# Where we are heading…

**Tomas Kåberger**

*Executive Board Chair of Renewable Energy Institute, Tokyo*
*Affiliate professor Chalmers University of Technology*
*Industrial Growth Executive InnoEnergy*
*Executive Board Chair Renewable Energy Institute*
*Member of the Swedish Climate Polity Council*
*Member of the Swedish Royal Academy of Engineering Sciences*

2016:

## Free Energy, $10 A Barrel Oil By 2025 Says French Utility Company

December 28th, 2016 by **Steve Hanley**

"The promise of quasi-infinite and free energy is here," says Thierry Lepercq, head of research, technology and innovation for Engie SA. He thinks the cost of solar power will drop below $10 a megawatt-hour ($0.01 per kWh) before 2025 in the world's sunniest places. Engie recently conducted a "very deep modeling" of the Provence-Alpes-Cote d'Azur region of France, which has about 5 million inhabitants. The study showed those regions could run entirely on renewable energy for about 20% less than the price of electricity today.

ENGIE

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ENGIE

## Portugal's second PV auction draws world record low bid of $0.0132/kWh

According to financial newspaper *Expresso*, the lowest bid in the exercise was €0.0112/kWh, slightly lower than the $0.0135/kWh submitted by French energy group EDF and China's JinkoPower in a 2 GW tender held in Abu Dhabi, a price which was confirmed last month.

AUGUST 24, 2020 EMILIANO BELLINI

HIGHLIGHTS UTILITY SCALE PV PORTUGAL

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ENGIE

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The record low price was offered for the 600 MW Al-Faisaliah PV IP project, which competed in the second round of the country's procurement scheme for renewable energies.

APRIL 8, 2021 EMILIANO BELLINI

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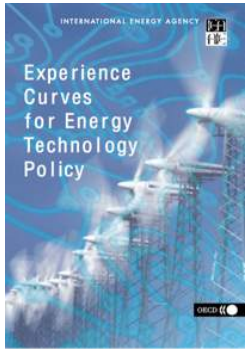
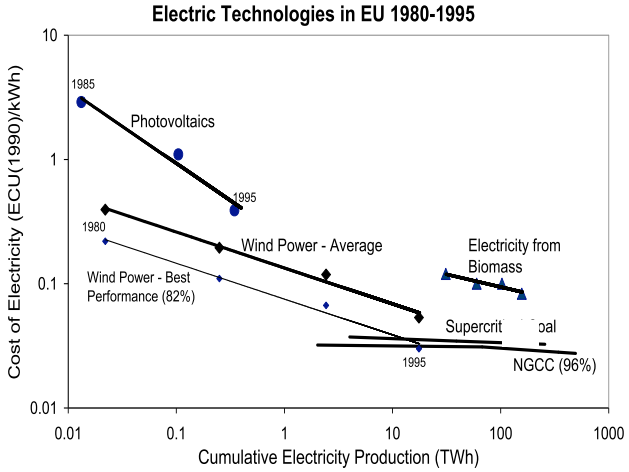
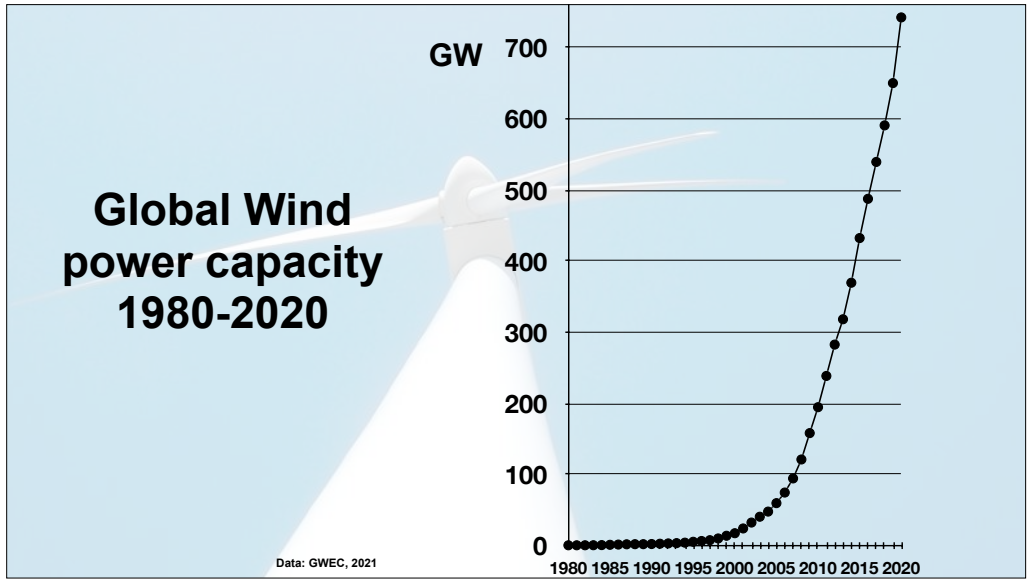
"The output capacity of these projects, in addition to the projects of Sakaka and Dumat Al-Jandal, will amount to more than 3,400 MW," he said in a statement, adding that one of the projects – the 600 MW Al-Faisaliah PV IP project – will sell power at a world record low price of $0.0104/kWh. The project was selected by the Ministry of Energy in Round 2 of the procurement scheme that is being held under the umbrella of the country's National Renewable Energy Program (NREP).

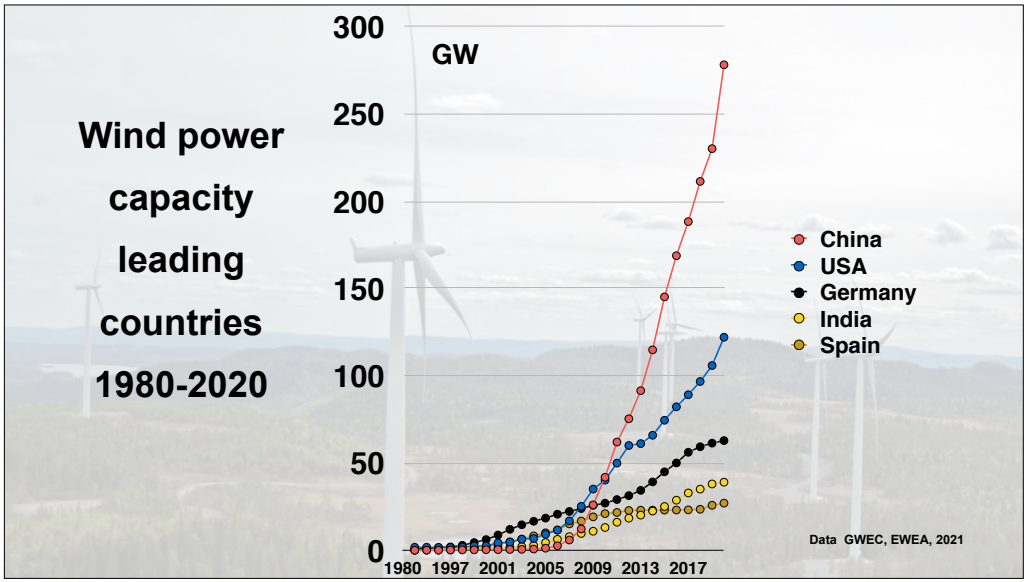
# Industrial learning by experience

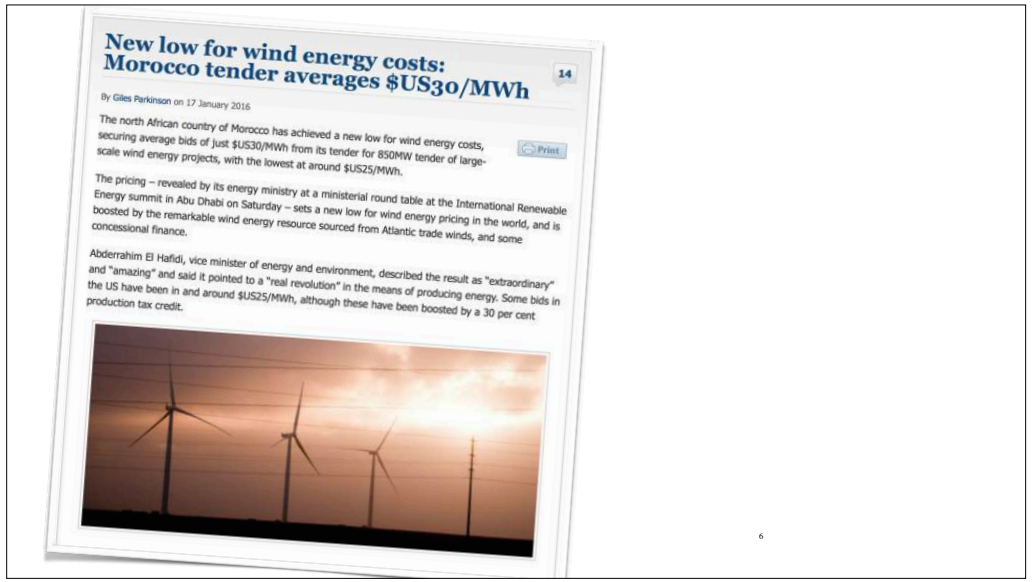



Prof. Clas-Otto Wene, Chalmers Univ. of Technology, 2000



New low for wind energy costs: Morocco tender averages $US30/MWh

By Giles Parkinson on 17 January 2016

The north African country of Morocco has achieved a new low for wind energy costs, securing average bids of just $US30/MWh from its tender for 850MW tender of large-scale wind energy projects, with the lowest at around $US25/MWh.

The pricing – revealed by its energy ministry at a ministerial round table at the International Renewable Energy summit in Abu Dhabi on Saturday – sets a new low for wind energy pricing in the world, and is boosted by the remarkable wind energy resource sourced from Atlantic trade winds, and some concessional finance.

Abderrahim El Hafidi, vice minister of energy and environment, described the result as "extraordinary" and "amazing" and said it pointed to a "real revolution" in the means of producing energy. Some bids in the US have been in and around $US25/MWh, although these have been boosted by a 30 per cent production tax credit.

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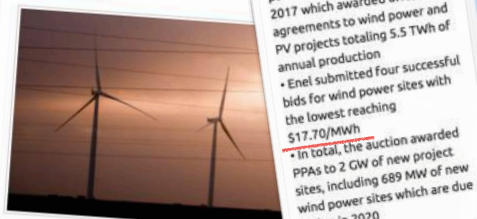

## Enel sets a new world wind record in Mexico, below $18/MWh

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 posits 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 project sites, including 689 MW of new wind power sites which are due online in 2020



## Offshore wind costs hit record low

1k Shares

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

Two 350MW arrays in the Netherlands will supply power at €87/MWh, beating the next cheapest project by miles

By Megan Darby

**Dong Energy has set a record low price for offshore wind power in a winning bid to build two arrays off the coast of the Netherlands.**

The Danish company committed to supply electricity at €72.70/MWh (US$80.40), not including transmission costs. The cables will add about €14/MWh, experts say.

That beats an industry goal of bringing costs below €100/MWh by 2020. The closest any rival had previously come was €103/MWh by Vattenfall in Denmark last year.

"It was a result that was well beyond anyone's expectations," said Oliver Joy, spokesperson for the European Wind Energy Association.



## Offshore wind

record low

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"It was a result tha
expectations," said
European Wind Ener

## New record for cheapest offshore wind farm

The costs of offshore wind have fallen significantly in recent years

By Emily Gosden, ENERGY EDITOR

14 SEPTEMBER 2016 • 7:35AM

The cost of building offshore wind farms has fallen to a new low, with Sweden's Vattenfall winning contracts to build two projects in Danish waters for just over €60 (£51) per megawatt-hour (MWh).



## Offshore wind

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## New record for cheapest offshore wind f

The costs of offsho

By Emily Gosden

14 SEPTEMBER 2016

The cost of bu
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VATTENFALL

*7.33 AM CET / 9-Nov-2016 / Vattenfall (STO:ONOT)*

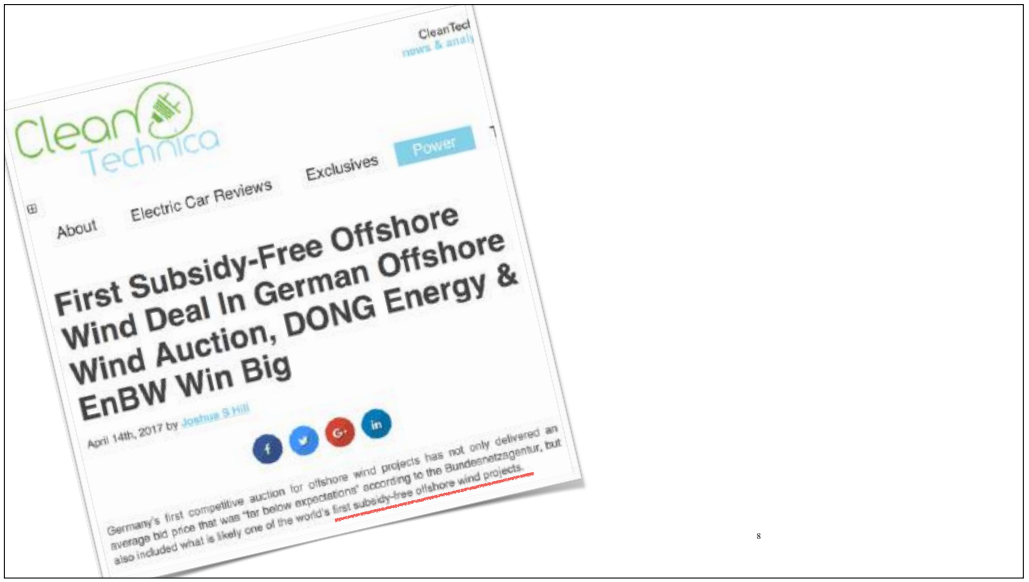
## Vattenfall wins tender to build the largest wind farm in the Nordics

**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 49.9 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 49,9 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 55 percent of the Danish households", says Gunnar Groebler, Head of Vattenfall Wind.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First Subsidy-Free Offshore Wind Deal In German Offshore Wind Auction, DONG Energy & EnBW Win Big
April 14th, 2017 by Joshua S Hill
Germany's first competitive auction for offshore wind projects has not only delivered an average bid price that was "far below expectations" according to the Bundesnetzagentur, but also included what is likely one of the world's first subsidy-free offshore wind projects.


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Vattenfall awarded Dutch zero-subsidy site
19 March 2018 by David Weston, Be the first to comment
NETHERLANDS: Developer Vattenfall has been granted the licence to build the 700MW Hollandse Kust Zuid offshore wind project in the latest Dutch offshore tender round, without subsidy.
Vattenfall, through its Dutch subsidiary Nuon, built Egmond aan Zee, the Netherland's first offshore wind project
The site, located 22.2km off the Dutch coast, will require €1.5 billion in investment from Vattenfall, the developer said. It comprises two 350MW projects and due online in 2022.


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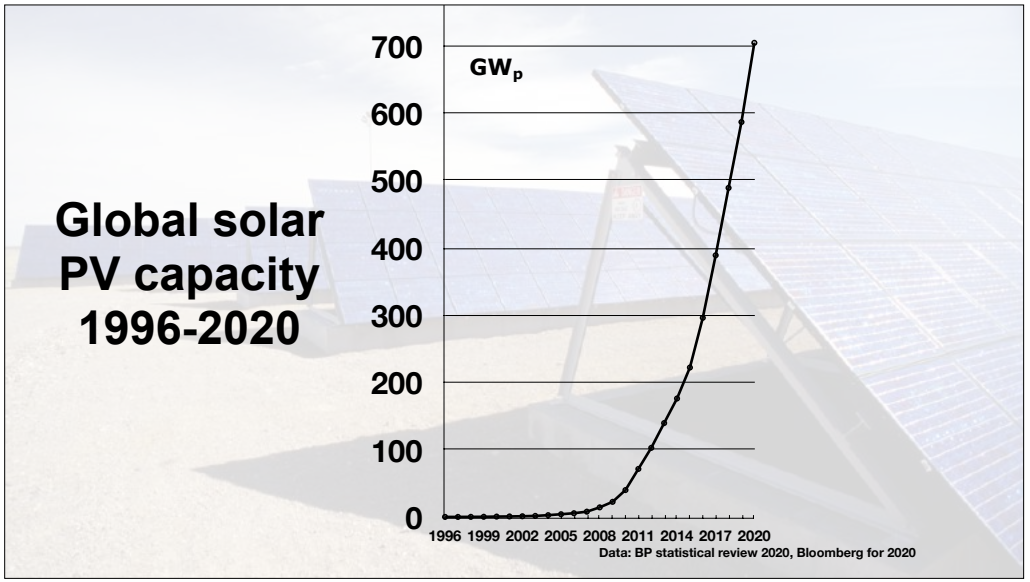
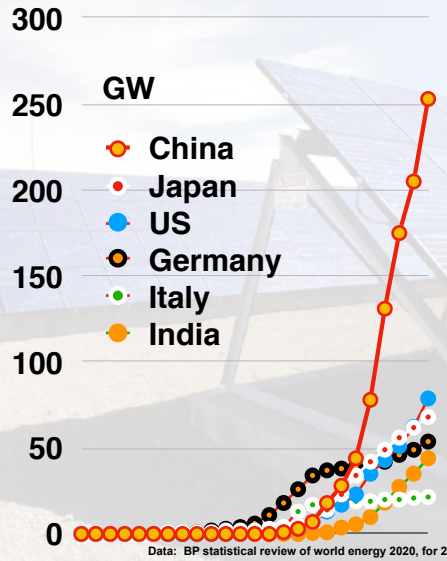
Vattenfall gives green light to world's largest offshore wind project
Vattenfall has taken final investment decision for Hollandse Kust Zuid 1-4 proceeding with the construction of what will be the world's largest offshore wind farm.
2020-06-04


Global solar PV capacity 1996-2020
GWp
700
600
500
400
300
200
100
0
1996 1999 2002 2005 2008 2011 2014 2017 2020
Data: BP statistical review 2020, Bloomberg for 2020

**Solar PV-capacity leading countries. 1996-2020**




Data: BP statistical review of world energy 2020, for 2020 own collection from various sources

Clean Technica

## Tremendously Low 4.8¢/kWh Solar Price In Peru, Unsubsidized

February 25th, 2016 by Guest Contributor

Peru recently awarded 185 megawatts (MW) of new solar photovoltaic (PV) contracts in a renewable energy solicitation, at record-low prices for a nation not offering any tax breaks for such development.

Of the 185 MW of new project capacity, 144 MW relates to a bid from Enel Green Power at $47.98/MWh (megawatt-hours) and 40 MW relates to a bid from Enersur at $48.50/MWh.

Notably, the projects aren't expected to be built until 2017 — when solar PV prices are expected to be notably lower, hence the lower bids and contracts.

According to the press release from Peru's Supervisory Agency for Energy and Mines (Osinergmin), the Enel Green Power contract is for the provision of 415 gigawatt-hours (GWh) of electricity a year from the company's planned Rubi solar PV project at the aforementioned price of $47.98/MWh. The Enersur contract is for the provision of 108 GWh of electricity a year from the planned Incapampa solar PV project at $48.50/MWh.

Delivery of electricity from the projects is currently set to begin by the end of 2018 — if the terms of the contracts are to be met.

Along with the above-mentioned solar energy projects, 3 wind energy projects were awarded contracts following the recent solicitation. Contract prices for these projects ranges from $36.84–37.65/MWh. In addition, a number of hydroelectric and biomass projects were awarded contracts as well.

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## Dubai Gets Record-Low Bid Of 2.99¢/kWh For 800 MW Solar PV Project

May 2nd, 2016 by Saurabh Mahapatra

Dubai Electricity and Water Authority has received yet another record-breaking bid for expansion of the iconic Mohammed bin Rashid Al Maktoum Solar Park, the lowest solar price bid in history, for an 800 MW solar PV project that expands on 213 MW.

## Cheapest Solar on Record Offered as Abu Dhabi Expands Renewables

Photographer: Seong Joon Cho/Bloomberg

by Anthony Dipaola @A_Dipaola17

offer at 2.42 cents a kilowatt-hour

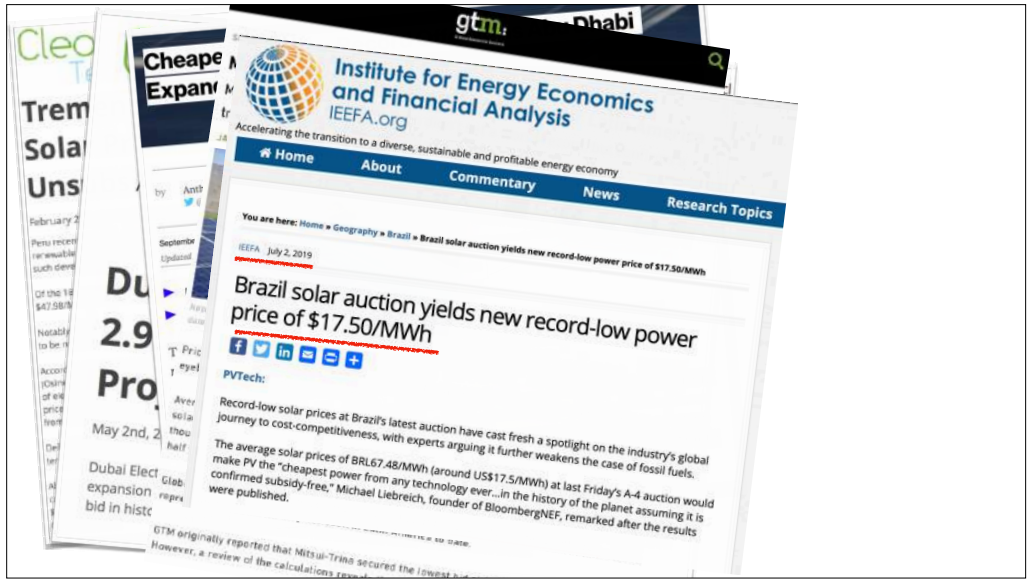
September 19, 2016 — 8:13 PM CEST
Updated on September 20, 2016 — 8:14 AM CEST

- Utility Adwea gets power offer at 2.42 cents a kilowatt-hour
- JinkoSolar makes lowest bid with offers still being evaluated

Two companies offered to build the cheapest solar power plant on record in Abu Dhabi, reflecting declining costs for photovoltaic cells and cheaper financing for clean-energy projects.

Government-owned Abu Dhabi Water & Electricity Authority received a record-low bid of 2.42 cents a kilowatt-hour for power from a planned facility in the Persian Gulf sheikhdom, state-run Emirates News Agency said. The utility on Monday opened six bids to build a solar plant capable of generating at least 350 megawatts, the agency said. JinkoSolar Holding Co. of China and Japan's Marubeni Corp. made the lowest joint offer, according to an official from the Middle East Solar Energy Industry Association, who asked not to be identified citing policy.


gtm:
SOLAR PROJECTS
Mexican Solar Sets a Record Low Price for Latin America
Mexico's latest energy auction didn't set a world record, but confirms a trend toward ultra low-cost PV worldwide.
JASON DEIGN NOVEMBER 29, 2017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You are here: Home » Geography » Brazil » Brazil solar auction yields new record-low power price of $17.50/MWh
IEEFA July 2, 2019
Brazil solar auction yields new record-low power price of $17.50/MWh
PVTech:
Record-low solar prices at Brazil's latest auction have cast fresh a spotlight on the industry's global journey to cost-competitiveness, with experts arguing it further weakens the case of fossil fuels.
The average solar prices of BRL67.48/MWh (around US$17.5/MWh) at last Friday's A-4 auction would make PV the "cheapest power from any technology ever...in the history of the planet assuming it is confirmed subsidy-free," Michael Liebreich, founder of BloombergNEF, remarked after the results were published.


Winners, projects, prices of Portugal's record PV auction
The Portuguese government has published the final results and a list of all projects selected in the procurement exercise. French IPP Akuo is the developer behind the record bid of €0.0147/kWh, which was for one of three projects it won in the auction. The second- and third-lowest winning bids were €0.01637/kWh and €0.0171/kWh, while the highest was €0.03116/kWh. Overall, the authorities allocated 1.15 GW of solar in the oversubscribed auction, down from initial plans for around 1.4 GW.
AUGUST 9, 2019 EMILIANO BELLINI
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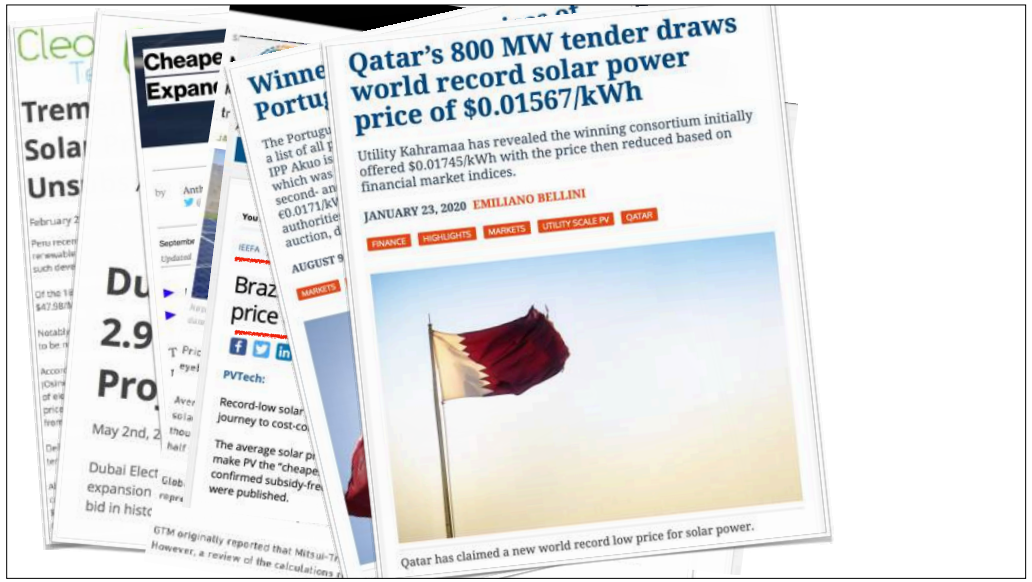
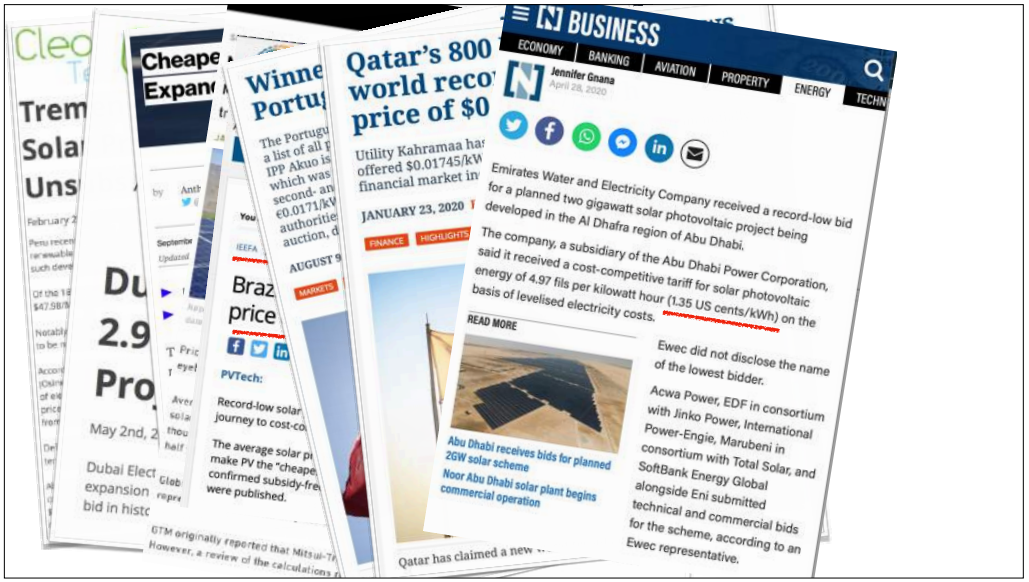

Qatar's 800 MW tender draws world record solar power price of $0.01567/kWh
Utility Kahramaa has revealed the winning consortium initially offered $0.01745/kWh with the price then reduced based on financial market indices.
JANUARY 23, 2020 EMILIANO BELLINI
FINANCE HIGHLIGHTS MARKETS UTILITY-SCALE PV QATAR
Qatar has claimed a new world record low price for solar power.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ENERGY
Jennifer Gnana
April 28, 2020
Qatar's 800
price of $0
Emirates Water and Electricity Company received a record-low bid for a planned two gigawatt solar photovoltaic project being developed in the Al Dhafra region of Abu Dhabi.
The company, a subsidiary of the Abu Dhabi Power Corporation, said it received a cost-competitive tariff for solar photovoltaic energy of 4.97 fils per kilowatt hour (1.35 US cents/kWh) on the basis of levelised electricity costs.
Ewec did not disclose the name of the lowest bidder.
Acwa Power, EDF in consortium with Jinko Power, International Power-Engie, Marubeni in consortium with Total Solar, and SoftBank Energy Global alongside Eni submitted technical and commercial bids for the scheme, according to an Ewec representative.
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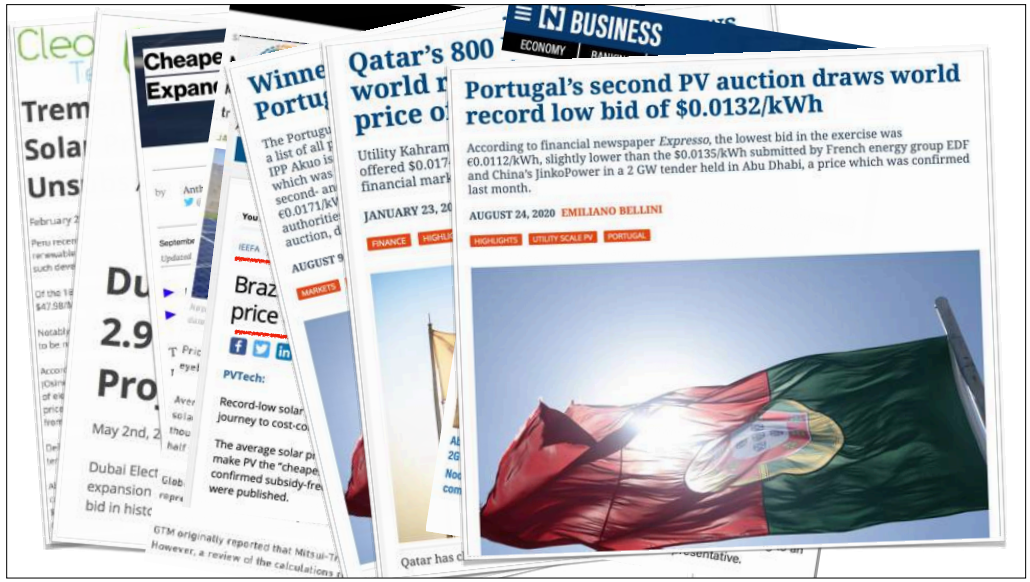
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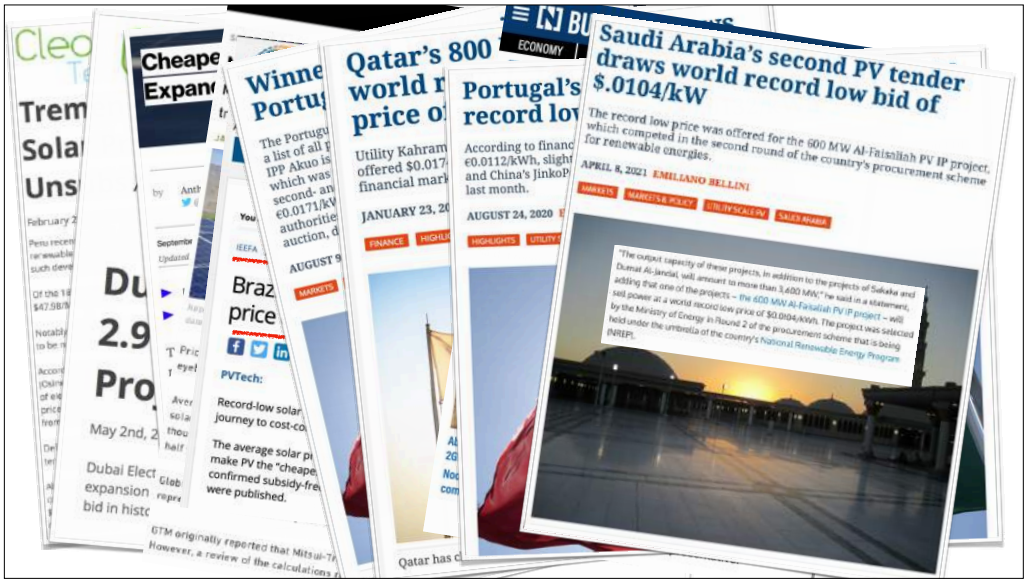
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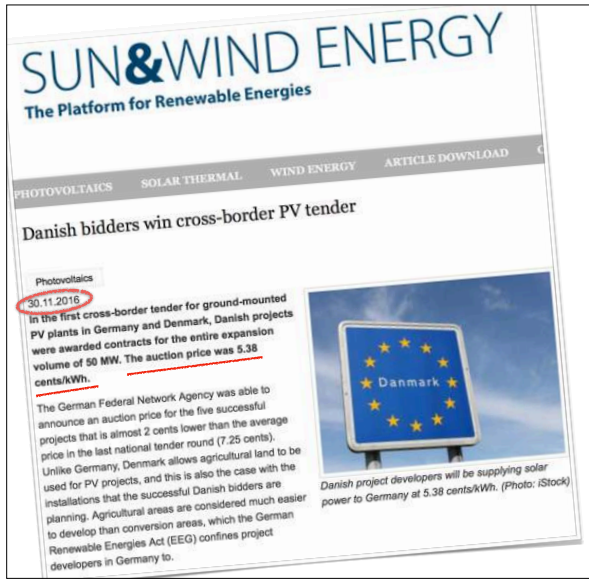
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Danish bidders win cross-border PV tender
Photovoltaics
30.11.2016
In the first cross-border tender for ground-mounted PV plants in Germany and Denmark, Danish projects were awarded contracts for the entire expansion volume of 50 MW. The auction price was 5.38 cents/kWh.
The German Federal Network Agency was able to announce an auction price for the five successful projects that is almost 2 cents lower than the average price in the last national tender round (7.25 cents). Unlike Germany, Denmark allows agricultural land to be used for PV projects, and this is also the case with the installations that the successful Danish bidders are planning. Agricultural areas are considered much easier to develop than conversion areas, which the German Renewable Energies Act (EEG) confines project developers in Germany to.
Danmark
Danish project developers will be supplying solar power to Germany at 5.38 cents/kWh. (Photo: iStock)


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German PV auction reaches record low price of €4.91c/kWh (Germany)
German PV auction reaches record low price of €4.91c/kWh (Germany)
18 Oct 2017
The German Federal network regulator (Bundesnetzagentur or BNetzA) published the results of the October 2017 solar PV auction round. In total, the BNetzA received 110 bids with a total volume of 754 MW and the average bid size was 6.9 MW. Only 20 bids won the round and a total capacity of 222 MW has been awarded. The maximum bidding price during this tender was previously set at €8.84c/kWh. The average bidding rate dropped further by €75c/kWh compared with the previous round and reached €4.91c/kWh (€49.1/MWh). The highest bid achieved €5.06c/kWh and the lowest one €4.29c/kWh. Three out of the 20 successful bids obtained a volume higher than 20 MW.
Photovoltaics
30.11.2016


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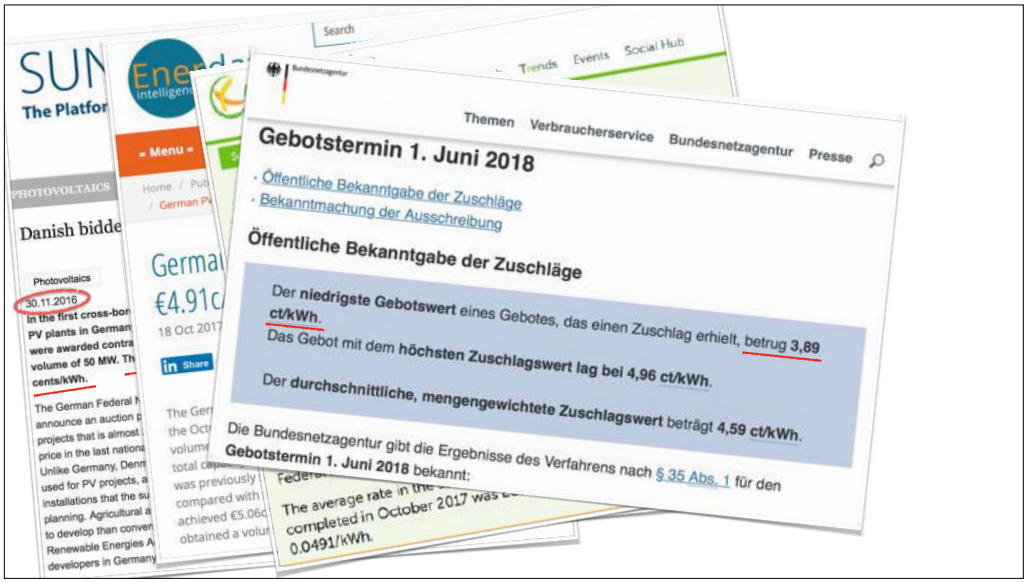
Solar
Avg solar bid at EUR 43.3/MWh in German solar tender
February 20 (Renewables Now) - The 200-MW German solar tender launched in December has been won by 24 projects, offering to sell their power at an average price of EUR 0.0433 (USD 0.054) per kWh, the Federal Network Agency said Tuesday.
The average rate in the solar tender completed in October 2017 was EUR 0.0491/kWh.
Large solar park. Source: IBC Solar. License: All Rights Reserved.
Photovoltaics
30.11.2016


Themen Verbraucherservice Bundesnetzagentur Presse
Gebotstermin 1. Juni 2018
Öffentliche Bekanntgabe der Zuschläge
Bekanntmachung der Ausschreibung
Öffentliche Bekanntgabe der Zuschläge
Der niedrigste Gebotswert eines Gebotes, das einen Zuschlag erhielt, betrug 3,89 ct/kWh.
Das Gebot mit dem höchsten Zuschlagswert lag bei 4,96 ct/kWh.
Der durchschnittliche, mengengewichtete Zuschlagswert beträgt 4,59 ct/kWh.
Die Bundesnetzagentur gibt die Ergebnisse des Verfahrens nach § 35 Abs. 1 für den Gebotstermin 1. Juni 2018 bekannt:
Photovoltaics
30.11.2016


Business
Germany's Biggest Solar Park Will Be Built Without Subsidies
By Brian Parkin
6 februari 2019 14:41 CET
EnBW to build 175MW solar park on 405 acres near Berlin
Park will join EnBW's zero-subsidy offshore wind assets
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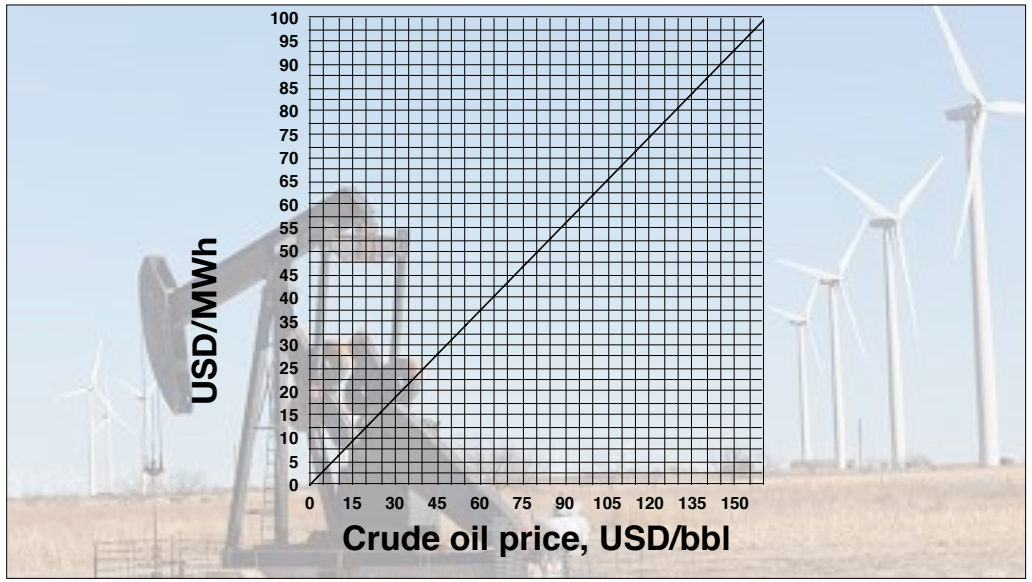
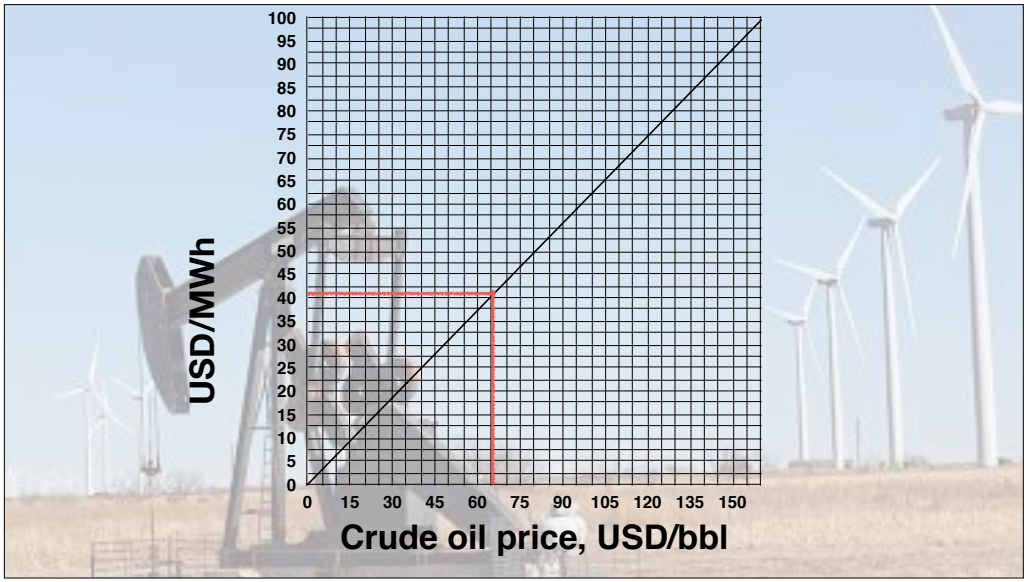
EnBW AG said it plans to build Germany's biggest solar park without subsidies, underscoring how falling costs are fueling green power investments in Europe's largest economy
Germany's fourth-biggest utility will build the 175-megawatt Weesow-Willmersdorf plant over 164 hectares (405 acres) in Brandenburg outside of Berlin, EnBW said on Wednesday. Its power will feed wholesale markets with enough electricity for about 50,000 homes.
Photovoltaics
30.11.2016


German PV tender delivers record low solar power price of €0.0355/kWh
The 100 MW tender was five times oversubscribed and the average final price tariff offered was €0.05 lower than the previous procurement round.
FEBRUARY 19, 2020 RALPH DIERMANN
The latest tender set a new record for cheap German solar power.
Image: Belectric

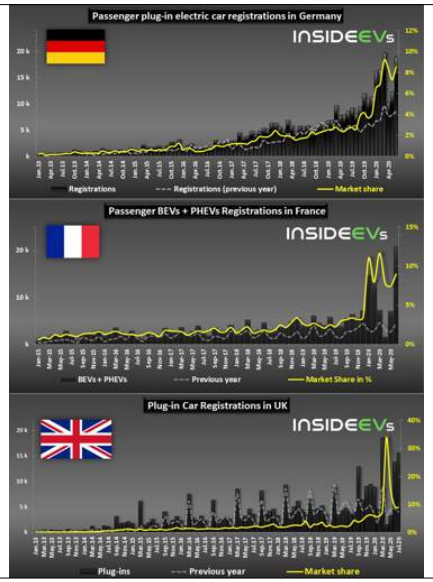

Another 500 MW of unsubsidized solar for Denmark
German PV asset manager Encavis and Danish renewables company Greengo have already secured approval for one large project.
MAY 28, 2020 RALPH DIERMANN
Unsubsidized solar is gaining ground in Denmark.
Image: Kirstinsfotos/Pixabay


UK's Largest Solar Project Approved, Will Snub Government Subsidies
A 350-megawatt U.K. solar project won its planning approval in Britain, hinting at a revival of a once-booming market.
JOHN PARNELL | MAY 29, 2020
Unsubsidized solar is gaining ground in Denmark.
Image: Kirstinsfotos/Pixabay


USD/MWh
Crude oil price, USD/bbl
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
0 15 30 45 60 75 90 105 120 135 150




# Growing markets for electric vehicles




## 40% Of New Cars In Oslo = Fully Electric Cars, 20% = Plug-In Hybrids [Hot!]

October 3rd, 2017 by Steve Hanley

Before jumping into the broader Norway electric car story from Steve Hanley below, there are some amazing highlights out of Oslo that helpful *CleanTechnica* reader Are Hansen pointed out to us:

◊ 40% of new cars registered in Oslo in September were fully electric cars.

◊ 20% of new cars registered in Oslo in September were plug-in hybrids.

◊ 7.5% of cars living in Oslo are now electric (~22,500). The total number of electric cars in the city is projected to nearly double by 2020, "expected to rise to 40,000 by 2020, as the toll road entry fee for petrol and diesel cars increases (to around $5.5)," Are reports.

## Aussies Introduce 1000 Kilometer Electric Bus

November 1st, 2015 by Steve Hanley

Australian company Brighsun, headquartered in Melbourne, has developed an electric bus with a certified range of 1,004 kilometers — enough to make the trip from Melbourne to Sydney without stopping to recharge and with more than 100 kilometers of range left over.

## How Did Shenzhen, China Build World's Largest Electric Bus Fleet?

by Lu Lu, Lulu Xue and Weimin Zhou - April 04, 2018

Comments | Add Comment | Print | More

Diesel buses—and the choking smog they spew—are a common sight in most cities. But not in Shenzhen, China.

The southeastern city, which connects Hong Kong to mainland China, announced at the end of last year that all of its 16,359 buses had gone electric. The city's buses are the world's first 100 percent electrified bus fleet, and its largest—bigger than New York's, Los Angeles's, New Jersey's, Chicago's and Toronto's electric bus fleets combined.

Electric buses have replaced diesel ones in Shenzhen, China. Photo by Lu Lu/WRI China

Electromobility

## Setting a Course for Carbon-Free Shipping

http://www.siemens.com/innovation/en/home/

In conjunction with Fjellstrand, a Norwegian shipyard, Siemens has developed the technology for the world's first electrically-powered car ferry. The fact that the electric ship, which will enter service in 2015, causes no carbon dioxide emissions is in part due to the electricity mix in Norway.

As silently as a crocodile, the white giant approaches the shore. It opens its "mouth," which is several meters across. Suddenly the silence is broken by the roar of engines as a stream of trucks and people emerge from the opening. Odd Moen, an engineer who is responsible for ship solution sales at Siemens Norway, smiles. If everything goes as planned, this vision of an electrically-powered ferry sailing across Norway's fjords will become a reality at the beginning of 2015. Making hardly a sound and producing absolutely no emissions, it will be the first and only ferry of its kind in the world.

**A Century of Battery-Powered Service**

For more than 100 years, there have been battery-powered submarines that run solely on electricity."

1 October 2014

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## ABB powers world's largest emission-free electric ferries

Tue 21 Jun 2016 by Paul Fanning

Tycho Brahe – along with Aurora – will operate completely on battery power between Helsingør (Denmark) and Helsingborg

## AIRBUS PUTS ELECTRIC E-FAN TRAINER INTO PRODUCTION IN PAU

Dave Calderwood May 1, 2015

Airbus is to put its two-seat E-Fan powered by electric motors into serial production in Pau, France. Construction on a new plant will start in 2016 and Airbus has set a target for entry-into-service for the E-Fan 2.0 of the end of 2017 or beginning of 2018.


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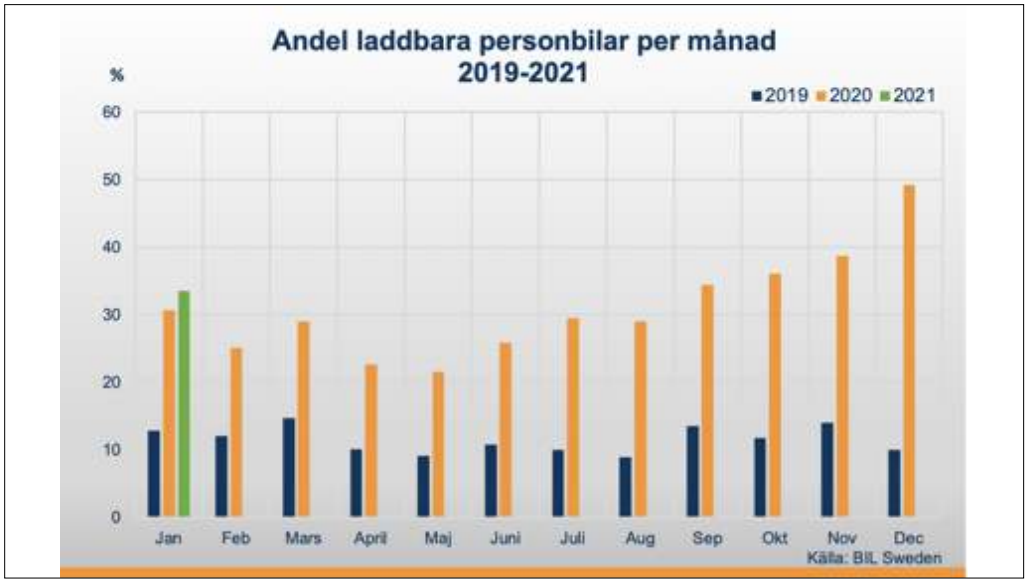
Electrifying regional air travel


Andel laddbara personbilar per månad
2019-2021
%
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2020
2021
60
50
40
30
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Jan
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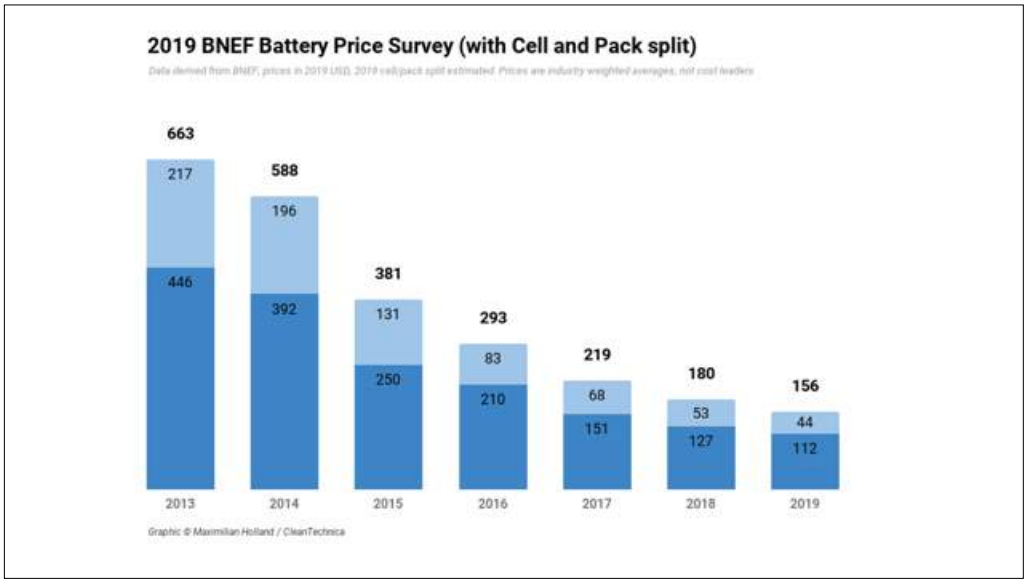
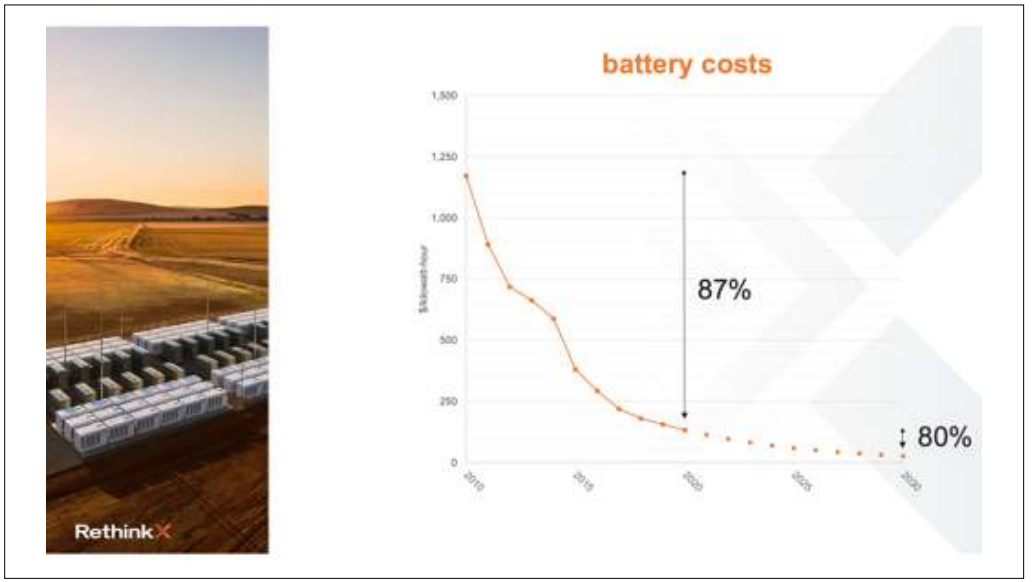
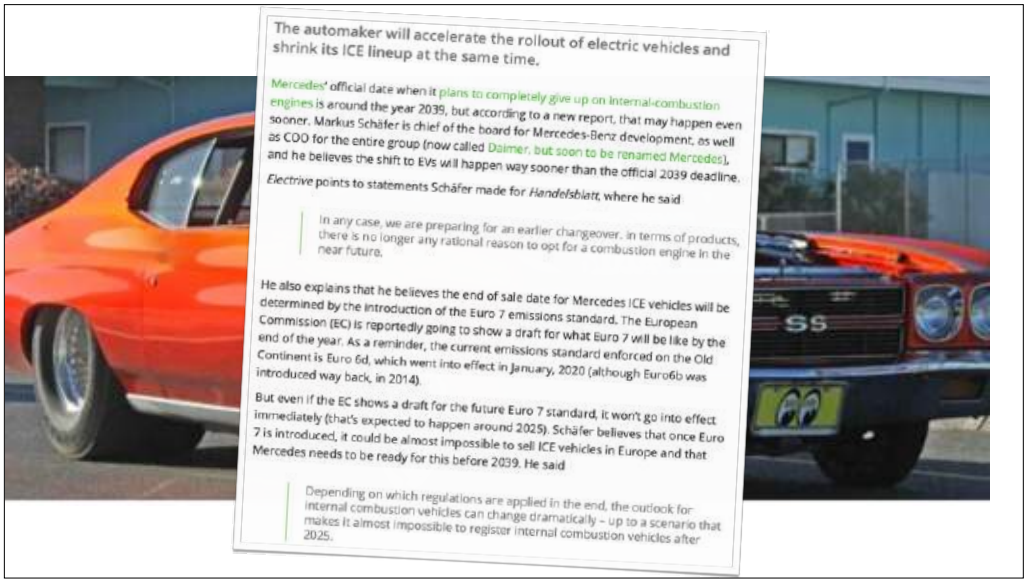
April
Maj
Juni
Juli
Aug
Sep
Okt
Nov
Dec
Källa: Bil Sweden


2019 BNEF Battery Price Survey (with Cell and Pack split)
663
217
446
588
196
392
381
131
250
293
83
210
219
68
151
180
53
127
156
44
112
2013
2014
2015
2016
2017
2018
2019
Graphic © Maximilian Holland / CleanTechnica


RethinkX
battery costs
87%
80%



The automaker will accelerate the rollout of electric vehicles and shrink its ICE lineup at the same time.

Mercedes' official date when it plans to completely give up on internal-combustion engines is around the year 2039, but according to a new report, that may happen even sooner. Markus Schäfer is chief of the board for Mercedes-Benz development, as well as COO for the entire group (now called Daimler, but soon to be renamed Mercedes), and he believes the shift to EVs will happen way sooner than the official 2039 deadline.

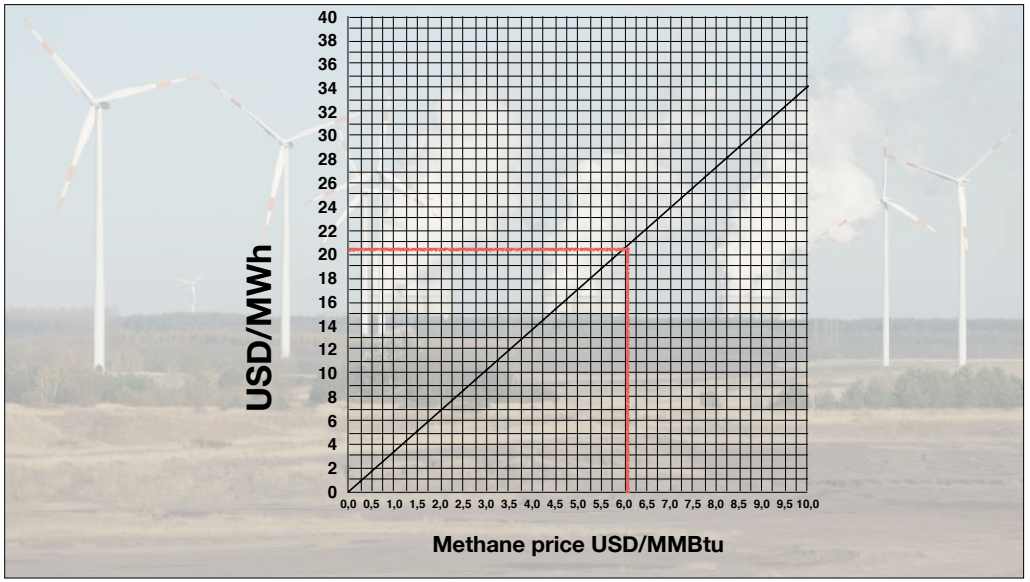
*Electrive* points to statements Schäfer made for *Handelsblatt*, where he said:

> In any case, we are preparing for an earlier changeover. In terms of products, there is no longer any rational reason to opt for a combustion engine in the near future.

He also explains that he believes the end of sale date for Mercedes ICE vehicles will be determined by the introduction of the Euro 7 emissions standard. The European Commission (EC) is reportedly going to show a draft for what Euro 7 will be like by the end of the year. As a reminder, the current emissions standard enforced on the Old Continent is Euro 6d, which went into effect in January, 2020 (although Euro6b was introduced way back, in 2014).

But even if the EC shows a draft for the future Euro 7 standard, it won't go into effect immediately (that's expected to happen around 2025). Schäfer believes that once Euro 7 is introduced, it could be almost impossible to sell ICE vehicles in Europe and that Mercedes needs to be ready for this before 2039. He said:

> Depending on which regulations are applied in the end, the outlook for internal combustion vehicles can change dramatically – up to a scenario that makes it almost impossible to register internal combustion vehicles after 2025.




7 July 2017

Nuon, Statoil and Gasunie join forces using hydrogen in future CO2-free energy plants

**ISPT has previously brought together various parties, one of them being Nuon, to do a feasibility study into the storage of electricity in Ammonia ($NH_3$). Now Nuon, Gasunie and the Norwegian Statoil announce their collaboration in a joint venture that aims to use hydrogen as fuel for the Magnum-power plant in the Eemshaven in Groningen. They will start an innovative project that aims to have one of the three available units fully transferred to hydrogen starting 2023. This is a very important step on the way to a 100% $CO_2$-free energy supply. This also brings the 'super battery', that Nuon has been working on a step closer to reality.**

UAE mulls hydrogen as a renewable energy source

Rohma Sadaqat /Dubai
Filed on February 2, 2019



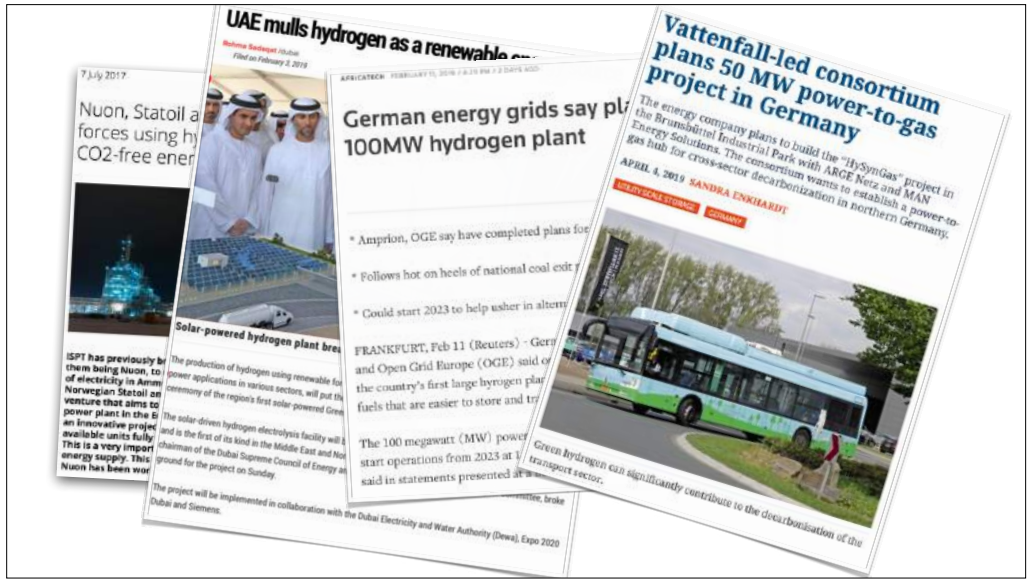
**Solar-powered hydrogen plant breaks ground**

The production of hydrogen using renewable forms of energy such as solar and wind, and its subsequent use to power applications in various sectors, will put the UAE on the global map, experts said at the ground breaking ceremony of the region's first solar-powered Green Hydrogen project.

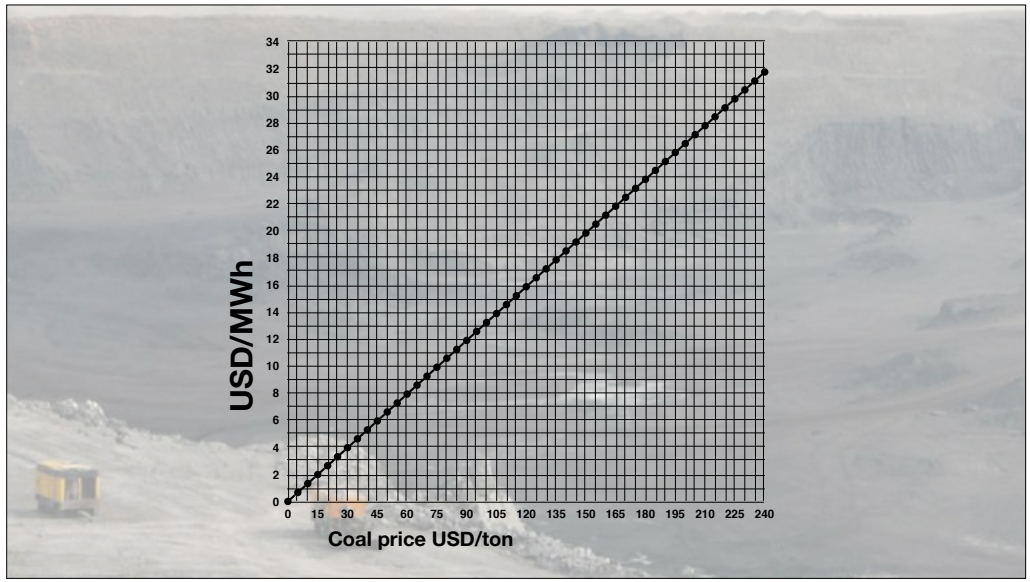
The solar-driven hydrogen electrolysis facility will be located at the Mohammed Bin Rashid Al Maktoum Solar Park and is the first of its kind in the Middle East and North Africa (Mena) region. Sheikh Ahmed bin Saeed Al Maktoum, chairman of the Dubai Supreme Council of Energy and chairman of the Expo 2020 Dubai Higher Committee, broke ground for the project on Sunday.

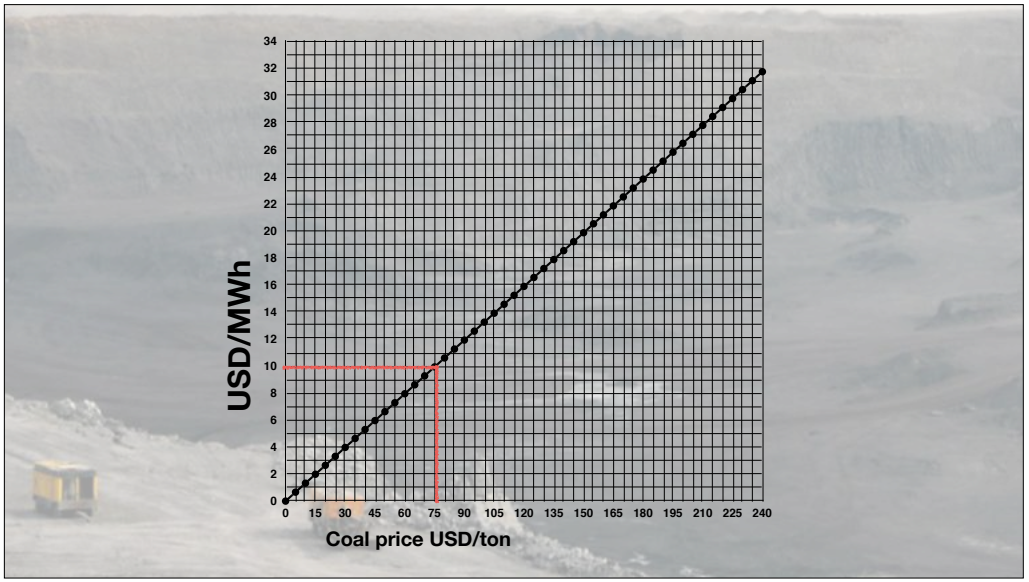
The project will be implemented in collaboration with the Dubai Electricity and Water Authority (Dewa), Expo 2020 Dubai and Siemens.

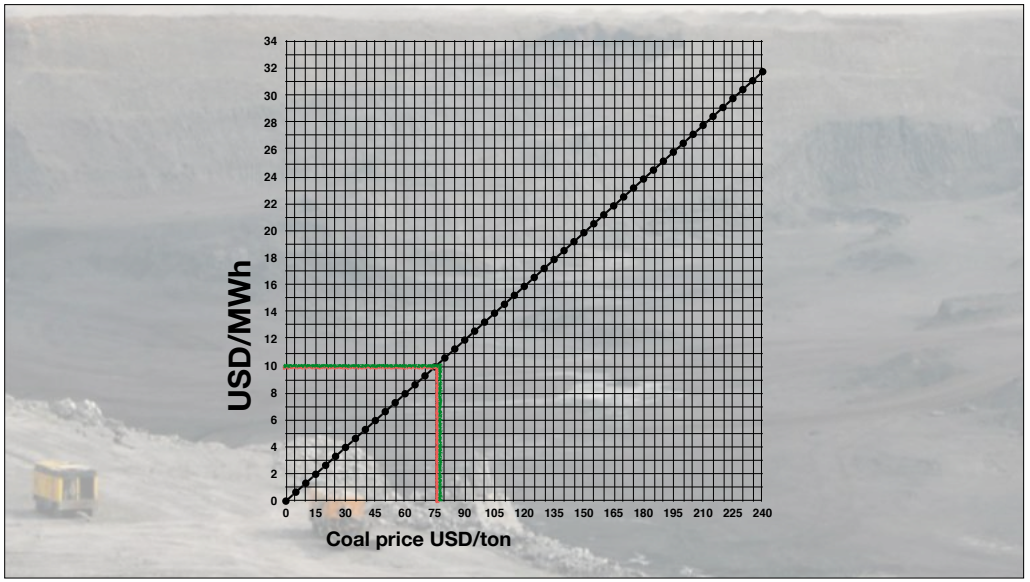

UAE mulls hydrogen as a renewable
German energy grids say plans ready for 100MW hydrogen plant
Amprion, OGE say have completed plans for 100 MW plant
Follows hot on heels of national coal exit plan by 2038
Could start 2023 to help usher in alternative fuels
FRANKFURT, Feb 11 (Reuters) - German power and gas grid firms Amprion and Open Grid Europe (OGE) said on Monday they would shortly apply to build the country's first large hyrogen plant that can convert windpower to alternative fuels that are easier to store and transport.
The 100 megawatt (MW) power-to-gas (ptg) plant to be called "hybridge" can start operations from 2023 at Lingen in Germany's windy north-west, the firms said in statements presented at a Berlin news conference.

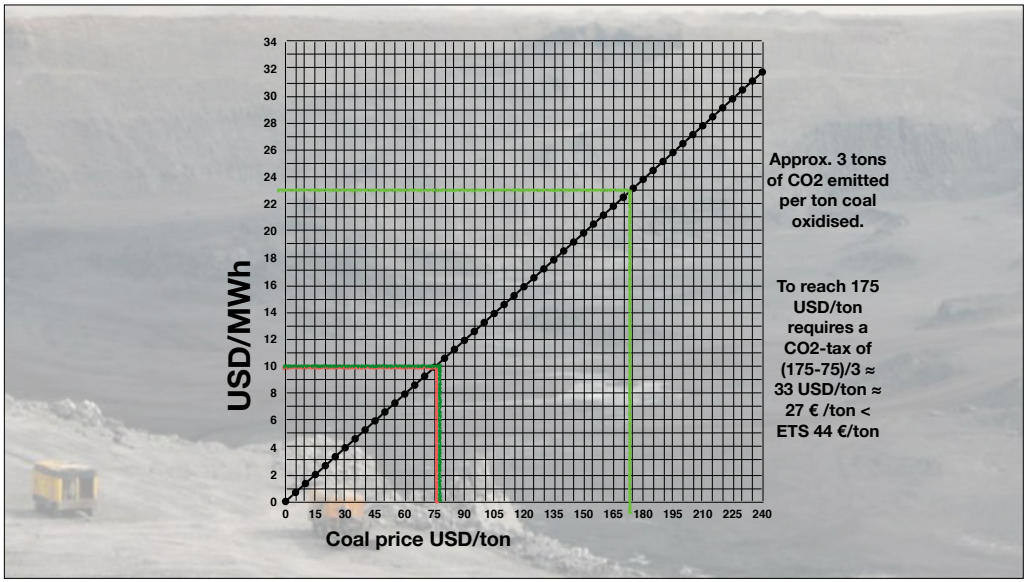

UAE mulls hydrogen as a renewable
German energy grids say pl
100MW hydrogen plant
Vattenfall-led consortium plans 50 MW power-to-gas project in Germany
The energy company plans to build the "HySynGas" project in the Brunsbüttel Industrial Park with ARGE Netz and MAN Energy Solutions. The consortium wants to establish a power-to-gas hub for cross-sector decarbonization in northern Germany.
APRIL 4, 2019 SANDRA ENGHARDT
Green hydrogen can significantly contribute to the decarbonisation of the transport sector.

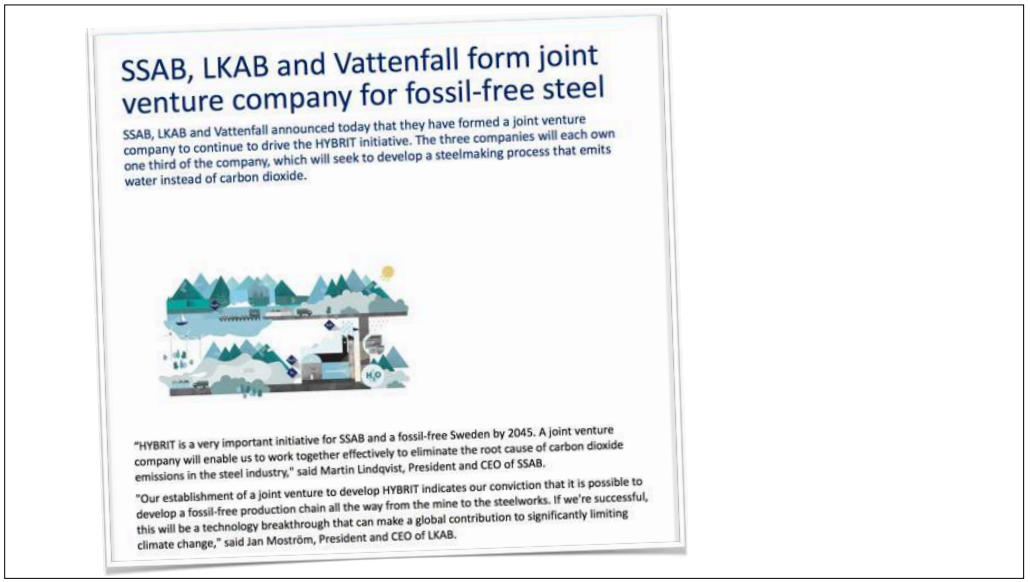

UAE mulls hydrogen as a renewable
Contact
Methanol Flagships Invest About Us Careers News
Liquid Wind
eMPowering our Future.
It's time to electrify fuel and empower our sustainable future.


USD/MWh
Coal price USD/ton
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
0 15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240



## 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.

# H2 Green Steel to build large-scale fossil-free steel plant in northern Sweden

H2 Green Steel ("H2GS") will be a large-scale steel producer based on a fossil-free manufacturing process targeting large European OEMs. H2GS will be located in the Boden-Luleå region in northern Sweden that offers unique conditions for fossil-free steel production. The project includes a giga-scale green hydrogen plant as an integrated part of the steel production facility. Production will begin in 2024 and by 2030, H2GS will have annual production capacity of five million tons of high-quality steel. Henrik Henriksson, currently CEO of Scania, will lead the company.

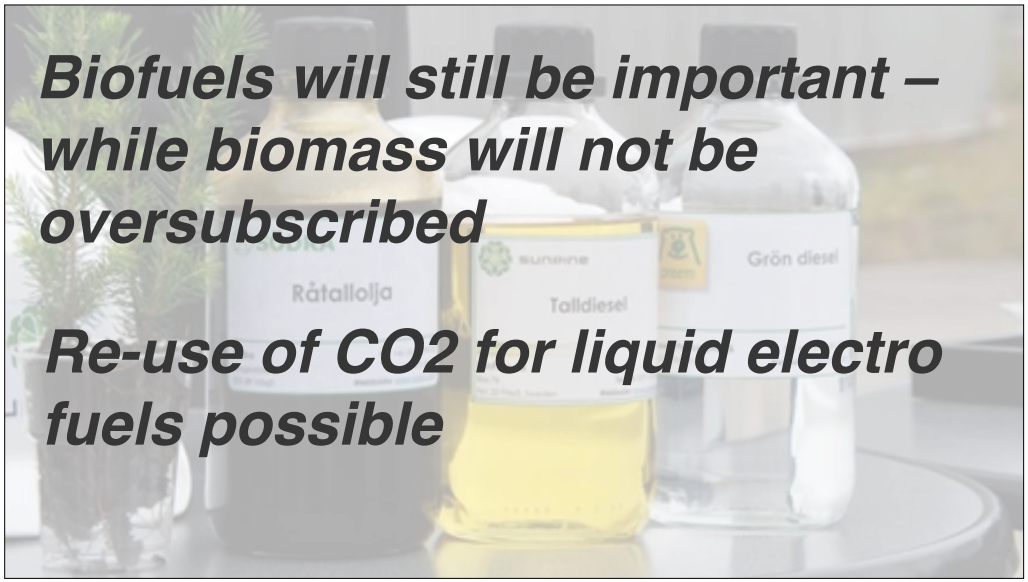
"Our establishment of a [illegible] develop a fossil-free production chain all the [illegible] this will be a technology breakthrough that can make a global [illegible] climate change," said Jan Moström, President and CEO of LKAB.

## Along the way to sustainable energy

- Fuel to produce electricity : Electricity price ≈ fuel price * 3
- Electricity substitutes fuel : Electricity price ≈ fuel price
- Electricity -> fuel : Electricity price < fuel price

- Market growth and learning curves
- Capital cost opportunities
- Power balancing

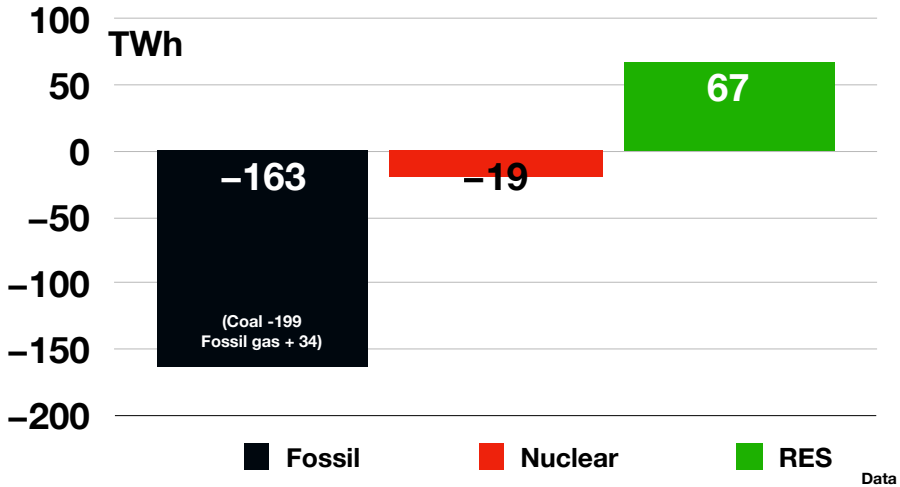

***Biofuels will still be important – while biomass will not be oversubscribed***




***Biofuels will still be important – while biomass will not be oversubscribed***

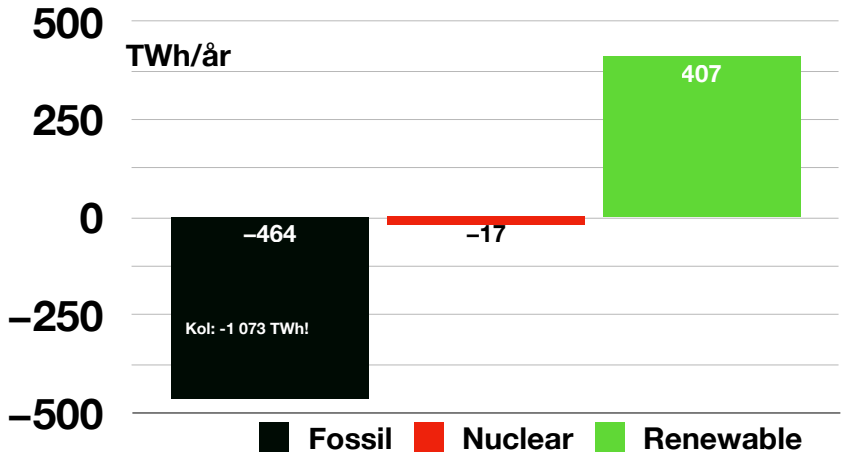
***Re-use of CO2 for liquid electro fuels possible***

# US electricity generation 2020-2019




Data from IEA

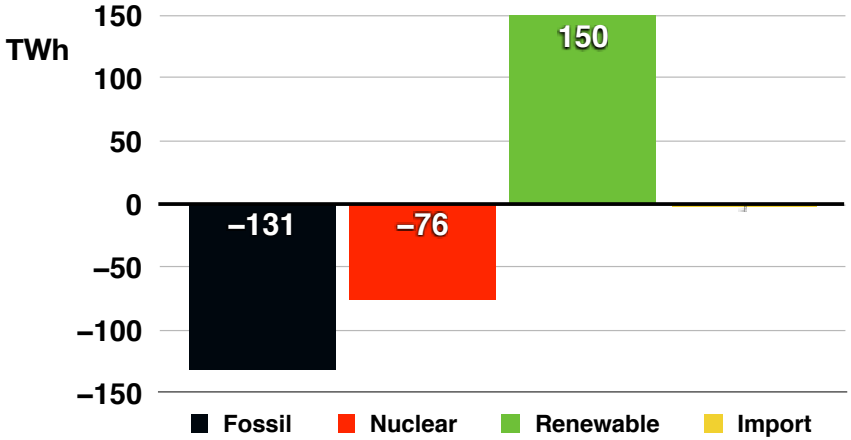
# US electricity production 2020-2010



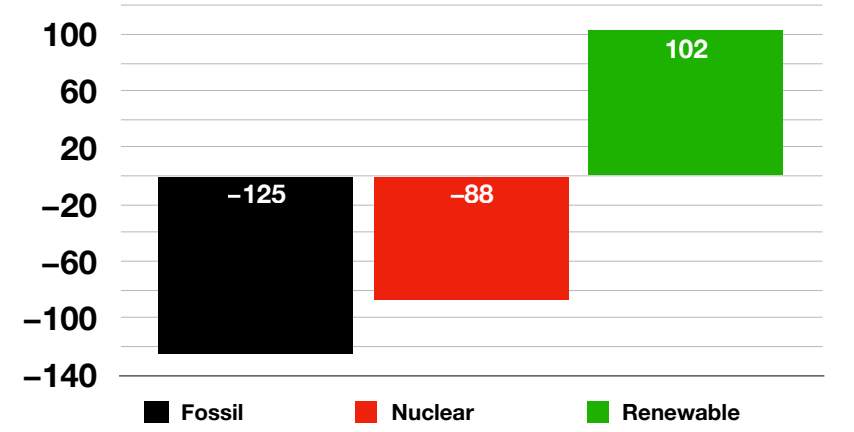

Data 2010:
Data 2020:

Table 7.2a

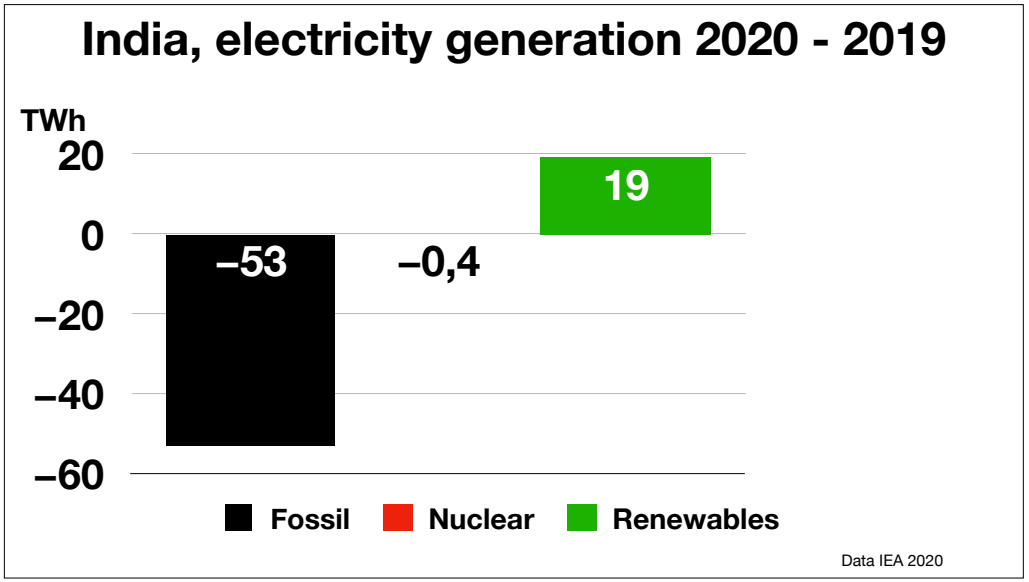
# German Electricity 2020-2010

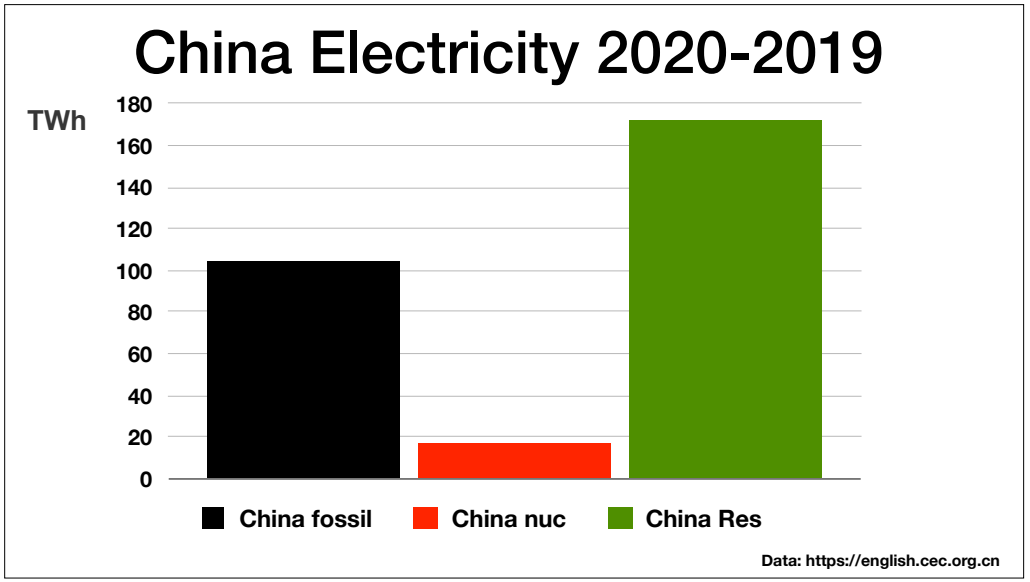


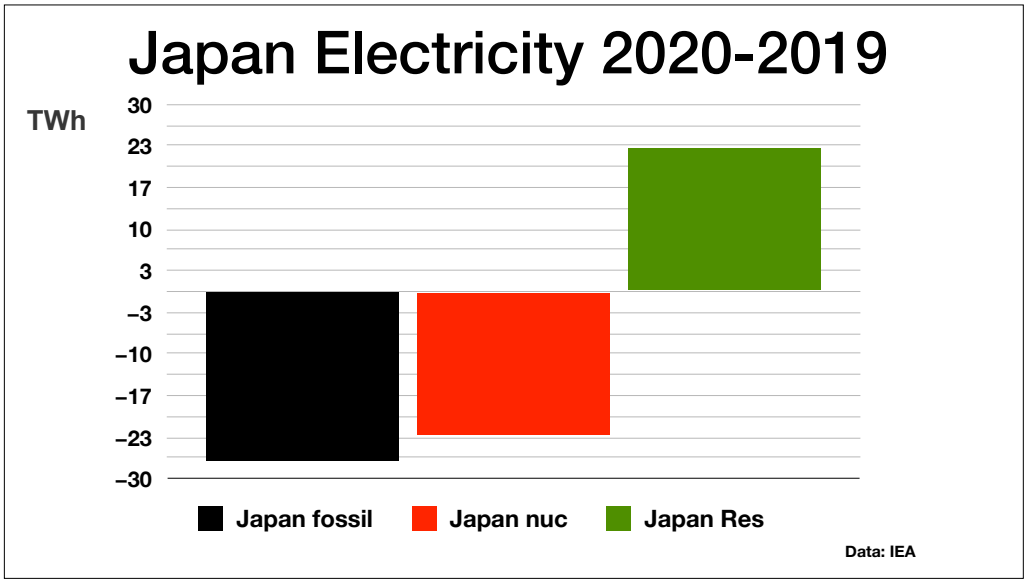

# OECD Europe Electricity 2020 - 2019




Data ENTSO-E via EnAppSys


India, electricity generation 2020 - 2019
TWh
20
0
−20
−40
−60
−53
−0,4
19
Fossil
Nuclear
Renewables
Data IEA 2020


China Electricity 2020-2019
TWh
180
160
140
120
100
80
60
40
20
0
China fossil
China nuc
China Res
Data: https://english.cec.org.cn


Japan Electricity 2020-2019
TWh
30
23
17
10
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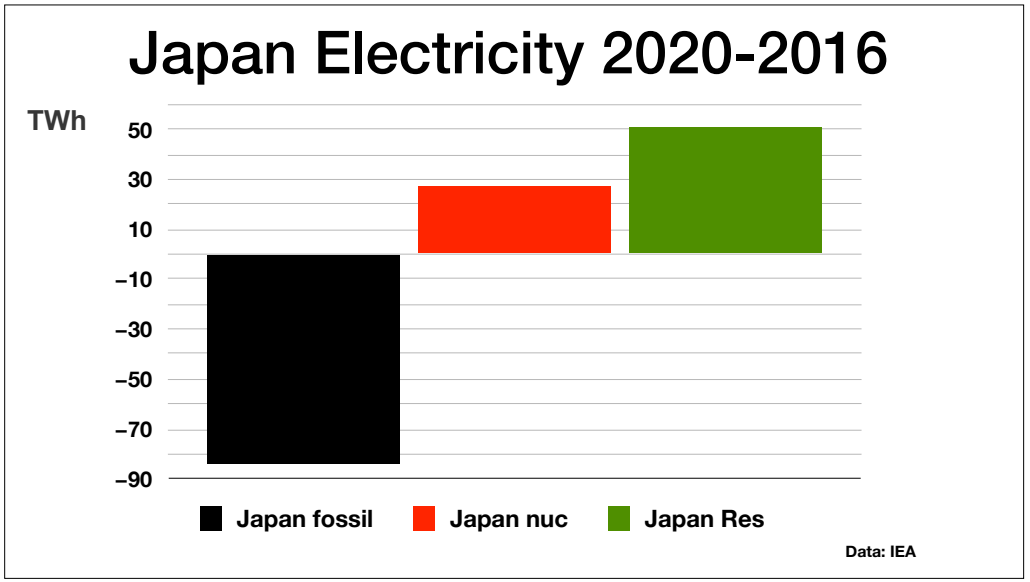
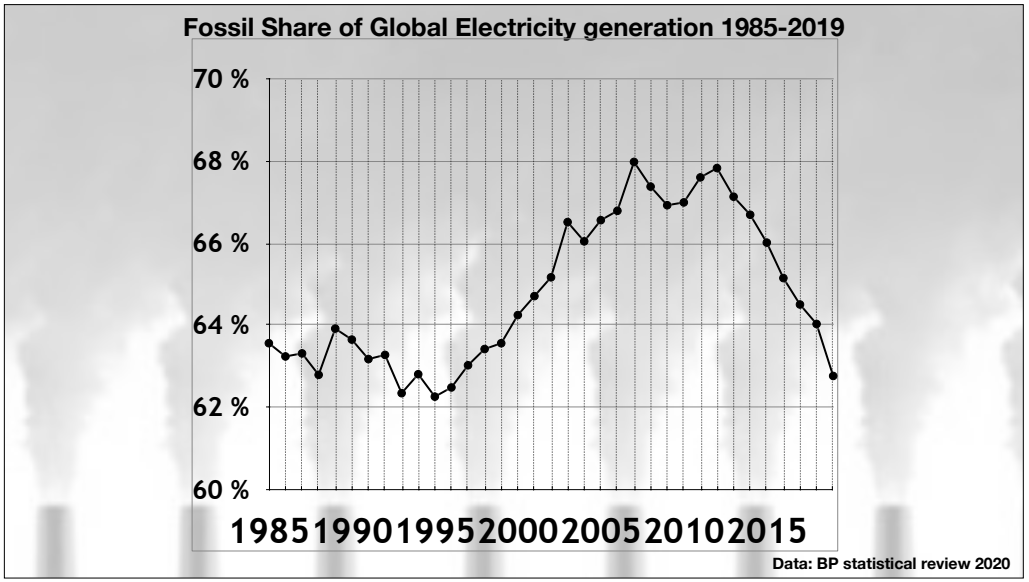
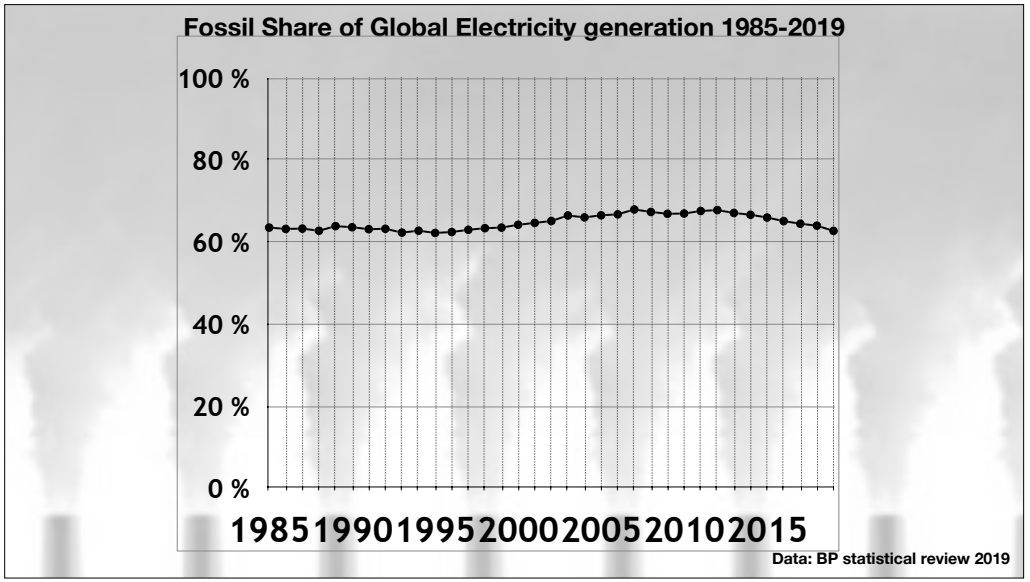
−3
−10
−17
−23
−30
Japan fossil
Japan nuc
Japan Res
Data: IEA


Japan Electricity 2020-2016
TWh
50
30
10
−10
−30
−50
−70
−90
Japan fossil
Japan nuc
Japan Res
Data: IEA




# Where we are heading!

**Tomas Kåberger**

*Executive Board Chair of Renewable Energy Institute, Tokyo*
*Affiliate professor Chalmers University of Technology*
*Industrial Growth Executive InnoEnergy*
*Executive Board Chair Renewable Energy Institute*
*Member of the Swedish Climate Polity Council*
*Member of the Swedish Royal Academy of Engineering Sciences*