

# 26<sup>th</sup> World Gas Conference

1 – 5 June 2015 – Paris, France



*SP or TS or ISC number*

## CONVERTING THE GAS SYSTEM FROM FOSSIL TO GREEN ENERGY CARRIER

Søren Juel Hansen  
Energinet.dk



# CONVERTING THE GAS SYSTEM FROM FOSSIL TO GREEN ENERGY CARRIER

Maximising Utilisation and Green Values in the Transport Systems

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*+45 23 33 87 44*



## Table of contents

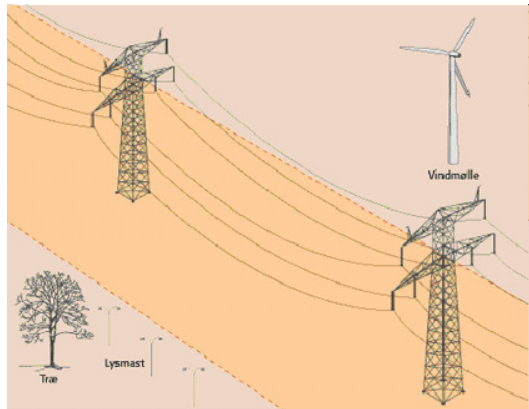
1. Energinet.dk and it's focus on converting from fossil to green
2. A little wind gas storage teaser
3. The natural gas challenge
4. Maximising Green Gas Transition

# Energinet.dk and it's focus on converting from fossil to green



# Who is ENERGINET/DK ?

Annual Report 2010



Danish Electricity TSO



Non-profit



State-owned



Independent board



Exchange co-owner

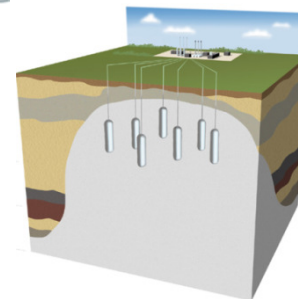
Transparent and secure Trading | GASPOINT NORDIC



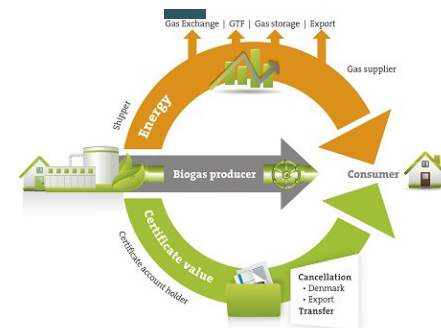
Renewables PSO



Gas TSO

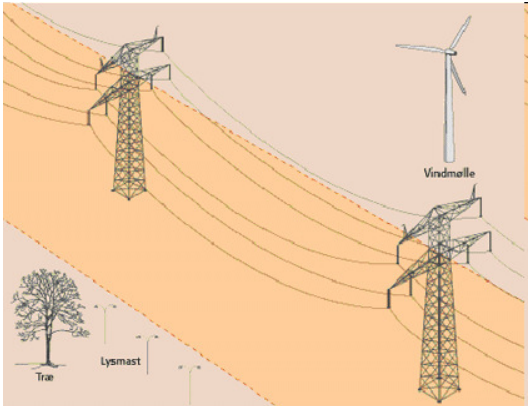


Gas storages



Renewable Gas and Electricity Certificate body

# Who is ENERGINET/DK ?



**Danish Electricity TSO**



**Non-profit**




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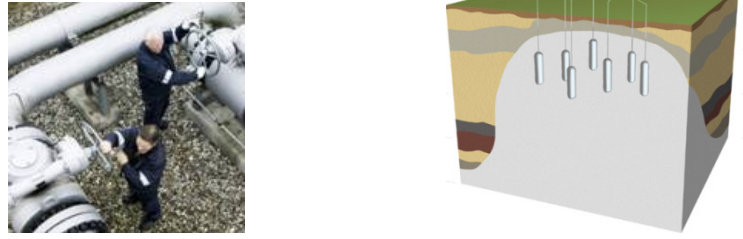
**Independent board**

nordpool spot

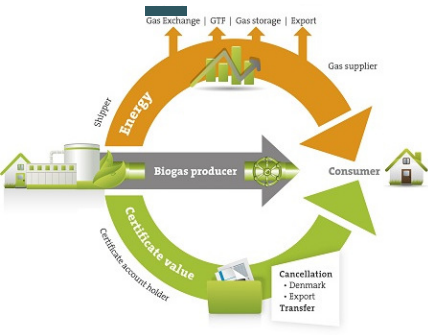


**Renewables PSO**

Exchange co-owner  
Transparent and secure Trading | **GASPOINT NORDIC**



**Gas TSO**      **Gas storages**



**Renewable Gas and Electricity Certificate body**

# Energinet.dk Gas Aims

According to the gas supply act:

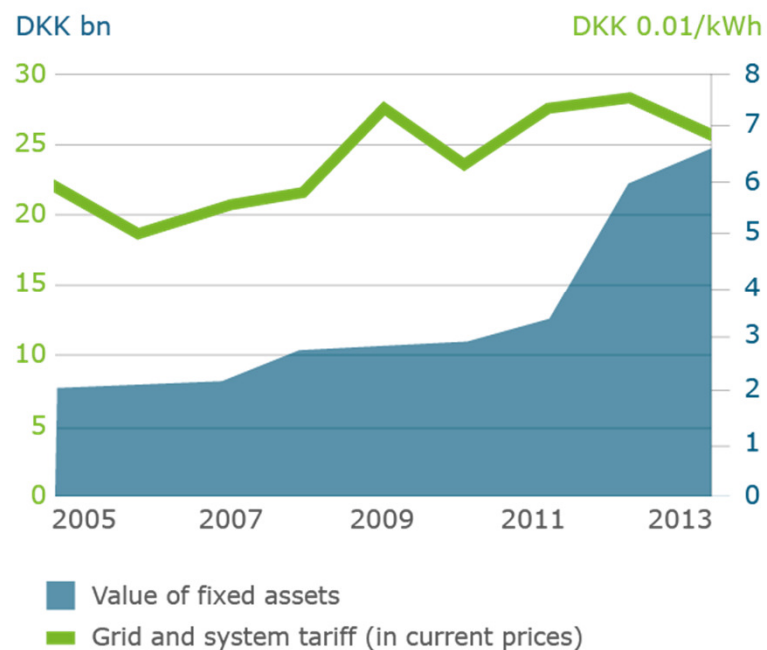
- 1. Security of Supply**
- 2. Market Development**
- 3. Climate and Environment**

Implicit aims:

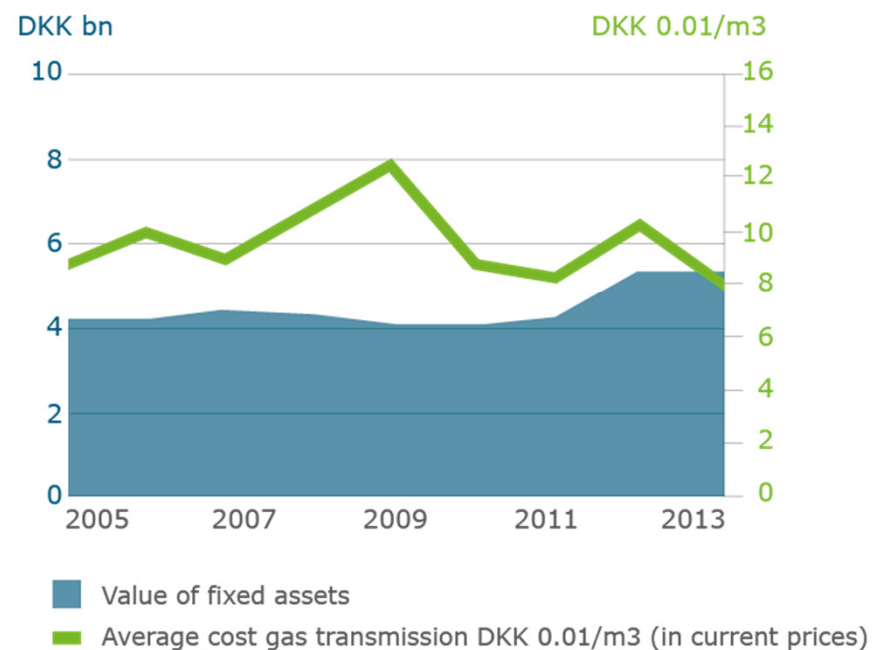
- 4. Maximise the socio economic values in the Recovery**  
(follows from the decision making Danish Energy Agency report on Ellund-Egtved from the Spring 2010)
- 5. Support the always current energy policy**  
(follows from Energinet.dk's 100% state ownership)

## Large-scale investments - stable tariff

### Electricity



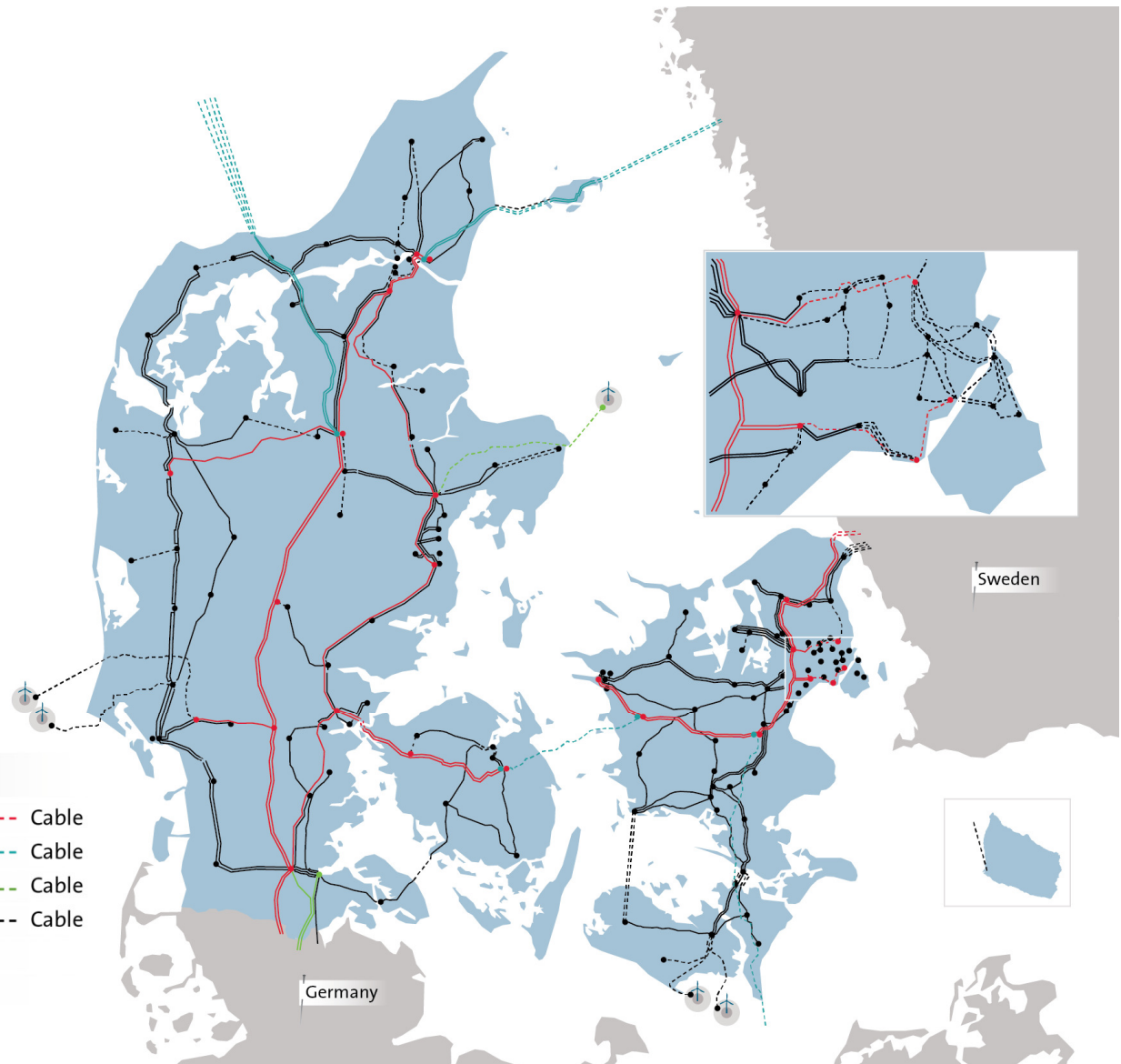
### Gas





# Electricity grid

POWER		Transmission grid	
400 kV AC	● Substation	— Overhead line	- - - Cable
400 kV DC	● Converter station	— Overhead line	- - - Cable
220 kV AC	● Substation	— Overhead line	- - - Cable
132/150 kV AC	● Substation	— Overhead line	- - - Cable
⚓ Offshore wind farm (owned by other companies)			
Last update: beginning of 2013			



# Gas grid

## GAS Transmission grid

- Station      — Pipeline      - - - Subsea pipeline
- ▼ Gas storage facility      ● Compressor station
- Gas processing plant      ◆ Platform \*owned by other companies

Last update: beginning of 2013



# Green transition



# The energy system is changing

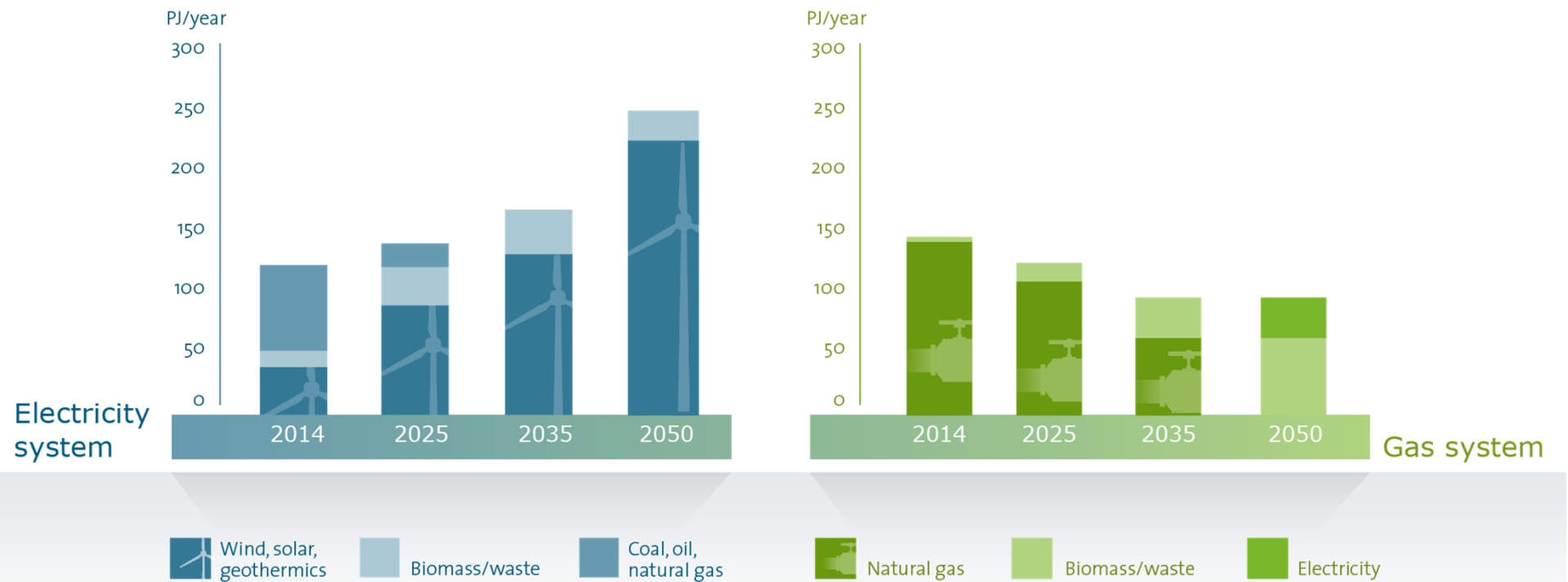
Europe is in the middle of a historic transition of the energy system  
- Denmark has a leading position

- By 2020, wind power must constitute 50% of the electricity consumption; in 2013 it constituted 32%.
- By 2050, Denmark must be 100% fossil-free.



# Energinet.dk's role in the green transition

We integrate more wind, sun and biogas while maintaining the security of supply

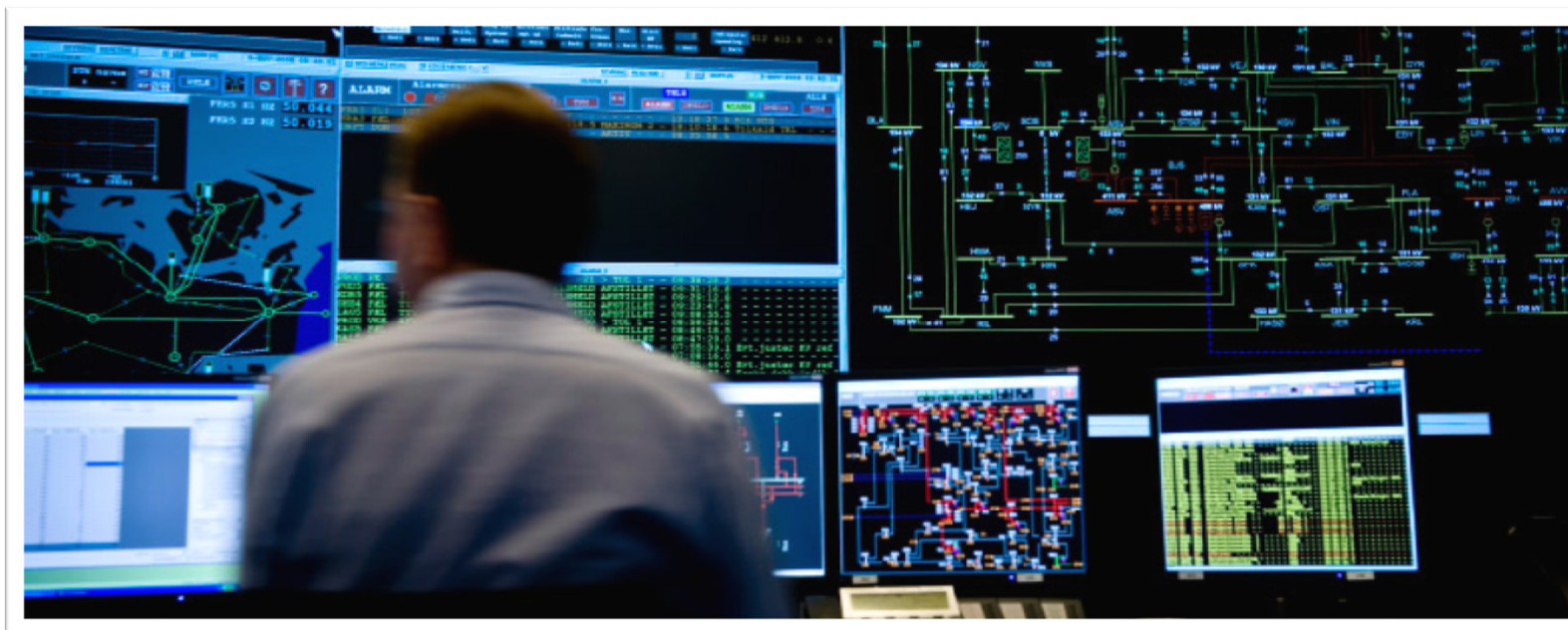


# Security of supply in Denmark

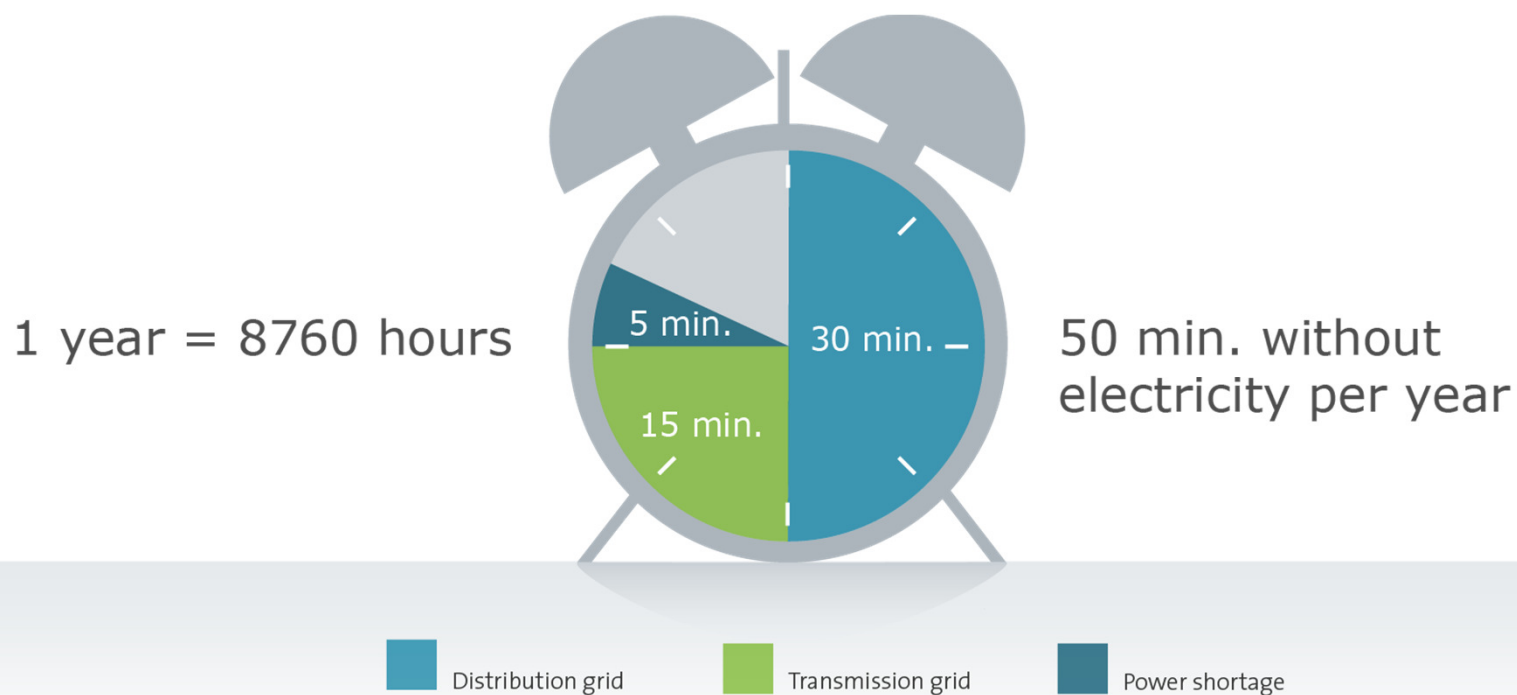


# We ensure supply of electricity and gas every minute

Energinet.dk is responsible for ensuring electricity in the socket and gas in the gas taps - both today at 20.50 and in 2050.



## We deliver a high level of security of supply

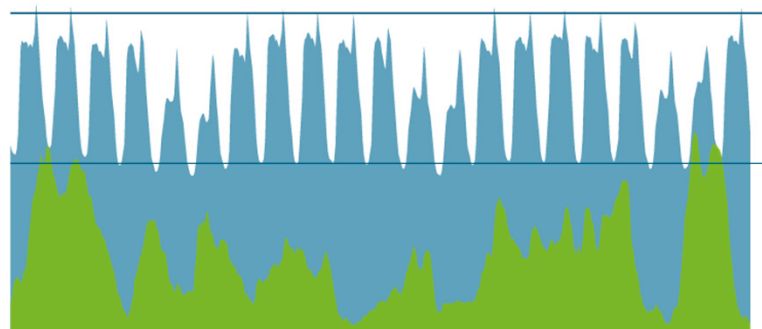




# Challenge of the transition

Electricity generation and electricity consumption do not go together

2013

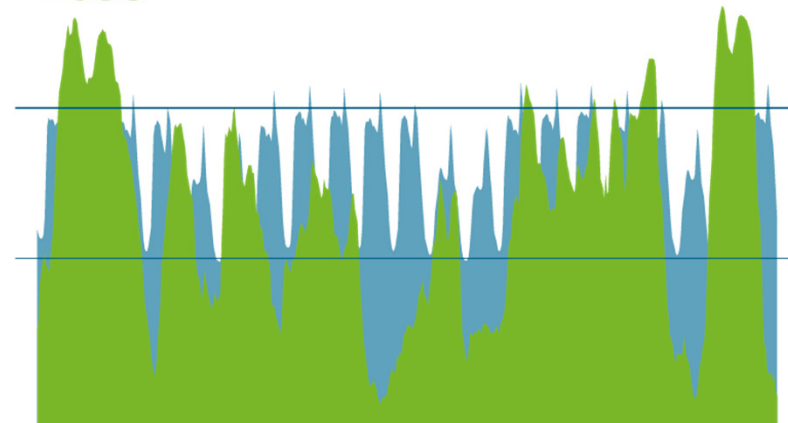


Week 1

Week 2

Week 3

2035



Week 1

Week 2

Week 3



Electricity consumption



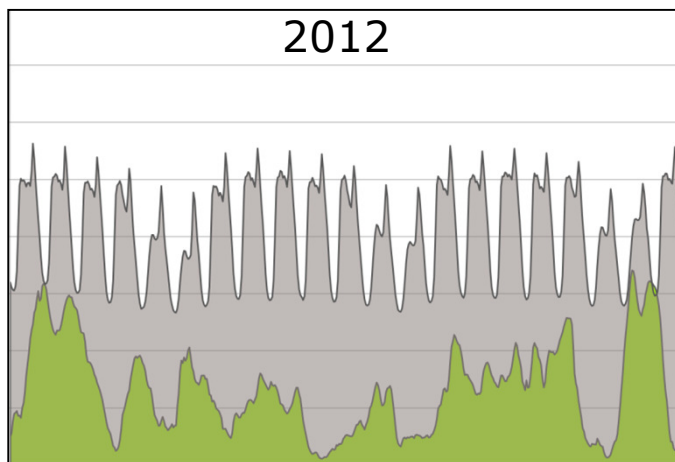
Electricity generation from wind turbines

# A little wind gas storage teaser

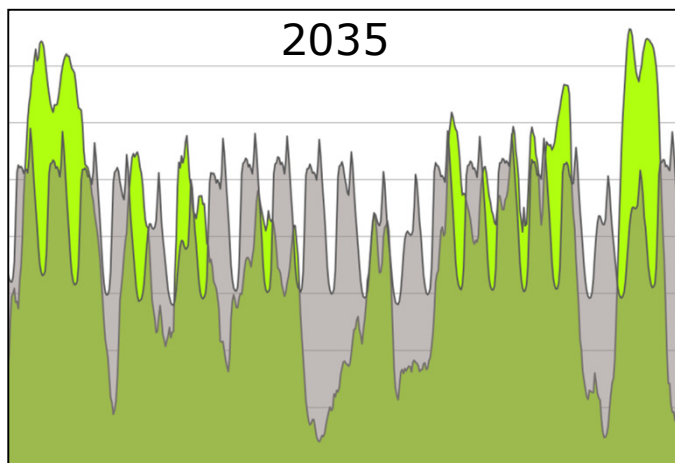


# Wind electricity production and current consumption

Prognosis for 3 weeks in November in Denmark

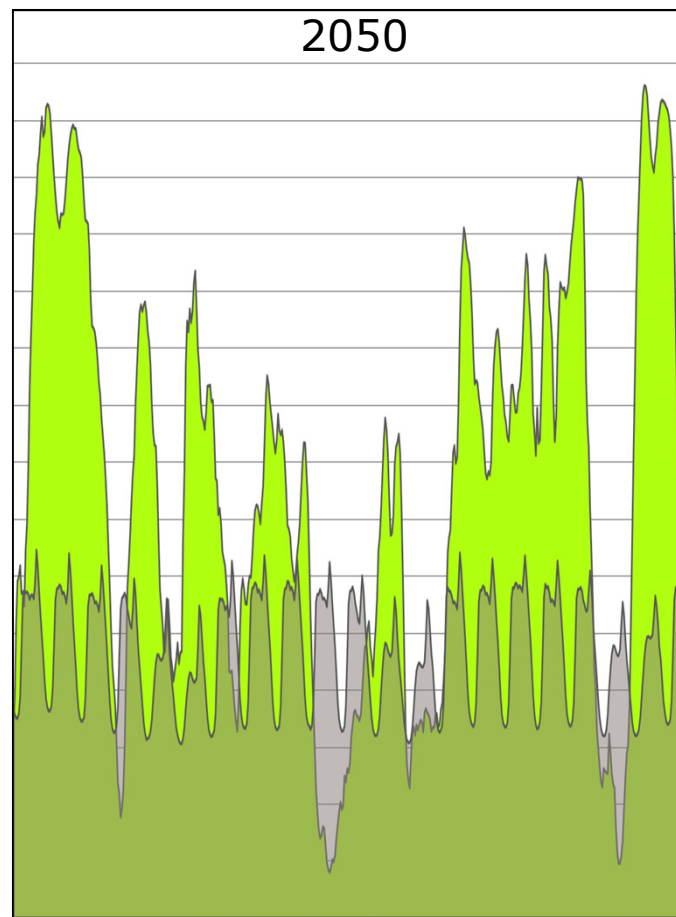


30 % of classic consumption



App. 75 % of classic consumption

## Prognosis based on the 2050 vision



App. 140 % of classic consumption

Part of former DK government energy policy:



Part of current DK government policy:



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# Energinet.dk – most important task

20 50

20 50

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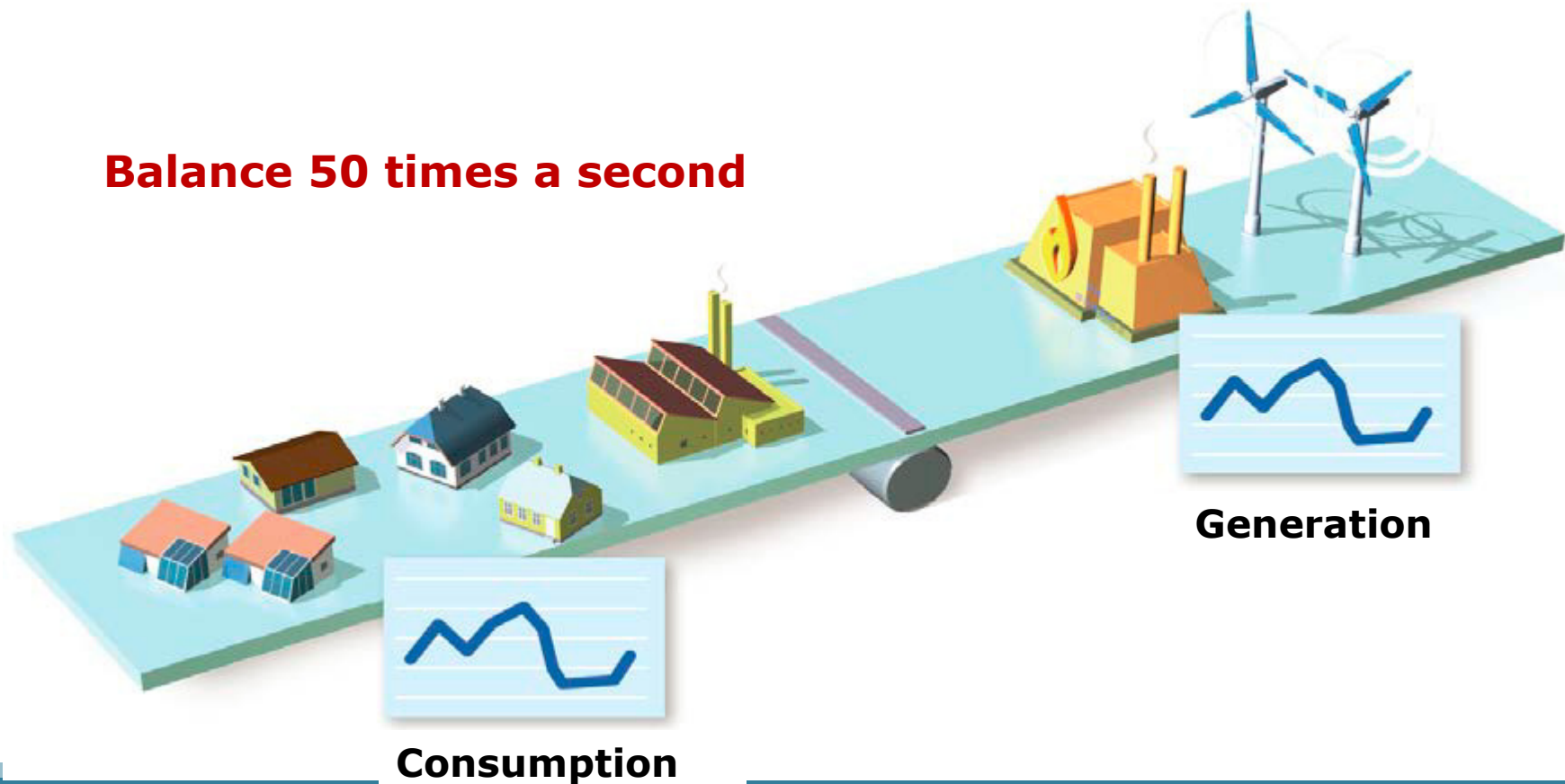
## Energinet.dk – most important task

Hour 20.50    Year 20 50

# Energinet.dk – most important task

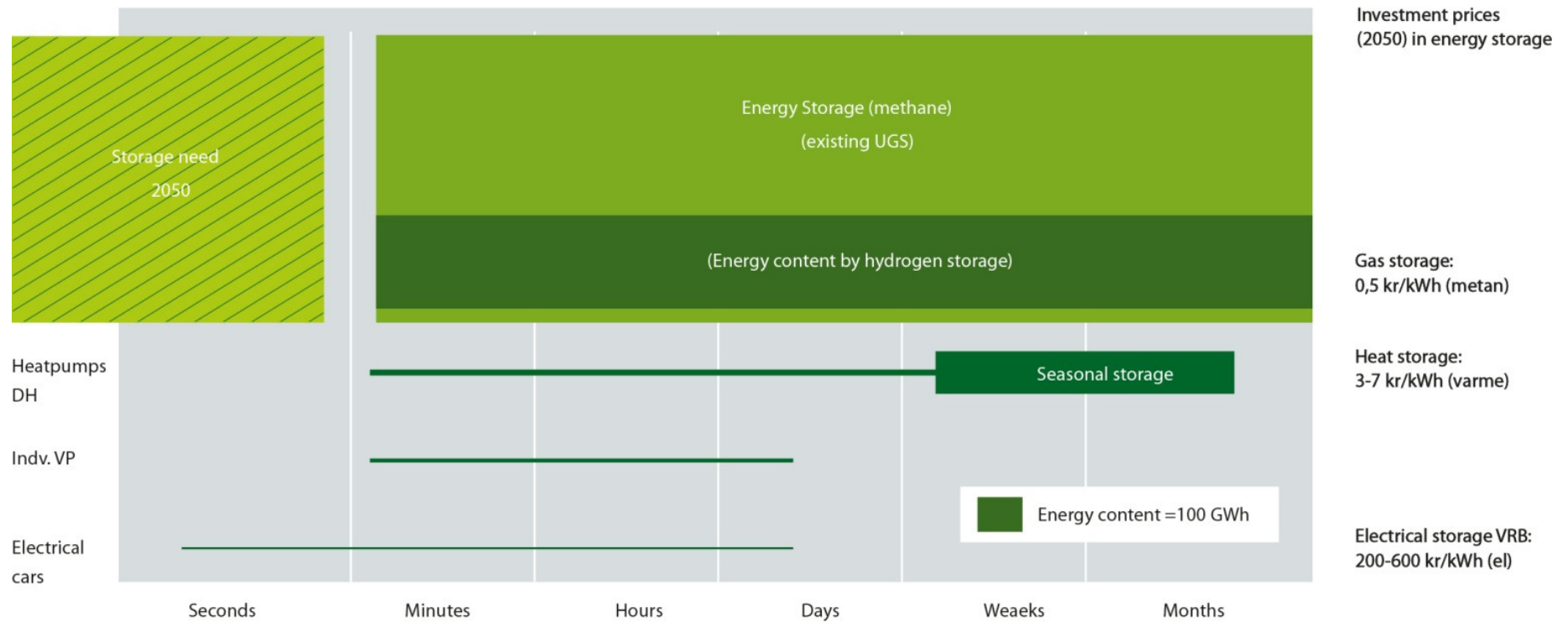
Hour 20.50 Year 20 50

**Balance 50 times a second**

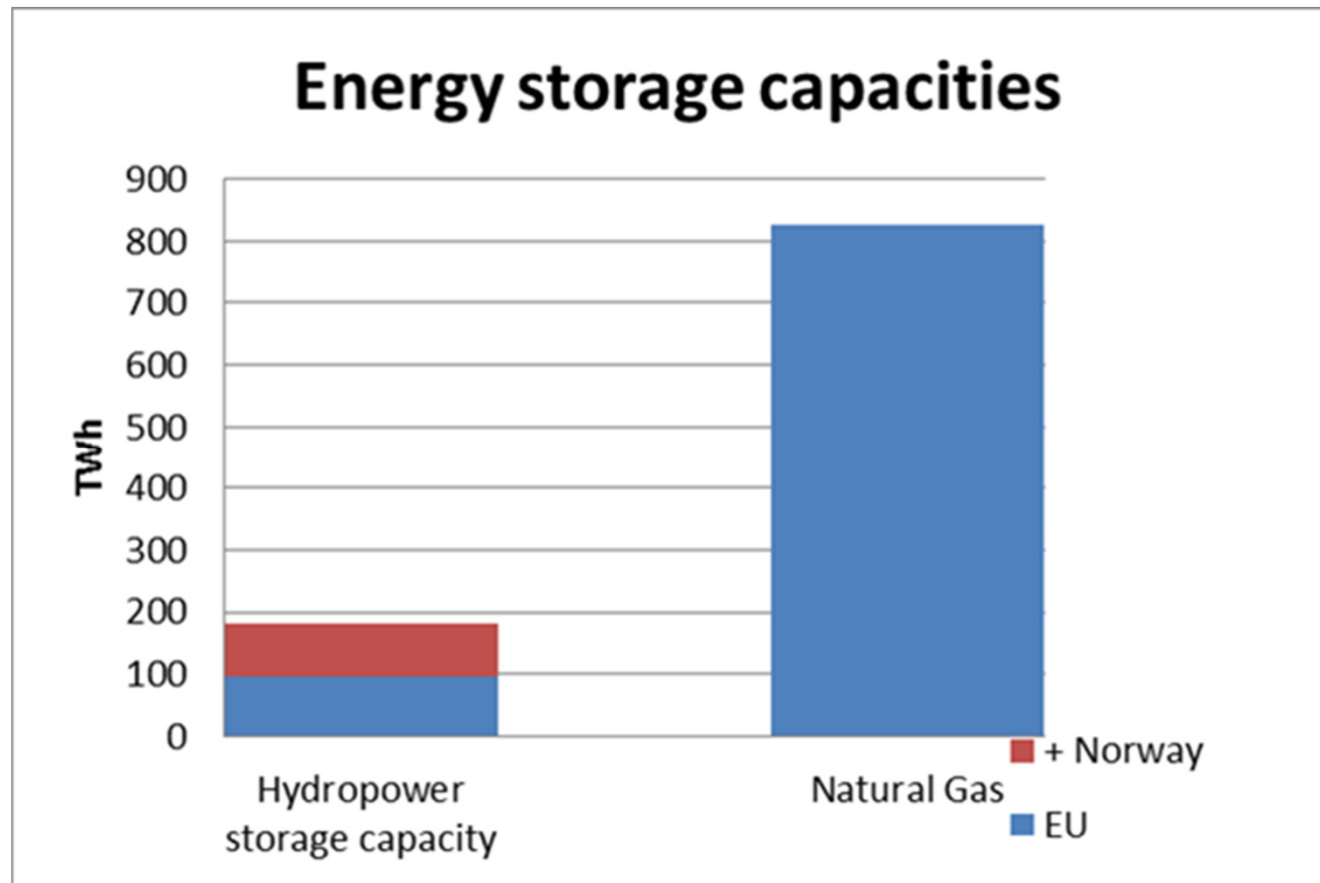


# Balancing tools for the power system - the Danish case

Storage capacity (electrical input)

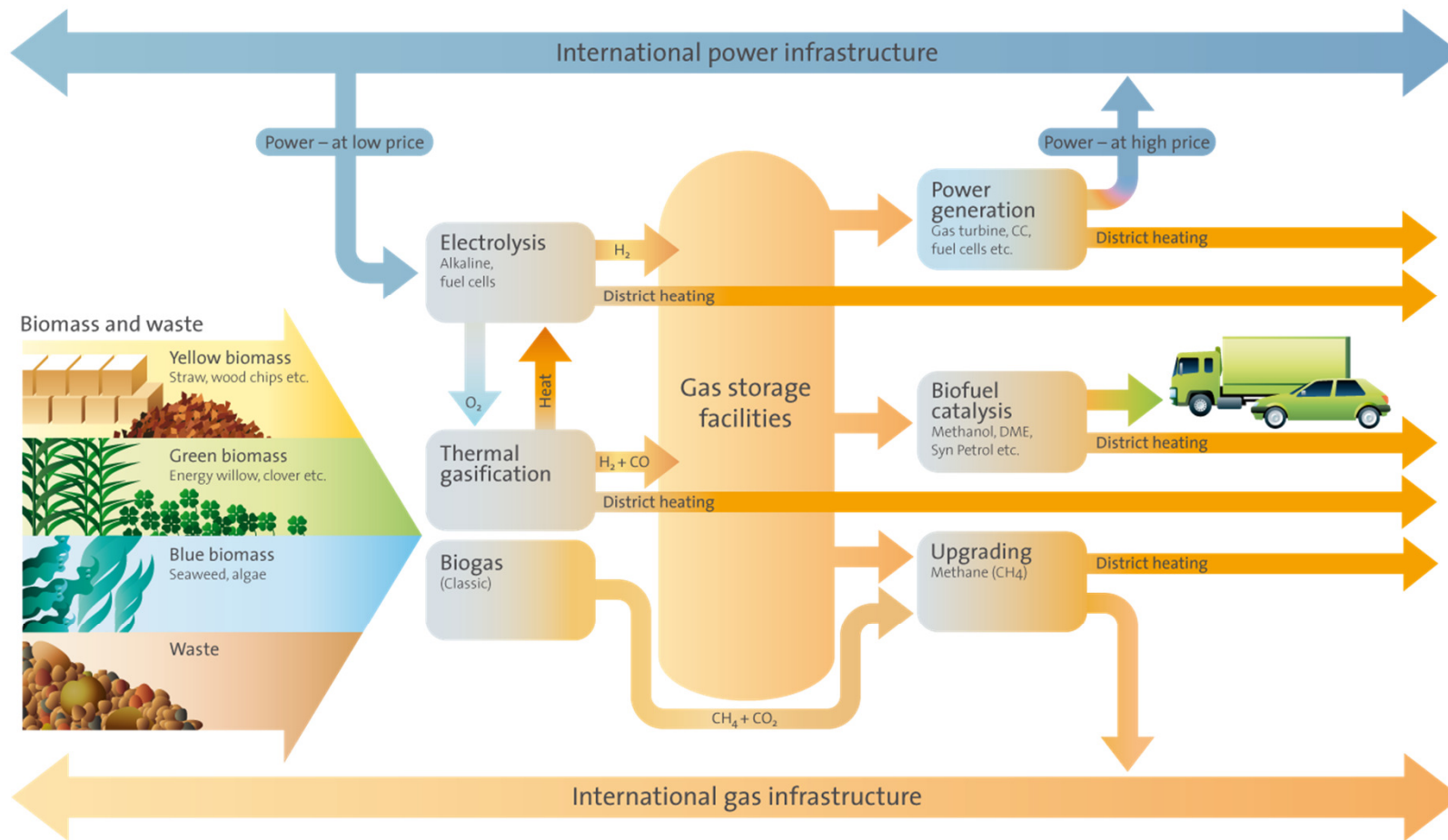


## What about Europe?





# Imagine a future renewables - power - heat - gas integrated energy system ... ... with gas storage at the centre

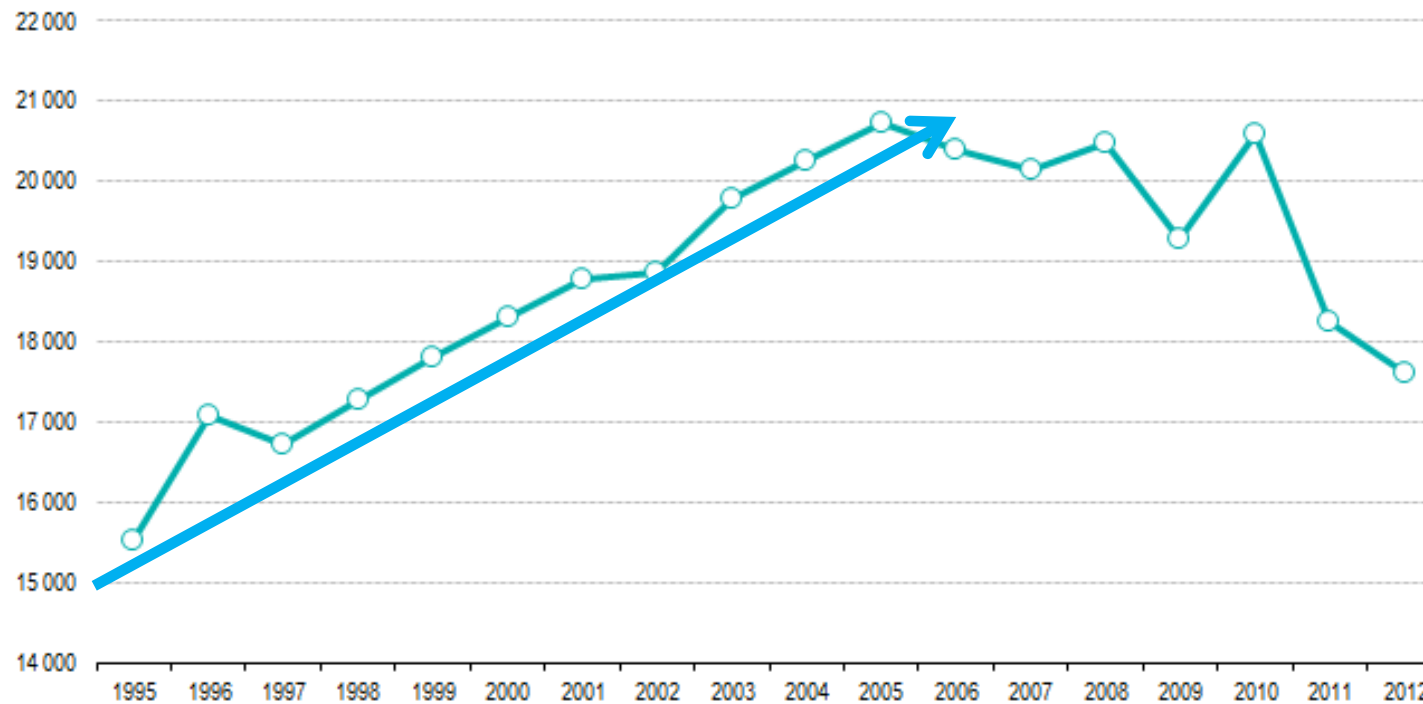


# The natural gas challenge





Before 2005 gas in EU got it all by it selves ...

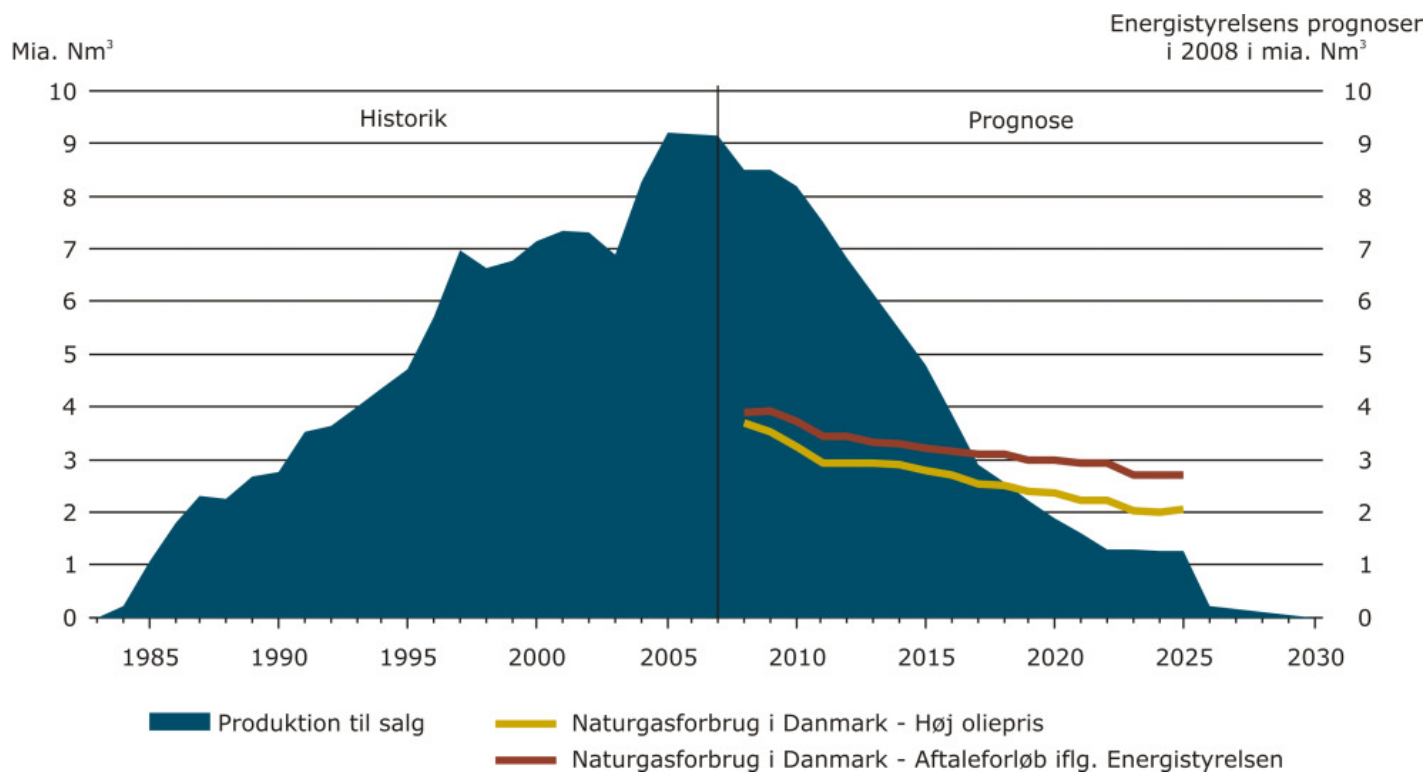


**Gross inland consumption in EU-27 2012, in thousand terajoules  
(Gross Calorific Value)**

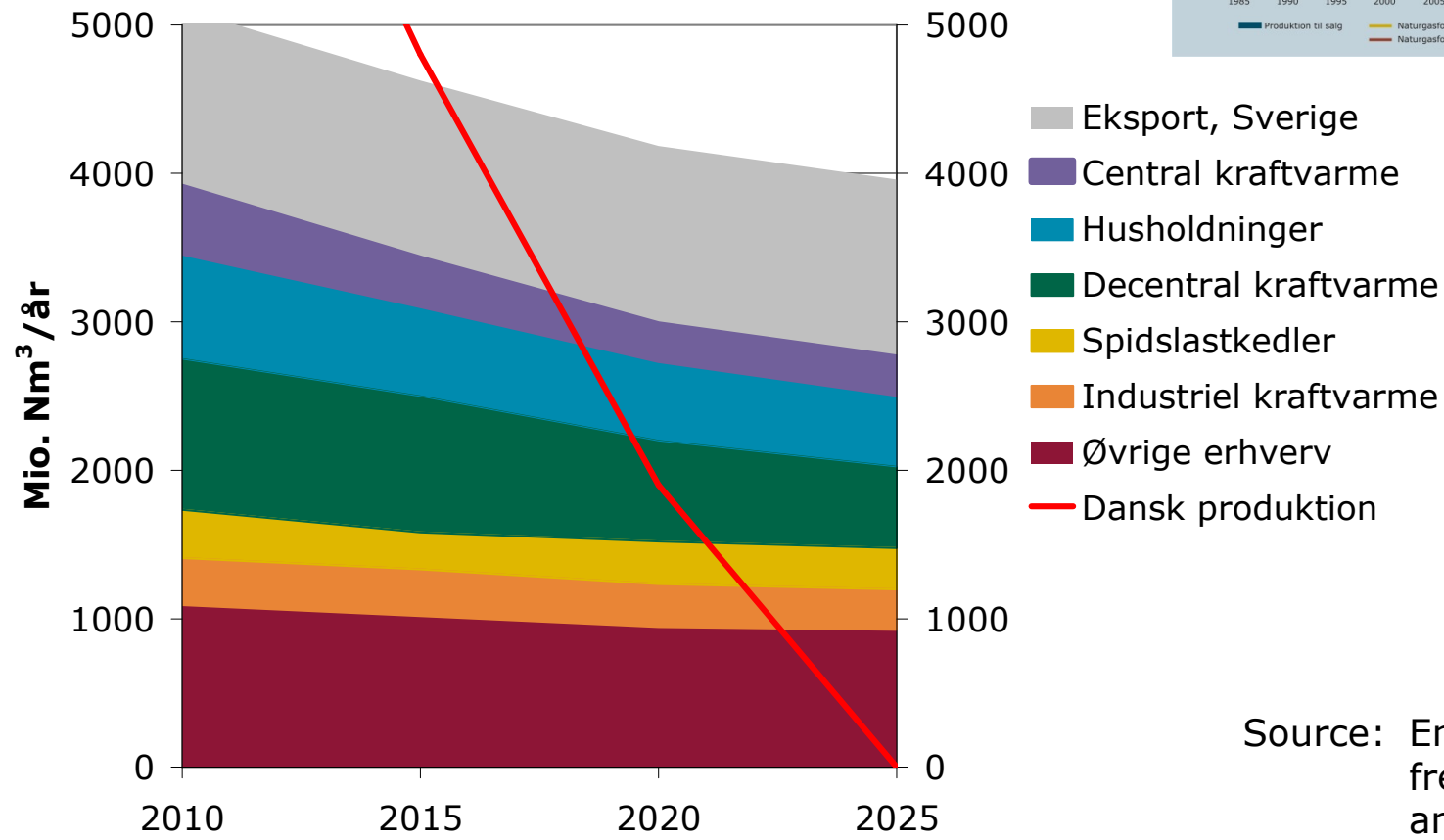
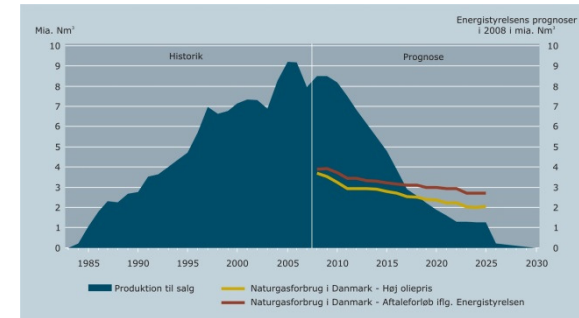
**Source: Eurostat**

# The Danish 2009 challenge

In 2009 all Swedish-Danish supply came from the Danish North Sea shelf

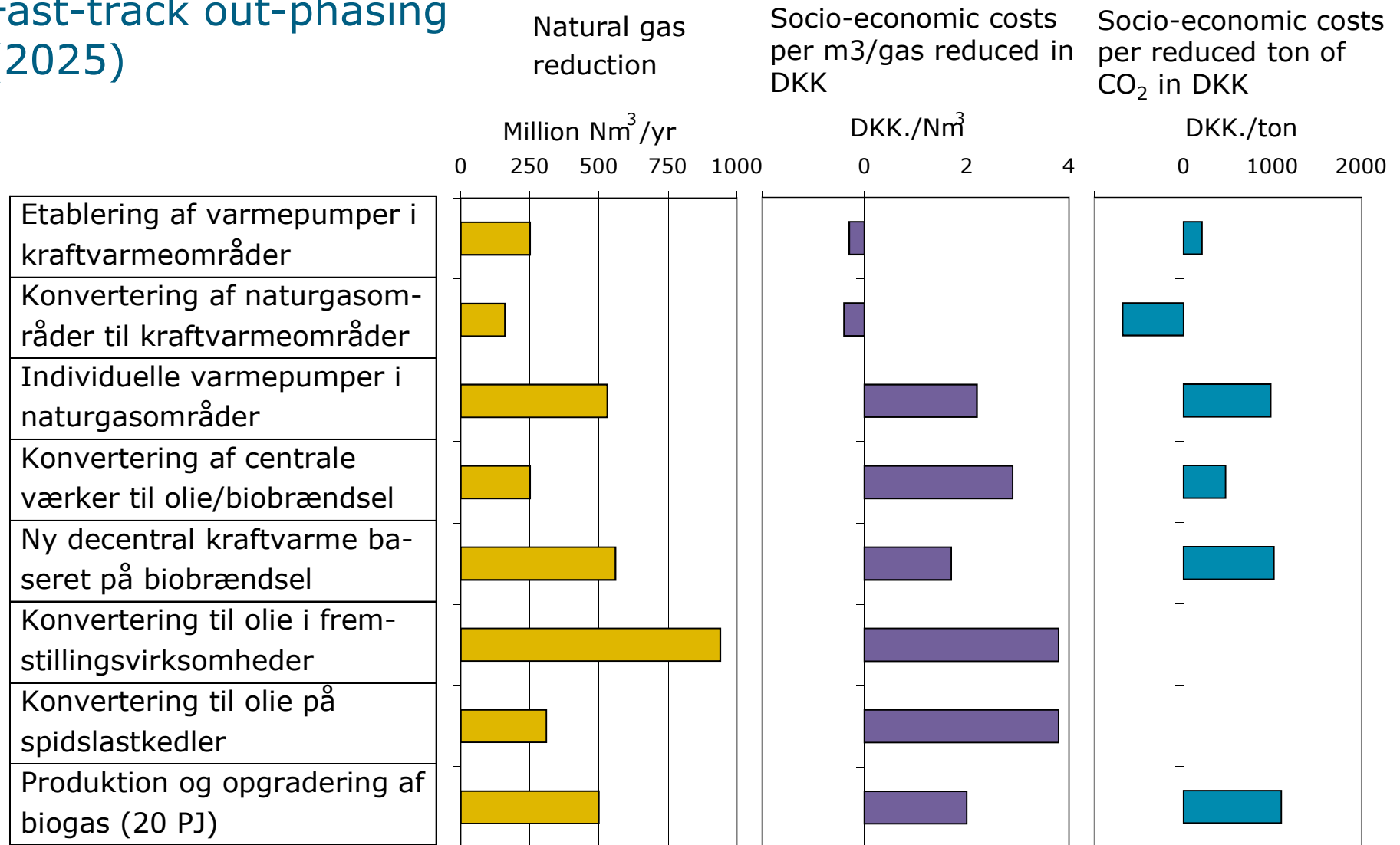


# 2025 North Sea supply simulation on district heating



Source: Energinet.dk:  
fremtidsperspektiv  
analysen, 2009

## Fast-track out-phasing (2025)



## 2025 fast-track natural gas out-phasing (1:2)

Fast-track natural gas out-phasing (2025) and out-phasing towards 2050 without new supplies for Sweden-Denmark is un-realistic as:

- **Consumption shall be reduced 50 % in 10 years** (Policy target is 20% in 2020)
- **Difference is 1.5 – 1.7 bcm/y in 2020 ...**
  - ... which has to be converted to other energy sources
- **Conversion investments required are app. 6 – 7 billion EUR**
  - 0.3 bcm/y natural gas can be converted with socio-economic benefit
  - Converting the remaining 1.2 – 1.4 bcm/y gives a significant socio-economic loss
- Investments will be required in: **biogas, heat pumps, district heating** and biomass
- Conversion will reduce CO<sub>2</sub>-foot print with app. 3.7 million tonnes/yr
  - **Reductions outside quota areas will be app. 3.3 million tonnes/yr**

Source: Energinet.dk:  
fremtidsperspektiv  
analysen, 2009

## 2025 fast-track natural gas out-phasing (2:2)

- Fast-track **out-phasing** (2025) and out-phasing towards 2050 **without new supplies is energy supply-wise unrealistic** and socio-economically costly
- The existing **natural gas infrastructure constitutes a major socio-economic asset**
  - Rough estimate is **+ 5 billion EUR** (year 2000 prices)
- **Future utilisation can be assured with 0.5 – 0.9 billion EUR** supply route investments (final investment was 0.2 billion EUR)
- The political ambition to make Denmark fossil free in the long run will anyway require some of the alternative investments to be made

Source: Energinet.dk:  
fremtidsperspektiv  
analysen, 2009



## 2010 basis for Energinet.dk's Ellund-Egtved decision towards Germany

### **Open Season long term market demand qualification**

70-100% demand for long-term contracts (10 years +)

+

### **Energinet.dk planning qualification**

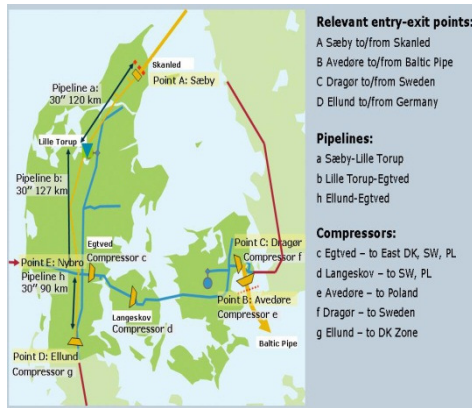
Open-season demand  
Socio-economic pros & cons

=

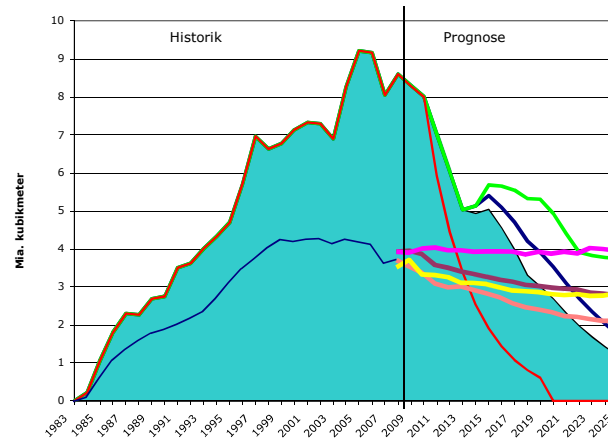
### **Business Case**

# The socio-economic arguments from the business case

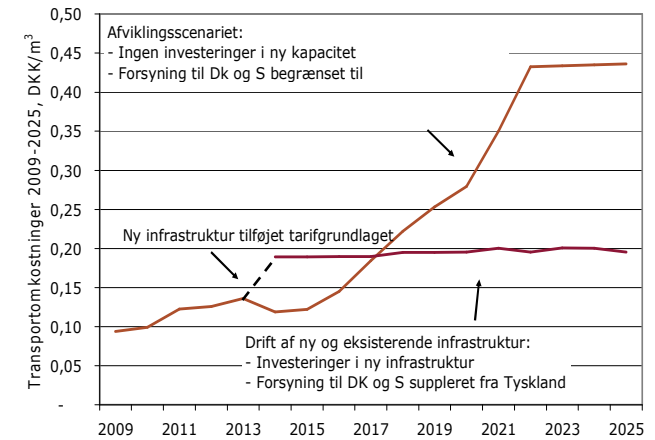
## Maintain exit capacities



## Security of supply

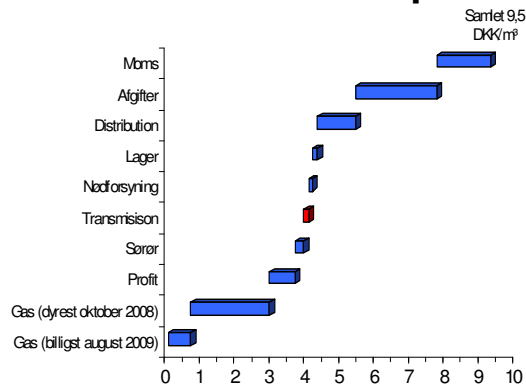


## Risk of accelerated out-phasing

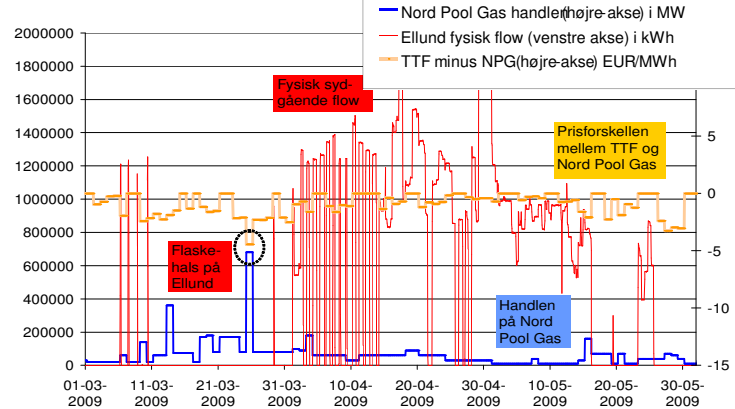


## Benefits

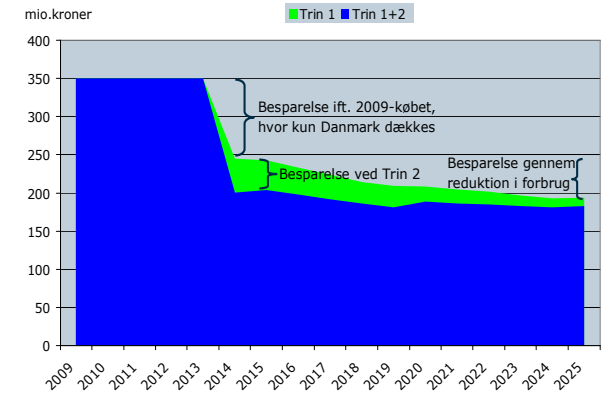
### Effect on consumer prices



### Bottlenecks



### Emergency-supply cost savings



# The Natural Gas Challenge Conclusion

Natural gas may benefit society  
in the short – medium term

But

Denmark, Europe and a lots of others are on a long term  
move from fossils to renewables

So challenge is:

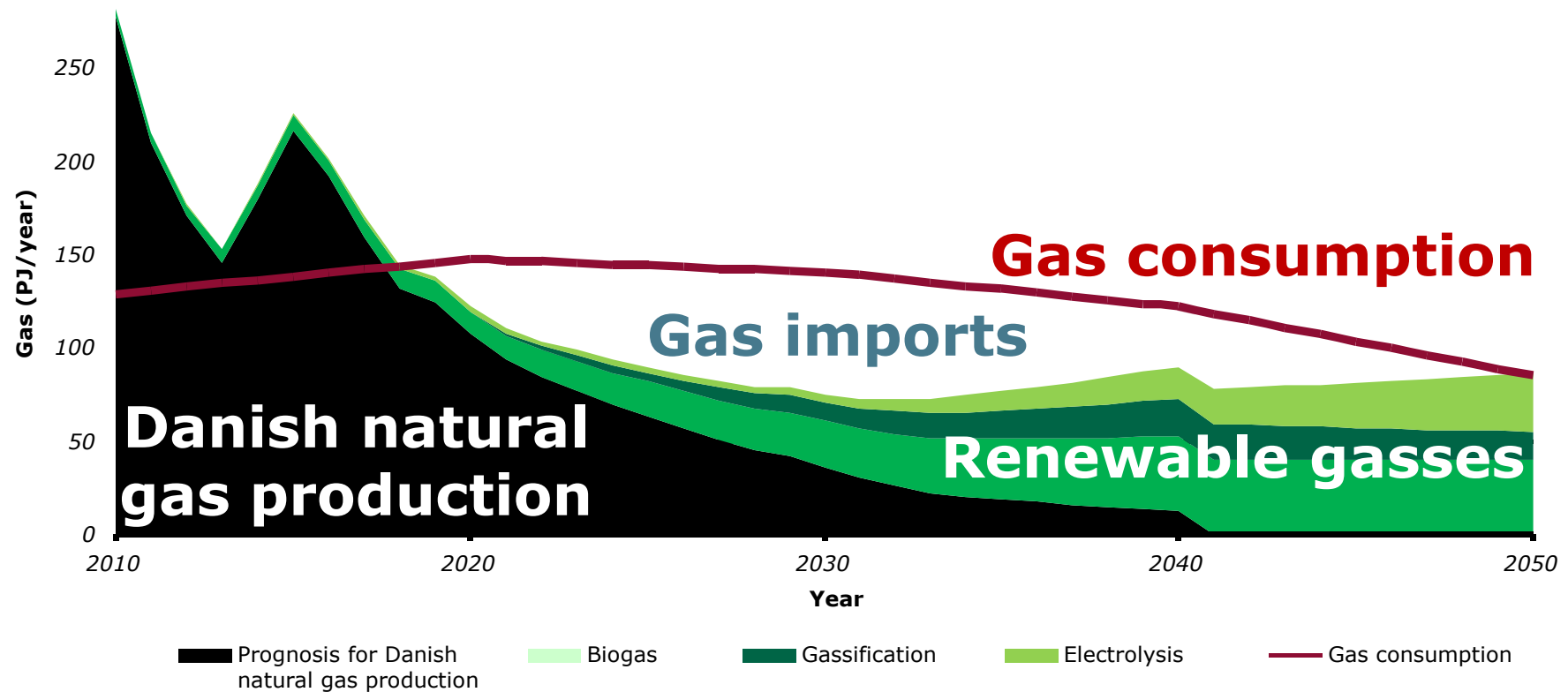
**How to move from fossil gas to renewable gasses**

# Maximising Green Gas Transition

Means Maximising the Green Value  
for  
Green Gas Producers  
and  
Green Gas Consumers

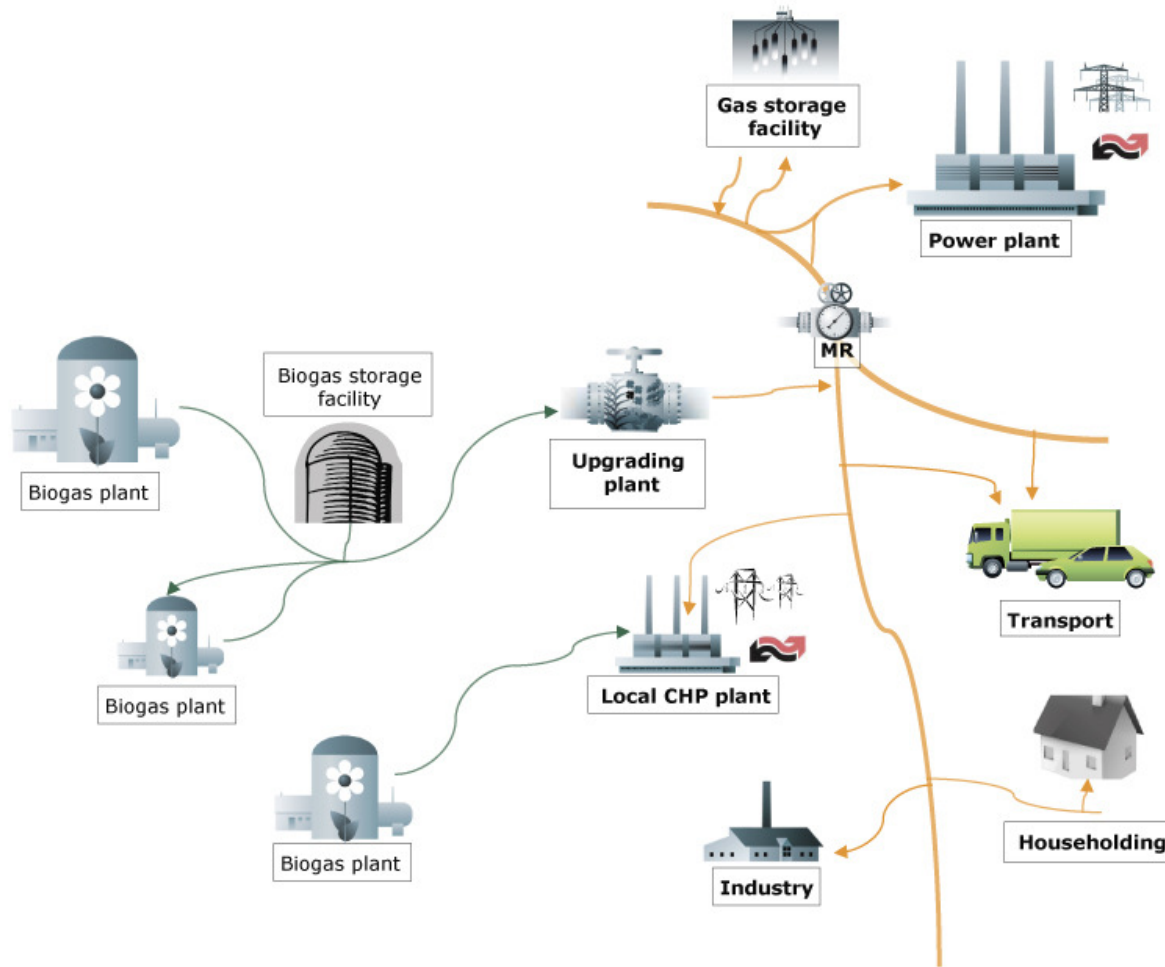


## What could the position of gas be in an alternative 2050 renewable scenario?



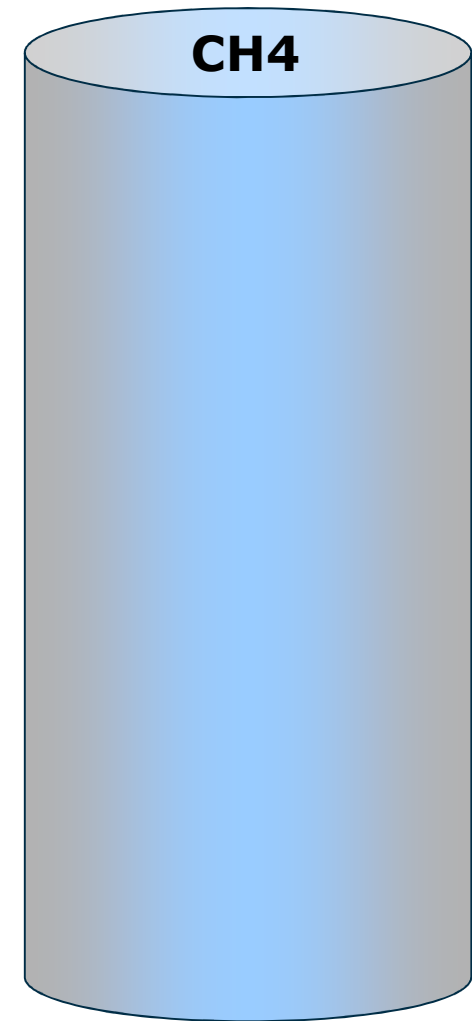
# The grid and the biomass is there ...

...



# How to make gas green

**We have a CH<sub>4</sub>+ gas system ...**  
... not just a natural gas system



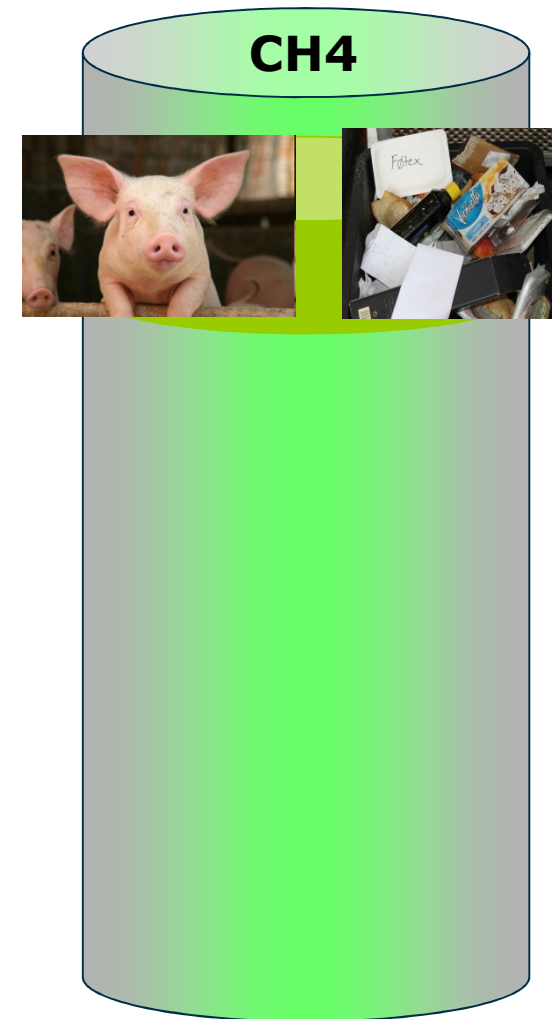
# How to make gas green

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## Biogas is now mature technology ...

... and is subsidised and injected into many gas systems





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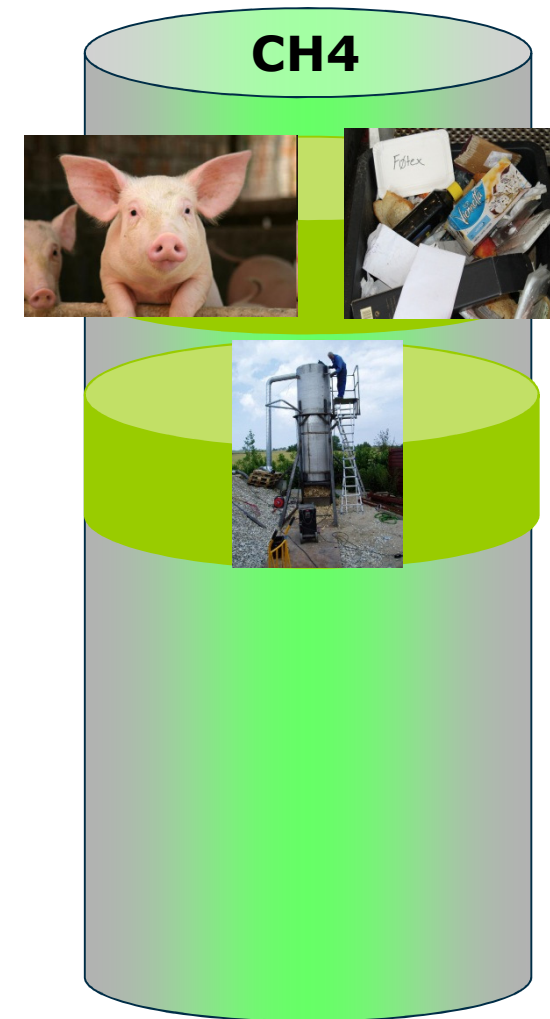
## Biogas is now mature technology ...

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## Gasification of e.g. wood is on the way back ...

... and based on more and more sophisticated technologies

(Examples are AU-VUT (Güssing+Oberwart), F-GAYA, D-ZSW and Blue Tower, NL-ECN (Milena+Olga), US-Great Point Energy, SF-Carbona, S-Chalmers, GOBIGAS, CORTUS-WoodRoll and E.ON-Bio2G, US-GreatPoint Energy, DK-Pyroneer and Haldor Topsoe)



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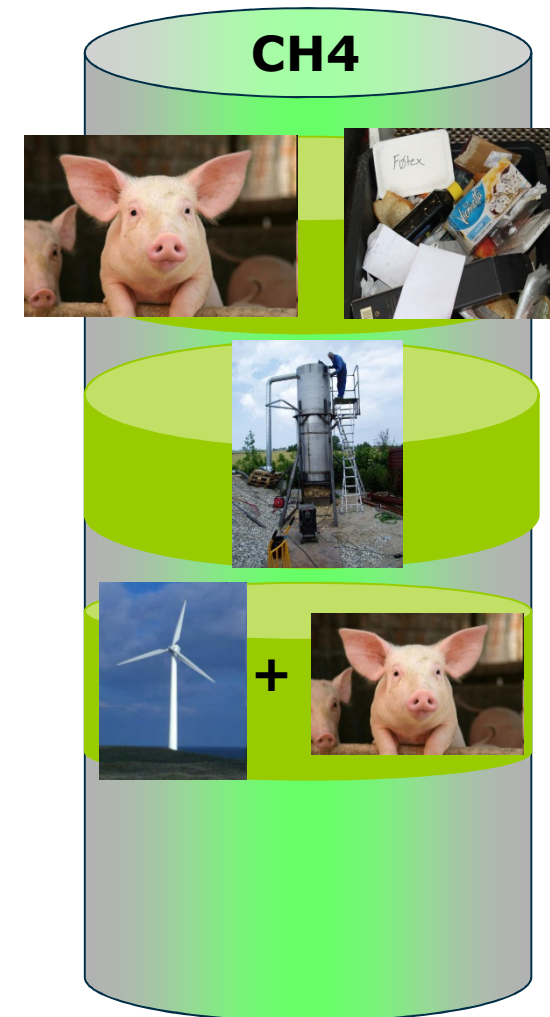
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## Next is power2gas from renewable electricity (H<sub>2</sub>) and the CO<sub>2</sub> we remove from biogas or from CCS ...

... demonstration is ongoing

(D-RH2-WKA, Audi, E.ON, Power2Gas Werlte, Power2Gas Morbach, juwi, Solarfuel, Fraunhofer IWES, ZSW, EWE, Enertrag Hybridkraftwerk, Total, Vattenfall, Deutsche Bahn, H-tec, DVGW, IOLITEC, Outotec, Engler-Bunte-Institut, EnBW Energie, US-Electrochaea, DK-Electrochaea.DK, Haldor Topsoe, HIRC, DTU, GreenHydorgen)



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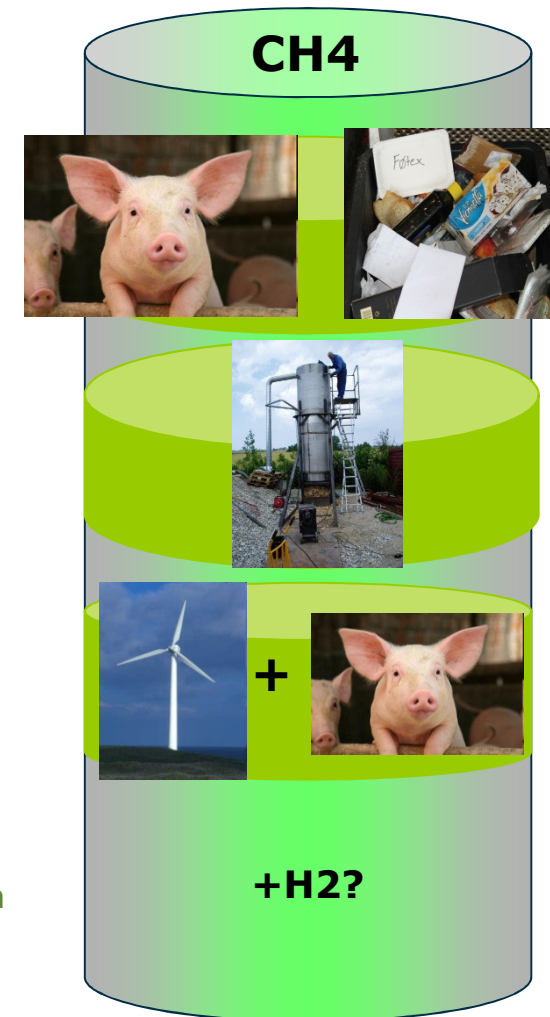
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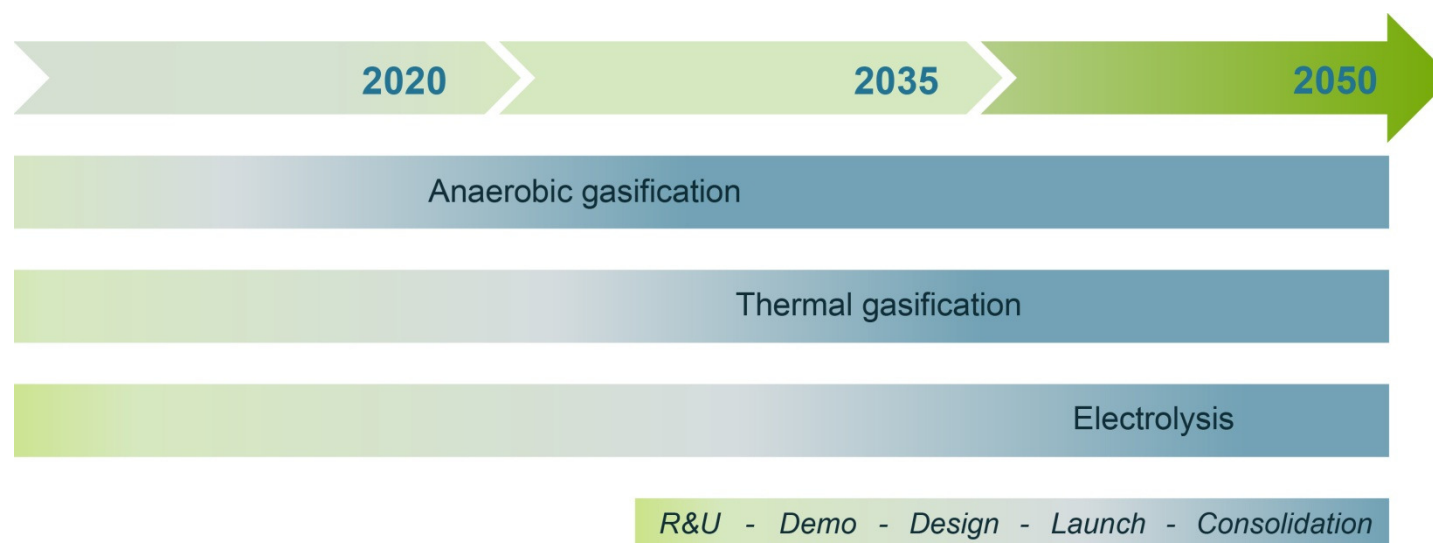
## Adding pure Hydrogen (H<sub>2</sub>) is also possible...

... demonstration is ongoing and it can make gas more low-carbon

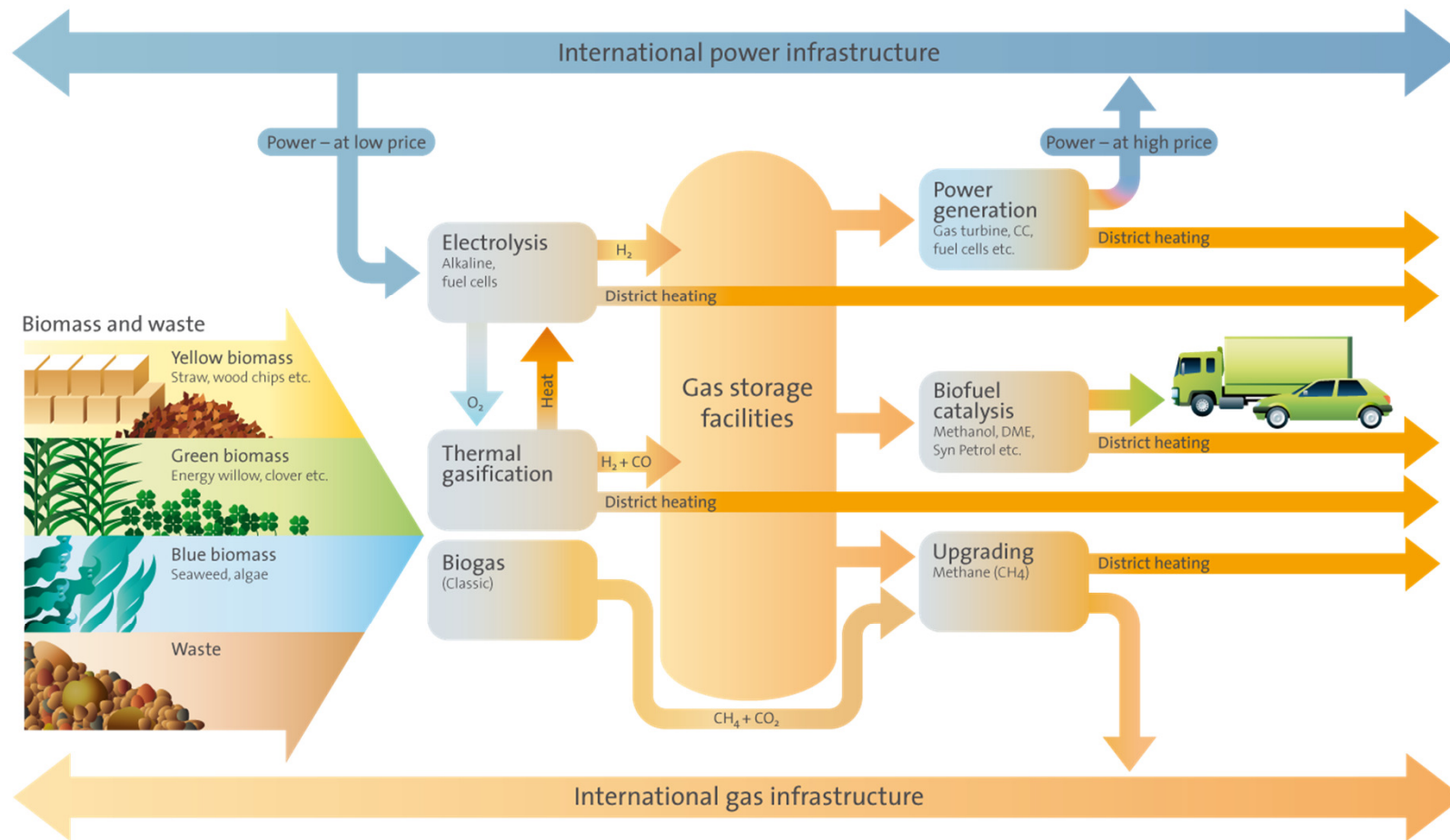
(NI-Greenpeace-Gasunie, F-GRTGaz, DK-Energinet.dk ...)



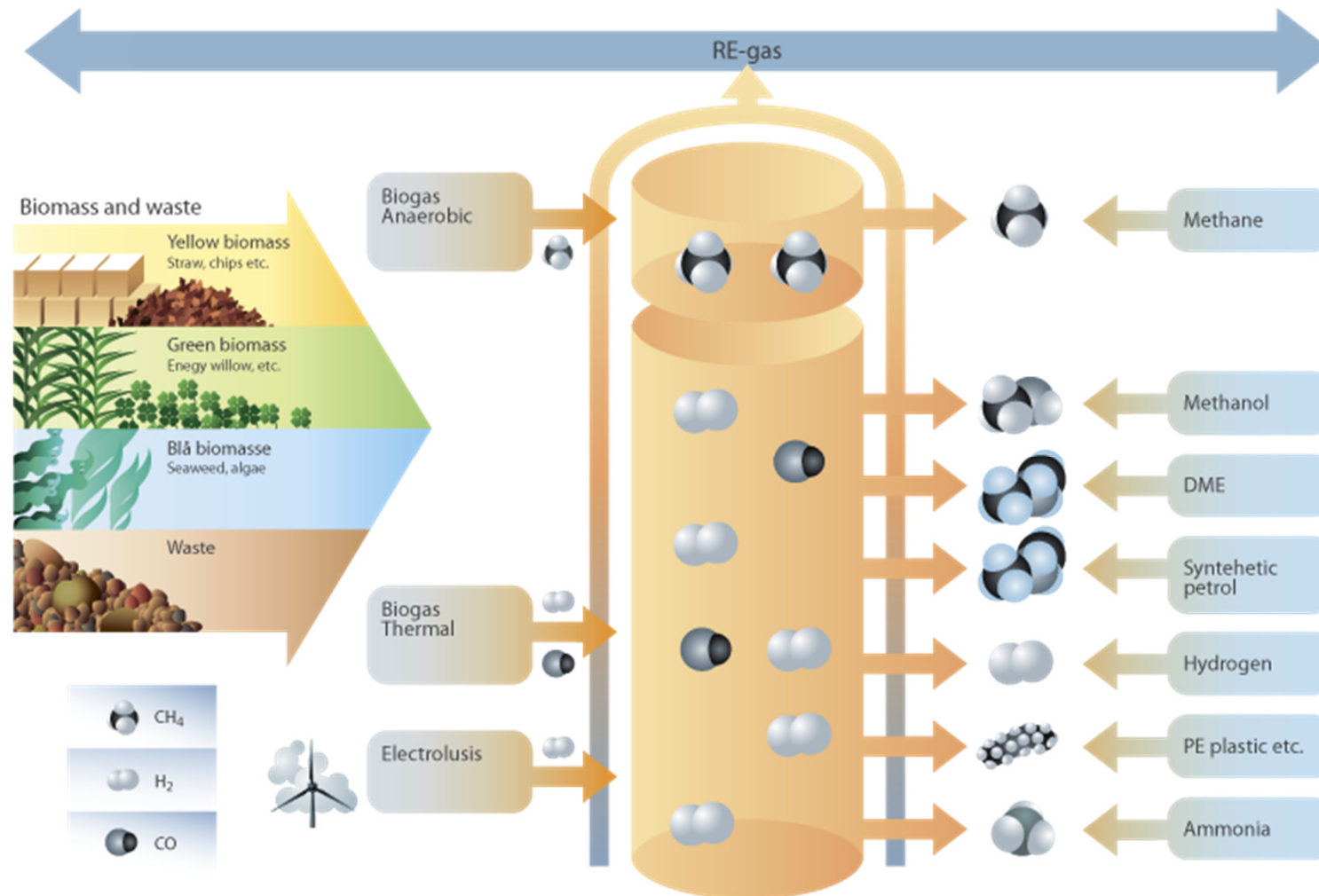
# Development perspectives



# Imagine a future renewables - power - heat - gas integrated energy system ...



Not just a renewables - power - heat - gas vision – to achieve true energy efficiency we have to integrate all energy carriers

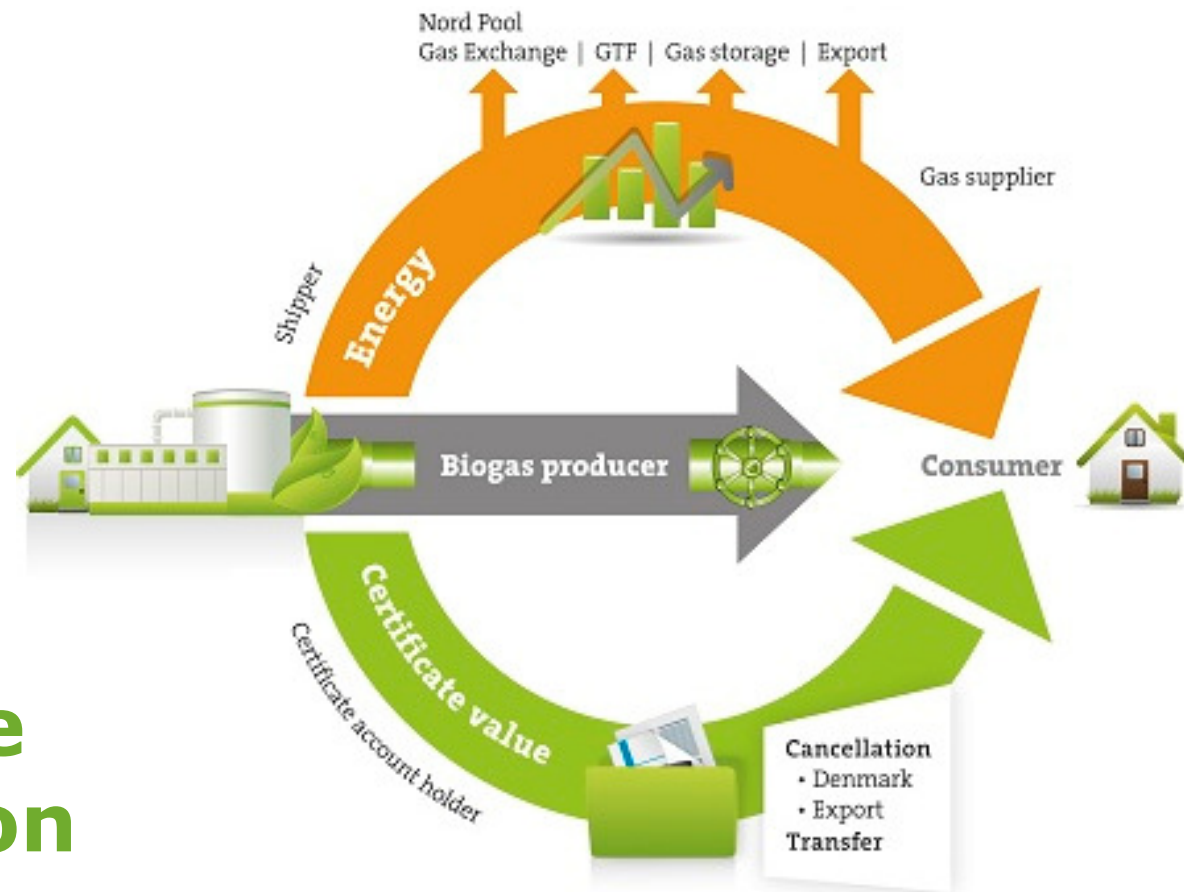


# Green Gas Value Maximisation is all about

## Access to EU Gas Market Prices

Grid access

## Certificate Green Value Maximisation



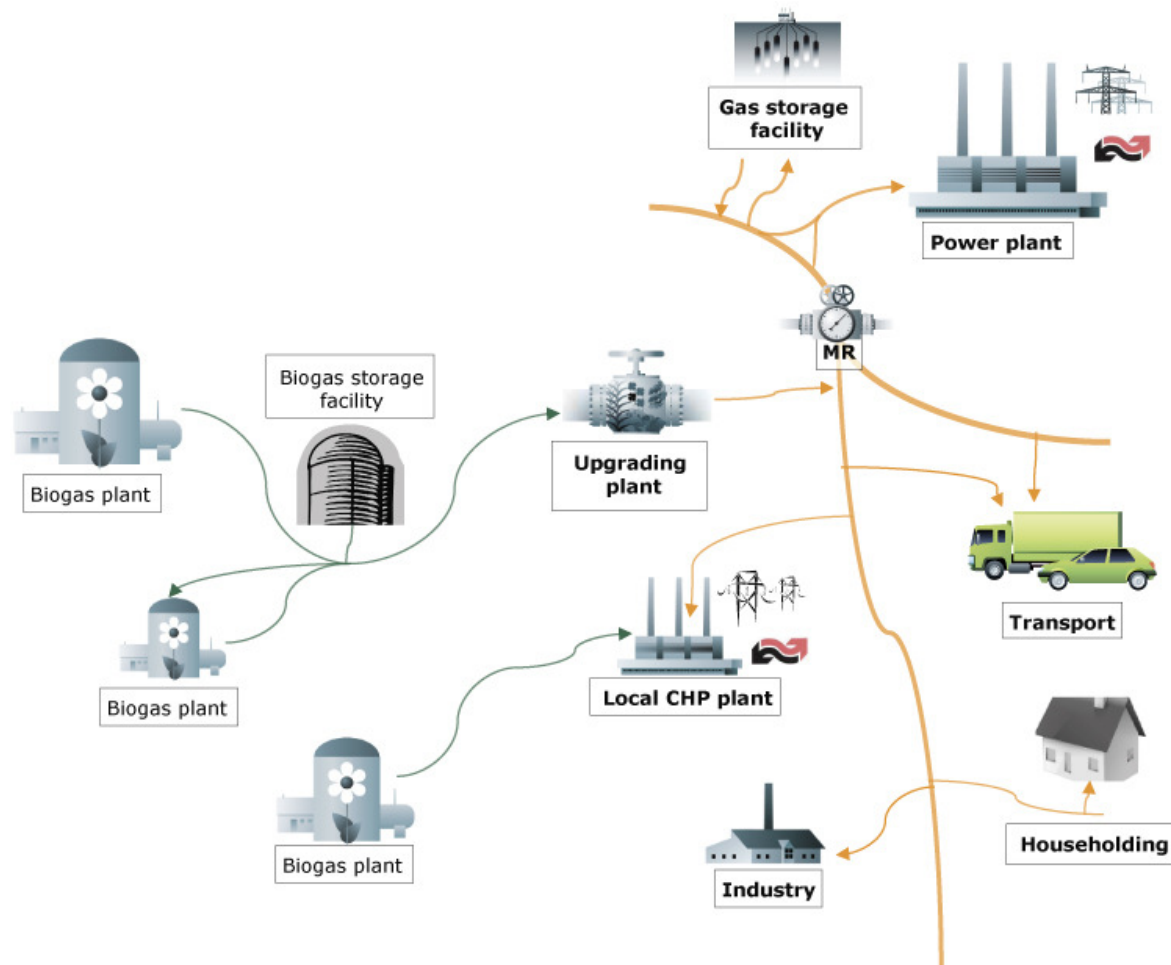
**Securing grid access  
secures that green gas can be  
stored and utilised  
in a market based optimal way ...**

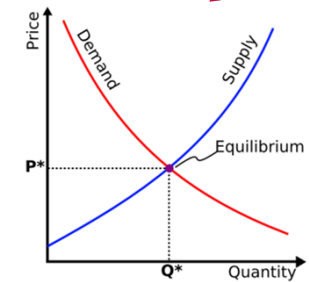


**... without loss of energy**

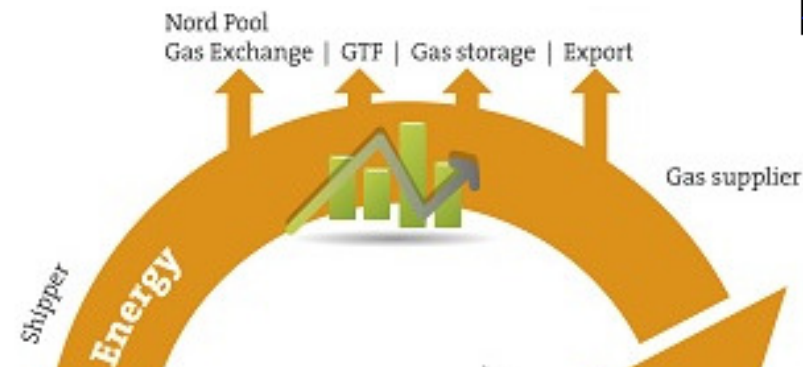


The grid and the biomass is there ...  
... we just need to connect





## Access to EU Gas Market Prices



**Securing EU gas market access to green gas production secures that a liquid spot gas market price can be obtained by green gas producers and consumers**



## Securing EU recognised green gas certificates can maximise the additional green value

### Certificate Green Value Maximisation

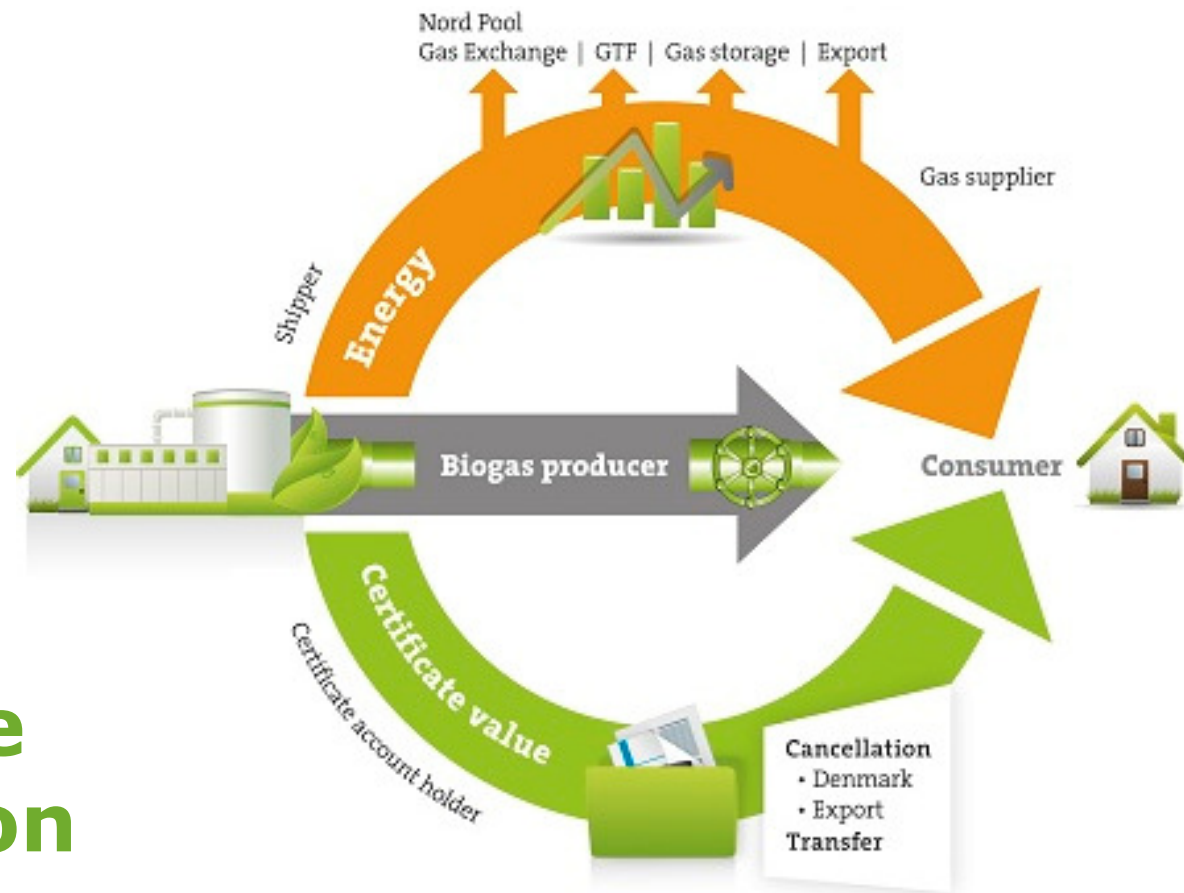


# Green Gas Value Maximisation is all about

## Access to EU Gas Market Prices

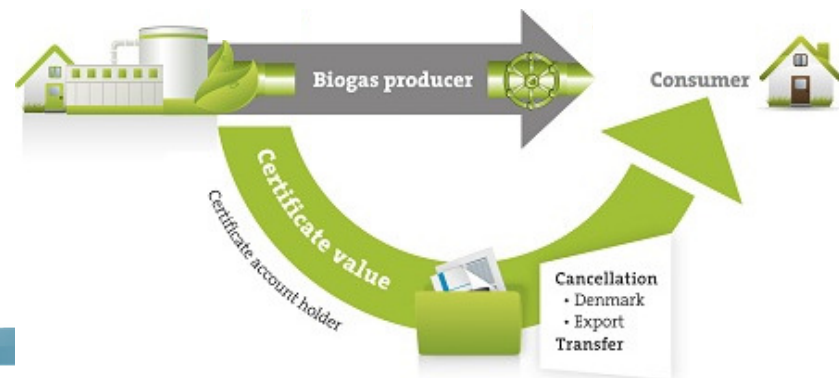
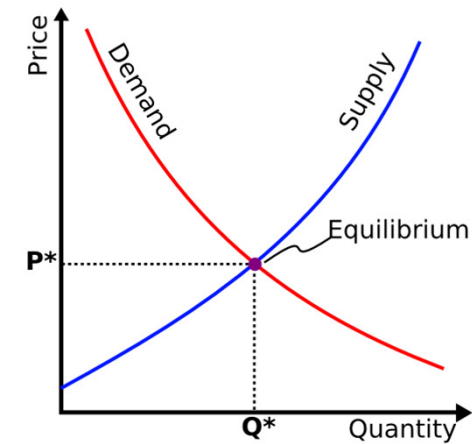
Grid access

## Certificate Green Value Maximisation

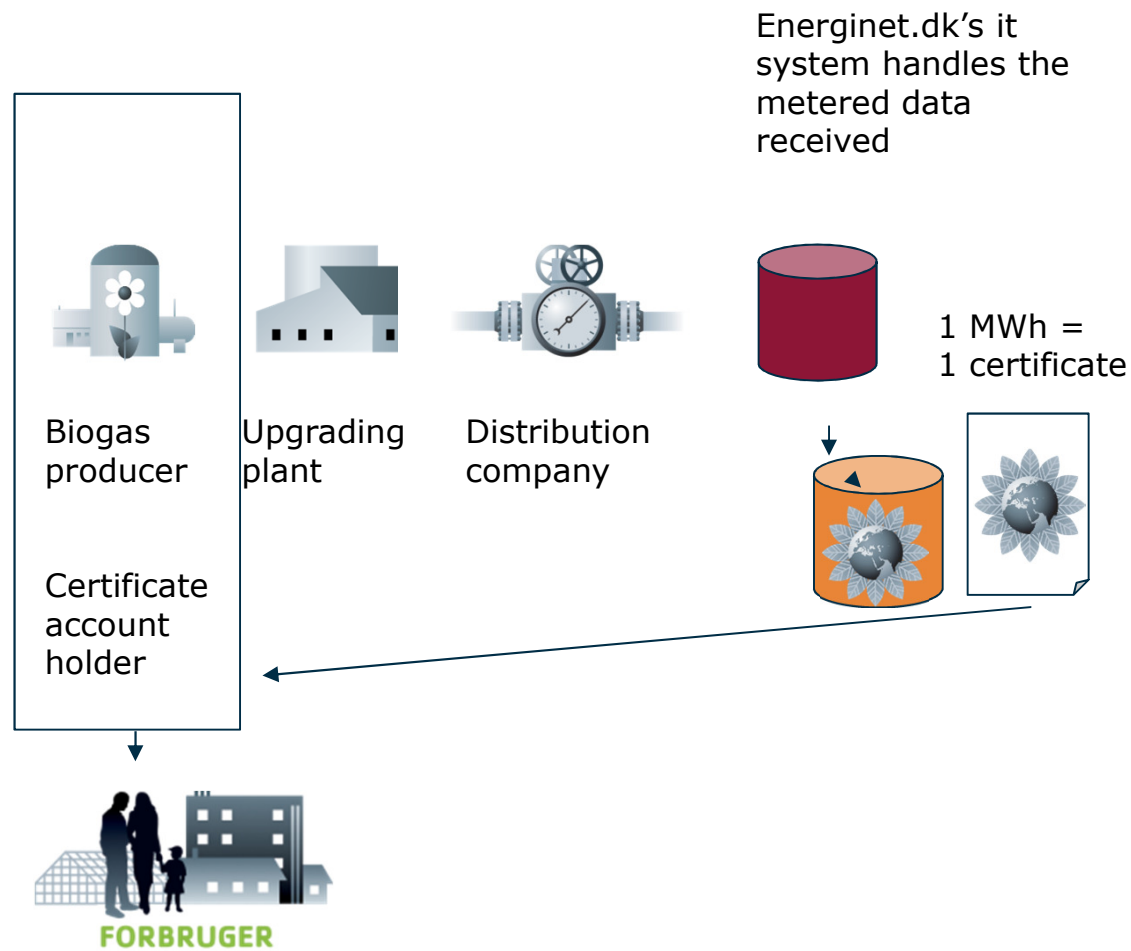


# We all know how to maximise gas value for producers, consumers and society 😊

But how about maximising the green value?

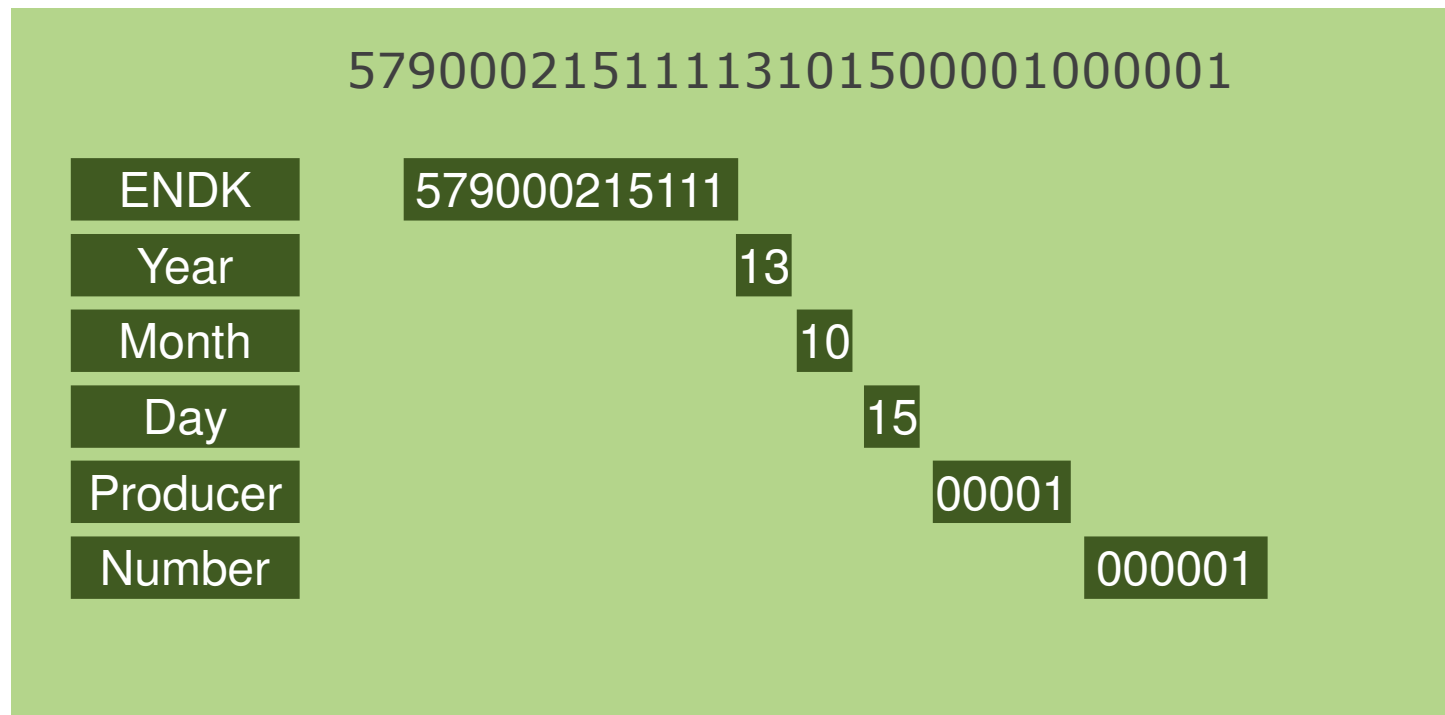


# Issuance of Green Gas Certificates

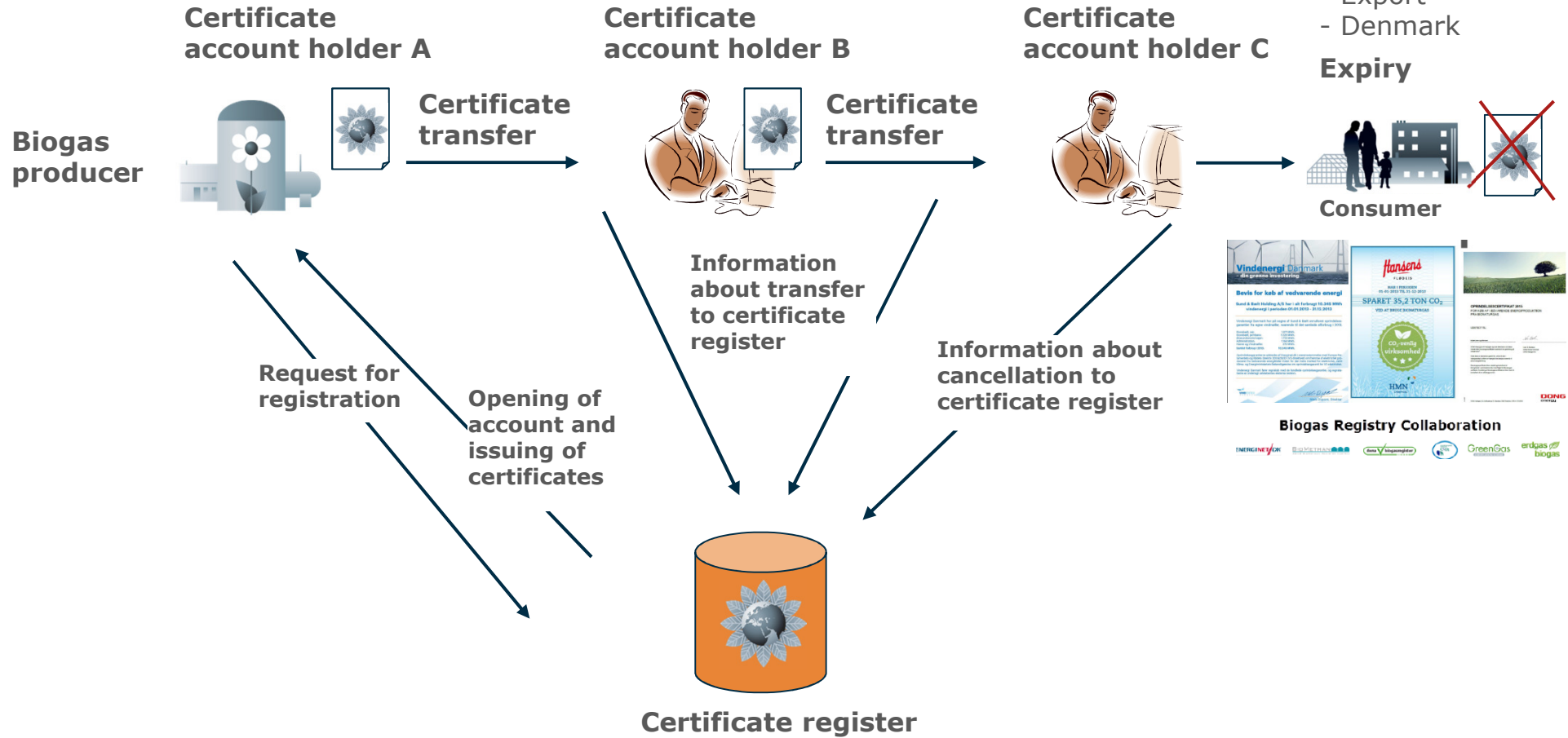


# Structure of a Green Gas Certificate

Example of the electronic identification



# Life Cycle of Green Gas Certificates





# Green Gas Challenge 1



## Green Gas Certificate Recognition:

Industries can use certificates for quota requirement recognition and CSR purposes

But certificates can not be used to fulfil e.g. EU renewable transport fuel requirements and e.g. local requirements to renewable energy supply for heating



# Green Gas Challenge 2



## Certificate tradability and market value:

Can be traded bilaterally

Can be traded over some borders  
– but not all

No multilateral trading facility in EU  
- Producers and consumers do not know  
the market value of the green certificates



## Key Greenstream Integration Messages

**Making Gas Part of the Energy Future**

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**Converting Gas from Fossil to Green**

**Converting Gas from Fossil to Green in a Market Based Way**

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**Making a Green Gas Market**

**Making a Green Gas Market**

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**Recognising the Green Value + Making it Tradable**

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Read more at

**energinet.dk**

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# Title

