

CO₂ capture at HVC



December 4th 2018

Carbon footprint of HVC

How to minimize

- Compensation
 - Wind at Sea and Land
 - District heating households (Alkmaar, Dordrecht)
 - Steam to industry (Dordrecht)
 - Steam to sludge drying (Alkmaar)
- Reduction
 - CCU (pilot and demo Alkmaar)
 - Gradual decrease WtE capacity (?)
(closure or switch to biomass)

Onderzoek De grootste opwarmers van Nederland

Gokken met de wereld

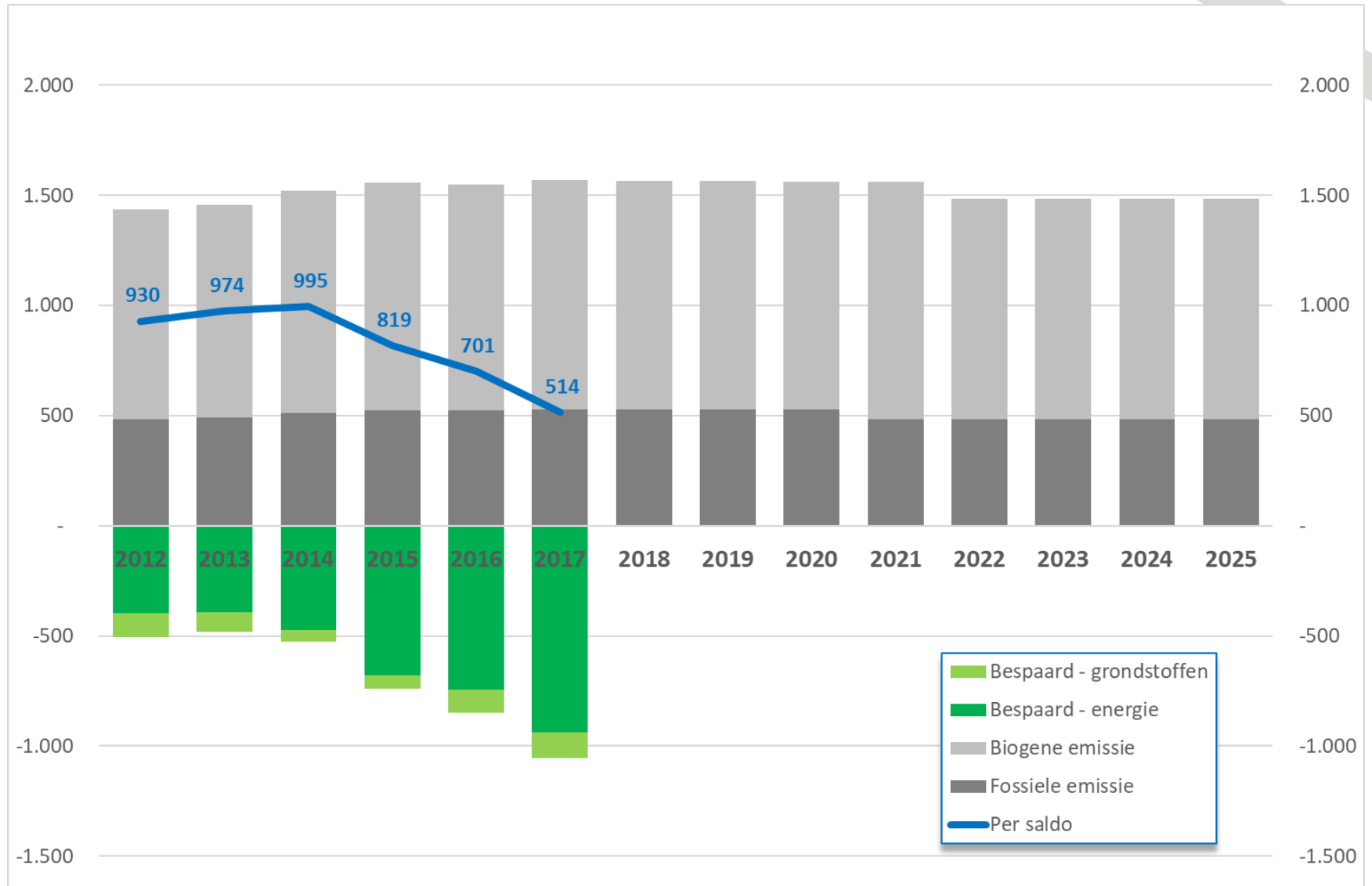
May 17th 2017...

De grootste opwarmers in de industrie

Shell	6,1
Tata Steel	5,8
Chemelot (chemie)	4,9
Yara Sluiskil (kunstmest)	3,5
Dow Chemical	2,8
ExxonMobil	2,6
Texaco/BP	2,3
Attero (afval)	1,7
AVR Afvalverweking	1,5
HVC (afval)	1,4

Uitstoot in megaton CO₂
Volledige lijst op groene.nl

Carbon footprint of HVC (kt/y)



Outlook CCU vs. CCS for WtE

CCU:

- Demand greenhouses mainly (only?) in summer
- Value in the greenhouse itself € 55 per ton
 - Unprofitable top 30 €/t (?)

CCS:

- No demand, no positive value (future obligation?)
- More transport en additional costs for storage
 - Unprofitable top at least 55 €/t (?)

*Some kind of financial solution needed
(Wbm?, ETS?, SDE++?, else?)
meanwhile: experience with CCU*

LCO₂ in North-Holland North

Agriport already has logistics (tanks) up to 400 ton LCO₂
(present demand: 10 kt/y; in 2030: 150 kt/y)



CCU subsidized projects HVC (1)

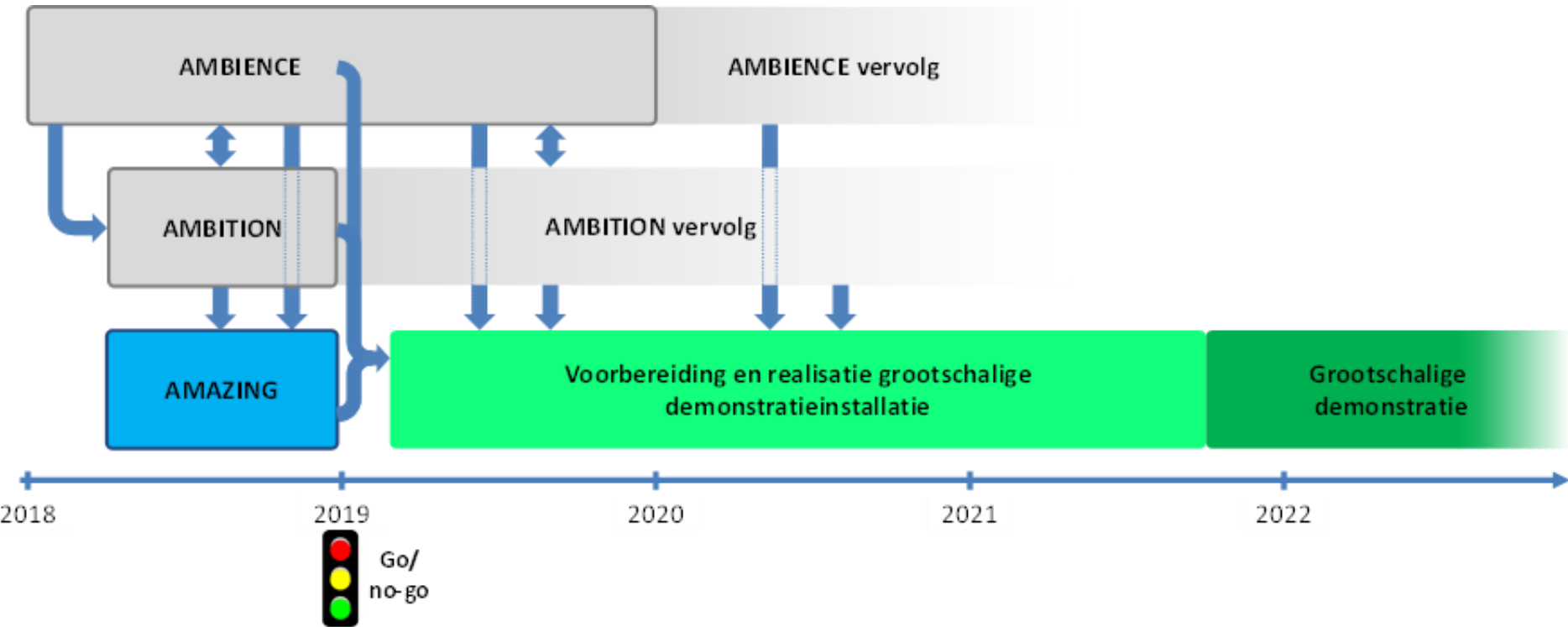
- TKI-CCUS (TCCU117006), known as 'Alkmaar biomass energy carbon capture use (AMBIENCE)'
- TKI-CCUS (TCCU118003), known as 'Alkmaar Bio-CO₂ Liquefaction for greenhouses (AMBITION)'
- TKI-CCUS (TESN218006), known as 'Alkmaar haalbaarheidsstudie grootschalige demo zuiver CO₂ afvang en vervloeiing (AMAZING)'

Pilot

Pilot

Demo

CCU subsidized projects HVC (2)



Project 1
(Ambience & Ambition)

small scale
CCU for (L)CO₂
Bio Energy Plant (BEC)

Pilot CCU at BEC of HVC (1)

Aim of the pilot

Practical step without large financial risks

- Amine adsorption - desorption proven technology
- Albeit in other flue gas environments
- Scale 0,5 t/h capture (4.000 t/y)
- Operation during 12 years foreseen (SDE+ timetable)
- Small scale allows offtake also during winter (?)
- Subsequent liquefaction
- Some 150 t/y of the CO₂ will be delivered as a gas to the IBA washing plant as an alternative for Soda.

Pilot CCU at BEC of HVC (3)

Datum 5 juli 2016
Onze referentie CEQ 16-011
Behandeld door Gerjan Emsbroek
Direct nummer 026 373 16 58
E-mail servicedesk@certiq.nl
Onderwerp SDE+ beschikking BEC Alkmaar

Geachte heer Den Blanken,

Op 22 juni 2016 ontvingen wij uw brief met kenmerk 160620-JPB. U heeft aangegeven een beschikking te hebben ontvangen van de Rijksdienst voor Ondernemend Nederland voor de verlengde levensduur van de BioEnergieCentrale (hierna: BEC) te Alkmaar. Een van de mogelijke toepassingen betreft de CO₂ afvang en u verzoekt ons om een schriftelijke bevestiging dat deze toepassing inderdaad

In de bijlagen van uw brief wordt aangegeven dat de CO₂ wordt afgevangen en als grondstof zal worden geleverd aan glastuinbouwkassen. Op grond van uw informatie concluderen wij dat de warmte voor CO₂ afvang wordt gebruikt voor de verwarming in industriële processen en de CO₂ afvang geen onderdeel is van de rookgasreiniging en evenmin een noodzakelijk onderdeel is van de BioEnergieCentrale. Op basis hiervan concluderen wij dat de CO₂ afvang valt onder de definitie van "nuttig aangewende warmte".

Pilot CCU at BEC of HVC (4)

Achievements in two years time

Actual data regarding:

- Energy consumption
- Solvent (Amine) consumption
- Quality liquid CO₂
- Effect on (remaining) flue gas
- Price liquid CO₂
- CO₂ demand in wintertime

In general:

Better assessment of business case full-scale installation

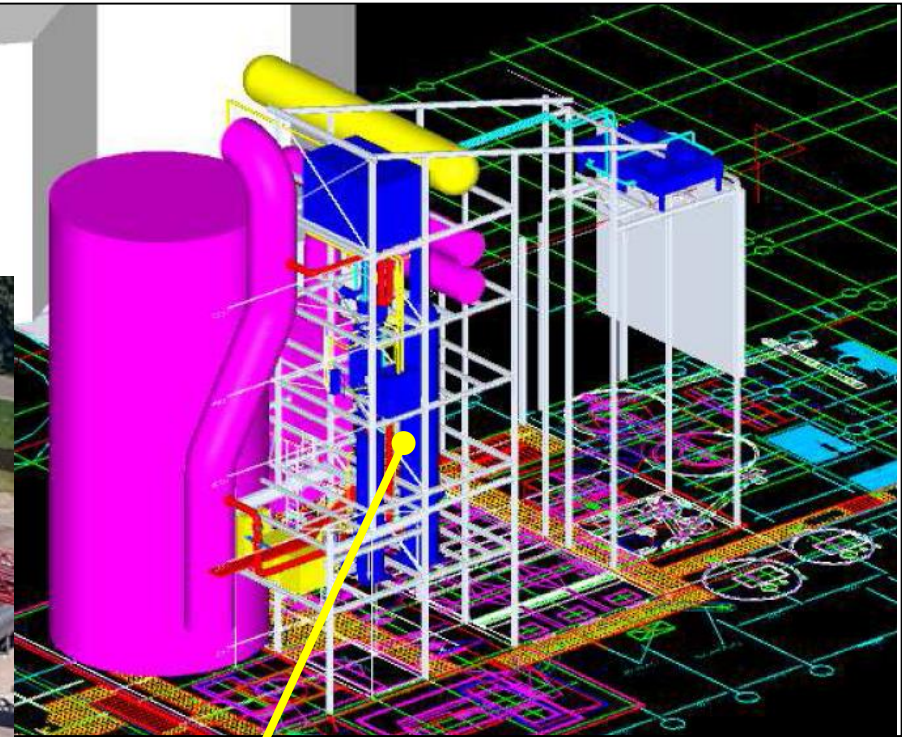
Pilot CCU at BEC of HVC (5)

Current status:

- Capture plant realized
(November 2018, first measurement ECN)
- Final tests for guaranties
(December 2018)
- Start operation capture (Soda replacement)
(January 2019)
- Measuring program ECN:
 - flue gas reboiler
 - gaseous CO₂
 - Amine solution
 - Liquid CO₂(till November 2019)

'Pilot' in BEC Alkmaar quite sizeable (4 kt/yr CO₂ : 12 meter high)

South view



Absorber CO₂,
12 meter high

North view

'Pilot' in BEC Alkmaar, 1st floor



'Pilot' in BEC Alkmaar, 4th floor



'Pilot' in BEC Alkmaar, 5th floor



***Project 2
(Amazing)***

***large scale
CCU to (L)CO₂
BEC and/or WtE plant***

Large scale demo CCU at HVC (1)

Aim:

- HVC: a substantial reduction of the CO₂ emission
- Linde/OCAP: nearby availability of LCO₂ in NHN

Approach:

- Prepare large scale CCU project, legally, financially and organisationally for investment decision
 - Basic Engineering
 - Finalise Business case
 - Prepare permit request
 - Outline cooperation between HVC and Linde/OCAP
 - Financing / subsidizing

Large scale demo CCU at HVC (2)

- Amine adsorption-desorption (proven) technology
- Scale 15 t/hr CCU tot LCO₂
- Approx. 60% of the CO₂ in flue gas AEC Line 4 / BEC
- 6 months (growing season) per year full production
- Wintertime partial production (?)
- Liquefaction and subsequent transport by truck
- Production some 75 kton LCO₂ annually
- Connection to both stack of AEC Line 4 as well as BEC
- Until 2030 SDE+ subsidized steam available (BEC)

Large scale demo CCU at HVC (4)

- Currently a feasibility study in progress
- Subsidized by TKI-CCUS (TESN218006), known as *'Alkmaar haalbaarheidsstudie grootschalige demo zuiver CO₂ afvang en vervloeiing (AMAZING)'*
- Originally scheduled for completion December 30th 2018
- Recently, a postponement request was submitted for June 1st 2019



Wrap up:

***In 2019
all (3) current projects
will be completed***

Planning projects HVC

- TKI-CCUS (TCCU117006), known as 'Alkmaar biomass energy carbon capture use (AMBIENCE)'
- TKI-CCUS (TCCU118003), known as 'Alkmaar Bio-CO₂ Liquefaction for greenhouses (AMBITION)'
- TKI-CCUS (TESN218006), known as 'Alkmaar haalbaarheidsstudie grootschalige demo zuiver CO₂ afvang en vervloeiing (AMAZING)'

30/11/19

01/9/19

01/6/19

Thanks for your attention!

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