cerre Centre on Regulation in Europe

RENEWABLE GASES & HYDROGEN
FROM ECONOMIC POTENTIAL TO SMART REGULATION

EXECUTIVE SEMINAR
12 SEPTEMBER 2019, BRUSSELS

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Improving network and digital industries regulation

The potential role of green gases and hydrogen in Europe: setting the right targets – Part I

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1. Types of gases
2. Costs of provision
3. European potential
4. Targets recommendations

Type of gases

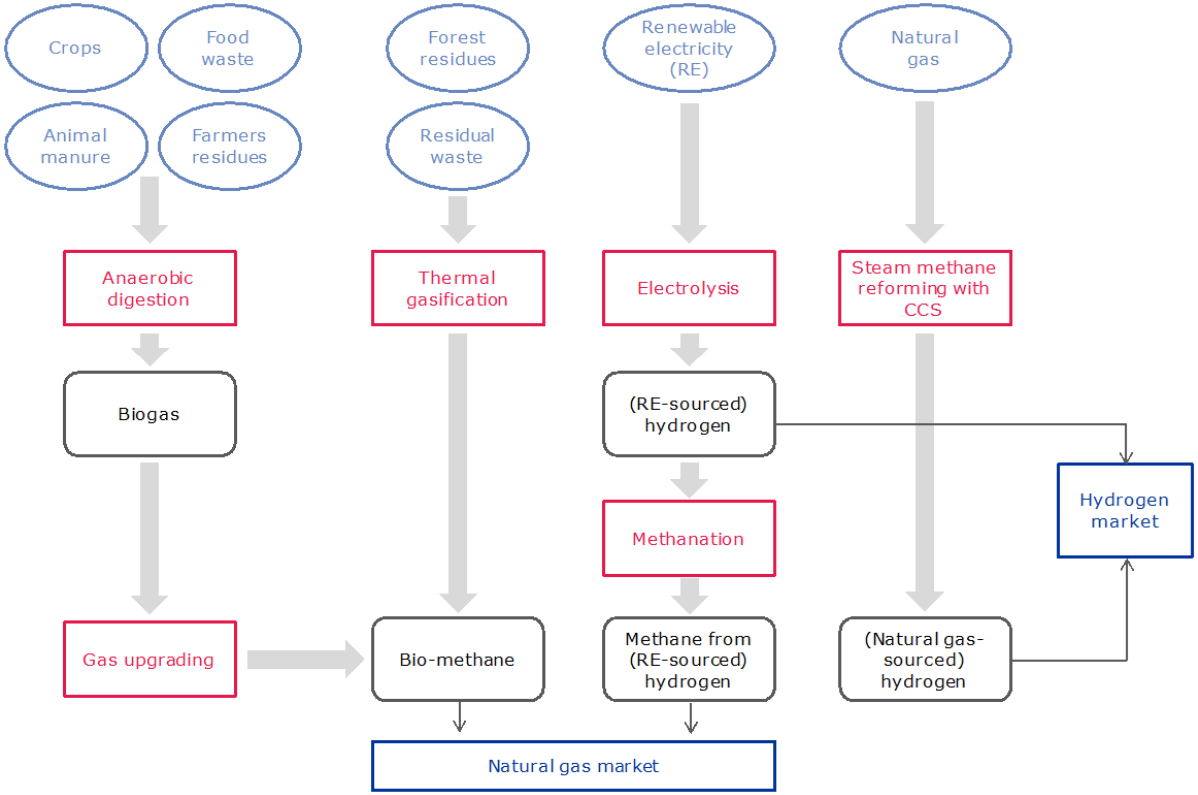
- Biogas
  - Produced through anaerobic digestion (AD)

- Bio-methane
  - Produced after the purification of biogas or,
  - Through thermal gasification (SMR)

- Hydrogen
  - Produced from natural gas using CCS/CCU (NG-sourced H_2)
  - Produced from the electrolysis of water with renewable electricity (RE-sourced H_2)

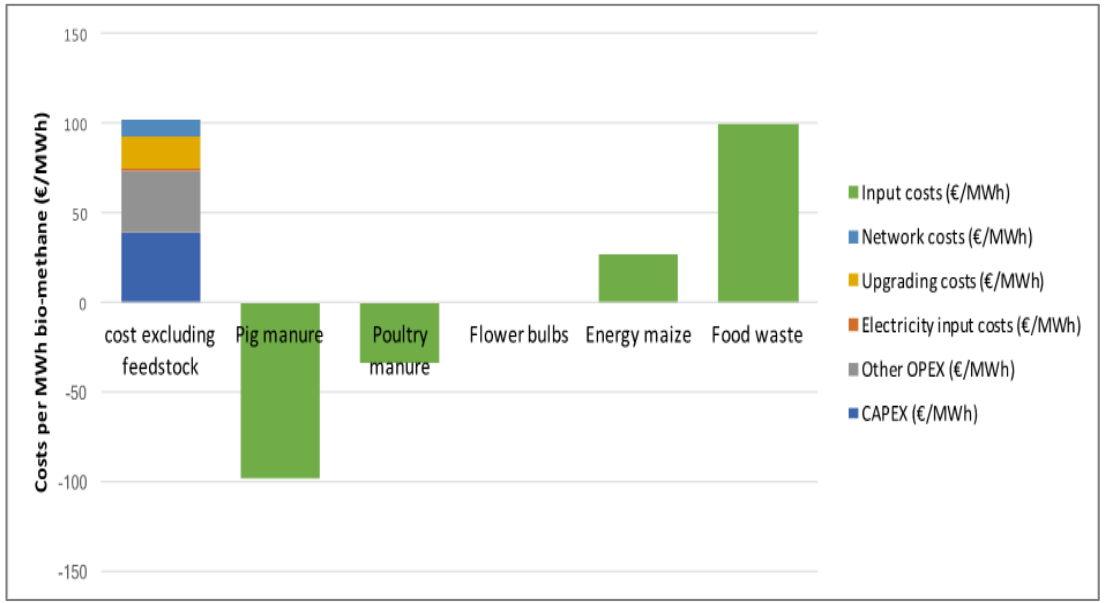
- Methane from hydrogen
  - Produced after methanation of RE-sourced H_2

Supply chain overview



Source: Authors' own elaboration, 2019

Anaerobic digestion: composition of costs of AD, per MWh bio-methane



Source: Authors' own elaboration, 2019

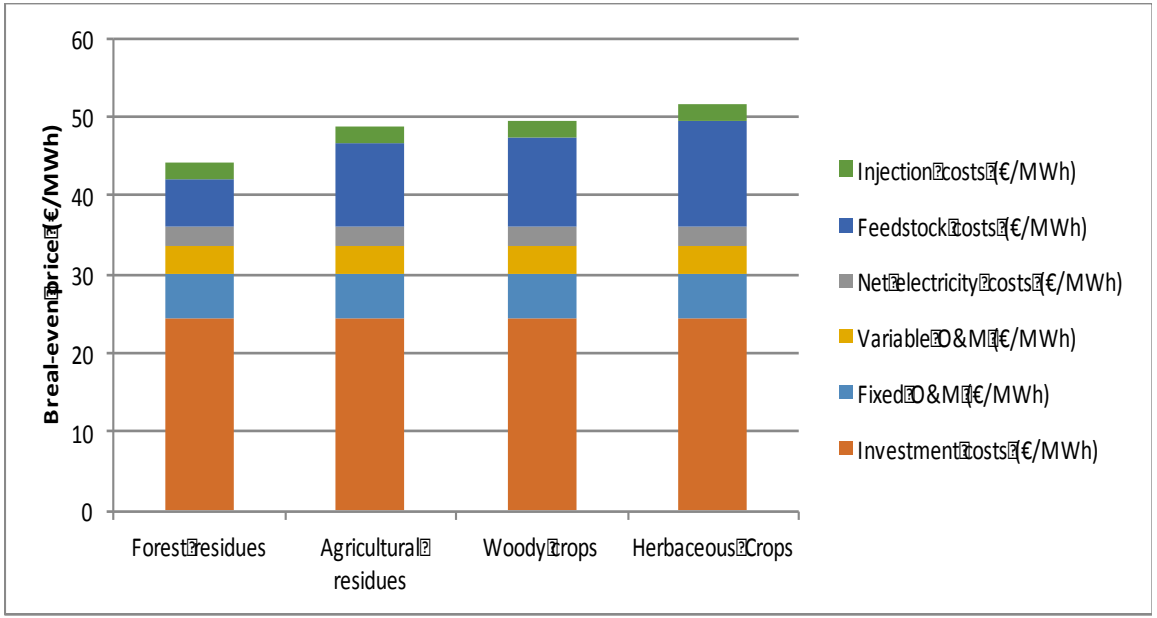
-Scale is low (<= 5MW)

-The costs of producing biomethane depend heavily on input costs.

-Costs range from approximately 5 to 200 €/MWh.

-Other studies (ENEA, Consorzio Italiano Biogas, Navigant) find average close to 80 €/MWh.

Thermal gasification: composition of the costs of thermal gasification, per MWh bio-methane



Source: Authors' own elaboration, 2019

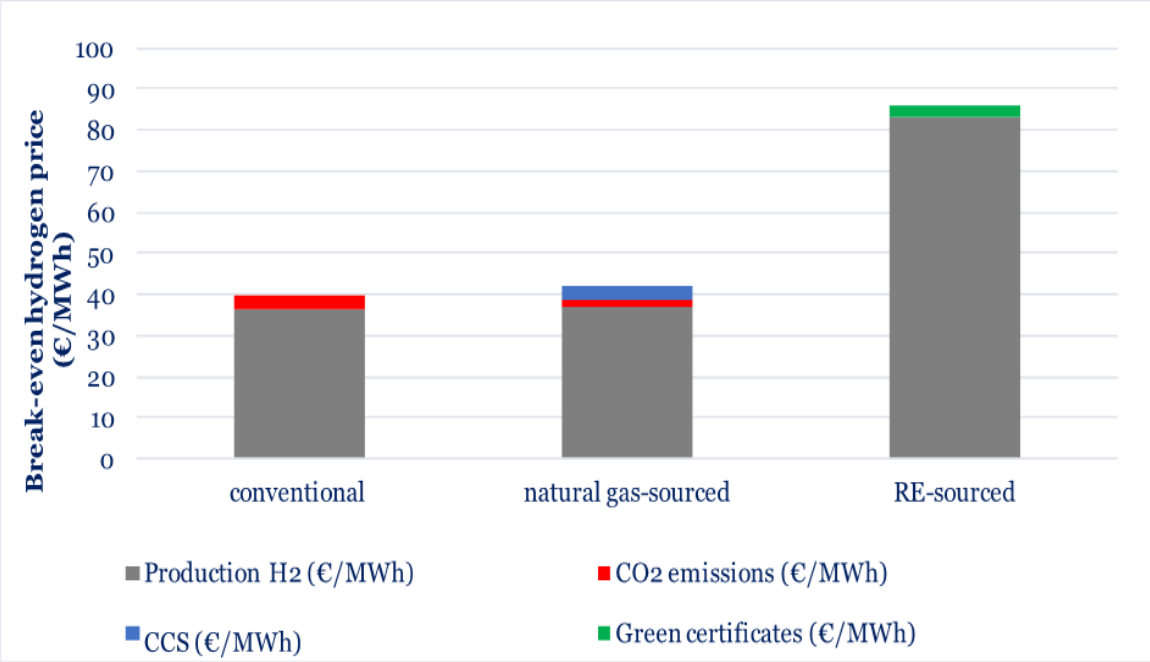
-Scale is bigger (1 GW)

-Costs are less dependent on feedstock.

-Costs range from approximately 44 to 52 €/MWh.

-Project demonstrations (Gaya, GoBiGas) show higher costs but potential to come down to 60 €/MWh.

Hydrogen: composition of the costs different production techniques, per MWh H2

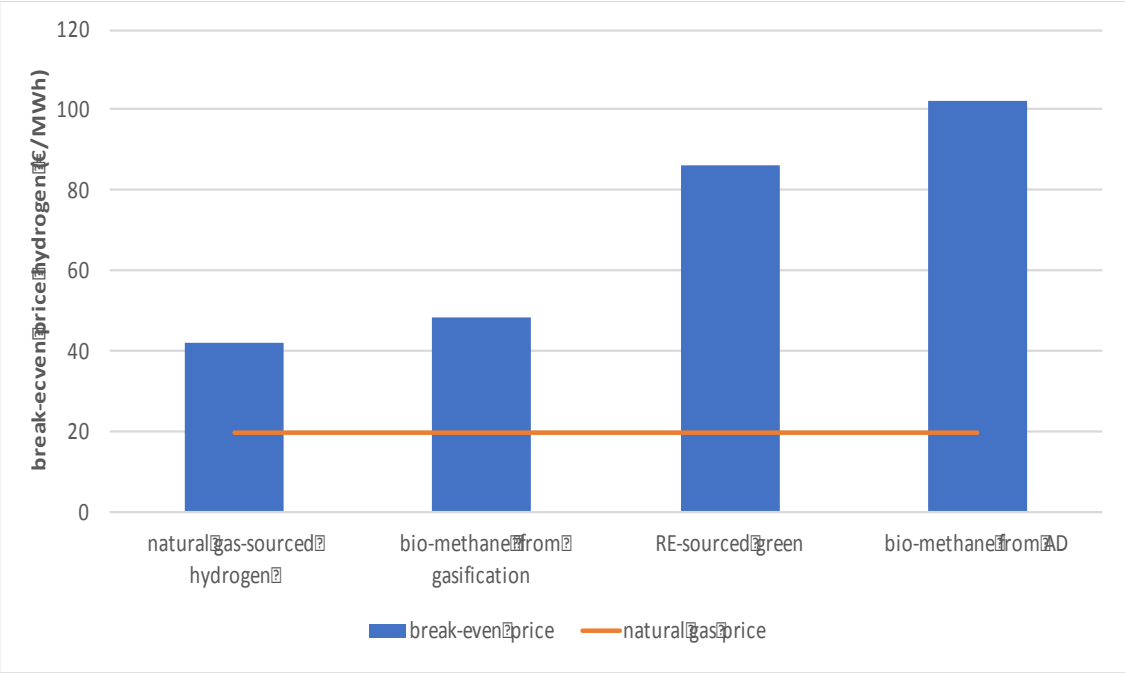


Source: Authors' own elaboration, 2019

-Costs of H2 production depend on natural gas or electricity price.

-With current prices, costs for NG-sourced H2 (with CCS) are around 40 €/MWh and for RE-sourced H2 are 85 €/MWh.

Conclusion on production costs

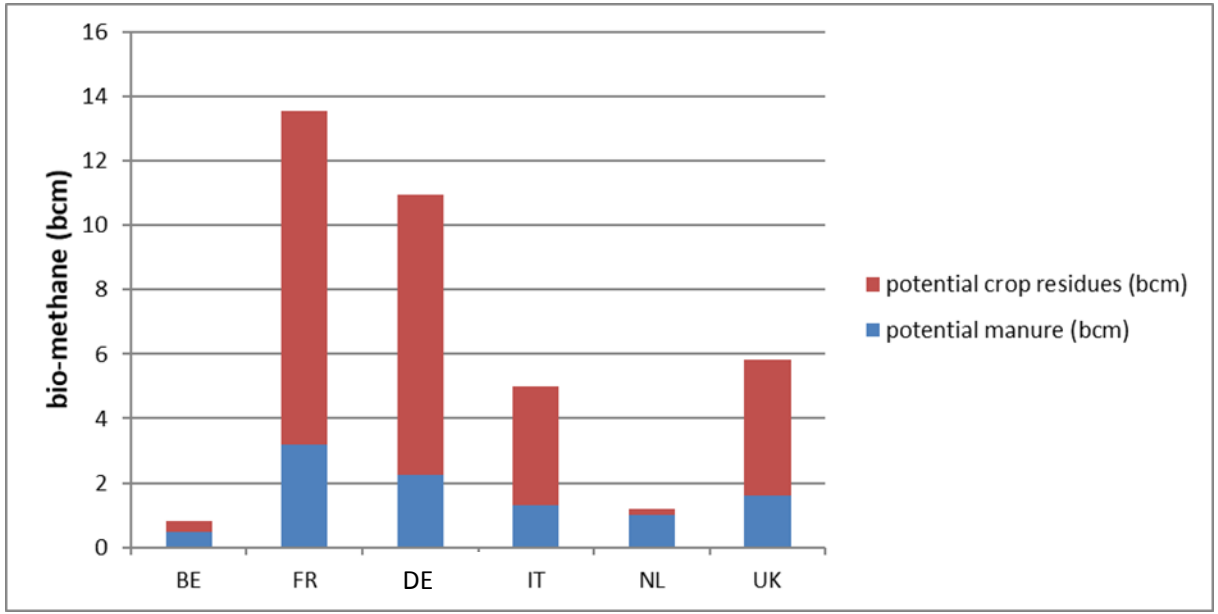


Source: Authors' own elaboration, 2019

-Cost vary significantly across technologies, but on average costs of bio-methane and H2 are quite high compared to the natural gas price (2 to 5 times as high).

Potential supply

Potential supply: Bio-methane from AD



Source: Authors' own elaboration, 2019

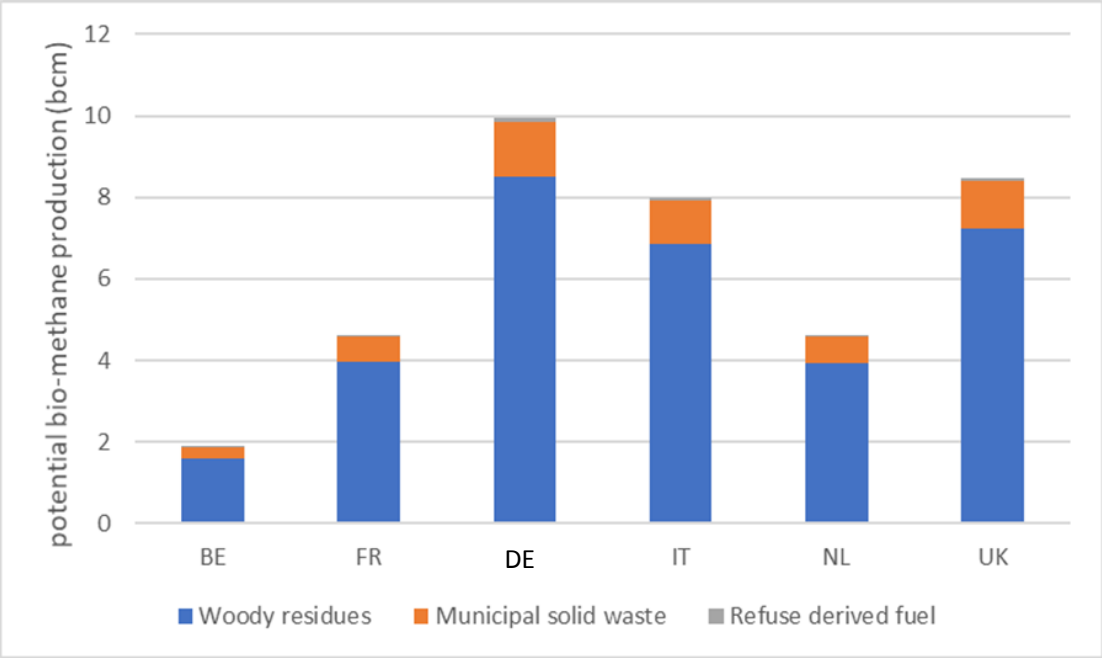
-Potential bio-methane from manure constrained by availability of feedstock within 25 km radius.

-Potential biomethane from crop residues constrained by amount of residues that can be harvested sustainably.

-Combined potential for countries of interest is 37 bcm.

-At the EU-28 level, potential is 68 bcm.

Potential supply: Bio-methane through thermal gasification



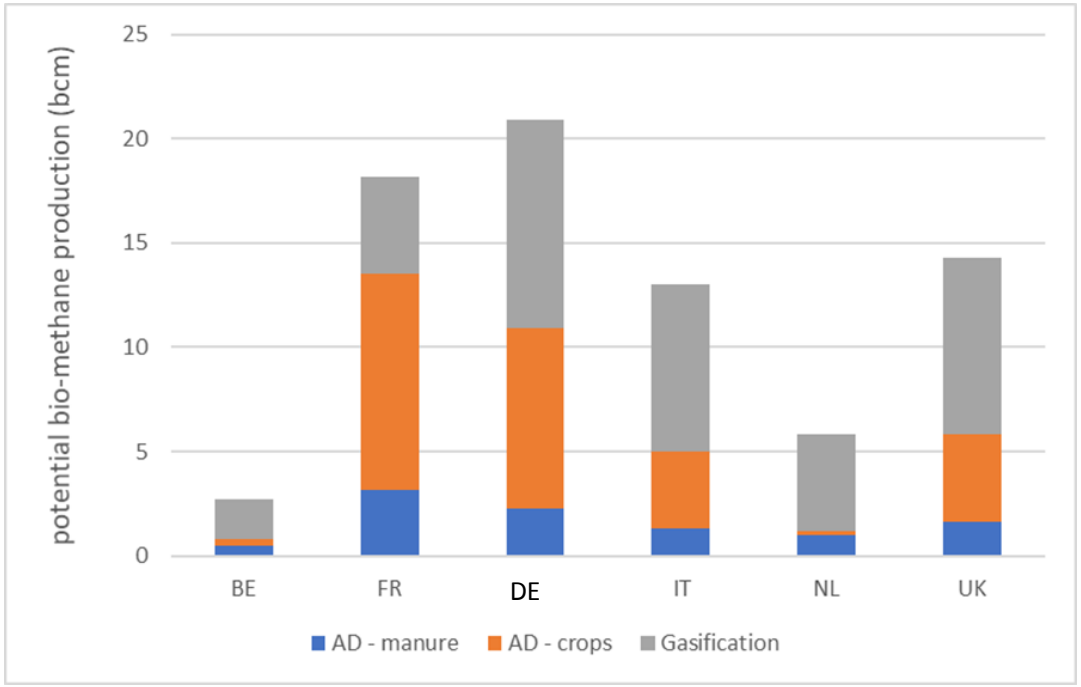
Source: Authors' own elaboration, 2019

-Bio-methane from thermal gasification can be deployed on larger scale as inputs can be transported over large distances.

-Combined potential for countries of interest of 38 bcm.

-EU-28 potential is 56 bcm.

Potential supply: Bio-methane in total

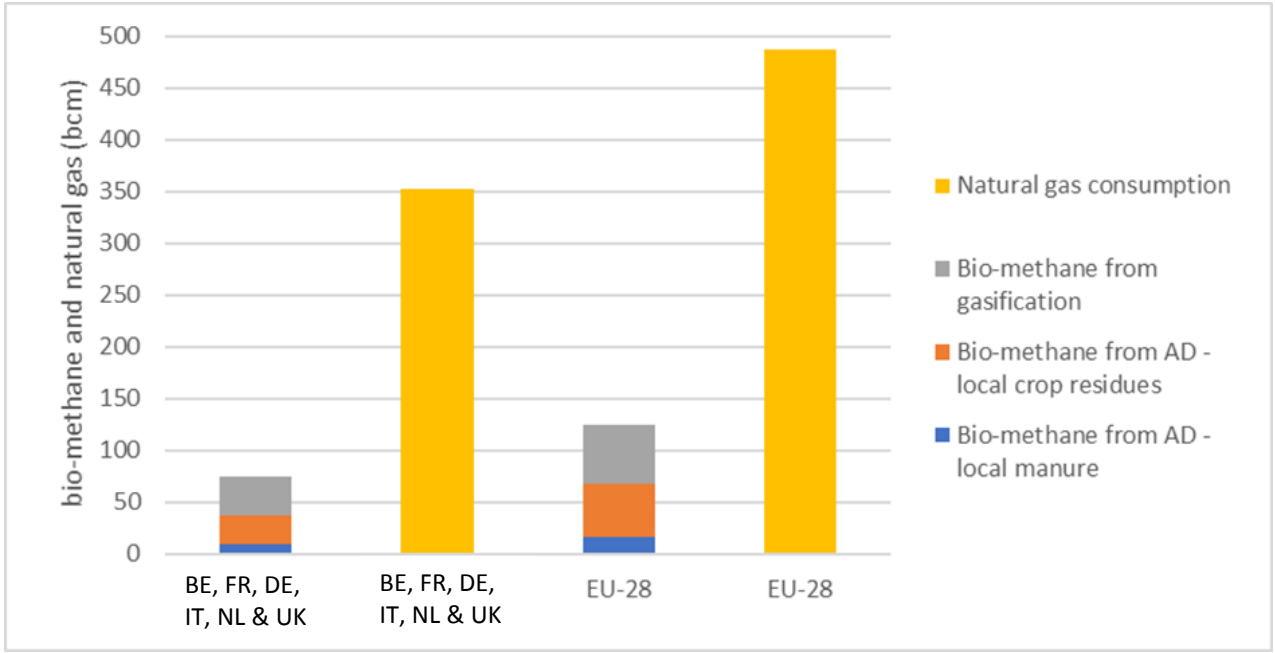


Source: Authors' own elaboration, 2019

- In total, the potential bio-methane for the countries of interests is estimated at 75 bcm.

- At the EU-28 we come to a large potential: 124 bcm.

Potential supply: Bio-methane for countries of interest and EU-28 in total



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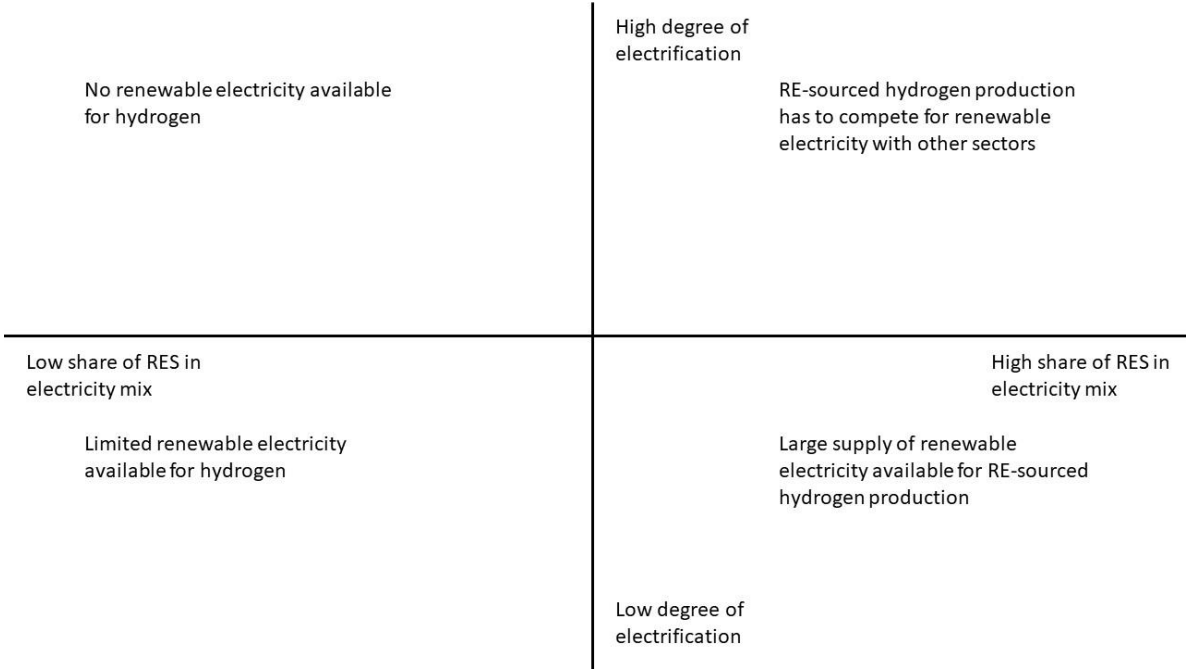
Potential supply: Hydrogen



- Potential of NG-sourced H2 very large conditional on CCS social acceptability.

- Potential of RE-sourced H2 very dependent on climate policy and electrification of other sectors.

Source: Authors' own elaboration, 2019

Why do we need targets?

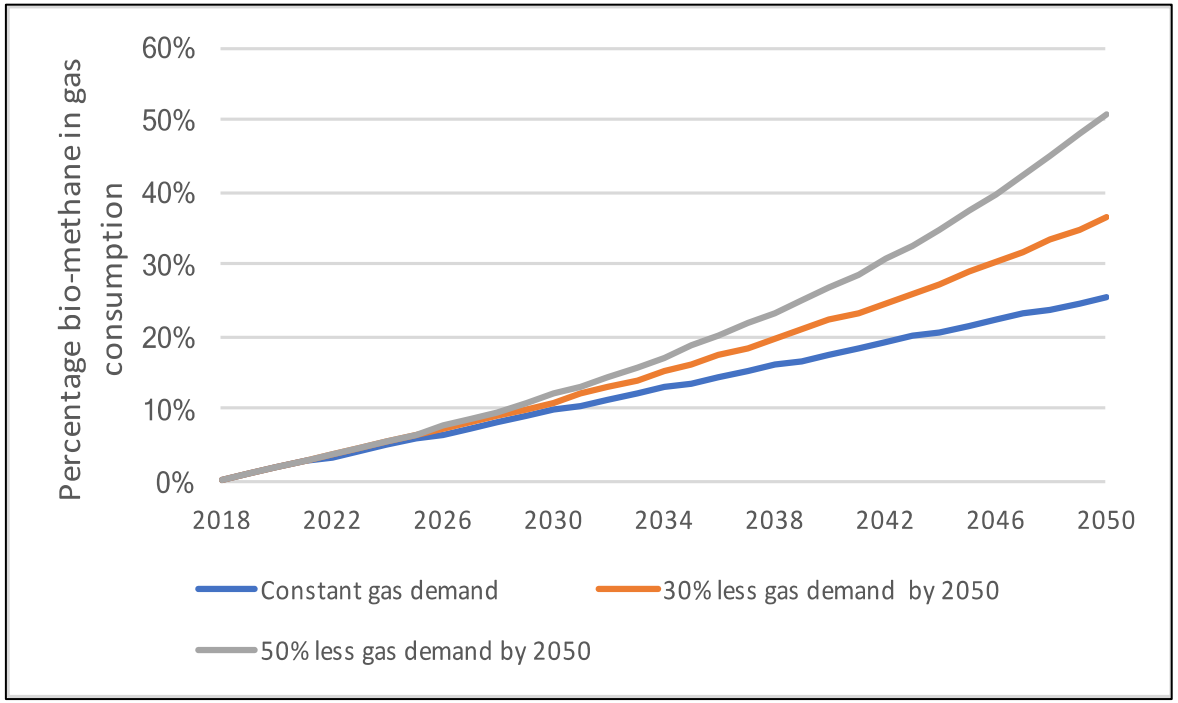
- If the price of carbon was adequate, we would not need targets or support schemes.
- The price of carbon works as a signal of the reward for emitting less and then the market picks the lowest cost manner to equalize marginal benefits to marginal costs.
- The carbon price makes low-carbon technologies more competitive, which fosters innovation in cleaner technologies.
- However the carbon price is hardly right (can it be at all?)

Policy targets: environmental regulation

CURRENT ENERGY POLICY								
Main goals for 2020								
		Italy	France	Germany	Belgium	Netherlands	UK	**EU**
% renewable heat in total heat		17,1	33	15,5	11,9	8,7	12	-
% renewables in final electricity		26,4	27	38,6	20,9	37	31	-
% renewable in transport		10,1	10,5	13,2	10,1	10,3	10,3	10
% overall RES in final energy consumption		17	23	19,6	13	14,5	15	20
Source: Renewable Energy Action Plans of the European Member States								
Main goals beyond 2020								
		Italy	France	Germany	Belgium	Netherlands	UK	**EU**
2030	% renewables in final electricity	55	40	40-60*	17**	-	-	-
	% overall RES in final energy cons.	30	32	30	20**	27-35	32	32
	% renewable gas in gas consumption	-	10	-	-	-	-	-
2050	% renewables in final electricity	-	-	80	-	-	-	-
	% overall RES in final energy cons.	-	-	-	-	100	-	100
Source: CEER Status Review of Renewable Support Schemes in Europe								
*: 2025: 40 - 45% (gross electricity consumed); 2035: 55 - 60%.								
**: 17% is off-shore wind; 20% excludes off-shore wind								

Only France has set a national target for RE gas by 2030.

Bio-methane targets



Source: Authors' own elaboration, 2019

-Heavily depend on future gas demand.

-Assuming constant, 10% by 2030 and 25% by 2050.

-If declines by 30% by 2050, target should be 35% by 2050.

-If declines by 50% by 2050, target should be 50% by 2050.

Hydrogen targets

- We do not expect there will be many hours of renewable generation capacity to remain scarce, so there won't be many hours of low prices to produce RE-sourced H2.
- The bulk of H2 will be produced from natural gas. However, public acceptance should not be an issue.
- Conditional on this, we recommend that 100% of the H2 produced by 2050 should be carbon-free.
- We believe this target can contribute to public acceptance and technology effectiveness.

Summary: quick re-cap

- Current costs of bio-methane and hydrogen are from 2-5 times the price of natural gas.
- Potential of bio-methane in EU-28 is substantial (124 bcm, 25% of gas demand).
- Potential of hydrogen is very large conditional on social acceptance of CCS and technology improvement.
- Targets should be set to harness the benefits of these technologies:
  - At least 10% of the gas should be bio-methane by 2030, and at least 25% by 2050.
  - All hydrogen should be carbon-free by 2050.

Making the case for an optimal EU regulatory toolbox – Part II

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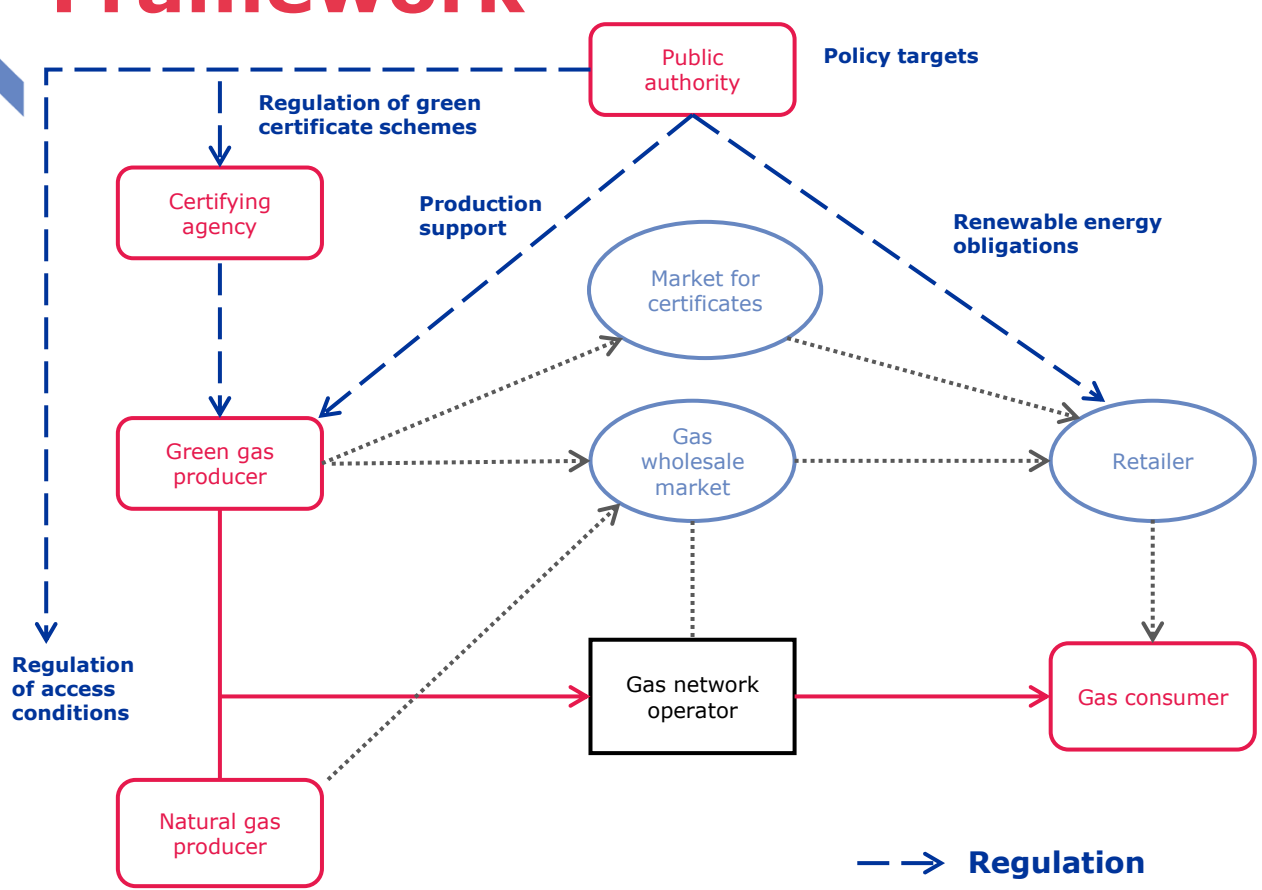
Framework


Public authority
Policy targets
Regulation of green certificate schemes
Certifying agency
Production support
Renewable energy obligations
Market for certificates
Green gas producer
Gas wholesale market
Retailer
Regulation of access conditions
Gas network operator
Gas consumer
Natural gas producer
POLICY
MARKETS
NETWORKS
Regulation
Commercial flows
Physical flows

Economic principles

Economic criteria	Categories of regulation				
	Policy targets	Certificates schemes	Access to the grid	Support schemes	
				Production support	Renewable energy obligations
Allocative efficiency: price=MC			Tariffs per unit should be equal to marginal costs	Support = value of externality – value of other regulatory measures to internalise (e.g. carbon tax)	Imposed cost = value of externality – value of other regulatory measures to internalise
Dynamic efficiency: sufficient return on investments	Long-term policy commitments	Long-term transparency on certificate scheme	Total regulated revenues should cover fixed costs of grid	Long-term certainty on support schemes	Long-term policy view on obligations
No market power			Third-party access, unbundling	In case of competitive tendering: many producers required	Retailers should have a choice among producers to buy renewable gas from
No information asymmetry		Increase trust of consumers by standardisation, public certifier	Capacity and tariffs should be clear to (potential) network users	Competitive tenders in case of many producers; otherwise smart incentive mechanisms, like menus, price caps	Traceability of green gas
No hold-up			Certainty for network operators about compensation of costs of connecting renewable gas	Governments should not be held-up after the support decision has been made	
Fair distribution			Fees related to actual costs producers cause + actual usage of the network + common costs fairly allocated among network users	Support <= actual costs – other revenues	Price certificates <= actual costs – other revenues
Cost-effective	Choose first lowest-cost options	Information about production characteristics	No discrimination among production technologies; only based on costs	Lowest-cost options should be chosen first	Lowest-cost options should be chosen first

Certification (1)

Market failure

- Information asymmetry: users cannot see how the gas is produced

- Result without regulation

adverse selection: users will not be prepared to pay extra for products of higher quality (e.g. more renewable)

General principles for regulation

- Users need to trust the whole process of certification

- Certification need to give all relevant information on product characteristics

- Long-term certainty about organization of the system

Certification (2)

Current situation

- National systems
- Restricted international trade
- International trade based on mass-balancing

Recommendations

- Improve international standardization of renewable gas
- Make certificates internationally interchangeable
- Make certificates interchangeable with ETS and electricity
- Process of certification should be done by public agencies
- Reconsider need for mass balancing in international trade

Access to the grid (1)

Market failure

- Grid is natural monopoly
- Result without regulation:
  -Monopolistic behavior, high tariffs, lower quality of network services

General principles for regulation

- Variable tariffs equal to marginal costs
- Total network revenues sufficient to cover total network costs
- 'Fair' distribution of fixed/common costs
- Equal treatment of various technologies
- Independent network operator (i.e. unbundling)

Access to the grid (2)

Current situation

- General EU principles regarding cost recovery and reasonable tariffs
- Incentive/tariff regulation implemented on national scale
- European regulation does not allow TSO's to charge different tariffs for renewable gases, due to non-discriminatory issues.

Recommendations

- Same principles for renewable and natural gas BUT two exceptions are possible:

  1. Renewable gas producers could be given discount in fixed fees because of negative externality of natural gas

  2. Priority access in case of congestion

Support Schemes (1)

Market failure

- Negative environmental externality: greenhouse gas emissions of natural gas
- Result without regulation:
  Too much use of natural gas / and less use of renewable gas

General principles for regulation

- Support for renewable gas should be equal to (marginal) value of negative externality
- Support should not be higher than surplus costs of renewable gas (compared to natural gas) minus support through other mechanisms (e.g. tax exemption)
- Support scheme should give incentives for innovation, cost reduction
- Lowest-cost options should be chosen first

Support Schemes (2)

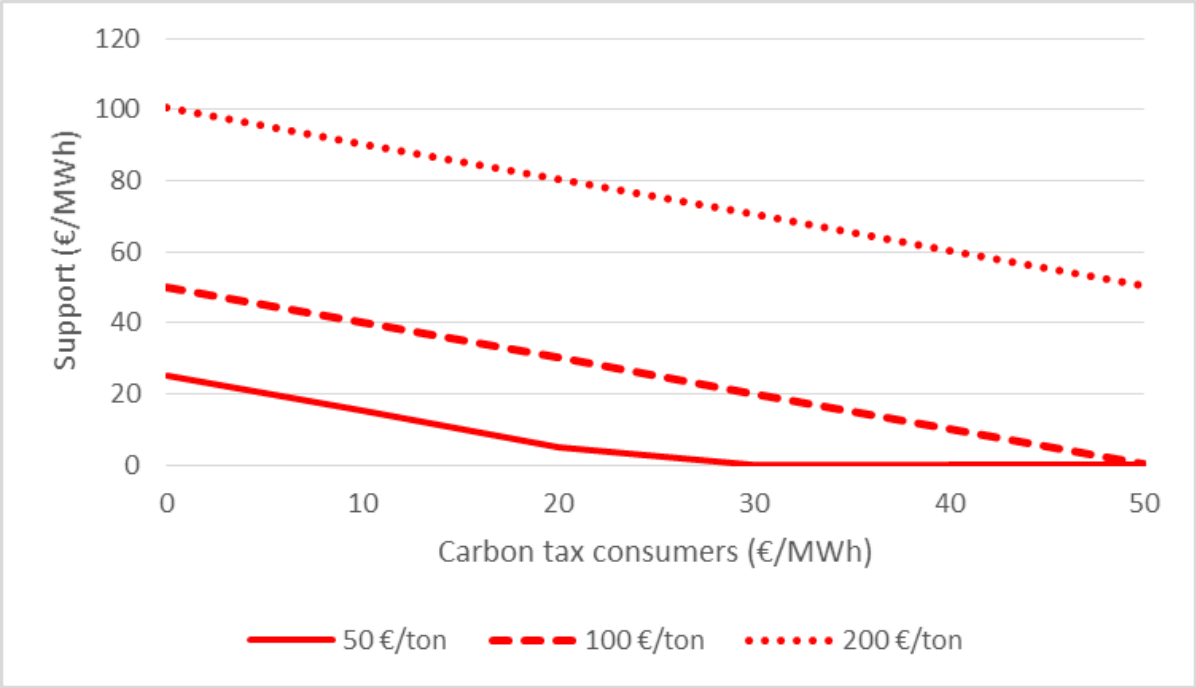
	FITs	FIPs	Duration support
UK	5.50 €ct/MWh if V<40 GWh 3.24 €ct/MWh if 40<V<80 GWh 2.50 €ct/MWh if V>80 GWh		20 years
NLs		4.5 €ct/kWh	12
BE		9,3 €ct/kWh***	10
FR	9.5 €ct/kWh for K<500 kW 4.5 €ct/kWh for K>3.5 MW		10-20 years
DE*	7.44 €ct/kWh for K<500kW 6.5 €ct/kWh for 500kW<K<20 MW		20 years
IT		6,46 €ct/kWh***	

Current situation

Various designs at national level such as:

- Production support: feed-in-tariff, feed-in-premium
- Renewable energy obligations
- Investment aids

Support Schemes (3)

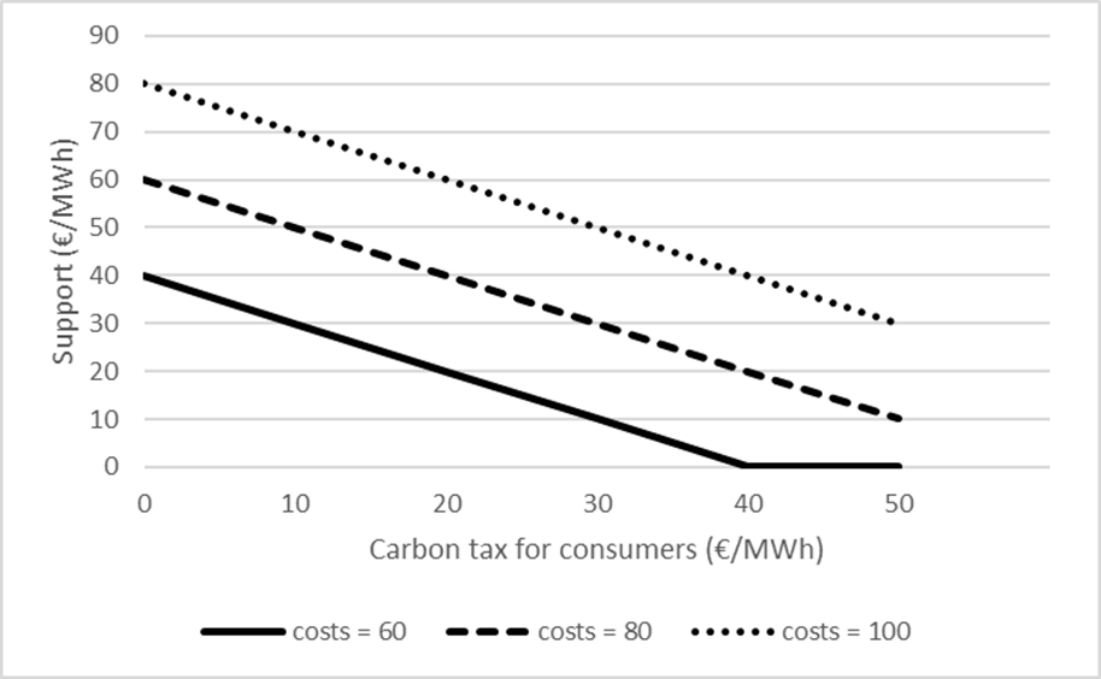


Source: Authors' own elaboration, 2019

Recommendation

Optimal support level depends on (marginal) value of negative externality and other benefits (e.g. tax on natural gas)

Support Schemes (4)

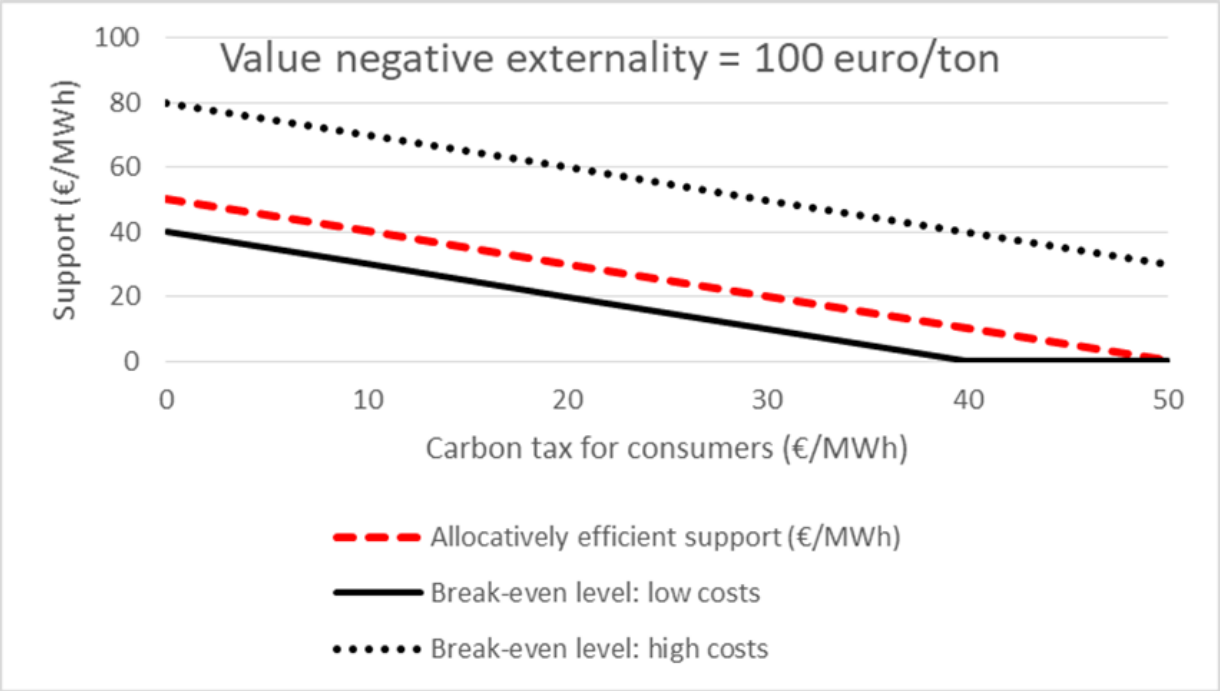


Source: Authors' own elaboration, 2019

Recommendations

- Maximum support levels based on the break-even constraint, for various levels of production costs and in relation to the value of carbon taxes to be paid by consumers

Support Schemes (5)



Source: Authors' own elaboration, 2019

Recommendations

- Support levels based on value negative externality, break-even constraint, the value of carbon taxes to be paid by consumers
- Without carbon taxes, support for low-cost technology should be 40 euro/MWh, for high-cost technology 50 euro/MWh

Support Schemes (6)

Recommendation for the design of future support schemes

- Incentives for efficient models:
  - Competitive tendering (offshore wind)
  - Degression mechanism (United Kingdom)
  - Budget constraints (The Netherlands)
  - Declining reserve bids (France)

Summary: quick re-cap

Targets

Certificates

Grid Access

Support Schemes

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