Climate Policy Atlas V1: Metadata on policy support for renewable electricity

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Please note that the carbon tax and emissions trading data are via the World Bank Carbon Pricing Dashboard, and must be cited as such for subsequent analyses.

The data is to the best of our knowledge correct, but we do not assume any responsibility for any remaining data errors or publication mistakes.

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# General information

These datasets contain detailed, machine-readable data on support policies for renewable energy from the years 2000-2024 for all EU countries and the UK. The work was performed by Silvia Wekoⁱ, Franziska Boldⁱ, Aksornchan Chaianongⁱ, Dogukan Günkördüⁱ, Daria Lebedevaⁱ, Puru Malhotra\*ⁱ, Ioannis Milioritsasⁱ, Johannes Weißⁱ, and Johan Lilliestamⁱ, during 2024-2026.

The data is published with CC BY-SA 4.0. The dataset should be cited as:

Weko, S., Bold, F., Chaianong, A., Günkördü, D., Lebedeva, D., Malhotra, P., Milioritsas, I., Weiß, J., and Lilliestam, J. (2026): Data on policy support for renewable electricity (Version 1, January 2026). Friedrich-Alexander-Universität Erlangen-Nürnberg. DOI: 10.5281/zenodo.18327812

Note that if you use data on carbon pricing or emissions trading, these are from the World Bank Carbon Pricing Dashboard, and must be cited as such for subsequent analyses.

Should you find errors or have data to fill gaps, please contact climatepolicyatlas@nfdi4energy.org, referencing the serial number provided in the column “serial\_number”.  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
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# About the data

## Data sources

The data are derived from publicly available sources. The main source upon which our dataset builds is “The global renewable power support dataset”, Hafner, S. & Lilliestam, J. (2019). This data can be accessed at https://doi.org/ 10.5281/zenodo.3371375. The data from this source go up until 2016 and in some cases 2017. However, we make a number of changes to this dataset and its structure to make it machine-readable and more easily accessible.

In addition, we conduct further research on renewable energy and to complete the dataset. Data was gathered using publicly available sources including Climate Policy Radar, Climate Policy Database, the IEA, RES-legal.eu, World Bank, the AURES II project, the OECD, IRENA, relevant national ministries, industry bodies, and other websites.

Information about the source of each individual observation can be found in the column “source”. Data from secondary sources include original source URLs, some of which are no longer valid. When possible, we have replaced these broken links with the archived version from the Internet Archive Wayback Machine.

# Data overview: time, jurisdictions, and technological scope

**Time:** We record data for the years 2000-2022. There are some observations available for 2023 and 2024, but some data (especially tenders) may not yet be completed, and these should only be used with caution until further updates are completed.

**Jurisdictions:** The datasets focus on national policy instruments. They do not include higher-level policies like the EU level or lower-level policies like the federal states or cities.[[1]](#footnote-1)

**Technological scope**: The datasets cover policies that support renewable electricity. The following technologies are included:

Table 1: Technologies included in the dataset

|  |  |  |
| --- | --- | --- |
| **Data type** | **Technologies included** | **Technologies excluded** |
| Renewable electricity generation | Bioenergy  Concentrated Solar Power (CSP)  Wind (onshore and offshore)  PV (rooftop and field) | Hydropower, geothermal, batteries, combined heat and power generation |

We also record information on policies when they apply to multiple different kinds of technologies. More details on how specific instances are coded can be found in the section 3.2, “Affected Technologies”.

# Scope: which policy instruments are recorded?

For policy support data, our focus is on public policies, which we define as “efforts made by governments to alter aspects of their own or social behavior in order to carry out some end or purpose and are comprised of complex arrangements of policy goals and policy means” (Howlett, 2014).

In terms of policy means, we look at policy instruments: the specific policy measures by which the government aims to achieve its objectives. Within this category, we have gathered information on both economic and regulatory instruments. We define an economic instrument is a policy instrument that hands out or takes away material resources while the addressees are not obligated to take the measures involved (Bemelmans-Videc et al., 2011). At this time, we do not gather data on information policy instruments or voluntary policy instruments.

For renewable electricity support policy instruments, we focus on 10 specific instruments which influence the expansion of renewable electricity generation. Some instruments, such as emissions trading, which target both the power and other sectors and therefore may indirectly impact the competitiveness of renewable power vs fossil fuels are also included. A list of the relevant policy instruments and their short descriptions is below (more details can be found in the respective sections).

Table 2: Summary of recorded policy instruments for renewable electricity adoption support

|  |  |
| --- | --- |
| **Policy instrument name** | **Description** |
| Feed-in tariff | A feed-in tariff is a market premium where energy producers are paid fixed prices for every unit of energy fed into the grid for a number of years in the future. |
| Feed-in premium | A feed-in premium is a market premium where energy generators are paid a premium on top of the price they achieve in the electricity market, for electricity fed into the grid for a number of years in the future. |
| Grant | A grant is a fiscal incentive where the government provides non-repayable funding for specific purposes. |
| Emissions trading | A greenhouse gas emissions trading scheme (also called carbon markets) is a trading scheme wherein governments issue tradable emissions certificates, often combined with a fixed emissions cap (overall or set on specific actors), thereby setting economic incentives to reduce emissions. We record only mandatory cap-and-trade schemes that include emission from power generation. |
| Soft loan | A soft loan is an economic policy instrument where the government provides loans for at preferential conditions to lower financing costs. |
| Loan guarantee | A loan guarantee is an economic policy instrument where the government guarantees to pay the loan should the project go bankrupt, lowering the default risk and therefore the required returns on debt and/or equity. |
| Tax incentives | A tax incentive is a fiscal incentive where the government reduces or exempts selected activities, goods or actors from taxes. These include subcategories such as tax exemptions, tax deductions (including accelerated depreciation), tax reductions, tax credits and tax returns. |
| Auctions | An auction is an economic instrument that allocates resources based on a bidding competition. These resources may be a financial (for example, an auction with a feed-in tariff) or other resources such as access to land. |
| Tradeable green certificates (TGC) | A green certificate scheme is a trading scheme where producers of renewable electricity receive tradable certificates for each unit of electricity generated. These certificates can then be sold separately from the electricity itself, typically to energy suppliers who are obligated via a quota to source a certain share of their electricity from renewables. This creates a market for certificates, providing a financial incentive for renewable energy investment and production. |
| Carbon taxes | A carbon tax is a tax on carbon or other greenhouse gas emissions, measured in CO2 equivalent values. By increasing the cost of carbon-intensive electricity, carbon taxes indirectly support renewable power by improving its competitiveness. |

**NOTE**: Policy names do not always correlate with actual instruments: a country might call a grant a “bonus”, “premium” or even a “business model” in the source text. We use the above definitions from the [Climate and Energy Policy Ontology](https://github.com/OpenEnergyPlatform/ClimateEnergyPolicyOntology) to categorize instruments, and note the name of the policy in the policy name column whenever possible.

## When are instruments not recorded?

We record instruments that would be expected to have an impact on investment decisions for new renewables. For this reason, support instruments are not recorded in some cases.

First, existing policies are no longer recorded once they are reduced to a very small scope and become irrelevant for the future development of the overall electricity system. For example: France’s feed-in tariff for wind was replaced by an auction mechanism. However, some very specific installations were still technically eligible to receive a feed-in tariff: that is, floating installations or wind energy plants “in an area particularly exposed to cyclonic risk and equipped with a device for forecasting and smoothing electricity production”. The FIT levels are not recorded for these installations, as it would make an observer think that there is continued FIT support for most wind power plants in France when in reality there was a major change in the policy that excluded most installations from the FIT.

Second, policies are not recorded if they only apply to a small sub-group of actors. We focus on policies that apply to larger actor groups, such as a grant where any household is eligible for a 1000 EUR grant, or any SME is eligible for a loan. We exclude those policies which only apply to specific sub-groups (like “only low-income farmers” or “only public buildings”).

## Correctness and completeness of data

We have aimed for the data to be as complete and correct as possible, but errors may still occur. If you see something that may be incorrect in the dataset, please write to us directly at [climatepolicyatlas@nfdi4energy.org](mailto:climatepolicyatlas@nfdi4energy.org) with the serial number of the observation.

In some cases, we are reasonably sure that a policy exists but are uncertain about details. In these cases, we record that an instrument exists but we do not fill out information on the support level and add additional information if we have any in the ‘notes’ column.

For example, the German KfW provides loans at favorable rates for the installation of renewable energy (a “soft loan”). However, we do not know the precise interest rates as the KfW does not share this information. We would record this as follows:

Table 3: Recording instruments with missing information

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **year** | **country** | **measure** | **loan\_interest\_rate** | **support\_duration** | **notes** |
| 2020 | Germany | soft loan | NA | 10 years | The yearly interest rate was recorded by the EU in the source as 1.03 %, but it varies daily and according to market conditions and is determined by the KfW when the loan is recorded. |

In other cases, we know some details of a policy but not all of them. For example, we might know about a grant to purchase solar panels that existed, but not all the details for every year. Here is how we would record it if:

* In the year 2000 the policy was introduced, but we couldn’t find any more details on it.
* In the year 2001, the previous grant (level unknown) was raised to EUR 1000 per PV panel installed. There was a cap on how much a recipient could get (i.e., you couldn’t install 100 solar panels and get EUR 100000), but we don’t know how much it was.
* In the year 2002, the government raised the cap to EUR 3000 per recipient.
* In the year 2003, the government removed the cap.
* In the year 2004, a new government was elected and cancelled the grant.
* In the year 2005, there is no evidence of any grants existing.

Table 4: Recording instruments with missing information

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **year** | **measure** | **policy\_change** | **what\_changed** | **level** | **level\_currency** | **level\_unit** | **cap\_possible** | **cap\_level** | **cap\_currency** | **cap\_units** |
| 2000 | grant | yes | introduced | NA | NA | NA | NA | NA | NA | NA |
| 2001 | grant | yes | grant increased | 1000 | EUR | per installation | yes | NA | NA | NA |
| 2002 | grant | yes | cap increased | 1000 | EUR | per installation | yes | 3000 | EUR | per recipient |
| 2003 | grant | yes | cap removed | 1000 | EUR | per installation | no | NA | NA | NA |
| 2004 | grant | yes | policy cancelled | NA | NA | NA | NA | NA | NA | NA |

# Variables common for all policy instruments

## Year and Month

The year and month are for when a policy is introduced. For example, a policy that comes into force on April 1st, 2000 would be recorded as Year (2000) and month (April).

In some cases, a policy may also have retrospective impacts: for example, a law is published in January 2020 which affects how businesses can report their 2019 taxes. We would still record this as (2020, January) and then in the notes add the information that this also applies retrospectively.

**NOTE:** for tenders, we also record the date when possible.

## Affected technologies

For each policy instrument, we describe what kind of technology is impacted (technology\_type). When information is available, we distinguish between specific technologies: for example, PV can be recorded as PV rooftop or PV field. If the policy applies to technologies more generally (such as any PV installation), or if there are no further details available, it is recorded as PV. The possible entries for renewable energy are listed in Table 3.

Table 5: List of technologies in the policy dataset

|  |  |
| --- | --- |
| **technology\_type** | **Definition** |
| Bioenergy | Energy derived from biomass: biological material derived from (recently) living organisms such as wood, crops, wastes and residues.[[2]](#footnote-2) Because our focus is on electricity generation, the majority of these projects are biomass rather than other forms of bioenergy such as biogas. |
| CSP | Concentrated solar power, or solar thermal power |
| Wind | Power derived from wind (may include onshore and offshore) |
| Onshore wind | Power derived from onshore wind only |
| Offshore wind | Power derived from offshore wind only |
| PV | Solar photovoltaic power (may include different types and technologies) |
| PV rooftop | Solar PV installed on rooftops (may be residential or not) |
| PV field | Solar PV installed on land (i.e., larger solar park/farm) |
| All renewables | All renewables (as defined by the source) are eligible, including technologies for which we do not gather data |
| Multiple renewables | More than one of the above technologies is supported, but it is not possible to differentiate how support is divided between technologies. Further information on which technologies are included available in the column technology\_type\_multiple. |

If a policy applies to all renewable power technologies, including technologies not included in our list because they are not in focus of renewables support in most countries (e.g., geothermal or wave power), this is indicated by “all renewables” in the technology row. Note that we follow the definition of each source, typically country-specific regulations, as to what is “renewable”. The technologies in Table 3 are always considered renewable technologies.

**NOTE:** We do not record policies specifically to promote co-generation of heat and electricity in this dataset.

Sometimes policy instruments will cover multiple technologies, without differentiating between support levels or quotas for different technology types (such as a tender for both solar PV and wind). In such cases, we record this as “multiple” under technology\_type. Further information about the combination of technologies supported when the value is “multiple” is recorded in the technology\_type\_multiple column.

In some cases, there are additional technology-specific requirements for eligibility. For example, some countries may only grant support to solar PV if it is grid-connected, or if it includes storage. A similar technology-specific requirement is a local content requirement, i.e., that the components for the installation must be from the country. These requirements are recorded in the column “technology\_requirement”. Requirement terms such as “dedicated energy crops” are taken from the source.

Table 6: Illustration: multiple technology types and technology requirements

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Description** | **Values (RE dataset)** |
| technology\_type\_multiple | When multiple technologies are supported without a clear differentiation of support levels | PV and wind  PV, hydro and bioenergy  biomass and wind  biomass, PV and wind |
| technology\_requirement | A technology-specific requirement for support eligibility | building-integrated, dedicated energy crops, small-scale, local content requirements, with storage …etc. |

## Actors

Some policies specify which actors are eligible, excluding others: for example, a tax break which is only for SMEs. In general, grants and tax incentives tend to have actors eligible. Other policies may have multiple conditions: for example, they give different support rates according to both the size of the installation, and the type of actor with low-income households getting higher support rates.

In these cases, we record the actor for whom this policy applies. We use the definition that is provided by the policymaker – if they say the policy is only for SMEs, we do not double-check what that definition is. There are a few projects that are given specific support, usually larger infrastructure projects; these are recorded under the instrument type “grant” with the Actor “project-specific subsidy”.

**NOTE**: we only record specified actors if this is included as an important condition for the policy. If a policy is extremely narrow in terms of actors it applies to (i.e., only public employees commuting over 100 km per day) we do not record it in the database.

**NOTE:** Since the technology\_requirement and actors variables represent conditions that must be fulfilled for the support to be granted, it is not possible to directly compare observations where they differ. For example, this applies to PV installations with and without storage, or to grants for SMEs in one case and for households in another, even though the technology\_type is the same in the dataset.

## Policy name and budget

**Name:** In column “policy\_name” we record the name of the policy or policy document where the benefits are granted. For example: in the case of tax exemptions, these are usually recorded in the yearly budget, so the column value for “name” would be “Budget 2008”, “Budget 2010”, etc. In other cases, the policy instrument has a common name by which is it is referred to, such as “Sustainable Energy Authority of Ireland (SEAI) Grant Scheme”. This is just to indicate to a data user that all cells with “Budget 2008” or “Sustainable Energy Authority of Ireland (SEAI) Grant Scheme” are related, in case they need to look more closely at them for analysis.

**Budget:** The government budget is the amount of currency which is budgeted for a support instrument per year. If information is available, we record information on the total budget for the policy instrument in in the columns “Government\_budget” and “Government\_budget\_currency”. Sometimes information on yearly budget is not available, but only for the total budget of a program. If this is the case, budget information is recorded in the notes section.

## Policy change and What changed

The entry “Policy change” is a binary variable, and is either “yes” or “no”, indicating that a policy did or did not change in a particular year (Table 6). Policy change is recorded for the year that a change was enacted, not when it was decided.

The entry “What changed” describes how the enacted policy change affected the policy instrument for one of the variables we collect. For example, if a new policy was introduced, if a policy was cancelled, extended, support levels were increased or reduced, etc. There is no coding scheme for the values in this column; it is simply an annotation to help make the data-set more accessible for users.

The “change” variable refers to events that were not already part of the policy. For example, the German EV purchase grant was originally slated to end in 2019, but was then extended. The decision in 2018 to extend the policy end year to 2025 constitutes a change. If a policy was originally scheduled to end in 2019 and did so, we record policy\_changed “yes” and then in the details about the change “policy ended”. This is different from a cancellation.

Sometimes a new policy document is published without changing the instrument for which we are recording data. For example, solar panel grants might apply to “new” installations and will include a definition of what is “new” (purchased within some date range). An updated policy document might have a different date range because it is published a year later, but it has the same exact grant amount and effect. As long as the policy instruments themselves do not change, such observations are recorded as “no”.

We do not register policy changes that do not affect any of the variables in the dataset.

Table 7: Summary of the policy change entries

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Description** | **Values** |
| policy\_changed | Whether the policy changed or not in a given year | yes, no |
| policy\_changed\_detail | Note on how the policy changed | introduced, cancelled, ended, support level increased, support duration changed, cap increased, etc. |

## Sources, notes, and CPDB policy identifier

For data up until 2017/2018, we build from the policy dataset of Hafner & Lilliestam. During our updating process, if we noticed a problem with their data, we record in the notes section how we updated it. For example, if I (Silvia Weko) fix an observation, I would write: “(#update S.W.: previous cap value recorded was govt budget, have corrected cap value and fixed dead link).”

From 2017/2018 onwards for renewables, we gather original data. To do so, we draw from various sources including Climate Policy Database (CPDB), Climate Policy Radar (CPR), the IEA policies and measures dataset, information requested from the EU on energy support schemes, and more. In case we record a policy instrument from a policy identified in CPDB, we record CPDB’s policy identifier and policy title. The variable CPDB\_identifier is the original CPDB identifier, plus a year value (i.e., for CPDB policy 211000789 for the year 2016, this is recorded “211000789\_16”). A blank space does not necessarily indicate that there is not an equivalent CPDB observation, as in some cases the information was from a different source and we did not check all observations for CPDB equivalency.

# Variables common for most policy instruments: support level and conditions

## Support level and conditions

Many policies have conditions about what support levels different technologies are eligible for. For example, some countries only provide FITs for installations under a certain size; or they have different rates for smaller or larger businesses. We illustrate how these conditions work with 3 cases.

**Case 1: One condition.** A country will only grant its FIT of EUR 0.06 per kW to solar PV installations up to 100 kW in size. This would be recorded as follows:

Table 8: Recording instruments with one condition

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| technology\_type | condition\_max\_1 | condition\_unit\_1 | level\_1 | level\_1\_currency | level\_1\_unit |
| solar PV | 100 | kW | 0.06 | EUR | kW |

**Case 2: Different group conditions.** A country has multiple conditions, so that different groups receiving different levels of support. For example, a country may have many possible levels of FIT for different sizes of installations: EUR 0.06 for installations under 100 kW, or EUR 0.04 for installations between 100-300 kW, etc. This would be recorded as follows:

Table 9: Recording instruments with multiple conditions for different groups

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| condition\_min\_1 | condition\_max\_1 | condition\_unit\_1 | lvl\_1 | lvl\_1\_currency | lvl\_1\_unit | condition\_min\_2 | condition\_max\_2 | condition\_unit\_2 | lvl\_2 | lvl\_2\_currency |
| NA | 100 | kW | 0.06 | EUR | kW | 100 | 300 | kW | 0.04 | EUR |

**NOTE:** For the variable condition\_max, an NA value may indicate that no upper limit applies. For example, if condition\_1 is between 20 and 30 kW, and condition\_2 has a minimum of 30 kW, then condition\_2\_max is recorded as NA to indicate an open-ended (i.e., unlimited) upper bound rather than missing information.

**Case 3: Multiple conditions.** Another possibility is that to receive a grant, several different conditions must all be fulfilled. Taking the example of grants for solar panel purchases, households must fulfill multiple conditions to receive a EUR 2000 purchase bonus:

* Condition 1: Capacity of under 20 kW, AND
* Condition 2: Installation costs of 10,000 EUR or less

We record this as in the table below. The level of support is only recorded in level\_1, and level\_2 is left blank. Details on the unit are recorded in the sections condition\_1\_notes and condition\_2\_notes.

Table 10: Recording instruments with multiple conditions that must be fulfilled

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| condition\_min\_1 | condition\_max\_1 | condition\_unit\_1 | lvl\_1 | lvl\_1\_currency | condition\_min\_2 | condition\_max\_2 | condition\_unit\_2 |
| NA | 20 | kW | 2000 | EUR | NA | 10000 | EUR installation cost |

**NOTE:** this is also the case for policies with technology requirements. For example, if only *building-integrated* solar PV installations under 100 kW are eligible for a FIT, the cell technology\_requirement should be filled in as “building-integrated” and both conditions must apply to receive the EUR 0.06 FIT.

**Multiple\_conditions\_attributes:** To signal to the data user the difference between Case 2 (different levels of support for different groups) and Case 3 (conditions that must all be met to receive support), we fill in the cell “Multiple\_conditions\_attribute”. Case 2 would be filled in as GROUP and case 3 as ALL. For Case 1, this column is marked NA (not applicable).

Condition\_1\_notes and Condition\_2\_notes.

Table 11: Multiple conditions variable

|  |  |
| --- | --- |
| Multiple\_conditions\_attribute | The condition attribute applies when the policy has multiple conditions.  GROUP: Each regulation condition applies separately, such as different levels of grants for different emissions thresholds  All: All conditions of apply together, and if you do not meet all conditions, you do not receive support. |

So far, we have collected data by adding instrument conditions and levels as needed: most do not have more than 2, and very few have more than 5. However, there are a few exceptions for this. For more than 5 conditions, we record as follows:

* condition\_1: the lowest value of all the classes
* condition\_2: the median value for all the classes.
* condition\_3: the highest value for all the classes.

**NOTE 1**: For the rooftop PV and wind FIT for the United Kingdom, we record all six capacity bands supported for the years 2010 to 2016 - on yearly averages of the quarterly values – to retain the full set of information available and identify the full set of policy changes regarding the capacities supported. Additionally, for biomass FIT in Bulgaria, we record averages of different ranges of supported capacities for each year for simplicity and comparison purposes, as both the levels of the FIT and the bands of the supported capacities vary significantly throughout the recorded sample. More details on the exact calculations for each year can be found on the notes of the FIT biomass for the respective year.

**NOTE 2:** For some policies, there are bonuses that can result in increased support levels. For example, the French “prime à l’intégration” (integration bonus): until 2018, very small solar PV installations received a higher FIT if they were building-integrated. The FIT without building integration is EUR 0.18 and can go up to EUR 0.22 including the bonus of EUR 0.04. We record the FIT as EUR 0.22 and include the information about the bonus in the notes.

## Support levels: currency and percent

In the policy instruments described above, support levels are determined by setting a specific currency price per unit. Monetary data usually represents the support paid per unit during a calendar year. Entries that concern monetary support are recorded as listed in the source, which is usually the local currency, and then transformed to EUR.

In some cases, policies and their support levels are changed during the year. We handle this as follows: Data from Hafner and Lilliestam were recorded using a time-weighted mean value. For example, if support was changed from EUR10 per kWh to EUR8 per kWh on 1 April, the entry is (10\*3+8\*9)/12 = EUR 8.5 per kWh in that year. If a policy was changed very late in the year (November or December), the support level during the longest part of the year was listed. If a policy was cancelled during the year, the support level up until the cancellation of the policy is recorded and it is noted when the policy was cancelled. We continue this method with the dataset updates.

Other support instruments instead set a threshold of support. For example, in grant instruments the government may reimburse up to 30% of the total investment cost of a project. We record this as ‘30’ in level\_1, and then give information on the % type detail in level\_1\_unit.

Table 12: Recording percentage vs EUR support levels

|  |  |  |  |
| --- | --- | --- | --- |
| **measure** | **technology\_type** | **lvl\_1** | **level\_1\_unit** |
| grant | Charging infrastructure | 30 | % total project cost |
| grant | Electric vehicle | 500 | EUR per vehicle |

In many cases, a range is given for the support percent (i.e., 50-70%) without any clear conditions for what ranges of support depend on which conditions. If there is no information on conditions, we record the highest support percent available in the “level\_percent” column and add further information in notes. The exception to this is if there is a different support amount between regions, in which case we record the average and add further information in notes.

Below is a summary table of the different kinds of support levels, and how they are recorded. The common **“level\_”** identifier records the level of support as described in the policy documents.

Table 13: Support level variables

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Description** | **Sample values** |
| level\_1 | The amount of support granted | Numeric |
| level\_1\_currency | The currency of the support level | EUR |
| level\_1\_unit | The unit that is granted the level of support | kWh, tCO2 equivalent, kWp, kW, tCO2, kWh, per project, % of investment, etc. |
| level\_2 | as above | as above |
| level\_3…5 | as above | as above |

## Support duration, cap, and degression

Some policies also determine the number of years that a project is eligible for support (for example a FIT is paid for 20 years). If this information is available, it is recorded under **support\_duration**. If a project is supported for its entire lifetime, the support duration is recorded as 99 years.

A slightly different concept is the **cap**, which is the maximum amount of support that will be given. (This differs from the level, in that the level is always the per unit amount: Euros per MWh, percent of project financed, etc.).

For example, some wind power projects only receive the FIT rate for up to a certain amount of full-load hours. Grants may also be capped at some percent of total investment or currency amount. In some cases, we were able to find information that a cap exists but not the actual limits, which we therefore record in the column “cap\_possible” as “yes”.

Table 14: Summary of different data entries for caps

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Description** | **Values** |
| cap\_possible | Indicates whether the policy had a cap beyond which no further support is paid | yes, no |
| cap | The numeric cap amount | Numeric |
| cap\_units | The unit of the cap | MWh, % of investment, MW per project, full-load hours, etc. |
| cap\_unit\_currency | The currency of the cap amount, if applicable | EUR, USD, GBP, etc. |
| cap\_ notes | Any further information on the cap |  |

Sometimes there are policies that set an overall cap: for example, a policy where PV installations between 0-5kW get a FIT of 0.10EUR, and from 5-15kW get a FIT of 0.05EUR, and there will be up to 33MW supported total in this year. This would be recorded as follows:

Table 15: Recording caps

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| technology\_type | condition\_min\_1 | condition\_max\_1 | level\_1 | Cmin2 | Cmax2 | l2 | cap |
| PV | 0 kW | 5 kW | 0.10EUR | 5kW | 15kW | 0.05EUR | 33MW |

However, sometimes there are installations that differ. In the example above, if there were a cap of 13 MW total for the smallest solar size and 20 MW total for the biggest solar size, this would be recorded as follows:

* Cap\_possible = yes
* (no cap level recorded)
* In notes: cap for 0-5kW is 13 MW per year, cap for 5-15kW is 20 MW per year.

**NOTE:** The cap is NOT the total budget of the program; or the budget that will be spent per year. Budget per year is recorded in the column “government budget”, and information on the total budget can be added in the notes section.

Finally, some policy support is subject to **degression**: This means that support levels decrease by a pre-determined rate. For example, a degression of 5% per year for a FIP means that the premium for new installations in year t+1 is 5% lower than for installations entering into operation in year t. If there is information on the degression, we record the unit and currency of this decrease.

**NOTE:** This policy is usually employed when a government sets a rate of support in one year and states that it should decrease by the degression rate in the following years. This means that the level we record already includes the degression rate. For example, in Germany a degression rate of 1.5% for wind energy was applied from 2002 onward. Because the FIT support levels remained identical to those of preceding years, the 2002 support level is recorded as the 2001 value multiplied by 0.985.

Table 16: Summary of different data entries for degression of support

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Description** | **Values** |
| degression\_possible | Whether a degression is present. Some values are coded with “yes” because there was a degression, but insufficient information on the actual level | yes, no |
| degression | The amount by which the support level decreases at the pace of degression\_unit | Numeric |
| degression\_unit | Unit of decrease | % per year, % per month, etc. |

# Details on renewable energy policy support instruments

Updates were done with the following process:

* Establishing an overview of which policies are likely to be in force in each country in the IEA, Climate Policy Radar and Climate Policy Database (as well as EU subsidies data requested from the European Commission). This allowed us to look closely at new laws and regulations passed by the government that could have influenced the existence of policy instruments and their level of support.
* When possible, we use the official government link, but there are some policies where we need more details (for example, the law does not set the FIT level, but the electricity operator does, and this is on their website). These are collected by searching the websites of relevant national institutions for further details on specific policy instruments (i.e., in the case of loans in Germany, the website of the KfW; or the national Irish budget which is published on the government website yearly). In some cases where information was difficult to find, we also looked at the websites and reports of industry associations, such as the French solar association: <https://franceterritoiresolaire.fr/>, as well as news sites, think tanks and other online sources.
* For previous observations, we check the source from Hafner and Lilliestam, and continuing using this source if it is valid. If we come across a better source for the policy (i.e., the official government link instead of RESLegal) we use this instead.

## Policy instruments for renewable energy support

This section explains in further detail the policy instruments for renewable energy support and notes on how data were gathered and processed.

### Feed-in Tariff (FIT)

Under a FIT, renewable power generators are paid a fixed sum of money for energy fed into the grid for a number of years.

Sometimes, the tariff paid for new installations decreases (either per year or sometimes per month or quarter); the amount paid to an existing installation is not affected. For example, a FIT for new installation may be EUR 0.08 per kWh in 2005 and is set to decrease by 10% per year for installations thereafter (so EUR 0.072 per kWh for installations completed in 2006, EUR 0.648 per kWh for those completed in 2007, and so on). This pre-defined rate of tariff decrease is called “**degression**”.

In most cases, FITs are open to all new generators fulfilling the requirements, but sometimes the support is limited by an overall **cap**, limiting the total capacity supported by the policy (or a maximum of how much can be spent).

For FITs, we record the support level, degression and cap data (if applicable). FITs often have multiple conditions. Many European FITs were phased out in 2016, leaving only very limited installations still eligible for support. We record data on small-scale support, but data users should pay careful **attention to the** **conditions columns** to understand which installations were eligible for FITs.

### Feed-in Premium (FIP)

Renewable power generators are paid a premium on top of the price they achieve in the general electricity market, for electricity fed into the grid, for a number of years into the future. Sometimes, the premium paid to new installations decreases at a pre-defined rate (the degression). In most cases, premiums are open to all new generators fulfilling the requirements, but sometimes the support is limited by an overall cap, limiting the total capacity supported by the policy. For this instrument, we record information on the degression, unit of degression, cap, and until when the cap is valid.

There are different kinds of feed-in premiums that can be awarded. Some premiums are a fixed amount on top of the market price, while others are “floating” where the premium depends on market prices.

Information on how the types of premiums are recorded is below. We record support levels in the “level” columns, and reference prices (relevant for floating FIPs) in the “refprice”.

Table 17: Premium types

|  |  |  |  |
| --- | --- | --- | --- |
| **Policy name** | **Definition** | **Example** | **What to record:** |
| Fixed FIP | Producers receive a **fixed** **premium on top of the market price**. | Producers get the market price, plus 4 cents on top (level = bonus paid per kWh) | level: 4 cents per kWh |
| One-sided floating FIP | Producers receive a **variable** **premium**, depending on electricity prices. The maximum threshold for electricity prices when they do not get any more premium is set (usually called the reference price – NOTE – this is different from reference prices in 2-sided FIPs) | The government sets a reference price of 30 cents per MWh, and a premium of 2.58 cents per MWh. When the market goes below the reference price (for example, market price of 10 cents per MWh), they receive the 2.58 cents per MWh on top (12.58 cents). When the market goes above the reference price + premium (32.58 cents) they do not receive the premium.  (level = bonus paid per kWh; refprice = reference price) | level: 2.58 cents per MWh  refprice: 30 cents per MWh  **NOTE:** in some cases, we only know the refprice or the level, but not both. We record whatever information is available. |
| Two-sided floating FIP (CfD) | Producers receive a **variable premium**, usually called a reference price or strike price. Works like a 1-sided FIP EXCEPT if they make more than this reference price, they must pay it back. | The government sets the revenue per kWh that should be awarded at 6.4 cents per kWh (level = total revenue per kWh). | Level: 6.4 cents per kWh |

The key information for premiums is as follows:

Table 18: Variables for premiums

|  |  |  |
| --- | --- | --- |
| **Variable** | **Definition** | **Values** |
| premium\_type | The type of FIP | fixed, one-sided floating, two-sided floating |
| refprice | The level of the reference price | numeric |
| refprice\_unit | The reference price unit | kW, kWh |
| refprice\_currency | The reference price currency | EUR |
| refprice\_notes | notes on the reference price | see dataset |
| refprice\_2 | The reference price level for condition\_2 | numeric |
| refprice\_2\_unit | The reference price currency for condition\_2 | EUR |
| refprice\_2\_currency | The reference price unit for condition\_2 | kW, kWh |
| level\_1 | The amount of support granted | Numeric |
| level\_1\_unit | The unit that is granted the level of support | kW, kWh |
| level\_1\_currency | The currency of the support level | EUR |

**NOTE:** In the case of the UK FIP, the electricity provider must provide a premium but they may determine the type of premium (i.e., it could be fixed or floating). We code this as premium\_type “other”.

### Auctions

In auctions, governments put out tenders for specific amounts of capacity (or energy) which will be built. Investors may bid on the amount they will build and the support amount that they will require. The selected bids are usually awarded support, for example with a fixed tariff or a premium for a number of years. The instrument is thus often similar to FITs and Premiums but differ in the qualification phase: only the winning bids are supported, whereas in FITs/Premiums all projects are (in principle) eligible for support.

There are different types of tenders, which result in different kinds of support recorded in the column “tender\_type”. These are similar to the premiums above, but also include additional types. These are recorded as follows.

Table 19: Recording tender types

|  |  |  |  |
| --- | --- | --- | --- |
| **Policy name** | **Definition** | **Example** | **What to record:** |
| Auction with FIT | Producers receive a **fixed monetary** amount for the energy that they produce. | Producers get 20 cents per kWh produced. (level = total revenue per kWh) | level: 20 cents per kWh |
| Auction with fixed FIP | Producers receive a **fixed** **premium on top of the market price**. | Producers get the market price, plus 4 cents. (level = bonus paid per kWh) | level: 4 cents per kWh |
| Auction with one-sided floating FIP | Producers receive a **variable** **premium**, depending on electricity prices. The maximum threshold for electricity prices when they do not get any more premium is set (usually called the reference price – NOTE – this is different from reference prices in 2-sided FIPs) | Auction sets a reference price of 30 cents per MWh, and a premium of 2.58 cents per MWh. When the market goes below the reference price (for example, market price of 10 cents per MWh), they receive the 2.58 cents per MWh on top (12.58 cents). When the market goes above the reference price + premium (32.58 cents) they do not receive the premium.  (level = bonus paid per kWh; refprice = reference price) | level: 2.58 cents per MWh  refprice: 30 cents per MWh  **NOTE:** in Italian FIPs (2012-2016), the reference price is set by auction; the premium amount is the difference between the reference price and the market price. So, we only know the REFERENCE price; the “level” should be recorded as NA. If there is only a reference price WITHOUT an additional subsidy, the level = 0. |
| Auction with two-sided floating FIP (CfD) | Producers receive a **variable premium**, usually called a reference price or strike price. Works like a 1-sided FIP EXCEPT if they make more than this reference price, they must pay it back. | Italian auctions after 2019: Auctions are held to set reference prices, resulting in reference price of 6.4 cents per kWh. (level = total revenue per kWh). | Level: 6.4 cents per kWh |
| Auction with zero subsidy | Producers do not receive any monetary support, they only bid for the right to develop the project. | Danish offshore auction in 2024 (resulting in no bids) | Level: 0 cents per kWh; cap: 0 cents per kWh  (if successful, otherwise blank) |
| Auction with subsidy | Producers compete for a subsidy such as grants covering a certain amount of project costs. | In Luxembourg there is a “tender for investment aid for the construction and operation of PV plants, launched to support the self-consumption of electricity produced by businesses” | Level: the level is calculated by dividing total amount of aid over planned installed capacity = 394.92 EUR per kW |

Tenders may include a maximum level of support that a bidder can ask for. This is recorded in the “cap” column in the dataset. The outcome of the auction (weighted average support price that bidders will receive) is recorded under level\_1, or in the refprice column in the case of one-sided floating FIPs.

We record each auction individually, including the name of the auction under “policy\_name”. If a country has multiple auctions per year, these are recorded separately.

Table 20: Variables that apply only to tenders

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Description** | **Values** |
| tender\_type | The type of support being tendered | FIP, FIT, CfD, no support, subsidy |
| tender\_amount\_tendered | The amount of renewable power auctioned | Numeric |
| tender\_amount\_tendered\_unit | The unit of the tendered amount | MW, kW, MWh, EUR/kW for all technologies, MWh/year, MW wind & biomass, MW non-CSP |
| tender\_amount\_contracted | The amount of renewable power contracted (the sum of all winning bids) | Numeric |
| tender\_amount\_contracted\_unit | The unit of the contracted amount | MW, kW, MWh, EUR/kW for all technologies, MWh/year, MW wind & biomass, MW non-CSP |
| AURESII\_id | The ID from the AURES II database corresponding with this observation |  |

**NOTE:** For the variables tender\_amount\_tendered\_unit and tender\_amount\_contracted\_unit, the value “EUR/kW for all technologies” is only possible when the support auctioned was available for multiple technologies (hence the value in the technology\_type column is “all renewables” or “multiple”.

Sometimes policy instruments will cover multiple technologies, without differentiating between support levels or quotas for different technology types (such as a tender for both solar PV and wind). In such cases, we record this as “multiple renewables” under technology\_type. Further information about the combination of technologies supported when the value is “multiple renewables” is recorded in the technology\_type\_multiple column.

Tender data are derived from Hafner & Lilliestam, AURES II (<http://aures2project.eu/>), and additional desktop research for all years after 2021. The sources are listed in the ‘notes’ column. Hafner & Lilliestam have tender data until 2016/17, AURES II has this information until 2021. For more information on the transformation of AURES II auction data, see Annex 1.

**Notes on some particular characteristics of auctions:**

If the policy for auctions to occur exists, but no auctions take place in that year, we still record that the policy existed (policy change = no), but we do not include any details on auction, write (“no auctions this year”) in the notes section, and put NA in the level\_1 and tender\_amount\_contracted columns. This is how we might record if Ireland held auctions in 2011 and 2013, but not in 2012, but they had not phased out their auction policy.

Table 21: Recording tenders

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Country | Year | policy\_changed | what\_changed | technology\_type | level\_1 | cap | tender\_amount\_tendered | tender\_amount\_contracted |
| IE | 2011 | no |  | biomass | 0.10 EUR | 0.11 EUR | 2 GW | 2 GW |
| IE | 2011 | no |  | biomass | 0.11 EUR | 0.12 EUR | 1 GW | 1 GW |
| IE | 2011 | no |  | PV | 0.12 EUR | 0.14 EUR | 3 GW | 3 GW |
| IE | 2012 | no |  | biomass | NA | NA | NA | NA |
| IE | 2012 | no |  | PV | NA | NA | NA | NA |
| IE | 2013 | yes | wind auctions introduced | wind | 0.09 EUR | 0.10 EUR | 5 GW | 5 GW |
| IE | 2013 | no |  | biomass | 0.11 EUR | 0.12 EUR | 1 GW | 1 GW |
| IE | 2013 | no |  | PV | 0.12 EUR | 0.14 EUR | 3 GW | 3 GW |

Failed auctions: If there are auctions that are unsuccessful – or where the design is changed because they didn’t get enough bids, we record 0 in the tender\_amount\_contracted column, but put NA in the level\_1 column.

Table 22: Recording failed tenders

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| year | technology\_type | policy\_change | policy\_change\_detail | level\_1 | tender\_amount\_tendered | tender\_amount\_contracted | Notes |
| 2006 | biomass | yes | Auction introduced | NA | 20 MW | 0 MW | Auction introduced, no capacity awarded |
| 2007 | wind | yes | Auction prolonged and design changed | NA | 20 MW | 0 MW | Auction prolonged, design changed, capacity reallocated to wind |
| 2008 | wind | No | Auction concluded, contracts awarded | 0.12 EUR | 20 MW | 20 MW | Auction concluded, same volume as 2008 but with changed design as in 2007, successfully awarded |

Therefore, **users must be careful when summing auction data:** users should NOT simply estimate auctioned capacity by adding the amount\_tendered together by country, because in this case it would look like the country had 80 MW, when in reality it was the same 20 MW tender repeated three times. Users should filter for cases where the amount tendered is greater than zero before summing data.

**Additional points:**

* **Regional differentiation**: when there are different levels of support in certain regions (e.g., northern vs southern Germany), we record the average level of these regional rates.
* **Actor differentiation**: when there are different average rates for actors awarded capacities in a single auction (e.g., community wind vs commercial wind), we record the overall tender average.
* **Installation age differentiation:** when there are different caps or prices depending on installation age, we proceed as follows:
  + **Bioenergy**: in Germany, there are different prices and caps for older versus new biomass installations. So far, Germany has only awarded capacities to these older installations, so we only record the support level for older installations. If there are cases in the future where support is awarded to both older and newer installations, we will continue to record only the support level for older installations to ensure this is comparable with previous observations.
  + **Onshore wind repowering**: in some countries, there are different support levels repowering versus other onshore wind (for example in Italy, from 2020 onwards). However, only new capacity has been awarded support. We therefore record only auction results for new capacity. If there are cases where both repowered and new auctions are awarded for onshore wind, we will continue to take the support levels and conditions for new-build onshore wind to ensure this is comparable with previous observations.
* **Location-specific auctions:** In the case of tenders for areas of land that are to be auctioned for specific wind projects, these are recorded under ‘tenders’ as they are still awarded through an auctioning process, rather than a non-competitive awarding procedure.

### Soft loans

With soft loans, the government (or other government body) provides loans for renewable power projects at preferential conditions. In most cases, this is a lower interest rate than the market would provide, so as to lower the financing costs of new projects. The number of years refers to the maximum length of the loan rather than their actual duration and is recorded in support\_duration.

Table 23: Variables that only apply to soft loans

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Description** | **Values** |
| loan\_interest\_rate | The interest rate for the loan | Numeric |

**NOTE**: most institutions do not report information on their loan interest rates and how they change over time. Therefore, some loan data is merely indicative that the policies exist but we do not know their precise conditions.

### Loan guarantee

With this instrument, governments seek to reduce the financing costs of new projects by guaranteeing to pay the loan should the project go bankrupt; this way, the required returns (on debt and/or equity) are lowered, because the default risk is lowered. The most relevant data for this instrument is the level, and the cap for the maximum size of the loan guarantee.

### Tax incentives

Tax incentives are a type of fiscal incentive where the government reduces or exempts selected activities, goods or actors from taxes. For tax incentives, the most relevant data is on the level, the actors to whom this applies (if specified), the conditions that must apply for exemptions, and unit.

There are several sub-types of tax incentives; the type is recorded in the column tax\_type. Below we include further information on the different types of tax incentives and actors.

Table 24: Variables that apply to tax incentives

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Description** | **Values** |
| tax\_type | the type of tax incentive | |  | | --- | | tax exclusion | | tax deduction | | tax deduction, accelerated depreciation | | reduced tax rate | | tax credit | | tax rebate | |
| level\_1\_unit | identifies the base financial category used to calculate a tax incentive | % sales tax/VAT on all transactions, % income/profits from electricity generation, % project costs, etc.… |

#### Tax deductions

Tax deductions allow you to reduce the amount of gross income (or for companies, profits/value) you have to pay taxes on by subtracting certain costs from it. For example, homeowners can deduct 40% of the cost of renewable energy renovations (e.g., solar, passive house improvements) from their income tax – so if I had a taxable income of $80,000 and my renovations were $50,000 (of which 40% is $20,000), my taxable income would $60,000.

6.1.1 Accelerated depreciation

Accelerated depreciation is a subtype of tax deduction, where companies can write off their investments more quickly. For example, in Portugal, companies can write off the entire value of their investments in renewables in 4 years.

#### Tax exemptions

Tax exemptions (sometimes also called tax exclusions) are when you do not pay taxes on certain streams of income or benefits; for example, in Ireland, employer-provided benefits-in-kind such as electric vehicles are not taxable. . The difference to tax deductions is that in a deduction, you calculate your income/profits and then subtract your costs from it which makes your taxable income lower. An example of a tax exemptions would be that the money you make from generating renewable electricity does not count as income at all. In this case, if I make $100,000 from electricity generation out of $110,000 profits total, my total taxable income is only $10,000. NOTE: the level here should always be 100%.

#### Reduced tax rates

Tax reductions lower the overall amount of taxes that actors pay on certain goods or services; or the amount of taxes that certain actors have to pay. This is often for consumable goods: for example, in the case of Italy, solar panels benefit from a reduced VAT of 10% (the usual VAT is 20%). Here, we record the level as 50% (because you pay only half as much VAT).

Within Europe, reductions will usually apply to sales tax/VAT (rarely but export taxes / import duties are also possible). If the regular VAT rate is not stated within the policy, we use historical information from the OECD (link: <https://www.oecd.org/en/publications/consumption-tax-trends-2024_dcd4dd36-en/support-materials.html>) and record this information in the notes.

#### 6.4 Tax credits

Tax credits are less common in Europe but sometimes still occur. This is when actors calculate their whole tax burden, and then can reduce their total tax burden by some amount (usually either a percent or a currency amount). For example, in a country where a credit of 10% for renewables investment exists, a company with a 500,000 EUR tax burden could reduce their tax burden by investing 100,000 EUR in renewables (of which 10% = 10,000) now owes 490,000 EUR.

Tax credits can also be tax amounts (for example, up to $30,000 if you invest in solar panels). These are sometimes tied to refunds: if they are, and you end up paying only $20,000 in taxes, you would then receive a pay-out of $10,000. In this case, we code as tax\_type “credit with refund”.

**NOTE:** the difference to tax reductions is that the reduction is a decrease in the rate of taxation (of profits, income etc.). The tax credit is a reduction which applies once the total taxes owed are calculated, on top of this.

#### 6.5 Tax refund

A tax refund is when you receive money back after paying your taxes (relatively rare in Europe). For example, if you paid VAT on equipment, in certain cases (if your project isn’t yet profitable) you can apply to get this money back. This can also occur if you receive a tax credit that has a cash amount (see example above – should be coded under tax\_type “tax credit with refund”).

### Grants

Grants include different instruments, where the government pays part of the cost for a renewable energy installation. For example, in an investment grant, the government pays part of the cost of investing in an installation, so that the amount paid by the investor and effectively the project cost is decreased. For grants, the most relevant data is on the level and the cap.

NOTE: if there are grant ranges without information on the conditions (i.e., “grant between 50-60% of investment cost), then we record the highest amount, and record the range in the notes.

### Emission trading (“ETS”): cap-and-trade schemes

The instrument Emission trading indirectly supports renewable power, as it makes carbon-intensive power generation relatively more expensive. We record data on mandatory cap-and-trade schemes. Data are from the World Bank Carbon Pricing Dashboard, and must be cited as such for subsequent analyses.

We record information on the prices for primary markets in “level\_1” and for secondary markets in “level\_2”. The ETS is only recorded if it applies to the electricity sector. In this case, it is coded as applying to “all renewables” as its technology type, as it makes them more competitive vis-à-vis fossil fuels.

**NOTE:** Supra- or subnational emissions trading systems, such as the European Emission Trading Scheme are not included in this data, as they are not national-level policy instruments.

### Tradeable green certificates (TGCs)

With the introduction of a tradeable green certificates scheme, a government sets a long-term goal for the share of renewable power, and mandates all suppliers to obtain certificates as proof that they have bought sufficient amounts of renewables in their power mix. This way, a separate market for renewables certificates is created, leading to an additional revenue stream for renewable generators under the scheme. We record the following for TGCs:

Table 25: Variables that apply only to TGCs

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Description** | **Values** |
| TGC\_certificates\_granted | The number of certificates awarded per technology (if different for different renewable technologies) | Numeric |
| TGC\_price\_max | The maximum permissible price for green certificates (ceiling price) | Numeric |
| TGC\_price\_min | The lowest permissible price for green certificates (or floor price) | Numeric |
| TGC\_price\_unit | The unit of the TGC price (both floor and ceiling prices) | kWh |
| TGC\_price\_currency | The original currency of the TGC price (both floor and ceiling prices) | EUR |
| TGC\_target\_level | The level of the long-term goal for the share or amount of renewables | Numeric |
| TGC\_target\_level\_unit | The unit of the target goal in more detail | % all power generation, % renewable energy in total energy distribution, % total electricity consumption, % renewable energy, % renewable energy per 100 GWh, % MWh…. |
| TGC\_level\_targetyear | The year by which the long-term goal is to be achieved | Numeric |

**NOTE:** the quota amount is a regulatory instrument, which can also exist without a related market instrument: regulators can simply require entities to procure 50% of their power from renewables, without creating a trading scheme. At this stage we only gather data on the existence of trading schemes.

### Carbon taxes

Carbon tax data are downloaded from the World Bank Carbon Pricing Dashboard, and must be cited as such for subsequent analyses. The full dashboard is available at <https://carbonpricingdashboard.worldbank.org/about>.

Carbon pricing is only recorded if it applies to the electricity sector. In this case, it is coded as applying to “all renewables” as its technology type, as it makes them more competitive vis-à-vis fossil fuels.

# Annex 1: transformation and corrections of AURES II dataset

**Step 1: Identified observations where “total” does not equal the sum of the separate technology types, and why this problem occurs.**

In the case of Poland, this is because there are no observations for separate technology types, only for the auction total. The total technology type is renamed to “all renewables” as this includes subtypes such as hydro, biogas and geothermal. The individual technology rows without details are removed.

The remainder are errors in AURES which we have corrected:

In the case of France (2018, FR\_82\_MT), the problem was that there was a technology type “Other” recorded which was a duplicate of the total auctioned capacity. This is deleted.

In Spain (2017, ES\_4\_MT) and Slovenia (SI\_13\_MT, SI\_14\_MT, SI\_6\_MT, SI\_7\_MT) the problem was an error in the data recording. We have therefore gone back to the original source and replaced it with the correct data.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **AURESII\_id** | **country** | **year** | **total\_amount** | **other\_tech\_sum** | **Notes** |
| ES\_4\_MT | Spain | 2017 | 5036921 | 5037000 | changed to correct values |
| FR\_82\_MT | France | 2018 | 203000 | 406000 | removed “other” as is duplicate of “total” |
| PL\_12\_MT | Poland | 2018 | 0 | 1000 | renamed “total” to “all renewables” (as includes hydro, biogas, geothermal); removed subtypes |
| PL\_15\_MT | Poland | 2018 | 0 | 500800 | renamed “total” to “all renewables” (as includes hydro, biogas, geothermal); removed subtypes |
| PL\_25\_MT | Poland | 2019 | 0 | 2340000 | renamed “total” to “all renewables” (as includes hydro, biogas, geothermal); removed subtypes |
| PL\_28\_MT | Poland | 2019 | 0 | 750000 | renamed “total” to “all renewables” (as includes hydro, biogas, geothermal); removed subtypes |
| PL\_3\_MT | Poland | 2016 | 0 | 76400 | renamed “total” to “all renewables” (as includes hydro, biogas, geothermal); removed subtypes |
| PL\_5\_MT | Poland | 2017 | 0 | 291000 | renamed “total” to “all renewables” (as includes hydro, biogas, geothermal); remove subtypes |
| SI\_13\_MT | Slovenia | 2019 | 3130 | 3120 | changed to correct values |
| SI\_14\_MT | Slovenia | 2019 | 7320 | 7316 | changed to correct values |
| SI\_6\_MT | Slovenia | 2017 | 89400 | 81620 | changed to correct values |
| SI\_7\_MT | Slovenia | 2017 | 8660 | 7780 | changed to correct values |

|  |  |  |  |
| --- | --- | --- | --- |
| **AURESII\_id** | **Tech type** | **Amount** | **Govt data** |
| SI\_6\_MT | Total | 81620 | 81602 |
| SI\_6\_MT | Onshore wind | 77950 | 77923 |
| SI\_6\_MT | PV | 3120 | 3129 |
| SI\_6\_MT | Bioenergy | 200 | 200 |
| SI\_6\_MT | Hydropower | 350 | 350 |
| SI\_6\_MT | Total | 7780 | NOTE – this is actually the total of Bioenergy and CHP in the next round (SI\_MT\_7). Delete observation. |
| SI\_7\_MT | Bioenergy | 400 | 1400 |
| SI\_7\_MT | CHP | 7380 | 6388 |
| SI\_7\_MT | Total | 8660 (NOTE – actual total is 7780, miscalculated by AURES) | 7788 |

Here, some sub-totals were incorrect as were the totals. Data are gathered from: <https://www.agen-rs.si/documents/10926/103769/Seznam_izbranih_2017/dd267de6-fa76-4f2b-89a2-3b98f0493aca>  

|  |  |  |  |
| --- | --- | --- | --- |
| **AURESII\_id** | **Tech type** | **Amount** | **Govt data** |
| SI\_13\_MT | Total | 3130 | 3119 |
| SI\_13\_MT | Bioenergy | 950 | 949 |
| SI\_13\_MT | CHP | 2170 | 2170 |
| SI\_14\_MT | Total | 7320 | 7304 |
| SI\_14\_MT | PV | 4900 | 4898 |
| SI\_14\_MT | Bioenergy | 50 | 49 |
| SI\_14\_MT | CHP | 10 | 9 |
| SI\_14\_MT | Hydropower | 2350 | 2342 |
| SI\_14\_MT | Onshore wind | 6 | 6 |

Here, some sub-totals were incorrect as were the totals. Data are gathered from: <https://www.agen-rs.si/documents/10926/159489/Dec2018_seznam_izbranih/817265b6-a984-43f6-b924-d3188ec79bc3>

|  |  |  |  |
| --- | --- | --- | --- |
| **AURESII\_id** | **Tech type** | **Amount** | **Govt data** |
| ES\_4\_MT | Total | 5036921 | 5036921 |
| ES\_4\_MT | PV | 3909000 | 3909103 |
| ES\_4\_MT | Onshore wind | 1128000 | 1127818 |

Here, totals were correct but the sub-totals were not. Data are gathered from: <https://www.boe.es/diario_boe/txt.php?id=BOE-A-2017-8997>

**Step 2: We perform the following operations in R:**

* The observations (“FR\_82\_MT”, “PL\_12\_MT”, “PL\_15\_MT”, “PL\_25\_MT”, “PL\_28\_MT”, “PL\_3\_MT”, “PL\_5\_MT”) where “other” is missing resulting in “total” not being equal to other technology subtypes are deleted. Then the “total” in technology\_type is renamed to “all renewables”.
* Then, the data is collapsed for unique values of AURESII\_id, country, year, technology\_type and type of auction product (budget vs capacity vs electricity). Numeric variables of interest are converted in the following manner-

|  |  |
| --- | --- |
| Column Name | Operation after collapsing |
| condition\_minimum | Minimum |
| condition\_maximum | Maximum |
| cap | Mean |
| support\_outcome | Mean |
| amount\_tendered | Max |
| amount\_contracted | Sum |
| Awarded.budget.... | Sum |
| Awarded.electricity..kWh. | Sum |

* The awarded\_tendered column records the maximum value of the product that could’ve been auctioned on a given day or programme. The awarded\_tender\_unit specifies what type of product is auctioned, it can be capacity (kW), budget (eur) or electricity(kWh). The value in the awarded\_tender can be for the specific technology in case of a specific auction or for all technologies for multi tech auctions (indicated by “eur/kw for all technologies).
* Level\_1 is set to = Average awarded price [ct/ kWh].
* The awarded\_capacity column records the results of the auction, i.e, the actually capacity/electricity/budget awarded to the bidder. Wherever capacity is recorded in the aures dataset (in the original column “Awarded.capacity..kW.”), the information is retained. In case the information in the original column was missing and budget or electricity awarded data was available, “awarded\_capacity” column records units in eur or kWh. These units are specified in the “awarded\_capacity\_units” column.
* For example, observations like “NL\_25\_MT”, “NL\_3\_MT” record “awarded\_capacity” in EUR and observations like “FI\_1\_MT”, “HU\_6\_MT” , “PL\_1” ,”PL\_12\_MT” ,”PL\_13” ,”PL\_15\_MT” ,”PL\_17”,”PL\_19”,”PL\_21”,”PL\_23”,”PL\_25\_MT”,”PL\_26”,”PL\_28\_MT”,”PL\_32”,”PL\_33”,”PL\_39\_MT”,”PL\_3\_MT”,”PL\_4\_MT”,”PL\_5\_MT”,”PL\_6\_MT” recorded “awarded\_capacity” in kWh.
* For consistency, all values in cap and support outcome are converted to EUR cents by dividing by 100.

**Finally, we clean to merge with our dataset:**

* AURESII awarded budget is set to “government budget”
* Tech types are recoded as follows:

|  |  |  |
| --- | --- | --- |
| **AURES Technology type** | **technology\_type** | **New technology\_requirement** |
| Remote Island Wind | wind | remote island |
| Onshore wind (repowered) | onshore wind | repowered |
| Biomass with CHP | bioenergy | with chp |
| Waste CHP | bioenergy | with chp |
| RES+storage | all renewable | with storage |
| PV+storage | pv | with storage |
| Anaerobic Digestion | bioenergy |  |
| Bioenergy | bioenergy |  |
| Biogas | bioenergy |  |
| Bioliquid | bioenergy |  |
| Biomass | bioenergy |  |
| Waste | bioenergy |  |
| Solar Thermal | csp |  |
| all renewables | KEEP AS IS |  |
| Offshore wind | KEEP AS IS |  |
| Onshore wind | KEEP AS IS |  |
| Other | KEEP AS IS |  |
| PV | KEEP AS IS |  |
| Wind onshore | KEEP AS IS |  |
| technology neutral | multiple |  |
| Advanced conversion | REMOVED |  |
| CHP | REMOVED |  |
| Geothermal | REMOVED |  |
| Hydropower | REMOVED |  |
| Hydropower (repowered) | REMOVED |  |
| Tidal stream | REMOVED |  |
| Wave | REMOVED |  |

# Annex 2: Column names and definitions for the renewable energy policy support dataset

|  |  |  |
| --- | --- | --- |
| **Column** | **Short definition** | **Unique\_Values** |
| Actor | the actor for whom this policy applies | SMEs, households, vulnerable households… (see dataset) |
| AURESII\_id | The ID from the AURES II database corresponding with this observation | (see dataset) |
| cap | The numeric cap amount | numeric |
| cap\_possible | Indicates whether the policy had a cap beyond which no further support is paid | yes, no |
| cap\_units | The unit of the cap | kW, kW for all technologies…(see dataset) |
| cap\_unit\_currency | The currency of the cap amount, if applicable | EUR |
| cap\_notes | notes on cap details | (see dataset) |
| condition\_maximum\_1 | The maximum level or amount for which support will be granted, under Condition 1 | numeric |
| condition\_maximum\_2 | The maximum level or amount for which support will be granted, under Condition 2 | numeric |
| condition\_maximum\_3 | The maximum level or amount for which support will be granted, under Condition 3 | numeric |
| condition\_maximum\_4 | The maximum level or amount for which support will be granted, under Condition 4 | numeric |
| condition\_maximum\_5 | The maximum level or amount for which support will be granted, under Condition 5 | numeric |
| condition\_minimum\_1 | The minimum level or amount for which support will be granted, under Condition 1 | numeric |
| condition\_minimum\_2 | The minimum level or amount for which support will be granted, under Condition 2 | numeric |
| condition\_minimum\_3 | The minimum level or amount for which support will be granted, under Condition 3 | numeric |
| condition\_minimum\_4 | The minimum level or amount for which support will be granted, under Condition 4 | numeric |
| condition\_minimum\_5 | The minimum level or amount for which support will be granted, under Condition 5 | numeric |
| condition\_notes\_1 | Any further notes on condition\_1 | (see dataset) |
| condition\_ notes \_2 | Any further notes on condition\_2 | (see dataset) |
| condition\_ notes\_3 | Any further notes on condition\_3 | (see dataset) |
| condition\_ notes\_4 | Any further notes on condition\_4 | (see dataset) |
| condition\_ notes\_5 | Any further notes on condition\_5 | (see dataset) |
| condition\_unit\_1 | The unit of condition\_minimum\_1 and condition\_maximum\_1 | kW, years, hours, kWp |
| condition\_unit\_2 | The unit of condition\_minimum\_2 and condition\_maximum\_2 | years, kW |
| condition\_unit\_3 | The unit of condition\_minimum\_3 and condition\_maximum\_3 | kW, kWh |
| condition\_unit\_4 | The unit of condition\_minimum\_4 and condition\_maximum\_4 | kW, kWh |
| condition\_unit\_5 | The unit of condition\_minimum\_5 and condition\_maximum\_5 | kW, kWh |
| country | The country where the policy is in force | (WB characterization) |
| degression\_possible | Whether a degression is present. Some values are coded with “yes” because there was a degression, but insufficient information on the actual level | no, yes |
| degression | The decrease in the support level | numeric |
| degression\_unit | Unit of decrease | % per year, % per month, % per quarter, % per 6 months, EUR/year… (see dataset) |
| government\_budget | The yearly budget for the support instrument. | numeric |
| government\_budget\_currency | The currency of the government budget. | EUR |
| level\_1 | The amount of support granted if condition\_1 is fulfilled | numeric |
| level\_1\_currency | The currency in which the support level was originally recorded for Condition 1 | EUR |
| level\_1\_unit | The unit that is granted the level of support for Condition 1 | kWh, tCO2 equivalent, kWp, kW, tCO2, kWh, per project, Square meters… (see dataset) |
| level\_2 | The amount of support granted for Condition 2 | numeric |
| level\_2\_unit | The unit that is granted the level of support for Condition 2 | kW |
| level\_2\_currency | The currency in which the support level was originally recorded for Condition 2 | numeric |
| level\_3 | The amount of support granted for Condition 2 | numeric |
| level\_3\_unit | The unit that is granted the level of support for Condition 3 | EUR |
| level\_3\_currency | The currency in which the support level was originally recorded for Condition 3 | numeric |
| loan\_interest\_rate | The interest rate for the loan | numeric |
| measure | The policy instrument of analysis | fit, premium, tender, tax incentive, grant, tgc, ETS cap-and-trade, soft loan, loan guarantee, carbon tax |
| month\_changed | The month when the policy changed. In some cases (especially for tenders) we also record the date. | (see dataset) |
| multiple\_condition\_attributes | The condition attribute applies when the policy has multiple conditions. GROUP: Each regulation condition applies separately, such as different levels of grants for different emissions thresholds. ALL: All conditions of apply together, and if you do not meet all conditions you do not receive support. | group, all |
| notes | Relevant notes on the policy and data treatment | (see dataset) |
| policy\_changed | Whether or not the policy changed in a given year | no, yes |
| policy\_changed\_detail | Details on how the policy changed | introduced, support level increased, support duration changed … (see dataset) |
| policy\_changed\_harmonized | the harmonized version of policy\_changed\_detail for legibility | (see dataset) |
| policy\_ID | The policy identifier from Climate Policy Database (CPDB). Note that the matching is not fully complete at this stage. | (see dataset) |
| Policy\_name | The name of the policy (or policies) that create the instrument. | (see dataset) |
| premium\_type | The type of feed-in premium awarded. | fixed, one-sided floating, two-sided floating, other |
| refprice | The reference price level (for feed-in premiums and auctions with feed-in premiums) | numeric |
| refprice\_currency | The reference price currency (for feed-in premiums and auctions with feed-in premiums) | EUR |
| refprice\_unit | The reference price unit (for feed-in premiums and auctions with feed-in premiums) | kW, kWh |
| refprice\_notes | notes on the reference price | (see dataset) |
| refprice\_2 | The reference price level for condition\_2 | numeric |
| refprice\_2\_unit | The reference price currency for condition\_2 | EUR |
| refprice\_2\_currency | The reference price unit for condition\_2 | kW, kWh |
| serial\_number | The serial number assigned to the observation | numeric |
| source | Links to the sources of the data | (see dataset) |
| support\_duration | The years of support projects are eligible for | (Numeric; 99 represents lifetime support) |
| tax\_type | The type of tax incentive | Tax deduction, tax credit, tax exclusion, reduced tax rate etc. |
| technology\_requirement | A technology-specific requirement for support eligibility | other systems, building integrated, ground-mounted …(see dataset) |
| technology\_type | Which technologies are supported by the policy | PV, wind, bioenergy, all renewables, PV rooftop, offshore wind, multiple, PV field, CSP, onshore wind |
| technology\_type\_multiple | When multiple technologies are supported without a clear differentiation of support levels | PV and wind, PV, hydro and bioenergy, biomass and wind, biomass, PV and wind |
| tender\_amount\_tendered | The amount of renewable power auctioned in a specific year, in (partial) fulfilment of the long term goal | numeric |
| tender\_amount\_tendered\_unit | The unit of the tendered amount | MW, kW, MWh, EUR for all technologies, MWh/year, MW wind & biomass, MW non-CSP |
| tender\_amount\_contracted | The amount of renewable power contracted (the sum of all winning bids in a year) | Numeric |
| tender\_amount\_contracted\_unit | The unit of the contracted amount | MW, MWh year |
| tender\_type | The type of support being tendered | FIP, FIT, CfD, no support, subsidy |
| TGC\_certificates\_granted | The number of certificates awarded per technology (if different for different renewable technologies) | numeric |
| TGC\_level\_targetyear | The year by which the long-term goal is to be achieved | numeric |
| TGC\_price\_currency | The original currency of the TGC price (both floor and ceiling prices) | EUR |
| TGC\_price\_max | The maximum permissible price for green certificates (ceiling price) | numeric |
| TGC\_price\_min | The lowest permissible price for green certificates | numeric |
| TGC\_price\_unit | The unit of the TGC price (both floor and ceiling prices) | kWh |
| TGC\_target\_level | The level of the long-term goal for the share or amount of renewables | numeric |
| TGC\_target\_level\_unit | The unit of the target goal in more detail | % all power generation, % renewable energy in total energy distribution, % total electricity consumption…. (see dataset) |
| year | The year observed | numeric |

# References

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1. The one exception to this is the Czech loan “ECO Energy Program”, which applies to the whole country except for Prague. [↑](#footnote-ref-1)
2. <https://www.europarl.europa.eu/RegData/etudes/BRIE/2015/568329/EPRS_BRI(2015)568329_EN.pdf> [↑](#footnote-ref-2)