GAS FIRED POWER PLANTS

Brussels, May 2018

EDF LUMINUS VISION

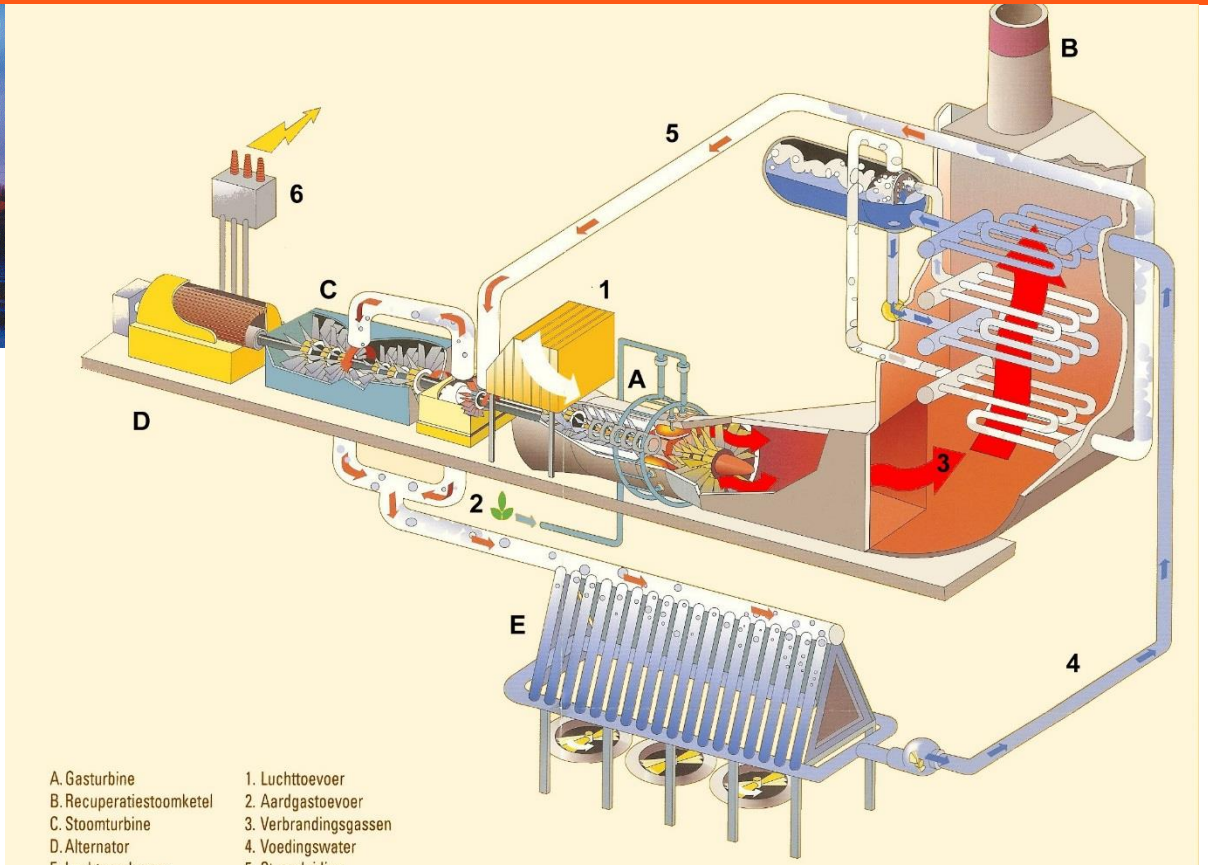
Help customers
save energy

Supply energy with
low carbon generation

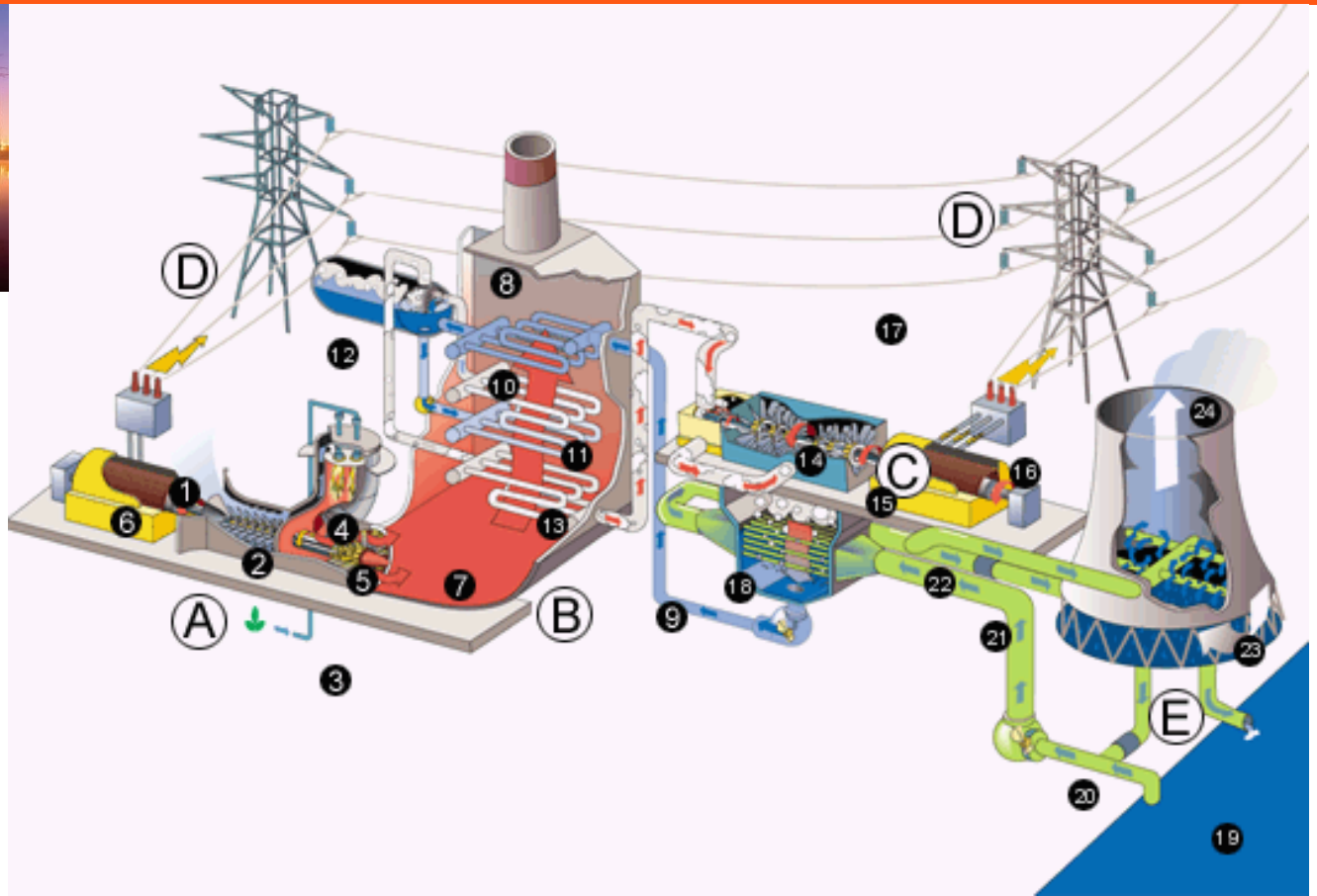
Provide affordable
security of supply

PERFORMANCE

RINGVAART: SINGLE SHAFT CCGT



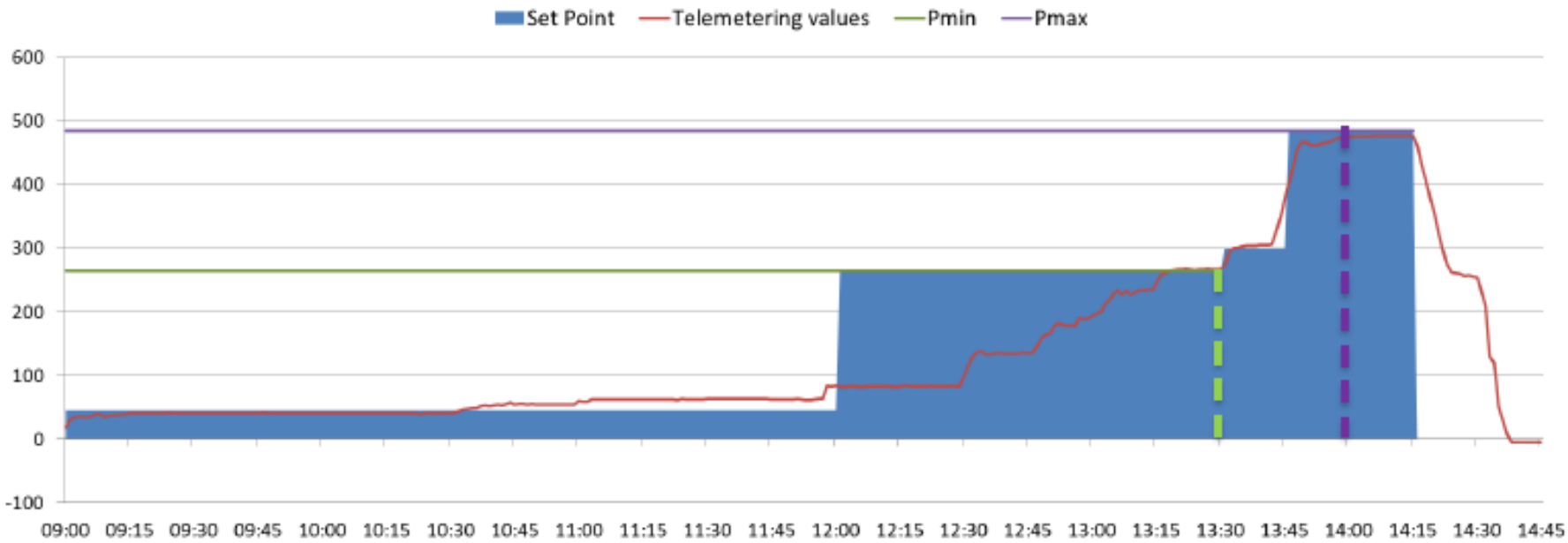
SERAING: DUAL SHAFT CCGT



PERFORMANCE

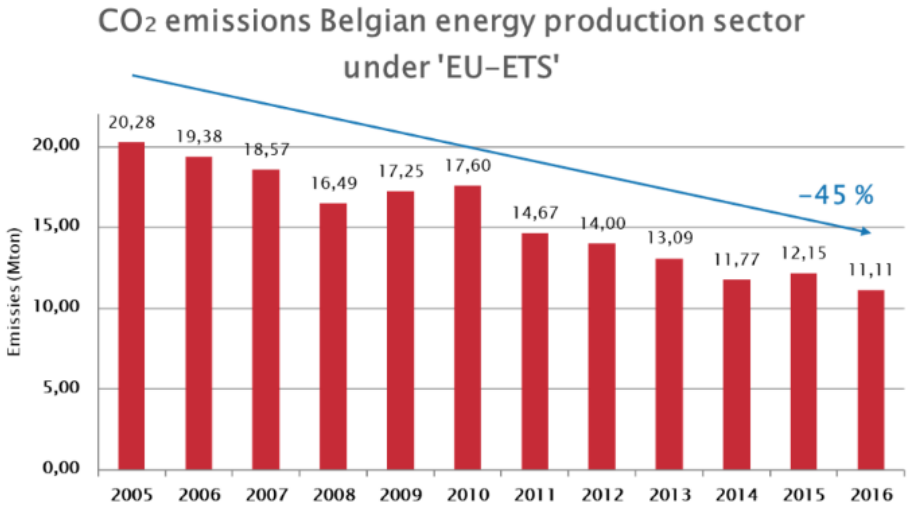
SERVICE	CCGT	CCGT +bypass	OCGT
Frequency containment (R1)	🟢	🟢	🟢
Automatic frequency restoration (R2)	🟢	🟢	🟢
Manual frequency restoration (R3)	🟠	🟢	🟢
Voltage regulation (Mvar)	🟢	🟢	🟢
System restoration (Black Start)	🟢	🟢	🟢

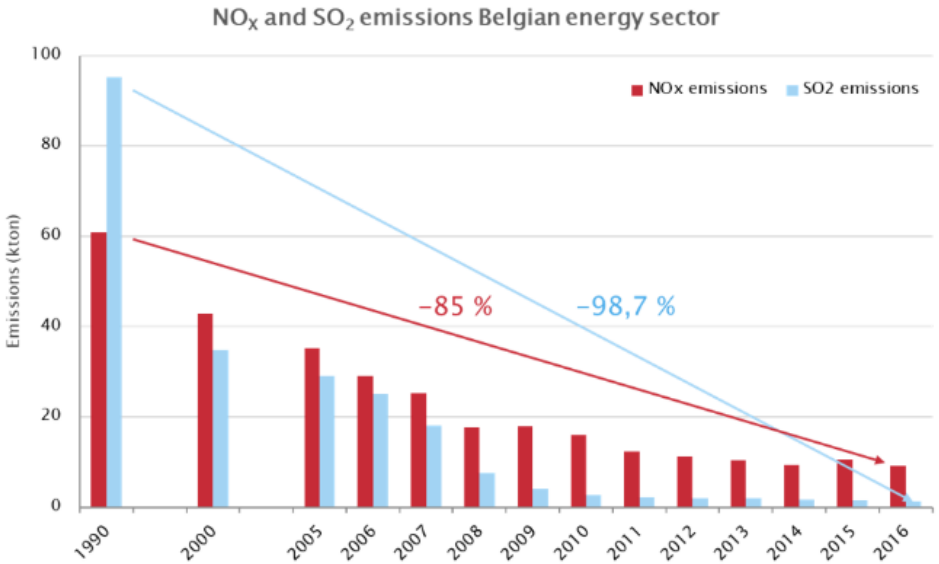
PERFORMANCE CCGT SERAING IN STRATEGIC RESERVE
(DELIVERY TEST TO FULL POWER 10/2/2016)



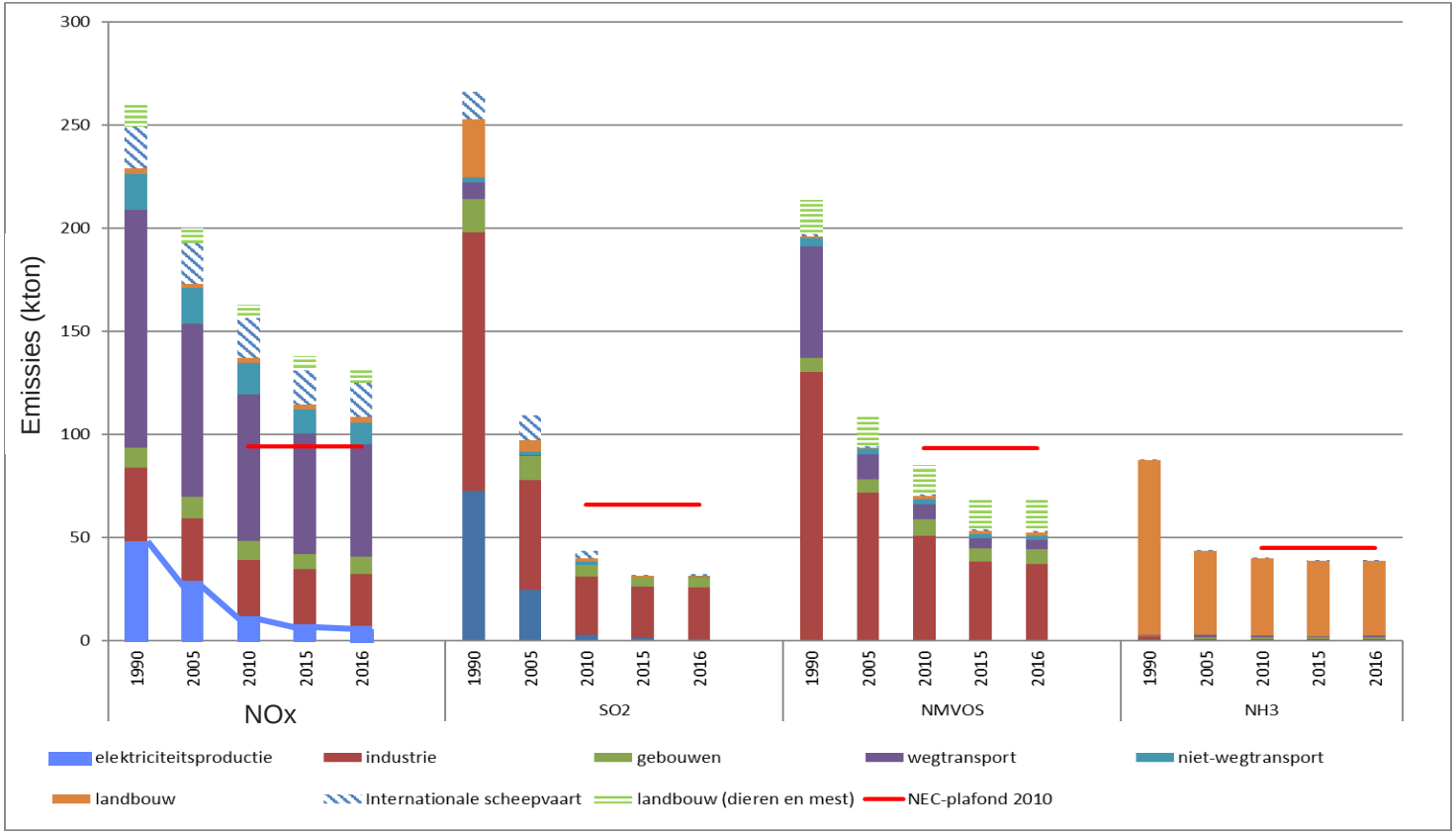
Source: Elia, registration as from grid synchronisation (1,5hours after notification)

EMISSIONS


CO2 emissions Belgian energy production sector under 'EU-ETS'
Emissies (Mton)
20,00
15,00
10,00
5,00
0,00
20,28
19,38
18,57
16,49
17,25
17,60
14,67
14,00
13,09
11,77
12,15
11,11
-45 %
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016


NOx and SO2 emissions Belgian energy sector
NOx emissions
SO2 emissions
Emissions (kton)
100
80
60
40
20
0
-85 %
-98,7 %
1990
2000
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016

EMISSIONS – COMPARED TO OTHER SECTORS



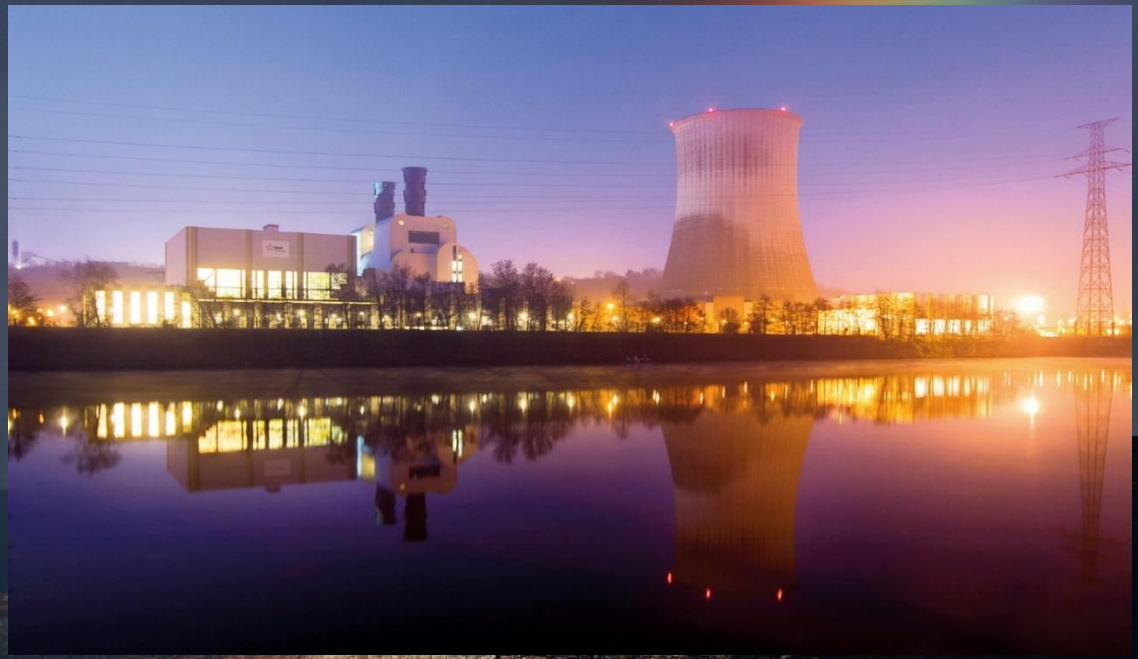
BELGIAN GENERATION PARK KEEPS PERFORMING WELL ON CO_2 EMISSIONS AND CAN EXPORT LOW CARBON ENERGY

Country gCO_2 **emissions/kWh electricity generated**	**2016**	**2026**	**2030**
Netherlands	505 gCO_2/kWh	357 gCO_2/kWh	314 gCO_2/kWh
France	46 gCO_2/kWh	25 gCO_2/kWh	16 gCO_2/kWh
Germany	492 gCO_2/kWh	518 gCO_2/kWh	450 gCO_2/kWh
UK	435 gCO_2/kWh	171 gCO_2/kWh	114 gCO_2/kWh
Belgium **LOW – HIGH capacity scenario**	**195 gCO_2/kWh**	**277-288 gCO_2/kWh**	**267 - 265 gCO_2/kWh**

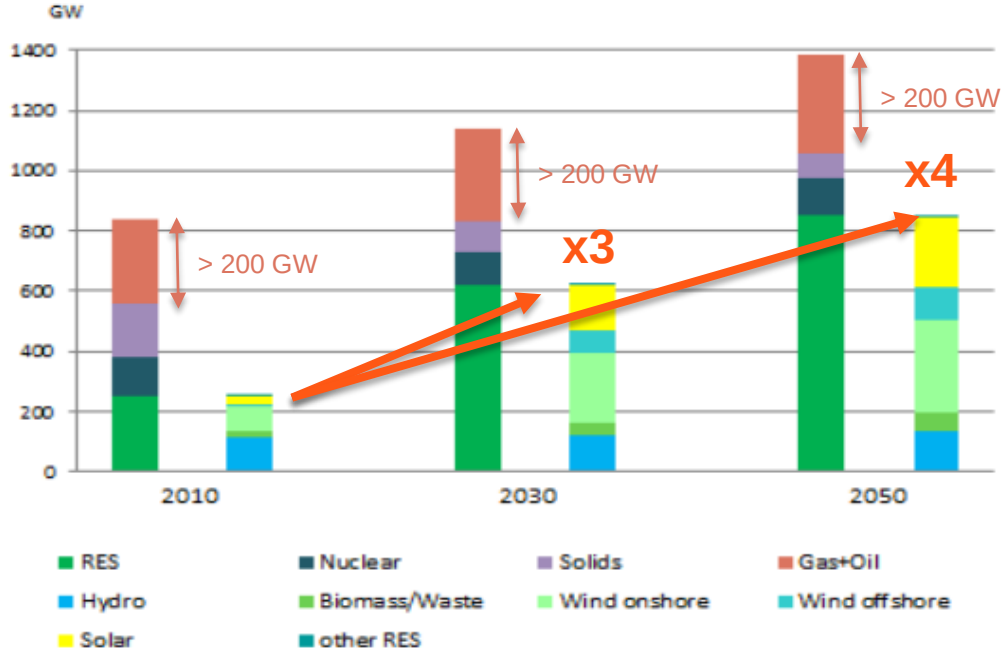
NL, FR, GER, UK values calculated based on PRIMES results (REF 2016)
BE values based on EnergyVille model results

EDF luminus

RELEVANCE



GROWING SHARE OF RENEWABLES DOES NOT REDUCE NEED FOR THERMAL CAPACITY

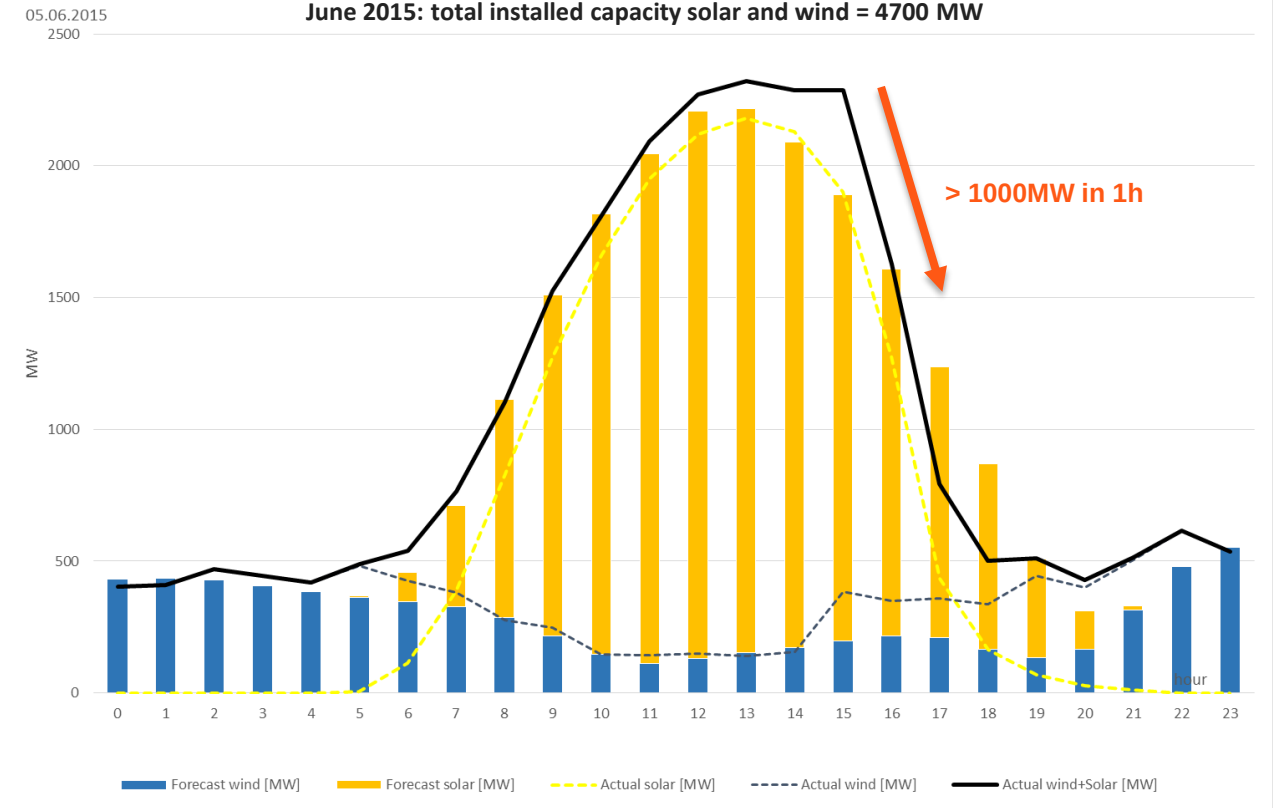


Source: European Commission [Impact Assessment on energy and climate policy up to 2030 [SWD(2014) 15]]

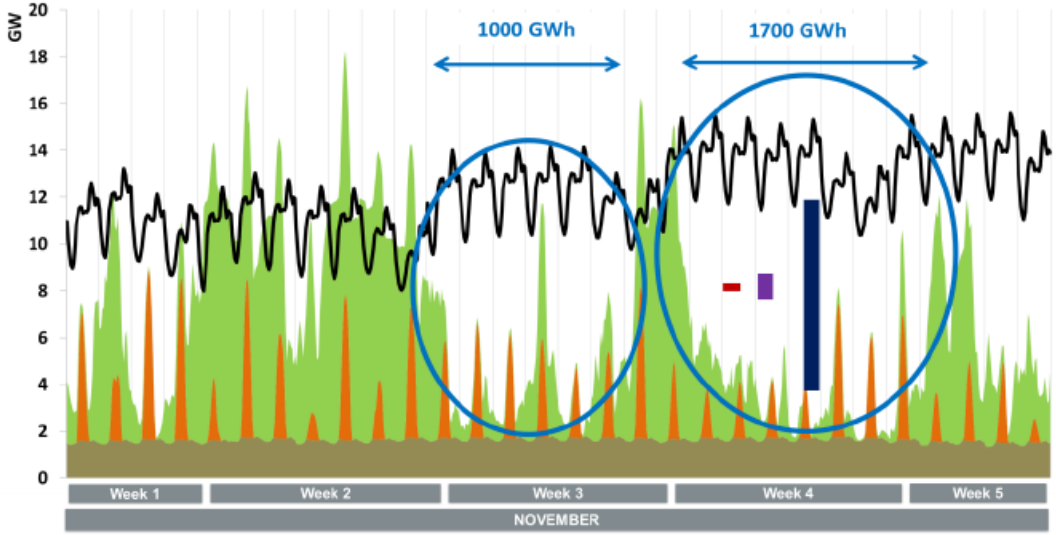
BELGIUM NEEDS GAS FIRED ASSETS TO SECURE SYSTEM ADEQUACY

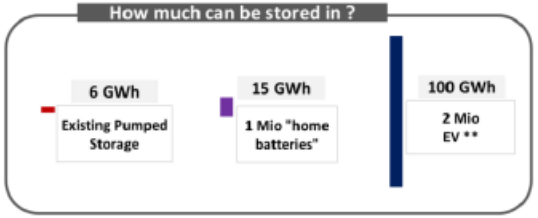
Scenario Figures for 2030	Full nuclear phase out	2 GW Nuclear prolongation (10y)
Elia	2300 MW existing gas fired power plants **+ 3600 MW new plants**	2300 MW existing gas fired power plants **+ 1600 MW new plants**
Study Federal Planning Bureau	2300 MW existing gas fired power plants **+ 4200 MW new plants**	2300 MW existing gas fired power plants **+ 700 MW new plants**
Study Albrecht	5000 MW CCGT + 2550 MW of OCGT (new and existing)	3000 MW CCGT + 2750 MW of OCGT (new and existing)

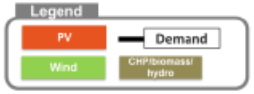
LARGE BACK-UP NEEDS TO INTEGRATE VARIABILITY OF RENEWABLES



DUNKELFLAUTE







** 18 GW of PV*
11 GW of wind

*** if connected permantly to the grid and batteries of EV only used to store energy to balance the system*

Source: Elia data (presentation adequacy report 2050)

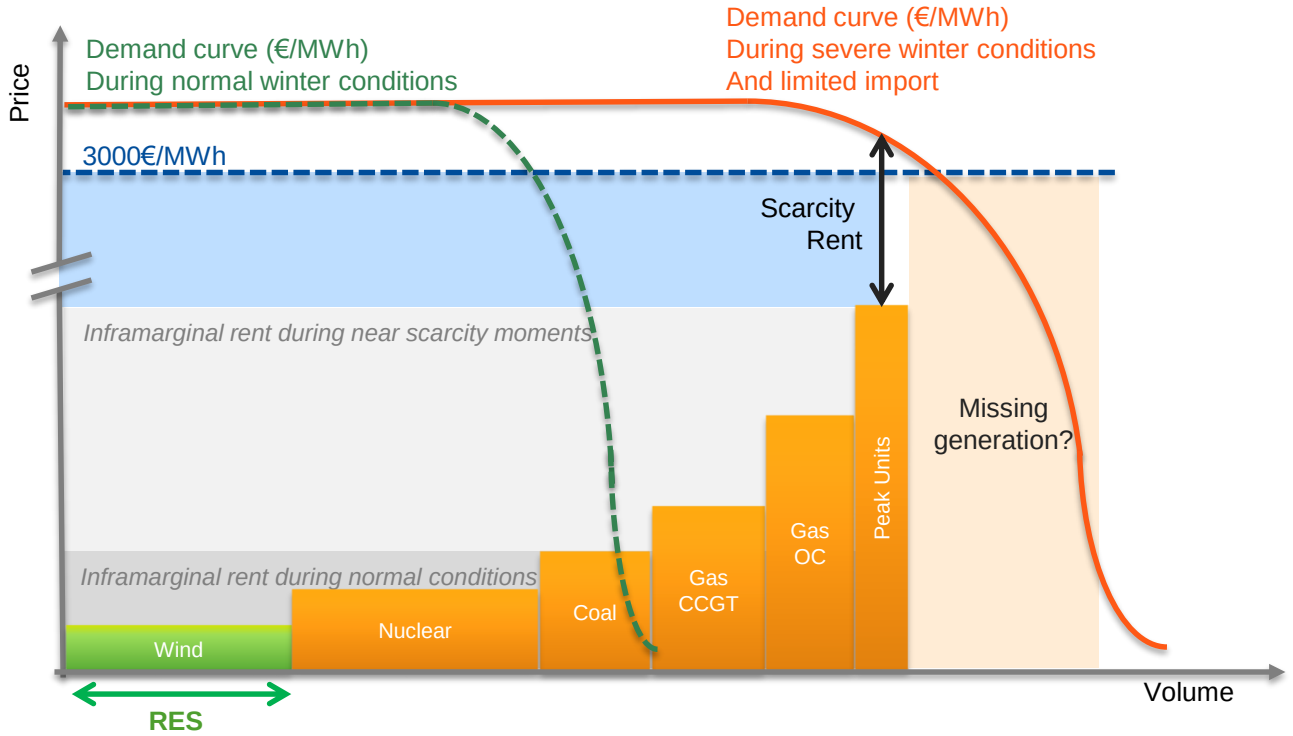
“Nothing lasts and yet nothing passes either, and nothing passes just because nothing lasts.”

— Philip Roth, The Human Stain

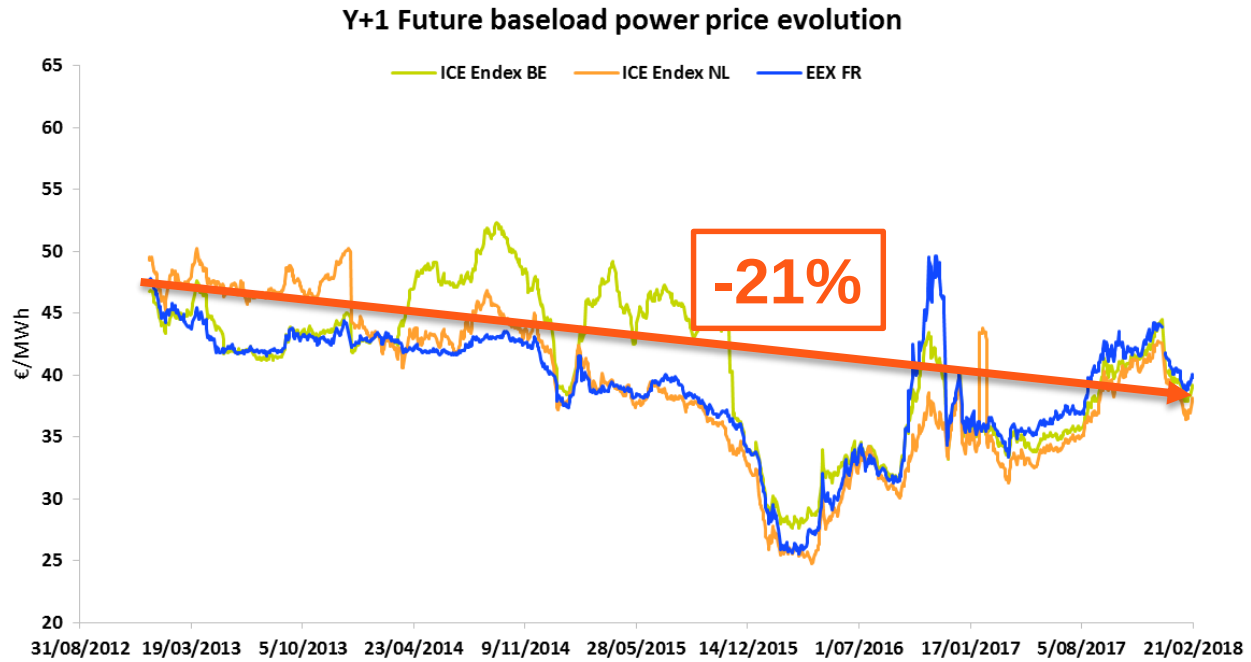
TRANSITION TO LOW CARBON GENERATION

>5.000 MW

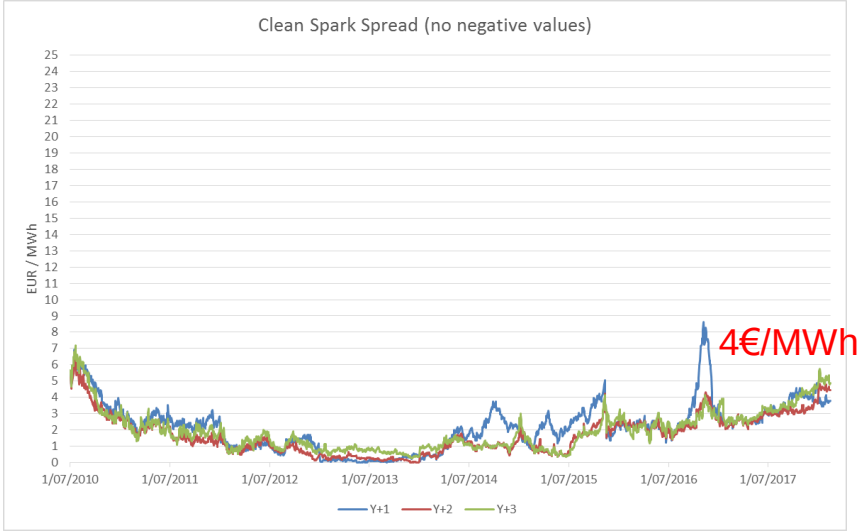
MARKET FUNDAMENTALS: THE MERIT ORDER



COAL, INTERCONNECTORS AND RENEWABLE ENERGY SOURCES HAVE A STRUCTURAL DOWNWARD PRESSURE ON POWER PRICES



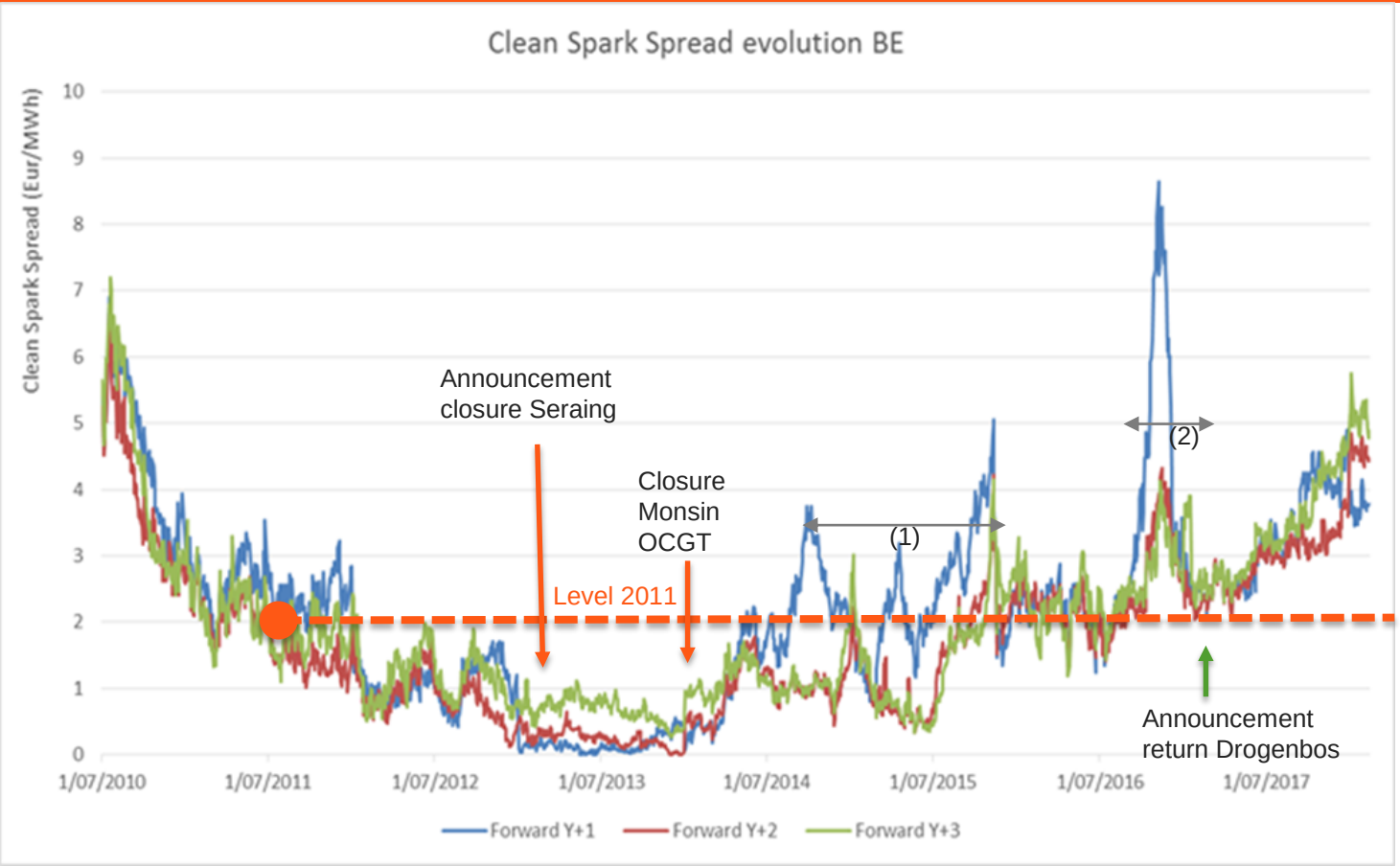
COAL PLANTS STILL HAVE LARGER MARGINS THAN GAS FIRED PLANTS



COAL

GAS

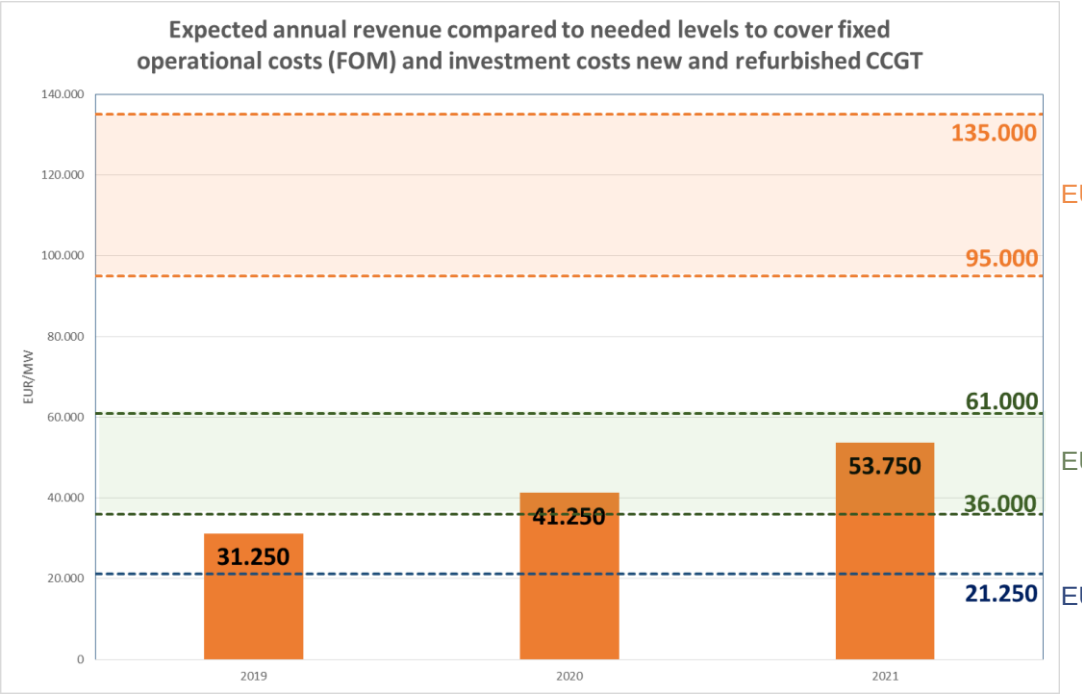
TEMPORARY MARKET REVIVAL
MAINTENANCE FREE, EFFICIENT CCGT CAN RETURN TO THE MARKET



(1) Belgian nuclear capacity prohibited (D3 & T2) by FANC + Sabotage D4

(2) French nuclear capacity prohibited by French Nuclear Safety Authority

CURRENT MARKET REVIVAL IS SUFFICIENT TO COVER OPERATIONAL COSTS OF EXISTING CCGT'S WITHOUT MAJOR OVERHAUL



(1) CREG (Z)1719 25/01/2018 Note relative aux évolutions marquantes sur les marchés de gros belges de l'électricité et du gaz naturel en 2017
(2) Elia, november 2017, Electricity scenarios for Belgium towards 2050 Elia's quantified study on the energy transition in 2030 and 2040
(3) CAPEX refurbishment = 20% to 35% of CAPEX new investment

Photo by Sage Friedman on Unsplash