The Dutch Coal Mistake:

How Three Brand-New Power Plants in the Netherlands Are at Risk Already of Becoming Stranded Assets

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Executive Summary

Coal-fired power generation is vulnerable everywhere to increasingly ambitious initiatives to cut carbon emissions.

This is acutely evident today in the Netherlands, where a recent court ruling and a parliamentary motion supporting tougher actions to avert climate change represent a growing trend.

This report assesses the impact of national pressures and beyond on the value of three new coal-fired power plants put into service in 2015 by the German energy companies RWE and Uniper, and the French energy company Engie.

More broadly, we note the implications from these examples for the business case for new-build coal power in Europe and further afield.

IEEFA's Main Findings:

- New regulatory pressures on coal in the Netherlands are creating headwinds for coal-fired power and increasing the penetration of competing renewables.
- RWE, Uniper and Engie have already taken underpublicized impairments on the new power plants collectively worth billions of euros, underlining the weak investment case for coal new-build in Europe.
- The value on the utility balance sheets of these new coal-power plants has dropped to about €1 billion or less each, compared with original capital expenditure of about €1.9 million per megawatt, or a total of €3 billion in the case of RWE's Eemshaven power plant.
- Using a discounted cash flow (DCF) model, and applying very generous assumptions to coal power, we see a net present value (NPV) in the range of €400 million, for a comparative 1,100MW power plant.
- The discrepancy between our DCF valuation and the assessed book values of these three coal plants suggests that RWE, Uniper and Engie will have to take another, thorough look at their valuations.
- Given European political and power market trends, we see even lower future valuations for the three plants examined.[1]

[1] The translated version of the executive summary can be found here

IEEFA's Conclusions and Recommendations:

These power plants are uneconomic in terms of meeting their original valuation and investment return targets, and their owners may have to make additional impairments. Their example rules out any new-build coal power in western Europe, while suggesting difficulties ahead for existing coal-fired generation.

Our analysis shows that these three new power plants are uneconomic under a wide range of plausible policy or market scenarios. It suggests that the investment logic that put them online in 2015 would not hold today, without government subsidies in the guise of capacity-market supports. We see gas-fired power as a more flexible and less carbon-emitting backup option than coal; renewables as more competitive, and other resources as more sensible, including more cross-border interconnection, more demand response and more electricity storage.

These three power plants offer an instructive example against investing in coal-fired plants in neighbouring countries.

Mandated, early retirement of these new plants may be the most cost-effective way to meet climate targets in the Netherlands.

Our analysis finds few if any scenarios under which these power plants can return value to investors, after accounting for the fact that the additional risk they bring needs additional remuneration.

Their early retirement may be cost-effective, in the context of tougher climate policies, and the level of asset impairments already undertaken. However, the utility-owners of the plants will resist closing them without compensation, given that they are still generating positive cash flows, notwithstanding their loss in value. We also note that plans for biomass co-firing mean that these coal plants are wrapped up in renewable energy targets in the Netherlands. And there are risks of cross-border carbon leakage from closing these power plants which are beyond the scope of this paper.

These three plants offer an abject lesson on investment in new coal-fired power.

The Netherlands case shows how policy and markets no longer support new coal-fired power plants. The Dutch plants were built on the expectation of robust power demand growth, which has not materialized. They are also rooted in a failure to anticipate massive capacity growth in near-zero marginal costs of wind and solar generation in neighbouring Germany; and the rising focus on carbon-emissions targets globally and growing government mandates to exit coal.

The mistaken energy orthodoxy that prevailed when these Dutch power plants were built still prevails in other developed countries. At present, for instance, OECD member countries with large pipelines of new coal-fired power plants planned or under active construction include: Turkey (74GW), Japan (22GW), South Korea (20GW) and Poland (9GW). We see stranded-asset risk in such new-build coal due to climate change policies and market trends, and especially to the rise of renewables and widening investment in energy efficiency, both of which have had such a devastating impact on wholesale power prices in the Netherlands.

The Dutch mistake tells utilities and investors to think twice about investing new coal-fired power plants. And it tells investors not to rely on the orthodox energy outlook of utilities.

1. Introduction

Since 2010, European utilities have taken impairments time and again to the value of their coal- and gas-fired power assets. Such impairments reached a record high €34.7 billion last year.[2] Of this total €34.7 billion, some €12 billion were tied specifically to coal- and gas-fired assets, which made up the single biggest component of impairments including other energy assets and goodwill.

These impairments are a result of the fall in oil and gas prices globally, and in the equally dramatic rise in renewable power. Wind and solar power have near-zero marginal costs, and so their rapid rise has crushed wholesale power prices across central-western Europe, causing cutbacks in generation—as measured by plant capacity factor—at competing coal- and gas-fired plants.

Going forward, high-carbon-emitting coal-fired power generation appears to be especially vulnerable to increasingly ambitious climate action targets. Nowhere is this more evident than in the Netherlands.

In June 2015, the District Court of The Hague, one of 19 district courts in the Netherlands, ruled in a case brought by an environmental group, the Urgenda Foundation, that the country was bound to take more aggressive action to combat climate action. The Dutch parliament then passed a resolution calling on the government to present a plan by the end of this year for phasing out coal-fired power. The parliament has since passed a resolution calling for cutting greenhouse gas emissions by more than half by 2030. Other political pressure is being brought to bear in the Netherlands signatory role to the 2015 Paris Agreement on climate change, which calls for all signers to take action to limit global average warming to "well below 2C," goal that implies lower carbon emissions across the board.

Against this backdrop, three utilities—RWE, Uniper and Engie— have fired up three brand new coal power plants in the Netherlands with a combined capacity of 3.5 gigawatts (GW). Partly as a result, coal-fired power generation in the Netherlands rose last year, even as the country mothballs for cleaner gas-fired power plants because of excess capacity.[3]

Table 1. Netherlands Coal Fleet, Beyond 2017, Showing Start Year and Capacity

Plant name	Start year	Parent	Net installed coal capacity, MW	Average efficiency, %	2015 CO2 emissions, mt
Maasvlakte 3	2015	Uniper	1070	0.46	2.98
Rotterdam	2015	Engie	800	0.46	2.79
Eemshaven	2015	RWE	1600	0.46	6.29
Hemweg 8	1994	Vattenfall	630	0.41	4.2
Amercentrale 9	1993	RWE	600	0.4	5.67

Source: Company reports

[2] http://www.ey.com/Publication/vwLUAssets/ey-benchmarking-european-power-and-utilities-asset-impairments-2016/$FILE/ey-benchmarking-european-power-and-utilities-asset-impairments-2016.pdf
[3] http://www.naturalgasworld.com/rwe-closes-dutch-gas-fired-plants-32101

Already, the owners have taken substantial impairments to these three new coal plants, even though they have not stated the precise amount. In 2013, RWE took an impairment of €2.3 billion across its Dutch coal and gas portfolio. Also in 2013, Engie took impairments against Dutch thermal power plants of €1.7 billion. And in the first half of 2016, Uniper (which is a spin-off of E.ON and is 46 percent owned by E.ON) took impairments worth €1.8 billion against coal-fired power plants in the Netherlands, France and Germany, specifically referencing the coal-exit debate in the Netherlands.

The coal sector in the Netherlands was in trouble before these plants went online. Under the terms of the country's 2013 Energy Agreement for Sustainable Growth, five coal power plants commissioned in the 1980s will be shut down. Two of the remaining five went into service in the 1990s and are under review.

The government is naturally reluctant to close the other three—which are brand new—having signaled already a preference instead to cut emissions through biomass co-firing of the plants, which would be less emissions intensive, and/or retrofit of largely untested carbon capture and storage technology.

The three plants in question are RWE's Eemshaven, Uniper's Maasvlakte 3 and Engie's Rotterdam.

Regardless of if or when these plant are retired, the mere prospect of their closing just a year after opening is a vivid demonstration of the extreme risk in building coal-fired power plants today. Such risks are endemic now across economies large and small. Among member countries of the Organization for Economic Cooperation and Development (OECD) new coal-fired power plants are planned or under active construction in Japan, South Korea, Poland and Turkey.

Sections 2, 3 and 4 of this report describe the policy, environmental and market backdrop to new coal-fired capacity. Section 5 reviews recent publications that have sought to quantify the value of coal power plants in the Netherlands. Section 6 describes the approach taken in this report to provide an assessment of the book value and impairment risk at the three new Dutch power plants. Section 7 summarizes our conclusions.

2. Policy Perspective

European Union Renewable Energy Directive, 2009

Under the European Union's renewable energy directive, the Netherlands is bound to source 14 percent of its primary energy consumption from renewables by 2020. In its latest progress report, published last year, the European Commission estimated that the Netherlands was less than halfway there, having achieved 5.9 percent renewables in 2014.[4]

Energy Agreement for Sustainable Growth, 2013

In 2013, the government, private companies, trade unions, environmental organizations, civil society groups and financial institutions committed to an Energy Agreement for Sustainable Growth.[5] Goals included increasing the proportion of renewables in energy use to 14 percent by 2020 and to generate savings of 1.5 percent of energy use annually. Regarding coal usage, the Energy Agreement committed to close five coal-fired power plants built in the 1980s. The agreement anticipated long-term emissions reductions from the remaining, newer coal plants through retrofitting of unproven carbon capture and storage technology.[6]

Urgenda Court Case, June 2015

The Netherlands-based Urgenda Foundation has an aim of accelerating a "transition toward a sustainable society."[7] In November 2012, the Foundation called for the government to increase the ambition of its climate action, with the goal of reducing carbon emissions by 25-40% below 1990 levels by 2020, citing research by the Intergovernmental Panel on Climate Change (IPCC).[8] Recent data suggests that the Netherlands is on track to reduce its emissions, but only by 23% by 2020. Urgenda argued that the Netherlands can and should do better by taking a global lead, given its wealth, vulnerability to sea level rise and high per capita emissions. In 2013, the Foundation sued the Dutch state, calling for the government to expand its climate ambition. In June 2015, The Hague District Court ruled in Urgenda's favour, concluding that the Netherlands must cut emissions by 25% below 1990 levels in 2020.[9,10] The government announced that it would appeal the verdict, which it must implement in the meantime.[11]

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4 http://eur-lex.europa.eu/resource.html?uri=cellar:4f8722ce-1347-11e5-8817-01aa75ed71a1.0001.02/DOC_2&format=PDF
5 https://www.government.nl/topics/energy-policy/contents/energy-agreement-for-sustainable-growth
6 https://www.ser.nl/~/media/files/internet/talen/engels/2013/energy-agreement-sustainable-growth-summary.ashx
7 http://www.urgenda.nl/documents/Staat-der-NL-Engels1.pdf
8 https://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4_wg3_full_report.pdf (Page 776)
9 http://uitspraken.rechtspraak.nl/inziendocument?id=ECLI:NL:RBDHA:2015:7196
10 http://www.urgenda.nl/documents/VerdictDistrictCourt-UrgendavStaat-24.06.2015.pdf
11 https://www.government.nl/latest/news/2015/09/01/cabinet-begins-implementation-of-urgenda-ruling-but-will-file-appeal

Parliament Call for Supporting Coal Phase-out Plan, November 2015

In November of last year, the Dutch parliament called for the government to draw up a coal phase-out plan by the end of 2016.[12] The government is expected to update parliament at the end of 2016 on how it plans to implement the Urgenda verdict and on how it will go about a coal phase-out plan.[13]

Paris Agreement, December 2015

Under the 2015 Paris Agreement, signatory countries have committed to limit global warming to "well below 2°C" above pre-industrial temperatures and to pursue efforts to limit global warming to 1.5°C. In October 2016, the Germany-based New Climate Institute research group published a Greenpeace-commissioned study on the implications of the Paris Agreement for the Dutch energy sector, from transport to power generation.[14] It recommended that energy sector emissions be reduced to zero globally by 2045, and in the Netherlands by 2035. It recommended further that Dutch power generation emissions be reduced to zero by 2025, and that all Dutch coal plants be closed by 2020 at the latest.

Parliamentary Resolution, September 2016

In September 2016, the Dutch lower parliament passed a resolution supporting the Urgenda emissions target, a steeper emissions reduction in 2030, and a coal phase-out timeline. It called specifically for a closure timetable "in line with the ambitions of the Paris Agreement, and a reduction in CO2 emissions by 25% by 2020 and 55% in 2030."[15] While the resolution was non-binding, it was supported by the Labour Party, a partner in the coalition government.

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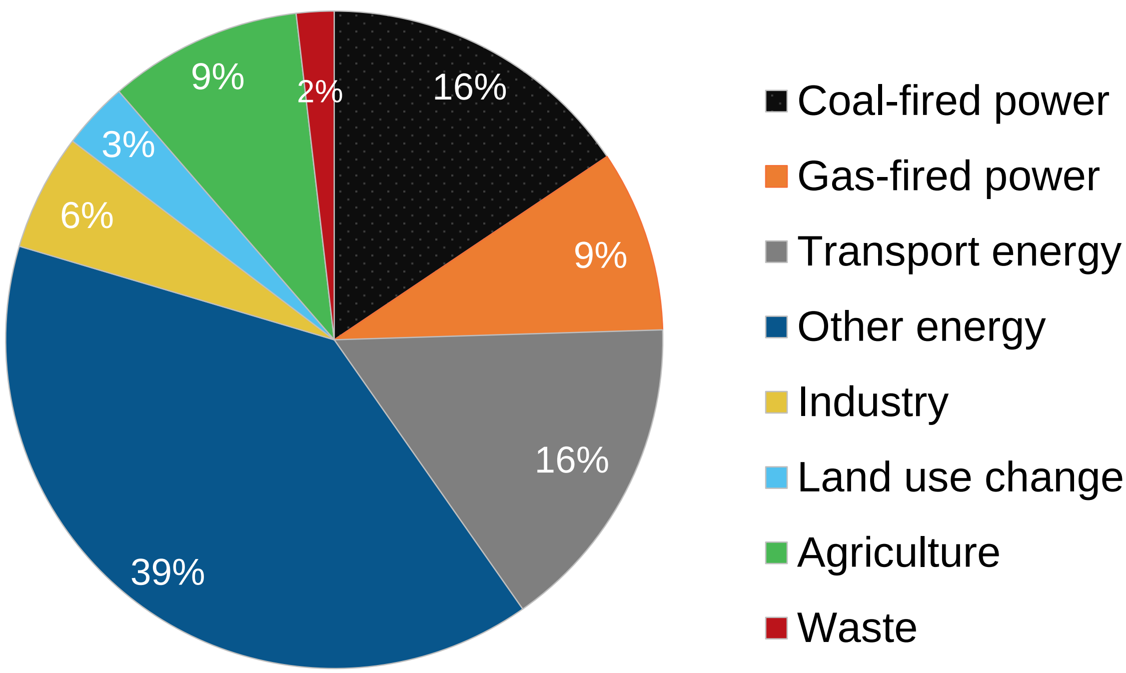
[12] http://news.vattenfall.com/en/article/coal-be-phased-out-netherlands
[13] http://uk.reuters.com/article/us-climatechange-netherlands-carbon-idUKKBN12E1OQ
[14] http://www.greenpeace.nl/Global/nederland/report/2016/klimaat%20en%20energie/Paris%20Agreement%20for%20NL%202016%2029%2009_NewClimate%20(1).pdf
[15] https://www.tweedekamer.nl/kamerstukken/detail?id=2016Z17190&did=2016D35499

3. CO2 Perspective: Netherlands Emissions Trends

According to the country's latest submission to the United Nations Framework Convention on Climate Change (UNFCCC), greenhouse gas emissions in the Netherlands in 2014 were down 16% relative to 1990 levels.[16] The government's latest National Energy Outlook, published in October, estimates that emissions will be 23% below 1990 levels in 2020.[17] The updated outlook implies less pressure in meeting the Urgenda ruling of a 25% emissions reduction in 2020. But it shows the country is far off track with regard to the parliament's resolution to cut emissions by 55% by 2030, projecting that emissions will be only 30% below 1990 levels by then.

The energy sector (transport, power generation, industrial and residential energy consumption) is by far the biggest in terms of greenhouse gas emissions, accounting for four-fifths of total national emissions. Coal-fired power generation alone is responsible for 16% of national greenhouse gas emissions, equivalent to the emissions from the entire national transport sector (see Figure 1).

Figure 1. Share of Coal-fired Power Generation in Total Greenhouse Gas Emissions, 2014

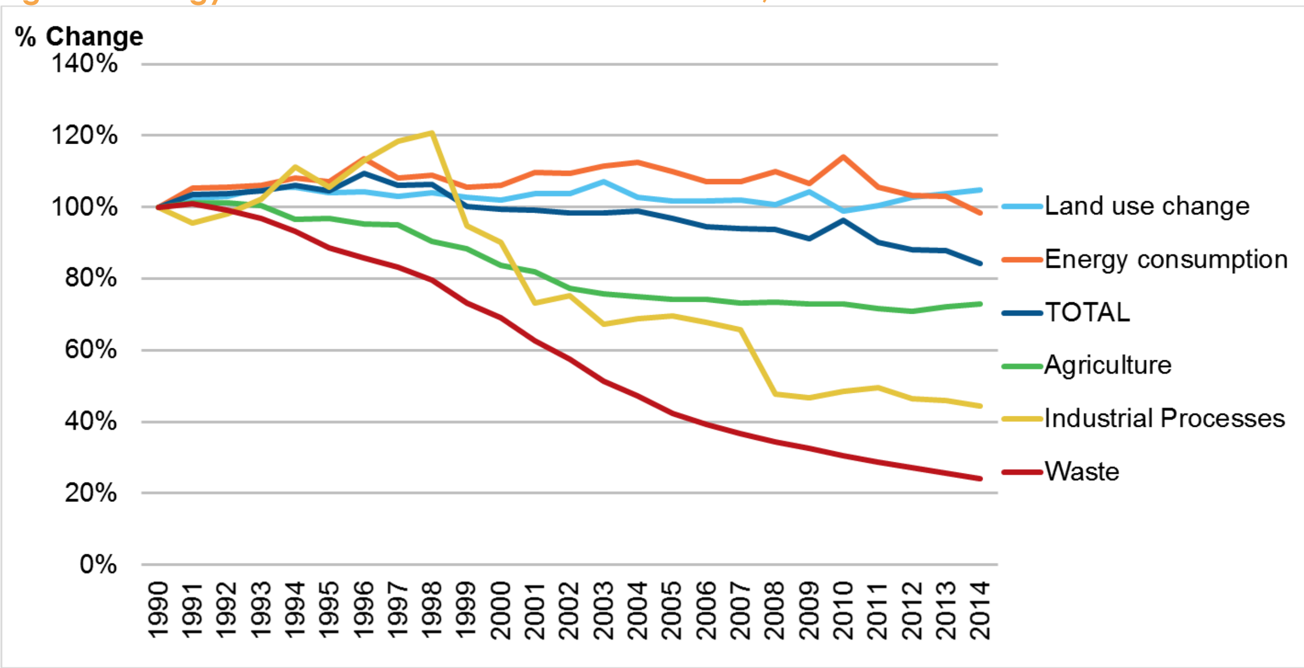


Source: UNFCCC

[16] http://unfccc.int/national_reports/annex_i_ghg_inventories/items/2715.php
[17] https://www.cbs.nl/nl-nl/nieuws/2016/41/nev-2016-laat-zien-doel-hernieuwbare-energie-in-zicht

To date, energy sector emissions have barely changed relative to 1990 levels, implying it will have to step up disproportionately (see Figure 2) if the Netherlands is to meet its emission-reduction goals.

Figure 2. Energy Sector Emissions Versus Other Sectors, 1990-2014



Source: UNFCCC

4. Market Perspective

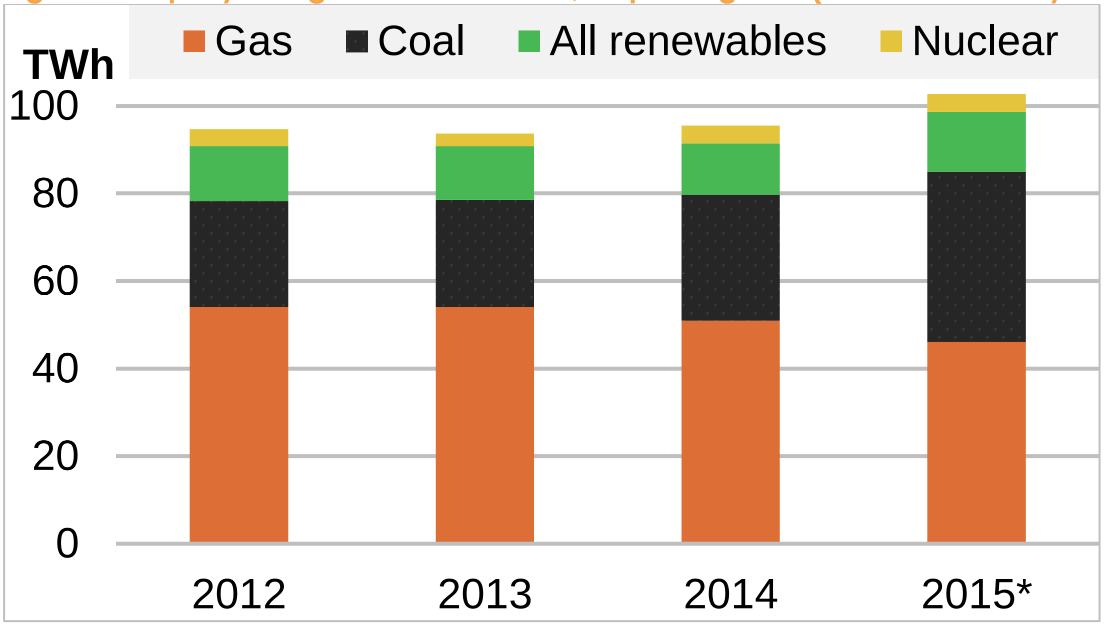
After its scheduled plant closures have gone into effect, the Netherlands will have five coal-fired power plants beyond 2017 with a combined, net installed capacity of 5,740MW (see Table 1 above).

Coal-fired power generation rose last year in the Netherlands, partly as a result of recently favourable economics compared with gas and with the impact of the start-up of the new, more efficient plants (see Figure 3).[18] This rise may be short-lived, as older capacity closes. In addition, the government is reviewing the viability of the two older remaining power plants, Amercentrale 9 and Hemweg 8, for mandated retirement in the light of the Paris Agreement and the Urgenda verdict.[19]

[18] http://statline.cbs.nl/Statweb/publication/?DM=SLEN&PA=80030eng&D1=1&D2=a&D3=0-6,8,11-12&D4=14-17&LA=EN&HDR=T&STB=G1,G2,G3&VW=T

[19] Government press release: https://www.rijksoverheid.nl/actueel/nieuws/2016/04/09/kabinet-maakt-afspraken-over-verdere-afname-co2

Figure 3. Rapidly Rising Coal Generation, Displacing Gas (*2015 Preliminary Data)

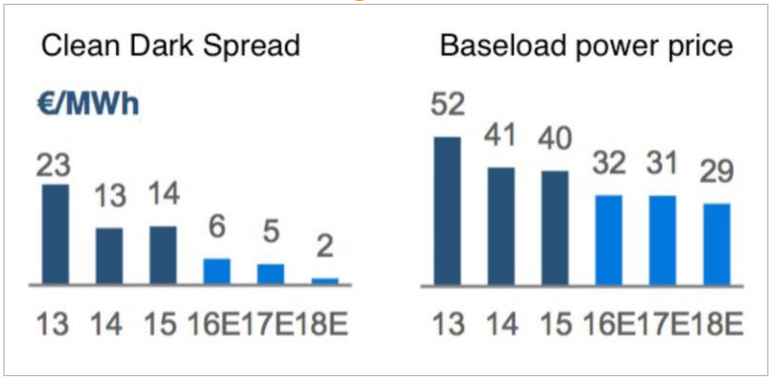


Source: Statistics Netherlands (CBS)

The operating profits of coal power plants are described by their "clean dark spreads," which are calculated as the difference between wholesale power prices and coal and carbon costs. Wholesale power prices in central western Europe have fallen dramatically in recent years, and fossil fuel generators have struggled amid muted demand and increased renewables penetration. Coal-fired generation has generally fared better than gas-fired generation, but margins have remained slim in the wake of the financial crisis.

Notwithstanding recent strong power price rises on the back of French nuclear power plant shutdowns, this long-run trend of lower operating margins is expected to continue. In April 2016, Uniper quoted the consulting firm IHS in its projections for much lower clean dark spreads over the next two to three years (See Figure 4),[20] a sure sign of fading profits. Projections this month by Reuters and from within the industry are for clean dark spreads of €6-7/MWh in 2017 falling to €3-6/MWh in 2019.

Figure 4. Uniper Projection for Clean Dark Spreads in the Netherlands, Through 2018



Source: Uniper/ IHS

Full proposals: http://www.rijksbegroting.nl/system/files/12/2016-ibo-kostenefficientie-co2-reductiemaatregelen.pdf

[20] https://www.eon.com/content/dam/eon-com/Investoren/cmd/Uniper_Equity_Story_Appendix.pdf

5. Counting the Cost of Closing Dutch Coal-Fired Power Plants: Recent Studies

Several studies over the past year have analyzed the cost/ benefit of early retirement of coal-fired power plants in the Netherlands. These studies are reviewed here briefly.

In September, the Dutch research institute CE Delft published a report titled "CO2 reduction in a modern coal plant Study of public expenditure and technical feasibility," which analyzed the cost of reducing emissions from Uniper's Maaslvakte 3 power plant to those of gas-fired power as an alternative to early retirement.[21] CE Delft estimated the discounted cost of three carbon mitigation scenarios: biomass co-firing (50%); carbon capture and storage (2.7 million tonnes captured CO2 annually); and a combination of approaches. The study calculated a €2.3-2.8 billion range of net additional costs on top of normal coal plant operations costs. Applying similar scenarios to all three new Dutch coal power plants resulted in a total cost of about €8 billion, CE Delft concluded, implying that closure was the cheapest way to mitigate their emissions.

In a follow-up study, in April, CE Delft quantified the most cost-effective way to plug an estimated 7-10 million-tonne emissions gap (the gap in 2020 between projected emissions and the Urgenda verdict target).[22] This study has since been overtaken by the latest National Energy Outlook, published by Netherlands Statistics in October, which cuts the projected emissions gap (see Section 3 above). The study found that efficiency investments plus the closure of one new coal plant (RWE's Eemshaven) were the least-cost way to cut emissions, at around zero net cost. It found much higher costs, at net €400 million annually, if measures other than retiring Eemshaven were attempted.

An unpublished government report, leaked in July by the Netherlands public service broadcaster Nederlandse Omroep Stichting (NOS), estimated that closing all remaining Dutch coal-fired power plants would cost €7 billion.[23] That study said closing the plants would cut national greenhouse gas emissions by 31 million tonnes annually, or net 9 million tonnes, after accounting for higher coal-fired electricity imports, NOS reported.

In June, Spring Associates published a financial analysis for Greenpeace estimating the cost of closing the five remaining coal power plants.[24] The study used a sophisticated discounted cash flow analysis based on a range of electricity market simulations to calculate the net present value of the three new power plants at €3.5 billion, a steep discount to the roughly €6 billion in construction costs.

[21] https://www.natuurenmilieu.nl/wp-content/uploads/2016/09/CE_Delft_3J22_CO2-reductie_bij_een_moderne_kolencentrale_Def.pdf
[22] http://www.cedelft.eu/publicatie/doing_justice_to_climate_change/1846
[23] http://nos.nl/artikel/2117294-sluiten-kolencentrales-vermindert-co2-uitstoot-met-31-procent.html
[24] http://www.greenpeace.nl/Global/nederland/image/2016/klimaat%20en%20energie/KOLENUIT_WINDAAN/160627%20Spring%20Associates_Kolencentrales_FINAL.pdf

In April, the research group SEO Amsterdam Economics published an analysis for the environmental group Natuur & Milieu estimating a net social benefit of €4.7 billion for early retirement of all five remaining Dutch coal plants.[25] The social benefits included €5.6 billion from lower CO2 emissions, and €4.2 billion from lower emissions of local pollutants. The social costs included lost consumer surplus of €3.1 billion, from higher energy costs, and lost producer surplus of €1.9 billion from lower utility profits.

6. Stranded-Asset Risk in the Netherlands: This Study

The Netherlands has the most modern coal power plants in Europe. However, aggregate impairments worth billions of euros already at the newest of these plants underline their failing economics.

Our analysis assesses what the power plants are worth now, on utility balance sheets, and compares this with our calculated, DCF-based valuation. Comparing the two, we explore the risk of further impairments.

We set out accounting definitions here, to frame the analysis that follows. These definitions are based on standard number 36 in the International Accounting Standards (IAS) under the International Financial Reporting Standards (IFRS).[26]

Definitions

Book value (or carrying value): an asset's value on a company's balance sheet. Where this is not reported by the company, we estimate the original construction cost, and subtract any accumulated depreciation, amortization or estimated impairment expenses to date.

Fair value: is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date. This can be extremely low, or zero, if the plant is somehow obsolete. To estimate fair value, we use a discounted cash flow model of the particular power plant.

Costs of disposal: the incremental costs attributable to the disposal of an asset, excluding finance costs and income tax expense.

Value in use: is the present value of the future cash flows expected to be derived from an asset or cash generating unit. Value in use is similar to fair value, but the latter includes additional details relevant to an actual transaction, such as costs of disposal.

[25] https://www.natuurenmilieu.nl/wp-content/uploads/2016/04/2016-18-Sluiting-Under kolencentrales.pdf
[26] http://www.ifrs.org/IFRSs/Documents/Technical-summaries-2014/IAS%2036.pdf

Recoverable amount: is the higher of an asset's value in use (from retaining the asset) and its fair value less costs of disposal (from selling it).

Impairment: we calculate an impairment loss as the amount by which book value exceeds the recoverable amount. As IAS 36 states: "If this is the case, the asset is described as impaired and the Standard requires the entity to recognise an impairment loss."

Stranded asset: is similar to the impairment loss, i.e. the amount by which fair value is below book value. Coal plants can be stranded when they are targeted for retirement due to high costs and/or to meet new regulations, as many coal plants are today.

Approach and Methodology

Companies must regularly conduct impairment tests to assess whether the value of certain assets on balance sheet have changed as a result of external factors such as market prices, or internal factors such as an intention to sell the asset.

The aim is to keep shareholders informed of material impacts on the value of the wider company. Under IFRS conventions, companies at the end of each reporting period assess whether to conduct impairment tests. In an impairment test, a company checks as to whether an asset's fair value is below its book value, in which case the company would register an impairment loss on its P&L statement equal to the difference.

Our approach is as follows:

- We assess book value using publicly available data
- We derive a power plant valuation using discounted cash flow analysis
- We determine any implied impairment loss where book value is higher
- We discuss the real-world likelihood of our generous DCF base-case assumptions

Assessment of Book Value

We assess the book value of these power plants on utility balance sheets from a consideration of company reports and conversation with investor relations teams.

- RWE, Eemshaven – At end-2013, while company was still building the plant, it eported a recoverable value of €1.3 billion for its coal and gas generation portfolio in the Netherlands after taking a €2.3 billion impairment on these assets.[27] The company's investor relations department states, as of publication of this study, that this was the only impairment relevant to Eemshaven to date. Since Eemshaven is the biggest and newest Dutch asset, we assume that it accounts for the larger part of this €1.3 billion

[27] http://www.rwe.com/web/cms/mediablob/en/2320248/data/1838136/5/rwe/investor-relations/reports/2013/RWE-Annual-Report-2013.pdf

recoverable value at the end of 2013. The investor relations department declined to comment on a more precise valuation of the power plant, and so any estimate of its new book value is very approximate, at around €0.5bln-€1bln. That compares with an original construction cost of €3 billion, according to RWE.

- Uniper, Maasvlakte 3 – At end-2015, Uniper reported that "one coal plant" in the Netherlands had taken a €0.2 billion impairment, leaving a recoverable value of €1.5 billion. We assume that this one coal plant was Maasvlakte 3, given that Uniper's other two coal plants were scheduled to close. Uniper has since made an additional, significant impairment across its Dutch, French and German coal generation assets of €1.8 billion, in the first half of 2016. Again, investor relations declined to provide a breakdown of that impairment, leaving a necessarily crude assumption that Maasvlakte 3 took a large hit, as the newest and biggest coal generation asset in the Netherlands, leaving a book value of about €0.5bln-€1bln.
- Engie, Rotterdam – Engie in 2013 made an impairment of €1.2 billion against thermal power plants in the Netherlands, but has not specified what this implies for remaining, recoverable value.[28]

Estimation of Value Using a DCF Model

We use a simplified discounted cash flow (DCF) model based on forecast of revenues and variable operating costs as applicable. The model is used to run a variety of sensitivities very quickly and assess reliability of estimates under different sets of assumptions. Our initial assumptions follow a selection of estimates from existing literature.

The baseline assumptions of our analysis are optimistic, favoring scenarios whether the continued operation of the coal power plants is at least reasonable.

- We assume that the plant will be able to earn an average operating margin of €19.5/MWh (per the clean dark spread (CDS) over the depreciable life of the asset (30 years). This CDS was selected as that required to yield a minimal, positive net present value (NPV). We assume such an operating margin effectively frees us from having to estimate uncertain fuel and electricity prices and their future distribution. The operating margin can be stressed to provide sensitivity to our initial assumptions. We note that that this is an optimistic CDS, exceeding values of the past two years, and far in excess of expected CDS over the next two years, as modelled by analysts and as implied by forward power, coal and carbon markets.
- We assume variable, operating and maintenance costs (VOM) in line with two recent studies, by CE Delft and by Spring Associates, referenced above, which estimate the non-fuel operating and maintenance costs for a coal-fired plant in the range of €6 to €7.5/MWh.
- We assume that the power plants operate for an average 7,300 hours annually, again over an assumed 30-year lifespan, implying an average capacity factor of 83%.

[28] http://www.engie.com/wp-content/uploads/2014/02/2013-consolidated-financial-statements-and-activities-report.pdf

- We use industry benchmarks for a capital cost of €1,479/kW, and we assume a 40:60 debt to equity ratio.
- We assume a cost of debt of 3.6%, for equity of 8.8% and an after-tax weighted average cost of capital – or discount rate – of 6.2%

Using these assumptions, and modelling for a hypothetical 1,100 MW power plant roughly equivalent to Uniper's Maasvlakte 3, we derive a net present value (NPV) of just above €400 million.

Estimating an asset's value in use is a very complex exercise. For example, IAS 36 details several elements that should be reflected in valuing the asset: (a) an estimate of the future cash flows the entity expects to derive from the asset; (b) expectations about possible variations in the amount or timing of those future cash flows; (c) the time value of money, represented by the current market risk-free rate of interest; (d) the price for bearing the uncertainty inherent in the asset; and (e) other factors such as illiquidity that market participants would reflect in pricing the future cash flows the entity expects to derive from the asset. In the absence of similar market transactions, it is very difficult to value factors such as illiquidity.

In our modelling exercise we have deliberately stretched our assumptions to favor the case for investing in coal. Our simplified, admittedly foolhardy DCF approach leads to obvious conclusions. And indeed one should not ignore that in the real world there can be advantageous legacy contracts, managers can "sweat" assets for value and trading teams can contribute materially to asset optimization.

But to ignore the underlying trends in the policy, macroeconomic and technological environment would be even more misguided. The transcript from Uniper's H1 2016 conference call with the press and analysts is emblematic in this sense: "The impairment charges on coal-fired generation assets were taken in response to current policy discussions in a number of European countries where we operate coal-fired power plants. Under discussion are plans to possibly shorten the operating lives of power plants and to possibly introduce new levies on coal-fired generation, such as a minimum carbon price or taxes. In view of these possible interventionist scenarios, we have to assume that it is not guaranteed that all of our plants will be able to remain in operation until the end of their useful operating lives."[29]

Implied Impairment Loss

Our calculated NPV of €400 million is not equivalent to the market value of the power plant to a utility. There are other synergies and portfolio effects to consider, which may increase value. Fair value would also ordinarily include the value of the real estate where the power plant is sited, plus the sale and scrap value of the power plant components, all of which are disregarded in this analysis. As a case in point, RWE has just published its interim release for Q1-Q3 2016, which—under Conventional Power Generation—mentions: "We earned income

[29] https://www.uniper.energy/content/dam/uniper-corporate/documents/en/press/20160822_Presserede_H1_Uniper_EN.pdf

from the sale of land in the United Kingdom, some of which was intended as sites for new power plants but is now surplus to requirements."[30]

Nevertheless, we note that this value is around half or less our crude estimates for the book value (€500mln to €1bln), as registered at present on the utility balance sheets for these power plants.

We discuss below the plausibility of the assumptions in our DCF model and consider what alternative scenarios could boost the overall business case for coal.

Plausibility of Our DCF Base-Case Assumptions

In our model, we assume an average operating margin available throughout the 30-year lifetime of the coal plant. However, we note that all else being the same, the NPV of the resulting cash flows will change based on the distribution of achieved CDS throughout the operating life of the asset. This effect results from the impact of greater discounting of cash flows further into the future. It is a concept expressly noted by IAS 36 for the estimation of the asset's future cash flows: the firm must determine the asset's value in use considering expectations about possible variations in the *amount or timing* of future cash flows.

To illustrate this effect, in our base-case modelling we use average CDS and NPV values based on a sample of 1,000 random runs using a SIP approach (Stochastic Information Packet).[31] In Figures 5 and 6 we show how an asset can fall behind (or get ahead) in NPV terms based on an unfavorable (favorable) distribution of operating revenues, even if on average a very similar CDS is achieved over the entire period. We examine the first 15 years, as a halfway point where the operator might review progress. By design, the entire sample of 1,000 runs for 15 years of the asset's life yields an average CDS of €19.5/MWh and a corresponding NPV of €148 million (at a 10% discount rate).[32] However, there is random variation in the distribution of realized CDS and associated NPV within each run, or scenario. For example, scenario 359 (see Figure 5) illustrates a case where the random distribution of realized CDS yields a slightly below average CDS (€19.42/MWh vs the assumed average of €19.5/MWh). The achieved CDS over 15 years for scenario 359 is better than 41.5% of all modelled CDS outcomes, but it is only better than 19.4% of all NPV outcomes, because in this scenario higher CDS tend to occur in later years. The year-by-year occurrence of realized CDS for Scenario 359 is documented on the chart on the left-hand side of the picture, while its position within the distribution of all CDS and relative NPV outcomes (based on 1,000 runs) is highlighted in red on the two charts on the right-hand side. Scenario 601, illustrated in Figure 6 below, provides an example of the opposite situation: an average realized CDS at €19.5/MWh (better than 48.8% of all modelled outcomes), but due to a favorable distribution

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30 http://www.rwe.com/web/cms/mediablob/en/3256198/data/110822/9/rwe/investor-relations/reports/RWE-interim-release-Q1-Q3-2016.pdf

31 http://probabilitymanagement.org/sip-math.html

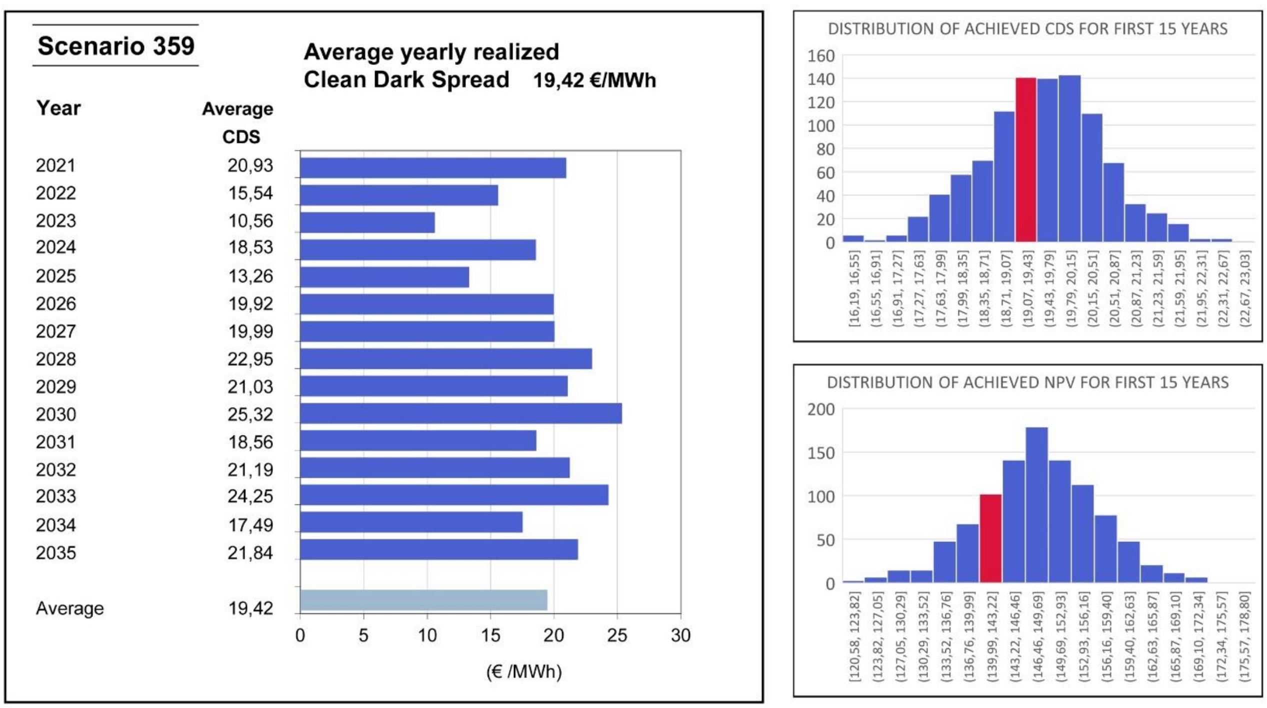
32 CDS values are simulated for each scenario by using a SIP. The total number of scenarios run is 1000. NPV values are illustrative, and based on a simple discounting of the CDS, assuming one million MWh is produced.

of higher CDS values in the early years—a higher than average NPV (better than 86.3% of all modelled outcomes).

These findings underline how unfortunate it is, for the NPV of these power plants, that the current forward curves imply very low CDS values in the early years of the plant's life – in turn this exacerbates the pressure on the asset to make up the cash flow deficit versus planning estimates. This effect is even more pronounced for the current assets in the Netherlands since they are already operational and will for sure earn CDS values much lower than our assumed €19.5/MWh in the next three to five years. The Spring Associates paper provides an illustration of historical realized CDS for coal plants, showing that CDS can vary a lot in just a few years. Based on Reuters data for current forward curves, the CDS for the next three years should be in the range of 4 to 7 €/MWh. Historical CDS values ranged between €10/MWh and €30/MWh from 2008 to 2015.

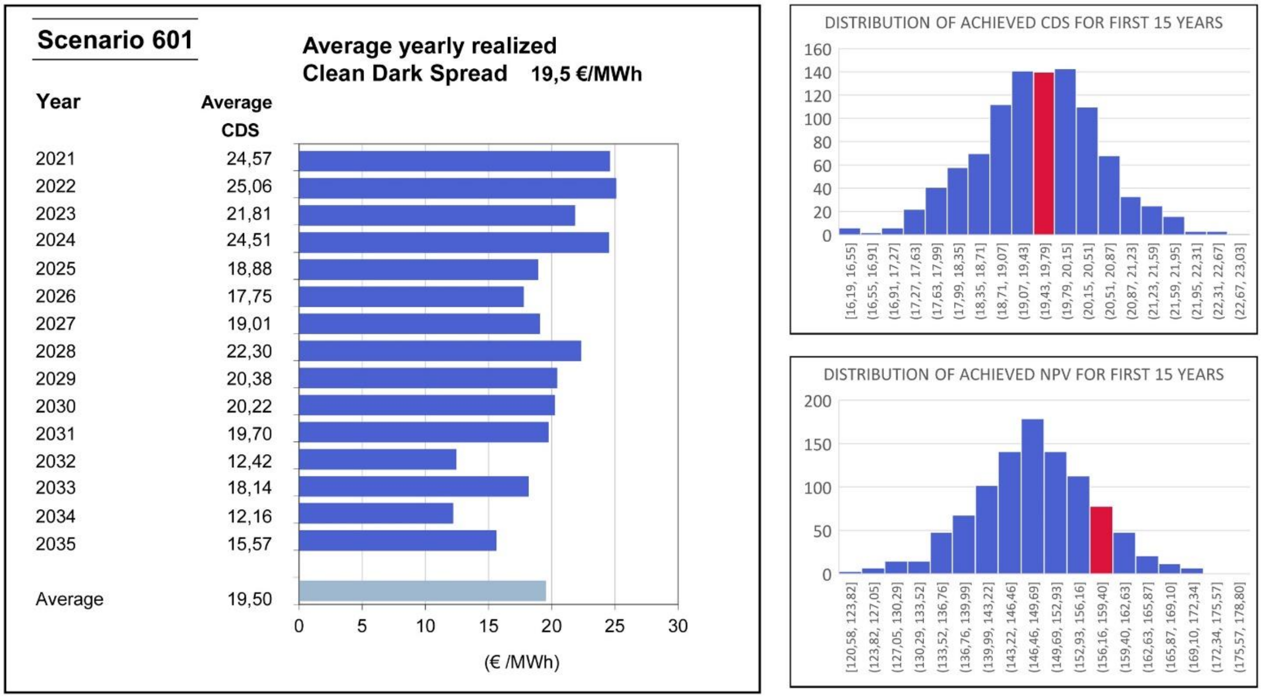
We conclude that the assumption of a CDS of €19.5/MWh is itself optimistic, and the assumption that this will remain constant, or that higher CDS values will be in the earlier rather than latter years, is additionally optimistic. This discussion and analysis provides an additional interpretation of our DCF result of €400 million: a prudent investor should consider that there are unfavorable combinations which would lower the project NPV.

Figure 5. Simulated CDS for 15 years – Scenario 359: Average CDS, Below Average NPV



Source: Acousmatics

Figure 6. Simulated CDS for 15 years – Scenario 601: average CDS, above average NPV



Source: Acousmatics

Sustained Low Carbon Prices

Our assumed CDS indirectly implies sustained low European carbon prices. Indeed, carbon prices have wallowed in the €0-10 range per tonne of carbon dioxide emissions in recent years, as a result of the global financial crisis and a massive glut in permits to pollute, or EU allowances (EUAs). However, most analysts expect slowly rising EUA prices, from around €5 today to €20 in 2030, as reported by Thomson Reuters Point Carbon. These forecasts take into account political steps to eradicate the EUA surplus.

Sustained low carbon prices would assume a failure to address the present oversupply of EUAs. This scenario could occur as a result of an EUA demand shock, in which a repeat economic crisis wipes out energy-intensive industry output and EUA demand, or an EUA supply shock as a result of an unwinding of the Paris Agreement and/or of EU political commitment to carbon market reforms.

We view such outcomes as unlikely. Given the direction of policy, illustrated by recent early entry into force of the Paris Agreement, we see evidence for the opposite: an acceleration of actual trends, with more aggressive rises in carbon prices.

High Coal Power Capacity Factors

The capacity factor assumed in our DCF model is extremely optimistic in the present context of growth in near-zero marginal cost renewable power. This growth has displaced more expensive generation, leading to lower running times for both coal and, in particular, gas-fired power plants. Lower wholesale power prices and weak capacity factors can also be traced to generating over-capacity in some countries. Over-capacity is partly about renewables growth, but also reduced energy demand growth, as a result of economic restructuring toward less energy-intensive manufacturing and services industries, and toward efficiency investment and innovation. Primary energy demand in the Netherlands last year was 15% below its peak, established in 2010, suggesting a structural decline.[33]

A return to higher coal power capacity factors would therefore require, first and foremost, much slower or zero growth in renewable power. However, the Netherlands is committed to an ambitious renewable power rollout under its 2013 "Energy Agreement," and the EU's Renewable Energy Directive. The EU has also recently committed to a further round of emissions and renewable energy targets in 2030, under the Paris Agreement. Higher coal power capacity factors may only be achievable if the Netherlands reverses course on these commitments, and on commitments to reduce energy demand.

We view such outcomes as unlikely. Indeed, it is more plausible to argue for the acceleration of trends that are actually in motion today. The EU is presently prioritizing fuel independence—with more solar power and wind power and fewer fossil fuels—and more R&D supporting renewables innovation, as described in its "Energy Union and Climate" commitments.[34]

7. Conclusions

We conclude that the three new coal power plants in the Netherlands were poor investment decisions, evidenced by billions of euros of impairments taken on the plants in the year since completion.

The multiple reasons for these impairments—a rise in renewables, flat power demand growth and tightening carbon-emissions targets—apply to other countries with big pipelines for new coal power plants. The example of Japan is notable, where we note stranded asset risks in new-build coal, with similar drivers to the Netherlands, namely: climate change policy; renewables subsidies; investment in energy efficiency; and low levels of population, GDP and energy demand growth.[35] Turkey may more reliably depend on rising power demand, but

[33] https://www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2016/bp-statistical-review-of-world-energy-2016-full-report.pdf
[34] https://ec.europa.eu/priorities/energy-union-and-climate_en
[35] http://www.smithschool.ox.ac.uk/research-programmes/stranded-assets/satc-japan.pdf

must be very careful about planning its future energy mix, given the impact we have seen of renewables growth on power prices in Europe.

The Netherlands is thus a cautionary lesson for investors.

What will happen to these new coal-fired power plants? Their retirement may prove to be the most cost-efficient way for the Netherlands to meet its emissions targets, especially given the impairments taken on them to date and, more broadly, given the momentum on climate-change policy and declining electricity demand.

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