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Charting the path for European biogas and biomethane: A comparative policy analysis

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Context

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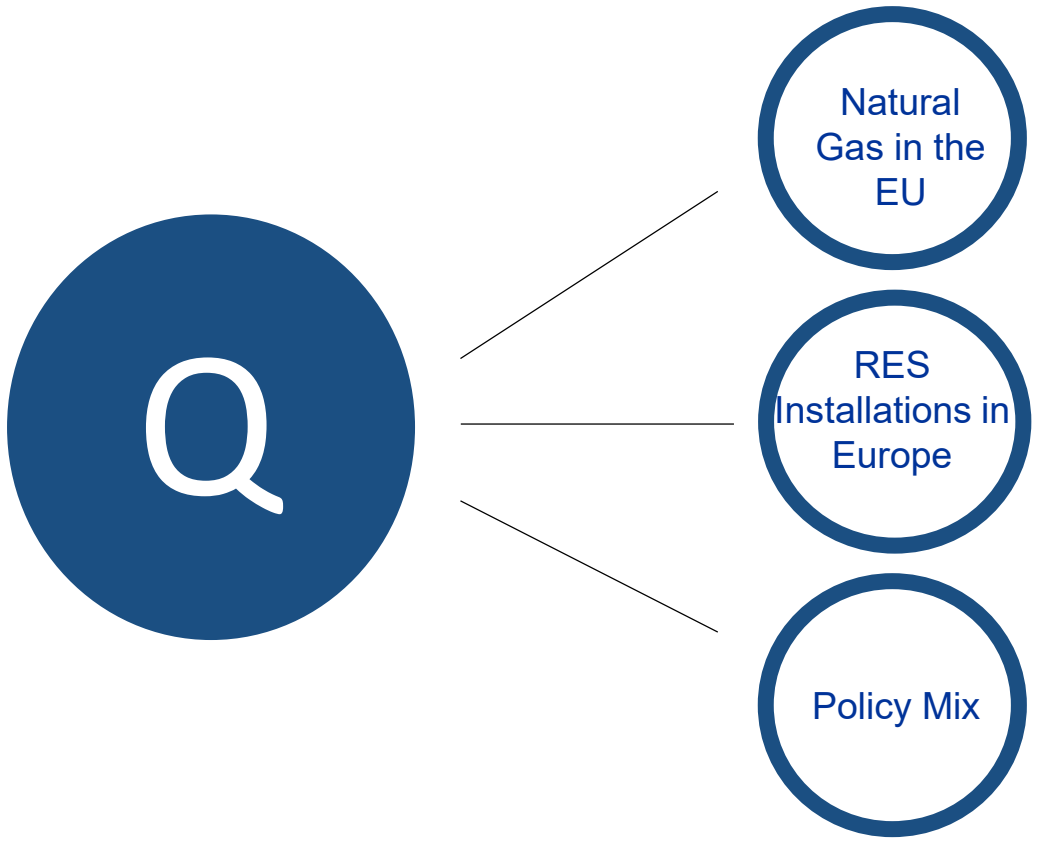
Context

Can renewable gas benefit from the same regulations that have effectively lowered the cost of renewable electricity towards the decarbonization of the EU energy system?



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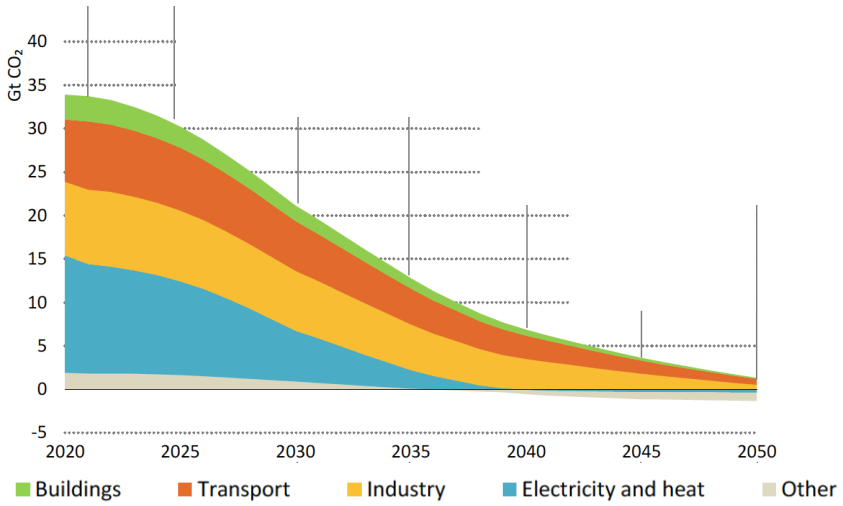
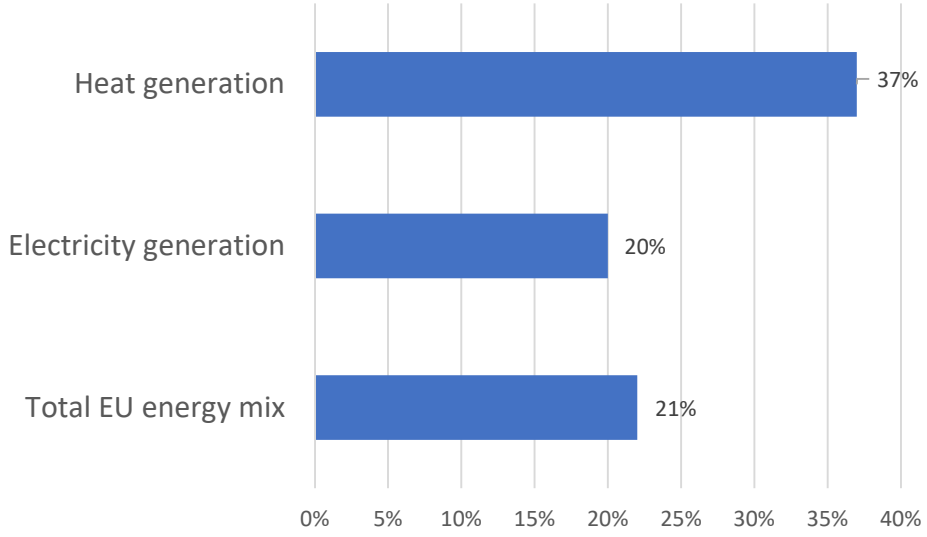
Gas supply in the EU market

- ✓ The EU goal of carbon neutrality by 2050 will require a significant system transformation.
- ✓ Natural gas today is the second largest primary energy source in the EU.



Pathway to net zero (Source: IEA, 2021)



Role of gas in the EU energy system in 2022 (Source: Author's elaboration, 2024)

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Financial Support to RES in Europe

RES installations have been financially supported as early as late 80s early 90s before the first EU Directive on Renewable Energy was adopted in 2001 (2001/77/EU).

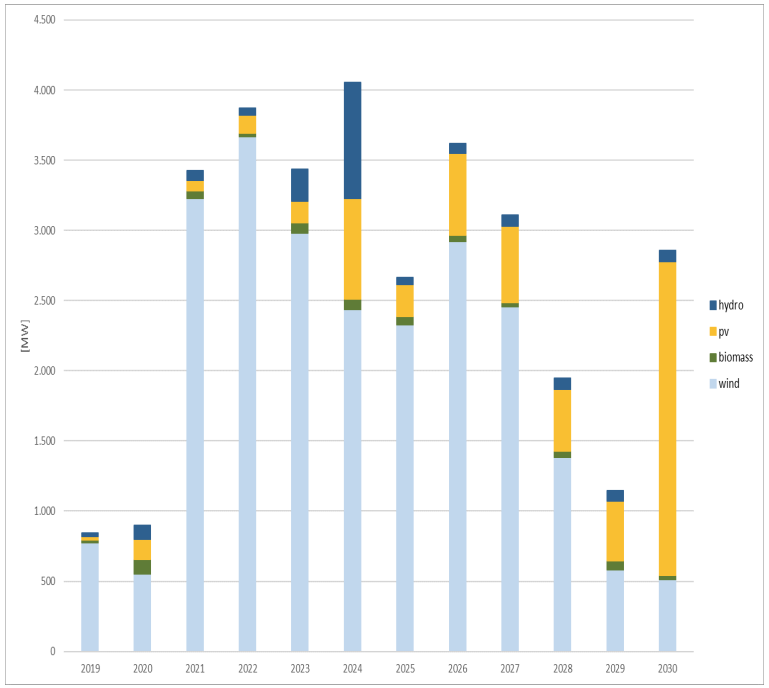
Year	2009*	2010**	2012/13	2015	2017	2018	2019
Weighted average support per unit of gross electricity consumed (€/MWh)	7,2	9	110.22	110.2	96.29	99.62	97.95
Average support (€/MWh)	-	7	81.41	-	-	-	-

* RES supported accounted for 10% of gross electricity generation

** RES supported accounted for 8% of gross electricity generation and 9% of final electricity consumption

RES supported electricity in the EU 2009-2019 (Source: Sesini, et al, 2024)

Meanwhile, a vast majority of schemes are reaching the end of their supporting time.



Installed capacity reaching the end of support (n=18 MS) (Source: CEER, 2020)

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Policy Mix

Various definitions, but fundamental aspects to include are:

- ✓ Includes more than a single political domain
- ✓ Change is manifold and goes beyond technologies
- ✓ No “one-size fits all” approach, but more “balancing” a complex mix.

“An overarching analysis of individual policies and their interactions, which captures both policy strategies and instrument mixes ”

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Methodology

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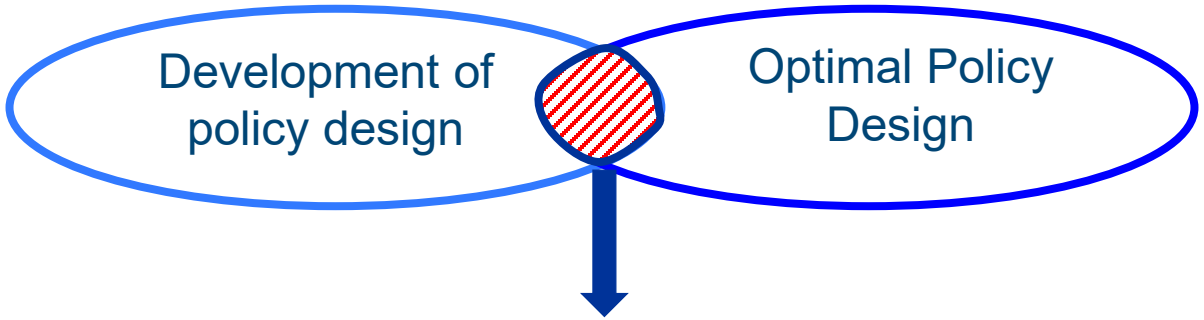
Research Goal



Definition	Contribution
Comparative Policy Framework: how different support schemes in Germany, Denmark, and Italy influence the deployment of biogas and biomethane.	**Absent in terms of structured cross-country comparison**
Direct Data Harmonization: data directly from policy statements across different Member States.	**Absent in the literature**
Policy Performance Analysis:: performance of various implemented schemes in relation to their public policy objectives	**Absent in terms of link schemes to the broader economic and policy contexts.**

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Methods

Literature

- Benchmark Member States renewable gas policy overviews
- Additional Policy Literature and Documentation

Database

- Historical data (2010-2019) creating a harmonized database for selected Member States

Results and Conclusions

- Trends and dynamics for renewable energy receiving support
- Policy impact on the biogas/biomethane value chain design
- Context dependency of biogas/biomethane sector evolution

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Analysis

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Policy implications in the RENGAS market development

Biogas	DE	DK	IT
Main end-use	CHP	CHP; gas grid	CHP
Market development	Stall (2012/2014 FIT tariff reduction; 2017 auctioning and defined target growth)	Downturn since 2015 with tendering mechanism	Stall (2013 FIT reduction and shift to FIP)

Biomethane	DE	DK	IT
Supporting Scheme	Decreased in 2014 and shifted to auctions	FIP (3 components) (2012-2020)); Tenders with price ceiling (2020)	Certificates (2018 Biomethane Decree)
Main end-use	CHP	CHP; gas grid	Transport, gas grid
Future strategy	Integration in other sectors but limited potential	Upgrading development	Substantial upgrading in other sectors

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DE, DK and IT complementary approaches

Data analyzed	Insight
Installed capacity (MW) by number of plants (2010-2019).	Reflects policy changes
Renewable energy installed capacity by year	Reflects the geographical and economics context
Renewable energy produced receiving support by year	Lower than RES (close to 5% yearly)
Share of biogas on renewable energy total installed capacity and share of natural gas on total energy mix	Lower than RES regardless of the reliance on natural gas in the energy mix
RES incentive costs in 2014 and 2017	Different challenges than RES
Biogas consumed by sector	Reflects policy changes and the geographical and economics context

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Policy impact on RENGAS sector evolution in DK

1980

- Starting of the sector but limited volume production.

2012-2018

- Subsidy scheme boomed biogas production with focus on upgrading it into biomethane for grid injection and district heating distribution CHP.
- 20 year FIP scheme divided into three components.

2016-2017

- Spiking up of subsidy annual costs

2020

- New subsidy scheme based on tenders with price ceilings with the intention to develop the technology further.
- Additional incentives in the environmental-, agricultural- and energy regulation

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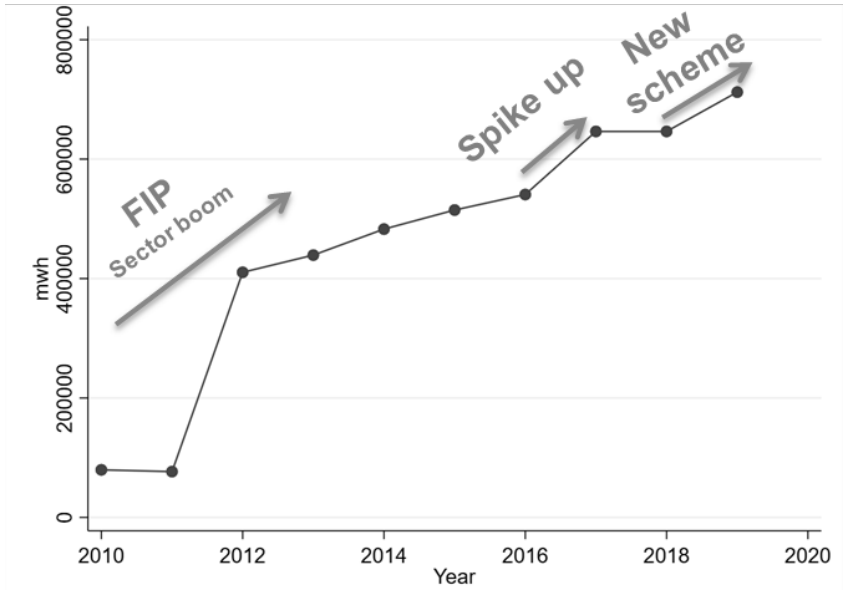
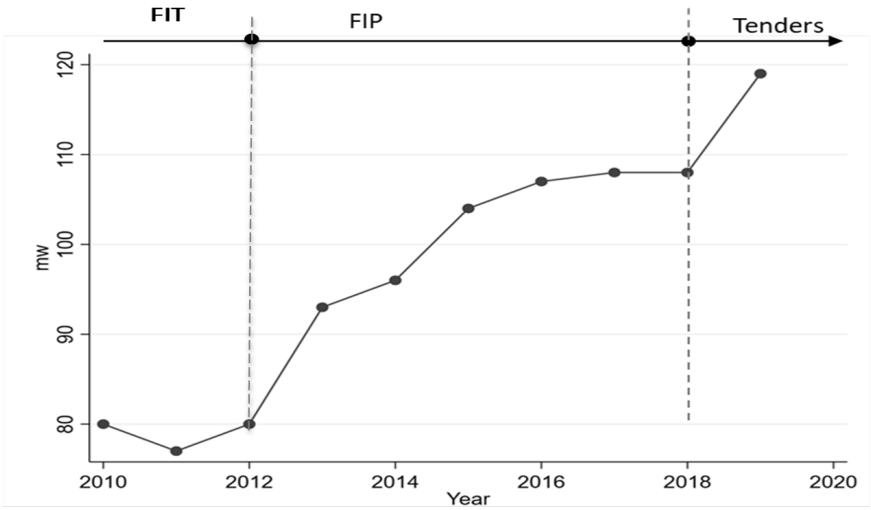
DK



Production



Installed capacity

Policy impact on RENGAS sector evolution in IT

2008-2012

- Strong FIT incentives for biogas and CHP valorisation unlocking the sector, energy crops included.

2013

- Policy re-oriented from biogas for electricity generation to biomethane production for NGV, high efficiency cogeneration and grid injection.
- Decreased incentives and introduction of FIP.

2018

- Biomethane Decree to promote biomethane, and advanced biomethane as well as advanced biofuels in the transport sector based on certificates with mandatory blending quotas.
- Introduction of specific measures dedicated to advanced biomethane and a Guarantees of Origin system for biomethane injected in to the grid.

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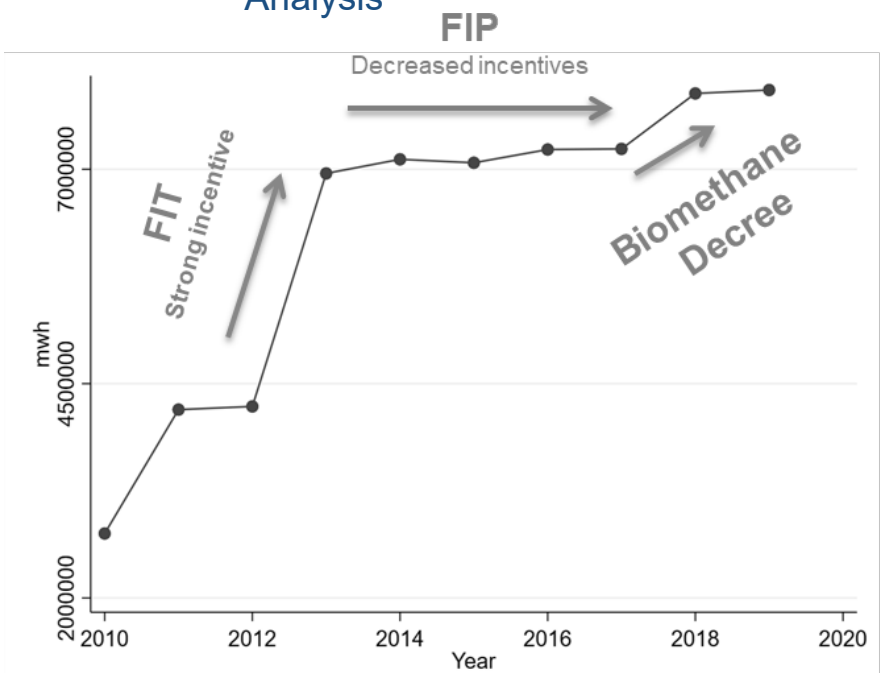
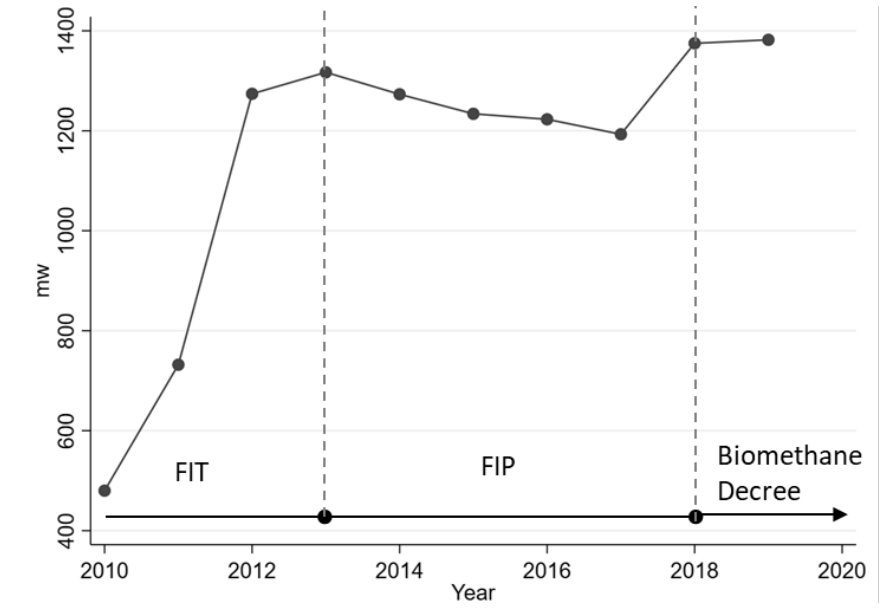
IT

Production



Installed capacity



Policy impact on RENGAS sector evolution in DE

2000-2012

- Biogas sector boomed with the Renewable Energy Sources Act (EEG) amended several times.

2004-2009

- Increased incentives for biogas generation capacity using energy crops.

2012-2014

- Restructuring and decreasing of the tariff due to“maizification” of cultures, high production costs, lack of efficient utilization of heat.

2017

- Pay-as-bid auctioning model to reduce costs, favor market integration and competitiveness of the market.

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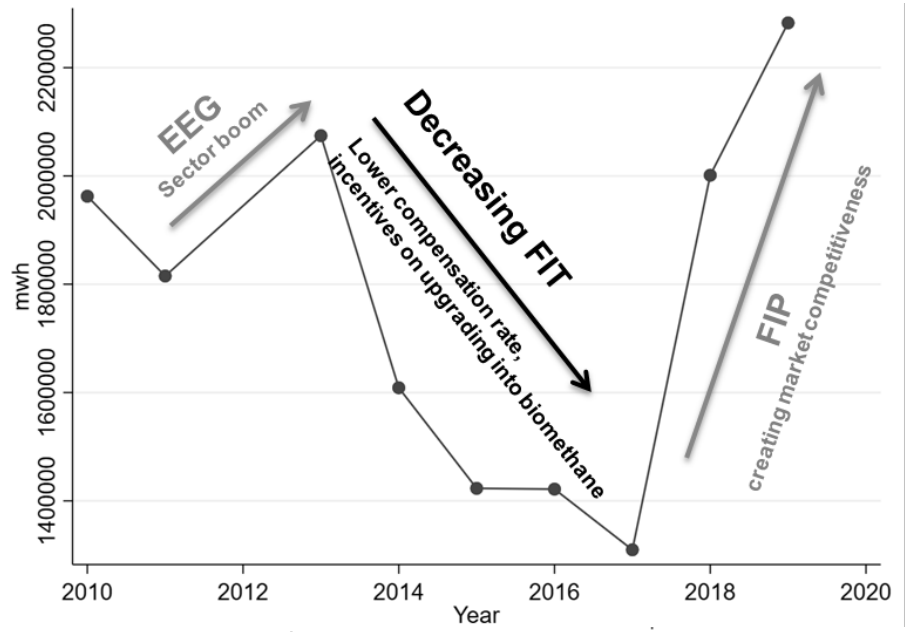
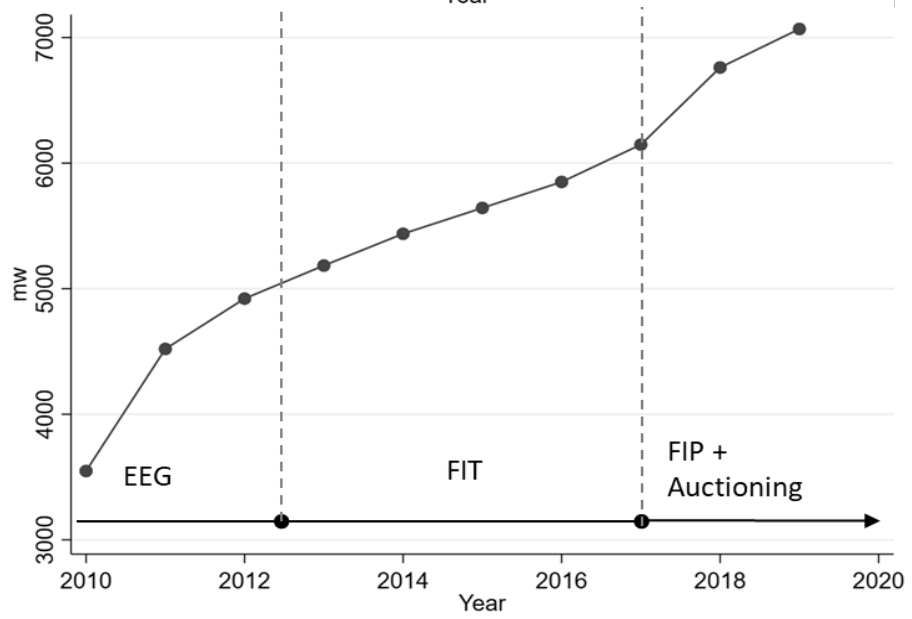
DE

Production



Installed capacity



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Results & Conclusions

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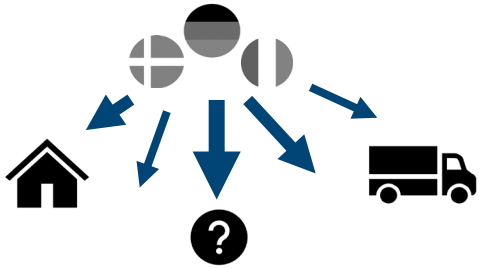
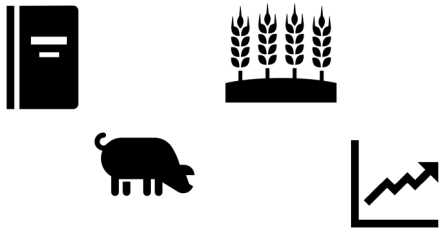
Results

- Supply-side incentives

- Demand and end-user heterogeneity



- Context-dependent evolution



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Conclusions

- ✓ The connection between success and setbacks in biogas and biomethane evolution is closely tied to **policy changes within Member States**.
- ✓ To maximize the effectiveness of substituting fossil fuels with biogas and biomethane, it is crucial to consider the entire value chain, with a stronger focus on the **end-use**.
- ✓ Unlike the approach taken with renewable electricity, which primarily focuses on production, best-practice countries recognize the importance of subsidizing **demand-side deployment**.

Future research venues could go in the direction of: Policy Coordination Across Sectors, Incentive Sharing in the Value Chain, Renewable Portfolio Standards for Biomethane, Guarantee of Origin, …

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Unlocking European biogas and biomethane: Policy insights from comparative analysis

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ABSTRACT

The scaling up of renewable gases is now being presented as a critical and effective component of the EU's long-term decarbonisation strategy. Yet, the support schemes implemented for biogas and biomethane are far less studied than the ones dedicated to renewable power generation (e.g., solar or wind). This work bridges this gap by reviewing the supporting policies implemented in the EU and conducting a retrospective comparative analysis of the mechanisms implemented in Germany, Denmark, and Italy. The analysis is based on primary data extracted from policy statements that have been harmonized. Results show that incentivising the supply side lowers the risk associated with early investments and market development. Conversely, they highlight in-homogeneity among countries in accounting for demand and end-use in their policies. Finally, they point at the availability of feedstock and the geographic and economic structure of a country as factors influencing the development of a market for renewable gases. The analysis stresses the value of policy mix in promoting biogas and biomethane in the EU's energy mix, and it hinges on the importance of scrutinizing sectoral massification, novel business models, infrastructure integration, and enhanced financial accessibility to improve their competitiveness and market advancement within the energy landscape.

Nomenclature:

Abbreviations		
MS-Member States		CHP-Combined heat and power
FIT-Feed in tariff	RES-Renewable energy sources	EU-European Union
FIP-Feed in premium	GC-Green certificate	
Units	MWh- Megawatt-Hour	MWh/d - Megawatt-Hour per day

1. Introduction

The EU's ambitious goal to reach carbon neutrality by 2050, as outlined in the 2019 EU Green Deal, necessitates a profound reconfiguration of the European energy system. This decarbonization effort requires increased end-use electrification and the large-scale deployment of low-carbon power generation, such as wind and solar. However, while these options are crucial, they are not the only solutions. Biofuels and hydrogen can also efficiently contribute to decarbonization, particularly in hard-to-abate sectors currently reliant on fossil hydrocarbon resources [1]. The methane pledge decided at COP27 and the REPowerEU Plan introduced in May 2022 following Russia's invasion of Ukraine further emphasize the importance of biomethane – a low-carbon substitute for natural gas – as a critical component of the decarbonization strategy. Specifically, the REPowerEU Plan stresses the significance of renewable gases, including hydrogen and biomethane, and insists on increasing their share in the EU energy mix [2].

In addition, in line with previous literature [3–5], this work adheres

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Questions?

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Back-up

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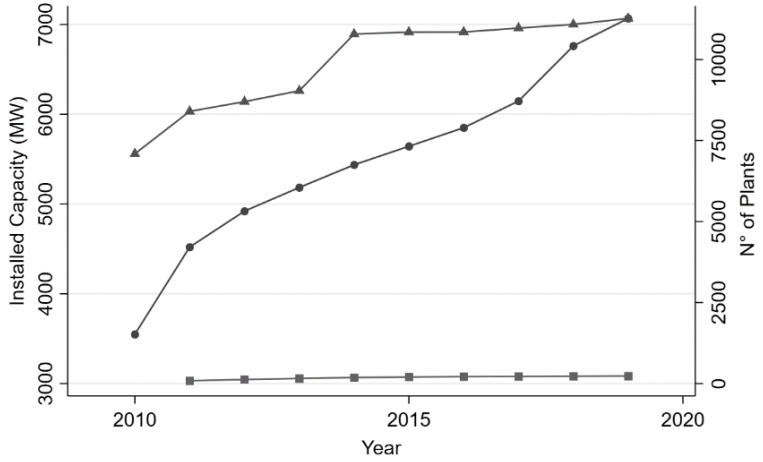
Installed capacity (MW) by number of plants

DE



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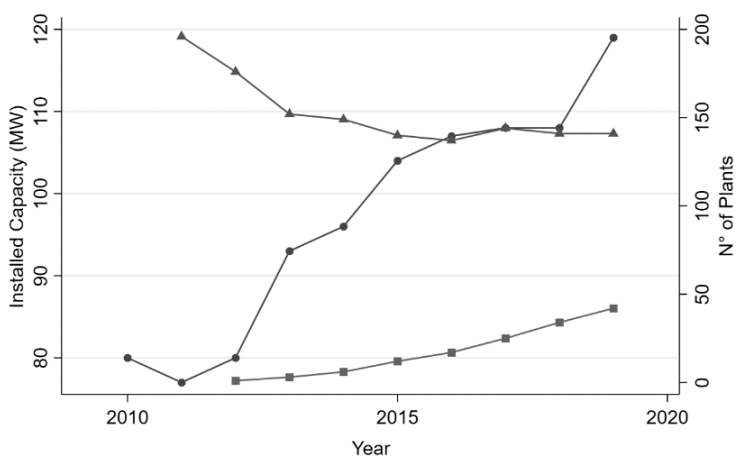
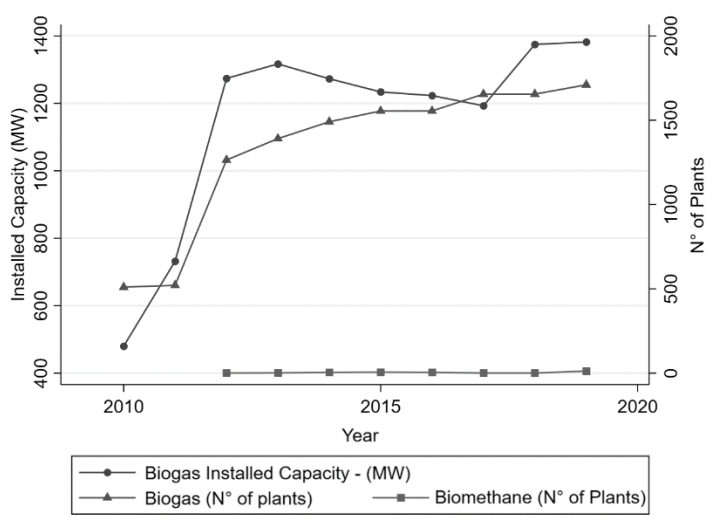


IT



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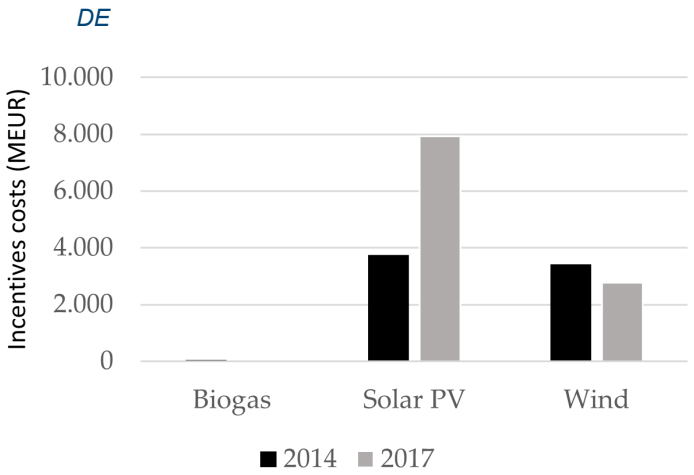
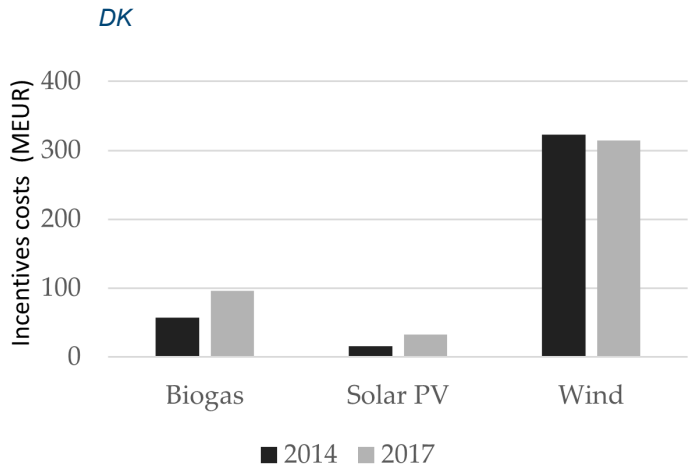
RES incentives costs in 2014 and 2017 (MEUR)





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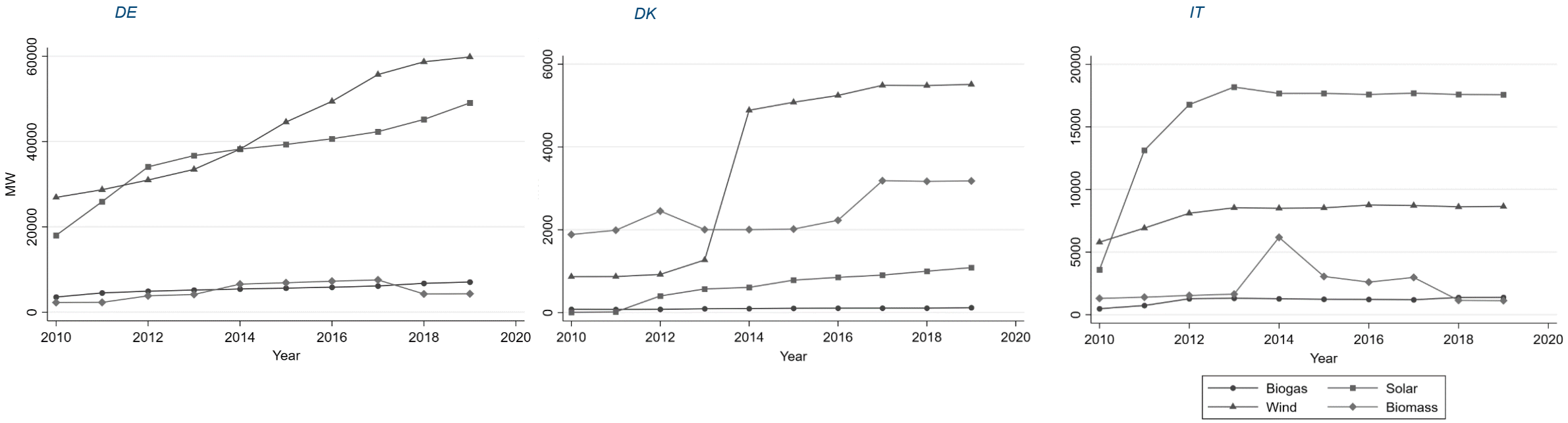
Renewable energy installed capacity (MW)



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Renewable energy produced receiving support (GWh)

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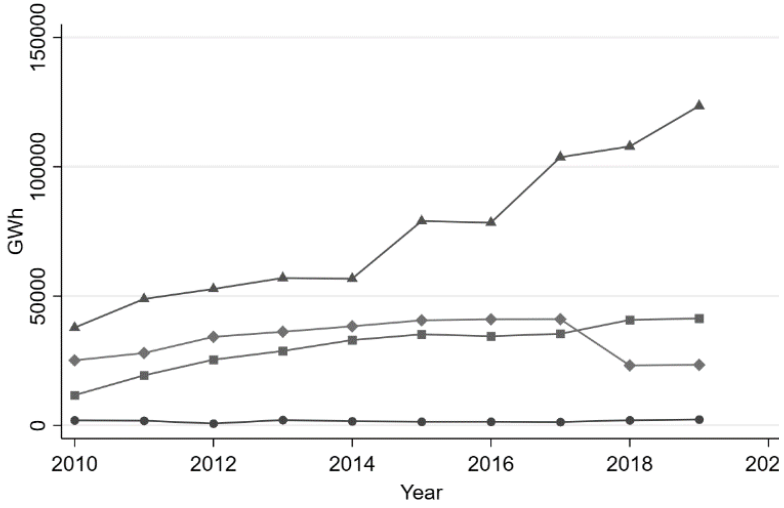

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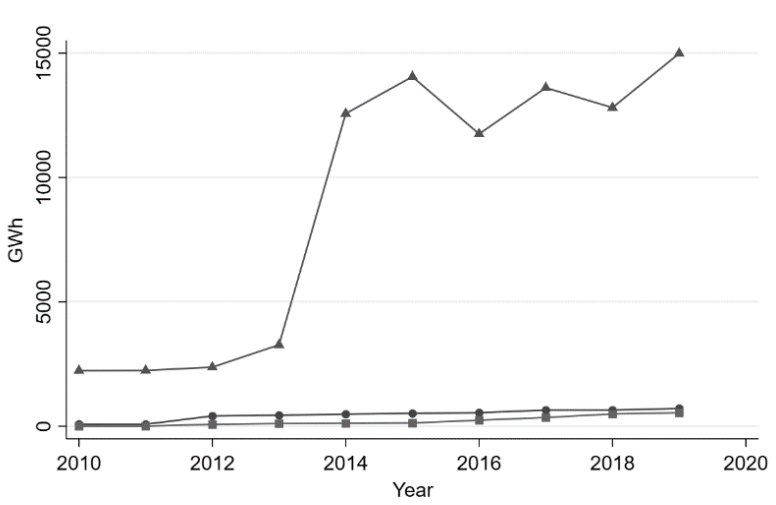

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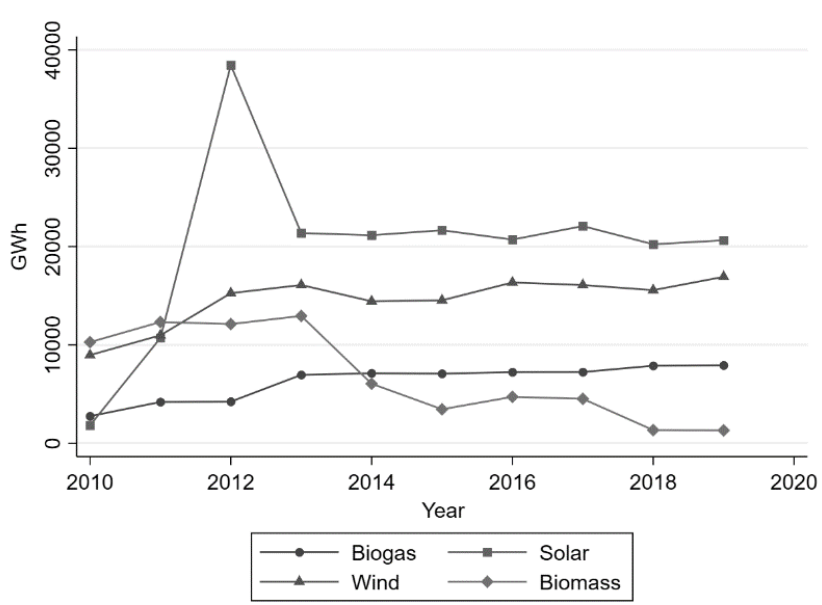

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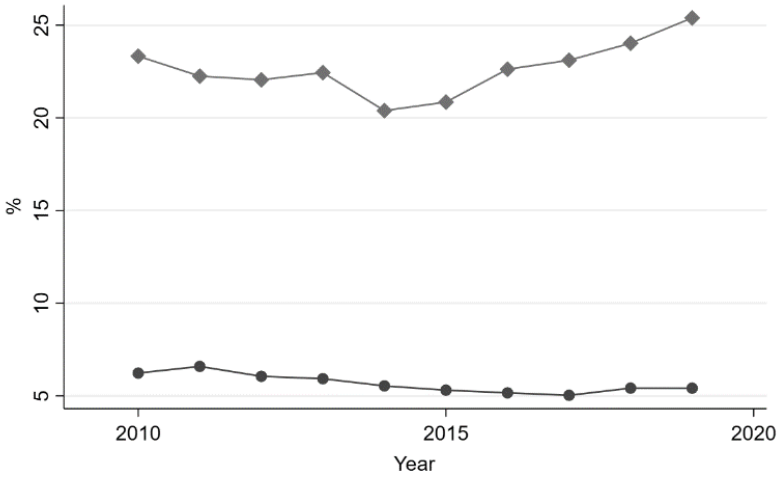
Share of biogas on renewable energy total installed capacity and share of natural gas on total energy mix (%)

DE



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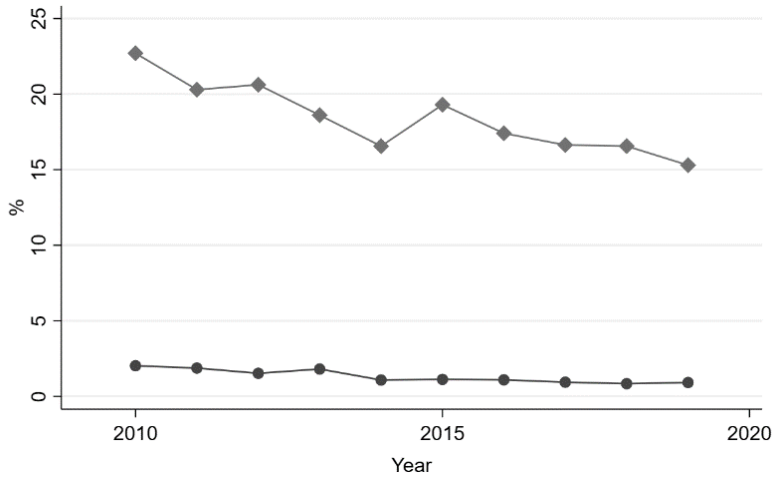

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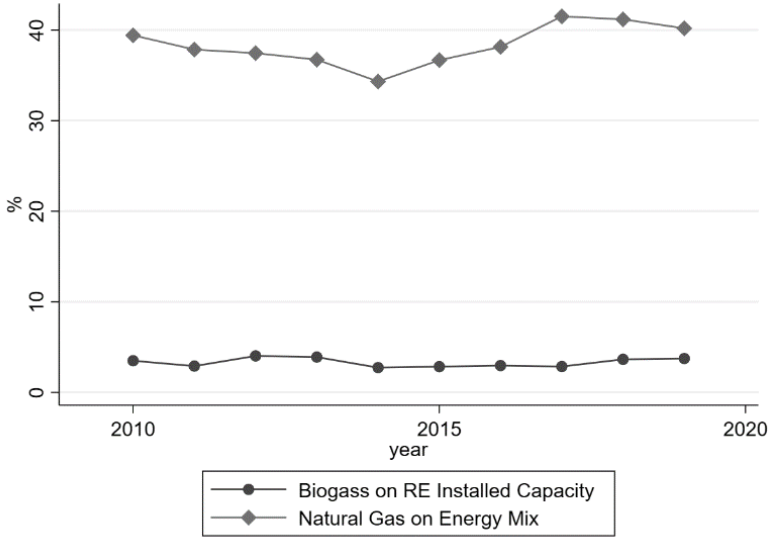

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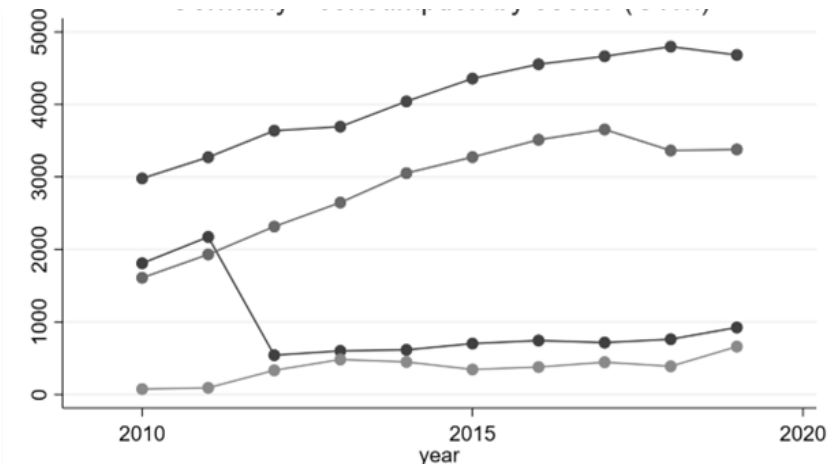
Biogas consumption by sector (GWh)

DE



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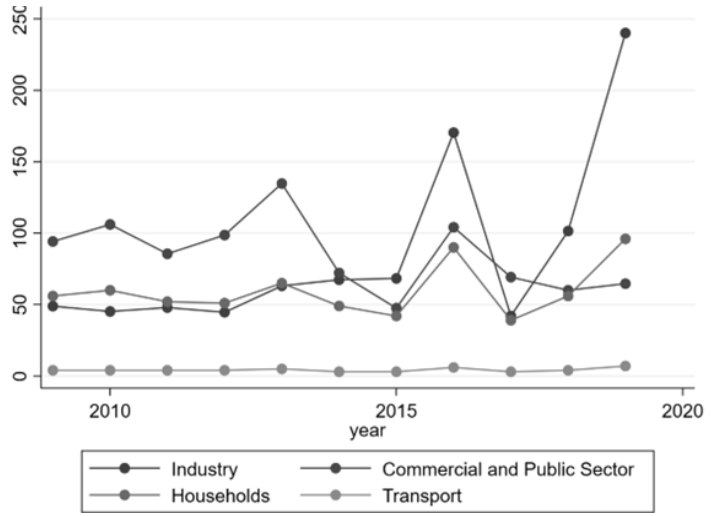

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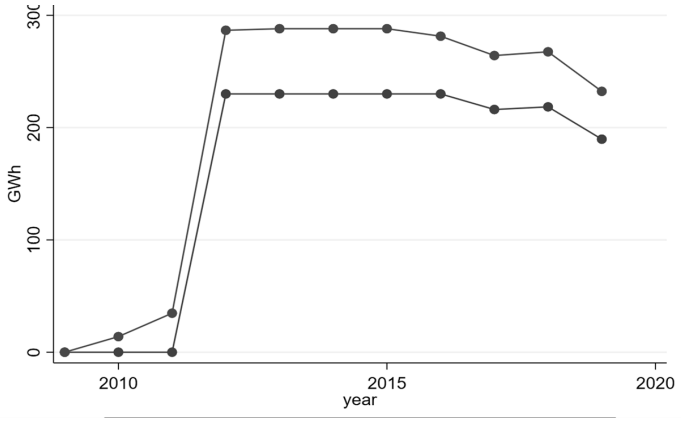

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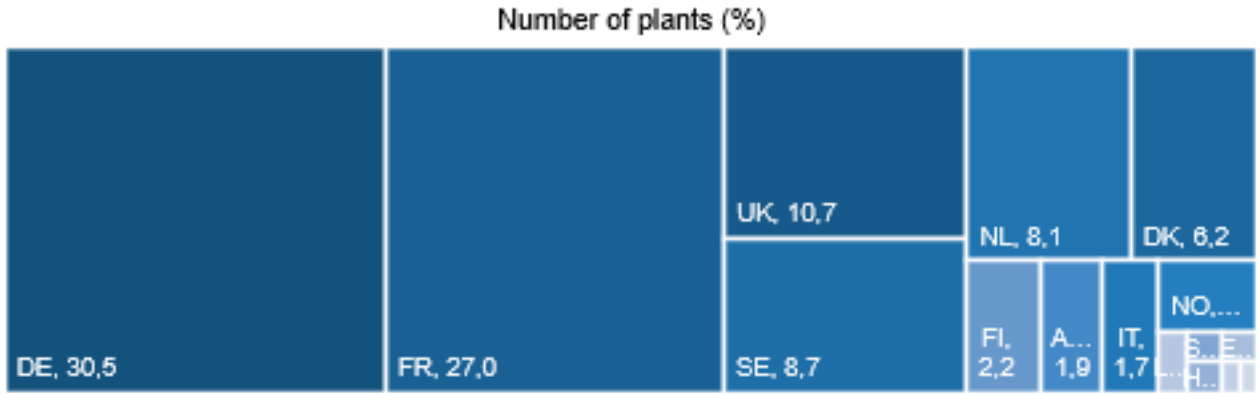
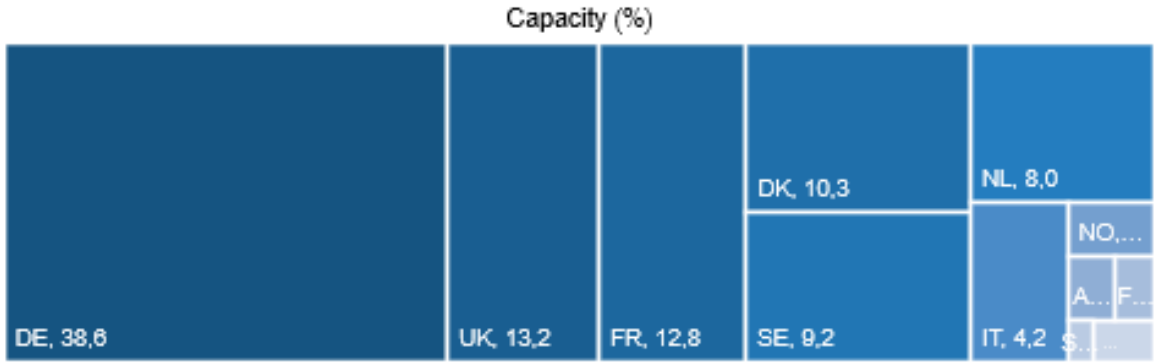
Selection of countries





Development of the European biomethane sector as of 2021

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