

VITO – innovatie

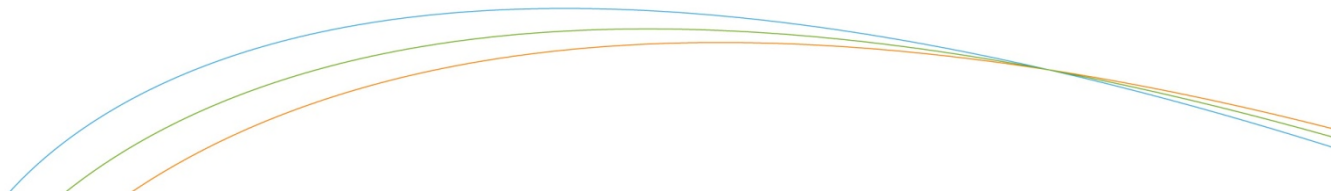
Vlaamse klimaatcommissie

Dirk Fransaer



Overzicht

- » *Situering : duurzame ontwikkeling*
- » *Analyse – “lock-in”*
- » *Toekomst : PV*
- » *Toekomst : Geothermie*
- » *Toekomst : CO2 capture en conversie*

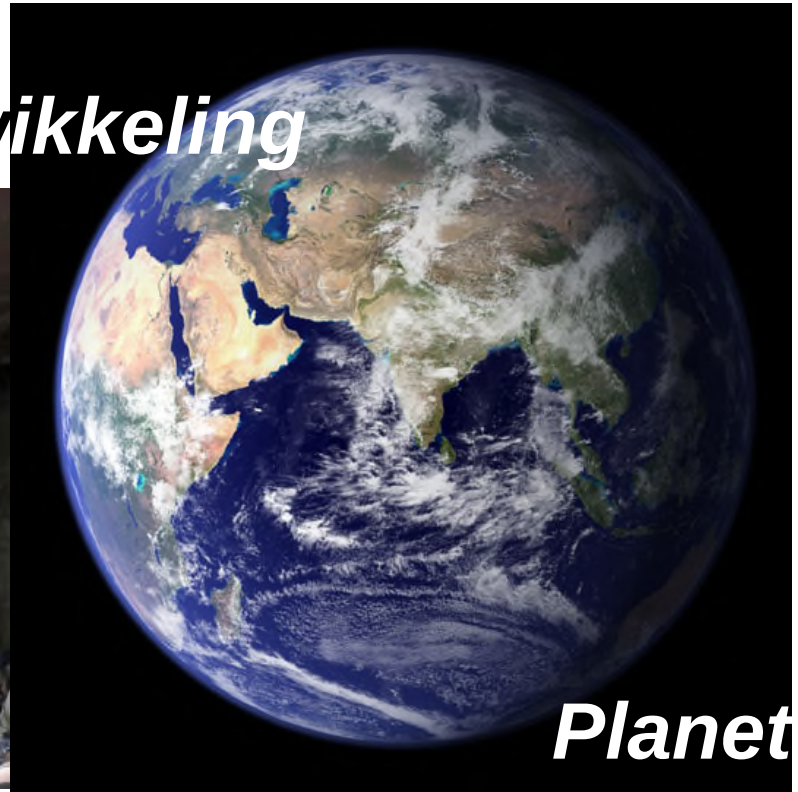


Cleantech en duurzame ontwikkeling

People



Planet



Profit



Governance



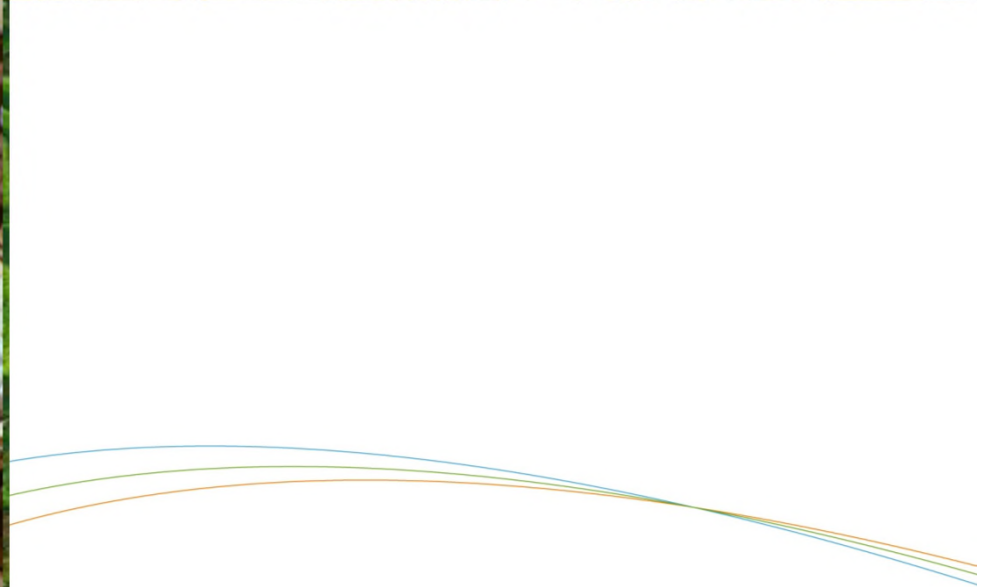
Of the wide variety of sources of atmospheric CH_4 , rice paddy fields are considered one of the most important. The Intergovernmental Panel on Climate Change (IPCC, 1996) estimated the global emission rate from paddy fields at 60 Tg/yr, with a range of 20 to 100 Tg/yr. This is about 5-20 per cent of the total emission from all anthropogenic sources. This figure is mainly based on field measurements of CH_4 fluxes from paddy fields in the United States, Spain, Italy, China, India, Australia, Japan and Thailand.

The IPCC (IPCC, 1996) presented a candidate list of CH_4 sources to the atmosphere as annual release rates. The total annual source is constrained by the observed rate of atmospheric increase of concentrations and by the estimated atmospheric lifetime to be 535 Tg CH_4 /yr. Rice paddies are listed as a source of 60 ± 40 Tg CH_4 /yr.

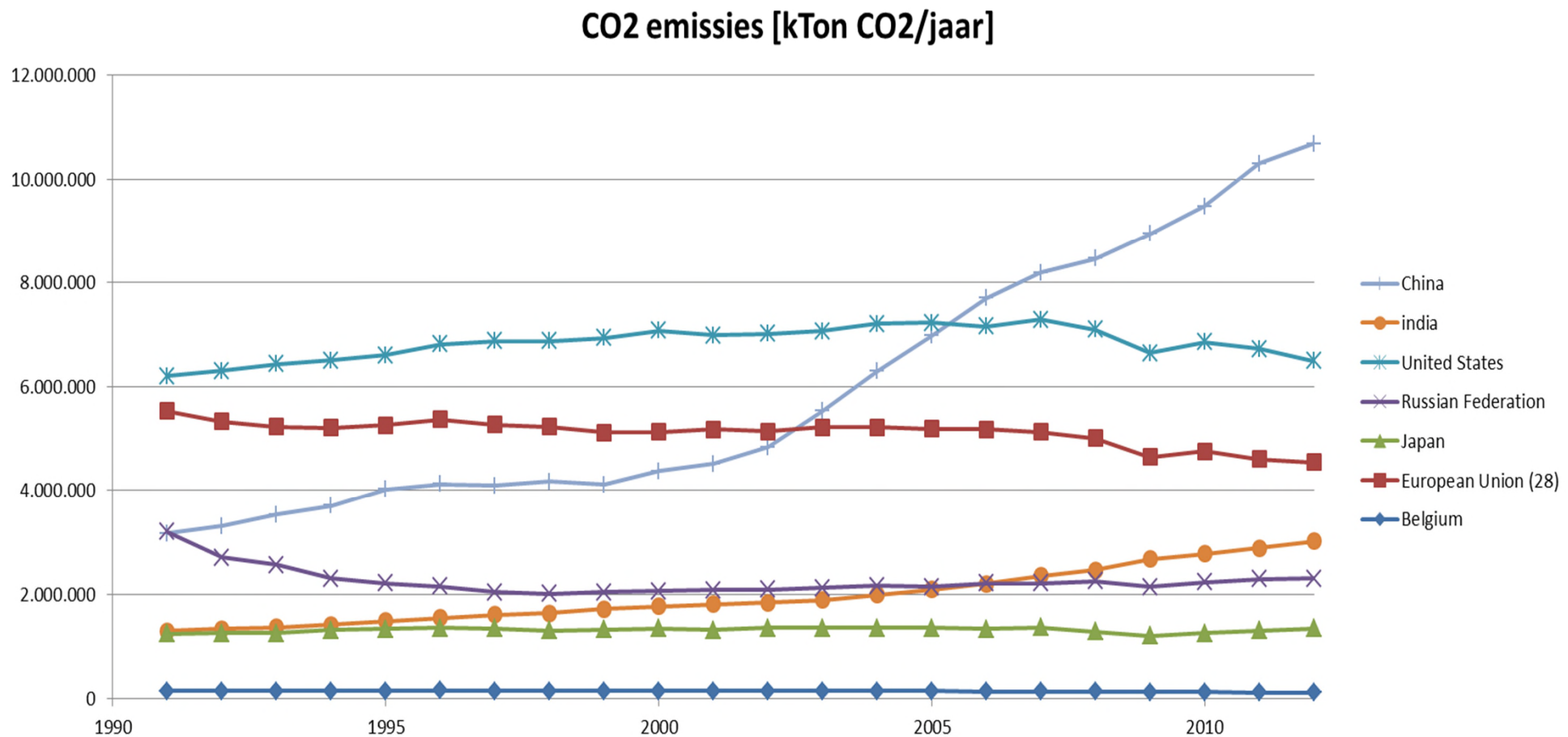
Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual



China



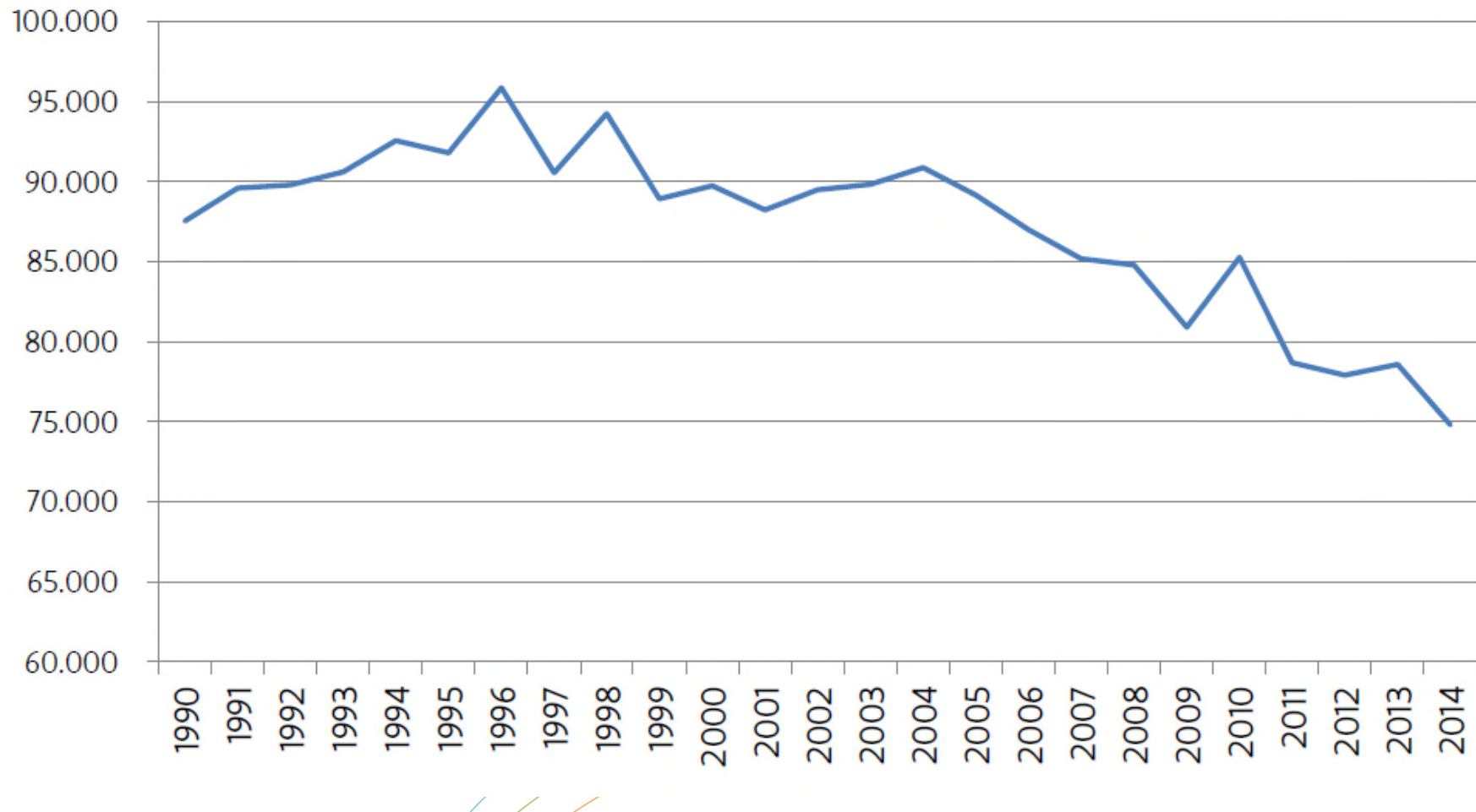
GHG-emissions excl. LULUCF



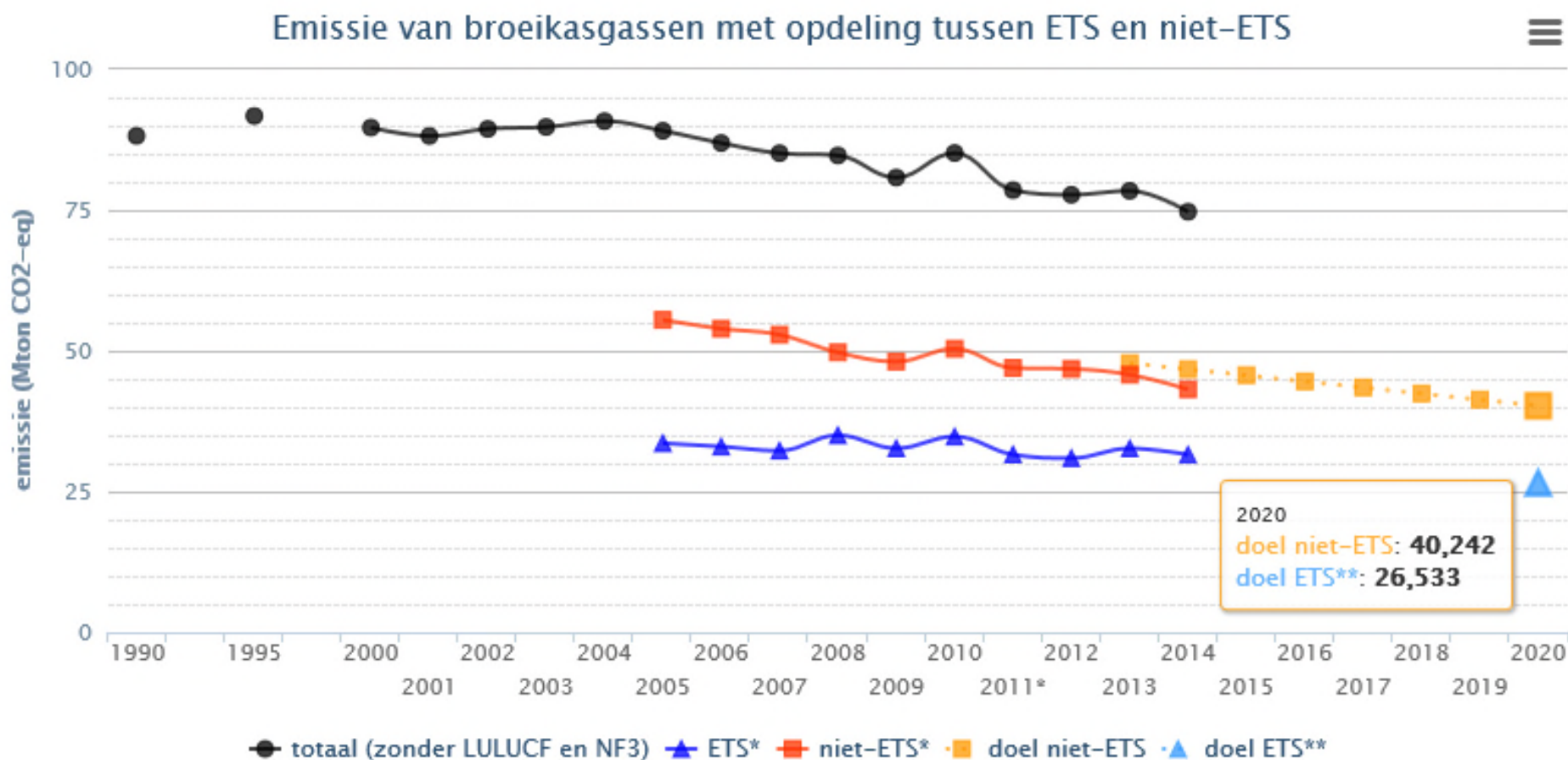
CAIT Climate Data Explorer. 2015. Washington, DC: World Resources Institute. Available online at: <http://cait.wri.org>

Vlaamse broeikasgasreducties 1990-2014

totale Vlaamse broeikasgasuitstoot (kton CO₂-eq)



Vlaamse emissie broeikasgassen



CO2	2005	2008	2009	2010	2012	2013	2014*
	kton	kton	kton	kton	kton	kton	kton
huishoudens	13.063	12.781	12.452	13.417	11.448	12.857	10.706
gebouw en verwarming huishoudens	13.063	12.781	12.452	13.417	11.448	12.857	10.706
industrie	22.055	20.938	18.198	21.251	20.008	20.427	20.186
industriële processen	7.588	7.059	5.307	6.610	6.040	6.615	6.590
verbrandingsprocessen	14.466	13.879	12.891	14.642	13.968	13.813	13.597
brandstofgebruik in industrie (excl. WKK)	13.278	12.645	11.681	13.248	12.630	12.801	12.549
WKK industrie	1.189	1.234	1.210	1.394	1.338	1.011	1.048
energie	22.648	21.047	21.446	21.848	20.163	18.801	16.892
elektriciteitscentrales	17.030	15.312	15.621	16.061	14.555	13.443	11.236
raffinaderijen	5.341	5.465	5.508	5.457	5.341	5.091	5.387
cokesfabrieken	163	161	131	159	161	160	161
opslag, transport en distributie van brandstoffen	115	110	185	172	106	107	107
verkeer	16.137	16.577	16.036	16.316	16.434	17.736	17.805
off-road	703	790	763	749	731	716	720
land- en tuinbouw	1.744	1.295	1.415	1.633	1.499	1.517	1.239
brandstofgebruik in de land- en tuinbouw	1.744	1.295	1.415	1.633	1.499	1.517	1.239
landgebruik, veranderingen in landgebruik en bosbouw (LULUCF)	-245	-175	-206	-197	-238	-232	-232
handel en diensten	4.512	4.663	4.690	4.799	4.394	4.648	3.884
gebouw en verwarming tertiaire sector	3.721	3.464	3.625	3.778	3.355	3.686	2.884
afvalverbranding	791	1.198	1.066	1.021	1.039	962	1.001
totaal	80.617	77.917	74.794	79.816	74.440	76.471	71.200

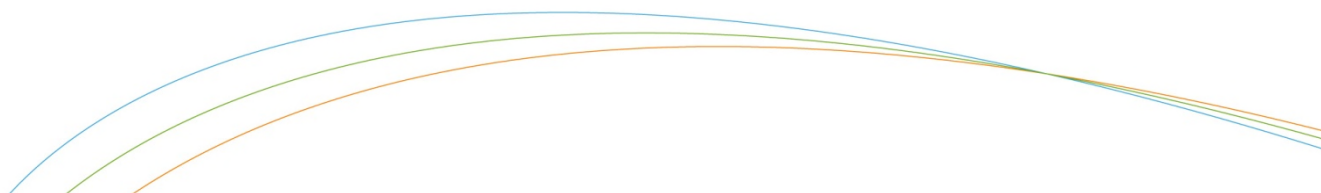
Lock-in

HOME > NIEUWS > BINNENLAND > KLIMAAT

‘Zonder biomassacentrales moeten er 1.000 windmolens bijkomen’

Gisteren om 20:35 door svg | Bron: belga

	Vermogen [GWe]	Totale steun [mld €]	Periode
Zon-PV	2,2	12,2	t/m 2032
Wind op land	0,67	1,3	t/m 2030
Wind op zee	2,2	15,8	t/m 2038



Stern-rapport – climate change

- » 1 à 2 % van BBP – transitie voor climate change
- » Grootste gedeelte is de energieomslag
- » Overheidsbeslag ca. 50 % BBP

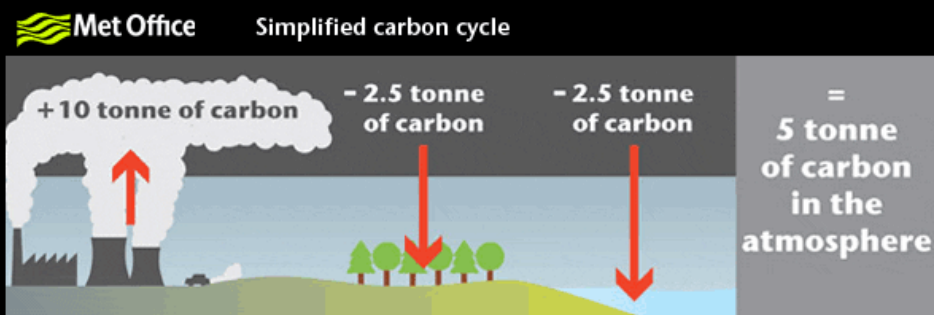


EU wants to cut carbon emissions from the energy sector by 85% by 2050. Present energy system already “down” with only 10 to 20 % renewables

IEA - By 2050 energy production doubles with fossil fuels accounting for 85 % of energy

“We need to save the world”

“We need economic growth to develop the world”



Non-intermittent sustainable energy needed with no opex
Electricity storage - cheap and not before 2030 (?)
Batteries : Target < 150 \$/kwh

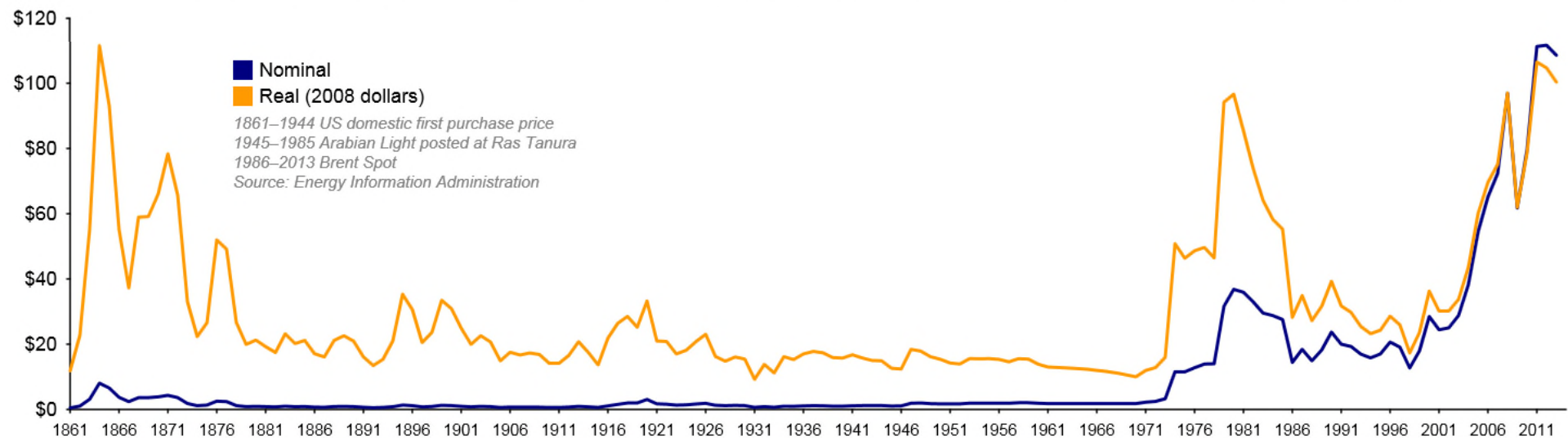
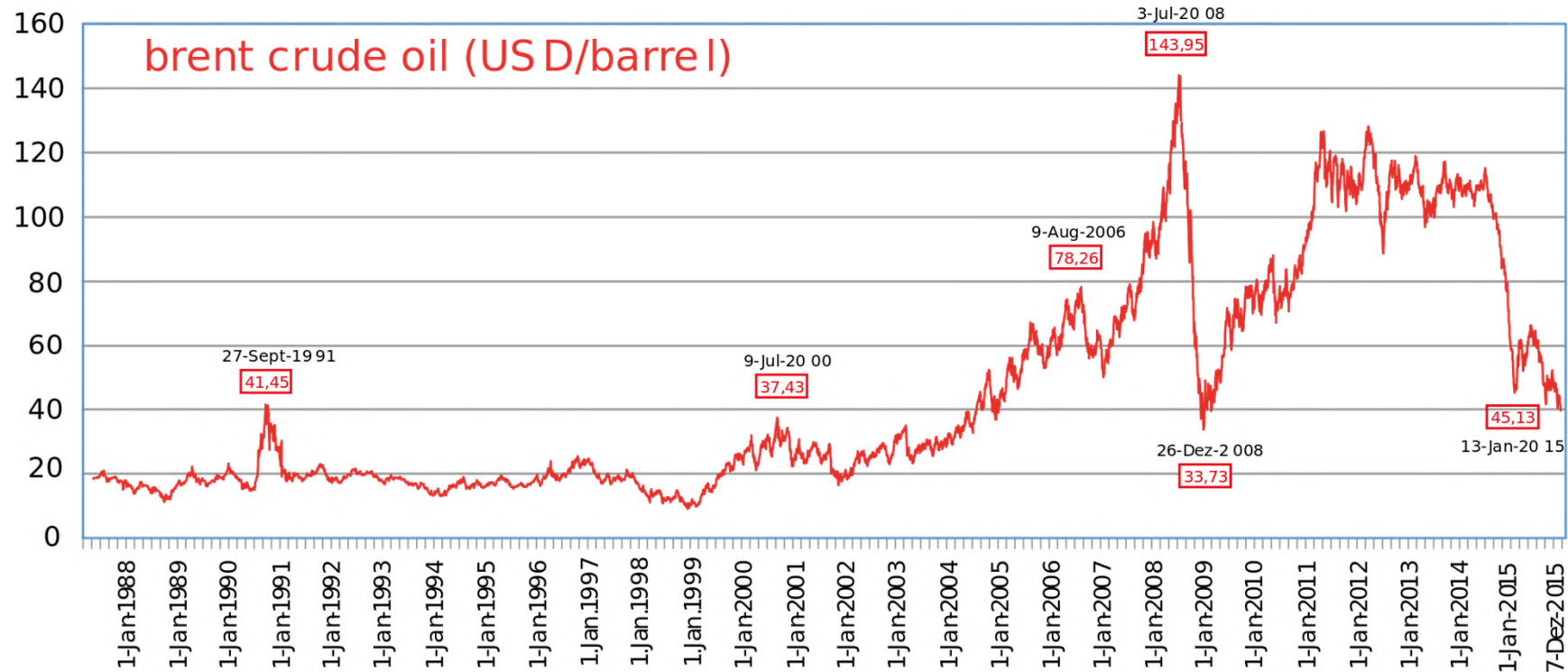
Carbon capture and re-use :
Production and use of renewable fuels and specific use of renewable energy

IPCC

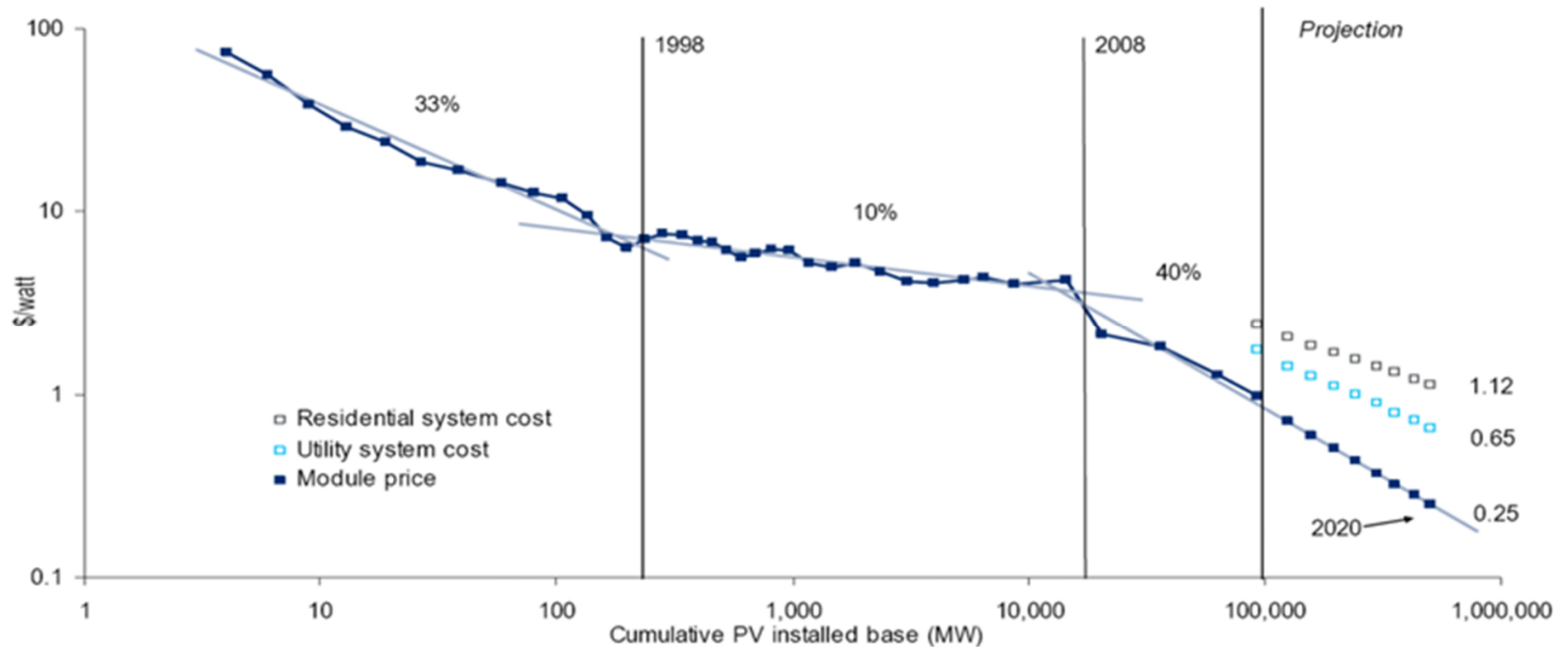
"Mitigation scenarios reaching about 450 ppm CO₂-eq in 2100 (consistent with a likely chance to keep warming below 2°C relative to pre-industrial levels) typically involve temporary overshoot of atmospheric concentrations, as do many scenarios reaching about 500 ppm CO₂-eq to about 550 ppm CO₂-eq in 2100 (Table SPM.1). Depending on the level of overshoot, overshoot scenarios typically rely on the availability and widespread deployment of bioenergy with carbon dioxide capture and storage (BECCS) and afforestation in the second half of the century. The availability and scale of these and other CDR technologies and methods are uncertain and CDR technologies are, to varying degrees, associated with challenges and risks. CDR is also prevalent in many scenarios without overshoot to compensate for residual emissions from sectors where mitigation is more expensive (high confidence)."



Price Brent crude oil since 2010



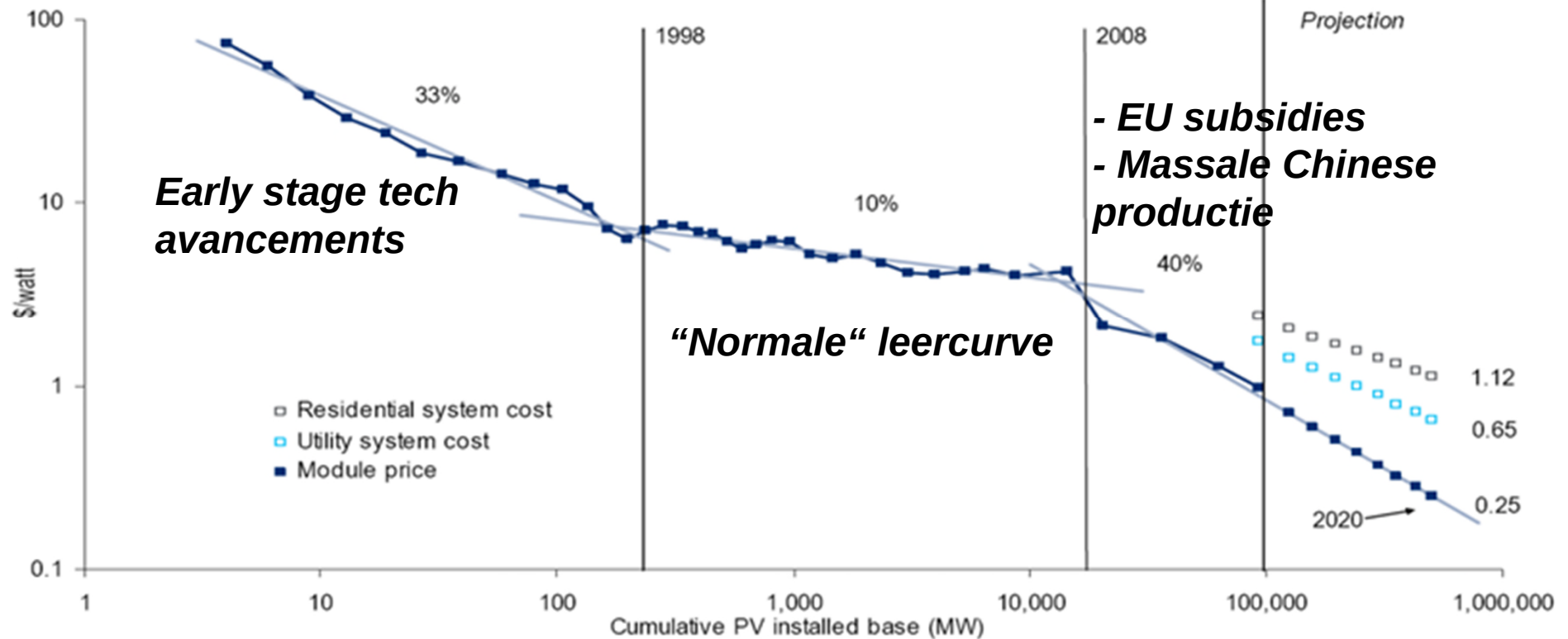
Evolution PV - worldwide



Source: Bloomberg New Energy Finance, Citi Research

Evolution PV - worldwide

2016



Source : Bloomberg New energy finance, Citi Research

India 100 GW by 2020

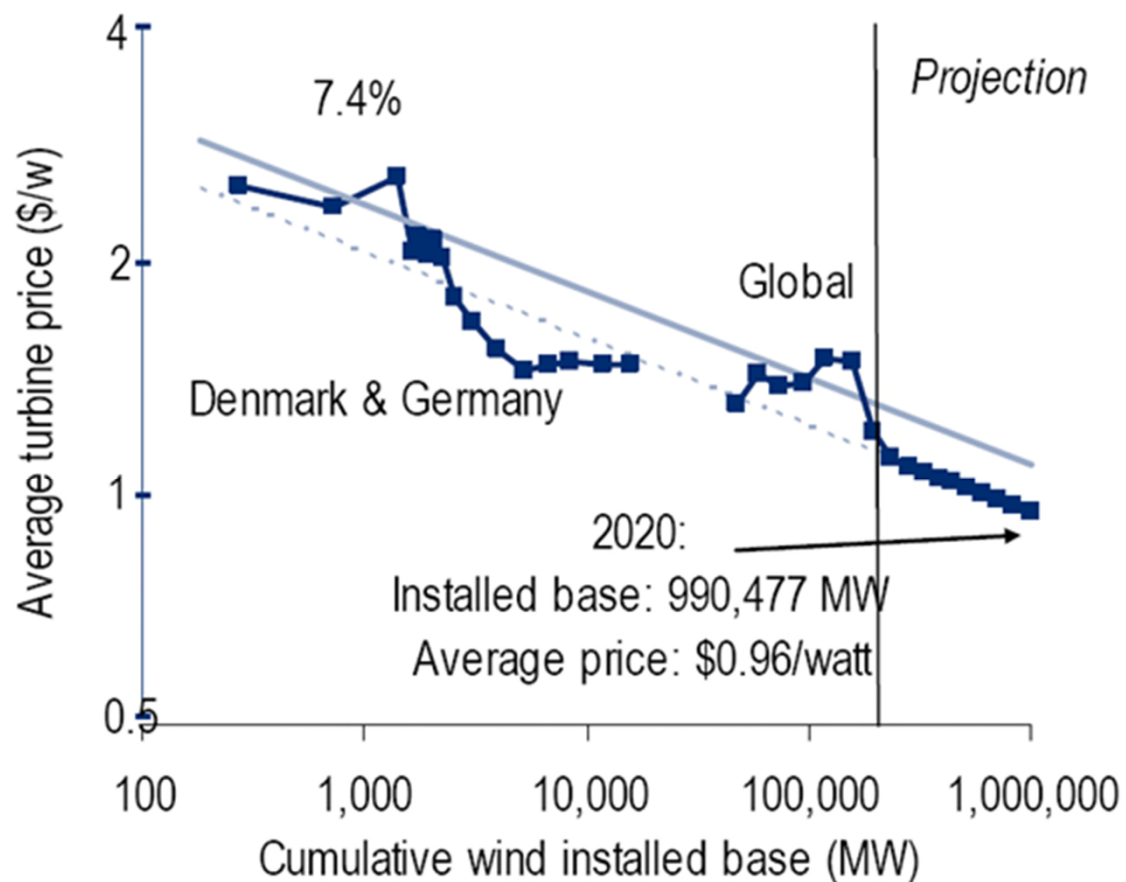
China 12 GW 6 months 2016

US 4 GW 2016

Jordanië : 61 \$/MWh

Peru : 48 \$/MWh

Evolutie “wind”-prijs

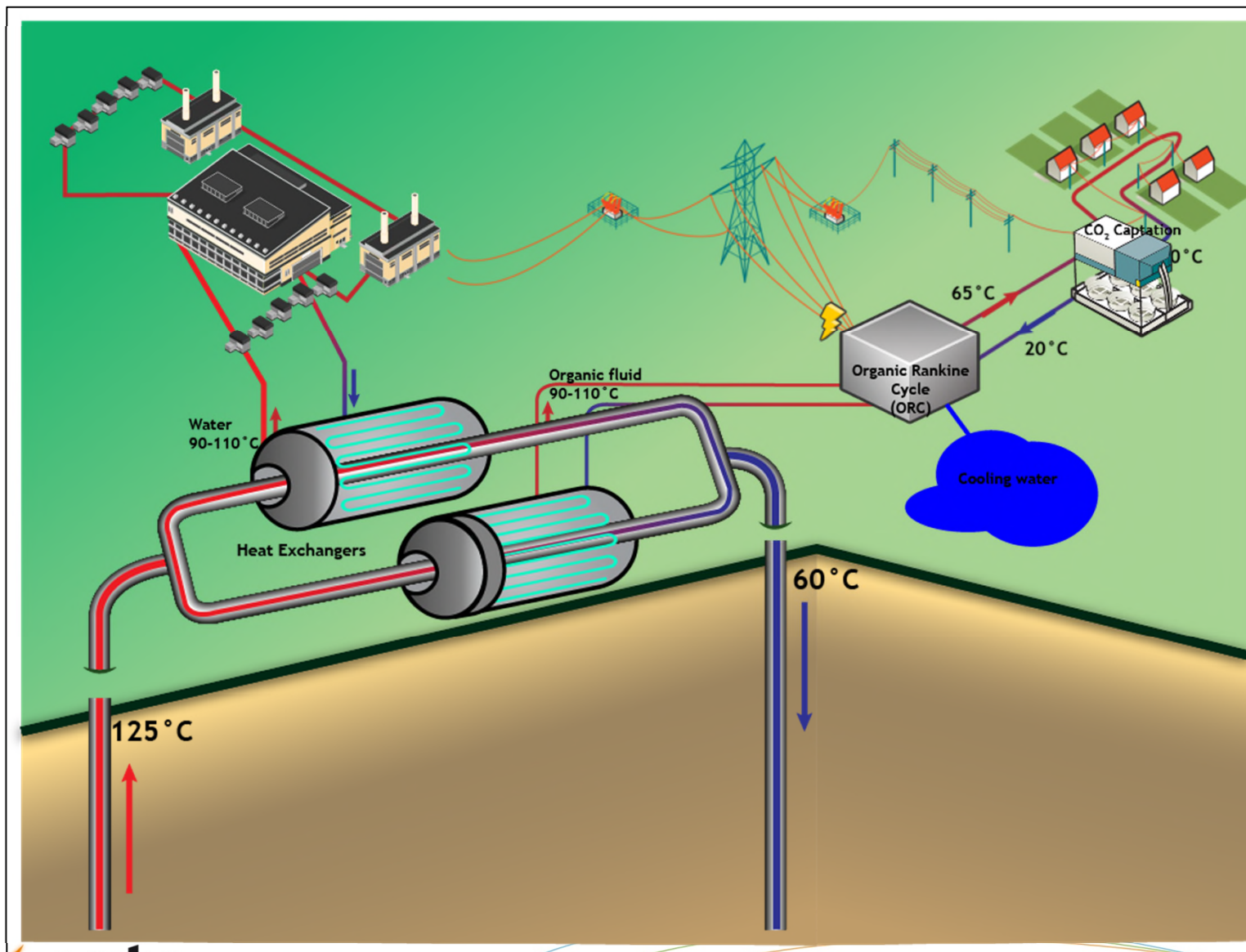


Source: Bloomberg New Energy Finance, Citi Research

Energietransport

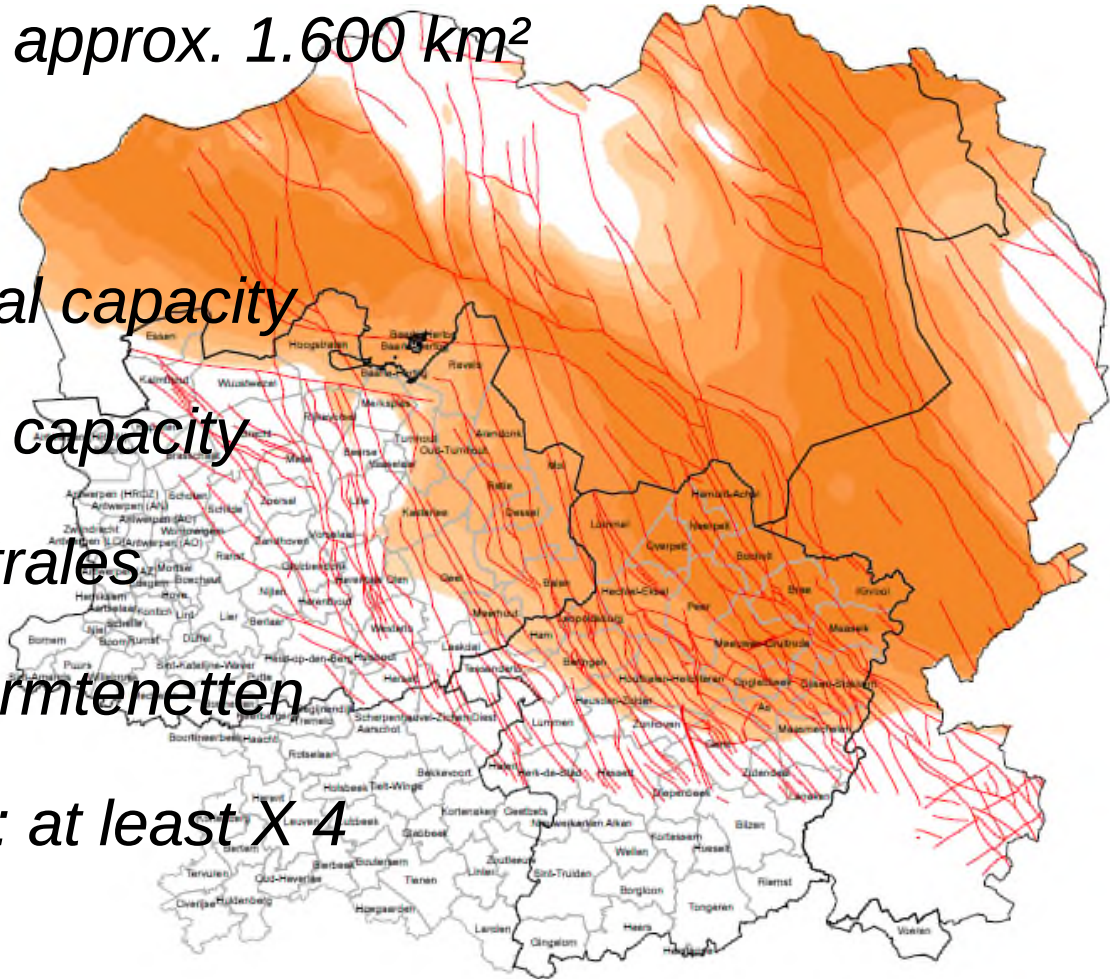
- » 24 Gwh per containerschip
- » Opgeslagen energie in ME en N-Afrika 50 % goedkoper
- » Instabiliteit net - Afkoppeling net



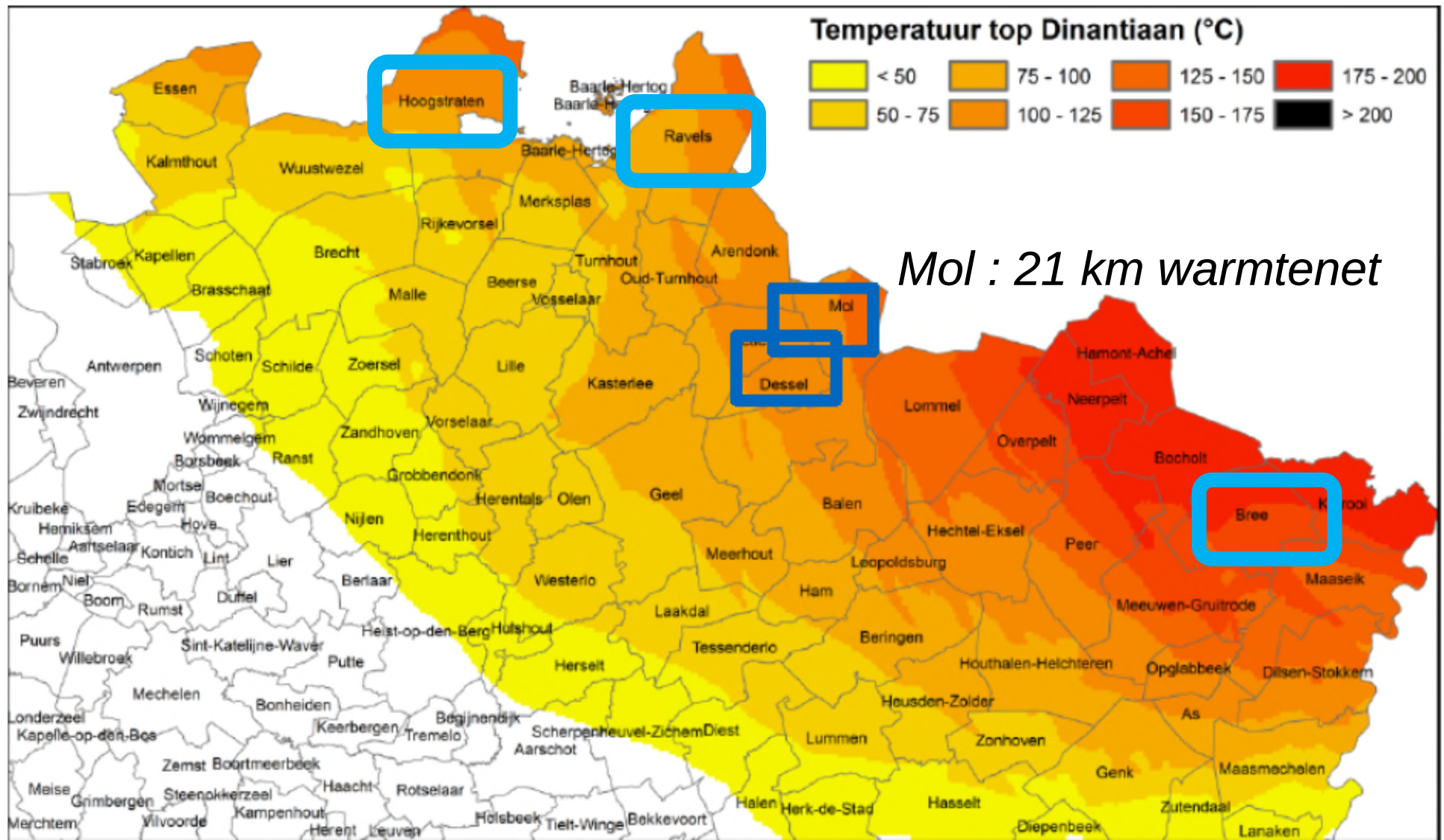


Doelgebied– Vlaanderen - Nederland

- » area in Flanders approx. 1.600 km²
- » Max. 500 wells
- » +/- 5 GW Thermal capacity
- » 0,8 GW Electric capacity
- » 7 miljard € : centrales
- » 24 miljard € : warmtenetten
- » Zuid-Nederland : at least X 4

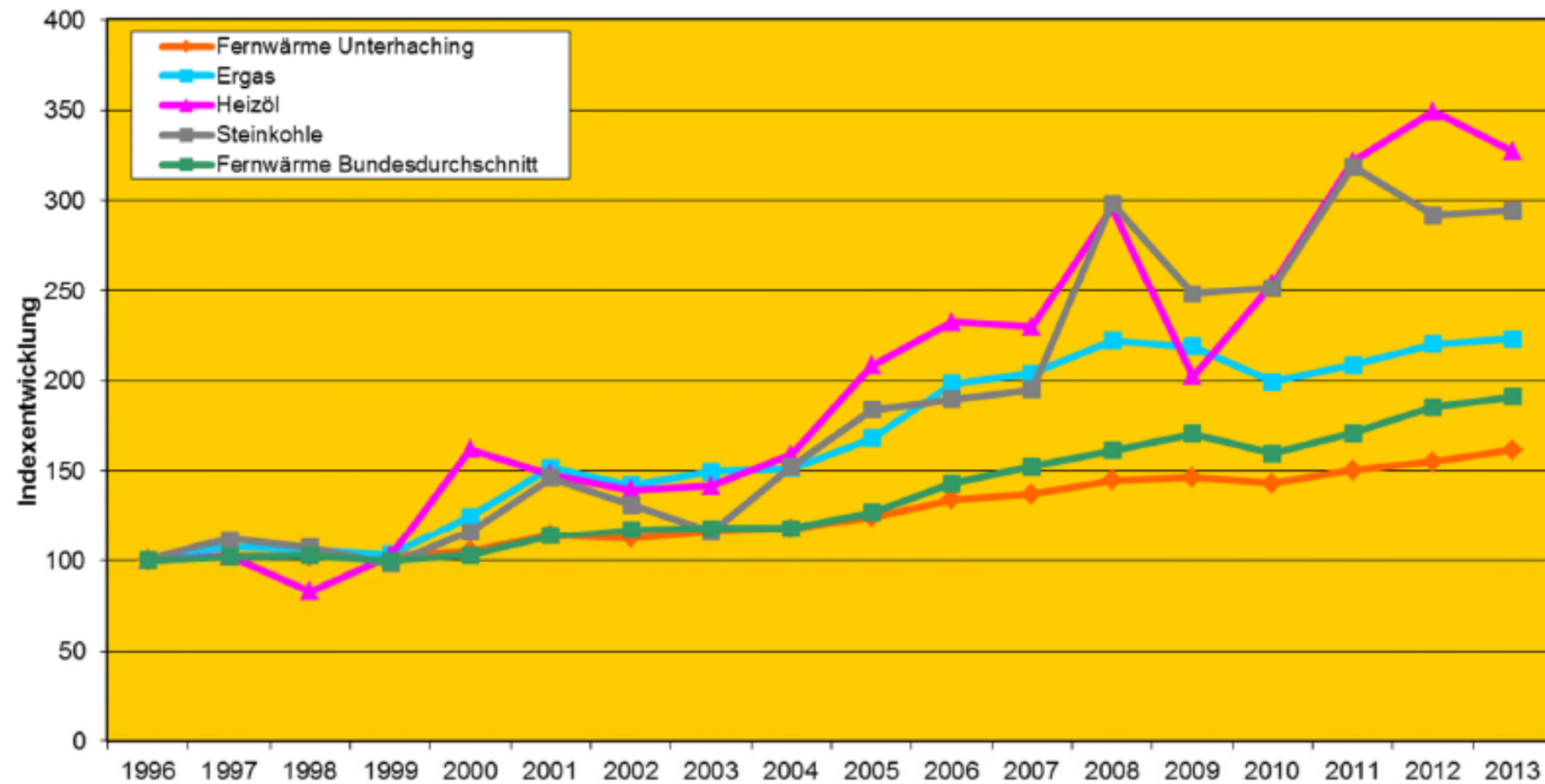


Roll out



Die Preisentwicklung bei der geothermischen Fernwärmeversorgung ist weitestgehend unabhängig von Schwankungen der fossilen Energieträger

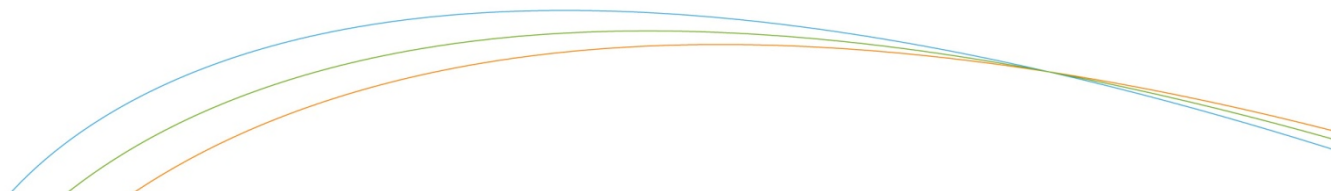
Indexentwicklung Fernwärme Unterhaching und sonstige Art Wärmeversorgung



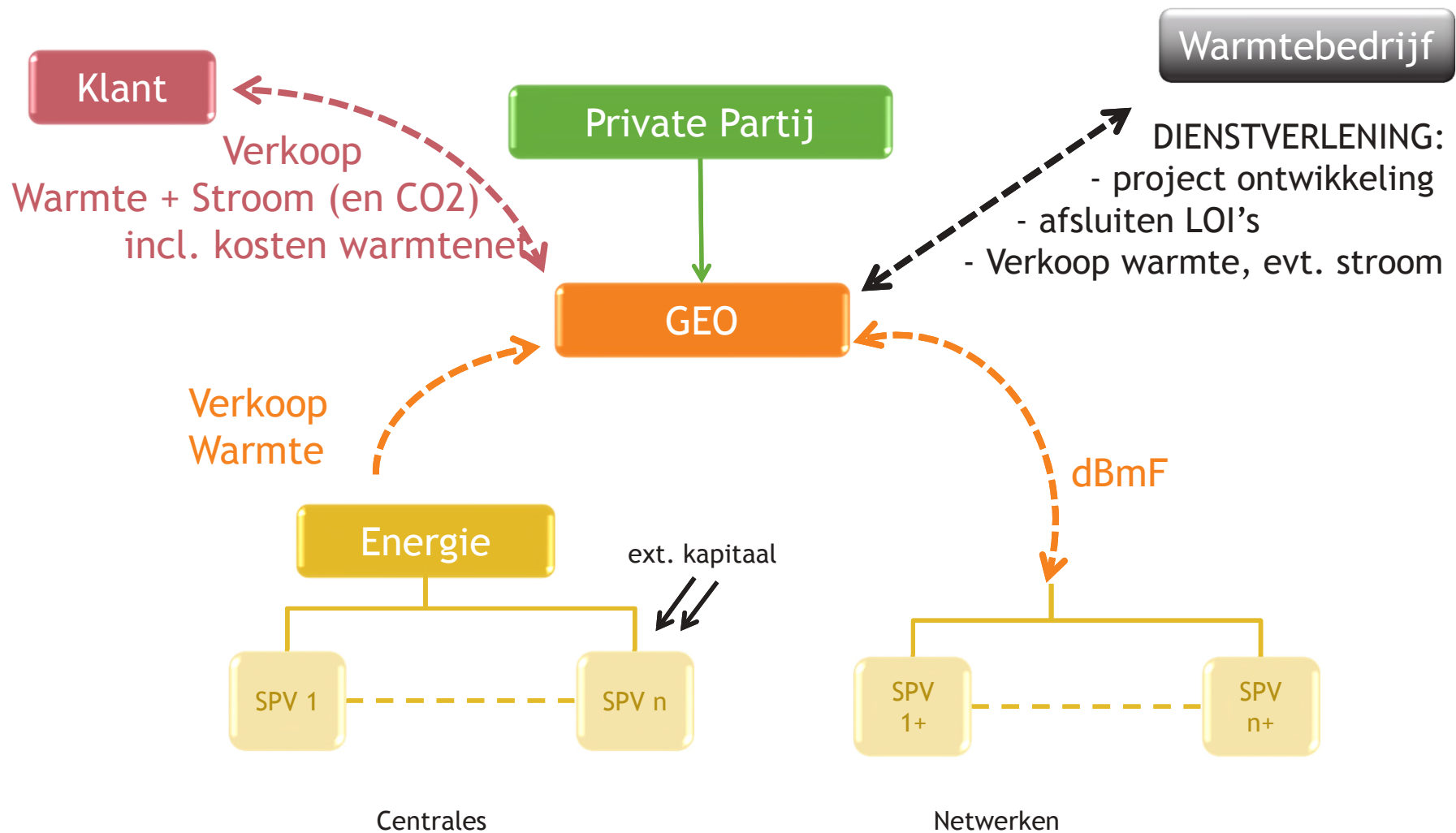
Quelle: Statistisches Bundesamt

Mogelijkheden :

- » *Vermindering CO₂ – emissies minimaal 4,5 Mton CO₂ (2 Mton verwarming – 2,5 à 5,5 Mton elektriciteit)*
 - » *Duurzame elektriciteitsproductie ca. 0,8 GW : 30 à 40 Euro/MWh*
 - » *Geen groenestroom certificaten*
 - » *Prijs verwarming in 45 gemeenten blijft “constant”*
 - » *Private investment in Vlaamse economie tot 31 miljard euro over 15 jaar*
 - » *Tewerkstelling : > 2000 VTE*
-
- » *Vanaf 202X : vermindering CO₂ – emissies door capture and re-use*
 - » *Verdere verbetering handelsbalans, emissies verkeer*



GEOthermie: CORPORATE STRUCTUUR EN ECONOMISCHE RELATIES



Wat vragen we van Vlaanderen?

- » Concessie voor het ganse gebied : 45 gemeenten
- » Wijziging EPB-regelgeving
 - » Gasnetten
- » Concessiebeleid voor locatie geothermiecentrales (max. 40 ha in 1600 km² = 0,5 % landgebruik)

Doelstellingen - Vlaanderen

- » Reductie CO₂-uitstoot
 - » 2013 : 76,471 Mton CO₂ (Vlaanderen)
 - » Woningen 14 % (2013) : ca. 11 Mton CO₂
 - » Woningen (45 gemeenten) : 1,5 Mton CO₂
 - » Warmte (45 gemeenten) : 2 Mton CO₂
- » hernieuwbare energie
 - » 2014 : 405 TWh – totale energiebehoefte Vlaanderen of 5 GW (vol vermogen)
 - » 0,8 GW = 10 % à 16 % van totale elektriciteitsproductie
- » Tegen 2021 alle nieuwbouw : E30 + energieopwekking
- » Particulier moet betaalbare energie (warmte en elektriciteit) hebben

Welke wijziging aan EPB?

- » Woning gekoppeld aan “groen” warmtenet + productie hernieuwbare energie = P30
- » Woning gekoppeld aan “groen” warmtenet van centrale die ook hernieuwbare energie produceert = P30 + voldoet aan eis van energieproductie
- » “Groen” warmtenet = warmtenet waarvan de warmte wordt geproduceerd met minimale tot geen CO2 uitstoot.
- » Toepasbaar in gans Vlaanderen ! => Woning op duurzame warmte met eigen elektriciteitsopwekking (PV + batterijen) = P30 + voldoet aan eis van energieproductie

Onderbouwde EPB-berekening

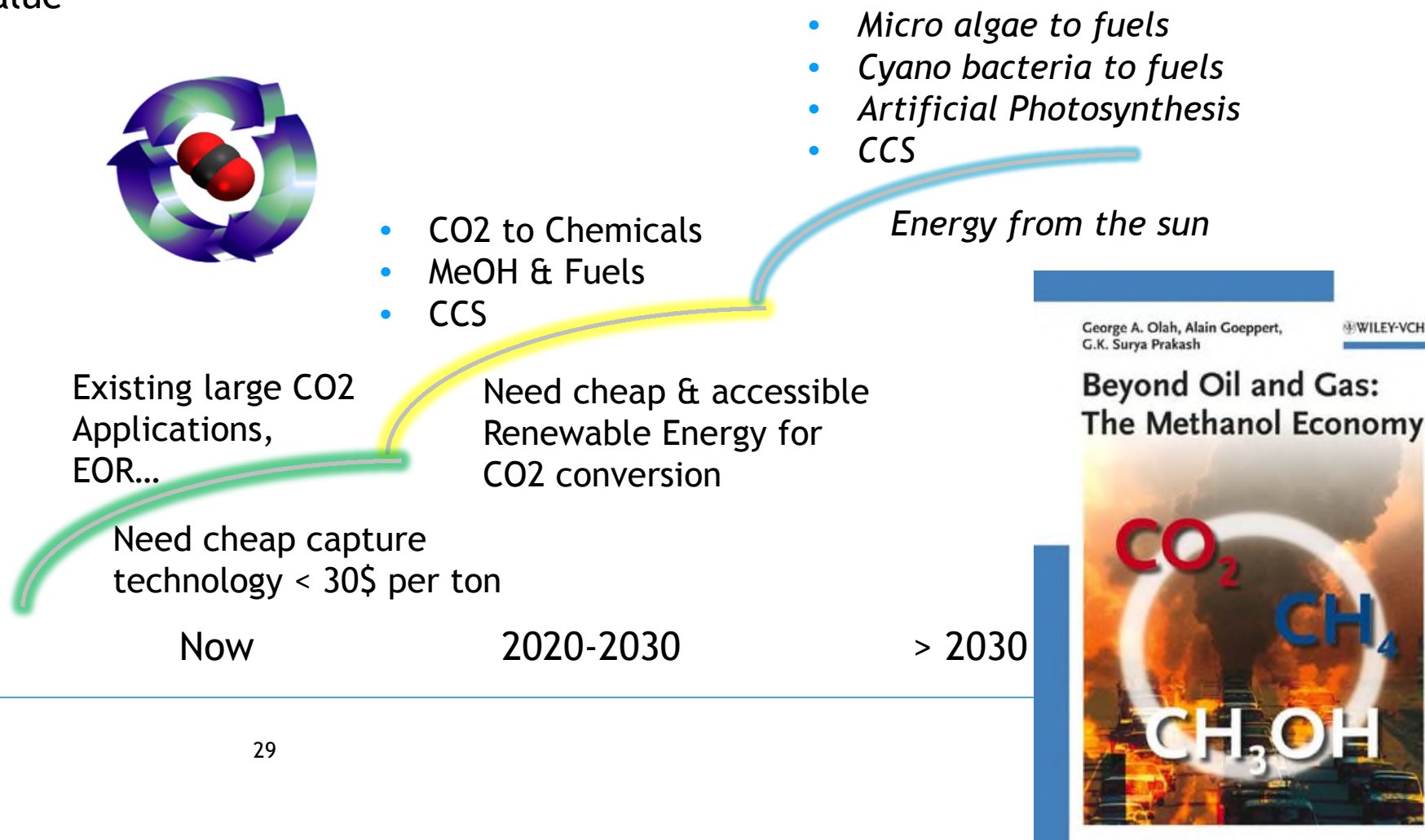
- » NPV(besparing, percentage, jaar) < investeringsbedrag : niet rendabel
- » NPV(besparing, percentage, jaar) >= investeringsbedrag : rendabel
- » VERBedrijven : 14 % (ebo-vlaanderen)
- » Particulieren : 3 % ? 5 % ? 14 % ?

- » Voorbeeld :
- » Besparing verwarmingskost van 1500 Euro naar 1000 Euro per jaar gedurende 20 jaar/30 jaar

CARBON CAPTURE & UTILIZATION (CCU)

CO₂ reuse - *Future steps & tracks*

Value



ETHANOL - LANZATECH

Lanzatech

- » LanzaTech's technology converts 2.3 ton CO into 1 ton bioethanol, replacing 5.2 barrels of gasoline
- » China Steel Corporation (CSC), Taiwan's largest integrated steel maker, has announced formal Board approval of a 1400M TWD (\$46M USD) capital investment in a LanzaTech commercial ethanol facility.
- » ArcelorMittal's steel plant in Ghent, Belgium, with bioethanol production.



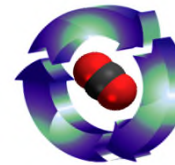
CO₂ reuse Power to gas : methanation

Power-to-Gas: Audi e-gas plant in Werlte (Northern Germany)



Audi future lab: mobility

Vorsprung durch Technik Audi

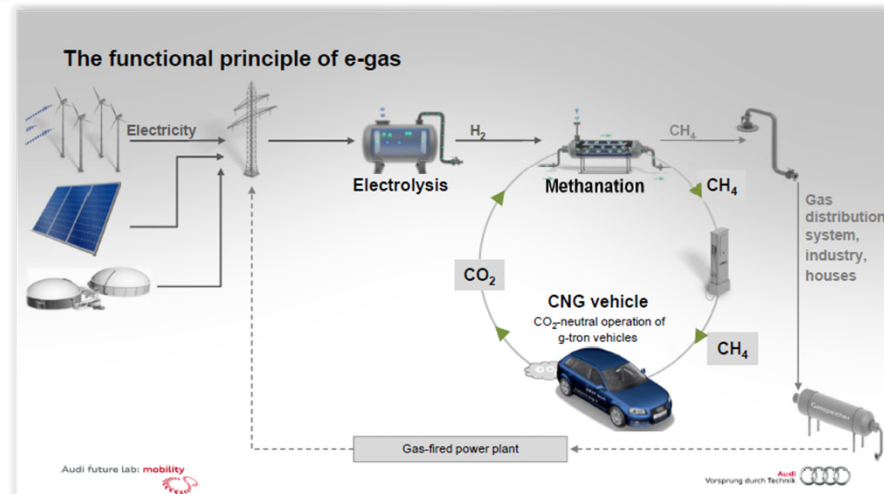


Source :

<http://www.cedec.com/en/events/sections/past-events/cedec-gas-day-27-may-2014-in-verona-italy>

last access 16th March 2015

Methanation of carbon dioxide coming from bio-methane with renewable hydrogen (windfarm)



CCU early demonstrators

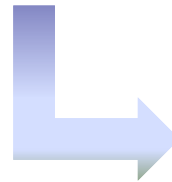
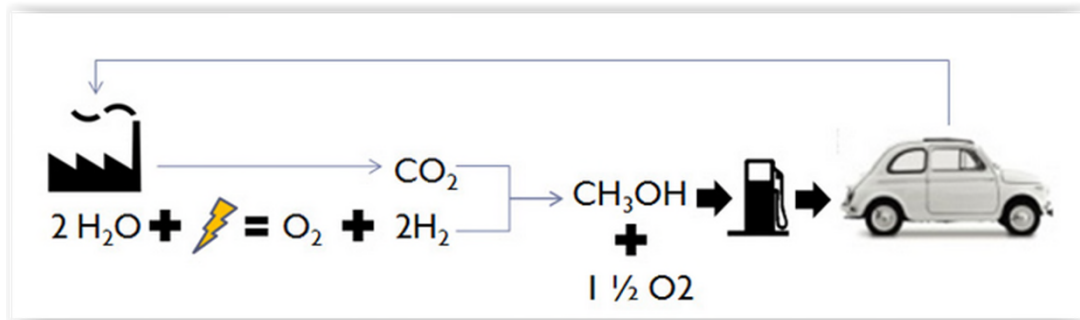
METHANOL - ICELAND

Methanolisation of carbon dioxide coming from geothermal power plant with renewable hydrogen (geothermy)

- » RM geothermal heat : more than 5 million liters methanol a year to reclaim 5.5000 tonnes of CO₂ a year from the atmosphere.
- » Proeffabriek in Antwerpen

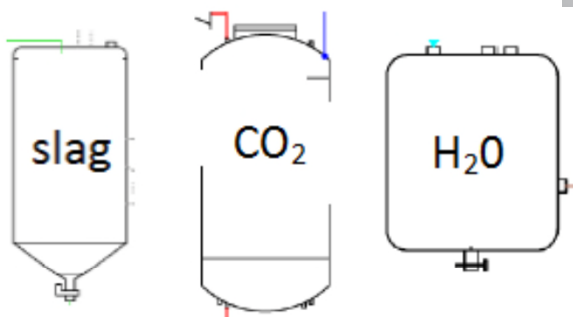


Source : <http://www.carbonrecycling.is/>
last access 16th March 2015



CO₂ AND (STEEL) SLAG => NEW BUILDING MATERIAL

VITO - spin-off Carbstone



**CARBSTONE
BOX**



AIR CAPTURE ON ROOFTOPS

- » 7,8 Gton emission = 1 ppm rise (Rielke, Environmental Science and Policy 12 (2009) 216-225)
- » Need to capture up to 8 Gton (Ranjan, Energy Procedia 4 (2011) 2869-2876)
- » AC Midsize apartment block : 10 kTon/year
- » 800 000 units will do the trick - worldwide
- » USA alone



ONE BLOCK IN MANHATTAN



Dank u!

谢谢！