Gas for Climate

Biomethane Potentials in the EU

Feasibility of REPowerEU 2030 targets, production potentials in the Member States and outlook to 2050

September 6th, 2022

Moderator

Matthias Schimmel

Associate Director
at Guidehouse

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Agenda

10.00 – 10.10	Welcome and introduction from Gas for Climate chair
10.10 – 10.15	A new landscape of EU energy system
10.15 – 10.35	Biomethane production potentials in the EU
10.35 – 11.00	Q&A

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Welcome from the Consortium

Gas for Climate was initiated in 2017 to analyse and create awareness about the role of renewable and low carbon gas in the future energy system. Gas for Climate is committed to achieve net zero greenhouse gas emissions in the EU by 2050.

Marie-Claire Aoun

Chair of Gas for Climate & Director of Prospective and Institutional Relations at Teréga

Consortium members

CIB Consorzio Italiano Biogas · DESFA Hellenic Gas Transmission System Operator S.A. · ontras Gastransport GmbH · enagas · ENERGINET · fluxys · GRTgaz · Fachverband BIOGAS German Biogas Association · EBA European Biogas Association · OGE · snam · Teréga · gasunie · NORDION ENERGI

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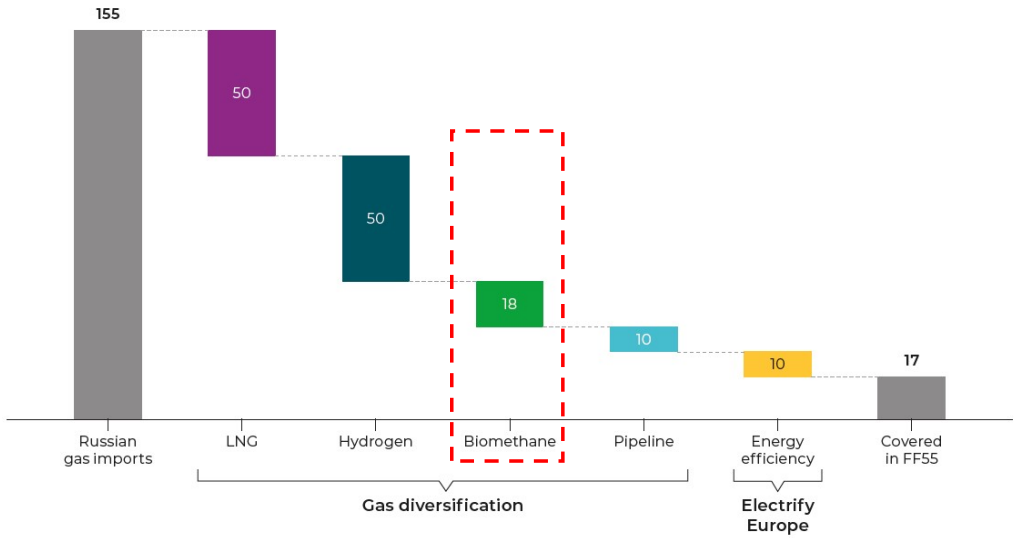
Gas for Climate over the years

REPowerEU aims to make Europe independent from Russian gas well before 2030

Gas savings additional to Fit for 55 as stated in REPowerEU for 2030 (in bcm)[18]



- Renewable gases play a key role in meeting the REPowerEU ambition
- Today, the EU produces 3 bcm of biomethane and 17 bcm of biogas. REPowerEU sets a target of 35 bcm of biomethane production per year by 2030—an increase of 18 bcm compared to the volume envisaged in the Fit for 55

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Speaker

Sacha Alberici

Associate Director
at Guidehouse

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Biomethane production potentials in Europe

Feasibility of REPowerEU 2030 targets, production potentials in the Member States and outlook to 2050

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Research Scope

Time horizon	Countries
2030 and 2050	EU-27 + Norway, Switzerland and UK

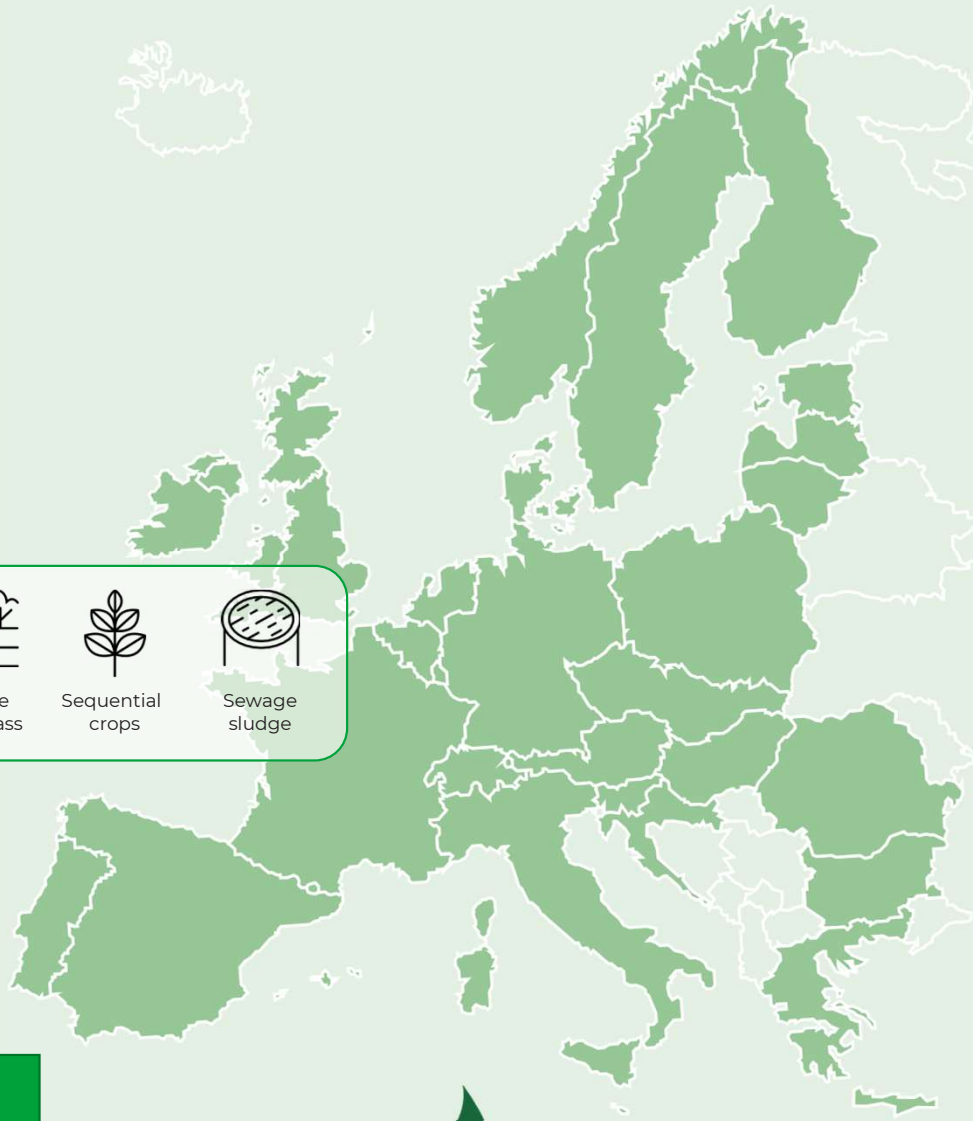
Technology & Feedstocks

Anaerobic Digestion

- Agricultural residues
- Animal manure
- Biowaste
- Industrial wastewater
- Permanent grassland
- Roadside verge grass
- Sequential crops
- Sewage sludge

Thermal Gasification

- Forestry residues
- Landscape care wood
- Municipal solid waste
- Pruning
- Wood waste



The study allocated each feedstock to one technology type to avoid potential double counting.

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Methodology

Step 1

Identify feedstocks and conversion technology option per feedstock

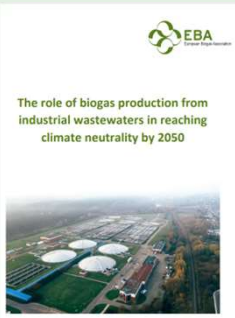
Step 2

Estimate potentials per feedstock per country in 2030/2050

Step 3

Convert feedstock potentials to biomethane potentials in 2030/2050

Based on **published reports** covering 2030-2050 time horizon <u>or</u> **current statistical data** (including Eurostat, FAOstat)



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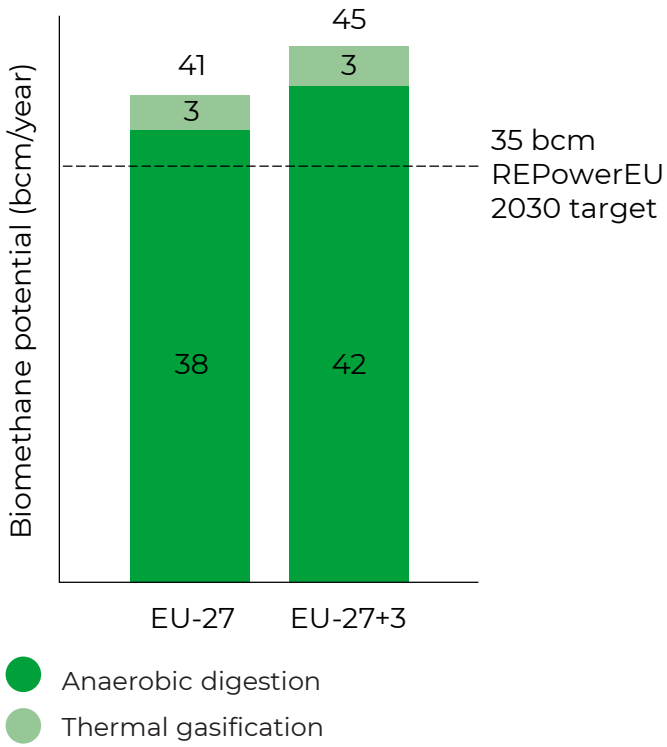
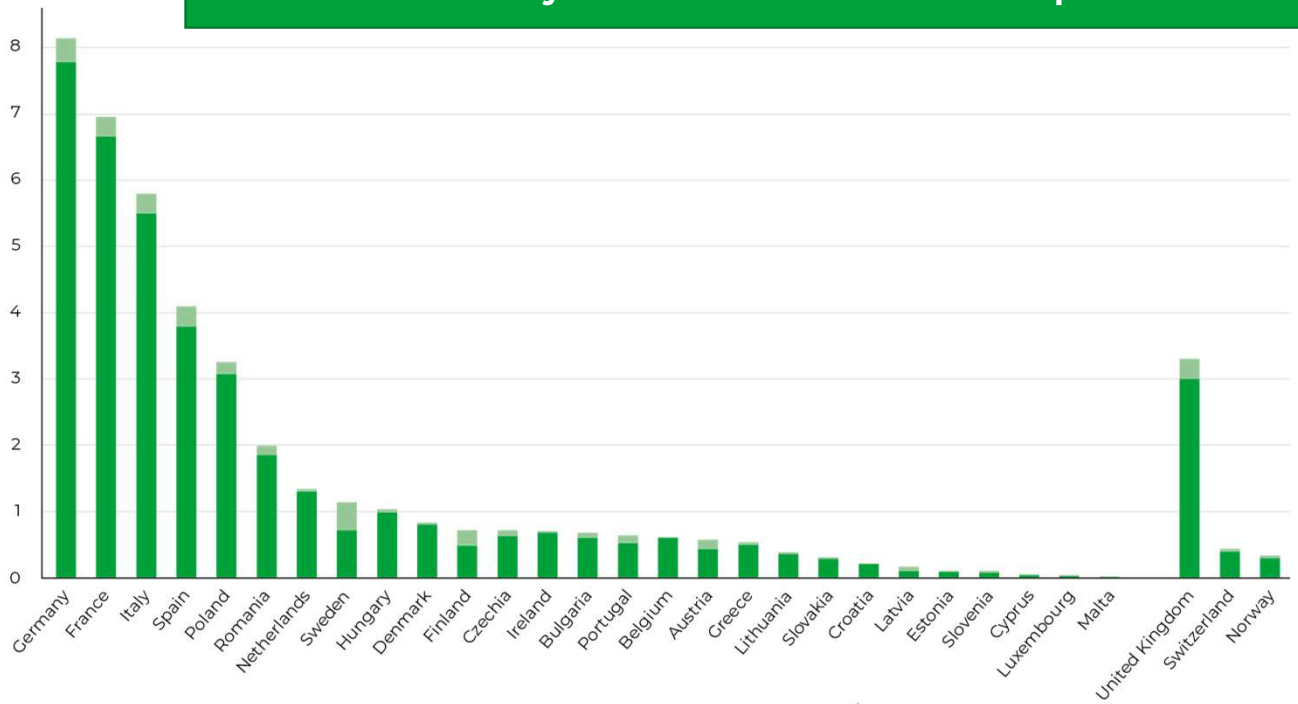
Biomethane potential in 2030 sufficient to meet REPowerEU target of 35 bcm



Estimates may deviate from nationally specific studies assessing feedstock availability for sustainable biomethane production



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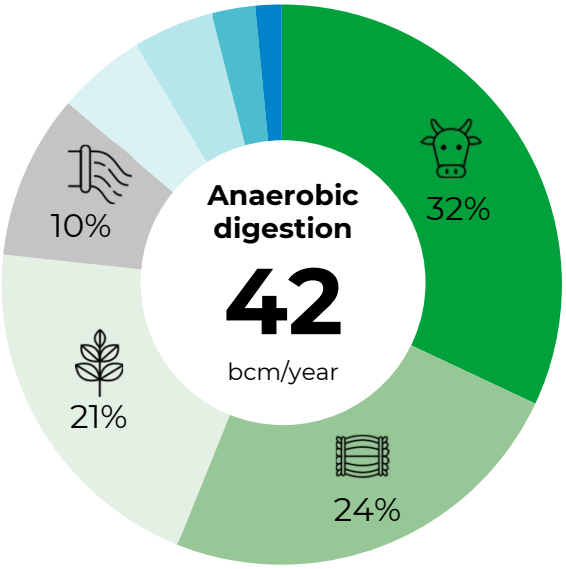
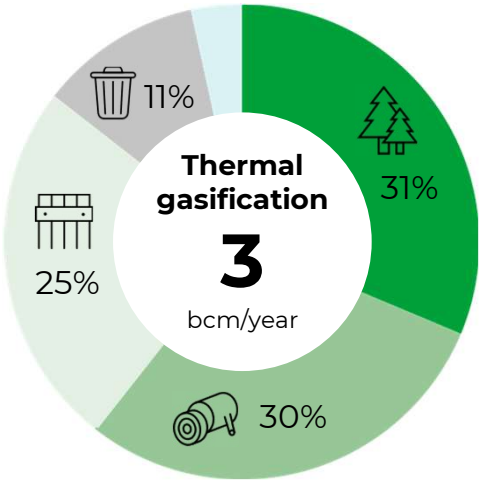
2030 feedstock mix: dominated by agricultural wastes and residues





- Animal manure
- Agricultural residues
- Sequential crops
- Industrial wastewater
- Permanent grassland
- Biowaste
- Sewage sludge
- Roadside verge grass

- Forestry residues
- Wood waste
- Landscape care wood
- Municipal solid waste
- Pruning

- 56% of AD potential based on agri. wastes and residues
- Sequential crops (21%) and Industrial wastewater (10%) also make a meaningful contribution to AD potential
- Woody wastes and residues dominate gasification potential

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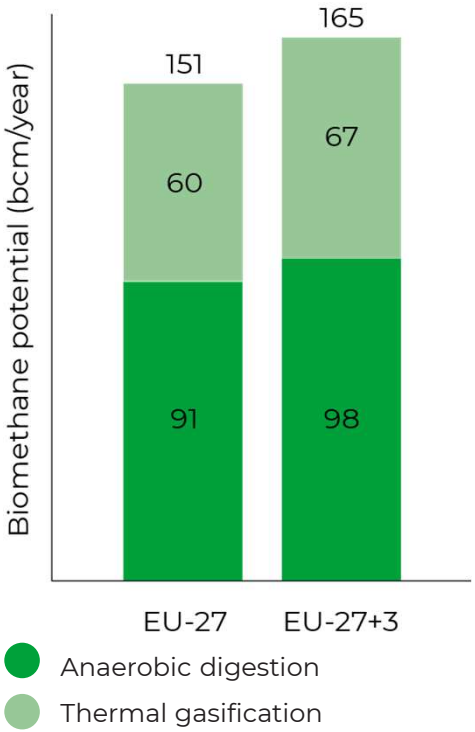
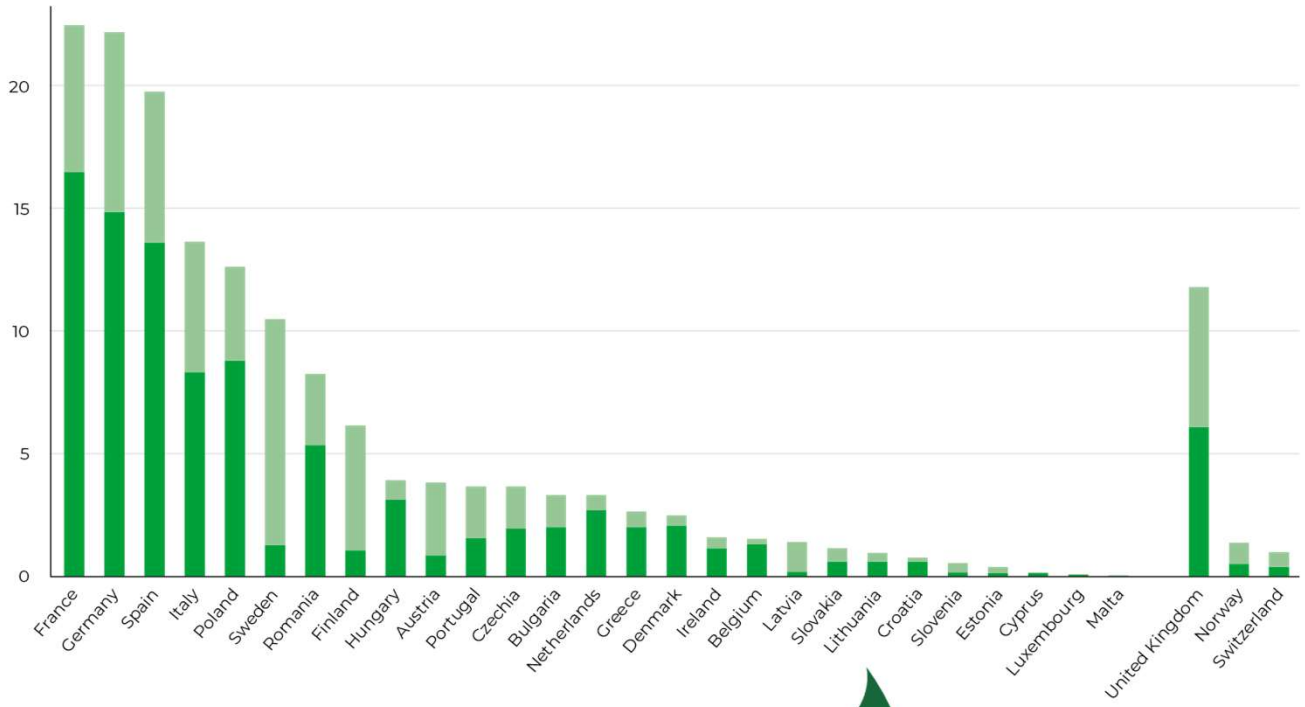
Biomethane potential in 2050 sees an important contribution for gasification

Estimates may deviate from nationally specific studies assessing feedstock availability for sustainable biomethane production





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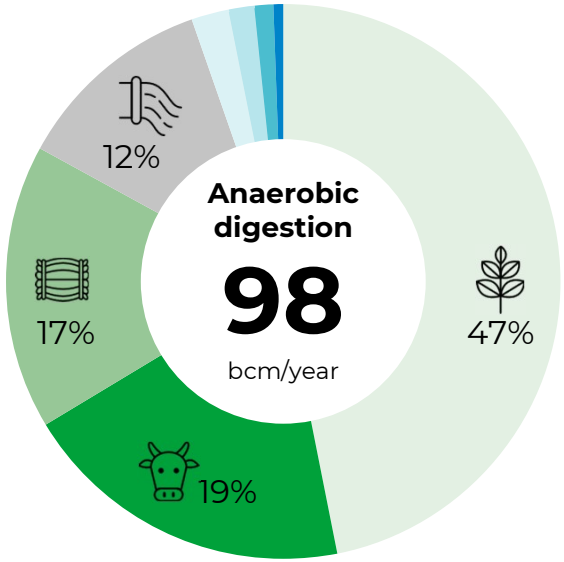
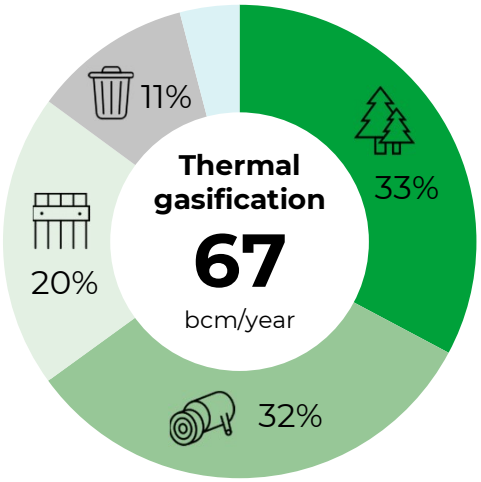
2050 feedstock mix: dominated by sequential crops and woody biomass





- Animal manure
- Agricultural residues
- Sequential crops
- Industrial wastewater
- Permanent grassland
- Biowaste
- Sewage sludge
- Roadside verge grass

- Forestry residues
- Wood waste
- Landscape care wood
- Municipal solid waste
- Pruning

- Sequential crops (47%) dominate AD potential
- Agri. wastes and residues again contribute a significant share of potential (36%)
- Woody wastes and residues again dominate gasification potential

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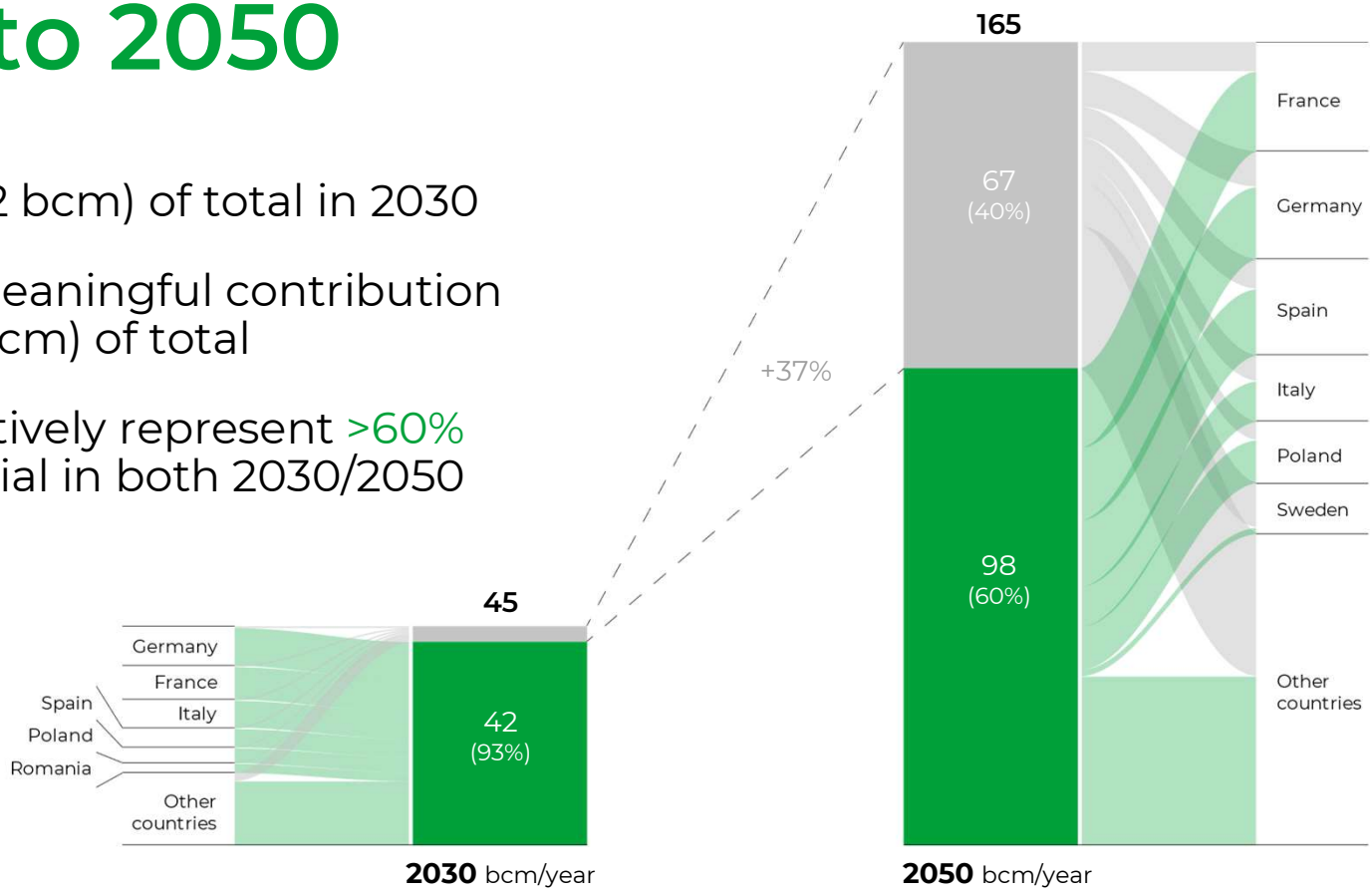
Significant scale up of potential from 2030 to 2050

- **AD** represents 93% (42 bcm) of total in 2030
- **Gasification** makes meaningful contribution in 2050 with 41% (67 bcm) of total
- Top 6 countries collectively represent >60% of biomethane potential in both 2030/2050



Anaerobic digestion

Thermal gasification

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Takeaways

1. Enough sustainable feedstock is available in the EU-27 to **meet the REPowerEU 2030 target (35 bcm)**

2. A potential of 38 bcm is estimated for **anaerobic digestion** in 2030 for EU-27 increasing to 91 bcm in 2050

3. A potential of 3 bcm is estimated for **thermal gasification** in 2030 for EU-27 increasing to 60 bcm in 2050

4. **More biomethane potential can be unlocked** by looking at additional feedstocks and technologies

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How do we realise the biomethane potentials at a national level?

Join the 2nd Webinar on Sep 20th!

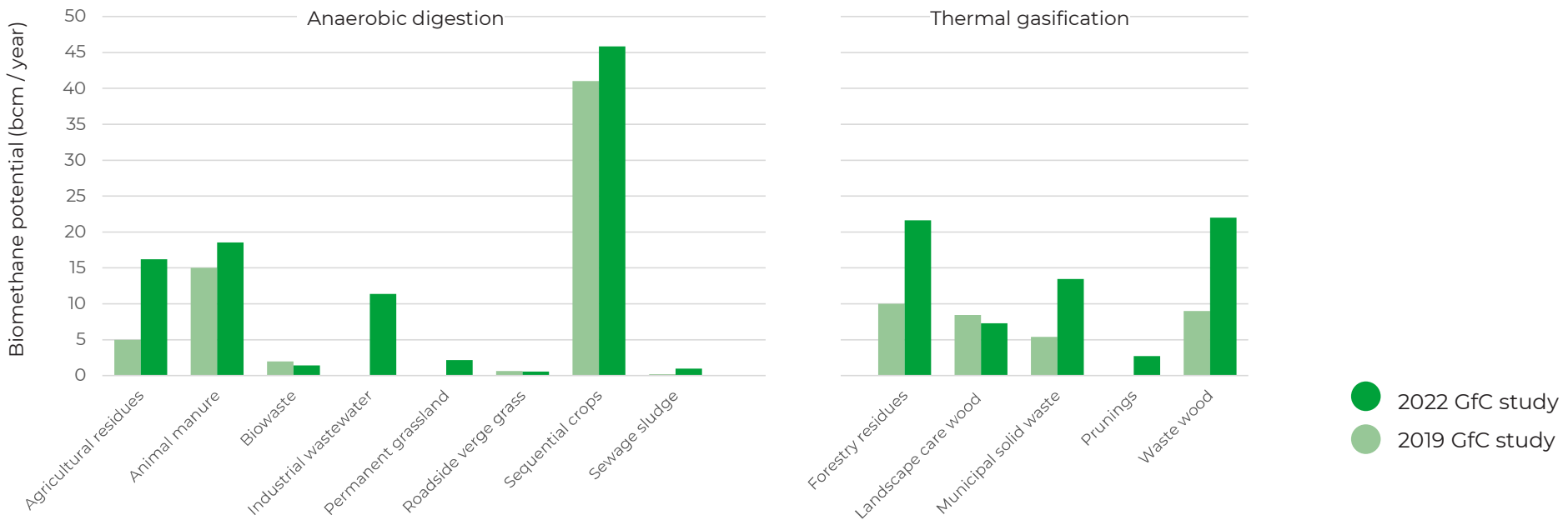
Register for the webinar

Download the full report

Sign up for newsletter

Biomethane potential 66 bcm higher than 2019 Gas for Climate study

Biomethane potential in 2050 per technology and feedstock



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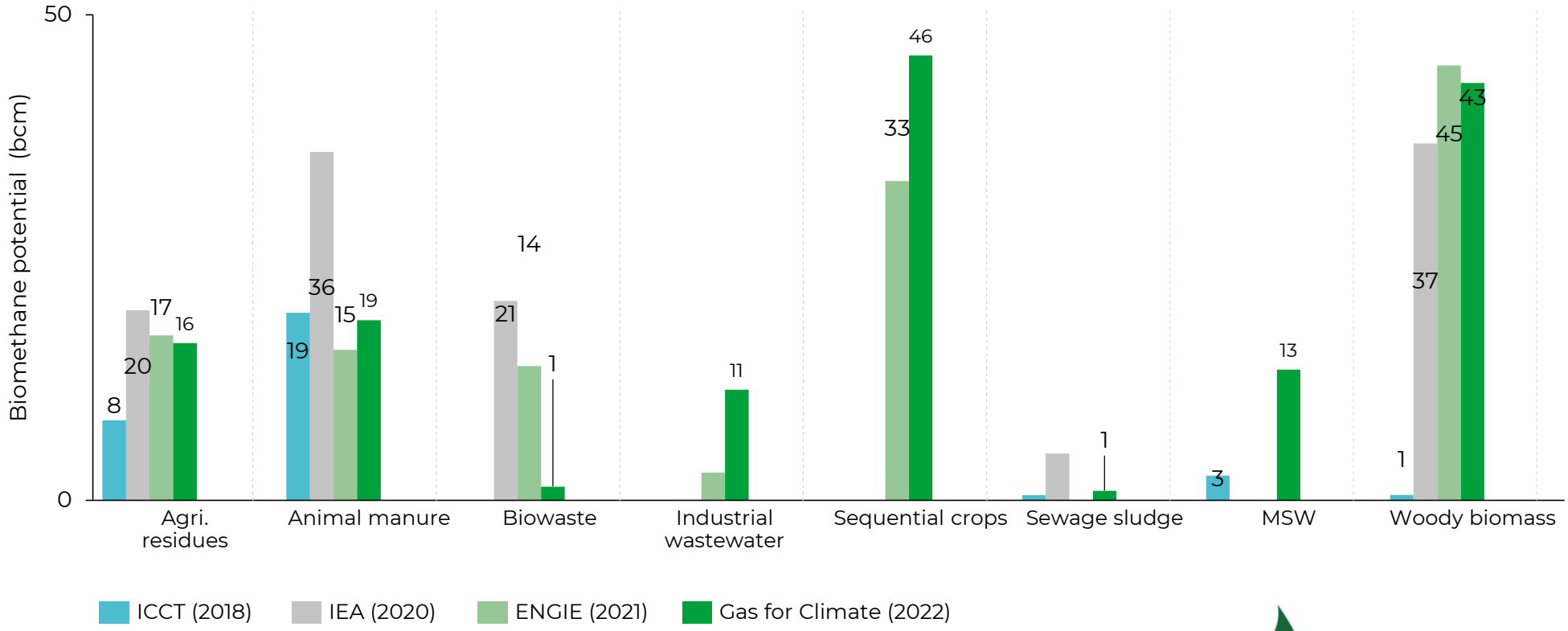
Sustainable biomethane supply to 2050 – study comparison per feedstock



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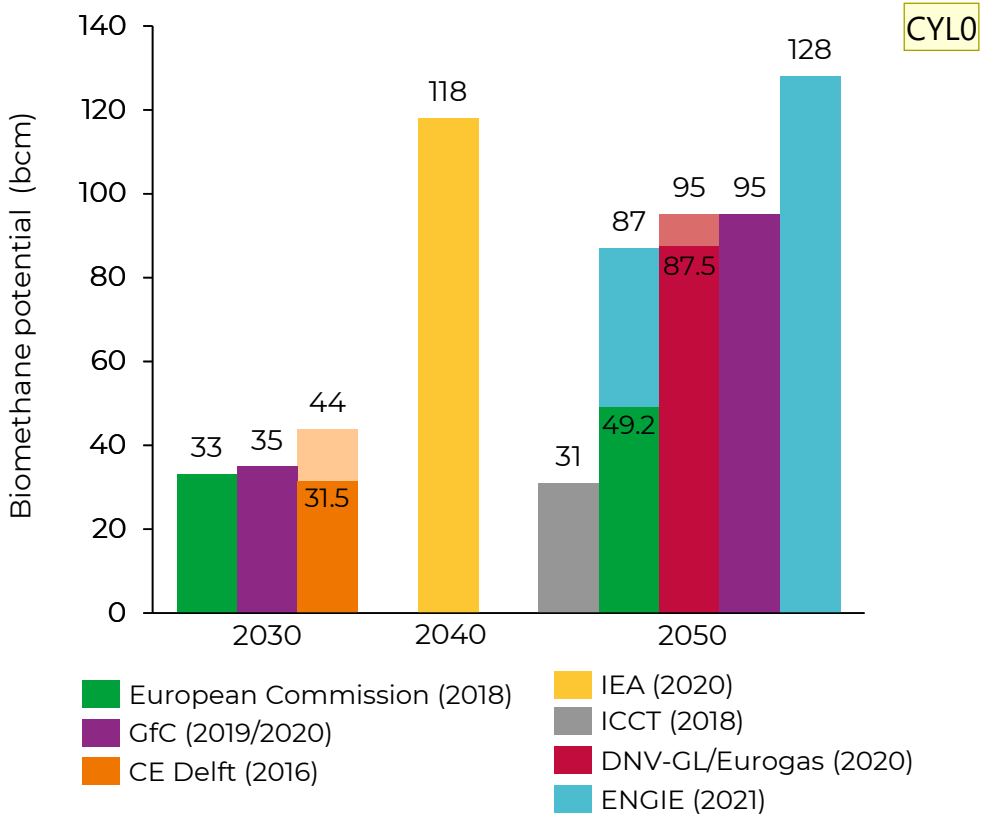
Significant potential to scale-up biomethane supply beyond current production levels



European biomethane potential to 2050

2030 Several studies see a potential that corresponds well with REPowerEU target

2050 Most studies assume a significant further scale up to 2050, but the picture that emerges is varied

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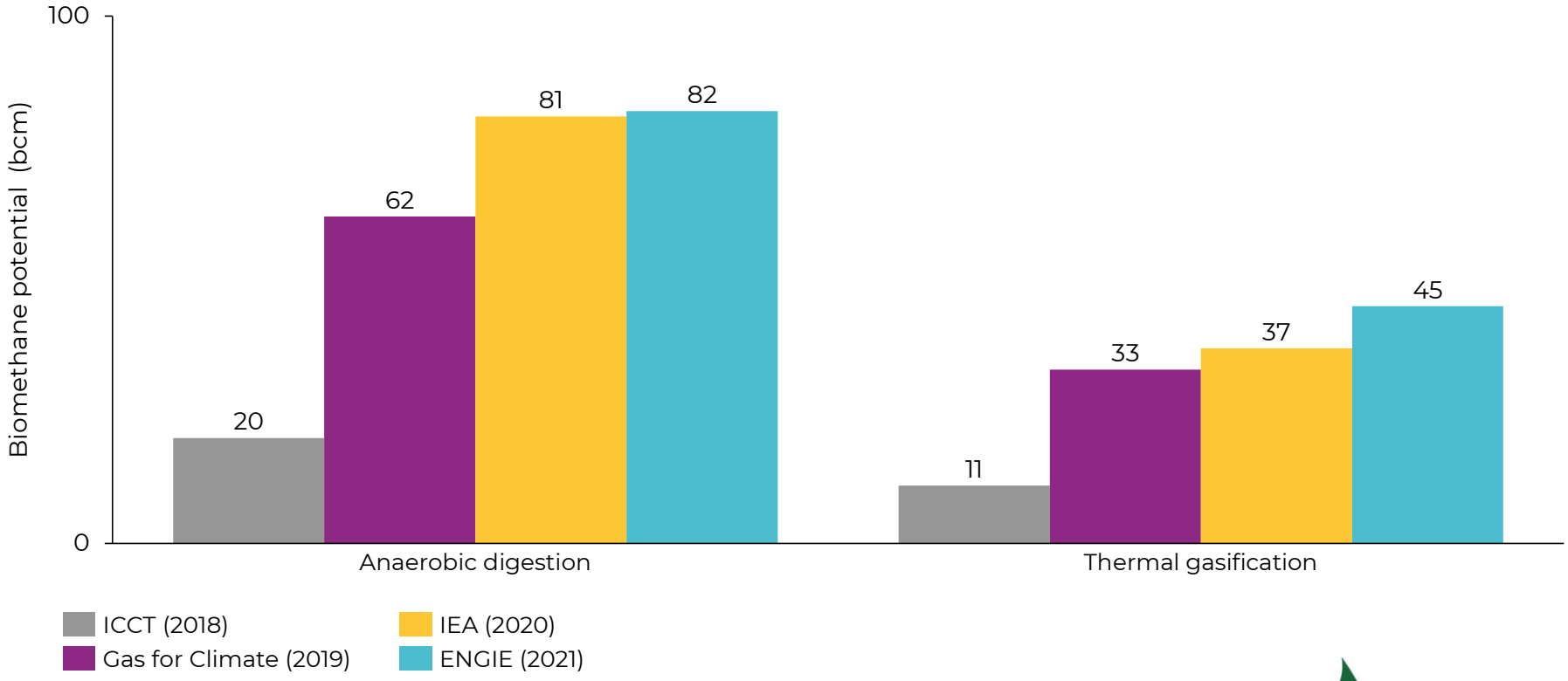
Slide 20

CYL0 Updated the chat to make the scale consistent. Let me know if the colour code is correct
Chia-Yu Lin, 2022-08-12T14:46:02.072

Sustainable biomethane supply to 2050 – study comparison per technology



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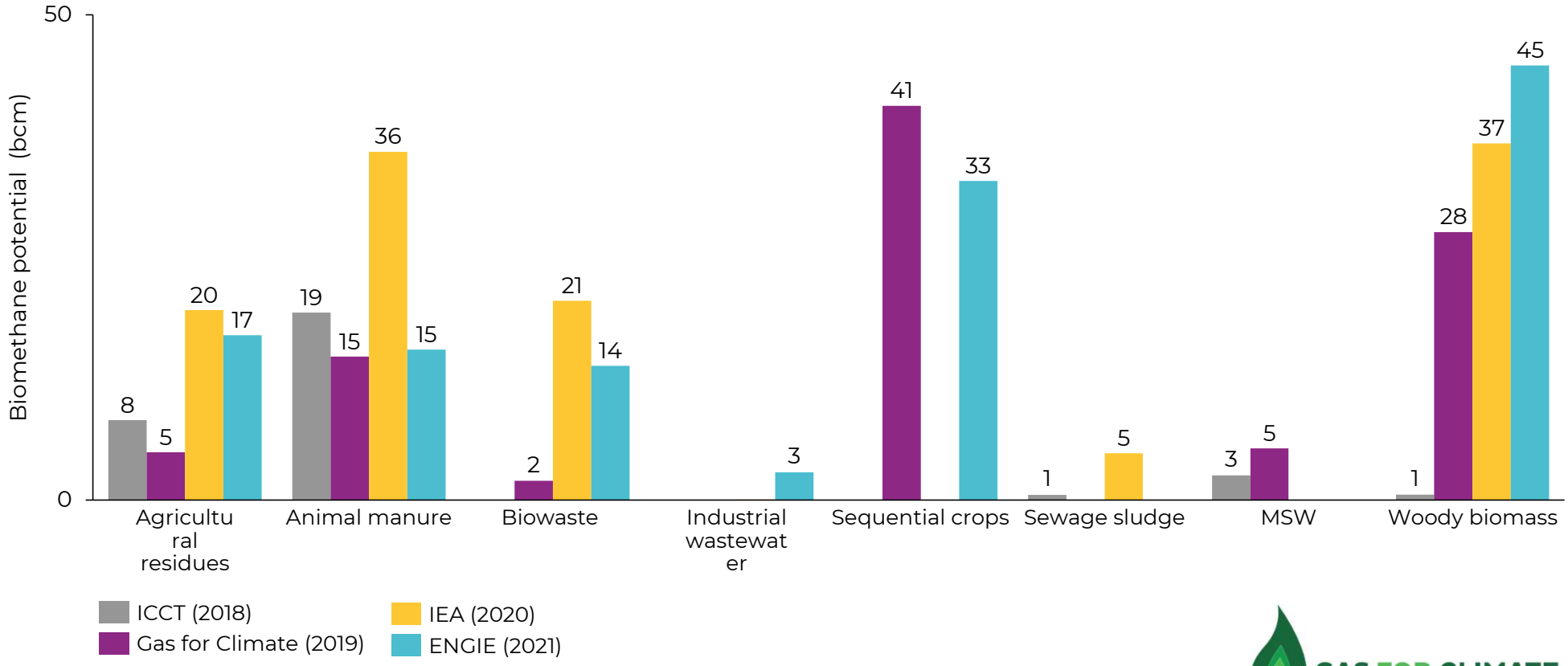
Sustainable biomethane supply to 2050 – study comparison per feedstock



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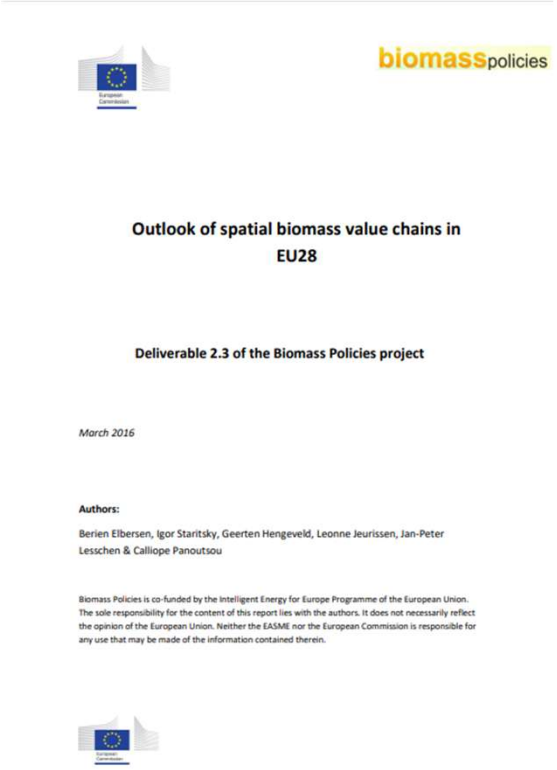
Step 2

We will base our estimates on existing studies, where available and justified (1/2)



biomasspolicies

Outlook of spatial biomass value chains in EU28

Deliverable 2.3 of the Biomass Policies project

March 2016

Authors:

Berien Elbersen, Igor Staritsky, Geerten Hengeveld, Leonne Jeurissen, Jan-Peter Lesschen & Calliope Panoutsou

Biomass Policies is co-funded by the Intelligent Energy for Europe Programme of the European Union. The sole responsibility for the content of this report lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither the EASME nor the European Commission is responsible for any use that may be made of the information contained therein.

Geographical analysis of biomethane potential and costs in Europe in 2050

ENGIE

Imperial College London

Consultants

Sustainable biomass availability in the EU, to 2050

Ref: RED II Annex IX A/B

Independent analysis provided by:
Dr Calliope Panoutsou from the Centre for Environmental Policy, Imperial College London and Dr Kyriakos Maniatis.

August 2021

contracted by Concawe

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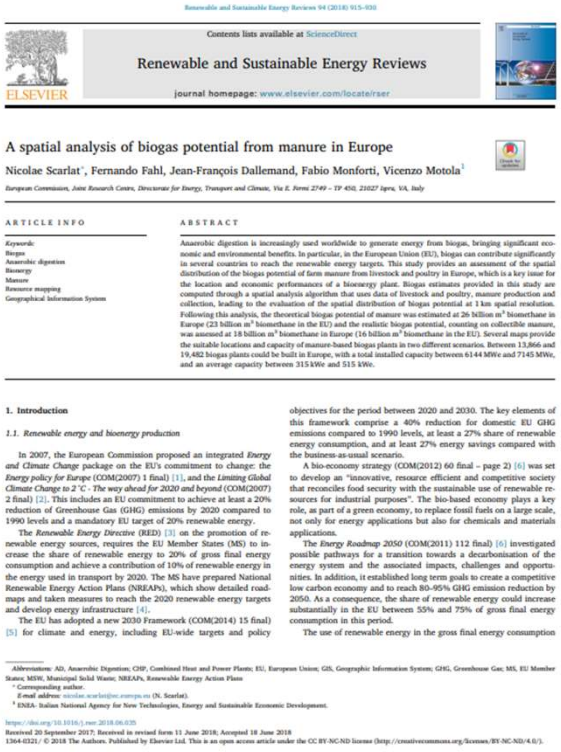
A path to 2050

Step 2

We will base our estimates on existing studies, where available and justified (2/2)



Renewable and Sustainable Energy Reviews 94 (2018) 915–930

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Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

A spatial analysis of biogas potential from manure in Europe

Nicolae Scarlat*, Fernando Fahl, Jean-François Dallemand, Fabio Monforti, Vicenzo Motola[1]

European Commission, Joint Research Centre, Directorate for Energy, Transport and Climate, Via E. Fermi 2749 – TP 450, 21027 Ispra, VA, Italy

ARTICLE INFO

Keywords:
Biogas
Anaerobic digestion
Bioenergy
Manure
Resource mapping
Geographical Information System

ABSTRACT

Anaerobic digestion is increasingly used worldwide to generate energy from biogas, bringing significant economic and environmental benefits. In particular, in the European Union (EU), biogas can contribute significantly in several countries to reach the renewable energy targets. This study provides an assessment of the spatial distribution of the biogas potential of farm manure from livestock and poultry in Europe, which is a key issue for the location and economic performances of a bioenergy plant. Biogas estimates provided in this study are computed through a spatial analysis algorithm that uses data of livestock and poultry, manure production and collection, leading to the evaluation of the spatial distribution of biogas potential at 1 km spatial resolution. Following this analysis, the theoretical biogas potential of manure was estimated at 26 billion m^3 biomethane in Europe (23 billion m^3 biomethane in the EU) and the realistic biogas potential, counting on collectible manure, was assessed at 18 billion m^3 biomethane in Europe (16 billion m^3 biomethane in the EU). Several maps provide the suitable locations and capacity of manure-based biogas plants in two different scenarios. Between 13,866 and 19,482 biogas plants could be built in Europe, with a total installed capacity between 6144 MWe and 7145 MWe, and an average capacity between 315 kWe and 515 kWe.

1. Introduction

1.1. Renewable energy and bioenergy production

In 2007, the European Commission proposed an integrated *Energy and Climate Change* package on the EU's commitment to change: the *Energy policy for Europe* (COM(2007) 1 final) [1], and the *Limiting Global Climate Change to 2 °C - The way ahead for 2020 and beyond* (COM(2007) 2 final) [2]. This includes an EU commitment to achieve at least a 20% reduction of Greenhouse Gas (GHG) emissions by 2020 compared to 1990 levels and a mandatory EU target of 20% renewable energy.

The *Renewable Energy Directive* (RED) [3] on the promotion of renewable energy sources, requires the EU Member States (MS) to increase the share of renewable energy to 20% of gross final energy consumption and achieve a contribution of 10% of renewable energy in the energy used in transport by 2020. The MS have prepared National Renewable Energy Action Plans (NREAPs), which show detailed roadmaps and taken measures to reach the 2020 renewable energy targets and develop energy infrastructure [4].

The EU has adopted a new 2030 Framework (COM(2014) 15 final) [5] for climate and energy, including EU-wide targets and policy objectives for the period between 2020 and 2030. The key elements of this framework comprise a 40% reduction for domestic EU GHG emissions compared to 1990 levels, at least a 27% share of renewable energy consumption, and at least 27% energy savings compared with the business-as-usual scenario.

A bio-economy strategy (COM(2012) 60 final – page 2) [6] was set to develop an "innovative, resource efficient and competitive society that reconciles food security with the sustainable use of renewable resources for industrial purposes". The bio-based economy plays a key role, as part of a green economy, to replace fossil fuels on a large scale, not only for energy applications but also for chemicals and materials applications.

The *Energy Roadmap 2050* (COM(2011) 112 final) [6] investigated possible pathways for a transition towards a decarbonisation of the energy system and the associated impacts, challenges and opportunities. In addition, it established long term goals to create a competitive low carbon economy and to reach 80–95% GHG emission reduction by 2050. As a consequence, the share of renewable energy could increase substantially in the EU between 55% and 75% of gross final energy consumption in this period.

The use of renewable energy in the gross final energy consumption

Abbreviations: AD, Anaerobic Digestion; CHP, Combined Heat and Power Plants; EU, European Union; GIS, Geographic Information System; GHG, Greenhouse Gas; MS, EU Member States; MSW, Municipal Solid Waste; NREAPs, Renewable Energy Action Plans

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[1] ENEA- Italian National Agency for New Technologies, Energy and Sustainable Economic Development.

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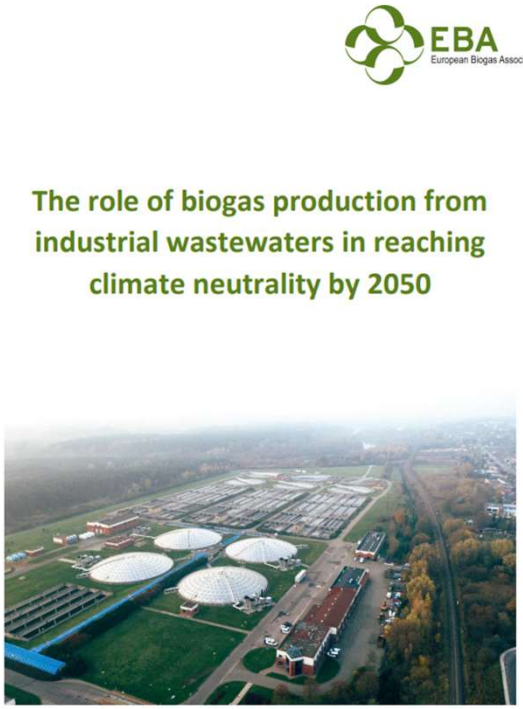

EBA European Biogas Association

The role of biogas production from industrial wastewaters in reaching climate neutrality by 2050

agronomy MDPI

Article

The Role of Sequential Cropping and Biogasdoneright™ in Enhancing the Sustainability of Agricultural Systems in Europe

Francesca Magnolo[1,*], Harmen Dekker[2], Mieke Decorte[2], Guido Bezzi[3], Lorella Rossi[3], Erik Meers[4] and Stijn Speelman[1]

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4 Green Chemistry and Technology Department, Faculty of Bioscience Engineering, Ghent University, Coupure Links 653, 9000 Gent, Belgium; erik.meers@ugent.be
* Correspondence: Francesca.magnolo@ugent.be

Abstract: Sequential cropping in the Biogasdoneright™ (BDR™) system in Italy has recently gained attention to combine food and renewable energy production in a sustainable way, as well as for carbon sequestration. However, little is known on the potential to expand the practice in other regions of Europe. In this paper, sequential crop calendars were developed for different EU climate regions, and the EU biomethane potential of the anaerobic digestion (AD) of sequential crops was estimated for a *Conservative_Scenario* and a *Maximum_Scenario*, assuming different percentages of primary crop land dedicated to the practice and biogas yields. A total EU biomethane potential of 46 bcm/yr and 185 bcm/yr was estimated from the AD of sequential crops in the two scenarios, respectively, and the Continental region registered the highest potential compared to the other regions. The additional benefits of the combination of sequential cropping with other agricultural conservation practices and digestate use included in BDR™ systems were also discussed. In conclusion, the paper shows that with appropriate innovations in crop management, sequential cropping could be applied in different agroclimatic regions of Europe, contributing to climate and renewable energy targets.

Keywords: Biogasdoneright™; biomethane; carbon sequestration; circular bioeconomy; sequential cropping

Citation: Magnolo, F.; Dekker, H.; Decorte, M.; Bezzi, G.; Rossi, L.; Meers, E.; Speelman, S. The Role of Sequential Cropping and Biogasdoneright™ in Enhancing the Sustainability of Agricultural Systems in Europe. *Agronomy* 2021, 11, 2102. https://doi.org/10.3390/agronomy11112102

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1. Introduction

Agriculture is at the heart of the most important global challenges mankind is currently facing and will face in the future, including food security, environmental degradation, economic development and climate change [1]. Agriculture is highly exposed to climate change, as its activities directly depend on climatic conditions [2]. At the same time, the agricultural sector itself is responsible for direct GHG emissions, such as nitrous oxide emissions from soils, fertilizer application and livestock farming, as well as indirect GHG emissions from land-use changes, such as land clearing and deforestation [3]. Nevertheless, agriculture holds the potential to also help mitigate climate change by reducing GHG emissions and sequestering carbon. The magnitude of the net effect is determined by different factors, such as land-use changes that are directly or indirectly caused by cultivation and the fossil energy input required [4]. In turn, these factors are influenced by the type of farming practices used [5]. In order to reach the climate-neutral goal of the Green Deal by 2050 and cut European GHG emissions by 55% by 2030 [6], while establishing a sustainable and circular bioeconomy [7], agricultural practices need to increasingly adapt to play a positive role in tackling climate change while concurrently providing quality food, materials and

Agronomy 2021, 11, 2102. https://doi.org/10.3390/agronomy11112102 https://www.mdpi.com/journal/agronomy

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Slides to be deleted

Policy recommendation (from EBA)

- On the RED:
- Progressive requirements to demonstrate substantial GHG emissions savings drive choices over sustainable feedstocks. However, their retroactive application on existing projects could discourage investments and damage existing capacity (reference article 29.10)

1) The update of the list of advanced feedstocks in Annex IX is a beneficial provision as it opens the possibility to progressively include novel feedstock and incentives sustainable practices. Yet, the ENVI committee proposal to give the possibility to remove feedstocks from the list would erode mkt confidence (especially considering updates should be performed every 2 years)
2) While competition of uses should be avoided, a dogmatic implementation of the cascading principle that does not consider local markets specificities could have a negative impact on mobilisation of sustainable feedstock. (Reference to art. 3.3 and 29.1 proposal from EP ENVI Committee)

- On revision of Permitting and Authorizations related rules (article 15 and 16 of RED), proposal tabled with the REPowerEU Communication:

- For the identification of RES-GO-TO, the list of areas that need to be prioritized should include rural areas as much of the sustainable feedstocks to be mobilized in the future are still agricultural residues

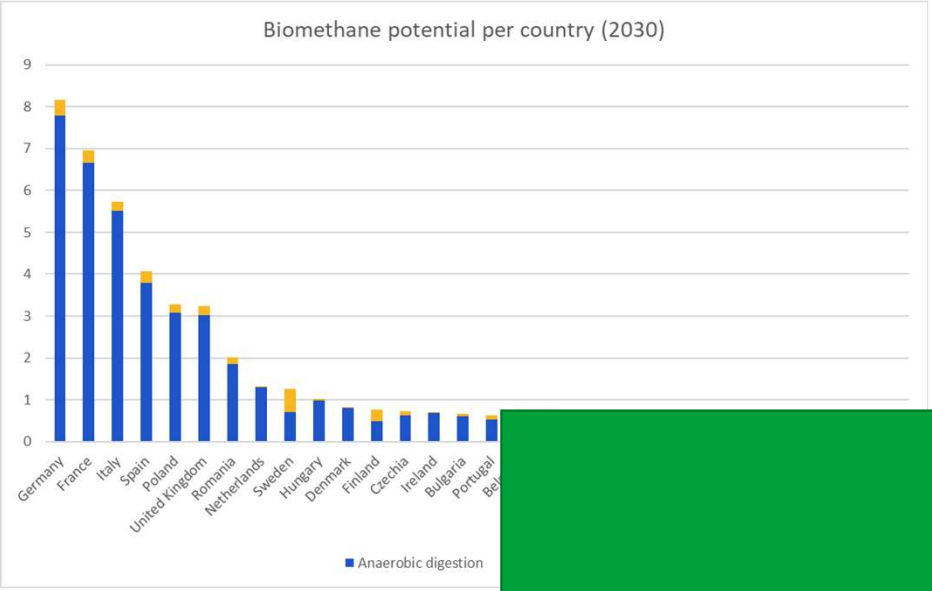
- General note on UWWTD -> Urban Wastewater Treatment Directive's upcoming revision provides an opportunity for the inclusion of regulatory drivers to maximize energy production potential and increase efficiency

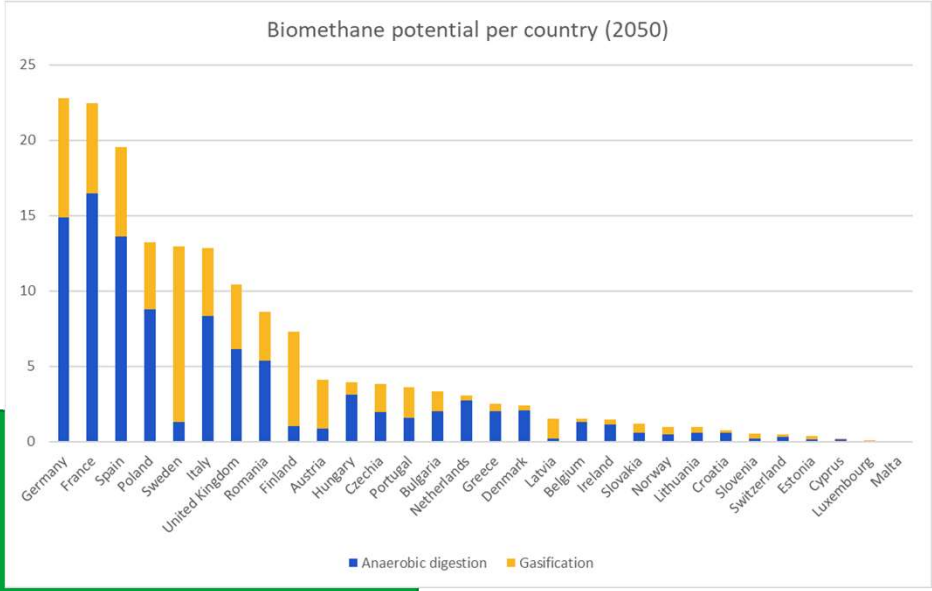
We propose not to include this slide as some of the recommendations are quite detailed (and in some cases based on ENVI 'proposals'), and do not directly flow from the rest of the presentation. We instead propose to provide some high level recommendations on the previous slide, and then introduce the Manual (slide 20).

Time to act now

- Analyses by Gas for Climate have shown that an acceleration of renewable gas uptake is feasible
- Existing EU energy and climate policies are not sufficient to speed-up renewable gas uptake
- FF55 and REPowerEU are steps in the right direction but need to be substantiated with prompt actions to become reality

We estimate 45 bcm biomethane potential in 2030 increasing to 167 bcm in 2050





2 slides: 2030 and 2050 (Figures 1 and 2 of report)

- AD represents 93% o
- Gasification makes r % of total (69 bcm)
- Key countries: Fran ectively represent >60% of biomethane pote

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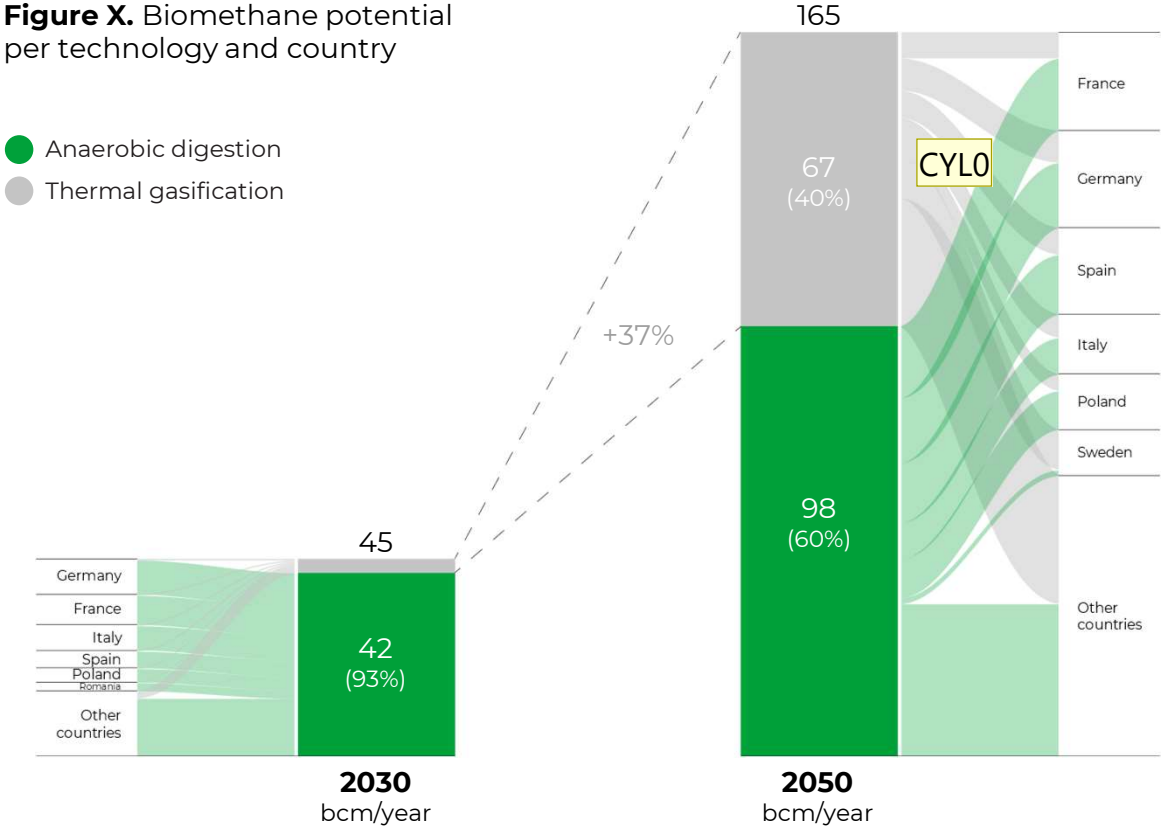
Biomethane potential reaching 167 bcm in 2050

Figure X. Biomethane potential per technology and country



- **AD** represents 93% (42 bcm) of total in 2030
- **Gasification** makes meaningful contribution in 2050 with 41% (69 bcm) of total
- **Key countries**: France, Germany, Spain, UK, Poland, Italy collectively represent >60% of biomethane potential

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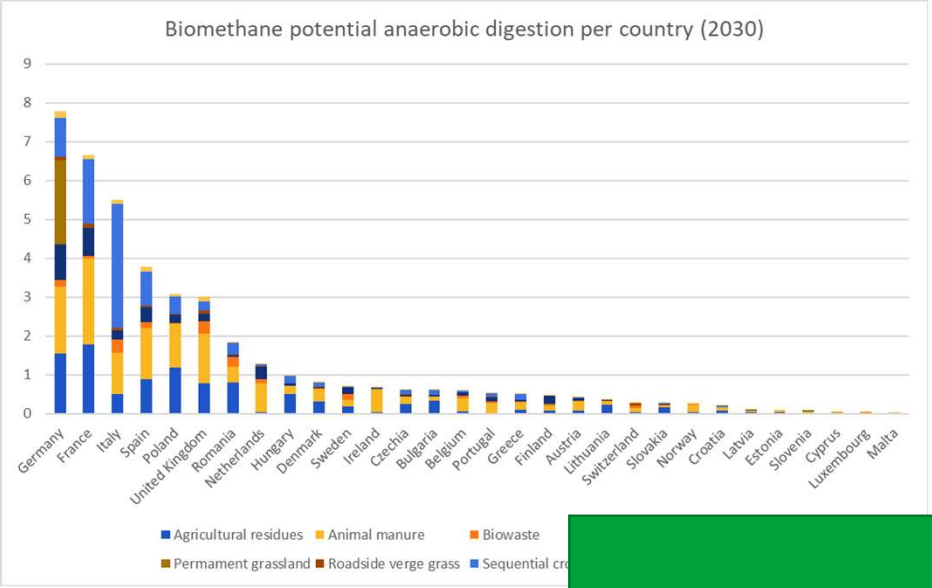
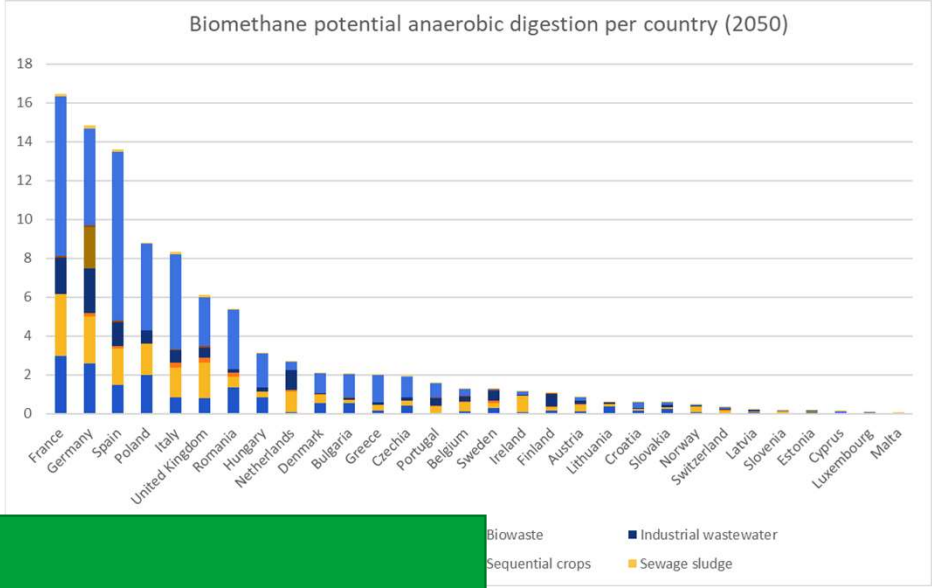
Slide 29

CYL0 The bcm of gasification is different in the excel file. It accounts for 40% (67 bcm) of biomethane potential in 2050 according to the data in excel. [@Sacha Alberici] do you know if the data is correct or up-to-date in the excel file?

Chia-Yu Lin, 2022-08-12T12:23:38.536

42 bcm biomethane potential from AD in 2030 increasing to 98 bcm in 2050





- +56 bcm increase in bio om 3 bcm in 2020)
- Key feedstocks – 2030: es (24%)
- Key feedstocks – 2050: re (19%), Agricultural residues (17%), and Indu

2 slides: 2030 and 2050 for AD per feedstock (Figures 5 and 6)

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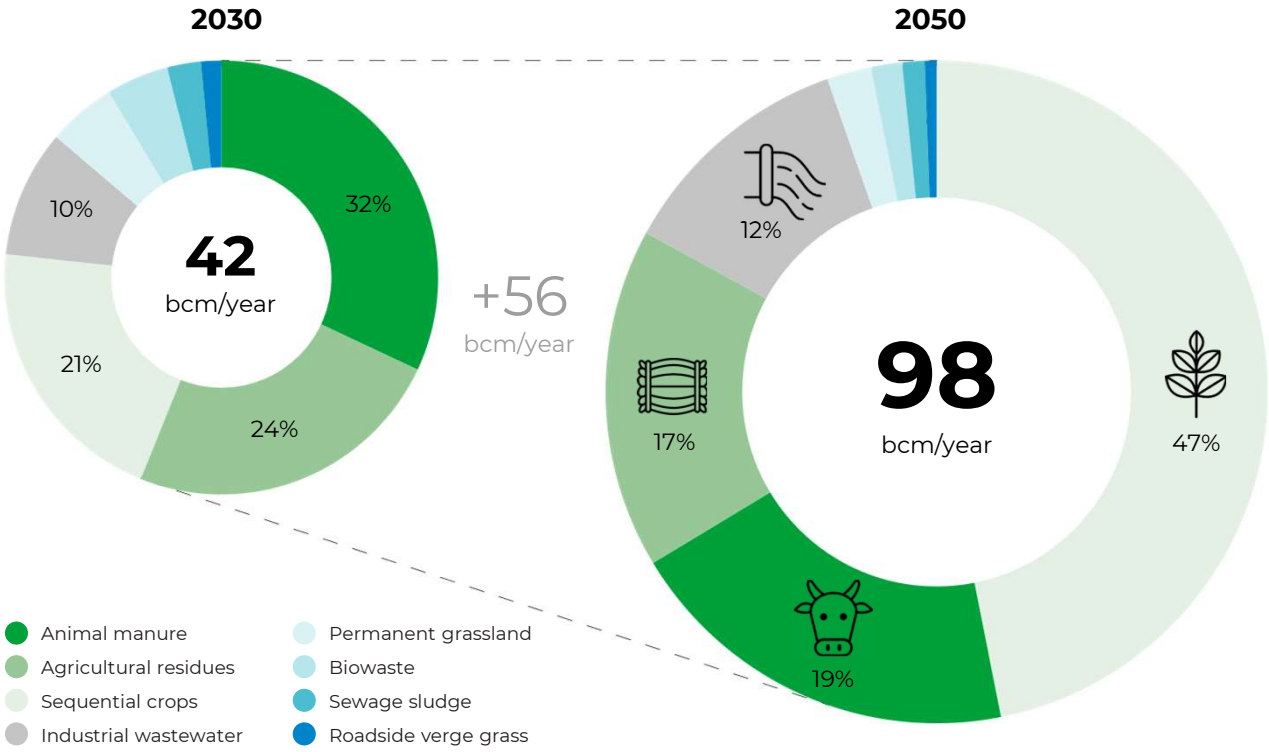
A path to 2050

Anaerobic digestion relying on sequential cropping

Figure X. Anaerobic digestion potential per feedstock



- +56 bcm increase in biomethane potential from 2030 to 2050
- **Key feedstocks**:

  2030: Animal manure (32%), Agricultural residues (24%)

  2050: Sequential cropping (47%), Animal Manure (19%)

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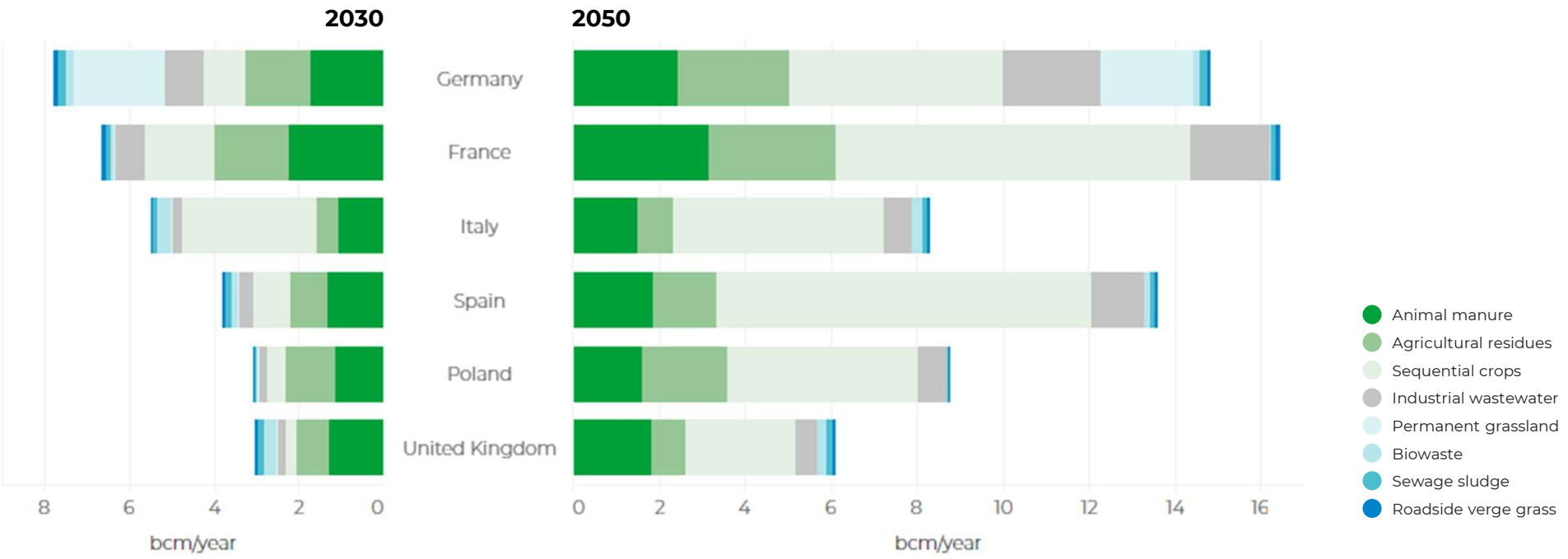
A path to 2050

CYL0

Figure X. Anaerobic digestion potential per feedstock per country (top 6)



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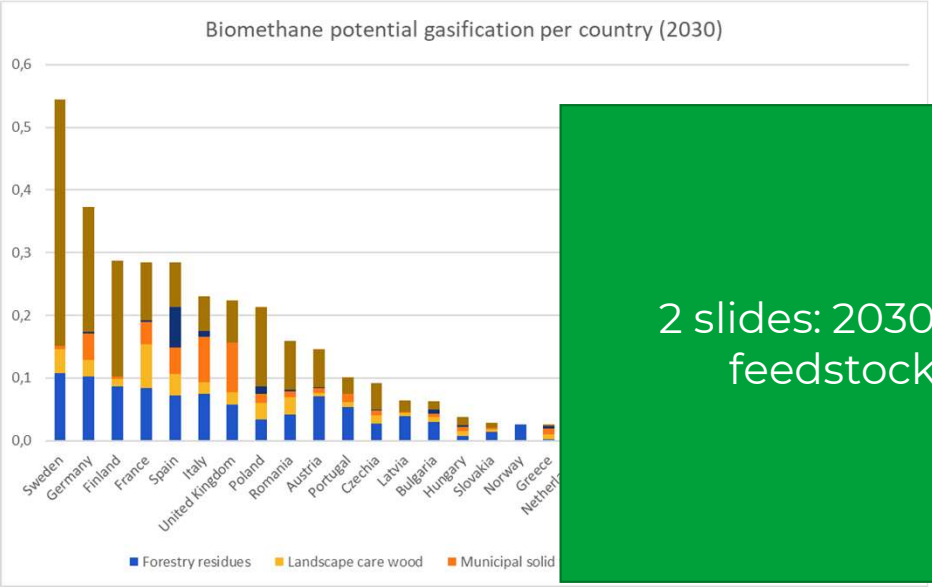
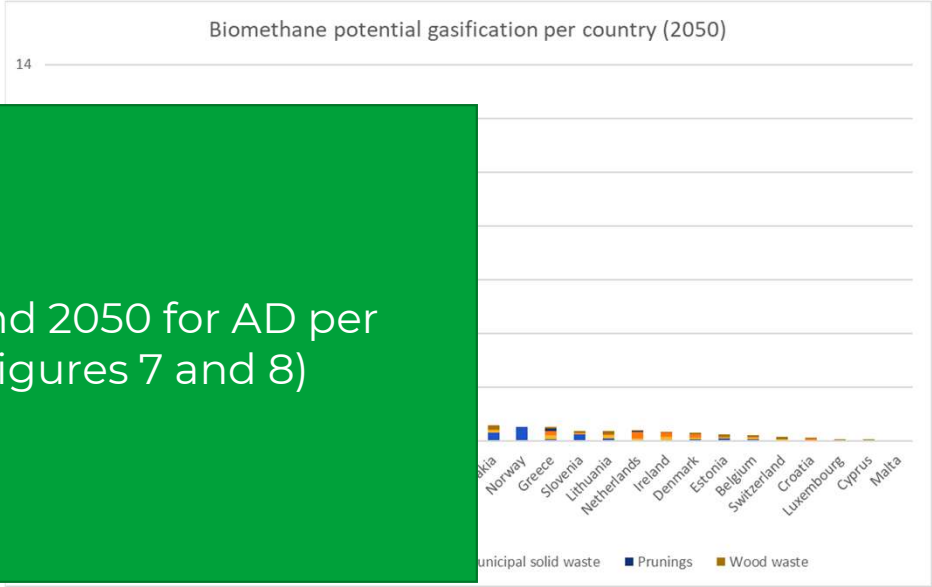
Slide 32

CYL0 Do we need a figure to illustrate the potential per feedstock per country? I'm not sure if this help to amplify the main point?
Chia-Yu Lin, 2022-08-12T14:05:04.917

3 bcm biomethane potential from gasification in 2030 increasing to 69 bcm in 2050





2 slides: 2030 and 2050 for AD per feedstock (Figures 7 and 8)

- +66 bcm increase in biomethane potential from 2030 to 2050
- Key feedstocks: Forestry residues (31% in 2050) and Wood waste (45% in 2050)

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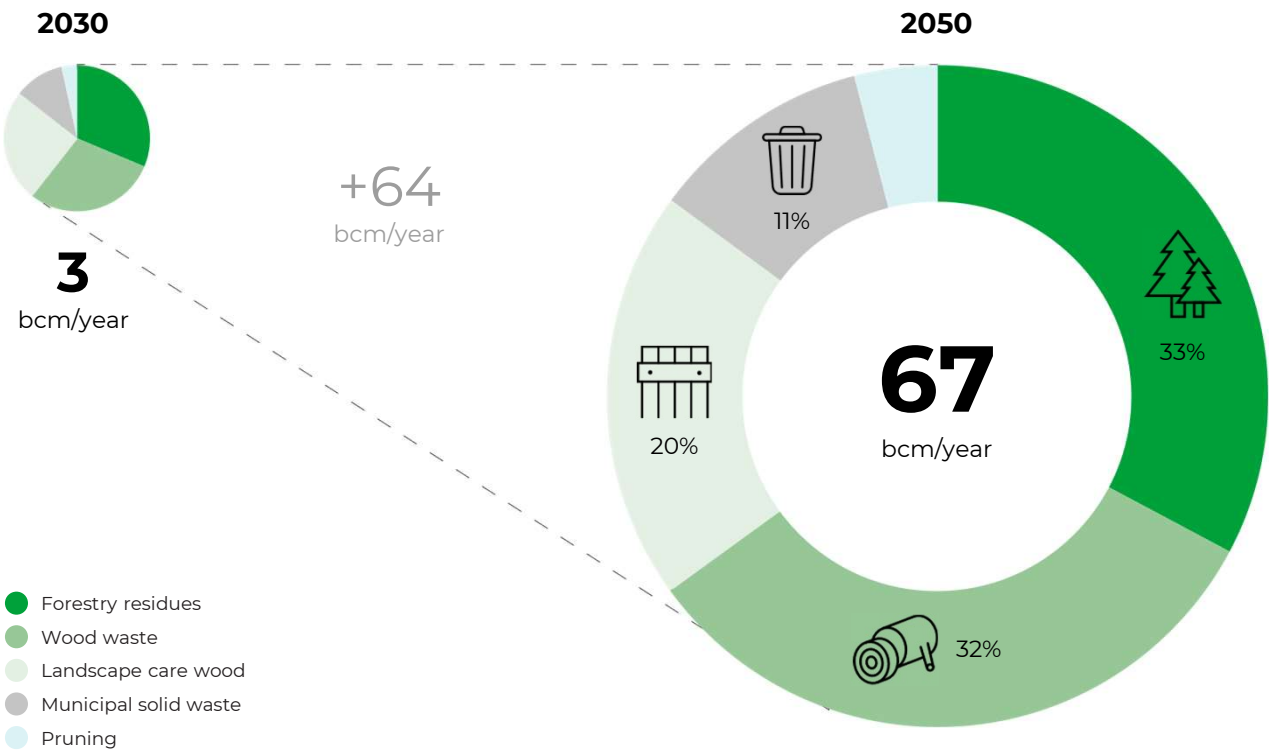
A path to 2050

CYL0

A twenty-fold increase of thermal gasification potential

Figure X. Thermal gasification potential per feedstock



- +66 bcm increase in biomethane potential from 2030 to 2050
- **Key feedstocks**: Forestry residues (31% in 2050) and Wood waste (45% in 2050)

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A path to 2050

Slide 34

CYL0 [@Sacha Alberici] the same question as page 22: shall it be 67 or 69 bcm?
Chia-Yu Lin, 2022-08-12T12:26:59.744

Strategies to scale-up sustainable biomethane

Mobilise waste and residue feedstocks

- Member States to prioritise mobilisation of manure, agricultural residues, biowaste and industrial wastewater
- Commission should prohibit incineration and landfilling of organic and food waste
- Pool feedstock and biogas supply to improve business case

im

- C
- T

more temperate parts of Europe

- Conduct large-scale training and awareness-raising programmes

TBC whether we want to include a slide such as this – it partly overlaps with the second webinar (Action Plan)

(e.g. straw and woody biomass) to be more easily biodegraded in digesters

Investing in commercial scale gasification plants

- Commission/Member States to set out long-term policy framework that supports biomethane gasification, while also targeting continuous cost reductions to minimise societal costs
- Industry to invest in commercial scale gasification plants (200 MW+)

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For more information:

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Let's see who we include: I should be included.

www.gasforclimate2050.eu

[REPowerEU slides] – separator maybe not needed (?)

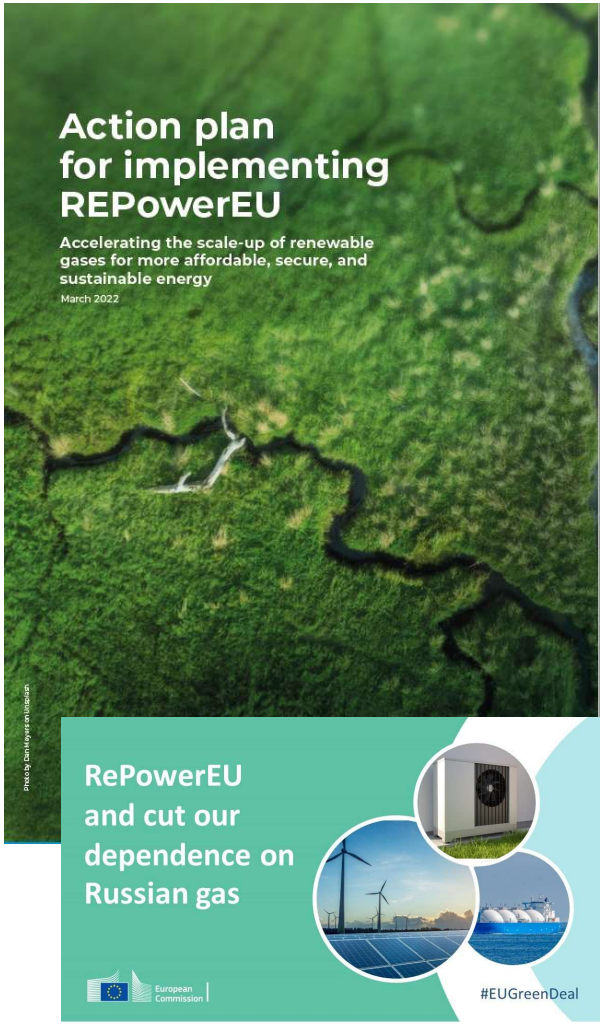
Time to act now

Placeholder – probably need a variation of this on Biomethane

- Recent analyses by Gas for Climate and the continued work on the European Hydrogen Backbone have shown that an acceleration of **renewable gas uptake is feasible**
- **Existing** EU energy and climate **policies are not sufficient** to speed-up renewable gas uptake
- **FF55 and REPowerEU** are steps in the right direction but need to be substantiated with **prompt actions** to become reality

This action plan

- Targets the "**how to implement**" REPowerEU for renewable gases
- Specific actions targeting ***supply and market, funding and permitting, and, infrastructure***



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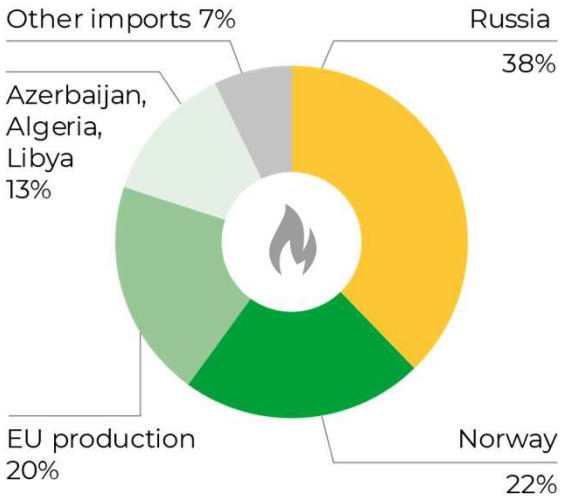
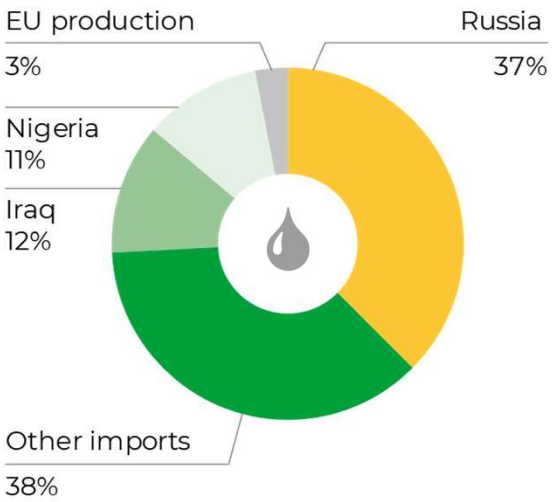
High dependency on Russian energy imports

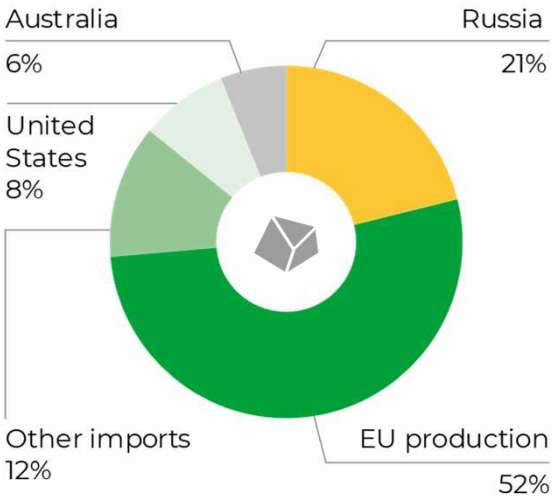
Gas import as % of total EU consumption



Oil import as % of total EU consumption



Coal import as % of total EU consumption



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A path to 2050

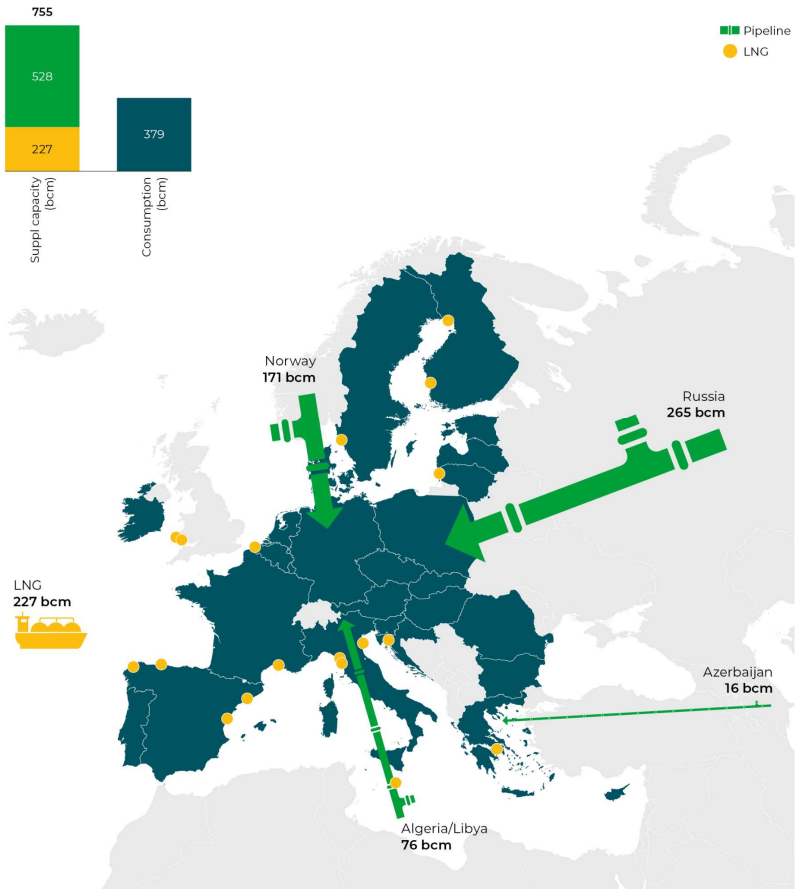
Slide 39

CYL0 I changed the colour and data order of the original pie charts to emphasize the key argument and make them easier to read. Pls let me know if it works better for you
Chia-Yu Lin, 2022-08-12T14:01:01.815

CYL0 0 What I changed:
Bright colours like yellow can draw the attention better than others, thus I apply yellow to Russia. I also change the data order to descending so ppl can understand what are the major import sources without sorting it themselves
Chia-Yu Lin, 2022-08-12T14:01:34.993

Diversification of gas supply is needed

Yearly gas supply capacity (in bcm) in Europe[12,13]



- Russia has the highest pipeline capacity supply Europe with 155 bcm of natural gas every year
- Increasing LNG imports is not a viable short-term solution
- Rapid scale-up of green hydrogen and biomethane is needed to replace Russian gas imports

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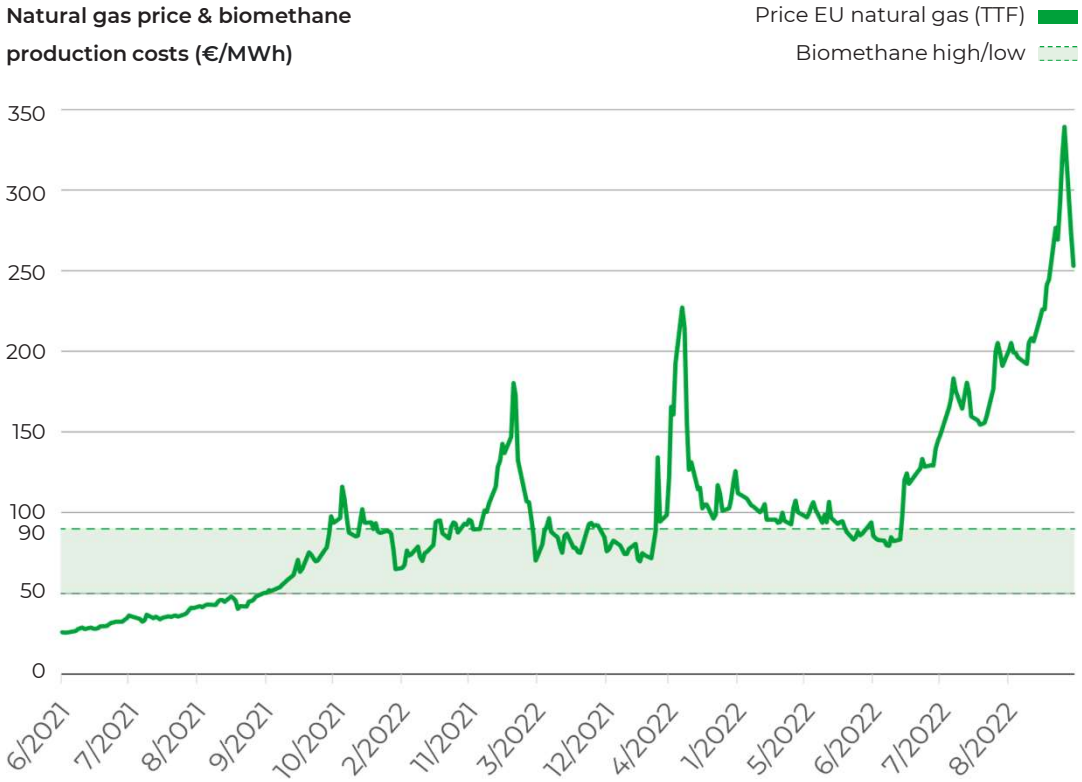
CYL0

Rising prices for natural gas make renewable gases cost competitive



- Gas prices have increased sixfold from €35/MWh to around €270/MWh between July 2021 and August 2022
- Biomethane production costs are competitive, ranging from €50-€90/MWh depending on feedstock and plant scale

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Slide 41

CYL0 update with new gas price

Chia-Yu Lin, 2022-08-25T09:23:22.829