ORDEM DOS ENGENHEIROS

WORLD ENGINEERING DAY FOR SUSTAINABLE DEVELOPMENT

WFEO / FMOI

In support of UNESCO World Engineering Day

unesco

Com o Alto Patrocínio de Sua Excelência

Under the High Patronage of the President of the Portuguese Republic

O Presidente da República

Lisbon

March 4th 2024

World Engineering Day 2024 | Conference “Energy Transition and Sustainability”

Engineering Solutions for a Sustainable World

Ordem dos Engenheiros

Lisbon March 4th 2024
Engineering Solutions for a Sustainable World

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Preface

Lisbon
March 4th 2024
Engineering Solutions for a Sustainable World

Prof. José Vieira, Lisbon, March 4 th 2024

As the world's largest association of international engineering organizations, WFEO, the World Federation of Engineering Organization, is committed to the implementation of the United Nations Sustainable Development Goals. It actively collaborates with national and international professional bodies to tackle both global and local challenges, leveraging pioneering engineering solutions and policy frameworks for the betterment of humanity.

Our world is experiencing unprecedented changes, marking a pivotal moment in history. We are facing numerous significant global crises. In such a context, the production and use of energy are, more than ever, at the centre of countries' strategic considerations, not only due to the need for decarbonisation policies in energy systems, given the emissions of greenhouse gases and their impacts on climate change but also due to issues of energy autonomy and economic independence that COVID-19, armed conflicts, and epic geopolitical divisions have dramatically highlighted.

The overarching goal of the Paris Agreement, adopted at the UN Climate Change Conference (COP21), is to limit the increase in the global average temperature to a maximum of 2°C above pre-industrial levels, with a commitment to restrict this temperature increase to 1.5°C. It recognizes that the global energy crisis, beyond its impact on climate change, poses a significant challenge to efforts to achieve energy security. This underscores the urgency of transforming energy systems to be more reliable and resilient and the need to accelerate clean and fair transitions to renewable energy.

The theme "Energy Transition and Sustainability," besides its political, social, economic, and environmental implications, constitutes a significant matter requiring active involvement from the field of engineering.

The decommissioning of conventional fossil energy plants and the massive development of variable renewable energies can pose issues of continuity and quality in electricity supply. Backup power plants, cost-effective and efficient energy storage technologies, demand flexibility development, and electrical grid development will be necessary to overcome the variability of renewable energies.
The issue of access to energy in general and electricity, in particular, remains a significant challenge in many regions of the world, requiring different responses for supplying large developing megacities and remote off-grid locations.

Engineering for sustainable development is especially critical in developing countries, to mitigate the effects of climate change, reduce poverty, and design relevant infrastructures and development models.

The implementation of scientific research and technological development projects in the field of energy systems engineering underlies industrial transformation, innovation, and global economic structure. Especially in the context of increasing tensions in the relationship between humans and nature, it is crucial for engineers and policymakers to adopt a balanced approach between economic progress, social justice, and environmental preservation, which is fundamental for a country's energy security.

I welcome you to this pivotal conference on energy transition. Together, let us embark on a journey of collaboration and innovation, forging a path towards a more sustainable and prosperous future.

José M.P. Vieira (WFEO Immediate Past President)

Sebastião Feyo de Azevedo,
President of the Portuguese Academy of Engineering, Portugal

Engineering for the sustainable development of Humanity

Sebastião Feyo de Azevedo

President Portuguese Academy of Engineering (2022-)

President Municipal Assembly of Porto (2021-2025)

Rector, University of Porto (2014-2018)

Dean, Faculty of Engineering, University of Porto (2010-2014)

National Vice-president, Ordem dos Engenheiros (2004-2010)

Correspondence to sfeyo@fe.up.pt

UNESCO WFEO WORLD ENGINEERING DAY

March 4, 2024

Ordem dos Engenheiros Lisbon, Portugal

To say what I am going to say....

- The core of the message

1. Engineering for Development, since always... What evolution? And changes?
2. Thoughts/Ideas I share – Reform, adapt; The evolution of the knowledge spectrum; Values; Work and training models; Innovation and entrepreneurship; Talent retention and attraction
3. Support the dimension and relevance of Engineering with Engineering cases

- Epilogue - Say what I said…

There is Engineering in everything around us... and outside in the World

- Affirm **the vital role of Engineering in ensuring the future, in promoting the socio-economic development of Countries/Communities**, for a sustainable development of Humanity;
- Affirm that the necessary increase in productivity and competitiveness, for any Nation or Community, is only feasible with the **SYSTEMIC VISION** and the **CAPACITY OF DOING** that characterize Engineering and the Engineers;
- Further affirm, on another level, that Engineering is a condition of the future, through its example of **ORGANIZATION, QUALITY, AND RESPONSIBILITY**, which is so badly needed in so many countries.

It is, therefore, crucial that **institutions responsible for the development of Engineering** commit themselves and impose themselves on the political level so that **engineering is a much more integral part of the design and implementation of public policies**

- **We recognize four Industrial Revolutions, the result of the combination of essentially four factors**
  - ✓ **New energy sources**
  - ✓ **Disruptive scientific and technological innovations, with an impact on production**
  - ✓ **Human Resources capable of absorbing change**
  - ✓ **A free market society, with investment incentives**

- **From the steam engine of the 18th century... to the Artificial Intelligence of the 21st century, a sequence of *qualitative leaps*, of *so-called vertiginous changes* in the History of Humanity**

With Engineering always at the center of the (R)evolution

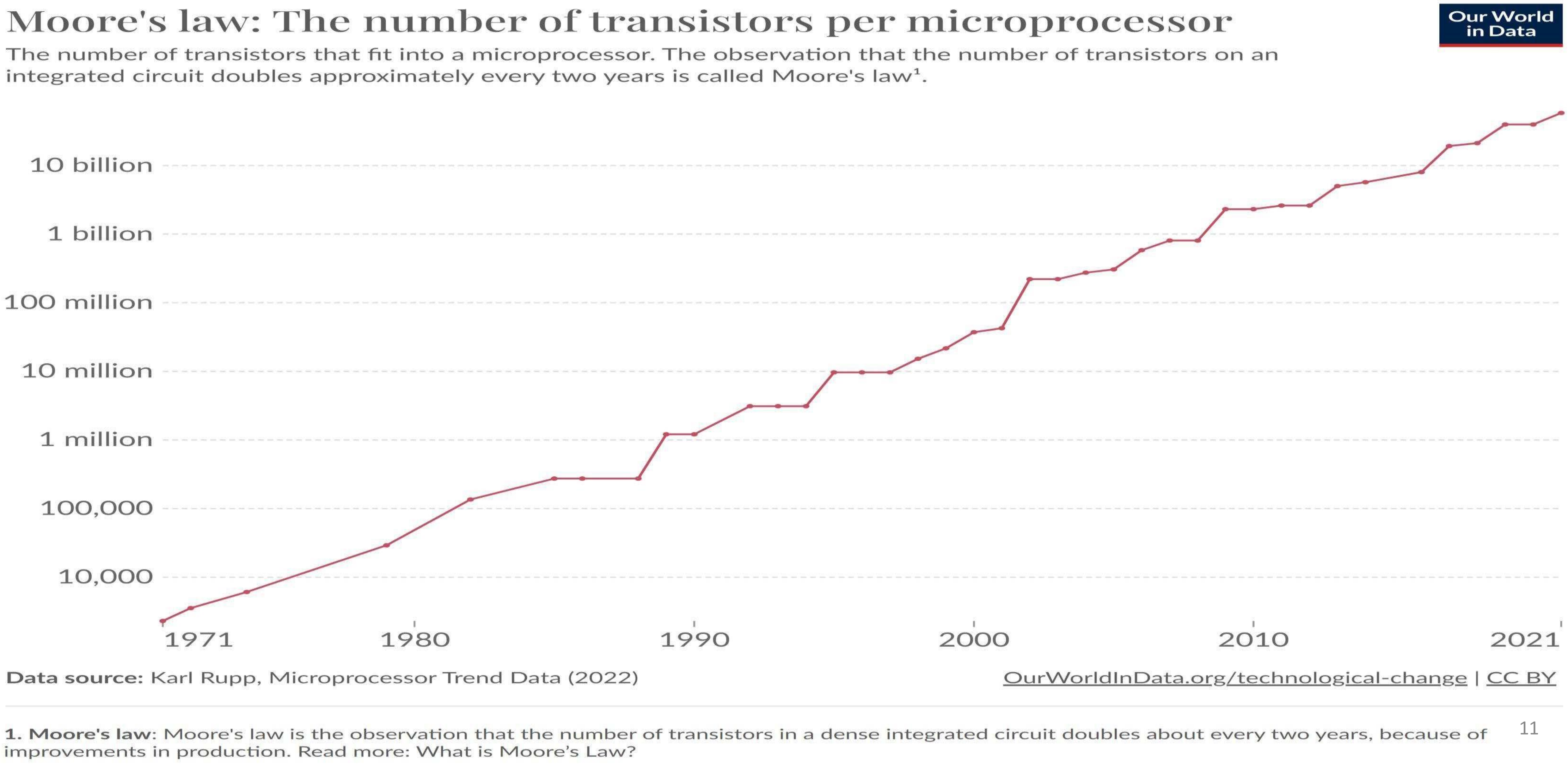
Four Industrial Revolutions - human reaction along the times

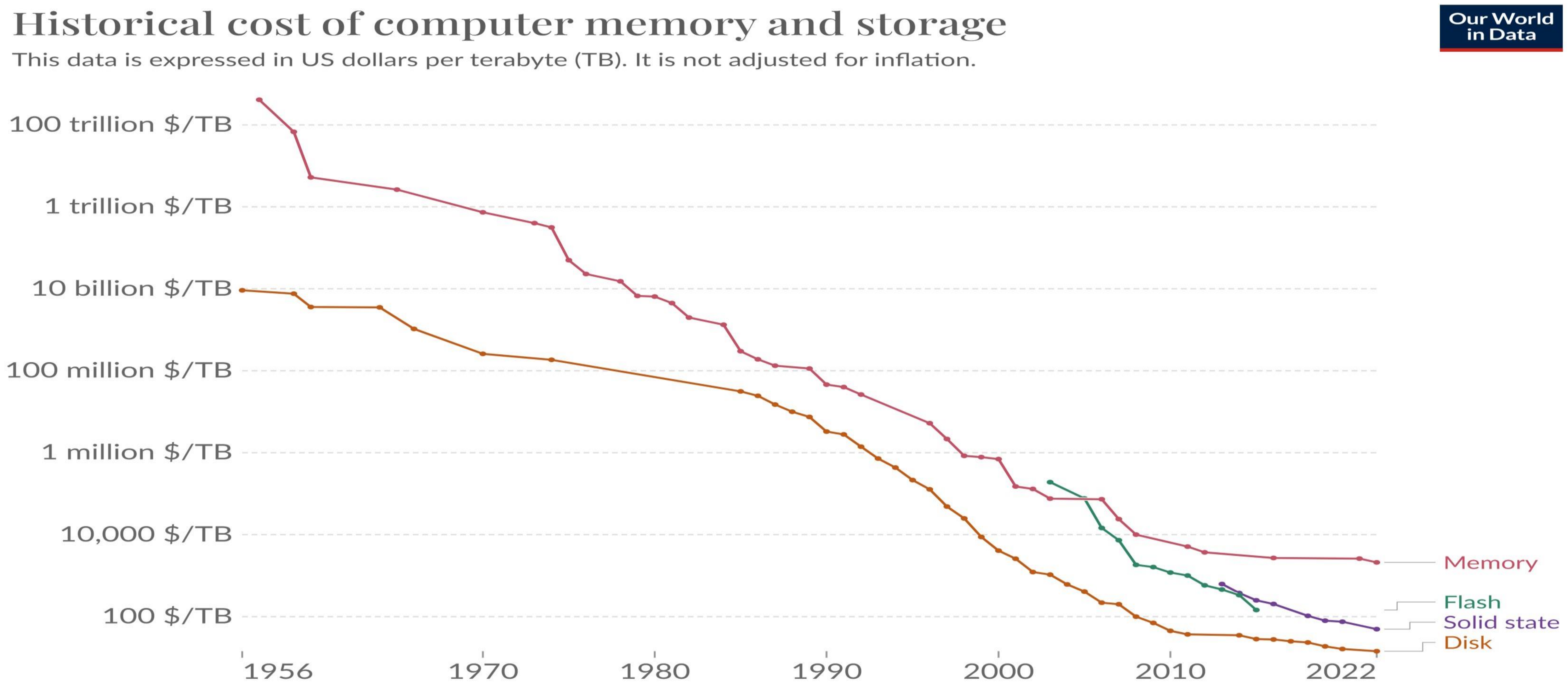
- The steam engine and the age of steel, with locomotives and steamboats, allowed goods to be "massively exported around the world"....
- or the inventions of Thomas Edison (1847-1931) that "changed the world forever"
- Or the invention of transistors (1926, 1947) which opened "times of dramatic change"
- In fact, we find in literature many other quotes from the past with the same words we use today to characterize contemporary life.

BUT, speaking of the present, IT IS CLEAR

what is the nature, the basis, of the evolution of scientific and technological innovations that brought us the fourth industrial revolution

INDICATORS OF THE FOURTH INDUSTRIAL REVOLUTION - I





Data source: John C. McCallum (2022)

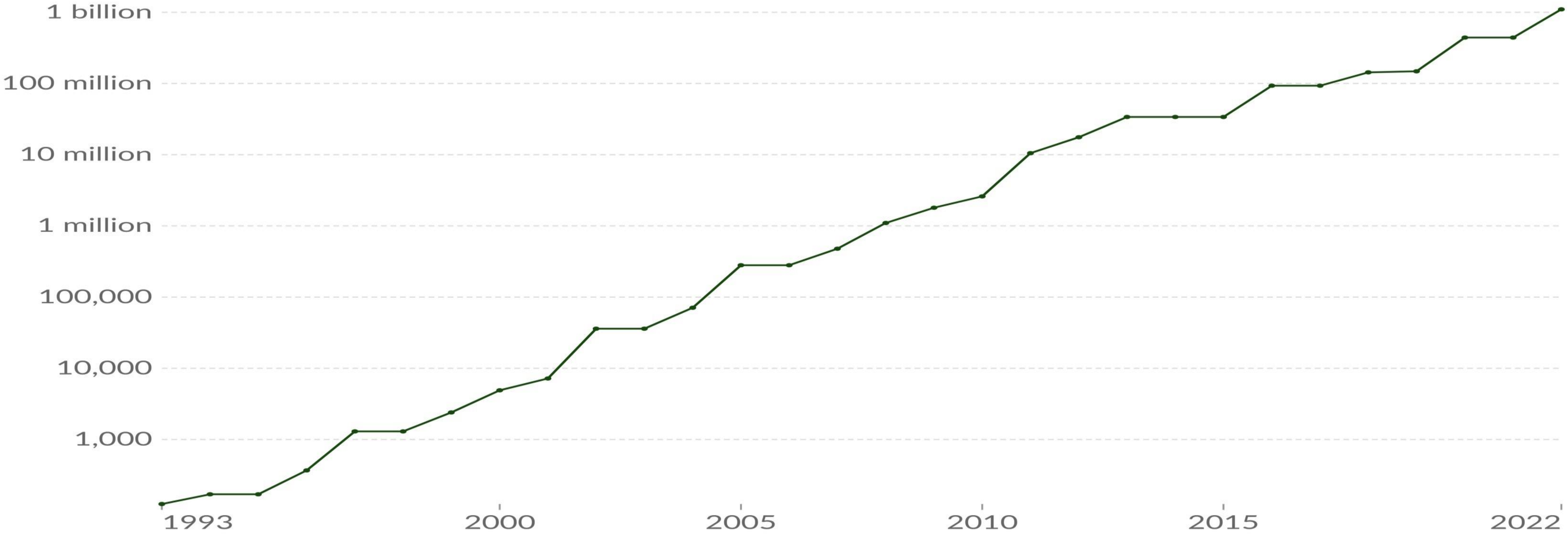
Note: For each year, the time series shows the cheapest historical price recorded until that year.

INDICATORS OF THE FOURTH INDUSTRIAL REVOLUTION – III

Computational capacity of the fastest supercomputers

Our World in Data

The number of floating-point operations[1] carried out per second by the fastest supercomputer in any given year. This is expressed in gigaFLOPS, equivalent to 10^9 floating-point operations per second.



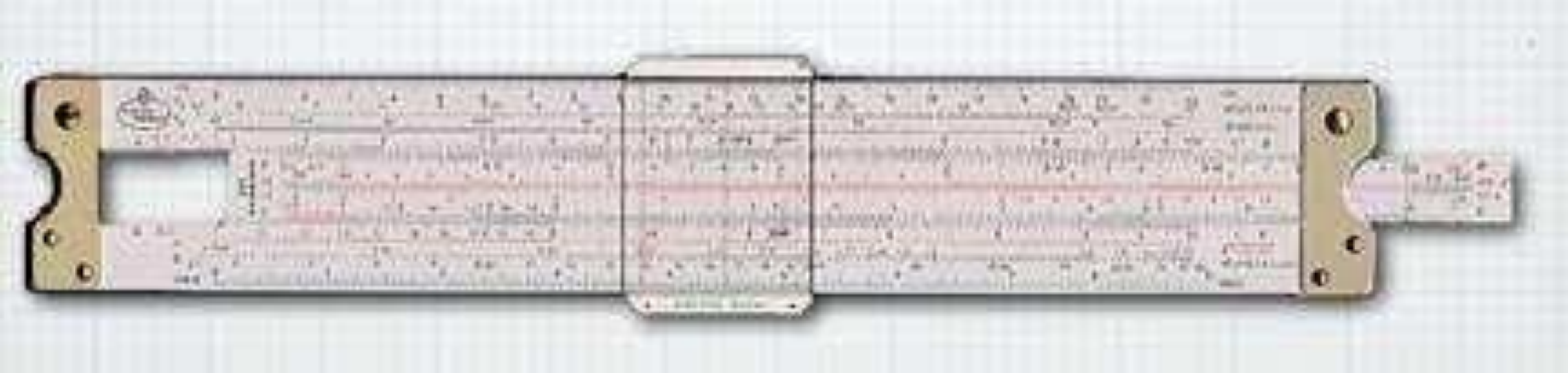
Data source: TOP500 Supercomputer Database (2023)

1. **Floating-point operation**: A floating-point operation (FLOP) is a type of computer operation. One FLOP is equivalent to one addition, subtraction, multiplication, or division of two decimal numbers.

THE EXPLOSION OF SCIENTIFIC CALCULATION CAPACITY
FUNDAMENTAL TECHNOLOGIES OF THE ‘UPPER PALEOLITHIC...‘

- **John Napier (1550 – 1617) – formulated the concept of Logarithm**

- **William Oughtred (1574 – 1660) - based on the Theory of Logarithms and the concept of Logarithmic Scales, he developed the Slide Rule (?)**



WELL, this Instrument, which really looks like it dates back to the ‘Paleolithic’, prevailed until 1973

THE EXPLOSION OF SCIENTIFIC CALCULATION CAPACITY
THE 'REVOLUTIONARY' FACIT MECHANICAL MACHINES (~1960 -)

☞ **What is (was) a FACIT..? Which I learned to use in my father's office, in 1959, and used at College in 1969, 1970...**

Indicators of the fourth Industrial Revolution – IV
Under the umbrela of Artificial Intelligence (I)

- **AI is today a designation that covers all the methods and technologies that HUMAN BEINGS DEVELOP, with which they design Machines that mimic or independently simulate much of HUMAN ACTIVITY**

- **An immense set of applications, emerging every day……..**
  - **Robots… increasingly ‘well trained’**
  - **CHATBOTS – Virtual Assistants with ‘interactive conversations’**
  - **CHATGPT.. and the new BING with associated CHATGPT**

Indicators of the fourth Industrial Revolution– IV
Under the umbrela of Artificial Intelligence (II)

Indicators of the fourth Industrial Revolution– IV
Under the umbrela of Artificial Intelligence (III)

The Guardian, 6 September, 2019

Thoughts and Ideas I share....

- Open mind, Reform, Adapt
- The evolution of the spectrum of knowledge
- Values
- Models of work and of Education
- Innovation and Entrepreneurship
- Retention and attraction of talents

The message of times... Which is relevant

Open mind, adapt... dedramatize

☞ **We are in the midst of the Fourth Industrial Revolution, in times of social and economic changes that new technologies, particularly those that use Artificial Intelligence, introduce into our lives, into our daily lives.**

☞ **I completely dedramatize this evolution felt today, which I view, in fact, with great expectations**

- **Today, we live in times of changes … as others have lived before**
- **Simply, we have to be up to date... as others have had to be before**
- **He have to adapt… like others have had before**
- **We have to maintain a critical spirit... as others have had to maintain before**

A THEMATIC LIST – TOPICS IN WHICH ENGINEERING HAS A FUNDAMENTAL SAY

i. Construction, housing and general infrastructure

ii. Agriculture and food

iii. Production of new materials

iv. Energy and climate

v. Environmental, economic and social sustainability

vi. Combating climate change and environmental threats

vii. Information and Communication Technologies

viii. Digital Transition

ix. Computing and processing of 'Big Data'

x. Artificial Intelligence Methods

xi. Innovation and emerging technologies in areas such as microelectronics, robotics, genetic engineering... and others that still have no face

xii. The paths of the energy transition

xiii. Electrification in transport, industry... and beyond...

xiv. Major problems associated with the scarcity of natural resources – WATER at the top

xv. Science and Innovation

xvi. The Organization and Management of the Territory

xvii. Social Integration

xviii.….

☞ **Trust - In free, market Societies, Trust is the most important value to guarantee Development - without Trust, Society falls apart**

- **associated with the perception of stakeholders, concerning our quality, organization, rigor, stability, and ethics**

☞ **Ethics - The most discussed of values... since the Philosophers of Ancient Greece, nowadays involving respect and courage in assuming professional and moral responsibilities, always in a transparent way**

☞ **Ambition - of a different nature, a very important state of mind, for a Nation/Community to have a future, obviously thinking of the global competitive World of Today**

Models of Work… and Training

- ☞ **Work and training in hybrid mode**
- ☞ **Work and training increasingly dematerialized**
- ☞ **Requirement to adapt spaces, in companies and training institutions**
- ☞ **Perception of the multidisciplinary nature of practically all processes, leading to the requirement of multidisciplinary Teams**
- ☞ **Perception of the requirement for multiculturalism,**
  - ➢ **the 'World has shrunk', World cultures are closer than ever… in real-time**
- ☞ **Perception that we live in a 24/7 World, with the appropriate adaptation of work organization**

Adapt the critical spirit to current communication models and AI instruments –

Critical Spirit that has always been required throughout times

- **Science for Humanity – the example of the fight against the COVID-19 pandemic**
- **Today, the degree of development of Science in a country says all about the country's state of development, particularly its competitive capacity**
- **It is important to implement public policies, aiming to incorporate Knowledge, particularly in the form of Innovation, in the Productive Market – Valuing Knowledge**
  - **Increase Projects, involving 'Research Institutions – Industry'**
  - **Promote PhDs with Industry**
  - **Promote the insertion of doctorates directly into the productive fabric**
  - **Promote entrepreneurship – support Science and Technology Park, Technology Valorization and Transfer Centers, and other institutions aimed at starting companies**

Globally - bring Scientists to the Market;

Value Knowledge in a tangible way

As relevant as tough social and political objectives in all Countries

- For Portugal, retaining and attracting Portuguese, EU Nationals, Nationals of Portuguese-speaking Countries and Nationals of Third Countries **is today identified as a major policy for development**
  - ✓ Young Portuguese are generally very well trained in Engineering
  - ✓ Availability and motivation to go abroad is high, namely for European Countries
  - ✓ Currently 30% of young people born in Portugal work somewhere in this World, out of Portugal!

- **So, create and /or improve conditions of attractiveness**
  - ✓ Of course, promoting salary improvements... for Young People, through various mechanisms ...
  - ✓ Including strengthening major motivation and achievement initiatives – entrepreneurship...

Essentially - Young People must feel that their country, or the country where they are, is developing and that it will provide them with opportunities to achieve their goals/dreams

Now, specifically about Engineering in Portugal

(I) Public perception and action

- I rate that Engineering is publicly recognized as a major asset for our development – Engineering is doing well, within Portugal and all over the World
  - ✓ Companies capable of competing internationally
  - ✓ Excellent Higher Education in Engineering – young people well prepared
  - ✓ Competitive high-level research

- The issue is largely on the real capacity of our institutions/associations to be able to influence the design and implementation of public policies, namely, thinking of quality, education and the economy
  - ➢ The Academy of Engineering
  - ➢ Engineers Portugal (Ordem dos Engenheiros)
  - ➢ Universities
  - ➢ Industrial associations

NOW, SPECIFICALLY ABOUT ENGINEERING IN PORTUGAL
(II) THE ROLE OF *ENGINEERS PORTUGAL*

- ***Engineers Portugal*** **is doing a fine job in promoting engineering - recognizing new areas of engineering , promoting quality, promoting internationalization, promoting lifelong learning, and fighting for adequate public policies**

  - ✓ **Currently, recognizes 17 specialties, 5 of them 'new' - Aeronautical and Space Engineering; Food Engineering; Biomedical Engineering; Engineering and industrial management; Safety and Quality Engineering**

  - ✓ **Promotes periodically in its Journal the discussion of major hot topics - Regional Development; Energy and Climate; Construction, Housing, and Infrastructures; Blue Engineering, a Sea of Opportunities; Food and Process Chain Engineering**

  - ✓ **Recently published "Engineering XXI" - an important publication that illustrates 144 notable engineering projects and works**

- **Engineers Portugal is undoubtedely a major asset for Portuguese Development**

Illustrating the potential of our Engineering – Case Study 1

A classical Engineering Project in its development

From the Lab to the Pilot, to the Plant

Today, ACS – Advanced Cyclone Systems,

Founder and Responsible - Prof. Romualdo Salcedo

- **Cyclone systems for Gas-Solid separation, internationally recognized worldwide as as of very high efficiency - solves many critical gas-solid separation problems**
- **History started at FEUP almost 40 years ago**
- **Project with solid scientific bases of separation processes, mathematical modeling and optimization**

Started at Lab level

Went through Pilot scale

Ending up with Industrial scale (I)

Installation at SONAE, a major Portuguese industrial company

Ended up with Industrial scale (II)

SSB – Brasil

188000 m³/h@150ºC;

<100 mg/Nm³

ILLUSTRATING THE POTENTIAL OF OUR ENGINEERING

ACS - FACTS & FIGURES, AS OF TODAY…

- **23 workers – 2 PhDs, 20 with master (second cycle) degrees**
- **National Prize of Environmental Innovation, 2008; SME Lider em 2015, 2016, 2023**
- **350 Customers**
- **38 Countries**
- **5 Continents**
- **280 installations for emission control**
- **120 installations for recovering valuable materials**
- **95% of revenues, from exports**

ACS – DISSEMINATION WORLDWIDE…

Another classical Engineering Project in its development

From the Lab to the Pilot, to the Field

Today, BERD, One Bridge, One Solution -

President and CEO - Prof. Pedro Pacheco

- ☞ **History started in FEUP, almost 20 years ago**
- ☞ **Recognized among World Leaders in the area of Bridge Construction Methods and Solutions – movable scaffolding systems, with organic prestress**
- ☞ **Continued scientific investment - New SPIN-OFF "BRIDGE INTELLIGENCE & A.I."**

BERD®
ONE BRIDGE, ONE SOLUTION

M1-70-S SLOVAKIA – BRIDGE OVER THE DANUBE RIVER

PHOTO CREDITS D4R7

ONE BRIDGE, ONE SOLUTION

- Multiple national and international awards
  - ✓ In Portugal – COTEC Award
  - ✓ In Europe - EUROPEAN STEEL BRIDGES AWARD
- 5 PCT Patents
- 1 Patent examined and granted in more than 60 countries
- Optimization of bridge solutions in several countries
- Frequent publication of scientific papers

BERD®
ONE BRIDGE, ONE SOLUTION

38

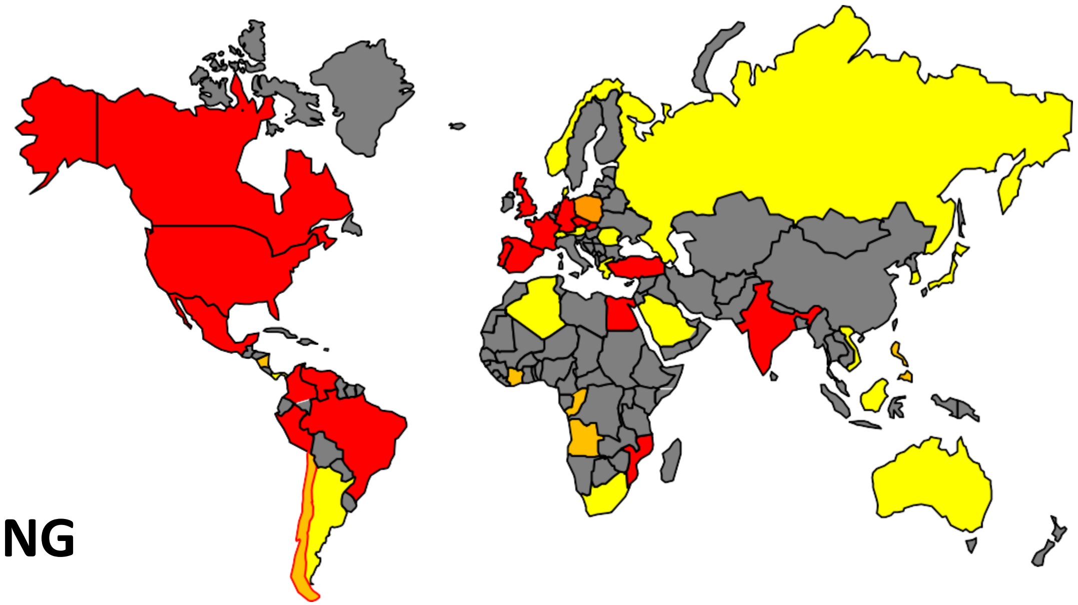
- **PARTICULARLY RELEVANT PROJECT published in Structural Engineering International, with a reduction of more than 400,000 Ton of materials (~30%+) and ~28,000 Ton of CO_2 emissions**
- **The M1-90-S movable scaffolding system operated in Turkey, in the construction of the deck of four viaducts of the Ankara – Sivas High-Speed Railway Line.**
- **Set a world record by building 90 meter spans in just 12 days, using the in situ concreting method**

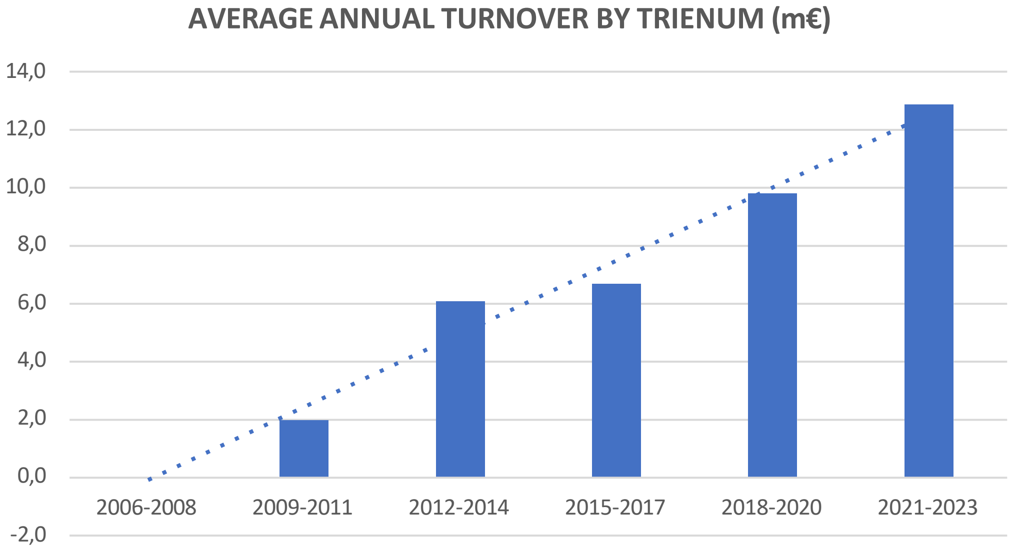
ELITE TEAM: **APROX. 60 Workers**
(5 PhD, +20 MSc)

CUSTOMERS / PROJECTS: **5 CONTINENTS**

INCOME GROWTH **> 16%/YEAR, FROM THE BEGINNING**

WEIGHT OF EXPORTS **> 95% OF BUSINESS VOLUME**





CASE STUDY 3

(Hidden) Engineering in large rehabilitation/renovation projects

Rehabilitation of
Super Bock Arena - Rosa Mota Pavilion

Lúcios – Engenharia e Construção

Coordination Eng. Filipe Azevedo


SUPER BOCK ARENA
SUPER BOCK
EuroBic


SUPER BOCK

Engineering in large rehabilitation projects

Super Bock Arena -

Rosa Mota Pavilion

Dome

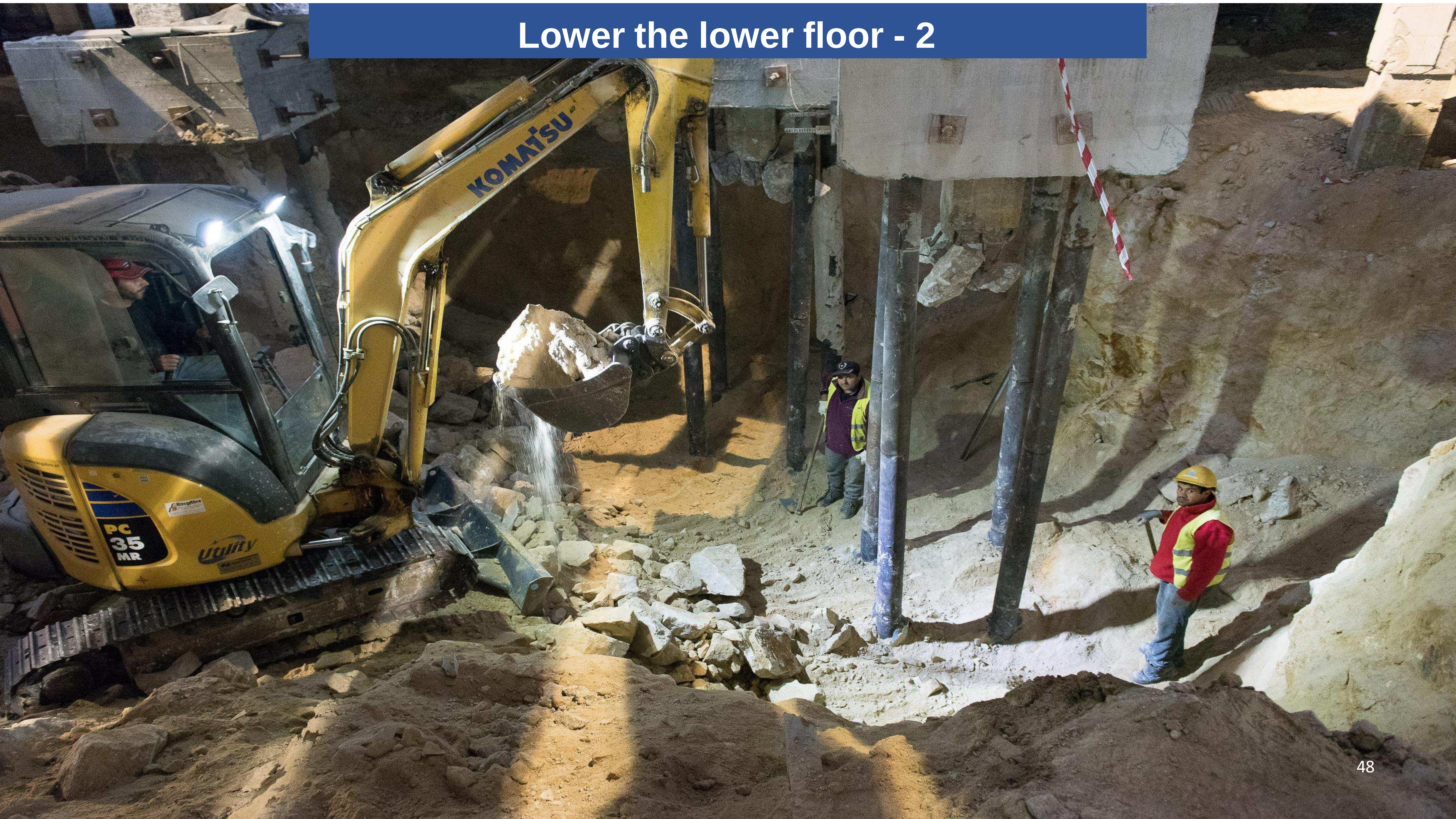
Reinforcement of the main floor

The work on the roof - 1

The work on the roof - 2

Lower the lower floor - 1

Lower the lower floor - 2



Lower the lower floor - 3

Lower the lower floor - 4

Engineering in large rehabilitation projects

Super Bock Arena - Rosa Mota Pavilion

A new lower floor was born…

(Hidden) Engineering in large rehabilitation/renovation projects

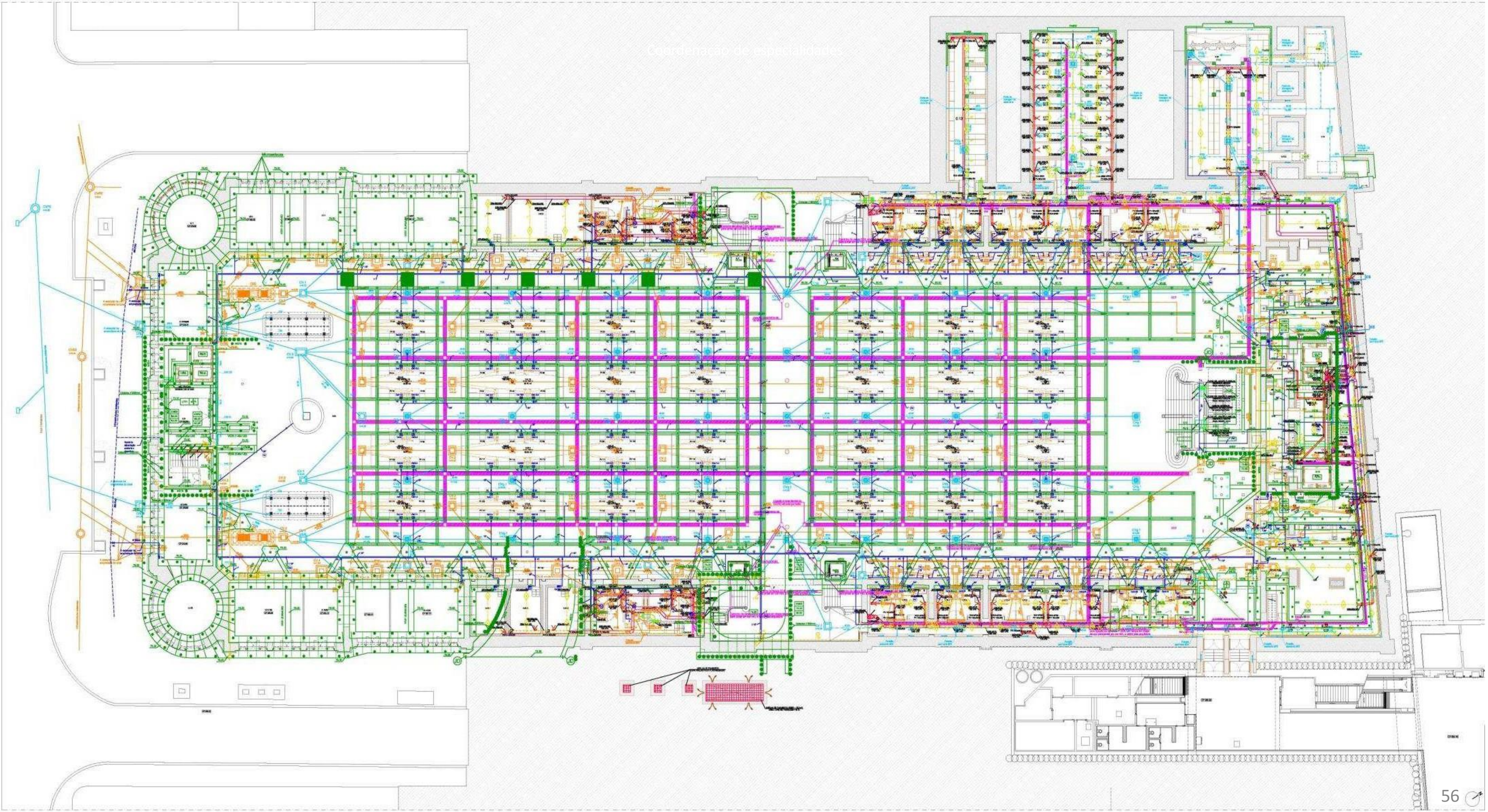
Arquitechture and Engineering in the Iconic century-old BOLHÃO Market

Coordination Prof. Arq. Nuno Valentim

Lúcios-Engenharia e Construção e ACA Engenharia &Construção

Teixeira Duarte – Engenharia e Construções S.A.


somirav

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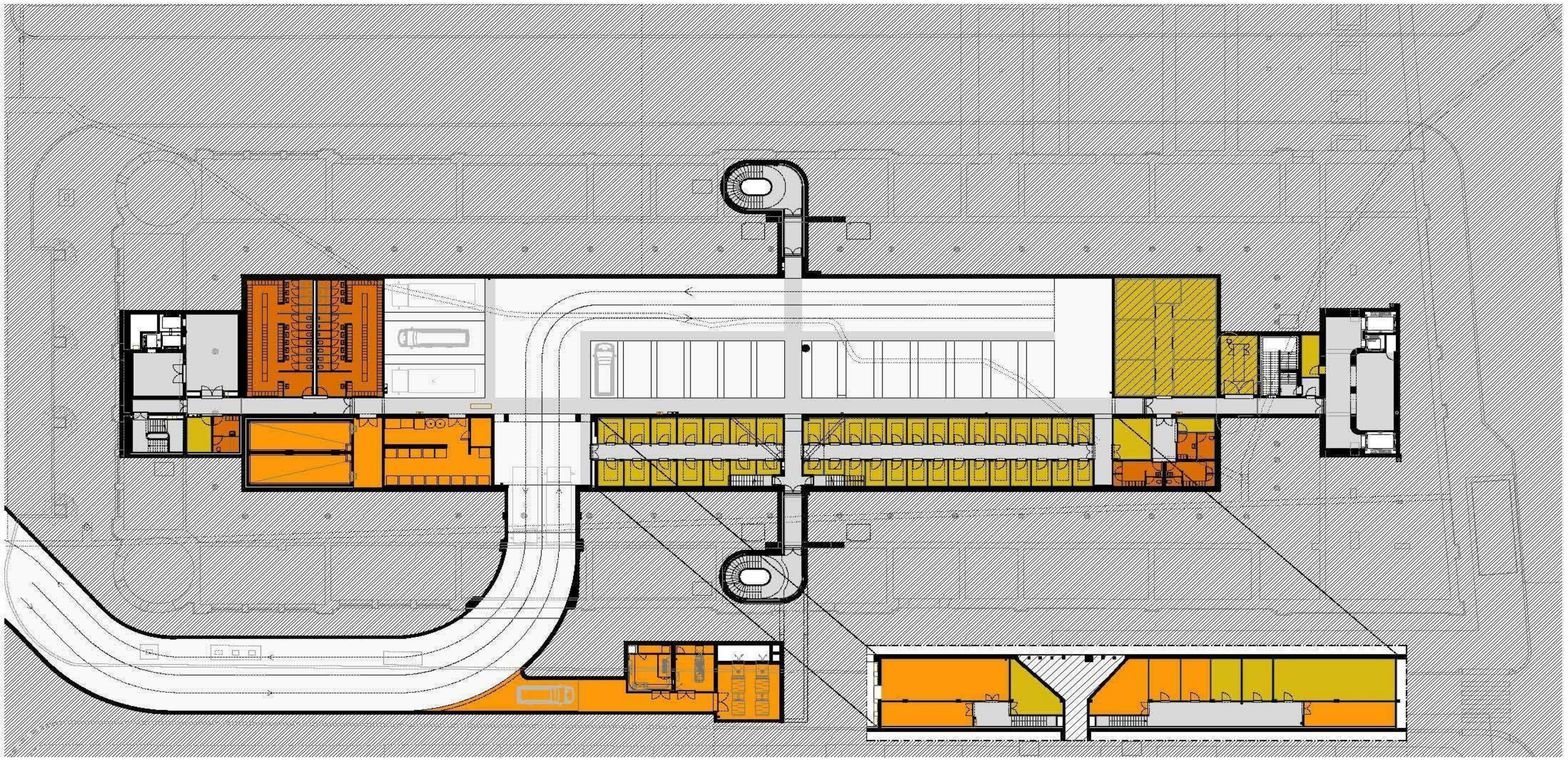
New lower floor for supply, logistics and technical support (cold storage and offices)



ACESSOS E CIRCULAÇÃO

RESTAURAÇÃO

ÁREA DE APOIO À RESTAURAÇÃO

LOJAS DE RUA

SOBRELOJAS

BANCAS DE FRESCOS

BANCAS DE VARIADOS

TALHOS

PEIXARIAS

ÁREAS DE APOIO
- CARGAS E DESCARGAS
- CÂMARAS FRIGORÍFICAS
- CÂMARAS CONGELADORAS
- COZINHA DE TRIPAS
- ARRUMOS

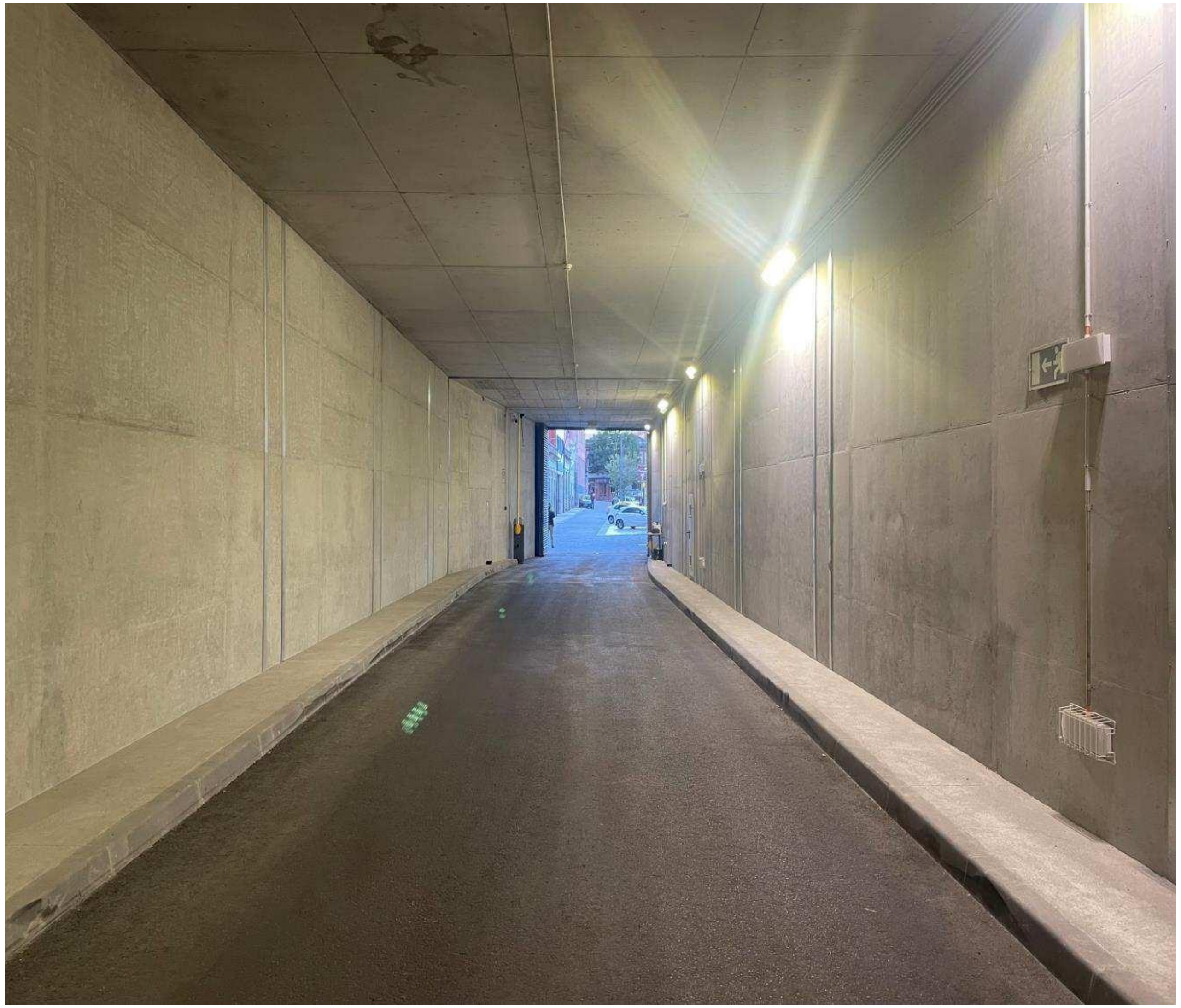
ÁREAS TÉCNICAS
- ÁREAS DE INSTAÇÕES
- RECOLHA DE RESÍDUOS SÓLIDOS
- DEPÓSITOS
- ARRUMOS

ADMINISTRAÇÃO
- SALA POLIVALENTE
- GABINETES
- SALA DE FORMAÇÃO
- SALA DE REUNIÕES
- ARQUIVO

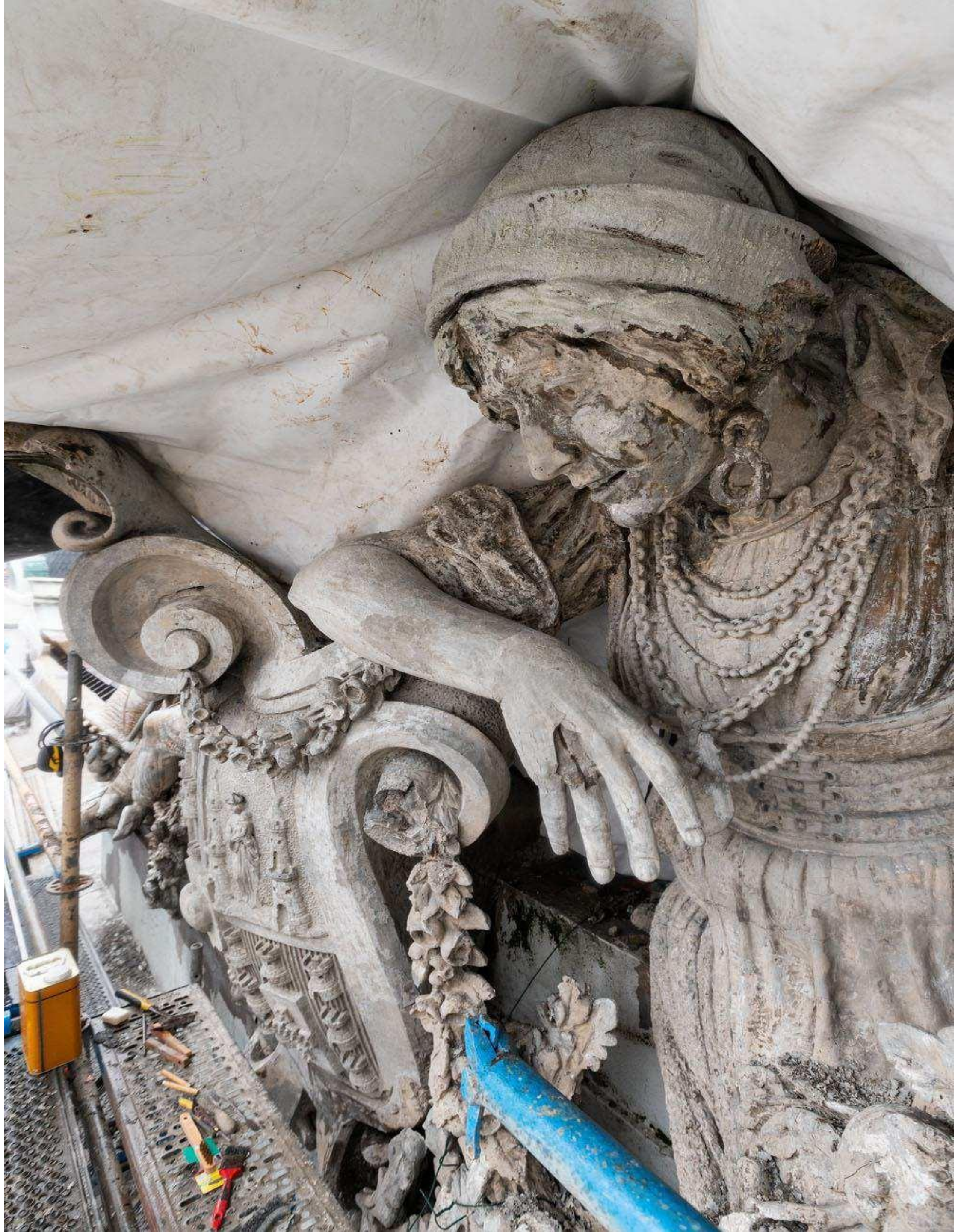
BALNEÁRIO COMERCIANTES E FUNCIONÁRIOS

INSTALAÇÕES SANITÁRIAS

A DEFINIR


R. do
do Porto
RESTAURANTE



SEMENTES



Innovation and Entrepreneurship in Engineering

The Supercapacitors of C2C-NewCap

Founders – Eng. Rui Pedro Silva, Eng. André Mão de Ferro, Eng. Sónia Eugénio (IST)

- Supercapacitors for mobility
- Significant reduction in truck operating costs and environmental costs
  - ✓ Savings on diesel consumption
  - ✓ Decrease in CO_2 emissions

C2C NEW CAP

Charge to Change

GO-START

Energy Storage Solutions for Trucks

Spin-off from Universidade de Lisboa

Portugal

Hcad Orricc

2014

Fo"→ıdcd bQ:

- R"i Pcdío Sil:a
- A→ıdíé Mão dc Fcíío a→ıd
- Só→ıia E"gé→ıio

Team

- 12 woíecíз
- « PkKз
- 7 E→ıgi→ıccíз
- 2 Píod"ctio→ı Ľcck→ıicia→ıз

500 m²

- Pilot Pla→ıt
- CapacitQ →ıto píod"cc 1000 ccllз / Qcaí

C2C NEW CAP | TECHNOLOGY

Battery type connectors
Easy Installation

Nickel & Carbon
Perfect combination

Aqueous electrolyte
Safe and non toxic

No need for a cell balancing system
Simple, reliable and robust

Go-Start

- An SME focused on research, development and production of Supercapacitors.
- Develops fundamental research in the area of materials for Supercapacitors
- Develops business in the area of Supercapacitors
- At European level – an immense business opportunity ~ 6.2 M trucks in circulation
- In 2023 – 50 Units installed
- For 2024 - 100 new Units are planned

Innovation and Entrepreneurship in Engineering

Omniflow – Solutions for Smart Cities

Founded by Eng. Pedro Ruão

- Founded in 2012
- Head Office in Porto, PORTUGAL
- Patented technology, designed and built in the EU
- Active in 35 markets worldwide

Omniflow
Solutions for Smart Cities

- **IoT smart light, powered by solar and wind energy**
- **Solution allows savings of over 90% in lighting**
- **… and also integrates other features such as security cameras, air quality sensors, 5G/wifi and electric vehicle chargers**


OMNIFLOW SMART POLE
Vertical wind turbine
Solar photovoltaic
Battery storage
AIR QUALITY SENSORS
CO, NO2, O3, PM, SO2, Noise level
CALL BUTTON
High quality video and audio
Facial recognition an other
analytics possible
EV CHARGER
Mast integrated EV Charger
INTEGRATED SERVICES
Ultra efficient LED system
4 x IP cameras, full field of view
Wi-Fi I 5G I LTE Small Cell
Audio for PA
Edge computing
IoT cloud based control system
Landing & charging pad for autonomous drone
INTERACTIVE DISPLAY
Capacitive Touch Screen
Audio system


Omniflow
SOLUÇÕES
PRODUTOS
SOBRE NÓS
SUPORTE
NEWS
SHOP
CONTACTOS

Omniflow
Solutions for Smart Cities

IMPLEMENTATION

+3000 Units
in 35 Countries

Team

21px

FINANCING

€4M

PATENTS

32 Granted
1 Pending

WEIGHT OF EXPORTS - ~70% OF BUSINESS VOLUME

Innovation and Entrepreneurship in Engineering

I-Charging mobilidade elétrica s.a.

CEO Eng. Alberto Milheiro Barbosa

- **They create technological products, reinforcing innovation, differentiation, design and quality, within the most sophisticated segments of infrastructure for electric mobility**

i-charging

A PIONEER EM DC FAST CHARGING

i-charging offers a comprehensive, leading product portfolio with output powers of up to 1,600 kW
with relevant, internationally recognized, certifications

blueberry
50kW

blueberry
FUSION
150kW

blueberry
PLUS
50-600kW

blueberry
CLUSTER
50-600kW

blueberry
MAX
50-1,600kW

5 years
A successful journey

2019

- Join the Team
- Launching the blueberry project

2020

- Test Center
- Launching the blueberry family

2021

- CE blueberry certifications
- Starting production
- First deliveries
- Opening of USA offices
- First commissioning
- E-mobility Awards & German Design Award

2022

- New power unit 200 kW
- Eichrecht module B
- German Innovation Award
- New power unit 300 kW

2023

- Intertek ETL for EUA & Canada
- Launching blueberry FUSION
- Eichrecht module D
- Certification Plug & Charge

A global company with a blue-chip customer base and strong presence in key electric vehicle countries

30+
Countries

6
continents

3,150+
blueberries sold

500+
Total MW sold

50+
Customers & Partners

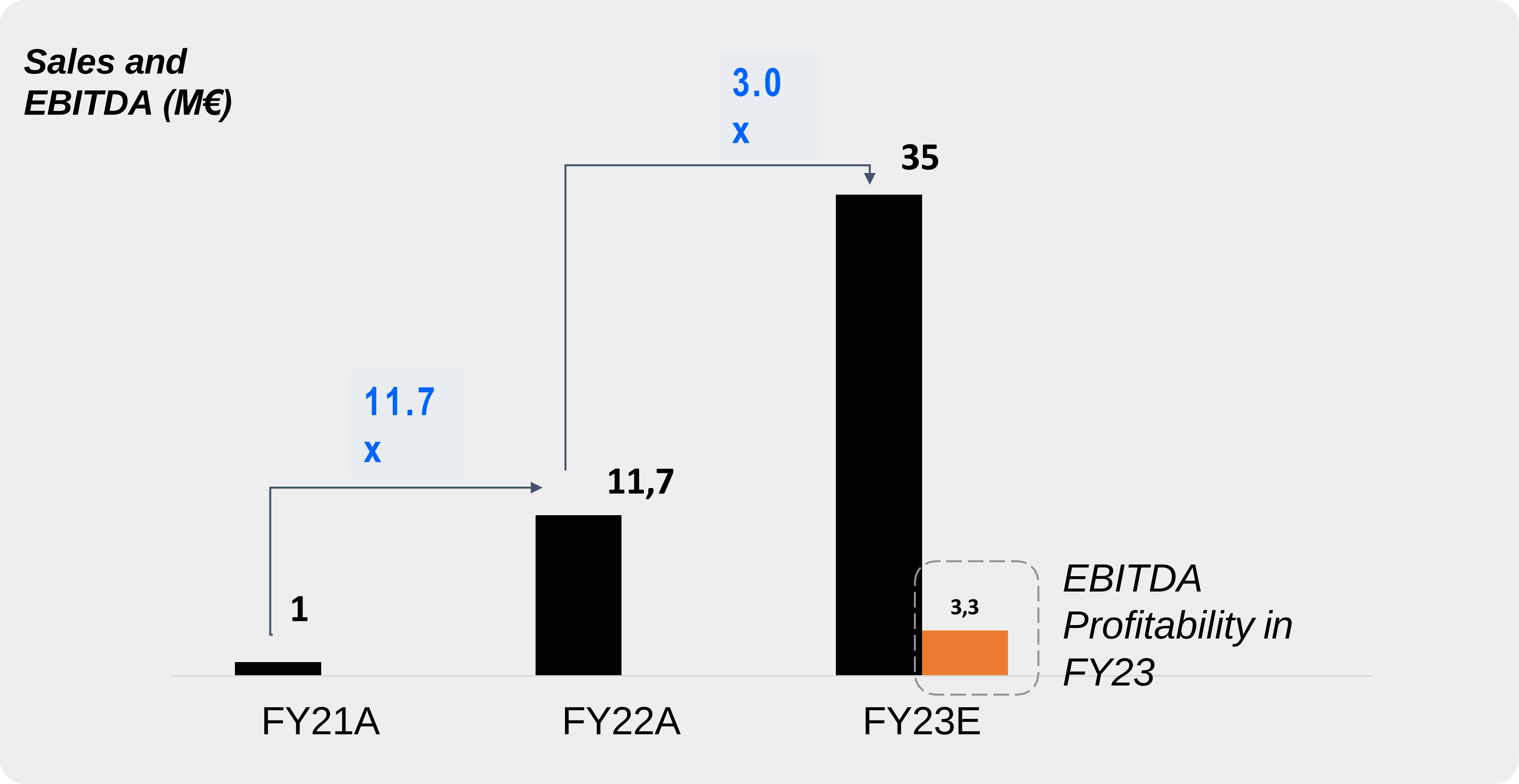
100+
FTE's

50+
FTE's in R&D and Engineering

Argentina
Australia
Brazil
Belgium
Dominican Republic
Egypt
France
Germany
Greece
Hungary
Koweit
India
Macau
Mexico
Morocco
Panama
Paraguay
Poland
Porto Rico
Portugal
Serbia
Slovenia
Spain
Thailand
Turkey
United Arab Emirates
United kingdom
Uruguay
USA

i-charging é a líder tecnológica, lucrativa e de crescimento mais rápido em carregamento rápido DC

i-charging has been on an impressive growth trajectory since the launch of the first Blueberry fast charger in 2021



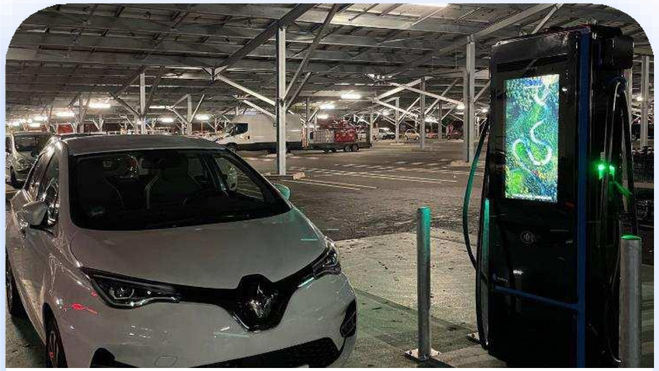
i-charging

more at www.i-charging.pt

Some examples

Antuã, **Portugal**

Punta Cana, **Dominican Republic**



Wittenheim, **France**

Montelimar, **France**

Albacete, **Spain**

Szeged, Hungary

i-charging

more at www.i-charging.pt

Some examples

AUDI, **UAE**

Bangkok, **Thailand**

Atlanta, GA, USA

Montabaur, Germany

S. Paulo, **Brazil**

Mont-de-Marsan, France

more at www.i-charging.pt

Some examples

Ostrzeszów, Poland

Panama City, Panama

Athens, Greece

Bourgoin Jallieu, France

UK

Mealhada, Portugal

Innovation and Entrepreneurship in Engineering

SEAMORTECH

Founders Eng. Eva Sousa, Eng. Sofia Delgado (Spin Off - DEQ, FEUP)

- **Make the desalination of seawater through reverse osmosis more environmentally friendly and profitable**
  - **Harness valuable minerals**
  - **Increase freshwater recovery efficiency**
  - **Minimize the impact of toxic brine discharge**

RISE NO SNS ENCHE URGÊNCIAS DE HOS

s particulares recebem doentes mais graves e já têm constr

No Algarve já não há água para salvar as laranjas

Escassez hídrica e seca obrigam a racionar abastecimento. Corte para a agricultura pode chegar a 70%

As albufeiras algarvias encontram-se a 25% da sua capacidade e os aquíferos subterrâneos também não estão em bom estado, devido à seca intensa que tem assolado a Região Sul do país há mais de dois anos. Para garantir água para abastecimento público até final de 2024, o Governo vai apresentar, na próxima quarta-feira, um novo plano de contingência para o Algarve, que passa por reduzir o abastecimento de água para a agricultura em 70% no Sotavento e em 15% para consumo humano; e por não licenciar novos furos. Em cima da mesa está também a proibição de novas áreas agrícolas de regadio na região. Os agricultores temem "uma catástrofe". P19

Water shortage

Cover page in major newspapers

12 January 2024

A TEAM OF SIX, WITH TWO FOUNDERS

VALUING RESOURCES FOR A SUSTAINABLE MARITIME ECONOMY

SUSTENTABILIDADE

Cientistas portuguesas extraem minerais valiosos da salmoura que ninguém quer

P AZUL PLANETA CLIMA SUSTENTABILIDADE BIODIVERSIDADE POLUIÇÃO MULTIMÉDIA OPINIÃO SOBRE ABC DA TERRA MAIS

O projecto das cientistas nasceu nos laboratórios da Faculdade de Engenharia da Universidade do Porto (FEUP) e, há dois anos, deu origem a uma *spin-off* chamada SeaMoreTech. "Foi um desafio que nos foi lançado pelo professor Adélio Mendes", explica ao PÚBLICO Eva Sousa, referindo-se ao investigador da FEUP muito conhecido por apoiar a transição de novas tecnologias para o tecido industrial.

Eva Sousa e Sofia Delgado criaram a *spin off* SeaMoreTech PAULO PIMENTA

U.PORTO NOTÍCIAS UNIVERSIDADE DO PORTO

NOTÍCIAS AGENDA PESSOAS NÓS POR

PÁGINA INICIAL / NOTÍCIAS / CIÊNCIA E INOVAÇÃO

12.09.23 Por Raquel Pires / FEUP

Solução criada por investigadoras do LEPABE permite obter minerais imprescindíveis na indústria farmacêutica, automóvel e eletrónica.

Eva Sousa e Sofia Delgado conheceram-se quando desenvolviam trabalho no âmbito das respetivas teses de doutoramento no LEPABE / FOTO: DR

Address the environmental problem

Reverse osmosis is currently the most promising desalination technology to address water scarcity. But…

Unconscious discharge of brine into the oceans → Ecological disruption of the seawater food chain

142 million m3 of toxic brine daily

Opportunity

Valorization of brine minerals – why?

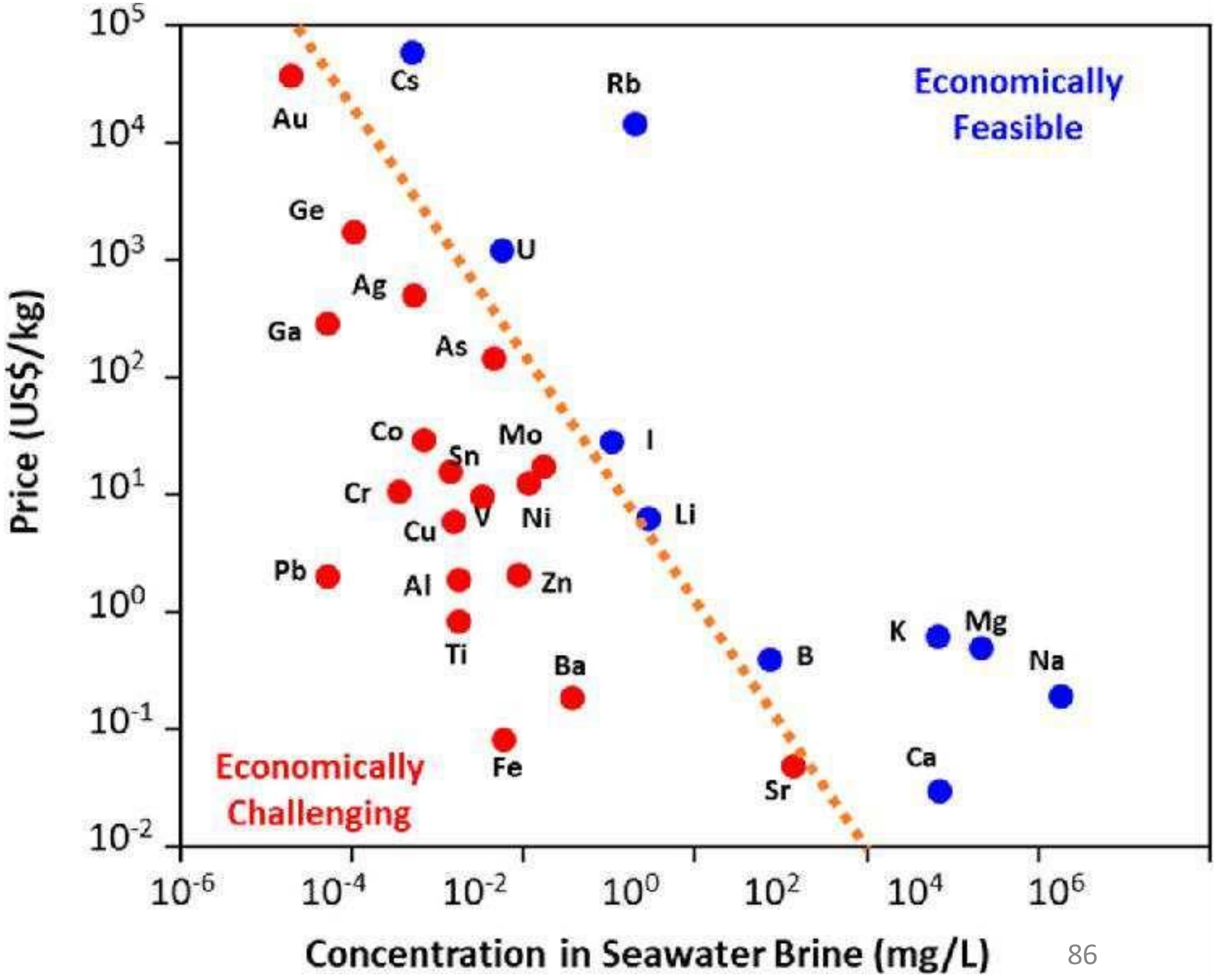
Concentration of minerals duplicates in brines resulting from inverse osmosis

Minerais that serve various industries

(Pharmaceutical, Automotive, Eletronics…)

Market currently very dependent on non-European industries

Critical raw materials in the EU



The Solution
Valuing resources for a sustainable maritime economy

A 2-Step Production Process

Project's final goal

Treat up to 600 m3 of toxic brine per hour

Toxic brine → **Membrane separation** → Enriched Pretreated brine → **Thermochemical Reactor** → **Mineral Production**

Membrane separation ↓ **Water**

Thermochemical Reactor ↓ **Residual water**

For 2024

Pilot scale experiment

Semi-industrial application contracted in an Industrial Desalination Plant (private) in the Algarve, with the expected treatment of 30 m3/day of brine

EPÍLOGUE

IS WORLD DEVELOPMENT IN THE HANDS OF ENGINEERING?

- ☞ **Naturally, it is also in the hands of other areas, but it is VERY MUCH in the hands of Engineering, of Engineers…**
- ☞ **Portugal has a large, high quality installed Engineering capacity, in Engineers and in Companies, with AMBITION… looking to the outside World…**
- ☞ **It is fundamental for our collective future that our Governments ENHANCE, BOOST, SUPPORT, the intervention of Engineering, recognizing and using its ability to DO –**

Bring Engineering to cooperate more in the design of policies

Give Engineering the responsibility to

make and implement these policies on the field

Shane McHugh
Royal Academy of Engineering, United Kingdom

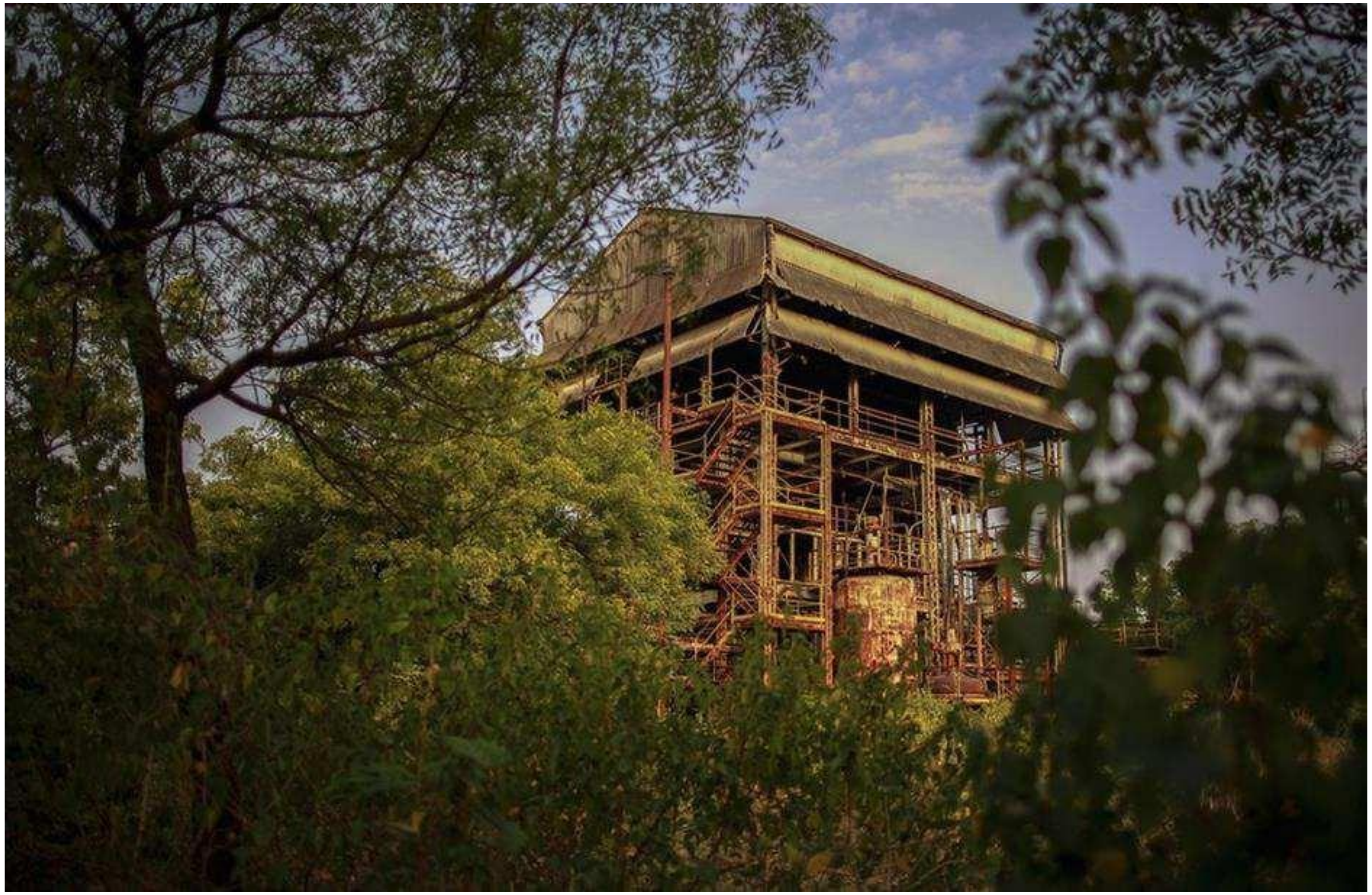
The Engineering X Global Engineering Capacity Review 2024

Shane McHugh
Royal Academy of Engineering, UK

Engineering X Skills for Safety

Lisbon
March 4th 2024
Engineering Solutions for a Sustainable World

- £5m partnership with Lloyd’s Register Foundation to improve the promotion of skills for safety
- Identifying and empowering champions of engineering safety skills
- Understanding the global engineering safety skills landscape and mapping how engineering skills and economic growth intersect



Global Engineering Capability Review

Review was developed to answer three key questions:

- Where is the most harm or risk of harm due to unsafe engineering practices? Where will this be in the future?
- What engineering safety skills are specifically needed?
- How do we create engineers with the skills to reduce harm and increase safety in their countries?

Methodology

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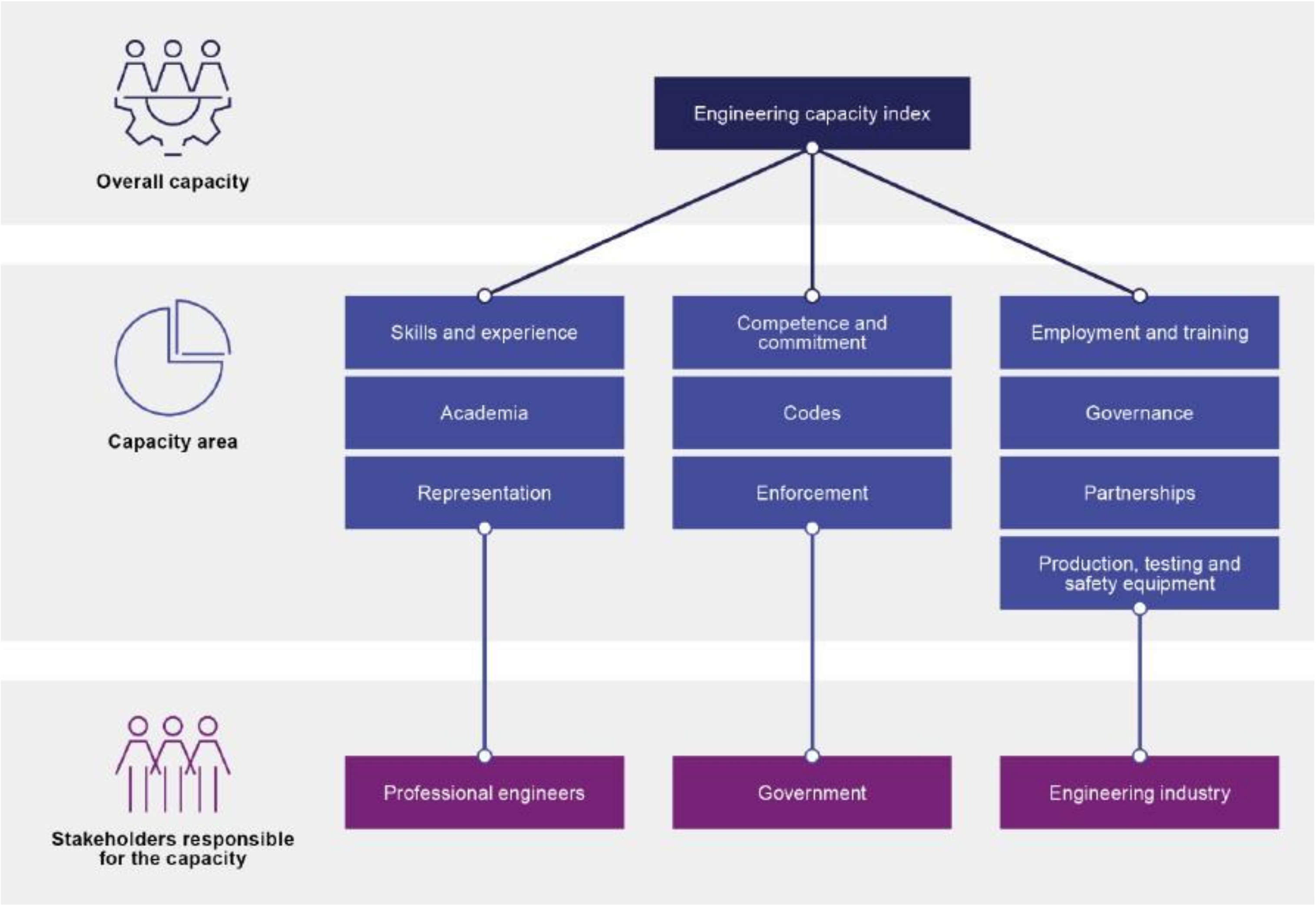
Index measures capability based on 76 indicators clustered in 10 capacity areas, owned by three stakeholder groups



Results

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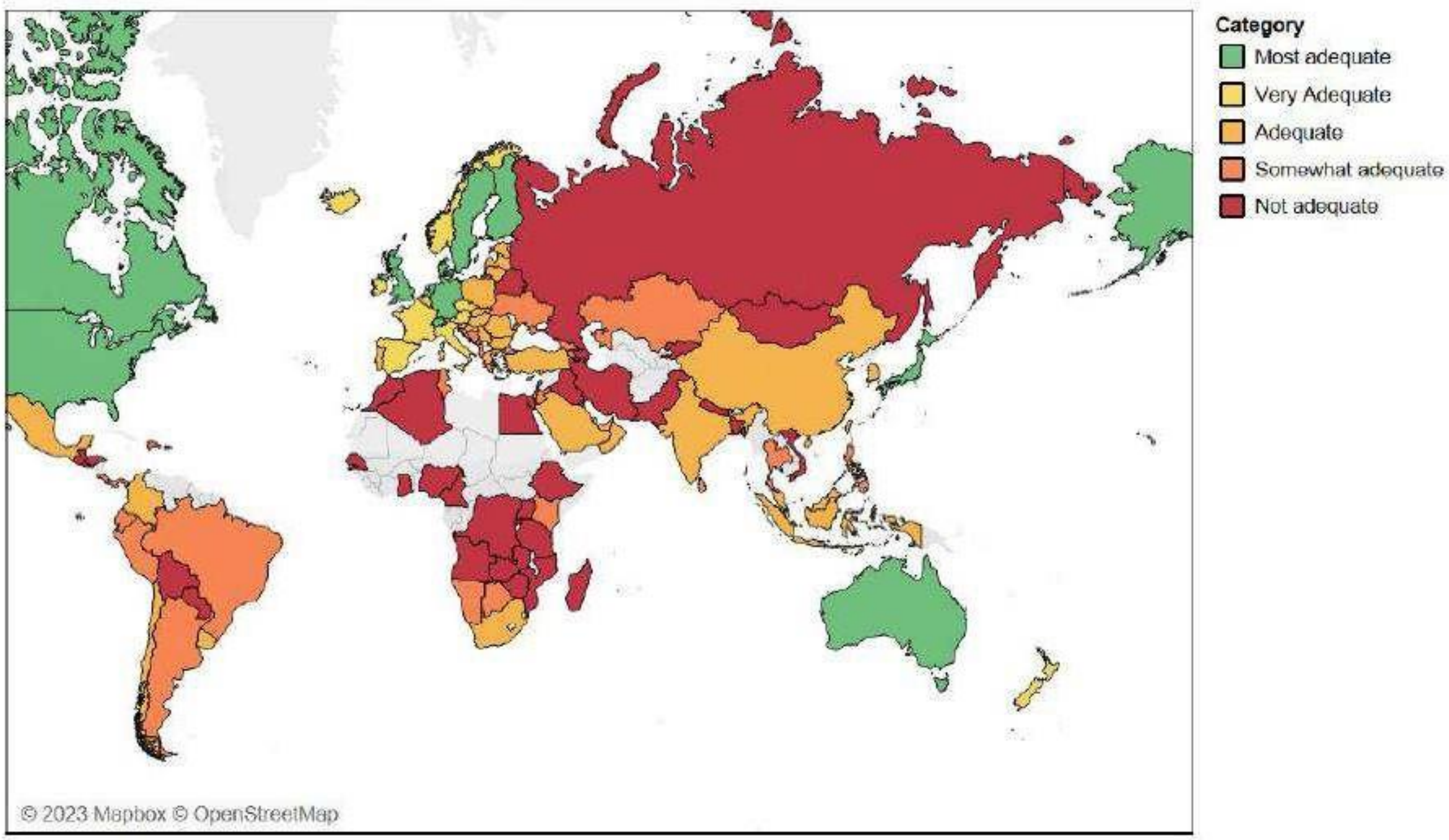
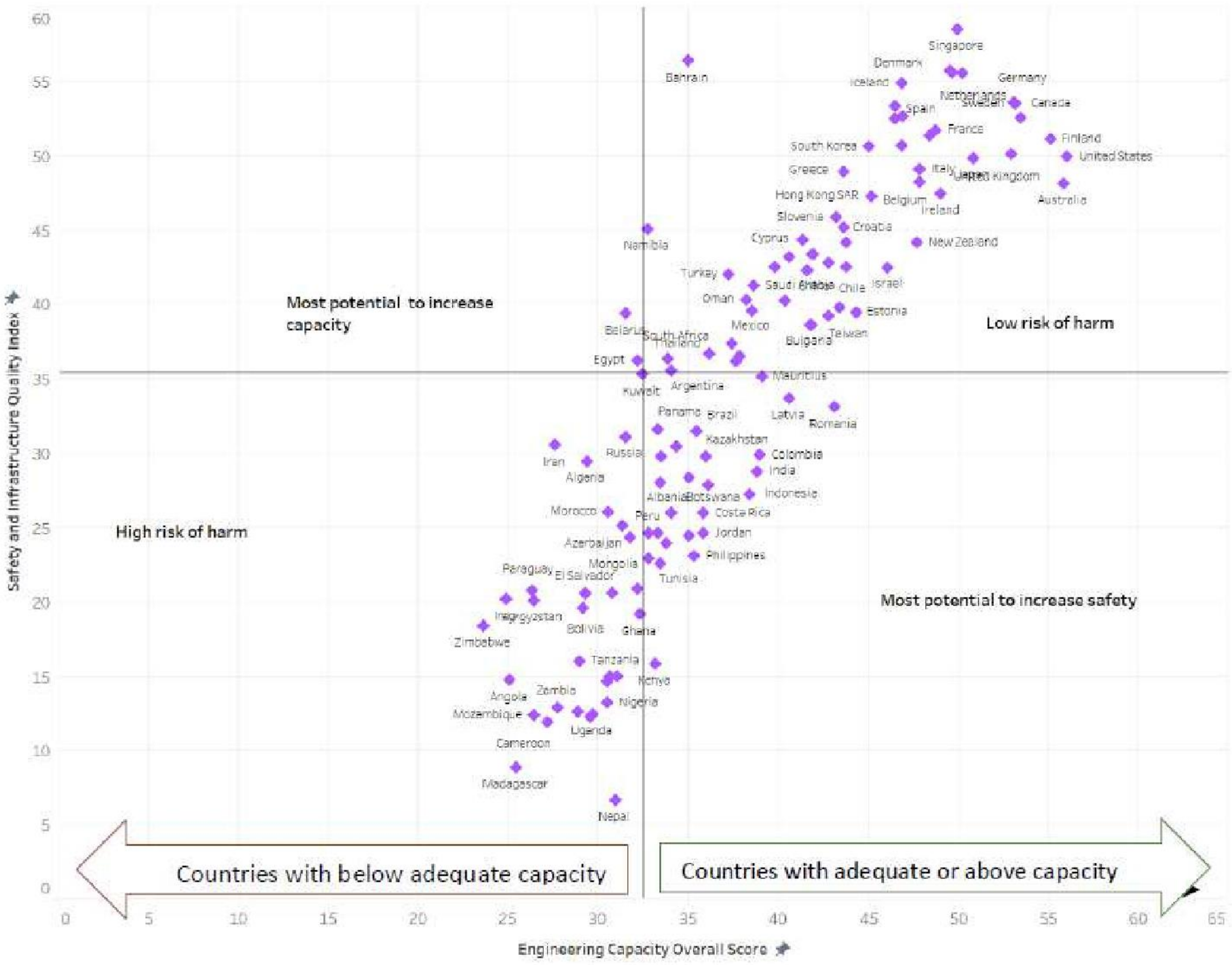


Note: Countries in grey did not have sufficient data for inclusion in the 2024 ECI

Index measures engineering capacity of 115 countries. Clustered in groups rather than ranked, ranging from Most Adequate (Green) to Not Adequate (Red), where risk of harm due to unsafe engineering practices is very high

Where is the greatest risk of harm and potential opportunity for increased safety?

Figure 7: ECI 2024 Scores vs EOI (Safety and Infrastructure Quality) Scores



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Mapping capability index to engineering outcomes index

Key Findings

- Strong evidence that investing in engineering capacity directly links to safety outcomes, and is a leading indicator of improvements or problems
- All countries have strengths in some areas- 47 different countries have exemplary capacity in at least one of the 10 key capacity areas.
- Every region has at least one country with good capacity, strong indication of the value of regional based partnerships to improve safety.
- Global need to improve engineering partnerships – and for better evidence on the kinds of partnerships that are most effective.

Emerging areas of focus

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- Six case studies explore 21st century engineering skills needs around global sustainability and emerging technologies.
- Areas addressed include safe and sustainable mining, achieving energy transition, decommissioning of renewable energy infrastructure, AI, continuous learning opportunities, and data collection for the SDGs.
- Facilitating knowledge sharing among engineering communities- and potentially identifying new Engineering X challenges.

Impact on Sustainability Challenges

- Launching major new collaboration on Open Burning to mark World Engineering Day for Sustainability
- Global consortium led by Engineering X has received $1.3m funding from UNEP's Climate and Clean Air coalition to help end open burning of waste
- Two year project will produce three roadmaps for phasing out of open burning in Africa, Asia and Latin America & the Caribbean, and will pilot each within one city in the region.

Dandora dumpsite, Nairobi 2023

Call for action

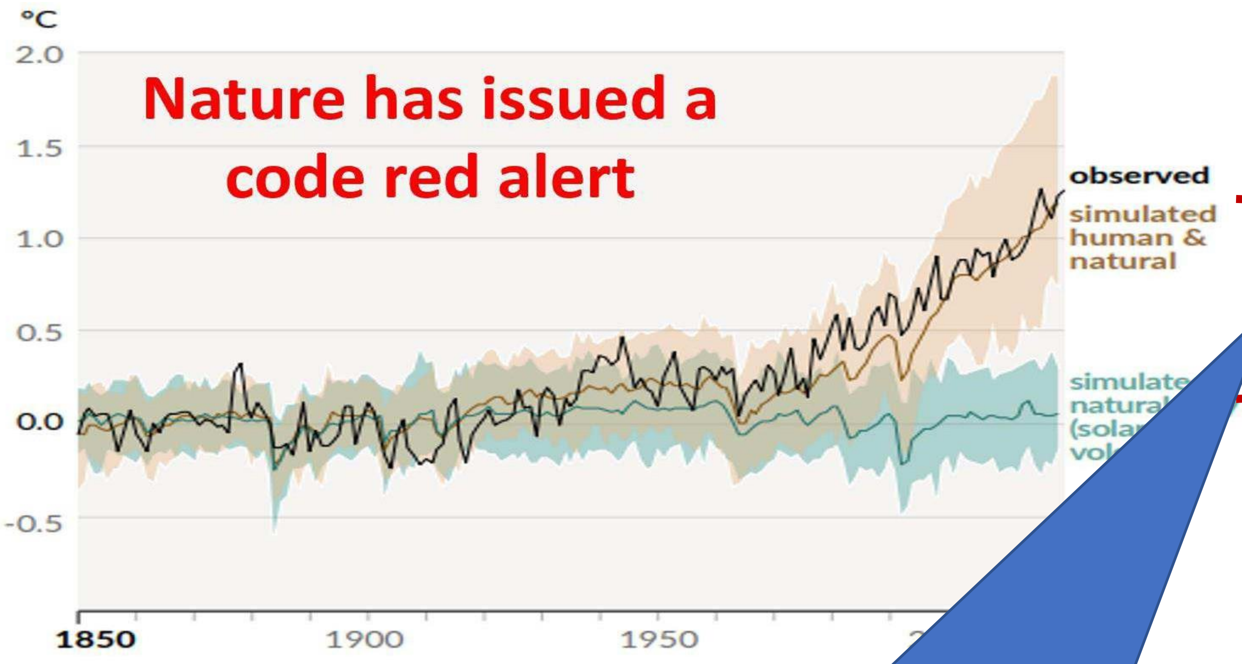
- Bookmark our webpage with the QR code opposite
- Download the report and use interactives to
- Share it with your national stakeholders, and promote it to guide investment in engineering skills
- Help us improve the accuracy and availability of data to build a better picture of the engineering skills that underpin social and economic growth

Scan me!

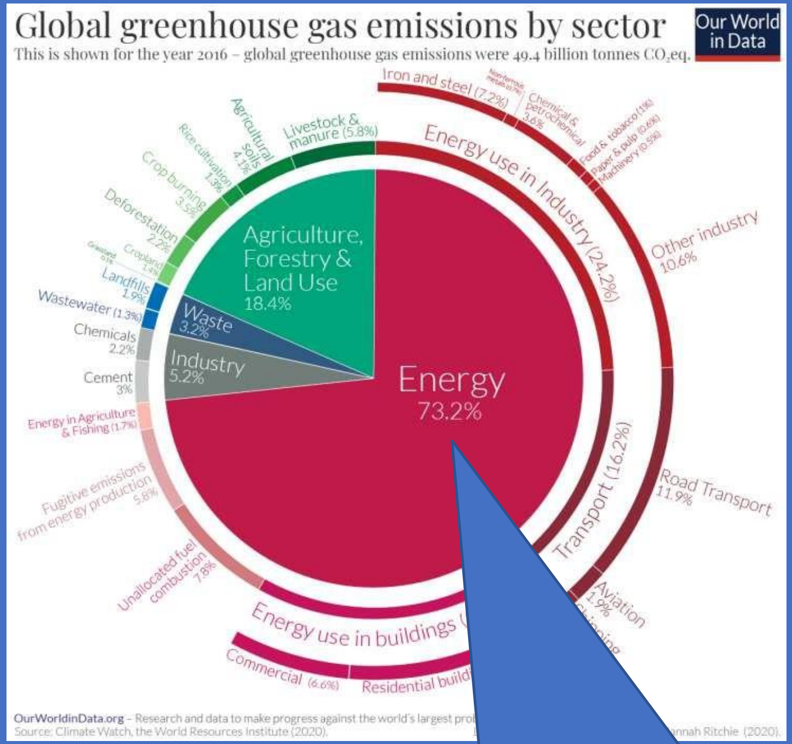
Gong Ke

WFEO Past President, China

Energy related human activities (most of which are Engineering related) are responsible to climate change



Global surface temperature changes (annual average) obs… d using both human and natural factors, as well as only natural…



Engineering activities are a significant part of the "HUMAN ACITIVITIES" increasing the Global surface temperature.

All engineering activities are dealing with energy

Engineers’ role is crucial in energy transition

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1
- Because engineers are crucial in energy generation, transmission, distribution and application.

2
- Because engineering practices are dealing with energy and related greenhouse gas emission.

3
- While engineering works rely on energy, energy transition relies on engineering and engineers.

Engineers’ contributions in transforming energy

Engineers are essential for designing, building and maintaining power infrastructure.

- **Electrical, mechanical and environmental engineers** have been central to the development of low-cost renewable energy solutions, including wind, solar, wave and geothermal energy, all of which provide access to electricity in remote regions while mitigating the impacts of climate change.

- Household energy generation and distribution, mini-grids and smart grids are all innovations developed by **electrical, electronics, mechanical and telecommunications engineers** that are transforming access to energy while reducing environmental impacts.

- Advances in energy storage are making sources of reliable energy accessible and affordable.

- the UNESCO Engineering Report: ***Engineering for Sustainable Development***

However, for transition away from fossils, engineers need to do more.

Engineers are to increase our awareness of the goal of energy transition

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- The UN SDG 7: ***Ensure access to affordable, reliable, sustainable and modern energy for all***
  1. **By 2030, ensure universal access to affordable, reliable and modern energy services**
  2. **By 2030, increase substantially the share of renewable energy in the global energy mix**
  3. **By 2030, double the global rate of improvement in energy efficiency.**

To meet the challenge of ensuring the energy transition benefiting of all the people, especially those 800 million people without modern energy services.

Engineers are to integrate digital technologies in electrification to empower the energy transition

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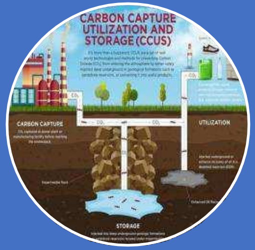
High efficient and cheaper renewable energy

Safe, reliable and efficient long-term storage



Scalable and economic CCUS and negative emissions technologies

Smart, resilient and effective transmission, distribution and operation

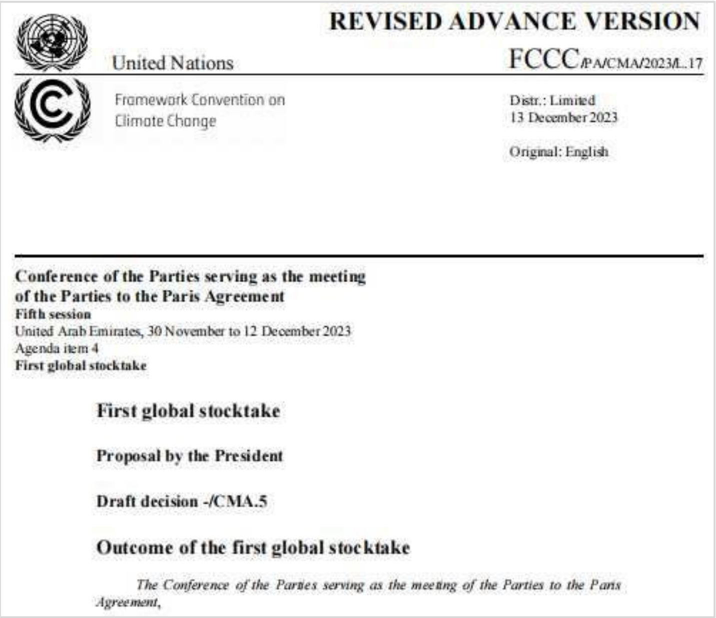
Widely and clean electrification of end uses and efficient usages

And much more

Digital technology has great potential in increasing the efficiency, stability, safety and reliability

Engineers should have the capability to make full use the proper digital technologies to increase the efficiency, stability, safety and reliability in energy services and applications.

Engineers are to further leveraging zero- and low-emission technologies to deepen the transition


REVISED ADVANCE VERSION

United Nations

FCCC/PA/CMA/2023/L.17

Framework Convention on Climate Change

Distr.: Limited
13 December 2023

Original: English

Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
Fifth session
United Arab Emirates, 30 November to 12 December 2023
Agenda item 4
First global stocktake

First global stocktake

Proposal by the President

Draft decision -/CMA.5

Outcome of the first global stocktake

The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement,

The first global stocktake presented on the COP 28

- "further recognizes the need for deep, rapid and sustained reductions in greenhouse gas emissions in line with 1.5 °C pathways and calls on Parties to contribute to the following global efforts,...
  - Accelerating **zero- and low-emission technologies**, including, inter alia, renewables, nuclear, abatement and removal technologies such as carbon capture and utilization and storage, particularly in hard-to-abate sectors, and low-carbon hydrogen production;......
  - Accelerating the reduction of emissions from road transport on a range of pathways, including through **development of infrastructure and rapid deployment of zero and low-emission vehicles**".

Engineers should understand the carbon footprint of his/her engineering practice and master related skills to achieve zero or low-emission.

Furthermore, Engineers are to

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ensure safe and stable energy supply during the transition

- The challenges come from
  - Volatility of **renewable energy supply**;
  - Complexity of **coordinating online supply, consumption and maintenance systems of renewable energy.**

ensure the transition adapting to regional circumstances and contexts

- Regional contexts differ in natural resources, disasters and ricks;
- COP28 stressed "that strategies related to just transition and economic diversification should be implemented **taking into account different national circumstances and contexts**".

And, ……

Engineers’ role is to make the energy transition away from Fossil Fuels a reality

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- On the COP28, nearly 200 countries for the first time recognized the need to transition away from fossil fuels.
- “**Rapid and far-reaching transitions across all sectors and systems** are necessary to achieve deep and sustained emissions reductions and secure a liveable and sustainable future for all.”

--*CLIMATE CHANGE 2023 Synthesis Report Summary for Policymakers*-IPCC

https://www.un.org/sg/en/content/sg/press-encounter/2023-12-11/un-secretary-generals-press-encounter-cop28

- UN SG António Guterres emphasized that the era of fossil fuels must end with justice and equity. “The Global Stocktake must **offer a clear plan for a tripling of renewables, a doubling of energy efficiency and a single-minded focus on tackling the root cause of the climate crisis – fossil fuel production and consumption.**”

Engineers’ role is to implement the plan, and to solve the problem by engineering practices!

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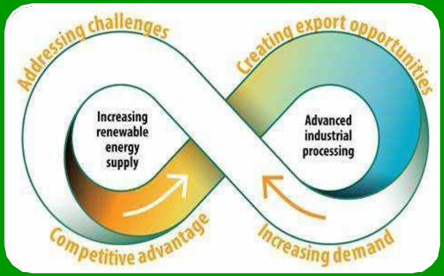

Energy transition is imperative and of great urgent to sustain humankind and the planet. All engineers are responsible to this comprehensive energy revolution in every engineering position.

To take on their role in energy transition, Engineers should have a strong sense of social responsibility to fully understand their role in energy transition, and strive to improve their professional capabilities.

WFEO unites all engineers, men and women, to engage into the energy transition with responsible and innovative engineering practices.

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Engineering Solutions for a Sustainable World

Clemente Pedro Nunes
Professor IST, Portugal

“Portugal and the Energy Transition: Some Vital Strategic Questions”

UNESCO WFEO World Engineering Day

Conference “Energy Transition and Sustainability”

Ordem dos Engenheiros

Lisboa, 4 / March / 2024

Clemente Pedro Nunes: - ***Full Professor of Instituto Superior Técnico, Universidade de Lisboa***
- ***Investigador do CERENA***

1. *Portugal, the Energy Transition, and Economic Competitiveness*

- **Engineers** have as their **mission** to **use Science and Technology** to promote **Projects** that **enhance** the **economic** and **social development**;
- As such, it is of the **utmost importance** that the **engineers** take good **note** of the **latest scientific** and **technological realities** that affect the current **Energy Transition**;

- In **Portugal**, one of the main **challenges** to the **economic viability** of this **transition**, is related to its **Electric System**, that is currently **based** in **intermitent power sources**.

- It is also very important to stress that **Portugal** is a **member** of the **European Union**, and as such **our Electric System** has to be **articulated** with those of the **other european countries**, and with the **decisions** of the **European Commission**.

  In **special** with **Spain**, and also with **France**.

2. *An Historic Introduction to the Portuguese Electric System*

- The national **expansion** of the **Electrical System** Network only **occurred after WW II**, **based** on the **National Hydroelectric Plan** of Professor Ferreira Dias.

  After 1960 this **System** was **strengthened** with fuel oil based **Power Stations** to guarantee the **stability** of the **electric supply**.

- **After** the two **oil shocks** of **1973/74** and **1980/81**, Portugal prepared the **Energy Plan** of **1983** that led to **two major decisions**:
  - **refuse** the introduction of **nuclear power**;
  - to **base** the **firm power** supply in **coal** and **natural gas** based power stations, **both** of which to be **imported** .

3. The Revolution of the Intermitent Power Sources: The FIT – Feed In Tariffs

- This **Electricity System** was **subverted,** from **2005 onwards,** by the introduction of massive of **intermitent sources, wind** and **solar;**

- This **“revolution** of a new **intermitent base”** was introduced **without** the **necessary** preliminary **studies** to evaluate the **cost / benefits** of the several available **alternatives, in** order to **optimize** the overall **economic competitiveness** of the **Electric System.**

- **Most** “final **energy products**”, like diesel, natural gas or biomass, **can be transported** and **stored** in a relatively **easy way**, and can be **used** afterwards **whenever** the client **request** them;

- But **electricity**, which is basically an “electronic flow”, **can not be directly stored;**

- Which means that **electricity** “has always to be **used** in the moment **when** it is **produced**”;

- To **guarantee** the **profitability** of the **investment** of **intermitent** power **sources**, it was **granted** to them by the portuguese government the **contractual regime** of the **FIT – Feed In Tariffs**;
- The **FIT grants**, to those that benefit from them, **two decisive advantages**:
  - **Whenever produced**, they are **paid** at a **fixed price**, **regardless** of the **consumption** that prevails in **each moment**;
  - **Besides**, these **intermitent powers** are **entitled** to "**expel**" any **competition** from the **market**, **even** in the case that the **alternative** is **much cheaper** for the consumer .

4. How an Unbalanced Eletric System was Created

- **Till 2011** were granted **FIT** to more than **6,000 MW** of **intermitent** power **sources: 5,400** from **wind** and **600 MW** from **solar**;

- As the **consumption in** the **"empty" hours in** only **3,900 MW** in **Portugal**, the **backup** power sources have to **adjust** to the **intermittency** of **wind** and **solar**, with all the **surcharges** that this imply;

- Already **in 2008** this situation was the **origin** of the **Tariff Debt of the Electrical Sector**, that **remained ever since**, despite the fact that the Portuguese government promised in 2011, to the Troika, that **it** would be fully paid till 2020;

- And **more ominous** is the fact that **ERSE**, the **Portuguese Energy Regulator**, **announced** last December that this **Debt** is going to **rise** again to **2,000 million euros** in **2024**, and **its payment** is the **responsibility** of the **consumers**.
- As these **FIT** were **granted** for **15 years**, counted from the respective start-up, it means that **till 2028** the **System** “will be held **hostage**” of two very serious **consequences** for the **consumers**:
  - — The **backup** power **sources** will **have to** continue to **adjust** to the **intermitent** nature of **wind** and **solar**;
  - — Any **new** electric **production**, including new and more efficient wind and solar power sources, **shall be “expelled** from the market ” whenever the “**old FIT decide**”.

5. *Intermitent Power, Indirect Storage of Electricity and the Need of Guaranteed Power Backup*

- In order for the **electricity production** to be **adjusted** to the **consumers requirements**, there are **two alternatives**:
  - To **produce electricity when** the **consumers need** it, or,
  - To **instal** a complex technological **process** that is able to "**indirectly store electricity**"

- In **Portugal,** the **three alternatives** that exist, or have already been proposed, for the "**indirect storage** of **intermitent electricity**, are the following:
  - To **pump water upriver** in **hydroelectric dams**, that will be turbined afterwards when it is required by the consumers ;
  - **Reversible electrochemical reactors**, commonly known as "**batteries**";
  - To **produce**, with the eventual surplus of electricity, an **"intermediate chemical compound"**, that will be **later reconverted** back into **electricity** when it will be necessary .

- "**Electrolytic Hydrogen**" is the **intermediate compound** that was recently **proposed** by the **Portuguese Government** for this purpose.

6. Eletrical Intermitency and Electrolytic Hydrogen

Hydrogen, produced from the **electrolysis** of **water**, is “a **tool** to promote the **indirect storage** of **intermitent electricity**”.

6.1 - *Eletrolitic Hydrogen: Risks and oportunities*

- **Electrolytic hydrogen** is very **inefficient** in terms of energy and, besides **requires high purity water**;
- It is **very difficult** that **hydrogen** reaches a **high energy density** in **volume**, since the respective **condensation temperature** is **extremely low**, **- 253 ºC**, and its **liquification** by compression needs very **high pressures**, of around **700 atmospheres**;

- As such, very important preliminary **technological developments** are still **needed** in order for **electrolytic hydrogen** to be able to **compete** in the **marketplace;**

- Unfortunately, **RCM nº 63/2020**, of 14 August, that establishes **seven targets** to be achieved by **electrolytic hydrogen till 2030**, is **not based** in any type of **economic analysis** .

7. *The Evolution of Energy Sources in Portugal*

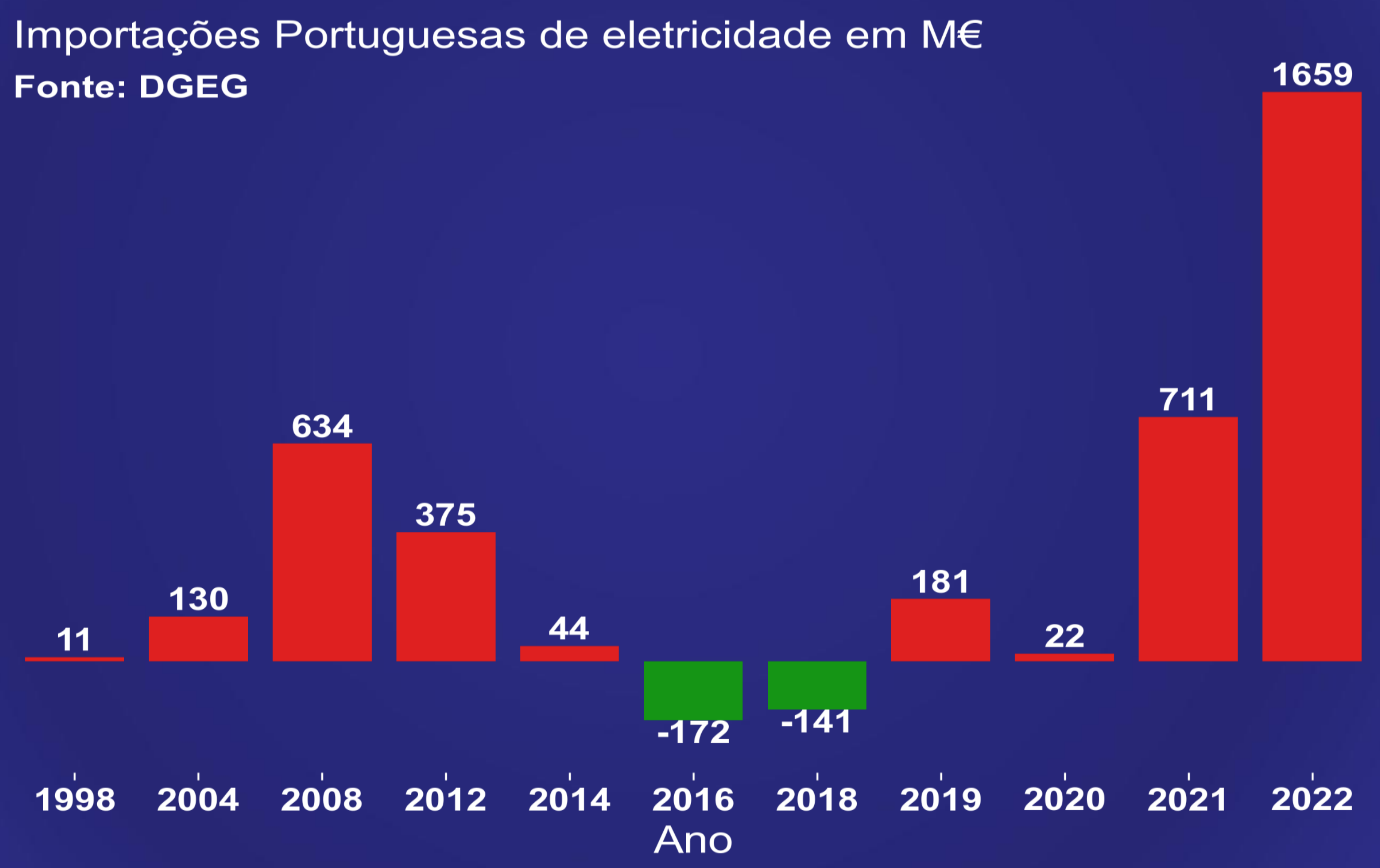
7.1 – *Electricity Imports*

- In **Portugal**, the value of **liquid electricity imports** have **climbed** in the last few years, having **reached in 2022** an **absolute high record**.

As it **can be seen** in **Table 1 below** (Source DGEG) :

Evolution of the value of the Liquid Imports of Electricity in Portugal from 1998 to 2022 (in millions of Euros)

	1998	2004	2008	2012	2014	2016	2018	2019	2020	2021	2022
Eletricidade	11	130	634	375	44	-172	-141	181	22	711	1659



Importações Portuguesas de eletricidade em M€
Fonte: DGEG
11
130
634
375
44
-172
-141
181
22
711
1659
1998
2004
2008
2012
2014
2016
2018
2019
2020
2021
2022
Ano

- The liquid **imports** of electricity have **risen from 181 million euros** in **2019** to **1.659 million euros in 2022**, which means that its **value** has been **multiplied by 9** !
- This important **bleeding** of **financial resources** is **regrettable**, since **Portugal disposes** of **20,000 MW** of **installed** power **capacity**, for a **consumption** of **only 10,000 MW** at “**maximum consumption” hours** and **only 3,900 MW** at “ **empty “ hours** .

What is the **reason** for this **apparent nonsense** ?

With the **closing down** of the **coal** based **power plants** in **2021**, **Portugal** can **only** use **natural gas** as a **reliable power source** and when possible, of hydric storage, in order to **avoid blackouts** .

In order to **avoid** the **surcharges** of the **stop and go** regime, that the **backup** power stations are forced **due** to the **FIT** granted to the **intermitent power sources**, it is **preferable** in many occasions, in terms of pricing, to **use imports** of electricity **from Spain**.

Spain that continues to **have** several "**reliable** power **sources**" based in **coal**, **natural gas** and **nuclear**, for instance.

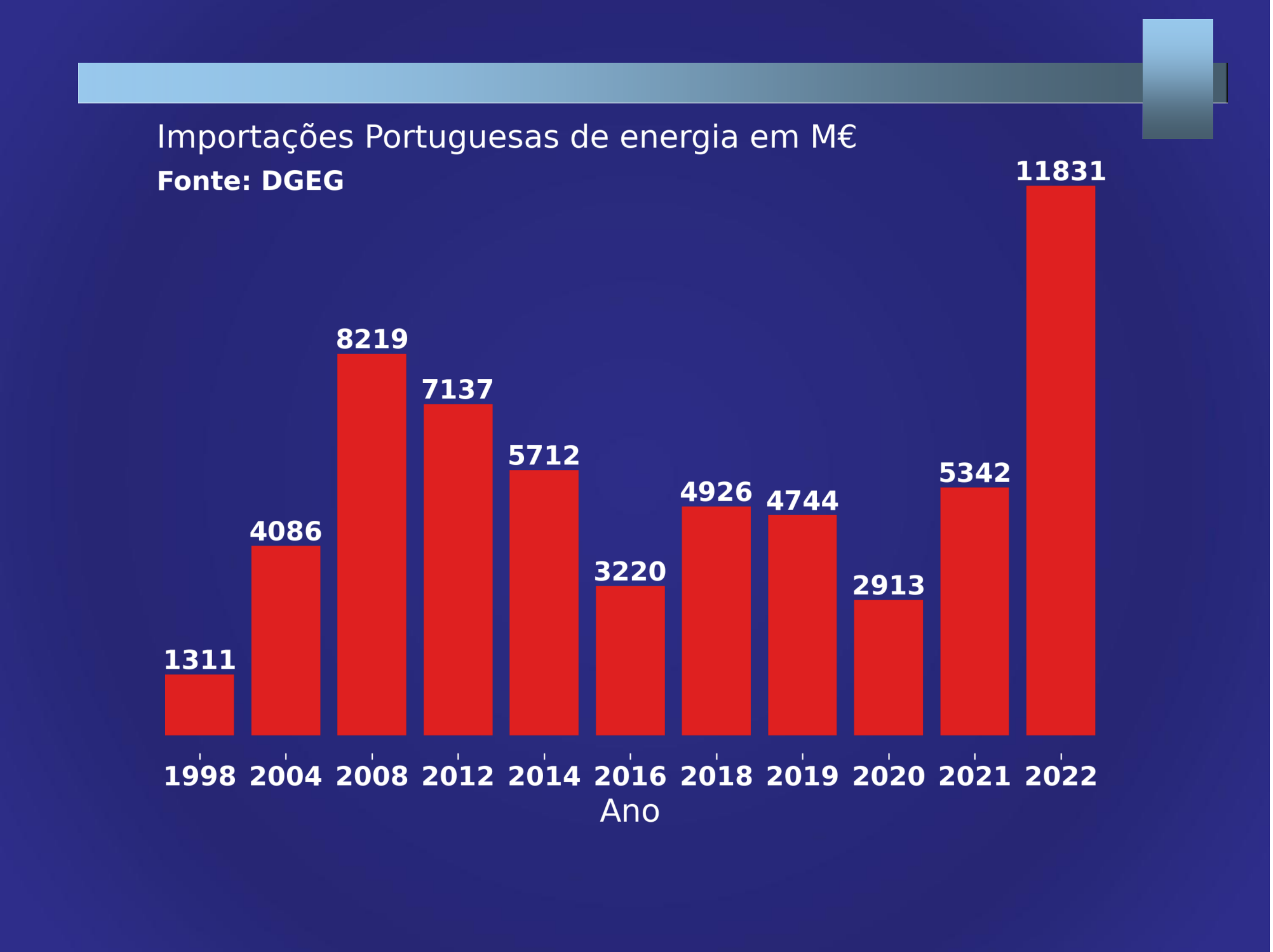
7.2 - Evolution of the Imports of All Energy Sources

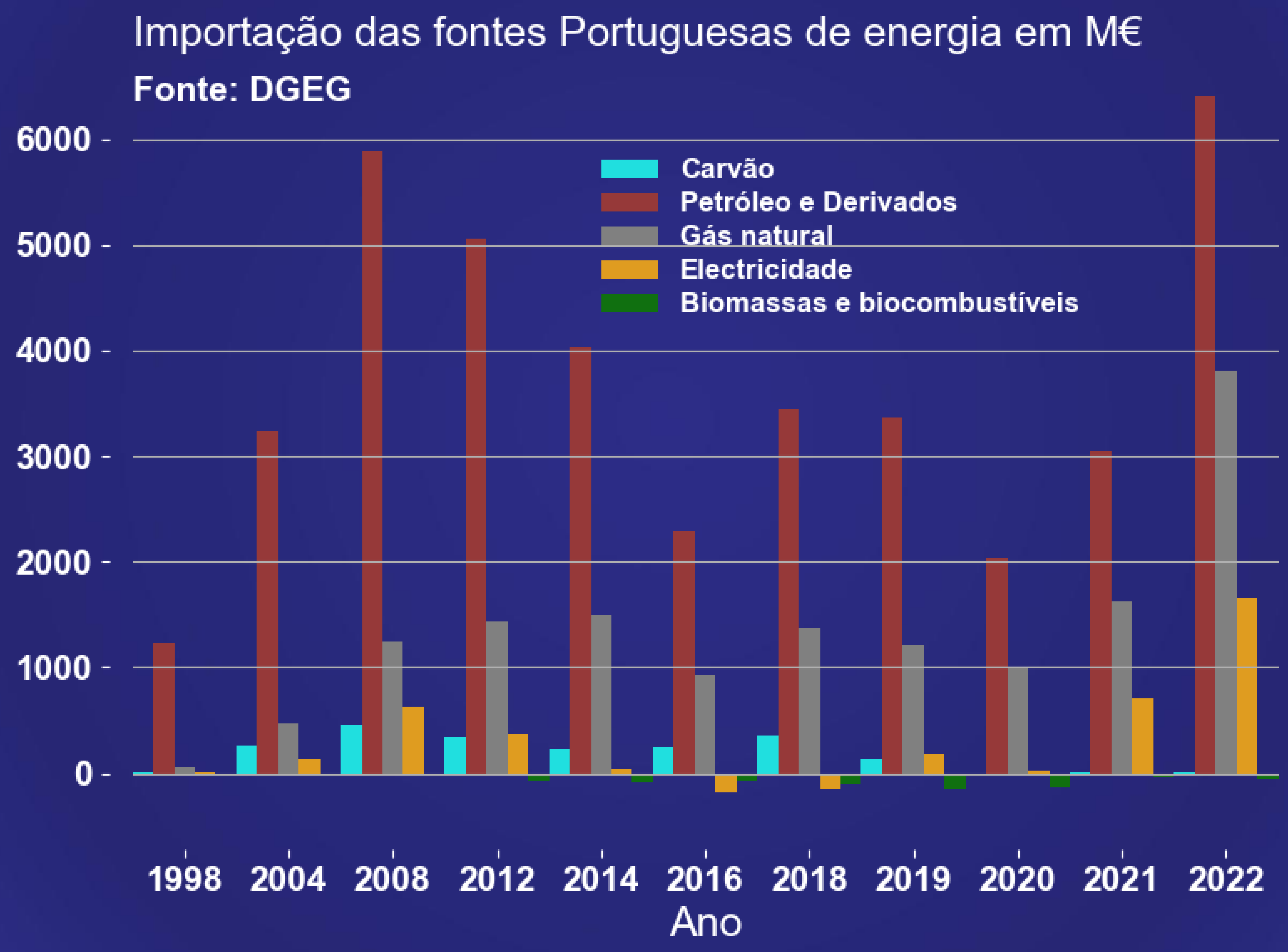
Table 2 Evolution of the Value of the Liquid Energy Imports in from 1998 to 2022 (in millions of Euros)

	1998	2004	2008	2012	2014	2016	2018	2019	2020	2021	2022
Carvão	164	261	455	342	231	248	356	143	-1	4	6
Petróleo e Derivados	1.224	3.233	(1) 5.881	(1) 5.059	(1) 4.035	(1) 2.289	(1) 3.440	(1) 3.368	(1) 2.031	(1) 3.043	(1) 6.410
Gás Natural	65	462	1.249	1.432	1.493	921	1.371	1.207	993	1.625	3.814
Eletricidade	11	130	634	375	44	-172	-141	181	22	711	1.659
Biomassas e Biocombustíveis	-	-	-	-71	-91	-66	-100	-155	-132	-41	-58
TOTAL	**1.464**	**4.086**	**(1) 8.219**	**(1) 7.137**	**(1) 5.712**	**(1) 3.220**	**(1) 4.926**	**(1) 4.744**	**(1) 2.914**	**(1) 5.342**	**(1) 11.831**

(1) Não estão incluídas nestas estatísticas oficiais as significativas quantidades de combustíveis líquidos adquiridos em Espanha diretamente pelos consumidores **(Fonte DGEG)**

+121,5%


Importações Portuguesas de energia em M€
Fonte: DGEG
11831
8219
7137
5712
4926
4744
5342
4086
3220
2913
1311
1998 2004 2008 2012 2014 2016 2018 2019 2020 2021 2022
Ano


Importação das fontes Portuguesas de energia em M€
Fonte: DGEG
6000
5000
4000
3000
2000
1000
0
Carvão
Petróleo e Derivados
Gás natural
Electricidade
Biomassas e biocombustíveis
1998
2004
2008
2012
2014
2016
2018
2019
2020
2021
2022
Ano

- The evolution of the **Overall Energy Imports** of Portugal, presented in **Table 2**, is a **decisive element** form de analysis of the **competitiveness of our economy**, and of the equilibrium of our external accounts**.**
- **Besides** the evolution of the Liquid Imports of Electricity that was already presented before, the **evolution** of the **other items** of the Overall **Energy Imports between 1999** and **2022** also **very troublesome**.
- In fact, the **Overall Energy imports** of **Portugal** reached **11.831 million euros** in **2022**.

That is, almost **6%** of our **GDP**!

- This also **represents**:

  - a **huge increase** of **121,5%**, in **relation** to the **5.321 million euros** of **2021**.

  - an **increase** of **7.077 million Euros** in **relation** to **2019**, that was the last "normal year" before the pandemic.

  - a **new absolute record**, and **3.612 million euros above** the **previous record** registered in **2008.**

- It should be stressed the Overall **Energy Bill** of **2008** was one of the **factors** that led to the **near – bankruptcy** of **2011**.

- If we analyse **Table 2**, we can see that the value **increase** of the **oil** and **natural gas imports** were also very relevant, besides electricity as already pointed out before.

- As such, and in **financial terms**, **coal** is a very **attractive alternative** to the imports of electricity and natural gas.

- It is then **understandable** the **decision** of **Spain** to **restart** the **coal** based power plants in **October 2021**, **contrary** to what **happened** in **Portugal** that **decided** to drastically **increase** the **dependence** on **natural gas**.

8. Proposals for the Optimization of the Eletric System till 2045

8.1 – To be Carried out in Portugal

To **optimize** the **Electric System**, and to “integrate” the intermitent power capacities already installed, I put forward **five proposals** in order to promote **economic competitiveness**:

a) **Keep** in operation the **natural gas** based **power stations** till **2045** as part of the **backup** system, as Germany has already decided;

b) **Increase** urgently the **electrical interconnections** between **France** and the **Iberian Peninsula** till **8,500 MW**, that is the more efficient way to “**soften** the **intermittency**” and to **reduce** the **CO2 emissions** within the European Electricity Market, as referred in 8.2 below;

c) **Increase** in **400 MW** till **2030** the **biomass** based **electricity capacity**, thus **strengthening** the **backup based** in **renewable** and **reliable power**;

d) To **promote R+D** Projects on the main **alternatives** for the "**indirect storage of electricity**" in order to obtain reliable data concerning the best solution to be adopted for this purpose**;**

e) The sequence of the **three dams** that already exist in the **river Zêzere – Cabril, Bouçã e Castelo de Bode** – offers an **excellent opportunity** to install new **reverse pumping systems** in the first two dams, thus **strengthening** the "**national capacity** to **store intermitent electricity**" in Portugal, allowing for the maximized production of hydroelectricity **without reducing** the strategic **storage** for the supply of **drinking water** to the greater **Lisbon** region.

As the **concession** of the **Cabril dam** is up for **renewal**, it is very **urgent** to include this aspect in the ongoing negotiations.

8.2 – *Eletrical Interconnections within the European Union: Stable and Intermitent Power Capacities*

- **Portugal** is a full **member** of the **European Union** and the **optimization** of its **Electric System depends** on the overall **grid network** in the **European Union**, and specially on the **future strengthening** of the **interconnections** between **France** and the **Iberian Peninsula**;

- Besides, and due to the **strong electric interconnections** that already exist **between Portugal** and **Spain**, the **optimization** of our **Electric System** has first of all take **good note** of what **happens** with the **evolution** of the electric production capacities that exist in **Spain;**

- As **Portugal** has **chosen** two types of **intermitent** power **sources** as its baseload, **wind** and **solar**, the **dependence** of its **Electric System** towards **Spain** has strongly **increased after** it was decided to **close down in 2021** the **coal** based **power plants** that existed till then in Pêgo / Abrantes and Sines;

- **Spain maintained several types** of **stable** electric **sources**, that includes nuclear, coal and natural gas, which has **indirectly contributed** for a greater **security** of the **electrical supply** in **Portugal**.

This “**Spanish protection**” has however triggered a **drastic increase** of the overall liquid **imports** of **electricity from Spain**;

- In order to promote economic competitiveness within the European Union, the **intermitent capacities**, **wind** and **solar**, **need** an important **increase** of the **electric Interconnections**;

- This is the **only way** to **sell** in the market, at **competitive prices**, the eventual **excesses** of **intermitent** short term **electric productions**.

  It allows also to have **better access** later on to **stable** electric **productions** when the intermitent sources disappear, and it is **necessary** to **avoid “blackouts”**;

- The **construction under way** of a **new Electric Interconnection**, in the **Gulf of Biscay**, that will increase these overall **interconnections between France** and **Spain** to **5,500 MW,** is **very positive**.

- It **is however necessary** to **take in consideration** that **this new connection** is forecasted **to be concluded** only in **2028**;

- As such, and as the **Electricity Production** and **Distribution Networks** in the **European Union** is **vital** for the **Portuguese** and **European economic prosperity**, **this Conference on "Energy Transition and Sustainability",** that was organized today within the framework of the UNESCO WFEO World Engineering Day 2024, **is so important.**

Luís Mira Amaral

Former Portuguese Minister of Industry and Energy, Portugal

ÍNDICE

I-THE ENERGY TRANSITION

The world has seen several **energy transitions**: from wood to coal,from coal to oil and from oil to oil and natural gas.

Today, in a context of decarbonisation:

- **Emergence of intermittent renewable energies**, wind and solar (solar thermal and photovoltaic panels)
- **Launch of renewable gases, such as hydrogen and biomethane**, as non-fossil alternatives to natural gas.

I-THE ENERGY TRANSITION

Previous energy transitions have been led by the market in a decentralised approach between producers and consumers

With a gradual transition in which emerging forms of energy are assisted in their development by existing forms of energy.

Nowadays, transition is being led in an enlightened way by the **visible hand of political power**

Particularly in the European Union and the USA, where the aim was to do away with incumbent energies overnight, replacing them abruptly and hastily, an approach that is not realistic.

This political approach raises serious questions about the **economic and social sustainability of the transition**

It could well be said that the aim was not an energy transition, as in the past, but a genuine energy disruption!

I-THE ENERGY TRANSITION

We are also witnessing a resurrection of nuclear energy for the following reasons:

- Along with wind power, it is one of the lowest emitters of C02 per unit of energy produced, which makes it attractive in a decarbonisation context
- it has a high energy density (a lot of energy produced per space occupied) while wind and solar energy have a low energy density, which makes it unrealistic in terms of space occupation to completely replace nuclear energy with wind and solar power
- it´s a reliable and stable energy source ,well adjusted to supply base-load consumption without the problems created by the intermittency of solar and wind power

It is therefore common sense to recommend to countries that have nuclear power stations: keep them!

I-THE ENERGY TRANSITION

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- This **transition aims to eliminate fossil fuels but is highly intensive in mineral resources and rare metals** to power wind and solar energy, batteries, fuel cells (FC), electric motors for both battery-powered vehicles (*BEV-Battery Electric Vehicles) and* hydrogen-powered fuel cell vehicles (*FCEV-Fuel Cell Electric Vehicles*), and in general all the electrification that is intended.

- **Problems on the supply side**, such as the scarcity of these mineral resources and rare metals, and dependence on areas of the world that we do not control, such as China, or the constraint of available space for renewables, **will create serious supply shortages slowing down the pace of the transition**, although the circular economy and recycling can alleviate this active constraint.

II-THE EUROPEAN ENERGY CRISIS

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Before Ukraine invasion the world economy and namely Europe began to deal with the **first energy crisis under the decarbonisation framework**.

Europe and USA underinvested in fossil fuels,oil,coal and natural gas	• Underinvestment was made under the political commitment I explained before, and with after-Covid strong economic recovery the world demand for fossil fuels increased dramatically creating a big shortage of fossil fuels supply. • So the prices for coal,oil and natural gas increased dramatically.
The Ukraine invasion exacerbated this energy crisis and has shown the dramatic dependence from Russia of european energy system	• Namely the huge german dependence from Russia on natural gas.
Europe launched after the war an energy diversification strategy from Russia,namely in natural gas ,and tried to increase either the energy efficiency or the energy savings.	• Under this diversification,US became the main liquified natural gas(LNG) exporter for Europe.

III-PORTUGUESE ENERGY SYSTEM UNDER THE IBERIAN FRAMEWORK

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Portugal needs to have again a true energy planning system :

- **with economic sustainability, not taking into account only the CO2 reduction (EU and Portugal account only for 7% and 0.11% of CO2 world emissions!**)

- To deal with energy surplus of renewable sources,wind an solar,to have redundant power from classical power plants when wind doesn´t blow and sum doesn´t shine

- To build, under the Iberian energy system ,new electrical and natural gas conexions between Spain and France to address the Iberian energy autarcy towards Europe.

III-PORTUGUESE ENERGY SYSTEM UNDER THE IBERIAN FRAMEWORK

In Portugal, and in the context of the energy transition with sound economic sustainability, a new government after the March 2024 elections should give priority

Decentralised photovoltaic solar energy for domestic and industrial consumers who become *prosumers*, **putting the brakes on mega-projects that are an attack on biodiversity and land use planning;**

Unblock the approval of projects under the Self-Consumption Production Units (*Unidades de Produção para o Autoconsumo* or UPACs) **and Renewable Energy Communities** (*Comunidades de Energia Renovável* or CERs), streamlining and simplifying this legislation;

Freeze the megalomaniac tenders for offshore wind, at a time when this type of project is being called into question everywhere, with Portugal having no comparative advantages in this technology

III-PORTUGUESE ENERGY SYSTEM UNDER THE IBERIAN FRAMEWORK

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In Portugal, and in the context of the energy transition with sound economic sustainability, a new government after the March 2024 elections should give priority

Redirect hydrogen projects from the unrealistic experimentalism of megaprojects to small demonstration projects and decentralised hydrogen projects for industrial consumers where electrification is difficult;

Boost the production of biomethane

As a solution to decarbonise natural gas as a complement to hydrogen, and low carbon content fuels as a quick and effective response to the decarbonisation of our stock of current car fleets;

Boost lithium mining projects and support investment either in lithium refining projects or in the production of lithium-ion batteries that will enable us to build a value chain(from lithium to batteries) in Portugal

The aim is to support our automotive cluster, and in particular vehicle assembly/production units (namely VW Autoeuropa in Palmela and Stellantis/Citroen in Mangualde) in the transition to the electric vehicle;

III-PORTUGUESE ENERGY SYSTEM UNDER THE IBERIAN FRAMEWORK

In Portugal, and in the context of the energy transition with sound economic sustainability, a new government after the March 2024 elections should give priority

Stimulate energy efficiency among domestic and industrial consumers;

Support municipal councils ether in switching to LEDs in public lighting systems or in **investing in battery electric buses;**

Guarantee the permanence and operation of natural gas-fired power stations (CCGT- combined cycle gas turbines) as an indispensable backup *to* intermittent renewables when the sun doesn´t shine and the wind doesn´t blow.

III-PORTUGUESE ENERGY SYSTEM UNDER THE IBERIAN FRAMEWORK

And the last but not the least,under a long term framework, we should return to:

PNEC 2030
PLANO NACIONAL ENERGIA-CLIMA

Real indicative economic planning in our power system, moving on from the National Energy and Climate Plans (*Planos Nacional Energia e Clima* or PNECs), which are basically nothing more than National Energy and Climate *Intentions* (*Intenções Nacionais de Energia e Clima* or INECs)..., taking into account only CO2 reductions, managing the production/consumption sides with minimum costs in the context of a global plan that would give it coherence, articulating interconnection and storage capacities with exports, production surpluses with pumping and other storage devices such as batteries, and economic analysis of the production cost/surplus cut(curtailment) binomial.

Marlene Kanga
WFEO Past President, Non-Executive Director, Endeavour Energy, Austrália

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WFEO / FMOI

Enabling the Energy Transition: Infrastructure Requirements and Impacts on Economic Development. A case study from Sydney Australia

Dr. Marlene Kanga AO FTSE FREng

WFEO President, 2017-2019
Non-Executive Director Endeavour Energy (2023 onwards)

4th March 2024

About Dr Marlene Kanga AO FTSE FREng

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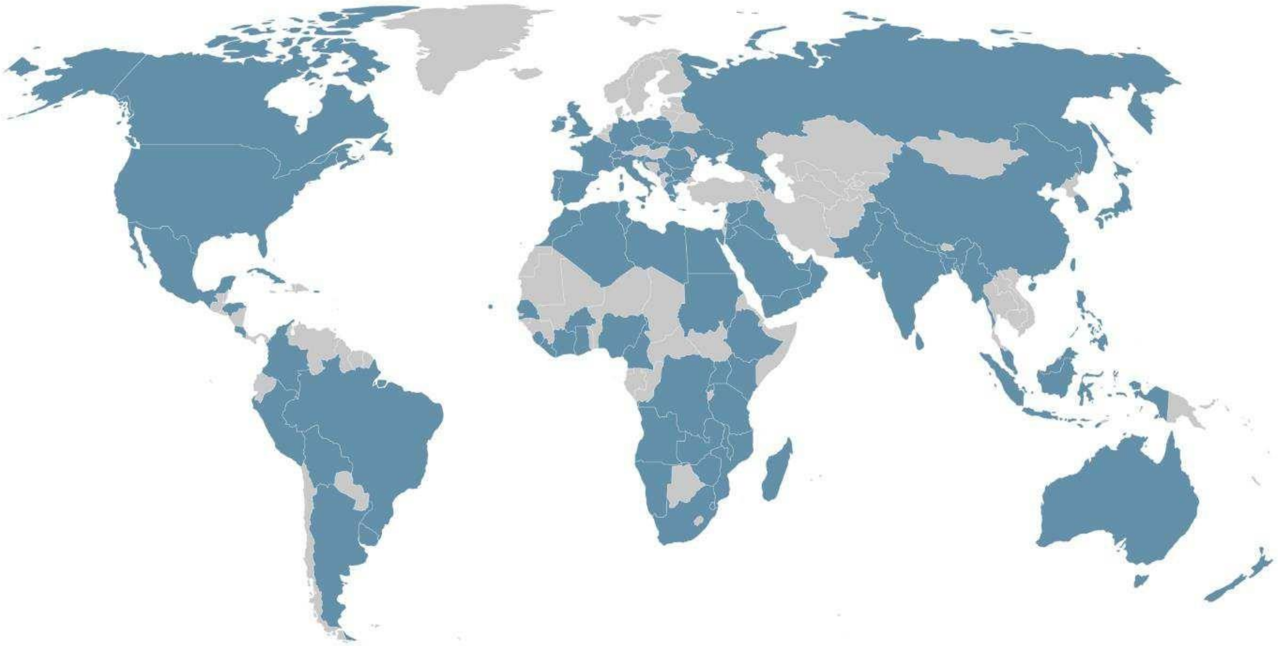
Chair and Non-Executive Director of large organisations in science and engineering in Australia and internationally:

- national and international
- public, private and not-for-profit sectors
- Airservices Australia, Endeavour Energy, Standards Australia, Business Events Sydney, Sydney Water Corporation (2017-2023) and formerly Innovation Australia (2013-2019)
- start-ups, collaborative research centres and innovation networks, Chair Rux Energy

Professional Organisations:

- President, World Federation of Engineering Organizations, 2017- 2019
- Vice President International Network for Women Engineers and Scientists, 2011-2017
- National President Engineers Australia, 2013
- International Fellow Royal Academy of Engineering
- Co-Chair Australian government ELEVATE project, advancing women in STEM in Australia, $42 million project, Australian Academy for Technology and Engineering
- Chair, Institution of Chemical Engineers Safety Centre, advancing process safety engineering globally, 100+ members



MEMBER MAP
SEPTEMBER 2023

The World Federation of Engineering Organizations (WFEO):

- **The leading international body for professional engineering institutions**
- **Founded in 1968, under the auspices of UNESCO**
- **100+ national professional engineering institutions, 12 international and continental/regional professional engineering institutions, representing 30 million engineers**
- **Co-Chair - Major Science and Technology Group at UN**
- **Represent engineering at major UN Organisations**

Engineering, Cities and the UN Sustainable Development Goals

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A key objective of the World Federation of Engineering Organizations is to advance the UN SDGs through engineering.

The UN Global Sustainable Development Report 2019: Science and Engineering and the Lever and Sustainable Cities as the Pathway

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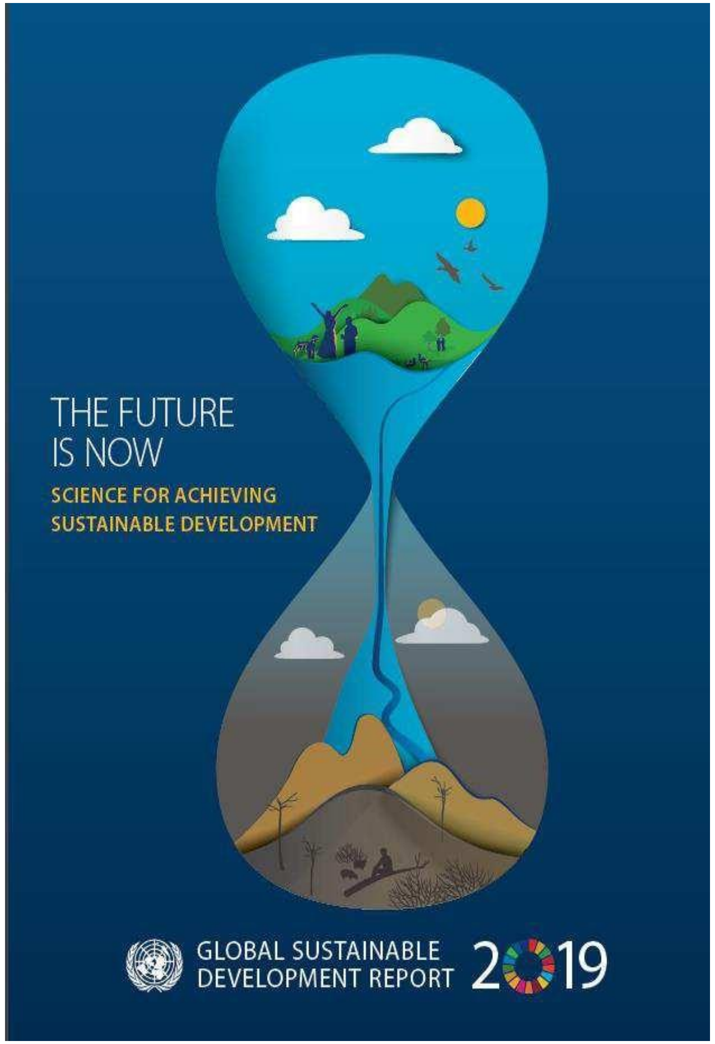
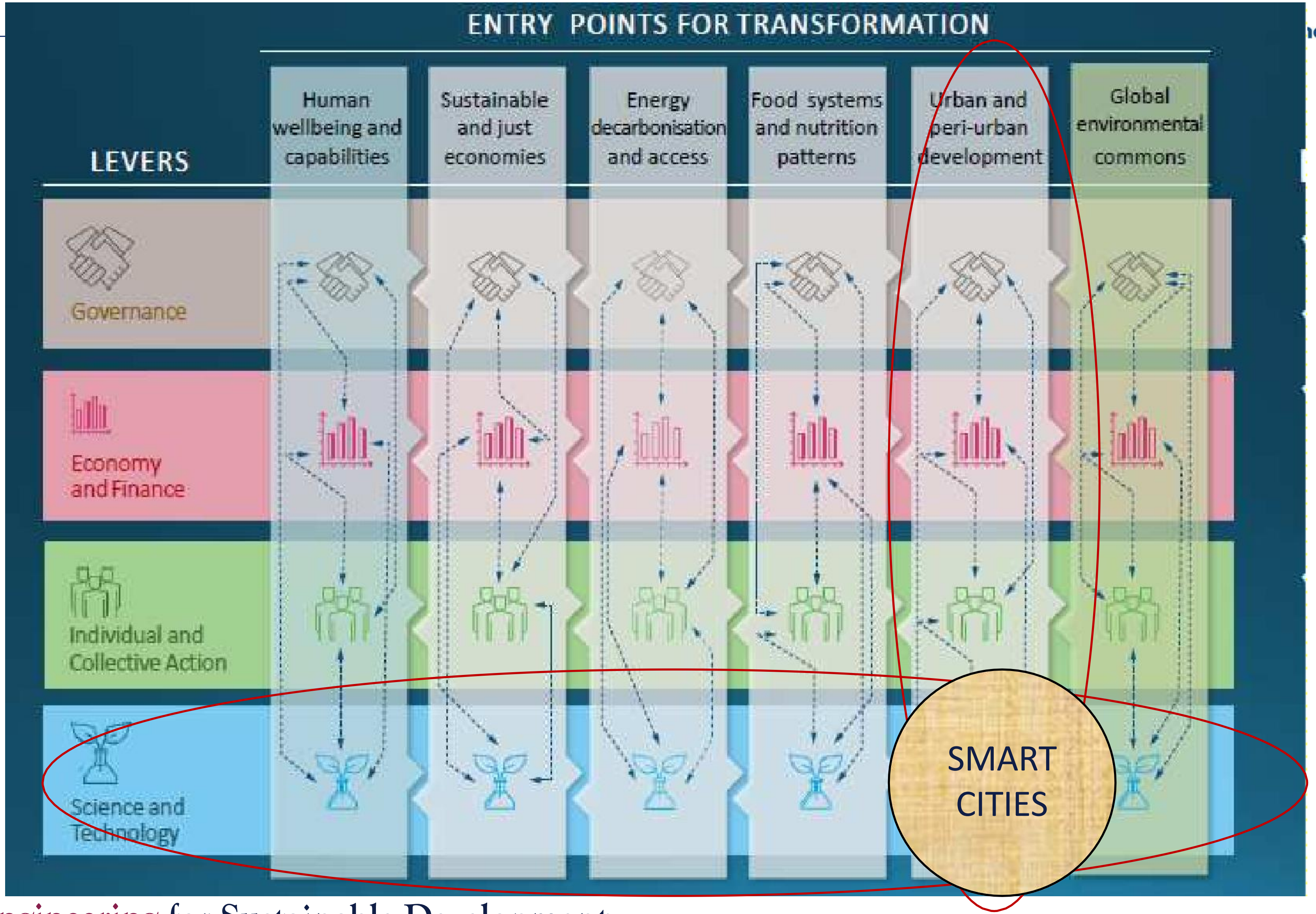
- **The UN Global Sustainable Development Report has identified science and engineering as one of four levers to accelerate sustainable development.**

- **Urban and peri-urban environments have been identified as one of six pathways that can accelerate transformation for sustainable development.**

See: https://sustainabledevelopment.un.org/content/documents/24797GSDR_report_2019.pdf



Science and Engineering as the Lever Urban and Peri-urban environments as the transformation pathway



Case Study: Implementation of Renewable Energy Networks in New South Wales Australia to supply western Sydney by Endeavour Energy, Acciona and Cobra

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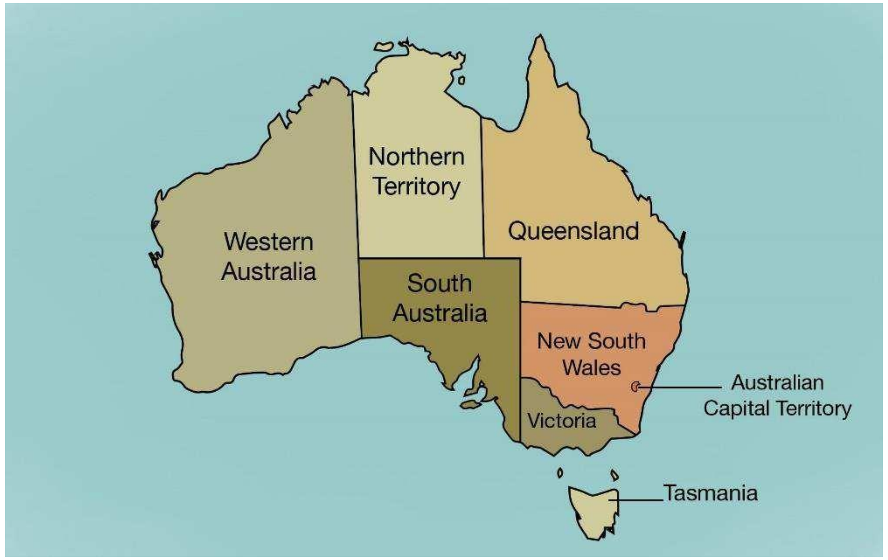
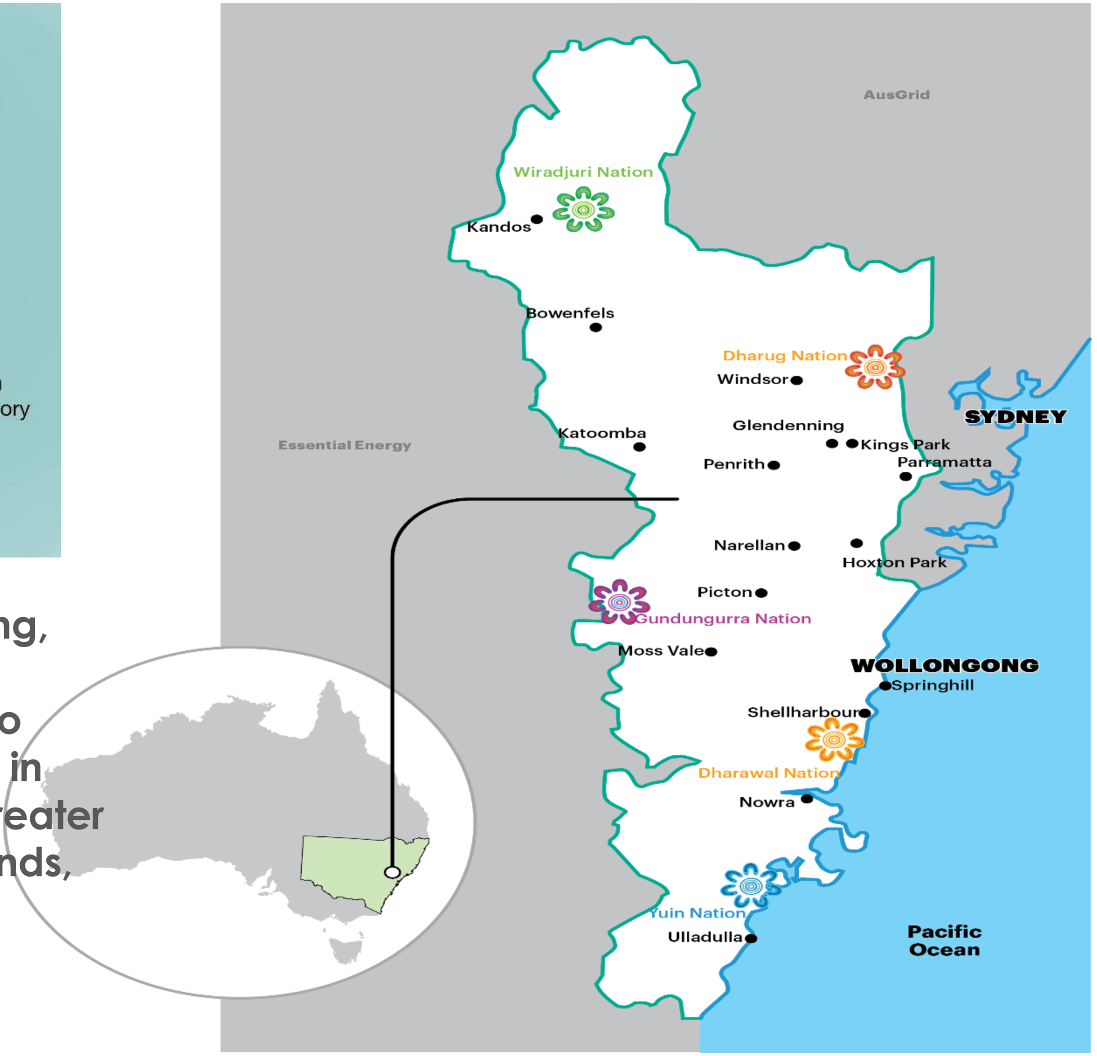
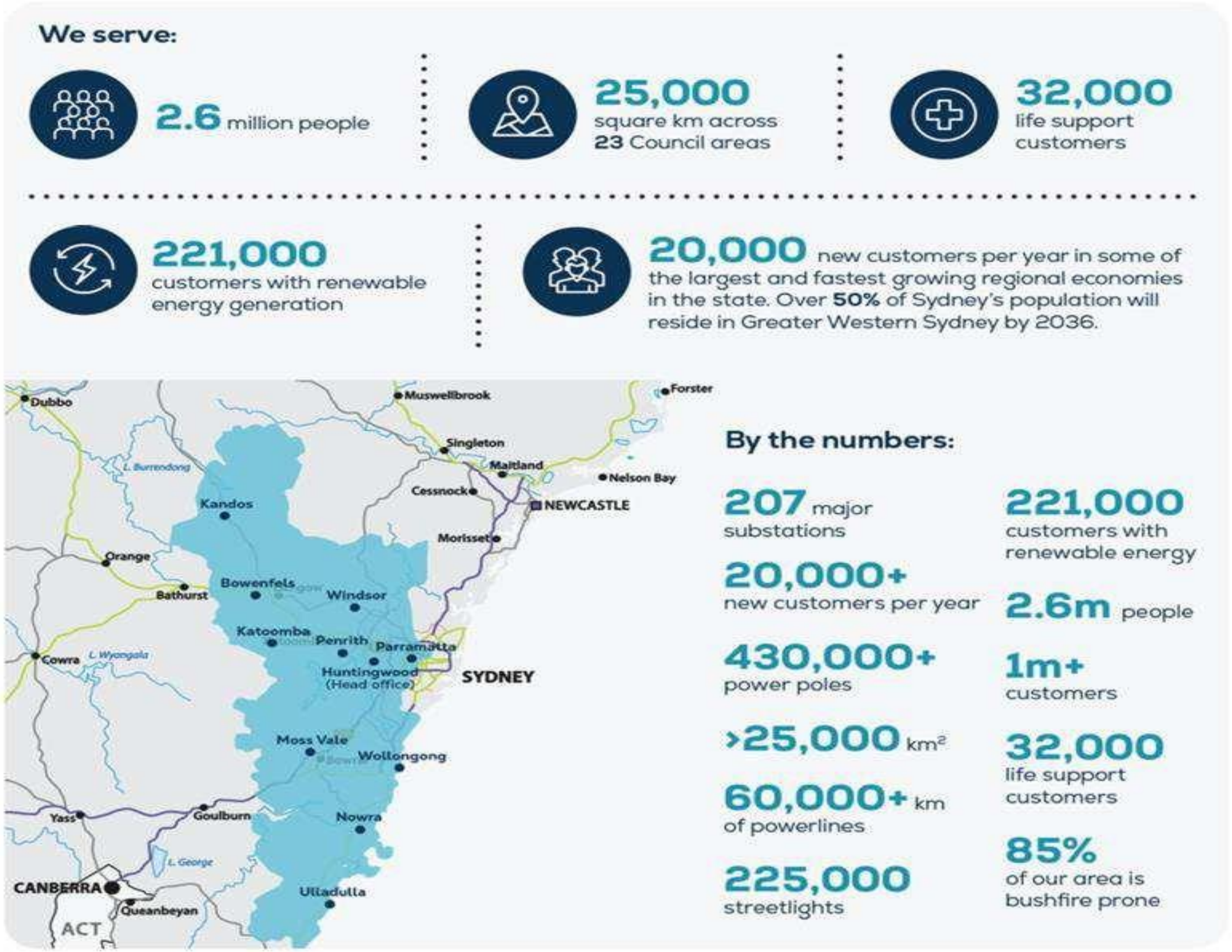




Endeavour Energy is responsible for building, maintaining and operating an electricity network that connects 2.6 million people to traditional and renewable energy sources in homes and businesses across Sydney's Greater West, the Blue Mountains, Southern Highlands, the Illawarra and the South Coast.

Endeavour Energy : By the Numbers (2022)



Source: 2021-2022-Energy-Charter-Disclosure-Report.pdf (endeavourenergy.com.au)

7 AFFORDABLE AND CLEAN ENERGY

13 CLIMATE ACTION

11 SUSTAINABLE CITIES AND COMMUNITIES

10 REDUCED INEQUALITIES

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Endeavour Energy: Commitment by leaders to the net zero energy transition

> We can't turn off the coal generation tomorrow, but we all have an ambition to have a transition. There's a huge shift underway and it's so exciting to be a part of it."
>
> - Scott Ryan, Endeavour Energy

Scott Ryan, Chief Asset & Operating Officer, Endeavour Energy

Scott Ryan is responsible for grid transformation, asset management and delivery operations for the safe and reliable supply of electricity to Endeavour Energy's customers. Scott began his career as a Cadet Engineer in 1989 and held a wide range of positions before assuming his current role in March 2020. He leads a team of 1,100 employees and has led major reform efforts for Endeavour's workforce and operations. He also established Endeavour's unregulated business, Ausconnex, which under his leadership has seen revenue grow by as much as 70 per cent annually.

7 AFFORDABLE AND CLEAN ENERGY

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9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Artist impression of the view to Merotherie energy hub east to south-west.

Endeavour Energy: Commitment to the UN Sustainable Development Goals

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See: Sustainability-Strategy-Report.pdf (endeavourenergy.com.au)

Endeavour Energy achieves 5 star GRESB Sustainability Rating

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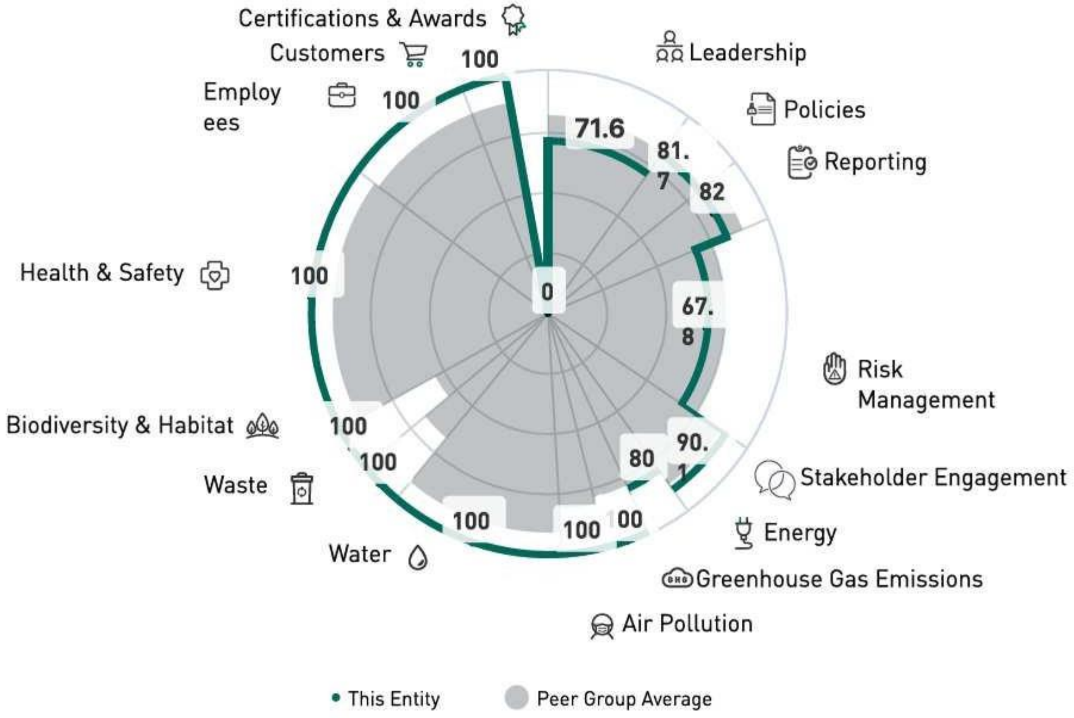

Sample of GRESB Sustainability Assessment

In 2021 and 2022, Endeavour Energy achieved a 5-star rating in the Global Real Estate Sustainability Benchmark (GRESB), the leading worldwide measurement for sustainability performance.

Endeavour Energy is ranked in the top 5% of global GRESB respondents, ranked 27th out of 649 infrastructure assets worldwide, and 2nd out of 8 participating worldwide electricity distribution companies.

[Source: GRESB five star rating | Endeavour Energy]()
[Source: How_to_read_your_benchmark_report_asset.pdf (gresb-prd-public.s3.amazonaws.com)]()

Implementing Targets for Sustainability: The Journey

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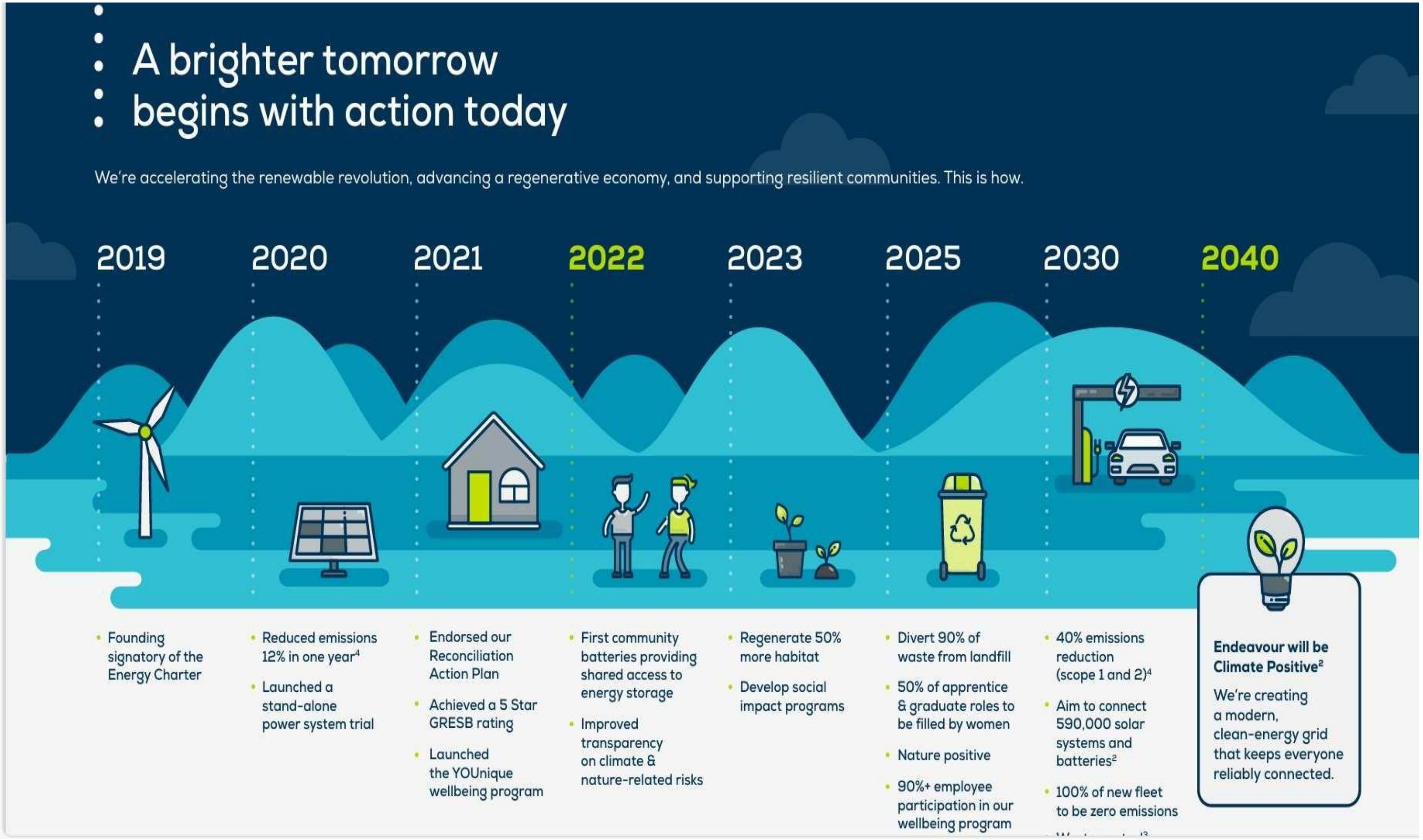
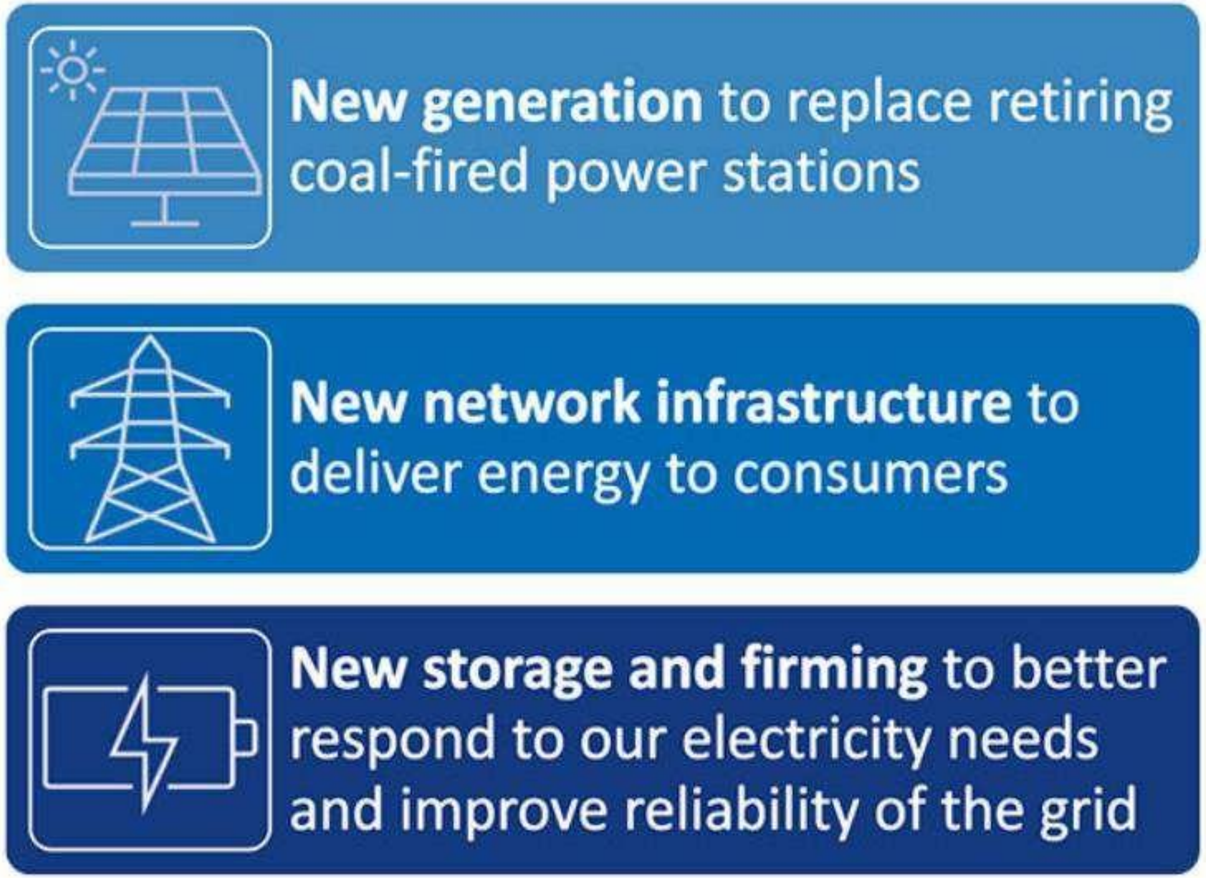


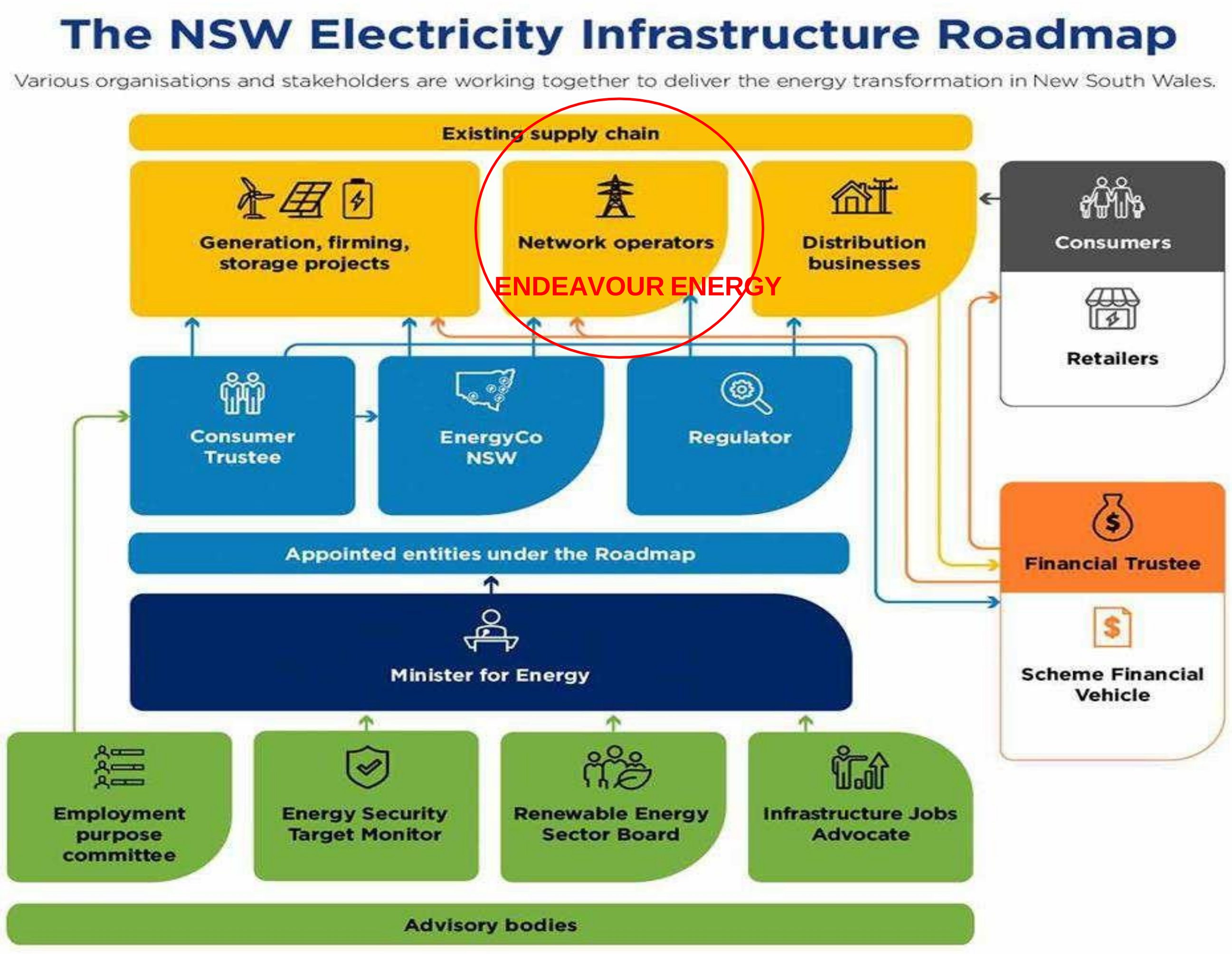
See: https://www.endeavourenergy.com.au/__data/assets/pdf_file/0024/37086/Sustainability-Strategy-Report.pdf

State Government of New South Wales Energy Roadmap (2020)



Source: Electricity Infrastructure Roadmap | NSW Climate and Energy Action

State Government of New South Wales Electricity Infrastructure Roadmap (2020)



Source: Entities delivering the Roadmap | NSW Climate and Energy Action

Suitable sites for wind energy in the State of New South Wales, Australia and existing and proposed transmission lines.

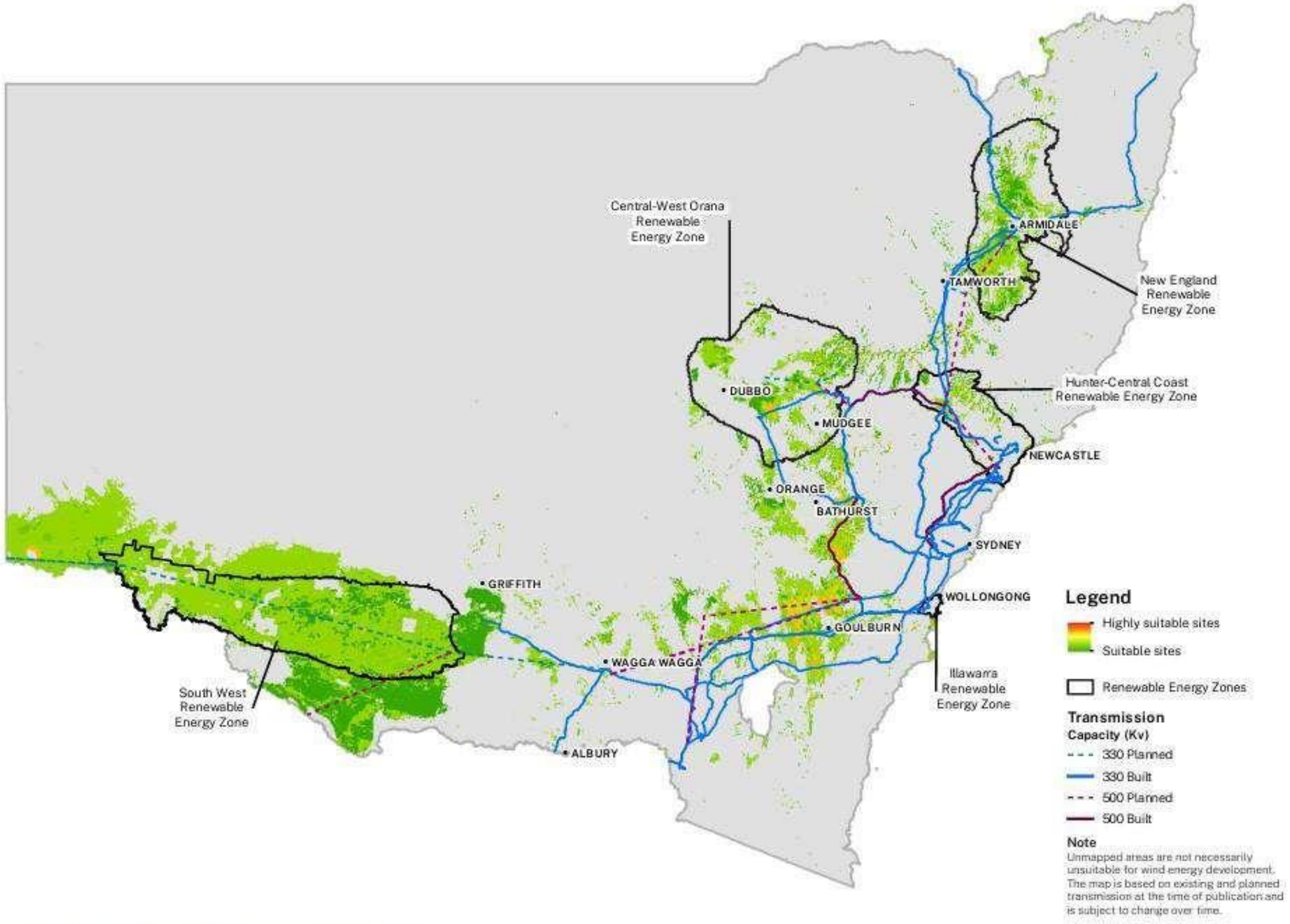


Figure 3 –Suitable areas for wind energy development

Draft Wind Energy Guideline | 21

Source: Embracing the energy transition: NSW energy policy updates - Johnson Winter Slattery (jws.com.au)

Suitable sites for solar energy in the State of New South Wales, Australia and existing and proposed transmission lines.

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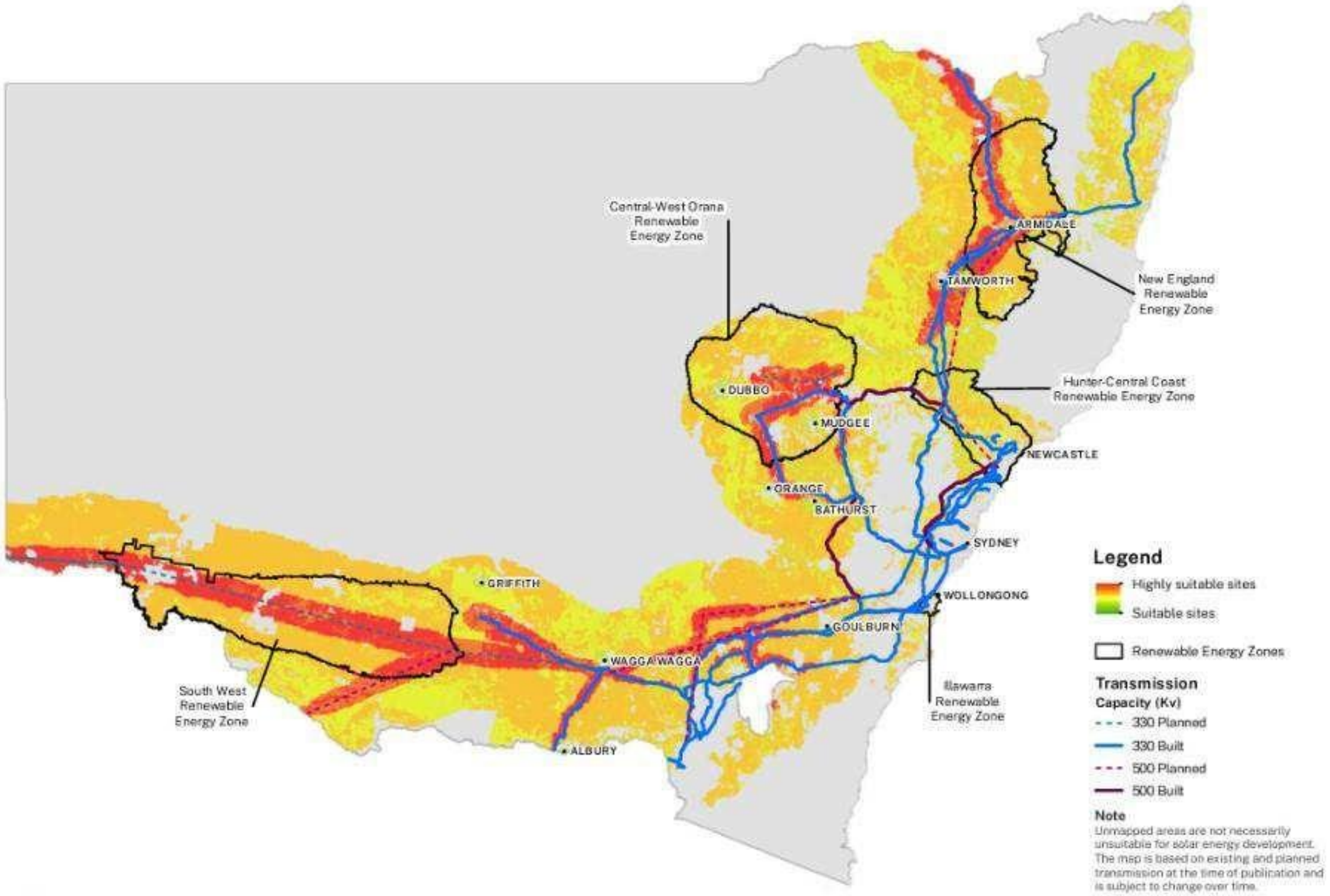
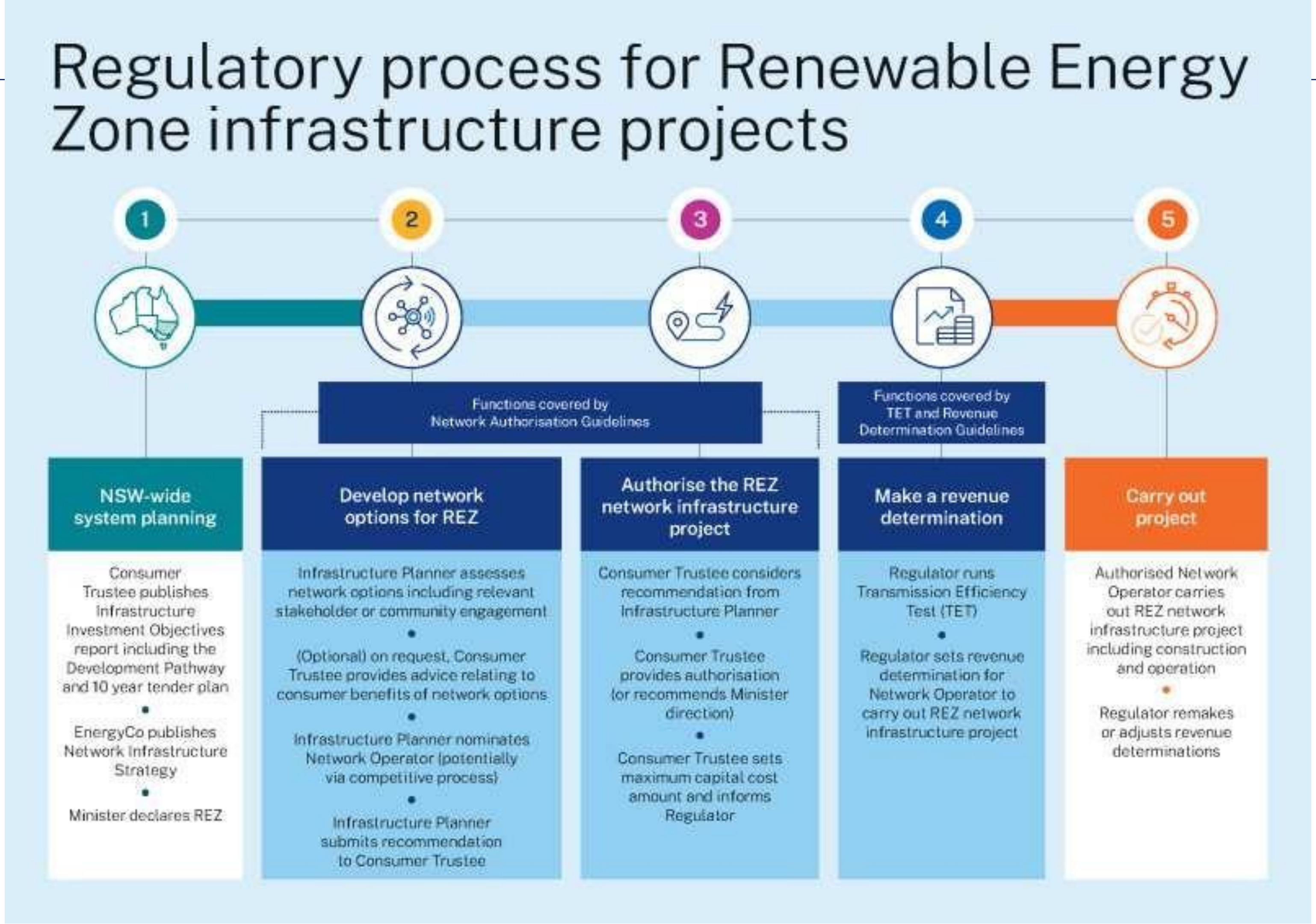


Figure 3. Suitable locations for solar development

Department of Planning and Environment | Draft Energy Policy Framework Overview 9

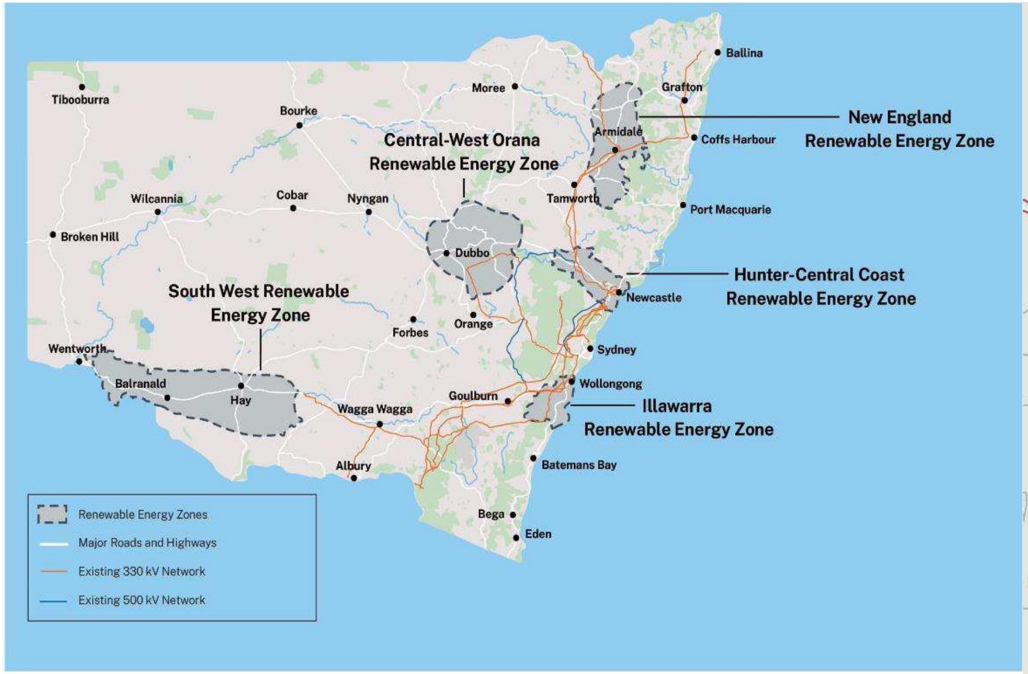
Source: Embracing the energy transition: NSW energy policy updates - Johnson Winter Slattery (jws.com.au)

Regulatory process for Renewable Energy Zone (REZ) Projects



[Source: Regulatory framework | NSW Climate and Energy Action]

Location of Government mandated Renewable Energy Zones



NSW Energy Co Renewable Energy Zones

Central West Orana (CWO) Renewable Energy Zone

Source: https://www.energyco.nsw.gov.au/cwo-rez

Central West Orana (CWO) Renewable Energy Zone where Endeavour Energy, Acciona and Cobra will be building transmission lines to customers in Western Sydney

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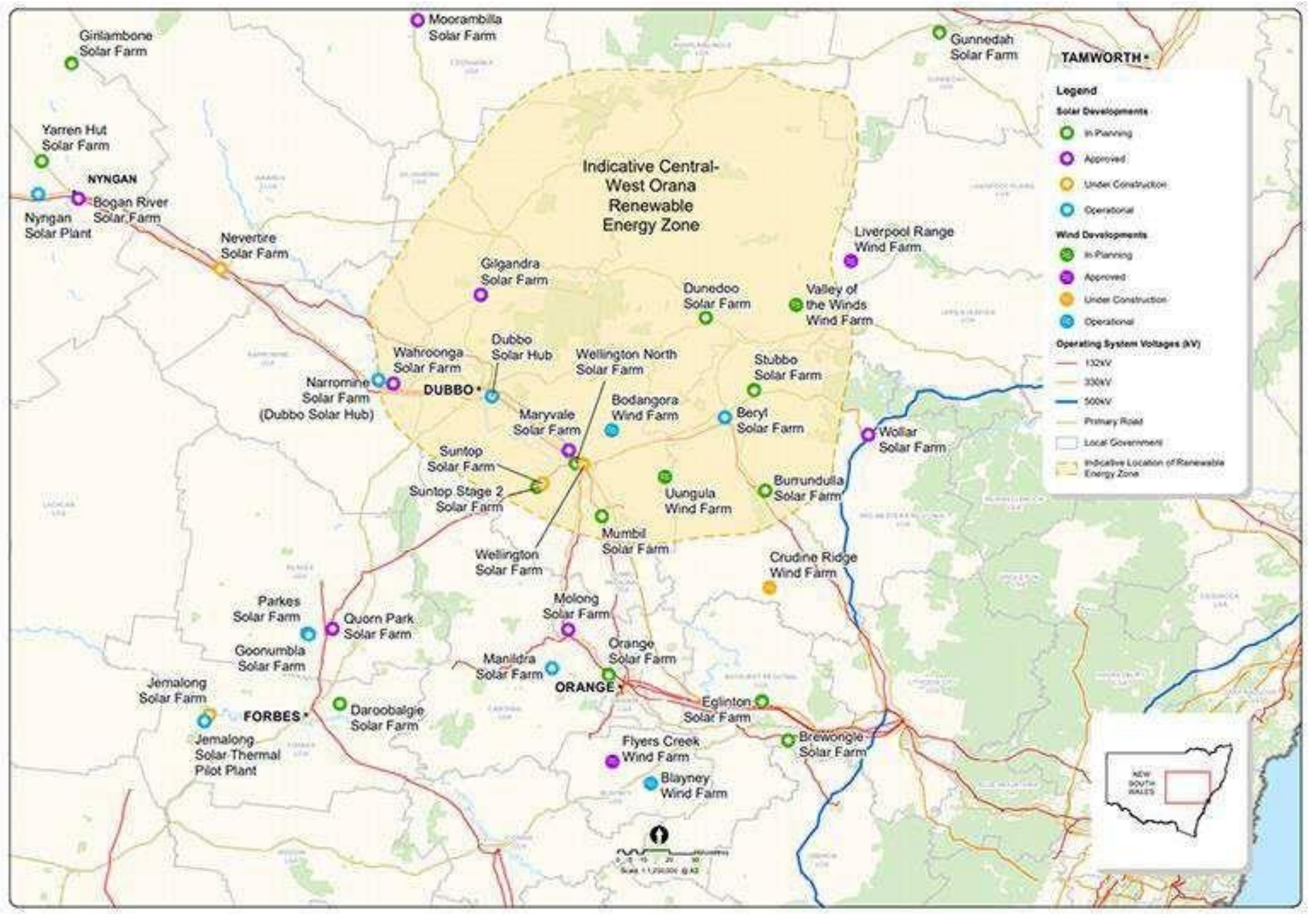


Sourced: Exploring the energy transition roadmap (essentialenergy.com.au)

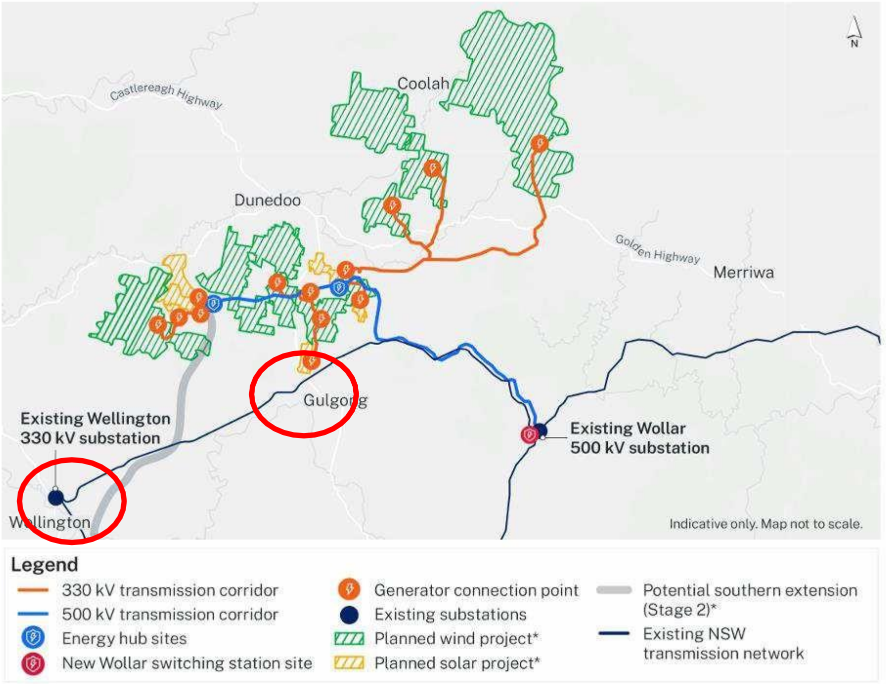
Signing of Commitment Deed to deliver the first transmission network for a Renewable Energy Zone (REZ) by Endeavour Energy in partnership with Acciona and Cobra, 18 December 2023

"ACEREZ", is a consortium comprised of Acciona, Cobra and Endeavour Energy as preferred Network Operator for the Renewable Energy Zone (REZ). The consortium ACEREZ has signed on to seek approval to deliver, operate and maintain the REZ transmission network for the next 35 years. This includes new high-capacity transmission lines, energy hubs and related infrastructure in the Central West Orana Region of NSW.

Source: https://www.nsw.gov.au/media-releases/orana-rez-powering-ahead

Scope of the Transmission Project from Central New South Wales to Sydney – provided for community consultation

Operational features of the project



* Subject to separate planning approvals.

The Central-West Orana REZ transmission project will involve the construction of new transmission lines, energy hubs, switching stations and related infrastructure. The new REZ network infrastructure will enable renewable energy from solar, wind and storage projects to be distributed to energy consumers across the State via the existing NSW transmission network

Source: cwo-rez-fact-sheet-eis-transmission-infrastru

The ACEREZ Project for the Central West Orana Region in New South Wales

- **Endeavour Energy, Acciona and Cobra, Madrid based companies, have formed ACEREZ, the preferred network operator to deliver the first 6GW capacity renewable energy zone.**
- **The partnership will design, build, operate and maintain the transmission network for the New South Wales (NSW) Government's first Renewable Energy Zone in Australia – in the Central West Orana region of New South Wales.**
- **The new transmission infrastructure will enable generators such as solar and wind farms and energy storage providers in the REZ to connect to the electricity grid at a scale never seen before.**
- **This will provide a reliable supply of clean, affordable electricity for households and businesses across NSW while helping to meet the State Government's newly legislated Net Zero targets.**
- **This is a great example of how engineers are leading the energy transition to meet the world's net zero targets.**

Acciona and Cobra Group are Madrid based companies and partners in the ACEREZ Renewable Energy Project

ACCIONA is a Spanish, global company with a business model based on sustainability, building projects for the provision of renewable energy, infrastructure, water and services.

See: https://www.acciona.com.au/

Grupo COBRA is a global company that designs, develops and operates and maintains industrial infrastructure.

See: Corporate Information – GRUPO COBRA

Social and Economic benefits to rural and regional communities

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Town Centre, Gulgong, NSW Australia

Social and Economic Benefits

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Healthcare

Together with NSW Health, we are investigating opportunities to attract medical workers such as doctors, nurses, specialists and other healthcare workers to the regions, including key worker accommodation to house medical staff in REZ communities.

Education

We are engaging with the NSW Department of Education to plan for increased demand on schools, childcare and tertiary education in the REZs due to incoming construction workforces and their families.

Justice and emergency services

As the REZs progress to the detailed design and construction phases, we are working with NSW Police, Rural Fire Service (RFS) and other emergency service providers to help understand and mitigate project activities and potential hazards and risks.

Recreation and community facilities

We are considering ways to improve local recreation and community facilities during delivery of the REZs. This will help support increased demand from incoming construction workforces and provide long-term legacy benefits for host communities.

See: NSW Electricity Infrastructure Roadmap - Benefits for Regional NSW.pdf

Social and Economic Benefits

12 RESPONSIBLE CONSUMPTION AND PRODUCTION
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
13 CLIMATE ACTION
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
7 AFFORDABLE AND CLEAN ENERGY

- Jobs
- Schools
- Housing
- Telecommunications
- Roads
- Local business growth

NSW Electricity Infrastructure Roadmap - Benefits for Regional NSW.pdf

Sustainable management of impacts on the community and environment

- **Land use, property and agriculture**, including temporary construction impacts such as traffic, noise and dust.
- **Visual amenity** changes where multiple renewable energy projects are in construction or operation.
- **Biodiversity**, including cumulative impacts to local flora and fauna species and habitats.
- **Aboriginal heritage**, including cumulative impacts to Aboriginal heritage sites, positive impacts from conservation, heritage interpretation and engagement.
- Increased **demand for social services – housing schools, hospitals** and impacts to social cohesion
- **Economic**, such as direct and indirect economic benefits to the region, increased demand for labour and goods and services and temporary population growth during construction.
- **Noise and vibration** from the transmission project and other nearby projects during construction.

Source: cwo-rez-fact-sheet-eis-cumulative-impacts.pdf (nsw.gov.au)


Artist impression of the view towards Elong Elong energy hub from Dapper Road.

Jobs growth versus environmental impacts

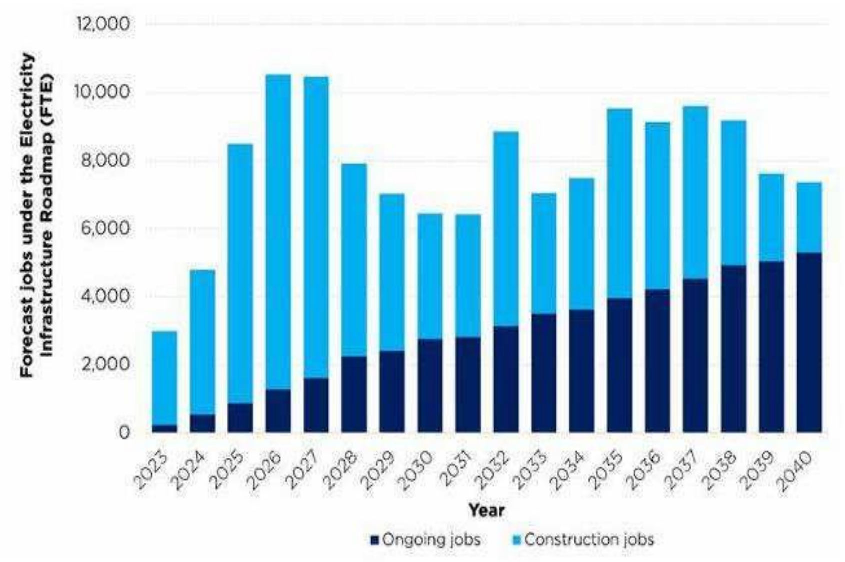


Figure 1. Forecast construction and ongoing jobs under the Electricity Infrastructure Roadmap.

Source: NSW Electricity Infrastructure Roadmap - Benefits for Regional NSW.pdf

Engineering Innovation for Electricity Services: Drones for powerline inspections

7 AFFORDABLE AND CLEAN ENERGY

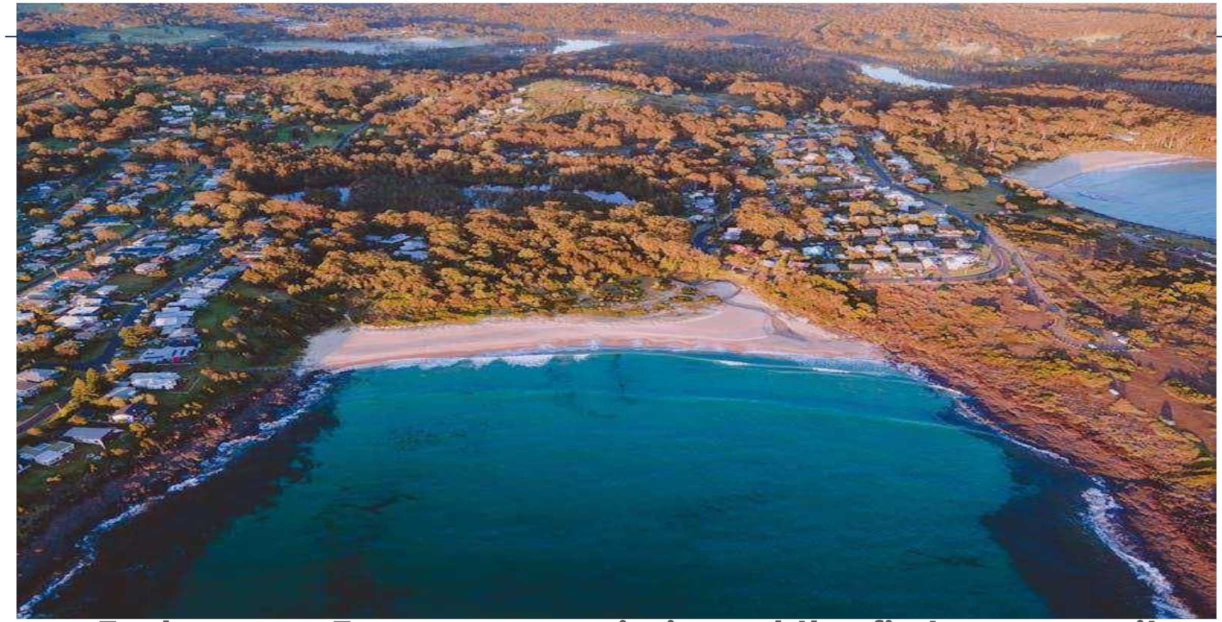
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Source: https://www.endeavourenergy.com.au/news/media-releases/drones-to-replace-helicopters-for-annual-powerline-safety-inspections, Feb 2024.

Engineering Innovation for Sustainable Electricity Services to remote and regional areas, leaving no one behind

Lisbon March 4th 2024

Engineering Solutions for a Sustainable World



Bawley Point, southern New South Wales

- **Endeavour Energy commissioned the first community microgrid to power two coastal towns from storms and bushfires, in December 2023.**
- **This is State's first community microgrid, which will power around 100 homes in Bawley Point and Kioloa, 250km south of Sydney on Australia's southeast coast.**
- **The AU$8 million project is a self-contained energy system, harnessing electricity from renewable sources including rooftop solar, home-based batteries, and a 3MW grid connected battery, strategically positioned between the two communities.**

See: https://www.microgridknowledge.com/community-microgrids/article/33009609/new-community-microgrid-brings-resilience-to-nsw-coastal-communities

Engineering Innovation for Sustainable Electricity Services to enable the transition to net zero emissions

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Substations with Battery and EV charging facilities

- **Endeavour Energy forecasts that one in four of its customers will be driving an electric vehicle (EV) within the next decade.**
- **It is partnering with innovative companies to make it easier for customers to choose an electric vehicle as their transport of choice.**
- **Smart meters are being installed to keep our customers informed and empowered.**
- **Batteries are being installed close to substations to provide grid stability as the percentage of solar PV generation by customers grows.**

See: hhttps://www.endeavourenergy.com.au/__data/assets/pdf_file/0018/61074/Western-Sydney-Developer-Brochure-powering-your-growth.pdf

Diversity Equity Inclusion for an Inclusive and Ethical Culture

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5 GENDER EQUALITY

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

10 REDUCED INEQUALITIES

- **Systematic approach for a diverse and inclusive workforce**
- **Track progress with diversity – gender, age, ethnicity, neurodiversity, physical capabilities, First Nations people**
- **Ensure pay equity, equal opportunities for recruitment, training, development, promotion and recognition**
- **Achieve 50% diversity by 2030**

See: https://www.endeavourenergy.com.au/about/inclusion-and-diversity

Financial Sustainability: Sustainability Bonds Programme

- New South Wales State Government Treasury Corp issues sustainability bonds to support projects that advance the UN SDGs and have social and economic benefits
- **Endeavour Energy signed a landmark $920 Million** Sustainability-Linked Loan in March 2022, becoming the first known Australian electricity distribution network to access sustainability linked financing.
- Endeavour Energy is the first known electricity distribution network service provider (DNSP) in Australia to access sustainability linked financing.
- The five-year sustainability-linked loan (SLL) facility, can be used for general corporate purposes, however, the pricing of the loan is tied to the Endeavour Energy achieving a set of agreed sustainability performance targets focused on four areas including greenhouse gas emissions reduction, landfill waste diversion, net habitat gain and mental health and wellbeing.

– Aligned to United Nations Sustainable Development Goals*

* The Sustainable Development Goals (SDGs) were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity. Source: https://www.undp.org/sustainable-development-goals

NSW Treasury Corporation Sustainability Bonds Programme - Source: NSW_Sustainability_Bond_Programme_Annual_Report_2022.pdf

Engineering Innovation for a more Resilient World
Engineering the Cities of the Future

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Cities are essential for sustainable development, economic growth and resilience. Sustainable engineering is an important enabler, to accelerate sustainable development in urban and peri-urban environments.

We engineers can make the difference!!

World Engineering Day for Sustainable Development
Engineering Solutions for a Sustainable World

Lisbon
March 4th 2024
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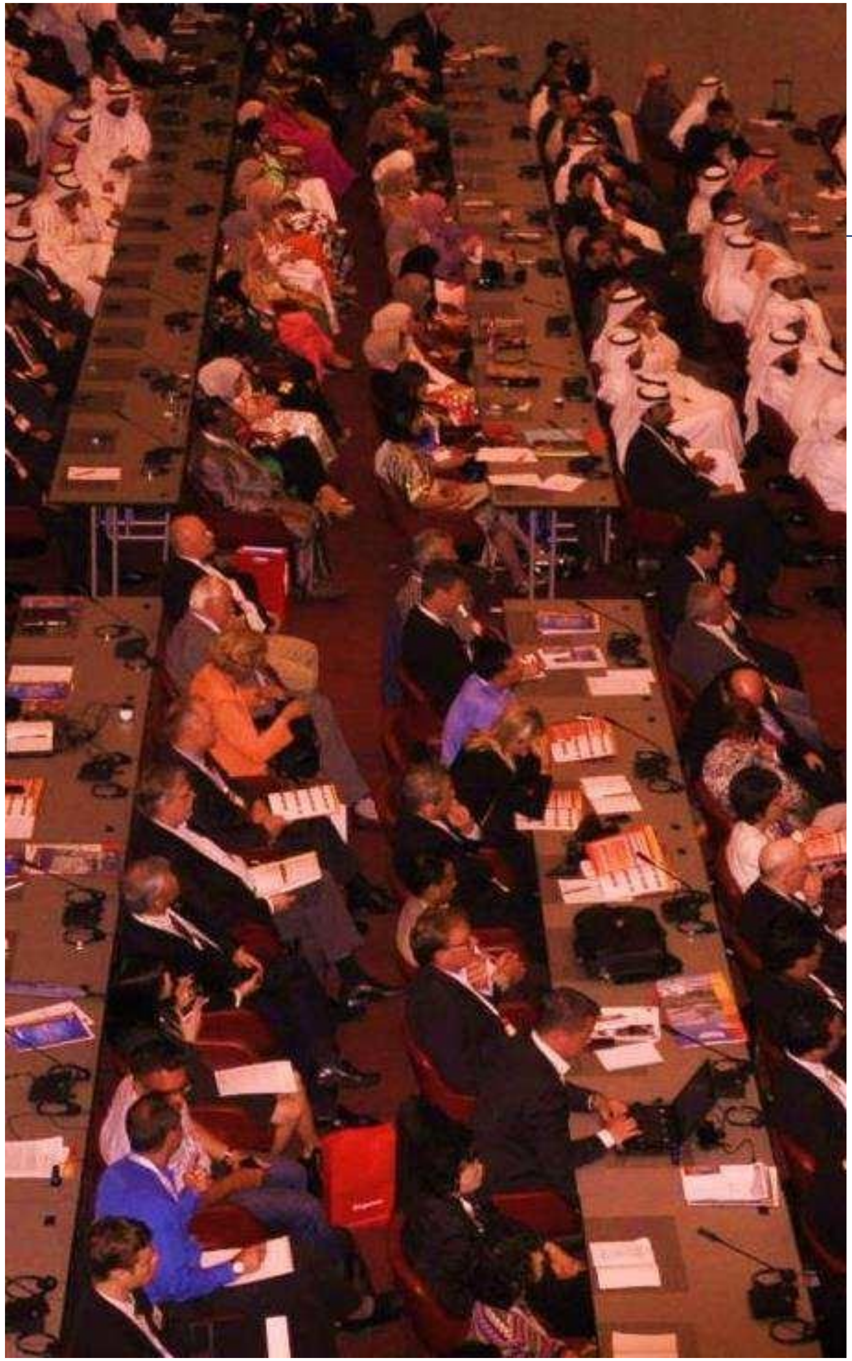
- **4th March every year**
- **Proud to lead the proposal as WFEO President 2017-2019**
- **Declared by UNESCO as an international day**
- **An opportunity to engage with people, government, policy makers, students on the importance of engineering in our societies**
- **Encourage young people, boys and girls, to consider engineering as a career for positive change for a better sustainable world**
- **Its our celebration of engineering!!**

See: https://worldengineeringday.net/

WORLD ENGINEERING DAY FOR SUSTAINABLE DEVELOPMENT



Engineering for Sustainable Development

- Participation
- Influence
- Representation

The world's engineers united in rising to the world's challenges. For a better, sustainable world.

WFEO / FMOI

The World Federation of Engineering Organizations

Fédération Mondiale des Organisations d'Ingénieurs

www.wfeo.org info@wfeo.org

@wfeo

Ania López
WFEO Executive Vice-President, Consiglio Nazionale degli Ingegneri, Italy

INTRODUCE

The types of renewable energy used in agriculture.
Overview of the 2030 Agenda and the Sustainable Development Goals (SDGs), linked to the agricultural sector.

Importance of renewable energy to achieve sustainable agriculture. The challenges of engineers in the agricultural sector

Agrivoltaics, an Italian Best Practice, engineering at the service of Agriculture.

Background:

Renewable Energy sources relevant to agriculture: SOLAR, WIND, BIOMASS, HYDROPOWER, and GEOTHERMAL ENERGY

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Solar energy involves harnessing sunlight to generate electricity or heat. In agriculture, solar energy can be utilized through photovoltaic (PV) panels to power various operations such as irrigation systems, lighting, and machinery. Solar panels can be installed on rooftops, ground mounts, or even integrated into agricultural infrastructure like greenhouses.

Source: The largest photovoltaic park in Italy in Troia (Foggia)
www.foggiatoday.it

Wind energy involves capturing the kinetic energy from wind to generate electricity. Wind turbines, typically installed in windy areas, convert wind energy into mechanical power which is then converted into electricity. In agricultural settings, wind turbines can be used to power farms or provide energy to remote locations where grid connectivity is limited.

Source: The Wind Farm in Italy in Portoscuso (Sardegna)
www.enelgreenpower.com

Biomass energy is derived from organic materials such as crop residues, animal manure, and dedicated energy crops. These materials are converted into biofuels like biogas, bioethanol, and biodiesel through processes such as fermentation, combustion, or gasification.

In agriculture, biomass energy can be generated from agricultural residues and waste products, providing an additional revenue stream for farmers while reducing waste.

Source: Electrical or thermal energy from woody biomass in Envie (Cuneo)
www.pezzolato.it

Background:

Renewable Energy sources relevant to agriculture

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Hydropower involves capturing the energy of flowing water to generate electricity. It can be harnessed through dams, turbines in rivers or streams, and other water infrastructure.
While not as directly applicable to traditional agriculture, hydropower can play a role in providing sustainable energy for irrigation systems and agricultural processing facilities in areas with access to flowing water sources.

Source: The Hydropowerplant in Sentino Sassoferrato (Macerata)
www.ergonbluenergy.org

Geothermal energy utilizes heat from the Earth's crust to generate electricity or provide direct heating. Geothermal power plants tap into hot underground reservoirs of steam or hot water to produce electricity.
While less common in agricultural settings, geothermal energy can be used for greenhouse heating, soil heating for crop production, and other agricultural processes in regions with geothermal resources.

Source: The Nuova Lardello Geothermal Power Plant (Toscana)
www.enel.com

Importance of renewable energy to achieve sustainable agriculture

Sustainable agriculture plays a pivotal role in achieving multiple Sustainable Development Goals (SDGs) outlined in the 2030 Agenda. Here's how it contributes to various SDGs:

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2 ZERO HUNGER

Sustainable agriculture ensures food security by promoting efficient and resilient farming practices.
By implementing sustainable agricultural techniques, such as crop rotation, integrated pest management, and agroforestry, farmers can enhance productivity and reduce the risk of crop failures.
Sustainable agriculture also emphasizes equitable access to resources and markets, which helps alleviate hunger and malnutrition, particularly among vulnerable populations.

7 AFFORDABLE AND CLEAN ENERGY

Sustainable agriculture promotes the use of renewable energy sources, such as solar, wind, and biomass, to power farming operations.
By transitioning from fossil fuel-based energy to clean energy alternatives, agriculture can significantly reduce greenhouse gas emissions and mitigate climate change. Additionally, sustainable agricultural practices, such as conservation tillage and organic farming, enhance soil health and sequester carbon, further contributing to climate action.

13 CLIMATE ACTION

Sustainable agriculture adopts climate-smart practices that reduce emissions, enhance resilience to climate change, and contribute to carbon sequestration.
Practices such as agroforestry, cover cropping, and conservation agriculture help mitigate greenhouse gas emissions by enhancing soil carbon storage and reducing the need for synthetic fertilizers and pesticides.
Sustainable agriculture also promotes adaptive strategies to cope with climate variability, such as drought-resistant crop varieties and efficient water management techniques.

15 LIFE ON LAND

Sustainable agriculture adopts climate-smart practices that reduce emissions, enhance resilience to climate change, and contribute to carbon sequestration. Practices such as agroforestry, cover cropping, and conservation agriculture help mitigate greenhouse gas emissions by enhancing soil carbon storage and reducing the need for synthetic fertilizers and pesticides. Sustainable agriculture also promotes adaptive strategies to cope with climate variability, such as drought-resistant crop varieties and efficient water management techniques.

What may be the challenges of engineers in the agricultural sector ?

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Engineers in the agricultural sector face a variety of challenges, ranging from technological and environmental to social and economic.
Here are some key challenges they may encounter:

Source: Phd reseacher Ania Lopez

ORDEM DOS ENGENHEIROS · WORLD ENGINEERING DAY · WFEO / FMOI · In support of UNESCO World Engineering Day · unesco · O Presidente da República

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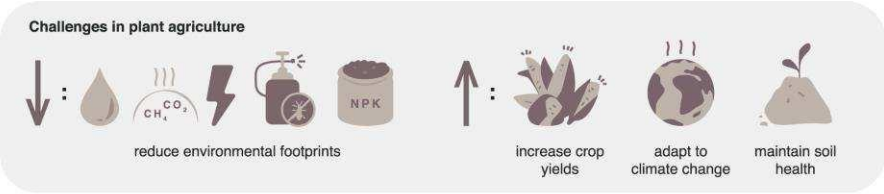
challenges

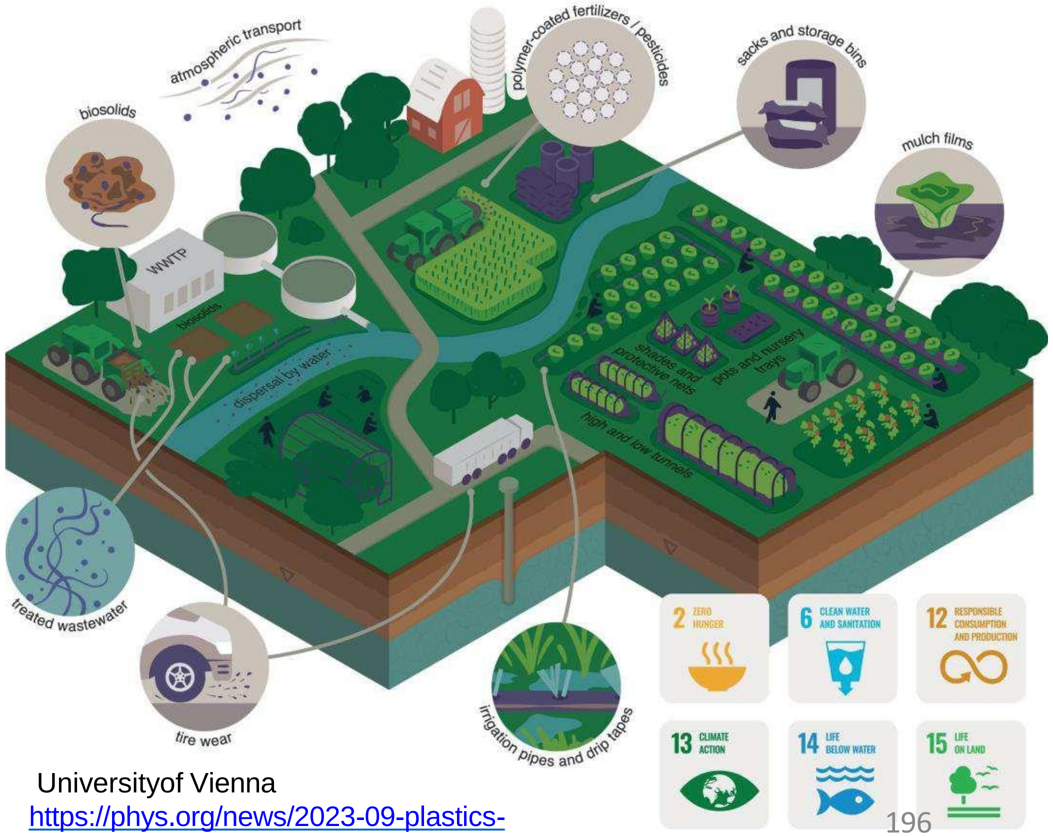
Technology Adoption


Source: produce.com

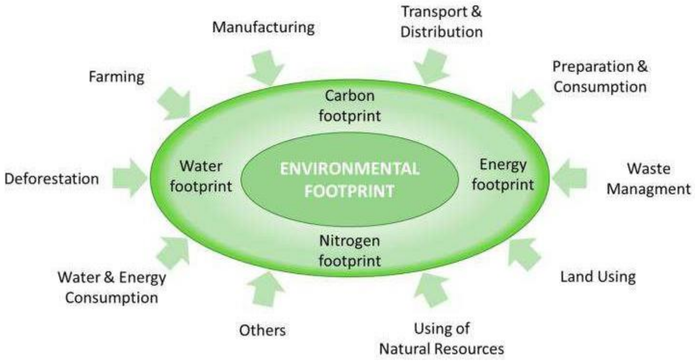
Encouraging farmers to adopt new technologies can be challenging due to factors such as cost, perceived risks, and lack of awareness or understanding.

Engineers must design technologies that are user-friendly, affordable, and adapted to local conditions to facilitate adoption.






Source: Globalagriculturalproductivity



Mdpi.com Sustainable Development in the Agri-Food Sector in Terms of the Carbon Footprint

Universityof Vienna
https://phys.org/news/2023-09-plastics-agriculture-sustainable.html

UN Sustainable Development Goals

Agricultural engineering projects often operate in resource-constrained environments, where access to materials, equipment, and skilled labor may be limited.

Engineers must find innovative solutions to maximize efficiency and productivity while minimizing the use of resources, scientific research with the application of new technologies will be the key to sustainability in raw material processing and waste.

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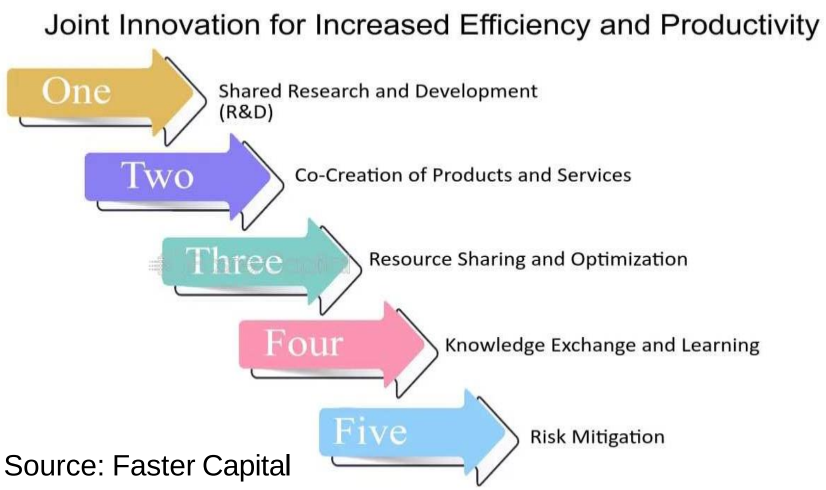
Source: FAO

Nearly 59 million tonnes of food (131 kg/inhabitant) are wasted in the EU each year with estimated market value of €132 billion. Over half of food waste (53%) is generated by households, followed by the processing and manufacturing sector (20%).

UE Commisiton
https://ec.europa.eu/commission/presscorner/detail/en/IP_23_3565



Source: Faster Capital

challenges

Resource Constraints

Source: Orage Fiber Ferragamo Capsule collection (Italy)

Climate Change and Environmental Sustainability

Source: el espanol

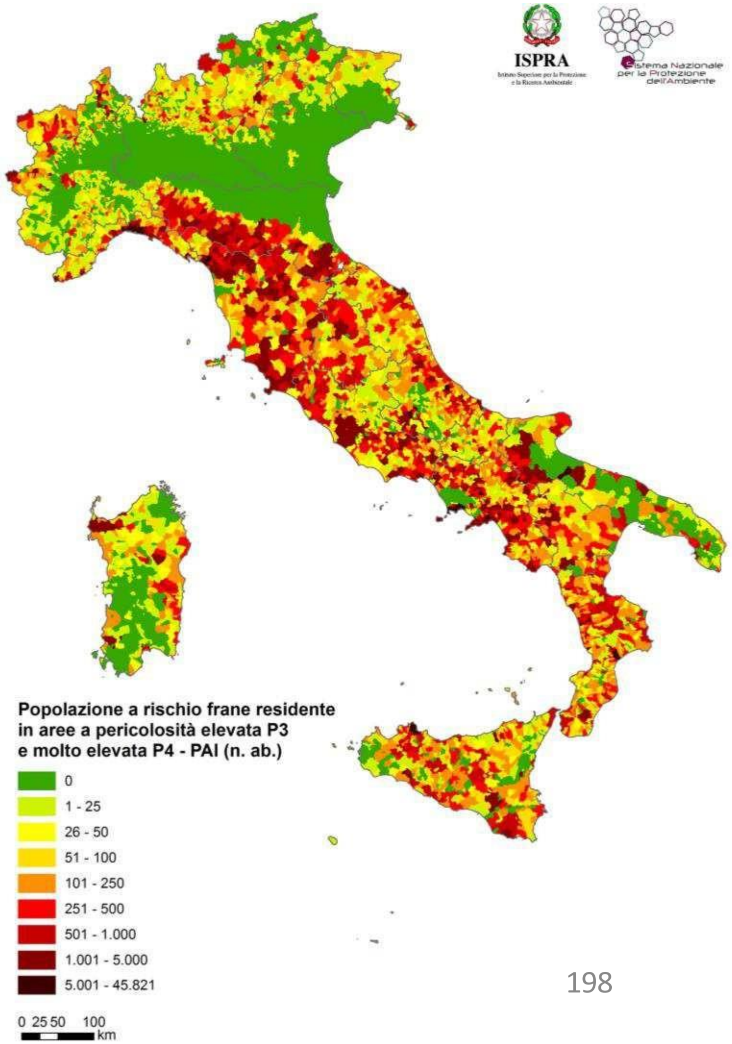

Source: Greenreport


Source: Eccodella città

Climate change poses significant challenges to agricultural systems, including unpredictable weather patterns, water scarcity and land degradation, including periods of intense drought and landslides.

challenges

Engineers must develop resilient technologies and practices that mitigate climate risks, preserve natural resources and minimize environmental impact, with periodic monitoring and control actions on the state of the areas most prone to landslides, avoiding illegal construction in unsuitable areas with high risk of dismantling and create natural barriers to contain it.



challenges

Infrastructure Development

Source: Faster Capital

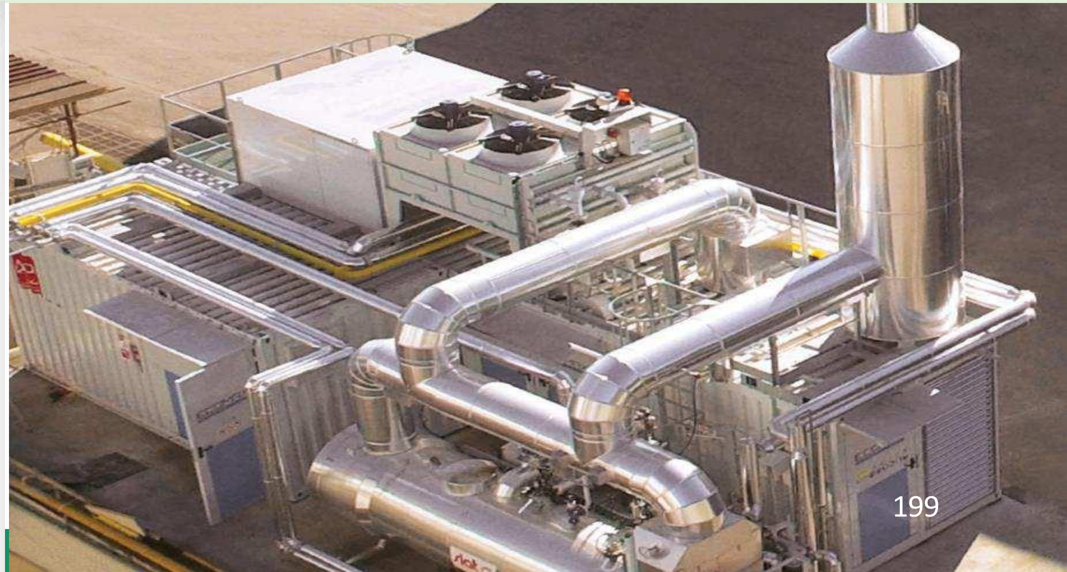
In many rural areas, inadequate infrastructure such as roads, electricity, and water supply hinders agricultural development.

Engineers play a crucial role in designing and implementing infrastructure projects that improve access to markets, inputs, and services for farmers.

Source: Confetti Crispo/Dragee Crispo

Lisbon

The company has two production plants for a total surface of mq. 20.000 and it reveal of a logistic warehouse with a capacity of 3.200 footboards.
It is the only producer of dragees with environmental impact zero, thanks to the use of a cogenerator for the production of energy, steam and water, which cover the total needs of the company.



challenges

Mechanization and Labor Issues

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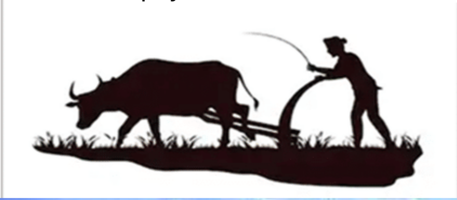
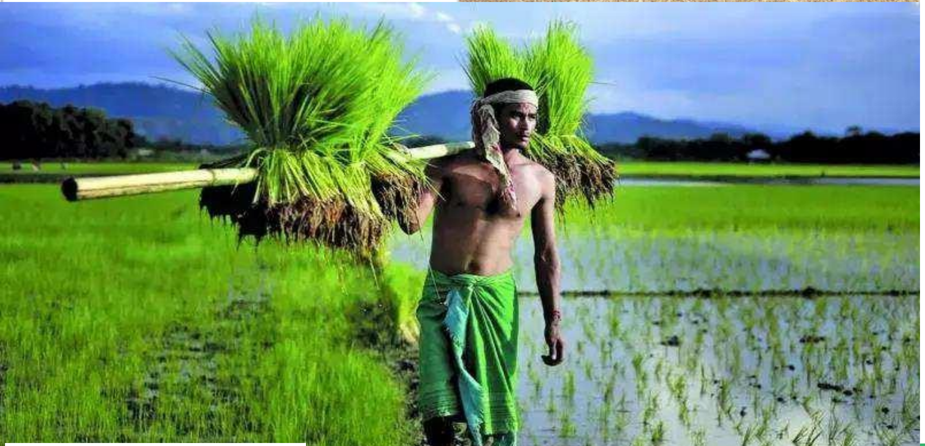
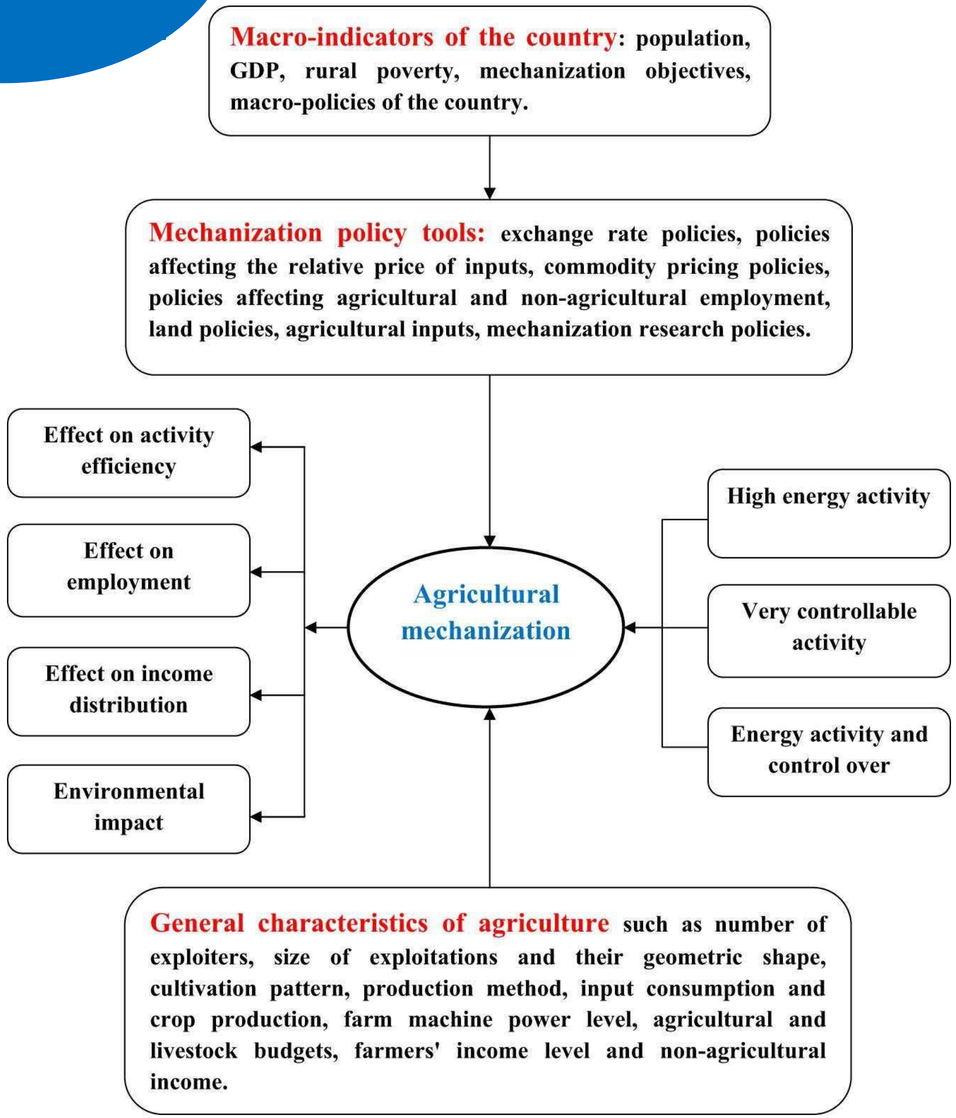
Source: Wikifarmer.com

Source: Biophysical Economics and Sustainability





Source: Niche Agriculture



Source:https://www.degruyter.com

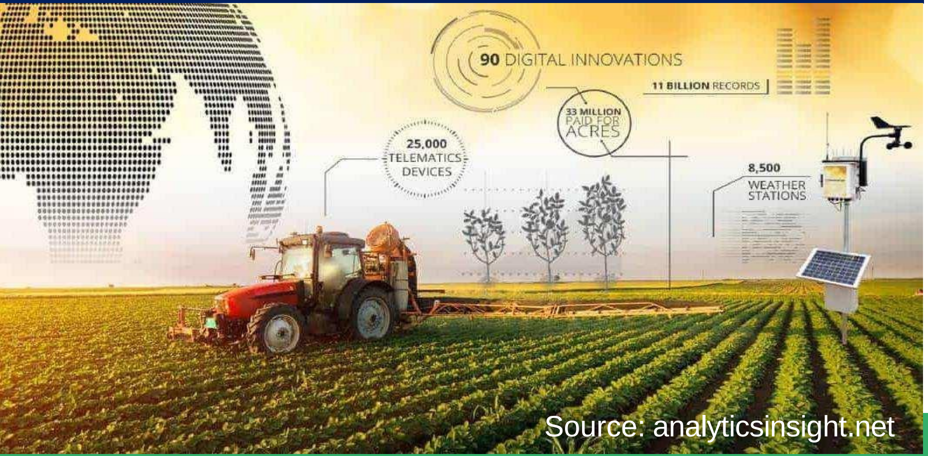
As agriculture becomes increasingly mechanized, there is a growing concern about the displacement of rural labor and its impact on livelihoods.

Engineers must balance the benefits of mechanization with the need to create employment opportunities and support rural livelihoods.

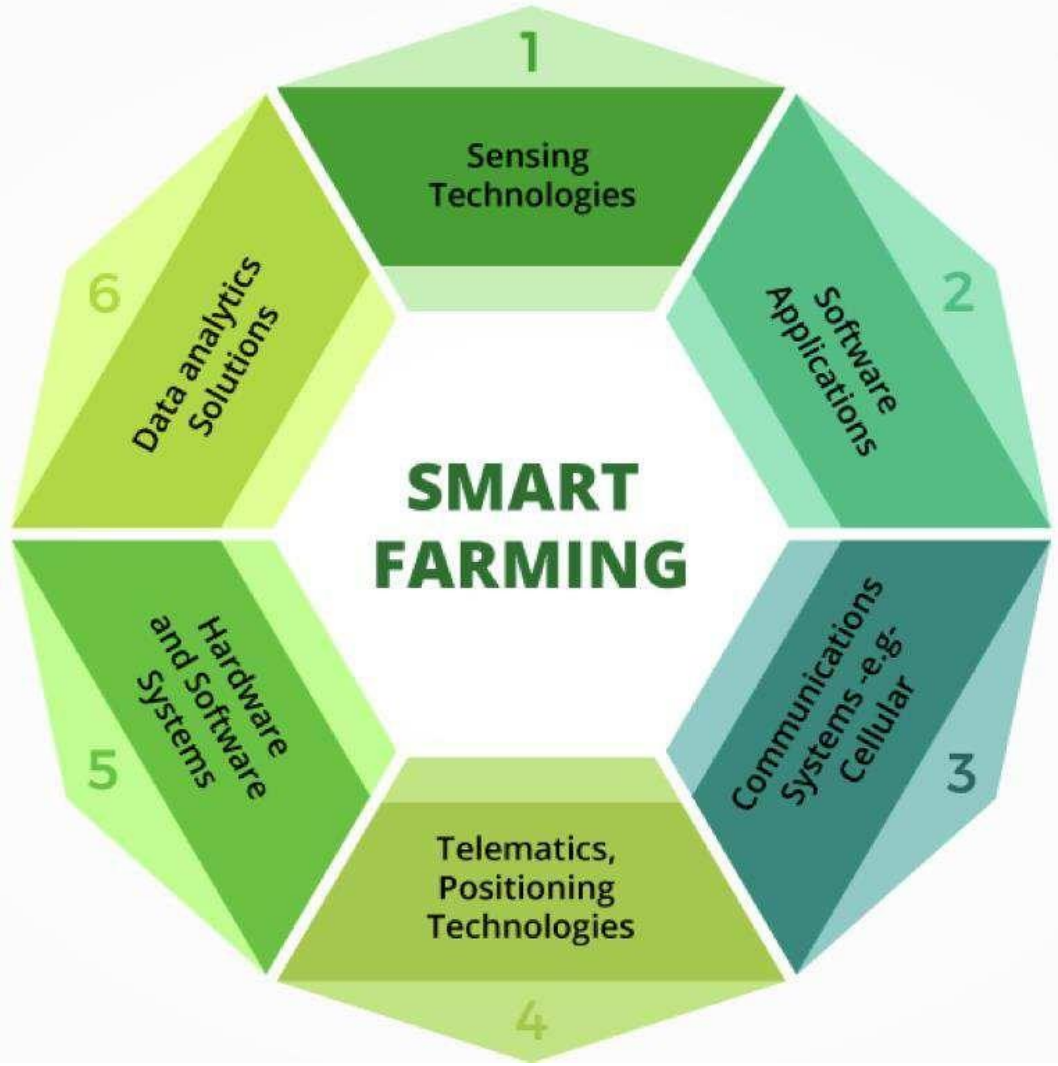
The agricultural sector is increasingly reliant on data-driven technologies such as precision agriculture, remote sensing, and digital platforms.

Source:agrifood.tech

Engineers face challenges related to data collection, management, and analysis, as well as concerns about data privacy and security.



Source: analyticsinsight.net



Source: Tesda .gov.ph Beecham Research

Data Management and Digitalization

challenges

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challenges

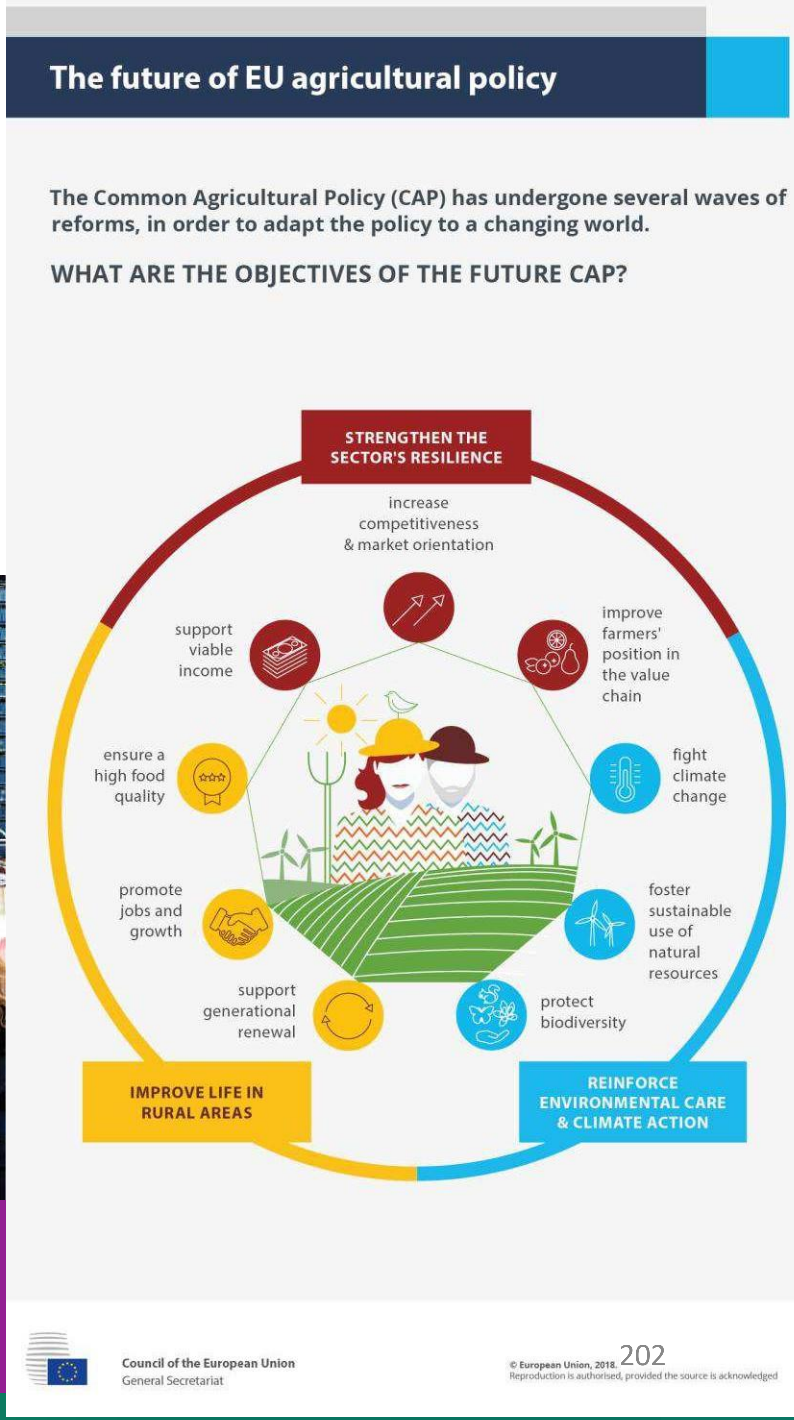
Policy and Regulation

Agricultural engineering projects are subject to a complex regulatory environment that can vary widely between regions and countries.

The common agricultural policy: 2023-27

The European Commission has adopted a set of proposals to make the EU's climate, energy, transport and taxation **policies fit for reducing net greenhouse gas emissions by at least 55% by 2030**, compared to 1990 levels. More information on Delivering the European Green Deal.

Engineers need to navigate regulatory requirements and ensure compliance with relevant standards and guidelines.



Socioeconomic factors such as land tenure systems, market dynamics, and cultural practices can influence the success of engineering interventions in agriculture.

Slow Food is a global movement in which activists, organized in convivia, communities and thematic networks, promote the defense of biodiversity through taste education and advocacy activity, encouraging dialogue between civil society and institutions.


techtitute.com

Engineers must consider the social context of their projects and engage with local communities to ensure their needs and priorities are addressed.

challenges

Socioeconomic Factors

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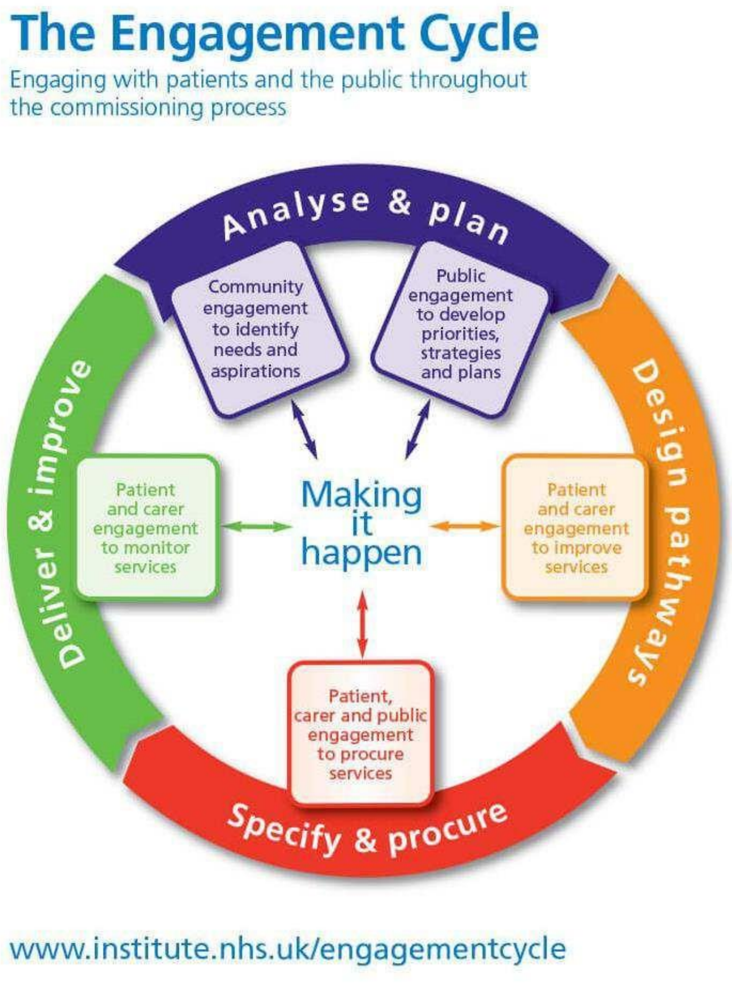


source:fsr.eui.eu/renewable-energy-cooperative


Slowfood

2022 Annual and monthly production of photovoltaic systems in Italy

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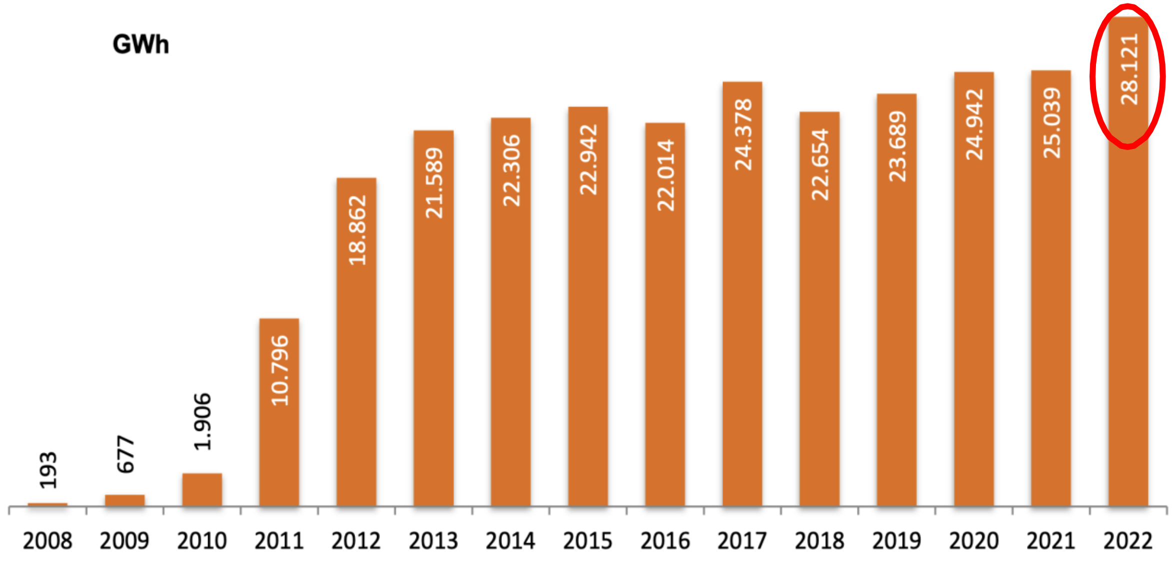
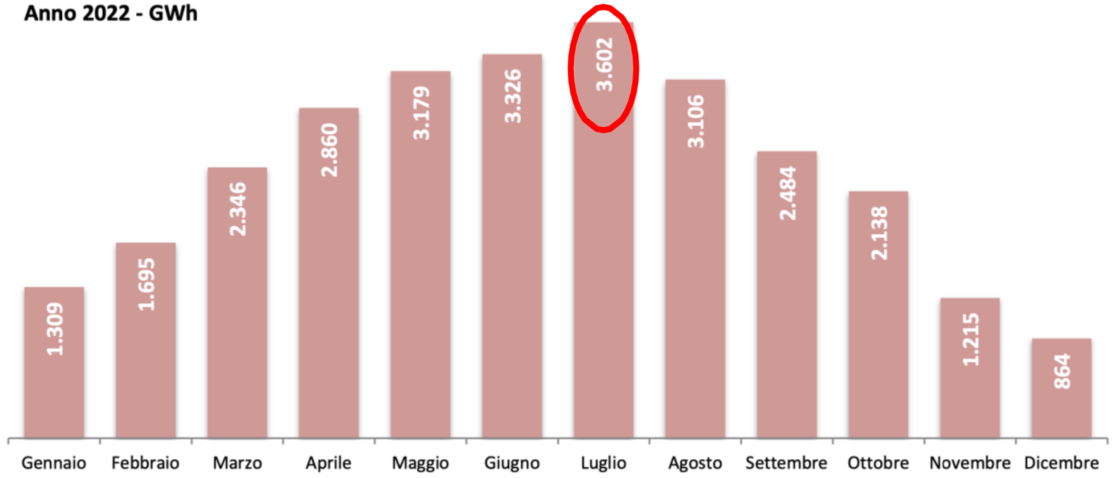


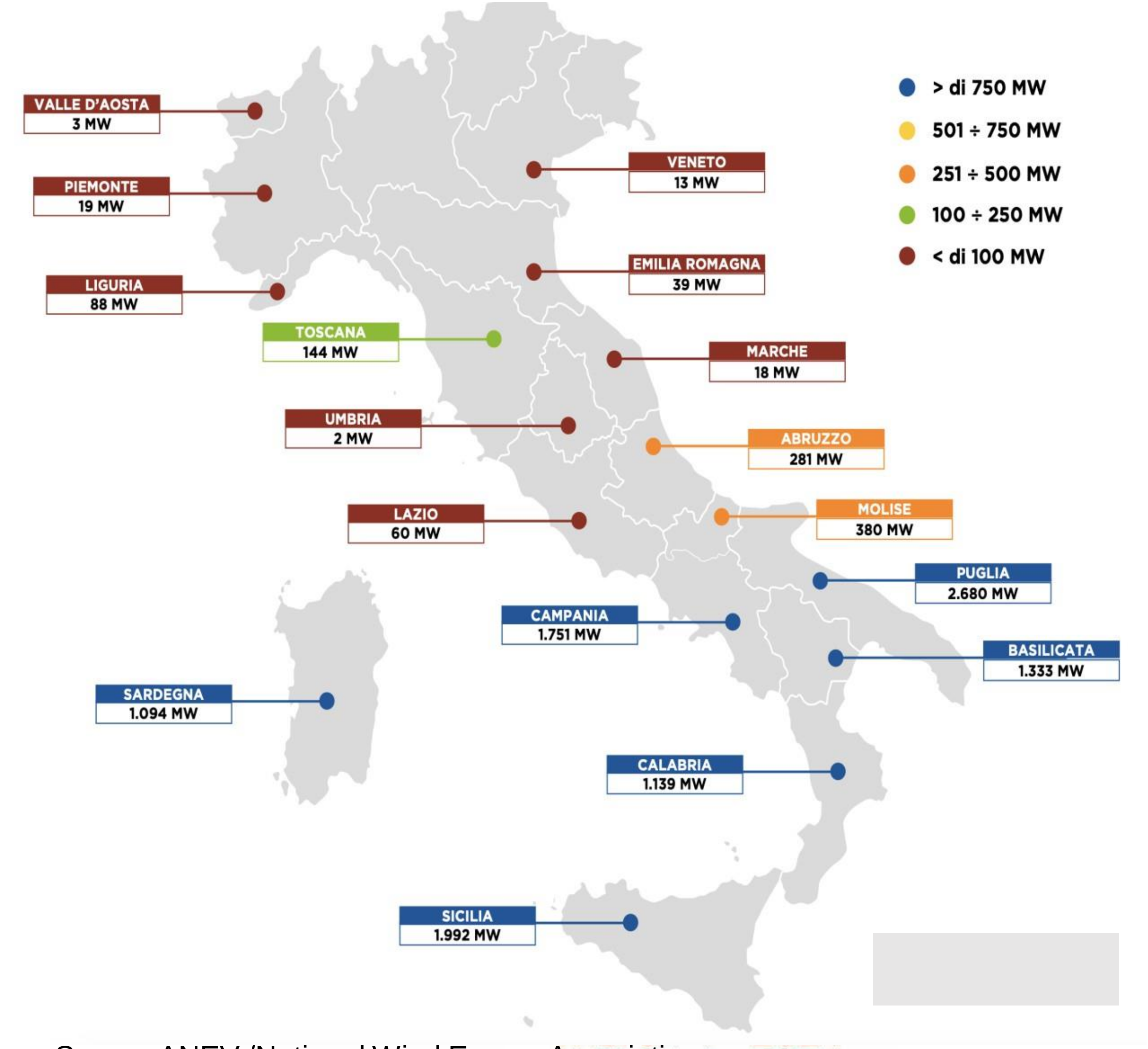


During 2022, the photovoltaic park in operation in Italy produced a total of **28,121 GWh** of electric energy; compared to the previous year, an increase in production of **+12.3%** was observed.

From the analysis of the monthly trend of 2022 production, the primacy of the central months emerges; **July, in particular,** it is the month characterized by the highest production (**over 3.6 TWh**).

Source:GSE/ Energy Services Manager

Information on Producibility of Wind Power Plants 2022



Source:ANEV /National Wind Energy Association

Source:GSE/ Energy Services Manager

The cumulative total of wind power in our country as of **31 December 2022 amounts, net of divestments, to 11,848 MW.** The new wind power in 2022 is 30.2% greater than that in 2021, when 404 MW of plants were connected to the grid.
In 3 years, just around 930 MW of wind power has been installed

Tarquinia Solar Park (Viterbo)

Technology	PV
Energy Production	280 GWh
Capacity	170 MW
Co2 emissions avoided	130.000 T/ year

ITALY

BEST

PRACTICE

RENEWAL

Piansano Wind Farm (Viterbo)

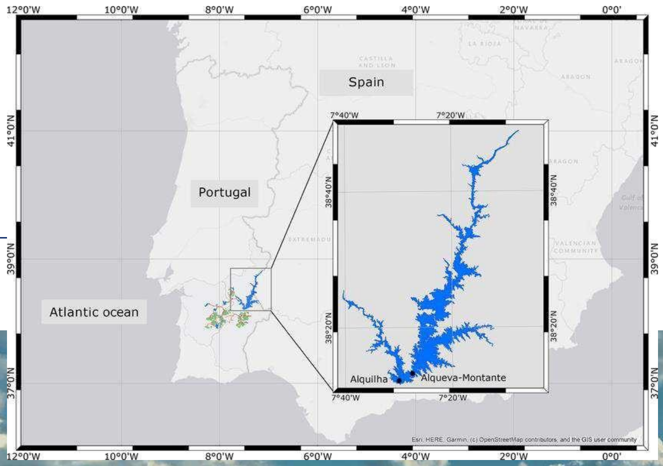
Technology	Wind
Energy Production	80.000 MWh
Number of wind turbines	21
Co2 emissions avoided	130.000 T/ year
Efficient Power	42MW

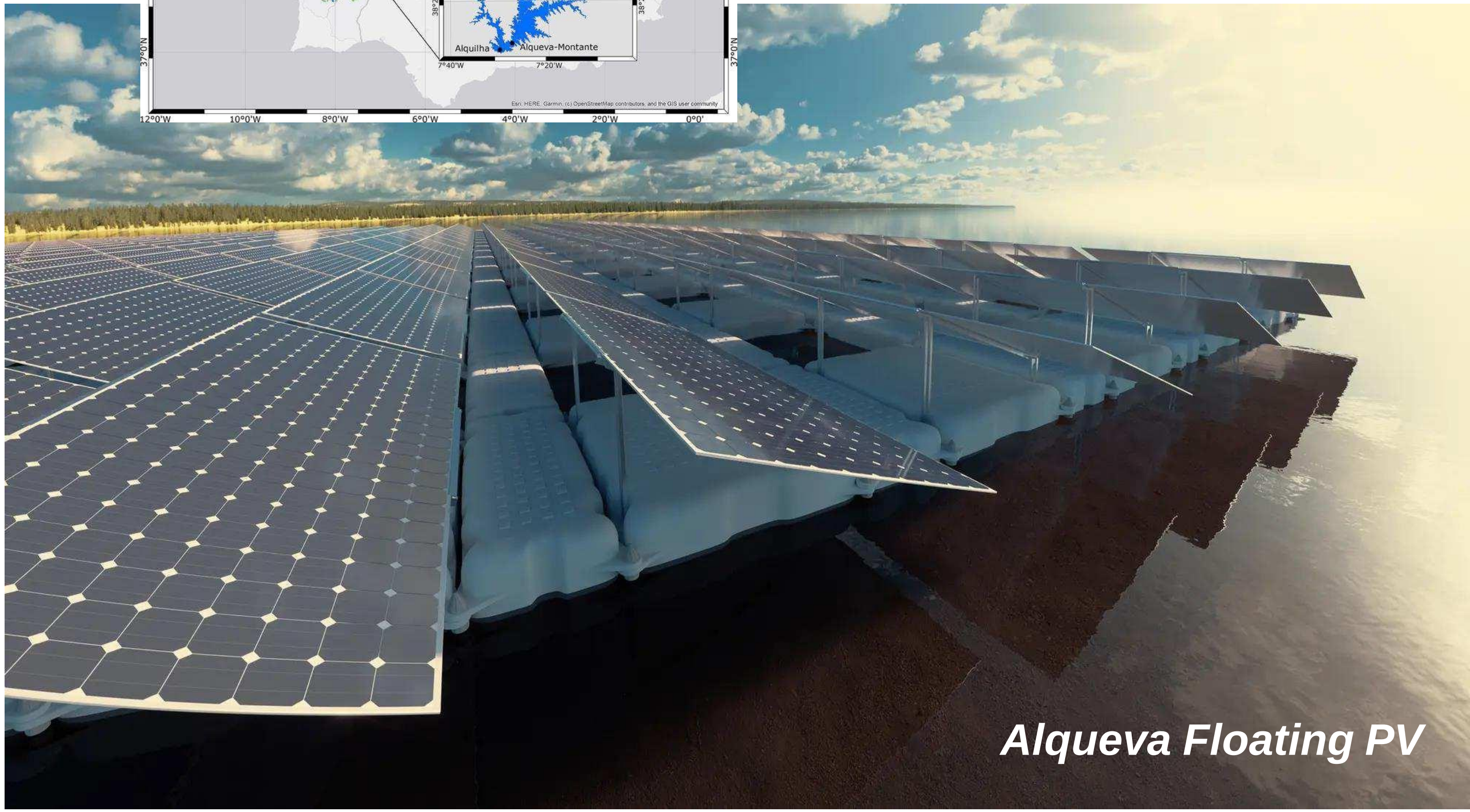
CONCLUTION

1.- Sustainable agriculture is essential to address interconnected challenges such as hunger, poverty, climate change and biodiversity loss.

2.- By adopting sustainable practices, agriculture can become a powerful catalyst to achieve multiple sustainable development goals and build a more resilient and equitable future for all, interdisciplinary collaboration, stakeholder involvement and a holistic approach that considers the social, economic and environmental of agricultural development.

3.- Engineers play a crucial role in driving innovation and sustainable growth in the agricultural sector.





The largest floating photovoltaic plant in Europe? It is being built in the Alqueva hydroelectric dam basin, Portugal.

Source Expedia: Praia da Rainha

What distinguishes people from each other is the strength to make it, or to let fate do it to us

Fernando Pessoa
1888-1935
Portuguese poet writer

O que distingue as pessoas umas das outras é a força para conseguir, ou para deixar o destino fazer isso connosco

Pedro Sampaio Nunes
Former Portuguese Secretary of State of Energy and Innovation, Portugal

The Future of Nuclear Energy in Europe

Pedro Sampaio Nunes

High costs for managing renewables intermitency…

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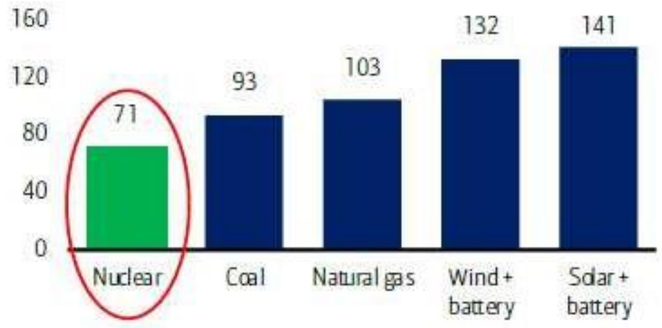
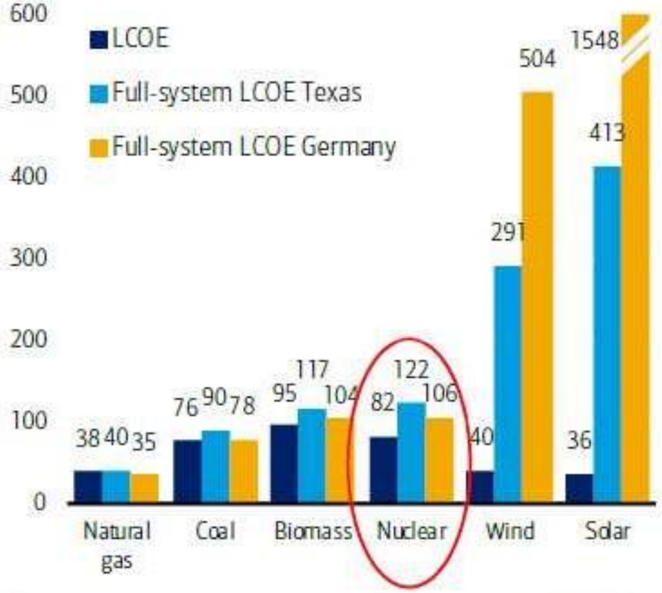
Cost of generation, different sources ($/MWh)



Source: BofA Research Investment Committee, Lazard, Entler, et al. (2018). Note: nuclear, coal, and natural gas price estimates from Entler, et al. Wind and solar cost estimates are from Lazard's 2023 Levelized Cost of Energy+ report. Wind + battery and solar + battery use estimates from California's Independent System Operator (CAISO) and assume a 4-hour lithium-ion battery storage system to account for firming costs. All cost estimates show unsubsidized costs.

BofA GLOBAL RESEARCH

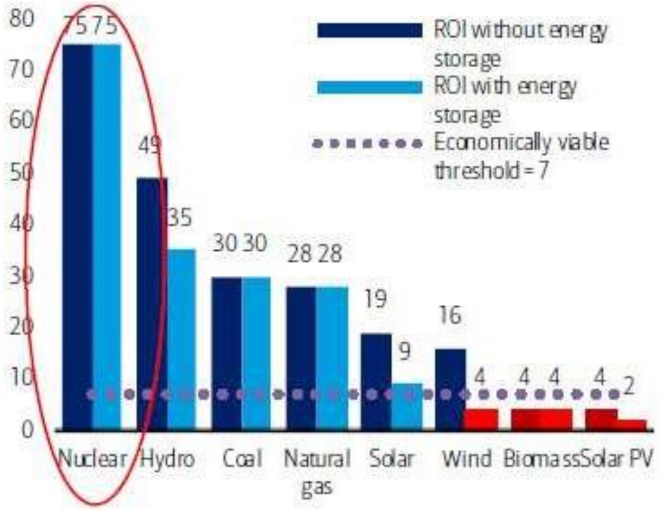
LCOE & LFSCOE calculations by energy source



Source: BofA Research Investment Committee, Idel 2022

BofA GLOBAL RESEARCH

Energy returned on energy invested, by source



Source: BofA Research Investment Committee, D. Weißbach, G. Ruprecht, A. Huke, K. Czerski, S. Gottlie, A. Hussein; Red signals EROI below economically viable threshold

BofA GLOBAL RESEARCH

And huge mining needs due to low energy density of renewables…

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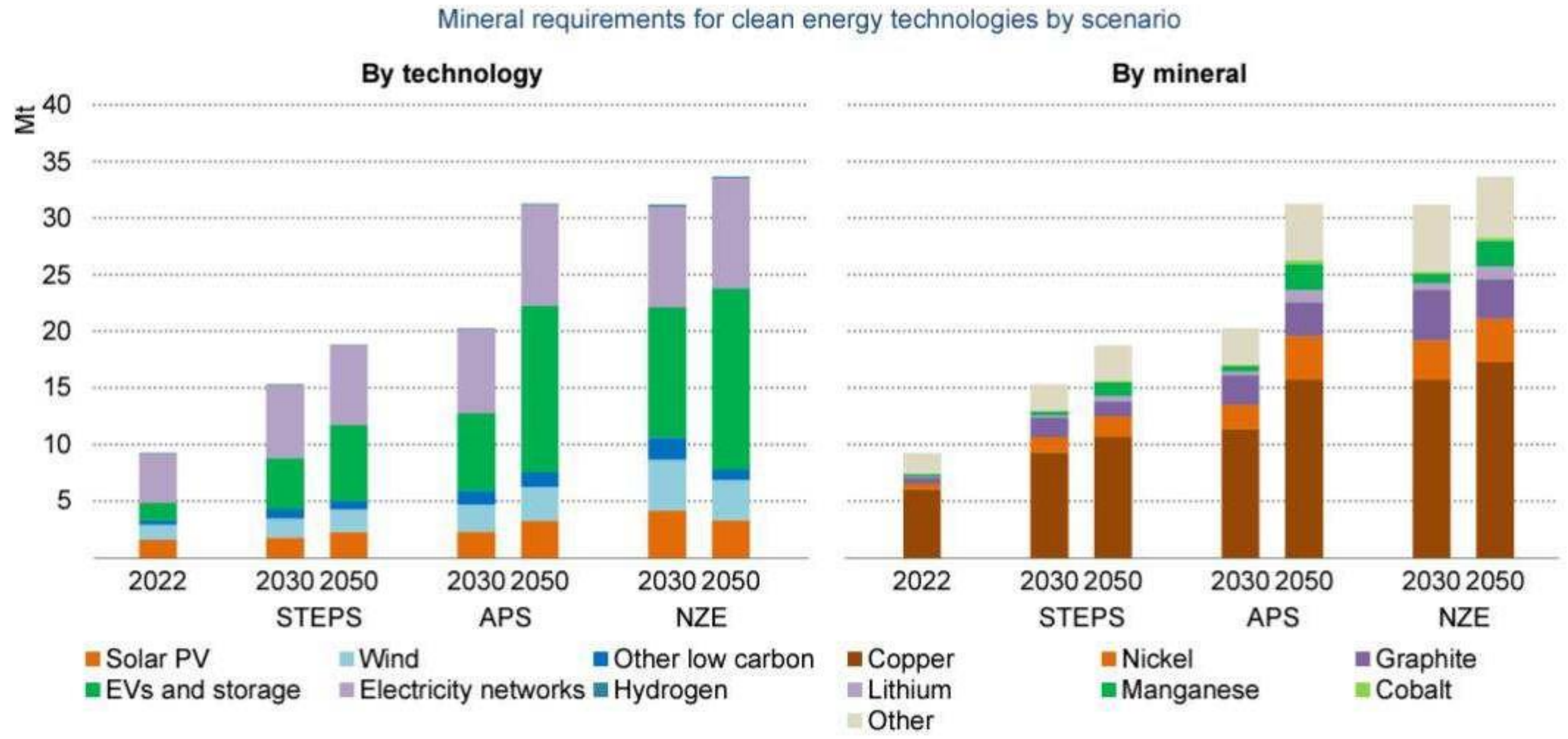
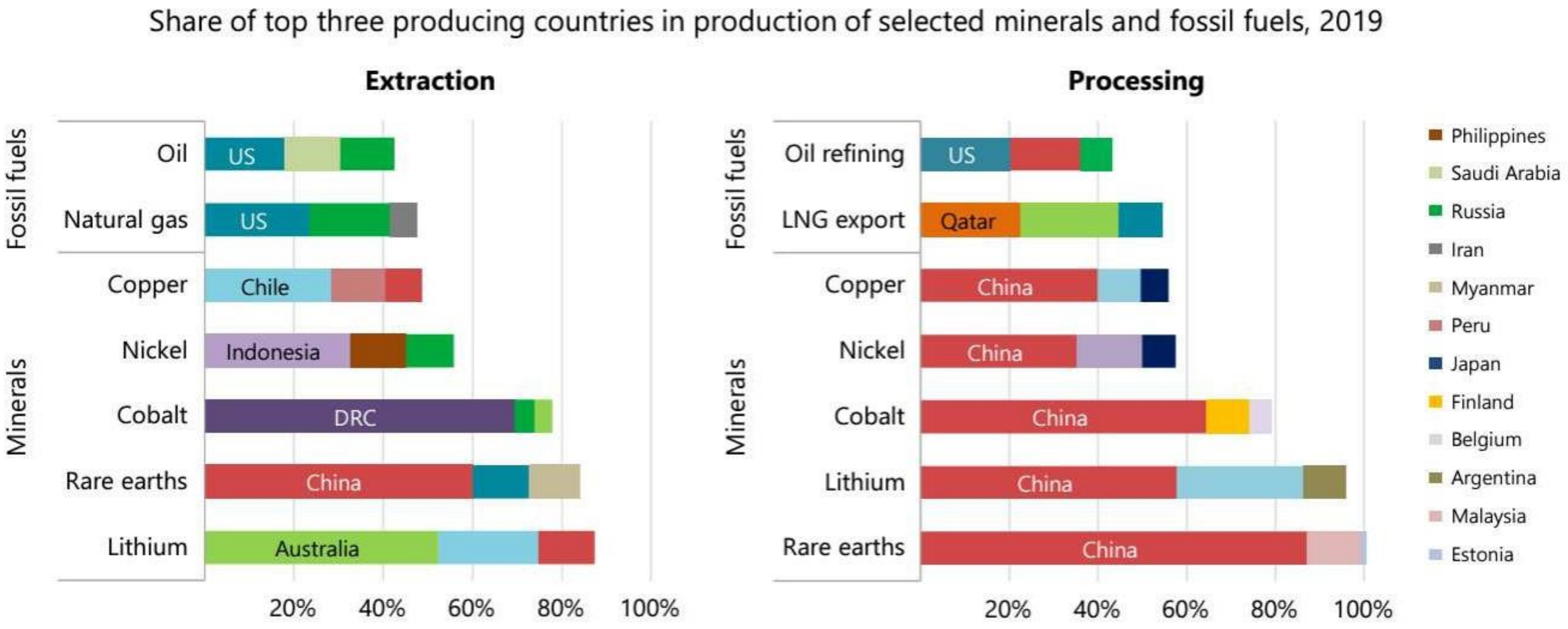
Critical minerals demand for clean energy is set to grow by up to three-and-a-half times over the period to 2030 as the world moves through energy transitions



Currently largely dominated by China, in extraction, processing and end products …



Production and processing of many minerals such as lithium, cobalt and some rare earth elements are geographically concentrated, with the top three producers accounting for more than 75% of supplies

Against a modest growth in mineral demand from nuclear power

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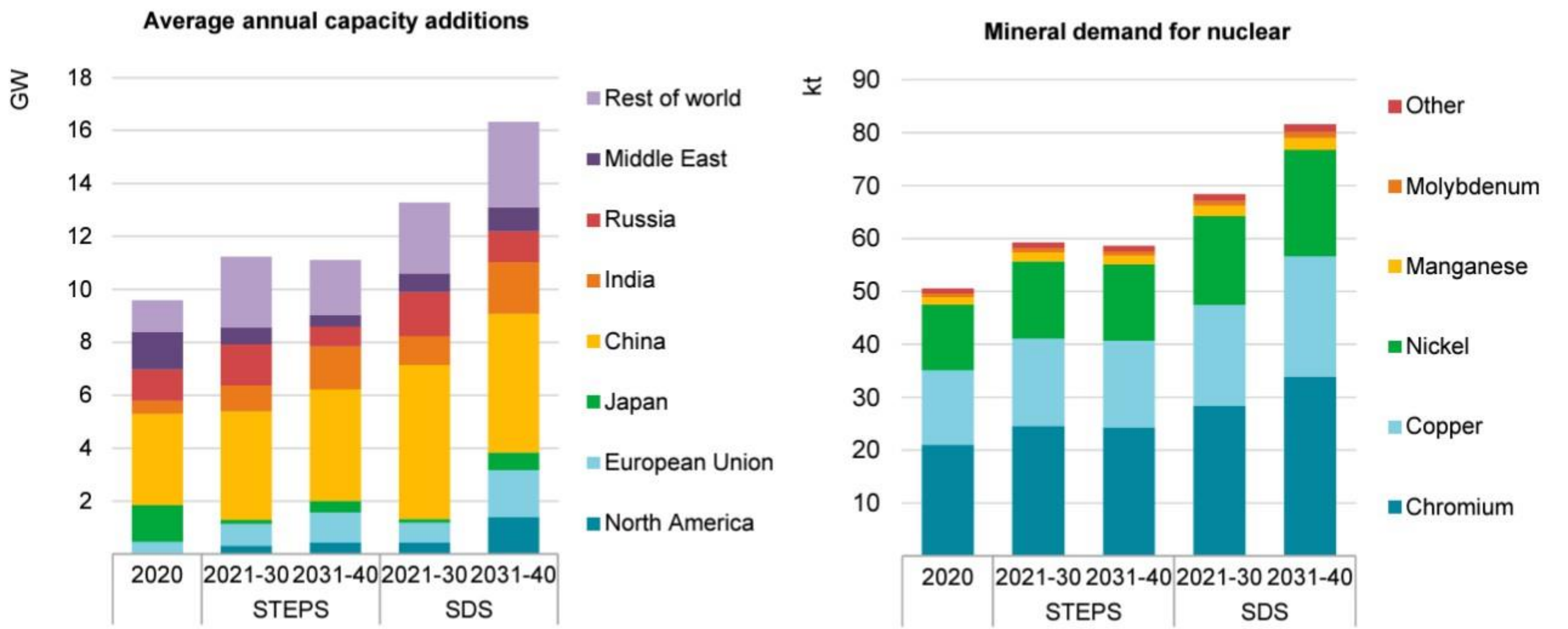
Average annual capacity additions and mineral demand from nuclear power



Note: Russia = Russian Federation.

And despite a huge investment in renewables, a disappoiting performance in emissions…

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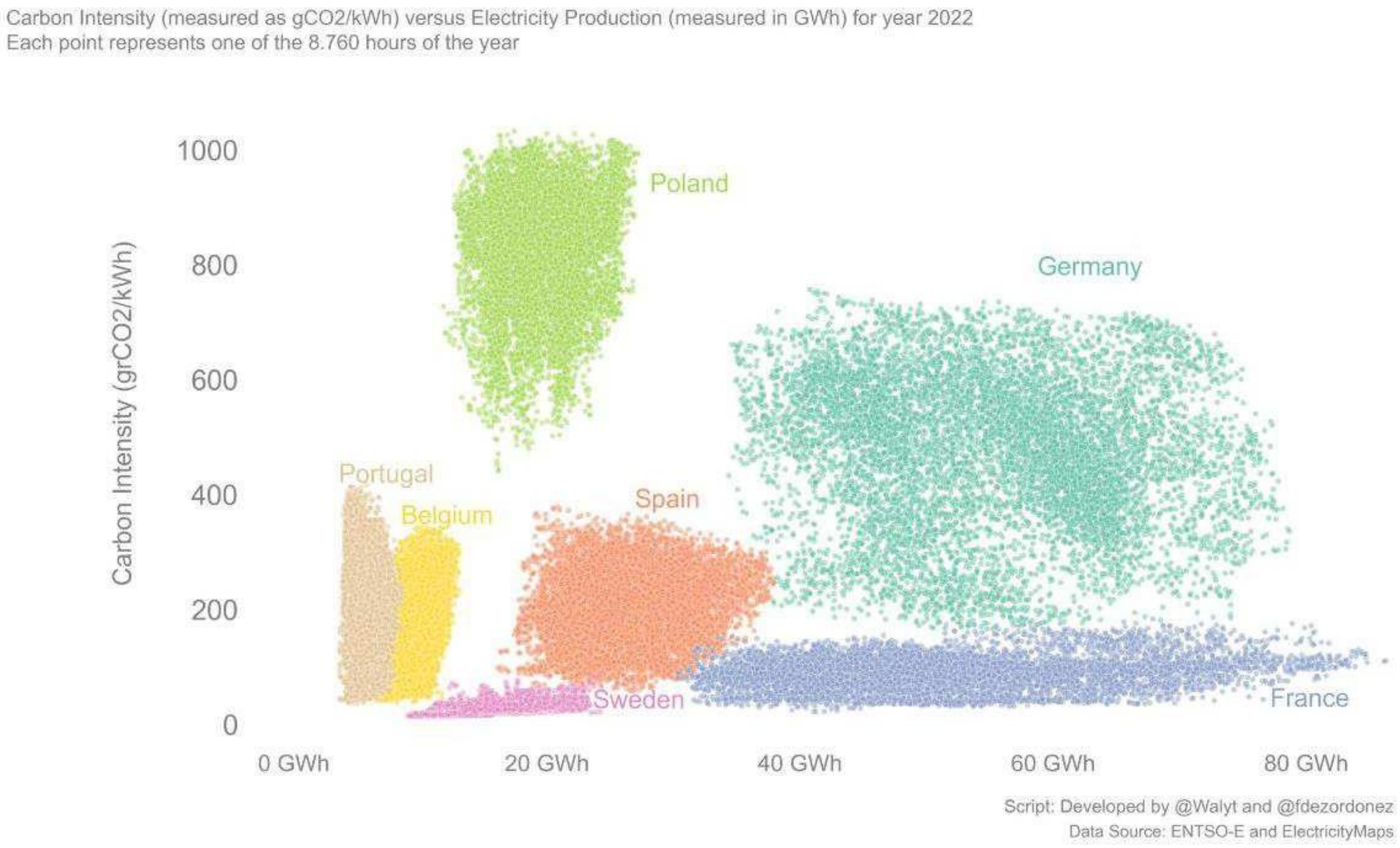

Recalling the effectiveness of the French nuclear program in reducing fossil fuels dependency …

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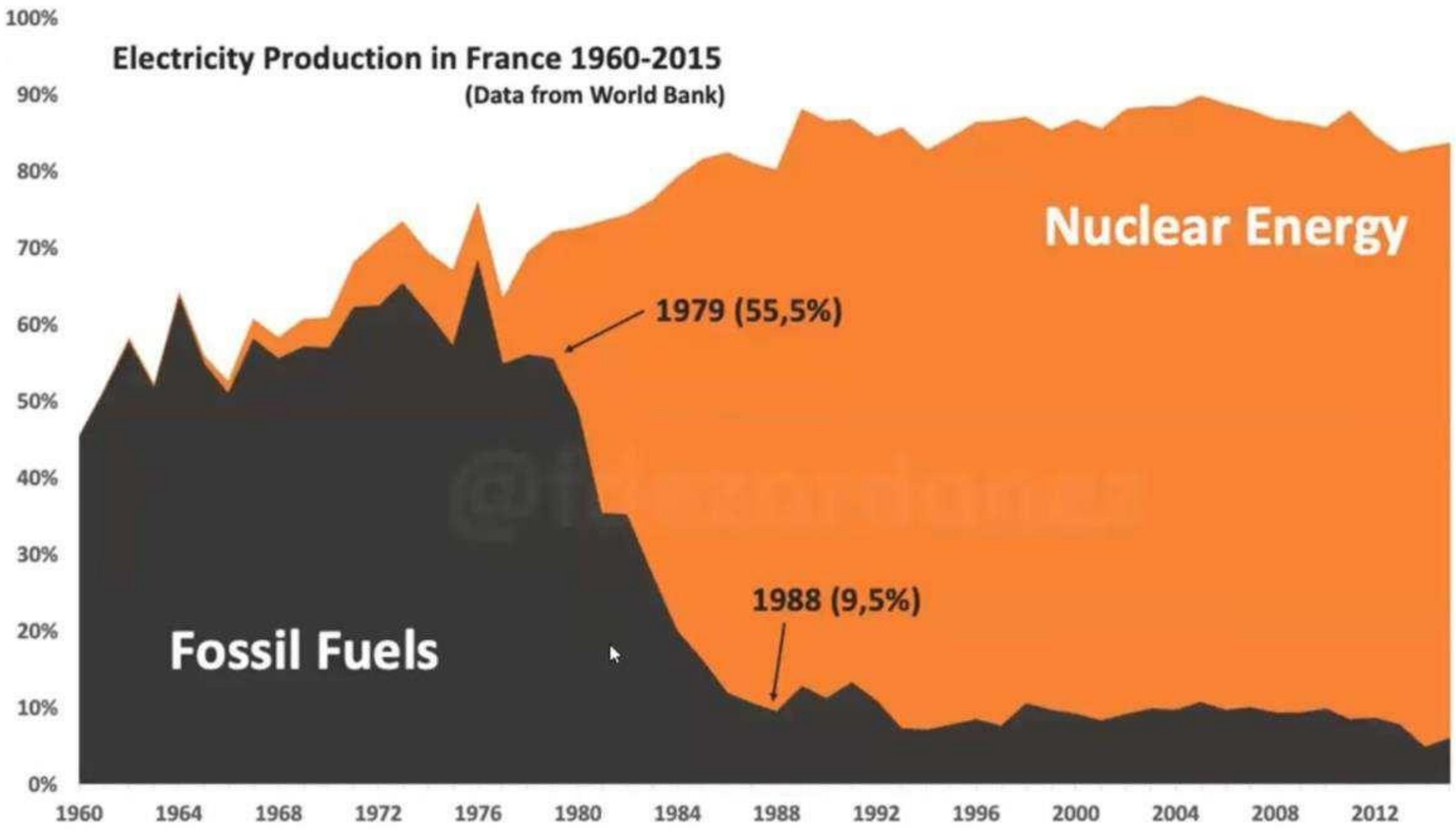

Are changing the nuclear landscape in Europe and in the World

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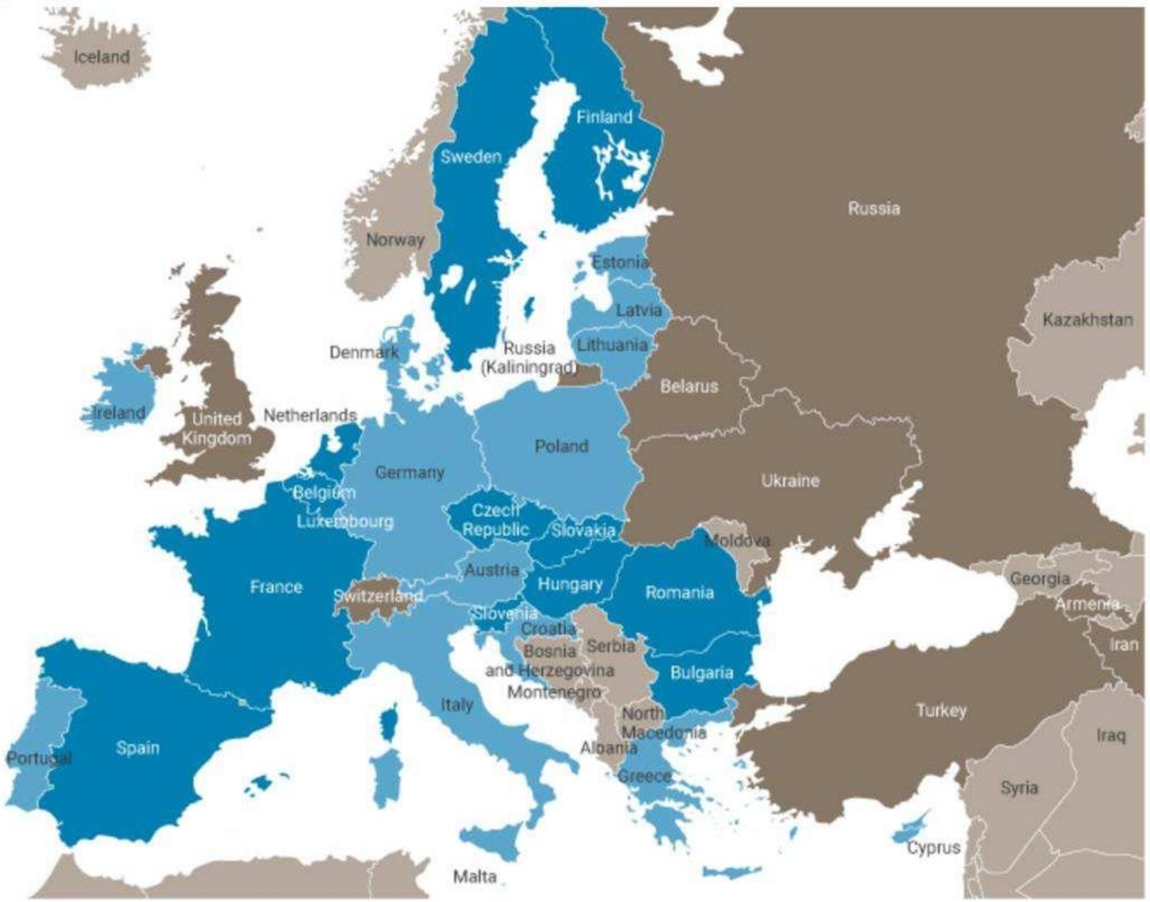
WORLD NUCLEAR ASSOCIATION



- EU member states with operating and / or under construction nuclear power plants (as of July 2022)
- EU member states without nuclear power plants
- Non-EU countries with operating and / or under construction nuclear power plants
- Non-EU countries without nuclear power plants

Nuclear Alliance: Belgium, Bulgaria, Croatia, Czech Republic, Estonia, Finland, France, Hungary, Netherlands, Poland, Romania, Slovenia, Slovakia, Sweden, United Kingdom as invitee and Italy as observer

The European Industrial Alliance on Small Modular Reactors (SMRs) aims to facilitate and accelerate the development, demonstration, and deployment of SMRs in Europe by the early 2030s.

Construction time: First concrete to commercial operation of last reactors

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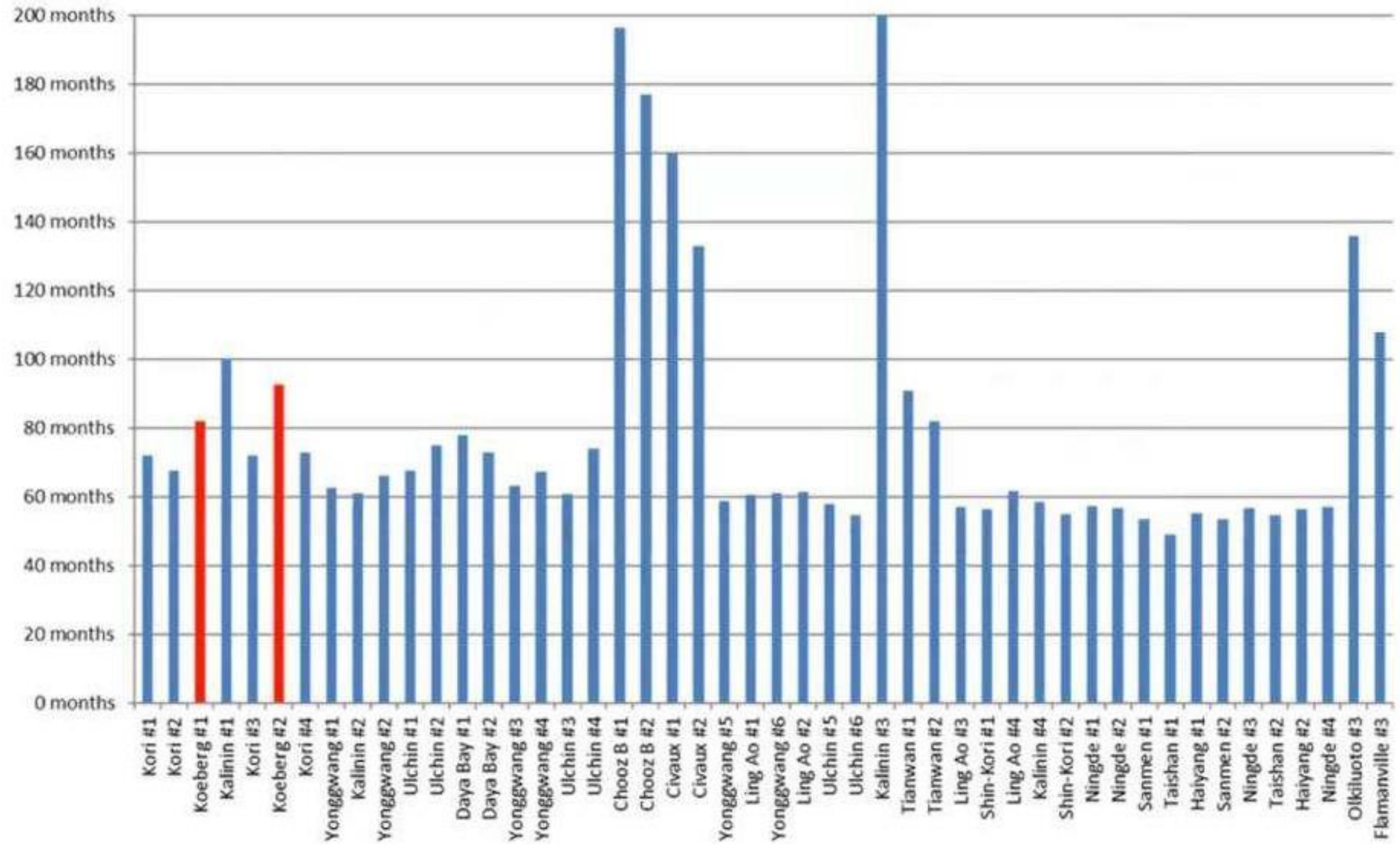

Cost of Nuclear: CAPEX from the last export contracts.

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Current Export Contracts

(public statements, various scope including fuel and O&M)

Country	Reactor	Capacity	Cost	$/kWe
Pakistan	HPR-1000 x 1	1 060MW	$3bn	$3 283/kW
India	VVER-1000 x 4	917MW	$12bn	$3 293/kW
China	VVER-1200 x 4	1 100MW	$18bn	$4 091/kW
UAE	APR-1400 x 4	1 337MW	$22bn	$4 114/kW
Belarus	VVER-1200 x 2	1 110MW	$10bn	$4 505/kW
Pakistan	HPR-1000 x 2	1 014MW	$10bn	$4 734/kW
Turkey	VVER-1200 x 4	1 114MW	$22bn	$4 937/kW
Bangladesh	VVER-1200 x 2	1 080MW	$13bn	$5 856/kW
Hungary	VVER-1200 x 2	1 100MW	$14bn	$6 364/kW
Egypt	VVER-1200 x 4	1 100MW	$29bn	$6 534/kW
UK	EPR x 2	1 650MW	$30bn	$9 061/kW

Financial Times - Opinion Inside Business 27 Jan 2019

"Nuclear is less costly than you think"

- Analysis for the Energy Technologies Institute (an organisation backed by the government and a number of energy companies) looked at 34 delivered nuclear projects round the world.

- First of a Class in USA/EU $9,000-$12,000/kWe
- 15% > $5,500/kWe
- 45% $5,500-$3,500/kWe
- 40% < $3,500/kWe

https://www.ft.com/content/1859ab32-2230-11e9-8ce6-5db4543da632?segmentid=acee4131-99c2-09d3-a635-873e61754ec6

Note that domestic projects in China, S Korea, Russia and India are quoted as below $3000/kW

Leading to the following levelized costs versus different net discount rates

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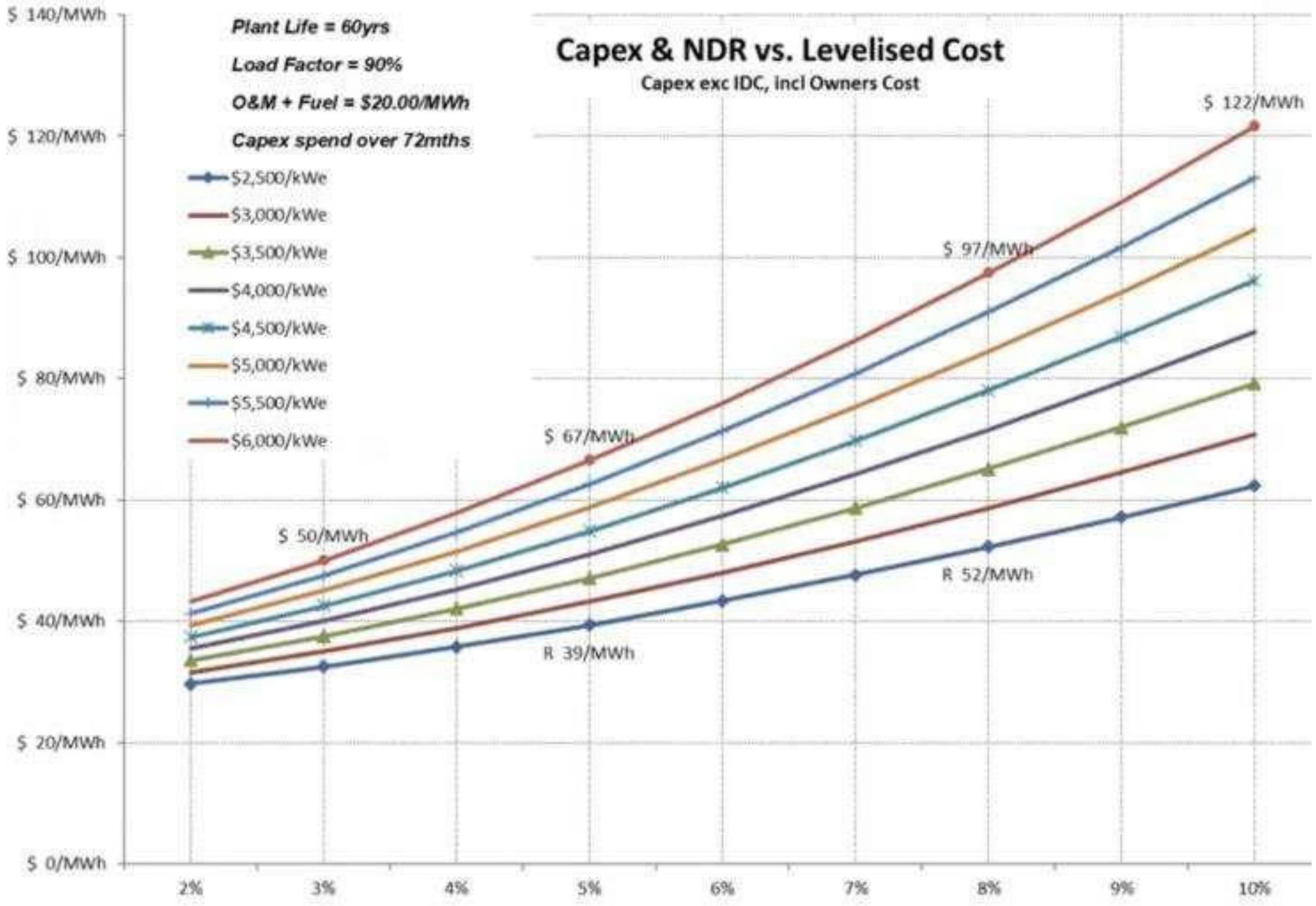
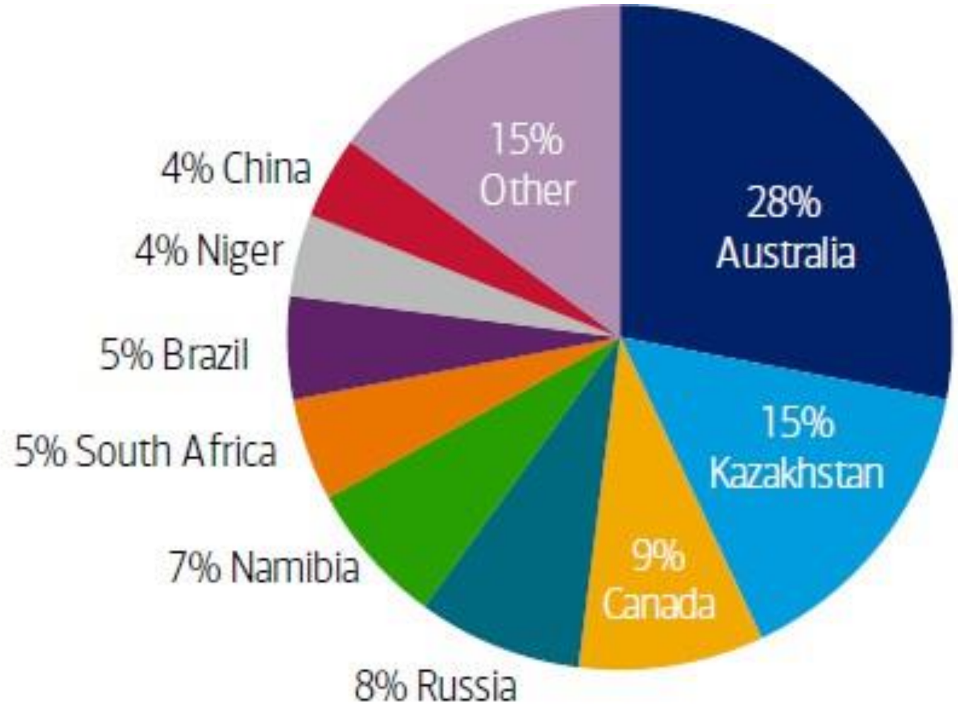


Today more than 50% of uranium comes from highly reliable sources



Source: BofA Research Investment Committee, World Nuclear Association

BofA GLOBAL RESEARCH

Pressure from the Nuclear Alliance led to nuclear being included in Netzero technologies

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Proposal for a

REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

on establishing a framework of measures for strengthening Europe's net-zero technology products manufacturing ecosystem (Net Zero Industry Act)

Article 3a

List of net-zero technologies

1. ***The net-zero technologies within the scope of this Regulation shall be:***

(a) ***Solar technologies, including: solar photovoltaic, solar thermal electric and solar thermal technologies;***

(b) ***onshore wind and offshore renewable technologies;***

(c) ***battery and energy storage technologies;***

(d) ***heat pumps and geothermal energy technologies;***

(e) ***hydrogen technologies, including electrolysers and fuel cells***

(f) ***sustainable biogas and biomethane technologies***

(g) ***carbon capture and storage technologies***

(h) ***electricity grid technologies, including electric charging technologies for transportation and technologies to digitalise the grid***

(i) ***nuclear fission energy technologies, including nuclear fuel cycle technologies;***

(j) ***sustainable alternative fuels technologies***

(k) ***hydropower technologies;***

(l) ***renewable energy technologies, not covered under the previous categories;***

Conclusions

- The recent decisions of the European Union will be a strong lever to advance nuclear programs, both for conventional reactors and for fast breeders and SMRs. In almost all European countries the debate on nuclear energy has been lively and conclusive, with growing support from public opinion. Even in Denmark and Norway, the debate on nuclear power is ongoing.

- Countries without nuclear power now have plans to install it, such as Poland and Italy. Countries that had decided to stop or freeze nuclear power have decided to increase their use of this energy source, such as Sweden, France, the Netherlands, Belgium and the United Kingdom.

- Countries where the current governments resist and intend to maintain the current policy of all renewables, such as Germany and Spain, will see their policies change when the opposition takes office. Only countries like Austria, Portugal and Luxembourg maintain a taboo on the subject. In Portugal, for the first time, some parties have included in their electoral programs the need to study this option.

Martin Manuhwa
WFEO Committee in Engineering Capacity Building and ZAIDG Consulting Engineers MD, Zimbabwe

Presentation Outline

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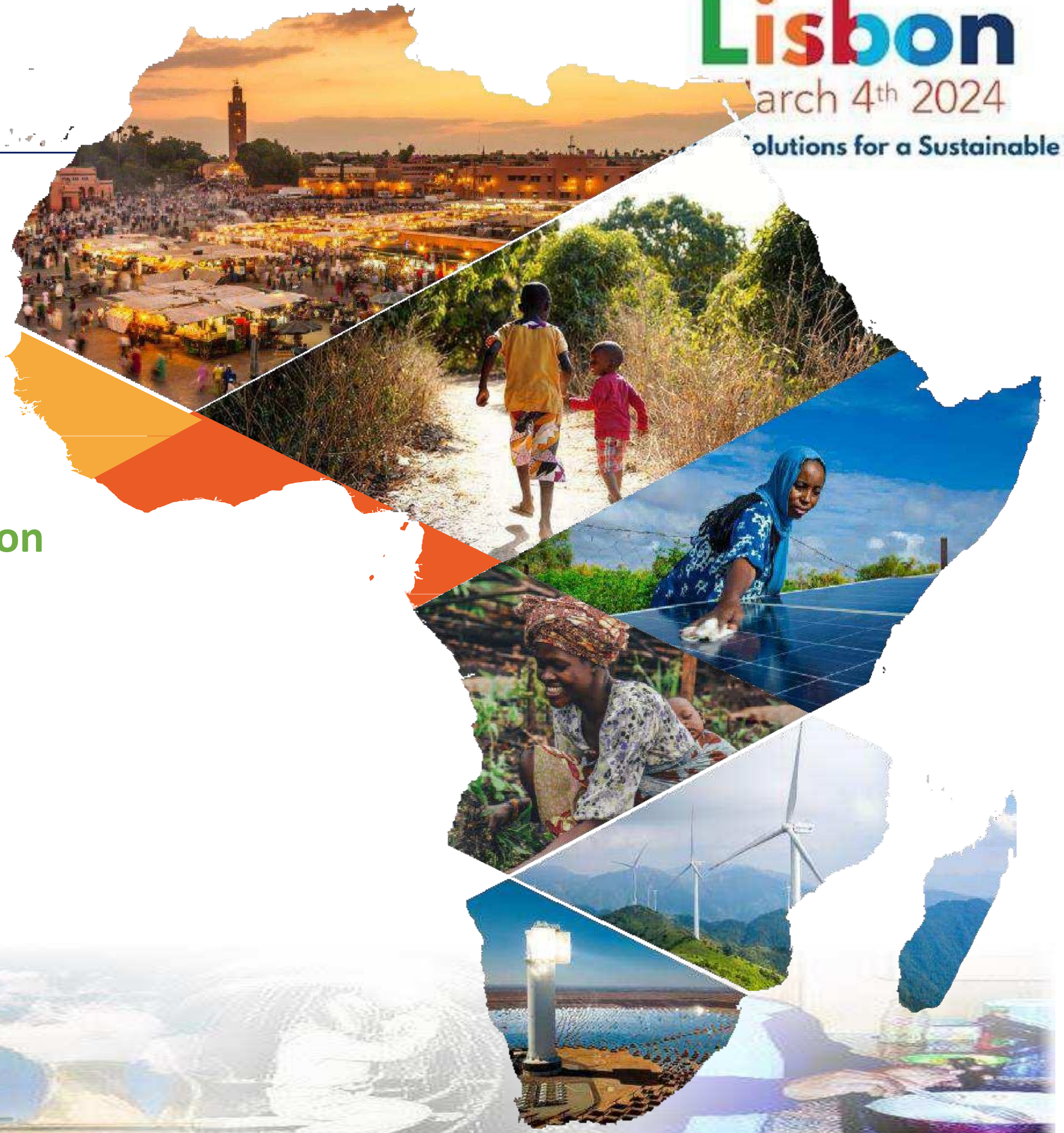

What is your Carbon Footprint?

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Introduction

Africa is bursting with ***possibilities*** and a vast endowment of natural resources. The continent's ***renewable energy potential is 50 times greater than the anticipated global electricity demand for the year 2040.***

The continent also has over 40% of the global reserves of key minerals for batteries and hydrogen technologies.

Africa, also, has the largest tracts of arable land, and the continent is young, ***with 70% of the people under 30 years of age.*** It is time to tap these riches to achieve the aspirations of the people.

"Africa has demonstrated that ***climate change, energy access, poverty, development, and conflict are all tightly connected and are different dimensions of the same phenomenon.*** I believe by becoming more assertive and pursuing a climate and development agenda through unified approaches, Africa will be able to mitigate the climate emergency and propel itself to prosperity." - ***William S. Ruto*** President of the Republic of Kenya Chair of the Committee of African Heads of State and Government on Climate Change

Introduction

- The ***energy sector* is crucial for the *socio-economic development*** of countries, particularly in Africa. However, Africa, as an ***energy-poor*** region, needs ***to balance economic development with access to modern energy forms through a just and equitable energy transition.***

- Net-zero transitional pathways in Africa should reflect ***local resources, viable development paths***, and other ***local-specific requirements.***

- There is need for ***contextualised and tailored strategies for Africa to accelerate renewable energy based on each country's specific needs and resources.*** Collaboration, political commitment, and long-term planning are essential for ***a successful transition to clean and sustainable energy in Africa.***

- We ***must prioritise the importance of focusing on a just energy transition hinged on net-zero obligations and carbon neutrality pathways***, as well as ***policies and institutional frameworks for energy efficiency and sufficiency to eliminate energy poverty.***

- ***Regarding Africa's energy transitions***, there is a need for urgent ***support and international cooperation to achieve both climate and development goals.***

Introduction

Sustainable Development Goals (SDGs) **should be prioritized as key pillars of a just and *inclusive energy transition* (especially *Goal 7*- that ensures affordable, reliable, sustainable, clean and modern energy and universal access for all by 2030).**

The earlier phase of the *net-zero initiative in developed countries focused on enhancing economic performance and decommissioning thermal power stations due to CO_2 regulations*.

Background and Context

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- It is important to acknowledge that ***Africa has abundance in unutilized energy resources*** and has the smallest share ***of CO2 emissions*** globally. ***Africa's contribution to global CO2 emissions is small compared to other countries.***

- As of 2015, ***China and USA contributed about 44%*** of the world's CO_2 emissions with Russia and India being the top four emitting countries that contributed about ***55% of the world's GHG*** emissions.

- ***Africa with a total of 54 countries contributed less than 3.8% through to 2020. In 2015, Africa registered a nominal GDP of about US$2.7 trillion (2.84%) of the world GDP for the 3.8% of world GHG emissions.***

- This only serves to emphasize the depth of ***under-development*** and the associated energy growth headroom from the economic growth potential.

- The underdevelopment and the associated potential for economic growth in Africa ***make energy access a priority, while also considering and balancing with climate change actions.***

Background and Context

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A global scan of successful energy policies in Africa have shown the following focus:

(a) Climate Change Mitigation and ***Adaptation***.

(b) Energy Transition, Carbon Neutrality and ***Net Zero.***

(c) Energy Poverty and ***Access Issues.***

(d) Renewable and ***Green Energy.***

(e) Battery Energy Storage Systems (BESS).

(f) Generation, Transmission and ***Distribution of Safe, Sound, Affordable*** and ***Sustainable Energy.***

(g) Demand Side Management, Energy Efficiency and ***Conservation.***

(h) Energy Projects Financing.

The above ***Energy fundamentals*** involve the principles and goals of a country's energy policies and the methods for implementing them. These are mainly guided by the ***17 Sustainable Development Goals (especially SDG 7).***

Challenges Affecting the Effective Implementation of Energy policies

In spite of the vital role of the energy sector in the economic and social development of the region, ***the sector has been faced with several challenges affecting its contribution to sustainable development.***

These challenges are:

- ***First***, energy accessibility to some segments of the poor and rural population,
- ***Secondly***, is the large disparity in per capita energy consumption and energy intensity among those countries, and
- ***Thirdly***, the challenge of relying heavily on fossil fuels to energy demand, this challenge further affects Climate Change and delays the attainment of net-zero and carbon neutrality in Africa.

In recognition of the above challenges, countries in the region have been continuously revising their policy framework aiming at promoting sustainable management of the energy sector.

The World at Night! Africa easily the darkest

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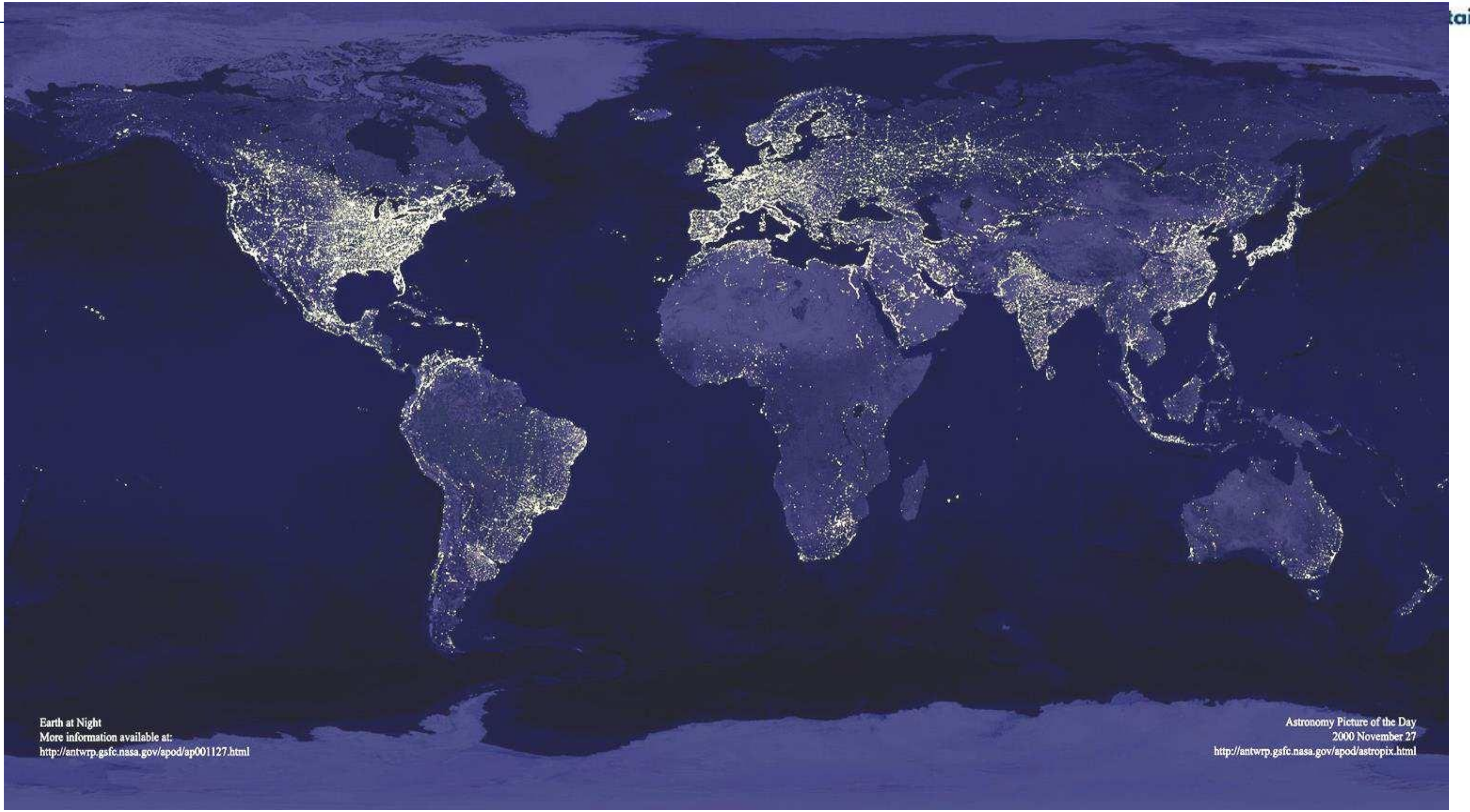
...tainable World



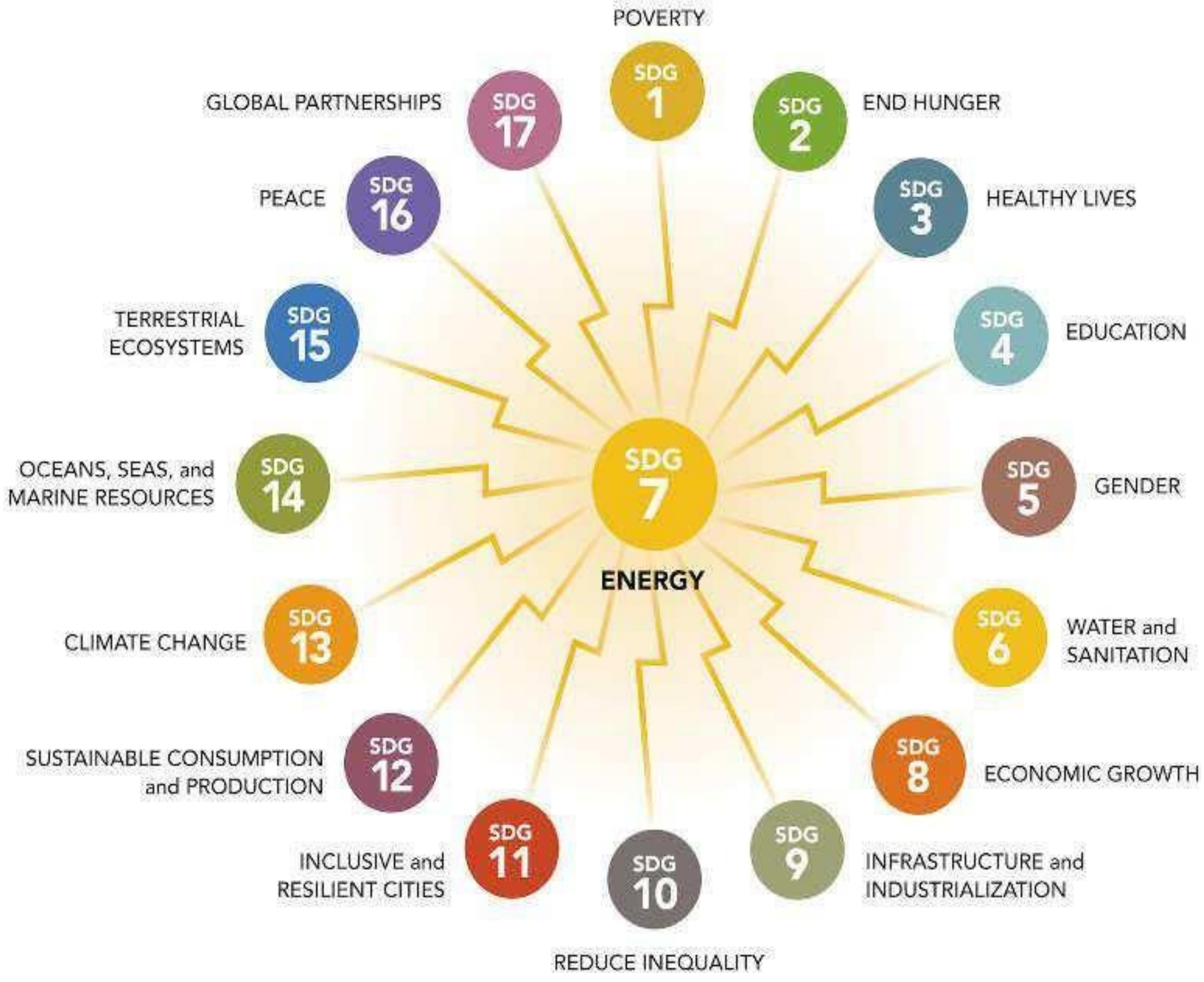
Why is Energy Critical?

Energy systems are the engine of economic and social development.

The Sustainable Development Goals (SDGs) are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity among others.

SDG 7 aims to "Ensure access to affordable, reliable, sustainable and modern energy for all.¨

Additionally, access to energy has a direct correlation to HDI (Human Development Index).



Major Options for Reducing Greenhouse Gas Emissions

"Energy efficiency" means economically efficient reductions in energy intensity.

Need to reduce energy intensity,

(the amount of energy used to produce a unit of GDP or to perform some desirable service.)

Sustainable Development (Integrated Approach)

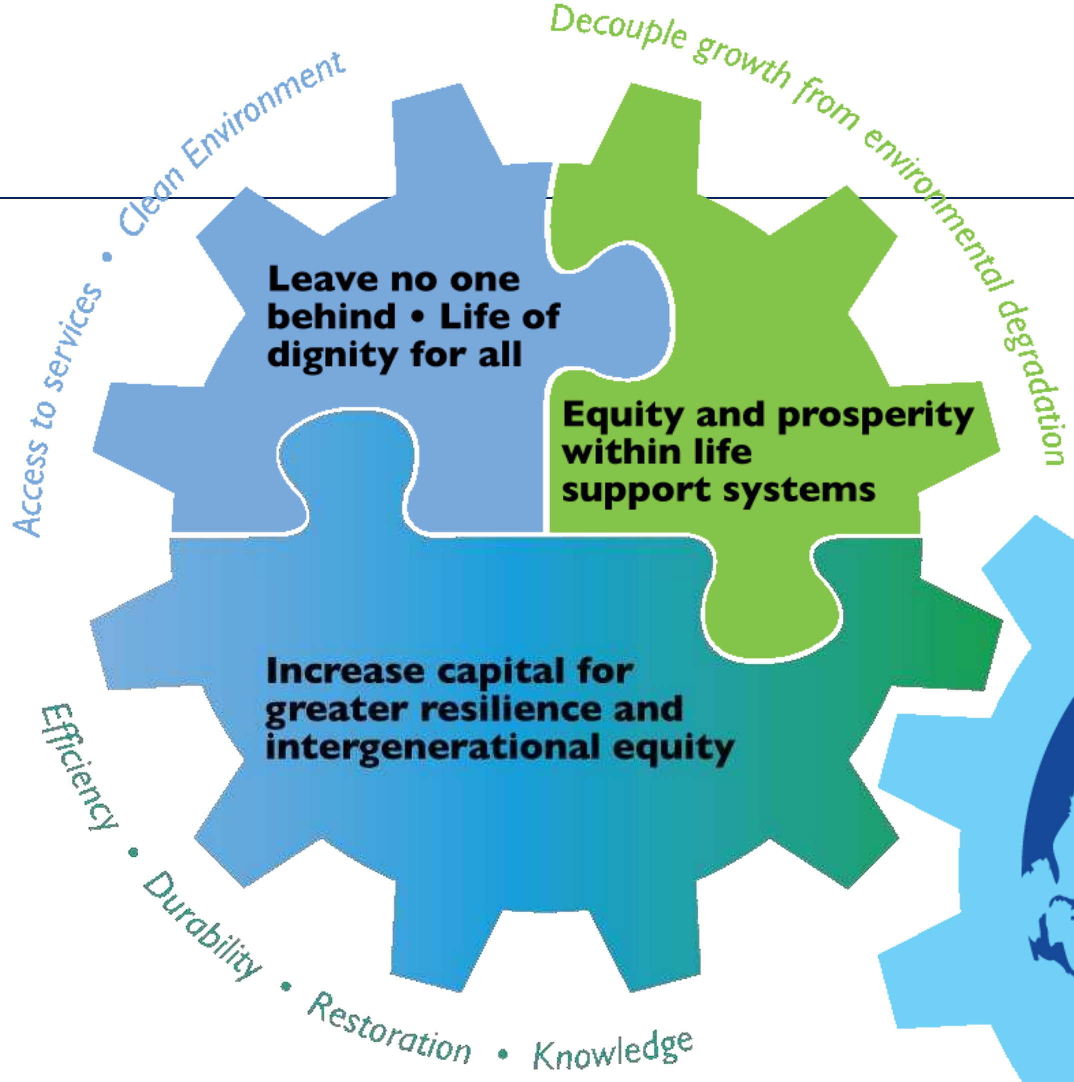
Sustainable Development: is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

An integrated approach provides for ***strategic decisions and actions*** aimed at meeting the objectives of sustainable development and poverty eradication. Former UN Secretary-General Ban Ki-moon makes a strong case for integration in his 2014 Synthesis Report on the post-2015 Agenda and SDGs, highlighting the need for ***a people-centred and planet-sensitive*** agenda and stressing:

*"This integration provides the **basis for economic models that benefit people and the environment**; for **environmental solutions that contribute to progress**; for **social approaches that add to economic dynamism** and allow for the **preservation and sustainable use of the environmental commons; and for reinforcing human rights, equality, and sustainability.** Responding to all goals as a **cohesive and integrated whole will be critical to ensuring the transformations needed at scale."***

The complexity, magnitude and the interconnectedness of environmental change does not mean that decision-makers are faced with the stark choice of "***doing everything at once in the name of integrated approaches or doing nothing"*** in the face of complexity

INTEGRATION: 3 principles



An **integrated approach** implies that **all aspects of sustainable development have to be taken into account when addressing certain issues** that may initially seem to be only about one dimension.

Delivery of Agenda 2030 requires us to have an Action Oriented Outlook to plan for the future!

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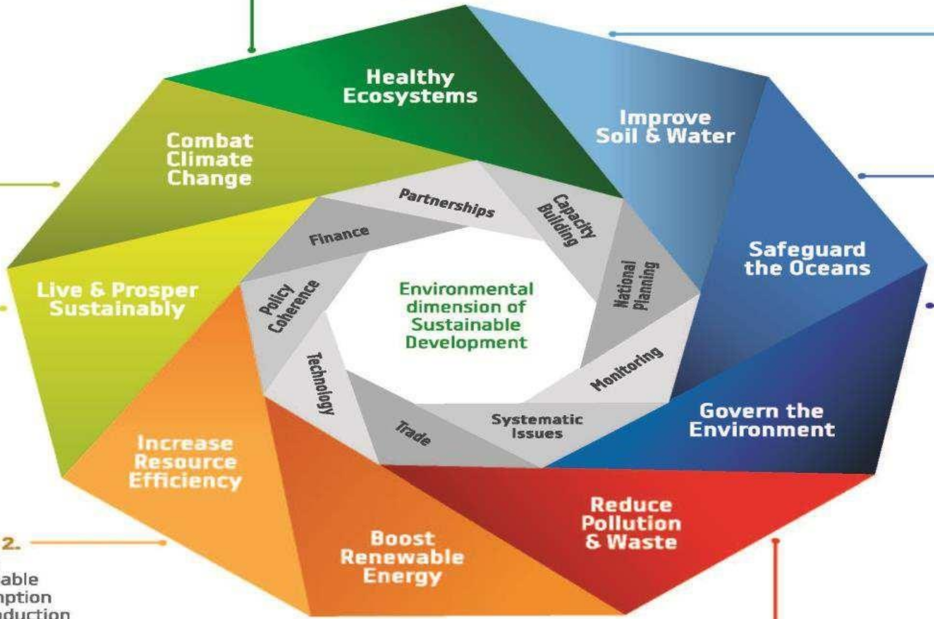
Delivery of Agenda 2030 requires us to have an Action Oriented Outlook to plan for the future!

Environmental sustainability for the Sustainable Development Goals in the 2030 Agenda

In September, the 2030 Agenda for Sustainable Development is expected to be adopted at the United Nations summit held in New York. The 17 Sustainable Development Goals build on the eight Millennium Development Goals and aim to end poverty, protect the planet, and ensure peace and prosperity for all.

(X) = related goal



15 LIFE ON LAND — **Goal 15.** Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
(1) (3) (6) (8) (9) (11) (12)

2 ZERO HUNGER — **Goal 2.** End hunger, achieve food security and improved nutrition and promote sustainable agriculture
(1) (5) (10) (11) (12) (14)

6 CLEAN WATER AND SANITATION — **Goal 6.** Ensure availability and sustainable management of water and sanitation for all
(1) (12) (15)

14 LIFE BELOW WATER — **Goal 14.** Conserve and sustainably use the oceans, seas and marine resources for sustainable development
(1) (2) (8) (15)

10 REDUCED INEQUALITIES — **Goal 10.** Reduce inequality within and among countries
(1) (12) (14) (15)

16 PEACE, JUSTICE AND STRONG INSTITUTIONS — **Goal 16.** Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
(1) (10) (12)

4 QUALITY EDUCATION — **Goal 4.** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
(1) (8) (12)

5 GENDER EQUALITY — **Goal 5.** Achieve gender equality and empower all women and girls
(1) (2) (3) (4) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16)

3 GOOD HEALTH AND WELL-BEING — **Goal 3.** Ensure healthy lives and promote well-being for all at all ages
(1) (8) (10) (11) (14) (15)

7 AFFORDABLE AND CLEAN ENERGY — **Goal 7.** Ensure access to affordable, reliable, sustainable and modern energy for all
(1) (2) (3) (4) (6) (10) (12) (14) (15)

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE — **Goal 9.** Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
(1) (2) (4) (8) (10) (12) (13)

12 RESPONSIBLE CONSUMPTION AND PRODUCTION — **Goal 12.** Ensure sustainable consumption and production patterns
(1) (2) (8) (11) (14) (15)

11 SUSTAINABLE CITIES AND COMMUNITIES — **Goal 11.** Make cities and human settlements inclusive, safe, resilient and sustainable
(1) (2) (3) (8) (9) (12) (13)

1 NO POVERTY — **Goal 1.** End poverty in all its forms everywhere
(5) (10) (12) (16)

8 DECENT WORK AND ECONOMIC GROWTH — **Goal 8.** Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
(1) (10) (12)

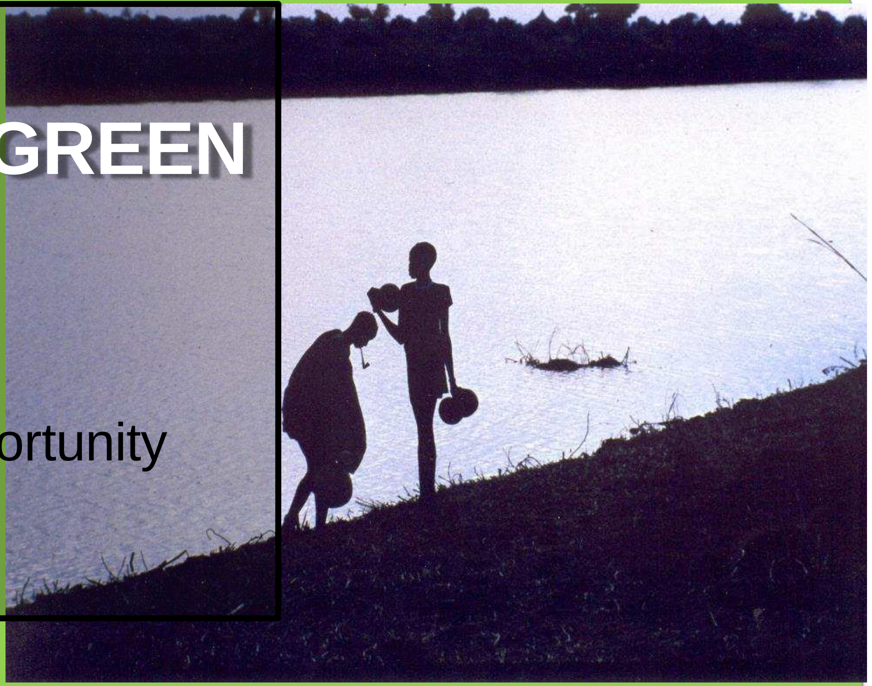
13 CLIMATE ACTION — **Goal 13.** Take urgent action to combat climate change and its impacts
(1) (7) (8) (11) (12)

Sustainable Development Goals

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

POVERTY ERADICATION THROUGH AN INCLUSIVE GREEN ECONOMY

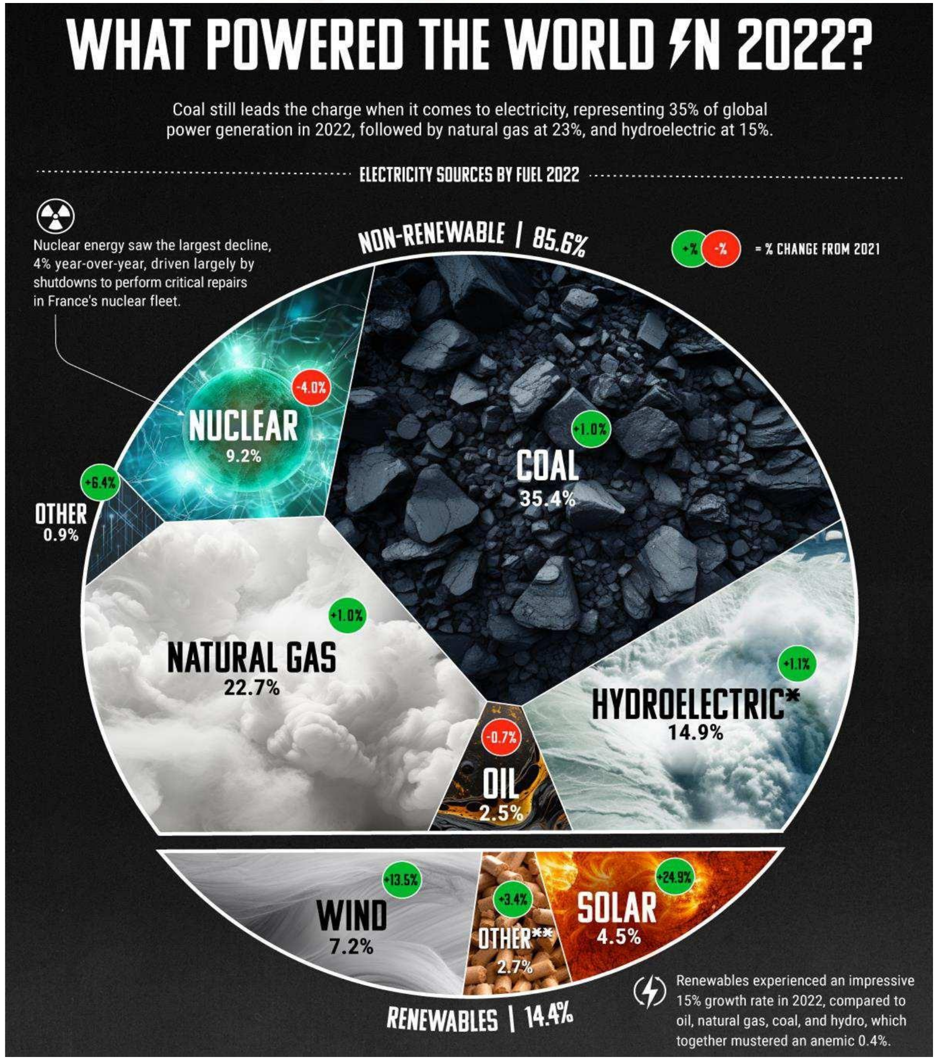
- Redefine poverty
- Redefine economic growth
- Green, decent jobs and equal opportunity
- Social protection and
- Universal services



Dinka women in Abyei. Photo credit: M. Niamir-Fuller 1981

Global Energy Sources

- In 2022, ***29,165.2 terawatt hours (TWh)*** of electricity was generated around the world, an increase of 2.3% from the previous year.
- ***Coal still leads the charge when it comes to electricity, representing 35.4%*** of global power generation. Over three-quarters of the world's total coal-generated electricity is consumed in just three countries. ***China is the top user of coal, making up 53.3% of global coal demand, followed by India at 13.6%, and the U.S. at 8.9%.***
- ***Renewables represented 14.4%*** of total electricity generation with an annual growth rate of 14.7%, driven by big gains in solar and wind.
- For ***Nuclear power, Disruptions at the Zaporizhzhia in Ukraine and shutdowns in France's nuclear fleet to address corrosion found in the safety injection systems of four reactors led to a 4% drop in global use***, year-over-year.

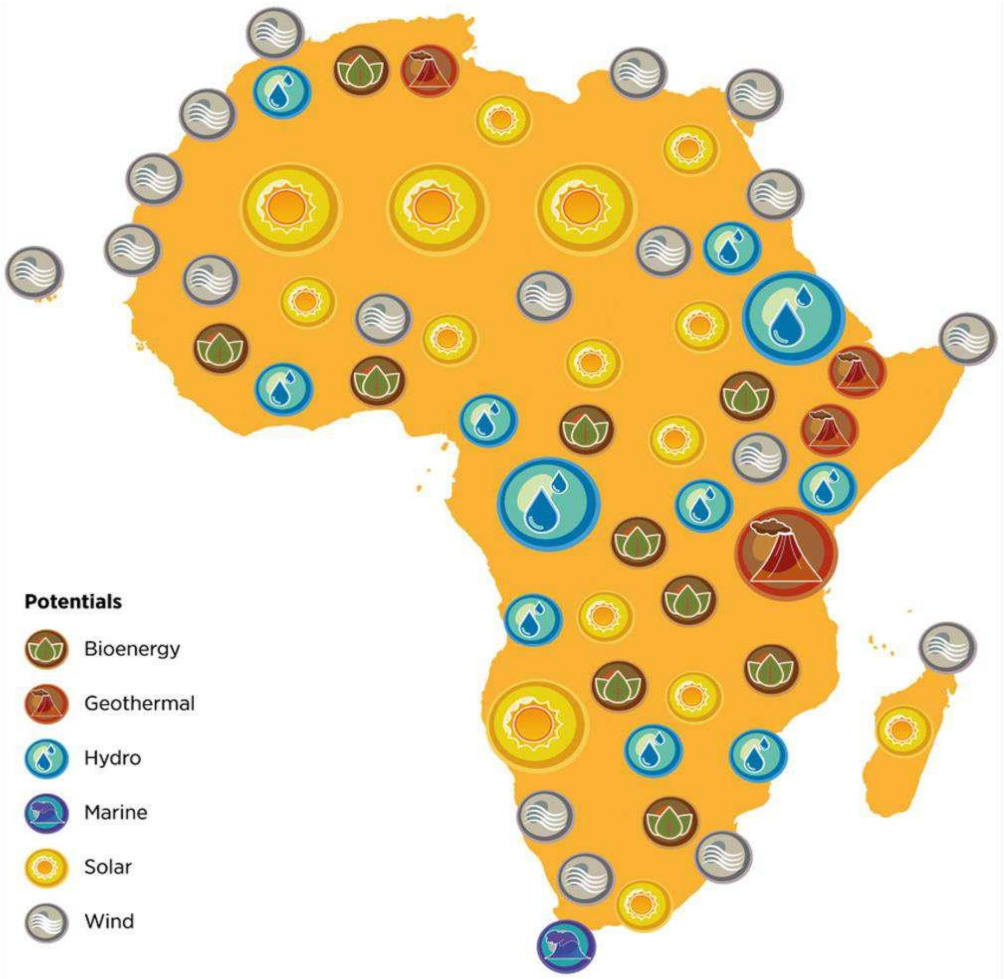


Energy Potentials:-Renewable Energy

It's sometimes said that if the Industrial Revolution had taken place in Africa, the world would now run entirely on solar energy.

Africa's renewable energy resources are diverse and enormous in quantity including:

- Unlimited solar potential (10 TW)
- Abundant hydro (350 GW)
- Wind (59 TW)
- Geothermal energy sources (15 GW)



Source: https://geographical.co.uk/climate-change/african-energy

Example of a Solar Farm (PV Technology)

Africa Energy Potentials - Critical Minerals

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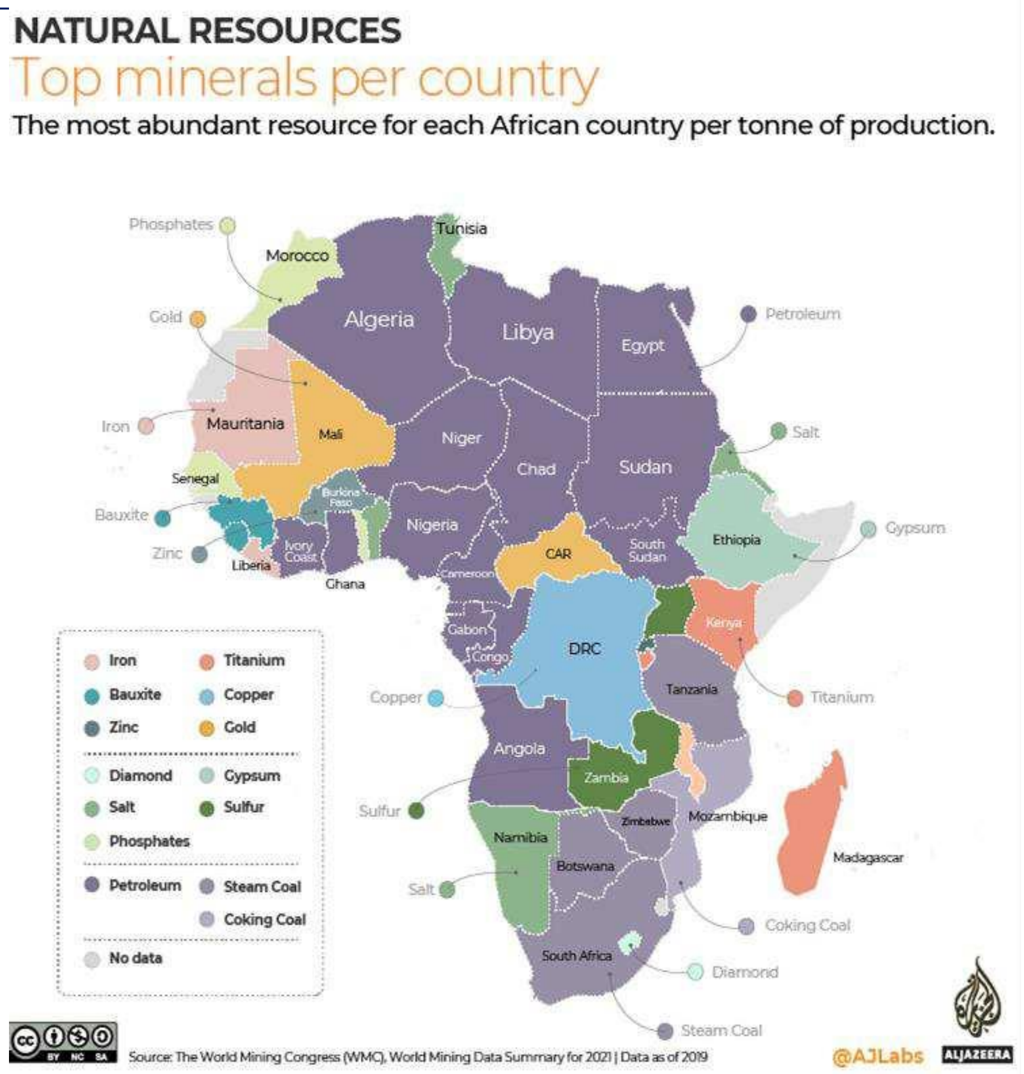
- The ***renewable energy momentum*** in recent years have become synonymous with ***clean energy revolution.*** But while we focus on the advanced technologies and innovative designs that drive these solutions, we often overlook what makes it all possible: ***critical minerals.***
- Africa's ***vast resources of minerals*** that are critical for ***multiple clean energy technologies*** are set to create new export markets but need to be managed well.
- Africa accounts for over ***40% of global reserves of cobalt, manganese and platinum – key minerals for batteries and hydrogen technologies.***
- South Africa, Democratic Republic of the Congo and Mozambique have a significant share of ***global production*** today, but many other countries may hold undiscovered deposits.
- ***Lithium*** deposits are also abundant in Africa especially in the Democratic Republic of Congo and Zimbabwe, . We need to value add and play our part in the ***renewable energy space.***



Access to Electricity

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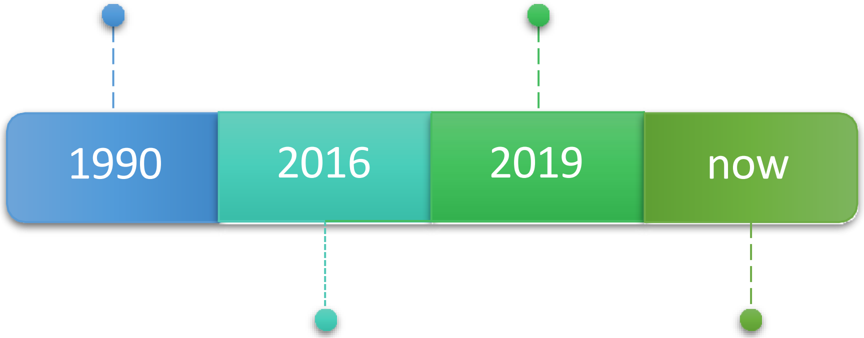
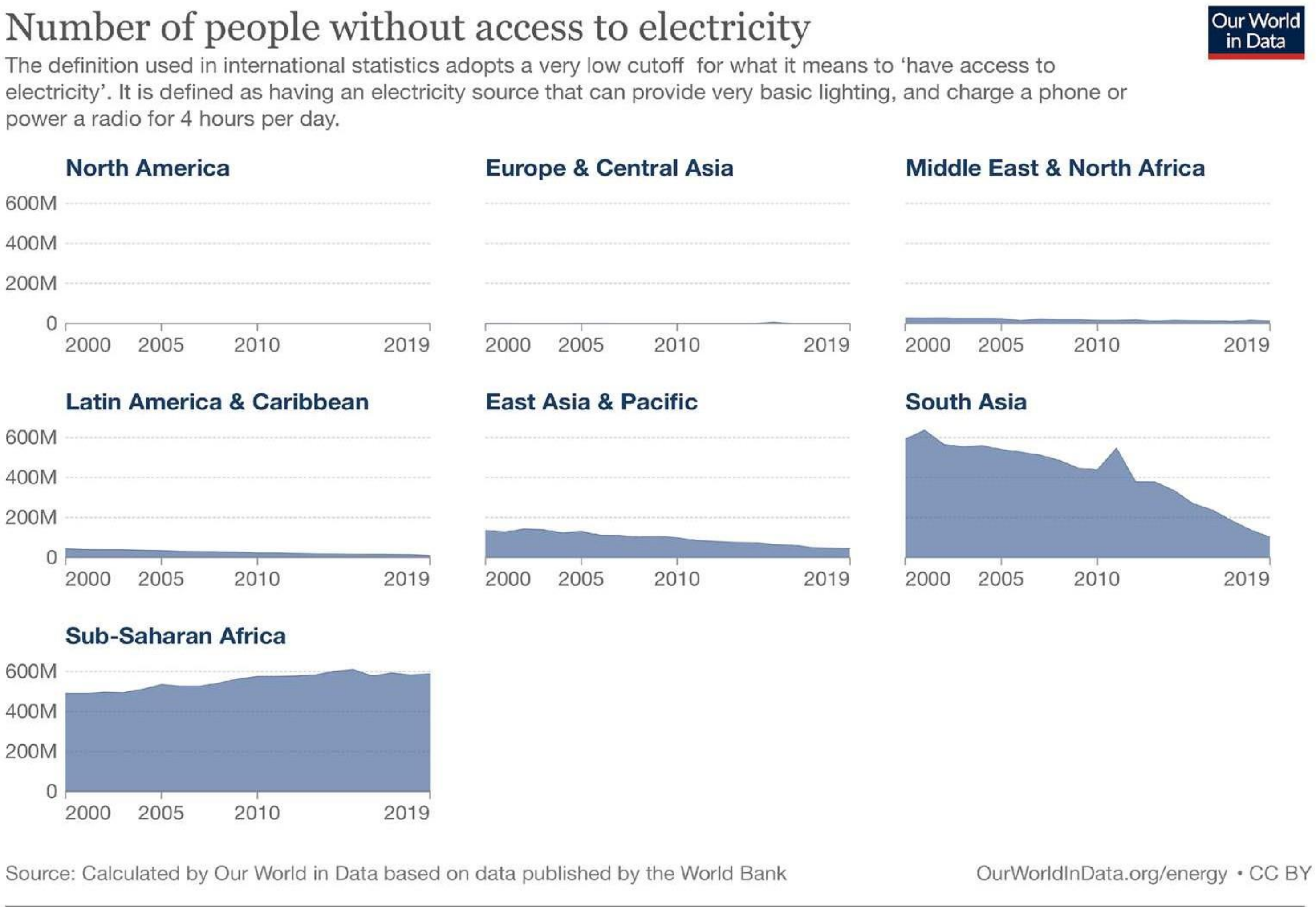
In 1990, nearly half (45 percent) of people in the world without access lived in South Asia.

Despite the share of the population with electricity rising steadily, population growth meant that the total number of people without access remained at 2016 levels.



By 2016 this had shifted significantly: the largest share lived in Sub-Saharan Africa (which is now home to nearly two-thirds of the world population without electricity access).

Accelerated progress will be needed to ensure this number now continues to fall.



The Role of Nuclear in Energy Transition

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- The role of nuclear in the energy transition, for ***decarbonizing both the electric grid and industrial facilities should be enhanced.*** This comes after a decade of low investments, accumulating nuclear waste, an aging fleet of reactors, public opposition, and regulatory mandates that stalled nuclear's growth globally and led to declines in production.

- Meanwhile we note, the nuclear industry has maintained its ***safety record, made remarkable progress in fusion and advanced nuclear reactors, and improved operating safety and efficiency.***

- The ***Future of Nuclear in the Energy Transition should address how headways in advanced nuclear reactors, fusion, and waste management can overcome the challenges of economic feasibility, efficient and safe waste disposal, and build public and regulatory support*** for the ***increased deployment of nuclear energy Africa***.

- African countries or regions should consider ***nuclear energy as it generates significant energy without emissions.*** This can be either ***large scale nuclear plants that can serve regional power pools*** or innovative technologies such as ***Small Modular Reactors (SMRs), Micro Modular Reactors (MMRs),*** and ***Nano Modular Reactors (NMRs)*** which are small, flexible, and require less infrastructure compared to large-scale nuclear plants.

Wake Up Call to Africa

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- In a report released at COP27, the rush for ***Africa's oil and gas has nothing to do with increasing energy access for Africans*** with around 89 per cent of the new LNG infrastructure being built for export, mainly to Europe and Asia.

- The IEA's 2022 projection predicted that, even if Africa developed all its known gas reserves, the ***continent's contribution to global emissions would rise from 3% to 3.5%*** – the equivalent of a small European economy such as Greece.

- The cost of the transition to ***Net zero is significant for already prosperous and dominant economies.*** What of Africa? We need to create a just framework to energy transition and net-zero transition which leaves no place and no one behind.

Way Forward

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- We believe the future of energy is ***low carbon*** and to achieve this African countries should first industrialize and then gradually utilize ***portfolio carbon intensity (PCI)*** systems that encompasses the ***full value chain carbon intensity of the products and services used***.
- In attempting to address Africa's energy gap, ***unconventional solutions and innovation must be employed.***
- Africa must be ***open to all solutions and options available*** on the table ***to achieve developmental aspirations that secure the lives and livelihood of its population.***
- A comprehensive strategy for the transformation of the ***African energy system also requires large-scale deployment of advanced coal technologies with carbon capture and storage (CCS)*** in order to address adequately both climate and energy security concerns.
- ***Mini grids can be employed in provision of energy to rural areas and small towns while conventional systems with some renewable solutions*** that will not disrupt stability can be used for cities and industrial areas.
- The role of nuclear in the energy transition, for decarbonizing both the electric grid and industrial facilities should be ***An all-inclusive global policy framework*** is required ***to facilitate the flow of finance, capacity, and technologies between countries.***
- The ***polluter must pay principle*** and the implementation of the ***Paris Agreement*** by all countries will go a long way to improve the ***carbon footprint of the world.***

RECOMMENDING A JUST ENERGY TRANSITION FOR AFRICA

Lisbon March 4th 2024 Engineering Solutions for a Sustainable World

Energy plays a fundamental role across multiple sectors. The choices Africa makes about energy systems will determine many other aspects of development*. Fit for purpose, modern and low-carbon, a new model of energy provision must address a number of important factors.* The ***system must provide accessible, affordable, reliable and sustainable energy to around 600 million Africans that currently lack access to electricity as an overriding priority for development.***

To achieve this goal, Africa will need to move away from outmoded models based on centralised infrastructure, towards more modern, integrated energy solutions that take advantage of Africa's massive renewable energy potential. The new energy system will embody a number of key principles and approaches that underpin a new African energy vision, including:

- Ensuring ***African ownership and agency*** in energy initiatives and plans
- ***Integrating energy systems design*** into wider development objectives and planning
- ***Establishing clear policy priorities, such as support for clean cooking and diversification of energy generation and ownership***
- Provide scope for the delivery of energy as a common good and to ***genuinely foster energy democratisation***
- ***Ensuring stakeholder participation, equity and sufficiency in terms of energy use***

Recommendations & Takeaways

- ***The Sustainable Energy Roadmap with climate stewardship must align the climate change and current developmental Aspirations of Agenda 2063 of the Africa we want and should further identify financial, funding, or incentive mechanisms needed to best position Africa to meet the energy challenges of the future.***
- ***We have noted that the net-zero transition model was initiated by developed countries with established and diverse energy systems*** and that the top four emitting countries (USA, China, Russia and India) contributed about ***55% of the world's GHG emissions compared to Africa (with a total of 54 countries) 's 3.5%.***
- ***Africa has stayed very long*** without meeting its energy needs, there is now a growing awareness among African leaders that the ***solution*** to the problem can only be sought when the continent looks at the peculiarity of its problem and take action from that perspective. In that respect all options (energy sources) need to be considered.
- Africa's energy ***policies*** should follow a ***just pathway informed by international best practices and lessons learned elsewhere.***
  - ***"The continent need to have enough energy to industrialize first, before it can fully join the industrialized countries in the 'energy transition' journey".*** – Engr. Mustafa Shehu – WFEO President.
  - ***"We cannot transition in darkness"***– His Excellency Paul Mashatile, the Deputy President, Republic of South Africa.

CONCLUSION REMARKS

It can be concluded that some emerging key ***considerations for energy transition policies*** for Africa include:

- ***Security of supply*** - ensuring a reliable and affordable supply of energy to meet demand and avoid shortages
- ***Environmental sustainability*** - minimizing the negative impact of energy production and use on the environment, particularly with regards to climate change
- ***Accessibility and affordability*** - ensuring that energy is available and affordable to all members of society, including those who are economically disadvantaged
- ***Innovation and research*** - investing in new technologies and research to develop cleaner, more efficient, and less expensive sources of energy
- ***Market competition*** - promoting competition among energy providers to ensure fair prices for consumers and encourage innovation and efficiency.

IN CONCLUSION

African's contribution to the emission of ***Carbon dioxide (CO_2) is by far the lowest with only 3 to 4% of the global emissions*** and Africa is a continent with vast unexploited energy resources. As Africans, our ***focus on issues regarding Energy Transition should consider the women in the villages, the vast unemployed, intelligent and vibrant youths and that little boy and girl on the street without food. We should focus on economic and human development of the African continent*** and again balance with the ***carbon reduction, net-zero emission or reduction to net-zero emission issues with due care to energy access.***

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March 4th 2024
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Marie-Line Vaiani

Secretary General, Conseil Français de l’Energie, France

International Panel on Climate Change - Sixth Assessment Report

Mitigation and Adaptation Options across Systems

C.3 Rapid and far-reaching transitions across all sectors and systems are necessary to achieve deep and sustained emissions reductions and secure a liveable and sustainable future for all. These system transitions involve a significant upscaling of a wide portfolio of mitigation and adaptation options. Feasible, effective, and low-cost options for mitigation and adaptation are already available, with differences across systems and regions. (*high confidence*) {4.1, 4.5, 4.6} (Figure SPM.7)

Finance, Technology and International Cooperation

C.7 Finance, technology and international cooperation are critical enablers for accelerated climate action. If climate goals are to be achieved, both adaptation and mitigation financing would need to increase many-fold. There is sufficient global capital to close the global investment gaps but there are barriers to redirect capital to climate action. Enhancing technology innovation systems is key to accelerate the widespread adoption of technologies and practices. Enhancing international cooperation is possible through multiple channels. (*high confidence*) {2.3, 4.8}

International Panel on Climate Change - Sixth Assessment Report

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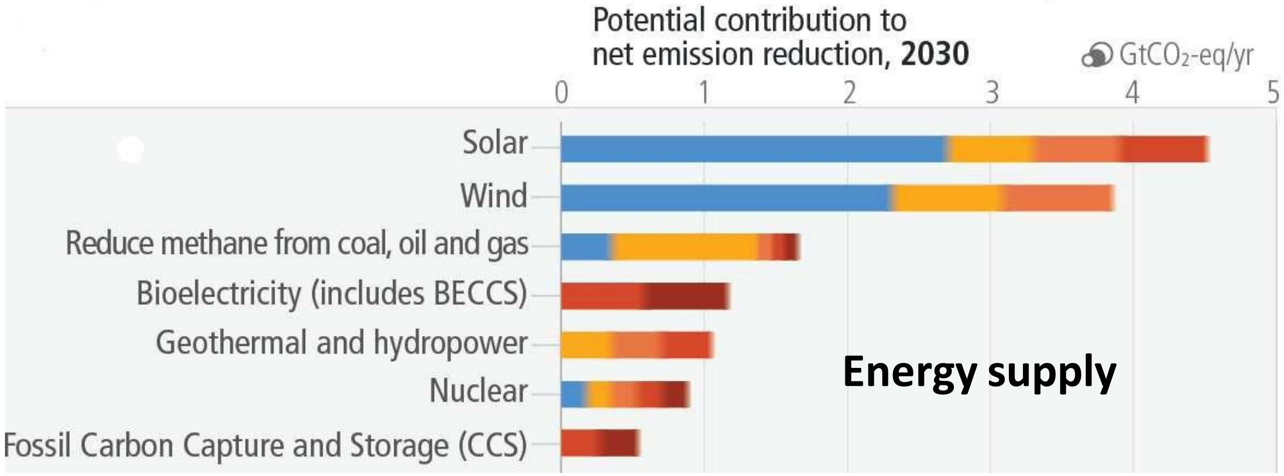
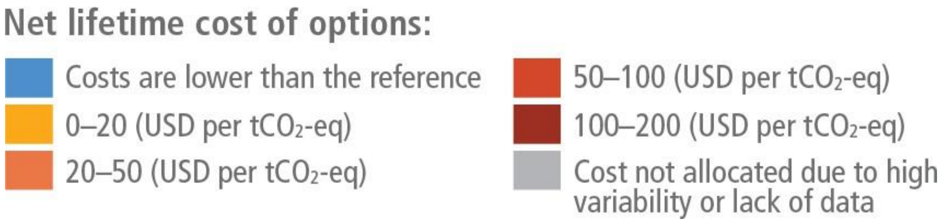
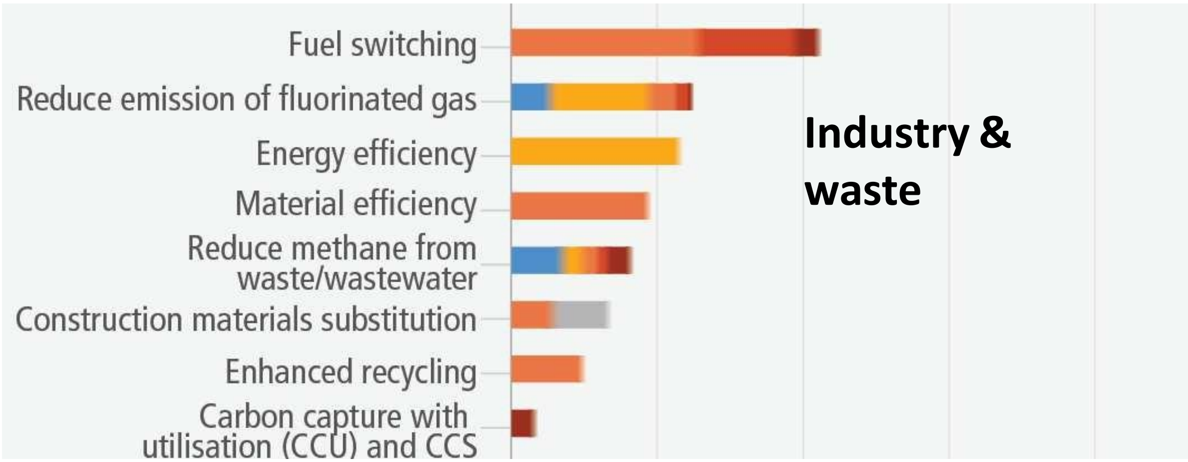
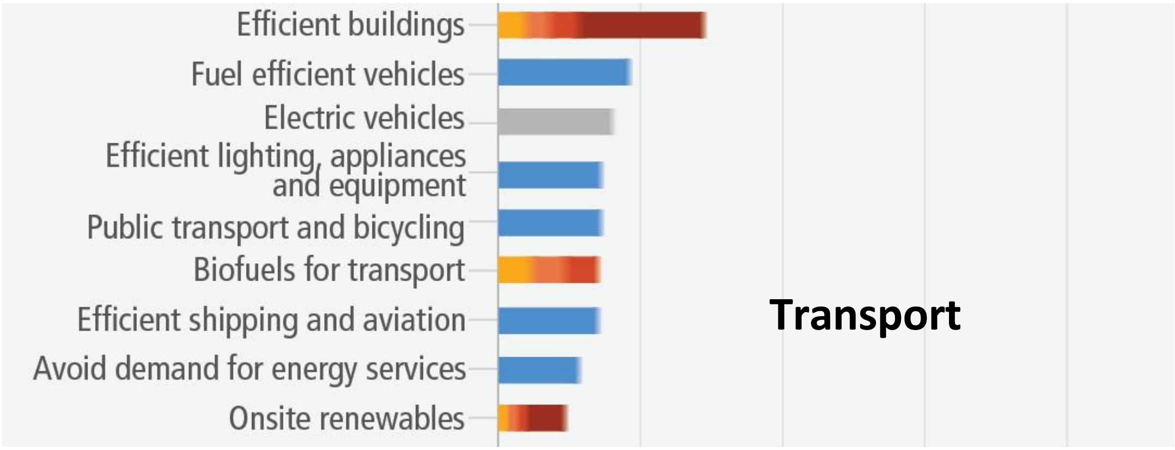


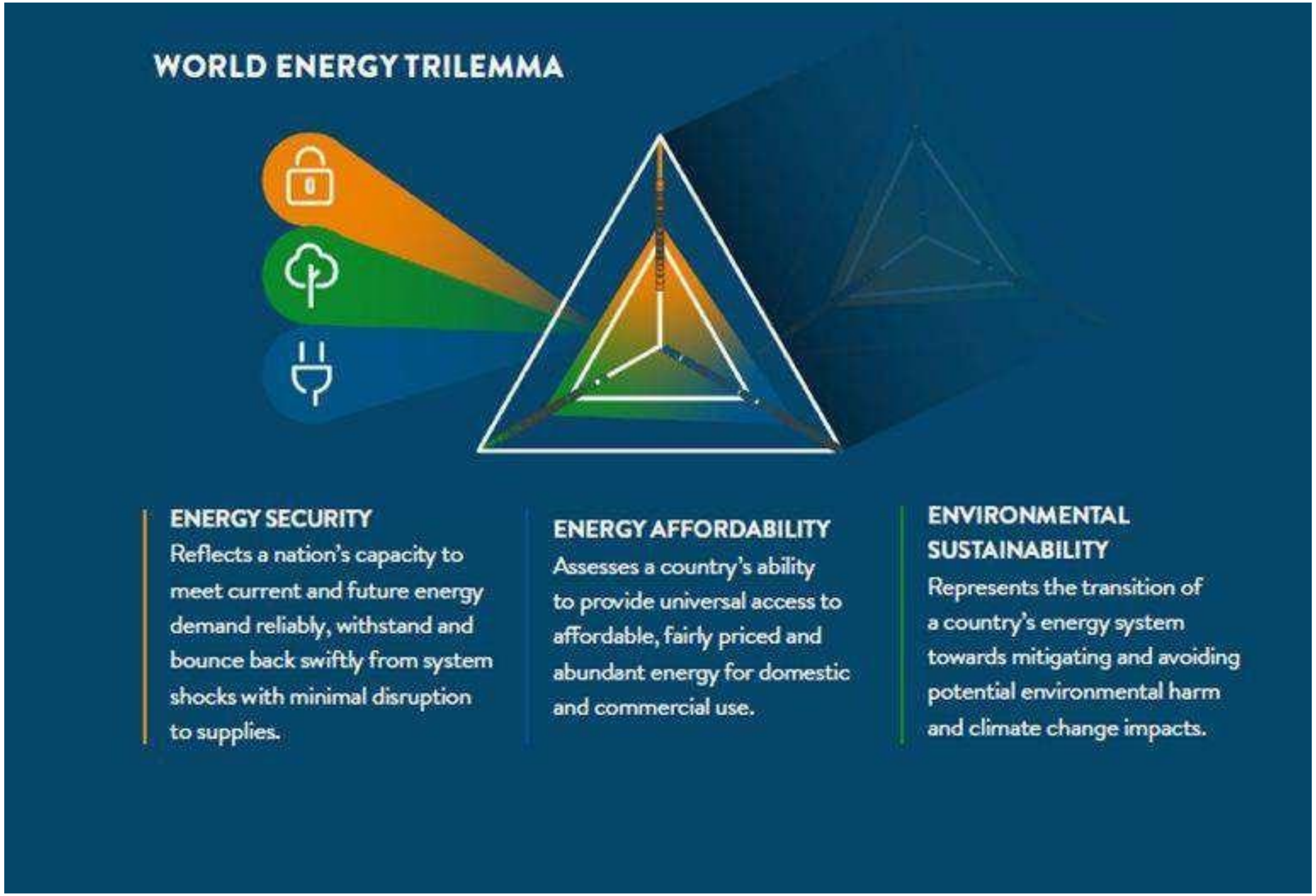


options costing 100 USD tCO_2-eq or less could reduce global emissions by at least half of the 2019 level by 2030





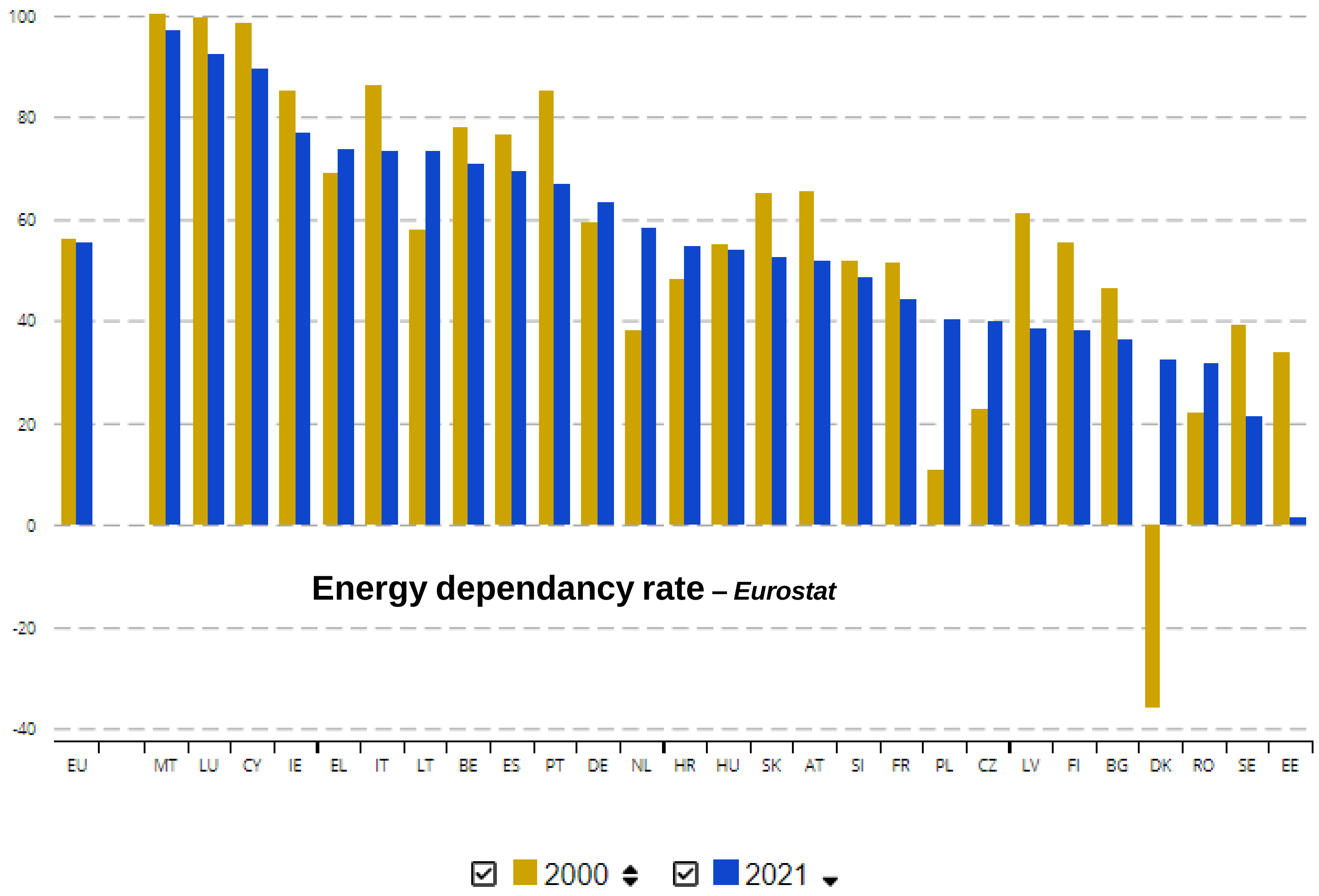
Energy Trilemma



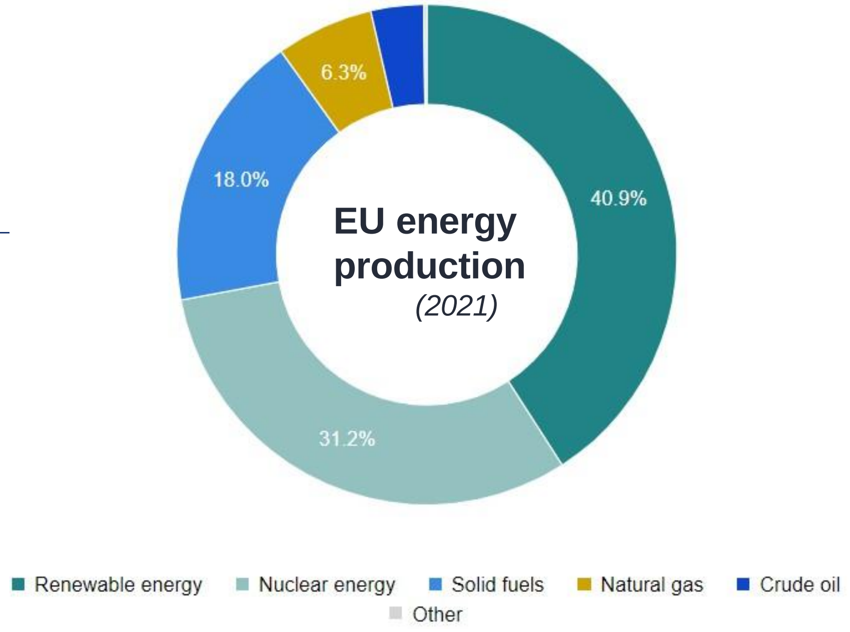
WORLD ENERGY COUNCIL

Europe : energy mix

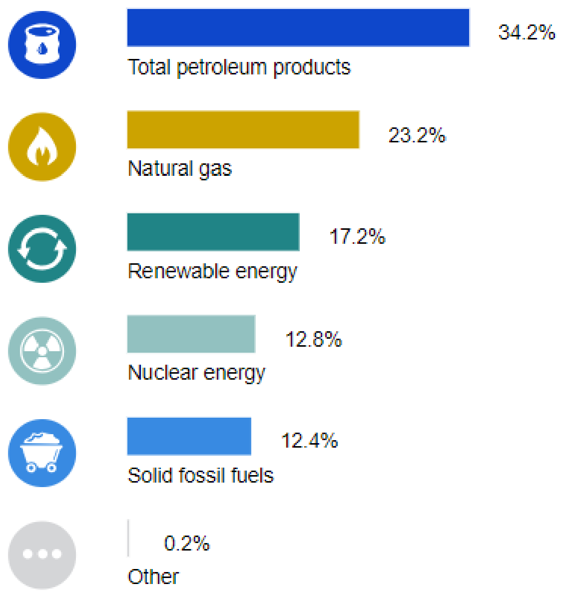
In 2021, the EU produced around 44% of its own energy, while 56% was imported.



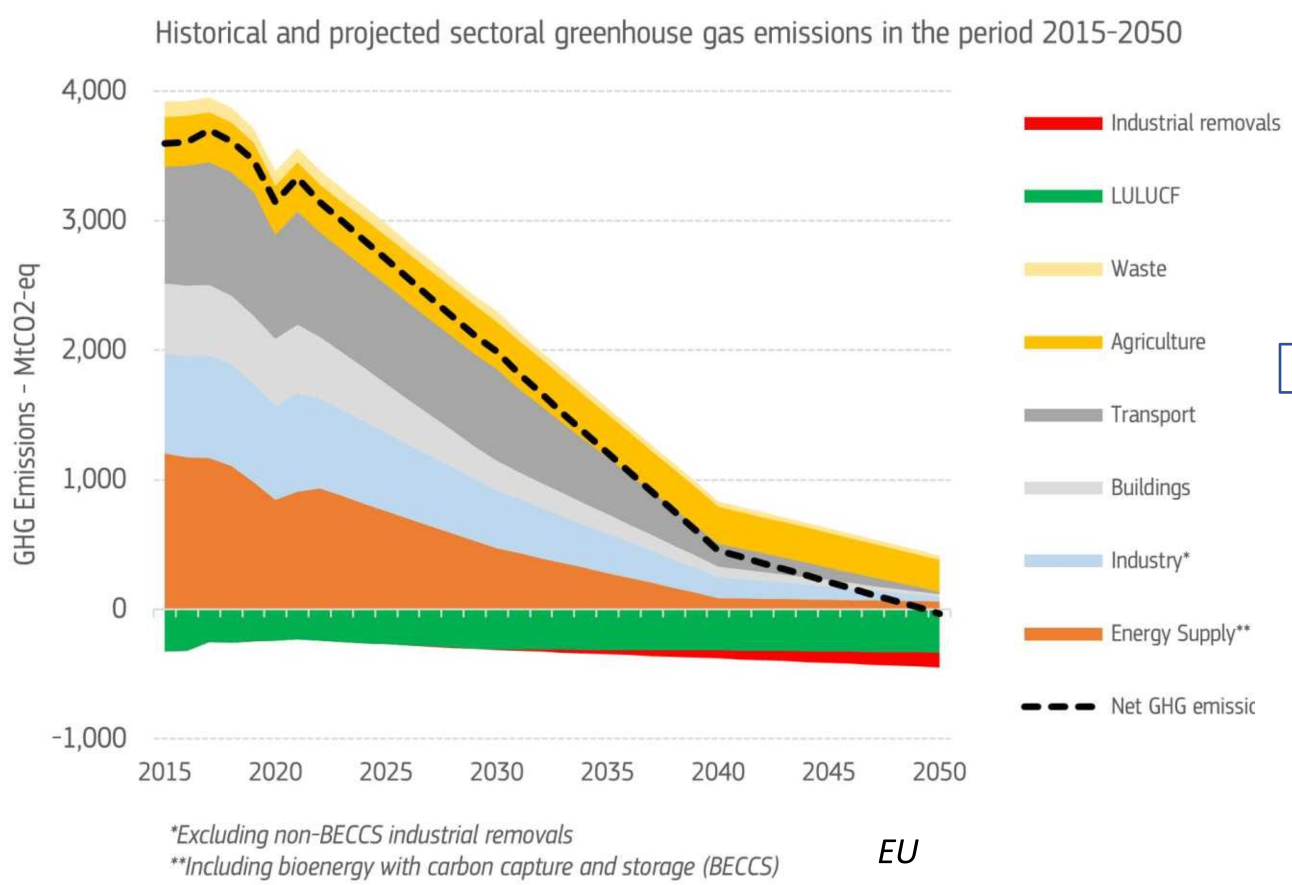
Energy dependancy rate – ***Eurostat***



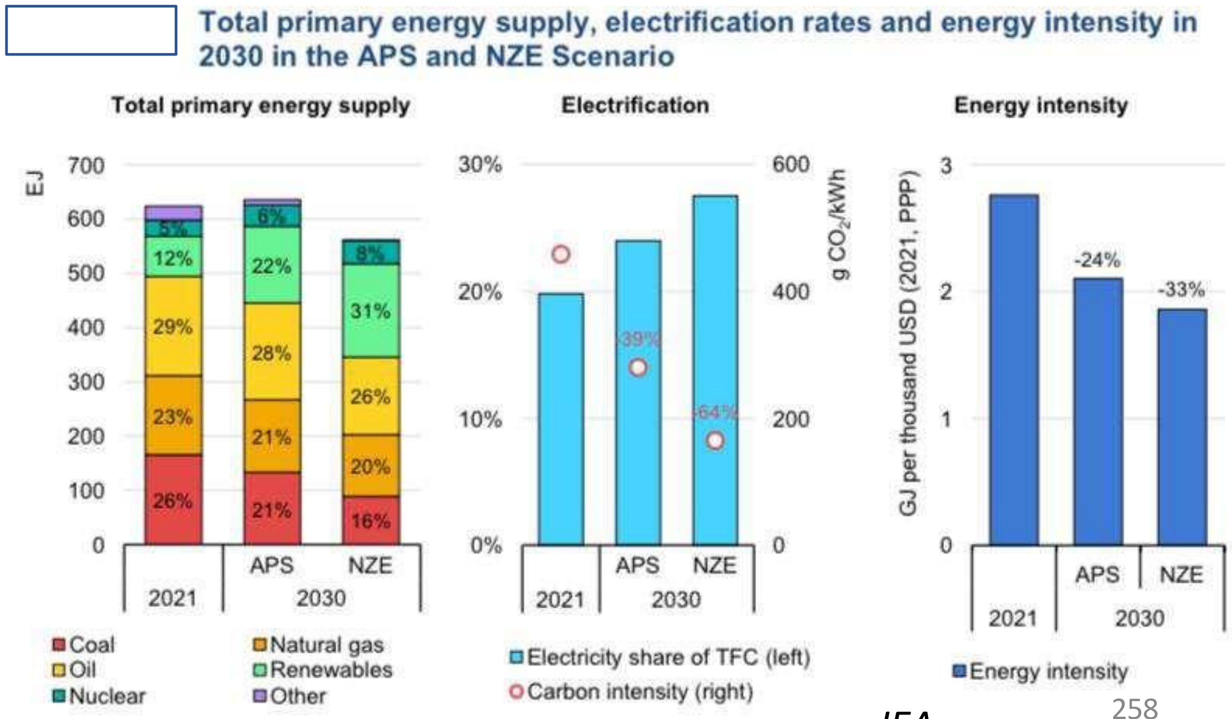
Energy mix for the European Union



Europe, a climate-neutral continent by 2050



EU



IEA

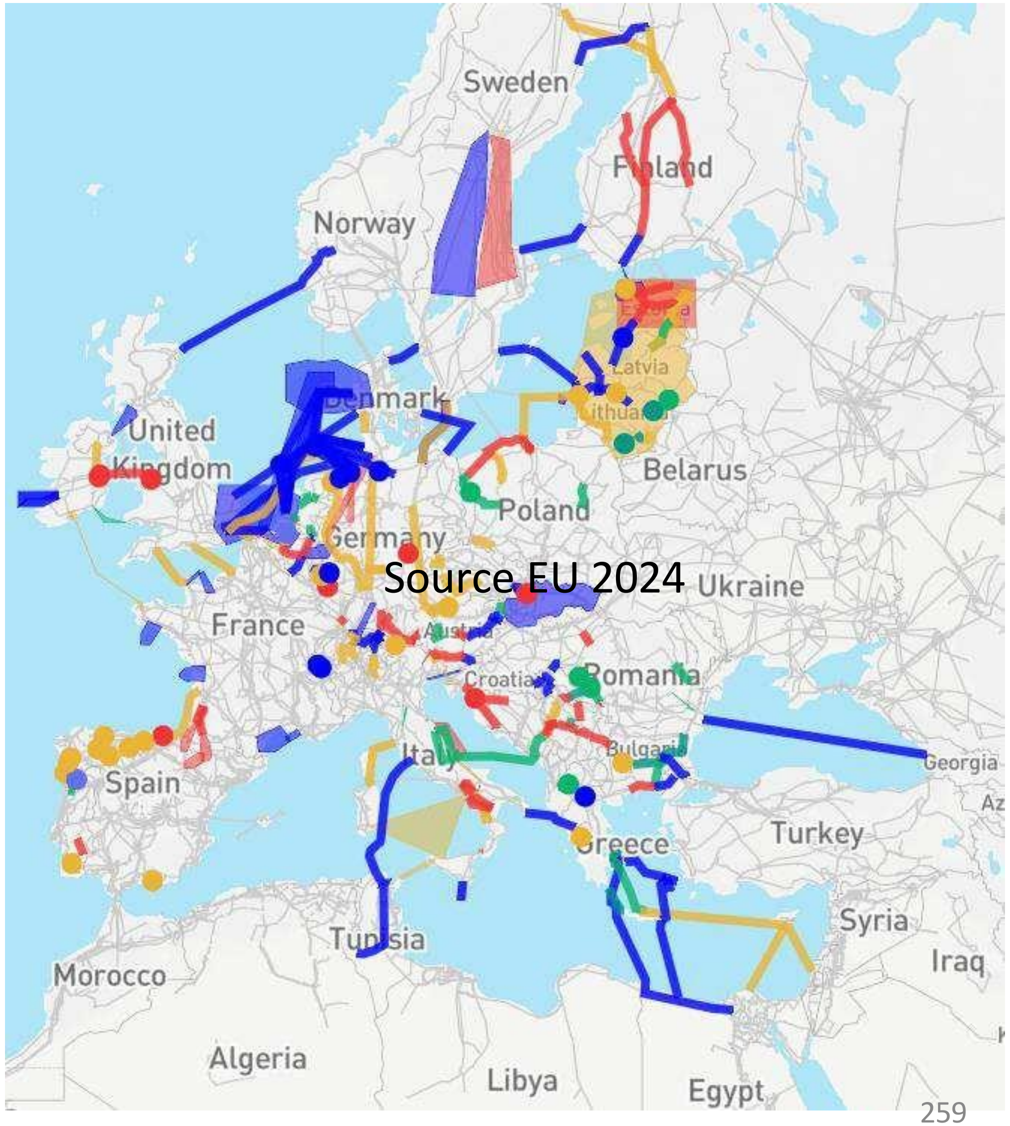
European Electricity interconnections

Interconnections are key for european electricity market(s)

- 305 000 km of power lines operating at the same frequency (50 Hz), more than 400 interconnections linking nearly 600 million European citizens
- Managed in real time by TSO, interdependence provides security of supply across the continent with each operator having access when needed to power-generation capacities located outside of its borders

Growing electrification, develpment of renewables, increasing flexibility challenges => development of electricty interconnections are a priority for Europe

141 projects in TYNDP 2022 of ENTSO-E



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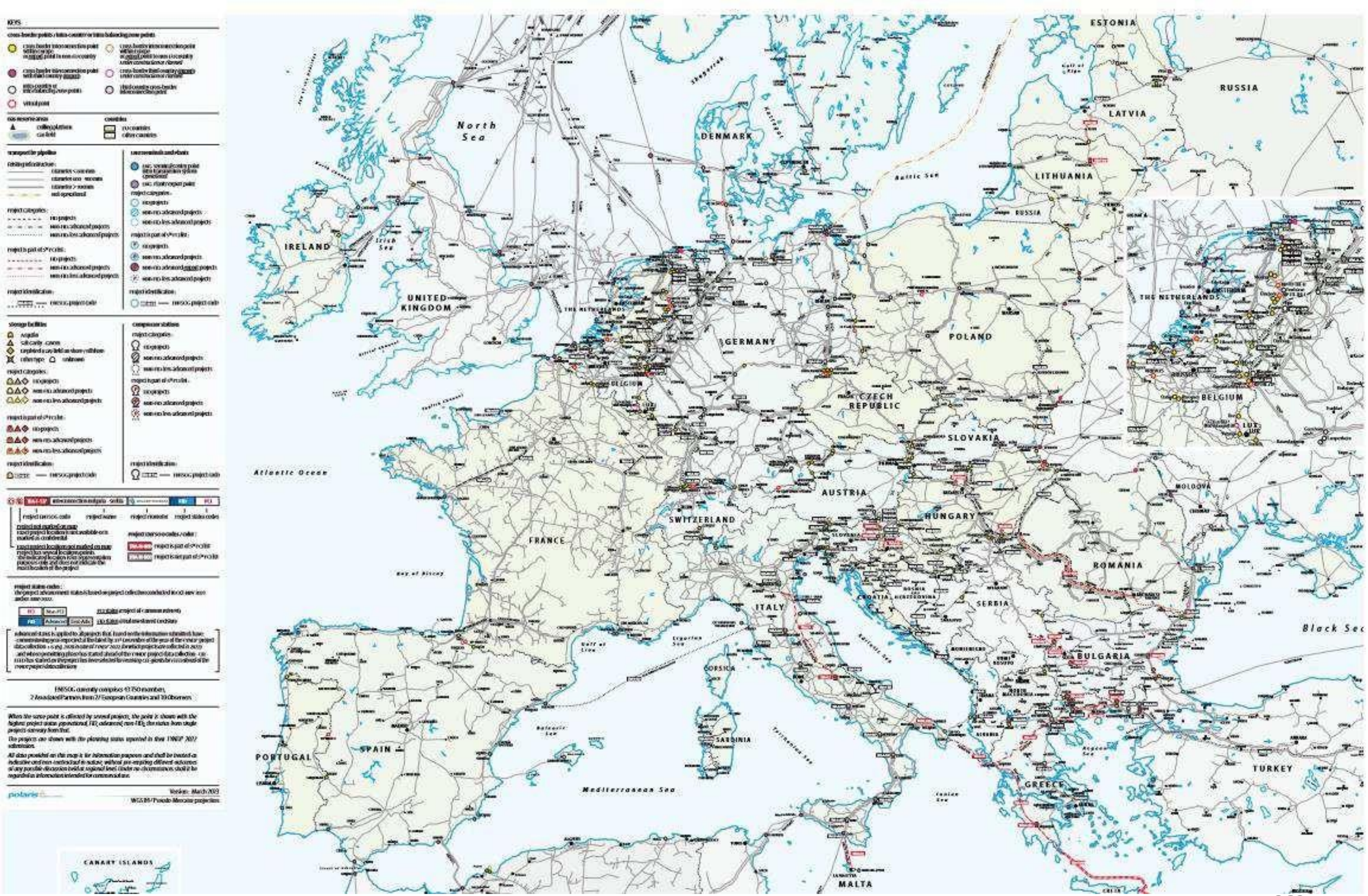
European gas interconnections



Projected CO2 infrastructures – 2030

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Source EU 2024

European H2 interconnection projects

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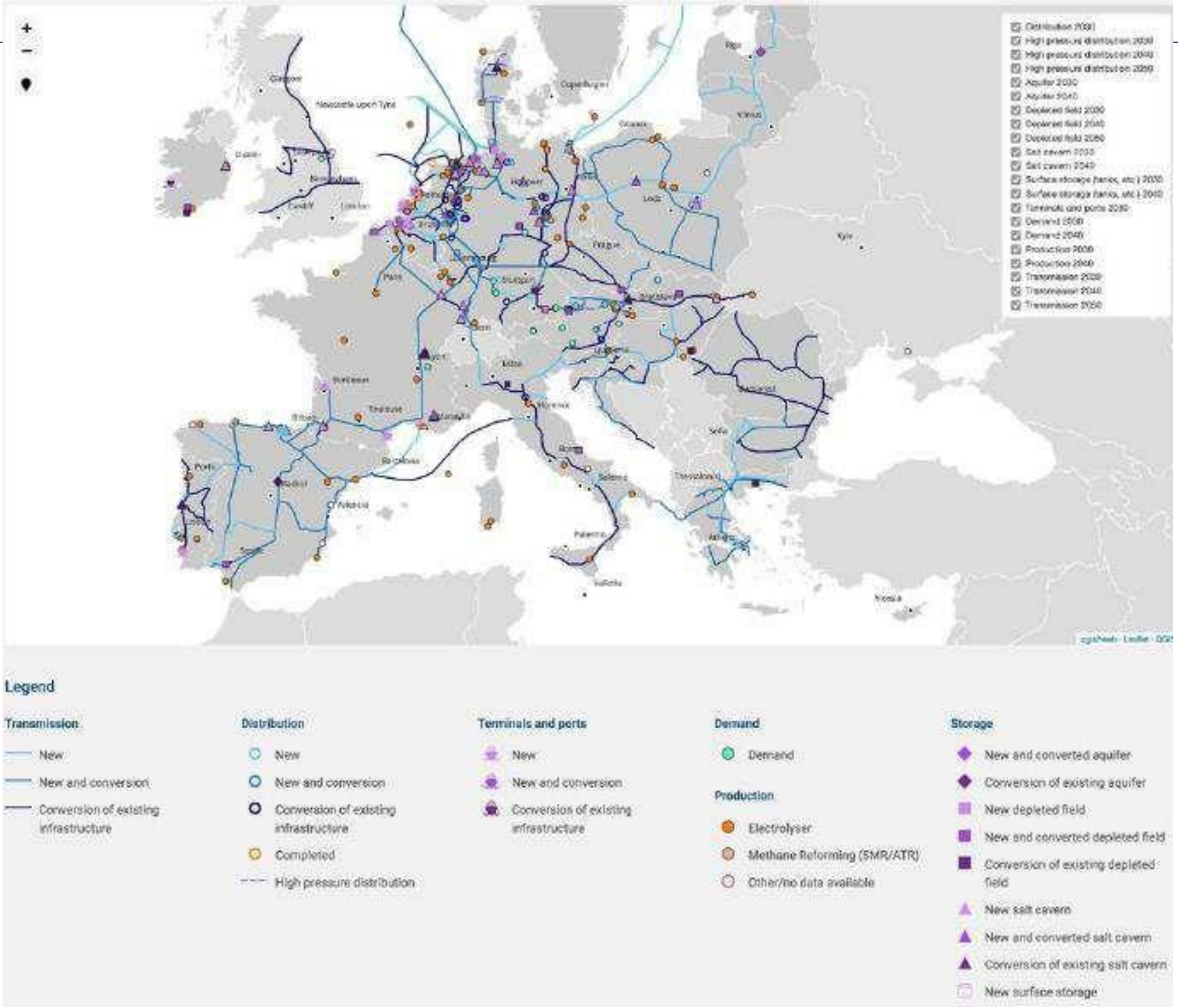
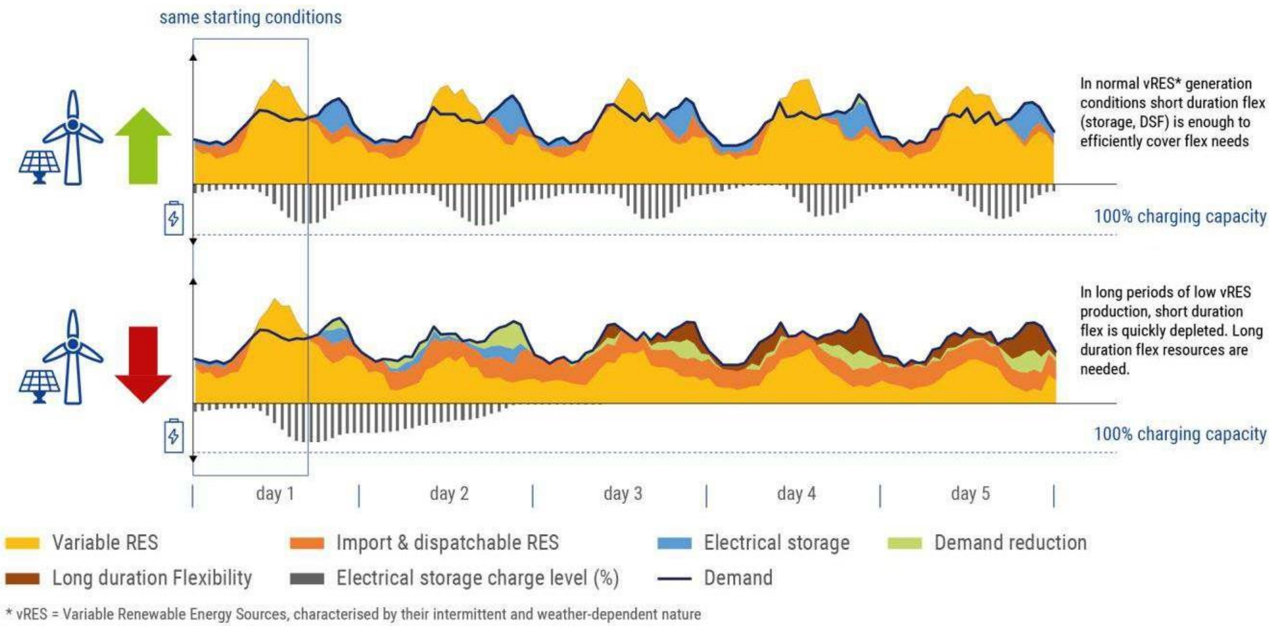
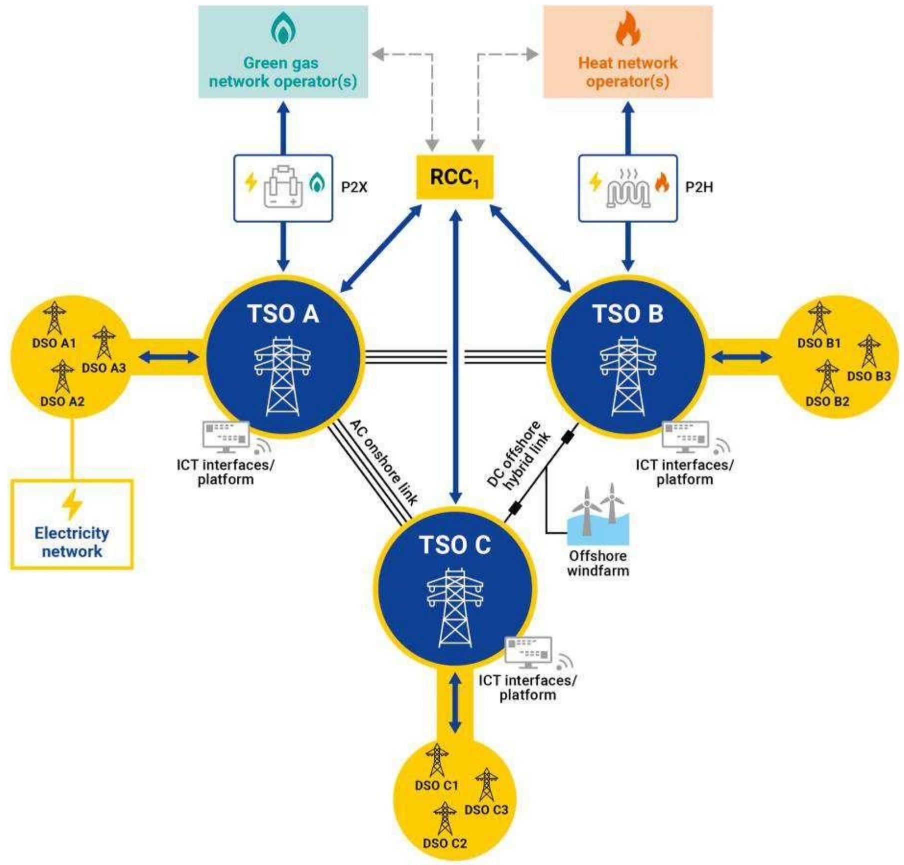


Source European Clean Hydrogen Alliance

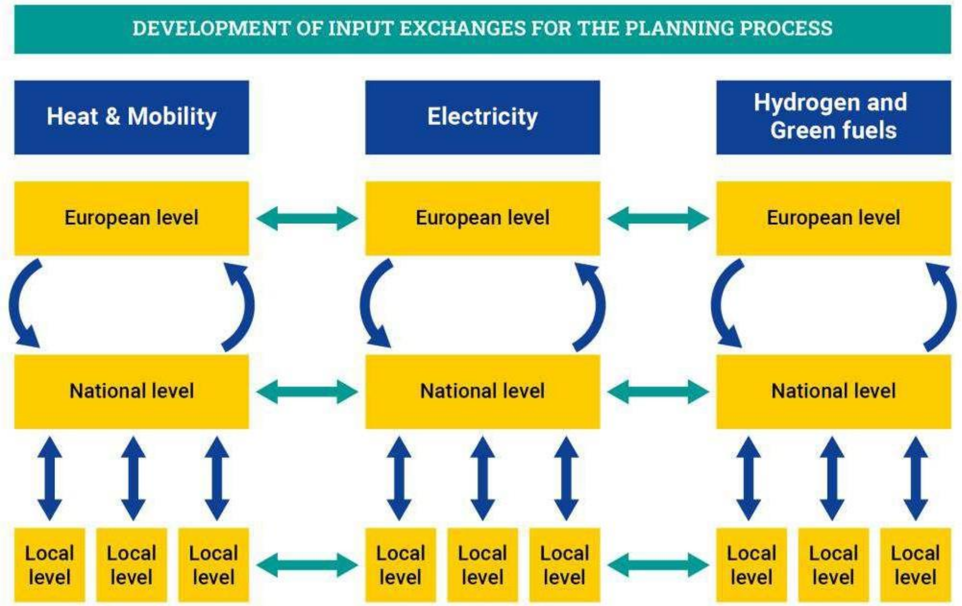
Energy interconnections : challenges

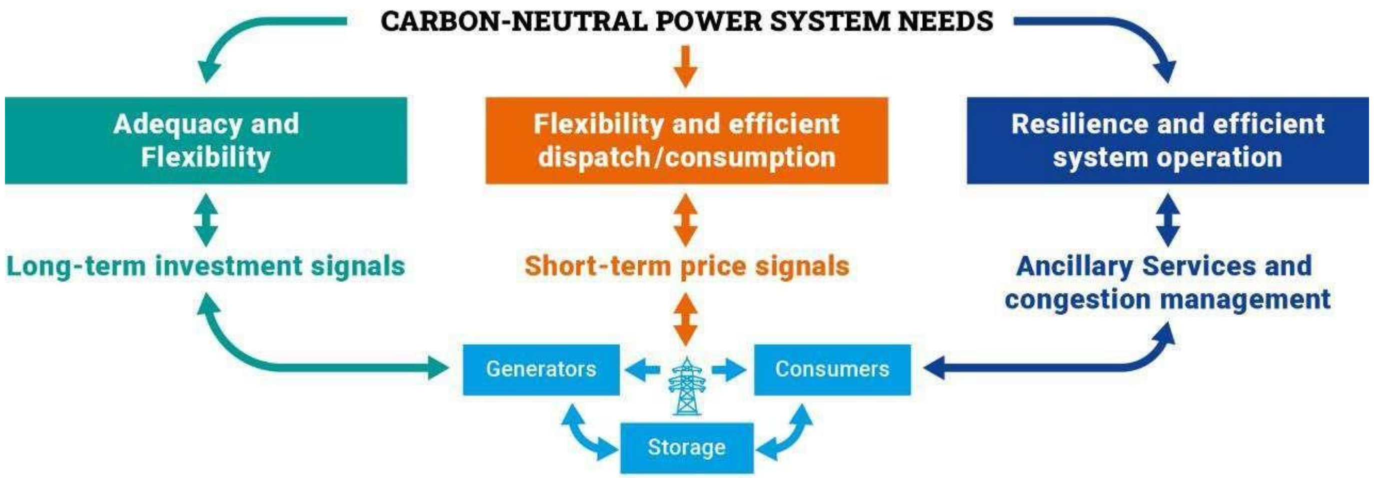




Source ENSTO-e

Energy market optimizations





Renaissance of european industrial policy
Green deal Industrial Plan

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- **Launched 1 February 2023**
- **Complements the Green Deal and the REPowerEU packages, to support the EU‘s ambitions to reduce net greenhouse gas emissions by at least 55% by 2030**
- **Substantial funding available**
- **<u>Four pillars</u>:**
  i) a predictable and simplified regulatory environment
  - **→ Net-Zero Industry Act, including simplified and fast-track permitting**
  - **→ Critical Materials Act**
  - **→ Reform of electricity market**

  ii) speeding up access to funding
  - **→ including relaxing of state aid rules**

  iii) enhancing skills
  - **→ Net-Zero Industry Academies**

  iv) open trade for resilient supply chains
  - **→ Free Trade Agreements and Clean-Tech Net Zero Industrial partnerships**

Renaissance of industrial policy
European industrial Alliances

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European Industrial Alliance on SMALL MODULAR REACTORS

2024 : Facilitate and accelerate the development, demonstration, and deployment of SMRs in Europe by the early 2030s.

European Solar Photovoltaic Industry Alliance

2022 : Scaling up EU manufacturing of competitive, innovative, and sustainable solar PV products as well as diversifying international PV value chain components and supply raw materials.

RLCF Alliance

2022 : boosting production and supply of renewable and low-carbon fuels in the aviation and waterborne sectors

EUROPEAN RAW MATERIALS ALLIANCE | ERMA

2021 : build resilience and strategic autonomy for Europe's rare earth and magnet value chains. Identify investment possibilities in raw materials value chain, while addressing sustainability and social impact.

European Clean Hydrogen Alliance
Kick-starting the EU Hydrogen Industry to achieve the EU climate goals

2020 : support large-scale deployment of clean hydrogen technologies by 2030. Promote investments and stimulate clean hydrogen production and use.

EUROPEAN BATTERY ALLIANCE | EBA250

2017 : creating a competitive and sustainable battery cell manufacturing value chain in Europe

Photos and Video Gallery

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World Engineering Day 2024 | Conference “Energy Transition and Sustainability”

Please consult the photo gallery here.
Also, view the video here.