Swedish view on challenges, barriers and drivers in biogas sector

Konrad Smolarczyk, Phd Candidate, Liu

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Agenda

1. Biogas Solutions Research Center
2. Overview of Swedish Biogas Sector
3. Challenges and drivers Of Sweden:
   - Policy and Regulation
   - Market and Economics
   - Technological and Infrastructure
   - Social and Cultural

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BSRC in brief

- **Vision** Wherever a biogas solution strengthen the overall resource efficiency, it is realised.
- **Scope** Any system that contain anaerobic digestion, addresses eight large societal challenges, including sustainable cities and regions and a competitive bioeconomy.
- **Strategy** Capacity building through co-production of new knowledge with actors from the whole supply chain and a diverse scientific disciplines.
- **Resources** 20 PhD-candidates, 30 senior researchers, 50 partner and member organisations, 5+5 years, economic turnover of three million Euro per year.

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Biogas production

Scandinavianbiogas
Tekniska verken
Gasum
Stl Biogas
NODRA
FordonsGas an Air Liquide company
Avfall Sverige
nature energy
Hagelsrums BIOGAS
WARRM
Renova
SYSAV
Härnösand Energi & Miljö
Borlänge Energi
biogas Gotland
ADVEN
Borås Energi och Miljö
Ingår i Borås Stadshus AB
Rena Hav

Biogas use

SSAB
OXGAS
Gotlands Slagteri Aktiebolag
Arla
Perstorp
Gotland Tech Development

Agriculture and Horticulture

Lantbrukarnas Riksförbund
Hushållnings sällskapet
ECONOVA
biototal
Stefan Halldorf Konsult

Technology Providers

SCANIA
PURAC
Hitachi Zosen INOVA
WÄRTSILÄ

Public organizations

Region Östergötland
Västra Götalandsregionen
Norrköping
City of Linköping
Göteborgs Stad
Kalmar
BIODRIV ÖST
BIOGAS VÄST
Region Jönköpings län
Region Gotland
Länsstyrelsen Kalmar län
Fyrbodal
Region Kalmar län
Linnæus University
Mörbylånga kommun
Örebro
Västerviks kommun
energikontor sydöst
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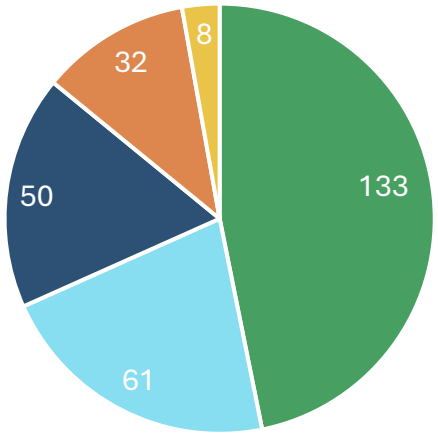
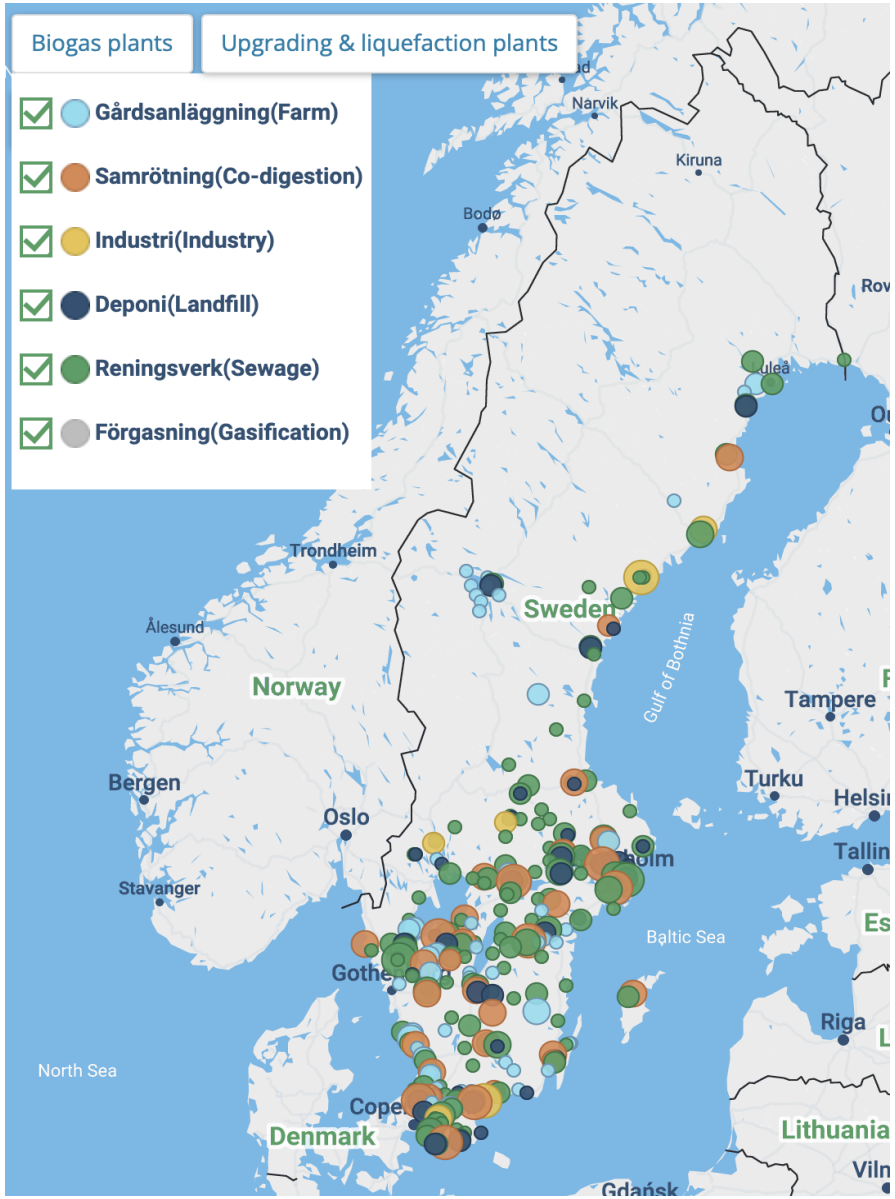
Overview of Swedish Biogas Sector

Biogas production

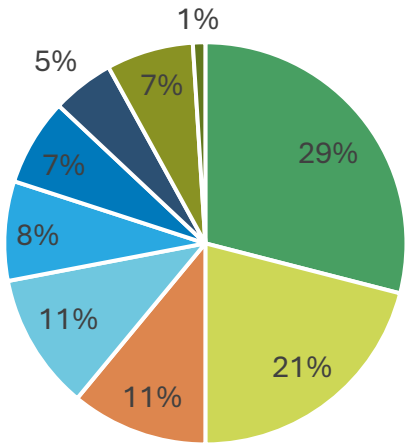
Number of biogas plants in 2022



- Wastewater treatment plants
- Farm plants
- Landfills
- Co-digestion plants
- Industrial wastewater treatment plants



Biogas production from substrates 2022



- Sewage
- Hausehold waste
- Manure
- Others
- Food industry
- Animal waste (slaughter houses)
- Landfill
- Industrial plant (sewage)
- Energy crops

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Source: Swedish Energy Agency/Swedish Gas Association

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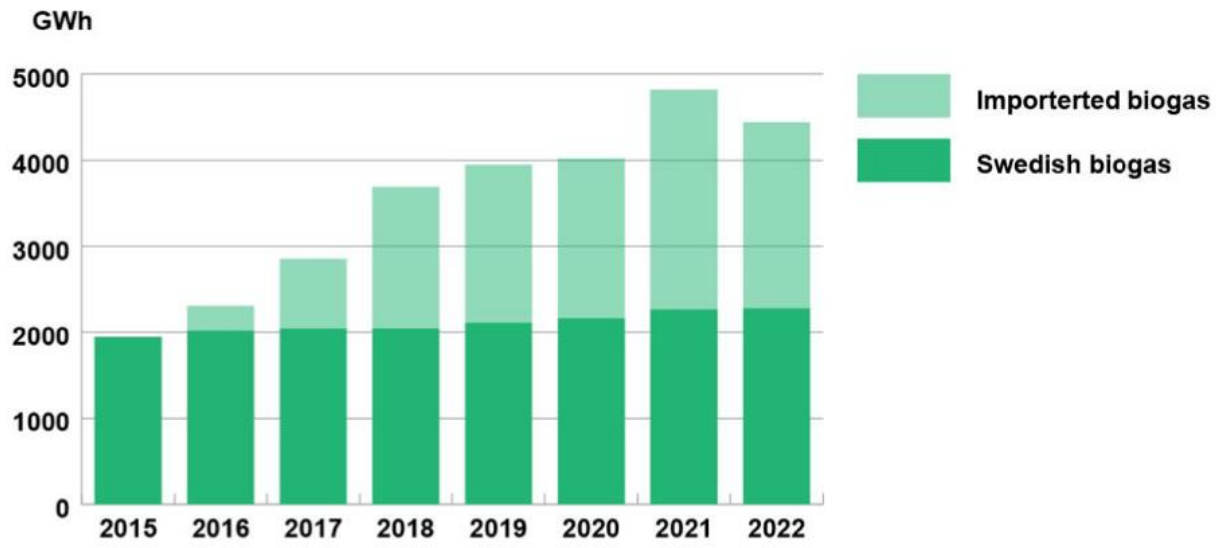
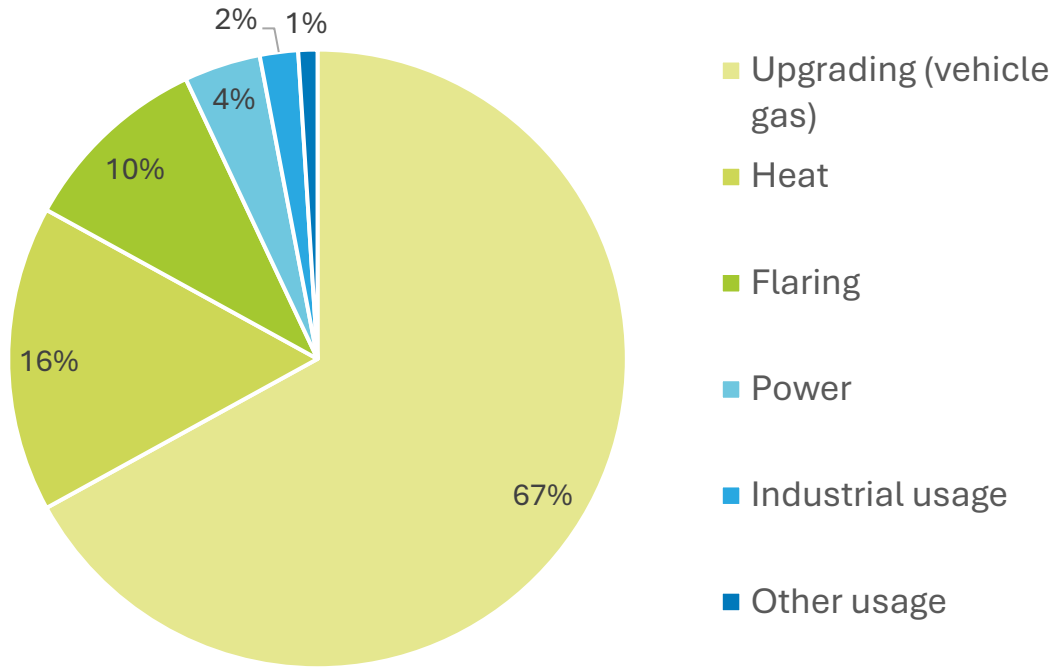
Biogas use

Total biogas use (GWh) in Sweden 2015-2022.



Biogas usage 2022



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Source: Swedish Energy Agency/Swedish Gas Association

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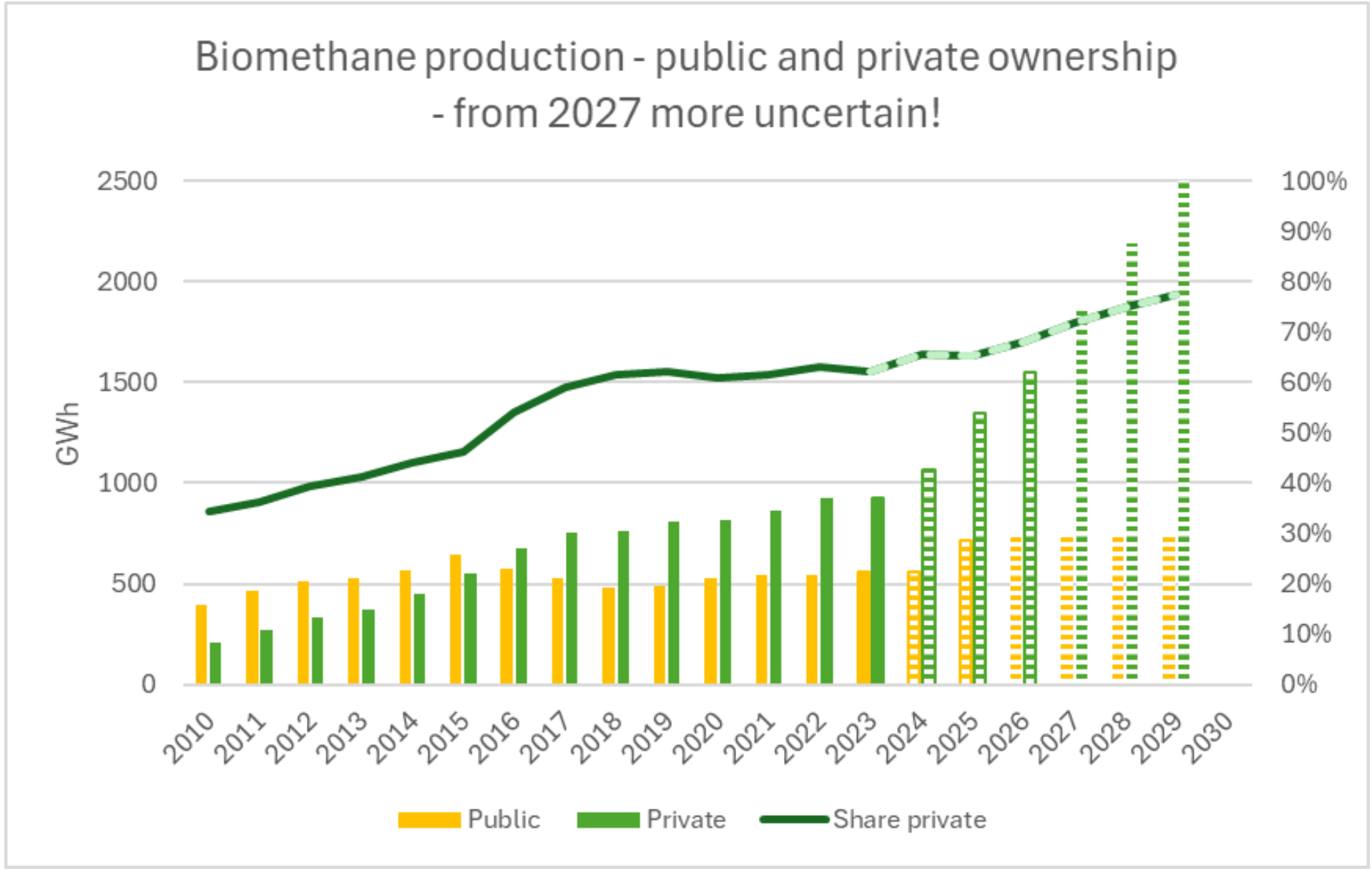

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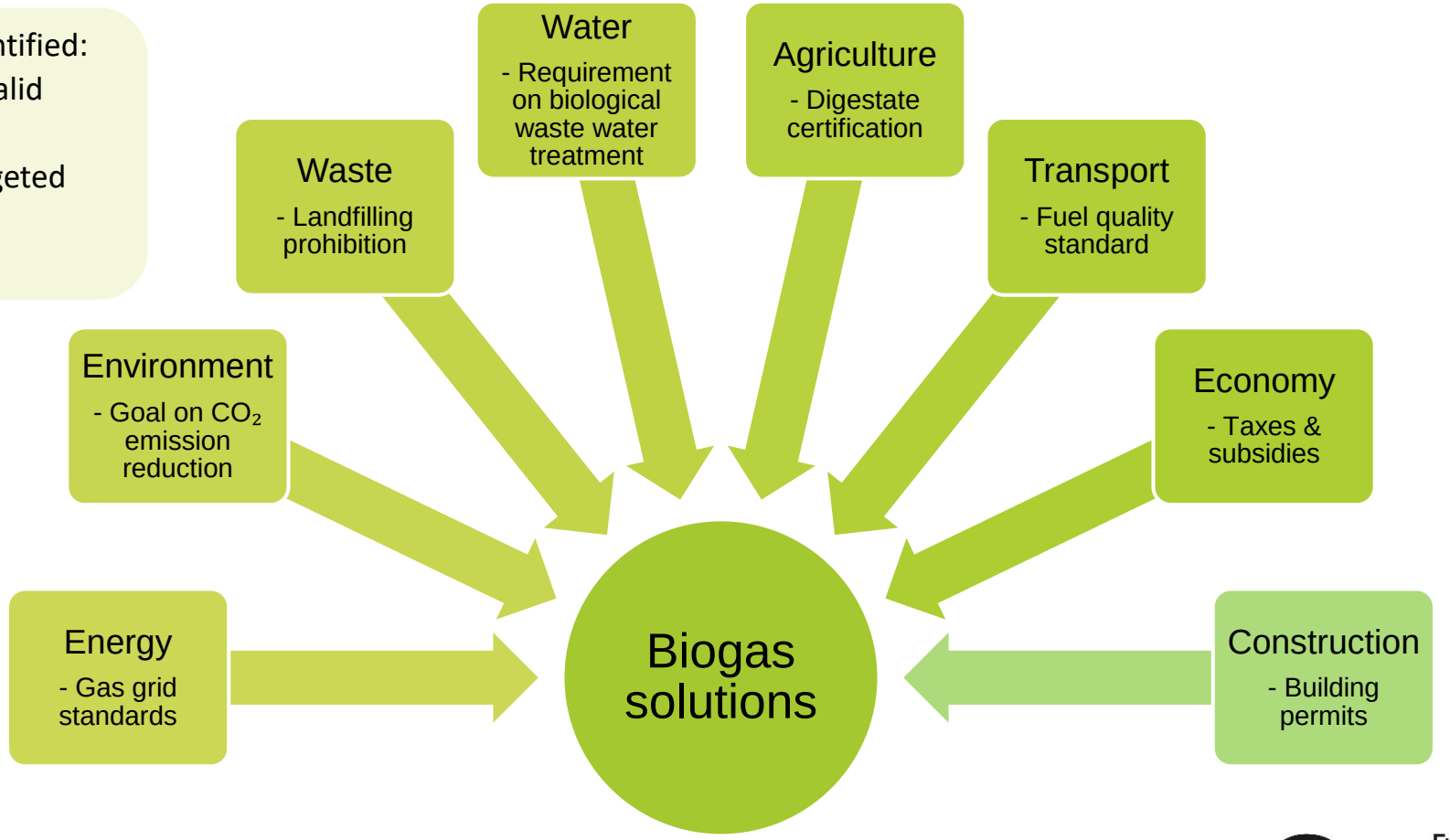
Policy and Regulation

The policy landscape of biogas solutions

Five dimensions of biogas policies can be identified:

- Administrative area where policies are valid
- Administrative level, from local to global
- Part of the biogas value chain that is targeted
- Temporal change and continuity
- Type of policy instrument



The lack of a centralized, coherent policy framework leads to regulatory uncertainty, which can delay or discourage investments in new biogas projects.

Gustafsson & Anderberg (2021). Dimensions and characteristics of biogas policies – Modelling the European policy landscape, Renewable and Sustainable Energy Reviews, 136

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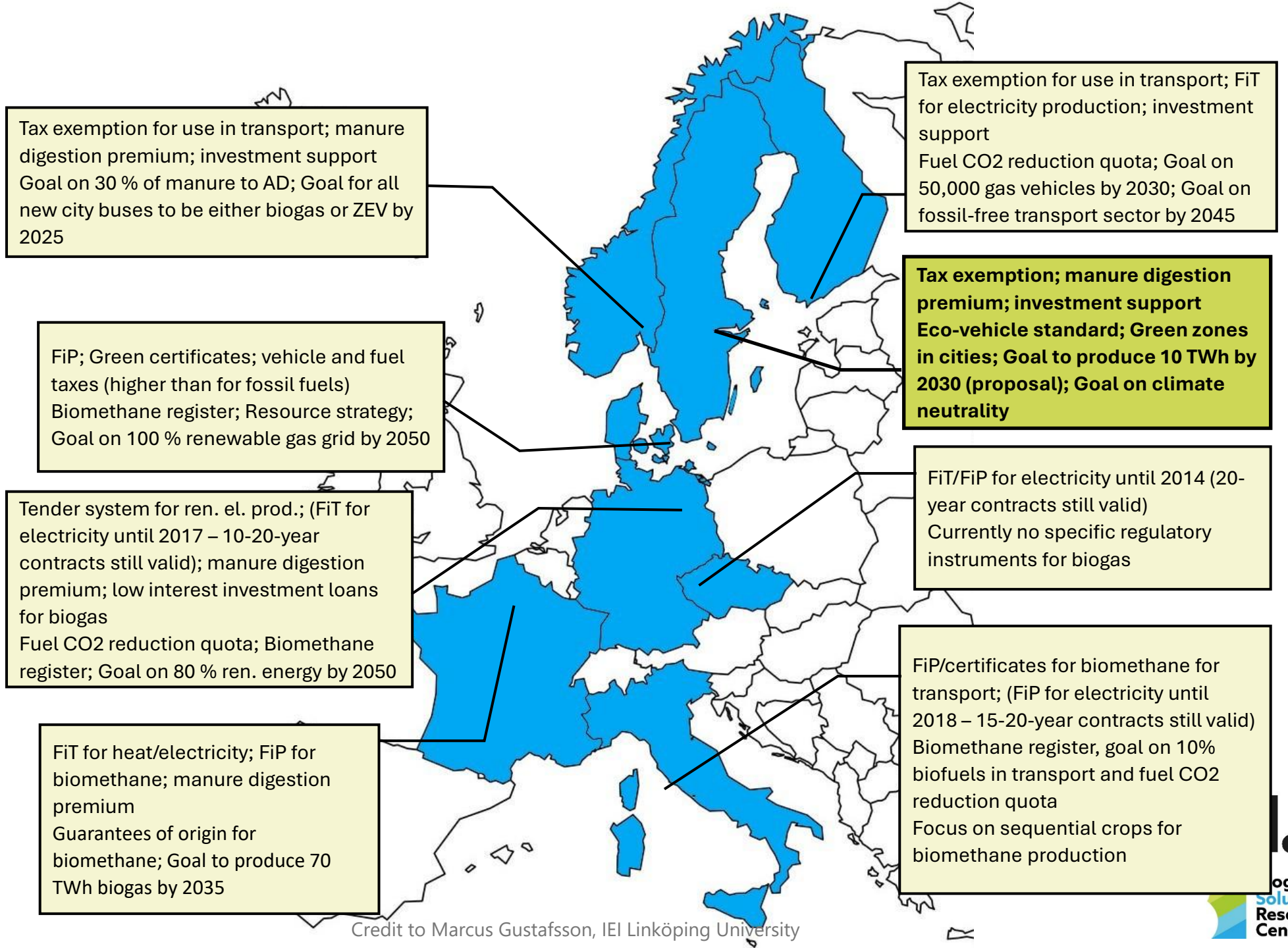

Credit to Marcus Gustafsson, IEI Linköping University

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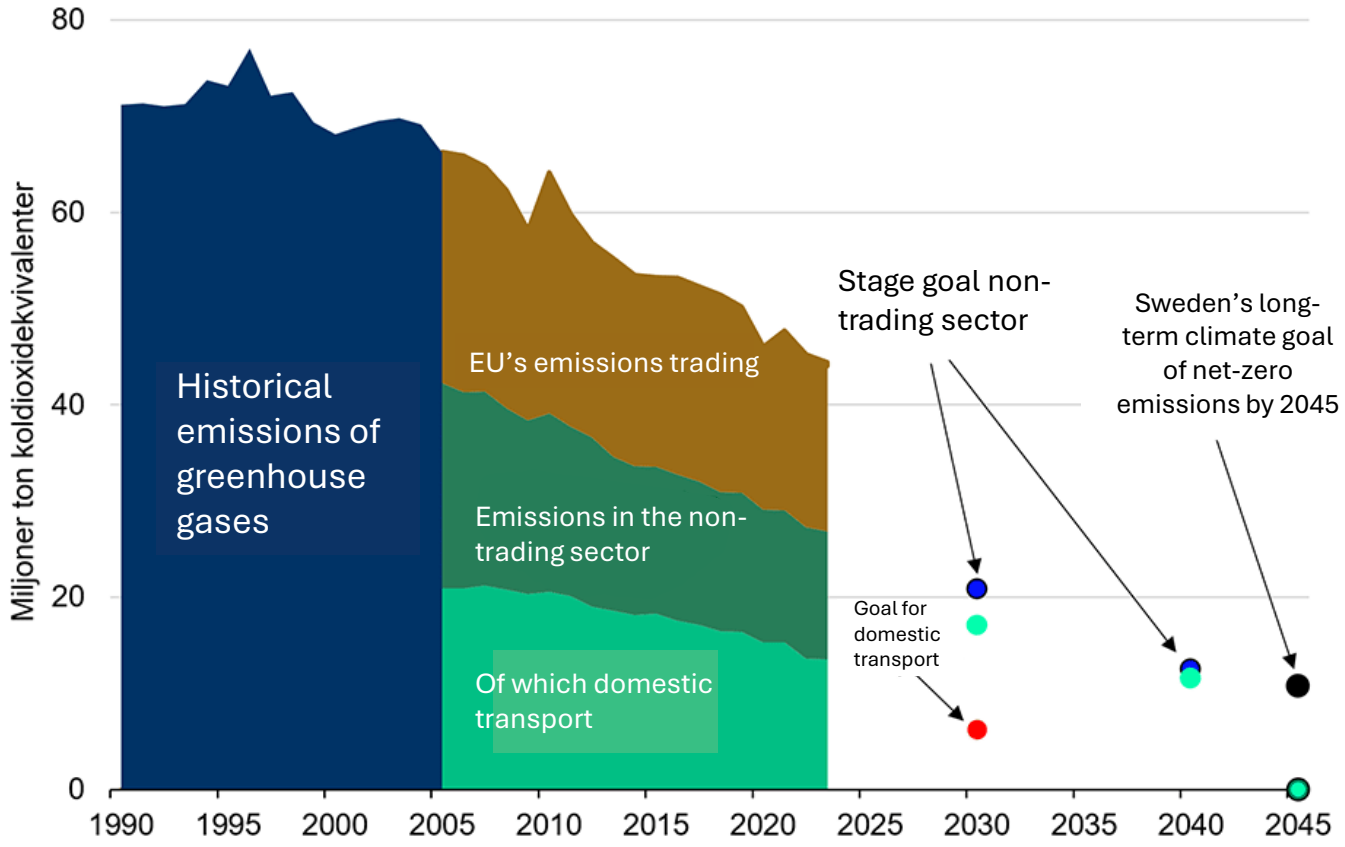
The Climate act from 2018

Climate goals:

- Climate-neutral energy sector 2045
- 100% renewable electricity production 2040
- 70% GHG emission reduction in domestic transport 2030



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Tax exemption and “green gas principle”

Tax exemption

- Biogas used as a motor fuel (compressed or liquefied) **is exempt from both CO_2 tax and energy tax** (that have been high since 1991)
- The same tax exemption applies to biogas used for heat production in boilers or district heating, provided it meets sustainability criteria

“Green gas principle”

- The “green gas principle” is **Sweden’s approach** to handling biomethane (upgraded biogas) injected into the national or regional gas grids.
- It is essentially a **mass-balance or book-and-claim** system that allows for the trading of “green” attributes separate from the physical gas flow.

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Other incentives

- Production support:
  - Biogas from manure up to 0.40 SEK/kWh (0.036 Euro)
  - Upgraded biogas to biomethane up to 0.30 SEK /kWh (0.027 Euro)
  - Liquified biogas up to 0.45 SEK/kWh (0.04 Euro)
- Investment support schemes:
  - Up to 45-65% for CO_2 reducing investments
  - Purchase bonus for HDV, up to 20%

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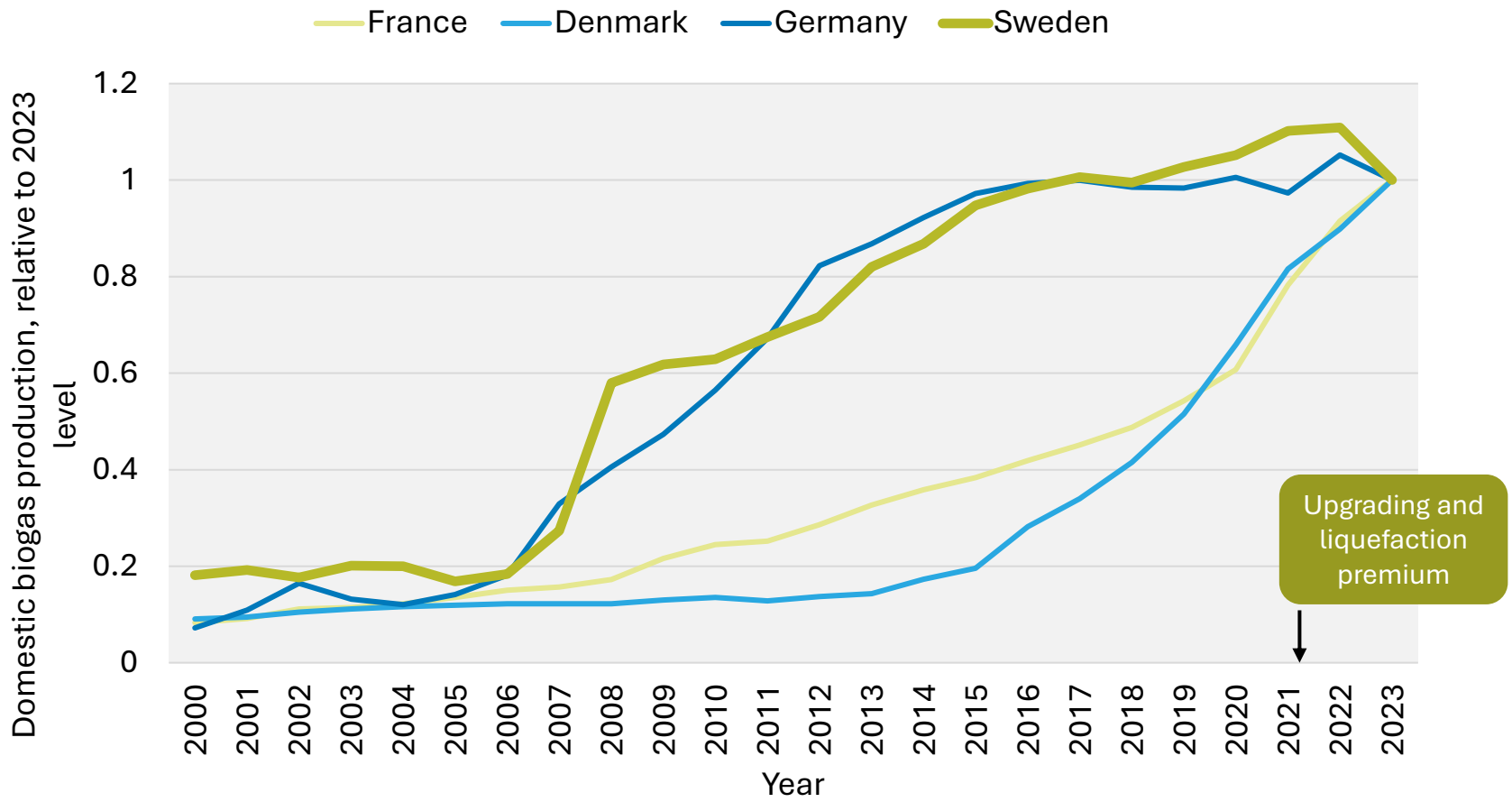
Biogas policies in different countries



(1994)

Energy tax exemption for use of renewable energy

Investment support for biogas plants

CO_2 tax for fossil energy
Investment support for gas vehicles

Manure digestion premium

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Credit to Marcus Gustafsson, IEI Linköping University

Political & Institutional

Challenges

- **Policy Fragmentation**

  Multiple agencies (Energy, Environment, Agriculture) → uncoordinated actions.

- **Short-Term Incentives**

  Frequent policy changes (tax exemptions, feed-in schemes) create uncertainty.

- **Complex Regulation**

  Varying rules on digestate, waste handling, and grid injection.

Drivers

- **Government Climate Goals**

  EU & national targets for greenhouse gas reductions push renewable gas development.

- **Policy Momentum**

  Growing recognition of biogas in Swedish climate/energy strategies.

- **Municipal and Regional Initiatives**

  Local procurement (e.g., biomethane buses) fosters demand.

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Market and Economics

Profitability concerns and High production costs

- Limited profitability, especially in agricultural feedstock-based biogas production
- High production costs as a major barrier to biogas development

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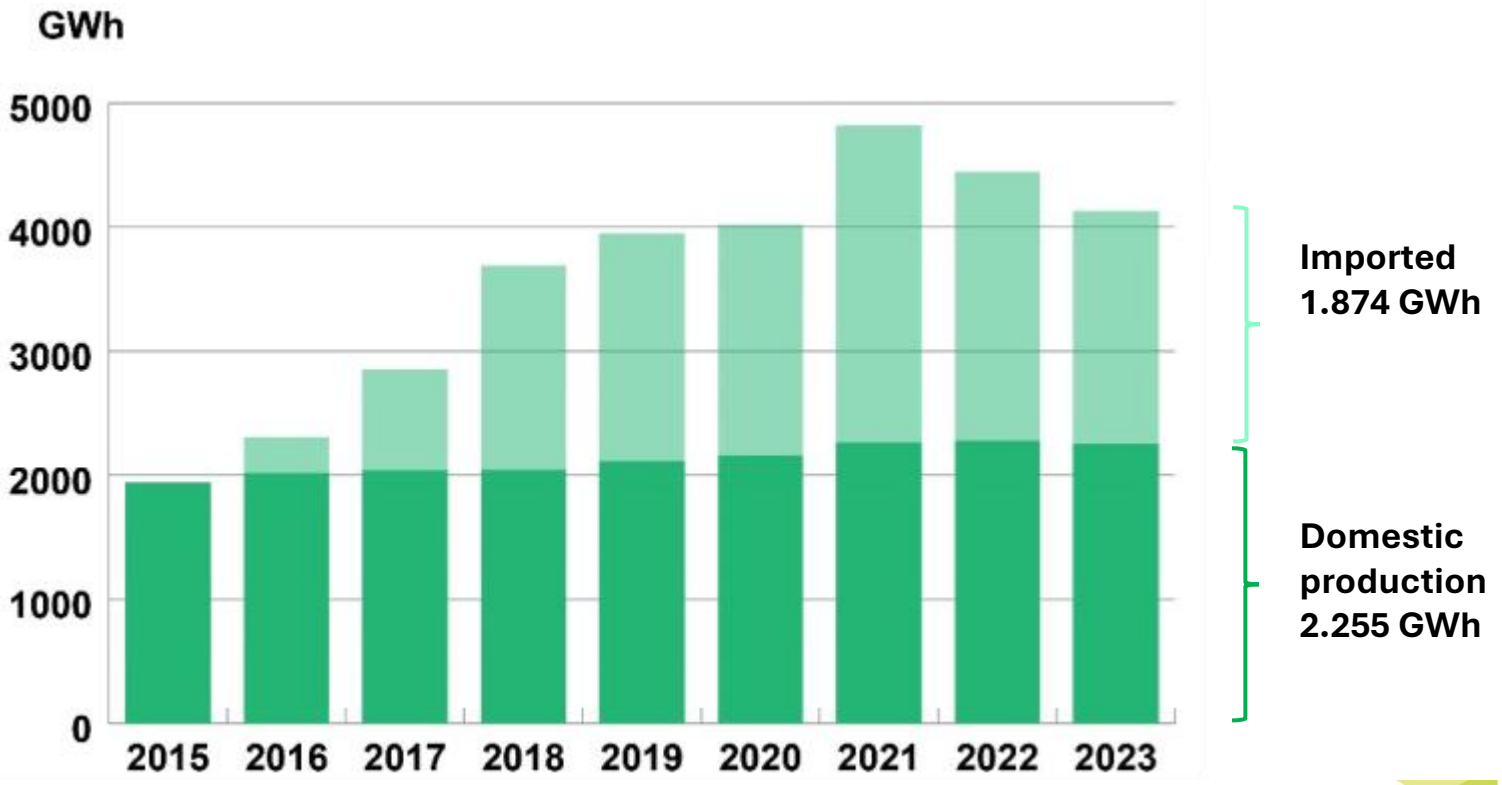
International trade – challenges and opportunities

Use of biogas/biomethane in Sweden



Klackenberg (2024). Produktion av biogas och rötrester och dess användning år 2023, Energigas Sverige.

Credit to Marcus Gustafsson, IEI Linköping University

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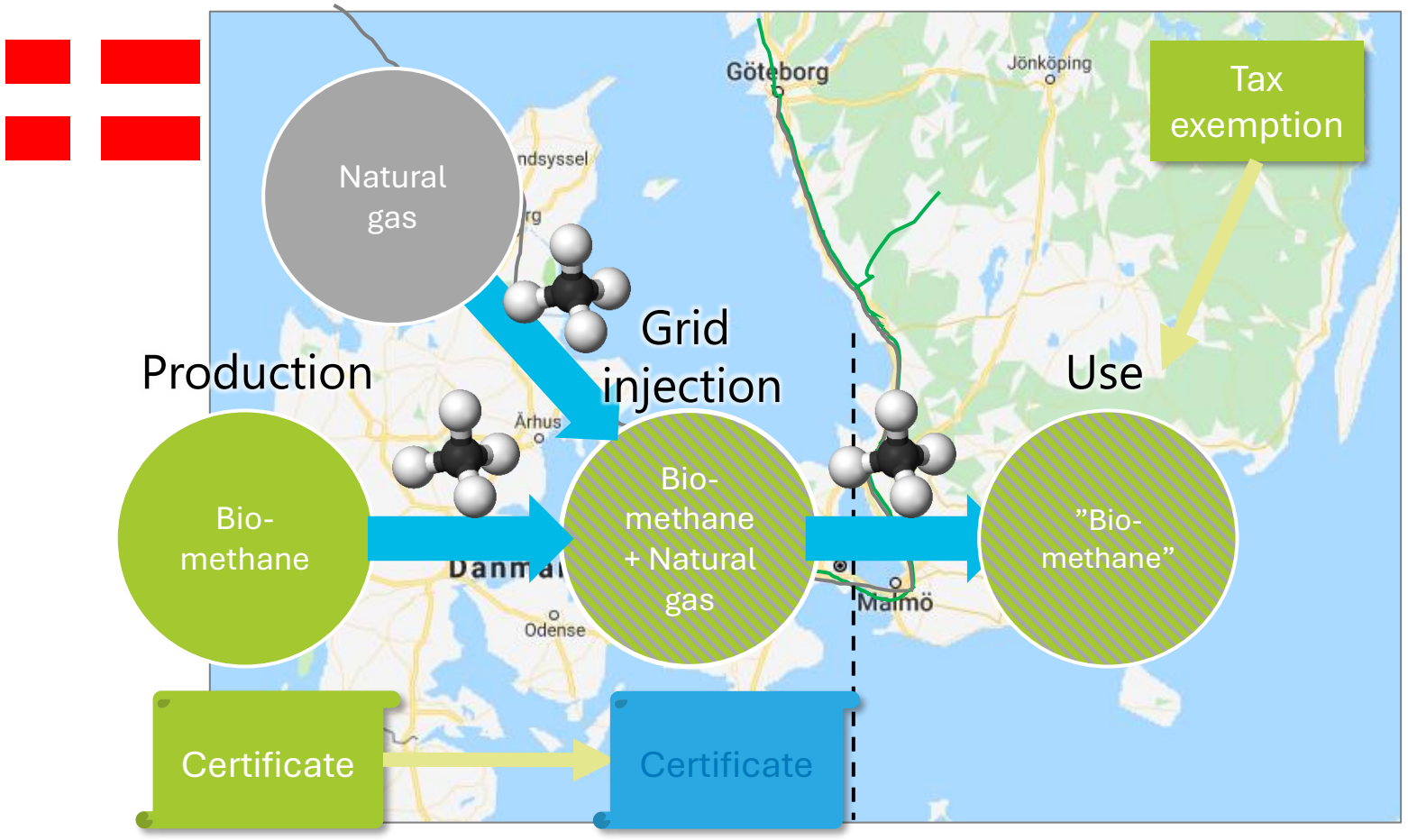
International trade – challenges and opportunities



Although tax exemptions for biogas (primarily used in transport) have driven demand, they haven't always spurred domestic production growth. Instead, Sweden increasingly relies on imports—especially from Denmark, where more predictable investment supports and feed-in premiums are in place.

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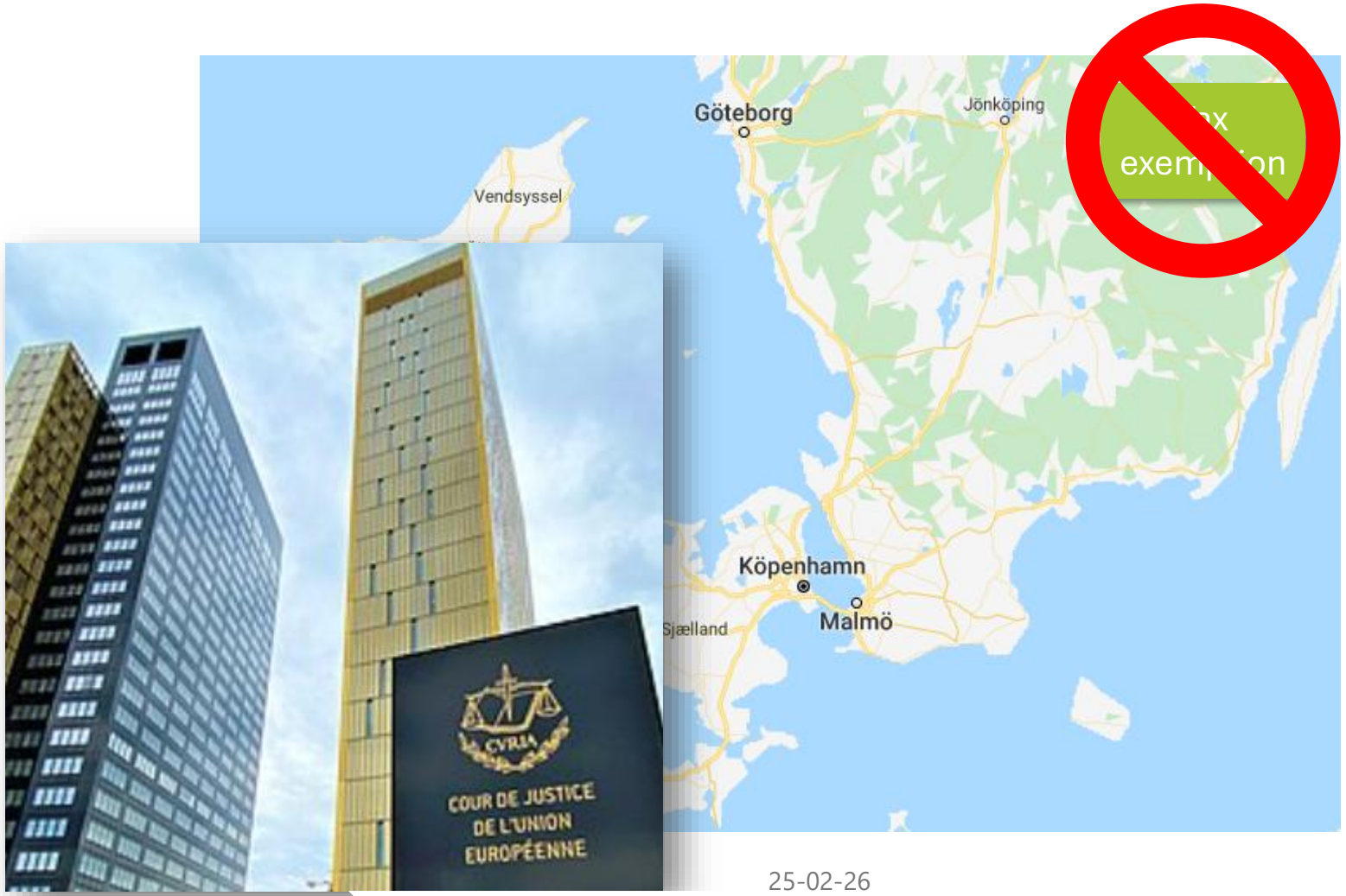
International trade – challenges and opportunities



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Economic & Financial

Challenges

- **High Capital Costs**

  Investment in AD (anaerobic digestion) plants, upgrading facilities, and distribution infrastructure.

- **Volatile Market Conditions**

  Fossil fuel price fluctuations and limited profitability hamper business models.

- **Uncertain Revenue Streams**

  Lack of stable, long-term support leads to investor hesitation.

Drivers

- **Tax Exemptions & Subsidies**

  Existing instruments (e.g., manure digestion premium, partial tax relief) can boost viability.

- **Growing Demand for Green Gas**

  Potential for replacing fossil fuels in transport, industry, heating.

- **Opportunity for Rural Development**

  Farmers can diversify income by supplying feedstock, investing in small-scale biogas plants and producing their own electricity to offset the volatility of electricity prices.

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Technological and Infrastructure

Technological and Infrastructure

Gas supply in Sweden

- Sweden, a small gas user in comparison to other countries
- Limited pipeline infrastructure for gas
- Many off grid solutions and local grids

From: Energigas Sverige

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Technological and Infrastructure

Challenges

- **Limited Gas Grid Coverage**

  Sweden's gas network is concentrated in the southwest; many AD plants off-grid.

- **Digestate Transport & Use**

  Handling and distributing digestate for fertilizer use requires cost-effective logistics.

- **Transport of Feedstock**

  Hauling manure and organic waste over distances can be expensive and environmentally burdensome.

Drivers

- **Local Energy Systems**

  Decentralized plants supplying local heat, electricity, or transport fuel.

- **Emerging Biomethane Corridors**

  Expansion of filling stations for compressed/liquefied biogas fosters demand.

- **Integration with Municipal Services**

  Joint waste collection and energy production can streamline logistics.

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Social & Cultural

Social & Cultural

- Public acceptance?

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Summary of key findings

Policy and Regulatory Framework:

- Lack of long-term strategies
- Bureaucratic barriers
- Regional policy variations

Market Development and Economic Factors

- Limited profitability
- High production costs
- Market competition

Technological and Infrastructure Factors

- Infrastructure limitations
- Site selection challenges
- Production potential

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Thank you for listening!