STUDY RELEASE

LUT University & Energy Watch Group

100% Renewable Energy across Europe is More Cost Effective than Current Energy System

with zero GHG emissions across power, heat, transport and desalination sectors before 2050

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100% RENEWABLE ENERGY STUDY

- First release of larger global study: 4.5-years | 14 scientists
- First-of-its-kind simulation study for 100% renewable energy
- Evaluation across sectors: power, heat, transport, and desalination across Europe from 2015 through 2050
- Energy transition is possible across sectors with existing renewable energy potential and technologies to supply energy at all hours
- More cost effective than today's energy system that is based primary on fossil fuels and nuclear

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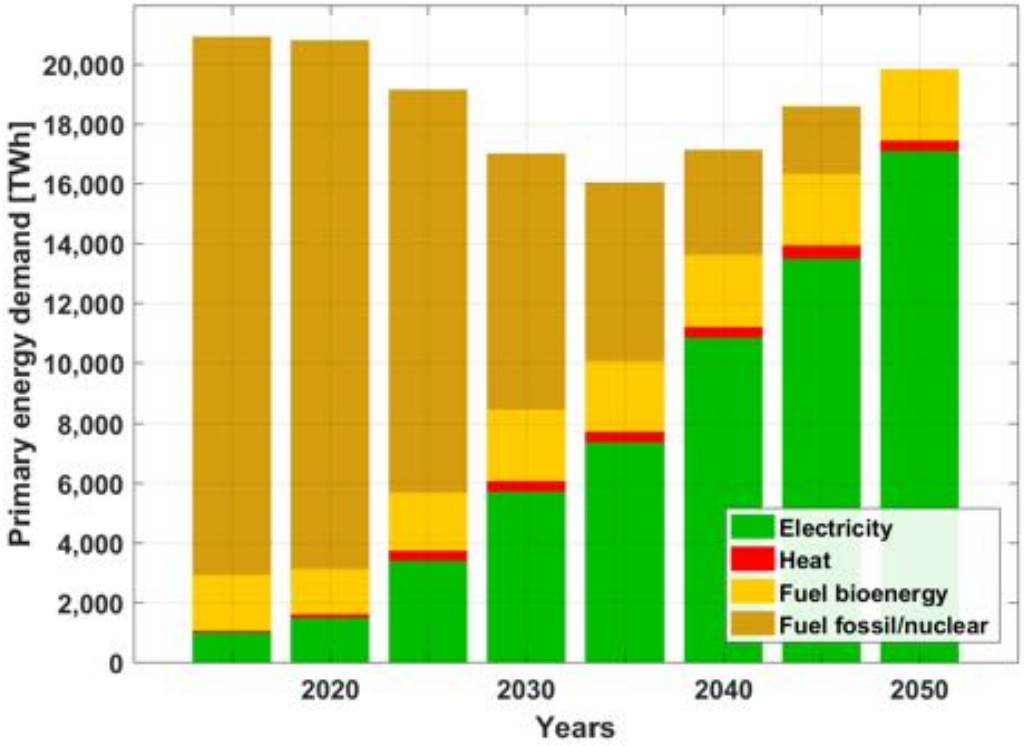
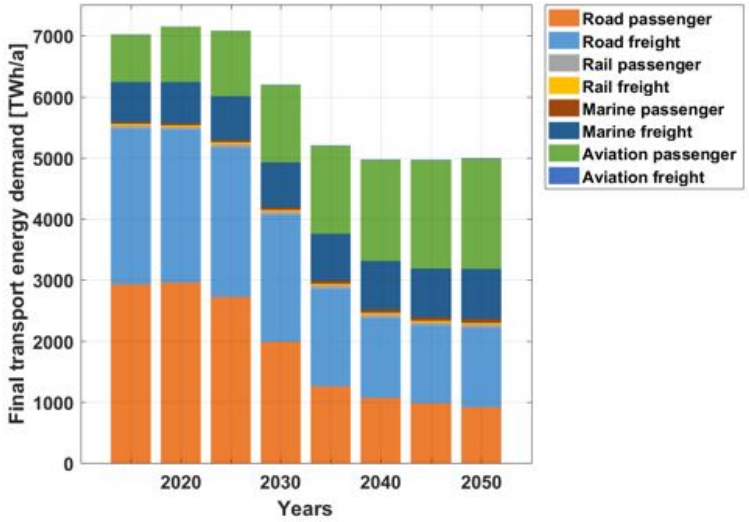
ELECTRIFICATION ACROSS ALL SECTORS IS INEVITABLE.

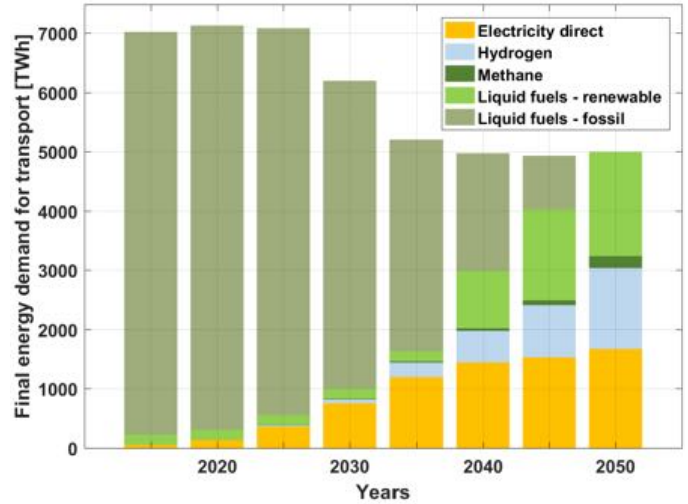
- Electricity in 2050:
  - 4-5X's that of 2015
  - 85% primary energy demand
- Nuclear and fossil fuels are phased out completely



TRANSPORT SECTOR

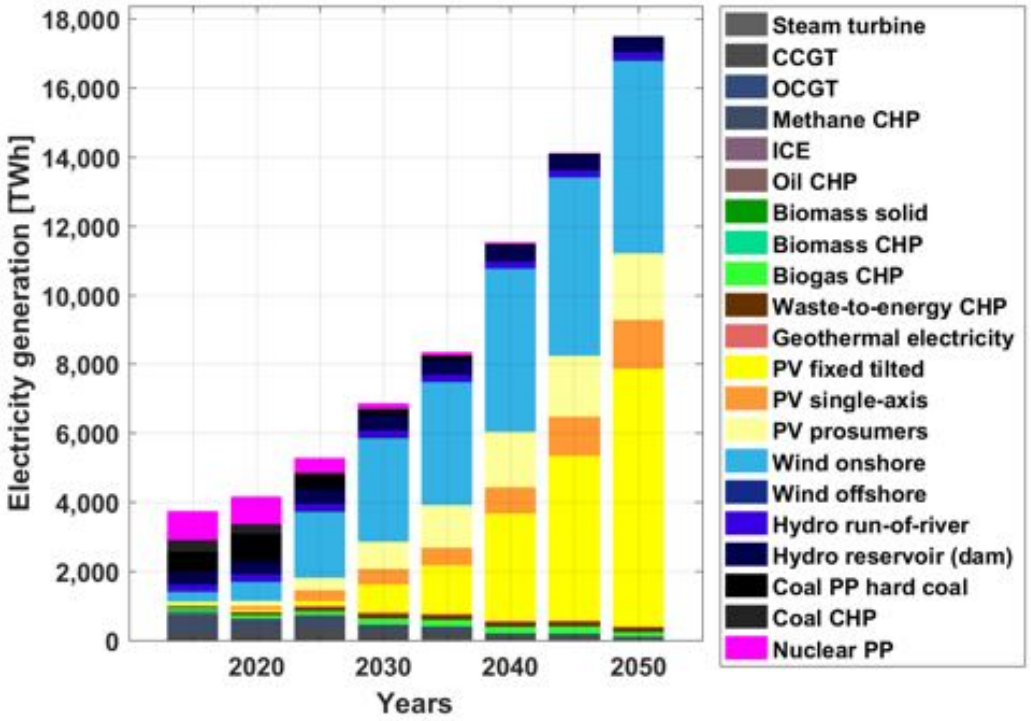
- Fossil fuels replaced by electricity, synthetic fuels, and some sustainable biofuels
- Road, rail, marine and aviation are electrified: direct and indirect
- Energy demand and fuel utilisation for transport decreases significantly, driven by massive electrification through transition





100% RENEWABLE GENERATION

Source	Supply
Solar PV	62%
Wind Energy	32%
Hydropower	4%
Bioenergy	2%
Geothermal Energy	<1%



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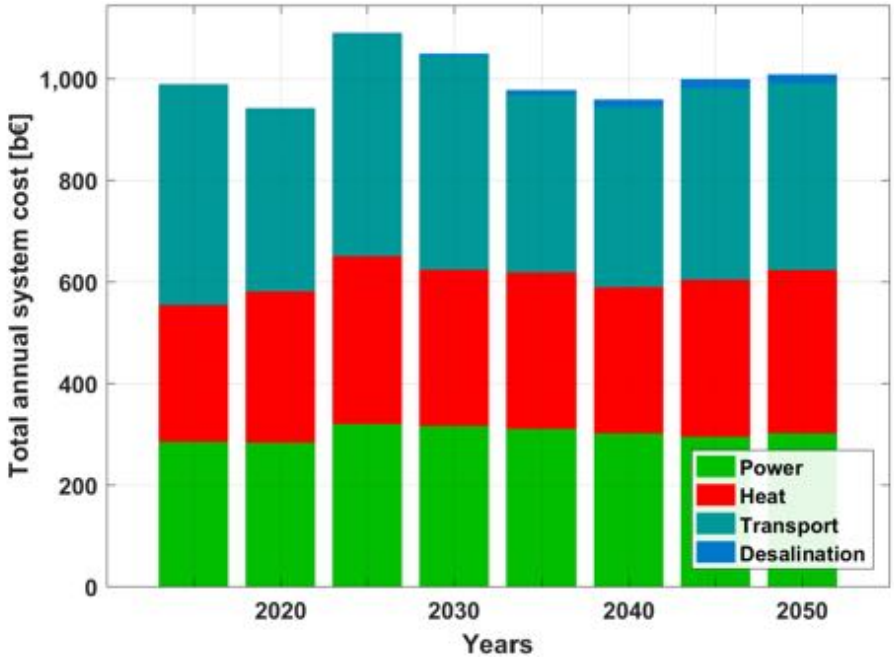
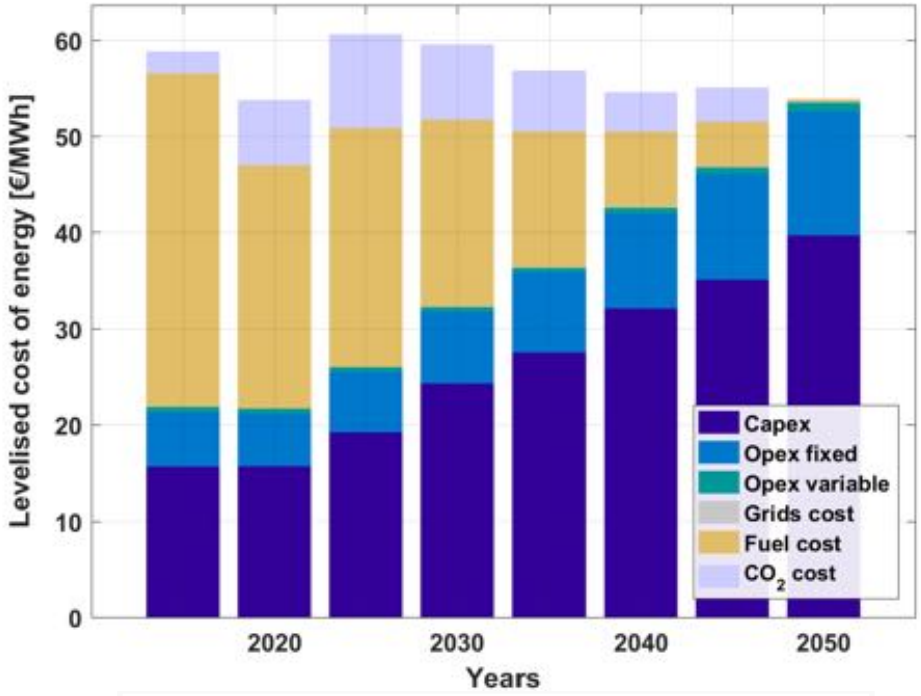
100% RENEWABLE ENERGY IS NOT MORE EXPENSIVE THAN EUROPE‘S CURRENT SYSTEM.



Total Annual Energy System Costs

LOWER LCOE WITH DEFOSSILISATION



Levelised Cost of Energy (LCOE)

- Sustainable energy system LCOE remains stable through 2015-2050 transition in Europe, ranging from 50-60 €/MWh
- Electricity cost decreases substantially from around 80 €/MWh to around 57 €/MWh
- Heat cost increases marginally from around 41 €/MWh to 47 €/MWh in 2030, and further declines to around 43 €/MWh by 2050

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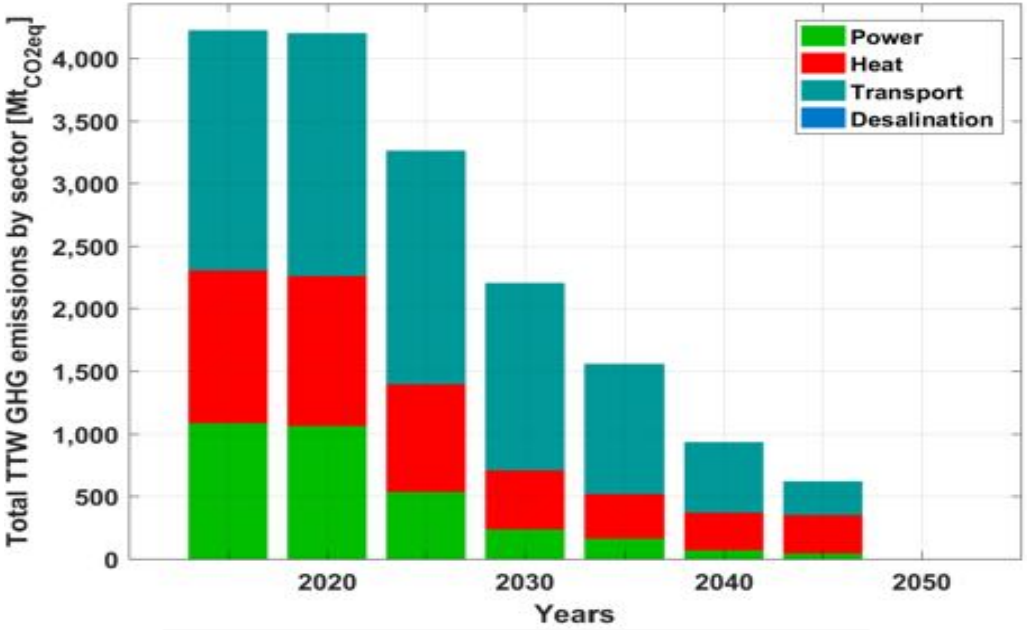
ZERO GHGs BY 2050, OR SOONER



GHG emissions by Sector

Supports global goals to limit temperature rise to 1.5°C above pre-industrial levels

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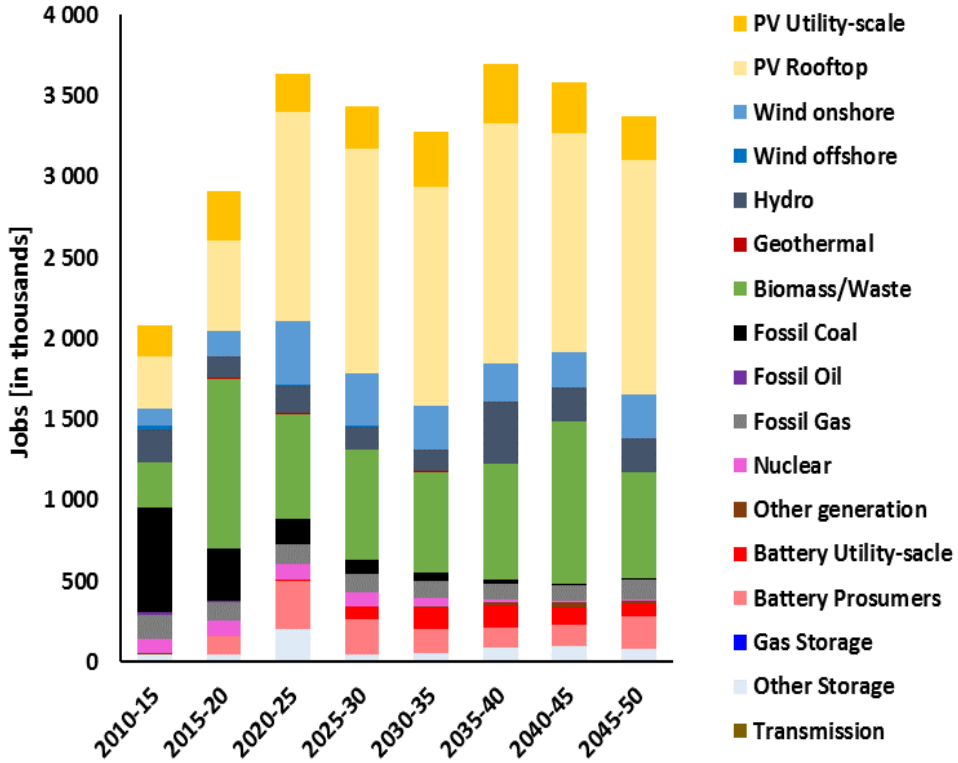
1.5-MILLION NEW JOBS CREATED

- Approximately 3.5M total power sector jobs
- Phaseout of 800k fossil fuel and nuclear jobs
- 1.5M new European jobs created by 2050



Jobs (in thousands)

The energy transition is not a question of technical feasibility or economic viability, but one of political will.

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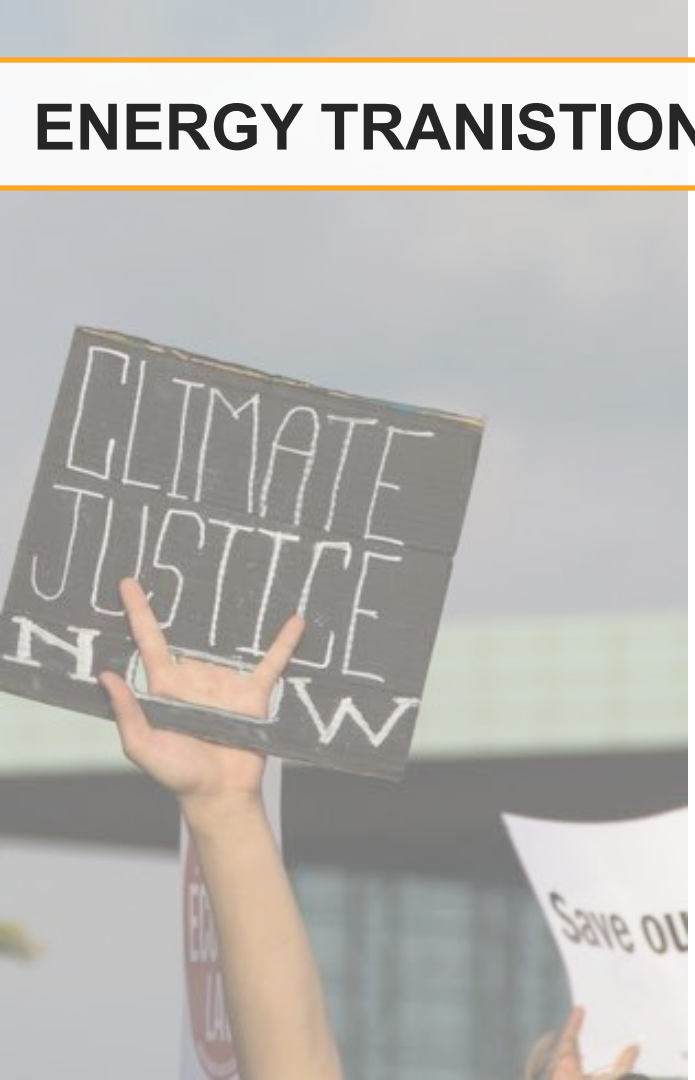
ENERGY TRANISTION PREREQUISITES



1. Public and government support

2. Clear legislative framework that promotes rapid and exponential growth of renewables

1. SECTOR COUPLING

Policies and instruments need to support sector integration across renewable, heat and transport in electrification.

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2. ENCOURAGE DIRECT PRIVATE INVESTMENT

- Feed-in Tariffs (FITs)
- Tenders: > 40MW projects
- Focus on decentralisation
- Innovation in FIT legislation for hybrid projects with storage

3. EXEMPTIONS, SUBSIDIES, LEGAL PRIVILEGES FOR CLEAN RENEWABLE ENERGY AND TECHNOLOGY

- Tax exemptions: Property, trade, purchase
- Direct tax subsidies
- VAT exemptions
- Motor tax exemptions
- Privileges for emission-free vehicles

4. PHASE-OUT OF FOSSIL FUEL AND NUCLEAR SUBSIDIES

All subsidies and tax exemptions for conventional fossil fuel projects must end, foremost coal power plants.

5. ENCOURAGE COGENERATION

- Cogeneration and bioenergy with full heat recovery are key to Europe’s energy transition
- Good space and construction planning with local heating networks
- Combined with heat storage (ice storage) and integrated solar thermal

6. CARBON, METHANE AND RADIOACTIVITY TAXES

- Sanction energy companies producing GHGs through fossil fuels and nuclear
- Tax must exceed avg. renewable energy price
- Reflect real costs of fossil fuels and nuclear (environmental, social, economical)

7. RESEARCH, EDUCATION, AND TRAINING

Renewable energy and zero emission technology education in schools, universities, and vocational training across professions.

100% renewable energy across Europe is more cost effective than the current energy system and leads to zero emissions before 2050.

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