10 July 2019

BC3-UPV/EHU Summer School:

Transformation, Adaptation and Mitigation for a 1.5 degree Global Warming

# Viability of deep decarbonization pathways

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Iberdrola

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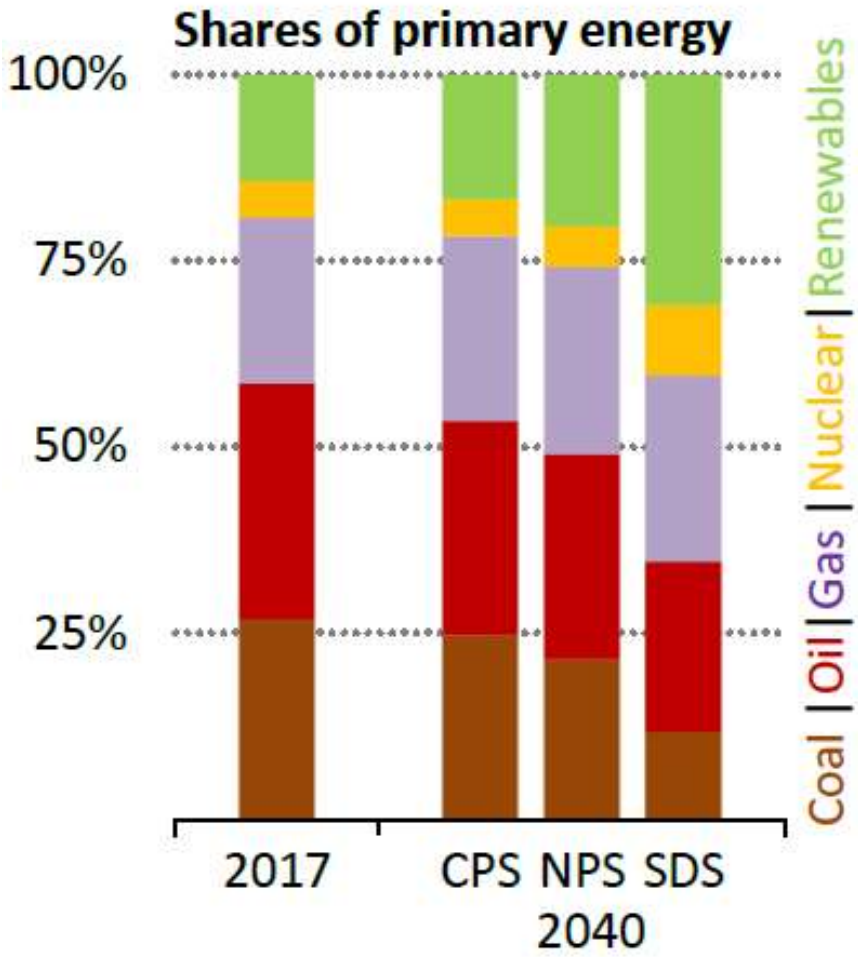
# The current energy model is one of the main drivers towards climate change

## Primary energy demand by fuel at WEO 2018




*80% of global energy consumption comes from fossil fuels*

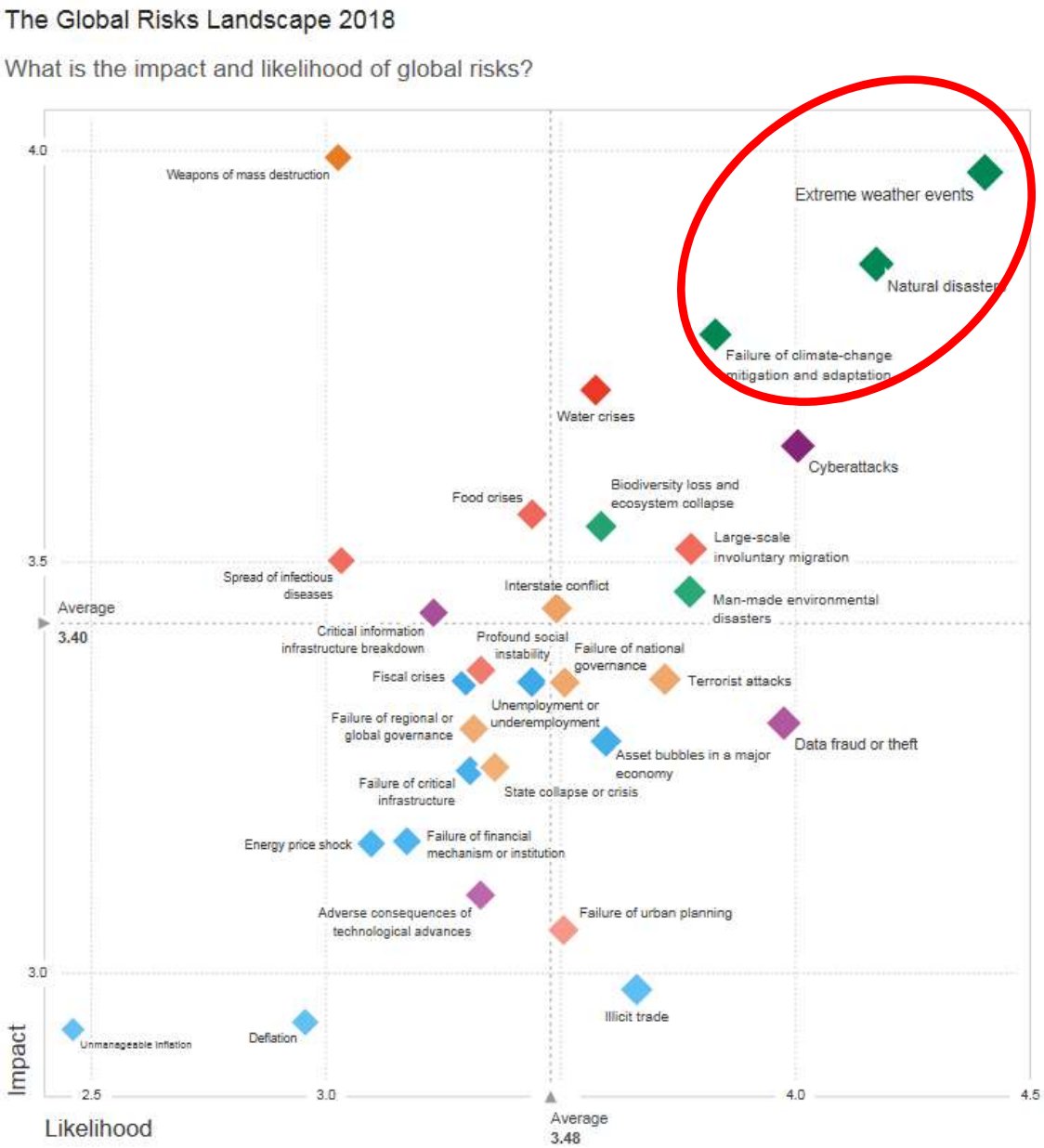
**Renewable energies have increased their participation, but still represent a small part of the global energy mix**

**Fuente**: IEA, World Energy Outlook, 2018

# Climate change is consolidating its position at the top of risk rankings

**Climate change and its side effects lead risk rankings in terms of probability and impact**

***Extreme events, natural disasters and failures in mitigation and adaptation to climate change***



# Air pollution is one of the main consequences of the current energy model

## Ambient air pollution

**91%**

of the world's population lives in places where **air quality exceeds WHO guideline limits**

## Household air pollution

**4.2 million**

**deaths** every year as a result of exposure to **ambient** (outdoor) **air pollution**

**3.8 million**

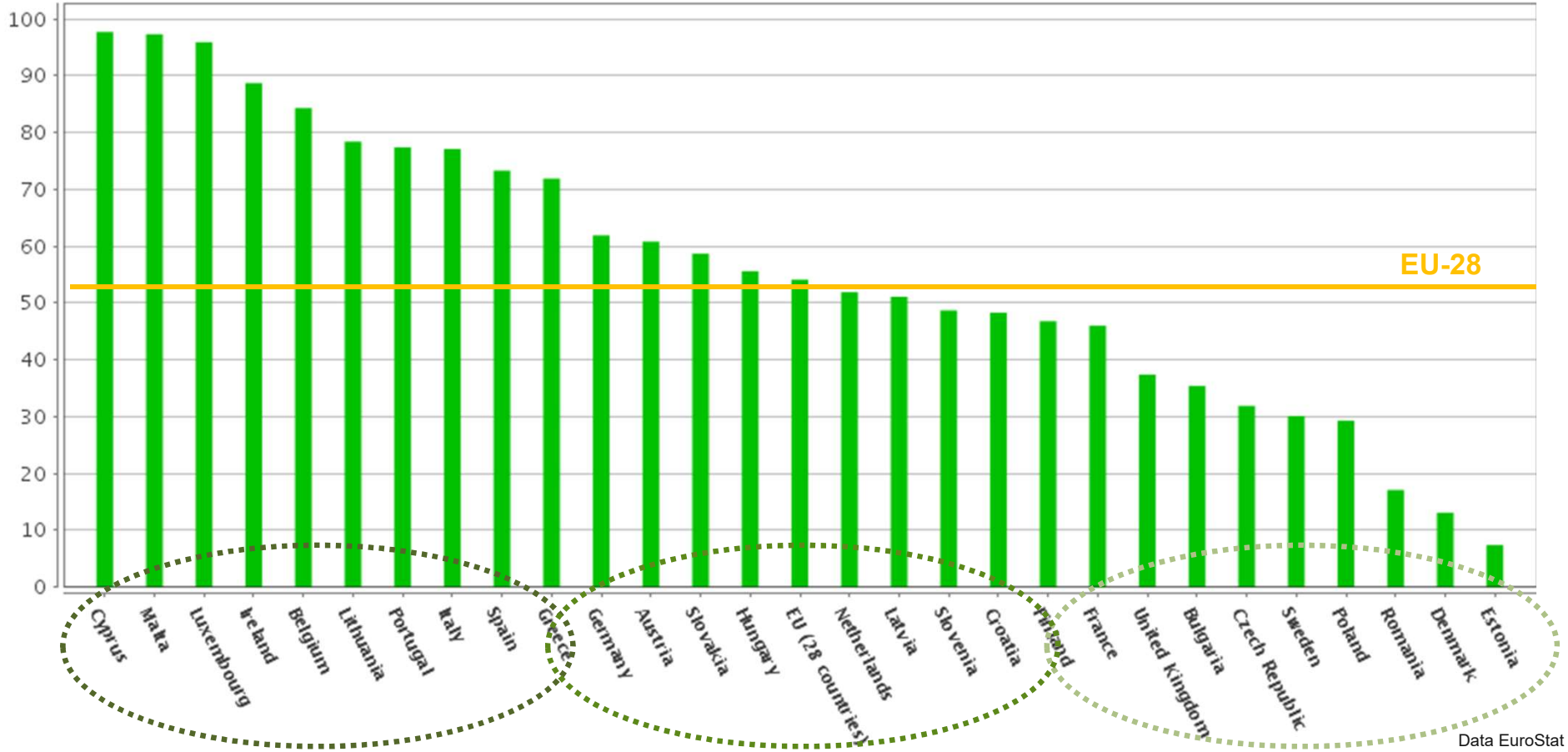
**deaths** every year as a result of **household exposure** to smoke from dirty cookstores and fuels

- The **highest ambient air pollution levels** are in the **Eastern Mediterranean Region** and in **South-East Asia**
- In general, **ambient air pollution levels** are **lowest** in **high-income countries**, particularly in Europe, the Americas and the Western Pacific
- In cities of high-income countries in **Europe**, **air pollution** has been shown to **lower average life expectancy** by anywhere between **2 and 24 months**, depending on the pollution levels

*Source: WHO*

# The current energy model implies a high energy dependence for many European countries

## Energy dependence in EU28 by country, 2015

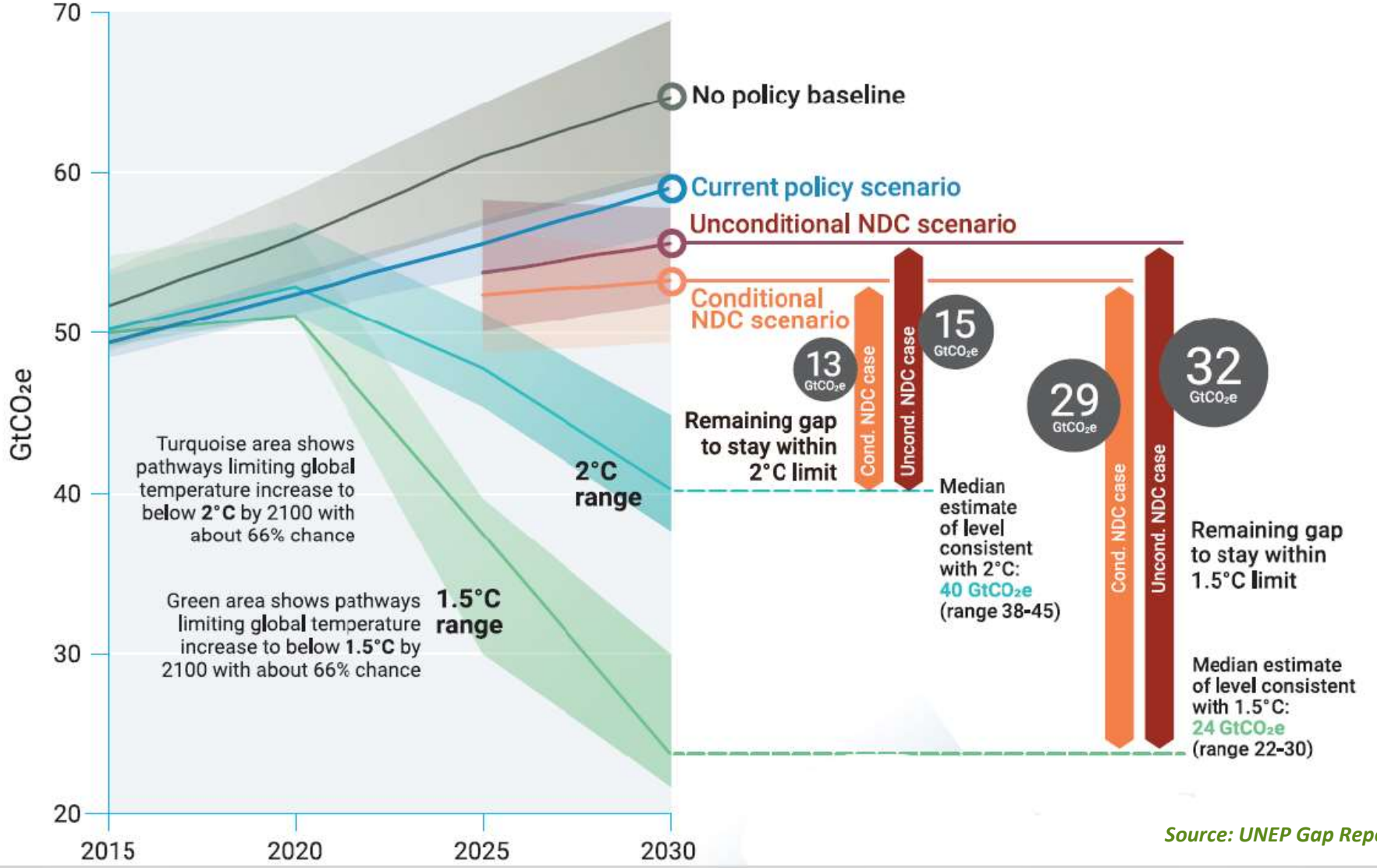



**High dependence** | **Average dependence** | **Low dependence**

**Reducing the consumption of fossil fuels improves energy security in externally dependent regions to meet their energy needs (e.g. EU)**

# The current energy model is one of the main drivers towards climate change

## Global greenhouse gas emissions under different scenarios and the emissions gap in 2030




*Source: UNEP Gap Report 2018*

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## Main 2030 targets from European Commission and NECP

| | European Union | Spain (NECP) |
|---|---|---|
| CO2 (eq) | 40% reduction compared to 1990 | 20-21% reduction compared to 1990 |
| Energy efficiency | 32,5% reduction compared to PRIMES 2007 | 39,6% reduction compared to PRIMES 2007 |
| Renewable energy | 32% of final consumption | 42% of final consumption |

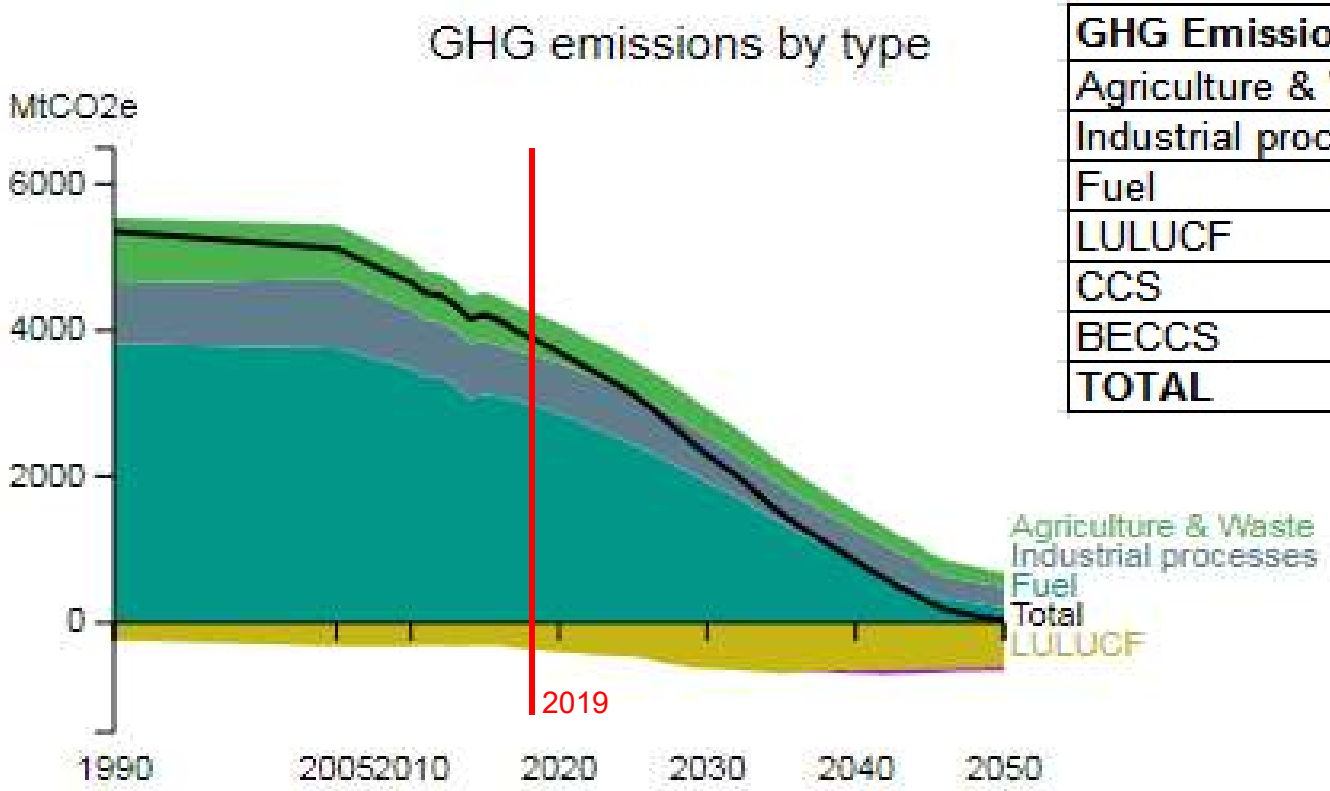
**Net – zero emission by 2050: debate at both EU and national level**

# Deep decarbonization pathways for the EU in the 2050 horizon...

An illustrative EU scenario * aligned with a net-zero emission goal by 2050

** The creation of scenarios using the ClimateWorks/CTI 2050 Roadmap Tool, that has been developed by Climact sa/nv and the European Climate Foundation, does not imply endorsement of those scenarios by either Climact or the ECF, nor endorsement of any conclusions based on those scenarios*

# An illustrative EU scenario * aligned with a net-zero emission goal by 2050




| GHG Emissions by Type (2050) | $MtCO_2e$ |
|---|---|
| Agriculture & Waste | 195 |
| Industrial process | 287 |
| Fuel | 215 |
| LULUCF | -607 |
| CCS | -55 |
| BECCS | -1 |
| **TOTAL** | **34** |

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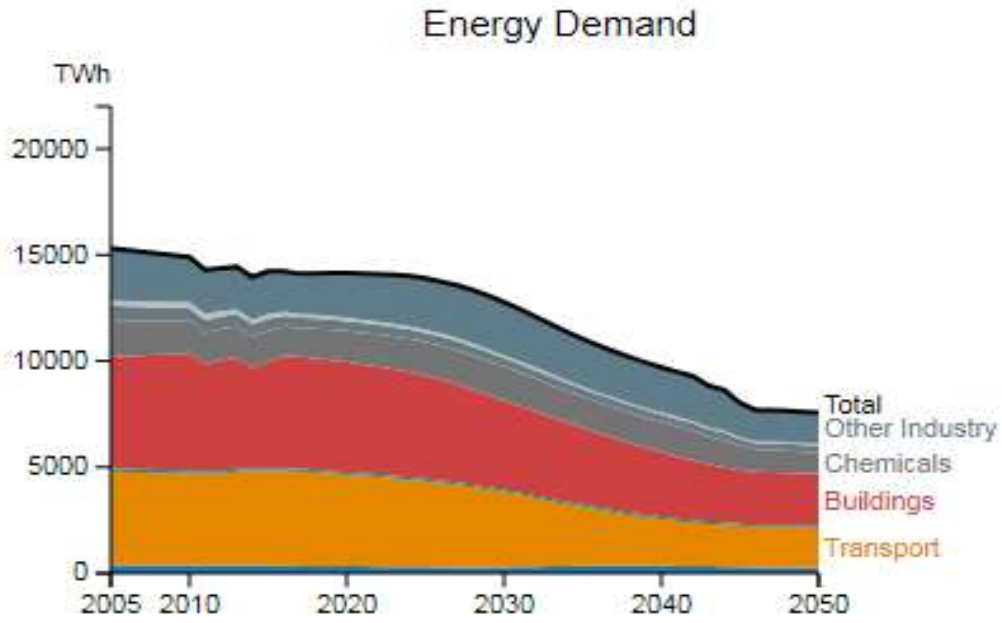
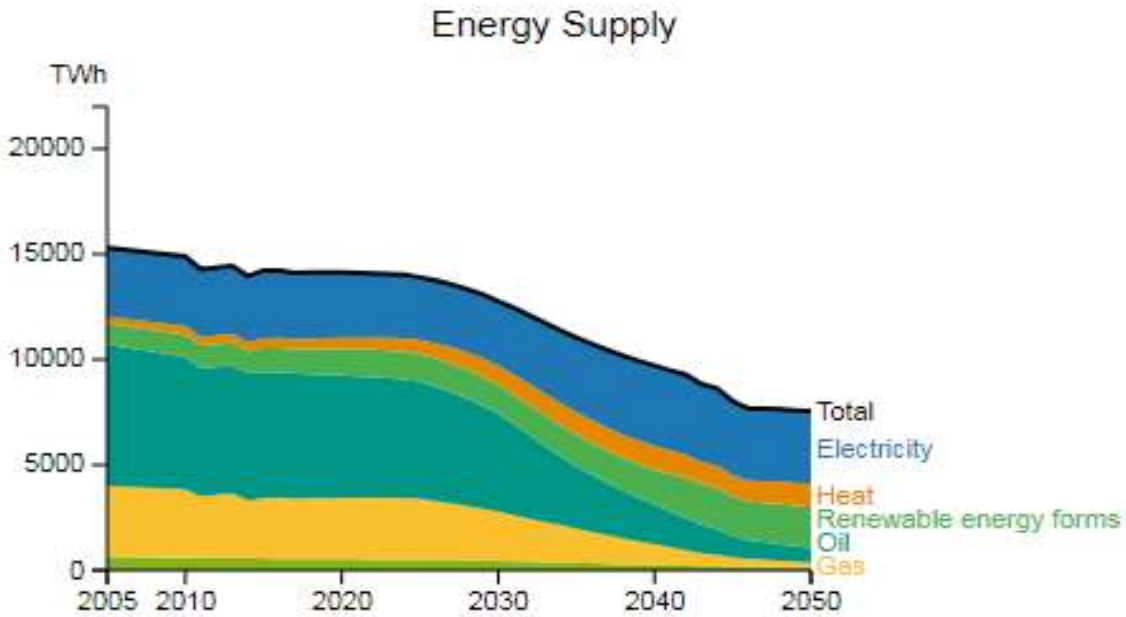
**The drastic reduction of the weight of fossil fuels in the European energy mix is a necessary condition**

# An illustrative EU scenario * aligned with a net-zero emission goal by 2050

## Evolution of energy consumption at EU level. (All Energy)

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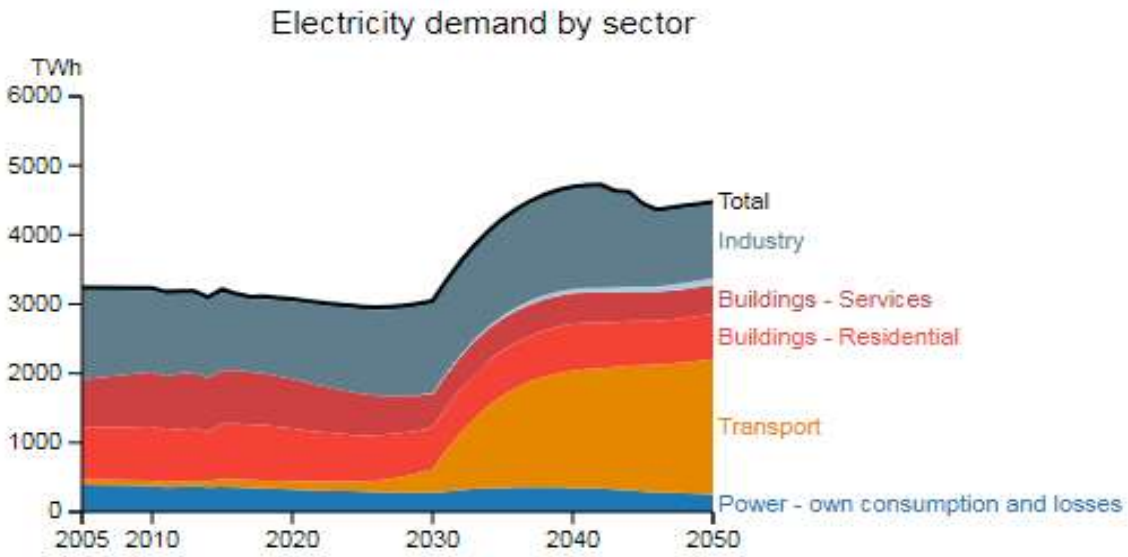
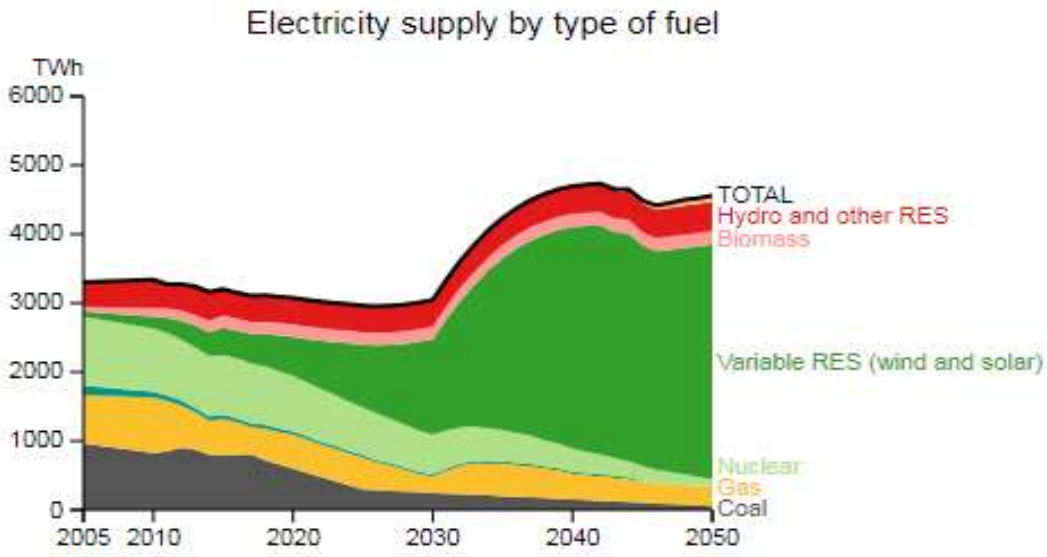
**Energy demand drops by 51% while electricity demand rises by 38% in 2050**

# An illustrative EU scenario * aligned with a net-zero emission goal by 2050

## Evolution of energy consumption at EU level. (Power: Demand)

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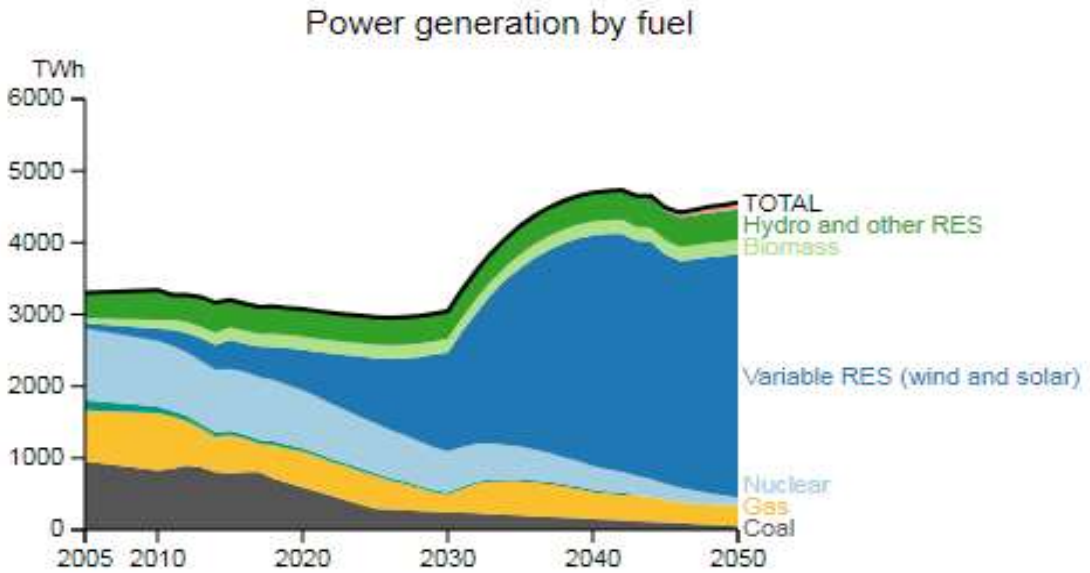
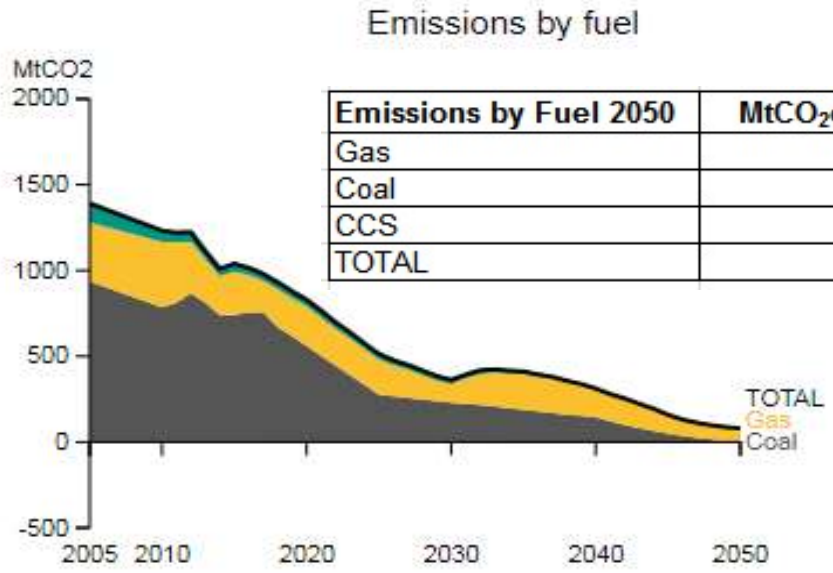
**There is a need for the improvement of energy efficiency and the replacement of fossil fuels by renewable sources**
**Transport is the sector that most increases its electricity demand (44% of the demand)**

# An illustrative EU scenario * aligned with a net-zero emission goal by 2050

## Evolution of electricity generation and emissions at EU level. (Power Generation)




| Emissions by Fuel 2050 | $MtCO_2e$ |
|---|---|
| Gas | 88 |
| Coal | 0 |
| CCS | -8 |
| TOTAL | 80 |

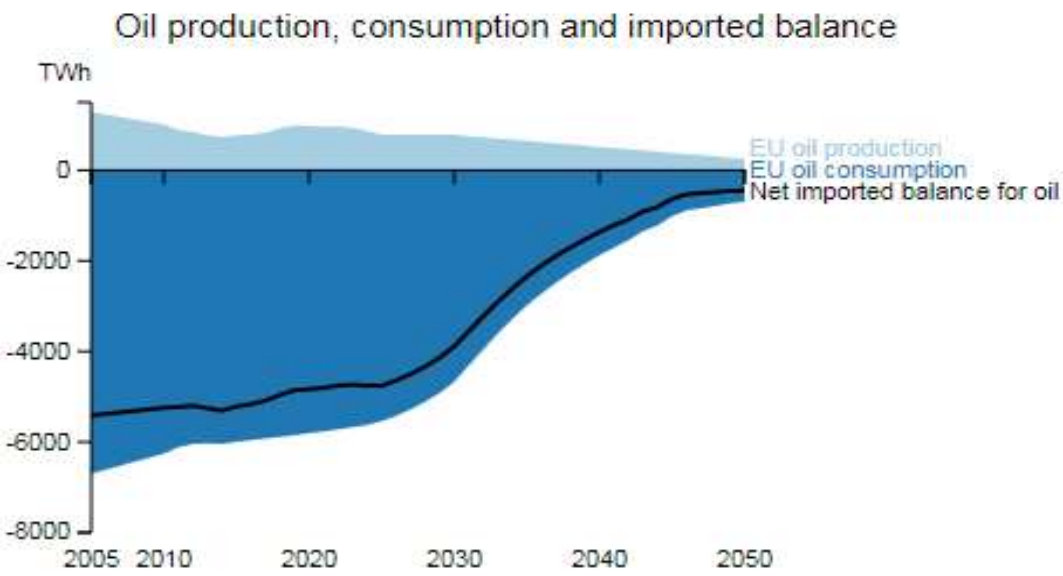
** The creation of scenarios using the ClimateWorks/CTI 2050 Roadmap Tool, that has been developed by Climact sa/nv and the European Climate Foundation, does not imply endorsement of those scenarios by either Climact or the ECF, nor endorsement of any conclusions based on those scenarios*

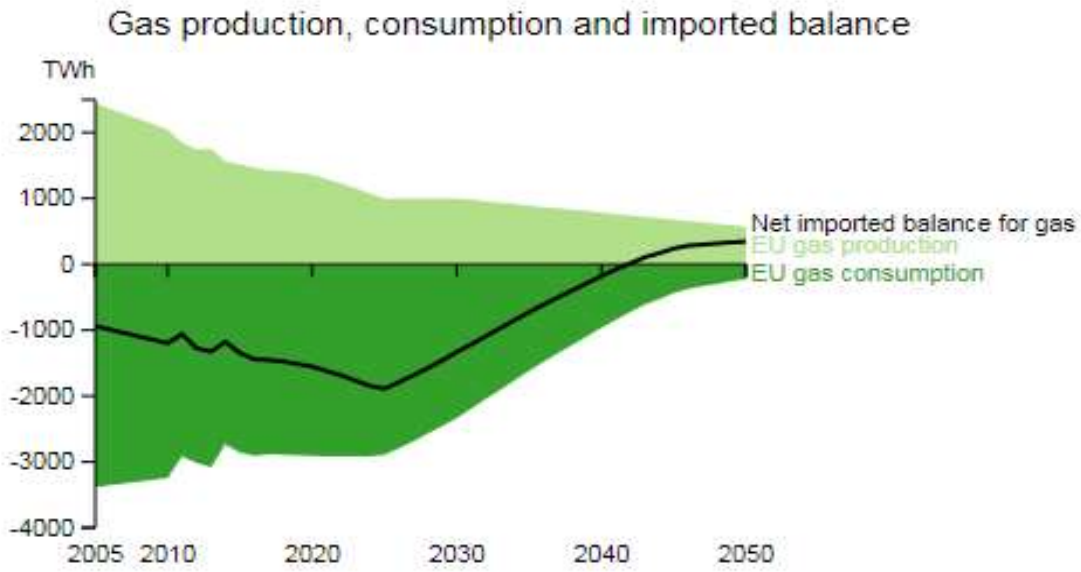
**Generation will be based mainly on renewables**
**(74,5% wind and solar)**
**Demand management measures will be required**

# An illustrative EU scenario aligned with a net-zero emission goal by 2050

## Evolution of dependence on oil and gas imports in the EU

(Oil and Gas import balance)

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**Oil and gas consumption is drastically reduced in 2050, reducing energy dependence**

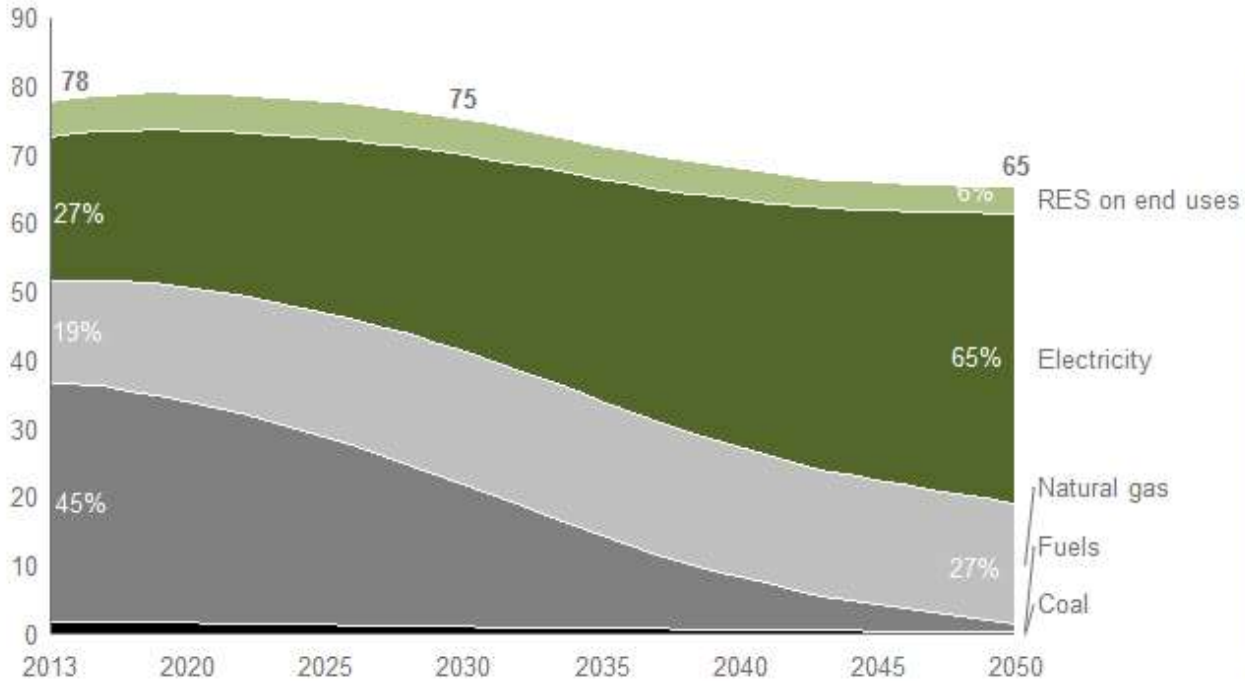
# Deep decarbonization pathways for Spain in the 2050 horizon...

# EU energy model decarbonization is viable and a source of opportunities

An **scenario** exercise shows it is **possible** to achieve 80% **decarbonization** in Spain by 2050 through almost 100% RES electricity and "smart solutions" in final uses.

**Final energy consumption by energy source in a "Sustainable Scenario" that meets EU goals** (Mtoe)

| | | | | |
|---|---|---|---|---|
| Emissions ($MtCO_2$) | ~322 | ~310 | ~250 | ~88 |
| Fulfilment of EU goals | | | ✓ | ✓ |



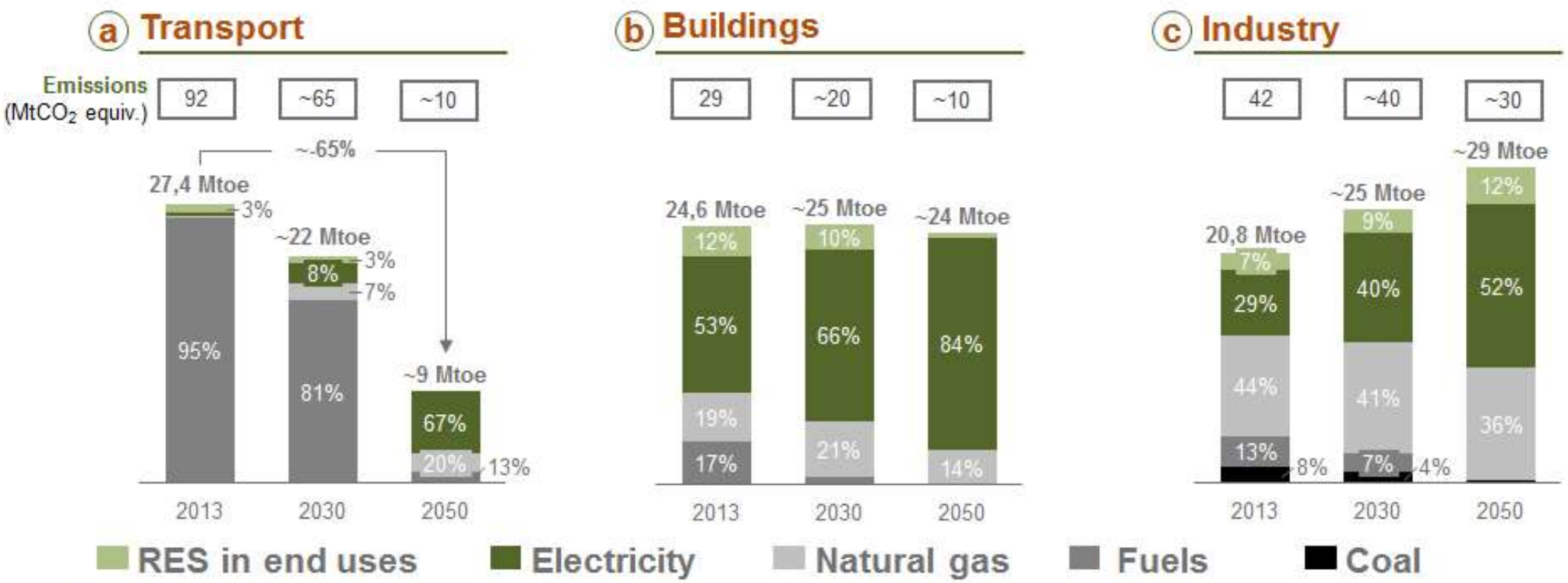

- Reduce **energy consumption**
- Phase out **oil and coal**
- Maintain **gas** as a transition energy wherever electrification is not viable
- Reach high penetration of **renewables**, through the **electricity** sector

[1] Includes hydro capacity

# EU energy model decarbonization is viable and a source of opportunities

RES and EE solutions in transport & buildings are key to meet climate goals in a cost effective way

## Breakdown of final energy consumption by sector (Mtoe)



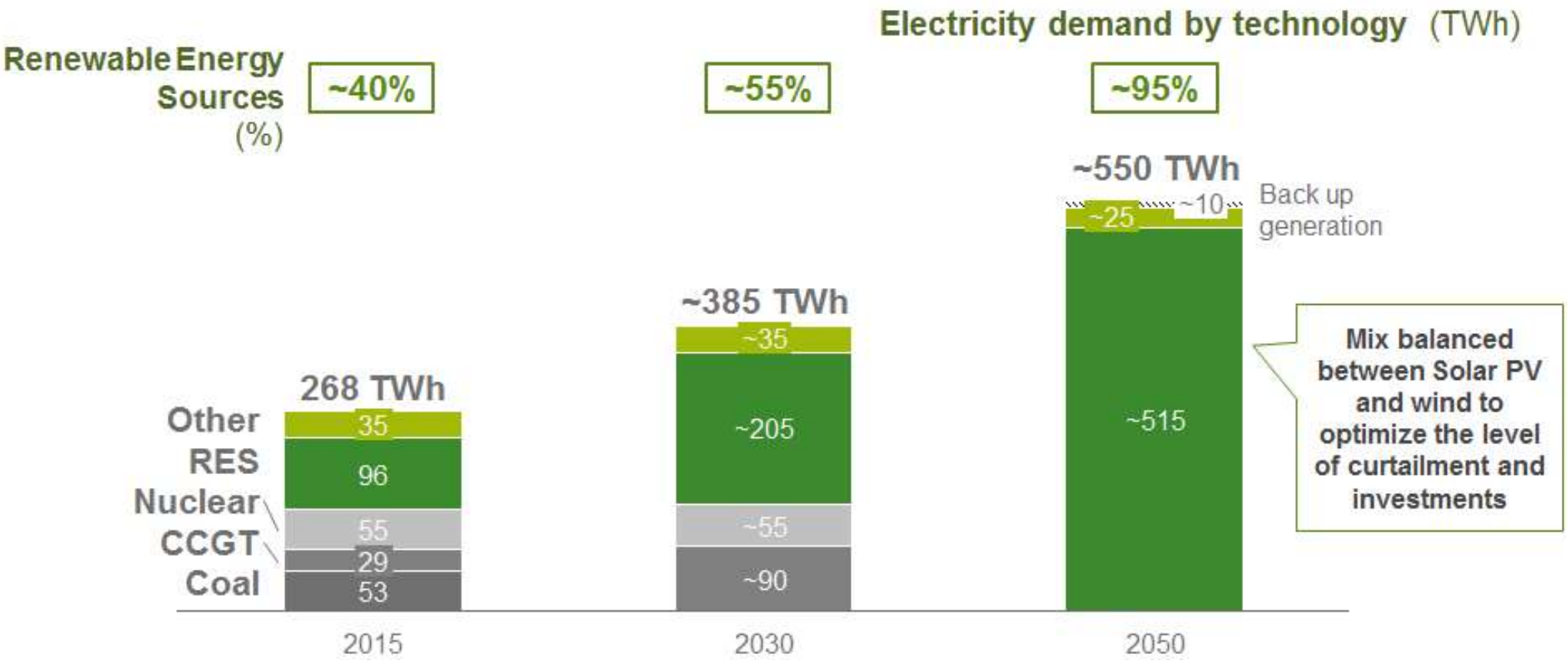

- **Electrification ~100%** of **light vehicle fleet** and increase of **rail and electric trucks** in freight transport (~85%) by 2050

- **Electrification of Heating & Cooling in Buildings** (important role of Heat Pumps)

- **Different penetration depending on the characteristics of each industry**

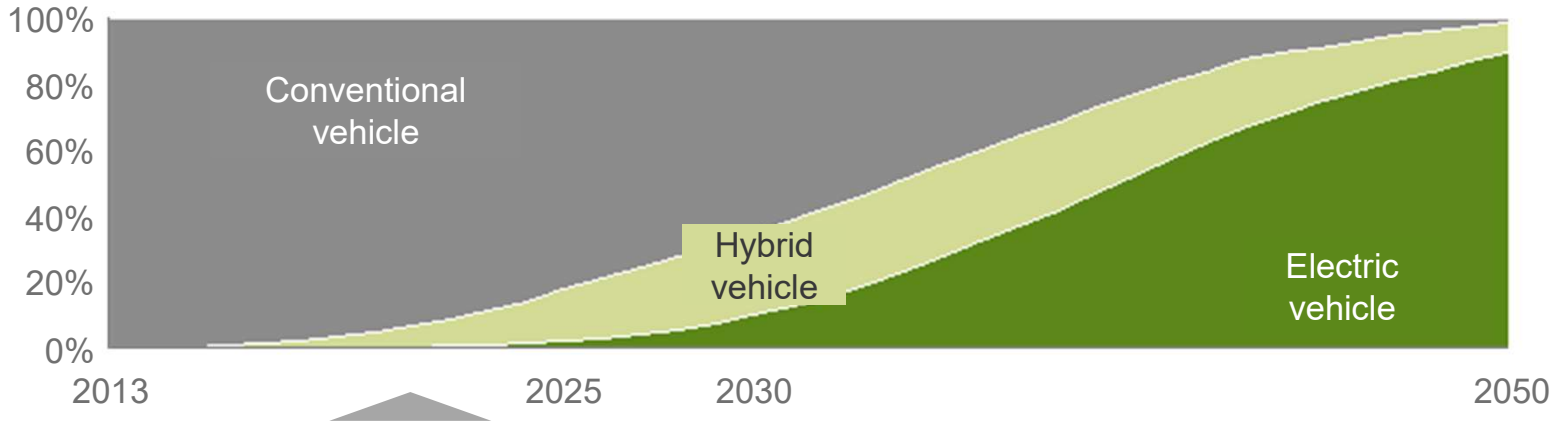
# EU energy model decarbonization is viable and a source of opportunities

Electricity model will be almost fully based on renewable energy sources by 2050 (~95% )



## Light vehicles park[1] depending on the type of fuel
(%)

| | | | | |
|---|---|---|---|---|
| **Emissions[2]** ($MtCO_2$ eq) | 60 | ~50 | ~40 | ~2 |
| **Final energy consumption of light transport** (Mtep) | 17,9 | 16,1 | 13,9 | 4,5 |
| **Electric vehicles sales [3]** (%) | ~0% | ~60% | ~65% | ~100% |




It is assumed that the price of the electric vehicle is equal to that of a conventional vehicle in 2022 in Spain

(1) It is considered a constant fleet of light vehicles (<3.5t) of ~27 million; constant annual sales of 1.500.000 vehicles
(2) Includes the corresponding share of oil refining emissions. Emissions for a model vehicle over its useful life (10 years and 10.000 km per year) are: hybrid: 8tCO2 (5tCO2 without considering the emissions of electricity generation); electric: 4tCO2; gasoline: ~20 tCO2; diesel: ~18 tCO2. Average park consumption and the 2015 generation mix are considered
(3) Includes electrical and plug-in hybrids
Source: DGT, own elaboration

**Electrifying light transport requires 65% of car sales to be electric vehicles by 2030 and 100% of sales by 2050**

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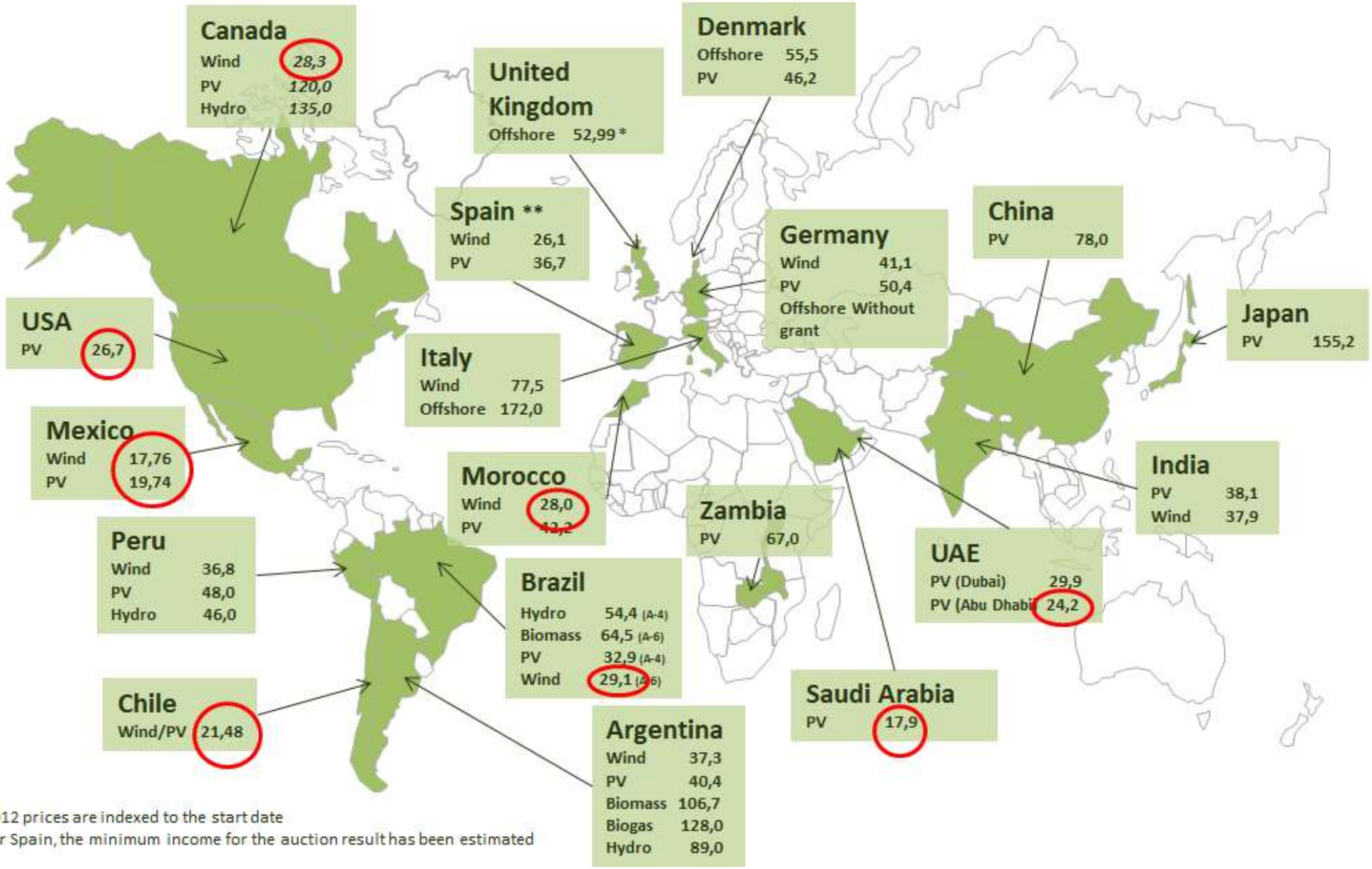
# Minimum price offered at latest auctions per country since 01/01/2016, USD/MWh




* 2012 prices are indexed to the start date

** For Spain, the minimum income for the auction result has been estimated

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# Positive impacts from a net – zero emission goal by 2050 at EU level

| | |
|---|---|
| **Job creation** | **1 million additional jobs** in 2050 in comparison to the baseline scenario |
| **Positive impact on climate change** | With the 1.5°C ambition as opposed to the 2°C one:<br>• **Reduce** people affected by **water scarcity** problems by 50%<br>• Drop of 50% in the ecosystem area under threat<br>• Three times **fewer losses** related to the **natural habitats** |
| **Air quality improvement** | **Premature deaths** caused by 2.5 pm and ozone **would fall by 40%** |
| **GDP increase** | **GDP** would rise **around 2.2%** in 2050 |
| **Reduction of energy dependence** | **Energy dependence** could go **down** from 55% to 20% in 2050 |
| **Reduction in the vulnerability of households to energy price variability** | **Households** would **spend** some **5.6% less** of their incomes in 2050 on energy |
| **Outdoor labour productivity** | Avoid a loss of 10 – 15% in outdoor labour productivity |



Source: EU long term emission reduction strategy. November 2018

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## Energy efficiency and RES deployment will play a key role to decarbonize economy

- A changeover to a **decarbonised energy model** is needed. One based on energy **efficiency** and **renewable** energies

- It is **economically feasible** to achieve an **80% reduction of emissions** with current technology by 2050.

- Reaching $CO_2$ neutrality will require the development of currently immature technologies

- Decarbonising the energy sector entails the **electrification** of **final energy uses** and the replacement of energy system based on fossil fuels

## Clear goals & coherent and robust policy frameworks

To make the most of these economic opportunities, we need:

- **Medium** and **long term goals**: to 2020, 2030 and 2050
- The policies needed to meet these goals must include an **environmental tax reform** based on the "**polluter pays**" principle
- Industrial sector plans: analysing opportunities, threats, the competitive benefits of European industry and setting out intelligent strategies, information plans and public awareness
  - **Industrial strategies** aligned with a **net – zero** scenario
- A fair and orderly transition must be designed in **collaboration** with all stakeholders
- The development of cutting-edge and valuable technology will play a crucial role (**R & D & i**)

# A CLIMATE NEUTRAL EUROPE

IBERDROLA

## IT'S POSSIBLE AND WILL DELIVER HUGE OPPORTUNITIES

PARIS AGREEMENT

$CO_2$

European Union long-term emissions reduction strategy proposal

CLEAR GOALS AND COHERENT, PREDICTABLE POLICIES

- Medium- and long-term objectives
- Sectoral roadmaps
- Environmental tax reform
- Fair transition
- Adequate electricity tariff design
- R&D policies

RENEWABLES AND ENERGY EFFICIENCY AS MAIN DRIVERS OF A DECARBONIZED ECONOMY

- Available technologies
- Electrification is critical
- Economic viability and opportunities

$CO_2$

GDP PROSPERITY

$CO_2$

ELECTRICITY SECTOR

Electricity provides business solutions aligned with climate goals.

POSTIVE IMPACTS

1. CLIMATE CHANGE MITIGATION
2. POSITIVE IMPACT ON GDP
3. AIR QUALITY IMPROVEMENT
4. INCREASE IN LABOUR PRODUCTIVITY
5. LESS ENERGY DEPENDENCY
6. REDUCTION IN HOUSEHOLD VULNERABILITY
7. INDUSTRIAL DEVELOPMENT
8. JOB CREATION

2015 — 2018 — 2030

NET-ZERO EMISSIONS BY 2050