

A row of white wind turbines in a hilly landscape under a blue sky. The turbines are arranged in a line, receding into the distance. The sky is a clear, pale blue, and the hills in the background are covered in green vegetation.

Renewable Energy Carriers «Wind Energy»

Matthias Bänziger, Tamara Keller, Jeannine Herren

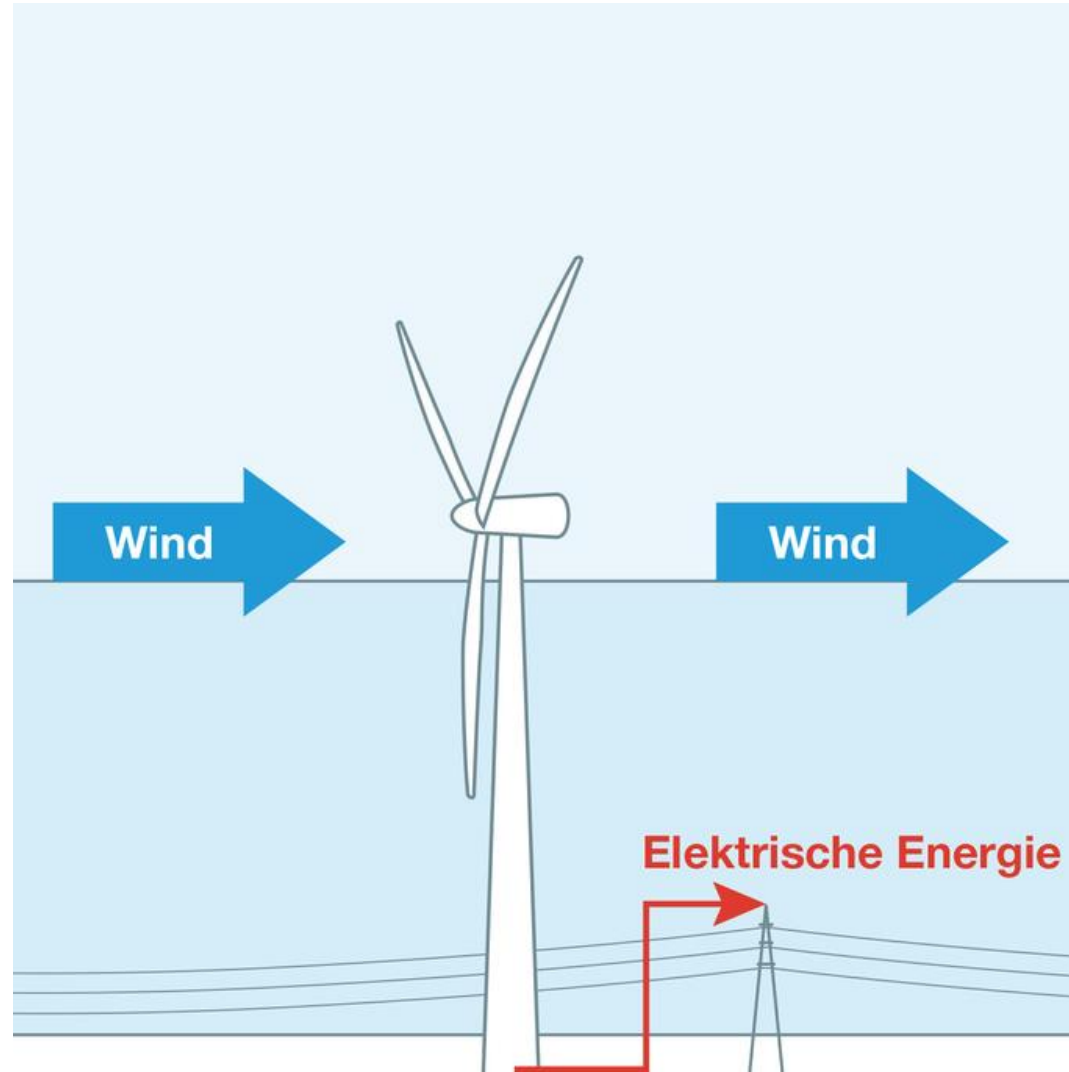
BM2, TZ19

**Wenn der Wind der Veränderung weht,
bauen die einen Mauern
und die anderen Windmühlen.**

Chinesisches Sprichwort



How does wind energy work?



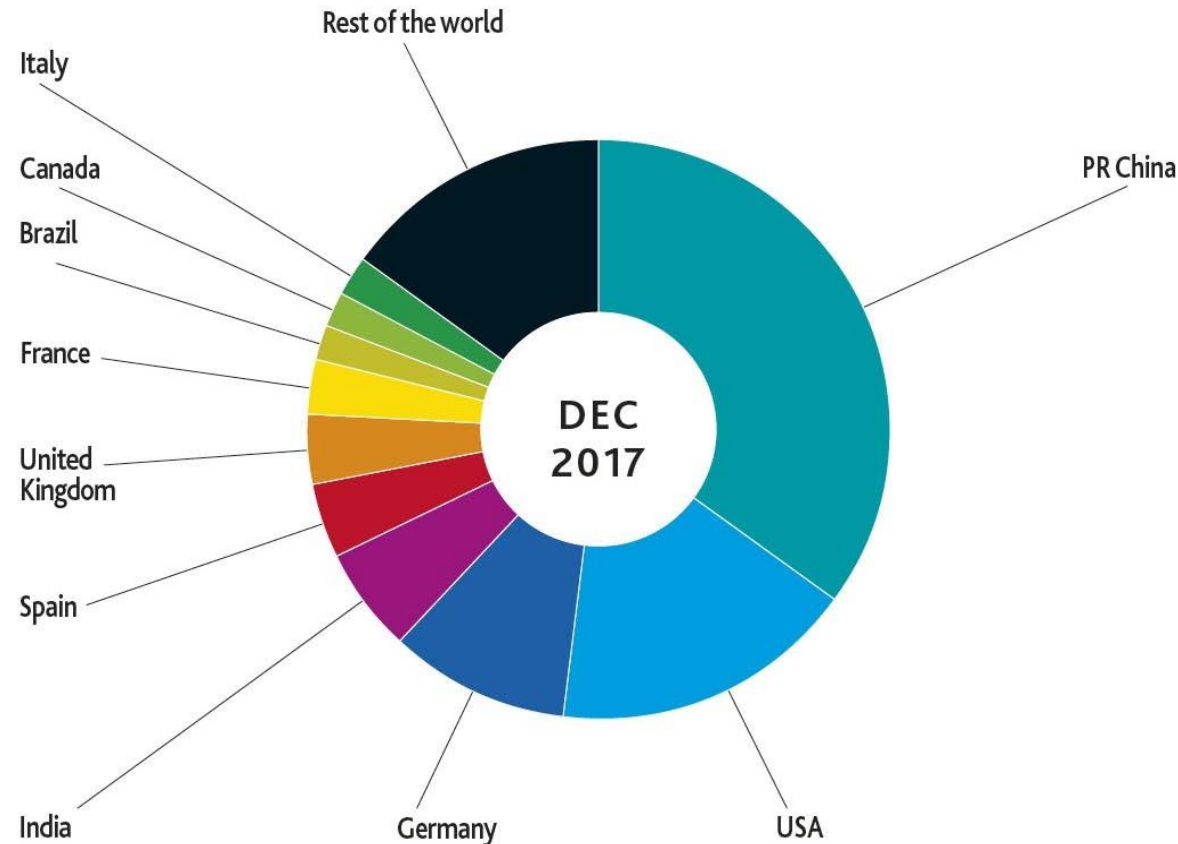
How does wind energy work?

- Electricity production with renewable wind energy
 - Very safe
 - Generates neither CO₂ or pollutants



In which countries and locations does wind energy occur?

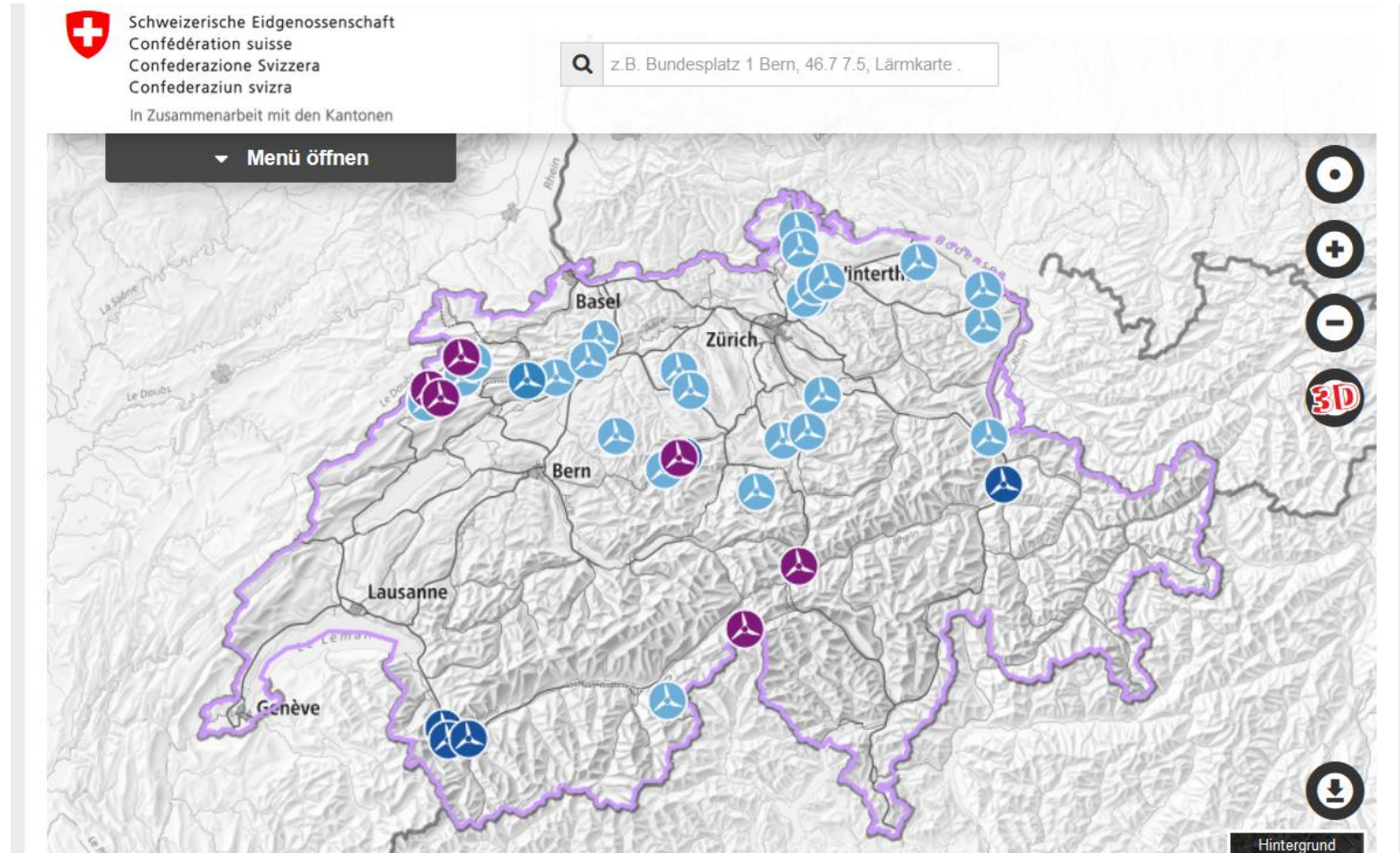
TOP 10 CUMULATIVE CAPACITY DEC 2017



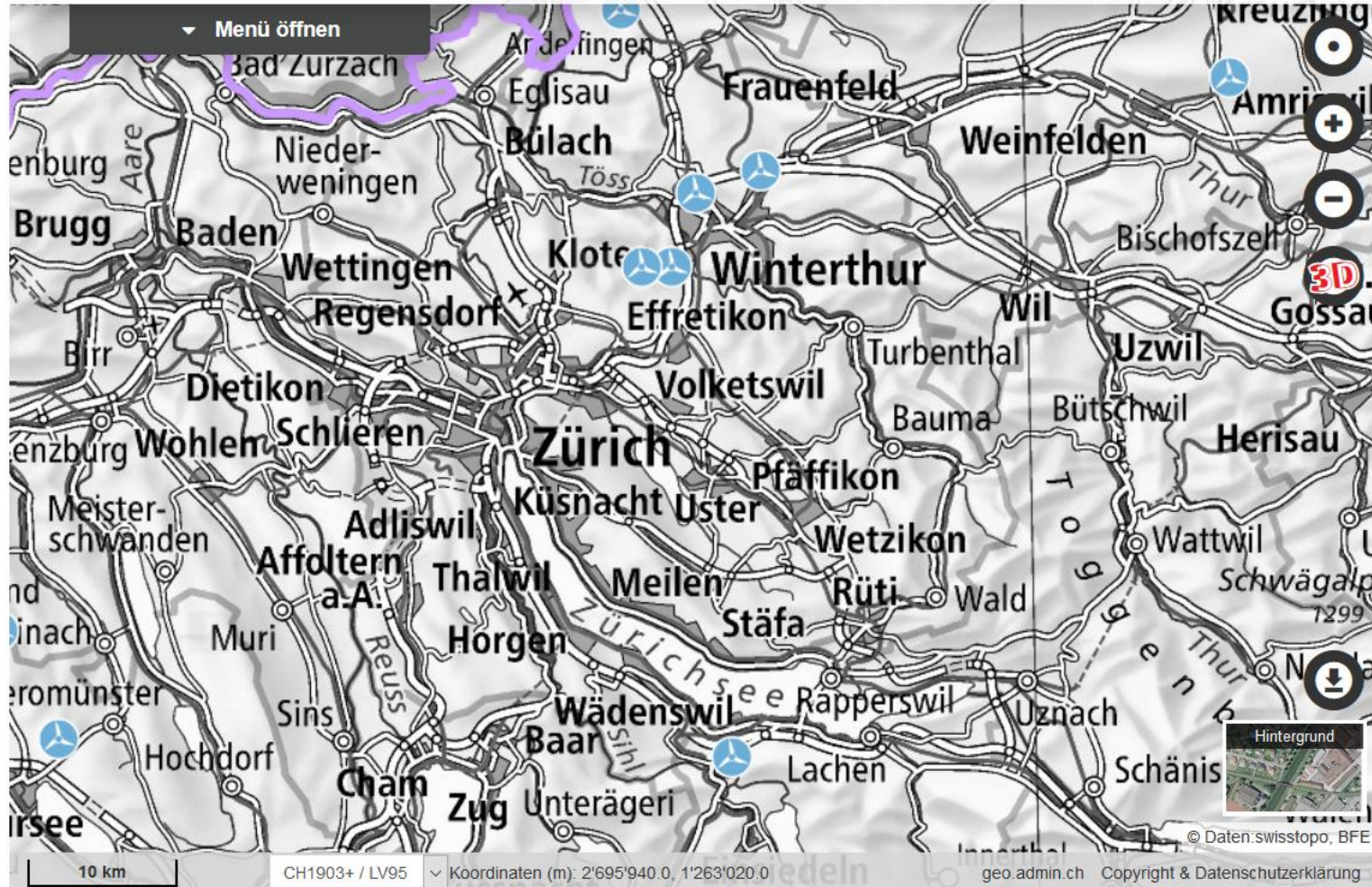
Wind turbines in Switzerland

- At the end of 2018, 37 large Wind turbines with capacity of 75 megawatts in Switzerland
- Annual Production in 2018, 121.7 million kilowatt hours
- 36'500 Swiss households or less than 0.2% of our total electricity consumption

Wind turbines in Switzerland

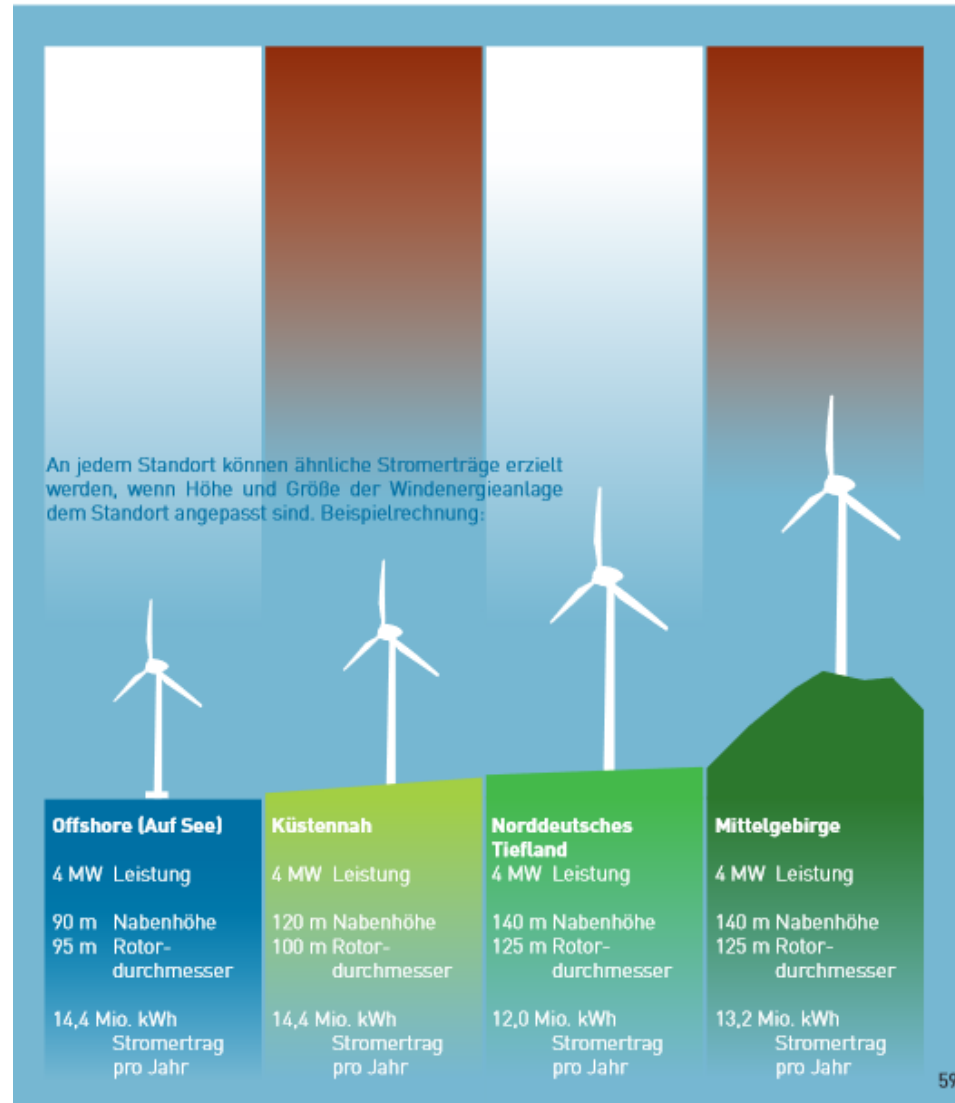


Wind turbines near Zürcher Oberland



- 2 turbines in Brütten
- 1 turbine Winterthur Taggenberg
- 1 turbine Winterthur Wiesendangerstrasse
- 1 turbine in Feusisberg

Es gibt überall Wind und für jeden Standort die passende Anlage.



Requirements to build «wind farms»

- Location factors
- Know more about local wind conditions
- Building regulations



Location factors

The most important question when choosing a location is:



- How many hours a year the wind blows here?
- Is it a «windy area»?
- How is the speed and the direction of the incoming winds?
- Are there obstacles in the way, that may reduce wind speed?
- How is the air density (Wind-Dichte)?

Know more about local wind conditions

How to find out:

- with online tools (www.wind-data.ch)
- with wind charts
- by local wind measurement (this is essential!)

How it is done:

- by wind power planning offices
- measurement at least 6 months at 50 m altitude to get more information about the existing wind potential.



Building regulations

- minimum clearance to inhabited area
- noise emissions / noise pollution
- protected and sensitive areas (nature)
- aviation obstacle check



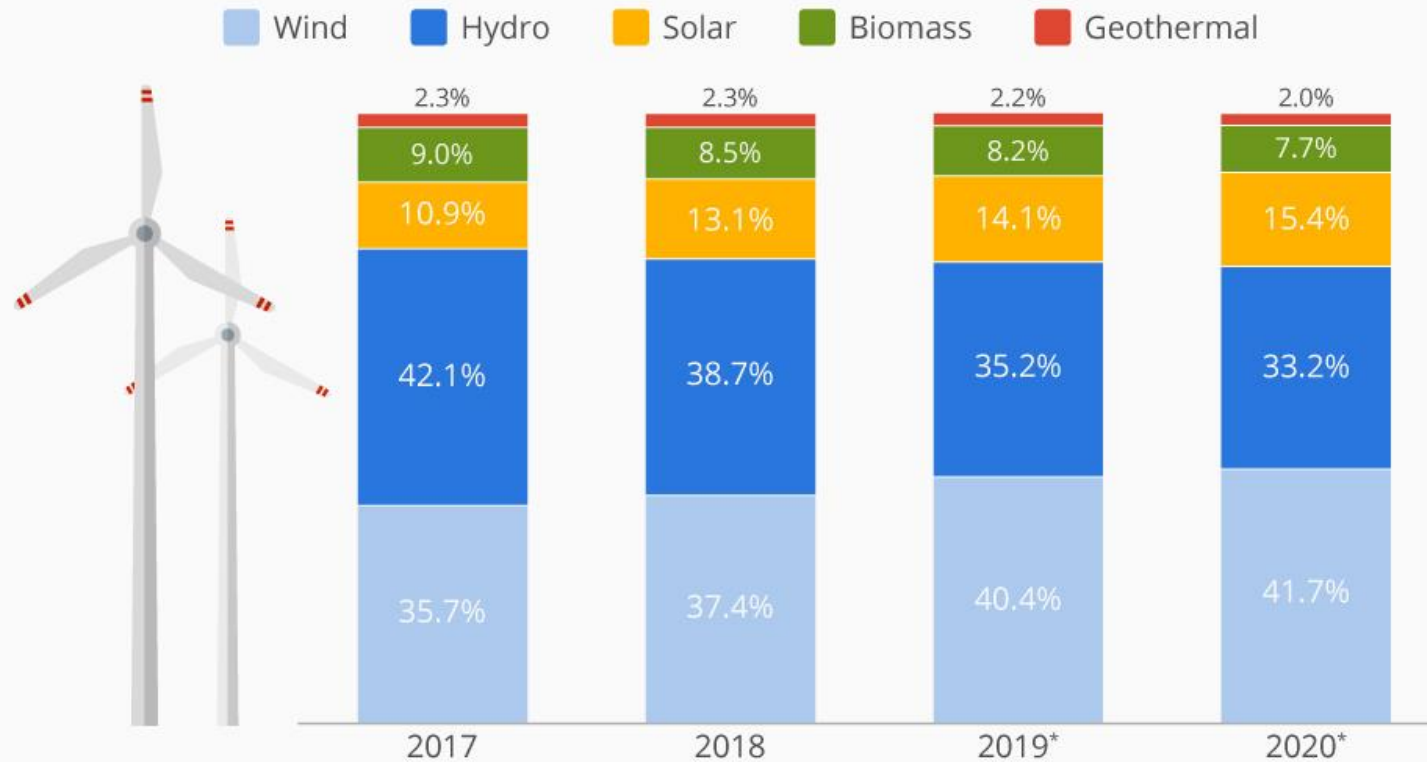
Opportunities of wind energy in the future

- safe and clean
- excellent eco-balance
- (mostly) wanted and accepted
- still high untapped (ungenutztes) potential above all at sea, as well as inland at high heights
- well-developed technologies are now available
- cost-effective power production
- low space requirement

Comparison to other energy carriers

Wind Power to Surpass Hydro Energy in 2019

Share of U.S. renewable electricity generation by source (2017-2020)



Contras and Pro`s

- Contra
 - Visibility (Sichtbarkeit)
 - Consistency (Konstant)
 - Audible
 - Very expensive
- PRO
 - 100% Clean and sustainable energy
 - Wind is a free resource and endless
 - Not much space to build a wind wheel
 - Everybody can build a Windwheel



Challenges to build a wind wheel

- Place
- Building permit (Baugenehmigung)
- Contrasts and protests from the general public
- Costs



Keywords on wind energy

- Wind wheel (Windrad)
- Power (Kraft)
- Electricity (Elektrizität)
- Renewable energy (erneuerbare Energien)
- Free energy (Freie Energie)
- Wind turbine (Windturbine)
- Wind speed (Windgeschwindigkeit)

If you are interested to learn more about renewable energy,
following event would be something for you:

Energy Day @ ETH 2019



The poster for Energy Day @ ETH 2019 features a central circular graphic with various green icons representing renewable energy and sustainability, including a wind turbine, a leaf, a recycling symbol, a CO₂ cloud, a train, a city skyline, and a power line. The text on the poster includes the ETH Zürich logo at the top, the event title 'Energy Day @ ETH', the date 'Dienstag, 10. Dezember 2019', the location 'ETH Zürich, Hauptgebäude', and the website 'www.esc.ethz.ch' for information and registration. A QR code is also present. The bottom left corner features the Energy Science Center logo.

ETH zürich

**Klimaneutrale
Energiesysteme bis 2050**
—
**(k)ein Problem oder
(k)eine Chance?**

**Dienstag, 10. Dezember 2019,
9 bis 18 Uhr**

**ETH Zürich, Hauptgebäude
Rämistrasse 101
8092 Zürich**

Energy Day @ ETH
Dienstag, 10. Dezember 2019
ETH Zürich, Hauptgebäude
Information und Anmeldung:
www.esc.ethz.ch

Energy
Science
Center

<https://esc.ethz.ch/events/>