GROENGAS NEDERLAND

Outlook & Learnings from a biogas intensive country

Gerd van de Logt

The Netherlands

Introduction by global top 10 listing

- No 4 Population density (countries bigger than 10 million)
- No 1 Tallest people (man & woman)
- No 1 Coffee drinkers

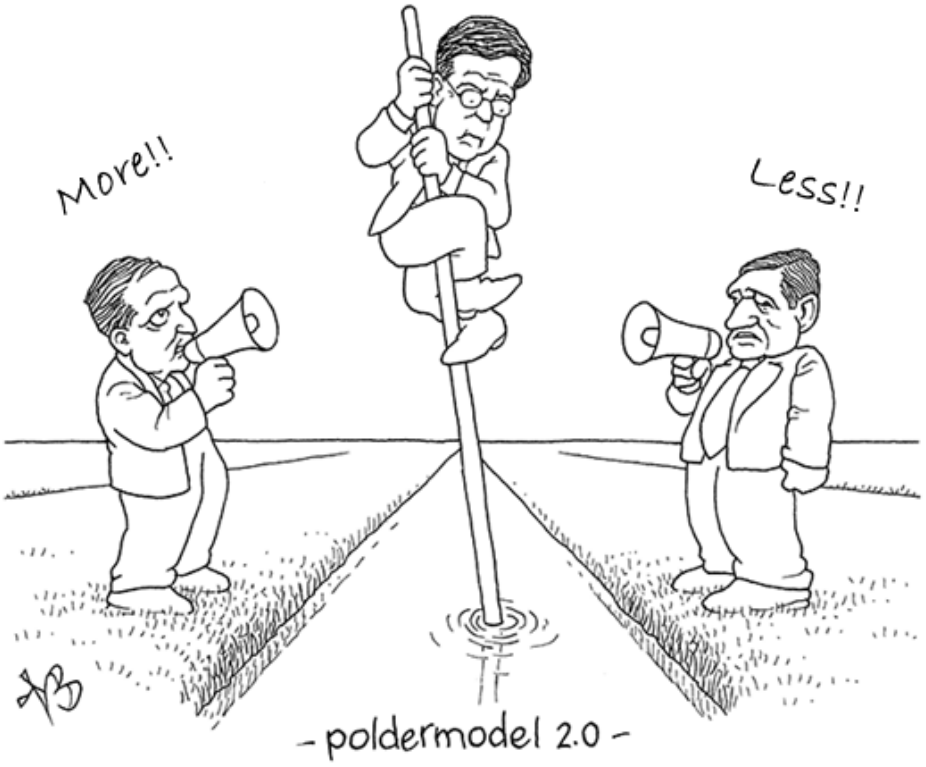
- No 4 Best country to live (The Good Country Index)
- No 1 Best country for children
- No 4 Most generous

- No 4 Highest recycling rates (46%)
- No 1 Lowest level business corruption
- No 4 Innovative (Global innovation index)
- No 3 Highly developed (Human development index)

Groen Gas Nederland (GGNL)

Introduction

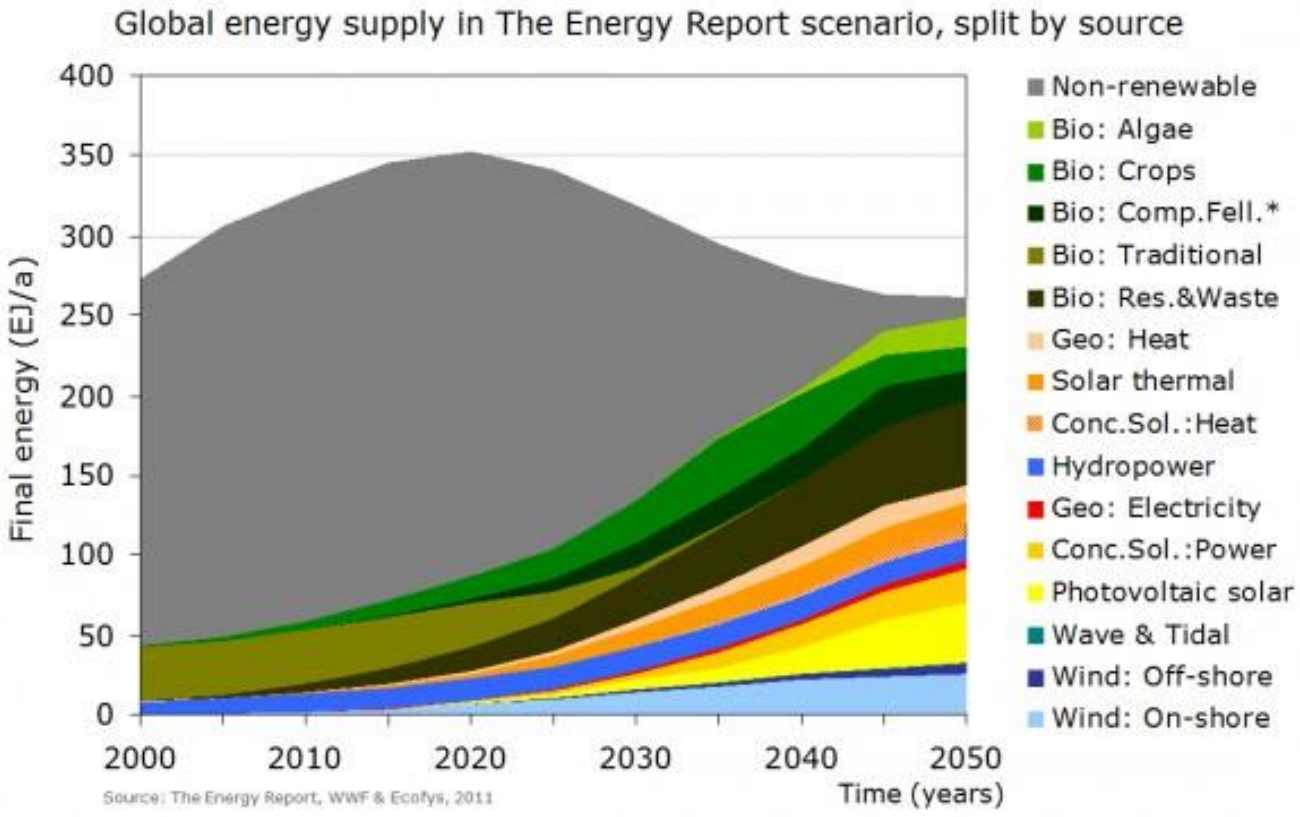
- GGNL started in 2011 to kick off new sustainable market
- Representing >**100 public/private partners** to develop Renewable Gas (RG) chains
- Reflecting the Dutch polder model too: first consensus before accelerate…..



Dutch sustainability targets

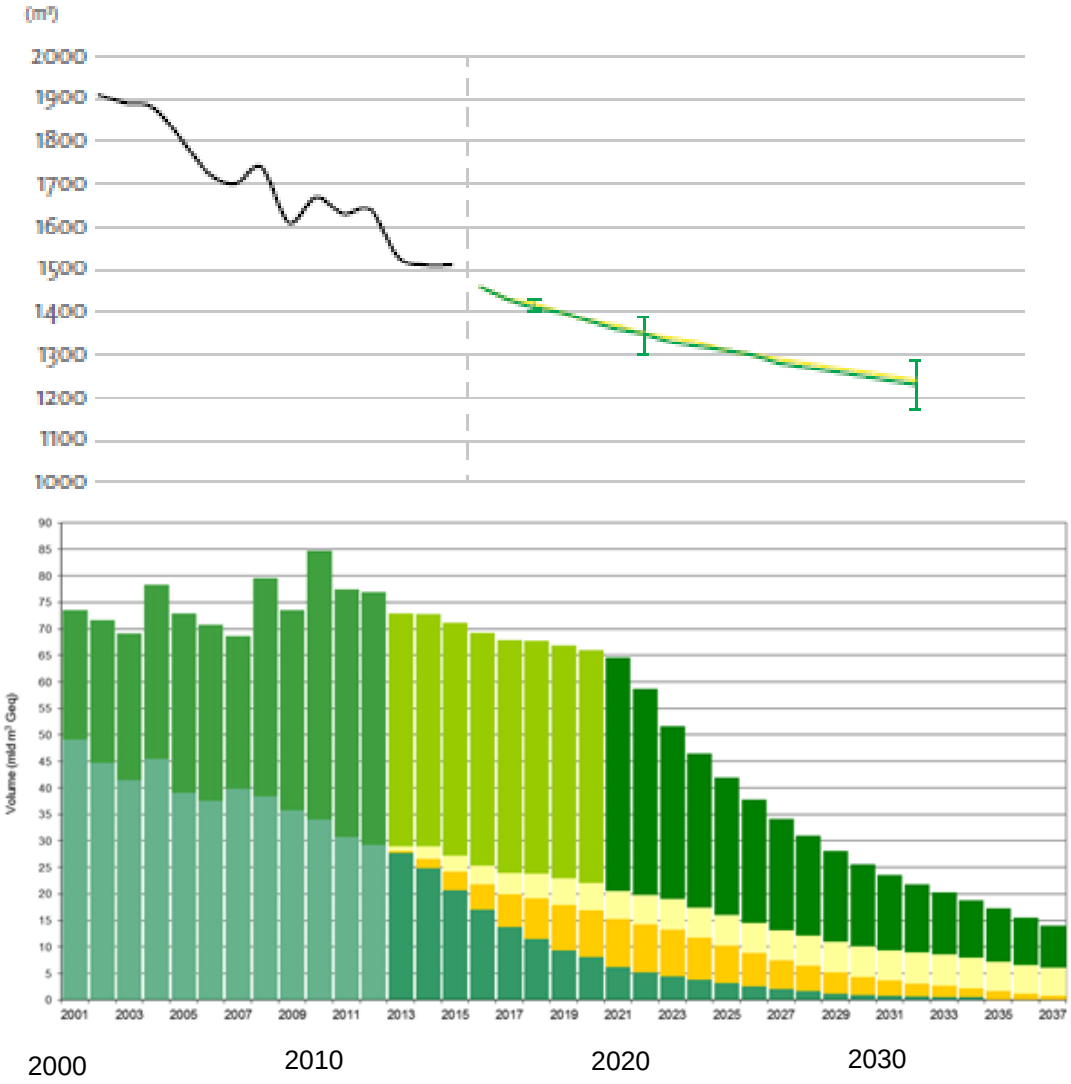
Introduction

- In 2023 16% of energy production should be renewable (350 PJ); in 2030 27%
- In every (global) scenario biomass will be dominant (40-60%)
- Today we are at **5,8%** and lacking behind in Europe (…like always we will accelerate…..)



Setting the scene for gas

Rapidly changing in NL



Average gas usage per household (Netherlands)

- New buildings no gas grid
- Gas in transition

Source: Nationale Energieverkenning

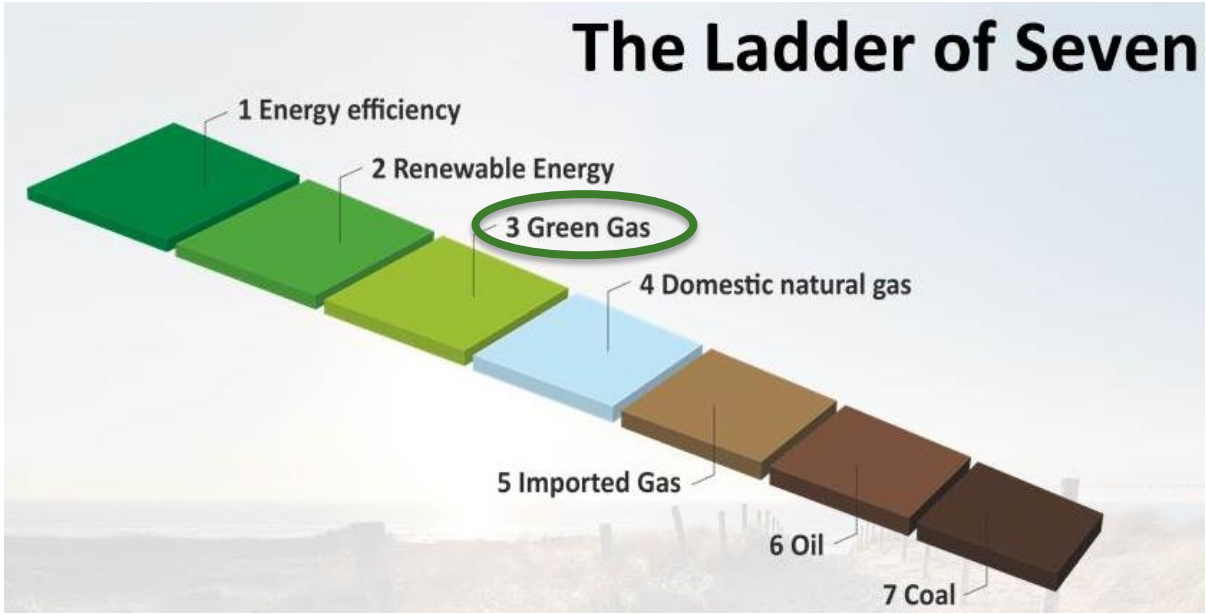
Dutch gas production, Netherlands no3 gas producer in EU (Russia no1, Norway no2)

- From 85 to 15 billion Nm3 py in 25 yrs
- More footprint if imported
- What about renewable gas?

Source: nlog.nl

Setting the scene

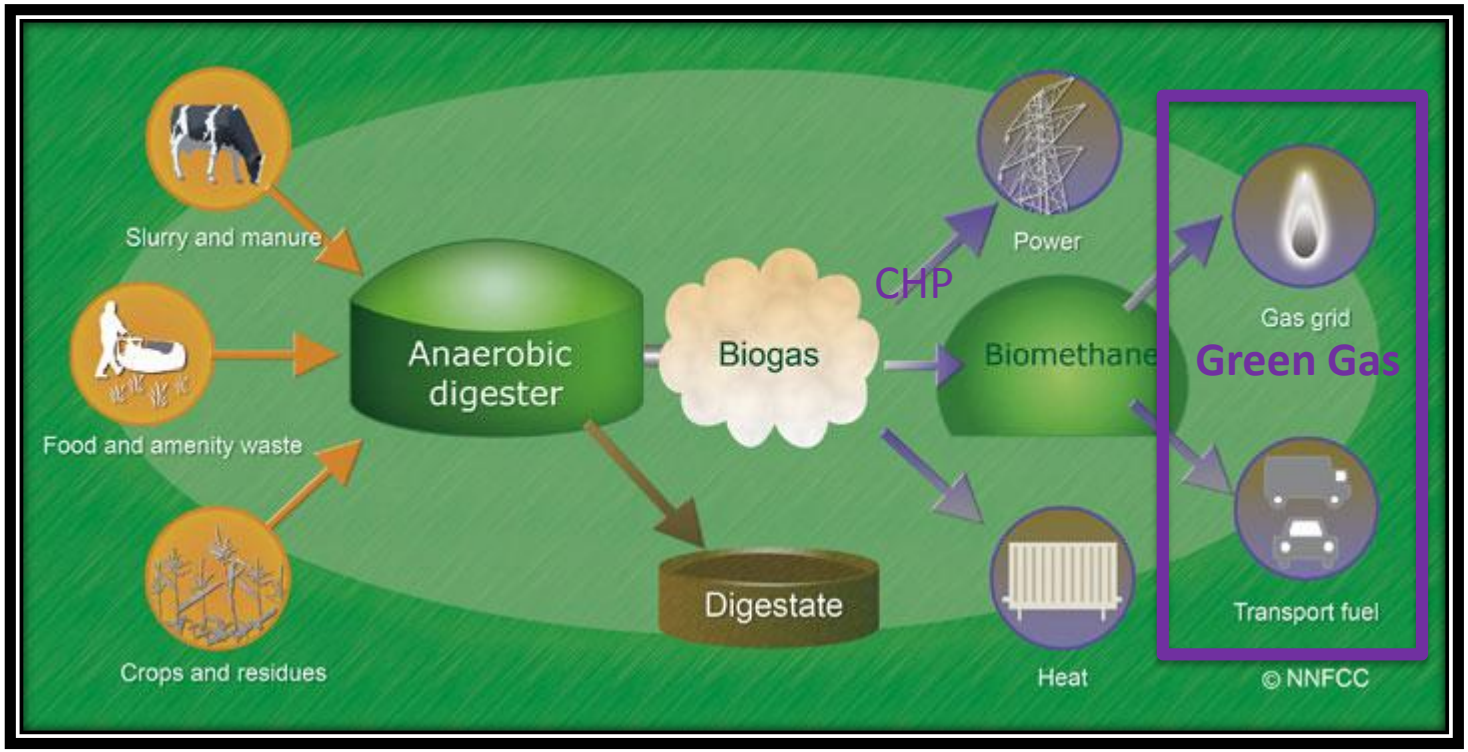
Position of gas in the transition (sequence of preferred energy options)



Source: NOGEPA, September 2015

What is green gas?

Biogas upgraded to natural gas quality (bio-methane)



Biogas in the Netherlands

Drivers for biogas and bio-methane (green gas)

Manure issue Netherlands

- How to grow our dairy business within sustainable criteria (NL is a dairy giant)
- Manure creates a lot of carbon footprint (incl. methane emission)
- Fermentation is the sustainable way to go

Netherlands is no3 gas producing country in EU

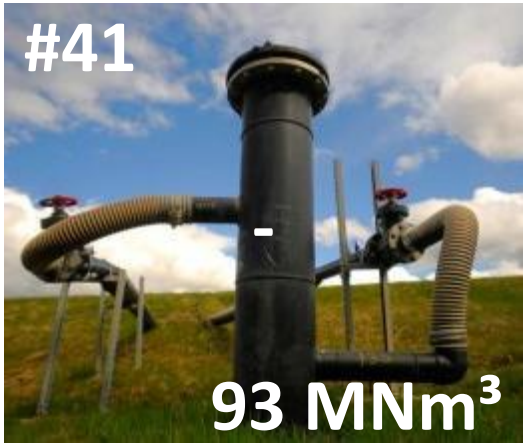
- How to replace gas with sustainable options?
- Electrification not fitting all sustainable needs (peak/offpeak, high temperatures etc.)
- Bio-methane more energy efficient (>65%) than biogas to power (35-55%)

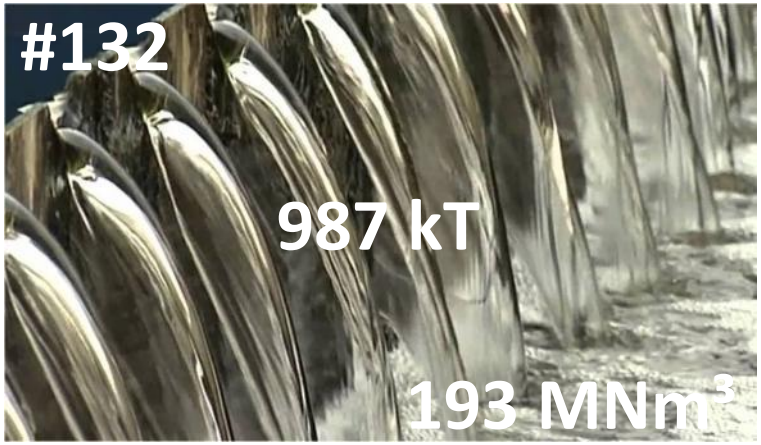
>99% of Netherlands is connected to gas grid

- How to continue with gas grid?
- How to scale up with new technologies beyond fermentation?
- Biomass natural partner (baseload) of gas (>50% is biomass in sustainable mix scenarios)

Biogas in the Netherlands

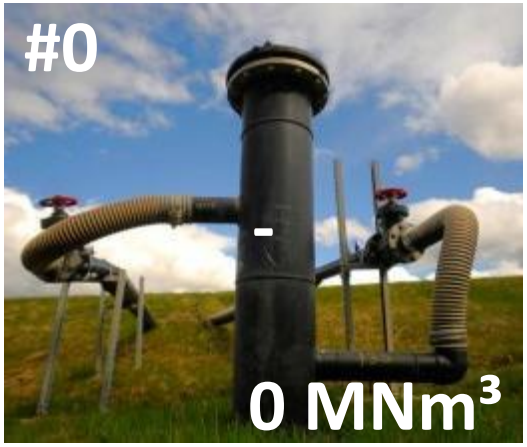
Overview 2012, 302 sites, mainly producing power

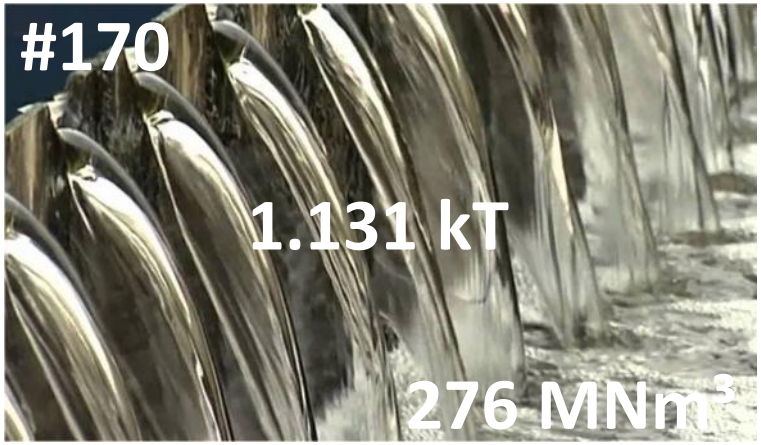




Biogas in the Netherlands

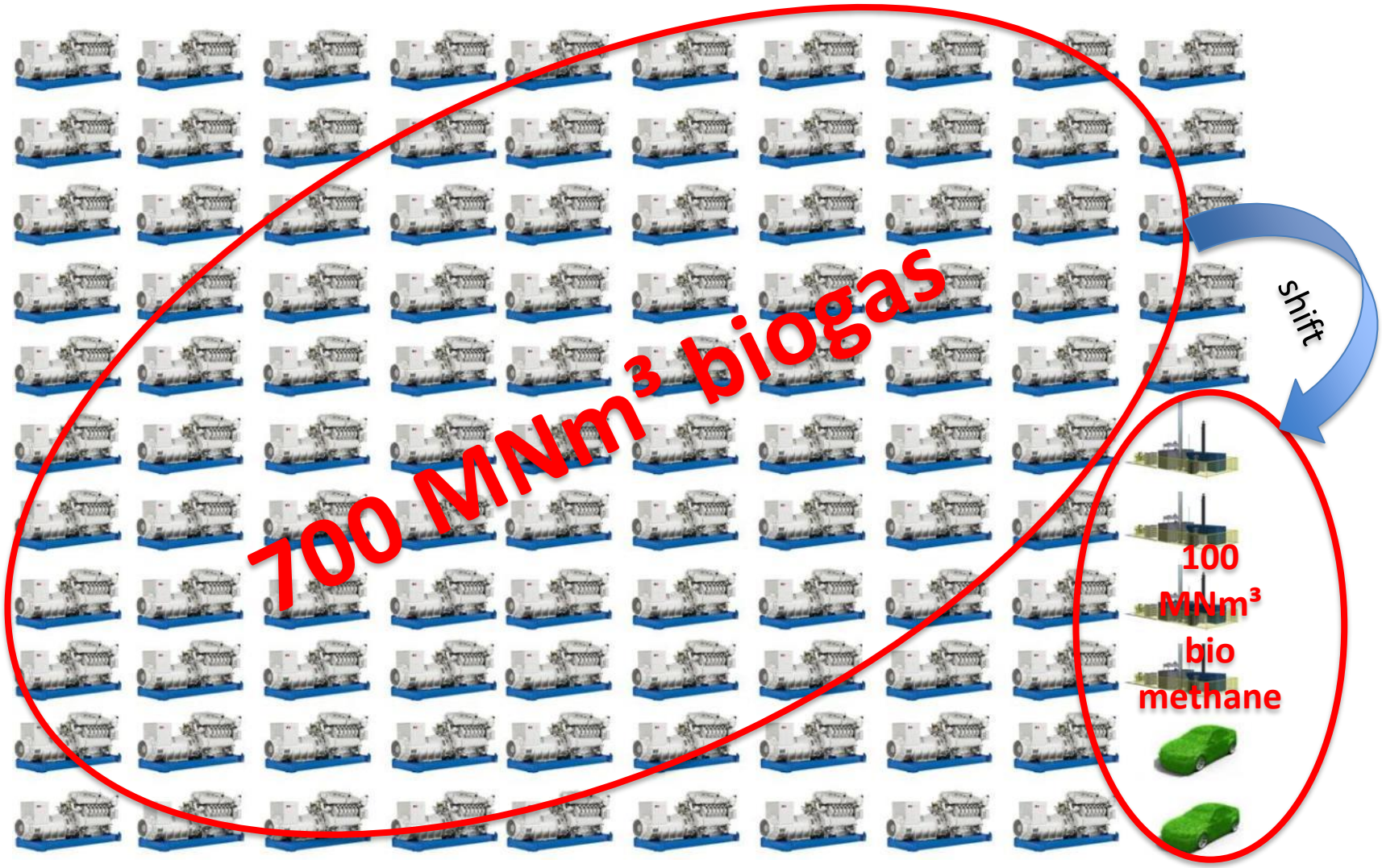
Potential 2020, 1280 sites, producing power + biomethane (green gas)





Biogas in the Netherlands

Today shifting to bio-methane, from CHP to upgrading biogas (green gas)



International trends Renewable Gas

For biogas and biomethane

NL - Biogas/biomethane starting to grow in the Dutch mix

- Biogas captures scalable technologies for growth potential after 2023
- Market now producing 100 million Nm3 biomethane , equals Wind Offshore Volumes (0.8 TWh)
- Horizon: in 2050 > 50% of natural gas replaced by renewable gas ?? (5-10 billion m3)

EU – Biomethane roadmap

- Shifting from biogas (producing power) to bio-methane (NL / Italy paving the way)
- In 2030 10% of natural gas replaced by renewable gas, equals 50 billion Nm3 (EBA)
- In 2030 renewable gas equals green power volumes

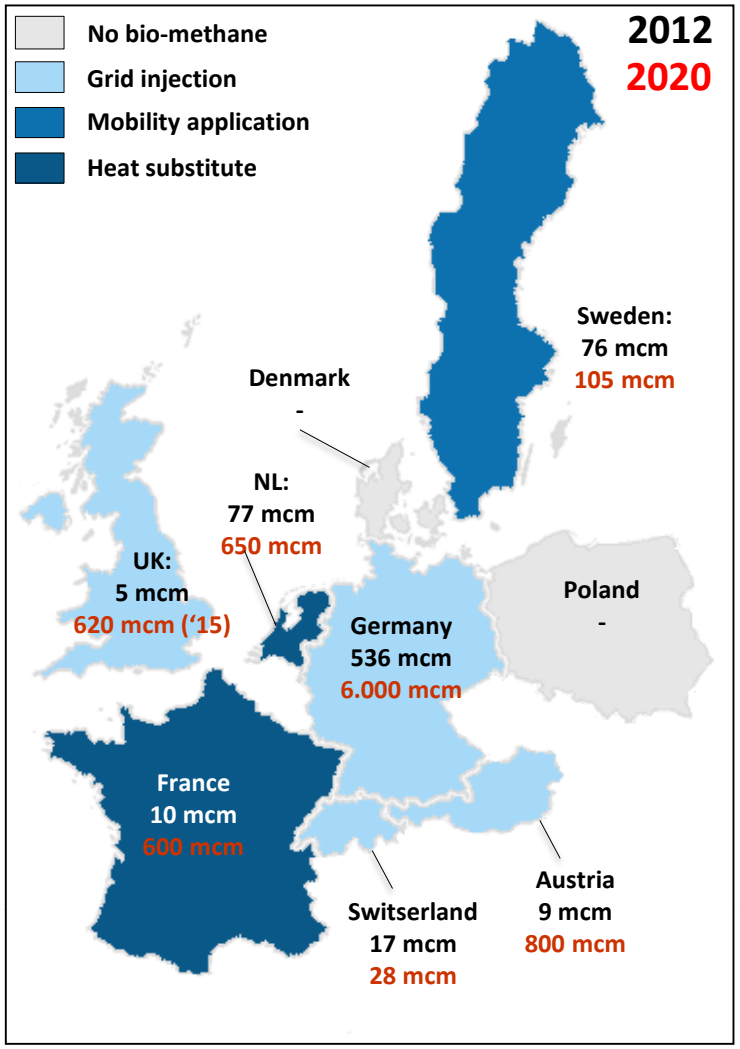
US – Biogas roadmap

- US currently 2000 biogas sites, could grow to 13000 sites
- Potential of biogas energy: 100% sustainable energy for 3 million households
- No focus yet on biomethane and RG technologies that might substitute natural gas

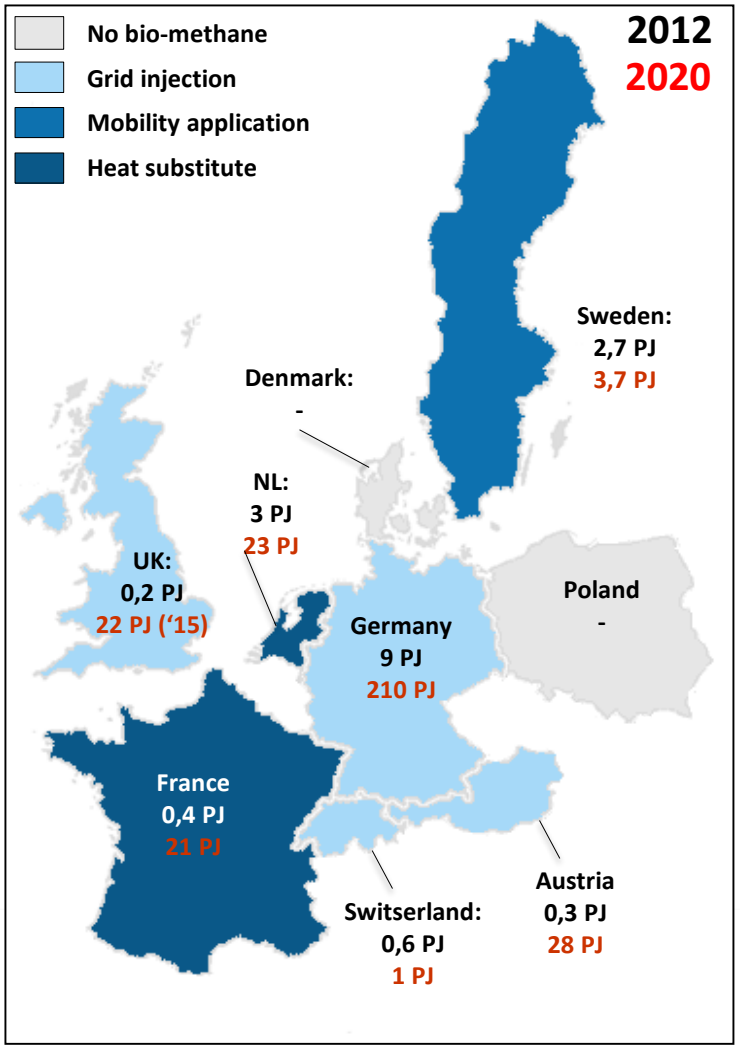
Bio-methane in Europe

First 2020 targets: 10 bcm already, potential 25 bcm (EBA)

Production 2012 Target 2020 (Nm3)



Production 2012 Target 2020 (PJ)



Challenges

Enough barriers

Biomass

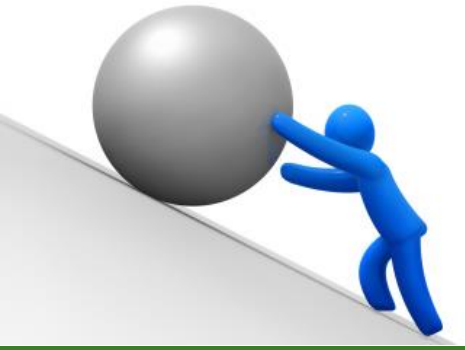
- Volatile biomass prices
- Opportunistic biomass traders
- Not enough availability of co-products

Operation

- Combination of biochemistry & gasupgrading (complex compared to a windmill)
- 24/7 focus needed (farmers not ready for focus for this extra job)
- Complex to upgrade biogas to biomethane (different interacting business cultures too)

Finance

- Rabobank (agri focus) very conservative now (recovering from their own crisis)
- Lots of failures in the past, now cherry picking
- If you do not own the biomass ….hard to finance…



Development Biogas

Innovation roadmap & learnings

VALORISATION

FERMENTATION 1.0
(2003 - 2011)

Biogas to power
Small scale/ hobby farmers
Subsidy volatile
Volatile biomass prices
Lots of failures

FERMENTATION 2.0
(2011 - 2020)

Biogas to bio-methane
Professionals enter market
More scale/ size
Subsidy with a cap
Biomass sourcing 70% LT
Controlled circulation

FERMENTATION 3.0
(> 2018)

Shift to bio-refinery
Shift to syngas
Shift to bio-based economy
Industrial scale

TIME

Dutch support for sustainable energy

Various instruments to cover capex or opex

Innovation Budget (capex support)

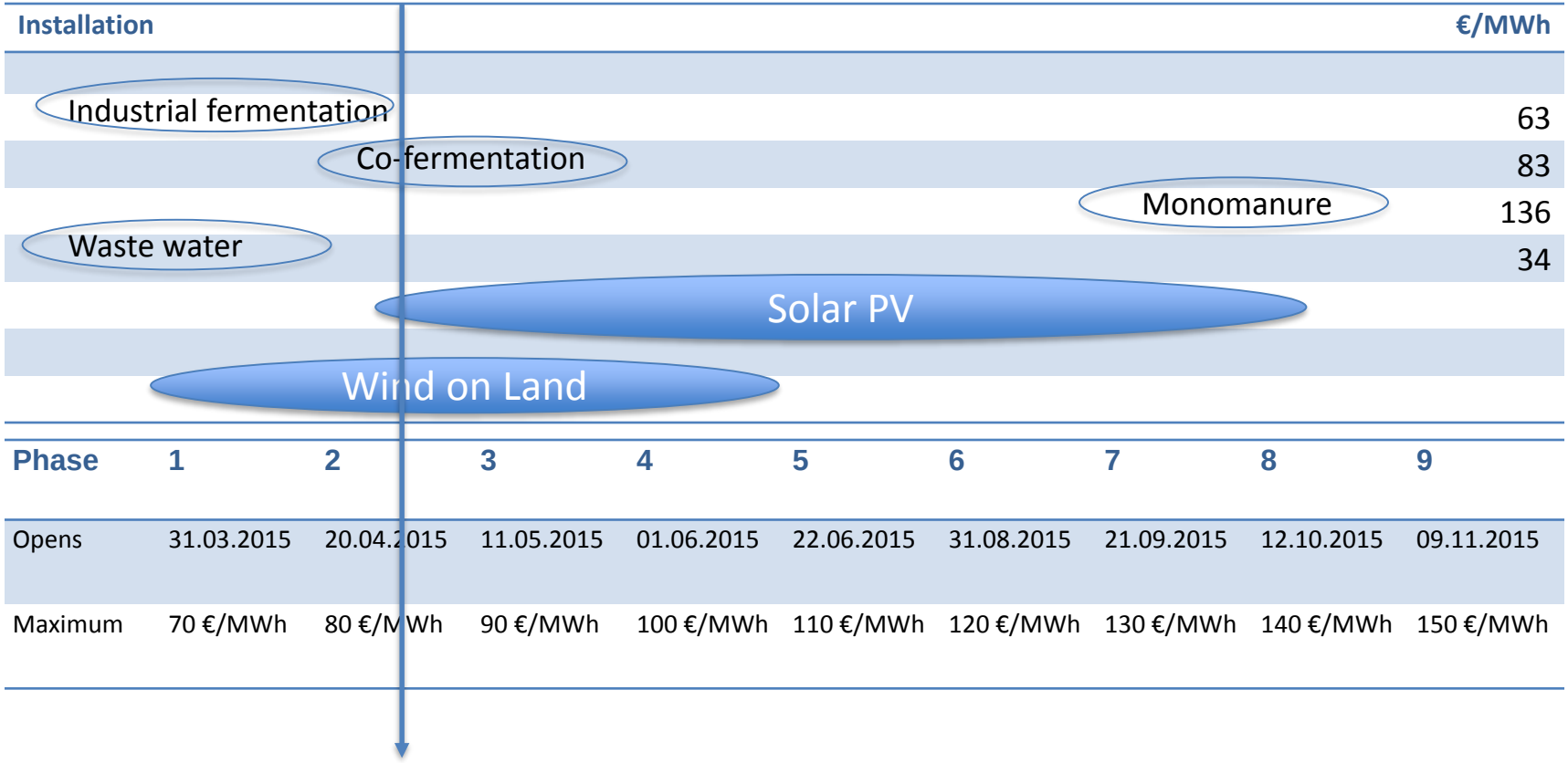
1. Topsector TKI: 40-50% capex support if **innovation project** leads to lower subsidy (SDE) needs in near future
2. DEI: 30-50% capex support to **demonstrate** new technologies
3. Green deal: **1 on 1 deals** between government & market (eg to improve regulation in return for investments)

Subsidy (SDE) budget Proven Projects (opex support)

1. 2016: 11.75 billion (CAD) budget
2. Budget tripled compared to 2015 (urgency)
3. All technologies compete (auction system), wind offshore own system & budget

Support measures

Subsidy system for proven projects, cheapest technology first

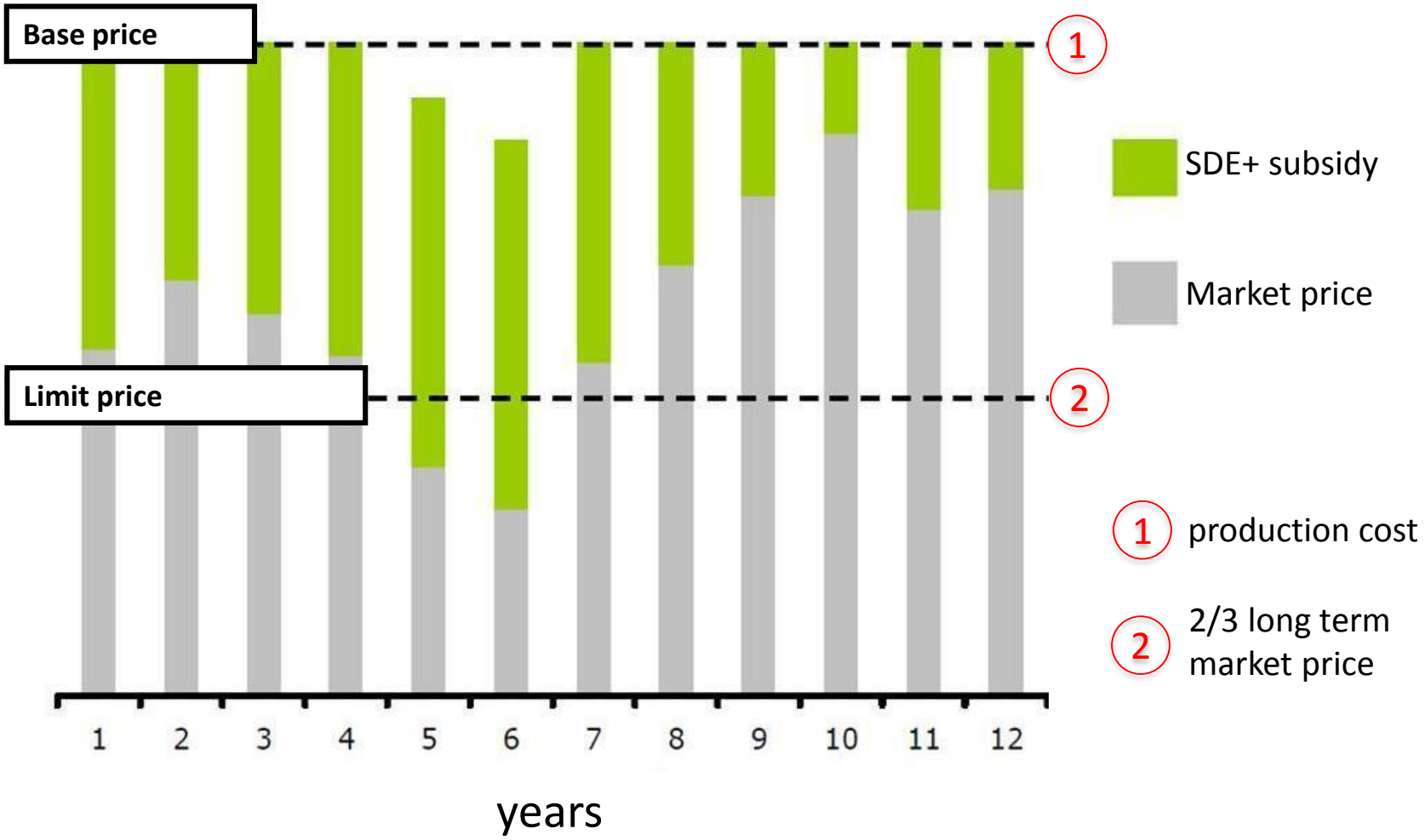


Phase	1	2	3	4	5	6	7	8	9
Opens	31.03.2015	20.04.2015	11.05.2015	01.06.2015	22.06.2015	31.08.2015	21.09.2015	12.10.2015	09.11.2015
Maximum	70 €/MWh	80 €/MWh	90 €/MWh	100 €/MWh	110 €/MWh	120 €/MWh	130 €/MWh	140 €/MWh	150 €/MWh

2015: In phase 3 budget sold out

Support measures

Subsidy (SDE) – cap system



Capturing learnings example

Jumpstart 2017: accelerate mono fermentation

Issue / challenges

- Volatile biomass prices co-products
- Mono manure minor chance in auction subsidy system (too expensive technology)

Strategic rationale

- Issue for FrieslandCampina, a Dutch dairy giant: 90% of footprint is @farm
- Self supporting farms & shift from co-fermentation to mono manure fermentation
- Reduce methane emissions (25 worse than co2), mono manure is closed system

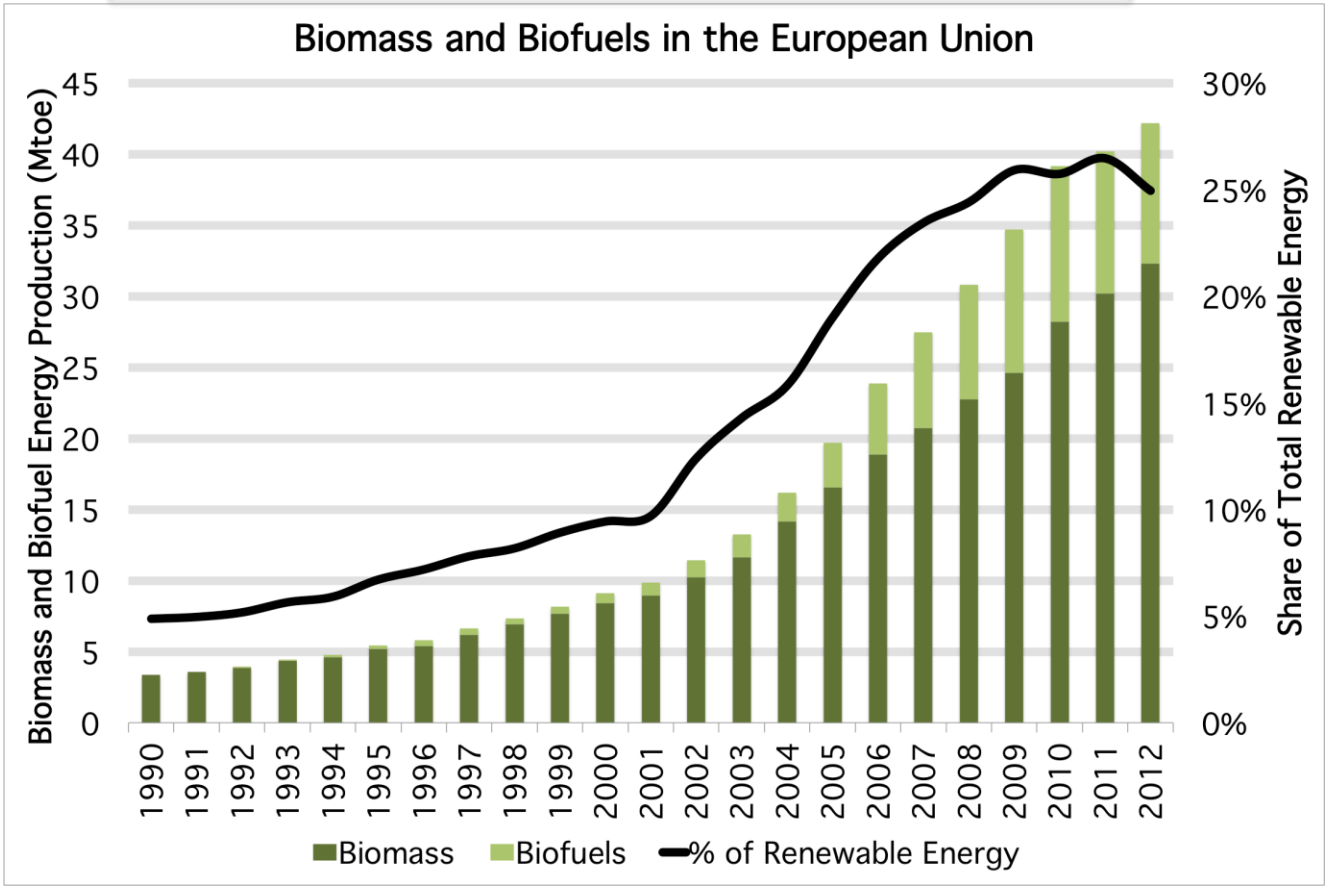
How

- Upscale with serial production; 30-40% decreasing costs of installation
- FrieslandCampina develops new organization to install / service 4000 of their farmers
- Government gives initial space within subsidy budget for mono manure roll out
- Valorisation manure, value broader than energy (reduction methane, nitrogen)

Alternative support measure

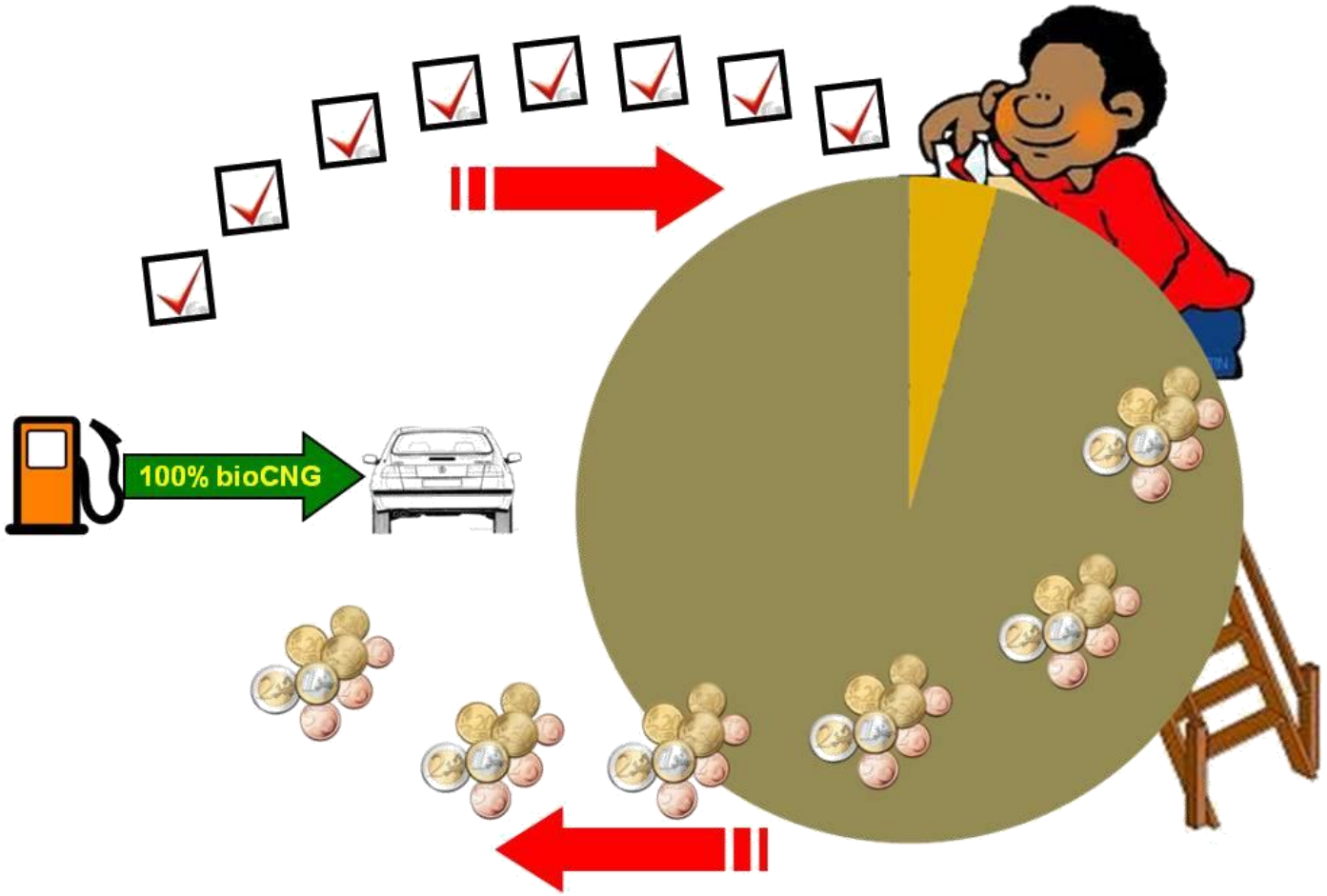
Blending obligation, market pays green premium, no subsidy government

Under the Dutch biofuels obligation, fuel suppliers are required to include a minimum share of biofuels in their overall sales of petrol and gasoline: **2015: 6,25 % > 2020: 10 %**



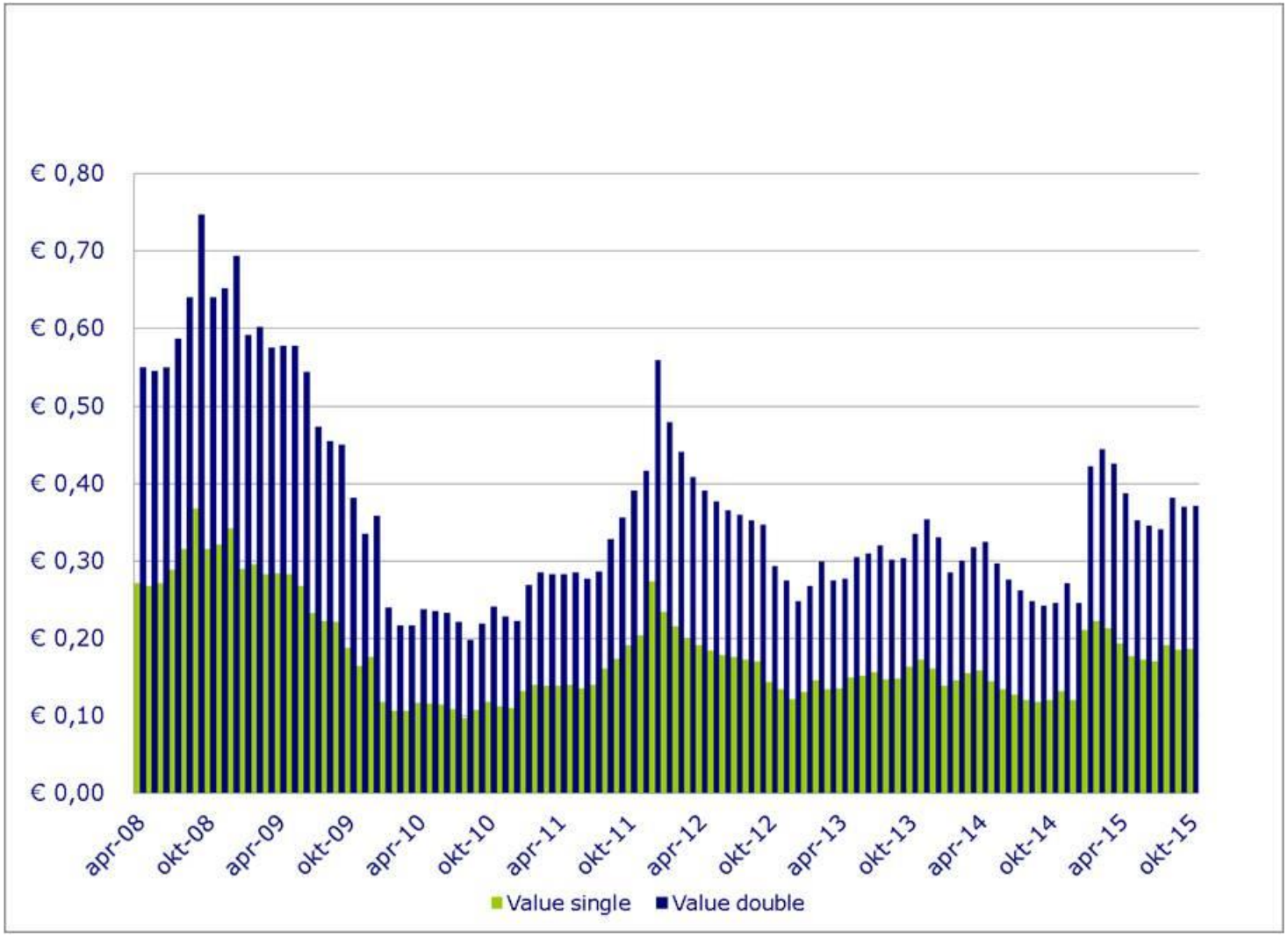
Blending obligation

BioCNG most cost effective biofuel (75% co2 reduction well-to-wheel)



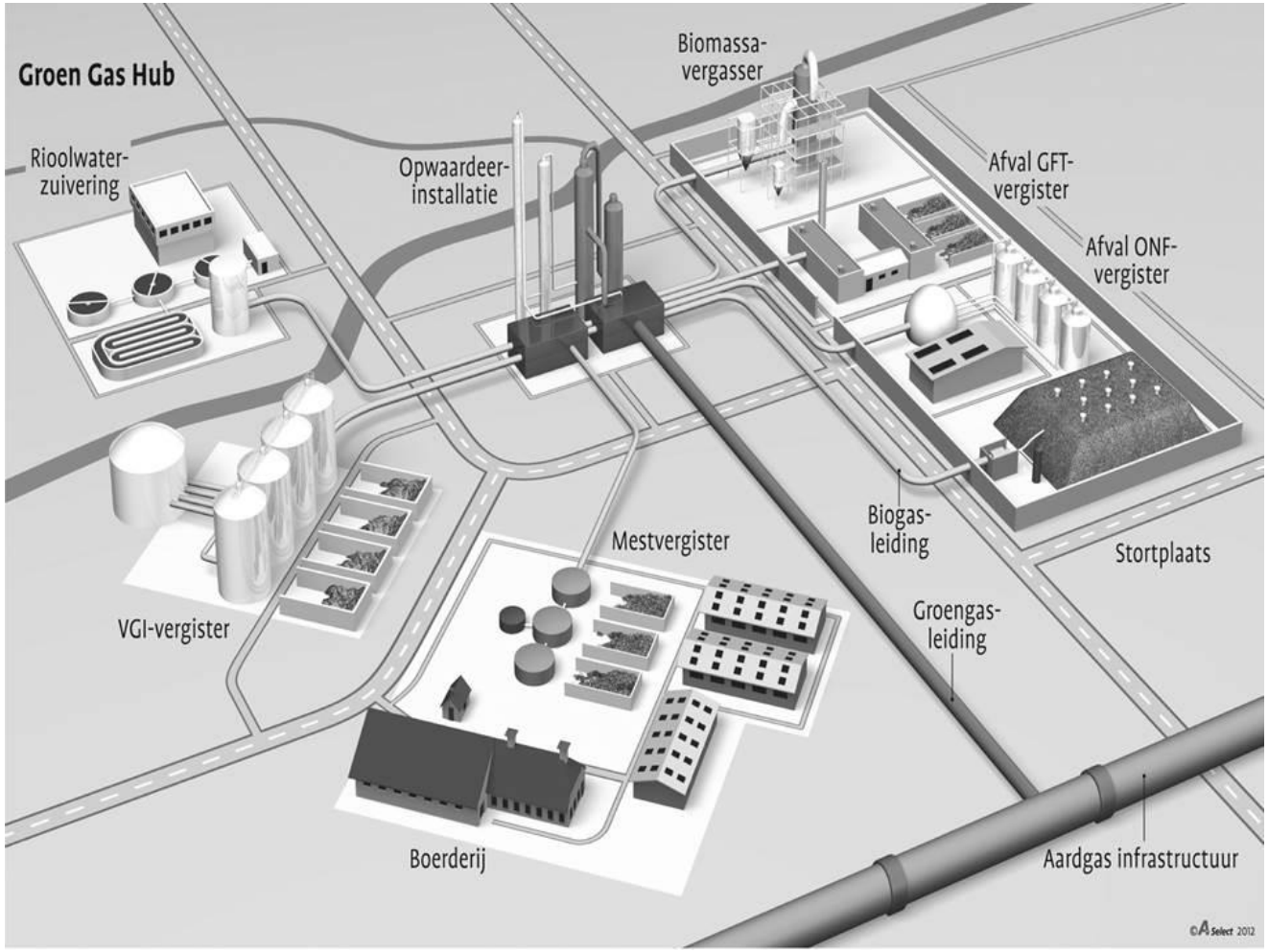
Blending obligation

Prices equalizing subsidy schemes – however too volatile for investors



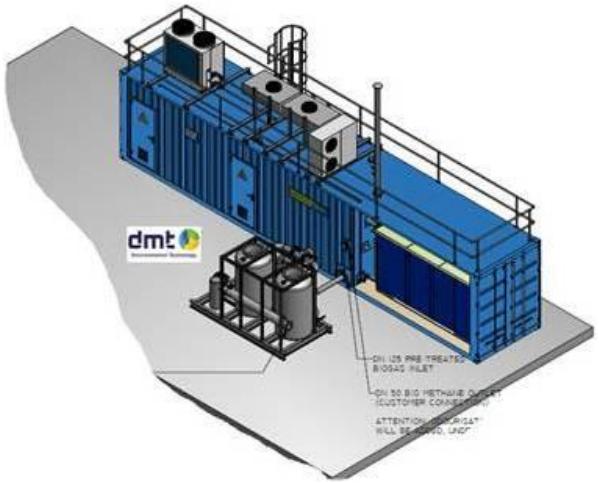
Interesting developments

Green gas hubs: centralizing upgrading & grid injection



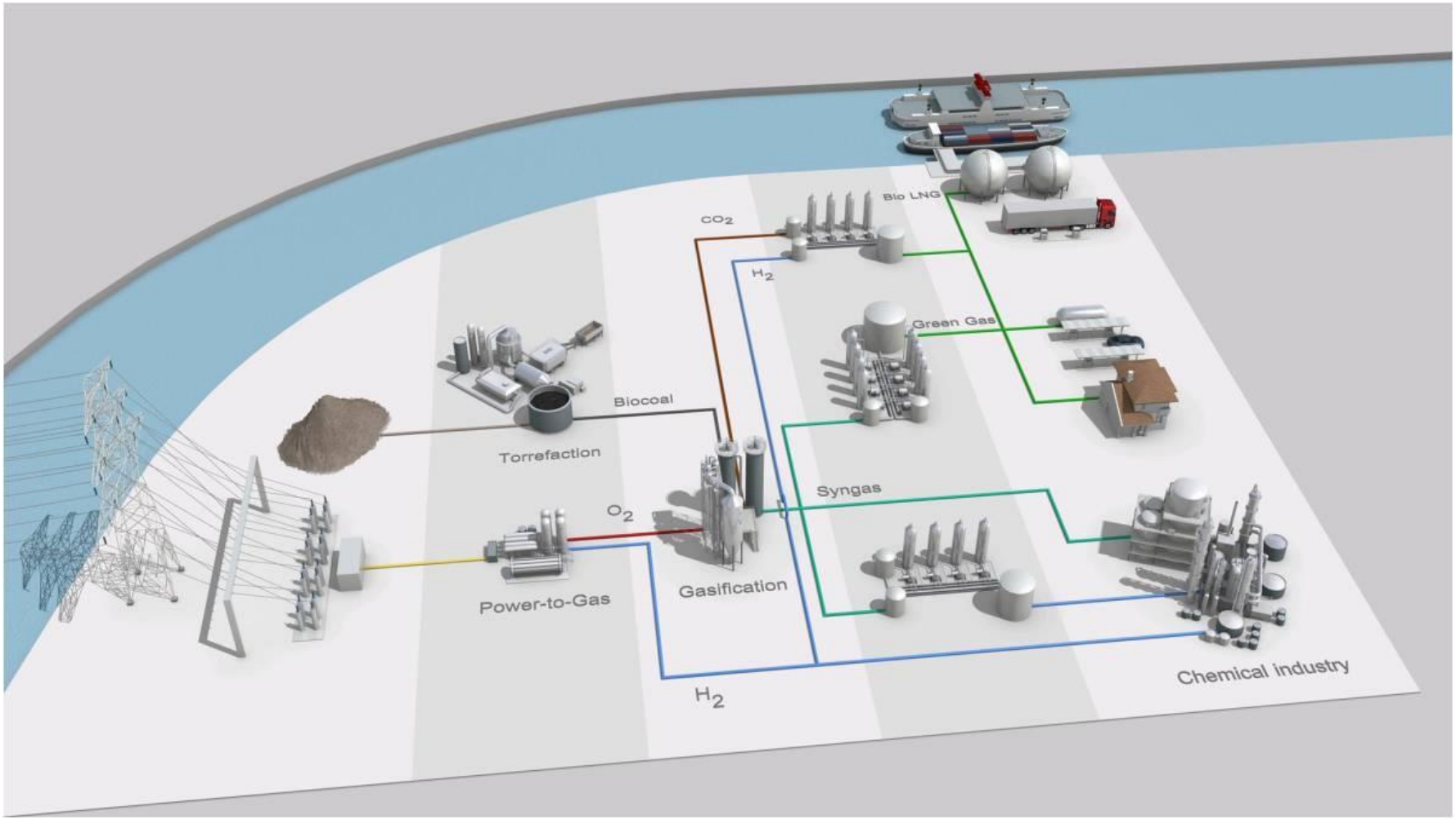
Interesting developments

Off grid BioCNG/BioLNG



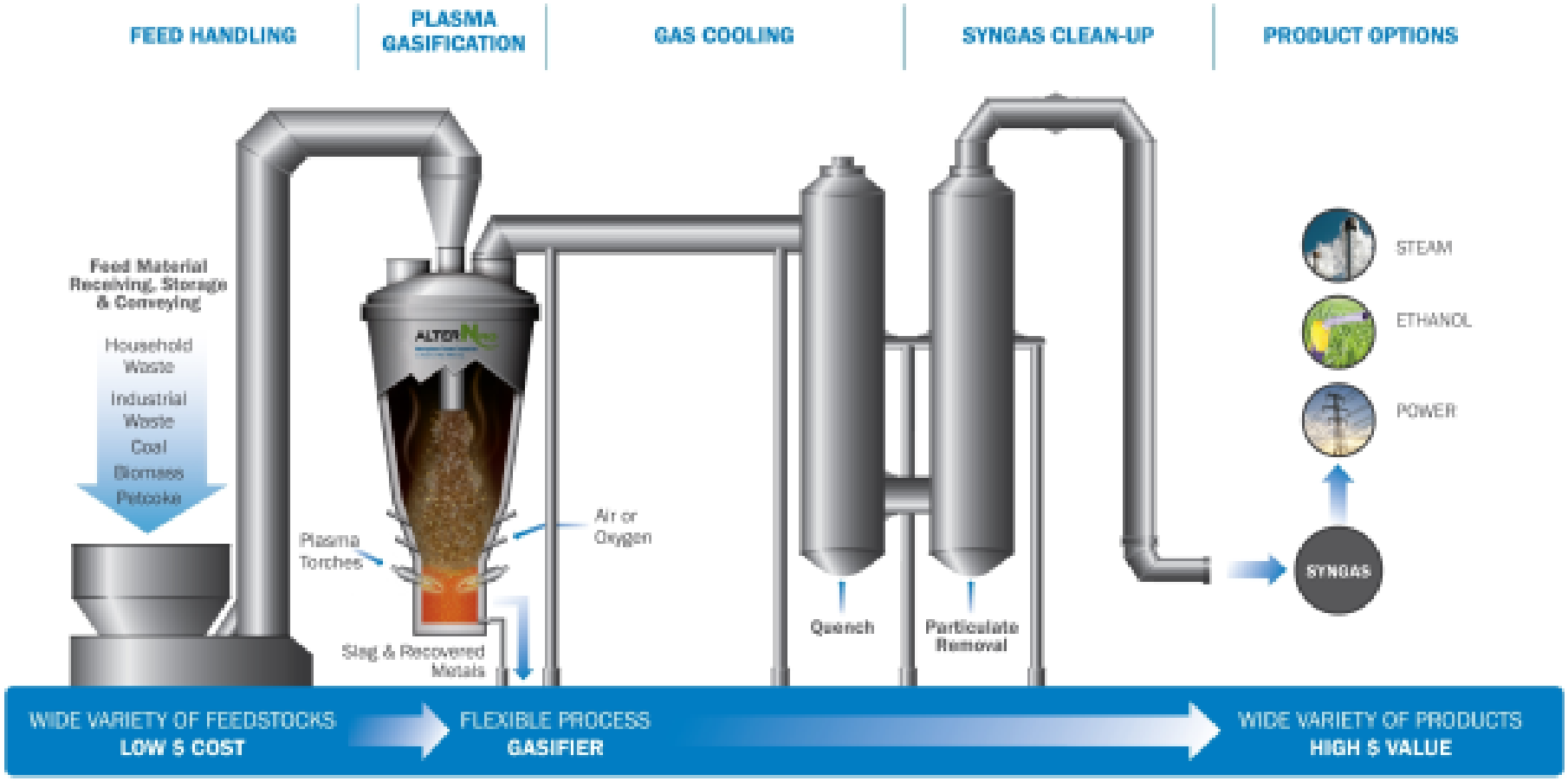
Interesting developments

Power to gas: unbalanced (wind) power for green gas production



Interesting developments

Gasification & syngas: renewable substitute for natural gas in specific categories (high temperature); dry biomass



Interesting developments

Auto generative high pressure fermentation (output: from 30 days to 6 days)

Interesting developments

Offshore bio-refinery: game changer?

- 70% of global biomass is aquatic
- Refinery offers multiple applications (e.g. dryed protein and biogas in 1 go)
- Nearshore & Offshore
- Plant can produce 400 million Nm3 biogas (besides other sustainable applications)

Start your engines…

Urgency to solve manure issue & biofuel application emerge RG