README
"The Economic Costs of NIMBYism: Evidence from Renewable Energy Projects"

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Overview

The code in this replication package conducts the analysis from a wide range of data sources using R. Eight main code files run all of the code to conduct the analysis and generate the tables and figures. The replicator should expect the code to run for 8-24 hours. The final two code files can be run on their own using pre-processed intermediate files to generate the final tables and figures for the paper and appendix. The replicator should expect the code to run for less than 1 hour.

Data Availability and Provenance Statements

Statement about Rights

I certify that the author of the manuscript has permission to redistribute/publish the publicly available data contained within this replication package. Any data found in this package should be appropriately cited when used to ensure compliance with appropriate licenses. Data that is proprietary or requires users to agree to a specific user license is not included in the package and must be accessed seperately.

License for Data

The data are licensed under a Creative Commons/CC-BY-NC license. However, please note that some data sources may be subject to inherited license requirements. Any data found in this package should be appropriately cited when used to ensure compliance with appropriate licenses.

Summary of Availability

All data sources used are publicly available, or freely available subject to agreeing to an end user license (e.g. around use for non-commercial purposes or on appro-

priate citations). The sole exception is the proprietary data from TheWindPower which can be purchased by any interested user. The code files and the list of data sources provided below note the data sources which are proprietary or require agreeing to an end user license.

Details on each Data Source

The analysis for the paper uses a wide range of data sources. The appendix contains detailed explanation of the key data sources and how they are used. The bibliography of this Readme and the code files both include relevant information on the name and URL of a data source (e.g. when first read in and cleaned).

Below is a list of the main raw data sources used.

- Centroids of post codes in the UK from the Office for National Statistics [Office for National Statistics, 2022e]
- Polygon boundaries for Local Authorities and Local Planning Authorities from the Office for National Statistics [Office for National Statistics, 2022a,b]
- Polygon boundaries for Lower Layer Super Output Area Census Geographies from the Office for National Statistics [Office for National Statistics, 2022c]
- Polygon boundaries for National Parks from the Office for National Statistics[Office for National Statistics, 2022d]
- Average Wind Speeds (at 10m, 50m, 100m, 150m and 200m height) and Average Capacity Factors (for IEC 1, 2 and 3) from the Global Wind Atlas [World Bank, 2022d]
- Average Photovoltaic Potential (including by month-of-year) from the Global Solar Atlas [World Bank, 2022b]
- Panorama Digital Terrain Model for Great Britain (files for England, Scotland and Wales) downloaded from Edinburgh University Data Share Portal [Blackwood, 2017]
- UK Rural Urban Classification from the Consumer Data Research Centre [Consumer Data Research Centre, 2013]
- Census data on the socioeconomic status of residents (social grade, occupation type and dwelling type) from the Office for National Statistics NOMIS Portal [Office for National Statistics, 2011]
- Index of Multiple Deprivation combined and harmonised across the UK [Abel et al., 2016]
- Local Election data for the UK from the Election Centre [Elections Centre, 2020]

- Price Paid Property Transactions data from His Majesty's Land Registry [His Majesty's Land Registry, 2022b]
- Local Authority House Price Index data from His Majesty's Land Registry [His Majesty's Land Registry, 2022a]
- Local Authority Property Counts data for England and Wales from the Valuation Office Agency [Valuation Office Agency, 2021]
- Local Authority Property Counts data for Scotland from the National Registers of Scotland [National Registers of Scotland, 2021]
- Lookup file for Scottish Data Zones 2001 to 2011 versions from Scottish Government [Scottish Government, 2015b]
- Lookup file for Scottish Data Zones to Output Areas from National Registers of Scotland [Scottish Government, 2015a]
- Planning Applications Database for Scotland from the Improvement Service accessed via the EDINA Portal [Improvement Service, 2022]
  - This item is not included here as it requires agreeing to an Educational User License. The data is still free to access and users can do so via the EDINA portal here: https://digimap.edina.ac.uk/os
- Renewable Energy Planning Database from the UK Department of Business, Energy and Industrial Strategy (now from the Department of Energy Security and Net Zero) [BEIS, 2022a]
- Renewable Energy Planning Database from the UK Department of Business, Energy and Industrial Strategy (now from the Department of Energy Security and Net Zero) [BEIS, 2022a]
- Database for Wind Projects and Wind Turbine Characteristics from TheWindPower [The Wind Power, 2019]
  - This item is not included here as it is proprietary and must be purchased from TheWindPower. There are two main datasets that need to be purchased. The first is information on the various wind turbines produced by wind turbine manufacturers: https://www.thewindpower.net/store_manufacturer_turbine_en.php?id_type=4 The second is information on the various wind farms in the UK (Note: the analysis uses a global version of the data but a UK only extract should be sufficient): https://www.thewindpower.net/store_country_en.php?id_zone=8. At the time of writing the first dataset costs 250 euros and the second costs 350 euros. Replicators should be aware that this proprietary data is only used for a very small portion of the analysis; most notably the process for assigning a likely turbine model to each proposed project and thus also estimating the wind turbine tip heights (e.g. for the visibility calculations).

- Wind and solar project spatial information retrieved from Open Street Map via OverpassTurbo [OpenStreetMap, 2022]
- Wind and solar simulated capacity factors from Renewables Ninja [Pfenninger and Staffell, 2022, 2016, Staffell and Pfenninger, 2016]
  - Files include preset downloads and requests to the API as described in the documentation section. Please be aware that replicating the API request process from scratch will likely be time consuming as there is a throttling limit on the number of requests that can be made within a set period of time. Further details can be found in the code on this.
- Annual exchange rates and inflation index data from the World Bank [World Bank, 2022c,a].
- Average wind and solar capital costs, operating costs and capacity factors from the International Renewable Energy Association [IRENA, 2022]
- Offshore wind project capacity factor estimates from EnergyNumbers [Smith, 2023]
- Capital costs by project size for wind and solar from the Lawrence Berkeley National Laboratory [Wiser et al., 2022, Bolinger et al., 2022, Barbose et al., 2022]
- Half-hourly wholesale prices and generation by fuel type from Elexon [Elexon, 2022]
  - These are specific data streams that have been extracted and cleaned from the extensive daily data provided via the Balancing Mechanism Reporting Archive, with original raw Elexon files not included due to their size. The original raw files are publicly available from the Elexon Portal here: https://www.elexonportal.co.uk/bmradataarchive?cachebust=e3wsjilgjw
- Annual UK energy system data, including electricity demand and industrial electricity prices, as reported in the Digest of UK Energy Statistics (DUKES) from the UK Department of Business, Energy and Industrial Strategy (now from the Department of Energy Security and Net Zero) [BEIS, 2022b]
- Historical wind and solar capacity data as reported in Energy Trends from the UK Department of Business, Energy and Industrial Strategy (now from the Department of Energy Security and Net Zero) [BEIS, 2020b]
- Long-term historical data on electricity demand from the UK Department of Business, Energy and Industrial Strategy (now from the Department of Energy Security and Net Zero) [BEIS, 2019]
- Projections of annual energy system data, including electricity demand, supply and prices, from the UK Department of Business, Energy and

Industrial Strategy (now from the Department of Energy Security and Net Zero) [BEIS, 2020a]

- Projections of annual valuation metrics, including prices and carbon values, from the UK Department of Business, Energy and Industrial Strategy (now from the Department of Energy Security and Net Zero) [BEIS, 2021]
- Annual historical emissions by pollutant and source type reported in the UK National Atmospheric Emissions Inventory from the Department of Environment, Food and Rural Affairs [DEFRA, 2022]
- Energy Generation Cost Projections for different generation technologies from the Department of Energy Security and Net Zero [BEIS, 2023]
- Projections of annual energy system data, including electricity demand and supply, as reported in the Future Energy Scenarios from National Grid Electricity System Operator [NGESO, 2022]
- Hourly historical generation mix from National Grid Electricity System Operator [NGESO, 2023]
- Historical data on Transmission Network Use of System Charges from National Grid Electricity Transmission [NGET, 2022]

Computational requirements

Software Requirements

- R 4.4.0
  - The `pacman` package is used to load packages in each code file and install any if not present. Make sure to install the pacman package once before running any of the subsequent code files.
  - Details on all packages used in R can be found in the `packages.pdf` file.
- QGIS 3.16.16
  - The `Visibility Analysis` v1.8 plugin is required.

Memory and Runtime Requirements

Approximate time needed to reproduce the analyses on a standard 2024 desktop machine: 8-24 hours.

The code was last run on a Windows laptop with an 8-core Intel i7-11800H CPU, 64GB RAM and Windows 10.

Description of programs/code

Code Files

The analysis for the paper is all conducted in R. The one exception is a small piece of the visibility analysis that is conducted in QGIS. All R code is broken

up across the following eight code files, all located in the "nimby/project" folder:

- `01_cleandata.R` - cleans up key geospatial and socioeconomic data needed for the analysis
- `02_projects.R` - cleans up the renewable energy projects data
- `03_propertycosts.R` - conducts the hedonic estimation and calculates project property costs
- `04_othercosts.R` - cleans up other cost data and calculates project capital and operating costs
- `05_elecbenefits.R` - conducts analysis to estimate electricity production and project energy and environmental benefits
- `06_npvestimation.R` - combines estimates of project costs and benefits to consistent net present value
- `07_planningestimation.R` - conducts analysis of determinants of project planning outcomes and misallocated investment
- `08_figuresandtables.R` - produces a range of summary figures and tables

License for Code

The code is licensed under a MIT license https://opensource.org/license/mit

Instructions to Replicators

The replication package contains the necessary files and code in the following folder structure.

→ project
  → data
  → clean
  → output
  → temp
→ docs
  → figures
  → tables

The code files are located in the "project" folder. Raw data files are then read in from the "project/data" subfolder. Cleaned up intermediate data files are stored in the "project/clean" subfolder. Temporary files made during analysis are put in the "project/temp" subfolder. Figures, tables and other outputs are exported to the "project/output" subfolder.

The main tex file documents (paper/appendix) are then located in the "docs" folder. Figures are then copied into the "docs/figures" subfolder. Tables are then copied into the "docs/tables" subfolder. Code is included in each code file to copy over figures/tables from the "project/output" folder.

To replicate all of the analysis in the paper the code should be run as follows:

- Run the code in `01_cleandata.R`

- Run the code in `02_projects.R`
- Run the code in `03_propertycosts.R`
- Run the code in `04_othercosts.R`
- Run the code in `05_elecbenefits.R`
- Run the code in `06_npvestimation.R`
- Run the code in `07_planningestimation.R`
- Run the code in `08_figuresandtables.R`

To replicate the figures and tables in the paper the code should be run as follows:

- Run the code in `07_planningestimation.R`
- Run the code in `08_figuresandtables.R`

Note that there are some sections of commented out code to avoid re-running certain tasks that take a long time to process and pre-procssed cleaned files are provided instead. However, these sections of code are clearly signposted and can be uncommented in order to re-run.

List of tables and programs

The provided code reproduces all tables and figures in the paper. Details on each table and figure can be found in the file `tablesandfigures.csv`. To reproduce the figures and tables in the main text and appendix only the last two code files need to be re-run.

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Acknowledgements

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