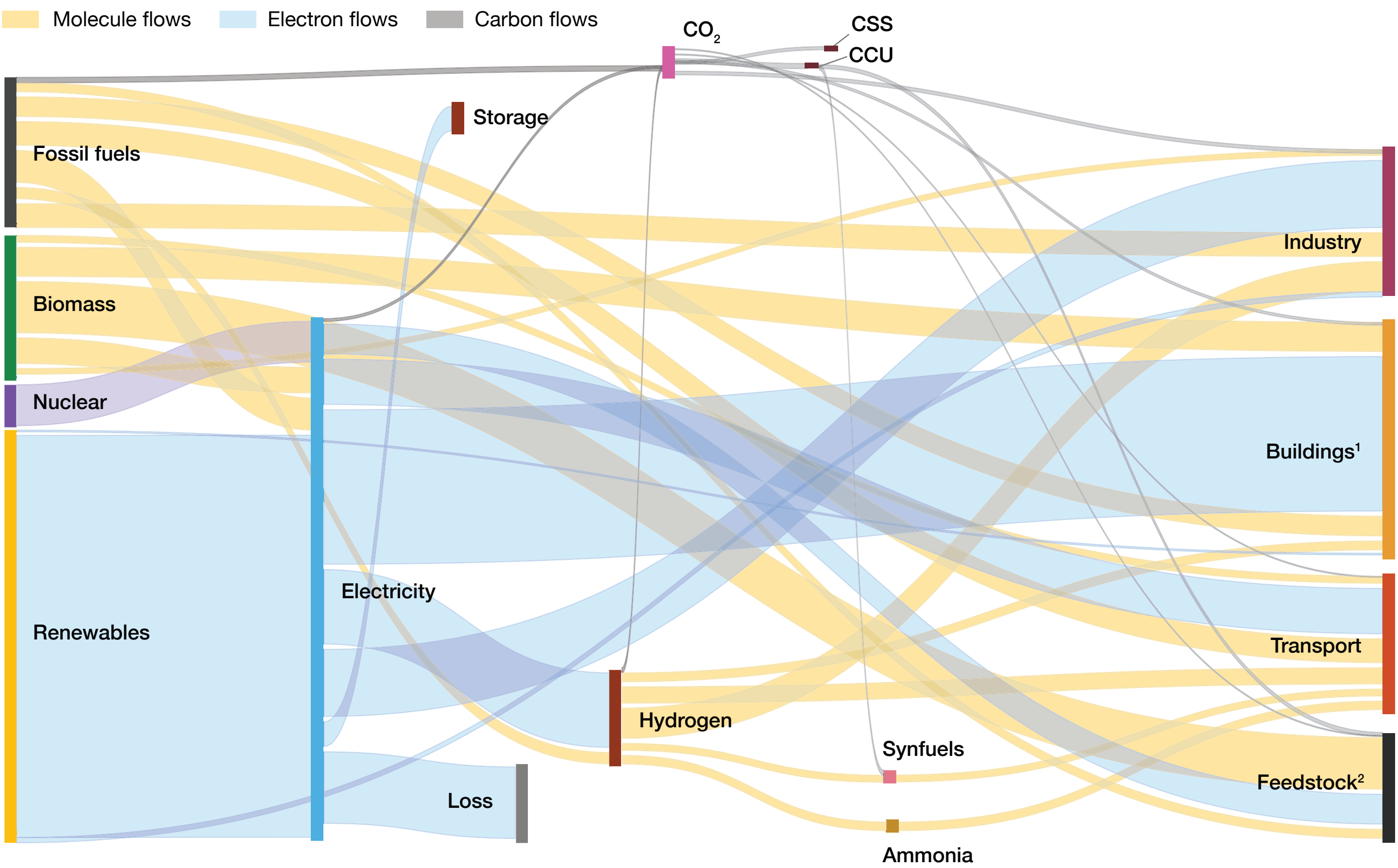
The future looks much different

As renewables gain market share and fossil fuels decline, the origins of electrons and molecules, and the paths they take, start to carve new routes (see Exhibit 5). By 2050, renewables will account for more than 90% of energy, and fossil fuels will account for less than 10%. Renewable energy sources will be the main feedstock for the economy, while fossil fuels will be required for sectors that are hard to decarbonise. Some portion of fossil fuels will go to refineries to create fuel for transport and to produce carbon for non–energy use in the chemical or food industry. Biomass and waste will surpass fossil fuels as creators of molecules, such as renewable natural gas, that will be used to heat buildings and power transport and industry. And the capturing and recycling of CO_2 will also create new flows of carbon molecules.

But electrons produced by renewables will be the dominant force in this system. They will provide the lion's share of electricity, fill up massive batteries that will become electricity generators in their own right, power factories, heat and cool buildings, and, as electrification hits the transport sector, emerge as a major fuel for vehicles. As Exhibit 5 shows, there will also be new paths for electrons to stimulate the creation of molecules—namely, green hydrogen, which can function as a fuel for heavy transport such as trains and ships or as a power source—and a greater circular movement throughout the system.

The final switch to a highly renewable energy system will require a quantum leap in storage for electrons and molecules; a rethinking of the role of baseload non-emitting technologies, such as nuclear, geothermal and hydro; and increased flexibility by end users in the ways they manage energy consumption and use.

Exhibit 5: Future energy flows, 2050, by source and target (illustrative)



[1]Includes residential, both commercial and public.
[2]Includes agriculture, forestry, fishing and non-specified.
Source: For illustration purposes based on various sources; analysis by Strategy&

The future system will be much greener than the one we have today, and much more complex.

It will have more paths, more interactions and more transformation steps from generation to application. In many ways, the roles of the molecule and electron become intertwined before reaching the end consumer, largely due to the rise of electrification and green hydrogen. The greater presence of intermittent sources of power, such as wind and solar, will create challenges in aligning peak demand with production and ensuring reliability in times of stress. It also will spur efforts to store electricity, manage its use effectively and create new sources of power supplies.

An additional layer of complexity is emerging in the industrial sector with the increasing push to decarbonise industrial processes and supply chains. This includes sharply rising demand for green power, the need to store electrons, and the need to transport green molecules. As electrification and fossil-based carbon stripping accelerate, the traditional boundaries between the oil and gas, power and utilities, and chemicals sectors will blur. New value chains will emerge that link distributed power generation from renewables to demand centres, and that involve new energy vectors (e.g., hydrogen) and integrated flows of electrons and molecules. Other new value chains will emerge based on carbon capture, recycling and storage.

Another challenge will be the adoption of new ways to source carbon molecules for industries. Solving these challenges makes the conversion and storage of energy increasingly important and will flip the traditional role of the carbon molecule from being an input or feedstock for an end product to being an output that can be harvested from fossil or renewable sources, used, captured and reused. There are already examples of carbon-focused companies and projects (e.g., carbon engineering).

Because it is unlikely that all demand can be fully electrified, methane and hydrogen derived from carbon-neutral sources will play an important role as sources of fossil-free carbon molecules for industrial demand and as stored sources for backup power.

As Exhibit 6 shows, we are already seeing the emergence of multiple energy vectors that can lead the way in promoting the decarbonisation of CO_2-emitting sectors.

Exhibit 6: New vectors for molecules and electrons

Electricity-dependant

Sectors	Heat and power	Transport	Feedstock/ chemical agent
Current vectors	Oil and gas	Fossil fuels; EV batteries	Natural gas; Grey hydrogen
End-state vectors	Cooling or heating: Heat pumps; Green hydrogen; Biogas Power: Pumped hydro storage; Renewable energy sources	Syngas and synfuel; Hydrogen; EV batteries	Bio-methane; Green hydrogen; Carbon capture
	• Electric heat pumps and district systems decarbonise cooling and heating. • Hydrogen and biogas replace fossil fuels to supply industries requiring high-temperature heat. • Power generation depends on renewables and carbon-free energy storage (e.g., pumped hydro).	• Fossil fuels convert to electricity-based energy and its byproducts, such as hydrogen and batteries. • Synfuels and syngas are a vital source of carbon-free fuel for heavy-duty long-haul transport.	• Chemical feedstock primarily depends on bio-methane and green hydrogen. • Chemical agents are prioritised for carbon-capture solutions, such as the recycling of complex molecules.

Source: Strategy& analysis

The new paths forged by electrons and molecules in tomorrow's energy system will create a new landscape for global energy flows. Currently, the sophisticated and powerful trade networks that connect production with consumption primarily consist of oil and gas pipelines and shipping routes with infrastructure for oil and gas tankers. The development of renewable electrons and molecules is forging new trade routes, which will require substantial new investment. There are discussions to export green hydrogen to Europe from places that have an abundance of cheap renewable electricity, such as the Middle East and Iceland, or from Australia to Japan. Projects have been proposed to build electricity transmission networks from areas that have vast capacity for renewable electricity production to centres of demand. These include the Australia-ASEAN Power Link, which would connect Australia to Singapore; IceLink, which would convey geothermal and hydro power through an underwater cable from Iceland to England; and China's ambitious Global Energy Interconnection initiative.

As predicted flows may change quickly, participants will struggle to manage the new energy system equilibrium and the high risks and volatility it will bring. And a world that relies less on oil and coal is likely to present a new set of geopolitical dynamics surrounding energy. There will be an increasing political push around the world for self-sufficiency and strategic autonomy; regions or countries that rely on imports will be keen to reduce dependency. The possible balkanisation of the current global energy market will further increase complexity and volatility.

Strategic implications

It is unclear precisely when the transition will conclude. But the direction of travel is clear, and the forces pushing in this direction are immense. The speed of change and the degree of complexity require a strategic response from all participants: national oil companies (NOCs), international oil companies (IOCs), utilities, chemical companies, service companies, investors, grid operators, and government entities such as ministries and regulators. For some players, especially the large oil companies, this transition poses existential questions. And a new crop of companies that historically have not been major players in the energy value chain—including battery manufacturers, automakers and green hydrogen shippers—will find they need to adapt as well, because their inputs, supply chains and, in some cases, end products will change markedly over the next two decades. Those that embrace the new energy landscape and create new value from the underpinning disruption while decarbonising their value chains will create lasting strategic and competitive advantage.

Convergence

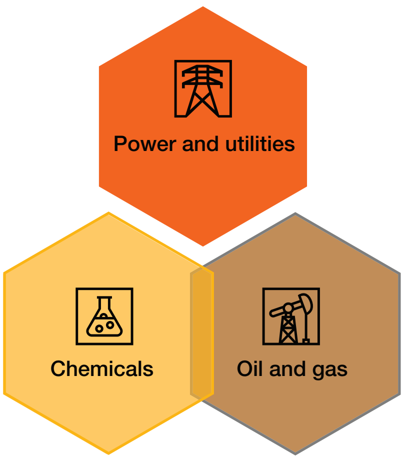
First and foremost, the new paths carved by molecules and electrons will lead to greater convergence and an erosion of the traditional barriers between energy sectors. That will push companies to become more integrated—combining electrons and molecules, and acting across broader parts of the value chain (see Exhibit 7). Companies that do not become integrated players will need to seek attractive niches based on differentiated capabilities.

Utilities, beyond assuming a renewed prominence as holders of the electrons, will have to delve into new business activities, such as data services and analytics, the financing and installation of household solar/charging solutions, and B2B behind-the-meter energy management. Chemicals companies must reinvent themselves as champions of circular economy activities, focusing on harvesting, creating, capturing and recycling molecules in a circular fashion.

Some of these moves are already underway. IOCs have been investing substantially in the power sector. Total has invested in Eren, a major renewable electricity developer in Europe. Shell acquired the smart energy storage company Sonnen and the Australian commercial and industrial power retailer ERM Power. OMV, the Austria-based oil and gas company, has taken a majority stake in Borealis, and the two are collaborating on efforts to increase circularity and recycling. Utilities are already pushing aggressively into the market for storage of molecules and electrons. Chemicals companies have identified hydrogen as an important production feedstock, energy source and business opportunity for their applications. Even transmission system operators (TSOs) are expanding their view. TenneT, the Dutch-German electricity TSO, has developed the Equigy platform that encourages small energy users to participate in grid-balancing efforts.

Exhibit 7: An age of convergence

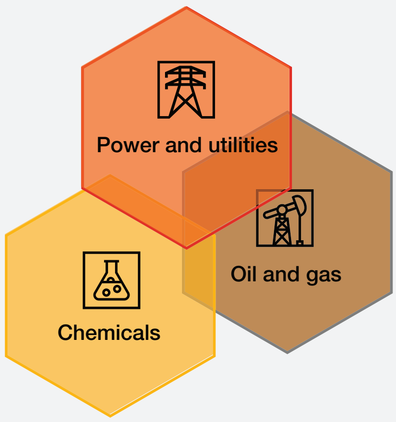
Traditional model



The **traditional model** implies a segregation of the role of the molecule and the electron, where:

- Oil and gas companies provide molecules.
- Power and utilities companies transform molecules to generate electricity.
- Chemical companies use both molecules and electrons to compose new molecules.

Converged model



The **converged model** is driving companies to intertwine the role of the molecule and the electron:

- Oil and gas companies become electricity and new molecules suppliers (e.g., H_2) and expand their business model into a utility provider (e.g., electricity generator).
- Chemical companies store electric power and utilise renewable carbon atoms to form molecules.
- Power and utilities companies dependent on storage to secure constant supply of power (e.g., batteries, H_2, ammonia) and become suppliers of green electrons.

Source: Strategy& analysis

Customers as value chain partners

One strategic dynamic at play relates to the role of customers and how they interact as value chain partners rather than as traditional receivers of goods and services. For example, industrial companies and other large users already work with utilities to implement demand-response services. They can contract to reduce their usage during periods of peak demand and get paid for doing so. As renewable energy and storage become more prevalent, such balancing services will become increasingly common. And customers themselves may be able to turn into providers of electrons, as in the Equigy example above.

All players must take far-reaching decisions on how they position their activities and value propositions. Exhibit 8 provides a glimpse into the strategic questions each player in the energy value chain is facing.

Exhibit 8: Strategic challenges for energy stakeholders

New role (yellow) | Traditional role (grey)

	Typical considerations	Strategic options	Strategic questions
International oil companies	Oil and gas portfolio characteristics Core, differentiated capabilities Stakeholder and regulatory environment Commercial returns	Leading integrated energy company (new role) Decarbonised oil and gas specialist (traditional role)	Shift to integrated model or focus on oil and gas? Aggressive pivot or gradual evolution to new energy? Pursue new energy growth via organic investments or deals?
National oil companies	National policy and ambitions Mandate and role in energy ecosystem Breadth of project management and other capabilities	National new energy champion (new role) Oil and gas resource custodian (traditional role)	Embrace role as national new energy champion or focus on oil and gas? Pursue net-zero ambitions or smaller emissions reduction? Develop new low-carbon products (e.g., hydrogen)?
Chemicals	Current portfolio and product mix Existing feedstock options and costs Geographic location R&D and competitive differentiation	Circular chemistry leader (new role) Traditional petrochemical company (traditional role)	Aggressively adopt sustainable feedstocks or continue oil and gas? Invest in captive new energy and hydrogen sources? Create and expand circular chemistry products and services?
Power and utilities	Current generation portfolio Market and regulatory structure Core, differentiated capabilities Corporate culture, agility and customer focus	Integrated energy provider (new role) Power generation and delivery (traditional role)	Strike a balance between traditional and low-carbon power generation? Expand into energy trading and service offerings? Develop hydrogen and other storage options?
Investors	Market outlook and expected returns Emerging growth sectors Investor sustainability expectations	Energy transition enabler (new role) Financial return seeker (traditional role)	Continue to focus on traditional energy or pursue low-carbon only? Invest in mature or emerging energy solutions? Balance growth and higher-margin segments?
Government and regulators	National policy and ambitions Private-sector capabilities Market and regulatory structure Economic strengths and investment capability Consumer/societal expectations	Energy transition orchestrator (new role) Free-market enabler (traditional role)	Balance state vs. private investment in infrastructure? Rewrite or evolve policies and regulations? Drive transition via state subsidies or free consumer choice?

Source: Strategy& analysis

An increased need for state orchestration

Although the required direction of travel and main building blocks of strategy are becoming clear, there are many practical hurdles to overcome. Costs must come down, and the right infrastructure investments must be made. Regulatory change typically lags technological and business model changes, and the new risks must be managed with constantly refreshed regulatory and operational standards and procedures. And just as these efforts require a rethinking of the paths and roles of molecules and electrons, they require a rethinking of the relationship between the market and the state.

Broadly speaking, there are two approaches to adapting to change and uncertainty. In a free-market approach, companies lead the transition, and market forces determine the end state. The state independently steers companies via policies, regulation, taxes and subsidies. Capital follows once the playing field is clear. Because the scale of this transition is so vast and complex, fragmentation and end-state discovery—with the associated failures along the way—may not lead to the desired new energy system.

In state-orchestrated realms, governments lead the transition and are responsible for setting the end state; governments initiate large projects, and private capital follows. But although governments might have the means to pursue a bold view and strategy, they face financial and political constraints and don't always have the requisite capabilities.

Addressing energy transformation challenges will require strong state orchestration, at least in the early stages during the development of markets and strategic infrastructure. But neither the government nor the private sector can manage the transition to net zero and the new energy landscape alone. The transition is simply too complex and too uncertain, and getting the outcome right is too important. What's needed is a collective response—the state and the market working together in new ways (what we call a 'tango' of state and market). We envisage three possible models being adopted around the world: policy driver, strategic infrastructure investor and co-investor (see Exhibit 9). Of these, policy driver would have the lowest level of state involvement, and co-investor the greatest.

Exhibit 9: Potential roles of the state

	Policy driver	Strategic infrastructure investor	Co-investor
How it works	• State leads using policy instruments and regulation. • Market makes significant investments and bears total risk.	• State leads and invests in select infrastructure. • State guarantees equal access for major infrastructure. • Market makes select investments only and shares specific risks with state.	• State and market co-invest in projects together. • State coordinates investments and cooperates with market. • Market shares the risk with the state.
What you have to believe	**The state** • has strong institutions and capabilities and deep knowledge of how to leverage the regulatory and tax regimes • can rapidly adapt to changing dynamics. **The market players** • have deep pockets • are willing to join forces to share the risk irrespective of competition. **The energy transition** • will happen faster than anticipated.	**The state** • already holds a significant share of key infrastructure that is necessary for energy transition • is willing to forfeit some state revenues and put political capital at risk to guarantee energy transition success. **The market players** • can operate in a model through which they partner with public-sector entities • are willing to co-invest and share risks. **The energy transition** • will happen faster than anticipated • will result in strong public infrastructure–based transition.	**The state** • can develop required capabilities to successfully co-invest • is willing to forfeit some state revenues for energy transition success. **The market players** • can operate in a model through which they partner with public-sector entities • are willing to invest in collaboration with the state. **The energy transition** • will happen faster than anticipated • will result in steep learning curves and new forms of cooperation across actors, driving down costs rapidly.
Potential regions	United States, European Union	Australia, Brazil, Mexico	Saudi Arabia, United Arab Emirates
Challenges	This energy transition is too big, complex and risky to allow governments to just sit back and watch, and for the market to 'discover' the outcome.	Government ownership of key infrastructure alleviates customer risks and encourages investment. The burden of risk remains on the market.	Full risk-sharing is required to build investors' confidence and to attract the necessary funds of market players, and requires strong long-term commitment by the state.

Source: Strategy& analysis

Policy driver

Government sets the vision for the energy system and uses the policy toolbox to guide market players and provide incentives for them to cooperate, through subsidies, tax credits, regulation and climate taxes. This requires strong institutions with policy-making skills and independent regulation, long-term political commitment and deep know-how at the government level of the desired end state. In this model, governments are hesitant, ideologically or financially, to be owners of commercial capital and co-invest. This is the most challenging of all models during the transition state, because it places the emphasis on the market to invest at the right time with the right assets. Thus, market 'discovery' is an important element, with failures along the way and no guarantee that the desired outcome is achieved. It implies a need for shared market information and alignment on how the uncertainties of the transition will be managed. This model has been the underpinning of energy markets in OECD countries.

Strategic infrastructure investor

Government goes beyond setting visions and policy and exerts control over critical infrastructure, such as energy networks and possibly even some dispatchable generation. This gives the state more leverage and control to direct investments and behaviour and to set the strategic intent of private actors. It allows these players to invest early in new infrastructure, such as hydrogen, and take more risks, given that government (or partial government) ownership puts less pressure on returns. Many countries already have a form of government involvement in critical energy infrastructure, be it directly through ownership, indirectly through government proxies or allied investors, or through legislative powers in case of emergencies. In this mode, the state needs to become a more active infrastructure owner and set the strategic agenda. The advantage of long-term investment in new infrastructure, such as hydrogen networks, can help create 'pull' for new investments by international players.

Co-investor

Governments either have a direct stake in the key stakeholders and their commercial activities or act as co-investor for necessary bets that may be riskier and more uncertain. The state provides capital and/or underwrites pricing. More important, it provides confidence and trust and attracts further investment. By mitigating risks, the state encourages crowding-in of investments by other players. This allows the government to further direct, dictate and orchestrate the desired outcome. The role of the state and market blur in this world, and the state becomes—in the words of economist Mariana Mazzucato—'entrepreneurial' and a 'co-creator of value.' Or, in our words, there is a tango of state and market: the entrepreneurial state will take the lead, and the market will have to follow, anticipate and complement, yet not shy away from taking the lead when required.

This approach runs against the decades-old OECD-driven trend, seen in Europe, the US, and Japan, of increasingly neutral governments that focus on policy and regulation to set the boundaries of the economic game, and is similar to the approach that governments have taken to develop natural gas markets. In our view, this new tango, if done correctly, will yield the highest societal value. But it will do so only if the state has a long-term commitment, works in unison with the market and accepts that some investments will not pay off. For market participants, it will require accepting a more visible hand and more politicised decision-making, and the need to work across parts of the value chain to share information and potential value pools.

The road ahead

Getting the energy transition right is vital in many dimensions: technological, strategic, environmental and economic. The scope of the required investments is starting to become clear and tangible, and so, too, are the benefits. Although the contours of the destination are starting to emerge, many challenges and questions remain as electrons and molecules find new pathways and new roles.

Indeed, it is clear that none of us can make this journey successfully on our own. In all regions, in a range of industries, it will be critical to forge new alliances and develop novel ways of working together across value chains and ecosystems. Of course, different stakeholders will pursue the strategies that make the most sense for them. But as we consider the road ahead, it is important to emphasise that everyone has to have a sense of urgency.

Those tasked with developing government policy and regulation should move quickly to gain clarity on the prospective roles of the state and market and put appropriate structures into place. Time is of the essence, not just in formulating and promulgating regulations and policies, but in setting targets and demands for change. Putting clear rules in place quickly will provide a road map to the private sector.

Investors have to reassess the risk profiles of existing investments with a view to how the new paths forged by electrons and molecules will impact them. They have to start developing alternate investment theses now for an increasingly decarbonised global future—even in areas and market sectors where policies are not firmly in place.

Private-sector players must act with a similar sense of urgency. All participants need to reassess their corporate ambition and strategy, mindful of the many real and significant challenges the global economy faces. And they must take pains to avoid the pitfalls that often plague industries in transition. Denial—i.e., assuming that there are too many hurdles to the transition and that hydrocarbons will maintain their current role—is not a viable strategy. Nor should companies take solace in thinking that many of the components of this transition are in the distant future—ten to 15 years down the road—and that they have plenty of time to devise a plan.

The transition is already well underway. And if our systems are to deliver on the ambitious climate agenda the globe has set, the work must begin now.

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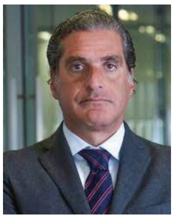

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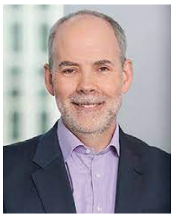

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