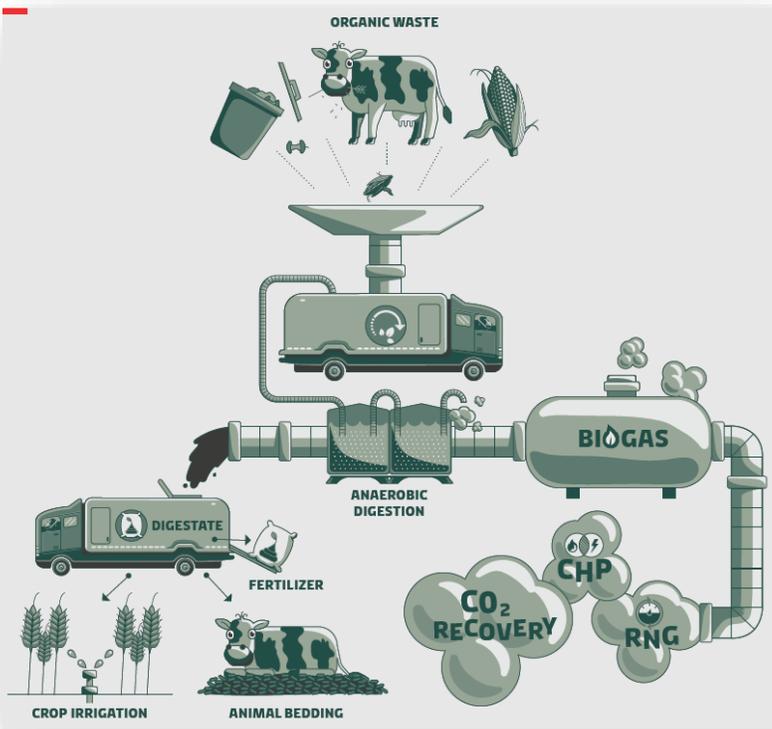




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*Ministry of Foreign Affairs  
of Denmark*



# RNG GROWTH

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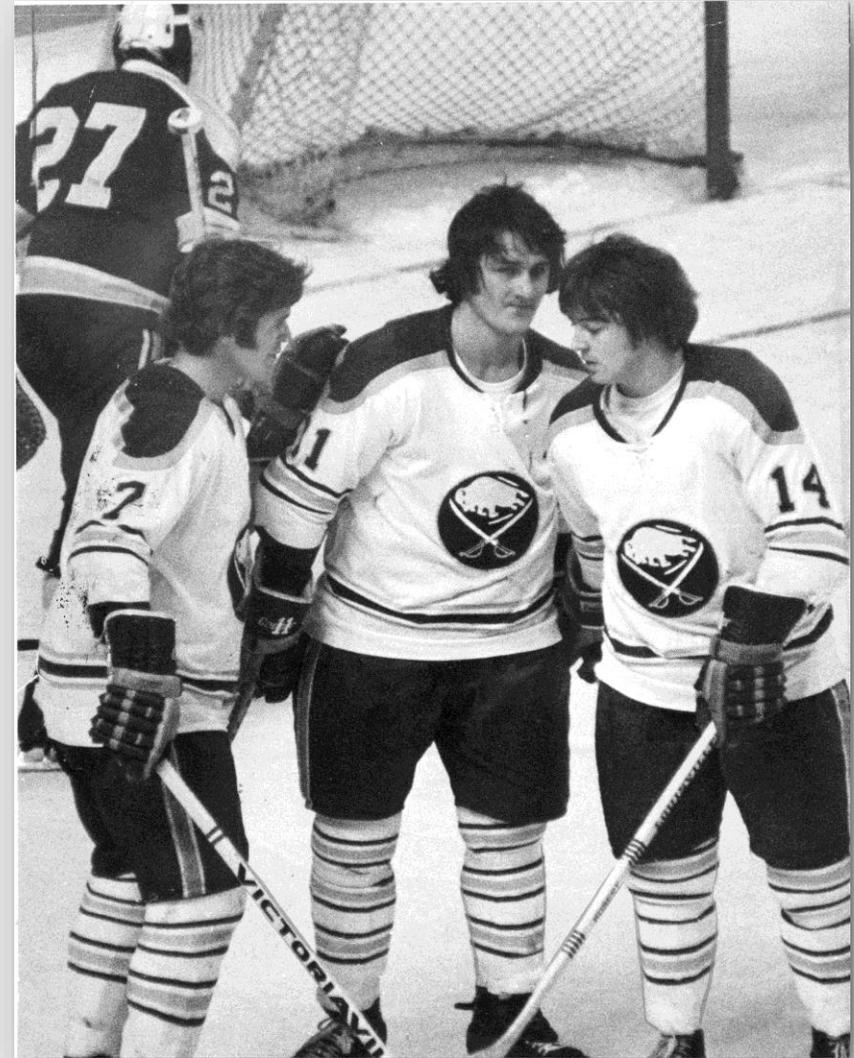
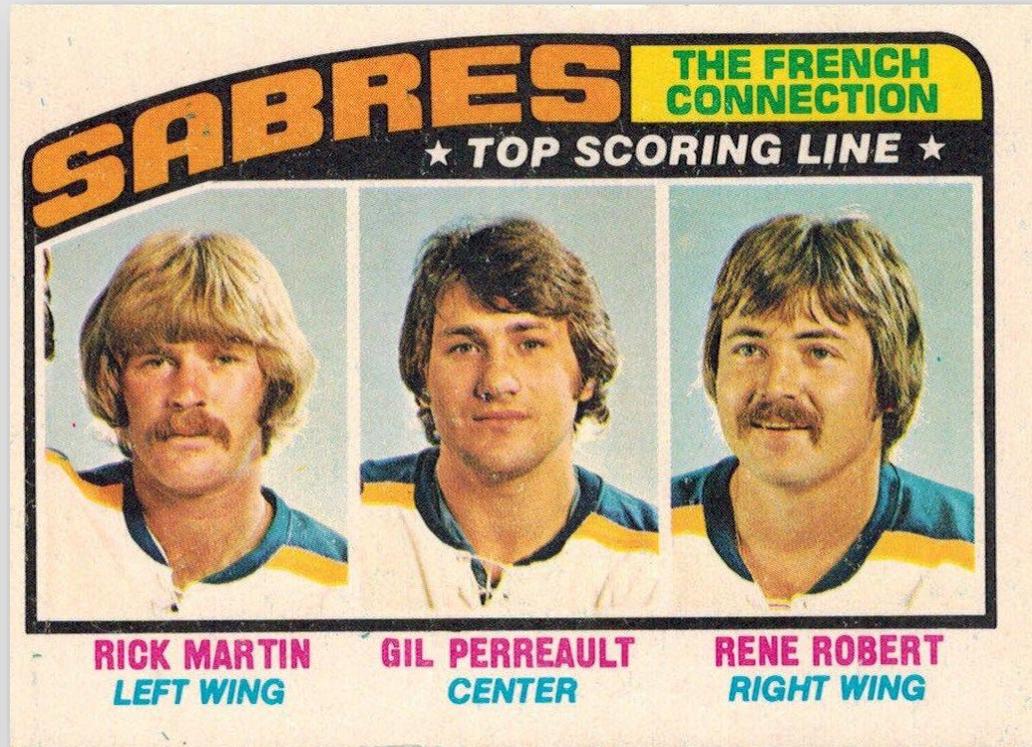
## EXPERIENCES FROM DENMARK

Chris Voell, Head - Waste, Recycling and Biogas

Ministry of Foreign Affairs of Denmark, Trade Council of North America

+1 202-797-5324 / +1 240-877-4745 / chrvoe@um.dk

# MY YOUTH IN BUFFALO – THE FRENCH CONNECTION



Mission: A 'triple helix' approach to facilitate growth of the North American and international biogas markets through knowledge sharing, research, and commercial exchange.



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*Ministry of Foreign Affairs of Denmark*



**Energistyrelsen**  
Danish Energy Agency



# BIOGAS GO GLOBAL- PROJECT TEAM AND ROLES



AGRO  
BUSINESS  
PARK



Facilitating **knowledge sharing** between research environments in Denmark and orchestrating project development workshops with innovation clusters and identify financing to fund innovation projects.

**Government2Government** knowledge exchange of policy frameworks focused on addressing regulatory barriers and positive externalities of biogas production and identify opportunities in third countries.

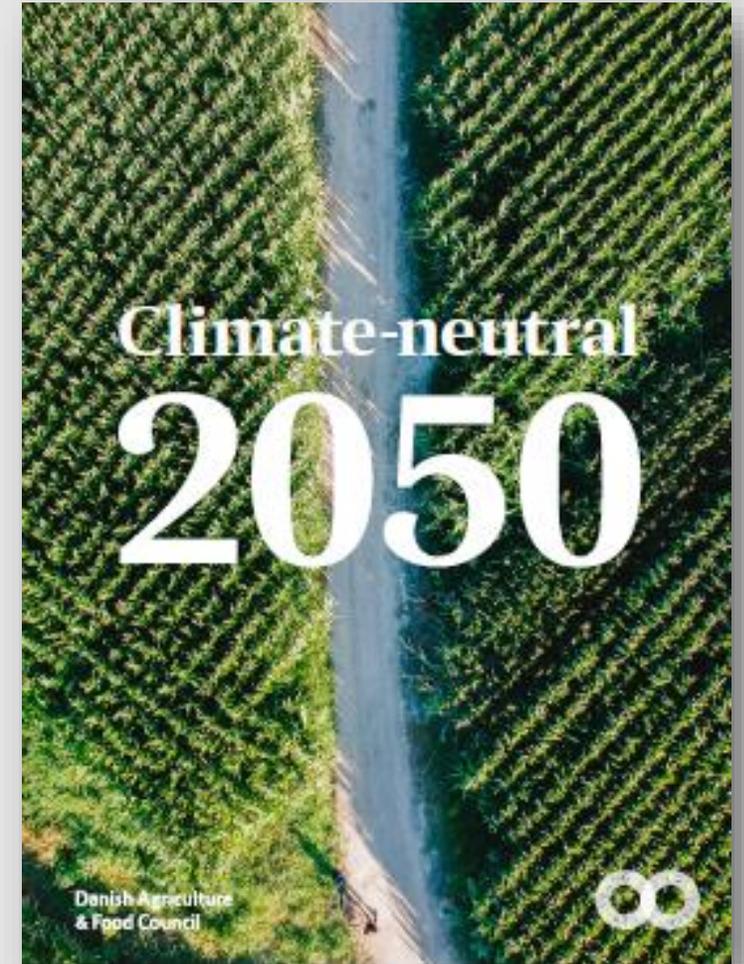
Facilitating and promoting a **Biogas Alliance** that represents complementary competencies and works collaboratively with an aim to unlock commercial opportunities in North America.



# DENMARK – THE CHALLENGES AHEAD

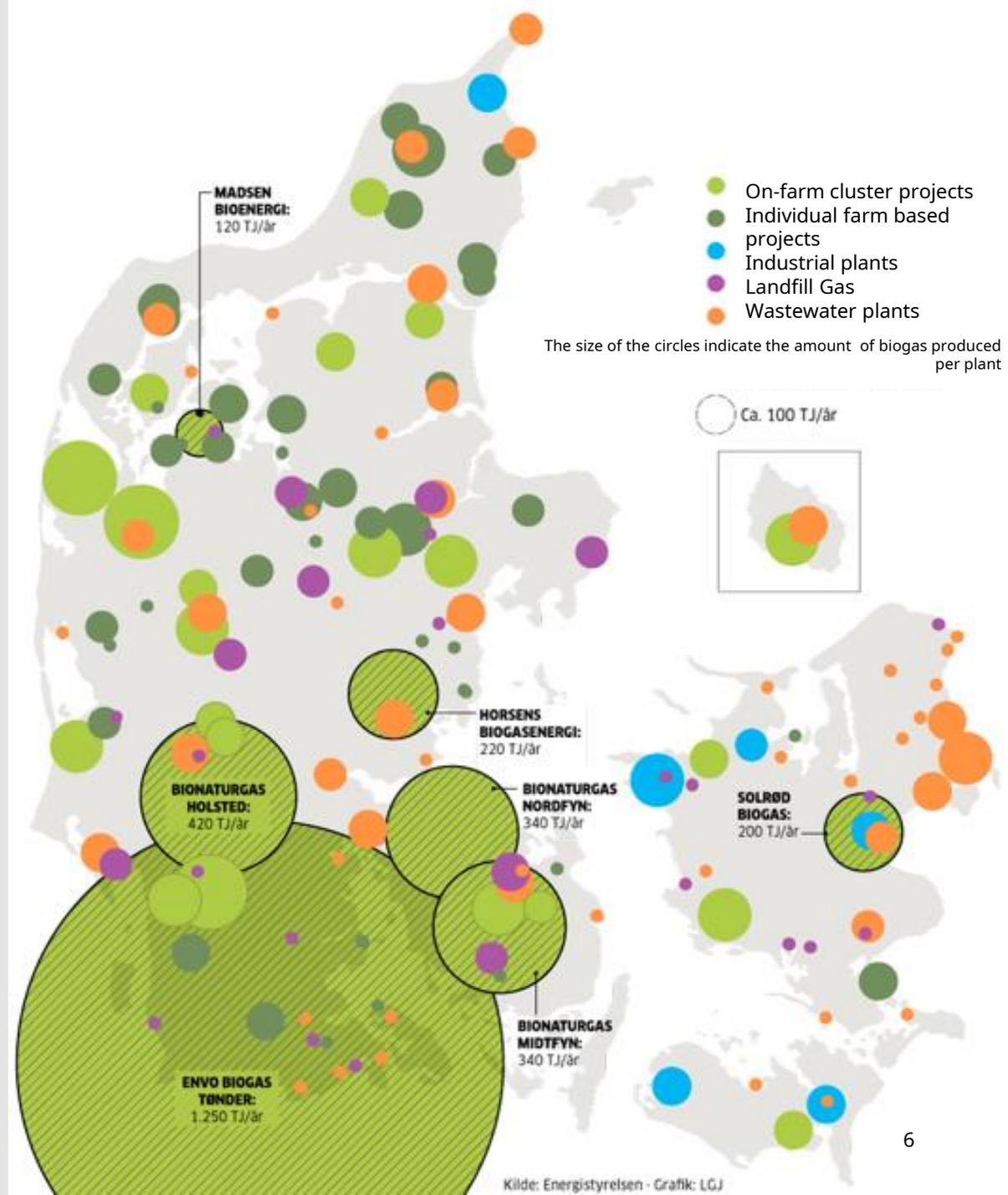
## Climate

- Government:
  - 70% reduction of greenhouse gas emissions by 2030
- Danish Agriculture and Food Council and other companies:
  - Climate-neutral in 2050



# THE 'LAY OF THE LAND'

- Denmark's population: 5.6 million
- Biogas Status
  - ~50 on-farm biogas plants
  - ~50 wastewater biogas plants
  - ~36 centralized biogas plants (largest processing up to 1 million tons/year)
  - 13% food/organic waste → 53 % share of biogas (co-digestion)
- Agricultural Roots
  - 38,800 farmers
  - 575,000 **dairy** cows
  - 62% of land area is cultivated (43,000 km<sup>2</sup>)
  - 12% of total manure is used for biogas production



# EUROPEAN FRONTRUNNER IN RNG

- In 2019 renewable natural gas constituted 11% of the Danish gas consumption.
- 33 plants connected to the natural gas grid.
- RNG mainly produced from manure and waste products biogas.
- Danish RNG in high demand in neighboring countries (Sweden & Germany).
- In 2022 RNG is expected to constitute 30% of the Danish gas consumption

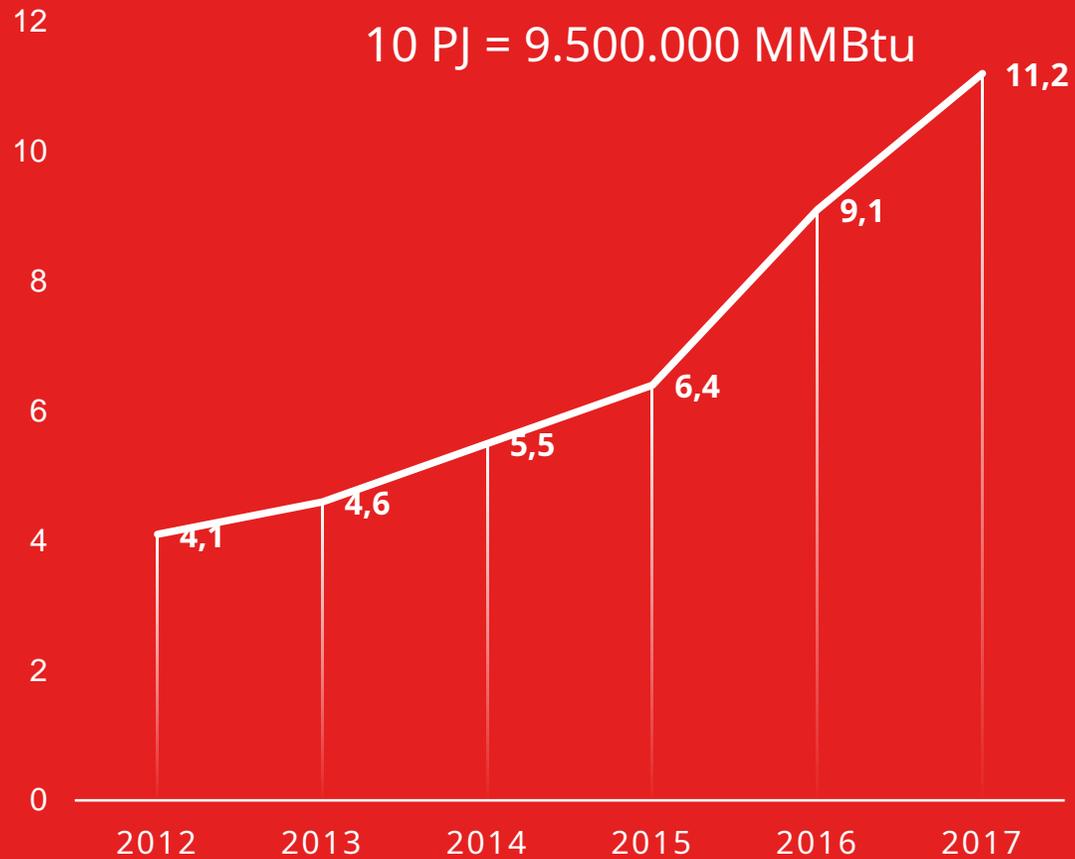
Denmark is the country in Europe with the highest share of renewable natural gas in the gas grid.



# BIOGAS / RNG IS BOOMING IN DENMARK

## PRODUCTION IN PJ

10 PJ = 9.500.000 MMBtu



**11%**  
RNG in  
the grid  
in 2019

**25-30%**  
RNG in  
2023 is  
projected

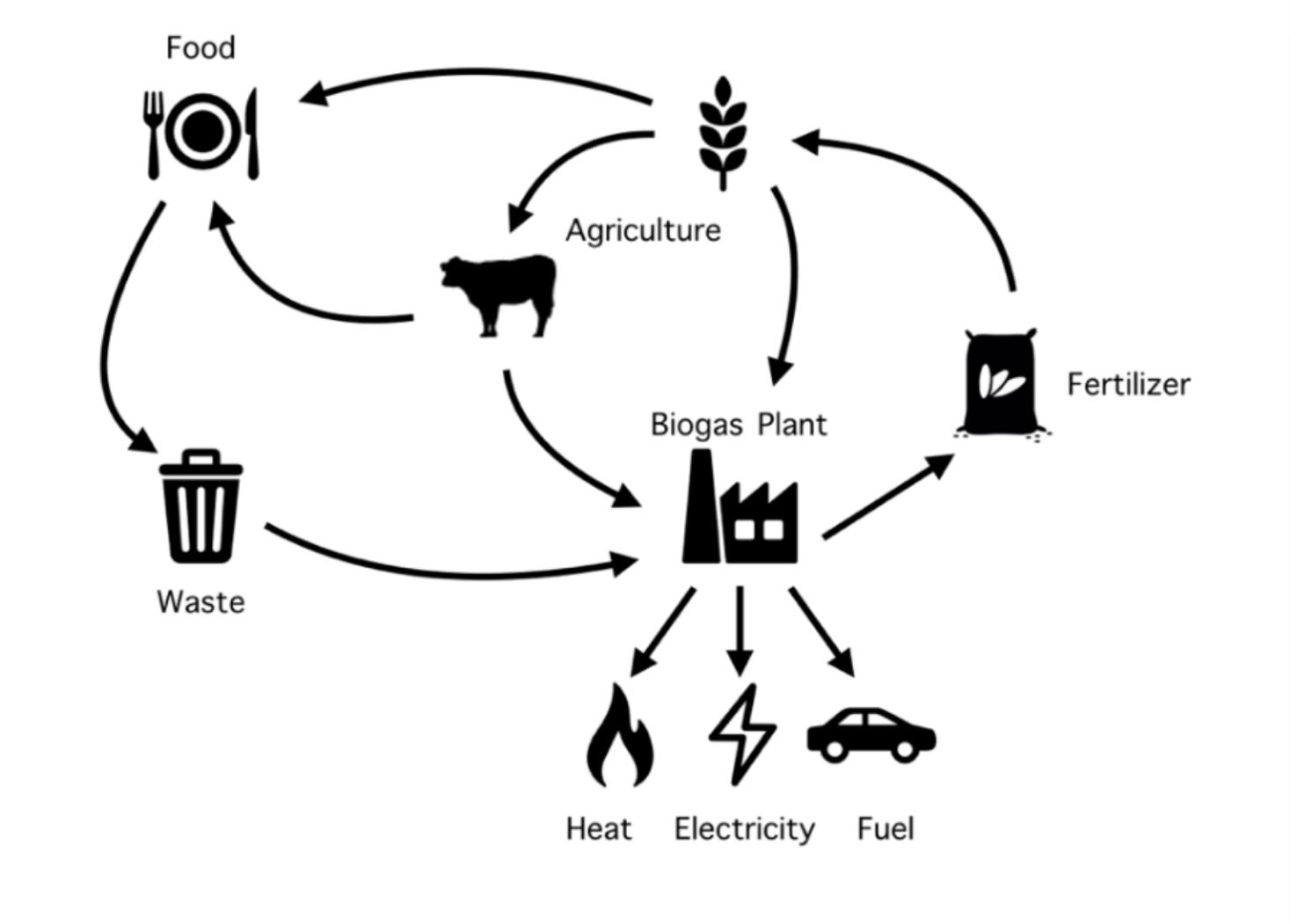
**100%**  
'Green Gas' (RNG,  
hydrogen,  
methanized gas)  
in the grid in 2035  
is technically  
feasible

# BIOGAS GROWTH IN DENMARK

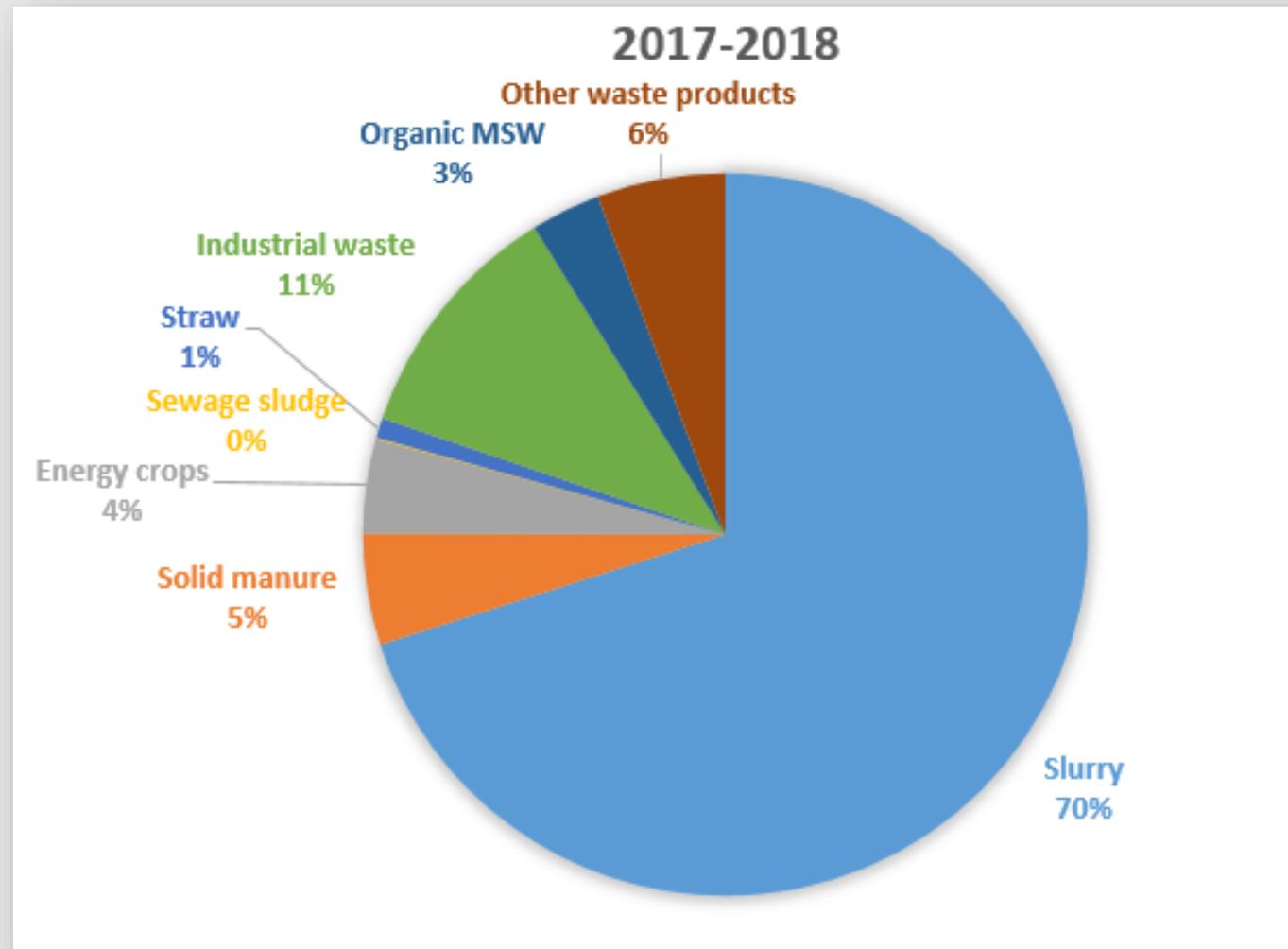
- Why a priority since mid 1980s?
- Transformation of the energy system
  - Reduces imported fuels, increase national energy supply, flexible applications
- Agricultural Waste Management
  - Large livestock population, manure must be land applied, nutrient economics
- Climate impact
- Job creation
- Export of know-how

- How did we get there?
  - Political Initiatives
  - Professionalization of the Industry
  - Energy Infrastructure
  - Value of Biogas – Govt Subsidy
  - Cross-Sector Collaboration
  - Controlling In- and Off-Take
  - Farmer Buy-In

# CLOSING THE LOOP: BIOGAS AS A LINK BETWEEN WASTE, ENERGY AND NUTRIENTS



# CO-DIGESTION: THE HEART OF THE DANISH BIOGAS MODEL



# ADVANTAGES OF CO-DIGESTION ... FROM A BIOGAS PERSPECTIVE

## Enhanced gas production:

- Higher yield per m<sup>3</sup> feedstock adding energy rich organic waste with slurry

## Supply diversity:

- Centralized plants receive wastes from many industries, which is more manageable than digesters on each industry.

## Stable digestion process:

- Co-digestion with slurry makes digestion of waste stable.

## Example of energy properties for different feedstocks

Basic biogas plant (2015)	Input share (by tons)	Methane production (GJ/ton)*	Methane production (% of total)
Pig and cattle slurry	79.8%	0.44	44%
Deep litter	8.0%	2.00	20%
Manure, stable	6.1%	1.57	12%
Straw	0.0%	7.27	0%
Industrial organic waste	1.0%	4.83	6%
Household waste	1.6%	3.41	7%
Energy crops	0.0%	1.5 - 3.5	0%
Other	3.5%	1 - 5	11%
Total	100%	0.80	100%

# ADVANTAGES OF CO-DIGESTION ... FROM A CIRCULAR ECONOMY POINT OF VIEW

## Danish waste regulation:

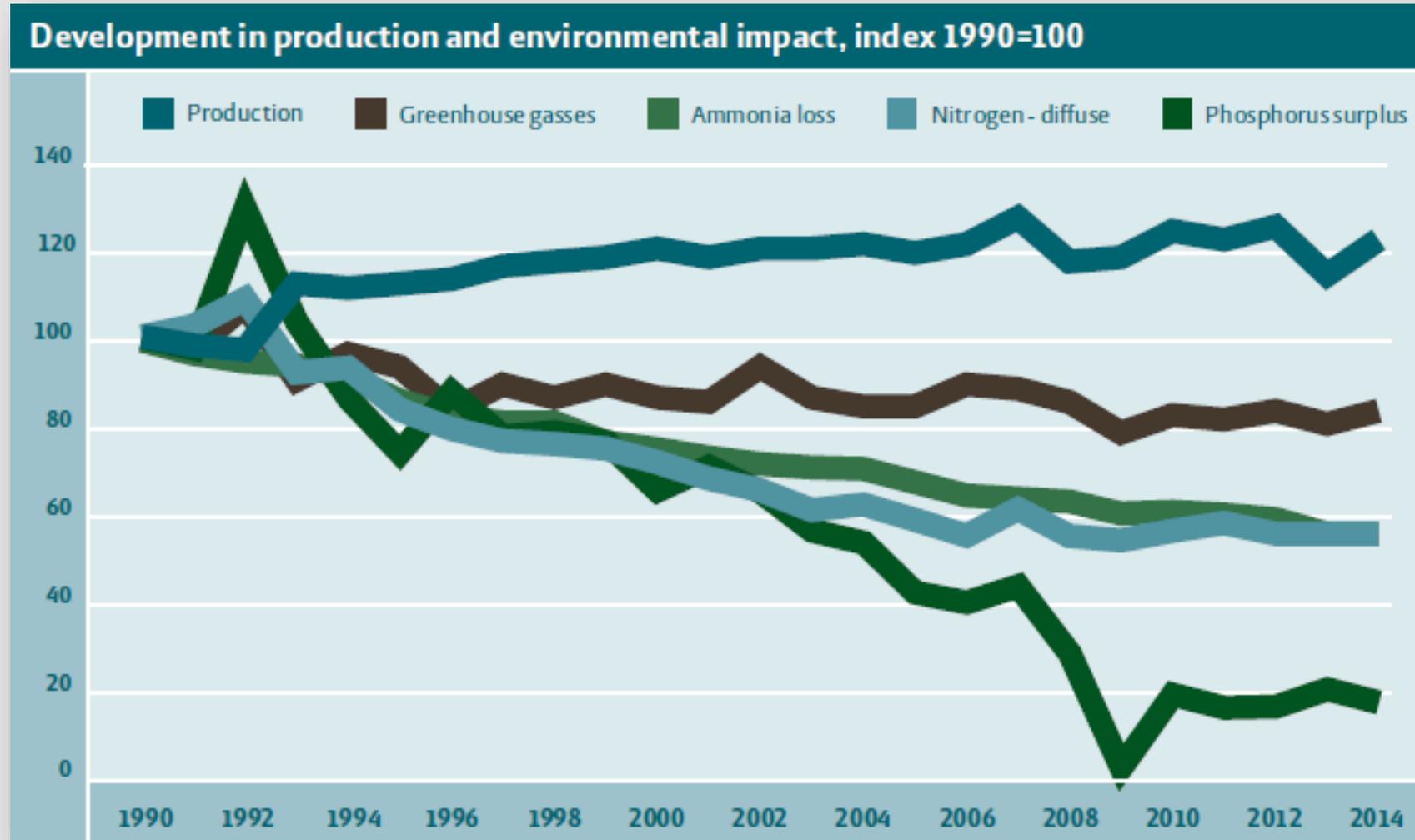
- Ban on organic landfills 1997
- 50% recycling of Danish MSW by 2022
- Waste Hierarchy must be adhered to by 2020
- Danish EPA concludes that MSW-based digestate does not pose health or contamination concern

## ...which incentivizes utilization of MSW for biogas production:

- Fees for food production waste treatment => Co-digestion
- Organic MSW => Co-digestion
- Biogas over incineration
- Recycling of nutrients



# DANISH AGRICULTURE – INCREASING PRODUCTIVITY WHILE REDUCING ENVIRONMENTAL IMPACT



# WHY DENMARK WANTS BIOGAS PLANTS

- Help meet ambitious 2030 climate targets
- Provide source of 'non-electric' renewable energy
  - Decrease reliance on fossil natural gas sources
- Protect valuable soil and water resources
- Diversify revenue sources for agriculture sector
- Produce organic fertilizer for crop production
- Advanced waste management option for food/organic waste streams

# A PATCHWORK OF POLICY DRIVERS AND INCENTIVES

Bio-methane in the grid  
18.1\$/GJ  
Taxes on consumption  
of fossil fuels

Energy  
Agreement  
- Feed in  
Tariffs  
(2012)

Green  
Growth  
Policy  
(2009)

Goal: 50% manure used for biogas  
30% investment grant (max. 7.5 mil  
Euro)

50% of household waste  
for reuse in 2023  
Specific targets at the  
municipal and city levels

Resource  
strategy  
(2013)

National  
Gas Distri-  
bution  
(2019)

"One company - One vision"  
Continued investment in the  
grid

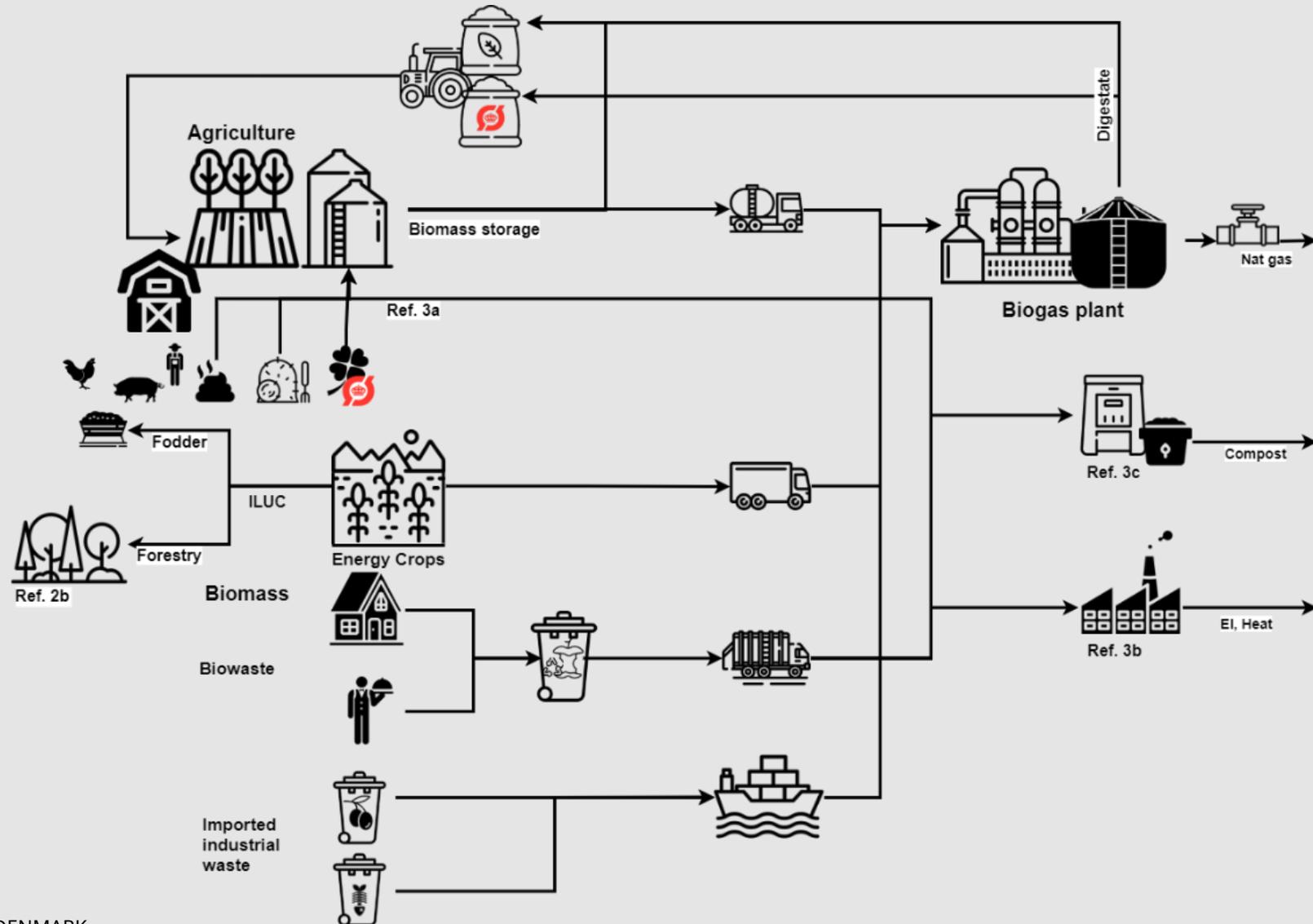
Climate Goal  
From 2020, new buses must be  
CO2 neutral - 8% blending  
requirement with bio-fuel

70 %  
reduction  
in 2030  
(2019)

Energy  
Agree-  
ment  
(2019)

New subsidy scheme pending (~40 mil. \$  
yearly for 20 years)

# DANISH ENERGY AGENCY STUDY - CLIMATE & ENVIRONMENTAL IMPACTS OF BIOGAS



# LOOKING INTO THE FUTURE

- Biogas will continue in Denmark to foster:
    - Green Transportation particularly in heavy duty vehicles
    - Sustainable agricultural production and a healthy rural economy
    - A flexible and reliable energy supply
    - Innovation and export of technologies
- ... and still much work to do!





MINISTRY OF FOREIGN AFFAIRS  
OF DENMARK  
*The Trade Council*

**QUESTIONS?**

Ammongas

Renew  
energy

BIO  
GASCLEAN

GEMIDAN  
FOOD

nature  
energy



## Waste, Recycling & Biogas Advisory

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