

HOW MUCH WILL RENEWABLE ENERGIES POWER OUR FUTURE?

NONPARAMETRIC STATISTICS PROJECT

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MOTIVATION

During the last few decades, the European Union has made several proposals to stimulate the creation of clean energy inside its country members (*European Green Deal, Clean Energy for all Europeans, 2030 Climate and Energy EU objectives...*) with the common objective of having a total renewable energy future.

Several projects have been carried out trying to predict whether these objectives are plausible in the near future. A nonparametric approach seems like an interesting path which could help analyze the effort made regarding this cause.

Since all energy related information for every EU member is open to the public in the EU's Eurostat portal, and all of its datasets contain clean and reliable information, we deem this project very interesting and quite feasible while using the nonparametric techniques learnt.



DATASETS DESCRIPTION

We have a variety of **time series datasets** about **European energy consumption** in the time window from 1990 to the present. We decided to consider yearly progressions taken from: <https://ec.europa.eu/eurostat/web/energy/data/database>



Complete energy balances (final energy consumption) dataset:

https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_bal_c&lang=en



Consumption of solid fossil fuels (inland consumption) dataset:

https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_sff&lang=en



Consumption of oil and petroleum products (gross inland deliveries) dataset:

https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_oil&lang=en



Consumption of renewables and wastes (inland consumption) dataset:

https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_rw&lang=en



Renewable energy sources percentage over total energy available dataset:

https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_ind_ren&lang=en



Imports of solid fossil fuels by partner country dataset:

https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_ti_sff&lang=en



Imports of oil and petroleum products by partner country dataset:

https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_ti_oil&lang=en



Use of renewables for electricity dataset:

https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_ind_ured&lang=en



Electricity production capacities by main fuel groups dataset:

https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_inf_epc&lang=en



AIM OF THE PROJECT

The principal aim of our time series analysis is **forecasting future renewable energies usage**, taking advantage of current and past knowledge of data about production, consumptions and imports.

Data from year to year are not independent and the assumption of normality is not respected, for these reasons we imagine that a nonparametric approach would be suitable since it permits to obtain consistent results under few conditions.

To derive the future renewable energy trend we will principally use **Conformal prediction**, the power of it being that it can be applied to any method that provides a prediction (such as Generalized Additive Models) and it is valid in a nonparametric setting.

In particular, to answer the general question, we will work with the proposed datasets while answering further **subquestions**. We will conduct analysis and perform predictions in each substudy.



SUBQUESTIONS

**How are the renewable energies levels of consumptions growing?
And the non renewables ones?**

To answer this question we will take advantage of nonparametric tests to compare year by year renewable vs non renewable energy usage and to look for substantial geographical differences.

Additionally we will apply regression to properly view the trend of energy consumptions.

Which countries are more projected to switch to renewable energy?

We propose using nonparametric regression on the solid fossil fuels and petroleum products imports datasets to investigate the renewable transition of each country. Furthermore we will analyze, for each country, the percentage of energy produced by renewable sources over the total energy produced.



SUBQUESTIONS

**How much of our electricity comes from renewable energies?
And which is the principal source?**

We want to compare year by year electricity production from each type of fuel, to highlight the most popular one and to forecast which renewable source will contribute the most to our future electricity production.

Will the electricity production capacity provided by renewable sources be enough to sustain large demands of energy?

We want to understand if the renewable energy network will have sufficient production capacity (in terms of daily generated power), in order to satisfy picks of demand. In particular we will analyze its growth, applying the already mentioned methods about nonparametric forecasting to the corresponding dataset.

