Our genuine view of your future energy

CEPSA ENERGY OUTLOOK 2030

2017 Edition

CEPSA

CEPSA ENERGY OUTLOOK

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This report contains forward-looking statements that involve risks and uncertainties, including trends in energy demand, supply, advances of new technologies, political, legal and regulatory developments, economic circumstances and climate conditions amongst others. Such statements are based on the current expectations and certain assumptions of contributing analysts, which may or may not occur in the future.

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WELCOME

H.E. SUHAIL AL MAZROUEI
President

There is no doubt that as we move along in the 21st century, the pace of change is accelerating at unprecedented speed. The business environment is evolving swiftly, with increasing globalization, a growing mobility revolution and unparalleled technological transformation.

To successfully navigate the complexities that come in the wake of such fast-paced change, companies will need to be nimble, responsive, proactive and forward-looking. They will have to identify the uncertainties, threats and opportunities on the horizon that can impact their business; anticipate emerging trends and their implications; and design a strategic course that prepares them for tomorrow while affording enough flexibility to move in a new direction when the environment shifts.

No company can accurately predict the future; to claim we can do so would be audacious. But with foresight, vision, and adaptive planning, we can be better prepared to effectively respond to changes, meet the challenges that arise and capitalize on the potential opportunities that lie ahead.

And this is precisely what Cepsa has done with its "2030 Energy Outlook": relying on its breadth of knowledge, expertise, insight and analysis, it has integrated all the many different elements in the environment into a cohesive and structured perspective of the path going forward, and the forces of change that will dominate the energy landscape into the foreseeable future.

Needless to say, it is an ambitious and daunting task; one that requires not only sound research and methodologies, reasoned judgments and assumptions, and thoughtful assessments, but the ability to adeptly forecast and track future trends to ensure that we, as an energy company, are staying ahead of the curve.

As Chairman of Cepsa, I would like to commend the teams involved in developing the "2030 Energy Outlook". They have provided a clear, comprehensive and compelling long-term global view of the energy evolution and I thank them for their dedicated work and efforts.

Few would deny that energy will be a key driver of human progress and prosperity in the years to come. I am confident that the entire oil and gas industry will continue to play a vital role in meeting and addressing the energy needs of a rapidly changing global marketplace, and to be at the forefront of those changes, delivering the necessary resources, solutions, technologies and innovations.

Companies that want to create long-term sustainable value will have to adopt farsighted approaches and strategies and I am convinced that this is more critical than ever as we face extraordinary challenges and opportunities. This "2030 Energy Outlook" embodies and articulates that aspiration. I hope this document not only proves to be useful and informative to you, the reader, but on a broader scale, will make a valuable and meaningful contribution to public discussion and debate on the future of energy.

PEDRO MIRÓ
Vicepresident and CEO

I take great pride and satisfaction in being able to present our first edition of the Cepsa Energy Outlook, appropriately timed to coincide with the revision of our long-term Strategic Plan which also sets its sights on Cepsa's 2030 targets and aspirations.

Much effort, work and commitment went into preparing this report, engaging numerous experts and analysts from across our organization, under the guidance and leadership of our Corporate Strategy Division. No doubt, it represents a milestone for our Company and comes at a critical juncture for our industry.

We at Cepsa firmly believed in the need to undertake a far-reaching, integrated yet plausible analysis and projection of the future of energy and contemplated doing so on several occasions. However, it was not until 2016, a pivotal year that witnessed a number of decisive developments in the global energy landscape, and in particular, the consequences of the landmark Paris Agreement on climate change, as well as the redefinition of the global energy mix, that we decided it was a fitting moment to embark on this project.

The growing fragmentation of our world economy, and consequently, of energy model archetypes, prompted us to identify and typify three groups of countries ("Regulators", "Energizers" and "Consumers") and accordingly, to structure our analysis into three supply-demand models, providing the Energy Outlook with an original, unique and genuine perspective. Furthermore, we made every effort to show the "human" side of the energy story through fieldwork and interviews, gathering personal testimonies from individuals from a diversity of backgrounds who shared their concerns and opinions and offered us their insights, and a reality check, on the aforementioned models and archetypes.

This report seeks to convey our particular views of the entire energy ecosystem, comprising an extraordinarily complex network of sectors and players across diverse segments of the global economy, all of which will shape the future of the industry. At a time when energy is being vigorously debated from a number of standpoints and considerations, most notably economic and environmental, we felt it was vital to make our contribution to this very public and timely debate and provide our own analysis, judgments and understanding of the wide array of energy issues, scenarios, and possible outcomes we face in the future to our different stakeholders.

Lastly, I would like to point out that this Energy Outlook is not intended to be an isolated, one-time achievement but rather a work-in-progress. It is a starting point rather than an endpoint. We will update and expand its contents as the environment evolves, although the underlying basis, methodologies and long-term focus will remain intact. We believe it serves a key purpose and represents a fundamental tool in the development of our long-term strategic planning process and I am pleased to have this opportunity to share it with all of you.

EXECUTIVE SUMMARY

FUNDAMENTALS

POPULATION
The middle class will grow strongly, particularly in Asia, supporting similar levels of economic growth as seen in the last 15 years

TECHNOLOGY
Renewables, batteries and digitization will continue to grow rapidly, and have the potential to significantly disrupt the energy system

MOBILITY
New urban mobility models will be shaped by three main factors: electrification, autonomous cars, and shared mobility services

ENERGY AHEAD

DEMAND
Global energy demand will grow at half the rate of the previous 15-year period as efficiency improves

ENERGY MIX
The global energy mix will continue to be dominated by fossil sources, though its share will be trimmed by the pace of growth in renewables

POWER
Electricity will be the fastest growing form of final energy as demand from all sectors grows globally

RENEWABLES
Wind and solar power generation will occupy the largest share of new electricity generation as lifecycle costs continue to dip

OIL
Oil demand will continue to grow, albeit at a lower rate as fuel efficiency improves and a switch is seen to other energy sources

GAS
Natural gas will be the fastest growing fossil fuel, displacing coal as the second energy source. But its role in power generation might be thwarted by renewables

CHEMICALS
Chemical products demand will rise sharply as the middle class increases, outpacing growth in most energy markets

EMISSIONS
Emissions growth will be curbed thanks to efficiency gains and fast emerging renewables

SPAIN

EFFICIENCY
Spain is on track to comply with its 2020 energy commitments. Efficiency and renewables will be the major drivers for the energy system in the years ahead

OIL DEMAND
Oil products will continue to dominate Spanish energy consumption. Certain fuel uses will peak and begin to see a fall in demand heading to 2030

CAR FLEET
Electric vehicles are not forecast to take off until the end of the 2020s. Spanish drivers will still largely use combustion engines, yet increasingly opting for gasoline and hybrid cars over diesel as we move to 2030.

0

INTRODUCTION

One World, many realities

Describing the world's different realities and energy needs through the eyes of its beholders

REGULATORS

Mature developed countries with a leading regulatory role and technological pioneers.

- USA & Canada
- Europe
- OECD Asia

70%

of global wind and solar generation in 2015

Pilar, 48
Spain, Wine producer

George, 76
USA, Retired engineer

Laura, 7
France, Student

Peter, 54
Ireland, Truck driver

ENERGIZERS

Resource rich countries, mainly net energy exporters.

- Middle East
- Latam
- Africa
- CIS

70%

of total new oil supply between 2015-2030

Javier, 8
Colombia, Student

Nudia, 26
Nigeria, Recepcionist

Hannan, 31
UAE, School teacher

Olga, 24
Russia, Air hostess

CONSUMERS

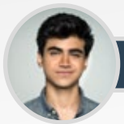
Largest energy demanding countries, mainly net energy importers.

- China
- India
- South East Asia
- Rest of Asia

70%

of total new primary energy demand between 2015-2030

Xiangzi, 53
China, Shop assistant



Kaushik, 20
India, Actor

Dakila, 36
Philippines, IT programmer

May, 14
Thailand, Student

We have divided the world up into three different regions that, although comprised of very different countries, each have a distinct and important role in the global macroeconomic outlook and energy sector. Whenever countries overlap, we group them with the region most in line with their prevailing future role.
"Regulators" comprise all OECD countries —except for Mexico (which is an Energizer)— and are included in this cluster due to their lower expected energy demand growth in the next few years.
These countries are the pioneers in implementing the most stringent regulations and developing new technologies that gradually transform the energy mix. They lead actions to tackle emissions, rise efficiency and implement regulations on transport and mobility.
"Energizers" include Latin America, Africa, the Middle East and former Soviet Republics. All these areas have one feature in common: they are the world's leading exporters of energy resources, chiefly oil and gas. Although economically very diverse, they lag behind Regulators in economic prosperity and tend to have more of a long-term potential.
We have thus dubbed most Asian countries "Consumers", including China and India, due to their impact on future energy consumption, which will far surpass that of other regions. Their high energy demand will be driven by above-average economic growth and a rapid increase in the proportion of middle-class inhabitants with higher purchasing power.

■ Source: Cepsa Analysis

1 Population & economy

POPULATION & ECONOMY

More for all

One planet, many realities.
In 2030, Earth will be home to more people than ever before, 8.4 billion that will have greater lifestyle expectations requiring increased access to energy resources. Meeting such rising needs in a diverse world, with countries at different stages and paces of economic development, will pose many challenges and energy will be the key to meeting them.

"My parents are so conservative. They're still freaking out about my last tattoo and now they complain about my new boyfriend in Ottawa. With the new low cost tickets we can fly almost every weekend to see each other but mum says distance relationships don't work and Dad says they're bad for climate change. I tell him our new pickup is worse, truly a driving chimney! One day I'll do the math to proof him wrong. It's so hard to be Millennial in this family!"

Susan, 19
Student, Canada

"My grandparents in Uttar Pradesh cooked on wooden logs —can you just imagine that? But those were different times altogether, even if they weren't that long ago. My life nowadays is so fast-paced here in Mumbai that if I do any cooking at all, I use a microwave oven. Usually I get around on a motorbike rickshaw to beat the traffic, although the pollution is just horrible. I'd like a car if I could afford it, to show my family and buddies that I've arrived".

Kaushik, 20
Actor, India

"Oil has changed everything for us, and much for the better. My parents can still remember when this city was a fishing village, but now you can see this wonderful, glittering, modern city with skyscrapers like the Etihad Towers and landmarks like the new Louvre Museum. Progress is making this city crowded. More and more I get stuck in traffic on my way to work, and those days when the malls were empty are over. Try a weekend visit to Al Wahda Mall on your next trip to Abu Dhabi and you'll understand what I mean".

Hannan, 31
School teacher, UAE

Despite a slowdown in population growth, the global economy will maintain a healthy evolution

■ Worldwide population will keep growing, but at a slower pace. Lower birth rates worldwide along with higher life expectancies will make for an ageing population.
This in turn will put more and more pressure on the relatively smaller labor force. World GDP will grow relentlessly, with China and India driving global growth. The years ahead to 2030 will consolidate the ongoing eastward economic shift.

Our world will be home to 8.4 billion people in 2030 —1.1 billion more than today— and to satisfy their growing needs they will all require more goods, services, natural resources and, of course, energy.
Declining birth rates, together with increased life expectancy, will make for an ageing global population. By 2030, the over-sixties will account for 16% of the world population and the number of centenarians will more than double, to reach 1 million.
The world's GDP will increase by 50% between now and 2030, growing at a similar rate than the previous 15-year period.
Regulators will still contribute most to world GDP in absolute terms in 2030, and the USA will still be the world's biggest economy (21% of global GDP), but China will be catching up (18%).
Nonetheless, the economic shift toward the East will be consolidated in the years ahead as population giants China and India lead global GDP growth.
China is expected to successfully face the challenge of transforming its economy from manufacturing for export to one based more on services and domestic consumption, which will be driven by a rising middle class.
India will stand out and see the strongest growth in Asia, (6.1% CAGR), as it benefits from having more and more people of working age and swiftly adopting new technologies.
In an increasingly competitive world, Energizers will be able to hold on to their share of global GDP due to their vast energy resources and a competitive labor force. But this cluster of countries will not reach its full economic potential until they implement deeper structural reforms.
Africa, at 3.8% CAGR, will come second only to Asia as the world's fastest growing regional economy, driven by its growing population and labor force. Nonetheless, it will start from too low a level to make much impact on the global picture in 2030.

World population
2000-30 (Billion people)

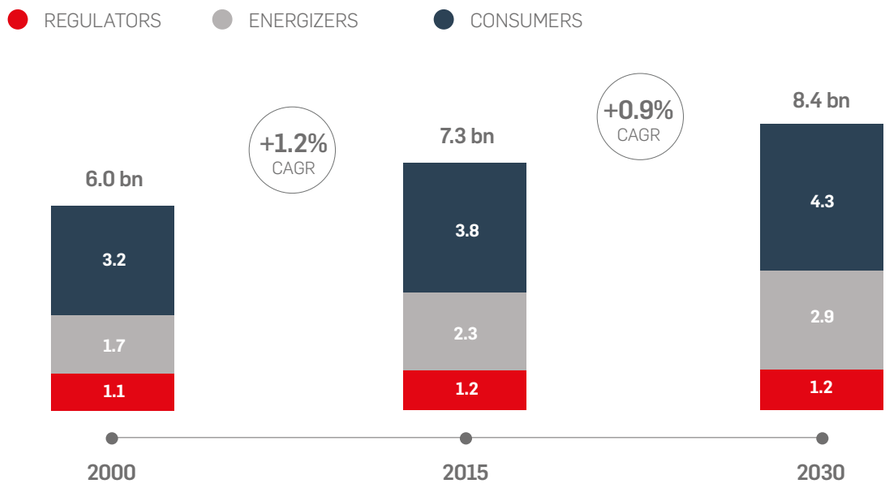


Fig. 1. Global population growth will slow down despite a similar increase in absolute terms.
■ Source: United Nations Statistics Division, Cepsa Analysis

World GDP growth and regional split
2000-30 (Trillion US$)

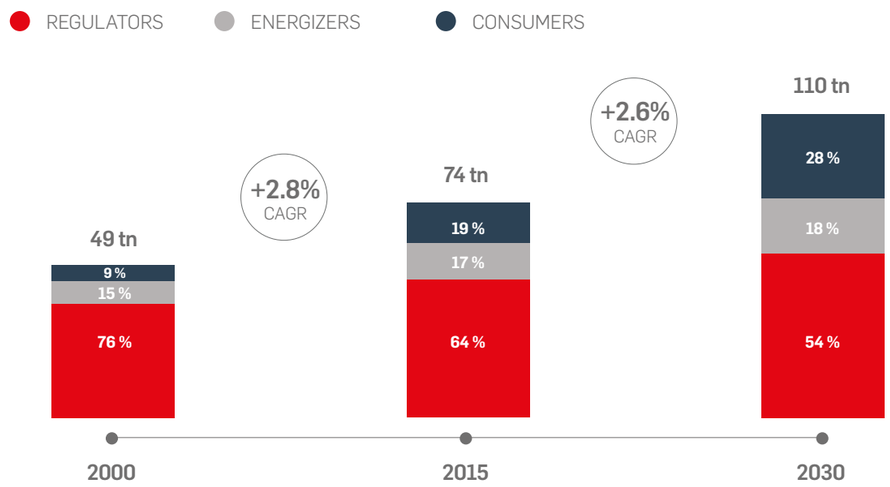


Fig. 2. Economic activity will grow at a similar pace to in the previous 15-year period and will be shifted to Consumers.
■ Source: Wood Mackenzie, World Bank, Cepsa Analysis

As middle class incomes increase and trigger economic development, they will have a knock-on effect on demand

■ A larger portion of the world's population will have access to improved living standards. The rise of a strong middle class majority will be the most relevant socio-economic factor affecting energy consumption in the years ahead. The challenge remains: to supply more people, but with more efficient energy.

Middle-class population changes
2000-30

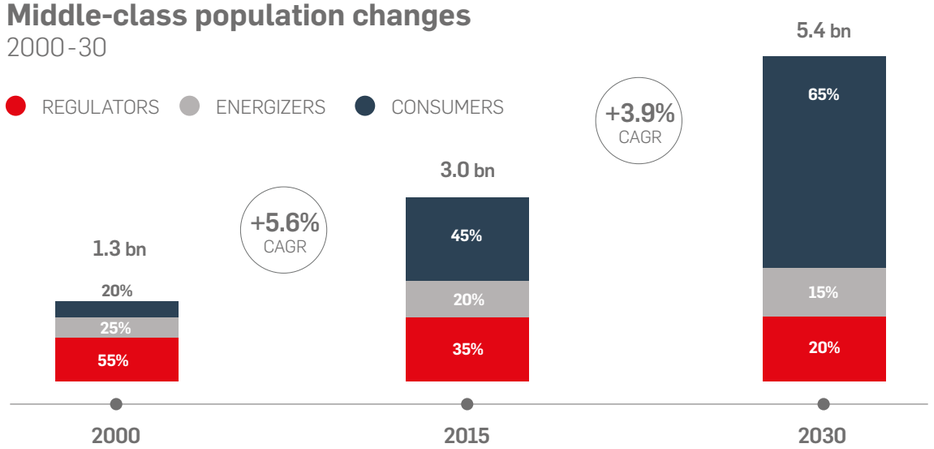


Fig. 3. The rise of the middle class will be particularly important in Consumers.

■ Source: Brookings Institution, Cepsa Analysis

Although the world's population will slow down in the next few years, economic growth rates will hold as the middle class will spread to become the most important socio-economic trend shaping energy demand.
Sustained economic development, globalization and the rapid industrialization of developing countries has led to improved living standards for billions of people in recent decades, so much so that by 2030 more than 60% of the population will be considered middle class. The middle class will boom in Consumer countries, in line with their rising purchasing power, especially in China and India and a marked shift toward Asian markets is already expected to be under way by 2020, and by 2030 they might well account for 65% of global middle class consumption. Countries with higher living standards tend to have higher per capita energy consumption.

Primary Energy Consumption per Capita vs UN Human Development Index in selected countries

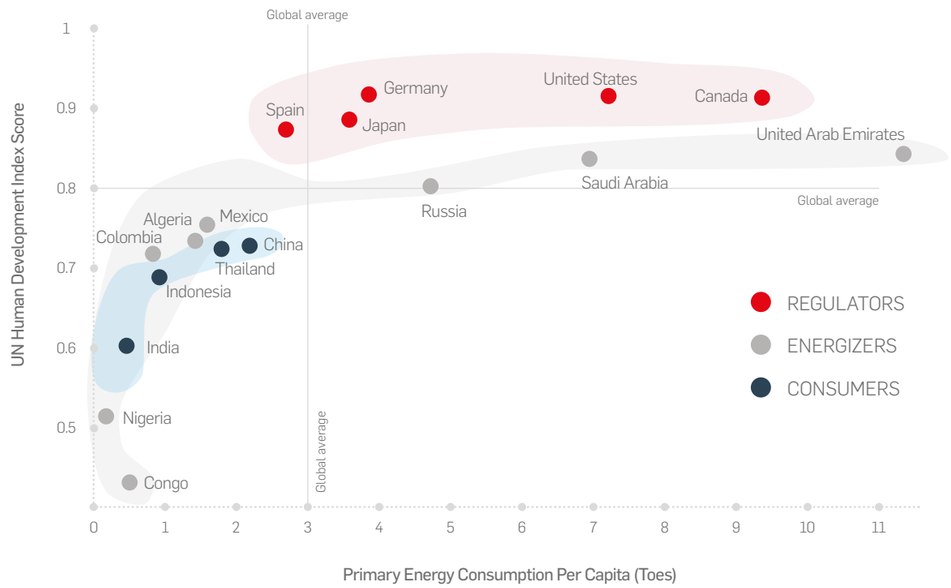


Fig. 4. The challenge will be for all countries to shift their metrics to the upper left-hand corner.

■ Source: IEA, UNDP Human Development Data, Cepsa Analysis

Nevertheless, primary energy demand is also heavily dependent on access to resources, so resource-rich countries such as Saudi Arabia tend to have higher per capita Primary Energy Consumption (PEC).
Therefore we expect different clusters and countries to follow different trends. Regulators, that are already highly developed, will try to cut back on energy needs by enacting regulations to boost efficiency.
Meanwhile Consumers, with the highest level of middle class growth, are expected to see a significant increase in both energy demand and economic development levels.
Energizers are the most spread cluster and the one whose trends diverge most in terms of development or overall energy consumption, so their outcomes will vary the most. On the one hand, outliers that produce oil and gas —such as Russia or the UAE— will cut their demand in the wake of efficiency drives. On the other, African countries in particular will increase their energy consumption considerably over the next few years as they ramp up development.

Big cities will get even bigger and become major energy consumption hubs

■ The share of the world's population living in cities will grow to 63% by 2030, from 59% at present, but far more impressive will be the 20% growth in the number of megacities —i.e. those with populations of 10 million or more— while small urban areas will fall behind.

Cities are leading the way in addressing burgeoning environmental and mobility challenges, using measures that are customized but increasingly coordinated on an international level. All of this will have a great impact on energy consumption.

More and more of us will live in cities, especially in Consumer countries, as people become increasingly middle class. Although Regulators will still have the world's highest urbanization levels in 2030, parts of Africa and Asia will be among the fastest urbanizing regions, and add one billion to the ranks of city dwellers in this time frame.

Cities will grow in number as well as size. There will be 41 megacities with more than 10 million inhabitants each in 2030 —12 more than today— and they will be home to 12% of the world's population. However, the fast growth and greater number of city dwellers will pose major challenges in terms of sustainable energy access and urban mobility, which will heighten concerns about growing pollution levels.

Today, urban areas account for most of global pollutants. Sulfur dioxide (SO_2) and oxides of nitrogen (NO_x) are concentrated in urban areas where traffic is denser, and health concerns are thus becoming acute. In response, regulation in cities is changing faster than in the countryside and setting the pace for broader nationwide changes.

Measures to combat urban pollution can have a large impact on energy demand, especially in the transport sector. On the other hand, technology will pave the way for efficiency measures that will help manage energy demand and make cities more livable.

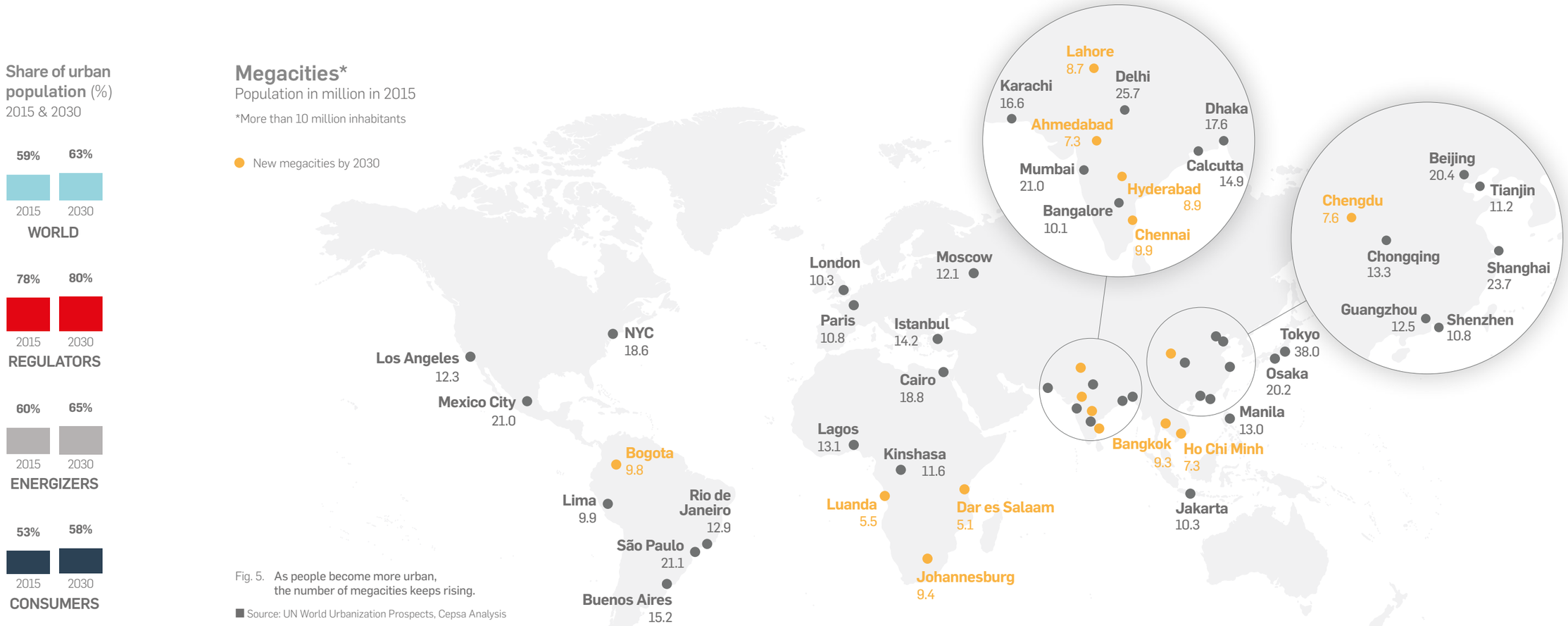


Fig. 5. As people become more urban, the number of megacities keeps rising.

■ Source: UN World Urbanization Prospects, Cepsa Analysis

Access to energy sources will be essential for development in the world's most vulnerable regions

■ Even today, one-fifth of the world's population still has no access to the power grid. The development of new, sustainable and affordable ways to access energy will be vital for developing countries to avoid replicating unsustainable paths taken by developed countries in the past.

Energy access changes in main regions
2015-30

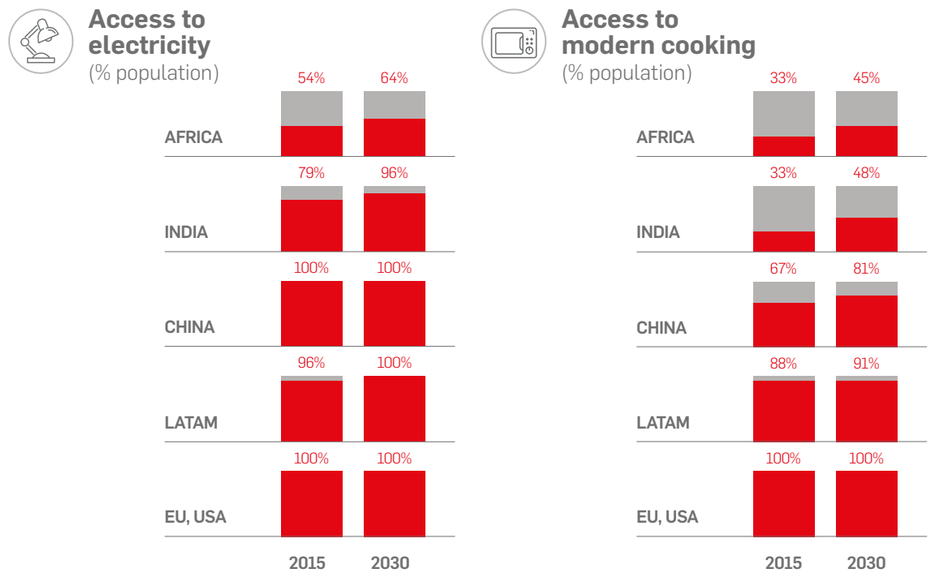


Fig. 6. Many parts of Energizer and Consumer countries do not yet have access to basic needs such as electricity and modern cooking.

■ Source: IEA, Cepsa Analysis

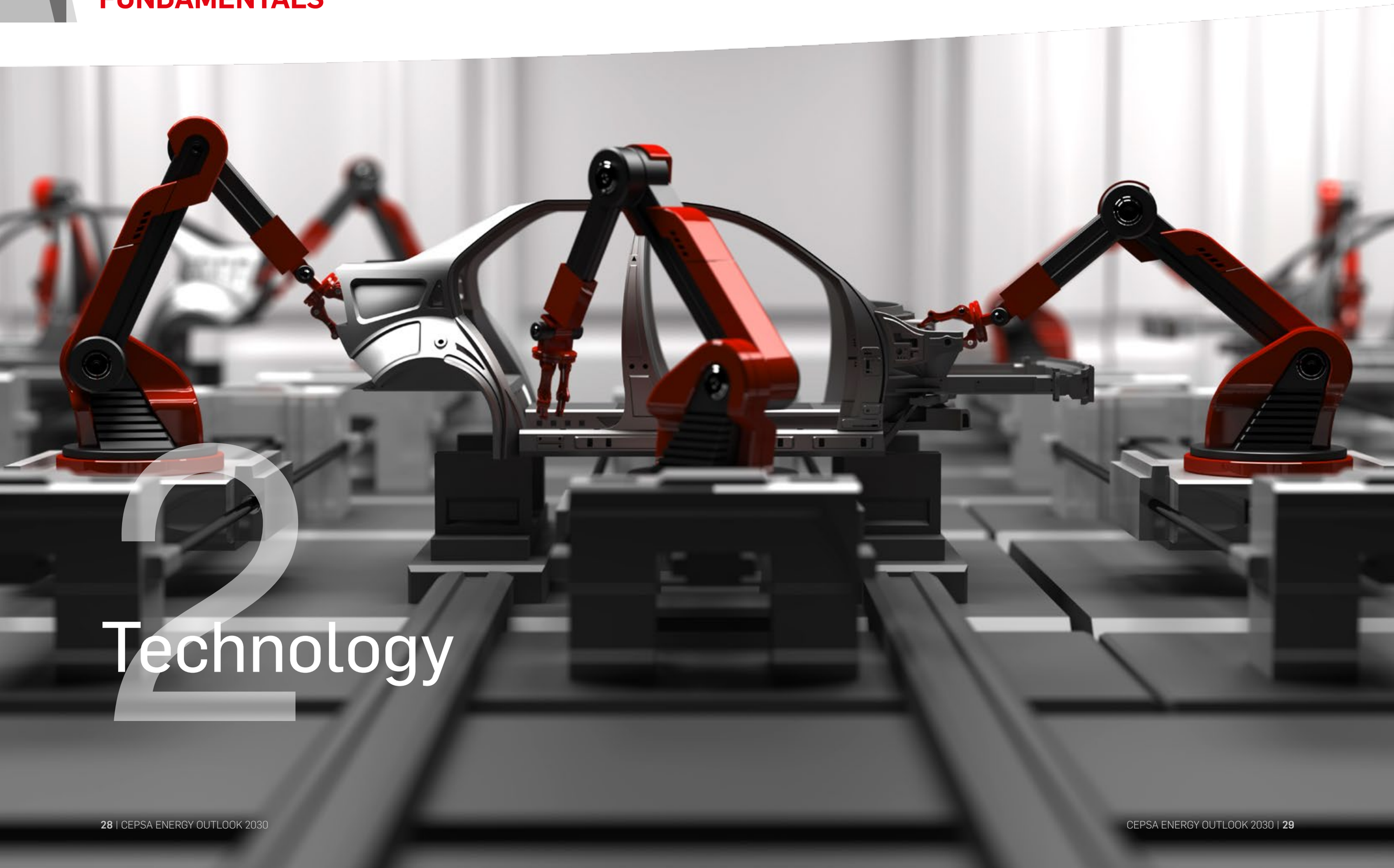
Living standards will improve not only for the middle class, but also the less fortunate. Ensuring access to affordable, reliable, sustainable and modern energy for all before 2030 is one of the UN Sustainable Development Goals (#7), mainly because energy access is closely linked to development.

One stumbling block in accessing energy is that one-fifth of the global population still has no access to the electric power grid, while one in two people still rely on biomass for cooking and heating, and thus they live in poverty. Traditionally, countries have relied on fossil fuels as the best way to access energy at an early stage in their development for its competitiveness, abundance and reliability.

Looking ahead, fossil fuels will still be the choice when no better alternatives are present. However, increasingly cheap new —and low-carbon— technologies could lead to a shift in energy supply toward off-grid models, which will be especially suited to people living in large, sparsely populated areas without access to a national power grid.

In Africa, more than 20 million pico-solar panels (i.e. generating less than 10 W) have been sold, and swift advances have been made in supplying high-efficiency appliances, as well as powering TVs and fans.

Looking ahead, by 2030 some 50 million households in Africa and Asia are likely to be able to afford simple, portable lamps, as well as solar home systems and appliances.



2 Technology

TECHNOLOGY

The game changer

Technology has always set the pace for change by driving profitability. In the next few years, however, it will speed up advances by finding new ways to save energy and boost productivity. This transformation could revolutionize the way business is done, but corporations will have to adapt constantly to keep their competitive edge.

"If you think you're living in the digital age, I can tell you; you aint' seen nothing yet!
I have just bought the newest gadget, an alarm clock connected to Google maps that lets me sleep in, depending on traffic conditions and the estimated time of arrival at my office. On top of that it recommends me the best transport alternative (car sharing, public transport) for every route. Now I can optimize by time or cost. Who needs a car anymore here in Manila!"

Dakila, 36
Philippines, IT programmer

TECHNOLOGY

Mapping

Rapid developments in key enabling technologies will pave the way for profound changes

■ Several emerging technologies are expected to mature in the coming years and transition from the adoption to the take-off stage.

		EXPERIMENTAL	ADOPTION	TAKE-OFF	SUSTAINED GROWTH
ICE* (liters / 100km)	The trend toward noteworthy improvements in efficiency seen over the last 15 years will continue into the next decade, due to encouragement from policy makers.				6.9 4.7 2.7 l/100km (for new cars in EU)
Power storage (Power installed)	Power storage is still far from maturity but it is on the radar screen. In years to come, it will be crucial to allowing renewables to boost their share of the energy mix.	negligible 1 GW	40 GW		
Electric cars (# cars)	EVs is expected to take off by the end of the 2020s, but could be disruptive thereafter when batteries are expected to become cheaper and have more capacity.	negligible	2M	80M cars	
Autonomous cars (# cars)	Autonomous cars must overcome technological and regulatory limitations mostly related to safety concerns to become a reality by 2030.	0 0		>10M cars	
Wind and solar (% global power mix)	Wind and solar power are already showing signs of competing head-to-head with other types of energy, and in the next few years they will thus take up a bigger share of the power mix.		< 1%	5%	17%
Carbon capture (Million tonnes CO_2 captured)	Carbon capture technologies will have limited impact because technical complexities prevent their widespread adoption	negligible	40 Mtpa 60 Mtpa		
Digital (Big data, robotics and Internet of Things)	The digital revolution will also come to the industrial sector, and thus shape not only energy consumers' habits but also those of energy suppliers.		2.0	4.0	X.0
		2000	2015	2030	

*ICE: Internal Combustion Engine

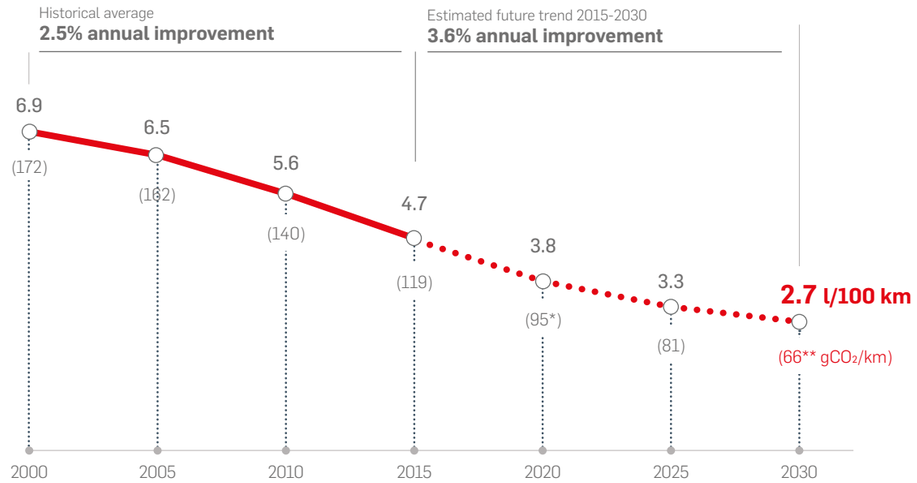
■ Source: Cepsa Analysis, European Comission, IHS Markit, IEA

The ICE will still dominate as efficiency improvements boost performance

■ In 2030, Internal Combustion Engines (ICE) will increasingly compete with electric vehicles and other mobility options while complying with regulatory emission targets. The latter apply to newly sold cars, that will largely contribute to the efficiency improvement.

New passenger cars* average fuel consumption in Europe

(l/100 km and (gCO_2/km))



* 2021 EU CO_2 emissions target phased in from 2020.
** 2025 and 2030 targets proposed by EU Commission as of 8.11.2017

Fig. 7. Internal combustion engines pushed by stricter regulatory standards have made notable progress and will further reduce consumption.

■ Source: European Commission, International Council of Clean Transportation, Cepsa Analysis

The energy sector is strongly linked to the transport sector, which is also going through a period of deep transformation.
Worsening air pollution in cities, increasing awareness of the impact of climate change and the international commitment to try to curb CO_2 emissions have driven the surge in Alternative Fuel Vehcicles (AFVs), policy support and stricter regulation on ICEs emissions.
Thus traditional ICEs face a double challenge: to stay competitive with AFVs while complying with stricter regulatory emissions targets.

Internal Combustion Engine (ICE) efficiency improvements in key markets

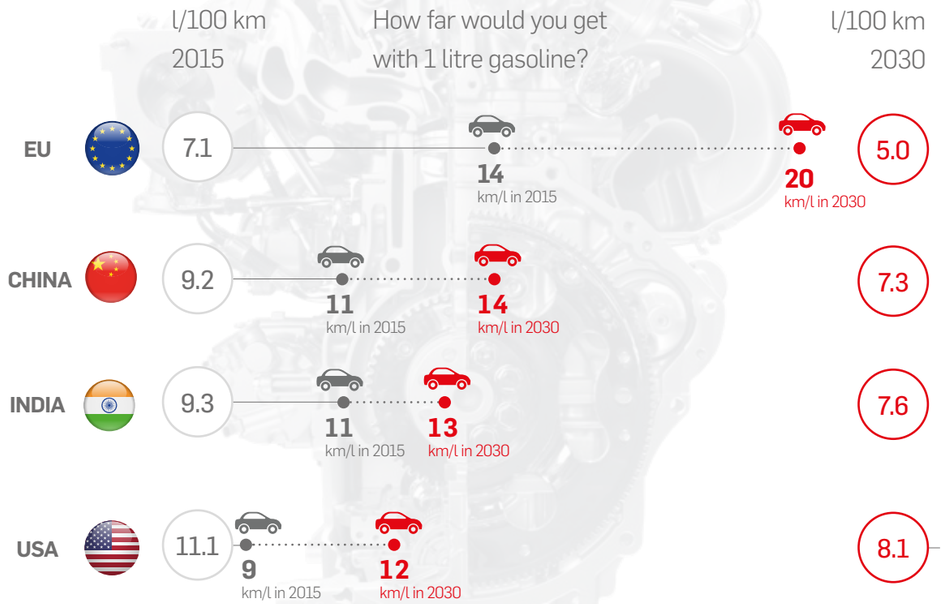


Fig. 8. Europe sets the standard for the most stringent consumption limitations.

■ Source: IHS Markit, Cepsa Analysis

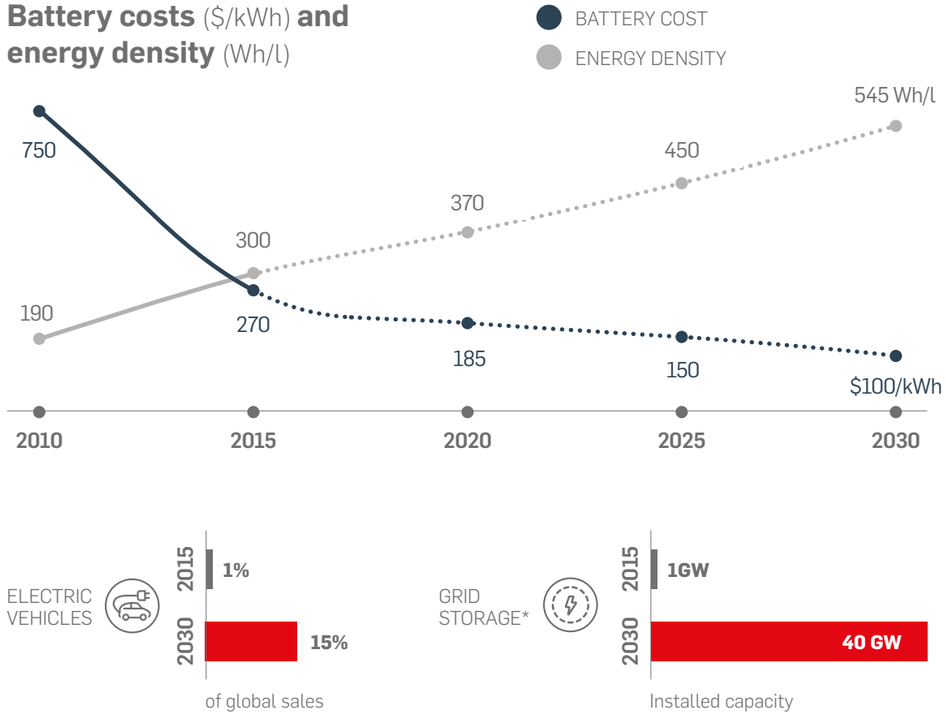
The EU will continue to lead the race in fuel efficiency standards and serve as a benchmark for others. As a result, regulations will become gradually more stringent worldwide, with other regions following the EU's lead in 2030.
Due to technological advances, ICE efficiency will have six times the impact on reducing oil consumption than the penetration of AFVs. ICEs have relentessly improved their efficiency at a rate of 3% per annum over the past 15 years. This trend has been recently accelerated as emissions regulation has become stricter. In China, India, Europe and the USA, the four selected markets representing over 80% of the global light duty vehicle fleet of 2030, new cars will continue improving their eficiency in the same line. Accordingly, the global passenger cars fleet in 2030 will be 25-30% more efficient than it is today.

Li-ion batteries cost reduction will accelerate the competitiveness of EVs and penetrate into the grid system

■ Energy storage will be one of the main disruptive technologies in energy markets in the next few years. Whereas electric vehicles today make up about 1% of global sales, they will account for 15% in 2030 due to cheaper Li-ion batteries. Grid storage will meanwhile gradually become more important and boost growth in intermittent renewable energy sources like wind and solar.

An astonishing cost reduction of 70% between 2010 and 2015, and the ability to ramp-up manufacturing capacity, make Li-ion batteries the technology of choice for energy storage. Within the 2030 horizon, the vast majority of newly installed storage capacity will be based on such technology. In 2015, 95% of newly installed storage capacity was Li-ion based. Reducing battery cost is the main enabler for spreading the full deployment of technologies such as electric vehicles and grid storage. Today's cost, estimated at $270/kwh, is still far from matching conventional costs, however. For electric vehicles, a $100-150 kWh cost range would be required for EVs to match the cost of combustion engine cars, while a greater cost reduction —down to $70/kWh— would be needed for grid storage to match the cost of power generation. As a result, grid storage will see less of an uptake than electric vehicles by 2030. Once deployed, energy storage will be crucial for renewable intermittent power sources like wind and solar, to grow exponentially and have more of a commanding share in the future global power mix. Battery cost reduction, coupled with increasingly affordable solar panels will also spur so-called "behind-the-meter" systems, i.e. energy storage installed on the customer's property and on his/her side of the power meter. Regulation will play an important role in enabling the adoption of behind-the-meter storage, as in some countries costly fees to remain connected to the grid may discourage such initiatives. In the longer run, new battery chemistry types might take over Li-ion batteries and enhance further penetration of energy storage technology. A number of them, e.g. solid state, aluminum-ion, lithium-sulfur and metal-air batteries, are currently at the experimental stage and have great potential for improving storage performance, in such terms as durability and energy density.

Battery costs ($/kWh) **and energy density** (Wh/l)



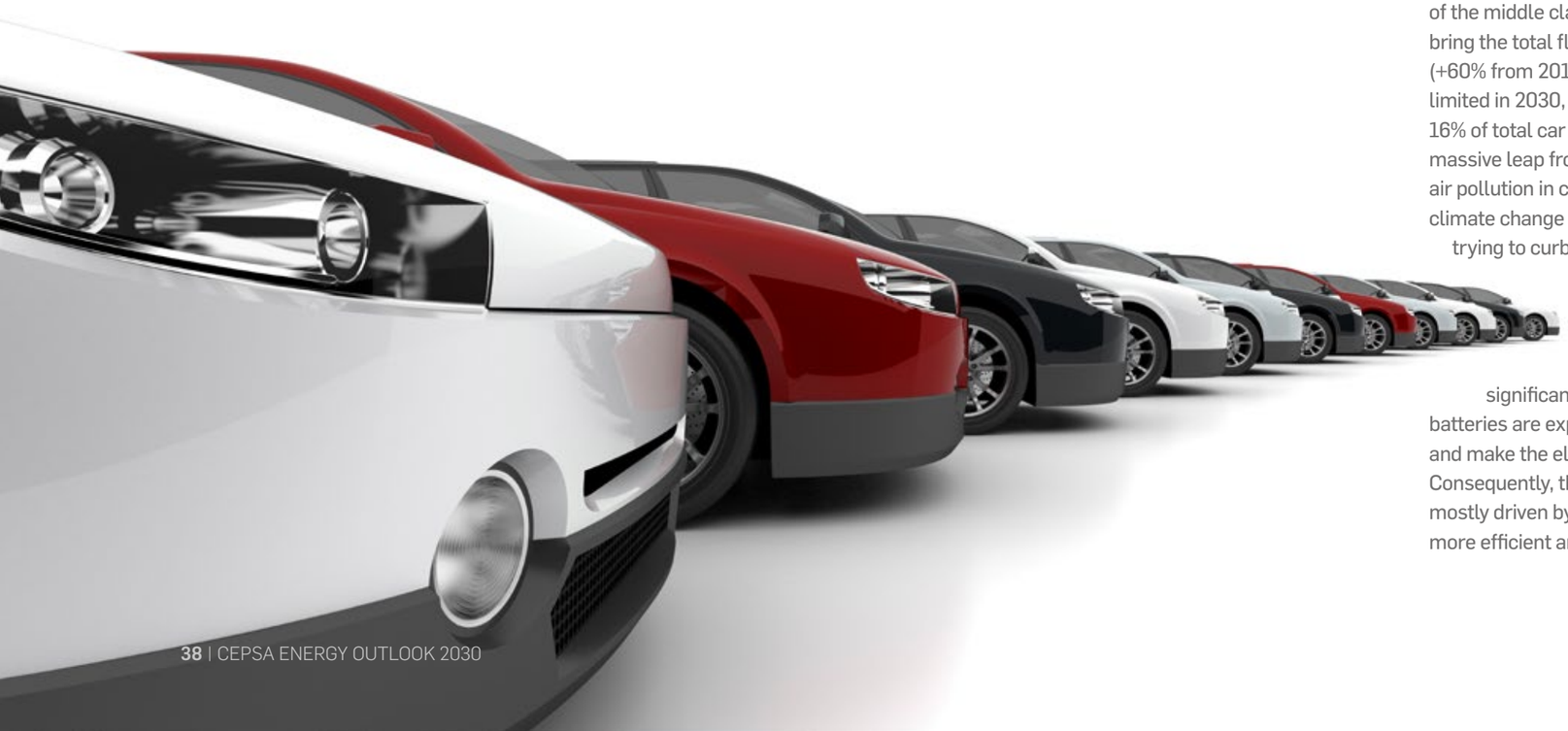
*Only batteries energy storage, pumped hydro not considered

Fig. 9. Advances in batteries development will enable several technologies to reach commercial status.

■ Source: International Energy Agency, Cepsa Analysis

Although electric vehicles will gain ground, the 2030 passenger car fleet will still be overwhelmingly fossil fueled

■ Light duty vehicle sales will rise by 24% globally by 2030. China will meanwhile overtake the USA as home to the world's biggest passenger car fleet. EV penetration will gather pace in the 2020s as this technology reaches breakeven with that of ICEs.



Global car sales by type and the 2030 fleet
2015-20-30

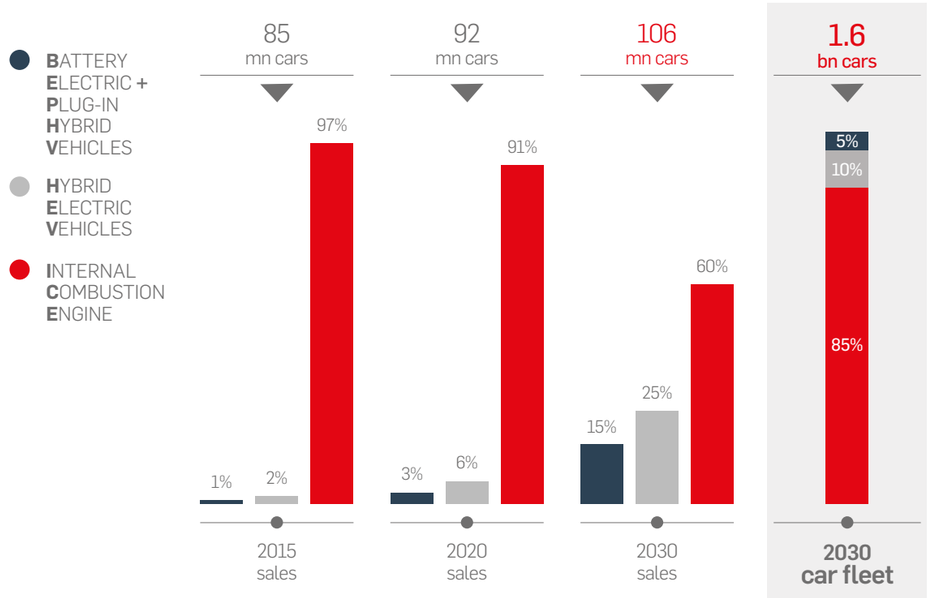


Fig. 10. Despite a strong uptake in electric vehicles, the global car fleet of 2030 will still be dominated by ICEs.

■ Source: Cepsa Analysis

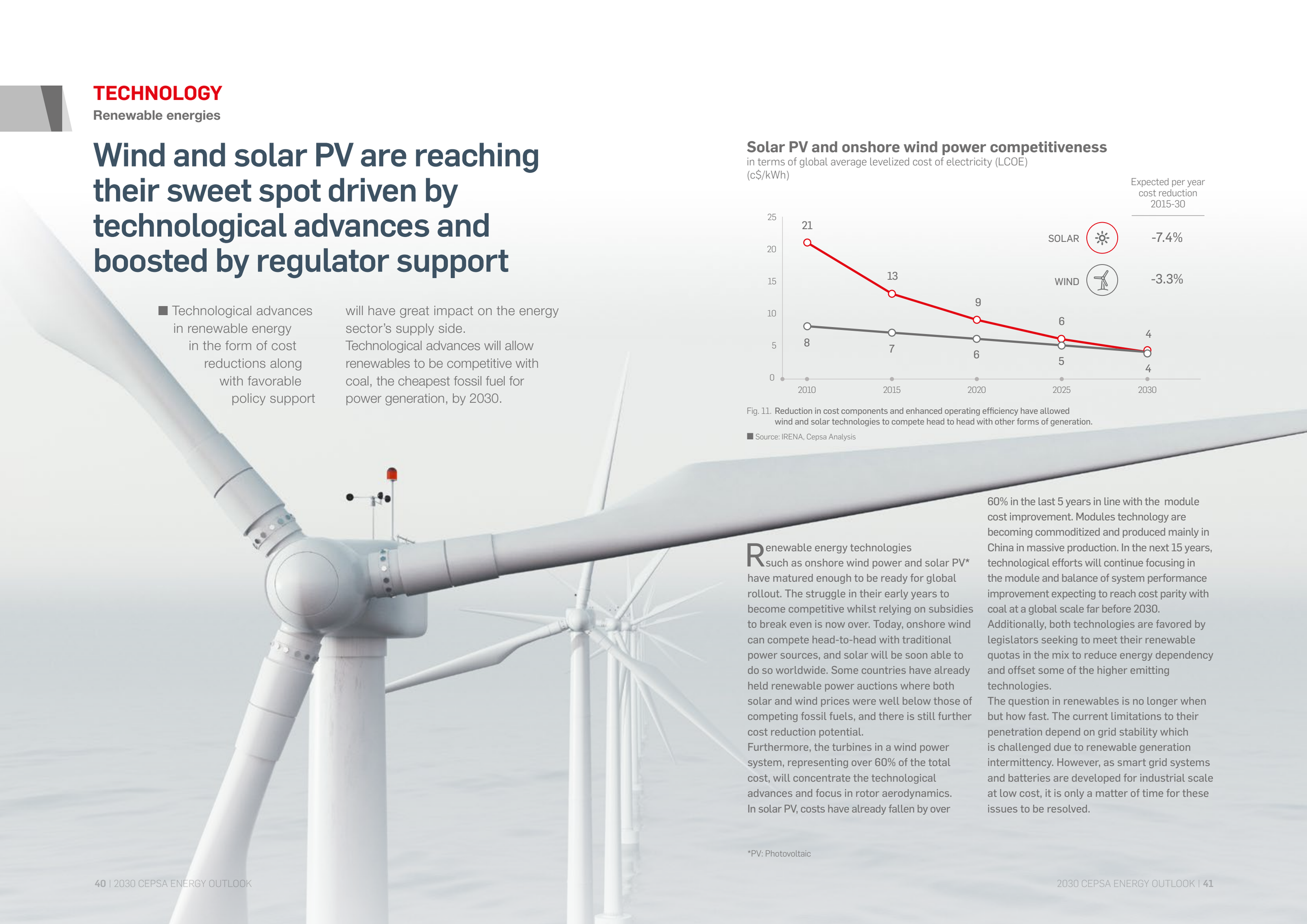
As more people around the world enter the ranks of the middle class, many will buy new cars and bring the total fleet to almost 1.6 billion by 2030 (+60% from 2015). EV penetration will still be limited in 2030, however, and account for just 16% of total car sales, although that will be a massive leap from less than 1% today. Worsening air pollution in cities, increased awareness of climate change and international commitments trying to curb CO_2 emissions will drive growth in EVs, as will policy support and stricter regulations for ICE emissions. EVs will nonetheless have the potential to be a significant disruptor after 2030, when batteries are expected to become much cheaper and make the electric option more attractive. Consequently, the 2030 car fleet will still be mostly driven by fossil fuels, but it will be notably more efficient and pollute less than that of 2015, and make way for EVs thereafter. But electric vehicles, although the most prominent, are not the only alternative to traditional ICEs.

Other alternative fuel vehicles

Alternative vehicle fuels also include Natural Gas (NGV), Autogas and Fuel Cell vehicles (FCV). NGVs run on compressed or liquefied natural gas. A shorter driving range and cumbersome modifications to the car make them often less atratctive. Autogas refers to ICEs fueled by liquefied petroleum gas, which have not been used widely due to limited refueling infrastructure and public support, and because they also require engine modifications. FCVs use a fuel cell to convert hydrogen into electricity, to drive an electric motor. This technology is under rapid development but entails some drawbacks, such as a hefty capital investment in infrastructure.

Wind and solar PV are reaching their sweet spot driven by technological advances and boosted by regulator support

■ Technological advances in renewable energy in the form of cost reductions along with favorable policy support will have great impact on the energy sector's supply side. Technological advances will allow renewables to be competitive with coal, the cheapest fossil fuel for power generation, by 2030.



Solar PV and onshore wind power competitiveness

in terms of global average levelized cost of electricity (LCOE) (c$/kWh)

Fig. 11. Reduction in cost components and enhanced operating efficiency have allowed wind and solar technologies to compete head to head with other forms of generation.

■ Source: IRENA, Cepsa Analysis

Renewable energy technologies such as onshore wind power and solar PV* have matured enough to be ready for global rollout. The struggle in their early years to become competitive whilst relying on subsidies to break even is now over. Today, onshore wind can compete head-to-head with traditional power sources, and solar will be soon able to do so worldwide. Some countries have already held renewable power auctions where both solar and wind prices were well below those of competing fossil fuels, and there is still further cost reduction potential.

Furthermore, the turbines in a wind power system, representing over 60% of the total cost, will concentrate the technological advances and focus in rotor aerodynamics. In solar PV, costs have already fallen by over 60% in the last 5 years in line with the module cost improvement. Modules technology are becoming commoditized and produced mainly in China in massive production. In the next 15 years, technological efforts will continue focusing in the module and balance of system performance improvement expecting to reach cost parity with coal at a global scale far before 2030.

Additionally, both technologies are favored by legislators seeking to meet their renewable quotas in the mix to reduce energy dependency and offset some of the higher emitting technologies.

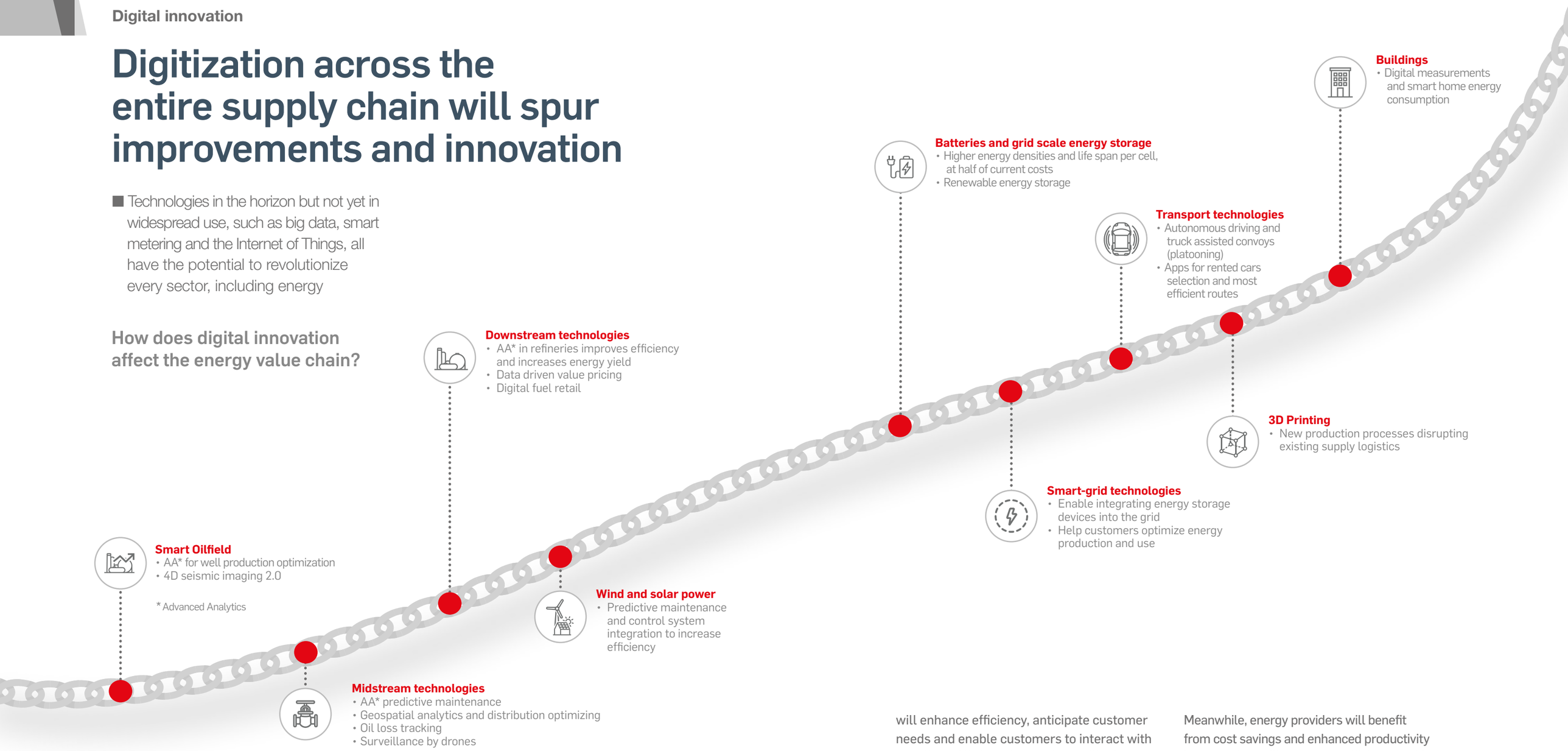
The question in renewables is no longer when but how fast. The current limitations to their penetration depend on grid stability which is challenged due to renewable generation intermittency. However, as smart grid systems and batteries are developed for industrial scale at low cost, it is only a matter of time for these issues to be resolved.

*PV: Photovoltaic

Digitization across the entire supply chain will spur improvements and innovation

■ Technologies in the horizon but not yet in widespread use, such as big data, smart metering and the Internet of Things, all have the potential to revolutionize every sector, including energy

How does digital innovation affect the energy value chain?



Technological advances in the digital field such as big data, automation or the Internet of Things (IoT) have the potential to revolutionize the energy sector and our everyday lives.

■ Source: Cepsa Analysis

Although still in its infancy today, the IoT will connect devices, vehicles and buildings, among other things, that are equipped with electronics, sensors and internet connections, in order to bundle and exchange data. This will enhance efficiency, anticipate customer needs and enable customers to interact with suppliers. All these innovations will allow users to consume energy smartly. Smart grids will allow network managers to optimize energy use and thus have flexibitlity on power generation, storage and transmission. Apps may also allow users to interact directly with energy providers.

Meanwhile, energy providers will benefit from cost savings and enhanced productivity because they will have more efficient machines and predictive maintenance available, due to advanced analytics. Furthermore, automated repairs and drone surveillance —which is already being used for electricity pylons— will allow more frequent access to remote spots, thus reducing manpower costs and safety issues.

3 Mobility

MOBILITY

A smart move

Mobility challenges will arise along with the sheer size of cities, but new solutions will also emerge to avoid congestion and improve air quality by moving away from private car ownership and toward cooperation, sharing and increasing electrification, which in turn will affect energy supply.

"There's no way I would go back home to living in the north of country, it takes me three days just to get there. Rio is much cooler and life is great here, although the city has its own transport problems. Some days the air quality can be so bad with so much traffic, and it means it can take up to two hours just to get to the south of the city. I think to improve things we'll have to car share more, there's just too many cars on the roads, and improve public transport".

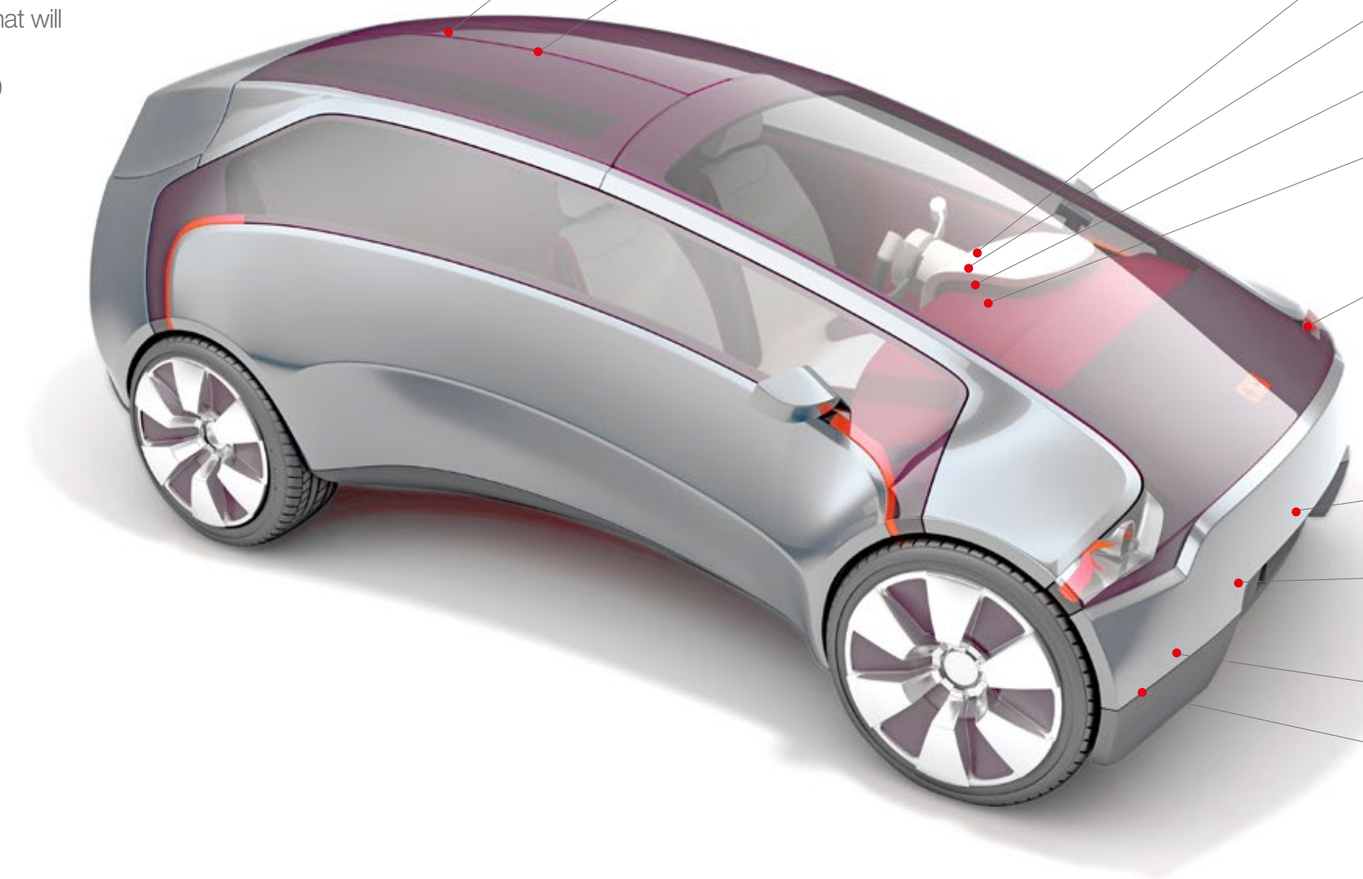
Manoel, 28
Brazil, Geologist

MOBILITY

Automotive sector - The car of 2030

A new mobility system will emerge led by a number of enabling technologies maturing

There are a large number of technologies that will contribute decisively to develop a future electric, connected and shared mobility system. The majority of these technologies already exist but need further development that will be within reach within the 2030 timeframe.



SHARED MOBILITY

- Internet of things: the spread of internet usage, smartphones and the digital technologies spurs the use of shared mobility services
- App based platforms: allows users to cherry-pick the vehicle that best suits needs at an specific moment

AUTONOMOUS AND CONNECTED MOBILITY

- Image recognition: detects indicators such as traffic and brake lights or turn signals
- Data processing: drives the car using all the data generated by the sensors instantaneously
- Man machine interface control: coordinates voice command and gesture control
- 5G telecommunications network: enables vehicle-to-vehicle and vehicle-to-infrastructure communication
- Light detection and ranging technology (LIDAR): builds 3D images of the car's surroundings, working day and night

ELECTRIC MOBILITY

- Li-ion battery: extends range up to 1,000 km while lowering costs to less than $100/kwh
- Battery chemistry (solid state, Li-Sulfur, Li-Oxygen): improves performance through higher energy densities, cyclability and reduced costs
- Inductive charging: uses wireless charging by means of magnetic fields
- New light-weighting materials: reduces car weight using advanced steel alloys, aluminum and composite materials

Source: Cepsa Analysis

Electrification, shared mobility and autonomous driving will shape mobility systems

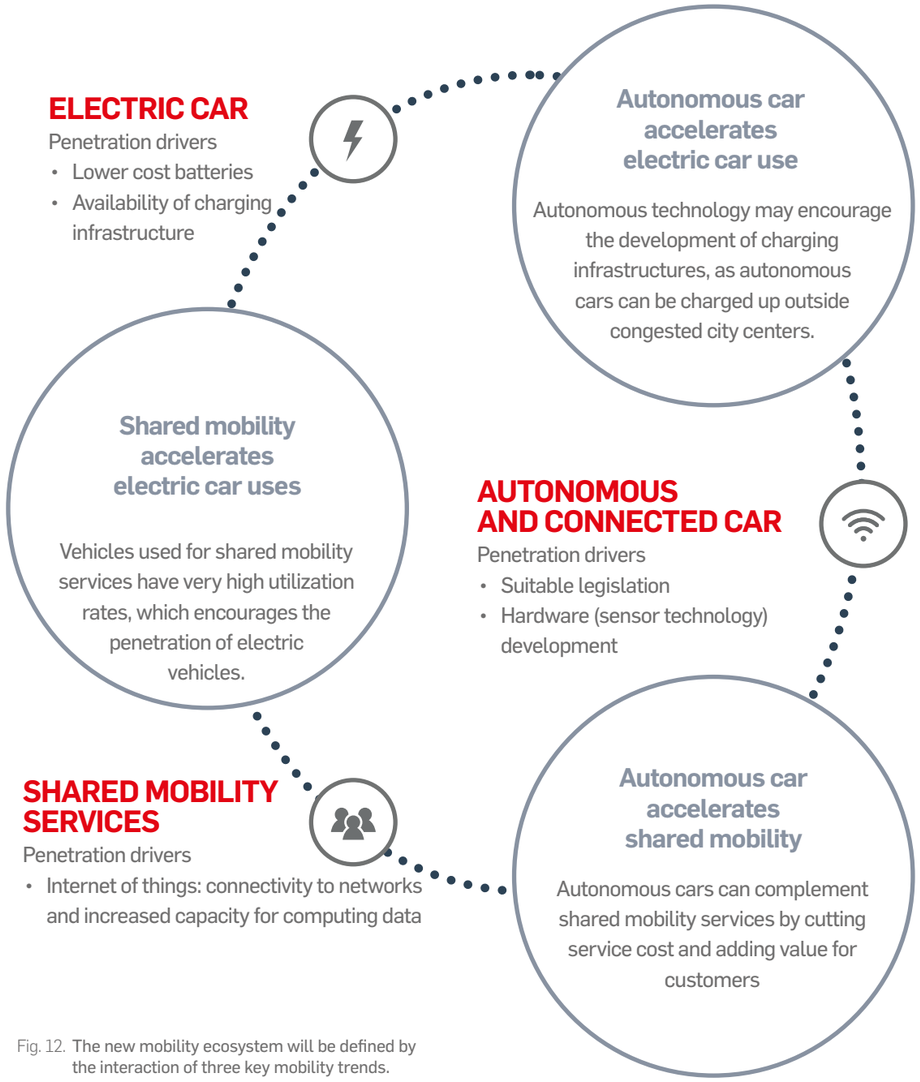


Fig. 12. The new mobility ecosystem will be defined by the interaction of three key mobility trends.

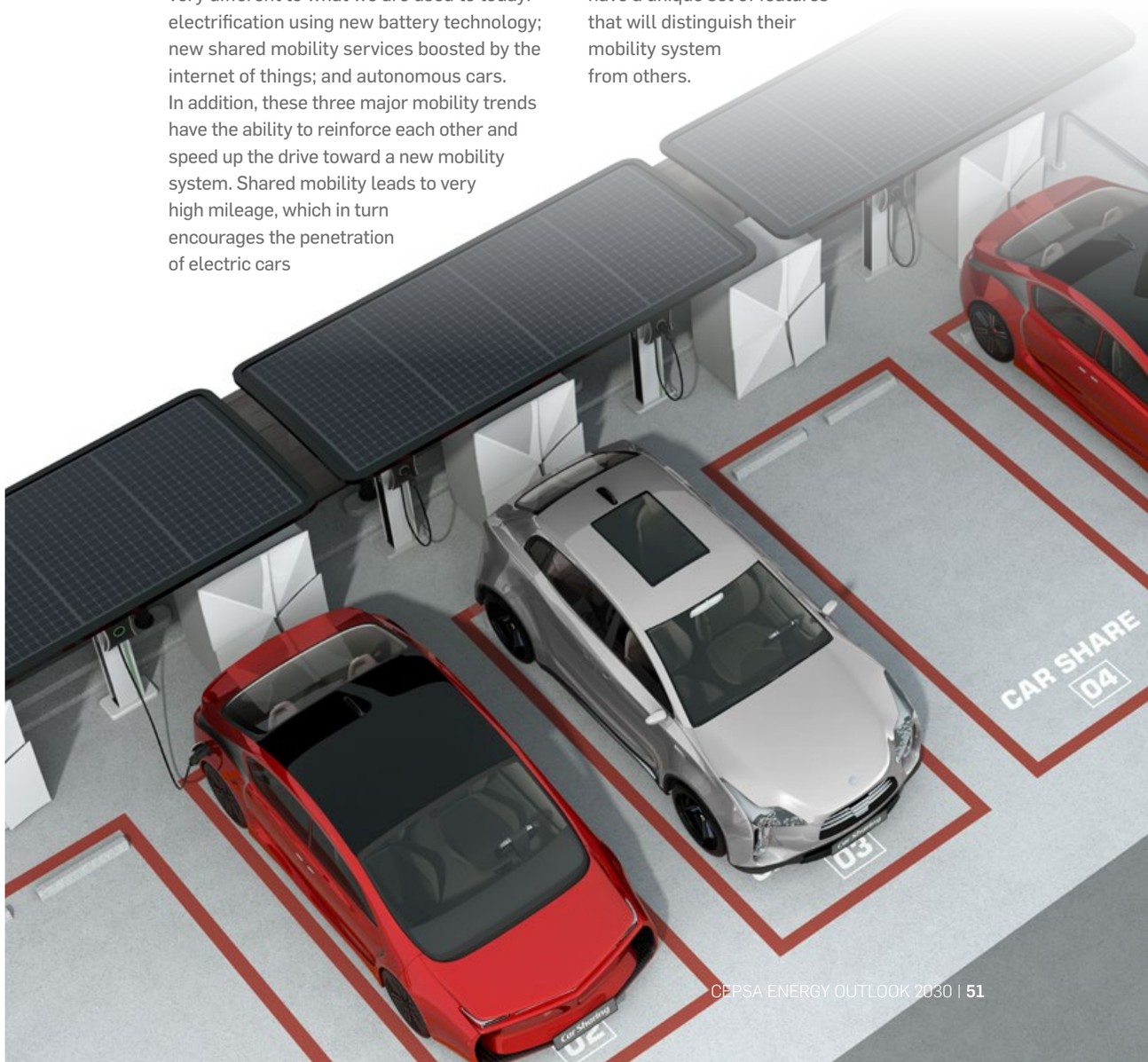
■ Source: Cepsa Analysis

Reducing congestion, improving air quality and livability will drive efforts to implements new urban mobility systems. Large urban areas will be at the forefront of this development and act as accelerators for this transition.

Urban mobility will probably be reshaped more in the years to come than at any time in the recent past. Technology is progressing very quickly in three particular fields that herald a near future where urban mobility may look very different to what we are used to today: electrification using new battery technology; new shared mobility services boosted by the internet of things; and autonomous cars.

In addition, these three major mobility trends have the ability to reinforce each other and speed up the drive toward a new mobility system. Shared mobility leads to very high mileage, which in turn encourages the penetration of electric cars because they will be more economical than ICEs when driven further. And in a similar way autonomous driving can spur the penetration of shared mobility services and the electric car. The extent to which these trends will develop and bring about a new mobility system will depend on how quickly technology progresses, and also -- crucially -- on how much consumers take to these new trends.

Each city will probably adopt its own approach to mobility, as they all have a unique set of features that will distinguish their mobility system from others.



Different mobility models will arise depending on how technologies trends are adopted

Today all three mobility trends are still in the infancy. Shared mobility has taken the lead and seen a strong uptake in recent years, as services like ride hailing, or car sharing have emerged. By contrast, electric vehicles only account for 1% of global car sales, and autonomous cars are still far from market deployment despite rapid progress.

MOBILITY MODELS	ELECTRIC CAR	SHARED MOBILITY	AUTONOMOUS CAR	SYSTEM DESCRIPTION
1 Traditional mobility	Low	Low	Low	Mobility barely moves on from where it is today, as several pitfalls hamper deployment of all new systems. Infrastructure bottlenecks, weak regulatory backing and stagnant technology all delay and even limit the penetration of electric and autonomous vehicles. Only minor advances in shared mobility can be achieved although not significant enough to have an impact. As a result, congestion rises in cities as car fleets gets bigger.
2 Shifting mobility	Medium	Medium	Low	Shared mobility is partially embraced, although technological and infrastructure barriers remain, thus hindering penetration of electric and autonomous cars. In this transitional model, car ownership falls in cities and leads to significantly fewer cars in city centers.
3 On-demand mobility	High	High	High	Door-to-door, tailor-made, fully flexible mobility services are rolled out in this model. Battery technology has matured to make electric cars fully competitive, while regulatory efforts to enable the gradual implementation of all driving automation levels. The autonomous car is the key enabler of this model as it triggers shared mobility services at large scale.

Degree of penetration: Low Medium High

Fig. 13. Interaction between mobility trends will determine new mobility models.

Source: Cepsa Analysis

MOBILITY

City types

The development path of mobility systems depends on the particular circumstances of each urban area

Legacy cities

High income, high density

33%

share of global urban population

Examples: **London, New York, Madrid, Tokyo**

Group of urban areas offering the best environment to develop an on-demand mobility system. Shared mobility services will see a strong uptake, going hand in hand with progress in the internet of things (IoT) while setting up a mobility model that will encourage the roll-out of electrification and autonomous cars. Strong regulatory support is foreseen in these cities.

Open cities

High income, low density

12%

share of global urban population

Examples: **Los Angeles, Melbourne, Abu Dhabi, Johannesburg**

Group of urban areas where larger distances traveled and lower population density make private car use more appealing. While electric and autonomous cars experience similar development than in Legacy cities, shared mobility services see less penetration. On-demand mobility system will not come about easily as car ownership prevails.

Entropic cities

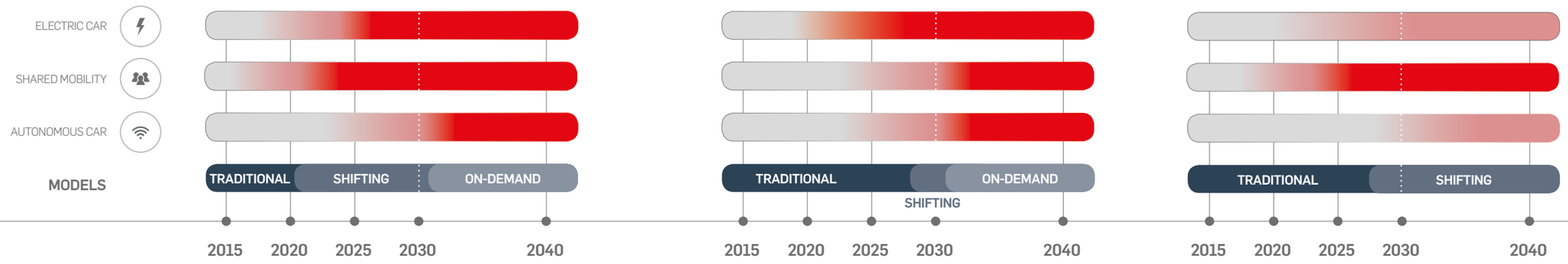
Low income, high density

55%

share of global urban population

Examples: **New Delhi, Jakarta, Bogotá, Rio de Janeiro**

Group of urban areas distinguished by infrastructure barriers to initial penetration of new mobility trends. Shared mobility services will be widely accepted and spread very quickly as high congestion levels make private car use less appealing. Electric and autonomous cars will struggle to gain ground until the deployment of these technologies becomes more economically accesible.



Source: Cepsa Analysis

4 GLOBAL ENERGY

GLOBAL ENERGY

Doing more with less

An ever-increasing population with growing and diverse economic aspirations will drive energy demand, and to sustain it, supply will have to be cleaner and consumption more efficient.
Demand for energy will keep rising over the next few years, and while improvements in efficiency will slow down the rise, this will pose multiple challenges: to supply more energy, to make it more sustainable, and to consume it smartly.

"My mum is always nagging me to turn the lights off. She said we have to save electricity! But you wont believe! We just moved into a new house where lights turn off automatically when you exit the room! Our fancy new windows keep the house temperature stable and we can control all the electronic devices from a phone app! It's just amazing!"

Laura, 7
France, Student

A new period driven by accelerated efficiency will reduce the growth rate in energy demand

■ Energy demand will grow in 2015-30 at half the rate it did in the previous 15 years, due to an unprecedented drop in global energy intensity. But as it will start at the highest level ever, growth in energy demand will be substantial (20%) and the second-largest absolute increase ever seen in any 15-year period. In keeping with recent trends, developing regions such as Consumers and Energizers will be the sole contributors to this rise in energy demand.

Global energy demand will continue to rise in the next few years in line with population growth, as it has done in recent years. Additional demand will come from the millions of people in Consumer countries that will adopt middle-class lifestyles hitherto mostly confined to Regulators. By looking at the recent past we can distinguish two clearly marked phases, with a turning point around 2000. Before 2000, rising energy demand was driven by OECD countries, which then accounted for 60% of global energy demand. Over the following 15 years, however, Chinese energy demand tripled as its economy underwent unprecedentedly swift industrialization. Other developing Asian countries followed suit in 2000-15, albeit at different speeds and scales, so Consumer countries dominated energy demand in that period.
The forthcoming period will differ from its forerunners because efficiency will play a leading role, while energy intensity will see its sharpest drop ever (20%). This change will be driven first and foremost by a strong regulatory drive in the form of ever stricter efficiency standards that affect all energy uses e.g. fuel economy in passenger vehicles or building codes.
The power mix will also be much more efficient due to renewables penetration, and natural gas-fired plants replacing less efficient coal- and oil-burning generators.
Finally, heavy industry will have less impact on demand as developing economies mature and their growth relies more on services, which are between five and seven times less energy-intense. All in all, although at global scale energy demand will increase, Regulator countries might have reached their peak demand. Such economies are heavily geared toward services and their economic growth has been decoupled from substantial increases in energy demand. The government-driven trend toward greater efficiency in Regulator countries sets them apart from the rest of the world; indeed several of them have some of the lowest energy intensities in the world.

World total primary energy demand
(Mtoe)

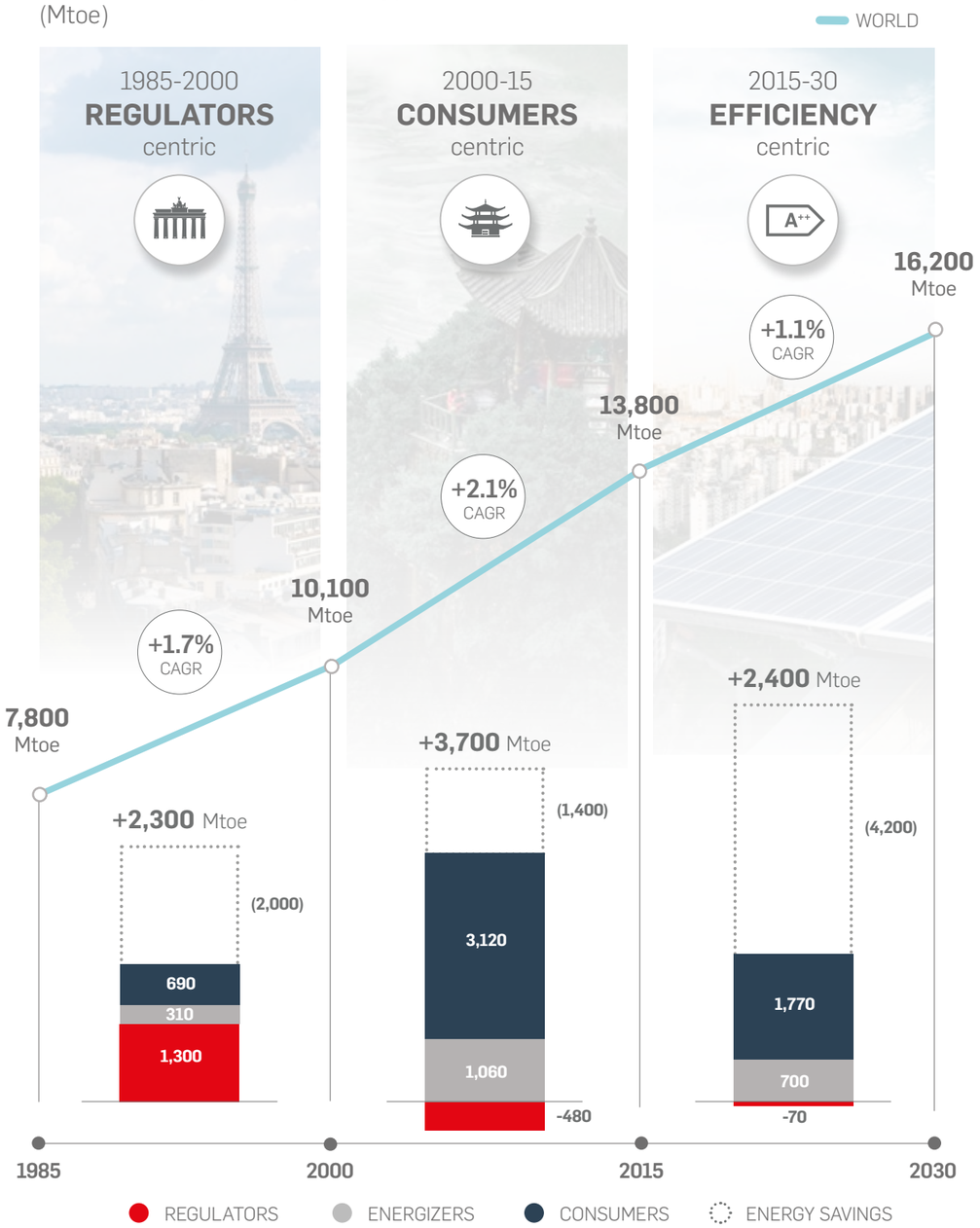
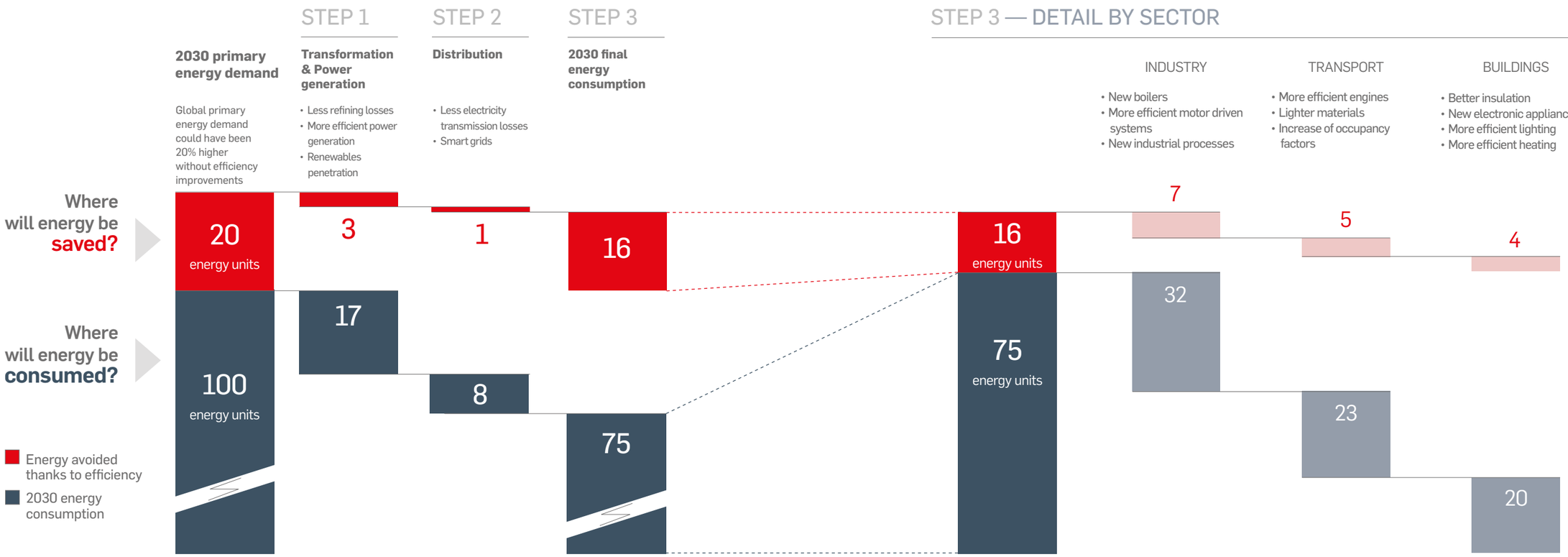


Fig. 14. Slowdown in primary energy demand growth as energy intensity keeps falling due to efficiency gains.

■ Source: Cepsa Analysis

Efficiency saves more than 20% of energy demand and is mostly achieved on the consumer end

■ Energy savings will be enormous over the next 15 years and will impact all parts of the energy value chain. Energy extractive, transformation and distribution industries play an important part. However, the largest energy saving potential occurs at the final user end.



Manoel, 28
BRAZIL
Geologist

"As an oil & gas person, if you ask me for the most relevant issue to consider in my daily job, I will definitely say efficiency. Our top management is pushing the company to become a top quartile operator by reducing costs in electricity, water and fuel costs in our operations."

George, 76
USA
Retired Engineer

"I was one of the engineers at the gas-to-power project in remote areas of Pennsylvania State. It was 3 years of hard work, but in the end the old coal power station was replaced by a cleaner and more efficient gas fired plant"

Laura, 7
FRANCE
Student

"Grandpa is a danger at the wheel! Last Saturday, on my way to ballet class, we had to stop to refuel and he almost crashed! Besides, his car is so old... I told him that one day we should buy an autonomous car that way we could all move around safer, have more time to talk, and even save some money on fuel".

Peter, 54
IRELAND
Truck driver

"In the old days it would take me a good day and two full tanks of fuel to get from Manchester to Glasgow. Today, I could get there almost straight away if I wanted, but I still like to stop at Mandy's Inn, I love their roast beef."

Fig. 15. Efficiency gains across all sectors contribute to a reduced energy demand.

■ Source: Cepsa Analysis

GLOBAL ENERGY

Regional primary energy demand

China will experience the largest energy demand growth while India will be the world's fastest growing country

■ Rising energy demand will be focused on Consumers, like population and the economy, due to their sheer size and economic growth.
Demand in Energizers will grow significantly in some cases (Africa), but they lack the scale of Consumers so their impact will be less noteworthy.
The trend in Regulators will be meanwhile toward greater efficiency and limited activity, thus their demand will level out.

Consumers and Energizers are not following the same path that developed countries did in the past, and this is one of the most important factors in forecasting how energy markets will behave in the near future. On the one hand, they are growing at an unprecedented rate, while on the other, they are less energy intensive because they can benefit from more efficient technology and greener energy sources that were not available in the past.

China is a good example, because its energy demand is quickly slowing down as the country moves to a services-led economy, and although it will account for most of the demand growth in absolute terms, the increase will be half that chalked up in the previous 15 years. India will go down a similar road.
Much the same trends will get under way in the rest of Consumers and Energizers, but these countries lack the size to make the same global impact as giants like China and India. Among Energizers, Africa and the Middle East deserve a special mention. Africa's energy demand, which is boosted largely by sub-Saharan countries, shows signs of taking off as sustained economic growth gives rise to a fledgling middle class.
Energy infrastructure is a serious concern in Africa, but its development could go down a different path to that which rich countries followed in the past, and solutions such as renewables might well play a major role.
The Middle East will undergo a notable slowdown. Whereas energy demand there doubled between 2000-15 due to strong world demand for oil and gas, a weaker outlook for hydrocarbons in the next few years will lead to a consequently much more modest rise in the region's energy demand.

Total primary energy demand growth by region
(Mtoe)

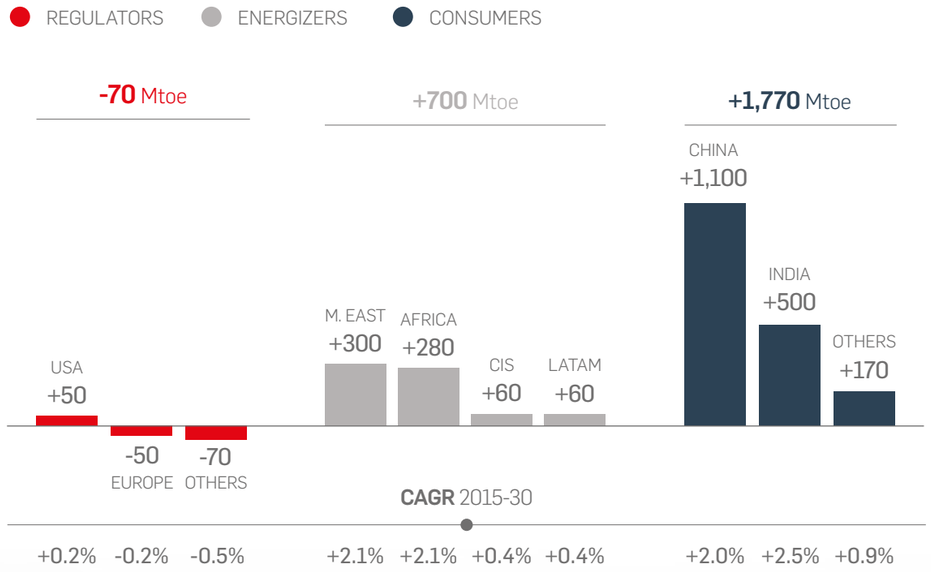


Fig. 16. Consumers, led by China and India, will account for most of the new energy demand.

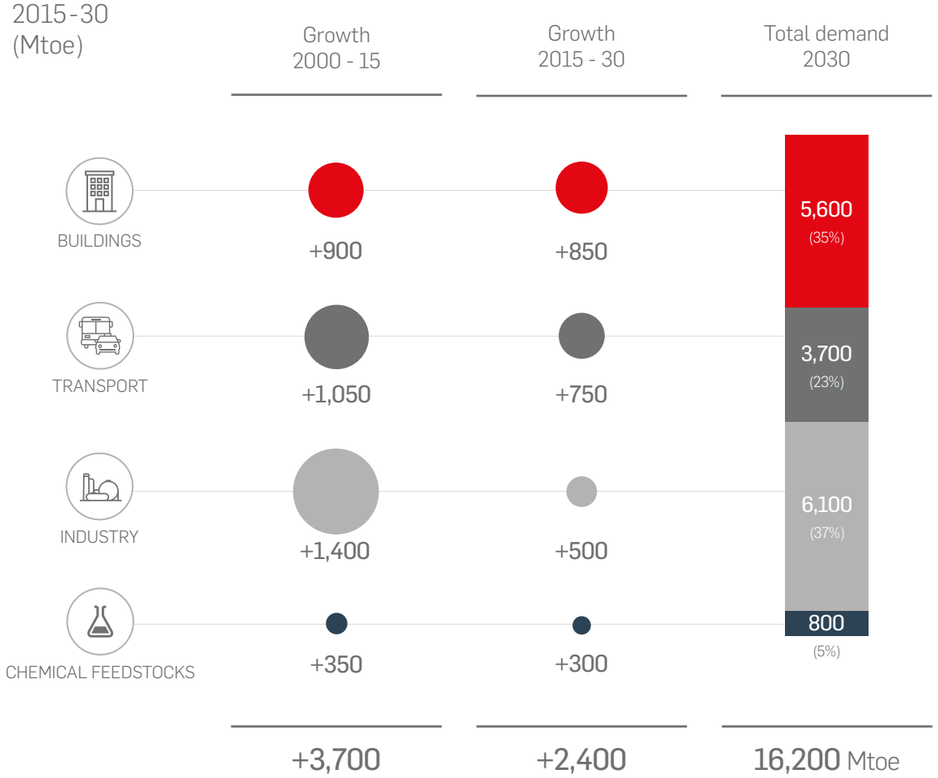
■ Source: Cepsa Analysis

Buildings and transport will drive increased global energy demand and replace industry as the largest contributor

■ As opposed to the previous 15 years, buildings and transport will overtake industry to lead new energy demand. Industry has grown quickly in the past but now seems to have run out of momentum. Meanwhile, a global rise in disposable income will boost demand for energy use in transport and residential buildings.

The rise in available income for millions of people joining the middle class will boost energy consumption, mainly for transport, residential buildings and chemical feedstocks.
Industrial energy demand will meanwhile slow down due to excess installed capacity after years of huge growth, mostly in China, in contrast to the previous 15 years, when industry made up the bulk of new energy demand. Buildings, both residential and non-residential, will account for the biggest increase in energy demand. Residential energy demand will be driven further as urbanization proceeds apace and millions of people move to better equipped homes. Most energy use in buildings will come from electrical appliances as home-makers install amenities such as air conditioning and refrigerators, because many people joining the middle class will live in hot climates.
Transport will also lead new energy demand. Road freight (whose activity in tn-km will increase by more than 30%), aviation —whose km travelled by person will double— and passenger cars —where the global car fleet will rise by 60%— will set the trend.
Efficiency measures, however, will make themselves particularly felt on transport and prevent this massive increase in activity from fully feeding through into an increase in energy demand.
Chemical feedstocks will see the fastest growth by sector, although they will have a smaller slice of the pie in absolute terms. Greater efficiency penetration in chemicals will be limited, so all the increase in final demand for chemically-derived products will translate into a rise in demand for feedstocks.

Total primary energy demand growth by sector*
2015-30
(Mtoe)



* Primary energy consumption for power is allocated according to final sector electricity demand.

Fig. 17. New energy demand growth will be driven by consumption in the building and transport sectors.

■ Source: Cepsa Analysis

Electricity will lead the way and grow to take more than 20% of total energy needs

Electricity will be the clear winner among energy sources in the next few years. It will gain ground in all sectors and regions, without exception. The main driver for this growth will be increased ownership of electrical household appliances in step with a global rise in disposable income, as more people adopt middle-class lifestyles in consumer countries.

Power generation and share of electricity on final energy consumption

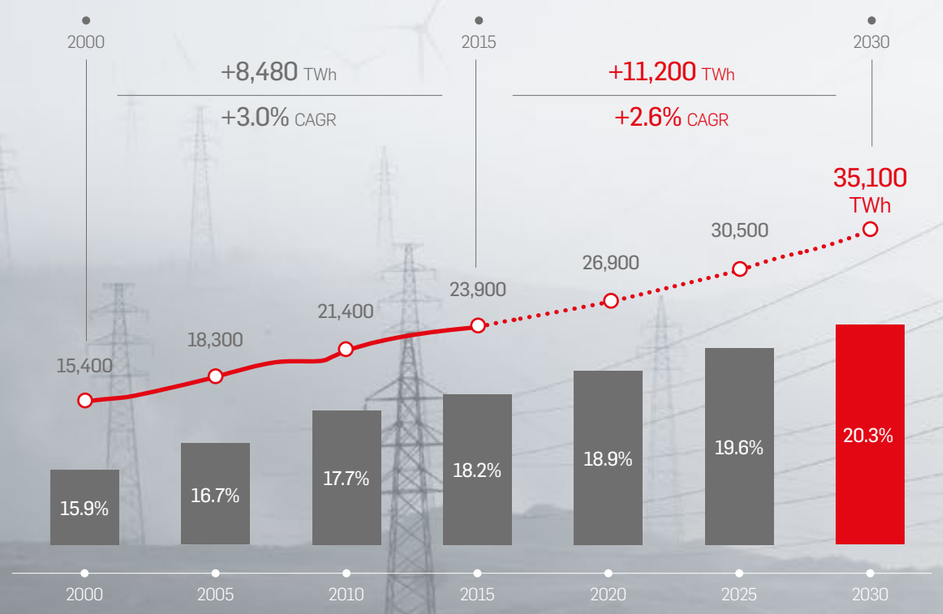


Fig. 18. Electricity consumption will soar to become the fastest growing final energy demand source.

Source: Cepsa Analysis

Global electricity consumption will rise by almost 50%, accounting for most of the projected increase in world energy demand over the next few years, which in turn will be driven mainly by new residential needs. Electricity will play more of a role in home heating and cooling as heat pumps and air conditioning systems are evidently widely used in homes.
Industry will come second in terms of rising demand for electricity, but it will be the fastest-growing energy user in this sector as improvements in efficiency will be slower because devices like electric motors have little room for improvement, so efforts to save energy will focus more on other applications, such as those producing heat or processing steam, e.g. power stations.
Electrification in transport, although accounting for only 5% of new electricity demand, will require power equivalent to forty nuclear stations.

Increase in power generation
(TWh)

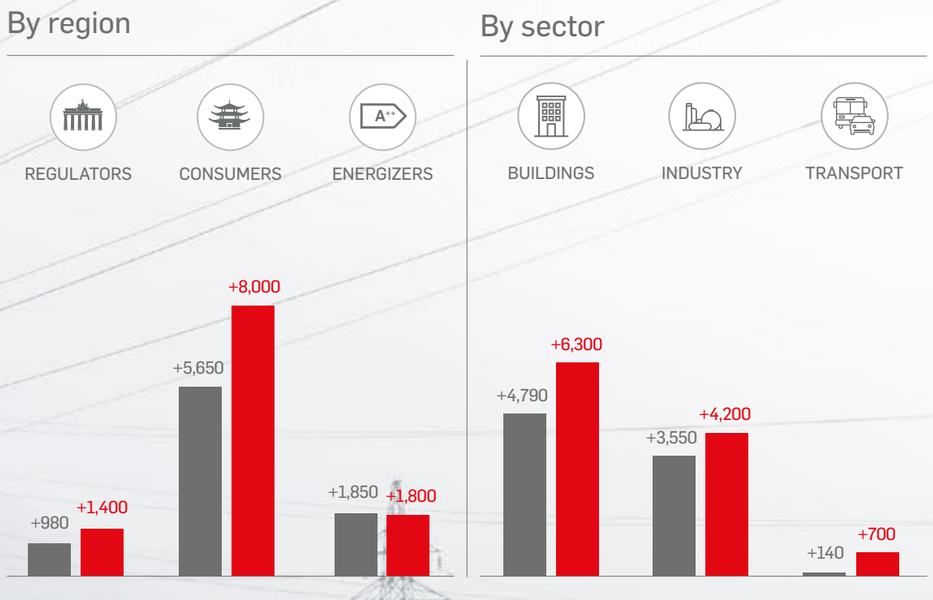


Fig. 19. Electricity consumption in buildings and industries, especially in Consumers, will pull most of the increased power generation

Source: Cepsa Analysis

Renewables and natural gas will dominate growth in power generated by 2030 as coal loses ground

■ Renewables will provide more than half of the increase in power generated over the next 15 years, an unprecedented event driven by increasing wind and solar penetration. Natural gas will come second but gain a share of only 1% in the global power mix, as it takes a back seat to renewables.

Solar and wind power are already the two largest sources of newly installed capacity. Indeed, together they accounted for 45% of the new capacity installed in 2016. Renewables are thus set to become the top power generation source by 2030 and will account for one-third of total power output.

The main drivers of this unprecedented growth will be swiftly improving technology that has allowed wind and solar to increasingly compete with —and unseat— conventional fossil fuel rivals. Wind and solar will thus account for the lion's share of forecast growth in generation by renewables, followed by hydropower and biomass.

However, wind and solar start from a very low share of the total mix, and although they are set to grow substantially, the ground they gain will be restricted by as yet unresolved issues, such as how grid managers can cope with supplies that vary greatly and uncontrollably, due to changes in weather conditions. Coal will move down to second place as fewer and fewer coal-fired plants will be built due to environmental concerns weakening government support, notably in China. In other markets, such as the USA, abundant and cheap natural gas supply has pushed coal aside in power generation. Most of the growth in demand for coal will come from India and Southeast Asia.

Natural gas will see very solid growth, despite having fallen out of favor compared to renewables. Extensive renewables penetration will crimp gas's potential for future growth and indeed its share in the power mix will remain relatively unchanged. Most new gas-fired plants will be logically located in gas-producing regions e.g. the USA, Middle East and CIS. Nuclear capacity additions will be mostly confined to China (80% of the total), due to high capital costs, and environmental and safety concerns in OECD countries. A small number of new reactors will be built elsewhere, largely in India and the Middle East (UAE and Saudi Arabia).

Oil will virtually disappear from the power mix and be confined to intermittent consumption in some Middle Eastern and remote locations in developing countries.

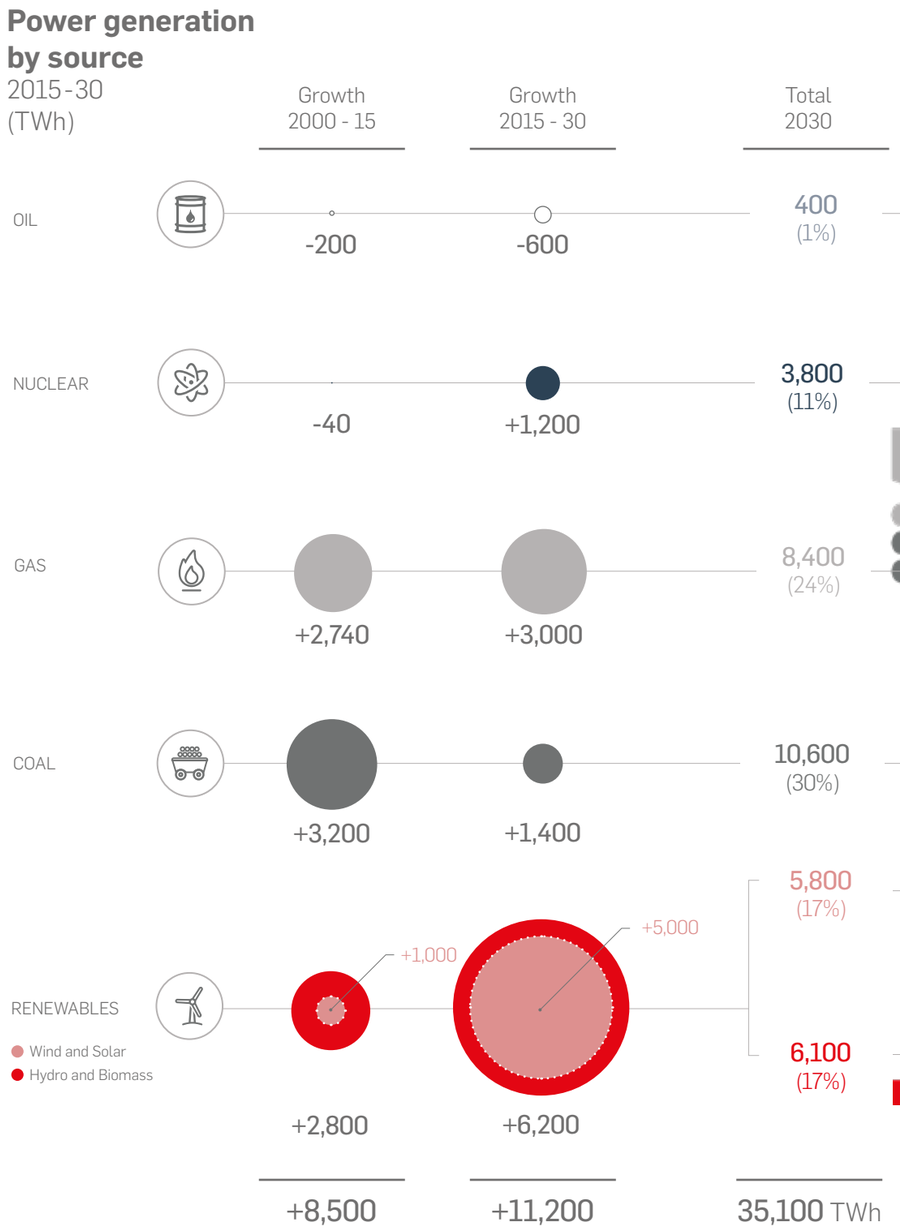
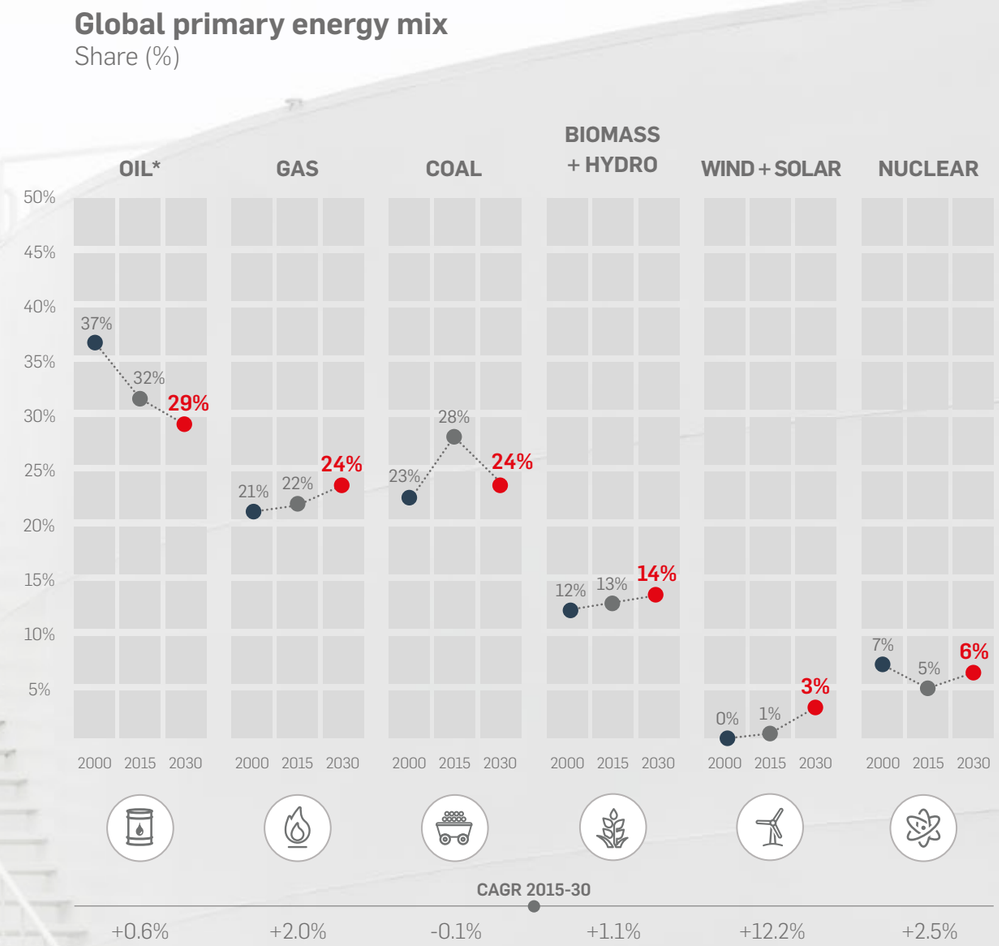


Fig. 20. More than half of new electricity demand between 2015 and 2030 will be met by renewables sources, mostly wind and solar.

■ Source: Cepsa Analysis

Fossil fuels will still dominate the 2030 primary energy mix, despite a remarkable growth by renewables

■ Fossil fuels benefit from a vast infrastructure that is already in place and can be neither easily nor quickly replicated. Among fossil sources, natural gas has the brightest outlook and will match coal for the first time in the primary mix, due to its increasing role in power generation.



*Biomass not included in oil. Included in Biomass.

Fig. 21. The 2030 energy mix will still be dominated by oil, gas and coal, but renewables are quickly gaining ground.

■ Source: Cepsa Analysis

Fossil fuels will clearly continue to dominate the energy landscape in 2030, when they will account for 77% of primary demand, despite liquids and —notably— coal losing out to other sources. Oil will hold on to top spot despite its overall share falling three percent points, although absolute demand for it will rise by 10%. Alternative sources will mildly erode its commanding position in transport by 2030, but not by enough to significantly undermine oil demand in the next few years.
Natural gas will be the fastest growing fossil fuel source and rival coal as the second-most used primary fuel, driven by newly built combined-cycle power plants in the USA, Middle East and China. Coal will also make way for alternatives in the generation mix and demand for it may well peak before 2030.

Despite buoyant forecasts for modern renewables penetration, they start from a very low level and are limited to electricity generation, which accounts for just 20% of total energy demand, so their share in the global primary mix will not be very significant in 2030.

5

LIQUIDS DEMAND

LIQUIDS DEMAND

Still in the lead

Consumption of liquid fuels has traditionally grown apace as a sign of development and prosperity.
In the future, ensuring cheap and reliable access to petroleum resources will continue to be paramount for thriving economies. However, efficiency measures and substitute technologies are here to stay as part of our new reality, at home, in offices, industries and when we travel.
Supply and demand for oil and other liquids will be affected by these changes, and we need to understand the extent of it.

Working for two years as an air hostess on a major European airline has probably been the most fun time I've ever had, but it's also been the most hectic. The company keeps adding new routes, maybe even transatlantic soon, and there's an amazing turn around on the planes we're using zipping between one European city to the next. While flights are so cheap, there doesn't seem to be any let up in the growth of this business. I'll just have to rest at the next stop over!

Olga 24
Russia, Air hostess

In 2030 world liquids demand will be 10% more than today, although it will be growing at a much slower rate

- Consumption will be 10 million barrels per day (Mbpd) greater in 2030 than today, mainly due to increased demand for transport and petrochemicals.

Although oil is the energy source most affected by advances in efficiency —particularly in transport— demand for it shows no sign of peaking before 2030.

Liquid hydrocarbons continue to play a commanding role as a cheap, abundant and reliable energy source. These attributes are not easy to replicate by alternative energy sources. Some cases in industry, residential and commercial buildings, and seaborne transport have potential substitutes (mainly natural gas). On the other hand, heavy duty vehicles, aviation, and —above all— petrochemicals, will continue to depend on hydrocarbon liquids as no viable alternatives are on the horizon.
Consumers countries will make up the bulk of increasing demand for liquids, bolstered by their size and robust economic growth. China and India will take the lion's share of growing demand among Consumers, which will account for most of the total world increase. Energizers will further add to demand that, overall, will be more than enough to offset a steady decline among Regulators.
The Middle East and Africa will spur most of the growth in demand from Energizers. African demand will be driven by its passenger vehicle fleet, which will grow 2.5 times by 2030, especially in sub-Saharan countries. By contrast, Middle Eastern demand growth will come from its industrial sector, where growing demand for petrochemical feedstocks (ethane and naphtha) will account for most new liquids consumption.
In Latin America, the potential for growth in liquids demand is weaker than in Asia and Africa, as population and economy are growing modestly.

World liquids* demand (Mbpd)

*Includes oil, NGLs and biofuels

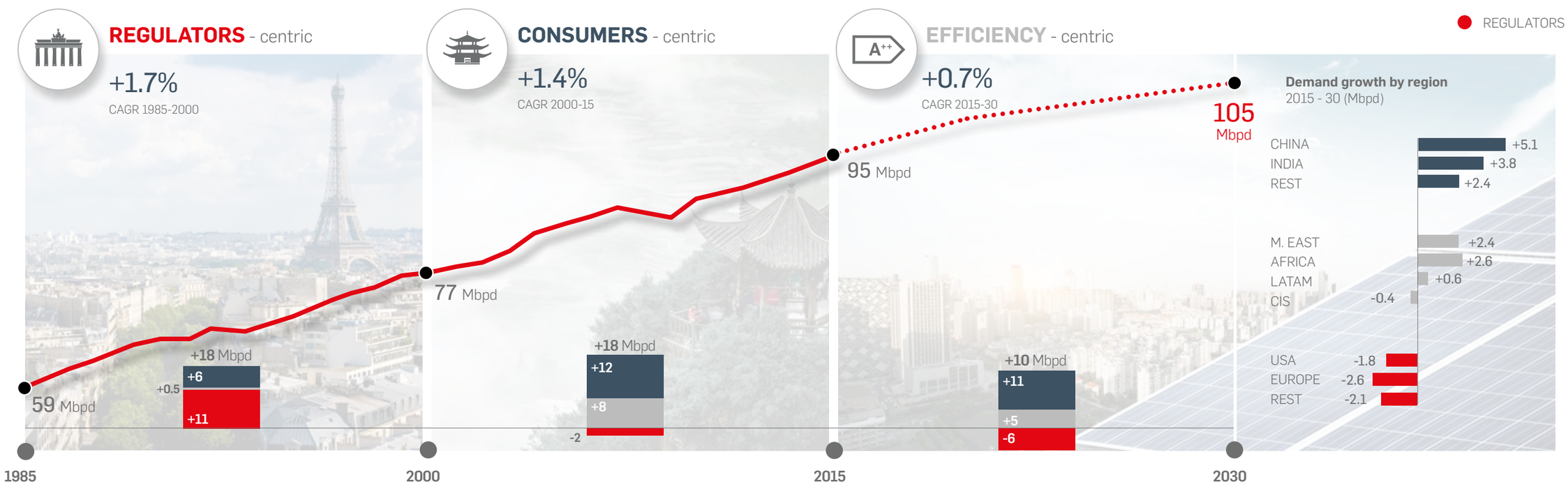


Fig. 22. Liquids demand will grow by 10 Mbpd, halving its growth rate compared to the previous 15-yr period.

Source: Cepsa Analysis

Efficiency and substitution will slash liquids demand in 2030 to 105 Mbpd, from a potential 145 Mbpd

■ Greater economic activity could catapult global liquids demand to a staggering 145 Mbpd. This shows not only how thirsty the world is for fuel to drive its growth needs, but also what a breakthrough efficiency will be.

Efficiency will emerge as the most critical factor in explaining the expected slowdown in liquids demand over the next 15 years, which we have dubbed the "efficiency-centric" phase. As much as 30 Mbpd of potential demand growth will vanish due to better fuel economy in passenger cars, heavy-duty vehicles, airplanes and boilers, among other end uses.

A large portion of oil is consumed by the road transport sector where efficiency —driven by mandatory standards— is improving very quickly. Passenger cars particularly show the impact of efficiency. In 2015, 80% of global passenger car sales took place in markets where mandatory efficiency standards were already in place, and they will become tighter in the next few years. By 2030, average global passenger fuel economy will consequently improve by 25-30%.

The second-largest impact on demand will come from substituting liquids for alternative fuels, mostly in applications such as industrial boilers, as well as residential and commercial heating.

Global liquids demand and adjusting factors
(Mbpd)

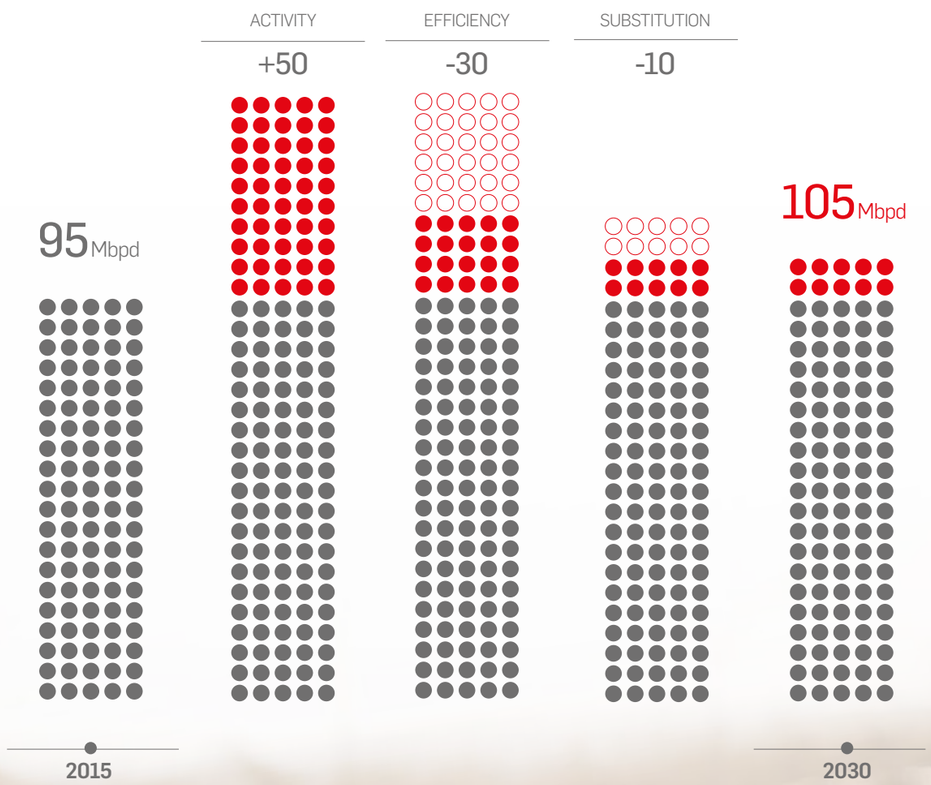


Fig. 23. Potential liquids demand could amount to 145 Mbpd by 2030 but for efficiency and substitution effects.

■ Source: Cepsa Analysis

Liquids demand in Regulators almost certainly peaked and shows no sign of going back to previous levels

■ Despite a recent pick-up in demand as most Regulator countries have recovered from a period of depressed economic activity in 2008-10, demand levels are still far from where they were in the recent past.

Liquids demand in Regulators will continue to slump in the next few years due to strong official backing for efficiency measures and economic activity levels saturating as the population stagnates or even declines.
The Regulator countries relied on cheap and abundant oil supplies to drive their economic booms from the 1940's, when efficiency took a back seat. Nowadays, as this region's economies mature and migrate away from industry towards services, its governments and societies at large are taking efficiency much more seriously. In these efficiency-centric times, Regulators save oil in many ways. An important example is that the passenger car fleet in this region is 20-25% more efficient than the global average, while road freight transport is 20% more efficient.
Regulators have also given official backing to alternatives such as electric vehicles. As a result, oil intensity in 2015 averaged 0.9 bpd of oil per million dollars of GDP in Regulators, compared to 1.7 in Consumers and 2.1 in Energizers.

Years since peak oil demand in selected countries and percentage of demand decline until today

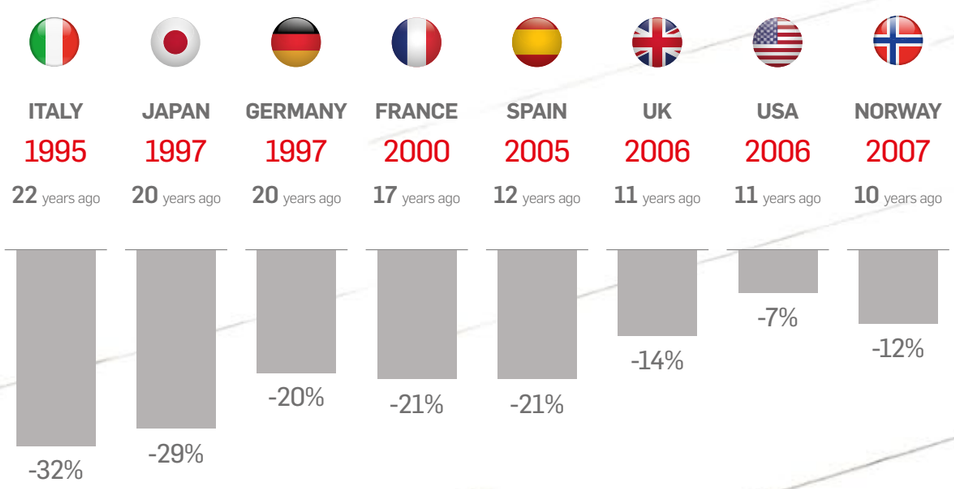


Fig. 24. Regulators liquids demand could have peaked years ago.
■ Source: Wood Mackenzie, Cepsa Analysis

Transport continues to ramp up demand for liquids and will account for 60% of global consumption in 2030

■ Road freight —as well as petrochemicals and aviation— will bolster demand in the next few years, due to a vigorous increase in activity and the absence of substitute fuels in these sectors. In other fuel-burning sectors, however, such as industry, buildings and power generation, liquid fuels do face competition from alternatives and demand will suffer, especially under the added impact of greater efficiency.

Petrochemicals will be the fastest growing sector at a staggering 2.5% growth p.a. in liquid feedstocks. But oil will still be the leading transport fuel and account for 95% of total energy demand in this sector. Heightened activity in transporting goods and people will be the two main drivers of liquids demand in the near future.

Freight transport, including seaborne cargoes, will also expand and drive additional demand for fuel oil and middle distillates. Most of this additional demand for transport will come from the Consumer countries. China alone will account for 40% of all new cars on the streets by 2030, whereas the Regulators between them will take up less than 10%. Activity growth will, however, have varying effects on volumes added, as efficiency measures and alternative energy sources will penetrate to a different extent, depending on transport modes and regions.

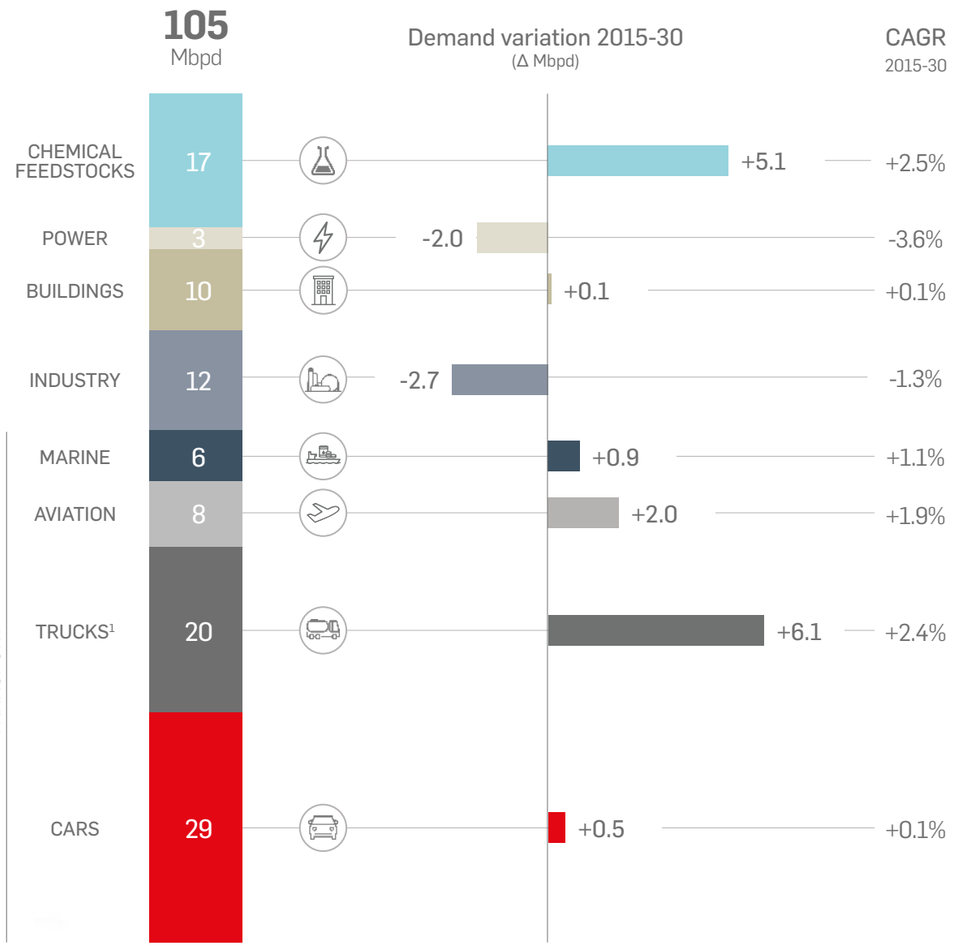
Trucks will account for the vast majority of the increase in demand in the road transport sector, because activity will grow strongly and only a small number of markets have fuel economy standards in place for trucks, so efficiency will improve more slowly than in other segments.

Air transport will still be uniquely driven by kerosene, while successful improvements in fuel efficiency will proceed apace due to heated competition between airlines. A remarkable increase in kilometers traveled per air passenger is expected, however, to outweigh the impact of efficiency and result in a net increase in demand for aviation fuel between 2015 and 2030.

In industry, buildings and power generation, demand will, however, take a big hit from alternative energy sources.

The increased worldwide availability of natural gas will displace oil from power generation and industrial use. In buildings, switching to gas, electricity and renewables will also displace oil from its traditional uses in heating and cooking.

Liquids demand by sector in 2030
Including NGLs and biofuels
(Mbpd)



[1] Includes railroads: Approx. 0.3 Mbpd

Fig. 25. Chemical feedstocks and heavy duty vehicles will drive most of the new demand for liquids.

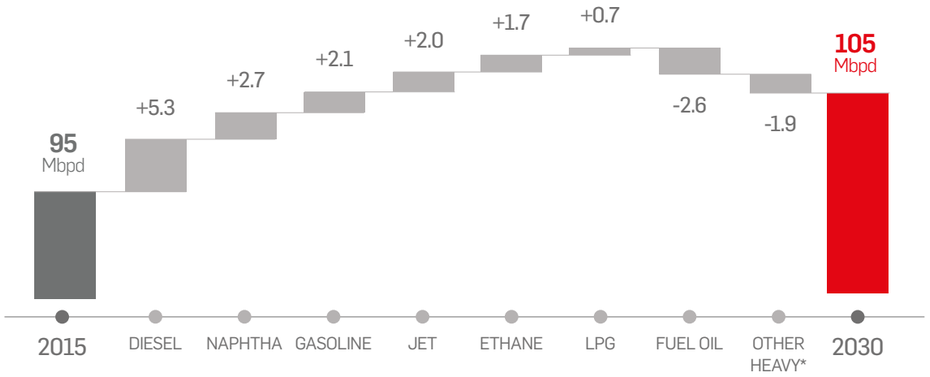
■ Source: Cepsa Analysis

PETROLEUM PRODUCTS DEMAND

The liquids market will gradually consist of a lighter mix of products

■ Middle distillates, especially diesel, will account for the biggest share of growth in demand for products due to its use in trucks, and will have a 40% share in the resulting global products mix in 2030. At the other end of the spectrum, heavy products have been steadily losing their share of the distillation mix due to regulatory pressure in response to their poor environmental performance. Their share of global products demand will be 13% in 2030, down from 19% in 2015 and 23% in 2000.

Liquids demand growth by product
2015-30 (Mbpd)



*Other heavy includes coke, asphalt and others

Fig. 26. The average barrel of oil will have a lighther overall products mix.

■ Source: Cepsa Analysis

Heavier products will be the hardest hit in the next few years as environmental regulations across all sectors put their traditional use under strain. Fuel oil will thus shed about one-third of its demand, mainly in power generation and industry —where boilers are switching to natural gas— and in international shipping, where new sulfur emissions regulations will limit the use of high sulfured fuel oil to ships fitted with scrubbing units.
Demand for other heavy products like petroleum coke, which is mostly used for power and heat generation, will also fall as gas and renewables take over. By contrast, diesel will lead growth in demand for products due to robust activity by road freight. Demand for gasoline will grow due to passenger engines turning away from diesel in Europe and increasing numbers of first-time car buyers in Consumer countries, with a majority gasoline fleet. Naphtha and ethane will benefit from increased demand for petrochemicals. Ethane will capture an important share of growth in this segment due to its availability as a by-product of natural gas production in the top producing regions like the USA and the Middle East.

Asian demand will grow quickly, with China's diesel market overtaking USA gasoline as the world's largest for products

■ Diesel and gasoline will continue to dominate demand for petroleum products across all regions. Mature European and USA markets will shrink, in contrast to the rest of the world. India and China will be meanwhile the fastest growing markets.

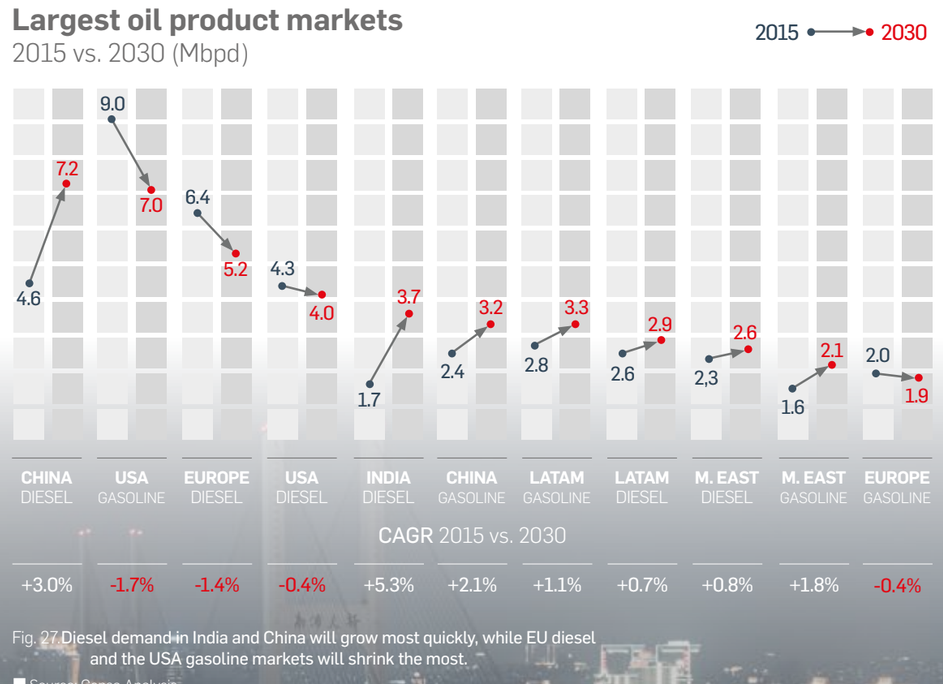


Fig. 27 Diesel demand in India and China will grow most quickly, while EU diesel and the USA gasoline markets will shrink the most.

■ Source: Cepsa Analysis

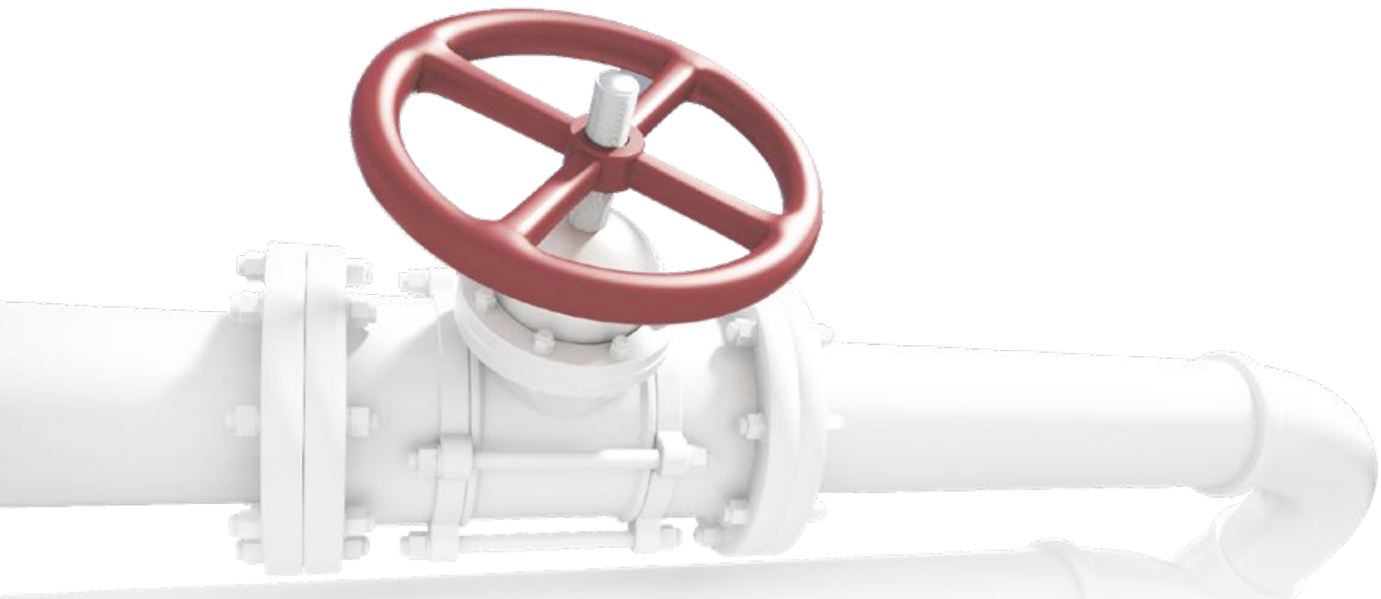
China's market for diesel is the world's third largest today and will hit the top spot by 2030, mainly due to increased activity by heavy duty vehicles. Gasoline demand will also be strong in China as its passenger vehicle fleet will meanwhile triple.

Indian gasoline demand will not be big enough to rank among the top 10 markets by 2030, as it will start from a very low level due to the country's small private car fleet. However, Indian diesel use is already intensive in trucks and industry, and will grow at more than 5% p.a. between 2015 and 2030. Traditional hubs of large diesel and gasoline demand, like Europe and the USA, will contract as efficiency measures are fully enforced. Gasoline, which virtually all USA passenger vehicles run on, will see demand there shrink substantially, as will consumption of diesel in Europe, where it is the most popular fuel for passenger cars. The overall decline in diesel use in Europe will, however, be limited because it is still mainly used in trucks, which have a brighter outlook than cars.

Diesel is losing appeal among car drivers. Many large cities across different Regulator countries are starting to restrict or even ban diesel vehicles in city centers. This trend will gather pace —especially in Europe, where diesel is the car fuel of choice— as municipal governments will likely increase pressure to improve air quality. Latam and Middle Eastern markets will steadily continue to add to global demand, albeit at lower rates.

Both natural gas liquids and naphtha will raise production to satisfy the increasing petrochemical demand

■ Massive natural gas output will drive the use of Ethane and LPG as feedstocks in the USA and Middle East, which is expected to trigger unrivaled growth in petrochemical production in these regions. Asia, especially China and India, will lead growth in demand for Naphtha.



Liquid feedstocks are used to feed ethylene crackers and produce the main precursors for the petrochemical industry, known as bulk petrochemicals, the most important being ethylene and propylene. The economics of bulk petrochemicals production depend greatly on feedstock costs. Producers that enjoy locally available feedstocks therefore have an important competitive edge.
The Middle East has vast supplies of natural gas liquids and naphtha, and is thus the world's largest petrochemical producing hub, despite limited local demand. More recently, the USA has had large ethane supplies locally available due to the advent of shale gas production, which has boosted its competitiveness in the petrochemical sector. It is expected that two-thirds of new bulk petrochemicals production between 2015-30 will come from these two regions alone.
In regions lacking local production, like Europe, the feedstock of choice is naphtha, because ethane and LPG are very costly to transport and in many cases the infrastructure simply does not exist. Ethane, for instance, would have to be liquefied and this is usually prohibitively expensive. Naphtha, obtained from refining processes, will be the preference in most Asian countries.

Growth in petrochemical feedstock demand by region
2015-30 (Mpbd)

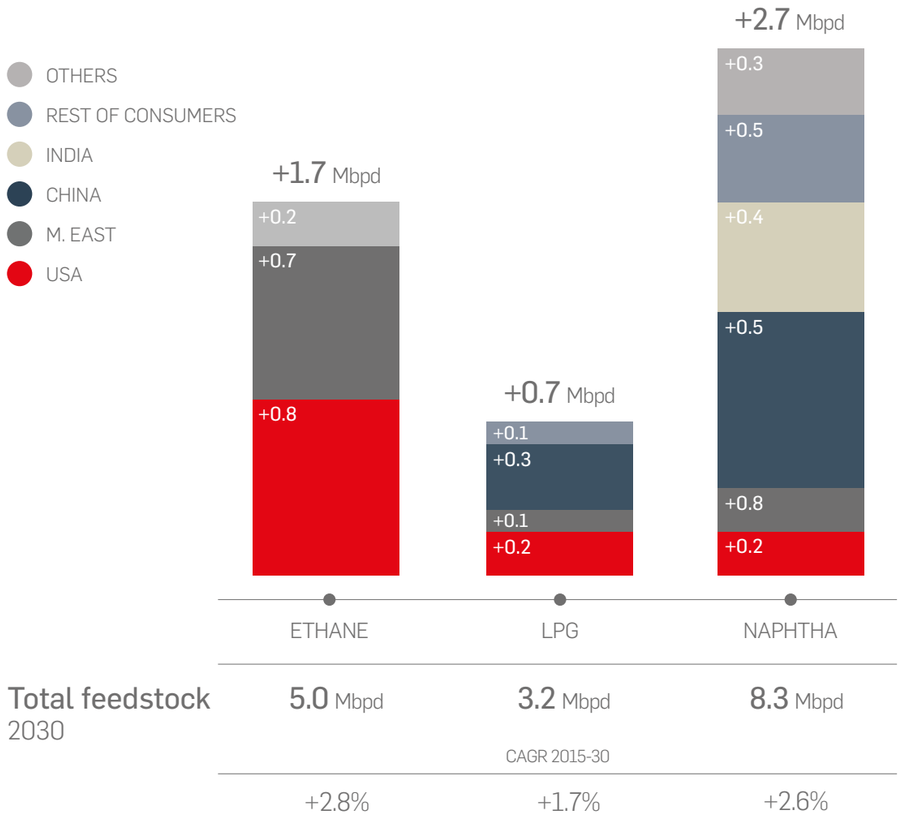


Fig. 28. Demand for Naphtha will raise significantly driven by Asian growth in population. Also, ethane and LPGs will grow in new feedstock volumes for petrochemicals production thanks to the strong natural gas production in USA and Middle East.

■ Source: Cepsa Analysis

Biofuels will contribute towards curbing transport emissions albeit at a slower pace

■ Growth prospects for biofuels are expected to lose ground as advances in electrification gather momentum and take over as the preferred route for emissions reduction programs.

However, demand for biofuels will increase to meet minimum blending requirements stipulated by local and regional regulations, in order to meet targets for the share of all renewables in the total energy mix.

Ethanol will still stand out among leading biofuel products because it can be blended with gasoline, on which most of the world's passenger vehicle fleet is run, although Europe has so far been the exception due to its preference for diesel.

Regulators have led the way in implementing compulsory blending and thus currently account for most of global consumption. In Europe, the experience gained from implementing the 20-20-20 directive on boosting renewables —including biofuels— has led to mixed feelings as the actual environmental benefits of first-generation biofuels are somewhat limited.

First-generation biofuels are produced from edible feedstocks and so their production competes with that of food. So-called second-generation biofuels do not compete with food and could, in theory, avoid this dilemma. As feedstocks they use either recycled oils or lignocellulosic residues (dry matter), which can be used to produce biodiesel and ethanol, respectively.

Industrial-scale conversion processes are not yet economically viable, however, so growth in worldwide biofuels programs will be sluggish.

The European Union is assesing new targets for 2030, and it is expected that first-generation biofuels will lose ground compared to the original 2020 targets. Second-generation targets, however, will be set at a minimum of 3.6% of the final road fuel mix by energy content, up from being non-existent at the moment.

Likewise, USA volume targets have been set in which conventional biofuels will not be increased further, because all the growth is expected to come from second-generation biofuels.

Brazil will continue to be a special case because it has been running passenger cars extensively on ethanol since the 1970s, using abundant local supplies of sugar cane as a feedstock. Other countries have had limited appetite to shift biofuels into their energy mix.

Biofuels demand over time by product
2000-30 (Mbpd)

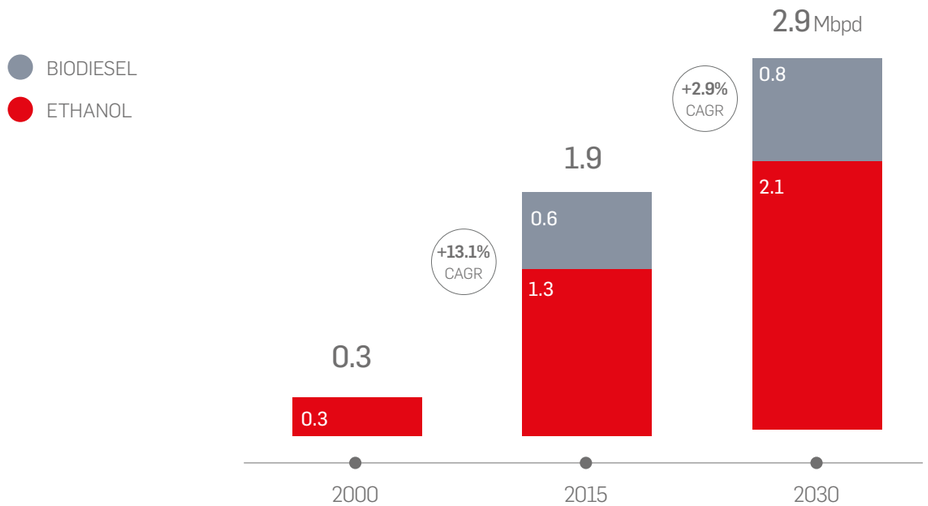
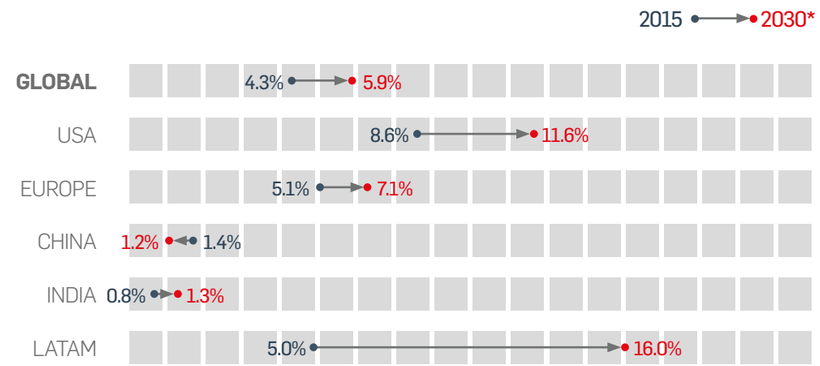


Fig. 29. Biofuels growth will slow down during the next 15 years.

■ Source: Cepsa Analysis

Biofuels content in selected regions
2015-30 (% volume in road fuels)



* 2030 figures are estimates and not neccesarily enforced.

Fig. 30. Biofuels share in road fuels formulation will increase mainly in the USA and Latam markets.

■ Source: Cepsa Analysis

The new IMO sulfur guidelines will significantly change the international shipping market after 2020

■ The International Maritime Organization (IMO), a body dependent on the United Nations, has set new guidelines that will come into force in 2020 and limit emissions in seaborne vessels to the equivalent of burning fuel with 0.5% sulfur content.

Ship owners have limited options for compliance, namely: 1) Retrofit exhaust gas scrubbers that remove the sulfur oxides; 2) Switch from high-sulfur (3.5%) fuel to either low-sulfur fuel or marine gas oil (MGO); or 3) use liquefied natural gas (LNG) instead.

Little is known about the final shape that marine fuels markets will have after new IMO restrictions come into force likely in 2020, because refiners and ship owners need to weigh up several major challenges before deciding on what options to take and making hefty investments.

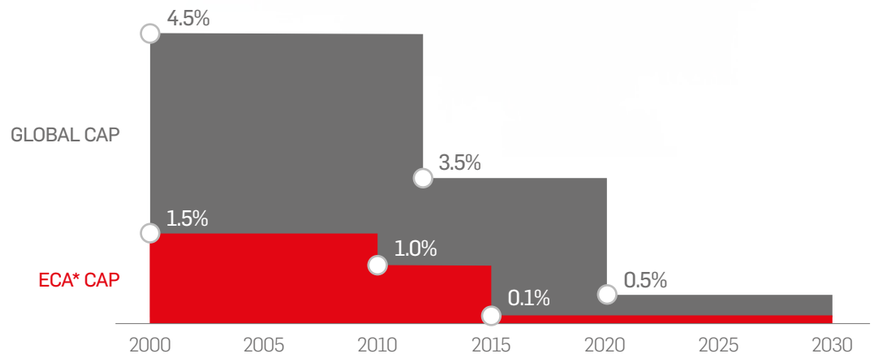
One option for existing vessels might be to keep them equipped as they are, and switch to the more expensive low-sulfur fuel or marine gas oil. If this should be the case, differentials for these products will widen and put pressure on refiners to modify their yields toward lighter products and thus reduce their bottom-of-the-barrel output. Other ships, though, might want to fit scrubbers from the outset and take advantage of the cheaper high sulfur fuel oil. LNG, meanwhile, might be an option in the short term for some newbuilds that have privileged access to related infrastructure.

About 50% of the global international fleet in 2030 will consist of ships built after 2015. The bulk of international shipping demand comes from large vessels e.g. container ships, bulk carriers and tankers. A combination of retrofitting scrubbers and fuel-switching may well prevail as LNG for shipping will still lack refueling facilities in major ports across the world.

However, as some ports are installing refueling facilities, LNG is expected to capture an increasing share of the market and could drive about 10% of the world's shipping fleet in 2030. Longer term, LNG is expected to capture a larger size of the market.

There will be a challenging transition phase at the start of the enforcement period, but compliance is expected to be largely met. The capacity installed scrubbers is limited, and many ships will not be able to retrofit in time. Therefore, many vessels will initially use the available compliant fuels, either marine gasoil or the new low sulfur (0.5% S) fuel formulation.

Sulfur limits according to new IMO guidelines
(% weight of sulfur content in marine fuels)



* ECA stands for emission control area, and it affects the North Sea, Baltic Sea, Atlantic and Pacific coasts of the USA, Canada and Hawaii.

Fig. 31. The IMO intends to limit the sulfur content of fuels to 0.5% from 2020 onwards in an effort to reduce sulphur emissions from shipping.

■ Source: IMO, Cepsa Analysis

6

LIQUIDS SUPPLY

LIQUIDS SUPPLY

By sea, land... and shale

UPSTREAM

The more we look for oil, the more we find. Oil supply dynamics in the near future will, however, be fraught with fundamental geopolitical and economic uncertainties.
Firstly, the unfolding of the geopolitical situation in key Energizers such as Iran, Iraq, Libya and Venezuela. Secondly the economics of shale oil and deepwater projects and, finally, OPEC's strategic positioning in maintaining quotas at the expense of spare capacity and inventories.

"You know, back in the seventies, we knew very little about shale, oil production was dwindling and we had lines a mile long at gas stations. We thought oil would run out by the end of the century so I even began to wonder whether there was a future in the auto industry. Yet here we are, forty years on, and boy was I wrong! With the shale boom, not only did I get to finish my career in the industry, but ten years into retirement I see my family all working for producing companies". Oil looks like being around for quite some time to come".

George, 76
USA, Retired engineer

Worldwide reserves keep growing despite rising production due to advances in upstream technology

Vast amounts of oil that were deemed subcommercial not so long ago have become viable in recent years due to important technological advances, and been added to known reserves at a pace that has outstripped production. The issue of resource scarcity has therefore taken a back seat for now to peak demand, which has yet to be reached.

Proven reserves available worldwide have increased due to heavy investment during the 2010-14 oil price boom.

According to the IEA, proven reserves alone of conventional and unconventional oil at the end of 2015 amounted to 1.7 tn bbl, the equivalent of 50 years' current consumption. Yet this amount is dwarfed by estimates of more than 6 tn bbl. in resource volumes available that have yet to mature into reserves.

Technology has been the leading enabler for this increase, especially in the development of shale and tight resources in North America, and the vast offshore resources in the deepwater Atlantic Margin.

This has favoured the USA & Canada becoming the world's fastest-growing oil-producing region. The USA will become the single largest producer in absolute terms in the next decade, and a net exporter before 2030.

Apart from the USA & Canada, only Kazakhstan, Brazil and Mexico are the non-OPEC countries expected to contribute to material production growth. In Latam, Brazil and Mexico will stand out in boosting production as they compete with each other to attract new skilled investment partners.

All Middle Eastern producers will boost output and thus exert more influence on OPEC, and on global supply as a whole. Meanwhile, Africa still shows no signs of emerging as a major oil supplier.

In the CIS region, Russia will manage to hold production steady throughout the 2015-30 period. Kazakhstan will post remarkable growth as major projects such as Kashagan and Tengiz reach full throttle.

Other non-OPEC producers like China, most of Europe and South East Asia, face lagging investment and mature productive fields.

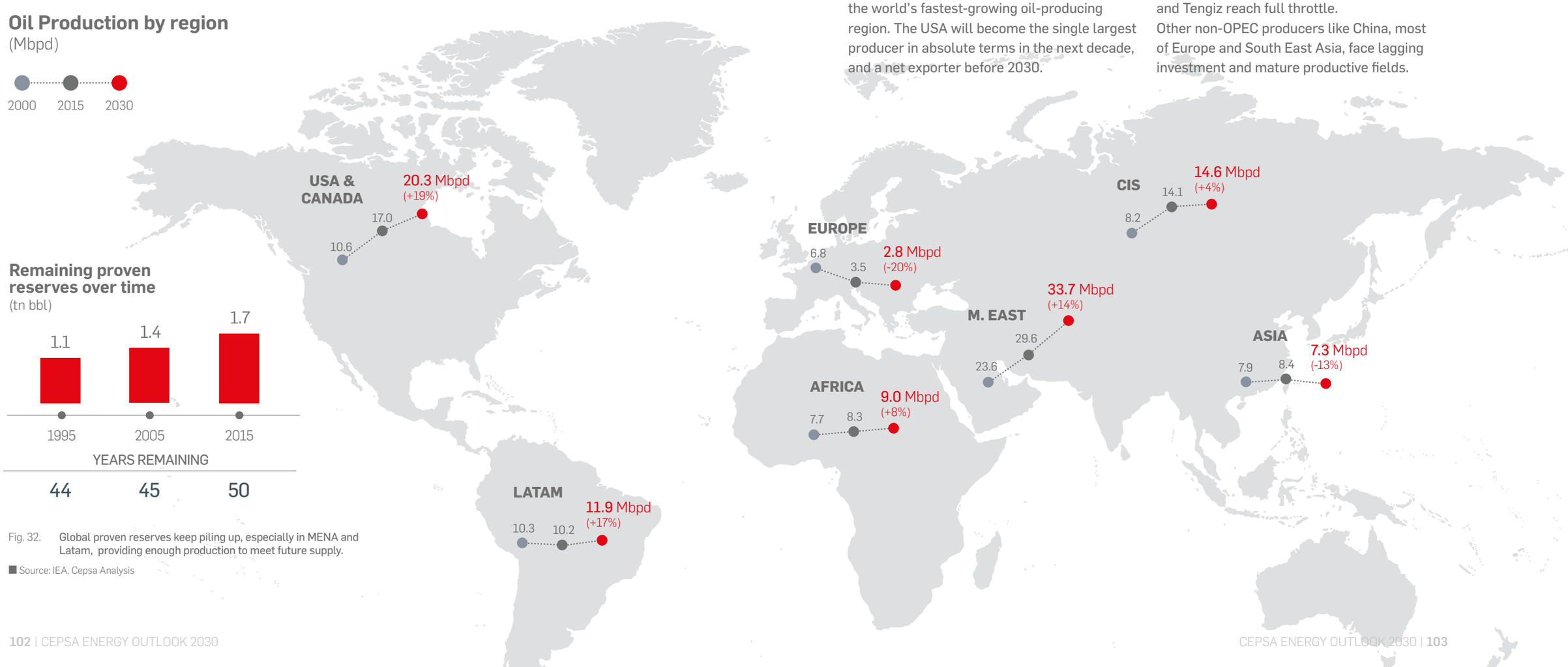


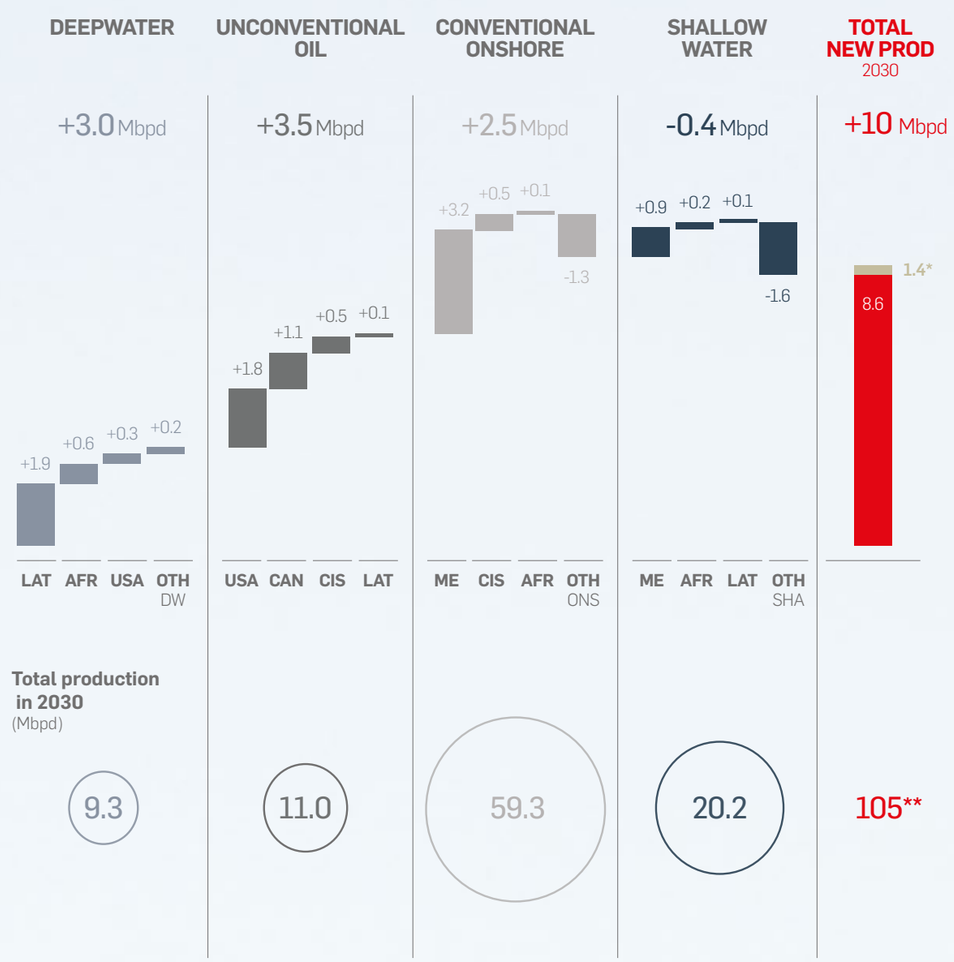
Fig. 32. Global proven reserves keep piling up, especially in MENA and Latam, providing enough production to meet future supply.

Source: IEA, Cepsa Analysis

Oil supply growth will be driven by onshore Middle East as well as unconventionals in North America and deepwater Latam

■ The Middle East, Latam and the USA will account for 90% of oil supply growth by 2030. These three producing hubs will dominate in onshore, deepwater and unconventionals technologies, respectively. Production from shallow waters will decline overall although growth is expected in some areas.

Presalt deepwater developments in Brazil, and new offshore developments in Mexico are expected to provide most new production in Latam. In Africa, Nigeria will struggle to maintain production levels and Angola deepwater will decline as investments are lured away to less risky environments.
Light tight oil (LTO) production is forecast to grow at 3.0% p.a. through to 2030, and add 2.6 Mbpd to global supply, and will be driven by improved productivity, cost compression, and recovering oil prices helping to open up new basins.
LTO outside North America will not add material volumes in the 2030 timeframe and activity will be confined to Russia (+0.5 Mbpd) and Vaca Muerta in Argentina(+0.1 Mbpd).
Canadian oil sands will ramp up before 2020 as newly built facilities come online, but longer term output will be curtailed as many greenfield projects require high breakeven prices.
Growth in conventional onshore technologies will be chiefly driven by Middle Eastern countries, which are capable of building up production by using bolt-on projects at marginal costs. Saudi Arabia will hold on to top spot among the region's producers, while Iran and —to a lesser extent— Iraq, will see the fastest production growth in the Middle East.
In North Africa, Libya will be the largest wildcard as its geopolitical situation unfolds, while Algeria is expected to raise production by just enough to offset natural declines.
Overall declines in shallow water output will depend on falls in Europe and Asia. In Europe, North Sea production will continue to decrease,more so in the UK than in Norway, where large, new projects are expected to come on stream toward the end of this decade, and thus offset the drop in mature areas.



* This number shows the growth in processing gains (+0.4Mboe/d) in this period, and in biofuels (1.0 Mboe/d).
** Total processing gains and biofuels equal 5.2 Mbpd in 2030

Fig. 33. Deepwater and Unconventionals will supply most of the new production to 2030. Regionally, Middle East, Latam and the USA stand out as growing producers.

■ Source: IEA, Cepsa Analysis

REFINING

Refining has enjoyed a boom recently. Access to low feedstock prices and growing demand have boosted refining margins. Some regions can look forward to a brighter future in this sector because they are close to forthcoming demand centers and have an advantage in feedstock supplies. Others, however, will have to remain continuously focused on operating excellence and maximizing efficiency to ensure their competitiveness.

Meeting 10 Mbpd of additional liquids demand will require increased product supply of 7 Mbpd in refineries

■ The refining sector will need to boost petroleum products production by 7 Mbpd by 2030 in order to process the estimated rise increase in liquids demand. Unprecedented growth in USA shale and cheap extraction of NGLs in the Middle East will likely provide the lion's share of feedstocks for this additional throughput. Output of both first —and second— generation biofuels will top up the rest.

Natural Gas Liquids (NGL) like ethane and LPG are by-products of natural gas production, and mainly used as petrochemical feedstocks, while the use of biofuels is limited to blending in road fuels.
Additional NGL supply will be concentrated in two regions: the USA and Middle East.
Additional supply of biofuels will be more common in Regulator countries, which have the world's highest mandatory blending targets for road fuels formulation, and in Brazil where ethanol for passenger cars will continue to dominate.
Regulators, led by the USA, will see the greatest decline in refined products demand due to the rise in supply of alternative liquids.
Additional supply of other NGLs and biofuels in the USA alone will contract refined products demand by 3.0 Mbpd, the largest in the world.
In Consumers and Energizers (except the Middle East), additional production of NGLs and biofuels will be less significant and refined products will meet most of the rise in liquids demand.

Breakdown of growth in liquids supply
2015-30 (Mbpd)

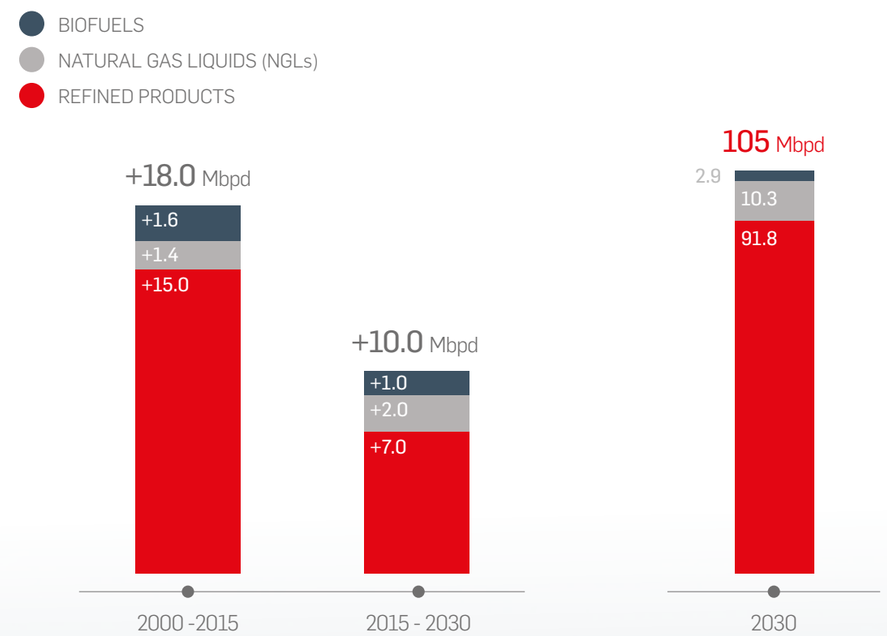


Fig. 34. An additional 7 Mbpd of liquids supply will be passing through the global refining system.
■ Source: Cepsa Analysis

New distillation capacity will outpace product demand growth and shift toward China, India and the Middle East

■ New refineries will be built mainly in major demand pockets in Consumer countries, with growing demand there as an additional driver.
Europe will take the lead in specialization and efficiency gains as refineries fight for survival, but capacity shut-downs are foreseen as a consequence of the region's lower utilization rates.

Refining capacity will grow by 11.5 Mbpd and outpace additional demand of 7 Mbpd for refined products. This will be due to an imbalance between new refineries being built to meet quickly rising demand in Consumers and Energizers, and refinery shut-downs lagging behind demand contraction in Regulators. This will lead to a worldwide glut in refining capacity, which will cut average global refining utilization rates by about 2% between 2015 and 2030. This effect will put pressure on the smaller and less complex refineries.
Consumers will build the majority of new refineries in the next few years, as they will lead world demand for petroleum products. About 12.5 Mbpd of new distillation capacity will be required in this region, of which about 4 Mbpd are already under construction. Although capacity additions in China will grow at a slower rate than in other Consumers —notably India— it will overtake the USA to become the world's largest country by refining capacity, at 19 Mbpd. The Middle East is the only region apart from the Consumers that will also boost refining capacity. Most of the additional 2 Mbpd distillation capacity forecast for this region is expected to come on stream before 2020. Export volumes from the region will increase by 2030, and more than one-third of capacity there will be geared entirely to export markets, mainly in Asia. The USA, on the other hand, will be able to hold on to its distillation capacity due to its highly competitive feedstock position —boosted by the increasingly availability of shale there— that will drive exports, primarily to Latin America, where many countries cannot finance enough additional capacity to meet domestic demand.
By contrast, Europe will be more exposed to distillation capacity rationalization. Expected demand contraction and increasing competition from outside the region will threaten Europe's most vulnerable refineries, where shutdowns totaling 1 Mbpd are therefore forecast in order to balance the market.
As European demand for petroleum products decreases, European refiners will have to rely more on exports to maintain output. Gasoline and fuel oil will likely make up the bulk of net European exports, but diesel will undergo the most abrupt change. Europe could shift from a diesel production deficit of about 800 kbpd to a surplus of 100 kbpd, driven by a forecast drop in sales of diesel passenger cars amid environmental concerns. Gasoline supply, on the contrary, will barely hold steady due to rationalization in distillation capacity that will undermine Europe's gasoline surplus.

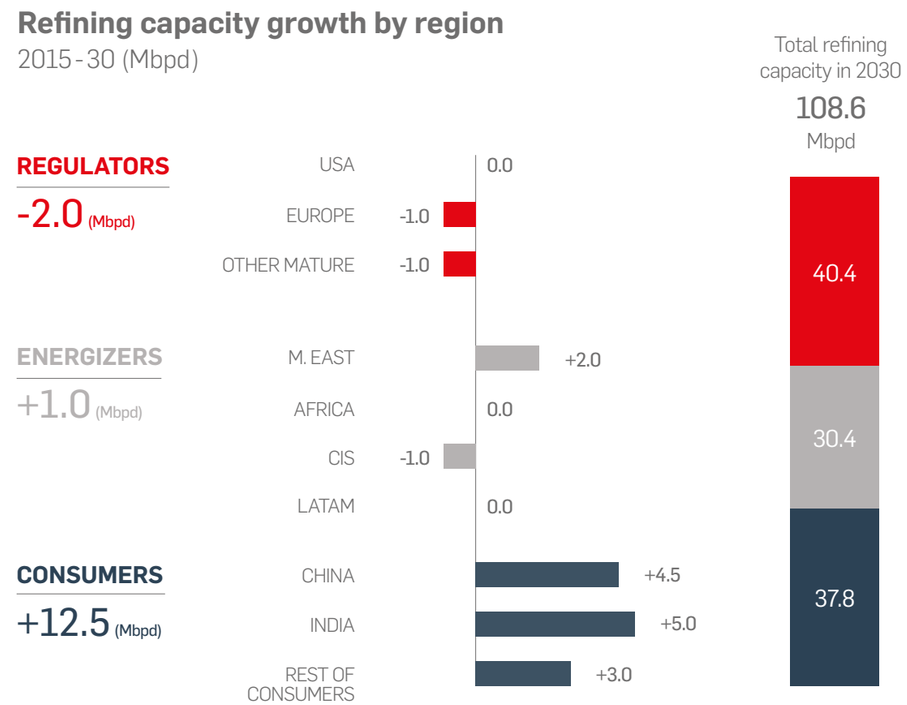


Fig. 35. Refining capacity adittions will be mostly concentrated in Consumers, whereas Regulators are bound to see some closures.

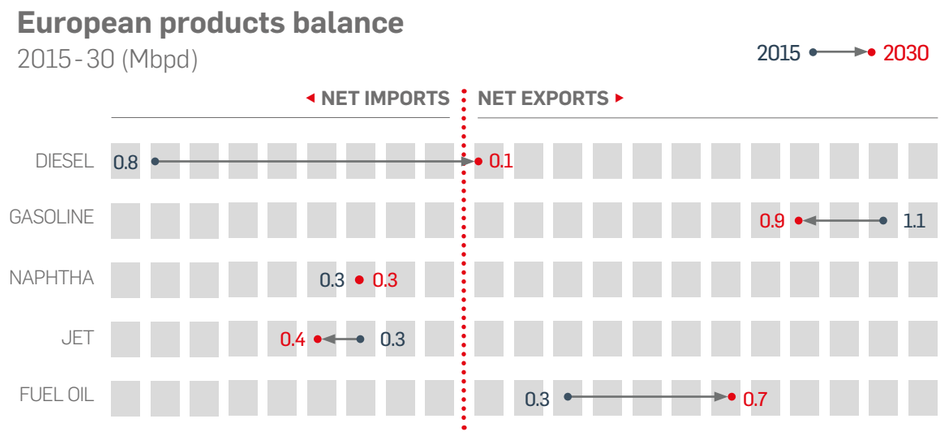


Fig. 36. Europe's traditional diesel deficit reverts to surplus; fuel oil exports are expected to rise under the impact of new IMO regulations.

■ Source: Cepsa Analysis

7

GAS

GAS

A volatile transition

There is a broad consensus that natural gas will be the fastest growing fossil fuel source in the next few years, and it could well unseat coal to become second only to oil as the world's leading energy source. Although its prospects may look bright, a number of significant uncertainties need to be borne in mind, because they will determine the role natural gas will play in the future energy system: how much renewable energy sources will develop, how fast new liquefied natural gas (LNG) projects will come on stream, and the extent to which natural gas demand grows in Asia.

"Things were hectic when I first started to work here on Bonny Island. After the construction of the gas plant, electricity became very reliable and power cuts a thing of the past! Nightlife at Port Harcourt is so much better now that we don't end up dancing in the dark! We are lucky that gas is apparently so common in my country. There's talk of more building work down the road at the new Brass LNG project, although they tell me that it might take a while, until the gas market recovers".

Nudia, 26
NIGERIA, Receptionist

GAS

Global demand

Natural gas use will grow by a solid 35%, but at a slower pace than in the past

■ Natural gas demand will continue to grow at 2% p.a., and outpace global primary energy demand (1.1% p.a.). This means natural gas will be the fastest-growing fossil fuel, and will boost its share in the world's primary energy demand mix to match coal as the second-largest primary energy source by 2030.

Globally, demand for natural gas has been growing faster than for any other energy source, except renewables, although the latter have started at a low level and thus have yet to make the same impact.

Underlying demand for gas is likely to continue to climb swiftly, due to infrastructure buildout, economic growth, the increasing use of gas in power generation and to a lesser extent, transportation.

However, gas faces an uncertain future as a player in the world's energy system. On the one hand, natural gas is the lowest carbon-emitting fossil fuel, and is therefore a good option for curbing emissions when used to replace oil or coal. On the other, compared with renewables, gas may look too carbon-intensive and not the best way to move toward a low-emissions energy system.

Natural gas's role thus risks being confined to that of a transitional fuel until renewable energies become more cost-effective. Its role will depend on the policy approach followed by governments worldwide. A review of pledges submitted after the COP21 Paris Accord by the end of 2016 shows that only one-quarter of them mooted natural gas as a means to curb CO_2 emissions. Most of the pledges came from gas-producing regions, with the exception of China. This may give an indication of how gas demand will perform in the future: producing regions, where gas is very competitive, will make very intense use of it, in contrast to importing regions, where gas will be priced out of a primary role.

Global gas natural demand
(Tcf/yr)

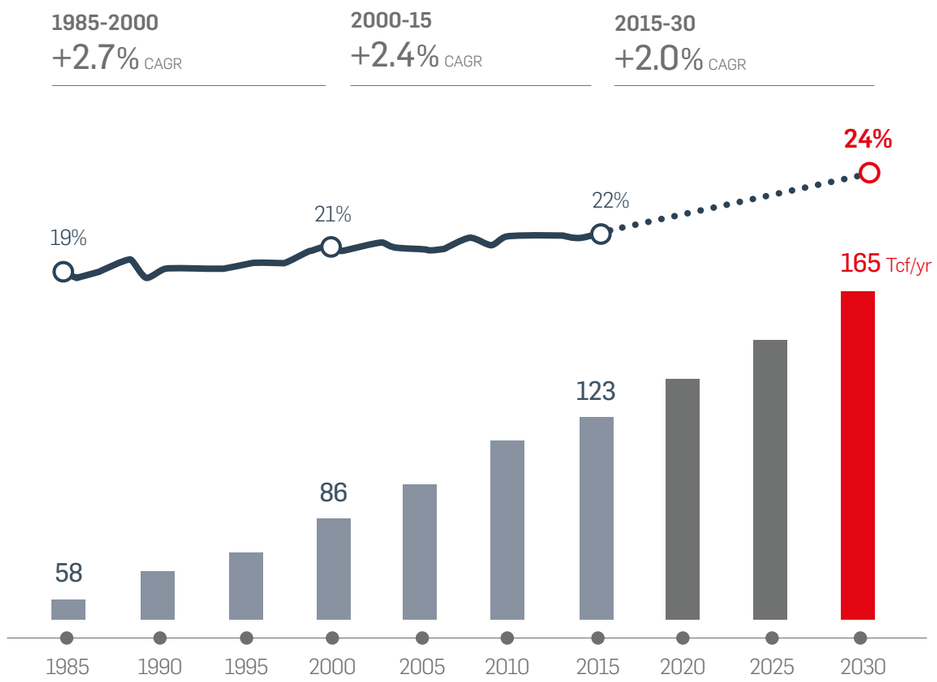


Fig. 37. Gas demand keeps rising and playing a larger role in the global energy mix.
■ Source: Cepsa Analysis

Gas demand will be driven by China and key producing regions led by the USA, Russia and the Middle East

■ Growth in natural gas demand will be driven by Asia, especially China, and also by producing countries as they encourage the use of cheaper, domestically-produced gas to meet their growing energy needs. Although output in Europe will decline as the North Sea is depleted, demand will still show signs of growth as individual economies swap coal for gas in order to reduce CO_2 emissions.

As the Chinese government aims to diversify the country's energy mix, natural gas will be promoted as an option for curbing emissions and improving air quality, despite being considerably more expensive than locally produced coal. Unsurprisingly, gas-producing regions will have the highest shares of natural gas in their primary energy mixes: the CIS and Middle East will stand out with 50% each, followed by the USA, on 35%.
Among gas producers, the Middle East will account for the largest demand addition in the next few years, where natural gas will be used increasingly as a source for power generation and in industrial processes.
The USA will also add to global gas demand by a remarkable 5 trillion cubic feet (tcf) per year, as shale gas production there carries on growing, forcing down natural gas prices and thus boosting demand generally. In contrast to other major producing regions, growth in the CIS will be sluggish as it suffers from a stagnating population and a discouraging economic outlook. Africa will post the fastest-growing demand, after China and India, but as it will start from a very low level, its net effect on the global picture will be less significant. Africa has vast resources that will put gas in a very competitive position to meet growing demand, although its lack of infrastructure will thwart its full development.
No major new uses of gas are foreseen in Europe. The expected increase in demand will mostly come from a recovery in utilization rates by gas-fired power plants that were displaced by coal in the past, when a sustained slump in emissions rights prices made it cheaper to burn coal than gas.
By 2030, however, should emissions rights were to rally, it would spur a rebound in natural gas use in existing plants, to the detriment of coal.

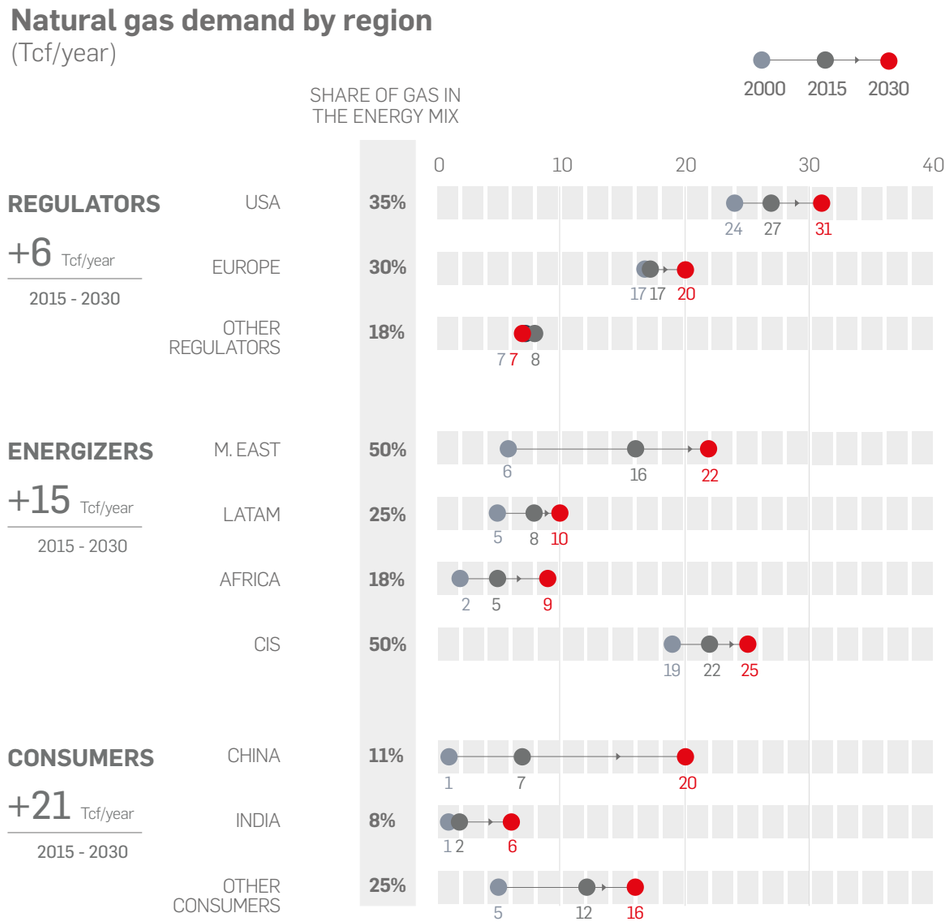


Fig. 38. Natural gas demand growth will be led by producing regions such as USA, Middle East and CIS. China, though not a large producer, will drive additional demand due to its vast market.

■ Source: Cepsa Analysis

Power generation still drives consumption and will account for most of the additional gas demand

■ Today, gas accounts for about one-quarter of global power generation. The expected rise in electricity consumption in the next few years will trigger an increase in natural gas demand.

Industry will come second as a driver while slowing down due to a more modest outlook for production, as developing economies shift toward services.

Electricity is the fastest-growing final energy source today, boosting demand for natural gas that is burned to generate about one-quarter of all electricity consumed worldwide. Natural gas use for power generation will expand in all regions, but particularly in the USA, the Middle East and China.

In industry, natural gas is used in boilers to produce heat and steam. Rising concerns about air quality are encouraging a gradual shift toward gas, which is cleaner than other fossil fuels.

As it is home to the world's largest industrial sector, China will lure more than half of all new industrial gas demand as its government plans to give gas priority over its traditional and more intensive reliance on coal, to drive industrial growth.

In the buildings sector, gas is predominantly used for heating. However, as urbanization gathers pace, and new building activity takes place mostly in hot climates (e.g. India, South East Asia), new demand for gas in buildings will be muted as they will rely on electric heat pumps to provide warmth, many of which are combined with air conditioners.

In the transportation segment, although growth rates for natural gas use are the most promising, it will translate only into modest final demand by 2030. The main hurdles for natural gas to clear before it can penetrate in the transportation sector are first, the infrastructure required to replicate the availability of oil, and second, its lower energy density by volume.

Natural gas is particularly suitable for transporting freight as the infrastructure required is less costly than for passenger transportation. Trucking in China, thanks to strong regulatory support, and seaborne freight (after the IMO introduces a cap on sulfur emissions in 2020) will start making significant use of gas.

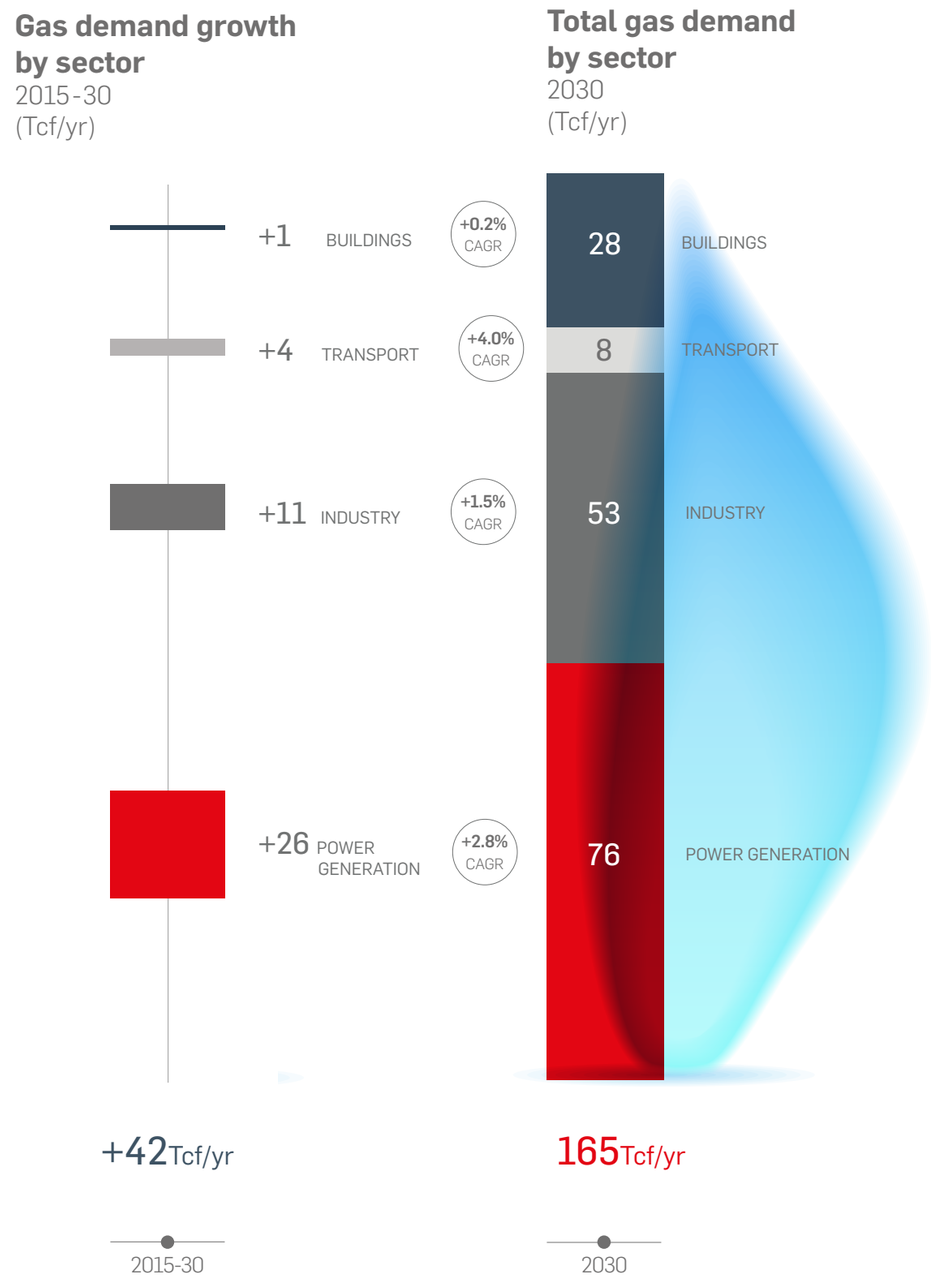


Fig. 39. Power generation will drive the bulk of new natural gas demand.

■ Source: Cepsa Analysis

International trade will meet more than half of the expected new gas demand and will increasingly revolve around Asia

■ Most of the gas consumed worldwide is domestically produced, but cross-border and overseas trade is becoming more important. Global trade will account for 35% of world natural gas demand in 2030, up from 25% in 2015.

Gas demand will be mostly met by international trade because a large part of the forecast increase will come from countries or regions that do not have enough domestic production. This is notably the case in China and India, and also Europe, where North Sea output has already peaked.

Therefore, pipeline flows from Russia to Europe will continue to be the world's largest, while exports to China and India —mostly LNG from Australia, the USA, Middle East and West Africa— will rise the most.

Europe will still be the world's biggest gas import market, where demand is expected to increase one-third by 2030. The biggest cross-border volumes will still flow in from Russia —and North Africa, to a lesser extent— as North Sea production continues to wane. LNG heading for Europe will be used mostly to meet peakload gas demand.

The busiest trading routes will be those bound for Asia. China, for example, will import three times as much gas as it does today and become the world's second-largest importing country.

LNG trade flows from Asia (Australia and Papua New Guinea), the Middle East (Qatar), West Africa (Nigeria) and the USA, bound for China and India, will see the biggest and fastest growth.

The USA will emerge as one of the world's leading exporters, to be surpassed only by Russia. USA gas will be piped to Mexico, and shipped as LNG to Asian consumers.

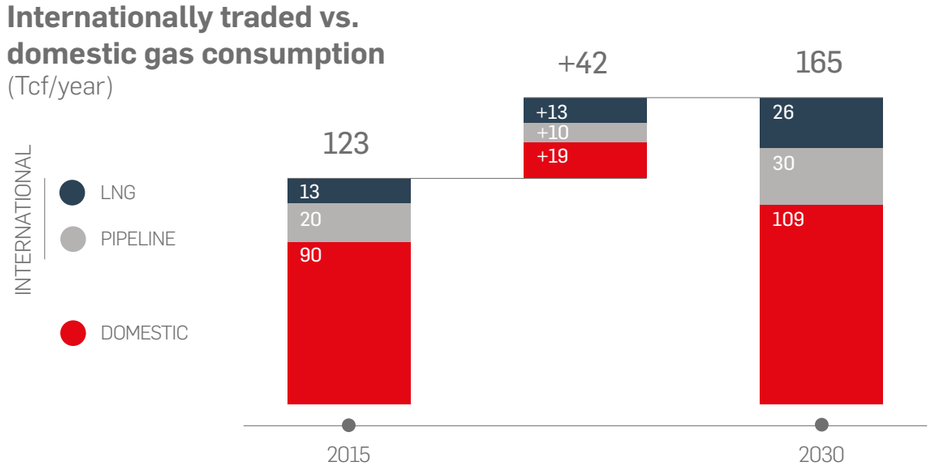
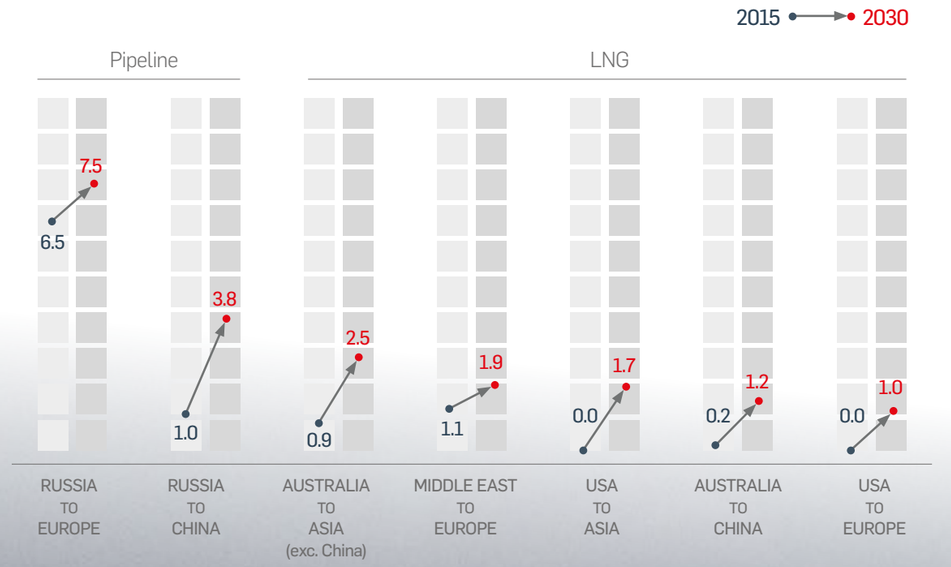


Fig. 40. Most gas will still be consumed domestically. Growth, though, will largely come from internationally traded gas.

■ Source: Cepsa Analysis



■ Source: IEA, Cepsa Analysis

Fig. 41. Trading routes bound for Asia will experience the greatest growth.

World LNG demand will double by 2030, but the market will likely be oversupplied until at least 2025

■ LNG's share in global gas demand will grow from a current 10% to 16% in 2030.
As international trade gains ground, and the distance between buyers and sellers increases, liquefied natural gas growth is set to outpace piped natural gas as a whole.

LNG will benefit most from this rise in international trade due to the increased distance between buyers and sellers, which is far too big to justify building pipelines. Policy makers aiming to diversify supplies in many countries for political reasons, as well as investment earmarked to boost capacity, will also shore up LNG's role in the future.
LNG has proven to be a cheaper and more effective option where pipeline imports are possible but building the required infrastructure becomes cumbersome, expensive and takes too long; in fact, floating regasification units can be built more quickly.
A period of very high LNG prices prior to 2014 spurred the construction of LNG terminals, so multiple projects are now under construction and will come on stream over the next few years.
All this new capacity will outstrip expected demand, so the market will be oversupplied until the mid-2020s. Several other LNG projects are also due for final investment decisions and will compete to fill the gap in demand after 2025, when additional capacity of some 8 tcf/yr will be required, assuming they run at an 85% utilization rate.
Liquefaction terminals have made notable technological progress that will also help LNG gain ground in the international gas trade. Their capital costs have steadily dropped, due to advances like modular design, while floating units and innovative processing technologies have made new gas discoveries economically viable, whereas not long ago they were in the doldrums.

Global LNG supply & demand
(Tcf/year)

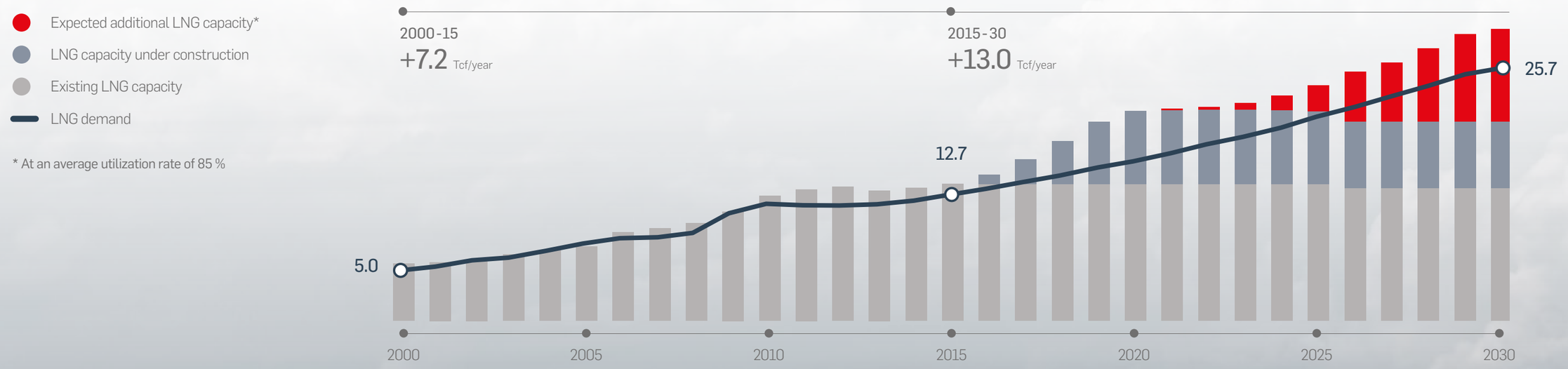


Fig. 42. Global LNG demand will double in the 2015-30 period. Supply projects awaiting approval will face tough competition to enter the market.

■ Source: IHS Markit, Cepsa Analysis

8 CHEMICALS

CHEMICALS

Look around

Everywhere we look, we see essentially chemical products without which life as we know it would be impossible, such as our very homes, clothes, cars, shampoo and the increasingly ubiquitous smartphone. Societies are moving on at different speeds around the world, and so myriad products are in demand for uses that range from meeting basic needs to dabbling in more luxurious and sophisticated lifestyles. Chemicals will be an intrinsic part of the whole lot.

"I just met my aunt and uncle for the first time, because they came over from Oregon. They speak funny and brought us a lot of stuff I've never seen before here. They got mum loads of face creams and things she uses in the bathroom. And I got some cool clothes, a baseball jacket and some tennis shoes, and loads of food we can't get here. Someday I want to be buying all of that in a shopping mall where they live."

Javier, 8
Colombia, Student

Consumption of chemical products will grow as it goes hand-in-hand with economic development

As disposable incomes rise around the world, demand growth for chemicals will outstrip that for other sectors, and overall economic growth.

Approximately 95% of all manufactured goods, like electronics, furniture, appliances or textiles are based on chemicals. As more people around the world adopt consumer lifestyles, the chemical industry will become the fastest growing sector to use oil as feedstock by 2030, as well as the one whose share in demand for oil will increase the most.
By sector, the increasing use of electronic devices in the wake of the digital revolution, as well as a boom in consumer goods, will drive growth in demand for chemical products, e.g. polyester for clothing, detergents for washing, as well as plastics in household goods, furniture and appliances.
New business opportunities will also abound, especially in Regulator countries, where the graying population will be a source of demand for both basics (diapers, personal care) and new specialized products and services, such as interactive devices for remotely monitoring health.

Chemicals growth vs. other sectors to 2030
(%)

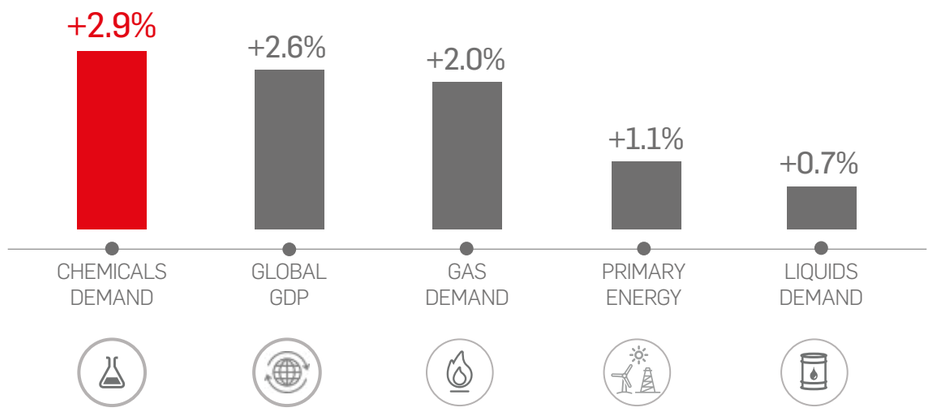


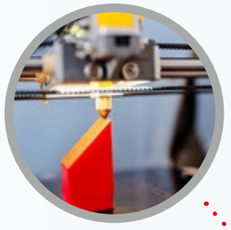
Fig. 43. Demand growth for chemically derived products will surpass that for any of the main energy-related markets.

Source: McKinsey, Cepsa Analysis

CHEMICALS

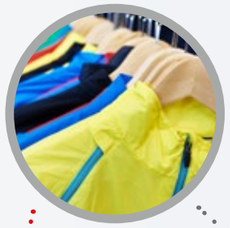
Strong fundamentals

Which new products will you be using in 2030?



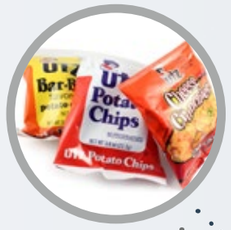
Print my own customized cell phone case using a **3D printer**

- LDPE, HDPE, Phenol



I will wear **trendy clothes** without spending too much

- Synthetic fibers from petrochemical products



I'd love to buy **food to go**

- Packaging plastics LDPE, HDPE

Live in a **smart mega city**

- Construction materials, paintings/coatings, cables made of chemicals

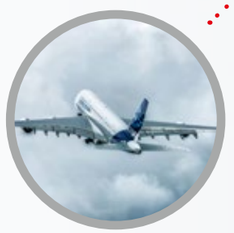
I will wear my **phone** and other sensors on my wrist

- Phenol & polyolefins

Laura, 10
France, student.

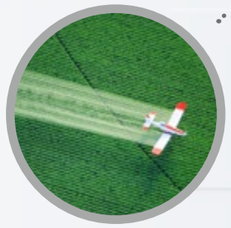
Javier, 8
Colombia, student.

May, 14
Thailand, student.



Travel more and faster

- Engeneering plastics for lighter composite materials for aerospace, less weight, less consumption



Cheap and healthy **food** for everyone

- Fertilizers

The latest **household appliances**

- Electronics, circuit boards

I will buy my first **car** to commute to work and travel

- Polymers and new composite materials

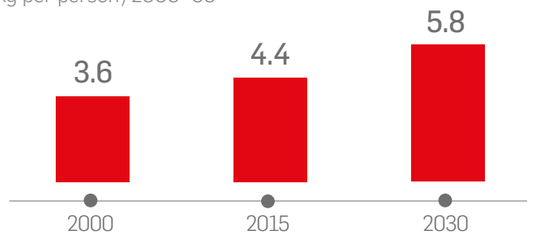
Economic development in Asia, social change and new policies will be the main drivers for increasing demand for chemicals

There will be three major growth drivers for chemical products demand in the next few years. Firstly, due to the increased use of existing products as more and more people have higher living standards. Secondly, innovation will allow some existing chemical products to begin to have myriad new applications. Finally, there will be a regulatory push encouraging the use of new, more advanced and environmentally friendly products.

Key drivers of chemicals demand growth

Asia in particular will fuel demand for traditional chemical products as people in Consumer countries adopt lifestyles that until recently were mostly confined to Regulators. More people will require more packaged food in shops, more houses to live in, more clothes to wear, more cars to get around and more detergent to wash them with. All are made of the chemicals already present in our daily lives. One example is LAB, a chemical used for the production of detergents.

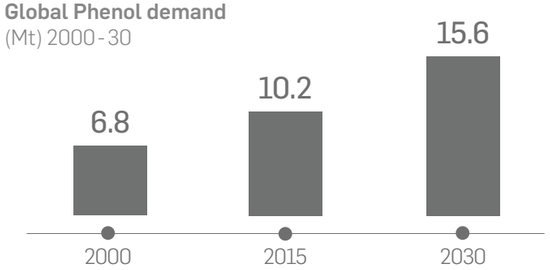
LAB Consumption per Capita
(kg per person) 2000-30



As societies change over time, demand for chemical products also drifts toward new applications. Besides their use in electronics, engineering plastics are becoming more efficient and sophisticated, and increasingly used instead of metals in making cars and aircraft, or as building materials.

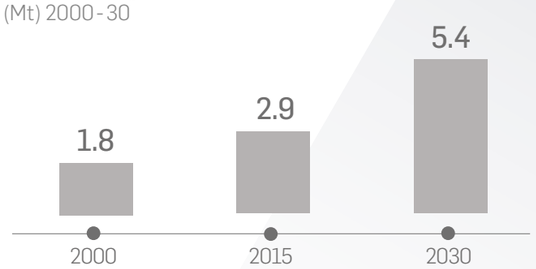
Innovation in the chemical industry will keep playing a major role in creating additional demand. Phenol, for example, is a chemical with a wide range of uses including engineering plastics. 3D printing is already in use in the aerospace industry, and has the potential to move into the automobile industry as the technology becomes cheaper. Likewise, the use of liquid-crystal polymers to flatten computer and smartphone screens, or the replacement of paper by plastics in new currency bills in economically developed countries, are further examples of new applications for plastics that have great potential.

Global Phenol demand
(Mt) 2000-30



Customer preferences and a widespread regulatory drive are creating the required environment for a larger market share for bio-derived products. Detergent Alcohols, for example, are oleo chemicals used in cosmetics and detergents. However, quite a few challenges lie ahead as most of these bio-chemical related technologies are at an early stage or still under development.

Global Detergent Alcohols demand
(Mt) 2000-30

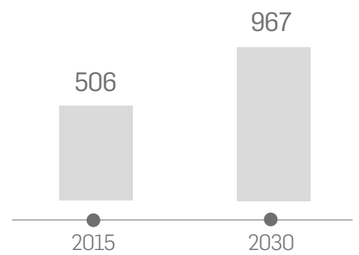


Source: Cepsa Analysis

Future supply growth will be determined by feedstock advantage and proximity to demand centers

■ The global chemical market will almost double in the next 15 years.
As world economic activity continues to inch up, overall capital expenditure earmarked for capacity by the chemical industry in 2020 will be 35% higher than in 2015, and continue to trend upwards in the following years.

World chemical production
(Mt)



REGULATORS WITH FEEDSTOCK ADVANTAGE
ENERGIZERS WITH FEEDSTOCK ADVANTAGE
CONSUMPTION HUB
CHEMICALS CAPACITY INCREASE (Mt)

World chemical production additions by region
(Mt)

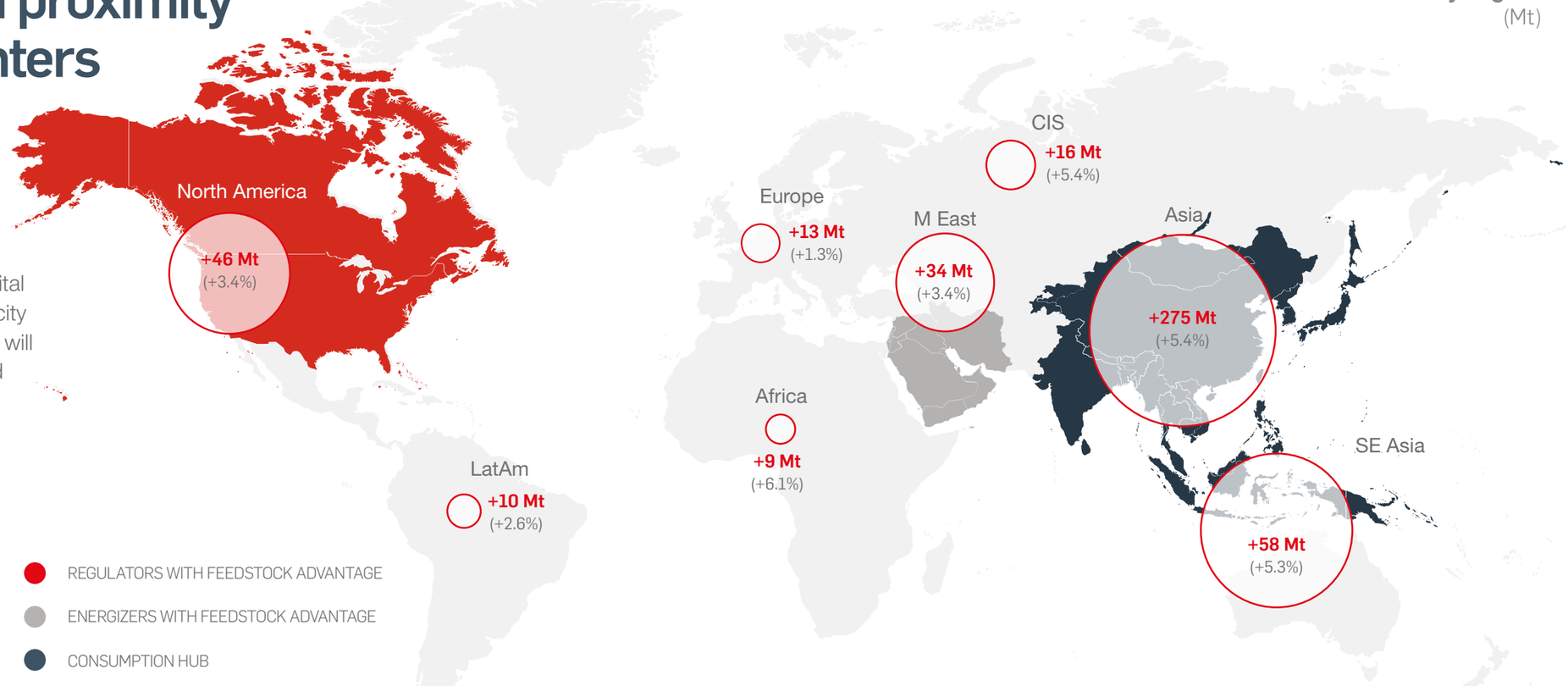


Fig. 44. Areas with chemical feedstock advantage such as North America and Middle East will be the key suppliers to the emerging Consumer countries of Asia.

■ Source: McKinsey, Cepsa Analysis

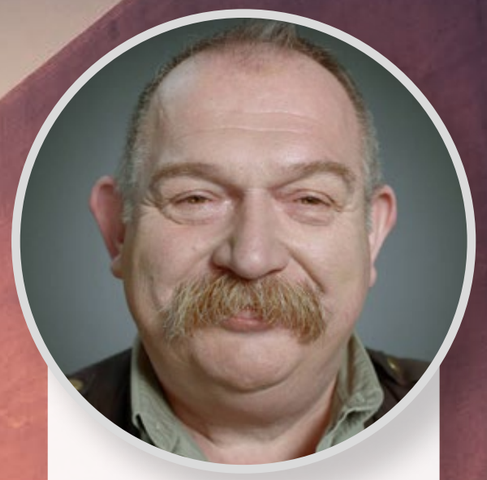
Consumer countries will lead the way in capacity expansions in line with well-known demographic trends. Asia, for example, will account for more than 70% of the total increase in chemical production over the next 15 years.
National oil companies (NOCs) in Consumer and Eastern Energizer countries are also putting greater emphasis on their chemical production and will keep building capacity in higher value-added products to feed downstream industries. Their privileged geographical position for suppling Asian markets, and cheap and abundant feedstock will put these players in a very advantageous position. In these markets, volumes will take priority over margins. On the other hand, as the USA increases NGL output using shale gas, investment has started to pour in and several new projects for building ethylene crackers have been approved and are expected to enter production toward the end of this decade.
As oil prices recover, United States gas-based chemical production will become more competitive than naphtha related markets. The USA chemical industry's feedstock of choice is ethane (derived from shale gas), whereas its Asian and Middle Eastern counterparts use mostly petroleum products such as naphtha and LPGs.

9 EMISSIONS

EMISSIONS

A crucial balancing act

Sustainability has become the watchword, because meeting increasing energy needs while being environmentally friendly is one of the planet's major challenges today. Countries worldwide have set efficiency standards and renewables targets that seek to reduce emissions, but without undermining economic development. The COP21 Paris climate accord was a historic milestone on the way to reducing global emissions, but doubts remain as to whether it goes far enough to ensure we have a sustainable future.



"Every time I get stuck in a traffic jam on the M1 —which is a lot, I can tell you— I have time to listen to all the stuff about global warming on the radio, and I worry what kind of a world my grandchildren will have".
"I mean, winters aren't nearly as cold as when I was a kid, and I don't think my grandchildren have ever made a snowman or had a snowball fight".
"We'll all have to do our bit, and I can say that I don't need to fill up as often as I used to with my new lorry, and I've even seen some trucks running on gas. That seems to be the way things are going, at least in my line of work".

Peter, 54
Ireland, Truck driver

The pledges committed at Paris will not be enough to keep global warming to "well below" a target of 2ºC above pre-industrial levels

■ The main challenge lies in getting the balance right between reducing emissions and encouraging economic growth.

The goal to reduce emissions by about 1.6% p.a. as per Paris Accord targets will take a greater reduction than ever in carbon and energy intensity.

Energy related CO_2 historical emissions and COP21 forecast
(Gt)

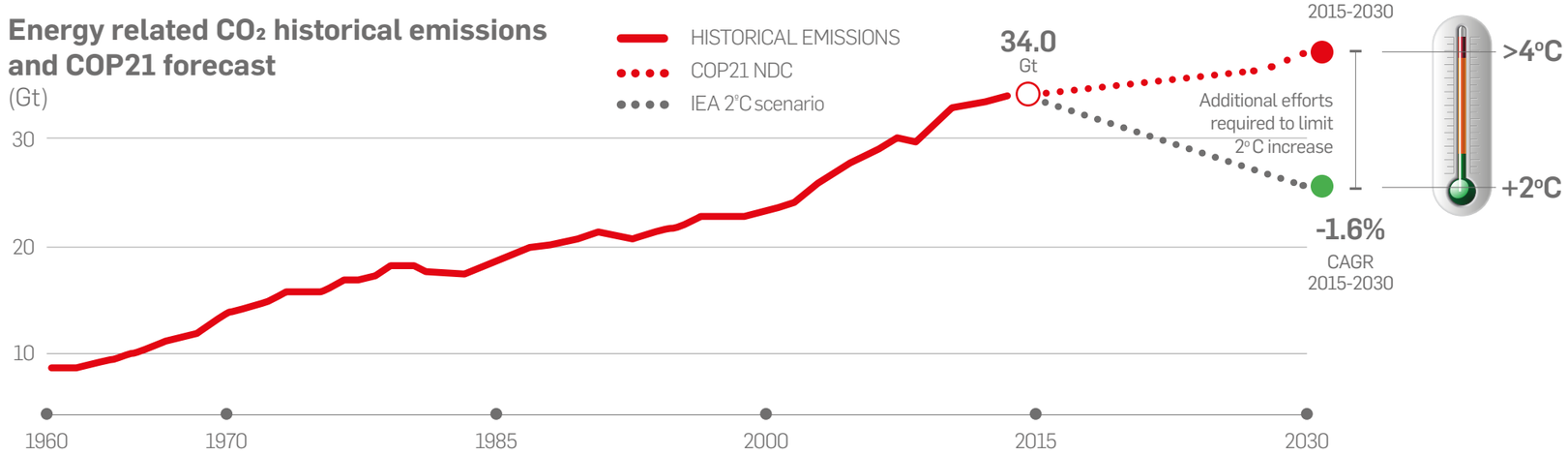


Fig. 45. The 2016 COP21 Paris accord requires unprecedented cuts in CO_2 emissions

■ Source: IEA, Cepsa Analysis

Energy and carbon intensity reduction and forecast
(CAGR % change in the period)

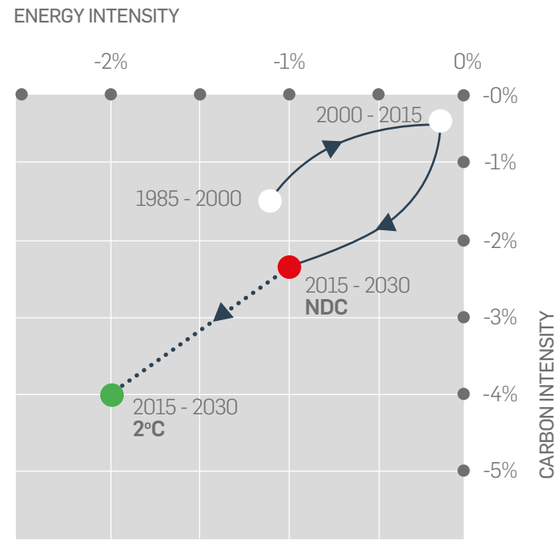


Fig. 46. The ambitioned COP21 carbon and energy intensity reductions are still far from the current intended NDCs.

■ Source: World Bank, Cepsa Analysis

The agreement reached at the COP21 Paris climate accord in 2016 has the potential to become a turning point for the entire energy industry, because the agreed emission cuts targets will entail the most stringent reduction in carbon and energy intensity levels in history. The Agreement sets the stage for an orchestrated effort to curb global CO_2 emissions. The parties that account for 99% of the world's emissions between them agreed to contain the rise in the earth's mean temperature to 2º C above pre-industrial levels by 2100. As the estimated temperature rise to date is already 1.2 —1.4º C, that leaves little room for maneuver.
However, the aggregate net effect of the submitted National Determined Contributions (NDC) is that emissions will still be growing in 2030, whereas they will need to come down to make the 2º C scenario a reality. Signatories will thus need to make bolder pledges when the Paris Agreement plans are reviewed in 2025.
The USA's withdrawal from the Agreement will put even more pressure on the 2º C scenario. Nonetheless, the administration's recent announcement will have no immediate effect as the Agreement requires any ratifying signatory to remain party to the accord for at least three years. USA federal policies and pledges may have a limited impact on thwarting decarbonization efforts due to initiatives at state and local level; California, for instance, has already committed to 100% renewable power generation by 2045. Furthermore, underlying shifts in economic and social behavior, combined with corporate policies, may allow market forces to ultimately enable decarbonization.
Also, key polluting powerhouses such as China, Russia and EU had ratified the Agreement before the USA's decision to abandon it.

COP21 was only the latest of several bids to decarbonize and bolster energy security

Governments, especially in Regulators, had already moved toward reducing emissions and dependency on fossil fuels well before the Paris Agreement. Measures taken over the last decade include carbon pricing, setting quotas for renewables within the energy mix, and stricter efficiency standards.
Economic growth has thus decoupled from rising CO_2 emissions and by 2030 carbon intensity will be falling faster than ever before.

Carbon intensity
(kt of CO_2 per million dollars of GDP)

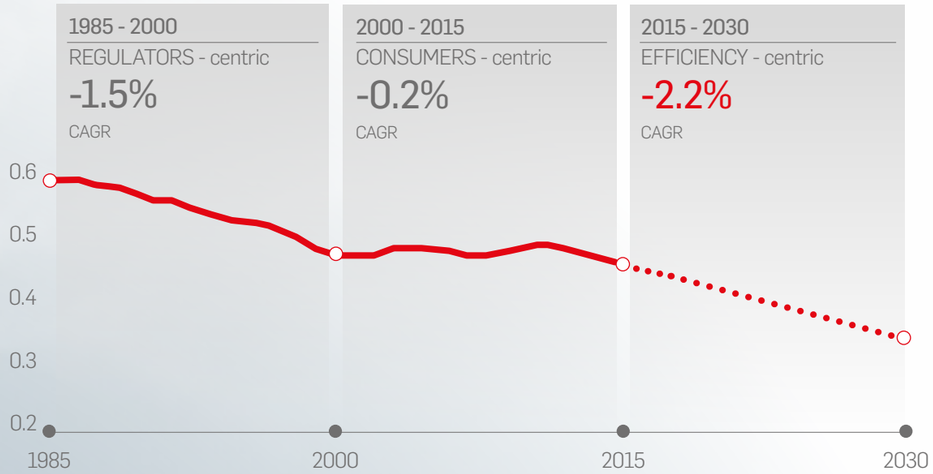


Fig. 47. Carbon intensity will experience a remarkable reduction as a result of efficiency initiatives and renewable energies penetration.
Source: World Bank, Cepsa Analysis

Carbon pricing: a market-based measure requiring international coordination

One way to combat CO_2 emissions is to levy a charge on those that emit most by putting a price on carbon, either in the form of a tax or requiring emitters to purchase permits.
Carbon pricing could become the most powerful market-based solution to cut emissions when it is implemented worldwide. Carbon pricing instruments already covered almost 15% of global greenhouse gas emissions in December 2016, having doubled in number in just four years. In addition, 78 parties to the Paris Agreement indicated that they would either implement —or consider implementing— pricing. However, a clear global carbon-pricing signal has yet to emerge because prices are not yet comparable between countries, so closer international coordination is required.

Setting renewables quotas

The lack of international coordination to bring about a global carbon price has turned renewable energy quotas into the most attractive way for policy makers to reduce emissions. Renewable energy policies in the power sector are currently in force in countries that account for almost 90% of the world's population, and cover 40% of global energy-related CO_2 emissions. Looking ahead, the increase in renewables penetration will allow the carbon intensity in the power mix to be 25% lower.

Boosting efficiency standards

Efficiency will be the most relevant factor in curbing CO_2 emissions in the next few years. By the end of 2015, efficiency standards had already been set in countries accounting for more than 30% of final global energy consumption. Improved insulation will be the focus for efficiency in buildings, in order to save energy in cooling and heating, as well as energy-saving lamps and devices.

CO_2 emissions are not expected to peak before 2030

■ Although progress has been made in slowing down the rise in CO_2 emissions, they are not expected to start on a downward path until after 2030.

Under a Business-As-Usual scenario, the increase in CO_2 emissions between 2015-2030 would be ten times higher than under our scenario, in which we forecast that three factors will hold sway. Enhanced efficiency will be the most important factor, and cut emissions by a further 1.8% (CAGR).

Energy related CO_2 emissions vs. business as usual scenario
(Gt)

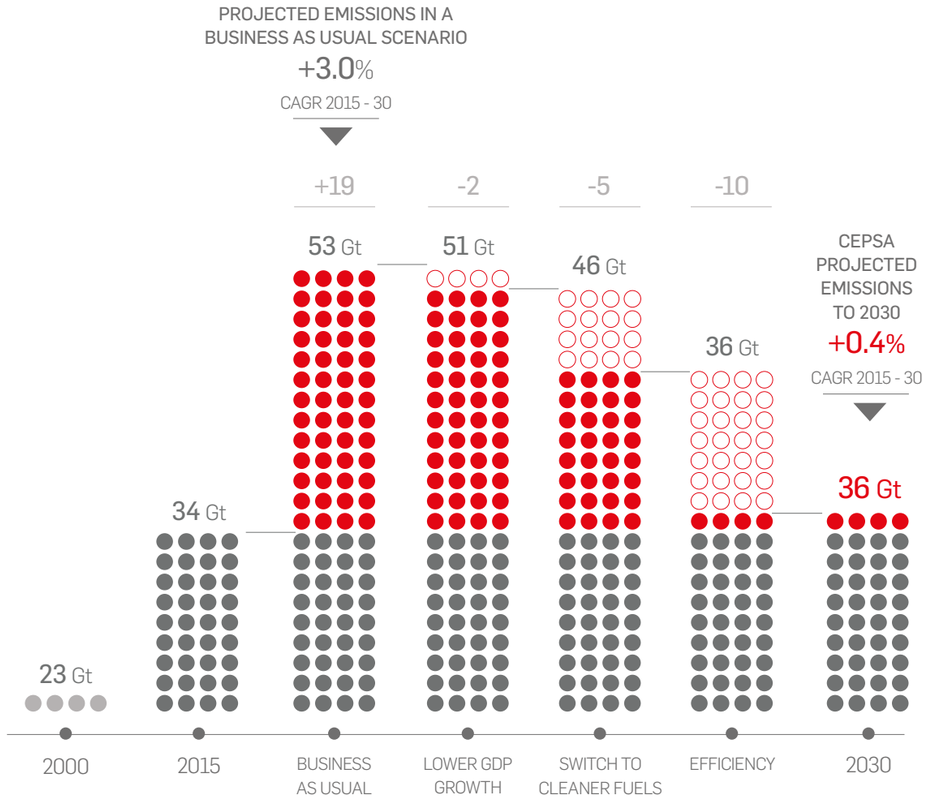


Fig. 48. Despite efforts to thwart the rise in energy related CO_2 emissions, they will not peak before 2030 and instead grow by 0.4% p.a.

■ Source: IEA, Cepsa Analysis

LOWER GLOBAL GDP GROWTH

Lower global GDP growth than expected will curb the forecast rise in energy consumption and thus trim emissions growth by 0.2% (CAGR) from the business-as-usual scenario over the next few years.

ENERGY INTENSITY REDUCTION

The increasing use of renewables, and replacing coal-fired generators with gas plants, will cut forecast emissions by another 0.6% (CAGR).

SWITCH TO CLEANER FUELS

The combined effect of these three factors will thus be to slash the projected increase in emissions from 3% (CAGR) to 0.4% over the next 15 years. Nonetheless, total emissions in 2030 will be 9% higher than in 2015 and still growing, so they will not peak in that time frame.

EMISSIONS

By sector

Transport will take the lead as the fastest growing CO_2 emitting sector

■ Industry will emit slightly less CO_2 but still lead other sectors.
Buildings have the biggest potential for decarbonization, as 70% of their emissions are due to power generation. Transport will continue to rely mainly on fossil fuels and will account for the highest growth in emissions in the next few years.

Energy related CO_2 emissions by sector

2015-30 (Gt CO_2)

Energy related CO_2 emissions due to power generation have been allocated according to electricity demand in each sector.

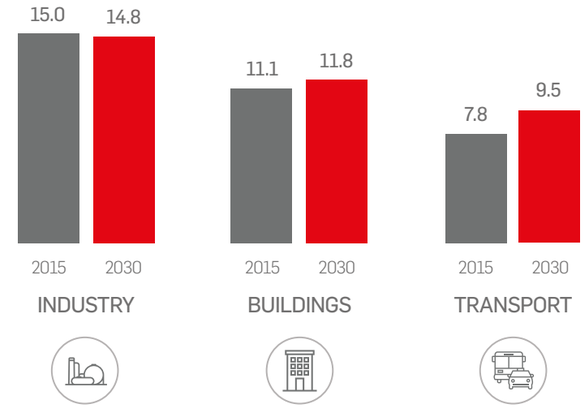


Fig. 49. Industry will still be the world's largest energy related CO_2 emitter, but buildings and transport will increase their emissions as they demand more and more energy.

■ Source: IEA, Cepsa Analysis

Industry will still be the biggest emitter in 2030 due to its high carbon intensity, however total emissions by this sector will decrease slightly for the first time ever as China shifts toward a services-based economy.
Buildings will increase in overall emissions due to galloping urbanization. However, because more than 70% of CO_2 emissions by this segment come from power generation, it has great potential for decarbonization in the future due to increasing renewables penetration in the generation mix, among other factors.
Transport activity will rise by 60% between 2015-30, and as it will still rely mostly on fossil fuels, it will increase emissions at a rate of 1.3% per annum and outpace other sectors.
Efforts to cut emissions in this sector will be focused on the increased use of electric vehicles, as well as market-based measures for aviation and shipping.
For EVs to have a significant impact on cutting CO_2 emissions, the additional power generation required to charge them up will need to migrate from fossil fuels to renewables. Nonetheless, many countries will have a hefty share of fossil fuels in their power mix, so emissions due to generating electricity for transportation will actually rise from a share of 3% to 5% of the total by this sector between now and 2030.
Aviation, for its part, accounts for 2% of CO_2 emissions due to human activity. Air passenger-kilometers are expected to double by 2030, which meanwhile could make emissions in this sector rise by 300%. To curtail this potential rise, the International Civil Aviation Organization (ICAO) is set to endorse the Global Market-Based Measure to offset CO_2 emissions from international air travel, and contribute to carbon-neutral growth by the sector from 2020 onwards.
As for shipping, the IMO has promised to look into introducing global market-based measures to cut marine CO_2 emissions, which are due to be implemented by 2023.

Economic growth in Consumers and sustained living standards in Regulators stand in the way of a faster emissions reduction

■ The main challenge for Regulators will be to maintain living standards while curbing emissions.
Consumer countries will need to sustain economic development without increasing per capita emissions to the same level as in Regulators.
Energizers will need access to cutting-edge energy to decouple economic development from increasing emissions for the first time ever.

Regulators account for a quarter of global emissions, of which they have the world's highest per capita levels. They are expected to cut per capita emissions, yet remain well above the global average as they maintain high living standards.
Consumer countries are home to most of the world's population and thus have the biggest share of carbon emissions in the world, at 50%.

Per capita levels are still below the global average but expected to rise above this threshold over the next 15 years due to increased energy demand, particularly in China.
In Energizers, meanwhile, per capita emissions will actually decrease as the population grows, particularly in sub-Saharan Africa, but limited economic growth will hold overall emissions steady.

CO_2 emissions vs. time per region and per capita
2000-15-30 (Gt CO_2)

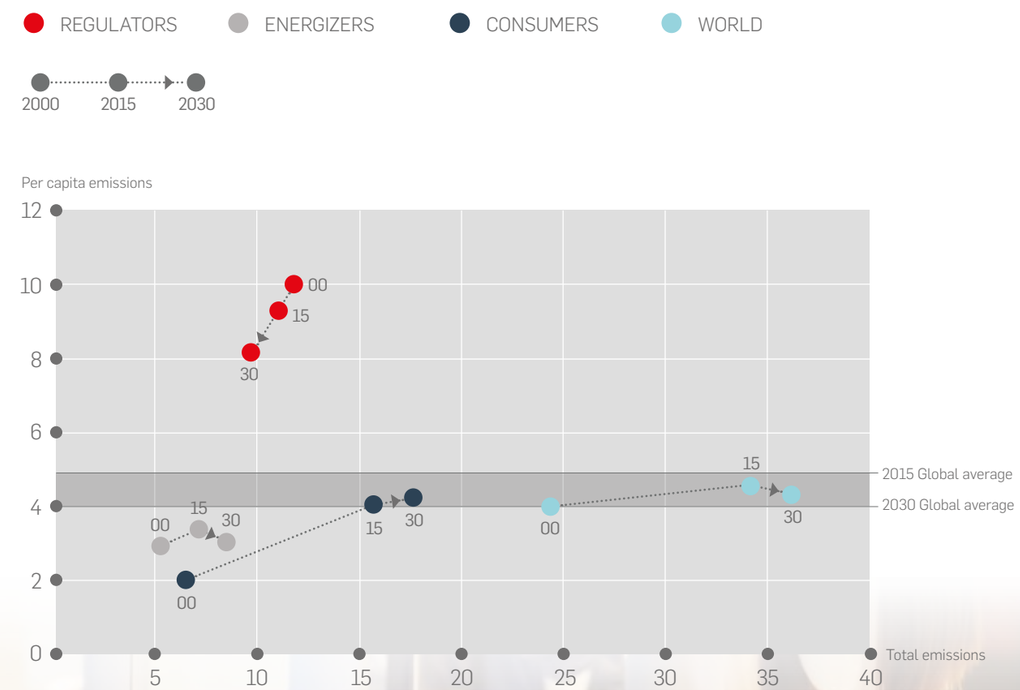


Fig. 50. Regulators will curtail emissions significantly, but developing regions in Energizers and Consumers will be able to hold their per capita emissions close to average levels.

■ Source: World Bank, Cepsa Analysis

10 SPAIN

SPAIN

A unique 21st century player

Spain is, in many ways, a global benchmark in the energy sector. The country enjoys a privileged geostrategic location being in close proximity to emerging markets in North and West Africa, and at the gateway for European energy trading markets.

Its refineries are among the most competitive and efficient in Europe thanks to the heavy investment programmes executed during the last decade. Domestic infrastructure for petroleum products, gas and electricity is very well developed, improving energy security and flexibility.

Spain has also managed to embrace the energies of the future and gradually transform its energy footprint. Thus, in many ways Spain, is a pioneer and an example for other countries in its early adoption and widespread use of renewable energy sources.

"A few years ago I decided to set aside some of my land in the Jerez countryside to build a new wind park. Now it is great to see how the cattle can graze while the turbines generate electricity".

And with the extra income I can now take the high-speed train to Madrid more often, and visit my daughter in just 3 hours. She is studying electrical engineering and tells me that one day she will build wind generators and solar panels for people like me".

Pilar, 48
Spain, Wine producer

An ageing population and dwindling workforce will mark Spain's future population trends

■ Spain's population will age as life expectancy increases while birth rates continue to decline. The labor force will decline as more people reach retirement age and fewer youngsters replace them.

Spain, like most of the European Union and OECD countries, has coped with a declining population fruit of lowering birth rates. This trend went temporarily into reverse during Spain's 2000-08 economic boom, which lured migrants that boosted the country's workforce and population.
New arrivals ceased after Spain entered into contraction in 2009, however, and the economy is unlikely to draw large numbers of migrants again. As fertility rates are likely to remain low, over-65s will be the largest segment of the population by 2030, with 1-2 million less people of working age. Spain has one of the world's highest life expectancies, especially for women. Therefore, the proportion of Spain's dependants, i.e. those aged 0-15 and over 65, will thus increase from 51% to 61% of the population as a whole.

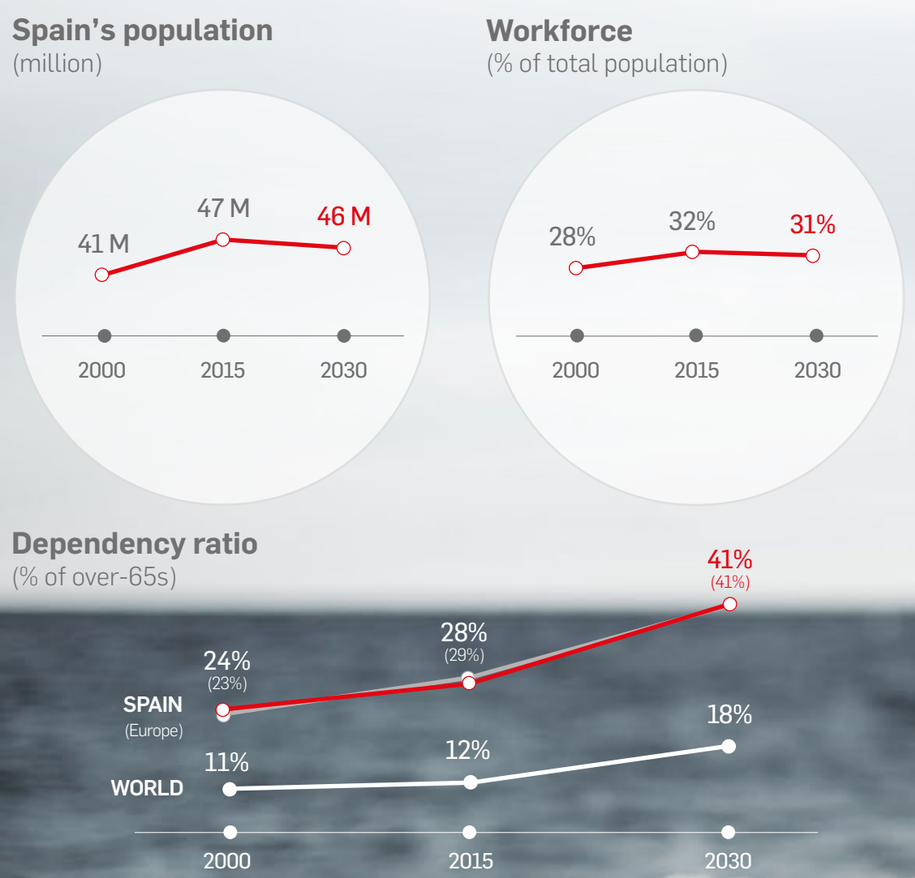


Fig. 51. Spain's population and labour force are expected to hold steady, and boost the proportion of people older than 65.

■ Source: United Nations Statistics Division, Cepsa Analysis

SPAIN

Economic outlook

Spain's economy is expected to return to steady but modest growth, in line with other Regulator countries

■ Spain's recession bottomed out in 2014 and GDP is expected to rise steadily over the next 15 years, albeit at a slower pace than during the 2000-07 boom. A graying population, high unemployment and low investment will moderate economic growth after consolidating a recovery.

There will be two distinct phases in the economic outlook between now and 2030: first, a recovery period during which the economy will make up for activity lost in the crisis years, which it is expected to do by about 2019-20; after that, demographic factors will take over and slow down Spanish growth.

Domestic demand and exports (especially in the form of massive international tourism) will drive the recovery period. Thereafter, increased economic activity will depend on productivity, so traditional labor-intensive sectors, like tourism or construction, will have to be complemented by new sectors where technology will play more of a role. In this phase, domestic demand growth rates will slow down steadily in step with a declining number of jobs created.

Spain's exports are expected to have a lasting and positive effect on its trade balance. The number of Spanish firms regularly exporting goods continues to rise and, as the domestic market has limited growth potential, exports will weigh more on the country's economic performance. Most Spanish exports will head primarily for the EU, followed by far by Asian, North African and Latin American markets.

Spain GDP

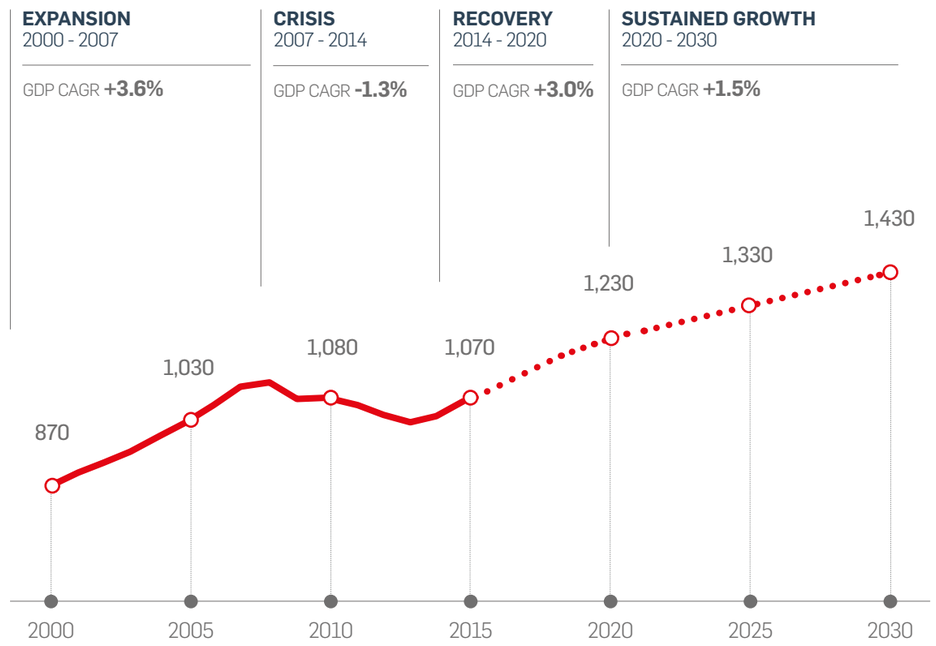


Fig. 52. Spain's economy will undergo solid recovery until 2019-20. Growth is then expected to slowdown and average 1.5% in the 2020-30 period, in line with European peers.

■ Source: Cepsa Analysis, Banco de España

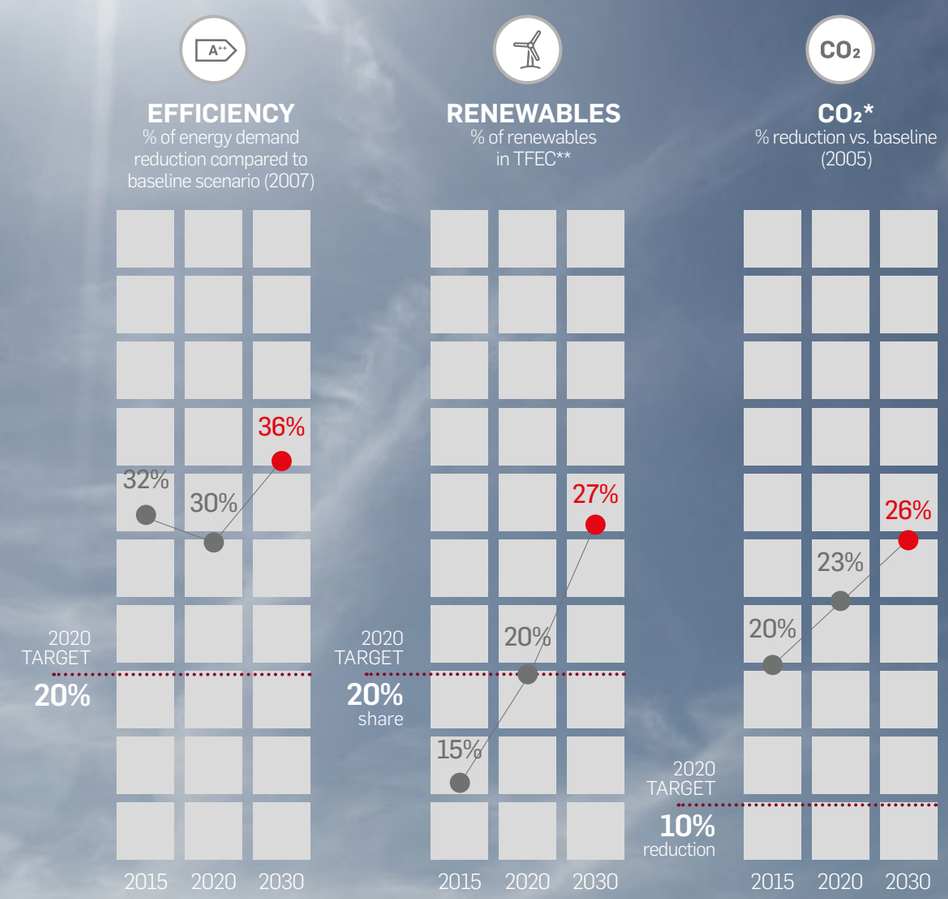
SPAIN

Regulatory environment

European climate and energy targets will be the main driver for the Spanish energy sector

■ The European Union climate and energy framework has set long-term goals in keeping with the aim to cut greenhouse gas emissions in 2050 by 90-95% from 1990 levels.
The current regulatory framework has set key targets for 2020, such as boosting efficiency and the role of renewables while cutting CO_2 emissions. 2030 targets will be set in a new framework to be approved in 2020, and are likely to be tighter.

Under the terms of the EU's 20-20-20 environmental directive, Spain has committed to cutting its final energy demand by 20% compared to the baseline forecast scenario built in 2007. Spain is widely expected to comply with this target despite energy demand rising until 2020 due to increased economic activity.
The target to boost the share of renewables in each country's final energy demand to 20% by 2020 could be achieved in Spain by increasing the use of renewable sources in power generation, mainly wind and solar. Other renewable sources, like biofuels in transport, will make a much more modest contribution.
The emissions reduction targets for 2020 is to reduce CO_2 emissions by 10% from 2005 levels in the sectors not subject to the European Emissions Trading System (ETS), the so-called diffuse sectors. These sectors are domestic transport (excluding international aviation and shipping), services, residential and agriculture. The rest of the emitting sectors, such as refining or power generation, are the most energy and carbon intensive and do not have targets at individual country level but an overall European cap determined by the number of emission rights in the ETS.
Spain has already cut emissions in the diffuse sectors by 20% from 2005 levels and should therefore have no trouble complying with the 2020 target.



* Non-ETS sectors emissions only. ETS sectors do not have targets per country member.
** Total Final Energy Consumption.

Fig. 53. **Spain will comply its commitments within the European energy 2020 framework.**

■ Source: European Commission, Cepsa Analysis

Energy demand will rebound slightly in the next few years then drop to meet 2030 targets

■ Spain is expected to meet an EU target of boosting efficiency by 30% in 2030, which will offset the impact of economic growth and drive final energy demand back down to around today's levels.

Along with other Regulators, Spain's total energy demand today is well below the heights it scaled during a long boom that ended when the global economy entered crisis in 2008-09.
In the next few years, although economic growth will be slower than in the boom years (but steady), two phases with distinctive trends will be seen. The first phase will last until 2019-20 and be driven by economic recovery, which will be strong enough to counteract a sharp ongoing drop in energy intensity.
Subsequently, Spain's energy demand will rise up to about 2020 then fall steadily as the ongoing downtrend in energy intensity will outweigh the impact of moderate economic growth. By 2030, energy demand will be back to where it was in 2015, therefore complying with EU energy demand reduction targets.

Spain final energy demand
2000-30
(Mtoe)

(International shipping not included)

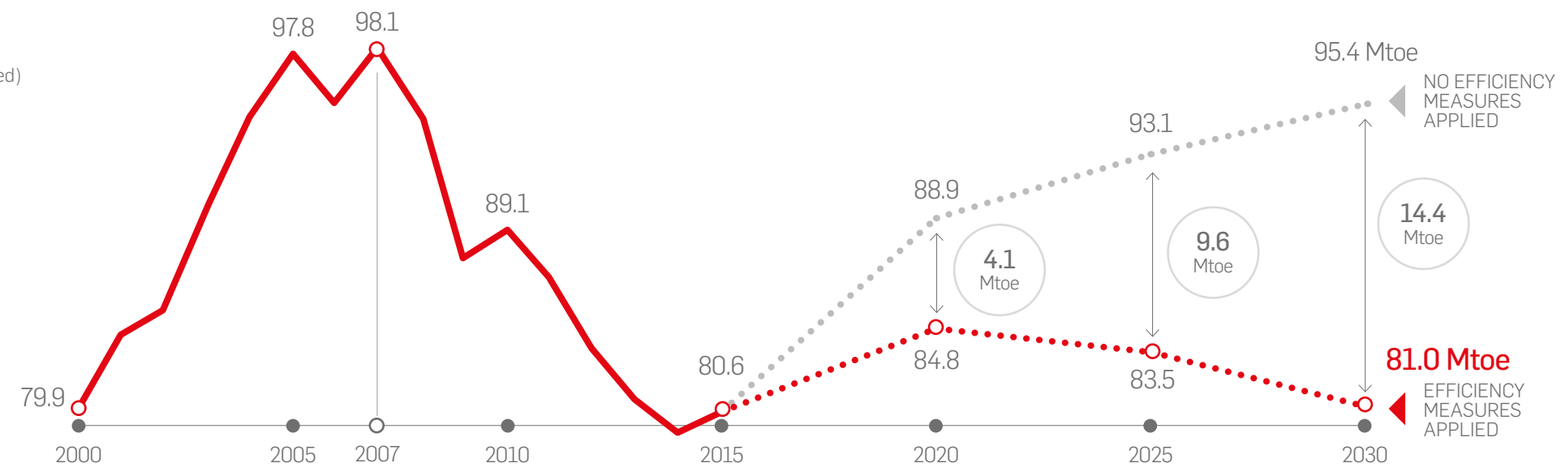


Fig. 54. Efficiency will determine Spain's energy demand and savings of some 15 Mtoe by 2030, to bring it back down to current levels.

■ Source: Cepsa Analysis

Efficiency will be felt across all sectors, particularly relevant in transport

■ Spain's forecast flat and ageing population will moderate potential growth in most end-use sectors, notably transport, where passenger demand may peak before 2030.

Growth will also be mild in the residential sector as the number of households levels out, but expansion is seen in services, buildings and tourism.

Transport will account for the biggest portion of Spain's energy demand in 2030, at about one-third of the total. Passenger travel, including both cars and planes, will be about 25-30% more efficient in 2030 than it is today. Freight transport will meanwhile lag behind in efficiency terms yet reduce its energy intensity by up to about 15%.

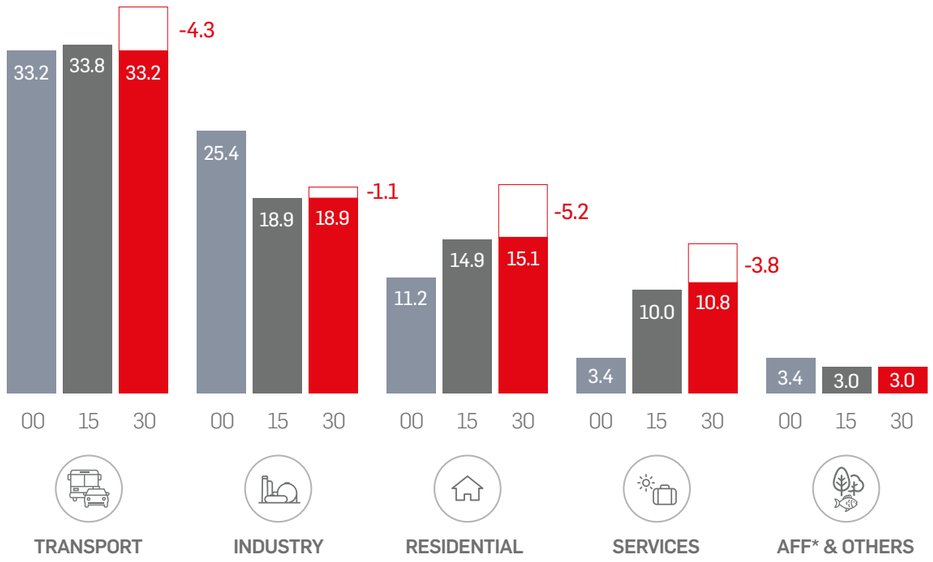
Spain's industrial sector will rank second in terms of energy demand, in the wake of a strong contraction during the economic crisis years that particularly hit energy-intensive heavy industry. Between 2015 and 2030, Spanish economic activity will be based mainly on services and thus limit industrial activity.

In the residential sector, activity will be relatively saturated as a strong regulatory drive to improve energy efficiency in new buildings will also curtail the rise in energy consumption in this sector.

By contrast, services buildings may see greater growth in energy demand because Spain's service sector is expected to grow as the economy depends less on industry. The improved economic outlook will thus have a reflection on increased levels of activity in offices and shopping centers.

Another important part of the service sector that will act as a major driver is Spain's tourist industry, which is already massive yet has vast and untapped potential to exploit cultural and natural landmarks, as well as traditional beach vacations.

Spanish energy demand by sector
2000-30
(Mtoe)



CAGR 2015-30

TRANSPORT	INDUSTRY	RESIDENTIAL	SERVICES	AFF* & OTHERS
-0.1%	0.0%	+0.1%	+0.5%	0.0%

* AFF stands for Agriculture, Forestry and Fisheries

Fig. 55. Efficiency will drive down demand slightly in every sector of Spanish activity.

■ Source: Cepsa Analysis

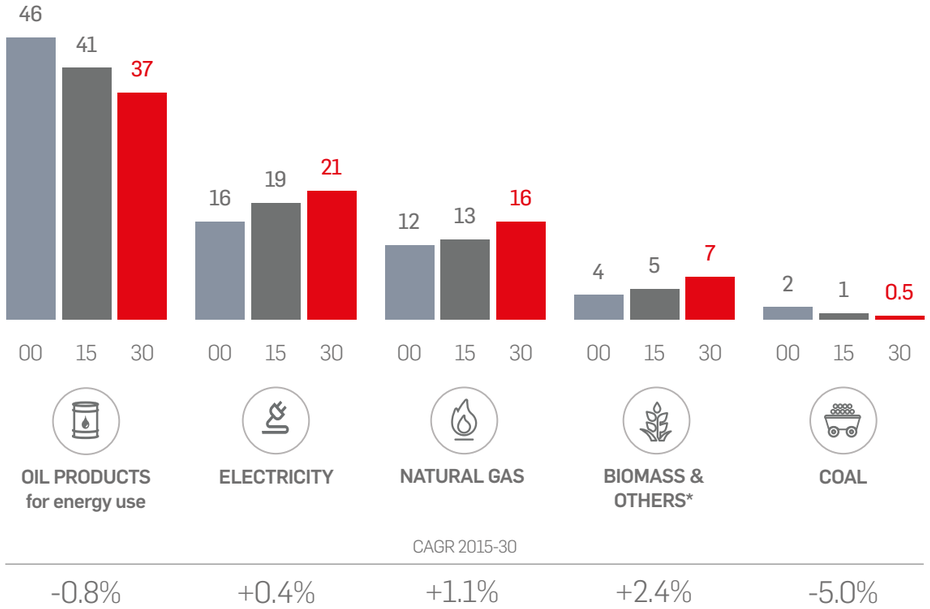
Despite their gradual decline, petroleum products will still dominate Spain's energy mix in 2030

■ As with other regulators, natural gas, electricity and biomass will be the winners of Spain's energy mix evolution, to the detriment of petroleum products and coal. Oil products, will however, still largely lead the Spanish energy mix in 2030 due to their commanding role in the transport sector.

Oil will meet almost half of Spanish final energy demand in 2030, although its share of the total will have fallen from current levels. It will dominate transport, the sector that consumes most energy, although there it will gradually lose ground to biofuels, electric cars and natural gas.
Electricity accounts for about one-quarter of Spanish energy demand and is where renewable energy sources have most scope for expanding, especially in the form of wind and solar power. Gas is expected to slowly increase its share in the overall mix due to replacing oil used for heating in residential and commercial building; in replacing carbon-intensive coal and fuel oil used to drive power generators; and its modest but increasing use in driving trucks and other heavy-duty vehicles.
Biomass use will increase substantially due to regulations requiring 8.5% of road fuel to be made from biofuels, in order to comply with European Union targets. Along with the forecast boom in renewable sources used in power generation, mandatory blending in road fuel will help Spain meet a target to derive 27% of its 2030 energy mix from renewables.

Spanish final energy consumption by energy source

2000-30
(Mtoe)



* Others include solar panels for domestic use, biofuels for transport and industrial waste heating.
** Excludes international navigation and other non-energy uses of oil, such as asphalts and petrochemical feedstocks.

Fig. 56. Oil products will be Spain's top energy source despite demand contraction. Electricity demand will keep growing, while natural gas and biomass will grow most and coal dwindles.

■ Source: Cepsa Analysis

SPAIN

Power mix

Spain's wind and solar capacity will need to more than double by 2030 to comply with renewable energy targets

■ Spain's power sector can already boast of high wind and solar penetration, yet installed capacity in these two technologies will have to soar to comply with the European renewable energy targets.

Share in the power generation mix by source

(%)

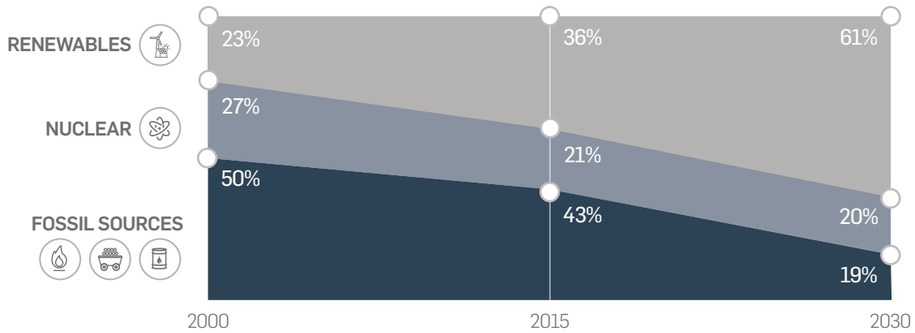


Fig. 57.Renewables will dominate the Spanish power generation mix to the detriment of fossil fuels.

■ Source: Cepsa Analysis

By 2030, renewables will meet more than 60% of Spanish electricity demand in order to comply with overall renewable energy targets. Out of all electricity generated, wind and solar power will need to account for 50%, up from 27% today.

That will translate into installing around 50 gigawatts (GW) of new wind and solar power plants, on top of 30 GW today. Wind will reinforce its leading role in Spain's power mix and account for two-thirds of the increase, with solar photovoltaic plants accounting for the rest.

Auctions are the preferred route to encourage installing new capacity, and an average rate of 3 GW every year would be required until 2030. Installed capacity is likely to remain steady in gas-fired cogeneration and combined-cycle plants, although their utilization rates are expected to drop as new renewable power sources enter the mix.

Hydroelectric capacity will remain constant, while nuclear capacity might be reduced slightly. Coal and oil-fueled power stations will continue to lose ground as they will be phased out and replaced by gas-fired plants or renewables.

Installed capacity by source

2015-30

(GW)

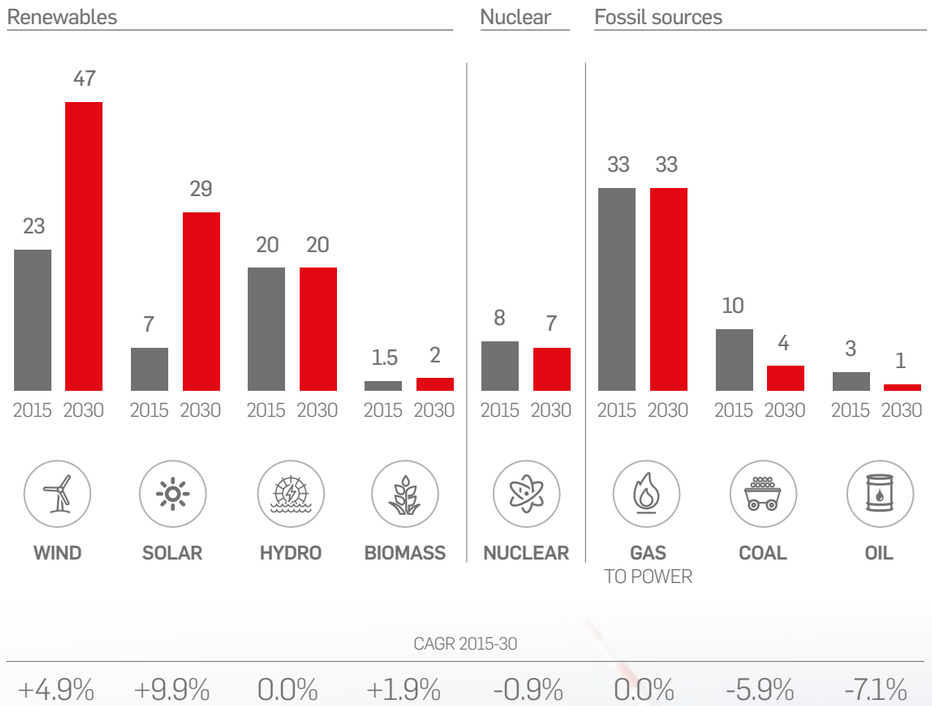


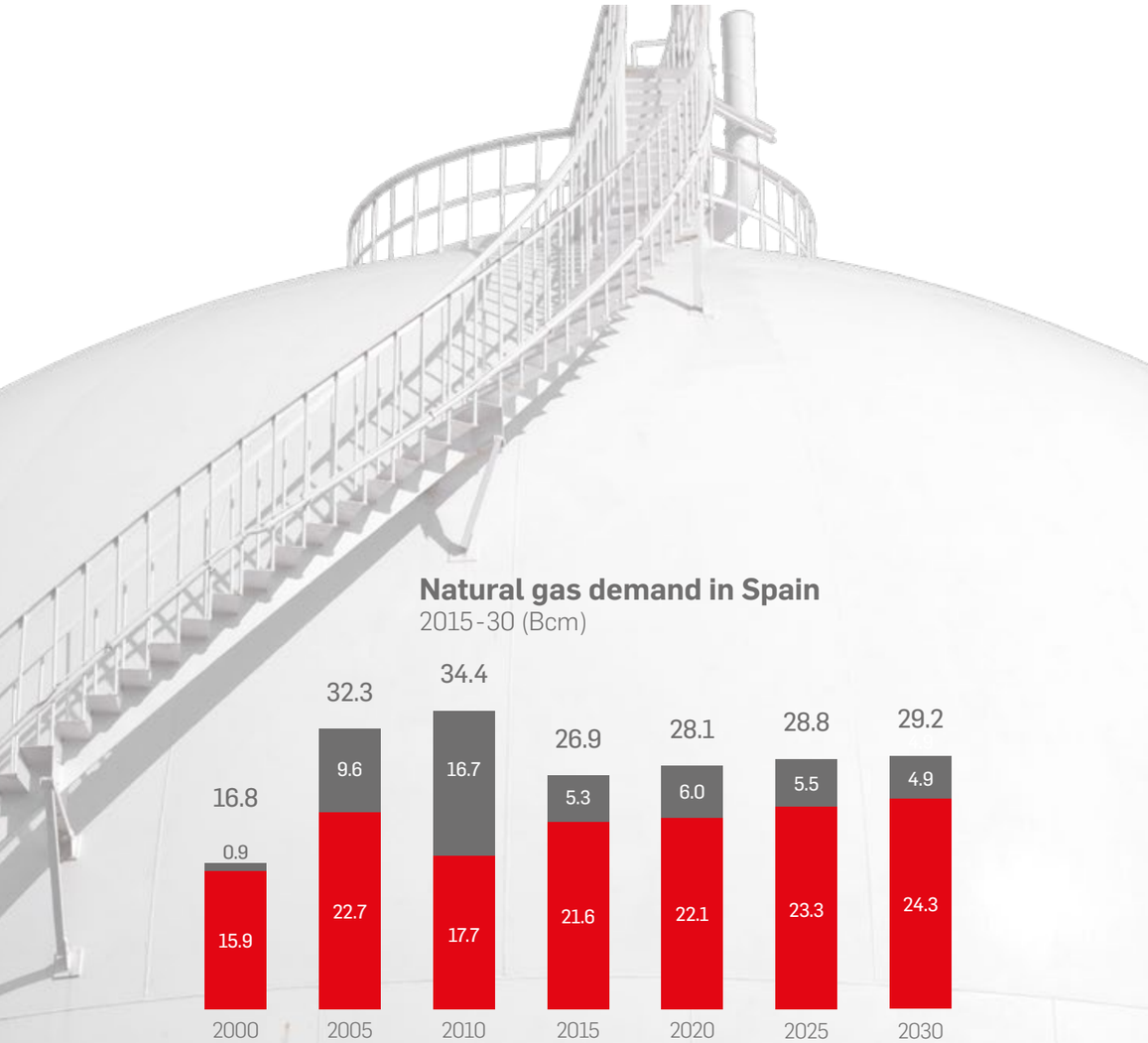
Fig. 58. Installed wind capacity is expected to double, solar to grow fourfold and gas to stay put.

■ Source: Cepsa Analysis

Natural gas demand will grow by 15% despite its reduced use in power generation

■ Two counteracting forces will play out in future natural gas demand in Spain. On the upside, the gradual switch in industry from oil products to gas will boost demand, while on the downside, lower utilization rates of combined-cycle plants due to renewables penetration in the power mix, will cut it.

Gas demand will rise by some 0.5% p.a. between now and 2030, mainly due to growth outside the power sector. The two sectors providing most growth will be industry and road transport. Phasing out oil —and coal— fired boilers in favor of cleaner and more efficient gas units will be the main growth driver in industry. In the road haulage sector, meanwhile, growth will be driven by the increasing use of natural gas-fueled trucks, whose share of the total fleet will rise from negligible levels in 2015 to 2-3% in 2030.
Gas demand will hold steady in other final demand sectors, such as housing and services, where little additional activity is foreseen.
By contrast, the trend in the power sector will be quite the opposite. Increasing penetration of renewables will further undermine the average utilization rate for combined-cycle plants, which will account for just 7-8% of all electricity generated in Spain in 2030. Activity levels will hold steady for cogeneration plants, which are used mainly to produce heat or steam for industry, thus their demand for natural gas in 2030 will be similar to what it was in 2015.
Gas will slightly increase its share of Spain's energy mix to account for about one-fifth of the country's final demand by 2030.
Pipelines from North Africa have consolidated their position as a reliable provider of gas to meet all this demand, while LNG remains a swing source.
LNG and pipelines currently supply almost equal volumes of gas and that is not expected to change.



	CAGR 2000-15	CAGR 2015-30
Power generation	+12.5%	-0.5%
Heating, transport and industry (including cogeneration)	+2.1%	+0.8%

Fig. 59. Two trends will coexist: declining gas use for power generation as the utilization rate for combined-cycle plants continues to fall; and growth in conventional use as natural gas displaces oil products.

■ Source: Cepsa Analysis

SPAIN

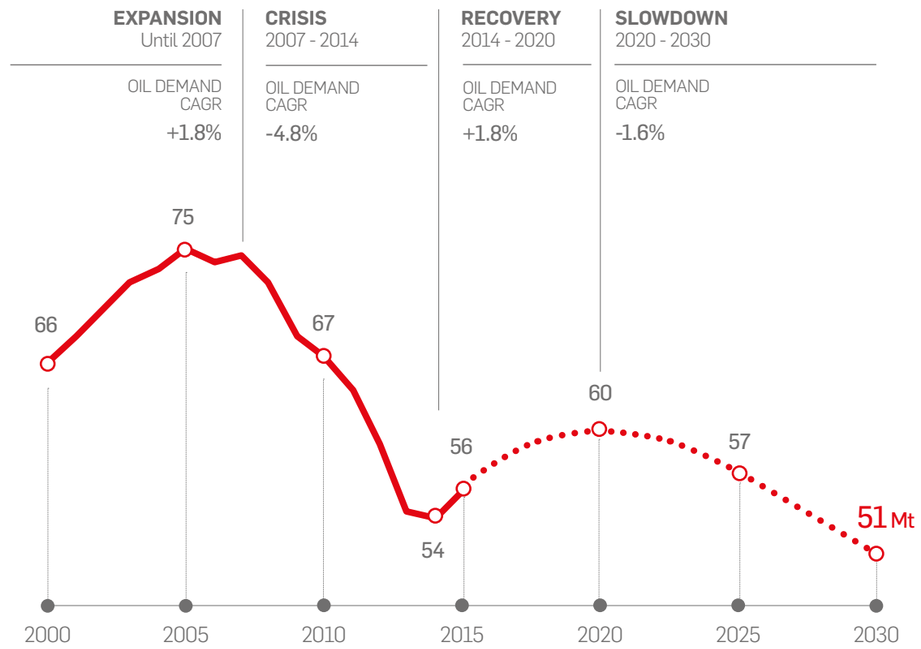
Petroleum products demand

After a few years of recovery, Spain's oil products demand will gradually decline beyond 2020

■ Oil product´s demand recovery has been under way since 2015 and is expected to last until 2019-20. Nonetheless, demand thereafter will slow down under the impact of enhanced efficiency and, to a lesser extent, oil substitutes.

In common with other Regulators, Spain's oil intensity —defined as the amount of oil required to generate $1 million of GDP— went into decline long before overall petroleum products demand peaked in 2005, due to improvements in efficiency and oil making way for different energy sources.
Nonetheless, an economic boom that lasted until 2007 was enough to offset the drop in oil intensity. After the economy entered crisis in 2008-09, petroleum products demand fell by an unprecedented 25% between 2008 and 2014. During the recession years, however, efficiency improvements and petroleum products substitution continued apace so consumption is extremely unlikely to return to 2005-2007 levels, even though the economy is now recovering and expected to rise steadily (but moderately) over the next few years.
Economic growth is expected to boost oil demand in the near future, due to increased car sales and record numbers of tourist arrivals driving demand for road and jet fuel, respectively. After 2020, economic growth will no longer be enough to counteract the effects of more fuel-efficient cars and the increasing use of electric vehicles, so demand for oil will decline steadily until 2030 and beyond.

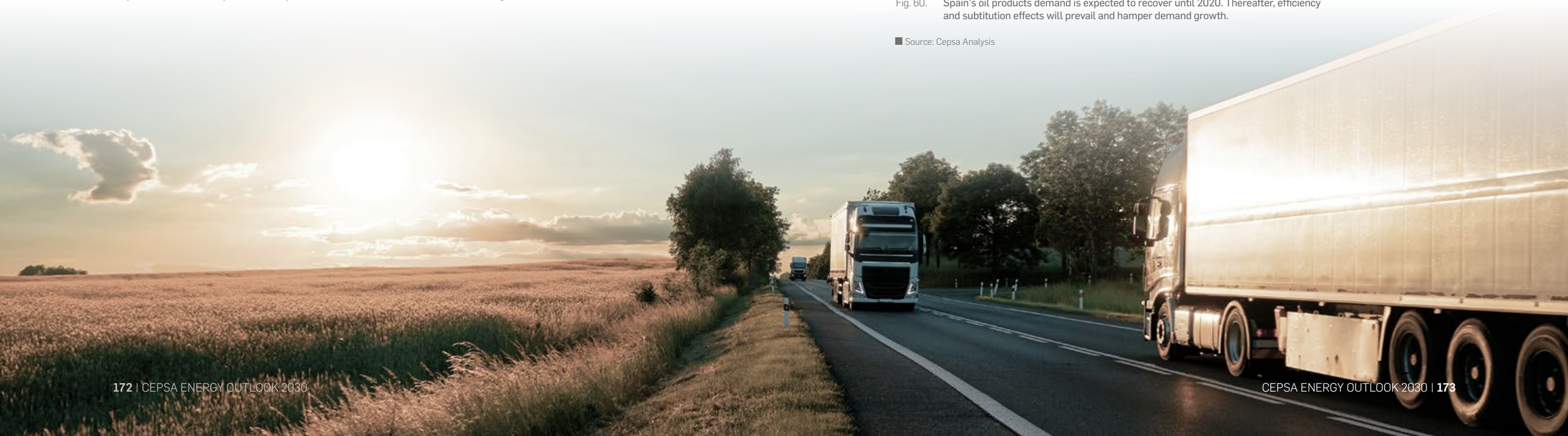
Spanish total petroleum products* demand
(Mt)



* Includes all uses of petroleum products both energy and non-energy, and international navigation.

Fig. 60. Spain's oil products demand is expected to recover until 2020. Thereafter, efficiency and subtitution effects will prevail and hamper demand growth.

■ Source: Cepsa Analysis



SPAIN

Petroleum products split and demand

The contraction of diesel and fuel oil demand will drive long term decline in petroleum products

■ Declining demand for Spanish petroleum products will mainly affect diesel and fuel oil, as gasoline will benefit from changing consumer trends. Diesel demand will drop due to an efficiency drive and new sales switching to gasoline and hybrids in a bid to cut air pollution, while fuel oil will feel the impact of substitution in power generation and international shipping.

Demand for gasoline will rise by 35% between 2015-2030. Today, most Spanish cars run on diesel although buyers are expected to gradually switch over to gasoline-burning engines and gasoline hybrids, due to environmental concerns over diesel and better fuel economy in passenger cars generally. Consequently, diesel demand will drop by a remarkable 20% between now and 2030. Demand for biofuels will meanwhile benefit from European Union targets for increasing the use of renewable energy sources, and further erode demand for diesel. The present goal is for biofuels to make up 8.5% of all road fuel (by energy content) in 2020, but blending levels might be subject to change in the following decade.

Most of the remaining drop in diesel demand will be due to homes retrofitting natural gas or biomass-burning boilers in rural areas. Extending the natural gas grid will boost conversion in some areas, while subsidies will encourage users to install costly biomass boilers in a bid to cut CO_2 emissions.

After diesel, demand for fuel oil will suffer the second-biggest drop, mainly due to new International Maritime Organization (IMO) regulations. Demand for high-sulfur bunker fuel used in shipping is forecast to plummet, but this will be partly offset by a surge in demand for lower-sulfur (less than 0.5%) fuel. Apart from shipping, the drop in fuel oil demand will be due to the dwindling number of power plants burning fuel oil in Spain, which are confined to archipelagoes like the Canary and Balearic Islands, and expected to become obsolete in the not-too-distant future.

Spanish petroleum products demand

2015-30 (Mt)

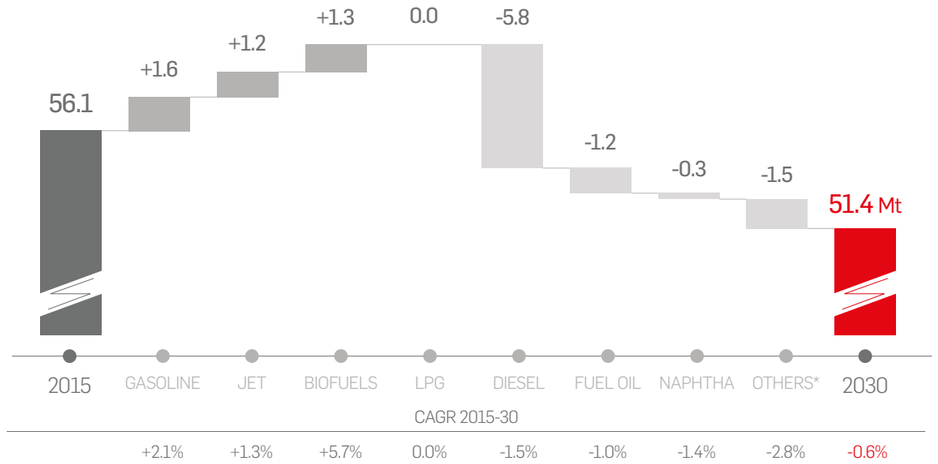
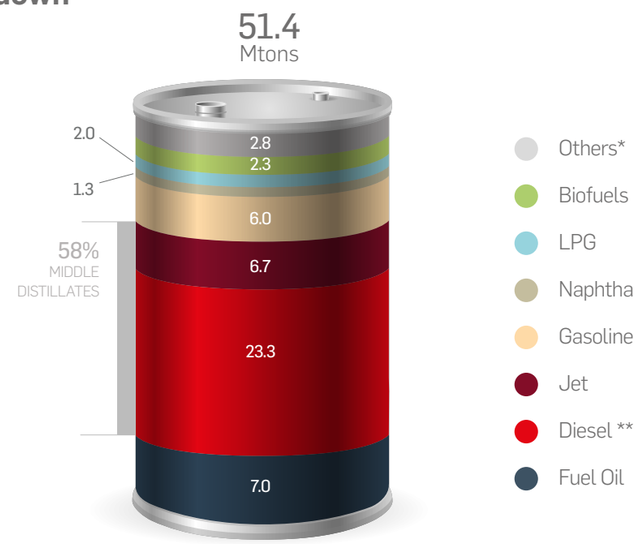


Fig. 61. Diesel, due to reduced diesel car sales, will make up the bulk of the demand contraction.

■ Source: Cepsa Analysis

Spanish petroleum products market breakdown

2030 (Mt)



*Others: include coke, asphalt and lubricants
** Diesel: include gasoil B and C

Fig. 62. Spanish petroleum products demand will continue to be largely dominated by middle distillates despite the significant contraction in diesel demand.

■ Source: Cepsa Analysis

SPAIN

Net trading balance

Spain's petroleum products surplus will double, with diesel taking up most exports

■ Diesel will overtake gasoline to become Spain's leading refined product for export, due to a drop in domestic demand.

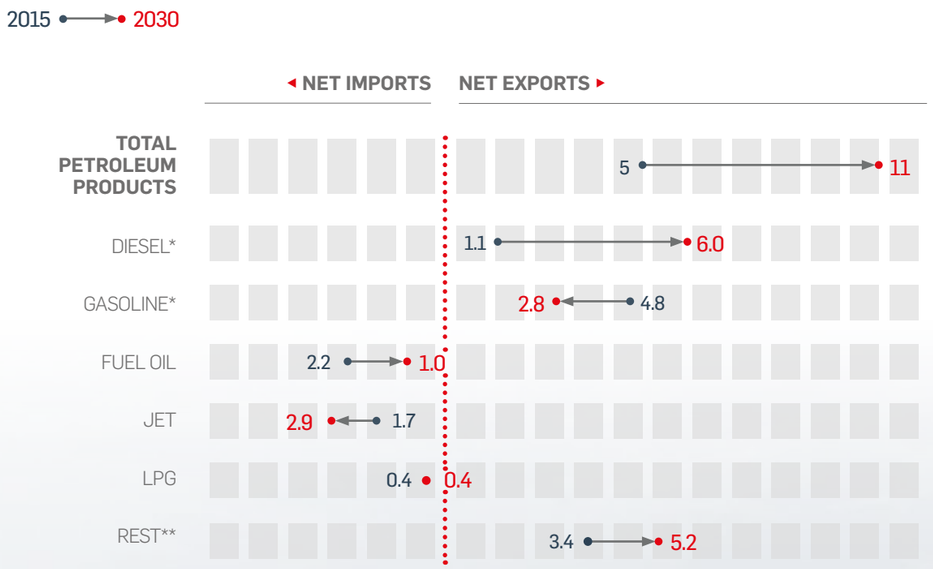
Spain's diesel surplus will grow by more than 6 million metric tonnes, assuming that refinery output stays close to 2015 levels.

Unlike Europe as a whole, Spain's refining capacity is expected to hold steady in the next few years, so exports will have to take up an increasing share of output.
Spanish refineries produced 65 million tonnes of products in 2015, but demand is seen at 51 Mt in 2030, thus an exportable surplus of 15 Mt is forecast, mainly to be sold in nearby North and West Africa, which have a shortfall in refinery output.

Diesel today accounts for over 40% of Spain's total refinery output, but demand is likely to dwindle as buyers switch to gasoline-driven cars in Spain and Europe, thus it stands to take up half of the forecast surplus by 2030.
Spanish refineries will see more of their gasoline production going into the domestic market as a response to the shift away from diesel in passenger cars. This would reduce the surplus, but its impact would be limited.

Spanish petroleum products trade balance*

(Mt)



*Figures include blended biofuels in diesel and gasoline formulation.
**Non exhaustive. It mainly includes coke, asphalts, lubricants and naphtha.

Fig. 64. Virtually all products will see their surplus grow, except gasoline. Spain's diesel surplus will raise sixfold due to a sharp drop in domestic demand.

■ Source: Cepsa Analysis

Spanish total petroleum products trade balance overtime

(Mt)

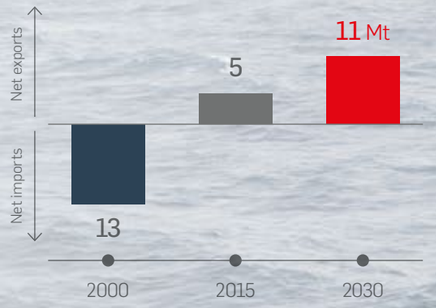


Fig. 63. Spain surplus will more than double as domestic demand dwindles.

■ Source: Cepsa Analysis

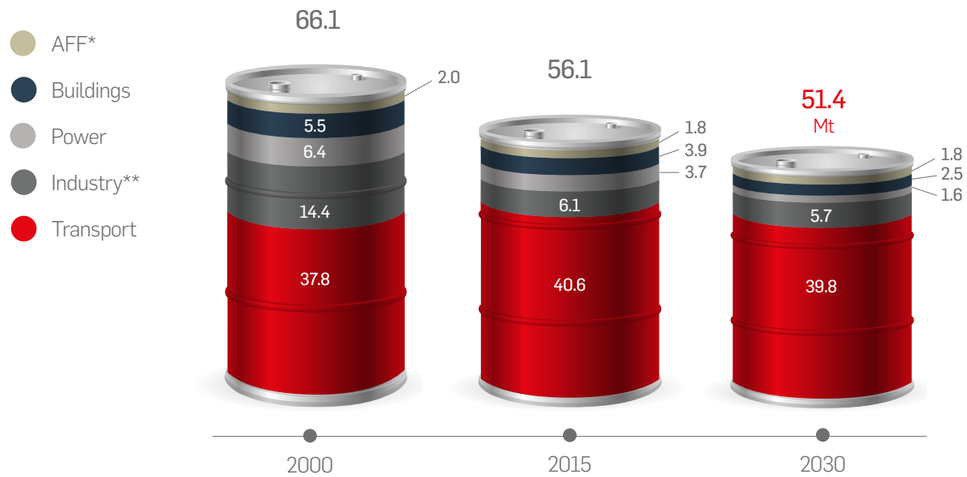
SPAIN

Sectoral demand

Oil products demand will be eroded mostly in those sectors where substitution is easiest

■ Increased activity by heavy-duty vehicles will help transport withstand the broad downtrend and edge up its share of Spanish demand for petroleum products to 77% in 2030, from 75% in 2015. Demand will suffer most in industry, power and buildings, due to greater fuel efficiency and substituting for gas.

Spanish oil products demand
(Mt)



* AFF includes agriculture, forestry and fisheries.
** Includes petrochemical feedstock and other non-energy uses such as coke, asphalts and lubricants.

Fig. 65. Transport will still be the most important sector and hold on to its demand for petroleum products in the future.

■ Source: Cepsa Analysis

As in other Regulators, the transport sector dominates Spanish consumption of petroleum products. Where Spain stands out is that aviation is relatively more important because the country is the world's third biggest international tourist destination. Shipping also has more of an impact on Spain's demand for petroleum products due to Gibraltar's strategic location on international routes. Overall, although transport will succumb to the broad downward trend in products consumption, it will withstand the impact better than other sectors and be the only one not to fall back to levels seen in 2000.

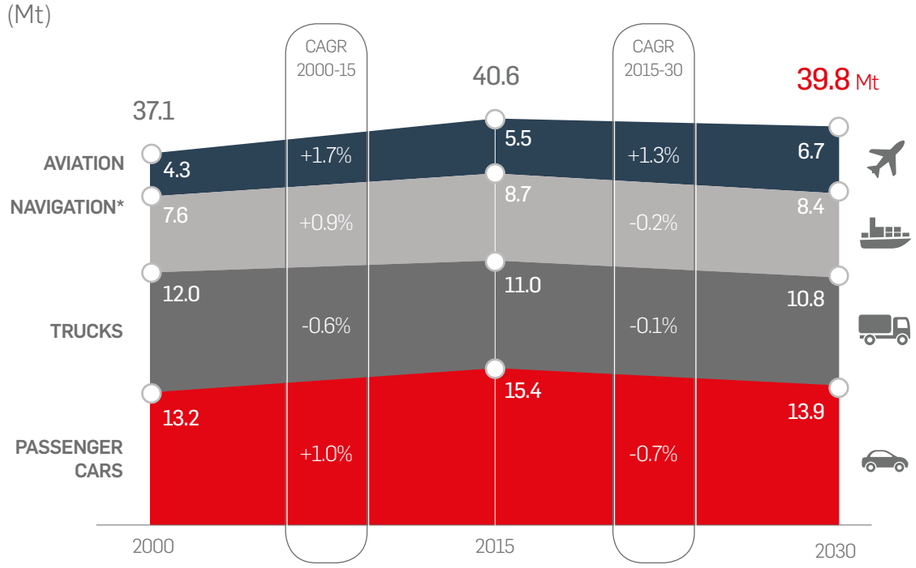
Petroleum products will fare less well in other sectors due to competition from alternative energy sources, notably natural gas and —more recently— renewables. Renewables and gas have made big inroads into power generation, while in industry petroleum products consumption is expected to continue on a downward path under way for some years, as gas oil and fuel oil boilers have made way for cleaner-burning gas-fired boilers.
In buildings, a similar trend is under way in which natural gas has replaced oil products previously used for cooking and heating.

Aviation, trucks and shipping will support demand for products in transport

■ Demand for road fuels will drop by 1.7 million tonnes over the next few years as new cars will have greater fuel efficiency and more electric vehicles will be sold. Heavy duty vehicles such as trucks and buses will actually see demand holding steady, due to increasing activity and more modest improvements in fuel efficiency.

Spanish demand for oil products by transport sector

(Mt)



* Navigation includes domestic shipping: 1.4Mt in 2000, 0.5Mt in 2015 and 0.4Mt in 2030.

Fig. 66. Passenger cars will account for most demand contraction due to the enhanced efficiency and penetration by electric cars. Jet fuel demand will be on the rise.

■ Source: Cepsa Analysis

Spain's aviation sector is relatively important because the country is the world's third biggest international tourist destination. Aviation will boost consumption to 6.7 Mt from 5.5 Mt between 2015 and 2030, due to an expected increase in international tourist arrivals of 10-15% in the next decade, and to greater volumes of airborne freight in step with Spain's rising exports.

Demand from international shipping will drop slightly due to the impact of the international Maritime Organization (IMO) sulfur mandate, which is due to come into force in 2020 and will make itself felt in Spain due to the country's location on major shipping routes. An expected increase in activity would otherwise have raised demand in this segment by 1 Mt.

Trucking activity will still be considerable in the coming years, as road haulage will gain momentum due to an increase in online shopping that will require moving a large volume of goods across the country.

Demand for oil products by passenger cars will be hit the hardest. New mobility patterns along with fleet electrification, limited new car sales and, above all, stark efficiency gains in ICEs will lead to a drop in the overall comsumption of oil products in this segment.

SPAIN

Passenger cars segment

A 25% gain in fuel efficiency will hit demand for oil products from car drivers

■ Spanish driving has little scope for growth, so a forecast moderate rise in passenger-kilometers traveled by road will not be enough to offset a substantial increase in efficiency.

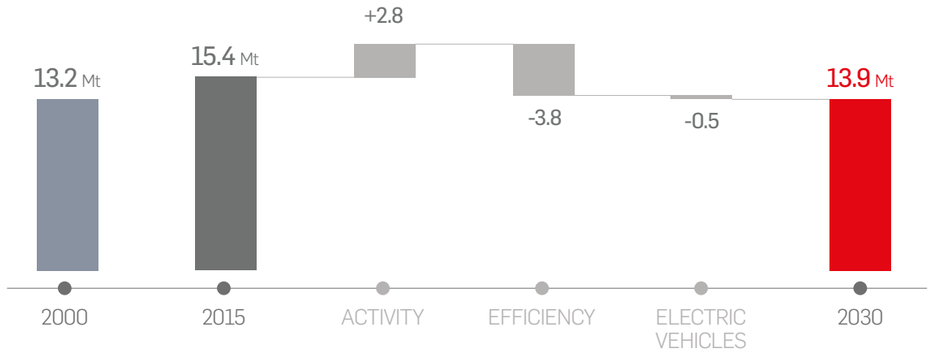
Electric vehicles will have a modest but growing impact as their share of passenger car sales will rise to 15% of the total in 2030, from negligible levels today.

Passenger cars are expected to account for a larger share (about one-third) of total oil consumption in Spain than any other segment, and thus they have been the focus for efforts to curb CO_2 emissions in line with European targets. Average emissions in new cars in Spain in 2015 were 115 g per km, or well within a European limit of 130 g, due to the increased use of lightweight materials and electronics, as well as more efficient engines. The EU requires average emissions to fall by another 20% to 95g/km CO_2 by 2021, a goal that looks feasible. The EU has yet to decide where to set limits after 2021, but cars do have scope for greater efficiency. Driving more hybrid cars can reduce urban oil consumption by one-quarter, as well as pave the way for greater electrification of the passenger vehicle fleet.

The impact of all these improvements will be slow to take effect, however, because they only apply to new cars, annual sales of which account for just 4% of the total Spanish fleet.

Oil demand from Spanish passenger cars*

2000-30 (Mt)



* Passengers cars include private cars, SUVs and motorbikes.

Fig. 67. Efficiency gains in passenger cars will offset additional consumption due to driving a greater number of kilometers.

■ Source: Cepsa Analysis

Average oil consumption by Spanish cars in 2030

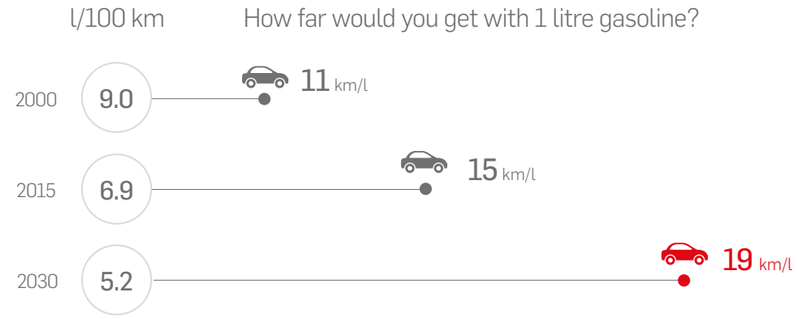


Fig. 68. Average fuel consumption is expected to continue its relentless decline.

■ Source: Cepsa Analysis

SPAIN

Car sales evolution

Combustion engines will still dominate the Spanish car fleet but hybrids will grab a significant share of new sales

■ Internal combustion engines will still power 96% of Spain's passenger car fleet in 2030. However, hybrids will become more competitive and cheaper to make and the preferred option to meet stricter European emissions targets.

Hybrids are expected to become the transition engine type, i.e. between the current ICE and fully electric vehicles, which are not yet very attractive for buyers but forecast to become so in the not-too-distant future.

Hybrid cars tend to run on gasoline. Car manufacturers attempt to target the largest customer base and see a bigger worldwide market running on gasoline cars. Europe is the only exception to that rule. Secondly, gasoline cars are cheaper to manufacture than their diesel counterparts. Therefore, it makes more sense to add the additional cost of a battery to the lower cost technology.

Most Spanish cars currently run on diesel, so hybridization will bring about a significant shift in the makeup of Spain's passenger car fleet. By 2030, diesel cars will account for just 15% of all sales, plunging from more than 60% in 2015, and be confined mostly to larger vehicles such as SUVs.

Diesel car sales are already in decline and the forecast slump will also be driven largely by opposition to diesel from local and national governments, because gasoline-burning cars produce less polluting NO_x.

Electric vehicles are still a costlier option today, though, and their sales are not expected to take off until the end of the next decade, when advances in technology are forecast to make batteries more affordable. Small urban cars requiring shorter driving ranges and smaller batteries, and large plug-in SUV hybrids, are expected to make up the bulk of EV sales in 2030.

LPG and compressed natural gas (CNG) cars will still account for a small share of the fleet. More vehicles are expected to convert from gasoline- to LPG-fueled engines, and the LPG cars fleet could rise to 300,000 vehicles by 2030, from 50,000 in 2015, whereas CNG cars will remain a niche market where very few new sales are foreseen.

Spain's changing vehicle fleet

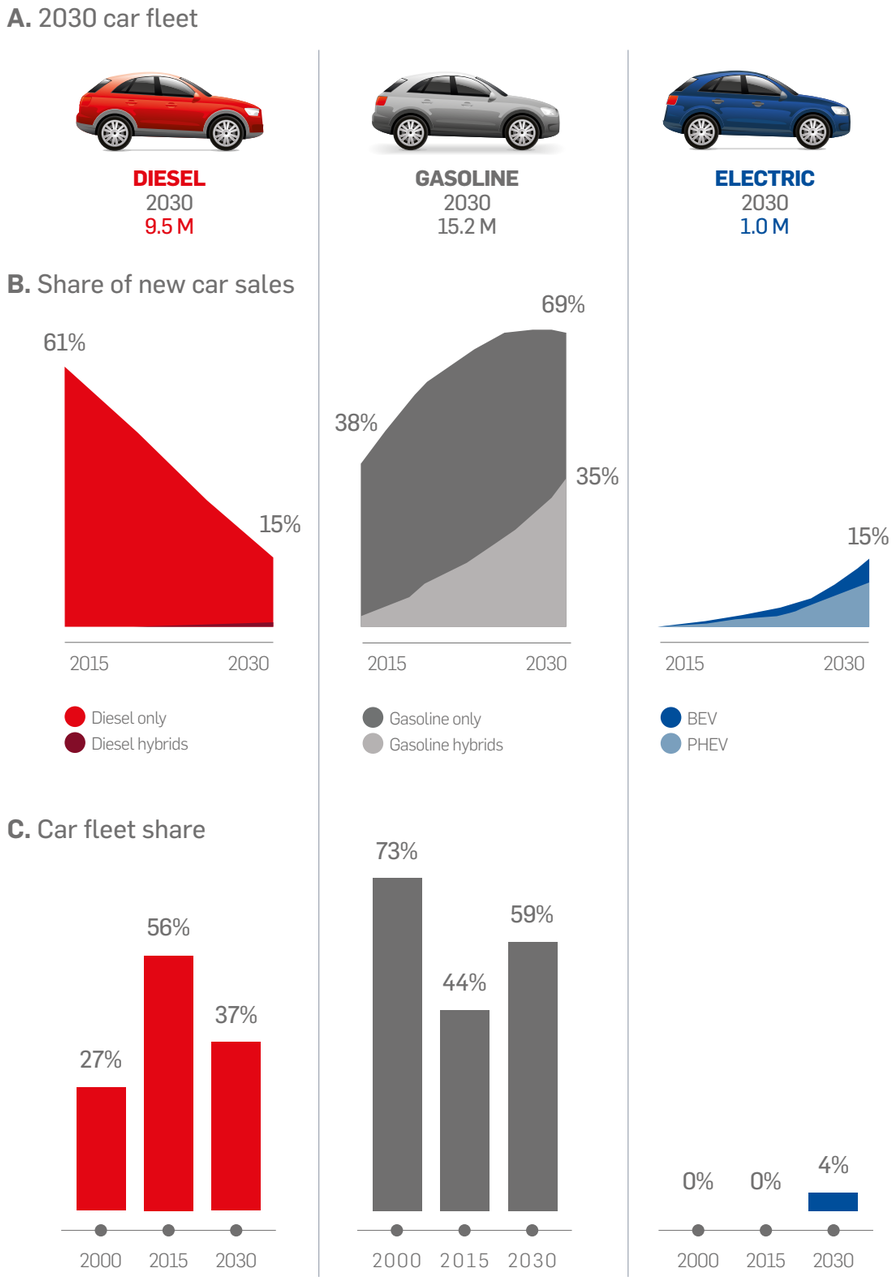


Fig. 69. Diesel cars sales are expected to decline sharply as consumer preferences shift to gasoline, hybrids and electric cars. Neverthreless, ICEs will have a commanding 96% share of the car fleet.

■ Source: DGT, ANFAC, Cepsa Analysis

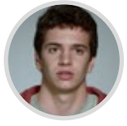
SPAIN

Battery cost

Lower battery costs will make electric cars much more competitive by 2030

■ Electric vehicles only make sense if the lower cost of electricity offsets their higher upfront price, so they need to be driven further to become the cheaper option. Consequently, EVs today are only economically attractive for those who cover more than 50,000 km a year, like taxi drivers.

Life cycle cost of an EV compared to its ICE alternative for typical Spanish drivers



Jordi, 23
Drives daily from university to home
12,000 km per year
Represents the majority of Spanish drivers

Pilar, 48
Drives every weekend to her beach house, 200km away
20,000 km per year
Represents a minority of Spanish drivers, about 10-20%

Ignacio, 32
Taxi driver in Madrid
50,000 km per year
Represents less than 1% of Spanish drivers

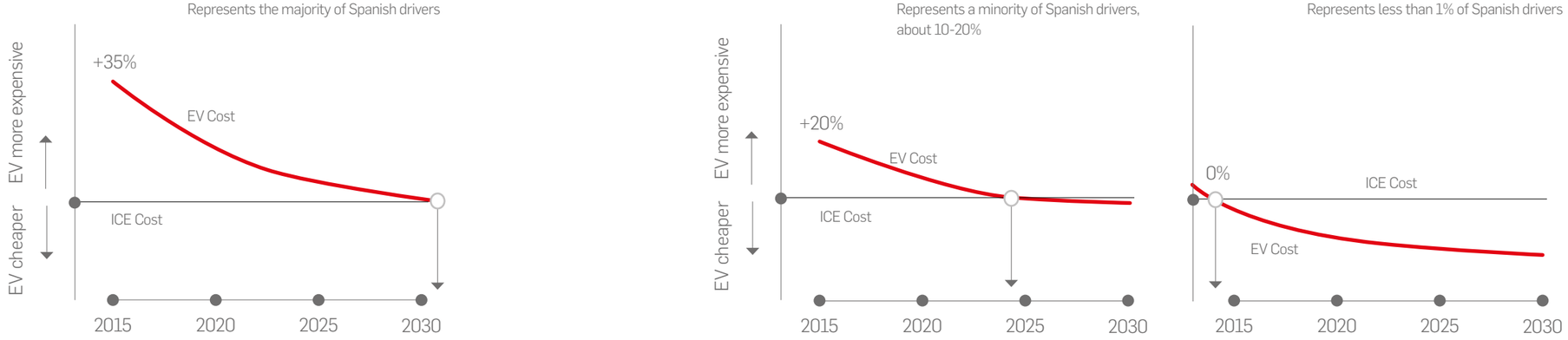


Fig. 70. Breakeven for an electric car is barely achieved.

An electric car starts to become economic towards the end of next decade.

The electric car is clearly economic today.

■ Source: Cepsa Analysis

At current prices for batteries and electricity (in Spain), an EV would have to be driven more than 50,000 km a year to bring running costs per kilometer down to the same level as a car fitted with a conventional ICE. This is far more than the average 10,000-15,000 km a year driven by the average Spanish motorist, so today EV penetration is confined to niche markets for cars requiring a very high mileage per annum, like taxis.

Nonetheless, battery costs have plummeted in the past few years to around 250 euros/kWh today and, if this trend continues, they will fall to some 100 euros/kWh before 2030 and make EVs much more competitive.
Such improvements in competitiveness will make electric cars economic before 2030 for drivers that use their cars intensively (see chart), which may apply to about one-fifth of Spanish drivers. Urban drivers by contrast would struggle to recoup the higher upfront cost unless they opted for a lower-range battery, which might well suffice for the vast majority of their trips.
Infrastructure is an important caveat, because at the moment there are very few charging points for EVs in Spain, making long-distance travel for EV owners virtually impossible. Most urban drivers will charge up their cars at home or in community parking lots, however, making urban charging points somewhat less necessary.

Meanwhile, manufacturers keen on driving EV sales may well back installing a network of charging stations in order to make long-distance travel more practicable.
A regulatory drive could also help, for instance if big cities in Spain should follow London's example and introduce a congestion charge from which EVs are exempt. Subsidies could also be raised for purchasing EVs, and penalties for buying an ICE vehicle.

SPAIN

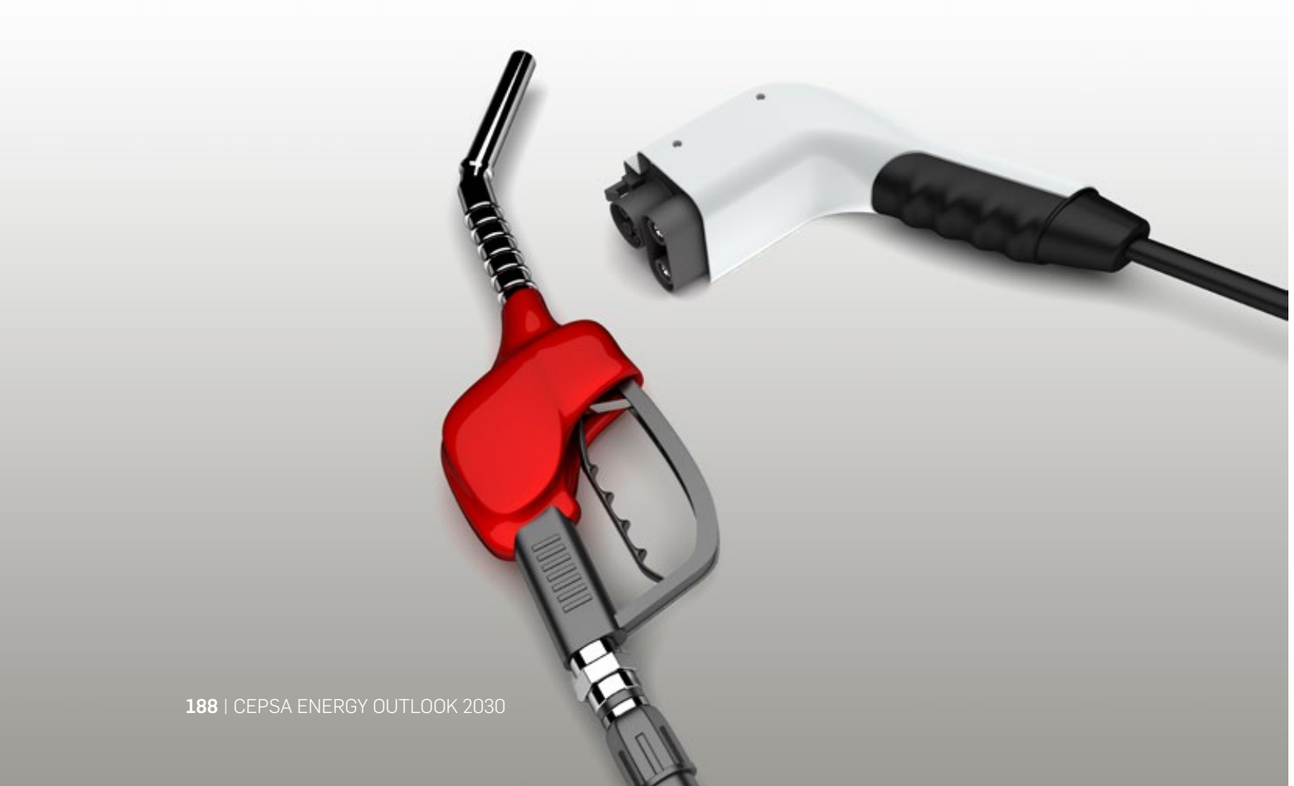
Electric vehicles vs. ICEs

The potential for EVs to curb CO_2 emissions largely depends on the country's power carbon footprint

EVs have lower driving emissions than ICEs in any case, but their potential for abating CO_2 depends on the breakdown of the electricity generation mix.

Replacing conventional ICE cars with EVs has two concurrent effects that explain how driving CO_2 emissions are abated.

Firstly, a large portion of electricty is generated by renewables and nuclear power, which do not emit CO_2, as opposed to burning oil or gas. Secondly, EVs are more energy-efficient due to their higher performance motors, so they require less energy to drive the same distance. More CO_2 emissions are reduced in countries with greener power mixes. In the case of a mostly renewable power mix, like Norway's, the abatement of running emissions would be close to 100%. Norway is an exception, however, and in other countries abatement ranges from 40% to 75%, depending on the breakdown of their power mixes. Spain falls in the latter category as its non-emitting generation sources account for almost 60% of the mix.



What if I change my old gasoline car for a new fancy electric one?

1,000 liters/year
is the gasoline I would save if I change to an EV assuming 15,000 km driven per year

3,000 kWh/year
is the additional electricity I would consume, roughly equivalent to the average Spanish household's annual consumption

50% energy savings
is the reduction in primary energy demand, thanks to the superior efficiency of the electric engine

But how much will the EVs impact electricity and oil demand in Spain in 2030?

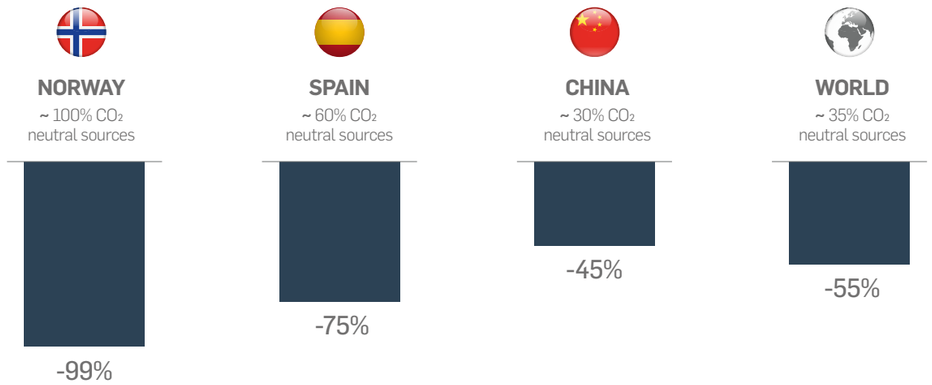
+1 million EVs*
Are expected to be part of the Spanish fleet by 2030, accounting for 4% of the total

+0.5% power demand
or 1.1 TWh will be the impact on growth in total Spanish power demand

-1.0% oil demand
or 0.5 Mt will be the expected decrease in fossil fuels demand

* 30% BEV, 70% PHEV

And how much will the EV reduce CO_2 emissions** compared with my old car?



** Driving emissions only.

Source: Cepsa Analysis

11

ALTERNATE REALITIES

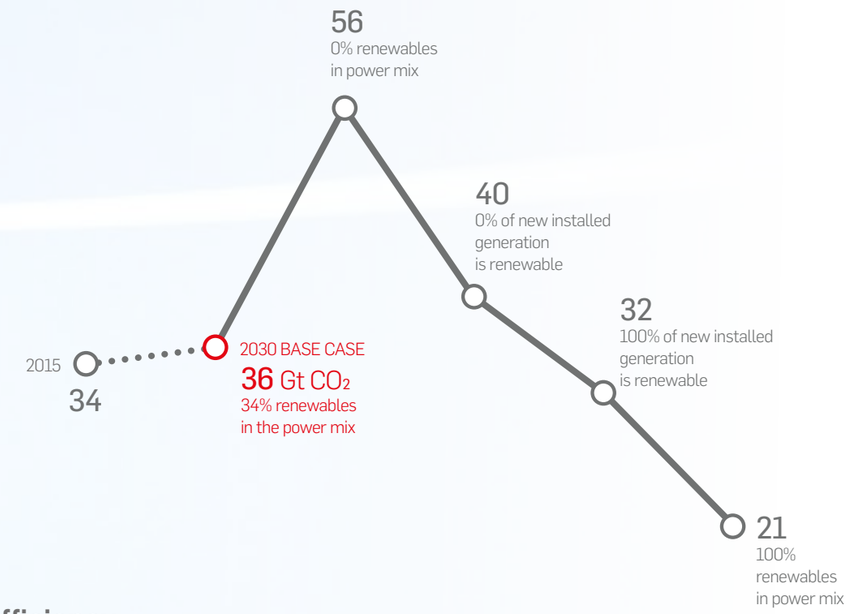
40% less energy related CO_2 emissions if the power mix is entirely renewable by 2030

As electricity demand will grow substantially in the years to come and power generation is the largest emitter of energy related CO_2 emissions, the penetration of renewables in the power mix is crucial for controlling emissions.
Cepsa's base case assumes that from 2015 to 2030, 45% of the increase in electricity generation will be renewable and that emissions will grow from 34Gt to 36Gt.
If renewables should account for 100% of additional electricity generation capacity, emissions will be 32 Gt or 10% below Cepsa's base case, but could rise up to 40 Gt should no additional renewables be installed between 2015 and 2030.
In the hypothetical case that all electricity is generated from renewable sources by 2030, emissions will be plummet to 21 Gt or 40% below Cepsa's base case, whereas if the power mix should dispense with renewables entirely, then emissions would soar up to 56 Gt above it.
Cutting demand by raising efficiency helps to reduce emissions. In the absence of efficiency gains, emissions would be 20% higher than our forecasts in 2030. One the other hand, if efficiency should improve twice as quickly as assumed in Cepsa's base case, then emissions would be 20% lower.

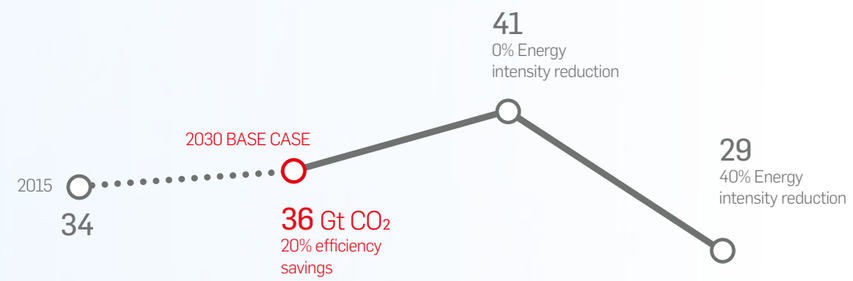
Energy related CO_2 emissions sensitivity to...

2030 Base case
(Gt CO_2)

...renewables penetration



...efficiency



Source: Cepsa Analysis

Technological breakthroughs could boost efficiency and thereby cut global oil demand by one-quarter

Oil supply-demand dynamics is a delicate balance with many intertwined factors playing out. We have chosen the three most representative factors driving oil demand, and played devil's advocate to check how oil demand might respond.

An absence of efficiency gains across the board over the next few years could boost oil demand by some 30 Mbpd, which would catapult crude prices and put severe strain on oil producing regions.

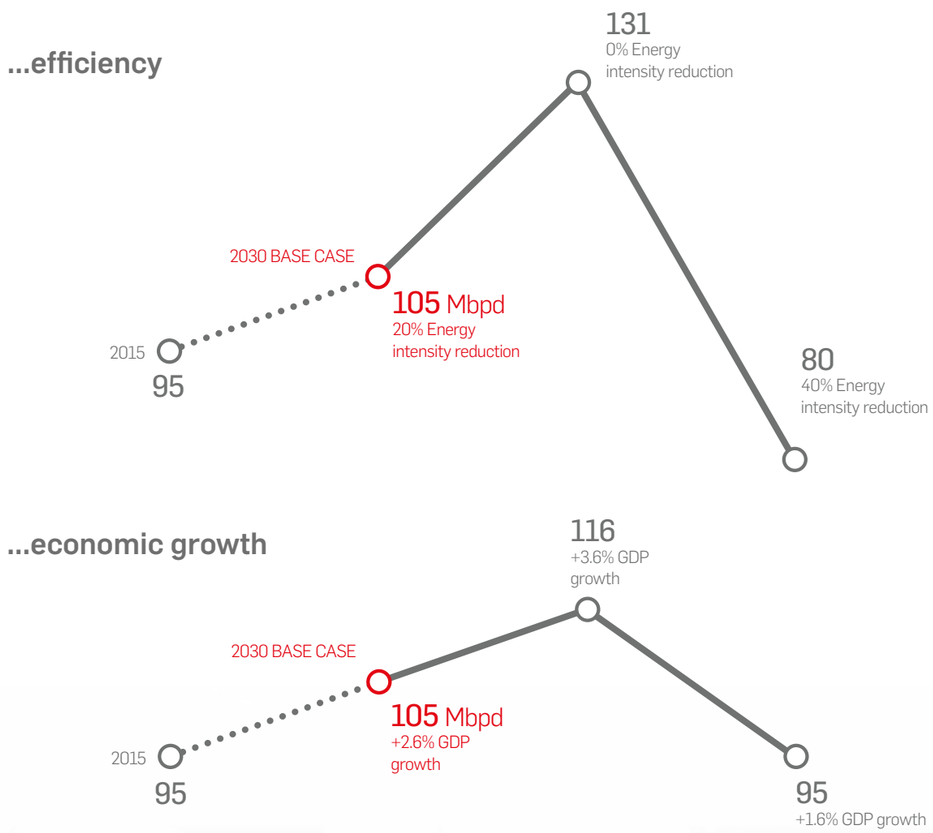
If, on the other hand, the global economy should grind to halt over the next 15 years, then oil demand will be curtailed by 20%.

Electric vehicle will have a modest impact on oil demand in 2030.

Even if four times as many EVs should be sold in 2030 (i.e. 60% of all new sales) than in our base case, oil demand will decline by just 3 Mbpd.

Global liquids demand sensitivity to...

2030 Base case
(Mbpd)



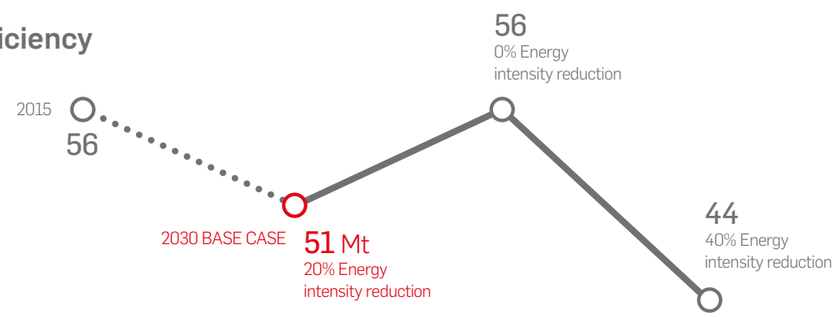
Source: Cepsa Analysis

In Spain, a 100% electric-powered car fleet would cut oil demand by 25%

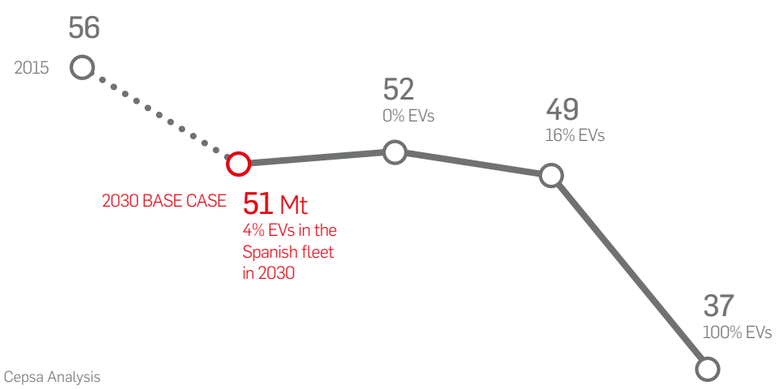
Spain's oil products demand sensitivity to...

2030 Base case
(Mt oil demand)

...efficiency



...electric vehicle



Source: Cepsa Analysis

Efficiency is the main factor affecting oil products demand in Spain. In the absence of efficiency gains, oil products demand in 2030 will be 12% above our base case at 56 million tonnes, or where it stood in 2015.
The share of a particular car type in sales lags a long way behind its share in the overall fleet, so adopting EVs will be a slow process; even assuming they accounted for a majority of sales, they would take some time to make up a majority of the car fleet.

In the extreme case of assuming that the whole Spanish passenger car fleet should be electric by 2030, oil products demand will fall by 25%, down to 37 Mtons. This shows that in the longer run, after 2030, EVs do have the potential to significantly reduce oil products demand.
Finally, if oil should maintain its share of energy demand in all of its uses, products demand will be 4 Mtons, or 8% higher.

BENCHMARKING

BENCHMARKING

Cepsa expects an increased relevance of gas and renewables in the energy mix compared to peers

Global primary energy mix
2030 (% of total primary energy demand)

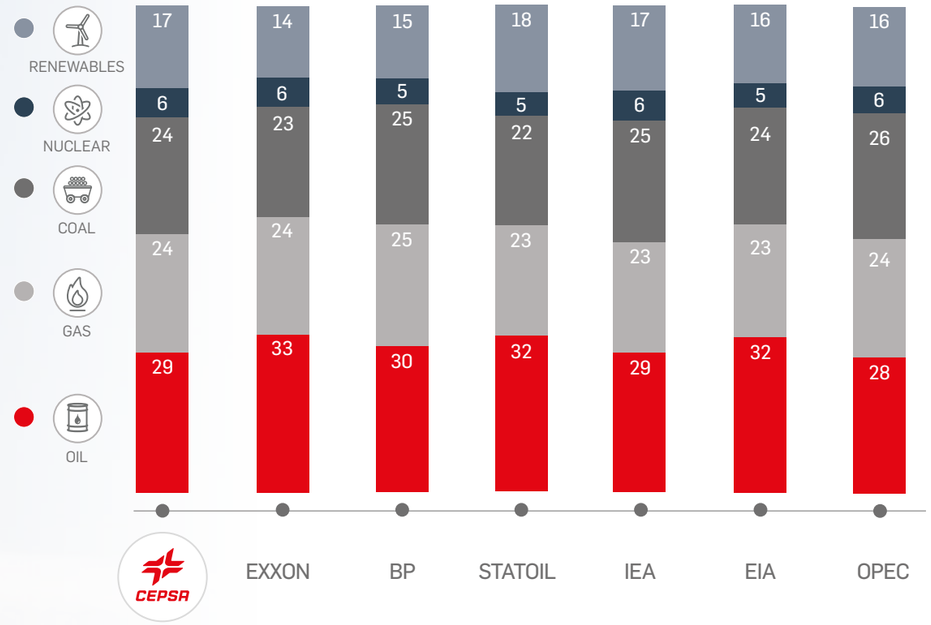


Fig. 70. Cepsa Energy Outlook foresees that renewable energies will reach a penetration of 17% in the global energy mix, amongst the highest of the analyzed publications.

■ Source: Cepsa Analysis; Exxon "The outlook for energy: a view to 2040" 2017; BP "Energy Outlook" 2017; Statoil "Energy Perspectives" 2016; IEA "World Energy Outlook" 2016; EIA "International Energy Outlook" 2017; OPEC "World Oil Outlook" 2016

All publications agree on a reduced share of oil in the global energy mix. Cepsa's share at 29% is below the average (30%), and this is believed to come mainly from a greater efficiency in transport, notably in passenger cars, and from a very low use of oil for power generation. Natural gas will lead in terms of additional electricity generation, and thanks to this additional demand, Cepsa expects that gas will take over coal as the second most demanded primary energy source by 2030. Natural gas outlook looks promising in other sectors like industry or residential, whilst in the case of coal, its demand is expected to peak at some point between 2015 and 2030. Exxon, BP and Statoil share this view of natural gas taking over coal by 2030.

All benchmarked outlooks agree on renewables being the fastest growing energy source, and the one capturing the greatest additional share of the global energy mix. According to Cepsa's view, renewable energy will account for 17% of the global energy mix in 2030, among the highest share, together with IEA and Statoil.
The high share in Cepsa's view comes from a greater penetration of wind and solar in the global power mix, which is in turn driven by a greater development of these two technologies in India and China. Both countries will add about 50% of the new global generation capacity, and both show a very strong commitment to develop wind and solar energy; which combined with the expected cost reductions in wind and solar technologies, will drive a very strong penetration.

Cepsa foresees a slower emissions growth compared to peers

Primary energy demand vs. renewables share

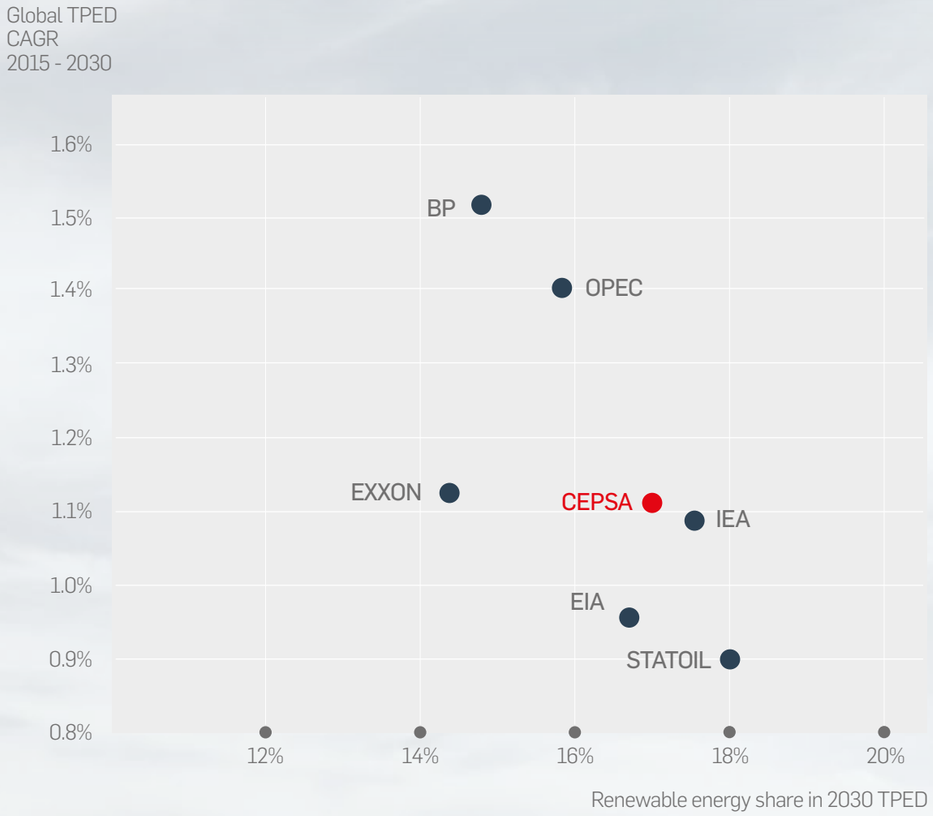
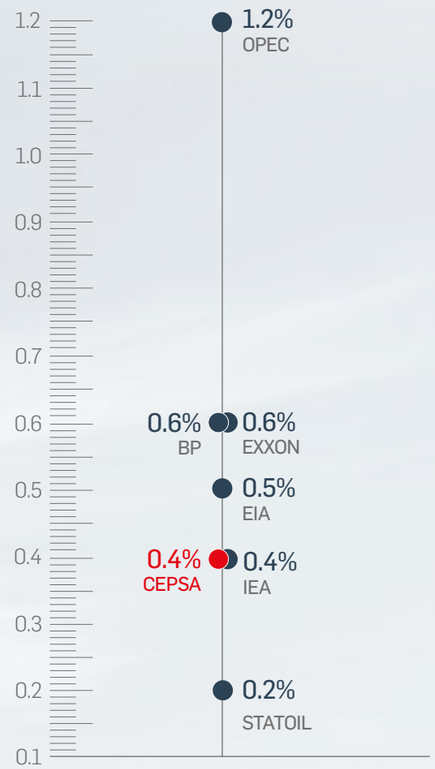


Fig. 71. Cepsa Energy Outlook characterizes by the high renewable share and the significant efficiency improvement curbing global energy demand. The combination of both results in a growth of emissions amongst the lowest, in line with the internatinoal energy agency base scenario (New Policies Scenario).

■ Source: Cepsa Analysis; Exxon "The outlook for energy: a view to 2040" 2017; BP "Energy Outlook" 2017; Statoil "Energy Perspectives" 2016, Reform Scenario; IEA "World Energy Outlook" 2016, New Policies Scenario; EIA "International Energy Outlook" 2017; OPEC "World Oil Outlook" 2016

Energy related CO_2 emissions

2015 - 2030 (CAGR, %)



All publications agree that energy demand growth will see a remarkable slowdown over the next 15 years. Cepsa's growth forecast (1.1%) is amongst the lowest, after the IEA's new policies (1.05%), due to widespread efficiency gains.

In fact, Cepsa's economic growth forecast is well in line with the rest of publications. However, its energy intensity reduction is well above the average. Measuring efficiency as the ratio of energy used per unit of GDP (in purchasing power parity), Cepsa foresees a 2.5% reduction rate until 2030, compared to a 2.0% average for the rest of publications. This means that in Cepsa's view, that efficiency gains will offset much of the impact of noteworthy economic activity and curb energy demand growth. In Cepsa's view, such enhanced efficiency will be the outcome of implementing regulatory policies in the shape of mandatory energy efficiency standards that will spread to other sectors and countries.

Energy related CO_2 emissions are mainly the result of the combination of two factors: the energy demand growth rate and the share of renewables in the global energy mix. In Cepsa's view, due to its low forecast energy demand growth rate and high renewables share, the emissions growth rate will stand at 0.4% between 2015 and 2030, in line with the IEA's new policies scenario and below most analysts.

Cepsa anticipates a slightly slower liquids demand growth driven by the acceleration of efficiency

All outlooks, including Cepsa's, agree that liquids demand will increase in the years to come, while no one expects oil demand to peak before 2030, but they all also predict a remarkable demand slowdown compared with the previous 15 years.
Cepsa's liquids demand forecast of 105 Mbpd is slightly below consensus due to the aforementioned impact of enhanced efficiency, which is especially relevant in the transport sector, where most of oil is consumed.

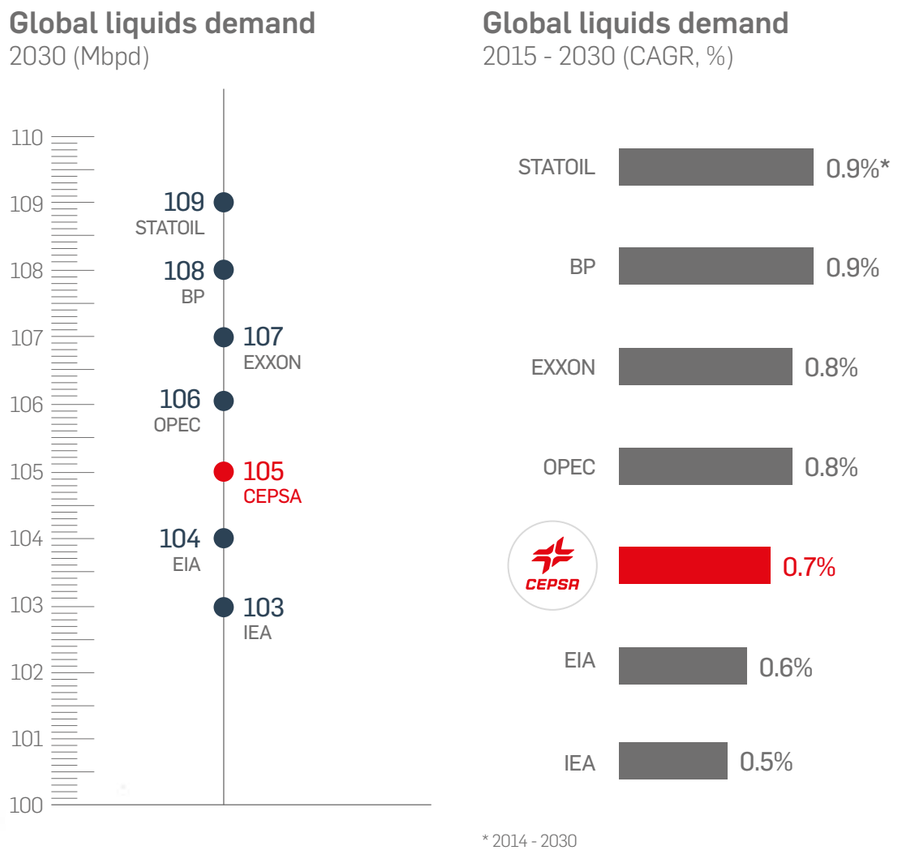


Fig. 72. Cepsa Energy Outlook 2030 liquids demand ranks below the average as a result of Cepsa's view of an accelerated energy efficiency improvement.

■ Source: Cepsa Analysis; Exxon "The outlook for energy: a view to 2040" 2017; BP "Energy Outlook" 2017; Statoil "Energy Perspectives" 2016; IEA "World Energy Outlook" 2016; EIA "International Energy Outlook" 2017; OPEC "World Oil Outlook" 2016

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World

	Total					15-yr CAGR (%)		5-yr CAGR (%)		
	2000[1]	2015[1]	2020	2025	2030	2000-15	2015-30	2015-20	2020-25	2025-30
1. Total primary energy demand (TPED)										
World (Mtoe)	10,100	13,800	14,700	15,550	16,200	2.1%	1.1%	1.3%	1.1%	1.0%
1.1 By region (Mtoe)										
Consumers										
China	1,130	3,100	3,450	3,850	4,200	7.0%	2.0%	2.2%	2.2%	1.8%
India	440	1,100	1,250	1,450	1,600	6.3%	2.5%	2.6%	3.0%	2.0%
Rest of consumers	680	1,170	1,200	1,270	1,340	3.7%	0.9%	0.5%	1.1%	1.1%
Energizers										
Middle East	400	800	900	1,010	1,100	4.7%	2.1%	2.4%	2.3%	1.7%
Latin America	620	870	900	920	930	2.3%	0.4%	0.7%	0.4%	0.2%
Africa	510	750	850	930	1,030	2.6%	2.1%	2.5%	1.8%	2.1%
CIS	920	1,090	1,100	1,120	1,150	1.1%	0.4%	0.2%	0.4%	0.5%
Regulators										
USA	2,340	2,150	2,200	2,220	2,200	-0.6%	0.2%	0.5%	0.2%	-0.2%
Europe	1,930	1,750	1,850	1,800	1,700	-0.7%	-0.2%	1.1%	-0.5%	-1.1%
Rest of Regulators	1,130	1,020	1,000	980	950	-0.7%	-0.5%	-0.4%	-0.4%	-0.6%
1.2. By primary fuel (Mtoe)										
Oil[2]	3,700	4,380	4,560	4,720	4,760	0.5%	0.6%	0.8%	0.7%	0.2%
Natural gas	2,090	2,960	3,310	3,660	3,960	1.8%	2.0%	2.3%	2.0%	1.6%
Coal[3]	2,300	3,850	3,850	3,840	3,810	0.1%	-0.1%	0.0%	-0.1%	-0.2%
Nuclear	680	640	790	900	930	2.5%	2.5%	4.3%	2.6%	0.7%
Renewables[4]	1,330	1,970	2,190	2,430	2,740	2.2%	2.2%	2.1%	2.1%	2.4%
of which wind and solar	7	92	190	330	520	12.2%	12.2%	15.6%	11.7%	9.5%
1.3 By primary fuel (% total)										
Oil[2]	36.6%	31.7%	31.0%	30.4%	29.4%	n.a.	n.a.	n.a.	n.a.	n.a.
Natural gas	20.7%	21.4%	22.5%	23.5%	24.4%	n.a.	n.a.	n.a.	n.a.	n.a.
Coal[3]	22.8%	27.9%	26.2%	24.7%	23.5%	n.a.	n.a.	n.a.	n.a.	n.a.
Nuclear	6.7%	4.6%	5.4%	5.8%	5.7%	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables[4]	13.2%	14.3%	14.9%	15.6%	16.9%	n.a.	n.a.	n.a.	n.a.	n.a.
of which wind and solar	0.1%	0.7%	1.3%	2.1%	3.2%	n.a.	n.a.	n.a.	n.a.	n.a.

	Total					CAGR (%)		5-yr CAGR (%)		
	2000[1]	2015[1]	2020	2025	2030	2000-15	2015-30	2015-20	2020-25	2025-30
2. Energy related CO_2 emissions										
World[4] (ktons of CO_2)	23,200	34,000	34,830	35,600	36,100	2.6%	0.4%	0.5%	0.4%	0.3%
2.1 By region (ktons of CO_2)										
Consumers										
China	3,360	9,290	9,800	10,300	10,590	7.0%	0.9%	1.1%	1.0%	0.6%
India	1,040	3,390	3,700	3,900	4,130	8.2%	1.3%	1.8%	1.1%	1.2%
Rest of consumers	1,090	3,050	3,150	3,250	3,300	7.1%	0.5%	0.6%	0.6%	0.3%
Energizers										
Middle East	1,040	1,900	2,100	2,300	2,370	4.1%	1.5%	2.0%	1.8%	0.6%
Latin America	1,280	1,940	1,930	1,920	1,900	2.8%	-0.1%	-0.1%	-0.1%	-0.2%
Africa	770	1,330	1,500	1,750	1,990	3.7%	2.7%	2.4%	3.1%	2.6%
CIS	2,250	2,300	2,300	2,360	2,380	0.1%	0.2%	0.0%	0.5%	0.2%
Regulators										
USA	5,360	5,000	4,900	4,800	4,730	-0.5%	-0.4%	-0.4%	-0.4%	-0.3%
Europe	4,360	3,400	3,300	3,170	2,950	-1.6%	-0.9%	-0.6%	-0.8%	-1.4%
Rest of Regulators	2,650	2,400	2,150	1,850	1,760	-0.7%	-2.0%	-2.2%	-3.0%	-1.0%
2.2 By primary fuel (ktons of CO_2)										
Oil	9,880	11,600	11,807	12,033	12,150	1.1%	0.3%	0.4%	0.4%	0.2%
Natural gas	4,520	6,900	7,732	8,508	9,300	2.9%	2.0%	2.3%	1.9%	1.8%
Coal	8,800	15,500	15,290	15,059	14,650	3.8%	-0.4%	-0.3%	-0.3%	-0.5%

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World

	Total					CAGR (%)		5-yr CAGR (%)		
	2000[1]	2015 [1]	2020	2025	2030	2000-15	2015-30	2015-20	2020-25	2025-30
3. Power generation										
World (twh)	15,400	23,900	26,870	30,520	35,100	3.0%	2.6%	2.4%	2.6%	2.8%
3.1 By region (twh)										
Consumers										
China	1,340	5,540	6,880	8,560	10,670	9.9%	4.5%	4.4%	4.5%	4.5%
India	550	1,360	1,820	2,470	3,390	6.2%	6.3%	6.0%	6.3%	6.5%
Rest of consumers	730	1,370	1,630	1,920	2,250	4.3%	3.4%	3.5%	3.3%	3.2%
Energizers										
Middle East	460	1,120	1,260	1,420	1,590	6.1%	2.4%	2.4%	2.4%	2.3%
Latin America	1,000	1,640	1,740	1,850	1,960	3.4%	1.2%	1.2%	1.2%	1.2%
Africa	440	750	900	1,110	1,390	3.6%	4.2%	3.7%	4.3%	4.6%
CIS	1,250	1,500	1,600	1,700	1,800	1.2%	1.2%	1.3%	1.2%	1.1%
Regulators										
USA	4,030	4,370	4,590	4,830	5,160	0.5%	1.1%	1.0%	1.0%	1.3%
Europe	3,390	3,750	3,900	4,060	4,230	0.7%	0.8%	0.8%	0.8%	0.8%
Rest of Regulators	2,210	2,500	2,550	2,600	2,660	0.8%	0.4%	0.4%	0.4%	0.5%
3.2 Share by source (%)										
Oil	7.9%	4.4%	3.3%	2.2%	1.2%	-1.0%	-6.0%	-3.1%	-5.4%	-9.4%
Natural gas	17.9%	22.9%	23.5%	23.7%	24.0%	4.7%	2.9%	2.9%	2.8%	3.1%
Coal	38.9%	38.4%	36.5%	34.0%	30.2%	2.9%	1.0%	1.4%	1.1%	0.4%
Nuclear	16.8%	10.7%	10.7%	10.7%	10.7%	-0.1%	2.6%	2.4%	2.6%	2.9%
Renewables	18.6%	23.7%	26.0%	29.4%	33.9%	4.7%	5.1%	4.3%	5.1%	5.8%
of which wind	0.2%	3.5%	5.5%	8.0%	11.2%	24.8%	10.9%	12.2%	10.6%	10.0%
of which solar	0.0%	1.0%	2.0%	3.8%	6.1%	n.a.	15.7%.	17.0%	17.1%	12.9%
of which hydropower	17.0%	16.3%	15.7%	14.8%	14.0%	2.7%	1.6%	1.6%	1.4%	1.7%
of which other renewables	1.4%	2.9%	2.8%	2.7%	2.6%	8.3%	1.9%	1.9%	1.7%	2.0%

	Total					CAGR (%)		5-yr CAGR (%)		
	2000[1]	2015 [1]	2020	2025	2030	2000-15	2015-30	2015-20	2020-25	2025-30
4. Liquids demand										
World [6] (Mbpd)	77	95	100	104	105	1.4%	0.7%	1.0%	0.8%	0.2%
4.1 By region (Mbpd)										
Consumers										
China	4.8	12.0	14.0	16.0	17.1	6.3%	2.4%	3.1%	2.7%	1.3%
India	2.3	4.4	5.5	7.0	8.2	4.4%	4.3%	4.7%	4.9%	3.2%
Rest of consumers	5.7	8.2	8.9	10.0	10.6	2.5%	1.7%	1.7%	2.4%	1.2%
Energizers										
Middle East	5.0	8.7	10.0	10.6	11.1	3.8%	1.6%	2.8%	1.2%	0.9%
Latin America	7.3	9.3	9.6	9.8	9.9	1.6%	0.4%	0.6%	0.4%	0.2%
Africa	2.5	4.0	4.9	5.7	6.6	3.2%	3.4%	4.1%	3.1%	3.0%
CIS	3.5	4.0	3.9	3.7	3.6	0.9%	-0.7%	-0.5%	-1.0%	-0.5%
Regulators										
USA	19.4	19.3	19.0	18.8	17.5	0.0%	-0.7%	-0.3%	-0.2%	-1.4%
Europe	15.8	14.7	14.5	13.4	12.1	-0.5%	-1.3%	-0.3%	-1.6%	-2.0%
Rest of Regulators	10.7	10.4	9.7	9.0	8.3	-0.2%	-1.5%	-1.4%	-1.5%	-1.6%
4.1 By sector (Mbpd)										
Transport	39.7	53.9	58.6	61.6	63.4	2.1%	1.1%	1.7%	1.0%	0.6%
Petrochemical	8.0	11.4	12.9	15.3	16.5	2.4%	2.5%	2.5%	3.5%	1.5%
Industry [7]	14.1	15.0	14.4	14.0	12.3	0.4%	-1.3%	-0.8%	-0.6%	-2.6%
Buildings [8]	9.8	10.0	10.1	10.1	10.1	0.1%	0.1%	0.2%	0.0%	0.0%
Power	5.4	4.7	4.0	3.0	2.7	-0.9%	-3.6%	-3.2%	-5.6%	-2.1%
4.1 By product (Mbpd)										
Diesel	20.2	29.2	31.6	34.3	34.5	2.5%	1.1%	1.6%	1.7%	0.1%
of which biodiesel	0	0.6	0.8	0.9	0.9	n.a.	2.7%	1.9%	0.8%	0.0%
Gasoline	19.8	24.1	25.5	26.0	26.2	1.3%	0.6%	1.1%	0.4%	0.2%
of which biogasoline	0.3	1.3	1.9	2.0	2.0	12.3%	2.9%	7.9%	1.0%	0.0%
Jet	6.5	6.2	7.2	7.8	8.2	-0.3%	1.9%	3.0%	1.6%	1.0%
Fuel	10.6	7.2	6.0	5.0	4.6	-2.5%	-2.9%	-3.6%	-3.6%	-1.7%
Naphtha	4.2	5.6	6.5	7.4	8.3	1.9%	2.7%	3.0%	2.6%	2.3%
LPG	6.3	8.1	8.4	8.6	8.8	1.7%	0.6%	0.7%	0.5%	0.5%
Ethane	1.5	3.3	3.9	4.6	5.0	5.4%	2.8%	3.4%	3.4%	1.7%
Other heavy products [9]	7.9	11.3	10.9	10.3	9.4	2.4%	-1.2%	-0.7%	-1.1%	-1.8%

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World

	Total					CAGR (%)		5-yr CAGR (%)		
	2000[1]	2015 [1]	2020	2025	2030	2000-15	2015-30	2015-20	2020-25	2025-30
5. Liquids supply										
World liquids supply (Mbpd)	77	95	100	104	105	1.5%	0.7%	1.0%	0.8%	0.2%
5.1 By product (Mbpd)										
Oil	75.5	91.1	95.3	99.0	99.7	1.4%	0.6%	0.9%	0.8%	0.1%
Of which crude	59.6	75.5	78.4	80.4	79.5	1.5%	0.3%	0.7%	0.5%	-0.2%
Of which condensates	5.8	7.4	8.1	9.1	10.0	1.6%	2.0%	1.9%	2.3%	1.9%
Of which natural gas liquids	9.1	8.2	8.8	9.5	10.2	-0.7%	1.5%	1.5%	1.5%	1.5%
Processing gains adjustment [12]	1.8	2.0	2.2	2.3	2.4	0.7%	1.2%	1.9%	1.2%	0.5%
Biofuels	1.0	1.8	2.5	2.7	2.9	4.0%	3.2%	6.8%	1.2%	1.8%
Unconventional oil [11]	1.3	7.5	9.3	10.2	11.0	12.4%	2.6%	4.4%	1.9%	1.5%
5.2 By key countries (Mbpd)										
USA	7.9	12.7	14.3	14.7	14.8	3.2%	1.0%	0.8%	0.2%	0.0%
Saudi Arabia	9.3	12.1	12.8	13.7	13.8	1.8%	0.9%	0.4%	0.4%	0.0%
Russia	6.5	11.0	10.8	10.9	10.9	3.6%	0.0%	-0.1%	0.0%	0.0%
Iran	3.8	3.6	4.3	4.5	4.6	-0.4%	1.6%	1.2%	0.3%	0.1%
Iraq	2.6	4.1	4.5	4.7	4.8	3.1%	1.0%	0.6%	0.3%	0.2%
Canada	2.7	4.4	5.2	5.3	5.5	3.2%	1.6%	1.2%	0.1%	0.3%
UAE	2.6	3.7	4.0	4.2	4.2	2.4%	0.8%	0.5%	0.3%	0.0%
Brazil	1.3	2.6	3.0	3.6	3.7	4.7%	2.4%	1.0%	1.2%	0.2%
Mexico	3.5	2.6	2.5	2.8	3.1	-2.0%	1.2%	-0.3%	0.8%	0.7%
Venezuela	3.2	2.6	2.1	2.2	2.3	-1.4%	-0.9%	-1.6%	0.5%	0.2%
Nigeria	2.2	2.3	2.1	2.3	2.4	0.3%	0.3%	-0.7%	0.7%	0.3%
Kazakhstan	0.7	1.7	2.3	2.5	2.6	6.2%	2.7%	2.0%	0.6%	0.1%
Rest of the World	29.2	27.8	27.4	27.6	27.1	0.1%	-0.2%	-0.1%	0.0%	-0.1%
Subtotal OPEC	41%	41%	41%	42%	42%	0.0%	0.2%	0.0%	0.2%	0.0%
Subtotal non-OPEC	59%	59%	59%	58%	58%	0.0%	-0.1%	0.0%	-0.1%	0.0%

	Total					CAGR (%)		5-yr CAGR (%)		
	2000[1]	2015 [1]	2020	2025	2030	2000-15	2015-30	2015-20	2020-25	2025-30
6. Natural gas demand										
World [12] (Tcf)	86.2	123	137	151	165	2.4%	2.0%	2.2%	2.0%	1.7%
6.1 By region (Tcf)										
Consumers										
China	0.8	6.8	12.0	17.0	20.0	15.3%	7.5%	12.0%	7.2%	3.3%
India	1.0	1.8	2.8	4.8	5.6	4.0%	7.9%	9.2%	11.4%	3.1%
Rest of consumers	4.4	12.3	13.2	14.2	15.6	7.1%	1.6%	1.4%	1.5%	1.9%
Energizers										
Middle East	6.1	16.2	18.0	19.5	22.6	6.7%	2.2%	2.1%	1.6%	3.0%
Latin America	4.6	8.4	8.0	9.0	10.1	4.1%	1.2%	-1.0%	2.4%	2.3%
Africa	2.0	4.7	5.5	6.5	9.1	5.9%	4.5%	3.2%	3.4%	7.0%
CIS	19.2	22.0	23.5	24.0	24.5	0.9%	0.7%	1.3%	0.4%	0.4%
Regulators										
USA	23.5	26.5	29.0	30.0	30.7	0.8%	1.0%	1.8%	0.7%	0.5%
Europe	17.1	16.9	18.0	19.0	19.5	-0.1%	1.0%	1.3%	1.1%	0.5%
Rest of Regulators	7.5	7.4	7.0	7.0	6.9	-0.1%	-0.5%	-1.1%	0.0%	-0.3%

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Spain

	Total					CAGR (%)		5-yr CAGR (%)		
	2000[1]	2015 [1]	2020	2025	2030	2000-15	2015-30	2015-20	2020-25	2025-30
1. Spanish primary energy demand (TPED)										
Spain (ktoe)	120,900	118,700	124,000	122,600	118,300	-0.1%	0.0%	0.9%	-0.2%	-0.7%
1.1. By primary fuel (ktoe)										
Oil [2]	62,500	53,700	57,200	57,100	55,300	-1.0%	0.2%	1.3%	0.0%	-0.6%
Natural gas	15,000	23,400	24,500	25,100	25,400	3.0%	0.5%	0.9%	0.5%	0.2%
Coal	20,500	13,600	9,600	5,200	600	-2.7%	-18.8%	-6.7%	-11.5%	-35.1%
Nuclear	16,200	14,400	14,900	14,900	14,600	-0.8%	0.1%	0.7%	0.0%	-0.4%
Renewables [3]	6,700	13,600	17,800	20,300	22,400	4.8%	3.4%	5.5%	2.7%	2.0%
Share of renewables in TPED (%)	5.5%	11.5%	14.4%	16.6%	18.9%	n.a.	n.a.	n.a.	n.a.	n.a.
2. Spanish final energy demand (TFED)										
Spain (ktoe)	79,900	80,600	84,800	84,100	81,000	0.1%	0.0%	1.0%	-0.2%	-0.7%
2.1. By sector (ktoe)										
Transport	33,200	33,800	36,500	35,600	33,200	0.1%	-0.1%	1.5%	-0.5%	-1.4%
Industry	25,380	18,900	19,100	19,100	18,900	-1.9%	0.0%	0.2%	0.0%	-0.2%
Residential	11,200	14,900	15,500	15,500	15,100	1.9%	0.1%	0.8%	0.0%	-0.5%
Services	6,700	10,000	10,700	10,900	10,800	2.7%	0.5%	1.4%	0.4%	-0.2%
Agriculture, forestry and fishing	2,570	2,500	2,500	2,500	2,500	-0.2%	0.0%	0.0%	0.0%	0.0%
Others [3]	850	500	500	500	500	-3.5%	0.0%	0.0%	0.0%	0.0%
2.2. By fuel (ktoe)										
Oil products	46,300	41,200	41,900	40,000	36,500	-0.8%	-0.8%	0.3%	-0.9%	-1.8%
Natural gas	12,150	13,400	14,300	15,200	15,800	0.7%	1.1%	1.3%	1.2%	0.8%
Coal	1,780	1,300	1,100	800	600	-2.1%	-5.0%	-3.3%	-6.2%	-5.6%
Electricity	16,200	19,400	20,400	20,600	20,500	1.2%	0.4%	1.0%	0.2%	-0.1%
Biomass & others [3]	3,470	5,300	7,100	7,500	7,600	2.9%	2.4%	6.0%	1.1%	0.3%
Share of renewables in TFEC [5]	8.0%	15.3%	18.8%	23.2%	27.0%	n.a.	n.a.	n.a.	n.a.	n.a.

	Total					CAGR (%)		5-yr CAGR (%)		
	2000[1]	2015 [1]	2020	2025	2030	2000-15	2015-30	2015-20	2020-25	2025-30
3. Spanish power generation (twh)										
Spain (twh)	204	267	279	282	281	1.8%	0.3%	0.9%	0.2%	-0.1%
3.1 By source (twh)										
Oil	13.3	6.7	5.6	4.2	2.8	-4.5%	-5.7%	-3.5%	-5.6%	-7.8%
Natural gas	20.8	55.4	55.2	53.1	51.2	6.7%	-0.5%	-0.1%	-0.8%	-0.7%
Coal	73.6	53.2	37.0	18.7	0.0	-2.1%	-100.0%	-7.0%	-12.8%	-100.0%
Nuclear	59.6	55.3	57.1	57.2	56.1	-0.5%	0.1%	0.6%	0.0%	-0.4%
Renewables [6]	36.7	96.4	124.1	148.8	170.9	6.6%	3.9%	5.2%	3.7%	2.8%
of which wind	n.a.	48.5	70.2	90.6	109.5	n.a.	5.6%	7.7%	5.2%	3.9%
of which solar	n.a.	13.3	15.8	17.9	19.6	n.a.	2.6%	3.5%	2.5%	1.8%
of which hydropower	30.4	28.2	31.2	33.1	34.5	-0.5%	1.4%	2.0%	1.2%	0.8%
of which other renewables	n.a.	6.4	6.9	7.2	7.3	n.a.	0.9%	1.5%	0.9%	0.3%
4. Spanish oil products demand										
Spain (Mtons)	66.1	56.1	59.7	56.5	51.4	-1.1%	-0.6%	1.3%	-1.1%	-1.9%
4.1 By product (Mtons)										
Diesel	26.1	29.8	32.8	29.4	24.9	0.9%	-1.2%	1.9%	-2.2%	-3.3%
of which biodiesel	0	0.7	2.1	1.9	1.6	n.a.	5.7%	24.6%	-2.0%	-3.4%
Gasoline	8.5	4.7	5.2	6.1	6.7	-3.9%	2.4%	2.0%	3.2%	1.9%
of which biogasoline	0	0.3	0.5	0.7	0.7	n.a.	5.8%	10.8%	7.0%	0.0%
Jet	4.3	5.5	6.5	6.7	6.7	1.7%	1.3%	3.4%	0.6%	0.0%
Fuel	11.9	8.2	7.9	7.6	7.0	-2.5%	-1.0%	-0.7%	-0.8%	-1.6%
Naphtha	4.9	1.6	1.3	1.3	1.3	-7.2%	-1.4%	-4.1%	0.0%	0.0%
LPG	2.5	2.0	2.4	2.2	2.0	-1.5%	0.0%	3.7%	-1.7%	-1.9%
Asphalt	1.9	0.9	0.7	0.7	0.7	-4.9%	-1.7%	-4.9%	0.0%	0.0%
Lubes	0.5	0.4	0.4	0.4	0.4	-1.5%	0.0%	0.0%	0.0%	0.0%
Coke	4.3	2.7	2.5	2.1	1.7	-3.1%	-3.0%	-1.5%	-3.4%	-4.1%
Other [7]	1.2	0.3	0	0	0	-8.8%	n.a.	n.a.	n.a.	n.a.
4.2 By sector (Mtons)										
Transport	37.8	40.6	45.1	43.4	39.8	0.5%	-0.1%	2.1%	-0.8%	-1.7%
Road	25.4	26.4	29.5	27.8	24.6	0.3%	-0.5%	2.2%	-1.2%	-2.4%
Domestic navigation	1.4	0.4	0.4	0.4	0.4	-8.0%	0.0%	0.0%	0.0%	0.0%
International navigation	6.2	8.2	8.6	8.4	8.0	1.9%	-0.2%	1.0%	-0.5%	-1.0%
Aviation	4.3	5.5	6.5	6.7	6.7	1.7%	1.3%	3.4%	0.6%	0.0%
Railway	0.5	0.1	0.1	0.1	0.1	-10.2%	0.0%	0.0%	0.0%	0.0%
Petrochemical	5.5	2.4	2.3	2.3	2.4	-5.4%	0.0%	-0.8%	0.0%	0.9%
Industry [8]	8.9	3.7	3.7	3.5	3.3	-5.7%	-0.8%	0.0%	-1.1%	-1.2%
Residential	3.8	2.9	2.6	2.1	1.6	-1.8%	-3.9%	-2.2%	-4.2%	-5.3%
Services	1.7	1.0	1.0	1.0	0.9	-3.5%	-0.7%	0.0%	0.0%	-2.1%
Agriculture, forestry and fishing	2	1.8	1.8	1.8	1.8	-0.7%	0.0%	0.0%	0.0%	0.0%
Power	6.4	3.7	3.2	2.4	1.6	-3.6%	-5.4%	-2.9%	-5.6%	-7.8%

SUMMARY TABLES

Footnotes & Geographical breakdown

FOOTNOTES

A. Global tables

1 Historic data based on IHS Markit and on IEA data from "World Energy Balances" © OECD/IEA 2015, www.iea.org/statistics, Licence: www.iea.org/t&c; as modified by CEPSA
2 Oil includes all liquids except biofuels, and also includes liquids consumed as petrochemical feedstock
3 Includes coal consumed as petrochemical feedstocks
4 It includes liquids biofuels
5 Energy related emissions comprise only those CO_2 emissions coming from the combustion of fossil fuels for energy purposes
6 Includes natural gas liquids (ethane, propane and butane) originated in the production of natural gas
7 Includes other non-energy uses such as asphalts or lubricants
8 Buildings comprises residential buildings (households) and buildings with commercial or public purposes like offices, malls, hospitals among others
9 Includes products such as petroleum coke and asphalts
10 Consumption of dry natural gas. Natural gas liquids not included
11 Unconventionals includes shale oil, tight oil and Canadian oil sands
12 Processing gains adjustment is defined as the volumetric growth of petroleum products compared to crude oil due to their lower density

B. Spain tables

1 Historical data based on Cores, Eurostat and Red Eléctrica Española
2 Oil includes all liquids except biofuels
3 Includes biofuels
4 Includes only energy uses
5 Reported as "non specified". Not associated to any final energy use sector
6 Includes the share of consumption of electricity generated from renewables
7 For 2000, there is no separate data for wind, solar and other renewables. They are all grouped together as "other renewable sources"
8 Non identified products. They are reported as "other petroleum products"
9 Includes asphalts and lubricants
10 AFF and others. Others are not reported uses. They account for a very small oil products demand, of about 0.1Mtons

GEOGRAPHICAL BREAKDOWN

WORLD

Consumers

- China
- India
- Rest of consumers
  - Sout East Asia
  - South Asia

Energizers

- Middle East
- Latin America
  - South America
  - Mexico
  - Central America
  - Caribbean
- Africa
  - North Africa
  - Sub-saharan Africa
  - East Africa
  - South Africa
- CIS
  - Russia
  - Kazakhstan
  - Other CIS

Regulators

- USA
- Europe
  - European Union (including Britain)
  - Turkey
  - Norway
  - Iceland
- Rest of regulators
  - Asia OECD
    - Japan
    - South Korea
    - Taiwan
    - Singapore
    - Australia
    - New Zealand
- Other
  - Canada

GLOSSARY

Acronyms & Energy conversions

ACRONYMS

AFF	Agriculture, Forestry and Fisheries
AFVs	Alternative Fuel Vehicles
BEV	Battery Electric Vehicle
bn	Billion
Bpd	Barrels per day
CAGR	Compounded Average Annual Growth Rate
CAPEX	Capital Expenditure
CCS	Carbon Capture and Storage
CCU	Carbon Capture and Utilization
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
COP	Conference of the Parties
CSP	Concentrated Solar Power
EOR	Enhanced Oil Recovery
EV	Electric Vehicle
FCV	Fuel Cell Vehicle
FID	Final Investment Decision
GDP	Gross Domestic Product
GHG	Greenhouse Gas
Gt	Gigatonnes
GW	Gigawatts
HDI	Human Development Index
HDV	Heavy-Duty Vehicle
HEV	Hybrid Electric Vehicle
HFO	Heavy Fuel Oil
ICAO	International Civil Aviation Organization
ICE	Internal Combustion Engine
ILUC	Indirect Land Use Change
IMO	International Maritime Organization
IoT	Internet of Things
kWh	Kilowatt Hour
LAB	Linear Alpha Olefin
LCOE	Levelized Cost Of Electricity
LDV	Light-Duty Vehicle
LNG	Liquedfied Natural Gas
LPG	Liquedfied Petroleum Gas
Mbbl	Million barrels
Mbpd	Million barrels per day
MGO	Marine Gas Oil
Mtoe	Million tonnes of oil equivalent
Mt	Million tonnes
NDC	Nationally Determined Contribution
NGL	Natural Gas Liquids
NGV	Natural Gas Vehicles
NOCs	National Oil Companies
NOx	Oxides of Nitrogen
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of Petroleum Exporting Countries
PEC	Per capita Energy Consumption
PJ	Petajoule
PV	Photovoltaics
SO_2	Sulfur dioxide
TCF	Trillion Cubic Feet
TCO	Total Cost of Ownership
TFED	Total Final Energy Demand
TOE	Tonnes of Oil Equivalent
TPED	Total Primary Energy Demand
TWh	Terawatt hour
UN	United Nations
W	Watts

2030

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