



Expanding Integrated Assessment Modelling:
Comprehensive and Comprehensible Science
for Sustainable, Co-Created Climate Action



Responsive science in support of climate policymaking
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Aligning NECPs with the 'Fit for 55' targets

Natasha Frilingou, National Technical University of Athens



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Policy Response Mechanism

Core
Working
Groups



Electrification

Question 1



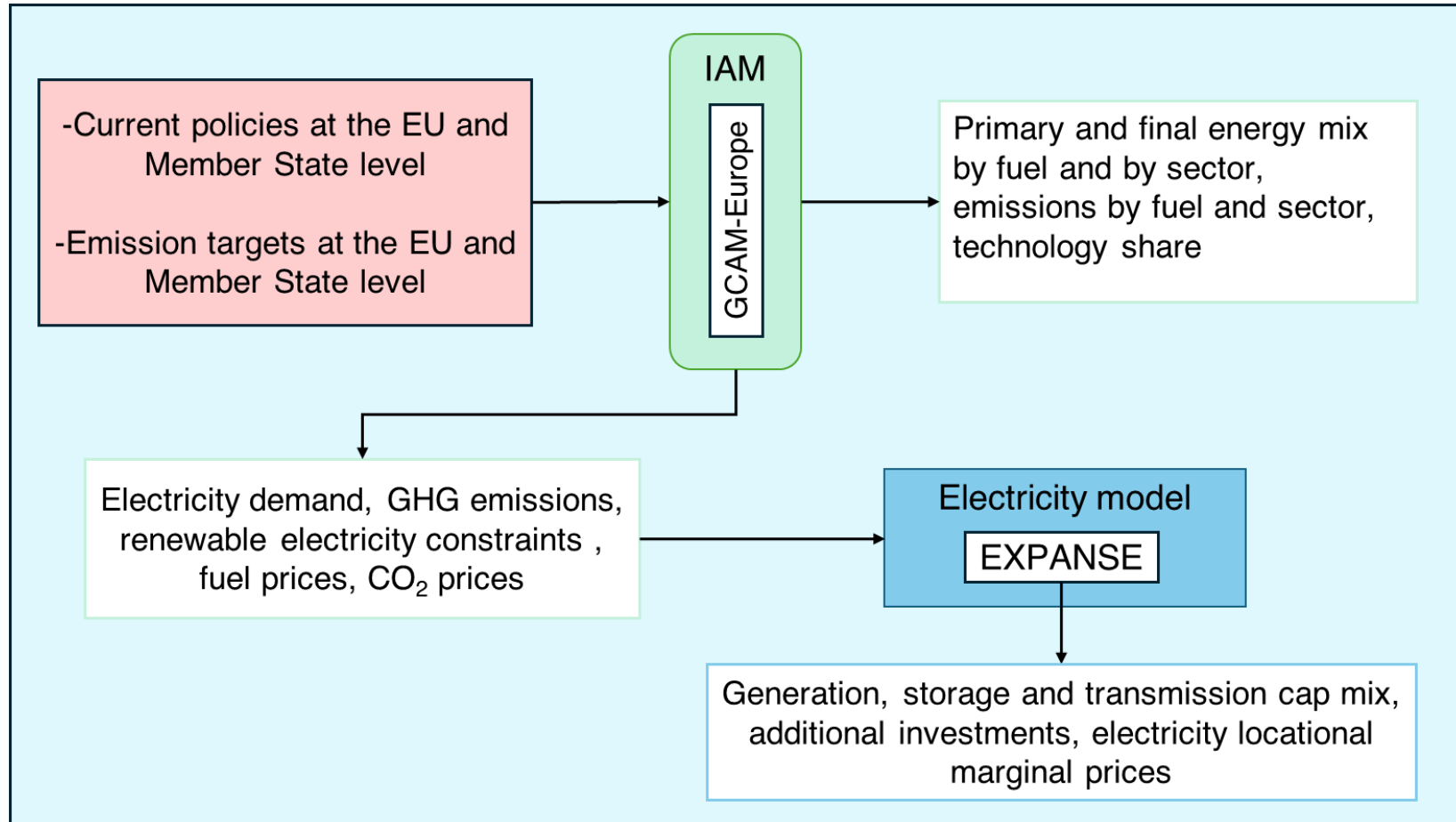
Question 2



What are the offshore grid investment needs to meet the **EU's 2030 targets**?

How does the implementation of the updated National Energy and Climate Plans compare to the **cost optimal approach** at a European level?

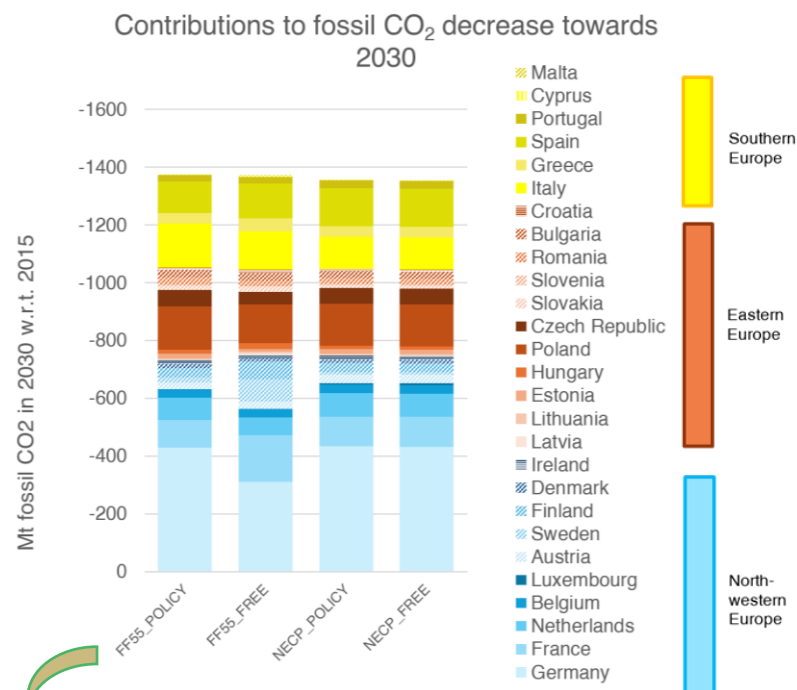
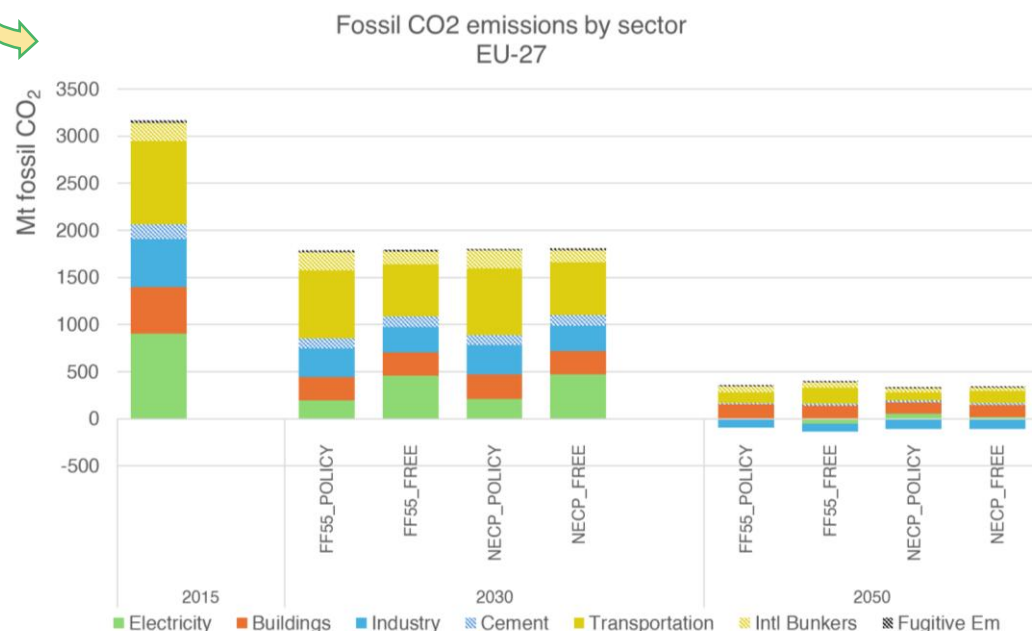




Scenarios	FF55: EU-wide targets	NECP: Member State targets
POLICY: Policies/targets to 2030, then linear interpolation to net zero	FF55_POLICY <i>EU-wide targets for 2030 in line with Fit-For-F55 are applied for renewables (42.5% of final energy) and energy efficiency (11.7% reduction in final energy w.r.t. 2020) and net-zero for 2050</i>	NECP_POLICY <i>EU-ETS (1 and 2), vehicle emission standards, country-specific coal phase-out strategies, renewable energy (% share of final energy) and energy efficiency as a maximum final energy use targets defined in country-specific NECPs.</i>
FREE: Cost-optimal pathways (models must achieve FF55/NECP and net zero emissions levels by 2030 and 2050)	FF55_FREE <i>Same level of CO₂ emissions mitigation in the EU as in the FF55_POLICY scenario through emissions constraints without considering the current climate policies, allowing the models to select the cost-optimal pathway for reducing emissions.</i>	NECP_FREE <i>Same level of CO₂ emissions mitigation in Member States as in the NECP_POLICY scenario through emissions constraints without considering the current climate policies, allowing the models to select the cost-optimal pathway for reducing emissions.</i>



- All scenarios reach the FF55 emissions target (-55% vs. 1990)
- Minor differences between POLICY and FREE variants:
 - **POLICY**: extra constraints (renewables, efficiency, carbon pricing) → more cuts in electricity sector
 - **FREE**: relatively higher reductions in transport
- By 2050, emissions in all scenarios reduced by ~94%

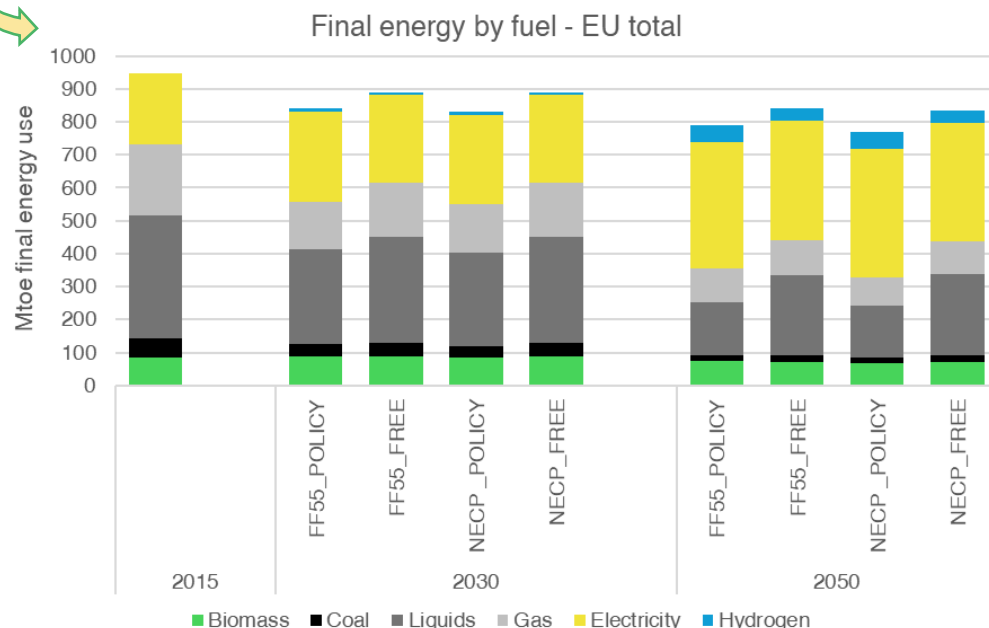


Big emitters (Germany, France) drive the bulk of absolute emissions declines, while smaller economies (Portugal, Greece) lead in "percentage terms," showing ambitious transformations relative to their baseline.

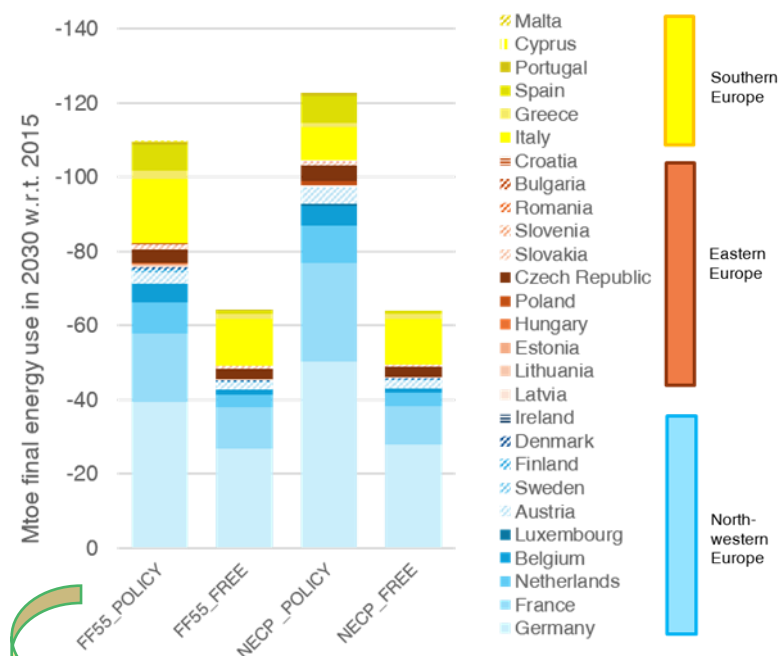


-No scenario reached the 763 Mtoe target (-11.7% w.r.t. 2015); best case: NECP_POLICY

- **POLICY:** push demand below the cost-optimal levels
- **FREE:** higher use of oil products, esp. in electricity



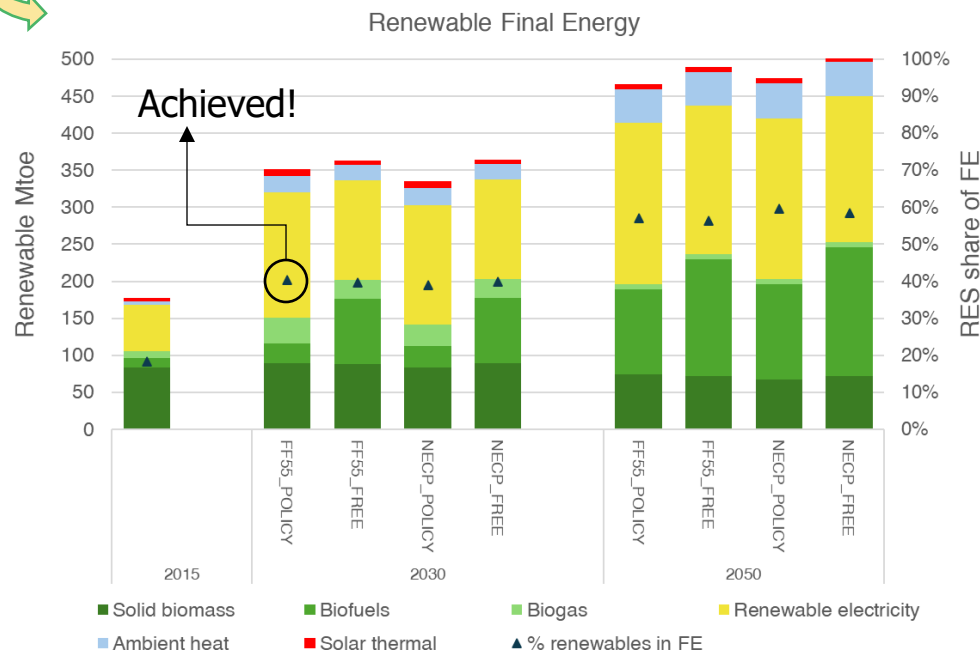
Contributions to Energy Efficiency towards 2030



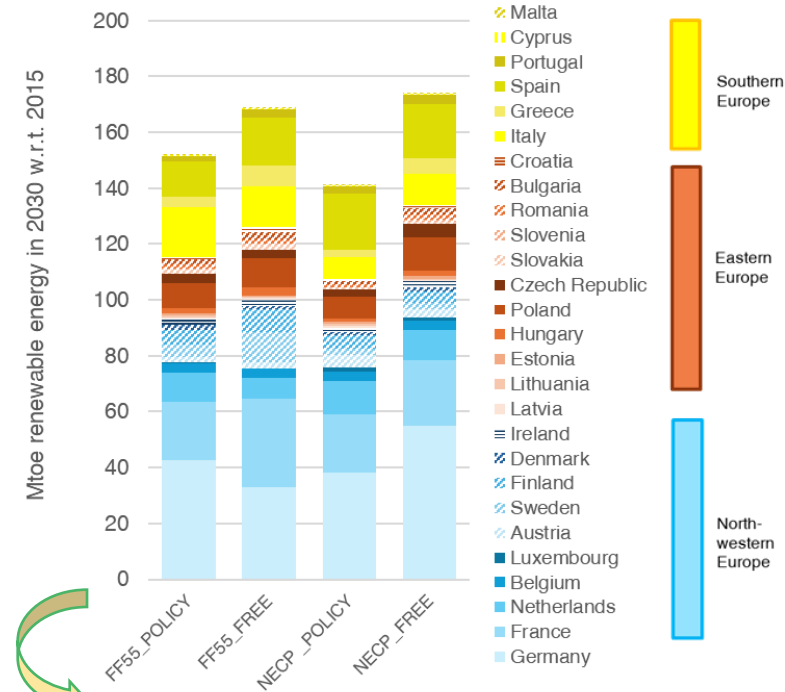
FREE: Model shifts effort to least-cost regions (Nordics, France)

POLICY: double the efficiency gain, spreading across many MS, not just the large emitters

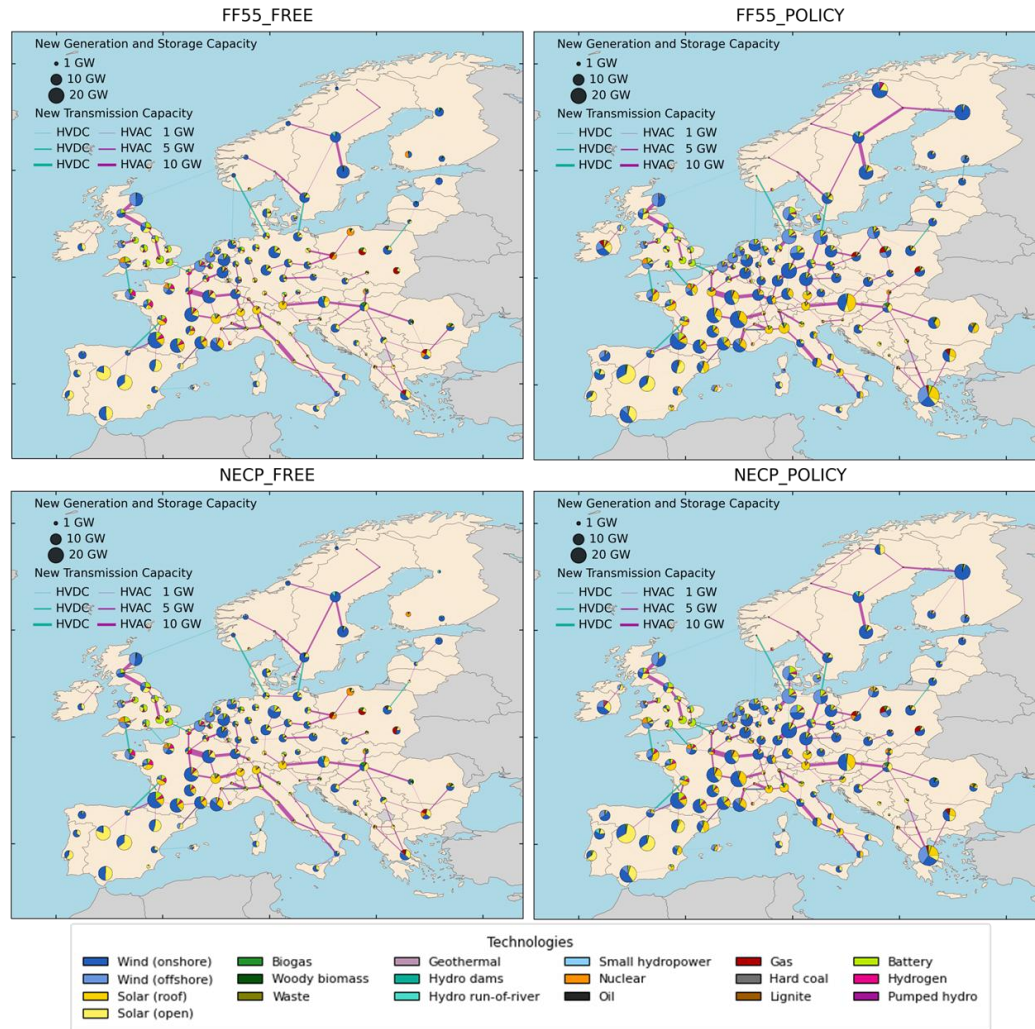
- All scenarios close to the RES share target (42.5%),
 - **POLICY:** accelerates electrification (renewable electricity + heat pumps) → more efficiency and RES gain.
 - **FREE:** closer to RES targets but leans heavily on biofuels/biogas as a substitute for fossil liquids.



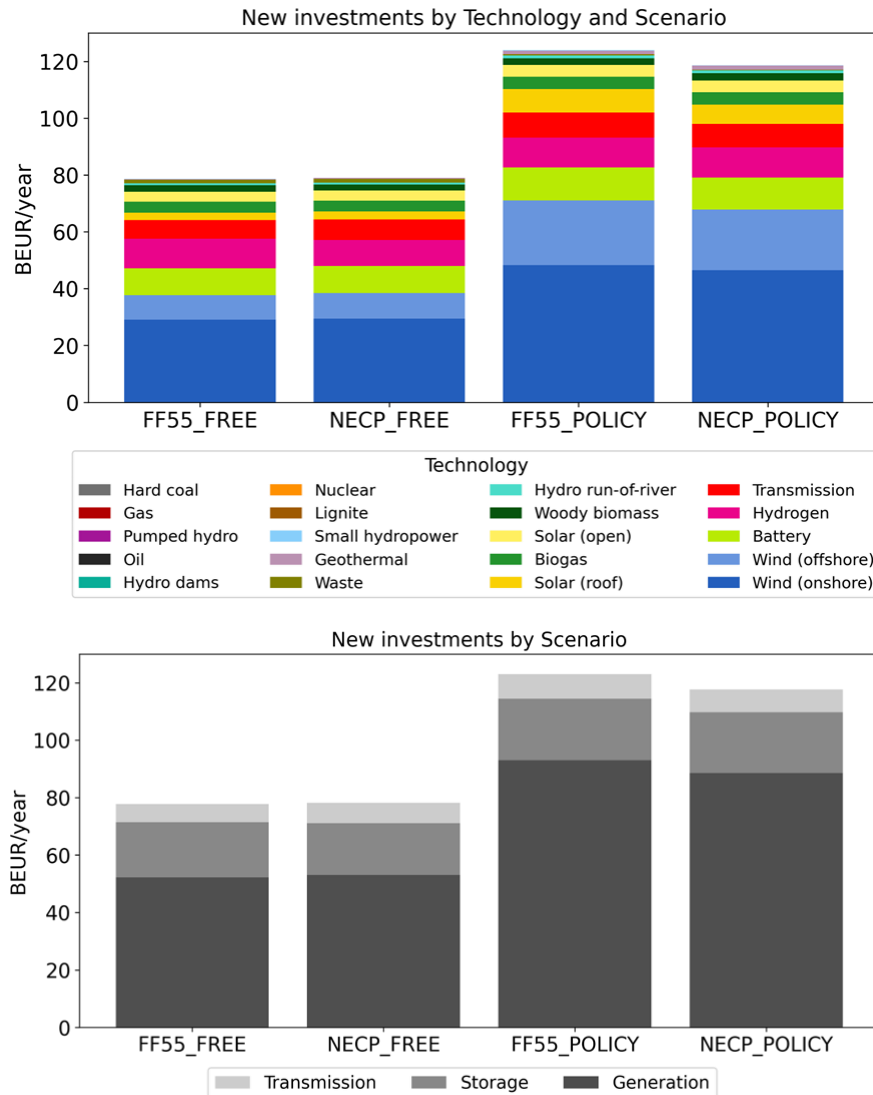
Contributions to Renewable Energy towards 2030



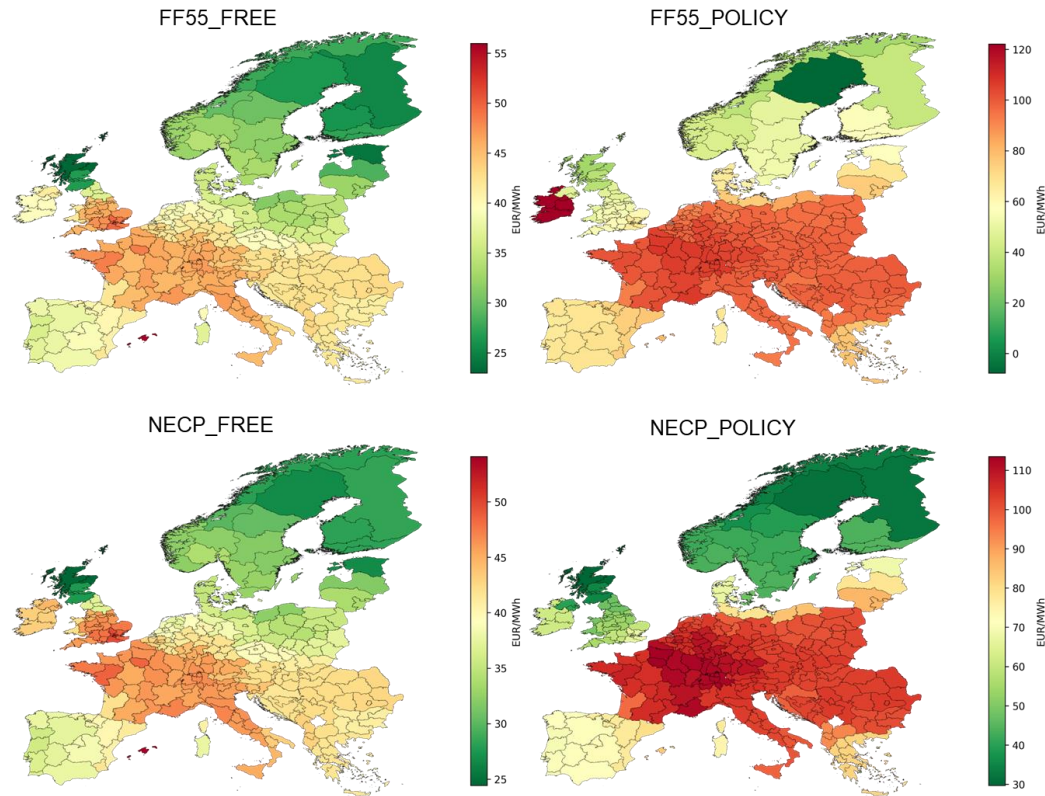
Germany, and France are the largest contributors to this expansion, supported by strong uptake in countries like Spain, the Netherlands, Sweden, Greece, and Poland



- **POLICY** (right panels): : More nodes with new capacity additions across Europe → deployment is more spatially distributed.
- **FREE** (left panels): Fewer nodes, with capacity concentrated in resource-rich regions → reflects a cost-optimal allocation.
- Massive build-out of **wind** (North Sea, Central & Eastern) and **solar** PV (South)
- **Batteries** & hydrogen key for storage, esp. in West & North Europe
- **Grid expansion** (HVAC/HVDC) crucial to link renewable hubs (North Sea, Iberia, Nordics) with demand centres in Central & Western Europe (Germany, Benelux, N. Italy, France, UK).



- **FF55_POLICY:** highest investments driven by stringent EU-wide carbon pricing & renewable targets. Capital-intensive deployment of new generation capacity dominates.
- **NECP_POLICY:** substantial but lower investments; less efficient (country-driven) allocation compared to EU-wide approach.
- **FREE scenarios:** similar emissions cuts at far lower costs, as investments concentrated where most cost-effective.
- **Investment composition:** Generation is the cost driver, storage grows with system inflexibility, and transmission costs higher in national policy pathways where cross-border efficiency is limited.



- **POLICY** (right panel): higher & more uneven LMP due to CO₂ price; greater price spikes in Central & Southern Europe, where reliance on dispatchable fossil plants is higher.
- **FREE**: Lower and more uniform prices across regions → better alignment of renewable resources and demand;
- Lower LMPs in Northern Europe due to RES abundance
- Geographic disparities in electricity affordability; highlights the value of flexibility and interconnection in mitigating high LMPs

- **Emissions:** Current EU and national policies can deliver 2030 targets, but sustaining momentum to 2050 requires stronger support for industrial transformation and CCS deployment.
- **Cost-optimal scenarios** can, in principle, achieve comparable decarbonisation outcomes at lower system costs and electricity prices, but real-world energy transitions rarely align with idealised optimisation outcomes due to political, institutional, and socioeconomic constraints.
- **Energy efficiency** gains are not cost-optimal but policy-driven; binding measures and funding instruments are essential to lock in demand reductions.
- **Wind, solar, and storage** must scale rapidly; EU-level planning should balance concentrated vs. distributed investments across Member States.
- **Grid congestion and underinvestment** could undermine decarbonisation; fast-tracking permitting, financing, and EU-level coordination of transmission projects is crucial to meet 2030 and 2050 goals.
- Use **ETS auction revenues** for bill rebates or green investments in high-price regions





Thank you!

Natasha Frilingou; nfrilingou@epu.ntua.gr (NTUA)

Co-authors:

Dirk-Jan Van de Ven (BC3)
Russel Horowitz (BC3)
Clàudia Rodés Bachs (BC3)
Shivika Mittal (CICERO)
Alexandre Torne (UNIGE)
Evelina Trutnevyte (UNIGE)
Konstantinos Koasidis (NTUA)
Alexandros Nikas (NTUA)

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