

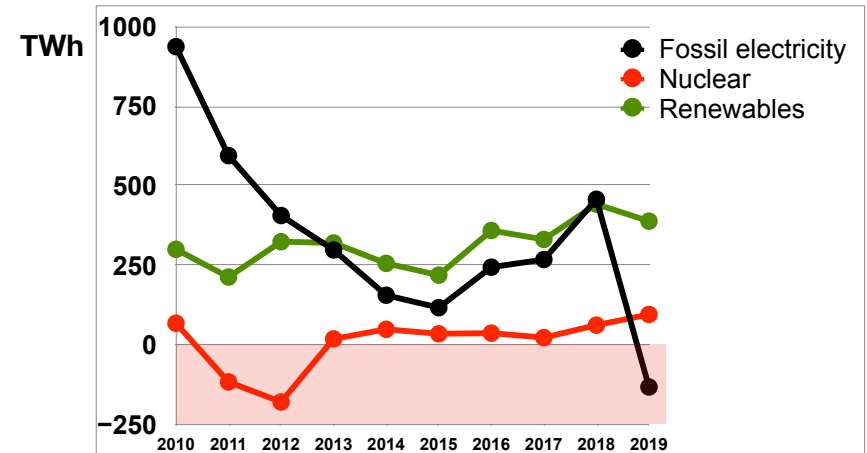
# Turning the fuel electricity system

REFORM 2020-08-24

**Tomas Kåberger**

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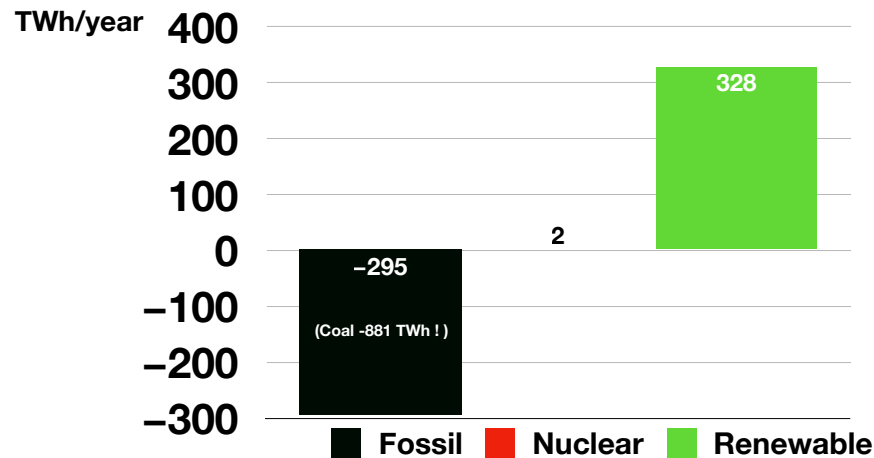
## Global, annual change of electricity generation 2010-2019



© Tomas Kåberger

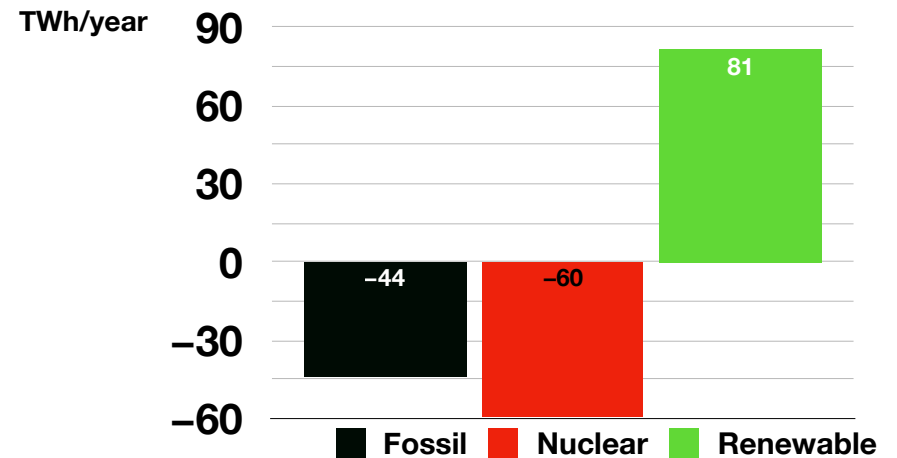
Data: BP statistical review 2020

## US Change in annual Electricity generation 2019-2010

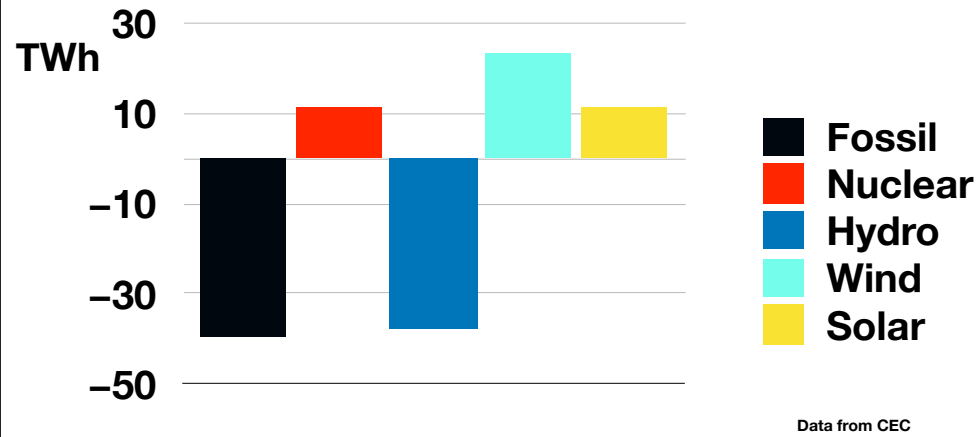


Data 2010: Table 7.2a  
 Data 2019: [https://www.eia.gov/electricity/monthly/epm\\_table\\_grapher.php?t=epmt\\_es1b](https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_es1b)

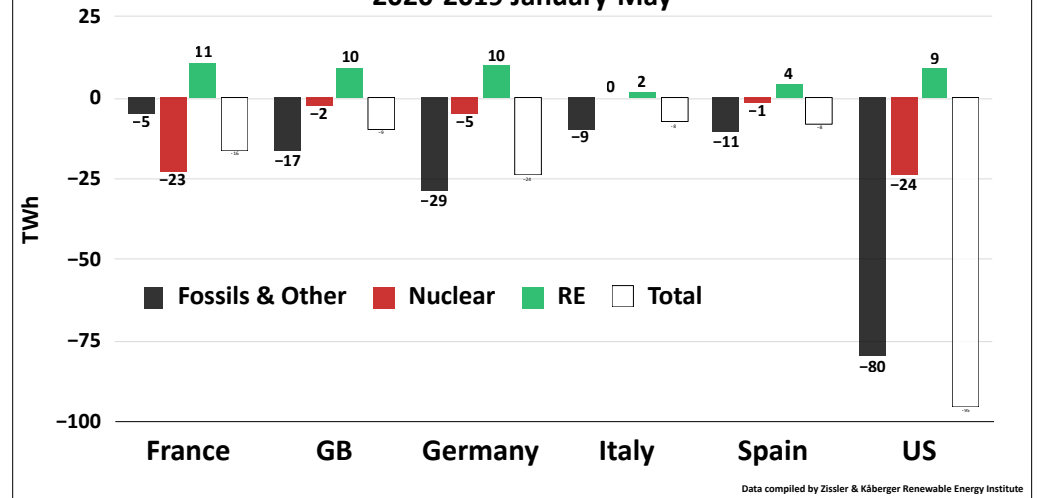
## EU change in electricity generation H1 2020-H1 2019



## China Electricity generation H1 2020-H1 2019



## Change in Electricity in Europe and the United States 2020-2019 January-May



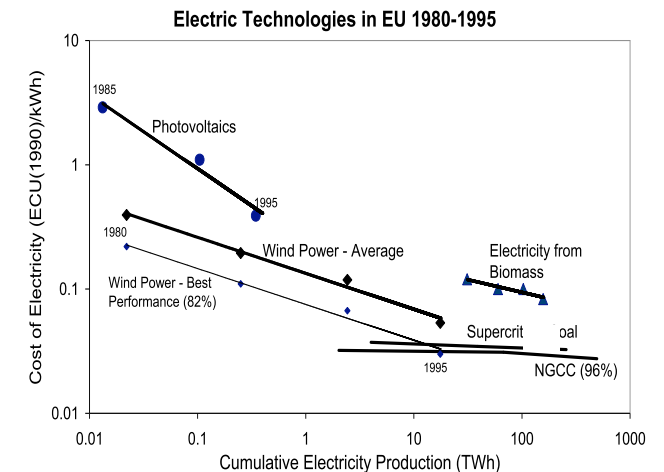
## German Electricity Production February 2020

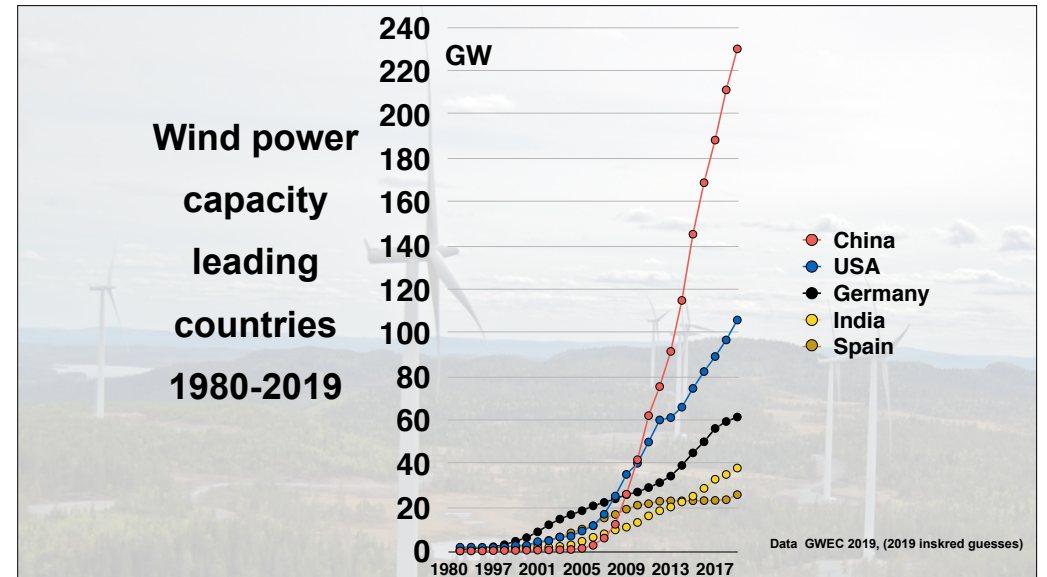
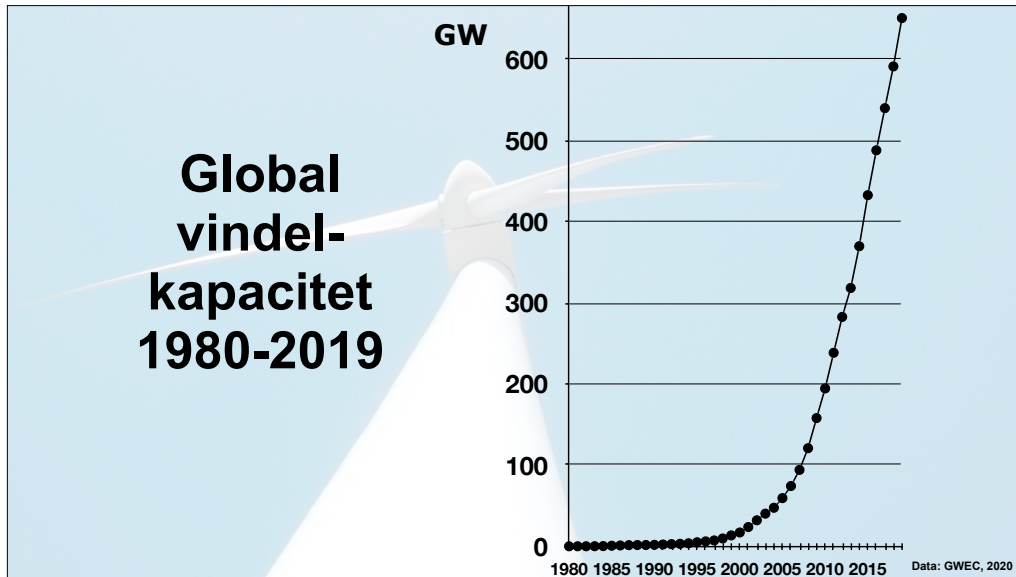


## Industrial learning by experience



Prof. Clas-Otto Wene, Chalmers Univ. of Technology, 2000





## New low for wind energy costs: Morocco tender averages \$US20/MWh

By Giles Parkinson on 17 January 2016

The north African country of Morocco has secured average bids of just \$US20/MWh for large scale wind energy projects, with the lowest at \$US17.70/MWh.

The pricing – revealed by its energy ministry at an Energy summit in Abu Dhabi on Saturday – sets a new benchmark for the region, and is boosted by the remarkable wind energy resource and concessional finance.

Abderrahim El Hafid, vice minister of energy and water, said the results were “amazing” and said it pointed to a “real revolution” in the US have been in and around \$US25/MWh, although production tax credit.

## Enel sets a new world wind record in Mexico, below \$18/MWh

November 29, 2017 Paul Dvorak - 0 Comments

This Flash Note from Make Consulting examines the results of Mexico's third long-term power auction held in November 2017. The note evaluates the event and its bidding within the context of previous auction rounds in Mexico as well as within the Latin American region. It analyses the dynamics that contributed to Enel's record low bidding and the results dynamics that favor low bidding in the Mexican market.

Key points:

- Mexico hosted a long-term power auction in November 2017 which awarded offtake agreements to wind power and PV projects totaling 5.5 TWh of annual production
- Enel submitted four successful bids for wind power sites with the lowest reaching \$17.70/MWh
- In total, the auction awarded PPAs to 2 GW of new projects sites, including 689 MW of new wind power sites which are due online in 2020

## Offshore wind record low

Published on 06/07/2016, 10:57am

Two 350MW arrays in the power at €87/MWh, head by miles

By Megan Darby

Dong Energy has set a new record for the lowest cost of offshore wind power in a tender on the coast of the Netherlands.

The Danish company offered €72.70/MWh (US\$80.40/MWh) for 100MW of power. The cables will be laid over the next few months.

That beats an industry record of €100/MWh by 2010. The cost of a new 100MW array would be €103/MWh per year.

"It was a result that exceeded expectations," said European Wind Energy Association (EWEA) President.

## New record for cheapest offshore wind farm

7:33 AM CET / 9-Nov-2016 / Vattenfall (STO:ONOT)

## Vattenfall wins tender to build the largest wind farm in the Nordics

Today, Vattenfall has won the tender to build Danish Kriegers Flak, a 600 MW offshore wind farm in the Baltic Sea. The winning bid was EUR 48.9 per MWh, which is among the lowest costs in the world for offshore wind power.

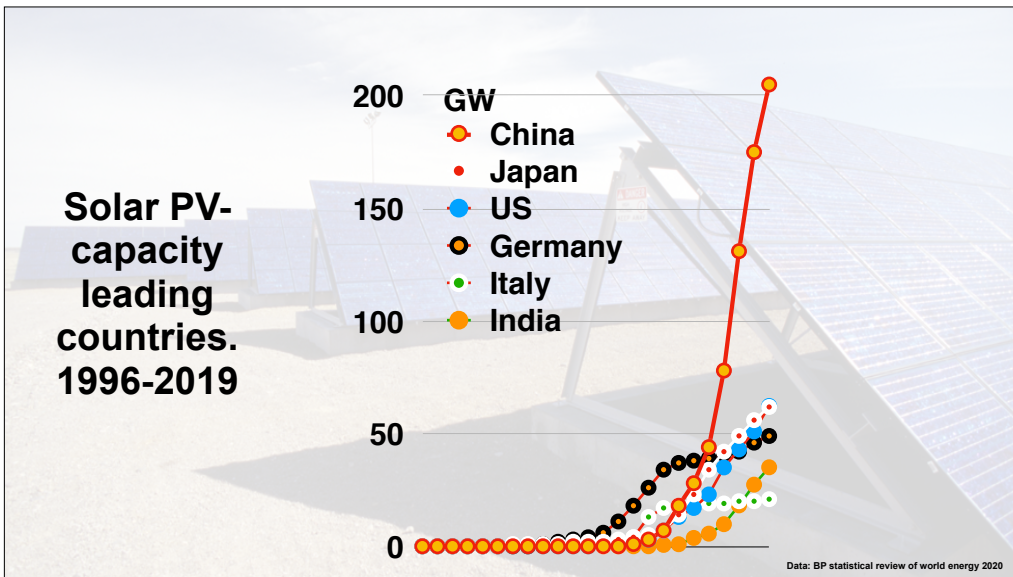
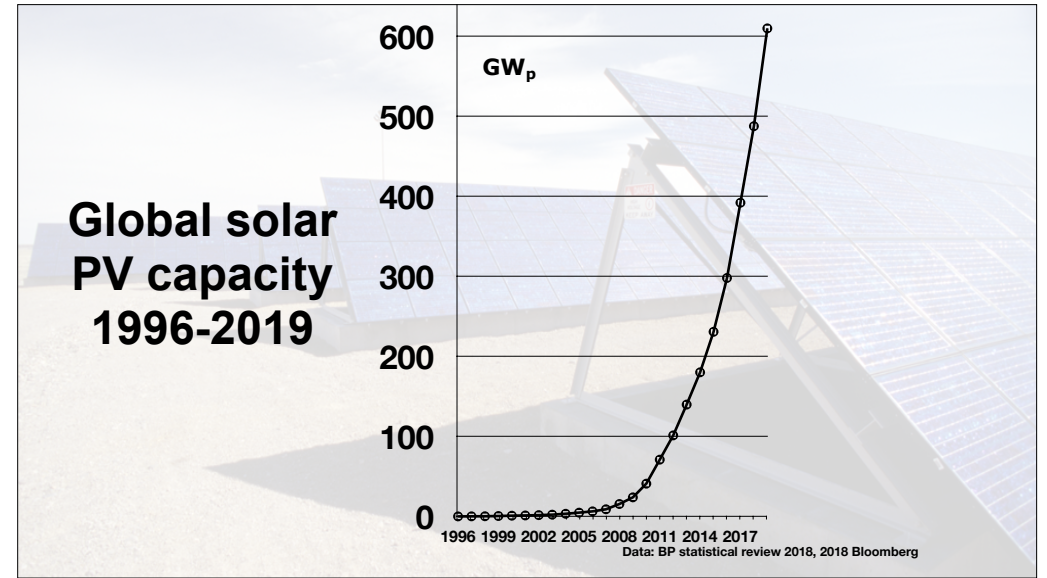
"The announcement is an essential milestone for our ambition to increase our production of renewable power. We are already the second largest offshore player globally. The winning bid of EUR 48.9 per MWh proves that Vattenfall is highly competitive and brings down the costs for renewable energy", says Magnus Hall, CEO Vattenfall.

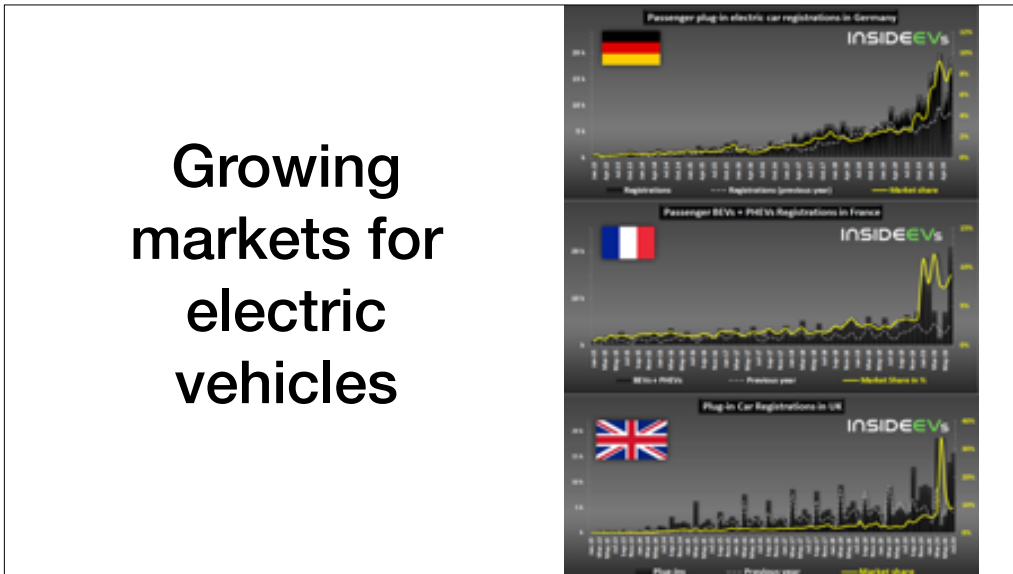
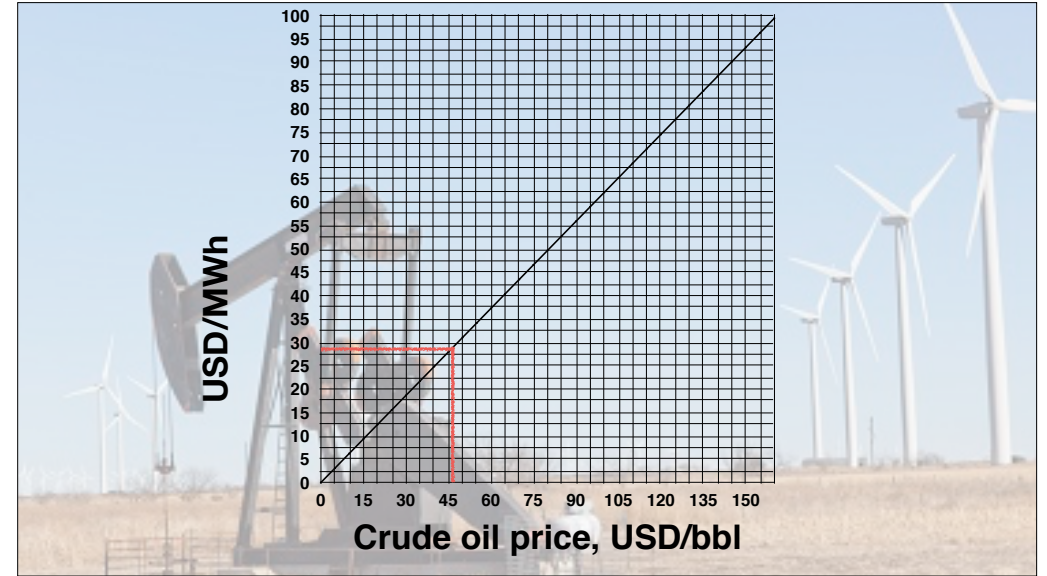
Kriegers Flak will be Denmark's largest offshore wind farm and can supply 600,000 Danish households with renewable energy – corresponding to 23 percent of all households in Denmark. Vattenfall's investment in Kriegers Flak will be EUR 1.1 – 1.3 billion, pending a final investment decision.

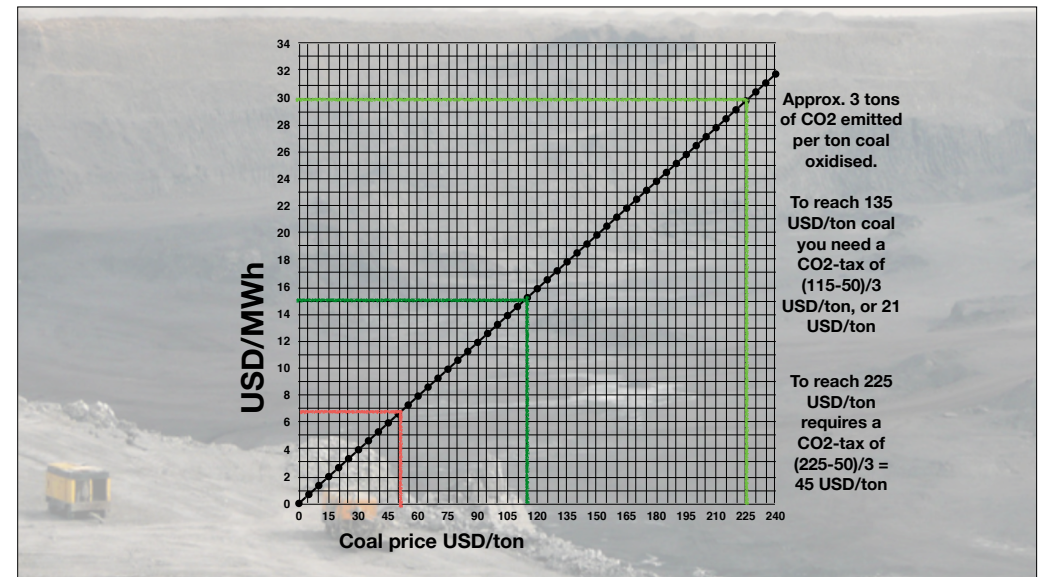
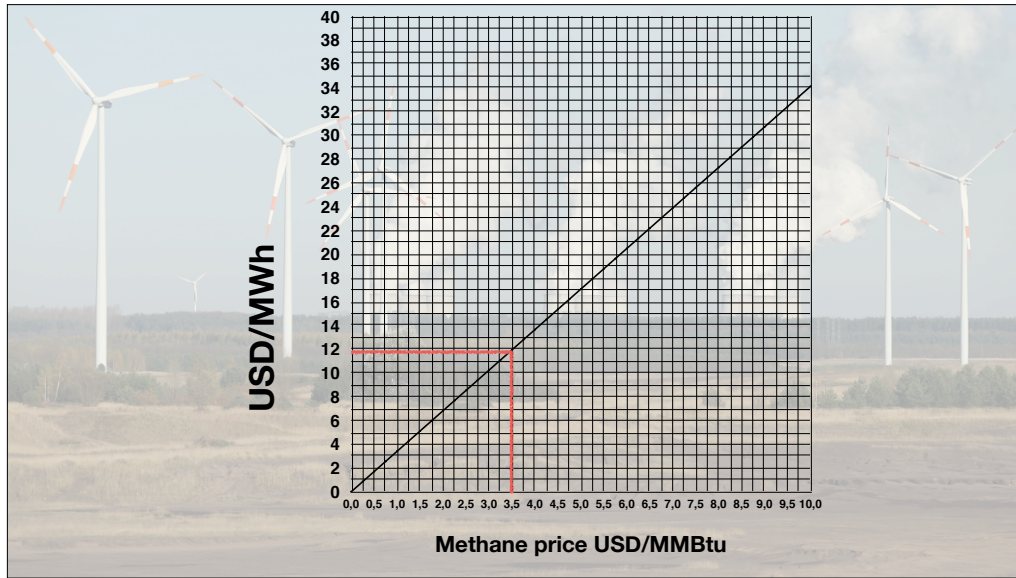
"This is exciting news. I'm very proud of our people in the Wind organisation who once again delivered a winning bid. Vattenfall has won the three latest offshore wind tenders in Denmark: Horns Rev 3, Danish Near Shore and Kriegers Flak, equivalent to the energy consumption of 50 percent of the Danish households", says Gunnar Groebler, Head of Vattenfall Wind.

By Emily Godden  
14 SEPTEMBER 2016

The cost of building a new low, wind contracts to build over €60 (£51) per







## SSAB, LKAB and Vattenfall form joint venture company for fossil-free steel

SSAB, LKAB and Vattenfall announced today that they have formed a joint venture company to continue to drive the HYBRIT initiative. The three companies will each own one third of the company, which will seek to develop a steelmaking process that emits water instead of carbon dioxide.

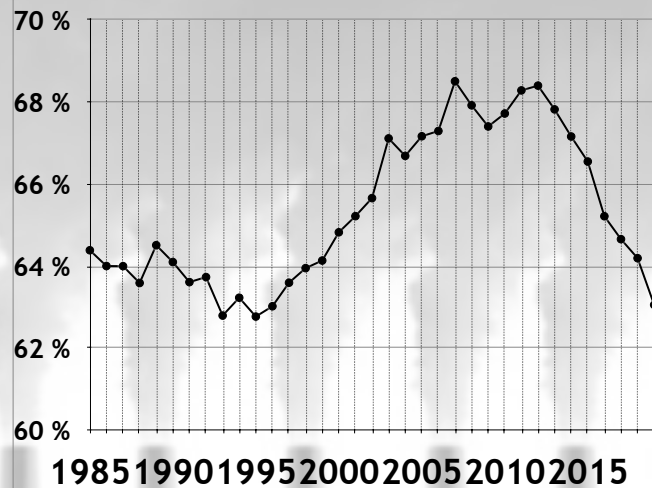


"HYBRIT is a very important initiative for SSAB and a fossil-free Sweden by 2045. A joint venture company will enable us to work together effectively to eliminate the root cause of carbon dioxide emissions in the steel industry," said Martin Lindqvist, President and CEO of SSAB.

"Our establishment of a joint venture to develop HYBRIT indicates our conviction that it is possible to develop a fossil-free production chain all the way from the mine to the steelworks. If we're successful, this will be a technology breakthrough that can make a global contribution to significantly limiting climate change," said Jan Moström, President and CEO of LKAB.

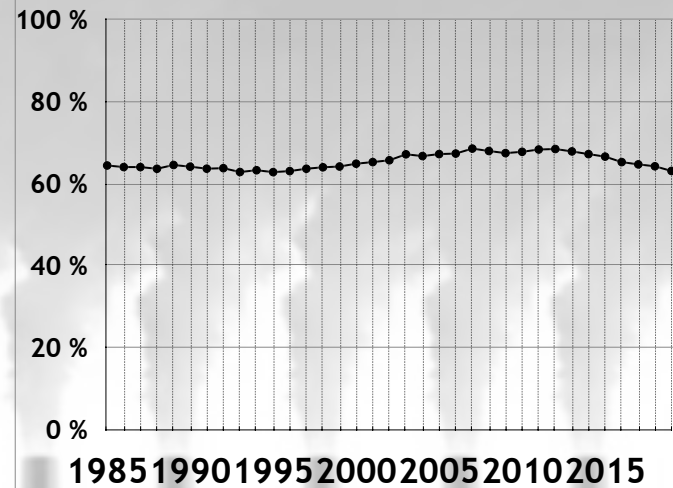
- Fuel to produce electricity : Electricity price  $\approx$  fuel price \* 3
- Electricity substitutes fuel : Electricity price  $\approx$  fuel price
- Electricity -> fuel : Electricity price < fuel price
- Market growth and learning curves
- Capital cost opportunities
- Power balancing

Fossil Share of Global Electricity generation 1985-2019



Data: BP statistical review 2019, 2019 based on preliminary data

Fossil Share of Global Electricity generation 1985-2019



Data: BP statistical review 2019, 2019 based on preliminary data

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