Tomorrow and electricityMap,
mapping emissions from EV charging in real-time

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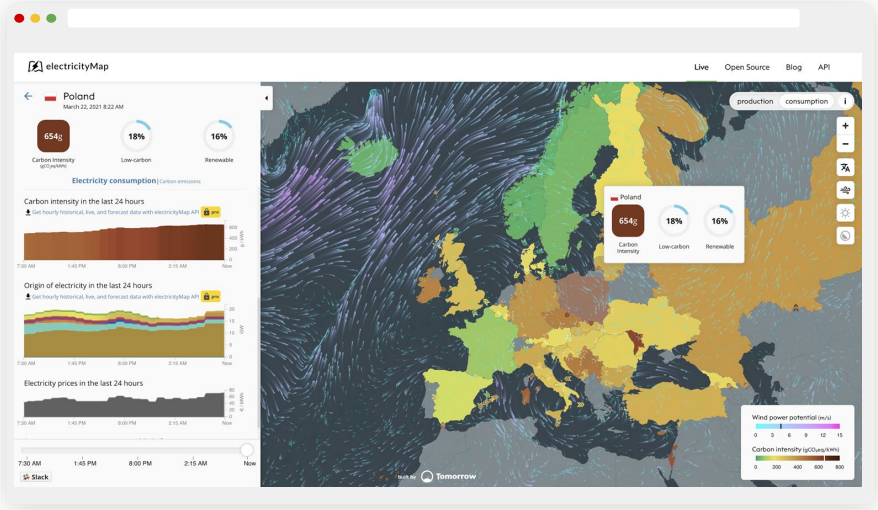
Tomorrow

tmrow.com

electricitymap.org

maps the world's electricity emissions, **in real-time**

- **Open source**
  >1300 contributions[1], global coverage. Most popular #climate-change project.
- **Publications & blog posts**
  Cited in 100+ articles.
- **Trusted**
  Used by ministers, head of states, by utilities, data centers, EV charging apps..



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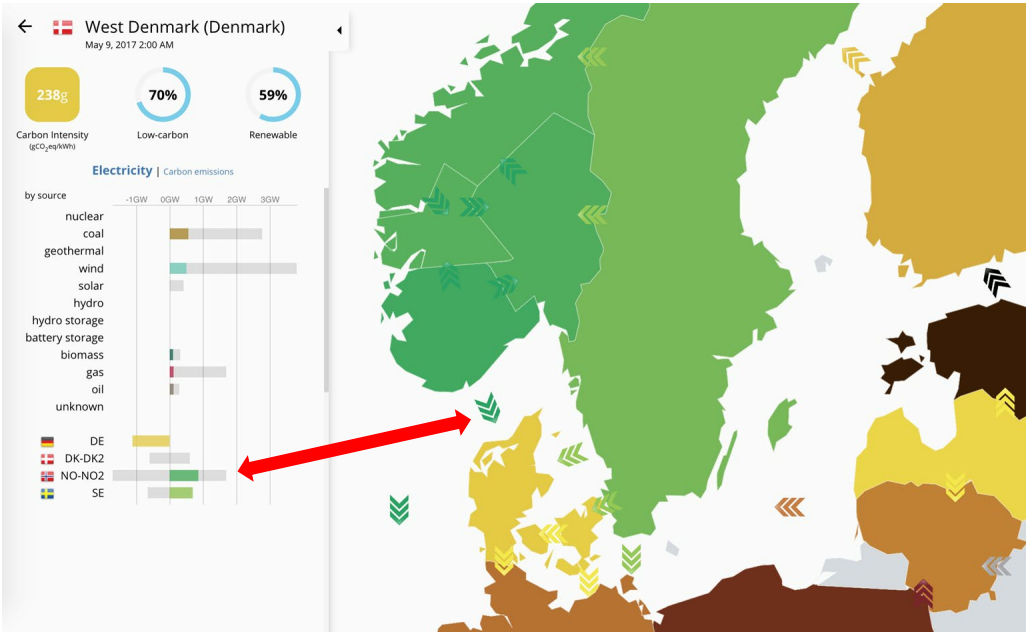
[1] See https://github.com/tmrowco/electricitymap-contrib
[2] See https://www.tmrow.com/blog/tags/electricitymap

Computing the origin of electricity with **flow-tracing**



Flow tracing rules

1. **Each "zone" is a copper plate**, with electrons perfectly and instantaneously mixed

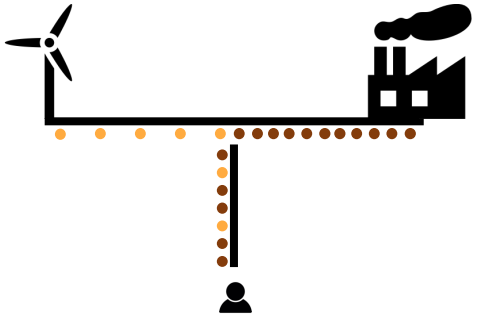
1. **Imports impact consumption mix** (and thereby carbon intensity) **proportionally to the amount imported**
   For instance, Denmark imports green power from Norway & Sweden, itself potentially importing from Finland etc…

2. **You don't choose what you export/import**.
   Germany imports from Denmark with the carbon intensity of Denmark at that time. It can't "choose" to import only "Norwegian hydro" electrons

See https://www.tmrow.com/blog/flow-tracing/

What about my purchased electricity?

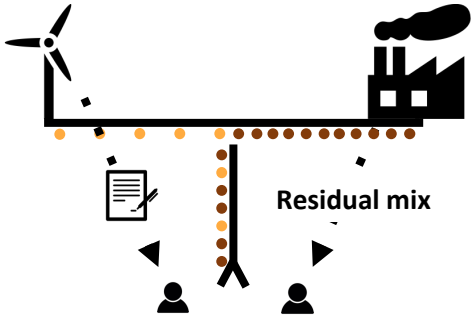
Location-based approach



33%
wind
67% coal

Using **average** carbon intensity

Market-based approach



100%
wind
0% coal

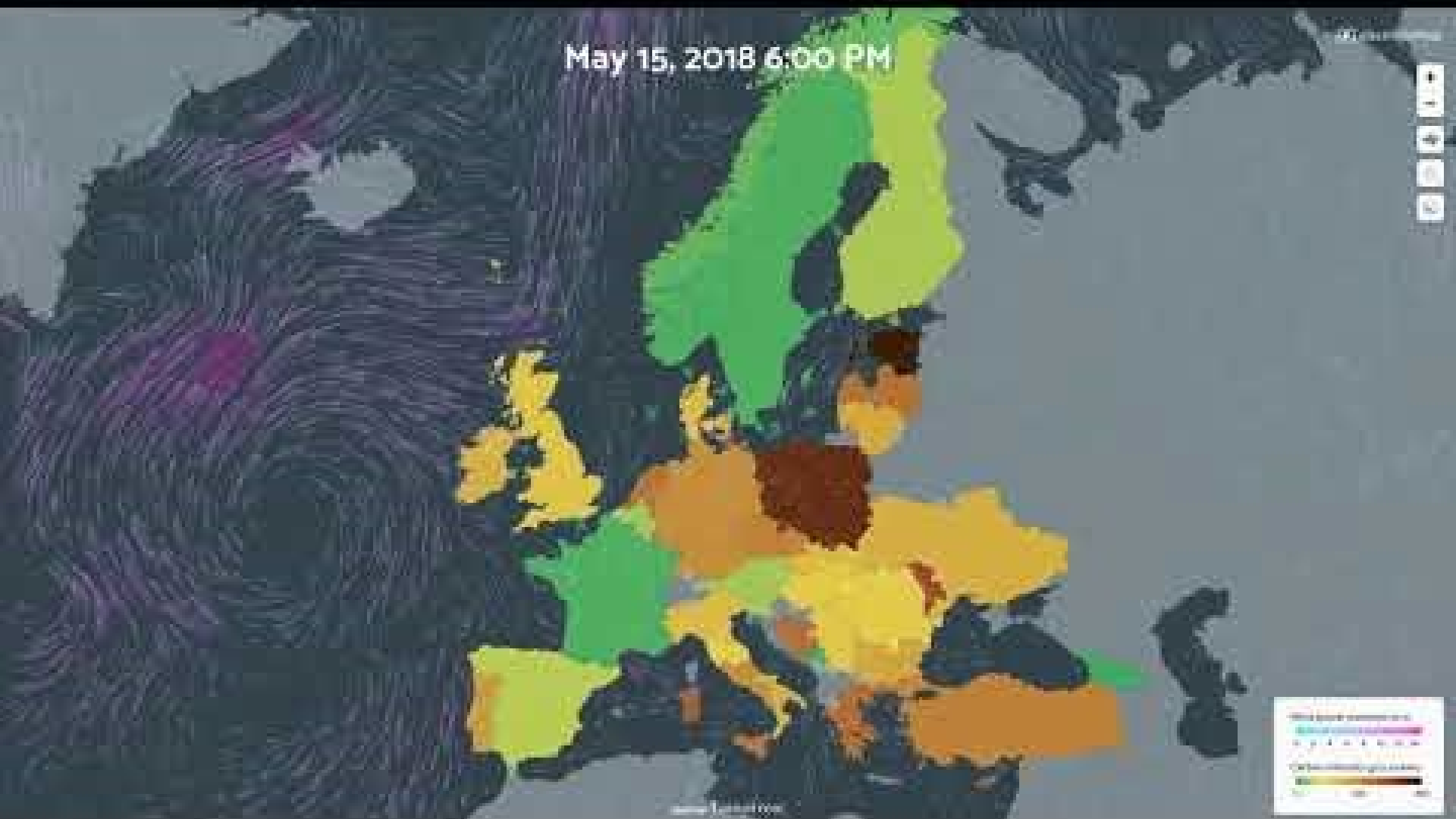
0% wind
100%
coal

Using "Guarantees of Origin" or RECs

Challenges with having both:

- 2 methodologies means **two consumers can claim the same greenness**
- Doesn't match up with **taxpayers' intuition**
- Granular GOs (hourly) **duplicates** the location-based method

Market-based will become a **subsidy** system, and location-based an **accounting** system.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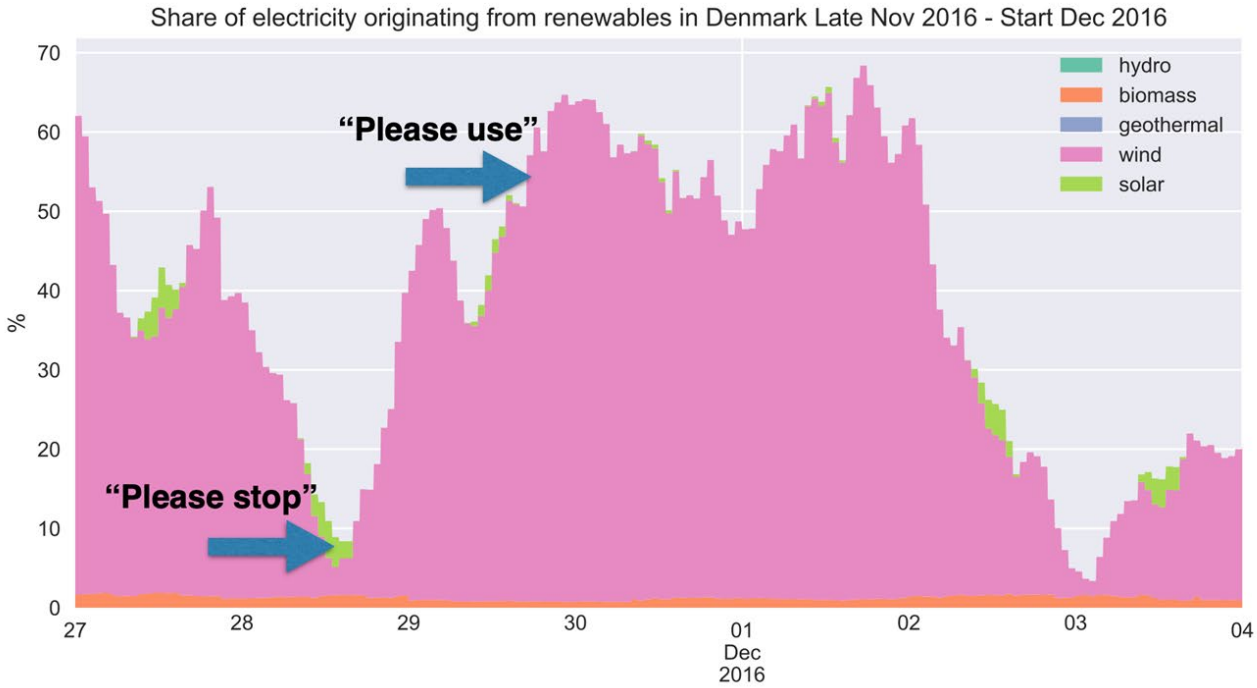
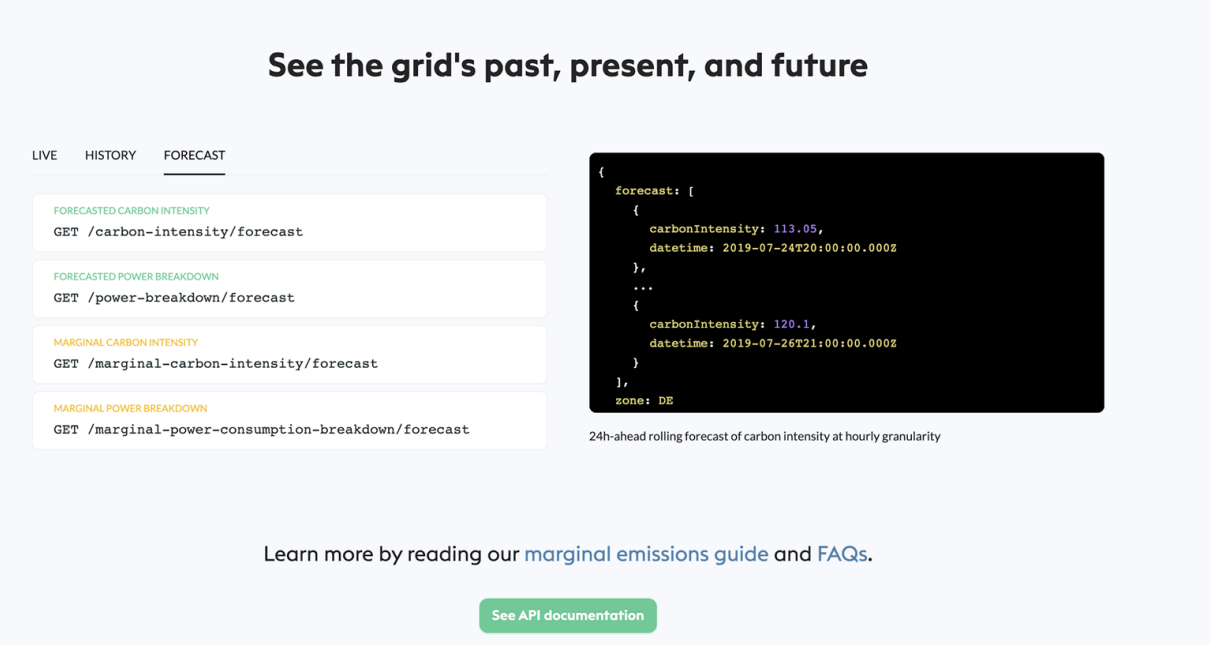
An opportunity to reduce emissions



Our **forecasts** predict when the electricity is cleanest



See https://api.electricitymap.org

electricityMap forecasts used by leading companies

Displaying carbon footprint data in **home energy management app**

Visualizing carbon footprint of **interconnectors**

Showing carbon data and forecasts to **electricity retailer** users

Showing carbon data and forecasts to **smart heater** users

Showing carbon data and forecasts to **electricity retailer users**

Displaying and utilizing forecast data for **smart charging EVs**

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Displaying and utilizing forecast data for **smart charging EVs**

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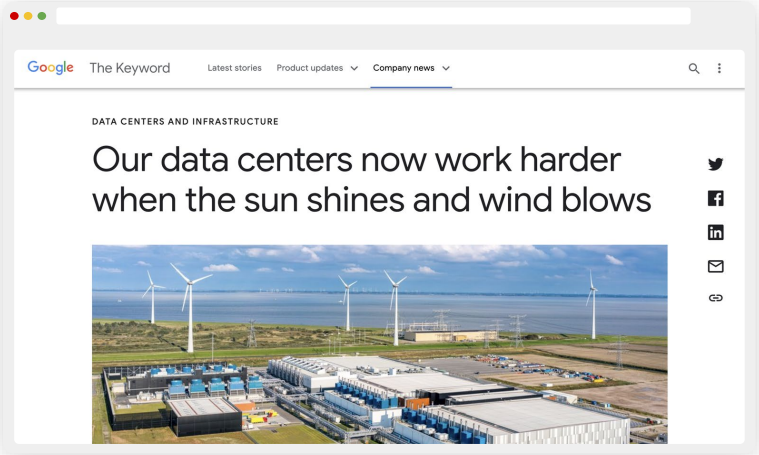
Carbon-aware demand-response of data centers

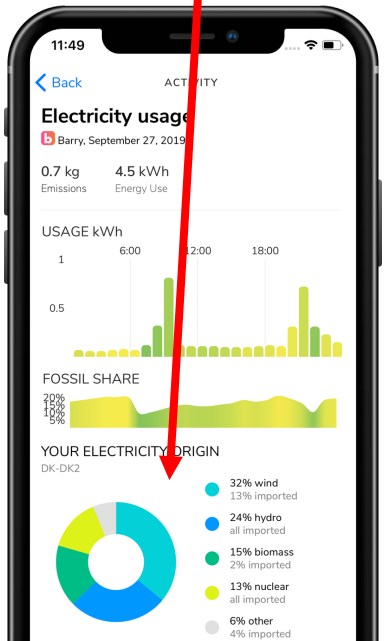
Google 24/7 Energy Program

Google uses **electricityMap's forecasts** to run computing jobs at times where the electricity is cleaner

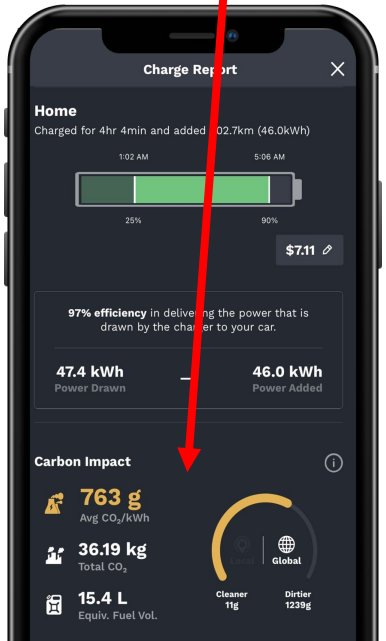


Charging your electricity vehicle when the grid electricity is low-carbon

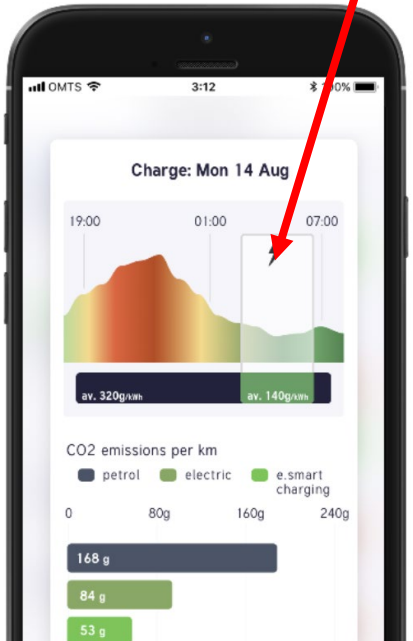
Origin of electricity explained



Carbon impact of EV charge



Smart charge scheduled for biggest CO2 savings



Computing the marginal origin of electricity

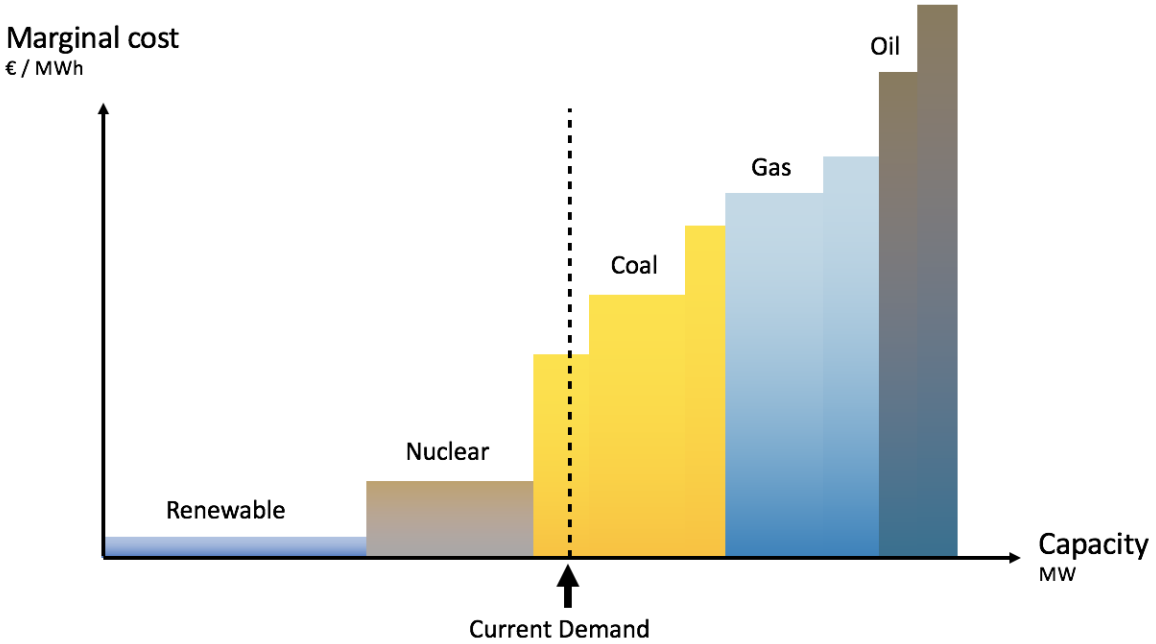
Use case: when I charge my EV, where does that electricity come from?

Power plants are dispatched by increasing cost

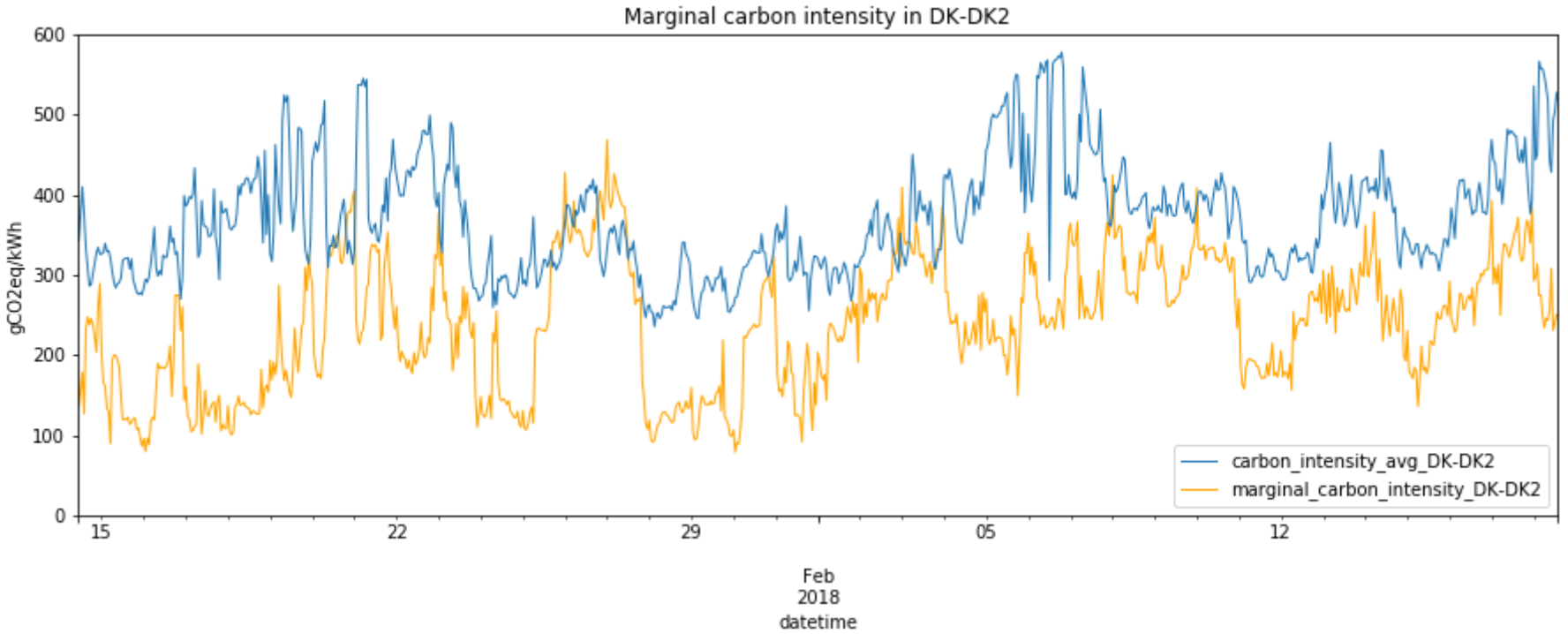
When electricity demand is increased, the first power plant to increase its production is cheapest that has spare capacity

We call that power plant the **marginal power plant**.

Problem: the dispatch order is **secret**

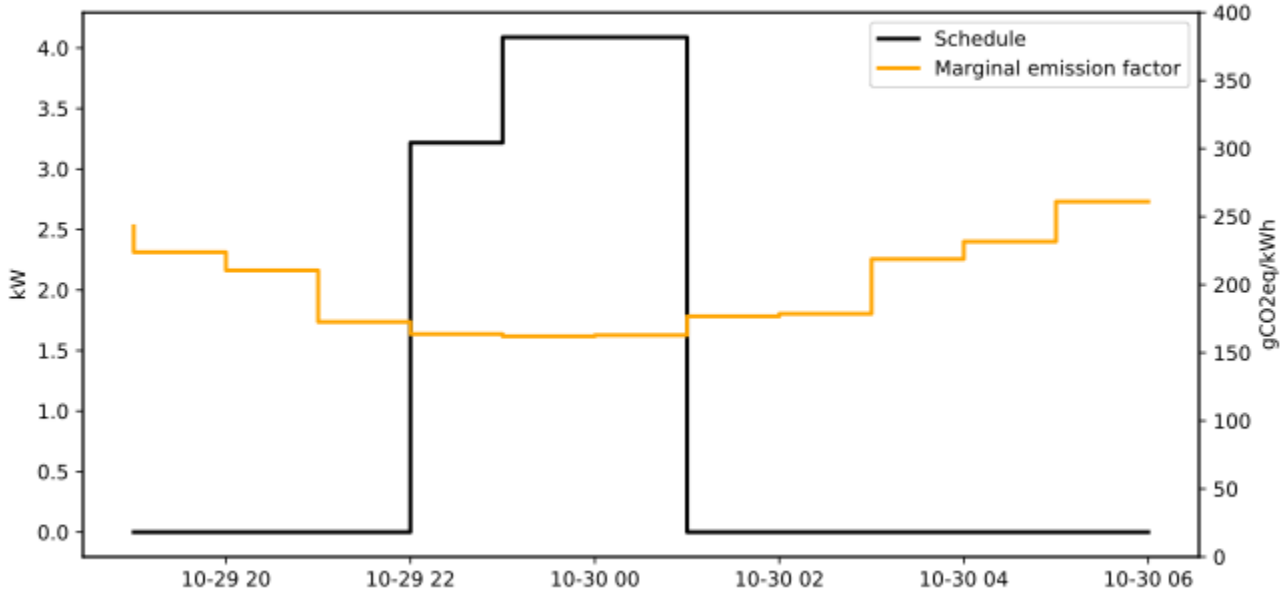


Marginal origin of electricity in East Denmark



See https://www.tmrow.com/blog/marginal-carbon-intensity-of-electricity-with-machine-learning/

20% savings in Denmark using smart charging



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