



Enel Perspectives on Energy Transition

Walking the path towards a decarbonised economy

November 20th, 2018



The Paris Agreement framework

Improving the investment context through clarity, accountability, financiability

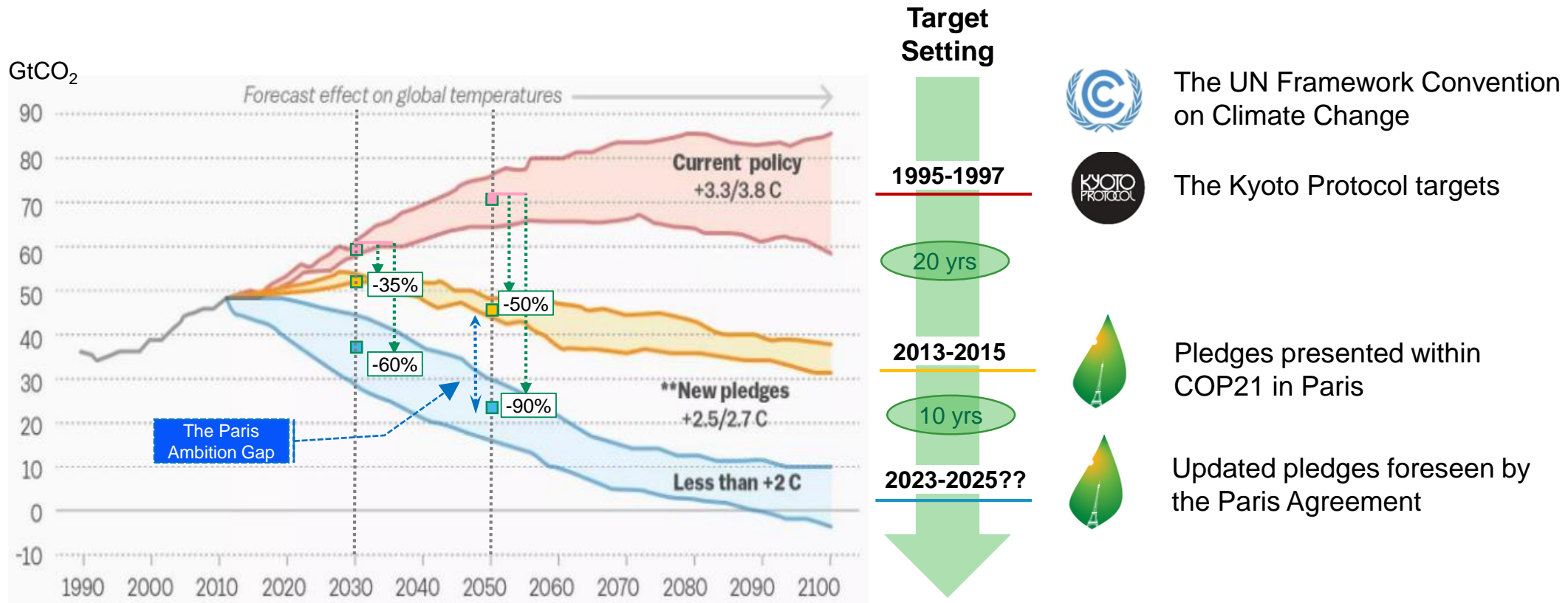


- **Ambition** - Long term goal of keeping raising temperature “well below 2°C” with efforts to stay within 1.5°C:
 - Emission peak “as soon as possible”
 - Carbon neutrality in the second half of the century
 - More than 95% of global emissions covered
- **Transparent Governance** - A transparent framework foreseeing:
 - Clear and transparent NDCs to be periodically upgraded
 - “Highest possible ambition” through NDC (Nationally Determined Contributions)
 - 5 years pledge review system
- **Climate Finance**
 - **Public Finance** – confirmation of the commitment to mobilize 100 Bn USD/yr to climate finance (current pledges are insufficient)
 - **Carbon Markets**- Reference to carbon trading through “mitigation outcomes” and new project-based crediting mechanism



The policy context is evolving ever more rapidly

Ambition has increased significantly since 2000s and will increase more rapidly by 2025

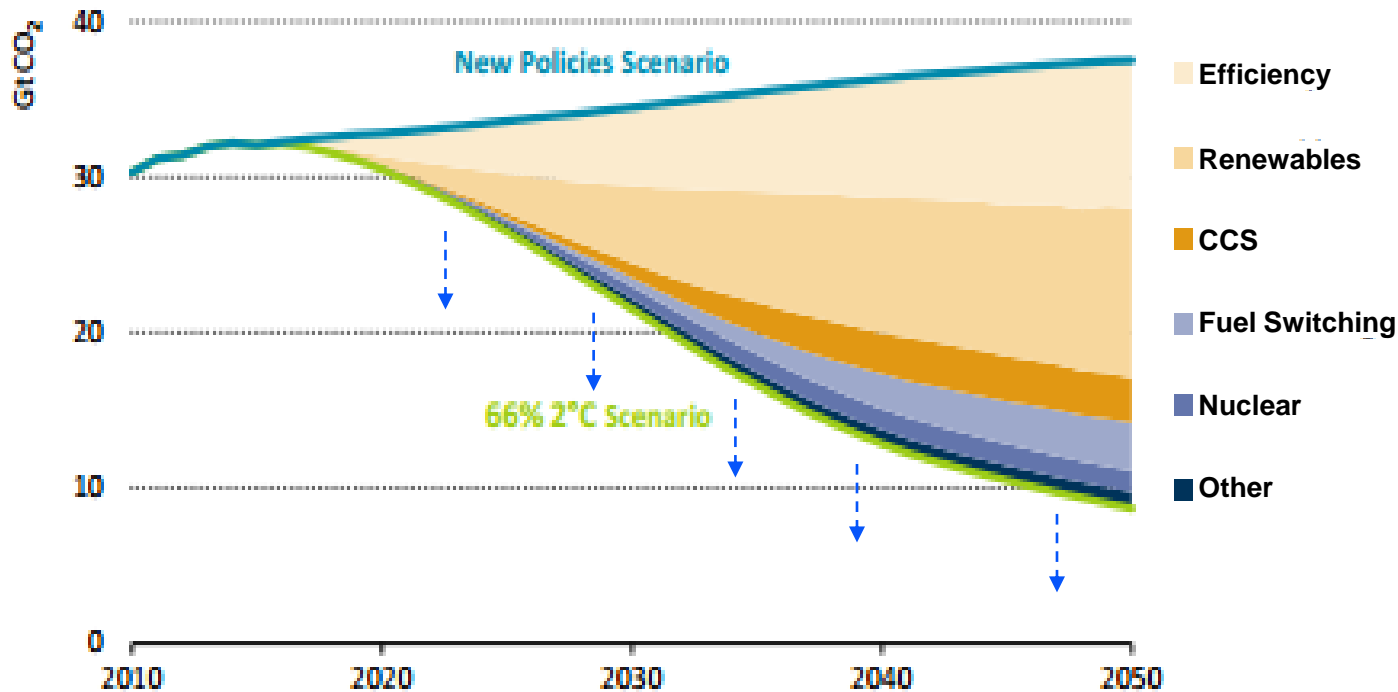


The challenge of filling the Paris Ambition Gap

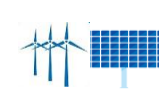
A transition “unprecedented in terms of scale, but not necessarily in terms of speed” *



Global emission abatement in the 66% 2°C Scenario**



A drastically different landscape in 2050



Low-carbon electricity representing 95% of the energy mix



Nearly 70% of new cars will be electric



The entire existing building stock retrofitted



CO₂ intensity of the industrial sector 80% lower than today

* Source: IPCC Special Report on Global Warming of 1.5°C

** Source: IEA-Irena, Perspective for the energy transition, 2017

Diversified energy transition policy drivers

Together with climate change, other important policies are accelerating the transition



Environment

Air quality and environmental sustainability



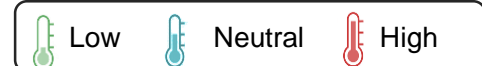
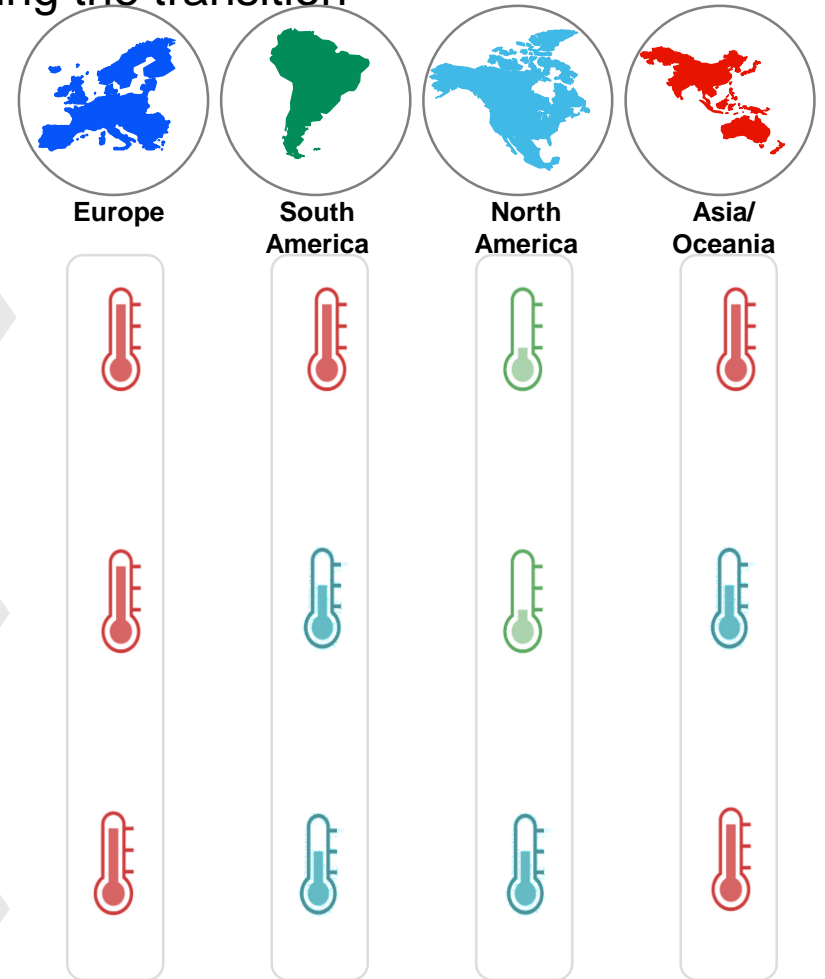
Geo-Politics

Security of primary energy supply



Industrial Development

Economic competitiveness vs green growth

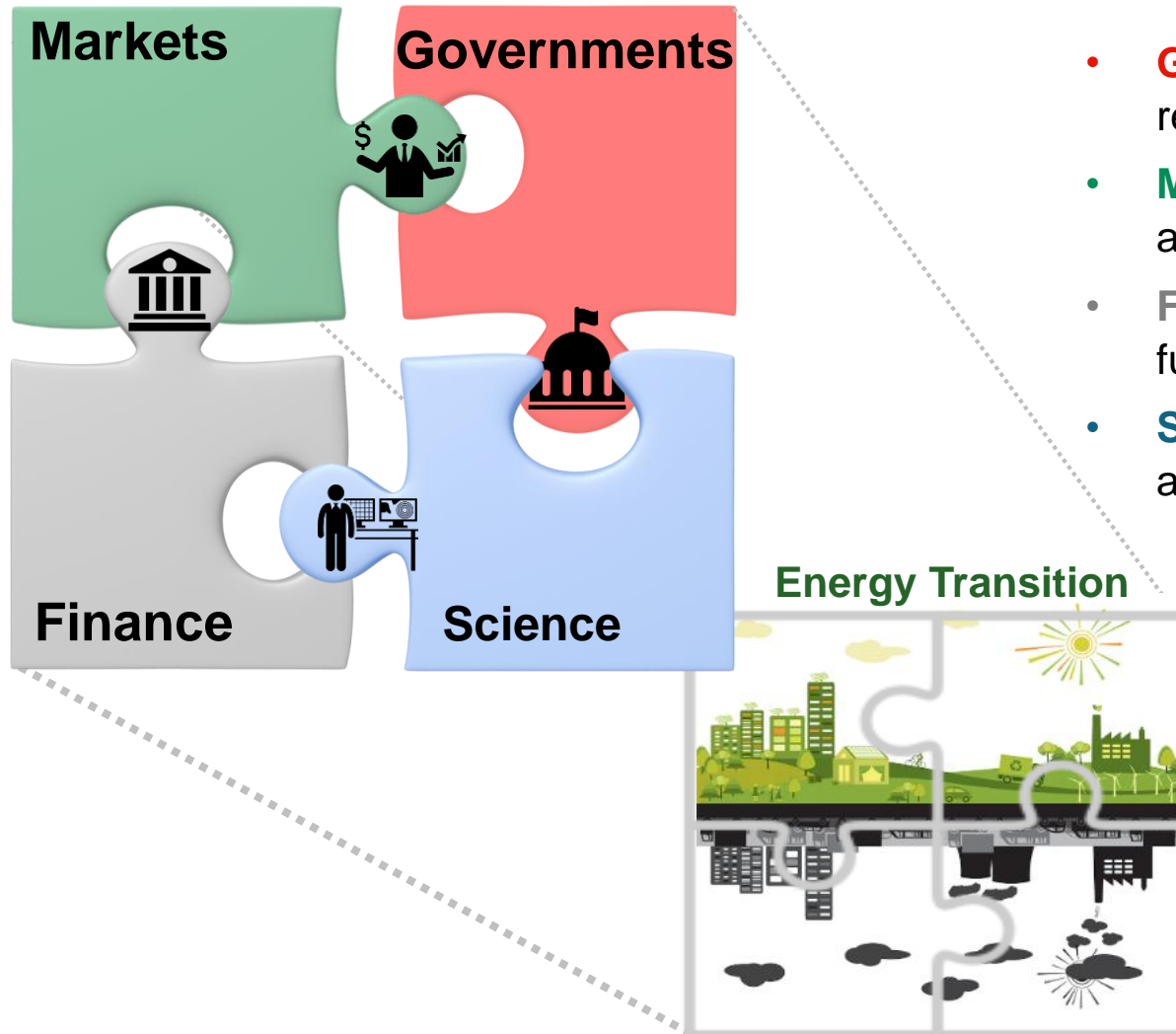


Note: Qualitative evaluation; within regions there are strong national differences

A shared long term vision for a low carbon economy



The transition pathway need an enhanced framework






- **Governments:** Need to provide transparent and stable regulatory frameworks
- **Markets:** Provide clear signals to operators incorporating a full range of risks (e.g. technological)
- **Finance:** Increase financial resources while providing a full range of financial products to low carbon investments
- **Science:** Fully reflect the urgency for climate action and accelerate the much needed technological development

Accelerated dynamics increase the need of a long term and cross-sector vision in the definition of appropriate policies, efficient market design and stable investment framework

Energy Transition Roadmaps

Translate COP21 global commitments at country and regional levels

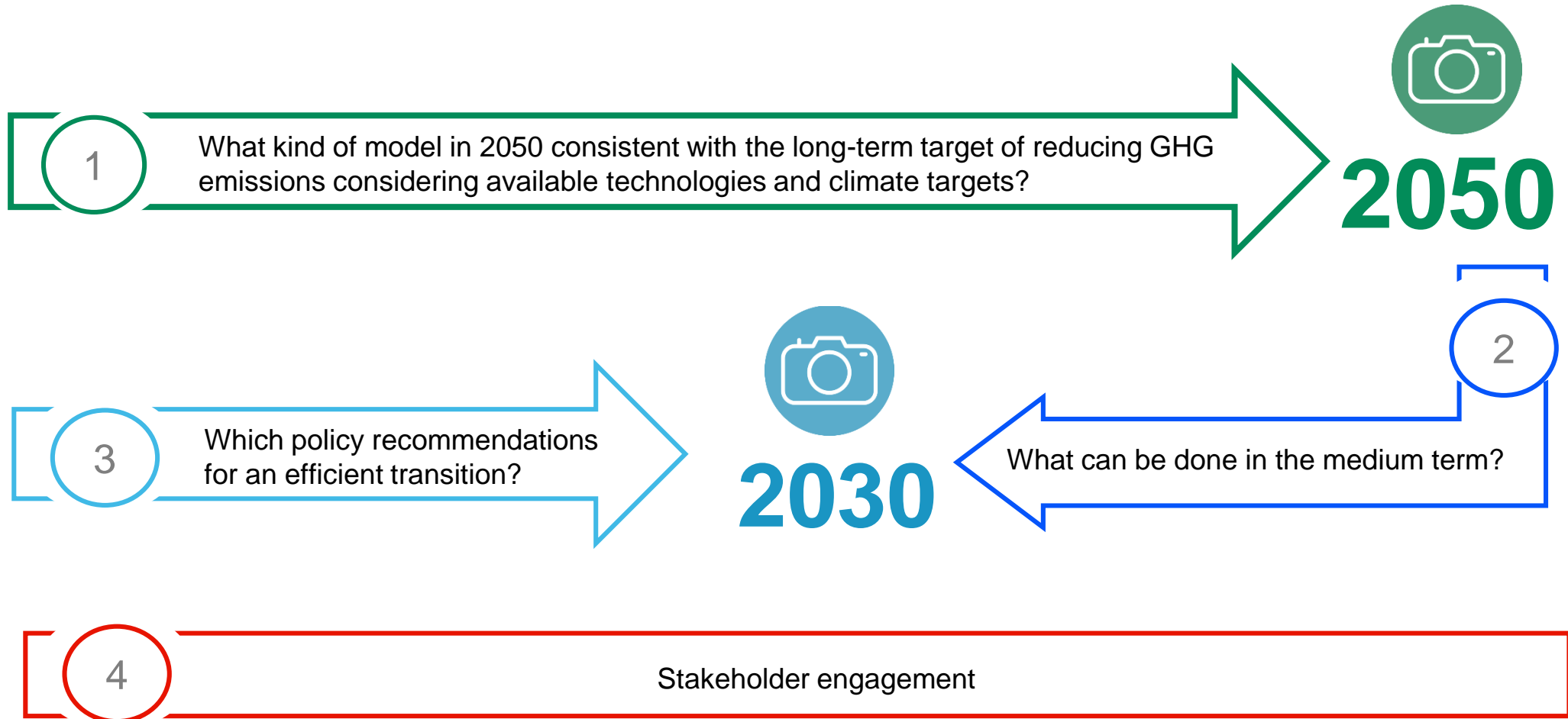


-  **Accelerating the energy transition at National Level:** roadmaps to support Governments in implementing the energy transition fully exploiting the three key levers of emission free electricity, digitalized grids, electrification
-  **Supporting transparent and stable policy and regulatory frameworks:** supporting Governments and UN Institutions in implementing the Paris Agreement with clear and effective Climate and Energy Plans reflected in transparent NDCs*
-  **Promoting effective climate finance programs and market mechanisms:** cooperation with National Governments, UNFCCC institutions and other Stakeholders (e.g. Development Banks, NGOs, Financial Community) to design effective up-scaled and streamlined financing tools and market mechanisms to support the energy transition

* NDC - Nationally Determined Contribution: national targets and related climate-energy policies foreseen by the Paris Climate Agreement

Project structure: pragmatic and effective

The transition scenario needs to be defined considering long term decarbonization goals



The transition requires the application of 3 levers

A single vision to be adapted case by case to national contexts

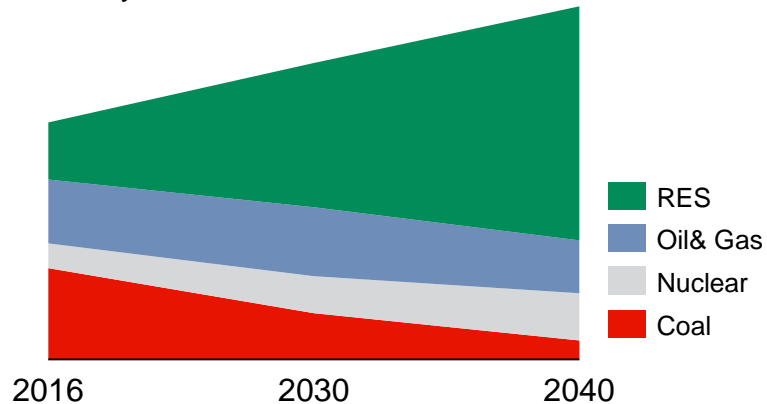


1

Emission Free Power generation

Global Electricity Generation¹

TWh/yr



Increase of Renewables requires a market design « fit for RES »

3

Infrastructure Development & Digitalization

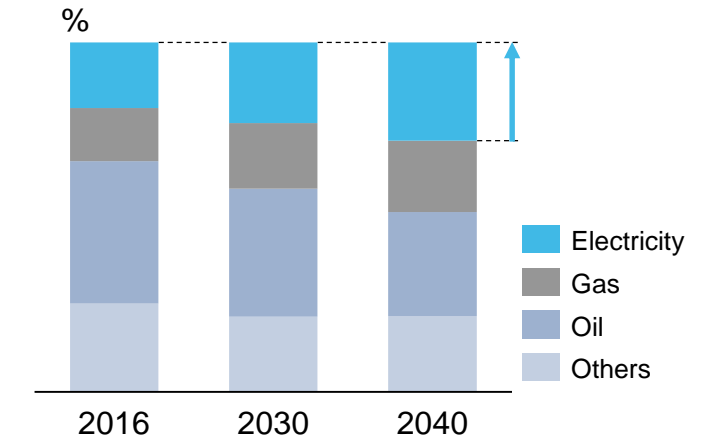


Grid development and digitalization is the cornerstone for the structural changes required

2

Switch to Energy Vectors with lower emissions

Global Final Energy Consumption¹

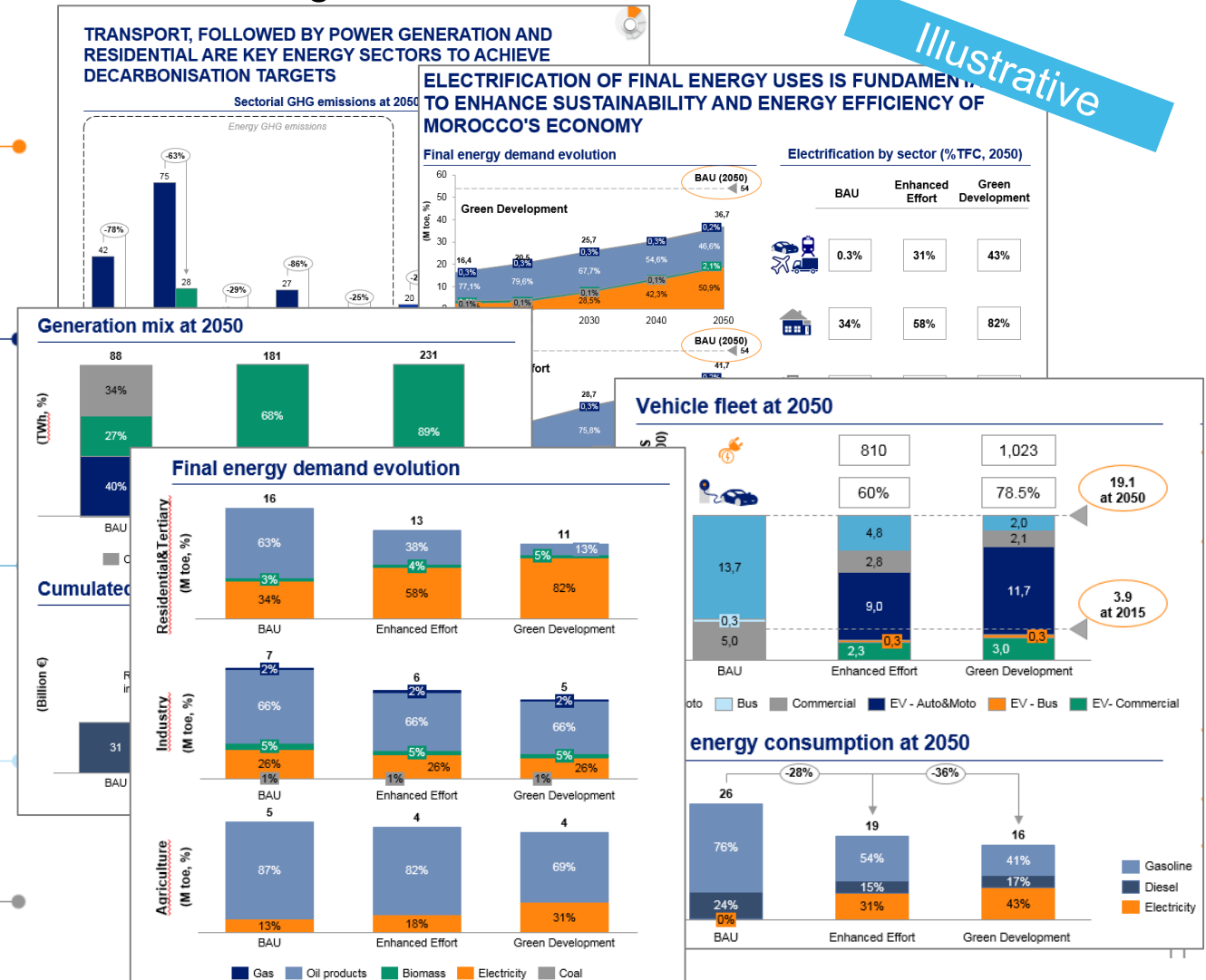
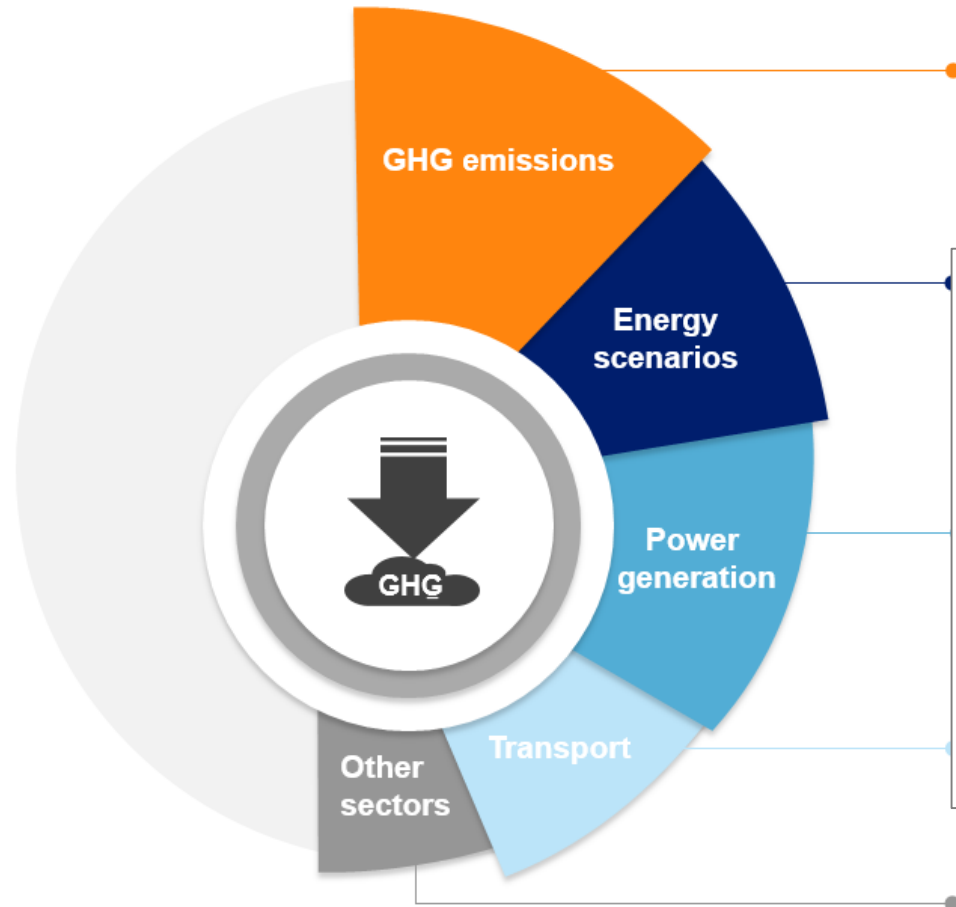


Electricity is key to an efficient transition towards zero emissions

¹ Source: IEA, World Energy Outlook 2018 – Sustainable Development Scenario

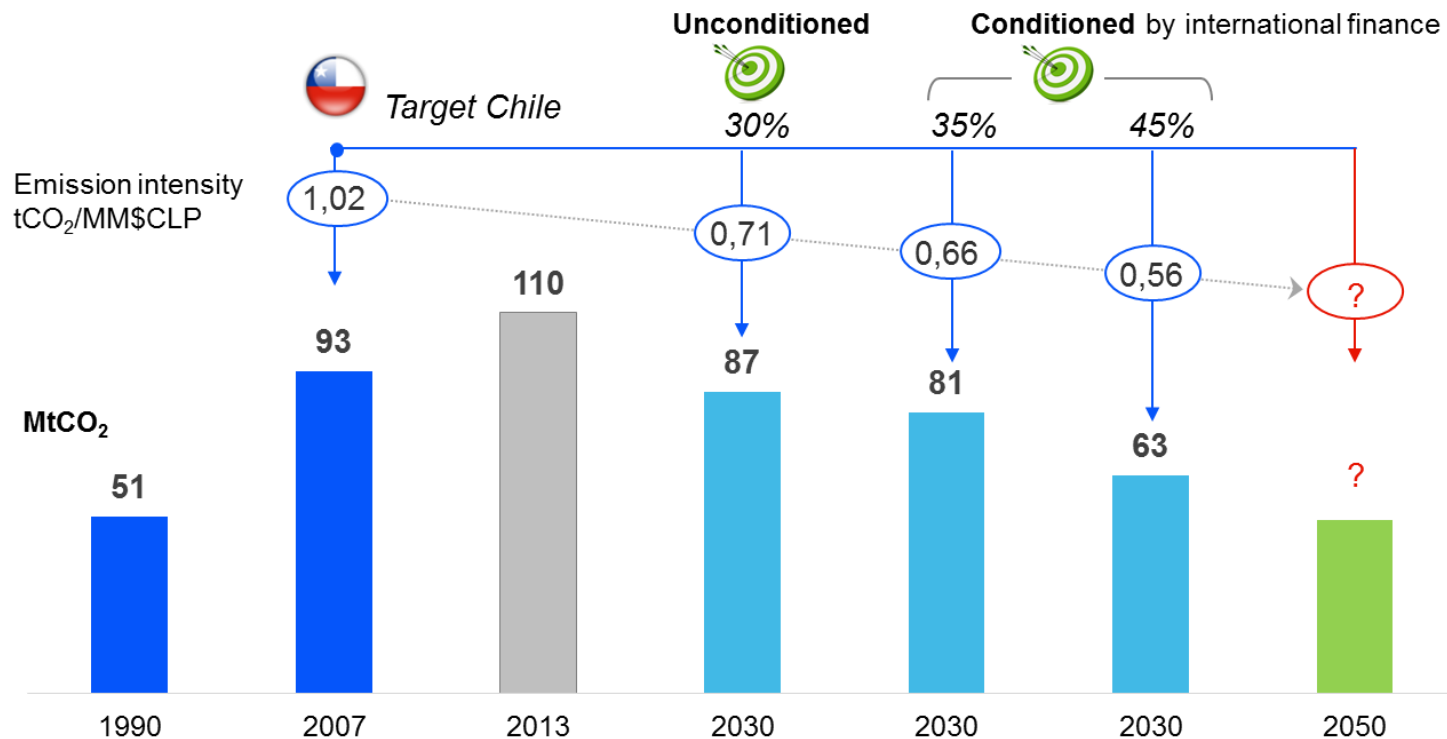
Developing long term scenarios by 2050

2050 and 2030 GHG reduction and energy outlook modelling



Chile's Nationally Determined Contribution

Energy transition requires ambitious decarbonisation targets



Selected Supporting Targets

- At least 70% of RES electricity by 2050 and 60% by 2035; 20% of the energy under supply contracts generated from non-conventional RES by 2025
- 20% energy saving below BAU by 2025
- 2050 EV share of 40% for private vehicles circulating on the roads and of 100% for public transport
- Grid resilience target by 2050 - not exceeding 1 hour/year outages in any location in Chile (and 4h/year by 2035)
- 100% coverage of smart meters by 2025.

Note: GDP to 2030 according to the GHG mitigation plan: 123,166,132 MM \$ CLP

Defining a set of policy recommendations

Focusing on the main levers required for a successful energy transition



Illustrative

RECOMMENDATIONS FOR AN EFFICIENT TRANSITION TOWARDS A LOW EMISSION ECONOMY

Power generation

1. Promote a faster transition towards an emission free generation, avoiding the risk of locking in fossil fuel assets
2. Introduce mechanism aimed at favouring such transition (e.g. CO2 pricing)
3. Foster investments in grids and enhance flexibility by encouraging energy storage and demand side management projects in order to allow the system to accommodate new intermittent capacity
4. Ensure effective market liberalization and the possibility for IPPs to access the market in HV and MV

Agriculture and Industry

1. Phase out incentives to emitting energy carriers (e.g. butane)
2. Promote the deployment of electric and solar water pumps for irrigation
3. Provide grants, subsidies and funding programmes supporting efficiency in industrial processes



Transport

1. Promote the renewal of the existing fleet through the introduction of emission and lifecycle cap on polluting vehicles
2. Support e-mobility, enacting measures aimed at favouring EVs deployment particularly for automobiles, light duty vehicles and public transport
3. Develop appropriate business models and regulations to enable investments in e-mobility infrastructure

Residential and Tertiary

1. Phase out incentives to emitting energy carriers (e.g. butane)
2. Foster electrification of final energy uses, supporting the diffusion of more efficient solutions (e.g. electricity for heating/cooling, hot water and household appliances)
3. Support energy savings through renovation in buildings

Energy Transition Roadmap in Morocco 2050

Enel Group Views

1. Tackling Climate Change at National levels. Morocco's Overview.

Paris Agreement's current pledges call for urgent action to enhance the currently weak ambition of Nationally Determined Contributions (NDCs) of all Parties and accelerate the transition to a low carbon economy. During the UNFCCC Paris Conference governments pledged to limit the rise in temperature well below 2°C vs. pre-industrial levels (with efforts to stay within 1.5°C), to peak emissions as soon as possible and to achieve carbon neutrality in the second half of the century. Even assuming the full achievement of the government pledges presented in Paris, the global concentration of GHG emissions will lead to an expected rise in global average temperature of 2.7°C, missing the 2°C goal.

Morocco's economy has grown by 4.1%¹ per year in the past two decades. The GDP per capita in 2016 is reported at \$2,800 with an average growth rate of 4.1 percent from 1999 to 2017, reaching an all-time high of 9.3 percent in the second quarter of 2006 and a record low of 0.50 percent in the fourth quarter of 1999. Inflation has been kept under 2%, reflecting a prudent monetary policy and the ripple effects of the fall in international commodity prices. Agribusiness accounts for 15% of GDP and contributes significantly to local manufacturing activity and employs just over 40% of the population. As a result, the economy is more vulnerable to adverse weather conditions than other North African states.

The development of Morocco's economy brought with it a 4.0% yearly increase of greenhouse gas emission, a rate above the average of North African countries of 3.4%². Morocco's total GHG emissions in 2012 were 72.5 MtCO₂e, totaling 0.16% of global GHG emissions. Energy was responsible for 76% of total GHG emissions, followed by the agriculture (4%), waste (2%) and bunker fuels (1%) sectors. The energy uses that emit most are electricity generation (36.7% of total emissions in 2012) and transport (27.9%).

Morocco is the largest energy importer in the region and its energy supply has grown considerably during the past decade. Over 91% of energy supplied comes from abroad: coal, oil and oil products from world markets, gas from Algeria and imported electricity. Total primary energy supply³ (TPES) in Morocco reached 18.8 Mtoe in 2012, increasing by a total of 6.9 Mtoe (about 58%) since 2002. Morocco's energy mix is dominated by oil, which represents 67.6% of TPES. Coal accounts for a further 16.1%, followed by biofuels and waste (7.4%), natural gas (5.7%), electricity net imports (2.2%) and, to a small extent, hydropower (0.7%) and wind (0.3%). When compared with IEA member countries, Morocco has the highest share of oil in its TPES, followed by Luxembourg, Japan and Greece.

Air pollution is the biggest environmental health problem in urban areas. Transport is the major source which contribute with almost 15% of the total emissions (carbon monoxide (CO), nitrogen oxides (NOx) and particles forms). Several factors linked to the vehicles fleet, road infrastructures, fuels, and inadequate reduction measures, are all responsible for the high pollution levels. The motor vehicles have increased from about 1.95 million in 2004 to approximately 3.43 million in 2014, of which two wheelers and light-duty vehicles saw a growth compared to the passenger vehicles that have seen a decline. In Morocco the fight against air pollution is today placed in the heart of the strategies of sustainable development and the protection of the environment, by reinforcing the policies of action through massive investments in prevention and management. Despite the progress made with the renewal

of the sector. Furthermore, ambitious energy efficiency policies, to improve and minimise consumptions in buildings, industrial and agricultural processes should be considered to reach wider results.

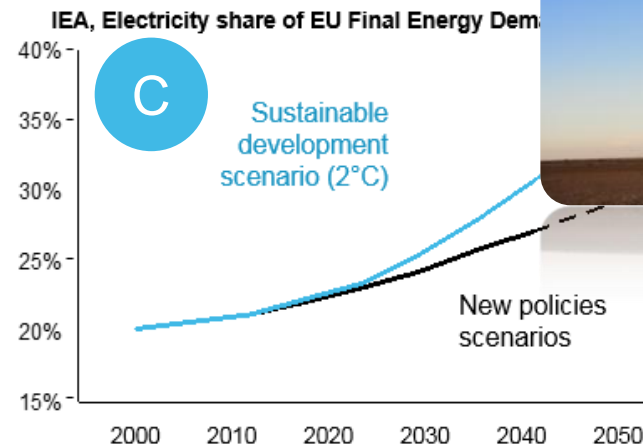
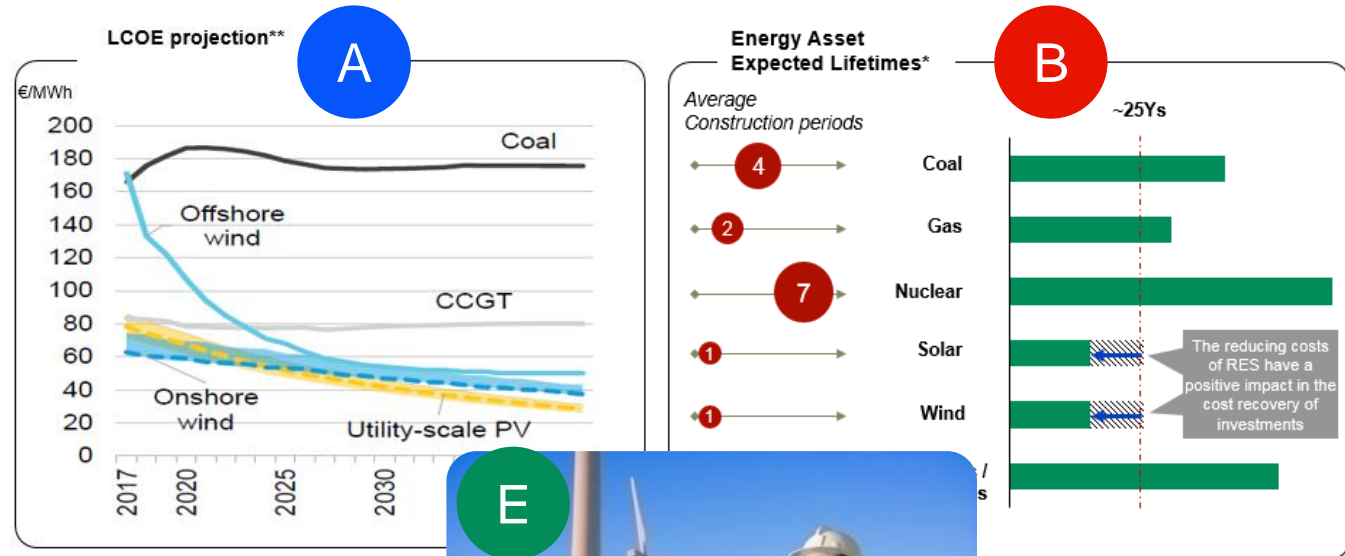
market design is not developed at its full potential specific measures should be envisaged for non-programmable renewables in order to guarantee a smooth transition. On a long term RES should be exposed to prices formed

Lessons Learnt from Energy Transition Roadmaps



Challenges exist along the full value chain

- A** Renewables falling costs
- B** Managing accelerated asset phase out
- C** Electrification of final energy consumption
- D** Digitalization of the infrastructure
- E** Jobs conversion and re-skilling



Just Transition to a Low Carbon Economy

It's about decarbonizing, digitalizing, circularizing and managing the social dimension



- System wide challenges and security
- Job conversion and site repurposing
- Optimal exploitation of natural resources (fossil vs. RES)
- Enabling framework and compensation
- Green and circular value chains



- The Government appointed a commission to define a roadmap for coal phase out by year end with the mandate to protect both the climate and jobs



- France has committed to anticipate coal phase-out by 2022 (instead of 2023) under the current administration



- A coal phase-out by 2025 in Italy implies additional investments worth 3.8-4.2 Bn€ on top of the investments needed for a natural phase out by 2030



Power Plant >> Commercial Center



COP24
Poland
2018

“The Polish presidency plans to focus its message on three key themes:

- **Technology** - development of climate-friendly modern solutions, such as electro mobility
- **Man** - solidary and just transition of industrial regions
- **Nature** – supporting achieving climate neutrality by absorbing CO₂ by forests and land, or by water management”

Source: <http://cop24.gov.pl>

Enel Group's growing experience in the transition

Case Study: Future-E Project in Italy



Repurposing more than
20 sites



SOCIAL SUSTAINABILITY

- Creating shared value for our business and for local communities
- Redeployment of ENEL employees within other company divisions
- Local capacity building through ad hoc training programs
- Promoting local employment as well as new development opportunities for local communities

ECONOMIC SUSTAINABILITY

- Creation of economic development through site reconversion, promoting the potentiality of local lands and communities
- Business development opportunities
- Promotion of local natural, cultural and artistic excellences and assets

ENVIRONMENTAL SUSTAINABILITY

- Protecting the environment and local lands and communities
- Reusing materials and revitalizing site features
- Reducing CO2 emissions

INNOVATION

- Development of start-ups and new businesses
- Enhancing creative thinking and solutions
- Leveraging on new partners in ICT, new technologies

FUTUR-E | 17 August 2018

Montalto di Castro: from power station to smart village



SUSTAINABILITY | 24 May 2018

A theme park in the new life of the former Trino power station



SUSTAINABILITY | 30 November 2017

Future-e, new life to the Portoscuso plant



SUSTAINABILITY | 09 March 2018

Future-e gives new life to the Campomarino turbo-gas power plant site



Enel and Milan Polytechnic present the strategy to lo

Job conversion and reskilling

A global challenge which calls for learning lessons across geographies and sectors



Future Scenario: Challenges & Opportunities

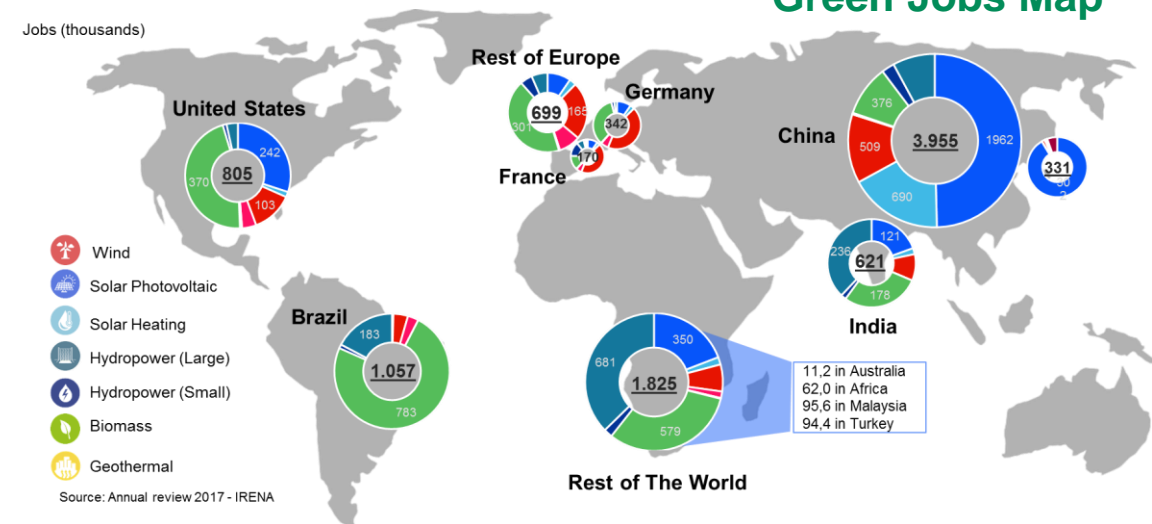
- **50% of current work activities** can **technically be automated** by adapting currently demonstrated technologies
- **Between 400 million and 800 million individuals** could lose their jobs **because of automation** and will need to find a new employment by 2030 around the world
- Between **75 million and 375 million individuals** could **need to change occupational category**.



Future Workforce: Need for Retraining

- **On the employer's side:** New jobs will be available but businesses will need to put talent and future <workforce development at the core of their growth strategy
- **On the government/education institutions' side:** Governments will need to **re-consider current education models**
- **New Skills development:** New roles connected to the digital evolution of processes. Evolution of the “blue collar” figure and role towards “digital worker” due to new activities more “data driven” with extensive use of digital devices

Green Jobs Map

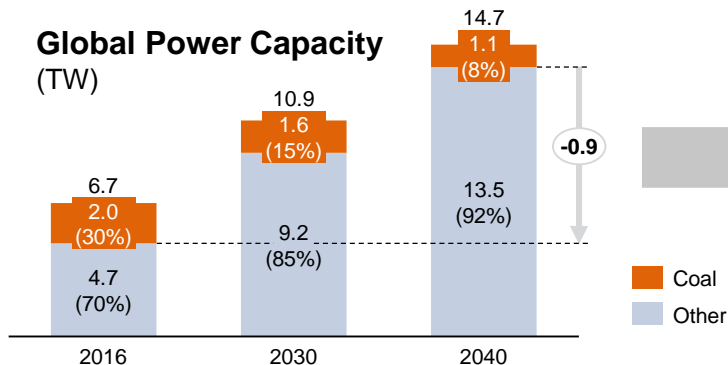
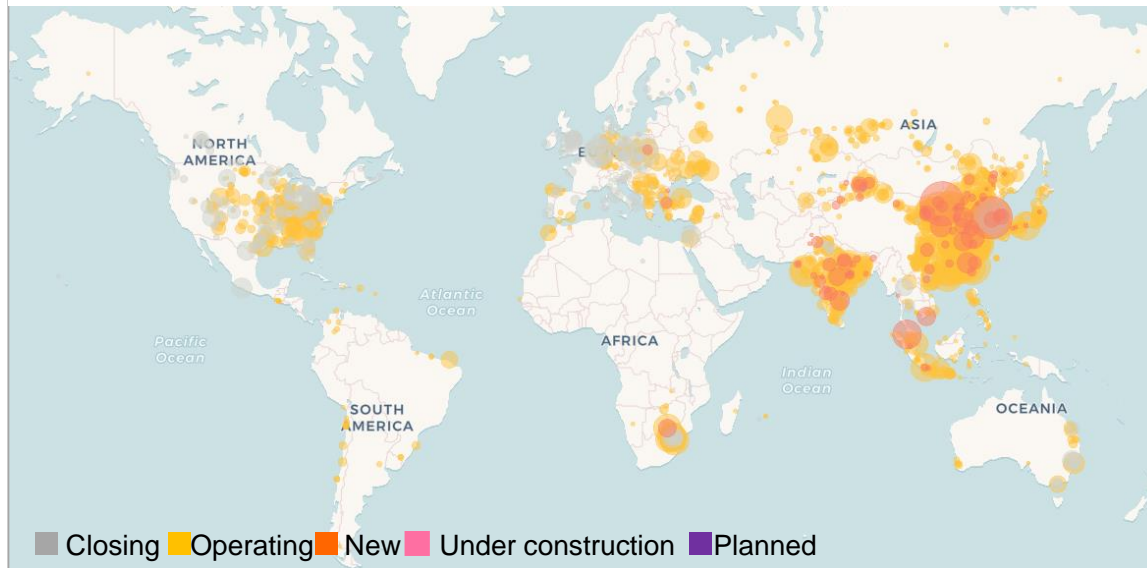


Repurposing of industrial sites

The need for clear signals and shared implementing pathways



Global Distribution of Coal Power Plants



- ~900 GW phase out by 2040 or ~3000 coal units to be closed*
- ~36 GW/year or ~120 coal power plant units per year*

Key Topics

- **The renovation of the power fleet** does not come without any changes and **calls for careful management of the social transition**
- **A proper decommissioning process** for the phase-out of old generating units can bring to light a residual value and win-win solutions for new uses, that otherwise would be lost forever

A sustainable energy transition calls for

- **Stability and predictability** of the policy framework for power plants shutdown and conversion of sites to new uses
- **Certainty of timing for authorizations.** Coordination among Authorities is needed to speed-up and simplify administrative processes for decommissioning
- **Adequate incentives for brownfields re-use**

Europe's Experience on Just Transition

Leaping from coal to renewable energy



Reconversion of coal mines for renewable energy generation is already happening

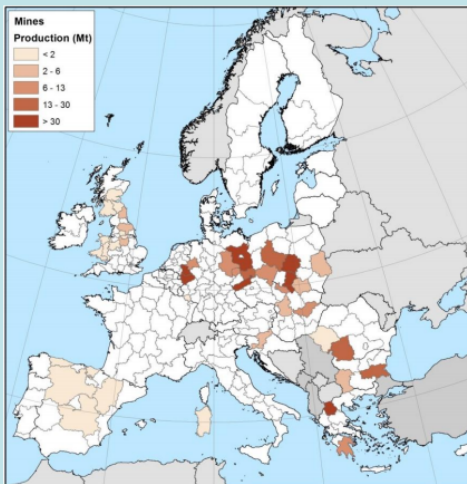


PV power plants (Visonta, HU):
16 MW PV plant
72 500 PV panels
Located on top of lignite mine dump site

Wind farms (Klettitz, DE):
5 wind parks
145.5 MW



Sources:
- Google Earth;
- Ra Boe/Wikipedia, 2013,
http://www.wikwand.com/de/Windparks_in_Schipzig

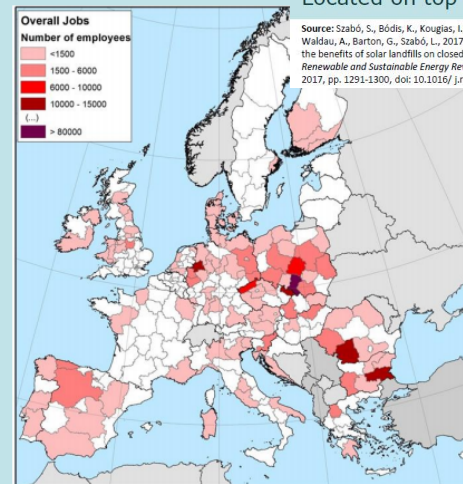


Coal Mines

- 157 coal mines in 12 Member States
- 41 NUTS-2 regions
- 500 Mt of coal and lignite

Direct jobs in coal power generation

- 55 000 in power stations
- 185 000 in mining
- 215 000 indirect jobs

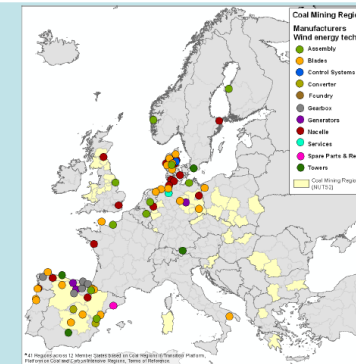


Source: Szabó, S., Bódis, K., Kougias, I., Moner-Girona, M., Jäger-Waldau, A., Barton, G., Szabó, L., 2017, A methodology for maximizing the benefits of solar landfills on closed sites, *Renewable and Sustainable Energy Reviews*, Volume 76, September 2017, pp. 1291-1300, doi:10.1016/j.rser.2017.03.117.

Source: JRC



Renewable manufacturing as a source for growth and jobs



- Most European OEMs have located their manufacturing facilities in the main wind markets.
- The highest number of manufacturing facilities is associated with blade manufacturing, followed by nacelle manufacturing and the assembly of wind turbine components.
- 9 out of the 41 coal regions have manufacturing facilities of wind turbine components installed.

Source: JRC

Source: European Commission 2017

Conclusions



- ❑ The Paris Agreement will require rapid and drastic decarbonisation to fill the ambition gap with change being accelerated by multiple policy drivers
- ❑ An effective and efficient transition requires Roadmaps that are clear and shared with all stakeholders (e.g. national and local governments, NGOs, private operators)
- ❑ Lessons are being learned along the full power sector value chain and require a system's view that bridges across policy areas and industrial sectors
- ❑ Picking up the required speed of change requires successful management of the just transition in its technical, social, administrative and financial dimension