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Universidad del País Vasco
Euskal Herriko Unibertsitatea

International Finance in Large-Scale Infrastructure Projects Related to Renewable Energy

Klimakonferanse «Energi – Infrastruktur – Nykolonialisme – Menneskerettigheter – EUs rolle»

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alvaro.campos@ehu.eus

STRUCTURE

1. *Notes for the energy transition*
2. *The corporate energy transition (CET)*
3. *Infrastructure of the corporate energy transition (CET)*
4. *Case study: The case of Spain*
5. *Closing remarks*

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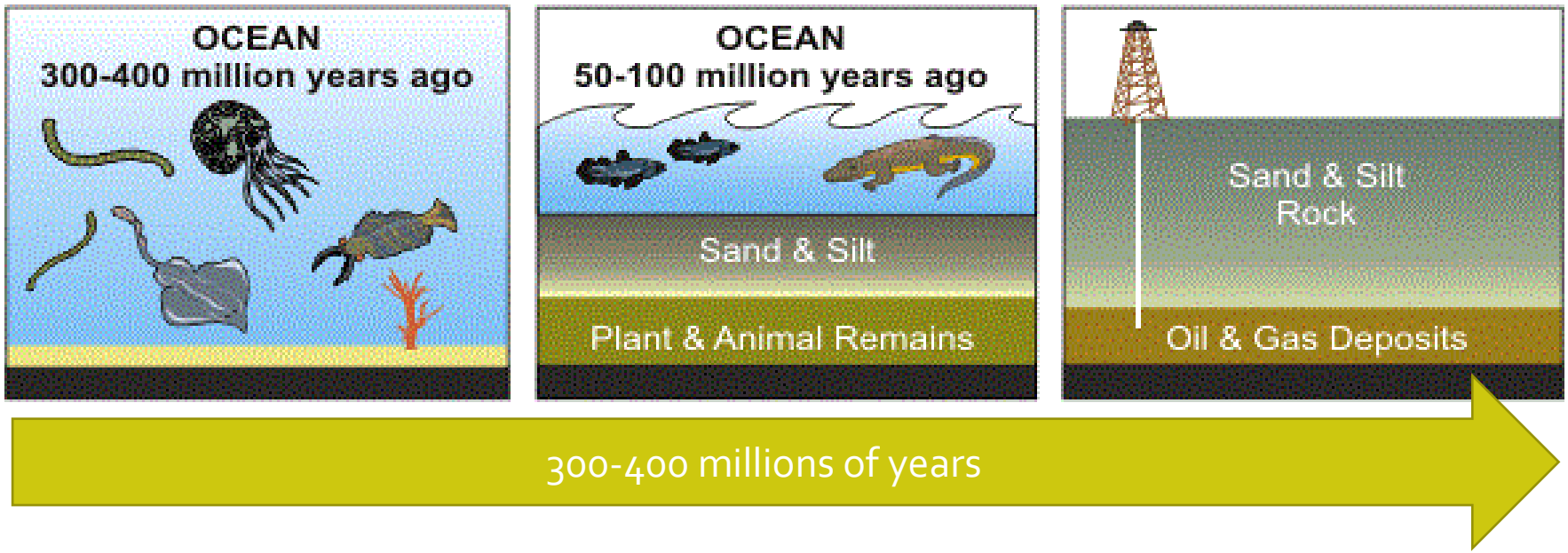
1. NOTES FOR THE ENERGY TRANSITION

THE FOSSIL PARADIGMA

¿What are fossil fuels?

Solar Energy, highly concentrated in time and space



1. NOTES FOR THE ENERGY TRANSITION

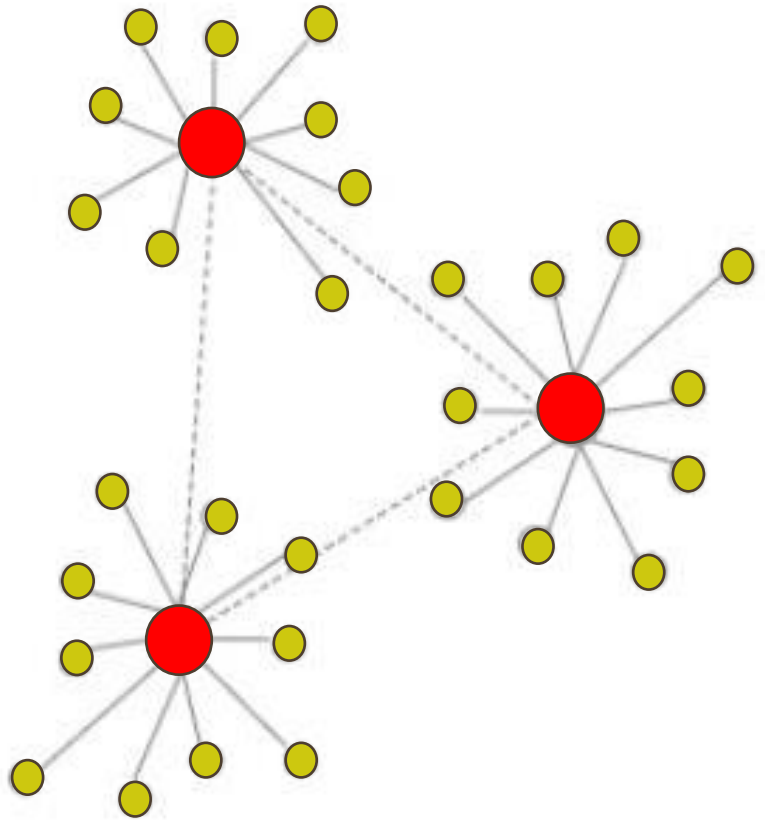
THE CURRENT ENERGY MODEL: Fossil Regime

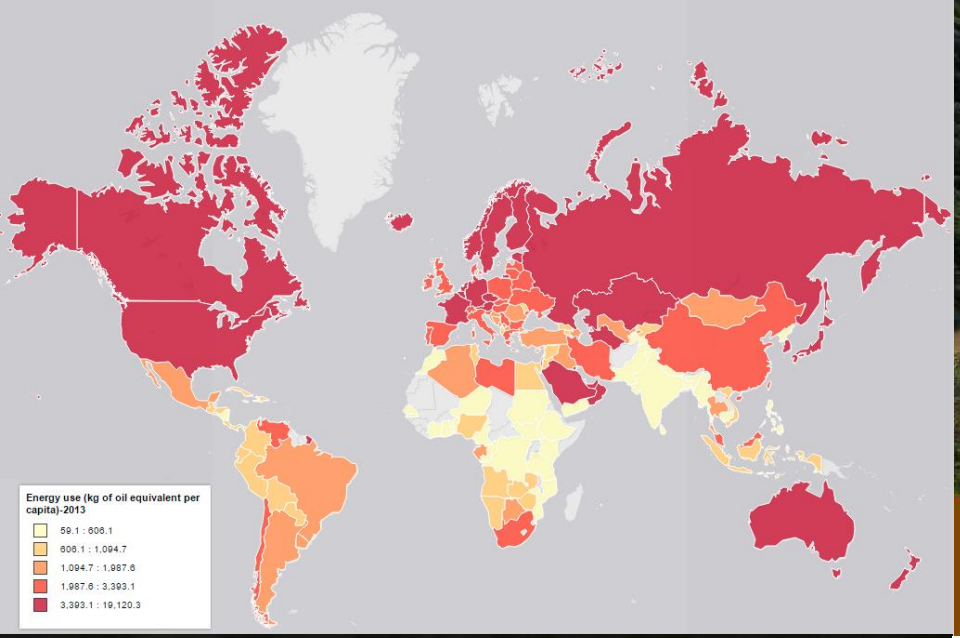
Based on fossil fuels:

- Highly concentrated
- Dispatchable
- High Energy density
- Need for high power

Centralized system

- Concentration in territory, power, power and profits
- Unidirections
- Cost-based decisions: energy as a commodity
- Individual and passive consumers




Energy use (kg of oil equivalent per capita)-2013
59.1 : 606.1
606.1 : 1,094.7
1,094.7 : 1,987.6
1,987.6 : 3,393.1
3,393.1 : 19,120.3

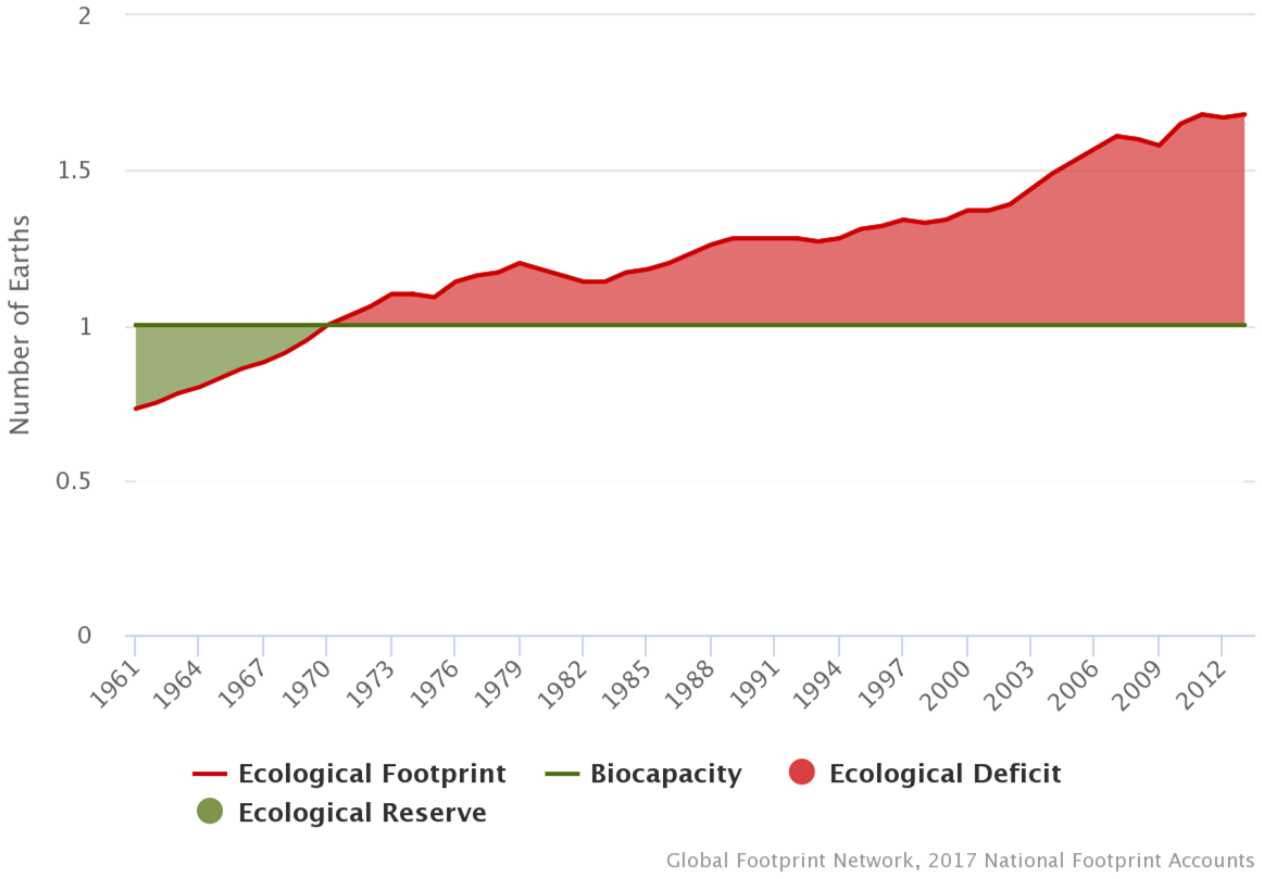

LA POBRESA ENERGÈTICA MATA
LA POBRESA ENERGÈTICA MATA
BAIX PENEDÈS


Geografía del caos
recursos naturales y bases militares
Países árabes
Zona de conflicto o tensión
Región sin control oficial
Explotación de petróleo o gas
Paso marítimo estratégico
Ciudad capital
Ciudad importante
Instalación militar de Estados Unidos
Presencia militar marítima de Estados Unidos

1. NOTES FOR THE ENERGY TRANSITION

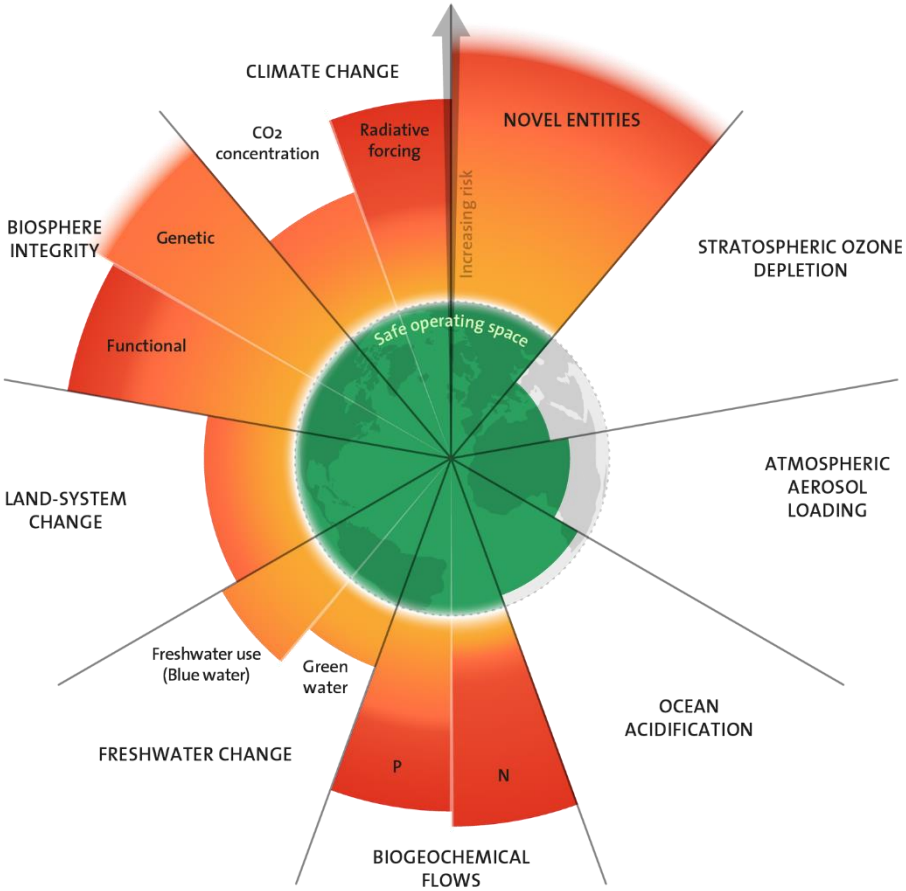
LIMITS TO FOSSIL REGIME

IMPACTS EXCEED BIOCAPACITY → **PROBLEM!**



1. NOTES FOR THE ENERGY TRANSITION

LIMITS TO FOSSIL REGIME



¿Where are we?

- Since the 1970s we have exceeded the planet's capacity to replenish itself
- CO_2 emissions are just a symptom of the problem

We must change the regime

1. NOTES FOR THE ENERGY TRANSITION

RENEWABLE ENERGY FLOWS



Based on fossil fuels:

- Highly concentrated
- Dispatchable
- High Energy density
- Need for high power

CONCENTRATED TIME

Based on renewable flows:

- Intermittent
- Resources geographically distributes
- Low Energy density
- Lower EROEI
- Highly modular

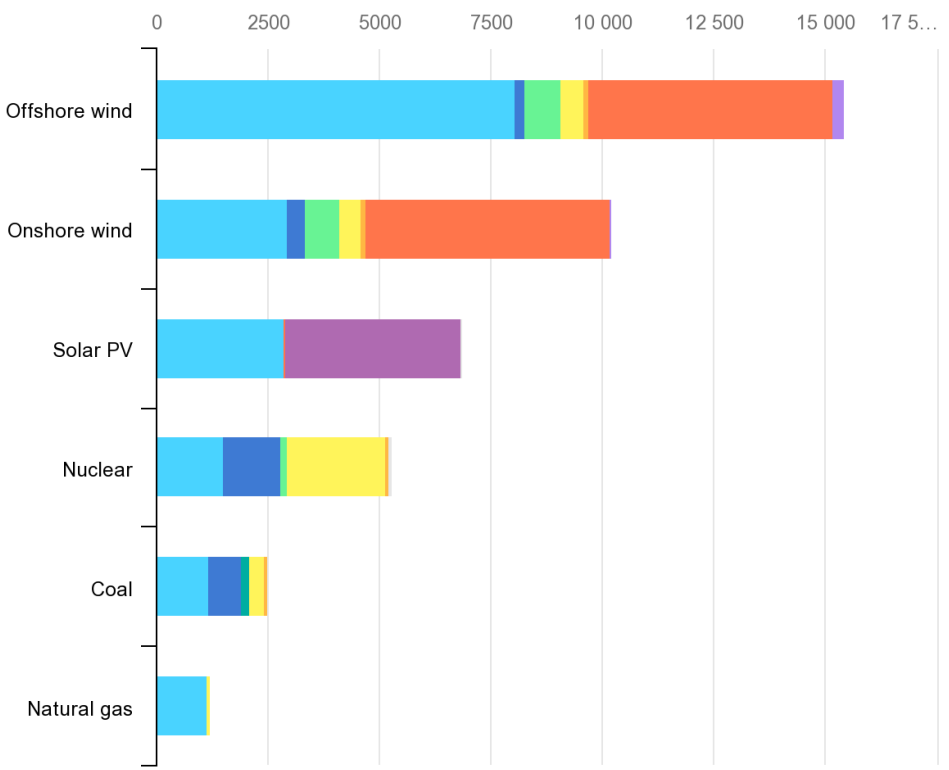
NATURAL TIME

1. NOTES FOR THE ENERGY TRANSITION

RENEWABLE FLOWS VS RENEWABLE TECHNOLOGY

What is technology?

Concentrated ENERGY, MATERIALS and ENERGY



The Guardian view on rare earths: mining them can't cost the Earth

Editorial

It will be no good if in transitioning to climate neutrality, large tracts of the planet are left uninhabitable by the mining of key raw materials

Thu 18 Aug 2022 19.25 CEST

465

Copper Nickel Manganese Cobalt Chromium Molybdenum Zinc Rare earths Silicon Others

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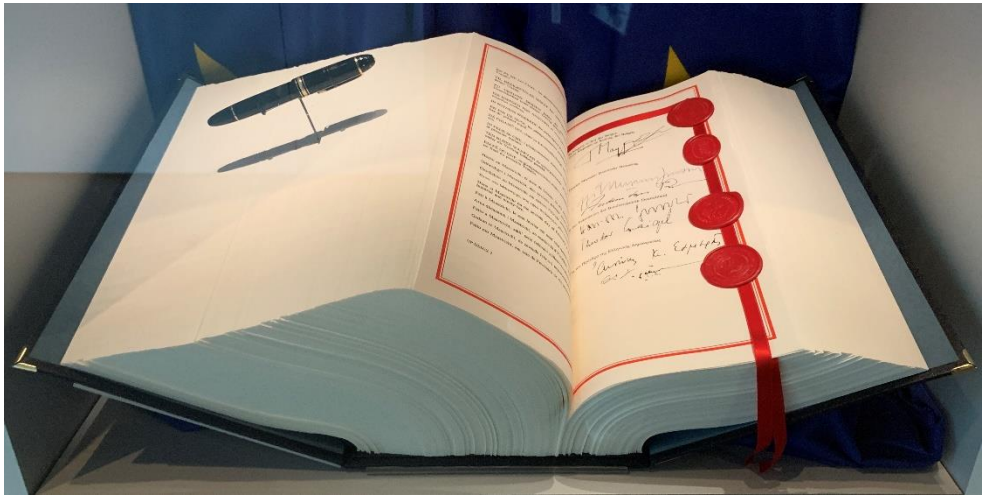
2. THE CORPORATE ENERGY TRANSITION

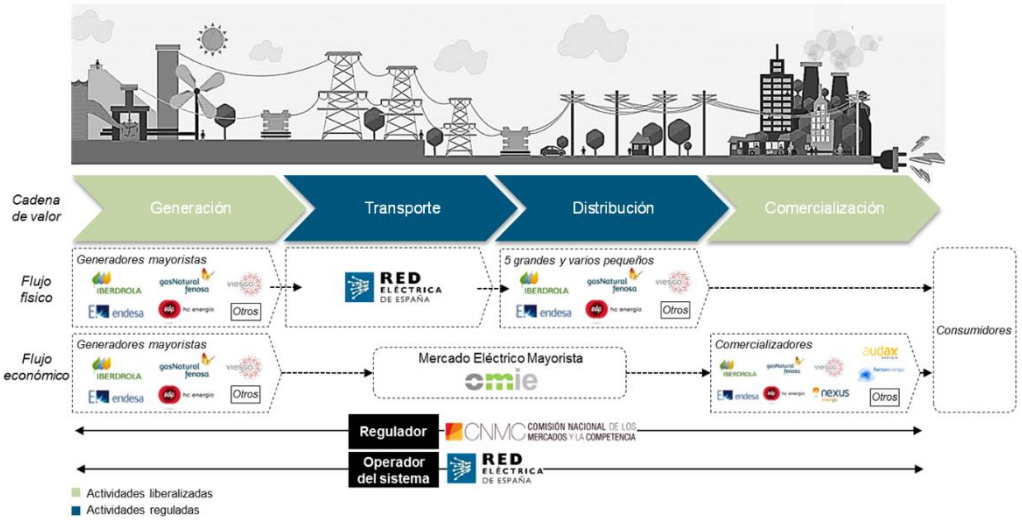
THE POLITICAL PLAN: THE ENERGY UNION



- The Maastricht Treaty
- Directive 96/92/EC concerning common rules for the internal market in electricity.
- Spain: Law 54/1997 on the Electricity Sector

PREMISE:

Deregulation of the electricity sector will bring efficiency gains and cost reductions.



2. THE CORPORATE ENERGY TRANSITION

THE POLITICAL PLAN: THE ENERGY UNION

TEN-E

Comisión Europea

3.6.2022 EN Official Journal of the European Union L 152/45

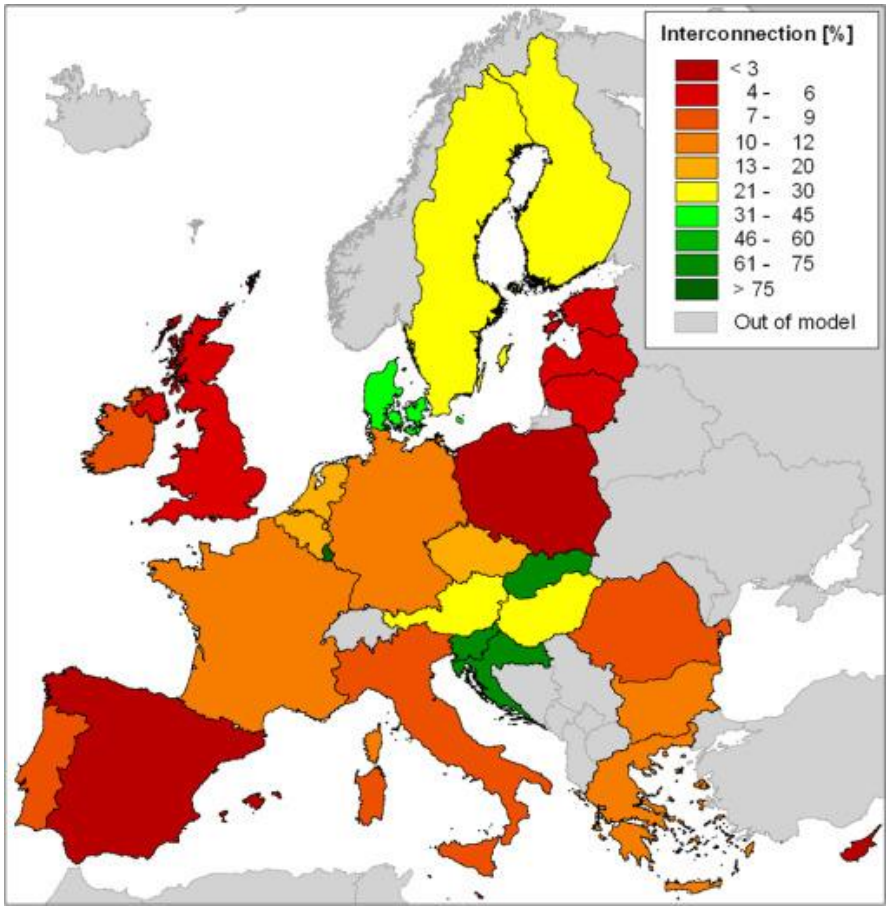
REGULATION (EU) 2022/869 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 30 May 2022

on guidelines for trans-European energy infrastructure, amending Regulations (EC) No 715/2009, (EU) 2019/942 and (EU) 2019/943 and Directives 2009/73/EC and (EU) 2019/944, and repealing Regulation (EU) No 347/2013

Objective: Encourage interconnections between states:

- Interconnection target of 10% of installed capacity
- Upgrade to 15% (2022)C

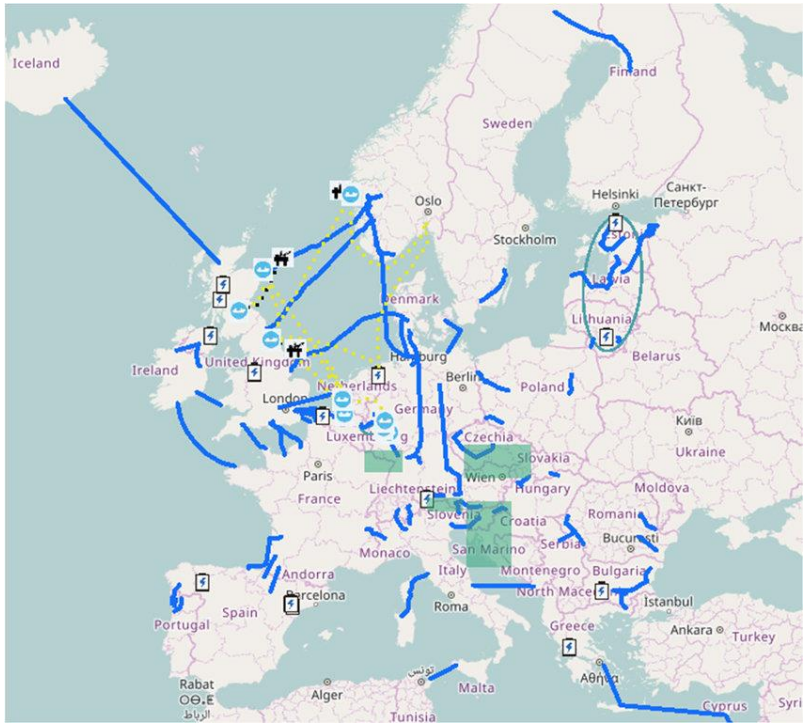


The tool: Projects of Common Interest (PCI)

2. THE CORPORATE ENERGY TRANSITION

PROJECTS OF COMMON INTEREST

- **Cross-border energy projects** considered **strategic** on the basis of their ability to increase energy security, competitiveness or contribute to climate goals.
- **Benefits:** simple procedures, reduced deadlines, increased publicity and media.
- In addition, some PCIs may be eligible for **additional funding** through the European Investment Bank's Connecting Europe Facilities programme.




In 2016 the European Commission approves the Juncker Plan
European Commission
Commission européenne

2. THE CORPORATE ENERGY TRANSITION

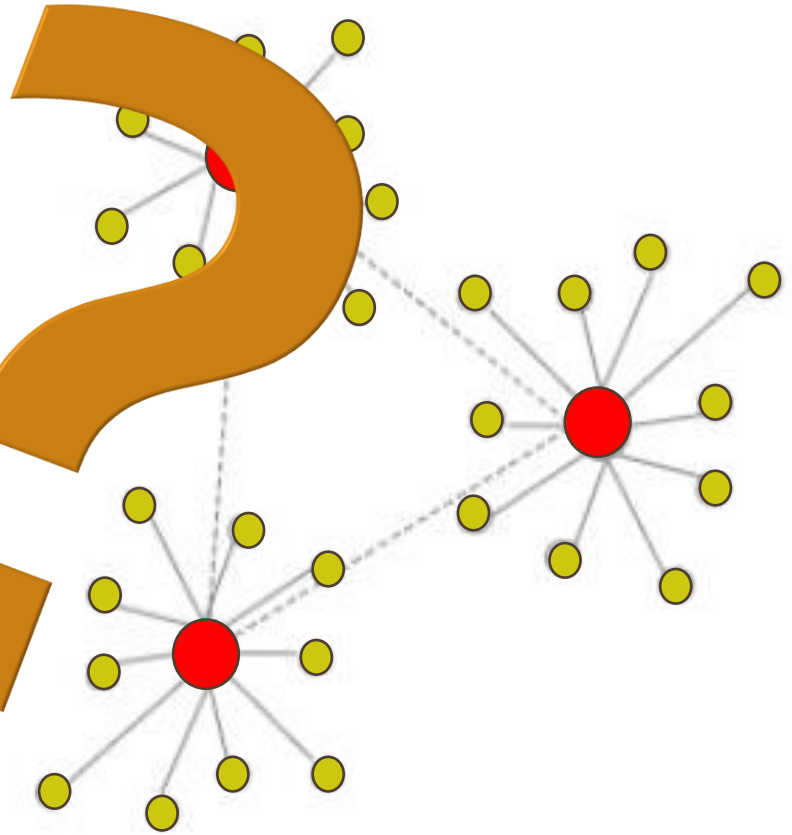
THE RESULTING TRANSITION

Based on renewable flows:

- Intermittent
- Resources geographically distributes
- Low Energy density
- Lower EROEI
- Highly modular

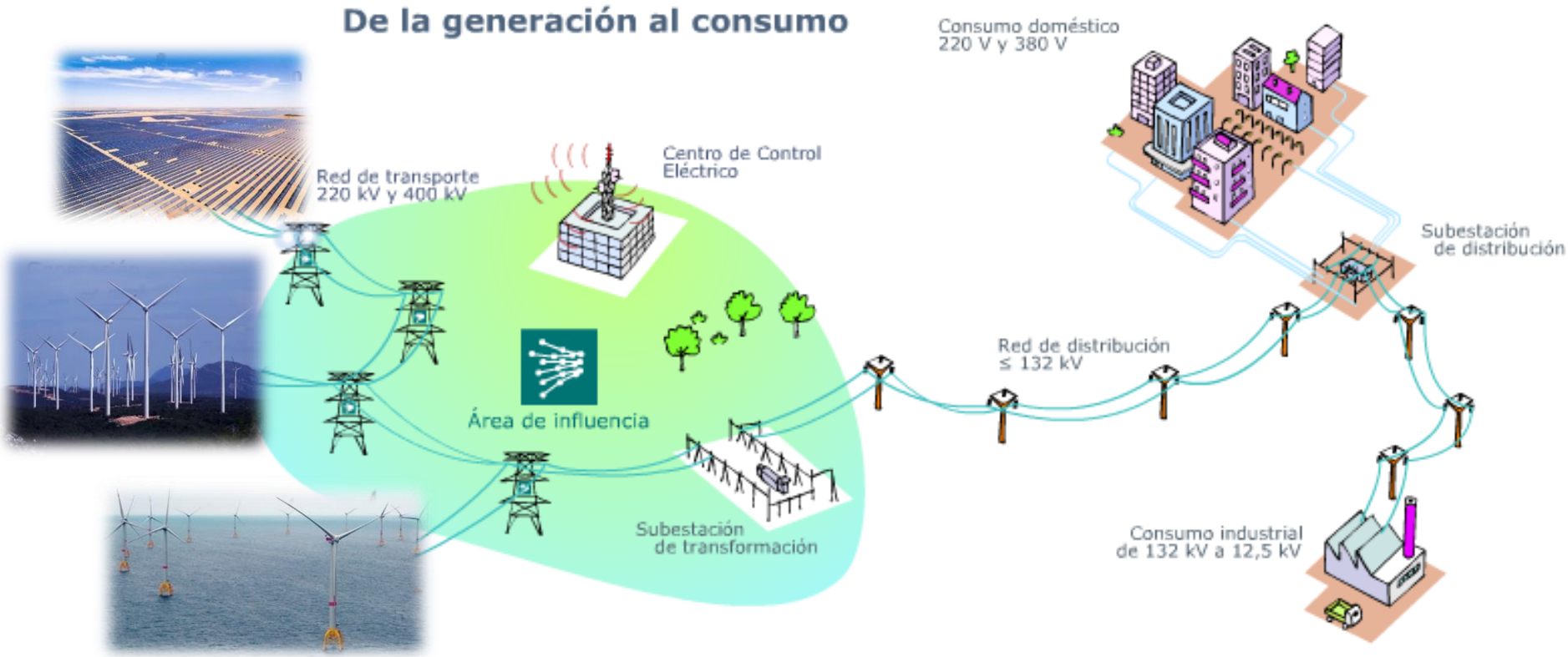
Centralized s

- concen of territory, power er and profits
- Unidire
- Cost-base energy as a commodity
- Individual and passive consumers



2. THE CORPORATE ENERGY TRANSITION

THE RESULTING TRANSITION



AND ALL THE ADAPTATIONS TO MAKE THIS POSSIBLE

2. THE CORPORATE ENERGY TRANSITION

PREMISE:

- Decarbonisation is compatible with economic growth.

DISCOURSE:

- Transition is an opportunity for development

CHARACTERISTICS:

- Continuation of the fossil regime
- Technological substitution
- The bigger the better
- It does not question demand
- Intensification of extractivism and inequalities

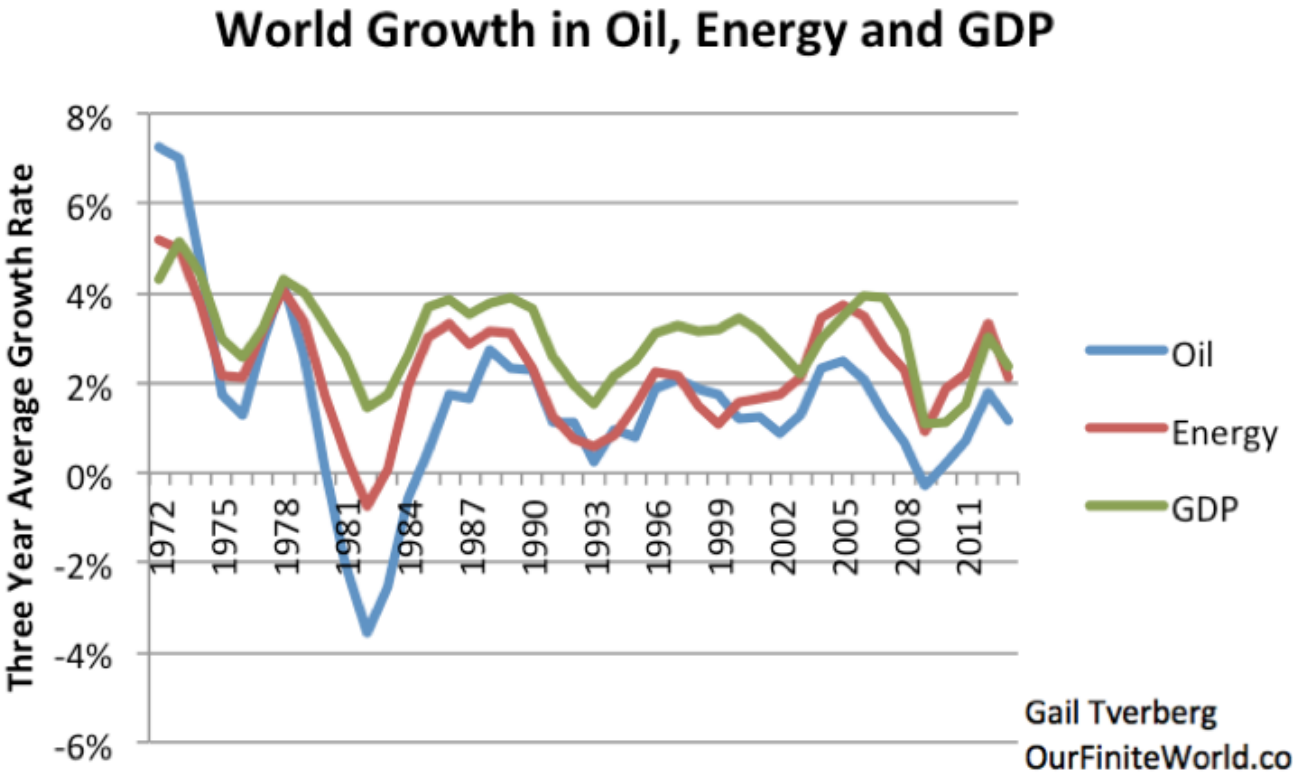
CONSEQUENCE:

- ENERGY COLONIALISM

2. THE CORPORATE ENERGY TRANSITION

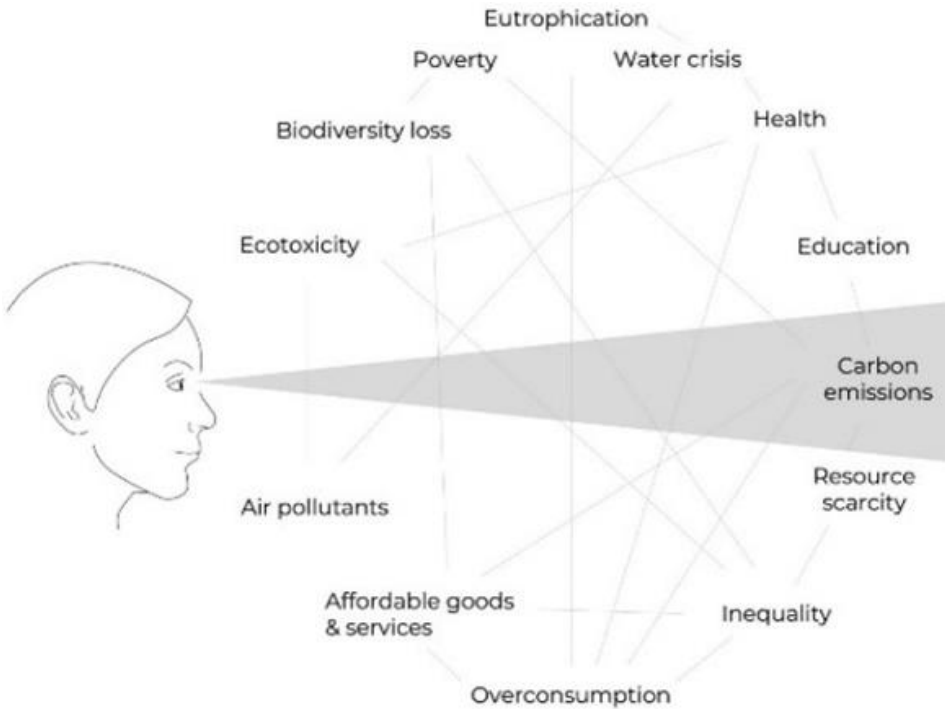
PREMISE:

- Decarbonisation is compatible with economic growth.



2. THE CORPORATE ENERGY TRANSITION

CARBON TUNNEL VISSION



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3. INFRASTRUCTURE IN THE CET

What is infrastructure nowadays?

A road, IS IT INFRASTRUCTURE?

WHO SETS THE AGENDA?

The Energy Megaproject

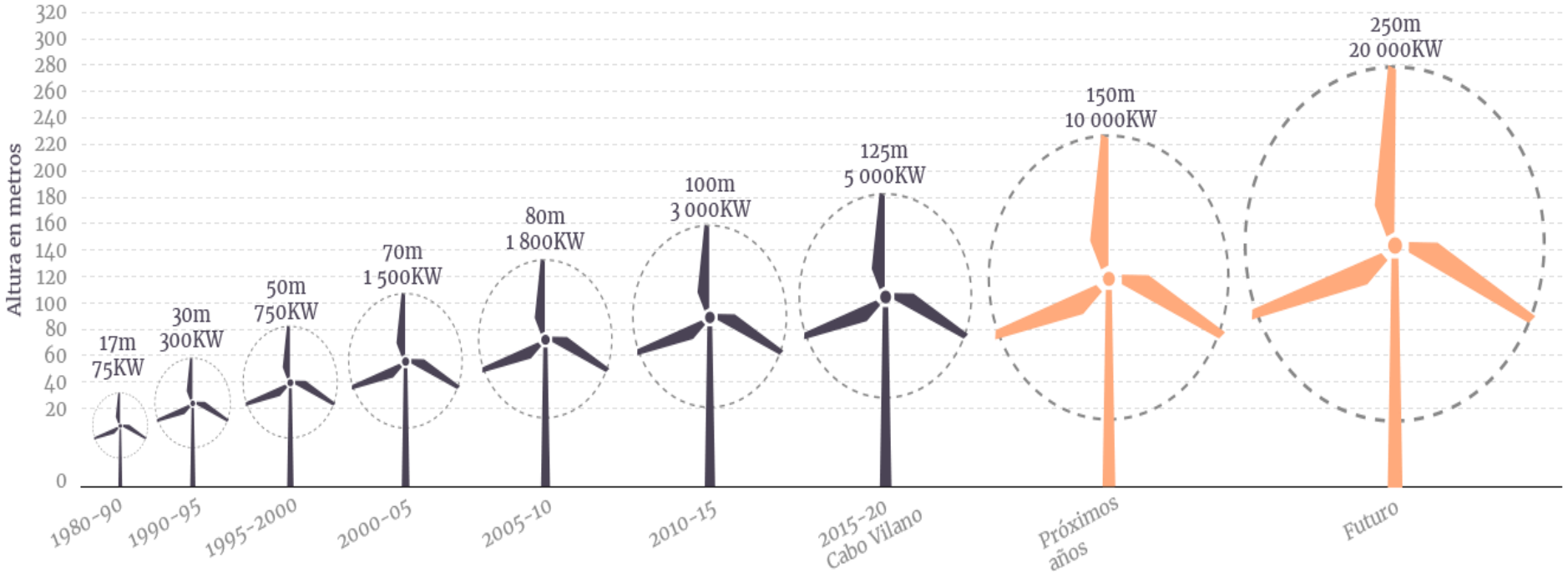
El megaproyecto energético

3. INFRASTRUCTURE IN THE CET

THE ENERGY MEGAPROJECT

Energy ¿for what?

Maximize the return on investment



3. INFRASTRUCTURE IN THE CET

THE ENERGY MEGAPROJECT

Energy ¿for what?

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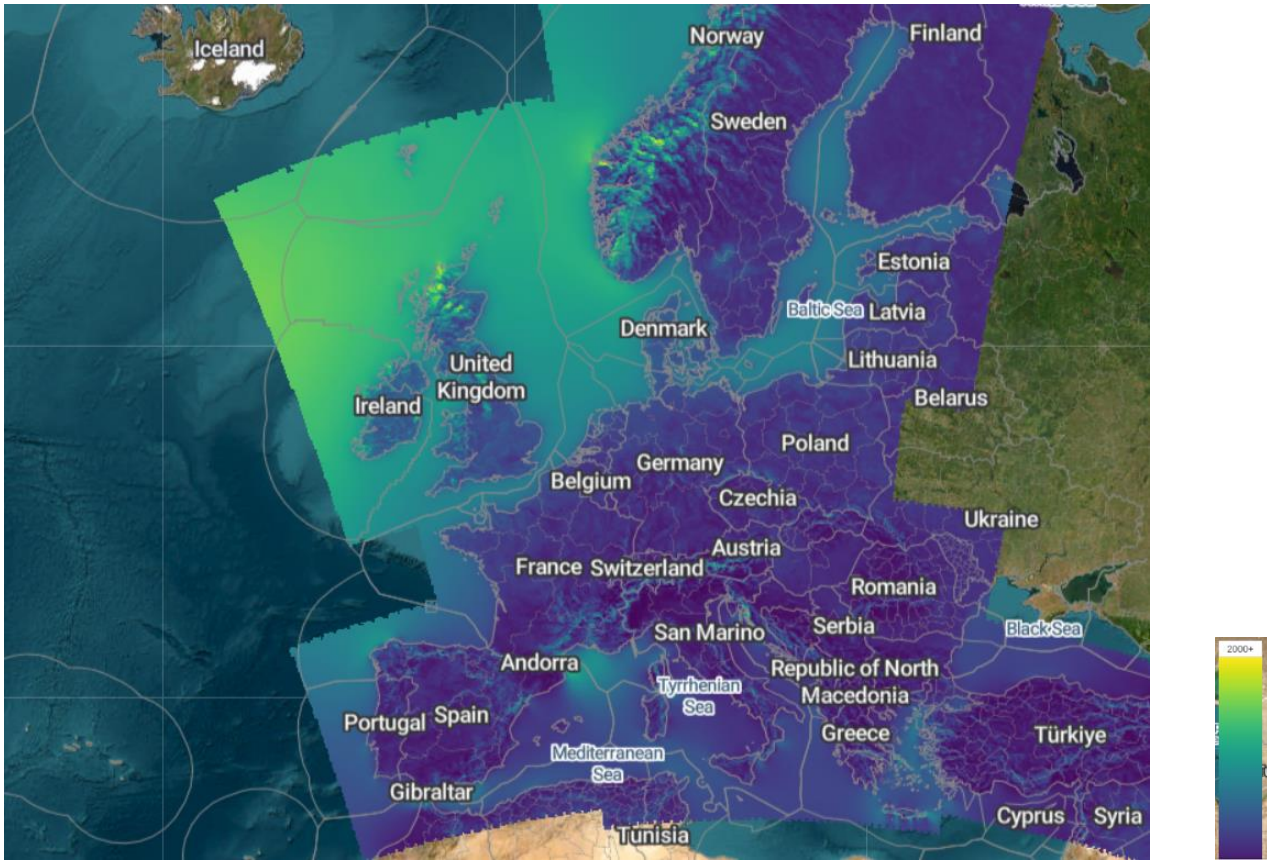


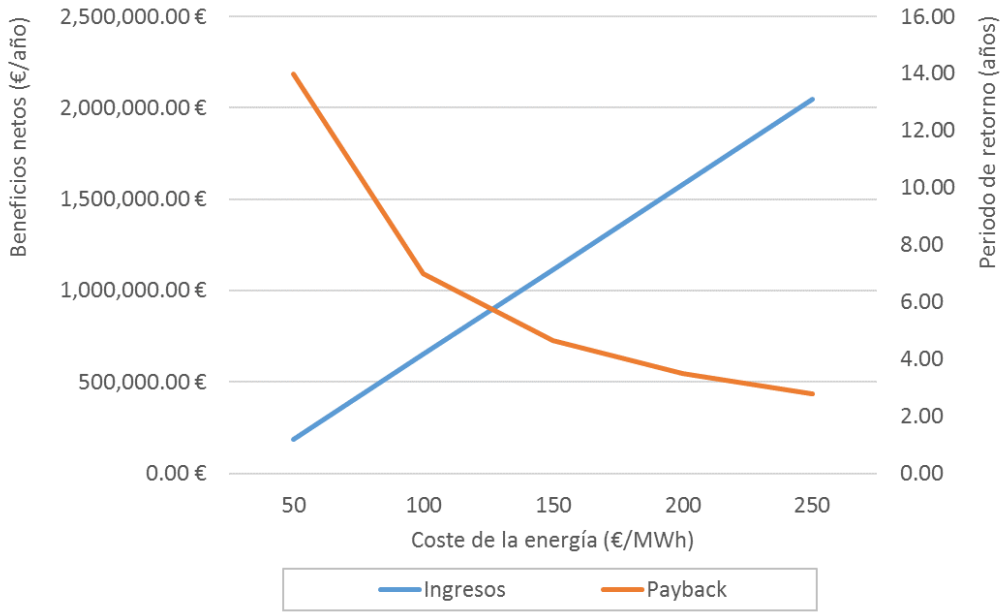
3. INFRASTRUCTURE IN THE CET

THE ENERGY MEGAPROJECT

The business

One example in Spain (a 6MW wind mill)

- Estimated production: 6.500.000 € /mill
- Estimated production: 9.500 MWh/year·mill



- Incomes to the municipality: 5.000-10.000 €/wind ¿?

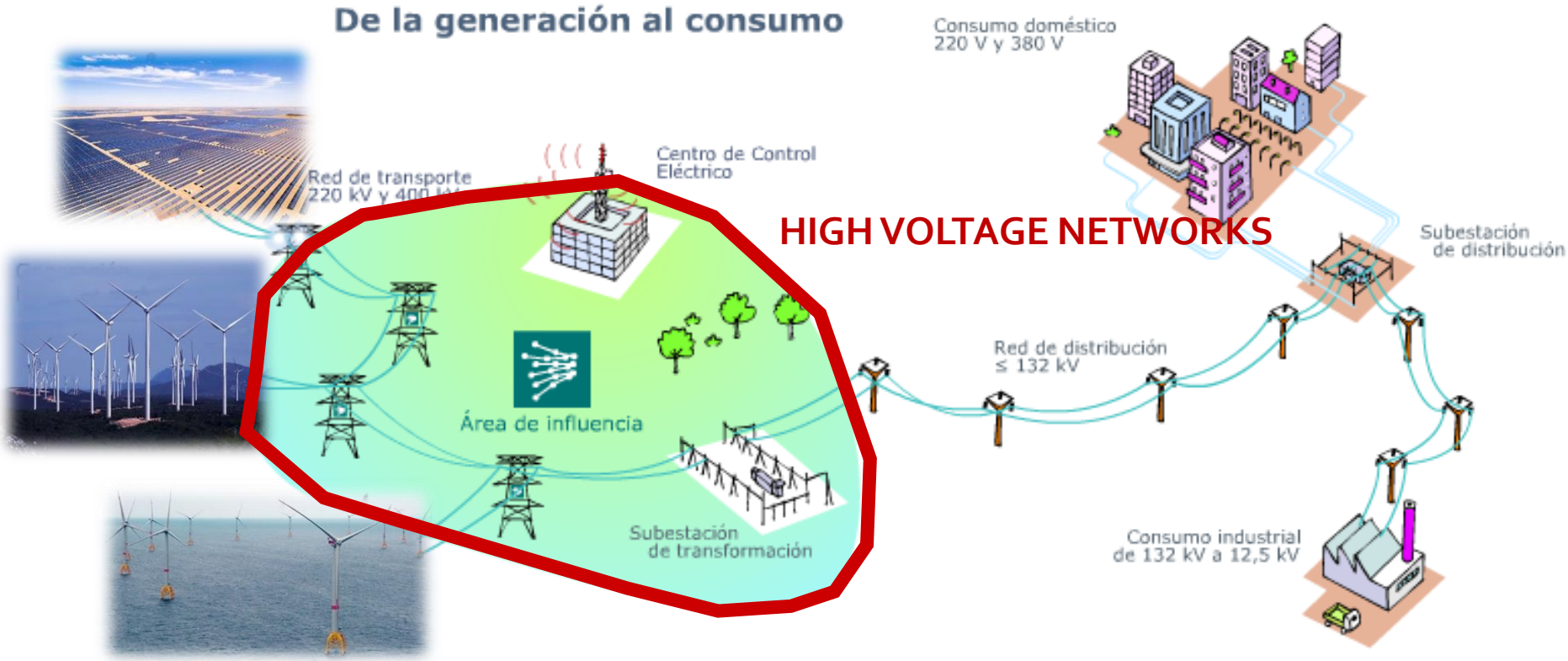
3. INFRASTRUCTURE IN THE CET

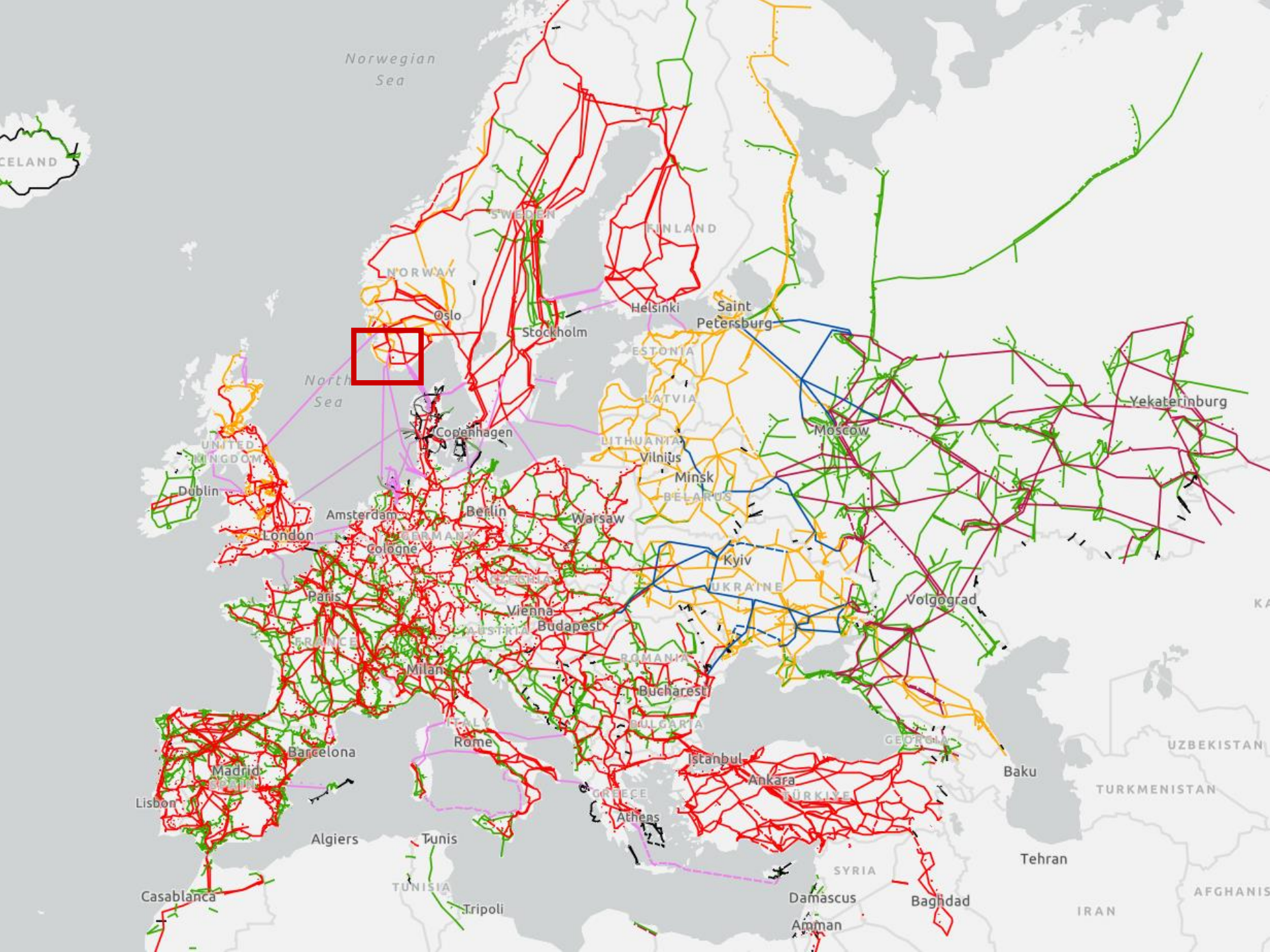
THE ENERGY MEGAPROJECT

The impacts

3. INFRASTRUCTURE IN THE CET

THE TRANSPORT SYSTEM




Norwegian Sea
North Sea
ICELAND
SWEDEN
FINLAND
NORWAY
Oslo
Stockholm
Helsinki
Saint Petersburg
ESTONIA
LATVIA
LITHUANIA
Vilnius
Minsk
BELARUS
Moscow
Yekaterinburg
Copenhagen
UNITED KINGDOM
Dublin
London
Amsterdam
Berlin
Warsaw
Cologne
GERMANY
Kyiv
UKRAINE
Volgograd
Paris
Vienna
Budapest
AUSTRIA
FRANCE
ROMANIA
Milan
Bucharest
ITALY
BULGARIA
Rome
Barcelona
Madrid
Lisbon
Istanbul
Ankara
GEORGIA
Baku
UZBEKISTAN
TURKMENISTAN
GREECE
Athens
Algiers
Tunis
TUNISIA
Casablanca
Tripoli
SYRIA
Damascus
Amman
Baghdad
Tehran
IRAN
AFGHANIS

Substation

ind farms

High voltage lines

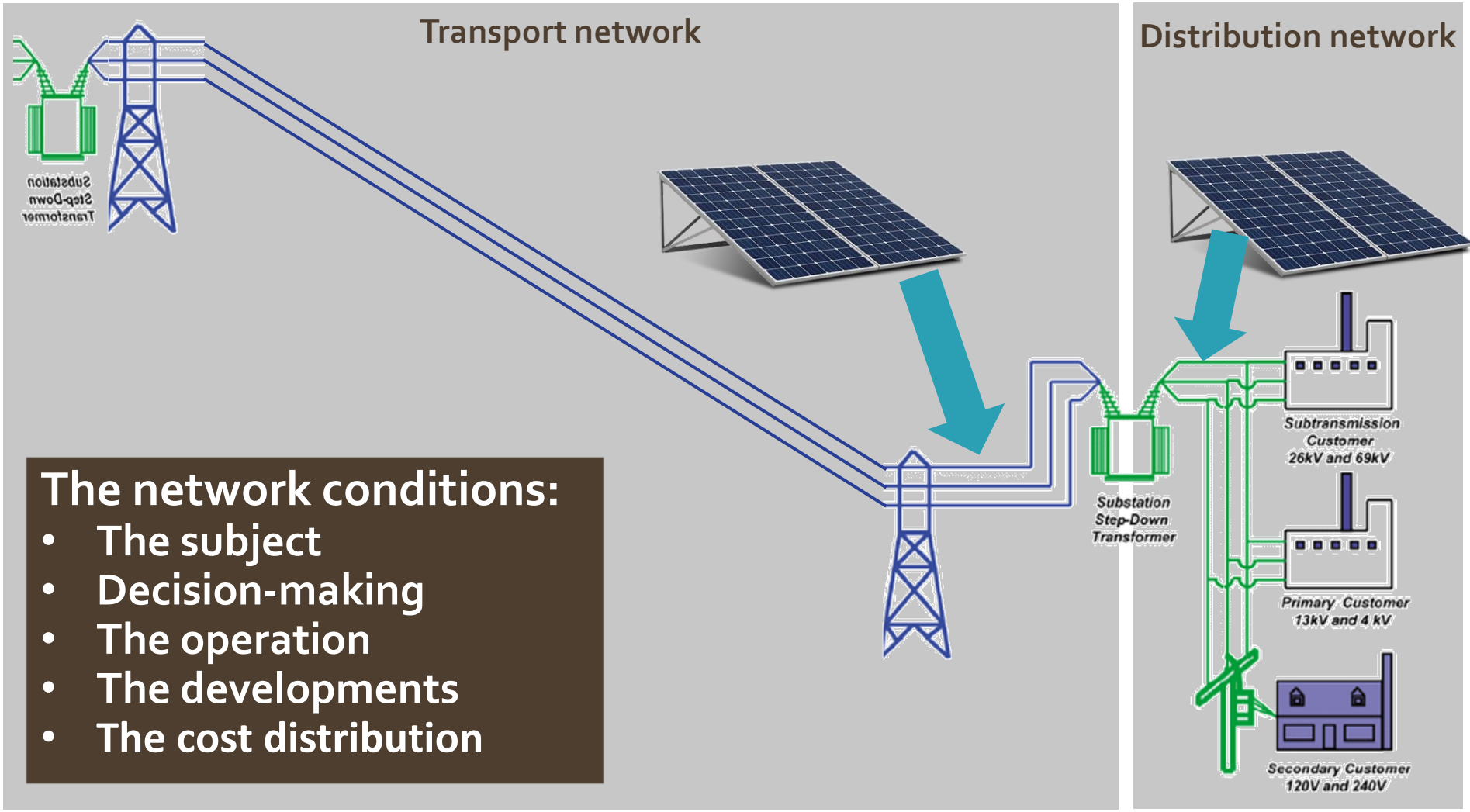
Hydro storage

HVDC submarine line

Stavanger
Sandnes
Gravdal
Egersund
Moi
Flekkefjord
Lyngdal
Farsund
Kristia

3. INFRASTRUCTURE IN THE CET

NETWORKS AND ENERGY SOVEREIGNITY



The network conditions:

- The subject
- Decision-making
- The operation
- The developments
- The cost distribution

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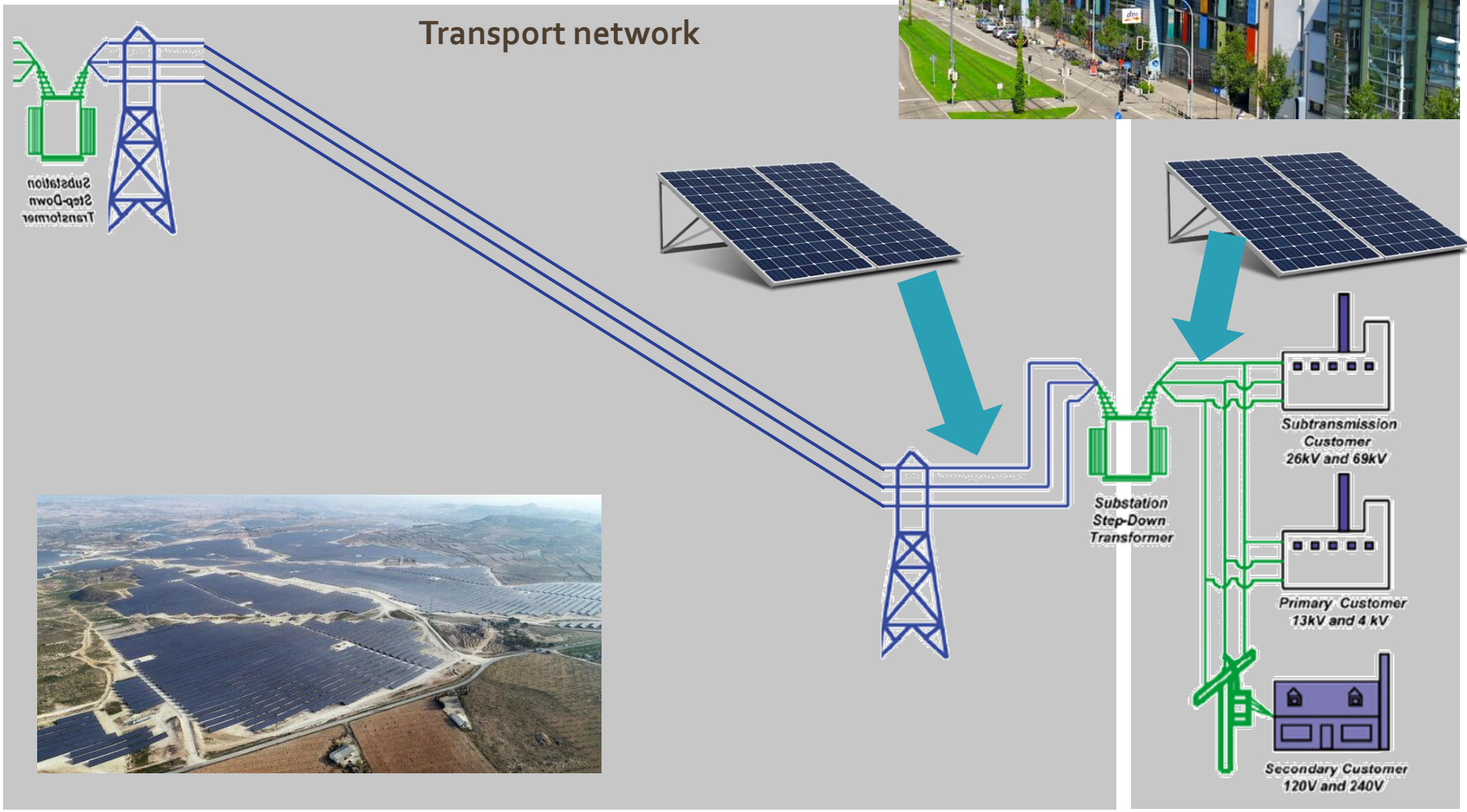
4. CASE STUDY: SPAIN

THE CURRENT SITUATION



4. CASE STUDY: SPAIN

THE CURRENT SITUATION

EL REPARTO DEL MERCADO FOTOVOLTAICO EN EUROPA

Potencia instalada

Residencial (inferior a 10KWp) | Comercial (10 - 250KWp) | Industrial (250 - 1.000KWp) | Gran escala (superior a MWp)

	0%	20%	40%	60%	80%	100%	GW
Rumanía							1,4
Bulgaria							1,2
España							4,7
Reino Unido							12,7
República Checa							2,2
Portugal							0,6
Francia							8,0
Dinamarca							0,9
Alemania							42,3
Grecia							2,6
Italia							19,7
Polonia							0,3
Hungría							0,3
Holanda							2,7
Austria							1,3
Suiza							1,9
Eslovenia							0,2
Bélgica							3,7
Eslovaquia							0,5
Media							

LA INFORMACIÓN - Fuente: SolarPower Europe, IRENA y elaboración propia. Datos a 31/12/2017

4. CASE STUDY: SPAIN

THE EUROPEAN TRANSITION PLAN → NECPs

Energy Conversion and Management: X 12 (2021) 100136

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Comparative analysis of national energy strategies of 19 European countries in light of the green deal's objectives

Attila Aszódi *, Bence Bíró, László Adorján, Ádám Csaba Doboz, Gergely Illés, Norbert Krisztián Tóth, Dávid Zagyi, Zalán Tas Zsiborás

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ARTICLE INFO

Keywords:
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Green deal
Security of energy supply
International renewable energy scarcen
Coal phase-out
Nuclear energy

ABSTRACT

The European Green Deal is setting clear objectives for the transformation of the economy into a cleaner and at the same time competitive working model. The energy sector and especially the electricity sector faces serious challenges in order to comply with the objectives set by the policy. Aging power plants and grid infrastructure, phasing out fossil based energy production, the nuclear phase-out in some countries, increasing weather dependent intermittent power sources, the requirements of the security of electricity supply are also individually stressing issues, but all together are even more challenging.

In line with the Treaty on the Functioning of the European Union (TFEU) the energy strategy is the competence of the individual countries, based on the fact that the different countries have very different geological, socio-economical and ecological conditions, and their access to natural resources can be diverse. Therefore the national governments and national Parliaments are setting the national strategies which has to be in-line with the European framework. An important question arises evidently, namely, whether the national pieces of the big European Puzzle will result to a picture that has been set by the European Green Deal published on 14th July 2021?

In the research presented in this paper, we tried to answer the abovementioned questions by investigating the energy strategy of 19 countries situated in continental Europe. We ran simulations for the year 2030 and 2040 using full year models with hourly resolution to investigate if the power plant portfolios of the individual countries could cover the electricity needs foreseen by their national energy strategies. Possible curtailment and unserved demand of the 19 countries in question were summed and final conclusions were drawn based on the simulation results.

Introduction

The focus of the European Union's policy is on the environmental protection, including climate protection and the climate-neutral transition. The European Green Deal aims to transform the European economy, while increasing its competitiveness, to make the most efficient use of resources and to develop and deploy technologies that can serve as a model not only for the region but also for the whole world [1].

The goals include the elimination of greenhouse gas emissions by 2050, making Europe the first climate-neutral continent by then, and ensuring that the transition takes into account the interests of individuals and regions to maximize the opportunities offered by new technologies.

On 14 July 2021, the European Commission announced a new implementation programme, "fit for 55" [2], which aims to achieve a 55% reduction in net greenhouse gas emissions by 2030 compared to 1990 levels. The legal framework for implementing the programme has also been announced [3].

Energy transformation and energy use are responsible for the vast majority of greenhouse gas emissions. Within this, the production of electricity, which is the most important source of energy, is responsible for most of the carbon-dioxide emissions. At the same time, the replacement of today's still largely fossil-based electricity generation by solar and wind power, which is the preferred choice of the public and politicians, raises technological issues, as the need for continuous supply and the security of supply requirements is not in question.

This paper examines the extent to which the conversion of the generation side of the continental European electricity system, as currently

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Aszodi et al. Comparative analysis of national energy strategies of 19 European countries in light of the green deal's objectives. Energy Convers Manag X 2021;12.

RES production by 2030 (%)

4. CASE STUDY: SPAIN

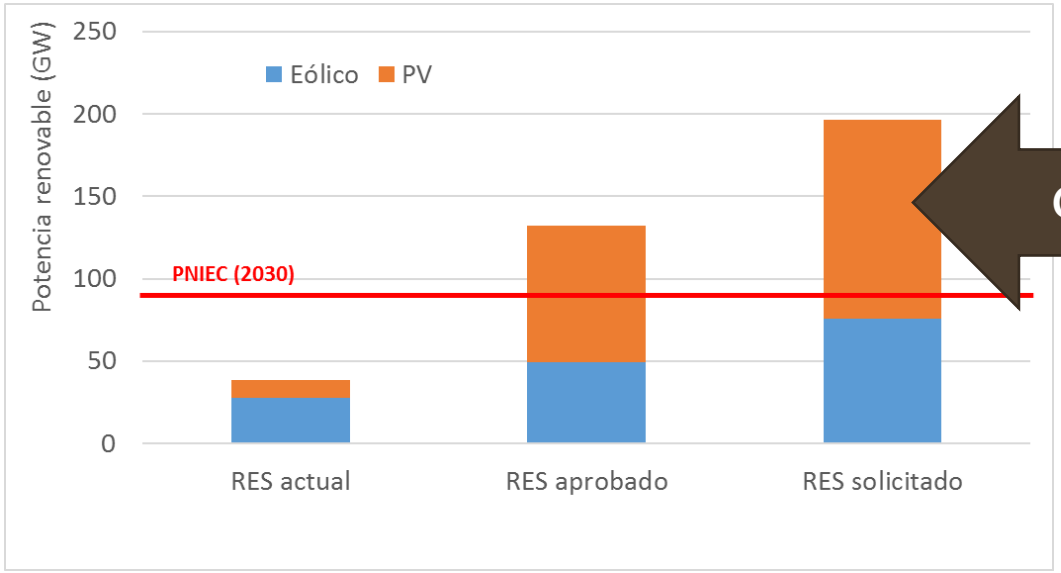
THE RENEWABLE ENERGY GOALS

Spanish National Energy and Climate Plan (NECP)

- Roadmap with renewable production targets

Parque de generación del Escenario Objetivo (MW)				
Año	**2015**	**2020**	**2025**	**2030**
Eólica	22.925	27.968	40.258	50.258
Solar fotovoltaica	4.854	8.409	23.404	36.882

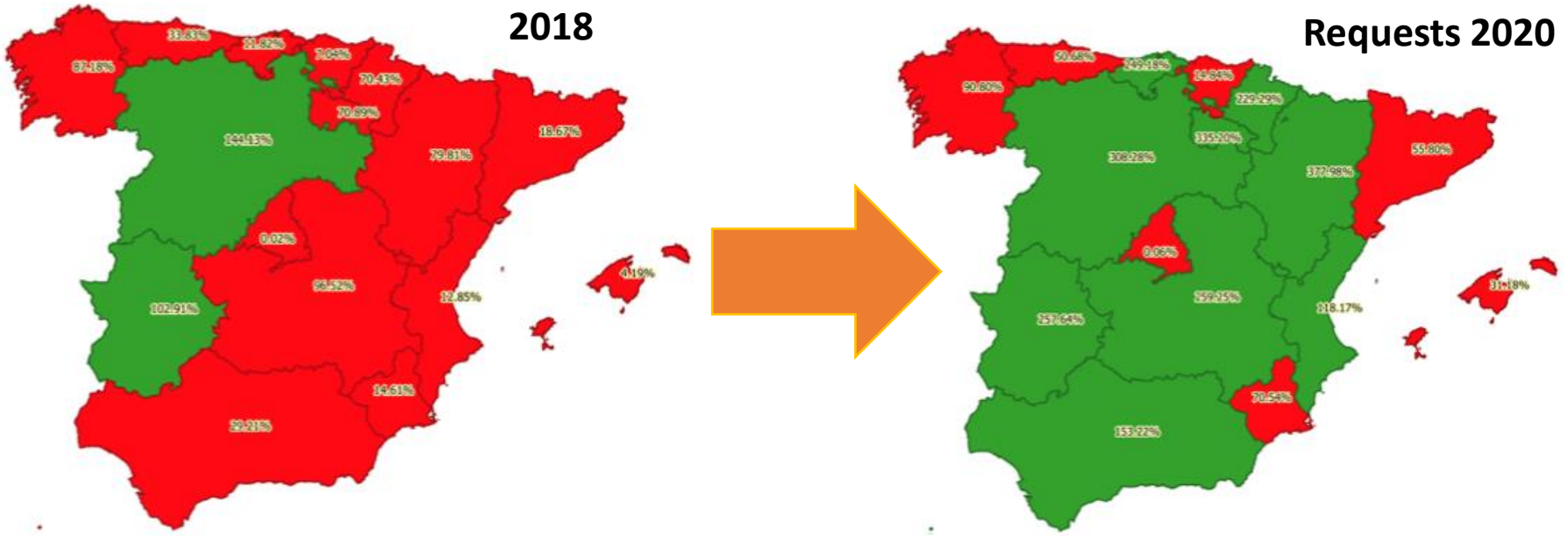
87.2 GW



Connection requests

4. CASE STUDY: SPAIN

THE CONNECTION REQUESTS



With the current transport network

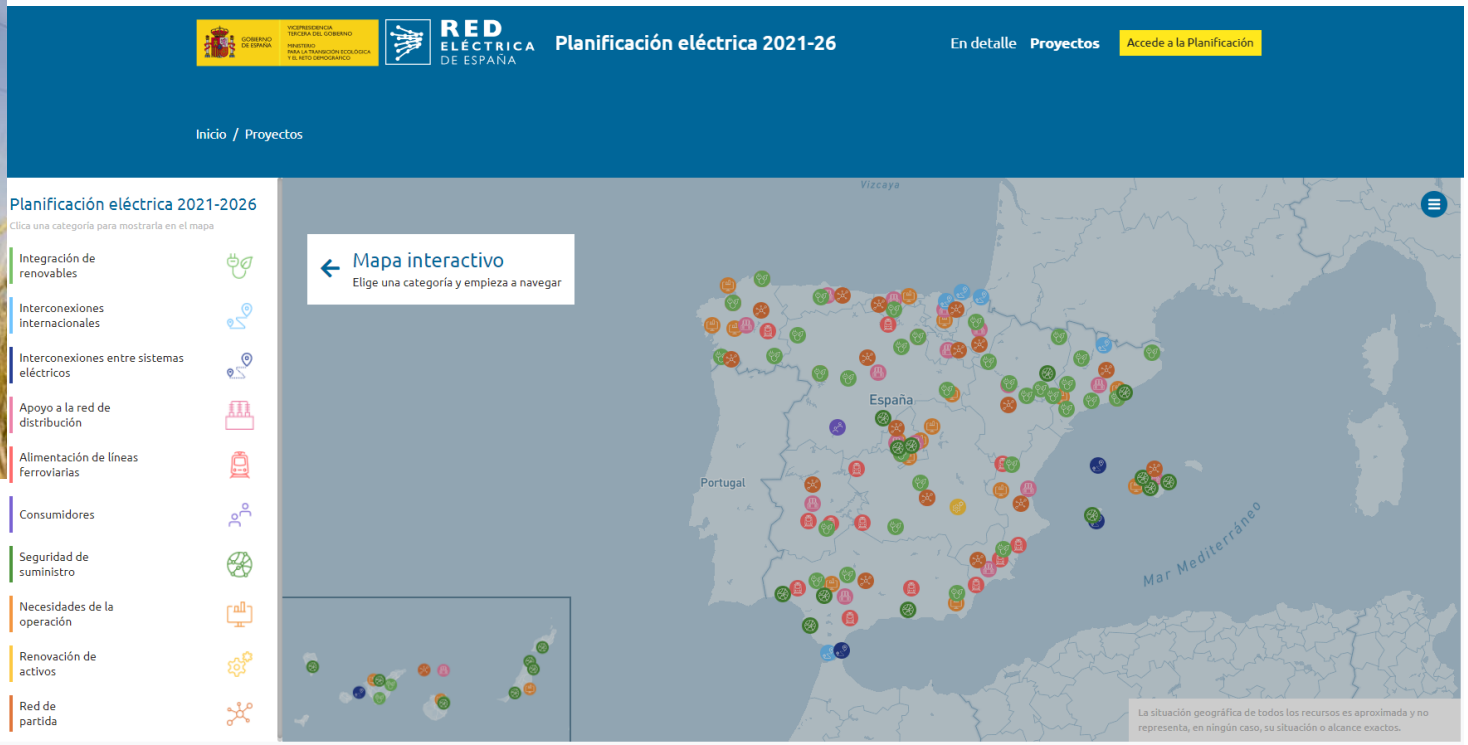
4. CASE STUDY: SPAIN

THE TRANSPORT NETWORK GROWS

RED ELÉCTRICA DE ESPAÑA

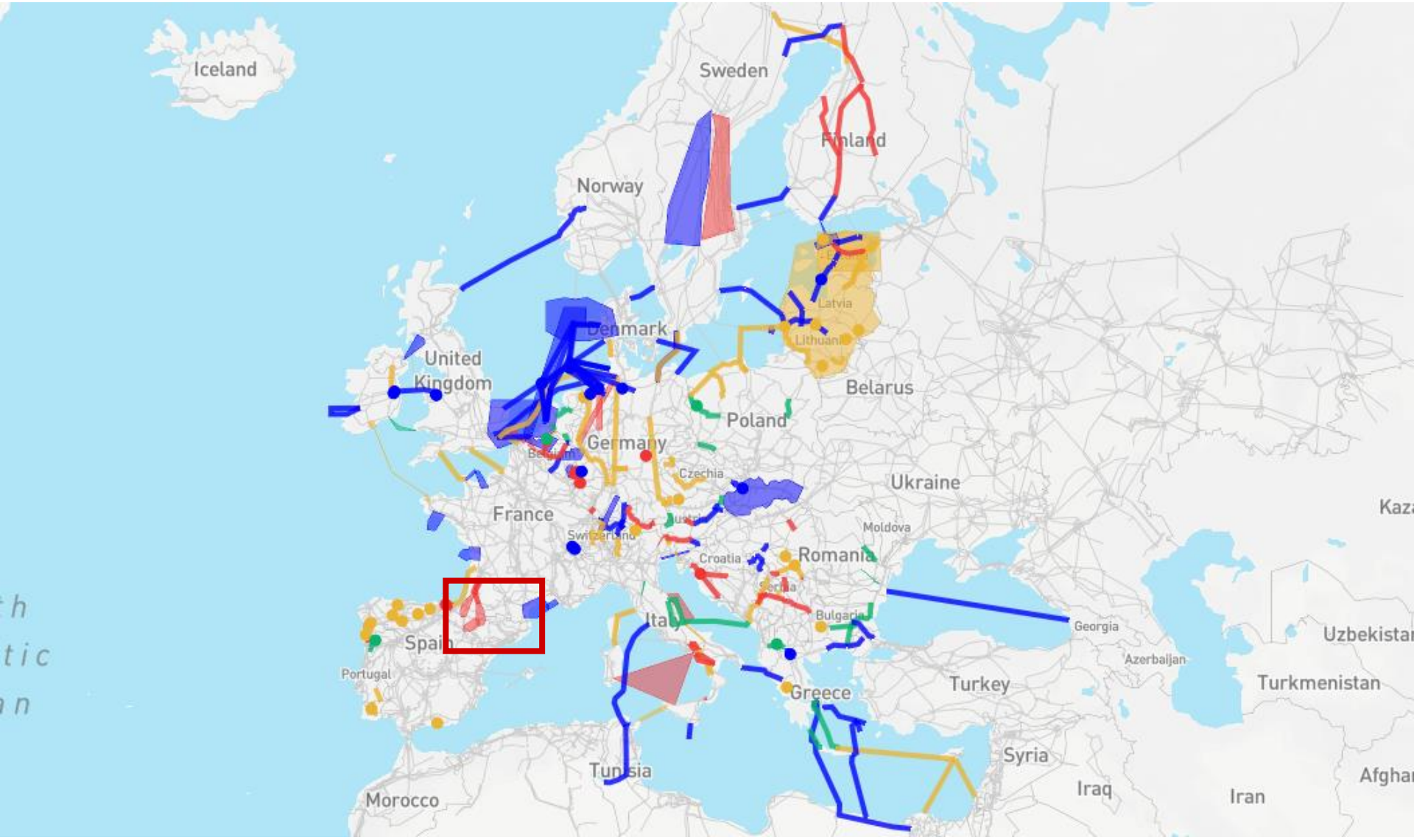
THE PLANNING OF THE ELECTRICITY TRANSPORT NETWORK

- Roadmap for transport network reinforcement (a new one every 5 years)
- investment is covered by the electricity bill

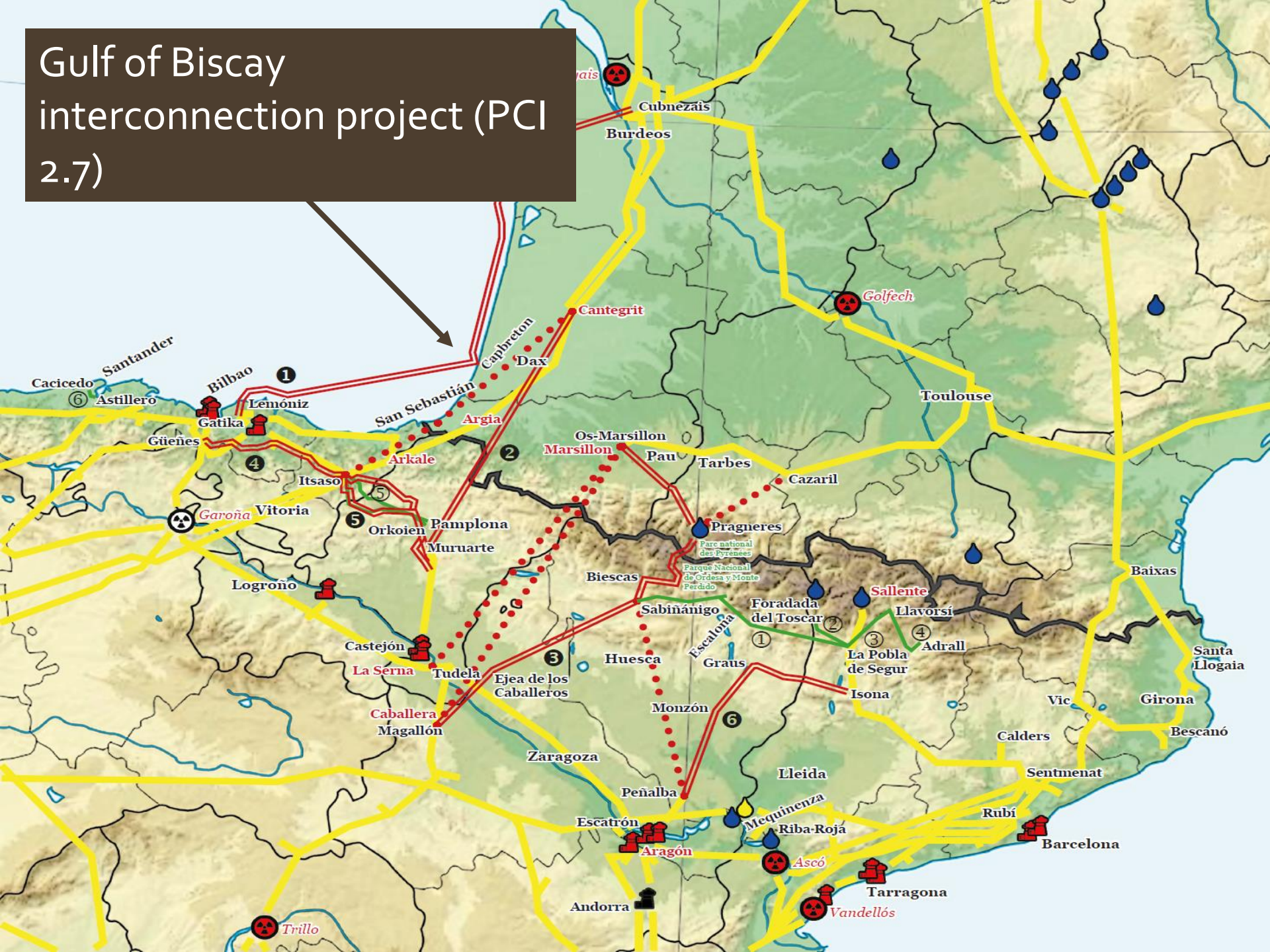


4. CASE STUDY: SPAIN

THE INTERNATIONAL DIMENSION



Gulf of Biscay interconnection project (PCI 2.7)



4. CASE STUDY: SPAIN

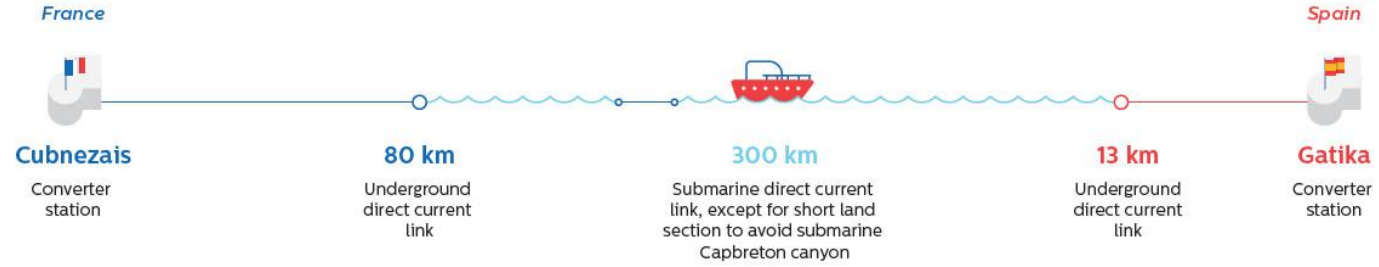
SPAIN-FRANCE INTERCONNECTION THROUGH THE GULF OF BISCAY

The numbers

- Initial Budget: **1750 M€**
- Lenght: **~400 km**
- Capacity: **2 GW**
- Need for network reinforcements
- Electricity bill increase of **3.5%**

The benefits

- **Security of supply**
- **Lower electricity prices**
- **More renewables**



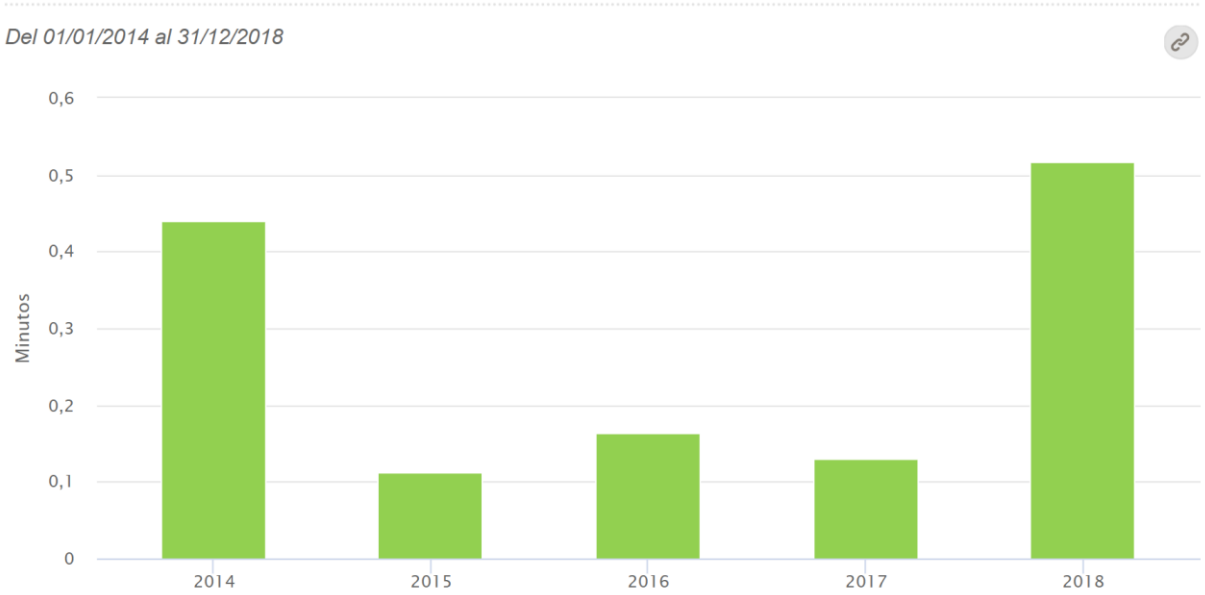
4. CASE STUDY: SPAIN

SPAIN-FRANCE INTERCONNECTION THROUGH THE GULF OF BISCAY

Benefits Security of Supply

- **Overall installed power:** 102 GW
- **Maximum historical demand:** 41 GW (2008)

> 2.5 x



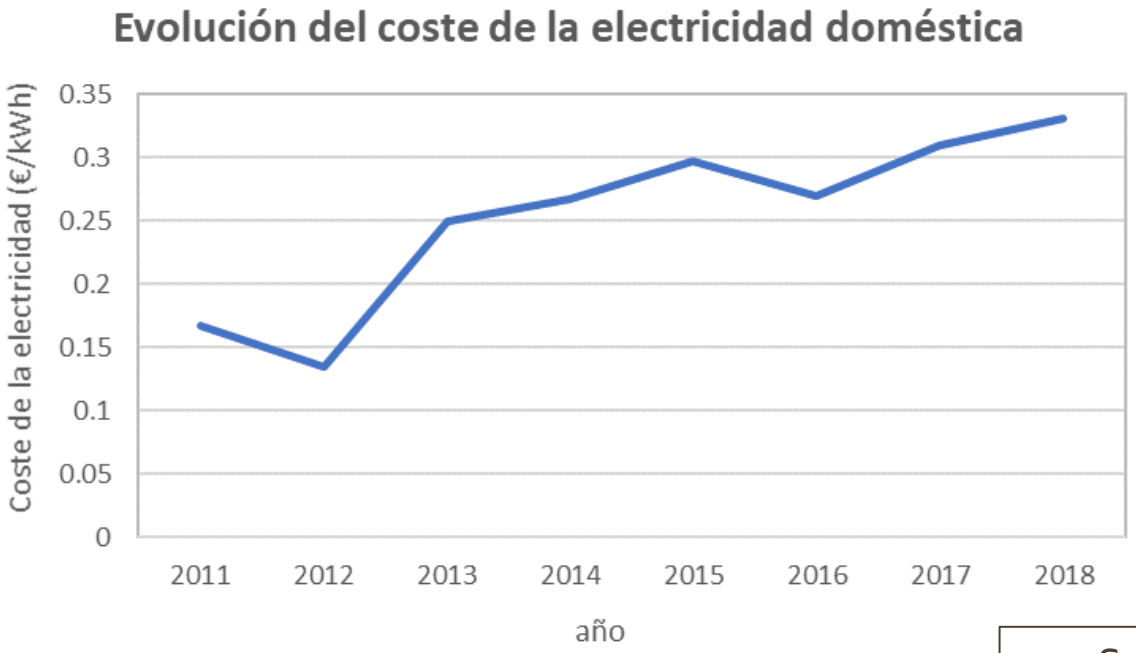
Average Interruption Time (AIT)
Maximum AIT according to standard: 15 minutes

4. CASE STUDY: SPAIN

SPAIN-FRANCE INTERCONNECTION THROUGH THE GULF OF BISCAY

Benefits Lower electricity prices (I)

So far, more interconnections have not led to lower prices.



Source: Eurostat

4. CASE STUDY: SPAIN

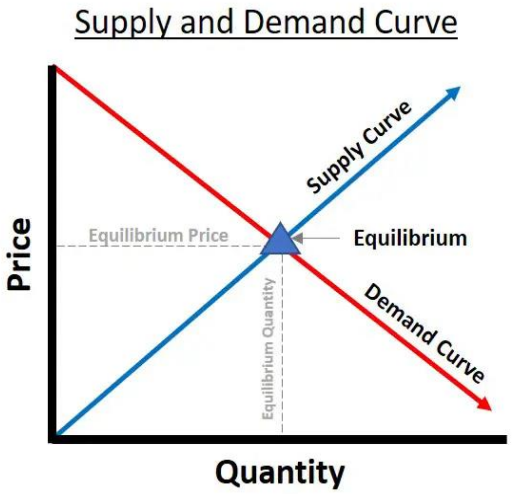
SPAIN-FRANCE INTERCONNECTION THROUGH THE GULF OF BISCAY

Benefits Lower electricity prices (II)

- There is no justified study of the capacity to be installed
- There is no justified study of the reduction in the cost of electricity
- There is no justified study of the aid received by the CEF

- The project will lead to an increase in the fixed term of the bill

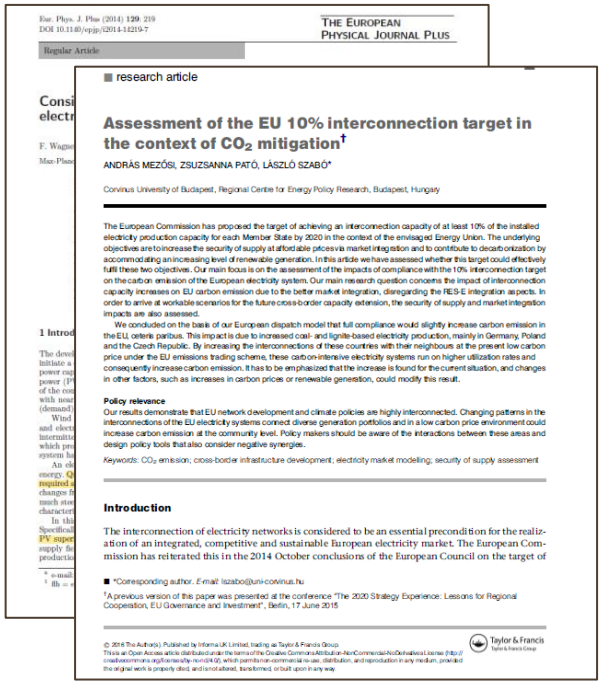
For a given supply, interconnection increases the number of consumers and therefore increases the cost of electricity.



4. CASE STUDY: SPAIN

SPAIN-FRANCE INTERCONNECTION THROUGH THE GULF OF BISCAY

Benefits More renewable energy



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THE EUROPEAN PHYSICAL JOURNAL PLUS

Regular Article

research article

Assessment of the EU 10% interconnection target in the context of CO_2 mitigation†

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The European Commission has proposed the target of achieving an interconnection capacity of at least 10% of the installed electricity production capacity for each Member State by 2020 in the context of the envisaged Energy Union. The underlying objectives are to increase the security of supply at affordable prices via market integration and to contribute to decarbonization by accommodating an increasing level of renewable generation. In this article we have assessed whether this target could effectively fulfil these two objectives. Our main focus is on the assessment of the impacts of compliance with the 10% interconnection target on the carbon emission of the European electricity system. Our main research question concerns the impact of interconnection capacity increases on EU carbon emission due to the better market integration, disregarding the RES-E integration aspects. In order to arrive at workable scenarios for the future cross-border capacity extension, the security of supply and market integration impacts are also assessed.

We concluded on the basis of our European dispatch model that full compliance would slightly increase carbon emission in the EU, ceteris paribus. This impact is due to increased coal- and lignite-based electricity production, mainly in Germany, Poland and the Czech Republic. By increasing the interconnections of these countries with their neighbours at the present low carbon price under the EU emissions trading scheme, these carbon-intensive electricity systems run on higher utilization rates and consequently increase carbon emission. It has to be emphasized that the increase is found for the current situation, and changes in other factors, such as increases in carbon prices or renewable generation, could modify this result.

Policy relevance

Our results demonstrate that EU network development and climate policies are highly interconnected. Changing patterns in the interconnections of the EU electricity systems connect diverse generation portfolios and in a low carbon price environment could increase carbon emission at the community level. Policy makers should be aware of the interactions between these areas and design policy tools that also consider negative synergies.

Keywords: CO_2 emission; cross-border infrastructure development; electricity market modelling; security of supply assessment

Introduction

The interconnection of electricity networks is considered to be an essential precondition for the realization of an integrated, competitive and sustainable European electricity market. The European Commission has reiterated this in the 2014 October conclusions of the European Council on the target of

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What does the TYNDP tell? entsoe

Integration of renewable energy sources

B3 Annual avoided curtailment (RES integration) (GWh / year) in the entire area covered by the study	max	2225
	average	**2023**
	min	1790

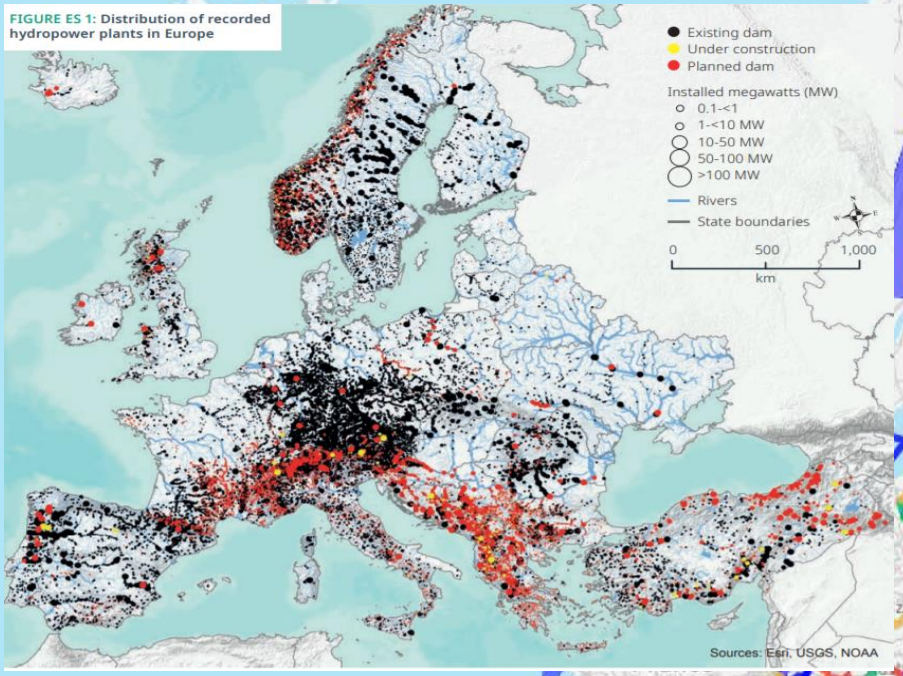
Impact on grid losses

B5 Variation of network losses (GWh / year) in the ENTSO-E area	average	**1717**

More than 80% of the not curtailed renewable energy will be lost through the European electricity transport system

4. CASE STUDY: SPAIN

THE INTERNATIONAL DIMENSION: ENERGY COLONIALISM



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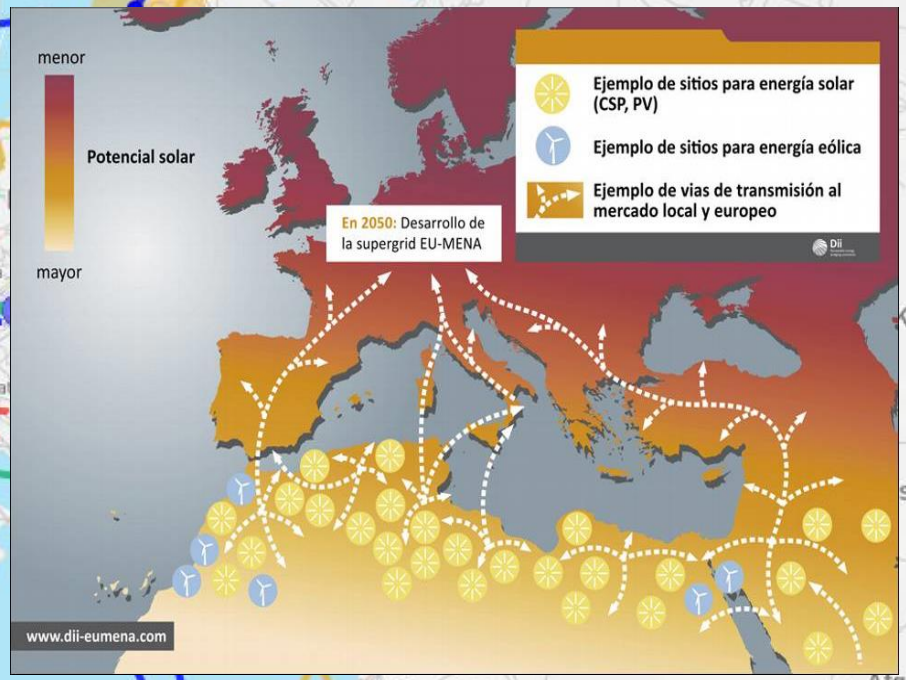


EXPLOTACIÓN ÁFRICA

Alemania, el Congo y el nuevo imperialismo energético europeo

El interés de Berlín por producir hidrógeno verde en la República Democrática del Congo genera controversia. Desde el país africano se critica que el proyecto no beneficiará a la población local.

STRUCTURE

1. *Notes for the energy transition*
2. *The corporate energy transition (CET)*
3. *Infrastructure of the corporate energy transition (CET)*
4. *Case study: The case of Spain*
5. *Closing remarks*

5. CLOSING REMARKS

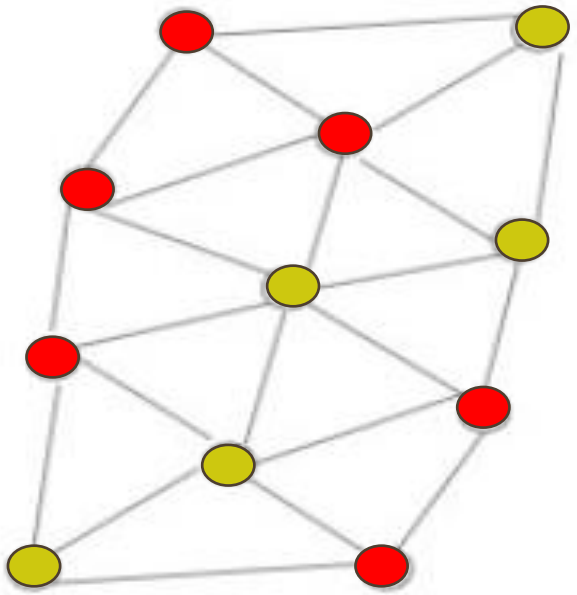
THE NEED FOR A RENEWABLE REGIME

Based on renewable flows:

- Intermittent
- Resources geographically distributes
- Low Energy density
- Lower EROEI
- Highly modular

Distributed system:

- Bidirectional system
- Distributed power in territory
- Role change of the consumer:
  - Produces
  - Manages
- **Less energy availability**



5. CLOSING REMARKS

HOW TO BUILD IT? ENERGY POLICY FOR A NEW PARADIGMA

It requires a bottom-up approach

Objective: To meet the demand

Some steps:

1. Quantify demands and management capabilities

   How can we act on the demand curve?

2. Assess the renewable potential of territories and créate tools for its development.

3. Complement it with interconnections and other centralized services

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THANK YOUR FOR YOUR ATTENTION!

Klimakonferanse «Energi – Infrastruktur – Nykolonialisme – Menneskerettigheter – EUs rolle»

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